VIKING VX
800 MHz UNIVERSAL STATION

Part No. 242-2008-332

First Printing
September 1994

Part No. 001-2008-300 9-94mwp Printed in U.S.A.

VIKING VX
800 MHz UNIVERSAL STATION
PART NO. 242-2008-332

E.F. Johnson designs and manufactures two-way radio equipment to serve a wide variety of communications needs. E.F. Johnson produces 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 E.F. Johnson, 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 E.F. Johnson 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.

E.F. Johnson will not be liable for any misunderstanding due to misinformation or errors found in this document.

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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-SU82, PN 242-2008-332.

1.2 DESCRIPTION

The VIKING VX-SU82 operates on the 800 MHz channels from 851-869 MHz (transmit). The receive frequencies are 45 MHz below these frequencies (806-824 MHz). Channel spacing is 25 kHz and RF power output is adjustable from 25 to 75 watts.

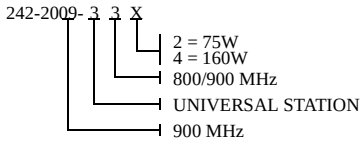
This Universal Station is modular in design for ease of service. There are separate assemblies for the logic, RF and power amplifier and power supply sections.

The Universal Station is programmed with a lap top or personal computer using the repeater software, Part No. 023-9998-297.

The VIKING VX-SU82 interfaces with a third party controller. All signal ports used to interface to the repeater are on J2 located at the back of the cabinet.

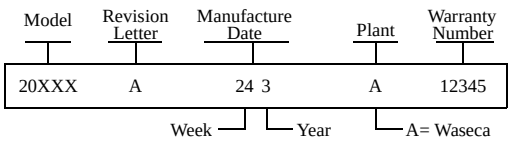
1.3 MODEL NUMBER BREAKDOWN

The following breakdown shows the part number scheme used for the VIKING VX-SU82.



1.4 IDENTIFICATION NUMBER

The Universal Station 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:



1.5 ACCESSORIES

The accessories available for the VIKING VX-SU82 are listed in Table 1-1. A brief description of some of these accessories follows.

External Speaker- This 16 ohm speaker plugs into the Third Party Interface (TPI) card jack. The speaker provides local audio and is adjusted by the volume control.

Programming Cable Kit- This cable provides the connectors for the Universal Station and a computer. The cable is used during programming and monitoring Universal Station activity at the site.

Extender Card- Used to extend the cards plugged into the backplane beyond the card rack enclosure. This is used when tuning the Universal Station and while troubleshooting.

Extender Cable Kit- These are seven foot extension cables for the RF Transceiver power and data. These cables are used when the transceiver is removed from the cabinet.

Rack Self Supporting- Accommodates from one to five Universal Stations mounted on vertical columns. Also provides space for combiners and duplexers.

Combiner Coaxial Protector- This accessory provides lightning and static suppression in-line between the antenna and combiner.

Isolator- Allows RF energy to pass through in one direction with very little loss, but absorbs RF power in the other direction.

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

Power Line Protector- This accessory provides lightning, static and surge protection on the AC power line. This line protector is rack mounted with multiple outlets.

Table 1-1 ACCESSORIES

Accessory	Part No.
RJ-11 to 6-BNC Adapter	023-2000-194
19" Aluminum Shelf	508-0500-029
12V DC Battery	503-5012-420
External speaker	250-0151-005
2000 Series Service Kit	250-2000-230
Low Power Supply w/Batt Backup	250-2000-100
High Power Supply w/Batt Backup	250-2000-101
Battery Backup option*	023-2000-225
Battery Backup Cable Kit	023-2000-224
2000 Series OCXO	561-0006-012
2000 Series OCXO Drawer w/1 OCXO	250-2000-921
2000 Series OCXO Drawer w/2 OCXOs	250-2000-922
1:8 Splitter shelf	023-2000-924
Attenuator Kit**	023-2000-923
5-Channel OCXO cable kit	023-2000-128
RG-316-BNC/BNC cable 68" ***	597-3003-260
RG-316-BNC/BNC cable 71" ***	597-3003-261
RG-316-BNC/BNC cable 87" ***	597-3003-262
RG-316-BNC/BNC cable 96" ***	597-3003-263
RG-316-BNC/BNC cable 106" ***	597-3003-264
RG316-BNC/BNC cable 12"	597-3003-253
RG316-BNC/BNC cable 118"	597-3003-265
PC programmer PGMR software	023-9998-297
Programming cable kit	023-2000-195
Extender Card	023-2000-230
Extender cable kit, 7 ft.	250-2000-010
Rack shelf supports	
3 ft.	508-0500-021
5.5 ft.	508-0500-022
6 ft.	508-0500-023
6.5 ft.	508-0500-024
7 ft.	508-0500-025
7.5 ft.	508-0500-026
8 ft.	508-0500-027
9 ft.	508-0500-028
Combiner coaxial protector	585-0898-005
External speaker/microphone	589-0015-011
FSK Modem IC (U110)	544-3988-008
Power line protector	597-1004-010
RJ-11 to RJ-11, 3 ft. cable	597-2002-200

*Factory installed only
** Includes hardware for mounting in an 023-2000-924 Splitter shelf and a 597-3003-253 cable.
***Included in kit 023-2000-128

2**000 Series Service Kit** - This kit contains an alarm wire harness, extender power cable, programming kit, extender card, extender harness, and a TIC bias cable. These items are used when tuning the repeater and while troubleshooting.

PC Programmer PGMR Software - 3.5" programming disk used to program the repeater.

2000 Series Battery Backup Option - This option can only be installed by the factory. It includes the battery backup module that resides in the power supply and the necessary interconnect cabling to connect the repeater to the batteries.

19" Aluminum Shelf - Rack mounted shelf, 20" deep, that can be used to support the batteries.

12V DC Battery - This is a sealed 12V DC lead-acid battery intended for battery backup systems. Two batteries are required per repeater. At 25°C, with a 100% transmit duty cycle, the 75W repeater will operate for 2 hours and the 175W repeater will operate for 1 hour.

2000 Series Low Power Supply With Battery Backup - Series 2000 low power repeater (i.e. 75W) power supply with the 2000 series battery backup module pre-installed. Interconnect cables are not included.

2000 Series High Power Supply With Battery Backup - Series 2000 high power repeater (i.e. 175W) power supply with the 2000 series battery backup module pre-installed. Interconnect cables are not included.

2000 Series Battery Backup Cable Kit - Interconnect cable to connect the battery backup module to the batteries.

1.6 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. Customer Service hours are 7:30 a.m. - 4:30 p.m. Central Time, Monday - Friday. There is also a 24-hour emergency technical support telephone number. From within the continental United States, the Customer Service Department can be reached toll-free at:

1-800-328-3911

When your call is answered at the 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 a first number of "1" or "2", another number is requested to further categorize the type of information. You may also enter the 4-digit extension number of the person that you want to reach.

FAX Machine - Sales (507) 835-6485
FAX Machine - Cust Serv (507) 835-6969

If you are calling from outside the continental United States, the Customer Service telephone numbers are as follows:

Customer Service Department - (507) 835-6911
Customer Service FAX Machine - (507) 835-6969

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:

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

1.7 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the Warranty Department, E.F. Johnson Company, 299 Johnson Avenue, PO Box 1249, Waseca, MN 56093-0514. This information may also be requested by phone from the Warranty Department. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service by dialing (507) 835-6970.

1.8 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 Technical Service Department before returning equipment. 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 Depot 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 Depot Repair (see Section 1.6) 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 phone number and contact name are very 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, it is also a good idea to 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.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Depot Repair. They require RA numbers for exchange units or if they want 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.

1.9 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 and then enter "1" as described in Section 1.6. 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 (refer to Section 1.4).

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.6.

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

1.10 SOFTWARE UPDATES/REVISIONS

All inquiries concerning updated software, its installation and revisions should be directed to the Customer Service Department (see Section 1.6).

1.11 UNIVERSAL STATION OPERATION

1.11.1 THIRD PARTY INTERFACE (TPI)

Refer to Figure 1-2.

Programming Jack

J1 provides input connection from the computer and the "flash memory" in the TPI. The programming information in an IBM® compatible personal computer programs the TPI directly from the serial port through interconnect cables connected to the COM1 or COM2 port.

Reset

S1 provides a manual reset of the Third Party Interface (TPI) microprocessor. A manual reset causes a complete power-up restart.

Display and LEDs

Each combination of DS1 display read-out and CR4/CR5 indication refers to an active alarm. See Table 1-2 for alarms and definitions. When CR1 is blinking, the TPI is operational. CR2 is the high power indicator and CR3 is not assigned at this time.

Alarms

When the Repeater is in the test mode the safety measures are disabled. Therefore, if the Universal Station is keyed for an extended period and the power amplifier temperature increases, thermal shutdown will not occur. There are pop-up windows that will appear in the Test mode screens to alert the user that there is an alarm and action should be taken. Refer to Figure 1-1 for an example of this type of alarm.

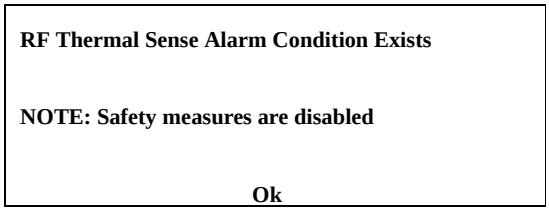


Figure 1-1 ALARM IN TEST MODE

External Speaker Jack

J104 provides local 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

R164 provides control of the receive audio output to J101 and J104. Turning this control clockwise past the detent 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 the ground connection for test equipment when monitoring test point J100.

1.11.2 INTERFACE ALARM CARD (IAC)

Voltage Test Output

J502 provides a test point to monitor +15V supply on the IAC. Refer to Figure 1-2.

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 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.

Xmit Indicator

Indicates that the Universal Station's transmitter is keyed by the logic.

1.11.3 POWER SUPPLY

The power supply is sealed and the line and supply fuses are inside. If a supply fuse opens, the power supply must be removed and opened for repair (see Section 2.4 and 8.5). Refer to the power supply service manual 004-2000-810.

Standby Battery Jack

This provides a connection point for a +24V DC standby battery. Current is drawn from the battery only when the power supply output voltage is lower than the battery voltage. A trickle charge switch on the supply ensures that the battery is fully charged. Disable this switch when a separate battery charger is used (see Section 2.5).

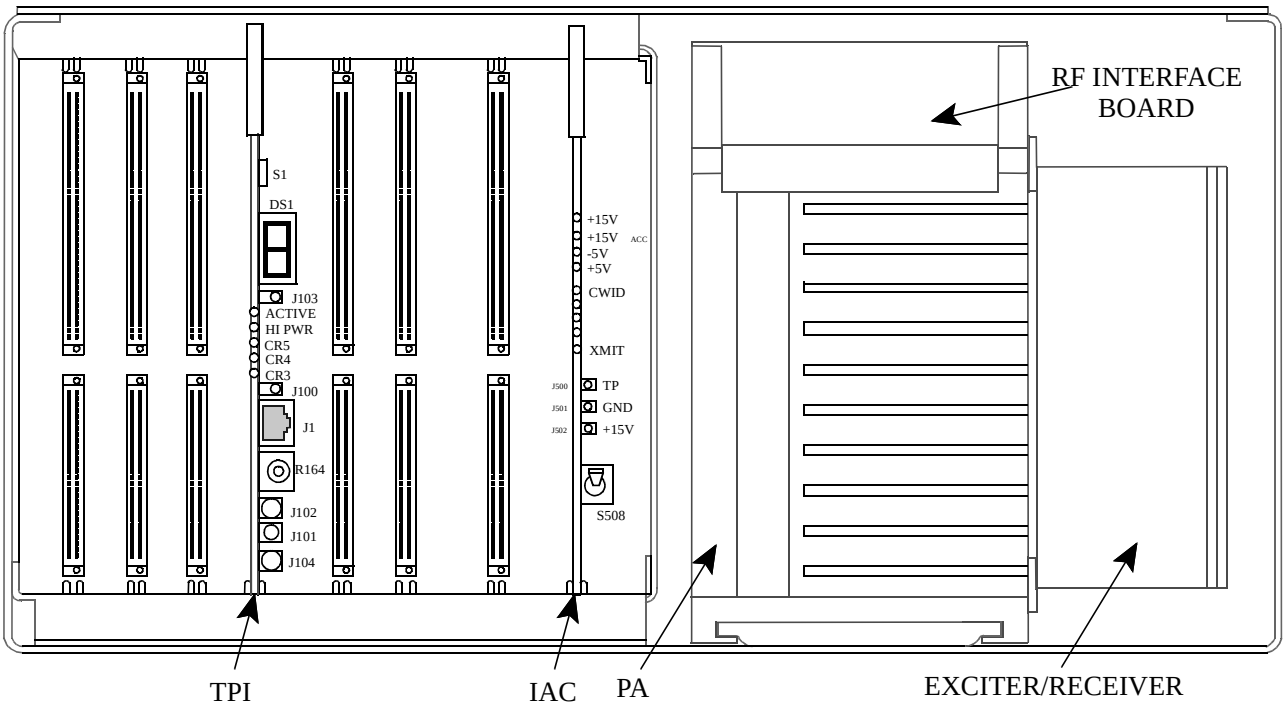


Figure 1-2 UNIVERSAL STATION CARDS

Table 1-2 ACTIVE 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
12	C	Off	On	RNT/CIM Channel Problem Alarm
13	D	Off	On	TIC Processor Alarm
14	E	Off	On	MMC 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

SPECIFICATIONS

GENERAL[1]

Dimensions	8.7" H x 17" W x 20.9" D
Weight	58.6 lbs. (26.58 kg)
AC Voltage/Frequency	100-240V AC/47-63 Hz
AC Current	0.38A (Standby), 2.8A (75W), 1.7A (25W)
AC Input Power	45W (Standby), 328W (75W), 199W (25W)
DC Current at 26.5V DC	12A (75W), 6.5A (25W)
Number of Channels	1 (Synthesized, programmable)
Frequency Range	806-824 MHz Receive, 851-869 MHz Transmit
Channel Spacing	25 kHz
Channel Resolution	12.5 kHz
Temperature Range	-30°C to +60°C (-22°F to +140°F)
Duty Cycle	Continuous

RECEIVER

Frequency Band	806-824 MHz
12 dB SINAD	0.35 µV
Signal Displacement Bandwidth	±2 kHz
Adjacent Channel Rejection	-85 dB
Offset Channel Selectivity	-20 dB
Intermodulation Rejection	-80 dB
Spurious & Image Rejection	-90 dB
Audio Squelch Sensitivity	12 dB SINAD
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than at 0.5W/16 ohms
Local Audio Power	0.5W/16 ohms
Audio Sensitivity	±1.5 kHz
Hum & Noise Ratio	-45 dB
Frequency Spread	6 MHz
Frequency Stability	±1 PPM -30°C to +60°C (-22°F to +140°F)

TRANSMITTER

Frequency Band	851-869 MHz
RF Power Out	75W minimum (Default setting), 25W (Variable Set Point)
Spurious Emissions	-90 dBc
Harmonic Emissions	-90 dBc
Audio Deviation	±3.5 kHz
Sub-Audible Data Deviation	±1 kHz
CWID Deviation	±1 kHz
Audio Response	+1/-3 dB TIA
Audio Distortion	Less than 2%
Hum & Noise (TIA)	-45 dB
Frequency Spread	6 MHz
Frequency Stability	±1 PPM -30°C to +60°C (-22°F to +140°F)
Emission Designators	14K0F3E, 16K0F3E, 14K0F3D, 16K0F3D, 14K0F1D, 16K0F1D

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.

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SECTION 2 INSTALLATION

2.1 INTRODUCTION

Information in this section tells how to set up the Universal Station for operation. It is assumed that the Universal Station has been previously aligned at the factory or as described in the alignment procedure in Section 7.

Even though each Universal Station 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 Universal Station is otherwise operating properly. Performance testing is described in Sections 7.1, 7.2 and 7.3.

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 Universal Station.

Operating Temperature.

-30°C to +60°C (-22°F to +140°F).

Humidity.

Less than 95% relative humidity at 50°C.

Air Quality.

Equipment operating in a controlled environment with the Universal Stations rack mounted, the airborne particles must not exceed 30 µg/m^3.

Equipment operating in an uncontrolled environment with the Universal Stations rack mounted, the airborne particles must not exceed 100 µg/m^3.

NOTE: If the Universal Station 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 module and the power supply are equipped with fans, controlled by thermostats, that force air from the front to the back of the equipment for cooling. This permits the cabinets to be stacked or rack mounted (see Figure 2-5). The following are needed for adequate air circulation.

1. 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.

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

3. 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 Universal Station 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 minimum of 560W. With the nominal 120V AC input, the source must supply 5A for each 110W Universal Station and

should be protected by a circuit breaker. (A separate 15A breaker is recommended for three Universal Stations). An AC surge protector is recommended for all equipment.

Each Universal Station requires an outlet and the Receiver multicouplers require one each, so for a 5-channel system, a minimum of 7 outlets is required. An additional three outlets should be added for test equipment. The outlets must be within 3 feet of each Universal Station cabinet. Future system expansion should be considered when electrical work is being planned for the initial system.

The Universal Station power supply can be equipped with an optional 24V DC back-up in the event of AC power failure. Since the transmitter will remain on full power, if desired, the DC power source must have a current capability of about 20A per 110W repeater or 100A for 5 - 110W repeaters. The multicoupler requires another 0.5A for a total system requirement at 24V DC of 100.5A for 110W Universal Stations.

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.

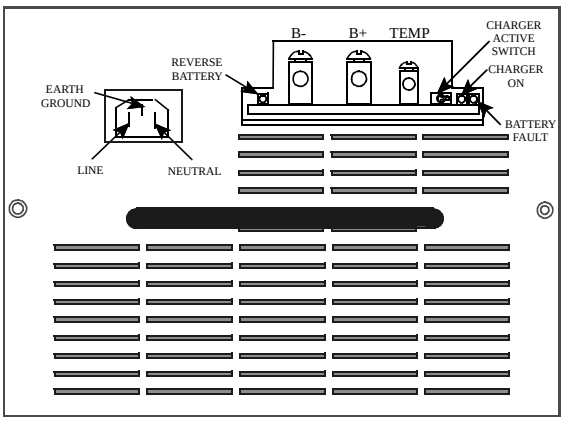


Figure 2-1 BATTERY BACKUP CONNECTOR

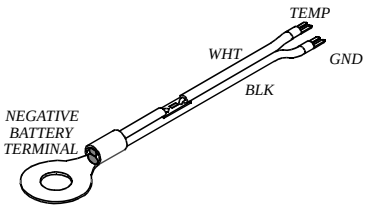


Figure 2-2 TEMPERATURE SENSOR CABLE

2.6 GROUNDING

CAUTION

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

As in any fixed radio installation, measures should be taken to reduce the possibility of lightning damage to the 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. Roof top 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 within 5 feet of the system with a runner of 6 AWG or larger solid copper wire or 8 AWG stranded copper wire to the floor area.

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.

RF

An RF protector keeps any lightning strike to the antenna feed line or tower from damaging the Universal Stations. 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 = Universal Station 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: Universal Station 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 E.F. 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.

2.6.1 PROTECTION GUIDELINES

Follow these guidelines for grounding and lightning protection. Each Universal Station installation site is different; all guidelines may not apply to a given situation.

- Ground connections are a good metal-to-metal ground (grounding rod, grounding tray, metal conduit) using #6 gauge solid wire or braided wire straps.
- With surge protectors, ground wires go directly to ground, not through other equipment.
- Run the ground wire for RF coax protectors directly to ground.
- With coax protectors, maximum instantaneous voltage does not exceed the rated voltage.
- Do not run ground wires parallel to any other wiring except other ground wires (a ground wire parallel to a telephone line).
- Double check all necessary equipment for good ground and that all connections are secure.

2.7 UNPACKING AND INSPECTION

E.F. Johnson ships the Universal Station securely crated for transportation. When the Universal Station arrives, ensure the crates remain upright, especially if storing the crates temporarily.

When unpacking the Universal Station, 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 E.F. Johnson. Contact Customer Service for assistance (see Section 1.6).

If everything appears undamaged, remove the Universal Station 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. E.F. Johnson cannot be responsible for damage to equipment caused by negligence.

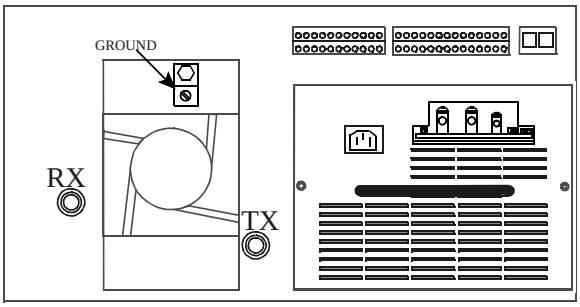


Figure 2-3 ANTENNA CONNECTIONS

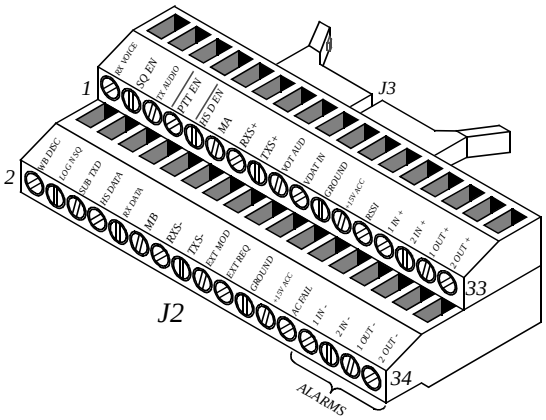


Figure 2-4 TERMINAL BLOCK J2

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

NOTE: Each Universal Station 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 2-3).

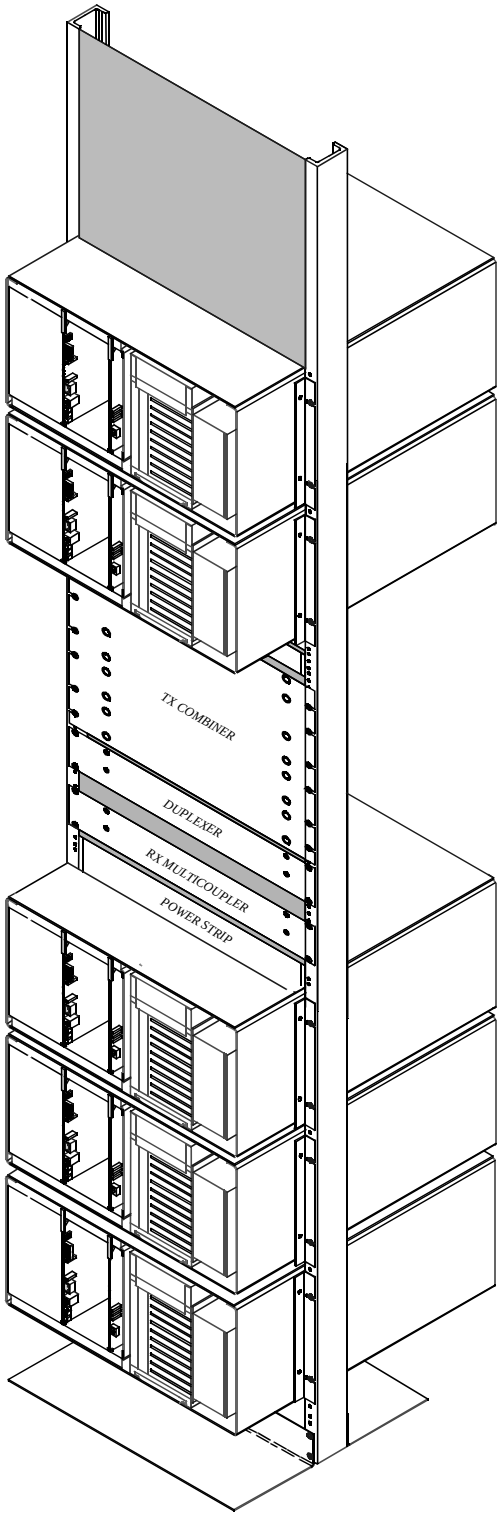


Figure 2-5 RACK MOUNTED UNIVERSAL STATIONS

SECTION 3 SOFTWARE

3.1 INTRODUCTION

The Johnson Programming software on 3.5 inch disk, Part No. 023-9998-297, uses an IBM® personal computer or compatible to program the Flash Memory in the Third Party Interface (TPI) card. To lessen the chance of programming errors and simplify operation, the program uses yes/no questions or toggles through the available responses.

The computer is connected directly from the serial port to the TPI. 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 TPI card.

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 port outputs and connections.

3.1.1 HOW TO USE THIS MANUAL

This manual introduces the program and illustrates how to use the features. This manual is organized to easily find programming information with the Table of Contents, Index and Parameter Tables for the responses required for programming.

Graphic reproductions of the screens are shown for reference. Adjacent to the screens are tables to provide the parameters, available responses and a brief description of the parameter. It is not the intent of this manual to teach computer operation, but to allow the user to become familiar with the available screens and the responses without having to be at the computer.

3.1.2 GETTING STARTED

NOTE: Before starting you should already know how to start MS-DOS®, 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 MS-DOS manual for your computer for more information (see Section 5).

Follow the computer instructions for loading the disk. The MS-DOS Revision 3.3 or later operating system is needed to run the programs. The computer needs to have RS-232C capability, for example, the Serial port in slot "COM1" or "COM2".

3.1.3 COMPUTER DESCRIPTION

The programming software is designed to run on an IBM PC or compatible computer that meet the following minimum requirements.

1. One 3.5" high density disk drive.
2. 2M of memory
3. MS-DOS version 3.3 or higher
4. One serial port
5. Monochrome or color monitor and video card

Although the program uses color to highlight certain areas on the screen, a monochrome (black and white) monitor or LCD laptop also provides satisfactory operation. Most video formats such as EGA and VGA are supported. A serial port is required to connect the Universal Station to the computer. This port is standard with most computers.

The cables from the TPI card to the computer are not included. With most computers, the adapter- to-computer cable is a standard DB-25 M-F cable, PN 023-5800-017, (the male connector plugs into the adapter). If your computer requires a male connector, a male-to-male cable is also available, PN 023-5800-016. The cable from the adapter to the Universal Station has a DB-9 to 8-pin connector (see Figure 3-2).

3.1.4 FLASH DATA STORAGE

The data programmed into the TPI card is stored in Flash Memory. Since this type of device is nonvolatile, data is stored indefinitely without the need for a constant power supply. A TPI can be removed from the site or even stored indefinitely without affecting programming. Since Flash Memory is also reprogrammable, a new device is not needed if programming is changed.

3.1.5 COMMAND LINE OPTIONS

HELP

To show all options available from the command line type: /h or /?. Either '/' or '-' can be used. For example: 2000pgmr /h

The options can be entered in any order. For example: 2000pgmr /d /b /c

COM PORT

The Johnson programming software defaults to serial port COM1. However, if this port is already in use, the software can be reconfigured to use serial port COM2. To do this, use one of the following methods:

- When running the compiled (.EXE) version, type /c2 on the command line after the program name. For example: 2000pgmr /c2 or -c2
- Select COM port from Utilities heading.

BAUD RATE

The software defaults to 9600 baud, however this rate can be changed. To do this from the command line, type /bxxxx (xxxx = baud rate). For example: 2000pgmr /b or -b

NOTE: When the baud rate is changed on the command line the baud rate jumpers on J10 in the TPI must also be changed to the same baud rate (see Section 6.7.20).

DEMO MODE

To view the screens for Read Setup Params and Write Setup Params from the Transfer menu when a Universal Station is not connected to the computer this option is used. Normally these screens are not available without a Universal Station connected. To do this from the command line, type: /d or -d. For example: 2000pgmr /d

3.1.6 COLOR OR MONOCHROME OPERATION

The programming software utilizes color for a color monitor and video card. However, with LCD-type displays, this may make some information hard to read because the contrast is poor. To improve contrast, a monochrome mode can be selected in the display mode from Utilities heading.

3.2 REPEATER PROGRAM SOFTWARE

3.2.1 INSTALLING THE SOFTWARE

When you receive the programming software, make a backup copy and store the master in a safe place. Copy the distribution disks using DOS DISKCOPY command. For example, type:

DISKCOPY A: A: (single floppy drive)

or

DISKCOPY A: B: or C: (multi-drive systems).

If you have a hard disk drive, you may want to create one or more separate directories for transceiver programming and then transfer the program disk files to those directories. To create a new directory, use the MKDIR command. For example, to create directory RADIOPRG, type:

MKDIR \RADIOPRG.

Then to make the new directory the current directory, use the CHDIR command. For example, to change to the \RADIOPRG directory, type

CHDIR \RADIOPRG.

To copy all files from a floppy disk in drive A: to this directory, type:

COPY A:*.*

If you have a single floppy drive and no hard disk drive, you need to create programming disks. The reason for this is that there is not adequate space on the backup disk(s) for storing radio files. If your computer has dual floppy disk drives, the backup disk can be placed in one drive and then the radio files stored on a disk in the second drive.

To make a programming disk, format a blank disk using FORMAT B: or FORMAT B: /S (use "/S" if it must be a bootable disk). Then copy the required program file or files to the programming disk. To do this, type COPY A:(filename.ext) B:(filename.ext). For example, to copy the file qx_pgmr.exe from drive A to drive B, type

COPY A:2000pgmr.exe B:2000pgmr.exe

This procedure works for either single or dual drive computers. Refer to your computer reference manual for more information on these DOS commands.

3.3 SOFTWARE PROGRAMS

When the program is loaded into the computer and executed, the menu shows the files available from the directory. The program is used to create, edit, transfer and receive the Universal Station and channel parameters described in Section 5.

IMPORTANT

The commands and displays referred to in this manual are for the IBM PC and may differ from IBM compatible. Refer to the computer's operating system manual for command explanations.

3.3.1 PROGRAM FILES

The files that appear in the program directory are needed for program operation:

3.4 ALIGNMENT SOFTWARE

The software for the Universal Station programs the TPI to open and close the audio/data gates necessary for the alignment selected from the Test-Full Universal Station menu. Under the menu heading Test are the alignment procedures for the PA (see Section 7.3), Receiver (see Section 7.1), Exciter (see Section 7.2) and overall Full Universal Station (see Section 7.4) including the TPI (see Figure 3-1).

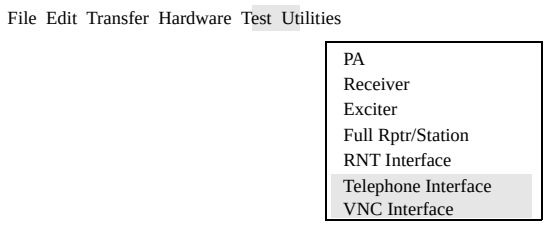


Figure 3-1 REPEATER TEST MENU

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

3.5 HELP F1

Help screens are available for most parameters and options in this program. Whenever a parameter or options clarification is needed, press F1 and if a help screen is available it will pop-up on the screen. Press Escape <ESC> to exit the pop-up screen.

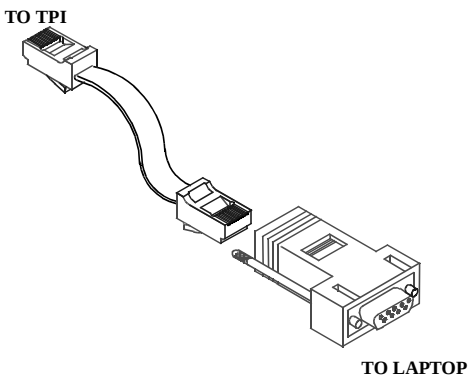


Figure 3-2 LAPTOP INTERCONNECT CABLE

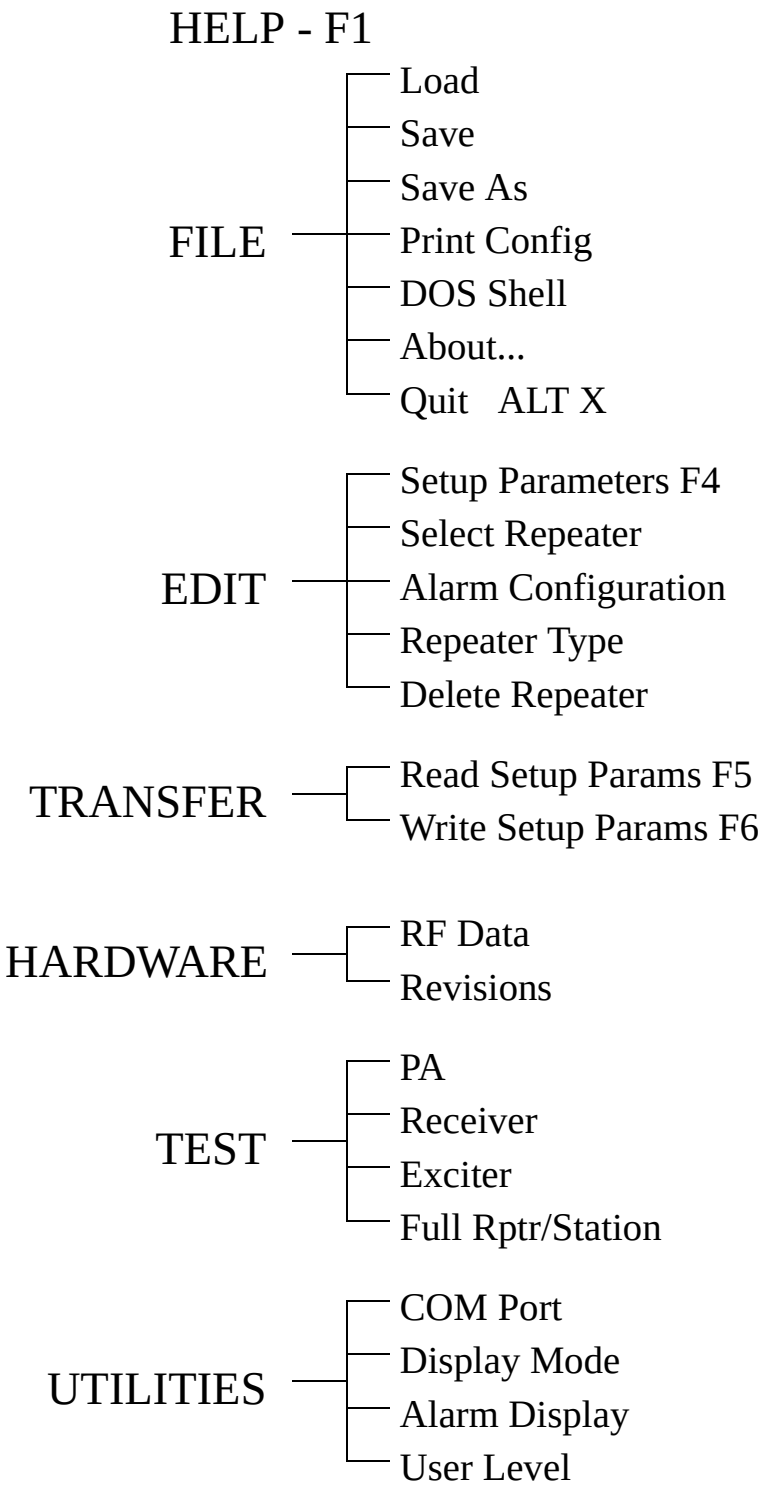


Figure 3-3 PROGRAMMING FLOWCHART

SECTION 4 PULL DOWN MENUS

4.1 MENU DISPLAYS

The menus available are listed at the top of the screen. Move the cursor with the arrow keys to highlight the menu name. Press Enter to view the menu and the arrow keys to scroll through the menu. Call up the highlighted selection by pressing Enter. The menu selections that do not apply to the Universal Station cannot be accessed and are shown in the menu as shaded text.

4.2 FILE MENU

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

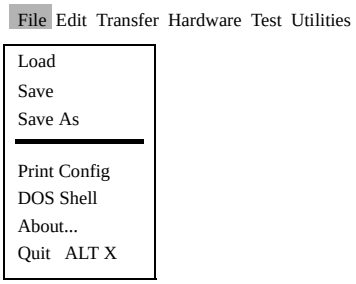


Figure 4-1 FILE MENU

4.2.1 LOAD

Load reads information from a stored file. The program requests the filename to be loaded into the buffer. The filename from a disk can be entered in the highlighted area. Then move the cursor down with the arrow key and highlight "Ok" and press Enter. To select an existing file, use the arrow keys to move down the menu list and press Enter when the highlighted filename is the file to load.

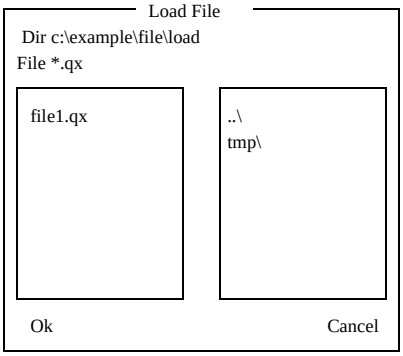


Figure 4-2 LOAD FILE

4.2.2 SAVE

This saves the edited version of an existing file loaded in the buffer under the same filename in the directory and deletes the old file. Loads a new file created in the Edit menu into the directory.

4.2.3 SAVE AS

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.

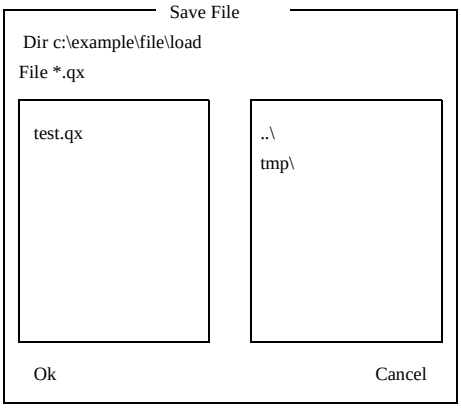


Figure 4-3 SAVE FILE

4.2.4 DOS SHELL

Temporarily suspends the program and returns to DOS. Directories and other DOS commands can be performed. To return to the program from DOS, type EXIT and press Enter.

4.2.5 QUIT (ALT X)

Exits the program and returns to DOS. Be sure all files are saved before exiting the program.

4.3 EDIT

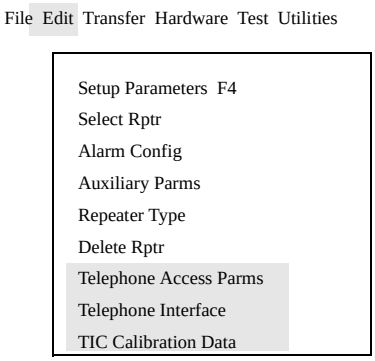


Figure 4-4 EDIT MENU

This menu is used to create new files and set or change the operating parameters. The filename for the file being edited is shown in the lower left corner of the screen.

4.3.1 SETUP PARAMETERS

Programs the Universal Station parameters and options. Table 5-1 lists the parameters that are set by this screen (see Figure 5-1) and gives a brief description of each.

NOTE: The parameters are shown in the lower left of the pop-up screen for reference.

REPEATER NUMBER

Each repeater is programmed with a repeater number from 1-20. Make sure that this number agrees with the Home number programmed in the controller assigned to this repeater.

NOTE: The Repeater Number is for reference only. It is not necessary for repeater operation.

CHANNEL NUMBER

Each Universal Station is programmed with a number of the channel that it is operating on (1-920). If the operating frequency of a Universal Station is changed, this channel number must also be changed (see Appendix A).

RF POWER LEVEL

This is the default power level. Enter the power level (25-75 Watts) that the Universal Station will use for transmit power.

NOTE: Not the actual power out level. Other factors must be considered for a true power out.

POWER SOURCE

Indicates the primary type of power source the Universal Station is powered from. AC or DC.

4.3.2 SELECT REPEATER

Select the repeater number to be programmed or edited from the pop-up menu (see Figure 4-5). Move the cursor with the arrow keys to highlight the repeater number and press Enter.

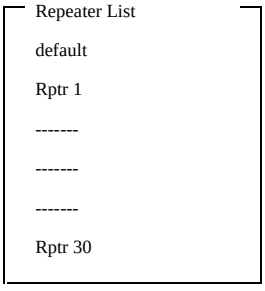


Figure 4-5 REPEATER LIST

4.3.3 ALARM CONFIGURATION

This programs the input alarm (see Figure 4-7) and output alarm (see Figure 4-8) configurations and provides a cross reference screen.

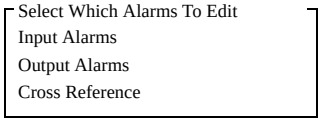


Figure 4-6 ALARM CONFIGURATION

Use the arrow keys to move down the list. Use the Space bar to toggle through the parameters: Disabled, Active Low, Active High, for each alarm.

INPUT ALARMS

There are eight input alarms that can be activated by external devices (see Section 6.8). These inputs can be disabled, energized or de-energized.

If the input is disabled, the input alarm line is inactive. When energized and current flow is detected, the alarm is activated. When de-energized and no current flow is detected, the alarm is activated.

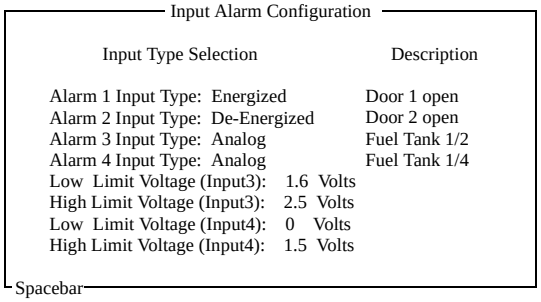


Figure 4-7 INPUT ALARMS

OUTPUT TYPE SELECTION

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

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

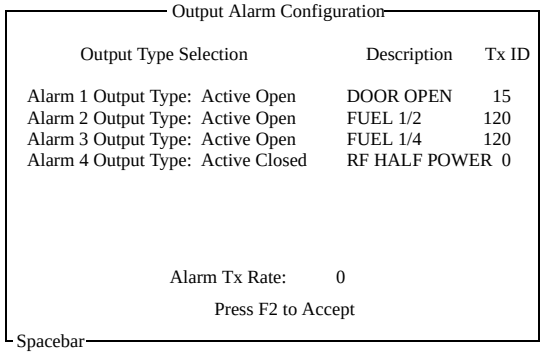


Figure 4-8 OUTPUT ALARMS

ALARM DESCRIPTION

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 and an output is selected in the cross reference menu (see Figure 4-9).

ALARM TRANSMIT RATE

Sets the time interval for transmitting the alarm message in Morse code (1-255 min, 0=disabled). 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), 8 external input alarms and 40 internal alarms (see Table 1-2). There are eight output alarms. An alarm condition on any input can cause an output alarm. This screen configures which input alarm activates an output alarm.

NOTE: More than one alarm condition can have the same output alarm (see Figure 4-9).

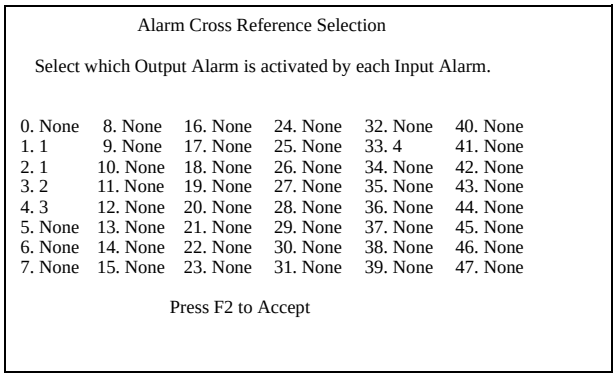


Figure 4-9 ALARM CROSS REFERENCE

4.3.4 REPEATER TYPE

Select Universal Station. The programming parameters are determined by this selection. Parameters that are invalid for some types are shaded and cannot be selected.

4.3.5 DELETE REPEATER

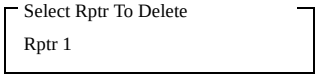


Figure 4-10 DELETE REPEATER

4.4 TRANSFER

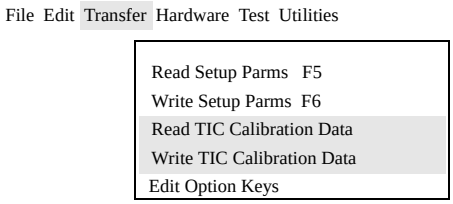


Figure 4-11 TRANSFER MENU

4.4.1 WRITE SETUP PARAMETERS

This command sends the contents of a file to program the Flash memory in the TPI card.

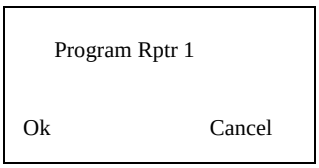


Figure 4-12 WRITE SETUP PARAMETERS

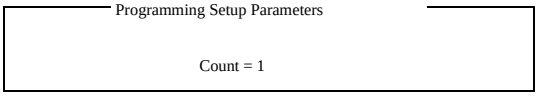


Figure 4-13 PROGRAM WRITE SETUP

4.4.2 READ SETUP PARAMETERS

This command reads the contents of the Flash memory of the TPI card and loads it into a buffer. The contents of the buffer is then displayed to show the programming of the Universal Station.

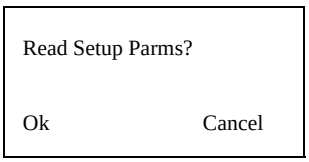


Figure 4-14 READ SETUP PARAMETERS

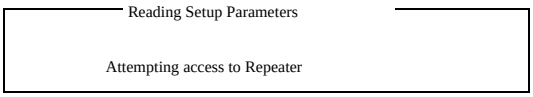


Figure 4-15 READING SETUP

4.5 HARDWARE

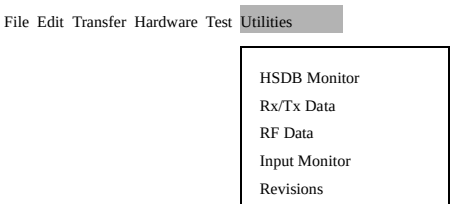


Figure 4-16 HARDWARE MENU

4.5.1 RF DATA

The A/D Monitor Screen shows the state of the lines (see Figure 4-17). These lines are being monitored by the A to D converter in the Interface Alarm Card (IAC). The normal values for each line are defined as follows.

Synthesizer Lock Lines	Yes or No
Forward Power (LP)	25-75 Watts
Forward Power (HP)	75-175 Watts
Reflected Power	0-6 Watts
Final Out (ratio)	approx equal
Chassis Temp	27°C-55°C
Battery Voltage	21V-28V
Wideband Audio Output	approx 200
LO Injection	approx 200
RSSI	20-150
Fan Current	100-200, 0
Fan	On or Off
Power Supply Temp	22°C-45°C

Values with no label are the actual A to 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.

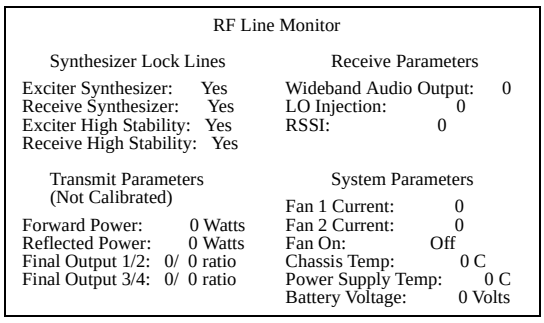


Figure 4-17 RF LINE MONITOR

4.5.2 REVISION/VERSION

The Revision/Version is displayed for the Universal Station modules in this screen. The format is R.V (revision.version) for all modules. The TPI card information also includes the release date of the software and the serial number of the Universal Station (see Figure 4-18 these numbers are for example only).

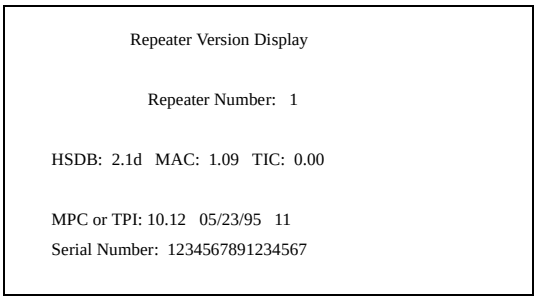


Figure 4-18 REVISION/VERSION

4.6 TEST

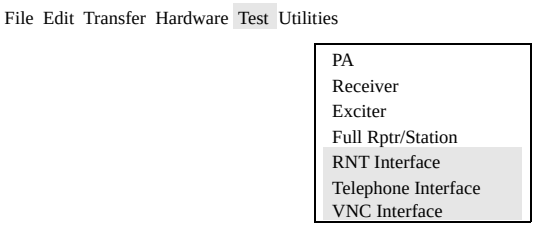


Figure 4-19 TEST MENU

4.6.1 POWER AMPLIFIER

This menu selection walks through the alignment of the Power Amplifier and RF Interface Board on the computer screen. Refer to Section 7.3 for the PA and RFIB alignment in this manual and Figures 7-3 and 7-4 for an alignment points diagram and Figure 7-7 of the Power Amplifier.

4.6.2 RECEIVER

This menu selection walks through the alignment of the receiver on the computer screen. Refer to Section 7.1 for the Receiver alignment in this manual and Figure 7-1 for an alignment points diagram and Figure 7-5 of the Receiver.

4.6.3 EXCITER

This menu selection walks through the alignment of the Exciter on the computer screen. Refer to Section 7.2 for the Exciter alignment and Figure 7-2 for an alignment points diagram and Figure 7-6 for a test setup of the Exciter.

4.6.4 FULL STATION

This menu selection walks through the alignment of the entire Universal Station. The Receiver and Exciter portions are performance tests and adjustments. The Audio and Data portions are level adjustments for the TPI card. Refer to Figure 7-11 for an alignment points diagram for the TPI card.

4.7 UTILITIES

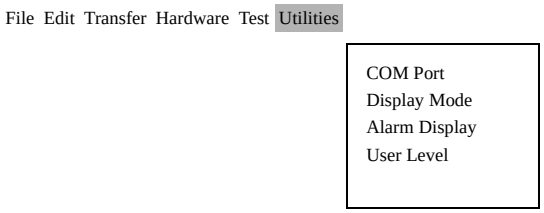


Figure 4-20 UTILITIES MENU

4.7.1 COM PORT

This is the COM port used to send and receive data from the TPI card. An interface cable connects the Universal Station to the computer.

4.7.2 DISPLAY MODE

This screen allows the color mode to be selected for color monitors. When using a non-color laptop, monochrome is recommend for better resolution.

4.7.3 ALARM DISPLAY

This screen displays a scrolling list of alarms generated by the repeater.

4.7.4 USER LEVEL

There are two levels to choose from, Novice and Advanced. The Novice uses prompts in the Edit-Parameters screens when Escape or F2 keys are pressed that ask "are you sure" before the task is executed. The Advanced selection performs the task without asking the question.

SECTION 5 REPEATER PROGRAMMING

5.1 CREATING A NEW FILE

An example will be used to show the programming for a new file.

NOTE: At any point in the programming sequence, if F1 is selected, a help screen appears to explain the menu selection highlighted at that point.

5.1.1 SELECT REPEATER TO EDIT

Universal Station is selected to program. When no file exists with programmed parameters, the default is selected and edited.

1. Highlight EDIT, press Enter.
2. Highlight Select Rptr, press Enter.
3. Default is the only Universal Station in the Repeater list, press Enter.
4. Highlight Setup Parameters, press Enter (or press F4).
5. The Setup Parameters screen appears (see Figure 5-1). Fill in the parameters for this Universal Station. A brief description of the parameters is in Table 5-1. Full descriptions are in Section 4.3.1.
6. Select parameters, press F2 to accept.
7. Highlight Alarm Configuration and press Enter, if alarms are to be configured.
8. Program the Alarms to be configured (see Section 4.3.3), press F2 to accept.
9. Highlight FILE, press Enter.
10. Highlight Save, press Enter.
11. Type in a valid DOS filename. For this example sta1.qx is used.
12. The file consists of default and Rptr 1 under the filename of sta1.qx.

5.2 ADDING A REPEATER TO A FILE

The example used for Station 1 will again be used to add repeaters to the filename sta1.qx.

1. Highlight EDIT, press Enter.
2. Highlight Select Rptr, press Enter.
3. The Repeater list shown for this file includes default and Rptr 1. These contain the same parameters with the exception that when selected for edit, the programmed information can be overwritten and the data lost.
4. Highlight Default, press Enter.
5. Highlight Setup Parameters, press Enter.
6. Change the Repeater Number and other parameters as required for this Universal Station, press F2.
7. Highlight Alarm Configuration and press Enter, if alarms are to be configured.
8. Program the Alarms to be configured (see Section 4.3.3), press F2 to accept.
9. Highlight FILE, press Enter.
10. Highlight Save, press Enter.
11. Rptr 2 is added to the List in file sta1.qx.

Table 5-1 REPEATER SETUP PARAMETERS

Parameter	Response	Description
Repeater Number	1-20	Each Universal Station is assigned a number from 1-20.
Channel Number	1-920	Each Universal Station is programmed with the Receive frequency that it is operating on.
RF Power Level	25-75	Power level in watts for transmit power.
Power Source	AC or DC	The type of primary power source for the Universal Station.

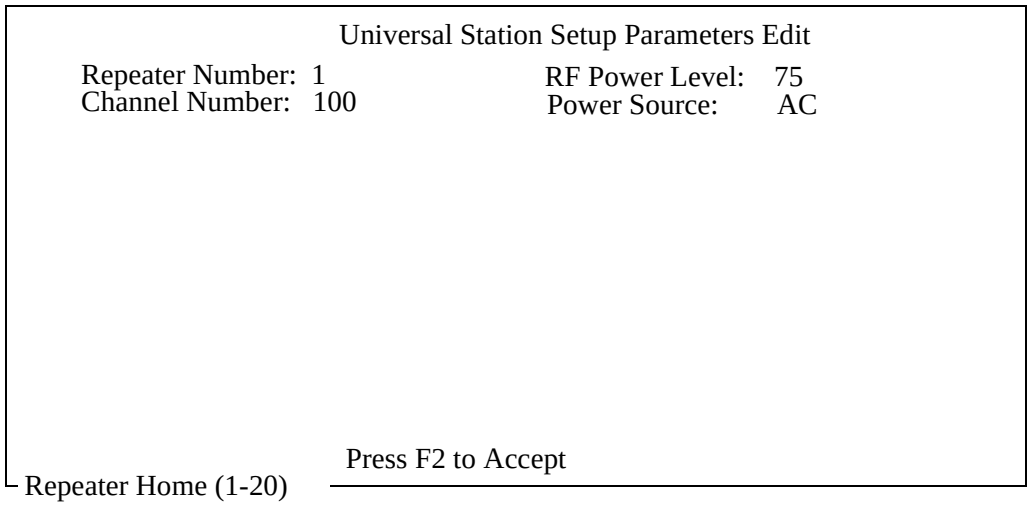


Figure 5-1 SETUP PARAMETERS

SECTION 6 CIRCUIT DESCRIPTION

6.1 RECEIVER

6.1.1 INTRODUCTION

The receiver is a double conversion type with intermediate frequencies of 52.95 MHz and 450 kHz. The first injection frequency is phase locked to a temperature compensated crystal oscillator (TCXO) with a frequency stability of ±1.0 PPM from -30° to +60° C (-22° to +140° F). Two 3-pole bandpass filters in the front-end reject signals outside the receive band and two 4-pole crystal filters and one 6-pole 450 kHz filter establish receiver selectivity. A Receiver block diagram is located in Figure 6-1.

6.1.2 REGULATED VOLTAGE SUPPLIES

The +15V DC power source is supplied by the Universal Station 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. U207 supplies +12V DC to the remaining circuits. U208 supplies +6V DC to the receiver.

6.1.3 HELICAL FILTER (L201-L203), RF AMPLIFIER (Q201)

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 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/R203 and C203/C204 provide bypassing. Additional filtering of the receive signal is provided by three-pole helical filter L204-L206. A section of microstrip on the collector of Q201 and C205/C207 match the impedance from Q201 to the filter.

6.1.4 FIRST MIXER (U201), CRYSTAL FILTER (Z201/Z202)

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 and C208. 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 15 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 (Q202), CRYSTAL FILTER (Z203/Z204)

Q202 amplifies the 52.95 MHz IF signal to recover filter losses and increase receiver sensitivity. Biasing for Q202 is provided by R208/R209/R210/R211/R313 and C212/C213 provide bypassing. The output of Q202 is matched to crystal filter Z203 at 52.95 MHz by R313, L211, C214 and C293.

Z203 and Z204 form a two-section, four-pole filter with a center frequency of 52.95 MHz and a -3 dB bandwidth of 15 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, C301, L225, C216, C338 and R322.

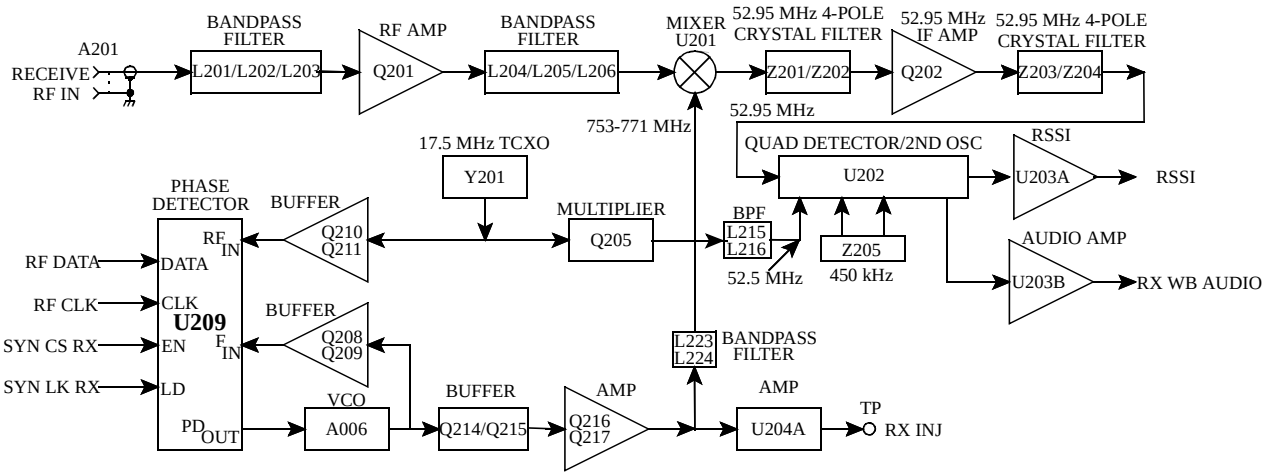


Figure 6-1 RECEIVER BLOCK DIAGRAM

6.1.6 SECOND MIXER/DETECTOR (U202)

As shown in Figure 6-2, U202 contains second oscillator, second mixer, limiter and detector. 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 (±1 PPM) output of Y201 is fed through C231 to tripler Q205. The tripler filter passes the third harmonic at 52.5 MHz to the oscillator input of U202.

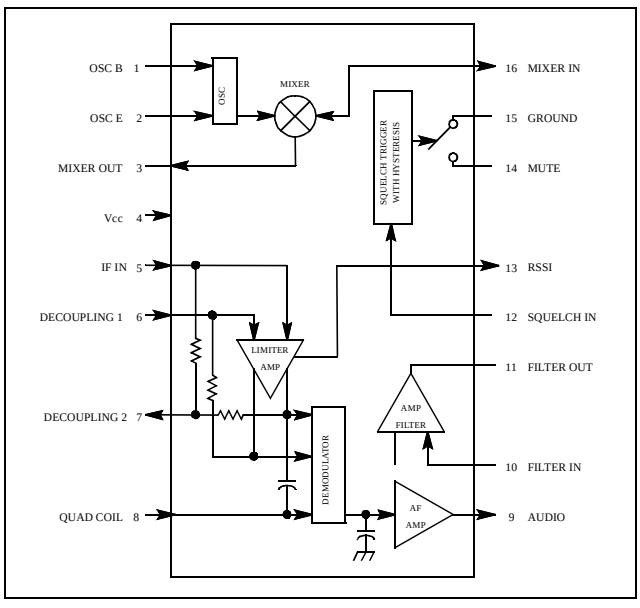


Figure 6-2 U202 BLOCK DIAGRAM

Biasing of Q205 is provided by R228, R227, R229 and R230. RF choke L214 blocks the flow of RF through R229. A bandpass filter is formed by C236, C235 and L215 is tuned to the third harmonic of Q205. C237 couples the third harmonic of Q205 to another bandpass filter formed by L216, C222 and C238. The third harmonic of the TCXO frequency is then used to drive the oscillator input at 52.5 MHz.

The 450 kHz second IF is then fed to ceramic filter Z205, then into the IF amplifier. The 6-pole ceramic filter has a center frequency of 450 kHz and a bandwidth of 15 kHz used for added receiver selectivity. The limiter amplifies the 450 kHz signal, then limits it to a specific value.

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 in phase). 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)

U203A amplifies the detected audio and data signal. R280/R263 set the gain of the amplifier and R256/R262 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 (U203A)

U202, pin 13 is an output from an internal RSSI (receive signal strength indicator) circuit which 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 output signal is then fed to J201, pin 7. The RSSI output is not used at this time.

6.1.9 VCO (A006)

The Voltage-Controlled Oscillator (VCO) is formed by Q802 circuitry and a resonator consisting of L220. The VCO oscillates in a frequency range from 753-771 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 the tank circuit. 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.

6.1.10 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 multiplied. If a noise pulse or other voltage change appears on the collector, the 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 and C811 provide RF bypass.

6.1.11 BUFFER (Q208, Q209)

A cascode amplifier formed by Q208 and Q209 provides amplification and also 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 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 decouples the output from AC ground. R273 lowers the Q of L219. The output is coupled by C309 to U209, pin 11.

6.1.12 SYNTHESIZER (U209)

The synthesizer inputs/outputs are shown in Figure 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 from the phase detector in synthesizer chip U209. This DC voltage is filtered by a loop filter; 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 ±1.0 PPM stability of TCXO Y201. This oscillator is stable from -30°C to +60°C (-22°F to +140°F).

The VCO frequency of A006 is controlled by a DC voltage produced by the phase detector in U209. The phase detector senses the phase and frequency of the 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 and the control voltage is constant.

One input signal is the reference frequency (f_R). This frequency is the 17.5 MHz TCXO frequency divided by the reference counter to half the channel spacing or 12.5 kHz.

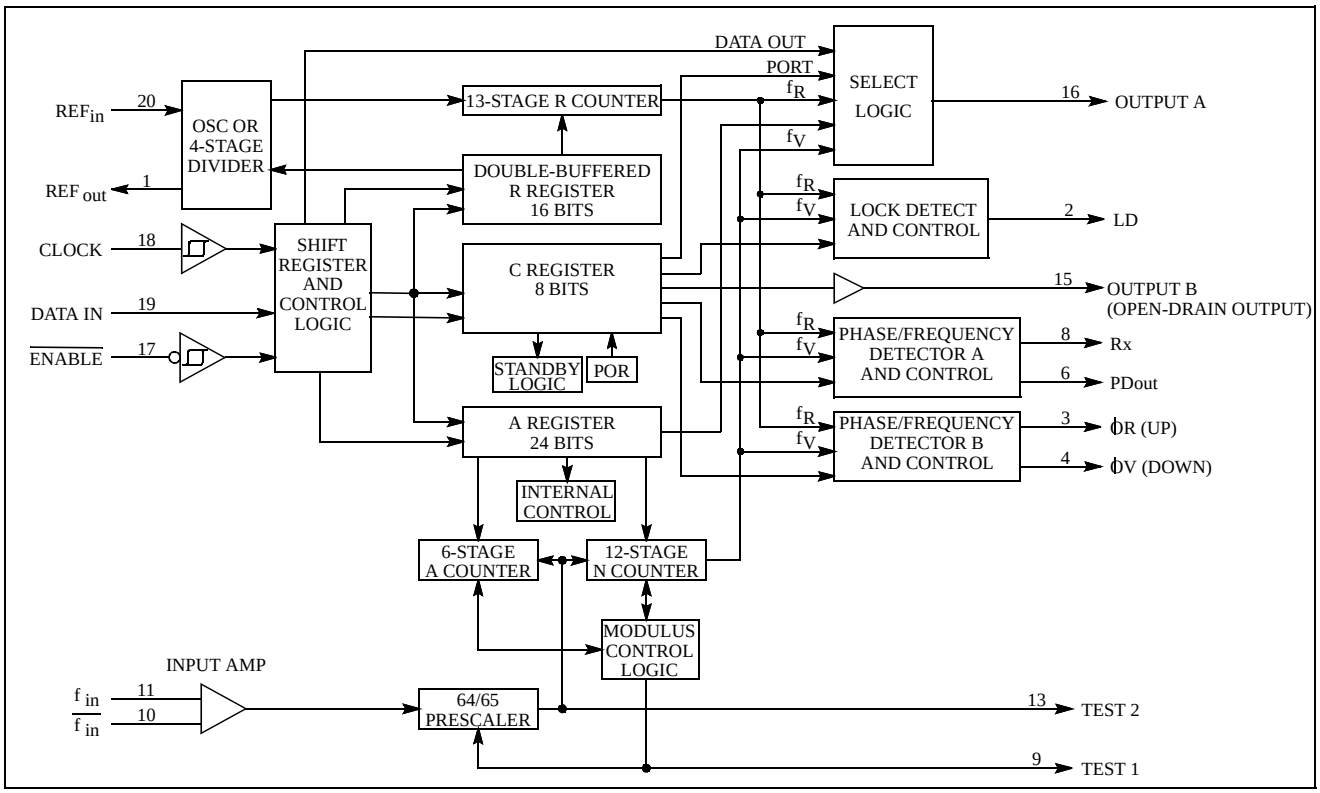


Figure 6-3 SYNTHESIZER BLOCK DIAGRAM

The other input signal (f_V) is from the VCO frequency divided down by the synthesizer "N" and "A" counters to 12.5 kHz. These counters are programmed through the synthesizer data line on J201, pin 20. Each channel is programmed by a divide number so that the phase detector input (f_V) is identical to the reference frequency (f_R) 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 Third Party Interface (TPI), 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 TPI via the IAC to J201, pin 18. The bit pattern is 8-bits long to access the C register, 16-bits to access the first buffer of the R register, or 24-bits to access the A register.

The values in the C, R, and A registers do not change during shifting because the transfer of data to the registers is controlled by $\overline{\text{ENABLE}}$. The 13 LSBs of the R register are double-buffered. Data is latched into the first buffer on a 16-bit transfer. The second buffer of the R register contains the 13-bits for the R counter. This second buffer is loaded with the contents of the first buffer when the A register is loaded (a 24-bit transfer). This allows presenting new values to the R, A and N counters simultaneously.

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 1400. This produces a reference frequency (f_R) of 12.5 kHz. Since the VCO is on frequency (receive frequency minus 52.95 MHz) and no multiplication is used, the frequencies are changed in 12.5 kHz steps and the reference frequency is 12.5 kHz for all frequencies.

The f_V 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 813.4875 MHz (channel 300). Since the VCO is 52.95 MHz below the receive frequency it must be 760.5375 MHz for channel 300. To produce this frequency, the N and A counters are programmed as follows: **N = 950 A = 43**

NOTE: Section 8.2.5 describes how the N and A counter numbers can be 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 43 or 2,795 input pulses. It then divides by 64 for 64 x (950 - 43) or 58,048 input pulses. The overall divide number K is therefore (58,048 + 2,795) or 60,843. The VCO frequency of 760.5375 MHz divided by 60,843 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.

6.1.13 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 lock detect pulses are applied to J201, pin 14 and sent to the RF Interface on J103, pin 14 for detection and sampling in the IAC.

6.2 EXCITER

6.2.1 VCO (A007)

The Voltage-Controlled Oscillator (VCO) is formed by Q802, associated circuitry and a resonator consisting of L204 in the Exciter. The screw in L204 in the Exciter tunes the tank circuit to the desired frequency range. The VCO oscillates in a frequency range from 851 MHz to 869 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 the tank circuit.

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 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, the two phase detector inputs remain in phase and no frequency shift is sensed. This produces a flat audio response. 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. Maintaining the voltage reference to the TCXO is critical to maintain correct frequency over temperature.

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 TPI on P100, pin 7.

With reference to the ground on the Exciter, the 3.5V reference stability is maintained by U206A/B. The 3.5V DC passes through summing amplifier U208B 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 output modulation level and along with the 3.5V DC is applied to U402A, pin 2. U402A, pin 3 is set to 3.5V to provide a very stable output on pin 1 to the 1 PPM TCXO Y401.

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 the capacitance that is multiplied. If a noise pulse or other voltage change appears on the collector, the base voltage does not change significantly because of C809. Therefore, the base current does not change and transistor current remains constant. R803 is the low impedance collector load for Q802 and decouples the output from AC ground. L803 is an RF choke and C807, C808, C810 and C811 provide RF bypass.

6.2.4 BUFFER (Q406, Q407)

A cascode amplifier formed by Q406 and Q407 provides amplification and also 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 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 output of the amplifier is coupled by C429 and C499 to U403, pin 11.

6.2.5 SYNTHESIZER (U403)

The synthesizer inputs/outputs are shown in Figure 6-3. 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 is established by the ±1.0 PPM stability of TCXO Y401. The oscillator is stable from -30°C to +60°C.

The VCO frequency of A007 is controlled by a DC voltage produced by the phase detector in U403. The phase detector senses the phase and frequency of the 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.

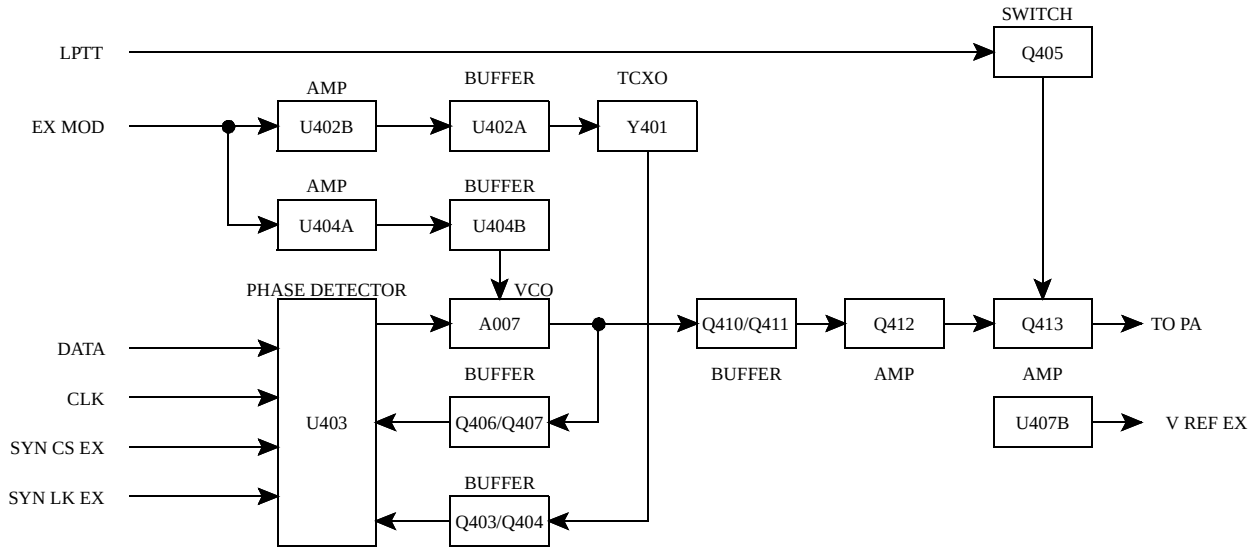


Figure 6-4 EXCITER BLOCK DIAGRAM

One input signal is the reference frequency (f_R). This frequency is the 17.5 MHz TCXO frequency divided by the reference counter to be half the channel spacing or 12.5 kHz.

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

The other input signal (f_V) is from the VCO frequency divided by the "N" and "A" counters in U403, programmed through the synthesizer data line on J401, pin 20. Each channel is programmed by a divide number so that 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 numbers. The programming of these counters is performed by circuitry in the TPI, which is 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. 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 TPI 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. This produces a reference frequency (f_R) of 12.5 kHz. Since the VCO is on frequency and no multiplication is used, the frequencies are changed in 12.5 kHz steps. The reference frequency is 12.5 kHz for all frequencies 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 858.4875 MHz (channel 300). Since the VCO is the channel frequency for transmit this frequency is used. To produce this frequency, the N and A counters are programmed as follows: **N = 1073 A = 7**

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 7 or 455 input pulses. It then divides by 64 for 64 x (1073 - 7) or 68,224 input pulses. The overall divide number K is therefore (68,224 + 455) or 68,679. The VCO frequency of 858.4875 MHz divided by 68,679 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.

6.2.6 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 lock detect pulses are applied to J401, pin 16 and sent to the RF Interface on J102, pin 16 for detection and sampling in the IAC.

6.2.7 BUFFER AMPLIFIER (Q410, Q411)

A cascode amplifier formed by Q410 and Q411 provides amplification and also isolation between the VCO and exciter RF stages. A cascode amplifier is used because it provides reverse isolation. The input signal to this amplifier is tapped from VCO A007. C441 provides DC blocking. Bias for the amplifier is provided by R464, R465, R466, R467 and R468. L406 is an RF choke and R483 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, R460 and two sections of microstrip.

6.2.8 RF AMPLIFIERS (Q412, Q413)

RF amplifier Q412 is biased by R469, R470 and R472. AC ground is provided by C450. C448 provides RF bypass from the DC line and R471 provides supply voltage isolation. A section of microstrip on the collector acts as an RF inductor. 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. When the Logic Push-To-Talk (LPTT) on J401, pin 11 is low Q405 turns on 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 provides DC blocking. The RF output of the exciter is on coaxial connector J402 to the power amplifier.

6.3 POWER AMPLIFIER

6.3.1 AMPLIFIER/PRE-DRIVER (U501)

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 851-869 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 4 to approximately 5W.

6.3.2 DRIVER (Q501)

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. C519, C520, C521 and microstrip match the output of the driver to 50 ohms at J501. A501 couples driver output to the input splitter of the finals.

6.3.3 FINAL AMPLIFIERS (Q502, Q503)

Q502 and Q503 are combined 60W amplifiers. The 22W RF input from J501 on the output of driver Q501 is applied to WO514 through a coaxial cable and connector. 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. A502 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 is present on both ends of the balancing resistor. Therefore, no current flows and no power is dissipated in the balance resistor. If one final failed, half the drive power would be dissipated by the resistor and the other final would continue to function.

6.3.4 POWER DETECTORS (U504A, U502B)

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 U504A and U502B are monitored by the repeater software through the RF Interface Board. If a final amplifier fails, the software will reduce the output power to prevent overdriving the remaining final amplifier.

6.3.5 THERMAL SENSOR (U503)

Thermal protection is provided by temperature sensor U503. The operating range of the sensor is from -30° C to 100° C (-22° F to 212° F). CR505 is used to reference U503 above ground to allow the sensor to read below 0° C. Amplifier U502A sends the output of U503 through WO509 to the RF Interface Board. The RF Interface Board reduces the power amplifier to half power (via the MPC) if the temperature reading is too high and turns the fan on and off (not via the MPC). The fan is turned on at approximately 50°C and off again at 42°C.

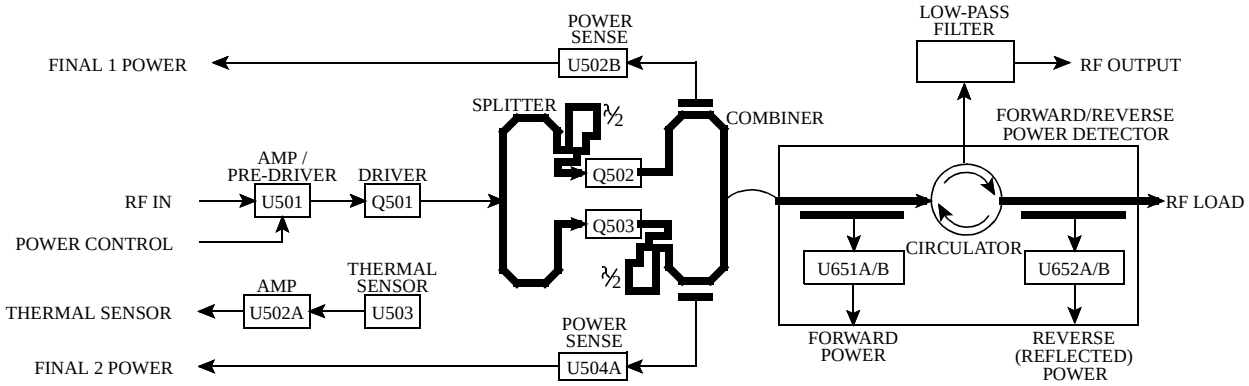


Figure 6-5 POWER AMPLIFIER BLOCK DIAGRAM

6.3.6 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 to the detectors on the input and reflected ports of the circulator. R663 and R680 calibrate the forward and reverse sense levels. The sensed levels are coupled to the RF Interface Board and software.

6.4 RF INTERFACE BOARD

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

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

6.4.1 POWER CONNECTOR

The power supply is connected to the RF Interface Board when the RF module is inserted into the Universal Station cabinet (see Figure 10-3). The jack portion of the connection is on the RF Interface Board, the plug portion is attached to the Universal Station cabinet.

P1 Ground

Ground return for the RF assembly.

P2 Ground

Ground return for the RF assembly.

P3 +15V DC

Supply voltage to Exciter, Receiver and Power Control. 15V, 1.5A.

P4 +26.5V DC

Supply voltage to PA. +26.5V, 12A nominal (16A max) at 75W.

P5 +26.5V DC

Supply voltage to PA. +26.5V, 12A nominal (16A max) at 75W.

6.4.2 SIGNAL CONNECTOR (J101)

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

Carries ground current between the RF Interface board and Backplane board.

Pin 2 PC STR

Power Control Strobe. 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

Not used at this time.

Pin 4 Ground

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 TPI card 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

Not used at this time.

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

The 3.5V DC TCXO reference voltage from the Exciter to the TPI card.

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

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 22 TX MOD

The audio from the TPI card in the Controller processes a number of inputs to the Universal 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

A pin that carries ground current between the RFIB and CBP board.

Pins 24-25 UNUSED

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

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

1. RF Forward Power Sense
2. RF Power Sense Device 1
3. RF Power Sense Device 2
4. RF Power Sense Device 3
5. RF Power Sense Device 4
6. RF Reflected Power Sense
7. PA Temperature

8. Transmit Audio Modulation
9. High Stability Exciter Lock Detector
10. Exciter Lock Detector
11. Receiver Detector Audio
12. Receive Signal Strength Indicator
13. Receiver Injection Level
14. High Stability Receive Lock Detector
15. Receiver Lock Detector
16. Fan Current 1
17. Fan Current 2
18. Fan 1 On Sense
19. Power Supply Temp
20. Battery Voltage
21. High-Low Power

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 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 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 40-60 dB. It will have an output from an op-amp with the voltage going from 0.5V to 4.5V. The level will have an adjustment in the Receiver.

Pin 31 GROUND

Carries ground current between the RFIB and Chassis Backplane.

Pin 32-36 UNUSED

6.4.3 FAN CONNECTORS (J104/J105)

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

The ground return for the motor in Fan 1.

Pin 2 FAN HI

Connected to Pin 4. Carries the voltage to Fan 1 and/or Fan 2. 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 42°C.

Pin 3 FAN2 LO

Ground return for the motor of Fan 2.

Pin 4 FAN HI

Connected to Pin 2. Carries the voltage to Fan 1 or Fan 2. The Voltage is 20V-30V at 1/4A nominal. This pin goes high when the PA heat sensor rises above 50°C and goes low below 42°C.

6.4.4 POWER AMPLIFIER CONNECTIONS

WO 116 +26V DC

This capacitive feedthrough pin is at +26.5V DC and carries the PA current, 12A nominal at 75W from the RFIB to the Power Amplifier board.

WO 117 +26V DC GROUND

This capacitive feedthrough pin carries ground current from the RFIB to the Power Amplifier board. It must be capable of carrying up to 20A.

WO 118 +15V DC

This capacitive feedthrough pin connects +15V DC from the RFIB to the PA, Exciter, and Forward/ Reverse Power Detect boards. Maximum current handling is 6A (1.5A nominal at 75W).

WO 119 UNUSED

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 5.5V-11V with current as high as 200 mA.

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 2.6V correlates to 75W 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 the forward power sense of the output power on one side of the Wilkinson combiner. It is a voltage source that is a function of the output power of RF device number 1. 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 the forward power sense of the output power on one side of the Wilkinson combiner. It is a voltage source that is a function of the output power of RF device number 2. 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
WO 125 RF OUT 4

Not used at this time.

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 linear function of temperature ranging from 0V-5V output and -30°C to +100°C (-22°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 will typically be turned on at 50°C and off at 42°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.

6.4.5 EXCITER CONNECTOR (J102)

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

Pin 1 VCC1

The voltage on this pin is +15V, nominal current of 150 mA. It provides current to the Exciter from the RFIB.

Pins 2-8 GROUND

Pin 9 3.5V DC

The 3.5V DC TCXO reference voltage from the Exciter to the TPI.

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

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 TPI card in the Controller processes a number of inputs to the Universal 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

Carries ground current between the RFIB and the Exciter board.

Pin 16 SYN LK EX

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

Pins 17-18 HS LK EX-HS CS EX

Not used at this time.

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

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.

6.4.6 RECEIVER CONNECTOR (J103)

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

Pin 1 VCC1

+15V with a nominal current of 1A provides current from the RFIB to the Exciter, Receiver.

Pin 2-6 UNUSED

Pin 7 RSSI

This pin is the Receive Signal Strength Indicator (RSSI) to the Controller. The RSSI is used to tune the Receiver front-end during test mode. The dynamic range is 40-60 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 TPI card in the Controller card cage. Typical amplitude is 387 mV RMS (-6 dBm) and 2V DC with Standard TIA Test Modulation into the Receiver. The only wave shaping in the Receiver board is 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

Carries ground current between the RFIB and the Receiver board.

Pin 12 SYN CS RX

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

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

Pin 15 GROUND

A pin that carries ground current between the RFIB and the Receiver board.

Pin 16 HS CS RX

Not used at this time.

Pin 17 GROUND

A pin that 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

Not used at this time.

Pin 20 RF DATA

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.

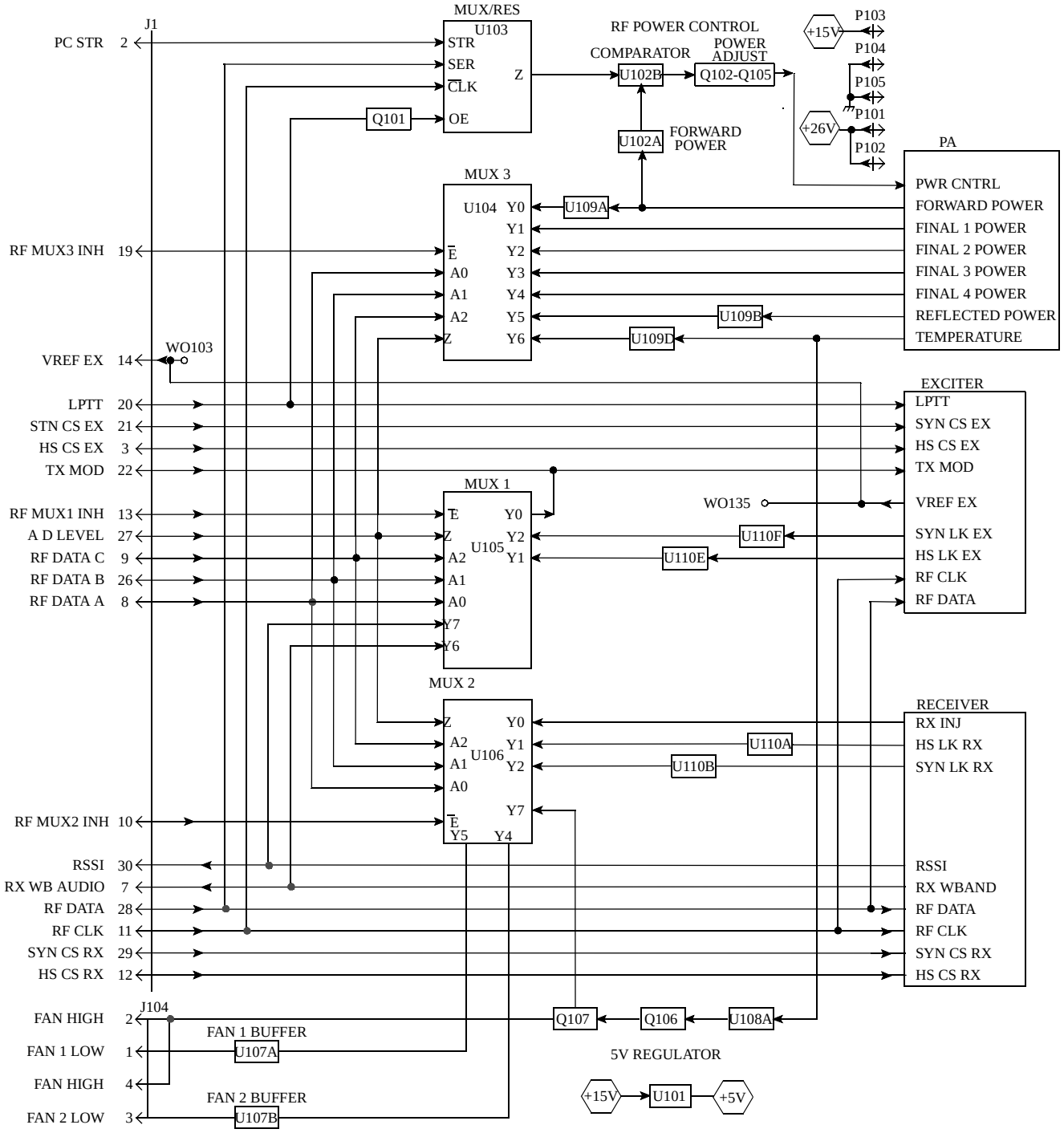


Figure 6-6 RF INTERFACE BOARD BLOCK DIAGRAM

6.5 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 1.5).

6.6 FILTER BOARD

AC power is brought into the power supply through the IEC connector in the front of the power supply (see Figure 2-1). 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.

6.6.1 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.

6.6.2 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.

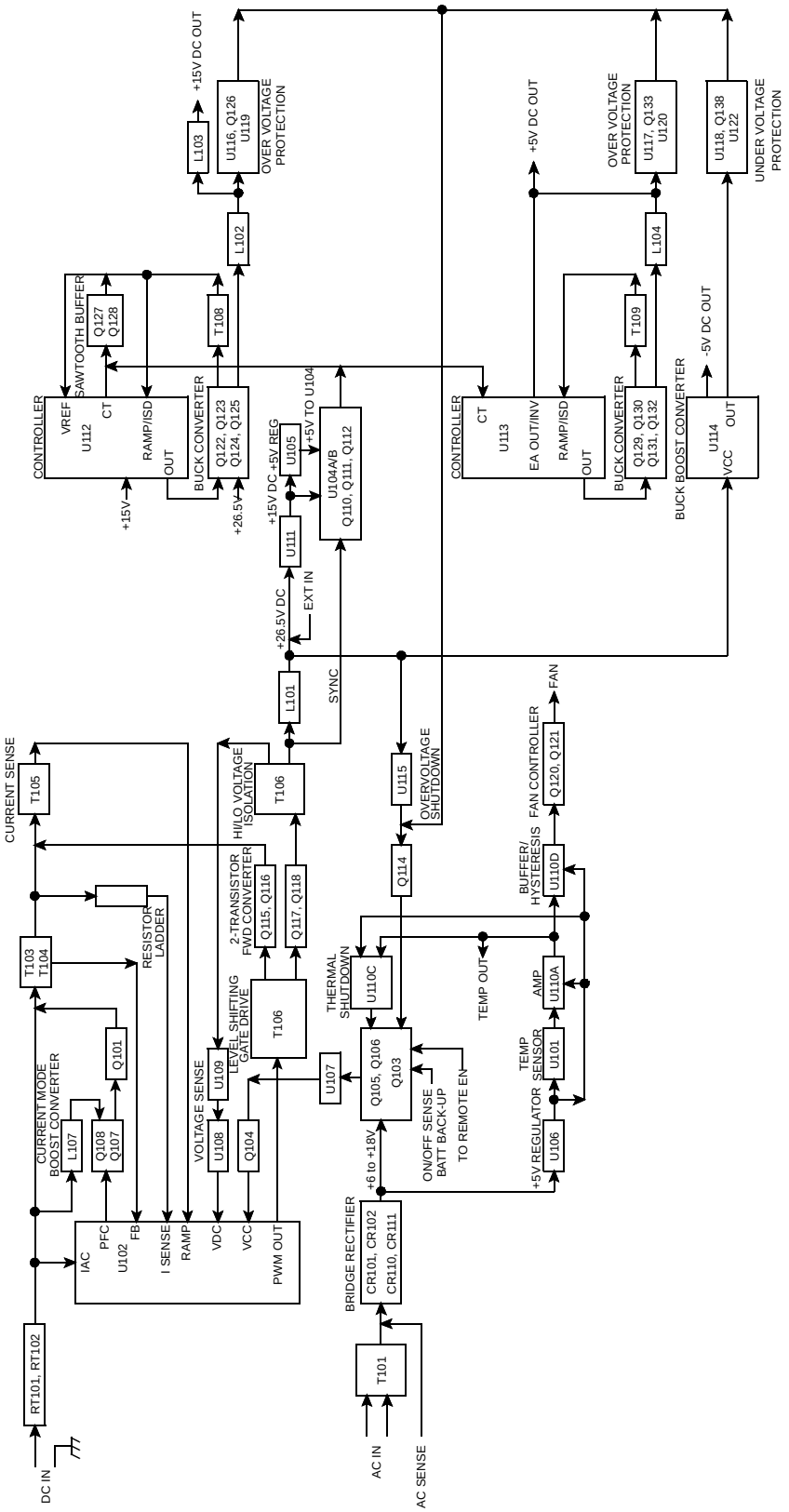


Figure 6-7 POWER SUPPLY BLOCK DIAGRAM

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.

6.6.3 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.

6.6.4 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 dependant 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.

6.6.5 +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.

6.6.6 +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%.

6.6.7 -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.

6.6.8 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.

6.7 BATTERY BACK-UP MODULE

6.7.1 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.

6.7.2 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 6-8 shows the algorithm used in float charge applications for two 12V lead-acid batteries in series. Figure 6-8 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 6-8. 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).

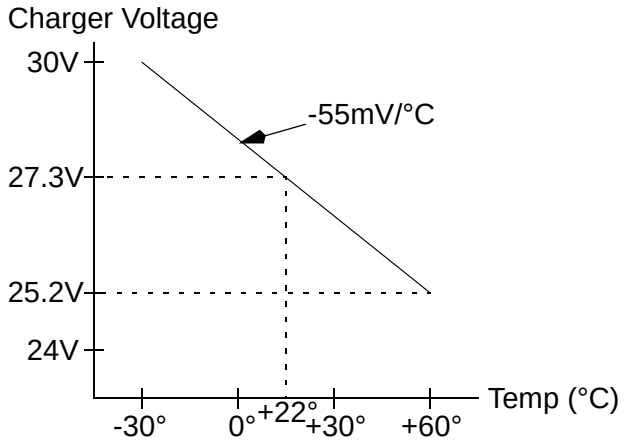


Figure 6-8 NO LOAD CHARGE VOLTAGE vs. TEMPERATURE

6.7.3 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.

6.7.4 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.

6.7.5 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.

6.7.6 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.

6.8 CARD RACK

The card rack provides slots for up to eight logic cards; including Third Party Interface (TPI) card 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 Universal Station backplane.

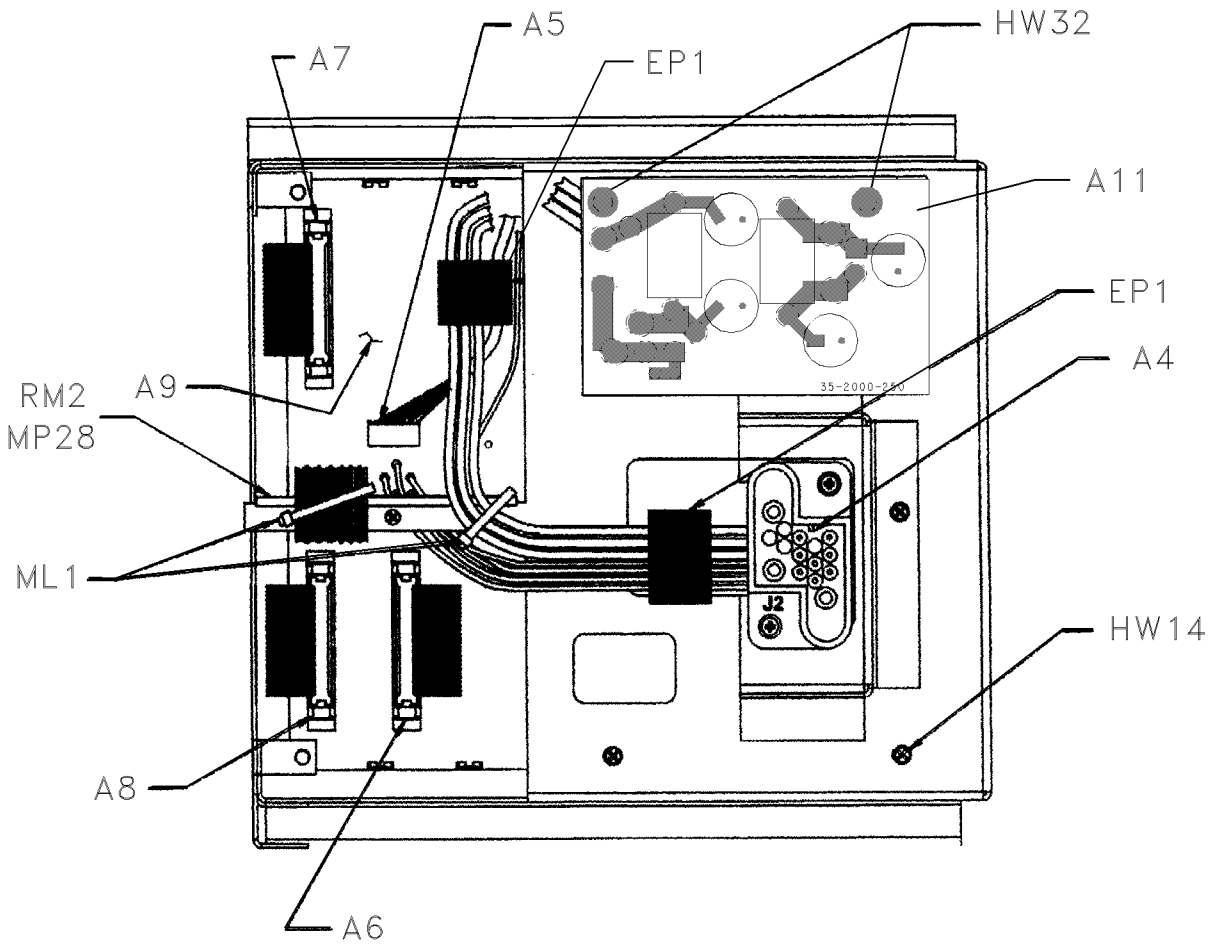


Figure 6-9 BACKPLANE CONNECTORS

6.9 EXTERNAL CONNECTOR BOARD

The external connector board (A10) is the interface for the alarm outputs, connections to and from the external and controller equipment.

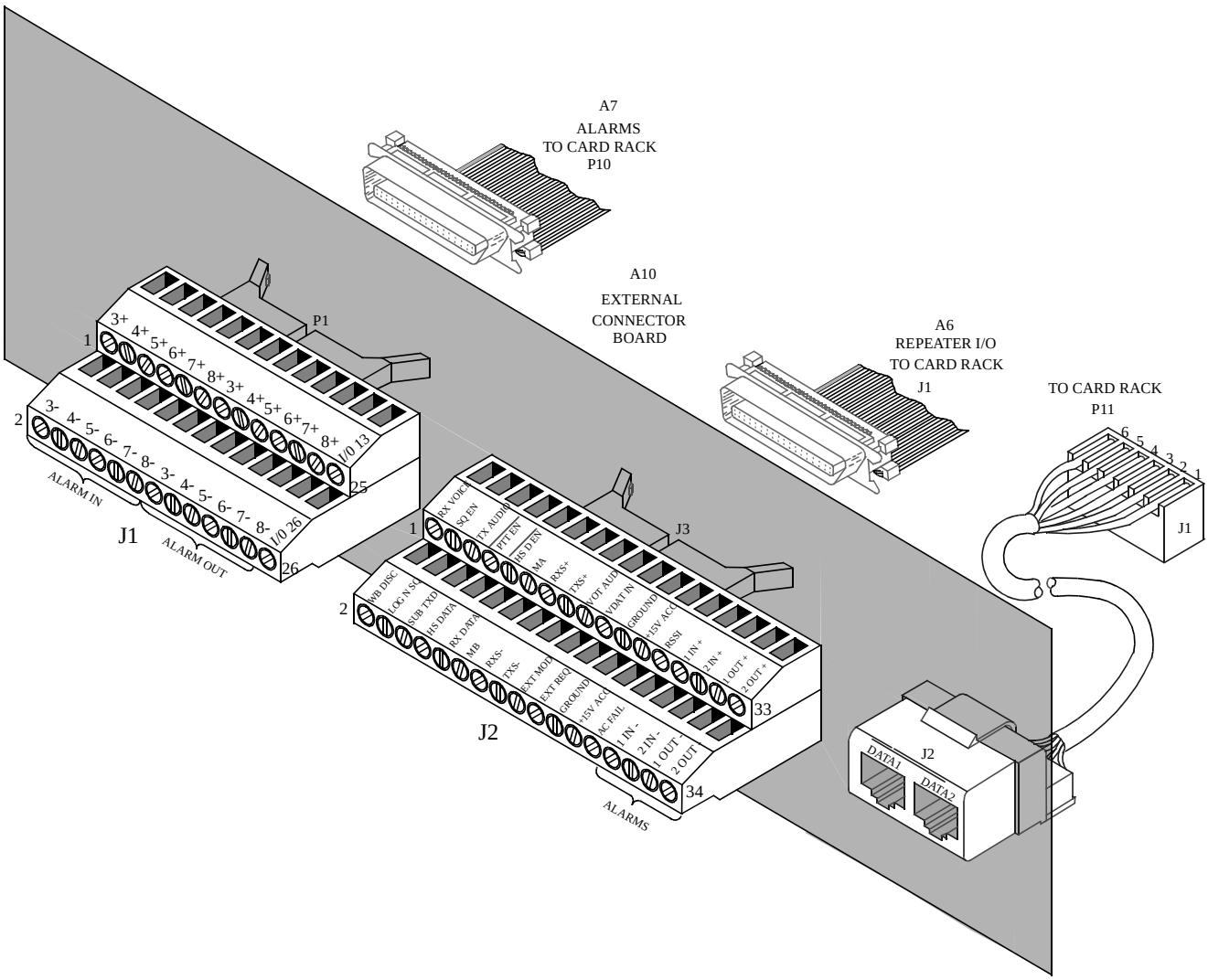


Figure 6-10 EXTERNAL CONNECTOR TERMINAL BOARDS

6.10 THIRD PARTY INTERFACE

6.10.1 INTRODUCTION

The Third Party Interface (TPI) card connects directly to the computer serial port. Using Universal Station software, the computer programs Universal Station parameters, sets and reads the alarms, maintains the audio gating and handles initialization requests from the IAC. The TPI card also contains the RF data for the Receiver, Exciter and PA.

A TPI card is installed in each Universal Station to control functions performed by the main processor. The TPI card contains the main software and control over the Universal Station via microprocessor U7 (see Figure 6-16).

The TPI card stores the information required to operate the routing of audio and data from the inputs of the Universal Station to the outputs. The information received on the address bus addresses the microprocessor and the latches open and close gates to route a path for the audio or data.

Audio control functions for each Universal Station are performed by the Main Processor in the TPI card installed in each Universal Station. The TPI card contains the software and control over the Universal Station via microprocessor U7. The main processor has the programmable parameters for the gates.

Information is exchanged with the IAC through the Controller Backplane via a data bus and an address bus. The address bus provides the link between the main processor and the address latches. These latches control the octal latches that select the audio and data gates. 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 Universal Station. The TPI card also contains:

- Flash Memory.
- 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 Rx and Ex synthesizers.
- Serial communication circuitry and processes for the Intra-Universal Station Data Bus (IRDB) (Factory Use Only).
- Synchronous parallel communication to the IAC, 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 Receiver and Exciter via the IAC.
- 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 center slicer circuitry for detecting the subaudible data.
- Transmit audio filter and limiter with pre-emphasis.

6.10.2 MICROPROCESSOR (U7)

This contains the main software and control over the Universal Station (see Figure 6-11).

The main controller (U7) 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 Intel 8086/8088. On chip components include; 256 bytes of RAM, serial and parallel inputs/outputs, comparator port lines and timers.

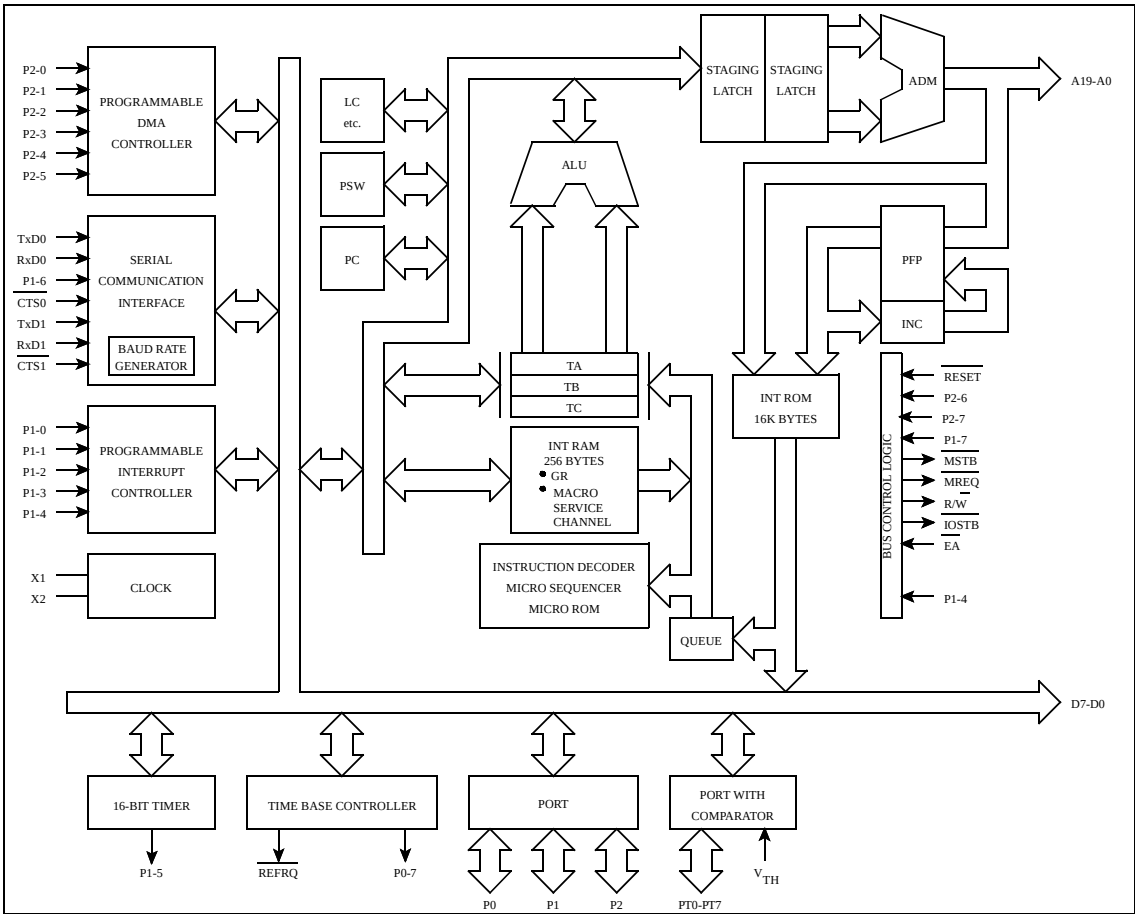


Figure 6-11 U7 BLOCK DIAGRAM

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 microprocessor can be reset by integrated circuit U2. Reset occurs when power is turned on, when the 5V supply drops below a threshold level or the reset switch (S1) is pressed.

When a microprocessor is reset, several internal registers are cleared and the program restarts. The reset circuitry provides additional protection against low voltage conditions.

When power is turned on, the RESET output U2, pin 6 is initially high. If the 5V supply drops below a nominal level, the RESET output changes states and microprocessor operation is halted until the 5V supply returns to normal.

The Watchdog timer resets the microprocessor if periodic pulses are interrupted to U2, pin 7. The jumper should be from J6 pin 2 to pin 3 for normal operation.

Manual reset can be accomplished by pressing push-button switch S1. When U2, pin 1 goes low, U2 goes into the reset sequence described.

6.10.3 RECEIVE AUDIO

The Receive Wide Band Audio (RX WBAND) signal from the Receiver is fed into the TPI card on P100, pin 27. This audio signal includes; audio, data, and noise. The audio processing circuit provides filtering and amplification of the audio signal before it is routed to the outputs on the TPI card.

A low-pass filter consisting of U101A/B attenuates frequencies above 3 kHz. This removes high-frequency noise from the audio signal. From the filter the signal is fed to amplifier U103A 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 U103B/C/D. This filter attenuates frequencies below 300 Hz which removes data present in the wide band audio signal. The signal is then fed to U104A which provides 6 dB per octave de-emphasis.

Audio gates U131B/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 U131B through U131D. When a carrier is detected, this input is high and U131B passes the signal. Receive Mute Gate U131C is controlled by the TPI card Squelch Enable input on P100, pin 15. This input comes from rear connector J2. J105/P105 can also control U131C with jumper P105 in place to close the gate. When audio is passed by U131B/C and U132A, the audio can be routed through other gates to various outputs (see Section 6.10.6).

P100, pin 27 provides receive wide band audio to the input of U138A/B. The output of U138B is applied to wide band discriminator output P100, pin 14 and rear connector J2, pin 2.

6.10.4 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.

U105A 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 U105B and U107A. A level control adjusts the gain of amplifier U105B. The gain of U107A 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 U107B. The output of U107B is positive-going pulses. These pulses are applied to U107C 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 U107C is applied to U107D and Logic Noise Squelch to Audio/Data Gate U137B. Gate U137B routes the squelch output to the Audio/Data Test Point J100. The output of U107C is also routed to the backplane on P100, pin 16 and then to rear connector J2. U107D functions as a timing buffer. The output of U107D is applied to Receive Squelch Active Gate U131D. When this gate is closed the squelch circuit controls Normal Receive Gate U131B to block receive audio if no signal is present.

6.10.5 RECEIVE DATA CIRCUITRY

The receive wide band audio signal is the unfiltered output of discriminator U202 in the Receiver. Therefore, this signal contains audio, data, and noise. A low-pass filter formed by U108A/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 U110A. The gain of U110A is adjusted by a level control. The output of U110A can be routed through Data To Audio/Date Gate U137C 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. U110B/C provide the reference voltage on the inverting input of comparator U110D. Positive peak detector U110B handles the positive-going peaks of the data signal. Negative peak detector U110C handles the negative-going peaks of the data signal.

The voltage on non-inverting input to U110D is midway between the positive- and negative-going peaks. The data input is on the non-inverting input of U110D. 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 the receive data output on the backplane P100, pin 22 and then to rear connector J2.

6.10.6 RECEIVE AUDIO PROCESSING

Amplifier U113B provides amplification of the receive audio signal fed to P100, pin 13 (or Tx Audio P100, pin 17 if P106 is used). The gain of U113B is set by R172. J105/P105 can also control U131C with jumper P105 in place to close the gate.

When the received audio must be routed to the backplane (i.e. for external connector J2), Receive Voice Gate U133B is enabled by processor U7/latch U15 and passes the audio signal to amplifier U113B. The level of U113B is adjusted by R172. Receive To Backplane (RX TO BP) U133C 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 U132D is enabled by U7/latch U15. The audio is passed to local audio output amplifier U111. The gain of U111 is adjusted by the local audio volume control and on/off switch.

6.10.7 TRANSMIT AUDIO

The Local Microphone PTT switch (Q201) provides Push-To-Talk (PTT) indication to U14 when the collector of Q201 goes low. U14 then tells U7 via the data bus that the local microphone PTT has been activated. The PTT Enable input from rear connector J2 is applied to the TPI card on J100, pin 19. When the input is pulled low, Q102 provides a PTT indication to U14 that tells U7 via the data bus that the PTT has been activated.

U203A amplifies the microphone audio signal to provide the correct input level to U203B. Local Microphone Mute Gate U134C is controlled by A/D processor U7/latch 16. The function of U134C 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.

Buffer U203B couples the microphone audio signal from U203A or the audio signal from the Repeat Gate U133C.

U204B/C form a high-pass filter that attenuates frequencies below 300 Hz to prevent interference with the data applied at U208B. Pre-emphasis at 6 dB per octave is provided by an RC combination before the signal is fed to the Limiter U204D.

Limiter U204D 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 low pass filter formed by U204A/B and U205.

The output from U205A is fed to Normal Modulation Mute Gate U135B. This gate is controlled by U7/latch U17. When enabled, the gate passes transmit audio to EEPOT U207. U207 is an electronically adjustable potentiometer that adjusts the gain of transmit audio amplifier U208C. The gain of U208C can only be adjusted through the software. Therefore, a computer must be attached to the TPI card when levels are set.

The output of U208C is fed to summing amplifier U208B where it is combined with transmit data when present. The gain of audio and data are the same so unity gain is produced. The output signal is fed to the TCXO and VCO where it frequency modulates the transmit signal.

6.10.8 TRANSMIT AUDIO PROCESSING

Transmit voice from rear connector J2, pin 5 goes to the backplane and comes into the TPI card on P100, pin 17. When used this signal passes to the transmit voice amplifier U202A. The output level of the

amplifier is adjusted by a level control R202. The output of U202A is applied to Transmit Voice Gate U136A. U136A is controlled by processor U7/latch U16. When enabled, the gate passes the voice to Transmit Option Gate U136C and on to the transmit audio buffer U203B.

6.10.9 TRANSMIT DATA AND CWID PROCESSING

The subaudible transmit data from rear connector J2, pin 6 is connected to P100, pin 18 and fed to buffer U206A. The output of U206A is applied to amplifier U205B. R237 sets the output level of U205B. The output of U205B is applied to the non-inverting input of the summing amplifier U208B and passed to the transmit modulation output on P100, pin 29 to the RFIB and the Exciter.

During Universal Station test, U7, pin 11 generates a 10 Hz 5V P-P square wave that is applied to transmit tone enable gate U135D. U135D is controlled by U7/latch 17. When enabled the square wave passes through the gate to buffer U206A and the same path as the subaudible transmit data. The square wave is used to balance the levels at the TCXO/VCO in the Exciter test procedure.

The CWID output is only used in the TPI card to send out alarms and is controlled by processor U7/latch U15. This output is fed to CWID tone generator U209B/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 U208A. This filter passes the 800 Hz fundamental present in the signal. The output of the filter is applied to the summing amplifier, gate U208B, to the backplane on J100, pin 29 and to the modulation input of the Exciter via the RFIB.

6.10.10 HIGH SPEED DATA PROCESSING

The high speed data input on P100, pin 20 is fed to External Modulation Mute Gate U135C. Gate U135C is controlled by processor U7/latch U17. When enabled, this gate passes the high speed data on pin 20 to the summing amplifier U208B through buffer U208D and P100, pin 29 to the modulation input of the Exciter.

6.10.11 CHIP SELECT DECODERS (U10/U13)

Selects the peripheral chip for read/write.

6.10.12 P101 SIGNAL CONNECTOR

The signal interface connector P101 (64 pin) that connects the Address and Data buses and control lines to the backplane connector.

Pins 1-10/33-42 ADDRESS BUS

Provides a path between the main processor and the external memory on the TPI card and the IAC. This bus retrieves information programmed into memory for the operation of the Universal Station.

Pins 11-14 DATA BUS
Pins 43-46

Provides a means of transferring data to and from the CPU on the TPI card, memory storage on each card and peripheral devices in and out of the TPI card 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 TPI card.

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

A memory strobe line used during TPI card main processor Read/Write operations to external memory on the TPI card and IAC plugged into the backplane.

Pin 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 22-24 UNUSED

Pins 25/57 IRDB+/IRDB-

Interconnects all repeaters to provide an exchange of programming information with the programming software and computer. This data bus allows all repeaters to be accessed without having to connect the computer to the TPI card on each Universal Station individually.

Pin 26 UNUSED

Pin 27/59 -5V IN

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

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

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

Pins 30/62 +15V IN

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

Pins 31/32-63/64 GROUND

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

Pin 47 READ

Used with the MREQ line to read data from the main processor and external memory.

Pin 48 WRITE

Used with the MREQ line to write data to the main processor and external memory.

Pins 49-56/58 UNUSED

6.10.13 P100 EXTERNAL OUTPUTS

Connector P100 contains the audio and data outputs to the terminal block on the back of the Universal Station cabinet. These outputs are connected to other external devices.

The input and output connections for the connector are defined as follows.

Pin 1-6 UNUSED

Pins 7 V REF EX

The +3.5V DC TCXO reference voltage from the Exciter to the TPI card.

Pin 8-12 UNUSED

Pin 13 RX VOICE

This is the 300 Hz to 3 kHz de-emphasized filtered receive audio output to the backplane and rear connector J2, pin 1.

Pin 14 WB DISC

This is wide band audio and data from the discriminator in the receiver to the backplane and rear connector J2, pin 2.

Pin 15 SQ EN

Input from the rear connector J2, pin 3 to the backplane. This TTL level controls the receive mute gate in the TPI card. A low on this line opens the gate. P105 jumpers J105 on this line if external squelch gate control is not used.

Pin 16 LOG NOISE SQ

The logic noise squelch output to the rear connector J2, pin 4 via the backplane. This is a receive TTL level fast squelch.

Pin 17 TX AUDIO

This is a 300 Hz to 3 kHz transmit audio input from the rear connector J2, pin 5.

Pin 18 SUB TX DATA

This input is subaudible transmit data from the rear connector J2, pin 6.

Pin 19 $\overline{\text{PTT N}}$

This input is from the rear connector J2, pin 7. The push-to-talk line is an active low TTL level control that keys the Universal Station.

Pin 20 HS DATA

The high speed data is passed from the rear connector J2, pin 8 to J100, pin 29, the transmit modulation output to the RFIB and Exciter.

Pin 21 $\overline{\text{HS DATA EN}}$

This input is from the rear connector J2, pin 9. The TTL level control line is active low.

Pin 22 RX DATA

This output is on the rear connector J2, pin 10. The output is TTL level sub-audible receive data.

Pin 23-26 UNUSED

Pin 27 RX WB AUDIO

Receive Wide Band Audio from the Receiver audio discriminator 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 for the computer. The gates in the TPI are controlled by U7 and the software to provide the specific output for alignment.

Pin 29 TX MOD

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

Pin 30-32 UNUSED

6.10.14 J100 A D LEVEL TEST POINT

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

6.10.15 J101 SPEAKER/MICROPHONE

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

6.10.16 J102 LOCAL MICROPHONE

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

6.10.17 J103 GROUND

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

6.10.18 J104 EXTERNAL SPEAKER

Provides an external speaker connection at the Universal Station site for monitoring.

6.10.19 J1 COMPUTER CONNECTOR

J1 is the TPI card connection to the computer or modem.

Pin 1	Ground
Pin 2	Computer Tx
Pin 3	Computer Rx

6.10.20 J10 BAUD RATE

J10 is jumpered to select the baud rate from the computer to the TPI card, these two I/O baud rates must be the same. The baud rate of the computer can be found from the command line by either requesting /b, /h or /? (see Section 3.1.5). To change jumper J10:

1. Power off the station.

2. Move jumper J10 on the TPI card to the proper rate.

3. Power on the station.

6.10.21 J6/P6 WATCHDOG TIMER/RESET

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.

6.10.22 J7/P7 J8/P8 IRDB

These jumpers are used in factory testing. P7 and P8 should be removed for normal operation.

6.10.23 J105/P105 RX MUTE GATE

Jumper P105 is used to connect +5V to the control pin of receive mute gate U131C. When the TPI card Squelch Enable input on J2, pin 3 is not used, this voltage keeps the gate closed so audio can be routed to other gates and outputs in the TPI card.

6.10.24 J106/P106 LTR LOGIC JUMPER

This jumper is normally removed. If the Universal Station is connected to an E.F. Johnson LTR logic drawer, this jumper is installed to complete the repeat audio path.

6.10.25 J201/P201 SUB TX DATA

Capacitors C215/C216 are used for DC blocking on the data input.

6.11 INTERFACE ALARM CARD

This card stores the information required to operate the alarms designated in the programming of the Universal Station. Data is received on the address bus from the TPI card 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 (see Figure 4-9).

The Interface Alarm Card (IAC) contains 8-input contacts and 8-output contacts. The eight inputs can be disabled, energized or de-energized. The eight 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 4.3.3 for alarm programming.

6.11.1 ISOLATED INPUTS

The isolated alarm inputs are provided via a terminal block on the back of the Universal Station (see Figures 6-13 and 6-14).

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 6-12).

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.

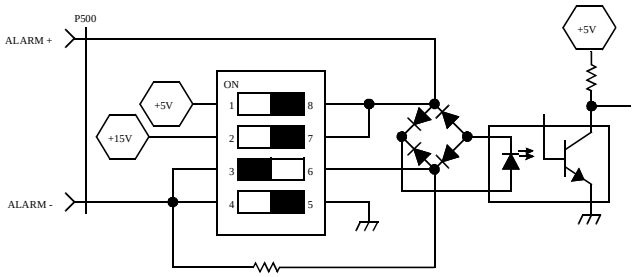


Figure 6-12 S500-S507

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.

6.11.2 RELAY OUTPUTS

The alarm relay outputs are provided via a terminal block on the back of the Universal Station (see Figures 6-13 and 6-14).

The alarm outputs are on the terminal block at the rear of the Universal Station.

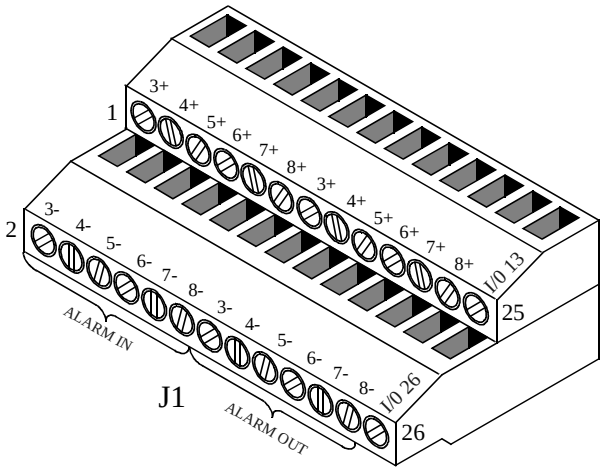


Figure 6-13 J1 ALARM OUTPUTS

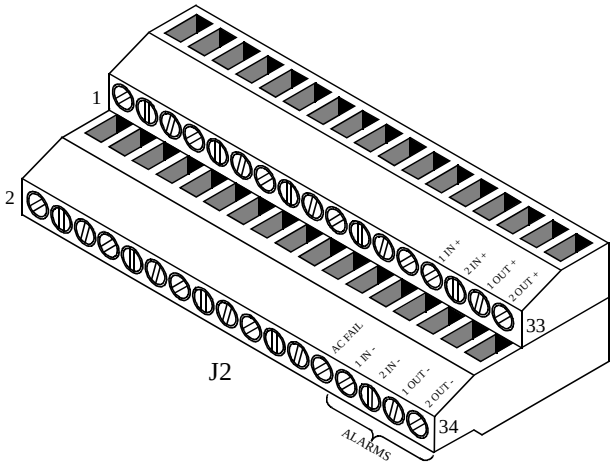


Figure 6-14 J2 ALARM OUTPUTS

6.11.3 ALARM INDICATORS

There are several forms of alarm indicators from the Universal Station. One is the two red LEDs and 7-segment display combination on the TPI card. Refer to Table 1-2 for the combinations and definitions of the active alarms.

Also the four power LEDs on the IAC. These are voltage indicators for the various supply voltages. If the LED indicator is does not light, that supply is not present.

Another form is the output relay to the terminal blocks at the rear of the Universal Station where outputs can be wired to external devices or alarm inputs.

The last 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 Universal Station and alert the system owner when an alarm occurs.

6.11.4 ALARM FUNCTIONS

The alarms can be configured in various modes to alert the system owner to conditions and hazards with the equipment and the Universal Station site facility. A few of the possibilities are shown in Figure 6-15. In this example Input Alarm 2 of Universal Station 1 is connected to the door of the building, Input Alarm 3 of Universal Station 5 is connected to the fire alarm system, the AC fail alarm (#16 see Table 1-2) is mapped to Output Alarm 2 so it can be transmitted (see Figure 4-9) and the Output Alarm 1 of Universal Station 1 is connected to the Input Alarm 1 of Universal Station 2 and so on until the Output Alarm 1 is fed back to the Input Alarm 1 of Universal Station 1. Then the RF Shutdown alarm (#32) is mapped for Alarm 1 in each Universal Station. This configuration allows Station 2 to give an alarm when Station 1 has an RF Shutdown alarm output, etc.

The input alarms are given a 15-character description during programming. 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.

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 4-9). 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 Universal Station to activate the battery backup.

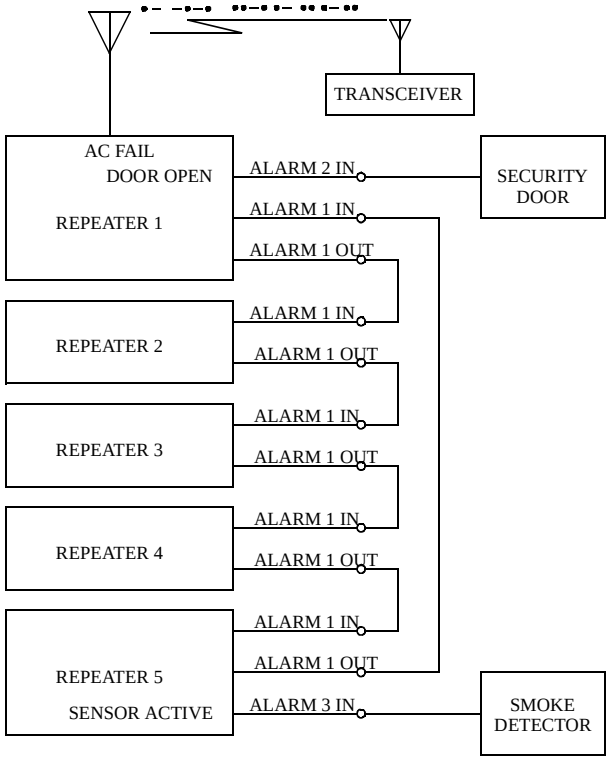


Figure 6-15 ALARM EXAMPLE

6.11.5 P101 SIGNALING CONNECTOR

The input and output connectors for the IAC are defined as follows. The signal interface connector P500 (64 pin) that connects the Address and Data buses and control lines to the backplane connector. See Figure 6-18.

Pins 1-4 ADDRESS BUS (A12-A19 Only)
Pins 33-36

Provides a path between the TPI card main processor and the latches and multiplexers of the IAC. This bus retrieves information programmed into the TPI card memory for the operation of the IAC.

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.

Pins 9/41 ALARM 5 IN +/ALARM 5 IN -

This is an input received from a connection to an external device as a specific alert condition.

Pins 10/42 ALARM 6 IN +/ALARM 6 IN -

This is an input received from a connection to an external device as a specific alert condition.

Pins 11-14 DATA BUS
Pins 43-46

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 provide the ability to read from or write to the TPI card processor memory.

Pin 16 UNUSED

Pins 17/49 ALARM 7 IN +/ALARM 7 IN -

This is an input received from a connection to an external device as a specific alert condition.

Pins 18/50 ALARM 8 IN +/ALARM 8 IN -

This is an input received from a connection to an external device as a specific condition.

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 ACC

This is an analog/digital supply voltage from the Universal Station. It is +15V DC supplied by the Universal Station to a third party controller.

Pins 26/58 +15V FILTERED

Pins 27/59 -5V IN

This is the -5V input to the TPI card from the power supply via the backplane.

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

This is the +5V input to the TPI card from the power supply via the backplane.

Pins 30/62 +15V IN

This is the +15V input to the TPI card from the power supply via the backplane.

Pins 31/32-63/64 GROUND

This is the ground connection to the TPI card from the power supply via the backplane.

Pin 47 READ

Used with the MREQ line to read data from the TPI card processor and external memory.

Pin 48 WRITE

Used with the MREQ line to write data to the TPI card processor and external memory.

Pins 53-55 UNUSED

Pin 56 THERMAL SENSOR

Monitors the temperature of the PA and creates an alarm condition if the temperature exceeds the limit.

Pin 57 POWER SWITCH

Turns the voltage from the power supply to the Universal Station on and off. This pin is connected to the on/off toggle switch S508.

6.11.6 P501 EXTERNAL OUTPUTS

Connector P501 contains data and control outputs to the terminal block on the back of the Universal Station cabinet. These outputs are connected to external devices.

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

Pins 1/17 ALARM 3 OUT +/ALARM 3 OUT -

This is an output to an external device to perform a specific function.

Pins 2/18 ALARM 4 OUT +/ALARM 4 OUT -

This is an output to an external device to perform a specific function.

Pins 3/19 ALARM 5 OUT +/ALARM 5 OUT -

This is an output to an external device to perform a specific function.

Pins 4/20 ALARM 6 OUT +/ALARM 6 OUT -

This is an output to an external device to perform a specific function.

Pins 5/21 ALARM 7 OUT +/ALARM 7 OUT -

This is an output to an external device to perform a specific function.

Pins 6/22ALARM 8 OUT+/ALARM 8 OUT -

This is an output to an external device to perform a specific function.

Pin 7 UNUSED

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

Input from the AC supply used by the AC fail output to indicate 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 output from the RF 1 Multiplexer 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 output from the RF 2 Multiplexer 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

Power Control Strobe. 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 UNUSED

Pin 23 AC FAIL OUT

An indication that the AC power has been interrupted.

Pin 24-25 UNUSED

Pin 26 SYN CS EX

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

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.

6.11.7 J500 A D LEVEL TEST POINT

This test point is used during Universal Station test and alignment to measure the various outputs that are switched to the test points by gates.

6.11.8 J501 GROUND

IAC ground reference for test points.

6.11.9 J502 +15V

Voltage test point.

6.11.10 POWER SWITCH

S508 turns the power supply DC voltage on and off from the front of the IAC.

6.12 J2 (REAR CONNECTOR)

Pin 1 TPI RX VOICE

This is an analog signal from the Universal Station. It is a demodulated receiver audio output which is filtered, gated, buffered and capable of being level adjusted.

Pin 2 TPI WB DISC

This is an analog signal from the Universal Station. It is demodulated wideband receiver audio/ data/ noise output which is unfiltered, buffered, and DC level shifted.

Pin 3 TPI SQ ENABLE

This is a digital signal into the Universal Station. It is an externally generated input to the Universal Station which represents the absence or presence of carrier in the receiver. It provides a means to mute and un-mute the Receiver audio.

WARNING

If this pin is not connected to a Third Party Controller, J105 on the TPI card must be installed. Failure to do this will not allow the Local Audio Amp or the TPI card Rx Voice Amp to produce an output.

Pin 4 TPI LOG NOISE SQ

This is a digital signal from the Universal Station. It is a noise squelch output representing the absence or presence of carrier in the receiver. It provides a means to mute and un-mute the receiver audio.

Pin 5 TPI TX AUDIO

This is an analog signal into the Universal Station. It is a transmit audio input that is amplified, gated, buffered, filtered, limited, filtered, and level adjusted before being applied to the Exciter VCO/ Synthesizer circuits.

Pin 6 TPI SUB TX DATA

This is an analog signal into the Universal Station. It is a sub-audible transmit input that is gated, buffered, amplified/attenuated, and buffered before modulating the VCO/Synthesizer in the Exciter.

WARNING

This port has no deviation limiting circuitry. Use of this port may result in non-compliance with FCC regulations.

Pin 7 TPI PTT N

This is a digital signal into the Universal Station. It is a Push-To-Talk input that turns on the Universal Station transmitter.

Pin 8 TPI HS DATA

This is an analog signal into the Universal Station. It is a high speed data input which is gated, buffered, and band limited before modulating the VCO/ Synthesizer in the Exciter.

WARNING

This port has no deviation limiting circuitry. Use of this port may result in non-compliance with FCC regulations.

Pin 9 TPI HS DATA EN

This is a digital signal into the Universal Station. It is a data enable signal which keys the transmitter and allows high speed data entering the Universal Station on TPI HS DATA (J2, pin 8) to modulate the VCO/Synthesizer in the Exciter.

Pin 10 TPI RX DATA

This is a digital signal from the Universal Station. It is receiver sub-audible data which is filtered, amplified, DC restored, detected, and level shifted.

Pin 11-20 UNUSED

Pin 21-22 GROUND

This is an analog/digital ground signal from the Universal Station. It is the ground between the Universal Station and a third party controller.

Pin 23-24 +15V ACC

This is an analog/digital supply voltage from the Universal Station. It is +15V DC supplied by the Universal Station to a third party controller.

Pin 25 RSSI

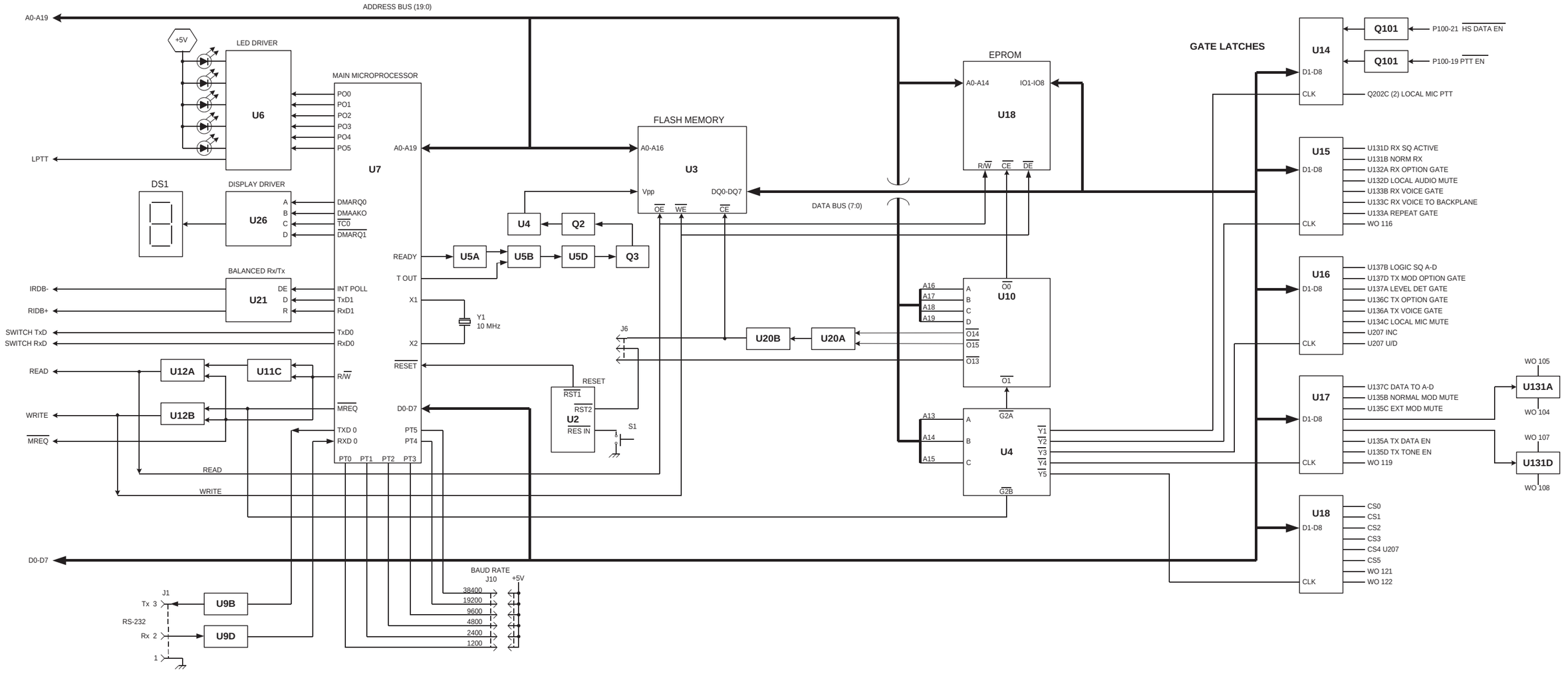
This is an analog signal from the Universal Station. It is a Receive Signal Strength Indicator output showing active strength of the on-channel carrier into the receiver. It is used during receiver front end alignment.

Pin 26-34 ALARMS

See Table 1-2.

6.13 J1 (REAR CONNECTOR)

Rear connector J1 contains all alarm inputs and outputs (see Figure 6-13).



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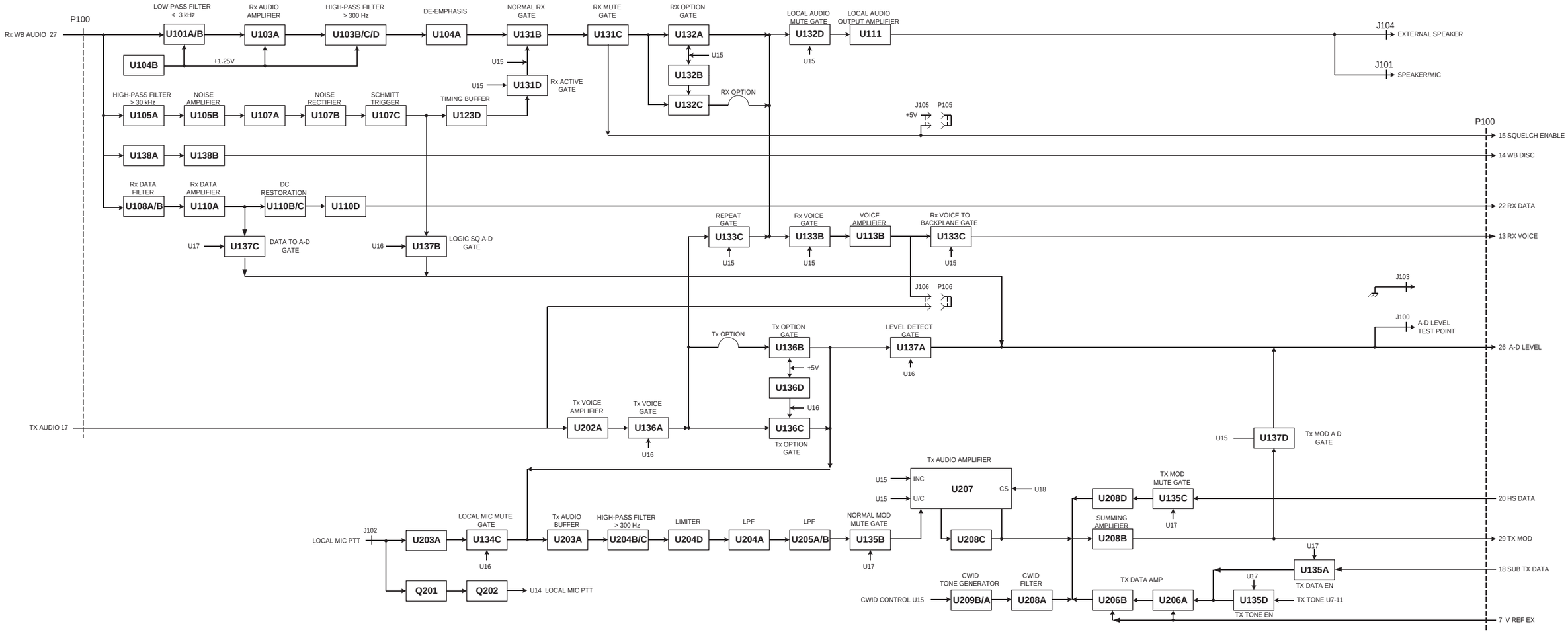
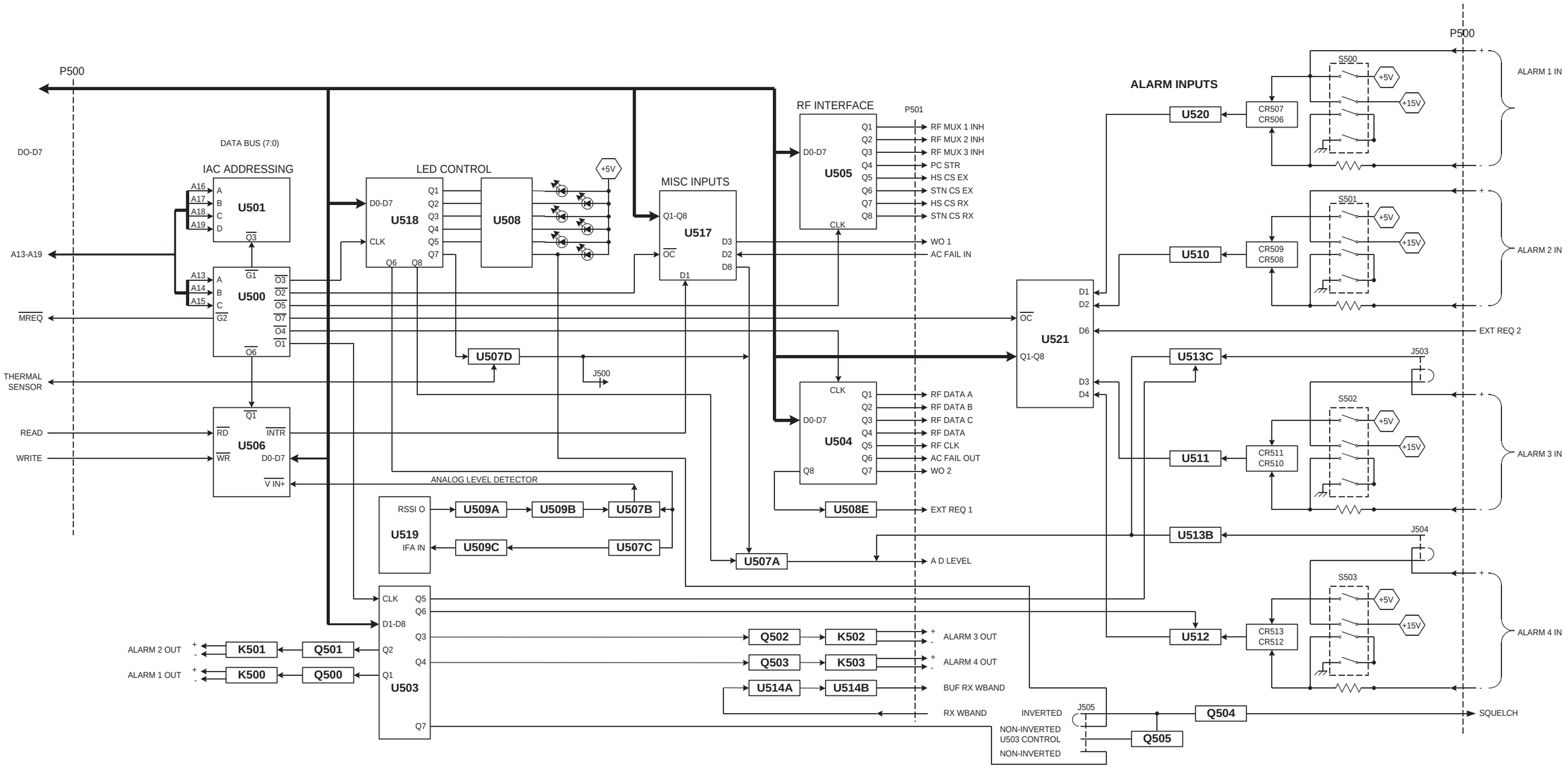
TPI CARD LOGIC BLOCK DIAGRAM
FIGURE 6-16



TPI CARD AUDIO BLOCK DIAGRAM
FIGURE 6-17



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INTERFACE ALARM CARD BLOCK DIAGRAM
FIGURE 6-18

SECTION 7 ALIGNMENT AND TEST PROCEDURES

7.1 RECEIVER ALIGNMENT

Refer to Figure 7-1 for component locations. Refer to Figure 7-5 for equipment needed and setup diagram.

7.1.1 PRE-TEST

1. Preset L201, 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 just barely above the tightening lock nuts.

7.1.2 VOLTAGE MEASUREMENTS

Apply power to the Receiver by plugging the 20-pin cable from the RF Interface Board into J201.

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
R309/R310 junction - +3.5V DC ±0.1V

7.1.3 PROGRAM TUNE-UP CHANNEL

3. Using the PC and software, program the Synthesizer for the Receive channel number.

4. Tune the VCO helical L220 for +4.5V DC ±0.05V on U209, pin 6 or TP2.

5. Alternately tune L223 and L224 in 1/2-turn to 1-turn increments until a voltage is measured on J201, pin 13. At that time, tune L223 for a peak, then L224 for a peak.

6. 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.

7.1.4 TCXO FREQUENCY ADJUST

1. Place a pick-up loop (sniffer) or RF probe connected to a frequency counter near L210.

2. Set Y201 (TCXO) for the Injection Frequency (tune-up channel freq - 52.95 MHz ±50 Hz).

7.1.5 VCO TEST

1. Program the Synthesizer for a channel 3 MHz above the Tune-Up Channel.

2. The voltage on U209, pin 6 should be < 7.5V.

3. Record the voltage on J201, pin 13 _____.

4. Program the Synthesizer for a channel 3 MHz below the Tune-Up Channel.

5. The voltage on U209, pin 6 should be > 2V.

6. Record the voltage on J201, pin 13 _____.

7. If the voltages recorded in Steps 3 and 6 are not within ±0.2V, tune L224 as required to balance the voltage readings.

8. Reprogram the Synthesizer for the Tune-Up Channel.

7.1.6 FRONT END ADJUSTMENTS

1. Set the signal generator to the Tune-Up Channel at a level sufficient to produce an output voltage on J201, pin 7 (RSSI Output).

2. Tune L204, L205, L206, L201, L202, L203 and L204 for a peak voltage on J201, pin 7. Decrease the generator output level to maintain a 2-3V DC reading at J201, pin 7.

3. Set the generator to 1000 µV with a 1 kHz tone at ±3 kHz deviation. (100 µV at the receiver antenna with 20 dB pad on the generator.)

4. Tune the Quadrature detector coil Z213 for 2V ±0.05V on J201, pin 9.

5. Tune R264 for 387 mV RMS, ±5 mV RMS, on J201, pin 9.

6. Repeat Steps 4 and 5.

7. Measure the distortion on pin J201, pin 9.

8. Tune L207, L209, L211 and L225 for minimum distortion (should be < 5%).

9. Repeat Step 8.

10. Repeat Steps 4 and 5.

7.1.7 AUDIO DISTORTION

1. Plug a 16 ohm load at J101 or J104 on the TPI 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 TPI card with the local volume control set to 2.8V RMS.

4. The reading should be less than 3%. (Typically less than 1%.)

5. Measure receive sensitivity at J101 or J104 on the TPI card.

6. The reading should be less than 0.35 µV. (Typically less than 0.30 µV.)

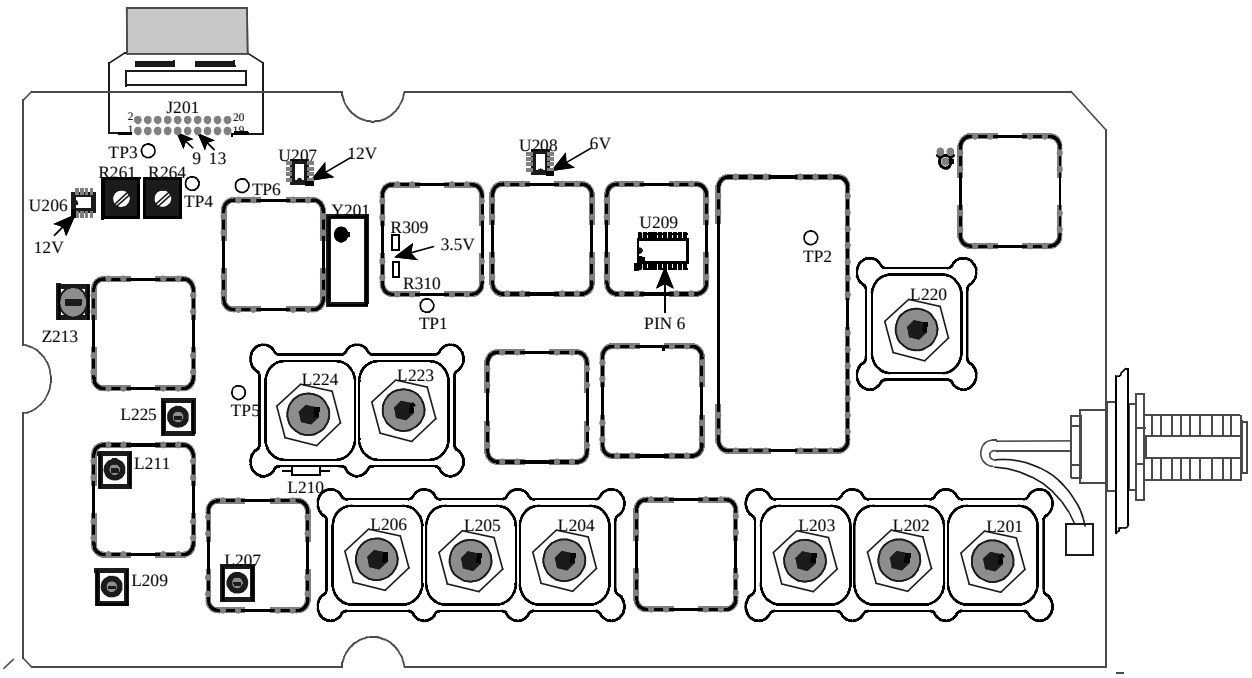

Figure 7-1 RECEIVER ALIGNMENT POINTS

7.2 EXCITER ALIGNMENT

Refer to Figure 7-2 for component locations. Refer to Figure 7-6 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.

7.2.1 PRETEST

1. Set TCXO modulation adjust R425 fully counter-clockwise.

2. Connect the power meter to J402.

7.2.2 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
- U402, pin 1 - +3.5V DC ±0.1V
- U404, pin 7 - +3.5V DC ±0.1V

7.2.3 PROGRAM TUNE-UP CHANNEL

1. Program the Tune-Up Channel.

2. Press the space bar to key the Exciter.

3. Tune VCO helical L404 for 4.5V ±0.05V on U403, pin 6 or "TP".

4. Measure the Power Output of the Exciter at J402. Reading should be +15 dBm ±0.5 dB.

5. Press the space bar to unkey the Exciter.

7.2.4 VCO TEST

1. Program the Synthesizer for a channel 3 MHz above the Tune-Up Channel.

2. Press the space bar to key the Exciter.

3. The voltage on U403, pin 6 should be < 7V. Power output should be +15 dBm ±0.5 dB.

4. Press the space bar to unkey the Exciter.

5. Program the Synthesizer for a channel 3 MHz below the Tune-Up Channel.

6. Press the space bar to key the Exciter.

7. The voltage on U403, pin 6 should be > 2.5V. Power output should be +15 dBm ±0.5 dB.

8. Press the space bar to unkey the Exciter.

9. Reprogram the Synthesizer for the Tune-Up Channel.

7.2.5 TCXO FREQUENCY ADJUST

1. Connect a 10 dB pad and frequency counter to J402.

2. Press the space bar to key the Exciter.

3. Tune TCXO Y401 for the Tune-Up Channel Frequency, ± 50 Hz.

4. Press the space bar to unkey the Exciter.

7.2.6 TRANSMIT MODULATION ADJUST

5. Connect a 10 dB pad and modulation analyzer to J402.

6. Press the "FM" and "3 kHz LPF" switches of the modulation analyzer.

7. Inject a 1 kHz sine wave with a level of 707 mV RMS into P100, pin 17 on the TPI card.

NOTE: This test changes the audio deviation limit. Perform test in Section 7.4.5 to correct.

8. Adjust U207 for 707 mV RMS on P100, pin 29. This waveform should be a "clean" sine wave.

9. Press the space bar to key the Exciter.

10. Set R446 for ±3 kHz deviation.

11. Press the space bar to unkey the Exciter.

12. Adjust R237 for a 2V P-P square wave on P100, pin 29.

NOTE: This test changes the transmit data level. Perform the test in Section 7.4.5 to correct.

13. Press the space bar to key the Exciter.

14. Set R425 for "best" square wave as observed on the modulation analyzer output to the oscilloscope.

    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.

15. Press the space bar to unkey the Exciter.

16. Repeat Steps 1-7. Very little adjustment of R446 should be needed.

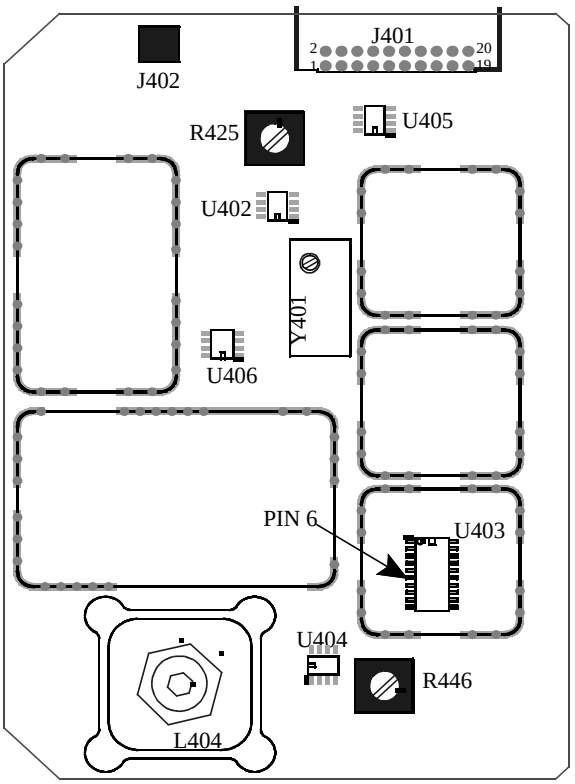

Figure 7-2 EXCITER ALIGNMENT POINTS

7.3 POWER AMPLIFIER ALIGNMENT

7.3.1 INTRODUCTION

Refer to Figures 7-3 and 7-4 for component locations. Refer to Figure 7-7 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 7.3.2, 7.3.3 and 7.3.4 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 R116, 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 *7.3.2* 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 *7.3.2* adjustments should be performed. No other adjustments are necessary in this case. Replacement of RF components surrounding Q501, U501 does not justify performance of Section 7.3.2 adjustments. Replacement of active components within the power control circuitry of the RF Interface Board would require Section 7.3.2 adjustments.

Section 7.3.3 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 7.3.3.

7.3.2 DRIVER TUNING AND LIMIT ADJUSTMENTS

1. Connect attenuator and power meter to J501.

2. 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 RF Interface Board.

3. Set the signal generator to +15 dBm ±0.1 dB at 870 MHz. Connect the signal generator to A9.

4. Press the space bar to key the PA.

5. Set R116 on the RFIB for 22W ±0.2 dB (±1W).

NOTE: Required measurement accuracy precludes the use of most "shop-quality" wattmeters for this Section. Cable and attenuator losses must be taken into account.

6. Tune C521 for maximum power.

7. Reset R116 for 22W ±0.2 dB (±1W).

8. Repeak C521.

9. Press the space bar to unkey the PA.

CRITICAL ADJUSTMENTS

NOTE: Improper adjustment may impair normal PA operation.

10. Set the generator to +15 dBm ±0.1 dB at 860 MHz.

11. Press the space bar to key the PA.

12. Adjust R116 for 40W ±2W (±0.2 dB).

13. Press the space bar to unkey the PA.

14. Set the generator to +15 dBm ±0.1 dB at 850 MHz.

15. Press the space bar to key the PA.

16. Adjust R116 for 40W ±2W (±0.2 dB) only if the power exceeds 40W.

17. Press the space bar to unkey the PA.

7.3.3 FORWARD POWER OUTPUT CALIBRATION

1. Remove +26.5V DC from P101. (This eliminates possible damage if the coax ground is accidently shorted to a live collector inductor.)

2. Disconnect the attenuator and power meter from J501 and connect to Transmit Antenna Connector A8.

3. Connect cable A501 to J501. Ensure the cable position is midway between the drive collector feed and the adjacent input Wilkinson combiner traces on the printed circuit board.

4. Reset R663 fully counterclockwise and reconnect +26.5V DC to P101.

5. Set the signal generator to +15 dBm ±0.1 dB at 860 MHz.

6. Press the space bar to key the PA.

7. Adjust Forward Power Calibration pot R663 for 85W ±0.1 dB (±2W).

8. Check power output at 850 and 870 MHz.

   Each reading should be within 0.25 dB (±5W) of the power at 860 MHz set in Step 8.

9. Tune C521 for a minimum voltage on W120.

10. Press the space bar to unkey the PA.

NOTE: Power output calibration is accurately done at the 85W level to ensure that a 75W minimum power output is attainable even if poorly calibrated power meters are used to set power in the field (using Setup Parameters menu in programming software).

CAUTION

Final transistor die temperatures become excessive at output power levels above 85W. The life of final transistors will be significantly reduced by power levels above 85W.

7.3.4 REFLECTED POWER ADJUST

1. Remove the load cable from A8.

2. Press the space bar 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. Press the space bar to unkey the PA.

5. Apply "Glyptol" to R663, R680 and R116.

6. Momentarily short R171 on the RFIB. The PA fan should turn ON.

7. Measure temperature detector voltage at W127 on the RFIB. Normal output at 25°C ambient is approximately +2.1V DC.

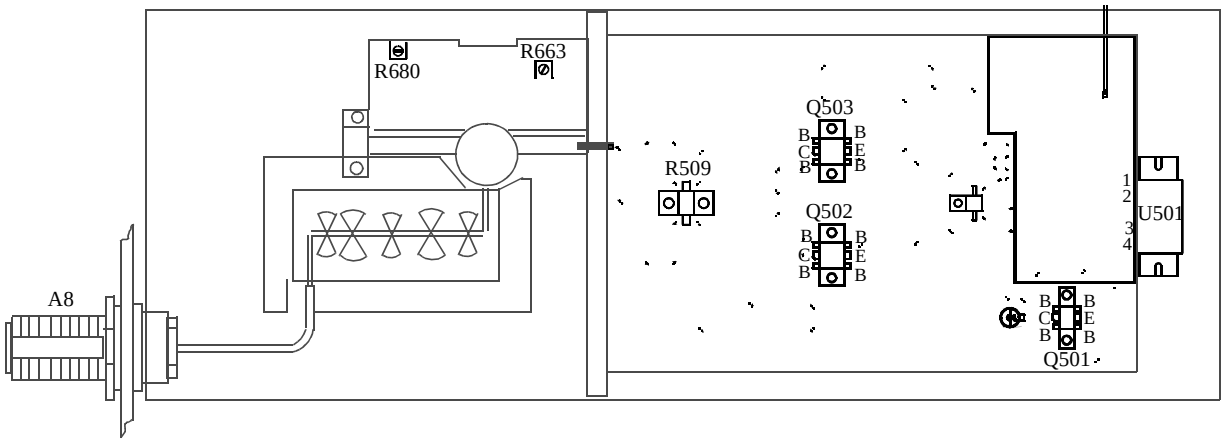

Figure 7-3 POWER AMPLIFIER ALIGNMENT POINTS

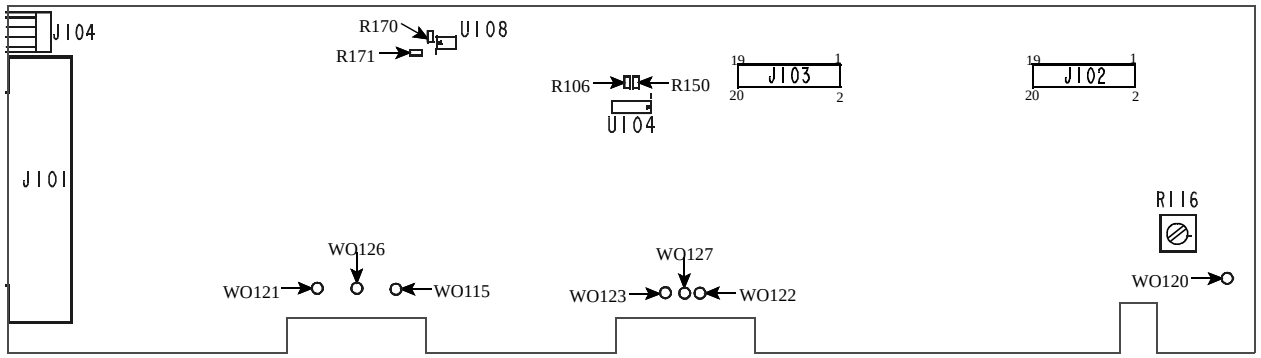

Figure 7-4 RF INTERFACE BOARD ALIGNMENT POINTS

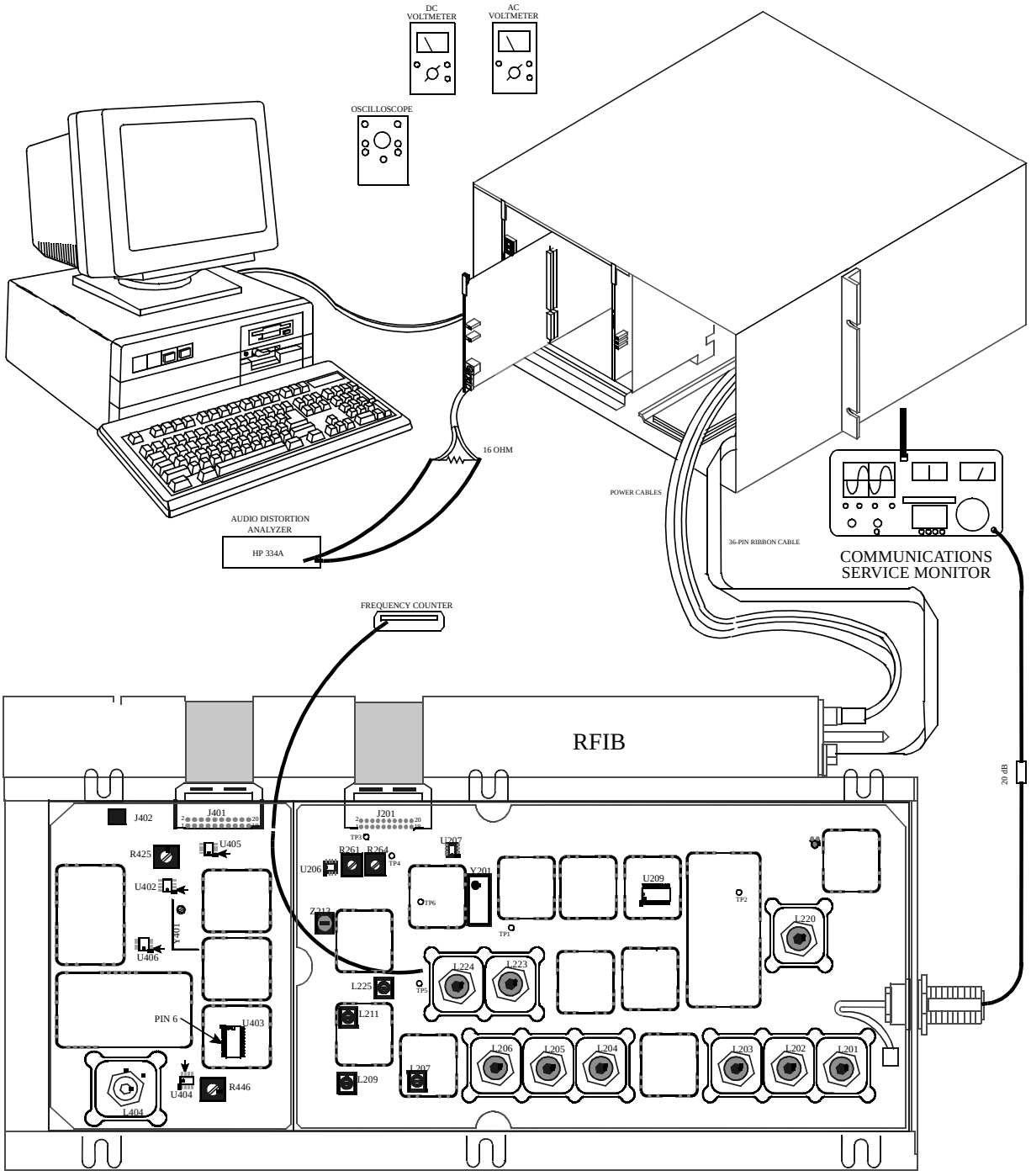

Figure 7-5 RECEIVER TEST SETUP

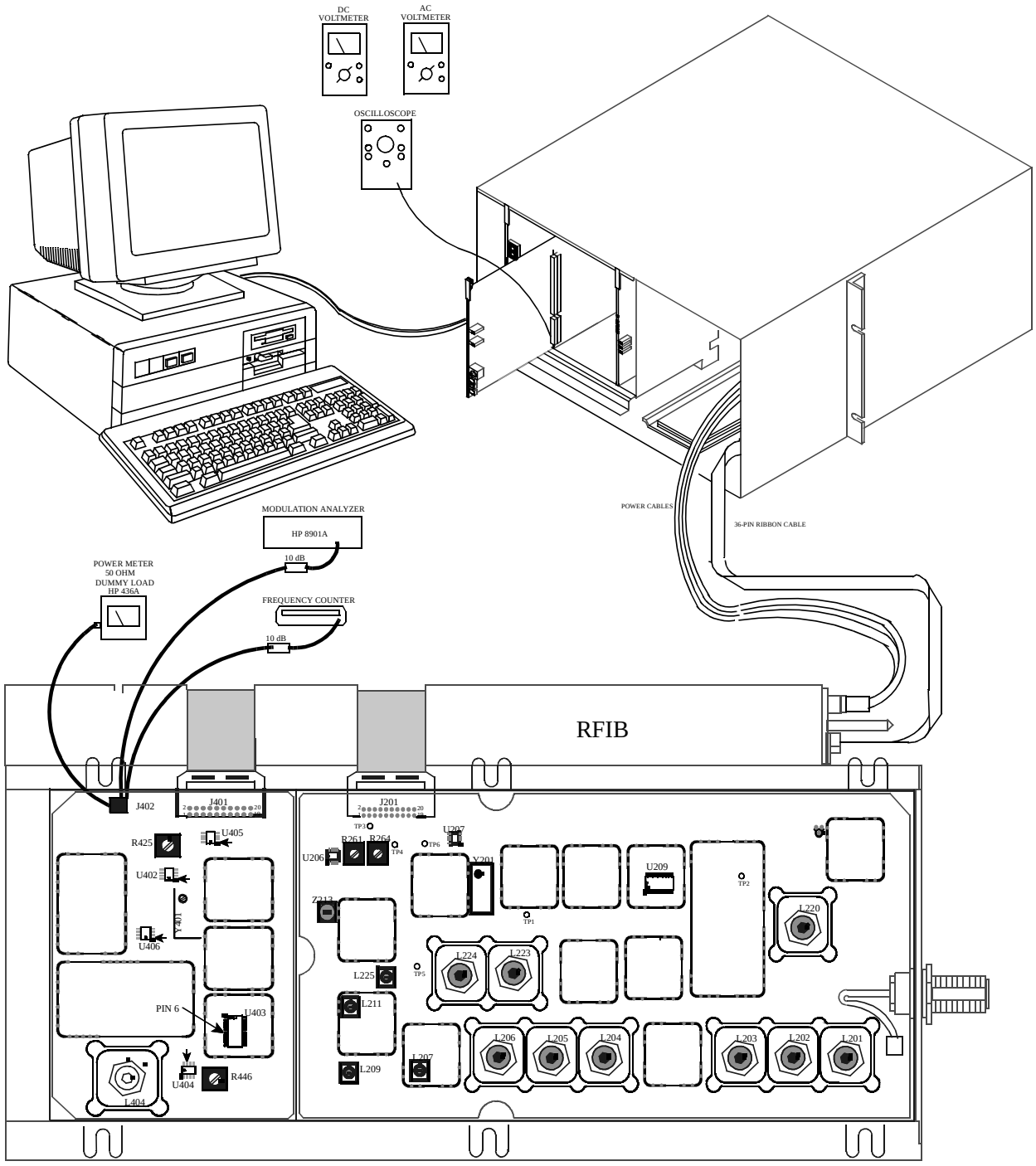

Figure 7-6 EXCITER TEST SETUP

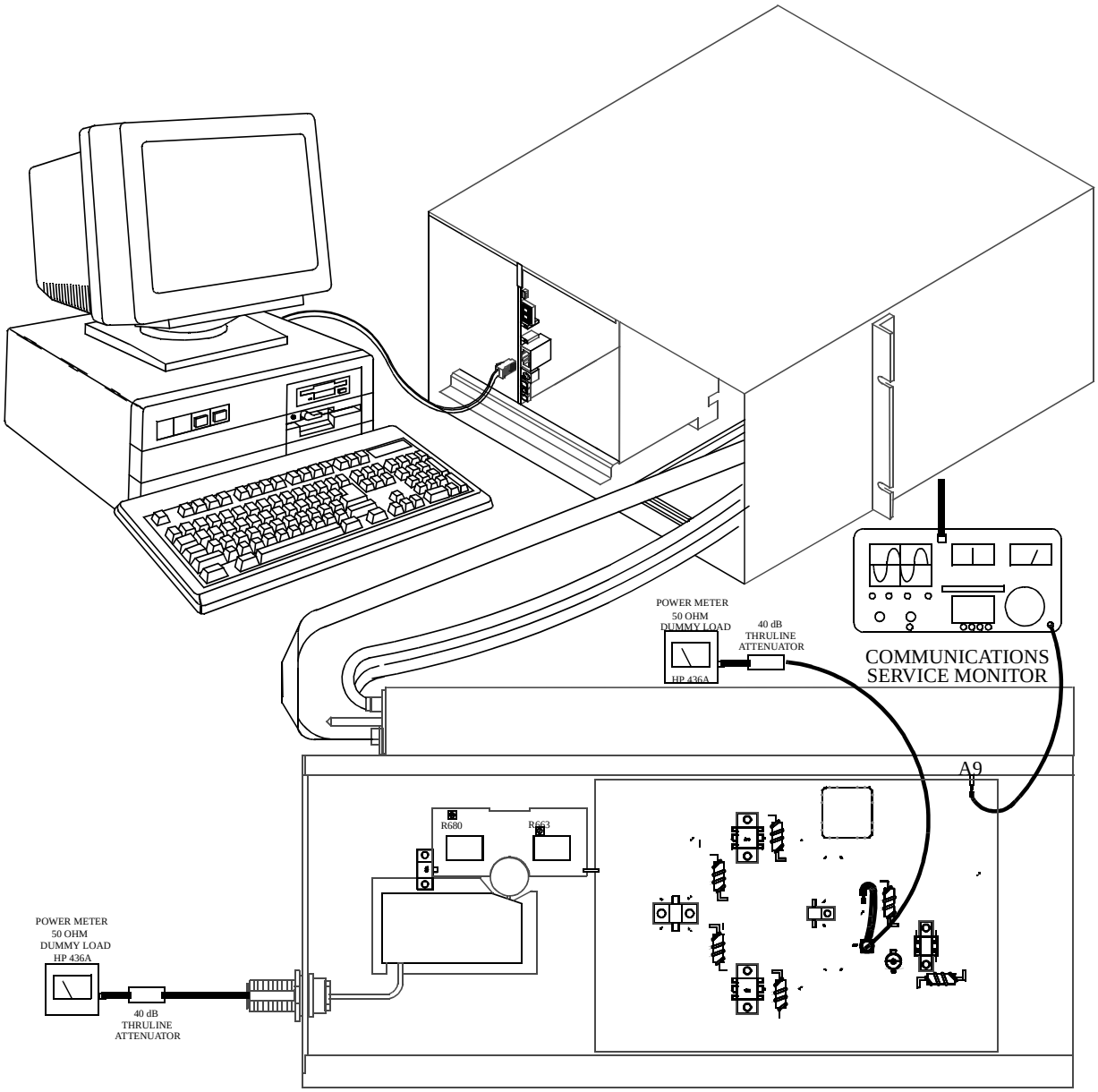

Figure 7-7 POWER AMPLIFIER TEST SETUP

7.4 FULL REPEATER ALIGNMENT

7.4.1 PERFORMANCE TEST PROGRAM

Select the TEST - FULL Universal Station - ALL TEST and press Enter.

7.4.2 REPEATER SETUP

The TPI Universal Station has been pretested at the factory, therefore only performance tests are required to check the Universal Station. Refer to test setup diagrams for equipment and cabling diagram.

Turn on the Universal Station power supply switch (S508) in the IAC or engage the locking lever (see Figure 7-12).

The baud rate for communications between the Universal Station and the PC Programmer is user configurable using J10 on the TPI card. The factory default is 9600 baud.

The operating code has been programmed at the factory. The parameters are programmed into the TPI card. If these parameters have changed or are incorrect, exit this test and reprogram the Universal Station.

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: All audio generators and audio voltmeters are unbalanced *unless specifically stated otherwise. All references to J2 refer to the green connector on the back of the Universal Station.*

Program the Universal Station for the required parameters using the PC Programmer. Select TPI card as the Universal Station Type by choosing Edit/Universal Station Type within the PC Programmer. Confirm the placement of the following jumpers on the TPI card: J105-ON; J106, J201, J6, J7 and J8-OFF.

7.4.3 TRANSMITTER TEST/ADJUSTMENTS

Transmit Mode

1. Press the space bar to key the transmitter.
2. The Transmit LED on the IAC should turn on to indicate transmitting.
3. Press the space bar to unkey the transmitter.

Transmit TCXO Frequency Adjustment

CRITICAL ADJUSTMENT

The TCXO must be adjusted within 5 minutes of turning the AC power on to the Universal Station. Do not under any circumstances try to set frequency later on in any of the tests, as TCXO frequency stability cannot then be guaranteed.

1. Press the space bar to key the transmitter.
2. Check the frequency of the transmitted signal. The frequency should be ±50 Hz of the channel frequency.
3. Adjust the frequency with Y401 (TCXO) on the Exciter (see Section 7.2.5).
4. Press the space bar to unkey the transmitter.

Transmitter Output Power Adjustment

1. Press the space bar to key the transmitter.
2. Check the transmit output power. The power can be adjusted from the computer using the cursor Up/Dn and PgUp/PgDn keys. The test equipment should be calibrated for ±2W.
3. Press the space bar to unkey the transmitter.
4. Use a jumper wire to ground pin 7 (PTT_N) to pin 21 (GND) on J2 on the back of the cabinet (see Figure 7-8). The transmitter should key up and achieve rated power.
5. Remove the wire. The transmitter should unkey.

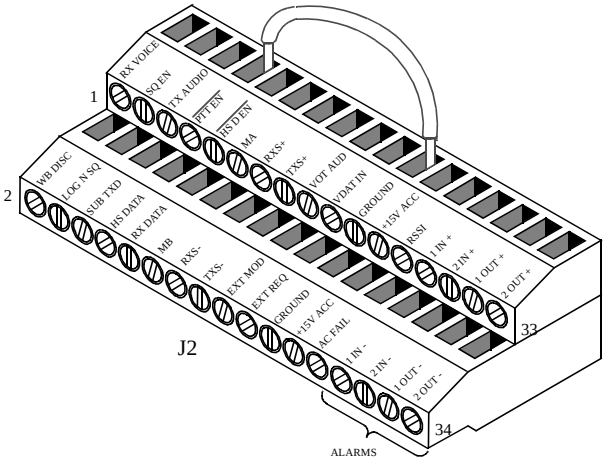

Figure 7-8 J2 - PTT JUMPER

7.4.4 RECEIVER TESTS/ADJUSTMENT

Receiver TCXO Frequency Adjustment

CRITICAL ADJUSTMENT

The TCXO must be adjusted within 5 minutes of turning the AC power on to the Universal Station. Do not under any circumstances try to set frequency later on in any of the tests, as TCXO frequency stability cannot then be guaranteed.

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 7.1.4).

2. Adjust Y201 (TCXO) on the Receiver to within ±50 Hz of the channel frequency.

Receiver Wide Band Audio Test

1. Adjust the RF generator for 100 µV into the Receiver with 1 kHz tone at ±3 kHz deviation.

2. Verify the following voltages on J2, pin 2.

   AC voltage - 387 mV RMS ±25 mV RMS
   DC voltage - 5V DC ±0.2V DC

Receiver Audio Distortion Measurement

1. Place J105 on TPI card to 'ON' position (see Figure 7-11).

2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.

3. Insert test cables into J100/J103 on the TPI card and connect to an AC voltmeter.

4. Adjust R107 for 0 dBm (775 mV RMS).

5. Adjust R172 for 0 dBm (775 mV RMS) at J2, pin 1.

6. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the TPI card.

7. Adjust R164 for 2.8V RMS and measure the distortion. Distortion should be < 3%.

Receiver Hum and Noise Measurement

1. Place J105 on TPI to 'ON' position.

2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.

3. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the TPI card.

4. Adjust R164 for 2.8V RMS (see Figure 7-11).

5. Remove modulation from the RF generator. The measured level must be ≤ -45 dB.

Receiver SINAD Measurement

1. Place J105 on TPI to 'ON' position.

2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.

3. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the TPI card.

4. Adjust R164 for 2.8V RMS.

5. 12 dB SINAD reading should be ≤ 0.35 µV.

Receiver Squelch Adjustment

1. Place J105 on TPI card to 'ON' position.
2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.
3. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the TPI card.
4. Adjust R164 for 2.8V RMS (see Figure 7-11).
5. Set the RF generator output for 5 dB SINAD.
6. Adjust R123 on the TPI card so the Receiver just squelches. Verify on J2, pin 4 (TPI_SQ_EN) for a logic 0 (<0.8V DC).
7. Increase the RF generator output until the Receiver unsquelches. Reading should be ≤ 10 dB SINAD. Verify on J2, pin 4 for a logic 1 (> 3.7V DC ±10%).

Receiver Data Level Adjustment

1. Place J105 on TPI card to 'ON' position.
2. Adjust the RF generator for 100 µV output with a 100 Hz tone at ±1 kHz deviation for 25 kHz channels or ±800 Hz for 12.5 kHz channels.
3. Insert test cables into J100/J103 on the TPI card and connect to an AC voltmeter.
4. Adjust R154 to achieve 283 mV RMS.
5. Connect an oscilloscope probe to J2, pin 10 and verify for a 100 Hz square wave with 0V DC to 5V DC levels (5 ms high, 5 ms low).

Local Speaker/Microphone Check

1. Place J105 on TPI card to 'ON' position.
2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.
3. Plug a Speaker/Microphone into J101/J102 of the TPI card (see Figure 7-11).
4. Adjust R164 until the 1 kHz tone is heard.

Squelch Enable Check

1. Place J105 on TPI card to 'OFF' position.
2. Adjust R164 for 1/4 turn clockwise from off.
3. Connect a Spkr/Mic to J101/J104 on the TPI card.
4. Connect a shorting wire from J2, pin 3 (TPI_SQ_EN) to J2, pin 23 (+15V ACC).
5. Verify 1 kHz tone is present on speaker.
6. Disconnect shorting wire and verify 1 kHz tone is not present.
7. Place J105 on TPI card to 'ON' position.

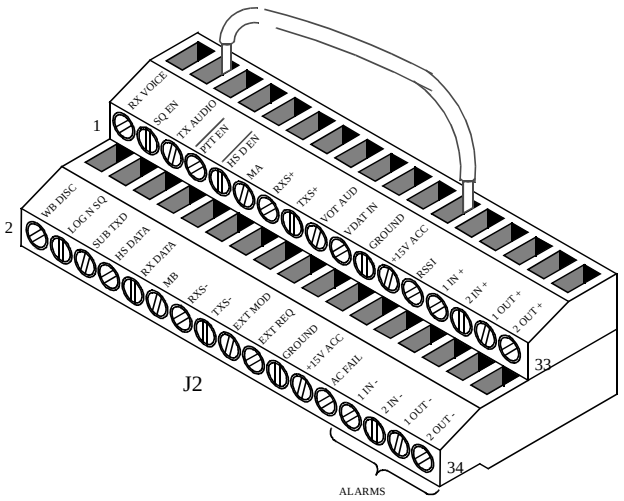

Figure 7-9 J2 - SQUELCH JUMPER

Receiver Desense Check

1. Place J105 on TPI card to 'ON' position.
2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.
3. Connect a 16 ohm load and distortion analyzer to J101 or J104 of the TPI card.
4. Adjust R164 for 2.8V RMS.
5. Adjust the RF generator output for 12 dB SINAD.

6. Press the space bar to key the transmitter.

7. SINAD should degrade a maximum of 1 dB or to no less than 11 dB SINAD.

8. Press the space bar to unkey the transmitter.

Receiver Miscellaneous Tests (Optional)

Several additional tests may be performed on the Universal Station 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, R164 levels and test probes following the latest TIA document measurement procedures.

7.4.5 TRANSMIT AUDIO/DATA LEVEL ADJUSTMENTS

*NOTE: All audio generators and audio voltmeters are **unbalanced** unless specifically stated otherwise.*

Audio Deviation Limit Adjustment

1. Apply a 1 kHz tone at -3 dBm (578 mV RMS) to J2, pin 5.

2. Insert AC voltmeter test cables into J100/J103.

3. Adjust R202 for 0 dBm (775 mV RMS).

4. Apply a 1 kHz tone at +7 dBm (1.73V RMS) to J2, pin 5.

5. Press the space bar to key the transmitter.

6. Adjust U207 with the PgUp/PgDn and CurUp/CurDn keys to set the maximum allowed deviation at ±3.5 kHz (±200 Hz) for 25 kHz channels or ±1.5 kHz (±100 Hz) for 12.5 kHz channels. (Set modulation analyzer LPF switch to 3 kHz.)

7. Press the space bar to unkey the transmitter.

8. Remove the signal from J2, pin 5.

Repeat Audio Level Adjustment

1. Place jumper J105 and J106 on TPI card to 'ON'.

2. Adjust the RF generator for 100 µV output with a 1 kHz tone at ±3 kHz deviation.

3. Insert AC voltmeter test cables into J100/J103.

4. AC level should be 0 dBm (775 mV RMS).

5. Place jumper J106 on the TPI to 'OFF'.

Data Level Adjustment

1. Apply 100 Hz at 237 mV RMS to J2, pin 6.

2. Press the space bar to key the transmitter.

3. Adjust R237 to achieve ±1 kHz (±100 Hz) transmit deviation. (Set modulation analyzer LPF switch to 3 kHz.)

4. Press the space bar to unkey the transmitter.

Audio/Data Deviation Check

1. Apply -10 dBm (237V RMS) at 100 Hz to J2, pin 6.

2. Apply +10 dBm (2.45V RMS) at 1 kHz to J2, pin 5.

3. Press the space bar to key the transmitter.

4. Check for measured deviation out of the modulation analyzer to be ±4.5 kHz (±200 Hz). (Set modulation analyzer LPF to 3 kHz.)

5. Press the space bar to unkey the transmitter.

6. Disconnect all cables.

High Speed Data Check

1. Apply 0 dBm at 1 kHz to J2, pin 8.
2. Press the space bar to key the transmitter.
3. Deviation should measure ±3 kHz ±300 Hz. (Set modulation analyzer LPF to 15 kHz.)
4. Press the space bar to unkey the transmitter.
5. Increase the frequency to 5 kHz.
6. Press the space bar to key the transmitter.
7. Deviation should measure ±2.5 kHz ±300 Hz. (±2 to ±2.5 kHz for NPSPAC.) (Set modulation analyzer LPF to 15 kHz.)
8. Press the space bar to unkey the transmitter.

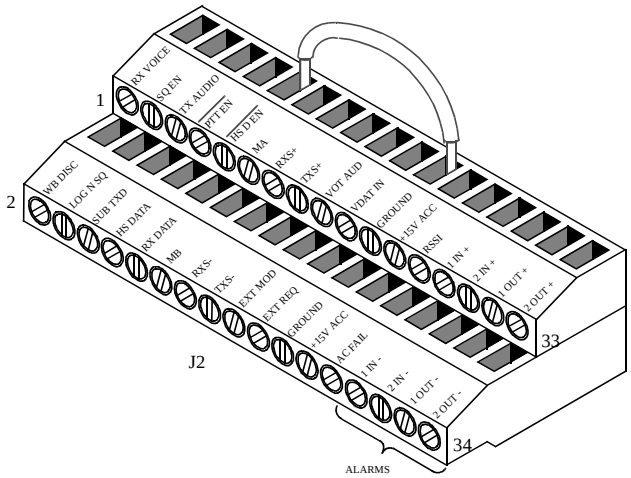

Figure 7-10 J2 - HIGH SPEED DATA JUMPER

High Speed Data Enable Check

1. Connect a shorting wire from J2, pin 9 to J2, pin 21 (see Figure 7-10).
2. Verify Transmit LED on IAC is 'ON'.
3. Remove shorting wire.
4. Verify Transmit LED on IAC is 'OFF'.

Local Speaker/Microphone Check

1. Plug a Speaker/Microphone into J101/J102 of the TPI.
2. Press the space bar to key the transmitter.
3. Press the microphone PTT and say "four" loudly into the microphone.
4. Deviation should measure ±3 to ±3.5 kHz. (Set modulation analyzer LPF to 3 kHz.)
5. Release the microphone PTT.
6. Press the space bar to unkey the transmitter.
7. Remove the Speaker/Mic from J101/J102.

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 .44, dB
2. Press the space bar to key the transmitter and measure the Hum and Noise Ratio. The reading should be < -45 dB.
3. Press the space bar to unkey the transmitter.

7.4.6 ALARM TEST

1. The Universal Station is now in Normal Operation mode.
2. Verify by the TPI card front panel indicators that no alarms have occurred (see Table 1-2). See the latest Active Universal Station Alarm chart for TPI Displayed and LED definitions.

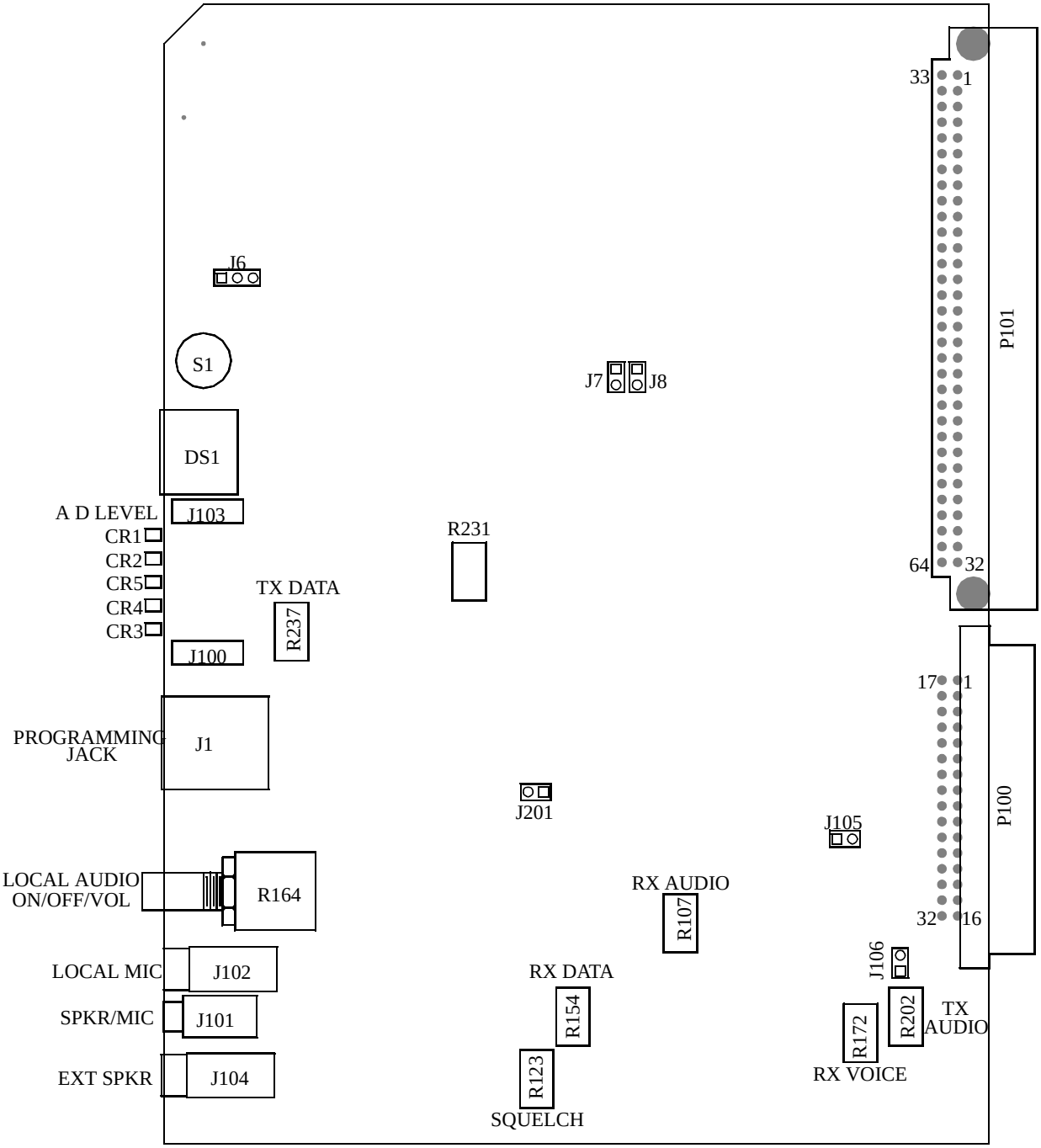

Figure 7-11 TPI CARD ALIGNMENT POINTS DIAGRAM

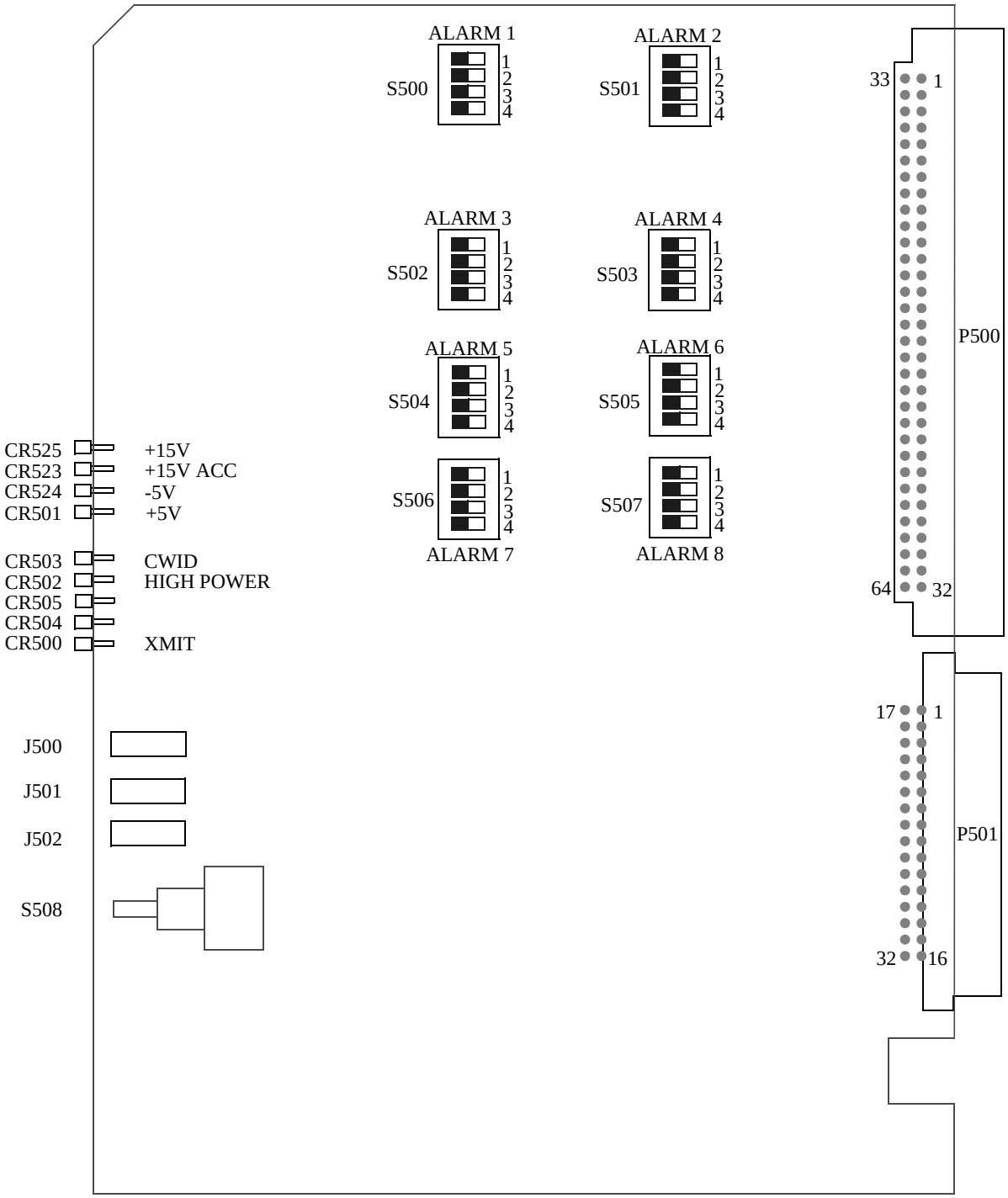

Figure 7-12 INTERFACE ALARM CARD ALIGNMENT POINTS

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SECTION 8 SERVICING

8.1 INTRODUCTION

8.1.1 PERIODIC CHECKS

This Universal Station 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 Universal Station 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 Universal Station 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 Universal Station 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 Universal Station is located in Section 9. Parts are listed alpha numerically according to designator. For information on ordering parts, refer to Section 1.9.

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 detected by the TPI card via the RF Data lines. The TPI card 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 6.1.12 and 6.2.5). 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.

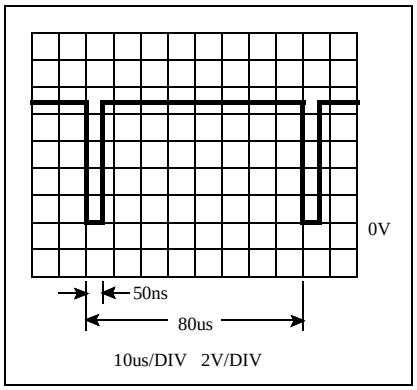


Figure 8-1 LOCK DETECT WAVEFORM

Modulus Control Signal

1. 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.

2. 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.

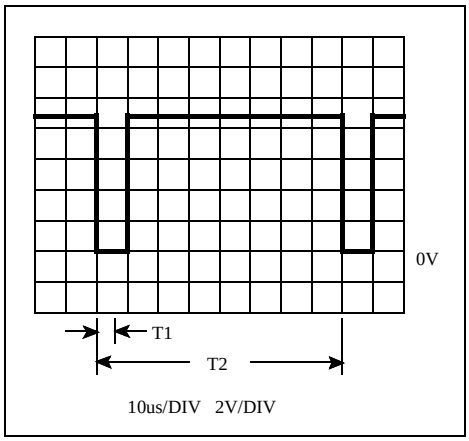


Figure 8-2 MODULUS CONTROL WAVEFORM

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 300 (receive)

Prescaler Div No = 64 + (45 ÷ 950) = 64.0474

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

760.5375 MHz (pin 11) ÷ 11.8746 (pin 13) = 64.0474

8.2.5 CALCULATING "N " AND "A " COUNTER DIVIDE NUMBERS

"N" Counter

N Counter Divide Number =
Integer (VCO Freq. (MHz) ÷ 0.8)

Example: Channel 300 (receive)

VCO freq = 813.4875 - 52.95 = 760.5375 MHz

N Cntr Div No = 760.5375 ÷ 0.8 = 950.67188

Integer (whole no.) of 950.67188 = **950**

Example: Channel 300 (transmit)

N Cntr Div No = 858.4875 ÷ 0.8 = 1073.1094

Integer (whole no.) of 1073.1094 = **1073**

"A" Counter

A Counter Divide Number =
(VCO freq (MHz) ÷ .0125) - (N Cntr Div No x 64)

Example: Channel 300 (receive)

A Cntr Div No = (760.5375 ÷ .0125) - (950 x 64)
= 60,843 - 60,800
= **43**

Example: Channel 300 (transmit)

A Cntr Div No = (858.4875 ÷ .0125) - (1073 x 64)
= 68,679 - 68,672
= **7**

8.3 RECEIVER SERVICING

To isolate a receiver problem to a defective section, start by checking the DC voltages shown in Section 6.4.6 and on the schematic diagram (Section 10). If that does not indicate the problem, perform the performance tests in Section 7.1 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 6.4.4 and 6.4.5 and on the schematic diagram (Section 10). If that does not indicate the problem, perform the performance tests in Sections 7.2 and 7.3 to isolate the problem. If the synthesizer is out of lock, the exciter is also nonfunctional because the software will not allow the Universal Station to transmit.

8.5 POWER SUPPLY SERVICING

The power supply is a switch mode type and is NOT SERVICABLE. If the supply is defective, even a blown fuse, the power supply must be removed and sent to E.F. Johnson, then to the manufacturer for repair (see Section 1.8).

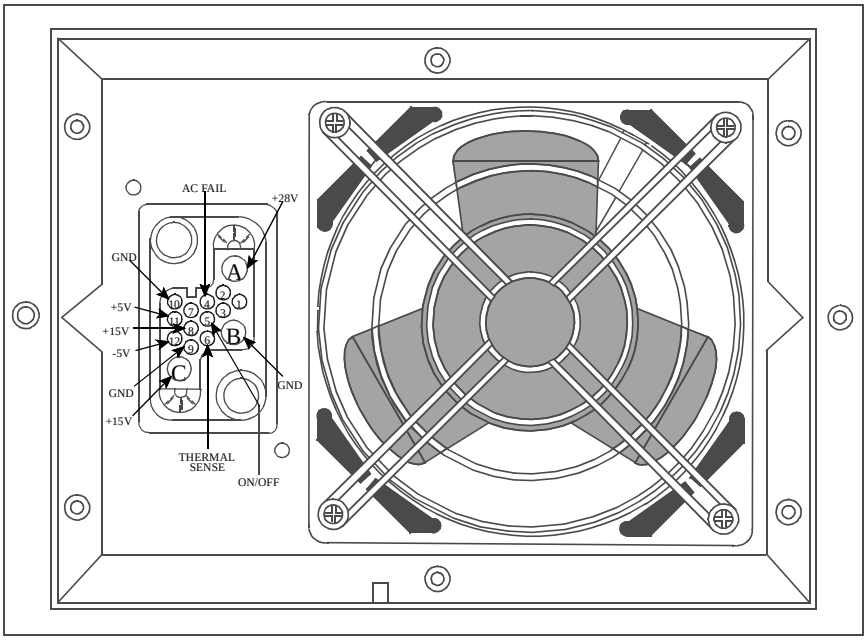


Figure 8-3 POWER SUPPLY REAR VIEW

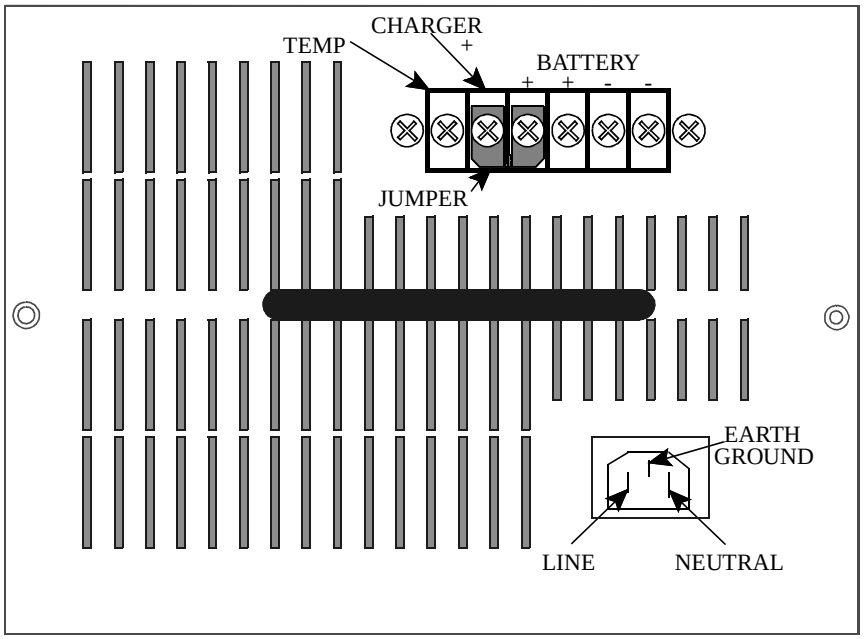


Figure 8-4 POWER SUPPLY FRONT VIEW

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 Universal Station. First the on/off line must be grounded, jumper pin 5 to ground, then check the supply voltages as shown (see Figure 8-3). 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

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

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 band 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 (see Figure 8-5).

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

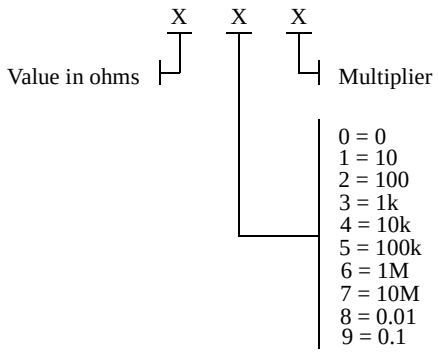
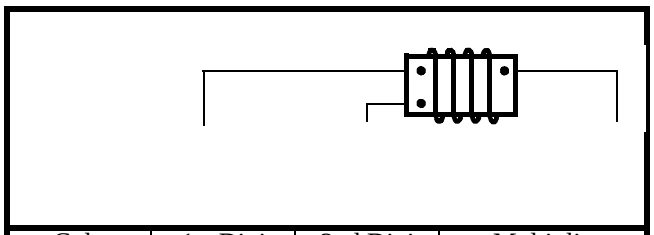


Figure 8-5 3-DIGIT RESISTOR

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)

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.

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

8.7 BERYLLIUM PRODUCT WARNING

Q501, Q502, Q503, R504, R505 and R685 in the 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. tooing tool) should be used to remove the old Grafoil.

SECTION 9 PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	800 MHz 75W UNIVERSAL STATION PART NO. 242-2008-332	
A 003	800 MHz 75W repeater assem	023-2008-032
A 010	PS 120V:+26/+15V DC ±5V	585-4001-508
HW001	6-32 machine panhead philips	575-1606-012
MP033	PA hold down bracket	017-2210-032
PA002	Third Party Interface Card	023-2000-390
PA003	Interface Alarm Card assem**	023-2000-350
PA004	Repeater enclosure assembly	023-2000-200
** Requires Application Engineering authorization to purchase		
	REPEATER ASSEMBLY PART NO. 023-2008-032	
A 002	860 MHz drop-in circulator	585-0590-004
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 assembly	023-2000-160
A 011	800 MHz LPF assembly	023-2008-600
PA001	75W PA mechanical assem	023-2008-732
PA002	Transceiver mechanical assem	023-2000-205
PA004	Receiver assembly	023-2008-200
PA005	Exciter assembly	023-2008-400
PA008	RF Interface board assembly	023-2008-100
PA009	PA assembly	023-2008-500
PA010	Forward/Reverse Power	023-2008-660
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 517	12 pF 250V mini mica	510-0019-120
C 518	12 pF 250V mini mica	510-0019-120
C 519	22 pF 250V mini mica	510-0019-220
C 520	22 pF 250V mini mica	510-0019-220
EP513	Ferrite bead SMD 1233	517-2503-010
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
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
HW249	10-32 panhead phil ZPS	575-1610-020
HW250	#10 flat washer ZPS	596-1410-016
J 001	2-pin lock receptacle #22	515-9032-232
L 657	6T 22 AWG 0.05 ID SMD air	542-0015-006
MP200	Transceiver pad	017-2210-105
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 504*	100 ohm 20W	569-5001-001
R 505*	100 ohm 100W	569-5001-002
R 685*	50 ohm 250W flange mount	569-5001-003
U 501	6W pwr module 806-870 MHz	544-4001-045
W 520	UT-85 coax cable assem	597-3001-212
W 521	UT-85 coax cable assem	597-3001-212

DANGER Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. See Material Safety Data Sheets for further details.

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	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
EP001	Ferrite bead	517-2002-010
EP002	Ferrite bead	517-2002-009
EP010	3/8" heat shrink tubing	042-0241-556
EP011	3/8" heat shrink tubing	042-0241-556
HW013	6-32 machine panhead philips	575-1606-014
HW014	6-32 panhead philips ZPS	575-1606-012
HW015	6-32 panhead philips ZPS	575-1606-008
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	575-8206-016
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
HW028	7/16" cable clamp	572-0001-006
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	574-0001-025
MP029	Flexible grommet	574-0001-025
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 pin latch ejection header	515-9031-400
J 002	34 pin latch ejection header	515-9031-400

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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
P 001	26-pin locking straight header	515-9031-397
PC001	PC board	035-2000-220

POWER SUPPLY FILTER BOARD
PART NO. 023-2000-250

C 001	1000 µF 50V axial low temp	510-4350-102
C 002	1000 µF 50V axial low temp	510-4350-102
C 003	1000 µF 50V axial low temp	510-4350-102
EP020	Ferrite bead	517-2002-007
EP021	Ferrite bead	517-2002-007
PC001	PC board	035-2000-240

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 axial low temp	510-4350-102
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	4.7V zener SOT-23	523-2016-479
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
FH101	Fuse holder PC mount	534-1017-001
FH102	Fuse holder PC mount	534-1017-001
HW105	Polarizing key box cnt	515-7109-010
HW106	Polarizing key box cnt	515-7109-010
HW247	6-32 machine panhead 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	7.5k ohm ±5% 1206 SMD	569-0115-752
R 049	1.5k ohm ±5% 1206 SMD	569-0115-152
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	562-0112-502
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 121	20k ohm ±1% 1206 SMD	569-0111-430
R 122	10k ohm ±1% 1206 SMD	569-0111-401
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 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

RECEIVE VCO 800 MHz
PART NO. 023-2008-800

C 803	1 pF ±0.1 pF 150V chip	510-3356-109
C 804	2.7 pF ±0.1 pF 150V chip	510-3356-279
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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	4.7 pF ±0.1 pF 150V chip	510-3356-479
C 813	6.8 pF ±0.1 pF 150V chip	510-3356-689
CR802	Varactor 2008-800	523-1504-915
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
PC800	PC board	035-2008-800
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	10 ohm ±5% 0805 chip	569-0105-100
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

800 MHz RECEIVER
PART NO. 023-2008-200

A 006	800 MHz VCO	023-2008-800
A 201	RF input coax assembly	023-2000-161
A 201	Top shield assembly	023-2000-199
C 201	6.8 pF ±5% NPO 1206 chip	510-3602-689
C 202	6.2 pF ±5% NPO 1206 chip	510-3602-629
C 203	4.7 µF 16V tantalum SMD	510-2625-479
C 204	56 pF ±5% NPO 1206 chip	510-3602-560
C 205	6.8 pF ±5% NPO 1206 chip	510-3602-689
C 206	56 pF ±5% NPO 1206 chip	510-3602-560
C 207	6.2 pF ±5% NPO 1206 chip	510-3602-629
C 208	24 pF ±5% NPO 1206 chip	510-3602-240
C 209	6.2 pF ±5% NPO 1206 chip	510-3602-629
C 210	10 pF ±5% NPO 1206 chip	510-3602-100
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	9.1 pF ±5% NPO 1206 chip	510-3602-919
C 215	7.5 pF ±5% NPO 1206 chip	510-3602-759
C 216	7.5 µF ±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 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 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
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	27 pF ±5% NPO 1206 chip	510-3602-270
C 263	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 264	27 pF ±5% NPO 1206 chip	510-3602-270
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	39 pF ±5% NPO 1206 chip	510-3602-390
C 272	27 pF ±5% NPO 1206 chip	510-3602-270
C 273	27 pF ±5% NPO 1206 chip	510-3602-270
C 274	27 pF ±5% NPO 1206 chip	510-3602-270
C 275	2.4 pF ±5% NPO 1206 chip	510-3602-249
C 276	6.8 pF ±5% NPO 1206 chip	510-3602-689
C 277	4.3 pF ±5% NPO 1206 chip	510-3602-439
C 278	27 pF ±5% NPO 1206 chip	510-3602-270
C 279	4.7 µF 16V tantalum SMD	510-2625-479
C 280	12 pF ±5% NPO 1206 chip	510-3602-120
C 281	4.7 µF 16V tantalum SMD	510-2625-479
C 282	27 pF ±5% NPO 1206 chip	510-3602-270

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 284	1.5 pF ±5% NPO 1206 chip	510-3602-159
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	10 pF ±5% NPO 1206 chip	510-3602-100
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	39 pF ±5% NPO 1206 chip	510-3602-390
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 302	27 pF ±5% NPO 1206 chip	510-3602-270
C 303	.1 µF ±10% X7R 1206	510-3606-104
C 304	39 pF ±5% NPO 1206 chip	510-3602-390
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 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 323	.001 µF ±5% NPO 1206 chip	510-3602-102
C 326	3 pF ±5% NPO 1206 chip	510-3602-309
C 328	820 pF ±5% NPO 1206 chip	510-3602-821
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	56 pF ±5% NPO 1206 chip	510-3602-560
C 338	.01 µF ±10% X7R 1206	510-3606-103
C 355	2.4 pF ±5% NPO 1206 chip	510-3602-249
C 356	2 pF ±5% NPO 1206 chip	510-3602-209
C 357	1.5 pF ±5% NPO 1206 chip	510-3602-159
C 358	3.9 pF ±5% NPO 1206 chip	510-3602-399
C 359	2.4 pF ±5% NPO 1206 chip	510-3602-249
C 362	4.7 µF 16V tantalum SMD	510-2625-479
CH200	3-cavity helical front end	015-0901-038
CH201	3-cavity helical front end	015-0901-038
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
CR002	Switching diode SOT-23	523-1504-002
CR203	Switching diode SOT-23	523-1504-002
CR204	Si 9.1V zener SOT-23	523-2016-919
EP200	Mini ceramic crystal pin insul	010-0345-280
EP201	Ferrite bead SMD 1206	517-2503-002
EP202	Ferrite bead SMD 1206	517-2503-010
EP203	Ferrite bead SMD 1206	517-2503-001
EP204	Ferrite bead SMD 1206	517-2503-010
EP205	Ferrite bead SMD 1206	517-2503-001
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
J 201	20-pin right angle header	515-9031-375
L 201	Helical coil	016-2186-201
L 202	2.25T helical coil	016-2186-205
L 203	Helical coil	016-2186-201
L 204	Helical coil	016-2186-201
L 205	2.25T helical coil	016-2186-205
L 206	Helical coil	016-2186-201
L 207	0.9 µH variable inductor 7mm	542-1012-008
L 209	0.9 µH variable inductor 7mm	542-1012-008
L 210	1.5T coil 22 AWG	542-0010-015
L 211	0.9 µH variable inductor 7mm	542-1012-008
L 212	1.5T coil 22 AWG	542-0010-015
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
L 218	.1 µH inductor SMD	542-9001-108
L 219	.018 µH inductor SMD	542-9001-187
L 220	2 3/8 turn helical coil	016-2186-200
L 221	3T 22 AWG 0.05 ID SMD air	542-0015-003
L 222	2T 22 AWG 0.05 ID SMD air	542-0015-002
L 223	Helical coil	016-2186-201
L 224	Helical coil	016-2186-201
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	3T 22 AWG 0.05 ID SMD air	542-0015-003
MP200	Helical coil form	013-1627-100
MP201	Helical coil form	013-1627-110
MP203	Damped washer 0.125	018-1132-152
MP204	Bottom shield	017-2210-101
PC200	PC board	035-2008-200
Q 201	NPN UHF low noise SOT-23	576-0003-636
Q 202	Si NPN RF amp SOT-23	576-0003-602
Q 205	Si NPN amp	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
Q 218	Si PNP low noise SOT-23	576-0003-657
R 201	10k ohm ±5% 1206 SMD	569-0115-103
R 203	62 ohm ±5% 1206 SMD	569-0115-620
R 204	10k ohm ±5% 1206 SMD	569-0115-103
R 208	15k ohm ±5% 1206 SMD	569-0115-153
R 209	4.7k ohm ±5% 1206 SMD	569-0115-472
R 210	100 ohm ±5% 1206 SMD	569-0115-101
R 211	100 ohm ±5% 1206 SMD	569-0115-101
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 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 247	2.2k ohm ±5% 1206 SMD	569-0115-222
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	330k ohm ±5% 1206 SMD	569-0115-334
R 255	27k ohm ±5% 1206 SMD	569-0115-273
R 256	43k ohm ±5% 1206 SMD	569-0115-433
R 257	470 ohm ±5% 1206 SMD	569-0115-471
R 258	75 ohm ±5% 1206 SMD	569-0115-750
R 260	Zero ohm ±10% 1206 SMD	569-0115-001
R 261	5k ohm single turn trimmer	562-0112-502
R 262	22k ohm ±5% 1206 SMD	569-0115-223
R 263	120k ohm ±5% 1206 SMD	569-0115-124
R 264	5k ohm single turn trimmer	562-0112-502
R 265	1.8k ohm ±5% 1206 SMD	569-0115-182
R 266	470 ohm ±5% 1206 SMD	569-0115-471
R 267	150 ohm ±5% 1206 SMD	569-0115-151
R 268	470 ohm ±5% 1206 SMD	569-0115-471
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 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	470 ohm ±5% 1206 SMD	569-0115-471
R 296	1.8k ohm ±5% 1206 SMD	569-0115-182
R 297	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 303	43 ohm ±5% 1206 SMD	569-0115-430
R 304	240 ohm ±5% 1206 SMD	569-0115-241

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 306	51 ohm ±5% 1206 SMD	569-0115-510
R 308	22 ohm ±5% 1206 SMD	569-0115-220
R 309	12.1k ohm ±1% 1206 SMD	569-0111-409
R 310	4.99k ohm ±1% 1206 SMD	569-0111-368
R 311	4.3k ohm ±5% 1206 SMD	569-0115-432
R 312	100 ohm ±5% 1206 SMD	569-0115-101
R 313	100 ohm ±5% 1206 SMD	569-0115-101
R 314	68 ohm ±5% 1206 SMD	569-0115-680
R 315	270 ohm ±5% 1206 SMD	569-0115-271
R 319	10k ohm ±5% 1206 SMD	569-0115-103
R 320	10k ohm ±5% 1206 SMD	569-0115-103
R 322	560 ohm ±5% 1206 SMD	569-0115-561
U 201	Mixer LRMS-2H	544-0007-013
U 202	FM IF MC3371D SO-16	544-2002-031
U 203	Dual op amp SOIC MC33178	544-2019-018
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
Y 201	17.5 MHz crystal 1 PPM	518-7117-500
Z 201	52.95 MHz 4-pole 15 kHz BW	532-0009-009
Z 203	52.95 MHz 4-pole 15 kHz BW	532-0009-009
Z 205	450 kHz cer filter 15 kHz BW	532-2006-032
Z 213	455 kHz var inductor w/cap	542-1012-010

TRANSMIT VCO 800 MHz
PART NO. 023-2008-850

C 802	1.5 pF ±0.1 pF 150V chip	510-3356-159
C 803	1 pF ±0.1 pF 150V chip	510-3356-109
C 804	2.4 pF ±0.1 pF 150V chip	510-3356-249
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	3.9 pF ±10% 50V chip	510-3352-399
C 813	5.6 pF ±10% 50V chip	510-3352-569
CR801	Varacap SOT-23 105G	523-1504-015
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	.039 µH inductor SMD	542-9001-397
PC800	PC board	035-2008-800
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	240 ohm ±5% 0805 chip	569-0105-241
R 814	10k ohm ±5% 1206 SMD	569-0115-103

800 MHz EXCITER
PART NO. 023-2008-400

A 007	800 MHz VCO	023-2008-850
C 409	.01 µF ±10% X7R chip	510-3606-103
C 410	.01 µF ±10% X7R chip	510-3606-103
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 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
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	27 pF ±5% NPO 1206 chip	510-3602-270
C 445	27 pF ±5% NPO 1206 chip	510-3602-270

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 446	39 pF ±5% NPO 1206 chip	510-3602-390
C 447	1 µF 16V tantalum SMD	510-2625-109
C 448	27 pF ±5% NPO 1206 chip	510-3602-270
C 449	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 450	39 pF ±5% NPO 1206 chip	510-3602-390
C 451	5.6 pF ±5% NPO 1206 chip	510-3602-569
C 453	820 pF ±5% NPO 1206 chip	510-3602-821
C 454	27 pF ±5% NPO 1206 chip	510-3602-270
C 455	.001 µF ±5% NPO 1206 chip	510-3602-102
C 457	39 pF ±5% NPO 1206 chip	510-3602-390
C 458	15 pF ±5% NPO 1206 chip	510-3602-150
C 459	15 pF ±5% NPO 1206 chip	510-3602-150
C 460	39 pF ±5% NPO 1206 chip	510-3602-390
C 461	15 pF ±5% NPO 1206 chip	510-3602-150
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	27 pF ±5% NPO 1206 chip	510-3602-270
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 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 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
CH400	Single helical cavity front end	015-0901-010
CR401	Si 9.1V zener SOT-23	523-2016-919
EP400	Helical core form 1.25	013-1627-104
HW400	10-32 hex set screw NPB	575-9059-024
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
L 402	.1 µH inductor SMD	542-9001-108
L 403	0.018 ceramic inductor SMD	542-9001-187
L 404	2.125T helical coil	016-2186-207
L 406	.039 µH inductor SMD	542-9001-397
MP402	Damped washer 0.125	018-1132-152
PC401	PC board	035-2008-400
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	Si NPN low noise SOT-23	576-0003-636
Q 413	NPN 750 mW UHF/800 MHz	576-0004-098
R 404	100 ohm ±5% SMD 1206	569-0115-101
R 405	1k ohm ±5% SMD 1206	569-0115-102
R 412	16k ohm ±5% SMD 1206	569-0115-163
R 414	12.1k ohm ±1% SMD 1206	569-0111-409
R 415	4.99k ohm ±1% SMD 1206	569-0111-368
R 416	270 ohm ±5% SMD 1206	569-0115-271
R 417	10k ohm ±5% SMD 1206	569-0115-103
R 419	12.1k ohm ±1% SMD 1206	569-0111-409
R 424	10k ohm ±5% SMD 1206	569-0115-103
R 425	50k ohm single turn trimmer	562-0112-503
R 426	10k ohm ±5% SMD 1206	569-0115-103
R 427	10k ohm ±5% SMD 1206	569-0115-103
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	150 ohm ±5% SMD 1206	569-0115-151
R 435	470 ohm ±5% SMD 1206	569-0115-471
R 436	100 ohm ±5% SMD 1206	569-0115-101

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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	100k ohm ±5% SMD 1206	569-0115-104
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	470 ohm ±5% SMD 1206	569-0115-471
R 457	36 ohm ±5% SMD 1206	569-0115-360
R 458	47 ohm ±5% SMD 1206	569-0115-470
R 460	10 ohm ±5% SMD 1206	569-0115-100
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	3.9k ohm ±5% SMD 1206	569-0115-392
R 470	1k ohm ±5% SMD 1206	569-0115-102
R 471	47 ohm ±5% SMD 1206	569-0115-470
R 472	150 ohm ±5% SMD 1206	569-0115-151
R 473	100 ohm ±5% SMD 1206	569-0115-101
R 474	1k ohm ±5% SMD 1206	569-0115-102
R 476	470 ohm ±5% SMD 1206	569-0115-471
R 477	100 ohm ±5% SMD 1206	569-0115-101
R 478	220 ohm ±5% SMD 1206	569-0115-221
R 479	220 ohm ±5% SMD 1206	569-0115-221
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 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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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 TCXO	518-7117-500

800 MHz 75 WATT POWER AMPLIFIER
PART NO. 023-2008-500

A 501	Coax driver to finals	023-2008-107
C 501	27 pF ±5% NPO 1206 chip	510-3602-270
C 502	.01 µF ±10% X7R chip	510-3606-103
C 503	.001 µF ±5% NPO 1206 chip	510-3602-102
C 504	56 pF ±10% high Q SMD	510-3653-560
C 505	15 µF 20V tantalum SMD	510-2633-150
C 506	.001 µF ±5% NPO 1206 chip	510-3602-102
C 507	56 pF ±10% high Q SMD	510-3653-560
C 508	56 pF ±10% high Q SMD	510-3653-560
C 509	.001 µF ±5% NPO 1206 chip	510-3602-102
C 510	15 µF 20V tantalum SMD	510-2633-150
C 511	.01 µF ±10% X7R chip	510-3606-103
C 512	56 pF ±10% high Q SMD	510-3653-560
C 513	15 µF 20V tantalum SMD	510-2633-150
C 514	.01 µF ±10% X7R chip	510-3606-103
C 515	56 pF ±10% high Q SMD	510-3653-560
C 516	3.9 pF high Q cube	510-3663-399
C 517	12 pF 250V mini mica	510-0019-120
C 518	12 pF 250V mini mica	510-0019-120
C 519	22 pF 250V mini mica	510-0019-220
C 520	22 pF 250V mini mica	510-0019-220
C 521	1.6-4.9 pF 125V ±20% air var	187-0103-175
C 522	5.6 pF high Q cube	510-3663-569
C 523	.01 µF ±10% X7R chip	510-3606-103
C 524	.001 µF ±5% NPO 1206 chip	510-3602-102
C 525	6.8 µF 35V tantalum SMD	510-2635-689
C 526	56 pF ±10% high Q SMD	510-3653-560
C 527	6.8 µF 35V tantalum SMD	510-2635-689
C 528	.01 µF ±10% X7R chip	510-3606-103
C 529	56 pF ±10% high Q SMD	510-3653-560
C 530	56 pF ±10% high Q SMD	510-3653-560
C 531	4.7 pF ±10% high Q SMD	510-3663-479
C 532	56 pF ±10% high Q SMD	510-3653-560
C 533	4.7 pF ±10% high Q SMD	510-3663-479

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 534	6.2 pF ±10% high Q SMD	510-3653-629
C 535	56 pF ±10% high Q SMD	510-3653-560
C 536	6.8 µF 35V tantalum SMD	510-2635-689
C 537	.01 µF ±10% X7R chip	510-3606-103
C 538	56 pF ±10% high Q SMD	510-3653-560
C 539	56 pF ±10% high Q SMD	510-3653-560
C 540	.001 µF ±5% NPO 1206 chip	510-3602-102
C 541	6.8 µF 35V tantalum SMD	510-2635-689
C 542	.01 µF ±10% X7R chip	510-3606-103
C 543	6.8 µF 35V tantalum SMD	510-2635-689
C 544	.01 µF ±10% X7R chip	510-3606-103
C 545	56 pF ±10% high Q SMD	510-3653-560
C 546	56 pF ±10% high Q SMD	510-3653-560
C 547	.001 µF ±5% NPO 1206 chip	510-3602-102
C 548	6.8 µF 35V tantalum SMD	510-2635-689
C 549	.01 µF ±10% X7R chip	510-3606-103
C 550	6.2 pF ±10% high Q SMD	510-3653-629
C 551	56 pF ±10% high Q SMD	510-3653-560
C 552	27 pF ±5% NPO 1206 chip	510-3602-270
C 553	27 pF ±5% NPO 1206 chip	510-3602-270
C 554	27 pF ±5% NPO 1206 chip	510-3602-270
C 555	.001 µF ±5% NPO 1206 chip	510-3602-102
C 556	15 µF 20V tantalum SMD	510-2633-150
C 557	27 pF ±5% NPO 1206 chip	510-3602-270
C 558	27 pF ±5% NPO 1206 chip	510-3602-270
C 559	.001 µF ±5% NPO 1206 chip	510-3602-102
C 560	56 pF ±10% high Q SMD	510-3653-560
C 561	56 pF ±10% high Q SMD	510-3653-560
C 562	27 pF ±5% NPO 1206 chip	510-3602-270
C 563	27 pF ±5% NPO 1206 chip	510-3602-270
C 567	.001 µF ±5% NPO 1206 chip	510-3602-102
C 568	27 pF ±5% NPO 1206 chip	510-3602-270
C 569	27 pF ±5% NPO 1206 chip	510-3602-270
C 570	.001 µF ±5% NPO 1206 chip	510-3602-102
C 571	27 pF ±5% NPO 1206 chip	510-3602-270
C 572	27 pF ±5% NPO 1206 chip	510-3602-270
C 573	27 pF ±5% NPO 1206 chip	510-3602-270
C 574	27 pF ±5% NPO 1206 chip	510-3602-270
C 575	27 pF ±5% NPO 1206 chip	510-3602-270
C 576	27 pF ±5% NPO 1206 chip	510-3602-270
C 577	56 pF ±10% high Q SMD	510-3653-560
C 578	15 µF 20V tantalum SMD	510-2633-150
C 579	4.7 µF 16V tantalum SMD	510-2625-479
C 580	4.7 µF 16V tantalum SMD	510-2625-479
C 581	27 pF ±5% NPO 1206 chip	510-3602-270
C 582	.001 µF ±5% NPO 1206 chip	510-3602-102
C 583	27 pF ±5% NPO 1206 chip	510-3602-270
C 584	.001 µF ±5% NPO 1206 chip	510-3602-102
CR501	Hot carrier diode SOT-23	523-1504-016
CR504	Hot carrier diode SOT-23	523-1504-016
CR505	Dual switching diode SOT-23	523-1504-023
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
EP509	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
J 501	PC jack assem JCM-B-DC	131-1701-201
L 501	5T 22 AWG .05 ID SMD air	542-0015-005
L 503	2.5T RF choke 1W	023-4405-510
L 504	2.5T RF choke 1W	023-4405-509
L 505	2.5T RF choke 1W	023-4405-510
L 506	2.5T RF choke 1W	023-4405-509
L 507	2.5T RF choke 1W	023-4405-510
PC500	PC board	035-2008-500
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 504*	100 ohm 20W	569-5001-001
R 505*	100 ohm 100W	569-5001-002
R 685*	50 ohm 250W flange mount	569-5001-003
R 502	Zero ohm ±5% 1206 SMD	569-0115-001
R 506	200 ohm ±5% 1206 SMD	569-0115-201
R 508	200 ohm ±5% 1206 SMD	569-0115-201
R 509	200 ohm ±5% 1206 SMD	569-0115-201
R 510	200 ohm ±5% 1206 SMD	569-0115-201
R 512	200 ohm ±5% 1206 SMD	569-0115-201
R 513	200 ohm ±5% 1206 SMD	569-0115-201
R 514	200 ohm ±5% 1206 SMD	569-0115-201
R 517	10k ohm ±5% 1206 SMD	569-0115-103
R 518	330k ohm ±5% 1206 SMD	569-0115-334
R 519	10k ohm ±5% 1206 SMD	569-0115-103

* DANGER Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. See Material Safety Data Sheets for further details.

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 520	10k ohm ±1% 1206 SMD	569-0111-401
R 521	10k ohm ±1% 1206 SMD	569-0111-401
R 522	470 ohm ±5% 1206 SMD	569-0115-471
R 525	10k ohm ±5% 1206 SMD	569-0115-103
R 526	200 ohm ±5% 1206 SMD	569-0115-201
R 527	330k ohm ±5% 1206 SMD	569-0115-334
R 528	10k ohm ±5% 1206 SMD	569-0115-103
R 529	10k ohm ±1% 1206 SMD	569-0111-401
R 530	10k ohm ±1% 1206 SMD	569-0111-401
R 531	470 ohm ±5% 1206 SMD	569-0115-471
R 532	1k ohm ±5% 1206 SMD	569-0115-102
R 533	100k ohm ±5% 1206 SMD	569-0115-104
R 534	10k ohm ±5% 1206 SMD	569-0115-103
R 535	200k ohm ±5% 1206 SMD	569-0115-204
R 536	56 ohm ±5% 1206 SMD	569-0115-560
R 537	240 ohm ±5% 1206 SMD	569-0115-241
R 538	470 ohm ±5% 1206 SMD	569-0115-471
U 501	6W pwr module 806-870 MHz	544-4001-045
U 502	Dual op amp 532 SO-8	544-2019-004
U 503	Temp sensor LM35 SO-8	544-2032-003
U 504	Dual op amp 532 SO-8	544-2019-004
U 505	+5V regulator 78L05 SO-8	544-2603-039
W 520	UT-85 coax cable assem	597-3001-212
W 521	UT-85 coax cable assem	597-3001-21

FORWARD/REVERSE POWER DETECTOR
PART NO. 023-2008-660

A 601	Forward/Reverse power det.	023-2008-662
C 651	27 pF ±5% NPO 1206 chip	510-3602-270
C 652	27 pF ±5% NPO 1206 chip	510-3602-270
C 653	27 pF ±5% NPO 1206 chip	510-3602-270
C 654	27 pF ±5% NPO 1206 chip	510-3602-270
C 655	27 pF ±5% NPO 1206 chip	510-3602-270
C 656	27 pF ±5% NPO 1206 chip	510-3602-270
C 657	27 pF ±5% NPO 1206 chip	510-3602-270
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
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 1206 chip	510-3602-270
C 665	27 pF ±5% NPO 1206 chip	510-3602-270
C 666	27 pF ±5% NPO 1206 chip	510-3602-270
C 667	27 pF ±5% NPO 1206 chip	510-3602-270
C 668	27 pF ±5% NPO 1206 chip	510-3602-270
C 669	27 pF ±5% NPO 1206 chip	510-3602-270
C 670	27 pF ±5% NPO 1206 chip	510-3602-270
C 671	27 pF ±5% NPO 1206 chip	510-3602-270
C 672	27 pF ±5% NPO 1206 chip	510-3602-270
C 673	.001 µF ±5% NPO 1206 chip	510-3602-102
C 674	27 pF ±5% NPO 1206 chip	510-3602-270
C 675	27 pF ±5% NPO 1206 chip	510-3602-270
C 676	27 pF ±5% NPO 1206 chip	510-3602-270
C 677	27 pF ±5% NPO 1206 chip	510-3602-270
C 678	27 pF ±5% NPO 1206 chip	510-3602-270
C 679	.001 µF ±5% NPO 1206 chip	510-3602-102
C 680	27 pF ±5% NPO 1206 chip	510-3602-270
C 681	.001 µF ±5% NPO 1206 chip	510-3602-102
C 682	.001 µF ±5% NPO 1206 chip	510-3602-102
CR651	Dual Schottky SOT-143	523-1504-033
CR652	Dual Schottky SOT-143	523-1504-033
L 651	.033 µH inductor SMD	542-9001-337
L 652	.039 µH inductor SMD	542-9001-397
L 653	.022 µH inductor SMD	542-9001-227
L 654	.033 µH inductor SMD	542-9001-337
L 655	.039 µH inductor SMD	542-9001-397
L 656	.022 µH inductor SMD	542-9001-227
L 657	6T 22 AWG 0.05 ID SMD air	542-0015-006
MP651	PA PC board shield	017-2210-089
MP652	PA PC board shield	017-2210-089
PC601	PC board	035-2008-660
R 651	110 ohm ±5% 1206 SMD	569-0115-111
R 653	100 ohm ±5% 1206 SMD	569-0115-101
R 654	4.7k ohm ±5% 1206 SMD	569-0115-472
R 655	100 ohm ±5% 1206 SMD	569-0115-101
R 656	1k ohm ±5% 1206 SMD	569-0115-102
R 657	180 ohm ±5% 1206 SMD	569-0115-181
R 658	22k ohm ±5% 1206 SMD	569-0115-223
R 659	49.9k ohm ±1% 1206 SMD	569-0111-468
R 660	49.9k ohm ±1% 1206 SMD	569-0111-468
R 661	20k ohm ±1% 1206 SMD	569-0111-430
R 662	20k ohm ±1% 1206 SMD	569-0111-430
R 663	5k ohm top adjust SMD pot	562-0135-502
R 664	1k ohm ±5% 1206 SMD	569-0115-102
R 665	24k ohm ±5% 1206 SMD	569-0115-243

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 666	10k ohm ±5% 1206 SMD	569-0115-103
R 667	470 ohm ±5% 1206 SMD	569-0115-471
R 668	110 ohm ±5% 1206 SMD	569-0115-111
R 670	100 ohm ±5% 1206 SMD	569-0115-101
R 671	4.7k ohm ±5% 1206 SMD	569-0115-472
R 672	100 ohm ±5% 1206 SMD	569-0115-101
R 673	1k ohm ±5% 1206 SMD	569-0115-102
R 674	180 ohm ±5% 1206 SMD	569-0115-181
R 675	22k ohm ±5% 1206 SMD	569-0115-223
R 676	49.9k ohm ±1% 1206 SMD	569-0111-468
R 677	20k ohm ±1% 1206 SMD	569-0111-430
R 678	49.9k ohm ±1% 1206 SMD	569-0111-468
R 679	20k ohm ±1% 1206 SMD	569-0111-430
R 680	5k ohm top adjust SMD pot	562-0135-502
R 681	1k ohm ±5% 1206 SMD	569-0115-102
R 682	10k ohm ±5% 1206 SMD	569-0115-103
R 683	24k ohm ±5% 1206 SMD	569-0115-243
R 684	470 ohm ±5% 1206 SMD	569-0115-471
R 685*	50 ohm 250W flange mount	569-5001-003
R 686	47 ohm ±5% 1206 SMD	569-0115-470
R 687	240 ohm ±5% 1206 SMD	569-0115-241
R 688	1k ohm ±5% 1206 SMD	569-0115-102
R 689	1k ohm ±5% 1206 SMD	569-0115-102
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

POWER AMPLIFIER MECHANICAL
PART NO. 023-2008-732

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
HW252	6-32 panhead philips ZPS	575-1606-024
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	806.78 x 1.92 grafoil mhw	018-1007-038
HW266	0.94" grafoil circulator	018-1007-040
HW267	4-40 socket head shield	575-9078-104
HW268	10-32 HHSL Sems screw ZPS	575-9810-012
HW269	0.062 x 0.85 x 5.65 poron stp	574-3002-110
MP253	Circulator hold down	017-2210-087
MP254	M PA plate align dowel pin	013-1723-216
MP255	PA heat sink	014-0771-122
MP256	PA shield, left	017-2210-021
MP257	PA shield, top	017-2210-022
MP258	PA shield, right, 1 fan	017-2210-024
MP260	Male/female hex spacer 0.375"	312-7483-012
MP261	Male/female hex spacer 0.75"	312-7483-024
MP262	Low-pass filter shield	017-2210-088
MP265	PA left side lock	017-2210-028
MP266	PA right side lock	017-2210-029
MP268	M PA stop	013-1723-222
MP270	PA shield	017-2210-095

THIRD PARTY INTERFACE CARD
PART NO. 023-2000-390

C 001	10 pF ±5% NPO 1206	510-3602-100
C 002	10 pF ±5% NPO 1206	510-3602-100
C 003	15 µF tantalum SMD	510-2626-150
C 004	.01 µF ±10% X7R 1206	510-3606-103
C 005	10 µF tantalum SMD	510-2625-100
C 006	47 µF 10V tantalum SMD	510-2624-470
C 007	.01 µF ±10% X7R 1206	510-3606-103
C 008	.01 µF ±10% X7R 1206	510-3606-103
C 009	.01 µF ±10% X7R 1206	510-3606-103
C 010	.01 µF ±10% X7R 1206	510-3606-103
C 011	.01 µF ±10% X7R 1206	510-3606-103
C 012	.01 µF ±10% X7R 1206	510-3606-103
C 013	.01 µF ±10% X7R 1206	510-3606-103
C 101	.1 µF ±10% X7R 1206	510-3606-104
C 102	.0022 µF ±10% X7R 1206	510-3606-222
C 103	.001 µF ±2% NPO 1206	510-3616-102
C 104	820 pF ±2% NPO 1206	510-3616-821
C 105	.001 µF ±2% NPO 1206	510-3616-102
C 106	100 pF ±2% NPO 1206	510-3616-101
C 107	68 pF ±5% NPO 1206	510-3602-680
C 108	.033 µF ±5% X7R 1210	510-3610-333
C 109	.22 µF ±5% X7R 1210	510-3610-224

* DANGER Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. See Material Safety Data Sheets for further details.

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 110	.033 µF ±5% X7R 1210	510-3610-333
C 111	.068 µF ±5% X7R 1206	510-3609-683
C 112	.022 µF ±5% X7R 1206	510-3609-223
C 113	2200 pF ±2% NPO 1206	510-3616-222
C 114	4700 pF ±2% NPO 1206	510-3616-472
C 115	.047 µF ±5% X7R 1206	510-3609-473
C 116	.1 µF ±5% X7R 1206	510-3609-104
C 117	.022 µF ±5% X7R 1206	510-3609-223
C 118	6800 pF ±2% NPO 1206	510-3617-682
C 119	.068 µF ±5% X7R 1206	510-3609-683
C 120	.1 µF ±5% X7R 1206	510-3609-104
C 121	.022 µF ±5% X7R 1206	510-3609-223
C 122	.022 µF ±5% X7R 1206	510-3609-223
C 123	.01 µF ±5% X7R 1206	510-3609-103
C 124	.1 µF ±5% X7R 1206	510-3609-104
C 125	100 pF ±5% NPO 1206	510-3602-101
C 126	100 pF ±5% NPO 1206	510-3602-101
C 127	100 pF ±5% NPO 1206	510-3602-101
C 128	.001 µF ±5% NPO 1206	510-3602-102
C 129	.01 µF ±5% X7R 1206	510-3609-103
C 130	.01 µF ±5% X7R 1206	510-3609-103
C 131	.1 µF ±5% X7R 1206	510-3609-104
C 132	.1 µF ±5% X7R 1206	510-3609-104
C 133	1 µF 16V tantalum SMD	510-2625-109
C 134	.022 µF ±5% X7R 1206	510-3609-223
C 135	.01 µF ±5% X7R 1206	510-3609-103
C 136	.047 µF ±5% X7R 1206	510-3609-473
C 137	.0068 µF ±10% X7R 1206	510-3606-682
C 138	15 µF 20V SMD tantalum	510-2626-150
C 139	15 µF 20V SMD tantalum	510-2626-150
C 140	.001 µF ±2% NPO 1206	510-3616-102
C 141	220 µF 25V aluminum axial	510-4325-221
C 142	10 µF 16V tantalum SMD	510-2625-100
C 143	.01 µF ±10% X7R 1206	510-3606-103
C 144	15 µF 20V SMD tantalum	510-2626-150
C 145	.1 µF ±10% X7R 1206	510-3606-104
C 146	.1 µF ±10% X7R 1206	510-3606-104
C 147	220 µF 25V aluminum axial	510-4325-221
C 148	.1 µF ±10% X7R 1206	510-3606-104
C 149	470 µF 16V axial low temp	510-4316-471
C 150	360 pF ±5% NPO 1206 chip	510-3602-361
C 151	.1 µF ±5% X7R 1206	510-3609-104
C 152	.1 µF ±5% X7R 1206	510-3609-104
C 153	10 µF 16V tantalum SMD	510-2625-100
C 154	.1 µF ±10% X7R 1206	510-3606-104
C 155	100 pF ±2% NPO 1206	510-3616-101
C 156	100 pF ±2% NPO 1206	510-3616-101
C 157	20 pF ±5% NPO 1206	510-3602-200
C 158	.1 µF ±5% X7R 1206	510-3609-104
C 170	.01 µF ±10% X7R 1206	510-3606-103
C 171	.01 µF ±10% X7R 1206	510-3606-103
C 172	.01 µF ±10% X7R 1206	510-3606-103
C 173	.01 µF ±10% X7R 1206	510-3606-103
C 174	.01 µF ±10% X7R 1206	510-3606-103
C 175	.01 µF ±10% X7R 1206	510-3606-103
C 176	.01 µF ±10% X7R 1206	510-3606-103
C 177	.01 µF ±10% X7R 1206	510-3606-103
C 178	.01 µF ±10% X7R 1206	510-3606-103
C 179	.01 µF ±10% X7R 1206	510-3606-103
C 180	.01 µF ±10% X7R 1206	510-3606-103
C 181	.01 µF ±10% X7R 1206	510-3606-103
C 182	.01 µF ±10% X7R 1206	510-3606-103
C 183	.01 µF ±10% X7R 1206	510-3606-103
C 184	.01 µF ±10% X7R 1206	510-3606-103
C 185	.01 µF ±10% X7R 1206	510-3606-103
C 186	.01 µF ±10% X7R 1206	510-3606-103
C 187	.01 µF ±10% X7R 1206	510-3606-103
C 188	.01 µF ±10% X7R 1206	510-3606-103
C 189	.01 µF ±10% X7R 1206	510-3606-103
C 190	.01 µF ±10% X7R 1206	510-3606-103
C 191	.01 µF ±10% X7R 1206	510-3606-103
C 192	.01 µF ±10% X7R 1206	510-3606-103
C 193	.01 µF ±10% X7R 1206	510-3606-103
C 194	.01 µF ±10% X7R 1206	510-3606-103
C 195	.01 µF ±10% X7R 1206	510-3606-103
C 196	.01 µF ±10% X7R 1206	510-3606-103
C 197	.01 µF ±10% X7R 1206	510-3606-103
C 198	.01 µF ±10% X7R 1206	510-3606-103
C 199	.01 µF ±10% X7R 1206	510-3606-103
C 201	.1 µF ±10% X7R 1206	510-3606-104
C 202	.1 µF ±10% X7R 1206	510-3606-104
C 203	.1 µF ±10% X7R 1206	510-3606-104
C 204	5600 pF ±2 NPO 1210	510-3617-562
C 205	4700 pF ±2 NPO 1206	510-3616-472
C 206	3300 pF ±2 NPO 1206	510-3616-332
C 207	3900 pF ±2 NPO 1206	510-3616-392
C 208	.0047 µF ±5% X7R 1206	510-3609-472
C 209	470 pF ±2% NPO 1206	510-3616-471
C 210	470 pF ±2% NPO 1206	510-3616-471
C 211	3300 pF ±2% NPO 1206	510-3616-332
C 212	680 pF ±2% NPO 1206	510-3616-681
C 213	.01 µF ±2 NPO 1210	510-3617-103
C 214	680 pF ±2% NPO 1206	510-3616-681
C 215	100 µF 25V aluminum axial	510-4325-101

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 216	100 µF 25V aluminum axial	510-4325-101
C 217	100 pF ±5% NPO 1206 chip	510-3602-101
C 218	360 pF ±5% NPO 1206 chip	510-3602-361
C 219	.047 µF ±5% X7R 1206	510-3609-473
C 220	.1 µF ±10% X7R 1206	510-3606-104
C 221	100 pF ±2% NPO 1206 chip	510-3616-101
C 222	.047 µF ±5% X7R 1206	510-3609-473
C 223	390 pF ±5% NPO 1206 chip	510-3602-391
C 224	.22 µF ±5% X7R 1210	510-3610-224
C 225	.1 µF ±10% X7R 1206	510-3606-104
C 226	.1 µF ±10% X7R 1206	510-3606-104
C 227	100 pF ±2% NPO 1206	510-3616-101
C 228	100 pF ±2% NPO 1206	510-3616-101
C 229	100 pF ±2% NPO 1206	510-3616-101
C 230	.01 µF ±2 NPO 1210	510-3617-103
C 231	4700 pF ±2% NPO 1206	510-3616-472
C 232	4700 pF ±2% NPO 1206	510-3616-472
C 233	.022 µF ±5% X7R 1206	510-3609-223
C 234	.01 µF ±10% X7R 1206	510-3606-103
C 235	.01 µF ±10% X7R 1206	510-3606-103
C 251	.01 µF ±10% X7R 1206	510-3606-103
C 252	.01 µF ±10% X7R 1206	510-3606-103
C 253	.01 µF ±10% X7R 1206	510-3606-103
C 254	.01 µF ±10% X7R 1206	510-3606-103
C 256	.01 µF ±10% X7R 1206	510-3606-103
C 258	1 µF 16V tantalum SMD	510-2625-109
C 259	47 µF 10V tantalum SMD	510-2624-470
C 260	47 µF 10V tantalum SMD	510-2624-470
C 261	.01 µF ±10% X7R 1206	510-3606-103
C 262	.01 µF ±10% X7R 1206	510-3606-103
C 263	.01 µF ±10% X7R 1206	510-3606-103
C 264	.01 µF ±10% X7R 1206	510-3606-103
C 265	.01 µF ±10% X7R 1206	510-3606-103
C 266	.01 µF ±10% X7R 1206	510-3606-103
C 267	.01 µF ±10% X7R 1206	510-3606-103
C 268	.01 µF ±10% X7R 1206	510-3606-103
C 270	.01 µF ±10% X7R 1206	510-3606-103
C 271	.01 µF ±10% X7R 1206	510-3606-103
C 272	.01 µF ±10% X7R 1206	510-3606-103
C 273	.01 µF ±10% X7R 1206	510-3606-103
C 275	.01 µF ±10% X7R 1206	510-3606-103
C 276	47 µF 10V SMD tantalum	510-2624-470
C 277	.01 µF ±10% X7R 1206	510-3606-103
C 278	47 µF 10V SMD tantalum	510-2624-470
C 279	47 µF 10V SMD tantalum	510-2624-470
C 280	.01 µF ±10% X7R 1206	510-3606-103
C 281	.01 µF ±10% X7R 1206	510-3606-103
C 282	.01 µF ±10% X7R 1206	510-3606-103
C 283	.01 µF ±10% X7R 1206	510-3606-103
C 284	.01 µF ±10% X7R 1206	510-3606-103
C 287	.01 µF ±10% X7R 1206	510-3606-103
C 288	47 µF 10V SMD tantalum	510-2624-470
C 289	.01 µF ±10% X7R 1206	510-3606-103
C 290	.01 µF ±10% X7R 1206	510-3606-103
C 291	.01 µF ±10% X7R 1206	510-3606-103
C 292	.01 µF ±10% X7R 1206	510-3606-103
C 293	.01 µF ±10% X7R 1206	510-3606-103
C 294	.01 µF ±10% X7R 1206	510-3606-103
C 295	15 µF 20V tantalum SMD	510-2626-150
CR001	Green LED subminiature	549-4001-122
CR002	Yellow LED subminiature	549-4001-121
CR003	Red LED subminiature	549-4001-120
CR004	Red LED subminiature	549-4001-120
CR005	Yellow LED subminiature	549-4001-121
CR101	Dual switch diode SOT-23	523-1504-023
CR102	Dual switch diode SOT-23	523-1504-023
CR103	4.3V zener SOT-23	523-2016-439
CR104	UHF/VHF band switch SOT	523-1504-012
CR105	UHF/VHF band switch SOT	523-1504-012
CR106	UHF/VHF band switch SOT	523-1504-012
CR107	Switching diode SOT-23	523-1504-002
CR108	Switching diode SOT-23	523-1504-002
CR109	5.1V zener SOT-23	523-2016-519
CR110	5.1V zener SOT-23	523-2016-519
CR201	Dual switch diode SOT-23	523-1504-023
CR202	2.4V 1W zener	523-2505-249
CR203	2.4V 1W zener	523-2505-249
CR204	Dual switch diode SOT-23	523-1504-023
CR205	Dual switch diode SOT-23	523-1504-023
CR206	3.9V zener SOT-23	523-2016-399
CR207	3.9V zener SOT-23	523-2016-399
CR208	3.9V zener SOT-23	523-2016-399
CR209	3.9V zener SOT-23	523-2016-399
CR210	3.9V zener SOT-23	523-2016-399
CR211	3.9V zener SOT-23	523-2016-399
CR212	Diode SOT-23 BZXC15	523-2016-150
CR213	Diode SOT-23 BZXC15	523-2016-150
CR214	Diode SOT-23 BZXC15	523-2016-150
CR215	Diode SOT-23 BZXC15	523-2016-150
CR216	Diode SOT-23 BZXC15	523-2016-150
CR217	Diode SOT-23 BZXC15	523-2016-150
DS001	7-segment display 0.3" green	549-4002-020

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
HW100	2-hole crystal pin insulator	018-1080-001
HW101	Card injector/extractor nylon	537-9057-020
HW102	Snap rivet 0.142 dia	574-9015-050
J 001	8-cond modular PC mt jack	515-2006-040
J 006	3-pin single inline header	515-7100-003
J 007	2-pin single inline header	515-7100-002
J 008	2-pin single inline header	515-7100-002
J 010	2-pos shorting socket	515-5010-001
J 100	Horiz tip jack 0.8 green	105-2204-105
J 101	Speaker jack	515-2002-012
J 102	3.6 mm enclosed jack	515-2001-011
J 103	Horiz tip jack 0.8 black	105-2203-101
J 104	3.6 mm enclosed jack	515-2001-011
J 105	2-pin single inline header	515-7100-002
J 106	2-pin single inline header	515-7100-002
J 201	2-pin single inline header	515-7100-002
MP010	Control knob	032-0792-010
P 006	2-pos shorting socket	515-5010-001
P 007	2-pos shorting socket	515-5010-001
P 008	2-pos shorting socket	515-5010-001
P 010	12-pin header	515-7101-406
P 100	32-pin DIN right angle male	515-7082-102
P 101	64-pin DIN right angle male	515-7082-101
P 105	2-pos shorting socket	515-5010-001
P 106	2-pos shorting socket	515-5010-001
P 201	2-pos shorting socket	515-5010-001
PC001	PC board	035-2000-390
Q 002	PNP switching	576-0003-612
Q 003	Si NPN gen purp sw/amp	576-0001-300
Q 101	NPN 80V SOT-23	576-0003-616
Q 102	NPN 80V SOT-23	576-0003-616
Q 201	Si PNP SOT-23	576-0003-657
Q 202	Si NPN SOT-23	576-0003-658
R 001	Zero ohm ±5%1206 SMD	569-0115-001
R 002	10k ohm ±5% 1206 SMD	569-0115-103
R 003	10k ohm ±5% 1206 SMD	569-0115-103
R 004	2.2k ohm ±5% 1206 SMD	569-0115-222
R 005	2.2k ohm ±5% 1206 SMD	569-0115-222
R 006	2.2k ohm ±5% 1206 SMD	569-0115-222
R 007	2.2k ohm ±5% 1206 SMD	569-0115-222
R 008	2.2k ohm ±5% 1206 SMD	569-0115-222
R 009	10k ohm ±5% 1206 SMD	569-0115-103
R 010	10k ohm ±5% 1206 SMD	569-0115-103
R 011	10k ohm ±5% 1206 SMD	569-0115-103
R 012	10k ohm ±5% 1206 SMD	569-0115-103
R 013	100k ohm ±5% 1206 SMD	569-0115-104
R 014	4.7k ohm ±5% 1206 SMD	569-0115-472
R 015	4.7k ohm ±5% 1206 SMD	569-0115-472
R 016	10k ohm ±5% 1206 SMD	569-0115-103
R 017	10k ohm ±5% 1206 SMD	569-0115-103
R 018	10k ohm ±5% 1206 SMD	569-0115-103
R 019	240 ohm ±5% 1206 SMD	569-0115-241
R 020	27 ohm ±5% 1206 SMD	569-0115-270
R 021	1.2k ohm ±5% 1206 SMD	569-0115-122
R 022	200 ohm ±5% 1206 SMD	569-0115-201
R 023	1.2k ohm ±5% 1206 SMD	569-0115-122
R 024	10k ohm ±5% 1206 SMD	569-0115-103
R 025	100 ohm ±5% 1206 SMD	569-0115-101
R 026	10k ohm ±5% 1206 SMD	569-0115-103
R 027	10k ohm ±5% 1206 SMD	569-0115-103
R 028	10k ohm ±5% 1206 SMD	569-0115-103
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 101	29.4k ohm ±1% 1206 SMD	569-0111-446
R 102	54.9k ohm ±1% 1206 SMD	569-0111-472
R 103	1M ohm ±5% 1206 SMD	569-0115-105
R 104	147k ohm ±1% 1206 SMD	569-0111-517
R 105	69.8k ohm ±1% 1206 SMD	569-0111-482
R 106	43k ohm ±5% 1206 SMD	569-0115-433
R 107	100k ohm trim pot	562-0110-104
R 108	390k ohm ±5% 1206 SMD	569-0115-394
R 109	15k ohm ±1% 1206 SMD	569-0111-418
R 110	100 ohm ±1% 1206 SMD	569-0111-201
R 111	1.07M ohm ±1% 1206 SMD	569-0111-604
R 112	110 ohm ±1% 1206 SMD	569-0111-205
R 113	1.07M ohm ±1% 1206 SMD	569-0111-604
R 114	110 ohm ±1% 1206 SMD	569-0111-205
R 115	1.07M ohm ±1% 1206 SMD	569-0111-604
R 116	18.2k ohm ±1% 1206 SMD	569-0111-426
R 117	47k ohm ±5% 1206 SMD	569-0115-473
R 118	6.2k ohm ±5% 1206 SMD	569-0115-622
R 119	1k ohm ±5% 1206 SMD	569-0115-102
R 120	18k ohm ±5% 1206 SMD	569-0115-183
R 121	150k ohm ±5% 1206 SMD	569-0115-154
R 122	5.1k ohm ±5% 1206 SMD	569-0115-512
R 123	100k ohm trim pot	562-0110-104
R 124	47k ohm ±5% 1206 SMD	569-0115-473

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 125	1.5k ohm ±5% 1206 SMD	569-0115-152
R 126	6.2k ohm ±5% 1206 SMD	569-0115-622
R 127	12k ohm ±5% 1206 SMD	569-0115-123
R 128	10k ohm ±5% 1206 SMD	569-0115-103
R 129	47k ohm ±5% 1206 SMD	569-0115-473
R 130	10k ohm ±5% 1206 SMD	569-0115-103
R 131	47k ohm ±5% 1206 SMD	569-0115-473
R 132	330k ohm ±5% 1206 SMD	569-0115-334
R 133	1M ohm ±5% 1206 SMD	569-0115-105
R 134	3.9k ohm ±5% 1206 SMD	569-0115-392
R 135	2.4k ohm ±5% 1206 SMD	569-0115-242
R 136	1k ohm ±5% 1206 SMD	569-0115-102
R 137	10k ohm ±5% 1206 SMD	569-0115-103
R 138	100k ohm ±5% 1206 SMD	569-0115-104
R 139	100k ohm ±5% 1206 SMD	569-0115-104
R 140	470k ohm ±5% 1206 SMD	569-0115-474
R 141	10k ohm ±5% 1206 SMD	569-0115-103
R 142	3.9k ohm ±5% 1206 SMD	569-0115-392
R 143	1k ohm ±5% 1206 SMD	569-0115-102
R 144	10k ohm ±5% 1206 SMD	569-0115-103
R 145	10k ohm ±5% 1206 SMD	569-0115-103
R 146	100k ohm ±5% 1206 SMD	569-0115-104
R 147	100k ohm ±5% 1206 SMD	569-0115-104
R 148	47k ohm ±5% 1206 SMD	569-0115-473
R 149	10k ohm ±5% 1206 SMD	569-0115-103
R 150	7.5k ohm ±5% 1206 SMD	569-0115-752
R 151	56k ohm ±5% 1206 SMD	569-0115-563
R 152	56k ohm ±5% 1206 SMD	569-0115-563
R 153	51k ohm ±5% 1206 SMD	569-0115-513
R 154	100k ohm trim pot	562-0110-104
R 155	270k ohm ±5% 1206 SMD	569-0115-274
R 156	47k ohm ±5% 1206 SMD	569-0115-473
R 157	100k ohm ±5% 1206 SMD	569-0115-104
R 158	100k ohm ±5% 1206 SMD	569-0115-104
R 159	10k ohm ±5% 1206 SMD	569-0115-103
R 160	5.1k ohm ±5% 1206 SMD	569-0115-512
R 161	1k ohm ±5% 1206 SMD	569-0115-102
R 162	18k ohm ±5% 1206 SMD	569-0115-183
R 163	47k ohm ±5% 1206 SMD	569-0115-473
R 164	10k ohm volume/audio switch	562-0018-044
R 165	39 ohm ±5% 1206 SMD	569-0115-390
R 166	10k ohm ±5% 1206 SMD	569-0115-103
R 167	220 ohm ±5% 1206 SMD	569-0115-221
R 168	2.2 ohm ±5% 1206 SMD	569-0115-229
R 169	100 ohm ±5% 1/4W CF	569-0513-101
R 170	100 ohm ±5% 1/4W CF	569-0513-101
R 171	36k ohm ±5% 1206 SMD	569-0115-363
R 172	100k ohm trim pot	562-0110-104
R 173	36k ohm ±5% 1206 SMD	569-0115-363
R 174	10k ohm ±5% 1206 SMD	569-0115-103
R 175	10k ohm ±5% 1206 SMD	569-0115-103
R 176	100k ohm ±5% 1206 SMD	569-0115-104
R 177	47k ohm ±5% 1206 SMD	569-0115-473
R 178	47k ohm ±5% 1206 SMD	569-0115-473
R 179	47k ohm ±5% 1206 SMD	569-0115-473
R 180	47k ohm ±5% 1206 SMD	569-0115-473
R 181	10k ohm ±1% 1206 SMD	569-0111-401
R 182	10k ohm ±1% 1206 SMD	569-0111-401
R 183	10k ohm ±1% 1206 SMD	569-0111-401
R 184	10k ohm ±1% 1206 SMD	569-0111-401
R 185	4.32k ohm ±1% 1206 SMD	569-0111-362
R 186	10k ohm ±1% 1206 SMD	569-0115-401
R 187	1k ohm ±5% 1206 SMD	569-0115-102
R 188	1k ohm ±5% 1206 SMD	569-0115-102
R 189	1k ohm ±5% 1206 SMD	569-0115-102
R 190	1k ohm ±5% 1206 SMD	569-0115-102
R 191	1k ohm ±5% 1206 SMD	569-0115-102
R 201	36k ohm ±5% 1206 SMD	569-0115-363
R 202	100k ohm trim pot	562-0110-104
R 203	36k ohm ±5% 1206 SMD	569-0115-363
R 204	2.2k ohm ±5% 1206 SMD	569-0115-222
R 205	6.8k ohm ±5% 1206 SMD	569-0115-682
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	16k ohm ±5% 1206 SMD	569-0115-163
R 210	180k ohm ±5% 1206 SMD	569-0115-184
R 211	10k ohm ±5% 1206 SMD	569-0115-103
R 212	43k ohm ±5% 1206 SMD	569-0115-433
R 213	43k ohm ±5% 1206 SMD	569-0115-433
R 214	22k ohm ±5% 1206 SMD	569-0115-223
R 215	43.2k ohm ±1% 1206 SMD	569-0111-462
R 216	86.6k ohm ±1% 1206 SMD	569-0111-491
R 217	25.5k ohm ±1% 1206 SMD	569-0111-440
R 218	909k ohm ±1% 1206 SMD	569-0111-593
R 219	3.3k ohm ±5% 1206 SMD	569-0115-332
R 220	1k ohm ±5% 1206 SMD	569-0115-102
R 221	150k ohm ±5% 1206 SMD	569-0115-154
R 222	150k ohm ±5% 1206 SMD	569-0115-154
R 223	150k ohm ±5% 1206 SMD	569-0115-154
R 224	121k ohm ±1% 1206 SMD	569-0111-509
R 225	121k ohm ±1% 1206 SMD	569-0111-509
R 226	35.7k ohm ±1% 1206 SMD	569-0111-454
R 227	27.4k ohm ±1% 1206 SMD	569-0111-443

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 228	22.6k ohm ±1% 1206 SMD	569-0111-435
R 229	17.4k ohm ±1% 1206 SMD	569-0111-424
R 230	180k ohm ±5% 1206 SMD	569-0115-184
R 232	39k ohm ±5% 1206 SMD	569-0115-393
R 233	1k ohm ±5% 1206 SMD	569-0115-102
R 234	1.2k ohm ±5% 1206 SMD	569-0115-122
R 235	10k ohm ±5% 1206 SMD	569-0115-103
R 236	100k ohm ±5% 1206 SMD	569-0115-104
R 237	100k ohm trim pot	562-0110-104
R 238	82k ohm ±5% 1206 SMD	569-0115-823
R 239	82k ohm ±5% 1206 SMD	569-0115-823
R 240	82k ohm ±5% 1206 SMD	569-0115-823
R 241	82k ohm ±5% 1206 SMD	569-0115-823
R 242	36k ohm ±5% 1206 SMD	569-0115-363
R 243	18k ohm ±5% 1206 SMD	569-0115-183
R 244	82k ohm ±5% 1206 SMD	569-0115-823
R 245	82k ohm ±5% 1206 SMD	569-0115-823
R 246	100 ohm ±5% 1206 SMD	569-0115-101
R 247	5.11k ohm ±1% 1206 SMD	569-0111-369
R 248	470k ohm ±1% 1206 SMD	569-0111-474
R 249	330k ohm ±5% 1206 SMD	569-0115-334
R 250	4.7k ohm ±5% 1206 SMD	569-0115-472
R 251	10k ohm ±5% 1206 SMD	569-0115-103
R 252	10k ohm ±5% 1206 SMD	569-0115-103
R 253	24k ohm ±5% 1206 SMD	569-0115-243
R 254	1M ohm ±5% 1206 SMD	569-0115-105
R 255	54.9k ohm ±1% 1206 SMD	569-0111-472
R 256	300k ohm ±5% 1206 SMD	569-0115-304
R 257	4.3k ohm ±5% 1206 SMD	569-0115-432
R 258	430k ohm ±5% 1206 SMD	569-0115-434
R 259	10k ohm ±5% 1206 SMD	569-0115-103
R 260	10k ohm ±5% 1206 SMD	569-0115-103
R 261	240k ohm ±5% 1206 SMD	569-0115-244
RT100	10k ohm chip thermistor	569-3013-007
S 001	SPST momentary	583-4005-002
U 001	BCD-7 latch MC14495L	544-3014-495
U 002	Micro monitor 50-8 DS1232	544-2003-085
U 003	1M flash EPROM DIP-28	544-5001-201
U 004	+12V regulator TO-92 78L12	544-2003-032
U 005	Quad 2-in NAND 74HC00	544-3766-000
U 006	Hex open drain buffer SO-14	544-3716-906
U 007	16-bit CMOS CPU ROMless	544-5002-016
U 008	32kx8 SCRAM CMOS SO-28	544-5001-412
U 009	RS232C/V.28 driver/rcvr	544-2023-014
U 010	1 of 16 demux SOIC 74HC154	544-3766-154
U 011	Quad 2-in NAND 74HC00	544-3766-000
U 012	Quad 2-in OR 74HC32	544-3766-032
U 013	1 of 8 demux 74HC138	544-3766-138
U 014	Transparent latch SOIC	544-3766-573
U 015	D flip flop SOIC 74HC574	544-3766-574
U 016	D flip flop SOIC 74HC574	544-3766-574
U 017	D flip flop SOIC 74HC574	544-3766-574
U 018	D flip flop SOIC 74HC574	544-3766-574
U 019	+8V regulator low pwr 78L08	544-2603-042
U 020	+12V regulator TO-02 78L12	544-2003-032
U 021	Differential bus xcvr SN65176	544-2023-025
U 101	Dual op amp SO-8 2904	544-2019-004
U 103	Quad op amp SOIC 3403	544-2020-008
U 104	Dual op amp SO-8 33178	544-2019-018
U 105	Dual op amp SO-8 33178	544-2019-018
U 107	Quad op amp SOIC 3403	544-2020-008
U 108	Dual op amp SO-8 2904	544-2019-004
U 110	Quad op amp SOIC 3403	544-2020-008
U 111	10W audio pentawatt 2003	544-2006-013
U 113	Dual op amp SO-8 33178	544-2019-018
U 131	Quad analog sw SPST SO-16	544-3003-001
U 132	Quad analog sw SPST SO-16	544-3003-001
U 133	Quad analog sw SPST SO-16	544-3003-001
U 134	Quad analog sw SPST SO-16	544-3003-001
U 135	Quad analog sw SPST SO-16	544-3003-001
U 136	Quad analog sw SPST SO-16	544-3003-001
U 137	Quad analog sw SPST SO-16	544-3003-001
U 138	Dual op amp SO-8 33178	544-2019-018
U 202	Dual op amp SO-8 33178	544-2019-018
U 203	Dual op amp SO-8 2904	544-2019-004
U 204	Quad op amp SOIC 3403	544-2020-008
U 205	Dual op amp SO-8 2904	544-2019-004
U 206	Dual op amp SO-8 2904	544-2019-004
U 207	Digi EEPOT 100k SO-8	544-0004-209
U 208	Quad op amp SOIC 3403	544-2020-008
U 209	Quad 2-input NOR gate	544-3766-002
X 001	10-pos right angle IC socket	515-5008-270
X 003	32-pin IC socket	515-5008-108
X 007	84-pos PLCC socket	515-5020-100
X 008	28-pin IC socket	515-5008-018
Y 001	10 MHz crystal HC-18	521-0010-000
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 500	.01 µF ±10% X7R chip	510-3606-103
C 501	.015 µF ±10% X7R chip	510-3606-153
C 502	.1 µF ±10% X7R 1210	510-3607-104
C 503	150 pF ±5% NPO 1206 chip	510-3602-151
C 504	10 µFD 16V tantalum SMD	510-2625-100
C 505	10 µFD 16V tantalum SMD	510-2625-100
C 506	10 µFD 16V tantalum SMD	510-2625-100
C 507	10 µFD 16V tantalum SMD	510-2625-100
C 508	33 µF 10V tantalum SMD	510-2624-330
C 509	1 µF 16V tantalum SMD	510-2625-109
C 510	33 µF 10V tantalum SMD	510-2624-330
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 520	.1 µF ±10% X7R chip	510-3607-104
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 524	10 µFD 16V tantalum SMD	510-2625-100
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 axial	510-4325-221
C 531	.01 µF ±10% X7R chip	510-3606-103
C 532	1000 µF 50V axial low temp	510-4350-102
C 533	.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
CR514	Dual switch diode SOT-23	523-1504-023
CR515	Dual switch diode SOT-23	523-1504-023
CR516	Dual switch diode SOT-23	523-1504-023
CR517	Dual switch diode SOT-23	523-1504-023
CR518	Dual switch diode SOT-23	523-1504-023
CR519	Dual switch diode SOT-23	523-1504-023
CR520	Dual switch diode SOT-23	523-1504-023
CR521	Dual switch diode SOT-23	523-1504-023
CR522	5.1V zener SOT-23	523-2016-519
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
F 501	1A 250V subminiature fuse	534-0017-014
FH501	Fuse holder PC mount	534-1017-001
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
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
K 504	12V SPDT 1A relay submin	567-2002-021
K 505	12V SPDT 1A relay submin	567-2002-021
K 506	12V SPDT 1A relay submin	567-2002-021
K 507	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
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 502	Si NPN SOT-23 2N3904	576-0003-658
Q 503	Si NPN SOT-23 2N3904	576-0003-658
Q 504	Si NPN SOT-23 2N3904	576-0003-658
Q 505	Si NPN SOT-23 2N3904	576-0003-658
Q 506	Si NPN SOT-23 2N3904	576-0003-658
Q 507	Si NPN SOT-23 2N3904	576-0003-658
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 503	5.1k ohm ±5% 1206 SMD	569-0115-512
R 505	2k ohm ±5% 1206 SMD	569-0115-202
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 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	4.7k ohm ±5% 1206 SMD	569-0115-472
R 523	4.7k ohm ±5% 1206 SMD	569-0115-472
R 524	4.7k ohm ±5% 1206 SMD	569-0115-472
R 525	4.7k ohm ±5% 1206 SMD	569-0115-472
R 526	4.7k ohm ±5% 1206 SMD	569-0115-472
R 527	4.7k ohm ±5% 1206 SMD	569-0115-472
R 528	2.4k ohm ±5% 1206 SMD	569-0115-242
R 529	4.7k ohm ±5% 1206 SMD	569-0115-472
R 530	4.7k ohm ±5% 1206 SMD	569-0115-472
R 531	4.7k ohm ±5% 1206 SMD	569-0115-472
R 532	4.7k ohm ±5% 1206 SMD	569-0115-472
R 533	4.7k ohm ±5% 1206 SMD	569-0115-472
R 534	4.7k ohm ±5% 1206 SMD	569-0115-472
R 535	4.7k ohm ±5% 1206 SMD	569-0115-472
R 536	10k ohm ±5% 1206 SMD	569-0115-103
R 538	100k ohm ±5% 1206 SMD	569-0115-104
R 539	100k ohm ±5% 1206 SMD	569-0115-104
R 540	100k ohm ±5% 1206 SMD	569-0115-104
R 541	200 ohm ±5% 1206 SMD	569-0115-201
R 542	430 ohm ±5% 1/4W CF	569-0513-431
R 543	430 ohm ±5% 1/4W CF	569-0513-431
R 544	430 ohm ±5% 1/4W CF	569-0513-431
R 545	430 ohm ±5% 1/4W CF	569-0513-431
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	2.4k ohm ±5% 1206 SMD	569-0115-242
R 550	2.4k ohm ±5% 1206 SMD	569-0115-242
R 551	2.4k ohm ±5% 1206 SMD	569-0115-242
R 552	2.4k ohm ±5% 1206 SMD	569-0115-242
R 553	2.4k ohm ±5% 1206 SMD	569-0115-242
R 554	2.4k ohm ±5% 1206 SMD	569-0115-242
R 555	2.4k ohm ±5% 1206 SMD	569-0115-242
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	200 ohm ±5% 1206 SMD	569-0115-201
R 564	200 ohm ±5% 1206 SMD	569-0115-201
R 565	200 ohm ±5% 1206 SMD	569-0115-201
R 566	200 ohm ±5% 1206 SMD	569-0115-201
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 570	1k ohm ±5% 1206 SMD	569-0115-102
R 571	10k ohm ±5% 1206 SMD	569-0115-103
R 572	16k ohm ±5% 1206 SMD	569-0115-163
R 573	5.1k ohm ±5% 1206 SMD	569-0115-512
R 574	51k ohm ±5% 1206 SMD	569-0115-513
R 575	82k ohm ±5% 1206 SMD	569-0115-823
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
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 504	4-pos recessed DIP switch	583-5002-104
S 505	4-pos recessed DIP switch	583-5002-104
S 506	4-pos recessed DIP switch	583-5002-104
S 507	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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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	NPN out opto isolator 4N35	544-2010-001
U 514	NPN out opto isolator 4N35	544-2010-001
U 515	NPN out opto isolator 4N35	544-2010-001
U 516	NPN out opto isolator 4N35	544-2010-001
U 517	Transparent latch SOIC	544-3766-573
U 518	D flip flop SOIC 74HC574	544-3766-574
U 519	Low pwr FM IF SO-16	544-2026-008
U 520	NPN out opto isolator 4N35	544-2010-001
U 521	Transparent latch SOIC	544-3766-573
U 522	+12V regulator TO-92 78L12	544-2003-032
U 523	+8V regulator 78M08	544-2003-081
Z 500	EMI suppression filter	532-3003-002
Z 501	EMI suppression filter	532-3003-002

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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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 whakeproof 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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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
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

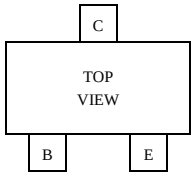
THERMAL SENSOR BOARD
PART NO. 023-2000-840

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
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

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		



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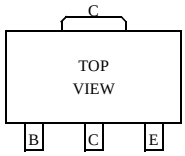

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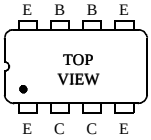

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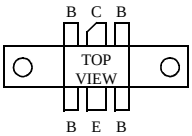

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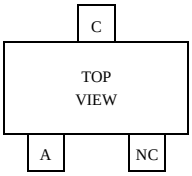
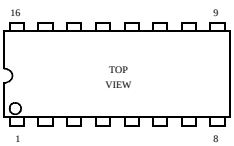
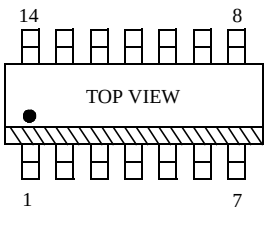
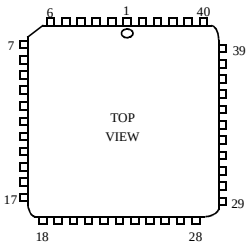


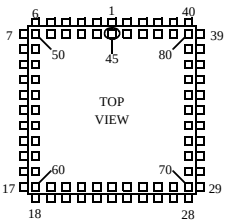
6

INTEGRATED CIRCUITS









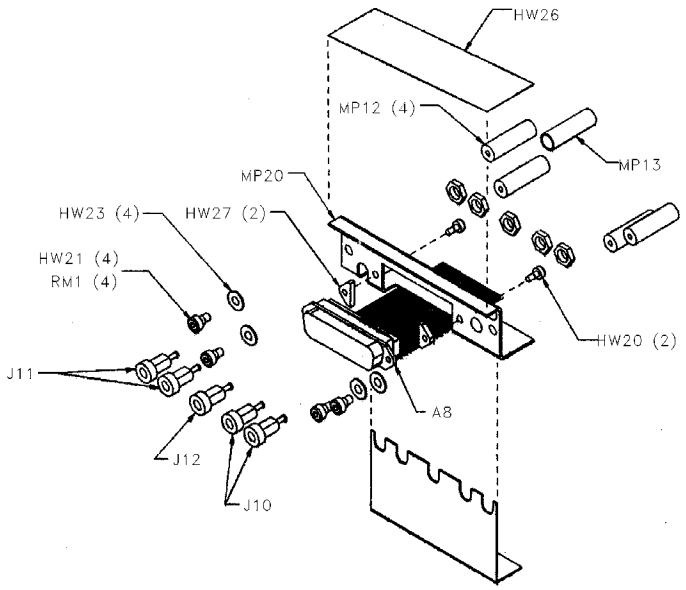
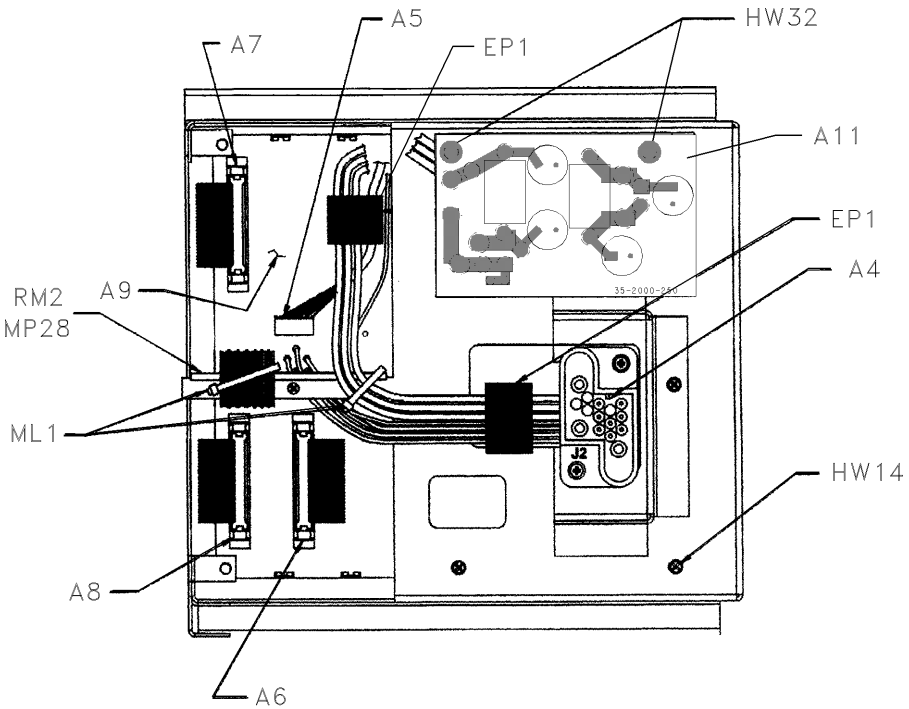
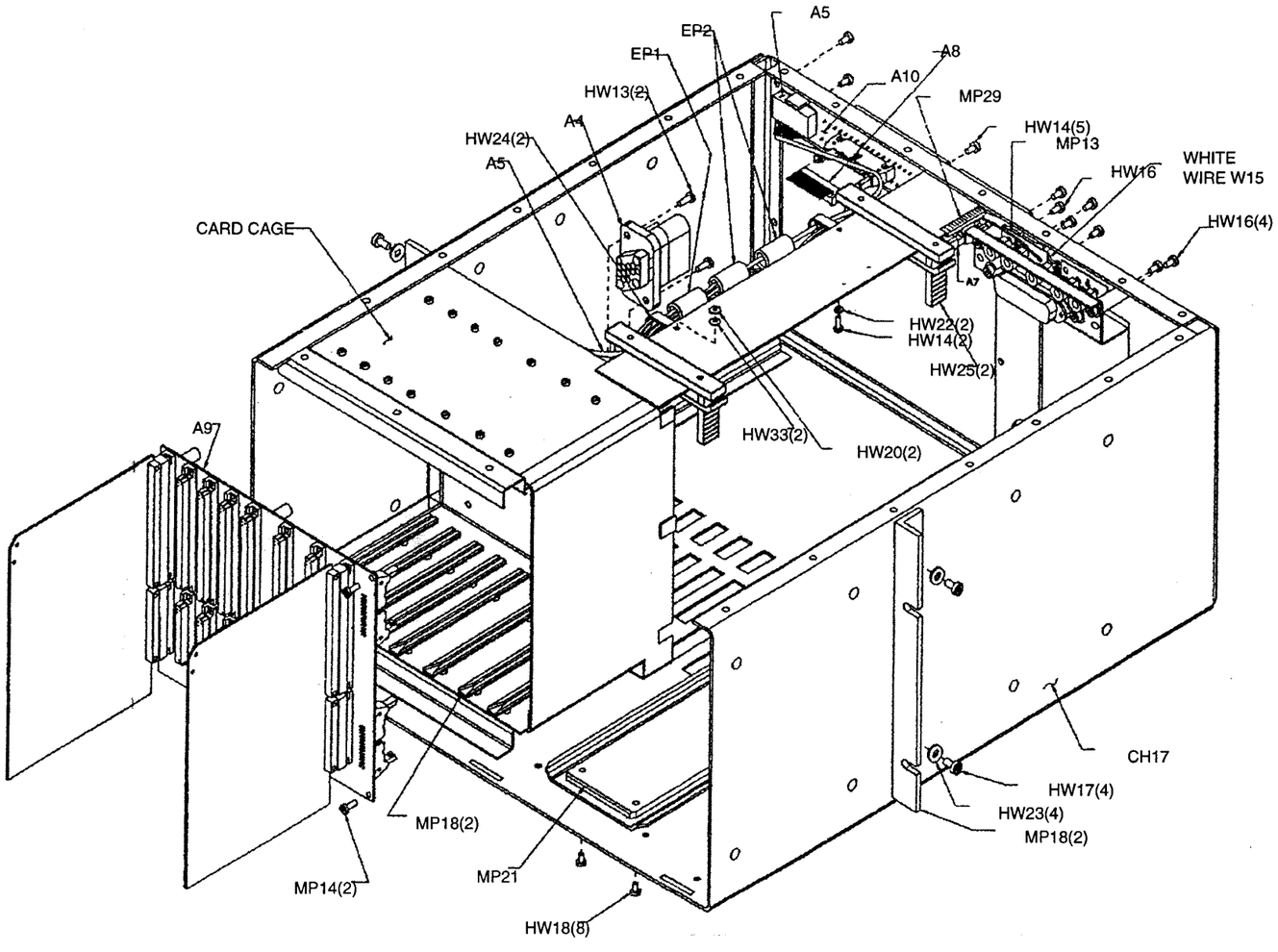
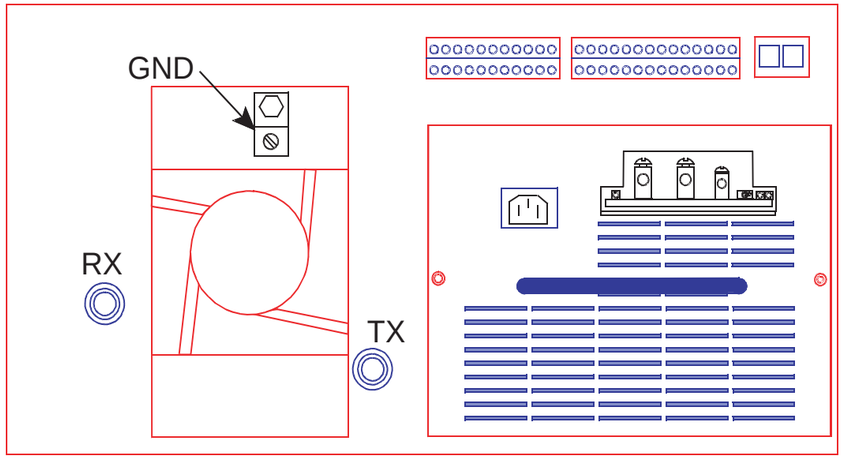


Figure 10-1 RF MODULE INTERFACE CONNECTOR



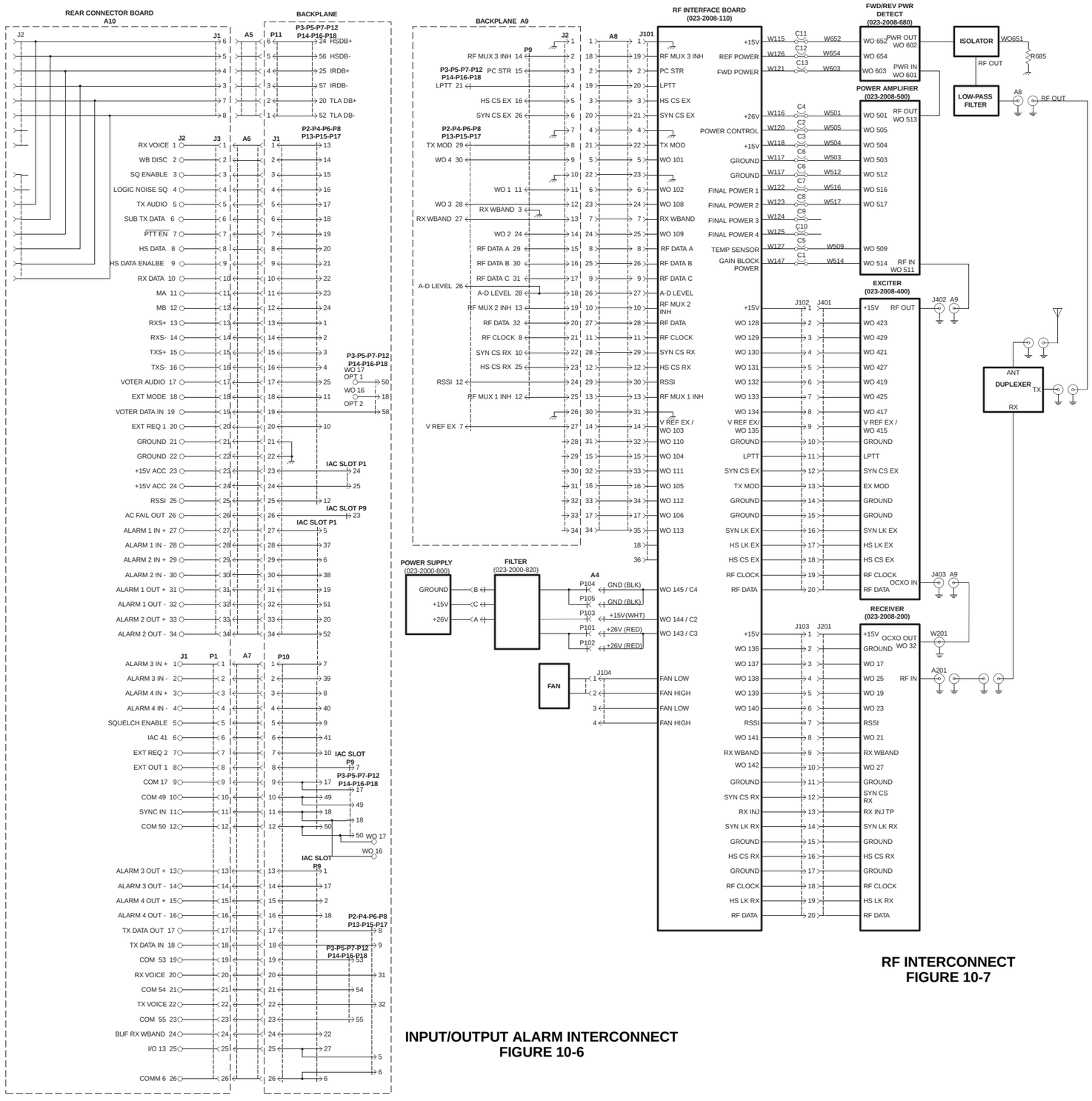


CABINET
FIGURE 10-3



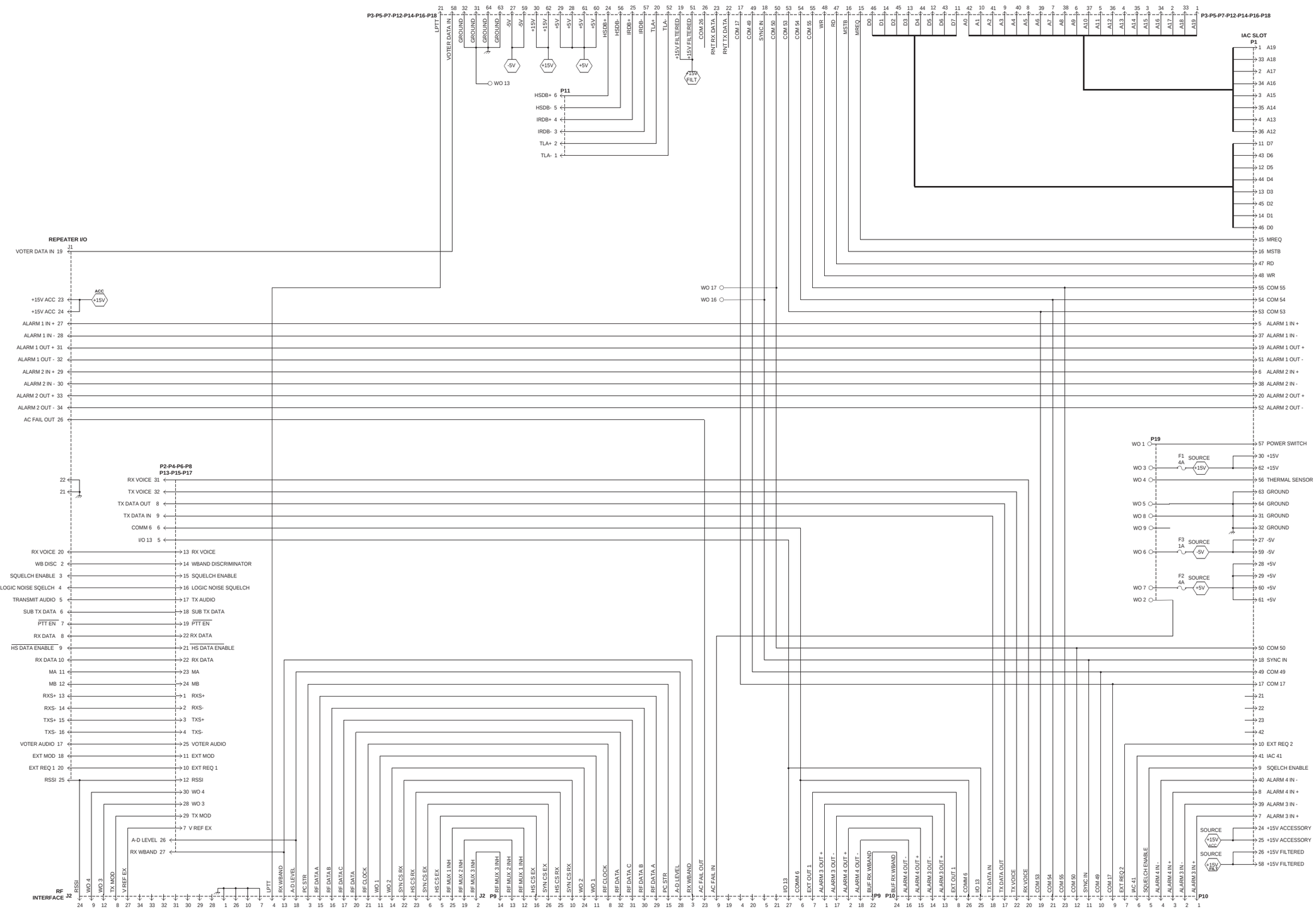
REAR VIEW
FIGURE 10-4

FRONT VIEW
FIGURE 10-5



INPUT/OUTPUT ALARM INTERCONNECT
FIGURE 10-6

RF INTERCONNECT
FIGURE 10-7



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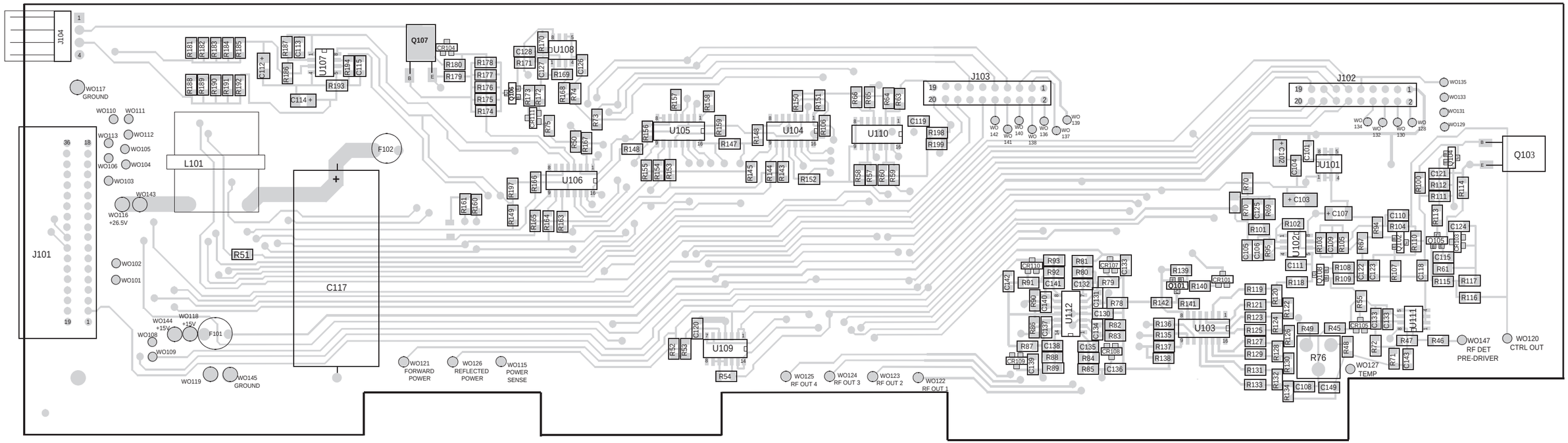
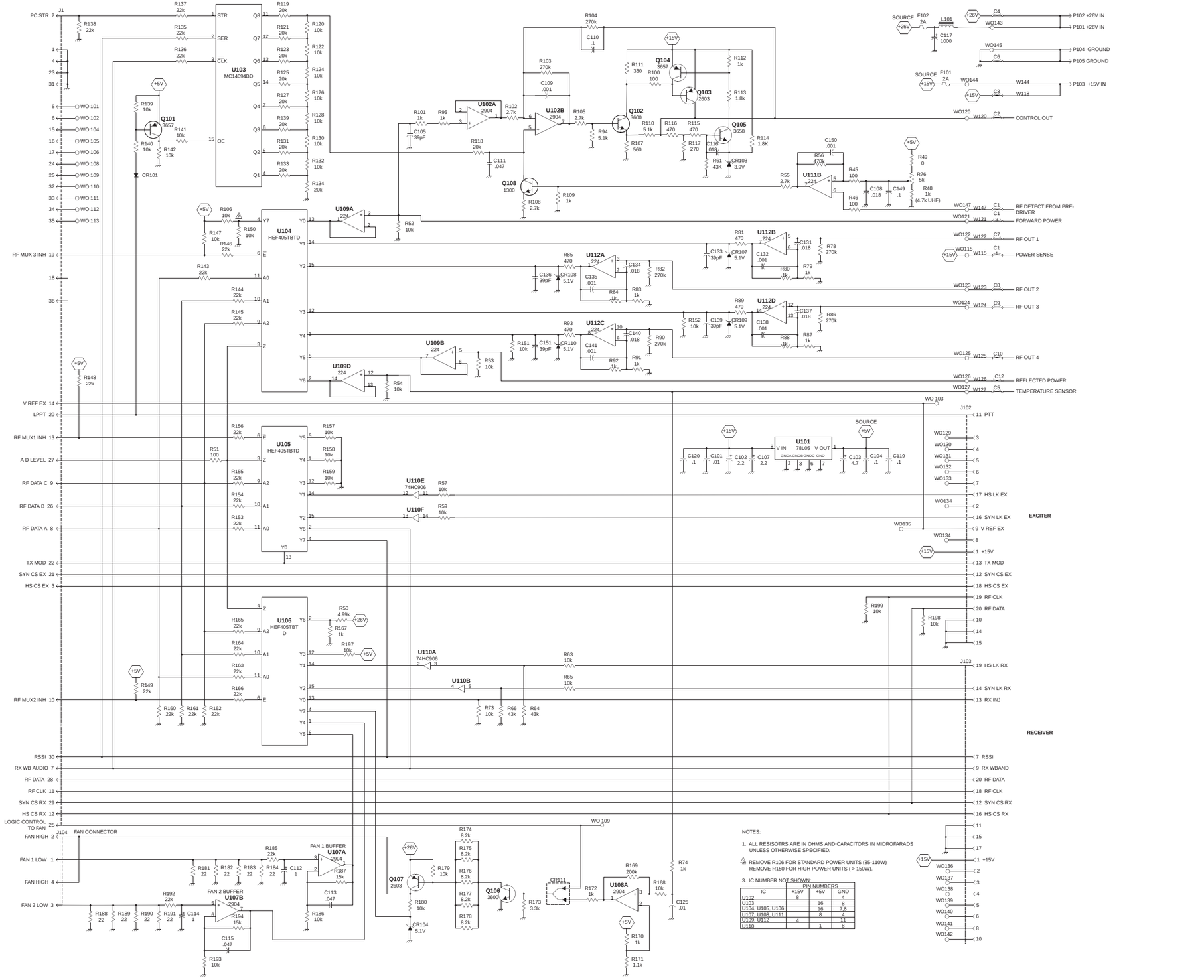
BACKPLANE INTERCONNECT
FIGURE 10-8


J104
J101
J103
J102
Q107
Q103
U107
U108
U105
U104
U110
U106
U109
U112
U103
U102
U101
U111
L101
F102
F101
C117
R51
R76
WO117 GROUND
WO110
WO111
WO112
WO113
WO105
WO106
WO104
WO103
WO143
WO116 +26.5V
WO102
WO101
WO118 +15V
WO144 +15V
WO108
WO109
WO119
WO145 GROUND
WO121 FORWARD POWER
WO126 REFLECTED POWER
WO115 POWER SENSE
WO125 RF OUT 4
WO124 RF OUT 3
WO123 RF OUT 2
WO122 RF OUT 1
WO147 RF DET PRE-DRIVER
WO120 CTRL OUT
WO127 TEMP



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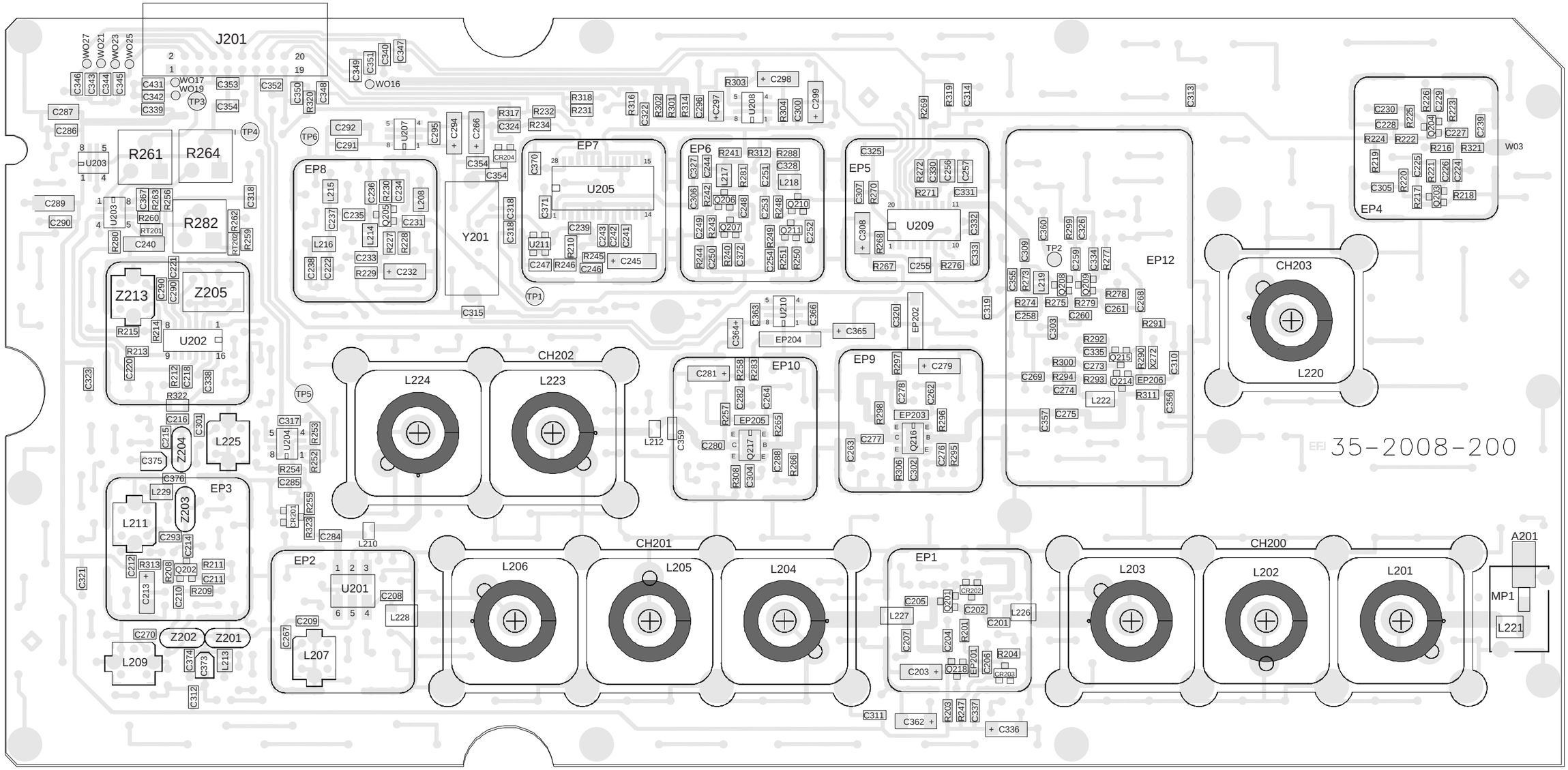
RF INTERFACE BOARD SCHEMATIC
FIGURE 10-10



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RECEIVER BOARD COMPONENT LAYOUT
(COMPONENT SIDE VIEW)
FIGURE 10-11

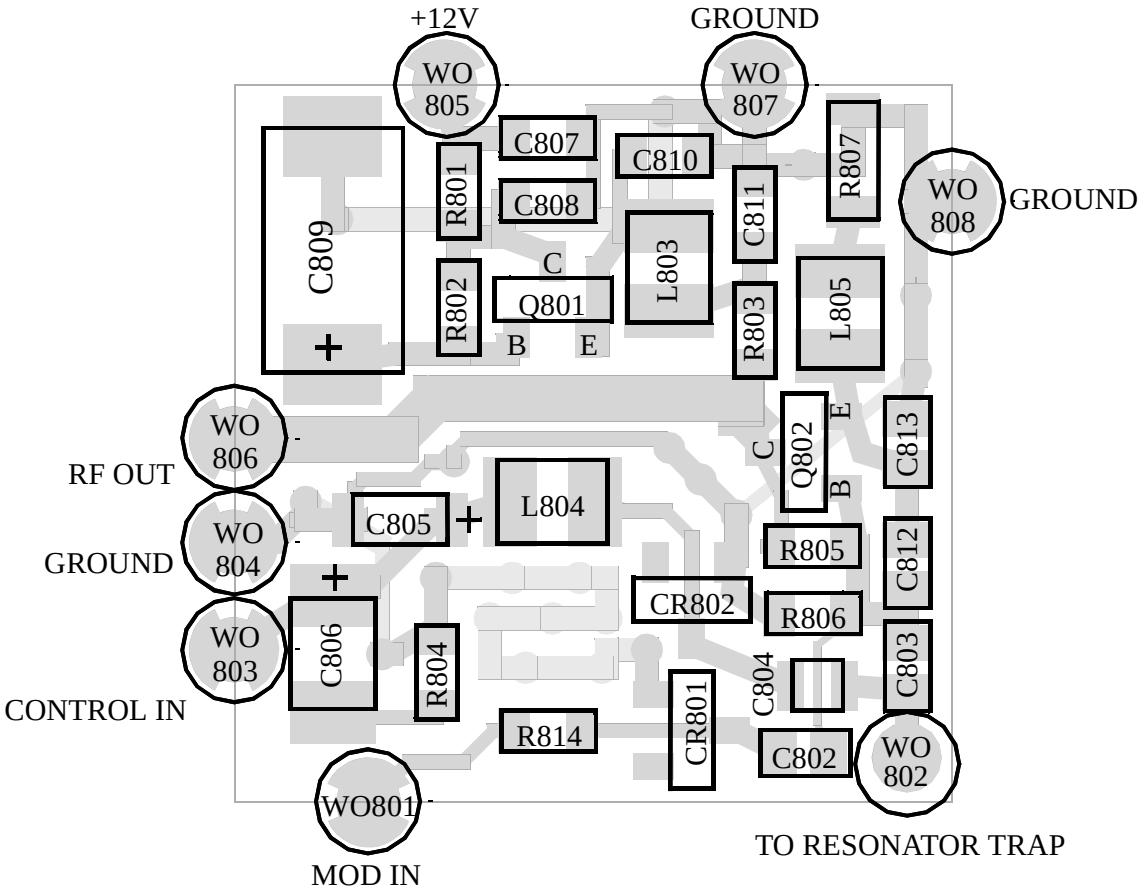


Figure 10-12 RECEIVE VCO COMPONENT LAYOUT

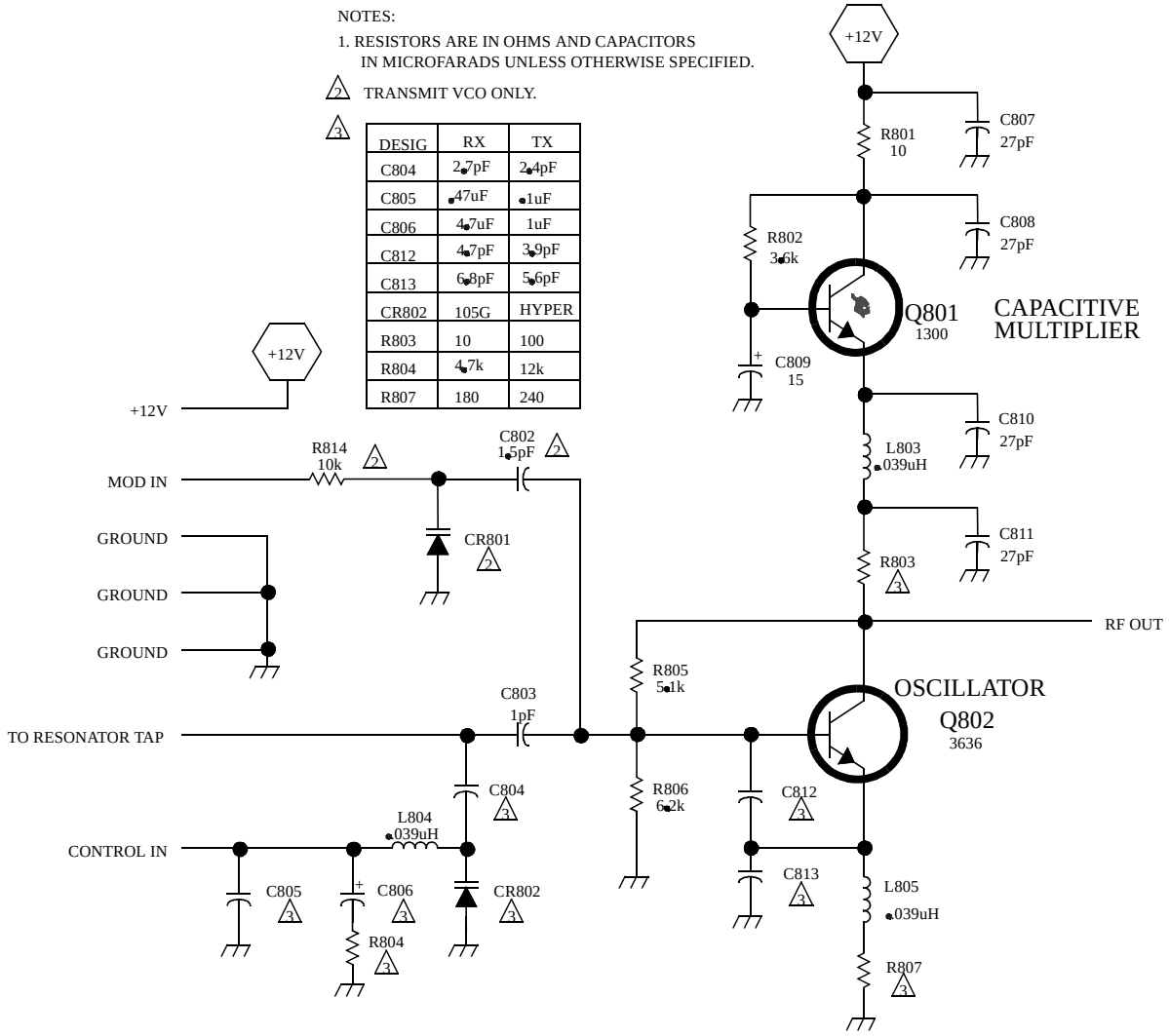
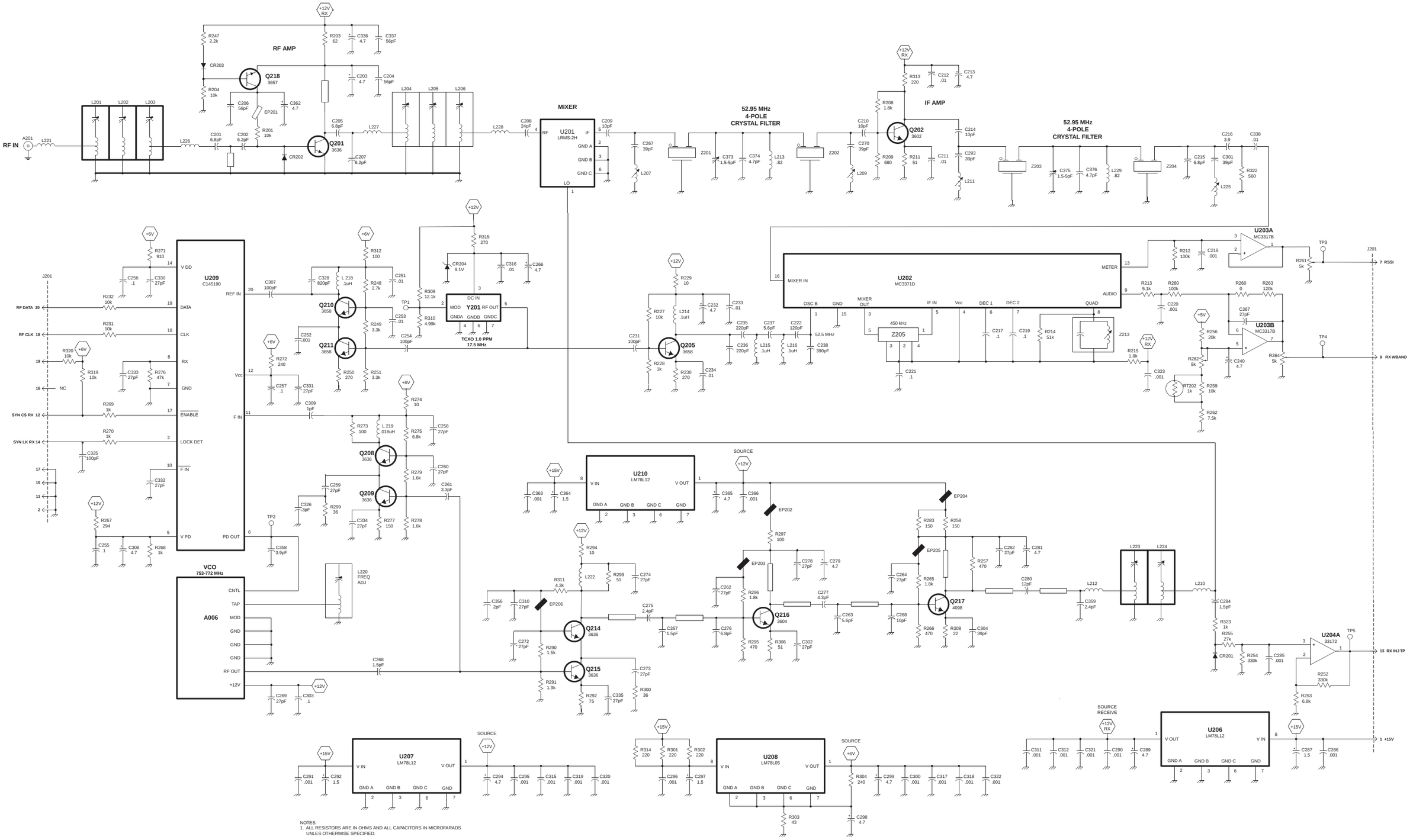


Figure 10-13 RECEIVE VCO SCHEMATIC



NOTES:
1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS IN MICROFARADS UNLES OTHERWISE SPECIFIED.

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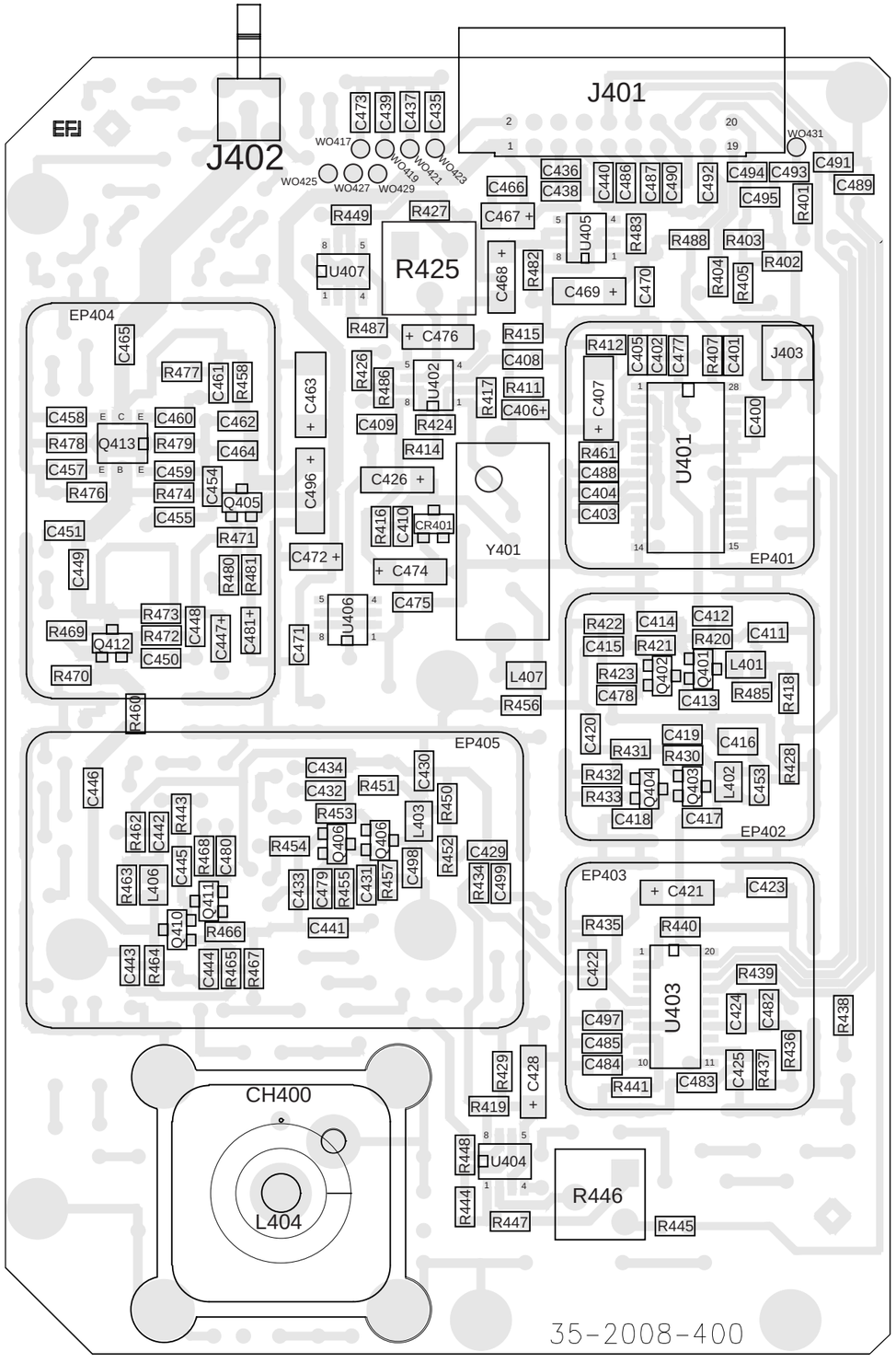
RECEIVER SCHEMATIC
FIGURE 10-14



EXCITER COMPONENT LAYOUT
FIGURE 10-15

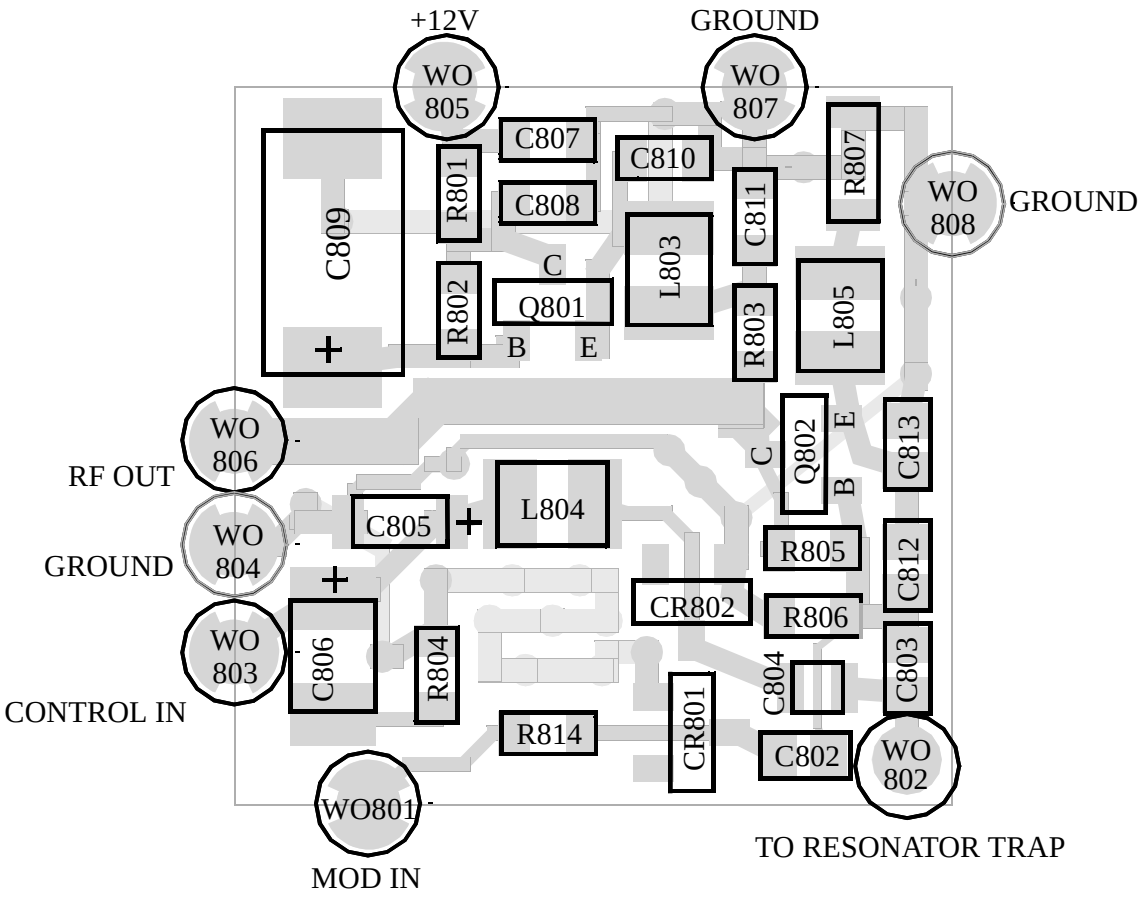


Figure 10-16 TRANSMIT VCO COMPONENT LAYOUT

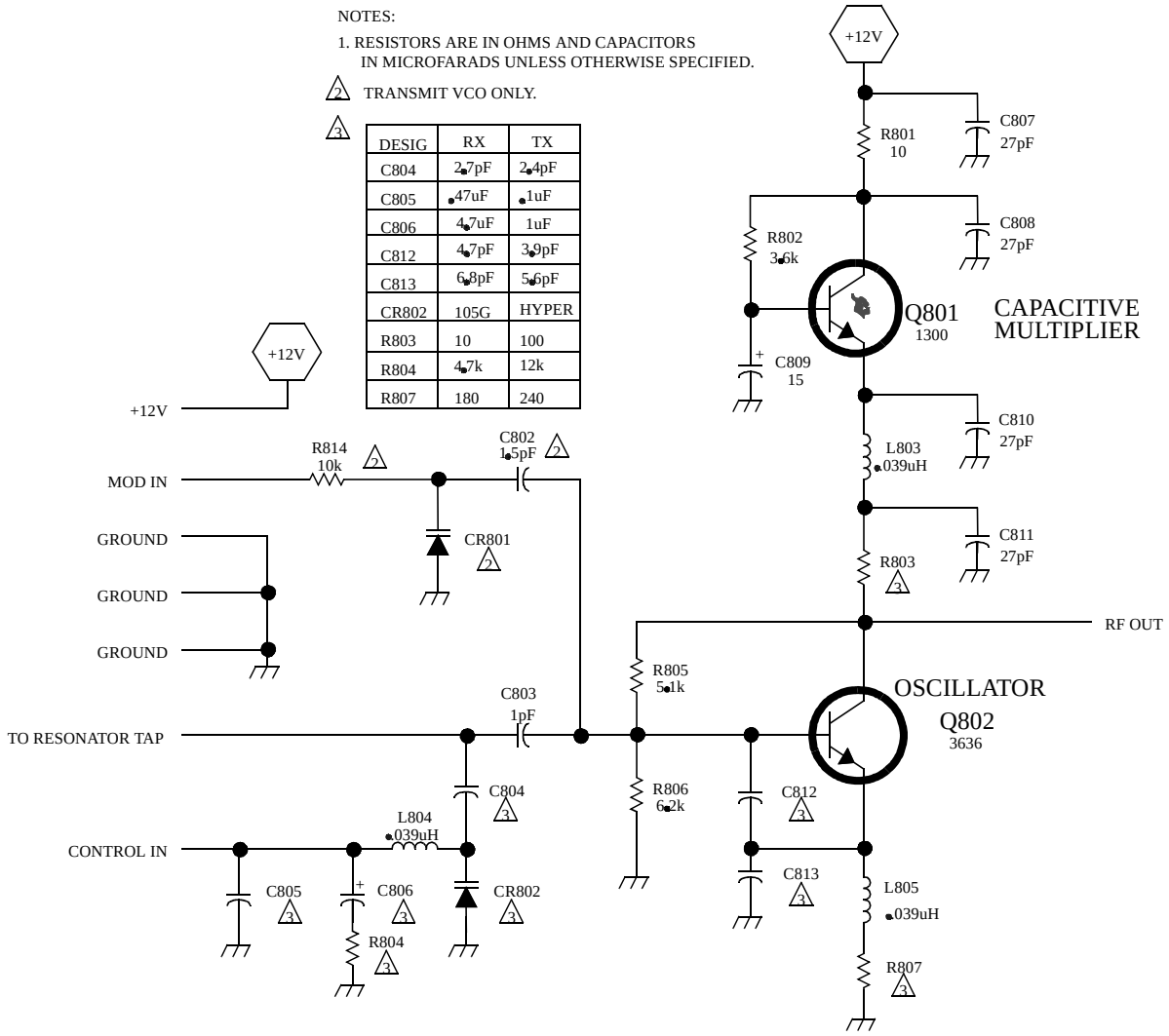
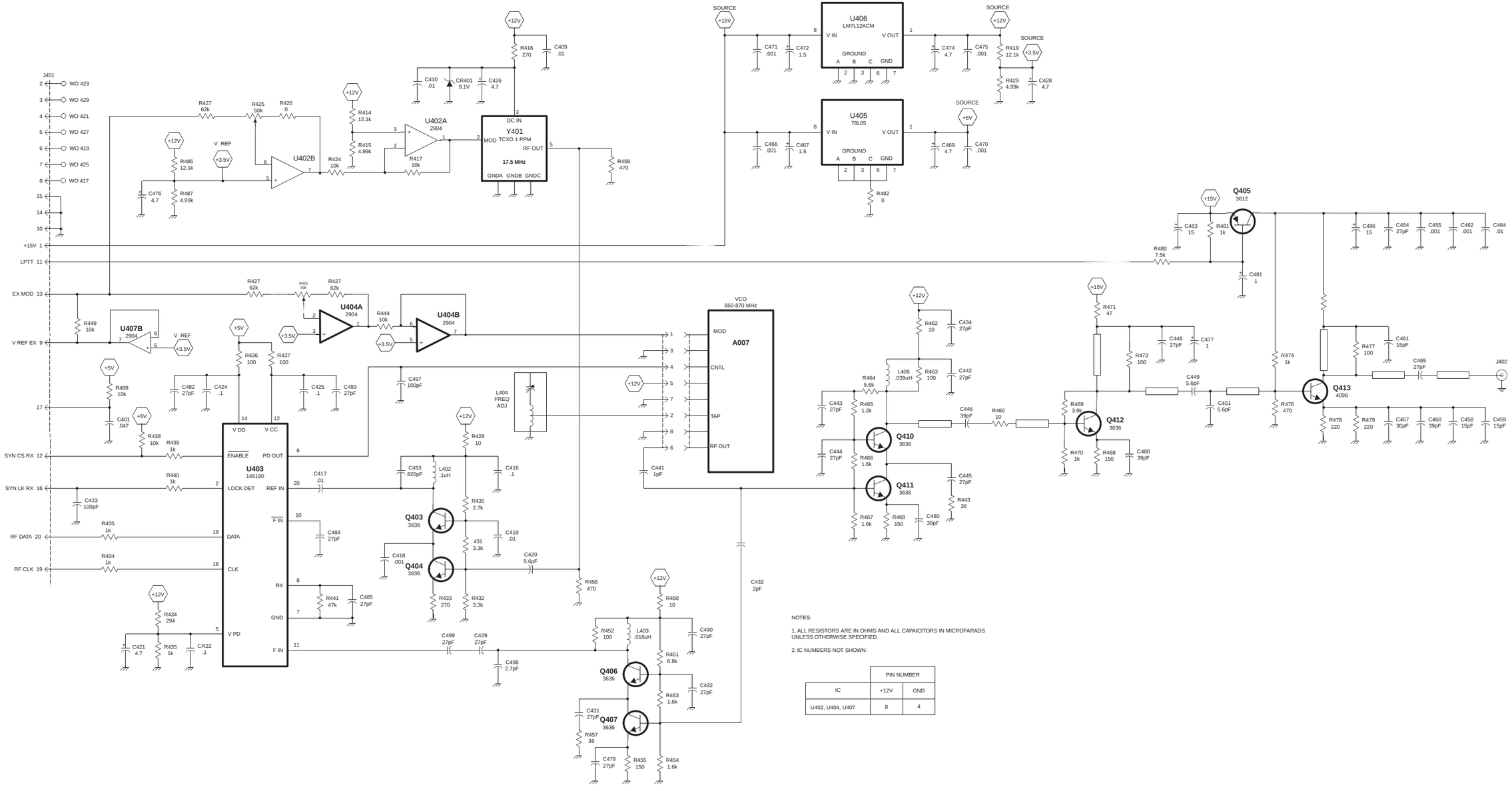


Figure 10-17 TRANSMIT VCO SCHEMATIC



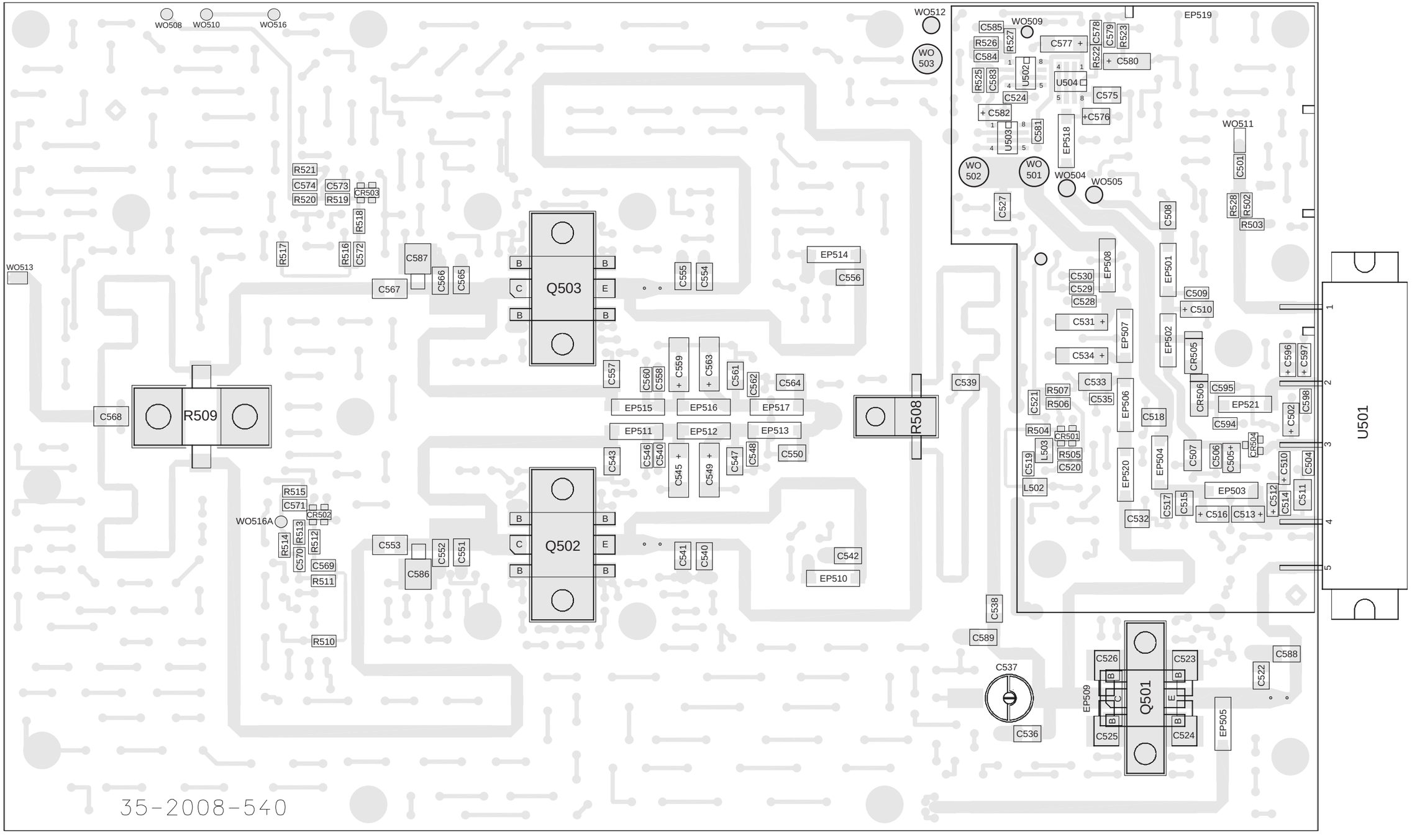
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

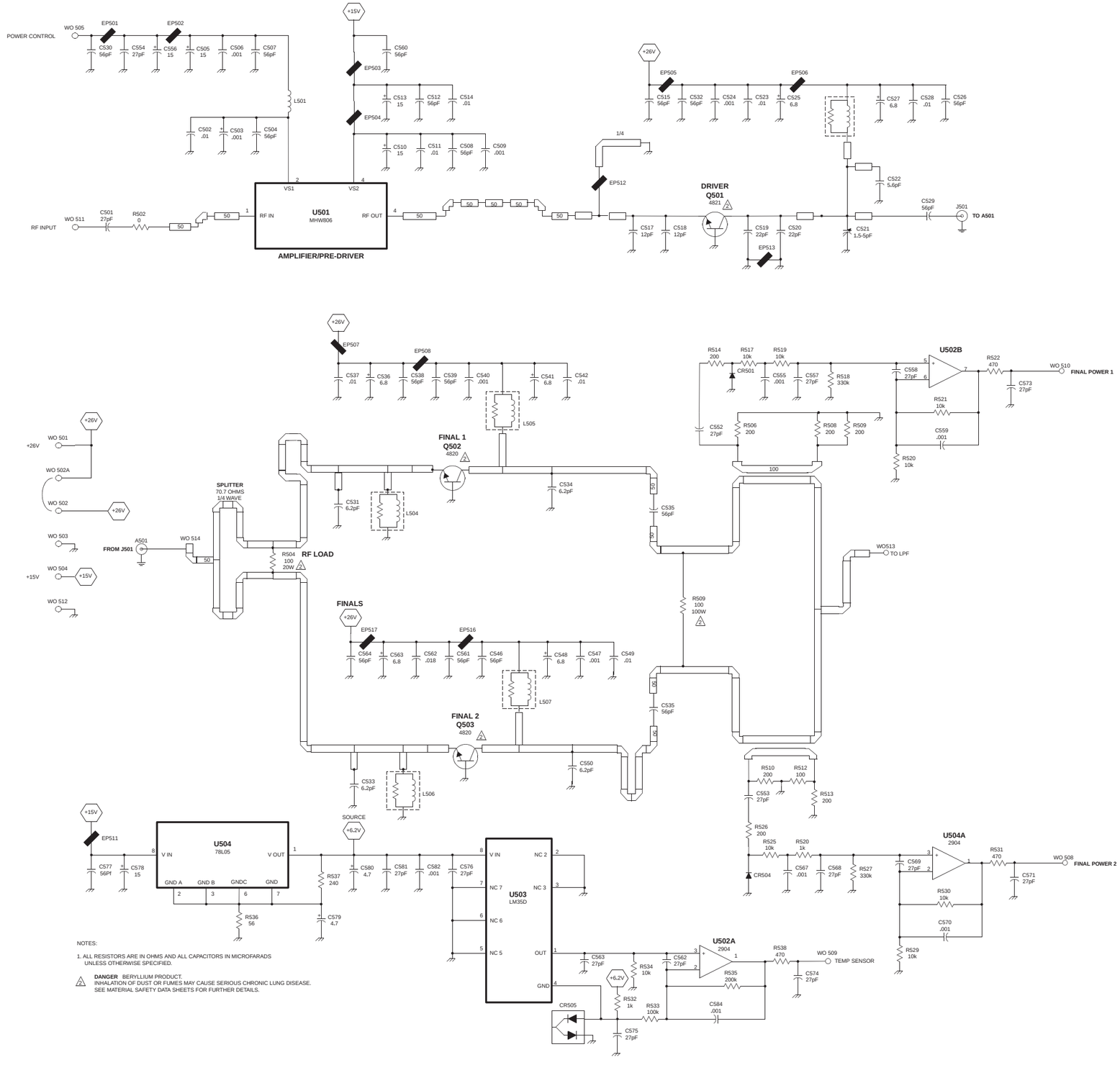
2. IC NUMBERS NOT SHOWN:

	PIN NUMBER	
IC	+12V	GND
U402, U404, U407	8	4

EXCITER SCHEMATIC
FIGURE 10-18



POWER AMPLIFIER COMPONENT LAYOUT
FIGURE 10-19

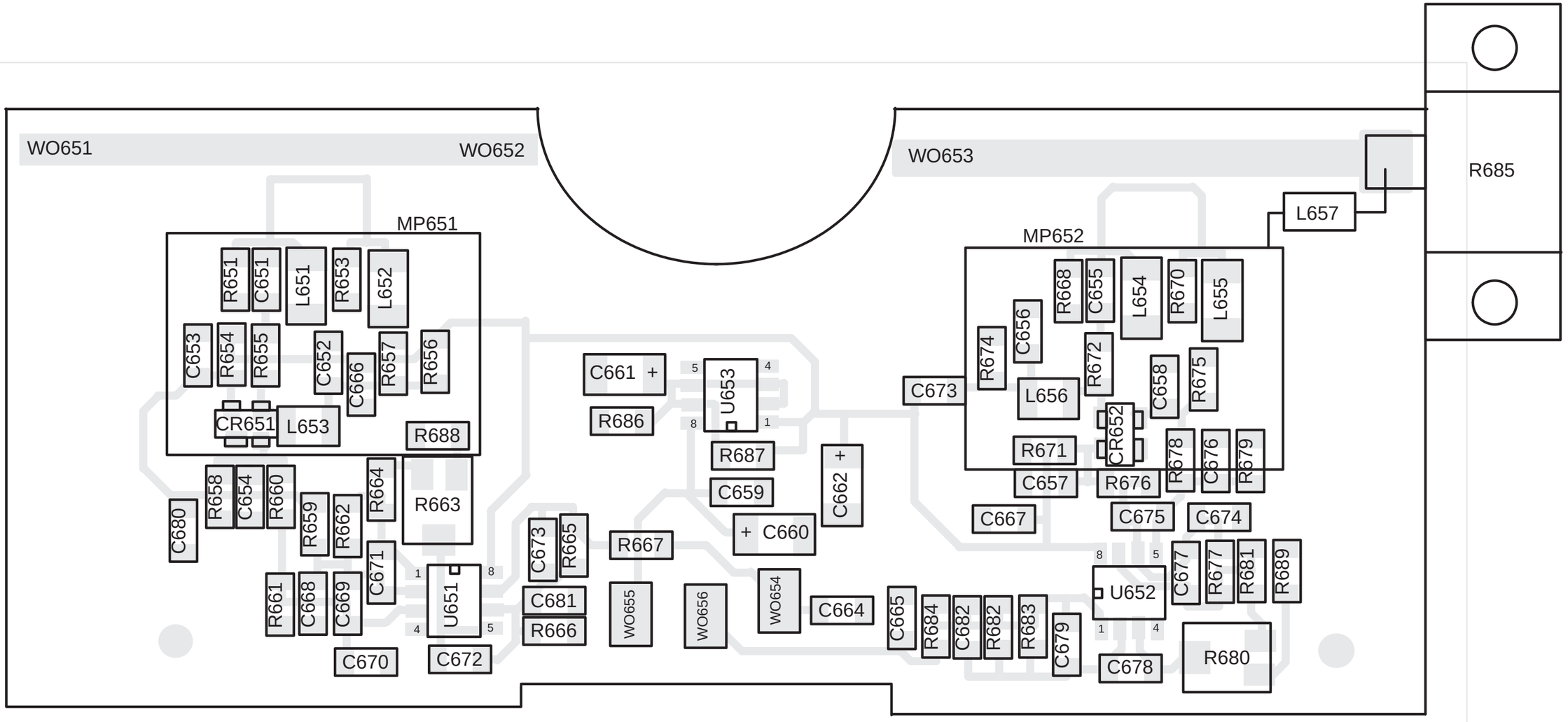


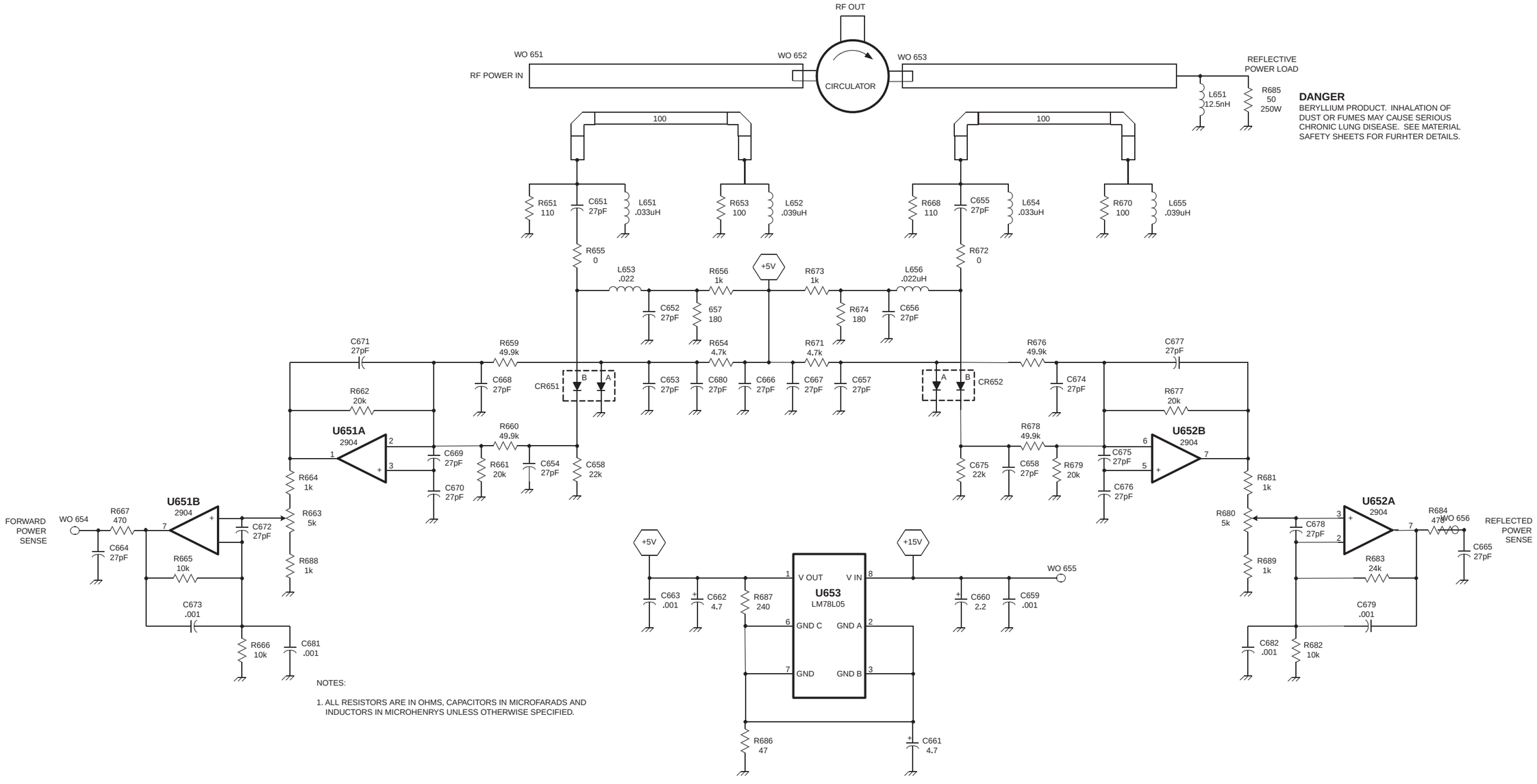
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

⚠2 **DANGER** BERYLLIUM PRODUCT. INHALATION OF DUST OR FUMES MAY CAUSE SERIOUS CHRONIC LUNG DISEASE. SEE MATERIAL SAFETY DATA SHEETS FOR FURTHER DETAILS.

POWER AMPLIFIER SCHEMATIC
FIGURE 10-20


WO651
WO652
WO653
MP651
MP652
R685
L657
R651
C651
L651
R653
L652
C653
R654
R655
C652
C666
R657
R656
CR651
L653
R688
C661
+
R686
U653
R687
C659
+ C660
C662
+
R658
C654
R660
R664
R663
C680
R659
R662
C671
C673
R665
R667
C681
R666
WO655
WO656
WO654
C664
C665
R684
C682
R682
R683
C679
R661
C668
C669
U651
C670
C672
R668
C655
L654
R670
L655
C656
R674
L656
R672
C658
R675
C673
CR652
R671
C657
R676
R678
C676
R679
C667
C675
C674
C677
R677
R681
R689
U652
C678
R680



NOTES:

1. ALL RESISTORS ARE IN OHMS, CAPACITORS IN MICROFARADS AND INDUCTORS IN MICROHENRYS UNLESS OTHERWISE SPECIFIED.

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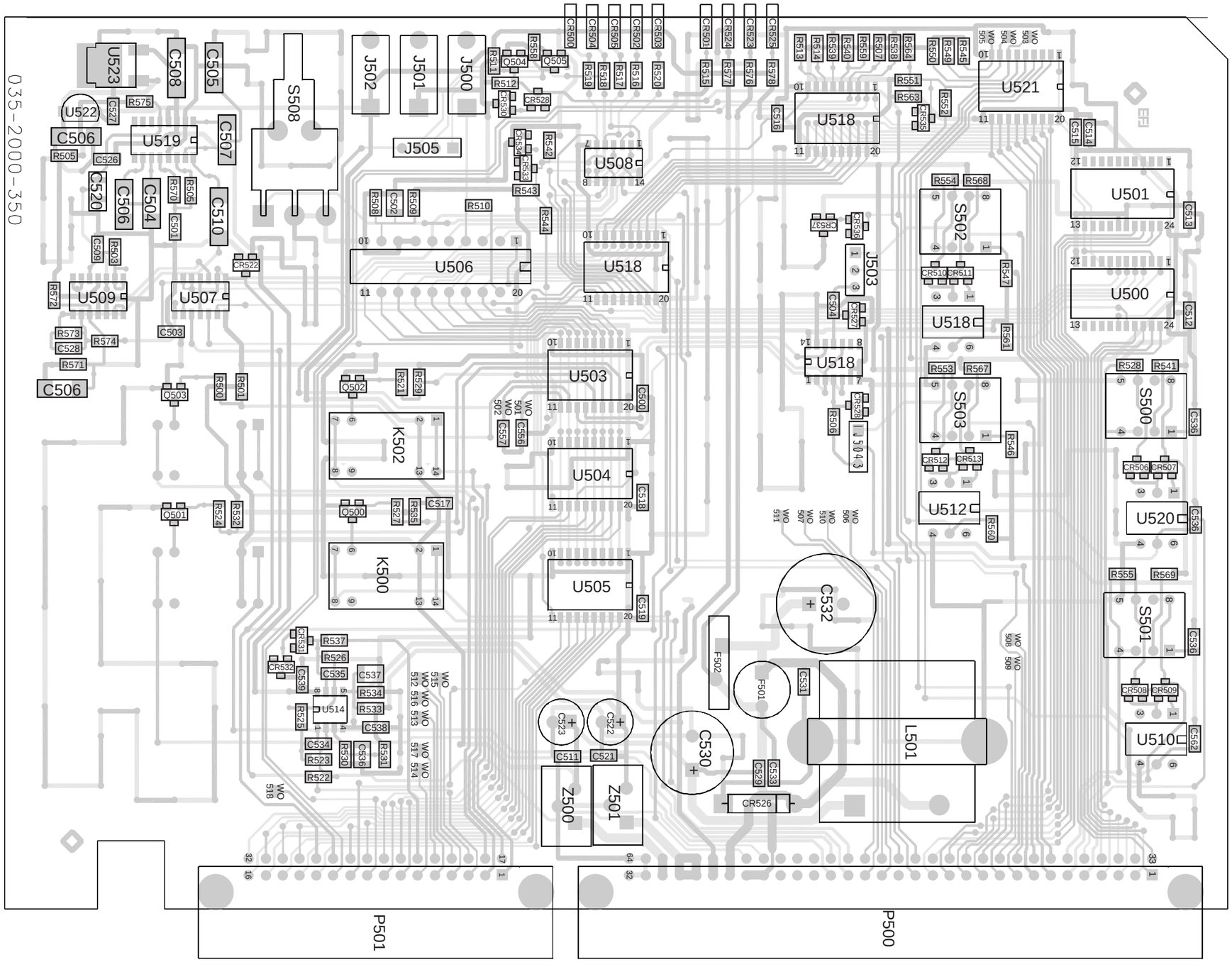
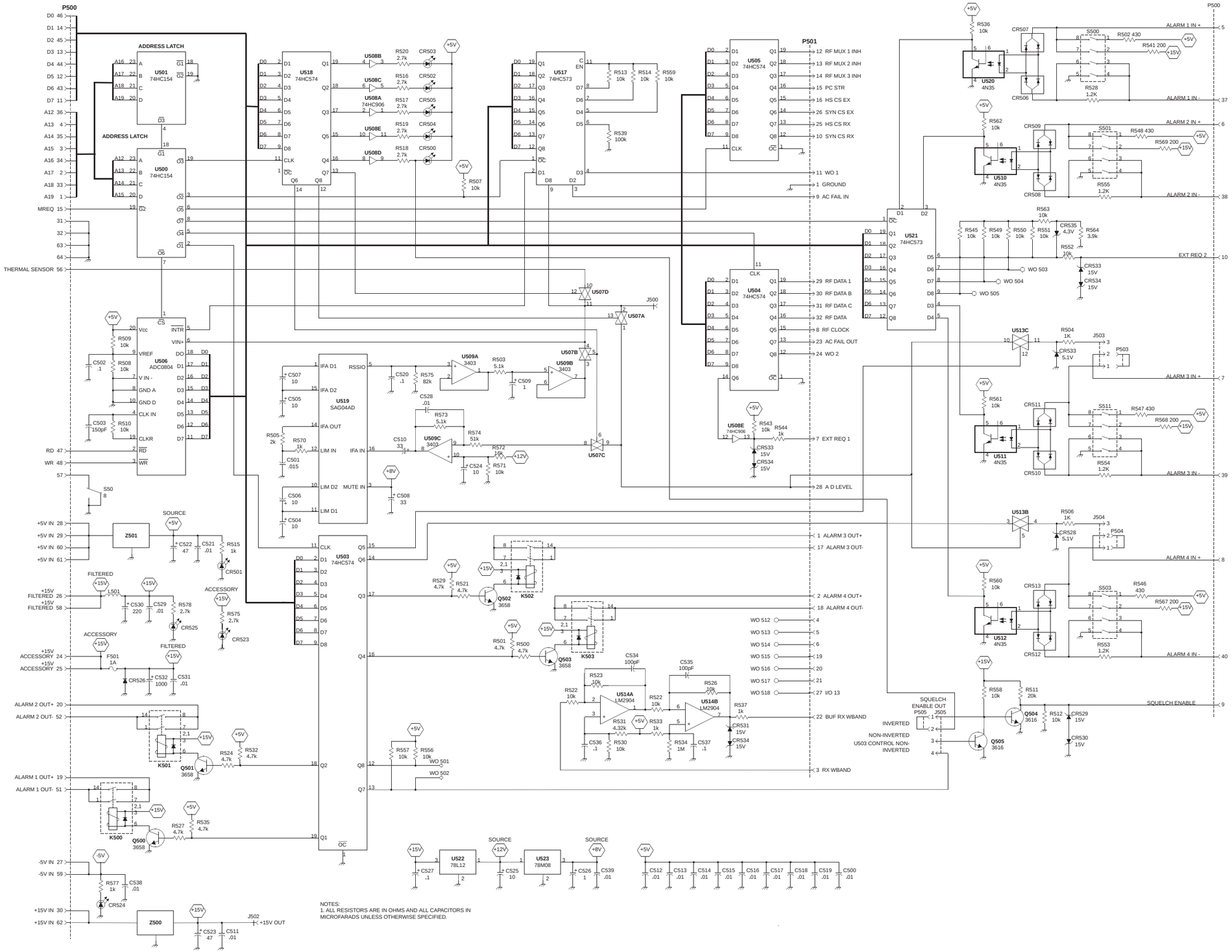
FORWARD/REVERSE POWER SCHEMATIC
FIGURE 10-22

035-2000-350



INTERFACE ALARM CARD COMPONENT LAYOUT
FIGURE 10-23



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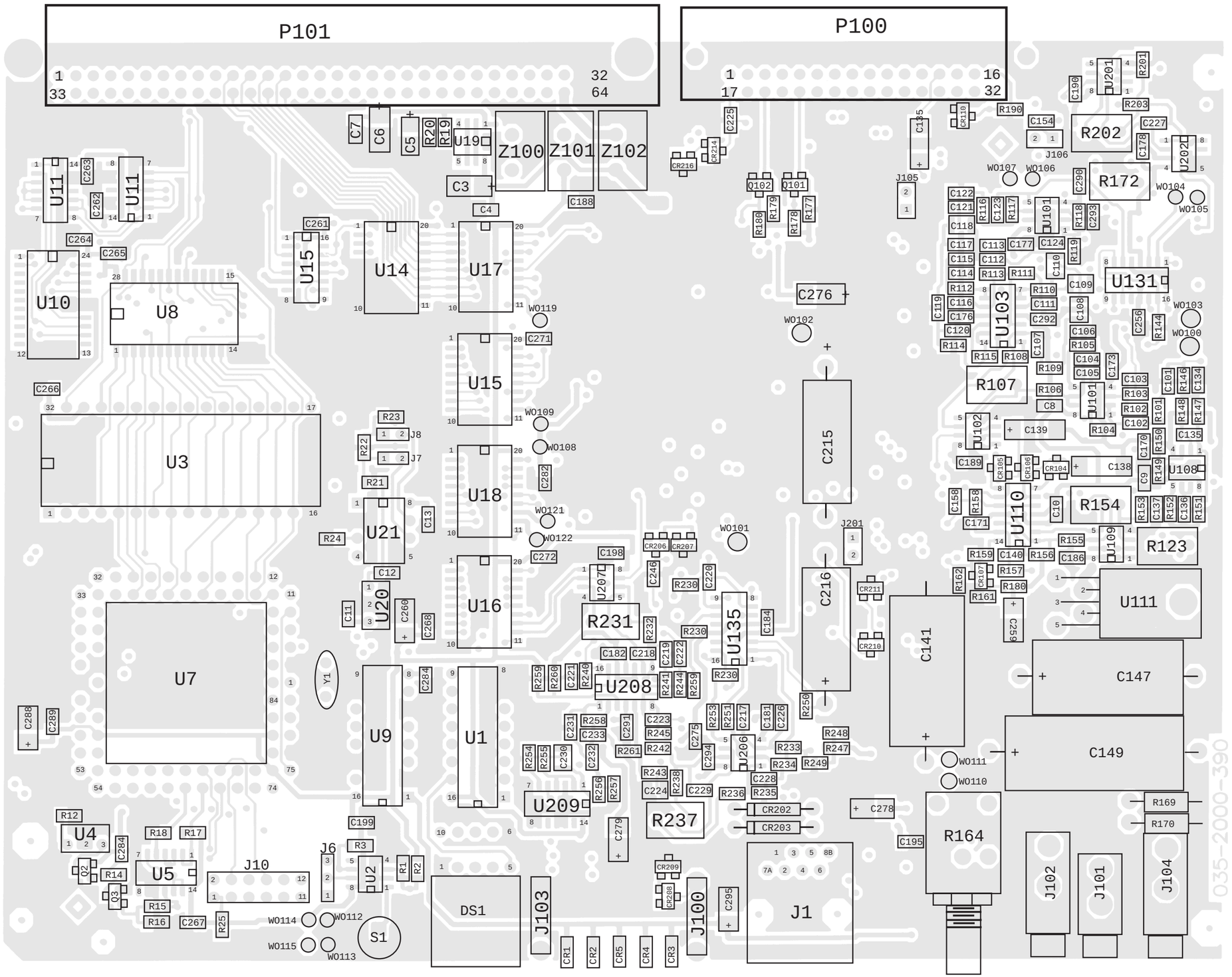
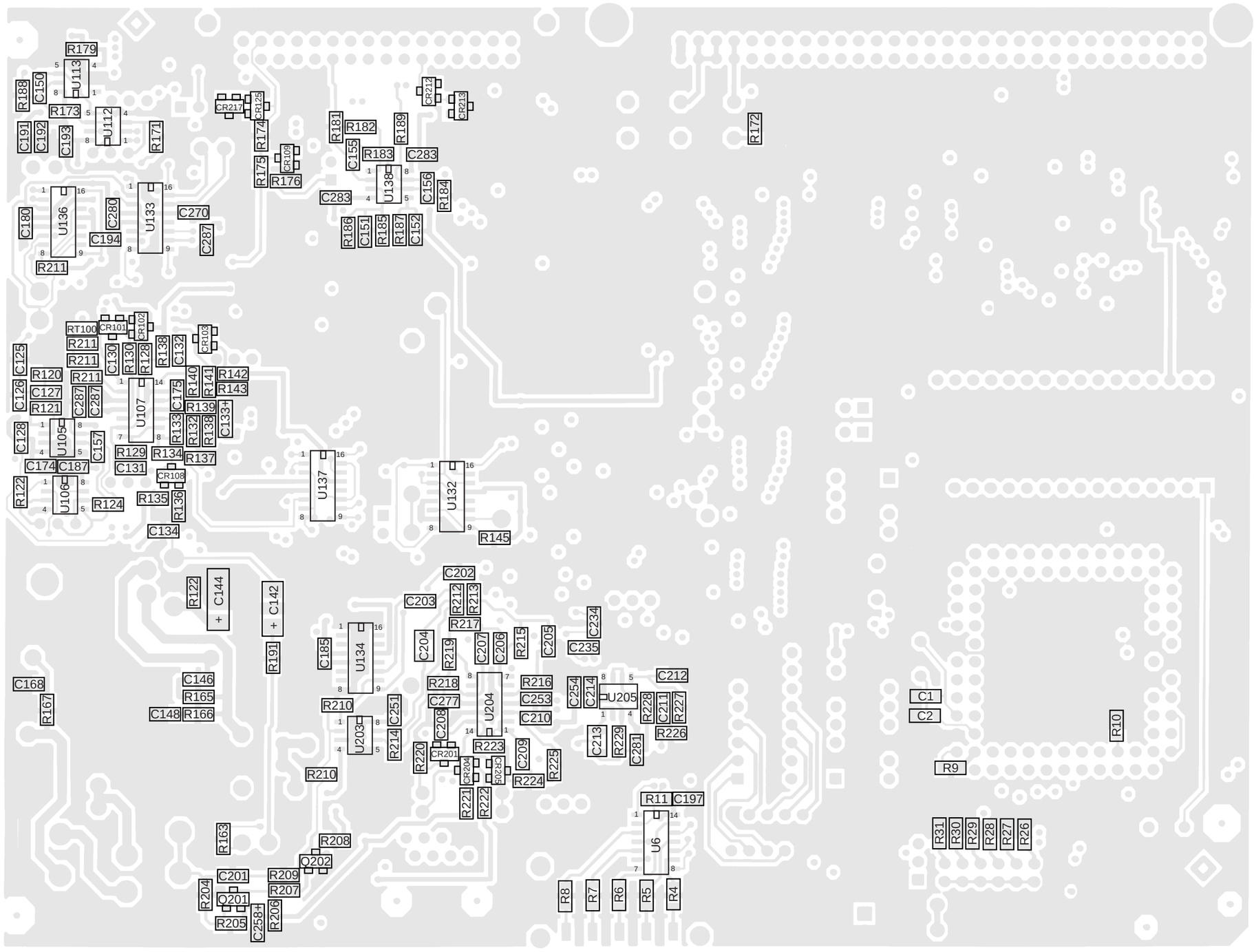
INTERFACE ALARM CARD SCHEMATIC
FIGURE 10-24



TPI CARD COMPONENT LAYOUT (COMPONENT SIDE VIEW)
FIGURE 10-25



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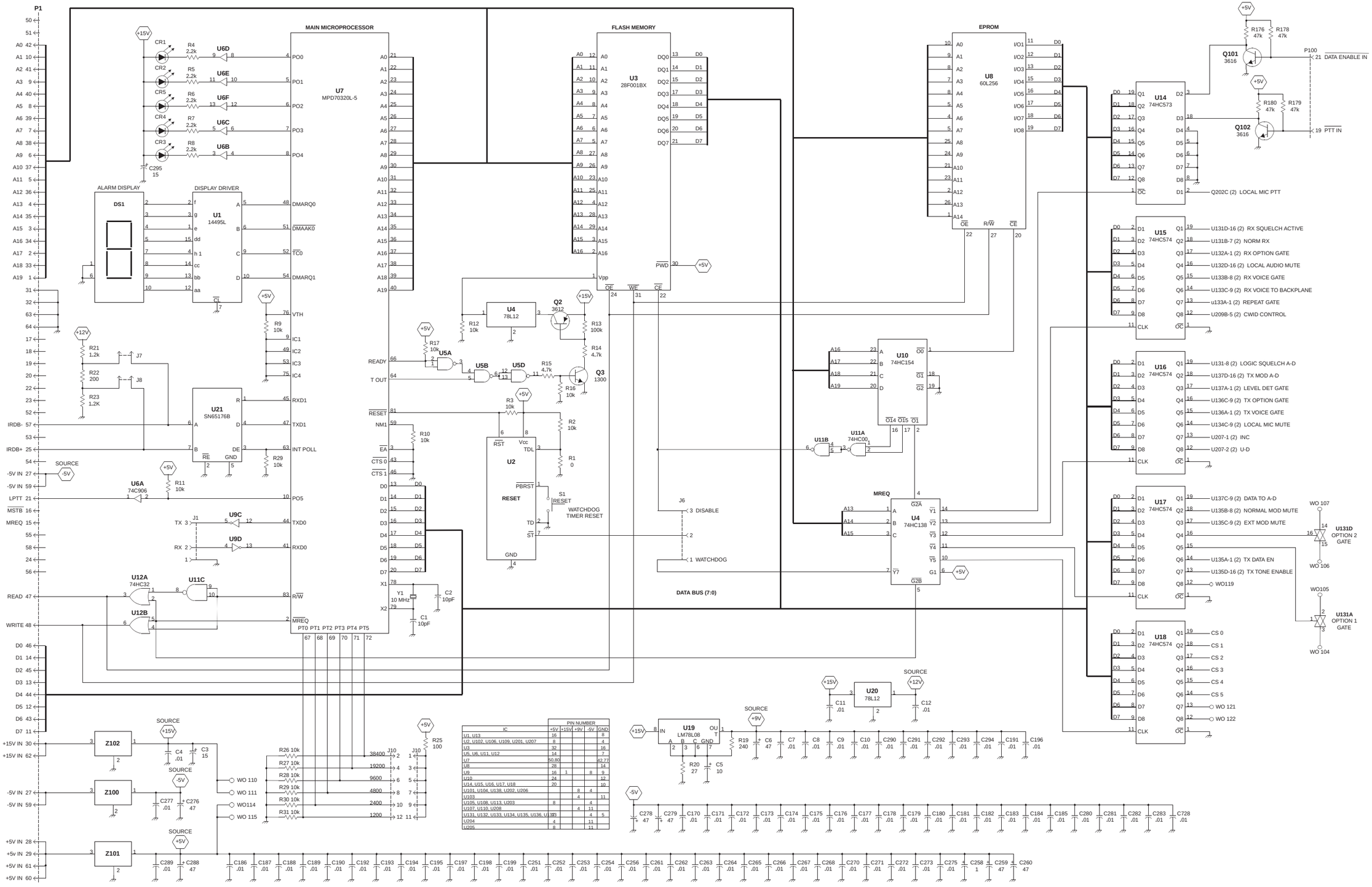
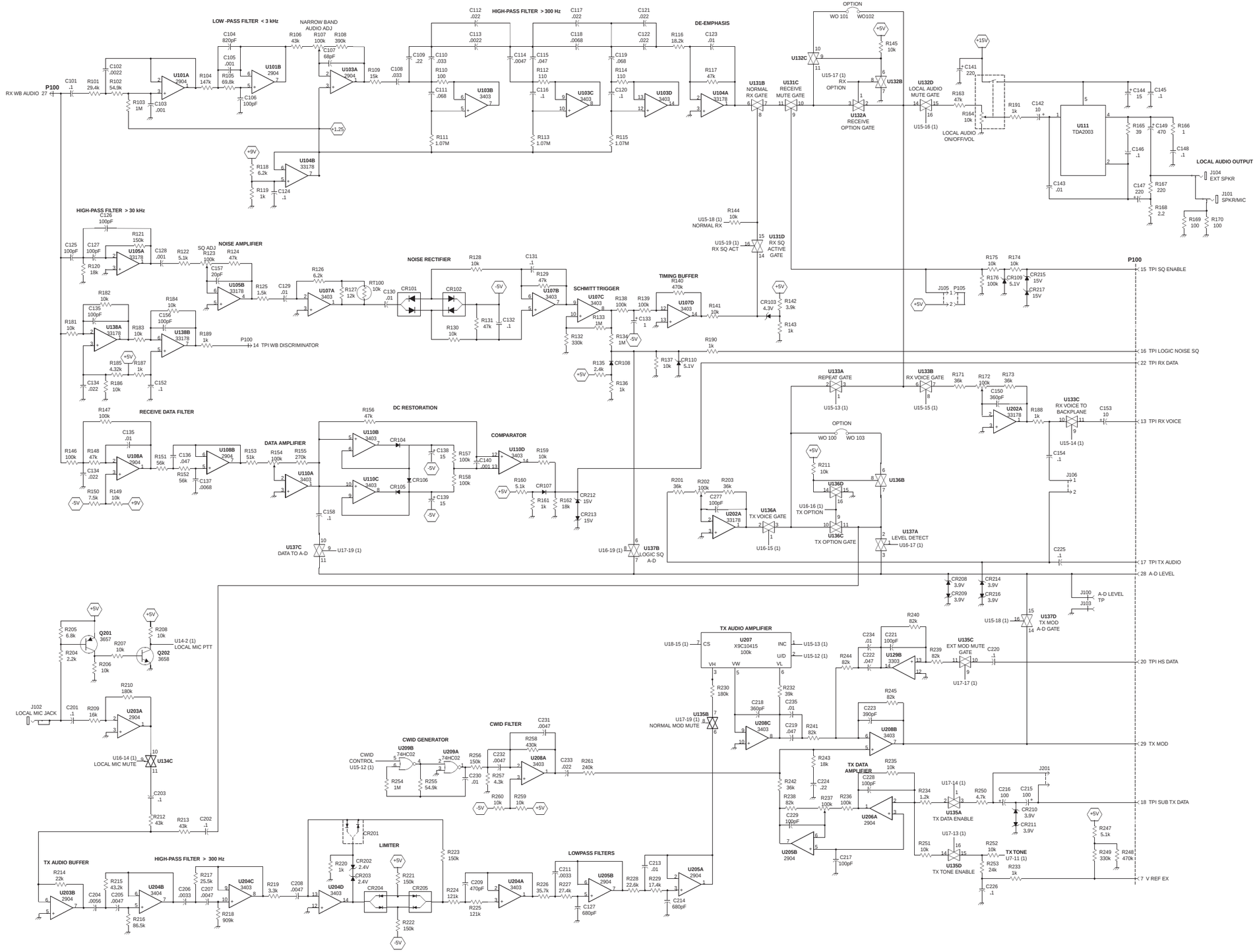
TPI CARD COMPONENT LAYOUT
(OPPOSITE COMPONENT SIDE VIEW)
FIGURE 10-26



TPI CARD SCHEMATIC (1 OF 2)
FIGURE 10-27



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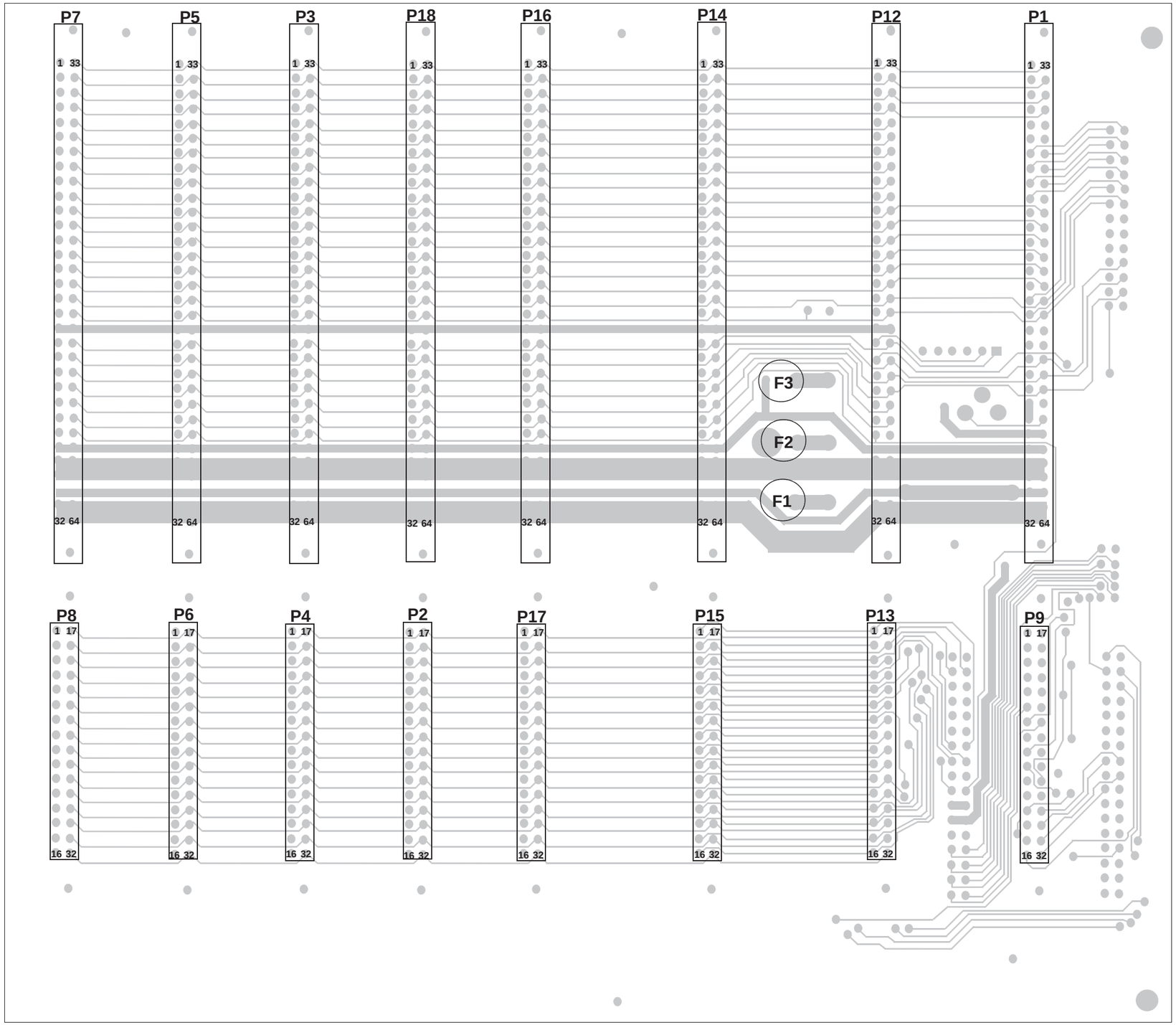
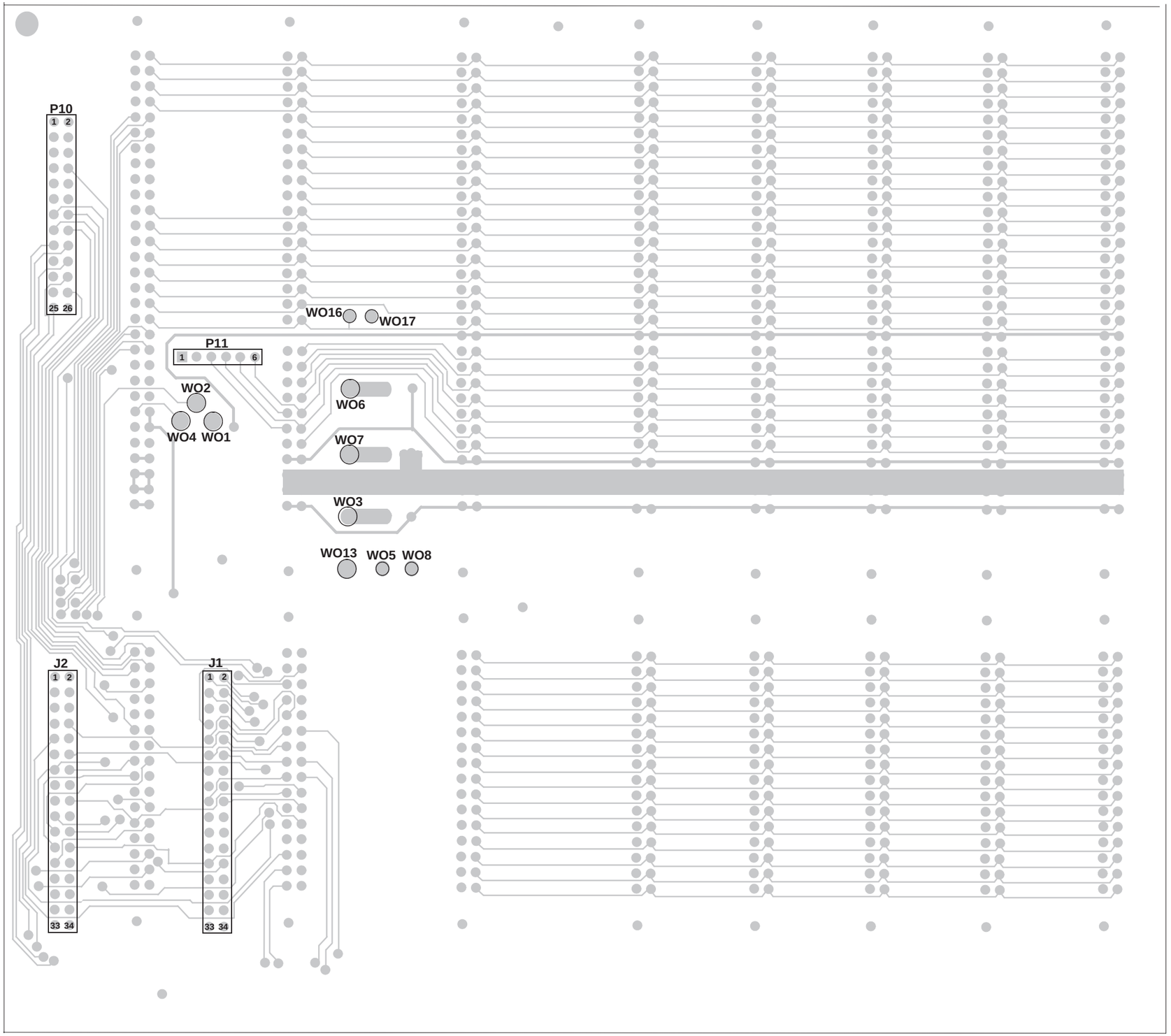
TPI CARD SCHEMATIC (2 OF 2)
FIGURE 10-28



BACKPLANE COMPONENT LAYOUT (CARD SIDE)
FIGURE 10-29



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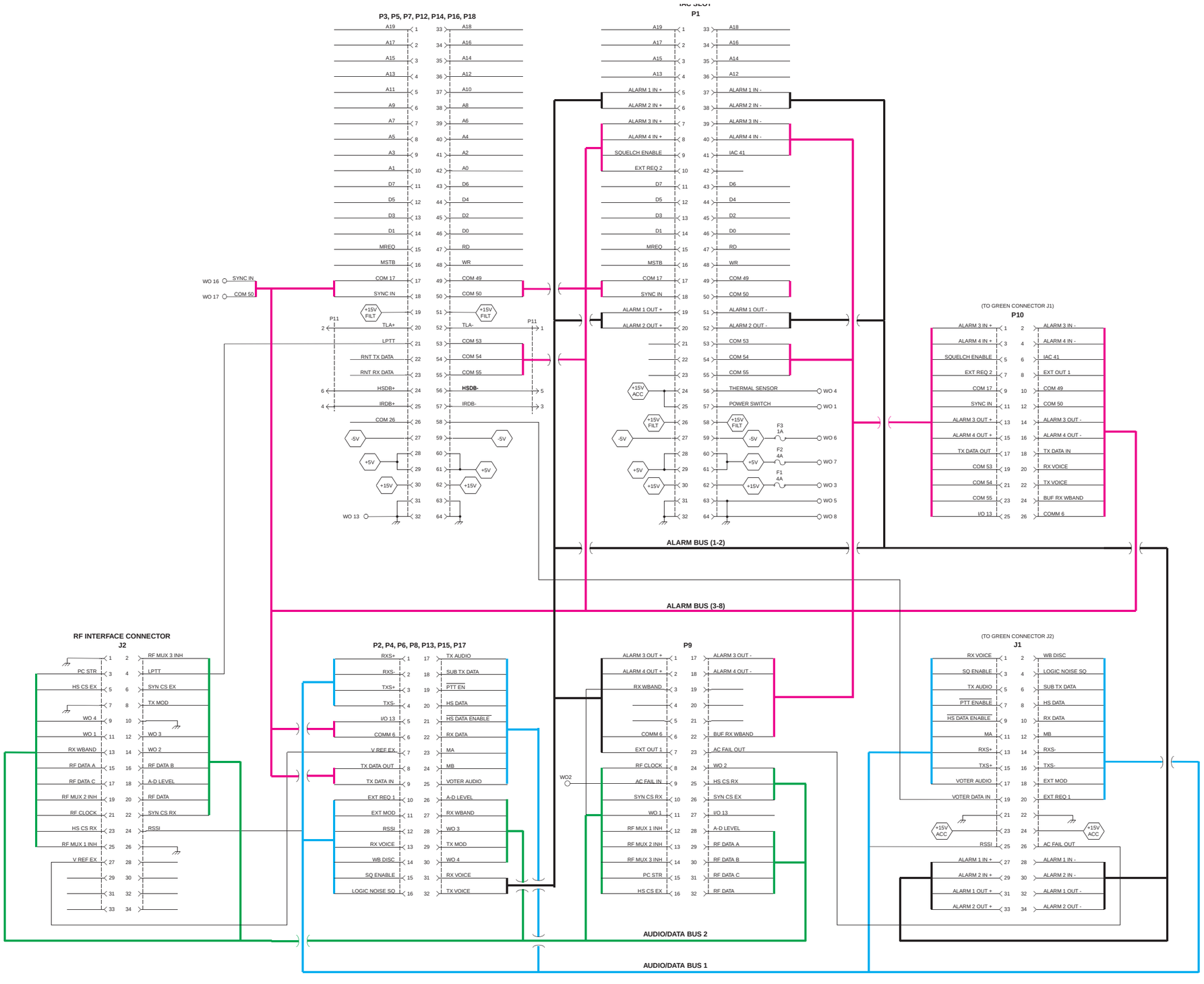
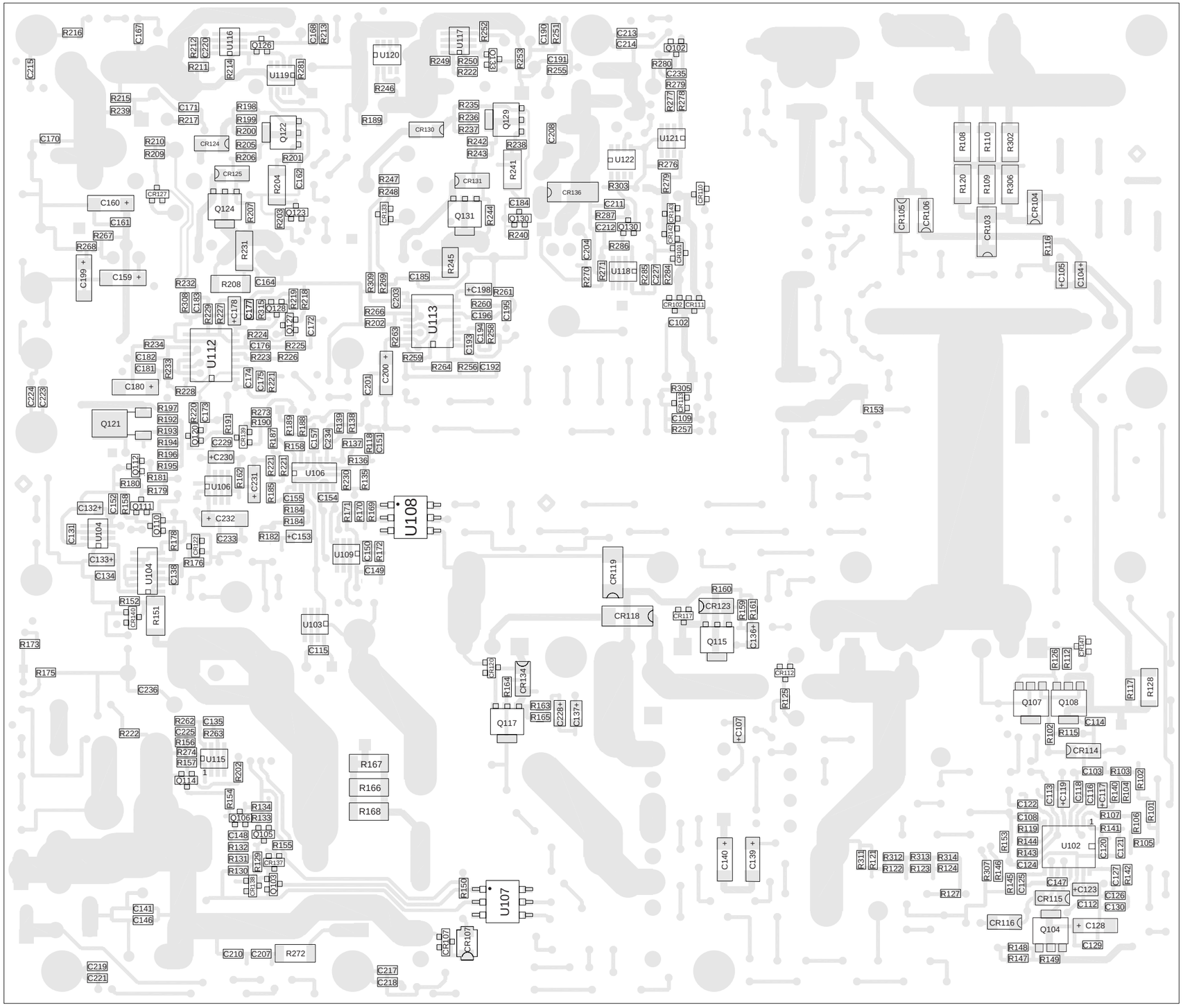
BACKPLANE COMPONENT LAYOUT (CABLE SIDE)
FIGURE 10-30



BACKPLANE SCHEMATIC
FIGURE 10-31



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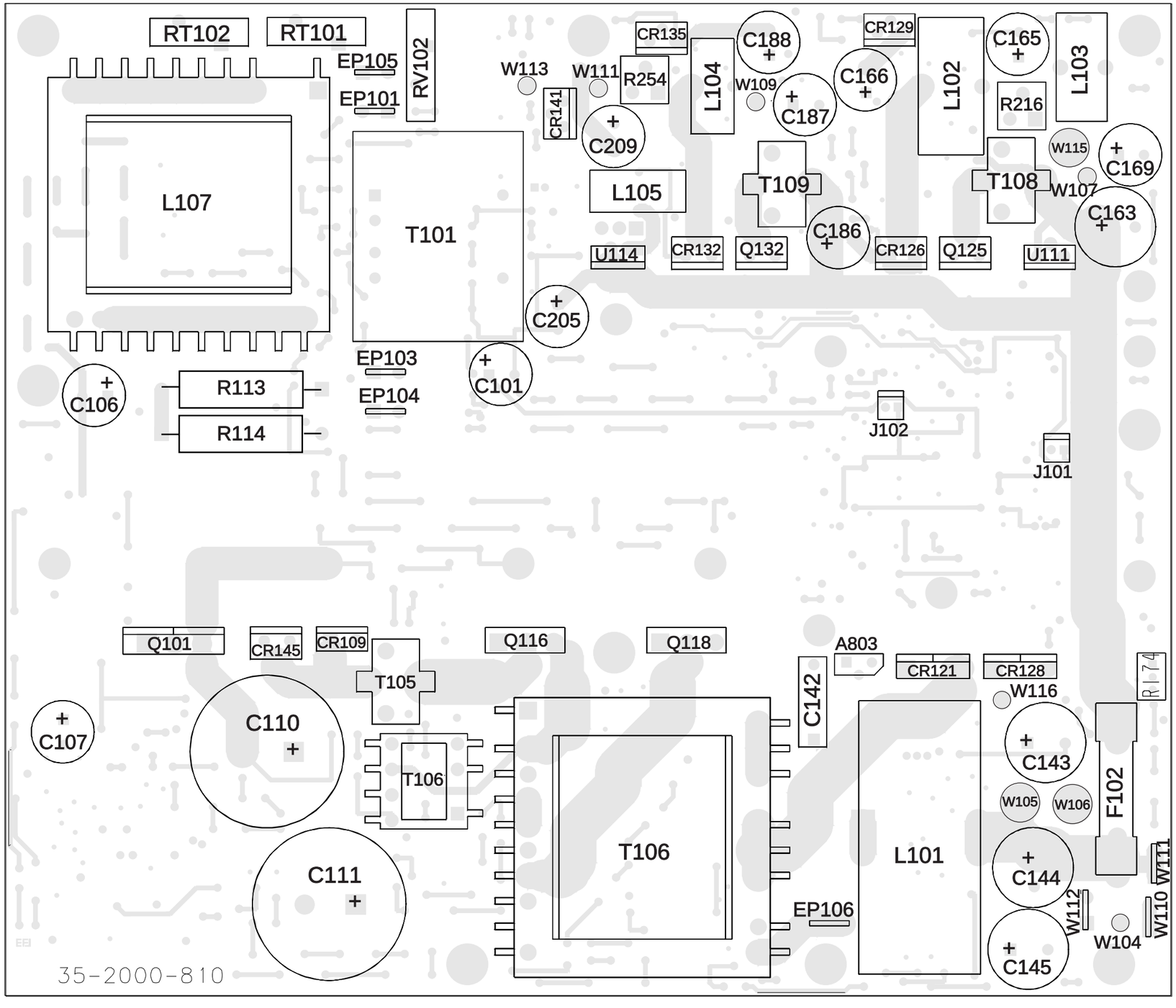
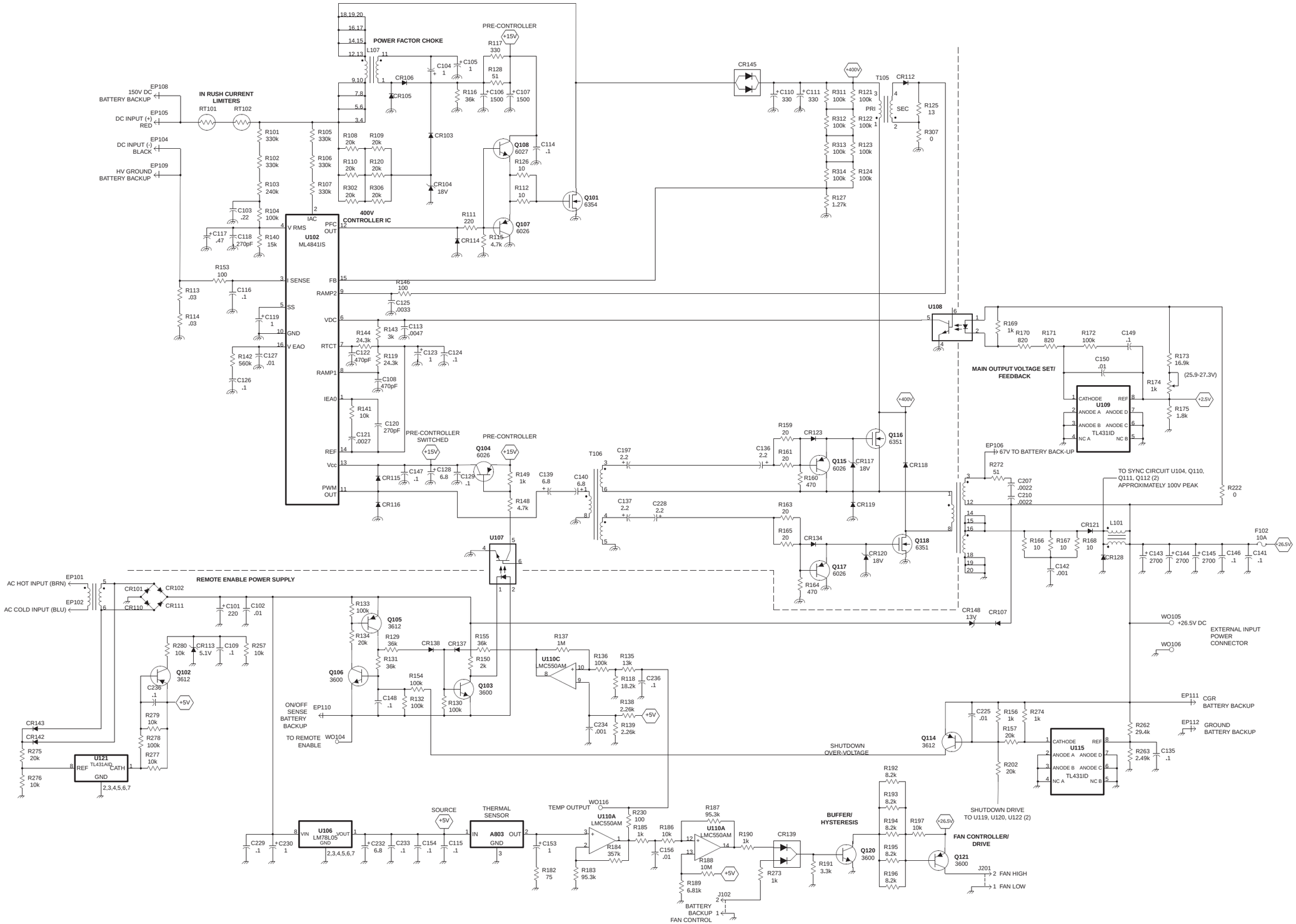
800W POWER SUPPLY COMPONENT LAYOUT
(OPPOSITE COMPONENT SIDE VIEW)
FIGURE 10-32



800W POWER SUPPLY COMPONENT LAYOUT
(COMPONENT SIDE VIEW)
FIGURE 10-33



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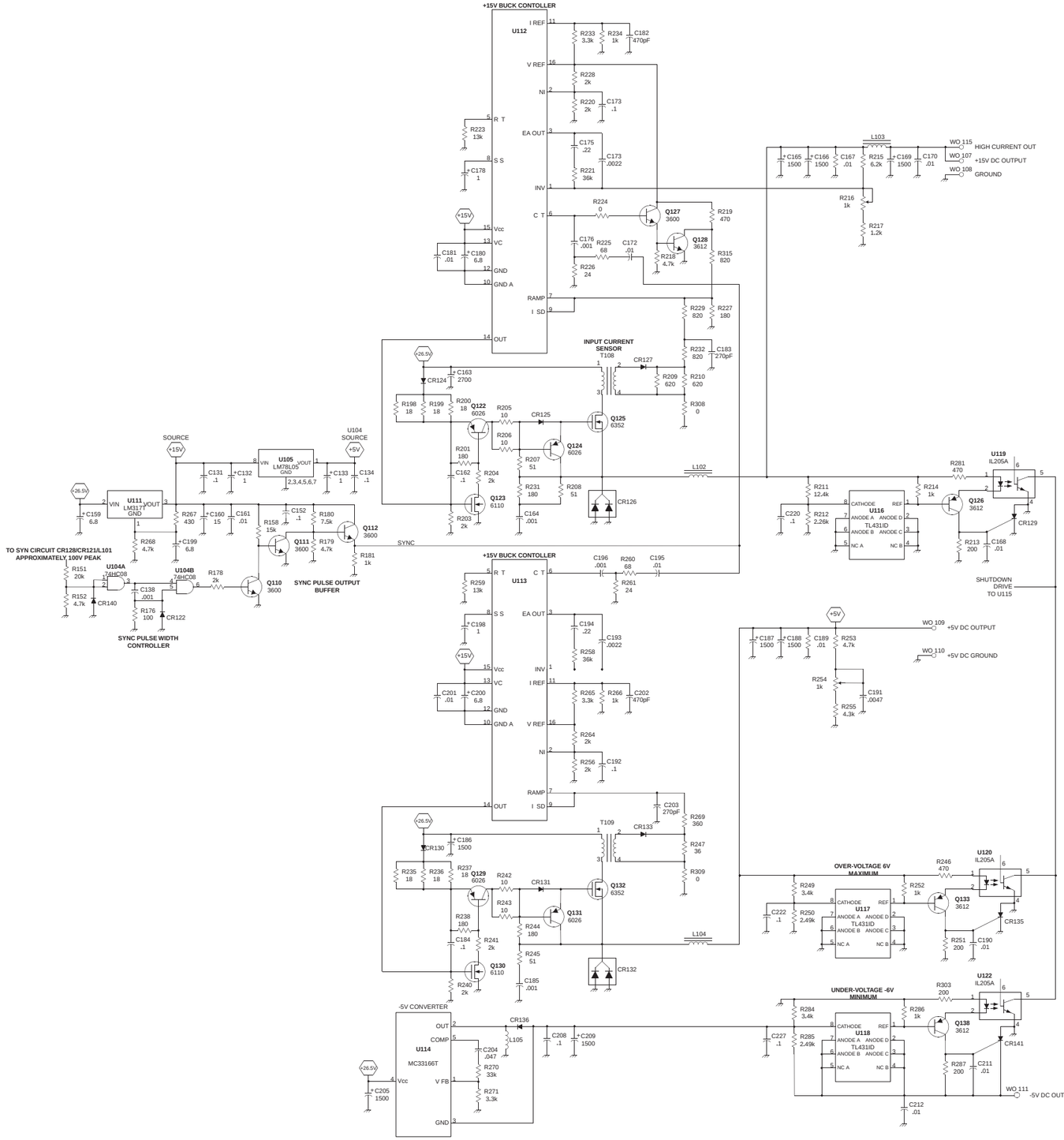
800W POWER SUPPLY SCHEMATIC (1 OF 2)
FIGURE 10-34



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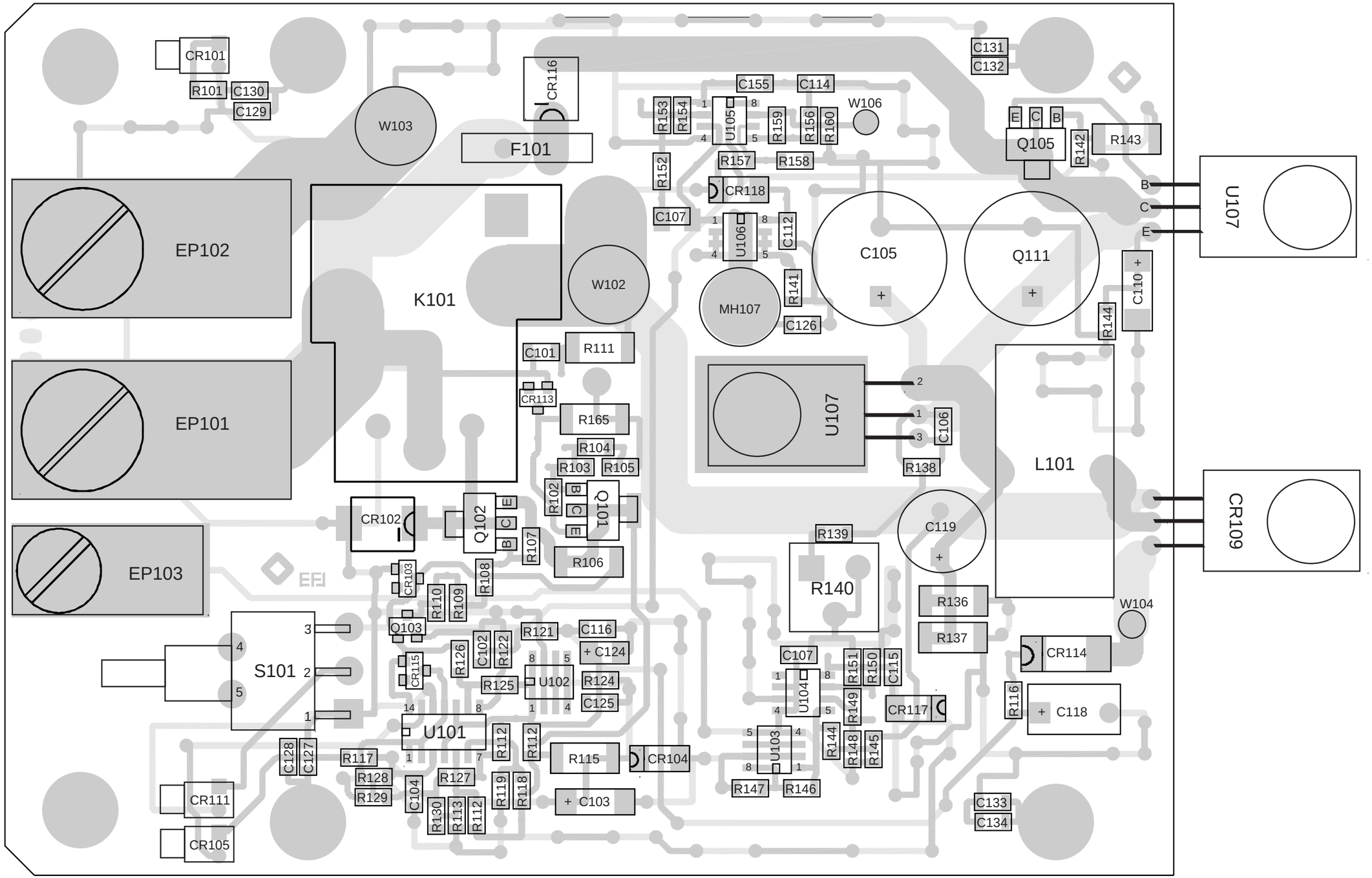
800W POWER SUPPLY SCHEMATIC (2 OF 2)
FIGURE 10-35



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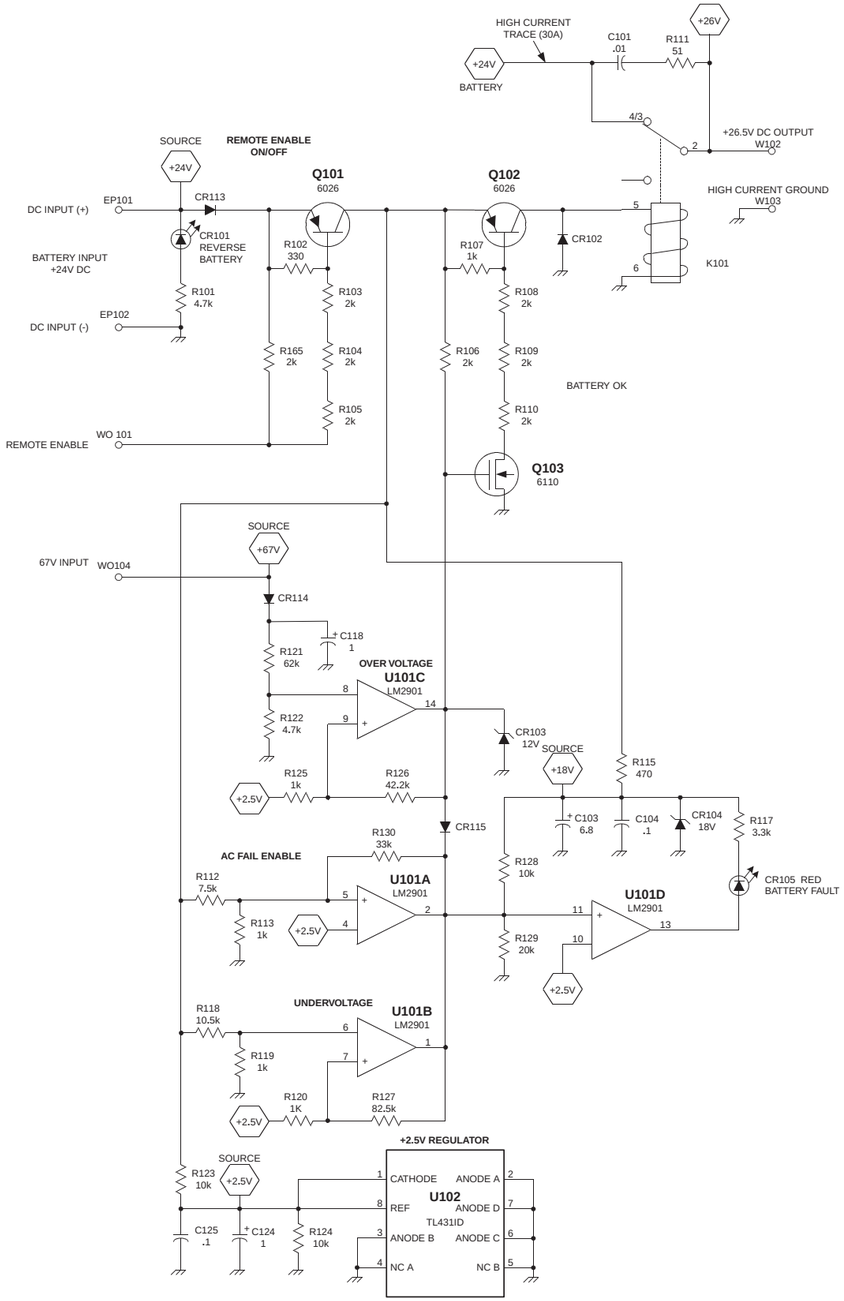
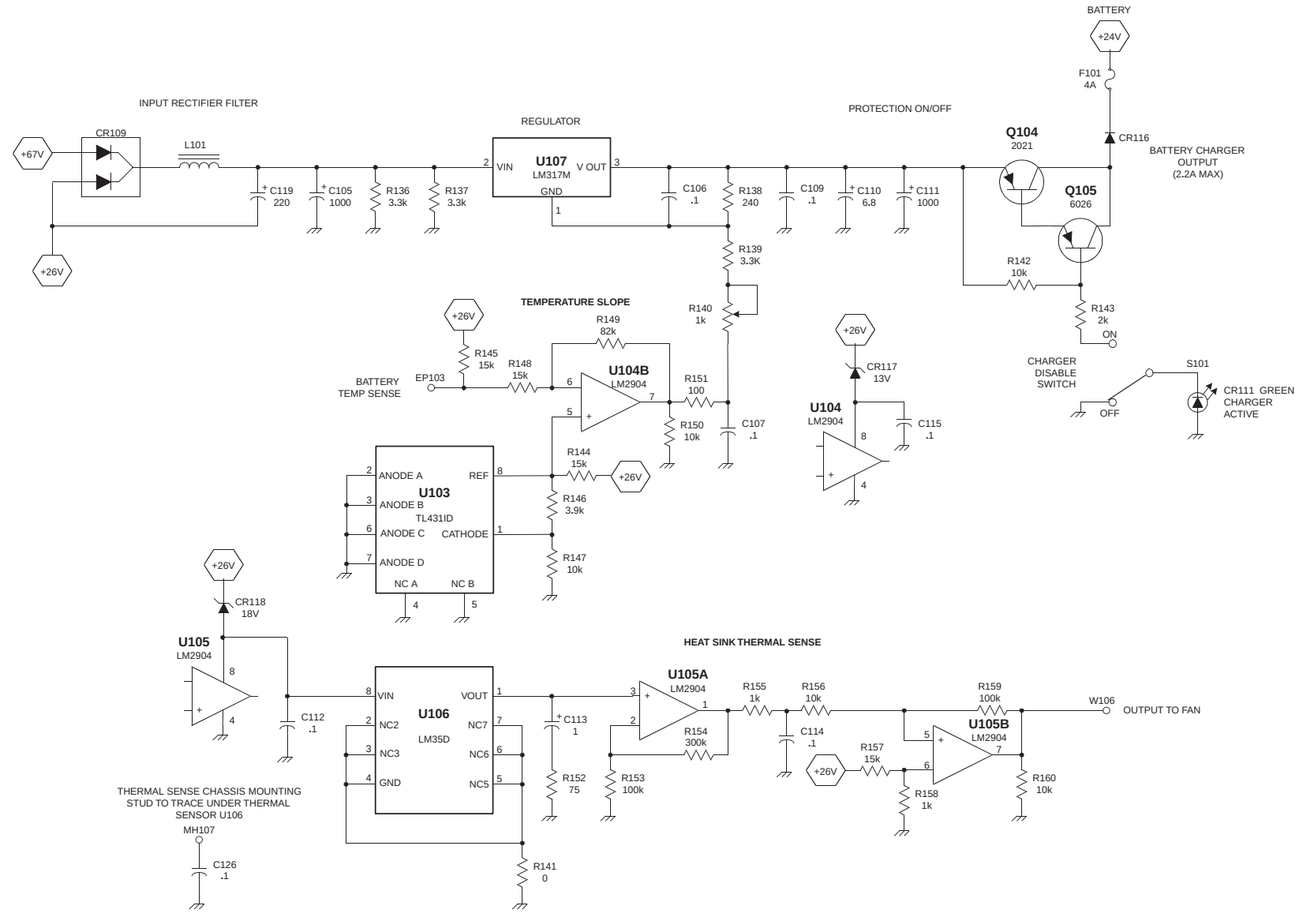
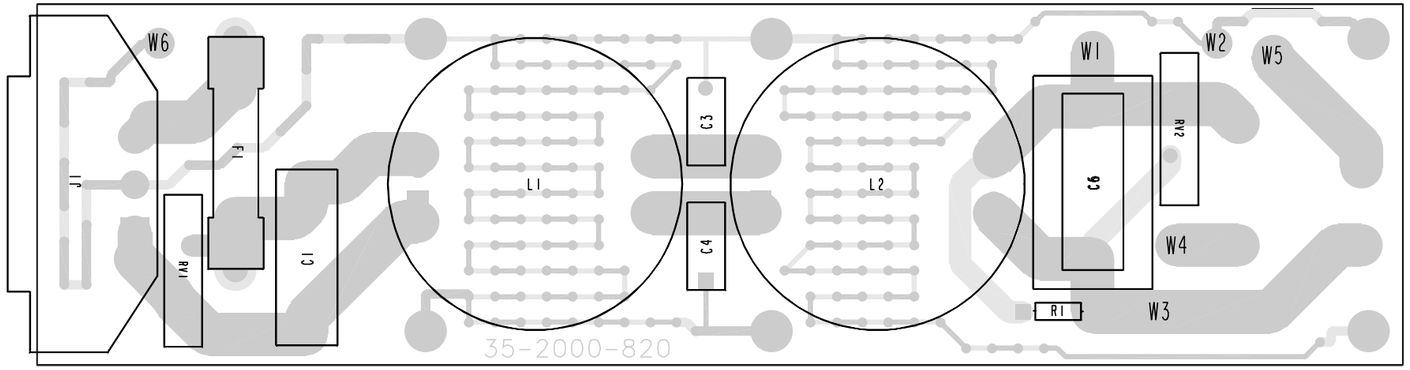
BATTERY BACK-UP COMPONENT LAYOUT
FIGURE 10-36



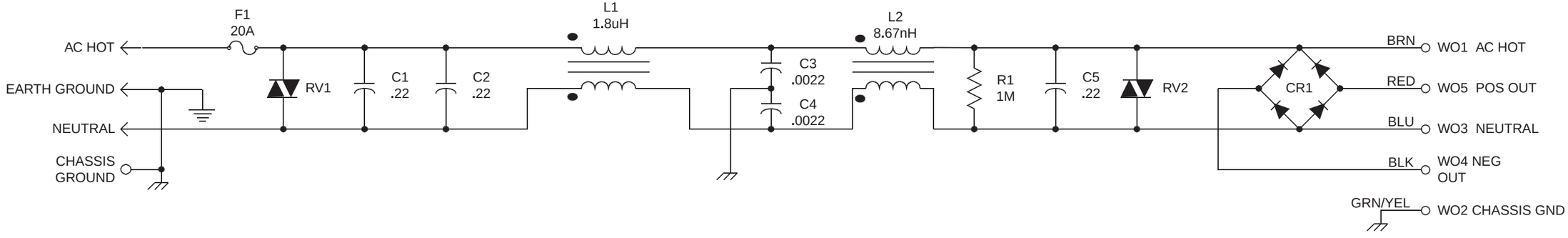


REVERT SECTION

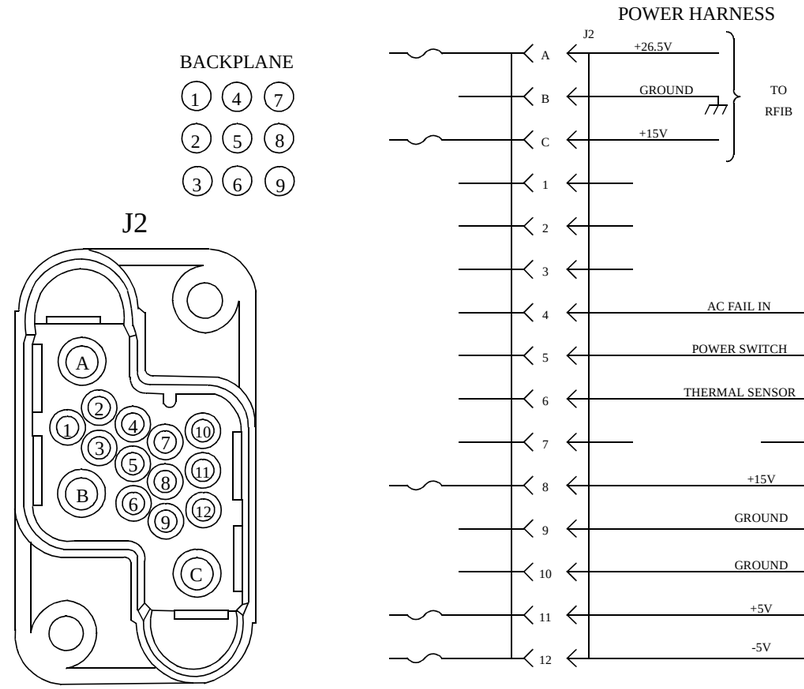
CHARGER SECTION



POWER SUPPPLY FILTER BOARD COMPONENT LAYOUT
FIGURE 10-38



POWER SUPPLY FILTER BOARD SCHEMATIC
FIGURE 10-39



POWER CABLE CONNECTOR AND SCHEMATIC
FIGURE 10-40

APPENDIX A 800 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	851.0125	806.0125	45	45	852.1125	807.1125
2	2	851.0375	806.0375	46	46	852.1375	807.1375
3	3	851.0625	806.0625	47	47	852.1625	807.1625
4	4	851.0875	806.0875	48	48	852.1875	807.1875
5	5	851.1125	806.1125	49	49	852.2125	807.2125
6	6	851.1375	806.1375	50	50	852.2375	807.2375
7	7	851.1625	806.1625	51	51	852.2625	807.2625
8	8	851.1875	806.1875	52	52	852.2875	807.2875
9	9	851.2125	806.2125	53	53	852.3125	807.3125
10	10	851.2375	806.2375	54	54	852.3375	807.3375
11	11	851.2625	806.2625	55	55	852.3625	807.3625
12	12	851.2875	806.2875	56	56	852.3875	807.3875
13	13	851.3125	806.3125	57	57	852.4125	807.4125
14	14	851.3375	806.3375	58	58	852.4375	807.4375
15	15	851.3625	806.3625	59	59	852.4625	807.4625
16	16	851.3875	806.3875	60	60	852.4875	807.4875
17	17	851.4125	806.4125	61	61	852.5125	807.5125
18	18	851.4375	806.4375	62	62	852.5375	807.5375
19	19	851.4625	806.4625	63	63	852.5625	807.5625
20	20	851.4875	806.4875	64	64	852.5875	807.5875
21	21	851.5125	806.5125	65	65	852.6125	807.6125
22	22	851.5375	806.5375	66	66	852.6375	807.6375
23	23	851.5625	806.5625	67	67	852.6625	807.6625
24	24	851.5875	806.5875	68	68	852.6875	807.6875
25	25	851.6125	806.6125	69	69	852.7125	807.7125
26	26	851.6375	806.6375	70	70	852.7375	807.7375
27	27	851.6625	806.6625	71	71	852.7625	807.7625
28	28	851.6875	806.6875	72	72	852.7875	807.7875
29	29	851.7125	806.7125	73	73	852.8125	807.8125
30	30	851.7375	806.7375	74	74	852.8375	807.8375
31	31	851.7625	806.7625	75	75	852.8625	807.8625
32	32	851.7875	806.7875	76	76	852.8875	807.8875
33	33	851.8125	806.8125	77	77	852.9125	807.9125
34	34	851.8375	806.8375	78	78	852.9375	807.9375
35	35	851.8625	806.8625	79	79	852.9625	807.9625
36	36	851.8875	806.8875	80	80	852.9875	807.9875
37	37	851.9125	806.9125	81	81	853.0125	808.0125
38	38	851.9375	806.9375	82	82	853.0375	808.0375
39	39	851.9625	806.9625	83	83	853.0625	808.0625
40	40	851.9875	806.9875	84	84	853.0875	808.0875
41	41	852.0125	807.0125	85	85	853.1125	808.1125
42	42	852.0375	807.0375	86	86	853.1375	808.1375
43	43	852.0625	807.0625	87	87	853.1625	808.1625
44	44	852.0875	807.0875	88	88	853.1875	808.1875

800 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
89	89	853.2125	808.2125	135	135	854.3625	809.3625
90	90	853.2375	808.2375	136	136	854.3875	809.3875
91	91	853.2625	808.2625	137	137	854.4125	809.4125
92	92	853.2875	808.2875	138	138	854.4375	809.4375
93	93	853.3125	808.3125	139	139	854.4625	809.4625
94	94	853.3375	808.3375	140	140	854.4875	809.4875
95	95	853.3625	808.3625	141	141	854.5125	809.5125
96	96	853.3875	808.3875	142	142	854.5375	809.5375
97	97	853.4125	808.4125	143	143	854.5625	809.5625
98	98	853.4375	808.4375	144	144	854.5875	809.5875
99	99	853.4625	808.4625	145	145	854.6125	809.6125
100	100	853.4875	808.4875	146	146	854.6375	809.6375
101	101	853.5125	808.5125	147	147	854.6625	809.6625
102	102	853.5375	808.5375	148	148	854.6875	809.6875
103	103	853.5625	808.5625	149	149	854.7125	809.7125
104	104	853.5875	808.5875	150	150	854.7375	809.7375
105	105	853.6125	808.6125	151	151	854.7625	809.7625
106	106	853.6375	808.6375	152	152	854.7875	809.7875
107	107	853.6625	808.6625	153	153	854.8125	809.8125
108	108	853.6875	808.6875	154	154	854.8375	809.8375
109	109	853.7125	808.7125	155	155	854.8625	809.8625
110	110	853.7375	808.7375	156	156	854.8875	809.8875
111	111	853.7625	808.7625	157	157	854.9125	809.9125
112	112	853.7875	808.7875	158	158	854.9375	809.9375
113	113	853.8125	808.8125	159	159	854.9625	809.9625
114	114	853.8375	808.8375	160	160	854.9875	809.9875
115	115	853.8625	808.8625	161	161	855.0125	810.0125
116	116	853.8875	808.8875	162	162	855.0375	810.0375
117	117	853.9125	808.9125	163	163	855.0625	810.0625
118	118	853.9375	808.9375	164	164	855.0875	810.0875
119	119	853.9625	808.9625	165	165	855.1125	810.1125
120	120	853.9875	808.9875	166	166	855.1375	810.1375
121	121	854.0125	809.0125	167	167	855.1625	810.1625
122	122	854.0375	809.0375	168	168	855.1875	810.1875
123	123	854.0625	809.0625	169	169	855.2125	810.2125
124	124	854.0875	809.0875	170	170	855.2375	810.2375
125	125	854.1125	809.1125	171	171	855.2625	810.2625
126	126	854.1375	809.1375	172	172	855.2875	810.2875
127	127	854.1625	809.1625	173	173	855.3125	810.3125
128	128	854.1875	809.1875	174	174	855.3375	810.3375
129	129	854.2125	809.2125	175	175	855.3625	810.3625
130	130	854.2375	809.2375	176	176	855.3875	810.3875
131	131	854.2625	809.2625	177	177	855.4125	810.4125
132	132	854.2875	809.2875	178	178	855.4375	810.4375
133	133	854.3125	809.3125	179	179	855.4625	810.4625
134	134	854.3375	809.3375	180	180	855.4875	810.4875

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
181	181	855.5125	810.5125	227	227	856.6625	811.6625
182	182	855.5375	810.5375	228	228	856.6875	811.6875
183	183	855.5625	810.5625	229	229	856.7125	811.7125
184	184	855.5875	810.5875	230	230	856.7375	811.7375
185	185	855.6125	810.6125	231	231	856.7625	811.7625
186	186	855.6375	810.6375	232	232	856.7875	811.7875
187	187	855.6625	810.6625	233	233	856.8125	811.8125
188	188	855.6875	810.6875	234	234	856.8375	811.8375
189	189	855.7125	810.7125	235	235	856.8625	811.8625
190	190	855.7375	810.7375	236	236	856.8875	811.8875
191	191	855.7625	810.7625	237	237	856.9125	811.9125
192	192	855.7875	810.7875	238	238	856.9375	811.9375
193	193	855.8125	810.8125	239	239	856.9625	811.9625
194	194	855.8375	810.8375	240	240	856.9875	811.9875
195	195	855.8625	810.8625	241	241	857.0125	812.0125
196	196	855.8875	810.8875	242	242	857.0375	812.0375
197	197	855.9125	810.9125	243	243	857.0625	812.0625
198	198	855.9375	810.9375	244	244	857.0875	812.0875
199	199	855.9625	810.9625	245	245	857.1125	812.1125
200	200	855.9875	810.9875	246	246	857.1375	812.1375
201	201	856.0125	811.0125	247	247	857.1625	812.1625
202	202	856.0375	811.0375	249	249	857.2125	812.2125
203	203	856.0625	811.0625	250	250	857.2375	812.2375
204	204	856.0875	811.0875	251	251	857.2625	812.2625
205	205	856.1125	811.1125	252	252	857.2875	812.2875
206	206	856.1375	811.1375	253	253	857.3125	812.3125
207	207	856.1625	811.1625	254	254	857.3375	812.3375
208	208	856.1875	811.1875	255	255	857.3625	812.3625
209	209	856.2125	811.2125	256	256	857.3875	812.3875
210	210	856.2375	811.2375	257	257	857.4125	812.4125
211	211	856.2625	811.2625	258	258	857.4375	812.4375
212	212	856.2875	811.2875	259	259	857.4625	812.4625
213	213	856.3125	811.3125	260	260	857.4875	812.4875
214	214	856.3375	811.3375	261	261	857.5125	812.5125
215	215	856.3625	811.3625	262	262	857.5375	812.5375
216	216	856.3875	811.3875	263	263	857.5625	812.5625
217	217	856.4125	811.4125	264	264	857.5875	812.5875
218	218	856.4375	811.4375	265	265	857.6125	812.6125
219	219	856.4625	811.4625	266	266	857.6375	812.6375
220	220	856.4875	811.4875	267	267	857.6625	812.6625
221	221	856.5125	811.5125	268	268	857.6875	812.6875
222	222	856.5375	811.5375	269	269	857.7125	812.7125
223	223	856.5625	811.5625	270	270	857.7375	812.7375
224	224	856.5875	811.5875	271	271	857.7625	812.7625
225	225	856.6125	811.6125	272	272	857.7875	812.7875
226	226	856.6375	811.6375	273	273	857.8125	812.8125

800 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
274	274	857.8375	812.8375	321	321	859.0125	814.0125
275	275	857.8625	812.8625	322	322	859.0375	814.0375
276	276	857.8875	812.8875	323	323	859.0625	814.0625
277	277	857.9125	812.9125	324	324	859.0875	814.0875
278	278	857.9375	812.9375	325	325	859.1125	814.1125
279	279	857.9625	812.9625	326	326	859.1375	814.1375
280	280	857.9875	812.9875	327	327	859.1625	814.1625
281	281	858.0125	813.0125	328	328	859.1875	814.1875
282	282	858.0375	813.0375	329	329	859.2125	814.2125
283	283	858.0625	813.0625	330	330	859.2375	814.2375
284	284	858.0875	813.0875	331	331	859.2625	814.2625
285	285	858.1125	813.1125	332	332	859.2875	814.2875
286	286	858.1375	813.1375	333	333	859.3125	814.3125
287	287	858.1625	813.1625	334	334	859.3375	814.3375
288	288	858.1875	813.1875	335	335	859.3625	814.3625
289	289	858.2125	813.2125	336	336	859.3875	814.3875
290	290	858.2375	813.2375	337	337	859.4125	814.4125
291	291	858.2625	813.2625	338	338	859.4375	814.4375
292	292	858.2875	813.2875	339	339	859.4625	814.4625
293	293	858.3125	813.3125	340	340	859.4875	814.4875
294	294	858.3375	813.3375	341	341	859.5125	814.5125
295	295	858.3625	813.3625	342	342	859.5375	814.5375
296	296	858.3875	813.3875	343	343	859.5625	814.5625
297	297	858.4125	813.4125	344	344	859.5875	814.5875
298	298	858.4375	813.4375	345	345	859.6125	814.6125
299	299	858.4625	813.4625	346	346	859.6375	814.6375
300	300	858.4875	813.4875	347	347	859.6625	814.6625
301	301	858.5125	813.5125	348	348	859.6875	814.6875
302	302	858.5375	813.5375	349	349	859.7125	814.7125
303	303	858.5625	813.5625	350	350	859.7375	814.7375
304	304	858.5875	813.5875	351	351	859.7625	814.7625
305	305	858.6125	813.6125	352	352	859.7875	814.7875
306	306	858.6375	813.6375	353	353	859.8125	814.8125
307	307	858.6625	813.6625	354	354	859.8375	814.8375
308	308	858.6875	813.6875	355	355	859.8625	814.8625
309	309	858.7125	813.7125	356	356	859.8875	814.8875
310	310	858.7375	813.7375	357	357	859.9125	814.9125
311	311	858.7625	813.7625	358	358	859.9375	814.9375
312	312	858.7875	813.7875	359	359	859.9625	814.9625
313	313	858.8125	813.8125	360	360	859.9875	814.9875
314	314	858.8375	813.8375	361	361	860.0125	815.0125
315	315	858.8625	813.8625	362	362	860.0375	815.0375
316	316	858.8875	813.8875	363	363	860.0625	815.0625
318	318	858.9375	813.9375	364	364	860.0875	815.0875
319	319	858.9625	813.9625	365	365	860.1125	815.1125
320	320	858.9875	813.9875	366	366	860.1375	815.1375

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
367	367	860.1625	815.1625	413	413	861.3125	816.3125
368	368	860.1875	815.1875	414	414	861.3375	816.3375
369	369	860.2125	815.2125	415	415	861.3625	816.3625
370	370	860.2375	815.2375	416	416	861.3875	816.3875
371	371	860.2625	815.2625	417	417	861.4125	816.4125
372	372	860.2875	815.2875	418	418	861.4375	816.4375
373	373	860.3125	815.3125	419	419	861.4625	816.4625
374	374	860.3375	815.3375	420	420	861.4875	816.4875
375	375	860.3625	815.3625	421	421	861.5125	816.5125
376	376	860.3875	815.3875	422	422	861.5375	816.5375
377	377	860.4125	815.4125	423	423	861.5625	816.5625
378	378	860.4375	815.4375	424	424	861.5875	816.5875
379	379	860.4625	815.4625	425	425	861.6125	816.6125
380	380	860.4875	815.4875	426	426	861.6375	816.6375
381	381	860.5125	815.5125	427	427	861.6625	816.6625
382	382	860.5375	815.5375	428	428	861.6875	816.6875
383	383	860.5625	815.5625	429	429	861.7125	816.7125
384	384	860.5875	815.5875	430	430	861.7375	816.7375
385	385	860.6125	815.6125	431	431	861.7625	816.7625
386	386	860.6375	815.6375	432	432	861.7875	816.7875
387	387	860.6625	815.6625	433	433	861.8125	816.8125
388	388	860.6875	815.6875	434	434	861.8375	816.8375
389	389	860.7125	815.7125	435	435	861.8625	816.8625
390	390	860.7375	815.7375	436	436	861.8875	816.8875
391	391	860.7625	815.7625	437	437	861.9125	816.9125
392	392	860.7875	815.7875	438	438	861.9375	816.9375
393	393	860.8125	815.8125	439	439	861.9625	816.9625
394	394	860.8375	815.8375	440	440	861.9875	816.9875
395	395	860.8625	815.8625	441	441	862.0125	817.0125
396	396	860.8875	815.8875	442	442	862.0375	817.0375
397	397	860.9125	815.9125	443	443	862.0625	817.0625
398	398	860.9375	815.9375	444	444	862.0875	817.0875
399	399	860.9625	815.9625	445	445	862.1125	817.1125
400	400	860.9875	815.9875	446	446	862.1375	817.1375
401	401	861.0125	816.0125	447	447	862.1625	817.1625
402	402	861.0375	816.0375	448	448	862.1875	817.1875
403	403	861.0625	816.0625	449	449	862.2125	817.2125
404	404	861.0875	816.0875	450	450	862.2375	817.2375
405	405	861.1125	816.1125	451	451	862.2625	817.2625
406	406	861.1375	816.1375	452	452	862.2875	817.2875
407	407	861.1625	816.1625	453	453	862.3125	817.3125
408	408	861.1875	816.1875	454	454	862.3375	817.3375
409	409	861.2125	816.2125	455	455	862.3625	817.3625
410	410	861.2375	816.2375	456	456	862.3875	817.3875
411	411	861.2625	816.2625	457	457	862.4125	817.4125
412	412	861.2875	816.2875	458	458	862.4375	817.4375

800 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
459	459	862.4625	817.4625	505	505	863.6125	818.6125
460	460	862.4875	817.4875	506	506	863.6375	818.6375
461	461	862.5125	817.5125	507	507	863.6625	818.6625
462	462	862.5375	817.5375	508	508	863.6875	818.6875
463	463	862.5625	817.5625	509	509	863.7125	818.7125
464	464	862.5875	817.5875	510	510	863.7375	818.7375
465	465	862.6125	817.6125	511	511	863.7625	818.7625
466	466	862.6375	817.6375	512	512	863.7875	818.7875
467	467	862.6625	817.6625	513	513	863.8125	818.8125
468	468	862.6875	817.6875	514	514	863.8375	818.8375
469	469	862.7125	817.7125	515	515	863.8625	818.8625
470	470	862.7375	817.7375	516	516	863.8875	818.8875
471	471	862.7625	817.7625	517	517	863.9125	818.9125
472	472	862.7875	817.7875	518	518	863.9375	818.9375
473	473	862.8125	817.8125	519	519	863.9625	818.9625
474	474	862.8375	817.8375	520	520	863.9875	818.9875
475	475	862.8625	817.8625	521	521	864.0125	819.0125
476	476	862.8875	817.8875	522	522	864.0375	819.0375
477	477	862.9125	817.9125	523	523	864.0625	819.0625
478	478	862.9375	817.9375	524	524	864.0875	819.0875
479	479	862.9625	817.9625	525	525	864.1125	819.1125
480	480	862.9875	817.9875	526	526	864.1375	819.1375
481	481	863.0125	818.0125	527	527	864.1625	819.1625
482	482	863.0375	818.0375	528	528	864.1875	819.1875
483	483	863.0625	818.0625	529	529	864.2125	819.2125
484	484	863.0875	818.0875	530	530	864.2375	819.2375
485	485	863.1125	818.1125	531	531	864.2625	819.2625
486	486	863.1375	818.1375	532	532	864.2875	819.2875
487	487	863.1625	818.1625	533	533	864.3125	819.3125
488	488	863.1875	818.1875	534	534	864.3375	819.3375
489	489	863.2125	818.2125	535	535	864.3625	819.3625
490	490	863.2375	818.2375	536	536	864.3875	819.3875
491	491	863.2625	818.2625	537	537	864.4125	819.4125
492	492	863.2875	818.2875	538	538	864.4375	819.4375
493	493	863.3125	818.3125	539	539	864.4625	819.4625
494	494	863.3375	818.3375	540	540	864.4875	819.4875
495	495	863.3625	818.3625	541	541	864.5125	819.5125
496	496	863.3875	818.3875	542	542	864.5375	819.5375
497	497	863.4125	818.4125	543	543	864.5625	819.5625
498	498	863.4375	818.4375	544	544	864.5875	819.5875
499	499	863.4625	818.4625	545	545	864.6125	819.6125
500	500	863.4875	818.4875	546	546	864.6375	819.6375
501	501	863.5125	818.5125	547	547	864.6625	819.6625
502	502	863.5375	818.5375	548	548	864.6875	819.6875
503	503	863.5625	818.5625	549	549	864.7125	819.7125
504	504	863.5875	818.5875	550	550	864.7375	819.7375

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
551	551	864.7625	819.7625	597	597	865.9125	820.9125
552	552	864.7875	819.7875	598	598	865.9375	820.9375
553	553	864.8125	819.8125	599	599	865.9625	820.9625
554	554	864.8375	819.8375	600	600	865.9875	820.9875
555	555	864.8625	819.8625	601	-	866.0000	821.0000
556	556	864.8875	819.8875	602	601	866.0125	821.0125
557	557	864.9125	819.9125	603	-	866.0250	821.0250
558	558	864.9375	819.9375	604	602	866.0375	821.0375
559	559	864.9625	819.9625	605	603	866.0500	821.0500
560	560	864.9875	819.9875	606	604	866.0625	821.0625
561	561	865.0125	820.0125	607	605	866.0750	821.0750
562	562	865.0375	820.0375	608	606	866.0875	821.0875
563	563	865.0625	820.0625	609	607	866.1000	821.1000
564	564	865.0875	820.0875	610	608	866.1125	821.1125
565	565	865.1125	820.1125	611	609	866.1250	821.1250
566	566	865.1375	820.1375	612	610	866.1375	821.1375
567	567	865.1625	820.1625	613	611	866.1500	821.1500
568	568	865.1875	820.1875	614	612	866.1625	821.1625
569	569	865.2125	820.2125	615	613	866.1750	821.1750
570	570	865.2375	820.2375	616	614	866.1875	821.1875
571	571	865.2625	820.2625	617	615	866.2000	821.2000
572	572	865.2875	820.2875	618	616	866.2125	821.2125
573	573	865.3125	820.3125	619	617	866.2250	821.2250
574	574	865.3375	820.3375	620	618	866.2375	821.2375
575	575	865.3625	820.3625	621	619	866.2500	821.2500
576	576	865.3875	820.3875	622	620	866.2625	821.2625
577	577	865.4125	820.4125	623	621	866.2750	821.2750
578	578	865.4375	820.4375	624	622	866.2875	821.2875
579	579	865.4625	820.4625	625	623	866.3000	821.3000
580	580	865.4875	820.4875	626	624	866.3125	821.3125
581	581	865.5125	820.5125	627	625	866.3250	821.3250
582	582	865.5375	820.5375	628	626	866.3375	821.3375
583	583	865.5625	820.5625	629	627	866.3500	821.3500
584	584	865.5875	820.5875	630	628	866.3625	821.3625
585	585	865.6125	820.6125	631	629	866.3750	821.3750
586	586	865.6375	820.6375	632	630	866.3875	821.3875
587	587	865.6625	820.6625	633	631	866.4000	821.4000
588	588	865.6875	820.6875	634	632	866.4125	821.4125
589	589	865.7125	820.7125	635	633	866.4250	821.4250
590	590	865.7375	820.7375	636	634	866.4375	821.4375
591	591	865.7625	820.7625	637	635	866.4500	821.4500
592	592	865.7875	820.7875	638	636	866.4625	821.4625
593	593	865.8125	820.8125	639	637	866.4750	821.4750
594	594	865.8375	820.8375	640	638	866.4875	821.4875
595	595	865.8625	820.8625	641	-	866.5000	821.5000
596	596	865.8875	820.8875	642	639	866.5125	821.5125

800 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
643	-	866.5250	821.5250	689	683	867.1000	822.1000
644	640	866.5375	821.5375	690	684	867.1125	822.1125
645	641	866.5500	821.5500	691	685	867.1250	822.1250
646	642	866.5625	821.5625	692	686	867.1375	822.1375
647	643	866.5750	821.5750	693	687	867.1500	822.1500
648	644	866.5875	821.5875	694	688	867.1625	822.1625
649	645	866.6000	821.6000	695	689	867.1750	822.1750
650	646	866.6125	821.6125	696	690	867.1875	822.1875
651	647	866.6250	821.6250	697	691	867.2000	822.2000
652	648	866.6375	821.6375	698	692	867.2125	822.2125
653	649	866.6500	821.6500	699	693	867.2250	822.2250
654	650	866.6625	821.6625	700	694	867.2375	822.2375
655	651	866.6750	821.6750	701	695	867.2500	822.2500
656	652	866.6875	821.6875	702	696	867.2625	822.2625
657	653	866.7000	821.7000	703	697	867.2750	822.2750
658	654	866.7125	821.7125	704	698	867.2875	822.2875
659	655	866.7250	821.7250	705	699	867.3000	822.3000
660	656	866.7375	821.7375	706	700	867.3125	822.3125
661	657	866.7500	821.7500	707	701	867.3250	822.3250
662	658	866.7625	821.7625	708	702	867.3375	822.3375
663	659	866.7750	821.7750	709	703	867.3500	822.3500
664	660	866.7875	821.7875	710	704	867.3625	822.3625
665	661	866.8000	821.8000	711	705	867.3750	822.3750
666	662	866.8125	821.8125	712	706	867.3875	822.3875
667	663	866.8250	821.8250	713	707	867.4000	822.4000
668	664	866.8375	821.8375	714	708	867.4125	822.4125
669	665	866.8500	821.8500	715	709	867.4250	822.4250
670	666	866.8625	821.8625	716	710	867.4375	822.4375
671	667	866.8750	821.8750	717	711	867.4500	822.4500
672	668	866.8875	821.8875	718	712	867.4625	822.4625
673	669	866.9000	821.9000	719	713	867.4750	822.4750
674	670	866.9125	821.9125	720	714	867.4875	822.4875
675	671	866.9250	821.9250	721	-	867.5000	822.5000
676	672	866.9375	821.9375	722	715	867.5125	822.5125
677	673	866.9500	821.9500	723	-	867.5250	822.5250
678	674	866.9625	821.9625	724	716	867.5375	822.5375
679	675	866.9750	821.9750	725	717	867.5500	822.5500
680	676	866.9875	821.9875	726	718	867.5625	822.5625
681	-	867.0000	822.0000	727	719	867.5750	822.5750
682	677	867.0125	822.0125	728	720	867.5875	822.5875
683	-	867.0250	822.0250	729	721	867.6000	822.6000
684	678	867.0375	822.0375	731	723	867.6250	822.6250
685	679	867.0500	822.0500	732	724	867.6375	822.6375
686	680	867.0625	822.0625	733	725	867.6500	822.6500
687	681	867.0750	822.0750	734	726	867.6625	822.6625
688	682	867.0875	822.0875	735	727	867.6750	822.6750

Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency	Program Channel Number	FCC Channel Number	Repeater Transmit Frequency	Repeater Receive Frequency
736	728	867.6875	822.6875	782	772	868.2625	823.2625
737	729	867.7000	822.7000	783	773	868.2750	823.2750
738	730	867.7125	822.7125	784	774	868.2875	823.2875
739	731	867.7250	822.7250	785	775	868.3000	823.3000
740	732	867.7375	822.7375	786	776	868.3125	823.3125
741	733	867.7500	822.7500	787	777	868.3250	823.3250
742	734	867.7625	822.7625	788	778	868.3375	823.3375
743	735	867.7750	822.7750	789	779	868.3500	823.3500
744	736	867.7875	822.7875	790	780	868.3625	823.3625
745	737	867.8000	822.8000	791	781	868.3750	823.3750
746	738	867.8125	822.8125	792	782	868.3875	823.3875
747	739	867.8250	822.8250	793	783	868.4000	823.4000
748	740	867.8375	822.8375	794	784	868.4125	823.4125
749	741	867.8500	822.8500	795	785	868.4250	823.4250
750	742	867.8625	822.8625	796	786	868.4375	823.4375
751	743	867.8750	822.8750	797	787	868.4500	823.4500
752	744	867.8875	822.8875	798	788	868.4625	823.4625
753	745	867.9000	822.9000	799	789	868.4750	823.4750
754	746	867.9125	822.9125	800	790	868.4875	823.4875
755	747	867.9250	822.9250	801	791	868.5000	823.5000
756	748	867.9375	822.9375	802	792	868.5125	823.5125
757	749	867.9500	822.9500	803	793	868.5250	823.5250
758	750	867.9625	822.9625	804	794	868.5375	823.5375
759	751	867.9750	822.9750	805	795	868.5500	823.5500
760	752	867.9875	822.9875	806	796	868.5625	823.5625
761	-	868.0000	823.0000	807	797	868.5750	823.5750
762	753	868.0125	823.0125	808	798	868.5875	823.5875
763	-	868.0250	823.0250	809	799	868.6000	823.6000
764	754	868.0375	823.0375	810	800	868.6125	823.6125
765	755	868.0500	823.0500	811	801	868.6250	823.6250
766	756	868.0625	823.0625	812	802	868.6375	823.6375
767	757	868.0750	823.0750	813	803	868.6500	823.6500
768	758	868.0875	823.0875	814	804	868.6625	823.6625
769	759	868.1000	823.1000	815	805	868.6750	823.6750
770	760	868.1125	823.1125	816	806	868.6875	823.6875
771	761	868.1250	823.1250	817	807	868.7000	823.7000
772	762	868.1375	823.1375	818	808	868.7125	823.7125
773	763	868.1500	823.1500	819	809	868.7250	823.7250
774	764	868.1625	823.1625	820	810	868.7375	823.7375
775	765	868.1750	823.1750	821	811	868.7500	823.7500
776	766	868.1875	823.1875	822	812	868.7625	823.7625
777	767	868.2000	823.2000	823	813	868.7750	823.7750
778	768	868.2125	823.2125	824	814	868.7875	823.7875
779	769	868.2250	823.2250	825	815	868.8000	823.8000
780	770	868.2375	823.2375	826	816	868.8125	823.8125
781	771	868.2500	823.2500	827	817	868.8250	823.8250

800 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
828	818	868.8375	823.8375	874	-	869.4125	824.4125
829	819	868.8500	823.8500	875	-	869.4250	824.4250
830	820	868.8625	823.8625	876	-	869.4375	824.4375
831	821	868.8750	823.8750	877	-	869.4500	824.4500
832	822	868.8875	823.8875	878	-	869.4625	824.4625
833	823	868.9000	823.9000	879	-	869.4750	824.4750
834	824	868.9125	823.9125	880	-	869.4875	824.4875
835	825	868.9250	823.9250	881	-	869.5000	824.5000
836	826	868.9375	823.9375	882	-	869.5125	824.5125
837	827	868.9500	823.9500	883	-	869.5250	824.5250
838	828	868.9625	823.9625	884	-	869.5375	824.5375
839	829	868.9750	823.9750	885	-	869.5500	824.5500
840	830	868.9875	823.9875	886	-	869.5625	824.5625
841	-	869.0000	824.0000	887	-	869.5750	824.5750
842	-	869.0125	824.0125	888	-	869.5875	824.5875
843	-	869.0250	824.0250	889	-	869.6000	824.6000
844	-	869.0375	824.0375	890	-	869.6125	824.6125
845	-	869.0500	824.0500	891	-	869.6250	824.6250
846	-	869.0625	824.0625	892	-	869.6375	824.6375
847	-	869.0750	824.0750	893	-	869.6500	824.6500
848	-	869.0875	824.0875	894	-	869.6625	824.6625
849	-	869.1000	824.1000	895	-	869.6750	824.6750
850	-	869.1125	824.1125	896	-	869.6875	824.6875
851	-	869.1250	824.1250	897	-	869.7000	824.7000
852	-	869.1375	824.1375	898	-	869.7125	824.7125
853	-	869.1500	824.1500	899	-	869.7250	824.7250
854	-	869.1625	824.1625	900	-	869.7375	824.7375
855	-	869.1750	824.1750	901	-	869.7500	824.7500
856	-	869.1875	824.1875	902	-	869.7625	824.7625
857	-	869.2000	824.2000	903	-	869.7750	824.7750
858	-	869.2125	824.2125	904	-	869.7875	824.7875
859	-	869.2250	824.2250	905	-	869.8000	824.8000
860	-	869.2375	824.2375	906	-	869.8125	824.8125
861	-	869.2500	824.2500	907	-	869.8250	824.8250
862	-	869.2625	824.2625	908	-	869.8375	824.8375
863	-	869.2750	824.2750	909	-	869.8500	824.8500
864	-	869.2875	824.2875	910	-	869.8625	824.8625
865	-	869.3000	824.3000	911	-	869.8750	824.8750
866	-	869.3125	824.3125	912	-	869.8875	824.8875
867	-	869.3250	824.3250	913	-	869.9000	824.9000
868	-	869.3375	824.3375	914	-	869.9125	824.9125
869	-	869.3500	824.3500	915	-	869.9250	824.9250
870	-	869.3625	824.3625	916	-	869.9375	824.9375
871	-	869.3750	824.3750	917	-	869.9500	824.9500
872	-	869.3875	824.3875	918	-	869.9625	824.9625
873	-	869.4000	824.4000	919	-	869.9750	824.9750
				920	-	869.9875	824.9875