

*Platinum Z5CD™
FM Transmitter Manual*

888-2408-002

*Platinum Z5CD™
FM Transmitter Manual*

HARRIS

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Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Division, specify the HARRIS Order Number or Invoice Number.

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Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/222-7041) or a TELEX service (650/372-2976).

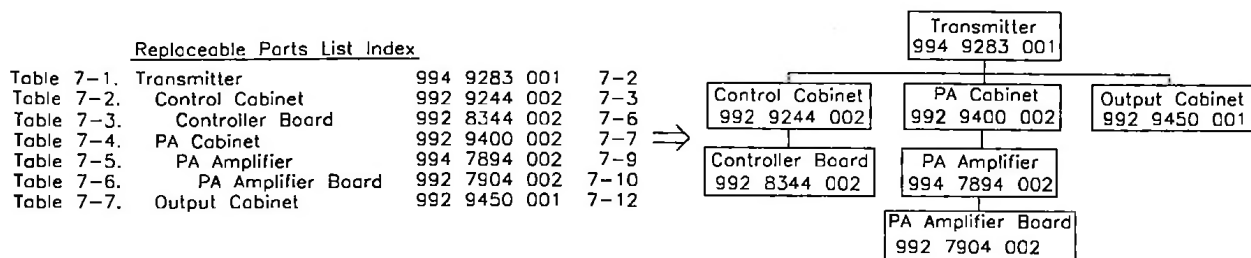
NOTE

The # symbol used in the parts list means used with (e.g. #C001 = used with C001).

Guide to Using Harris Parts List Information

The Harris Replaceable Parts List Index portrays a tree structure with the major items being leftmost in the index. The example below shows the Transmitter as the highest item in the tree structure. If you were to look at the bill of materials table for the Transmitter you would find the Control Cabinet, the PA Cabinet, and the Output Cabinet. In the Replaceable Parts List Index the Control Cabinet, PA Cabinet, and Output Cabinet show up one indentation level below the Transmitter and implies that they are used in the Transmitter. The Controller Board is indented one level below the Control Cabinet so it will show up in the bill of material for the Control Cabinet. The tree structure of this same index is shown to the right of the table and shows indentation level versus tree structure level.

Example of Replaceable Parts List Index and equivalent tree structure:



The part number of the item is shown to the right of the description as is the page in the manual where the bill for that part number starts.

Inside the actual tables, four main headings are used:

Table #-#. ITEM NAME - HARRIS PART NUMBER - this line gives the information that corresponds to the Replaceable Parts List Index entry;

HARRIS P/N column gives the ten digit Harris part number (usually in ascending order);

DESCRIPTION column gives a 25 character or less description of the part number;

REF. SYMBOLS/EXPLANATIONS column 1) gives the reference designators for the item (i.e., C001, R102, etc.) that corresponds to the number found in the schematics (C001 in a bill of material is equivalent to CI on the schematic) or 2) gives added information or further explanation (i.e., "Used for 208V operation only," or "Used for HT 10LS only," etc.).

Inside the individual tables some standard conventions are used:

A # symbol in front of a component such as #C001 under the REF. SYMBOLS/EXPLANATIONS column means that this item is used on or with C001 and is not the actual part number for C001.

In the ten digit part numbers, if the last three numbers are 000, the item is a part that Harris has purchased and has not manufactured or modified. If the last three numbers are other than 000, the item is either manufactured by Harris or is purchased from a vendor and modified for use in the Harris product.

The first three digits of the ten digit part number tell which family the part number belongs to - for example, all electrolytic (can) capacitors will be in the same family (524 xxxx 000). If an electrolytic (can) capacitor is found to have a 9xx xxxx xxx part number (a number outside of the normal family of numbers), it has probably been modified in some manner at the Harris factory and will therefore show up farther down into the individual parts list (because each table is normally sorted in ascending order). Most Harris made or modified assemblies will have 9xx xxxx xxx numbers associated with them.

The term "SEE HIGHER LEVEL BILL" in the description column implies that the reference designated part number will show up in a bill that is higher in the tree structure. This is often the case for components that may be frequency determinant or voltage determinant and are called out in a higher level bill structure that is more customer dependent than the bill at a lower level.

WARNING

THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks.

During installation and operation of this equipment, local building codes and fire protection standards must be observed. The following National Fire Protection Association (NFPA) standards are recommended as reference:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

WARNING

ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances.

WARNING

IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.

WARNING

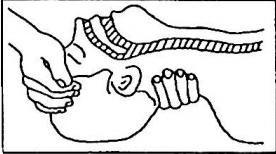
IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.

TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-C'S OF BASIC LIFE SUPPORT.
PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

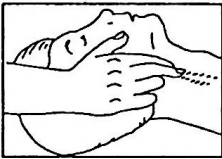
(A) AIRWAY

IF UNCONSCIOUS.
OPEN AIRWAY



LIFT UP NECK
PUSH FOREHEAD BACK
CLEAR OUT MOUTH IF NECESSARY
OBSERVE FOR BREATHING

CHECK
CAROTID PULSE



IF PULSE ABSENT.
BEGIN ARTIFICIAL
CIRCULATION

(B) BREATHING

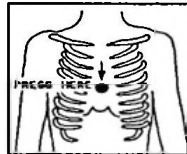
IF NOT BREATHING.
BEGIN ARTIFICIAL BREATHING



TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL
4 QUICK FULL BREATHS
REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

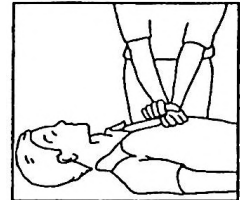
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



APPROX. RATE
OF COMPRESSIONS { ONE RESCUER
--80 PER MINUTE { 15 COMPRESSIONS
2 QUICK BREATHS

APPROX. RATE
OF COMPRESSIONS { TWO RESCUERS
--60 PER MINUTE { 5 COMPRESSIONS
1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS
WHEN SECOND PERSON IS GIVING BREATH

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

- KEEP THEM WARM
- KEEP THEM AS QUIET AS POSSIBLE
- LOOSEN THEIR CLOTHING
- A RECLINING POSITION IS RECOMMENDED

FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is a brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

Treatment of Electrical Burns

1. Extensive burned and broken skin
 - a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)
 - b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
 - c. Treat victim for shock as required.
 - d. Arrange transportation to a hospital as quickly as possible.
 - e. If arms or legs are affected keep them elevated.

NOTE

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)
 - a. Apply cool (not ice cold) compresses using the cleanest available cloth article.
 - b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
 - c. Apply clean dry dressing if necessary.
 - d. Treat victim for shock as required.
 - e. Arrange transportation to a hospital as quickly as possible.
 - f. If arms or legs are affected keep them elevated.

REFERENCE:

ILLINOIS HEART ASSOCIATION

AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL (SECOND EDITION)

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Introduction/ Specifications

1

1.1 Introduction

This technical manual describes the Harris Platinum Z5 solid-state FM radio transmitter. This manual contains all the information needed to install, operate and service these transmitters.

This manual contains the following sections:

- Section 1: Introduction/Specifications, identifies the versions of the product available and the possible options, and provides specifications.
- Section 2: Installation/Initial Turn-on, details the procedures to receive, install and prepare the transmitter for use, up through the initial turn-on of the equipment.
- Section 3: Operators Guide, describes operation of the equipment and is intended to be the primary section referenced by operating personnel.
- Section 4: Overall System Theory, is included to help service personnel to understand the inner workings of the transmitter.
- Section 5: Maintenance/Alignments-Adjustments, lists and explains alignments and adjustments which might be required once the transmitter leaves the Harris Broadcast factory.
- Section 6: Troubleshooting, is included as a servicing aid, to be used along with Sections 4 and 5 by qualified service personnel to identify and correct any equipment problem which might develop.
- Section 7: Parts List, a comprehensive listing any of the equipment's components which might ever be needed.

1.2 Features/Benefits

- Includes the field-proven Harris DIGIT Digital FM Exciter with built in DSP stereo generator. As the world's first all-digital FM exciter the Harris DIGIT accepts AES/EBU digital audio and generates the fully modulated RF carrier totally in the digital domain for the lowest noise and distortion available in any FM transmitter (16 bit digital audio quality).
- Power output range: 1.25 - 5kW for Z5CD; up to 5.5kW into a 1.1 or less VSWR.
- Redundant, autoswitching, IPA amplifiers to eliminate a single point of failure.
- Microprocessor based controller for advanced control, diagnostics and display capability. Includes built-in logic and commands for switching between main/alternate DIGIT exciters and IPAs.
- Redundant RF amplifier modules that allow maintenance while the transmitter remains on the air at reduced power ("Hot-Pluggable" modules).
- Redundant power supplies to keep the transmitter on the air.
- Broadband design to eliminate tuning adjustments from 87 through 108MHz (N+1 capable). Frequency change can be done manually in less than five minutes using simple switch settings, and in less than 0.5 seconds using an optional, external controller.
- Quick start design provides full output power meeting all specifications within five seconds of an "On" Command.
- Versatile air cooling design uses either an internal blower or an external air system.
- Dual output power settings, standard, along with a third available power setting for use with UPS or generator backup systems.
- Directional RF sample port provided for customer use.
- Available for single or three phase mains power, 50/60Hz.

1.3 General Description

The Harris Platinum Z is a series of highly-functional, cost-effective FM radio transmitters designed using a concept called Z-Axis 3-dimensional electronic design. The Z5CD and Z5FM are 5kW versions of the Platinum Z FM transmitter. The Z5CD (Clearly Digital) utilizes the Harris DigitCD, Digital FM exciter, while the Z5FM would designate an analog exciter such as the Harris SuperCiter is being used.

The Z-axis approach arranges the system RF components such as dividers, combiners and amplifiers in three dimensions, to permit the most efficient possible signal paths between them. The method allows the transmitter amplifying group to be broken down economically into the smallest possible blocks for removal, servicing and replacement. See Figure 4-1 on page 4-2 for overall block diagram.

1.3.1 Harris DIGIT Digital FM Exciter

The Harris DIGIT FM exciter is supplied as standard equipment with all Platinum Z transmitters. The DIGIT, with its digital input module, generates the complete stereo FM waveform in the digital domain, using a digital signal processor (DSP) as a stereo generator and composite limiter, and a 32-bit numerically controlled oscillator (NCO) as a digital modulator. Digital techniques allow direct connection of standard AES/EBU stereo audio data to the FM exciter to eliminate the distortion and alignment problems of analog signal paths and analog FM exciters. DIGIT is also available with an analog interface module for stations with analog program paths, easily interchangeable with the digital module.

1.3.2 Harris SuperCiter Analog Exciter

The optional Harris SuperCiter is a 55 watt, high quality, analog exciter designed for broadcasters needing state-of-the-art analog performance at a value price. The SuperCiter combines time-proven PLL technology with modern RF amplifier circuits to provide driving power of very high quality to any FM transmitter.

1.3.3 Redundant Exciters

Each transmitter includes one exciter in a basic version but allows space for a second optional exciter with the needed exciter exchange autoswitching hardware and control already within the cabinet.

1.3.4 PA/IPA Modules

Each PA Modules consists of two independent RF amplifiers or PAs. Each PA has two MOSFET devices mounted on a compact heat spreading assembly and is capable of providing up to 425 watts (850W per module). Each PA module consists of two RF PAs mounted on opposite sides of the heatsink assembly. The RF modules plug directly into an isolated combiner without using channel sensitive RF cables. PA modules are “hot-pluggable” and can be removed and inserted into an operating transmitter without removing plugs and cables. Each PA module is conservatively rated to produce over 750 watts of output power into a system VSWR of 1.5:1 at up to 50 degrees C ambient temperature at sea level.

The IPA consists of a standard PA Module with only one side active at a time to provide the required drive to the 5kW PA. The transmitter contains sensing, logic and switching circuitry which will automatically switch from a failed IPA to the remaining one. For even further redundancy, any PA module can also be used as an IPA module, without modification.

1.3.5 RF Combining

Each PA (one half of a PA module) is combined first in groups of eight in a compact, “Z plane” isolated combiner. True isolation means that each module will continue to work into a nominal 50 ohm load regardless of the number of active amplifiers, for almost zero stress to the amplifiers during fault conditions. The outputs of the 8 way combiners are then combined in a compact 3dB hybrid. The 3dB hybrid provides improved load conditions for the RF modules and tends to absorb power received by the antenna. This can reduce the amount of RF intermodulation generated by the transmitter when co-sited with other FM transmitters.

1.3.6 Control System

A microprocessor based controller monitors over 100 operating functions of the transmitter and makes intelligent operating decisions based on operating conditions. Detailed system information is available using the front panel diagnostic display. The controller is designed for direct connection to standard parallel remote control systems.

The Controller also includes built-in logic and controls for automatically switching to the reserve IPA section, and a backup exciter if installed. The main controller provides automatic power control, VSWR overload protection, automatic VSWR foldback, RF power soft start, AC restart and diagnostics. Basic control functions available even without the main controller are VSWR protection, IPA protection, transmitter on/off, failsafe and interlock.

The control system for the transmitter is modular and is centered on the backplane which is also the control panel for the transmitter. Various control printed circuit

boards are plugged into the backplane to fit the transmitter for the configuration being supplied.

The control system front panel includes an output metering LCD display which can be used to view power output, VSWR, PA voltage and PA current. A second LCD window, the Diagnostics Display, permits extensive viewing of internal voltages, temperatures and a detailed Fault Log to easily pin-point problems. Long-life LED fault and status indicators and reliable membrane switches provide all needed local control and selection for the transmitter.

1.3.7 Directional RF Sample Port

Platinum Z FM transmitters provide an RF sample port with 30dB nominal directivity. A directional RF sample provides more accurate performance measurements by supplying a nearly reflection free RF sample source for external monitoring equipment.

1.3.8 Power Supplies


The Z5 can be configured with a 3-Phase or Single Phase power supply. Both of these supplies are dual units, with each supply powering half of the PA amplifiers. Most other sections such as the IPA and the control system are powered from both supplies. The supplies are regulated by reliable tap-switching techniques (non-switching design). This approach provides high conversion efficiency and excellent power factor with very low line harmonics, in an easy to service design. The power supplies are mounted on a roll-out mounting plate for complete accessibility. The dual-supply concept protects against total loss of service due to loss of a single supply.

1.3.9 Air System

The Platinum Z uses a 2 speed fan to pull air in the back of the transmitter and exhausts it out the top. There are air channels up through the PA assembly for cooling. Upon startup, the transmitter will run at high speed for 1 minute, then will drop to a lower speed provided there are no active faults. If a fault does occur during normal operation the fan will automatically switch to high speed. For detailed airflow information, refer to the Cabinet Outline Drawing in the Schematic package.

1.4 Performance Specifications

See Sales Brochure at the end of this manual for a listing of the Performance Specifications for the Platinum Z FM Transmitter.

 **NOTE:**
Specifications subject to change without notice.



Installation & Initial Turn-On

2

2.1 Introduction

This section contains information for the installation of the Platinum Z5 solid state FM Broadcast Transmitter and for performing the pre-operational checks.



NOTE:

For Dual transmitter installations refer to the Systems Manual before proceeding with this procedure.

2.2 Unpacking

Carefully unpack the transmitter and perform a visual inspection to ensure that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that the unit is not damaged. The contents of the shipment should be as indicated on the packing list. If the contents are incomplete or if the unit is damaged electrically or mechanically, notify the carrier and HARRIS CORPORATION, Broadcast Systems

2.3 Returns and Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Systems, specify the HARRIS Order Number or Invoice Number.

2.4 Air Cooling Requirements

Harris transmitters are designed to operate in a free, unobstructed environment with a maximum inlet air temperature of 50°C. This means that the transmitter air system is designed to supply sufficient air at the required static pressure to cool the transmitter only. Any additional pressure losses introduced by air exhaust systems & air supply systems must be satisfied by means other than the transmitter blowers. These inlet & exhaust systems generally need to be fan driven. Refer to the Outline Drawing in the schematic package for information on intake and exhaust air flows.



NOTE:

"Clean" air is required. No salt air, polluted air, or sulphur air can be tolerated. A closed air system is recommended in these environments; that is, an air conditioned room that recirculates, and properly filters, the room air. No outside air is brought into the transmitter room.

2.5 Z5 Transmitter Installation

Prior to installation, this Technical Manual and the appropriate FM Exciter Technical Manual should be carefully studied to obtain a thorough understanding of the principles of operation, circuitry and nomenclature. This will facilitate proper installation and initial checkout.



CAUTION:

ALL CONNECTIONS REFERRED TO IN THIS INSTALLATION PROCEDURE SHOULD BE VERIFIED USING THE SCHEMATICS SUPPLIED WITH THE TRANSMITTER. THE SCHEMATICS SHOULD BE CONSIDERED THE MOST ACCURATE IN CASE OF A DISCREPANCY.

The FM Transmitter installation is accomplished in the following order:

1. Transmitter placement
2. Visual Inspection
3. Exciter Installation
4. Power Supply Installation
5. Transmitter wiring
6. Initial checkout
7. Remote Control Connections

2.5.1 Transmitter Placement

Set the transmitter in place on a level surface near power and signal cables. Either or both sides of the FM Transmitter may be placed against a wall or other equipment. Complete access is through the front and rear of the transmitter. The floor must be capable of supporting a load of 250 pounds per-square-foot (1221 kg per-square-meter) (refer to Cabinet Outline drawing). Also be aware that the power supplies are very heavy and roll out the front of the transmitter for maintenance. Be sure to have a smooth flat surface in front of the transmitter of at least 36 inches for power supply maintenance.

2.5.1.1 Removal of Pallet Bolts

There are 4 bolts which must be removed in order to take the transmitter off the wooden pallet, 2 toward the front of the cabinet and 2 toward the rear. Location of these bolts can be verified by looking for the bolt heads underneath the pallet. If the transmitter was shipped with the power supply removed, simply remove the power supply cover from the bottom front of the transmitter cabinet to access the pallet bolts. However, if the transmitter was shipped with the power supply installed, the power supply tray is covering the bolts, so the fan assembly on the rear of the transmitter will also have to be removed to access the rear pallet bolts (the power supply itself does not have to be removed). Open and remove the rear door by lifting it off its hinges. Remove the fan assembly by removing six screws and two nuts located around the outside edge of the fan assembly. Slowly move the assembly to the righthand side and disconnect the blower wire connector. The fan assembly can now be set aside while removing the transmitter from the pallet. The rear pallet bolts can now be accessed under the rear of the power supply tray.

After the transmitter is off the pallet, it is also a good idea to remove the shipping screws holding the rear of the power supply tray. This will allow the power supply to be rolled out the front of the transmitter at a later date without having to take off the fan assembly.

2.5.2 Visual Inspection

Be sure to check the connection of all cables and wires in the transmitter. Areas to check would include:

a. Power Supply Connections

1. Check for loose cables and connections on the power supply trays and loose hardware on the floor of the cabinet.
2. Make sure the Rectifier Boards are properly seated in the connectors on top of the transformers (3-phase version).
3. Check the power supply and control connections to the Rectifier Boards.

b. Controller Connections

1. Check the Ribbon cables connected to the back of the controller boards and to the exciter(s).
2. Make sure that all of the boards in the controller are properly seated in the backplane (motherboard) connector.

2.5.3 Exciter Installation

The exciter may or may not be removed from the transmitter depending on the shipping considerations. If the exciter was not removed for shipping, then all transmitter connections will already be hooked up. The audio input connections and level adjustments can be found in the exciter manual accompanying the transmitter.

Install the exciter input cables in a metal conduit which is separate from the AC supply. Remote control cabling may be included in the same conduit with the exciter cabling. AC power wiring and small signal lines should never be put in the same conduit.

If the exciter was removed for shipping, there are three cables which will need to be hooked up (not counting the audio inputs).

- a. A ribbon cable which will hook to the remote control connector on the back of the exciter. This is A10-J2 on the SuperCiter and J2 on the 'DIGIT.
- b. A coaxial cable with a male BNC connector which connects to the exciter rf output. This is A10-J11 on the SuperCiter and J1 on the DIGIT.
- c. AC Power Cable. Verify that the exciter is set for the correct operating voltage. For more information refer to the Exciter Manual, Section II, Installation.

NOTE:

For Digit Exciters, the VCO shipping screws must be removed as outlined in the exciter manual in Section II.

2.5.4 3-Phase Power Supply Installation

The Z5 transmitter can be configured with either a 3-Phase or Single Phase power supply. Operation of the supplies is basically the same with both using the dynamic tap switching for efficiency. However, their physical make-up is different and requires separate installation procedures. The 3-phase will be discussed first, then the Single Phase will follow. Note that some transmitters may be shipped with the power supply installed, depending on where and how it is shipped. If the power supply is already installed and your measured AC voltage at the wall breaker matches the Factory test data sheet and the tag on the main AC contactor in the rear of the transmitter then skip the power supply installation and proceed directly to "2.5.6 Transmitter AC Connections" on page 2-11. If there are any discrepancies then the transformer tapping will have to be checked and possibly changed as outlined below.



WARNING:

DISCONNECT AND LOCKOUT STATION PRIMARY POWER AT THE WALL BREAKER BEFORE MAKING ANY CONNECTIONS.

2.5.4.1 Power Transformer Tapping

The power transformers are tapped at the factory for the primary AC voltage specified by the customer. This voltage should be documented in the factory test data accompanying the transmitter and tagged at the main contactor in the rear of the transmitter. However, the voltage at the site and the transformer tapping should be verified by the installation personnel. The input voltage and strapping chart is shown on the Overall System Block Diagram along with the transformer schematic. Verification and/or re-tapping will require opening the power supply access panel on the front of the transmitter, disconnecting the supply and rolling it out (this is only if the transmitter was shipped with the power supply installed). To remove the power supply, refer to Section V, under the heading "Power Supply Removal."

2.5.4.2 Power Supply Connections

First, remove the front cover panel from the power supply compartment at the bottom of the transmitter. The power supply connection cables are either tied up in the power supply compartment (in the bottom of the transmitter) or tied up with the power transformers. The power supply should be rolled into position in front of the transmitter. Do not roll it in yet. There are two separate supplies on the tray, PS1 is in front and PS2 is in the rear. The following cables will need to be connected:

- a. There are two ribbon cables W11 and W12 (blue) and one control voltage cable W21 (gray with orange connector) hanging on the right side of the power supply compartment.
 1. First connect W12 to J4 on the PS2 Rectifier Board. See Figure 2-1.
 2. Now the supply can be rolled into the cabinet. Be sure to get the orange AC input cables, #1, #2 and #3 and wires #40 and #41 out of the way before rolling the power supply all of the way in. These are bundled on the left side of the power supply compartment.
 3. Connect W11 to J4 on the PS1 Rectifier Board.
 4. Connect W21 (flat gray cable with orange connector) to J6 on the PS1 Rectifier Board.
- b. The cable labeled A1P2 (gray multi-conductor cable with 12 pin gray connector) plugs into its mating connector on the left wall of the power supply compartment.
- c. Roll the power supply the rest of the way into the cabinet.

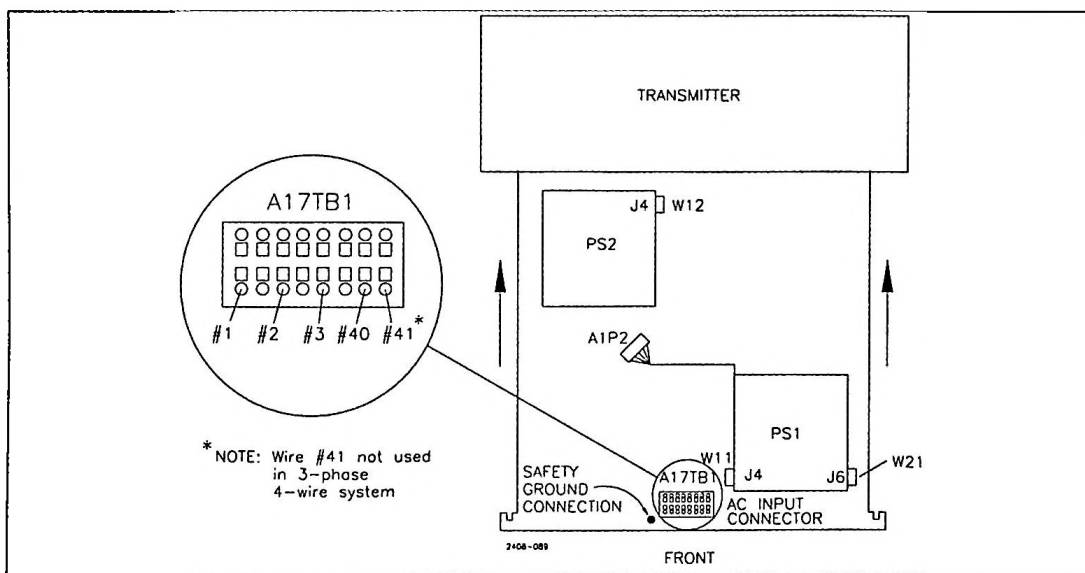


Figure 2-1 3-Phase Power Supply Top View

Installation & Initial Turn-On

d. Wires 45 and 52 (large orange cables tied up with the transformers) connect to the feed-thru terminals, C3 and C4 at the top of the power supply compartment. These are the 52Vdc outputs from the two supplies. See Figure 2-2. The wires connect as follows:

- Wire #52 connects to C4 (on the left along with wire #81)
- Wire #45 connects to C3 (on the right along with wire #80)

e. Wires #1, #2, and #3 (orange cables tied up on the left side of the power supply compartment) and two smaller gray wires #40 and #41* plug into the gray Wego block connector, A17TB1 on the front of the power supply tray (A17 designates a component on the power supply tray). See Figure 2-1. The Wego block has 8 terminals labeled terminal #1 on the left and #8 on the right. The connections are as follows:

- Wire #1 connects to terminal #1
- Wire #2 connects to terminal #3
- Wire #3 connects to terminal #5
- Wire #40 connects to terminal #7
- Wire #41* connects to terminal #8

(*Wire #41 is not used on 3 phase 4-wire system)



NOTE:

If these wires are not connected to the appropriate terminal on the Wego block, as designated on the Overall System Block Diagram, the blower may not operate.

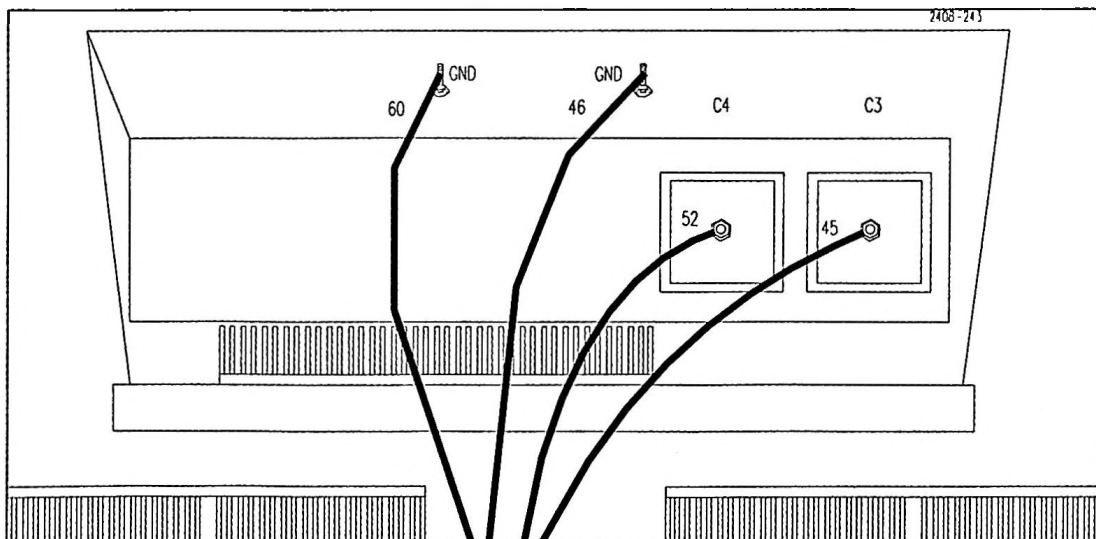


Figure 2-2 DC and Ground Connections for 3-Phase Power Supply

888-2408-002

WARNING: Disconnect primary power prior to servicing.

- f. To insert the wires into the Wego block, insert a screwdriver into the rectangular slot above the wire hole then carefully lift. This will open the contact inside the Wego block and the wire can be inserted. Be very careful not to let the wire ends fray as the connectors are very close together and could cause a short. The wire insulation should actually extend just inside the Wego block hole.
- g. The large orange ground wires, #46 and 60, coming from the top of each rectifier assembly attach to ground studs at the top-front edge of the power supply compartment. It is located under the shelf which separates the power supply from the PA compartment just above C3 and C4. See Figure 2-2.
- h. Connect the safety ground wire to the stud on the front of the power supply tray, just in front of A17TB1, See Figure 2-1.
- i. Tighten the two hold down nuts located on the bottom front corners of the power supply compartment. Re-install the front cover panel for the power supply compartment.

2.5.5 Single Phase Power Supply Installation

Before installing the power supply check the primary ac tapping on the power transformers as outlined below. Even if the transmitter was shipped with the power supply installed, it would be a good idea to check the power supply tapping if possible.

2.5.5.1 Power Transformer Tapping

The power transformers are tapped at the factory for the primary AC voltage specified by the customer. This voltage should be documented in the factory test data accompanying the transmitter and tagged at the ac contactor. However, the voltage at the site and the transformer tapping should be verified by the installation personnel. The input voltage and strapping chart is shown on the Overall System Block Diagram along with the transformer schematic. Verification and/or re-tapping will require opening the power supply access panel on the front of the transmitter and rolling out the power supply if the transmitter was shipped with the power supply already installed (this depends on where and how it is shipped).

2.5.5.2 Single Phase Power Supply Connections

First, remove the front cover panel from the power supply compartment at the bottom of the transmitter. The power supply connection cables are either tied up in the power supply compartment (in the bottom of the transmitter) or tied up with the power transformers. The power supply should be rolled into position in front of the transmitter. Do not roll it all the way in. The following cables will need to be connected:

- a. There are two ribbon cables and one power connector hanging on the right side of the power supply compartment inside the transmitter. The ribbon cables connect to J4 on the Rectifier Boards. The longer ribbon cable, W12 connects to the Rectifier Board on PS2 (nearest the back of the transmitter) and should be connected first. Be sure to route this cable so it does not touch the resistor standing up on top of the Rectifier heatsink. See Figure 2-3.
- b. The shorter blue ribbon cable, W21 connects to the front Rectifier Board on PS1. The power cable, W11 (the gray cable with the orange connector) connects to J6, on the Rectifier Board nearest the front of the transmitter.
- c. The cable labeled A1P2 (gray and yellow multi-conductor cable with gray connector) plugs into its mating connector on the left wall of the power supply compartment. Roll the power supply all the way into the cabinet.
- d. Wires 80 and 81 (large orange cables tied up with the transformers) connect to the feed-thru terminals at the top of the power supply compartment. See Figure 2-4. The cables are dressed such that the shorter cable, 81 connects to the left hand terminal and the longer cable, 80 connects to the right hand terminal.

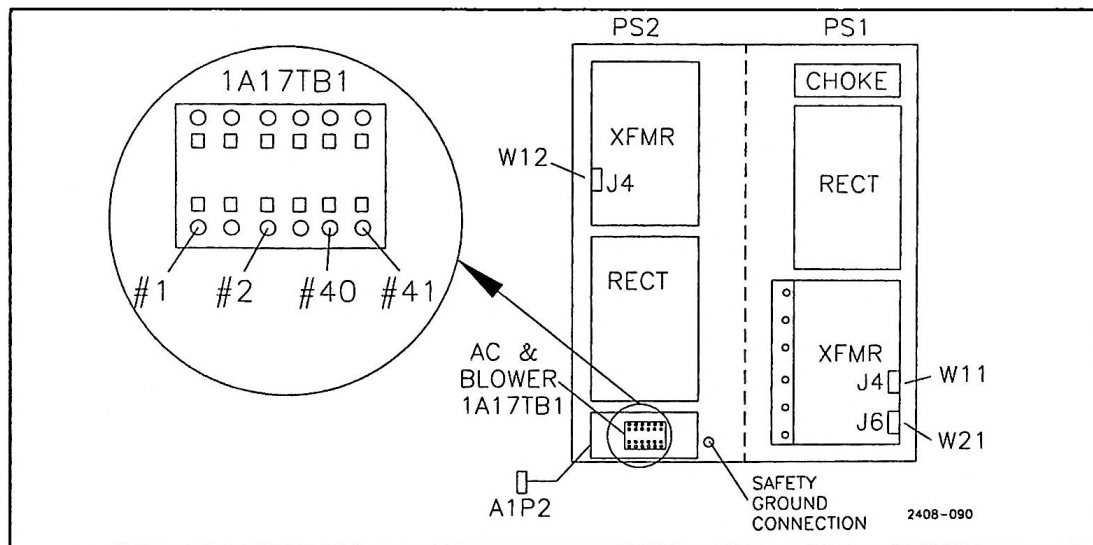


Figure 2-3 Single Phase Power Supply Top View

888-2408-002

WARNING: Disconnect primary power prior to servicing.

Installation & Initial Turn-On

- e. Wires #1 and #2 (orange cables tied up on the left side of the power supply compartment) plug into the gray Wego block connector on the front of the power supply tray. See Figure 2-3. Wire #1 goes to the left and #2 in the 3rd hole from the left. Wires #40 and #41 are inserted into the 5th and 6th holes respectively from the left. To insert the wires into the Wego block, insert a screwdriver into the rectangular slot behind the wire hole and then carefully push toward the rear of the transmitter. This will open the contact inside the Wego block and the wire can be inserted. Be very careful not to let the wire ends fray as the connectors are very close together and could cause a short. The wire insulation should actually extend just inside the Wego block hole.
- f. The large orange ground wires, #52 and 152, coming from the power supply attach to the ground stud at the top-front edge of the power supply compartment. It is located under the shelf which separates the power supply from the PA compartment, see Figure 2-4.
- g. Connect the safety ground wire to the stud on the front of the power supply tray, just in front of A17TB1, See Figure 2-3.
- h. Tighten the two hold down nuts located on the bottom front corners of the power supply compartment.

Re-install the front cover panel for the power supply compartment.

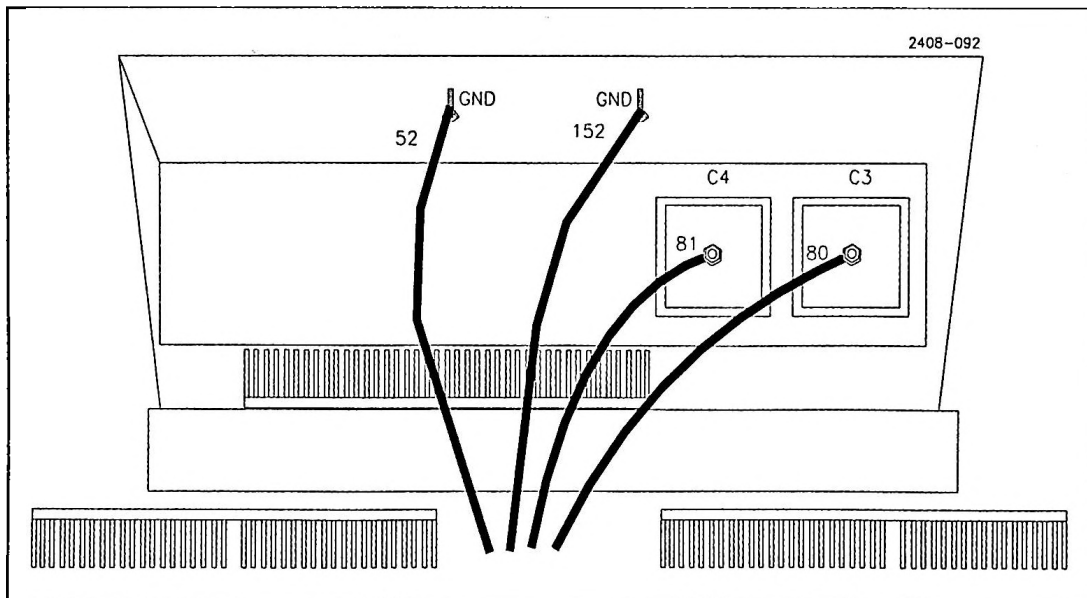


Figure 2-4 DC and Ground Connections for Single Phase Power Supply

2.5.6 Transmitter AC Connections

The ac input for the transmitter should be low impedance, 50/60 Hz, single or three phase depending on transmitter phase supply with sufficient capacity to supply the transmitter. Refer to the “Z2 Outline Drawing” in the drawing package for current ratings, nominal fuse sizes and wire gauge for the 3 phase delta, 4 wire wye, and single phase input voltage combinations. For more information AC power requirements see “Power Distribution for Optimum Transmitter Performance” at the end of this section.

A customer supplied ac primary power disconnect or means to completely de-energize the transmitter primary circuit for servicing is necessary.

⇒ NOTE:

Harris does not recommend using circuit breakers for the main transmitter disconnect due to the inrush current during turn-on.

The recommended fuse type is class RK5, a dual element time delay fuse. Examples are the Bussmann FRN-R (250V), FRS-R (600V), Littelfuse FLNR (250V), FLSR (600V), and Ferraz gG fuses. If you prefer to use a circuit breaker in your installation, select one with a motor-starting trip curve, similar to the RK5 curve for fuses. This type of delayed response is needed in order to accommodate the momentary in-rush current. This can be 300 to 600 amps, depending on the transmitter model and AC configuration.



WARNING:

DISCONNECT AND LOCK OUT PRIMARY POWER TO THE TRANSMITTER BEFORE PROCEEDING.

2.5.6.1 Information concerning some 360 to 416 volt systems

This transmitter is equipped with MOVs (metallic oxide varistors) which provide a measure of protection against incoming overvoltage transients. However, the selection of some of the MOVs relies upon knowing the approximate voltage from each AC phase to ground. Unfortunately a few AC power systems around the world do not have a direct connection to earth ground, thereby making it impossible to predict the phase-to-earth ground voltage.

In a typical 380 volt system that has a connection to earth ground, each AC phase will measure about 220 volts to ground. The phase-to-phase, and phase-to-ground voltages should be balanced within a few percent.

However, in a system which has no direct connection to earth ground, each AC phase will measure a voltage which follows no particular pattern. In such a case, the

Installation & Initial Turn-On

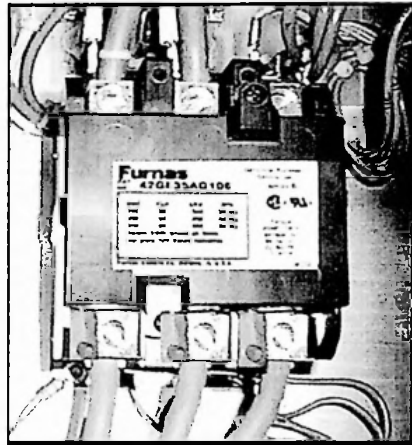
MOV protection may need to be modified. Please consult with an electrician if this applies to your installation. If applicable, the phase-to-earth 275 volt MOVs in the RV7 through RV13 and RV20 positions may be replaced with 510 volt MOVs (Harris part number 560-0042-000, quantity 8).

For safety reasons, you also must install a 4 pole disconnect device if your neutral line is not connected to earth ground.

2.5.6.2 AC Input Connection

AC connections are made to the top of the main contactor K1, located in the top righthand corner in the back of the transmitter. Bring the ac wires through the holes in the top of the transmitter and connect to the top terminals on contactor K1. Access is also available through the bottom of the transmitter.

For 380VAC (342 - 432VAC) 3 Phase 4-wire systems, there is also a large insulated standoff located near the main contactor for the NEUTRAL connection.



CAUTION:

THE NEUTRAL CONNECTION IS EXTREMELY IMPORTANT IN 380VAC 4 WIRE APPLICATIONS. BY VIRTUE OF THE SINGLE PHASE LOADS WITHIN THE TRANSMITTER, THE SYSTEM IS NOT ENTIRELY BALANCED, REQUIRING NEUTRAL CURRENT TO MAINTAIN PROPER PHASE TO NEUTRAL VOLTAGES. A POOR NEUTRAL CONNECTION COULD CAUSE DAMAGE TO THE SINGLE PHASE ELEMENTS IN THE TRANSMITTER.



NOTE:

The NEUTRAL connection is NOT required for 208/220VAC 4-wire WYE source voltage and should not be run to the transmitter. There is no connection in the transmitter for the neutral connection (for this application) and it should not be connected to chassis ground. The power supply transformers in the transmitter will be configured as delta for this application.

2.5.6.3 Grounding

The importance of a good grounding system and lightning protection can hardly be overemphasized for reasons of personnel safety, protection of the equipment, and equipment performance. The following is only a brief overview.

Lightning and transient energy via the power line or tower connections can impose serious threats to your personal safety as well as damage the equipment. For these reasons you should have a good protective earthing system to divert these forms of energy to earth ground. Proper grounding of the equipment also guards against electrical shock hazards that would exist if the equipment failed in a way which put a hazardous voltage on the chassis.

A good grounding system should include substantial grounding at the tower base using copper ground rods and/or a buried copper ground screen, with copper strap used to connect the tower base to earth ground. A low impedance will help carry lightning current directly into the ground instead of into your building. Additionally, coax shield(s) should be electrically connected to and exit the tower as near to the bottom as practical to minimize the lightning voltage potential carried by the coax into your building.

For coaxes, a single point of entry into the building is best, with all connected to a common grounding plate (or bulkhead panel) having a low impedance connection to the building perimeter ground. Wide copper straps should be used for making the connection from the common grounding plate to earth ground.

A common grounding plate is also the best location for coaxial surge protectors for sensitive equipment such as an STL receiver. Ideally, this plate should also be the entry point for all signal lines, and serve as a single point ground for AC power surge protection.

A good ground system should include perimeter grounding of the transmitter building using copper ground rods and copper strap. There should also be a copper strap running from tower ground to the building perimeter ground.

Good grounding and shielding will help keep stray RF current to a minimum. RF interference usually shows up in one of several ways, intermittent problems with digital or remote control circuits, audio feedback or high pitched noise. Even a small amount of non-shielded wire makes a very efficient antenna for RF and transient energy. If RF is allowed into the audio equipment, it can be rectified and may show up as noise or feedback. Wire and cable shields should normally be connected at both ends to the equipment chassis.

A ground strap attachment point is located on the top, right rear, of the cabinet (use four 1/4-20 brass screws with brass washers). Use this connection when utilizing a single point grounding system, attaching your ground strap to the common grounding plate. An alternate ground connection is a short copper strap on the back of the Platinum Z transmitter, on the bottom right side. Unfold this strap and securely bolt or silver solder it to the building ground. This strap can be removed from the bottom and used at the top.

A grounding stud is also provided near the AC input connections in the upper portion of the Platinum Z transmitter. Use this connection for the power line ground. It is located above the low voltage power supply board.

2.5.6.4 Low Voltage Power Supply and Blower

The Low Voltage Power Supply and the blower motor operate from any voltage within the specified range of the tapping chart without re-tapping.

2.5.6.5 Exciter AC Voltage Selection

Once the site voltage has been checked, verify that the exciter(s) are set for the proper input ac voltage. For verification, the selected voltage should be visible next to the ac power cord connection on the rear of the exciter. For information on setting the exciter voltage, refer to the exciter technical manual.

2.5.7 RF Output Connection

The station transmission line may now be connected at the 1 5/8" EIA flange located on top of the transmitter. Be sure the bullet seats correctly and all flange bolts are tight. Make sure the clamp at the top of the harmonic filter is tightened.

2.5.8 Audio Input Connections

All audio signals connect directly to the back of the exciter(s) by routing the cables through the top or bottom of the transmitter. The exciter technical manual has all of the information pertaining to audio connections, input levels and adjustments. Be sure to leave enough cable slack to allow the exciter to be pulled all of the way out on the rack slides.

2.5.9 External and Fail-Safe Interlock Connections

The transmitter is shipped with two jumpers installed on TB1, the Remote Control Interface terminal strip. TB1-7 to TB1-6(GND) is for External Interlock and TB1-8 to TB1-10(GND) is for Failsafe.

2.5.9.1 External Interlock Connection

To use the External Interlock connection, remove the jumper between terminals TB1-7 to TB1-6(GND), then connect the external interlock wires. A contact closure allows the transmitter to operate. The external interlock wires can also be connected directly to the Life Support Board at J4-7 and J4-10 if it is desired to have the interlock completely separate from the remote control interface. The TB1 and J4 connections are in parallel. Only one or the other is to be used.

⚠ CAUTION:
TO CONNECT TO THE WEGO BLOCK, J4 ON THE LIFE SUPPORT BOARD REQUIRES PRESSING A SCREWDRIVER INTO THE RECTANGULAR SLOT ON THE FRONT SIDE OF THE BLOCK SO THE WIRE CAN BE INSERTED FROM THE REAR. BE SURE TO PROPERLY SUPPORT THE BOARD SO THAT IT IS NOT BENT OR STRESSED IN ANY WAY WHILE INSERTING THE WIRES.

2.5.9.2 Failsafe Connection

To use the remote control failsafe interlock connection, remove the jumper between TB1-8 to TB1-10(GND) and connect in your normally closed contacts when the remote control unit is operational. The failsafe interlock wires can also be connected directly to the Life Support Board at J4-7 and J4-8 if it is desired to have the failsafe interlock completely separate from the remote control interface. The TB1 and J4 connections are in parallel. Only one or the other is to be used.

2.5.10 Initial Turn-on

Each transmitter is thoroughly checked out during factory final test but adjustment may be required during installation due to shipping, variations in primary power, antenna systems, or transmission line differences. Any remote or extended control connections should be connected only after the transmitter is checked out and fully operational. Refer to the Factory Test Data Sheets supplied with the transmitter for typical meter readings. The transmitter was checked into a 50-ohm resistive load at the Factory.

The Transmitter ON-OFF sequence is controlled by three separate buttons:

- HIGH
- LOW
- OFF

These buttons are located on the front panel of the Controller.

STEP 1 Activate the STATION AC POWER source to the transmitter.

STEP 2 Turn on the low voltage power supply breaker, CB1, located in the rear of the transmitter cabinet in the upper right-hand corner. There are 6 green LEDs on the Low Voltage Supply board which should be illuminated. Close and secure the rear door.

STEP 3 Verify that the two LCD displays on the front of the controller are active. The Diagnostics display should look like Figure 2-5. The Fault LED on the front panel will be lit, since the modules are not installed yet, and should be ignored at this point.

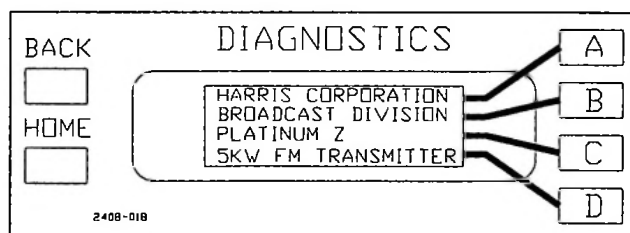


Figure 2-5 Default Display

STEP 4 Press the PA VOLTS button on the front panel of the controller.

STEP 5 Press the LOW power ON button on the front of the controller, but be ready to quickly press the off button if necessary. The PA VOLTS reading on the front panel should be above 40Vdc and the blower should come on at HIGH Speed.

⇒ NOTE:

If the blower does not run, check the position of wires #1, #2 and #3 for 3-phase or wires #1 and #2 for a single phase, at A17TB1. If these are connected in the wrong position, the fan may not operate (this is also true for the single phase transmitter due to switching on the Low Voltage Supply Board). Also check blower fuses F1 and F2 located in the bottom deck of the front PA compartment (F2 not used in 3 phase 4-wire systems).

STEP 6 If the PA VOLTS reading appears okay then shut the transmitter off and insert the PA and IPA Modules as directed below. See Figure 2-6 and Figure 2-7.

STEP 7 PA Module installation - Four PA modules and 1 IPA module are inserted in the front of the cabinet and four PA modules are inserted in the back of the cabinet. The PA and IPA modules are symmetrical which means they can be inserted with either side of the module facing up and cannot be inserted improperly. The modules should only require a minimal amount of force for insertion into the card edge connectors. If they do not slide in easily, check the connectors on the combiner boards, and visually inspect the combiner assembly to verify nothing has come loose and/or moved during shipment.



WARNING:

THE PA MODULES ARE DESIGNED TO HANDLE VERY HIGH TEMPERATURES AND MAY BE EXTREMELY HOT. DO NOT TOUCH THE MODULES WITH BARE HANDS AFTER THE TRANSMITTER HAS BEEN RUNNING, ESPECIALLY IN HIGH AMBIENT TEMPERATURE ENVIRONMENTS.

STEP 8 Optimization - The Factory Test Data Sheet contains the serial numbers of each of the PA and IPA modules. The data sheet also tells which slot each of the PA modules were connected into during factory testing. While it is Not Critical to operation, the transmitter readings may be closer to the data sheet if the PA and IPA modules are placed in the same positions as during factory testing. The module serial number tag should be on top of the module when inserted into the transmitter.



CAUTION:

EACH MODULE HAS TWO CAPTIVE THUMBSCREWS WHICH MUST BE TIGHTENED TO ASSURE PROPER MODULE OPERATION. THEY SHOULD BE FINGER TIGHT. IF A SMALL SCREWDRIVER IS USED, BE SURE NOT TO OVERTIGHTEN.

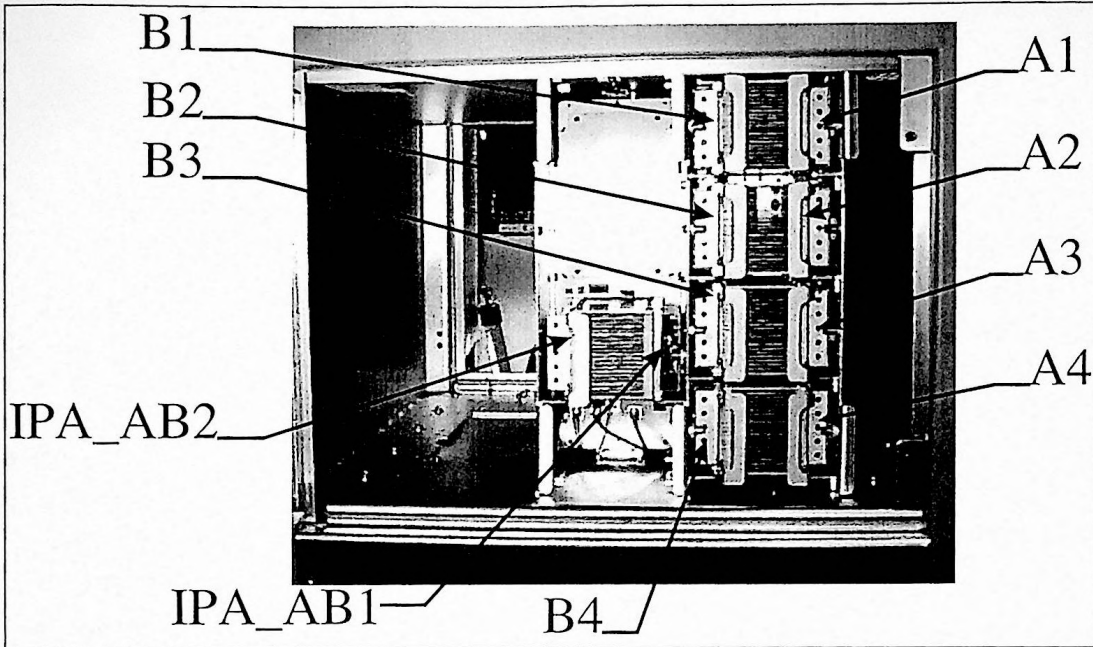


Figure 2-6 PA Compartment Front View

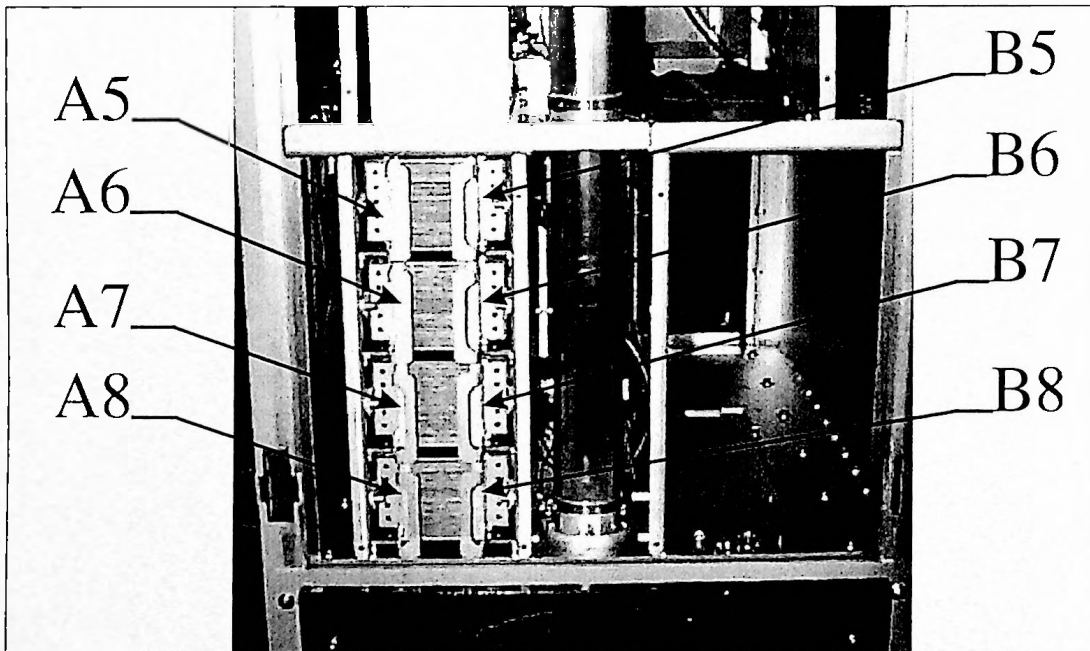


Figure 2-7 PA Compartment Rear View

STEP 9 For the dual IPA configuration, the IPA will be identical to any of the PA modules and may be plugged in with either side up in the IPA slot. To see which IPA is active press [HOME, STATUS D,B]. This should bring up the screen shown in Figure 2-8. If the transmitter is configured with only a single IPA, then one half of the module will be empty. It is recommended that the IPA module be inserted with the amplifier on the right side of the heatsink. This places the amplifier in the IPA_AB1 position (the default for the controller). If the IPA is on the left side of the heatsink when inserted, then IPA_AB2 will have to be selected before operating the transmitter. To select IPA_AB2 press the [D] or switch key to toggle from IPA_AB1 to IPA_AB2 and back.

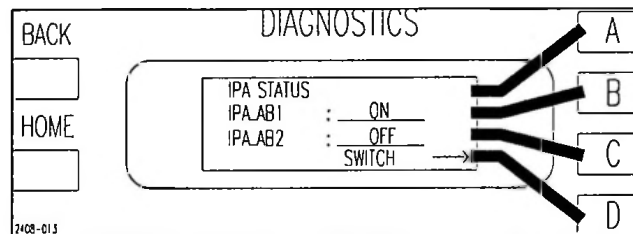


Figure 2-8 IPA Status and Manual Switch
[HOME, STATUS D,B]

STEP 10 With all of the modules installed, the Fault LED on the controller front panel should be flashing at this point. This indicates that there are inactive faults in the fault log which need to be cleared at this time. To reset the Fault Log press [FAULT, C, and then D for YES]. This will erase all inactive faults in the Fault Log and the front panel Fault LED should be off. If the “FAULT” LED on the front panel of the controller is not lit, then proceed to the next step. If the “FAULT” LED, on the front panel of the controller, is illuminated (not flashing), use the Fault Log to find the active fault(s) and refer to Section VI, Troubleshooting for information on how to track down the problem.

STEP 11 Turn the transmitter back ON at LOW power. Verify that the exciter power is the same as the factory test data sheet. This can affect performance. The fan will run at high speed for 1 minute then will automatically switch to low speed provided there are no faults. Any fault will cause the fan to automatically switch to high speed. There is also an option to force the fan speed to HIGH in the Configuration menus of the Diagnostics Display. See Table 2-14 on page 2-24.

Installation & Initial Turn-On

STEP 12 At this point, if there are no faults, verify that the transmitter display readings closely resemble those on the factory test data sheet for LOW power. If the “FAULT” LED comes on, go to the Fault Log in the Diagnostics Display to find out which fault has been activated and refer to Section VI, Troubleshooting. If everything looks okay, proceed to the next step.

STEP 13 Press the HIGH power ON button on the front panel of the controller. If there are no faults, again verify all of the transmitter display readings against those in the factory test data sheet.

STEP 14 This step is optional, as it simply makes the transmitter FWD PWR % meter read 100% at the customer specified Transmitter Power Output (TPO), which should already be factory set. This will not change the kW reading on the FWD PWR display.

- a. Set the power to the desired TPO using the raise and lower buttons.
- b. Go to the 100% TPO SET screen [HOME,MORE,CONFIGURATION B,A] and set the power level to your TPO. Press [BACK] to update and store the new information.
- c. The front panel FWD PWR reading should be 100%. You may also want change the MAX HIGH and MAX LOW power settings to something more in line with your new TPO as well. MAX HIGH sets the maximum power level when the HIGH ON button is pressed, while MAX LOW sets the maximum power level when the LOW ON button is pressed. The procedure for changing power limits is given in Section V, Maintenance and Alignments.

The initial turn on is now complete.

2.5.11 Remote Control Connections

The Platinum Z5 Transmitter may be operated by remote control by installing a remote control system. If the transmitter is to be remotely controlled, it is important to initiate thorough inspection and maintenance procedures at the transmitter location. Installation of equipment to monitor temperature and humidity at the remote transmitter site is also recommended.

Terminations provided in the Platinum Z5 Transmitter allow remote control of the transmitter functions by connection to terminals on terminal board AITB1. TB1 is a 38 pin Terminal strip with a D-connector on the back which connects to J20 on the controller. Table 2-1 on page 2-28 contains a complete listing and explanation of connections for TB1. Figure 2-9 shows TB1 pinout and connections. TB1 is located in the upper left side in the rear of the transmitter when viewing from the back.

Use shielded cable for the remote control lines and/or install it in a metal conduit. It is acceptable to install it in the same conduit as the exciter input cables.

	⊗	⊙	
1 XMTR ON (HI)	(X)	⊗	
2 XMTR ON (LO)	(X)	(X)	SUMMARY FAULT 20
3 XMTR OFF	(X)	(X)	VSWR FAULT 21
4 XMTR RAISE	(X)	(X)	VSWR FOLDBACK 22
5 XMTR LOWER	(X)	(X)	AMB TEMP FAULT 23
6 GND	(X)	(X)	ISO LOAD FAULT 24
7 EX1 INTERLOCK	(X)	(X)	GND 25
8 FAILSAFE	(X)	(X)	INTERLOCK IND 26
9 CONFIGURABLE IN	(X)	(X)	FAILSAFE IND 27
10 GND	(X)	(X)	IPA FAULT 28
11 XMTR ON HI IND	(X)	(X)	GND 29
12 XMTR ON LO IND	(X)	(X)	FWD PWR SAMPLE 30
13 XMTR PWR LO IND	(X)	(X)	RFL PWR SAMPLE 31
14 LOC REM IND	(X)	(X)	PAV SAMPLE 32
15 MUTE IND	(X)	(X)	PAI SAMPLE 33
16 GND	(X)	(X)	APC REF SAMPLE 34
17 AFC FAULT	(X)	(X)	GND 35
18 PA FAULT	(X)	(X)	SPARE OUT 36
19 PS FAULT	(X)	(X)	PHASE LOSS 37
	⊗		

Figure 2-9 TB1 Customer Interface Connections

2.5.11.1 Control Inputs

Input control lines are standard ground switching inputs. The inputs can be operated by relay contact or transistor switching. See Figure 2-10.

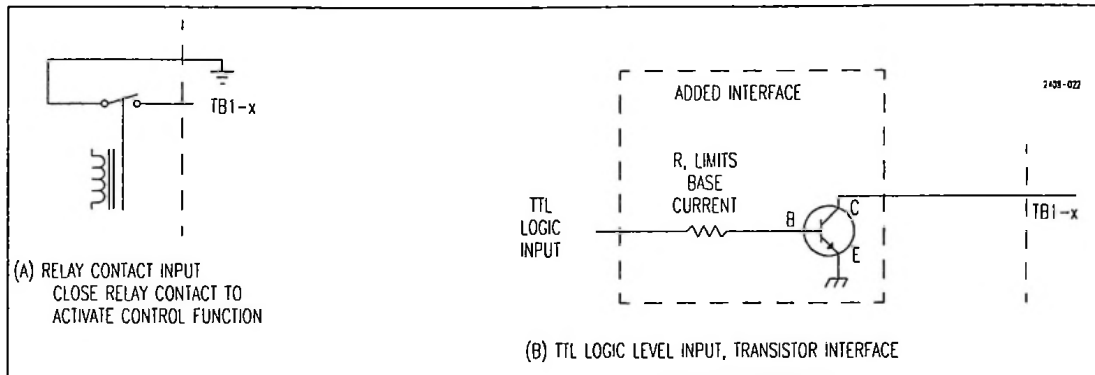


Figure 2-10 Ground Switching for Remote Control Lines

2.5.11.2 Status Outputs

The status output lines on TB1 are transistor type - open collector. Figure 2-11(A) illustrates how to interface TB1 outputs with TTL logic circuits. Figure 2-11(B) illustrates how to interface TB1 with an external relay.

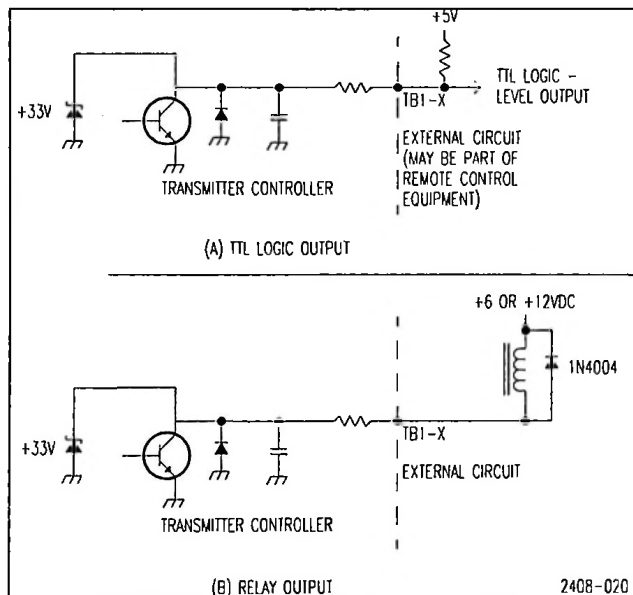


Figure 2-11 TTL Logic and Relay Status Outputs

Installation & Initial Turn-On

A series resistor and LED can also be used for extended status indications. Maximum external supply voltage should not exceed +28Vdc.

⇒ **NOTE:**

Maximum status line current is 25 mA. If the output is used to drive a small printed circuit board type relay, check current requirements for relay coil and be sure to install a circuit protection diode across the coil. A 1N4004 or equivalent will work.

Figure 2-12 shows typical remote/extended control and status connections.

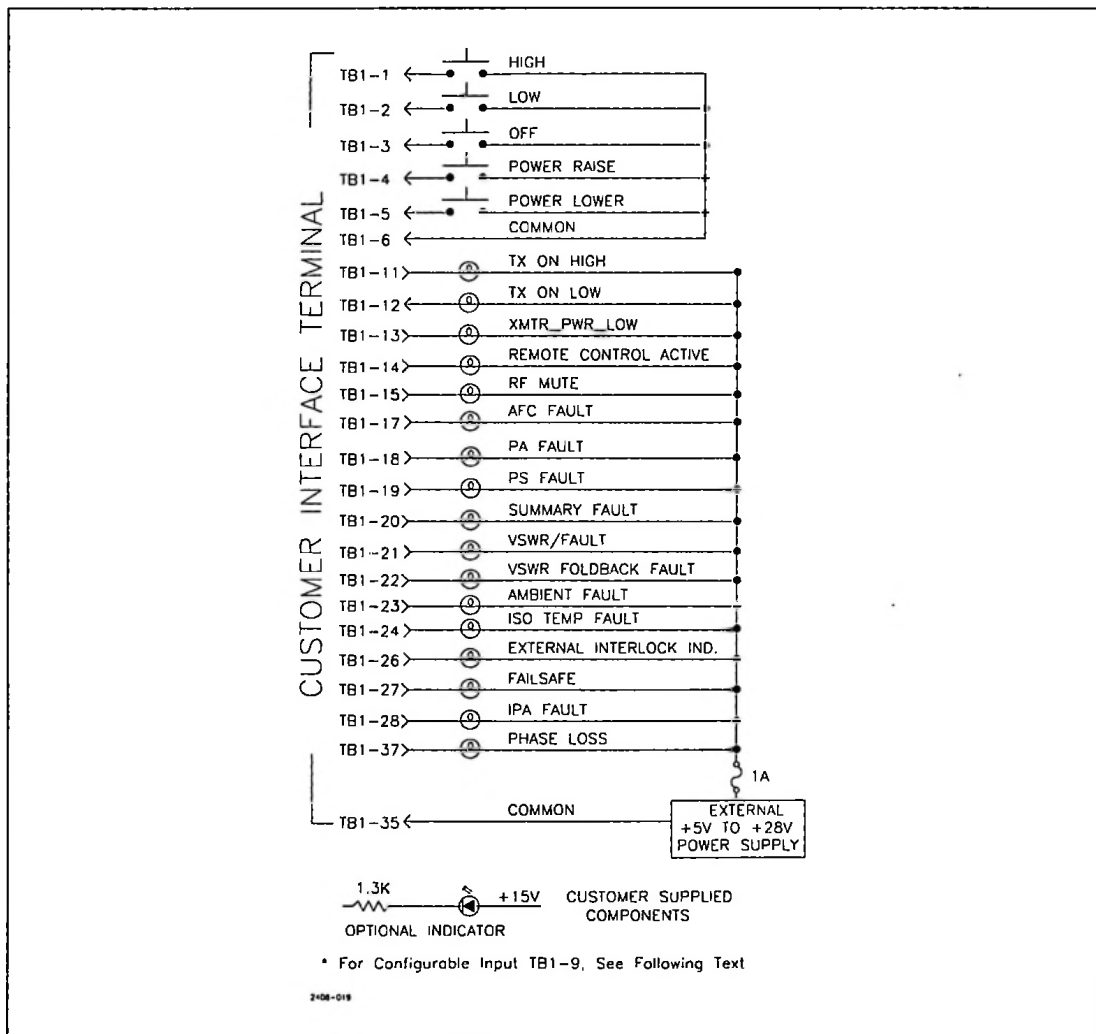


Figure 2-12 Remote/Extended Control and Status Connections

Installation & Initial Turn-On

Extended metering can also be connected to TB1 terminals. See Figure 2-13 for an example of extended metering connections.

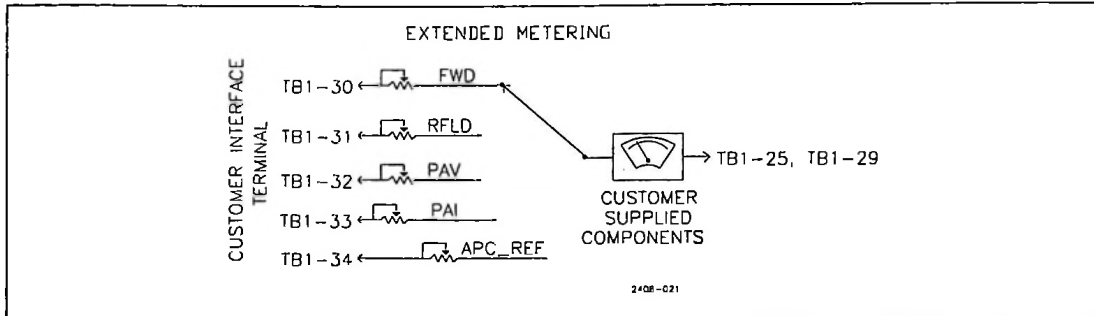


Figure 2-13 Extended Metering

2.6 UPS IN/Remote Exciter Select, Configurable Input TB1-9

The remote input at TB1-9 is a software configurable input which is set via the Diagnostics Display Menu. It can be used as either a UPS Mode select input or as a Remote Exciter select when a second exciter is installed in the transmitter. To configure the input using the Diagnostics Display Menu press [HOME, MORE, CONFIGURATION A,D]. This should bring up the screen shown in Figure 2-14. The default setting is shown as "UPS". This means the input is ready to be used as the UPS Mode select. To use TB1-9 as a Remote Exciter Select input press [B]. This will toggle the display to read "EXC". This re-configures the TB1-9 input so that when it is pulsed low momentarily, the transmitter will switch to the other exciter.

⇒ NOTE:

This input is simply a switch command and does not care which exciter was on the air to begin with. For example, if the Main exciter is on the air, then it will switch to the alternate, but if the alternate is on the air it will switch to the main exciter.

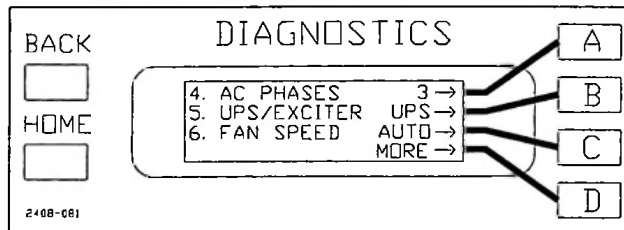


Figure 2-14 Configurable Input Select
[HOME, MORE, CONFIGURATION A,D]

2.6.1 Using an Uninterruptable Power Supply or UPS

If the transmitter is backed up with a UPS, to keep it operating during an ac power failure, then the logical thing to do is to lower the transmitter power to conserve the UPS for as long as possible. Therefore, during an ac power failure, the transmitter has the ability to automatically operate at a reduced power level when backed up by a UPS or even a generator if so desired.

When the UPS is activated, TB1-9, the remote control interface terminal strip, must be pulled low. This will take the transmitter to the preset UPS power level which is factory set for 2.5kW, via software in the Diagnostics Display System. However, if the transmitter is operating in LOW power when the UPS mode is activated, then the transmitter will stay at the LOW power level unless the UPS level is set lower. For example, if LOW power is set for 2kW and UPS is set for 2.5kW, the transmitter will stay at the LOW power level of 2kW. If the transmitter is operating at HIGH power when the UPS mode is activated then it will drop to the UPS power setting.

2.6.1.1 Setting The UPS Power Level

The setting of the UPS power level is done in the software of the Diagnostics Display Menu. To set the UPS power level press [HOME, MORE, CONFIGURATION B,D,A] see Figure 2-15. Once the new UPS power level is set press [BACK] to save the new information. Pressing [HOME] instead will cancel any changes made and take you back to the main menu.

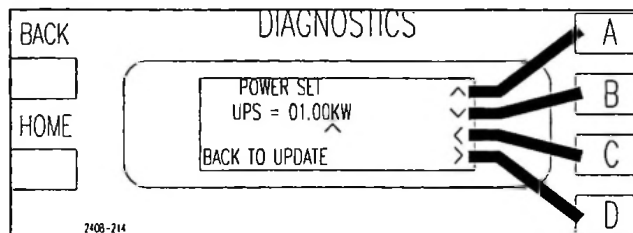


Figure 2-15 UPS Power Set
[HOME, MORE, CONFIGURATION B,D,A]

2.7 Optimizing Efficiency

The transmitter has the ability to Manually or Automatically optimize its own operating efficiency. It is not a requirement, and the transmitter will meet all specifications without activating this function. When activated, the controller will adjust the transmitter operating parameters to get the best possible efficiency. The user must select whether the function is in Manual or Automatic mode via the Diagnostics Display Menus. To select the mode press [HOME, MORE, CONFIGURATION A,D,D then A to Toggle: ON for Auto and OFF for Manual]. See Figure 2-16.

- **Automatic Mode** - When AUTO mode is selected, the transmitter will automatically optimize the efficiency every 12 hours if there are no active faults present. This is the recommended mode of operation and is the default mode from the factory.
- **Manual Mode** - In the Diagnostics Display, under Configuration, there is a menu screen which can be used to optimize the transmitter efficiency. To optimize efficiency press [HOME, METERING D,C then D for Maximization]. See Figure 2-17.

⇒ **NOTE:**

The REF VOLTAGE in Figure 2-17 is merely an internal reference point the controller uses to reduce the supply voltage in optimized mode. This reading is usually in the low 40's when the transmitter is optimized (well below the actual supply voltage).

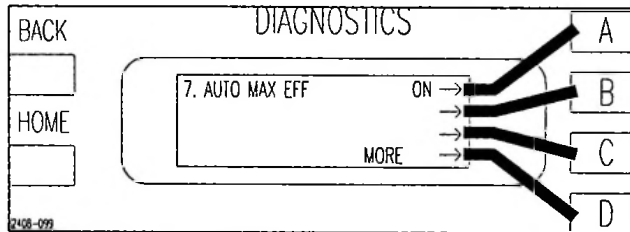


Figure 2-16 Configuring Auto Max Efficiency [HOME, MORE, CONFIGURATION A,D,D]

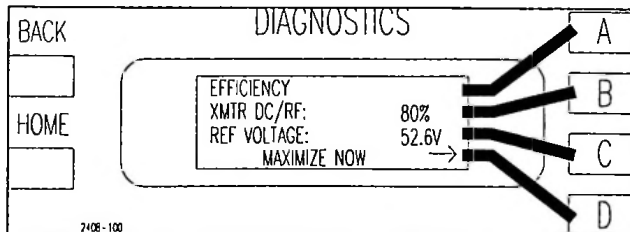


Figure 2-17 Efficiency Status [HOME, METERING D,C]

2.8 Setting the Low Power Alarm

The transmitter has a low power alarm output for a remote control system. The power level at which this remote alarm output is triggered, at TB1-13 XMTR_PWR_LO_IND, is selectable in the Configuration Menus. To set this power level press [HOME, MORE, CONFIGURATION B,D,B]. This should take you to the screen in Figure 2-18. Set the power level at which you want the alarm to become active and press [BACK] to save changes. For a complete listing of all configurable parameters see “System Configuration and Calibration” in Section VI, Troubleshooting.

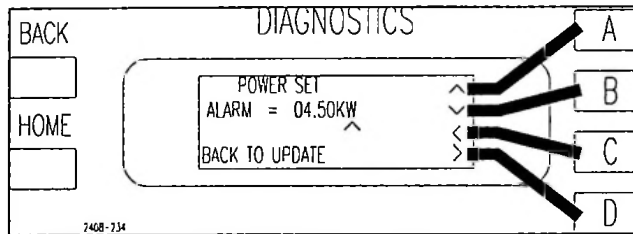


Figure 2-18 Low Power Alarm Set Screen

2.9 Jumper Settings for Installation of a Harris Exciter

The following is for installing an exciter other than the one or two which came with the transmitter. Any exciter tested and shipped with the transmitter will have already been configured properly for the transmitter and should not require any jumper changes. Table 2-2 includes all relevant jumper placement for the transmitter and the following exciters:

- Digit CD Exciter with 994-9410-004 Part Number
- Digit Exciter with 994-9410-002 Part Number
- SuperCiter
- THE-1

Mounting Kits are available for each of the exciters listed.

Table 2-1 TB1 Remote Control Interface Connections

TB1-1	A1A10 J20-1	XMTR_ON_HIGH	Remote HIGH power ON command input. Active Low. Connect to any TB1 ground terminal to activate. Open collector compatible.
TB1-2	A1A10 J20-2	XMTR_ON_LOW	Remote LOW power ON command input. Active Low. Connect to any TB1 ground terminal to activate. Open collector compatible.
TB1-3	A1A10 J20-3	XMTR_OFF	Remote transmitter off command input. Active Low. Connect to any TB1 ground terminal to activate. Open collector compatible.
TB1-4	A1A10 J20-4	XMTR_RAISE	Remote power RAISE command input. Active Low. Connect to any TB1 ground terminal to activate. Open collector compatible.
TB1-5	A1A10 J20-5	XMTR_LOWER	Remote power LOWER command input. Active Low. Connect to any TB1 ground terminal to activate. Open collector compatible.
TB1-6	A1A10 J20-6	GROUND	
TB1-7	A1A10 J20-7	EXTERNAL INTERLOCK	A closed connection must be provided between this terminal and ground to operate the transmitter. If no external interlock connections are required, then a jumper must be installed between TB1-7 and ground (such as TB1-6). A second, parallel, External Interlock connection is available on the Life Support Board, A1A8 J4-9 and J4-10(ground). If this connection is used, TB1-7 should be left open, and an External Interlock connection or jumper must be installed between J4 pins 9 and 10 of the Life Support Board. Only ONE of these connections should be used.
TB1-8	A1A10 J20-8	FAILSAFE	A continuously closed contact between this terminal and ground is required to turn on or operate the transmitter. If the contact is broken the transmitter will MUTE. A second, parallel, Failsafe interlock connection is available on the Life Support Board, A1A8 J4-8 and J4-10(ground). If this connection is used, TB1-8 should be left open, and a Failsafe connection or jumper must be installed between J4 pins 8 and 10 of the Life Support Board. Only ONE of these connections should be used.
TB1-9	A1A10 J20-9	CONFIGURABLE IN This input is software selectable. It can be used as either of the following: UPS MODE Select or REMOTE EXCITER Select. To configure this input press UPS MODE Select or CONFIGURATION A,D then B to toggle between modes].	UPS IN For sites with an Uninterruptable Power Supply which is capable of powering the entire transmitter (including rf output of at least 1.25kW) it allows for a power setting which is to be used during ac power failures. Customer UPS or generator circuits should pull this line to ground when ac power fails. The transmitter will then revert to the UPS power level set by the customer. When ac power returns, the UPS line should go high and the transmitter will return to its previous power level. For more information see "Using an Uninterruptable Power Supply or UPS" in this section. EXCITER SELECT If configured for Exciter Select, in the Diagnostics Display Menu, then bringing this line momentarily low will select the other exciter.
TB1-10	A1A10 J20-10	GROUND	
TB1-11	A1A10 J20-11	XMTR_ON_HIGH_IND	Remote HIGH power Indicator. Provides a remote indicator that the transmitter is operating at HIGH power.
TB1-12	A1A10 J20-12	XMTR_ON_LOW_IND	Remote LOW power Indicator. Provides a remote indicator that the transmitter is operating at LOW power.
TB1-13	A1A10 J20-13	XMTR_PWR_LOW_IND	Remote RF Fault indicator. Provides an indication that the transmitter power output has fallen below the customer set threshold level. To set this level press [HOME, MORE, CONFIGURATION B,D,B]. [BACK] to update.
TB1-14	A1A10 J20-14	LOC_REM_IND	LOCAL/REMOTE Indicator. Provides an external indicator which lights when the transmitter is under remote control.
TB1-15	A1A10 J20-15	MUTE_IND	Remote Mute indication. Provides an external indicator which lights when the transmitter is muted.
TB1-16	A1A10 J20-16	GROUND	2408-093

** In earlier versions of this transmitter, this threshold was permanently set at 90%.

Table 2-1 TB1 Remote Control Interface Connections (continued)

TB1-17	A1A10 J20-17	AFC_FAULT	Provides an external indication of an exciter fault. This is a latching fault that remains active until the fault log is reset. For further information see the exciter technical manual.
TB1-18	A1A10 J20-18	PA_FAULT	Provides an external indication that one of the following PA Faults has been detected: PA Overcurrent, PA Undercurrent, PA Overtemp, or ISO Load fault. This is a latching fault that remains active until the fault log is reset, or a Local/Remote ON (HIGH or LOW) command is issued.
TB1-19	A1A10 J20-19	PS_FAULT	Provides an external indication of one of the following faults in one of the PA Power Supplies: current, top fault, blown fuse, over voltage. This is a latching fault that remains active until the fault log is reset, or a Local/Remote ON (HIGH or LOW) command is issued.
TB1-20	A1A10 J20-20	SUMMARY_FAULT	Provides an external indication that there is an active fault in the transmitter (not latching).
TB1-21	A1A10 J20-21	VSWR_FAULT	Provides an external indication that the transmitter has detected a high VSWR on the transmitter output. This is a latching fault that remains active until the fault log is reset, or a Local/Remote ON (HIGH or LOW) command is issued.
TB1-22	A1A10 J20-22	VSWR_FOLDBACK	Provides an external indication that the transmitter has folded back power due to a high VSWR condition. This is not a latching fault.
TB1-23	A1A10 J20-23	AMBIENT_FAULT	Provides an external indication that ambient temperature is high. This is a latching fault that remains active until the fault log is reset, or a Local/Remote ON (HIGH or LOW) command is issued.
TB1-24	A1A10 J20-24	ISO_TEMP_FAULT	Provides an external indication of an overtemperature condition in any of the transmitter PA or system ISO loads. This is a latching fault that remains active until the fault log is reset, or a Local/Remote ON (HIGH or LOW) command is issued.
TB1-25	A1A10 J20-25	GROUND	
TB1-26	A1A10 J20-26	INTERLOCK_IND	Provides an external indication that the external interlock connection has been opened. This is not a latching fault.
TB1-27	A1A10 J20-27	FAILSAFE_IND	Provides an external indication that the Failsafe connection has been opened. This is not a latching fault.
TB1-28	A1A10 J20-28	IPA_FAULT	Provides an external indication that one of the following IPA faults has been detected: IPA Overcurrent, IPA Overtemp, IPA Load, or IPA Low. This is a latching fault that remains active until the fault log is reset.
TB1-29	A1A10 J20-29	GROUND	
TB1-30	A1A10 J20-30	FWD_PWR_SAMPLE	Provides a remote DC metering sample of the transmitter forward power output. 3.5V = 120% power output.
TB1-31	A1A10 J20-31	RFL_PWR_SAMPLE	Provides a remote DC metering sample of the transmitter reflected power. 3.5V = full scale (see Factory Test Data for nominal value).
TB1-32	A1A10 J20-32	PAV_SAMPLE	Provides a remote DC metering sample of the transmitter PA Voltage. 3.5V = full scale (see Factory Test Data for nominal value).
TB1-33	A1A10 J20-33	PAI_SAMPLE	Provides a remote DC metering sample of the transmitter PA current. 3.5V = full scale (see Factory Test Data for nominal value).
TB1-34	A1A10 J20-34	APC_REF_SAMPLE	Provides a remote DC metering sample of the transmitter APC loop voltage (Automatic Power Control). 4V = 5V front panel reading.
TB1-35	A1A10 J20-35	GROUND	
TB1-36	A1A10 J20-36	SPARE_OUT	
TB1-37	A1A10 J20-37	PHASE_LOSS	Phase Loss provides an external indication of loss of one or more AC phases. This is a latching fault that remains active until the fault log is reset, or a Local/Remote ON (HIGH or LOW) command is issued.

2408-094

Table 2-2 Jumper Setting for installation of a Harris Exciter

EXCITER	EXCITER JUMPER SETTINGS	TRANSMITTER JUMPERS			
		FOR MAIN EXCITER		FOR ALTERNATE EXCITER	
		LIFE SUPPORT BOARD	BACKPLANE BOARD	LIFE SUPPORT BOARD	DISPLAY/BACKPLANE BOARD
DIGIT CD PART# 994 9410 004	JP1 = 2-3 MUTE SENSE = ACTIVE HIGH JP2 = 2-3 CONTROL = INTERNAL JP3 = 2-3 FAULT SENSE STATUS = ACTIVE HIGH JP4 = 1-2 N + 1 MUTE = DISABLED JP5 = 1-2 MUTE-PULL = PULL DOWN JP6 = 1-2 CROWBAR = 70 WATT NOTE: JP1 AND JP5 ARE FOR THE MUTE INPUT ONLY. FAST MUTE IS ALWAYS ACTIVE LOW WITH A FIXED PULL UP RESISTOR, R64.	JP1 = 2-3 SELECTS LOW = MUTE	JP2 = 1-2 SELECTS EXCITER FAST MUTE INPUT	JP2 = 2-3 SELECTS LOW = MUTE	JP3 = 1-2 SELECTS EXCITER FAST MUTE INPUT
DIGIT PART# 994 9410 002	JP1 = 2-3 MUTE SENSE = ACTIVE HIGH JP2 = 2-3 CONTROL = INTERNAL JP3 = 2-3 FAULT SENSE STATUS = ACTIVE HIGH JP4 = 1-2 N + 1 MUTE = DISABLED NOTE: MUTE INPUT HAS FIXED PULL UP RESISTOR, R3.	JP1 = 1-2 SELECTS HIGH = MUTE	JP2 = 2-3 SELECTS EXCITER NORMAL MUTE INPUT	JP2 = 1-2 SELECTS HIGH = MUTE	JP3 = 2-3 SELECTS EXCITER NORMAL MUTE INPUT
SUPERCITER	JP1 = 2-3 CONTROL = INTERNAL JP2 = 2-3 MUTE SENSE = ACTIVE HIGH JP3 = 2-3 FAULT SENSE STATUS = ACTIVE HIGH JP4 = 1-2 MUTE-PULL = PULL DOWN JP5 = 1-2 CROWBAR = 70 WATT	JP1 = 2-3 SELECTS LOW = MUTE	JP2 = 1-2 SELECTS EXCITER FAST MUTE INPUT	JP2 = 2-3 SELECTS LOW = MUTE	JP3 = 1-2 SELECTS EXCITER FAST MUTE INPUT
THE-1	J13 = C-1 J13 IS INSIDE THE EXCITER LOW = MUTE ON THE A3 MOTHERBOARD (C = CENTER (ON THE BACK PANEL) OR COMMON)	JP1 = 2-3 SELECTS LOW = MUTE	JP2 = 2-3 SELECTS EXCITER NORMAL MUTE INPUT	JP2 = 2-3 SELECTS LOW = MUTE	JP3 = 2-3 SELECTS EXCITER NORMAL MUTE INPUT

2408-082

⚠ JUMPERS ARE LOCATED ON REGULATOR BOARD BEHIND FRONT PANEL.
 OPEN TOP OF EXCITER FOR ACCESS (SEE TECHNICAL MANUAL FOR FURTHER INFORMATION).

IMPORTANT: FOR ZD20CD, SEE SYSTEM MANUAL FOR JUMPER SETTINGS.

888-2408-002
 WARNING: Disconnect primary power prior to servicing.

2.10 Power Distribution for Optimum Transmitter Performance

This section is applicable to the three phase supplies only, as well as other three phase equipment. For many years HARRIS engineers have recommended that the three phase power distribution system should be either a closed delta or WYE configuration to provide better radio and television transmitter performance by helping prevent line unbalance. Operation with substantial voltage unbalance from line to line results in higher than normal signal-to-noise ratio in the transmitter output signal, increased three phase transformer heating, and hot three phase motors.

2.10.1 Overheating from Line Unbalance

Even a device as simple as a three phase motor should be operated from a power line in which the voltage is balanced within 1%. It takes only a 3.5% line unbalance to produce a 25% increase above normal temperature. A 5% unbalance will cause destructive temperature rises of 50% greater than normal!

Similar characteristics can be expected in the windings of a three phase power transformer down inside the cabinet of your transmitter. Transformers and motors can be designed with extra safety features where thermal rise is limited to acceptable levels; however, in this case, other transmitter parameters cannot be made acceptable at a reasonable cost.

2.10.2 Transmitter Noise Performance

The most difficult parameter to meet with power line unbalance is transmitter noise performance. Most large transmitters use six-phase or twelve-phase high voltage power supplies. The energy storage capacitors are expensive to install and large stored energies make destructive faults inevitable. A good design will have sufficient energy storage capacitors to meet the specified signal-to-noise but not much more. When the equipment is then operated from an unbalanced line, the power supply ripple frequency will be twice the line frequency instead of six to twelve times. It becomes obvious that it would take three times as much energy storage to achieve the original performance goal.

2.10.3 The Causes of Line Unbalance

How does a line unbalance occur? It is a rare case in which a large commercial power producer would generate unbalanced voltage, so we must look elsewhere in the system. When you have large single phase power users on a power line this can cause uneven distribution of the line currents in the system. Uneven currents through balanced impedances will result in line-to-line voltage unbalance.

Another likely source of this problem can come from unbalanced impedances in the power distribution system. Unbalanced impedance will always be seen when an "open" delta three phase distribution system is used. Transformer design textbooks clearly show that the voltage regulation of an unbalanced system is poor.

2.10.4 Three Phase Delta Distribution Transformers

Figure 2-19 shows open and closed delta systems. The closed delta impedance looking into each terminal (A, B & C) is exactly the same; but this is not the case in the open delta configuration. Depending on the impedances of the transformers in the open delta circuit, line voltage unbalance sufficient to impair satisfactory operation of the overall transmitter may result. For this reason, along with their inherent susceptibility to transients, Harris does not recommend the use of open delta systems.

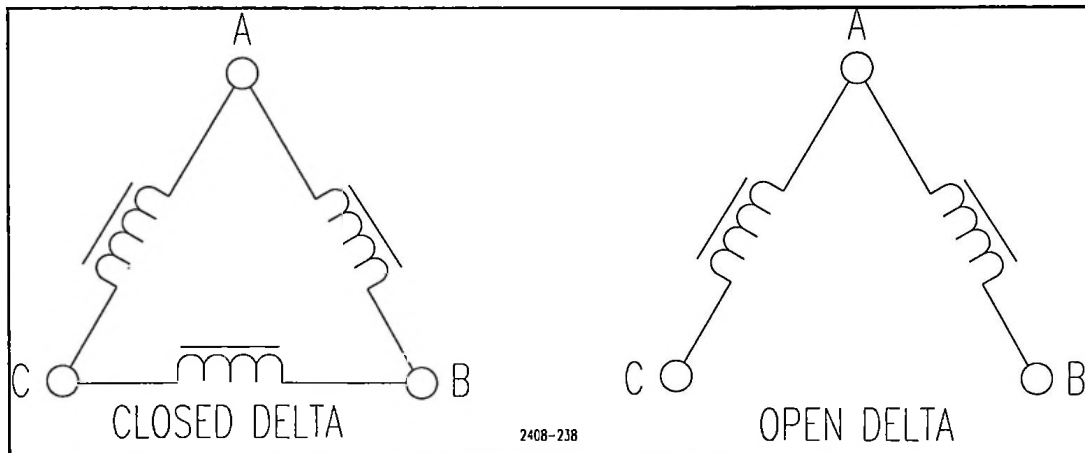


Figure 2-19 Closed Delta vs. Open Delta

The only advantage of the open delta is lower initial cost, and this is partially offset by the fact that when only two transformers are used, they must be larger than the three transformers in a closed delta system.

Difficulties have often been experienced with open delta systems; but when a third transformer was added to close the delta, the problems disappeared.

There is another problem which can occur with an open delta system, and that is caused by lightning and switching transients. When lightning strikes or heavy loads are switched on a power distribution system, high voltage transients are propagated throughout the system. Unbalanced impedances will enhance these transients and can cause transmitter damage, particularly to solid state rectifiers.

Many transmitters are located at the end of a long transmission line which is highly susceptible to transient phenomena. Devices such as Metal Oxide Varistors are inexpensive and very effective in reducing over voltage spikes. These units are limited in the amount of energy that can be dissipated, but will handle, if designed properly, very large currents. You can't take a direct lightning hit and still operate, but not many things will. It has been reported by engineers that installation of a third transformer and transient protection devices, have eliminated the difficulty.

2.10.5 Three Phase Wye Distribution Transformers

The WYE connected system is also considered a symmetrical form of three phase power distribution. All impedances are balanced as seen from each terminal, see Figure 2-20. It is important when using a WYE connected system that the fourth wire (neutral) is connected to the mid-point of the system as shown in the diagram. When this connection is made it provides a path for the zero sequence currents as well as any harmonic currents which are generated due to the rectification of the secondary voltages.

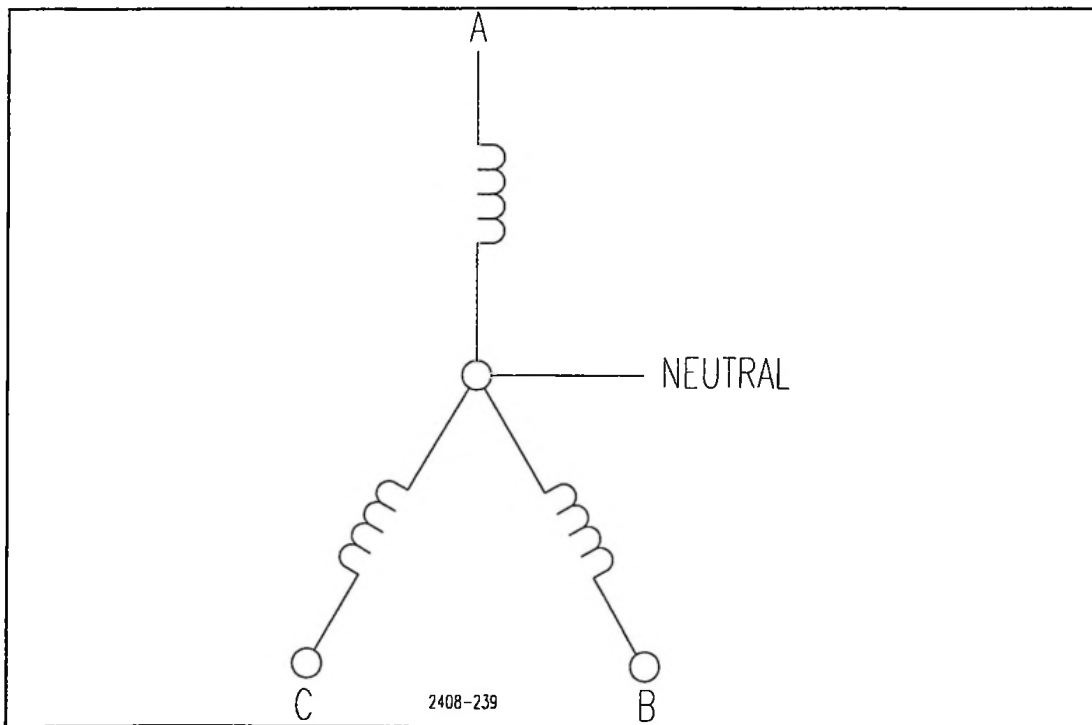


Figure 2-20 3-Phase 4-Wire WYE

Installation & Initial Turn-On

Today, many transformers are supplied with all of the primary terminals available so that either a delta or WYE connection can be made. Table 2-3 shows the different line-to-line voltages that are available with this configuration.

In summary, both symmetrical power distribution systems are satisfactory because of their balanced impedances. Use either a closed delta or a four wire WYE system for maximum transmitter performance. Never use an open delta system just to cut costs - it could cost dearly in the long run.

Table 2-3 Typical Line Voltages, Delta or WYE

Delta Connected Transformer	WYE Connected Transformer
210	364
220*	380*
230	400
240*	415*
250	433
*Typical voltages in some areas of the world.	

Operator Guide

3

3.1 Introduction

This section contains normal operational procedures and information pertaining to the function of the Platinum Z5 Transmitter. Most important, is the information regarding use of the Diagnostic System. All of the information in this section assumes the transmitter and controller are in proper working order.

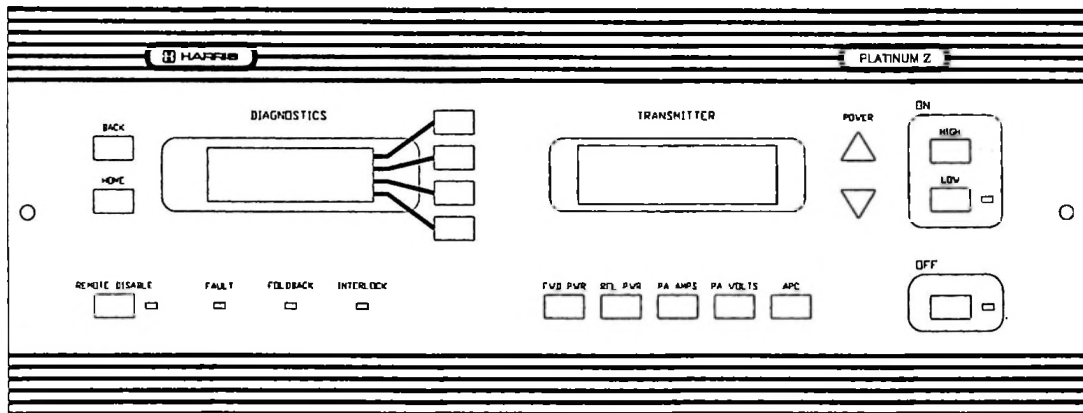


Figure 3-1 Transmitter Controller Panel

3.2 Transmitter Controls

The transmitter controls are mostly on the right half of the controller front panel at the top of the transmitter, See Figure 3-1. These controls and their function are listed below.

OFF - Used to turn the transmitter off

ON - HIGH - Turns the transmitter on to the previous HIGH setting. If the transmitter has folded back power automatically, due for instance to high VSWR, pressing the HIGH button will return the transmitter to the normal high power level provided the cause of the foldback is gone.

ON - LOW - Turns the transmitter on to the previous LOW setting. If the transmitter has folded back power automatically, due for instance to high VSWR, pressing the LOW button will return the transmitter to the normal low power level provided the cause of the foldback is gone.

POWER (up/down arrows) - used to raise and lower the transmitter power.

REMOTE DISABLE - (Located on the left side of the controller) used to disable any remote control system which is connected to the transmitter. When the LED is lit, the remote control inputs are disabled.

⇒ NOTE:

Some of the less often used transmitter controls, such as calibration and configuration, are located in the menu screens of the Diagnostics system. These are covered as part of the Diagnostics system later in this section.

3.3 Transmitter Metering

There are five function keys below the Transmitter display on the front of the controller:

1. FWD PWR (Forward Power)
2. RFL PWR (Reflected Power)
3. PA Amps
4. PA Volts
5. APC (Automatic Power Control)

These are dedicated metering selections for the 5 most important transmitter parameters. The Diagnostic Display will provide all other necessary metering, while still being able to monitor these five readings.

3.3.1 Forward Power (FWD PWR) Units of Measure

The default unit of measure for the forward power reading is percentage, with 100% representing the nominal power output for the station. This percentage can be calibrated to any power level using the Configuration controls in the Diagnostics System. If desired, the forward power reading can be converted to kilowatt by simply pressing and holding the FWD PWR button for at least 3 seconds. After 3 seconds the display should automatically change to power in kilowatts.

3.3.2 Reflected Power (RFL PWR) Units of Measure

The default unit of measure for reflected power is VSWR. If desired, the reflected power reading can be converted to kilowatt by simply pressing and holding the RFL PWR button for at least 3 seconds. After 3 seconds the display should automatically change to power in kilowatts.

3.4 Using the Diagnostic Display

The Platinum Z Series transmitters utilizes a very unique and powerful diagnostic system. The diagnostic system is actually your interface to the inner workings of the transmitter. It is used for Status, Metering, Fault Logging, Configuration and even hardware and software Testing of the controller. A good working knowledge of the diagnostic system is crucial to proper transmitter maintenance and operation. Familiarization with the display and its operation should be quick and easy. Simply press the HOME key and follow the menus. A drawing labeled “Diagnostics Display Menu Tree” is included in the schematic package. This drawing shows all of the menus and screens available in the Diagnostic display system. Note that the drawings are divided into layers from left to right, with Layer 1 considered the HOME layer at the left and successive layers to the right.

The diagnostic system consists of the LCD Diagnostic display and 6 function keys, HOME, BACK and the four selection keys on the right side of the LCD screen.

IMPORTANT: For all discussions pertaining to the Diagnostic system, the four function keys to the right side of the Diagnostic LCD display will be called A, B, C and D from top to bottom as in Figure 3-2. This figure also shows the default screen which will show up when the controller is first turned on or after being idle for 15 minutes.

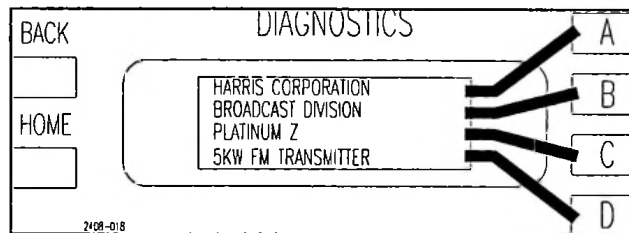


Figure 3-2 Default Diagnostics Screen

3.4.1 HOME

HOME takes you to the home layer or root menu. This menu should look like the one in Figure 3-3, which is the first of two screens in this layer. The second screen in the HOME layer is accessed by pressing the “D” function key to the right of the display which is labelled “MORE -” on the display. The screen should now look like Figure 3-4. These two screens give access to all six HOME menus:

- **Status**
- **Metering**
- **Fault**
- **Configuration**
- **Test**
- **Software Revision**

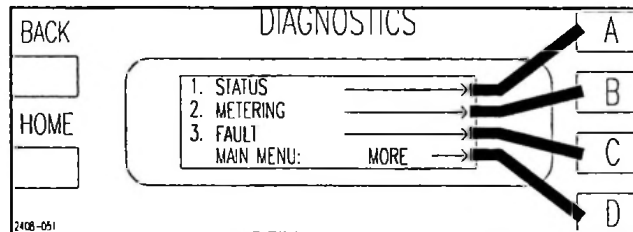


Figure 3-3 Home Menu Page 1

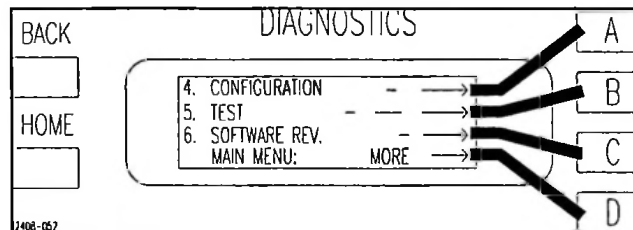


Figure 3-4 Home Menu Page 2

3.4.2 BACK

BACK takes you to the previous layer in the menu tree, not necessarily to the previous screen. As an example, if you were to press HOME and then choose STATUS you would now be in layer 2 of the STATUS menu. You should see the screen shown in Figure 3-5. If you press MORE, you go to the second screen in layer 2. Now press the BACK key. Notice that it did not take you to the previous screen but back to Layer 1, the HOME layer, shown in Figure 3-3. However, if instead of pressing BACK, you pressed more again, this would have taken you to the first screen in layer 2 (since there are only two screens).

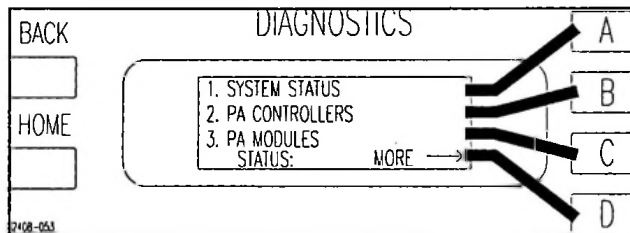


Figure 3-5 Status Layer 2, Page 1

3.4.3 MORE

MORE is a menu item which is used when there are more menu items on a layer than will fit on one screen. It will take you to the next screen in the same layer. When you have reached the last screen in that layer, pressing MORE again will take you back to the first screen in that layer. This is shown on the Diagnostics Display Menu Tree drawings.

3.4.4 Diagnostic Codes

For ease of discussion a simple code will be used to guide you to the area or screen being discussed. The code will have the name of one of the HOME menu items listed above, followed by the appropriate A, B, C or D function key presses required to get to the screen being discussed. The code will always be enclosed in brackets [x,x,x].

⇒ NOTE:

It will be assumed that you always press the HOME key first before entering the key sequences in the brackets.

Example 1

If you wanted to check the temperature of the individual Power Amplifiers on Z Plane A, you would press the following keys;

[HOME, METERING C,A,C]

After entering this key sequence the screen should look like Figure 3-6. This is equivalent to pressing the following menu items as they appear on each successive screen: METERING, TEMPERATURE, PA, Z PLANE A.

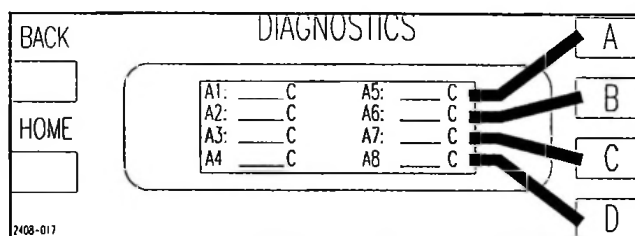


Figure 3-6 PA Temperature Metering
[HOME, METERING C,A,C]

Example 2

You want to check or possibly change the Maximum High Power Setting. This falls under the category of CONFIGURATION, but this menu item only shows up on the second screen of the HOME layer. Therefore, press the following keys:

[HOME, MORE, CONFIGURATION B,B]

This should have taken you to the screen shown in Figure 3-7. This screen now allows the operator to change the Maximum High Power setting using the A,B,C and D function keys. Pressing the BACK key updates the change, while pressing HOME would cancel any changes.

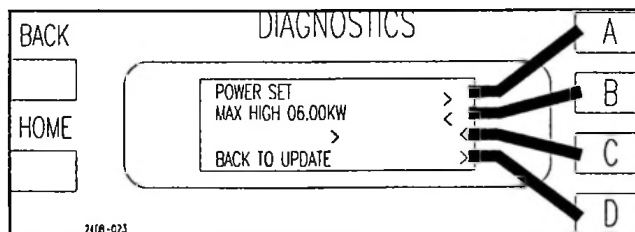


Figure 3-7 Max High Power Configuration Screen
[HOME, MORE, CONFIGURATION B,B]

3.4.5 Asterisk and Pound Signs(*, #)

The asterisk and the pound sign characters are used in some of the metering menus of the Diagnostics Display. If an asterisk (*) shows up in a metering menu, it means that there is no data being received for that reading. The pound sign will only be used in the Vg (Gate Control Voltage for the individual PAs) menus and signifies that there has been a crossover (this is a condition where one PA Controller crosses over and mutes the PAs associated with another PA Controller).

3.4.6 Fault Logging

The Fault Log is located under "Fault" in the Main Menu. Pressing Fault will take you to the screen shown in Figure 3-8. This screen gives you a choice of resetting the transmitter faults and fault log (and clearing any red indicators) or viewing the Fault Log. Pressing B then takes you to the Fault Log, shown in Figure 3-9. This screen shows the latest of a possible 32 faults as designated by "LOG No. 1 of N", where N would be the total number of faults present. "Type" gives the name of the fault. The individual faults and their cause are given in Section VI, Troubleshooting. "Time" gives the elapsed time since the fault occurred, not the actual time at which it occurred. "Status" tells you whether the fault is cleared or is still active. Pressing the D or PREV button will take you to the previous fault in the display.

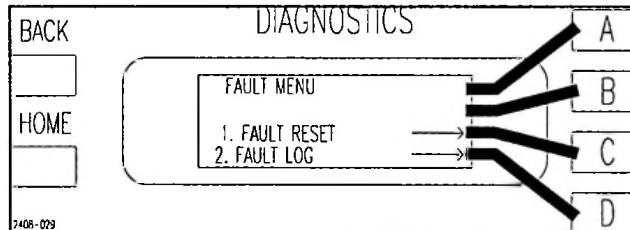


Figure 3-8 Fault Menu
HOME, FAULT

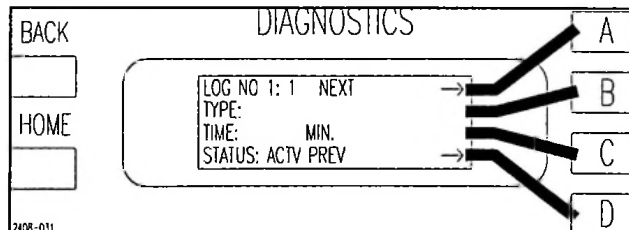


Figure 3-9 Fault Log
[HOME, FAULT D]

3.5 Emergency Operating Procedures

3.5.1 Multiple PA Failures in a Foursome

⚠ WARNING:
THE PA MODULES ARE DESIGNED TO HANDLE VERY HIGH TEMPERATURES AND MAY BE EXTREMELY HOT. DO NOT TOUCH THE MODULES WITH BARE HANDS AFTER THE TRANSMITTER HAS BEEN RUNNING, ESPECIALLY IN HIGH AMBIENT TEMPERATURE ENVIRONMENTS.

If two PAs were to fail in a single group of four or Foursome, the resulting system imbalance could result in a power foldback to approximately 84% of nominal power output. Since a single PA failure in a foursome does not create an imbalance severe enough to cause foldback, one of the PA modules with a bad PA should be taken out, turned over and re-inserted, placing the bad PA in a different foursome. For example, if PA amplifiers B1 and B2 have failed, pull out the A2/B2 PA module, turn it over and plug it back in so that the bad PA is in position A2 instead of B2. There are still 2 failed PAs, B1 and A2, but now each one is in a different foursome. This will restore balance to the system and the transmitter will still be able to operate at or near full power output by automatically increasing the drive to the remaining PAs (via the APC voltage). For more information on Foursomes refer to Section IV, Overall System Theory, under the heading "8-Way Combiner".

For quick reference, the foursome groupings are as follows:

(See Figure 4-5 and Figure 4-6 on page 4-12)

- **A1, A2, A3 and A4 - Front Right Foursome**
- **B1, B2, B3 and B4 - Front Left Foursome**
- **A5, A6, A7 and A8 - Rear Left Foursome**
- **B5, B6, B7 and B8 - Rear Right Foursome**

3.6 Manual Exciter Switching

The active exciter (if dual exciters are installed) can be switched manually from the Status menus in the Diagnostics Display. To manually switch from Exciter 1 to Exciter 2 press [HOME, STATUS D,C]. This will bring up the screen shown in Figure 3-10. Pressing [D] will toggle between the two exciters.

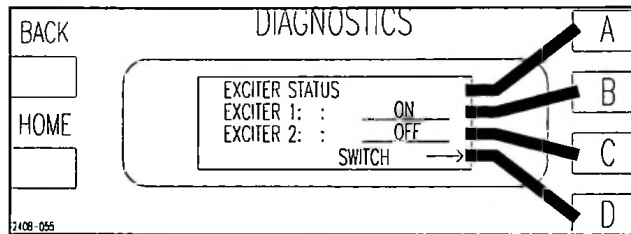


Figure 3-10 Exciter Status Screen
[HOME, STATUS D,C]

3.7 Manual IPA Switching

The active IPA can be switched manually from the Status menus in the Diagnostics Display. To manually switch from IPA_AB1 to IPA_AB2 press [HOME, STATUS, D,B]. This will bring up the screen shown in Figure 3-11. Pressing [D] will toggle between the two IPAs.

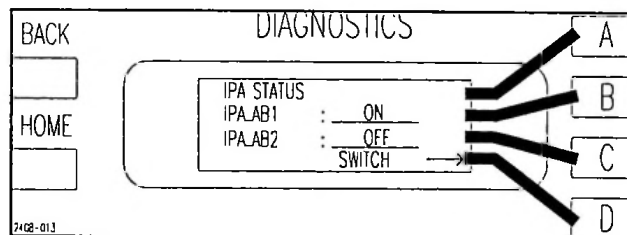


Figure 3-11 IPA Status Screen
[HOME, STATUS, D,B]

3.8 Optimizing Efficiency

The transmitter has the ability to Manually or Automatically optimize its own operating efficiency. It is not a requirement, and the transmitter will meet all specifications without activating this function. When activated, the controller will adjust the transmitter operating parameters to get the best possible efficiency. The user must select whether the function is in Manual or Automatic mode via the Diagnostics Display Menus. To select the mode press [HOME, MORE, CONFIGURATION A,D,D then A to toggle: ON for auto mode or OFF for Manual mode]. The configuration screen is shown in Figure 3-12.

- **Automatic Mode** - When AUTO mode is selected, the transmitter will automatically optimize the efficiency every 12 hours if there are not faults present. This is the recommended mode of operation and is the default mode from the factory.
- **Manual Mode** - In the Diagnostics Display there is a menu screen which can be used to optimize the transmitter efficiency. To optimize efficiency press [HOME, METERING D,C then D for Maximization]. The Efficiency Status/Manual Optimize screen is shown in Figure 3-13.

⇒ **NOTE:**

The REF VOLTAGE in Figure 3-13 is merely an internal reference point the controller uses to reduce the supply voltage in optimized mode. This reading is usually in the low 40's when the transmitter is optimized (well below the actual supply voltage).

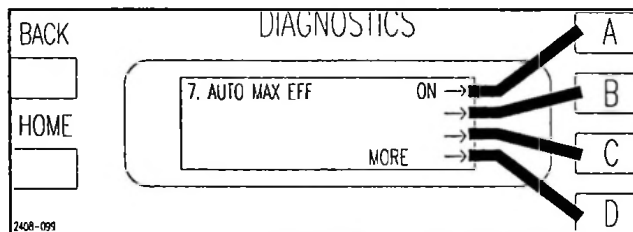


Figure 3-12 Efficiency Configuration Screen [HOME, MORE, CONFIGURATION A,D,D]

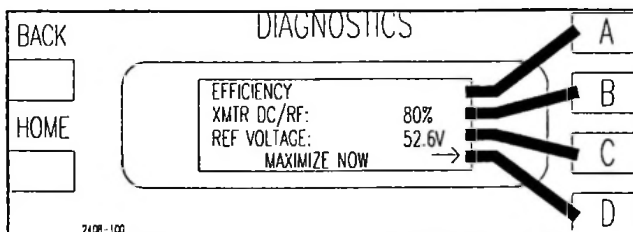


Figure 3-13 Efficiency Status Screen [HOME, METERING D,C]

3.9 Fan Speed

The Platinum Z is equipped with a 2 speed blower. This normally runs at the LOW speed to reduce ambient noise and increase transmitter efficiency. However, if any fault occurs, the fan will automatically switch to high speed until the fault is no longer active. The fan can also be forced to HIGH speed using the configuration menus in the Diagnostics Display. See Figure 3-14. The normal setting for the fan speed is AUTO. Pressing the [C] button toggles between AUTO and HIGH.

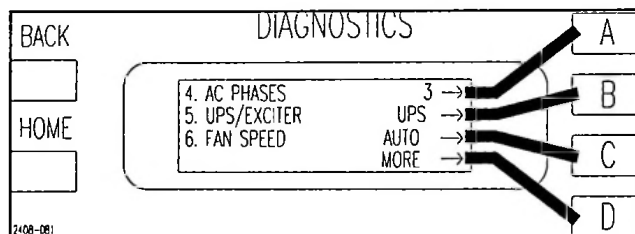


Figure 3-14 Efficiency Status Screen [HOME, MORE, CONFIGURATION A,D]

Overall System Theory

4

4.1 Introduction

This section contains theory of operation and circuit descriptions of the Platinum Z5™ FM Broadcast Transmitter.

The Platinum Z5™ has two possible designations:

- Z5CD, which is a 5kW FM transmitter supplied with the DIGIT, digital FM exciter. CD stands for Clearly Digital.
- Z5FM which is a 5kW FM transmitter supplied with the SuperCiter, analog FM exciter.

4.2 RF Flow Block Diagram Description

Figure 4-1 is a block diagram of RF flow of the Platinum Z5 transmitter. Not shown on this diagram is the control and monitoring associated with the advanced Controller and Diagnostics system.

4.2.1 Exciters

It starts with the built in dual exciter option (in other words the switching components are present but the exciter is optional). The RF output of both exciters (if present) connect in to the Exciter/IPA Backplane board. The exciter RF switch shown on this board is activated by the controller if Exciter A were to fail, placing Exciter B on the air automatically. This fault and all other transmitter faults are stored in the Fault Log in the Diagnostics Display System. The active exciter output is selected by the first RF switch and directed to the active IPA by the second RF switch. Both RF switches are controlled by the Master Controller.

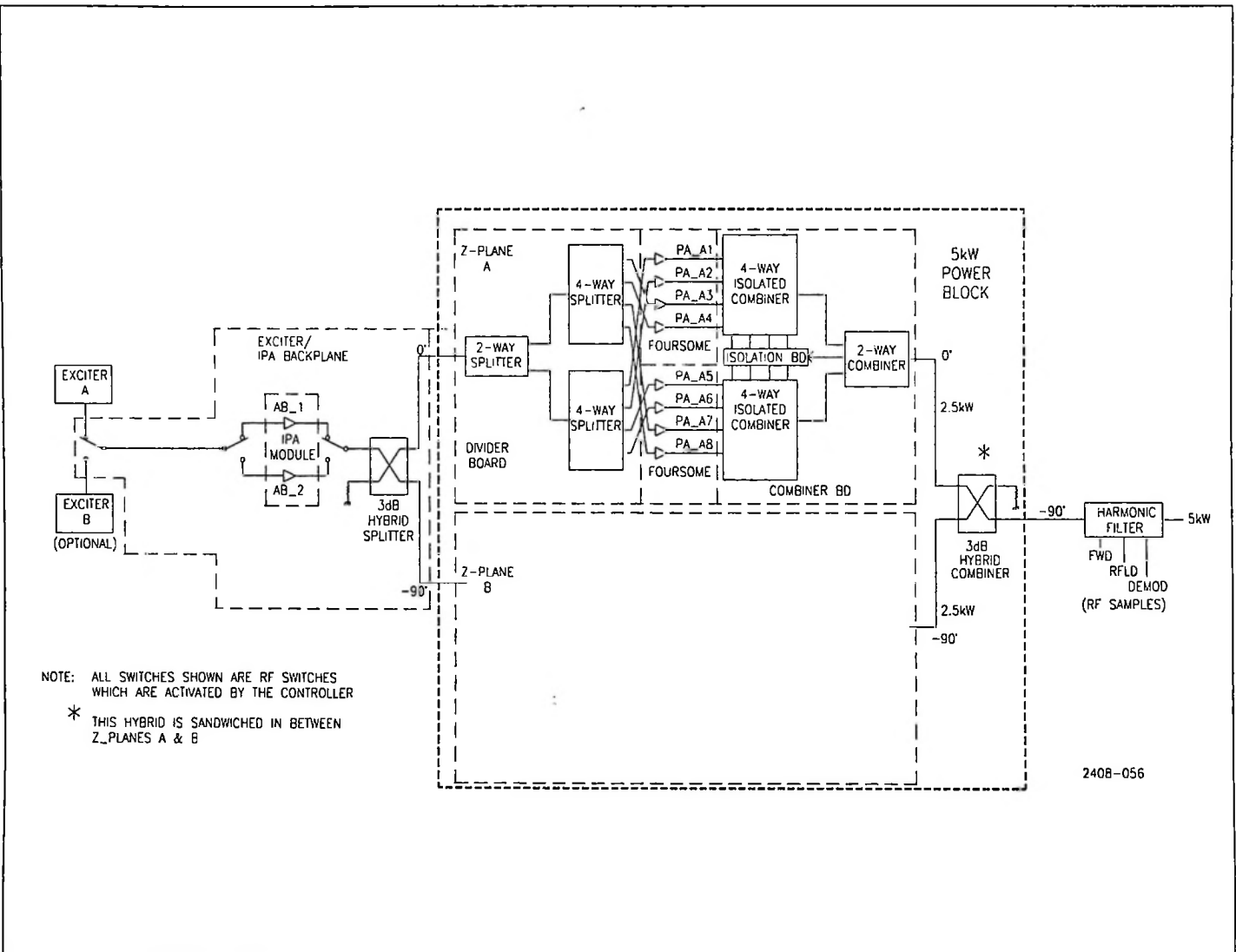


Figure 4-1 RF System Block Diagram

888-2408-002
 WARNING: Disconnect primary power prior to servicing.

4.2.2 IPAs

The Z5 has 1 IPA Module, which is made up of 2 power amplifiers or PAs. The IPA Module is identical to, and interchangeable with, the PA Modules. The 2 IPAs per IPA Module operate in Main/Alternate mode, meaning that only one of them is active at a time. The block diagram shows that IPA_AB1 is the normally active amplifier. RF switching on the input and output of the IPA is activated by the controller if a fault is sensed in the active IPA. The IPA output is split using a 3dB hybrid built onto the IPA Backplane Board. This provides 2 equal amplitude outputs 90 degrees out of phase to drive the Power Amplifiers.

4.2.3 PA

The Z5 contains two Z-Planes which could be considered 2.5kW Power Blocks. For simplicity in Figure 4-1, Z-Plane A is the only one which shows the actual component assemblies located on each Z-Plane. Z-Plane B is identical. Next, each Z-Plane can also be broken down into 2 parts, a Divider Board and a Combiner Board.

4.2.3.1 Z-Plane Divider Board

The Divider Board takes the IPA input and uses a 2 way wilkinson splitter to drive two more 4 way Wilkinson splitters. This provides the necessary 8 drive signal for the 8 PAs connected to Z-Plane A. The PAs are labeled A1-A8 for Z-Plane A and B1-B8 for Z-Plane B. PAs 1-4 on each Z-Plane are located in the front of the transmitter, while 5-8 are located in the rear of the transmitter. Any four PAs labeled 1-4 are considered a FOURSOME, because they are connected to the same 4 Way combiner. Any PAs labeled 5-8 are also considered a Foursome. Here is a list of the 4 different Foursomes in the Z5: (See Figure 4-5 and Figure 4-6)

- A1, A2, A3 and A4 - Front, Z-Plane A
- B1, B2, B3 and B4 - Front, Z-Plane B
- A5, A6, A7 and A8 - Rear, Z_Plane A
- B5, B6, B7 and B8 - Rear, Z-Plane B

4.2.3.2 Z-Plane Combiner Board

The Combiner Board receives the outputs from the 8 PAs and combines them in two 4 Way Isolated Wilkinson Combiners, whose outputs are then combined in a 2 way Wilkinson combiner for a 2.5kW nominal output. Each PA is capable of delivering up to 425 watts into a good load, but will be operating at approximately 325 watts nominally for 5kW of combined transmitter output. The isolation loads for all 3 combiners are located on another board called the Isolation Board for better heat dissipation and easier access. The Isolation boards are located on each side of the Power Block. The Isolation Board also contains RF switches which can switch out a faulty PA without causing a severe system imbalance, allowing greater redundancy.

This also allows the PA Modules to be HOT-PLUGGABLE, meaning that a PA module may be removed while the transmitter is operating. Interlock pins on the module connectors mute the PA modules before it switches out the unplugged module.

4.2.4 5kW Hybrid Combiner

The 2.5kW outputs from Z-Plane A and Z-Plane B are combined in a 3dB Hybrid which is specially fit in between the two Z-Planes. The 5kW output from the hybrid passes through an aluminum box under the PA (in the Power Supply Compartment) and connects to the transmission line Harmonic Filter at the top rear of this box. The harmonic filter connects to the output flange on the top rear of the transmitter. The Harmonic Filter has 3 directional couplers. One is for Forward Power, one is for Reflected Power and the third is left available for on site use as a Demodulator or analyzer sample. The couplers are designed for at least 30dB directivity.

4.3 Detailed RF Theory of Operation

The exciter theory is described in a separate technical manual included with the transmitter. Each of the remaining RF sections of the transmitter are described in the following paragraphs.

4.3.1 Exciter Operation

The exciter output is basically fixed and should not require adjustment. The exciter power output is set using the controls on the front of the exciter and should be set to the "Exciter Power" reading on the factory test data sheet for the transmitter. For information on setting exciter power, refer to the exciter manual.

4.3.1.1 Automatic Exciter Switching

If a second or backup exciter is installed and the on air exciter fails, the controller will automatically switch to the backup exciter and log the fault. Note that the controller will wait 10 seconds for the on-air exciter to recover before switching to the backup. If a backup exciter is added anytime after factory testing, the installer must go into the Configuration Menus on the Diagnostic Display and set "ALT EXCITER" to YES to let the controller know that the backup exciter exists. If this is not done the controller will not auto switch.

4.3.1.2 Manual Exciter Switching

For dual exciter configurations, the on-air exciter can be selected manually using the Diagnostics Display. The exciter select screen is located in the Status menus and shown in Figure 4-2. For exact location, refer to the "Diagnostics Display Menu Tree" drawing in the schematic package. Manual exciter switching can also be done via the configurable remote input. See Table 2-1 on page 2-28 for more information on this remote control input.

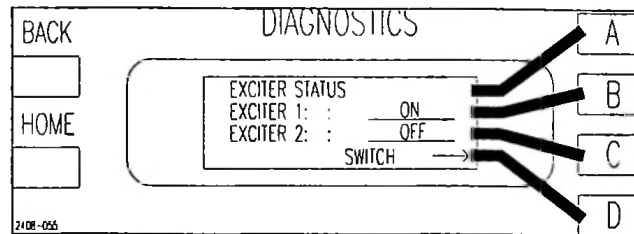


Figure 4-2 Exciter Status Screen
[HOME, STATUS D,C]

4.3.2 IPA

The IPA amplifier and/or module is identical to any one of the PA modules. This allows a PA module to be used in place of a failed IPA. The standard IPA configuration includes dual IPA amplifiers, used in a main/alternate configuration (in other words only one is used at a time). In this configuration the IPA Module is identical to a PA module. If one of the IPA amplifiers fails, the controller will automatically switch to the second IPA with a minimal interruption of service. For a detailed explanation of the RF amplifier operation refer to the paragraph “Power Amplifier” later in this section.

4.3.2.1 IPA Power Output

The power output of the IPA determines the power output of the transmitter and is varied by changing the gate bias on the IPA amplifiers MOSFETs. The gate bias for the IPA is adjusted by the controller, specifically the Master Controller Board, using the front panel “POWER” Raise and Lower controls.

4.3.2.2 IPA Power Supply

The IPA power supply is +52 volts and is diode or’ed from both of the PA power supplies for redundancy. The +52Vdc is connected to the IPA(s) via the IPA Backplane Board.

4.3.3 IPA Backplane Board

Refer to the IPA Backplane schematic for the following. The IPA module plugs into the IPA Backplane Board. This board interfaces all inputs and outputs for the IPA module. It is also responsible for:

- Main/Alternate exciter switching (only active with optional dual exciter configuration).
- Main/Alternate IPA switching (active with standard, dual IPA configuration).
- Monitoring of IPA temperature, voltage, current and forward power.

- Splitting of the IPA output into 2 equal amplitude signals 90 degrees out of phase, by way of a 3dB hybrid, to drive the Z Plane dividers.
- Air flow sensing
- Ambient temperature sensing
- IPA 1 and IPA 2 interlocking

4.3.3.1 Main/Alternate Exciter Switching

Exciter selection is done via relay K1 and the EXCITER SELECT control signal from the Life Support Board. The EXCITER SELECT signal is normally low which places K1 in the position shown on the schematic, sending the Exciter 1 RF output to the IPA input relay K2. If EXCITER SELECT goes high, K1 will be energized and switches to the Exciter 2 RF output. This switching will take place automatically if an exciter fault is detected by the Master Controller board. Exciter switching can also be done manually using the Diagnostics display. Press [HOME, STATUS D,C] (this code is explained in Section III, Operation). This should bring up the screen in Figure 4-2. Pressing the D function key will now toggle K1, switching from exciter 1 to exciter 2 or vice versa.

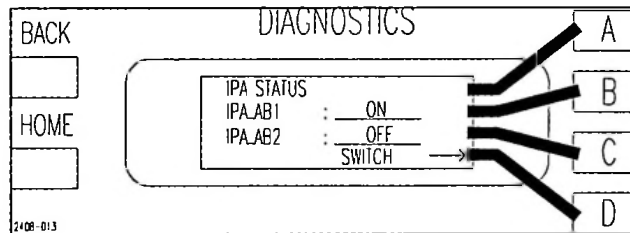


Figure 4-3 IPA Status Screen
[HOME, STATUS D,B]

⇒ **NOTE:**

For easy navigation through the Diagnostic menus, refer to “Using the Diagnostic Display” in Section III, Operation and to the “Diagnostics Display Menu Tree”, in the schematic package, which gives a complete overview of the Diagnostics menu structure.

4.3.3.2 Main/Alternate IPA Switching

Selection of IPA_AB1 or IPA_AB2 (both input and output) is done via relays K2, K3 and the IPA DRIVER SELECT control signal from the Life Support Board.

⇒ NOTE:

The term “AB” is used to associate a component with Z-Plane A and Z-Plane B.

K2 switches the input RF drive from the exciter to IPA_AB1 or IPA_AB2 while K3 selects the active IPA RF output. The control signal, IPA DRIVER SELECT, is normally low which places K2 and K3 in the IPA_AB1 position as shown on the schematic. If IPA DRIVER SELECT goes high, K2 and K3 will be energized and switch to the IPA_AB2 position. If the Master Controller detects a loss of RF output from the active IPA it will automatically switch to the second IPA.

IPA switching can also be done manually using the Diagnostics display. Press [HOME, STATUS, D,B] This should bring up the screen in Figure 4-3. Pressing the D function key will now toggle K2 and K3, switching from IPA_AB1 to IPA_AB2 or vice versa.

4.3.3.3 IPA Monitoring

The IPA Backplane Board provides for monitoring and/or interfacing of 4 main IPA parameters:

- IPA temperature (VTEMP_IPA1 and/or VTEMP_IPA2). If the IPA board exceeds 100°C, the controller will mute the transmitter and/or switch to the alternate IPA. The sensor is actually located on the IPA board, but is interfaced through the Backplane.
- IPA supply voltage (Vd_IPA_SAMPLE). A monitoring sample is sent to the controller through fuse F2. The Supply voltage for the IPA is diode or'ed from both PA supplies for redundancy.
- IPA current (Id_IPA). IPA current is measured by measuring the voltage drop across the series resistor R1. IPA current fault threshold is set at 14.3 amps.
- IPA Forward Power (IPA FWD PWR). A sample of the IPA forward power is taken by the directional coupler (shown right after K3 on the schematic) and detected by CR1. The DC voltage at TP1 will therefore be relative to the IPA output. This is also sent to the controller for monitoring and main/alternate IPA switching.

4.3.3.4 Air Flow Sensing.

Airflow is sensed as the difference in temperature between a heated sensor, RT1, and an ambient sensor, RT2. RT1 is actively biased via R3 which will cause a steady increase in temperature with no air flow. Under normal operation, the voltage difference between the two sensor outputs will stabilize at some value depending on the amount of air flow. If the airflow is reduced or non-existent, then RT1 will heat up increasing its voltage output, whereas RT2 will stay the same. Eventually the voltage difference between the two sensors will reach a threshold where the controller will turn the fan to high speed to compensate for the reduced airflow. If the airflow is still insufficient, the transmitter will be shut off.

4.3.3.5 IPA_AB1 and IPA_AB2 interlocking.

The signals IPA1_PCB_OK and IPA2_PCB_OK are the interlock signals for the IPA boards. The interlock connections on the IPA board (and the PAs as well) are shorter than the other pins. This causes the interlock connection to break before the RF and voltage contacts when the module is unplugged. This gives the controller time to shut off the IPAs (via the IPA gate voltage, IPA1_GATE) so that the connector contacts do not arc.

4.3.3.6 IPA Power Divider (3dB Hybrid)

The IPA power divider is actually a 3dB hybrid which splits the IPA output into 2 equal amplitude signals 90 degrees out of phase to drive the Z Planes at J5 and J6. Remember that the output of the Z Planes is recombined using another 3dB hybrid which requires a relative 90 degree phase angle between the two input signals. The reject port on the hybrid is connected to an external Reject Load. The hybrid integrated onto the IPA Backplane Board.

4.3.4 Z-Plane Combiner/Divider Boards

There are two Z-Plane Combiner/Divider Boards in the Z5 transmitter. These two boards provide all inputs to and outputs from the PA modules. The Z Plane is the overall term for the combination of the Combiner and Divider boards. There is a separate schematic for each part of the Z Plane in the schematic package. The first page of each schematic is identical and is a block diagram of the entire Z Plane.

Each Z-Plane assembly contains:

- Edge connectors for 8 PA amplifier boards (4 in front and 4 in the rear). These connectors are labeled J1-J8.
- An 8 way Wilkinson Divider, driven by the IPA, which feeds RF drive to each of the 8 PA amplifiers.
- An 8 way Wilkinson Combiner which combines the output of the same 8 PA amplifiers.

The RF output of the Z-Plane board connects directly to the 3dB hybrid where it is combined with the output of the second Z-Plane Combiner/Divider board. The Z plane boards are identical, but the outputs connect to opposite ends of the 3dB hybrid (one at the top and one at the bottom). This requires that one of the Z Planes be physically inverted.

4.3.4.1 8-Way Divider

Refer to the Divider schematic for the following. Each 8-Way Divider is a 2-stage Wilkinson divider. The 8 way dividers are located on the Z-plane boards in the center of the PA assembly.

The input to the divider is first divided into two equal outputs at approximately 35 ohms by a two-way Wilkinson divider with a 70.7 ohm isolation resistor, R9. Each of these outputs (each end of R9) is then divided into 4 outputs in a 4-way Wilkinson divider.

The Wilkinson dividers contain terminating resistors which dissipate no power when all of the outputs are correctly loaded, but if a PA is removed, resulting in an open-circuit on an output, the Wilkinson circuit and the load resistors act to keep the input impedance of the splitter near the nominal value of 50 ohms. Each output from each 8-Way Divider is fed to the input of one PA Amplifier boards, at J1 - J8.

4.3.4.2 8-Way Combiner

Refer to the Combiner schematic for the following. Each 8-way combiner consists of two 4-way Wilkinson combiners, called **FOURSOMES**, followed by a 2-way Wilkinson combiner which combines the outputs of the two Foursomes. The Foursomes are split up as follows:

- A1, A2, A3 and A4 - Front Right Foursome
- B1, B2, B3 and B4 - Front Left Foursome
- A5, A6, A7 and A8 - Rear Left Foursome
- B5, B6, B7 and B8 - Rear Right Foursome

The Wilkinson combiners include isolation loads (ISO loads) which dissipate no power if all PA outputs are equal and in phase. These resistors are located on the Isolation Boards and labeled RT1-RT8. The ISO resistors connect to the points labeled E1-E8 on the Combiner schematic. If any input is lost due to failure of a PA module, the associated ISO load will dissipate some power; approximately 150 watts, until the RF switch on the Isolation board disconnects the ISO load and grounds that point (E1-E8) on the combiner. This now looks like an open to the 4-way combiner output at E9 or E10 (the input to the 2-way combiner).

4.3.4.3 PA Modules

Each of the 8 PA Modules contain two PA Amplifier boards mounted on opposite sides of the PA Module heat sink. The modules are numbered 1 through 8 with the top module in the front being #1 and counting to #4 at the bottom. The top rear module is #5 counting down to #8 at the bottom rear, see Figure 4-5 for the front view and Figure 4-6 for the rear view. The PAs are numbered as 1A, 1B, 8A, 8B etc... with the "A" side PAs being plugged into the "A" Z Plane, and the "B" PAs plugged into the "B" Z Plane. From the front of the transmitter, the "A" Z Plane is on the right and the "B" Z Plane is on the left. Keep in mind this is reversed when viewing from the rear of the transmitter. All DC, signal and RF connections to a PA board are through one edge connector.

4.3.4.4 Power Amplifier (PA)

See Figure 4-4. The RF drive from the IPA enters the PA Amplifier Boards at Pin C. The RF input level for each amplifier is typically 15-20 watts. TL1, C1 and C2 allow the input impedance to be matched to 50 ohms and permit the phase shift through the module to be trimmed to a nominal value which allows all modules to combine in-phase. The RF signal is then sent to T1, a coaxial 9:1 transformer which also splits the phase providing 0 degree and 180 degree outputs to drive a pair of push-pull RF power MOSFETs (Q1 and Q2). Bias to Q1 and Q2 (labeled VG for Gate Voltage) is connected through the center of the secondary winding of T1.

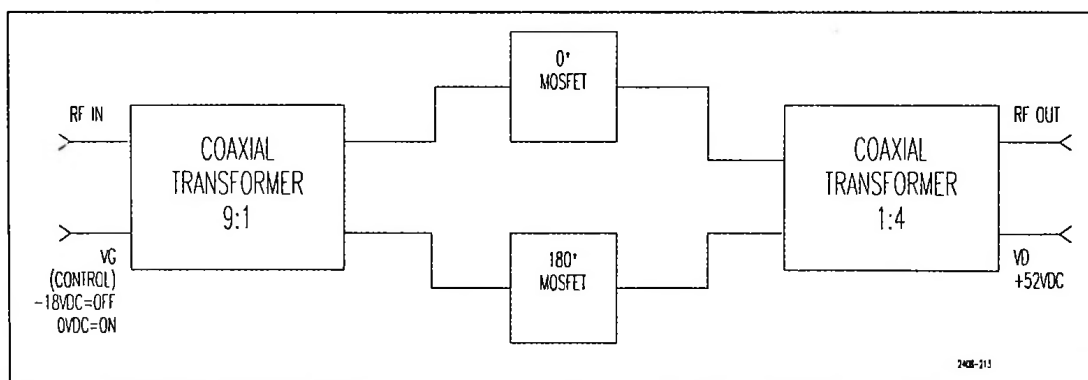


Figure 4-4 Power Amplifier Block Diagram

The control voltage input called VG can be thought of as a bias voltage which can be used to vary the amplifier output. Normally for the PAs it is simply used to turn the amplifiers on and off. If VG is -18V the amplifier is off or muted. If VG is 0V the amplifier is fully turned on and drive level from the IPA determines the amplifier power output.

Overall System Theory

When the amplifier is used as the IPA, VG is used to linearly vary the IPA output which then controls the transmitter power output. For an IPA, VG comes from the Life Support Board and is controlled by the APC loop on the Master Controller Board. Pressing the RAISE and LOWER controls on the front of the transmitter will vary the APC voltage which in turn will vary VG to the IPAs. This will vary the IPA RF output, which will raise or lower transmitter power.

The MOSFET outputs are combined in T2, a 1:4 transformer. C19 and C20 fine-match the 50 ohm load impedance at the PA output to the output impedance of T2. The +52Vdc or VD (Drain Voltage) from the main power supply enters at location C-1 and is decoupled and filtered by C11, C12, C13, C14, C16, C24, L1 and L2. The DC voltage reaches the drain of MOSFETs Q1 and Q2 through the center tap of T2's primary winding. The advantage of this method is to allow direct DC connection to the MOSFETs and have an AC RF output through the coax without the need for a blocking capacitor.

Maximum RF output is 425 watts. Typical output level is 300 to 340 watts. The power module is designed for single amplifier field replacement. In the event an RF power MOSFET fails, field replacement is not practical due to the cost of components, time and test equipment involved in repair and alignment of phase, gain and response. This is a highly critical area, and if not done correctly, improper module and transmitter operation will occur.

As an additional consideration, please observe the following warning from the MOSFET manufacturer regarding beryllium oxide.

⚠ WARNING:
PRODUCT AND ENVIRONMENTAL SAFETY-TOXIC MATERIALS. THIS PRODUCT CONTAINS BERYLLIUM OXIDE. THE PRODUCT IS ENTIRELY SAFE PROVIDED THAT THE BEO DISC IS NOT DAMAGED. ALL PERSONS WHO HANDLE, USE OR DISPOSE OF THIS PRODUCT SHOULD BE AWARE OF ITS NATURE AND OF THE NECESSARY SAFETY PRECAUTIONS. AFTER USE, DISPOSE OF AS CHEMICAL OR SPECIAL WASTE ACCORDING TO THE REGULATIONS APPLYING AT THE LOCATION OF THE USER. IT MUST NEVER BE THROWN OUT WITH THE GENERAL OR DOMESTIC WASTE.

Failed PA boards should be sent in for repair or exchanged mainly due to the minimal cost involved. Refer to the Maintenance section of this manual for the RF amplifier replacement procedure.

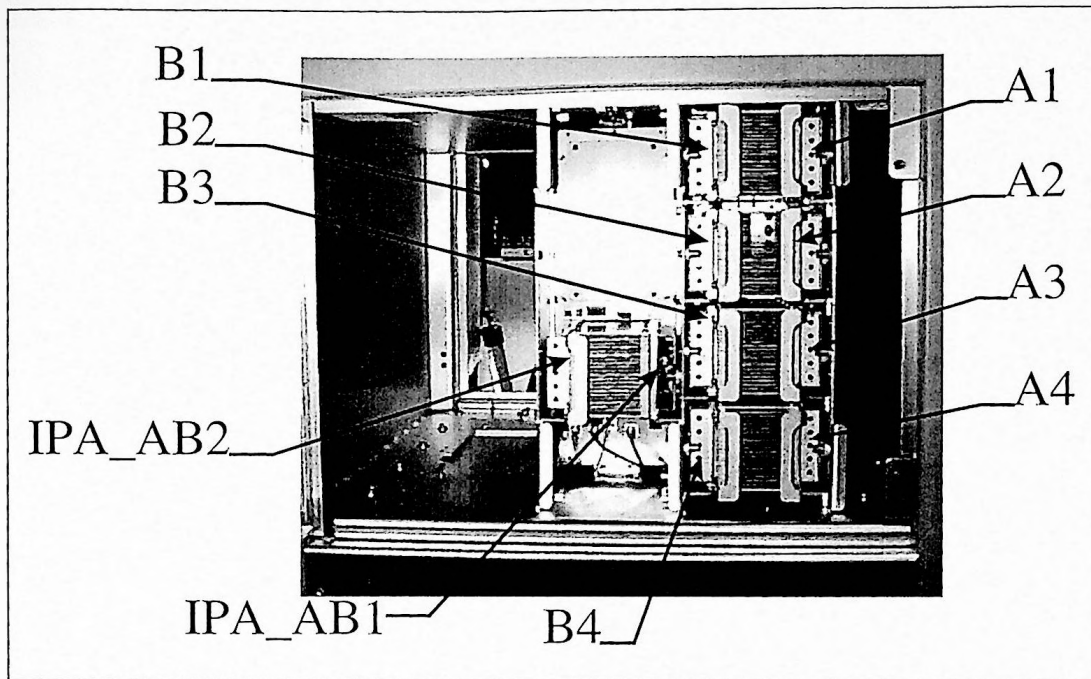


Figure 4-5 PA Compartment Front View

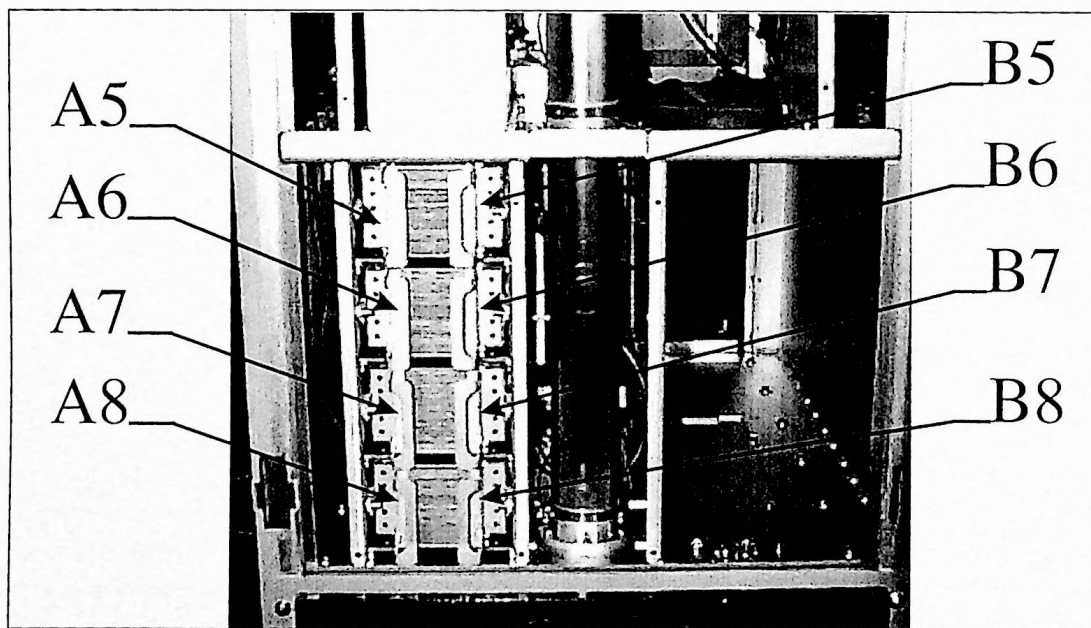


Figure 4-6 PA Compartment Rear View

4.3.4.4.1 Isolation Boards

Each Z Plane has an associated Isolation Board which contains the isolation resistors and disconnect switches for the two 4-way wilkinson combiners and the isolation resistor for the 2-way Wilkinson combiner. The isolation resistors for the four way combiners, R1-R8, are each 50 ohm. When all modules are working properly, these resistors dissipate little or no power. However, when a PA fails approximately half of the power of one module will be across the isolation resistor. The resistors will handle the imbalance of a failed module for about 20 seconds. Therefore when a module has failed, the isolation resistor will start to heat up. This rise in temperature is detected by a thermistor, RT1-RT8, which is physically attached to the resistor. The thermistor is monitored by the associated PA Controller Board (there are two). The PA Controller then shuts off the module RF output via the PA gate voltage and activates the associated RF switch on the isolation board. The switch disconnects the isolation resistor from the combiner and grounds output of the PA (E1-E8). The entire Z Plane will be operating with a slight impedance mismatch (it is now a 3-way combiner instead of a 4-way) but is well within the ratings of the modules. The effects are minimized by the 2 way combiner and its isolation resistor, which will tend to absorb imbalances, and by the characteristics of the 3dB hybrid combiner, which tends to ignore minor amplitude and phase imbalances in the two Z Plane outputs.

4.3.4.5 3 dB Hybrid Combiner

The 3dB combiner is located in the middle of the Power Block, between the two Z Planes. The two outputs from the Z Planes are summed in the 3dB output combiner. Since the RF inputs to the two Z Planes, driving the PA inputs, come from the 3dB hybrid splitter on the IPA Backplane Board, they differ in phase by 90 degrees. Thus, the outputs from the Z Planes differ by 90 degrees, allowing them to be combined in the 3dB hybrid output port with very little power appearing at the reject load.

If the two Z Plane outputs are not equal, or are not exactly 90 degrees apart in phase, a portion of the power appears to the reject load, however the 3dB hybrid is a very stable device which sends most of the input power to the combined output over a fairly wide range of input power ratios and input phase differences. The reject load is a 50 ohm 800 watt resistor mounted on a heatsink which is located on the upper end of the hybrid, just above the Z-Planes. The output of the 3dB hybrid is on the lower end of the hybrid and is connected to the transmission line Harmonic Filter in the rear of the cabinet, via the aluminum enclosure just above the power supply. There is a static drain choke located inside this box.

4.3.5 Harmonic Filter

The vertical transmission line at the rear of the cabinet contains the Harmonic Filter.

4.3.6 Directional Coupler Assembly

The directional coupler assembly is installed directly before the output from the transmitter. It consists of 3 directional couplers with two of the couplers adjusted to produce a sample of the forward output power, and one coupler arranged to provide a sample of the reflected output power. The isolation, or directivity, of the couplers is better than 30dB, with 40dB typical.

 **NOTE:**

Note that the reflected coupler cannot be interchanged with the other 2 couplers due to the different coupling ratio for the forward and reflected samples.

The typical coupling ratio for each of the couplers is given below:

Forward Coupler - 48.8dB @ 88MHz to 47dB @ 108MHz

Reflected Coupler - 43.8dB @ 88MHz to 42dB @ 108MHz

(Typical tolerance is +/- 0.1dB but this is not guaranteed since any minor variation can be factored out using the calibration procedures).

4.4 Power Supply Block Diagram Description

There are two different types of power supplies in the transmitter, the PA Power Supply and the Low Voltage Power Supply.

4.4.1 PA Power Supply

There are three power supply configurations available for the Z5 transmitter:

- 3-Phase, 3 wire (198-250VAC)
- 3-Phase, 4 wire (342-432VAC)
- Single Phase (198-250VAC)

The supplies are very much alike operationally. The 3-Phase 3 wire and 4 wire supplies have all of the same components, but have a different wiring harness. The PA power supplies, whether 3-Phase or Single Phase, are regulated by reliable tap switching techniques which provides excellent efficiency, while avoiding the power line harmonic problems associated with switching supplies. The regulation range is 48-54Vdc at 2Vdc per tap.

4.4.1.1 3-Phase Power Supply

The Z5 transmitter uses dual main power transformers whose DC outputs are combined through large inductive chokes. Figure 4-7 shows a simplified diagram of one of the PA power supply transformers.

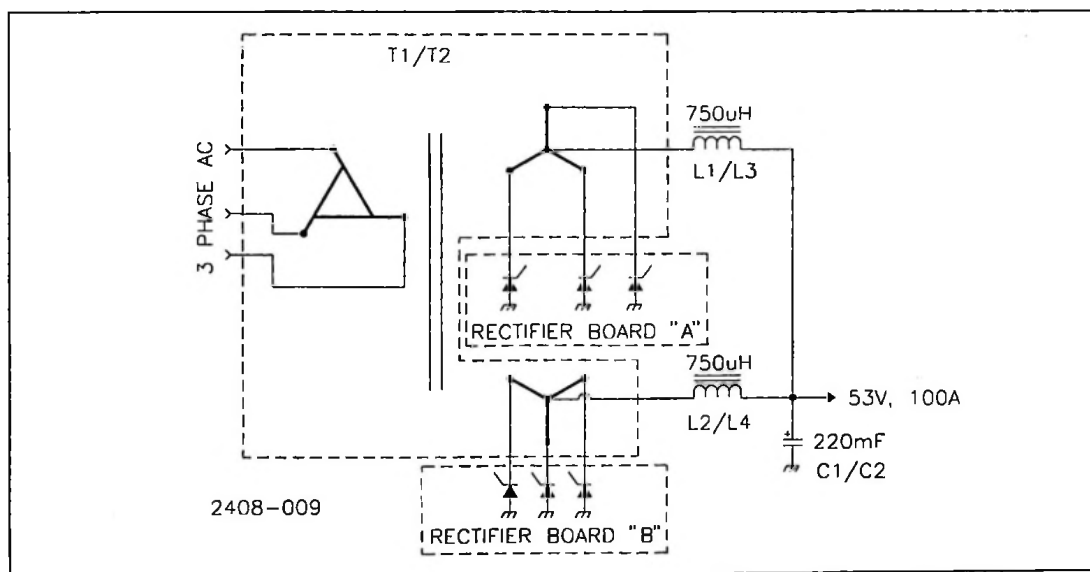


Figure 4-7 3-Phase Power Supply Simplified Diagram (1 Transformer)

Each transformer has a 3 wire extended DELTA or extended WYE primary (depending on your AC input configuration) and two secondaries labeled A and B which are always WYE wound, with the center tap being the output. The outputs of the 2 secondaries are combined through chokes and filtered by a single 120,000uF capacitor. The combination of the extended primary windings and the dual secondaries (each at a different phase angle) results in an output ripple frequency of 600/720Hz for 50/60Hz input. Each of the secondary windings has 4 output taps, each of which are connected through an SCR to ground. The SCRs act as both tap switches, activating the tap which gives the appropriate DC voltage output, and as rectifiers. This gives a total of 12 SCRs per secondary, but only 3 SCRs will be activated at any one time providing the ability to regulate the output DC voltage by changing the transformer turns ratio. The 4 secondary taps basically change the primary to secondary turns ratio allowing allow DC outputs of 48, 50, 52 and 54Vdc. The tap switching is controlled by the Power Supply Controller board. The two transformer assemblies are designated PS1 and PS2. PS1 provides power for 8 of the 16 PAs. Four of these are on Z Plane A and four on Z Plane B. Therefore PS2 provides power for the remaining 8 PAs. There is only one PS Controller for both supplies, however each supply still operates independently. Also each Power Supply is connected to the same PAs as its corresponding PA Controller.

PS1 and PAC1 connect to A1, A2, A5, A6, B3, B4, B7 and B8.

PS2 and PAC2 connect to A3, A4, A7, A8, B1, B2, B5 and B6.

This information is also shown in Table 4-1 on page 4-60.

4.4.1.1.1 Soft Start

During transmitter turn on, a fifth set of SCRs is activated. See Figure 4-8. These are connected to the lowest voltage output tap of transformer secondary "B" (the one with the fewest secondary turns). However, the Soft Start SCRs are connected through a common surge limiting resistor to ground, instead of the direct ground connection provided with the rest of the SCRs. This allows the "Soft start" by limiting the maximum surge current while charging the power supplies. The soft start lasts for about two seconds during turn on. After the two second soft start the resistor is bypassed by activating the normal run-mode SCRs which are also attached to the lowest voltage output tap but connect directly to ground. This allows the supplies to come up to full charge. If the voltage is not high enough, the Power Supply Controller will activate the next highest tap to increase the voltage. It will continue this process until the DC output voltage is approximately 52Vdc or it reaches the highest tap.

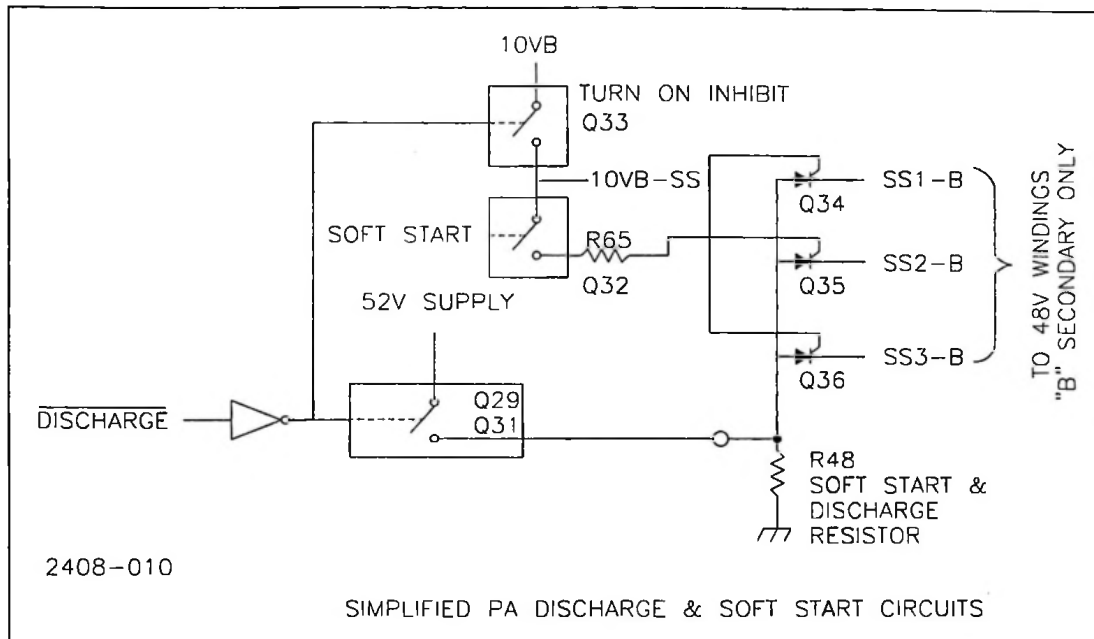


Figure 4-8 3-Phase Power Supply
Simplified Soft-Start and Discharge Circuit

4.4.1.1.1 PA Power Supply Discharge

The PA Power Supply Discharge circuit also uses the Soft Start resistor to discharge the 52Vdc PA supply. The discharge circuit is activated when the transmitter is turned off. When the discharge circuit is active, it disables the SCRs to prevent the supply from trying to turn on during a discharge cycle.

4.4.1.2 Single Phase Power Supply

Refer to the Overall System Block Diagram in the schematic package and Figure 4-9 for the following discussion. The power supply consists of two power transformers each with a single center tapped secondary. The center tap is the 52Vdc output and is filtered by a large choke and 3 large filter capacitors. The single phase supply is full wave rectified giving a ripple frequency of 120Hz and therefore requires more filtering than the 3-Phase supply.

Each of the secondary windings has 4 output taps, each of which are connected through an SCR to ground. The SCRs act as both tap switches, activating the tap which gives the appropriate DC voltage output, and as rectifiers. This gives a total of 8 SCRs per secondary, only 2 of which will be activated at any one time providing the ability to regulate the output DC voltage by changing the transformer turns ratio. The 4 secondary taps allow DC outputs of 48, 50, 52 and 54Vdc. The tap switching is controlled by the Power Supply Controller board. The two transformer assemblies are designated PS1 and PS2. PS1 provides power for 8 of the 16 PAs. Four of these are on Z Plane A and four on Z Plane B. Therefore PS 2 provides power for the remaining 8 PAs.

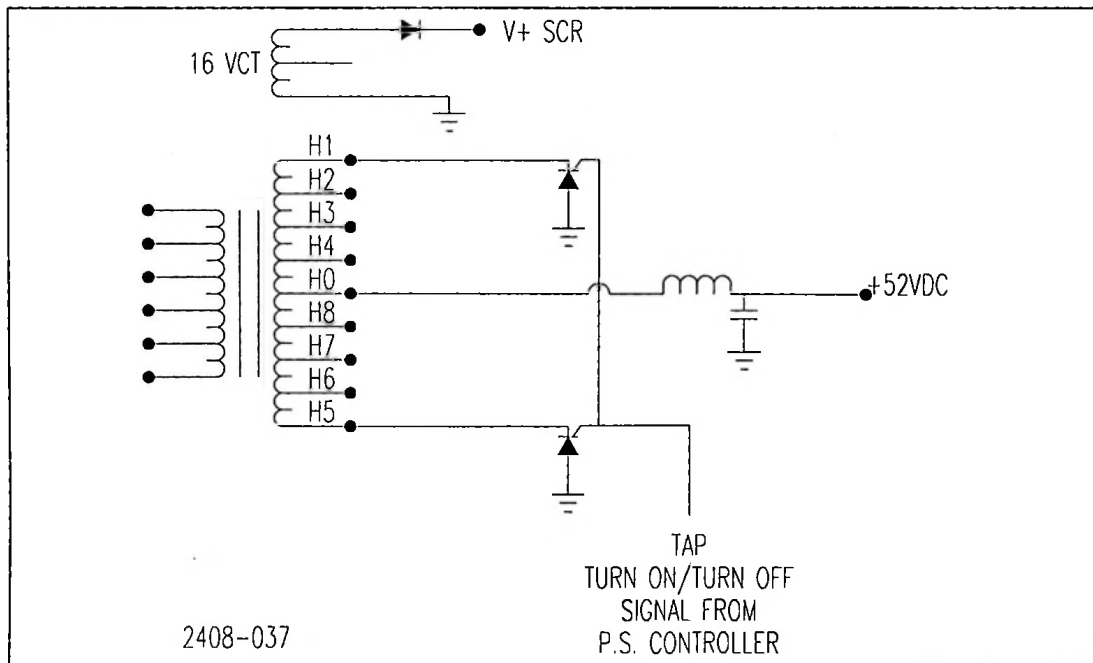


Figure 4-9 Single Phase Power Supply Simplified Diagram

4.4.1.2.1 Soft Start

During transmitter turn on, a fifth set of SCRs is activated (these are located on the Rectifier Boards). See Figure 4-10. These SCRs are connected to the lowest voltage output tap of each transformer secondary (the one with the fewest secondary turns). However, the Soft Start SCRs are connected through a common surge limiting resistor to ground, instead of the direct ground connection provided with the rest of the SCRs. This allows the “Soft start” by limiting the maximum surge current while charging the power supplies. The soft start lasts for about 6 seconds during turn on. After the 6 second soft start the resistor is bypassed by activating the normal run-mode SCRs which are also attached to the lowest voltage output tap but connect directly to ground. This allows the supplies to come up to full charge. If the voltage is not high enough, the Power Supply Controller will activate the next highest tap to increase the voltage. It will continue this process until the DC output voltage is approximately 52Vdc or it reaches the highest tap.

4.4.1.2.2 PA Power Supply Discharge

The PA Power Supply Discharge circuit also uses the Soft Start resistor to discharge the 52Vdc PA supply. The discharge circuit is activated when the transmitter is turned off. When the discharge circuit is active, it disables the SCRs to prevent the supply from trying to turn on during a discharge cycle.

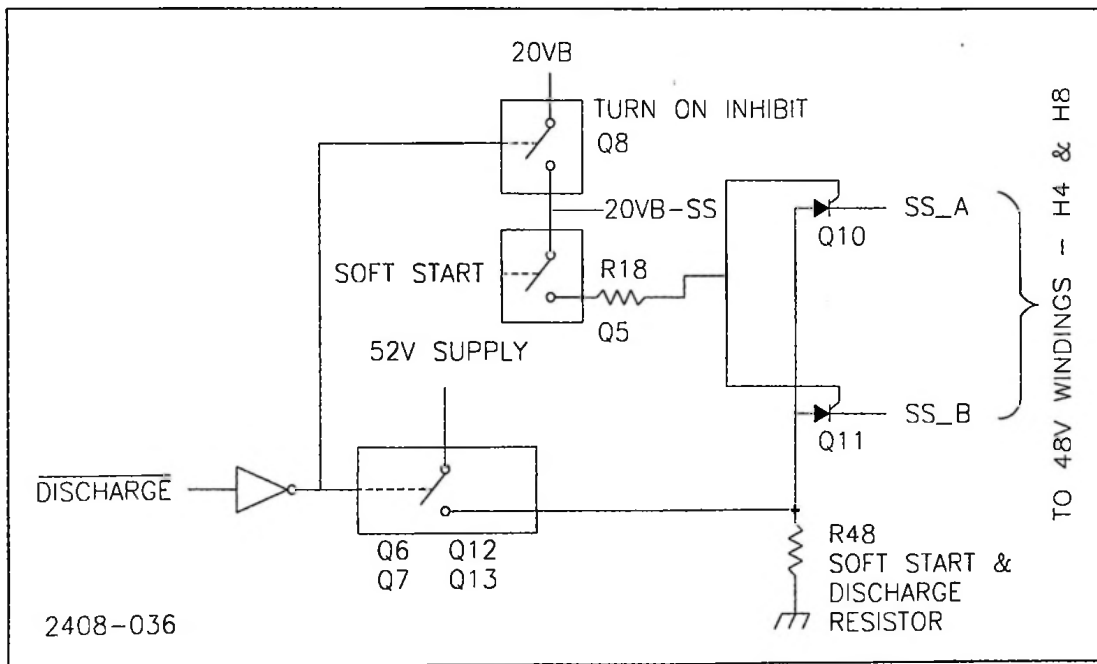


Figure 4-10 Single Phase Power Supply Simplified Soft Start and Discharge Circuit

4.4.2 Low Voltage Power Supply

The Low Voltage Power Supply is a single PC board mounted in the rear of the transmitter near the main contactor. It is designated A19 (assembly 19). The circuit board is the same for the 3-Phase and single phase configurations, only the wiring to and from the board is changed. It supplies DC voltages to all circuits in the transmitter. These include:

- +20VDC
- -20VDC
- +10VDC

These voltages are sent to the Rectifier boards and then on to the controller boards.

The board contains 3 relays, A19K1, A19K2 and A19K3. When the transmitter is turned on, A19K1 activates the main contactor (simply called K1) which then applies AC to the PA power Supplies, while A19K2 applies AC to turn on the exciter(s). A19K3 selects the low or high fan speed by actuating the fan speed select relay K2 which is mounted near the main AC contactor.

4.5 Detailed Power Supply Descriptions

4.5.1 3-Phase PA Power Supply

Refer to the Overall System Block Diagram in the schematic package for the following discussion. The transmitter 3 phase AC inputs connect directly to K1, the AC mains contactor. The transformer side of the contactor is wired in parallel to power transformers T1 and T2 primaries in the bottom of the transmitter. T1 and T2 primaries must be tapped for the proper AC input voltage. The tapping chart can be found on the Overall System Block Diagram. T1 and T2 can accommodate input voltages in the range of 198 to 250 Vac.

Each transformer has 2, four wire WYE, secondaries with the center connection being the rectified DC output of 52Vdc. The two secondary outputs are combined via L1 and L2, for T1, and L3 and L4 for T2. C1 and C2, 120,000uF filter caps, provide the final filtering. Each of the transformer secondary taps is connected to a Rectifier Board.

The secondaries of T1 and T2 use the unique tap switching design to give a small window of coarse regulation (approximately 2Vdc change per tap) to compensate for 3 phase AC line variations.

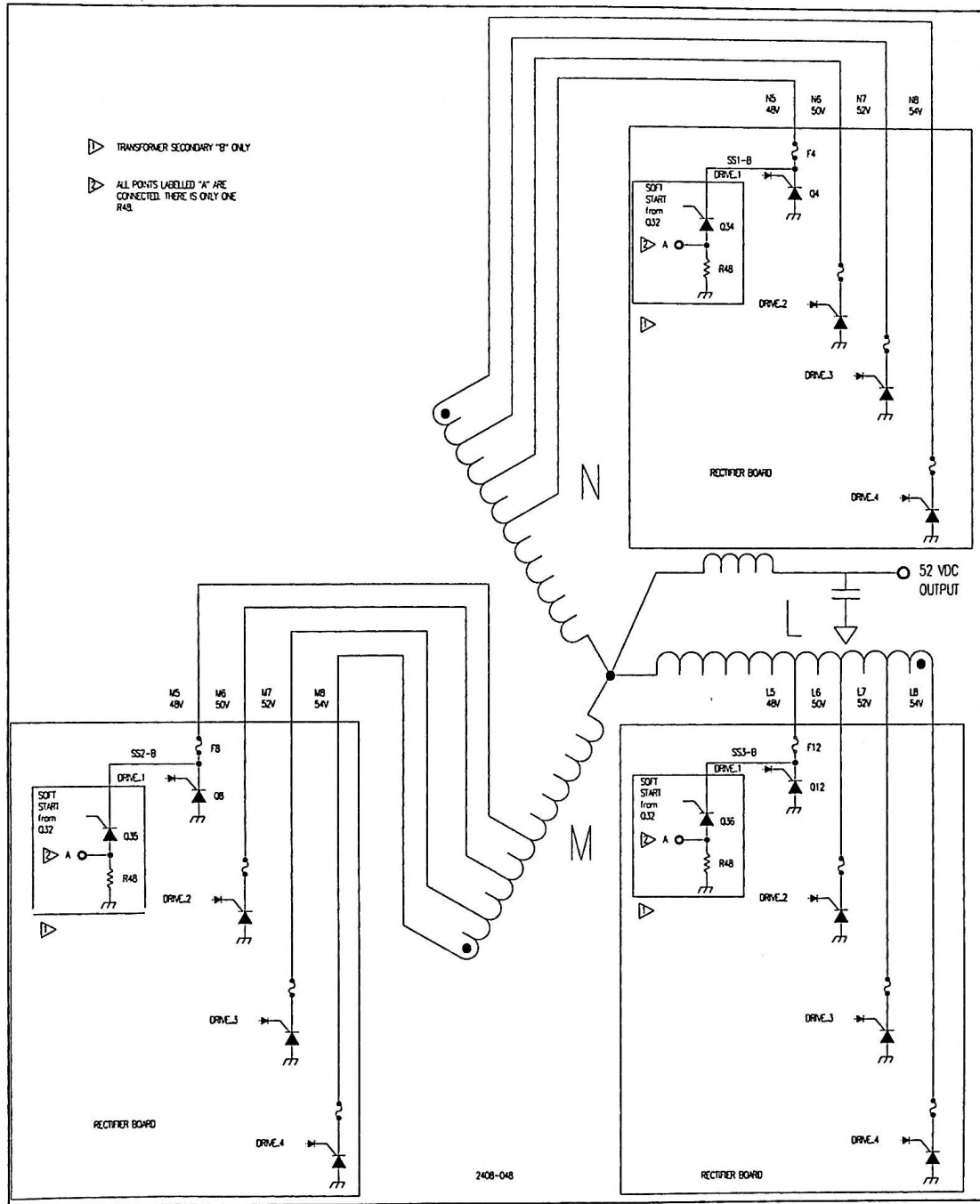


Figure 4-11 3-Phase Power Supply
Simplified Diagram of Transformer and Rectifier Connections

4.5.1.1 Rectifier Board

The Rectifier Board contains the SCRs which are used for the tap switching as well as rectification of the 3 phase AC. Each secondary winding has four taps, see Figure 4-11. Each of these taps have one SCR to ground. The Power Supply Controller can turn on any one of the four SCRs at a given time. If the voltage is not high enough at the DC output, the PS Controller can change the transformer turns ratio by turning on a different SCR and therefore utilizing a different secondary tap. The taps closest to the center will provide the least amount of secondary turns in circuit and will therefore give the lowest DC output voltage. This means that the taps which are furthest from the center will give the highest DC output voltage due to more active turns in the secondary.

There are two rectifier boards mounted on the top of each power transformer. The two boards were originally made as one board which is broken apart for assembly. Therefore, there is an "A" side and a "B" side, both of which are shown on the same schematic. The left side of the schematic is the "B" side and the right side is the "A" side (except on sheet 3 which is "B" side only). There is also only one part number for both boards. The "A" Rectifier Board is for the transformer secondary "A" with the "B" Rectifier Board used with transformer secondary "B". The Rectifier Boards are operated in parallel and are tied together by a ribbon cable, J3, which is shown in the middle of the schematic connecting the "A" and "B" sides.

4.5.1.2 Rectifier Board Circuit Description

Refer to the Rectifier Board schematic and Figure 4-11 for the following. The Rectifier Boards perform three primary functions:

- Dynamic secondary tap switching using SCRs, to maintain a relatively constant supply voltage and thus maintain constant transmitter power output despite fluctuations in the 3 phase AC line voltage. It also allows the controller to optimize transmitter efficiency by selecting the best power supply voltage within its limited range of about 6 volts.
- PA Power Supply Soft-Start.
- PA Power supply Discharge.

4.5.1.2.1 Tap Switching Circuit Operation

The control signals for the SCRs are active high and come directly from the PS Controller Board. They enter the “B” Rectifier Board at:

- J4-1 - DRIVER 1 (activates SCRs for 48V tap)
- J4-3 - DRIVER 2 (activates SCRs for 50V tap)
- J4-5 - DRIVER 3 (activates SCRs for 52V tap)
- J4-7 - DRIVER 4 (activates SCRs for 54V tap)

⇒ NOTE:

The circuit for the 48V tap will be explained here as the other three are identical, but are attached to different transformer taps.

The DRIVE_1 signal is used to activate the 48Vdc tap on T1 and T2 secondaries. When active (HIGH) it causes the output of U2-17 to go low. This turns on Q28 which applies 10VB-SS, now called DRIVE_1, to R12 on the “B” side of the 48V section. Interconnect cable J3 then connects the same signal to R25 on the “A” side Rectifier Board 48V section.

⇒ NOTE:

The 10VB-SS (SS = Soft Start) will only be present if the DISCHARGE signal at J4-6 is inactive. See PA Power Supply Discharge later in this section for more information.

The 10VB-SS forward biases diodes CR4, CR8 and CR12 on the “B” side and CR13, CR17 and CR21 on the “A” side. This turns on the associated SCRs, Q4, Q8 and Q12 for the “B” side and Q13, Q17 and Q21 on the “A” side. Each of the SCR anodes are tied to ground with the cathode connected through a 30 amp fuse to a tap on one of the transformer secondaries. The “B” side is connected to L5, M5 and N5 with the “A” side connected to L4, M4 and N4 (see the Overall System Block Diagram for these connections). Note that both the “A” and “B” side SCRs have selected the same relative (lowest voltage) taps on each of the two transformer secondaries.

4.5.1.2.2 PA Power Supply Soft-Start

Soft-Start is used to limit the surge current during transmitter turn on. The Soft Start and PA Power Supply Discharge circuits are able to use the same resistor, R48 since only one or the other will be active at any one time. A simplified diagram of the Soft Start and PA Power Supply Discharge circuits is shown in Figure 4-8. The Soft-Start control signal is active high and comes directly from the PS Controller Board, via J4-8. A high SOFT START signal at J4-8 causes U2-12 to go low. This turns on FET switch Q32 which then applies the 10VB-SS through R65 to CR28, CR29 and CR30. This in turn activates SCRs Q34, Q35 and Q36. The three SCR outputs are

labeled SS1-B, SS2-B and SS3-B and are connected to the 48V taps on the transformer "B" secondaries of T1 and T2. This allows the power supply to start charging through R48, a 5 ohm 100W current limiting resistor. After about 2 seconds, the DRIVER 1 signal will activate the normal 48V tap SCRs which will tie the taps directly to ground, bypassing R48.

4.5.1.2.3 PA Power Supply Discharge

The PA Power Supply Discharge circuit uses R48 to bleed down the supply whenever the transmitter is turned off. The DISCHARGE signal is active low and comes from the PS Controller Board. When low, it causes the output of U2-14 to go high. This does two things:

- a. First, it reverse biases CR31 which allows the gate of Q33 to pull high through R54, thus shutting Q33 off. This removes the 10VB-SS used to activate the transformer taps. This prevents the PA Supply (and Soft Start) from being activated while the DISCHARGE signal is active.
- b. Second, it allows the base of Q37 to pull high, shutting it off. R62 will then pull the gates of Q29 and Q31 low turning them on. Q29 and Q31 are switches which tie the 52Vdc to R48, and the supply is discharged.

4.5.1.2.4 Voltage Samples

Two AC voltage samples are taken from the 48V taps using 301K ohm resistors. One from the "A" secondary at J4-14 and one from the "B" secondary at J4-13. The samples are pulsating DC with a frequency of 360Hz, and an amplitude whose average is equal to the DC power supply output. They are sent to the PS Controller and used to control the tap switching based on the amplitude of the pulses. The signals are also bandpass filtered at 60Hz to detect blown SCR fuses and 120Hz to detect the loss of one AC input phase.

To determine if a tap has failed (blown fuse), refer to the Diagnostics Display. For Power Supply 1, Press [HOME, STATUS, D,A,A,D] This will show you the screen in Figure 4-12. Press D again to see the status of Tap 4. For Power Supply 2, Press [HOME, STATUS, D,C,B,D].

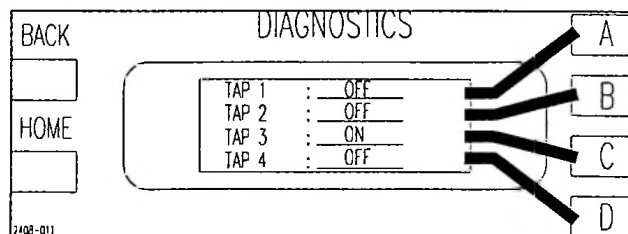


Figure 4-12 Transformer Tap Status
[HOME, STATUS, D,A,A,D]

4.5.2 Single Phase PA Power Supply

Refer to the Overall System Block Diagram in the schematic package for the following discussion. The transmitter single phase AC inputs connect directly to K1, the AC mains contactor. The transformer side of the contactor is wired in parallel to power transformers T1 and T2 primaries in the bottom of the transmitter. T1 and T2 primaries must be tapped for the proper AC input voltage. The tapping chart can be found on the Overall System Block Diagram. T1 and T2 can accommodate input voltages in the range of 198 to 250 Vac.

Each transformer one center tapped secondary with the center connection being the rectified DC output of 52Vdc. The DC output are filtered by L1, C1, C15 and C16 for T1, and L3, C2, C25 and C26 for T2. Each of the transformer secondary taps is connected to an SCR which is controlled by ON/OFF signals from the PS Controller board via the Rectifier Board.

The secondaries of T1 and T2 use the unique tap switching design to give a small window of coarse regulation (approximately 2Vdc change per tap) to compensate for AC line variations.

4.5.2.1 Rectifier Board

The SCRs for the single phase are required to carry a much larger amount of current than the 3-Phase counterparts and are therefore much larger. They are mounted on large heatsinks on top of the transformers. The SCRs are used for the tap switching as well as rectification of the AC voltage. Each transformer secondary winding has 8 taps. Each of these taps have one SCR to ground. The secondary is full wave rectified, which means that one SCR on each side of the center tap is used for each voltage level. For example CR1 and CR5 on either transformer will be active at the same time. The other pairs are CR2 and CR6, CR3 and CR7 and CR4 and CR8. The Power Supply Controller can turn on any pair of the SCRs at a given time. If the voltage is not high enough at the DC output, the PS Controller can change the transformer turns ratio by turning on a different SCR pair and therefore utilizing a different secondary tap. The taps closest to the center will provide the least amount of secondary turns in circuit and will therefore give the lowest DC output voltage. This means that the taps which are furthest from the center will give the highest DC output voltage due to more active turns in the secondary.

4.5.2.2 Rectifier Board Circuit Description

Refer to the Rectifier Board schematic for the following. The Rectifier Boards perform three primary functions:

- Dynamic secondary tap switching using SCRs, to maintain a relatively constant supply voltage and thus maintain constant transmitter power output despite fluctuations in the AC line voltage. It also allows the controller to optimize transmitter efficiency by selecting the best power supply voltage within its limited range of about 6 volts.
- PA Power Supply Soft-Start.
- PA Power supply Discharge.

4.5.2.2.1 Tap Switching Circuit Operation

The control signals for the SCRs are active high and come directly from the PS Controller Board. They enter the Rectifier Board at:

- J4-1 - DRIVER 1 (activates SCRs for 48V tap)
- J4-3 - DRIVER 2 (activates SCRs for 50V tap)
- J4-5 - DRIVER 3 (activates SCRs for 52V tap)
- J4-7 - DRIVER 4 (activates SCRs for 54V tap)

⇒ NOTE:

The circuit for the 48V tap will be explained here as the other three are identical, but are attached to different transformer taps.

The DRIVE_1 signal is used to activate the 48Vdc tap on T1 and T2 secondaries. When active (HIGH) it causes the output of U2-17 to go low. This turns on Q1 which applies 20VB-SS, now called DRIVE_1, to R16.

⇒ NOTE:

The 20VB-SS (SS = Soft Start) will only be present if the DISCHARGE signal at J4-6 is inactive. See PA Power Supply Discharge later in this section for more information.

The 20VB-SS forward biases diodes CR3, and CR4. This turns on the associated SCRs, CR4 and CR8 on each power supply. Each of the SCR anodes are tied to ground with the cathode connected through a 100 amp fuse to a tap on one of the transformer secondaries. Note that both power supplies have selected the same relative (lowest voltage) taps on each of the transformer secondaries.

4.5.2.2.2 PA Power Supply Soft-Start

Soft-Start is used to limit the surge current during transmitter turn on. The Soft Start and PA Power Supply Discharge circuits are able to use the same resistor, R48 since only one or the other will be active at any one time. A simplified diagram of the Soft Start and PA Power Supply Discharge circuits is shown in Figure 4-10. The Soft-Start control signal is active high and comes directly from the PS Controller Board, via J4-8. A high SOFT START signal at J4-8 causes U2-12 to go low. This turns on FET switch Q5 which then applies the 20VB-SS through R18 to CR28 and CR29. This in turn activates SCRs Q10 and Q11. The SCR outputs are labeled SS_A and SS_B, and are connected to the 48V taps, H4 and H8, on the secondary of T1 and T2. This allows the power supply to start charging through R48, a 5 ohm 100W current limiting resistor. After about 6 seconds, the DRIVER 1 signal will activate the normal 48V tap SCRs, CR4 and CR8, which will tie the taps directly to ground, bypassing R48.

4.5.2.2.3 PA Power Supply Discharge

The PA Power Supply Discharge circuit uses R48 to bleed down the supply whenever the transmitter is turned off. The DISCHARGE signal is active low and comes from the PS Controller Board. When low, it causes the output of U2-14 to go high. This does two things:

- a. First, it reverse biases CR31 which allows the gate of Q33 to pull high through R54, thus shutting Q8 off. This removes the 20VB-SS used to activate the transformer taps. This prevents the PA Supply (and Soft Start) from being activated while the DISCHARGE signal is active.
- b. Second, it allows the base of Q9 to pull high, shutting it off. R62 will then pull the gates of Q6, Q7, Q12 and Q13 low, turning them on. Q6, Q7, Q12 and Q13 are switches which tie the 52Vdc to R48, and the supply is discharged.

4.5.2.2.4 Voltage Samples

An AC voltage sample is taken from the 48V taps using 200k ohm resistors. One from SS_A and one from SS_B. The samples are pulsating DC with a frequency of 120Hz and an amplitude whose average is equal to the DC power supply output. They are sent to the PS Controller and used to control the tap switching based on the amplitude of the pulses. The signals are also bandpass filtered at 60Hz to detect blown SCR fuses.

To determine if a tap has failed (blown fuse), refer to the Diagnostics Display.

4.5.2.2.5 Low Voltage Supply Regulators

U1, U3 and U4 regulate the voltages from the Low Voltage Supply down to 7.1Vdc, +20Vdc and -20Vdc respectively. These voltages are sent to the controller where they will be distributed to the individual controller boards. Input voltages to these regulators will vary depending on the AC mains voltage.

4.5.2.2.6 16VCT, V+SCR Supply

The 16VCT secondary winding is fused by F3 and F4 on the Rectifier Board. These are self-resetting fuses which physically look like disc capacitors. The AC is rectified by CR10 and CR11 and becomes V+SCR which is the gate drive signal for the tap and soft start SCRs.

4.5.2.2.7 Heat Sink Temperature

The temperature of the rectifier heatsink is monitored by Thermistor, RT1. A fault is triggered if the temperature of the rectifier heatsink exceeds 100°C and the power supply will be shut off. This temperature can be monitored in the Status Menu of the Diagnostics Display. If the thermistor is shorted, the temperature reading will be about 155°C and the supply shut off. If it is open it will cause a Thermistor Fault to show up in the fault log.

4.5.3 Power Supply ID Jumpers

The 3 Phase and Single Phase supplies both have ID jumpers which are set to designate the power supply as PS1 or PS2. This lets the PS Controller know which power supply it is connected to, for proper reporting to the Master Controller. The PS Controller will not allow 2 IDs to be the same. The jumper configurations are given below: These jumpers are located on the Rectifier Boards on both the 3 Phase and Single Phase supplies.

	PS #1	PS #2
JP1	IN	OUT
JP2	OUT	IN
JP3	OUT	OUT

4.5.4 Low Voltage Power Supply Board

The AC input for this board is dependent on the AC voltage and configuration for the transmitter, 3-phase Delta (3 wire), 3-phase WYE (4 wire) or single phase. The same board is used in all three cases. The AC inputs to the board come from circuit breaker, CB1, and enter the board at J1-1 and J1-4. For the 3-phase Delta and Single Phase J1-1 is Phase A and J1-4 is Phase B (Phase C for the 3-Phase does not connect to this board). For the 3-phase 4 wire WYE J1-4 is Phase B and J1-1 is the Neutral.

Transformer T1 has dual full wave rectifiers. The T1 secondary outputs are fused by F3, F4, F5 and F6, and are then full wave rectified for two DC outputs of +10Vdc. The +10Vdc is filtered by C1-C6 and connected to the rectifier boards, on top of the PA power supply transformers, in the bottom of the transmitter. Transformer T2 secondaries are fused by F7, F8, F9 and F10 before going to dual bridge rectifiers. The rectifier outputs are filtered by C7-C10 and supply +20Vdc and -20Vdc to the

Rectifier Boards on the PA power supply transformers. All three voltages pass through the rectifier boards and are sent to the Backplane Board to power all of the controller PC boards.

4.5.4.1 Relays

There are three mechanical relays on the Low Voltage Power Supply Board assembly A19. They are A19K1, A19K2 and A19K3. The relays are powered by +12Vdc from the Life Support Board in the controller.

- A19K1 is activated when the transmitter is turned on and the “CONTACTOR_ON” signal from the Life Support Board goes low. When activated, A19K1 supplies Phase A (or Neutral) to the coil of the AC mains contactor K1 (and K3 in the Auxiliary cabinet for the single phase), which then supplies AC to the PA power supply transformers.
- A19K2 is activated by the same “CONTACTOR_ON” signal and supplies Phase B to the exciter(s). Note that this means the exciter(s) will not have power until the transmitter is turned on.
- A19K3 is activated by the active low “FAN_SPEED_SELECT” signal from the Life Support Board. A19K3 activates the fan speed select relay K2 mounted next to the AC mains contactor on the cabinet wall. K2 is shown on the Overall System Block Diagram in the HIGH fan speed position. When A19K3 pulls in so does K2 (not A19K2).

4.6 Cooling System Description

The transmitter is cooled by the single, two speed fan in the lower rear of the transmitter. It uses a high volume, low velocity, air system. Air ducting for inlet air should be well filtered and, if possible, at a slightly positive pressure. The exhaust air ducting should cause very little or no back pressure due to the low velocity air system. Air handling recommendations are shown on the Cabinet Outline Drawings in the schematic package.

Upon transmitter turn on, the fan will run at high speed for one minute, then will normally run at the low speed until a fault occurs or there is a significant increase in temperature detected by the controller. The blower motor is a 2 speed, single phase motor. Contactor K2 selects the fan speed and is controlled by the Master Controller. The fan speed can also be manually set to HIGH speed or AUTO in the Configuration Menus of the Diagnostics Display.

4.7 Control System Description

The control system is a micro-controller based master/slave system. It monitors over 100 operating functions in the transmitter and can make intelligent operating decisions based on operating conditions. It has the standard parallel remote connections. The microprocessor control system allows fast and efficient monitoring of the entire transmitter offering a level of protection and diagnostics not available with a simple logic controller. It also makes changes and upgrades a simple matter of changing the firmware.

The Controller consists of the following boards:

- Master Controller Board
- PA Controller #1
- PA Controller #2
- Power Supply Controller #1
- Power Supply Controller #2 (Optional)
- Life Support Board
- Display/Backplane Board (motherboard)

All of these boards are located directly behind the transmitter control panel and plug into the Display/Backplane Board. The entire assembly is considered the “System Controller”.

The Controller functions include:

- Transmitter Control Functions
- Automatic Power Control, or APC
- VSWR Monitoring and Overload Protection
- Power Supply Monitoring and Protection
- Power Amplifier Monitoring and Protection
- Automatic power foldback for VSWR, Over-temperature and Over-current conditions.
- AC Restart
- System Calibration and Configuration
- Detailed Status, Metering, Configuration and Fault Diagnostics display screens.

4.7.1 Master Controller

The Master Controller is responsible for primary transmitter control and is the summary point for all of the information gathering. It controls and/or receives information from the PA Controllers, Power Supply Controllers and Life Support Board and takes action appropriate to the operating conditions of the transmitter. It is also responsible for the transmitter power control, system configuration, calibration, VSWR protection and the Transmitter and Diagnostics displays on the front panel.

However, the rest of the control system is designed to operate with the Master Controller removed from the system in what is called Life Support Mode. The PA and PS Controllers report to the Master Controller but operate independently to allow them to continue operating even if the Master is removed. In the event of a Master Controller failure the Life Support Board disconnects all Master Controller control functions from the transmitter and initiates minimal protection and control to keep the transmitter on the air. For more information on Life Support Mode, refer to the Life Support Board description later in this section.

4.7.1.1 EEPROM U39

The Master Controller has 3 memories, ROM (firmware), RAM (volatile) and an EEPROM (non-volatile) U39. When the low voltage is applied to the controller it loads up the program from ROM to RAM and then goes to the EEPROM for all of the transmitter configuration, calibration settings, power levels, fault limits etc.. Basically EEPROM U39 stores any settings that can be changed in the Diagnostics Display. Any changes made in the Diagnostics Display will be either automatically saved in the EEPROM or is saved when the [BACK] button is pressed (ie. Back to Update).

All the individual bits or bytes of information stored here have a default setting which is stored in the firmware ROM. When the information in U39 is uploaded to RAM it is checked against the default values. If it is considered to be out of tolerance (or invalid data) it will automatically be replaced with the default value from the ROM. When this happens the fault "EEPROM_DEF" (Default) will be placed in the fault log. The only time this should happen is when a new EEPROM, U39 is installed in the Master Controller. Since it is basically blank, all of the default settings from the ROM will be written to U39 one at a time as it finds they are out of tolerance. After this has happened, the EEPROM_DEF fault should never happen again. If it does, U39 should be replaced since a memory location is probably bad. For information on replacing EEPROM U39 see Section V, Maintenance and Alignments

The following is a listing of all of the Default Values which are stored in the Firmware:

- Forward Factor - 0.007697
- Reflect Factor - 0.000306
- Cal APC Factor - 7.58
- Cal Frequency - 98MHz
- Operating Frequency - 98MHz
- IPA Factor - 200
- Exciter Factor - 200
- TPO 100% - 05.00kW
- Max High - 06.00kW
- Max Low - 2.50kW
- UPS Setting - 2.50kW
- Low Power Alarm - 4.50kW
- VSWR Foldback - 1.35
- VSWR Fault - 1.5

4.7.1.2 APC, Automatic Power Control

One important function of the Master Controller is transmitter power control, which is accomplished via the APC Loop. The APC Loop controls the transmitter power and keeps it constant by varying the IPA RF output indirectly proportionate with the forward power. In other words, if the forward power output goes up, the IPA output will be reduced, which will in turn reduce the PA RF output. If the forward power output goes down, the IPA RF output will be increased, which will increase the PA RF output to compensate.

The APC loop starts at the forward power directional coupler. The forward sample is connected to the Life Support Board where it is calibrated with R127 for 8.9V@ 100% TPO at TP9. This voltage sample is then sent to the Master Controller (schematic sheet 7) where it is squared by multiplier chip U1 (to make the voltage from the coupler proportional to power) and divided by 10. This is then sent to U5-6 where it is compared to APC_REF voltage (APC Reference).

APC_REF is the DC output of a D/A Converter or DAC whose input is called DAC_APC_REF and is controlled by the RAISE and LOWER buttons on the front of the controller (or by the remote control inputs) or can be varied automatically by the Master Controller's foldback routines. Pressing RAISE increases the APC_REF voltage and pressing LOWER decreases it. The DAC_APC_REF is responsible for

all transmitter power control functions including power level, foldbacks and mute. This makes it a very important number to know and understand for troubleshooting.

⇒ NOTE:

As calibrated from the factory, the digital DAC_APC_REF number should be approximately 660 (this number should be on the factory test data sheet). This number can be checked by pressing [HOME, MORE, CONFIGURATION C,B]. The DAC_APC_REF output voltage APC_REF can be metered at TP8 or in the Diagnostics Display, press [METERING, B,B].

The output at U5-7 is the difference between the forward power sample and the APC_REF voltage. This difference can be measured at TP3 on the Master Controller and is called the APC voltage. R13 and R102 divide this voltage down for display on the Transmitter LCD Display on the right side of the controller. The APC voltage is not the same as the APC_REF voltage. The dipswitch, S1-10, is present to allow the APC loop to be opened for troubleshooting. This APC voltage is now sent back to the Life Support Board (Schematic, sheet [3,B8]) and is called MSTR_IPA_CTL (Master IPA Control).

If the Master Controller is operational, then the MSTR_IPA_CTL signal will pass through to U5-4 which will in turn pass the signal if there are no System Mutes present. Due to the low impedance of the circuit, the Manual PWR REF pot R25 has little or no effect on the circuit. CR4 and R30 shift the positive APC voltage to a proportional negative voltage which is passed on to IPA_AB1 or AB2 depending on the position of K2. Remember that the gate bias on the RF amplifiers is -18V for OFF and -0.6V for fully ON.

Since the exciter power is fixed, changing the IPA bias will increase or decrease the IPA output which will then proportionately increase or decrease the output of the PAs.

EXAMPLE:

The following is an example of how the entire loop would work. For our example the power output of the transmitter goes down due to a failed PA. This would decrease the output of the forward power directional coupler and the voltage at the input to the difference amp at U5-6 on the Master Controller Board. Since U5 has almost infinite gain, the loop will try to force the forward power sample input to U5 to be the same as the APC_REF input. This will increase the APC voltage at TP3 and on the front panel APC reading. The increased APC voltage will pass through the U5 analog switches (on the Life Support Board) bringing the input to U15-3 less negative. This less negative voltage is sent to the IPA, increasing its output. More drive to the PA will increase the transmitter RF output to compensate for the failed PA. If the RF power output were to increase, the APC loop voltage would be reduced, lowering the IPA and PA output.

4.7.1.2.1 Manual Power Control

It is possible to shut off the APC by opening dip-switch S1-10 (Open = OFF) on the Master Controller Board. This switch opens the APC Loop, disconnecting the APC voltage from the IPAs. When S1-10 is opened, MANUAL PWR REF R25 on the Life Support board controls the transmitter power output. R25 also serves as the power control for Life Support Mode which means the Master Controller Board has failed. If the Master Controller fails, U5 pins 1-2 are opened, removing the APC voltage from the IPAs, breaking the APC loop. In Life Support Mode, R25 is set to operate the transmitter at 25% of rated power. Proper setting of R25 requires an external wattmeter and is covered in Section V, Maintenance under "Setting Life Support Power Level."



CAUTION:

IN LIFE SUPPORT MODE THERE IS LIMITED OVERLOAD PROTECTION AND NO FOLDBACK FUNCTIONS. ADJUSTING R25 TO MORE THAN 25% RATED POWER WILL CAUSE THE TRANSMITTER TO SHUT OFF AND COULD DAMAGE THE TRANSMITTER. REFER TO SETTING LIFE SUPPORT POWER LEVEL IN SECTION V, MAINTENANCE.

4.7.2 Calibration Factors and A/D Values

The configuration menus in the Diagnostics Display contain the calibration factors and A/D values used by the transmitter for calibration, operation and protection. The cal factors are calculated by the micro when the transmitter is calibrated. The A/D readings are the decimal equivalents of the forward and reflected power sample voltages. The following is a listing of their nominal values:

Calibration Factors:

- Forward Factor - 0.007697
- Reflect Factor - 0.000306
- APC_Factor - 7.58
- EXC_Factor - See Factory Test Data (Frequency dependent)
- IPA_Factor - See Factory Test Data (Frequency dependent)

A/D Readings

- DAC_APC_REF - 660 (nominal)
- A/D_FWD_PWR - 806 (nominal @ 5kW)
- A/D_RFL_PWR - 700 (nominal @ 150W reflected)

These cal factors and A/D values will be approximately the same for all Z5 transmitters that are factory calibrated or have been field calibrated at the rated transmitter power of 5kW as detailed in the Maintenance procedures. These numbers are also stored in the Backup memory area of the EEPROM, U39 and can be recalled if necessary. The actual numbers obtained during the factory calibration are recorded in the Factory Test Data.

⇒ NOTE:

If the transmitter is calibrated at other than 5kW these numbers will change and their new values should be recorded.

It is important to note that as long as the hardware calibration of the forward and reflected directional couplers is not disturbed, the Cal Factors could be entered manually and the transmitter calibration would be within a few percent of the factory calibration. To access the edit controls for each parameter, go to the screen containing the value and press and hold the [D] button and then press [C]. The edit controls should now show up on the screen.



CAUTION:

ENTERING A WRONG VALUE IN ONE OF THESE SCREENS COULD CAUSE SERIOUS DAMAGE TO THE TRANSMITTER OR EXTERNAL SYSTEMS. IT IS RECOMMENDED THAT THESE NUMBERS BE RECALLED FROM THE BACKUP MEMORY OR BE OBTAINED BY FOLLOWING THE CALIBRATION PROCEDURES AS OUTLINED IN SECTION V, MAINTENANCE.

The following is a description of each of the Calibration and A/D parameters.

4.7.2.1 DAC_APC_REF

DAC_APC_REF [HOME, MORE, CONFIGURATION C,B] is a counter (internal to the micro), whose output will be between 0 and 900, that is controlled by the RAISE and LOWER buttons on the front panel. RAISE increases the count and LOWER decreases the count. This number is then D/A converted to get the APC_REF voltage which controls the APC loop discussed earlier in this section. The correct APC_REF voltage for a specific DAC_APC_REF number can be calculated from the formula:

$$\text{APC_REF voltage} = \text{DAC_APC_REF} * 0.004883$$

Example: For the nominal DAC_APC_REF value of 660, APC_REF Voltage = 660 * 0.004883 = 3.22V and can be measured at TP8 on the Master Controller. This DAC value is used to control transmitter power level for all conditions where the Master Controller is operational and the APC Loop switch S1-10 is closed.

4.7.2.2 Forward Factor and A/D_FWD_PWR

The Forward Factor is a calibration factor that is calculated during forward power calibration. To check the Forward Factor press [HOME, MORE, CONFIGURATION C,A,A]. All Z5 transmitters are factory calibrated with a forward sample voltage of 8.9vdc at 5kW, as measured at TP9 on the Life Support Board. This sample voltage is low pass filtered on the Master Controller and then A/D converted in the micro for metering. This A/D value shows up as A/D_FWD_PWR [HOME, MORE, CONFIGURATION C,B], which at 8.9V should be very close to 806 (the A/D converter is 10 bit for 0 to 1024 range, but the input to the A/D is not actually 8.9V). By setting the FWD PWR CAL screen to 5kW and calibrating we are telling the micro that 806 represents 5kW. The micro now calculates the Forward Factor by dividing the 5kW by the square of 806 or

$$\text{Forward Factor} = \text{FWD PWR CAL (kW)} / \text{A/D_FWD_PWR}^2$$

$$\text{Forward Factor} = 5\text{kW} / 806^2 = 0.007697 \text{ (rounded up)}$$

The A/D FWD PWR reading must be squared to make the voltage from the coupler linearly track the transmitter power output (Power is the square of the voltage).

The Forward Factor is now used for all forward power level settings. For example, to set the Low power control to 2.5kW you press the lower button. This gradually lowers the transmitter power output by reducing the DAC_APC_REF and therefore the APC_REF voltage and transmitter power. This in turn lowers forward power sample and the A/D_FWD_PWR number which can be calculated at 2.5kW as:

$$\text{A/D FWD PWR} = \text{SQRT}(\text{FWD PWR} / \text{Forward Factor})$$

$$\text{A/D FWD PWR} = \text{SQRT}(2.5\text{kW} / 0.007697) = 570$$

At an A/D FWD PWR reading of 570 the front panel Forward Power meter will read 2.5kW.

4.7.2.3 APC Factor

APC_Factor is also calculated during the Forward power calibration. APC_Factor allows the micro to calculate the necessary DAC_APC_REF number to obtain any specific power level. For the Z5, APC_Factor is calculated as Forward calibration power divided by the DAC_APC_REF number or:

$$\text{APC_Factor} = \text{FWD PWR (kW)} / \text{DAC_APC_REF}$$

$$\text{APC_Factor} = 5\text{kW} / 660 = 7.58$$

Once the APC_Factor is known, the controller uses this number to calculate the DAC_APC_REF necessary to obtain the MAX HIGH, MAX LOW and UPS power levels in the Diagnostics Display.

4.7.2.3.1 Operating APC versus Calibrated APC

There are actually 2 APC_Factors due to the fact that the directional coupler outputs are not flat across the entire FM band. They are:[HOME, MORE, CONFIGURATION C,A,D,C]

- CAL_APC_Factor (Calibrated APC_Factor)
- OP_APC_Factor (Operating APC_Factor)

The Operating APC Factor is frequency compensated based on the slope of the coupler output and is the factor calculated above. **If the transmitter is operating at the same frequency at which it was calibrated then the two numbers will be the same.** If the operating frequency is changed, the OP_APC_Factor will be higher or lower depending on whether the frequency went down or up compared to the calibrate frequency. This means that if the exciter frequency is changed the transmitter calibration can be maintained by simply changing the OPERATING_FREQUENCY in the Diagnostics Display.

4.7.2.4 MAX HIGH, MAX LOW and UPS Power Levels

MAX HIGH, MAX LOW and UPS power levels are set using the Diagnostics Display and stored in the EEPROM, U39.

MAX HIGH SET screen [HOME, MORE, CONFIGURATION B,B] sets the maximum power level when the HIGH ON button is pressed.

MAX LOW SET screen [HOME, MORE, CONFIGURATION B,C] sets the Maximum power level when the LOW ON button is pressed.

UPS SET Screen [HOME, MORE, CONFIGURATION B,D,A] sets the power level when the transmitter is operating on a backup UPS or generator AC supply.

Overall System Theory

Once the operator has set a power level in kW in these screens, the controller uses the OP_APC_Factor to find the DAC_APC_REF that would represent each of the power levels and sets that number as the power level limit. This maximum DAC_APC_REF setting is called DAC_MAX and is calculated for each mode from the formulas below:

For HIGH ON mode:

$$\text{DAC_MAX} = \text{MAX HIGH SET (kW)} / \text{APC_Factor}$$

For LOW ON mode:

$$\text{DAC_MAX} = \text{MAX LOW SET (kW)} / \text{APC_Factor}$$

For UPS mode:

$$\text{DAC_MAX} = \text{UPS SET (kW)} / \text{APC_Factor}$$

DAC_MAX [HOME, MORE, CONFIGURATION C,B] is the display variable which will contain one of the above numbers depending on which mode the transmitter is in. Once these are set, the DAC_APC_REF in that mode can never go above the DAC_MAX setting.

Example: If the transmitter is calibrated at 5kW (HIGH ON), and the desired MAX Power setting is 6kW, this would be entered into the MAX HI SET screen. Remember that for 5kW the nominal DAC_APC_REF is 660. The micro would now use the formula:

$$\text{DAC_MAX_HIGH} = \text{MAX HIGH SET (kW)} / \text{APC_Factor}$$

$$\text{DAC_MAX_HIGH} = 6\text{kW} / 7.58 = 792$$

This is now the highest possible number for the DAC_APC_REF and will limit the transmitter power to 6kW. To prove that:

$$\text{FWD PWR} = \text{APC Factor} * \text{DAC_APC_REF}$$

$$\text{FWD PWR} = 7.58 * 792 = 6\text{kW}$$

4.7.2.5 EXC Factor and IPA Factor

When the transmitter Forward Power is calibrated, the micro samples the exciter and IPA outputs and sends the A/D readings to the screen as:

- EXC_Factor [HOME, MORE, CONFIGURATION C,A,D,A]
- IPA_Factor [HOME, MORE, CONFIGURATION C,A,C]

The calibration merely takes the A/D reading for each of these and makes it equal to 100% in the Diagnostics metering of exciter and IPA power output. Since Drive Level changes with frequency, so will these cal factors. The factory cal numbers are in the factory test data sheet.

4.7.2.6 Reflect Factor and A/D_RFL_PWR

Reflect Factor is a calibration factor that is calculated during reflected power calibration. To check the Reflect Factor press [HOME, MORE, CONFIGURATION C,A,B]. All Z5 transmitters are factory calibrated by reversing the reflected coupler (it now measures forward power) and adjusting for a reflected sample voltage of 2.1V at 150W, as measured at TP18 on the Life Support Board. This sample voltage is low pass filtered on the Master Controller and then A/D converted in the micro for metering. This A/D value shows up as A/D_RFL_PWR [HOME, MORE, CONFIGURATION C,B], which at 2.1V should be very close to 700 (the A/D converter is 10 bit for 0 to 1024 range, but the input to the A/D is not actually 2.1V). By setting the RFL PWR CAL screen to 150W and calibrating we are telling the micro that 700 represents 150W. The micro now calculates the Reflect Factor by dividing the 150W by the square of 700 or

$$\text{Reflect Factor} = \text{RFL PWR CAL (kW)} / \text{A/D_RFL_PWR}^2$$

$$\text{Reflect Factor} = 150\text{W} / 700^2 = 0.000306$$

The A/D_RFL_PWR reading must be squared to make the voltage from the coupler linearly track the transmitter power output (Power is the square of the voltage).

The actual VSWR fault level in the transmitter is set at 1.5:1 (which is 200W). The Foldback level is set at 1.35:1 (which is 111W). The Reflect Factor can now be used to set the fault and foldback levels by calculating the A/D_RFL_PWR number that would represent a specific power level using the formula:

$$\text{A/D_RFL_PWR} = \text{SQRT}(\text{RFL_PWR} / \text{Reflect Factor})$$

$$\text{A/D_RFL_PWR} = \text{SQRT}(200\text{W} / 0.000306) = 808 \text{ (Fault) or}$$

$$\text{A/D_RFL_PWR} = \text{SQRT}(111\text{W} / 0.000306) = 602 \text{ (Foldback)}$$

VSWR protection is based on this A/D reading, which is directly proportional to a reflected power level, not on a calculated VSWR reading.

4.7.3 VSWR Foldback

The Master Controller contains another DAC called VSWR_FB_LVL which stands for VSWR Foldback Level. The output of this DAC is directly controlled by the setting in the VSWR Foldback Screen [HOME, MORE, CONFIGURATION B,D,C,D]. The normal setting for this screen is 1.35. Using the formula below, this is equal to 111W for 5kW forward power.

$$\text{RFL PWR} = (\text{VSWR}-1 / \text{VSWR}+1)^2 * 5\text{kW}$$

$$\text{RFL PWR} = (1.35-1 / 1.35+1)^2 * 5\text{kW} = 111\text{W}$$

Now using a formula from the previous section:

$$\text{A/D_RFL_PWR} = \text{SQRT}(111\text{W} / \text{Reflect Factor}) = 602$$

This says that when the output voltage from the reflected coupler is sufficient to increase the A/D_RFL_PWR reading to 602, the reflected power is 111W. Therefore, the VSWR_FB_LVL DAC is set to 602 and its dc output voltage will be about 1.8V. This voltage is sent to U7-12 as one input to the open loop gain differential amplifier. U7-13 is the calibrated voltage from the reflected coupler (from Life Support Board). As long as there is little or no reflected power the voltage at U7-13 will be zero and the U7-14 output will be at the positive rail. This reverse biases diode CR1 which is connected to the APC Voltage at U5-10. If the voltage from the coupler exceeds the VSWR_FB_LVL, U7-14 will try to go to the negative rail (GND). This will forward bias CR1 and the APC voltage will be pulled to ground through CR1 and R5. This in turn will reduce the reflected coupler output and the clamp will be removed from the APC Voltage and the power will try to come back to normal. Since this is happening extremely fast, once the reflected coupler output voltage exceeds the VSWR_FB_LVL, the new APC loop will try to keep the 2 inputs to U7 the same, preventing the reflected power from exceeding 111W. Basically, a new APC loop (using the output from the reflected coupler instead of the forward) has been formed which takes precedence over the forward power loop.

4.7.3.1 Master Controller Faults

For a complete listing of the faults associated with the Master Controller refer to Section VI, Troubleshooting.

4.7.3.1.1 3 Strike Routine

There are 4 faults in the transmitter that will initiate what is called a 3 strike routine. They are:

- **RFL_PWR** - VSWR greater than 1.5:1
- **ISO_AB_OT** - The predicted temperature of the 5kW hybrid reject load is greater than 130°C.
- **ISO_AZ_OT** - The predicted temperature of R9 on the “A” Z-Plane Isolation board is greater than 130°C.
- **ISO_BZ_OT** - The predicted temperature of R9 on the “B” Z-Plane Isolation board is greater than 130°C.
 - a. **Strike 1** - When any of the above fault conditions is met, the transmitter output is muted (DAC_APC_REF is brought to zero) for 3 seconds (6 seconds for transmitters with a Single Phase power supply). At the end of the 3 (or 6) seconds the transmitter power is slowly ramped back up and a 10 second timer is started.
 - b. **Strike 2** - If another fault is detected before the 10 seconds is up, the transmitter will again mute for 3 (or 6) seconds, start the 10 second timer again and slowly ramp the power up again.
 - c. **Strike 3** - A third fault detected within this 10 seconds will cause the transmitter to be muted until the operator gives the transmitter an ON command (High or Low), locally or by remote. If the cause of the fault is still present, the transmitter will simply repeat the 3 strikes and mute again.

⇒ NOTE:

If no faults occur during either of the 10 second time periods, then the strike counter is reset and will allow 3 more strikes before muting the transmitter.

The slow ramp up in power after a strike should allow the foldback controls to limit the transmitter power output before the fault thresholds are reached again. The slow power ramps are designed to allow the transmitter to operate at the maximum possible power level without over-dissipating the isolation resistors or exposing the transmitter to excessive reflected power. This would mean that there would be a fault in the log but it would be inactive and the transmitter would be in a foldback condition.

4.7.4 PA Controller Boards

There are two (2) PA Controller Boards in the Z5 transmitter. They utilize micro-controllers which report to the Master Controller, but operate independently of the Master. Each controls half or 8 of the 16 PAs. Table 4-1 on page 4-60 shows which PAs are controlled by each of the PA Controller Boards. The two boards are identical except for the programmable ID number which is set with DIP switches on the board to determine which board is PA Controller 1 and which is PA Controller 2. The following is a listing of the PAs under the control of each PA Controller:

PA Controller #1 (PAC1)

- A1, A2, A5, A6, B3, B4, B7, B8

PA Controller #2 (PAC2)

- A3, A4, A7, A8, B1, B2, B5, B6

The PA Controllers are responsible for the following:

- Turn on/Turn off of the PAs via the PA gate bias voltage.
- Metering, status and fault monitoring of the PAs and the isolation resistors associated with them.
- Control of the combiner isolation switches (located on the isolation boards) which are associated with the PAs under its control.
- Crossover protection (the ability to mute the PAs which are controlled by the other PA Controller Board in case of a failure).

4.7.4.1 PA Turn On/Turn Off

The PA Controllers primary responsibility is to turn the PAs on and off. The PAs are turned on and off by varying the bias voltage on the gates of the MOSFETs on the PAs. If the gate voltage is -0.6V, the PA is turned on full. If the gate voltage is -18V, then the PA is turned off. This means the PA Controllers have the ability to turn off or MUTE each PA individually, or all at the same time if it is necessary to MUTE the entire transmitter RF output.

Whenever a defective PA is to be shut off or MUTED, all of the PAs will be MUTED for 120mS while the defective PA is disconnected from the combiner by the isolation switch. The rest of the PAs are then turned back on.

4.7.4.1.1 Control Distribution and Controller Failure

Each PA Controller controls half (8) of the PAs, see Table 4-1 on page 4-60. Note that each PA Controller Board controls two PAs on each foursome. This pattern of control distribution allows for maximizing of power output if one of the PA Controller Boards fails.

4.7.4.2 Metering

The PA Controllers are responsible for metering of the following parameters:

- PA Current - The current draw of each PA is monitored by measuring the voltage drop across 0.01 ohm resistors, R11-R18, on the Z-Planes. The resistors show up as part of the Divider Schematic. This allows the current of each individual PA to be available on the Diagnostics Display. To check the PA currents press [METERING A,B then B or C (to check Z-plane A or B)].
- PA Supply Voltage - The Voltage of PS1 and PS2 are monitored individually with fused samples also from the Z-Plane Divider. To check the PA supply voltages press [METERING B,C].
- PA Gate Voltage - Each individual PA gate voltage can be checked on the Diagnostics Display by pressing [METERING B,D then C or D (to check Z-Plane A or B)].
- PA Temperature - There is a temperature sensor on each PA which sends a temperature sample voltage to one of the PA Controllers. The temperature of each individual PA can be checked by pressing [METERING C,A then C or D (to check Z-Plane A or B)].
- PA ISO Resistor Temperatures - VTEMP PA1 through VTEMP PA8 -Each ISO resistor has a thermistor, used as a temperature sensor, attached to it for metering and fault monitoring. To check the ISO resistor temperatures press [METERING C,C then B or C to check Z-Plane A or B]. A rise in the ISO resistor temperature indicates an imbalance in the phase or amplitude of a PA output.

⇒ **NOTE:**

The temperature of the different PA ISO resistors (A1-A8 and B1-B8) can vary quite a bit, but are considered okay if they are under Ambient + 75°C.

Az and Bz, which also show up in these screens, are the temperature indications for the 2.5kW, 2 way combiner isolation load resistors. A rise in this temperature would indicate an imbalance between the outputs of the two foursomes on that Z Plane. ISO_AB_LOAD is the temperature of the reject load on the 3dB hybrid which combines the outputs of the Z Planes.

4.7.4.3 Crossover (XOVER) Protection

Each PA Controller has what is called a Watchdog Timer. The outputs of the watchdog timers are each monitored by the other PA Controller. If the pulses from the watchdog timer are interrupted, due to either hardware or software problem, the other PA Controller will initiate what is called a Crossover (or XOVER). Basically, the operational PA Controller will apply a mute to all of the PAs associated with the defective PA Controller, and switch them out of circuit before releasing the mute on its own PAs. Maximum power output with one PA Controller out is approximately 33% of nominal.

⇒ NOTE:

The Power Supplies, PS1 and PS2, each power the PAs associated with the same number PA Controller. This means that the loss of one power supply will create the same scenario as loss of one PA Controller (the loss of 2 PA per foursome).

4.7.4.4 PA Controller Faults

For a complete listing of the faults associated with the PA Controllers refer to Section VI, Troubleshooting.

4.7.5 Power Supply Controller

There is only one PS Controller Board in the standard Z5 transmitter. It is capable of controlling both of the Z5 power supplies completely independent one from another. This allows one of the supplies to have a critical failure and be shut off without interrupting the operation of the second supply. However, a second PS Controller can be added as an option, to increase redundancy by having one controller board for each supply.

The PS Controller functions include the following:

- Control of the tap switching which is used to coarsely regulate the power supply voltage to 52Vdc.
- Control of the Soft-Start and PA Power Supply Discharge functions.
- All power supply monitoring and fault detection. These include voltage, current, temperature and status.

4.7.5.1 Power Supply Turn On

The primary function of the PS Controller is to turn the power supplies on and off. The on/off signal is called PS_DISABLE and comes in on J3-13. The signal originates on the Master Controller but passes through a logic gate on the Life Support Board before reaching the PS Controller. PS_DISABLE is an active high signal which means that if the signal is high the power supplies will be shut off.(the secondaries will be deactivated by shutting of the SCRs but primary voltage could still be present). If it is low, the power supplies will be activated, unless there is a critical fault on the PS Controller board, in which case the supplies will be shut off regardless of the PS_DISABLE signal. The power supplies are turned on via one of the four outputs:

- DRIVER 1 (TAP 1 - 48V)
- DRIVER 2 (TAP 2 - 50V)
- DRIVER 3 (TAP 3 - 52V)
- DRIVER 4 (TAP 4 - 54V)

These outputs are duplicated, one set for PS1 and the other for PS2. When the transmitter is turned on the Master Controller brings the PS_DISABLE signal low (provided the contactor has been activated and the Master Controller is operating normally). This will first activate the SOFT_START outputs at J1-8 and J2-8. This allows the supplies to charge slowly, limiting the in-rush current via the soft-start resistor and SCRs on the rectifier boards. The supply voltage must reach at least 40Vdc within 3 seconds (6 seconds for a Single Phase supply), otherwise the turn on sequence will be aborted. After 3 (or 6) seconds, if the voltage is within tolerance, the PS Controller will activate the lowest available voltage tap by activating one of the four DRIVER signals. Since DRIVER_1 is connected to the 48V tap, it will be activated first (if available) and the power supplies will come up to full charge.

The PS Controller will now check the power supply voltages via the DC Voltage Samples from each power supply. These come into the board at J1 and J2, pins 13 and 14 from the rectifier boards. These signals pass through U7 which acts as a linear amplifier and buffer to prevent the analog samples from overloading the front end of the A/D converter in the micro controller IC, U6. Using these samples the PS Controller will determine when and if it is necessary to change taps to increase or decrease the DC PA voltage. It will try to maintain the voltage as close as possible to 52Vdc.

4.7.5.2 PA Power Supply Discharge

When the PS_DISABLE signal goes high, all of the SCR taps are disabled and the DISCHARGE signals at J1-7 and J2-7 go low. This activates the PA Power Supply Discharge circuits on the rectifier boards, which allows a quick and safe discharge of the PA supply.

4.7.5.3 Power Supply Standby Mode

Under certain circumstances, such as RF Mute, the power supplies will be placed in standby mode via the signal PS_STANDBY. This signal comes from the Master Controller and both PA Controllers. PS_STANDBY shuts off all the DRIVER signals which deactivates all of the SCR taps on both power supplies. However, it does not activate the discharge circuit. This allows the filter capacitors to maintain charge and be ready to supply power at a moments notice without having to go through the Soft-Start sequence again. However, the capacitors will bleed down slowly if the standby mode is maintained. To keep the voltage within reasonable limits, the PS Controller will activate the Soft-Start circuit if the PA voltage drops below 42Vdc and shuts it off when the voltage is above 52Vdc. The PS Controller will maintain charge in this manner until the PS_STANDBY signal goes low, and the power supplies are fully active again or shut off by the PS_DISABLE signal.

4.7.5.4 Discharge Protection Circuit

The discharge protection circuit protects the power supply and the discharge circuit components from a failure in the discharge circuit. Specifically it protects against a short which would cause the discharge resistor to be "In circuit" when the power supply is activated.

A sample of the voltage across the discharge resistor from each supply is sent to the PS Controller at J1-20 and J2-20. If the voltage is more than 30Vdc, the comparator will trip, and the output at U1-1 or U1-2 will go LOW. The fault signal 1_DISCH_SAMPLE or 2_DISCH_SAMPLE is then sent to U9-2 or U10-2 where it is buffered before reaching the micro-controller. The PS Controller would then shut down the power supply. The detection circuit contains a lot of hysteresis to prevent false triggering.

4.7.5.5 RESET

There is a RESET line from the Life Support Board which is monitoring the +20Vdc from the regulators on the Rectifier Boards. This is basically monitoring the Low Voltage Power Supply. If the voltage falls below a set threshold, U37 on the Life Support Board generates the RESET (active low) which is sent to all of the controller boards (Master, PAC and PSC). On the PS Controller this RESET clears U2 and U3, which brings their outputs low. This deactivates all of the DRIVER signals, disconnecting all of the SCR taps and shutting off the supply. This also activates the DISCHARGE(BAR) signal which then bleeds off the supply.

4.7.5.6 Watchdog Timer

The watchdog timer, U4 is basically looking for two things. First, it must receive a pulse from the micro-controller every 1.0mSec. If it does not it will activate the RESET line at TP4, and the supplies will be shut off. It is also monitoring the +20Vdc supply. If the voltage falls below the minimum limit of 12V, it will activate the RESET line.

4.7.5.7 Analog Inputs

U7 acts as a linear amplifier and buffer for the analog inputs to the A/D converter which is part of U6.

- SAMPLE 1 and SAMPLE 2 are the voltage samples from the Rectifier Boards. Primarily they are used to control the power supply tap switching. However they are also digitally filtered by the micro by two filters. The first is a 50 to 60 HZ band pass filter whose output is used to detect a loss of a rectifier fuse on the transformer secondary, a non-critical fault. The second is a 100 to 120 Hz band pass filter which is used to detect a severe primary phase imbalance or loss of phase. Loss of phase is a critical fault which will shut the power supply off momentarily (see "Power Supply Controller Faults" in Section 6 of this manual).
- HEAT SINK THER(mistor) is the temperature sensor located on the rectifier heatsink. If the heat sink temperature exceeds 100°C it will shut the power supply off.

⇒ NOTE:

There are test points located after U7 which give a place to check the analog voltages actually going into the A/D converter.

4.7.5.8 PS Controller Faults

For a complete listing of the faults associated with the PS Controller refer to Section VI, Troubleshooting.

4.7.6 Life Support Board

The Master Controller is backed up by the Life Support Board. The Life Support Board allows safe transmitter operation at reduced power if the Master Controller is not operating. The transmitter does require that the PA and PS Controller Boards be operational to control the power supplies and PAs.

The Life Support Board has two basic modes of operation:

1. Normal Operational Mode. The Life Support Board basically acts as an interface between the Master Controller and various parts in the transmitter when the Master Controller is functioning properly.

2. Life Support Mode. This mode provides a minimal backup control system should the Master Controller fail. If the Master Controller board fails, the Life Support Board disconnects (via AND gates) all signals from the Master Controller and allows the transmitter to stay on the air at 1/4 power with minimal fault protection and no visible monitoring for the operator.

Transmitter functions available in Life Support Mode:

- a. VSWR Protection
- b. System Mute
- c. Transmitter ON (LOW only) and OFF (both LOCAL and REMOTE inputs are active)
- d. Failsafe Interlock
- e. External Interlock

4.7.6.1 Normal Operational Mode

The following contains all pertinent circuit operation when the Master Controller is functioning properly.

4.7.6.1.1 Transmitter Turn On

When the transmitter is turned on, either HIGH or LOW, the Master Controller generates a high TX_ON signal which enters the Life Support Board at J1-A55 and is tied to AND gate U26-9. TX_ON is generated when either LOW ON or HIGH ON is pressed on the front panel, or when a remote HIGH ON is sent from the remote control system. Since the Master Controller is working, U26-10 is high which sends a high via U26-8 to OR gate U32-10. This brings U32-8, U32-11 and finally U4-12 high.

4.7.6.1.1.1 Pulse Stretcher, U4

U4 is a pulse stretcher which will output a 100mSec pulse whenever the transmitter ON button is pressed. Provided there is no power failure signal, POWERFAIL(BAR) from U37-7, The 100mSec pulse from U4-10 will pass through to U6-13, U8-12 and leaves the board to reset the PA and PS Controller Boards at J1-A83.

- TX_RESTART - Every time an ON command is received all of the controller boards will be reset, initializing and clearing any faults. The transmitter will then try to come up to full power. If a fault returns, the transmitter will simply revert back to the previous fault condition.

⇒ NOTE:

Pressing an ON command will not erase any faults from the Diagnostics Fault Log. Basically, any components which were shut off due to a fault will now be turned back on, such as PAs or controllers.

4.7.6.1.1.2 External Interlock

The TX_RESTART signal from U4 is gated by AND gate U6-13. This is the turn on signal for the contactor and will only pass if U6-12 is also high. U6-12 is the External Interlock signal. To satisfy the External Interlock, there must be a closed connection between J4-10 and J4-7 (GND) on the Life Support Board (or between TB1-7 and TB1-6 on the Remote Control Interface terminal strip). This will activate the optical isolator, U24 making U27-11 and U33-1 both low. U27-10 inverts the signal and makes U6-12 high, allowing the high turn on signal at U6-13 to pass to inverter U16-6. U16-11 now sends a low to the SET input on the contactor turn on relay, K4 (the contactor is shown in the RESET position).

The External Interlock line going to U33-1 ties the external interlock into the OFF command circuit. When the External Interlock is closed, this line is low and U33-1 ignores the input. If the External Interlock were opened, the line would go high which would send a high to the RESET input on relay K4 and the main AC contactor would disengage.

4.7.6.1.1.3 Contactor Turn On Relay, K4 (Latching)

K4 is a latching relay which only needs to be pulsed to make it change positions and will then stay in that position until the opposite input is pulsed to make it change back. When K4 is SET, K4-13 will go high and K4-4 will go low. K4-13, the CONTACTOR-ON-STATUS signal for the Master Controller, is AND gated with POWERFAIL and inverted at U16-12 to become the CONTACTOR_ON(BAR) signal. This signal is sent to the Low Voltage Power Supply Board where it activates the main contactor and the exciter(s).

4.7.6.1.1.4 CONTACTOR_ON(BAR), K4-4

The signal at K4-4 is called CONTACTOR_ON(BAR) and ties to several places, U33-12, U30-12, and U30-10. This signal is low when K4 is in the SET position and the contactor is engaged.

- a. The CONTACTOR_ON(BAR) signal at U33-12 is only used during Life Support Mode. Whenever the transmitter is on, K4-4 will be low, which holds U33-12 low. If the Master Controller has failed the MSTR_NORMAL 1 signal will also be low. This makes the output at U33-11 and the input to U32-1 low. Once the initial 100mSec turn on pulse from U4-10 is gone, the CLR input to U4 will also go low, holding the Q output low whether the ON button is pressed or not. This prevents U8-10 from generating a 3 second mute command for no reason, since the Master Controller is not working and cannot be initialized (if the Master was working, MSTR_NORMAL 1 at U33-13 would be high removing the clear from U4-13). The transmitter must first be turned off, then turned back on to try to initialize the system. Once the transmitter is turned off, a turn on pulse can be generated since K4-4 will be high when the contactor is disengaged. This removes the clear from U4 allowing the transmitter to turn on. In summary, the signal at U33-12, CONTACTOR_ON(BAR), will not allow a second turn on pulse to be delivered while the transmitter is still running and in Life Support Mode.
- b. The CONTACTOR_ON(BAR) signal at U30-12 is used to disable the power supply when the contactor is turned off. The signal is high when the transmitter is off and low when turned on. The other input, U30-13 comes from the Master Controller, SUPPLY_DISABLE, which will pass through to U6-8 as long as the Master Controller is operating normally. When the PS DISABLE signal at U30-11 goes high, the power supplies will be shut off via the PS Controller.
- c. U30-10 ties the CONTACTOR_ON(BAR) signal into the SYSTEM_MUTE line, which will mute the exciter and IPA when the contactor is off.

4.7.6.1.1.5 Remote Low Power ON Command

This command should only be used during Life Support Mode and is therefore discussed later.

4.7.6.1.2 Transmitter Turn OFF

Whenever the OFF button on the front panel is pressed, the Master Controller sends a high TX_OFF command to J1-A53 on the Life Support Board. This is tied to AND gate U25-12. When the Master Controller is working, MSTR_NORMAL1 at U25-13 will be high and U25-11 will go high. This high will pass through to U31-11, U33-6 and inverted at U16-10 before reaching the RESET input of K4. When K4 is RESET, the contactor will de-energize, shutting off the transmitter. The CONTACTOR_ON(BAR) signal at K4-4 will go high, applying a

SUPPLY_DISABLE at U30-11 to shut off the power supplies and a SYSTEM_MUTE via U30-10 which will mute the exciter and IPA.

4.7.6.1.2.1 Remote Transmitter Turn OFF

REM_OFF(BAR) is activated via the remote control interface. When the remote control pulls this line low, it will activate optical isolator, U23, bringing U23-6 low. This is inverted at U27-6 and applied to U25-10 as an active high signal. The input at U25-9 is not used and will always be high. Therefore the AND gate output at U25-8 will follow the U25-10 input. The remote off command is then tied in to the same off command circuitry discussed earlier.

4.7.6.1.2.2 Failsafe

The Failsafe input can be used for any purpose which requires muting of the transmitter output, such as failure of the remote control, or external RF switching systems. Customer connection to the Failsafe circuit can be done in one of three places:

- a. At the TB1 remote control terminal strip in the rear of the transmitter (see Section II, Installation). As shipped from the factory, there is a jumper from TB1-8 to TB1-10(ground).
- b. It can also be connected directly to the Life Support Board to J4-7 and J4-8. Be very careful when connecting to these terminals. The pressure necessary to operate the Wago connector on the rear of the board must be properly supported to keep from bending and possibly damaging the Life Support Board.
- c. Lastly, it can be connected at J20-8, a 37 pin D connector, located on the Display/Backplane Board directly behind the controller front panel. This connects to the Life Support Board at J1-A6.

In any of the three cases, Failsafe is an active low signal which must be pulled low before the transmitter will output any power. To use the failsafe, the factory jumper must be removed.

When the failsafe circuit is satisfied, it will cause U23-8 and U25-4 to go low and U25-6 will stay low, having no effect on transmitter operation. If the Failsafe connection is opened, U23-8 and U25-4 will go high, but the signal is gated by U25-5, which is the FAILSAFE_ENABLE signal from the Master Controller. This line is not used and is always high, allowing a Failsafe open condition to pass the high to U29-10 which ties into the SYSTEM_MUTE circuit. In the Life Support Mode the signal MASTER_NORMAL(BAR) will be high at U31-2 and will enable U25-5 and the Failsafe signal.

4.7.6.1.3 External Interlock

The External Interlock input can be used for any purpose which requires shutting off the transmitter, such as a protective door being opened or a water (or air) switch on a dummy load. The primary purpose is for the protection of personnel. Customer connection to the External Interlock circuit can be done in one of three places:

- a. At the TB1 remote control terminal strip in the rear of the transmitter (see Section II, Installation). A jumper is installed at the factory to make the External Interlock connection. It is installed between TB1-7 and TB1-6(GND).
- b. At J20-7, a 37 pin D connector, located on the Display/Backplane Board directly behind the controller front panel. This connects to the Life Support Board at J1-A4.
- c. Lastly, it can be connected directly to the Life Support Board at J4-10 and J4-7(ground).

In any of the three cases, External Interlock is an active low signal which must be pulled low before the transmitter may be turned on. To use the External Interlock, in any of the above 3 locations, the factory jumper from TB1-7 to TB1-6(GND) must be removed. External Interlock circuit operation was discussed earlier in the Transmitter Turn On discussion.

4.7.6.1.4 SYSTEM_MUTE

The SYSTEM_MUTE line is used to mute the RF output from the exciter and IPA. It is the summation of mute signals from several sources which are discussed below. The SYSTEM_MUTE is an active high signal at U30-6 and passes through to U38-3. The signal then splits and goes to relay K1-13 as the exciter mute and to inverter U13-7 as an IPA mute.

- a. Exciter Mute - K1 directs the mute signals, SOFTSTART-MUTE and SYSTEM_MUTE to the on air exciter (K1 is shown in the RESET or Exciter 1 on air mode). The mute will pass through to U36-8 or U36-11 depending on the position of K1. If your exciter requires an active high to mute the exciter then JP1 and JP2 should be left in the 1-2 position. This directs the signal through inverter U27-2 or U27-4 and then through inverter U28-1 or U28-2 for an active high mute signal to the exciter(s). If your exciter requires an active low to mute, then JP1 and JP2 should be placed in the 2-3 position where the mute signal bypasses the U27 inverters and is inverted to an active low by U28-1 or U28-2, again depending on the position of K1. For proper positioning of these and other related jumpers, refer to "Alternate Exciter Installation" in Section II, Installation.

- b. IPA Mute - When U5-5 goes high, the analog switch will open, disconnecting U5-4 and U5-3, and the IPA gate voltage will go maximum negative, via R30, effectively shutting the IPA off. Relay K2 directs the IPA gate control voltage to the active IPA, when dual IPAs are used. K3 is not used in the 5kW transmitter. The following is a list of signals which can cause a SYSTEM_MUTE:
 - c. PA_CTRL1_MUTE and PA_CTRL2_MUTE. This a mute command from the PA Controller Boards which will be triggered by various events such as a PA being removed or inserted.
 - d. MASTER_IPA_MUTE.
 - e. FAILSAFE. Discussed earlier.
 - f. PA_15V_FAIL. This fault comes from both of the PA Controller Boards. It is triggered when there is a loss of the -15V on **BOTH** of the PA Controllers. If the -15V supply is lost, the PA Controllers will not be able to mute the PAs and therefore cannot protect them, so the exciter and IPA will be muted to protect the PAs.
 - g. CONTACTOR_ON(BAR). Discussed earlier.

4.7.6.1.5 Exciter Select

Exciter Select is only applicable if the transmitter is configured with Main/Alternate exciters. Exciter select is software controlled by the Master Controller. It can be switched manually or will switch automatically if the active exciter fails (no RF output). Exciter switching is done by latching relay K1. EXCITER1_SELECT is a pulsed signal which will go high to select exciter 1. This will make U12-8 high if the Master Controller is working (MSTR_NORMAL 1 will be high). This passes through inverter U13-16 and resets K1. This places K1 in the position shown on the schematic. K1-4 will be pulled low. This is sent two places:

- a. The low from K1-4 goes off the board to the IPA Backplane Board where it actuates the exciter select relay K1 to the position shown on the schematic. It also goes to the Master Controller as a status signal, so it knows which exciter is physically selected.
- b. The signal from K1-4 is also used to mute the off air exciter when in the Life Support Mode, via U35-3 and U35-6, which tie into the exciter mute lines.

Exciter 2 is selected when EXCITER2_SELECT goes high which will SET K1. K1-4 will go high and this will switch K1 on the IPA Backplane board to the exciter 2 position.

4.7.6.1.6 IPA Select

IPA select is software controlled by the Master Controller. It can be switched manually or will switch automatically if the active IPA fails (no RF output). IPA switching is done by latching relay K2. IPA_SELECT_AB1 is a pulsed signal which will go high to select IPA_AB1 (the AB represents Z-Plane A and Z-Plane B). This will make U14-3 high if the Master Controller is working (MSTR_NORMAL 1 will be high). This passes through inverter UI3-14 and will RESET K2. This places K2 in the position shown on the schematic. K2-4 will be pulled low. This is sent two places:

- a. The low from K2-4 goes off the board to the IPA Backplane Board where it actuates the IPA select relays, K2 and K3 to the position shown on the schematic.
- b. It also goes to the Master Controller as a status signal, so it knows which IPA is selected.

IPA AB2 is selected when IPA_SELECT_AB2 goes high which will SET K2. K2-4 will go high and this will switch K2 and K3 on the IPA Backplane board to the IPA_AB2 position. K2 is also responsible for switching the IPA gate control voltage (transmitter power control signal) to the active IPA.

4.7.6.1.7 Power Control

The transmitter power output is controlled by the IPA output level. The IPA output level is controlled by the signal MSTR_IPA_CTL, which is an analog voltage (variable DC) which will control the IPA gate voltage. Varying the gate voltage will vary the IPA power output. MSTR_IPA_CTL, enters the board at J1-A35 where it is applied to analog switch, U5-1. If the Master Controller is working, then U5-13 is high and MSTR_IPA_CTL passes through the switch to U5-4. If there is no mute signal present at U5-5, the signal will pass through to CR4 and U15-3. CR4 and R30 basically create a negative gate bias for the IPA which will vary with the MSTR_IPA_CTL signal. The IPA requires about -15V to be completely shut off and about 0V to be fully turned on. For more information on Power Control refer to the APC discussion earlier in this section under the Master Controller.

4.7.6.1.8 IPA Current and Voltage Samples

IPA current is detected as the differential voltage across a current shunt resistor in series with the IPA supply voltage on the IPA Backplane Board. The shunt resistor is R1 on the IPA Backplane. The current sample is called IPA_AB_I Sample. This is compared against IPA_AB_V Sample, which comes from the input side of the shunt resistor. The voltage difference between these two samples is directly proportional to the current flowing through the shunt resistor. The difference is amplified by U18-6 and Q1 and is sent to the Master Controller for monitoring and protection. The IPA_CD samples are only used in the 10kW transmitter.

The IPA Voltage sample is taken from the voltage divider made up of R45 and R48. This is sent to the Master Controller for monitoring and protection.

4.7.6.1.8.1 U18 Supply Voltage

The supply voltage for U18, VDP1 and VDN1 comes from U22 and diodes CR16, CR17 and CR6. The samples coming into U18 at pins 2 and 3 are about 52 VDC. The supply voltage for U18 is floating at VDP which is the PA voltage plus 4 volts and VDN which is the PA voltage minus 4 volts. Basically U22 is a small switching supply providing a floating +/- supply for the op-amps U18 and U21.

4.7.6.1.9 Forward Power Sample

The forward power sample from the directional coupler enters the Life Support Board at J2. The sample is detected by CR8 and buffered by U1-14. The DC voltage at TP8 is proportional to the forward power output of the transmitter. This is sent to the Master Controller where it is used for monitoring, display, automatic power control or APC and calibration.

4.7.6.1.9.1 CPLR_DISC_FAULT

This is an interlock fault which will mute the transmitter if the cable to the forward directional coupler is disconnected. The fault line is pulled up through R1 to +5V. If the coupler is connected, the line is pulled low and no fault occurs. When disconnected, the line will pull high and the Master Controller will mute the transmitter.

4.7.6.1.10 Reflected Power

The reflected power sample enters the board at J3. It is detected by CR10 and buffered by U1-1. The voltage at TP7 is directly proportional to the amount of reflected power coming back to the transmitter from the antenna or transmission line. This DC sample voltage is sent to the Master Controller, via J1-A19, for VSWR protection and monitoring when the Master Controller is operational. The VSWR fault comparator output at U3-2 will only be able to effect transmitter operation in Life Support Mode.

4.7.6.2 Life Support Mode

The following contains all pertinent circuit information for operating in the Life Support Mode. This is when the Master Controller has failed and the Life Support Board has taken over control of the transmitter.

4.7.6.2.1 Master Controller Failure

The Master Controller has what is referred to as a "Watchdog Timer". As long as the micro-controller on the Master Controller board is working and executing its program normally, the Watchdog Timer will be sending out a pulse every 1.0msec. These pulses are detected by I/2 of U4 on the Life Support Board (U4-4), a re-triggerable one-shot with a 2msec time-out, which will stay triggered (SET) as long as the Watchdog Timer pulses continue. If the Watchdog Timer pulses are

interrupted (which means the Master Controller has failed), U4 will time-out and go to the RESET mode. The Q output will go low and Q_NOT will go high. The low signal from the Q output is inverted at U16-13, and pulls the MASTER_NORMAL(BAR) signal high (this signal is normally low when the Master Controller is working). The high Q_NOT signal at U4-7 is inverted at U16-14 and U16-15. U16-14 pulls the MSTR_NORMAL 1 signal low while U16-15 pulls the MASTER_NORMAL signal low (these signals are normally high when the Master Controller is working).

4.7.6.2.1.1 MASTER_NORMAL

This signal goes low when the Master Controller fails and only has one function. It is the control signal for U5-13, an analog switch. The input to the switch at U5-1 is the analog control signal, MSTR_IPA_CTL from the Master Controller APC circuit, which controls the IPA gate voltage and therefore the power output of the transmitter. When the Master Controller is working, the analog IPA control signal passes through to U5-2. Provided there is no SOFTSTART_MUTE or SYSTEM_MUTE, the IPA control signal will also pass through to U5-3 and on to U15-3. U15 buffers the signal and sends it to IPA select relay K2. K2 directs the IPA control signal to the active IPA.

When the Master Controller fails, MASTER_NORMAL will go low, opening the U5-13 switch. The MANUAL PWR REF pot R25 now controls the transmitter power output. This is factory set for 1/4 of the rated transmitter power output.

4.7.6.2.1.2 MSTR_NORMAL 1

This signal goes low when the Master Controller fails. Its primary responsibility is to disconnect all of the control lines coming from the Master Controller via AND gates. It causes the following actions to occur:

- a. MSTR_NORMAL 1 applies a low to AND gate U6-4, fan speed select gate. When in Life Support Mode the fan will be forced to high speed operation due to the possible higher than normal dissipations when running at reduced power. The output of AND gate U6-6 passes through to U16-16 and on to the Low Voltage Power Supply Board and the fan select relay, K3.
- b. MSTR_NORMAL 1 applies a low to AND gate U6-10. This interrupts the SUPPLY_DISABLE command from the Master Controller to the PS Controller by holding U6-8 low. The SUPPLY_DISABLE is an active high command, which is used to place the PA Power Supplies in standby mode (standby mode is when the tap SCRs are all shut off but the discharge circuit is not activated).
- c. MSTR_NORMAL 1 applies a low to AND gate U25-13. This inhibits the Master Controller from giving the transmitter OFF command. The OFF command can still be given directly via the front panel overlay button or by remote control, REM_OFF(BAR). The remote inputs REM_ON_LOW,

REM_OFF and FAILSAFE become active due to the signal MASTER_NORMAL(BAR) going high when Life Support is initiated. This is discussed in the paragraphs labeled MASTER_NORMAL(BAR).

- d. MSTR_NORMAL 1 applies a low to AND gate U25-2. This inhibits the Master Controller from initiating a SYSTEM_MUTE which would mute the exciters and the IPA.
- e. MSTR_NORMAL 1 applies a low to NAND gate U7-2 causing U7-3 to go high. This enables the direct connection of the front panel overlay buttons to the on and off logic by enabling U26-13 and U26-2, bypassing the control circuits on the failed Master Controller.
 1. When the OFF button is pressed, U26-1 will go high, causing U26-3 to go high. This then passes through a series of OR gates, U31-8, U31-11 and U33-6 and on to U16-10. This then connects to the RESET line on latching relay K4, placing it in the position shown on the schematic. K4-13 will go low, and this is sent through U16-12 and on to the LOW Voltage Power Supply Board to relays K1 and K2. K1 and K2 will both open, shutting off the AC to the contactor and the exciters (K1 applies AC to the contactor coil, while K2 applies AC to the exciters).
 2. The high at U26-13 enables the XMTR_ON_LOW pushbutton on the front panel overlay when in Life Support Mode to enable the local transmitter ON LOW command. Remote ON LOW (REM_ON_LOW) is also available in Life Support Mode. Note that the HIGH ON pushbutton on the front panel overlay has no function when in Life Support Mode.
- f. MSTR_NORMAL 1 applies a low to all four AND gates in both U12 and U14. This prevents the Master Controller from applying exciter mute, exciter select or IPA select signals.

4.7.6.2.1.3 MASTER_NORMAL(BAR)

This signal goes high when the Master Controller fails. It causes the following actions to occur:

- a. MASTER_NORMAL(BAR) applies a high to AND gate U6-2. This enables the fault, LS_SYST_FAULT (Life Support System Fault) only while in Life Support Mode. This fault is caused by excessive VSWR or IPA Current and will shut the transmitter off.
- b. MASTER_NORMAL(BAR) applies a high to OR gate U32-5. This enables the remote command, REM_ON_LOW(BAR) so the transmitter can be turned on by remote control when the Master Controller has failed. Note that the REMOTE_ON_LOW(BAR) command can be disabled, during normal operation, by placing the controller in LOCAL mode using the front panel REMOTE DISABLE pushbutton. This disables the remote ON command via

the REM_ON_ENABLE signal at U32-4. If the Controller is in LOCAL mode, U26-5 will be low and the REM_ON_LOW(BAR) command is inhibited. When Life Support Mode is initiated, U32-5 and therefore U26-5 is forced high enabling the REM_ON_LOW(BAR) command.

- c. MASTER_NORMAL(BAR) applies a high to the CLEAR line of U8-3. This enables U8-6, the Q output, to apply a 3 second SOFTSTART_MUTE after a power failure. The POWERFAIL(BAR) signal comes from U37-7 and is a minimum 200mSec low pulse. U37 is monitoring the +20Vdc supply and will bring pin 7 low if the voltage drops below approximately +12Vdc. Note that the POWERFAIL(BAR) signal will not go back to the high condition until 200mSec after power is restored. In Life Support Mode, after a power failure U37-7 will go high which triggers U8-4. This will then trigger a SOFTSTART_MUTE via OR gate U33-10 for 3 seconds. The SOFTSTART_MUTE signal mutes the exciter RF output, to make sure there is no RF applied to the system for at least 3 seconds to allow the supplies to fully charge. U8 is only active in Life Support Mode. It is cleared by the MASTER_NORMAL(BAR) signal when the Master Controller is operational. The Master Controller normally takes care of this function via the SYSTEM_MUTE line.
- d. MASTER_NORMAL(BAR) applies a high to the CLEAR line of U8-13. This enables U8-10, the Q output, to apply a 3 second SOFTSTART_MUTE whenever an on command is given via U35-11. The SOFTSTART_MUTE mutes the exciter RF output, to make sure there is no RF applied to the system for at least 3 seconds to allow the supplies to fully charge. U8 is only active in Life Support Mode. It is cleared by the MASTER_NORMAL(BAR) signal when the Master Controller is operational. The Master Controller normally takes care of this function via the SYSTEM_MUTE line.
- e. MASTER_NORMAL(BAR) applies a high to OR gate U31-5. This circuit is not used.
- f. MASTER_NORMAL(BAR) applies a high to OR gate U31-2. This enables the FAILSAFE command by placing a high at U25-5, when in Life Support Mode.
- g. Lastly, MASTER_NORMAL(BAR) applies a high to AND gates U35-2 and U35-5. This applies a mute to the inactive exciter for as long as the transmitter is in Life Support Mode. Latching relay K1 determines which exciter is muted. K1 is shown in the RESET position, which mutes Exciter 2. When SET, K1 will mute Exciter 1. The position of K1 cannot be changed while in Life Support Mode.

4.7.6.2.2 Reflected Power

The reflected power sample enters the board at J3. It is detected by CR10 and buffered by U1-1. The voltage at TP7 is directly proportional to the amount of reflected power coming back to the transmitter from the antenna or transmission line. This DC sample voltage is sent to the Master Controller, via J1-A19, for VSWR protection and monitoring when the Master Controller is operational.

If the Master is not functioning (Life Support Mode), then the RFL PWR Overload Adjust, R24 and comparator U3-2, will protect the transmitter from excessive VSWR by shutting it off. R24 sets the reference voltage for U3-5, which is the VSWR comparator for Life Support Mode. If the VSWR exceeds 150 watts reflected in this mode the comparator will trip and U3-2 will go low. This is inverted at U7-6 and becomes, LS_SYST_FAULT, which stands for Life Support System Fault. This signal is sent to AND gate U6-1. U6-2 is connected to the MASTER_NORMAL line. This line will be high only if the Master Controller has failed, which is the case here for Life Support Mode. Therefore the LS_SYST_FAULT will cause U6-3 to go high. Next, OR gates U33-3 and U33-6 will also go high, making U16-10 output high. This is connected to the RESET side of latching relay, K4. When K4 resets, K4-14 will go low, which will send a low to the Low Voltage Power Supply Board, via U16-12. The main AC contactor will disengage and the transmitter will be shut off.

It is important to note that if the Master controller is working, then U6-3 would not go high and therefore the LS_SYST_FAULT is not active. This is due to the fact that the Master Controller has the primary responsibility for VSWR protection. This circuit only has function when the Master Controller has failed and the transmitter is running in the Life Support Mode.

4.7.6.2.3 IPA Current Fault

While in Life Support Mode, IPA Current overload protection is accomplished using comparator U3-1 and IPA Current Fault Adjust, R23. R23 is set for a conservative IPA current level. If the IPA current is too high, U3-1 will go low. This is tied into the LS_SYST_FAULT circuit at U7-6 discussed earlier and will shut the transmitter off.

Table 4-1 PA Control Distribution

PA Designations		PA Designations on PA Controller Schematics				PA Designations on Combiner and Divider Schematics	Related Isolation Relay #	Related Isolation Resistor #
		PAC #1	PAC #2	PAC #3	PAC #4			
Z-PLANE A	A1	PA6				PA8 (J8)	K8	RT8
	A2	PA5				PA7 (J7)	K7	RT7
	A3		PA8			PA6 (J6)	K6	RT6
	A4		PA7			PA5 (J5)	K5	RT5
	A5	PA3				PA1 (J1)	K1	RT1
	A6	PA4				PA2 (J2)	K2	RT2
	A7		PA1			PA3 (J3)	K3	RT3
	A8		PA2			PA4 (J4)	K4	RT4
Z-PLANE B	B1		PA5			PA5 (J5)	K5	RT5
	B2		PA6			PA6 (J6)	K6	RT6
	B3	PA7				PA7 (J7)	K7	RT7
	B4	PA8				PA8 (J8)	K8	RT8
	B5		PA4			PA4 (J4)	K4	RT4
	B6		PA3			PA3 (J3)	K3	RT3
	B7	PA2				PA2 (J2)	K2	RT2
	B8	PA1				PA1 (J1)	K1	RT1

This chart is meant as an aid in tracking control, status and metering signals between the PA Controllers and the individual PAs. The first column groups the PAs by Z-Plane. The second column gives the actual PA designation or location as silkscreened on the inside of the PA doors. As for columns 3 through 6, each PA Controller is identical and has the ability to control 8 PAs, PA1-PA8. However, an output labeled PA1 on the PA Controller schematic does not necessarily go to amplifier A1 or B1. For example, On Z-Plane A, amplifier A4 is connected to any input or output of PAC #2 that is labeled PA7, such as PA7_GATE. Note that on Z-Plane B, amplifier B4 is connected to any input or output labeled PA8 on PAC #1. This cross numbering is due to the fact that Z-Plane B is inverted compared to Z-Plane A. The seventh column is actually the intermediate step between the PAs and the PA Controllers and gives the designation and connector number for each of the PAs. The last 2 columns give the component designator for the Isolation Switch and Isolation Resistor for each of the PAs. The Isolation switches and resistors are located on the Isolation boards mounted on the sides of the Z-Planes.

Maintenance and Alignment

5

5.1 Introduction

This section provides maintenance and alignment information, for the purpose of routine maintenance and replacement of PC boards and other major components of the Platinum Z5 FM BROADCAST TRANSMITTER.

5.2 Routine Maintenance

Routine maintenance of the Platinum Z series transmitter basically consists of regular cleaning and monitoring of temperatures, currents, voltages and faults.

5.2.1 Safety Precautions

It is very dangerous to attempt to make measurements or to replace components with power on. The design of the transmitter provides safety features such that lethal voltages are shielded behind doors or clear lexan shields which require a tool to be opened. Shut off all power before servicing the transmitter, other than replacement of modules. The Front and rear doors are hinged and can be opened while the transmitter is running for access to the modules. The modules are "HOT-PLUGGABLE" which means they can be accessed and removed or replaced without turning the transmitter off.

5.2.2 Record Keeping

The importance of keeping station performance records cannot be over-emphasized. Logbooks should be maintained for all operation and maintenance activities. These records can provide data for predicting potential problem areas and analyzing equipment malfunctions.

5.2.2.1 Recommended Log Readings

There is a listing of the recommended meter readings contained in Table 5-2, "Z5 Minimum Recommended Transmitter Log Readings," on page 5-26.

5.2.2.2 Transmitter Logbook

As a minimum performance characteristic, the transmitter should be monitored (using front panel metering and the Diagnostic Display) and the results recorded in the transmitter logbook at least once a day.

5.2.2.3 Maintenance Logbook

The maintenance logbook should contain a complete description of all maintenance activities required to keep the transmitter operational. A list of maintenance information to be recorded and analyzed to provide a database for a failure reporting system is as follows:

DISCREPANCY

- Describe the nature of the malfunction. Include all observable symptoms and performance characteristics.

CORRECTIVE ACTION

- Describe the repair procedure used to correct the malfunction.

DEFECTIVE PART(S)

List all parts and components replaced or repaired. Include the following details:

- COMPONENT TIME IN USE
- COMPONENT PART NUMBER
- COMPONENT SCHEMATIC NUMBER
- COMPONENT ASSEMBLY NUMBER
- COMPONENT REFERENCE DESIGNATOR

SYSTEM ELAPSED TIME

- Total transmitter time on.

NAME OF REPAIRMAN

- Person who actually made the repair.

STATION ENGINEER

- Indicates chief engineer noted and approved the transmitter repair.

5.2.3 Cleaning

Proper airflow is essential in keeping the transmitter in top working condition. If outside air is brought into the building it should be well filtered to keep dirt out of the building and the transmitter.

5.2.3.1 Module cleaning

The heatsinks on the modules are high efficiency, and therefore do not have large openings for airflow and will tend to collect dirt over time. The modules should be cleaned with compressed air on a schedule to be determined on site, depending on the air system, filtering, humidity etc... (at least once a year). This determination can be made either by visual inspection or by monitoring the module temperatures in the Diagnostics Display.

⚠ WARNING:
THE PA MODULES ARE DESIGNED TO HANDLE VERY HIGH TEMPERATURES AND MAY BE EXTREMELY HOT. DO NOT TOUCH THE MODULES WITH BARE HANDS AFTER THE TRANSMITTER HAS BEEN RUNNING, ESPECIALLY IN HIGH AMBIENT TEMPERATURE ENVIRONMENTS.

To locate the PA Temperature Monitoring press [METERING, C,A, then select the desired Z-Plane]. Keeping a regular log of the PA temperatures versus Ambient temperature will give a quick indication of a possible problem or that cleaning is necessary. To check the ambient temperature reading press [METERING, C,D,B].

5.2.3.2 Cleaning the Air Filter

The indication as to when to clean or replace the air filter is basically the same as mentioned in the previous paragraphs, mainly with the airflow indicator, but temperatures and/or a visual inspection would also suffice. To monitor Airflow press [METERING D,B].

5.2.3.3 Cleaning the Power Supply

The power supply can either be cleaned with a vacuum cleaner or compressed air or both. For example, the rectifier heatsinks on top of the transformers should be cleaned with compressed air, then after the dust settles, the rest of the compartment vacuumed. Be very careful when moving cables to clean. Anytime a cable or wire is moved, there is the possibility of breakage or open connections. Therefore cables should always be moved as little as possible.

5.3 Blower Motor Maintenance

Current transmitter models use GE brand motors which have sealed bearings with no grease fittings, and require no lubrication.

5.4 Routine Annual Tests

These tests should be used as part of a routine maintenance program at least once a year. It should also be done if major combiner components are removed and/or replaced, such as a Z-Plane or Isolation Board or if cabling is disconnected and re-connected to the Z-Planes or Isolation Boards.

5.4.1 System Level ISO/Reject Load Ohmmeter Test

The ISO/Reject loads for the Z-Plane can be physically tested using an ohmmeter. Shut off the transmitter and disconnect primary power at the wall breaker. Remove a PA module to allow access to the Z-Plane connectors. Connect the common lead of the meter to the chassis and check pins 14 or 15 on the Z-Plane connector. The resistance should be 50 ohms +/- 3 ohms for Z-Plane B. This is checking ISO_AB, the 50 ohm reject load on the 3dB hybrid which is combining the 2 Z-Plane outputs. Z-Plane A will read a short due to the static discharge choke L1 at the bottom of the harmonic filter. Figure 5-1 shows the connector numbering and lettering for the Z-Plane connectors. This diagram will work when looking at the front or back of the transmitter on any power block, or PA slot.

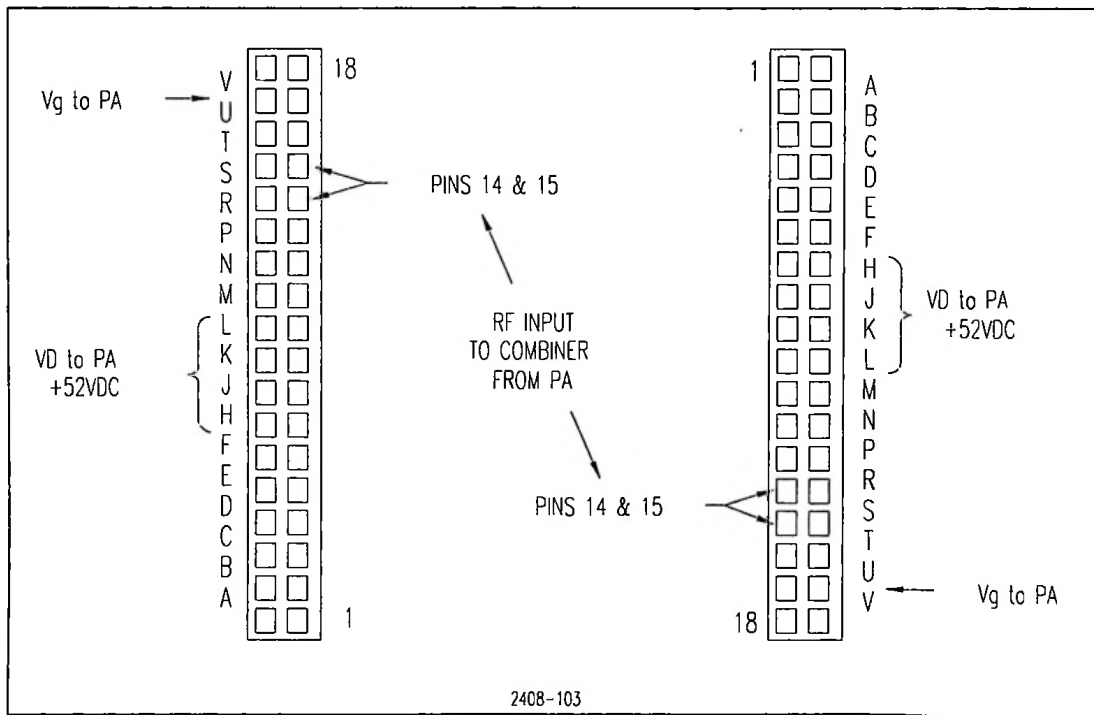


Figure 5-1 Z-Plane Connector Pinouts for any PA Module

5.4.2 System Test

The purpose of the SYSTEM test is to check the combiner configuration, cabling and integrity. The length of time required for the SYSTEM test will be indicated on the display. The test will reduce the transmitter power to 40% of nameplate TPO (2kW) and will be going through a MUTE cycle for each PA. **The antenna VSWR must be 1.2:1 or less with no faults present in order to run the test.** If the VSWR is too high the test will be aborted, but nothing will be reported in the Fault Log (the abort screen will read VSWR high). During the test the HIGH ON and LOW ON buttons will not work. The test can be started at any time and any power level above 50%. If a fault is detected during the test it will be aborted and the fault will be noted in the Fault Log. Also the user can abort the test at any time by pressing the OFF button or via the test screen on the Diagnostics Display. The results of the test will be either Aborted, Failed or Passed. If the test fails, check the Fault Log to find out why. To run the SYSTEM test press [MORE TEST C]. This will bring up the screen in Figure 5-2. Press [D] to run the test or [C] to go back to the previous menu.

⇒ NOTE:

For further details, see “Self Diagnostics” portion of Section 6 in this manual.

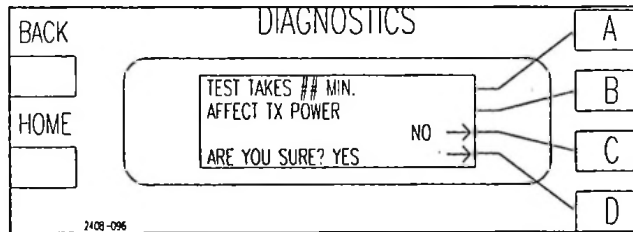


Figure 5-2 System Test (takes about 8 minutes)

5.5 Isolation Board Maintenance

If it is determined that one of the Isolation Boards needs repair or replacement, the recommended procedure is to completely exchange the board. The entire Isolation assembly is relatively inexpensive and easy to remove and replace. The Isolation resistors and RF switches are critical to the proper operation of the combiner system. Replacement of any parts on the Isolation Boards requires the proper soldering equipment and techniques to prevent damage to components or the PC board itself. The isolation resistors all have thermistors attached to them with epoxy for temperature sensing. Therefore the resistors and thermistors, labeled RT1 - RT8, must be obtained from Harris, pre-assembled. De-soldering on the Isolation Board requires a lot of heat due to the large amount of ground plane. If the resistors are not heated and removed properly, the PC board will be damaged and the feed-throughs pulled out.

5.5.1 Isolation Board Replacement

There are 2 Isolation Boards in the Z5, one for each Z-Plane. The boards are mounted on each side of the 5kW power block.

5.5.1.1 Isolation Board Removal

- a. There are 2 ribbon cables connecting to each Isolation assembly. The cables should be disconnected from the RFI filter boards. They can be removed from the Isolation Board once it is removed from the transmitter. It does make a difference where these re-connect. The cables and connectors are labeled so proper connection can be verified on the Overall System Block Diagram.
- b. Remove the 4 hex standoffs near the corners of the assembly. There are 4 round standoffs very close to the corners of the assembly which are merely guide pins and do not need to be removed.
- c. Once the hex standoffs are removed, the Isolation board can be pulled straight out from the Z-Plane until the connection pins are disengaged.



CAUTION:

THERE ARE 10 SMALL PINS WHICH CONNECT THE ISOLATION RESISTORS TO THE Z-PLANE. THESE ARE EASILY BENT IF THE ASSEMBLY IS NOT PULLED STRAIGHT OUT. IF BENT, THEY WILL HAVE TO BE STRAIGHTENED BEFORE IT WILL BE ABLE TO BE RE-INSTALLED. IF BENT TOO FAR, THE PINS MAY BREAK OFF WHEN STRAIGHTENED.

- d. The Isolation assemblies for Z-Plane A must be taken out the front of the transmitter. The Isolation assemblies for Z-Plane B can be taken out the front or rear of the transmitter.

⇒ NOTE:

Each Isolation Board is programmed for a specific Z-Plane. Therefore, if more than one Isolation assembly is removed at one time, mark each one as to its proper location. The programming is a simple jumper selection on the PC board. The jumper chart is printed on the PC Board next to the jumpers and can also be found on the Isolation Board schematic if verification is required.

5.5.1.2 Inspection

All of the isolation resistors have a thermistor attached to them with a special epoxy. Verify that all of the thermistors are firmly attached and that the epoxy has not cracked as this will give incorrect temperature readings.



CAUTION:

BE VERY CAREFUL WHEN DESOLDERING ANY OF THE RESISTORS AS A LARGE AMOUNT OF HEAT IS REQUIRED. DO NOT PULL VERY HARD OR THE FEED THROUGH HOLES ON THE PC BOARD COULD BE DAMAGED.

The resistors should be ordered as an assembly, with the thermistor already attached as this is very critical to proper transmitter operation.

5.5.1.3 Installation of Isolation Assembly

If a new Isolation Board is being installed be sure to set the ID jumpers to the proper location as marked on the PC Board next to the jumper pins. The safest method is to set the ID the same as the board being replaced.

The Isolation assembly should slide back into place fairly easily as long as none of the pins are bent. Re-install the 4 hex standoffs and the 2 ribbon cables, making sure that the cables are connected to the same port from which they were removed. Be careful not to over-tighten the hex standoffs.

5.6 PA Replacement

Since field repair of the Power Amplifiers is not a recommended procedure, the only option is to replace it (especially during the warranty period). A replacement PA will include the 1/4 inch thick copper plate under the PC board. Do not remove the PC Board from the copper plate. When installing the new PA, be sure to apply a thin but even coating of thermal compound before re-assembly to the heatsink. Tolerance on the screw holes will assure alignment into the Z-Plane connector.

5.7 Directional Coupler Removal and Replacement

First, note that 2 of the couplers are labeled Forward sampling and one is Reflected. They cannot be interchanged as the coupling ratio is different. The difference is how far the coupler is inserted into the base. The Forward couplers are not inserted as far as the reflected and have a small gap between the coupler and the base.

Before removal, mark each coupler for the following:

- a. Proper position - the couplers should go back into the same hole from which they came.
- b. Orientation - mark the couplers with an arrow pointing up to be sure and replace them correctly. Reversing a forward coupler makes it read reflected and vice-versa.
- c. Cable Number - write on the coupler, the number of the BNC cable which attaches to it.

⇒ NOTE:

The directional couplers are held in place on the harmonic filter with 2 hose clamps. Be sure to place the clamps as far toward the edge of the coupler body as possible and do not over-tighten.

- d. A calibration of the Forward or Reflected power should be done depending on which coupler was replaced.

⇒ NOTE:

If both couplers are being replaced at the same time, Reflected Power should be calibrated first, then the Forward Power. An external meter is required to calibrate Reflected Power in this case.

5.7.1 Typical Coupling Ratios

Typical Coupling Ratios for the directional couplers is as follows:

Forward Couplers: 48.8dB @ 88MHz to 47dB @ 108MHz

Reflected Couplers: 43.8dB @ 88MHz to 42dB @ 108MHz

(tolerance is +/- 0.1dB with directivity greater than 30dB. This is not guaranteed since any minor variations can be factored out by using the calibration procedures).

For frequencies between 88 and 108MHz the actual coupling ratio can be extrapolated linearly. For example: At 98 MHz the typical Forward Coupling ratio is 47.9dB.

5.8 Setting Maximum Power Limits

There is a maximum power limit which can be set for each of the transmitter power settings, LOW and HIGH. The “MAX HIGH SET” sets the maximum power output when the transmitter is on HIGH power. The “MAX LOW SET” sets the maximum power output when the transmitter is on LOW power. While these settings are normally used to prevent the transmitter power output from exceeding legal limits, they can also be used to protect an under rated RF system.

The MAX HIGH Power limit is set as follows:

- STEP 1** Turn the transmitter on at HIGH power and set the power output to a power level which is less than the desired maximum power using the Raise and Lower buttons.
- STEP 2** To enter a new MAX HIGH setting go to the MAX HIGH SET screen, [HOME, MORE, CONFIGURATION B,B] change to the new maximum power level and press [BACK] to save the changes.
- STEP 3** Press Raise to make sure the power level will not go above the new MAX HIGH setting. The MAX HIGH setting in Step 2 can be adjusted slightly to get the exact desired power level.

The MAX LOW Power limit is set as follows:

- STEP 1** Turn the transmitter on at LOW power and set the power output to a power level which is less than the desired maximum power using the Raise and Lower buttons.
- STEP 2** To enter a new MAX LOW setting go to the MAX LOW SET screen, [HOME, MORE, CONFIGURATION B,C] change to the new maximum LOW power level and press [BACK] to save the changes.
- STEP 3** Press Raise to make sure the power level will not go above the new MAX LOW setting. The MAX LOW setting in Step 2 can be adjusted slightly to get the exact desired power level.

5.9 Setting FWD PWR to Display 100%

This procedure simply makes the transmitter FWD PWR % meter read 100% at the present transmitter power output (this will not change the kW reading on the FWD PWR display). Changing TPO does not require re-calibration and is accomplished with the following 2 steps:

- STEP 1** Set the power to the desired TPO using the raise and lower buttons.
- STEP 2** Go to the 100% TPO SET screen [HOME, MORE, CONFIGURATION B,A]. Set the power level to your new TPO. Press [BACK] to update and store the new information.

The front panel FWD PWR reading should be 100%. You may also want to change the MAX HIGH and MAX LOW power settings to something more in line with your new TPO as well. MAX HIGH sets the maximum power level when the HIGH ON button is pressed, while MAX LOW sets the maximum power level when the LOW ON button is pressed.

5.10 Setting Life Support Power Level

This procedure is to be used to set the MANUAL PWR REF pot R25 on the Life Support Board to the proper level (R25 sets the power output of the transmitter if the Master Controller ever fails). The procedure requires an external wattmeter. If the MANUAL PWR REF pot R25 is adjusted for any reason, the following will assure it is set back to the proper position:

- STEP 1** Adjust R25 maximum CCW.
- STEP 2** Set switch S1-9 (RESET) on the Master Controller to the ON position to place the transmitter in Life Support Mode (the fan will switch to high speed).
- STEP 3** Adjust R25, Manual PWR Reference on the Life Support Board for 1.25kW on the external meter.
- STEP 4** Switch S1-9 to OFF and the transmitter should return to your normal TPO. It may be necessary to raise or lower power slightly.

5.11 Forward Power Calibration

If at all possible, it is recommended that the transmitter be calibrated at the full 5kW power level, even if your TPO is different. This restores all of the calibration parameters to the same relative values as were set up in the factory. It will also assure that the transmitter will be able to reach its full 6kW power output if so desired (this is a user defined level which is set by the MAX HIGH SET in the configuration menus). If it is not possible to calibrate at 5kW use your normal transmitter power output (TPO).

The following Forward Power Calibration procedure requires an external power meter to be used as the calibration reference.

- STEP 1** Shut the transmitter off. Press [HOME, MORE, CONFIGURATION, D] and set your operating frequency.
- STEP 2** Go to the 100% TPO SET screen [HOME, MORE, CONFIGURATION B,A]. Set this screen to read the power at which you are going to calibrate (5kW or your TPO).
- STEP 3** Press [HOME, MORE, CONFIGURATION B,B]. This should take you to the MAX HIGH SET screen. Make a note of the setting and then change it to 6kW for this procedure. Press [BACK] to update the information.
- STEP 4** Press [HOME,MORE,CONFIGURATION C,A,A] to go to the Forward Factor screen in Figure 5-3. If necessary edit this screen to read 0.007697. To access the edit controls press and hold the [D] key and press [C]. Press [BACK] to save the changes.

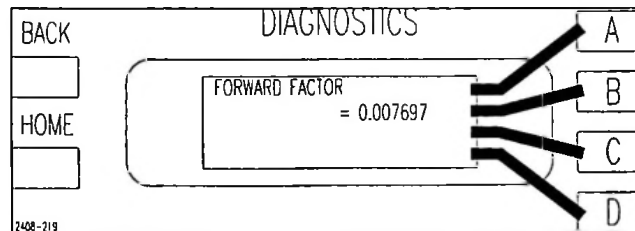


Figure 5-3 Forward Calibration Factor Screen
[HOME,MORE,CONFIGURATION C,A,A]

- STEP 5** Press [HOME, MORE, CONFIGURATION C, A, D, C] to go to the APC Factor screen in Figure 5-4. Set the CAL_APC_FACTOR to 7.58. To access the edit controls press and hold the [D] key and press [C]. Press [BACK] to save the changes.

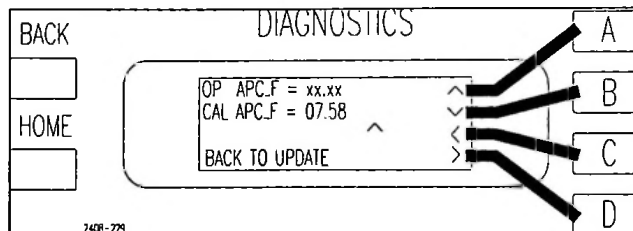


Figure 5-4 APC Calibration Factor Screen
[HOME, MORE, CONFIGURATION C, A, D, C]

- STEP 6** Set R127 on the Life Support Board maximum CW.
- STEP 7** Turn the transmitter on. Make sure the exciter power is on and unmuted.
- STEP 8** Press [HOME, MORE, CONFIGURATION C, B]. This will take you to the screen shown in Figure 5-5. Using the Raise and Lower buttons, set the DAC_APC_REF to 660.

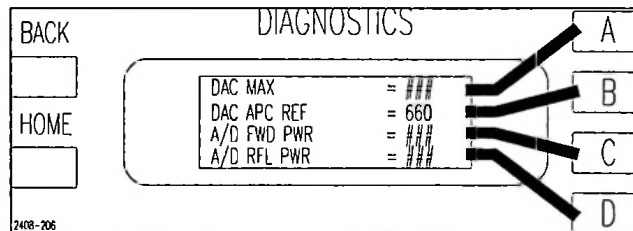


Figure 5-5 A/D FWD PWR Screen
[HOME, MORE, CONFIGURATION C, B]

- STEP 9** Re-Adjust R127 on the Life Support Board until the external meter reads 5kW or the TPO at which you are calibrating. **The adjustment will be sensitive, so be careful not to go too fast.**

- STEP 10** Set the power level in the FWD POWER CAL screen [HOME,MORE,CONFIGURATION C,C] (see Figure 5-6) to 05.00kW or the TPO at which you are calibrating.

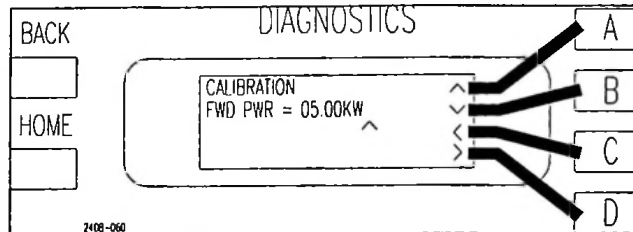


Figure 5-6 Forward Power Calibration Screen
[HOME,MORE,CONFIGURATION C,C]

- STEP 11** Set the Transmitter LCD meter (the right-hand display) to read FWD PWR in kW.
- STEP 12** Calibrating - Verify once more that the FWD POWER CAL screen and the external power meter agree. If necessary, re-adjust R127 on the Life Support Board to make the external meter read exactly 5kW or your TPO. **Press and hold the [D] key at the bottom right of the display and then press the [BACK] key to the left of the display to calibrate the FWD power and save the new information.** The display will flash "Calibration Done" very quickly at the bottom of the Diagnostics Display. The external meter and the FWD PWR reading on the transmitter should now agree.
- STEP 13** Return to the 100% TPO SET screen [HOME, MORE, CONFIGURATION B,A] and change the level to match your TPO. Press [BACK] to save the changes. The FWD PWR meter should read 100% (or your TPO in kW depending on the setting).
- STEP 14** Set the MAX HIGH back to the setting noted in Step 3 or to set a new MAX HIGH go to "Setting Maximum Power Limits" earlier in this section.
- STEP 15** It is recommended that the following "Cal Values" be noted for future reference since they may have changed from those noted on the factory test data sheet: [HOME,MORE,CONFIGURATION C,A]

- FORWARD FACTOR
- IPA FACTOR
- EXC FACTOR
- CAL FREQUENCY
- CAL APC FACTOR

Forward power calibration is now complete.

5.12 Reflected Power Calibration

This procedure can be done using the forward power reading on the transmitter. If the forward power also needs to be calibrated, then an external meter will have to be used.

- STEP 1** Shut the transmitter off. Turn R128 on the Life Support Board maximum CCW. This reduces the VSWR sensitivity to minimum.
- STEP 2** On the Diagnostics Display, check the VSWR fault and foldback settings. Press [HOME, MORE, CONFIGURATION B,D,C,C]. This is the screen used to set the VSWR Fault level. It should read 1.50. If so, press [BACK]. If not, use the ABCD keys to set it to 1.50. Once it is set press [BACK] and the screen information will be saved.
- STEP 3** Press [D], to go to the VSWR Foldback screen. Set the VSWR FOLDBACK to 1.49. Press [BACK] to save the settings.
- STEP 4** Press [HOME, MORE, CONFIGURATION C,A,B]. Set the value of "REFLECT FACTOR" to **0.000306**, see Figure 5-7. To access the edit controls for the screen press and hold the [D] and then press the [C] button. Press [BACK] to save changes.

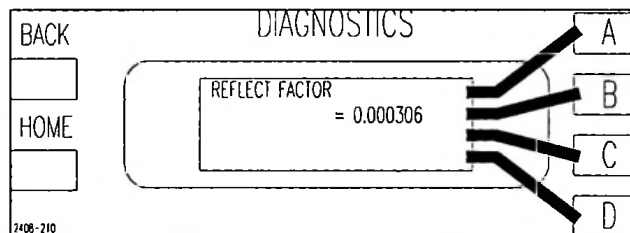


Figure 5-7 Reflected Calibration Factor Screen
[HOME, MORE, CONFIGURATION C,A,B]

- STEP 5** Open the back of the transmitter and locate the Reflected power directional coupler (it should be the one on the left side). It is marked with a small tag. If necessary trace the wire numbers to determine the correct coupler. Be very careful to keep track of the top to bottom orientation. Loosen the 2 clamps until the Reflected Coupler can be taken off. Now rotate the coupler 180° and re-install it. This lets the coupler sense forward power. Be sure to push the clamps as far toward the outside edge as possible and do not over-tighten. Also make sure the BNC cable is attached.

- STEP 6** Press the HIGH ON button and then quickly press and hold the LOWER button for 10 seconds. This will turn the transmitter on at zero power output.
- STEP 7** Raise the transmitter power very slowly until the **Forward Power** meter reading is 150 watts (or 00.15 kW). If Forward Power is not yet calibrated, then an external meter will have to be used.
- STEP 8** Press [HOME, MORE, CONFIGURATION C,B]. You should now be at the screen shown in Figure 5-8, A/D RFL PWR. Re-adjust R128 until the A/D RFL PWR reading is 700. Go slowly, the adjustment is sensitive.

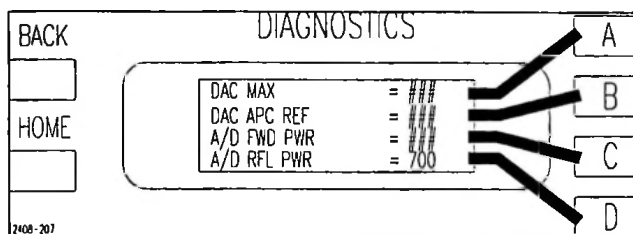


Figure 5-8 A/D RFL PWR Screen
[HOME, MORE, CONFIGURATION C,B]

- STEP 9** Set the Transmitter LCD meter (the right-hand display) to read RFL PWR in kW. If it reads VSWR press and hold the button for about 5 seconds and it will change to kW.
- STEP 10** Press [HOME, MORE, CONFIGURATION C,D]. This will take you to the Reflected Power Cal screen and should look like Figure 5-9. Set this screen to 00.15kW. **Press and hold [D] and then press [BACK] to calibrate the reflected power meter to 150 watts and save the information.** The display will flash “Calibration Done” very quickly at the bottom of the Diagnostics Display.

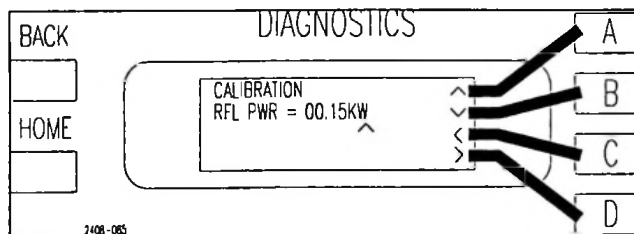


Figure 5-9 Reflected Power Calibration Screen
[HOME, MORE, CONFIGURATION C,D]

- STEP 11** Shut the transmitter off and return the Reflected Power Directional Coupler back to its normal position.
- STEP 12** Press [HOME, MORE, CONFIGURATION B,D,C,D]. This takes you to the Foldback Set screen. Set the VSWR FOLDBACK to 1.35 and press [BACK] to save the setting.
- STEP 13** Turn the transmitter back on and press the RAISE button on the front panel until you have 100% or nominal station TPO.
- STEP 14** It is recommended that the following Cal Value be noted for future reference since it may have changed from the reading in the factory test data:
- REFLECT FACTOR from Figure 5-7 on page 5-14.

Reflected power calibration is now complete.

5.13 PC Board Replacement Procedures



WARNING:

BE SURE TO USE AN ANTI-STATIC WRIST STRAP WHEN HANDLING PC BOARDS OR IC'S TO PREVENT DAMAGE TO THE COMPONENTS.

5.13.1 Replacement of the Life Support Board

If the Life Support Board is replaced, the following procedure should be performed.

- STEP 1** Turn off the transmitter and remove all power at the wall breaker.
- STEP 2** Remove the two screws holding the controller assembly in place and slide it out. It will come almost all of the way out before catching and will then drop down in the front to about a 30 degree angle. Then remove bracket across the boards.
- STEP 3** Set all jumpers on the new Life Support Board to the same locations as the board to be replaced. There are only 3 jumpers on the Life Support Board. JP1 and JP2 select the main and alternate exciter mute as active HIGH or LOW. Table 2-2 on page 2-30 shows the proper settings for a Harris exciter. JP3 should be set from pins 1-2 for a Z5.
- STEP 4** Be careful to mark and note where all cables connect to the defective Life Support Board before removing. External Interlock and Failsafe could also be connected to this board at J4.

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- STEP 5** Install the new Life Support Board, and reconnect all wires and cables. Be very careful not to bend the PC board when installing any wires into the Wago block on the rear of the card. The card should be supported from the back side due to the pressure required to open the Terminals.
- STEP 6** Turn on the AC at the wall breaker but do not turn the transmitter on yet. Make sure CB1, the circuit breaker in the rear of the transmitter is also turned on.
- STEP 7** Setting the +5V REF - with a digital voltmeter, check TP4, the +5V REF(reference). The voltage should be 5.00V, +/- 0.01V. If not, adjust R28 to make it so.
- STEP 8** IPA Current Fault Adjustment - this adjustment only affects operation in Life Support Mode. Adjust R23 on the Life Support Board for 2.9Vdc at U3-7. This sets the fault threshold to 10.0 amps of IPA current.
- STEP 9** RFL PWR Overload Adjust - this adjustment only affects operation in Life Support Mode. Adjust R24 on the Life Support Board for 2.1Vdc at U3-5. This sets the fault threshold to 150 Watts of reflected power when Life Support Mode is active.
- STEP 10** Set R127 Maximum CW. This sets power output at a minimum.
- STEP 11** Set R128 Maximum CCW. This reduces the sensitivity of the VSWR circuit.
- STEP 12** Set R25 Maximum CCW.

⚠ WARNING:
TURNING R128 MAXIMUM CCW DEFEATS THE VSWR PROTECTION. THE REFLECTED POWER CALIBRATION SHOULD THEREFORE BE DONE FIRST TO PREVENT DAMAGE TO THE TRANSMITTER (TRANSMITTER POWER IS ONLY RAISED TO 150 WATTS FOR THE REFLECTED POWER CALIBRATION).

- STEP 13** Power Calibration - complete the Reflected Power Calibration and then the Forward Power Calibration procedures located earlier in this section then return here to finish replacement of the Life Support Board.
- STEP 14** Set switch S1-9 on the Master Controller to the ON position to place the transmitter in Life Support Mode (the fan will switch to high speed). Adjust R25, Manual PWR Reference on the Life Support Board for 1.25kW on the external meter. Switch S1-9 to OFF and the transmitter should return to your normal TPO. It may be necessary to raise or lower power slightly.

5.13.2 Replacing the Power Supply Controller Board

Replacement of a PS Controller Board requires no analog adjustments. Set all dip switches and jumpers to the same position as the board being replaced. If the new board does not have the firmware IC's already installed, then the firmware will have to be transferred from the old board. Refer to "5.15 Removing/Replacing Firmware ICs" on page 5-24.

The following is a listing of the normal dipswitch and jumper settings:

- a. For PSC #1 - All switches OFF
- b. For PSC #2 - S1-1 ON, all other switches OFF (PSC #2 is optional in a Z5)
- c. JP1 pins 1-2
- d. JP2 pins 1-2

5.13.3 Replacing a PA Controller Board

Replacement of a PA Controller Board requires no analog adjustments. Set all dip switches and jumpers to the same position as the board being replaced. If the new board does not have the firmware IC's already installed, then the firmware will have to be transferred from the old board. Refer to "Removing/Replacing Firmware IC's" later in this section. The following is a listing of the normal dipswitch settings for S1 on each PA Controller:

- a. For PAC #1 - All S1 switches OFF.
- b. For PAC #2 - S1-1 = ON, all other switches OFF.

⇒ NOTE:

The switches set the board ID #. Once the ID for the board has been set, it must be placed in the proper slot and the correct cables connected to that # controller. An improper ID or incorrect cabling will generate cable or jumper faults in the Fault Log and the transmitter will not turn on.

5.13.4 Replacing the Master Controller Board

In the unlikely event that the Master Controller Board needs to be replaced, there are two possible scenarios:

- a. Replacement using EEPROM U39 from the old board. This procedure should be tried first.
- b. Replacement when using a New EEPROM U39.

In either case, the Firmware IC's U18 and U28 will have to be transferred from the old board or be replaced with new. EEPROM U39 contains all of the configuration and calibration settings for the transmitter including configuration, software calibration settings, power levels and fault limits etc.

5.13.4.1 Replacement Using EEPROM U39 From Old Board

If the Master Controller needs to be replaced, but EEPROM U39 can be swapped from the old board, then proceed as follows:

- STEP 1** Shut the transmitter off and remove AC power from the transmitter.
- STEP 2** Remove the defective Master Controller Board.
- STEP 3** Carefully remove U39 from the new Master Controller Board and replace with the EEPROM from the defective Master.
- STEP 4** To transfer the Firmware IC's from the old board to the new one or to simply install new firmware refer to "5.15 Removing/Replacing Firmware ICs" on page 5-24, then return here.
- STEP 5** Set all dip switches on the new board according to the list below. Typical settings are:
 - **S1-1 thru S1-4** - Customer set RS232 ID
 - **S1-5 ON** for U39 model 25040 and Firmware part # 917-2435-203, revision "AA" or later Master Controller code (**S1-5 set to OFF** for use with U39 model 25C04 and any part number firmware).
 - **S1-6 thru S1-8 OFF** (Factory use only)
 - **S1-9 OFF** (ON = Microcontroller RESET)
 - **S1-10 ON** (APC ON)
- STEP 6** Install the new Master Controller Board and apply AC power to the transmitter. It is a good idea to verify the transmitter configuration settings in the Diagnostics Display.

⇒ NOTE:

To verify the most important configuration parameters, follow the steps listed under "5.14.1 Configuration" on page 5-22, before continuing.

STEP 7 Turn the transmitter on and check the calibration. If the transmitter calibration and configuration seem to be okay, then this procedure is finished. If it is still not working, U39 will have to be replaced using the following procedure "Replacing EEPROM U39".

5.13.5 Replacing EEPROM U39

If it is necessary to replace EEPROM U39, with the old Master Controller or with a new Master Controller, the "5.14 System Configuration and Calibration" on page 5-22 procedure will have to be performed. However, since a new EEPROM is being installed a few preliminary steps will have to be done first:



WARNING:

BE SURE TO USE AN ANTI-STATIC WRIST STRAP WHEN HANDLING PC BOARDS OR IC'S TO PREVENT DAMAGE TO THE COMPONENTS.

- STEP 1** Shut the transmitter off and remove AC power from the transmitter.
- STEP 2** Remove the Master Controller Board. If only the EEPROM U39 is being replaced then exchange U39 with the new one, re-install the Master Controller Board and skip to STEP 6. If the Master Controller Board is also being replaced then proceed with STEP 3.
- STEP 3** Install the new U39 in the new Master Controller Board.
- STEP 4** To transfer the Firmware ICs from the old board to the new one or to simply install new firmware refer to "5.15 Removing/Replacing Firmware ICs" on page 5-24, then return here.
- STEP 5** Set all dip switches on the new board according to the list below and install the Master Controller Board. Typical settings are:
- **S1-1 thru S1-4** - Customer set RS232 ID
 - **S1-5 ON** for U39 model 25040 and Firmware part # 917-2435-203, revision "AA" or later Master Controller code (**S1-5 set to OFF** for use with U39 model 25C04 and any part number firmware).
 - **S1-6 thru S1-8 OFF** (Factory use only)
 - **S1-9 OFF** (ON = Microcontroller RESET)
 - **S1-10 ON** (APC ON)
- STEP 6** Turn on the Low Voltage breaker in the rear of the transmitter. If the EEPROM is blank, the Fault Log will register EEPROM_DEF which means it loaded the default settings for the EEPROM (shown in Table 5-1). Reset the fault Log.

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- STEP 7** All of the parameters in Table 5-1 are editable from the Diagnostics Display and should be set to the values listed on the Factory test Data sheet not necessarily the default values listed. If the Factory Test Data is not available or you are not sure that the values in the Factory Test Data are still valid then verify, and where necessary, change the values to those listed in Table 5-1. (To edit any of these screens, press and hold [D] and then press [C]. The edit controls should appear on the screen).
- STEP 8** Press the HIGH ON button and then quickly press and hold the LOWER button for 10 seconds. This will turn the transmitter on at zero power output.
- STEP 9** Proceed to "5.14 System Configuration and Calibration" on page 5-22.

Table 5-1 EEPROM U39 Parameter Checklist

Platinum Z5	
Parameter	Default Settings
Forward Factor	0.007697 (see Figure 5-3)
Reflect Factor	0.000306 (see Figure 5-7)
IPA Factor	200
Exciter Factor	200
CAL Frequency	Set to your frequency (Default = 98MHz)
Operating Frequency	Set to your frequency (Default = 98MHz)
Cal APC Factor	07.58 (see Figure 5-4)
100% TPO Set	5.00kW
Max High Set	6.00kW
Max Low Set	2.50kW
UPS Setting	2.50kW
Low Power Alarm	4.50kW
VSWR Foldback	1.35
VSWR Fault	1.50
NOTE: Set to Factory Test Data numbers if available	

5.14 System Configuration and Calibration

System configuration and calibration is mainly for setting the transmitter up for the first time by factory personnel. The procedures contained here should NOT be done as part of a routine maintenance or adjustment schedule. The following procedure should only be done if EEPROM U39 on the Master Controller Board is bad or suspect (EEPROM U39 is the memory chip which contains all of the Backup and Customer configuration and calibration settings). Replacement of the Master Controller Board can be accomplished by swapping U39 from the old board to the new one. See "5.13.4 Replacing the Master Controller Board" on page 5-19. The procedure will be broken up into two sections:

- a. Configuration
- b. Calibration

5.14.1 Configuration

The transmitter should be turned off, but with AC power applied from the wall breaker. The REMOTE DISABLED LED should be lit on the front panel of the transmitter. For the following setup refer to the Diagnostics Display Menu Tree for more details of how to get to System Calibration and Setup screens referred to below.

⇒ NOTE:

For the following procedures do not press [HOME] or [BACK] unless specifically told to do so.

STEP 1 Press [HOME, MORE, CONFIGURATION A] From here the following System choices need to be made:

- a. ALTERNATE EXCITER - Yes or No ("Yes" if there is an second alternate Exciter in the transmitter).
- b. INTLK LOG - ON or OFF (ON if you want interlock faults to be entered into the Diagnostics Display Fault Log, OFF if you do not want the interlock faults entered into the Fault Log). Combined transmitters should be set to OFF, while single transmitter installations should be set to ON. This can be changed later if so desired.
- c. PSC Number - Number of Power Supply Controllers - 1 or 2. This is normally 1 for a Z5.

STEP 2 Press [MORE] and then continue below.

- a. AC PHASE - Select "1" phase or "3" phase to match your transmitter power supply configuration.

b. UPS/EXCITER - This is the configurable remote input at TB1-9. Set for UPS if the low power UPS mode is to be used, or to EXC if it is going to be used for remote exciter select.

c. FAN SPEED - This should be set to AUTO, otherwise the fan will stay on HIGH speed all the time.

STEP 3 Press [MORE] and then continue below.

a. AUTO MAX EFF - Should be set to ON for normal operation. This allows the transmitter to automatically optimize its efficiency every 12 hours as long as there are no faults. Can be set to OFF if this function is not desired. Manual optimization is still possible in either case.

STEP 4 Press [BACK] then press [B] POWER SET and setup the following screens:

a. 100% TPO SET. In this screen you will set the power in kW which is to be displayed as 100% on the FWD PWR meter. (Default is 05.00KW).

b. MAX HIGH SET. This screen will let you set the upper limit the transmitter will be allowed to go to in the High Mode of operation. (120% TPO or 06.00KW is the MAX setting).

c. MAX LOW SET. This screen will let you set the upper limit the transmitter will be allowed to go to in the Low Mode operation. (Default is 50% TPO or 2.50KW). When finished press [BACK] to update.

d. Press [D,A], UPS SET. This screen will let you set the power output the transmitter will go to in the UPS Mode. (Default is 1KW). When finished press [BACK] to update.

e. Press [B], Low Power Alarm. This screen lets you set the power level at which the remote low power alarm is triggered. The default for the low power alarm is 4.50kW. When finished press [BACK] to update.

STEP 5 Press [BACK, D] to go to the FREQUENCY CAL screen and enter the transmitter operating frequency. If the transmitter is to be used in an N + 1 operation then just set to 98.1 MHz. Press [BACK] to update the information.

5.14.2 Calibration

To finish replacing the Master Controller EEPROM U39 a complete calibration is required. To calibrate the transmitter refer to the following procedures in this order:

- "5.12 Reflected Power Calibration" on page 5-14, then
- "5.11 Forward Power Calibration" on page 5-11



WARNING:

REFLECTED POWER CALIBRATION SHOULD BE COMPLETED FIRST TO PROVIDE VSWR PROTECTION DURING THE FORWARD POWER CALIBRATION PROCEDURE. THIS REQUIRES THE USE OF AN EXTERNAL WATT METER CAPABLE OF READING 150 WATTS.

5.15 Removing/Replacing Firmware ICs

Each of the controller boards, with the exception of the Life Support Board, have 2 Firmware IC's which contain the software for the microcontrollers. It is possible that these may need to be replaced as part of a firmware upgrade, or they may need to be transferred from a defective controller board to a new one. Each of these IC's has a printed label on top which gives:

- a. The part number of the software.
- b. The revision number for the software.
- c. A U## component designator to locate the correct socket on the board. The following is a list of the component designators for each of the Firmware IC's:
 1. Master Controller - U18 and U28
 2. PA Controllers - U23 and U30
 3. PS Controller - U5 and U8



WARNING:

BE SURE TO USE AN ANTI-STATIC WRIST STRAP WHEN HANDLING PC BOARDS OR IC'S TO PREVENT DAMAGE TO THE COMPONENTS.

Firmware IC removal:

- Shut off the Low Voltage breaker in the back of the transmitter.
- Pull out the controller and remove the pc board hold-down bracket.
- It will be necessary to remove the appropriate PC board and place it on an anti-static work surface (a large anti-static bag works well if an anti-static mat is not available). PA and PS controllers have cables attached at the rear of the card which need to be noted and then removed.
- Note that the PA Controllers 1 and 2 have an ID setting which means they must be placed back in the same slot from which they were removed.
- Before removal, notice that the IC has one corner which is beveled and the IC socket has a pointer etched in the top which is pointing to the beveled corner. See Figure 5-10.
- The manufacturers do make a special extraction tool for these type of IC's but it has been found that a sharp meter lead or ice pick actually works better for extracting them. Place the sharp tool point into one of the slots at the corners of the IC pry it up just a little. Then move to the opposite corner and pry it up a little. Work back and forth from one corner to the other until the IC comes out.
- If the IC is going to be re-installed and you need to set it down, make sure it is placed on an anti-static mat or in an anti-static bag.

Firmware IC Installation:

- To install the firmware IC's, you first need to match the U## component designator printed on the IC label with the proper socket on the board (the socket has a label printed on the board). For example U18 and U28 are for the Master Controller and must be placed in the correct socket.
- To install the IC, simply place the chip over the socket with the beveled edge oriented correctly and press it in with your thumb. Be sure to press evenly across the top of the IC.

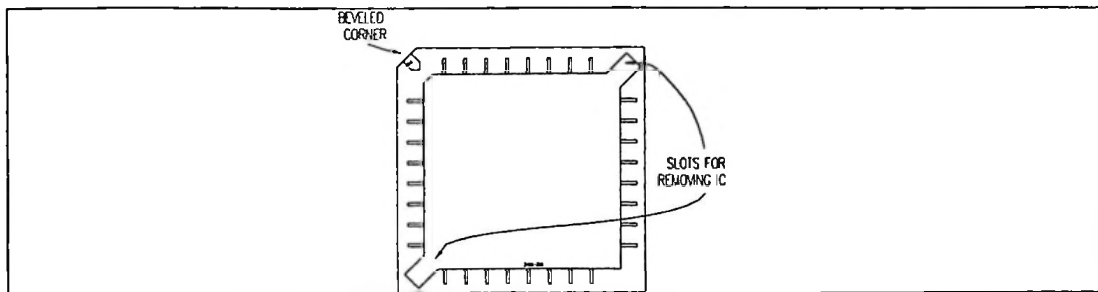


Figure 5-10 Top View of Firmware IC Socket

Maintenance and Alignment

Table 5-2 Z5 Minimum Recommended Transmitter Log Readings

Primary Front Panel Readings

Forward Power: _____ Watts
 Reflected Power: _____ Watts
 PA Amps: _____ Amps
 PA Volts: _____ Volts
 APC Voltage: _____ Volts

Exciter Readings

Exciter Forward Power: _____ Watts
 Exciter Reflected Power: _____ Watts
 Exciter PA Amps: _____ Amps
 Exciter PA Volts: _____ Volts

Power Amplifier Currents

Amplifier	1	2	3	4	5	6	7	8
Z-Plane A								
Z-Plane B								

Power Amplifier Temperatures in °C

Amplifier	1	2	3	4	5	6	7	8
Z-Plane A								
Z-Plane B								

PA Isolation Resistor Temperatures in °C

Amplifier	1	2	3	4	5	6	7	8
Z-Plane A								
Z-Plane B								

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System Level Isolation Load Resistor Temperatures in °C

ISO AZ: _____ C ISO AB: _____ C
 ISO BZ: _____ C

Voltages	Power Supply Tap Status	Currents	Temperatures
PS1: _____ Volts	PS1 TAP: _____ ON	PS1: Idc _____ Amps	PS1: _____ °C
PS2: _____ Volts	PS2 TAP: _____ ON	PS2: Idc _____ Amps	PS2: _____ °C
IPA: _____ Volts		IPA:AB: _____ Amps	IPA:AB1: _____ °C
APC REF: _____ Volts			IPA:AB2: _____ °C
APC MAX: _____ Volts			AMBIENT: _____ °C

System Foldback Status

PA: _____ ISO TEMP: _____ PS VOLTAGE: _____ AIR FLOW: _____ %
 IPA: _____ VSWR: _____ DIV ISO TEMP: _____

Troubleshooting

6

6.1 Introduction

In order to assist in the troubleshooting of the Platinum Z5 transmitter this section will concentrate in the following areas:

- Using the Diagnostics Display System, concentrating on the Fault Log.
- Defining all of the transmitter fault indications, their origin, and their effect on the transmitter.

In the technicians favor is the fact that the Platinum Z5 transmitter has relatively few individual parts due to the modular design. The basic philosophy behind the design is to allow exchange of and/or replacement of relatively inexpensive modular components when a failure does occur, rather than troubleshooting down to the component level. This is not to say that component level troubleshooting is not an option. But due to the complexity of the circuitry and the use of surface mount components, especially in the controller boards, (which are multi-layer boards as well), troubleshooting and field replacement can be very difficult. It is relatively easy to damage these boards with improper equipment and soldering techniques due to the size of the components, traces and soldering pads.

There are only 6 analog adjustments in the transmitter and control system, with most of them being factory, one-time, adjustments. This all but eliminates mis-adjustment as a cause of failure. The controller itself is also modular, using at least 5 separate boards, with its own self diagnostics for communications between the microprocessors and read/write tests for the on board memory. There is also the redundancy factor provided by the Life Support Board, which will operate the transmitter at a reduced power level if the Master Controller fails.

6.2 Power Amplifier Repair

Field replacement of the MOSFETs on the PAs should NOT be attempted. To repair a PA requires an extensive amount of test equipment and expertise due to the tight tolerances allowed for calibration of the test equipment setup and especially for phase and gain of the PA.

As an additional consideration, please observe the following warning from the MOSFET manufacturer regarding beryllium oxide.



WARNING:

PRODUCT AND ENVIRONMENTAL SAFETY-TOXIC MATERIALS THIS PRODUCT CONTAINS BERYLLIUM OXIDE. THE PRODUCT IS ENTIRELY SAFE PROVIDED THAT THE BEO DISC IS NOT DAMAGED. ALL PERSONS WHO HANDLE, USE OR DISPOSE OF THIS PRODUCT SHOULD BE AWARE OF ITS NATURE AND OF THE NECESSARY SAFETY PRECAUTIONS. AFTER USE, DISPOSE OF AS CHEMICAL OR SPECIAL WASTE ACCORDING TO THE REGULATIONS APPLYING AT THE LOCATION OF THE USER. IT MUST NEVER BE THROWN OUT WITH THE GENERAL OR DOMESTIC WASTE.

Defective PAs should be exchanged by contacting the Harris, Service Parts Department (available 24 hours a day 7 days a week).

6.2.1 Transmitter Power vs. Module Failures

Table 6-1 lists the typical best case and worst case power levels for the Z5 transmitter due to loss of PAs, removal of PA Modules (2 PAs) or the loss of a PA controller or Power supply. These power levels are due to either calculated or actual foldback conditions and may vary quite a bit due to individual operating conditions.



NOTE:

These are typical power levels operating into a dummy load with minimal VSWR and low ambient temperature. These power levels are not guaranteed and are given merely as an approximate guideline to aid in troubleshooting.

Table 6-1 Transmitter Power vs. Failure Modes

Platinum Z5		
	Best Case Power Out	Worst Case Power Out
1 PA Failed	100%	100%
2 PA Failed	100%	75%
1 Module Removed	95%	95%
2 Modules Removed	75%	40%
*1 Power Supply Failed	20%	20%
*1 PA Controller Failed	20%	20%
*Loss of a PA Controller or Power Supply represents an equivalent loss of 8 of the 16 PAs.		

6.2.2 Multiple PA Failures in a Foursome

If 2 PAs were to fail in a single group of four or Foursome, the resulting system imbalance would result in a power foldback to one of the Worst Case conditions as stated in the table above. Since a single PA failure in a foursome does not create a severe imbalance, one of the PA modules with a bad PA should be taken out, turned over and re-inserted, placing the bad PA in a different foursome until there is sufficient time to replace the failed PA. For example, if PA amplifiers B1 and B2 have failed, pull out the A2/B2 PA module, turn it over and plug it back in so that the bad PA is in position A2 instead of B2. There are still 2 failed PAs, B1 and A2, but now each one is in a different foursome. This will restore balance to the system and the transmitter will still be able to operate at near full power output by automatically increasing the drive to the remaining PAs (via the APC voltage). For more information on Foursomes refer to Section IV, Overall System Theory, under the heading "8-Way Combiner".

For quick reference, the foursome groupings are as follows:

See Figure 4-5 and Figure 4-6 on page 4-12.

- A1, A2, A3 and A4 - Front, Z-Plane A
- B1, B2, B3 and B4 - Front, Z-Plane B
- A5, A6, A7 and A8 - Rear, Z-Plane A
- B5, B6, B7 and B8 - Rear, Z-Plane B

6.3 Software Revision

Each of the controller boards contains its own software (actually firmware) and therefore each controller has its own software revision number or letter. It is possible to get the revision numbers from the Diagnostics Display Menu labeled, "SOFTWARE REV." To check the software revisions press [MORE SOFTWARE REV]. This will bring up the screen shown in Figure 6-1. The Firmware part number is printed on a label attached to the ICs on the individual controller boards. Before calling Harris Technical Support personnel it is a good idea to get the software part number and revisions for each of the controller boards.

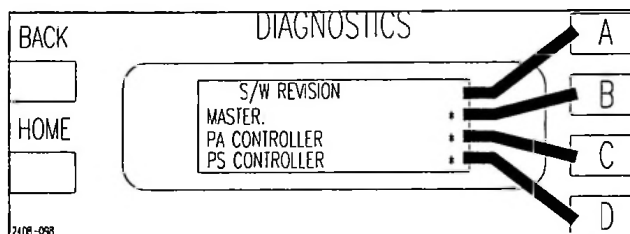


Figure 6-1 Software Revision Screen

6.4 System Reset - TX_RESTART

Pressing the ON (LOW or HIGH) button on the transmitter will issue the TX_RESTART command and try to return the transmitter to normal operation after any fault has occurred. Note that this will not reset, or erase any of the faults stored in the Fault Log in the Diagnostics Menu. Take the example of a failed and switched out PA. The controller writes to memory the fact that the PA has failed and will not try to turn it on again. To get the control system to try the PA again simply press the ON (LOW or HIGH) button. The data concerning the failed PA will be reset and the controller will try to operate normally, turning the previously defective PA on with all of the rest of the PAs. Naturally, if it still has a problem it will be switched out again. However, if the PA is fixed and re-installed, the controller will automatically activate the PA.

6.4.1 3 Strike Routine

There are 4 faults in the transmitter that will initiate what is called a 3 strike routine. They are:

- **RFL_PWR** - VSWR greater than 1.5:1
- **ISO_AB_OT** - The predicted temperature of the 5kW hybrid reject load is greater than 130°C.

Troubleshooting

- **ISO_AZ_OT** - The predicted temperature of R9 on the "A" Z-Plane Isolation board is greater than 130°C.
- **ISO_BZ_OT** - The predicted temperature of R9 on the "B" Z-Plane Isolation board is greater than 130°C.
- **Strike 1** - When any of the above fault conditions is met, the transmitter output is muted (DAC_APC_REF is brought to zero) for 3 seconds (6 seconds for transmitters with a Single Phase power supply). At the end of the 3 (or 6) seconds the transmitter power is slowly ramped back up and a 10 second timer is started.
- **Strike 2** - If another fault is detected before the 10 seconds is up, the transmitter will again mute for 3 (or 6) seconds, start the 10 second timer again and slowly ramp the power up again.
- **Strike 3** - A third fault detected within this 10 seconds will cause the transmitter to be muted until the operator gives the transmitter an ON command (High or Low), locally or by remote. If the cause of the fault is still present, the transmitter will simply repeat the 3 strikes and mute again.

⇒ **NOTE:**

If no faults occur during either of the 10 second time periods, then the strike counter is reset and will allow 3 more strikes before muting the transmitter.

The slow ramp up in power after a strike should allow the foldback controls to limit the transmitter power output before the fault thresholds are reached again. The slow power ramps are designed to allow the transmitter to operate at the maximum possible power level without over-dissipating the isolation resistors or exposing the transmitter to excessive reflected power. This would mean that there would be a fault in the log but it would be inactive and the transmitter would be in a foldback condition.

6.5 Diagnostics Display Menu Tree

The most important documentation concerning the Diagnostics Display is the “Diagnostics Display Menu Tree” located in the schematic drawing package. This shows the complete Diagnostics Display menu structure. The menus flow from the Main Menu at the left (on each sheet) up to 6 layers deep to the right. Due to the number of menu screens, the drawing is divided by main menu items into 3 drawings.

- Page 1 is **Status**
- Page 2 is **Metering and Faults**
- Page 3 is **Configuration, Test and Software Revision.**

It greatly simplifies the display by letting you see the entire tree with all of the screens, guiding you to the screen you want. The only thing missing is the 6 control buttons, HOME and BACK on the left side of the display and ABCD to the right. To avoid confusion, every line from one screen to the next is labelled A, B, C or D where it leaves a screen, to correspond with the keypress required on the actual display. The function and use of the buttons is very straight forward. However, an explanation is given in Section III, Operation, for these and all other front panel transmitter controls.

6.6 Fault Log

The Fault Log is in the “FAULT” menu of the Diagnostics Display. To access the Fault Log press [Fault, D]. This should bring up the screen shown in Figure 6-2. This screen shows the latest of a possible 32 faults (the maximum number of faults which can be stored in the log) as designated by “LOG No. 1 : N”, where N would be the total number of faults present. “Type” gives the name of the fault. “Time” gives the elapsed time since the fault occurred, not the actual time at which it occurred. “Status” tells you whether the fault is active or non-active. Pressing A or PREV (Previous), will take you to the next fault in the log.

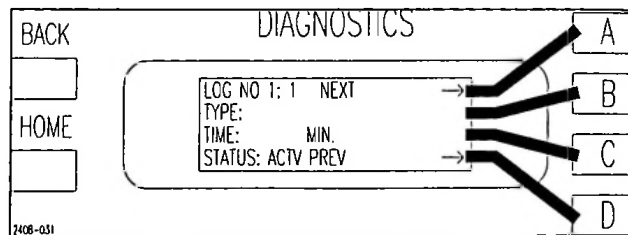


Figure 6-2 Fault Log

6.6.1 Front Panel Fault LED

When a fault is detected the Fault LED on the front panel of the controller will illuminate a steady red as long as there is an active fault. If there are faults in the log, but none are active, the Fault LED will flash to alert the technician to check the Fault Log.

6.6.2 Fault Reset

Press [HOME, FAULT C]. This screen, shown in Figure 6-3, allows access to the Fault Reset. Note the warning asking if you really want to erase the faults in the log, just in case this screen was reached by accident. Pressing YES [D] will erase any of the faults in the Fault Log which are inactive (an active fault cannot be erased). Pressing NO [C] will simply take you back to the previous MENU without erasing the fault log.

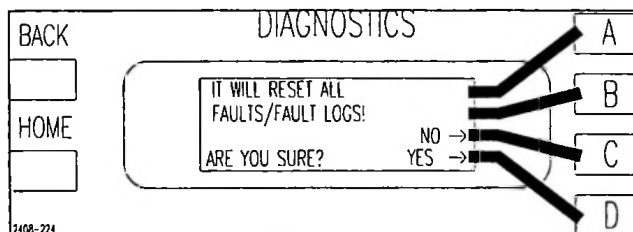


Figure 6-3 Fault Reset Screen

6.6.3 Abbreviations Used In Fault Reporting

The following is a listing of abbreviations used in the Fault Log.

- AMB - Ambient
- INTLK - Interlock
- RFL - Reflected
- FLT - Fault
- REF - Reference Voltage
- CPLR - Directional Coupler
- NC - Not Connected
- IPA_AB - IPA for Z-Planes A&B
- OT - Over-Temperature
- OC - Over-Current
- UC - Under-Current

- PAC - Power Amplifier Controller
- COMM - Communications
- XOVER - Crossover Protection: One PA Controller crosses over to protect the PAs controlled by the other PA Controller, should it become inoperative.
- PSC - Power Supply Controller
- PS# - Power Supply # (PS1 or PS2)
- DSCHG - Discharge
- Start - Soft Start
- HS - Heat Sink
- PHS_LS - Phase Loss
- OV - Over Voltage
- UV - Under Voltage
- TAP# - Power Supply SCR TAP# (TAP1, TAP2, TAP3, or TAP4)

6.6.4 Fault Listing

Table 6-3, Table 6-4, and Table 6-5 provide a quick reference, containing a complete listing of all of the faults which can show up on the Diagnostics Display Menu, including their effect on transmitter operation and a brief comment explaining the fault.

- Table 6-3 on page 6-35 includes faults that are associated with the Master Controller Board (which includes the IPA).
- Table 6-4 on page 6-37 includes faults that are associated with the PA Controller Boards, PAs and ISO Loads.
- Table 6-5 on page 6-39 includes faults that are associated with the PS Controller Board and the power supply itself.

These tables are meant as a summary and quick reference point. The rest of this section will be dedicated to giving detailed information on each of these faults.

6.7 Self Diagnostics

The Z Series transmitter is equipped with a set of TEST menus for testing various internal systems. To access the TEST menus press [MORE, TEST]. This brings you to the screen in Figure 6-4. This screen gives you 2 choices:

- SYSTEM TEST
- CONTROL HARDWARE

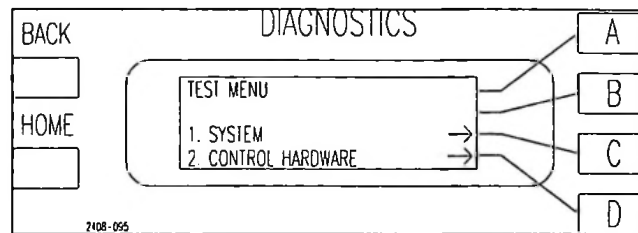


Figure 6-4 Diagnostic Test Menu

6.7.1 System Test

The purpose of the SYSTEM test is to check the combiner integrity, cabling and configuration. The length of time required for the SYSTEM test will be indicated on the display (about 8 minutes). The test will reduce the transmitter power to 40% of nameplate TPO (2kW) and will be going through a MUTE cycle for each of the 16 PAs. **The antenna VSWR must be 1.2:1 or less with no faults present in order to run the test.** If the VSWR is too high the test will be aborted. The abort screen will read VSWR high, but nothing will be reported in the Fault Log. During the test the HIGH ON and LOW ON buttons will not work. The test can be started at any time and any power level above 50%. If a fault is detected during the test it will be aborted and the fault will be noted in the Fault Log. Also the user can abort the test at any time by pressing the OFF button or via the test screen on the Diagnostics Display. The results of the test will be either Aborted, Failed or Passed. If the test fails, check the Fault Log to find out why.

To run the SYSTEM test press [MORE TEST C]. This will bring up the screen in Figure 6-5. Press [D] to run the test or [C] to go back to the previous menu.

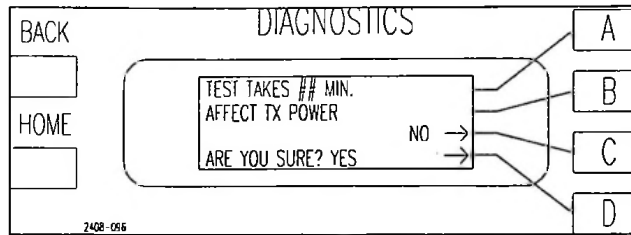


Figure 6-5 System Test Screen

⇒ NOTE:

Due to operational variables, it is possible to get false indications which place a fault in the log and abort the test. If the System Test fails, note the fault in the Fault Log, clear the fault log, and run the test again to verify the problem.

This test should be used as part of a routine maintenance program at least once a year. It should also be done if major combiner components are removed and/or replaced, such as a Z-Plane or Isolation Board or if cabling is disconnected and re-connected to the Z-Planes or Isolation Boards.

The following sequence of tests make up the SYSTEM TEST:

- PA Muting Test
- PA ISO Resistor and Thermistor Test
- PA RF Switch Test

6.7.1.1 PA Muting Test

Each PA will be muted for 1 second, one at a time. The controller then checks the current draw of each PA, which should be close to zero. If it finds a PA that is drawing too much current while it is supposed to be muted it will abort the test and report an A#_MUTE_FLT or B#_MUTE_FLT. For more information refer to PA MUTE Faults later in this Section.

6.7.1.2 PA_ISO Resistor and Thermistor Test

If the PA Muting Test is passed, the PA_ISO resistors and thermistors will be checked. The first two tests are actually done at the same time. With the PA muted, the ISO resistor temperature for that PA should increase within a few seconds. If it does not the test will be aborted and an A#_ISO_LOW or B#_ISO_LOW will be reported to the Fault Log. This could indicate one of four main possibilities.

- a. The most likely problem is a defective PA RF Switch on an Isolation Board (K1-K8). The PA RF switch could simply have bad or open contacts which would disconnect the resistor from the PA. The PA would operate normally as long as the system is balanced, but the resistor would not heat up when the PA is muted. To replace the switches will require removing the associated isolation board from the transmitter. See Table 4-1 on page 4-60, to cross reference the PA number to the specific Isolation switch. For example; the test aborts and reports B2_ISO_LOW to the fault log. Follow B2 across Table 4-1 and it says that the Related RF Switch is K6 and the Related Isolation Resistor is RT6 on the Isolation Board attached to Z-Plane B.
- b. The PA RF switch could be stuck in the energized position. In this position the ISO resistor is open and does not draw any current. However, if this is the problem, the PA may be failed since the switch is grounding the its output. A normal PA current would rule this out.
- c. The ISO resistor is open which means it would not draw any current and would not get hot. These resistors are 50 ohms @ 12W and are located on the Isolation Boards (RT1-RT8).
- d. The thermistor has come loose from the resistor. Each thermistor is attached to the resistor which a high temp epoxy. If this has come loose the thermistor would not heat up as it should. With the transmitter on and operating normally, check the ISO temperature of the PA reported as bad and see if it is approximately the same as the others on that Z-Plane.

6.7.1.3 PA RF Switch Test

If it passes the previous tests, then the PA RF switches will be energized one at a time. If it works as it should, the ISO resistor will not rise in temperature within a 2-20 second window. At the same time the controller is also checking to see how much the system dropped in output power to make sure the combiner is configured properly and that the PA was working in the first place. If either part of the test indicates a problem, it will report an A#_ISO_SW or B#_ISO_SW Fault to the Fault Log and will abort the test.

6.7.2 Hardware Test

The other option in Figure 6-4 is to test the hardware. Pressing [D] should bring up the screen in Figure 6-6. This screen gives 3 more choices:

- a. LCD/LED Test - This is a test of all of the LCD segments and LEDs on the front panel to make sure the overlay indicators are operational. Pressing [B] will activate the test. Press [B] again to shut off the test.
- b. EEPROM TEST - This will test EEPROM U39 on the Master Controller (the only socketed IC on the board). This is where all of the user data and the Factory Default Settings are stored. This test should only be done if there is a problem recalling the Factory Default Settings in the Diagnostics Display or if the Master Controller needs to be replaced. If it fails the test, U39 will have to be replaced and a complete "System Configuration and Calibration" will have to be done per the procedure in Section V.
- c. Main DAC Test - This test should only be done as a last resort in a case where the system control appears erratic. To run the test requires an oscilloscope. It is a test of the main Digital-To-Analog-Converter on the Master Controller Board. To run the test shut the transmitter off and press [MORE, TEST, D,D]. The display will read "Main DAC test is running." With the scope probe, monitor TB1-36 on the Remote Control Terminal strip which is labelled "SPARE OUT" or on the Master Controller Board at U9-14 or either side of R47. There should be a 28Hz sinewave at about 4Vp-p. If the sinewave is present the DAC is working. If not, the Master will have to be replaced per the procedures in Section V. Pressing BACK shuts off the test.

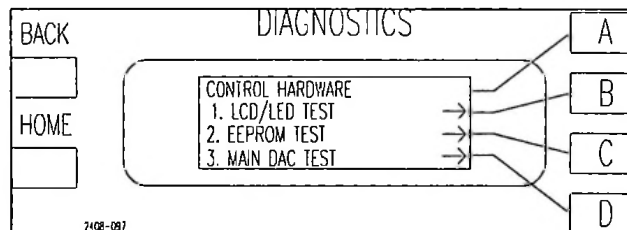


Figure 6-6 Hardware Testing

6.8 General Troubleshooting Tips

6.8.1 Foldback Conditions

The Master Controller is responsible for transmitter power foldback conditions, however a foldback condition by itself will not cause a fault to be registered in the Fault Log. Foldback limits in the transmitter are always set lower than the actual fault limit. This allows the transmitter to stay on the air at some maximum power level without shutting off, but since the actual fault level was not reached, no fault will be logged. If the cause of the foldback goes away the transmitter will return to full power and no indication of a problem will be evident.

If the front panel FOLDBACK LED is illuminated it is possible to check the SYSTEM FOLDBACK screen in the Diagnostics Display under [HOME, STATUS A,B]. This screen shows that there are 3 possible foldback conditions:

- VSWR FOLDBACK YES or NO
- SYSTEM ISO TEMP YES or NO
- IPA FOLDBACK YES or NO

These screens can be extremely helpful in determining where to start looking for the source of the fault. This screen will only show a YES status if the front panel FOLDBACK LED is illuminated.

6.8.2 Turning the Transmitter ON with No Power Output

There are times when it is advantageous to be able to turn the transmitter on with the rf power output at zero watts. This would allow the power to be slowly ramped up for monitoring of temperatures, currents, voltages and VSWR without over-loading and tripping the faults circuits. To do this, press the HIGH or LOW ON button and then quickly press and hold the LOWER button for at least 10 seconds. The transmitter will come on but the output power will be at zero.

6.8.3 Asterisk and Pound Signs(*, #)

The asterisk and the pound sign characters are used in some of the metering menus of the Diagnostics Display. If an asterisk (*) shows up in a metering menu, it means that there is no data being received for that reading. The pound sign will only be used in the Vg (Gate Control Voltage for the individual PAs) menus and signifies that there has been a crossover (this is a condition where one PA Controller crosses over and mutes the PAs associated with another PA Controller).

6.9 Master Controller Related Faults

The following is a listing of the faults which are handled by or merely related to the Master Controller. A quick reference for each of these faults is given in Table 6-3 on page 6-35.

6.9.1 THERMISTOR, Fault

The Thermistor fault is detected if a thermistor temperature reading is 5° C below the ambient temperature, provided the ambient temperature is above 25° C. Can be caused by an actual open thermistor but is more likely an open connection between the thermistor and the controller board monitoring the thermistor.

This fault protects against a thermistor (temperature sensor) circuit being open. The thermistors are used on all amplifiers, iso loads, and the power supplies to sense temperatures and use pull up resistors to +V. As the temperature increases, the resistance of the thermistor goes down, lowering the voltage on a detector input, which gives an increased temperature reading. If the thermistor circuit becomes open, the detector input goes high which gives a cold temperature reading. This leaves the device to which the thermistor is connected, unprotected from an over-temperature condition. Once this fault is detected it will stay active in the log until the Fault Log is reset.

⇒ NOTE:

If one of the thermistors or connecting cables is **shorted**, a temperature fault for the device it is connected to will be registered in the Fault Log, **not** a THERMISTOR fault. A shorted thermistor or cable will give a very hot reading which will not change, about 155° C or higher. If the thermistor for one of the PA ISO resistors has shorted the fault "PA_ISO_OT" is triggered and the transmitter will be shut off (see PA_ISO_OT under PA Controller Faults).

Troubleshooting:

- a. First, locate the problem thermistor by systematically looking at all of the temperature readings. One of them will show a # sign instead of a temperature. The temperatures to look for include:
 1. IPA Temps - IPA_AB1 and IPA_AB2. The thermistor is located on the IPA right next to the FETs.
 2. PA Temps for A1-A8 and B1-B8. The thermistor is located on the PA right next to the FETs.
 3. ISO Resistor Temps for A1-A8 and Az / B1-B8 and Bz. These are all located on the Isolation Boards.

4. System ISO Temp - ISO_AB. Located on the 3dB hybrid which combines the Z-Planes. Is above the PA Modules under the rectangular cover. The sense line (BNC coax) comes out the top of the box.
 5. Power Supply Temps - PS1 and PS2. These sensors are part of a screw connector bolted to the top of the power supply heatsink (it is covered with heat-shrink tubing).
- b. Once the problem thermistor is located, shut off the Low voltage supply with CB1 in the rear of the transmitter. Use an ohmmeter to check the resistance of the thermistor. It should be from 10K to 50K ohms depending on which thermistor is being checked.
- c. If the thermistor is not open, turn the low voltage back on and check to see if there is voltage across the thermistor. No voltage to the thermistor means an open between the controller and the thermistor. Trace the connection back to the controller board. Also, note that in this case the RFI boards have a series inductor which may have opened.

6.9.2 EEPROM_DEF, EEPROM U39 Default Load

This fault means that when the controller loaded the transmitter settings from the EEPROM U39 on the Master Controller, one or more of the values was considered to be invalid or out of tolerance and was replaced with a Default value from the firmware prom. This fault is an indication that the EEPROM U39 should be replaced. (Refer to Section V, Maintenance and Alignments, for the replacement procedure). The only time this fault should occur is when a new EEPROM U39 is being installed. In this case it is random data and all defaults will be loaded automatically. However, after the first default load it should never happen again.

6.9.3 REF_WARNING, +5V Reference Warning

This is simply a warning that the +5Vdc reference voltage, used for system software calibration, is less than 4.75Vdc. No transmitter action is taken other than to report the fault in the fault log and light the Fault LED on the front panel. The +5V Ref can be checked at TP4 on the Life Support Board where it originates. It is adjusted with R28 also on the Life Support Board for +5.0Vdc.

6.9.4 MSTR_REF, +5V Reference Fault

This fault means that the +5V reference voltage, which comes from the Life Support Board and is common to all of the controller boards, is less than 4.6V. This voltage is used as the reference for all system calibration. A change in this voltage would cause major errors in system calibration and overload settings and is therefore a critical fault. The transmitter will be shut off. The +5V Ref can be checked at TP4 on the Life Support Board and adjusted with R28 also on the Life Support Board.

If a PAC_REF fault appears along with the MSTR_REF fault, then the +5V reference is most likely the problem. If only the MSTR_REF fault is present then the Master Controller or a connection between the Life Support Board and the Master Controller should be suspected. The +5V REF can also be checked at TP19 on the Master Controller Board. Note that CR11 will supply +5Vdc to TP19 if the actual +5V REF has failed, but with the diode drop it will be less than 4.6Vdc and adjusting R28 on the Life Support Board will have no effect.

6.9.5 RFL_PWR, Reflected Power Fault

This fault is activated when the VSWR overload trip point is exceeded. This fault will only show up if there is a large and quick change in the transmitter load impedance or if the VSWR foldback setting is too close to the overload setting. The VSWR overload should be set at 1.5:1 with the VSWR foldback setting normally at 1.35:1. A gradual change in impedance should be caught by the VSWR foldback threshold and the RFL_PWR fault will not occur, although the transmitter may be operating at a reduced power. If the 1.5:1 VSWR overload threshold is exceeded, the transmitter will mute and then very slowly ramp the power up until back at full power or until the foldback threshold of 1.35:1 is exceeded. The controller will now try to keep the transmitter at its maximum power level while staying below the foldback threshold. The Foldback light on the front of the controller will be illuminated.

The VSWR Fault threshold is set via software in the Diagnostics Display Menu. To check the VSWR Fault threshold press [CONFIGURATION B,D,C,C]. Caution, this setting can be changed using the ABCD buttons to the right of the display. To leave a screen without saving any changes, press [HOME]. The default for this setting is 1.50:1. The VSWR foldback setting is under [CONFIGURATION B,D] and should be 1.35:1. For all system calibrations refer to Section V, Maintenance and Alignment.

It is also possible that a VSWR fault could be caused by a defective forward or reflected directional coupler or simply from calibration error. An external reflected power meter should be used to verify if there is really a VSWR problem or if it is an internal sensor problem. Keep in mind that the reflected reading will be less than 200 watts when the transmitter is in foldback. This would barely be visible on a 5kW scale, but care should be taken to avoid overloading a lower power element.

6.9.6 INTLK, External Interlock Fault

This fault is activated anytime the External Interlock circuit is opened. An External Interlock fault shuts the transmitter off by disengaging the main AC contactor. There must be a closed contact between the external interlock connections in order for the transmitter to operate. This fault also illuminates (not flashing) the Interlock Fault LED on the controller front panel. See Table 2-1, "TBI Remote Control Interface Connections," on page 28, for more information on External Interlock Connections.

6.9.7 FAILSAFE, Interlock Fault

This fault will mute the transmitter output anytime the Failsafe interlock contacts are opened. There must be a closed contact between the failsafe interlock contacts in order for the transmitter to operate. This fault also flashes the Interlock Fault LED on the controller front panel. See Table 2-1, "TBI Remote Control Interface Connections," on page 28, for more information on Failsafe Interlock Connections.

6.9.8 POWER_FAIL, Fault

This fault is activated as a result of an AC power failure. This fault is detected by monitoring the +20Vdc supply on the Life Support Board (IC U37). If the +20Vdc supply drops below the power fail threshold (approximately 12V) the POWER_FAIL signal is sent to the Master Controller telling it to save the time and ignore certain types of faults which will obviously be present during a power failure. The transmitter will return to its previous operating condition automatically when the AC power returns (no operator intervention required).

6.9.9 LOW_AIR, Fault

Nominal air flow for the Z5 is 350 cfm. The airflow reading should be near 100% at high fan speed and is typically around 60% for low fan speed. If the airflow is reduced to 25% or 88 cfm, the LOW_AIR fault is triggered. The fan will be switched to high speed in an attempt to compensate. However if the airflow is not increased above 25%, the transmitter will shut off. Also, if the transmitter is already at high fan speed when this fault occurs, the transmitter will be shut off. The air flow percentage can be seen on the Diagnostics Display by pressing [METERING, C,D,B]. Depending on the ambient temperature, one of several temperature faults could proceed an air flow fault. The most likely cause of this fault is failure of the blower motor. The motor also has thermal protection which will automatically shut the motor down.



CAUTION:

TURN OFF ALL POWER TO THE TRANSMITTER AT THE WALL BREAKER BEFORE ATTEMPTING TO SERVICE THE BLOWER MOTOR. THE THERMAL PROTECTION, INTERNAL TO THE MOTOR, IS AUTOMATIC. IT WILL SHUT THE BLOWER OFF IF THE MOTOR TEMPERATURE GETS TOO HIGH, BUT IT WILL ALSO AUTOMATICALLY TURN IT BACK ON AFTER A FEW MINUTES AS THE TEMPERATURE GOES DOWN.

6.9.10 UPS, Uninterruptable Power Supply Fault

This fault indicates that the transmitter has switched over to the UPS (or generator possibly). The transmitter power output is now controlled by the UPS Power Level setting in the Configuration menus of the Diagnostics Display. To check or set the UPS Power Level press [CONFIGURATION B,D,A]. The default factory setting is 1.00 kW. Use the ABCD keys to set a new UPS power level. Press [BACK] to save any changes and [HOME] to cancel any changes.

6.9.11 CPLR_NC, Forward Directional Coupler Cable Not Connected

This fault is active anytime the sample cable from the Forward power directional coupler to the Life Support Board is disconnected. The fault immediately mutes the transmitter until the cable is re-connected due to the effect this would have on the Automatic Power Control (APC) loop.

6.9.12 IPA_AB#_MUTE, Fault

This fault could be for IPA_AB1 or IPA_AB2. Whenever the IPA is muted, the control system checks the IPA current draw by the IPA amplifier. If the current is not less than 1 amp, then the system does not have the ability to shut off the IPA and will mute the system by shutting off the PAs and the exciter.

6.9.13 IPA_AB#_LOW, (Power) Fault

If one of the IPAs should be putting out power, but is not according to the IPA directional coupler sample (from the IPA Backplane Board), the controller will switch to the second IPA (provided it has not previously faulted off). The controller looks to see if the exciter or IPA is muted before reporting this fault.

6.9.14 IPA_AB#_OC, Fault

This IPA Over-Current fault could be for IPA_AB1 or IPA_AB2. The overcurrent threshold is 14.5 amps. If this IPA current limit is exceeded, the transmitter will automatically switch over to the second IPA.

6.9.15 IPA_TW, IPA Temperature Warning

If the temperature of an IPA exceeds 85°C the fan will be switched to high speed and IPA_TW will be registered in the Fault Log. There is a 10°C hysteresis so the fan will not switch back to low speed until the IPA reaches 75°C or less.

6.9.16 IPA_OT, Fault

If the IPA amplifier temperature exceeds 100°C, as detected by the thermal sensor on the amplifier, the transmitter will initiate a switch to the other IPA. If one of the thermistors or its wiring is shorted the temperature indication will be approximately 155°C.

6.9.17 IPA_AB#_OUT, Fault

This fault indicates that the IPA_AB1 or IPA_AB2 is not physically plugged into the connector. Each amplifier has 2 edge connections which are slightly shorter than the others. These are used for interlocking. If the amplifier is not inserted far enough into the connector, these 2 pins will not make contact and the amplifier will not be activated. The control system will switch to the other IPA if it is not faulted also.

6.9.18 IPA_LOAD, Fault

To check for bad RF Cables, the Master Controller checks Z-Plane currents for proper IPA load balance. If a severe imbalance is found, the transmitter is muted.

6.9.19 PSC#_COMM, Fault

This fault means there is a communication failure between the Power Supply Controller and the Master Controller. No action is taken when this fault is detected since the PS Controller is designed to operate without the Master Controller. It is simply used to alert the operator to the fault condition. All power supply meter readings will be replaced with an asterisk (*).

6.9.20 PAC#_COMM, Fault

This is a communications fault between one of the PA Controllers and the Master Controller. No action is taken when this fault is detected since the PA Controllers are designed to operate without the Master Controller. It is simply used to alert the operator to the fault condition. All PA controller meter readings will be replaced with an asterisk (*).

6.9.21 AMB_WARNING, Ambient Temperature Warning

If the ambient temperature exceeds 50°C, the controller will switch the fan to high speed. If the temperature goes down after high fan speed is initiated, the fan will go back to low speed when the ambient temperature reaches 45°C (the hysteresis between 50 and 45°C prevents the fan from quickly oscillating between low and high fan speed).

⇒ NOTE:

Ambient temperature is sensed with a thermistor on the IPA Backplane Board.

6.9.22 AMB_TEMP, Ambient Temperature Fault

There are 2 thresholds associated with this fault, 60 and 65°C. If the temperature continues to rise at high fan speed, after an Ambient Warning, then at 60°C the transmitter is muted. If the temperature exceeds 65°C, then the transmitter is shut off.

6.9.23 ISO_##_OT, Over-Temperature

There are 3 System Level ISO loads in the Z5 transmitter. These are designated :

- ISO_Az and ISO_Bz - These 2 are the 2.5kW ISO loads located in the middle of the Isolation Boards. Their component designation is R9 on the Isolation Board schematic.
- ISO_AB - This one is the ISO (reject) load on the 5kW hybrid which is combining the outputs of the Z-Planes. It is physically located above the 5kW power block. The component designation is A2A5R1 on the Overall Wiring Diagram.

All of these loads are monitored for temperature by the Master Controller and both of the PA controllers simultaneously. The responsibility for system protection belongs to the Master Controller, with the PA Controllers acting as backup in case of a Master failure.

6.9.23.1 System ISO Foldback

The Master Controller has a foldback routine it will use to protect these system components called ISO APC Foldback. ISO APC Foldback uses 2 thresholds, 115°C and 130°C. If one of these 3 loads reaches 130°C the Master Controller will switch the fan to high speed and start the foldback routine by reducing the APC voltage at a fixed rate. If the temperature is reduced, the foldback will stop at 115°C. If the temperature goes below 115°C the foldback will be reversed and the power will be very slowly increased until the power output is back to normal or until the load temperature again rises to 115°C at which point the power increase would stop. If the temperature then rises back up to 130°C the foldback procedure will start all over. In other words, the Master Controller is going to try and keep the load temperature between 115°C and 130°C at some maximum power output. It is important to note that no faults will be reported in the fault log for a foldback, only the foldback indication while the overtemperature condition is present.

⇒ NOTE:

All PA and ISO temperature faults are based on actual thermistor temperatures and/or a predicted value of temperature based on the rate of rise in temperature over a given period of time. Therefore, a resistor temperature which is predicted to reach 130°C will cause an overload the same as an actual reading. Due to the prediction, it is possible to get over-temperature faults even though the actual temperature reading is not above the threshold.

6.9.23.2 System ISO Overload (Fault)

If the System ISO APC Foldback routine fails to reduce the temperature of the offending ISO load and the temperature reaches 145°C, the Master Controller will mute the IPAs and the exciter and the PA Controllers will mute the PAs. At this point an ISO_Load fault will be reported in the fault log and the transmitter will mute momentarily. The possible faults are:

- **ISO_Az or ISO_Bz** - These faults will most likely be preceded by PA and PA_ISO faults which have imbalanced the Z-Plane outputs. PA currents, voltages and temperatures and PA_ISO load temperatures should be checked as a likely cause of this problem.
- **ISO_AB** - This fault will most likely be preceded by PA and PA_ISO faults which have imbalanced the Z-Plane outputs. PA currents, voltages and temperatures and PA_ISO load temperatures should be checked as a likely cause of this problem.

Lastly, if the system is muted and the temperature continues to rise to 150°C, the Master Controller will shut the transmitter off.

6.9.24 EXC#_FAULT, Fault

Indicates there is an exciter malfunction. This is a summary fault including VSWR, Overtemp, etc.

6.9.25 EXC#_LOW, Fault

If forward power drops to 70% or less of normal exciter RF output an indication is given.

6.9.26 EXC#_AFC Fault

This is the PLL unlock fault from the DIGIT Exciter or the SuperCiter. It causes no direct transmitter action, but is merely displayed in the fault log and on the front panel fault light. Action will not be taken until an exciter low power condition is detected. The controller will delay 10 seconds to give the exciter time to recover, then switch to another exciter (if available).

6.10 PA Signal Tracing

Tracing signals from the PA Controller to the PAs can be very confusing. The problem lies in the fact that the PA Controller Boards and the Z-Planes are generic except for the ID jumper settings which designate the board for a specific position. Since the schematics for each of these boards must apply to any position, the labeling is also generic.

For instance, the PA Controllers have the ability to control and monitor 8 amplifiers. These lines to and from the amplifiers are labeled PA1-PA8 on the PA Controller schematic. Since PAC#1 and PAC#2 control and monitor different amplifiers it would not be possible to put the correct labels on the schematic with respect to specific amplifier connections. As an example, the gate control voltage to amplifier A4 comes from PA Controller#2. Tracing the signal from the A4 gate voltage input back to PA Controller #1 would reveal that it is actually connected to the PA7_GATE signal on the PA Controller schematic. PAC#1 also has a PA7_GATE output, but it goes to amplifier B3.

Table 4-1 on page 4-60 is intended to ease this confusion. For instance, in the process of troubleshooting a PA problem it is found that amplifier B2 has no gate control voltage. Tracking this back to its source can be tricky. Table 4-1 gives you the necessary information to skip steps or at least verify your path.

According to Table 4-1, amplifier B2 is controlled by PAC#2. Following this across the table, the PAC#2 output labeled PA6_GATE, on the PA Controller schematic, is the control line for B2. Following this on across, this signal would also pass through the Divider schematic as PA6 and connect to the combiner connector J6. The last 2 columns give the Isolation Switch # and the Isolation Resistor # associated with the PA in question. In this case K6 and RT6 are used with amplifier B2. The Isolation switches and resistors are located on the Isolation Board attached to each Z-Plane.

Also be aware that there could also be a problem on the RFI Filter boards which are in series with all of the lines between the controllers and the PA components.

6.11 PA Controller Faults

The following paragraphs give a detailed description of all faults associated with the PA Controller Boards. This mostly deals with the PAs and Isolation resistors. A quick reference of these faults is given in Table 6-4 on page 6-37.

6.11.1 General PA Troubleshooting

As a general rule, the first step in troubleshooting any PA (or IPA) problem is to swap the PA or the entire module with another in the transmitter. If the problem moves with the PA, you have verified that it is the PA and not the slot to which it is connected. If the problem appears to stay with the particular slot, then more advanced troubleshooting of the Z-Plane or cabling back to the controller should be explored. This is where Table 4-1 can save a lot of time.

6.11.2 A or B#_OC, PA Over-Current Fault

The PA Current overload threshold for each PA is nominally 14.5 amps, provided there are no failed PAs. If an individual PA exceeds this current, the PA will be muted and the Combiner isolation switch will disconnect the associated isolation resistor from the combiner and apply a ground to the PA output. This optimizes the combiner for the other PAs until a TX_RESTART is initiated by pressing one of the ON buttons. This will un-mute the faulty PA. If the current is still too high, the PA will be switched out again.

However, it should be noted that the Z5 control system is adaptive. With the failure of one PA, the other 3 PAs in that foursome will have a reduced PA current foldback level due to the increased combiner mismatch. If a second PA fails, it depends on where it is located in relation to the first one as to the action the controller will take when reducing the current foldback limit on the PAs. Basically, this means that with

2 PAs failed, the transmitter could be as high as 97% power or worst case around 84% (possibly less based on individual operating conditions), depending on the location of the failed PAs. See “Multiple PA Failures in a Foursome” earlier in this chapter.

6.11.3 PA Current Foldback

The normal PA Current Foldback threshold is 12.4 amps. This means the PA Controllers will try to foldback the power of a PA, to keep its current at or below 12.4 amps, by making the PA gate voltage more negative. The PA Foldback current rating is a moving target depending on the number of working PAs and VSWR. The PA Current Foldback points can be checked using the Diagnostics Display by pressing [METERING A,B,D then C or D to check Z Plane A or B].

6.11.4 A or B#_UC, PA Under-Current

PA Under-current is comparing the current readings of the PAs which are common to each foursome. For example, A1, A2, A3 and A4. All four of these PAs are plugged into one 4-way combiner. If one of these PAs has a current reading that is less than 10% of the average current of the other three, the system will be muted for 120mS, the isolation switch for that PA activated (removing the PA from the combiner), and the mute released on the rest of the PAs. The Master Controller actually detects this fault since the PA Controller does not have the current readings on all four PAs in a foursome (each PA Controller only controls 2 PAs on any one foursome). When a low current fault is detected, the Master sends a command to the related PA Controller to shut down the PA.

6.11.5 A or B#_MUTE_FLT, PA Mute Fault

Whenever a mute is applied to the PAs, the current draw by each PA is also checked. If a MUTE is being applied but there is still current flow in a PA, then a MUTE_FLT will cause the entire transmitter to be MUTED until all currents are under 1 amp. This is most likely a metering problem. This will show up in the fault log as an A#_MUTE_FLT or B#_MUTE_FLT (where # is a number from 1-8). Turn the transmitter off and try turning the PA module over and re-inserting or switching it with another module to see if it is really the PA or the slot that has the problem.



CAUTION:

WHEN A MUTE FAULT OCCURS, BE SURE TO SHUT THE TRANSMITTER OFF BEFORE REMOVING ANY MODULES TO PREVENT ARCING OF THE PA EDGE CONNECTORS.

6.11.6 A or B#_OT, PA Over-Temperature

The temperature of each PA is sensed by thermistor, RT1 (located on each individual amplifier board). If the temperature reaches 100°C, the transmitter will mute and disconnect the problem PA via the isolation switch. If one of the thermistors or its wiring is shorted the temperature indication will be 155°C.

6.11.7 A or B#_OUT, PA Out Fault

This is the interlock fault for each PA. Two of the edge connector contacts on each PA, J1-A and J1-V, are shorter than the others. They will not make contact unless the PA is fully engaged in the Z Plane connector. If the PA is not inserted, these two contacts are open and the controller will disconnect the PA from the system and report the fault in the Fault Log as A#_OUT or B#_OUT (where # is a number from 1-8). This information also shows up in the Diagnostics Display “Status Menu” under PA Status. To check the status of each PA press [STATUS C, then C or D to check Z Plane A or B].

6.11.8 A or B#_ISO, PA ISO Temperature Fault

The fault threshold for the PA Isolation load resistors is 150°C. These resistors are located on the Isolation Boards mounted on each side of the PA. Normally the ISO resistors have minimal current flow through them and run about 40-100°C. If the amplifier connected to the ISO resistor has a difference in phasing or amplitude compared to the other three amplifiers in its foursome, then the resistor will try to absorb the imbalance, increasing its temperature. The bigger the imbalance the faster the temperature rises. Each resistor has a thermistor attached to it with a special epoxy to sense the resistor temperature. When 150°C is exceeded (or predicted to do so), the fault log will register an A#_ISO or B#_ISO fault (where # is a number from 1-8), the transmitter will be muted for 120mS, the problem PA will be switched out and the mute released. This overload is actually a predicted overload based on the measured temperature rise in the ISO load over a given amount of time. This means the ISO resistor will not actually get to 150°C before the system trips, but that the system will switch out the problem PA if that temperature would have occurred based on the ISO resistor rate of temperature rise. To monitor the ISO resistor temperatures on the Diagnostics Display by Z-Plane press [METERING C,C].

⇒ NOTE:

The individual PA ISO resistor temperatures can vary quite a bit but are to be considered okay if they are under ambient temperature + 75°C. For example, with an ambient temperature of 25°C the PA ISO temperatures are okay if they are under 100°C (25°C + 75°C).

6.11.9 PA_ISO_OT

This is a general over-temperature fault which will shut the transmitter off if one of the PA Isolation resistors in the combiner physically reaches 170°C (no prediction). This protects against a failure in the combiner system where the Isolation resistor does not get switched out of circuit. The primary cause would be a failure of the Isolation Switch associated with the resistor.

However, a shorted thermistor (each PA isolation resistor has one attached to it for temperature sensing) could also cause this fault since it will give what appears to be a maximum temperature reading, greater than 170°C.

If this fault is triggered, all of the PA ISO temperatures should be checked. Since the transmitter was shut off, they all should have cooled down. If one of them is still extremely hot, above 150°C, then a thermistor (or the line to it) is probably shorted. If all of the readings have cooled down then it is probably a failure of the RF Switch. To locate the correct RF Switch and/or ISO Load get the A# or B#_ISO (there should also be one of these in the Fault Log) fault number and use Table 4-1 to cross reference.

6.11.10 PA_ISO_LOW, Fault

This fault will only show up if there is a problem found with the PA ISO resistor during the System Test. During the System Test the PAs are muted one at a time. This should cause the temperature of the ISO resistor to heat up. If it does not, then the System Test is aborted and this fault is reported in the Fault Log. For more information refer to “Self Diagnostics” earlier in this section.

6.11.11 PA_ISO_SW, Fault

This fault will only show up if there is a problem found with the PA ISO Switch during the System Test. During the System Test each PA, and its related ISO resistor, are switched out one at a time. The ISO resistor for that PA should be disconnected and therefore should not increase in temperature. If it heats up, then the switch is not actually disconnecting the PA and ISO resistor. The System Test is aborted and this fault is reported in the Fault Log. For more information refer to “Self Diagnostics” earlier in this section.

6.11.12 Combiner ISO Faults

There are two more ISO faults:

- **PAC_ISOAz and PAC_ISOBz** (2.5kW combiner ISO Resistors Az and Bz located on the Isolation Boards). This is a temperature fault which is caused by an imbalance between the outputs of the two foursomes on the respective Z Plane. If one of these loads reaches 145°C the PA Controllers will mute all of the PAs. The system can be reset by pressing an ON button. This fault will only show up if the Master Controller is not operational or if the ISO APC Foldback routine initiated by the Master Controller fails to reduce the temperature of the Iso load. The foldback description is in the Master Controller Faults under "System ISO Foldback."
- **PAC_ISOAB**(5kW combiner ISO load on the Hybrid). This is a temperature fault which is caused by an imbalance between the outputs of Z Planes A and B. If the temperature of this load reaches 145°C the PA Controllers will mute all of the PAs. The temperature of these loads is also sensed by the Master Controller. Therefore this fault should be preceded by a an ISO APC Foldback which will be initiated by the Master Controller. The PA controllers will protect the system if the Master Controller is not operational or if the foldback routine fails to reduce the load temperature. The foldback description is in the Master Controller Faults under "System ISO Foldback."

6.11.13 PAC#_REF, +5V Reference Fault

This fault means that the +5V reference voltage, which comes from the Life Support Board and is common to all of the controller boards, is less than 4.6V. This voltage is used as the reference for all system calibration. A change in this voltage would cause major errors in system calibration and overload settings and is therefore a critical fault. If only one of the PA Controllers has this fault, all PAs associated with that board will be muted and switched out. This fault will show up in the fault log as PAC1_REF or PAC2_REF.

6.11.14 PAC#_VOLTS, Power Supply Fault

This fault is activated if the supply voltage to the PAs under the control of an individual PA Controller is under 30Vdc or over 65Vdc. Initiates a 3 strike sequence. If fault remains, all PAs under that controller (and power supply) will be muted and switched out. Remember that all 8 PAs controlled by PA Controller 1 are fed from Power Supply 1 and PA Controller 2 is associated with the same PAs as Power Supply 2.

⇒ NOTE:

A severe AC phase imbalance or complete loss of phase could trigger this fault. If an AC phase loss fault is logged at approximately the same time, then this fault should be ignored.

6.11.15 PAC#_ -15V, PA Controller PS Fault

This is a critical fault since the affected PA Controller has basically lost its muting ability if the -15V is lost. When this fault is detected the affected PA Controller will request that the other PA Controller mute its PAs (XOVER) and switch them out. This will cause a major system imbalance and the transmitter power will in most cases go to approximately 33% of nominal power output.

6.11.16 PAC#_J#, Cable Fault

This fault means that one or more cables is connected to the wrong place or an ID jumper is set wrong. It prevents wiring the transmitter control cables incorrectly. There are four cables connected to each PA Controller, at J1, J2, J11 and J12. J1 and J2 connect to the Isolation Boards, while J11 and J12 connect to the Z Planes. The PA Controller boards have ID jumpers to select the board as PA Controller 1 or PA Controller 2. The Z Planes have ID jumpers to select whether they are Z Plane A or Z Plane B. The Isolation Boards also have ID jumpers to select the Z Plane they are used with. The ID Jumpers are necessary because the two PA Controllers, the two Z Planes and the two Isolation Boards are the same. Cabling of these boards is critical because it determines the control distribution (basically which PAs are controlled by which PA Controller). The ID's are checked by the PA Controllers. If the PA Controller does not see the proper ID, the transmitter will be muted and the fault log will display one of the following depending on which cable is mis-connected (or disconnected):

- PAC1_J1 or PAC2_J1
- PAC1_J2 or PAC2_J2
- PAC1_J11 or PAC2_J11
- PAC1_J12 or PAC2_J12

6.12 Power Supply Controller Faults

The following paragraphs give a detailed description of all faults associated with the PS Controller Boards. A quick reference of these faults is given in Table 6-5 on page 6-39.

There are two types of power supply faults:

- a. Critical
- b. Non-Critical

Critical faults will shut the power supply off, while the non-critical faults give a fault indication on the front of the controller and are written into the fault log.

6.12.1 General Power Supply Troubleshooting

Since each PS Controller controls 2 supplies, a first line of defense against most types of power supply faults is to swap the cables (ribbon cables W11 and W12) on the back of the PS controller board to see if the problem follows the controller or is actually a power supply problem. If the controller is at fault, the problem will move to a different supply (each supply has its own ID and will therefore show up as the same supply no matter what controller port they are connected to). The only other easy troubleshooting would be to swap out the controller card if a spare is available. This also requires setting the ID switches on the new PS Controller board to the same as the one being replaced and possibly moving the firmware from the old board to the new one. See “Replacing the PS Controller Board” in Section V, Maintenance and Alignments.

If the transmitter has the dual PS Controller option then the cables can be swapped between the 2 controller cards (W11 would be attached to PSC #1 and W12 would be attached to PSC #2 before swapping but this is not critical). If the problem moves to a different power supply then the controller is bad and should be replaced.

6.12.2 Critical Power Supply Faults

The following is a list of critical Power Supply faults with a brief description and where the status of these faults can be found in the Diagnostics Display System.

Under Critical Fault conditions the power supply is going to be turned off. The only way to reset a critical fault is by pressing one of the ON buttons on the front panel, which will send out a TX_RESTART command to all of the controller boards. The system will try to re-initialize and come back up to full power. If the faults are still present, the power supply will simply fault off again.

⇒ NOTE:

Since one power supply controller is able to control up to two power supplies, one of the power supplies can be turned off, due to a fault, while the other one continues to operate normally. Due to the distribution of voltage to the PAs, this will affect all of the PAs associated with one of the PA Controllers. Therefore the effect is the same as the loss of a PA Controller and the transmitter will have a maximum power output of about 33% of nominal.

6.12.2.1 PS#_START, Soft Start Circuit Fault

This fault is tripped, and the power supply shut off, if the PA voltage does not reach a minimum of 40 volts within 3 seconds (5 seconds for a single phase supply) of activating the softstart circuit. This prevents the SCR's (other than the soft start SCR's) from attempting to charge a partially (or perhaps completely) discharged capacitor which would overload the fuses. The most likely cause would be an open soft start/Discharge resistor or failed SCRs and/or SCR fuses.

6.12.2.2 PS#_HS_TEMP, Rectifier Heatsink Temperature

There is a thermistor, temperature sensor, mounted on each of the rectifier heat sinks (on top of the transformer). This fault is triggered if the temperature of the rectifier heatsink exceeds 100°C. If one of the thermistors or its wiring is shorted the temperature indication will be about 155°C or higher and will not change. To monitor the heatsink temperature on the Diagnostics Display press [METERING C,D,A]. This screen gives the heatsink temperature of each power supply.

6.12.2.3 PS#_DSCHG, Discharge circuit fault

If during the operation of the supply the discharge circuit becomes active, due to a malfunction, this fault is triggered preventing the supply from discharge and charge at the same time. During normal operation the voltage at the soft start resistor (which is also used for discharge) must be very close to 0 Volts. This voltage, called DISCHARGE SAMPLE, is monitored by comparator U1 on the PS Controller board and will trigger the fault if the voltage is not low enough. The most likely cause is a failure of the discharge FETs on the Rectifier Board or an open discharge resistor.

6.12.2.4 PS#_PHS_LS, Phase Loss (100-120 Hz ripple)

When Phase Loss is detected the transmitter will mute for 20 seconds and then try to restart. It will continue to do this until it is successful. For all 3 phase transmitters, detection is based on the level of 100 to 120 Hz ripple at the output of a DSP band pass filter (on the PS Controller) operating on the DC input voltage data. The DC voltage samples are taken from the center taps of the WYE wound secondaries on each supply (before the filtering). An excessive level of 100 or 120Hz (the predominant ripple frequency should be 300 or 360Hz) is interpreted as an indication of a transformer primary fault or line loss. The filter as a whole was implemented in software via the microcontroller, hence not requiring any further adjustment. Note that a major voltage imbalance between one or more phases could also trigger this fault. This fault is not used in the single phase transmitter.

It is also important to note that there could be several other faults show up as a result of a phase loss:

- PAC#_VOLTS
- IPA_LOW
- EXC#_AFC

These faults are incidental and simply occur due to the timing of when the phase loss occurs and which components see it first.

6.12.2.5 PSC#+20V, Fault

+20 Volts supply fault. Since this voltage is very important for the operation of the controller (without it no analog reading can be carried out) it is continuously monitored by the watchdog IC (MAX 705). If it is below 12 volts the fault is tripped. Troubleshooting will require tracing the +20Vdc back to the Low Voltage Supply to find out where it is being lost.

6.12.2.6 PS#_CONFIG, Configuration Fault

The controller is continuously checking the configuration, meaning the number of supplies connected and their identification numbers (ID), as part of this process a check of the valid configurations is also carried out, not allowing any power supply number above 4 or two equal ID numbers. The Supply number is set by jumpers JP1, JP2 and JP3 on the Rectifier Boards as follows:

Power Supply ID Chart		
	PS #1	PS #2
JP1	IN	OUT
JP2	OUT	IN
JP3	OUT	OUT

6.12.2.7 PS#_JUMP

If a power supply tap fails and the next one available is two or more taps away, a JUMP fault is triggered and the supply will be shut off and discharged. The only situations where this could happen are:

- If operating in tap 1 and it fails, having previously failed tap 2.

If tap 2 is being used and fails, and tap 1 and tap 3 have failed previously.

If tap 3 is being used and fails, and tap 2 and tap 4 have failed previously.

6.12.3 Non Critical Power Supply Faults

Non-Critical faults provide indications that there is a problem with the power supply which is not serious enough to take any immediate transmitter action, but should be corrected as soon as possible.

6.12.3.1 PS#_TAP#, Power Supply Tap Fault

Detection is based on the level of 50/60 Hz ripple at the output of a two stage, DSP based, band pass filter in the PS Controller. The BPF is looking at the DC input voltage data from the PA Power Supply (+52Vdc). It is interpreted as an indication of a transformer secondary fault which could be a fuse or SCR. If one of the taps has been detected as faulty the next available Tap (lower ones are the first choice and the next upper one is the second choice) will be connected depending on availability.

Note that if the power supply chassis is not properly grounded, or is completely floating, this induces a considerable amount of 50/60Hz in the voltage sample lines to the controller so as to erroneously trip this type of fault. The fault is logged as PS1_TAP1 (up to TAP4) or PS2_TAP1 (up to TAP4). This fault is the same for 3 phase and single phase transmitters.

Table 6-2 on page 6-32 shows the SCRs and fuses on each Rectifier Board associated with each of the taps. Each transformer has an "A" side and a "B" side Rectifier Board.

Figure 6-7 on page 6-33 is a component locator for the 3 Phase Rectifier assembly. It is a top view with the Rectifier Boards oriented horizontally instead of vertically.

Figure 6-8 on page 6-34 is a component locator for the Single Phase power supply Rectifier assembly.

Troubleshooting

Table 6-2 Power Supply Tap Troubleshooting Chart

	3 Phase Power Supply				Single Phase Supply	
	Rectifier Board "A"		Rectifier Board "B"		SCRs	Fuses
	SCRs	Fuses	SCRs	Fuses		
TAP 1 48V	Q13	F13	Q4	F4	CR4	F4
	Q17	F17	Q8	F8	CR8	F8
	Q21	F21	Q12	F12		
TAP 2 50V	Q14	F14	Q3	F3	CR3	F3
	Q18	F18	Q7	F7	CR7	F7
	Q22	F22	Q11	F11		
TAP 3 52V	Q15	F15	Q2	F2	CR2	F2
	Q19	F19	Q6	F6	CR6	F6
	Q23	F23	Q10	F10		
TAP 4 54V	Q16	F16	Q1	F1	CR1	F1
	Q20	F20	Q5	F5	CR5	F5
	Q24	F24	Q9	F9		
Soft Start Tap	There are no Soft Start SCRs on Rectifier Board "A"		Q34	F4	Q10	F1
			Q35	F8	Q11	F2
			Q36	F12		

All component numbers should be verified with the schematic.

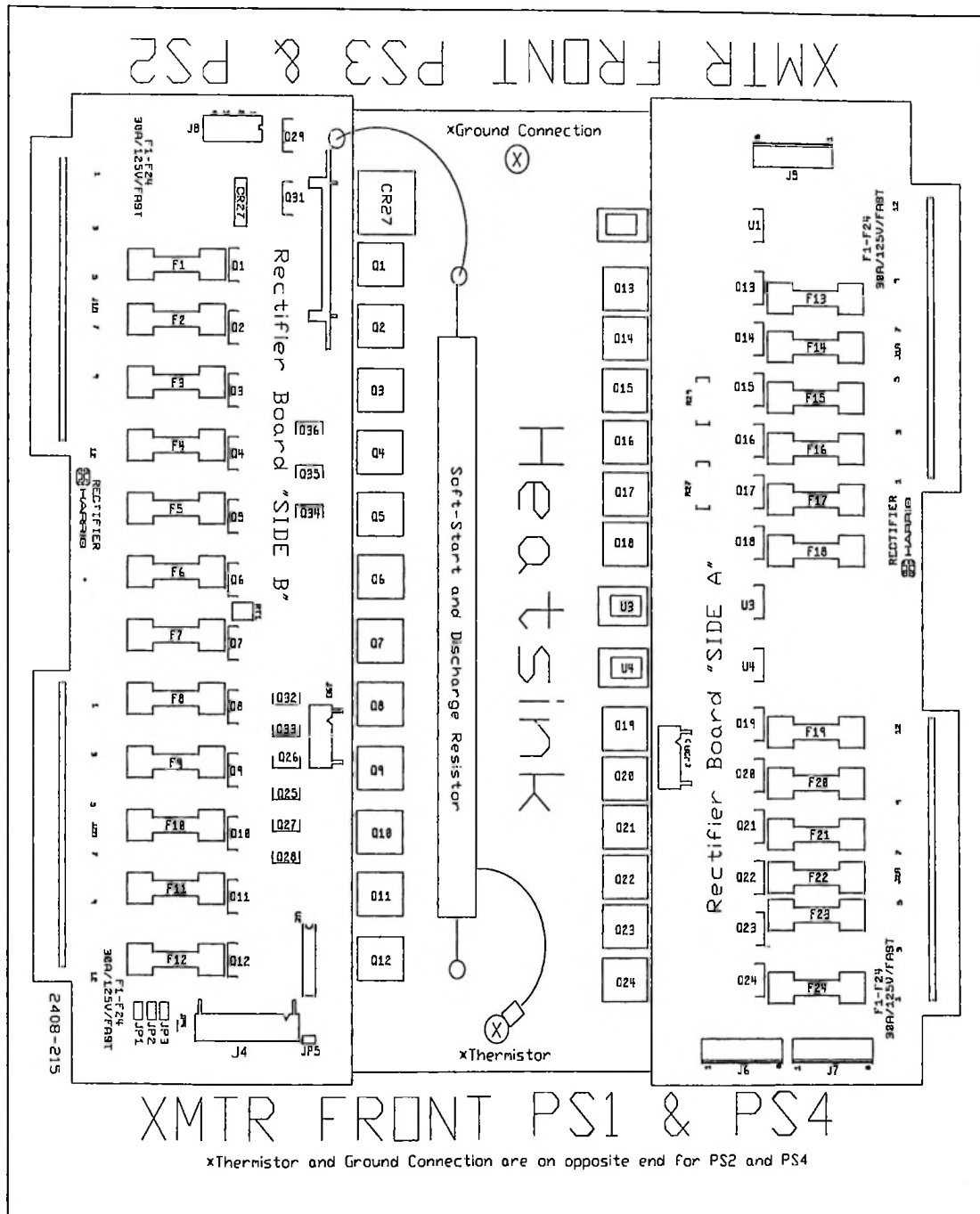


Figure 6-7 3-Phase Power Supply
Component Locator, Top View

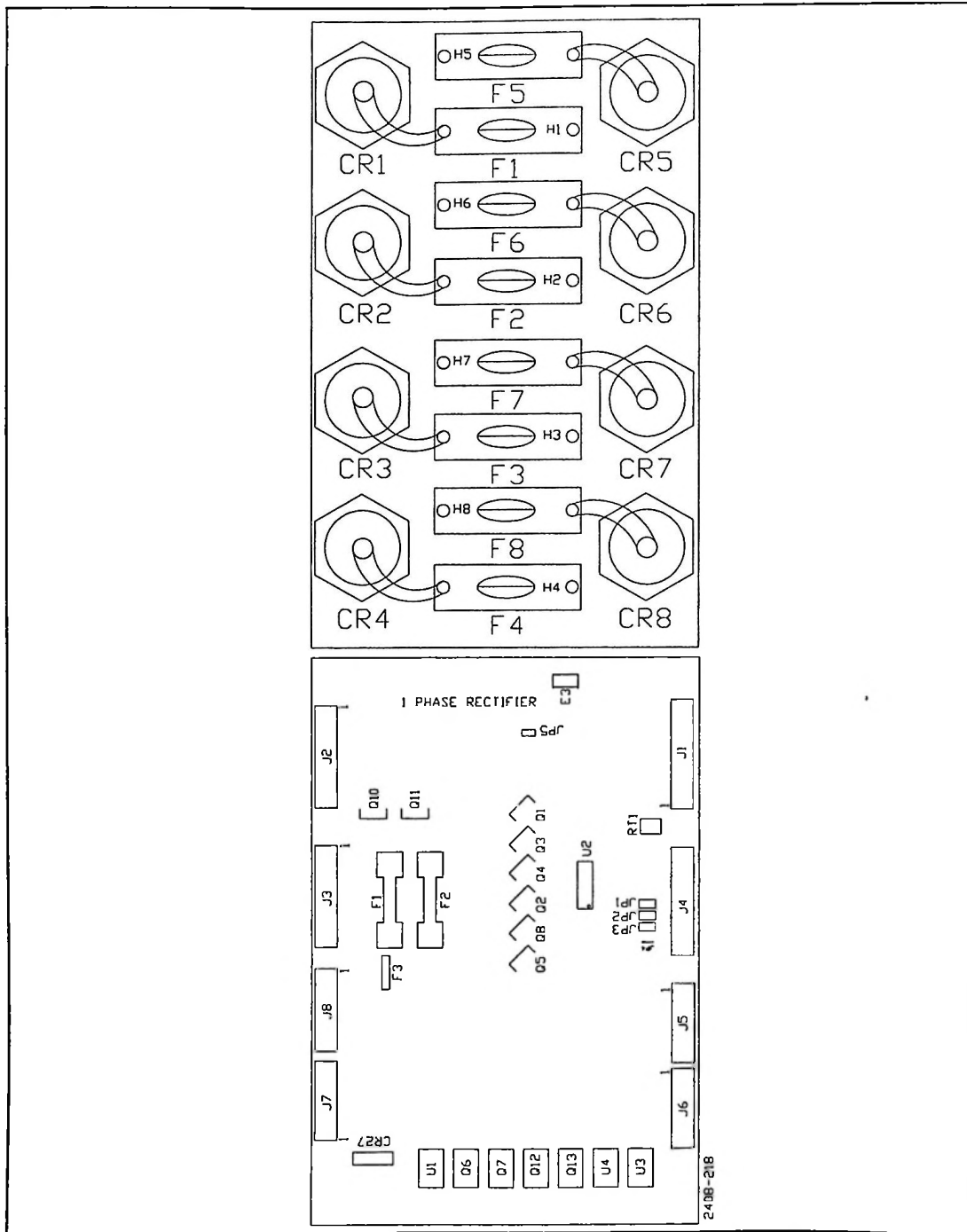


Figure 6-8 Single Phase Power Supply
Rectifier Assembly Component Locator, Top View

Table 6-3 Platinum Z5 Master Controller Related Faults

ABBREVIATION	COMMENT	ACTION
MSTR_REF	+5V reference fault. Indicates +5V reference is < 4.6V	Mute XMTR (IPA & Exciter, Power supplies)
REF_WARNING	Indicates +5V Reference is out of tolerance at the Master Controller Board with error of more than 0.25V but < 0.4V	Reports fault in Log without shutting down the PAs.
RFL_PWR	Reflected power has exceeded VSWR overload threshold	Will follow 3 Strike Routine (described in Section 6) Transmitter will mute and try to slowly ramp power back up to normal.
INTLK	External Interlock fault	Turn off XMTR, light <i>INTERLOCK</i> LED
FAILSAFE	Failsafe fault, AC on and power supply in standby mode	Mute XMTR, blink <i>INTERLOCK</i> LED
POWER_FAIL	AC power supply failed, +20V power supply on Life Support Board is less than 12V.	Mute XMTR & save fault time. Transmitter will automatically return to operation when power returns.
LOW_AIR	Low air flow fault at 25% (88 cf/m)	Low-fan TO high-fan, OR high-fan TO AC off
UPS	Logic LOW detected at Remote UPS input	Transmitter is switched to the UPS Forward Power setting
CPLR_NC	Forward power Directional coupler cable is not connected	Mute XMTR. Restart required to restore power
IPA_AB1_MUTE	IPA_AB1 current still present with $V_g < -15V$	Mute XMTR (exciter and PAs)
IPA_AB1_LOW	IPA_AB1 power is < 30% of calibrated output with $V_g = 0V$	Mute, then switch to other IPA
IPA_AB1_LOW	IPA_AB1 power is < 30% of calibrated output with $V_g = 0V$	Mute, then switch to other IPA
IPA_AB1_OC	IPA_AB1 current has exceeded the 14.5A threshold	Mute, then switch to other IPA
IPA_AB_TW	IPA Temperature Warning, IPA_AB temperature > 85°C	Switch fan to high speed
IPA_AB1_OT	IPA_AB1 temperature has exceeded 100°C	Mute, then switch to other IPA

Table 6-3 Platinum Z5 Master Controller Related Faults

IPA_AB1_OUT	IPA_AB1 is not inserted completely into the connector	Switch to IPA_AB2 if it is not faulted
IPA_AB2_MUTE	IPA_AB2 current still present with Vg < -15V	Mute XMTR (exciter and PAs)
IPA_AB2_LOW	IPA_AB2 power is < 30% of calibrated output with Vg = 0V	Mute, then switch to other IPA
IPA_AB2_OC	IPA_AB2 current has exceeded the 14.5A threshold	Mute, then switch to other IPA
IPA_AB2_OT	IPA_AB2 temperature has exceeded 100°C	Mute, then switch to other IPA
IPA_AB2_OUT	IPA_AB2 is not inserted completely into the connector	Switch to IPA_AB1 if it is not faulted
IPA_LOAD	Z-Plane currents are checked during startup to determine if IPA load is balanced. Most likely caused by bad rf cable.	Mute XMTR
PSC1_COMM	Power supply controller 1 has no communication to Master	Indication of fault
PAC1_COMM	Communication lost between Master and the PA controller	Request another controller to mute
ISO_AB	Reject Load ISO_AB, on the 3dB hybrid, is > 145°C	Will follow 3 Strike Routine (described in Section 6)
EXC1_FAULT EXC1_LOW EXC2_FAULT EXC2_LOW	The exciter has signaled the transmitter that it has a problem. For more information on exciter faults, refer to the exciter manual.	Exciter AFC fault and/or Exciter FAULT are detected by the exciter and are recorded in the transmitter fault log. No action will be taken until an exciter low power condition is detected. Controller will then delay 10 seconds before switching to another exciter, if it is available.
EXC#_AFC	Phase Locked Loop not locked	10 Sec to recover, then switch to 2 nd Exciter (if available)
THERMISTOR	Protection against a temperature-sensor circuit open	Indication of fault
AMB_WARNING	Ambient Temperature Warning > 50° degree	Switch Fan to high speed
AMB_TEMP	Ambient temperature critical > 60°C	Ambient Temperature > 60°C if mute, > 65°C AC OFF

Troubleshooting

Table 6-4 Platinum Z5 PA Controller Related Faults

ABBREVIATION	COMMENT	ACTION
PAC#_REF (n = 1 or 2)	+5V voltage reference fault (< 4.6V) Transmitter will go to about 20% power as long as only one PA Controller was affected.	Mute all PAs for the designated PA Controller and energize all its relays
PAC#_VOLTS	PSn fault, take out its PAs, other controller's PAs still operate	Mute all its PAs & energize all its relays
PAC#_-15V	Without -15V, PACn has lost its ability to MUTE the PAs under its control.	Request another controller to mute the PAs controlled by designated PAC.
A#_OC B#_OC	The designated Power Amplifier has exceeded 14.5A (where # is a number from 1-8).	Mute XMTR 120ms, switch out the PA and release the mute on the rest of the amplifiers
A#_OT B#_OT	The designated Power Amplifier has exceeded 100°C (where # is a number from 1-8).	Mute XMTR 120ms, switch out the PA and release the mute on the rest of the amplifiers.
A#_OUT B#_OUT	The designated PA is not properly seated in the connector. Make sure the module is properly inserted and the thumbscrews on the PA module are engaged (where # is a number from 1-8).	Mute XMTR 120ms, switch out the PA and release the mute on the rest of the PAs. Re-inserting the PA into the connector should clear the fault and re-initialize the PA and the system.
A#_MUTE_FLT B#_MUTE_FLT	Designated PA cannot be muted. Any time PAs are muted the system checks to see if any PA is drawing current. If so, then the controller does not have the ability to mute that PA and the mute fault is activated.	Mute XMTR (exciter and PAs)
A#_UC B#_UC	Designated Power Amplifier's current is less than 10% of the Foursome Ave. current. Could Indicate a failed PA, loss of rf drive to that PA, a power supply problem or a control problem.	Mute XMTR 120ms, switch out the PA and release the mute on the other PAs.
A#_ISO B#_ISO	PA isolation load temperature > 150°C. These loads are located on the Isolation Boards connected to each Z-Plane.	Mute XMTR 120ms, switch out the PA and release the mute on the rest of the PAs.

Troubleshooting

Table 6-4 Platinum Z5 PA Controller Related Faults

PAC#_ISOAZ PAC#_ISOBZ	Designated ISO load Temp > 145°C. Means ISO_APC foldback has failed to reduce temperature of the load. Fold-back level is 135 °C. NOTE: These are the large ceramic loads in the middle of the Isolation Boards which are used as the Isolation resistors for the 2 way combiners on each Z-Plane. Heating is caused by PA imbalance.	Will follow 3 Strike Routine (described in Section 6)
PAC#_ISOAB	Designated ISO load Temp > 145°C. Means ISO_APC foldback has failed to reduce temperature of the load. Fold-back level is 135 °C. NOTE: This is the load on the 5kW 3dB hybrid which is combining the Z-Plane outputs. Heating is caused by imbalance between Z-Plane outputs.	Will follow 3 Strike Routine (described in Section 6)
PAC#_J11	Configuration or Cabling fault. Check cabling and ID jumpers.	Mute XMTR
PAC#_J12	Configuration or Cabling fault. Check cabling and ID jumpers.	Mute XMTR
PAC#_J1	Configuration or Cabling fault. Check cabling and ID jumpers.	Mute XMTR
PAC#_J2	Configuration or Cabling fault. Check cabling and ID jumpers.	Mute XMTR

Troubleshooting

Table 6-5 Platinum Z5 PS Controller Related Faults

ABBREVIATION	COMMENT	ACTION
PSC# +20V	+20V DC supply to PSC failed	Shut PS OFF and discharge
PS#_DSCHG	Discharge circuit failed which means the PS will not discharge. If discharge resistor is open, a PS#_START fault will prevent the transmitter from being turned on again. The same resistor is used for both purposes.	Transmitter is shut OFF
PS#_START	Not able to soft start. Could be an SCR problem or open soft start/discharge resistor (Mounted on top of each transformer).	Shut PS OFF and discharge
PS#_HS_TEMP	SCR heat sink temperature overload	Shut PS OFF and discharge
PS#_PHS_LS	Transformer primary phase loss or severe imbalance	Transmitter will Mute for 20 seconds, then try to turn on again. This will be repeated until successful.
PS#_CONFIG	Power supply #n has cable configuration fault	Mute
PS#_JUMP	Upper or lower tap not available once current tap failed	Shut power supply off and discharge
PS#_TAP1	Tap 1 failed. One or more of the secondary SCRs for the 48V tap have failed on the designated Power Supply.	Tap1 fault indication. PSC will automatically switch to Tap2 if it is not faulted. If Tap2 is faulted, off shut Tx off with PS#_JUMP fault.
PS#_TAP2	Tap 2 failed. One or more of the secondary SCRs for the 50V tap have failed on the designated Power Supply.	Tap2 fault indication. PSC will automatically switch to Tap1 if it is not faulted. If Tap1 is faulted off, switch to Tap3. If Tap3 is faulted off, shut TX off with PS#_JUMP fault.
PS#_TAP3	Tap 3 failed. One or more of the secondary SCRs for the 52V tap have failed on the designated Power Supply.	Tap3 fault indication. PSC will automatically switch to Tap2 if it is not faulted. If Tap2 is faulted off, switch to Tap4. If Tap4 is faulted off, shut TX off with PS#_JUMP fault.
PS#_TAP4	Tap 4 failed. One or more of the secondary SCRs for the 54V tap have failed on the designated Power Supply.	Tap4 fault indication. PSC will automatically switch to Tap3 if it is not faulted. If Tap3 is faulted off, shut TX off with PS#_JUMP fault.
PS#_COMM	PS Controller not able to communicate with the Master	Fault indication. No transmitter action taken.
NOTE: # is the number of the power supply 1 or 2		

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Table 7-1. XMTR, Z5, FORMAT - 994 9714 005

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (F)</i>
570 0329 000	*CONTACTOR 90A 3-POLE 60HZ	0.0 EA	ORDER QTY 1 FOR 3PH & 1PH 60HZ
570 0372 000	CONTACTOR 90A 3 POLE 50HZ	0.0 EA	ORDER QTY 1 FOR 3PH & 1PH 50HZ
646 1662 040	NAMEPLATE, Z5CD	0.0 EA	
646 1662 041	NAMEPLATE, Z5FM	0.0 EA	
917 2435 123	KIT, FIRMWARE, 3PH, Z5	0.0 EA	
917 2435 124	KIT, FIRMWARE, 1PH, Z5	0.0 EA	
939 8168 152	PANEL, BLANK	0.0 EA	ORDER QTY 1 WITH SINGLE EXCITER.
943 5467 144	ADAPTOR, EXHAUST DUCT	0.0 EA	
943 5467 232	ADAPTOR, 3-1/8 TO 1/5/8	1.0 EA	USED TO ADAPT 3-1/8 RF OUTPUT OF LP FILTER TO 1-5/8 OUTPUT
988 2408 005	DP, PLATINUM Z5	1.0 EA	
992 9521 002	MODULE, PA, 850W	9.0 EA	
992 9522 511	POWER BLOCK, RF, 5KW	1.0 EA	
992 9719 009	P/S, 5KW, 3PH, 3W	0.0 EA	ORDER QTY 1 FOR 3 PHASE 3-WIRE
992 9719 010	P/S, 5KW, 3PH, 4W	0.0 EA	ORDER QTY 1 FOR 3 PHASE 4-WIRE
992 9719 023	P/S, 1PH, Z5, Z3.5, & Z2R	0.0 EA	ORDER QTY 1 FOR SINGLE PHASE
992 9766 001	KIT, PLAT Z SERVICE PARTS	0.0 EA	
992 9767 001	KIT, PLAT Z, 1PH SEMICOND,FUSE	0.0 EA	IF SERVICE PARTS KIT IS DESIRED, SELECT THIS KIT FOR ALL 1PHASE ORDERS.
992 9767 003	KIT, PLAT Z, 3PH SEMICOND,FUSE	0.0 EA	IF SERVICE PARTS KIT IS DESIRED, SELECT THIS KIT FOR ALL 3PHASE ORDERS.
992 9768 002	! KIT, PLATINUM Z BOARDS	0.0 EA	
992 9851 050	KIT, CE, SINGLE EXCITER	0.0 EA	
992 9851 051	KIT, CE, DUAL EXCITER	0.0 EA	
994 9410 005	! EXCITER, DIGIT CD	0.0 EA	
994 9678 002	! EXCITER, SUPERCITER	0.0 EA	

Table 7-2. MODULE, PA, 850W - 992 9521 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (C)</i>
302 0051 000	SCR, 4-40 X 3/16	8.0 EA	8# SHIELDS
302 0105 000	SCR, 6-32 X 5/16	4.0 EA	4 # HANDLES
302 0411 000	SCR, 6-32 X 3/8	16.0 EA	16# PAS
314 0003 000	WASHER, SPLIT-LOCK 4	8.0 EA	8# SHIELDS
314 0005 000	WASHER, SPLIT-LOCK 6	20.0 EA	4# HANDLES, 16# PAS
335 0020 000	WASHER NYLON .261 ID	8.0 EA	
357 0098 000	BUTTON, GLIDE 0.750 DIA.	4.0 EA	
404 0899 007	PAD, THERMAL INTERFACE	2.0 EA	
448 1081 000	GASKET, EMI/RFI SHIELDING	0 FT	
448 1082 000	GASKET, EMI/RFI SHIELDING,	0 FT	
646 0665 000	INSPECTION LABEL	1.0 EA	
922 1260 178	SHIELD, PA	2.0 EA	
939 8168 057	HANDLE, MODULE	2.0 EA	
943 5467 004	ASSY, MODULE HEATSINK	1.0 EA	
992 9261 002	PWA, PA, 425W	2.0 EA	

Table 7-3. PWA, PA, 425W - 992 9261 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (F)</i>
055 0100 005	*THERMAL COMPOUND, 8OZ JAR	0.0 EA	#Q001 #Q002
086 0004 054	SOLDER, SN63/PB37	0.0 EA	
086 0004 055	SOLDER, SN62/PB36/AG2	0.0 EA	#C031
254 0002 000	WIRE, BUS CU 20AWG	0.0 FT	L005
254 0055 000	WIRE, 16AWG, SOLID, 600V	0 FT	JPR#3
302 0053 000	SCR, 4-40 X 5/16	3.0 EA	3#PWB
302 0441 000	SCR, 4-40 X 3/8	4.0 EA	2#Q001 2#Q002
310 0003 000	WASHER, FLAT NO. 4	3.0 EA	3#PWB
314 0003 000	WASHER, SPLIT-LOCK 4	7.0 EA	2#Q001 2#Q002 3#PWB
354 0055 000	SOLDER LUG 6 MTG HOLE	4.0 EA	2#Q001 2#Q002
358 3698 000	JUMPER, 0.85" LG, 1/8 HIGH	2.0 EA	JPR#1 JPR#2
385 0002 001	DIODE, RECT 4004 ESD	1.0 EA	CR001
500 0904 000	CAP, VAR 12-60PF 175WVDC	1.0 EA	C001
500 1231 000	CAP 47PF 500V 10% CLAD	1.0 EA	C020
500 1327 000	CAP 200PF 500V 10% CLAD	1.0 EA	C010
500 1354 000	CAP 91PF 5% 250V	2.0 EA	C008 C009
500 1359 000	CAP 150PF 5% 250V	1.0 EA	C032
500 1370 000	CAP, VAR 25-150 PF 250V	1.0 EA	C019
515 0128 000	*CAP .01UF 100V 10% 1206 X7R	5.0 EA	C004 C015 C021 C022 C023
515 0129 000	CAP CHIP .001UF 10% 100V	3.0 EA	C005 C025 C028
515 0131 000	*CAP CHIP 10PF 100V 5%	1.0 EA	C003
515 0138 501	CAP 0.1UF 100V 10% 1812 X7R	2.0 EA	C017 C018
516 0417 000	CAP 1000PF 10% 200V	5.0 EA	C006 C007 C012 C014 C030
516 0484 000	CAP 0.1UF 100V 10%	2.0 EA	C013 C024
516 0768 000	CAP 18PF 5% 100V C0G	2.0 EA	C026 C027
519 0035 000	CAP RF CHIP 24PF 5% 500V	1.0 EA	C031
522 0545 000	CAP 10UF 100V 20%	1.0 EA	C029
540 1600 101	RES 10 OHM 3W 5%	2.0 EA	R001 R002
544 1652 000	* RES 100 OHM 2W 5%	2.0 EA	R003 R004
545 0309 213	RES 332 OHM 1% 1/4W 1206	1.0 EA	R005
545 0309 301	RES 1K OHM 1% 1/4W 1206	1.0 EA	R006
545 0309 501	RES 100K OHM 1% 1/4W 1206	1.0 EA	R007
551 0017 305	TRIMPOT 5K OHM 1/4W 4MM SQ	1.0 EA	R008
559 0055 000	THERMISTOR NTC CHIP 50K @ 25C	1.0 EA	RT001
690 0021 000	*INSPECTOR'S LACQUER, RED	0.0 EA	#C001 #C019
817 2435 197	TEST SPEC, ELECTRICAL	0.0 EA	
843 5471 061	SCH, FM PA	0.0 EA	
843 5471 063	PWB, POWER AMPLIFIER, FM	1.0 EA	
917 2435 022	TRANSFORMER, OUTPUT, PA	1.0 EA	T002
917 2435 026	TRANSFORMER, INPUT, PA	1.0 EA	T001
917 2435 135	FET, RF, MATCHED PAIR	1.0 EA	Q001 Q002
917 2501 021	STRAP, T2	1.0 EA	
922 1085 020	CHOKE, RESISTIVE, 1000OHM	1.0 EA	L001
922 1085 021	CHOKE, FERRITE, 2500 PERM	1.0 EA	L002
922 1085 062	FEEDBACK COIL	2.0 EA	L003 L004
922 1260 005	SPREADER, FM PA	1.0 EA	

Table 7-4. CHOKE, RESISTIVE, 1000OHM - 922 1085 020

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (F)</i>
251 0114 000	WIRE, MAGNET 18 AWG GREEN	1 FT	
540 1600 301	RES 1K OHM 3W 5%	1.0 EA	
822 1085 020	ASSY INSTR, CHOKE,	0.0 EA	

Table 7-5. POWER BLOCK, RF, 5KW - 992 9522 511

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (E)</i>
302 0146 000	SCR, 10-32 X 7/8	8.0 EA	
358 2629 000	PLUG, WHITE .75" HOLE	1.0 EA	
358 2772 000	STANDOFF 6-32 X 3/4	4.0 EA	
358 3607 000	MODULE GUIDE, POLYCARBONATE	18.0 EA	
424 0025 000	GROMMET 9/16 MTG DIA	2.0 EA	
424 0641 000	GROMMET EDGING	0 FT	
612 0233 000	RECEPTACLE N UG-58A/U	1.0 EA	
700 1225 000	TERMINATION 50 OHM 800W	1.0 EA	
839 7900 010	BRACKET, "N" CONNECTOR	1.0 EA	
917 2435 017	STANDOFF, COMBINER	8.0 EA	
917 2435 044	STANDOFF, COMBINER	4.0 EA	
917 2435 072	HEXNUT, ISO MOUNT	8.0 EA	
917 2435 149	CABLE, Z5	1.0 EA	
917 2435 219	LABEL, PA OUTLINE, 5, 2KW	1.0 EA	
917 2435 951	CADS 5KW JUMPERS	1.0 EA	
922 1260 191	COVER, FEEDTHRU PCB	9.0 EA	
922 1260 227	ASSY, LOAD SINK	1.0 EA	
943 5467 161	PNL, LT INNER/RT OUTER REAR	1.0 EA	
943 5467 168	PNL, RT INR/LT OUTER REAR	1.0 EA	
992 9269 002	PWA, NETWORK, RF ISOLATION	2.0 EA	
992 9278 001	*PWA, CTRLR, PA	1.0 EA	
992 9281 003	PWA, COMBINER/DIVIDER, 2.7KW	2.0 EA	
992 9541 001	PWA, BACKPLANE, IPA	1.0 EA	
992 9719 016	COMBINER, 5.3KW, RF	1.0 EA	
992 9719 022	XMTR, BASIC Z5, Z3.5, Z2	1.0 EA	
992 9756 001	PWA, 20 CONDUCTOR FILTER	5.0 EA	
992 9756 101	PWA, 26 CONDUCTOR FILTER	4.0 EA	

Table 7-6. PWA, NETWORK, RF ISOLATION - 992 9269 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (F)</i>
328 0074 000	WASHER, STEEL COMPRESSION	4.0 EA	
336 1245 000	PIN, CONTACT 0.093 OD 0.045 ID	16.0 EA	2/R001 2/R002 2/R003 2/R004 2/R005 2/R006 2/R007 2/R008
358 3524 000	PIN PRINTED CIRCUIT BOARD	10.0 EA	E001 E002 E003 E004 E005 E006 E007 E008 E009 E010
382 1502 000	IC, L603C, 8 DRIVER, ESD	1.0 EA	U001
384 0854 000	DIODE ARRAY, 8 ISOLATED ESD	1.0 EA	CR009
404 0766 000	SOCKET, DIP, 18 PIN (DL)	1.0 EA	XU001
492 0865 000	INDUCTOR, FIXED RF 475NH	8.0 EA	L001 L002 L003 L004 L005 L006 L007 L008
515 0078 000	*CAP CHIP 1000PF 10% 50V	39.0 EA	C001 C002 C003 C004 C005 C006 C007 C008 C009 C010 C011 C012 C013 C014 C015 C016 C017 C018 C019 C020 C031 C032 C033 C034 C035 C036 C037 C038 C039 C040 C041 C042 C043 C044 C045 C046 C047 C048 C049

519 0050 000	CAP RF CHIP 100PF 5% 500V	8.0 EA	C029 C030 C050 C051 C052 C053 C054 C055
545 0309 319	RES 5.62K OHM 1% 1/4W 1206	1.0 EA	R010
574 0511 000	*RELAY SPDT 48VDC 16AMPS	8.0 EA	K001 K002 K003 K004 K005 K006 K007 K008
610 0877 000	HDR, STR, 2 PIN, SQ	2.0 EA	JP001 JP002
610 0981 000	HDR 20C 2ROW VERTICAL	2.0 EA	J001 J002
612 1184 000	SHUNT JUMPER 0.1" CENTERS	2.0 EA	1/#JP001 1/#JP002
843 5471 271	SCH, ISOLATION BOARD	0.0 EA	
843 5471 273	PWB, ISOLATION	1.0 EA	
917 2435 185	ASSY, ISO RESISTOR	8.0 EA	RT001 RT002 RT003 RT004 RT005 RT006 RT007 RT008
917 2435 186	ASSY, ISO RESISTOR, 70.7 OHM	1.0 EA	R009
939 8168 069	ANGLE, ISO CHASSIS	2.0 EA	
939 8168 070	COVER, ISO CHASSIS	1.0 EA	
943 5467 060	HEATSINK, ISO BD	1.0 EA	
943 5467 172	CHASSIS, ISO BOARD	1.0 EA	
999 2872 001	HARDWARE LIST, PWA NETWORK	1.0 EA	

Table 7-7. ASSY, ISO RESISTOR - 917 2435 185

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (A)</i>
540 1550 000	RES 50 OHM, 12W 10%	1.0 EA	
559 0056 000	THERMISTOR, 50K @25C 5%	1.0 EA	
690 0023 000	EPOXY, ADHESIVE, ONE COMPONENT	0.0 PT	
817 2435 185	ASSY INSTR, ISO RESISTOR	0.0 EA	

Table 7-8. ASSY, ISO RESISTOR, 70.7 OHM - 917 2435 186

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (B)</i>
055 0190 009	* COATING 3140 RTV	0.0 EA	
296 0309 000	TUBING, TEFLON 24 AWG	0 FT	
515 0078 000	*CAP CHIP 1000PF 10% 50V	1.0 EA	
544 1675 000	RESISTOR 70.7 OHM 400W	1.0 EA	
559 0053 000	THERMISTOR,NTC,10K@25C,1%	1.0 EA	
690 0023 000	EPOXY, ADHESIVE, ONE COMPONENT	0.0 PT	
817 2435 186	ASSY INSTR, ISO RES, 70.7 OHM	0.0 EA	

Table 7-9. *PWA, CTRL, PA - 992 9278 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (Y)</i>
610 0980 000	HDR 20C 2ROW RT ANG	2.0 EA	J001 J002
610 0983 000	HDR 26C 2ROW RT ANG	2.0 EA	J011 J012
817 2435 152	FIRMWARE MATRIX	0.0 EA	
992 9278 002	*PWA, CTRL PA, SMT	1.0 EA	

Table 7-10. *PWA, CTRL PA, SMT - 992 9278 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (T)</i>
381 0020 000	XSTR, MMBTA64LT1 SOT ESD	8.0 EA	Q001 Q002 Q003 Q004 Q005 Q006 Q007 Q008
382 1392 000	IC, LM324 QUAD OP AMP ESD	3.0 EA	U009 U029 U035
382 1443 000	IC, 79L12-12V REG ESD	1.0 EA	U022
383 0053 000	IC, TL750M05 ESD	1.0 EA	U001
383 0093 015	IC, 78L15 ESD	1.0 EA	U006
383 0094 015	IC, 79L15 ESD	1.0 EA	U007

383 0126 000	*IC MAX705/ADM705 WATCHDOG ESD	1.0 EA	U028
383 0149 000	IC, 74HC573ADW SOL-20 ESD	6.0 EA	U011 U021 U024 U025 U031 U034
383 0152 000	IC, MAX528 DAC SOL-24 ESD	1.0 EA	U019
383 0155 000	IC, MAX366/ADG466 SO-8 ESD	1.0 EA	U012
383 0157 000	IC, ADG506 ESD	2.0 EA	U010 U015
383 0158 000	IC, NE555 ESD	1.0 EA	U008
383 0159 000	IC, OP-07 ESD	16.0 EA	U002 U003 U004 U005 U013 U014 U017 U018 U026 U027 U032 U033 U036 U037 U038 U039
383 0254 000	IC, 74HC04 (SMT) ESD	1.0 EA	U020
383 0257 000	IC, MMAD1108 ESD	3.0 EA	CR001 CR018 CR028
385 0001 000	DIODE, RECT 4148 / 914 ESD	11.0 EA	CR002 CR003 CR004 CR006 CR010 CR016 CR017 CR019 CR020 CR021 CR030
385 0011 000	DIODE, SCHOTTKY MBRS340 ESD	2.0 EA	CR023 CR029
387 0005 005	ZENER, 4.7V 225MW ESD	2.0 EA	CR015 CR022
387 0005 009	ZENER, 6.8V 225MW ESD	1.0 EA	CR005
387 0005 025	ZENER, 33V 225MW ESD	8.0 EA	CR011 CR012 CR013 CR014 CR024 CR025 CR026 CR027
387 0010 006	DIODE, TVS 5.0V 1500W ESD	1.0 EA	CR009
387 0010 017	DIODE, TVS 15V 1500W ESD	2.0 EA	CR007 CR008
393 0020 000	IC, 68HC16Z116	1.0 EA	U016
404 0869 000	SOCKET, PLCC-32, SMT	2.0 EA	XU023 XU030
444 3011 000	*XTAL 32.768KHZ SMT	1.0 EA	Y001
496 0040 000	IND CHIP 10 UH 10%	1.0 EA	L001
496 0050 000	IND CHIP .027UH 10%	4.0 EA	L002 L003 L004 L005
515 0134 109	CAP 22PF 100V 5% 0805 C0G	2.0 EA	C040 C044
515 0134 201	CAP 100PF 100V 5% 0805 C0G	7.0 EA	C005 C059 C063 C193 C194 C204 C205
515 0136 301	CAP 1000PF 100V 10% 0805 X7R	114.0 EA	C006 C007 C008 C016 C020 C025 C029 C033 C034 C035 C036 C045 C046 C047 C050 C051 C052 C053 C056 C057 C058 C069 C074 C080 C083 C087 C088 C093 C094 C095 C096 C100 C101 C102 C103 C104 C105 C106 C107 C108 C109 C110 C113 C114 C115 C116 C117 C119 C120 C121 C122 C123 C124 C126 C128 C129 C135 C137 C139 C144 C155 C161 C167 C168 C169 C170 C171 C172 C173 C174 C175 C176 C177 C178 C179 C180 C181 C182 C183 C184 C185 C186 C187 C188 C189 C190 C195 C196 C197 C198 C199 C200 C201 C206 C207 C208 C209 C210 C211 C219 C220 C221 C222 C223 C224 C225 C226 C227 C228 C229 C230 C231 C232 C233
515 0136 401	CAP 0.01UF 100V 10% 0805 X7R	65.0 EA	C001 C002 C003 C004 C009 C010 C012 C013 C014 C015 C021 C022 C023 C024 C032 C041 C048 C049 C054 C060 C061 C062 C066 C067 C070 C072 C078 C079 C081 C082 C086 C090 C091 C092 C111 C112 C131 C133 C134 C136 C138 C140 C141 C142 C143 C145 C146 C147 C148 C149 C151 C152 C153 C154 C157 C158 C159 C160 C162 C163 C164 C165 C166 C215 C216
515 0136 501	CAP 0.1UF 50V 10% 0805 X7R	28.0 EA	C026 C027 C037 C038 C039 C042 C043 C055 C068 C071 C075 C076 C084 C085 C089 C097 C098 C118 C127 C130 C132 C150 C156 C191 C192 C212 C217 C218
515 0138 601	CAP 1UF 50V 20% 1812 X7R	10.0 EA	

523 0001 201	CAP 100UF 6.3V 20% SMT	1.0 EA	C028 C030 C031 C065 C073 C099 C125 C202 C203 C213
523 0003 101	CAP 10UF 35V 20% SMT	6.0 EA	C017
540 1545 000	RESISTOR NETWORK 10K OHM	4.0 EA	C011 C018 C019 C064 C077 C214
540 1557 000	RES NETWORK 1K OHM 2%	5.0 EA	R011 R026 R034 R087
545 0295 000	RES 10M OHM 1/4W 5% 1206	1.0 EA	R027 R029 R031 R032 R036
545 0300 000	RES 9.09K 0.1% 1/8W 1206	10.0 EA	R022
545 0302 000	RES 113K OHM 1% 1/4W 1206	2.0 EA	R010 R016 R017 R018 R019 R044 R046 R047 R048 R049
545 0306 000	RES 274 OHM 1% 1206 SMT	8.0 EA	R009 R043
545 0308 218	RES 511 OHM 1% 0.1W 0805	7.0 EA	R013 R014 R020 R021 R038 R039 R041 R042
545 0308 222	RES 750 OHM 1% 0.1W 0805	1.0 EA	R092 R097 R098 R099 R100 R101 R102
545 0308 301	RES 1K OHM 1% 0.1W 0805	6.0 EA	R001
545 0308 305	RES 1.5K OHM 1% 0.1W 0805	1.0 EA	R006 R059 R060 R093 R094 R095
545 0308 308	RES 2K OHM 1% 0.1W 0805	1.0 EA	R033
545 0308 312	RES 3.01K OHM 1% 0.1W 0805	8.0 EA	R081
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	1.0 EA	R066 R067 R071 R072 R073 R074 R075 R078
545 0308 320	RES 6.19K OHM 1% 0.1W 0805	2.0 EA	R076
545 0308 321	RES 6.81K OHM 1% 0.1W 0805	8.0 EA	R082 R096
545 0308 401	RES 10K OHM 1% 0.1W 0805	13.0 EA	R008 R015 R028 R050 R051 R054 R056 R057
545 0308 402	RES 11K OHM 1% 0.1W 0805	8.0 EA	R005 R024 R030 R045 R052 R053 R055 R058
545 0308 408	RES 20K OHM 1% 0.1W 0805	4.0 EA	R077 R083 R084 R085 R086
545 0308 411	RES 26.7K OHM 1% 0.1W 0805	1.0 EA	R061 R062 R063 R064 R065 R068 R069 R070
545 0308 421	RES 68.1K OHM 1% 0.1W 0805	1.0 EA	R002 R003 R004 R035
545 0308 422	RES 75K OHM 1% 0.1W 0805	1.0 EA	R088
545 0308 512	RES 301K OHM 1% 0.1W 0805	1.0 EA	R040
545 0308 513	RES 332K OHM 1% 0.1W 0805	1.0 EA	R012
545 0308 518	RES 511K OHM 1% 0.1W 0805	1.0 EA	R089
545 0309 205	RES 150 OHM 1% 1/4W 1206	2.0 EA	R023
545 0309 401	RES 10K OHM 1% 1/4W 1206	4.0 EA	R007
561 0002 007	POSISTOR 0.5 AMP 15VDC 1812	1.0 EA	R090 R091
561 0003 007	POSISTOR 0.5 AMP 60VDC 2029	2.0 EA	R025 R037 R079 R080
604 1162 000	DIPSWITCH, 8 SPST SMT	1.0 EA	F001
843 5471 121	SCH, PA CONTROLLER	0.0 EA	F002 F003
843 5471 123	PWB, PA CONTROLLER	1.0 EA	S001

Table 7-11. PWA, COMBINER/DIVIDER, 2.7KW - 992 9281 003

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (D)</i>
254 0001 000	WIRE, BUS CU 22AWG	8.0 FT	
302 0106 000	SCR, 6-32 X 3/8	4.0 EA	4/J010
306 0016 000	NUT, HEX KEP 6-32	4.0 EA	4/J010
336 1245 000	PIN, CONTACT 0.093 OD 0.045 ID	18.0 EA	2/R001 2/R002 2/R003 2/R004 2/R005 2/R006 2/R007 2/R008 2/R009
350 0108 000	RIVET .094 DIA X .500 LG	6.0 EA	
540 1550 000	RES 50 OHM, 12W 10%	8.0 EA	R001 R002 R003 R004 R005 R006 R007 R008
540 1551 000	RES 70.7 OHM, 12W @40 DEG C	1.0 EA	R009
612 1479 000	CONN, EDGE CARD, 36 CONT	8.0 EA	J001 J002 J003 J004 J005 J006 J007 J008
620 2873 000	CONN PANEL 7/16 (MALE)	1.0 EA	J010
646 0665 000	INSPECTION LABEL	1.0 EA	
817 2435 197	TEST SPEC, ELECTRICAL	0.0 EA	
917 2435 094	CLIP, Z-PLANE GROUND	16.0 EA	
917 2435 160	COVER, 7/16 CONNECTOR	1.0 EA	

917 2435 187	PLATE COAX CONN, Z PLANE BOARD	2.0 EA
917 2435 188	ELEMENT, CAPACITIVE,	1.0 EA
917 2435 189	ELEMENT, CAPACITIVE,	2.0 EA
992 9283 202	PWA, DIVIDER, 160W, RF	1.0 EA
992 9284 002	PWA, COMBINER, 2.7KW, RF	1.0 EA

Table 7-12. PWA, DIVIDER, 160W, RF - 992 9283 202

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (C)</i>
384 0854 000	DIODE ARRAY, 8 ISOLATED ESD	1.0 EA	CR001
404 0675 000	SOCKET, DIP, 16 PIN (DL)	2.0 EA	#CR001 #R009
516 0736 000	CAP .001UF 10% 100V X7R	8.0 EA	C001 C002 C003 C004 C005 C006 C007 C008
519 0019 000	CAP RF CHIP 5.1PF 500V	1.0 EA	MAY BE REMOVED DURING TEST. C009
519 0030 000	CAP RF CHIP 15PF 5% 500V	1.0 EA	C010
540 1366 000	RES NETWORK 100 OHM 2%	1.0 EA	R009
542 1603 000	RES, 0.01 OHM, 3W 1%	8.0 EA	R011 R012 R013 R014 R015 R016 R017 R018
560 0121 010	POSISTOR 0.9 AMP 60VDC DISC	4.0 EA	F001 F002 F003 F004
610 0933 000	JUMPER, PWB TEST POINT	1.0 EA	TP001
610 0982 000	HDR 26C 2ROW VERTICAL	2.0 EA	J011 J012
610 1121 000	HDR 4C 2ROW STRAIGHT	1.0 EA	JP001
612 1184 000	SHUNT JUMPER 0.1" CENTERS	2.0 EA	2/#JP001
620 2023 000	RECEPTACLE, BNC VERT PCB	1.0 EA	J009
843 5471 281	SCH, DIVIDER	0.0 EA	
843 5471 283	PWB, DIVIDER	1.0 EA	

Table 7-13. PWA, COMBINER, 2.7KW, RF - 992 9284 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (A)</i>
358 3525 000	PIN RECEPTACLE	10.0 EA	E001 E002 E003 E004 E005 E006 E007 E008 E009 E010
843 5471 291	SCH, COMBINER	0.0 EA	
843 5471 293	PWB, COMBINER	1.0 EA	

Table 7-14. PWA, BACKPLANE, IPA - 992 9541 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (M)</i>
252 0420 000	WIRE, RIBBON 5 X 100 MIL	0 FT	1/JP001 1/JP002
254 0001 000	WIRE, BUS CU 22AWG	0 FT	8/GND
358 2684 000	PC BD STANDOFF 4-40X.125	6.0 EA	
382 1502 000	IC, L603C, 8 DRIVER, ESD	1.0 EA	U001
384 0321 000	*DIODE 5082-2800 ESD	1.0 EA	CR001
404 0766 000	SOCKET, DIP, 18 PIN (DL)	1.0 EA	XU001
492 0858 000	IND, FIXED RF 158NH 5% Q=68	2.0 EA	L001 L003
492 0871 000	IND, FIXED RF 138NH 5% Q=68	1.0 EA	L002
516 0736 000	CAP .001UF 10% 100V X7R	9.0 EA	C001 C002 C004 C005 C006 C007 C008 C009 C012
518 0112 000	CAP, TRIM 2-10PF 50V	1.0 EA	C013
519 0030 000	CAP RF CHIP 15PF 5% 500V	1.0 EA	C011
519 0034 000	*CAP RF CHIP 22PF 5% 500V	1.0 EA	C003
519 0035 000	CAP RF CHIP 24PF 5% 500V	1.0 EA	C010
540 1600 308	RES 2K OHM 3W 5%	1.0 EA	R003
542 1603 000	RES, 0.01 OHM, 3W 1%	1.0 EA	R001
545 0309 201	RES 100 OHM 1% 1/4W 1206	1.0 EA	R002
548 2400 201	RES 100 OHM 1/2W 1%	1.0 EA	R005

559 0053 000	THERMISTOR,NTC,10K@25C,1%	2.0 EA	RT001 RT002
560 0121 010	POSISTOR 0.9 AMP 60VDC DISC	2.0 EA	F001 F002
574 0511 000	*RELAY SPDT 48VDC 16AMPS	3.0 EA	K001 K002 K003
610 0933 000	JUMPER, PWB TEST POINT	2.0 EA	TP002 TP006
610 1155 000	HDR 20C 2 ROW .1" CTRS	1.0 EA	J007
612 1488 000	CONN, EDGECARD 36 CONT	2.0 EA	J001 J002
620 1677 000	RECEPTACLE, PC MT, BNC	5.0 EA	J003 J004 J005 J006 J008
843 5467 070	PWB, IPA BACKPLANE GND	2.0 EA	
843 5471 201	SCH, IPA BACKPLANE	0.0 EA	
843 5471 203	PWB, IPA BACKPLANE	1.0 EA	
999 2871 001	HARDWARE LIST, IPA BACKPLANE	1.0 EA	

Table 7-15. COMBINER, 5.3KW, RF - 992 9719 016

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (B)</i>
354 0319 000	TERM LUG .375 HOLE	1.0 EA	
357 0087 000	SCR, 1/4-20 X 1/2 HHMS	1.0 EA	
357 0093 000	SCREW, 1/4-20 X 7/8 FHMS	2.0 EA	
357 0112 000	SCREW, 8-32 X 1.00 TEFLON	2.0 EA	
620 0410 000	JACK, BULKHEAD UG-657/U	1.0 EA	
817 2435 197	TEST SPEC, ELECTRICAL	0.0 EA	
917 2435 008	STANDOFF, STRIPLINE	4.0 EA	
917 2435 013	SPACER, STRIPLINE	2.0 EA	
917 2435 015	INSULATOR, 5KW COMBINER	1.0 EA	
917 2435 024	INSULATOR, 5.3KW COMBINER	1.0 EA	
917 2435 136	ASSY, RES/THERM, COMBINER	1.0 EA	
917 2435 200	BULLET, 5.3KW COMBINER	1.0 EA	
917 2435 218	SOLDER LUG, 5KW COMBINER	1.0 EA	
922 1260 189	CLAMP, MODIFIED	1.0 EA	
922 1260 227	ASSY, LOAD SINK	1.0 EA	
922 1260 229	SUPPORT, TEFLON	5.0 EA	
939 8168 009	ASSY, OUTER CONDUCTOR	1.0 EA	
943 5467 153	ASSY, MAIN STRIPLINE	1.0 EA	
943 5467 154	ASSY, COUPLER STRIPLINE	1.0 EA	
943 5467 235	ENCLOSURE, 5.3KW COMBINER	1.0 EA	
943 5467 236	COVER, ENCLOSURE	1.0 EA	
999 2874 001	HARDWARE LIST, COMBINER	1.0 EA	

Table 7-16. ASSY, RES/THERM, COMBINER - 917 2435 136

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (A)</i>
051 0001 016	*WIRE TACKING ADHESIVE KT	0.0 EA	
055 0190 009	* COATING 3140 RTV	0.0 EA	
296 0310 000	TUBING TEFLON 20 AWG	0 FT	
515 0078 000	*CAP CHIP 1000PF 10% 50V	1.0 EA	
559 0053 000	THERMISTOR,NTC,10K@25C,1%	1.0 EA	
690 0023 000	EPOXY, ADHESIVE, ONE COMPONENT	0.0 PT	
700 1225 000	TERMINATION 50 OHM 800W	1.0 EA	
817 2435 136	INSTR, 800W 50 OHM,	0.0 EA	

Table 7-17. XMTR, BASIC Z5, Z3.5, Z2 - 992 9719 022

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (F)</i>
007 4030 001	BRZ, FGR STK 97-520-02	4 EA	
007 4030 002	FINGER STOCK 0097-0542-02	0 EA	
007 4060 029	BRZ, FINGERS TWIST 97-560	3 IN	
007 4060 079	BRZ, FGR STK 0097-0606-02	15.0 EA	
026 6010 003	GROMMET STRIP, 0.125	1 FT	
041 6030 013	CHANNEL 1/16 MTL	4 FT	
356 0208 000	CLAMP, FLAT CABLE 2"	17.0 EA	
356 0214 000	CLAMP, FLAT CABLE 1 IN.	2.0 EA	
358 0498 000	CLAMP, HOSE	4.0 EA	
358 1214 000	SCREWLOCK, FEMALE	1.0 EA	TB001
358 2598 000	CABLE TIE MOUNT, 4-WAY	6.0 EA	
398 0554 000	FUSE, SLOW CART 10A 250V MDA	1.0 EA	
402 0203 000	FUSEHOLDER 3AG SHOCKSAFE	1.0 EA	F001 F002
424 0023 000	GROMMET 1 IN MTG DIA	2.0 EA	
424 0025 000	GROMMET 9/16 MTG DIA	2.0 EA	
424 0026 000	GROMMET 3/8 MTG DIA	1.0 EA	
424 0641 000	GROMMET EDGING	0 FT	
448 0254 000	FASTENER, RIGHT HAND	3.0 EA	
448 1075 000	SHIELDING GASKET, RFI EMI	5 FT	
614 0807 000	INTERFACE, 37PIN, TB/"D"	1.0 EA	
620 0455 000	ADPT BNC UG492A/U	2.0 EA	J003 J004
646 1353 000	NAMEPLATE, XMTR EQUIPMENT	1.0 EA	
646 1483 000	HARRIS NAMEPLATE	1.0 EA	
646 1483 002	OVERLAY, CAB TRIM STRIPE	1.0 EA	
646 1647 000	LABEL, PATENT, ZFM,	1.0 EA	
917 2435 045	PANEL, ACCESS	1.0 EA	
917 2435 047	PLATE, SINK	1.0 EA	
917 2435 057	SPACER, P/S DOCKING	2.0 EA	
922 1260 023	SIDE, LEFT, DUCT	1.0 EA	
922 1260 024	SIDE, RIGHT, DUCT	1.0 EA	
922 1260 025	FRONT, DUCT	1.0 EA	
922 1260 043	GUIDE, MODIFIED	2.0 EA	
922 1260 057	BASE, DUCT	1.0 EA	
922 1260 062	ANGLE, P/S SHIPPING	2.0 EA	
922 1260 113	BRACKET, FEED-THRU	1.0 EA	
922 1260 142	STRAP, GROUND, 2 FT LONG	1.0 EA	
922 1260 156	AIR PLATE, IPA DUCT	1.0 EA	
922 1260 157	CLOSEOUT, IPA DUCT	1.0 EA	
922 1260 187	BRKT, LT INNER/RT OUTER	1.0 EA	
922 1260 188	BRKT, RT INNER/LT OUTER	1.0 EA	
922 1260 192	BRKT LT INNER/RT OUTER REAR	1.0 EA	
922 1260 193	BRKT RT INNER/LT OUTER REAR	1.0 EA	
922 1260 206	DAM, AIR	1.0 EA	
922 1260 214	COVER, CHASSIS REAR	2.0 EA	
922 1260 223	DEFLECTOR, AIR COOLED RESISTOR	2.0 EA	
922 1260 224	SPACER BRACKET, IPA	1.0 EA	
922 1260 232	COVER, 3-1/8 FLANGE	1.0 EA	SHIPPING COVER LPF OUTPUT
939 8168 021	FACEPLATE, IPA MODULE	1.0 EA	
939 8168 031	BRKT, 10KW COMBINER SUPPORT	2.0 EA	
939 8168 036	ANGLE, EIA, POWER SUPPLY	2.0 EA	
939 8168 043	PANEL, SIDE, COMBINER COVER	1.0 EA	
939 8168 058	PLATE, CLOSEOUT	1.0 EA	
939 8168 060	ANGLE, SLIDE, L/R	2.0 EA	

939 8168 061	SPACER, RECT, L/R	2.0 EA
939 8168 065	ANGLE, GASKET MTG	1.0 EA
939 8168 067	ANGLE, GASKET MTG	2.0 EA
939 8168 097	FLANGE, CLOSEOUT	2.0 EA
939 8168 155	SIDE, COMBINER SHIELD, 10KW	1.0 EA
939 8168 166	TOP, COMBINER SHIELD, 10KW	1.0 EA
939 8168 170	PANEL, FRONT MTG	2.0 EA
939 8168 181	CHASSIS, REAR	1.0 EA
939 8168 182	CHASSIS, FRONT	1.0 EA
939 8168 185	ANGLE, FACE PLATE	2.0 EA
939 8168 186	ANGLE, GASKET MTG	2.0 EA
939 8168 187	ANGLE, RFI, PB DOOR	1.0 EA
939 8168 188	PLATE, CLOSEOUT	1.0 EA
939 8168 192	DECK, UPPER CENTER	1.0 EA
939 8168 193	PLATE, UPPER REAR DECK	1.0 EA
939 8168 294	ANGLE, EIA, POWER BLOCK, RT	1.0 EA
939 8168 299	CLOSEOUT, RIGHT SIDE,	1.0 EA
939 8168 309	BRACKET, REAR SHIELD	1.0 EA
939 8168 310	CLOSEOUT, LEFT SIDE,	1.0 EA
943 5467 022	PLT,CLOSEOUT,LOWER SHELF,FRONT	1.0 EA
943 5467 076	SHIELD, CONTROLLER/EXCITER	1.0 EA
943 5467 115	PANEL, POWER SUPPLY	1.0 EA
943 5467 158	DECK, LOWER	1.0 EA
943 5467 159	DECK, UPPER RIGHT REAR	1.0 EA
943 5467 163	DECK, UPPER FRONT	1.0 EA
943 5467 164	DECK, UPPER LEFT REAR	1.0 EA
943 5467 186	PANEL, LEFT INNER	1.0 EA
943 5467 187	DEFLECTOR, AIR CLOSEOUT	2.0 EA
943 5467 188	DEFLECTOR, AIR CLOSEOUT	2.0 EA
943 5467 205	BASKET, 10KW COMBINER	1.0 EA
943 5467 207	CLOSE OUT PLATE	2.0 EA
943 5467 224	BRACKET, FILTER MTG.	1.0 EA
943 5467 230	ASSY., LOWPASS FILTER	1.0 EA
943 5467 238	ASSY, POWER BLOCK DOOR	1.0 EA
943 5467 249	PANEL, INNER, RIGHT SIDE	1.0 EA
952 9199 027	ASSY, CABINET WELDMENT, ALUM	1.0 EA
992 9515 200	CONTROLLER, TRANSMITTER	1.0 EA
992 9719 003	ASSY., AIR 2 SPEED	1.0 EA
992 9719 015	AC MAINS, BASIC	1.0 EA
992 9719 018	XMSN LINE, 5.3KW, 50 OHM	1.0 EA
992 9803 001	ASSY, DIRECTIONAL COUPLER DB	1.0 EA
992 9936 001	ATTENUATOR, 3DB DUAL, 25W	1.0 EA
999 2901 001	HARDWARE LIST, XMTR, BASIC,5KW	1.0 EA

Table 7-18. CONTROLLER, TRANSMITTER - 992 9515 200

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (C)</i>
299 0015 000	TAPE, PVC VINYL CLOSED	0.0 RL	
358 2105 000	CARD GUIDE	8.0 EA	
358 3556 000	TENSION CARD GUIDE	8.0 EA	
917 2435 050	HANDLE, CTLR/DIGIT	2.0 EA	
922 1260 041	SPACER, HEX .375 X 6.07	6.0 EA	
939 8168 059	BAR, BOARD RESTRAINT	1.0 EA	
939 8168 062	PLATE, CHASSIS RUNNER	2.0 EA	
943 5467 075	CHASSIS, CONTROLLER	1.0 EA	

992 9278 001	*PWA, CTRL, PA	1.0 EA
992 9279 001	*PWA, CTRL, MASTER	1.0 EA
992 9515 500	ASSY, FRONT PANEL/OVERLAY	1.0 EA
992 9516 001	PWA, CTRL, LIFE SUPPORT	1.0 EA
992 9517 001	*PWA, CONTROLLER, P/S	1.0 EA
992 9518 001	PWA, DISPLAY/BACKPLANE,CONTROL	1.0 EA

Table 7-19. *PWA, CTRL, MASTER - 992 9279 001

Harris PN	Description	QTY UM	Reference Designators (X)
392 0066 000	EEPROM, 25C040 PROG/ESD	1.0 EA	U39
404 0673 000	SOCKET, DIP, 8 PIN (DL)	1.0 EA	
817 2435 152	FIRMWARE MATRIX	0.0 EA	
992 9279 002	*PWA, CTRL MASTER, SMT	1.0 EA	

Table 7-20. *PWA, CTRL MASTER, SMT - 992 9279 002

Harris PN	Description	QTY UM	Reference Designators (T)
382 1393 000	IC, LM324A ESD	5.0 EA	U005 U006 U007 U009 U012
383 0049 000	IC, AD7808 ESD	1.0 EA	U008
383 0053 000	IC, TL750M05 ESD	1.0 EA	U002
383 0054 000	IC, LM2931 ESD	1.0 EA	U035
383 0094 015	IC, 79L15 ESD	1.0 EA	U034
383 0126 000	*IC MAX705/ADM705 WATCHDOG ESD	1.0 EA	U036
383 0128 000	IC UCN5818EPF ESD	1.0 EA	U033
383 0148 000	IC, 74HC14AD ESD	1.0 EA	U016
383 0149 000	IC, 74HC573ADW SOL-20 ESD	10.0 EA	U003 U010 U014 U015 U021 U022 U026 U032 U037 U038
383 0151 000	IC, 74HC08AD SO-14 ESD	1.0 EA	U040
383 0153 000	IC, MAX238/ADM238 SOL-24 ESD	1.0 EA	U004
383 0155 000	IC, MAX366/ADG466 SO-8 ESD	1.0 EA	U024
383 0157 000	IC, ADG506 ESD	2.0 EA	U019 U020
383 0161 000	IC, SN75468, 7 DRIVER, ESD	3.0 EA	U027 U029 U041
383 0164 000	IC, IDT6116 SRAM ESD	1.0 EA	U031
383 0204 000	IC 68681 DUART ESD	1.0 EA	U025
383 0244 000	IC ILD206 OPTO-COUPLER ESD	2.0 EA	U013 U017
383 0254 000	IC, 74HC04 (SMT) ESD	1.0 EA	U023
383 0257 000	IC, MMAD1108 ESD	1.0 EA	CR003
383 0259 000	IC, AD633 MULTIPLIER ESD	1.0 EA	U001
385 0001 000	DIODE, RECT 4148 / 914 ESD	4.0 EA	CR001 CR007 CR008 CR009
385 0011 000	DIODE, SCHOTTKY MBRS340 ESD	2.0 EA	CR010 CR011
385 0027 000	DIODE, 2800 SCHOTTKY SMT ESD	2.0 EA	CR002 CR013
387 0002 006	DIODE, TVS 5.0V 1500W ESD	1.0 EA	CR004
387 0002 017	DIODE, TVS 15V 1500W ESD	2.0 EA	CR005 CR006
387 0005 025	ZENER, 33V 225MW ESD	1.0 EA	CR012
393 0020 000	IC, 68HC16Z116	1.0 EA	U030
404 0869 000	SOCKET, PLCC-32, SMT	2.0 EA	XU018 XU028
444 3011 000	*XTAL 32.768KHZ SMT	1.0 EA	Y002
444 3012 000	XTAL 3.6864 MHZ SMT	1.0 EA	Y001
496 0040 000	IND CHIP 10 UH 10%	1.0 EA	L001
515 0100 000	CAP CHIP .33UF 10% 50V	6.0 EA	C015 C021 C029 C042 C051 C060
515 0134 101	CAP 10PF 100V 5% 0805 C0G	2.0 EA	C097 C100
515 0134 109	CAP 22PF 100V 5% 0805 C0G	2.0 EA	C132 C133
515 0134 201	CAP 100PF 100V 5% 0805 C0G	5.0 EA	C088 C089 C104 C107 C129

515 0136 301	CAP 1000PF 100V 10% 0805 X7R	50.0 EA	C002 C003 C004 C005 C009 C010 C011 C012 C013 C016 C017 C018 C019 C023 C024 C025 C026 C027 C028 C035 C036 C037 C041 C043 C044 C049 C052 C053 C054 C057 C058 C059 C066 C067 C068 C071 C072 C073 C092 C093 C101 C102 C108 C109 C112 C113 C135 C139 C140 C144
515 0136 401	CAP 0.01UF 100V 10% 0805 X7R	38.0 EA	C001 C014 C020 C030 C032 C033 C034 C038 C039 C048 C056 C063 C069 C070 C075 C076 C078 C079 C080 C081 C082 C086 C087 C091 C095 C096 C115 C116 C118 C121 C123 C124 C127 C131 C134 C136 C137 C138
515 0136 501	CAP 0.1UF 50V 10% 0805 X7R	26.0 EA	C008 C022 C040 C045 C050 C055 C064 C065 C083 C084 C085 C090 C098 C099 C103 C106 C110 C111 C117 C122 C125 C126 C128 C130 C141 C142
515 0138 601	CAP 1UF 50V 20% 1812 X7R	3.0 EA	C074 C119 C120
523 0001 201	CAP 100UF 6.3V 20% SMT	2.0 EA	C077 C094
523 0002 201	CAP 100UF 25V 20% SMT	1.0 EA	C114
523 0003 101	CAP 10UF 35V 20% SMT	8.0 EA	C006 C007 C046 C047 C061 C062 C105 C143
540 1545 000	RESISTOR NETWORK 10K OHM	4.0 EA	R065 R067 R078 R079
540 1557 000	RES NETWORK 1K OHM 2%	2.0 EA	R011 R024
540 1562 000	RES NETWORK 10K OHM 2%	1.0 EA	R049
545 0295 000	RES 10M OHM 1/4W 5% 1206	1.0 EA	R074
545 0300 000	RES 9.09K 0.1% 1/8W 1206	3.0 EA	R050 R058 R092
545 0308 208	RES 200 OHM 1% 0.1W 0805	2.0 EA	R062 R063
545 0308 212	RES 301 OHM 1% 0.1W 0805	19.0 EA	R018 R042 R046 R047 R048 R051 R053 R054 R059 R060 R061 R068 R069 R070 R071 R072 R073 R076 R077
545 0308 218	RES 511 OHM 1% 0.1W 0805	7.0 EA	R104 R105 R106 R107 R108 R109 R110
545 0308 301	RES 1K OHM 1% 0.1W 0805	9.0 EA	R081 R101 R111 R112 R113 R114 R115 R116 R117
545 0308 308	RES 2K OHM 1% 0.1W 0805	1.0 EA	R034
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	1.0 EA	R004
545 0308 319	RES 5.62K OHM 1% 0.1W 0805	3.0 EA	R019 R027 R052
545 0308 320	RES 6.19K OHM 1% 0.1W 0805	3.0 EA	R035 R099 R118
545 0308 401	RES 10K OHM 1% 0.1W 0805	26.0 EA	R009 R010 R012 R015 R020 R023 R032 R033 R036 R043 R055 R056 R057 R064 R085 R086 R087 R088 R089 R090 R091 R096 R097 R098 R102 R103
545 0308 402	RES 11K OHM 1% 0.1W 0805	5.0 EA	R001 R022 R026 R031 R041
545 0308 408	RES 20K OHM 1% 0.1W 0805	2.0 EA	R013 R039
545 0308 411	RES 26.7K OHM 1% 0.1W 0805	1.0 EA	R095
545 0308 419	RES 56.2K OHM 1% 0.1W 0805	4.0 EA	R040 R083 R084 R093
545 0308 422	RES 75K OHM 1% 0.1W 0805	4.0 EA	R007 R037 R045 R100
545 0308 501	RES 100K OHM 1% 0.1W 0805	3.0 EA	R005 R044 R066
545 0308 503	RES 121K OHM 1% 0.1W 0805	7.0 EA	R002 R003 R006 R014 R025 R028 R038
545 0308 512	RES 301K OHM 1% 0.1W 0805	1.0 EA	R094
545 0308 513	RES 332K OHM 1% 0.1W 0805	1.0 EA	R075
545 0308 601	RES 1MEG OHM 1% 0.1W 0805	4.0 EA	R008 R021 R029 R030
545 0309 205	RES 150 OHM 1% 1/4W 1206	2.0 EA	R080 R082
545 0309 999	RES ZERO OHM JUMPER 1206	2.0 EA	R016 R017
561 0002 007	POSISTOR 0.5 AMP 15VDC 1812	1.0 EA	F003
561 0003 007	POSISTOR 0.5 AMP 60VDC 2029	2.0 EA	F001 F002
603 0001 000	DIPSWITCH, 10 SPST SMT	1.0 EA	S001

843 5471 131	SCH, MASTER CONTROLLER	0.0 EA
843 5471 133	PWB, MASTER CONTROLLER	1.0 EA

Table 7-21. PWA, CTRLR, LIFE SUPPORT - 992 9516 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (U)</i>
300 1485 000	SCR, 4-40 X 5/16	1.0 EA	1/U010
304 0087 000	NUT, HEX 4-40	1.0 EA	1/U010
308 0003 000	NO 4 FLAT WASHER BRS	1.0 EA	1/U010
312 0045 000	WASHER, SPLIT-LOCK 4	1.0 EA	1/U010
358 2997 000	END PLATE,236 TERM MODULE	1.0 EA	J004
380 0587 000	XSTR, MJE210 ESD	1.0 EA	Q003
382 0406 000	IC, MC7812CT ESD	1.0 EA	U010
404 0825 000	SOCKET, DIP16, LO PROFILE	4.0 EA	XK001 XK002 XK003 XK004
540 1600 112	RES 30 OHM 3W 5%	1.0 EA	R071
548 2400 201	RES 100 OHM 1/2W 1%	4.0 EA	R117 R118 R119 R120
574 0485 000	RELAY DPDT 12VDC 2 AMP	4.0 EA	K001 K002 K003 K004
610 0900 000	HEADER 3 CKT STRAIGHT	3.0 EA	JP001 JP002 JP003
610 0978 000	HDR 10C 2ROW RT ANG	1.0 EA	J005
612 1184 000	SHUNT JUMPER 0.1" CENTERS	3.0 EA	1/JP001 1/JP002 1/JP003
612 1350 000	RECP, SMB PCB MT	2.0 EA	J002 J003
614 0790 000	TERM MODULE,1C PC MTG 236	10.0 EA	J004
843 5471 211	SCH, LIFE SUPPORT	0.0 EA	
992 9516 002	*PWA, CTRLR, LIFE SUPPORT, SMT	1.0 EA	

Table 7-22. *PWA, CTRLR, LIFE SUPPORT, SMT - 992 9516 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (X)</i>
000 0000 010	B/M NOTE:	0.0 EA	THE FOLLOWING REF DES ARE TO BE LEFT OPEN: C005
381 0020 000	XSTR, MMBTA64LT1 SOT ESD	2.0 EA	Q001 Q002
382 1392 000	IC, LM324 QUAD OP AMP ESD	3.0 EA	U001 U011 U015
383 0053 000	IC, TL750M05 ESD	1.0 EA	U034
383 0054 000	IC, LM2931 ESD	1.0 EA	U009
383 0094 015	IC, 79L15 ESD	1.0 EA	U017
383 0126 000	*IC MAX705/ADM705 WATCHDOG ESD	1.0 EA	U037
383 0148 000	IC, 74HC14AD ESD	1.0 EA	U027
383 0151 000	IC, 74HC08AD SO-14 ESD	6.0 EA	U006 U012 U014 U025 U026 U035
383 0154 000	IC, REF-02 SO-8 ESD	1.0 EA	U002
383 0158 000	IC, NE555 ESD	1.0 EA	U022
383 0159 000	IC, OP-07 ESD	4.0 EA	U018 U019 U020 U021
383 0161 000	IC, SN75468, 7 DRIVER, ESD	3.0 EA	U013 U016 U028
383 0165 000	IC, LM339 DQUAD COMPAR ESD	1.0 EA	U003
383 0183 000	IC, MC14538 ESD	2.0 EA	U004 U008
383 0184 000	IC 4066/14066 ESD	1.0 EA	U005
383 0185 000	IC, 74HC00 ESD	1.0 EA	U007
383 0188 000	IC 74HC32 ESD	7.0 EA	U029 U030 U031 U032 U033 U036 U038
383 0244 000	IC ILD206 OPTO-COUPLER ESD	2.0 EA	U023 U024
385 0001 000	DIODE, RECT 4148 / 914 ESD	14.0 EA	CR001 CR002 CR016 CR017 CR018 CR019 CR020 CR023 CR024 CR025 CR026 CR027 CR028 CR035
385 0011 000	DIODE, SCHOTTKY MBRS340 ESD	4.0 EA	CR030 CR031 CR032 CR033
385 0027 000	DIODE, 2800 SCHOTTKY SMT ESD	5.0 EA	CR008 CR009 CR010 CR011 CR029
387 0005 005	ZENER, 4.7V 225MW ESD	2.0 EA	CR006 CR012

387 0005 009	ZENER, 6.8V 225MW ESD	1.0 EA	CR015
387 0005 015	ZENER, 12V 225MW ESD	3.0 EA	CR004 CR021 CR022
387 0005 017	ZENER, 15V 225MW ESD	1.0 EA	CR034
387 0005 025	ZENER, 33V 225MW ESD	2.0 EA	CR013 CR014
387 0010 006	DIODE, TVS 5.0V 1500W ESD	1.0 EA	CR007
387 0010 017	DIODE, TVS 15V 1500W ESD	2.0 EA	CR003 CR005
496 0050 000	IND CHIP .027UH 10%	2.0 EA	L001 L002
515 0134 201	CAP 100PF 100V 5% 0805 C0G	1.0 EA	C053
515 0136 301	CAP 1000PF 100V 10% 0805 X7R	37.0 EA	C003 C004 C006 C007 C020 C021 C022 C024 C025 C026 C027 C028 C029 C030 C031 C032 C033 C034 C035 C037 C038 C041 C042 C043 C050 C057 C058 C059 C060 C061 C062 C066 C067 C088 C089 C100 C111
515 0136 401	CAP 0.01UF 100V 10% 0805 X7R	10.0 EA	C001 C052 C054 C056 C064 C068 C069 C070 C090 C107
515 0136 501	CAP 0.1UF 50V 10% 0805 X7R	51.0 EA	C008 C009 C010 C011 C012 C013 C014 C016 C017 C018 C019 C036 C039 C040 C044 C045 C047 C048 C055 C063 C065 C071 C077 C079 C080 C081 C082 C083 C084 C085 C086 C087 C091 C092 C093 C094 C095 C096 C097 C098 C099 C101 C103 C104 C105 C106 C108 C109 C112 C113 C114 C015 C073 C074 C075 C078 C115
515 0138 601	CAP 1UF 50V 20% 1812 X7R	6.0 EA	C023
523 0001 201	CAP 100UF 6.3V 20% SMT	1.0 EA	C002
523 0002 201	CAP 100UF 25V 20% SMT	1.0 EA	C046 C049 C051 C072 C076 C102 C110
523 0003 101	CAP 10UF 35V 20% SMT	7.0 EA	R046 R048 R049 R052
545 0300 000	RES 9.09K 0.1% 1/8W 1206	4.0 EA	R045 R051
545 0302 000	RES 113K OHM 1% 1/4W 1206	2.0 EA	R047 R050
545 0306 000	RES 274 OHM 1% 1206 SMT	2.0 EA	R033 R056 R057 R058 R059 R070
545 0308 212	RES 301 OHM 1% 0.1W 0805	6.0 EA	R031 R035 R036 R039 R040 R053 R054 R062 R110 R126
545 0308 301	RES 1K OHM 1% 0.1W 0805	10.0 EA	R109 R124 R125
545 0308 312	RES 3.01K OHM 1% 0.1W 0805	3.0 EA	R018 R021 R034 R038 R041 R092 R113 R114 R123
545 0308 318	RES 5.11K OHM 1% 0.1W 0805	9.0 EA	R106
545 0308 320	RES 6.19K OHM 1% 0.1W 0805	1.0 EA	R001 R002 R003 R019 R022 R026 R029 R032 R037 R042 R043 R044 R060 R061 R063 R064 R065 R066 R069 R072 R073 R074 R075 R076 R077 R081 R082 R083 R084 R085 R086 R087 R093 R095 R096 R097 R098 R099 R100 R101 R102 R103 R104 R105 R111 R115 R116 R122 R129
545 0308 401	RES 10K OHM 1% 0.1W 0805	49.0 EA	R108
545 0308 402	RES 11K OHM 1% 0.1W 0805	1.0 EA	R130
545 0308 405	RES 15K OHM 1% 0.1W 0805	1.0 EA	R055
545 0308 408	RES 20K OHM 1% 0.1W 0805	1.0 EA	R067
545 0308 411	RES 26.7K OHM 1% 0.1W 0805	1.0 EA	R107
545 0308 415	RES 39.2K OHM 1% 0.1W 0805	1.0 EA	R006 R007 R012 R013 R020
545 0308 415	RES 39.2K OHM 1% 0.1W 0805	1.0 EA	R008 R009 R010 R011 R014 R015 R016 R017 R027 R030 R078 R079 R080 R089 R090 R094 R112
545 0308 420	RES 61.9K OHM 1% 0.1W 0805	5.0 EA	R068 R088 R091
545 0308 501	RES 100K OHM 1% 0.1W 0805	16.0 EA	R004 R005 R121
545 0308 502	RES 110K OHM 1% 0.1W 0805	1.0 EA	R025 R028 R128
545 0308 512	RES 301K OHM 1% 0.1W 0805	3.0 EA	
545 0308 601	RES 1MEG OHM 1% 0.1W 0805	3.0 EA	
551 0018 401	TRIMPOT 10K OHM 1/4W 4MM SQ	3.0 EA	

551 0018 405	TRIMPOT 50K OHM 1/4W 4MM SQ	1.0 EA	R127
551 0018 505	TRIMPOT 500K OHM 1/4W 4MM SQ	2.0 EA	R023 R024
561 0002 007	POSISTOR 0.5 AMP 15VDC 1812	1.0 EA	F001
561 0003 007	POSISTOR 0.5 AMP 60VDC 2029	2.0 EA	F004 F005
843 5471 211	SCH, LIFE SUPPORT	0.0 EA	
843 5471 213	PWB, LIFE SUPPORT	1.0 EA	

Table 7-23. *PWA, CONTROLLER, P/S - 992 9517 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (X)</i>
610 0900 000	HEADER 3 CKT STRAIGHT	2.0 EA	JP001 JP002
610 0983 000	HDR 26C 2ROW RT ANG	2.0 EA	J001 J002
612 1184 000	SHUNT JUMPER 0.1" CENTERS	2.0 EA	XJP001 XJP002
817 2435 152	FIRMWARE MATRIX	0.0 EA	
992 9517 002	*PWA, CONTROLLER P/S, SMT	1.0 EA	

Table 7-24. *PWA, CONTROLLER P/S, SMT - 992 9517 002

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (R)</i>
383 0053 000	IC, TL750M05 ESD	1.0 EA	U011
383 0126 000	*IC MAX705/ADM705 WATCHDOG ESD	1.0 EA	U004
383 0149 000	IC, 74HC573ADW SOL-20 ESD	2.0 EA	U009 U010
383 0165 000	IC, LM339 DQUAD COMPAR ESD	1.0 EA	U001
383 0175 000	IC, 74HC273ADW SOL-20 ESD	2.0 EA	U002 U003
383 0205 000	IC, MAX367/ADG467 ESD	1.0 EA	U007
383 0257 000	IC, MMAD1108 ESD	2.0 EA	CR003 CR004
385 0001 000	DIODE, RECT 4148 / 914 ESD	8.0 EA	CR001 CR002 CR006 CR009 CR010 CR011 CR013 CR014
385 0011 000	DIODE, SCHOTTKY MBRS340 ESD	2.0 EA	CR007 CR008
387 0010 006	DIODE, TVS 5.0V 1500W ESD	1.0 EA	CR005
393 0020 000	IC, 68HC16Z116	1.0 EA	U006
404 0869 000	SOCKET, PLCC-32, SMT	2.0 EA	XU005 XU008
444 3011 000	*XTAL 32.768KHZ SMT	1.0 EA	Y001
496 0040 000	IND CHIP 10 UH 10%	2.0 EA	L001 L002
496 0050 000	IND CHIP .027UH 10%	2.0 EA	L004 L005
515 0134 109	CAP 22PF 100V 5% 0805 C0G	2.0 EA	C049 C050
515 0136 301	CAP 1000PF 100V 10% 0805 X7R	12.0 EA	C002 C003 C005 C006 C008 C009 C013 C014 C018 C019 C024 C025
515 0136 401	CAP 0.01UF 100V 10% 0805 X7R	7.0 EA	C034 C036 C038 C043 C044 C052 C055
515 0136 417	CAP 0.047UF 100V 10% 0805 X7R	2.0 EA	C017 C023
515 0136 501	CAP 0.1UF 50V 10% 0805 X7R	30.0 EA	C010 C011 C015 C020 C021 C022 C026 C027 C028 C029 C030 C031 C032 C033 C035 C037 C039 C040 C041 C045 C046 C047 C048 C051 C053 C054 C058 C059 C060 C061
515 0138 601	CAP 1UF 50V 20% 1812 X7R	6.0 EA	C016 C056 C064 C065 C066 C067
523 0001 201	CAP 100UF 6.3V 20% SMT	6.0 EA	C001 C004 C007 C012 C042 C063
523 0003 101	CAP 10UF 35V 20% SMT	1.0 EA	C057
540 1545 000	RESISTOR NETWORK 10K OHM	4.0 EA	R022 R026 R027 R032
540 1562 000	RES NETWORK 10K OHM 2%	1.0 EA	R018
545 0295 000	RES 10M OHM 1/4W 5% 1206	1.0 EA	R029
545 0300 000	RES 9.09K 0.1% 1/8W 1206	2.0 EA	R011 R016
545 0308 205	RES 150 OHM 1% 0.1W 0805	2.0 EA	R031 R056
545 0308 209	RES 221 OHM 1% 0.1W 0805	8.0 EA	R009 R013 R014 R041 R045 R046 R047 R048
545 0308 301	RES 1K OHM 1% 0.1W 0805	17.0 EA	

545 0308 317	RES 4.75K OHM 1% 0.1W 0805	1.0 EA	R001 R003 R005 R007 R015 R023 R028 R033
545 0308 319	RES 5.62K OHM 1% 0.1W 0805	4.0 EA	R034 R035 R036 R037 R038 R057 R058 R059
545 0308 401	RES 10K OHM 1% 0.1W 0805	6.0 EA	R060
545 0308 406	RES 16.2K OHM 1% 0.1W 0805	3.0 EA	R039
545 0308 412	RES 30.1K OHM 1% 0.1W 0805	2.0 EA	R002 R004 R006 R008
545 0308 420	RES 61.9K OHM 1% 0.1W 0805	2.0 EA	R020 R021 R040 R054 R055 R061
545 0308 501	RES 100K OHM 1% 0.1W 0805	3.0 EA	R025 R052 R053
545 0308 513	RES 332K OHM 1% 0.1W 0805	1.0 EA	R050 R051
545 0309 999	RES ZERO OHM JUMPER 1206	4.0 EA	R012 R017
561 0002 007	POSISTOR 0.5 AMP 15VDC 1812	1.0 EA	R010 R019 R024
604 1162 000	DIPSWITCH, 8 SPST SMT	1.0 EA	R030
843 5471 171	SCH, P/S CONTROLLER	0.0 EA	R042 R043 R044 R049
843 5471 173	PWB, P/S CONTROLLER	1.0 EA	F001
			S001

Table 7-25. PWA, DISPLAY/BACKPLANE,CONTROL - 992 9518 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (J)</i>
302 0011 000	SCR, 2-56 X 3/16	8.0 EA	8/DS001
310 0036 000	WASHER, FLAT .097 ID	8.0 EA	8/DS001
314 0001 000	WASHER, SPLIT-LOCK 2	8.0 EA	8/DS001
383 0494 000	IC, MM5453 ESD	1.0 EA	U001
384 0431 000	RECT. 1N4001 ESD	2.0 EA	CR001 CR002
404 0830 000	SOCKET, PLCC-44, THROUGH HOLE	1.0 EA	XU001
404 0851 000	SOCKET, 18 PIN SIP	2.0 EA	2/DS002
406 0527 000	LCD MODULE 4LINE X20 CHARACTER	1.0 EA	DS001
406 0529 000	DISPLAY, LCD	1.0 EA	DS002
516 0453 000	CAP .1UF 100V 20% X7R	5.0 EA	C005 C006 C007 C008 C010
516 0971 000	CAP 470PF 5% 100V C0G	1.0 EA	C004
516 0974 000	CAP 1000PF 5% 100V C0G	82.0 EA	C001 C002 C003 C009 C011 C012 C013 C014 C015 C016 C017 C018 C019 C020 C021 C022 C023 C024 C025 C026 C027 C028 C029 C030 C031 C032 C033 C034 C035 C036 C037 C038 C039 C040 C041 C042 C043 C044 C045 C046 C047 C048 C049 C050 C051 C052 C053 C054 C055 C056 C057 C058 C059 C060 C061 C062 C063 C064 C065 C066 C067 C068 C069 C070 C071 C072 C073 C074 C075 C076 C077 C078 C079 C080 C081 C082 C083 C084 C085 C086 C087 C088
548 2400 369	RES 5.11K OHM 1/2W 1%	1.0 EA	R007
548 2400 373	RES 5.62K OHM 1/2W 1%	3.0 EA	R003 R004 R005
548 2400 401	RES 10K OHM 1/2W 1%	1.0 EA	R006
548 2400 601	RES 1MEG OHM 1/2W 1%	1.0 EA	R001
550 0958 000	POT 10K OHM 1/2 W 10%	1.0 EA	R002
604 0935 000	SW, PB SINGLE SECT	1.0 EA	S001
610 0893 000	CONN 25 PIN D STRATE POST	1.0 EA	J021
610 0900 000	HEADER 3 CKT STRAIGHT	3.0 EA	JP001 JP002 JP003
610 0904 000	HEADER 14 PIN SINGLE ROW	2.0 EA	J009 J010
610 0918 000	HEADER SINGLE ROW 16 PIN	1.0 EA	1/XDS001
610 0933 000	JUMPER, PWB TEST POINT	5.0 EA	TP001 TP002 TP003 TP004 TP005
610 0981 000	HDR 20C 2ROW VERTICAL	3.0 EA	J011 J012 J013
610 1083 000	*PLUG, D, 37 PIN, STRAIGHT	1.0 EA	J020

610 1106 000	HDR, 8PIN, 1ROW, STRT,POL	1.0 EA	J014
612 1184 000	SHUNT JUMPER 0.1" CENTERS	3.0 EA	1/JP001 1/JP002 1/JP003
612 1341 000	*RECP, D, 15 PIN, STRAIGHT	2.0 EA	J018 J019
612 1350 000	RECP, SMB PCB MT	3.0 EA	J015 J016 J017
612 1491 000	CONN, EDGE CARD, 112 POSITIONS	1.0 EA	J008
612 1492 000	CONN, EDGE CARD, 36 POSITIONS	6.0 EA	J002 J003 J004 J005 J006 J007
612 1495 000	CONN, EDGE CARD, 188 POSITIONS	1.0 EA	J001
843 5471 191	SCH, DISPLAY/BACKPLANE,CONTROL	0.0 EA	
843 5471 193	PWB, DISPLAY/BACKPLANE,CONTROL	1.0 EA	
917 2435 039	STANDOFF, LCD DISPLAY	4.0 EA	4/XDS001

Table 7-26. ASSY., AIR 2 SPEED - 992 9719 003

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (C)</i>
299 0014 000	TAPE, PVC VINYL CLOSED	0.0 RL	
350 0100 000	PREF PRT IS 350-0105-000	23.0 EA	
430 0278 000	FAN BLADE, 20" DIA,	1.0 EA	
436 0329 000	MOTOR, 2 SPEED, 50/60HZ	1.0 EA	
448 1032 000	HINGE, METAL LIFT-OFF	2.0 EA	
448 1124 000	LATCH, RAISED, ADJ LEVER	2.0 EA	
448 1146 000	AIR FILTER 19.62 X 24.62 X .88	1.0 EA	
917 2435 155	CABLE, FAN	1.0 EA	
943 5467 200	PANEL, MOTOR MTG.	1.0 EA	
943 5467 201	FRAME, MOTOR SUPPORT	1.0 EA	
943 5467 204	ASSY., VENTURI PANEL	1.0 EA	
943 5467 239	DOOR WRAP, UPPER	1.0 EA	
943 5467 240	DOOR PANEL, REAR UPPER	1.0 EA	
943 5467 241	LOWER DOOR WRAP	1.0 EA	
943 5467 247	PANEL, BOTTOM, LOWER DOOR	1.0 EA	
943 5467 248	PANEL, TOP, LOWER DOOR WRAP	1.0 EA	
943 5467 254	FRAME, FILTER	1.0 EA	

Table 7-27. AC MAINS, BASIC - 992 9719 015

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (B)</i>
424 0031 000	GROMMET 2.5 MTG DIA	1.0 EA	
574 0388 000	RELAY 240VAC DPDT	1.0 EA	K2
606 0816 000	CKT BREAKER 10A 3 POLE	1.0 EA	CB1
917 2435 201	INSULATOR, AC MAIN	1.0 EA	
917 2435 949	CABLE, CAB AC DISTRIBUTION	1.0 EA	
917 2538 001	PLATE, C B CLOSEOUT	1.0 EA	
939 8168 295	COVER, AC DISTRIBUTION	1.0 EA	
939 8168 296	CHASSIS, AC DISTRIBUTION	1.0 EA	
992 9718 001	PWA, SUPPLY, LOW VOLTAGE	1.0 EA	A19

Table 7-28. PWA, SUPPLY, LOW VOLTAGE - 992 9718 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (J)</i>
384 0341 000	RECTIFIER 1N5404 ESD	4.0 EA	CR001 CR002 CR003 CR004
384 0610 000	LED, GREEN ESD	6.0 EA	DS001 DS002 DS003 DS004 DS005 DS006
384 0665 000	RECT, FW BRIDGE 2A 600V ESD	2.0 EA	CR005 CR006
472 1765 000	XFMR, PWR 40V 1.20A	1.0 EA	T002
472 1766 000	XFMR 20V 2.4A	1.0 EA	T001
516 0453 000	CAP .1UF 100V 20% X7R	9.0 EA	

			C005	C006	C011	C012	C013	C014	C015	C016
522 0642 401	CAP 10,000UF 25V 20% SNAP-MT	4.0 EA	C001	C002	C003	C004				
522 0643 309	CAP 2200UF 50V 20%	2.0 EA	C008	C010						
522 0644 301	CAP 1000UF 100V 20%	2.0 EA	C007	C009						
548 2400 318	RES 1.5K OHM 1/2W 1%	2.0 EA	R002	R005						
548 2400 359	RES 4.02K OHM 1/2W 1%	4.0 EA	R001	R003	R004	R006				
560 0121 010	POSISTOR 0.9 AMP 60VDC DISC	4.0 EA	F007	F008	F009	F010				
560 0121 015	POSISTOR 1.6 AMP 60VDC DISC	4.0 EA	F003	F004	F005	F006				
574 0472 000	RELAY SPDT 12VDC 10A	3.0 EA	K001	K002	K003					
610 0979 000	HDR 10C 2ROW VERTICAL	1.0 EA	J002							
610 1106 000	HDR, 8PIN, 1ROW, STRT,POL	1.0 EA	J003							
610 1238 000	HEADER, STRAIGHT 16 PIN	1.0 EA	J001							
843 5471 231	SCH, SUPPLY, LOW VOLTAGE	0.0 EA								
843 5471 233	PWB, SUPPLY, LOW VOLTAGE	1.0 EA								

Table 7-29. ASSY, DIRECTIONAL COUPLER DB - 992 9803 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (B)</i>
992 9701 002	ASSY, DIRECTIONAL COUPLER,42DB	1.0 EA	
992 9701 003	ASSY, DIRECTIONAL COUPLER,47DB	1.0 EA	
992 9701 004	*ASSY,DIRECTIONAL COUPLER,47DB	1.0 EA	

Table 7-30. PWA, COUPLER, DIRECTIONAL - 992 9526 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (B)</i>
518 0112 000	CAP, TRIM 2-10PF 50V	1.0 EA	C001
540 1600 123	RES 82 OHM 3W 5%	1.0 EA	R003
548 2400 242	RES 267 OHM 1/2W 1%	1.0 EA	R002
551 0017 305	TRIMPOT 5K OHM 1/4W 4MM SQ	1.0 EA	R001
843 5471 221	SCH, DIRECTIONAL COUPLER	0.0 EA	
843 5471 223	PWB, DIRECTIONAL COUPLER	1.0 EA	

Table 7-31. ATTENUATOR, 3DB DUAL, 25W - 992 9936 001

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (A)</i>
556 0101 000	ATTENUATOR, 3.00DB, 150W,	2.0 EA	
620 0410 000	JACK, BULKHEAD UG-657/U	4.0 EA	
922 1260 180	CHASSIS, ATTENUATOR	1.0 EA	
922 1260 181	HEATSINK, ATTENUATOR	1.0 EA	

Table 7-32. *PWA, 20/26 COND FILTER, SMT - 992 9756 002

Harris PN	Description	QTY UM	Reference Designators (D)
415 0002 001	FERRITE CHIP, 1206 SIZE	26.0 EA	L001 L002 L003 L004 L005 L006 L007 L008 L009 L010 L011 L012 L013 L014 L015 L016 L017 L018 L109 L020 L021 L022 L023 L024 L025 L026
515 0134 213	CAP 330PF 100V 5% 0805 COG	52.0 EA	C001 C002 C003 C004 C005 C006 C007 C008 C009 C010 C011 C012 C013 C014 C015 C016 C017 C018 C019 C020 C021 C022 C023 C024 C025 C026 C027 C028 C029 C030 C031 C032 C033 C034 C035 C036 C037 C038 C039 C040 C041 C042 C043 C044 C045 C046 C047 C048 C049 C050 C051 C052
843 5471 261	SCH, FILTER, 20/26 COND.	0.0 EA	
843 5471 263	PWB, FILTER, 20/26 COND.	1.0 EA	

Table 7-33. P/S, 5KW, 3PH, 3W - 992 9719 009

Harris PN	Description	QTY UM	Reference Designators (D)
296 0003 000	PLASTIC TUBE 20AWG	0 FT	
299 0014 000	TAPE, PVC VINYL CLOSED	0.0 RL	CUT (1) PIECE (7")
354 0011 000	LUG BLUE RING .25	4.0 EA	
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	
358 3793 000	BOLT, SHOULDER AXLE	4.0 EA	
398 0554 000	FUSE, SLOW CART 10A 250V MDA	1.0 EA	F002
402 0203 000	FUSEHOLDER 3AG SHOCKSAFE	1.0 EA	F002
448 1064 000	CASTER, WHEEL ONLY	4.0 EA	
472 1750 000	XFMR, 3PHASE, 240V PRI	2.0 EA	
476 0427 000	CHOKE, POWER SUPPLY,	4.0 EA	
506 0299 000	CAP 25UF 330VAC 10%	3.0 EA	
524 0355 000	CAP 120,000 UF 60 VDC	2.0 EA	
540 1600 305	RES 1.5K OHM 3W 5%	2.0 EA	
614 0808 000	*TERM BLK, 2C MODULAR 283	8.0 EA	
614 0810 000	JUMPER, 2-POLE ADJACENT 283	3.0 EA	
646 1426 000	END PLATE 283 FRONT ENTRY	1.0 EA	
817 1594 022	ROD, FILAMENT	2.0 EA	C3 C4
822 1004 001	BLOCKER, FILAMENT	4.0 EA	C3 C4
829 9728 034	PLATE, FILAMENT FEEDTHRU	4.0 EA	C3 C4
917 2435 130	CABLE, PWR SUPPLY 2KW	1.0 EA	
917 2435 131	CABLE, 5KW PWR SUPPLY UPGRADE	1.0 EA	
917 2435 224	LABEL, PS OUTLINE, 3 PH, 5KW	1.0 EA	
922 1260 114	BRACKET, WAGO	1.0 EA	
939 8168 285	BRACKET, LOWER CHOKE MTG.	1.0 EA	
939 8168 286	BRACKET, UPPER CHOKE MTG.	1.0 EA	
943 5467 206	ANGLE, PS CHASSIS	4.0 EA	
943 5467 209	CHASSIS, PS, 3 PHASE	1.0 EA	
943 5467 211	GUIDE ROLLER, PS CHASSIS	2.0 EA	
943 5467 233	CAP/WAGO BRACKET	1.0 EA	
992 8553 001	PWA, MOV-AC 198-250 VAC	1.0 EA	AC MAINS
992 9719 006	ASSEMBLY, RECTIFIER, 3PH	2.0 EA	
999 2883 001	HARDWARE LIST, P/S, 3PH, 3WIRE	1.0 EA	

Table 7-34. PWA, MOV-AC 198-250 VAC - 992 8553 001

Harris PN	Description	QTY UM	Reference Designators (E)
296 0345 000	TUBING, SHRINKABLE 3/4	1.0 FT	CUT 12 PIECES 1.0" EACH
560 0111 000	VARISTOR 275VAC 140J 275VRMS	12.0 EA	CR001 CR002 CR003 CR004 CR005 CR006 CR007 CR008 CR009 CR010 CR011 CR012
610 1066 000	CONN, .25 FASTON PC MOUNT	3.0 EA	A B C
839 7900 606	PWB, MOV-AC PROTECTOR	1.0 EA	
839 7900 614	SCHEM, MOV-AC PROTECTOR	0.0 EA	
999 2710 001	WIRE/TUBING LIST	0.0 EA	QTY 1 NEEDED FOR SERVICEREPLACE- MENT.

Table 7-35. ASSEMBLY, RECTIFIER, 3PH - 992 9719 006

Harris PN	Description	QTY UM	Reference Designators (A)
335 0274 000	BUSHING, NYLON	4.0 EA	1/#U001 1/#U003 1/#U004 1/#CR027
358 0003 000	BRACKET RESISTOR MTG	2.0 EA	2/R048
358 1928 000	JUMPER 1/4 LG 1/8H	1.0 EA	JP004
358 3318 000	STANDOFF .143 ID X .250 L	10.0 EA	
380 0190 000	XSTR, PNP 2N3906 ESD	1.0 EA	Q037
380 0721 000	XSTR MOSFET IRF9640 ESD	8.0 EA	Q025 Q026 Q027 Q028 Q029 Q031 Q032 Q033
382 1127 000	IC ADJ VOLT REG ESD	2.0 EA	U001 U003
382 1186 000	IC, NEG., VOLT REG. 1.5A, ESD	1.0 EA	U004
382 1502 000	IC, L603C, 8 DRIVER, ESD	1.0 EA	U002
384 0253 000	RECTIFIER 1N4007 ESD	28.0 EA	CR001 CR002 CR003 CR004 CR006 CR007 CR008 CR009 CR010 CR011 CR012 CR013 CR014 CR015 CR016 CR017 CR018 CR019 CR020 CR021 CR022 CR023 CR024 CR028 CR029 CR030 CR031 CR037
384 0341 000	RECTIFIER 1N5404 ESD	3.0 EA	CR005 CR025 CR032
384 0862 000	RECTIFIER, 400V 30A ESD	1.0 EA	CR027
384 0935 000	SCR, MCR265-8 ESD	27.0 EA	Q001 Q002 Q003 Q004 Q005 Q006 Q007 Q008 Q009 Q010 Q011 Q012 Q013 Q014 Q015 Q016 Q017 Q018 Q019 Q020 Q021 Q022 Q023 Q024 Q034 Q035 Q036
386 0082 000	ZENER, 1N4744A 15V 1W 5% ESD	1.0 EA	CR026
398 0518 000	FUSE, 30A, 125V FAST CART	24.0 EA	F001 F002 F003 F004 F005 F006 F007 F008 F009 F010 F011 F012 F013 F014 F015 F016 F017 F018 F019 F020 F021 F022 F023 F024
402 0199 000	CLIP, 1/4 DIA FUSE	48.0 EA	2/XF001 2/XF002 2/XF003 2/XF004 2/XF005 2/XF006 2/XF007 2/XF008 2/XF009 2/XF010 2/XF011 2/XF012 2/XF013 2/XF014 2/XF015 2/XF016 2/XF017 2/XF018 2/XF019 2/XF020 2/XF021 2/XF022 2/XF023 2/XF024
404 0766 000	SOCKET, DIP, 18 PIN (DL)	1.0 EA	XU002
410 0413 000	INSULATOR PAD FOR TO-247	4.0 EA	1/U001 1/U003 1/U004 1/CR027
516 0453 000	CAP .1UF 100V 20% X7R	40.0 EA	C001 C002 C003 C004 C005 C006 C007 C008 C009 C010 C011 C012 C013 C014 C015 C016 C017 C018 C019 C020 C021 C022 C023 C024 C025 C032 C033 C034 C035 C036 C037 C040 C041 C042 C043 C044 C045 C046 C047 C048
516 0530 000	CAP .01UF 10% 100V X7R	1.0 EA	C038
516 0813 000	NTWK, CAP .01UF 50V 20% SIP	1.0 EA	C027
522 0548 000	CAP 10UF 50V 20%	1.0 EA	C026

522 0555 000	CAP 100UF 50V 20%	3.0 EA	C029 C030 C039
522 0574 000	CAP 22UF 50V 20%	1.0 EA	C028
522 0590 000	CAP 470UF 25V 20%	3.0 EA	C031 C049 C050
540 1380 000	RES NETWORK 10K OHM 2%	1.0 EA	R001
540 1461 000	RES NETWORK 100 OHM 2%	1.0 EA	R002
540 1600 208	RES 200 OHM 3W 5%	9.0 EA	R004 R008 R010 R012 R025 R027 R029 R031 R065
542 0286 000	RES 5 OHM 5% 100W	1.0 EA	R048
548 2400 130	RES 20 OHM 1/2W 1%	1.0 EA	R060
548 2400 201	RES 100 OHM 1/2W 1%	30.0 EA	R005 R007 R009 R011 R013 R015 R016 R017 R018 R020 R021 R022 R023 R026 R028 R030 R032 R034 R035 R036 R037 R039 R040 R041 R046 R049 R051 R052 R064 R066
548 2400 209	RES 121 OHM 1/2W 1%	3.0 EA	R042 R056 R058
548 2400 278	RES 634 OHM 1/2W 1%	1.0 EA	R043
548 2400 328	RES 1.91K OHM 1/2W 1%	2.0 EA	R057 R059
548 2400 401	RES 10K OHM 1/2W 1%	7.0 EA	R047 R053 R054 R055 R061 R062 R063
548 2400 501	RES 100K OHM 1/2W 1%	1.0 EA	R050
548 2400 509	RES 121K OHM 1/2W 1%	3.0 EA	R003 R044 R045
548 2400 547	RES 301K OHM 1/2W 1%	6.0 EA	R006 R014 R019 R024 R033 R038
610 0877 000	HDR, STR, 2 PIN, SQ	5.0 EA	JP001 JP002 JP003 JP005 JP006
610 0979 000	HDR 10C 2ROW VERTICAL	2.0 EA	J003A J003B
610 0982 000	HDR 26C 2ROW VERTICAL	1.0 EA	J004
610 1066 000	CONN, .25 FASTON PC MOUNT	1.0 EA	E003
610 1106 000	HDR, 8PIN, 1ROW, STRT,POL	3.0 EA	J005 J006 J007
610 1235 000	HEADER, STRAIGHT 4 PIN	1.0 EA	J008
612 1184 000	SHUNT JUMPER 0.1" CENTERS	4.0 EA	1/JP001 1/JP002 1/JP003 1/JP005
843 5471 181	SCH, P/S RECTIFIER	0.0 EA	
843 5471 183	PWB, P/S RECTIFIER	1.0 EA	
917 2435 116	CLAMP, RIBBON CABLE	1.0 EA	
922 1260 045	BASE, RECTIFIER SINK	1.0 EA	
922 1260 095	CABLE, RIBBON	1.0 EA	
939 8168 287	DUCT, RECTIFIER	1.0 EA	
992 8608 003	THERMISTOR ASSEMBLY	1.0 EA	RT001
999 2861 001	HARDWARE LIST, PWA, RECTIFIER	1.0 EA	

Table 7-36. THERMISTOR ASSEMBLY - 992 8608 003

Harris PN	Description	QTY UM	Reference Designators (A)
051 0001 025	* ADHESIVE, LOCTITE 392	0.0 EA	
051 0001 026	* ACTIVATOR, LOCTITE 7387	0.0 EA	
252 0004 000	WIRE, STRD 18AWG WHT/YEL	1.0 FT	
296 0261 000	TUBING, SHRINK 1/8 WHITE	0.0 FT	
296 0395 000	TUBING, SHRINK 1/4 BLACK	0 FT	
354 0119 000	TERM LUG, RING .25 HOLE	1.0 EA	
516 0935 000	CAP 0.012UF 10% 50V	1.0 EA	C1
559 0053 000	THERMISTOR,NTC,10K@25C,1%	1.0 EA	R1

-30AJ 4 REV-B-

Table 7-37. P/S, 5KW, 3PH, 4W - 992 9719 010

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (E)</i>
296 0003 000	PLASTIC TUBE 20AWG	0 FT	
299 0014 000	TAPE, PVC VINYL CLOSED	0.0 RL	CUT (1) PIECE (7")
354 0011 000	LUG BLUE RING .25	4.0 EA	
358 0293 000	PLUG, BUTTON-1/2" HOLE	1.0 EA	#F002
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	
358 3134 000	STUD, BRS 1/4-20 X 1-3/4	1.0 EA	AC MAINS
358 3343 000	LUG, 8 SOL TO 4 STR	1.0 EA	AC MAINS
358 3793 000	BOLT, SHOULDER AXLE	4.0 EA	
448 1064 000	CASTER, WHEEL ONLY	4.0 EA	
472 1750 000	XFMR, 3PHASE, 240V PRI	2.0 EA	
476 0427 000	CHOKE, POWER SUPPLY,	4.0 EA	
506 0300 000	CAP 20UF 440VAC 10%	3.0 EA	
524 0355 000	CAP 120,000 UF 60 VDC	2.0 EA	
540 1600 305	RES 1.5K OHM 3W 5%	2.0 EA	
614 0808 000	*TERM BLK, 2C MODULAR 283	8.0 EA	
614 0810 000	JUMPER, 2-POLE ADJACENT 283	3.0 EA	
646 1426 000	END PLATE 283 FRONT ENTRY	1.0 EA	
817 1594 022	ROD, FILAMENT	2.0 EA	C3 C4
822 1004 001	BLOCKER, FILAMENT	4.0 EA	C3 C4
829 9728 034	PLATE, FILAMENT FEEDTHRU	4.0 EA	C3 C4
917 2435 060	STANDOFF, AC DIST 4-WIRE	1.0 EA	AC MAINS
917 2435 130	CABLE, PWR SUPPLY 2KW	1.0 EA	
917 2435 131	CABLE, 5KW PWR SUPPLY UPGRADE	1.0 EA	
917 2435 224	LABEL, PS OUTLINE, 3 PH, 5KW	1.0 EA	
922 1260 114	BRACKET, WAGO	1.0 EA	
939 8168 285	BRACKET, LOWER CHOKE MTG.	1.0 EA	
939 8168 286	BRACKET, UPPER CHOKE MTG.	1.0 EA	
943 5467 206	ANGLE, PS CHASSIS	4.0 EA	
943 5467 209	CHASSIS, PS, 3 PHASE	1.0 EA	
943 5467 211	GUIDE ROLLER, PS CHASSIS	2.0 EA	
943 5467 233	CAP/WAGO BRACKET	1.0 EA	
992 8553 003	PWA, MOV-AC 342-432 VAC	1.0 EA	AC MAINS
992 9719 006	ASSEMBLY, RECTIFIER, 3PH	2.0 EA	
999 2883 001	HARDWARE LIST, P/S, 3PH, 3WIRE	1.0 EA	

Table 7-38. PWA, MOV-AC 342-432 VAC - 992 8553 003

<i>Harris PN</i>	<i>Description</i>	<i>QTY UM</i>	<i>Reference Designators (B)</i>
296 0345 000	TUBING, SHRINKABLE 3/4	1 FT	CUT 6 PIECES 1.0" EACH FOR 560-0042-000 CUT 14 PIECES .75" EACH FOR 560-0049-000
560 0042 000	MOV 6500A 190J 510VAC	6.0 EA	RV001 RV002 RV003 RV004 RV005 RV006
560 0049 000	MOV 4500A 75J 275VAC	14.0 EA	RV007 RV008 RV009 RV010 RV011 RV012 RV013 RV014 RV015 RV016 RV017 RV018 RV019 RV020
610 1066 000	CONN, .25 FASTON PC MOUNT	4.0 EA	A B C N
839 8115 031	SCH, MOV-AC PROTECTOR	0.0 EA	
839 8115 033	PWB, MOV-AC PROTECTOR,	1.0 EA	
999 2711 002	WIRE/TUBING LIST	0.0 EA	*QTY 1 NEEDED FOR SERVICE REPLACE- MENT*

Table 7-39. P/S, 1PH, Z5, Z3.5, & Z2R - 992 9719 023

Harris PN	Description	QTY UM	Reference Designators (A)
398 0554 000	FUSE, SLOW CART 10A 250V MDA	1.0 EA	F002
402 0203 000	FUSEHOLDER 3AG SHOCKSAFE	1.0 EA	F002
817 1594 022	ROD, FILAMENT	2.0 EA	C3 C4
822 1004 001	BLOCKER, FILAMENT	4.0 EA	C3 C4
829 9728 034	PLATE, FILAMENT FEEDTHRU	4.0 EA	C3 C4
992 8553 001	PWA, MOV-AC 198-250 VAC	1.0 EA	
992 9719 013	P/S, 5KW, 1PH	1.0 EA	

Table 7-40. P/S, 5KW, 1PH - 992 9719 013

Harris PN	Description	QTY UM	Reference Designators (D)
252 0006 000	WIRE, STRD 14AWG BLU	2 FT	
296 0003 000	PLASTIC TUBE 20AWG	0 FT	
296 0262 000	TUBING, SHRINK 1/4 WHITE	0 FT	
302 0748 000	SCREW 1/4-28 X .625	12.0 EA	
354 0008 000	LUG #6 RING BLUE 16-14AWG	2.0 EA	
354 0011 000	LUG BLUE RING .25	4.0 EA	
354 0252 000	TERM 250 FEM BLU 16-14	2.0 EA	
358 0003 000	BRACKET RESISTOR MTG	4.0 EA	2/R048
358 0473 000	CLAMP, HOSE	2.0 EA	
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	
358 3466 000	END PLATE W/FIXING FLANGE	1.0 EA	
358 3793 000	BOLT, SHOULDER AXLE	4.0 EA	
384 0767 000	SCR, 1000PIV 150A 150C100	16.0 EA	CR001A CR001B CR002A CR002B CR003A CR003B CR004A CR004B CR005A CR005B CR006A CR006B CR007A CR007B CR008A CR008B
398 0526 000	FUSE, LIMITER TYPE, 100A 125V	16.0 EA	F001A F001B F002A F002B F003A F003B F004A F004B F005A F005B F006A F006B F007A F007B F008A F008B
448 1064 000	CASTER, WHEEL ONLY	4.0 EA	
472 1761 000	TRANSFORMER, 1 PHASE	2.0 EA	
476 0428 000	CHOKER, PWR SUP, 1.5MH 100A	2.0 EA	
506 0287 000	CAP 45UF 330VAC 50/60HZ	2.0 EA	
524 0355 000	CAP 120,000 UF 60 VDC	6.0 EA	
540 1600 305	RES 1.5K OHM 3W 5%	2.0 EA	
542 0286 000	RES 5 OHM 5% 100W	2.0 EA	2/R048
612 1451 000	FEMALE CONNECTOR, 4C	8.0 EA	
614 0808 000	*TERM BLK, 2C MODULAR 283	6.0 EA	
614 0810 000	JUMPER, 2-POLE ADJACENT 283	2.0 EA	
614 0885 000	MODULAR TERMINAL BLOCK	1.0 EA	
646 1426 000	END PLATE 283 FRONT ENTRY	1.0 EA	
917 2435 061	SPACER, FUSE PLATE	8.0 EA	
917 2435 223	LABEL, PS OUTLINE, 1PH	1.0 EA	
917 2435 954	CABLE, 5KW,1PH, PS	1.0 EA	
922 1195 010	RAIL TERM BLOCK MTG	1.0 EA	
922 1260 071	ASSY, RECTIFIER HEATSINK	2.0 EA	
922 1260 072	PLATE, FUSE MTG.	2.0 EA	
922 1260 228	STRAP CONNECTION CAP	2.0 EA	
939 8168 291	CLAMP, CAPACITOR	2.0 EA	
939 8168 292	PLATE, RECTIFIER MTG.	2.0 EA	
943 5467 206	ANGLE, PS CHASSIS	4.0 EA	

943 5467 210 CHASSIS, PS, 1 PHASE 1.0 EA
 992 9762 001 PWA, P/S RECTIFIER, 1 PH 2.0 EA

Table 7-41. PWA, P/S RECTIFIER, 1 PH - 992 9762 001

Harris PN	Description	QTY UM	Reference Designators (T)
086 0001 004	SEALANT, HIGH STRENGTH	0.0 EA	
357 0037 000	SCREW 6-32 X .25 BHMS	8.0 EA	XU001 XU003 XU004 XQ006 XQ007 XQ012 XQ013 XCR027
358 1928 000	JUMPER 1/4 LG 1/8H	1.0 EA	JP004
380 0190 000	XSTR, PNP 2N3906 ESD	1.0 EA	Q009
380 0721 000	XSTR MOSFET IRF9640 ESD	10.0 EA	Q001 Q002 Q003 Q004 Q005 Q006 Q007 Q008 Q012 Q013
382 1127 000	IC ADJ VOLT REG ESD	2.0 EA	U001 U003
382 1186 000	IC, NEG., VOLT REG. 1.5A, ESD	1.0 EA	U004
382 1502 000	IC, L603C, 8 DRIVER, ESD	1.0 EA	U002
384 0253 000	RECTIFIER 1N4007 ESD	11.0 EA	CR001 CR002 CR003 CR004 CR006 CR007 CR008 CR009 CR028 CR029 CR031
384 0341 000	RECTIFIER 1N5404 ESD	4.0 EA	CR005 CR010 CR025 CR032
384 0862 000	RECTIFIER, 400V 30A ESD	1.0 EA	CR027
384 0935 000	SCR, MCR265-8 ESD	2.0 EA	Q010 Q011
386 0082 000	ZENER, 1N4744A 15V 1W 5% ESD	1.0 EA	CR026
398 0140 000	FUSE, FAST CART 15A 250V	2.0 EA	F001 F002
402 0199 000	CLIP, 1/4 DIA FUSE	4.0 EA	2/XF001 2/XF002
404 0766 000	SOCKET, DIP, 18 PIN (DL)	1.0 EA	XU002
410 0405 000	INSULATOR XSTR TO220	7.0 EA	XQ004 XQ006 XQ007 XQ012 XQ013 XU001 XU003
410 0413 000	INSULATOR PAD FOR TO-247	1.0 EA	XCR027
516 0453 000	CAP .1UF 100V 20% X7R	23.0 EA	C002 C003 C004 C005 C006 C007 C008 C009 C025 C032 C033 C034 C035 C036 C037 C040 C041 C043 C044 C045 C046 C047 C048 C013
516 0530 000	CAP .01UF 10% 100V X7R	1.0 EA	C010 C011
516 0736 000	CAP .001UF 10% 100V X7R	2.0 EA	C027
516 0813 000	NTWK, CAP .01UF 50V 20% SIP	1.0 EA	C001
516 0825 000	CAP 3300PF 10% 100V	1.0 EA	C029 C030 C039
522 0555 000	CAP 100UF 50V 20%	3.0 EA	C028
522 0574 000	CAP 22UF 50V 20%	1.0 EA	C012
522 0576 000	CAP 1,000UF 50V 20%	1.0 EA	C031 C049 C050
522 0590 000	CAP 470UF 25V 20%	3.0 EA	R001
540 1380 000	RES NETWORK 10K OHM 2%	1.0 EA	R002
540 1461 000	RES NETWORK 100 OHM 2%	1.0 EA	R015 R016 R017 R019 R021 R022 R023 R024
540 1600 204	RES 130 OHM 3W 5%	8.0 EA	R018
540 1600 212	RES 300 OHM 3W 5%	1.0 EA	R060
548 2400 130	RES 20 OHM 1/2W 1%	1.0 EA	R003 R004 R005 R006 R011 R012 R013 R014 R025 R026 R027 R028 R046 R051 R064
548 2400 201	RES 100 OHM 1/2W 1%	15.0 EA	R042 R056 R058
548 2400 209	RES 121 OHM 1/2W 1%	3.0 EA	R043
548 2400 278	RES 634 OHM 1/2W 1%	1.0 EA	R057 R059
548 2400 328	RES 1.91K OHM 1/2W 1%	2.0 EA	R020
548 2400 334	RES 2.21K OHM 1/2W 1%	1.0 EA	R047 R053 R054 R058 R061 R063
548 2400 401	RES 10K OHM 1/2W 1%	6.0 EA	R062
548 2400 430	RES 20K OHM 1/2W 1%	1.0 EA	R007 R008
548 2400 488	RES 80.6K OHM 1/2W 1%	2.0 EA	R050
548 2400 501	RES 100K OHM 1/2W 1%	1.0 EA	R009 R010
548 2400 530	RES 200K OHM 1/2W 1%	2.0 EA	

560 0121 011	POSISTOR 1.1 AMP 60VDC DISC	1.0 EA	F003
610 0877 000	HDR, STR, 2 PIN, SQ	4.0 EA	JP001 JP002 JP003 JP005
610 0982 000	HDR 26C 2ROW VERTICAL	1.0 EA	J004
610 1066 000	CONN, .25 FASTON PC MOUNT	1.0 EA	E003
610 1106 000	HDR, 8PIN, 1ROW, STRT,POL	3.0 EA	J005 J006 J007
610 1235 000	HEADER, STRAIGHT 4 PIN	1.0 EA	J008
610 1236 000	HEADER, STRAIGHT 8 PIN	3.0 EA	J001 J002 J003
612 1184 000	SHUNT JUMPER 0.1" CENTERS	4.0 EA	1/JP001 1/JP002 1/JP003 1/JP005
646 0665 000	INSPECTION LABEL	1.0 EA	
843 5471 251	SCH, P/S RECTIFIER, 1PH	0.0 EA	
843 5471 253	PWB, P/S RECTIFIER, 1PH	1.0 EA	
939 8168 120	HEATSINK, 1PH RECTIFIER	1.0 EA	
943 5467 131	CHASSIS, 1PH RECTIFIER	1.0 EA	
992 8608 004	THERMISTOR ASSEMBLY	1.0 EA	RT001
999 2881 001	HARDWARE LIST, PWA, P/S	1.0 EA	

Table 7-42. THERMISTOR ASSEMBLY - 992 8608 004

Harris PN	Description	QTY UM	Reference Designators (A)
051 0001 025	* ADHESIVE, LOCTITE 392	0.0 EA	
051 0001 026	ACTIVATOR, LOCTITE 7387	0.0 EA	
252 0004 000	WIRE, STRD 18AWG WHT/YEL	1 FT	
296 0261 000	TUBING, SHRINK 1/8 WHITE	0.0 FT	
296 0395 000	TUBING, SHRINK 1/4 BLACK	0 FT	
354 0119 000	TERM LUG, RING .25 HOLE	1.0 EA	
516 0935 000	CAP 0.012UF 10% 50V	1.0 EA	C1
559 0053 000	THERMISTOR,NTC,10K@25C,1%	1.0 EA	R1

Table 7-43. KIT, PLAT Z SERVICE PARTS - 992 9766 001

Harris PN	Description	QTY UM	Reference Designators (L)
357 0093 000	SCREW, 1/4-20 X 7/8 FHMS	1.0 EA	
357 0101 000	SCREW, 6-32 X 1.00, TEFLON	2.0 EA	
357 0112 000	SCREW, 8-32 X 1.00 TEFLON	2.0 EA	
358 3524 000	PIN PRINTED CIRCUIT BOARD	2.0 EA	
358 3525 000	PIN RECEPTACLE	2.0 EA	
404 0675 000	SOCKET, DIP, 16 PIN (DL)	1.0 EA	
404 0766 000	SOCKET, DIP, 18 PIN (DL)	1.0 EA	
436 0329 000	MOTOR, 2 SPEED, 50/60HZ	1.0 EA	
448 1074 000	FILTER MEDIA 12 X 24 X 1	8.0 EA	
522 0347 000	CAP 1000UF 50V 20%	1.0 EA	
522 0565 000	CAP 2200UF 63V 20%	1.0 EA	
540 1366 000	RES NETWORK 100 OHM 2%	1.0 EA	
540 1380 000	RES NETWORK 10K OHM 2%	1.0 EA	
540 1461 000	RES NETWORK 100 OHM 2%	1.0 EA	
540 1550 000	RES 50 OHM, 12W 10%	3.0 EA	
540 1551 000	RES 70.7 OHM, 12W @40 DEG C	1.0 EA	
542 0286 000	RES 5 OHM 5% 100W	1.0 EA	
542 1603 000	RES, 0.01 OHM, 3W 1%	2.0 EA	
559 0053 000	THERMISTOR,NTC,10K@25C,1%	2.0 EA	
559 0055 000	THERMISTOR NTC CHIP 50K @ 25C	2.0 EA	
560 0049 000	MOV 4500A 75J 275VAC	6.0 EA	
574 0388 000	RELAY 240VAC DPDT	1.0 EA	
574 0472 000	RELAY SPDT 12VDC 10A	1.0 EA	

574 0485 000	RELAY DPDT 12VDC 2 AMP	1.0 EA
574 0511 000	*RELAY SPDT 48VDC 16AMPS	2.0 EA
612 1479 000	CONN, EDGE CARD, 36 CONT	2.0 EA
612 1488 000	CONN, EDGE CARD 36 CONT	1.0 EA
917 2435 136	ASSY, RES/THERM, COMBINER	1.0 EA
917 2435 185	ASSY, ISO RESISTOR	3.0 EA
917 2435 186	ASSY, ISO RESISTOR, 170.7 OHM	1.0 EA
917 2435 215	ASSY., RESISTOR, 800W - 50 OHM	1.0 EA
917 2435 216	ASSY., RES/THERM 800W, 50 OHM	1.0 EA

Table 7-44. ASSY., RESISTOR, 800W - 50 OHM - 917 2435 215

Harris PN	Description	QTY UM	Reference Designators (A)
055 0190 009	* COATING 3140 RTV	0.0 EA	
544 1689 000	RESISTOR, 50 OHM 800W 5%	1.0 EA	
817 2435 215	ASSY. INSTR., RESISTOR	0.0 EA	

Table 7-45. ASSY., RES/THERM 800W, 50 OHM - 917 2435 216

Harris PN	Description	QTY UM	Reference Designators (A)
051 0001 016	*WIRE TACKING ADHESIVE KT	0.0 EA	
055 0190 009	* COATING 3140 RTV	0.0 EA	
296 0310 000	TUBING TEFLON 20 AWG	0 FT	
515 0078 000	*CAP CHIP 1000PF 10% 50V	1.0 EA	
544 1689 000	RESISTOR, 50 OHM 800W 5%	1.0 EA	
559 0053 000	THERMISTOR, NTC, 10K@25C, 1%	1.0 EA	
690 0023 000	EPOXY, ADHESIVE, ONE COMPONENT	0.0 PT	
817 2435 216	ASSY. INSTR., RESISTOR	0.0 EA	

Table 7-46. KIT, PLAT Z, 1PH SEMICOND, FUSE - 992 9767 001

Harris PN	Description	QTY UM	Reference Designators (U)
380 0190 000	XSTR, PNP 2N3906 ESD	1.0 EA	
380 0587 000	XSTR, MJE210 ESD	1.0 EA	
380 0721 000	XSTR MOSFET IRF9640 ESD	3.0 EA	
381 0020 000	XSTR, MMBTA64LT1 SOT ESD	1.0 EA	
382 0406 000	IC, MC7812CT ESD	1.0 EA	
382 1127 000	IC ADJ VOLT REG ESD	1.0 EA	
382 1186 000	IC, NEG., VOLT REG. 1.5A, ESD	1.0 EA	
382 1392 000	IC, LM324 QUAD OP AMP ESD	1.0 EA	
382 1502 000	IC, L603C, 8 DRIVER, ESD	1.0 EA	
383 0051 000	IC, LP2954	1.0 EA	
383 0054 000	IC, LM2931 ESD	1.0 EA	
383 0094 015	IC, 79L15 ESD	1.0 EA	
383 0126 000	*IC MAX705/ADM705 WATCHDOG ESD	1.0 EA	
383 0148 000	IC, 74HC14AD ESD	1.0 EA	
383 0151 000	IC, 74HC08AD SO-14 ESD	1.0 EA	
383 0154 000	IC, REF-02 SO-8 ESD	1.0 EA	
383 0158 000	IC, NE555 ESD	1.0 EA	
383 0159 000	IC, OP-07 ESD	1.0 EA	
383 0161 000	IC, SN75468, 7 DRIVER, ESD	1.0 EA	
383 0165 000	IC, LM339 DQUAD COMPAR ESD	1.0 EA	
383 0183 000	IC, MC14538 ESD	1.0 EA	
383 0184 000	IC 4066/14066 ESD	1.0 EA	

383 0185 000	IC, 74HC00	ESD	1.0 EA
383 0188 000	IC 74HC32	ESD	1.0 EA
383 0244 000	IC ILD206 OPTO-COUPLER	ESD	1.0 EA
384 0253 000	RECTIFIER 1N4007	ESD	6.0 EA
384 0341 000	RECTIFIER 1N5404	ESD	2.0 EA
384 0665 000	RECT, FW BRIDGE 2A 600V	ESD	1.0 EA
384 0767 000	SCR, 1000PIV 150A 150C100		2.0 EA
384 0854 000	DIODE ARRAY, 8 ISOLATED	ESD	1.0 EA
384 0935 000	SCR, MCR265-8	ESD	6.0 EA
386 0082 000	ZENER, 1N4744A 15V 1W 5%	ESD	1.0 EA
392 0066 000	EEPROM, 25C040	PROG/ESD	1.0 EA
398 0526 000	FUSE, LIMITER TYPE, 100A 125V		4.0 EA
398 0554 000	FUSE, SLOW CART 10A 250V MDA		2.0 EA
406 0527 000	LCD MODULE 4LINE X20 CHARACTER		1.0 EA
406 0529 000	DISPLAY, LCD		1.0 EA
560 0042 000	MOV 6500A 190J 510VAC		6.0 EA
560 0049 000	MOV 4500A 75J 275VAC		6.0 EA
560 0121 010	POSISTOR 0.9 AMP 60VDC DISC		1.0 EA

Table 7-47. KIT, PLAT Z, 3PH SEMICOND,FUSE - 992 9767 003

Harris PN	Description	QTY UM	Reference Designators (A)
380 0190 000	XSTR, PNP 2N3906 ESD	1.0 EA	
380 0587 000	XSTR, MJE210 ESD	1.0 EA	
380 0721 000	XSTR MOSFET IRF9640 ESD	3.0 EA	
381 0020 000	XSTR, MMBTA64LT1 SOT ESD	1.0 EA	
382 0406 000	IC, MC7812CT ESD	1.0 EA	
382 1127 000	IC ADJ VOLT REG ESD	1.0 EA	
382 1186 000	IC, NEG., VOLT REG. 1.5A, ESD	1.0 EA	
382 1392 000	IC, LM324 QUAD OP AMP ESD	1.0 EA	
382 1502 000	IC, L603C, 8 DRIVER, ESD	1.0 EA	
383 0051 000	IC, LP2954	1.0 EA	
383 0054 000	IC, LM2931 ESD	1.0 EA	
383 0094 015	IC, 79L15 ESD	1.0 EA	
383 0126 000	*IC MAX705/ADM705 WATCHDOG ESD	1.0 EA	
383 0148 000	IC, 74HC14AD ESD	1.0 EA	
383 0151 000	IC, 74HC08AD SO-14 ESD	1.0 EA	
383 0154 000	IC, REF-02 SO-8 ESD	1.0 EA	
383 0158 000	IC, NE555 ESD	1.0 EA	
383 0159 000	IC, OP-07 ESD	1.0 EA	
383 0161 000	IC, SN75468, 7 DRIVER, ESD	1.0 EA	
383 0165 000	IC, LM339 DQUAD COMPAR ESD	1.0 EA	
383 0183 000	IC, MC14538 ESD	1.0 EA	
383 0184 000	IC 4066/14066 ESD	1.0 EA	
383 0185 000	IC, 74HC00 ESD	1.0 EA	
383 0188 000	IC 74HC32 ESD	1.0 EA	
383 0244 000	IC ILD206 OPTO-COUPLER ESD	1.0 EA	
384 0253 000	RECTIFIER 1N4007 ESD	6.0 EA	
384 0341 000	RECTIFIER 1N5404 ESD	2.0 EA	
384 0665 000	RECT, FW BRIDGE 2A 600V ESD	1.0 EA	
384 0854 000	DIODE ARRAY, 8 ISOLATED ESD	1.0 EA	
384 0935 000	SCR, MCR265-8 ESD	6.0 EA	
386 0082 000	ZENER, 1N4744A 15V 1W 5% ESD	1.0 EA	
392 0066 000	EEPROM, 25C040 PROG/ESD	1.0 EA	
398 0518 000	FUSE, 30A, 125V FAST CART	6.0 EA	

398 0554 000	FUSE, SLOW CART 10A 250V MDA	2.0 EA
406 0527 000	LCD MODULE 4LINE X20 CHARACTER	1.0 EA
406 0529 000	DISPLAY, LCD	1.0 EA
560 0042 000	MOV 6500A 190J 510VAC	6.0 EA
560 0049 000	MOV 4500A 75J 275VAC	6.0 EA
560 0121 010	POSISTOR 0.9 AMP 60VDC DISG	1.0 EA

Table 7-48. KIT, PLATINUM Z BOARDS - 992 9768 002

Harris PN	Description	QTY UM	Reference Designators (B)
917 2435 141	KIT, FIRMWARE, 3PH, SPARE, Z10	0.0 EA	
917 2435 142	KIT, FIRMWARE, 1PH, SPARE, Z10	0.0 EA	
917 2435 143	KIT, FIRMWARE, 3PH, SPARE, Z5	0.0 EA	
917 2435 144	KIT, FIRMWARE, 1PH, SPARE, Z5	0.0 EA	
917 2435 171	KIT, FIRMWARE, 3PH, SPARE, Z2	0.0 EA	
917 2435 172	KIT, FIRMWARE, 1PH, SPARE, Z2	0.0 EA	
917 2435 173	KIT, FIRMWARE, 3PH, SPARE, Z2R	0.0 EA	
917 2435 174	KIT, FIRMWARE, 1PH, SPARE, Z2R	0.0 EA	
992 8553 001	PWA, MOV-AC 198-250 VAC	0.0 EA	
992 8553 003	PWA, MOV-AC 342-432 VAC	0.0 EA	
992 9261 002	PWA, PA, 425W	2.0 EA	
992 9269 002	PWA, NETWORK, RF ISOLATION	1.0 EA	
992 9278 001	*PWA, CTLR, PA	1.0 EA	
992 9279 001	*PWA, CTLR, MASTER	1.0 EA	
992 9507 001	PWA, RECTIFIER, 3PH	0.0 EA	
992 9516 001	PWA, CTLR, LIFE SUPPORT	1.0 EA	
992 9517 001	*PWA, CONTROLLER, P/S	1.0 EA	
992 9518 001	PWA, DISPLAY/BACKPLANE, CONTROL	1.0 EA	
992 9541 001	PWA, BACKPLANE, IPA	0.0 EA	
992 9541 002	PWA, EXC SWITCHER/DIVIDER	0.0 EA	
992 9541 003	PWA, BACKPLANE, IPA 2KW	0.0 EA	
992 9718 001	PWA, SUPPLY, LOW VOLTAGE	1.0 EA	
992 9756 001	PWA, 20 CONDUCTOR FILTER	1.0 EA	
992 9756 101	PWA, 26 CONDUCTOR FILTER	1.0 EA	
992 9762 001	PWA, P/S RECTIFIER, 1 PH	0.0 EA	

7-7:30

888-2408-002

WARNING: Disconnect primary power prior to servicing.

01/02/01