TECHNICAL MANUAL
888-2687-001
Ranger™ Mobile SeriesUHF
Transmitter

Ranger™ Mobile Series UHF Transmitter

T.M. No. 888-2687-001

Rev. A, October, 2007

PRELIMINARY

Returns And Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS Broadcast Communications 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 Broadcast Communications Division, specify the HARRIS Order Number or Invoice Number.

Unpacking

Carefully unpack the equipment and preform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that all received equipment is not damaged. Locate and retain all PACKING CHECK LISTs. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

Technical Assistance

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS Broadcast Communications Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. Technical Support by e-mail: *tsupport@harris.co*m. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

Replaceable Parts Service

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 Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

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

Manual Revision History

Ranger™ Mobile Series

REV.	DATE	ECN	Pages Affected
Preliminary	Oct. 19, 2007		Added power supply note. Section 4.

WARNING: Disconnect primary power prior to servicing.

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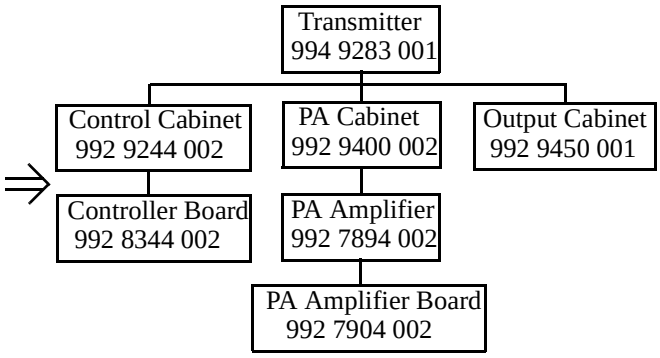
Guide to Using Harris Parts List Information

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:

Replaceable Parts List Index	Part Number	Page
Table 7-1. Transmitter	994 9283 001	7-2
Table 7-2. Control Cabinet	992 9244 002	7-3
Table 7-3. Controller Board	992 8344 002	7-6
Table 7-4. PA Cabinet	992 9400 002	7-7
Table 7-5. PA Amplifier	994 7894 002	7-9
Table 7-6. PA Amplifier Board	992 7904 002	7-10
Table 7-7. Output Cabinet	992 9450 001	7-12



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 C1 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: Disconnect primary power prior to servicing.

HARRIS Broadcast Systems Division
P.O. Box 4290, QUINCY, IL 62305

PARTS ORDER FORM

HARRIS PHONE: 217-222-8200
HARRIS FAX: 217-221-7096

BILLING INFORMATION

CUSTOMER NAME: _____

ADDRESS: _____

_____

_____

_____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

PREFERRED PAYMENT METHOD: _____

SHIPPING INFORMATION

SHIP TO: _____
(if different from billing information)

ADDRESS: _____

_____

_____

_____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

SHIPPING METHOD PREFERRED: _____

FREQUENCY (If required): _____

EQUIPMENT NAME: _____

EQUIPMENT PART NUMBER: _____

EQUIPMENT SERIAL NUMBER: _____

GUIDE FOR ORDERING PARTS

Please use the following parts order form, filling is as much information as possible. The complete informaiton will allow double checking the part number for correctness or locating a substitude if the part is not available.
The equipment name, part number, and serial number will be found on the metal ID plate on the back of the unit. The serial number MUST be included for any parts ordered under warranty.
Describe the part using the description in the parts list if possible. Include the schematic information, schematic number, or number of next higher assembly. The next higher assembly is usually a 992-xxxx-00x type.

ITEM #	QTY ORD	HARRIS PART NUMBER	DESCRIPTION OF PART (PART'S NAME, DESCRIPTION, SPECIFICATION FROM PARTS LIST IF AVAILABLE)	SCHEMATIC REFERENCE REFERENCE NAME (e.g. C001, R100, etc)	ITEM USED ON (NEXT HIGHER ASSEMBLY IF KNOWN) (e.g. C001 used on 992 8025 001, SCHEMATIC 839 8099 991)	COMMENTS

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.

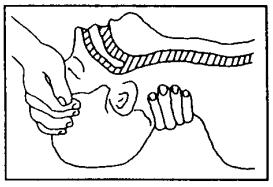
TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-CS OF BASIC LIFE SUPPORT.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

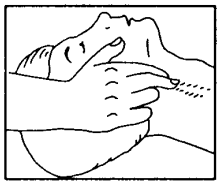
(A) AIRWAY

IF UNCONSCIOUS,
OPEN AIRWAY



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

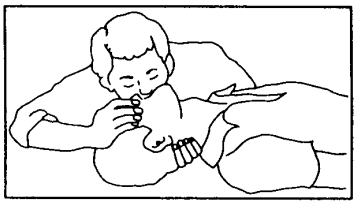
CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

(B) BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING



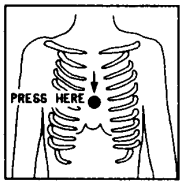
TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL

4 QUICK FULL BREATHS

REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

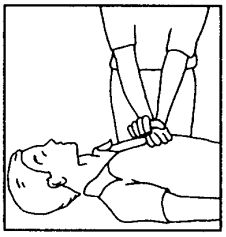
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



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

APPROX. RATE OF COMPRESSIONS --60 PER MINUTE
- TWO RESCUERS
- 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.

A. KEEP THEM WARM
B. KEEP THEM AS QUIET AS POSSIBLE
C. LOOSEN THEIR CLOTHING
D. A RECLINING POSITION IS RECOMMENDED

WARNING: Disconnect primary power prior to servicing.

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 there by 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)

WARNING: Disconnect primary power prior to servicing.

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Section 7
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Section 1 Introduction

1

1.1 Purpose of This Manual

This technical manual contains the information pertaining to the Ranger™ Mobile Series UHF solid-state transmitter, with Apex exciter, featuring FLO^R technologies. The various sections of this technical manual provide the following types of information.

- Section 1, Introduction, provides general manual layout, frontispiece, equipment description, block diagram and performance specifications.
- Section 2, Installation/Initial Turn-on, provides physical and electrical installation procedures for the transmitter and RF systems and basic remote control connections.
- Section 3, Operation/Adjustments, provides information encompassing all uses of the Graphical User Interface or GUI. These include:
  a. Operation and navigation information for the Graphical User Interface and front panel controls.
  b. Since almost all alignments are done from the GUI, this section also provides for all alignment procedures which are done using the GUI
  c. Lastly, it provides information on the use of the GUI for diagnostics and trouble-shooting of all faults which will show up on the GUI.
- Section 4, Theory of Operation, provides block diagram and detailed theory of operation.
- Section 5, Replacement Procedures, provides procedures for replacement of PC boards and mechanical components and any alignments which may be required as a result of the replacement.
- Section 6, ISP (In-System Programming), provides procedures for the use of the ISP software for updating transmitter firmware.
- Section 7, Parts List, provides a parts list for the overall transmitter as well as individual modules.

1.2 General Description

This section contains a general description of the Ranger™ Mobile Series Solid State UHF Digital television transmitters featuring FLO^{R} Technologies. Included in this section are descriptions of the:

- Control System
- Power Amplifier
- System Block Diagram
- System Specifications

Ranger™ Mobile Series solid state UHF FLO™ transmitters share many of the unique features and field-proven benefits that have made Harris digital transmitters the industry standard. Ranger transmitters employ ultra-reliable air-cooled LDMOS FET power amplifier modules and the Harris APEX exciter. A redundant control system combined with a serial bus architecture assure the highest levels of reliability and on-air availability.

Transmitter Features:

- Low loss external filter.
- Remote transmission monitoring with eCDi ™
- Real-Time Adaptive Correction (RTAC) system provides continuous and automatic correction for linear distortions including mask filter
- Straightforward diagnostics using a 320x240 pixel color touch-screen
- On air servicing of PA modules (1kW model)
- Air-cooled amplifiers for ease of installation and maintenance
- Field-proven Apex Exciter using FLO^{R} technologies.
- Standard Parallel remote control interfaces

The Ranger Series™ transmitter is available in 2power levels as listed in Table 1-1. It is also available with external (low loss) mask filters for applications where the full 500W or 1000W output (after the filter) is required.

Table 1-1 Ranger ™ Mobile Series Transmitter Models

Tx Models	PA Modules	Power Supplies	Power before Filter	Filter location
CZ500F	1	1	375W	External
CZ1000F	2	1	750W	External
NOTE: All power levels given in average power assuming the use of FLO technology modulation				

The Ranger ™ Mobile series transmitter is a low power FLO^{R} transmitter which utilizes components from existing, proven transmitter designs. The PA Modules and power supply are from the Diamond Series UHF DTV transmitter and as such are completely interchangeable with a Diamond transmitter or Sigma IOT transmitter with Diamond Drive IPA. This provides the opportunity for upgrade to a higher power Diamond or Sigma IOT transmitter in the future where the PA modules, power supply and the Apex exciter can be transferred to the new transmitter or used as spares.

The control system is adapted from the state-of-the-art Atlas Series UHF (COFDM) solid state transmitter using a very simple control panel and easy to use Graphical User Interface or GUI.

It consists of a single cabinet with a single power supply and one or two PA modules depending on the model.

Figure 1-1 at right, shows a front view of the Ranger transmitter. All models look identical due to the use of false module covers for the 2 or 3 right-hand slots.

Figure 1-1 Transmitter Front View

WARNING: Disconnect primary power prior to servicing.

1.2.1 System Block Diagrams

The Figure 1-2 contains the system block diagram of the CZ1000F Ranger Transmitter. The CZ500F has only 1 PA Module and is therefore identical with the following items deleted: (CZ500F and CZ1000F both use external filters)

- PA Module 2, along with its circulator and reject attenuator
- 3dB Hybrid Combiner and Reject attenuator

NOTE:
For components locations refer to Figure 2-11 on page 2-21 and Figure 2-12 on page 2-22.

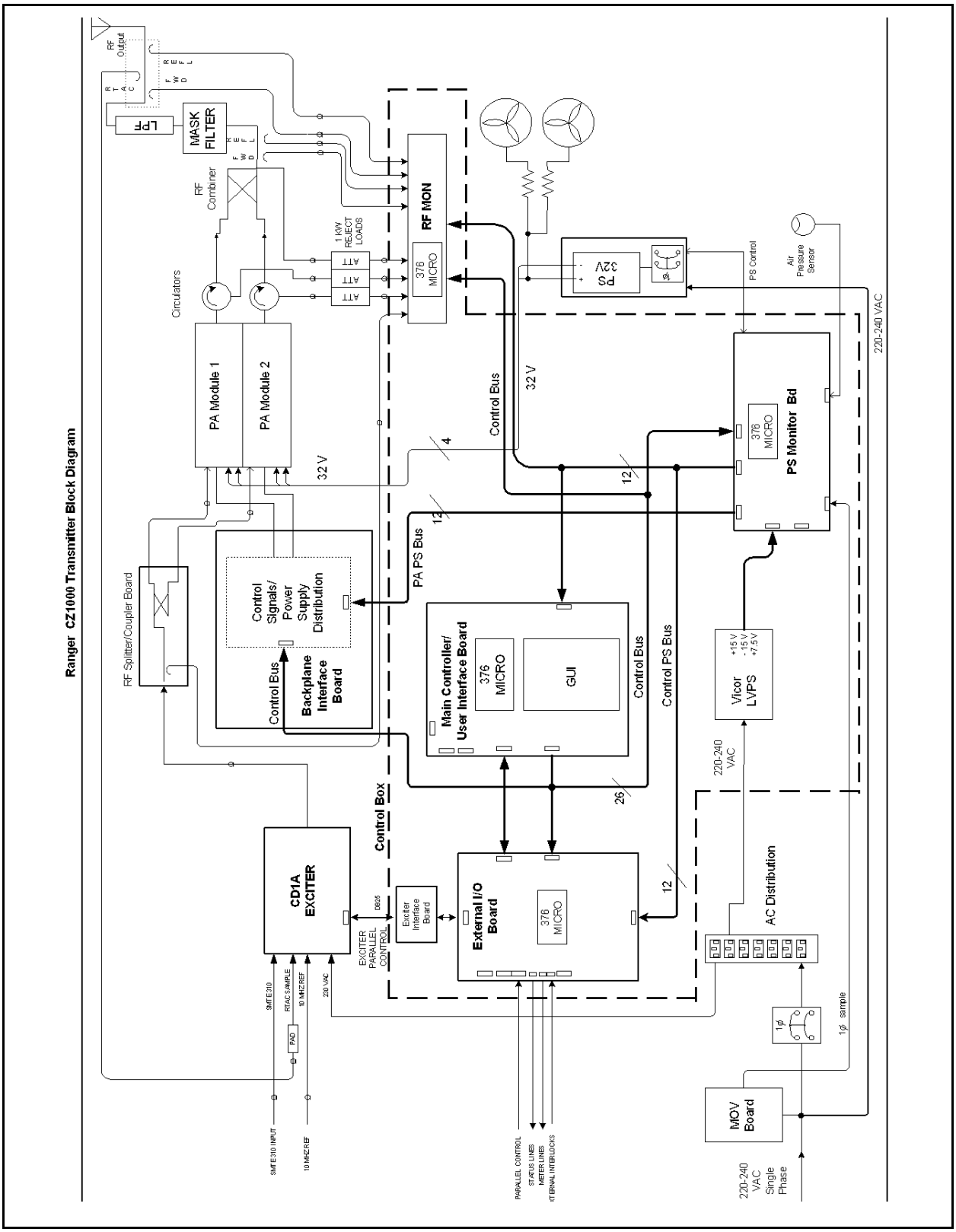


Figure 1-2 Ranger Series™ System Block Diagram

WARNING: Disconnect primary power prior to servicing.

1.2.2 Transmitter Control System

The transmitter uses a distributed architecture control system. This means that each transmitter sub-system is responsible for its own monitoring and protection and simply reports back to the Main Controller for display on the GUI (Graphical User Interface) or to a remote interface. The heart of the system is the 376 Micro Module which is used in all of the transmitter systems for control, monitoring and protection. The Micro Module is used on each of the following controllers and sub-systems:

a. Main Controller Board - This board is responsible for transmitter control and monitoring. However, with the distributed control architecture, it is not directly responsible for protection of the individual transmitter components. It merely gathers all status and fault data from the individual sub-systems and reports that information to the operator. The Main Controller is responsible for system level control (issues which effect multiple systems) since it is the only part of the control system which can monitor the entire transmitter.

b. RF Monitor Board - Responsible for cabinet VSWR protection and monitoring of combiner reject loads. Reports directly to the Main Controller.

c. Power Supply Monitor Board - Responsible for control and monitoring of the PA power supply and distribution of the low voltage. Also responsible for monitoring the cooling system including temperature and air pressure. Reports directly to the Main Controller.

d. External I/O Board - Provides all customer interface connections including parallel remote control. Reports directly to the Main Controller.

e. PA Module Controllers (1 in each module) - This is not actually a 376 micro module but is a micro controller and is responsible for protection and control of the PA Module. Reports directly to the Main Controller Board via the CAN bus.

1.2.2.1 Graphical User Interface

The front panel user interface is a 1/4 VGA, LCD touchscreen display. The touchscreen display is used to monitor the transmitter. Hardware buttons for the primary transmitter functions such as ON, OFF, RAISE and LOWER are provided on the overlay panel next to the display.

1.2.2.2 Control System Communications

The control system uses a serial communications system called a CAN bus. CAN stands for Controller Area Network. The CAN bus is a closed loop serial network operated by the Main Controller Board. Each circuit board and module connected to the CAN bus is

considered a node and therefore has a specific address. This allows the Main Controller to gather information from all parts of the transmitter and display it on the GUI. One big advantage of the CAN bus is that it requires only 2 wires of the system control ribbon cable, eliminating a large amount of discrete wiring which would otherwise be required.

For redundancy, the CAN bus is backed up by parallel, hardwired, control lines that allow the transmitter to stay on the air even if the CAN bus fails. The parallel control lines also provide the instantaneous OFF and RF MUTE commands necessary for transmitter protection.

1.2.2.3 In-System Programming or ISP

The use of the CAN bus for communication between the various Micro Modules in the transmitter also allows for easy updating of the software used in each transmitter sub-system via a serial port connection to an external computer. This is referred to as In-System Programming or ISP.

The real benefit of In-System Programming is that it allows any or all of the transmitter software to be updated without removing or replacing any firmware ICs. The Harris ISP program is provided on the CD-ROM accompanying this manual along with all of the transmitter software as it shipped from the factory. The Harris ISP program is easy to use and it only takes a few minutes to load or update software.

NOTE:
Software does not need to be loaded into the transmitter unless new components are installed or an update is sent from Harris. The transmitter, as shipped from the factory, is preloaded and ready to run.

1.2.2.4 Remote Control

The Ranger™ Mobile Series transmitter has all of the standard parallel remote control, status and analog metering connections for use with a third party remote control system. For a complete listing of the remote control connections, see Table 2-1, Table 2-2 and Table 2-3 at the end of section 2.

1.2.3 PA Module

The Ranger Mobile Series™ PA Module utilizes the same LDMOS amplifier module as used in the Diamond Series DTV transmitter. Each PA Module will produce up to 400W average power output. A block diagram of the PA module is shown in Figure 1-3.

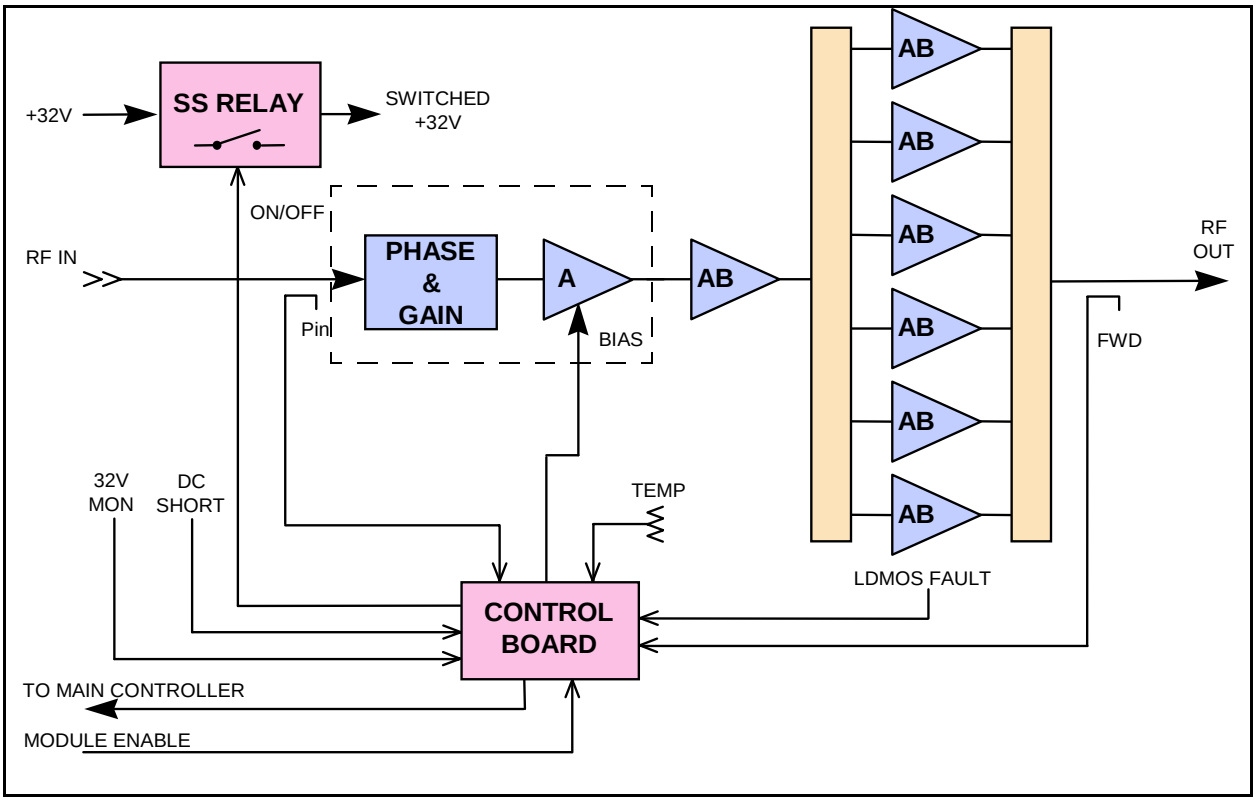


Figure 1-3 PA Module Block Diagram

Each PA module consists of the following components:

a. PA Module Controller Board - Responsible for all monitoring and protection of the module. Reports to the transmitter Main Controller via the CAN bus but is also connected to the parallel control lines in case the CAN bus is not operational. Also provides for FET switching and distribution of the +32Vdc power to the driver and PA pallets and sensing of driver and pallet currents.

b. Phase and Gain Board - Provides for module phase and gain adjustments to minimize the PA module combiner reject power for the CZ1000F.

c. One LDMOS Driver Pallet - Provides enough power to drive the 6 way splitter and the inputs to the power amplifier pallets.

d. Six-way Pallet Splitter and Combiner.

e. Six (6) LDMOS Amplifier Pallets - When combined, they provide up to 400 watts of average power at the output of the module. These pallets are field replaceable.

f. RF Output Directional Coupler - Samples both Forward and Reflected power for metering, module ALC and module VSWR protection.

WARNING: Disconnect primary power prior to servicing.

Each Ranger Series™ PA Module is a self-contained transmitter (except for the power supply) with its own internal control, monitoring and protection. The modules only receive basic On/Off, Mute, Restart, Phase and Gain commands from the transmitter control system. This means that each module will protect itself without relying on the system controller.

1.2.4 Power Supplies

A single +32 Vdc switching power supply is used to provide the DC voltage to the PA modules within each PA cabinet. The power supply can provide power for 1 or 2 PA modules. The control system in the PA Cabinet is powered by a self contained low voltage power supply with +/-15Vdc and +7.5Vdc outputs.

1.2.5 Apex™ Exciter

For information on setup and operation of the Apex Exciter utilizing FLO^{R} technologies refer to the separate exciter manual, 888-2604-001. The exciter manual is bundled with the transmitter documentation for shipment

1.3 General Specifications

Table 1-2 provides the performance specifications for the Ranger series transmitters.

NOTE:
All specifications subject to change without notice

Table 1-2 Ranger Performance Specifications

Item	Units	Conditions	Value
General			
Frequency Range	Mhz	Any specified FCC Channel 14-69	470-806 Mhz
Channel Bandwidth	Mhz	FLO Technologies COFDM standard	6, 7, or 8 Mhz
Output Power before System Filters	W	At 36 dB shoulders (measured +/-3.00 MHz from center of 6 MHz channel)	CZ500F - 550W CZ1000F - 1090W
RF Load Impedance	Ohms		50 Ohms

Item	Units	Conditions	Value
RF Load VSWR		Over specified TV channel	1.1:1
Output Connector			1-5/8” EIA Flanged
Data Input			
Input Rate	Mb/s		270
Impedance	Ohms		75
Standard	DVB-ASI		EN 50083-9
Connector			BNC Female
External Frequency Reference Input			
Frequency	Mhz		10 Mhz
Impedance	Ohms		50 Ohms
Level	dBm	Sinusoidal Waveform	0 to +10 dBm
Connector			BNC Female
Performance			
Modulation Error Ration (MER)	dB	Measured at transmitter output	$\geq$ 33dB
Shoulder Level	dB	Measured at transmitter output before filter, for 6 MHz channel, F_c +/- 3 MHz	$\geq$ 36 dB
Carrier Suppression	dB		$\geq$ 20
I/Q Imbalance	dB	Residual Sideband Level	$\geq$ 50
Frequency Tolerance (without external reference)	Hz	for at least 24 hrs.	1 x 10^{-8}
Frequency Tolerance (with external reference)	Hz	for at least 24 hrs.	1 x 10^{-9}
Frequency Tolerance (with external reference)	Hz	for at least 24 hrs.	1 x 10^{-9}
Pilot Frequency Stability	Hz	With External Reference	Less than +/- 3 Hz
Stability of Output Power	%	Over entire operating temperature range and indefinite time period	+/-10%, or less
Phase Noise		Frequency Offset Relative to Carrier Frequency	Phase Noise
		100 Hz	-80
		1 kHz	-90
		10 kHz	-95
		100 kHz	-110
		1 MHz	-120
		> 1 MHz	-120
Spurious Radiation			

WARNING: Disconnect primary power prior to servicing.

Item	Units	Conditions	Value
Conducted Spurious Radiation		Measured at transmitter outptut before filter	< -30
AC Line			
AC Line Voltage	VAC	Single Phase 50/60 Hz	208/240 VAC
AC Line Voltage Variation	%		+/-10%
Power Factor			> 0.97
Overall Efficiency (Typical)	%	AC power to RF average power	20% (for CZ500 & 1000F)
Power Consumption (Typical)	kW		2.5kW for CZ500F 5 kW, for CZ1000F
Environmental			
Operational Temperature Range	^{o} C	Derate 2 degree C per 300m AMSL	0 - 45
Operational Relative Humidity	%	Non-condensing	0 - 90
Guaranteed Specification Temperature Range	^{o}C		5-45
Storage Temperature	^{o}C		-20+60
Maximum Altitude	Ft.	AMSL (Above Mean Sea Level)	7500
Cooling Method			Air Cooled
Residual Heat Transferred to Room	kW	Normal operating conditions	2.0kW for CZ500F 4.0 kW, for CZ1000F
Acoustic Noise	dBA	Measured 1m from front of cabinet	<67 dBa
Physical			
Dimensions	In	Cabinet only	72H x 27.6W x 40D
Weight	Lbs	Does not include options	CZ500F 600 Lbs CZ1000F 1000 Lbs

Cl-PS-02-003 Ranger Performance Spec

WARNING: Disconnect primary power prior to servicing.

Section 2 Installation / Initial Turn-On

2

2.1 Introduction

This section includes the information necessary for installation and initial turn on of a Ranger™ Mobile Series FLO^{R}, solid state UHF transmitter. Information is included for single and dual PA module configurations. Due to the modular nature of the Ranger, all models have the same basic cabinet level installation and testing procedures, with additional information given for dual PA module testing in CZ1000F.

NOTE:
For component locations, refer to Figure 2-11 and Figure 2-12 at the end of this section.

2.1.1 Installation Drawings

The following is a list of documentation that ships with the transmitter. This documentation should be available for reference during the commissioning process. The top level Document Package numbers for each transmitter model are shown below:

- CZ500F & CZ1000F: **988-2687-001**

A Document Package includes:

1. 888-2685-001 Commissioning Manual (this technical manual)
2. 888-2497 Ranger^{TM} Mobile Series Transmitter Manual
3. 888-2604-001 Apex Exciter using FLO^{R} Technology Operating Manual

It is recommended that you look through the drawing package to familiarize yourself with the information available. Although drawings are provided for all assemblies in the transmitter, most of the installation and planning information is given in the following drawings (in the supplied drawing package):

a. Transmitter Outline Drawing - 843-5560-071 - Shows physical connection points for AC and control conduits and RF output. Also gives cabinet dimensions, required cabinet clearances and a table of basic requirements for both models.

b. Transmitter Wiring Diagram - 843-5560-001 - Interconnection wiring diagram for all assemblies inside the transmitter cabinet.

c. AC Flow Diagram - 843-5560-098 - Shows external AC wiring requirements along with minimum wire and breaker sizing for each model.

d. RF Flow Diagram - 843-5560-097 - Shows external RF connections and possible layout for patch panel and dummy load.

e. Ranger External I/O Connections - 843-5560-105 - Shows connections to the External I/O board for an RF patch panel or motorized switch.

The included CD-ROM contains:

1. Transmitter control software files of the same revision as loaded into the transmitter at the factory
2. ISP (In-System Programming) software application which is used to install software upgrades into the transmitter controllers.
3. An Acrobat (pdf) version of the transmitter Technical Manual.

2.2 Installation Checkboxes

☐ Located to the left of each important step in the installation procedure is a checkbox like the one to the left of this paragraph. As each step in the procedure is completed, the box should be checked. This provides a quick confidence check at the end of the procedure that no steps were skipped. **The primary goal of each step is also in bold letters**, with the rest of the paragraph being support information toward that goal.

NOTE:
In case of discrepancy between the connections listed in the schematics versus the information given in this installation section, the wiring information in the schematics should be considered the most accurate. All connections listed in this section should be verified with the schematics before initial turn on.

2.3 Transmitter Cabinet Placement

The transmitter cabinet should be placed where it will have approximately 3 feet of clearance on each side and in the back. The front of the transmitter should have a clearance of at least 5 feet to allow for access to the PA and power supply modules. The

transmitter outline, 843-5560-001 drawing gives all cabinet dimensions and required clearances as well as conduit connections and cabinet layout.

☐ **Remove the transmitter from the wooden pallet.** The transmitter is bolted to the pallet with 2 bolts. One is accessible via the back door, the other can be removed by pulling the PA Power supply out the front of the cabinet. The power supply is held in place by the 2 screws, one on each side of the PS breaker.

☐ **Use shims or flat washers to make sure the transmitter is level and solid (not rocking).**

☐ **Secure the transmitter to the floor as required by local codes.**

2.4 Transmitter AC Connection

⚠ **WARNING:**

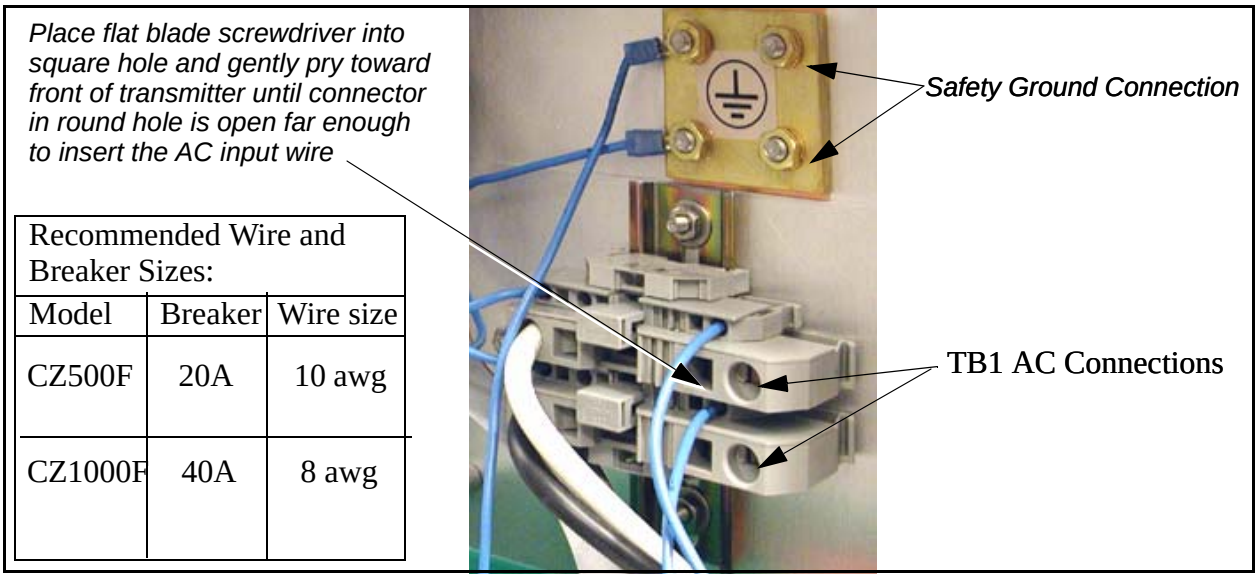
DISABLE AND LOCK OUT STATION PRIMARY POWER BEFORE PRIMARY POWER CABLES ARE CONNECTED TO THE EQUIPMENT.

NOTE:
The Ranger transmitter is equipped for single phase 208/240Vac at 50/60Hz. If voltage variations in excess of +/-10% are anticipated, the transmitter power input must be equipped with automatic voltage regulators (optional equipment) capable of correcting the mains voltage.

☐ **Connect the Primary AC conduit to the top of the transmitter cabinet.** The top of the transmitter cabinet has a pre-cut hole for a 3/4” conduit connection. For Conduit connections to the transmitter refer to the Transmitter Outline Drawing 843-5560-071, Top View. The AC input is the routed straight down to TB1, shown in Figure 2-1.

☐ **Connect the AC wires to TB1-2 and TB1-4.** The AC Flow diagram shows ac wiring to the transmitter along with recommended wire gauge and breaker size. Wire gauge and breaker size are also given in the Figure 2-1.

☐ **Connect the safety ground wire to one of the terminals on the grounding block.**



Recommended Wire and Breaker Sizes:		
Model	Breaker	Wire size
CZ500F	20A	10 awg
CZ1000F	40A	8 awg

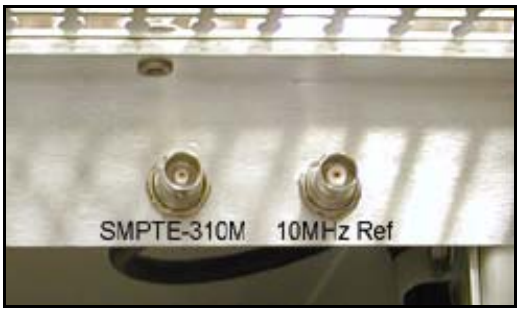
Figure 2-1 AC and Safety Ground Connections

WARNING: Disconnect primary power prior to servicing.

2.5 Signal and Ground Connections

NOTE:
Control and signal wires should never be run in the same conduit with any AC wiring. A separate conduit should be used for control/signal cables.

☐ **Connect the SMPTE 310M input and the optional 10MHz reference.** There are 2 bulkhead BNC connectors located just inside the back door at the top of the cabinet as shown to the right.



NOTE:
Note that the 10Mhz reference is optional.

☐ **Connect a ground strap from the transmitter cabinet to the station ground**. There is a brass ground block located on top of the cabinet or a strap coming out the back of the cabinet (only one should be used). For connection to the top of the cabinet, remove the block, punch holes in the copper ground strap and then mount the strap under the block. The loose strap at the bottom of the cabinet should be soldered to the station ground strap. The copper strap must be at least 2" wide.

2.6 Interlock Connections

There are 2 types of interlock connections for the Ranger:

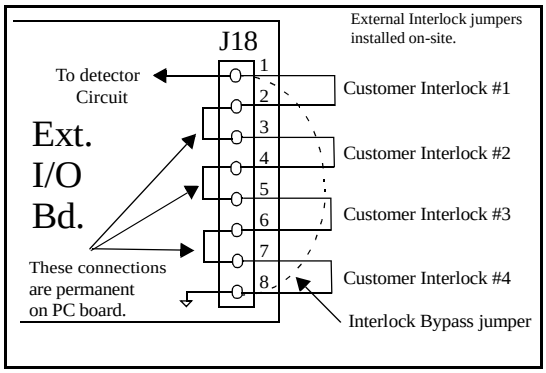
- External Interlock which shuts the transmitter off and requires the user to give an ON command (local or remote) to turn the transmitter back on. Used for protection of personnel and equipment. For more information see "4.3.7.1 External Interlocks" on page 4-10.
- RF Mute Interlock which only mutes the rf drive and therefore reduces the transmitter power output to zero. This interlock is meant to be used for a motorized RF switch or possibly a dummy load thermal interlock.

NOTE:
To operate the transmitter without any interlock connections requires 3 jumpers:

- J18-1 to J18-8 (defeats the External Interlocks)
- J18-9 to J18-12 (defeats the RF Mute Interlocks)
- J14-1 to J14-3 (defeats the RF Switch Status feedback interlock)

2.6.1 External Interlocks

The transmitter has inputs for up to four external interlocks on the External I/O Board. Note that these 4 connections comprise one interlock with 4 series connection points. The transmitter, as shipped from the factory, has no external interlock connections. The Ranger External I/O Connection schematic (843-5560-105 or 843-5549-141, sht 20) shows that Interlock #1, J18-1 to J18-2, is usually used by a 3 port patch panel. The other three are to be used at the customers discretion.



IMPORTANT:
The External Interlock circuit requires a closed connection between **all** of the following terminals on the External I/O Bd to turn the transmitter on:

- J18 pins 1-2 (usually connected to 3 port patch panel)
- J18 pins 3-4 (for customer use)
- J18 pins 5-6 (for customer use)
- J18 pins 7-8 (for customer use)

If these 3 interlocks are not used, a single jumper from J18-3 to J18-8 is recommended

2.6.2 RF Mute Interlock

There are 2 more interlock connections on J18 which can be used to apply an RF Mute; instead of a Fault OFF condition as discussed above. This could be used for RF switch changeover or a dummy load thermal interlock. The connections are:

- J18-9 to J18-10
- J18-11 to J18-12

CAUTION:
THE RF MUTE INTERLOCK CONNECTIONS ARE NOT TO BE USED IN ANY SITUATION WHERE PROTECTION OF PERSONNEL IS AN ISSUE.

2.7 3 Port Patch Panel

IMPORTANT:
If no patch panel or motorized switch is to be installed in the transmitter RF output line, or if the patch panel does not have status switches, then a jumper must be placed on the External I/O board from J14-3 (RF_SW_A_STAT) to J14-1 (ground).

NOTE:
Refer to the Ranger External I/O Connections schematic **843-5560-105** for the following connections: (S1 = Antenna position / S2 = Test Load position)

☐ **Connect one side of S1A and S2A on the patch panel to J18-1 and the other side to J18-2 on the External I/O Board in the transmitter.** See External I/O Schematic 843-5549-141, sheet 20, for External interlock connections. This is the transmitter external interlock input and will shut the transmitter off if the U-Link is removed during operation. A closed contact between J18-1 and J18-2 is required for the transmitter to operate. Jumpers must also be placed in the other 3 External Interlock positions, J18-3 to J18-4, J18-5 to J18-6 and J18-7 to J18-8 or one jumper from J18-3 to J18-8.

CAUTION:
ALWAYS SHUT THE TRANSMITTER OFF BEFORE REMOVING THE U-LINK TO PREVENT POSSIBLE DAMAGE TO THE CONTACTS.

☐ **If the RF Mute interlock connections are not going to be used (and they are normally not used for patch panels), connect a jumper from J18-9 to J18-12.**

☐ **If the patch panel has status switches then connect S1B and S2B to the RF switch status inputs on J14 of the External I/O Board in the transmitter.** This allows the GUI to display the position of the patch panel and will cause a transmitter mute if neither of these connections are pulled low. These connections include:

- S1B and S2B commons connect to J14-1 (ground)
- S1B (antenna position) connects to J14-3
- S2B (test load position) connects to J14-4

NOTE:
If the patch panel does not have status switches then a jumper must be placed between J14-1 (ground) and J14-3 (RF_SW_A_STAT) on the External I/O board. The transmitter will be muted without this connection.

2.8 Motorized RF Switch Connections

IMPORTANT:
If no patch panel or motorized RF switch is to be installed in the transmitter RF output line, or if the RF switch does not have status switches, then a jumper must be placed on the External I/O board from J14-3 (RF_SW_A_STAT) to J14-1 (ground).

NOTE:
Refer to the Ranger External I/O Connections schematic **843-5560-105** for the following connections: (S1 = Antenna position / S2 = Test Load position)

☐ **Connect the RF_SW_SEL_OUT at J15-9 on the External I/O board to the select input on the switch.** This output is a TTL open collector, active low, momentary signal meant to cause a switch to the opposite position. The RF switch should then latch in that position until pulsed again.

☐ **Connect one side of S1A and S2A (interlock switches on the rf switch) to J18-9 and the other side to J18-10 on the External I/O Board in the transmitter.** See diagram 843-5560-105 and/or 843-5549-141 sheet 20, for RF Mute interlock connections. This is one of the transmitter rf mute interlock inputs and will mute the transmitter while the switch changes position. Another jumper must be connected between J18-11 & J18-12 to operate the transmitter.

☐ **If the patch panel has status switches then connect S1B and S2B to the RF switch status inputs on J14 of the External I/O Board in the transmitter.** This allows the GUI to display the position of the patch panel and will cause a transmitter mute if neither of these connections are pulled low. These connections include:

- S1B and S2B commons connect to J14-1 (ground)
- S1B (antenna position) connects to J14-3
- S2B (test load position) connects to J14-4

NOTE:
If the patch panel does not have status switches then a jumper must be placed between J14-1 (ground) and J14-3 (RF_SW_A_STAT) on the External I/O board. The transmitter will be muted without this connection.

☐ **Connect Jumpers to the External I/O board for all unused External Interlocks.** See "2.6.1 External Interlocks" on page 2-6 for information on connections. If no external interlocks are used, connect J18-1 to J18-8.

2.9 Install PA and PS Modules

PA and PS modules normally ship already installed in the transmitter. If not, perform the following steps.

☐ **Plug the power supply module into the slot at the bottom of the cabinet**. The breaker on the front of the power supply should be set to OFF. Two screws are used to hold the module in place.

⚠ **WARNING:**
THE PA MODULES ARE LARGE AND RELATIVELY HEAVY AT ABOUT 38 LBS. CARE SHOULD BE TAKEN TO AVOID PERSONAL INJURY AND/OR DAMAGE TO THE MODULES. PROPER LIFTING TECHNIQUES SHOULD ALWAYS BE USED WHEN HANDLING THE MODULES.

☐ **Install the PA module(s) into the front of the transmitter cabinet.** The RF output connector on the back of the module should be nearest the top when inserting the module.

NOTE:
For the CZ1000F, the PA Modules should be placed into the same slot in which they were tested at the factory. Each module has a serial number tag. This serial number is recorded on the factory test data sheet along with the appropriate slot number. Placing the module in a different slot will not cause any harm to the transmitter but will require more time for module phasing.

⚠ **WARNING:**
THE RANGER PA MODULES ARE DESIGNED TO HANDLE VERY HIGH TEMPERATURES AND MAY BE EXTREMELY HOT, UP TO 90^{O} F (50^{O} C) ABOVE ROOM TEMPERATURE. DO NOT TOUCH THE MODULES WITH BARE HANDS AFTER THE TRANSMITTER HAS BEEN RUNNING, ESPECIALLY IN HIGH AMBIENT TEMPERATURE ENVIRONMENTS. SPECIAL GLOVES HAVE BEEN PROVIDED IN THE REAR OF THE CABINET OR CAN BE OBTAINED FROM HARRIS, PART #0990006483 OR GRAINGER ITEM #4JF36.

2.10 Initial Turn-On

Read and understand the entire initial turn-on procedure before starting. Detailed use of all GUI screens is given in Section 3 Operation/Alignments.

☐ **Shut off the control circuit breaker CB1 and the PS Module breaker** (both located on the bottom front of the transmitter).

☐ **Apply primary power to the transmitter at the ac mains disconnect**. Be ready to quickly disconnect the power if necessary.

☐ **Turn on the Control circuit breaker, CB1**. This should power up the LVPS and bring up the GUI display. It may be necessary to turn on the LVPS switch (letter "C" in Figure 2-11 on page 2-21). It is located in the back of the transmitter at the top of the controller assembly.

The GUI display should show the Home (default) screen shown in Figure 2-2. Try using the touchscreen buttons on the right side of the GUI display (not the hardware buttons to the right of the GUI). If they do not seem to be working or only work when pressed outside the button graphic, then go to "5.7 Touch Screen Calibration" on page 3-20 before continuing. If the buttons are working then proceed on to the next step.

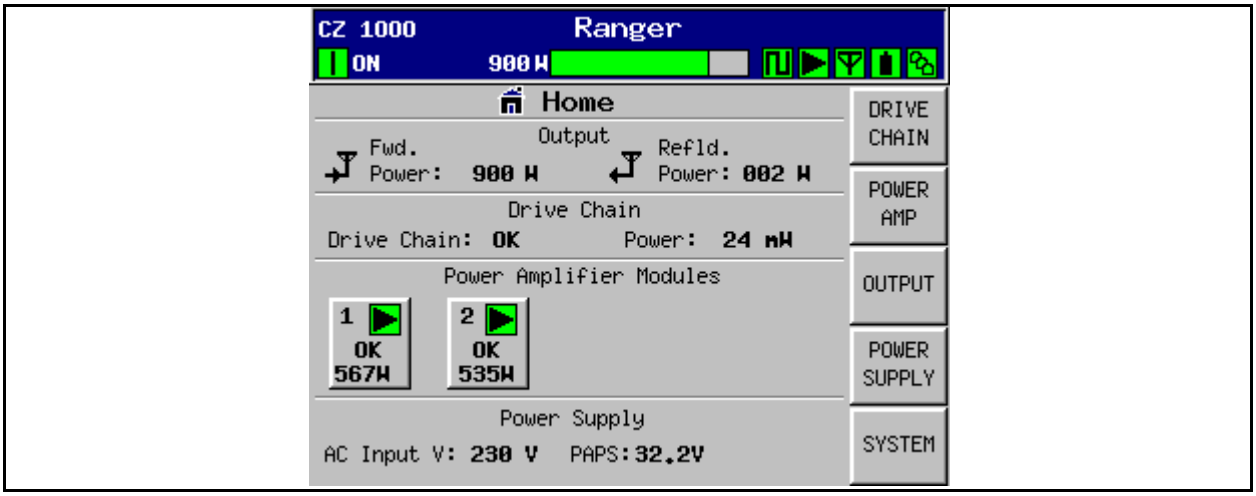


Figure 2-2 Home Page

☐ **Check the Low Voltage power supplies and AC Mains voltage.** Press the POWER SUPPLY button to access the PS fault and metering screen. Check for +15, -15 and +7.5 volts on LV PSU, with the BUS voltage slightly lower. There should be NO red indications or faults present. If a fault is present, find the picture of the screen with the fault in Section 3 for more information.

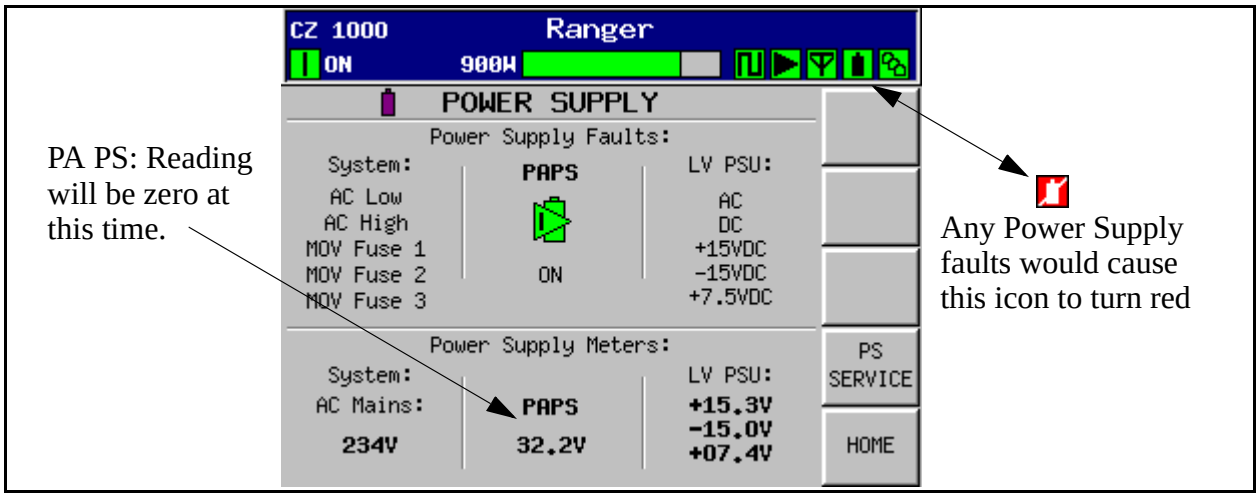


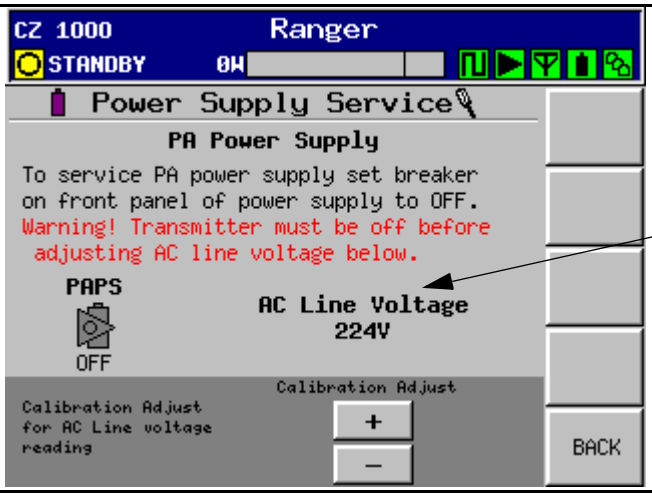
Figure 2-3 Power Supply Metering

NOTE:
The PAPS (Power Amplifier Power Supply) readings should be zero and will be shown as OFF. The PAPS is only active after the transmitter ON button is pressed. Do not press the transmitter ON button at this time.

☐ **Calibrate the AC Mains Reading.** Check your ac mains voltage at the disconnect box. Next press the PS SERVICE button shown in Figure 2-3. This will take you to the screen in Figure 2-4. Use the +/- buttons at the bottom of the screen to set the AC Mains voltage to the same as your measured ac voltage. This is a critical adjustment as this reading is used for the AC low and high fault thresholds.

NOTE:
This calibration should always be done with the transmitter shut off. Adjustment can cause various power supply faults to appear momentarily including PS Mute.

WARNING: Disconnect primary power prior to servicing.



This adjustment will only need to be done during installation or in the event the MOV board or the PS Monitor board is changed.

Figure 2-4 PS Service Screen

☐ **Customize the transmitter System Setup.** Press the SYSTEM button then enter the default password - 1895. Then press SYSTEM SERVICE and SYSTEM SETUP to access the screen shown in Figure 2-5. The System Setup screen displays the settings for station name, model number, nominal output power, etc. Touch the screen at each field to enter the data pertinent to the site. For more information on this screen see "3.9.3.1 System Setup" on page 3-27.

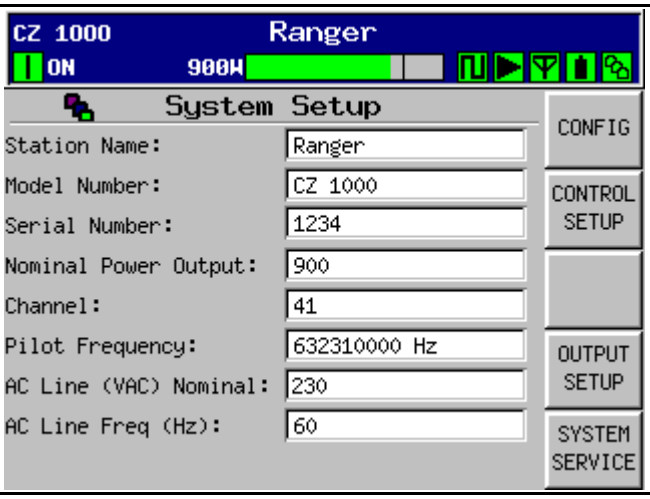


Figure 2-5 System Setup Screen

WARNING: Disconnect primary power prior to servicing.

☐ **Press the CONTROL SETUP button in Figure 2-5 to set the Date, Time, LCD screen contrast and Password on the Control Setup screen, shown in Figure 2-6.** Touch the screen at each field to enter the correct data for Date, time, contrast and password. There is also a time entry for the LCD screen saver feature.

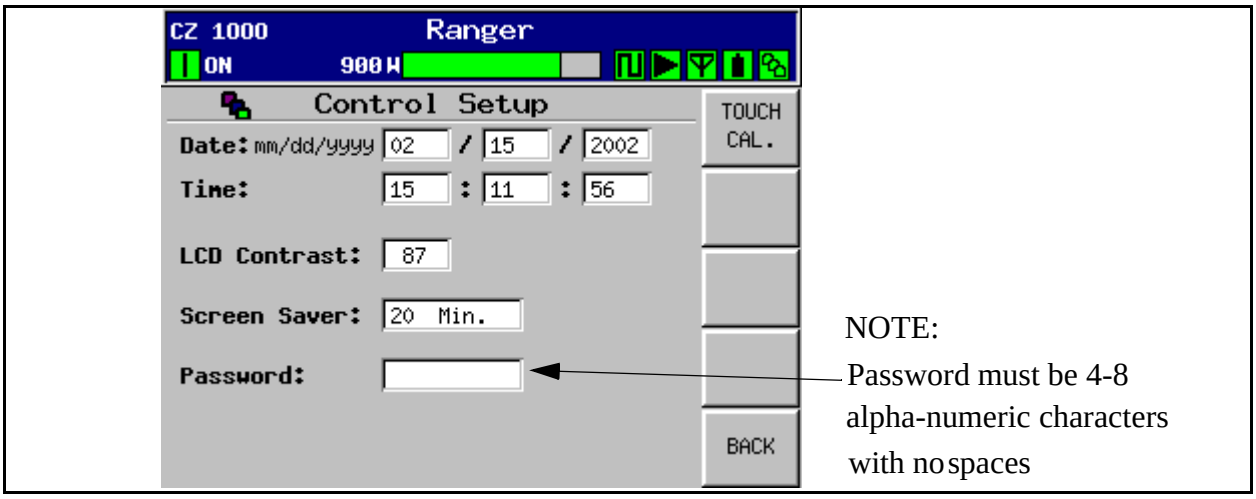


Figure 2-6 Control Setup Screen

WARNING: Disconnect primary power prior to servicing.

2.10.1 RF Initial Turn ON

☐ **Shut the transmitter OFF.** The transmitter should be initially powered into a test load.

☐ **Set the Exciter power to zero**. This can be done via the raise/lower button on the front of the CD-1A exciter or the Lower button on the transmitter control panel.

☐ **Switch ON the ac breaker on the front of the PA power supply**. Monitor the Power Supply screen shown in Figure 2-3 on page 2-11.

☐ **Press the transmitter ON button**. Make sure the PA PS reading is close to 32Vdc. Next, go to the Power Amp screen shown in Figure 2-7.

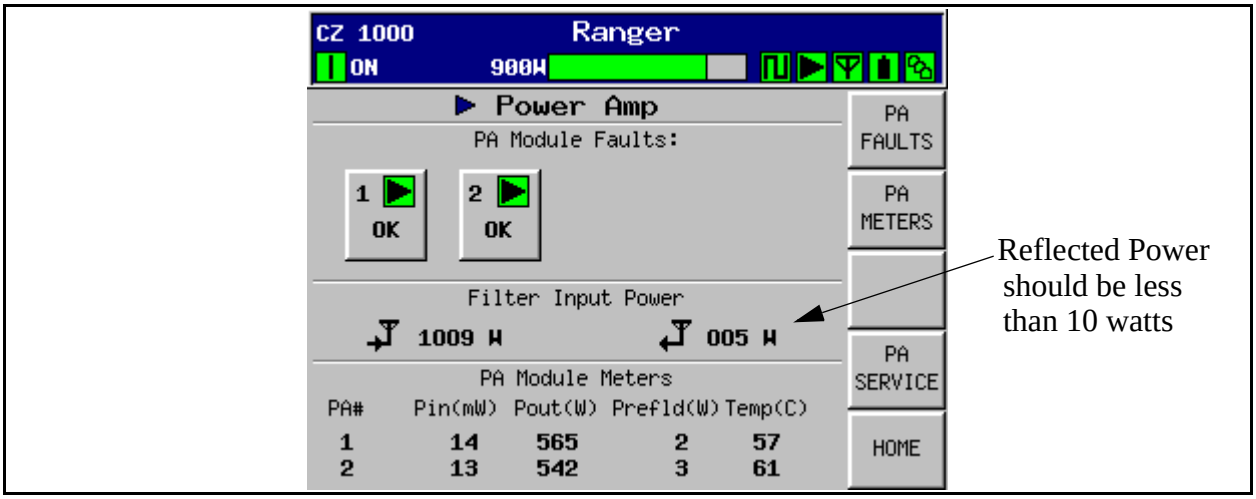


Figure 2-7 Power Amp Main Menu

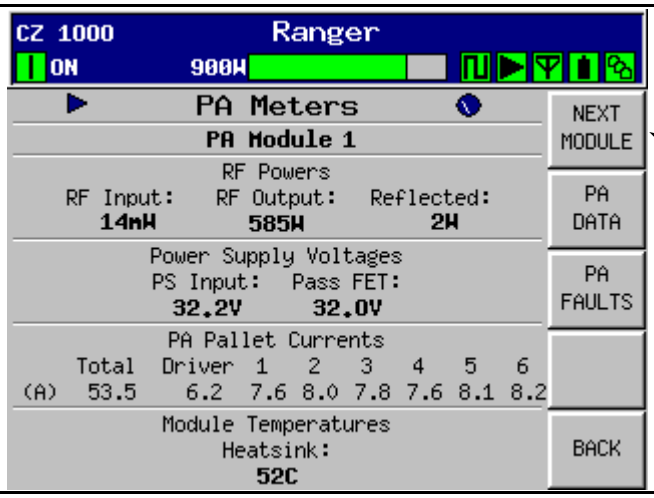
☐ Raise the transmitter power (or exciter power) slowly until about 50% nominal and check the transmitter reflected and PA module reflected powers. The transmitter should be operating normally with no faults indicated. Any faults should be corrected before continuing. The power output bargraph on the top of the GUI screens will be yellow until the power is 80% or more. Verify that the reflected power is under 10 watts.

☐ Check the power on the HOME screen (shown in Figure 2-2) to check for excessive reflected power after the mask filter.

☐ All PAs should show a green (OK) status on the GUI (Power Amp screen).

☐ Monitor the PA Meters screen shown in Figure 2-8. This screen can be accessed by pressing the PA Meters button on the Power Amp screen in Figure 2-7.

NOTE:
See Factory Test Data for nominal readings.



Use this button to check PA Module #2 on the CZ1000F (This button not used on CZ500F)

Figure 2-8 PA Meters Screen

☐ **Press POWER SUPPLY and verify that all PA power supplies show OK status (green)**.

☐ **Press OUPUT then OUTPUT METERS.** This page shows the forward and reflected powers for the Cabinet and Total System power (after filters). The VSWR is indicated as well. Calibration should not be required since all couplers are inside the cabinet and calibrated as part of the factory testing. If the calibration is not correct as determined by a digital power meter, refer to "3.7.3 Forward and Reflected Power Calibrations" on page 3-20.

☐ **Slowly bring up the transmitter power to the nominal value, as indicated by the bar graph**. Monitor the cabinet forward and reflected powers, as well as the VSWR reading. A large VSWR (above 1.1) is indicative of a bad RF connection to the test load.

☐ **Check the PA Module "Gain Balance" on the PA Setup screen** (press Power Amp, PA Service, PA Setup to get to Figure 2-9). This is adjusted at the factory and does not require re-adjustment as long as the current readings in Figure 2-9 are within 1 amp of each other. If the readings are more than 1 amp apart then perform the following:

NOTE:
This adjustment should only be done at full power and after the module temperatures have had time to stabilize. PA Module phasing should always be optimized after finishing this procedure.

STEP 1 Press the RESET button. This allows the adjustment to always start from a common point.

STEP 2 Use the Left and/or Right arrow buttons until the numbers match. There will be some bounce in the readings, but they should be as close as possible and no more than 1 amp apart.

NOTE:
This adjustment is **not** to be used to decrease the PA module combiner reject power. In some cases this adjustment may actually increase the PA module combiner reject power by a few watts.

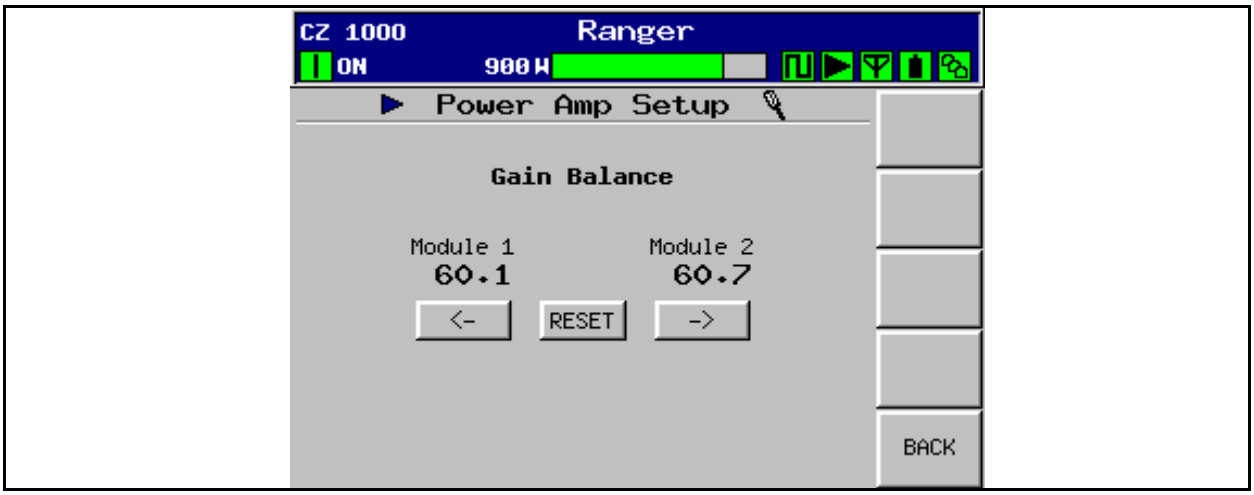


Figure 2-9 PA Setup Screen

☐ **Check the PA Module Phasing** (press Output, Output Service). The Reject Load Power (relative) reading should be less than 0030 with the gain button set to low (at full rated power). If not, refer to "3.7.2 Module Phasing Procedure" on page 3-18, before proceeding, then return here to finish the installation.

☐ **Make sure the PA and HPF correctors are turned ON on the APEX exciter and check transmitter performance.** Refer to the APEX exciter manual 888-2604-001 for settings.

☐ **Make sure the RTAC (Real Time Adaptive Correction) is turned on in the Apex exciter.**

2.11 Parallel Remote Control Connections

External Parallel remote control units can interface at the External I/O Board in the rear of the cabinet. J13 through J17 are for remote Control, Status and Analog readings. The connectors are organized as follows:

- J13 and J14 - Remote Transmitter Control Functions
- J15 and J16 - Remote Status Outputs
- J17 - Remote Analog Metering Outputs

NOTE:
The forward slash (/) in front of a signal name means active low. The signal / INPUT 1 for example is activated by momentarily bringing that input low. Signal names without the forward slash are considered active high. This convention is used throughout the schematics.

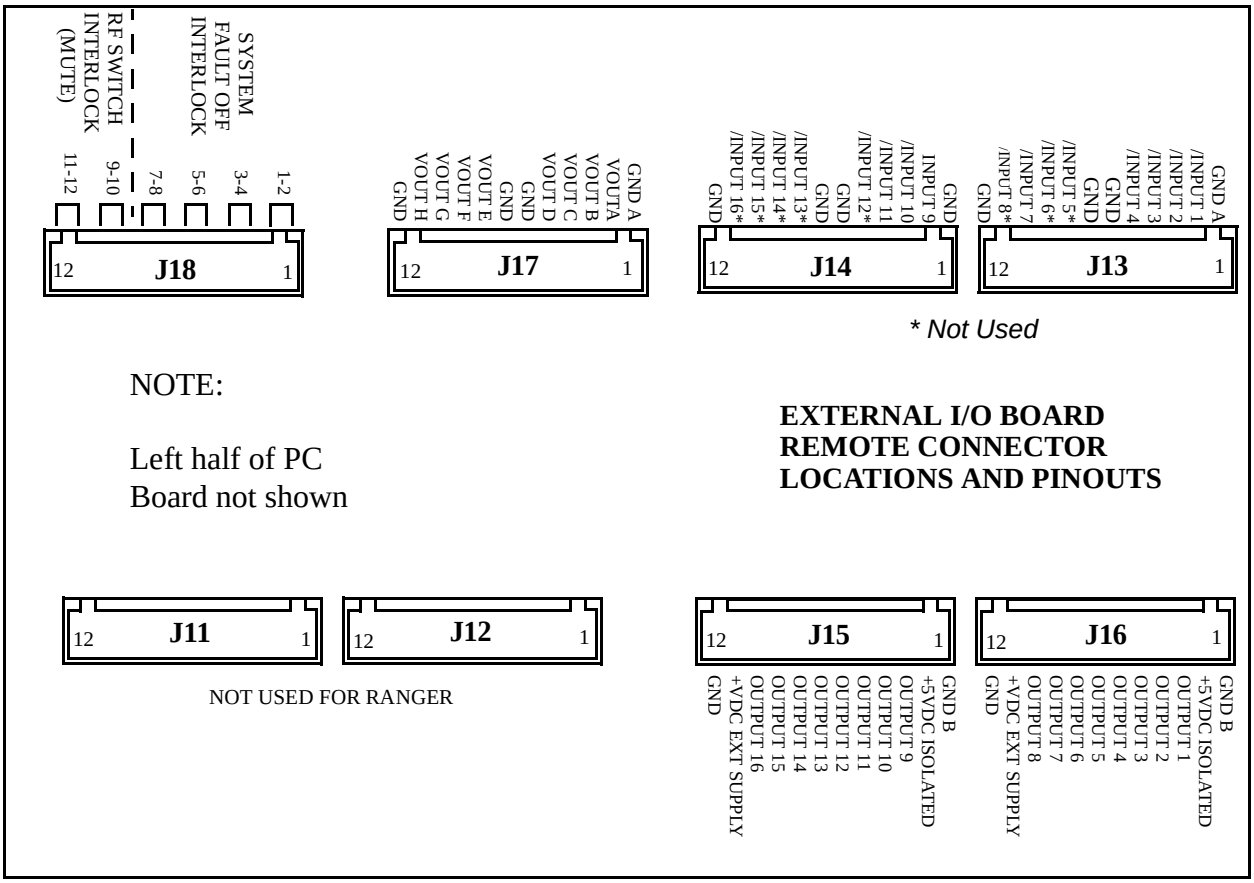


Figure 2-10 External I/O Connector Locator

2.11.1 Transmitter Control Functions, J13 and J14

All control inputs use opto-isolators for surge protection. The opto-isolators are powered by an internal +5Vdc from an isolation protection circuit, U54. All transmitter

control functions (except Remote RF Mute) are momentary ground switching and require the remote control equipment to sink at least 15mA to activate the function. The Pinouts of J13 and J14 are listed in Table 2-1.

Table 2-1 J13 & J14, External I/O Board, Remote Control Connectors

Connector	Schematic Label	Function
J13-1	GND	Ground
J13-2	/INPUT 1	REMOTE_ON
J13-3	/INPUT 2	REMOTE_OFF
J13-4	/INPUT 3	REMOTE_RAISE
J13-5	/INPUT 4	REMOTE LOWER
J13-6	GND	Ground
J13-7	GND	Ground
J13-8	/INPUT 5	Spare
J13-9	/INPUT 6	Spare‘
J13-10	/INPUT 7	REMOTE_RF MUTE_ON- Transmitter RF output is muted as long as this input is held low. (High = Un-mute)
J13-11	/INPUT 8	Spare
J13-12	GND	Ground
J14-1	GND	Ground
J14-2	/INPUT 9	REMOTE_RF_SW A/B_SELECT
J14-3	/INPUT 10	RF_SW_A_STAT (from 3 port U-Link panel or motorized RF switch, Antenna position status) Input held low while in antenna position
J14-4	/INPUT 11	RF_SW_B_STAT (from 3 port U-Link panel or motorized RF switch, Load Position status) Input held low while in test load position
J14-5	/INPUT 12	Not Used
J14-6	GND	Ground
J14-7	GND	Ground
J14-8	/INPUT 13	Spare
J14-9	/INPUT 14	Spare
J14-10	/INPUT 15	Spare
J14-11	/INPUT 16	Spare
J14-12	GND	Ground

2.12 Remote Status Outputs, J15 & J16

All of the remote status outputs are open collector and will sink 100mA at up to +24Vdc to provide an indication status is active. The pull up supply voltage for the status indications can be supplied via J15 & J16 or can be supplied by an external voltage source. The status output connections are listed in Table 2-2.

Table 2-2 J15 & J16, External I/O Board, Remote Status Outputs

Connector	Schematic Label	Status Output
J16-1	GNDB	Isolated Ground
J16-2	+5VDC_ISOLATED	Output - install jumper to J16-11 to use internal supply for status pull ups. Otherwise an external supply will have to be connected to J16-11.
J16-3	/OUTPUT 1	Off/On Status
J16-4	/OUTPUT 2	Life Support Status
J16-5	/OUTPUT 3	RF Mute Status
J16-6	/OUTPUT 4	External Interlock Status
J16-7	/OUTPUT 5	Drive Chain Fault Status
J16-8	/OUTPUT 6	Power Amp Fault Status
J16-9	/OUTPUT 7	Output Fault Status
J16-10	/OUTPUT 8	Power Supply Fault Status
J16-11	+VDC_EXT_SUPPLY	Input For External Pull Up Supply Voltage
J16-12	GNDB	Isolated Ground
J15-1	GNDB	Isolated Ground
J15-2	+5VDC_ISOLATED	Output - install jumper to J15-11 to use internal supply for status pull ups. Otherwise an external supply will have to be connected to J15-11.
J15-3	/OUTPUT 9	Control Fault Status
J15-4	/OUTPUT 10	Cooling Fault Status
J15-5	/OUTPUT 11	Summary Fault Status
J15-6	/OUTPUT 12	Remote Control Enabled Status
J15-7	/OUTPUT 13	Transmitter Off Status
J15-8	/OUTPUT 14	RF Switch A/B Status
J15-9	/OUTPUT 15	RF_SW_SEL_OUT (to motorized RF switch)
J15-10	/OUTPUT 16	VSWR Fault/Foldback Active Status
J15-11	+VDC_EXT_SUPPLY	Input For External Pull Up Supply Voltage
J15-12	GNDB	Isolated Ground

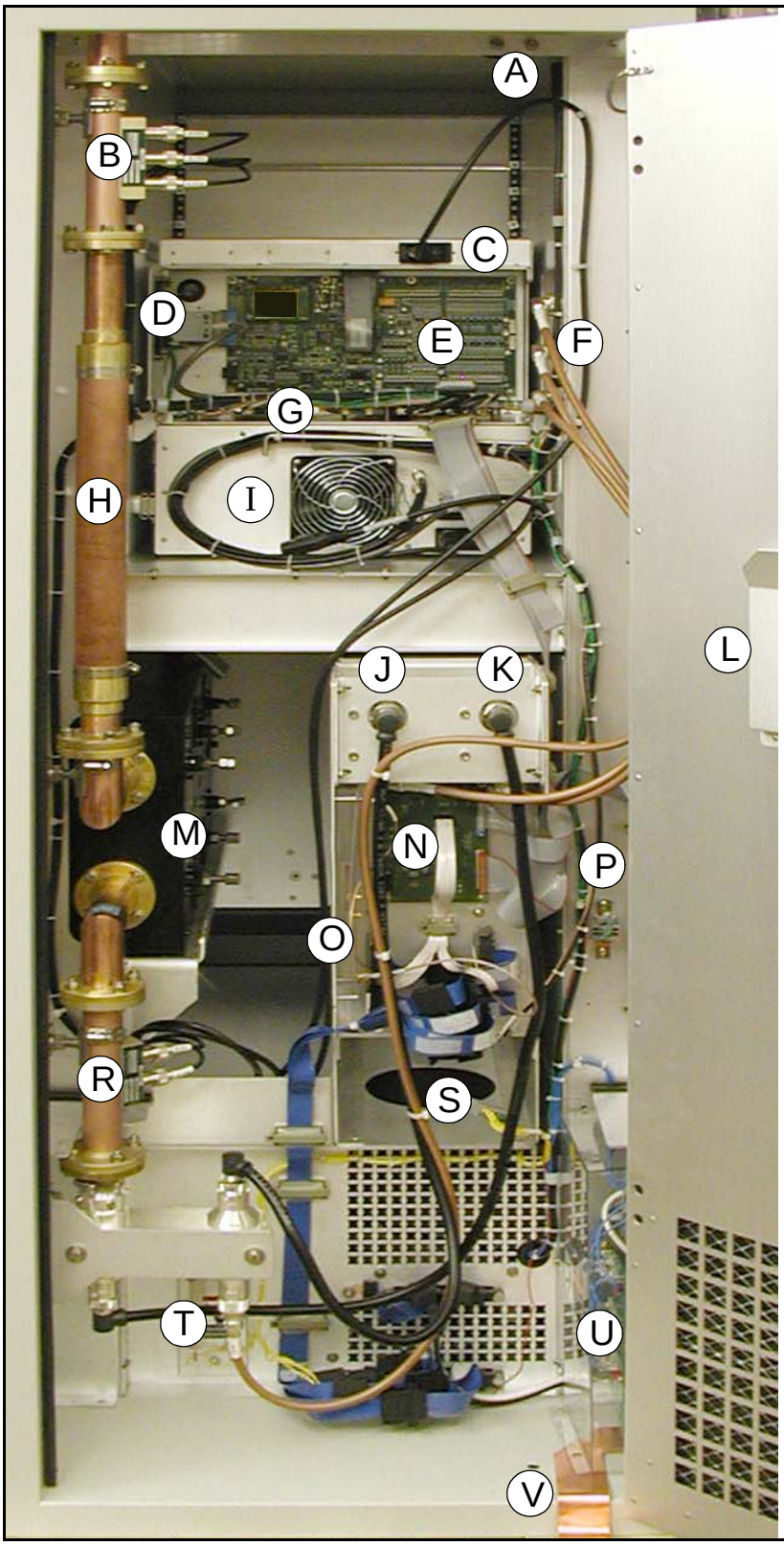
WARNING: Disconnect primary power prior to servicing.

2.12.1 Remote Power Metering, J17

Each analog metering output will provide 0 - 4.096Vdc output into a 400 ohm load (where 3Vdc = Nominal). The connections for J17 are listed in Table 2-3.

Table 2-3 J17, External I/O Board, Remote Power Metering

Connection	Schematic Label	Metered Parameter
J17-1	GND	Ground
J17-2	VOUTA	Total Forward Power (After Filter)
J17-3	VOUTB	Total Reflected Power (After Filter)
J17-4	VOUTC	Forward Power Cabinet #1 (Before Filter)
J17-5	VOUTD	Reflected Power Cabinet #1 (Before Filter)
J17-6	GND	Ground
J17-7	GND	Ground
J17-8	VOUTE	Spare
J17-9	VOUTF	Spare
J17-10	VOUTG	Spare
J17-11	VOUTH	Spare
J17-12	GND	Ground



A - ASI and optional 10MHz reference inputs for the exciter

B - Total Forward and Reflected power samples (after filter) and RTAC sample for the exciter

C -Low Voltage Power Supply switch and fuse assembly

D - Exciter Interface Board

E - External I/O Board. Remote Control connections are directly above and below the marker

F - Reject Attenuators for PA module circulators and PA module 3dB hybrid combiner

G - RF Monitor Board (laying flat)

H - Lowpass Filter

I - Apex^{R} Exciter

J and **K** - Circulator output connections to PA module combiner

L - PA Module glove holder

M - ATSC Mask Filter. Located externally on CZ500F and CZ1000F

N - Backplane Interface Board

O - RF Splitter Board

P - TB2, PS enable lines

R - Forward and Reflected Power samples before the filter

S - Blower assembly (shown removed)

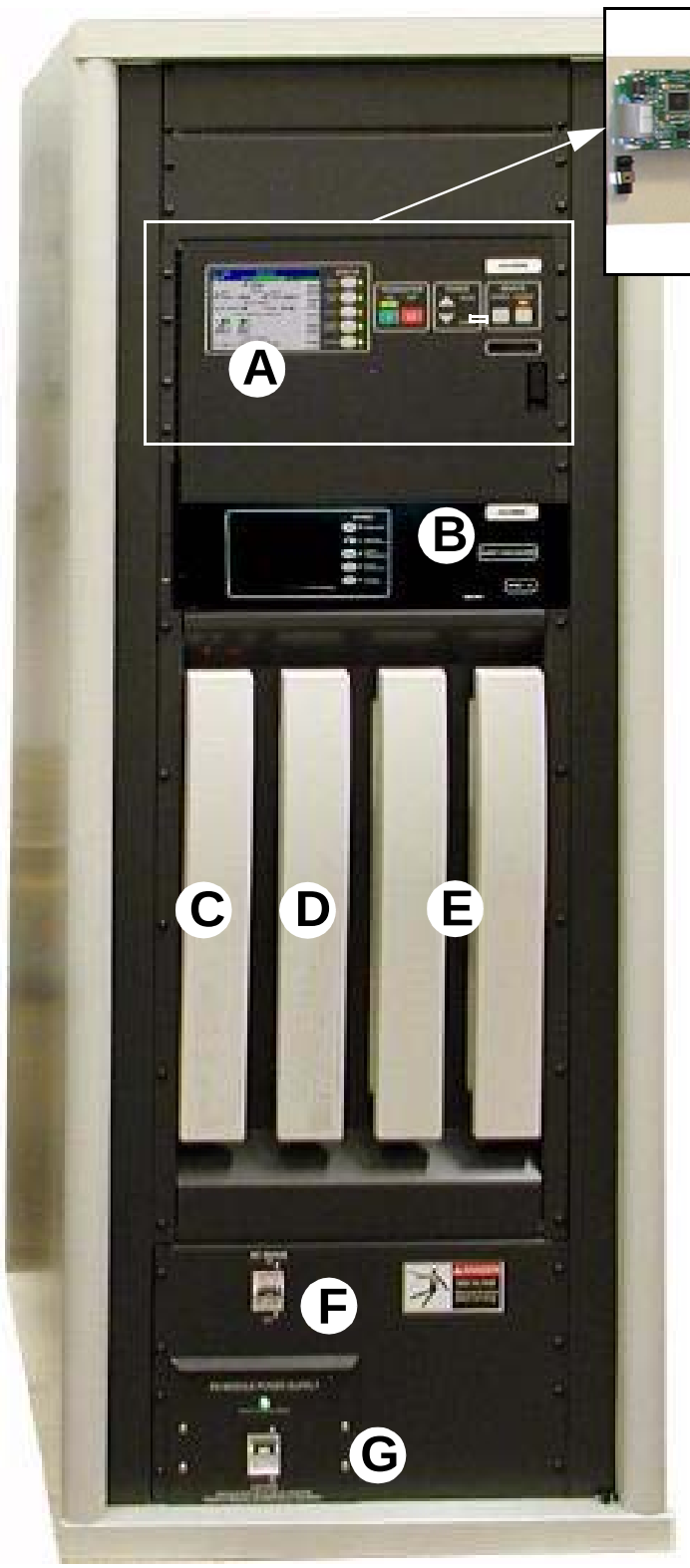
T - 3dB Hybrid Combiner

U - AC Input and MOV board

V - Ground strap (an alternative ground block is also provided on top of the cabinet)

Figure 2-11 Component Locator, Cabinet Rear View

WARNING: Disconnect primary power prior to servicing.



A - Control panel with GUI Touchscreen

B - Apex^{R} Exciter

C - PA Module #1

D - PA Module #2 for CZ1000F (blank panel in CZ500F)

E - Blank panels

F - Control Circuit Breaker, CB1. Supplies power for the LV PSU (J).

G - PA Power Supply (and Circuit Breaker)

H - Main Controller Board

I - Power Supply Monitor Board

J - Low Voltage Power Supply (LV PSU)

Figure 2-12 Component Locator, Cabinet Front View

WARNING: Disconnect primary power prior to servicing.

Section 3 Operation/ Adjustments

3

3.1 Introduction

This section gives detailed operation and adjustment information for the Ranger™ Series Solid-State UHF FLO^R transmitter. It contains all information necessary to make any operational changes or adjustments which appears on any of the Graphical User interface (GUI) Touchscreen display screens.

NOTE:
Operation and adjustment of the Apex exciter using FLO^R Technology is covered in a separate manual which came with the transmitter.

3.2 Transmitter Control Panel

The front panel user interface is a 1/4 VGA, LCD touchscreen display. The touchscreen display uses software buttons to monitor the transmitter. Hardware buttons for the primary transmitter functions such as ON/OFF, RAISE/LOWER and Remote Enable/ Disable are provided on the overlay panel next to the display as shown in Figure 3-1.

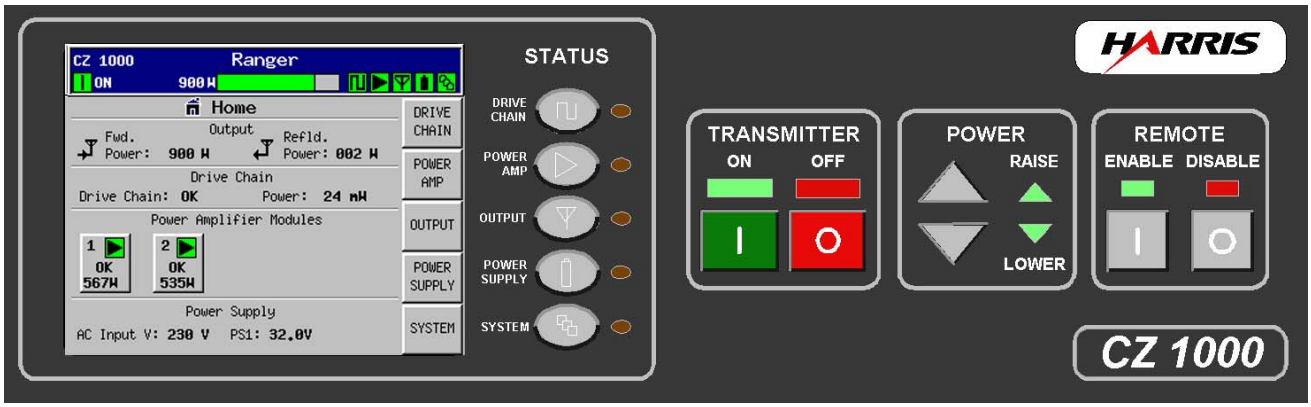
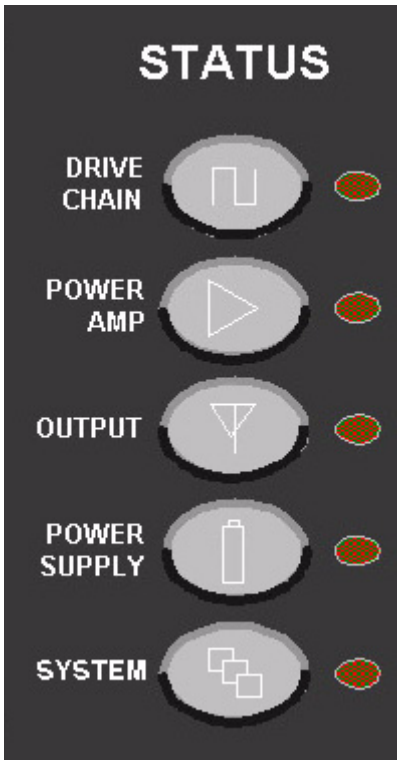


Figure 3-1 Transmitter Control Panel

WARNING: Disconnect primary power prior to servicing.

3.2.1 Main Menu “Hardware” Buttons



Just to the right of the touchscreen, there are 5 hardware buttons which are part of the front panel overlay. Located next to each button is a Status LED which illuminates green under normal, no fault conditions. These buttons provide quick access to each of the 5 main transmitter groups, namely:

a. Drive Chain

b. Power Amp

c. Output

d. Power Supply

e. System

The Status LED next to the button will turn red if there is a warning or fault condition in that section of the transmitter. It will be green if the sub-system is normal. This provides quick access to the required and relevant diagnostics information, without having to be familiar with a menu structure.

NOTE:
To differentiate these buttons from the ones which show up on the LCD display, these will be referred to as “Hardware” buttons in the manual text.

3.3 Graphical User Interface (GUI)

The GUI (“Gooey”) was designed to provide an intuitive interface into the transmitter control system. Once you know what information is available, finding the information you want is simply a matter of following the screens to the desired section of the transmitter. Menu Trees of all available screens is given at the end of this section, see "3.10 GUI Menu Structures" on page 3-32.

For the most part, all navigation through the GUI screens is done via the touchscreen and softkeys (software buttons). The exceptions are the 5 hardware buttons mentioned above. The touchscreen display is also divided into an active display area, which will change with each screen, and the global areas which are present on all screens.

3.3.1 Global Status and Navigation

The top 2 lines of the touchscreen display (shown in Figure 3-2) are considered global because they show up on all screens. The top line gives the transmitter model number and the station name and/or location which is entered by the customer in the System Setup screen, in Figure 3-22, with a maximum of 24 characters including spaces.

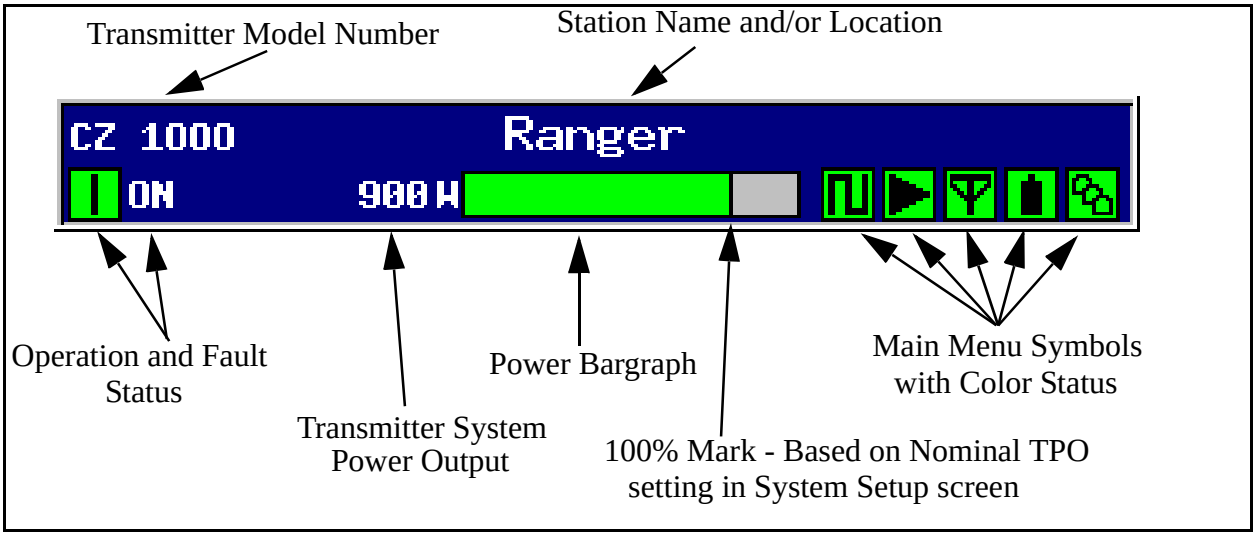


Figure 3-2 Global Touchscreen Display Sections

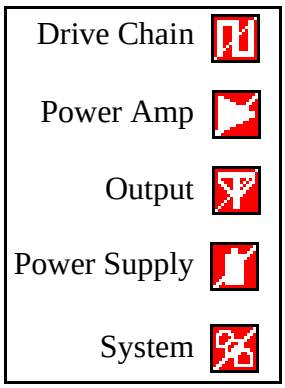
The second line of the display has operational and status information including:

a. ON, Standby, OFF or Fault OFF as well as status information.

b. Transmitter Forward power output reading (after Filter) in numerical format.

c. Transmitter Forward power output reading in a Bargraph format. The 100% mark is based on the nominal power level or TPO (Transmitter Power Output) entered into the System Setup screen in Figure 3-22. The bargraph will also turn yellow if the power level is more than 20% higher **or** lower than the nominal 100% level.

d. Main Menu Symbols which are basically status for the 5 main transmitter sections. If illuminated red, as shown to the right, that section of the transmitter has one or more faults. These status indicators correspond to the 5 hardware buttons to the right of the display.



The icons on the top bar in Figure 3-2 should be all green under normal (no fault) operating conditions. A red symbol or status indication should be investigated by the station engineer.

WARNING: Disconnect primary power prior to servicing.

3.4 GUI Home Page

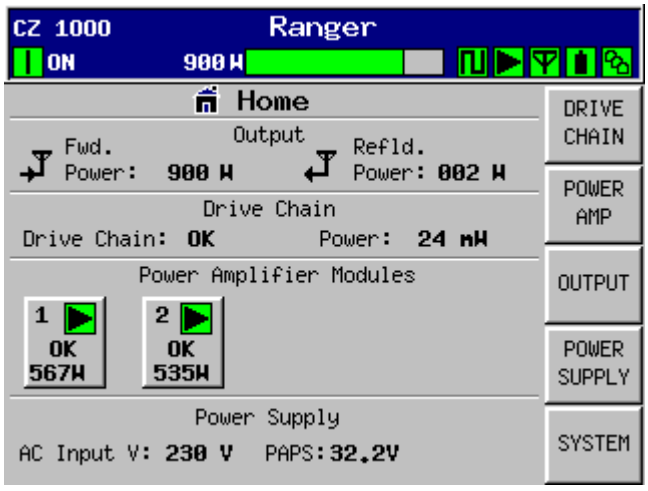
The HOME screen shown in Figure 3-3 is the primary operator screen and the default screen after boot up. The HOME screen contains the most important general operator information such as:

a. System Forward and Reflected power

b. Drive chain status and power level

c. Individual Power Amplifier PA Module status and power level

d. AC line voltage and PA power supply voltage.



To Figure 3-4 on page 3-5
To Figure 3-6 on page 3-7
To Figure 3-12 on page 3-15
To Figure 3-16 on page 3-21
To Figure 3-18 on page 3-23

Figure 3-3 Home Screen

It also has the global status and operation information at the top of the screen which shows the transmitter status and if there are any faults present.

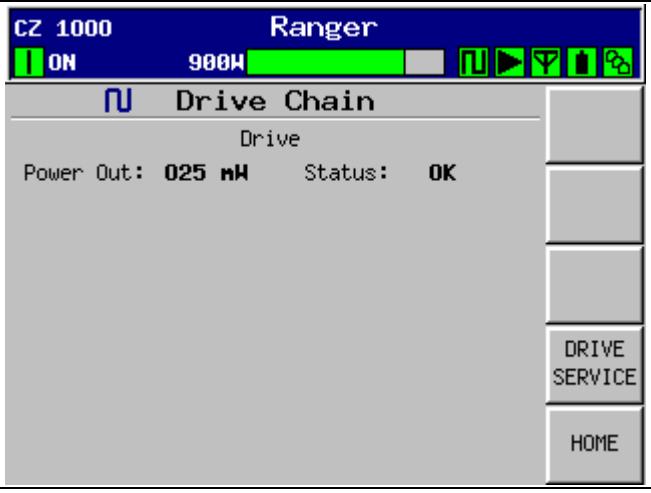
The HOME button is a software button located in the lower right-hand corner of all 5 main menu screens for quick navigation to the HOME screen in Figure 3-3. This screen can **only** be accessed using the software buttons on the touchscreen (there is no hardware HOME button). The quickest way to access the HOME screen is to press any of the 5 hardware buttons to the right of the display as there is a HOME button on each of those main menu screens.

There are always five touchscreen navigation buttons on the right side of the display. These are different on almost every screen and, with the exception of the HOME screen, do not relate to the hardware buttons on the front panel just to the right of the display.

NOTE:
To simplify the discussion of GUI navigation, the following will navigate and describe all of the screens under each of the 5 main menu buttons located to the right of the touchscreen display (and on the right side of the GUI Home screen).

3.5 Drive Chain Main Menu

If you press the Drive Chain button on the control panel overlay, or the Drive Chain button on the HOME screen, it will take you to the screen shown in Figure 3-4. The Drive Chain screen is simply a dedicated exciter power monitoring screen. The power reading comes from RF Splitter/Coupler (A12) and is detected on the RF Monitor Board.



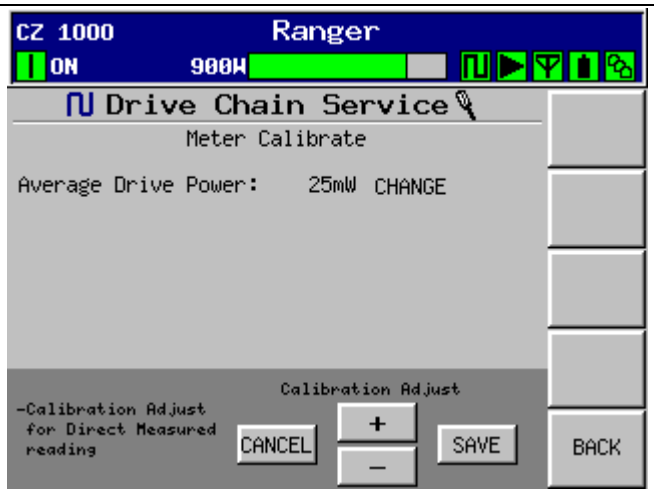
To Figure 3-5

To Figure 3-3

Figure 3-4 Drive Chain Screen

3.5.1 Drive Service

When the “Drive Service” button in Figure 3-4 is pressed, it will bring up the screen shown in Figure 3-5. This screen allows for calibration of the exciter power reading on the Drive Chain screen in Figure 3-4. This reading should be set to match the measured exciter output.



To Figure 3-4

Figure 3-5 Drive Service Screen

3.5.2 Drive Meter Calibration

To calibrate the reading Drive Chain power output reading in Figure 3-4, go to the Drive Chain Service screen shown above.

STEP 1 Measure the exciter power output with a digital power meter. This should be done with the exciter running at nominal TPO.

STEP 2 Press the (+) or (-) buttons to adjust the reading on the Drive Service screen until it matches the measured value.

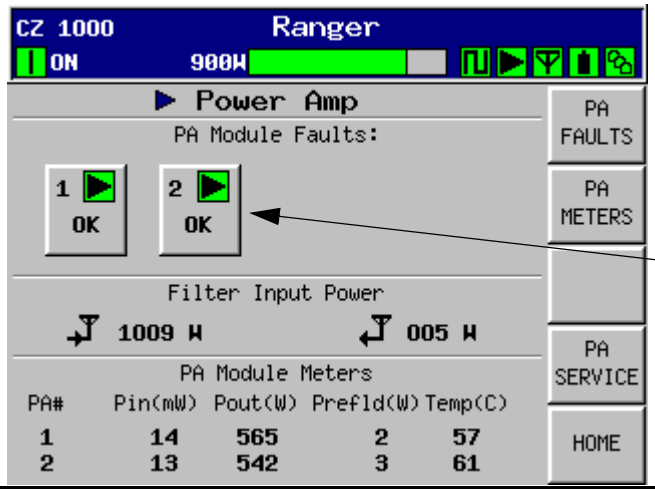
STEP 3 Press SAVE to calibrate the GUI reading or CANCEL to abort the changes.

WARNING: Disconnect primary power prior to servicing.

3.6 Power Amp Main Menu

If you press the Power Amp button on the control panel overlay, or the Power Amp button on the HOME screen, it will take you to the screen shown in Figure 3-6. The Power Amp Menu Tree is shown in Figure 3-32 on page 3-33.

NOTE:
Module 2 button will be grayed out for CZ500F.



To Figure 3-7

To Figure 3-8

To PA Faults screen, Figure 3-7

To Figure 3-10

To Figure 3-3

Figure 3-6 Power Amplifier Screen

This screen shows the Forward and Reflected power for the PA Modules and the total output power before the mask filter. Each of the amplifier select buttons in the middle of the screen are for navigation to the PA Faults screen. These buttons are also status indicators with 3 different modes:

Button showing PA Module has been turned OFF.

Button showing PA Module #2 has a Fault. Press the button to go to PA Faults.

Button showing PA Module 2 ON with no faults.

Button showing PA Module removed from transmitter.

3.6.1 PA Faults

This screen is basically a list of all of the faults monitored in each PA Module.

- An active fault will be highlighted in RED
- A warning condition will be highlighted in YELLOW.

The PA Faults screen in Figure 3-7, shows that PA Module #2 has 1 LDMOS fault and a Frequency warning. The NEXT MODULE button is to toggle between the fault information on each module and will be inactive for the CZ500F. Table 3-1 is a listing of all of the faults shown on this screen, including the fault limit and action taken by the module.

NOTE:
The only part of the module which is field repairable is the individual PA pallets (the six in the center of the module). There is a special pallet replacement kit available. For more information refer to Section 5, Replacements Procedures.

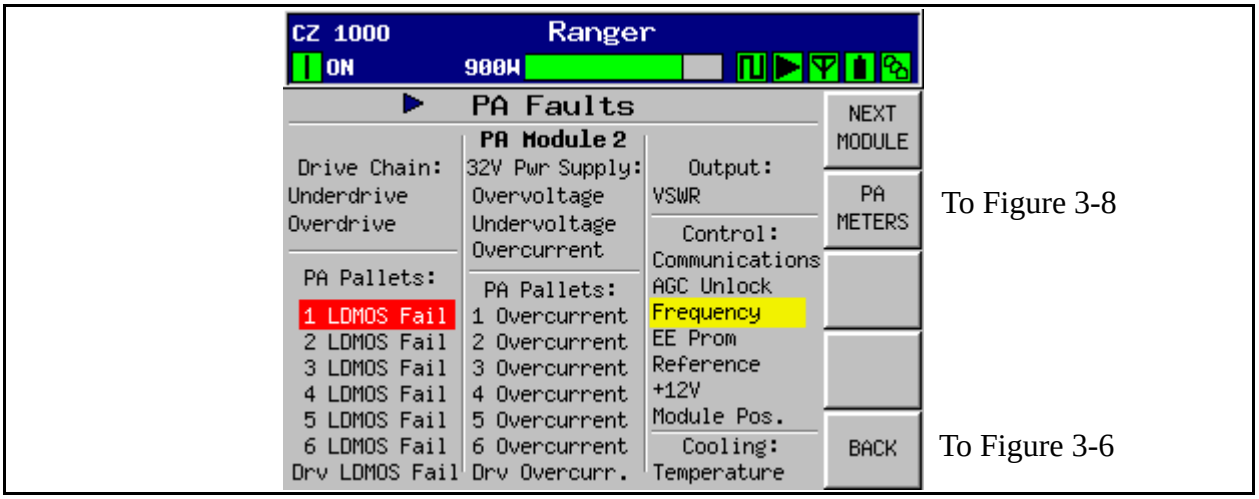


Figure 3-7 PA Faults Screen (PA Module 2 Selected)

3.6.1.1 Module 3 strike Routine

Under certain critical fault conditions, the PA module will try to shut off (Strike) and then re-initialize to try and clear the fault condition. If the fault is still present after the module turns back on it will shut off (Strike) again. If the fault is still present after a 3rd strike or returns within several seconds after the 3rd strike, the fault is latched and the module is shut off. The module may be turned on again by pressing the transmitter ON button. If the fault is still present, the module will simply repeat the 3 strike routine again. Table 3-1 tells which faults activate the 3 strike routine.

Table 3-1 PA Module Faults

Fault	Fault limit	Action Taken
Frequency	Channel frequency or frequency band reported by module does not match system settings. Affects Module Calibration.	Warning
EEPROM	Error was detected writing to EEPROM on Module Controller	Warning
Reference	+5V reference voltage is not within tolerance	Warning
+12V Fault	+12V not in tolerance	Warning
Com Fail	Module is not talking on CAN bus. Module might continue operating. Re-seat module to see if problem clears.	Warning
Pallet Over-current	Amplifier pallet current has exceeded 12 amps. Most likely blown FET	Module shuts off
Driver Pallet Over-current	Amplifier pallet current has exceeded 12 amps. Most likely blown FET. Note that this reading also includes current for Phase and gain driver transistors	Module shuts off
LDMOS Fail	FET failure based on pallet current levels. Fault is set for each push-pull pair. Fault is set when pallet current is less than 60% of highest pallet current in module. If pallet current is below 40%, the whole pallet is considered bad which is 2 LDMOS failures. For pallet replacement procedure refer to Section 5.	Up to 3 LDMOS faults on a single module = warning. 4 LDMOS faults = OFF
Over Voltage	+32V source has exceeded 33V	Module 3 strike
Under Voltage	+32V source is below 30 V	Module 3 strike
Over Current	Total current on +32V line has exceeded 75A	Module 3 strike
Over Temp	Module temperature has exceeded 95^{o}C	Module 3 strike
High VSWR	Internal reflected RF too high. About 200W of reflected power. Most likely a bad cable or circulator	Module 3 strike
Over Drive	Input RF is too high. Trip point set to 1.9dB above nominal or approximately 23mW	Module 3 strike
Low Input	Input RF is too LOW. Module continues to run	Warning
AGC Unlock	Module AGC circuit is unable to maintain constant gain. Module gain is 46dB. This fault means the DAC number for the I or Q Vector reading on the PA Data screen has reached “0” or “4095” and the module gain is still not 46dB	Module 3 strike

3.6.2 PA Meters

This screen is accessed by pressing the “PA Meters” button in Figure 3-6 or Figure 3-7. A complete set of PA Meter readings is given in the Factory Test Data. The Factory Test Data readings are taken at rated power unless otherwise specified by the customer. Any reading out of tolerance will be reported as a fault to the control system and show up on the PA Faults screen in Figure 3-7.

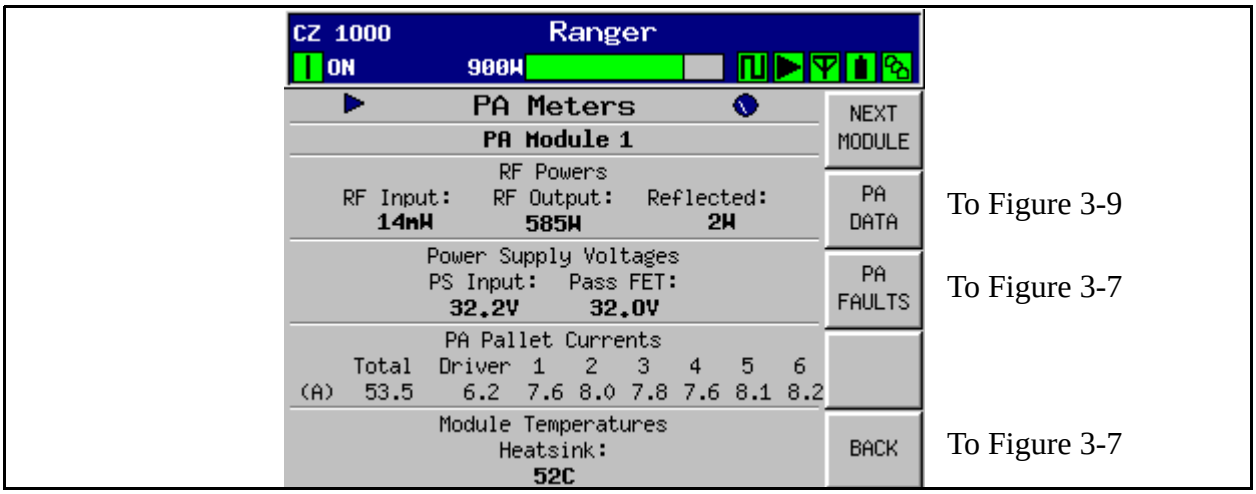


Figure 3-8 PA Metering Screen

The following table gives typical readings (at 600W output) and fault limits for each reading. See factory test data for more accurate readings for your transmitter and frequency.

Table 3-2 PA Module Typical Readings and Fault limits

Reading	Typical Reading	Fault Limit
RF Input	**15mW**	**0 = underdrive / 23mW = Overdrive**
RF Output	**600W**	**none**
Reflected	**Less than 10 watts**	**Fault = 200W**
Power Supply Voltage	**32Vdc**	**Under V = 30V / Over V = 33V**
Total Module Current	**55 - 65 amps**	**75 amps**
Driver Pallet Current	**6 - 7 amps**	**12 amps**
PA Pallet Currents	**8 - 10 amps each**	**12 amps**
Heatsink Temperature	**60 - 65°C (affected by ambient)**	**90°C**
*****Current readings will vary with frequency and power output**.**		

WARNING: Disconnect primary power prior to servicing.

3.6.3 PA Data

The PA Data screen in Figure 3-9 is accessed from the PA Meters screen in Figure 3-8. It contains vital information about the operation of the PA module. The readings are ADC or DAC counts in either 10 bit (0 - 1023) or 12 bit (0 - 4095). For detailed theory on the PA Module refer to Section 4, Theory of Operation.

a. **Phase** - This is an analog voltage from the Backplane Interface board which is used to adjust the insertion phase of the module. In the CZ1000F this is used to adjust the phase of PA Module 2 to match that of PA Module 1 (and to optimize the PA Module combiner). The module controller converts the analog voltage from the Backplane Interface board to a digital 10 bit word from 1 - 1023 with the ideal being 512 or centered in the range. PA Module 1 receives a fixed voltage which places it approximately in the center of the range (it is not critical), while module 2 receives a variable voltage via R7 on the Backplane Interface to allow for module phasing. This input controls the I and Q Vector outputs to the Phase and Gain board in the module.

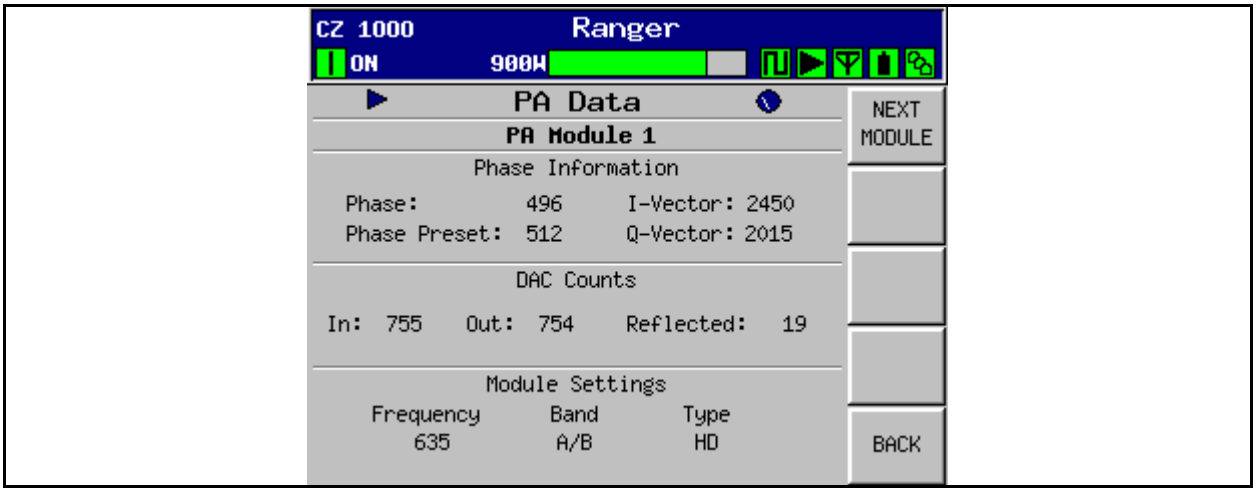


Figure 3-9 PA Data Screen

b. **I and Q Vectors** -These are 12 bit DAC outputs from the module controller to the Phase and Gain board in the module with a range of 0 - 4095. The phase voltage from the Backplane Interface board adjusts these readings in opposite directions to set the insertion phase through the module but they are also used to adjust the module gain as part of the module AGC. These readings are considered OK as long as they are not at the limit of the range. If either of these numbers are 0 or 4095, the PA Faults screen will register an AGC Unlock fault.

c. **Phase Preset** - This is a fixed setting inside the module and should read approximately 512.

d. **DAC Counts** - These are 10 bit (0-1023) ADC samples of the detected RF input and Forward and Reflected power output.

- **IN** - Is a sample of the detected RF drive input to the module. Nominal input for 400W output is 15mW. This number is usually in the 800 range for full rated output. The input overdrive fault is detected from this reading and is triggered when the DAC reading is approximately 1.9dB above nominal or about 23mW of input drive. It is also the input sample for the module AGC.
- **Out** - This is a sample of the detected forward power sample from the directional coupler on the module output. This is used for metering and as the sample for the module AGC. This number is forced by the AGC to track the IN reading, thereby keeping the module gain at 46dB.
- **Reflected** - This is the detected sample from the reflected coupler on the module output. It is used for metering of reflected power or VSWR. Can be used as a relative reading to detected changes in the module output.

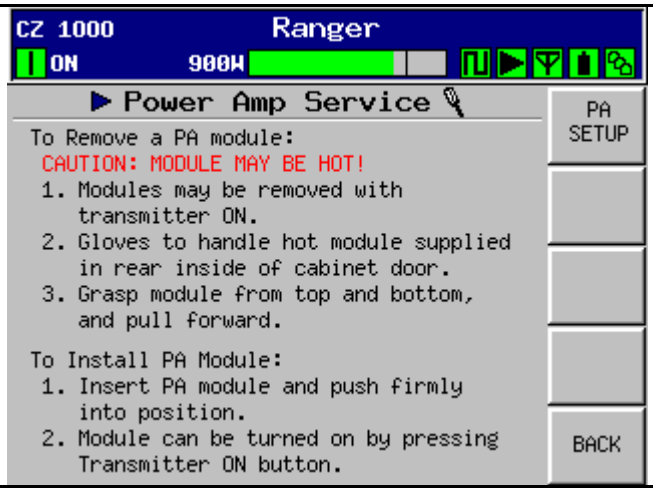
e. **Module Settings** - These are status readings from the module to the transmitter controller. The FREQUENCY and the BAND are set via the Channel number entered into the System Setup screen shown in Figure 3-22. These are simply read backs to verify that the module is setup properly. If not set properly, module calibration could be affected. All Ranger modules should read HD (High power Diamond) under TYPE.
The Bands are:

- Band A/B - Channels 14 - 41
- Band C/D - Channels 42 - 69

3.6.4 PA Service

This screen is accessed by pressing the “PA Service” button in Figure 3-6. This is a help screen for removing and replacing PA Modules. Be sure to have a place ready to set the module down after it is removed. It also provides access to the PA Setup screen in which is used in the CZ1000F to balance the gain of the 2 modules.

WARNING:
HOT SURFACE
THE RANGER PA MODULES ARE DESIGNED TO HANDLE VERY HIGH TEMPERATURES AND MAY BE EXTREMELY HOT, UP TO 90^{O} F (50^{O} C) ABOVE ROOM TEMPERATURE. DO NOT TOUCH THE MODULES WITH BARE HANDS AFTER THE TRANSMITTER HAS BEEN RUNNING, ESPECIALLY IN HIGH AMBIENT TEMPERATURE ENVIRONMENTS. SPECIAL GLOVES HAVE BEEN PROVIDED IN THE REAR OF THE CABINET OR CAN BE OBTAINED FROM HARRIS, PART #0990006483 OR GRAINGER ITEM #4JF36.



To Figure 3-11

To Figure 3-6

Figure 3-10 PA Service Screen

3.6.4.1 PA Setup (Gain Balance)

This screen is accessed by pressing the PA Setup button in Figure 3-10. Its sole purpose is to balance the gain of the 2 PA modules in the CZ1000F transmitter. The goal is to match the 2 module gain readings. Adjustment is only required if the module current readings in Figure 3-11 are more than 1 amp apart. This procedure will have to be done if a module is changed. The adjustment procedure is simple.

NOTE:
This adjustment should only be done at full power and after the module temperatures have had time to stabilize. PA Module phasing should always be optimized after finishing this procedure.

STEP 1 Press the RESET button. This allows the adjustment to always start from a common point.

STEP 2 Use the Left and/or Right arrow buttons until the numbers match. There will be some bounce in the readings, but they should be as close as possible and no more than 1 amp apart.

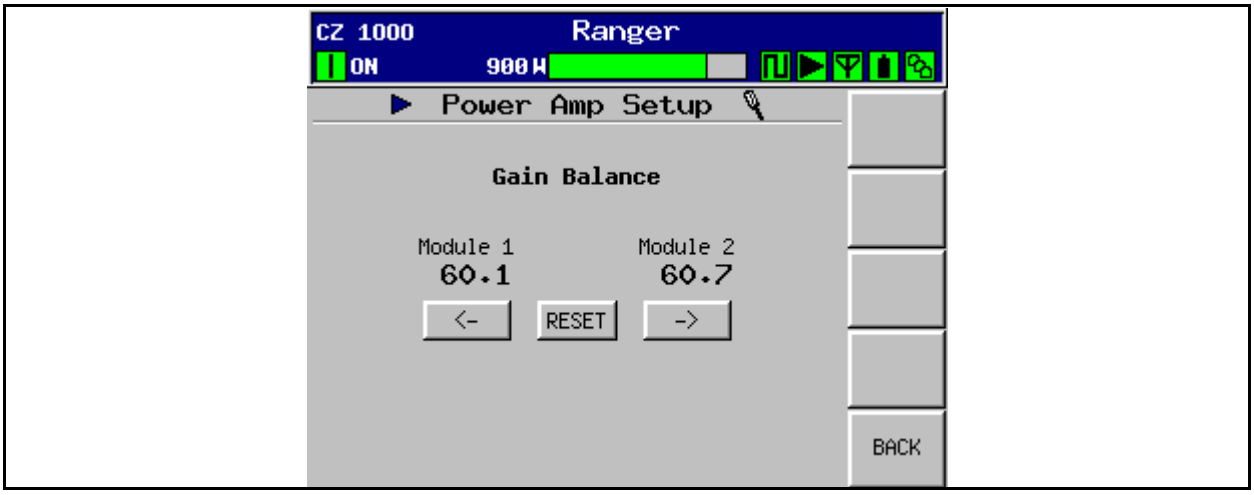


Figure 3-11 PA Setup Screen

NOTE:
This adjustment is **not** to be used to decrease the PA module combiner reject power. In some cases this adjustment may actually increase the PA module combiner reject power by a few watts.

It may be necessary to adjust the PA module phasing via the pot on the Module Backplane board. For PA Module phasing see "3.7.2 Module Phasing Procedure" on page 3-18.

WARNING: Disconnect primary power prior to servicing.

3.7 Output Main Menu

If you press the Output button on the control panel overlay, or the Output button on the HOME screen, it will take you to the screen shown in Figure 3-12. The Output Menu Tree is shown in Figure 3-31 on page 3-33.

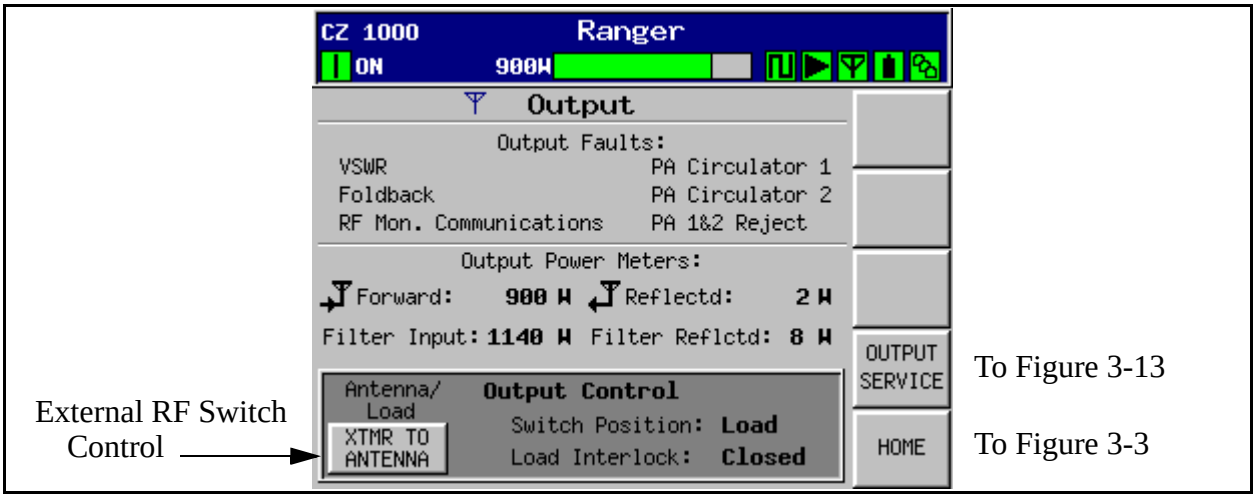


Figure 3-12 Output Screen

This screen is broken into 3 main areas:

a. Output Faults - This panel lists the 6 possible output screen faults. A fault would cause one or more to be highlighted in red while a warning condition would highlight yellow.

1. VSWR - VSWR has exceeded fault threshold of 1.9:1
2. Foldback - VSWR has exceeded foldback threshold of 1.4:1 (VSWR foldback is accomplished automatically by reducing the exciter power).
3. RF Monitor Communications - A warning condition stating that the RF Monitor board is not communicating over the CAN bus to the Main Controller.
4. PA Circulator 1 or PA Circulator 2- the power to the circulator reject load has exceeded 400W. The RF Monitor board is calibrated to give a 3 Vdc detected sample when the output from the reject attenuator is 40mW (40dB below 400W).
5. PA 1&2 Reject - the power to the combiner reject load has exceeded 400W. The RF Monitor board is calibrated to give a 3 Vdc detected sample when the output from the reject attenuator is 40mW (40dB below 1kW).

b. Output Power Meters - This panel gives the Forward and reflected power outputs both before and after the built-in mask filter.

c. Output Control - This area of the screen can be used to control an external motorized RF switch so that the transmitter can be switched from Antenna to the Test Load, provided the System Configuration screen in Figure 3-23 on page 3-28 is set for “Motor”. For systems with a manual patch panel the System Configuration screen should be set to “Manual”. It also reads out the position of an RF switch or a 3-port patch panel, based on micro-switches located on the switch or panel. Lastly, it shows the condition of the Test Load interlock. The test load interlock will not affect transmitter operation if the switch is in the antenna position.

NOTE:
If the load interlock (also called the RF Mute Interlock) is open and the transmitter is switched to the “Test Load” position, the transmitter output will be muted. If a test load interlock is not used the appropriate connection on the External I/O board must be jumpered. For more information see "2.6 Interlock Connections" on page 2-5.

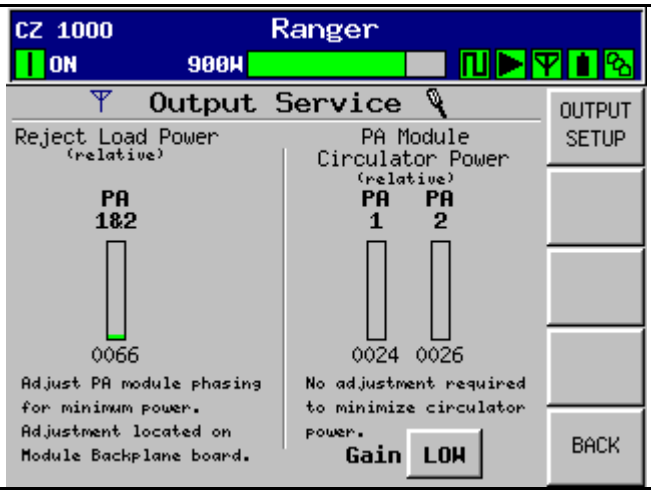
3.7.1 Output Service

This screen is accessed from the Output screen in Figure 3-12. It is used for 2 purposes:

a. To monitor the PA Module Circulator reject power. Provides a bargraph and a DAC count of 0 - 1023 (0 meaning no reflected power and 1023 being maximum). This allows for a relative reading which can be monitored for changes which could mean increased system VSWR or a bad circulator. There is no adjustment for this reading.

b. To monitor Combiner Reject Load Power in the CZ1000F. Provides a bargraph and a DAC count of 0 - 1023 (0 meaning no reflected power and 1023 being maximum). It is used to adjust the phase relationship of PA Module #2 to minimize the power to the module combiner reject load. The combiner reject load is actually a 40dB 1kW attenuator whose output is sent to the RF Monitor board where it is detected and then A/D converted for the reading shown below the “PA 1&2” bargraph. It is a relative reading which will simply be minimized with the phasing adjustment R7 on the Backplane Interface board. See "3.7.2 Module Phasing Procedure".

NOTE:
The left side of the screen, “Reject Load Power” is left blank for the CZ500F.



To Figure 3-15

To Figure 3-12

Figure 3-13 Output Service Screen

NOTE:
The GAIN button can be toggled between LOW and HIGH, with high only being used to increase the detector resolution for finer adjustment of the module phasing. Proper phasing can usually be obtained using only the LOW setting and monitoring the DAC reading.

3.7.2 Module Phasing Procedure

NOTE:
This procedure is for the CZ1000F only.

The goal is to minimize the PA module combiner reject load power reading in Figure 3-13, by adjusting the phase of module #2. The phase of PA module #1 is fixed. The “PA 1&2” reading should be less than 0030 with the GAIN button at the bottom of the screen set to LOW. If the GAIN button is pressed it will toggle to high, increasing the detector gain and allowing for finer resolution when adjusting module phasing. The reading should be less than 0100 with the GAIN set to HIGH.

STEP 1 Check the PA module gain balance on the PA Setup screen, shown in Figure 3-11 on page 3-14. These current readings should be less than 1 amp apart. If not, refer to "3.6.4.1 PA Setup (Gain Balance)" and adjust the module gains before proceeding with the module phasing.

STEP 2 Using a digital voltmeter, monitor the test point on the Backplane Interface board shown in Figure 3-14.

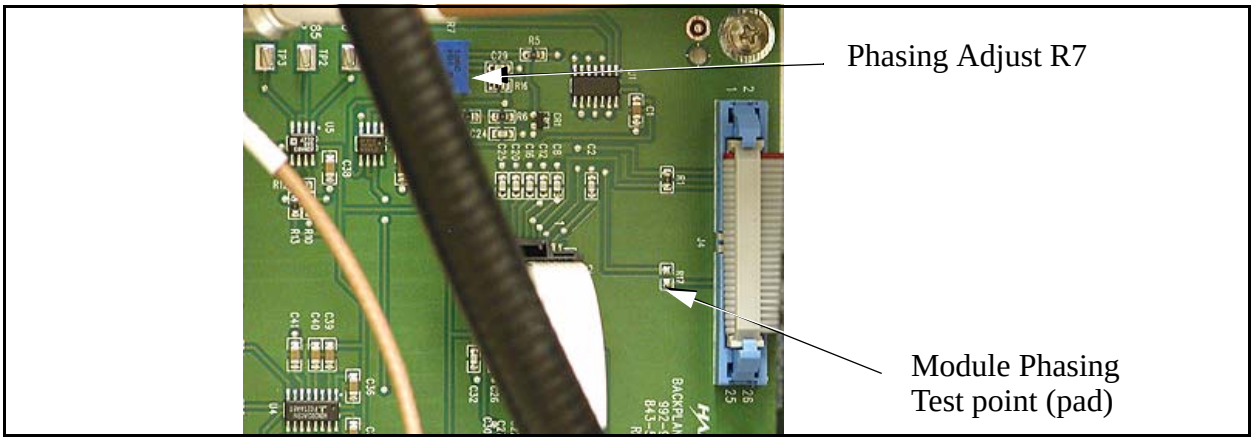


Figure 3-14 Test Point for Module Phasing

STEP 3 Adjust R7 (the only potentiometer) on the Backplane Interface board for minimum voltage reading on the voltmeter. This should minimize the reading on the Output Service screen in Figure 3-13. The location of the Backplane Interface board is shown in Figure 2-11 on page 2-21 under the letter N.

NOTE:
The reject power should be less than 12W when finished.

3.7.2.1 Output Setup

This screen is accessed by pressing the Output Setup button on the Output Service screen in Figure 3-13. It is used to calibrate the filter input power and Total cabinet Forward and Reflected power (after the filter).

It also calculates the VWSR protection thresholds of Foldback power and Fault threshold and displays them at the bottom of the screen. These values are based on the "Nominal Power Output" value entered into the System Setup screen in Figure 3-22 on page 3-27.

- The foldback level is calculated using a VSWR = 1.4:1. Therefore the actual foldback power can be calculated as:

Foldback Power = Nominal Power Output x 0.0278

- The fault threshold is calculated using a VSWR = 1.9:1. Therefore the actual fault threshold can be calculated as:

VSWR Fault Threshold = Nominal Power Output x 0.0963

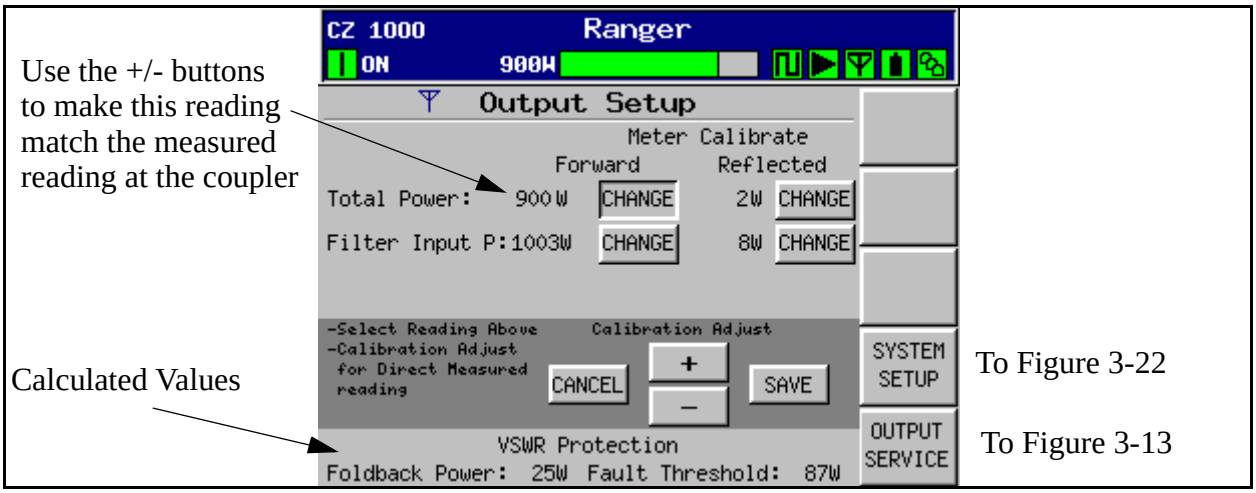


Figure 3-15 Output Setup Screen

3.7.3 Forward and Reflected Power Calibrations

The following procedure is used to calibrate the forward and reflected power readings via the Output Setup screen. The forward must be calibrated first, then the reflected can be calibrated. The procedure requires a digital power meter and a 10dB pad. Since calibration is relatively easy and quick, it is recommended that both forward and reflected always be calibrated together.

Forward Power

STEP 1 Connect the digital power meter to the forward power (incident) port on the directional coupler either before or after the filter. For the location of these ports see Figure 2-11 on page 2-21, designated B and R. The cables numbers connected to these ports are #40 for the Total output and #42 at the filter input.

STEP 2 Measure the power at the forward coupler. The coupler comes with a table of precision coupling values for the various UHF channels which should be used as the offset for the digital power meter. Make sure the coupler serial number matches the coupling table. The coupling values are also written on stickers which are attached to the couplers at the factory.

STEP 3 Press the CHANGE button to select the coupler being calibrated (before or after the filter) and then use the +/- buttons to make the displayed power match the measured value on the digital power meter.

STEP 4 Press SAVE to store the setting or CANCEL to discard the changes.

Reflected Power

STEP 5 Press the CHANGE button for the desired reflected coupler (before or after the filter). This temporarily disables the reflected power fault.

STEP 6 Note the forward power and remove the power meter from the forward coupler. Connect the 10dB pad to the forward power coupler.

STEP 7 Remove the cable from the reflected coupler to be calibrated and connect it to the 10dB pad. The cables are labeled #50 for the Filter input and #39 for the Total reflected.

STEP 8 Use the +/- buttons to set the reflected reading on the GUI to 10% of the forward reading noted earlier.

STEP 9 Press SAVE to store the setting or CANCEL to discard the changes.

3.8 Power Supply Main Menu

If you press the Power Supply button on the control panel overlay, it will take you to the screen shown in Figure 3-16. The Power Supply Menu Tree is shown in Figure 3-32 on page 3-33.

This is the overall Power Supply metering screen for both the PA Power Supply, the Low Voltage Power Supply Unit or LV PSU and the AC Mains. It is also the fault status screen for the power supplies. A fault would cause one of the listed faults to be highlighted red for fault or yellow for a warning condition.

System Faults:

- AC Low - triggers if the AC input to the MOV board goes below 177Vac
- AC High - triggers if the AC input to the MOV board is above 264Vac
- MOV Fuse 1, 2 or 3 - turns yellow if one or more of the MOV protection fuses on the MOV board is open.

LV PSU Faults are generated by the Vicor power supply unit and monitored by the PS Monitor board. The dc voltage faults are triggered at +/-15% of nominal.

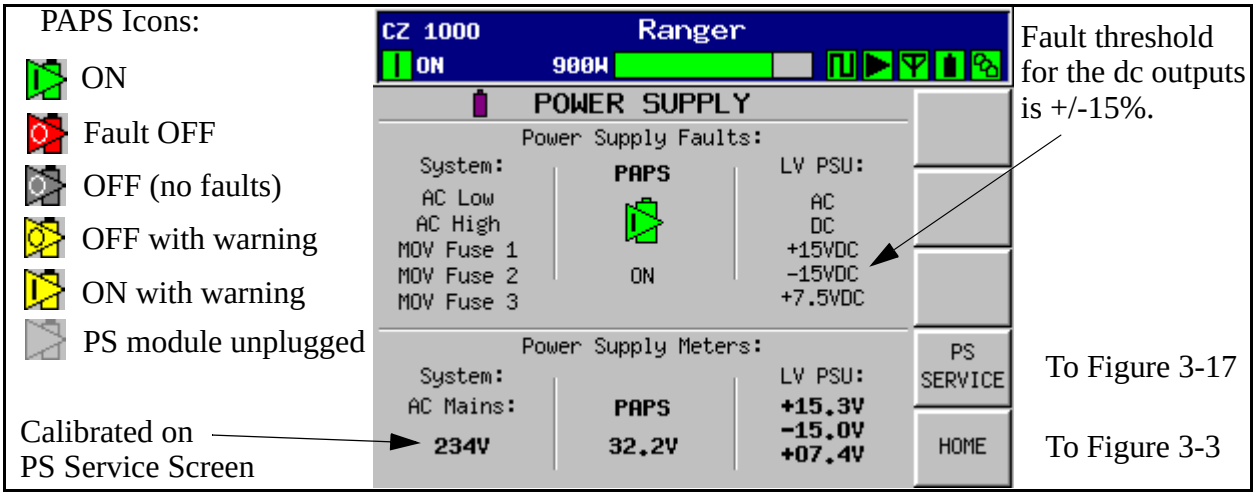


Figure 3-16 Power Supply Screen

The PAPS (Power Amplifier Power Supply) icon will turn red or yellow if any of the faults on this screen are activated. Figure 3-16 shows the possible icon configurations with red being critical faults and yellow simply a warning condition.

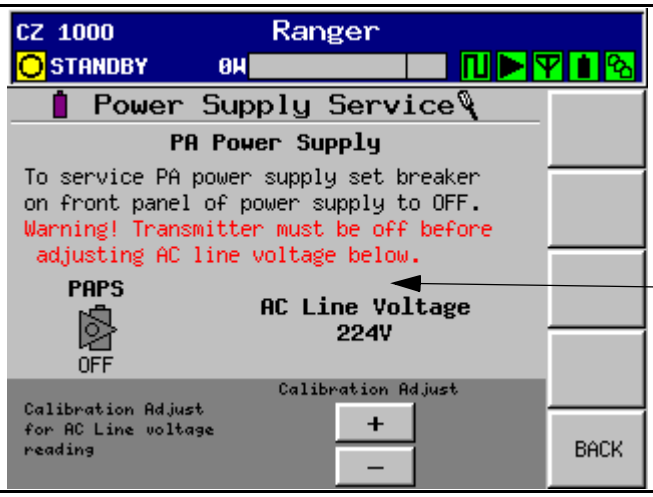
3.8.1 PS Service

This is an on-line help screen telling how to remove a power supply, but also allows for calibration of the AC Mains reading on the Power supply screen in Figure 3-16.

CAUTION:
ALWAYS SHUT THE BREAKER OFF ON THE FRONT OF THE PA POWER SUPPLY BEFORE REMOVING TO PREVENT DAMAGE TO CONTACTS AND/ OR THE POWER SUPPLY.

3.8.1.1 AC Mains Meter Calibration

The AC Mains calibration must be done during transmitter installation, but will most likely not require adjustment again unless the MOV or PS Monitor board is changed. This is a critical transmitter adjustment as this reading is used for the AC high and AC low faults.



To calibrate, simply measure your ac mains voltage at the wall disconnect and then use the +/- buttons here to set this reading to the same as the measured value.

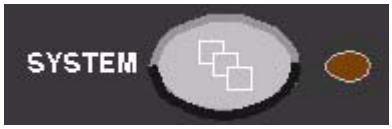
To Figure 3-16

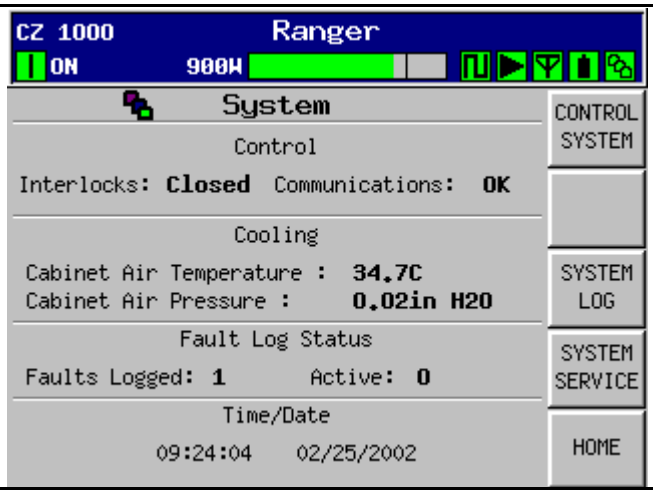
Figure 3-17 PS Service Screen

NOTE:
This calibration should always be done with the transmitter shut off. This adjustment can cause various power supply faults to appear momentarily, but can be safely ignored. If the transmitter is turned ON, these faults can cause the transmitter to mute momentarily.

3.9 System Main Menu

If you press the System button on the control panel overlay, it will take you to the screen shown in Figure 3-18. The System Menu Tree is shown in Figure 3-33 on page 3-34.





To Figure 3-19

To Figure 3-20

To Figure 3-21

To Figure 3-3

Figure 3-18 System Main Menu

This screen is basically a System Main Menu which gives overall status information about the screens which can be accessed from here. This includes:

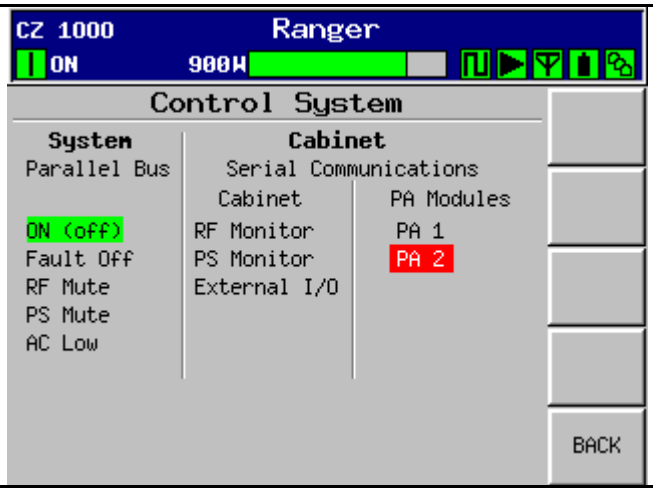
a. Control System - For more in-depth information press “Control System”
   1. External Interlocks - Can read Open or Closed (as shown)
   2. Communications - Can read OK or Fault. This could be a problem with any of the serial communication links inside the transmitter.

b. System Log - For more in-depth information press “System Log”
   1. Gives the current date and time (MM/DD/YYYY and HH:MM:SS)
   2. Faults Logged - Total of fault list including Active and Inactive Faults
   3. Active - Shows how many Active faults are present

c. System Service - Gives frequency and selected channel number. Pressing “System Service” gives access to configuration, touchscreen calibration, software and hardware revisions, time and date setting, screen saver time-out and LCD display contrast.

3.9.1 Control System

The Control system screen in Figure 3-19 is a status and fault screen for the parallel control bus lines and the internal serial communication bus to each of the controller boards and the PA Module(s).



To Figure 3-18

Figure 3-19 Control System Screen

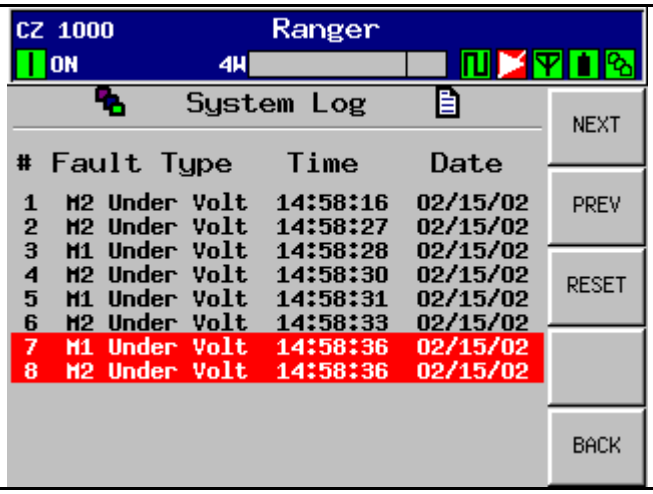
WARNING: Disconnect primary power prior to servicing.

3.9.2 System Log

This screen is accessed by pressing the System Log button on the System screen in Figure 3-18. It is a complete listing of all transmitter and system faults in the order in which they occurred. It can hold up to 99 faults. Active Faults will be highlighted and cannot be reset. All other faults will be cleared when the RESET button is pressed. Figure 3-20 shows that only faults #7 and #8 are active (at least on this screen), all other faults are inactive. Use the Next and Previous buttons to view the entire list.

This should be thought of as a record of the faults which have occurred or as a summary point of all transmitter faults. Individual faults may be investigated by pressing any of the 5 hardware buttons to the right of the GUI display and then if necessary pressing any highlighted buttons on the GUI to go deeper into the system.

The faults which show up on any particular screen are discussed with that screen image in this section.



Note:
Date format is DD/MM/YY

To Figure 3-18

Figure 3-20 System Log Screen

3.9.3 System Service

This screen is accessed by pressing the System Service button in Figure 3-18. This screen simply provides information concerning the use of the sub-menus accessed from this point. These are:

a. System Setup
    1. Control Setup
        a. Touchscreen Calibration
    2. Config (Configuration)
b. SW REVS (Software Revisions)
    1. HW REVS (Hardware Revisions)

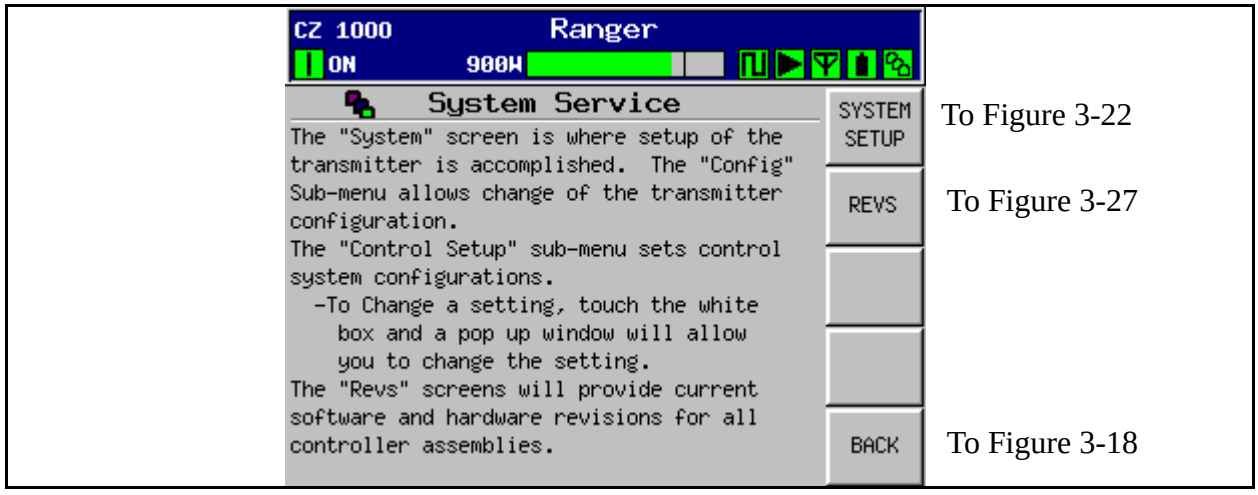


Figure 3-21 System Service Screen

WARNING: Disconnect primary power prior to servicing.

3.9.3.1 System Setup

This screen provides a way to change important pieces of information which are then used throughout the GUI. To make a change, simply touch the white text box and a pop-up window will allow you to enter the new information. Be sure to press CANCEL if you do not wish to make a change.

a. Station Name - This can be up to 24 characters and will appear at the top of Every GUI screen.

b. Model Number - This value is selected from a pull down list by touching the white box. The model number chosen must match the transmitter name plate. It is used to gray out portions of the GUI screens which are not used by some models.

c. Serial Number - Please note this for reference before calling for support.

d. Nominal Power Output (after all system filters) - This number is used to:

1. Set the 100% mark on the power bargraph at the top of every GUI screen.
2. Calculate the VSWR foldback and fault thresholds, see "3.7.2.1 Output Setup" on page 3-19.

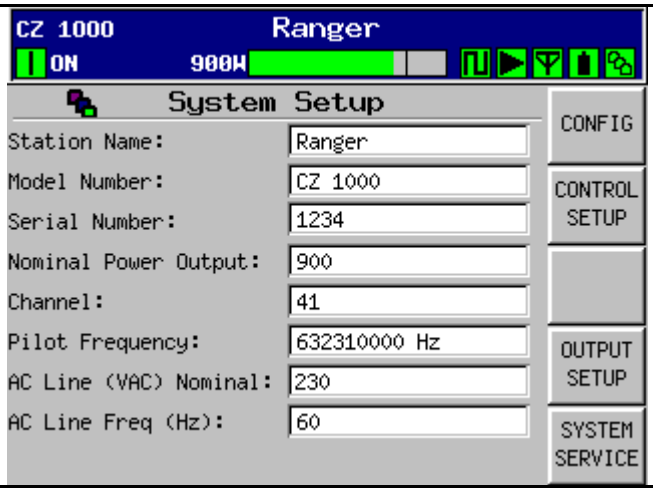
e. Channel - Used by the PA module for calibration.

f. Pilot Frequency - Exact station pilot frequency should be entered in **Hz**. This entry has no function and is for informational purposes only.

g. AC Line (VAC) Nominal - This number should reflect your nominal AC line voltage as measured at the disconnect.

h. AC Line Frequency (Hz) - 50 or 60Hz. Should reflect your line frequency.

Note:
Be sure to press CANCEL on any pop-up window if you do not wish to make any changes. Pressing DONE without making an entry will cause the field to revert to its default and the previous information will be lost.



To Figure 3-23
To Figure 3-24
To Figure 3-15
To Figure 3-21

Figure 3-22 System Setup Screen

3.9.3.1.1 System Configuration

This screen is used to configure the transmitter to operate with either a 3 port patch panel or a motorized RF switch. To change this setting touch the white text box and the Output Switch pop up widow will appear (as shown in Figure 3-23). There are only 2 choices, “Manual” for the manual patch panel or “Motor” for a motorized switch. Selecting Motor activates the XMTR TO ANTENNA button in the Output Control section of the Output screen in Figure 3-12 on page 3-15.

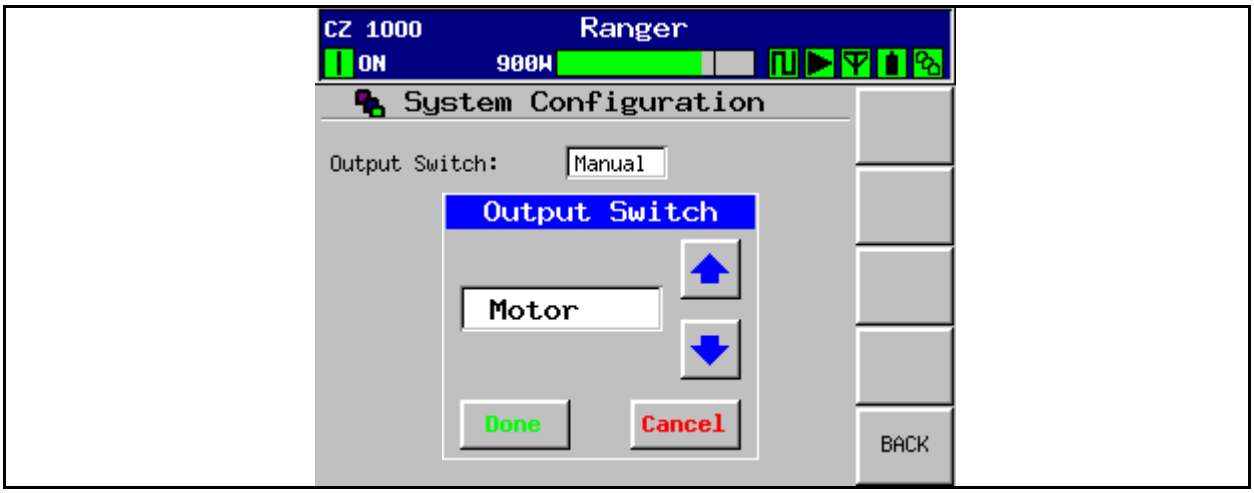


Figure 3-23 System Output Switch Configuration

3.9.3.1.2 Control Setup

To set any of the parameters on this screen, simply touch inside the text box and a pop-up menu will appear with the appropriate information (number pad or keyboard).

This screen allows the user to set the **Date** and **Time** which will be used for reporting and for the fault log. The real time clock is backed up by a battery on the Main Controller to prevent having a reset due to a power outage.

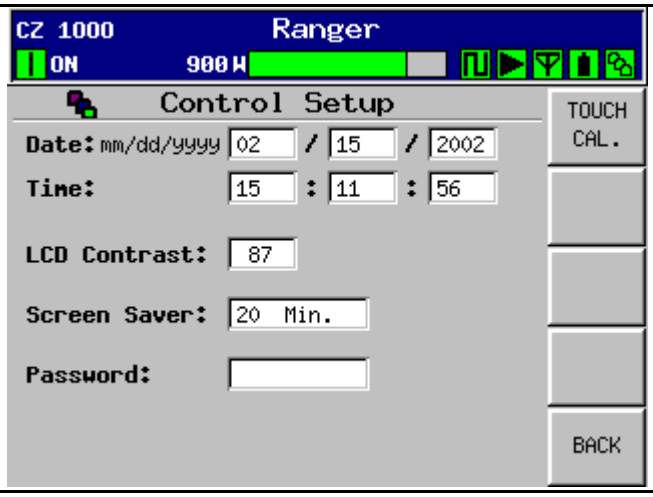
It also allows for adjustment of the **Contrast** of the GUI LCD display. The display contrast will adjust dynamically as the number is changed to allow for room lighting. A setting in the mid 80’s is normal.

The **Screen Saver** setting allows the user to select how long it will take for the screen to blank out due to inactivity.

Password: The last box allows a password to be entered. The password protects against unwanted entry to the transmitter configuration and setup screens, basically any screen

in which information can be changed. The default password is 1895, which will override any other password and allow access.

The only function button is the Touch Cal or Touchscreen Calibration. This should not require routine adjustment. The procedure is given next.



To Figure 3-25 & Figure 3-26

To Figure 3-22

Figure 3-24 Control Setup Screen

3.9.3.1.3 Touch Screen Calibration

If the touch screen soft buttons on the GUI are working and seem to be accurate, then this procedure is not required. If the soft buttons on the touch screen do not seem to work or can only be activated by pressing outside the button graphic, then a simple touch screen calibration will have to be done as follows:

STEP 1 Go to the touch screen calibration setup screen by pressing the Touch Cal button in Figure 3-24. If you are not able to get to the screen, open the control panel and press and hold the Remote Enable and Disable buttons at the same time and momentarily reset the main controller. The Main Controller Reset button is located near the center of the board (directly behind the GUI). Keep the Enable and Disable buttons pressed until the display is up and running. After the micro resets, the Main Controller will prompt the operator to calibrate the touch screen.

STEP 2 Once you see the screen in Figure 3-25, simply touch the X in the first 2 screens. This will get you to the first screen in Figure 3-26.

STEP 3 To test the calibration simply touch the screen in several places to make sure an X shows up where you touched.

STEP 4 If the calibration is good, then press ACCEPT. If not, press CANCEL and the cal procedure will be started over.

NOTE:
The procedure can be aborted by pressing any of the 5 hardware Quick keys on the control panel.

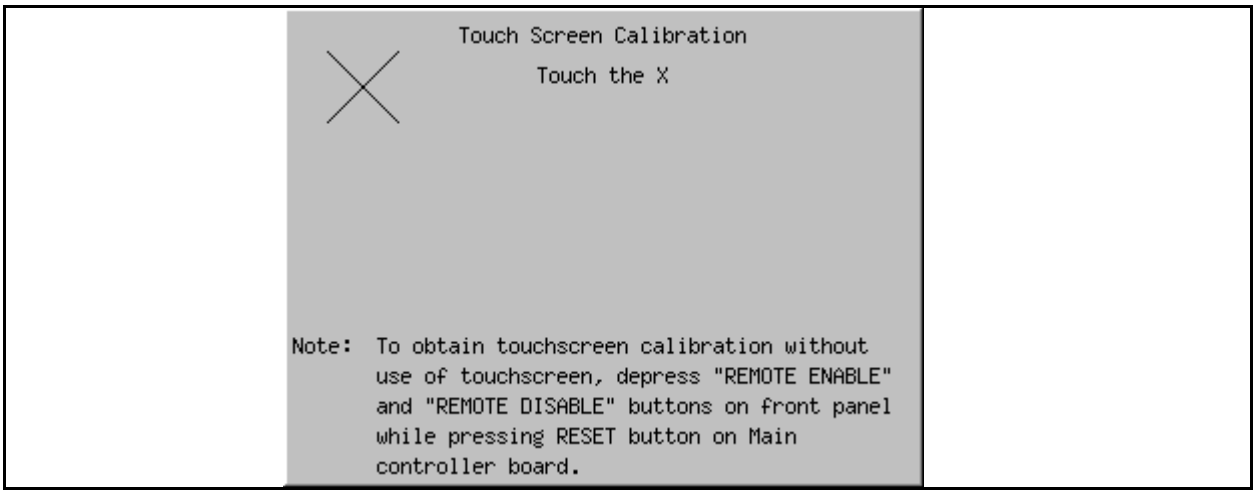


Figure 3-25 Touchscreen Calibration Screen

NOTE:
Touch this screen in several places to make sure an X shows up exactly where the screen was touched.

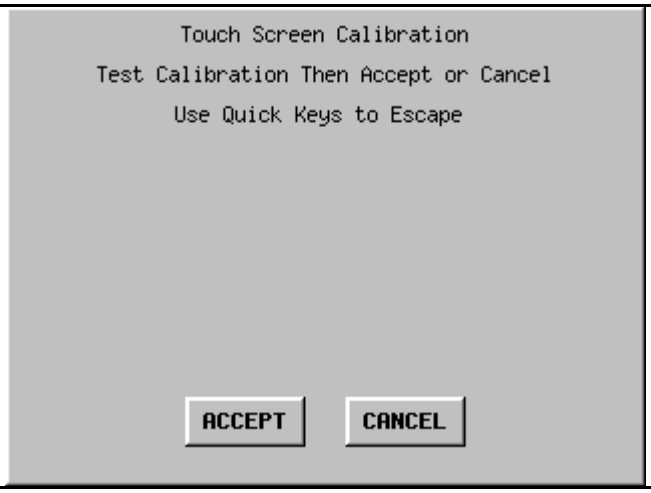
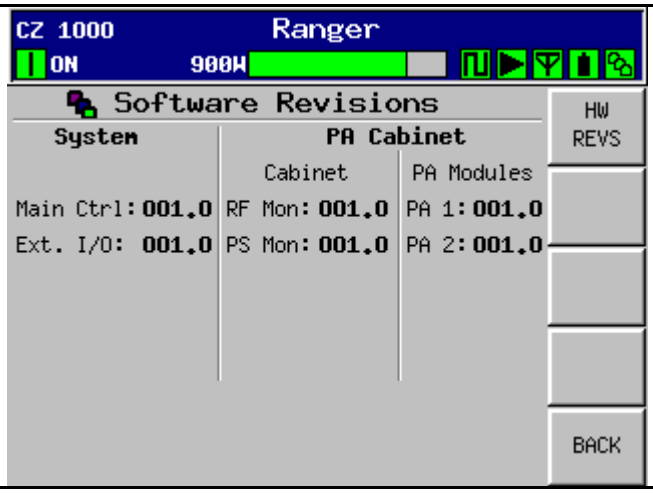


Figure 3-26 Touchscreen Calibration Test Screen

WARNING: Disconnect primary power prior to servicing.

3.9.3.2 Software Revisions (SW REVs)

This screen shows the software revision for all transmitter controllers and PA module controllers. This information should be known before calling for technical support.



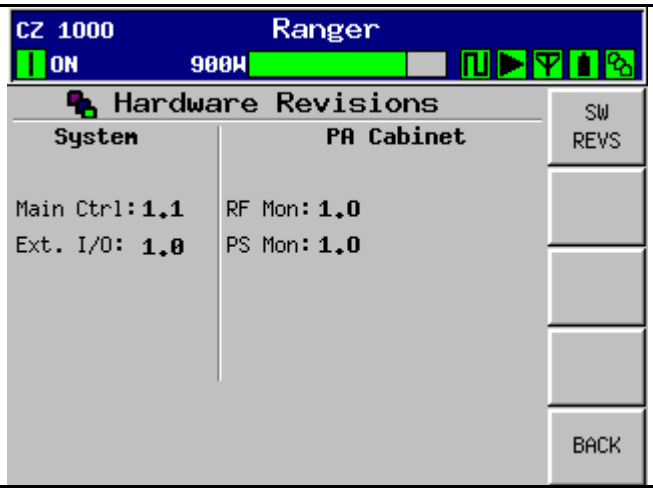
To Figure 3-28

To Figure 3-21

Figure 3-27 Software Revisions Screen

3.9.3.2.1 Hardware Revisions

This screen shows the hardware revisions for all of the transmitter control boards. This information is read from each board and is set using jumpers at the factory and should be known before calling technical support.



To Figure 3-27

Figure 3-28 Hardware Revisions Screen

WARNING: Disconnect primary power prior to servicing.

3.10 GUI Menu Structures

The following figures are simply showing all of the possible screens which can be accessed on the GUI. This is mainly helpful when learning to navigate. The shaded block at the top of each menu tree represents the Main Menu which is accessed using the Quick navigation hardware button on the Control Panel or one of the 5 software buttons on the right side of the HOME Page. Each successive level represents the software buttons which will show up on the right side of the GUI.

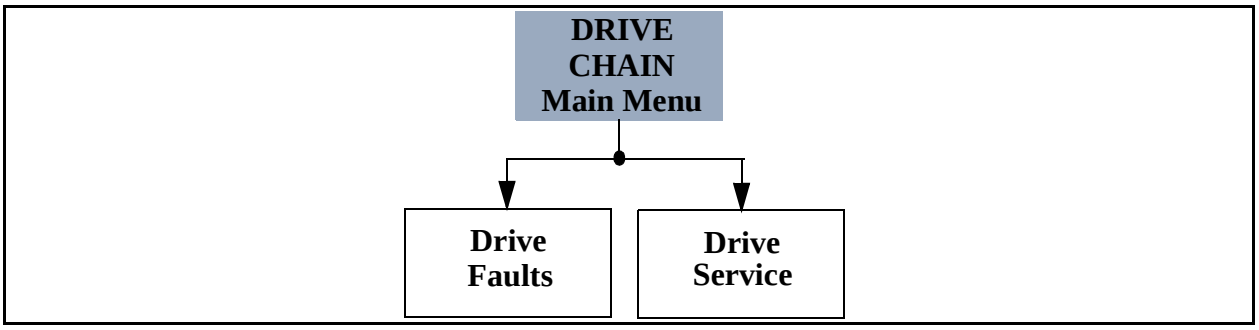


Figure 3-29 Drive Chain Menu Structure

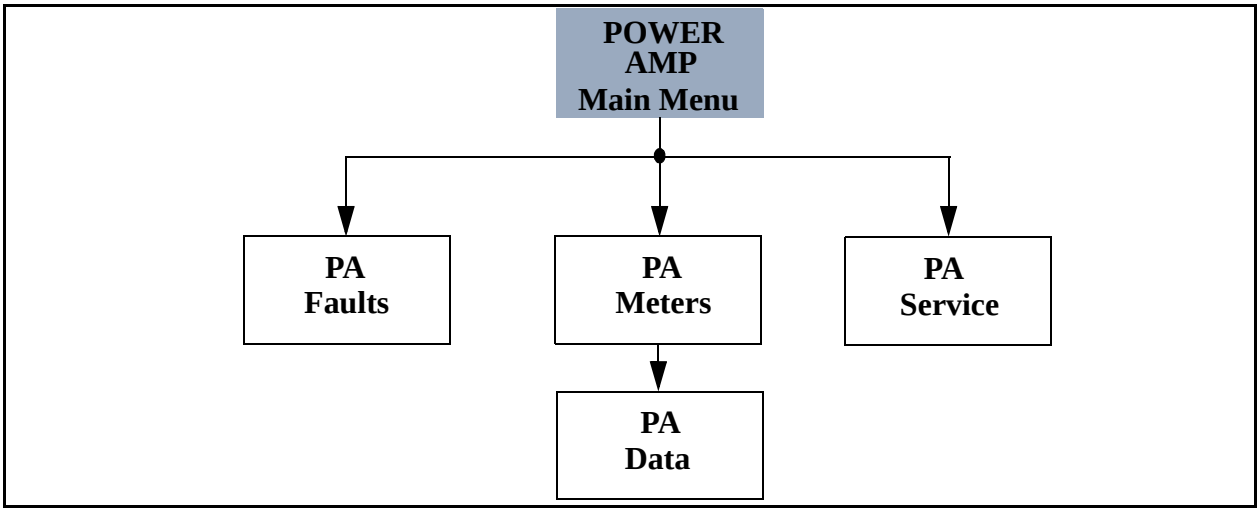


Figure 3-30 Power Amp Menu Structure

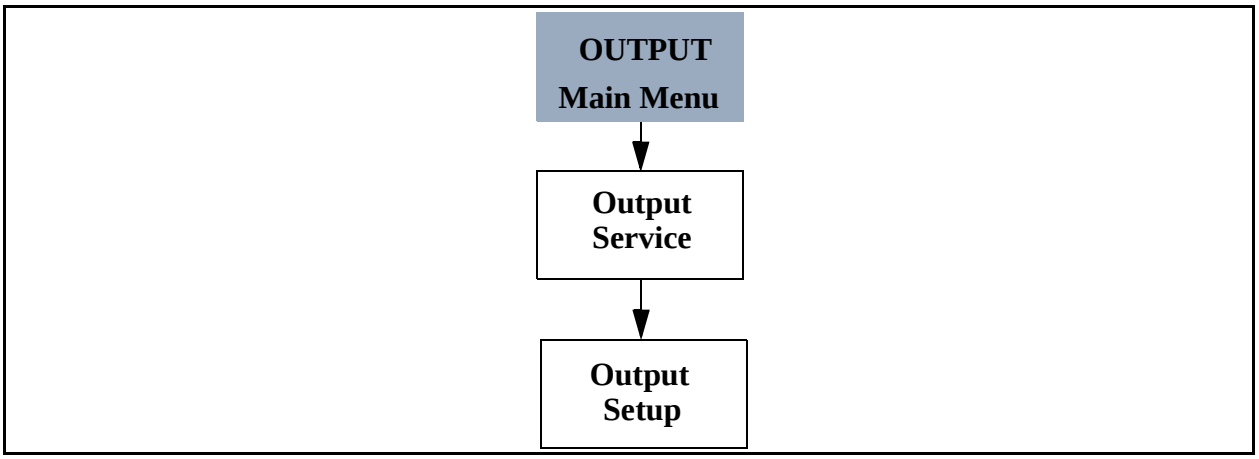


Figure 3-31 Output Menu Structure

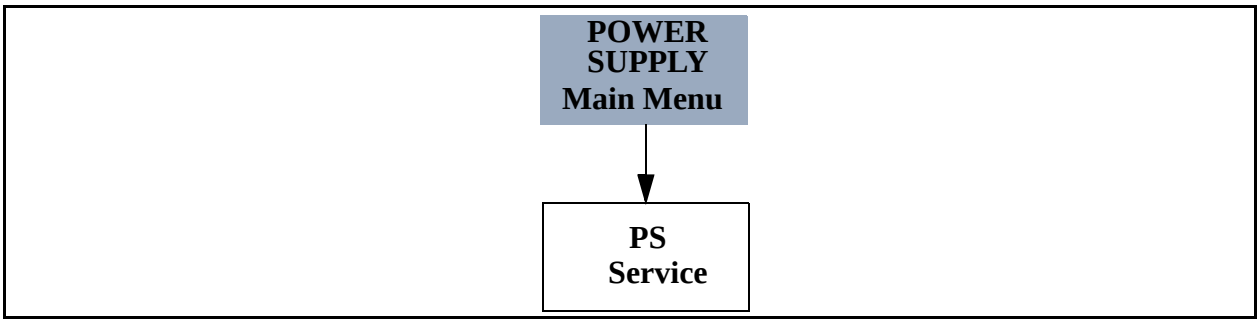


Figure 3-32 Power Supply Menu Structure

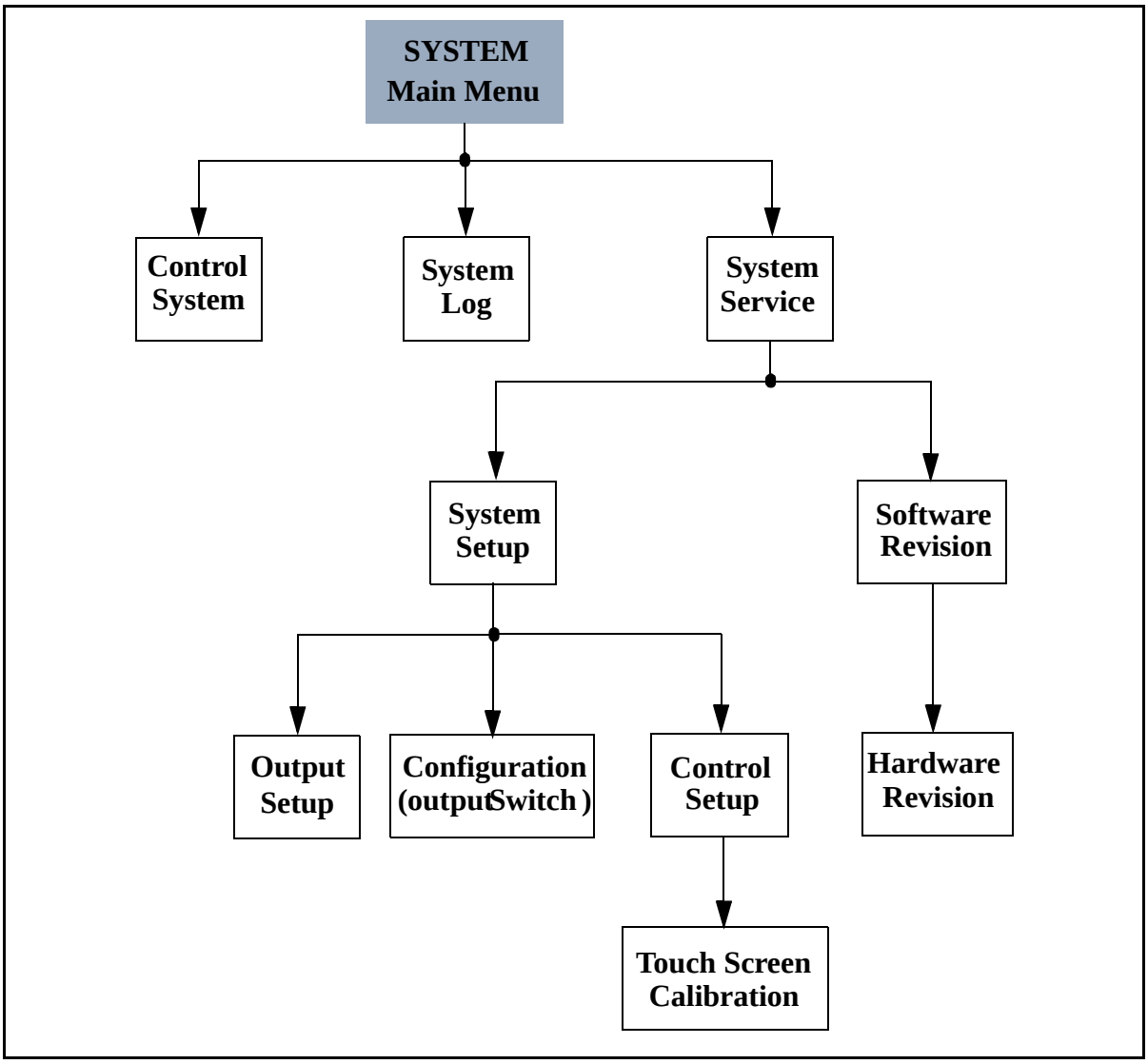


Figure 3-33 System Menu Structure

Section 4 Theory of Operation

4

4.1 Introduction

This section contains detailed descriptions of the Ranger Series transmitter and its internal sub-assemblies. Due to the modular make-up of the transmitter all models of the Ranger Series transmitter are covered by this manual. Model differences will be discussed throughout the text as needed. The various models are given in Table 4-1.

Table 4-1 Ranger Series™ Transmitter Models

Tx Models	PA Modules	Power Supplies	Power before Filter	Power after Filter	Filter location
CZ500F	1	1	375W	TBD	External
CZ1000F	2	1	750W	TBD	External
NOTE: All power levels given in Average power. CZ500F and CZ1000F use an External Low Loss mask filter provided by others.					

4.2 Block Diagram Descriptions

For a basic transmitter overview and block diagram descriptions refer to Section 1, Introduction. There is an overall transmitter wiring diagram, drawing #843-5560-001, which also serves as a transmitter block diagram. Also, as part of our standard practice, the first page of a pc board schematic is also a block diagram of that board.

The remainder of this section will be broken up into 3 main topics:

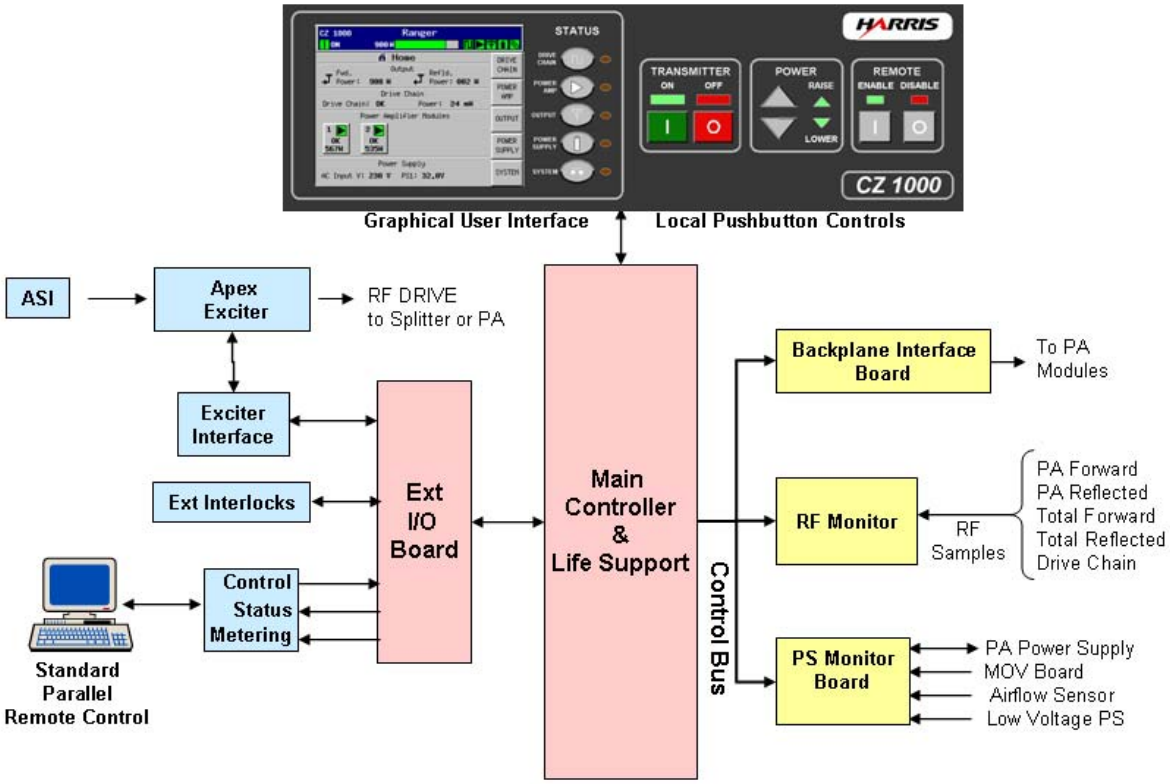
- **Control System**
- **RF System**
- **Power Supplies**

WARNING: Disconnect primary power prior to servicing.

4.3 Transmitter Control System

The Ranger Series transmitters utilize a very advanced but simple to use control system. It is a microprocessor, serial communication based software control system but uses backup Life Support logic circuitry and hard wired control lines, allowing the transmitter to be on the air even if the main control system fails.

Figure 4-1 shows a simplified block diagram of the transmitter control system. The left side of the diagram shows the external connections to the transmitter or more specifically the External I/O Board. The right side of the diagram shows the internal control system inter-connections from the Main Controller to the various sub-systems inside the transmitter cabinet.



Note: Serial Remote control is not available

Figure 4-1 Control System Simplified Block Diagram

WARNING: Disconnect primary power prior to servicing.

4.3.1 Active Logic Symbols

Each logic signal has an active and inactive state and a unique name within the system. To differentiate between active high or active low logic states on the schematics, a forward slash (/) is placed in front of an active LOW signal name such as /RF_MUTE. This means that if this logic line is pulled low, the transmitter RF will be muted. By the same logic, the signal RF_MUTE_LED (an active high signal with no forward slash) will turn on the RF mute LED when it goes high.

In some cases, a logic signal may act as a toggle with both states active, as with the signal /ON_OFF, where LOW = ON and a HIGH = OFF. If this signal is inverted it would be ON_/OFF.

4.3.2 Micro Module

The Main Controller, External I/O, PS Monitor and RF Monitor boards all use the 376 Micro Module. The micro module is a daughter board with a standardized interface which is plugged into a motherboard. It contains Flash memory for storage of its programming and SRAM for program execution. The programming in the flash memory can be re-programmed or upgraded using In-System Programming or ISP (no hardware needs to be changed) via serial connection. In general the micro modules are responsible for control, monitoring and reporting, but have very little to do with transmitter protection which is handled mainly by the CPLDs (see "4.3.3 CPLD, Complex Programmable Logic Device" on page 4-4). Features of the 376 module include:

a. Built-in CAN (Controller Area Network) bus controller
b. 16 A/D inputs for analog metering
c. A serial EEPROM for non-volatile memory storage
d. A built in clock running at 4.194MHZ which will let the micro run at 16-25MHz
e. Power failure detection
f. A watchdog which will reset the micro if it is not triggered at least every 1.6 seconds (this time interval will change depending on the application). A discrete logic device or CPLD is almost always provided on the motherboard to act as an I/O expansion device and in some cases as life support if the micro module fails.
g. Multiple I/O lines whose direction of signal flow is based on the flash memory programming. These could be control or status, inputs or outputs, depending on the particular use.

The main responsibility of the micro module is control of the CPLD and the reporting and receiving of information over the CAN bus. This means that the CPLD will continue to monitor and protect the systems to which it is connected even if the micro module fails. However, there will be no reporting of information to the rest of the transmitter system since access to the CAN bus is gone without the micro module.

4.3.3 CPLD, Complex Programmable Logic Device

The transmitter control boards with the micro module also incorporate a CPLD (Complex Programmable Logic Device) with the exception of the module controllers. The CPLD is not a microprocessor but is actually just programmed discrete logic and is therefore very stable and reliable. The CPLDs in the transmitter perform two vital functions in terms of control and transmitter monitoring:

a. I/O Expansion

b. Life Support Backup

4.3.3.1 I/O Expansion

Each Micro Module only has a limited number of Input/Output or I/O lines available. The CPLDs provide a way to easily expand the available I/O ports on each control board. Basically, the CPLDs are actually controlling and monitoring the I/O for each control board. The micro module is taking that information and relaying it, via the CAN bus, to the Main Controller for display on the front panel control screen or a remote control system. If the micro module wants to send a control command, it simply addresses the correct I/O line on the CPLD and it then sends out the command.

4.3.3.2 Life Support Backup

The CPLD monitors the watchdog circuit or more specifically the RESET line on the micro module. If the micro module stops executing its programming, the watchdog circuit will activate the micro reset line and the control board in question is considered to be in “Life Support Mode”. Since all metering and status is done via the CAN bus, the CPLD will still monitor and protect the systems to which it is connected, but there will be no information reporting to the rest of the control system, the front panel display or a remote control. Control and protection are now limited to the hardwired control lines on the system control bus and any protection circuits built into the CPLD or the control board itself.

4.3.4 Controller Area Network (CAN) Bus

The Controller Area Network or CAN bus is a high speed serial communications link which is used between the transmitter control boards for transmission of control, status, fault and metering information. **The CAN bus is distributed as part of the System Control Bus (ribbon cable)**. The CAN bus can operate at speeds up to 1Mbps and is designed to operate in hostile industrial environments. The transceivers feature cross wire, loss of ground, over voltage and over temperature protections. A CAN transceiver connected to the CAN bus is considered a Node. There can be up to 110 nodes on the bus with a maximum bus length of about 40 meters for 1Mbps operation.

In a CAN system, data is transmitted and received using Message Frames. Message Frames carry data from a transmitting node to one or more receiving nodes. The messages transmitted from any node on a CAN bus do not contain addresses of either the transmitting node or of any intended receiving node.

Instead, the **content** of each Message Frame (e.g. ON, OFF, PS 1 Voltage) is labeled by an identifier that is unique throughout the network. All other nodes on the network receive the message and each performs an acceptance test on the identifier to determine if the message, and thus its content, is relevant to that particular node. If the message is relevant, it will be processed; otherwise it is ignored.

The micro modules have a built in CAN controller which connects to a CAN Transceiver which becomes a node on the CAN bus. The CAN transceiver interfaces the single ended CAN controller to the differential CAN bus for high common mode noise immunity, as shown in Figure 4-2. All of the control boards can send and receive information over the differential CAN bus, however the Main Controller determines what information is sent and when it is sent for this application.

NOTE:
There is an LED on the Main Controller, DS24, which will flicker on and off at a random rate indicating that there is activity on the CAN bus. If the LED is off or always on, then the CAN bus is most likely not communicating.

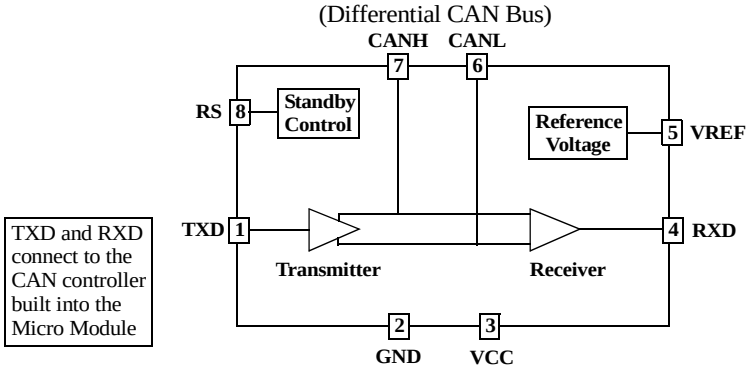


Figure 4-2 CAN Transceiver Diagram

4.3.5 System Control Bus

The System Control Bus is a multi-conductor ribbon cable which distributes the CAN (Controller Area Network) bus and several parallel control lines to all micro-controllers in the system. System Control Bus connection points include:

1. Main Controller
2. Backplane Interface Board
3. PA Module Controllers (via the Backplane Interface Board)
4. RF Monitor Board
5. PS (Power Supply) Monitor Board
6. External I/O Board

- **CAN Bus** - The CAN bus is the primary communication and control system in the transmitter. It is a high speed serial communications network in which information is merely broadcast over the network. All of the system control boards are monitoring the information on the network, but will only respond to information relevant to each controllers operation. All control boards also have the ability to send information over the CAN bus. All fault reporting and status and metering information displayed on the GUI is sent on the CAN bus to the Main Controller and to the External I/O board for remote monitoring. Transmitter control signals are also sent via CAN but are also sent over hardwired parallel control lines.
- **Parallel Control Lines** - The parallel control lines are used for quick actuation of critical functions, such as ON, OFF, RF mute, PS mute, AC_Low and Fault Off. These lines are also the backup control lines in Life Support mode when the Main Controller (and therefore the CAN bus) is not operational. Each board in the control system can independently activate some or all of the parallel control lines to protect the transmitter in case of a fault or other condition that may adversely affect the transmitter. These parallel control signals are duplicated in the CAN messages. The following is a brief explanation of each of the parallel control lines included in the system control bus.

    a. ON_/OFF
    This command corresponds to the transmitter operator pushing the “ON” or “OFF” button, thereby turning the transmitter on or off respectively. This signal is high for ON and low for OFF. This is driven only by the Main Controller and is a sense only line for the rest of the control boards.

b. /RESTRIKE (reset)

This command is monitored by all of the control boards but is driven only by the Main Controller board. When the transmitter is already turned ON and the operator presses the “ON” button again, this line will be pulsed low for a minimum of 100ms. This will cause all of the controller boards to reset any faults and status and try to return to normal operation. This line is a sense only line for the rest of the control boards.

This command is basically a RESET pulse which will try to turn on any transmitter components which have faulted off due to a critical fault condition. If they are still faulty, this will be detected and the component will simply be shut off again. This will not reset or clear the Fault Log.

c. /FLT_OFF

This command is initiated whenever a fault occurs that requires all RF to be shut off and the PA supplies to be disabled. This is a latching type signal that requires user input to clear the fault and turn the transmitter back on. This signal is active low. The Main Controller, PS Monitor, External I/O and RF Monitor Boards monitor this line and have the ability to activate it if necessary.

d. /RF_MUTE

The /RF_MUTE line shuts down all RF output temporarily until the fault condition is cleared. This is a non-latching signal. The Main Controller, PS Monitor, External I/O and RF Monitor Boards monitor this line and have the ability to activate it if necessary.

e. /PS_MUTE

The /PS_MUTE line shuts down the output of the 32 Volt PA module supplies temporarily until the fault condition is cleared. This is a non-latching signal. The Main Controller, PS Monitor, External I/O and RF Monitor Boards monitor this line and have the ability to activate it if necessary.

f. /AC_LOW

This signal is an early warning of impending loss of control voltage. When the AC line voltage that powers the LVPS(s) drops below an acceptable threshold the board will pull this open collector line low. The AC sample from L1 to L2 (A-B) will be monitored. The other boards in the control system will use this indication as an advanced warning to save any data and prepare for loss of power.

The PS Monitor board is the only control board with the ability to drive this signal and it will affect the Main Controller, External I/O and RF Monitor Boards.

WARNING: Disconnect primary power prior to servicing.

4.3.6 Main Controller

The Main Controller is the primary interface between the transmitter and the operator via the front panel Graphical User Interface or GUI. It is connected to all transmitter subsystems, both internal and external to the transmitter, through either an RS-232 serial port or the CAN (Controller Area Network) bus and dedicated parallel control lines. The CAN bus and the parallel control lines are distributed on a single multi-conductor cable called the System Control Bus.

The Main Controller is mounted directly behind the front control panel. It is directly connected to the front panel switchboard which is considered a “Mezzanine” board. The front panel switchboard uses a CPLD to serialize the I/O (the control lines and status signals) to and from the Main Controller.

4.3.6.1 Transmitter Control

The Main Controller is the central point for all system control, metering and diagnostics. It reports this information to the operator via the Graphical User Interface or GUI and through several remote control options.

4.3.6.1.1 Graphical User Interface (GUI)

The GUI is a touchscreen LCD display which is equivalent to 1/4 of a VGA display. This is the primary local interface for the operator but is not required to operate the transmitter. The primary operator controls, ON, OFF, Raise, Lower are located on the front panel next to the GUI. Operation and navigation of the GUI is covered in Section 3 of this manual.

4.3.6.1.2 Remote Controls

The External I/O Board has connections for dedicated remote control systems with the standard parallel control inputs, status outputs and analog metering outputs.

4.3.6.2 Life Support Mode, Main Controller

The CPLD handles most of the inputs and outputs or I/O to the Main Controller. It also allows the CPLD to be able to maintain the transmitter on the air in a limited protection mode called “Life Support” in case the micro module fails. In this mode, the main function of the CPLD is to monitor the primary transmitter control and status lines and interface the front panel controls (ON/OFF, Raise/Lower, Remote Enable/Disable) to the rest of the transmitter.

In Life Support Mode, there is also limited remote control input available from the External I/O Board via J11 on the Main Controller, including:

- Remote ON and OFF
- Remote Raise and Lower
- External Interlock

4.3.6.3 Manual RF MUTE

The Main Controller has a toggle switch, S3 which can be used to mute the transmitter RF output without shutting it off. This switch is primarily used for initial turn on and troubleshooting but can be used for any purpose which requires the RF output to be muted. When activated, the GUI will indicate an RF MUTE is present.

4.3.7 External I/O Board

The primary function of the External I/O Board is exactly as its name implies. It is the interface between the internal transmitter control system and all external or peripheral devices. Input/Output or I/O ports on the External I/O Board include:

a. System Control Bus connection to the Main Controller which includes the CAN bus and parallel control lines.

b. External I/O Control Cable which connects to the Main Controller. This cable has an RS-232 connection and several discrete remote control and status lines which will be used in the event of a failure of the CAN bus. These remote control and status lines include:

   1. On and OFF
   2. Raise and Lower
   3. External Interlock

NOTE:
These lines represent the basic remote control functions and status indications that will be available if the CAN bus is not functioning.

c. Five (5) parallel remote control connections.

1. Two (2) Remote Control Input Connectors (J13 and J14)
2. Two (2) Remote Status Output Connectors (J15 and J16)
3. One (1) Remote Metering Output Connection (J17)

NOTE:
A complete listing of the parallel remote control connectors is given in Table 2-1, Table 2-2, and Table 2-3 starting on page 2-18.

d. External Interlock Terminal Block which gives a connection point for up to 6 external interlocks.

e. Mezzanine Interface connector J8 to Exciter Interface Board. This provides a serial interface, RF mute and foldback signals to the Exciter Interface board which translates its input into the discrete lines required by the CD-1A exciter.

4.3.7.1 External Interlocks

There are 4 External Interlock terminals provided on J18 which will shut the transmitter off when the circuit is opened. These are primarily to be used for the protection of personnel. The External Interlock circuit requires a closed contact between J18-1 and ground. This activates the External interlock relay K1 and allows the transmitter to turn on. J18 is designed to allow connection of up to 6 serially connected external interlock contacts. The transmitter is shipped with 6 jumpers installed on J18, bypassing all of the external interlocks. The jumpers are installed as follows:

- J18-1 to J18-2 - Interlock #1
- J18-3 to J18-4 - Interlock #2
- J18-5 to J18-6 - Interlock #3
- J18-7 to J18-8 - Interlock #4

To use any one of the interlocks simply remove a jumper and connect the terminals to the interlock contacts of the external device. If the device opens the contact, the transmitter will be shut off. If the external interlock is not going to be used, all 6 jumpers must be installed, effectively connecting J18-1 to ground to allow the transmitter to turn on.

The External Interlock circuit uses relay K1 to directly drive the parallel control lines on the System Control Bus. If an interlock circuit is opened, relay K1 will relax to the position shown on the schematic. This will apply an RF Mute, PS Mute and most importantly Fault OFF. The transmitter is now shut off and cannot be turned on again until the external interlock circuit is closed and a new ON command is given locally or by remote.

4.3.7.2 RF Mute Interlock

There are 2 more interlock connections on J18 which can be used to apply an RF Mute; instead of a Fault OFF condition as discussed above. This could be used for RF switch changeover or a dummy load thermal interlock. The connections are:

- J18-9 to J18-10
- J18-11 to J18-12

⚠ **CAUTION:**
THESE INTERLOCK CONNECTIONS ARE NOT TO BE USED IN ANY SITUATION WHERE PROTECTION OF PERSONNEL IS AN ISSUE.

4.4 Transmitter RF System

Figure 4-4 shows a simplified block diagram of the transmitter RF system. The RF system for each model will be described separately.

4.4.1 CZ500F RF System Description

The CZ500F has only one PA module, which makes the RF system very simple. The Apex^{R} exciter feeds the Splitter board. The RF drive output of the splitter going to PA2 is simply terminated with a 50 ohm load. The PA Module output is determined by the exciter power level. The PA module output passes through the circulator to the mask filter and then to the cabinet RF output. The circulator reject load is a 1kW 40dB attenuator which supplies a sample of the reflected power to the RF Monitor Board for metering on the GUI Output Service screen.

There are Forward and Reflected power directional coupler samples both before and after the mask filter for calibration and metering. A third sample is provided after the mask filter for the RTAC (Real Time Adaptive Correction) sample required by the Apex^{R} exciter.

The Backplane Interface board provides for connection of the Control bus (CAN bus and parallel control lines) and the LVPS (+/-15Vdc and +7.5Vdc) for the module.

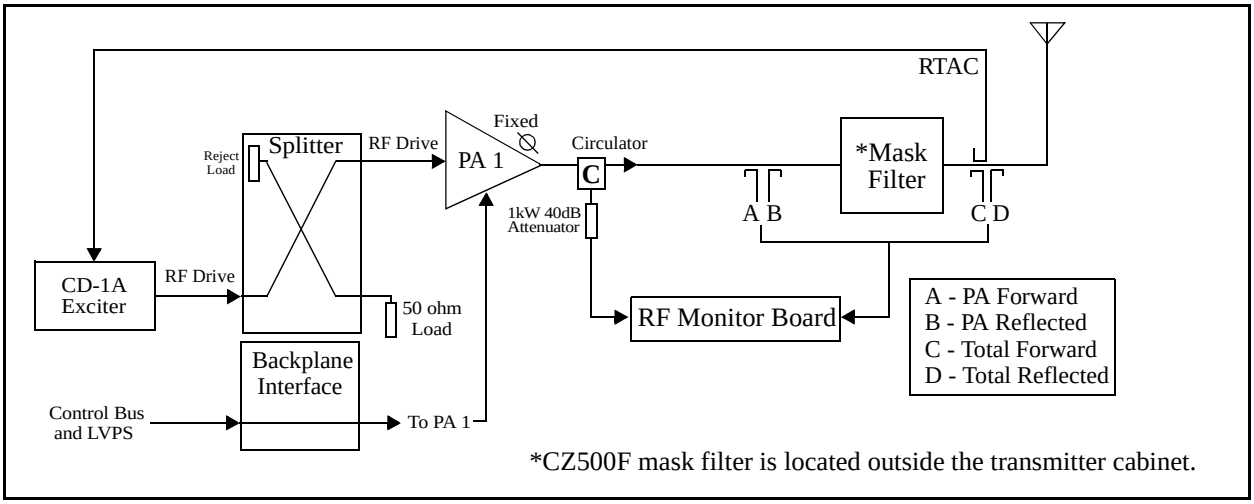


Figure 4-3 CZ500F RF System Block Diagram

4.4.2 CZ1000F RF System Description

The block diagram of the CZ1000F RF system is shown in Figure 4-4. The Apex^{R} exciter feeds the Splitter board. With 2 PA Modules in the CZ1000F, the splitter board provides equal amplitude outputs for each PA module with a 90^{o} phase relationship. The power output of the PA Modules is determined by the exciter power level. The PA module outputs pass through a circulator before connecting to the 3dB hybrid. This isolates and protects the module from external reflected power. The circulator reject load is a 1kW 40dB attenuator which supplies a sample of the reflected power to the RF Monitor Board for metering on the GUI Output Service screen.

The 3dB hybrid is a wideband component useable over the entire UHF band. The reject port on the hybrid is terminated with a 1kW 40dB attenuator whose output is sent to the RF Monitor board for metering on the Output Service Screen shown in Figure 4-7. The phase of PA Module 2 is adjustable to allow this sample to be minimized, optimizing the combiner and PA efficiency. The adjustment is a pot, R7 on the Backplane Interface Board (the only pot on the board). As shown here the easiest way to adjust module phasing is to remove the sample cable where it connects to the RF Monitor board, connect it to a digital power meter and adjust the pot for minimum reject power. The output of the Hybrid connects to the built-in mask filter. There are Forward and Reflected power directional coupler samples both before and after the mask filter for calibration and metering. A third sample is provided after the mask filter for the RTAC (Real Time Adaptive Correction) sample required by the Apex^{R} exciter.

The Backplane Interface board provides for connection of the Control bus (CAN bus and parallel control lines) and the LVPS (+/-15Vdc and +7.5Vdc) for the modules.

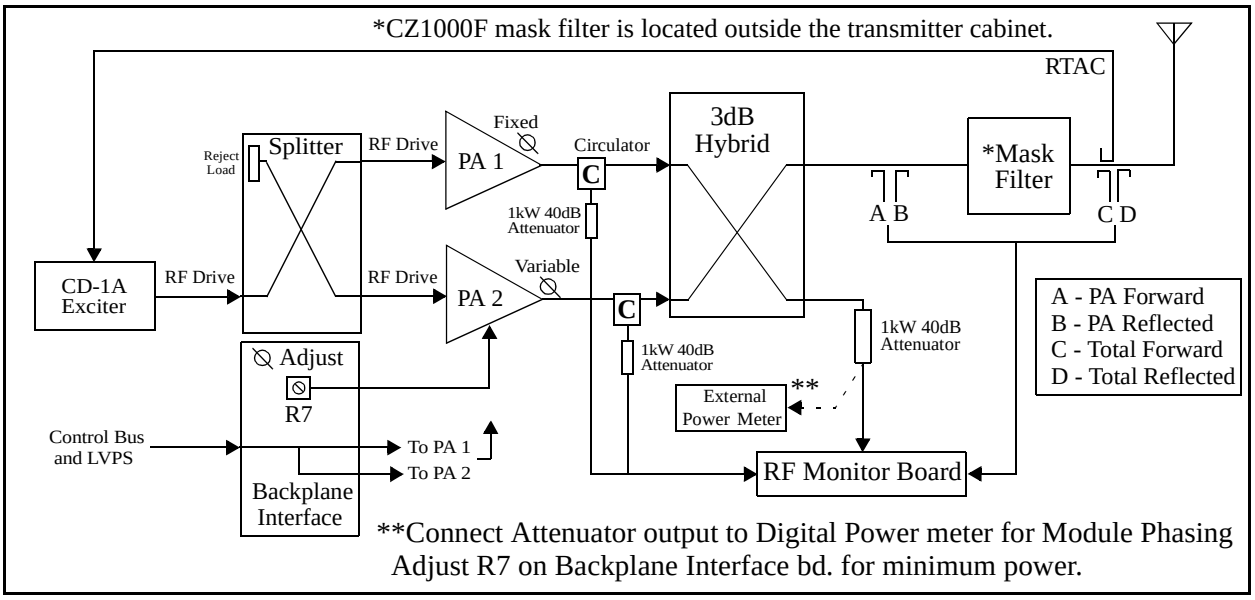


Figure 4-4 CZ1000F RF System Block Diagram

WARNING: Disconnect primary power prior to servicing.

4.4.3 Apex^{R} Exciter

The Ranger Series™ transmitter comes standard with a single Apex^{R} exciter and no option for adding a backup. For information about the Apex^{R} exciter, refer to the Apex^{R} Exciter Manual, 888-2604-001 which came with the transmitter. The output of the Apex^{R} exciter is connected to the Backplane Interface board.

4.4.4 Backplane Interface Board

The Backplane Interface Board is accessed from the rear of the transmitter and is located just above the PA Module compartment. The location of this board is shown in Figure 2-11 on page 2-21. Its function is to distribute low voltage and control signals to the PA modules. It also has the Module phasing adjustment pot, R7 which is used in the CZ1000F for phasing PA module #2 to minimize the PA module combiner reject power.

4.4.4.1 Control Distribution

The System Control Bus is distributed to the PA Modules from here. The control bus includes both dedicated parallel control lines and the CAN (Controller Area Network) bus. An RS-232 to RS-485 converter is implemented to provide serial compatibility with the module.

4.4.4.2 Low Voltage Power Supply Distribution

The LVPS comes in on connector J5 from the PS Monitor Board and is distributed to the PA Modules and includes:

- +7.5Vdc
- +15Vdc
- -15Vdc

There are 3 green LED indicators on the board which will be illuminated if the supplies are present. For more information on the Low Voltage Power Supplies or LVPS, see "4.5.3 Low Voltage Power Supply (LVPS)" on page 4-23.

4.4.5 PA Module

The Ranger Series™ PA Module is a high gain, air cooled RF amplifier. The CZ500F has 1 PA Module while the CZ1000F has 2 PA Modules. The Power Amplifier modules use LDMOS FETs for amplification. The amplifiers use a palletized approach to provide a means of module repair at the pallet level. Six output pallets provide up to 400 watts RMS power , a seventh pallet is used as a driver for the output pallets. Modules are self protecting, using an on-board module controller and on/off solid state relay to facilitate fast shut down if a fault occurs. All module faults are communicated to the controller via the CAN serial bus. Module on/off control is via the serial interface and a separate parallel control. The modules are hot pluggable to allow on-air maintenance and repair. Modules include temperature compensation and AGC to control gain stability over the ambient temperature range of the transmitter. A simplified block diagram of the PA module is shown in Figure 4-5.

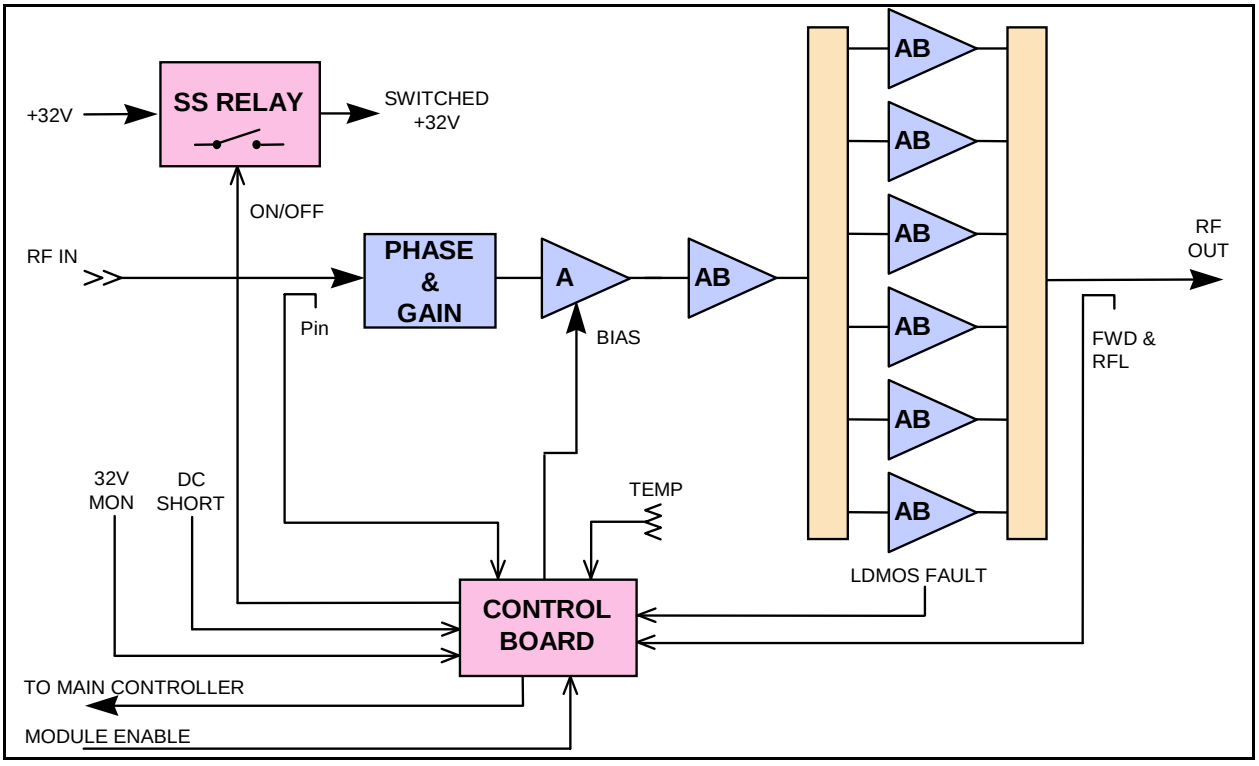


Figure 4-5 PA Module Simplified Block Diagram

WARNING: Disconnect primary power prior to servicing.

The PA Module is made up of the following components:

a. Phase and Gain Board
b. One driver pallet
c. A 6-way RF splitter
d. Six Power Amplifier pallets
e. A 6-way pallet combiner
f. Directional Coupler for Forward and Reflected power metering and protection
g. PA Module Control Board (this includes a micro module)

4.4.5.1 Phase and Gain Board

The RF enters the module and is routed directly to the Phase and Gain Board. Figure 4-6 shows a simplified diagram of the board. This board provides several functions which are key to operation of the module:

a. It acts as a gain block to increase the RF input to a level that is sufficient to drive the predriver pallet.
b. It has an RF input switch which is used to mute and un-mute the RF through the module.
c. Input power sampling for metering, AGC and Input over-drive detection.
d. Receives I and Q vector control signals from the Module Controller Board which are used for module insertion phase and gain. For the CZ1000F this allows the modules to be adjusted for best phase and gain by the adjustment on the Back-plane Interface Board in order to reduce the reject power in the module combiner and optimize PA efficiency.

NOTE:
The DAC values of the I and Q vector signals show up on the PA Data screen. They can range from 0 to 4095. If either number reaches 0 or 4095 an AGC Unlock fault will occur indicating that the module cannot maintain the required 46dB gain value. These values can vary greatly depending on the module and the frequency.

e. Automatic Gain Control or AGC to keep the gain of the module constant.

The RF output from the Phase and gain board connects to the Predriver pallet.

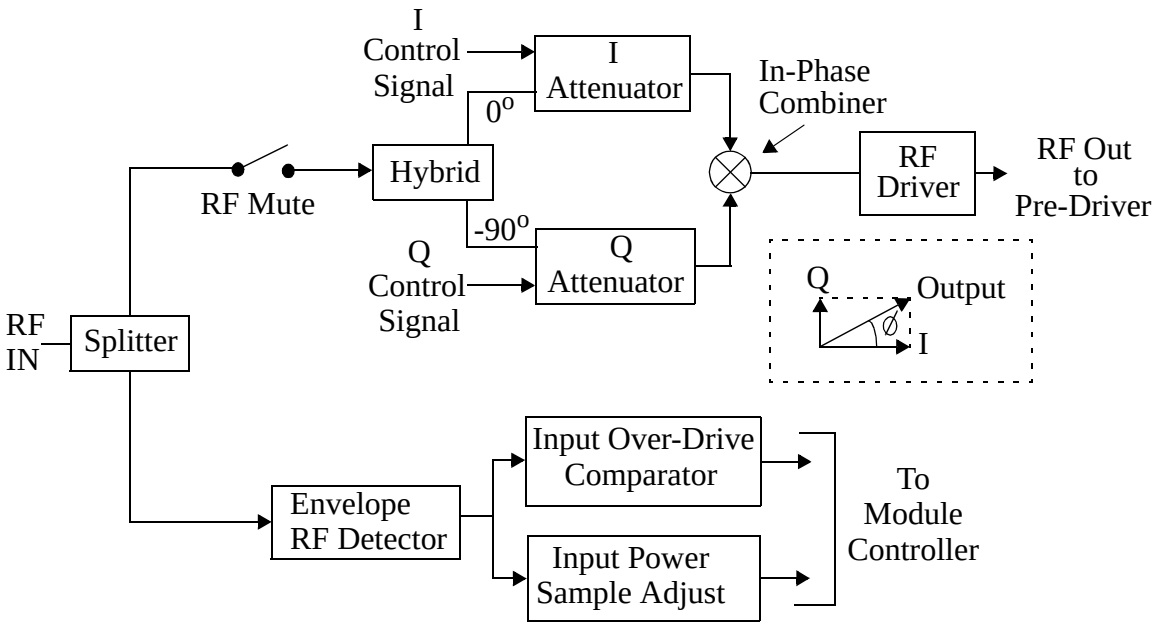


Figure 4-6 Phase and Gain Board Block Diagram

4.4.5.2 Automatic Gain Control (AGC)

Each PA module uses an Automatic Gain Control or AGC circuit to keep the module gain constant at 46dB. It monitors the input power and output power of the module and holds the gain of the module constant using the I and Q vector signals from the module controller. Transmitter power is controlled by adjusting the exciter power output.

4.4.5.3 RF Pallets

The PA module utilizes 7 LDMOS RF amplifier pallets. The pallet is actually made up of 2 push-pull amplifiers with a hybrid splitter on the input and a hybrid combiner on the output. Six (6) pallets are used as the main power amplifiers or PA pallets, with one (1) used as a Driver Pallet. The PA pallets are field replaceable but the Driver pallet is not. See Appendix A for the pallet replacement procedure.

4.4.5.4 RF Splitter and Combiner

The module uses a 6 way splitter to feed the amplifier pallets and a 6 way combiner at the pallet outputs. The pallet combiner also has a directional coupler to sense forward and reflected power at the output of the module. The forward power sample is used for power monitoring and module AGC (Automatic Gain Control). The reflected sample is used to protect the module from excessive VSWR.

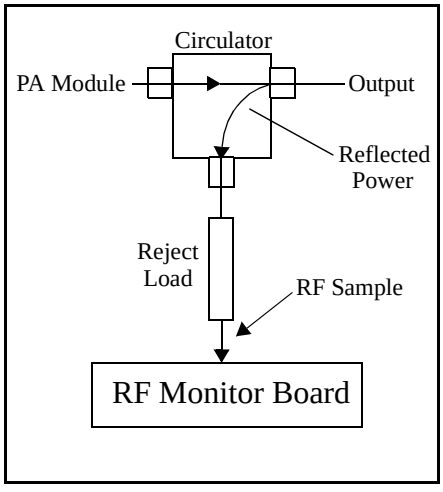
4.4.5.5 Module Controller

The Module Controller uses a micro controller and is responsible for the following:

- Communicating with the Main Controller via the CAN bus.
- Monitoring +32V current to each of six RF pallets, driver and phase and gain board in the module for over-current conditions and for pallet biasing.
- Monitoring the heatsink temperature of the combiner.
- Supply voltage monitoring, with over and under voltage alarms.
- Executing phase and gain set commands from the Main Controller by generating I and Q control signals for the Phase and Gain Board.
- Fault monitoring and alarm generation, and control of module 3 Strike process.
- Monitoring RF input and output power to/from the module.

4.4.6 PA Module Circulators

The output of the PA Module is fed through a circulator to isolate the PA from any reflected power at the transmitter output. The circulator is a 3 port directional device which sends any reflected power to a reject load instead of allowing it to return to the module. The reject load for the circulator is actually a 40dB 1kW attenuator whose output is fed to the RF Monitor board for monitoring purposes. This RF sample level shows up on the Output Service Screen on the GUI as PA Module Circulator Power PA 1 / PA 2 as shown on the right side of Figure 4-7. There is no adjustment for these readings. They are given for monitoring purposes only.



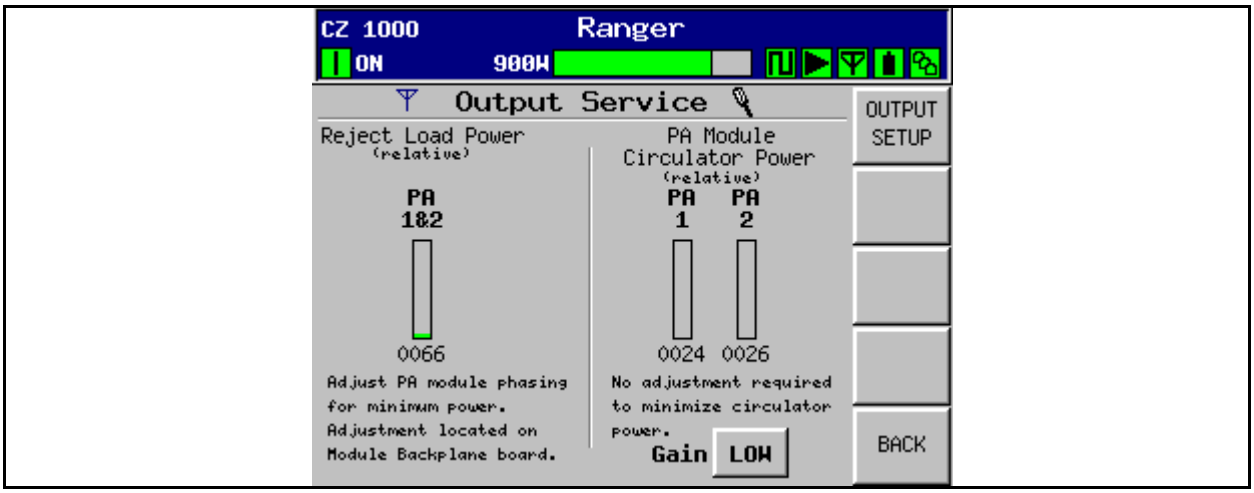


Figure 4-7 Output Service Screen

4.4.7 PA Module Combiner (CZ1000F only)

For the CZ1000F (which has 2 modules) the PA module combiner is a wideband hybrid optimized to work across the entire UHF frequency band from 470MHz to 860MHz.

4.4.7.1 Combiner Isolation Load (CZ1000F only)

For the CZ1000F the combiner isolation load is actually a 1kW, 40dB attenuator whose output is taken to the RF Monitor Board for metering and protection. The RF sample is detected by the RF Monitor Board and shows up on the Output Service screen on the GUI as Reject Load Power PA 1&2 as shown in Figure 4-7. The isolation load is mounted on the side of the cabinet along with the circulator reject loads. The phase of PA Module # 2 is adjusted via R7 on the Backplane Interface board to minimize power to the reject load.

4.4.8 RF Monitor Board

The RF Monitor Board is located just above the PA Modules in the rear of the transmitter. The RF Monitor is responsible for the following:

a. Communicating with the System Controller via the internal CAN (Controller Area Network) bus

b. Monitoring the power into the reject power loads from the modules

c. Monitoring system forward RF power

d. Monitoring system reflected RF power

e. Maintaining hardware trip points for reject loads and forward and reflected power sense ports to generate an exception on the transmitter parallel bus in the event of a fault while in Life Support mode

f. Calculation of VSWR based on Forward and Reflected power samples (Not applicable in Life Support mode)

While this board utilizes the micro module, the CPLD is responsible for all of the critical power and VSWR overload protection. The micro module is basically just responsible for communicating information to the Main Controller.

4.4.8.1 RF Detectors

There are 2 types of RF detectors used on the RF Monitor Board:

- Relative - Used to monitor the reject load power levels. These detectors are very accurate at a calibrated power level, but are not linear across a wide dynamic range.
- Precision - Used for metering of critical (metered) forward and reflected power levels of the cabinet and the system. These are true RMS detectors that are linear at all power levels, giving the accurate readings required for metering and VSWR protection.

Parameters monitored by the RF detectors include:

a. PA Circulator Reject load #1 power (Relative)

b. PA Circulator Reject load #2 power (Relative)

c. PA Module Combiner Reject load #3 power (Relative)

d. PA Forward Power before filter (Precision)

e. #2 PA Reflected Power before filter (Precision)

f. #3 System Forward Power after filter (Precision)

g. #4 System Reflected Power after filter (Precision)

h. #5 Drive Chain Power exciter (Precision)

4.4.8.2 Reject Load RF Detector (Relative)

The reject load RF detectors are a diode based envelope detector. These detectors are intended to provide relative readings only, not accurate absolute power measurements. The inputs for these detectors come from the 40dB attenuators being used as reject loads for the PA module combiner. Each detector has 2 gain settings, Low and High which can be set from the GUI screen in Figure 4-7. The chosen sample levels from the reject loads and the gain of the detectors allow them to operate in the Low gain position for normal operation.

In other words, for a 1kW reject load (which is actually a 40dB attenuator) with 1kW applied, the RF input sample to the detector would be 100mW. In the Low gain position, this would give approximately 3Vdc detected output. This 3Vdc level is used to protect the reject loads from over-dissipation. If the detector output reaches 3Vdc the fault comparators will trip, causing a FAULT_OFF to be sent over the parallel control bus, shutting the transmitter off. The micro module will communicate the cause of the fault to the Main Controller over the CAN bus.

The High gain settings is only used when adjusting module phasing to minimize combiner reject load power. When you leave the Output Service screen on the GUI, the detector defaults back to the Low gain setting.

The reject load RF detector samples are used for 2 purposes:

- Overload protection of the reject loads
- PA Module and Cabinet RF phase alignment

4.4.8.2.1 PA Module Phase Alignment

The outputs of the reject load detectors are also multiplexed into a 10bit ADC (Analog to Digital Converter) on the micro module. The ADC output will be between 0 and 1023 for a given input voltage range of 0 - 3Vdc. This ADC number shows up on the Output Service screen on the GUI.

Remember that the default gain setting for the reject load detectors is Low. This means that if all of the modules have the correct insertion phase, the reject load will show minimum reject power on the Phase Align screen, and the ADC reading will be very close to zero. However, at Low gain, this relates to a very coarse setting where the phasing could be off quite a bit but very little reject power shows up on the screen due to the lack of sensitivity of the detector.

To compensate for this each detector has two gain settings on the Phase Align screen, Low and High. Once the reject power is minimised in the Low gain setting, the gain of

the detector can be increased to High to allow for better resolution and thus better phase alignment of the PA Modules. For details on how to set PA Module Phase see Section 3, Operation/Maintenance.

4.4.8.3 Precision RF Power Detectors

The precision RF power detectors use the Analog Devices AD8361 TruPower© RF detector IC. These detectors are configured with a fixed pi-network attenuator on the input to adjust the input signal to the appropriate level for sensing based on the source level.

4.4.8.4 Normal Mode / Life Support Mode

The RF Monitor operates in one of two modes, Normal and Life Support (micro module failure). Normal Mode differs from Life Support mode only in that reporting capability back to the Main Controller is lost in Life Support mode. All other fault handling functions, including three strike and comparator thresholds, are maintained by the CPLD even though the micro module is not functioning.

4.5 Power Supplies

This section covers both the AC and DC portions of the power supply as well as control, protection and monitoring. Actual sub-assemblies involved include:

a. PS (Power Supply) Monitor Board

b. MOV Board

c. +32Vdc PA Power Supply

d. Low Voltage Power Supply or LVPS

4.5.1 AC Input

The AC mains input comes into the transmitter and attaches to TB1, the AC Mains terminal strip above the MOV board. TB1 provides the necessary tie points for distribution to all of the power supplies and the MOV board. Nominal input voltage is 208 - 240 VAC single phase. Tolerable AC line variation is +/-10% (187 - 264V). The switching power supplies will work within this range.

4.5.2 PA Power Supply Module

The Power Amplifier modules are powered by a modular switching power supply located in the bottom of the PA Cabinet. The one power supply module operates 1 or 2 PA modules. The PS Module operates directly from the ac line and has its own circuit breaker on the front of the module. Its dc output is 32V at up to 150 amps.

The power supply is controlled and monitored by the PS (Power Supply) Monitor Board. The PS Module is monitored for Over-voltage, under-voltage, over-current by the PA modules.

The power supply module is over-temperature protected. It will automatically shut down (latching fault) if an over-temperature condition is encountered. After cool down the power supply can be restarted by removing and re-reapplying AC power to the unit. This can be accomplished by turning the circuit breaker on the front of the power supply to the off position and then back to the on position. The power supply can also be reset by turning the transmitter cabinet main AC breakers off and then back on.

NOTE:
The PA power supply modules must have AC power removed and reapplied in order to resume operation after a power supply over-temperature fault.

4.5.3 Low Voltage Power Supply (LVPS)

The transmitter comes with a single Low Voltage Power Supply or LVPS. The supply is located near the middle of the cabinet and is accessed from the front of the transmitter. The outputs from the LVPS are connected to the PS Monitor Board.

The Power Supply Monitor Board acts as a distribution point for low voltage to the rest of the transmitter. The outputs from the LVPS are:

- +7.5Vdc @ 100W (13.3A) - This voltage is used to drive all the logic contained on the various control boards throughout the Ranger transmitter. The 7.5 volt output will be regulated on each board with a linear regulator to step down the voltage to 5Vdc and/or 3.3Vdc as needed.
- +15Vdc and -15Vdc @ 75W (5A) each - These voltages are used as the supply for biasing op-amps and other analog circuitry for each board.

Each of the three output voltages of the LVPS will be monitored and distributed by the Power Supply Monitor Board. The +7.5V output is fused with a 10 Amp fast acting fuse while both the +15V and -15V outputs are fused with a 5 Amp fast acting fuse for each polarity. The AC supply input is auto ranging and will accept 180-264Vac at a frequency of 47 to 63 Hz.

4.5.4 Power Supply Monitor Board

The Power Supply (PS) Monitor Board monitors and controls the various power supplies and monitors the internal transmitter cooling. It uses the 376 micro module and is interfaced to the Main Controller via the CAN bus and the parallel control lines (System Control Bus). As is standard with all of the control boards, a CPLD is used for processing the digital I/O and interfaces with the micro-module. This allows the CPLD to be able to provide control and status monitoring in the event that the CAN bus or micro-controller fails. The following paragraphs give a detailed description of the individual PS Monitor Board functions.

4.5.4.1 LVPS Interface

The PS Monitor Board controls the low voltage power supply and acts as the distribution point for the low voltage to the rest of the system.

There are 2 Power Bus cables, J8 and J9, which carry the +7.5Vdc and +/-15Vdc from the LVPS. J9 connects to the Backplane Interface board for distribution of low voltage to the PA modules. J8 distributes low voltage to the RF Monitor Board, External I/O Board and the Main Controller.

4.5.4.2 PA Power Supply Monitoring and Control

The Power Supply Monitor board also interfaces and controls the remote enable/disable function on the supply. Should a fault off condition or a power supply mute condition exist, the PS Monitor board will disable the outputs of the PA supply. This lines is monitored and controlled by the CPLD.

4.5.4.3 AC Line Monitoring

The PS Monitor board monitors the condition of the incoming AC line and provides status updates to the main controller via the CAN network. Upon detecting certain conditions, the power supply monitor can activate the /FLT_OFF, /RF_MUTE, /PS_MUTE, or /AC_LOW command based on the fault. It is monitoring for Over or Under voltage +10/-15% respectively.

The MOV board supplies a scaled ac current sample of each of the ac lines to the PS Monitor board. The MOV board also provides discrete lines to the PS Monitor Board to indicate when a fuse is open on the MOV board.

4.5.4.4 Cabinet Cooling System Sensors

The PS Monitor has 2 sensors which are monitoring the cabinet cooling system.

- Ambient Temperature
- Air Pressure

The air pressure sensor is located off the board with the ambient air temperature sensor physically mounted on the PS Monitor Board.

4.5.4.4.1 Ambient Temperature

An ambient temperature sensor is installed on the Power Supply Monitor board. The sensor outputs a voltage that is directly proportional to the temperature in degrees Celsius. The micro-controller will monitor this reading and report it to the main controller.

4.5.4.4.2 Air Pressure

The PS Monitor board monitors the air pressure within the transmitter cabinet. It is a differential pressure sensor that provides a voltage output which is directly proportional to the difference in pressure between the pressurized fan compartment and the air intake area in the rear of the cabinet. The air pressure reading on the GUI is nominally 0.25 inches of H_2O.

The sensor is used to give a relative pressure indication on the GUI, thus indicating that the flushing air fans are operating normally. The micro-controller will monitor its status and report it to the Main Controller. The CPLD also monitors the output of a discrete comparator circuit which is set to trip when the air pressure is too low. This sends an air pressure warning to the Main Controller, but the transmitter continues to operate. Temperature sensors on the modules will protect them from fan failures.

4.5.4.5 PS Monitor LEDs

The PS Monitor has quite a few on board LEDs which can be used for troubleshooting or fault verification. Table 4-2 provides details on the use of each of the LEDs.

Table 4-2 PS Monitor, LED Indicators

LED Number	Function	Condition	Color
1	FLT_OFF	Faults Present	RED
2	RF_MUTE	Mute	RED
3	PS_MUTE	Mute	RED
4	AC_LOW	AC line voltage low	RED
12	+3.3V	ON	GRN
13	+5V	ON	GRN
14	+12V	ON	GRN
15	-12V	ON	GRN
16	+7.5V FUSE	Open	RED
17	+15V FUSE	Open	RED
18	-15V FUSE	Open	RED
19	AIR TEMP	Air Temperature High	RED
20	AIR PRESSURE	Air Press Low	RED
24	AC MAINS HIGH	Average Voltage High	RED
25	AC MAINS LOW	Average Voltage Low	RED
28	FUSE OPEN	1 to 3 Fuses Open on MOV	RED
29	CPLD PROGRAMMING	LED flashed by micro when programming CPLD	RED

Section 5 Replacement Procedures

5

5.1 Introduction

This section contains information on how to remove and replace electrical and mechanical parts and any alignments or adjustments associated with the replacement. All routine alignment procedures are contained in Section 3 with the associated GUI screen.

5.2 PA Module Removal

The PA module(s) simply push in or pull out of the transmitter. There are no latches or screws. There is a module off switch located behind the front cover at the top and bottom of the module so that when the module is grasped to be pulled out, the touch switch shuts it off first.

5.2.1 CZ1000F PA Module Air Block

For the CZ1000F, a special Air Block (a long, thin Lexan shield shown in Figure 5-1) has been provided in case one of the modules is to be removed for an extended period of time. The Air Block simulates the back pressure of a module. This keeps the airflow through the rest of the transmitter at normal levels even with the module removed. The Air Block will only fit in Slot #2 (the right-hand slot). Therefore, if a module is to be removed for a period of more than a few hours, the Air Block should be installed in slot 2 and the remaining module must be placed in slot 1 (if not already there).

Figure 5-1 Lexan Air Block

WARNING: Disconnect primary power prior to servicing.

To install the Air Block, place the right side into the slot as shown in Figure 5-2. To finish, squeeze near the back until it starts into the slot on the left. Now using either your hands or a screwdriver, work it into the slot from back to front. It could also be installed starting at the front and working your way to the back, whichever works best for you. When finished, both sides of the Air Block should be captive under the shelf.

NOTE:
If you use a tool to aid installation, be very careful not to bend the aluminum guide to the left of the slot.

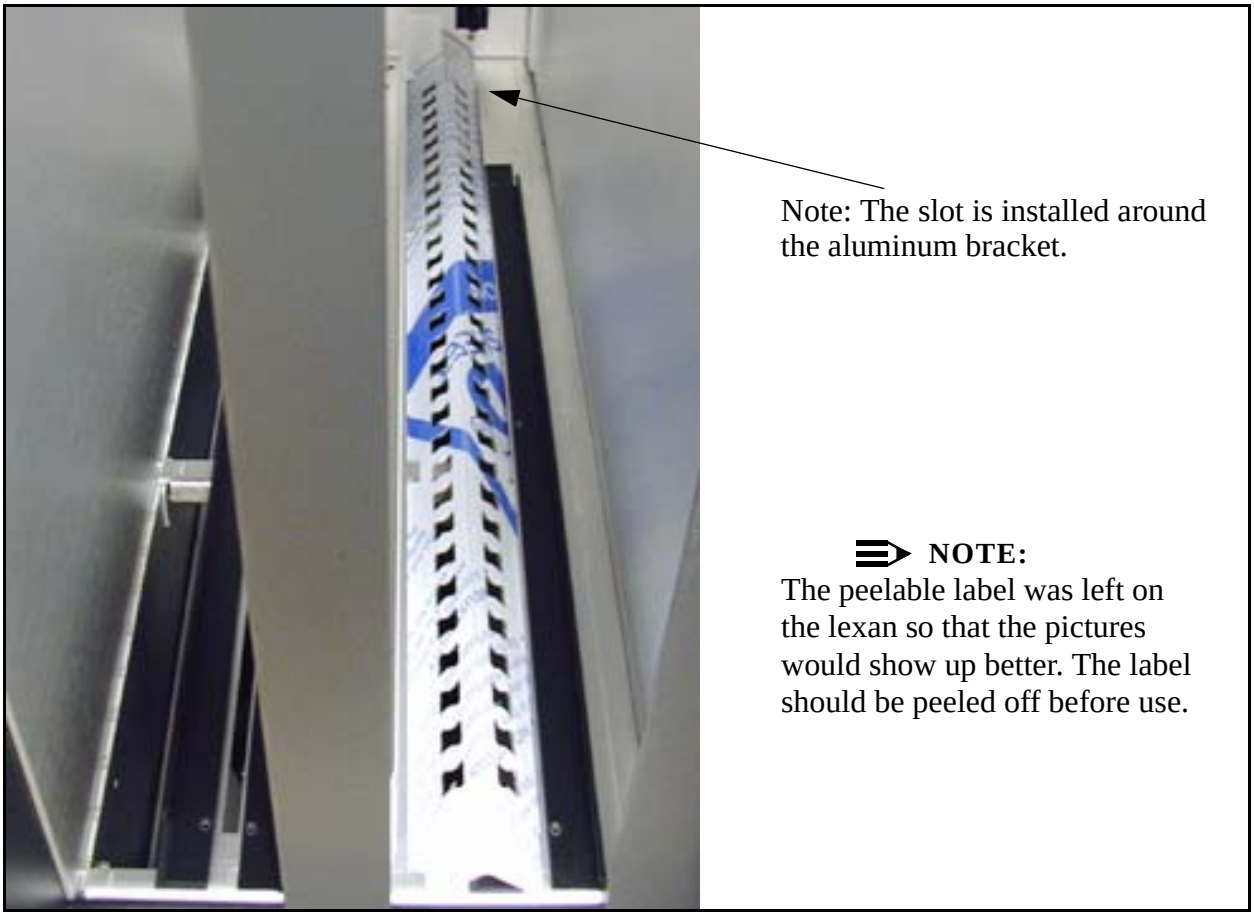


Figure 5-2 Air Block Installed

5.3 PA Module Pallet Replacement

The phase and gain of the individual pallet amplifiers in the PA Module are tightly controlled in manufacturing allowing field replacement of the individual pallets using a "PA Pallet Replacement Kit". The PA Modules are designed to cover a specific frequency range or BAND within the UHF DTV spectrum. The PA Modules for each band have a different part number and so do the Pallet Replacement Kits. See Table 5-1.

Table 5-1 PA Pallet Replacement Kit Part Numbers

Replacement Kit Part #	Channels (Frequency Band)
994-9782-002	42 - 58 (636 - 741MHz)
994-9782-003	59 - 78 (736 - 860MHz)
994-9782-004	14 - 26 (470 - 550MHz)
994-9782-005	27 - 41 (547 - 638MHz)

The tools required for the replacement include:

- Safety glasses
- Soldering iron
- Sn63Pb37 solder (Harris Part# 086-0004-054)
- Alcohol and a piece of cotton cloth
- Phillips screwdriver
- 7/64" size Allen wrench with torque indicating mechanism (15 inch pounds)

The Pallet replacement procedure is as described below:

WARNING:
THE DIAMOND PA MODULES ARE DESIGNED TO HANDLE VERY HIGH TEMPERATURES AND MAY BE EXTREMELY HOT, UP TO 90^{O} F (50^{O} C) ABOVE ROOM TEMPERATURE. DO NOT TOUCH THE MODULES WITH BARE HANDS AFTER THE TRANSMITTER HAS BEEN RUNNING, ESPECIALLY IN HIGH AMBIENT TEMPERATURE ENVIRONMENTS. SPECIAL GLOVES HAVE BEEN PROVIDED IN THE REAR OF THE CONTROL CABINET OR CAN BE OBTAINED FROM HARRIS, PART #099-0006-483 OR GRAINGER ITEM #4JF36.

STEP 1 Using the protective gloves, remove the PA module from the Transmitter.

STEP 2 Place the module on the bench with the lid up.

STEP 3 Remove the cover using the Phillips screwdriver to remove all the screws.

STEP 4 Unsolder the brown DC power wire from the bad pallet, and stretch it up.

NOTE:
Be sure to properly identify the failed pallet prior to removal. Figure 5-3 can be used to verify pallet location. The pallets are numbered 1 through 6 with pallet number 1 being closest to the front of the module.

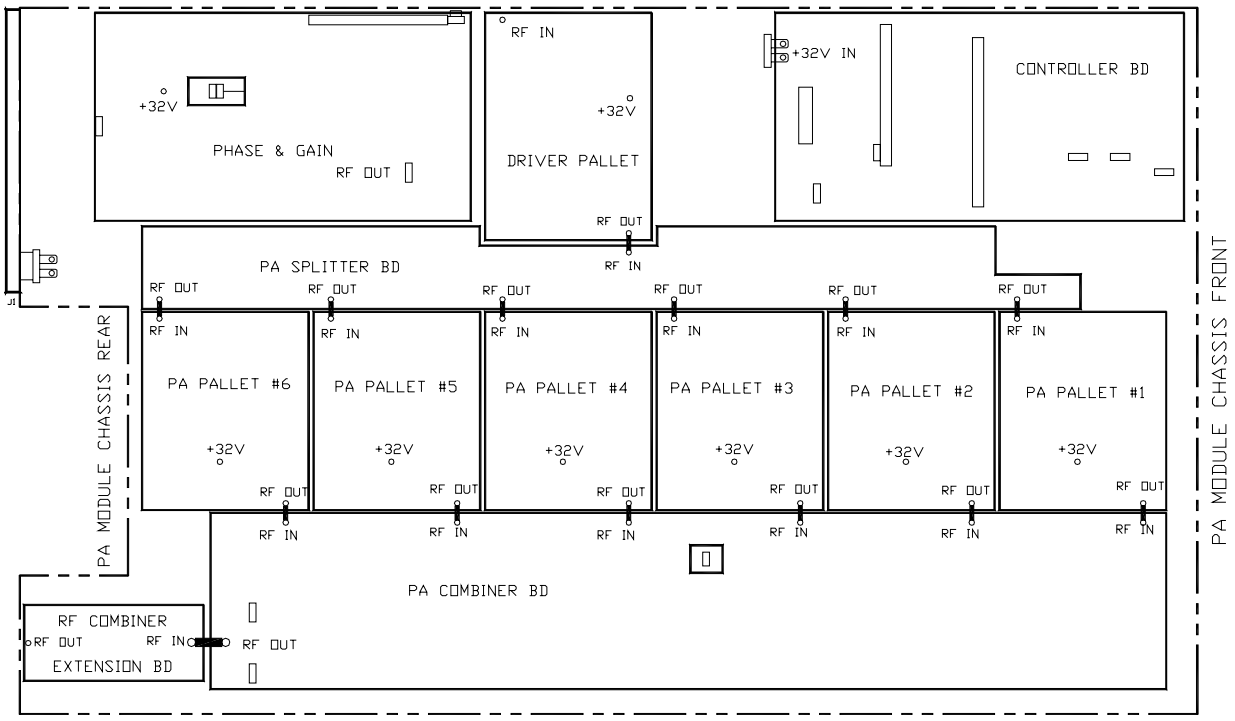


Figure 5-3 PA Pallet Numbering Scheme

STEP 5 Unsolder the input and output ribbon wires from the pallet side leaving them attached on the combiner and splitter. Carefully bend them up and out of the way. Remove the 7 Allen head mounting screws holding the pallet in place.

STEP 6 Carefully lift up the pallet using the copper clamps, situated over the RF Transistors as handles.

NOTE:
Lifting the pallet can be made easier by using a flat blade screwdriver to gently pry upward on the edge of one of the screws still mounted to the pallet being removed. Use an adjacent screw on an adjacent board to pry against lifting up on

WARNING: Disconnect primary power prior to servicing.

the board that is being removed. Once the board is loosened in this way the copper clamps can be used to finish removal of the board with less pressure required.

STEP 7 Remove the thermal pad from the heat sink and discard. These pads should not be reused.

STEP 8 Wipe off any thermal grease or other residue from the heat sink using the cotton cloth and alcohol. Make sure the surface is completely clean in preparation for the installation of the new pallet.

STEP 9 Install the new thermal pad. The pad is oriented so the brown wire is passed through the hole as the pad is installed on top of the heat sink. It does not matter which side of the thermal pad is up and which side is down as there is no performance difference.

STEP 10 Position the new PA pallet in place with the brown wire directed through the corresponding hole in the pallet.

STEP 11 After the pallet is placed, make sure the DC power wire passing underneath the pallet is entirely inside of the designated channel in the heat sink and is not between the pallet and the heat sink.

STEP 12 Install the seven mounting screws and torque each to 15 inch pounds.

STEP 13 Solder the brown DC power wire onto the newly installed pallet using the soldering iron and Sn63Pb37 solder.

STEP 14 Use an Ohmmeter to check the resistance from the brown power wire pad to ground. It should be 1K ohm or greater. If the meter shows a short circuit or low Ohm reading between these two points, remove the pallet, and check the wire position underneath the pallet. Fix the position of the wire and re-mount the pallet.

STEP 15 Solder the input and output ribbon wires to the pallet, make sure the ribbon wire is not broken, damaged, or touching ground at any point.

STEP 16 Clean all three solder connections with a piece of cotton cloth and alcohol.

STEP 17 Replace the lid on the module and reinstall all the screws.

Install the module back into the transmitter and push the ON button, check the value of the DC current consumed by the new pallet. It should be the same as for the rest of the pallets +/- 10%.

5.4 Power Supply Module Replacement

Removal and replacement of the power supply module is a simple matter of shutting off the breaker on the front of the module, removing the 2 black screws in the front panel and pulling the module out.

Before replacing the module with a new one be sure to check the AC voltage strapping on the front side of the supply (inside the aluminum chassis). The power supply modules can be strapped for 240 or 480 Vac but all Ranger supplies should be strapped for 240 Vac operation. Proper strapping for 240Vac is shown in Figure 5-4, along with a picture of the inside of the actual supply chassis. This information (and 480Vac strapping) is also shown on the Power Supply Wiring Diagram, 843-5494-353 in the schematic package.

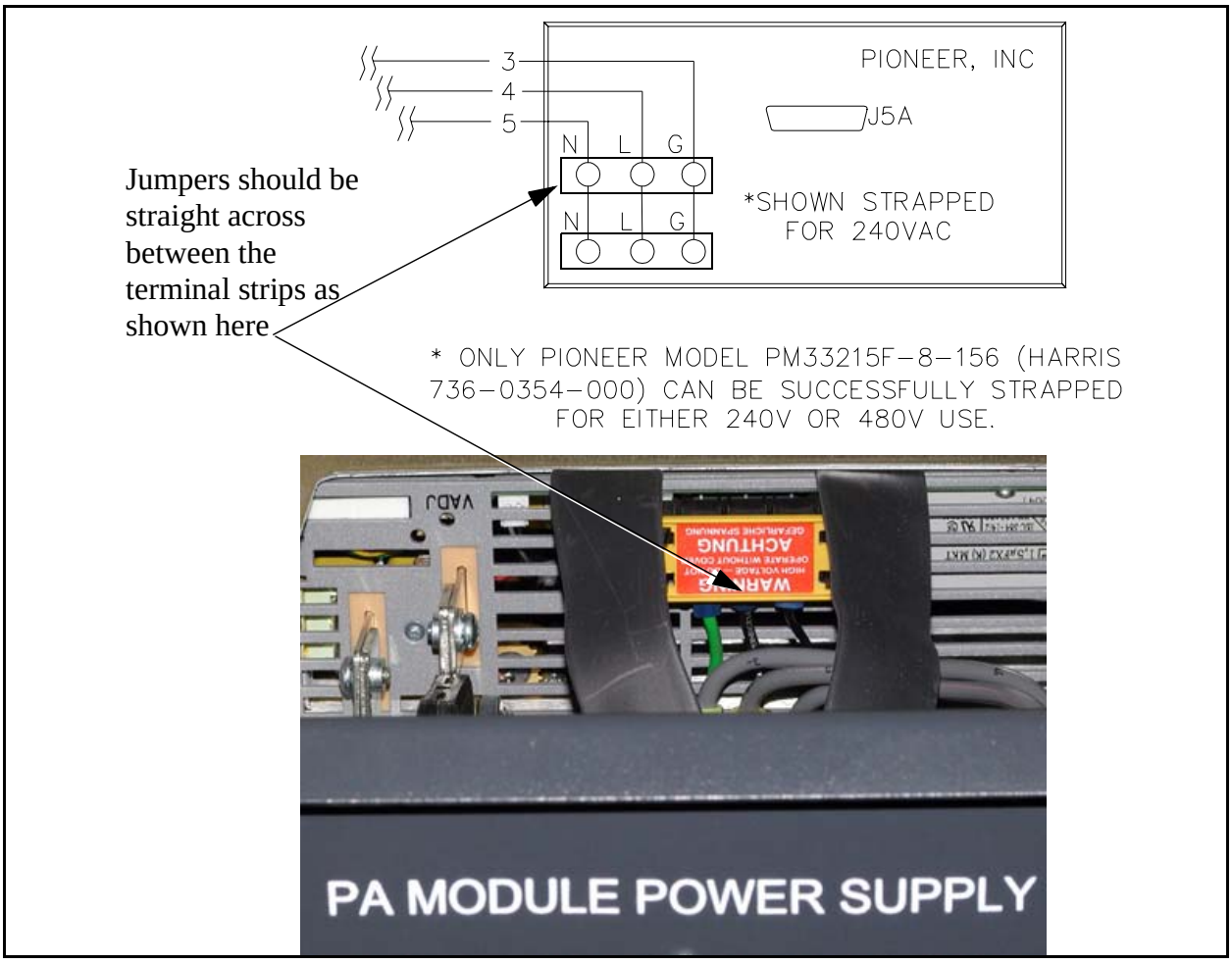


Figure 5-4 Power Supply AC Strapping

WARNING: Disconnect primary power prior to servicing.

5.5 Circulator Removal/Replacement

The circulators are mounted on an adjustable plate behind the PA modules. It is very important that when they are replaced that they are mounted correctly or the module may not seat properly in the circulator. If mounted too far forward, the circulator could actually hold the module out so that it does not seat properly in the lower module connector which carries PS, signal and control causing the module not to operate or become intermittent.

STEP 1 Shut the transmitter off along with the breaker on the power supply.

STEP 2 Pull the PA modules out a few inches to disengage them from the rear connectors.

STEP 3 Mark the adjustable plate shown in Figure 5-5 for front to back position (F) on the top as shown and on the bottom. This will make re-assembly much easier and increase confidence that it is back in the correct position.

STEP 4 Remove the RF output cables (D) and the reject cables from the circulators. If necessary, mark them for proper installation later.

STEP 5 Remove the adjustable plate screws (C) and pull circulator assembly straight back. This should provide access to the screws on the side of either circulator. The heatsink screws pass all the way through the heatsink and should only be removed if better access to the circulator screws is required.

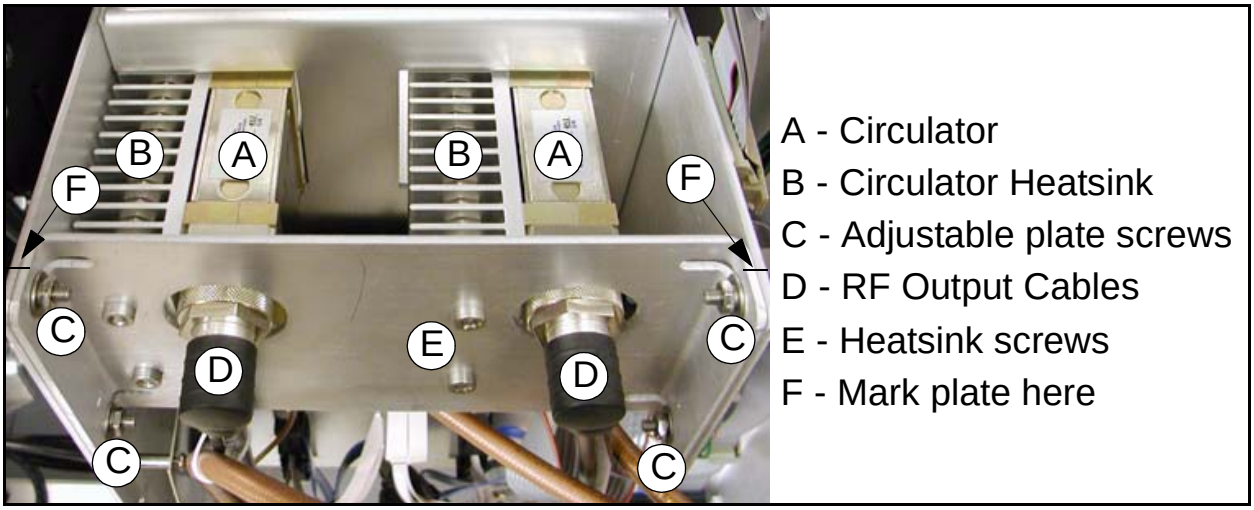


Figure 5-5 Circulator Assembly

WARNING: Disconnect primary power prior to servicing.

STEP 6 The circulator screws are hex head and require an allen tool to remove. These screws are shown in Figure 5-6.

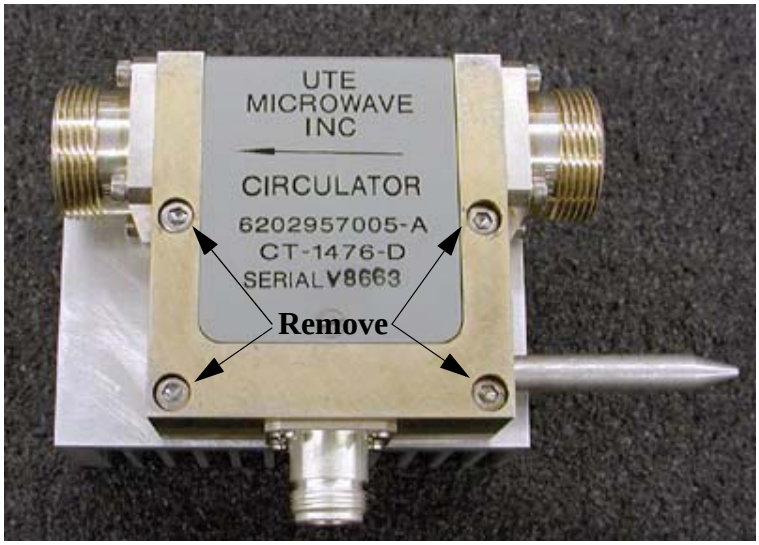


Figure 5-6 Circulator Side View

STEP 7 Clean the old thermal compound off of the heatsink with cotton cloth and alcohol. Put a thin layer of thermal compound on the new circulator and mount it to the heatsink.

STEP 8 Push the modules back into place. Have someone hold the modules firmly in place or tape them to the cabinet for the next step.

STEP 9 Re-install the adjustable plate with the circulators mounted on it. With the modules held in place, seat the circulators into the module. The marks you made earlier should be very close to lining up. They should not be any further away from the module than before. The most important thing is that you are not holding the module away from the lower connector but are making good RF contact to the circulator.

STEP 10 Tighten the screws (C) in the adjustable plate and then re-connect the RF output and reject cables to the circulators. Make sure you connect the cables to the same circulator as before.

NOTE:
Swapping the output cables will cause all of the power to end up in the combiner reject load, while swapping the reject cables will cause the attenuator readings to be reversed on the GUI and therefore protect the wrong attenuator.

It should not be necessary but you may want to check module phasing and adjust if necessary for the CZ1000F, see "3.7.2 Module Phasing Procedure" on page 3-18.

5.6 Blower Assembly Removal

The blower assembly is a slide-in unit which can be removed as follows: (See Figure 5-7)

- Shut the transmitter off.
- Remove the horizontal divider plate directly behind the blower assembly.
- Disconnect the blower power connector at the back of the blower assembly.
- Pull down on the spring loaded locking pin at the back of the assembly and pull the blower assembly out the back of the cabinet. It may be necessary to move some cable out of the way. Be careful not to over-extend any of the smaller cables.

⚠ WARNING:

DO NOT LEAVE THE DIVIDER PLATE OUT DURING RE-ASSEMBLY. THE DIVIDER PLATE IS NECESSARY FOR PROPER TRANSMITTER AIRFLOW AND COOLING.

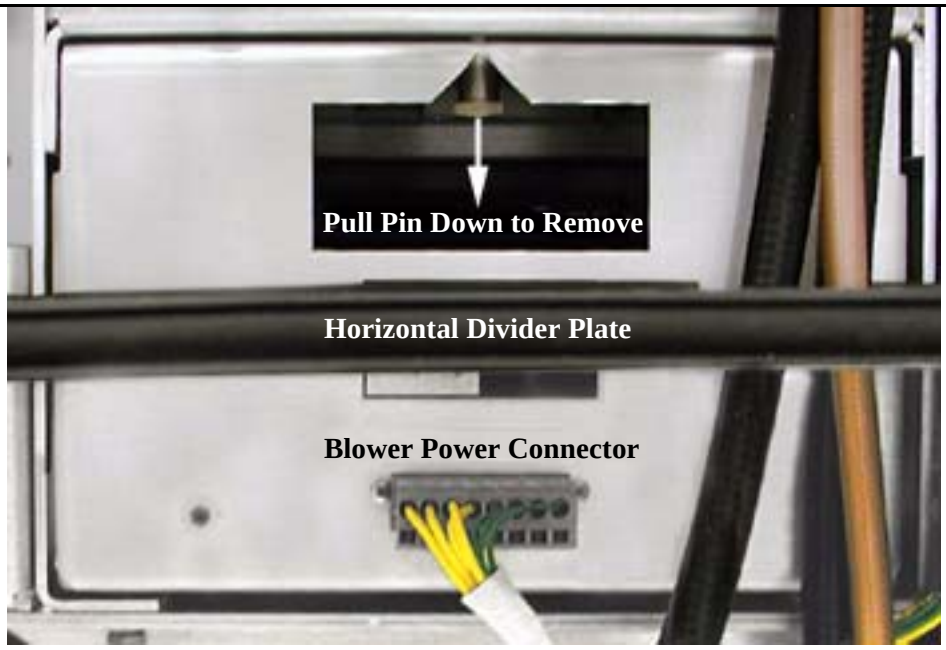


Figure 5-7 Blower Tray, Rear View

STEP 11

Section 6 ISP (In-System Programming)

6

6.1 Introduction

This section provides step by step procedures for updating the software loaded onto each of the controllers in the Ranger transmitter via the In-System Programming feature or ISP. This allows for software updates without having to change firmware ICs. The ISP program and the software files for each of the controllers is supplied on the CD-ROM which came with the transmitter, along with an acrobat version of the technical manual. The ISP program requires an external Windows PC with an available RS-232 serial port which can be connected to the Main Controller board. This single connection (via ISP bridging) will allow updating of all controllers, including:

- Main Controller Bd
- PS Monitor Bd
- RF Monitor Bd
- External I/O Bd

NOTE:
The PA Modules require a different serial connection point and therefore have a separate ISP procedure than the 4 controllers mentioned above.

6.2 Installing the ISP Program

The In-System Programming (ISP) application, HarrisISP.exe, is a Windows based software program. The main requirements are a Windows based PC and an open COM port.

To install the HarrisISP.exe program simply double click the Setup.exe program located on the CD-ROM in the directory D:\Firmware\Isp\ as shown in Figure 6-1 or use the RUN command in the START menu.

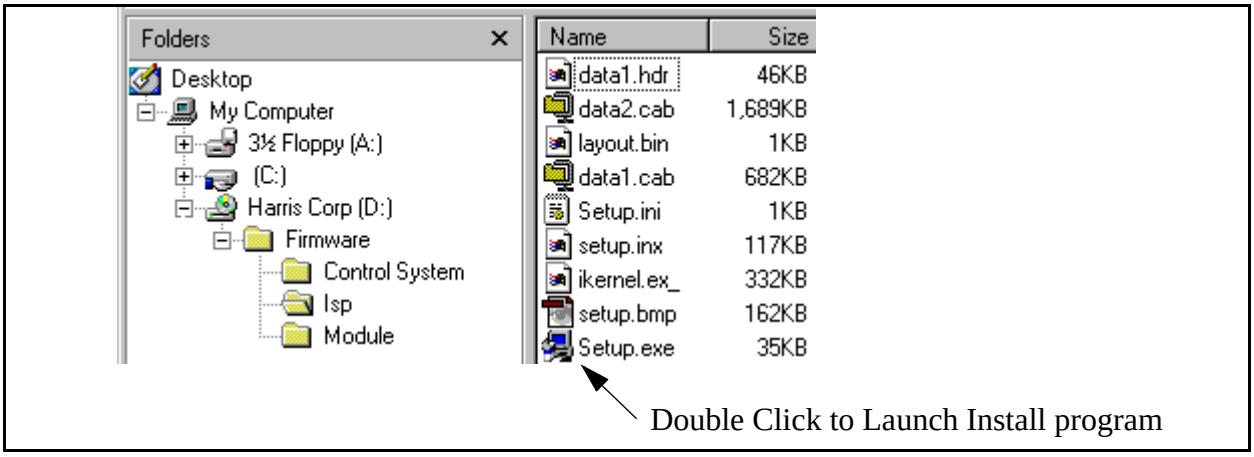


Figure 6-1 CD-ROM ISP Directory

Simply follow the on screen instructions and do not change the paths where the program wants to be installed. When finished you should have the Harris ISP icon on your desktop, like the one to the right.

6.3 ISP Procedures

The ISP procedure is basically the same for all of the control boards (Main Controller, RF monitor, PS monitor and External I/O) but is slightly different for the PA Module controller. The main differences are the serial connection point and the baud rate. This means there are 2 ISP procedures:

- Control System ISP
- PA Module ISP

When firmware in the transmitter is updated, **all** firmware revisions (for the controllers and the modules) should be checked and brought up to the revision levels on the CD-ROM if not already the same. The .s19 file names for the controllers and the modules have the revision number as part of the name.
For example: RANGER_CTRL_APP_0013.s19 is revision 1.3 Main Controller code.

6.3.1 Control System ISP Procedure

The example given here is for updating the Main Controller board since the steps are the same for the other control boards except for the update file. This means the procedure is to be repeated for updating each of the following control boards:

- Main Controller
- RF Monitor
- PA Monitor
- External I/O

STEP 1 Insert the CD-ROM into the disk drive.

STEP 2 Open the transmitter controller front door. Connect a standard RS-232 cable from the serial port on your computer to DB9 connector J90 on the left edge of the Main Controller Board.

STEP 3 Run the “Harris ISP.exe” program. The window shown in Figure 6-2 should open.

STEP 4 Set “Port” to the number of the COM port being used on your computer.

STEP 5 Set “Baud” to 19200.

STEP 6 Press Query Micros; wait for system to recognize the 4 controller boards as shown in Figure 6-3. If it does not find the micros, press Stop Query, change the COM port and press Query Micros again.

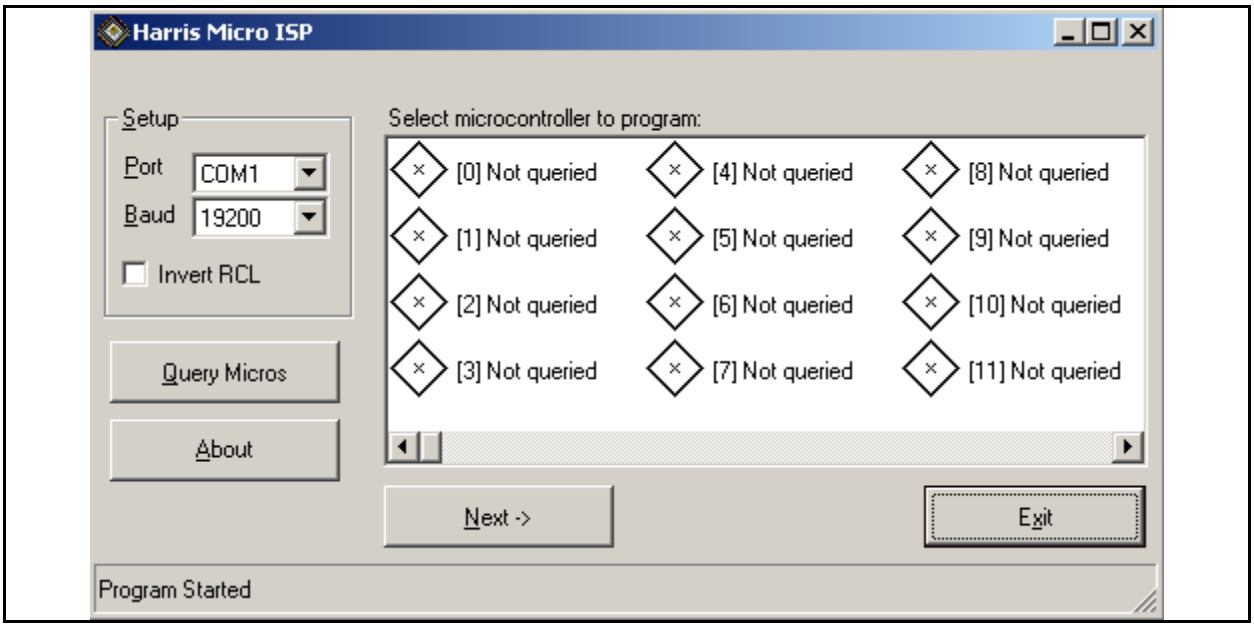


Figure 6-2 ISP Opening Screen

STEP 7 If you only see one micro (RF Monitor, PS Monitor or External I/O), instead of the four, as in Figure 6-3, press the Break Bridge button and then press Query Micros again. This will clear any previous ISP bridge connection and you should now see all four micros.

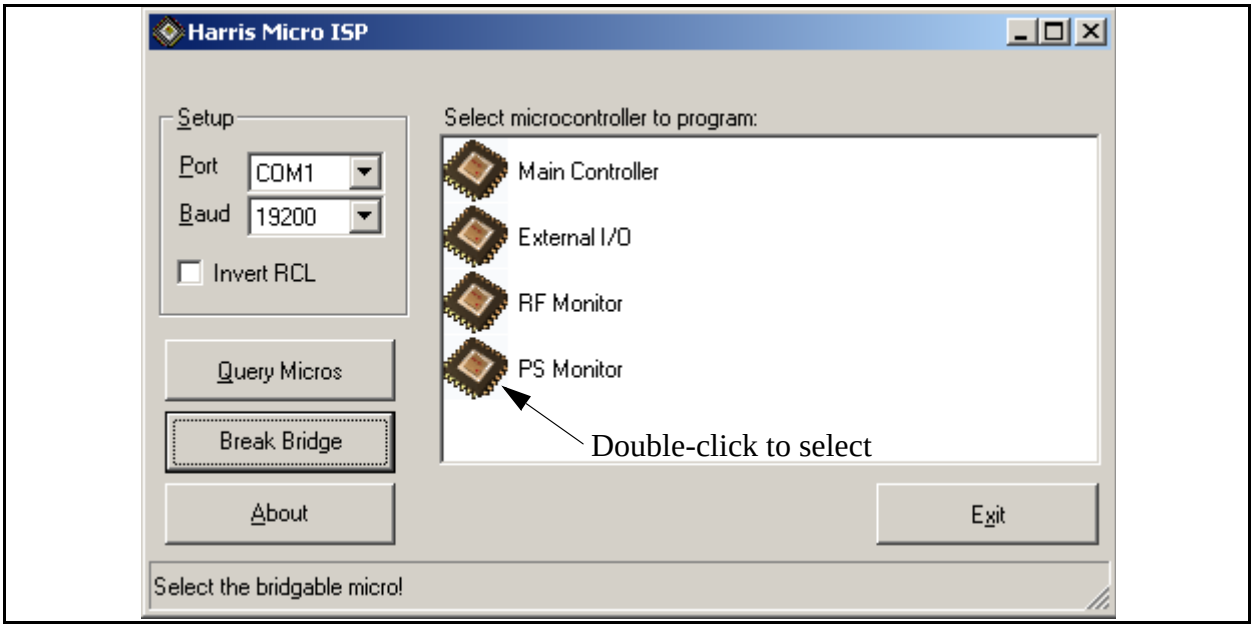


Figure 6-3 Response to "Query Micros"

STEP 8 Once it has found the micros, select the one you want to update by double-clicking the icon to the left of the name. This will open the smaller pop-up window shown in Figure 6-4.

STEP 9 Select the **Program File** button as shown. This will open the "Select Program Files" window shown in Figure 6-5.

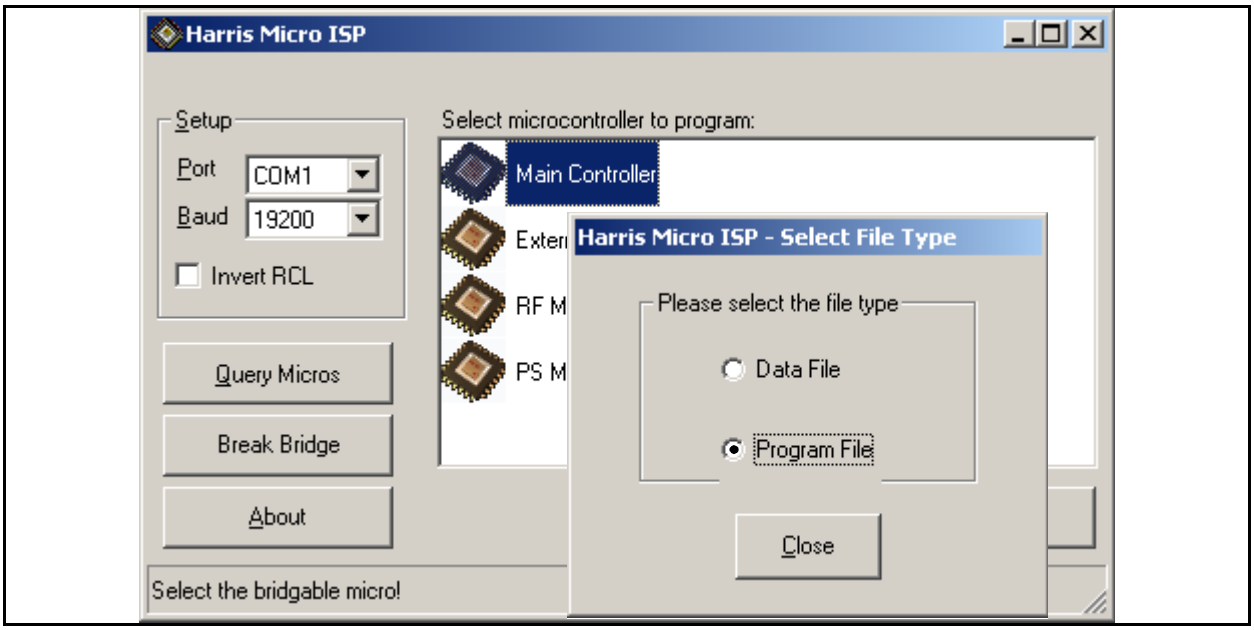


Figure 6-4 Controller Selected for Update, Program File Selected

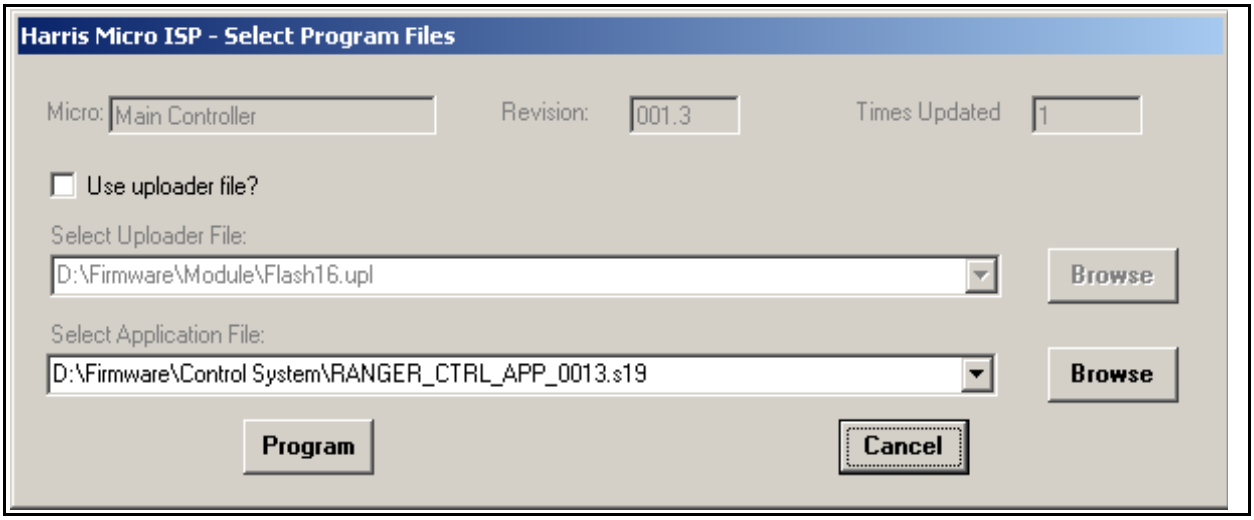


Figure 6-5 Browse the CD for the Desired S19 Application File

STEP 10 Under the “Select Application File” press the browse button and find the appropriate file on the CD-ROM for the board you are updating. The files are located on the cd at (insert your drive letter in place of D): D:\Firmware\Control System*.s19. The file names are given below. Note that the numbers to the left of the period are the revision number and may be different than shown here.

- "RANGER_CTRL_APP_0013.s19" to update the Main Controller
- "RANGER_PSM_APP_0013.s19" to update the PS Monitor
- "RANGER_RFM_APP_0011.s19" to update the RF Monitor
- "RANGER_EXIO_APP_0011.s19" to update the External I/O

NOTE:
Remember to select the correct application file (.s19 file) for the board being updated.

STEP 11 Press Program. This will open the window in Figure 6-6 which monitors the transfer process. This will take several minutes.

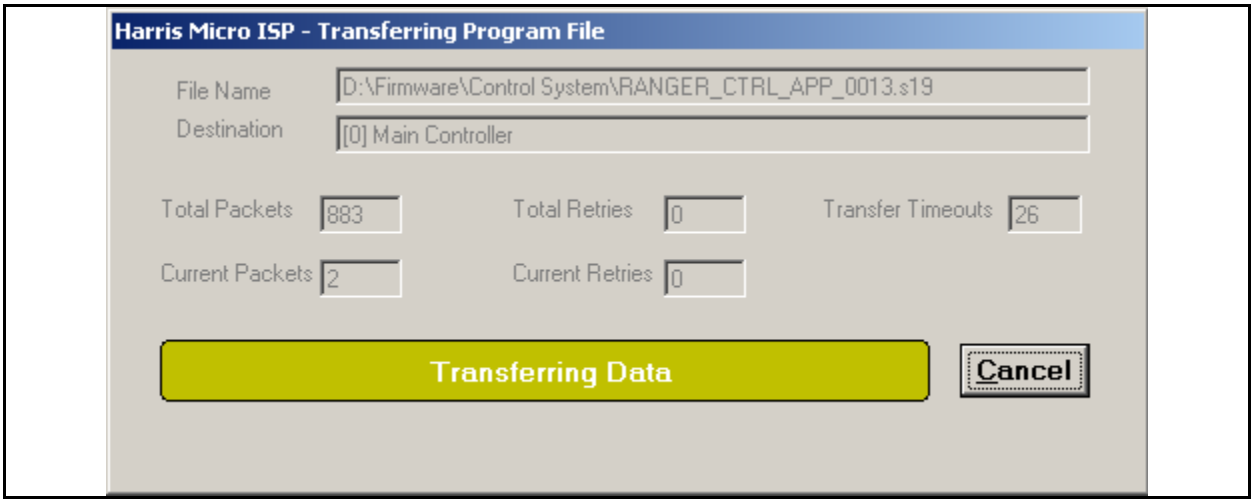


Figure 6-6 Data Being Transferred (will take several minutes)

STEP 12 When it has transferred all of the new programming packets it will then take a couple seconds to program the flash chip as shown in Figure 6-7.

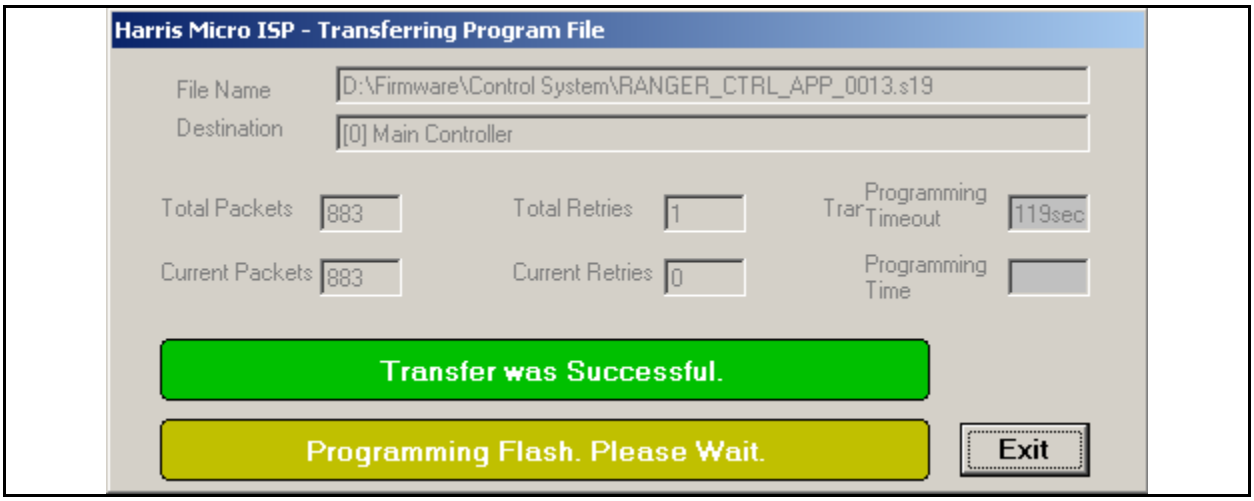


Figure 6-7 Programming Flash

STEP 13 The final screen is shown in Figure 6-8 which shows "Programming Successful". Press OK to finish the update and get back to the main screen shown in Figure 6-2. **Do not skip STEP 14**.

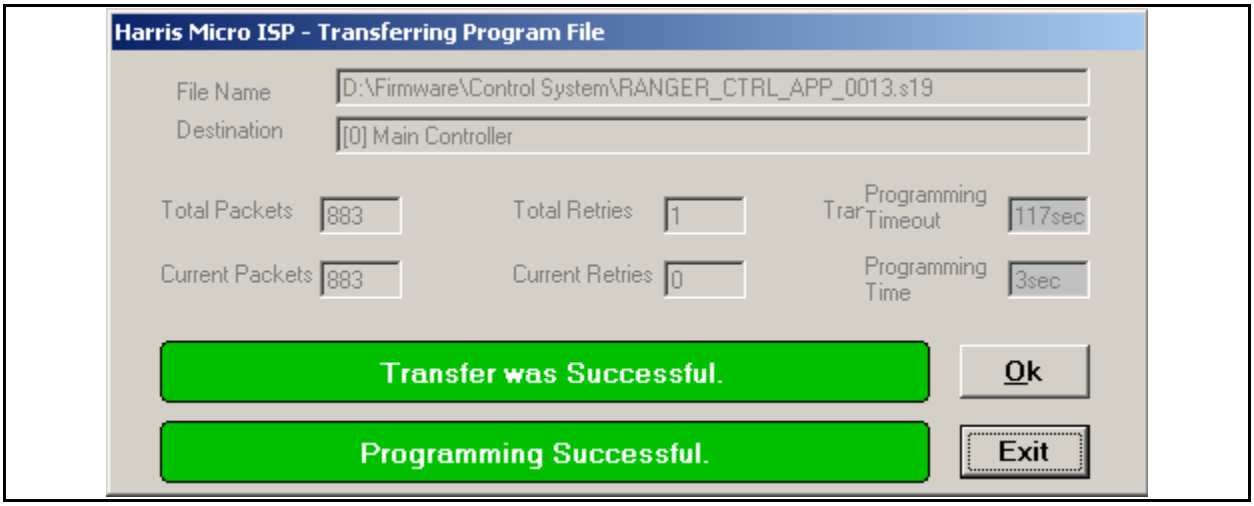


Figure 6-8 Programming Successful

STEP 14 To program another controller board or to simply check the current firmware revisions, press the "Break Bridge" button and then press Query micros. This should bring up the display shown in Figure 6-3. Select the next micro to be updated and repeat the procedure if necessary.

6.3.2 PA Module ISP Procedure

This procedure is only for updating the software in the PA Module(s). The HarrisISP.exe program must have already been installed on your computer.

IMPORTANT:
This procedure is intended for use on the CZ500F and CZ1000F modules only.

STEP 1 Insert the CD-ROM into the disk drive.

STEP 2 Open the transmitter back door. Connect a standard RS-232 cable from the serial port on your computer to the DB9 serial connector on the Backplane Interface board. See Figure 2-11 on page 2-21 for physical board location.

STEP 3 Run the “Harris ISP.exe” program. The window shown in Figure 6-9 should open.

STEP 4 Set “Port” to the number of the COM port being used on your computer.

STEP 5 Set “Baud” to 9600.

STEP 6 Press Query Micros; wait for system to recognize the 1 or 2 PA Module micros as shown in Figure 6-10. The micros are at address 33 and 34 so it will take a minute for them to show up. Note the status indicator at the bottom left corner of the window. If it does not find the micros, press Stop Query, change the COM port and press Query Micros again.

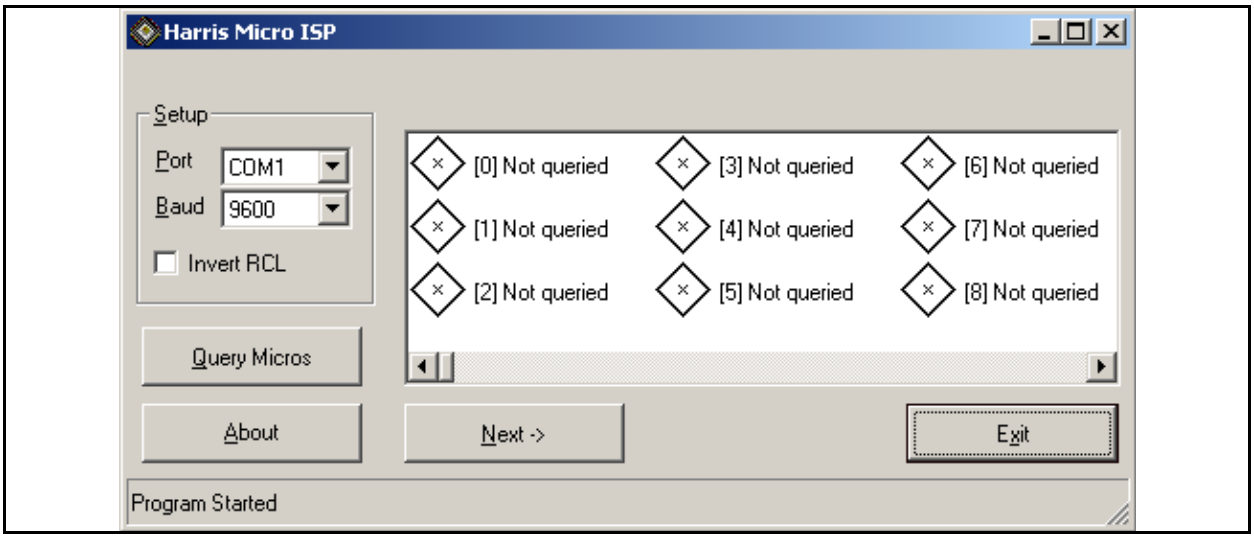


Figure 6-9 ISP Opening Screen

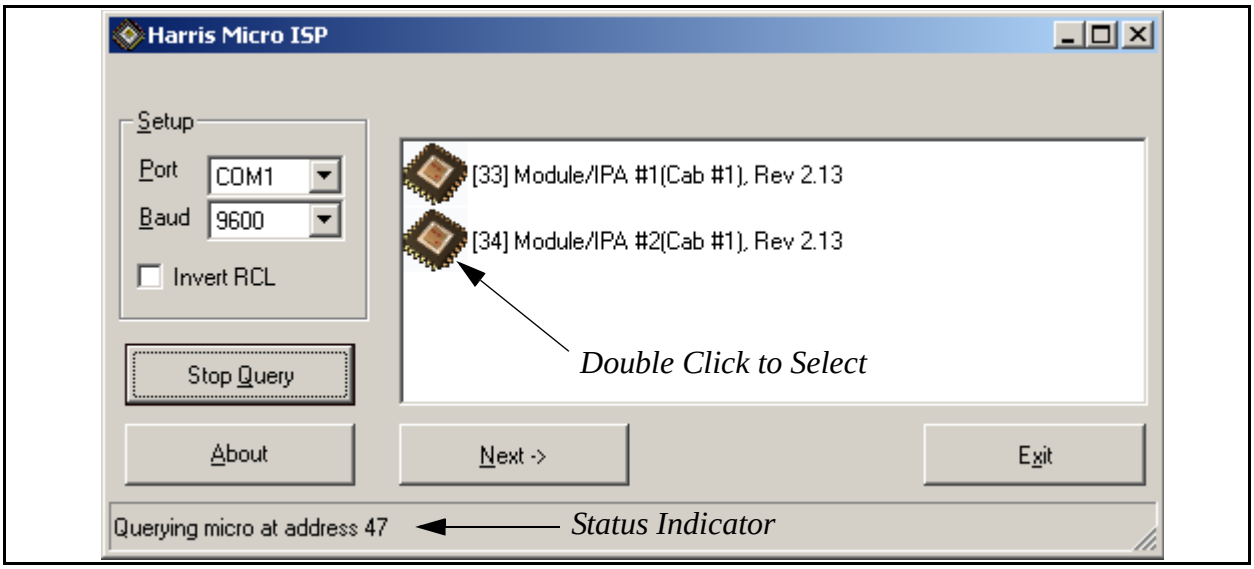


Figure 6-10 Response to "Query Micros"

STEP 7 Once it has found the micros, select the one you want to update by double-clicking the icon to the left of the name. This will open the smaller pop-up window shown in Figure 6-11. Select the Program File button as shown. This will open the "Select Program Files" window shown in Figure 6-12.

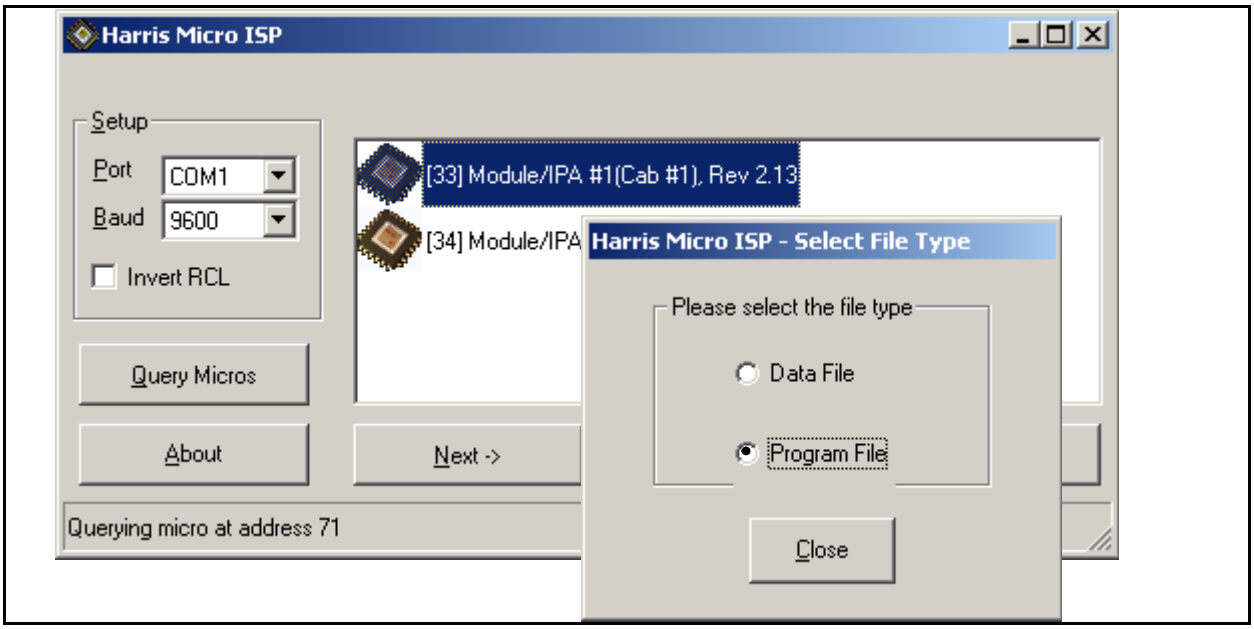


Figure 6-11 Controller Selected for Update, Program File Selected

STEP 8 Make sure the "Use uploader file?" box **is checked** as shown in Figure 6-12 and browse to find the uploader file "Flash16.upl" on the CD-ROM. It is located in the directory D:\Firmware\module\

STEP 9 Under the "Select Application File" press the browse button to find the "module213.s19" application file in the same directory. The 213 means revision 2.3 and therefore may be different on your disk.

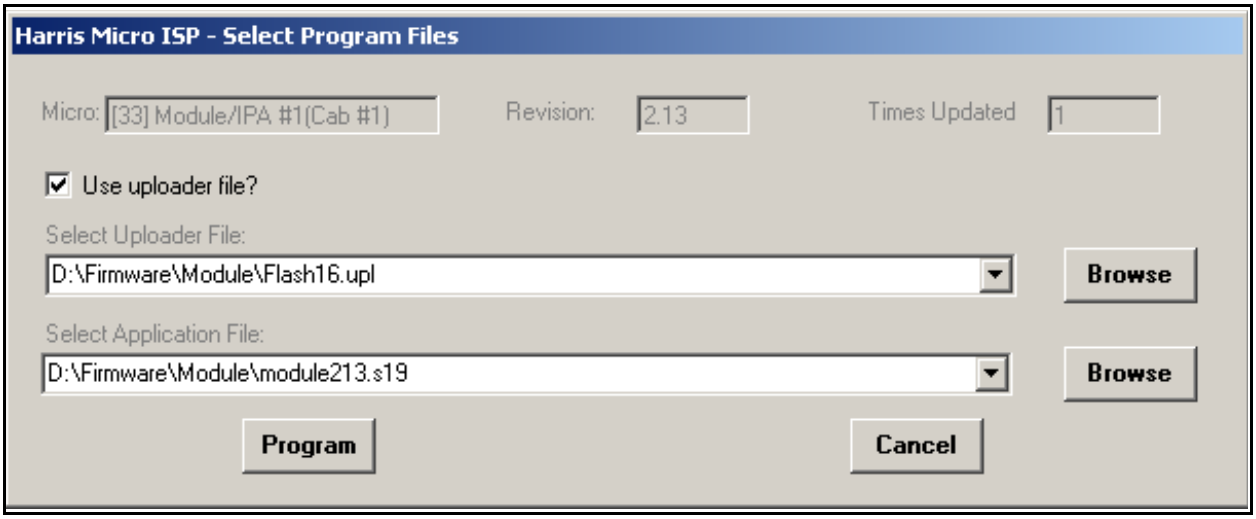


Figure 6-12 Select Uploader and Application File

STEP 10 Press Program. This will open the window in Figure 6-13 which monitors the transfer process. This will take several minutes.

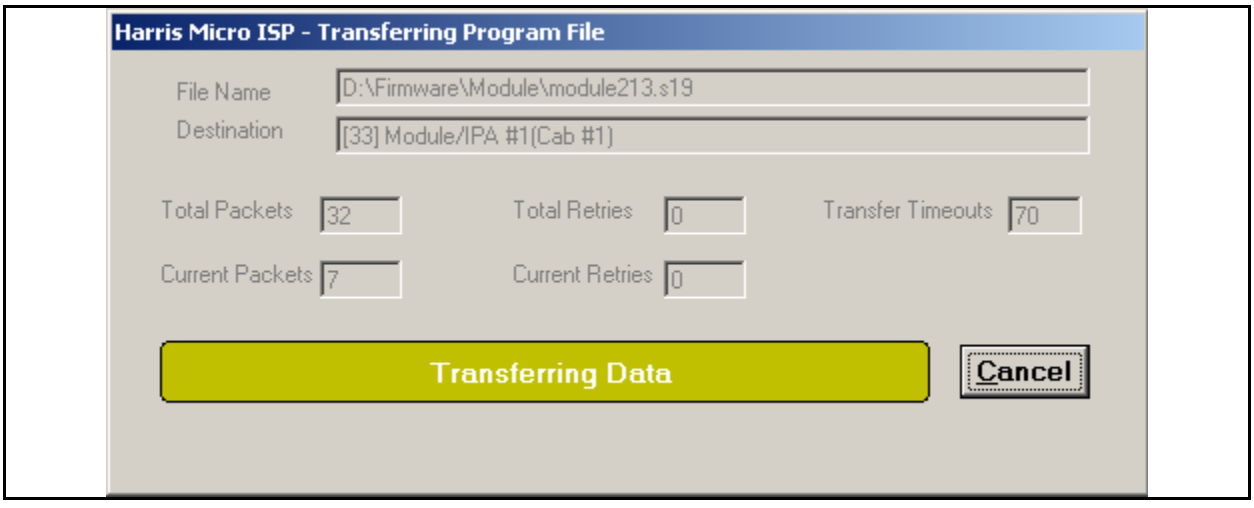


Figure 6-13 Data Being Transferred (will take several minutes)

WARNING: Disconnect primary power prior to servicing.

STEP 11 When it has transferred all of the new programming packets it will then take a couple seconds to program the flash chip as shown in Figure 6-14.

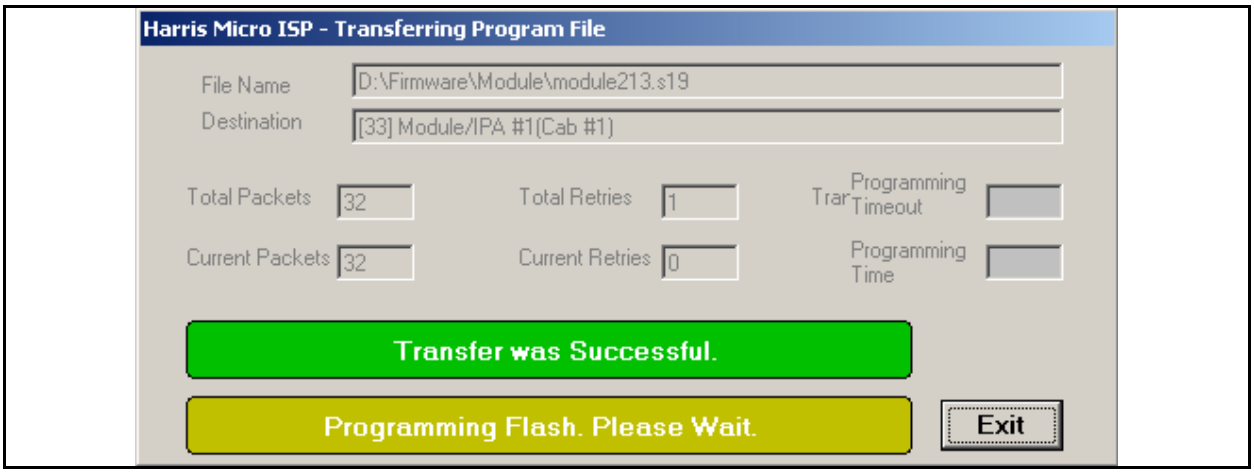


Figure 6-14 Programming Flash

STEP 12 The final screen is shown in Figure 6-15 which shows “Programming Successful”. Press OK to finish the update and then repeat the procedure to update the second PA Module, at address 34, for the CZ1000F.

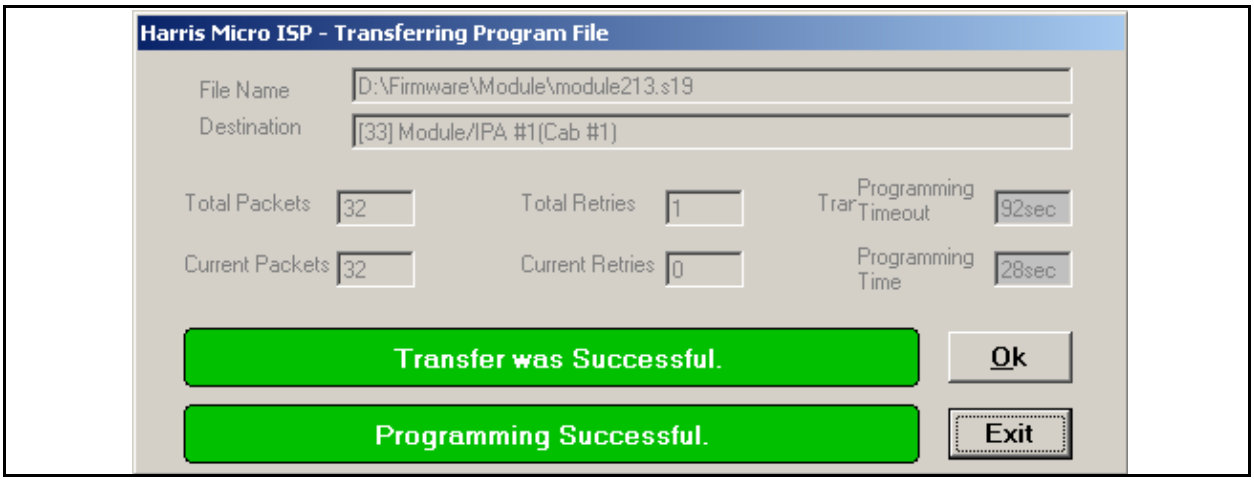


Figure 6-15 Programming Successful

6.3.3 ISP Errors

If an error is encountered during the ISP process, close the program, check or change the serial cable and try the procedure again. If the problem persists, contact Harris technical support.

Section 7 Parts List

7

7.1 Parts List Index

Replaceable Parts List Index

WARNING: Disconnect primary power prior to servicing.

Table 7-1 FORMAT, 1KW UHF RANGER - 994 9697 001

Harris PN	Description	Qty UM	Reference Designators (N)
250 0592 000	PLUG, 2 MALE, SINGLE STRAP	1.0 EA	W4
250 0595 000	CABLE, FFC, 24C 2ROW	1.0 EA	W10
250 0622 037	STRAP, SINGLE, F/F WITH TAP	2.0 EA	W6 W8
303 7125 022	BOLT, SST, M8-1.25 X 18	2.0 EA	# A10 MOUNTING
358 1895 000	NUT W/SPRING 1/2-13	2.0 EA	#A10 MOUNTING
484 0560 000	*FILTER BANDPASS 1.3KW UHF DTV	0.0 EA	(1 REQ'D) LAST TWO DIGITS OF PART NUMBER INDICATES CHANNEL, XX = US CHANNELS 14-69 A14
484 0562 100	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 470-550 MHZ, CHANNELS 14-26) FL1
484 0562 200	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 547-638 MHZ, CHANNELS 27-41) FL1
484 0562 300	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 636-741 MHZ, CHANNELS 42-58) FL1
484 0562 400	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 736-806 MHZ CHANNELS 59-69) FL1
610 1362 000	HEADER, 12C 2 ROW STRAIGHT	2.0 EA	W12
612 1554 000	HSG, SIZE 8 CAVITY, PIN SIDE	1.0 EA	
620 2957 004	CIRCULATOR, UHF 1000W	0.0 EA	(2 REQ'D FOR 470-518 MHZ) CIR1 CIR2
620 2957 005	CIRCULATOR, UHF 1000W	0.0 EA	(2 REQ'D FOR 518-598 MHZ) CIR1 CIR2
620 2957 006	CIRCULATOR, UHF 1000W	0.0 EA	(2 REQ'D FOR 596-704 MHZ) CIR1 CIR2
620 2957 007	CIRCULATOR, UHF 1000W	0.0 EA	(2 REQ'D FOR 701-860 MHZ) CIR1 CIR2
620 3268 000	CABLE, COAX, 7/16" PLUG	1.0 EA	W12
620 3270 000	HYBRID, 3DB 2KW UHF DTV	1.0 EA	A10
646 1353 000	NAMEPLATE, XMTR EQUIPMENT	1.0 EA	(MOUNTS TO OUTSIDE OF REAR DOOR)
700 1413 000	ATTENUATOR 40DB, 1KW	2.0 EA	AT2 AT3
822 0900 016	PIN, ALIGNMENT	1.0 EA	#PA2
917 2570 008	CABLE PA TO SPLITTER	1.0 EA	W16
922 1340 003	CABLE COMBINER TO LOAD	1.0 EA	W27
922 1340 005	CABLE CIRCULATOR TO LOAD	1.0 EA	W14
943 5494 069	MOUNTING SCREW PA REJECT SINK	2.0 EA	# CIR2
943 5560 083	BRKT, COMBINER MTG.	1.0 EA	# A10
943 5560 092	MOD, CIRCULATOR HEATSINK	1.0 EA	# CIR2
988 2497 001	DP RANGER SERIES	2.0 EA	
992 9898 005	PA MODULE, 600W, 470-550MHZ,	0.0 EA	(2 REQ'D, THIS FREQUENCY) PA1 PA2
992 9898 006	PA MODULE, 600W, 547-638MHZ	0.0 EA	(2 REQ'D, THIS FREQUENCY) PA1 PA2
992 9898 007	PA MODULE, 600W, 636-741MHZ	0.0 EA	(2 REQ'D, THIS FREQUENCY) PA1 PA2
992 9898 008	PA MODULE, 600W 736-806MHZ	0.0 EA	(2 REQ'D, THIS FREQUENCY) PA1 PA2
992 9990 001	BASIC, UHF RANGER XMTR	1.0 EA	
994 9782 002	KIT, SPARE PALLET (636-741MHZ)	0.0 EA	# INSIDE PA1
994 9782 003	KIT, SPARE PALLET (736-860MHZ)	0.0 EA	# INSIDE PA1
994 9782 004	KIT, SPARE PALLET (470-550MHZ)	0.0 EA	# INSIDE PA1
994 9782 005	KIT, SPARE PALLET (547-638MHZ)	0.0 EA	# INSIDE PA1
994 9785 010	EXCITER, CD-1A,	1.0 EA	A6

WARNING: Disconnect primary power prior to servicing.

994 9797 060	KIT, SPARE PARTS, ADVANCED	0.0 EA	(OPTION, 1 REQ'D. IF PURCHASED)
994 9797 061	KIT, SPARE BOARDS, ADVANCED	0.0 EA	(OPTION, 1 REQ'D IF PURCHASED)
994 9797 062	KIT, RANGER INSTALLATION MATL.	0.0 EA	(OPTION, 1 REQ'D IF PURCHASED)

Table 7-2 BASIC, UHF RANGER XMTR - 992 9990 001

Harris PN	Description	Qty UM	Reference Designators (Y)
026 6010 003	GROMMET STRIP, 0.125	1.0 FT	
041 1310 001	GASKET, RUBBER	1 FT	(USED TO SEAL REAR DOOR & MOD CAGE TOP & SIDE)
041 1310 030	GASKET, RUBBER	2 FT	(USED TO SEAL REAR OF MOD CAGE)
099 0006 483	GLOVES, THERMAL	1.0 EA	
250 0550 016	CABLE ASSY, AC PWR DISTR, XMTR	1.0 EA	W2
250 0591 000	PLUG, 4 MALE, SINGLE STRAP	1.0 EA	W1
250 0592 000	PLUG, 2 MALE, SINGLE STRAP	1.0 EA	W5
250 0595 000	CABLE, FFC, 24C 2ROW	1.0 EA	W11
250 0622 037	STRAP, SINGLE, F/F WITH TAP	2.0 EA	W7 W9
250 0626 000	CORD, AC, IEC PLUG TO IEC RECP	1.0 EA	
265 0255 000	AC OUTLET STRIP, 6 IEC, 10 AMP	1.0 EA	AC1
296 0344 000	TUBG, POLYETHYLENE 1/4 OD	1 FT	# A9
357 0089 000	GUIDE, MODULE	2.0 EA	# PS1
357 0103 000	MODULE FRONT, REAR CLAM SHELL	2.0 EA	USED AS PSEUDO MODULES, (PA2, PA3, PA4)
357 0103 001	MODULE FRONT CLAM SHELL	2.0 EA	USED AS PSEUDO MODULES, (PA2, PA3, PA4)
358 0002 000	*BRACKET RESISTOR MTG	4.0 EA	#R1 #R2
358 1316 000	CLAMP, ADJ, SIZE 24	3.0 EA	#943-5560-024
358 1895 000	NUT W/SPRING 1/2-13	3.0 EA	#943-5560-024
358 1974 000	SPEED NUT 10-32	60.0 EA	
358 2472 000	FLAT PLATE FITTING	3.0 EA	#943-5560-024
358 2589 000	FLAT CABLE MOUNT	6.0 EA	
358 3186 000	PLUG, WHT 1.375" HOLE	2.0 EA	USED TO CLOSE HOLES IN BASE
358 3190 000	PLUG, WHT .500" HOLE	12.0 EA	# FAN CHASSIS
358 3490 000	END STOP, 264 TERM BLOCK	2.0 EA	#TB2
358 3491 000	END PLATE, 264 TERM BLOCK	1.0 EA	#TB2
358 3579 000	SLIDES, DRAWER	0.0 PR	(SUPPLIED WITH CD1A EXCITER)
358 3606 000	COVER PLATE, STEP-DOWN, 282	2.0 EA	#TB1
358 3637 000	PLATE, END STOP, DIN RAIL MTG	2.0 EA	#TB1
358 3671 000	MOUNTING BRACKET, CKT BREAKER	1.0 EA	(MAIN BREAKER BRACKET CB1)
358 3797 000	PLATE, END COVER (283, 2-COND)	2.0 EA	#TB1
404 0895 003	HEATSINK, REJECT LOAD	1.0 EA	#AT1, AT2, AT3
424 0033 000	GROMMET 1-1/16 MTG D	1.0 EA	# WIRING TO CB1
430 0289 000	FAN, 12-28 VDC, 24V NOMINAL	2.0 EA	B1 B2
448 0868 000	AIR FILTER 14 X 20 X .88	1.0 EA	REAR DOOR FILTER
448 0999 000	HINGE DOOR POSITIONING	2.0 EA	REAR DOOR
542 1598 000	RES 3 OHM 5% 50W	2.0 EA	R1 R2
556 0138 000	ATTENUATOR FIXED SMA 10DB	1.0 EA	#A6 AT4
560 0019 000	MOV, 320WVAC, 460J, 40MM DISC	3.0 EA	RV1 RV2 RV3
606 0920 000	CKT BREAKER 6A 480VAC	1.0 EA	CB1
610 1362 000	HEADER, 12C 2 ROW STRAIGHT	2.0 EA	#W11
612 1554 000	HSG, SIZE 8 CAVITY, PIN SIDE	1.0 EA	#W11
614 0793 000	TERM BLOCK,3C MODULAR 281	2.0 EA	#TB1
614 0794 000	JUMPER, 2-POLE STEP-DOWN 283	2.0 EA	#TB1
614 0893 000	TERM BLOCK, 2C RAIL MNT	2.0 EA	#TB2

WARNING: Disconnect primary power prior to servicing.

614 0930 000	TERM BLK, 2C MODULAR 283	2.0 EA	#TB1
620 0573 000	CONN, ANCHOR INS 1-5/8	2.0 EA	(PART OF RF CHAIN)
620 2109 000	JACK, BNC 75 OHM BULKHEAD	1.0 EA	A1J2
620 2381 000	ELBOW 1-5/8 50 OHM FLANGE	2.0 EA	(PART OF RF CHAIN)
620 3188 000	ADAPTER, 1-5/8"	1.0 EA	
620 3268 000	CABLE, COAX, 7/16" PLUG	1.0 EA	W13
620 3269 000	DIR COUPLER, 1-5/8", UHF	1.0 EA	DC1
620 3274 000	DIR COUPLER, 1-5/8", UHF	1.0 EA	DC3
646 0973 000	*LABEL, 230V	1.0 EA	#AC1
646 1698 000	NAMEPLATE, DOMED, HARRIS LOGO	1.0 EA	
646 1710 001	NAMEPLATE, DOMED, "RANGER"	1.0 EA	
700 1413 000	ATTENUATOR 40DB, 1KW	1.0 EA	AT1
822 0900 016	PIN, ALIGNMENT	3.0 EA	# PA1
827 6893 001	PLATE	3.0 EA	GROUNDING BLOCKS
843 5560 001	WIRING DIAGRAM, RANGER	0.0 EA	
843 5560 080	WAVECRIMP MARKING CHART	0.0 EA	
917 2413 500	RAIL, CARRIER, 3.0"	1.0 EA	TB2
917 2456 081	SPACER	8.0 EA	
917 2567 003	DIN RAIL, CUT LENGTH 108MM	1.0 EA	TB1
917 2570 003	CABLE RANGER CABINET	1.0 EA	
917 2570 007	CABLE FAN TRAY	1.0 EA	
917 2570 008	CABLE PA TO SPLITTER	1.0 EA	W17
917 2570 017	RANGER SOFTWARE PACKAGE	1.0 EA	
922 1297 014	BRACKET, CABLE SUPPORT	1.0 EA	# A6
922 1300 031	RAIL, SUPPORT	1.0 EA	# A6
922 1340 001	STANDOFF, MOV BOARD	2.0 EA	# A8
922 1340 005	CABLE CIRCULATOR TO LOAD	1.0 EA	W15
922 1340 006	RESTRAINT	1.0 EA	(USED AS GND STRAP)
943 5494 069	MOUNTING SCREW PA REJECT SINK	2.0 EA	(2 PER HEATSINK #404-0902-000)
943 5494 236	PLATE, REAR SHELL RIGHT MTG.	2.0 EA	#357-0103-000
943 5494 237	PLATE, REAR SHELL LEFT MTG	2.0 EA	#357-0103-000
943 5494 291	SCREW SHOULDER 6-32	6.0 EA	(2 EA REQ'D FOR PA1, 4 REQ'D FOR PS1)
943 5494 614	TRAY, GLOVE	1.0 EA	
943 5560 006	DOOR, REAR ASSY.	1.0 EA	
943 5560 011	RETAINER, FILTER REAR DOOR	1.0 EA	
943 5560 014	RAIL, EIA LEFT FRONT	1.0 EA	
943 5560 015	RAIL, EIA RIGHT FRONT	1.0 EA	
943 5560 016	RAIL, EIA LEFT REAR	1.0 EA	
943 5560 017	RAIL, EIA RIGHT REAR	1.0 EA	
943 5560 018	ANGLE, EIA SUPPORT	1.0 EA	
943 5560 019	PANEL, MODULE	1.0 EA	(PART OF MODULE CAGE)
943 5560 020	ANGLE, EIA FRONT	2.0 EA	
943 5560 021	PLATE, MOV MOUNTING	1.0 EA	
943 5560 023	ANGLE, REAR RIGHT GASKET	2.0 EA	
943 5560 024	SADDLE ASSY	3.0 EA	USED TO MOUNT RF COMPONENTS
943 5560 026	PLATE, CABINET TOP	1.0 EA	
943 5560 027	COVER, MOV SAFETY	1.0 EA	# A8
943 5560 028	DIVIDER, POWER SUPPLY	1.0 EA	
943 5560 029	PANEL, POWER SUPPLY	1.0 EA	
943 5560 031	PLATE, POWER CONECTOR	1.0 EA	
943 5560 039	STRAP, GROUND	1.0 EA	
943 5560 040	DIVIDER, LEFT AIR	1.0 EA	
943 5560 041	DIVIDER, RIGHT AIR	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

943 5560 042	LINER, TOP RIGHT	1.0 EA	
943 5560 043	LINER, TOP LEFT	1.0 EA	
943 5560 044	LINER, BOTTOM LEFT	1.0 EA	
943 5560 045	LINER, BOTTOM RIGHT	1.0 EA	
943 5560 046	SUPPORT, MASK FILTER	1.0 EA	
943 5560 047	BRACKET, MASK FILTER	1.0 EA	
943 5560 048	SHELF, FAN	1.0 EA	
943 5560 049	BRACKET, REJECT LOAD	1.0 EA	
943 5560 050	ANGLE, REJECT LOAD	1.0 EA	
943 5560 052	PANEL, FRONT BLANK 2U	1.0 EA	
943 5560 053	PANEL, FRONT BLANK 3U	1.0 EA	
943 5560 057	SHELF, MODULE CAGE	1.0 EA	
943 5560 058	SHIM, MODULE GUIDE	2.0 EA	(PART OF MODULE CAGE)
943 5560 059	SIDE, MODULE CAGE LEFT	1.0 EA	
943 5560 060	SIDE, MODULE CAGE RIGHT	1.0 EA	
943 5560 061	BRACE, MODULE CAGE	2.0 EA	
943 5560 062	SHELF, MODULE	1.0 EA	
943 5560 063	BRACKET, CIRCULATOR	1.0 EA	(PART OF MODULE CAGE)
943 5560 066	CLOSURE, ANGLE	1.0 EA	
943 5560 068	BRACKET, RF UNISTRUT	3.0 EA	
943 5560 069	UNISTRUT, RF SUPPORT	1.0 EA	
943 5560 073	PLATE, MODULE BLANK	1.0 EA	# 358-0103-000
943 5560 074	TOP, MODULE CAGE	1.0 EA	
943 5560 075	ANGLE, TOP MODULE	2.0 EA	(PART OF MODULE CAGE)
943 5560 076	ANGLE, BOTTOM MODULE	1.0 EA	(PART OF MODULE CAGE)
943 5560 077	BLOCK, MODULE AIR	1.0 EA	
943 5560 078	CONTROL, SUPPORT LEFT	1.0 EA	# A1
943 5560 079	CONTROL, SUPPORT RIGHT	1.0 EA	# A1
943 5560 081	ASSY RF OUTPUT	1.0 EA	(PART OF RF CHAIN)
943 5560 082	ASSY INNER CONDUCTOR	1.0 EA	(PART OF RF CHAIN)
943 5560 084	ASSY MODIFIED GUIDE	4.0 EA	#PA1, PA2 BLANK
943 5560 085	DIVIDER, CENTER AIR	1.0 EA	
943 5560 086	BLOCK, MODULE AIR	1.0 EA	# PA2 BLANK FOR 500W TRANSMITTER, FOR 1000W TRANSMITTER IT IS A MODULE REPLACEMENT, IF MODULE IS SENT BACK TO HARRIS FOR REPAIR. TO BE SECURED IN BACK OF TRANSMITTER AND READY FOR USE IF REQ'D.
943 5560 091	COVER, RESISTOR	1.0 EA	#R1, R2
943 5560 092	MOD, CIRCULATOR HEATSINK	1.0 EA	
943 5560 096	BAFFLE, REJECT AIR	1.0 EA	
943 5560 099	BAFFLE, PA CHASE AIR	1.0 EA	
943 5560 100	DUCT, AIR	1.0 EA	
943 5560 101	AIR DAM, PA EXHAUST	1.0 EA	
952 9230 001	WELDMENT, CABINET	1.0 EA	
992 7275 100	PWA, MOV/AC SAMPLE, 1 PH	1.0 EA	A8
992 7302 100	PWA, AIR PRESSURE SENSOR	1.0 EA	A9
992 9697 002	PWA, RF SPLITTER/COUPLER	1.0 EA	A12
992 9990 003	PWA, BACKPLANE INTERFACE	1.0 EA	A7
992 9990 019	CONTROL UNIT	1.0 EA	A1
992 9990 023	ASSY, PWR SUPPLY, 240V, 5KW	1.0 EA	PS1

WARNING: Disconnect primary power prior to servicing.

Table 7-3 PWA, MOV/AC SAMPLE, 1 PH - 992 7275 100

Harris PN	Description	Qty UM	Reference Designators (C)
350 0105 000	RIVET 3/16 ALUM .126/.25	6.0 EA	2/XF1 2/XF2 2/XF3
382 1020 000	IC, 4N33 OPTO-COUPLER ESD	3.0 EA	U1 U2 U3
384 0253 000	RECTIFIER 1N4007 ESD	4.0 EA	CR1 CR2 CR3 CR5
384 0611 000	LED, RED ESD	1.0 EA	DS1
398 0586 000	FUSE, FAST 600VAC/500VDC 12A	3.0 EA	F1 F2 F3
402 0220 000	CLIP, FUSE 13/32 DIA, SOLDER	6.0 EA	2/XF1 2/XF2 2/XF3
506 0232 000	CAP, 0.01UF 100V 5%	3.0 EA	C1 C2 C3
506 0233 000	CAP, 0.1UF 63V 5%	3.0 EA	C6 C8 C10
516 0516 000	CAP 1UF 100V 20%	1.0 EA	C11
522 0548 000	CAP 10UF 50V 20%	3.0 EA	C5 C7 C9
540 1600 405	RES 15K OHM 3W 5%	4.0 EA	R18 R19 R20 R21
540 1600 408	RES 20K OHM 3W 5%	4.0 EA	R32 R33 R34 R35
542 1732 000	RES, 30K 5% 10W 600V AXIAL WW	6.0 EA	R1 R5 R9 R40 R41 R42
542 1733 000	RES, 110K 5% 10W 600V AXIAL WW	3.0 EA	R2 R6 R10
548 2400 401	RES 10K OHM 1/2W 1%	3.0 EA	R4 R8 R12
548 2400 601	RES 1MEG OHM 1/2W 1%	3.0 EA	R3 R7 R11
560 0015 000	RESISTOR, PTC 60V 0.15A	1.0 EA	R17
610 0827 000	HEADER, 20 PIN PC RIBBON	1.0 EA	J1
610 1066 000	CONN, .25 FASTON PC MOUNT	9.0 EA	E1 E4 E5 E9 E10 E14 E15 E19 E21
638 0040 000	VOLTAGE TRANSDUCER, ESD	1.0 EA	U5
843 5549 071	SCH, MOV/AC SAMPLE	0.0 EA	
843 5549 073	PWB, MOV/AC SAMPLE	1.0 EA	

Table 7-4 PWA, AIR PRESSURE SENSOR - 992 7302 100

Harris PN	Description	Qty UM	Reference Designators (B)
382 1696 000	TRANSDUCER, PRESSURE ESD	1.0 EA	U1
610 1239 000	HEADER, RT ANGLE 4 PIN	1.0 EA	J1
843 5549 261	SCH, AIR PRESSURE SENSOR	0.0 EA	
992 7302 101	*PWA, AIR PRESSURE SENSOR, SMT	1.0 EA	

Table 7-5 *PWA, AIR PRESSURE SENSOR, SMT - 992 7302 101

Harris PN	Description	Qty UM	Reference Designators (A)
383 0389 000	IC, LMC6482 SMT ESD	1.0 EA	U2
515 0134 213	CAP 330PF 100V 5% 0805 C0G	1.0 EA	C1
515 0136 501	CAP 0.1UF 50V 10% 0805 X7R	2.0 EA	C2 C3
523 0001 117	CAP, 47UF 6.3V 20% SMT	1.0 EA	C4
545 0308 217	RES 475 OHM 1% 0.1W 0805	1.0 EA	R1
610 1330 000	TEST POINT, LOOP, SMT	4.0 EA	TP1 TP2 TP3 TP4
843 5549 261	SCH, AIR PRESSURE SENSOR	0.0 EA	
843 5549 263	PWB, AIR PRESSURE SENSOR	1.0 EA	

Table 7-6 PWA, RF SPLITTER/COUPLER - 992 9697 002

Harris PN	Description	Qty UM	Reference Designators (C)
408 0383 000	RF SHIELD, CUSTOM	1.0 EA	
545 0309 118	RES 51.1 OHM 1% 1/4W 1206	2.0 EA	R1 R2
612 1347 000	JACK, SMA PCB MT STRAIGHT	4.0 EA	CONNECTORS SOLDERED ON THE GROUND PLANE SIDE OF THE BOARD J1 J2 J3 J4
843 5549 063	PWB, CENTER STAGE	1.0 EA	HY1
843 5565 301	SCH, RF SPLITTER/COUPLER	0.0 EA	
843 5565 303	PWB, RF SPLITTER/COUPLER	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

Table 7-7 PWA, BACKPLANE INTERFACE - 992 9990 003

Harris PN	Description	Qty UM	Reference Designators (B)
086 0001 010	*SEALANT GLYPTOL	0.0 QT	XJ1
357 0033 000	SCREW 4-40 X .375 BHMS	2.0 EA	2/J1
550 0949 000	TRIMPOT 100K OHM 1/2W 10%	1.0 EA	R7
610 0828 000	HEADER, 26 PIN PC RIBBON	1.0 EA	J4
610 1107 000	HDR,12PIN,1ROW,STRT,POL	1.0 EA	J5
612 1227 000	RCPT, 9 PIN D PC MT	1.0 EA	J1
843 5565 281	SCH, BACKPLANE INTERFACE	0.0 EA	
992 9990 004	*PWA, BACKPLANE INTERFACE, SMT	1.0 EA	

Table 7-8 *PWA, BACKPLANE INTERFACE, SMT - 992 9990 004

Harris PN	Description	Qty UM	Reference Designators (C)
000 0000 010	B/M NOTE:	1.0 EA	DO NOT POPULATE AT THIS TIME R21
383 0148 000	IC, 74HC14AD ESD	1.0 EA	U1
383 0241 000	IC, 2940 5V REGULATOR ESD	1.0 EA	U3
383 0277 001	IC LM4040CIM3-4.1 ESD	1.0 EA	CR1
383 0373 000	IC, RS-485/422 TRANSCEIVER ESD	1.0 EA	U5
383 0389 000	IC, LMC6482 SMT ESD	1.0 EA	U2
383 0391 000	IC, ADM202 SMT ESD	1.0 EA	U4
385 0011 002	DIODE, SCHOTTKY MBRS360 ESD	1.0 EA	CR2
389 0010 002	LED, GRN, 1.4MM RECT ESD	3.0 EA	DS1 DS2 DS3
515 0134 213	CAP 330PF 100V 5% 0805 C0G	30.0 EA	C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C25 C26 C27 C28 C29 C30 C31 C32
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	13.0 EA	C1 C24 C33 C34 C36 C37 C38 C39 C40 C41 C43 C44 C45
523 0002 201	CAP 100UF 25V 20% SMT	1.0 EA	C35
523 0004 000	*CAP 10UF 16V 20% SMT	1.0 EA	C42
545 0308 201	RES 100 OHM 1% 0.1W 0805	1.0 EA	R5
545 0308 203	RES 121 OHM 1% 0.1W 0805	2.0 EA	R1 R12
545 0308 218	RES 511 OHM 1% 0.1W 0805	2.0 EA	R10 R13
545 0308 223	RES 825 OHM 1% 0.1W 0805	2.0 EA	R17 R20
545 0308 301	RES 1K OHM 1% 0.1W 0805	3.0 EA	R6 R18 R19
545 0308 308	RES 2K OHM 1% 0.1W 0805	1.0 EA	R4
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	3.0 EA	R2 R3 R8
545 0308 401	RES 10K OHM 1% 0.1W 0805	3.0 EA	R11 R14 R15
545 0308 999	RES ZERO OHM JUMPER 0805	1.0 EA	R16
561 0003 009	POSISTOR 0.75 AMP 30VDC 2029	1.0 EA	R9
610 1330 000	TEST POINT, LOOP, SMT	7.0 EA	TP1 TP2 TP3 TP4 TP5 TP6 TP7
611 0007 001	* HDR 24C 2 ROW STRAIGHT	2.0 EA	J2 J3
843 5565 281	SCH, BACKPLANE INTERFACE	0.0 EA	
843 5565 283	PWB, BACKPLANE INTERFACE	1.0 EA	

Table 7-9 CONTROL UNIT - 992 9990 019

Harris PN	Description	Qty UM	Reference Designators (L)
250 0597 000	CABLE, FFC 18C 0.5MM 3" LG	1.0 EA	
335 0150 000	WASHER, NYLON	4.0 EA	
358 2589 000	FLAT CABLE MOUNT	8.0 EA	
358 2628 000	CABLE PUSH MOUNT	5.0 EA	
358 3490 000	END STOP, 264 TERM BLOCK	2.0 EA	

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358 3491 000	END PLATE, 264 TERM BLOCK	1.0 EA	
358 3615 000	STANDOFF MALE/FEMALE 6-32 X3/4	7.0 EA	
398 0496 000	FUSE, SLOW CART 4A 250V	2.0 EA	#FL1
424 0033 000	GROMMET 1-1/16 MTG D	1.0 EA	
424 0641 000	GROMMET EDGING	1 FT	
448 1177 000	LATCH, FLUSH, SWELL	1.0 EA	
484 0446 000	FILTER, RFI POWER LINE ENTRY	1.0 EA	FL1
548 2400 534	RES 221K OHM 1/2W 1%	1.0 EA	
614 0892 000	TERM BLOCK, 4C RAIL MNT	1.0 EA	
614 0893 000	TERM BLOCK, 2C RAIL MNT	1.0 EA	
646 1710 000	OVERLAY, RANGER CONTROL	1.0 EA	
736 0315 000	SWITCHER, AUTORANGING 115/230V	1.0 EA	LVPS1
746 0257 000	LCD DISPLAY, 1/4 VGA COLOR	1.0 EA	A6
917 2413 500	RAIL, CARRIER, 3.0"	1.0 EA	
917 2570 005	CABLE CONTROL UNIT	1.0 EA	
922 1340 008	STRAP, GROUND	1.0 EA	
943 5560 034	CHASSIS, CONTROL	1.0 EA	
943 5560 035	COVER, CONTROL	1.0 EA	
943 5560 037	BRACKET, PWB MTG, EXT I/O	1.0 EA	
943 5560 038	BRACKET, PWB MTG, PS MON	1.0 EA	
943 5560 064	SPACER, DOOR MTG	1.0 EA	
943 5560 065	BRACKET, DOOR CATCH	1.0 EA	
943 5560 087	PLATE, COVER	2.0 EA	
943 5560 103	COVER, RF MONITOR	1.0 EA	
943 5560 104	COVER, DISPLAY	1.0 EA	
992 7256 101	*PWA, PS MONITOR	1.0 EA	A2
992 7257 101	PWA, FRONT PANEL SWITCH BOARD	1.0 EA	A7
992 7263 101	*PWA, RF MONITOR	1.0 EA	A3
992 7264 101	*PWA, MAIN CONTROLLER	1.0 EA	A1
992 7291 101	*PWA, EXTERNAL I/O	1.0 EA	A4
992 9990 017	PWA, EXCITER INTERFACE	1.0 EA	A5

Table 7-10 *PWA, PS MONITOR - 992 7256 101

Harris PN	Description	Qty UM	Reference Designators (D)
000 0000 010	B/M NOTE:	6.0 EA	DO NOT POPULATE CR3 CR6 CR21 CR25 J5 J7
055 0100 005	*THERMAL COMPOUND, 8OZ JAR	0.0 EA	
086 0001 010	*SEALANT GLYPTOL	0.0 QT	J12
357 0033 000	SCREW 4-40 X .375 BHMS	2.0 EA	2/J12
357 0037 000	SCREW 6-32 X .25 BHMS	2.0 EA	376 MOD
357 0059 000	NUT, HEX 6-32	2.0 EA	376 MOD
358 3383 000	JUMPER, 0.1" LG, 0.125" H	3.0 EA	CR3-1TO2 CR21-1TO2 CR25-1TO2
358 3789 000	STANDOFF, HEX 6-32 X 5/16 M/F	2.0 EA	376 MOD
398 0583 000	FUSE, FAST CART 5A 250V	2.0 EA	F1 F2
398 0584 000	FUSE, FAST CART 10A 250V	1.0 EA	F3
402 0198 000	CLIP, FUSE 5MM DIA FUSE	6.0 EA	2/F1 2/F2 2/F3
610 0827 000	HEADER, 20 PIN PC RIBBON	1.0 EA	J14
610 0828 000	HEADER, 26 PIN PC RIBBON	1.0 EA	J11
610 0877 000	HDR, STR, 2 PIN, SQ	1.0 EA	JP1
610 0902 000	HDR 10 PIN STRAIGHT	1.0 EA	J13
610 0903 000	HDR, STR, 12 PIN, SQ	1.0 EA	J15
610 0991 000	HDR, STR, 6 PIN, 0.025 SQ	1.0 EA	J4
610 1069 000	HEADER 9 PIN SINGLE ROW	1.0 EA	J3
610 1107 000	HDR,12PIN,1ROW,STRT,POL	2.0 EA	J8 J9

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610 1145 000	HDR, 6PIN, 1ROW, STRT,POL	1.0 EA	J6
610 1367 000	HDR, 16C 1ROW STRAIGHT	1.0 EA	J10
612 1227 000	RCPT, 9 PIN D PC MT	1.0 EA	J12
817 2570 014	SW/FW, RANGER_PSM	0.0 EA	
992 7203 001	PWA, 376 MICRO MODULE	1.0 EA	
992 7255 101	*PWA, PS MONITOR, SMT	1.0 EA	

Table 7-11 PWA, 376 MICRO MODULE - 992 7203 001

Harris PN	Description	Qty UM	Reference Designators (J)
381 0029 000	N-MOSFET, 2N7002 SMT ESD	3.0 EA	Q1 Q2 Q3
383 0126 000	*IC MAX705/ADM705 ESD		1.0 EAU7
383 0166 000	IC, 71024/7C109/6226 ESD	2.0 EA	U5 U6
383 0277 001	IC LM4040CIM3-4.1 ESD	1.0 EA	CR2
383 0426 000	IC NC7ST04 ESD	1.0 EA	U1
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	1.0 EA	CR1
389 0010 001	LED, RED, 1.4MM RECT ESD	1.0 EA	DS2
389 0010 002	LED, GRN, 1.4MM RECT ESD	1.0 EA	DS1
393 0050 000	IC, MC68376 PROG/ESD	1.0 EA	U2
393 0063 000	EEPROM, 25C040 PROG/ESD	1.0 EA	U3
393 0077 000	IC AM29F800BB PROG/ESD	1.0 EA	U4
445 0008 000	XTAL 4.194304 MHZ SMT	1.0 EA	Y1
496 0059 000	IND CHIP 1UH 10%	3.0 EA	L1 L2 L3
515 0134 111	CAP 27PF 100V 5% 0805 C0G	2.0 EA	C25 C26
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	22.0 EA	C4 C5 C6 C7 C8 C9 C10 C11 C13 C14 C16 C17 C18 C19 C20 C21 C22 C23 C24 C27.C28 C29
526 0383 000	CAP 10UF 10V 10% 6032	5.0 EA	C1 C2 C3 C12 C15
540 1568 000	RES NETWORK, 10K OHM 5% SMT	5.0 EA	R13 R14 R17 R25 R26
545 0308 109	RES 22.1 OHM 1% 0.1W 0805	11.0 EA	R1 R2 R3 R6 R7 R8 R15 R16 R19 R20 R22
545 0308 201	RES 100 OHM 1% 0.1W 0805	1.0 EA	R29
545 0308 208	RES 200 OHM 1% 0.1W 0805	1.0 EA	R10
545 0308 301	RES 1K OHM 1% 0.1W 0805	5.0 EA	R4 R9 R12 R18 R21
545 0308 305	RES 1.5K OHM 1% 0.1W 0805	1.0 EA	R28
545 0308 306	RES 1.62K OHM 1% 0.1W 0805	1.0 EA	R11
545 0308 401	RES 10K OHM 1% 0.1W 0805	1.0 EA	R23
545 0308 408	RES 20K OHM 1% 0.1W 0805	1.0 EA	R24
545 0308 601	RES 1MEG OHM 1% 0.1W 0805	1.0 EA	R27
545 0308 999	RES ZERO OHM JUMPER 0805	1.0 EA	R5
604 1163 000	SWITCH, PB, SPST MOM, SMT	1.0 EA	S1
610 1369 004	PLUG, 80C 2 ROW VERTICAL	2.0 EA	J1 J2
843 5522 000	SPEC, 376 MICRO MODULE	0.0 EA	
843 5522 001	SCH, 376 MICR0 MODULE	0.0 EA	
843 5522 003	PWB, 376 MICRO MODULE	1.0 EA	

Table 7-12 *PWA, PS MONITOR, SMT - 992 7255 101

Harris PN	Description	Qty UM	Reference Designators (D)
000 0000 010	B/M NOTE:	144.0 EA	DO NOT POPULATE C13 C39 C45 C57 C73 C78 C79 C80 C81 C82 C83 C84 C88 C113 C119 C122 C130 C131 C133 C134 C135 C136 CR29 CR30 DS20 DS21 DS22 DS32 DS33 DS34 DS37 DS38 Q14 R32 R33 R34 R52 R53 R61 R63 R66 R67 R68 R69 R70 R79 R106 R153 R154 R155 R167 R168 R169 R170 R171 R172 R173

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			R181 R182 R194 R195 R196 R197 R198 R199 R200 R201 R202 R203 R209 R211 R212 R225 R226 R227 R228 R229 R230 R231 R236 R237 R240 R246 R247 R248 R249 R250 R251 R252 R253 R254 R260 R261 R262 R263 R264 R268 R269 R270 R271 R272 R273 R282 R283 R289 R290 R291 R292 R293 R294 R295 R296 R297 R298 R308 R310 R311 R312 R316 R318 R321 R322 R323 R324 R325 R326 R336 R337 R338 R341 R342 R346 R347 R348 R350 R351 S1 U7 U17 U28 U29 U34 U38 U42
381 0029 000	N-MOSFET, 2N7002 SMT ESD	12.0 EA	Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q16
382 1392 000	IC, LM324 QUAD OP AMP ESD	3.0 EA	U4 U6 U20
383 0126 000	*IC MAX705/ADM705 ESD		1.0 EAU8
383 0148 000	IC, 74HC14AD ESD	3.0 EA	U19 U40 U43
383 0158 000	IC, NE555 ESD	1.0 EA	U26
383 0165 000	IC, LM339 DQUAD COMPAR ESD	2.0 EA	U27 U30
383 0241 000	IC, 2940 5V REGULATOR ESD	1.0 EA	U25
383 0277 001	IC LM4040CIM3-4.1 ESD	1.0 EA	CR24
383 0329 000	IC PCA82C251 ESD	1.0 EA	U13
383 0389 000	IC, LMC6482 SMT ESD	2.0 EA	U15 U32
383 0391 000	IC, ADM202 SMT ESD	1.0 EA	U39
383 0421 000	IC 74HCT573 ESD	2.0 EA	U1 U3
383 0422 000	IC 74HCT273 ESD	1.0 EA	U2
383 0434 000	IC SN74CBT3245A ESD	1.0 EA	U11
383 0444 000	IC, 2940 ESD	1.0 EA	U41
383 0465 000	IC 74HC4051 ESD	3.0 EA	U14 U21 U23
383 0475 000	IC 74HCT14 ESD	7.0 EA	U9 U10 U33 U35 U36 U37 U44
383 0524 000	IC, LM2990S-12 ESD	1.0 EA	U5
383 0547 000	IC, LM50C ESD	1.0 EA	U24
383 0570 000	IC, 2940 +12V REG ESD	1.0 EA	U16
383 0637 000	IC, X9251 ESD	1.0 EA	U12
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	23.0 EA	CR1 CR2 CR4 CR5 CR7 CR8 CR9 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR22 CR23 CR26 CR27 CR28
385 0051 000	DIODE ARRAY, SRDA70-4 ESD	1.0 EA	U18
389 0007 001	LED, RED/GRN, 1.7MM RECT ESD	1.0 EA	DS19
389 0010 001	LED, RED, 1.4MM RECT ESD	17.0 EA	DS10 DS12 DS15 DS18 DS23 DS24 DS25 DS26 DS27 DS28 DS29 DS30 DS31 DS35 DS36 DS39 DS40
389 0010 002	LED, GRN, 1.4MM RECT ESD	15.0 EA	DS1 DS2 DS3 DS4 DS5 DS6 DS7 DS8 DS9 DS11 DS13 DS14 DS16 DS17 DS41
393 0063 000	EEPROM, 25C040 PROG/ESD	1.0 EA	U31
393 0082 000	IC, XC95288XL ESD	1.0 EA	U22
515 0134 201	CAP 100PF 100V 5% 0805 C0G	3.0 EA	C38 C56 C106
515 0136 417	CAP 0.047UF 100V 10% 0805 X7R	7.0 EA	C15 C16 C17 C18 C19 C20 C21
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	97.0 EA	C3 C4 C5 C6 C7 C8 C9 C10 C12 C14 C22 C23 C24 C25 C26 C28 C29 C30 C31 C33 C34 C35 C36 C37 C40 C41 C42 C43 C44 C46 C47 C48 C49 C51 C52 C54 C55 C58 C59 C60 C61 C62 C63 C64 C66 C67 C68 C69 C70 C72 C74 C75 C76 C77 C85 C86 C87 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C101 C102 C103 C104 C105

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			C107 C108 C109 C110 C111 C112 C114 C115 C116 C117 C118 C120 C121 C123 C124 C125 C126 C127 C129 C132 C138 C140 C141 C142 C143
515 0138 517	CAP 0.47UF 100V 10% 1812 X7R	3.0 EA	C32 C65 C139
515 0139 601	CAP 1UF 50V 20% 1812 Z5U	3.0 EA	C1 C2 C53
523 0001 201	CAP 100UF 6.3V 20% SMT	2.0 EA	C89 C137
523 0002 201	CAP 100UF 25V 20% SMT	6.0 EA	C11 C27 C50 C71 C100 C128
540 1568 000	RES NETWORK, 10K OHM 5% SMT	2.0 EA	R9 R60
545 0308 001	RES 1 OHM 1% 0.1W 0805	1.0 EA	R101
545 0308 109	RES 22.1 OHM 1% 0.1W 0805	7.0 EA	R40 R41 R42 R43 R44 R45 R46
545 0308 201	RES 100 OHM 1% 0.1W 0805	1.0 EA	R259
545 0308 203	RES 121 OHM 1% 0.1W 0805	2.0 EA	R83 R319
545 0308 207	RES 182 OHM 1% 0.1W 0805	3.0 EA	R37 R38 R39
545 0308 216	RES 432 OHM 1% 0.1W 0805	1.0 EA	R320
545 0308 217	RES 475 OHM 1% 0.1W 0805	46.0 EA	R11 R31 R35 R47 R48 R54 R73 R74 R78 R80 R89 R95 R100 R107 R110 R111 R114 R115 R117 R119 R121 R123 R126 R127 R133 R137 R138 R140 R141 R145 R146 R156 R157 R164 R166 R176 R178 R179 R191 R239 R255 R257 R281 R285 R305 R317
545 0308 221	RES 681 OHM 1% 0.1W 0805	1.0 EA	R174
545 0308 301	RES 1K OHM 1% 0.1W 0805	42.0 EA	R1 R2 R3 R4 R5 R6 R7 R8 R25 R26 R76 R81 R93 R99 R103 R109 R112 R125 R132 R144 R158 R163 R175 R220 R245 R275 R300 R307 R314 R327 R328 R329 R330 R331 R332 R333 R334 R335 R339 R340 R343 R344
545 0308 302	RES 1.1K OHM 1% 0.1W 0805	1.0 EA	R277
545 0308 305	RES 1.5K OHM 1% 0.1W 0805	2.0 EA	R92 R162
545 0308 312	RES 3.01K OHM 1% 0.1W 0805	3.0 EA	R57 R139 R143
545 0308 314	RES 3.57K OHM 1% 0.1W 0805	2.0 EA	R94 R183
545 0308 315	RES 3.92K OHM 1% 0.1W 0805	2.0 EA	R108 R131
545 0308 321	RES 6.81K OHM 1% 0.1W 0805	1.0 EA	R219
545 0308 401	RES 10K OHM 1% 0.1W 0805	52.0 EA	R18 R30 R56 R58 R71 R82 R91 R120 R134 R142 R147 R148 R149 R150 R151 R152 R161 R165 R180 R185 R187 R189 R192 R193 R204 R206 R208 R210 R213 R216 R218 R221 R222 R224 R238 R242 R258 R265 R266 R267 R274 R279 R284 R287 R288 R299 R302 R303 R304 R309 R313 R349
545 0308 402	RES 11K OHM 1% 0.1W 0805	2.0 EA	R87 R244
545 0308 403	RES 12.1K OHM 1% 0.1W 0805	1.0 EA	R184
545 0308 404	RES 13K OHM 1% 0.1W 0805	1.0 EA	R98
545 0308 405	RES 15K OHM 1% 0.1W 0805	1.0 EA	R241
545 0308 406	RES 16.2K OHM 1% 0.1W 0805	3.0 EA	R113 R124 R160
545 0308 407	RES 18.2K OHM 1% 0.1W 0805	1.0 EA	R243
545 0308 409	RES 22.1K OHM 1% 0.1W 0805	1.0 EA	R214
545 0308 412	RES 30.1K OHM 1% 0.1W 0805	1.0 EA	R88
545 0308 414	RES 35.7K OHM 1% 0.1W 0805	2.0 EA	R159 R233
545 0308 417	RES 47.5K OHM 1% 0.1W 0805	1.0 EA	R215
545 0308 419	RES 56.2K OHM 1% 0.1W 0805	1.0 EA	R205
545 0308 501	RES 100K OHM 1% 0.1W 0805	10.0 EA	R36 R49 R84 R96 R128 R129 R130 R276 R301 R315
545 0308 505	RES 150K OHM 1% 0.1W 0805	3.0 EA	R72 R75 R122

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545 0308 508	RES 200K OHM 1% 0.1W 0805	11.0 EA	R12 R13 R14 R15 R16 R17 R19 R20 R21 R22 R23
545 0308 601	RES 1MEG OHM 1% 0.1W 0805	17.0 EA	R10 R24 R55 R102 R104 R105 R116 R177 R186 R188 R207 R217 R223 R232 R256 R278 R280
545 0308 999	RES ZERO OHM JUMPER 0805	14.0 EA	R50 R51 R62 R64 R65 R77 R85 R86 R97 R135 R136 R234 R235 R286
545 0309 208	RES 200 OHM 1% 1/4W 1206	1.0 EA	R345
561 0002 003	POSISTOR 0.2 AMP 30VDC 1812	7.0 EA	R27 R28 R29 R59 R90 R118 R306
561 0003 007	POSISTOR 0.5 AMP 60VDC 2029	1.0 EA	R190
604 1162 000	DIPSWITCH, 8 SPST SMT	1.0 EA	S3
604 1163 000	SWITCH, PB, SPST MOM, SMT	1.0 EA	S2
610 1330 000	TEST POINT, LOOP, SMT	24.0 EA	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20 TP32 TP34 TP35 TP36 TP37 TP38 TP39 TP40
612 1591 001	RECP, 80C 2 ROW VERTICAL	2.0 EA	J1 J2
843 5549 101	SCH, POWER SUPPLY MONITOR	0.0 EA	
843 5549 103	*PWB, POWER SUPPLY MONITOR	1.0 EA	

Table 7-13 PWA, FRONT PANEL SWITCH BOARD - 992 7257 101

Harris PN	Description	Qty	UM	Reference Designators (D)
384 0806 000	LED, BI-COLOR RED/GREEN ESD	5.0	EA	DS1 DS2 DS3 DS4 DS5
384 0826 000	LED LIGHT BAR, RED ESD	1.0	EA	DS12
384 0827 000	LED LIGHT BAR, GREEN ESD	1.0	EA	DS11
384 0849 000	LED LIGHT BAR, GREEN ESD	3.0	EA	DS13 DS14 DS15
384 0858 000	LED LIGHT BAR, YELLOW ESD	1.0	EA	DS16
598 0450 000	CAP, SPACING W/2 HOLES	11.0	EA	FOR PUSHBUTTON SWITCHES
604 1141 000	SW, PB MEMBRANE SPST	11.0	EA	S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11
610 0854 000	HEADER, 40 PIN PC RIBBON	1.0	EA	J1
610 1041 000	HDR, RT ANG, 10 PIN, SQ	1.0	EA	J2
817 2570 015	SW/FW, FP_SWBD	0.0	EA	USED WITH U7 ON SMT LEVEL
992 7302 110	*PWA,FRONT PANEL SWITCHBD, SMT	1.0	EA	

Table 7-14 *PWA,FRONT PANEL SWITCHBD, SMT - 992 7302 110

Harris PN	Description	Qty	UM	Reference Designators (B)
383 0200 000	IC, 74ACT240 SMT ESD	2.0	EA	U1 U2
383 0241 000	IC, 2940 5V REGULATOR ESD	1.0	EA	U8
383 0560 000	IC, UDN2987 ESD	1.0	EA	U3
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	1.0	EA	CR1
385 0051 000	DIODE ARRAY, SRDA70-4 ESD	3.0	EA	U4 U5 U6
393 0072 000	CPLD, XC9572XL PROG/ESD	1.0	EA	U7
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	31.0	EA	C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C14 C15 C16 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C31 C32 C35 C36
523 0001 201	CAP 100UF 6.3V 20% SMT	3.0	EA	C17 C30 C34
523 0003 101	CAP 10UF 35V 20% SMT	3.0	EA	C13 C33 C37
540 1568 000	RES NETWORK, 10K OHM 5% SMT	1.0	EA	R35
540 1569 000	RES NETWORK 2K OHM 2% SMT	1.0	EA	R16
545 0308 201	RES 100 OHM 1% 0.1W 0805	5.0	EA	R23 R24 R26 R29 R30
545 0308 203	RES 121 OHM 1% 0.1W 0805	3.0	EA	R25 R27 R28
545 0308 217	RES 475 OHM 1% 0.1W 0805	11.0	EA	R11 R12 R13 R14 R15 R19 R22 R32 R33 R37 R39
545 0308 308	RES 2K OHM 1% 0.1W 0805	2.0	EA	R17 R20

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545 0308 401	RES 10K OHM 1% 0.1W 0805	11.0 EA	R6 R7 R8 R9 R10 R18 R21 R31 R34 R36 R38
545 0308 999	RES ZERO OHM JUMPER 0805	5.0 EA	R40 R41 R42 R43 R44
545 0309 212	RES 301 OHM 1% 1/4W 1206	5.0 EA	R1 R2 R3 R4 R5
610 1330 000	TEST POINT, LOOP, SMT	1.0 EA	TP9
843 5549 181	SCH, FRONT PANEL SWITCHBOARD	0.0 EA	
843 5549 183	PWB, FRONT PANEL SWITCH BOARD	1.0 EA	

Table 7-15 *PWA, RF MONITOR - 992 7263 101

Harris PN	Description	Qty UM	Reference Designators (D)
000 0000 010	B/M NOTE:	1.0 EA	DO NOT POPULATE U14
086 0001 010	*SEALANT GLYPTOL	0.0 QT	XJ3
357 0033 000	SCREW 4-40 X .375 BHMS	2.0 EA	2/J3
357 0037 000	SCREW 6-32 X .25 BHMS	2.0 EA	MICRO MODULE
357 0059 000	NUT, HEX 6-32	2.0 EA	MICRO MODULE
408 0355 000	SHIELD, RF	1.0 EA	
408 0356 000	SHIELD, RF	1.0 EA	
610 0828 000	HEADER, 26 PIN PC RIBBON	1.0 EA	J1
610 0902 000	HDR 10 PIN STRAIGHT	1.0 EA	J19
610 1069 000	HEADER 9 PIN SINGLE ROW	1.0 EA	J4
610 1107 000	HDR,12PIN,1ROW,STRT,POL	1.0 EA	J2
612 1227 000	RCPT, 9 PIN D PC MT	1.0 EA	J3
620 2940 000	JACK RECEPTACLE SMA	8.0 EA	J5 J6 J7 J9 J10 J11 J12 J18
817 2550 140	SW/FW, ATLAS_RFM	0.0 EA	
817 2570 013	SW/FW, RANGER_RFM	0.0 EA	
843 5549 151	SCH, RF MONITOR	0.0 EA	
992 7203 001	PWA, 376 MICRO MODULE	1.0 EA	
992 7302 103	*PWA, RF MONITOR, SMT	1.0 EA	

Table 7-16 *PWA, RF MONITOR, SMT - 992 7302 103

Harris PN	Description	Qty UM	Reference Designators (E)
000 0000 010	B/M NOTE:	102.0 EA	NOT USED AT THIS TIME C98 C99 C100 C101 C102 C120 C121 C122 C123 C124 C125 C126 C127 C128 C129 C130 C131 C132 C133 C134 C138 C142 C143 C144 C145 C146 C162 C163 C164 C165 C166 C184 C185 C186 C187 C188 C189 C190 C191 C192 C193 C194 C195 C196 C197 C198 C203 C204 C209 C210 C214 C215 C216 C217 C218 C222 C223 C224 C225 C226 C228 C235 C236 C237 C238 C239 C240 C241 C242 C243 C244 CR41 CR42 CR43 CR44 CR45 CR49 CR50 CR51 CR52 CR53 J8 J13 J14 J15 J16 J17 Q15 Q16 Q17 Q18 Q19 Q23 Q24 Q25 Q26 Q27 Q31 Q32 Q33 Q34 Q35 NOT USED AT THIS TIME R77 R95 R96 R97 R98 R117 R118 R119 R120 R151 R152 R153 R154 R155 R156 R157 R158 R159 R160 R167 R168 R169 R170 R171 R172 R173 R174 R183 R184 R185 R186 R187 R188 R189 R190 R191 R192 R193 R194 R202 R204 R205 R206 R208 R214 R215 R216 R217 R218 R221 R222 R224 R226 R227 R228 R232 R236 R237 R238 R239 R240 R241 R242 R255 R256 R257 R258 R259 R260 R261 R262 R263 R264 R265 R266 R267 R268 R269 R270 R271 R272

WARNING: Disconnect primary power prior to servicing.

			R273 R274 R278 R279 R280 R281 R283 R285 R286 R289 R290 R291 R292 R305 R306 R307 R308 R309 R310 R311 R312 R313 R314 R315 R316 R317 R318 R319 R320 R321 R322 R323 R324 R325 R326 R334 R335 R336 R337 R338 R350 R357 R358 R359 R360 R361 R362 R363 R364 R365 R366 R370 R371 R372 R373 R374 TP22 TP23 TP24 TP25 TP26 TP30 U18 U28 U47 U48 U49 U50 U51 U52 U53 U54 U55 U56 U57 U58 U59 U60 U61 U65 U69
381 0029 000	N-MOSFET, 2N7002 SMT ESD	20.0 EA	Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q20 Q21 Q22 Q28 Q29 Q30
383 0158 000	IC, NE555 ESD	1.0 EA	U21
383 0165 000	IC, LM339 DQUAD COMPAR ESD	3.0 EA	U27 U29 U30
383 0241 000	IC, 2940 5V REGULATOR ESD	2.0 EA	U11 U31
383 0253 000	IC, LM358 ESD	3.0 EA	U39 U42 U45
383 0329 000	IC PCA82C251 ESD	1.0 EA	U10
383 0389 000	IC, LMC6482 SMT ESD	7.0 EA	U22 U33 U34 U35 U36 U37 U64
383 0391 000	IC, ADM202 SMT ESD	1.0 EA	U2
383 0421 000	IC 74HCT573 ESD	2.0 EA	U6 U15
383 0422 000	IC 74HCT273 ESD	1.0 EA	U24
383 0434 000	IC SN74CBT3245A ESD	1.0 EA	U5
383 0444 000	IC, 2940 ESD	1.0 EA	U1
383 0465 000	IC 74HC4051 ESD	3.0 EA	U23 U26 U32
383 0475 000	IC 74HCT14 ESD	3.0 EA	U7 U9 U16
383 0524 000	IC, LM2990S-12 ESD	1.0 EA	U13
383 0530 000	IC, AD8361 ESD	5.0 EA	U62 U63 U66 U67 U68
383 0558 000	IC 74VHC4066 CMOS ESD	6.0 EA	U38 U40 U41 U43 U44 U46
383 0570 000	IC, 2940 +12V REG ESD	1.0 EA	U12
383 0637 000	IC, X9251 ESD	3.0 EA	U17 U19 U20
385 0001 000	DIODE, RECT 4148 / 914 ESD	4.0 EA	CR12 CR38 CR39 CR40
385 0011 002	DIODE, SCHOTTKY MBRS360 ESD	4.0 EA	CR1 CR2 CR3 CR29
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	32.0 EA	CR4 CR5 CR6 CR7 CR8 CR9 CR10 CR11 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR22 CR23 CR24 CR25 CR26 CR27 CR28 CR30 CR31 CR32 CR33 CR34 CR35 CR36 CR37
385 0033 000	DIODE, 2805 DUAL SHTKY SMT ESD	3.0 EA	CR46 CR47 CR48
385 0051 000	DIODE ARRAY, SRDA70-4 ESD	2.0 EA	U4 U8
389 0010 001	LED, RED, 1.4MM RECT ESD	3.0 EA	DS3 DS4 DS18
389 0010 002	LED, GRN, 1.4MM RECT ESD	15.0 EA	DS1 DS2 DS5 DS6 DS7 DS8 DS9 DS10 DS11 DS12 DS13 DS14 DS15 DS16 DS17
393 0063 000	EEPROM, 25C040 PROG/ESD	1.0 EA	U25
393 0082 000	IC, XC95288XL ESD	1.0 EA	U3
515 0134 101	CAP 10PF 100V 5% 0805 C0G	3.0 EA	C159 C160 C161
515 0134 201	CAP 100PF 100V 5% 0805 C0G	38.0 EA	C64 C65 C66 C67 C70 C71 C72 C73 C80 C81 C82 C83 C87 C88 C89 C90 C108 C150 C155 C156 C173 C174 C175 C178 C181 C199 C200 C207 C211 C212 C213 C219 C220 C221 C227 C229 C231 C233
515 0136 301	CAP 1000PF 100V 10% 0805 X7R	7.0 EA	C171 C172 C205 C206 C230 C232 C234
515 0136 401	CAP 0.01UF 100V 10% 0805 X7R	18.0 EA	C85 C91 C103 C104 C105 C106 C107 C109 C110 C135 C136 C137 C152 C153 C154 C168 C170 C208
515 0136 417	CAP 0.047UF 100V 10% 0805 X7R	3.0 EA	C21 C22 C30

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515 0136 501	CAP 0.1UF 50V 10% 0805 X7R	88.0 EA	C1 C2 C3 C4 C6 C7 C8 C9 C11 C14 C15 C16 C17 C18 C20 C23 C24 C25 C26 C27 C28 C29 C31 C32 C33 C34 C35 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C56 C57 C58 C59 C61 C62 C63 C68 C69 C74 C75 C76 C77 C78 C79 C84 C92 C94 C95 C96 C97 C111 C112 C113 C114 C115 C116 C117 C118 C119 C139 C140 C141 C147 C148 C149 C151 C157 C158 C167 C169 C201 C202
515 0137 601	CAP 1UF 25V 10% 1206 X7R	6.0 EA	C176 C177 C179 C180 C182 C183
515 0162 509	CAP 0.22UF 25V 0805 Z5U	1.0 EA	C13
523 0001 117	CAP, 47UF 6.3V 20% SMT	3.0 EA	C5 C55 C86
523 0002 201	CAP 100UF 25V 20% SMT	2.0 EA	C12 C19
523 0004 000	*CAP 10UF 16V 20% SMT	4.0 EA	C10 C36 C60 C93
540 1568 000	RES NETWORK, 10K OHM 5% SMT	4.0 EA	R46 R66 R67 R71
545 0308 001	RES 1 OHM 1% 0.1W 0805	1.0 EA	R54
545 0308 021	RES 6.81 OHM 1% 0.1W 0805	3.0 EA	R351 R353 R355
545 0308 109	RES 22.1 OHM 1% 0.1W 0805	3.0 EA	R29 R30 R41
545 0308 122	RES 75 OHM 1% 0.1W 0805	5.0 EA	R275 R276 R328 R330 R349
545 0308 201	RES 100 OHM 1% 0.1W 0805	9.0 EA	R331 R332 R333 R352 R354 R356 R367 R368 R369
545 0308 217	RES 475 OHM 1% 0.1W 0805	38.0 EA	R19 R21 R32 R43 R45 R47 R53 R56 R72 R73 R74 R75 R82 R83 R84 R85 R87 R88 R89 R90 R108 R109 R110 R111 R112 R130 R141 R142 R143 R144 R162 R164 R165 R166 R175 R176 R197 R198
545 0308 223	RES 825 OHM 1% 0.1W 0805	1.0 EA	R8
545 0308 301	RES 1K OHM 1% 0.1W 0805	14.0 EA	R1 R4 R5 R6 R12 R64 R131 R132 R133 R134 R135 R136 R137 R138
545 0308 303	RES 1.21K OHM 1% 0.1W 0805	2.0 EA	R7 R9
545 0308 314	RES 3.57K OHM 1% 0.1W 0805	2.0 EA	R10 R11
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	3.0 EA	R50 R60 R139
545 0308 321	RES 6.81K OHM 1% 0.1W 0805	1.0 EA	R58
545 0308 401	RES 10K OHM 1% 0.1W 0805	58.0 EA	R2 R3 R13 R14 R18 R22 R23 R24 R28 R34 R36 R37 R38 R39 R48 R51 R55 R57 R59 R62 R70 R79 R80 R81 R113 R114 R115 R116 R121 R122 R123 R124 R125 R126 R127 R128 R146 R148 R150 R161 R163 R178 R180 R182 R195 R196 R199 R200 R207 R209 R210 R231 R245 R249 R253 R282 R287 R288
545 0308 405	RES 15K OHM 1% 0.1W 0805	1.0 EA	R33
545 0308 407	RES 18.2K OHM 1% 0.1W 0805	3.0 EA	R145 R147 R149
545 0308 412	RES 30.1K OHM 1% 0.1W 0805	2.0 EA	R35 R49
545 0308 415	RES 39.2K OHM 1% 0.1W 0805	2.0 EA	R52 R61
545 0308 418	RES 51.1K OHM 1% 0.1W 0805	6.0 EA	R293 R296 R297 R300 R301 R304
545 0308 423	RES 82.5K OHM 1% 0.1W 0805	2.0 EA	R219 R220
545 0308 501	RES 100K OHM 1% 0.1W 0805	15.0 EA	R78 R201 R203 R211 R212 R213 R223 R225 R229 R230 R246 R250 R254 R277 R284
545 0308 503	RES 121K OHM 1% 0.1W 0805	1.0 EA	R65
545 0308 508	RES 200K OHM 1% 0.1W 0805	8.0 EA	R15 R20 R25 R26 R31 R40 R42 R44
545 0308 516	RES 432K OHM 1% 0.1W 0805	6.0 EA	R233 R234 R235 R244 R248 R252
545 0308 523	RES 825K OHM 1% 0.1W 0805	6.0 EA	R177 R179 R181 R243 R247 R251

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545 0308 601	RES 1MEG OHM 1% 0.1W 0805	18.0 EA	R91 R92 R93 R94 R99 R100 R101 R102 R103 R104 R105 R106 R294 R295 R298 R299 R302 R303
545 0308 999	RES ZERO OHM JUMPER 0805	7.0 EA	R63 R68 R69 R76 R86 R107 R129
545 0309 107	RES 18.2 OHM 1% 1/4W 1206	2.0 EA	R327 R329
545 0309 212	RES 301 OHM 1% 1/4W 1206	4.0 EA	R345 R346 R347 R348
545 0310 123	RES 82.5 OHM 1% 1W 2512	4.0 EA	R339 R341 R342 R344
545 0310 124	RES 90.9 OHM 1% 1W 2512	2.0 EA	R340 R343
561 0002 009	POSISTOR 0.75 AMP 13VDC 1812	2.0 EA	R17 R140
561 0003 009	POSISTOR 0.75 AMP 30VDC 2029	2.0 EA	R16 R27
603 0004 000	DIPSWITCH, 8 SPST SMT	1.0 EA	S1
610 1330 000	TEST POINT, LOOP, SMT	24.0 EA	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20 TP21 TP27 TP28 TP29
612 1591 001	RECP, 80C 2 ROW VERTICAL	2.0 EA	XA1J1 XA1J2
843 5549 151	SCH, RF MONITOR	0.0 EA	
843 5549 153	*PWB, RF MONITOR	1.0 EA	

Table 7-17 *PWA, MAIN CONTROLLER - 992 7264 101

Harris PN	Description	Qty UM	Reference Designators (E)
055 0100 005	*THERMAL COMPOUND, 8OZ JAR	0.0 EA	
086 0001 010	*SEALANT GLYPTOL	0.0 QT	XJ5 XJ6 XJ7
300 1484 000	SCR, 4-40 X 1/4	3.0 EA	1/XU31 1/XU38 1/XU42
304 0087 000	NUT, HEX 4-40	3.0 EA	1/XU31 1/XU38 1/XU42
310 0036 000	WASHER, FLAT .097 ID	2.0 EA	2/J90
312 0045 000	WASHER, SPLIT-LOCK 4	3.0 EA	1/XU31 1/XU38 1/XU42
350 0048 000	RIVET POP .093X.337	2.0 EA	2/J90
357 0033 000	SCREW 4-40 X .375 BHMS	6.0 EA	2/J5 2/J6 2/J7
357 0037 000	SCREW 6-32 X .25 BHMS	2.0 EA	MICRO MODULE
357 0059 000	NUT, HEX 6-32	2.0 EA	MICRO MODULE
358 3789 000	STANDOFF, HEX 6-32 X 5/16 M/F	2.0 EA	MICRO MODULE
382 1321 000	IC LM2940CT-5 ESD	2.0 EA	U31 U38
382 1695 000	IC, MIC29150 3.3V REG, TO220	1.0 EA	U42
404 0922 000	HEATSINK, VERTICAL, TO-220	3.0 EA	XU31 XU38 XU42
506 0303 000	CAP, 1.0F 5.5V GOLD	1.0 EA	C49
566 0032 000	INVERTER, DC TO AC 4.5W	1.0 EA	U28
610 0877 000	HDR, STR, 2 PIN, SQ	1.0 EA	JP1
610 0902 000	HDR 10 PIN STRAIGHT	1.0 EA	J1
610 0979 000	*HDR 10C VERT 2ROW TOP LATCH	1.0 EA	J12
610 0982 000	*HDR 26C VERT 2ROW TOP LATCH	2.0 EA	J10 J11
610 1043 000	*HDR 40C VERT 2ROW TOP LATCH	1.0 EA	J13
610 1069 000	HEADER 9 PIN SINGLE ROW	1.0 EA	J8
610 1107 000	HDR,12PIN,1ROW,STRT,POL	1.0 EA	J15
610 1235 000	HEADER, STRAIGHT 4 PIN	1.0 EA	J14
610 1388 000	HDR, 4C 1 ROW STRAIGHT	1.0 EA	J3
612 1184 000	SHUNT JUMPER 0.1" CENTERS	1.0 EA	1/JP1
612 1227 000	RCPT, 9 PIN D PC MT	3.0 EA	J5 J6 J7
612 1575 000	RECPT 9 PIN D RT ANGLE, PCB	1.0 EA	J90
612 2146 000	RECP, 8C RT ANGLE, ZIF	1.0 EA	J4
660 0068 000	BATTERY 3V LITHIUM COIN CELL	1.0 EA	1/BT1
817 2570 011	SW/FW, RANGER_CTLR	0.0 EA	
843 5549 131	SCH, MAIN CONTROLLER	0.0 EA	
992 7203 001	PWA, 376 MICRO MODULE	1.0 EA	

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992 7302 106	*PWA, MAIN CONTROLLER, SMT	1.0 EA

Table 7-18 *PWA, MAIN CONTROLLER, SMT - 992 7302 106

Harris PN	Description	Qty UM	Reference Designators (B)
000 0000 010	B/M NOTE:	17.0 EA	DO NOT POPULATE AT THIS TIME C165 C166 C167 C168 J9 J16 R11 R12 R23 R96 R118 R135 R154 R240 R252 R254 R256
381 0027 000	FET, SI9430DY SMT ESD	1.0 EA	Q18
381 0029 000	N-MOSFET, 2N7002 SMT ESD	25.0 EA	Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26
383 0126 000	*IC MAX705/ADM705 ESD		1.0 EAU33
383 0148 000	IC, 74HC14AD ESD	4.0 EA	U21 U23 U24 U25
383 0149 000	IC, 74HC573 ESD	2.0 EA	U6 U7
383 0204 000	IC 68681 DUART ESD	2.0 EA	U29 U30
383 0277 001	IC LM4040CIM3-4.1 ESD	1.0 EA	CR5
383 0329 000	IC PCA82C251 ESD	2.0 EA	U5 U40
383 0337 000	IC, HCPL-0631 ESD	2.0 EA	U9 U14
383 0389 000	IC, LMC6482 SMT ESD	2.0 EA	U8 U18
383 0391 000	IC, ADM202 SMT ESD	4.0 EA	U2 U35 U36 U37
383 0421 000	IC 74HCT573 ESD	2.0 EA	U26 U27
383 0426 000	IC NC7ST04 ESD	1.0 EA	U4
383 0429 000	IC 74HCT245 ESD	1.0 EA	U17
383 0430 000	IC S1D13705 ESD	1.0 EA	U44
383 0434 000	IC SN74CBT3245A ESD	2.0 EA	U10 U11
383 0436 000	IC, 74HCT244 ESD	2.0 EA	U43 U46
383 0475 000	IC 74HCT14 ESD	3.0 EA	U19 U34 U39
383 0479 000	IC DS1306 ESD	1.0 EA	U20
383 0493 000	IC LM317MDT SMT ESD	1.0 EA	U13
383 0533 000	IC, ADS7846 ESD	1.0 EA	U45
383 0547 000	IC, LM50C ESD	1.0 EA	U16
383 0549 000	IC, MAX3238 ESD	1.0 EA	U32
383 0559 000	IC, MCP2510 ESD	1.0 EA	U15
383 0561 000	IC AD7302 ESD	1.0 EA	U12
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	7.0 EA	CR1 CR2 CR3 CR4 CR6 CR7 CR8
385 0051 000	DIODE ARRAY, SRDA70-4 ESD	2.0 EA	U41 U47
389 0010 001	LED, RED, 1.4MM RECT ESD	6.0 EA	DS12 DS13 DS21 DS22 DS26 DS27
389 0010 002	LED, GRN, 1.4MM RECT ESD	23.0 EA	DS1 DS2 DS3 DS4 DS5 DS6 DS7 DS8 DS9 DS10 DS11 DS14 DS15 DS16 DS17 DS18 DS19 DS20 DS23 DS24 DS25 DS28 DS29
393 0063 000	EEPROM, 25C040 PROG/ESD	1.0 EA	U1
393 0077 000	IC AM29F800BB PROG/ESD	1.0 EA	U3
393 0082 000	IC, XC95288XL ESD	1.0 EA	U22
407 0004 000	BATTERY HOLDER, COIN CELL SMT	1.0 EA	BT1
444 3010 000	XTAL 3.6864 MHZ SMT	1.0 EA	Y3
444 3011 000	*XTAL 32.768KHZ SMT	1.0 EA	Y2
445 0002 000	XTAL 16 MHZ SMT ESD	1.0 EA	Y1
496 0059 000	IND CHIP 1UH 10%	1.0 EA	L1
515 0134 105	CAP 15PF 100V 5% 0805 C0G	2.0 EA	C53 C56
515 0137 401	CAP 0.01UF 50V 10% 1206 X7R	4.0 EA	C128 C129 C142 C143
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	140.0 EA	C1 C2 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30

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			C31 C32 C34 C35 C36 C37 C39 C40 C41 C42 C43 C44 C47 C50 C51 C52 C54 C58 C59 C60 C61 C62 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C81 C82 C83 C84 C86 C87 C88 C89 C91 C92 C93 C94 C96 C97 C98 C99 C100 C101 C102 C103 C104 C106 C108 C109 C110 C111 C112 C113 C114 C115 C116 C117 C118 C119 C120 C121 C122 C123 C124 C125 C127 C130 C131 C132 C133 C134 C135 C136 C137 C138 C139 C140 C141 C144 C145 C146 C148 C149 C150 C151 C152 C153 C154 C155 C158 C159 C160 C161 C162 C163 C164 C169 C170
523 0001 201	CAP 100UF 6.3V 20% SMT	7.0 EA	C3 C33 C48 C63 C95 C126 C156
523 0003 101	CAP 10UF 35V 20% SMT	12.0 EA	C38 C45 C46 C55 C57 C80 C85 C90 C105 C107 C147 C157
540 1568 000	RES NETWORK, 10K OHM 5% SMT	2.0 EA	R146 R156
545 0308 001	RES 1 OHM 1% 0.1W 0805	1.0 EA	R68
545 0308 101	RES 10 OHM 1% 0.1W 0805	1.0 EA	R82
545 0308 109	RES 22.1 OHM 1% 0.1W 0805	28.0 EA	R89 R90 R92 R93 R95 R98 R99 R100 R159 R165 R166 R244 R246 R248 R250 R271 R272 R273 R274 R275 R283 R284 R285 R286 R287 R288 R290 R291
545 0308 201	RES 100 OHM 1% 0.1W 0805	6.0 EA	R71 R113 R132 R214 R216 R217
545 0308 203	RES 121 OHM 1% 0.1W 0805	2.0 EA	R75 R212
545 0308 210	RES 237 OHM 1% 0.1W 0805	1.0 EA	R102
545 0308 213	RES 332 OHM 1% 0.1W 0805	2.0 EA	R79 R111
545 0308 214	RES 357 OHM 1% 0.1W 0805	2.0 EA	R28 R78
545 0308 217	RES 475 OHM 1% 0.1W 0805	51.0 EA	R10 R13 R18 R19 R20 R26 R30 R31 R35 R36 R39 R41 R43 R46 R47 R48 R53 R54 R55 R59 R60 R64 R141 R186 R187 R190 R191 R192 R193 R203 R204 R205 R207 R209 R219 R221 R223 R225 R227 R229 R231 R233 R235 R237 R239 R241 R242 R253 R258 R262 R265
545 0308 221	RES 681 OHM 1% 0.1W 0805	2.0 EA	R44 R51
545 0308 222	RES 750 OHM 1% 0.1W 0805	1.0 EA	R101
545 0308 301	RES 1K OHM 1% 0.1W 0805	39.0 EA	R1 R24 R27 R33 R37 R45 R50 R65 R74 R97 R103 R112 R127 R144 R145 R147 R149 R151 R153 R155 R158 R171 R172 R173 R174 R175 R176 R177 R185 R195 R196 R197 R198 R202 R206 R208 R211 R215 R270
545 0308 303	RES 1.21K OHM 1% 0.1W 0805	1.0 EA	R184
545 0308 305	RES 1.5K OHM 1% 0.1W 0805	1.0 EA	R38
545 0308 309	RES 2.21K OHM 1% 0.1W 0805	1.0 EA	R126
545 0308 315	RES 3.92K OHM 1% 0.1W 0805	1.0 EA	R32
545 0308 316	RES 4.32K OHM 1% 0.1W 0805	1.0 EA	R183
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	17.0 EA	R49 R114 R115 R116 R120 R124 R128 R129 R130 R131 R136 R137 R138 R139 R140 R142 R289
545 0308 401	RES 10K OHM 1% 0.1W 0805	59.0 EA	R4 R7 R22 R29 R34 R40 R42 R62 R66 R67 R69 R70 R72 R73 R76 R77 R80 R81 R83 R84 R86 R87 R91 R94 R104 R105 R106 R107 R108 R109 R110 R119 R121 R122 R123 R125 R133 R143 R160 R161 R162 R163 R168 R169 R170 R178 R179

WARNING: Disconnect primary power prior to servicing.

			R180 R181 R188 R189 R194 R199 R200 R201 R210 R213 R276 R278
545 0308 406	RES 16.2K OHM 1% 0.1W 0805	1.0 EA	R25
545 0308 408	RES 20K OHM 1% 0.1W 0805	18.0 EA	R5 R6 R21 R218 R220 R222 R224 R226 R228 R230 R232 R234 R236 R238 R251 R255 R263 R264
545 0308 418	RES 51.1K OHM 1% 0.1W 0805	1.0 EA	R281
545 0308 501	RES 100K OHM 1% 0.1W 0805	4.0 EA	R167 R182 R277 R282
545 0308 508	RES 200K OHM 1% 0.1W 0805	12.0 EA	R52 R57 R58 R61 R63 R243 R245 R247 R249 R267 R268 R269
545 0308 999	RES ZERO OHM JUMPER 0805	20.0 EA	R2 R3 R8 R9 R14 R15 R16 R17 R56 R85 R117 R134 R148 R150 R152 R157 R257 R259 R260 R261
545 0310 118	RES 51.1 OHM 1% 1W 2512	1.0 EA	R88
561 0002 007	POSISTOR 0.5 AMP 15VDC 1812	1.0 EA	R164
561 0002 009	POSISTOR 0.75 AMP 13VDC 1812	2.0 EA	R266 R280
561 0004 018	POSISTOR 2.5 AMP 15VDC 3425	1.0 EA	R279
603 0004 000	DIPSWITCH, 8 SPST SMT	1.0 EA	S1
604 1163 000	SWITCH, PB, SPST MOM, SMT	3.0 EA	S2 S4 S5
604 1201 000	SW, TGL DPDT SMT	1.0 EA	S3
610 1330 000	TEST POINT, LOOP, SMT	18.0 EA	TP1 TP2 TP3 TP4 TP6 TP7 TP8 TP9 TP10 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20 TP21
612 1591 001	RECP, 80C 2 ROW VERTICAL	2.0 EA	XA1J1 XA1J2
612 2147 000	RECP, 18C 1 ROW RT ANGLE SMT	1.0 EA	J2
843 5549 131	SCH, MAIN CONTROLLER	0.0 EA	
843 5549 133	*PWB, MAIN CONTROLLER	1.0 EA	

Table 7-19 *PWA, EXTERNAL I/O - 992 7291 101

Harris PN	Description	Qty	UM	Reference Designators (D)
055 0100 005	*THERMAL COMPOUND, 8OZ JAR	0.0	EA	XU22
086 0001 010	*SEALANT GLYPTOL	0.0	QT	XJ2
300 1485 000	SCR, 4-40 X 5/16	1.0	EA	XU22
304 0087 000	NUT, HEX 4-40	1.0	EA	XU22
308 0003 000	NO 4 FLAT WASHER BRS	1.0	EA	XU22
310 0036 000	WASHER, FLAT .097 ID	2.0	EA	2/J3
312 0045 000	WASHER, SPLIT-LOCK 4	1.0	EA	XU22
350 0048 000	RIVET POP .093X.337	2.0	EA	2/J3
357 0033 000	SCREW 4-40 X .375 BHMS	2.0	EA	2/J2
357 0037 000	SCREW 6-32 X .25 BHMS	2.0	EA	MICRO MODULE
357 0059 000	NUT, HEX 6-32	2.0	EA	MICRO MODULE
358 3789 000	STANDOFF, HEX 6-32 X 5/16 M/F	2.0	EA	MICRO MODULE
382 1321 000	IC LM2940CT-5 ESD	1.0	EA	U22
398 0583 000	FUSE, FAST CART 5A 250V	1.0	EA	F1
402 0198 000	CLIP, FUSE 5MM DIA FUSE	2.0	EA	2/F1
404 0513 000	HEAT SINK PA1-1CB	1.0	EA	XU22
560 0021 000	SPARK GAP CG75L	1.0	EA	E1
566 0037 000	CONVERTER, DC/DC 5V .75W ESD	3.0	EA	U27 U54 U55
578 0026 000	RELAY DPDT 12VDC 2 AMP	4.0	EA	K1 K2 K3 K4
610 0877 000	HDR, STR, 2 PIN, SQ	2.0	EA	JP1 JP2
610 0902 000	HDR 10 PIN STRAIGHT	1.0	EA	J1
610 0982 000	*HDR 26C VERT 2ROW TOP LATCH	2.0	EA	J5 J6
610 0986 000	*HDR 40C RT ANG 2ROW TOP LATCH	1.0	EA	J8
610 1069 000	HEADER 9 PIN SINGLE ROW	1.0	EA	J4
610 1107 000	HDR,12PIN,1ROW,STRT,POL	1.0	EA	J7

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610 1423 012	HDR, 12C 1ROW VERTICAL	8.0 EA	J11 J12 J13 J14 J15 J16 J17 J18
612 1184 000	SHUNT JUMPER 0.1" CENTERS	1.0 EA	1/JP1
612 1227 000	RCPT, 9 PIN D PC MT	1.0 EA	J2
612 1575 000	RECPT 9 PIN D RT ANGLE, PCB	1.0 EA	J3
612 2156 012	PLUG, 12C 1ROW VERTICAL	6.0 EA	J13 J14 J15 J16 J17 J18
817 2570 012	SW/FW, RANGER_EXT I/O	0.0 EA	
843 5549 141	SCH, EXTERNAL I/O	0.0 EA	
992 7203 001	PWA, 376 MICRO MODULE	1.0 EA	
992 7302 109	*PWA, EXTERNAL I/O SMT	1.0 EA	

Table 7-20 *PWA, EXTERNAL I/O SMT - 992 7302 109

Harris PN	Description	Qty UM	Reference Designators (B)
000 0000 010	B/M NOTE:	19.0 EA	J9 J10 R44 R47 R57 R70 R91 R110 R132 R136 R138 R144 R147 R152 R167 R172 R176 R183 R202
381 0029 000	N-MOSFET, 2N7002 SMT ESD	51.0 EA	Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33 Q34 Q35 Q36 Q37 Q38 Q39 Q40 Q41 Q42 Q43 Q44 Q45 Q46 Q47 Q48 Q49 Q50 Q51
382 1392 000	IC, LM324 QUAD OP AMP ESD	2.0 EA	U34 U36
383 0049 000	IC, AD7808 ESD	1.0 EA	U31
383 0126 000	*IC MAX705/ADM705 ESD		1.0 EAU13
383 0148 000	IC, 74HC14AD ESD	4.0 EA	U5 U6 U16 U26
383 0204 000	IC 68681 DUART ESD	1.0 EA	U15
383 0244 000	IC ILD206 OPTO-COUPLER ESD	23.0 EA	U28 U29 U30 U32 U33 U35 U37 U38 U39 U40 U41 U42 U43 U44 U45 U46 U47 U48 U49 U50 U51 U52 U53
383 0277 001	IC LM4040CIM3-4.1 ESD	1.0 EA	CR1
383 0329 000	IC PCA82C251 ESD	2.0 EA	U20 U23
383 0337 000	IC, HCPL-0631 ESD	2.0 EA	U18 U21
383 0389 000	IC, LMC6482 SMT ESD	1.0 EA	U1
383 0391 000	IC, ADM202 SMT ESD	2.0 EA	U3 U14
383 0421 000	IC 74HCT573 ESD	3.0 EA	U10 U11 U12
383 0444 000	IC, 2940 ESD	1.0 EA	U19
383 0475 000	IC 74HCT14 ESD	1.0 EA	U9
383 0480 000	IC, LTC1387	1.0 EA	U25
383 0493 000	IC LM317MDT SMT ESD	1.0 EA	U24
383 0547 000	IC, LM50C ESD	1.0 EA	U2
383 0559 000	IC, MCP2510 ESD	1.0 EA	U7
385 0001 000	DIODE, RECT 4148 / 914 ESD	31.0 EA	CR9 CR11 CR13 CR14 CR16 CR17 CR19 CR20 CR21 CR22 CR23 CR24 CR25 CR26 CR27 CR28 CR30 CR32 CR34 CR36 CR38 CR40 CR42 CR44 CR46 CR48 CR50 CR52 CR54 CR56 CR58
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	3.0 EA	CR2 CR3 CR5
385 0051 000	DIODE ARRAY, SRDA70-4 ESD	1.0 EA	U4
387 0001 024	DIODE, TVS 30V 600W ESD	20.0 EA	CR10 CR12 CR15 CR18 CR29 CR31 CR33 CR35 CR37 CR39 CR41 CR43 CR45 CR47 CR49 CR51 CR53 CR55 CR57 CR59
387 0007 024	DIODE, TVS 30V 600W ESD	4.0 EA	CR4 CR8 CR60 CR61
387 0016 000	DIODE, TVS ARRAY 15V ESD	2.0 EA	CR6 CR7
389 0010 001	LED, RED, 1.4MM RECT ESD	6.0 EA	DS9 DS11 DS12 DS13 DS14 DS15

WARNING: Disconnect primary power prior to servicing.

389 0010 002	LED, GRN, 1.4MM RECT ESD	17.0 EA	DS1 DS2 DS3 DS4 DS5 DS6 DS7 DS8 DS10 DS16 DS17 DS18 DS19 DS20 DS21 DS22 DS23
393 0063 000	EEPROM, 25C040 PROG/ESD	1.0 EA	U8
393 0082 000	IC, XC95288XL ESD	1.0 EA	U17
444 3010 000	XTAL 3.6864 MHZ SMT	1.0 EA	Y2
445 0002 000	XTAL 16 MHZ SMT ESD	1.0 EA	Y1
484 0468 000	FILTER, T-TYPE FERRITE EMI,SMT	44.0 EA	FL1 FL2 FL3 FL4 FL5 FL6 FL7 FL8 FL9 FL10 FL11 FL12 FL13 FL14 FL15 FL16 FL17 FL18 FL19 FL20 FL21 FL22 FL23 FL24 FL25 FL26 FL27 FL28 FL29 FL30 FL31 FL32 FL33 FL34 FL35 FL36 FL37 FL38 FL39 FL40 FL41 FL42 FL43 FL44
496 0059 000	IND CHIP 1UH 10%	1.0 EA	L1
515 0134 105	CAP 15PF 100V 5% 0805 C0G	2.0 EA	C42 C44
515 0137 401	CAP 0.01UF 50V 10% 1206 X7R	5.0 EA	C12 C19 C31 C47 C109
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	142.0 EA	C1 C2 C3 C5 C6 C7 C8 C9 C10 C11 C13 C15 C16 C17 C18 C20 C21 C22 C23 C24 C25 C27 C28 C29 C30 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C43 C45 C46 C48 C49 C51 C52 C53 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C70 C71 C72 C73 C74 C75 C76 C77 C78 C81 C83 C84 C85 C86 C87 C89 C90 C91 C92 C93 C95 C96 C97 C98 C100 C101 C103 C104 C105 C106 C108 C110 C111 C113 C115 C116 C119 C122 C123 C124 C125 C126 C132 C134 C135 C136 C137 C138 C139 C140 C141 C142 C143 C144 C145 C146 C148 C149 C150 C151 C152 C153 C154 C155 C156 C159 C161 C162 C163 C164 C165 C166 C167 C168 C169 C170 C171 C172 C173 C174 C175 C176 C177 C178 C179
523 0001 201	CAP 100UF 6.3V 20% SMT	8.0 EA	C50 C69 C79 C80 C107 C112 C128 C181
523 0002 117	CAP 47UF 25V 20% SMT	6.0 EA	C117 C118 C157 C158 C180 C182
523 0003 101	CAP 10UF 35V 20% SMT	19.0 EA	C4 C14 C26 C54 C82 C88 C94 C99 C102 C114 C120 C121 C127 C129 C130 C131 C133 C147 C160
540 1568 000	RES NETWORK, 10K OHM 5% SMT	2.0 EA	R105 R131
545 0308 001	RES 1 OHM 1% 0.1W 0805	1.0 EA	R161
545 0308 109	RES 22.1 OHM 1% 0.1W 0805	7.0 EA	R24 R52 R59 R73 R115 R119 R196
545 0308 201	RES 100 OHM 1% 0.1W 0805	11.0 EA	R8 R148 R155 R255 R256 R265 R266 R277 R278 R284 R285
545 0308 203	RES 121 OHM 1% 0.1W 0805	2.0 EA	R159 R162
545 0308 210	RES 237 OHM 1% 0.1W 0805	1.0 EA	R181
545 0308 213	RES 332 OHM 1% 0.1W 0805	22.0 EA	R53 R157 R219 R225 R232 R239 R288 R295 R301 R307 R312 R318 R324 R330 R336 R342 R349 R355 R360 R365 R372 R378
545 0308 214	RES 357 OHM 1% 0.1W 0805	1.0 EA	R33
545 0308 217	RES 475 OHM 1% 0.1W 0805	41.0 EA	R10 R11 R12 R13 R14 R15 R21 R35 R42 R43 R56 R64 R76 R77 R78 R79 R80 R81 R82 R83 R84 R88 R90 R112 R133 R140 R149 R164 R168 R169 R177 R178 R190 R192 R203 R210 R212 R214 R220 R227 R234
545 0308 221	RES 681 OHM 1% 0.1W 0805	1.0 EA	R3
545 0308 222	RES 750 OHM 1% 0.1W 0805	1.0 EA	R180

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545 0308 301	RES 1K OHM 1% 0.1W 0805	53.0 EA	R2 R9 R16 R34 R36 R50 R54 R58 R62 R68 R87 R89 R92 R96 R97 R99 R113 R114 R116 R117 R118 R120 R123 R128 R142 R154 R158 R171 R174 R185 R191 R216 R217 R218 R228 R235 R238 R290 R297 R303 R308 R314 R320 R325 R332 R338 R344 R351 R356 R361 R368 R374 R380
545 0308 303	RES 1.21K OHM 1% 0.1W 0805	1.0 EA	R124
545 0308 305	RES 1.5K OHM 1% 0.1W 0805	1.0 EA	R98
545 0308 309	RES 2.21K OHM 1% 0.1W 0805	1.0 EA	R22
545 0308 312	RES 3.01K OHM 1% 0.1W 0805	7.0 EA	R226 R249 R259 R269 R273 R279 R286
545 0308 315	RES 3.92K OHM 1% 0.1W 0805	1.0 EA	R1
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	20.0 EA	R23 R25 R37 R45 R46 R49 R63 R93 R121 R135 R143 R151 R163 R166 R170 R173 R179 R193 R195 R208
545 0308 401	RES 10K OHM 1% 0.1W 0805	69.0 EA	R17 R18 R39 R41 R60 R61 R66 R67 R69 R74 R75 R86 R95 R126 R127 R129 R130 R139 R146 R156 R160 R221 R222 R224 R229 R231 R236 R241 R242 R243 R246 R257 R258 R268 R272 R276 R281 R289 R291 R294 R296 R298 R302 R304 R309 R313 R315 R319 R321 R326 R329 R331 R333 R337 R339 R343 R345 R348 R350 R352 R357 R362 R366 R367 R369 R373 R375 R379 R381
545 0308 406	RES 16.2K OHM 1% 0.1W 0805	1.0 EA	R100
545 0308 408	RES 20K OHM 1% 0.1W 0805	23.0 EA	R40 R51 R85 R134 R141 R150 R189 R293 R300 R306 R311 R317 R323 R328 R335 R341 R347 R354 R359 R364 R371 R377 R383
545 0308 501	RES 100K OHM 1% 0.1W 0805	2.0 EA	R122 R125
545 0308 508	RES 200K OHM 1% 0.1W 0805	23.0 EA	R4 R5 R6 R7 R38 R72 R94 R101 R102 R103 R104 R175 R182 R184 R186 R204 R207 R211 R213 R215 R251 R252 R253
545 0308 999	RES ZERO OHM JUMPER 0805	29.0 EA	R19 R20 R26 R27 R28 R29 R30 R31 R32 R48 R55 R71 R106 R107 R108 R109 R111 R137 R145 R153 R187 R194 R197 R198 R200 R201 R205 R206 R209
545 0309 101	RES 10 OHM 1% 1/4W 1206	28.0 EA	R223 R230 R237 R244 R248 R254 R261 R267 R271 R275 R280 R283 R292 R299 R305 R310 R316 R322 R327 R334 R340 R346 R353 R358 R363 R370 R376 R382
545 0309 206	RES 162 OHM 1% 1/4W 1206	4.0 EA	R240 R262 R263 R264
545 0309 209	RES 221 OHM 1% 1/4W 1206	1.0 EA	R65
545 0323 209	RES 220 OHM 1% 2W 2512	7.0 EA	R233 R245 R250 R260 R270 R274 R282
561 0002 003	POSISTOR 0.2 AMP 30VDC 1812	2.0 EA	R287 R384
561 0002 007	POSISTOR 0.5 AMP 15VDC 1812	1.0 EA	R247
561 0002 009	POSISTOR 0.75 AMP 13VDC 1812	1.0 EA	R199
561 0003 012	POSISTOR 1.25 AMP 15VDC 2029	1.0 EA	R188
561 0004 018	POSISTOR 2.5 AMP 15VDC 3425	1.0 EA	R165
603 0004 000	DIPSWITCH, 8 SPST SMT	1.0 EA	S2
604 1163 000	SWITCH, PB, SPST MOM, SMT	1.0 EA	S1
610 1330 000	TEST POINT, LOOP, SMT	16.0 EA	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16
612 1591 001	RECP, 80C 2 ROW VERTICAL	2.0 EA	XA1J1 XA1J2
843 5549 141	SCH, EXTERNAL I/O	0.0 EA	
843 5549 143	*PWB, EXTERNAL I/O	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

Table 7-21 PWA, EXCITER INTERFACE - 992 9990 017

Harris PN	Description	Qty UM	Reference Designators (D)
000 0000 010	B/M NOTE:	3.0 EA	DO NOT POPULATE J4 J5 J6
086 0001 010	*SEALANT GLYPTOL	0.0 QT	J3
357 0033 000	SCREW 4-40 X .375 BHMS	2.0 EA	2/J3
610 0893 000	CONN 25 PIN D STRATE POST	1.0 EA	J3
610 1043 000	*HDR 40C VERT 2ROW TOP LATCH	1.0 EA	J1
610 1069 000	HEADER 9 PIN SINGLE ROW	1.0 EA	J2
817 2570 016	SW/FW, EXTR_INTFC	0.0 EA	#U001
843 5565 291	SCH, EXCITER INTERFACE	0.0 EA	
992 9990 018	*PWA, EXCITER INTERFACE, SMT	1.0 EA	

Table 7-22 *PWA, EXCITER INTERFACE, SMT - 992 9990 018

Harris PN	Description	Qty UM	Reference Designators (C)
381 0029 000	N-MOSFET, 2N7002 SMT ESD	19.0 EA	Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19
383 0148 000	IC, 74HC14AD ESD	2.0 EA	U6 U8
383 0241 000	IC, 2940 5V REGULATOR ESD	1.0 EA	U3
383 0340 000	IC, LM4040AIM3-5.0 ESD	1.0 EA	CR1
383 0389 000	IC, LMC6482 SMT ESD	1.0 EA	U4
383 0444 000	IC, 2940 ESD	1.0 EA	U2
383 0614 000	IC, AD5300 ESD	1.0 EA	U5
385 0012 000	DIODE, SCHOTTKY MBR0520 ESD	2.0 EA	CR2 CR3
385 0051 000	DIODE ARRAY, SRDA70-4 ESD	1.0 EA	U7
393 0072 000	CPLD, XC9572XL PROG/ESD	1.0 EA	U1
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	32.0 EA	C3 C4 C5 C6 C7 C11 C12 C13 C14 C15 C16 C17 C18 C19 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C33 C34 C35 C36 C37 C38 C39
523 0001 201	CAP 100UF 6.3V 20% SMT	2.0 EA	C1 C2
523 0003 101	CAP 10UF 35V 20% SMT	3.0 EA	C9 C10 C32
545 0308 109	RES 22.1 OHM 1% 0.1W 0805	1.0 EA	R7
545 0308 121	RES 68.1 OHM 1% 0.1W 0805	1.0 EA	R41
545 0308 201	RES 100 OHM 1% 0.1W 0805	13.0 EA	R5 R30 R31 R32 R33 R34 R35 R36 R37 R38 R42 R58 R59
545 0308 210	RES 237 OHM 1% 0.1W 0805	1.0 EA	R1
545 0308 217	RES 475 OHM 1% 0.1W 0805	6.0 EA	R14 R16 R20 R27 R52 R55
545 0308 308	RES 2K OHM 1% 0.1W 0805	1.0 EA	R9
545 0308 317	RES 4.75K OHM 1% 0.1W 0805	12.0 EA	R6 R8 R10 R11 R18 R19 R22 R23 R24 R25 R57 R60
545 0308 401	RES 10K OHM 1% 0.1W 0805	6.0 EA	R12 R15 R26 R29 R51 R54
545 0308 501	RES 100K OHM 1% 0.1W 0805	6.0 EA	R13 R17 R21 R28 R53 R56
545 0308 999	RES ZERO OHM JUMPER 0805	13.0 EA	R2 R3 R4 R39 R40 R43 R44 R45 R46 R47 R48 R49 R50
610 1330 000	TEST POINT, LOOP, SMT	4.0 EA	TP1 TP2 TP3 TP4
843 5565 291	SCH, EXCITER INTERFACE	0.0 EA	
843 5565 293	PWB, EXCITER INTERFACE	1.0 EA	

Table 7-23 ASSY, PWR SUPPLY, 240V, 5KW - 992 9990 023

Harris PN	Description	Qty UM	Reference Designators (C)
250 0550 012	RECP, 4 STRAP W/MULTILUG 5/16"	1.0 EA	J001
250 0550 015	RECP, 600VAC, TWO 8AWG W/GND	1.0 EA	J002
299 0040 000	TAPE, PVC FOAM,1"W X 0.062"TH	3.0 FT	#JOO1
302 0106 000	SCR, 6-32 X 3/8	2.0 EA	2#CB001

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302 0130 000	SCR, 8-32 X 3/8	4.0 EA	4#FRONT PNL
302 0356 000	SCR, 8-32 X 1/4	8.0 EA	
306 0007 000	NUT, HEX 1/4-20	2.0 EA	
310 0009 000	WASHER, FLAT 1/4	1.0 EA	
314 0005 000	WASHER, SPLIT-LOCK 6	2.0 EA	2#CB001
314 0006 000	WASHER, SPLIT-LOCK 8	4.0 EA	4#FRONT PNL
314 0009 000	WASHER, SPLIT-LOCK 1/4	2.0 EA	
358 3671 000	MOUNTING BRACKET, CKT BREAKER	1.0 EA	#CB001
384 1129 000	LED, GREEN CART 2.4V ESD	1.0 EA	DS001
606 0989 000	CIRCUIT BREAKER, 40A 2P 480VAC	1.0 EA	CB001
646 0665 000	INSPECTION LABEL	1.0 EA	
736 0354 000	*PSU, SW, 32VDC 240/480VAC 5KW	1.0 EA	PS001
843 5494 353	WIRING DIAG, POWER SUPPLY	0.0 EA	
917 2515 355	CABLE PKG, POWER SUPPLY	1.0 EA	
943 5494 291	SCREW SHOULDER 6-32	4.0 EA	2#J001 2#J002
943 5494 529	CHASSIS, HALF, PS	2.0 EA	
943 5560 032	PANEL, POWER SUPPLY FRONT	1.0 EA	

Table 7-24 KIT, SPARE PALLET (636-741MHZ) - 994 9782 002

Harris PN	Description	Qty UM	Reference Designators (B)
252 0465 000	WIRE, RIBBON 5 X 50 MIL	0 FT	USED TO SOLDER RF OUT, RF IN ON A5, A8-A13
404 0899 003	PAD, THERMAL INTERFACE	1.0 EA	#A5, #A8-A13
817 2515 032	REPLACE INSTRUCT, PA PALLET	1.0 EA	
992 9970 001	PWA, PALLET, BAND 'C'	1.0 EA	USED AS A5, A8-A13

Table 7-25 KIT, SPARE PALLET (736-860MHZ) - 994 9782 003

Harris PN	Description	Qty UM	Reference Designators (C)
252 0465 000	WIRE, RIBBON 5 X 50 MIL	0 FT	USED TO SOLDER RF OUT, RF IN ON A5, A8-A13
404 0899 003	PAD, THERMAL INTERFACE	1.0 EA	#A5, #A8-A13
817 2515 032	REPLACE INSTRUCT, PA PALLET	1.0 EA	
992 9973 001	PWA, PALLET, BAND D	1.0 EA	USED AS A5, A8-A13

Table 7-26 KIT, SPARE PALLET (470-550MHZ) - 994 9782 004

Harris PN	Description	Qty UM	Reference Designators (B)
252 0465 000	WIRE, RIBBON 5 X 50 MIL	0 FT	USED TO SOLDER RF OUT, RF IN ON A5, A8-A13
404 0899 003	PAD, THERMAL INTERFACE	1.0 EA	#5, #A8-A13
817 2515 032	REPLACE INSTRUCT, PA PALLET	1.0 EA	
992 9975 001	PWA, PALLET, BAND 'A'	1.0 EA	USED AS A5, A8-A13

Table 7-27 KIT, SPARE PALLET (547-638MHZ) - 994 9782 005

Harris PN	Description	Qty UM	Reference Designators (B)
252 0465 000	WIRE, RIBBON 5 X 50 MIL	0 FT	USED TO SOLDER RF OUT, RF IN ON A5, A8-A13
404 0899 003	PAD, THERMAL INTERFACE	1.0 EA	#5, #A8-A13
817 2515 032	REPLACE INSTRUCT, PA PALLET	1.0 EA	
992 9979 001	PWA, PALLET, BAND 'B'	1.0 EA	USED AS A5, A8-A13

Table 7-28 FORMAT, 500W UHF RANGER - 994 9696 001

Harris PN	Description	Qty UM	Reference Designators (N)
357 0103 000	MODULE FRONT, REAR CLAM SHELL	1.0 EA	(PART OF PA2 BLANK)

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357 0103 001	MODULE FRONT CLAM SHELL	1.0 EA	(PART OF PA2 BLANK)
484 0560 000	*FILTER BANDPASS 1.3KW UHF DTV	0.0 EA	(1 REQ'D) LAST TWO DIGITS OF PART NUMBER INDICATES CHANNEL, XX = US CHANNELS 14-69 A14
484 0562 100	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 470-550 MHZ, CHANNELS 14-26) FL1
484 0562 200	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 547-638 MHZ, CHANNELS 27-41) FL1
484 0562 300	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 636-741 MHZ, CHANNELS 42-58) FL1
484 0562 400	FILTER, LOW PASS, UHF 5KW	0.0 EA	(1 REQ'D FOR 736-806 MHZ CHANNELS 59-69) FL1
620 2957 004	CIRCULATOR, UHF 1000W	0.0 EA	(1 REQ'D FOR 470-518 MHZ) CIR1
620 2957 005	CIRCULATOR, UHF 1000W	0.0 EA	(1 REQ'D FOR 518-598 MHZ) CIR1
620 2957 006	CIRCULATOR, UHF 1000W	0.0 EA	(1 REQ'D FOR 596-704 MHZ) CIR1
620 2957 007	CIRCULATOR, UHF 1000W	0.0 EA	(1 REQ'D FOR 701-860 MHZ) CIR1
620 3261 000	ADAPTER, 1-5/8" TO 7/16 FEMALE	1.0 EA	# A10 (PART OF RF CHAIN)
646 1353 000	NAMEPLATE, XMTR EQUIPMENT	1.0 EA	(MOUNTS TO OUTSIDE OF REAR DOOR)
700 1422 019	LOAD, 50 OHM, 1/2W	1.0 EA	#A12 R3
943 5560 090	MODULE 2 BLANK	1.0 EA	(PART OF PA2 BLANK)
988 2497 001	DP RANGER SERIES	2.0 EA	
992 9898 005	PA MODULE, 600W, 470-550MHZ,	0.0 EA	(1 REQ'D, THIS FREQUENCY) PA1
992 9898 006	PA MODULE, 600W, 547-638MHZ	0.0 EA	(1 REQ'D, THIS FREQUENCY) PA1
992 9898 007	PA MODULE, 600W, 636-741MHZ	0.0 EA	(1 REQ'D, THIS FREQUENCY) PA1
992 9898 008	PA MODULE, 600W 736-806MHZ	0.0 EA	(1 REQ'D, THIS FREQUENCY) PA1
992 9990 001	BASIC, UHF RANGER XMTR	1.0 EA	
994 9782 002	KIT, SPARE PALLET (636-741MHZ)	0.0 EA	# INSIDE PA1
994 9782 003	KIT, SPARE PALLET (736-860MHZ)	0.0 EA	# INSIDE PA1
994 9782 004	KIT, SPARE PALLET (470-550MHZ)	0.0 EA	# INSIDE PA1
994 9782 005	KIT, SPARE PALLET (547-638MHZ)	0.0 EA	# INSIDE PA1
994 9785 010	EXCITER, CD-1A,	1.0 EA	A6
994 9797 060	KIT, SPARE PARTS, ADVANCED	0.0 EA	(OPTION, 1 REQ'D IF PURCHASED)
994 9797 061	KIT, SPARE BOARDS, ADVANCED	0.0 EA	(OPTION, 1 REQ'D IF PURCHASED)
994 9797 062	KIT, RANGER INSTALLATION MATL.	0.0 EA	(OPTION, 1 REQ'D IF PURCHASED)

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