

TECHNICAL MANUAL
888-2685-001

Ranger Series™
Commissioning Manual

Ranger Series™
Commissioning Manual



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Rev. A1, Dec. 24, 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.

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Technical Assistance

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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).

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12/24/07

WARNING: Disconnect primary power prior to servicing.

Manual Revision History

Ranger™ Mobile Commissioning Manual

REV.	DATE	ECN	Pages Affected
Rev A	9/20/07	Prelim.	Created and Manual Sent To Review
Rev A1	12/24/07	Prelim.	Added exciter settings.

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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:
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.

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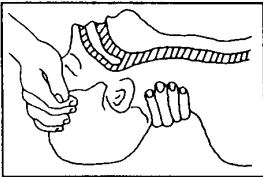
TREATMENT OF ELECTRICAL SHOCK

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

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

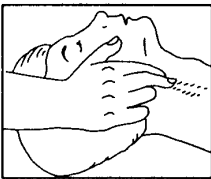
(A) AIRWAY

IF UNCONSCIOUS,
OPEN AIRWAY



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

CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

(B) BREATHING

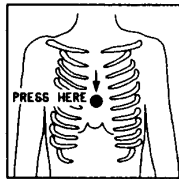
IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING



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

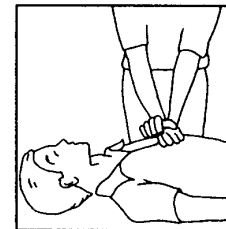
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



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

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



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

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

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

FIRST-AID

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

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Section 1

Introduction

1

1.1 Purpose of This Manual

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

- Section 1, Introduction, provides general manual layout, equipment description, block diagram and general specifications.
- Section 2, Installation Confirmation, provides step by step instructions to confirm installation has been completed.
- Section 3, Operation, contains information regarding transmitter operation and GUI (graphical user interface) screen content.
- Section 4, RF Testing, provides examples of measurements that are required to verify transmitter RF performance. Examples are configured in a report format.
- Section 5, Replacement Procedures, outlines required procedures for removal and replacement of components.
- Section 6, ISP (In System Programming) instructions for reprogramming transmitter software.

1.2 Ranger Transmitter Models

The Ranger Series™ transmitter utilizing FLO™ technology is available in 2 power levels as listed in Table 1-1. Both systems are designed to use external (low loss) mask filters for maximum usable RF power output.

Table 1-1 Ranger 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 control system is adapted from the state-of-the-art Atlas Series UHF 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 an Apex exciter, 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 Ranger models look identical due to the use of false module covers for the 2 or 3 right-hand slots.



Figure 1-1 Ranger Transmitter - Front View

1.3 System Block Diagrams

Figure 1-2 shows the system block diagram of the CZ1000F Ranger Transmitter. The CZ500F model has only 1 PA Module and is identical to the CZ1000F with the following items deleted:

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

⇒ NOTE:

For components locations refer to Figure 2-1 on page 2-2 and Figure 2-3 on page 2-6.

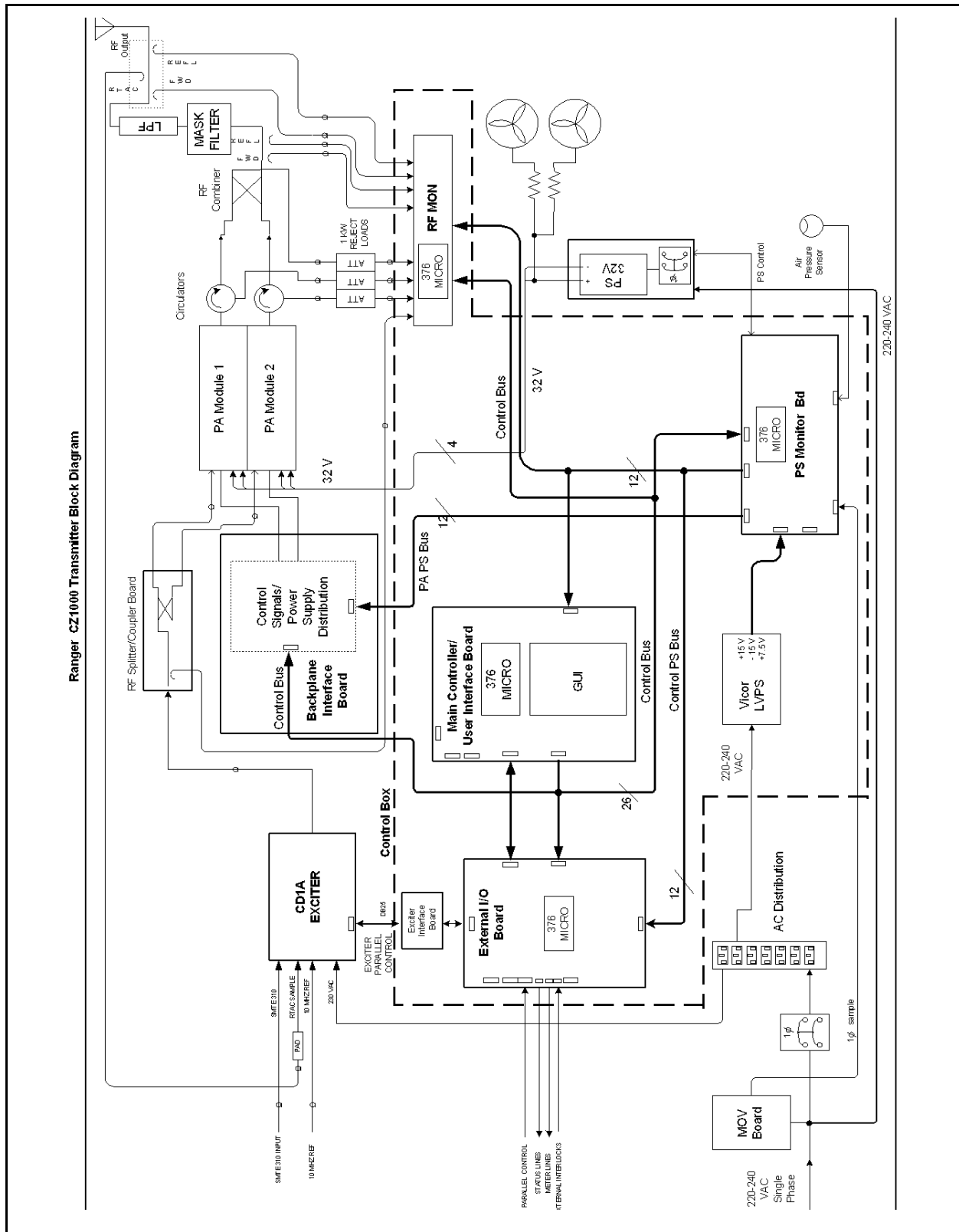


Figure 1-2 Ranger Series™ System Block Diagram

1.4 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.

1.4.1 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.

1.4.2 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

Section 1 Introduction

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.

1.4.3 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.

1.4.4 Remote Control

The Ranger 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.

1.5 PA Module

The Ranger 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.

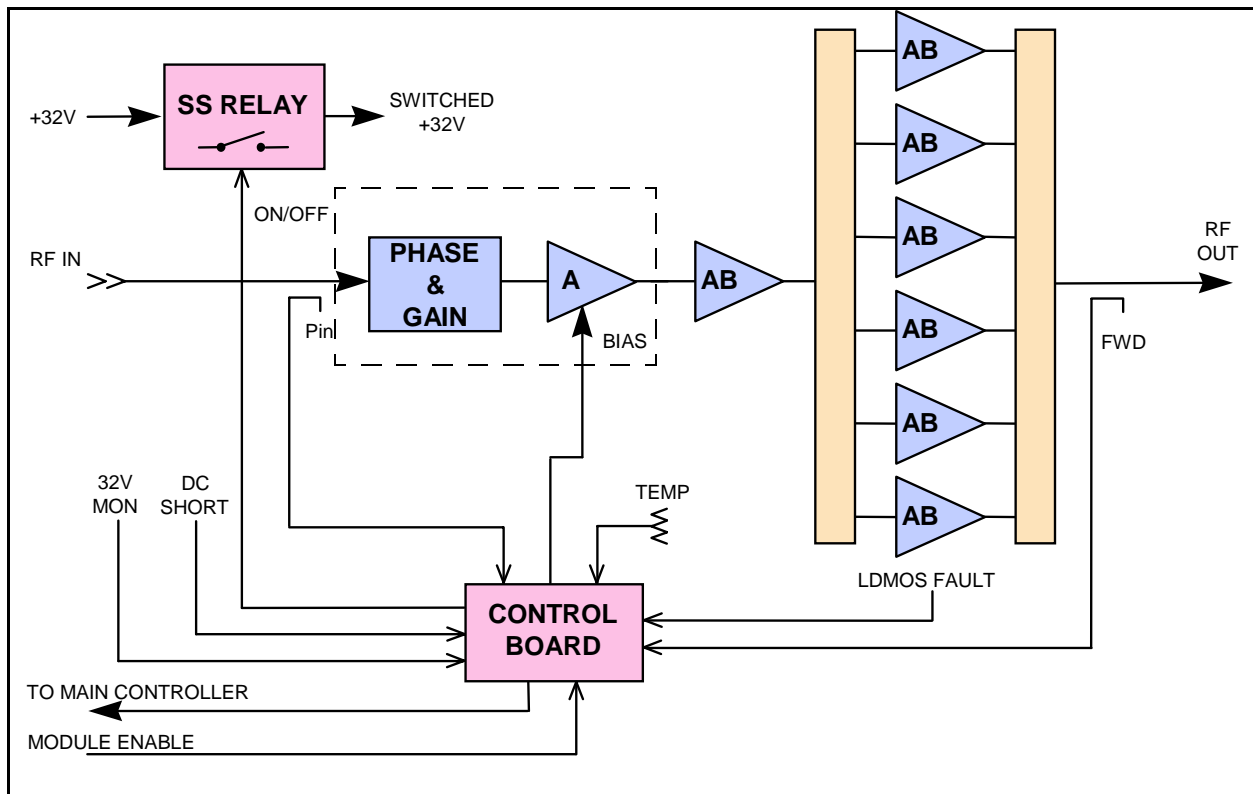


Figure 1-3 PA Module Block Diagram

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.

Section 1 Introduction

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.

1.6 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.

1.7 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.

1.8 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 Mask Filter	W	At 36 dB shoulders (measured +/-3.00 MHz from center of 6 MHz channel)	CZ500F - 375W CZ1000F - 750W
RF Load Impedance	Ohms		50 Ohms
RF Load VSWR		Over specified TV channel	1.1:1
Output Connector			1-5/8" EIA Flanged

Item	Units	Conditions	Value
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	≥ 33 dB
Shoulder Level	dB	Measured at transmitter output before filter, for 6 MHz channel, $F_c \pm 3$ MHz	≥ 36 dB
Carrier Suppression	dB		≥ 20
I/Q Imbalance	dB	Residual Sideband Level	≥ 50
Frequency Tolerance (without external reference)	Hz	for at least 24 hrs.	1×10^{-8}
Frequency Tolerance (with external reference)	Hz	for at least 24 hrs.	1×10^{-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	$\pm 10\%$, 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			
Conducted Spurious Radiation	dBc	Measured at transmitter output before filter	< -30
AC Line			

Section 1 Introduction

Item	Units	Conditions	Value
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 CZ500F & CZ1000F)
Power Consumption (Typical)	kW		2.5kW for CZ500F 5 kW, for CZ1000F
Environmental			
Operational Temperature Range	°C	Derate 2 degree C per 300m AMSL	0 - 45
Operational Relative Humidity	%	Non-condensing	0 - 90
Guaranteed Specification Temperature Range	°C		5-45
Storage Temperature	°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

CI-PS-02-003 Ranger Performance Spec

Section 2

2

Installation Verification &

Initial Turn-on

2.1 Introduction

This section includes the information necessary for installation confirmation prior to initial system start-up of the Ranger™ Series, 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 similar installation and testing procedures.

**CAUTION:**

THE PROCEDURE THAT FOLLOWS ASSUMES THAT THE INSTALLATION PROCESS HAS BEEN COMPLETED AND THAT ALL TESTING OUTLINED IN SECTION 2 OF THE RANGER MOBILE TRANSMITTER MANUAL HAS BEEN COMPLETED. IF AT SOME POINT DURING THIS CONFIRMATION PROCESS THE COMMISSIONING AGENT DISCOVERS THAT INSTALLATION STEPS HAVE BEEN MISSED THEN THE INSTALLATION STEPS OUTLINED IN THE TRANSMITTER MANUAL SHOULD BE REPEATED IN THEIR ENTIRETY BEFORE PROCEEDING WITH COMMISSIONING.

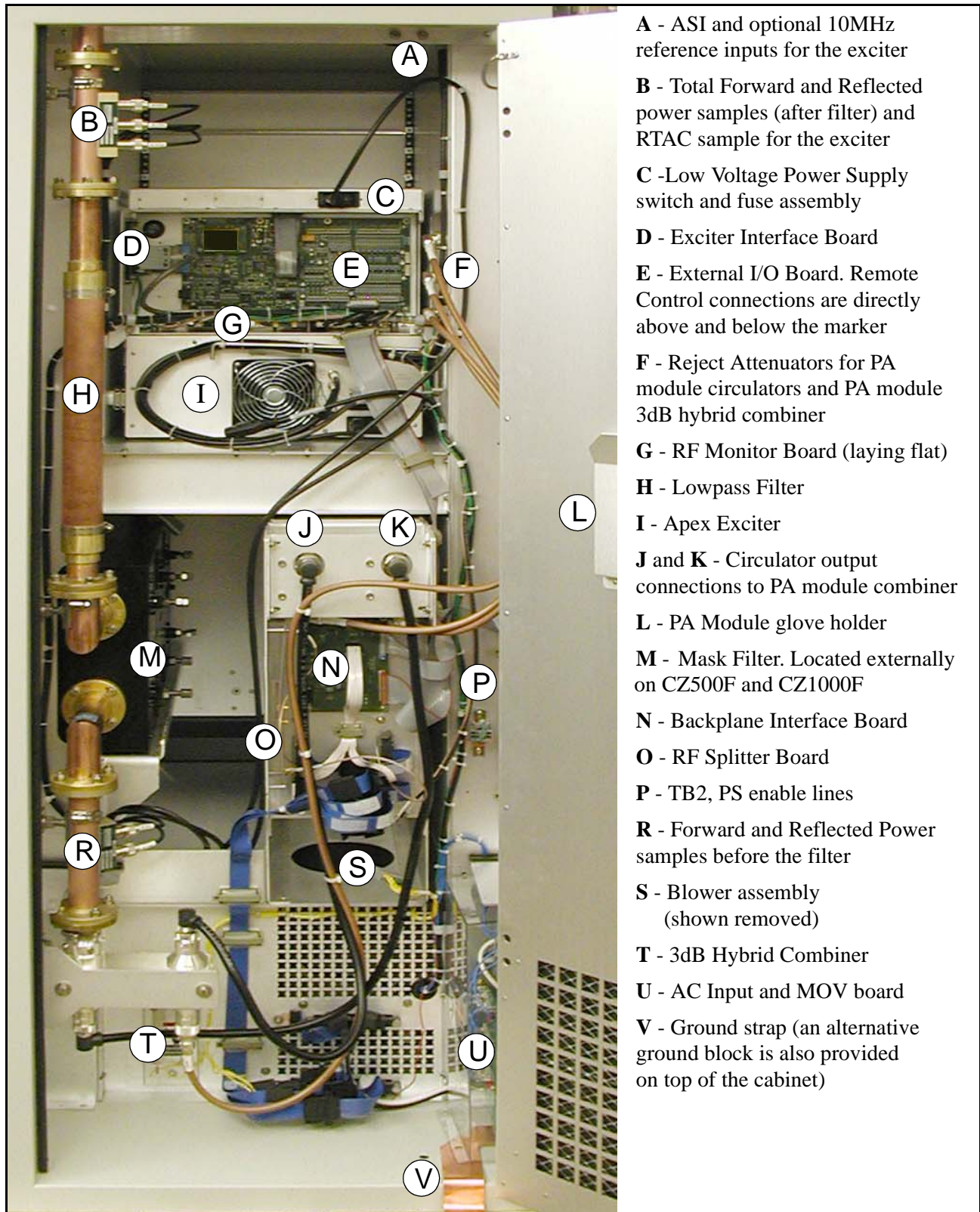


Figure 2-1 Component Locator, Cabinet Rear View



- A - Control panel with GUI Touchscreen
- B - Apex 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 2-2 Component Locator, Cabinet Front View

2.2 Documentation

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™ Mobile Series Transmitter Manual
3. 888-2604-001 Apex Exciter using FLO^R Technology Operating Manual
4. Drawing Package with a complete set of installation schematics for the transmitter system

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.

2.2.1 Installation Drawings

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.

2.3 Installation Confirmation Checkboxes

- Located to the left of each important step in the commissioning 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 an opportunity for review at the end of the procedure to insure 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.*

2.4 Transmitter Cabinet Placement

- The transmitter cabinet as **approximately 3 feet of clearance on each side and in the back. The front of the transmitter has a clearance of at least 5 feet to allow for access to the PA and power supply modules.**
- The transmitter is secured to floor as required by local codes.**
- The transmitter is level and solid (not rocking).**

2.5 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.

- The Primary AC conduit is securely attached 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 2-3.
- The AC supply wires have been connected 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 installed as outlined in the Figure 2-3.**
- The safety ground wire is attached to one of the terminals on the grounding block.**

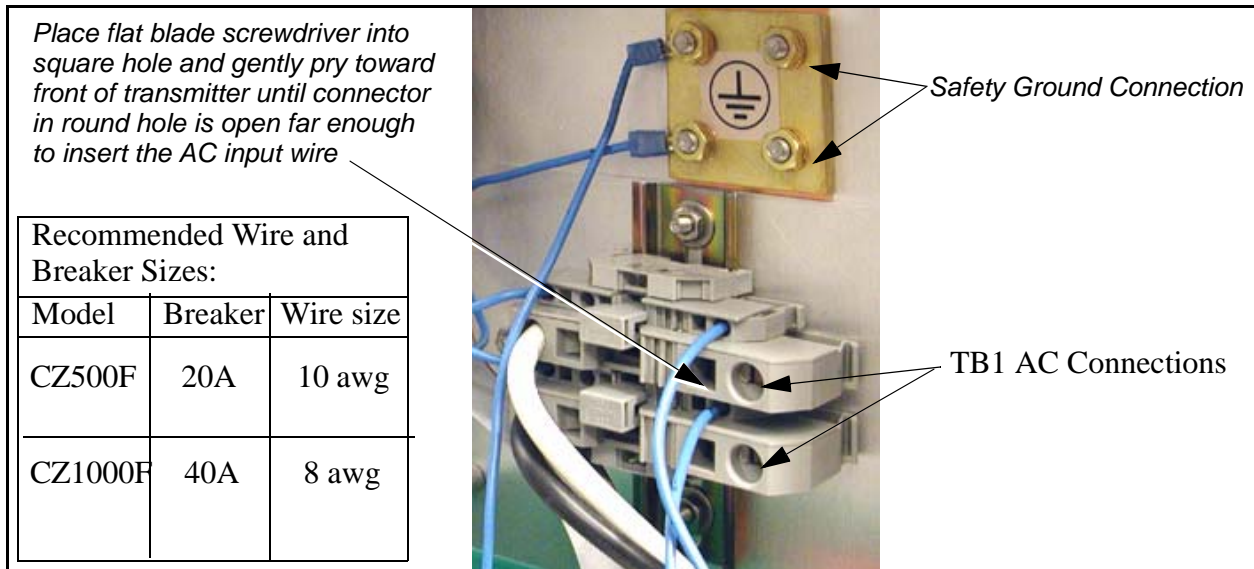


Figure 2-3 AC and Safety Ground Connections

- Verify that the AC wires are securely connected to the primary AC terminal block TB1.** Be sure that the wires are fully seated and that the insulating jacket has not been pinched between the contact jaws inside the connector.

2.6 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.



Confirm that the ASI input is connected to the terminal (may be labeled SMPTE 310M as seen in the photo). 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.



Verify that a ground strap is connected 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.

2.7 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 "2.7.1 External Interlocks" on page 2-8.
- 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.

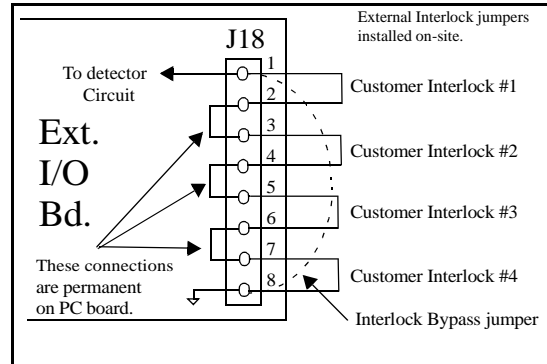
⇒ **NOTE:**

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)

2.7.1 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

2.7.2 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:

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



The required fault-off and rf-mute interlocks have been properly wired. These interlock requirements may vary from site to site.

2.8 3 Port Patch Panel Connection Confirmation

⇒ 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.

2.9 Motorized RF Switch Connections (if equipped)

⇒ **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)



The RF_SW_SEL_OUT at J15-9 on the External I/O board is connected 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.



One side of S1A and S2A (interlock switches on the rf switch) is connected 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 S1B and S2B are connected 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.



Confirm that the jumpers in the External I/O board for all unused External Interlocks are installed. See "2.7.1 External Interlocks" on page 2-8 for information on connections. If no external interlocks are used, connect J18-1 to J18-8.

- Verify that the patch panel or RF switch has been installed and the proper jumpers and interlocks are in place.** These may vary from site to site.

2.10 PA and PS Module Installation

**WARNING:**

THE PA MODULES AND POWER SUPPLIES ARE LARGE AND RELATIVELY HEAVY, WEIGHING APPROXIMATELY 17KG. 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.



The power supply module is installed at the bottom of the cabinet and secured with two screws. The breaker on the front of the power supply should be set to OFF.



The PA module(s) are installed and fully seated into the front of the transmitter cabinet.

**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 90⁰ F (50⁰ 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.

2.11 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 2-1 on page 2-2). 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 2-4. 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.

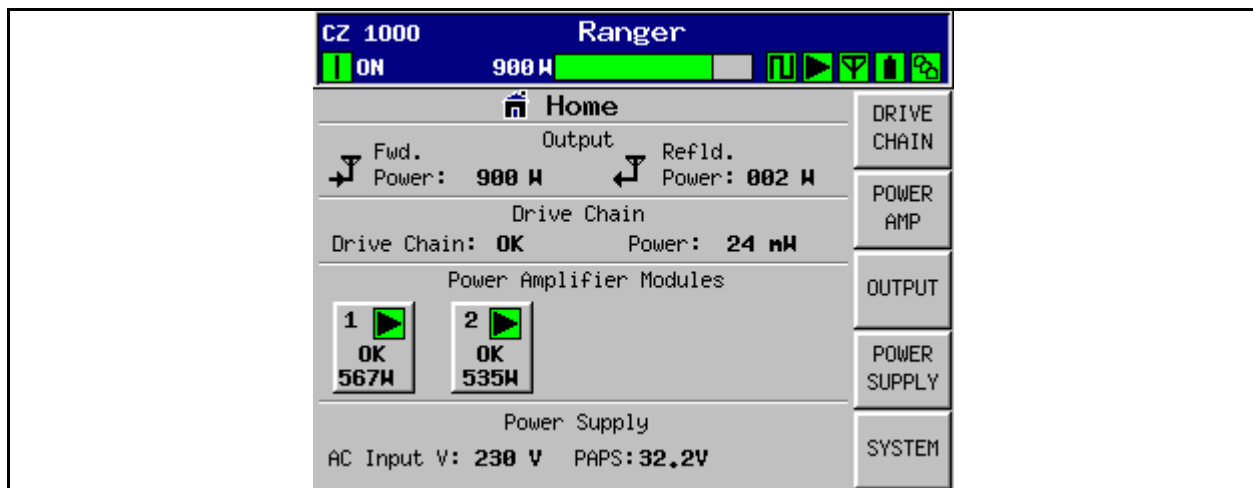


Figure 2-4 Home Page

- 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.

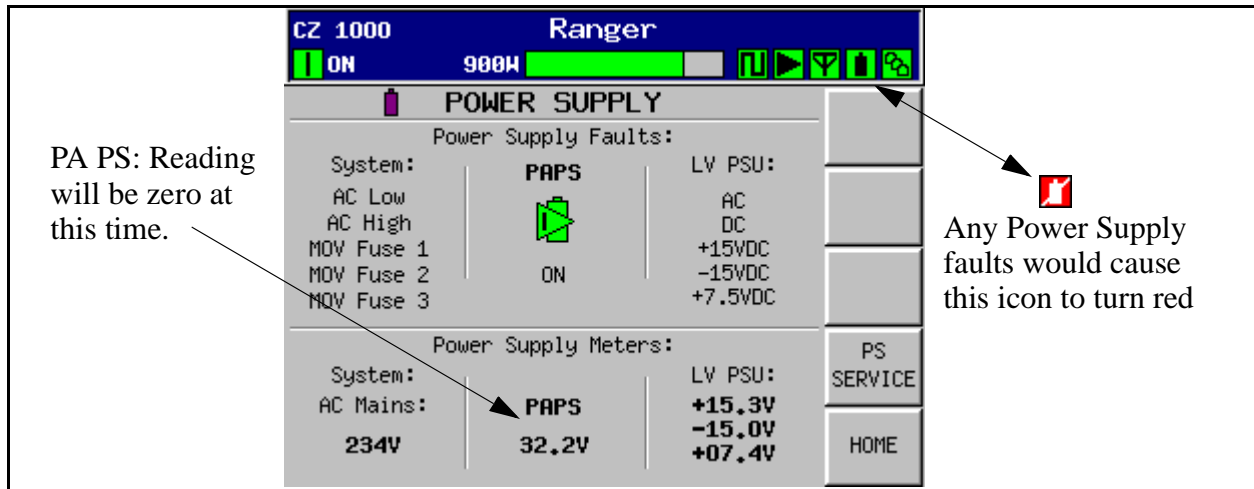


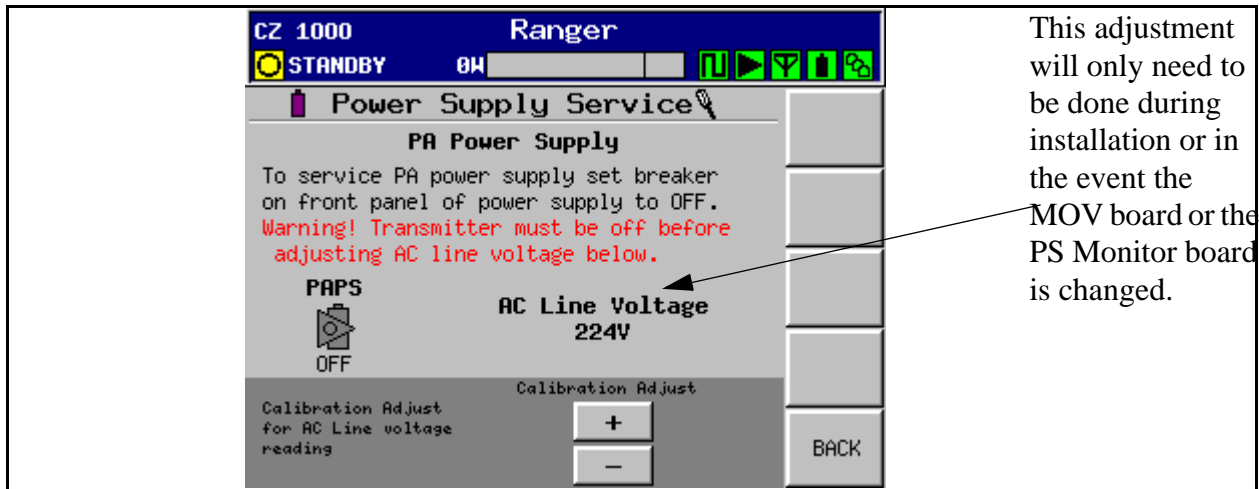
Figure 2-5 Power Supply Metering

⇒ **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 2-5. This will take you to the screen in Figure 2-6. 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.



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 2-6 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 2-7. 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.

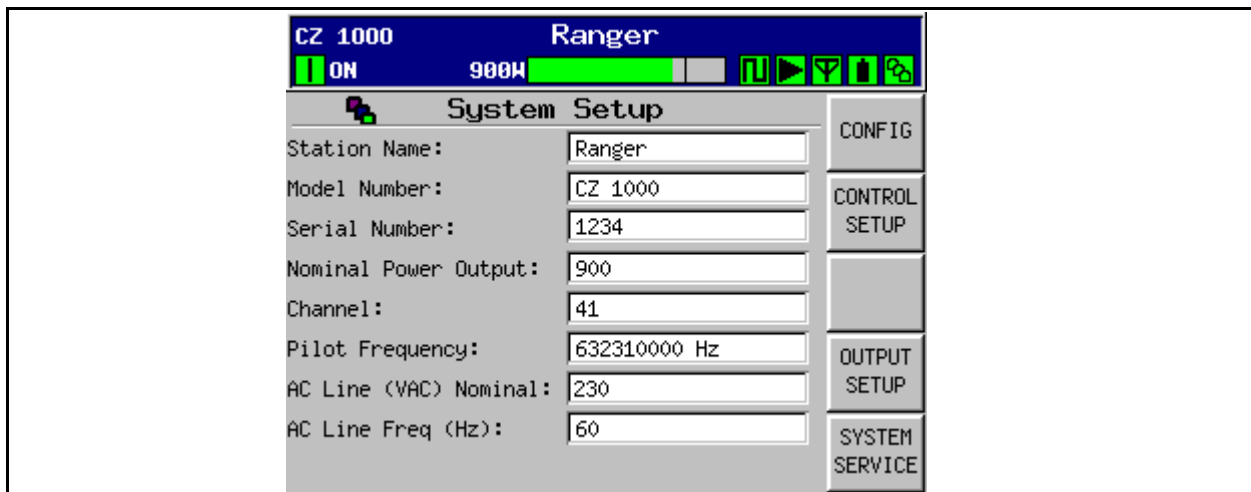


Figure 2-7 System Setup Screen

- Press the **CONTROL SETUP** button in Figure 2-7 to set the **Date, Time, LCD screen contrast and Password on the Control Setup screen, shown in Figure 2-8.** 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.

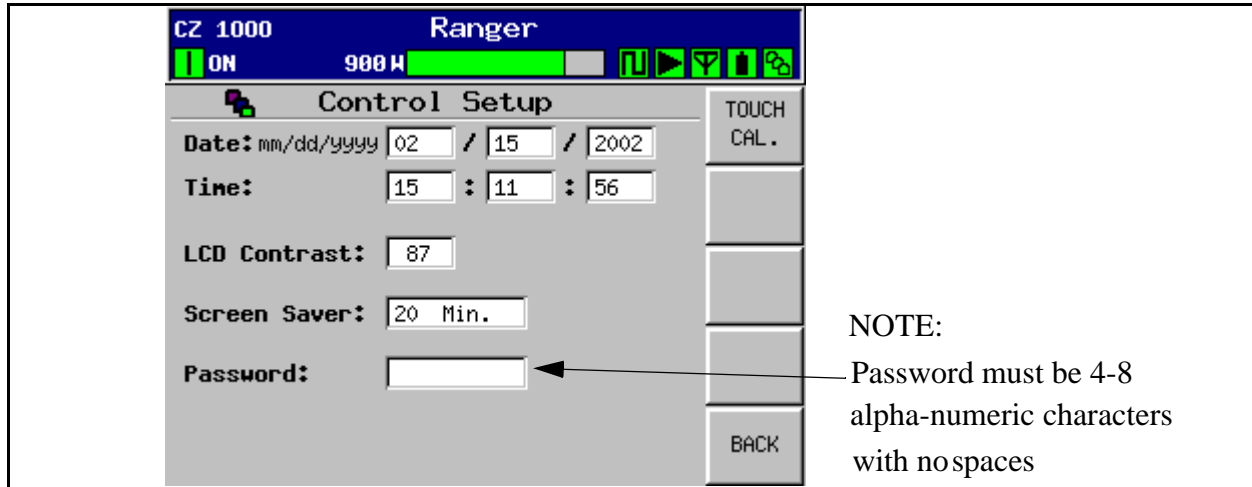


Figure 2-8 Control Setup Screen

2.11.1 Exciter Setup

The Apex exciters have been factory tested in the transmitter and preset to factory values. See the Apex Exciter technical manual to modify factory default settings to site specific parameters.

The exciters are located below the control panel. If there are two exciters Exciter A is always factory installed as upper unit (located immediately below the transmitter control panel). The optional exciter B is installed beneath exciter A.

2.11.1.1 Verify Exciter Signal Connections

Most of the input and output connections are at the rear of the exciter, only the RS232 connections are available at the front and rear. Figure 2-9 shows the rear panel connections.



Figure 2-9 Exciter Inputs and Outputs

- ASI #1 and or ASI #2 are connected to the exciter for the low and high priority ASI transport streams. For best common mode rejection, this cable shield should be grounded only at the source end.

The input impedance for each connector is 75 ohms. Belden 8281 or similar high-quality video cable can be used to deliver this signal to the exciter over a distance of up to 1000 feet.

- ASI OUT is a sample output of the active transport stream. It should not have a cable connected to it unless specified locally.
- ANT (GPS antenna input) connector should not have a cable attached since the GPS receiver is an option and not present in most Mobile exciters.
- 10MHZ REF IN (BNC) is optional and normally not used in a Mobile system.
- 1PPS (1 pulse per second input from the GPS receiver) should have a cable connected to it that comes from the GPS receiver.
- HPF RF SAMPLE IN (SMA) has a cable connected to it that comes from the output of high power mask filter. It is used by RTAC™ (Real Time Adaptive Correction) to correct for the linear distortions of the high power filter. Normal input signal range is -30 dBm to 0 dBm. The input impedance is 50 ohms.

- PA SAMPLE IN (SMA) should have a cable connected to it that comes from the output of the transmitter power amplifier, taken before the HPF and after the PA combiner for transmitters with multiple PAs. It is used by RTAC™ to correct for the nonlinear distortion caused by the power amplifier. Normal input signal range is -30 dBm to 0 dBm. The input impedance is 50 ohms.
- IPA SAMPLE IN (SMA), is **not used**. There should be no cable connected to this exciter input.
- RF OUT (SMA) should be have a cable connected to it. This is the on-channel RF signal output from the exciter. The output level is adjustable up to 250 mW average but is initially adjusted to produce an 80 ALC value on the transmitter GUI display.
- EXC/CTRL UHF (25 Pin D) should not have a cable connected to it.
- CAN (controller area network) should have a cable connected to it. The connector is a provision for the exciter to communicate with the transmitter GUI (graphical user interface) system controller.
- LAN 10Base-T should have a cable connected to it. The connector is a provision for connecting the exciter to a local area network.
- RS232 (on front and rear panels of exciter) is a 9 Pin D interface connector and they should not have cables attached to them. They are used to communicate with various computer applications. The front and rear panel connections can be programmed and used independently of each other.

2.11.1.2 AC Power

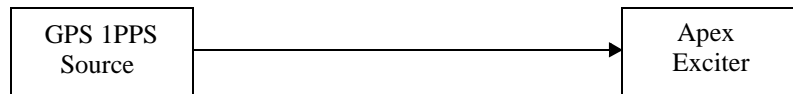
- AC Power is applied through a standard power cord to the connector at the right side of the rear panel as shown in Figure 2-9. The AC inlet connector also contains the power switch.

The power supply will automatically select the AC input voltage in two ranges. The two ranges are 85 to 132 VAC or 170 to 264 VAC

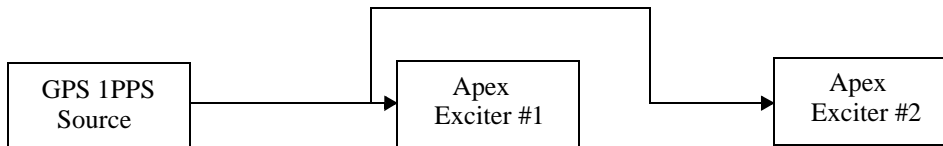
2.11.1.3 Verify Installation of the GPS 1PPS Signal

The GPS (global positioning system) 1PPS (1 pulse per second) signal has a rise time in the order of a few nanoseconds. It is delivered by a 50 ohm transmission line to the exciter. Improper termination can cause ringing on the pulse, which, if severe enough can cause timing errors in the system. The 1PPS signal must be properly distributed and terminated to avoid the ringing problem.

Figure 2-10 on page 2-18 shows two methods of distributing the 1PPS signal.



For a single 1PPS run from source to exciter, set the exciter FPGA modulator board 1PPS input termination jumper (JP1) to position 1 - 2 (50 ohm termination).



For a two exciters, the 1PPS signal can be bridged through exciter 1,

1. Keep the tee connector close to exciter 1's 1PPS connector (within one foot) to avoid the ringing problem.
Do not position the tee connector more than one foot from exciter 1, because this will aggravate the ringing problem.
2. Set exciter 1's FPGA modulator board 1PPS input termination jumper (JP!) to position 2 - 3 (high impedance).
3. Set exciter 2's FPGA modulator board 1PPS input termination jumper (JP!) to position 1 - 2 (50 ohms).

Figure 2-10 1PPS Signal Termination Methods.

2.11.1.4 Verify Exciter Configuration

The APEX exciter is configured using the LCD touch screens on the front of the exciters. The basic functions of these screens are discussed in the Apex Mobile Technical Manual 888-2604-001. It is necessary to be familiar with these screens in order to configure the exciter. The following steps are simply a configuration checklist and should be performed prior to turning on the transmitter PA's.

2.11.1.4.1 Verify Configuration of Setup Screens

⇒ NOTE:

The screen menus are given in *Italics* before the setup values.

Main Screen.

- Set exciter RF output power (the display reads average power) Normal value is less than 120 mW.

- Set the two RTAC functions. These are typically set to ADAPT.

Main Screen > Setup > Exciter Setup.

- Power Limit is usually set to 250 mW.

- Reference, refers to **External or Internal GPS** use. **External is the normal mode.** If used, it requires an external 1PPS input at the rear panel connector.

- Verify that the exciter is set to the correct channel.

⇒ NOTE:

Diagnostic Setup must be unlocked before the frequency or offsets can be changed.

- Verify that the correct transmitter type has been selected.

- If waveguide is used to feed the antenna and group delay precorrection is desired, select the type and length (in feet) of waveguide. Typically, coaxial line and not waveguide will be used.

Main Screen > Setup > Display Setup.

- Verify the Date and Time.

- Enter a new page title, if something other than APEX Exciter is desired. For example a site name might be entered.

- Select the desired Chart selection to allow the operator to view the Main screen response display at various points along the transmitter system.

- Adjust LCD Contrast to allow best viewing in the local conditions. Higher numbers produce greater contrast, lower numbers produce less contrast.

Main Screen > Setup > Change Password (or Security) Setup.

- Change passwords as required to satisfy operational requirements.
Main Screen > Setup > User Setup (Lock or Unlock).
- Lock or unlock User Setup to satisfy operational requirements.
Main Screen > Setup > Diagnostic Setup (Lock or Unlock).
- Lock or unlock Diagnostic Setup to satisfy operational requirements.

2.11.1.5 Verify Configuration of FPGA Screens

When configuring an exciter for the first time, it is useful to check the settings in the FPGA screens. The exciter manual gives detailed information on settings but the values on FPGA screen 4/5 are especially important. Values shown in Figure 2-11 are typical for 6 MHz operation but may need to be updated to meet on-site operational requirements.

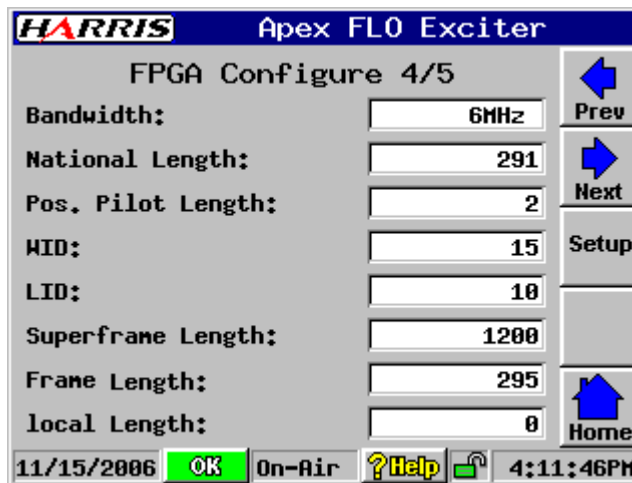


Figure 2-11 FPGA Configure 4/5

FPGA Configure 4/5 consists of registers whose values are written immediately to the FPGA when changed through the GUI.

FPGA re-initialization shall occur automatically after any FPGA Configure 4/5 register is changed.

The parameters of the FPGA Configure 4/5 screen are as follows.

- **Bandwidth:** 5MHz / 6MHz / 7MHz / 8MHz.
- **National Length:** Unsigned Decimal, range dependent on bandwidth:
0-245 5MHz, 0-295 6MHz, 0-345 7MHz, 0-395 8MHz. **XXX** Define
- **Pos. Pilot Length:** 2 / 6 / 10 / 14 – not bandwidth dependent. **XXX** Define
- **WID:** Unsigned Decimal, range 0-15. **XXX** Define

- **LID:** Unsigned Decimal, range 0-15. **XXX** Define
- **Superframe Length** - Display Only
- **Frame Length** - Display Only
- **Local Length** - Display Only.

2.11.1.6 Verify Configuration of Status Screens

When configuring an exciter for the first time, it is useful to check certain portions of the following status screens.

Main Screen > Status > ASI Input.

- This screen should show no faults if both ASI #1 and ASI #2 transport streams are present at the exciter input.
- If either transport stream is present no transport stream fault will appear on the front panel Transport Stream hardware switch, it will light green. If both are missing, the front panel Transport Stream and the Digital Processing hardware switches will show faults (light red)

Main Screen > Status > Adaptive Processing.

- HPF feedback (RF sample from output of high power filter), and Amp Feedback (RF power amplifier output sample) bargraphs:
- These bargraphs, each of which contain blue (peak power) and yellow (average power) traces, should be within their active travel ranges if the feedback signals are within the correct power range (-30 to 0 dBm). If the signal is out of range, that input will fault.
- ADC OvrRange (analog to digital converter over range) will be Ok if all feedback signals are within their proper ranges, and will fault if any are too large.

Main Screen > Status > ASI Input screen will show fault if both transport streams are missing.

- Main Screen > Status > Digital Processing > FLO FPGA Registers > FPGS Summary 1/5 > TS Active Indicates the active transport stream (TS1 Active or TS2) It will show fault if both ASI transport streams are missing.
- Main Screen > Status > Digital Processing > FLO FPGA Registers > Transport Stream Status Screen 3/5 > TS1 Detect and TS2 Detect indicates the presence of the transport streams by yes or their absence by no.
- Main Screen > Status > Digital Processing > FLO FPGA Registers > FPGA Summary 2/5 > SFN MODE should be set to **ON at all times**.

2.11.1.7 Normal Settings for Diagnostic Screens

The Diagnostics screens offer tests used to diagnose exciter problems. If the diagnostic selections are left in the wrong states, normal operation of the exciter could be impaired. The default values for the diagnostics screens can be found in Table 5-1 on page 10.

The following is a list of the normal states of the more critical diagnostic functions and the exciter mute.

Status > Adaptive Processing > Diagnostics

- LoopBack: None
- Test Tones: Disabled

Status > IF & RF Processing > Up Converter > Diagnostics

- Output Power AGC: Enabled

Status > IF & RF Processing > Down Converter > Diagnostics

- RF Sample Select: Automatic
- RF Sample AGC: Enabled

Status > System Control > External I/O Board > Diagnostics

- Analog Loopback: Disabled

Setup > Exciter > Exciter Setup screen > Mute soft key.

- The exciter is normally un-muted. Pressing the button will open a sub window which will have instruction to mute or un-mute the exciter output.

2.11.2 RF Initial Turn ON

- Shut the transmitter OFF.** The transmitter should be initially powered into a test load.
- Measure the test load impedance prior to application of RF power.** The load can be measured with a network analyzer prior to application of RF. Typical load VSWR values are $< 1.05:1$ at the operating channel. If verification of load VSWR is not possible then proceed with RF turn on at low levels and gradually increase power while monitoring reflected power levels. If significant reflected power levels are noted then measurement of the test load will be required.
- Set the Exciter power to zero.** This can be done using the lower button on the exciter GUI 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 2-5 on page 2-13.
- 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 2-12.

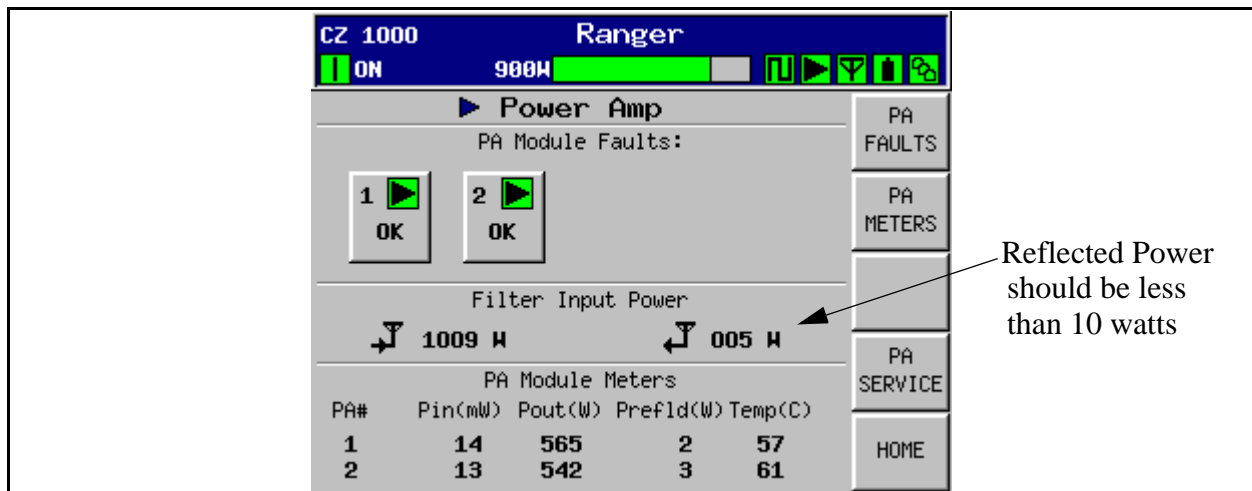


Figure 2-12 Power Amp Main Menu

- 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 2-4) 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 2-13. This screen can be accessed by pressing the PA Meters button on the Power Amp screen in Figure 2-12.

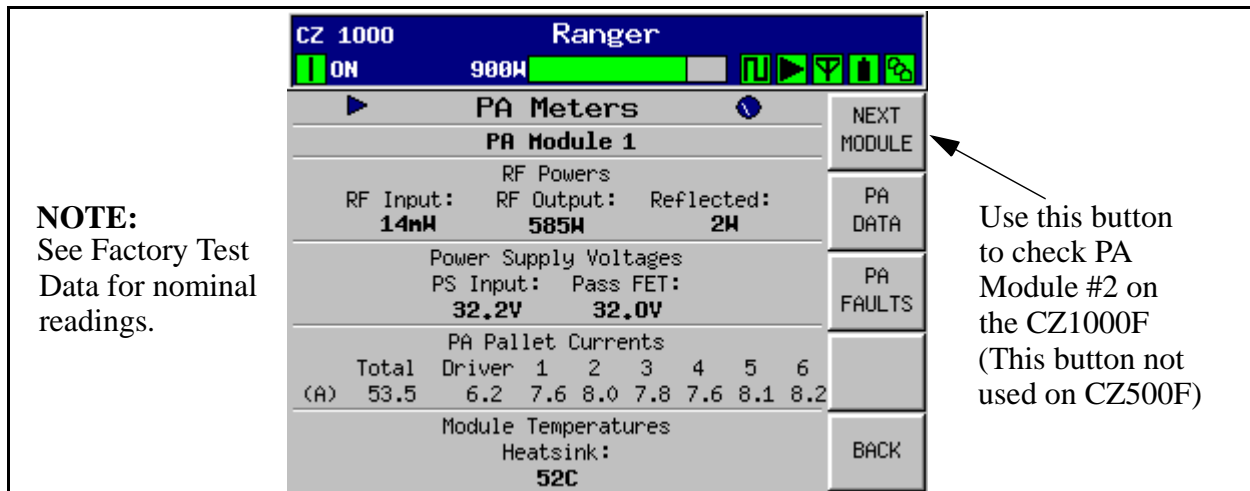


Figure 2-13 PA Meters Screen

- Press **POWER SUPPLY** and verify that all PA power supplies show **OK status (green)**.
- Press **OUTPUT** 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 2-14). This is adjusted at the factory and does not require re-adjustment as long as the current readings in Figure 2-14 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.

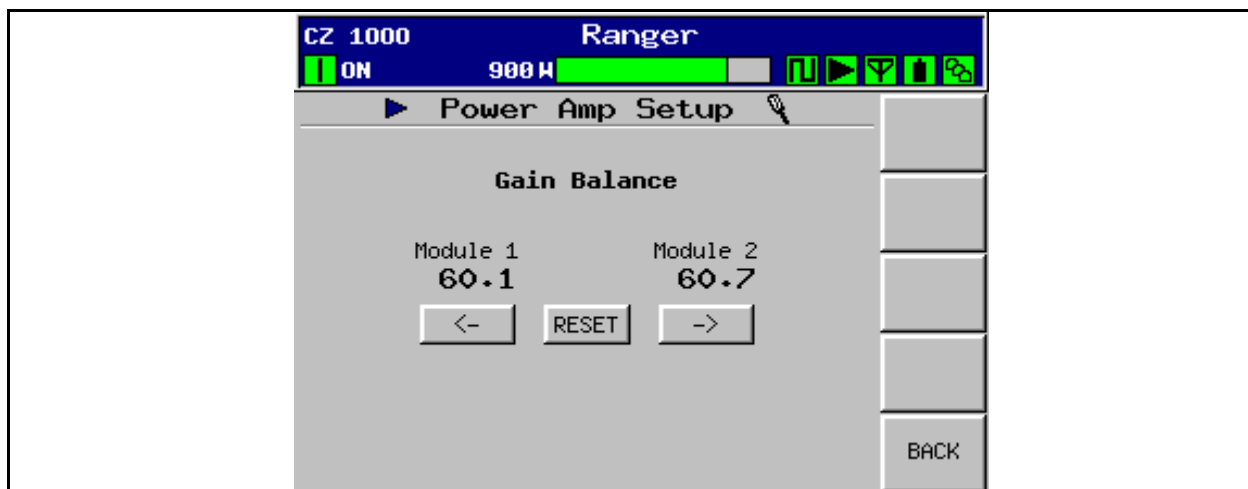


Figure 2-14 PA Setup Screen

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.

⇒ **NOTE:**

Section 4 RF Testing outlines commissioning RF measurements.

- Press transmitter off button to turn off RF output power.

- Measure the antenna and transmission line impedance prior to application of RF power to the antenna system. The transmission line and antenna can be measured with a network analyzer prior to application of RF.

⚠ CAUTION:
MEASURE THE AMOUNT OF RF POWER ON THE ANTENNA TRANSMISSION LINE PRIOR TO MEASUREMENT WITH A NETWORK ANALYZER. IN SOME INSTANCES THE RF ENERGY FROM NEARBY STATIONS MAY BE PRESENT ON THE TRANSMISSION LINE IN AMOUNTS LARGE ENOUGH TO DAMAGE THE NETWORK ANALYZER. IN CASES LIKE THIS MEASUREMENTS MAY BE TAKEN WITH AMPLIFIERS USED TO AMPLIFY THE NETWORK ANALYZER SIGNAL SO THAT IT IS LARGE ENOUGH TO OVERCOME THE RFI PRESENT ON THE SYSTEM TO BE MEASURED.

Typical antenna system VSWR values are < 1.2:1 at the operating channel. If verification of antenna system VSWR is not possible then proceed with RF turn on at low levels and gradually increase power while monitoring reflected power levels. If significant reflected power levels are noted then measurement of the system will be required.

2.12 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.

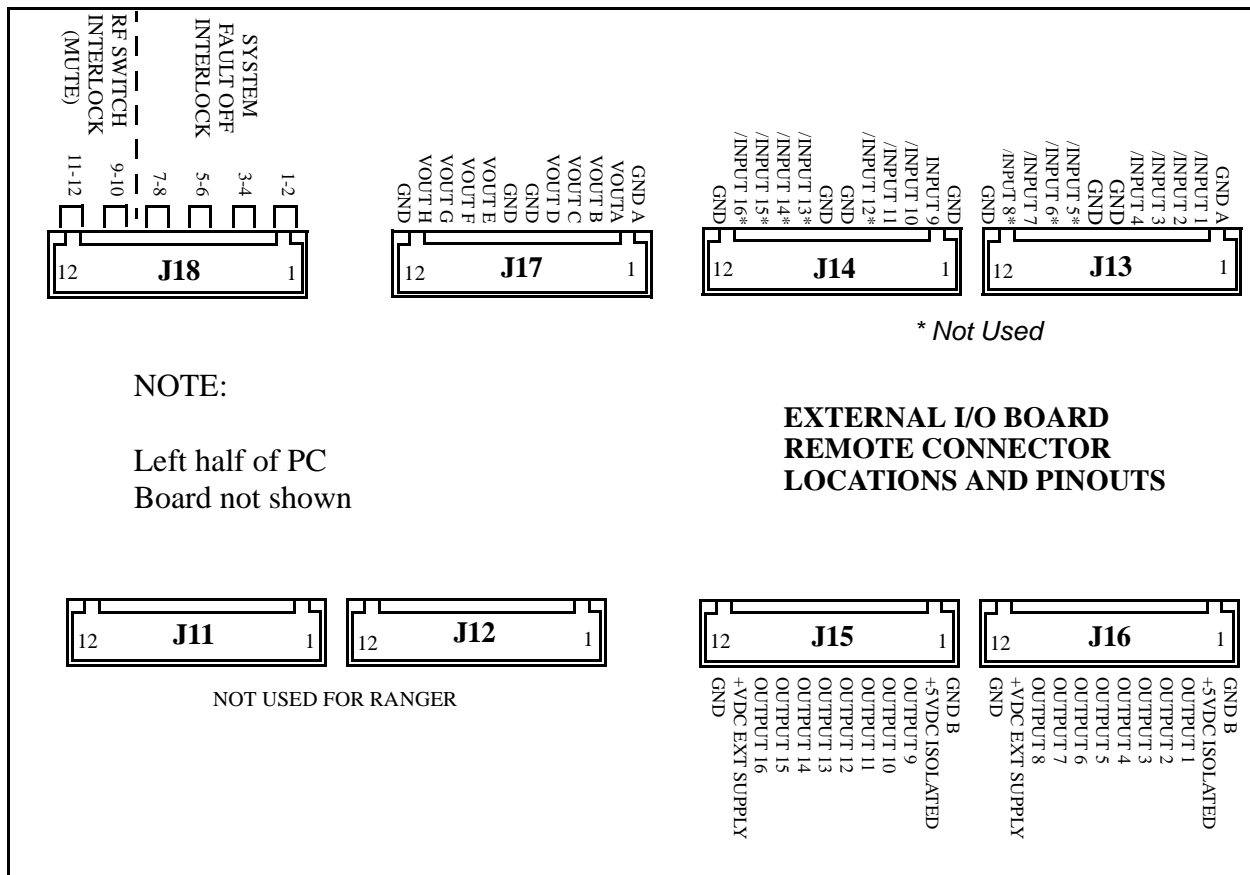


Figure 2-15 External I/O Connector Locator

2.12.1 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

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

Connector	Schematic Label	Function
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

2.13 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

2.13.1 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

Section 3

Operation and Adjustments

3

3.1 Introduction

This section gives detailed operation and adjustment information for the Ranger™ Series Solid-State UHF Series 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.

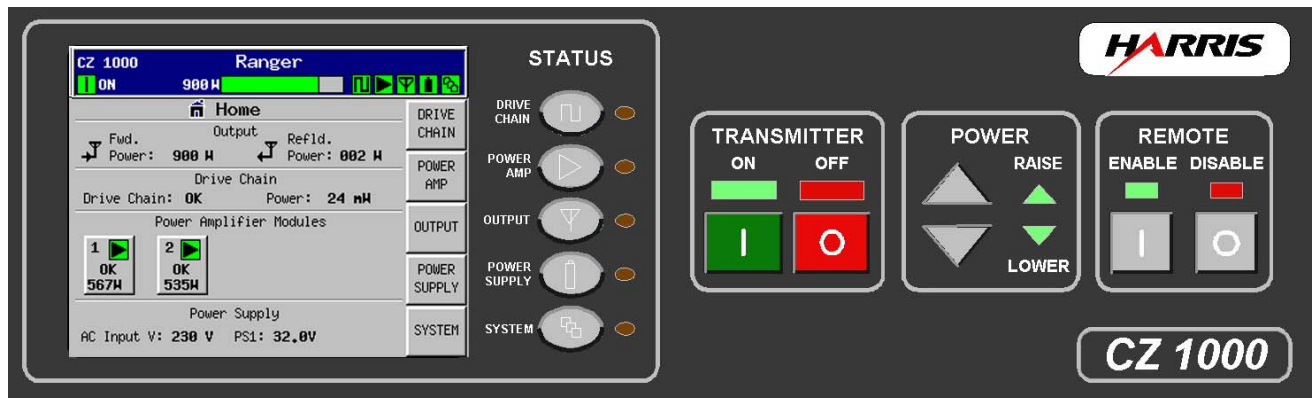
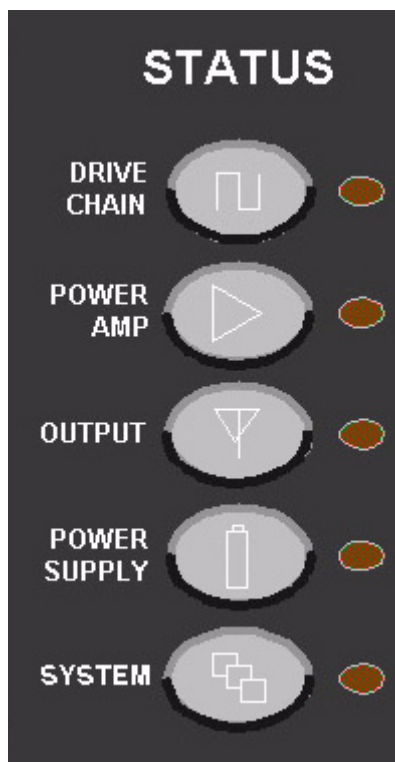


Figure 3-1 Transmitter Control Panel

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 (“Goocy”) 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.

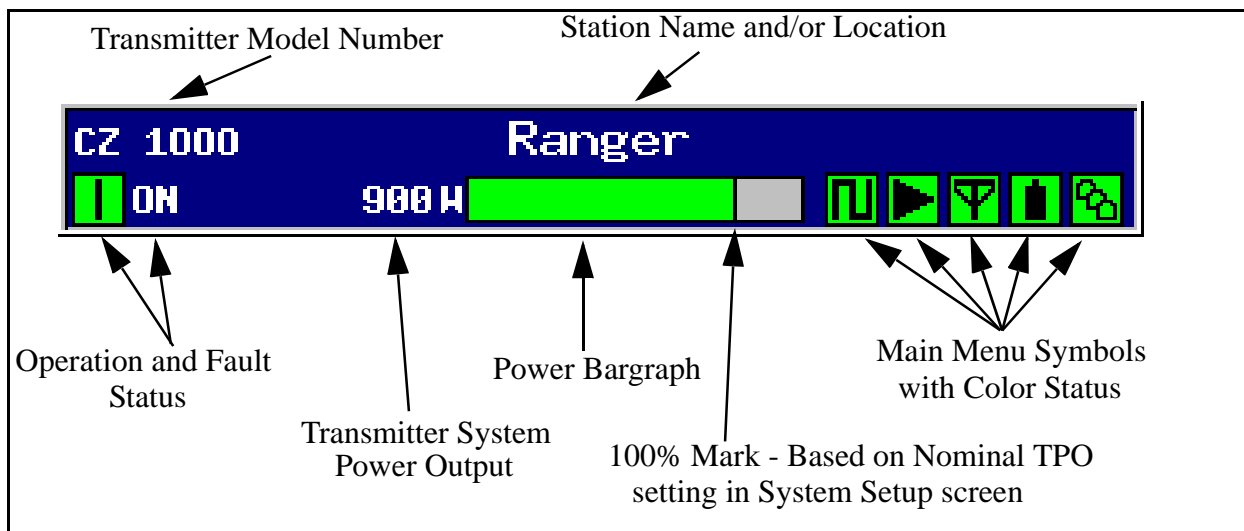


Figure 3-2 Global Touchscreen Display Sections

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.

Drive Chain	
Power Amp	
Output	
Power Supply	
System	

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.

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:

- System Forward and Reflected power
- Drive chain status and power level
- Individual Power Amplifier PA Module status and power level
- AC line voltage and PA power supply voltage.



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.

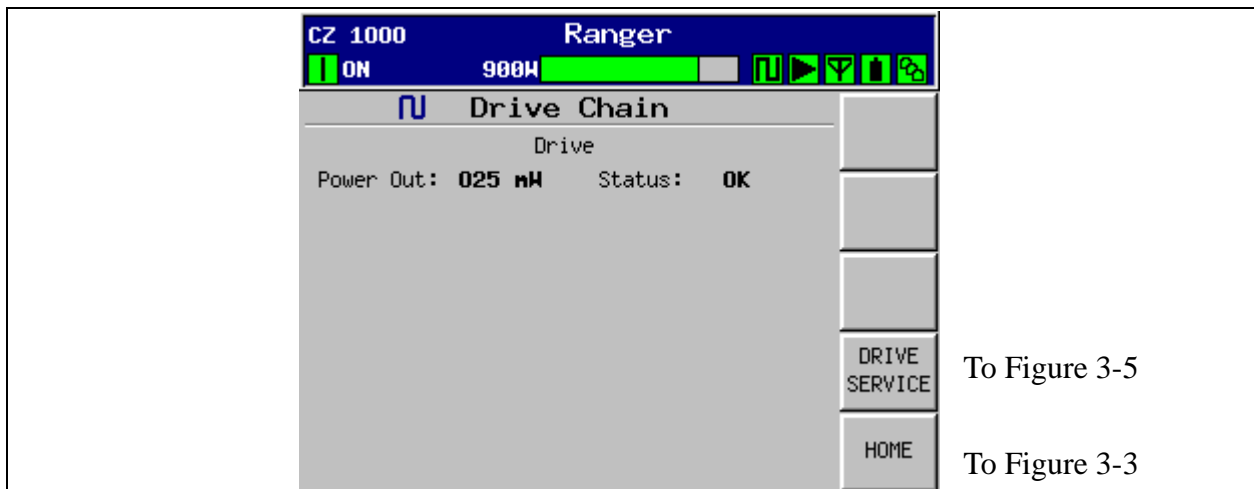


Figure 3-4 Drive Chain Screen

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.



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.

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.

CZ 1000
Ranger

ON 900M

Power Amp

PA Module Faults:

1 ▶
OK

2 ▶
OK

Filter Input Power

1009 W
005 W

PA Module Meters

PA#	Pin(mW)	Pout(W)	Prefld(W)	Temp(C)
1	14	565	2	57
2	13	542	3	61

PA
FAULTS

PA
METERS

PA
SERVICE

HOME

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.

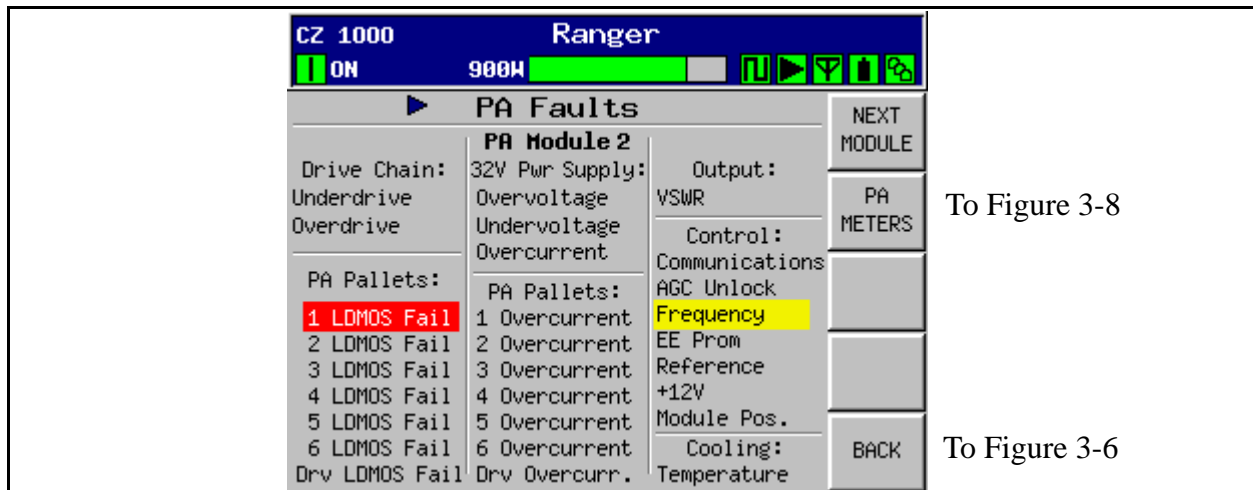


Figure 3-7 PA Faults Screen (PA Module 2 Selected)

3.6.1.1 Module 3 strike Routine

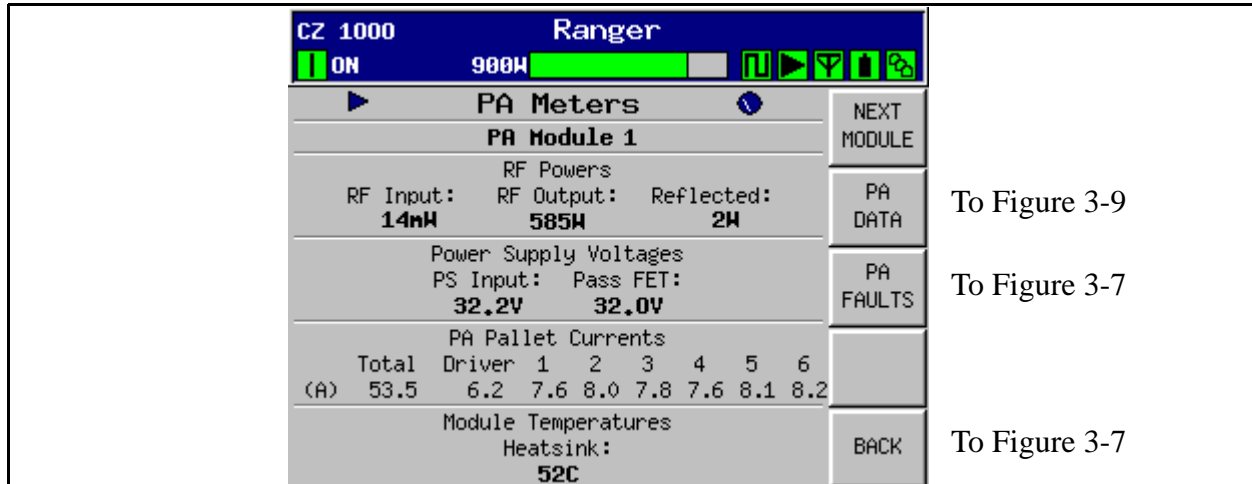
Under certain critical fault conditions, the PA module will try to shut off (Strike) and then re-initialize to try and clear the fault condition. If the fault is still present after the module turns back on it will shut off (Strike) again. If the fault is still present after a 3rd strike or returns within 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°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.



To Figure 3-9
To Figure 3-7
To 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.		

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.

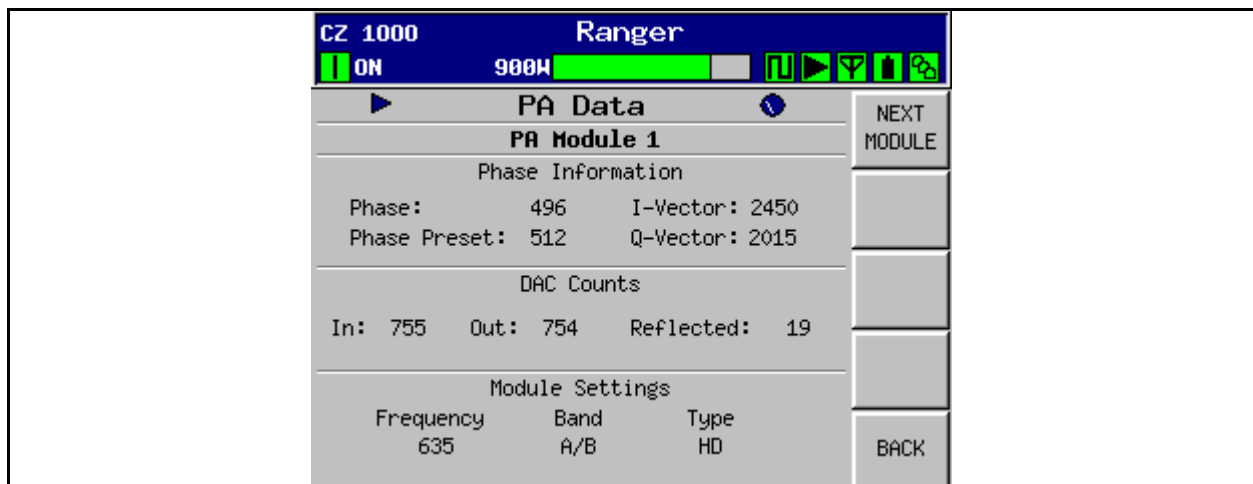


Figure 3-9 PA Data Screen

- 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
- **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 90⁰ F (50⁰ 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.

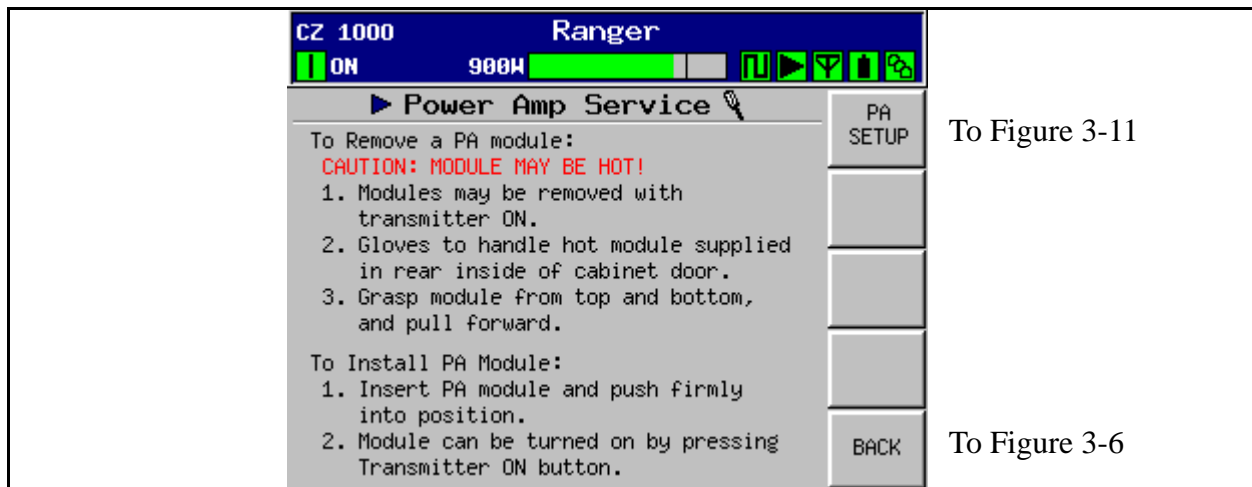


Figure 3-10 PA Service Screen

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.

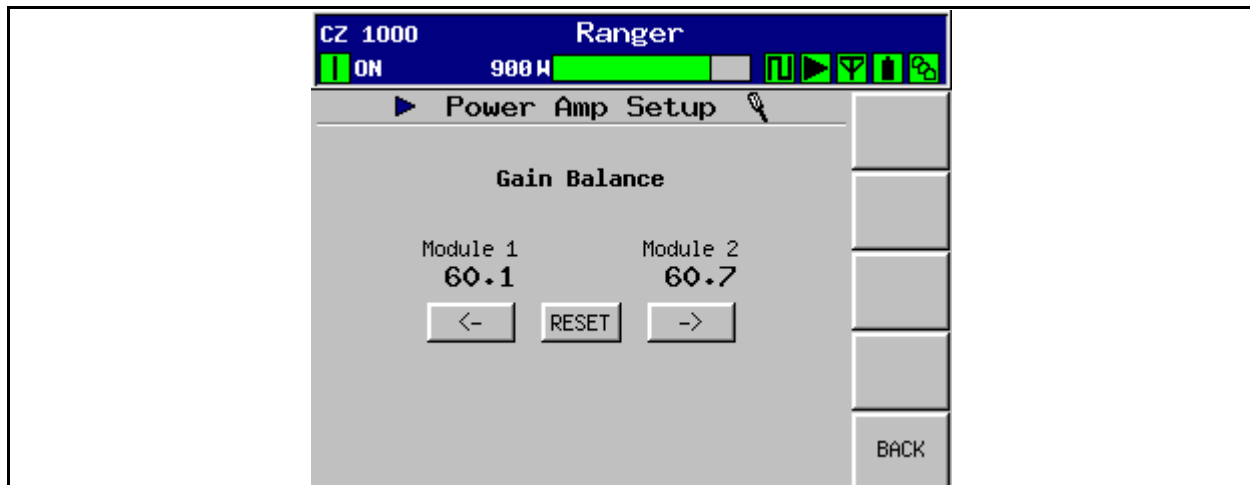


Figure 3-11 PA Setup Screen

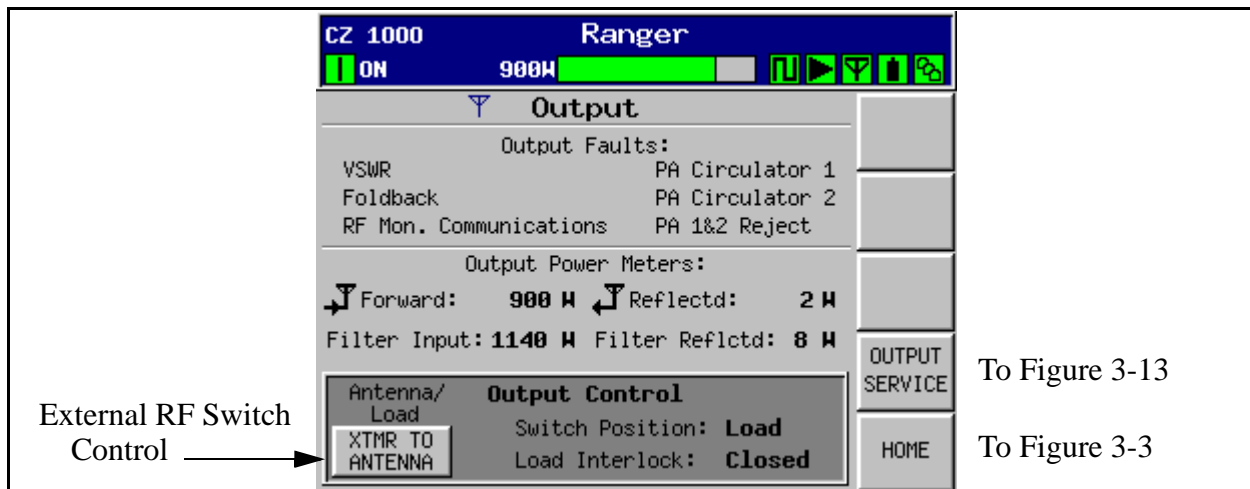
⇒ **NOTE:**

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.

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.



To Figure 3-13

To Figure 3-3

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 "2.7 Interlock Connections" on page 2-7.

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".

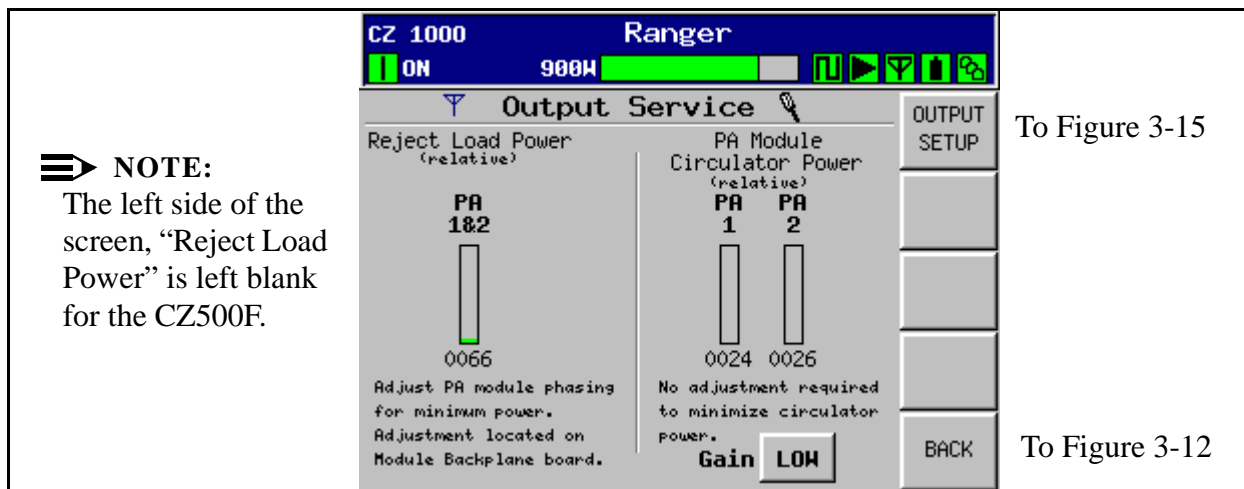


Figure 3-13 Output Service Screen

- ⇒ **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.

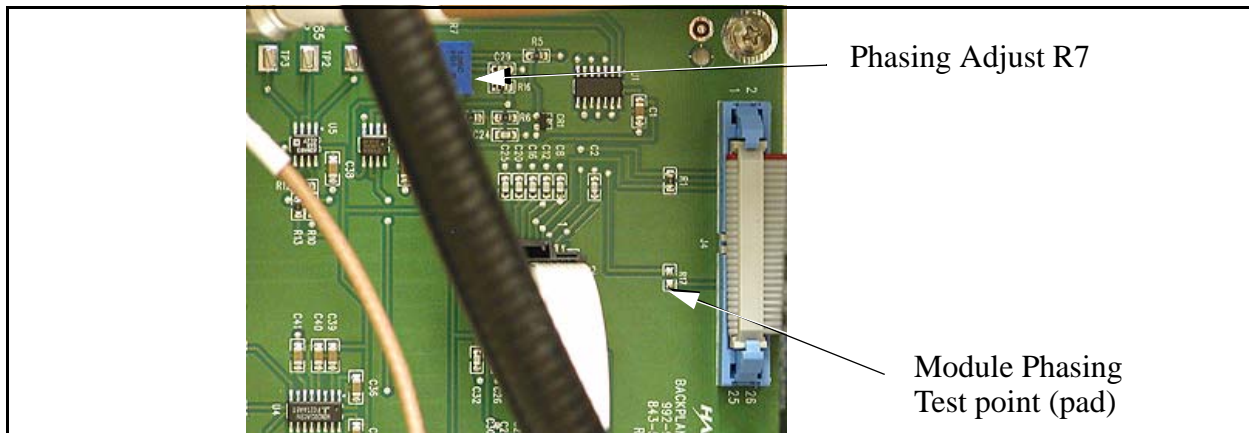


Figure 3-14 Test Point for Module Phasing

- 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 2-1 on page 2-2 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:

$$\text{Foldback Power} = \text{Nominal Power Output} \times 0.0278$$

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

$$\text{VSWR Fault Threshold} = \text{Nominal Power Output} \times 0.0963$$

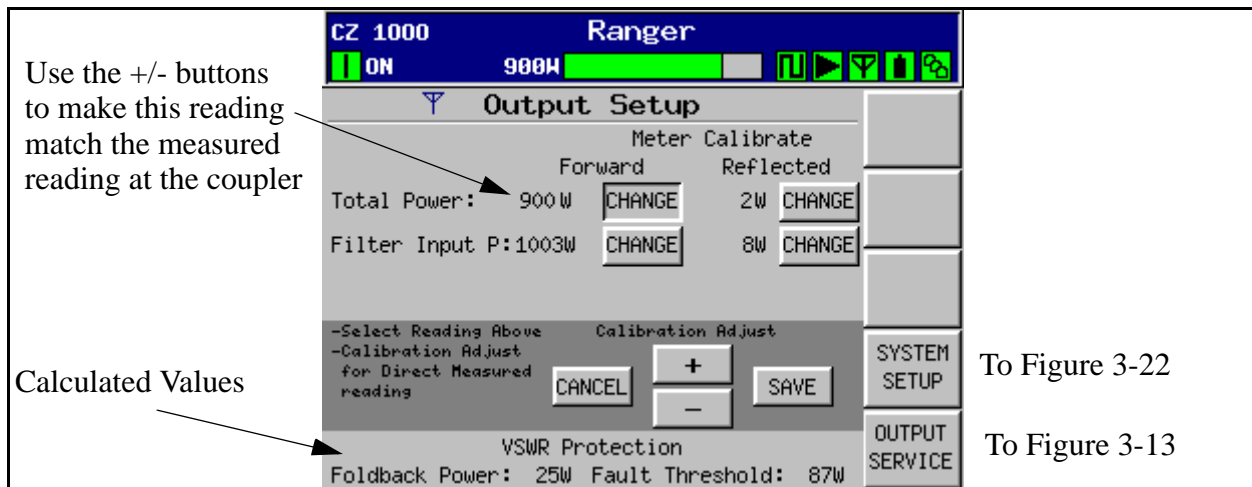


Figure 3-15 Output Setup Screen

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 2-1 on page 2-2, 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.

<p>PAPS Icons:</p> <ul style="list-style-type: none"> ON Fault OFF OFF (no faults) OFF with warning ON with warning PS module unplugged <p>Calibrated on PS Service Screen</p>		<p>Fault threshold for the dc outputs is +/-15%.</p> <p>To Figure 3-17</p> <p>To Figure 3-3</p>
---	--	---

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.

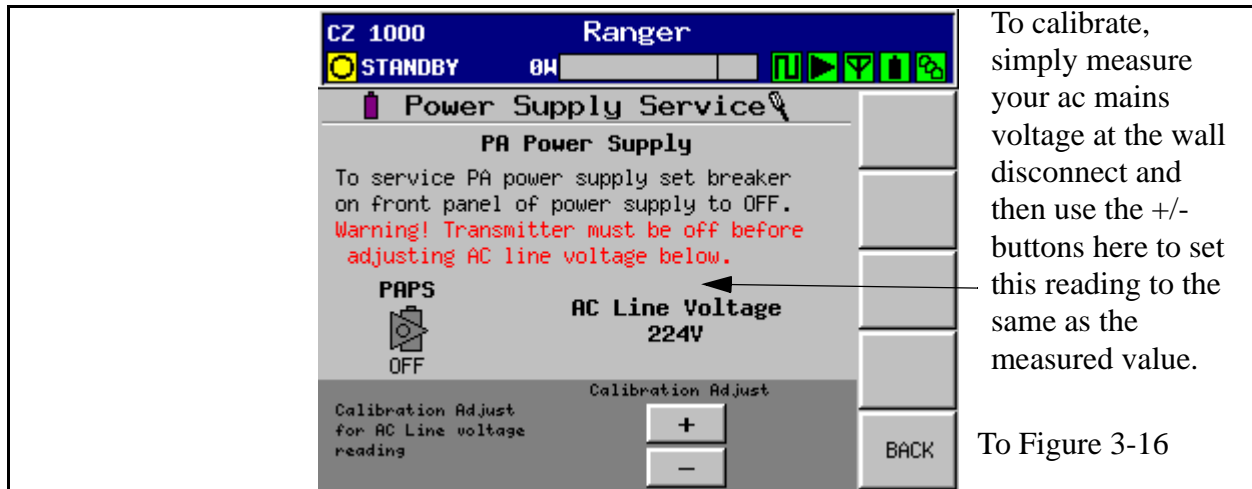


Figure 3-17 PS Service Screen

⇒ 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.

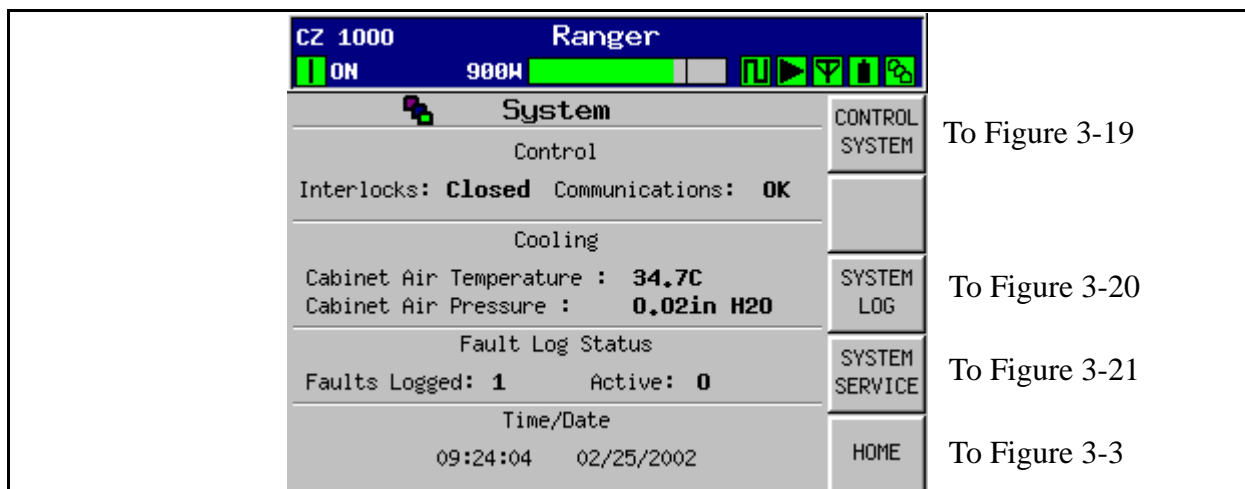


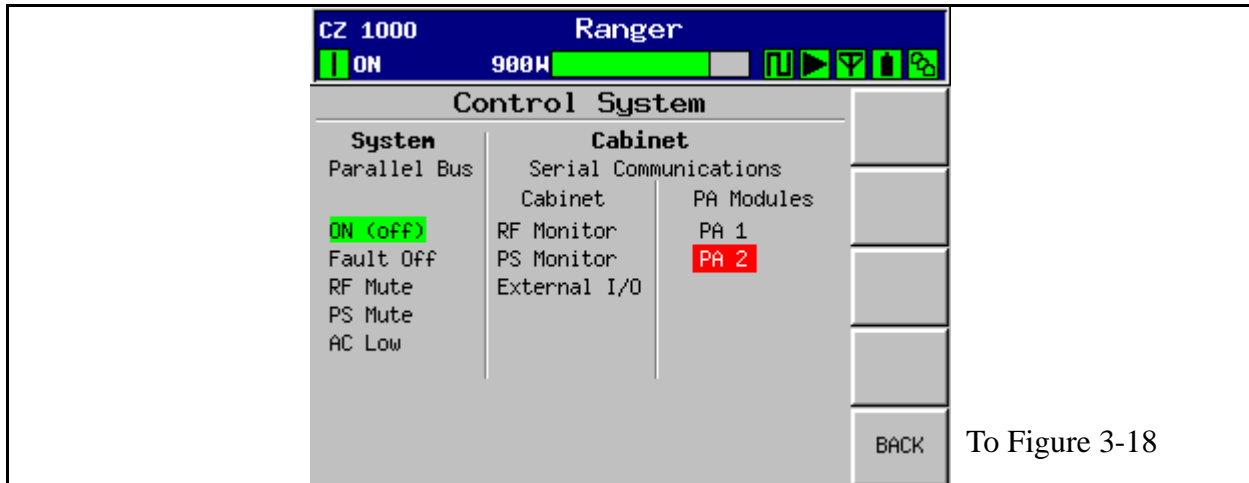
Figure 3-18 System Main Menu

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

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.

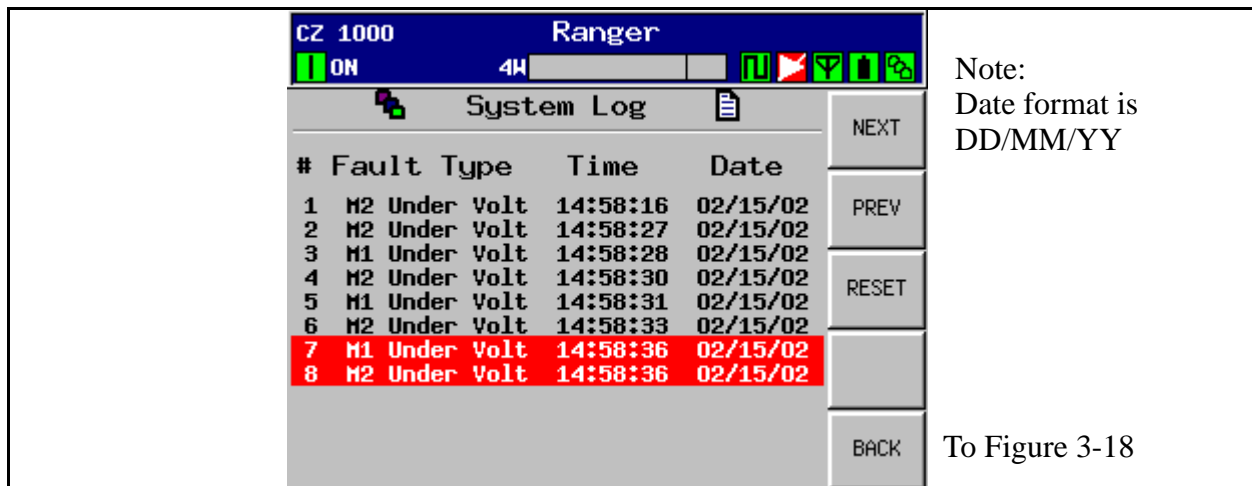


Figure 3-20 System Log Screen

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)

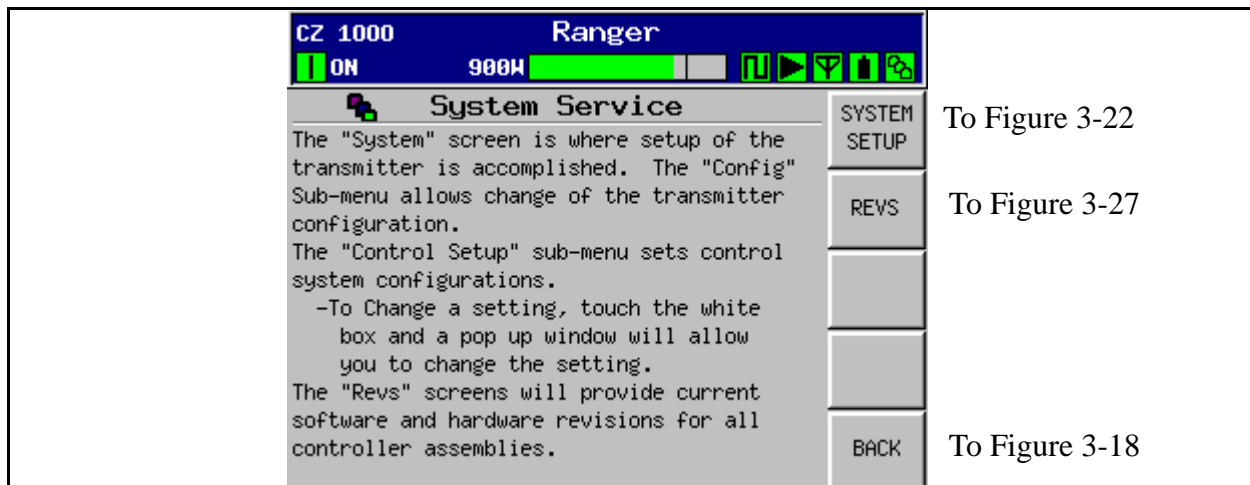


Figure 3-21 System Service Screen

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.

<p>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.</p>			
	Station Name:	Ranger	CONFIG To Figure 3-23
	Model Number:	CZ 1000	CONTROL SETUP To Figure 3-24
	Serial Number:	1234	
	Nominal Power Output:	900	
	Channel:	41	
	Pilot Frequency:	632310000 Hz	OUTPUT SETUP To Figure 3-15
	AC Line (VAC) Nominal:	230	SYSTEM SERVICE To Figure 3-21
AC Line Freq (Hz):	60		

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.

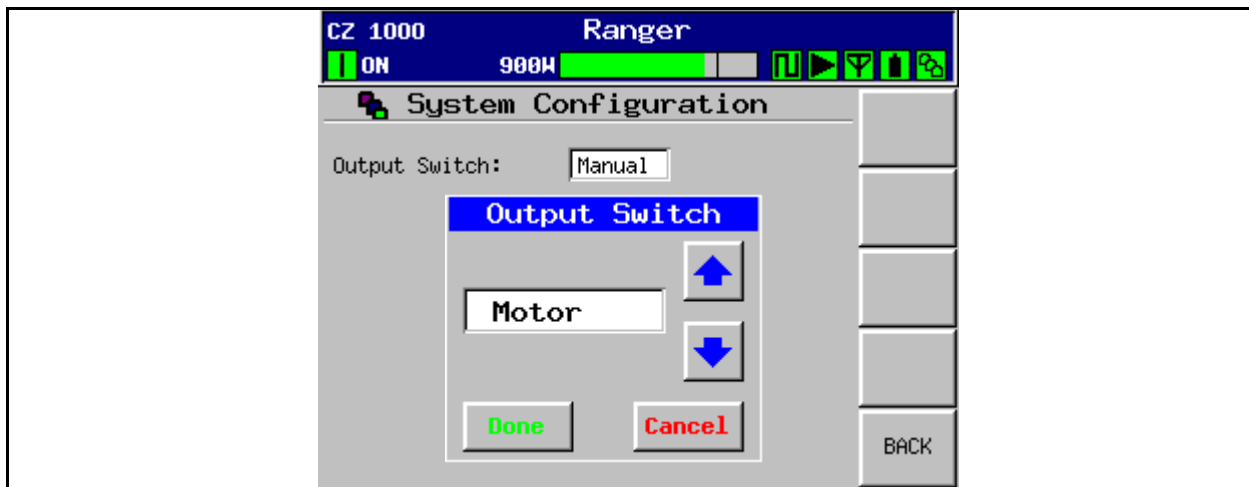


Figure 3-23 System Output Switch Configuration

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.

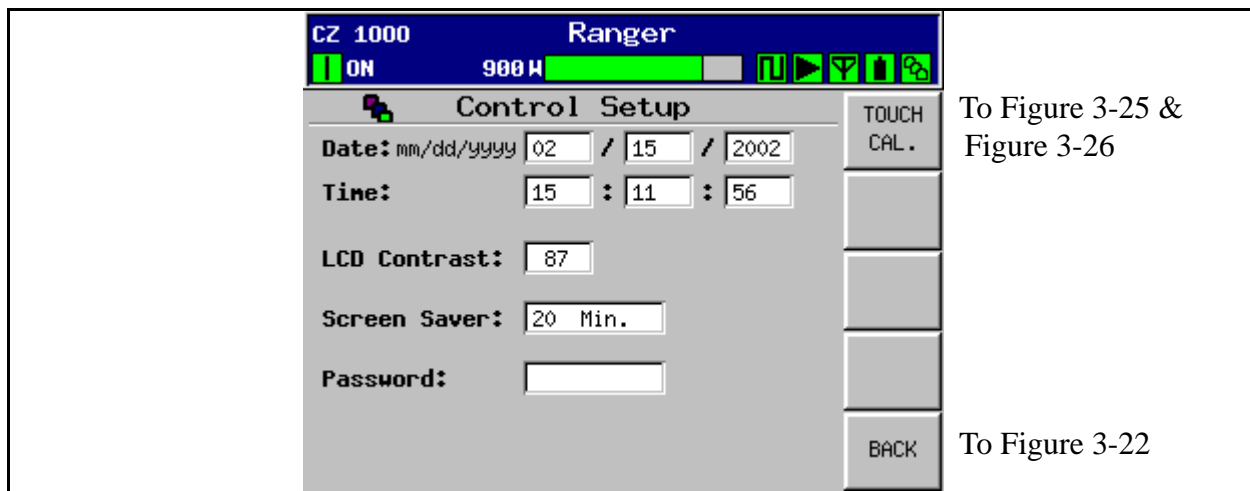
It also allows for adjustment of the **Contrast** of the GUI LCD display. The display contrast will adjust dynamically as the number is changed to allow for room lighting. A setting in the mid 80's is normal.

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.

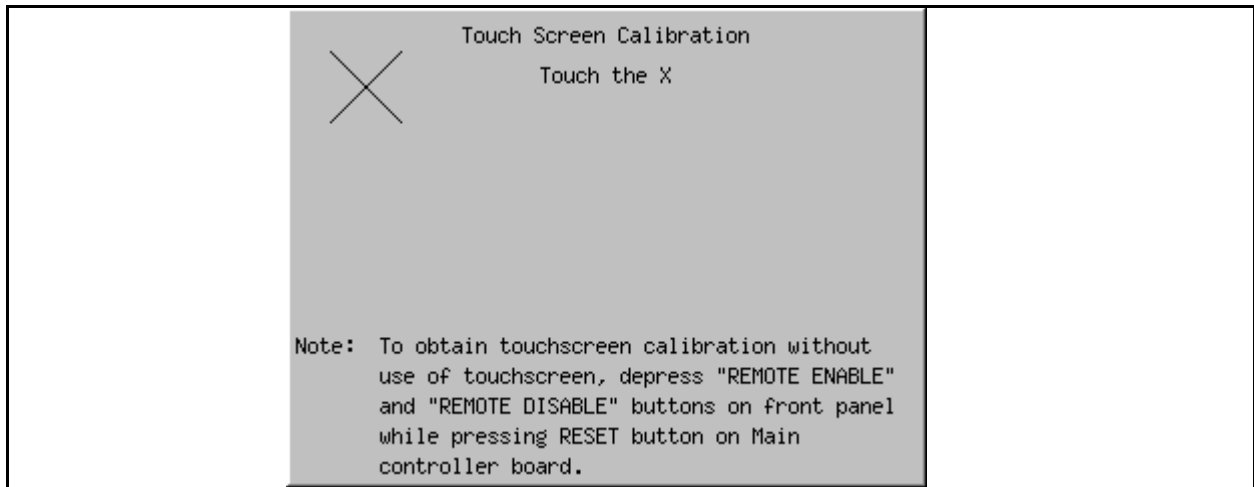


Figure 3-25 Touchscreen Calibration Screen

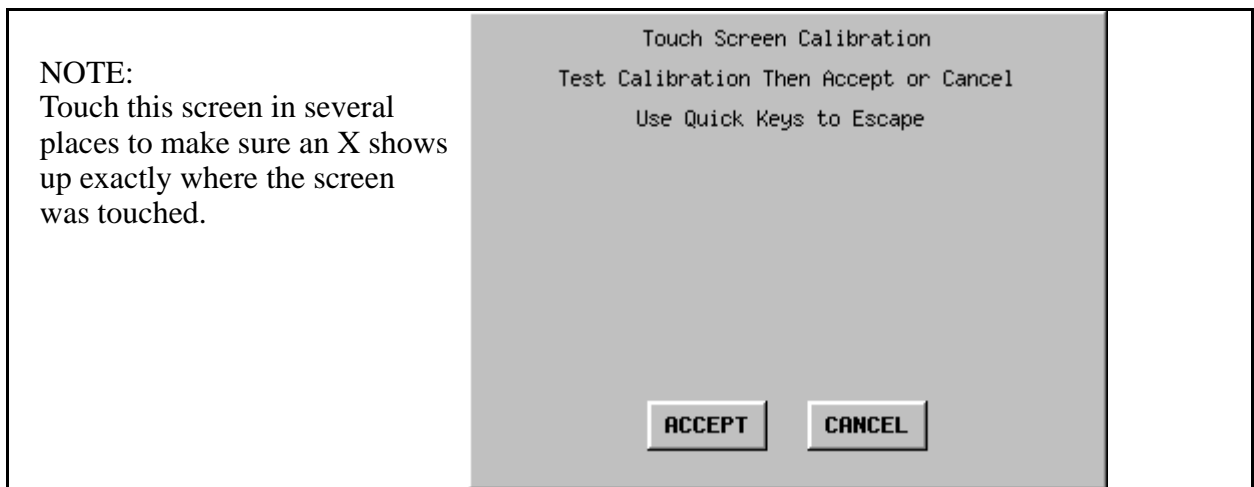
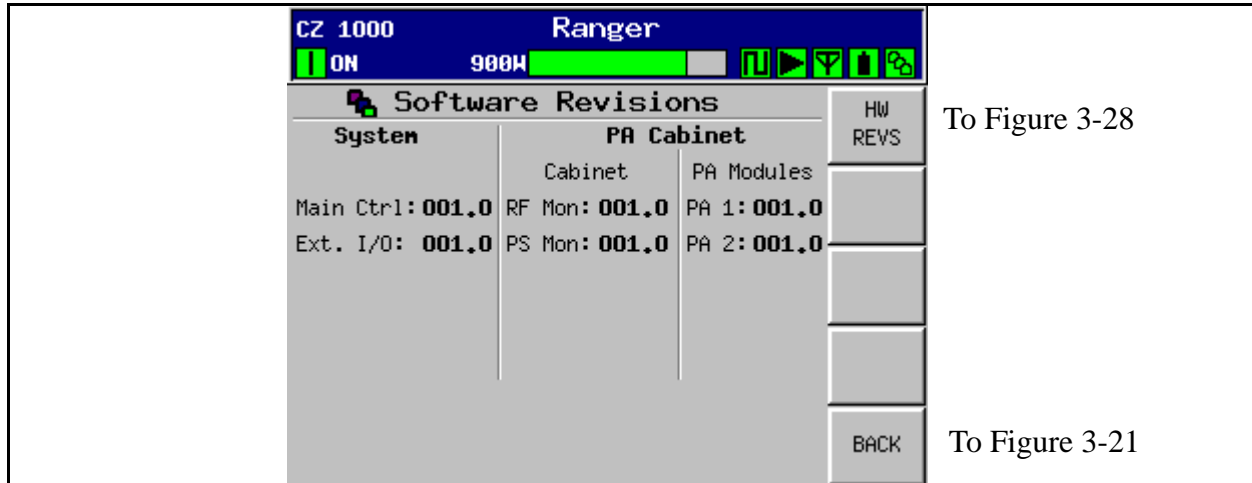


Figure 3-26 Touchscreen Calibration Test Screen

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.



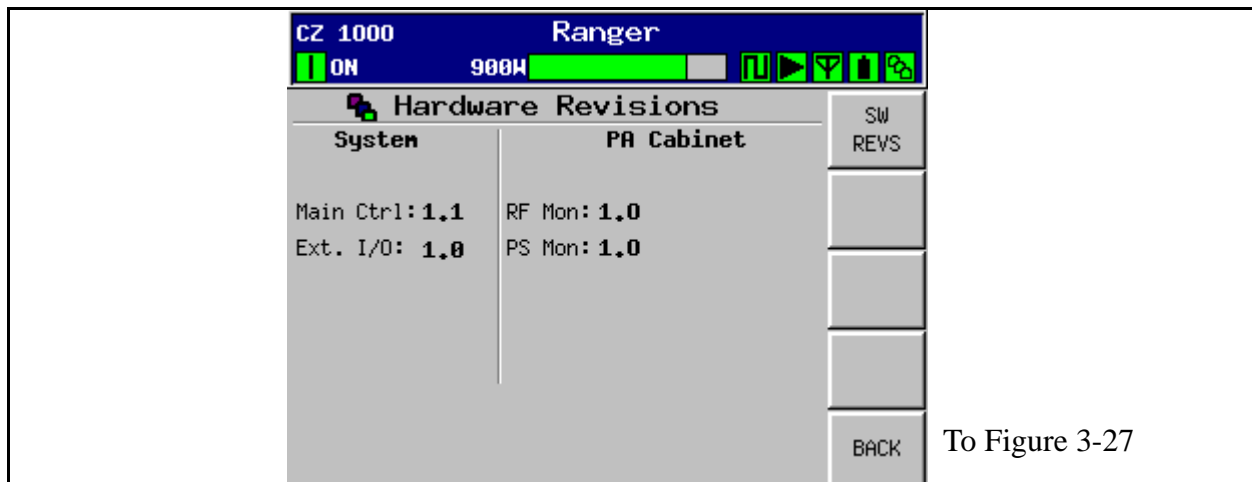
To Figure 3-28

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

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.

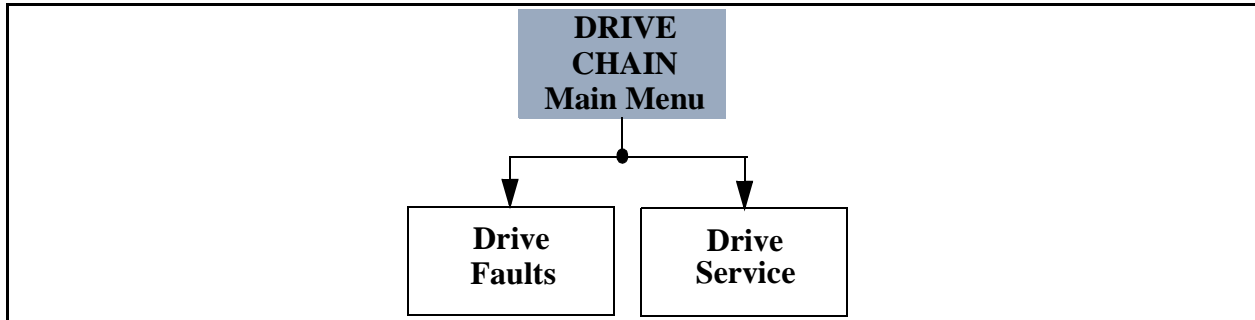


Figure 3-29 Drive Chain Menu Structure

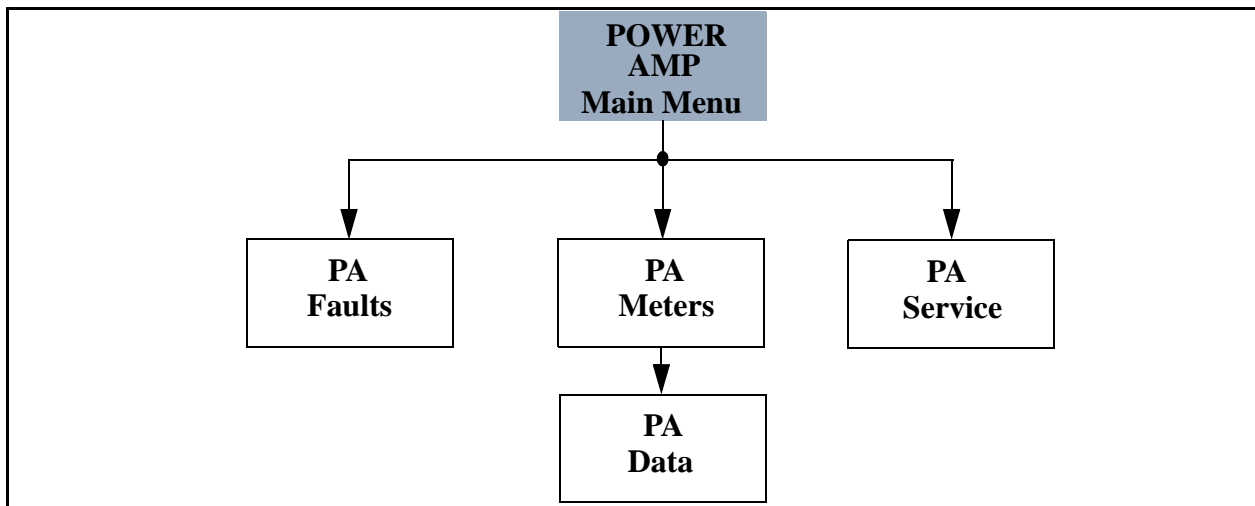


Figure 3-30 Power Amp Menu Structure

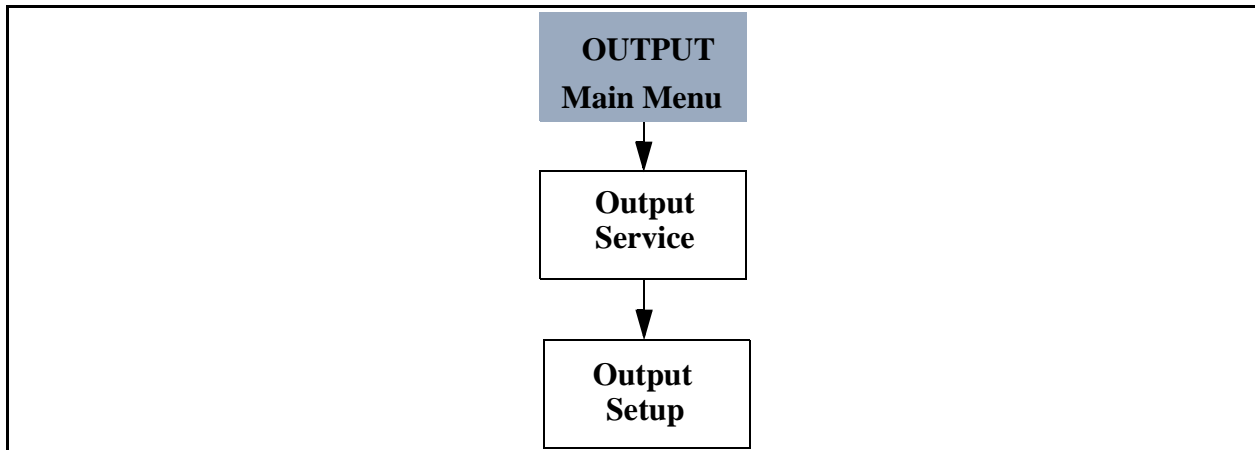


Figure 3-31 Output Menu Structure

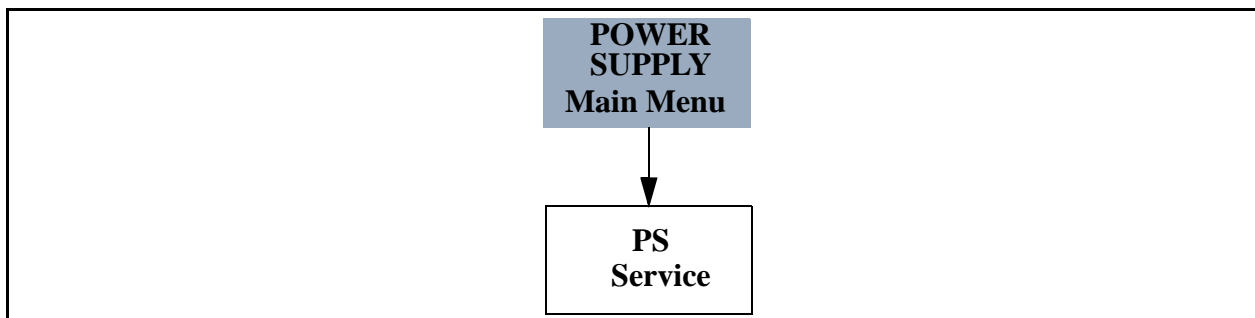


Figure 3-32 Power Supply Menu Structure

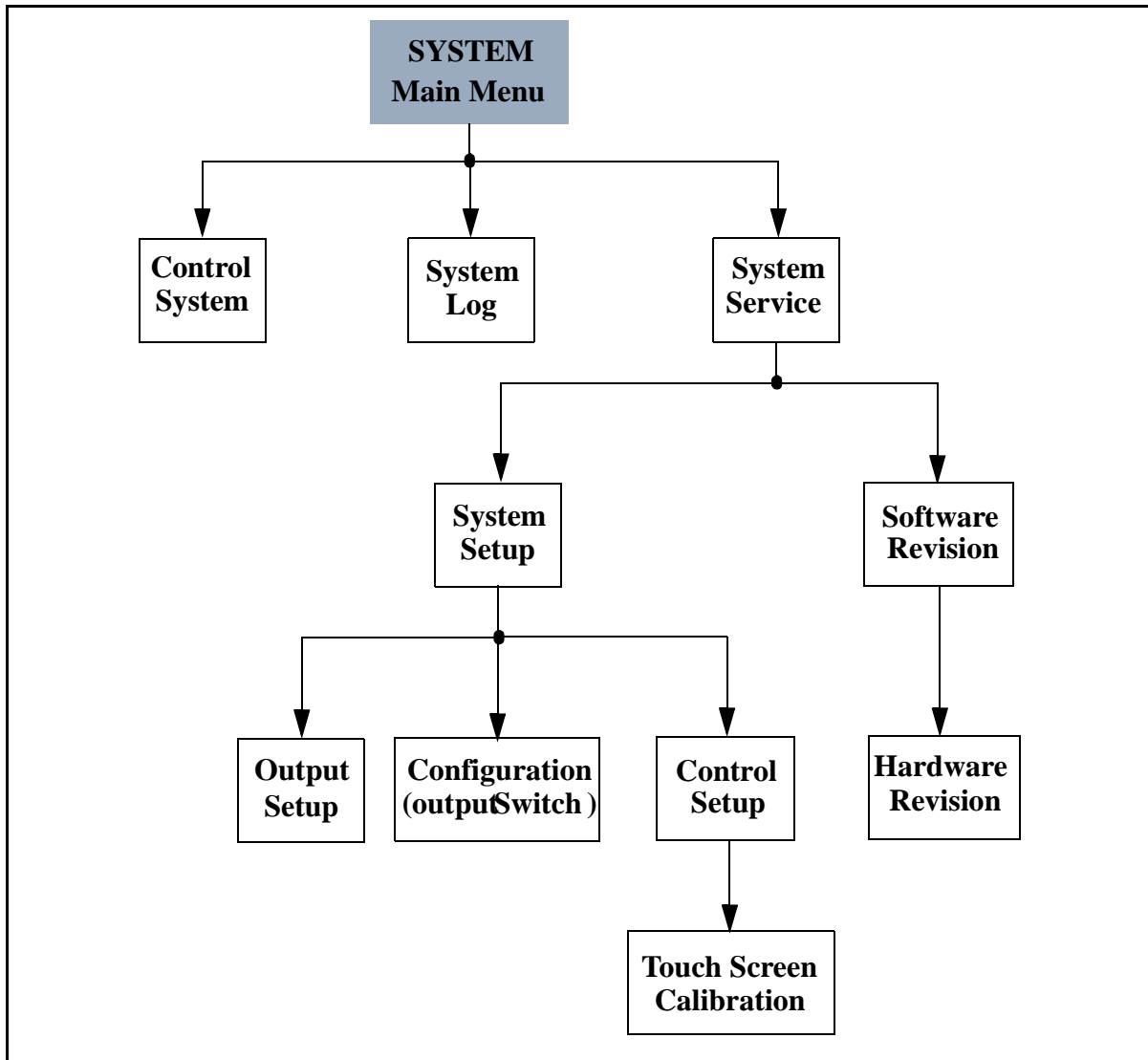


Figure 3-33 System Menu Structure

Section 4

RF Testing

4

4.1 Introduction

This section defines suggested data and measurements that are to be included in the report that should be generated as part of a Ranger Transmitter Proof of Performance. The various sections of the report and measurements are defined and in some instances samples are provided.

4.2 Proof Testing and Report

4.2.1 Report Cover Page

Title: *Engineering Report of Television Transmitter Performance Characteristics*

- Station Call Letters:
- Channel:
- Transmitter Model:
- Measured By:
- Measurement Date:
- Signature of Field Engineer:

4.2.2 Table of Contents

Table 4-1 describes the content of a typical Performance Report. The page numbers are added as the report is generated. The report contents may also need to be modified depending on specific site requirements or equipment provided.

Table 4-1 Typical Report Table of Contents (sample)

Section Title	Report Page No.
Facilities Authorized in Construction Permit	
Transmitter Location	
Transmitter Type and Power Output	
Block Diagram for Measuring Transmitter	
Test Equipment List	
Output Power	
Frequency Tolerance	
Non-Linear Precorrection (Shoulders & Amplitude Response)	
Out of Band Emissions	
Spurious Emissions	
Linear Precorrection (Group Delay & Amplitude Response)	
Modulation Error Ratio	
Systems Metering	
Station Test Load Return Loss	
Software Versions	

4.2.3 Facilities Authorized in Construction Permit

- Name of Applicant:
- Call Letters:
- Channel Number:
- File Number of License:

4.2.4 Transmitter Location

- State:
- County
- City:
- Street Address:

4.2.5 Transmitter Manufacturer ID Plate

Insert photograph of transmitter identification plate in this section. If photo is not available transcribe the data from the nameplate into the report.

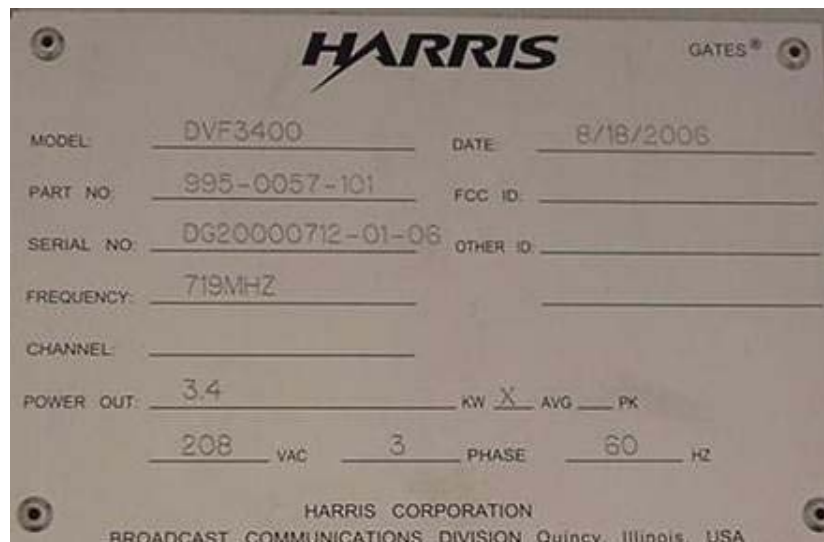


Figure 4-1 Sample Identification Plate

4.2.6 RF Power Summary

Table 4-2 RF Power Budget (Average, Digital)

Description	dBK	Watts
Amplifier(s) Rated Power		
Transmitter System Rated Power		
Transmitter Power Output (TPO)		
Transmission Line Loss		
Antenna Input Power		
Antenna Power Gain (Maximum)		
Effective Radiated Power (Average)		

$TPO \text{ (dBK)} - \text{Transmission Line Loss (dB)} + \text{Antenna Gain (dB)} = \text{ERP (dBK)}$

$10 \times \text{Log TPO(kW)} = \text{dBK}$

4.2.7 Antenna and Bandpass Filter Information

- Filter Manufacturer:
- Filter Type:
- Filter Serial No.:
- Antenna Manufacturer:
- Antenna Type:
- Antenna Serial No.:

4.2.8 System Block Diagram

A simplified block diagram should be included in the report. A sample diagram is shown below. The diagram should define signal flow and major components in the system under test. The diagram may vary from site to site depending on the specific site layout and equipment.

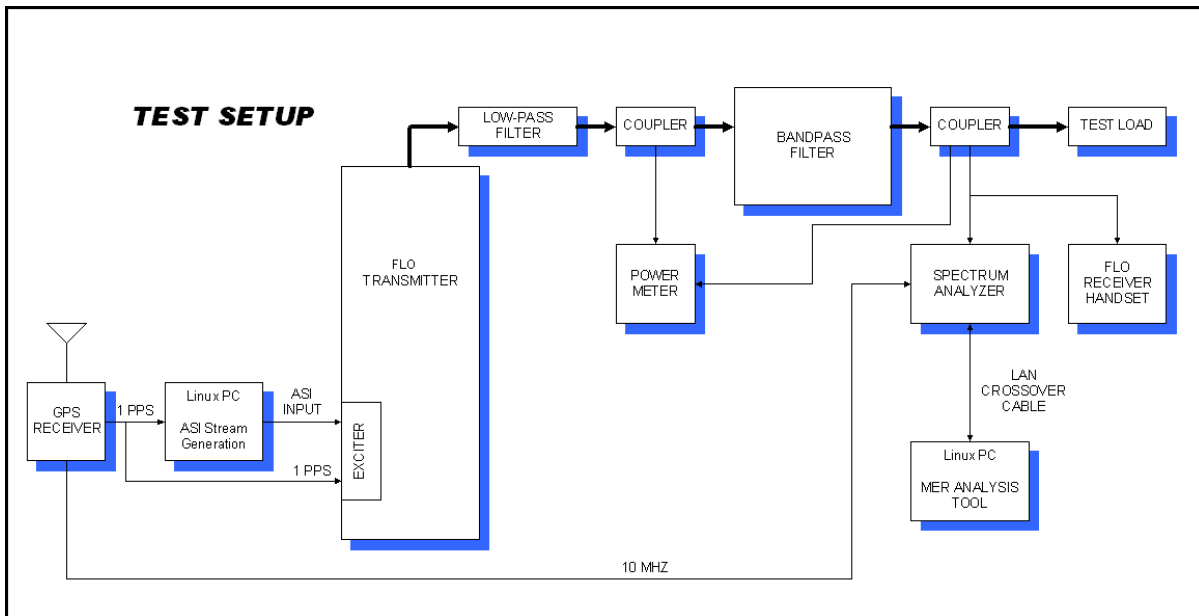


Figure 4-2 Block Diagram of the MER Measurement Setup

NOTE: This diagram shows the measurement being taken from fwd coupler DC1 of the filter assembly. If desired, the measurement can also be taken from exciter output and fwd couplers of the transmitter.

4.2.9 Test Equipment List

Table 4-3 Test Equipment for Measurements

Test Equipment	Mfg.	Model	Serial No.
Spectrum Analyzer	R&S	FSQ3	
Network Analyzer	HP	HP8714B	
RF Power Meter	HP	E4418A	
Power Sensor	HP	8482H	
Frequency Counter	HP	HP53181A	
Qualcomm MER Tool Set	N/A	N/A	

⇒ NOTE:

The test equipment outlined above is an example of typical equipment used to perform the measurements. Other equipment with similar capabilities can be substituted. The serial nThe Qualcomm MER tool set consists of hardware and software. In addition to the FSQ3 spectrum analyzer a Linux based PC is needed to control the analyzer, a Linux based PC is needed to generate the test ASI stream to feed the Apex excitors, and a GPS receiver to provide a 1PPS reference signal. The software is provided by Qualcomm.

⇒ NOTE:

Rather than use two Linux PC's a single, high performance, Linux PC could be used to perform both functions. An additional Windows PC will be needed to analyze the measured data sets.

4.2.10 Transmitter Power Output

4.2.10.1 Objective

To verify the nominal rated RF output power (average) of the transmitter in digital mode (FLO modulation).

⇒ NOTE:

The transmitter output power is measured at the forward output precision directional coupler located before the filter. The output of the transmitter must be connected to an appropriately sized dummy load or to the MediaFLO channel filter assembly which is connected to a dummy load.

4.2.10.2 Requirement(s)

The output power shall be measured using a true RMS RF power meter and a precision directional coupler. Output power shall be 375 or 750 W (within +/- 10%)

4.2.10.3 Setup and Test Equipment

Table 4-4 Power Measurement Setup

	Transmitter	Exciter
Status 1	Active on Exciter A	External GPS Active
Status 2	Active on Exciter B	External GPS Active

Table 4-5 Power Measurement Test Equipment

True RMS power meter
Spectrum Analyzer
Spectrum Analyzer

4.2.10.4 Power Measurement Procedure

Step	Procedure Description	Expected Observation	✓
1	Configure the transmitter to operate on air with Exciter A with precorrector settings to: Non-Linear Precorrection = ADAPT Linear Precorrection = BYPASS		
2	Connect the true RMS power meter probe to the transmitter output directional coupler (forward port located before the filter). The transmitter output should be connected to the load.	Measured power output is within +/- 10% of rated power	
3	Configure the transmitter to operate on air with Exciter B with precorrector settings to: Non-Linear Precorrection = ADAPT Linear Precorrection = BYPASS	Measured Pout is within +/- 10% of rated power	

4.2.10.5 Power Measurement Test Results

Expected Results	Result (circle)	
Rated Pout with Exciter A at output of directional couplers.	PASS	FAIL
Rated Pout with Exciter B at output of directional couplers.	PASS	FAIL

4.2.11 Frequency Tolerance

4.2.11.1 Objective

To verify the Channel Center Frequency meets the tolerance requirements.

The transmitter will be operated in CW mode (719 MHz for U.S. applications and at other frequencies to be defined by Qualcomm for international operation) while the frequency is measured at the transmitter forward output directional coupler. Output power must be adjusted to 375 or 500 watts +/- 10% (output level depends on power level of transmitter).

4.2.11.2 Requirement(s)

The relative maximum frequency difference $(|f-f_c|/f_c)$ between the mean actual transmit carrier (f) frequency and the specified transmit frequency (f_c) shall be less than 1×10^{-9} with the external reference connected.

With external reference disconnected, the relative maximum frequency difference shall be less than 1×10^{-8} for at least 24 hours.

4.2.11.3 Setup and Test Equipment

Table 4-6 Frequency Tolerance Setup

	Transmitter	Exciter
Status 1	Active on Exciter A	External GPS Active
Status 2	Standby on Exciter B	External GPS Active

Table 4-7 Frequency Tolerance Test Equipment

Frequency Meter (error < +/- 0.72 Hz
RF Test Cables (with known and measured losses)

4.2.11.4 Frequency Tolerance Procedure

Step	Procedure Description	Expected Observation	
1	Generate a CW tone as per the instructions in Appendix B.		✓
2	Using a frequency counter (or a spectrum analyzer) measure the frequency of the tone coming out of the Exciter for 30 minutes (Provide the frequency counter/spectrum analyzer with a reference signal derived from the same GPS signal that the Exciter has).	The maximum deviation of the carrier tone from 719000000 should be less than ± 1.0 Hz	
3	Set FLO FPGA, SFN mode = Off. Also, increase the SFN limit to 500 microseconds. Remove the 1PPS signal, and using the frequency counter/spectrum analyzer measure the frequency of the tone overnight/ 24 hours.	The maximum deviation of the carrier tone from 719000000 should be less than ± 10.0 Hz	

⇒ NOTE:

The operating frequency of 719 MHz is for U.S. operation. Qualcomm may define other UHF frequencies for international operation.

4.2.11.5 Frequency Tolerance Test Results

Expected results	Result (circle)	
Maximum deviation with GPS signal is less than +/- 1.0 Hz.	PASS	FAIL
Maximum deviation without GPS signal is less than +/- 10.0 Hz.	PASS	FAIL

4.2.12 Non-Linear Precorrection (Shoulders & Amplitude Response)

4.2.12.1 Objective

To verify the shoulders with the non-linear precorrection set to ADAPT mode.

The transmitter will be operated in digital mode (FLO modulation) at 719 MHz and the RF spectrum is measured at the transmitter output directional coupler forward port.

⇒ NOTE:

The operating frequency of 719 MHz is for U.S. operation. Qualcomm may define other UHF frequencies for international operation

The transmitter must be connected to the MediaFLO channel filter assembly terminated in a dummy load.

4.2.12.2 Requirement(s)

The measured shoulder levels should be <-36 dB

4.2.12.3 Setup and Test Equipment

Table 4-8 Non-Linear Precorrection Setup

	Transmitter	Exciter
Status 1	Active on Exciter A	External GPS Active
Status 2	Active on Exciter B	External GPS Active

Table 4-9 Non-Linear Precorrection Test Equipment

Spectrum Analyzer
RF Test Cables (with known and measured losses)

4.2.12.4 Non-Linear Precorrection Procedure

Step	Procedure Description	Expected Observation	✓
1	Configure the transmitter to operate on air with Exciter A with precorrector settings to: Non-Linear Precorrection = ADAPT Linear Precorrection = BYPASS Then connect the spectrum analyzer to the transmitter output directional coupler forward port.	RF Spectrum output should be clean.	
2	Configure the spectrum analyzer as follows: Center Frequency = 719 MHz Span = 10 MHz Resolution BW = 30 KHz Video BW = 300 Hz Sweep = Auto Sweep Points = 10001 Amplitude Reference Level = 10 dB Amplitude Attenuation = 30 dB		
3	Measure shoulders level at $F_c \pm 3.0$ MHz with Exciter A	Shoulders level < -36 dB	
4	Measure shoulders level at $F_c \pm 3.0$ MHz with Exciter B	Shoulders level < -36 dB	
5	Repeat steps 3-4 with the spectrum analyzer configured as follows: Start Frequency = 698 MHz Stop Frequency = 746 MHz Resolution BW = 30 KHz Video BW = 300 Hz Sweep = Auto Sweep Points = 10001 Amplitude Reference Level = 10 dB Amplitude Attenuation = 30 dB	Results should be consistent with those from steps 3-4.	

4.2.12.5 Non-Linear Precorrection Test Results

Expected results	Result (circle)	
Shoulders level <-36 dB with Exciter A at $F_C \pm 3.0$ MHz.	PASS	FAIL
Shoulders level <-36 dB with Exciter B at $F_C \pm 3.0$ MHz	PASS	FAIL

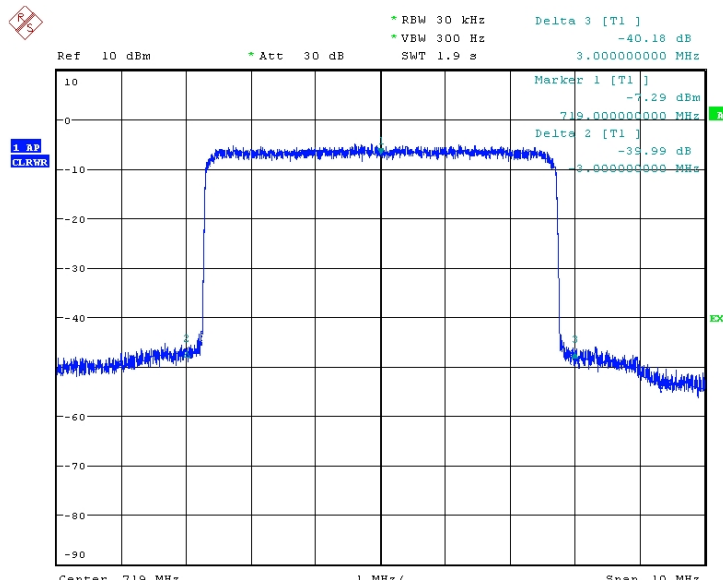


Figure 4-3 Non-Linear Precorrection Plot

NOTE:
 The operating frequency of 719 MHz is for U.S. operation. Qualcomm may define other UHF frequencies for international operation

4.2.13 Out of Band Emissions

4.2.13.1 Objective

To verify the out of band spurious emissions at the output of band pass filter.

The transmitter will be operated in digital mode (FLO modulation) at the nominal rated RF output power at 719MHz channel frequency.

**NOTE:**

The operating frequency of 719 MHz is for U.S. operation. Qualcomm may define other UHF frequencies for international operation

4.2.13.2 Requirement(s)

See Expected Observations column in the following Procedure.

4.2.13.3 Setup and Test Equipment

Table 4-10 Out of Band Emissions Setup

	Transmitter	Exciter
Status 1	Active on Exciter A	External GPS Active
Status 2	Active on Exciter B	External GPS Active

Table 4-11 Out of Band Emissions Test Equipment

Spectrum Analyzer
RF Test Cables (with known and measured losses)

4.2.13.4 Out of Band Emissions Procedure

Step	Procedure Description	Expected Observation	✓
1	Configure the transmitter to operate on air with Exciter A with precorrector settings to: Non-Linear Precorrection = ADAPT Linear Precorrection = ADAPT Then connect the spectrum analyzer to the transmitter output of the bandpass filter.	RF Spectrum output should be clean.	
2	Configure the spectrum analyzer as follows: Start Frequency = 698 MHz Stop Frequency = 715.9 MHz Resolution BW = 100 KHz Video BW = 300 Hz Sweep = Auto Sweep Points = 10001(number of points in sweep) Amplitude Reference Level = 10 dB Amplitude Attenuation = 30 dB Then measure 698–715.9 MHz with Exciter A on air.	Less than -38 dBm/100 kHz	
3	Change the following spectrum analyzer settings: Start Frequency = 722.1 MHz Stop Frequency = 746 MHz. Then measure 722.1–746 MHz with Exciter A on air.	Less than -38 dBm/100 kHz	
4	Change the following spectrum analyzer settings: RBW = 30 KHz Start Frequency = 715.9 MHz Stop Frequency = 716 MHz. Then measure 715.9-716 MHz with Exciter A on air.	Less than -38 dBm/30 kHz	

Step	Procedure Description	Expected Observation	✓
5	Change the following spectrum analyzer settings: RBW = 30 KHz Start Frequency = 722 MHz Stop Frequency = 722.1 MHz. Then measure 722 – 722.1 MHz with Exciter A on air.	Less than -38 dBm/30 kHz	
6	Attach a notch filter between the spectrum analyzer and the output of the bandpass filter. Change the following spectrum analyzer settings: RBW = 100 kHz Start Frequency = 698 MHz Stop Frequency = 746 MHz. Then measure 698-746 MHz	Less than -38 dBm/100 kHz	
7	Repeat steps 2-6 with Exciter B on air.	Results should be consistent with those from steps 2--6.	

⇒ NOTE:
The operating frequency of 719 MHz is for U.S. operation. Qualcomm may define other UHF frequencies for international operation.

4.2.13.5 Out of Band Emissions Test Results

Expected results	Result (circle)	
Out of band emissions with exciter A	PASS	FAIL
Out of band emissions with exciter B	PASS	FAIL

The following plots show the typical results:

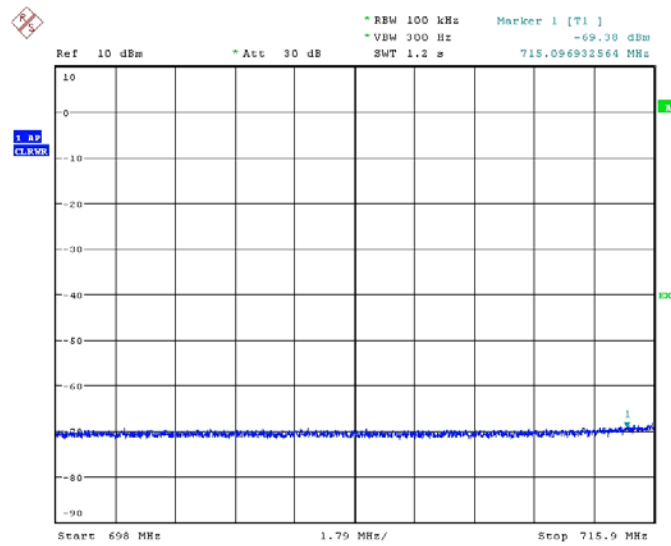


Figure 4-4 Out of Band Emissions Plot 1

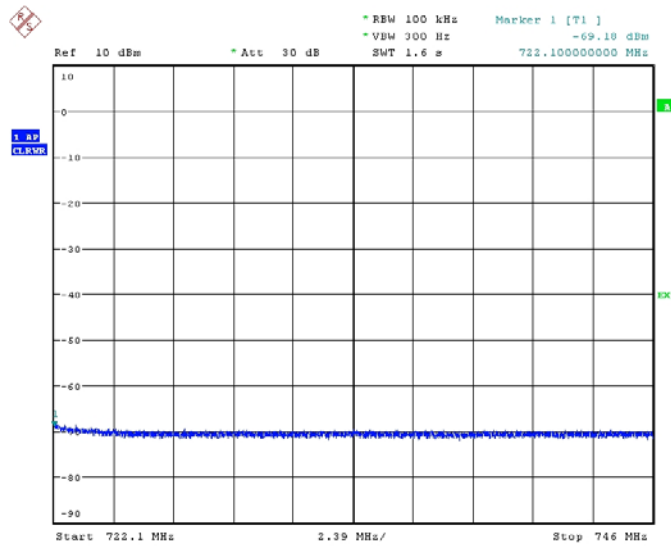


Figure 4-5 Out of Band Emissions Plot 2

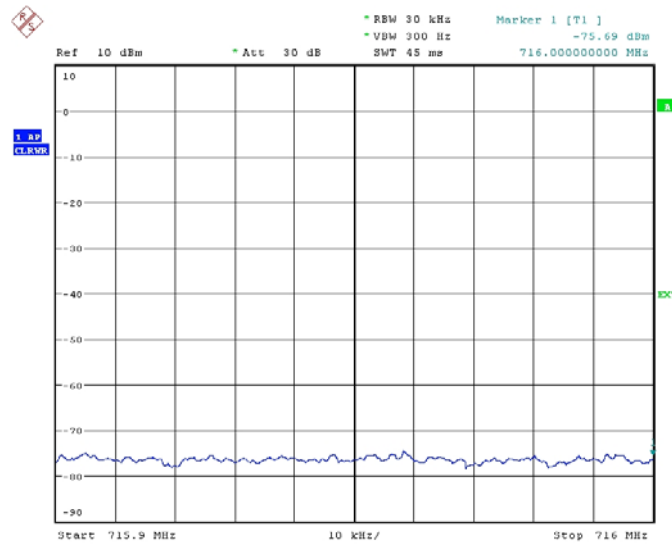


Figure 4-6 Out of Band Emissions Plot 3

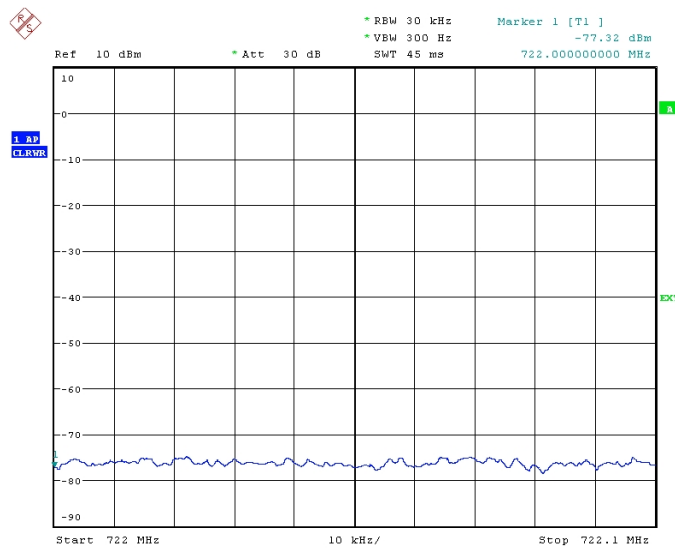


Figure 4-7 Out of Band Emissions Plot 4

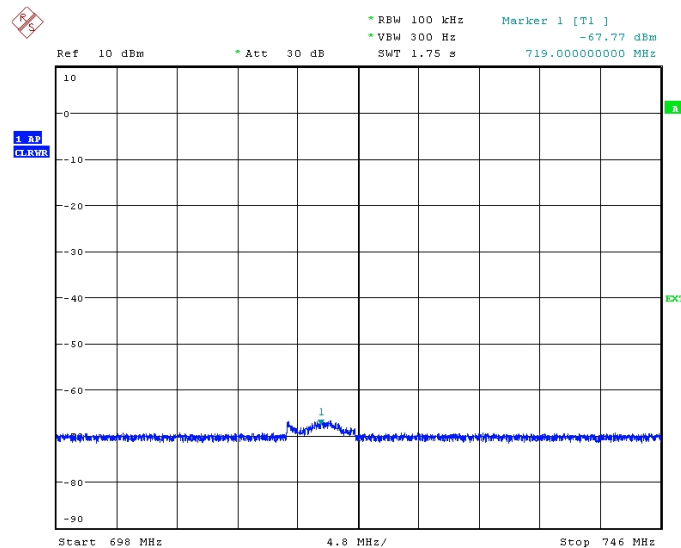


Figure 4-8 Out of Band Emissions Plot 5

4.2.14 Spurious Emissions (including 2nd & 3rd harmonics)

4.2.14.1 Objective

To verify the spurious emissions - including 2nd and 3rd harmonics - at the output of the band pass filter.

The transmitter will be operated in digital mode (FLO modulation) at the nominal rated RF output power at 719 MHz channel frequency.

⇒ NOTE:

The operating frequency of 719 MHz is for U.S. operation. Qualcomm may define other UHF frequencies for international operation

4.2.14.2 Requirements

See Expected Observation in the procedure below.

4.2.14.3 Setup & Test Equipment

Table 4-12 Spurious Emissions Setup

	Transmitter	Exciter
Status 1	Active on Exciter A	External GPS Active
Status 2	Active on Exciter B	External GPS Active

Table 4-13 Spurious Emissions Test Equipment

Spectrum Analyzer
RF Test Cables (with known and measured losses)

4.2.14.4 Spurious Emissions Procedure

In order to prevent overloading of the spectrum analyzer, a band-reject filter covering the transmit channel is inserted in front of the analyzer. A high pass filter can be used instead of a band-reject filter to measure the transmitter harmonics. Connect the spectrum analyzer to the transmitter band pass filter output forward directional coupler through the channel band reject filter or the high pass filter as documented.

Step	Procedure Description	Expected Observation	✓
1	Configure the transmitter to operate on air with Exciter A with precorrector settings to: Non-Linear Precorrection = ADAPT Linear Precorrection = BYPASS Then connect the spectrum analyzer to the transmitter band pass filter output directional coupler.		
2	Configure the spectrum analyzer as follows: Start Frequency = 746 MHz Stop Frequency = 824 MHz Resolution BW = 100 KHz Video BW = 300 Hz Sweep = Auto Sweep Points = 10001 Amplitude Reference Level = 10 dB Amplitude Attenuation = 30 dB Then measure 746-824 MHz with Exciter A on air.	Less than -13dBm/100 kHz	
3	Change the following spectrum analyzer settings: Start Frequency = 824 MHz Stop Frequency = 894 MHz. Then measure 824-894 MHz with Exciter A on air.	Less than -38 dBm/100 kHz	
4	Change the following spectrum analyzer settings: Start Frequency = 894 MHz Stop Frequency = 1850 MHz. Then measure 894-1850 MHz with Exciter A on air.	Less than -13 dBm/100 kHz	

Step	Procedure Description	Expected Observation	✓
5	Change the following spectrum analyzer settings: Start Frequency = 1850 MHz Stop Frequency = 1990 MHz. Then measure 1850-1990 MHz with Exciter A on air.	Less than -38 dBm/100 kHz	
6	Change the following spectrum analyzer settings: Start Frequency = 1900 MHz Stop Frequency = 3000 MHz. Then measure 1900-3000 MHz with Exciter A on air.	Less than -13 dBm/100 kHz	
7	Repeat steps 2-6 with Exciter B on air.	Results should be consistent with those from steps 2-6.	

4.2.14.5 Spurious Emissions Test Results

Expected results	Result	
2nd Harmonic with Exciter A	PASS	FAIL
2nd Harmonic with Exciter B	PASS	FAIL
3rd Harmonic with Exciter A	PASS	FAIL
3rd Harmonic with Exciter B	PASS	FAIL
No emission above limit from 847-3000 MHz with Exciter A	PASS	FAIL
No emission above limit from 847-3000 MHz with Exciter B	PASS	FAIL

The following plots show the typical results:

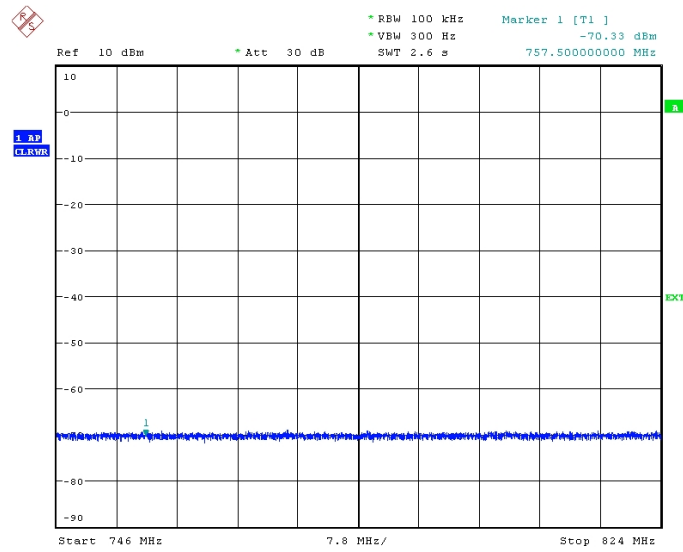


Figure 4-9 Spurious Emissions Plot 1

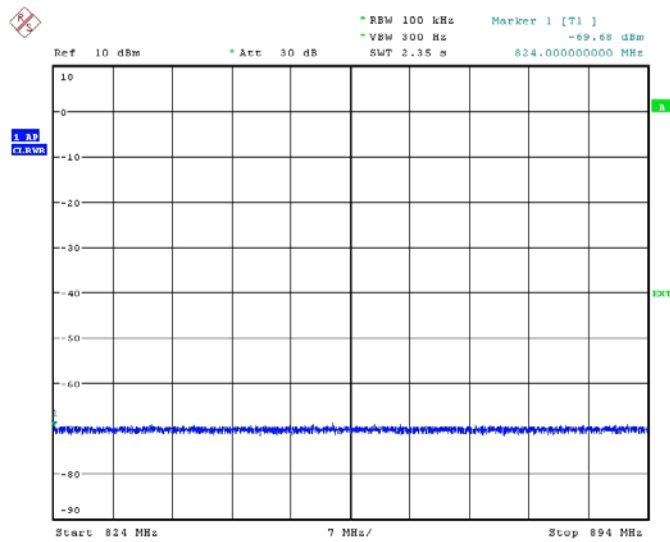


Figure 4-10 Spurious Emissions Plot 2

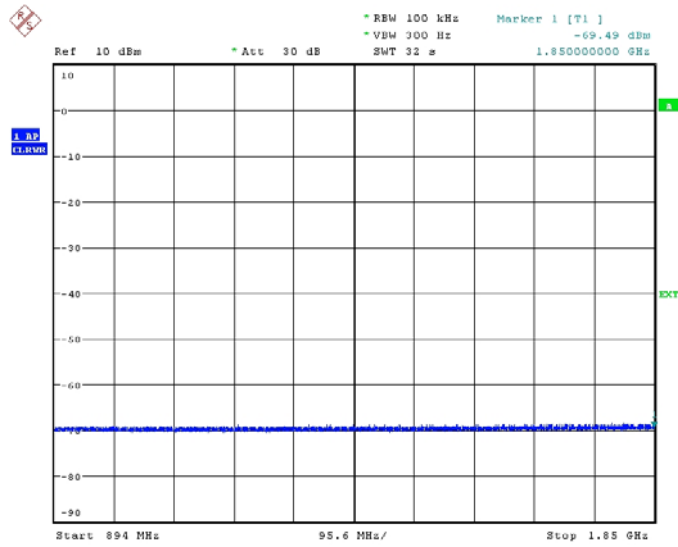


Figure 4-11 Spurious Emissions Plot 3

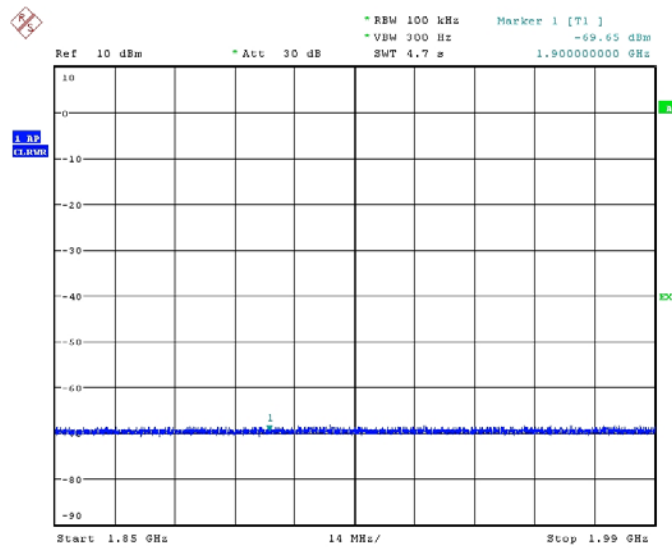


Figure 4-12 Spurious Emissions Plot 4

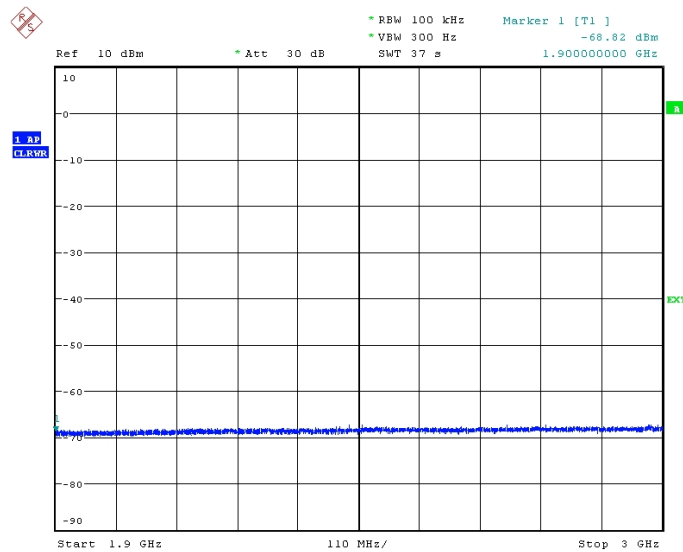


Figure 4-13 Spurious Emissions Plot 5

4.2.15 Linear Precorrection (Group Delay & Amplitude Response)

4.2.15.1 Objective

To verify the linear precorrection - group delay and amplitude response compensation - at the output of the band pass filter.

The transmitter will be operated in digital mode (FLO modulation) at the rated output power at the MediaFLO channel frequency. The transmitter output will be connected to the MediaFLO channel filter assembly terminated in a dummy load.

⇒ NOTE:

The transmitter RF must be turned ON at the rated RF output power for at least four (4) hours to allow for the filter to warm up.

4.2.15.2 Requirements

Group Delay < 1usec

Amplitude Response ± 0.5 dB

4.2.15.3 Setup & Test Equipment

Table 4-14 Linear Precorrection Setup

	Transmitter	Exciter
Status 1	Active on Exciter A	External GPS Active
Status 2	Active on Exciter B	External GPS Active

Table 4-15 Spurious Emissions Test Equipment

Spectrum Analyzer
RF Test Cables (with known and measured losses)

4.2.15.4 Spurious Emissions Procedure

In order to prevent overloading of the spectrum analyzer, a band-reject filter covering the transmit channel is inserted in front of the analyzer. A high pass filter can be used instead of a band-reject filter to measure the transmitter harmonics. Connect the spectrum analyzer to the transmitter band pass filter output forward directional coupler through the channel band reject filter or the high pass filter as documented.

4.2.15.5 Spurious Emissions Test Results

Expected results	Result (circle)	
2nd Harmonic with Exciter A	PASS	FAIL
2nd Harmonic with Exciter B	PASS	FAIL
3rd Harmonic with Exciter A	PASS	FAIL
3rd Harmonic with Exciter B	PASS	FAIL
No emission above limit from 847-3000 MHz with Exciter A	PASS	FAIL
No emission above limit from 847-3000 MHz with Exciter B	PASS	FAIL

The following plots show the typical results:

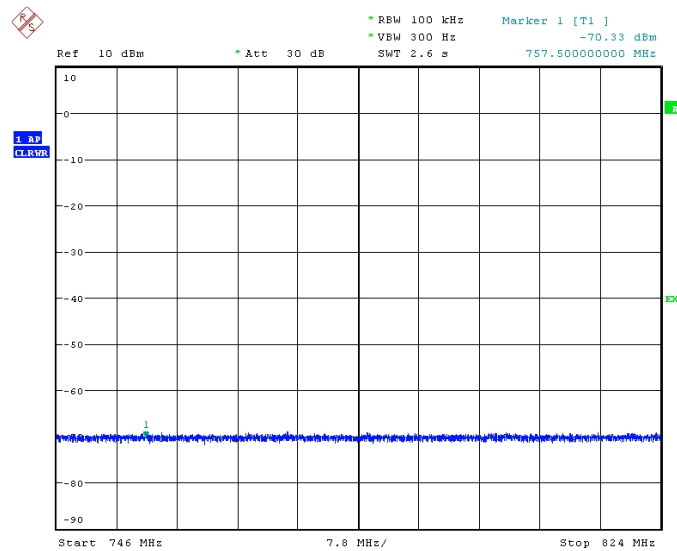


Figure 4-14 Spurious Emissions Plot 1

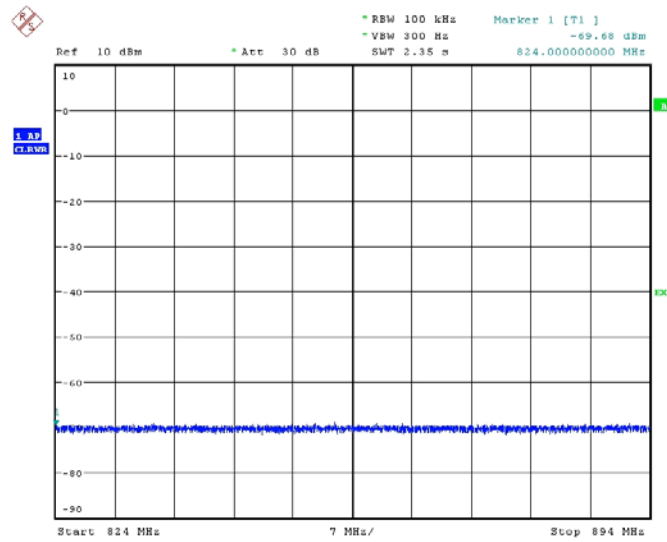


Figure 4-15 Spurious Emissions Plot 2

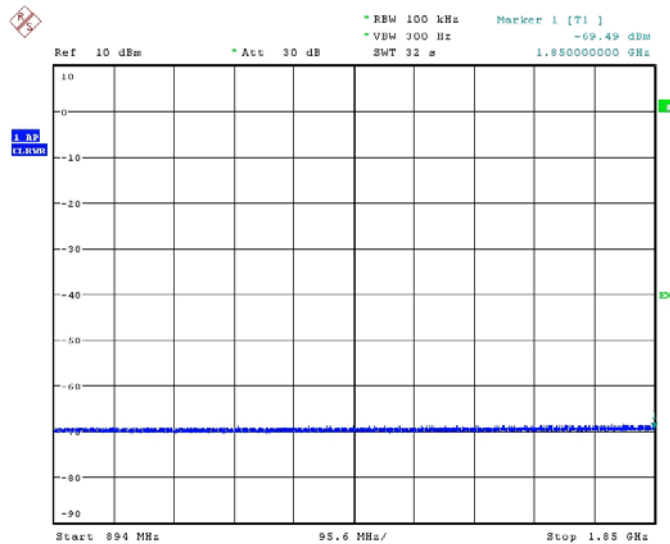


Figure 4-16 Spurious Emissions Plot 3

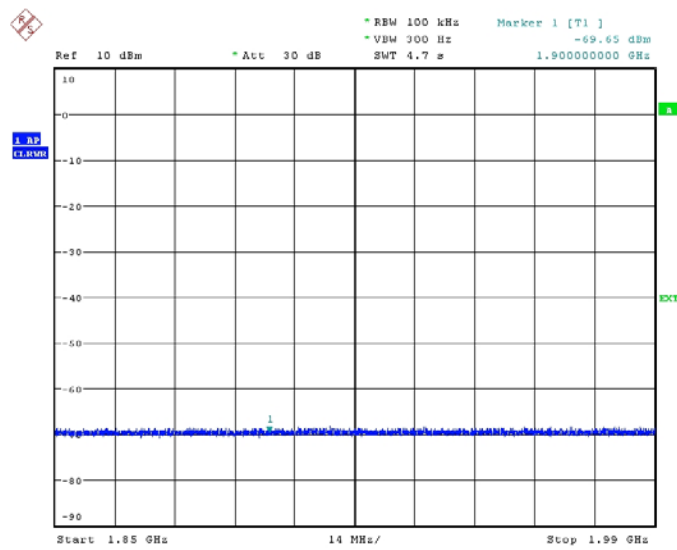


Figure 4-17 Spurious Emissions Plot 4

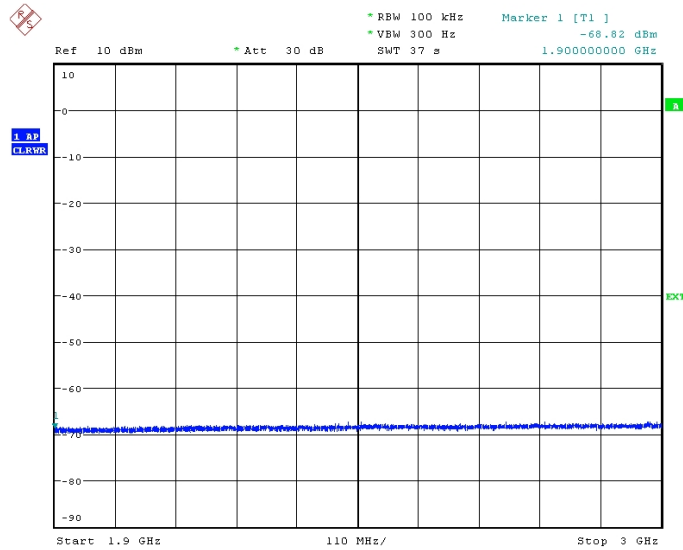


Figure 4-18 Spurious Emissions Plot 5

4.2.15.6 Linear Precorrection Procedure

Step	Procedure Description	Expected Observation	✓
1	Connect the FSQ3 to the transmitter Mask filter output directional coupler forward port. The filter output must be connected to the dummy load. NOTE: The transmitter RF must be turned ON at the rated RF output power for at least four (4) hours to allow for the filter to warm up.		
2	Configure the transmitter to operate on air with Exciter A with precorrector settings to: Non-Linear Precorrection = ADAPT Linear Precorrection = BYPASS		
3	Using Katts, transmit test pattern MER_p2.katts (provided by QC). Let the PID setting on the transmitter remain 16. Collect 10 sets of data after the bandpass filter using the FSQ test receiver, and compute the MER.	The MER should be at least 33dB for all active subcarriers	
4	Perform the MER measurement 100 times at the MediaFLO channel filter assembly output directional coupler forward port. The MER measurement procedure also outputs the residual group delay. Group delay data may be averaged with 16 sliding averages in post processing procedure (using excel).	Residual Group Delay is less than 1usecs over $F_c+2.71\text{MHz}$ or $F_c-2.71\text{MHz}$ in all the 100 MER measurements.	
5	Transmitter turned ON with linear and non-linear precorrection performed and turned ON with Exciter A Measure the amplitude response.	Amplitude variations within $F_c\pm 2.71\text{MHz}$ is less than $\pm 0.5\text{dB}$ in all the 100 MER measurements.	
6	Repeat steps 3-5 with Exciter B on air.	Results should be consistent with those from steps 3-5.	

4.2.15.7 Linear Precorrection Test Results

Expected results	Result	
Residual Group Delay < 1 usecs with Exciter A	PASS	FAIL
Residual Group Delay < 1 usecs with Exciter B	PASS	FAIL
Amplitude Variations , 1 dB with Exciter A	PASS	FAIL
Amplitude Variations , 1 dB with Exciter B	PASS	FAIL

The following plots show the typical results:

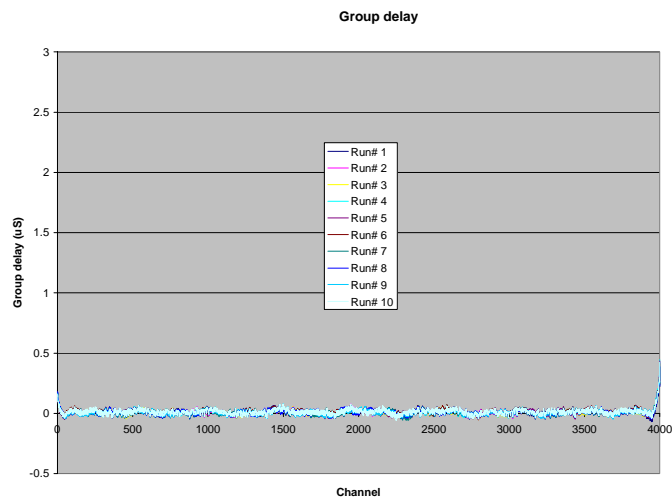


Figure 4-19 Group Delay Plot 1

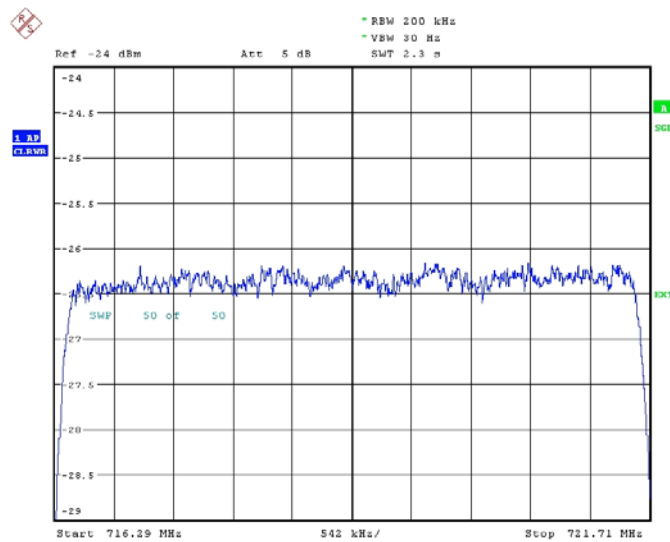


Figure 4-20 Amplitude Variation Plot 2

4.2.16 Modulation Error Ratio (MER)

4.2.16.1 Objective

To verify the modulation error ratio (MER) at the output of the band pass filter.

4.2.16.2 Requirement(s)

MER > 33dB

4.2.16.3 Setup and Test Equipment

The Setup and test procedure to measure the MER will be based on the MER Memo from QUALCOMM in Appendix A.

Table 4-16 Modulation Error Ratio Setup

	Exciter	Katts
--	---------	-------

Status	Active Set FLO FPGA, SFN mode = OFF Disable auto-mute	Active, playing configurations specified in procedure
---------------	---	---

Table 4-17 Modulation Error Ratio Test Equipment

Per memo provided by Qualcomm in Appendix A

4.2.16.4 Modulation Error Measurement Procedure

Step	Procedure Description	Expected Observation	
1	Using the controller software, provision the following set of parameters: P = {National Length = 288, Local Length = 0, PPC Symbols = 14, Frame Length = 292, WID = 5 and LID 6, Active TS = TS1, WPID = LPID = 16, Network Geographic Delay = 0, Transmitter Delay = 13 microseconds}, and let the exciter be initialized. Note: WID & LID values must match the MER tool settings. Provide the exciter RF output to the phone over a cable. Precorrection settings should be set to Non-Linear Precorrection = Adaptive, Linear Precorrection = Adaptive	RF Spectrum output should be clean, and the phone should decode the signal	
2	Set FLO FPGA, SFN mode = Off. Do not provide any ASI input to the transmitter	The RF should still be present	
3	Collect 10 sets of data after the bandpass filter using the FSQ test receiver, and compute the MER as per Appendix A	The MER should be at least 33dB for all active subcarriers	
4	Using Katts, transmit test pattern MER_p2.katts (provided by QC). Let the PID setting on the transmitter remain 16. Collect 10 sets of data after the bandpass filter using the FSQ test receiver, and compute the MER.	The MER should be at least 33dB for all active subcarriers	
5	Using Katts, transmit test pattern MER_p3.katts (provided by QC). Let the PID setting on the transmitter remain 16. Collect 10 sets of data after the bandpass filter using the FSQ test receiver, and compute the MER.	The MER should be at least 33dB for all active subcarriers	

4.2.16.5 Modulation Error Results

Expected Results	Result (circle)
MER is greater than 33 dB for all the subcarriers in all the three cases	<div style="display: flex; justify-content: space-around;"> PASS FAIL </div>

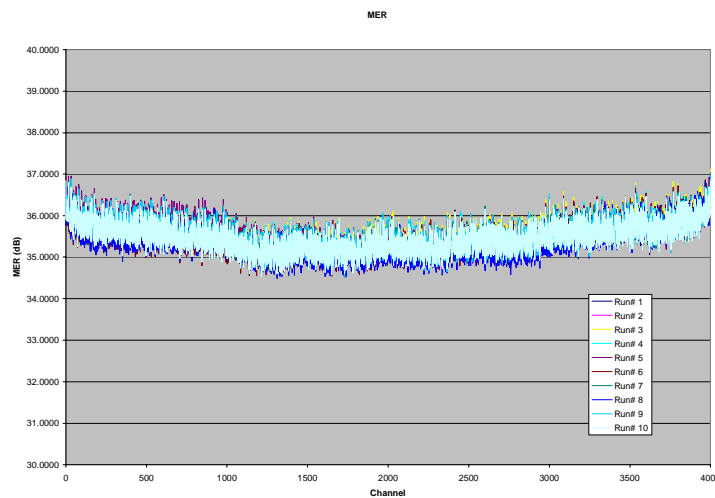
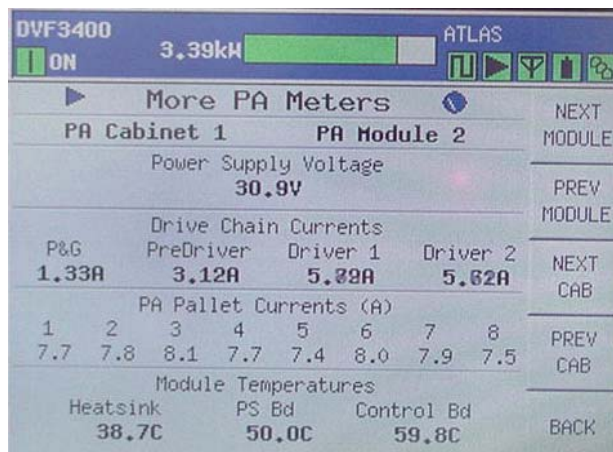
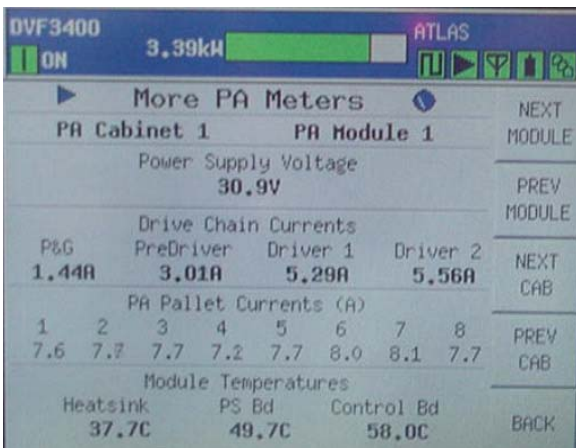
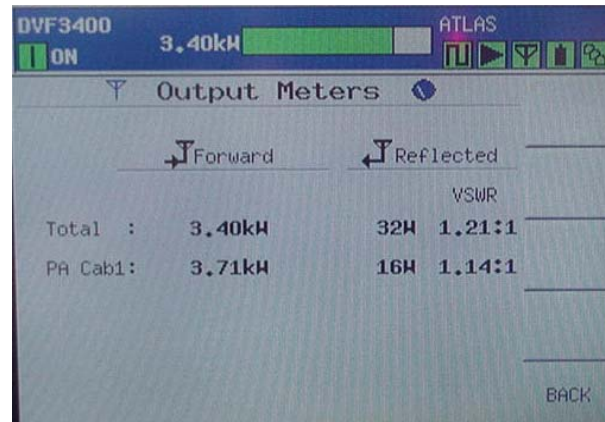
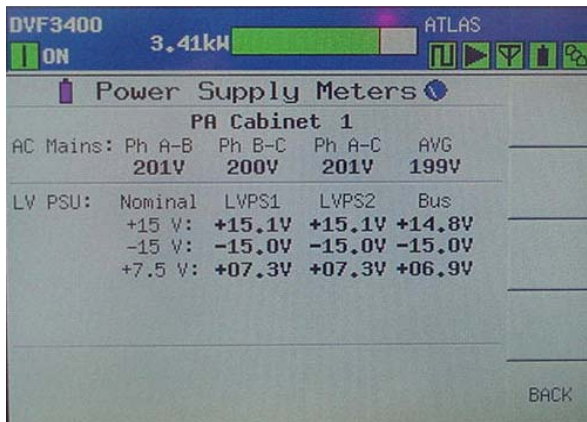
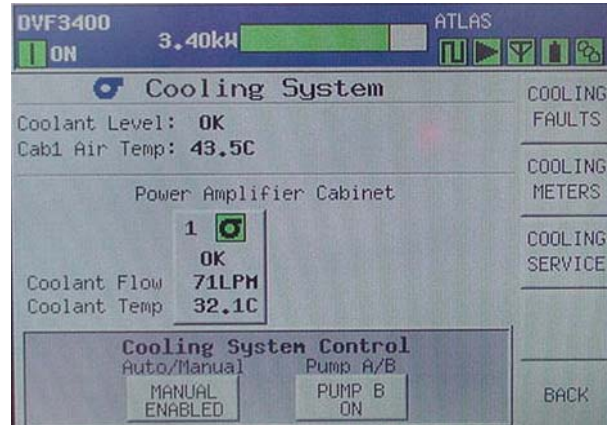
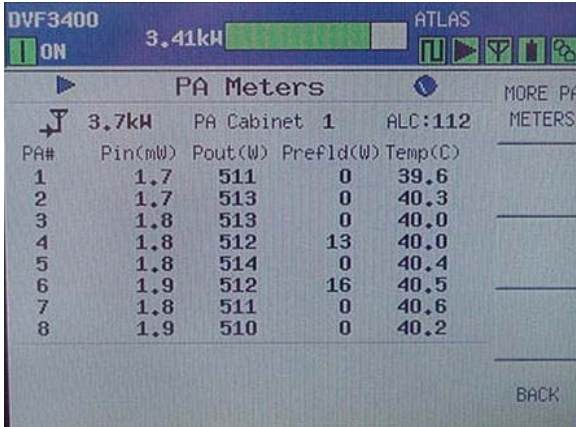


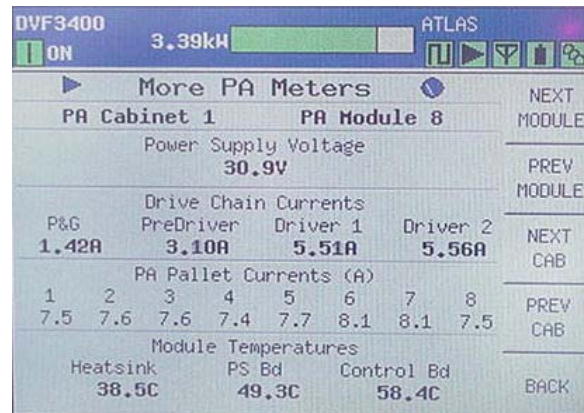
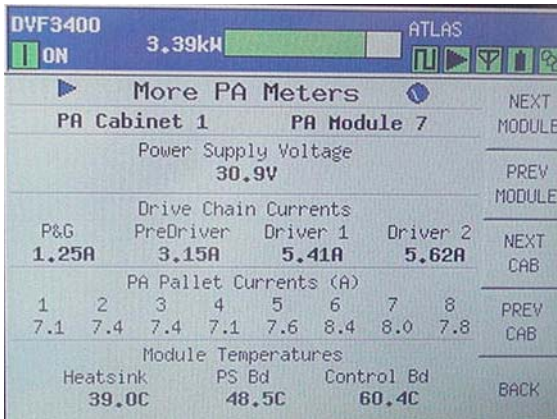
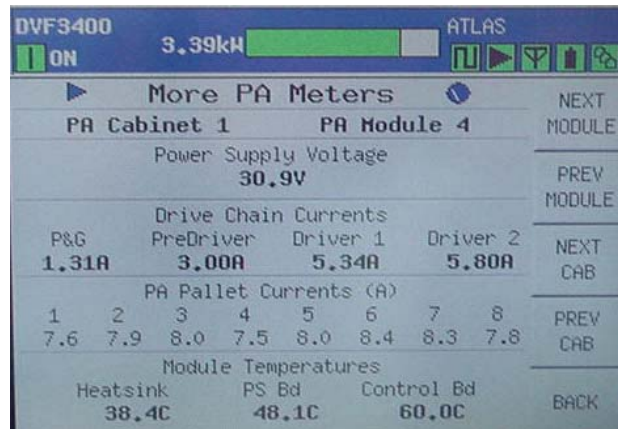
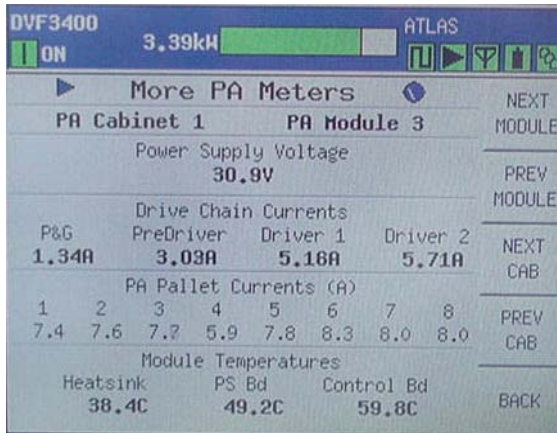
Figure 4-21 Modulation Error Ration Plot 1

The plot above is the output of Qualcomm’s MER tool. It shows the MER of 10 data captures (runs).

4.2.17 Meter Readings

The following GUI screens should be captured or photographed and included in the report:





4.2.18 System VSWR Plots

The following VSWR plots should be included in the report:

- System VSWR into station load
- System VSWR into transmission line and antenna.

CAUTION:
 PRIOR TO MEASURING THE VSWR OF THE TRANSMISSION LINE AND ANTENNA MEASURE THE AMOUNT OF RF PRESENT ON THE TRANSMISSION LINE. IN AREAS OF HIGH RF RADIATION THERE MAY BE ENOUGH RF PRESENT ON THE TRANSMISSION LINE TO DAMAGE THE INPUT OF THE NETWORK ANALYZER. IN THESE INSTANCES IT MAY BE NECESSARY TO USE AN AMPLIFIER AT THE OUTPUT OF THE NETWORK ANALYZER IN ORDER TO GET ACCURATE MEASUREMENTS.

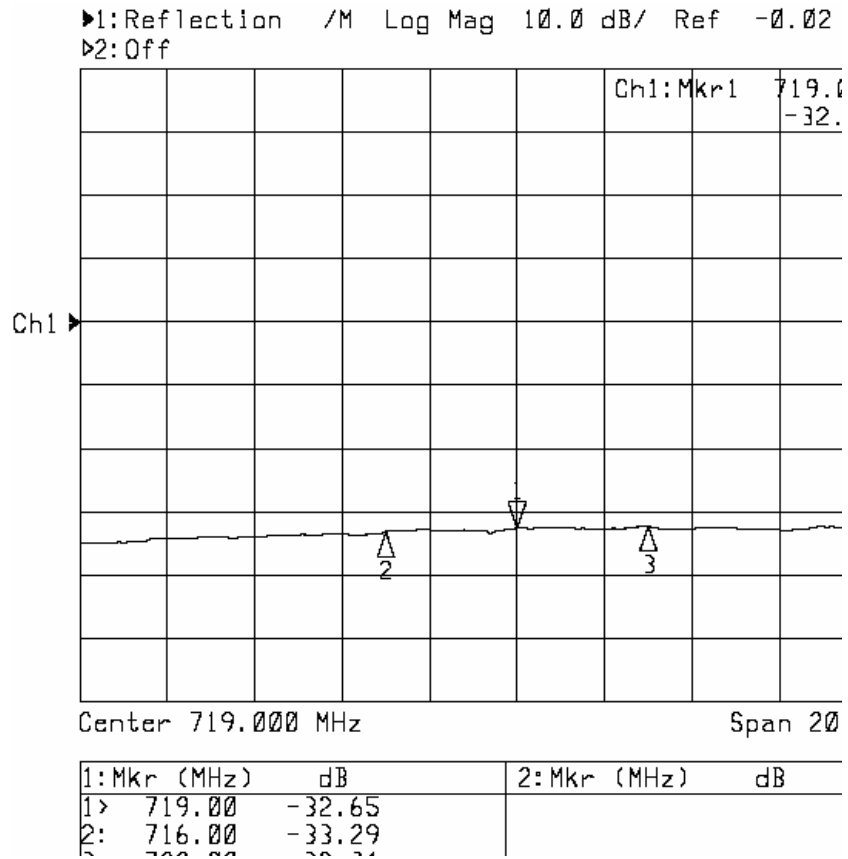
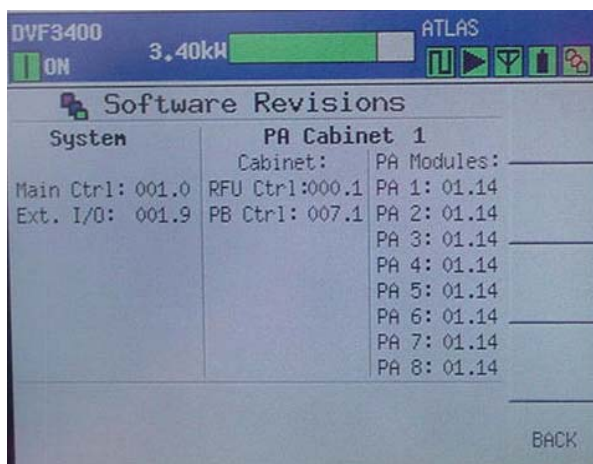


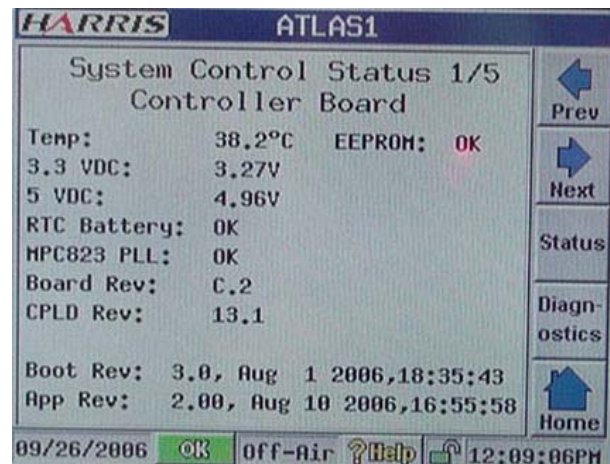
Figure 4-22 Station Load Return Loss (sample)

4.2.19 Software Versions

- The following GUI screens should be captured on transmitter GUI and the APEX GUI:
- Software Revisions (Tx GUI sample shown below)
- Adaptive Processing Status (APEX)
- System Control Status Controller 1/5 (APEX sample shown below)
- IF & RF Processing Status UDC Interface Board 1/4 (APEX)
- System Control Status Front Panel Board 4/5 (APEX)
- System Control Status External I/O Board 2/5)



TX GUI



APEX

4.3 Appendix A - Linux Data Capture & Processing

4.3.1 Introduction

This document is written with the assumption that the “pp” directory has been placed with the path /local/mnt/pp. In cases where the “pp” directory has been placed with another path, substitute that path in everywhere this document calls for /local/mnt.

- a. In this document a space is indicated by , an underlined blank character.
- b. The “pp” directory contains 4 subdirectories:
 1. tracdata: This directory contains files used to capture the I/Q data from the FSQ.
 2. testreceiver: This directory contains files used to process the I/Q data.
 3. results: This directory is where the results are stored after processing.
 4. automation: This directory contains the shell scripts which run the capture and processing.
- c. The processing main menu discussed later in this document contains the following 8 choices:
 1. Enter “1” to perform the measurement.
 2. Enter “2” to change the FLO signal parameters.
 3. Enter “3” to view the current FLO signal parameters.
 4. Enter “4” to change the Linux computer’s IP address.
 5. Enter “5” to view the current Linux computer IP address.
 6. Enter “6” to change the setting for the FSQ’s IP address.
 7. Enter “7” to view the current setting for the FSQ’s IP address.
 8. Enter “8” to exit the processing menu and return to the terminal command line.

4.3.2 Required Equipment

- a. Rhode & Schwarz FSQ
- b. Linux Laptop
- c. 1PPS source

4.3.3 Block Diagram

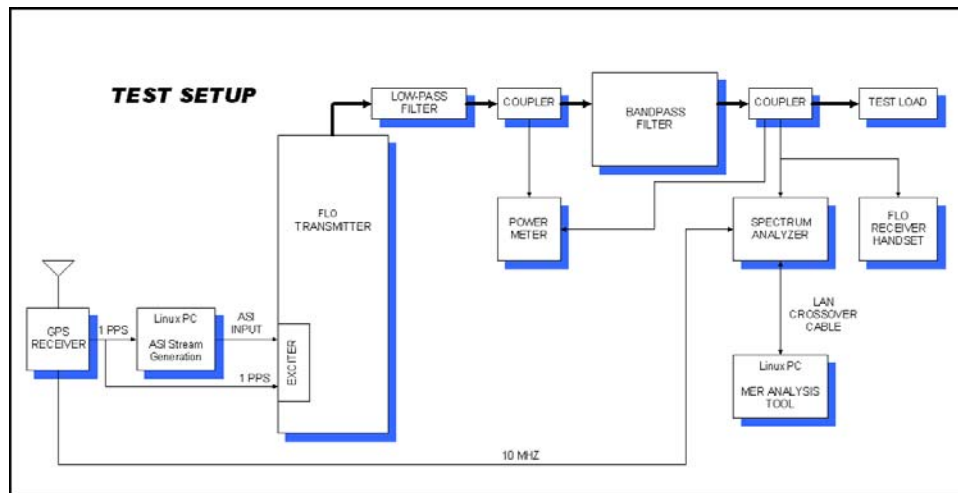


Figure 4-23 MER Measurement Block Diagram

⇒ NOTE:

This diagram shows the measurement being taken from fwd coupler DC1 of the filter assembly. If desired the measurement can also be taken from exciter output and fwd couplers of the transmitter.

4.3.4 1PPS Source Setup

- a. The following setup is required when a 1PPS source is not available at the testing site.
 1. Disconnect the GPS RF input from the exciter you are not testing. This is located on the top of Transmitter rack A.
 2. Connect this GPS RF feed to the Synpaq III 1PPS source “ANTENNA” input.
 3. Connect the AC power adapter to the Synpaq III 1PPS source “DC POWER” input.
 4. The Synpaq III “1PPS” output will now be active and will require a Phono-M to BNC-F adapter.

4.3.4.1 FSQ Connections

- a. Connect the FSQ analyzer to an AC source.
- b. Connect the 1PPS source to the FSQ rear port labeled “EXT TRIGGER/GATE IN”.

- c. Connect an RF cable from the 10MHz monitor port of the exciter under test to the FSQ rear port labeled "REF IN 1...20MHz".
- d. Connect an Ethernet crossover cable between the LAN interface on the rear of the FSQ and the Linux laptop.
- e. Connect an RF cable from the filter assembly desired measurement port to the FSQ front port labeled "RF INPUT".

⇒ NOTE:

The power level into the FSQ should be $-27\text{dBm} \pm 1\text{dBm}$. Measure the input feed power level with a power meter and adjust the level with attenuators as needed to get as close as possible to -27dBm .

4.3.4.2 FSQ Settings

- a. Press the “PRESET” key to restore the FSQ default state.
- b. Recall the “DATA_CAPTURE” state from the FSQ:
 1. Press the “FILE” key on the FSQ
 2. Press the “RECALL” softkey on the FSQ
 3. Select the path to the disk where the state is saved.
 4. Select “DATA_CAPTURE” and select “OK”
 5. Verify the following:
 - a. Press “SETUP” key and verify “REFERENCE” is set to “EXT”
 - b. RBW = 30kHz
 - c. VBW = 300Hz
 - d. Attn = 5dB
 - e. Ref Lev = -20dBm
 - f. Press “TRIG” key and verify the “EXTERN” softkey is selected.
- c. If the FSQ “DATA_CAPTURE” state is not available:
 1. Press the “SETUP” key and then use “REFERENCE” softkey to set to EXT.
 2. Press the “FREQ” key and enter the desired center frequency using the number pad and unit selections.
 3. Press the “SPAN” key and enter “10” from the numeric keypad and terminate the entry with the “MHZ” key.
 4. Press the “BW” key. Press the “RES BW MANUAL” softkey and enter “30 kHz”. Then press the “VIDEO BW MANUAL” softkey and enter “300 Hz”.
 5. Press the “TRIG” key and then press the “EXTERN” softkey.

4.3.5 Setting Static IP Address for FSQ & Linux Machine

Connect an Ethernet crossover cable between the LAN interface on the rear of the FSQ and the Linux laptop.

4.3.5.1 For the FSQ

- a. Press the “SETUP” key. Press the “GENERAL SETUP” soft key and then the “CONFIGURE NETWORK” softkey.
- b. Using the arrow keys or knob, select the desired Local Area Connection and then press the enter key.
- c. The LAN status dialog box appears, select “Properties” and press enter.
- d. Using the arrow keys select “Internet Protocol (TCP/IP)”, and then use the knob to select properties and press enter.
- e. Enter an IP address and Subnet mask. The following is suggested:
 1. IP address: 10.46.252.190
 2. Subnet mask: 255.255.255.0

4.3.5.2 For Linux Laptop

- a. Log on to Linux laptop
 1. Username: root
 2. Password: M3diaFL0
- b. Open a new terminal by right clicking on the desktop and selecting “New Terminal” from the drop down menu.
- c. Go to the processing main menu by typing:
 1. `cd_/local/mnt/pp/automation`
 2. `./PROCESSING`
- d. Change the Linux machines settings for the FSQ’s IP address.
 1. Enter “6” and press “ENTER”.
 2. Enter the static IP address which was set for the FSQ. The suggested FSQ IP address is 10.46.252.190
- e. Set the Linux machine to have a static IP address similar to the FSQ:
 1. Enter “4” and press “ENTER”.
 2. Enter “1” and press “ENTER”.
 3. Enter the IP address and press “ENTER”. The suggested IP address is 10.46.252.189
 4. Enter the subnet mask and press “ENTER”. The suggested subnet mask is 255.255.255.0

- f. To verify the connection with the FSQ:
 1. Open a new terminal by right clicking on the desktop and selecting “New Terminal” from the drop down menu.
 2. In the terminal type “ping xxx.xxx.xxx.xxx” where the x’s represent the FSQ’s IP address. After pressing enter the screen should display that the ping was returned with 0% loss. After a few lines have progressed with 0% loss press “CTRL+C” to stop the ping.

4.3.6 Capturing and Processing Data

4.3.6.1 Setting Flo Signal Parameters

The FLO signal parameters must be correct for each site in order to ensure accurate results. Once the FLO signal parameters are set through they do not need to be changed until there is a change in the FLO signal.

- a. Log on to Linux laptop
 1. Username: root
 2. Password: M3diaFLO
- b. Open a new terminal by right clicking on the desktop and selecting “New Terminal” from the drop down menu.
- c. Go to the processing main menu by typing:
 1. `cd_/local/mnt/pp/automation`
 2. `./PROCESSING`
- d. Changing the FLO signal Parameters:
 1. Enter “2” and press “ENTER”.
 2. Enter the WID and press “ENTER”.
 3. Enter the LID and press “ENTER”.
 4. Enter the # of OFDM symbols per frame and press “ENTER”.
 5. Enter the # of reserved symbols (PPC) and press “ENTER”.
 6. Enter the first local symbol and press “ENTER”. The first local symbol is equal to the national length +2.

4.3.6.2 Performing the Measurement

- a. Open a new terminal by right clicking on the desktop and selecting “New Terminal” from the drop down menu.
- b. Go to the processing main menu by typing:
 1. `cd_/local/mnt/pp/automation`
 2. `./PROCESSING`
- c. If the FLO signal parameters have changed since the last capture change the settings for FLO signal parameters.
- d. Perform the measurements
 1. Enter “1” and press “ENTER”.
 2. Enter the desired number of captures and press “ENTER”.

4.3.6.3 Looking at the Results

- a. Open a new terminal by right clicking on the desktop and selecting “New Terminal” from the drop down menu.
- b. The results are stored in a directory indexed by data and time
- c. Go to the results directory
 1. `cd_/local/mnt/pp/results`
- d. Go to the indexed directory for the day, month, year of the desired capture
 1. `ls --` To list the possible directories
 2. `cd_ddMMYYYY`
- e. Go to the indexed directory for the hour, minute, second of the desired capture
 1. `ls --` To list the possible directories
 2. `cd_HHMMSS`
- f. Open a file to view its contents
 1. `ls --` To view the files in the directory
 2. `emacs_filename`

4.3.6.4 Moving Results to Flash Drive

- a. Mounting the flash drive

1. Click on the “RedHat” icon on the taskbar.
 2. Select “System Tools”
 3. Select “Disk Management”
 4. In the user mount tool, select the directory /mnt/flash and click “Mount”
- b. Open a new terminal by right clicking on the desktop and selecting “New Terminal” from the drop down menu.
- c. Go to the indexed directory for the day, month, year of the desired capture
1. `cd_/local/mnt/pp/results/ddMMYYYY`
 2. `ls --` To view the possible results in the directory
- d. Copy the desired result directory to the flash drive
1. `cp_-rf_HHMMSS/_/mnt/flash`
- e. Unmounting the flash drive
1. Click on the “RedHat” icon on the taskbar.
 2. Select “System Tools”
 3. Select “Disk Management”
 4. In the user mount tool, select the directory /mnt/flash and click “Unmount”

4.4 Appendix B - Generating a CW Tone

a. Open a web browser and enter the IP address of the eCDi with the target exciter port.

1. `http://eCDI's IP:20080 exciter AAdd: Steps 1, 2 & 3.`
2. `http://eCDI's IP:20180 exciter B`
3. (API Test Configuration Register 1)
4. "Request Memory File"
5. Memory Start Address: 40000C8
6. Memory Length: 1
7. This will be used to verify the current value.
8. Go to "Upload/Execute FPGA Script File" and upload the script file "CWEnable.txt"
9. Script "CWDisable.txt" will disable the tone once testing is completed.

b. CW enable script

1. n
2. # Script file for testing FPGA Modulator board
3. # m <address> <count> <cr>- dump data command; dumps "count" 32-bit words at <address>
4. # l <address> <count> <data> <cr>- fill same data command; fills "count" 32-bit words with data starting at <address>
5. # p <address> <count> <d(n) d(n+1)... d(count)> <cr> - fill data command; fills "count" 32-bit words data(n) to data(count) starting at <address>
6. # k <address> <cr>- peek address command; reads 32-bit data word at <address>
7. # o <address> <data> <cr>- poke data command; writes 32-bit data word at <address>
8. # h <cr>- echo on command - enables echo of command file to log file
9. # n <cr>- echo off command - disables echo of command file to log file
10. # w <cr>- wait for 10 msec.
11. # z - END FILE: z
12. h
13. # enable cw tone IQ_MUX_ATT

c. CW disable script

1. n
2. # Script file for testing FPGA Modulator board
3. # m <address> <count> <cr>- dump data command; dumps "count" 32-bit words at <address>
4. # l <address> <count> <data> <cr>- fill same data command; fills "count" 32-bit words with data starting at <address>
5. # p <address> <count> <d(n) d(n+1)... d(count)> <cr> - fill data command; fills "count" 32-bit words data(n) to data(count) starting at <address>
6. # k <address> <cr>- peek address command; reads 32-bit data word at <address>
7. # o <address> <data> <cr>- poke data command; writes 32-bit data word at <address>
8. # h <cr>- echo on command - enables echo of command file to log file
9. # n <cr>- echo off command - disables echo of command file to log file
10. # w <cr>- wait for 10 msec.
11. # z - END FILE: z
12. h
13. # disable cw tone IQ_MUX_ATT

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

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.

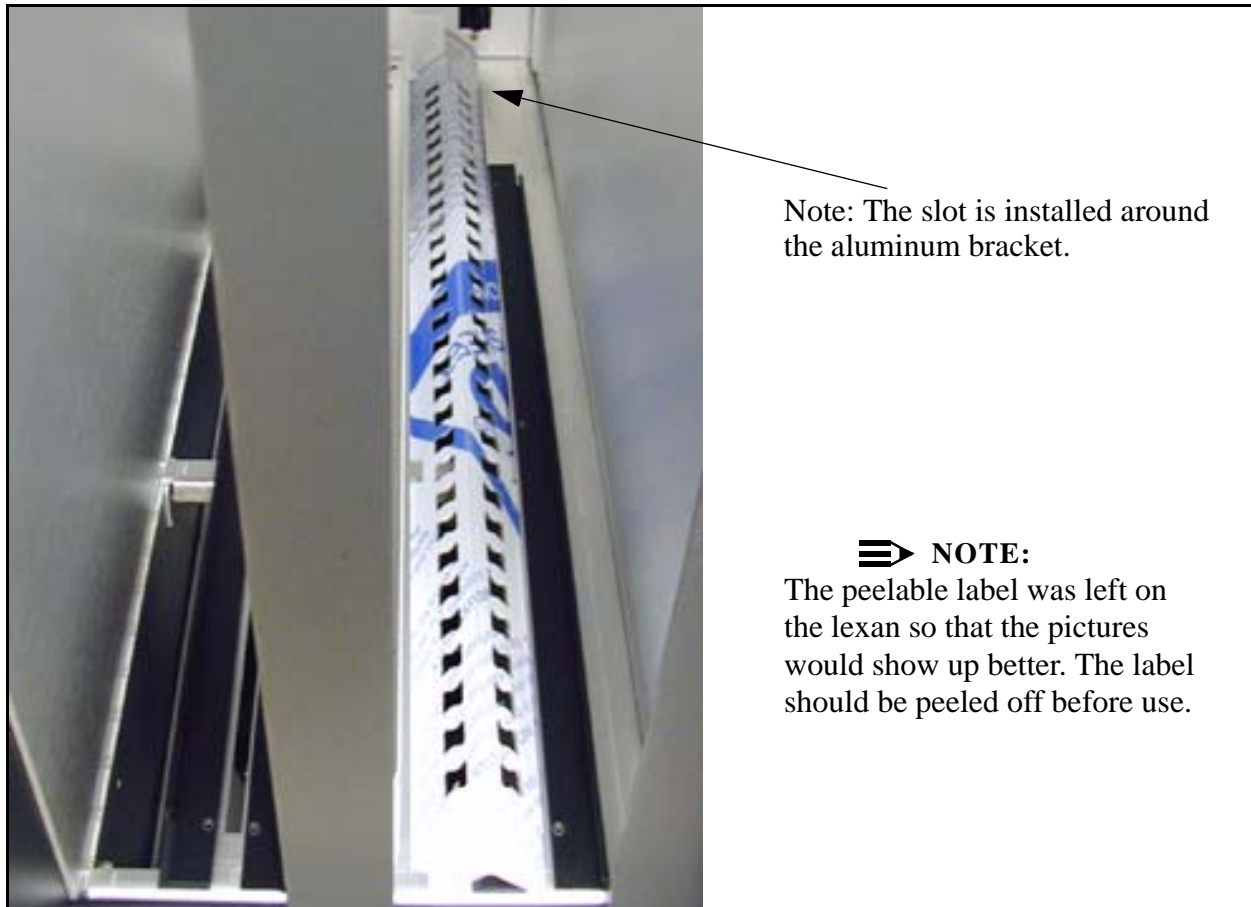


Figure 5-2 Air Block Installed

5.2.2 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
- Medium size Phillips blade screwdriver
- Medium size flat blade 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° F (50° 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.

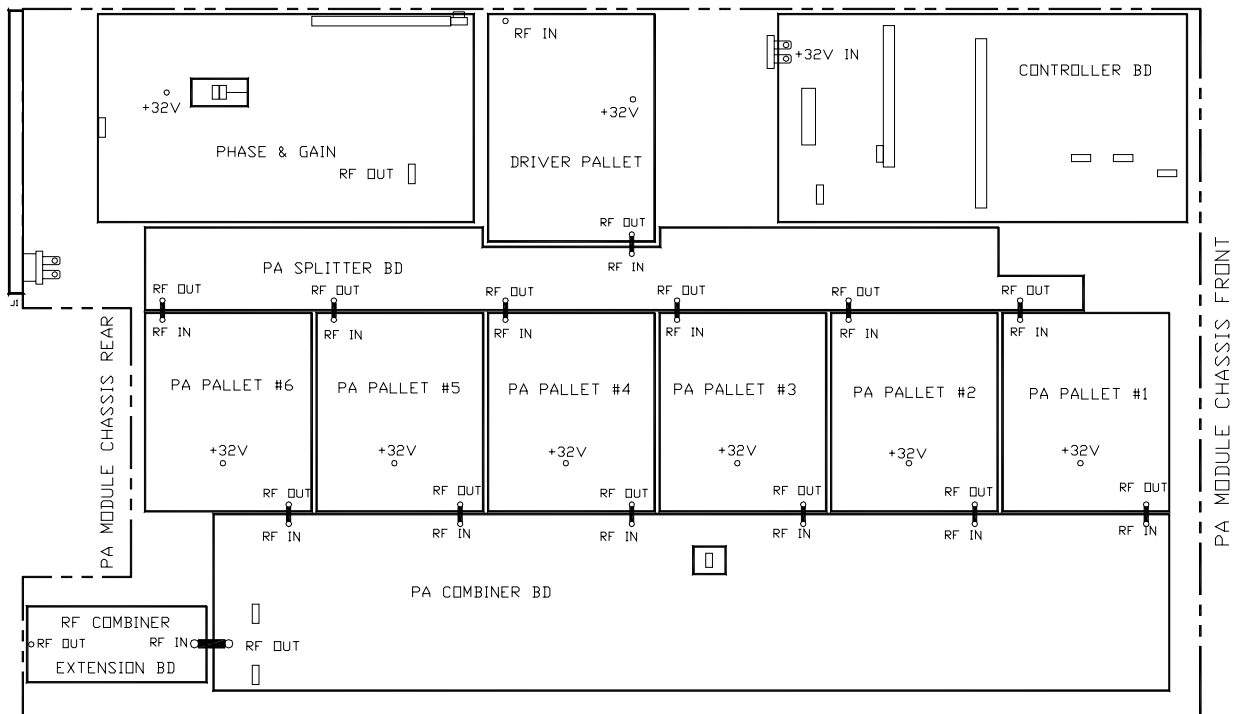


Figure 5-3 PA Pallet Numbering Scheme

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 the board that is being removed. Once the board is loosened in this way the cop-

per 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%.

5.3 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.

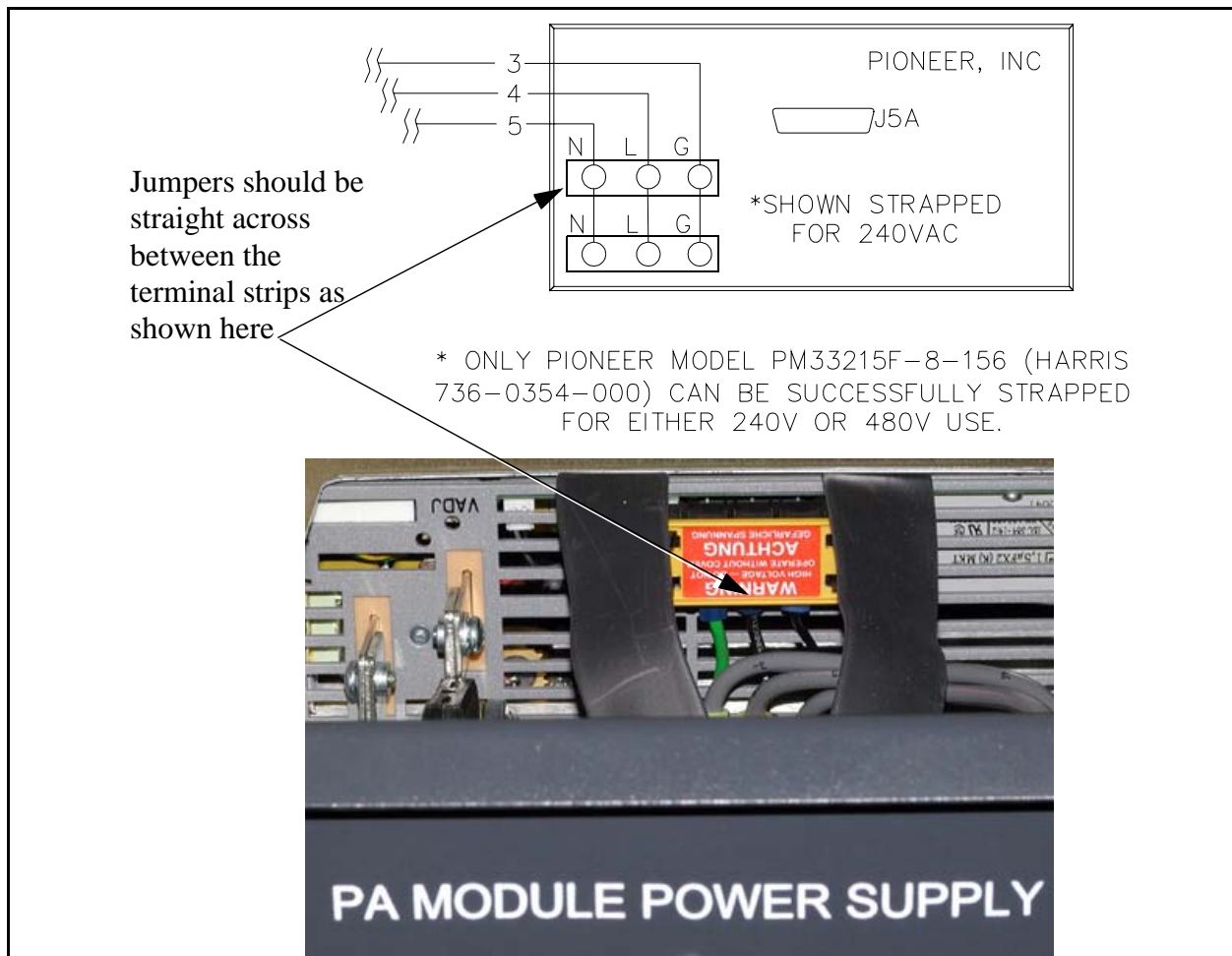


Figure 5-4 Power Supply AC Strapping

5.4 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.

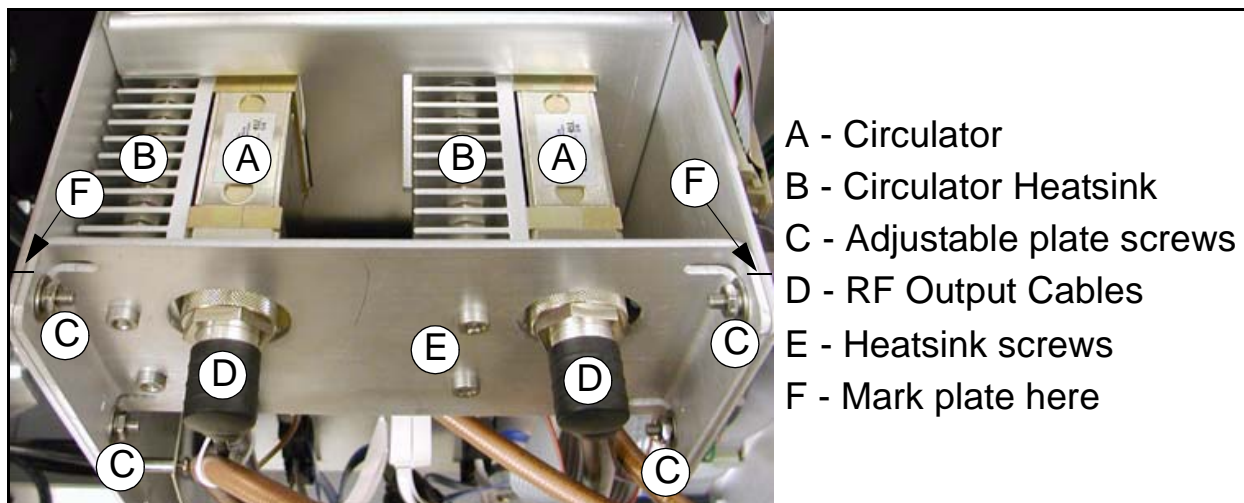


Figure 5-5 Circulator Assembly

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

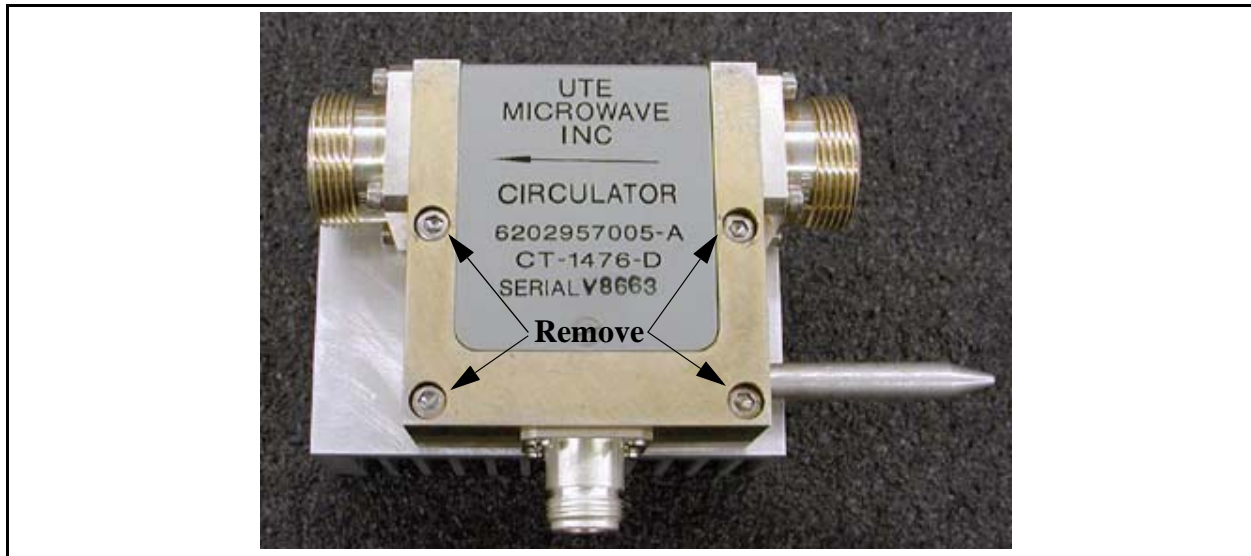


Figure 5-6 Circulator Side View

- 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.

5.5 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.

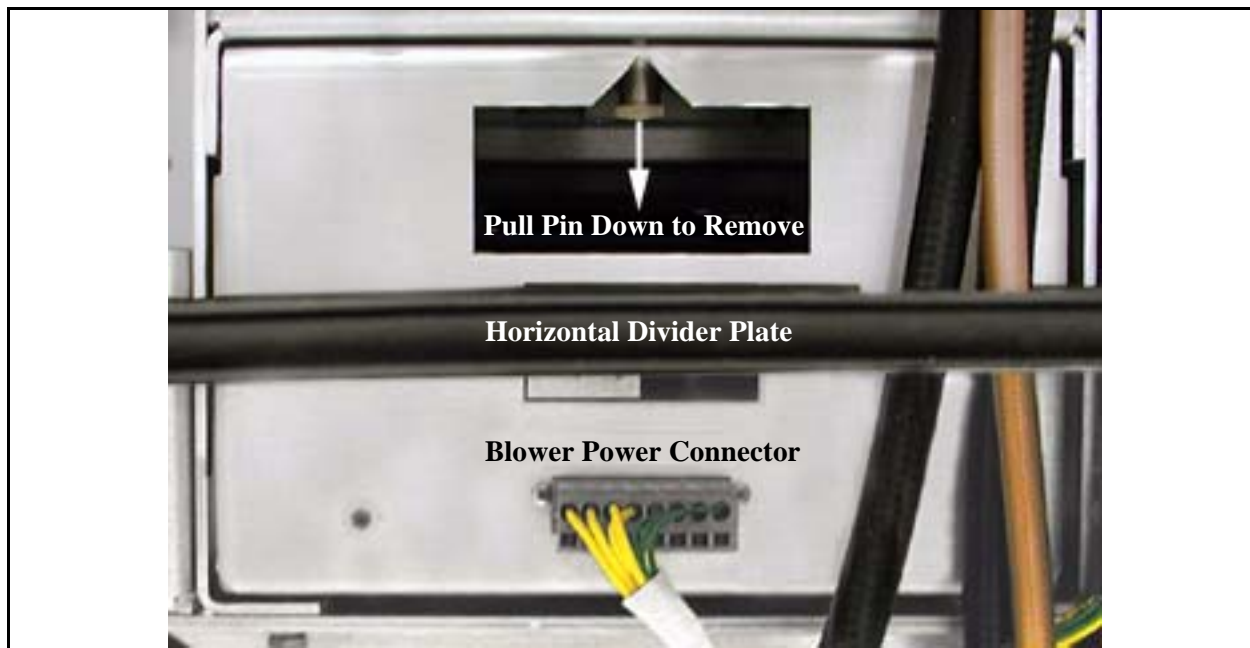


Figure 5-7 Blower Tray, Rear View

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.

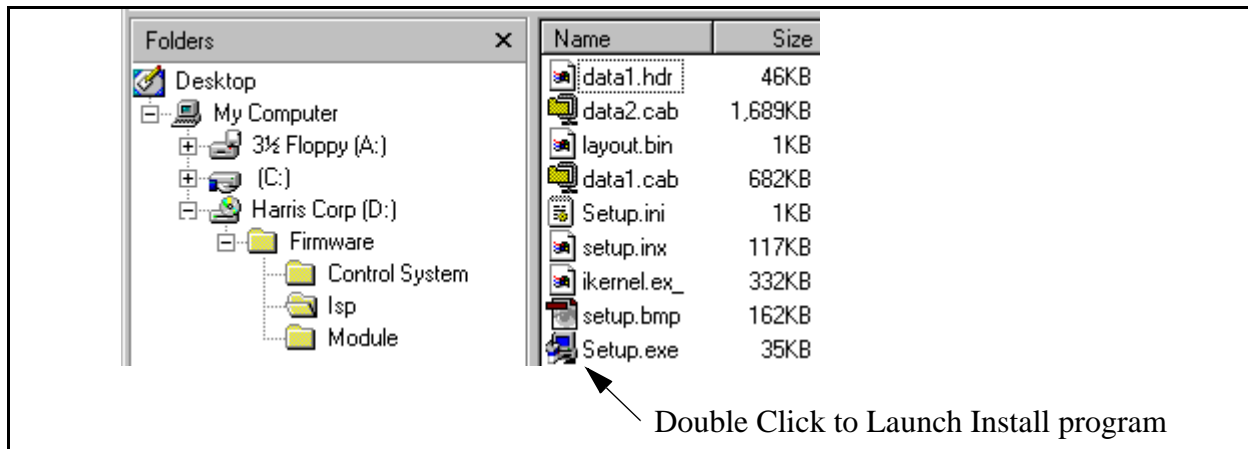


Figure 6-1 CD-ROM ISP Directory

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.

⇒ NOTE:

There is a separate ISP procedure used to update the Apex exciter. See the Apex exciter manual for details on updating Apex exciter software.

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.

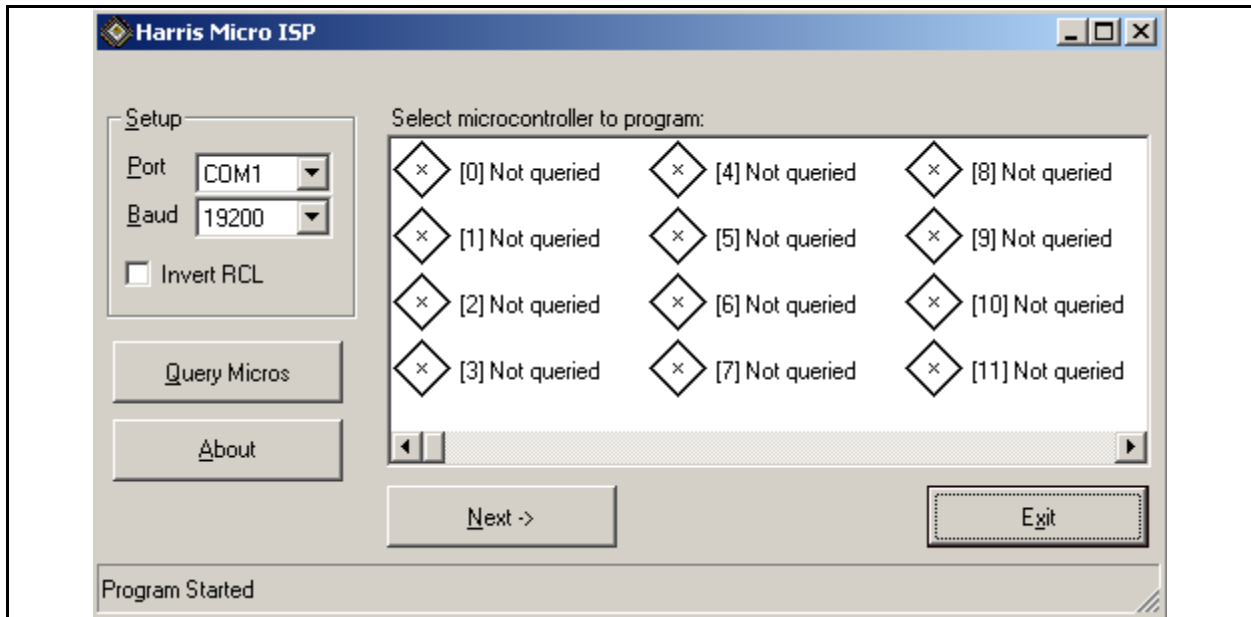


Figure 6-2 ISP Opening Screen

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.

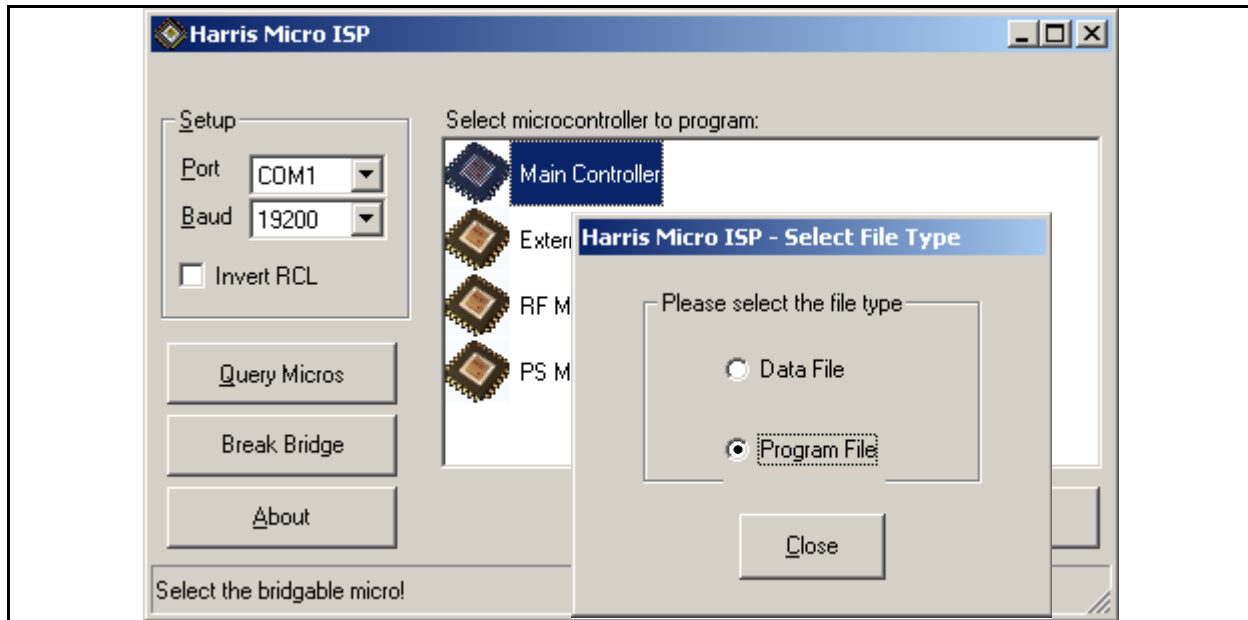


Figure 6-4 Controller Selected for Update, Program File Selected

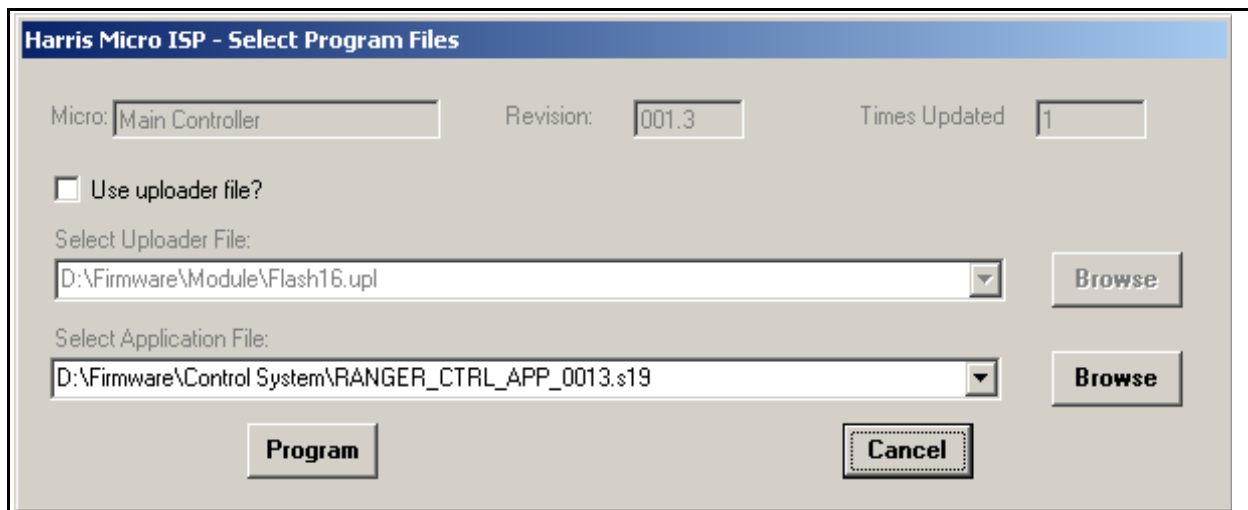


Figure 6-5 Browse the CD for the Desired S19 Application File

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.

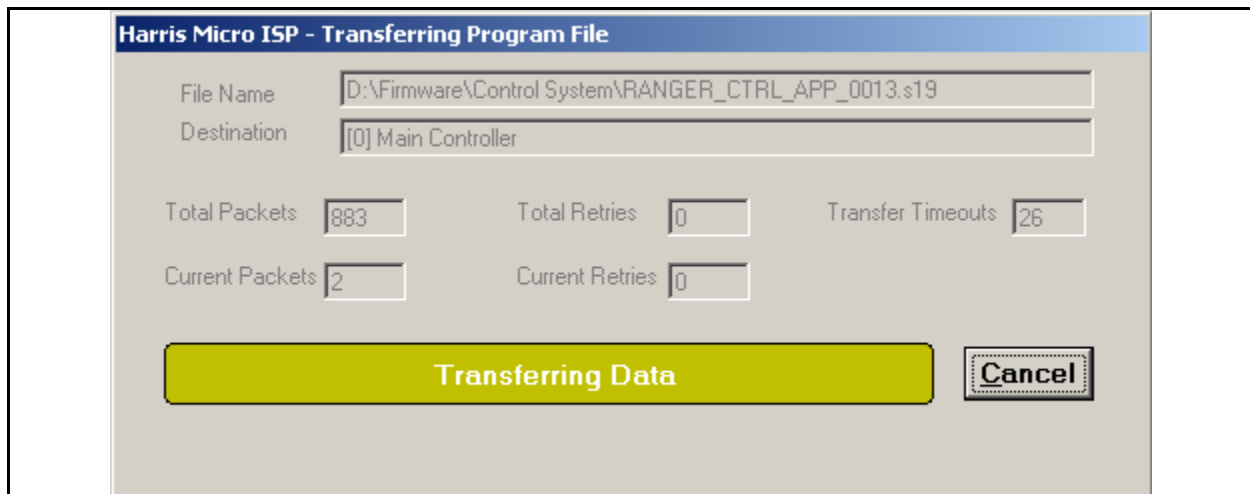


Figure 6-6 Data Being Transferred (will take several minutes)

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.

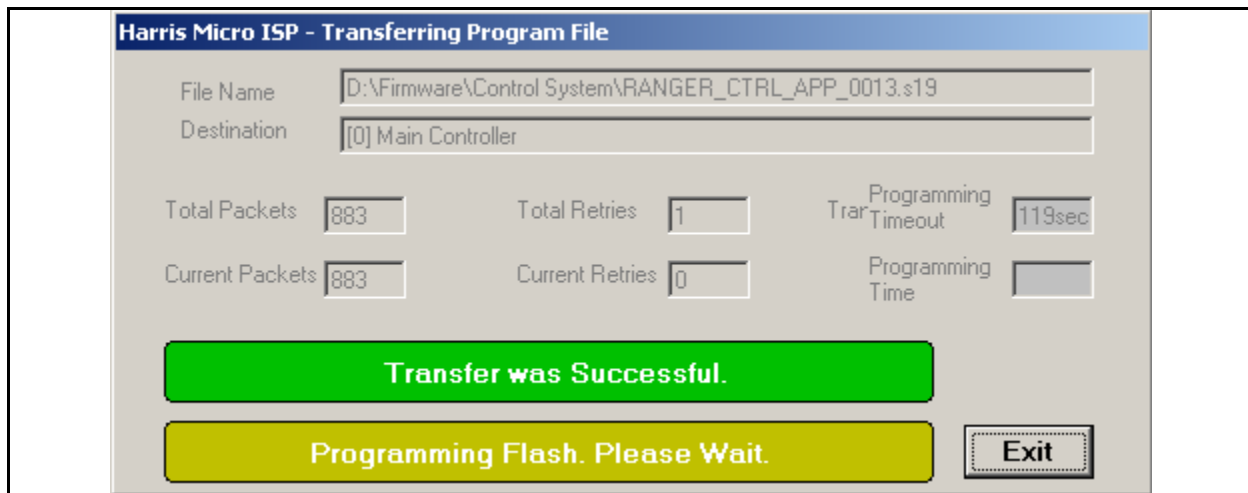


Figure 6-7 Programming Flash

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.**

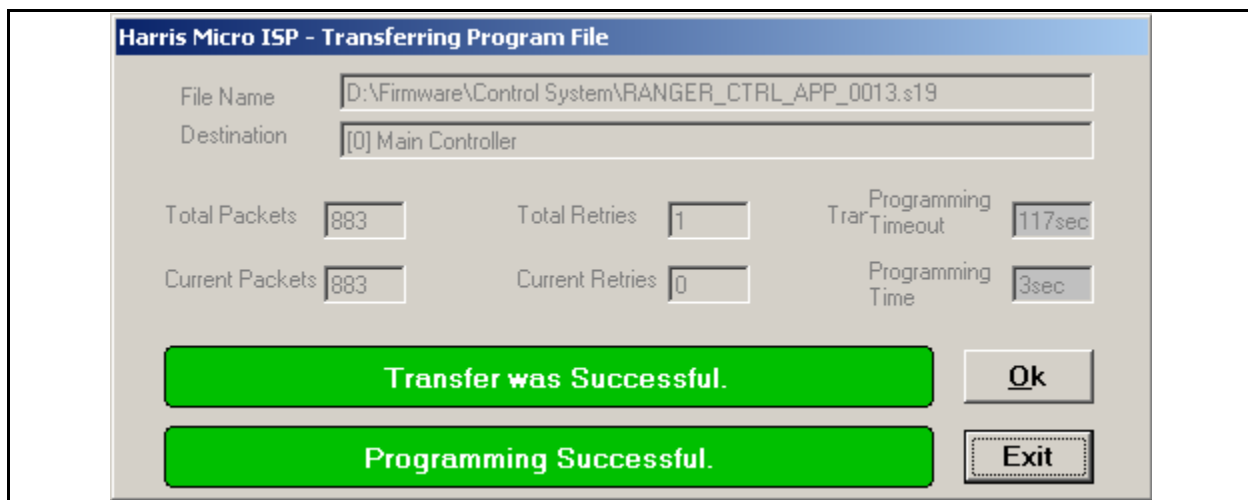


Figure 6-8 Programming Successful

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 2-1 on page 2-2 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.

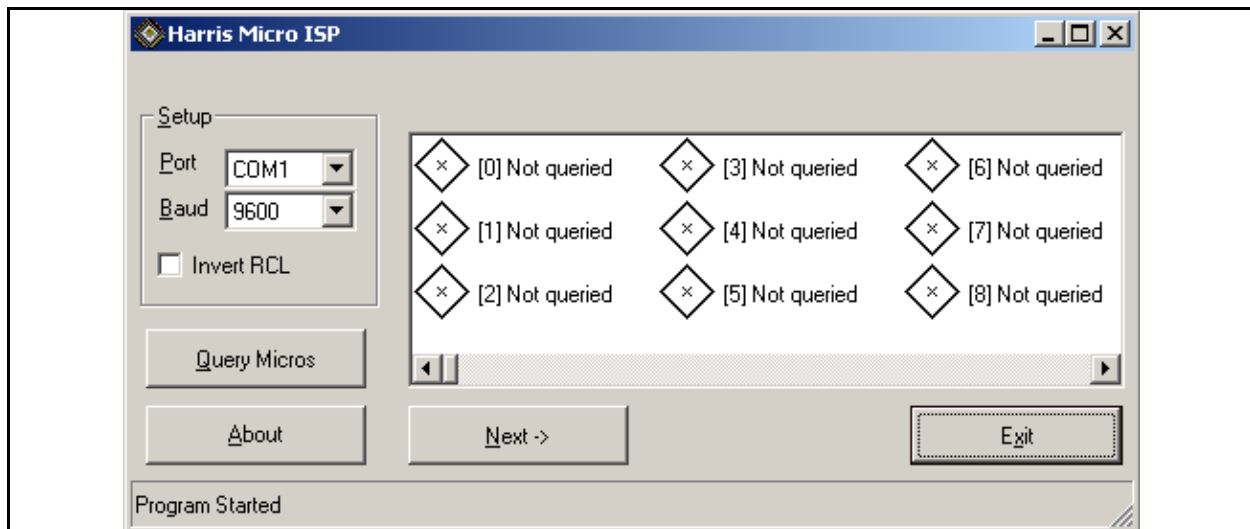


Figure 6-9 ISP Opening Screen

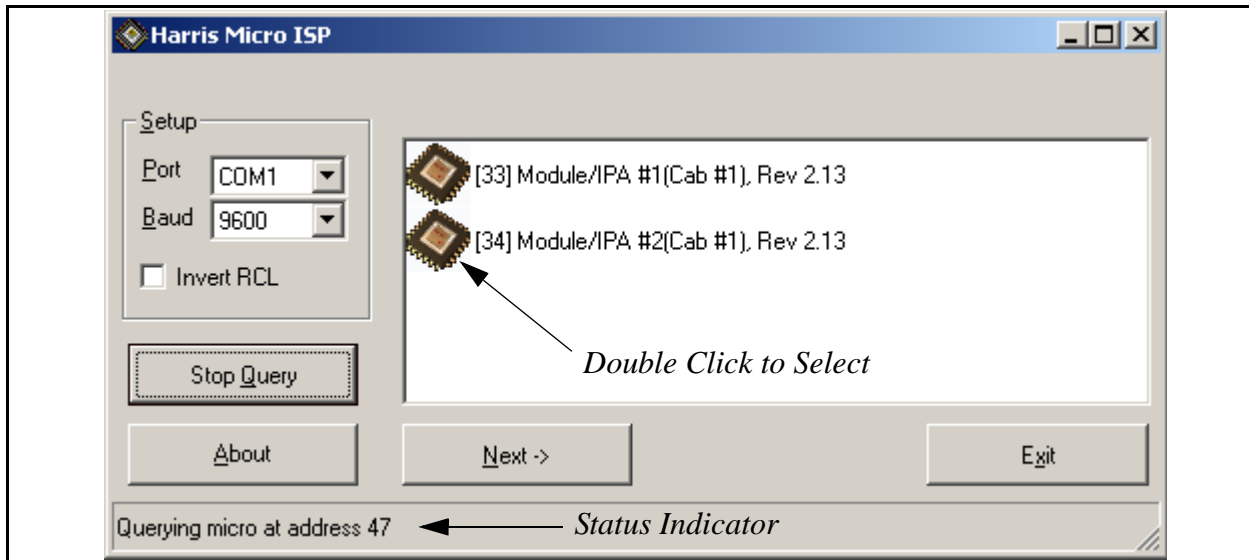


Figure 6-10 Response to “Query Micros”

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.

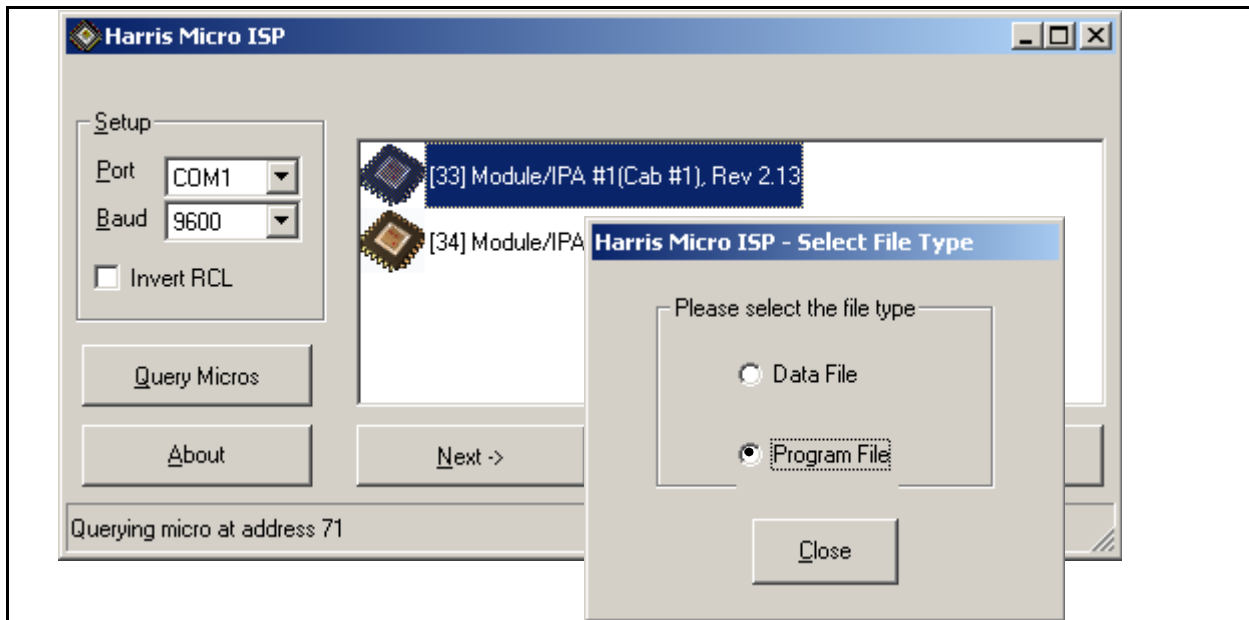


Figure 6-11 Controller Selected for Update, Program File Selected

- 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.

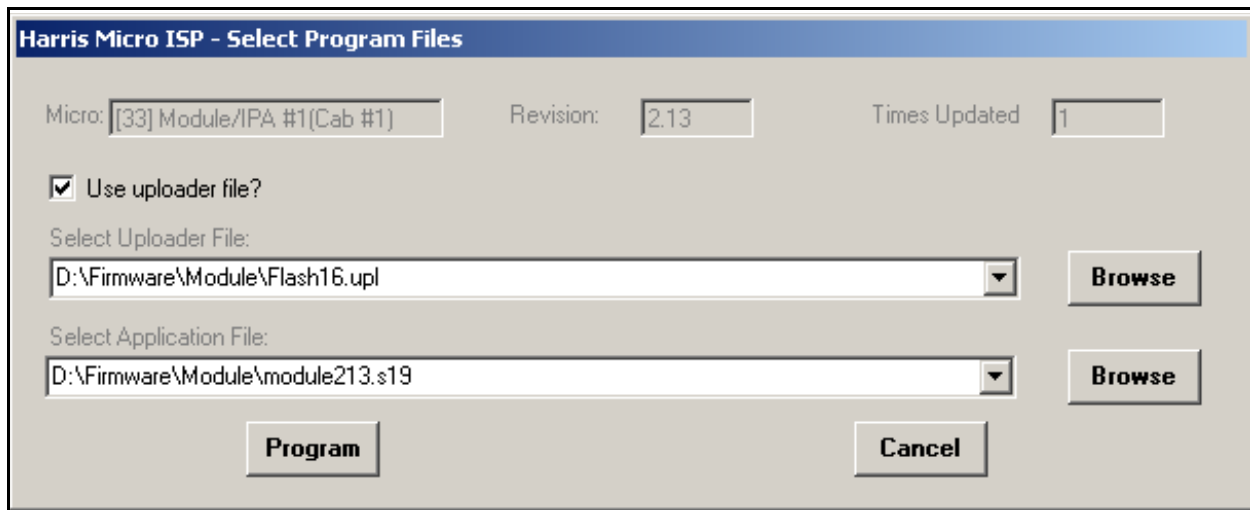


Figure 6-12 Select Uploader and Application File

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

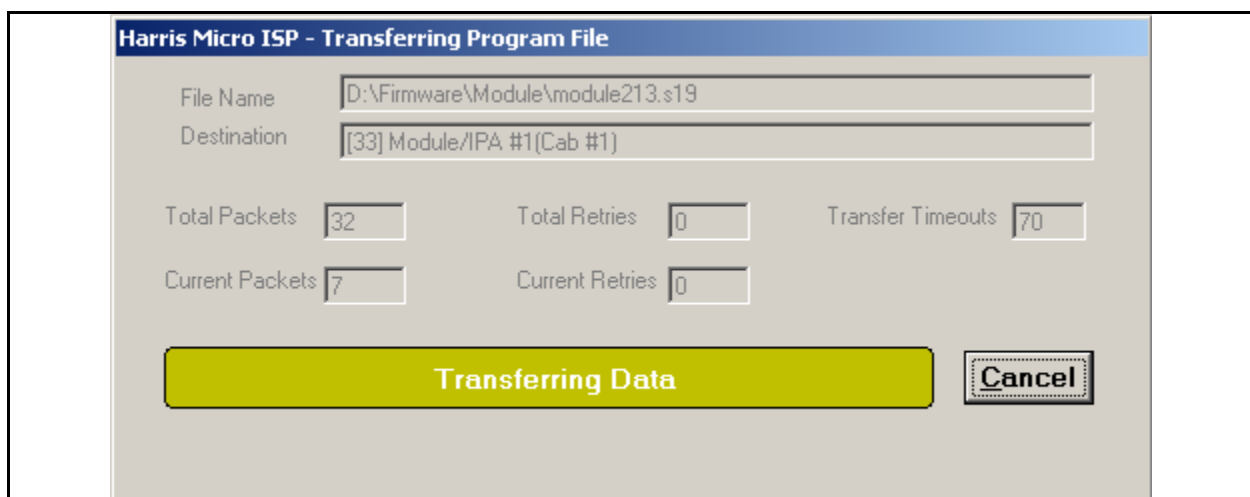


Figure 6-13 Data Being Transferred (will take several minutes)

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.

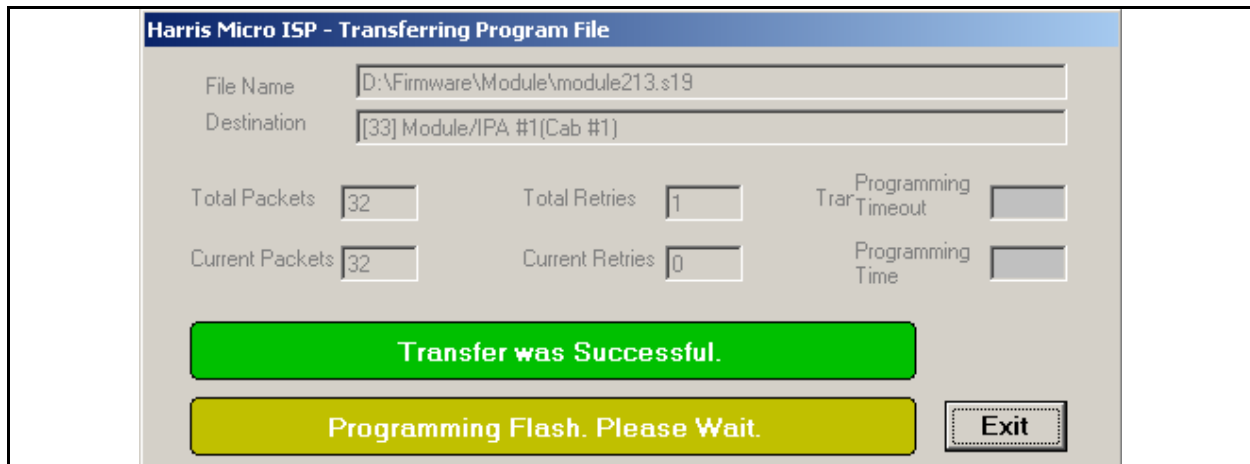


Figure 6-14 Programming Flash

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.

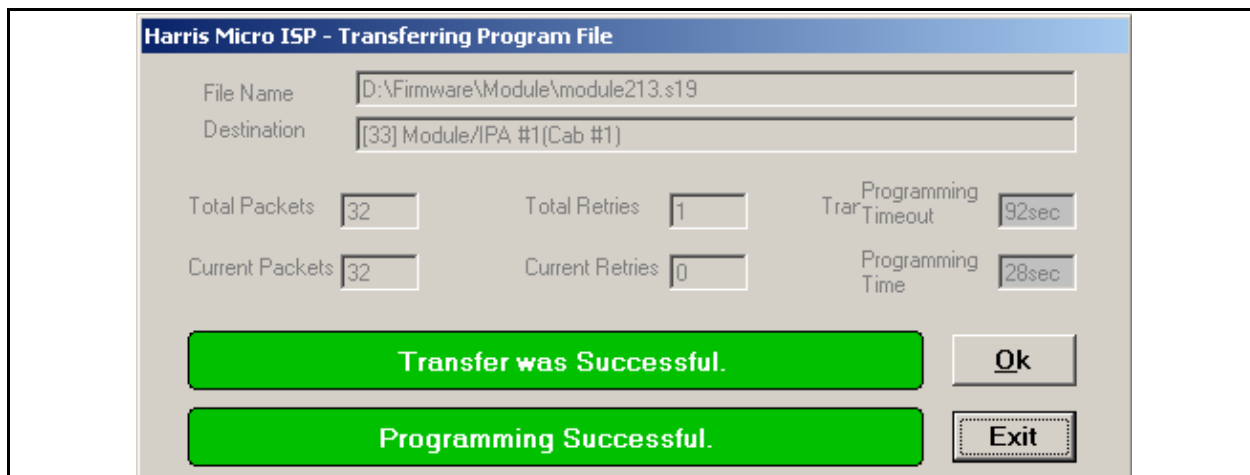


Figure 6-15 Programming Successful

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.

