Note: Chapters 1, 2, 4, 5, 6, Appendix A and Appendix B are part number 888-2624-001. The remainder of this book is part number 888-2624-010
### MANUAL REVISION HISTORY
APEX-M2X Exciter, DVB-T2 Mode
888-2462-010

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<td>Add TM to ATSC BOM's</td>
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<td>9/25/9</td>
<td>P45262</td>
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<td>4/5/11</td>
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<td>B</td>
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<td>61551</td>
<td>Update software to revision N</td>
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<td>Revise table Table 3-3 on page 31</td>
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<td>Update Title Pages.</td>
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<td>Updated Exciter GUI Screens In Appendix A</td>
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<td>61566</td>
<td>Corrected error in title block of Manual Revision History table in the Title Section.</td>
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<tr>
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<td>8/17/12</td>
<td>61972</td>
<td>Updated manual to revision U software</td>
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<td>Rewrote the PFRU Status screen Holdover Sub Window section</td>
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**WARNING:** Disconnect primary power prior to servicing.
Technical Assistance

Technical and troubleshooting assistance for HARRIS Transmission products is available from HARRIS Field Service (factory location: Quincy, Illinois, USA) during normal business hours (8:00 AM - 5:00 PM Central Time). Telephone +1-217-222-8200 to contact the Field Service Department; FAX +1-217-221-7086; or E-mail questions to tsupport@harris.com. Emergency service is available 24 hours a day, seven days a week, by telephone only. Online assistance, including technical manuals, white papers, software downloads, and service bulletins, are available at http://www.broadcast.harris.com (from there, click on Customer Support Portal under the Services & Support tab dropdown menu).

Address written correspondence to Field Service Department, HARRIS Broadcast Communications Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. For other global service contact information, please visit: http://www.broadcast.harris.com/contact.

NOTE: For all service and parts correspondence, you will need to provide the Sales Order number, as well as the Serial Number for the transmitter or part in question. For future reference, record those numbers here: ___________________/____________________

Please provide these numbers for any written request, or have these numbers ready in the event you choose to call regarding any Service, or Parts requests. For warranty claims it will be required, and for out of warranty products, this will help us to best identify what specific hardware was shipped.

Replaceable Parts Service

Replacement parts are available from HARRIS Service Parts Department 7:00 AM to 7:00 PM Central Time, Monday through Friday, and 8:00 AM to 1:00 PM Central Time on Saturday. Telephone +1-217-222-8200 or email servicepartsreq@harris.com to contact the Service Parts Dept.

Emergency replacement parts are available by telephone only, 24 hours a day, seven days a week by calling +1-217-222-8200.

Unpacking

Carefully unpack the equipment and perform a visual inspection to determine if any apparent damage was incurred during shipment. Retain the shipping materials until it has been verified that all equipment has been received undamaged. Locate and retain all PACKING CHECK LISTs. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

Returns And Exchanges

No equipment can 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.

WARNING: Disconnect primary power prior to servicing.
WARNING:
THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.

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

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

The following National Fire Protection Association (NFPA) standards are recommended as reference:

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

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

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

WARNING:
IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.

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

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

   A) AIRWAY
   IF UNCONSCIOUS, OPEN AIRWAY
   LIFT UP NECK
   PUSH FOREHEAD BACK
   CLEAR OUT MOUTH IF NECESSARY
   OBSERVE FOR BREATHING

   B) BREATHING
   IF NOT BREATHING, BEGIN ARTIFICIAL BREATHING
   TILT HEAD
   PINCH NOSTRILS
   MAKE AIRTIGHT SEAL
   4 QUICK FULL BREATHS
   REMEMBER MOUTH TO MOUTH RESUSCITATION MUST BE COMMENCED AS SOON AS POSSIBLE

   C) CIRCULATION
   DEPRESS STERNUM 1 1/2 TO 2 INCHES
   APPROX. RATE OF COMPRESSIONS
   --80 PER MINUTE
   ONE RESCUEER
   15 COMPRESSIONS
   2 QUICK BREATHS
   APPROX. RATE OF COMPRESSIONS
   --60 PER MINUTE
   TWO RESCUERS
   5 COMPRESSIONS
   1 BREATH

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

   CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

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

WARNING: Disconnect primary power prior to servicing.
FIRST-AID

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

Treatment of Electrical Burns

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

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

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

REFERENCE:
ILLINOIS HEART ASSOCIATION
AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL (SECOND EDITION)
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:

<table>
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<td>Table 7-3. Controller Board</td>
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<td>Table 7-5. PA Amplifier</td>
<td>971 7894 002</td>
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<tr>
<td>Table 7-6. PA Amplifier Board</td>
<td>901 7904 002</td>
<td>7-10</td>
</tr>
<tr>
<td>Table 7-7. Output Cabinet</td>
<td>981 9450 001</td>
<td>7-12</td>
</tr>
</tbody>
</table>

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. Each table headings is in the format of; Table #-#. ITEM NAME - HARRIS PART NUMBER - this line gives the information that corresponds to the Replaceable Parts List Index entry;

Inside the actual tables, four main headings are used:

- **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;
- **Qty UM** column notes the quantity and unit of measure of the item;
- **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.).

**NOTE:** Inside the individual tables some standard conventions are used:

- A # symbol in front of a component such as #C001 under the REF. SYMBOLS/EXPLANATIONS column means that this item is used on or with C001 and is not the actual part number for C001.
- In the ten digit part numbers, if the last three numbers are 000, the item is a part that Harris has purchased and has not manufactured or modified. If the last three numbers are other than 000, the item is either manufactured by Harris or is purchased from a vendor and modified for use in the Harris product.
- The first three digits of the ten DIGIT part number tell which family the part number belongs to - for example, all electrolytic (can) capacitors will be in the same family (524 xxxx 000). If an electrolytic (can) capacitor is found to have a 9xx xxxx xxx part number (a number outside of the normal family of numbers), it has probably been modified in some manner at the Harris factory and will therefore show up farther down into the individual parts list (because each table is normally sorted in ascending order). Most Harris made or modified assemblies will have 9xx xxxx xxx numbers associated with them.

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

---

**WARNING:** Disconnect primary power prior to servicing.
**BILLING INFORMATION**

**C**USTOMER NAME: ________________________________

**A**DDRESS: ______________________________________

**T**ELEPHONE NUMBER: ___________________________

**F**AX NUMBER: __________________________________

**P**REFERRED PAYMENT METHOD: ____________________

**F**REQUENCY (If required):_________________________

**E**QUIPMENT NAME: _______________________________

**E**QUIPMENT PART NUMBER: ________________________

**E**QUIPMENT SERIAL NUMBER: ______________________

---

**SHIPPING INFORMATION**

**S**HIP TO: ______________________________________

**A**DDRESS: ______________________________________

**T**ELEPHONE NUMBER: ___________________________

**F**AX NUMBER: __________________________________

**S**HIPPING METHOD PREFERRED: ____________________

---

**GUIDE FOR ORDERING PARTS**

- Please use the following parts order form, filling in as much information as possible.
- The complete information will allow double checking the part number for correctness or locating a substitute if the part is not available.
- The equipment name, part number, and serial number will be found on a metal ID plate on the back of the unit. The serial number MUST be included for any warranty parts.
- Describe the part using the description in the parts list if possible. Include the schematic information, schematic number, or number of next higher assembly. The next higher assembly is usually a 981-xxxx-yx type.

---

**ITEM # | QTY | HARRIS PART NUMBER | DESCRIPTION OF PART (PART NAME, DESCRIPTION, SPECIFICATION FROM PARTS LIST IF AVAILABLE) | SCHEMATIC REFERENCE NAME (e.g. CO01, R100, etc.) | ITEM USED ON (NEXT HIGHER ASSEMBLY IF KNOWN) (e.g. CO01 used on 892 8025 001, SCHEMATIC 859 8099 991) | COMMENTS**

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1 Introduction

This technical manual contains installation, operating and maintenance procedures for the HARRIS APEX-M2X exciter.

1.1 APEX-M2X Exciter Quick Start Guide

If assistance is needed when first operating or installing a new APEX-M2X exciter, see Appendix A, APEX-M2X Exciter Quick Start Guide.

1.2 Organization of Technical Manual

The manual is divided into these sections:

- Section 1 - Introduction, describes the APEX-M2X exciter and lists the sections of this technical manual.
- Section 2 - Connecting To The APEX-M2X Exciter
- Section 3 - Operating the APEX-M2X Exciter, explains how to operate the exciter.
- Section 4 - APEX-M2X Exciter Theory, explains the functioning of each part of the exciter as an aid to servicing the product.
- Section 5 - Maintenance and Troubleshooting, describes checks and tests which may be used to isolate a suspected problem in the exciter.
- Section 6 - Parts List, is an indexed listing of field-replaceable parts for the APEX exciter.
- Appendix A - APEX-M2X Exciter Quick Start Guide, provides an outline of activities required to install and activate a M2X exciter in an existing Harris transmitter.
- Appendix B - Installation, describes the mounting, environmental requirements and initial setup of the exciter.

1.3 General Description

The APEX-M2X exciter is a multi-platform low power TV transmitter signal source for the broadcast service. It receives the program material to be transmitted in transport stream format and generates a low-level on-channel RF signal. It performs pre-corrections for non-linear distortions which occur in the transmitter RF power amplifiers and for linear distortions which occur in the high power filter.

This exciter can be operated on multiple digital TV modulation platforms through a software change and can operate on various analog TV modulation platforms by changing a circuit board and software.

The APEX-M2X exciter can be installed in any Harris digital television transmitter, or for testing, it can also be operated on any desktop or tabletop surface.

1.4 Physical Description

The APEX-M2X does not have an on/off switch. Power is applied to the unit by plugging an energized power cord into the ac connector on the back of the exciter. The exciter will operate over a voltage range of 90 to 264Vac, auto ranging.
The APEX-M2X exciter consists of a single rack mounted chassis with the various circuit boards all available from the top of the exciter.

The exciter is not designed to be secured to any rack from its front panel. It is normally mounted in the transmitter on slides or on a special shelf, permitting it to be extended forward out of the cabinet for service.

The exciter is 3.5" high and 19" wide to allow mounting in a 3 rack unit space in a standard 19" EIA rack. A minimum of 21" depth in the mounting rack is needed to allow space for the exciter and connecting cables.

The exciter contains two muffin fans mounted in the right and left sides of the front of the chassis. Cooling air is drawn into the assemblies from the front and forced over the top and bottom sides of the circuit boards, and exits from the rear of the exciter.

The top cover may be removed to provide access to the digital and analog circuit boards, however, there are no adjustments on the circuit boards. See Figure 5-4, Top View of Exciter Showing Interconnection RF and Ribbon Cables, on page 5-3. This drawings provides the names and locations of the various circuit boards of the exciter and also shows the cabling between the boards.

All system interconnections are via the rear panel, see Figure 1-1. An RS232 diagnostic port is provided on the rear panel.
Refer to Figure 1-3 for a picture of the exciter front panel.

A small swing-open door mounted right of center on the front panel provides access to three monitoring connectors (an RF output sample through an SMA connector and two BNC connectors which provide 10 MHz reference and 1PPS samples) and an ethernet RJ45 connector.

Two front panel mounted switches provide on/off control for the linear and nonlinear RTAC correction circuits, and two rows of six LEDs each provide status indications for the linear and nonlinear RTAC operating modes.

A bank of four LEDs provide signal input status for the high and low priority (HP and LP) signals at inputs 1 and 2.

A vertical column of five LEDs provide a summary status for exciter Mute, GPS/PLL Lock, Warning/Fault, RF Output presence, and Power Supply.

1.4.1 Special Input Boards

The Analog and DAB Modulation systems require special input boards, see lower right side of Figure 1-1.

The **Analog Input board** (AIB) option, shown in Figure 1-1, serves as the M2X analog front end for main / aux video and main / aux audio input signals. In addition it provides a composite audio input (BTSC system) and a video sync output (back porch pulses).

The **ETI Input board Option**, part number 901-0215-211G, is required by the M2X DAB modulation system. It is installed in the Input Option slot, see Figure 1-2. This is because DAB uses ETI (Ensemble Transport Interface) to send the data from the ensemble provider to the transmission network provider.
1.5 **Technical Overview**

The exciter accepts four digital input program streams via four rear panel BNC input connectors, shown in Figure 1-4. The top two connectors are inputs, 1, ASI high priority on the left and ASI low priority on the right. The bottom two connectors are inputs, 2, SMPTE 310 high priority on the left and SMPTE 310 low priority on the right. The modulation process is fully digital, with analog circuits used after the D/A converter to up-convert the IF signal to the desired channel.

The exciter RF output can be set to any VHF or UHF channel and may be adjusted to any level up to 100mW average power when operated in the digital mode and up to 200mW peak of sync in the analog mode.

The exciter can accept a 10 MHz external frequency standard input or a 1PPS (pulse per second) input via rear-panel connectors. An external standard is used whenever the user requires either greater frequency precision, or a precise frequency offset.

The exciter uses RTAC™ (Real Time Adaptive Correction) to monitor and manage pre correction for the transmitter system linear and nonlinear distortions, no manual correction circuits are employed. Low power RF samples from various stages of the transmitter are required by the RTAC circuits.

Front Panel Input LEDs.JPG and Rear Panel TS Inputs.jpg.

![Front Panel Input LEDs and Rear Panel TS Inputs](image-url)

**Figure 1-4 Transport Stream Input Presence Indicators and Rear Panel Input Connectors**

1.6 **APEX-M2X System and Modulation Standards**

ATSC = American Television Standards Committee, North American 8VSB digital TV standard

ATSC A110 = Single frequency network standard for ATSC

ATSC MH = Mobile TV standard for ATSC (ATSC A/153)

DVB-T = Digital Video Broadcasting - Terrestrial, European digital TV standard, COFDM

DVB-H = Digital Video Broadcasting - Handheld, European digital TV standard, COFDM

DVB-T2 = Digital Video Broadcasting - Terrestrial second generation European digital TV standard, COFDM

DAB = Digital Audio Broadcasting, older European digital radio standard, COFDM

ISDB-T = South American and Japanese digital TV standard
CMMB = China Mobile Multimedia Broadcasting
CTTB = China Terrestrial Television Broadcasting
ATV = Analog television
  PAL = Phase Alternate Line, analog TV standard for much of Europe and other Countries
  NTSC = National Television Standards Committee, USA analog TV standard, system M
1.7 APEX-M2X Exciter Specifications

Note
Specifications subject to changed without notice.

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<td>SMA, 50 ohm impedance</td>
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<td>RF output power</td>
<td>Analog TV: 23 dBm (200 mW) peak of sync power, Digital: 20 dBm (100 mW) average power, Analog and Digital: Regulation of output power &lt; 0.25 dB</td>
</tr>
<tr>
<td>RF sample, from the high power filter output</td>
<td>SMA, 50 ohm impedance, exciter input level: -20 to +5 dBm</td>
</tr>
<tr>
<td>RF sample, from the power amplifier output</td>
<td>SMA, 50 ohm impedance, exciter input level: -20 to +5 dBm</td>
</tr>
<tr>
<td>Frequency range</td>
<td>Band I: 47 to 88 MHz, Band III: 174 to 240 MHz, Band IV: 470 to 606 MHz, Band V: 606 to 862 MHz, L-Band: 1400 to 1492 MHz</td>
</tr>
<tr>
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<td>2 - BNC connectors, see note. Left top connector is HP (high priority) ASI1, Left bottom connector is HP (high priority) SMPTE-310M (or ASI2)</td>
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<td>Note: The Transport Stream (ASI or SMPTE 310) is a 75 ohm system, but the ASI specification specifically calls for 50 Ohm connectors at the exciter input due to their better structural rigidity by design.</td>
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<td>1 - 50 Ohm, BNC</td>
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<td>1 PPS Reference Input</td>
<td>1 - 50 Ohm, BNC</td>
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<td>10 MHz Reference Output</td>
<td>1 - 50 Ohm, BNC Front Panel Access</td>
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<tr>
<td>1 PPS Reference Output</td>
<td>1 - 50 Ohm, BNC Front Panel Access</td>
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<td>Ethernet</td>
<td>1 - RJ45 Front, DHCP-enabled customer access, 1 - RJ45 Rear, transmitter or network backbone interface (SNMP)</td>
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<td>GPS Antenna Input</td>
<td>1 - 50 Ohm, SMA Provides +5 VDC at 0.15 Amps maximum for an amplified GPS antenna. GPS receiver normal signal input level is -130 dBm to -100 dBm, its antenna input impedance is 50 ohms, and its center frequency is 1.57542 GHz.</td>
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<td>Ambient temperature</td>
<td>0° to 50° celsius (32° to 122° fahrenheit)</td>
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<td>Ambient humidity</td>
<td>0 to 95% relative, non-condensing</td>
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<td>Altitude</td>
<td>up to 4500m AMSL, de-rate 2 °C per 300m of elevation</td>
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Table 1-2  Harris APEX-M2X Exciter Service Conditions Specifications

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<td>19 pounds</td>
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<td>Electrical Requirements</td>
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<td>Voltage</td>
<td>90Vac to 264Vac, auto ranging</td>
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<td>2.0 A (at 90 Vac) ranging to 0.68 A (at 264 Vac)</td>
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<td>Power</td>
<td>180 W maximum</td>
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<tr>
<td>Frequency</td>
<td>47-63HZ</td>
</tr>
<tr>
<td>Fuse size</td>
<td>T4A/250V</td>
</tr>
</tbody>
</table>
### 1.7.1 Transmitter I/O Board Option Connectors

#### 1.7.1.1 Bottom Rear Panel, UHF Transmitter Interface Connector

<table>
<thead>
<tr>
<th>Signal, Digital/Analog</th>
<th>Direction</th>
<th>Description, Digital/Analog</th>
<th>Control I/O Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Power Raise</td>
<td>Input</td>
<td>Digital: power raise command</td>
<td>I/O Bus 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analog: visual power raise command</td>
<td></td>
</tr>
<tr>
<td>2 Power Lower</td>
<td>Input</td>
<td>Digital: power lower command</td>
<td>I/O Bus 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analog: visual power lower command</td>
<td></td>
</tr>
<tr>
<td>3 not used</td>
<td>Input</td>
<td>Digital: not used</td>
<td>I/O Bus 2</td>
</tr>
<tr>
<td>Aural Raise</td>
<td></td>
<td>Analog: aural power raise command</td>
<td></td>
</tr>
<tr>
<td>4 not used</td>
<td>Input</td>
<td>Digital: not used</td>
<td>I/O Bus 3</td>
</tr>
<tr>
<td>Aural Lower</td>
<td></td>
<td>Analog: aural power lower command</td>
<td></td>
</tr>
<tr>
<td>5 not used</td>
<td>Input</td>
<td>Digital: not used</td>
<td>I/O Bus 4</td>
</tr>
<tr>
<td>RF Mute Command</td>
<td></td>
<td>Analog: aural mute command</td>
<td></td>
</tr>
<tr>
<td>Mute Command</td>
<td>Input</td>
<td>Digital: RF mute command</td>
<td>Input directly to Signal Processing board</td>
</tr>
<tr>
<td>6 Aural Mute Status</td>
<td>Output</td>
<td>Digital: not used</td>
<td>I/O Bus 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analog: aural mute status</td>
<td></td>
</tr>
<tr>
<td>7 RF Mute Status</td>
<td>Output</td>
<td>Digital: RF mute status</td>
<td>I/O Bus 6</td>
</tr>
<tr>
<td>Status</td>
<td></td>
<td>Analog: visual mute status</td>
<td></td>
</tr>
<tr>
<td>8 UPS Shutdown</td>
<td>Input</td>
<td>Disables battery backup functionality</td>
<td>Input directly to Signal Processing board</td>
</tr>
<tr>
<td>10 EQ Reset</td>
<td>Input</td>
<td>Resets adaptive correction tables to default</td>
<td>I/O Bus 16</td>
</tr>
<tr>
<td>11 EQ Hold</td>
<td>Input</td>
<td>Holds current adaptive correction tables</td>
<td>I/O Bus 7</td>
</tr>
<tr>
<td>12 Power Foldback</td>
<td>Input</td>
<td>Digital: analog input, 0 – 5V, used for power foldback</td>
<td>Analog Input 0</td>
</tr>
<tr>
<td>Visual VSWR Input</td>
<td></td>
<td>Analog: analog input, 0 – 5V, used for visual power foldback</td>
<td></td>
</tr>
<tr>
<td>13 RF Mute Command</td>
<td>Input</td>
<td>Digital: not used</td>
<td>Analog Input 1</td>
</tr>
<tr>
<td>Mute Command Input</td>
<td></td>
<td>Analog: aural power foldback</td>
<td></td>
</tr>
<tr>
<td>14 RS232 Port Enable</td>
<td>Output</td>
<td>Indicates that the exciter is active</td>
<td>I/O Bus 8</td>
</tr>
<tr>
<td>15 RF Present</td>
<td>Output</td>
<td>Indicates that exciter RF output is valid</td>
<td>I/O Bus 9</td>
</tr>
<tr>
<td>16 not used</td>
<td>Output</td>
<td>Digital: not used</td>
<td>I/O Bus 10</td>
</tr>
<tr>
<td>Dual Correction Status</td>
<td></td>
<td>Analog:</td>
<td></td>
</tr>
<tr>
<td>17 not used</td>
<td>Input</td>
<td>Digital: not used</td>
<td>I/O Bus 11</td>
</tr>
<tr>
<td>Composite To Mono Switch</td>
<td></td>
<td>Analog: Switches between composite and mono</td>
<td></td>
</tr>
<tr>
<td>18 not used</td>
<td>Input</td>
<td>Digital: not used</td>
<td>I/O Bus 12</td>
</tr>
<tr>
<td>Notch Diplexer Remote</td>
<td></td>
<td>Analog:</td>
<td></td>
</tr>
<tr>
<td>19 not used</td>
<td>Input</td>
<td>Digital: not used</td>
<td>I/O Bus 13</td>
</tr>
<tr>
<td>Aural Group Delay Remote</td>
<td></td>
<td>Analog:</td>
<td></td>
</tr>
<tr>
<td>20 Spare In</td>
<td>Output</td>
<td>Digital: spare command input</td>
<td>I/O Bus 14</td>
</tr>
<tr>
<td>Visual Unlock Status</td>
<td></td>
<td>Analog: visual unlock status</td>
<td></td>
</tr>
<tr>
<td>21 Spare Out I/O</td>
<td>Output</td>
<td>Digital: spare status output</td>
<td>I/O Bus 15</td>
</tr>
<tr>
<td>Aural Unlock Status</td>
<td></td>
<td>Analog: aural unlock status</td>
<td></td>
</tr>
<tr>
<td>22 GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 1.7.1.2 Top Rear Panel, User Remote Connector

#### Table 1-4 Transmitter I/O Top Rear Panel Control/Status Connector

<table>
<thead>
<tr>
<th>Top Connector - 25 Pin Female (For User Remote)</th>
<th>Description, Digital/Analog</th>
<th>Control I/O Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 not used Visual Power Sense</td>
<td>Digital: not used Analog: 0 – 4.096Vdc analog output representing visual power level</td>
<td>Analog Output 0</td>
</tr>
<tr>
<td>2 not used Aural Power Sense</td>
<td>Digital: not used Analog: 0 – 4.096Vdc analog output representing aural power level</td>
<td>Analog Output 1</td>
</tr>
<tr>
<td>3 Spare Analog In 1</td>
<td>Digital: not used Analog: not used</td>
<td>Analog Input 2</td>
</tr>
<tr>
<td>4 Spare Analog In 2</td>
<td>Digital: not used Analog: not used</td>
<td>Analog Input 3</td>
</tr>
<tr>
<td>5 +12Vdc</td>
<td>Output +12Vdc, 200mA max</td>
<td></td>
</tr>
<tr>
<td>6 GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>7 GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>8 GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>9 GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>10 GND</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>11 Alarm 0 Common</td>
<td>Alarm 0 Relay Common</td>
<td></td>
</tr>
<tr>
<td>12 Alarm 0 Normally Closed</td>
<td>Alarm 0 Relay Normally Closed (Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>13 Alarm 0 Normally Open</td>
<td>Alarm 0 Relay Normally Open (Non-Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>14 Alarm 1 Common</td>
<td>Alarm 1 Relay Common</td>
<td></td>
</tr>
<tr>
<td>15 Alarm 1 Normally Closed</td>
<td>Alarm 1 Relay Normally Closed (Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>16 Alarm 1 Normally Open</td>
<td>Alarm 1 Relay Normally Open (Non-Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>17 Alarm 2 Common</td>
<td>Alarm 2 Relay Common</td>
<td></td>
</tr>
<tr>
<td>18 Alarm 2 Normally Closed</td>
<td>Alarm 2 Relay Normally Closed (Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>19 Alarm 2 Normally Open</td>
<td>Alarm 2 Relay Normally Open (Non-Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>20 Alarm 3 Common</td>
<td>Alarm 3 Relay Common</td>
<td></td>
</tr>
<tr>
<td>21 Alarm 3 Normally Closed</td>
<td>Alarm 3 Relay Normally Closed (Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>22 Alarm 3 Normally Open</td>
<td>Alarm 3 Relay Normally Open (Non-Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>23 Alarm 4 Common</td>
<td>Alarm 4 Relay Common</td>
<td></td>
</tr>
<tr>
<td>24 Alarm 4 Normally Closed</td>
<td>Alarm 4 Relay Normally Closed (Faulted) Position</td>
<td></td>
</tr>
<tr>
<td>25 Alarm 4 Normally Open</td>
<td>Alarm 4 Relay Normally Open (Non-Faulted) Position</td>
<td></td>
</tr>
</tbody>
</table>
1.7.1.3  **VHF to UHF Transmitter Interface Adaptor Cable**

The APEX-M2X exciter Transmitter I/O Board Option contains two 25 pin D sub connectors. The top (female) is the user remote connector, and the bottom (male) is the transmitter interface connector.

Harris VHF transmitters have a 37 pin male D sub connector for their transmitter interface.

An interface cable is available which has a 37 pin female D sub connector to connect to the VHF transmitter exciter control cable. This cable terminates in a male 25 pin D sub connector for the exciter transmitter I/O board top (user remote) connector and a female 25 pin D sub connector for the bottom (transmitter interface) transmitter I/O connector.

Table 1-5 lists the pinout for this interface cable.

<table>
<thead>
<tr>
<th>APEX-M2X UHF Connector</th>
<th>Analog VHF</th>
<th>Digital VHF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>25 Pin Male (TX INTERFACE)</strong> (Cable interface is 25 Pin Female)</td>
<td><strong>37 Pin Female</strong></td>
<td><strong>37 Pin Female</strong></td>
</tr>
<tr>
<td>1 Visual Raise</td>
<td>1 Visual Raise</td>
<td>1 Power Raise</td>
</tr>
<tr>
<td>2 Visual Lower</td>
<td>2 Visual Lower</td>
<td>2 Power Lower</td>
</tr>
<tr>
<td>3 Aural Raise</td>
<td>3 Aural Raise</td>
<td></td>
</tr>
<tr>
<td>4 Aural Lower</td>
<td>4 Aural Lower</td>
<td></td>
</tr>
<tr>
<td>5 Aural Mute Command</td>
<td>5 Aural Mute Command</td>
<td></td>
</tr>
<tr>
<td>6 Visual Mute Command</td>
<td>6 Visual Mute Command</td>
<td>6 RF Mute Command</td>
</tr>
<tr>
<td>7 Aural Mute Status</td>
<td>10 Aural Mute Status</td>
<td></td>
</tr>
<tr>
<td>8 Visual Mute Status</td>
<td>9 Visual Mute Status</td>
<td>9 RF Mute Status</td>
</tr>
<tr>
<td>9 UPS Shutdown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 EQ Reset</td>
<td>18 EQ Reset</td>
<td>18 EQ Reset</td>
</tr>
<tr>
<td>11 EQ Hold</td>
<td>19 EQ Hold</td>
<td>19 EQ Hold</td>
</tr>
<tr>
<td>12 Visual VSWR Input</td>
<td>15 Visual VSWR Input</td>
<td>15 VSWR Foldback Input</td>
</tr>
<tr>
<td>13 Aural VSWR Input</td>
<td>16 Aural VSWR Input</td>
<td></td>
</tr>
<tr>
<td>14 RS232 Port Enable</td>
<td>17 RS232 Port Enable</td>
<td>17 RS232 Port Enable</td>
</tr>
<tr>
<td>15 RF Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Dual Correction Status</td>
<td>13 Dual Correction Status</td>
<td></td>
</tr>
<tr>
<td>17 Composite To Mono Switch</td>
<td>20 Composite To Mono Switch</td>
<td></td>
</tr>
<tr>
<td>18 Notch Diplexer Remote</td>
<td>21 Notch Diplexer Remote</td>
<td></td>
</tr>
<tr>
<td>19 Aural Group Delay Remote</td>
<td>22 Aural Group Delay Remote</td>
<td></td>
</tr>
<tr>
<td>20 Visual Unlock Status</td>
<td>11 Visual Unlock Status</td>
<td>11 PLL Unlock Status</td>
</tr>
<tr>
<td>21 Aural Unlock Status</td>
<td>12 Aural Unlock Status</td>
<td></td>
</tr>
<tr>
<td>22 GND</td>
<td>23 GND</td>
<td>23 GND</td>
</tr>
<tr>
<td>23 GND</td>
<td>24 GND</td>
<td>24 GND</td>
</tr>
<tr>
<td>24 GND</td>
<td>25 GND</td>
<td>25 GND</td>
</tr>
<tr>
<td>25 GND</td>
<td>26 GND</td>
<td>26 GND</td>
</tr>
<tr>
<td><strong>25 Pin Female (USER REMOTE)</strong> (Cable interface is 25 Pin Male)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Visual Power Sense</td>
<td>7 Visual Power Sense</td>
<td>7 Power Sense</td>
</tr>
<tr>
<td>2 Aural Power Sense</td>
<td>8 Aural Power Sense</td>
<td></td>
</tr>
</tbody>
</table>
### Table 1-5  VHF To UHF Interface Cable

<table>
<thead>
<tr>
<th>Channel</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Spare Analog In 1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Spare Analog In 2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>+12Vdc</td>
<td>14 +12Vdc</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Alarm 0 Common</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Alarm 0 Normally Closed</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Alarm 0 Normally Open</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Alarm 1 Common</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Alarm 1 Normally Closed</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Alarm 1 Normally Open</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Alarm 2 Common</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Alarm 2 Normally Closed</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Alarm 2 Normally Open</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Alarm 3 Common</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Alarm 3 Normally Closed</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Alarm 3 Normally Open</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Alarm 4 Common</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Alarm 4 Normally Closed</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Alarm 4 Normally Open</td>
<td></td>
</tr>
<tr>
<td>26-37</td>
<td>No Connect</td>
<td>3 - 5, 8, 10, 12 - 13, 16, 20 - 23, 27 - 37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Connect</td>
</tr>
</tbody>
</table>
2 Connecting To The APEX-M2X Exciter

Computer setup instructions given in this chapter are for the Windows XP operating system.

2.1 APEX-M2X Exciter Quick Start Guide

If assistance is needed when first operating or installing a new APEX-M2X exciter, see Appendix A, APEX-M2X Exciter Quick Start Guide.

2.2 Introduction

There are 5 ways for the user to interact with the exciter.

- Through a transmitter control panel (in transmitters so equipped).
- Front panel RJ45 connector, limited to a direct connection to a computer.
- Web browser
- Telnet
- Serial (typically service only)

All exciter setup, control, operation, and software downloads are performed through the user interface.

This chapter contains the following sections:

- Section 2.3, Uses For The Exciter Front and Rear RJ45 Connectors, on page 2-1
- Section 2.4, Exciter Log In Authorization Levels, on page 2-2
- Section 2.5, Changing the User Name and Password, on page 2-2
- Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3
- Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4
- Section 2.8, Exciter Ethernet Address For Transmitters Using eCDI., on page 2-5
- Section 2.9, Changing Computer Operating Mode Between Static and DHCP, on page 2-6
- Section 2.10, Telnet Connection Via Tera Term, on page 2-7
- Section 2.11, Telnet Connection Via HyperTerminal, on page 2-8
- Section 2.12, RS232 Connection Via Tera Term, on page 2-11
- Section 2.13, RS232 Connection Via HyperTerminal, on page 2-12

2.3 Uses For The Exciter Front and Rear RJ45 Connectors

The Front RJ45 Connector. As shipped from the factory, the exciter front RJ45 ethernet connector has a fixed (static) IP address which is 192.168.117.88. The front RJ45 connector of the exciter is intended for direct connection to a computer which is operated in the DHCP (dynamic host configuration protocol) client mode. The front connector is driven by a DHCP server which will automatically provide a proper IP address to a directly connected computer (operated in the DHCP client mode). This address will be 192.168.117.yyy, where yyy ranges from 129 to 135.
When connecting to the exciter front panel ethernet port, if the computer being used does not auto-detect for cross connection, a crossover cable must be used to connect the exciter front ethernet port to the computer.

The rear RJ45 connector of the exciter can operate in the DHCP client mode or static IP. It is intended for connection to an ethernet network which is driven by a DHCP server. That ethernet network will supply the exciter rear connector with an appropriate IP address when it is in the DHCP client mode.

Caution: Do not connect the exciter’s front RJ45 connector to a network because the DHCP server in the exciter will conflict with the DHCP server in the network.

DHCP Client Mode Computer. A computer operated in the DHCP client mode will be given an appropriate IP address if connected to a network or device which is driven by a DHCP server.

Static Mode Computer. A computer operated in the static mode has a fixed IP address and will not accept a new address offered by a DHCP server driven network.

2.4 Exciter Log In Authorization Levels

When the ethernet connection to the exciter is established, multiple levels of login are available. They are:

- Two Secure (administrator) level logins, which allow full access to the exciter programming functions. The default user names and passwords for the two secure login is as follows:
  
  The user 1 secure login name is admin and the password is admin.
  
  The user 2 secure login name is user2 and the password is pass2.

  When logging in as an administrator the user will be logged out if no changes are made for five minutes. This is a security measure to prevent unauthorized personnel from making exciter changes.

- One guest level login, which allows viewing only and no programming.
  
  The login sub window offers a choice to Skip Login and enter as a guest. This login has no time limit.

2.5 Changing the User Name and Password

The secure login names and passwords are changed by an ethernet VT100 (Telnet) connection to the exciter using Tera Term or Hyperterminal. The process of changing user names and passwords (using Tera Term) is as follows.

1 Perform a Telnet login to the exciter using the front or rear panel ethernet port. For connection details, see Section 2.10, Telnet Connection Via Tera Term, on page 2-7 or Section 2.11, Telnet Connection Via HyperTerminal, on page 2-8.

2 Navigate to page 4.

3 Enter U, for users.

4 The “Enter user number” prompt appears. Enter the user login to be changed (1 or 2).
   
   A Press Enter to show the existing user name and password for users 1 and 2.
   
   B Enter 1 to change user 1 login or enter 2 to change user 2 login.

5 If the existing user 1 and 2 logins are displayed, the prompt “Press ‘Y’ for a new entry” appears.
2.6 Connection Through The Exciter Front Ethernet Connector

When connecting to the exciter front panel RJ45 connector, the connecting computer can be setup as a DHCP client, where the DHCP server associated with the exciter front RJ45 port will assign an address to the computer. This method of obtaining a computer address is described in Section 2.6.1, Obtaining Address With Computer in DHCP Client Mode.

The computer can be in the Static IP, where its address must be assigned manually. In this mode, its address must be assigned as 192.168.117.yyy, where yyy is any address between 2 and 254, except 88.

When the computer has been assigned a correct address, connect to the exciter using the procedure in Section 2.6.2, Making the Connection to the Exciter, on page 2-4.

Note

When connecting to the exciter front panel ethernet port, if the computer being used does not auto-detect for cross connection, a crossover cable must be used to connect the exciter front ethernet port to the computer.

2.6.1 Obtaining Address With Computer in DHCP Client Mode

If the computer is in the DHCP client mode, it will automatically obtain an address from the front panel RJ45 connector. Use the following procedure to obtain an address for the computer.

1 Connect an ethernet cable between the computer’s RJ45 connector and the exciter front panel RJ45 connector.
2 Press Start > Run.
3 The Run window should open.
4 The run window open box should display cmd. If not, type cmd, then press ok.
5 The cmd.exe window will open.
6 Type in ipconfig/release, then hit enter.
   A This will disassociate the computer from the previous ethernet network to which it was connected.
7 Type in ipconfig/renew, then hit enter.
   A This associates the computer with the exciter front panel RJ45 ethernet connector.
The exciter will assign an address to the computer, which is 192.168.117.yyy, where yyy ranges from 129 to 135.

To verify the new address type in ipconfig, then hit enter.

The present computer ethernet address will appear.

It should be possible to connect to the exciter using the procedure in Section 2.6.2, Making the Connection to the Exciter, on page 2-4.

When it is necessary to reconnect to another ethernet network, connect the computer to the desired ethernet network and perform the above procedures.

### 2.6.2 Making the Connection to the Exciter

1. Connect an ethernet cable between the computer’s RJ45 connector and the exciter front panel RJ45 connector.
   - If the computer being used does not auto-detect for cross connection, a crossover cable must be used to connect the exciter front ethernet port to the computer.
2. Go to Internet Explorer and type the exciter’s front connector address (192.168.117.88).
3. The Log In Screen should appear.
4. Log in using user name and password.
   - The default user name and password for user1 is admin. Provisions to change the login user names and passwords are given in Section 2.4, Exciter Log In Authorization Levels, on page 2-2.
5. The exciter web GUI is now displayed and can be navigated as needed.

### 2.6.3 Obtaining Exciter Rear Ethernet Connector Address

The exciter rear RJ45 connector should have already been connected to the existing ethernet.

Connect a computer to the exciter front panel RJ45 connector and log in as shown above.

1. Navigate to the Exciter Setup > Communications Tab.
2. The rear panel ethernet connector address will be given on this page in the Ethernet #2 sub window.
3. The Ethernet #1 window gives the front ethernet parameters.

### 2.7 Connecting Via The Exciter Rear Panel Ethernet Connector

Two methods are used to connect to the rear panel RJ45 connector, they are as follows:

- Connecting through an existing ethernet network.
- Direct connection, computer to exciter rear RJ45 connector.

Both of these connection methods are described below.
2.7.1 Connecting To The Exciter Through An Existing Ethernet Network

When connecting to an exciter through an existing ethernet network, the connecting computer can be setup on static IP if it has already been assigned an address on the network in question. If it has not already been assigned an address on that network, it must be setup as a DHCP client so the network can assign it an address.

1. Connect the exciter rear RJ45 connector to the existing ethernet network.
2. Connect the computer to a connector on the existing ethernet network.
3. Go to Internet Explorer and type the exciter rear RJ45 connector address.
4. Log In Screen should appear.
5. Log in using user name and password.
6. The exciter web GUI is now displayed and can be navigated as needed.

**Note:** Some network switches utilizing secure connections will require the MAC address to be given to the switch to allow traffic to pass to and from it. The MAC address can be found just above the IP address Field.

2.7.2 Direct Connection, Computer To Exciter Rear Ethernet Connector

Direct connection to the exciter’s rear RJ45 connector is not recommended, but it can be done. The front panel, with its DHCP server is recommended for direct connection.

When directly connecting a computer to the exciter rear panel ethernet connector, the connecting computer must be setup on Static IP mode with the first three segments of its address set the same as the first three segments of the address of the rear connector of the exciter. **For example,** assume the exciter rear panel address is 137.237.242.138. The computer address must be set to 137.237.242.yyy, where yyy is any number below 255, excluding 138 and 0.

Direct connection to the rear panel by a computer set to the DHCP client mode **may** work if both had been connected to the same network.

1. Connect an ethernet cable between the computer and the exciter rear panel RJ45 connector.
2. Go to Internet Explorer and type the rear RJ45 connector address. Using the example given above, the rear connector address will be 137.237.242.138
3. Log In Screen should appear.
4. Log in using user name and password.
5. The exciter web GUI is now displayed and can be navigated as needed.

2.8 Exciter Ethernet Address For Transmitters Using eCDi.

When installing the APEX-M2X exciter in a PowerCD transmitter, or any transmitter using eCDi, the exciter rear panel ethernet connector must be set as follows:

- Exciter A address is 192.168.217.200.
- Exciter B address is 192.168.217.201.

1. Log into the exciter front panel RJ45 connector. If additional instructions are needed, refer to Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
2. Enter the appropriate address using the Ethernet 2 sub window in the Exciter Setup > Communications screen.
2.9 Changing Computer Operating Mode Between Static and DHCP

1. Connect an ethernet cable between the computer and the exciter rear panel RJ45 connector.

2. On the computer, click Start > Settings > Network Connections. The network connections window will appear.

3. In the network connections, right click on the network connections soft key, a drop down list will appear.

4. From the drop down list, select properties. The Local Area Connection Properties window will appear.

5. In the local area connection properties window, scroll down in the sub window until the Internet Protocol (TCP/IP) selection appears.

6. Click on the Internet Protocol (TCP/IP) selection.

7. Click on the Properties soft key below and to the right of the sub window.

8. The Internet Protocol (TCP/IP) Properties window will appear.

9. In this window, two choices appear, they are:
   A. Obtain an IP address automatically. This choice sets the computer in the DHCP client mode.
      1. If this choice is selected, the ethernet network to which the computer is connected will automatically give it an IP address for that network, as long as that network has a DHCP server.
   B. Use the following IP address. This choice sets the computer in the Static address mode.
      1. If this choice is selected, enter the desired IP address in the space provided. The first three sections of the address must be the same as the network or exciter to which the computer is connected
      2. The last section of the address must be a number which is not already in use by that network. It can range from 1 to 254.
      3. The subnet mask address will automatically be entered when its space is entered.

2.9.1 Verifying The Computer IP Address

When the previous procedure has been completed, the computer’s IP address can be verified using the following procedure.


2. The Run window should open.

3. The run window open box should display cmd.
   A. If cmd is not displayed, type cmd.
   B. Next press ok.

4. The cmd.exe window will open.

5. Type in ipconfig, then hit enter.
   A. The present computer IP address and other information will appear.
2.10 Telnet Connection Via Tera Term

This is an alternative connection, used for exciter troubleshooting, and can also be used to change user login name and password, see Section 2.5, Changing the User Name and Password, on page 2-2.

1. The computer must be capable of making an ethernet connection through the exciter’s front or rear RJ45 connectors.
   A. Connection through the exciter’s front connector is described in Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
   B. Connection through the exciter’s rear connector is described in Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4.

2. Open Tera Term on the computer.
4. Select the TCP/IP choice. The Host sub window will become active.
5. Type the exciter’s IP address, for the RJ45 connector (front or rear) being used, in the host sub window.
6. Press the OK soft key.
7. When the connection is made, a window will appear with the words “Enter pass- word”. Type the User1 or User2 password and hit enter.
8. If the password is accepted, one of several screens will appear, see Figure 2-1 for a typical screen view.
   A. This display has several pages. Use the left or right arrow key to change the page being viewed.

Figure 2-1 Ethernet VT100 Connection Login Screen
### 2.11 Telnet Connection Via HyperTerminal

This is an alternative connection, used for exciter troubleshooting, and can also be used to change user login name and password, see Section 2.5, Changing the User Name and Password, on page 2-2.

1. Ethernet VT100 connection can be made to the front or rear exciter ethernet port.
2. Connection to the rear ethernet port is made through the local ethernet network. for additional information, refer to Section 2.6.2, Making the Connection to the Exciter, on page 2-4.
3. When connecting from the computer directly to the exciter front panel ethernet port, if the computer being used does not auto-detect for cross connection, a crossover cable must be used. For additional information, refer to Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
4. Open Hyperterminal on the computer.
   A. Starting in the lower left side of the screen, Select Start > Programs > Accessories > Communications > Hyperterminal, see the top half of Figure 2-2.
   B. If the screen shown in the left side of Figure 2-3 appears, click cancel.
   C. The New Connection screen, right side of Figure 2-3, will appear.

---

**Figure 2-2 Path To Hyperterminal**
WARNING: Disconnect primary power prior to servicing.

Telnet Connection Via HyperTerminal

Connecting To The APEX-M2X Exciter

Figure 2-3 Hyperterminal New Connection Window

Note

If a previous HyperTerminal connection has been saved, that connection can be recalled by pressing “File > Open” in the New Connection Window. A new window which displays previous saved connections will open. Click the desired connection and press the open soft key. That connection should be established.

5 In the New Connection screen select File > Properties.
   A The New Connection Properties window will appear.

6 In the New Connection Properties window, click on the Connect using drop down arrow.
   A A drop down list will appear.

7 Select TCP/IP (Winsock)

8 Type in the desired exciter ethernet port address for the port being used (front or rear).

9 Select the Setting tab in the New Connection Properties window.
   A The New Connection Properties Settings window, shown in Figure 2-4, will open.
   B Press the Emulation drop down arrow and select VT100.
   C Configure the Settings widow like the one shown in Figure 2-4.
   D Press OK.

10 To save the configuration, press File > Save in the New Connection window.
   A The Connection Description window, shown in Figure 2-3, will appear.
   B Click in the name box and type in a name, such as “Apex-M2X Telnet”.
   C Press OK.

11 Connect by Clicking the phone icon or by using the menu selection “Call, Call.

12 When the connection is made, a window will appear with the words “Enter password”. Type the User1 or User2 password and hit enter.

13 If the password is accepted, a screen like that shown in Figure 2-5 will appear.
HY Term Emulation Setup Screen.jpg (125)

Figure 2-4 New Connection Properties Settings Window

HY Term APEX-M2X Login Screen.jpg (140)

Figure 2-5 APEX-M2X VT100 Login Screen

WARNING: Disconnect primary power prior to servicing.
2.12 RS232 Connection Via Tera Term

This mode of connection is not normally recommended. It is used for exciter troubleshooting and to reload software in case of a power failure or crash during a software download, see Section 5.3, Recovery From A Crashed Or Incomplete Software Download, on page 5-16. Connection to the exciter should normally be made through the exciter’s front or rear panel RJ45 (ethernet) connectors.

1. Connect a male-female DB-9 straight-through cable from your computer (usually Com 1) to the Top RS232 connector (Com 1) on the exciter rear panel.

2. Open Tera Term Pro on the computer.

3. Select “Setup > Serial port”.
   - A Set the serial port parameters to match the exciter Com 1 RS232 parameters. The exciter Com 1 parameters are as follows:
     • Baud Rate: 115200
     • Data: 8 bits
     • Parity: none
     • Stop: 1 bit
     • Flow Control: none.
   - B Hit OK to accept the setup.

4. Press Enter twice in rapid succession to access the exciter. If connection is successful, one of several screens will appear, see Figure 2-6 for a typical screen view.
   - A The ethernet port setup is on page 4 of 4 when viewed on the computer. If any other page or a blank screen appears, use the left or right arrow key to change to the correct page.
   - B The ethernet port setup, found on page 4 of 4, is listed below, where #1 refers to the exciter front panel RJ45 connector and #2 refers to the exciter rear panel RJ45 connector. Connection to the exciter should normally be made directly through the exciter’s front RJ45 connector, or to the rear panel RJ45 connector via an ethernet.
     1. #1 MAC Address: The MAC Address is unique for each port and is assigned by the equipment manufacturer.
     2. #1 Mode: Static.
     3. #1 IP Address: 192.168.117.88
     4. #2 MAC Address: The MAC Address is unique for each port and is assigned by the equipment manufacturer.
     5. #2 Mode: DHCP (Can be changed to Static if needed.)
     6. #2 IP Address: xxx.xxx.xxx.xxx If this port is set to DHCP it will be provided an IP address by the users network.
2.13 RS232 Connection Via HyperTerminal

This mode of connection is not normally recommended. It is used for exciter troubleshooting and to reload software in case of a power failure or crash during a software download, see Section 5.3, Recovery From A Crashed Or Incomplete Software Download, on page 5-16. Connection to the exciter should normally be made through the exciter’s front or rear panel RJ45 (ethernet) connectors.

1. Connect a male-female DB-9 straight-through cable from your computer (usually Com 1) to the Top RS232 connector (Com 1) on the exciter rear panel.

2. Open Hyperterminal on the computer.
   
   A. Starting in the lower left side of the screen, Select Start > Programs > Accessories > Communications > Hyperterminal, see Figure 2-6.

   B. Two Hyperterminal icons may appear, see Figure 2-7.

      1. The top icon is used for a new connection. If used, continue with step 3.

      2. If an established connection it to be used, click on the bottom icon and select the desired connection. If a blank screen appears, hit enter twice or hit the left or right arrow key.

---

Figure 2-6 Path To Hyperterminal
3 The Hyperterminal New Connection window, shown in Figure 2-8 will appear.
   A Type in the connection name in the name box.
   B Select an icon for the connection, typically, the one on the left is used, since
      the icon will not effect the connection parameters.
   C Click OK.

Figure 2-7 Hyperterminal Icons

Figure 2-8 Hyperterminal New Connection Window
4 The widow in Figure 2-9 will appear. Use the drop down Connect Using list to select the com port to be used, typically, it will be com 1. Click OK.

Figure 2-9  Hyperterminal Com Port Selection
5 The Com1 Properties, Port Setup window, shown in Figure 2-10, will appear.

A Set the serial port parameters to match the exciter 1 parameters as follows:
   • Baud Rate: 115200
   • Data: 8 bits
   • Parity: none
   • Stop: 1 bit
   • Flow Control: none.

B Hit OK to accept the setup.

Figure 2-10 Hyperterminal Com Port Setup
6 The next window to appear will be a blank Hyperterminal screen.
   A From the menu bar at the top of the screen, select View > Font.
7 The Font Window, shown in Figure 2-11, will appear, perform the setups shown then click OK.

Figure 2-11 Hyperterminal Font Window
8 The blank Hyperterminal window will reappear.
   A From the menu bar at the top of the screen, select File > Properties.

9 The Properties window, shown in Figure 2-12, will appear. Click the Settings tab and perform the setups shown.
   A Make sure the emulation mode is VT100.
   B When connection is secured, the APEX-M2X screens continually update with new data. Previously captured data can be viewed by scrolling up. The Backscroll buffer lines selection (range is 0 to 500) determines the amount of stored data which can be viewed, with 0 providing no stored data and 500 providing maximum stored data.
   C When selections are complete, click OK.

![Hyperterminal File > Properties Window](001/CH2/HY Term Properties Window.jpg)

*Figure 2-12 Hyperterminal File > Properties Window*
10 Press Enter twice in rapid succession to access the exciter. If connection is successful, one of several screens will appear.

A The ethernet port setup is on page 4 of 4 when viewed on the computer, see Figure 2-13. If any other page or a blank screen appears, use the left or right arrow key to change to the correct page.

B The ethernet port setup is listed below, where #1 refers to the exciter front panel RJ45 connector and #2 refers to the exciter rear panel RJ45 connector:

1. #1 MAC Address: The MAC Address is unique for each port and is assigned by the equipment manufacturer.
2. #1 Mode: Static.
3. #1 IP Address: 192.168.117.88
4. #2 MAC Address: The MAC Address is unique for each port and is assigned by the equipment manufacturer.
5. #2 Mode: DHCP (Can be changed to Static if needed.)
6. #2 IP Address: xxx.xxx.xxx.xxx If this port is set to DHCP it will be provided an IP address by the users network.

---

![Figure 2-13 APEX-M2X Hyperterminal Presentation Page 4](001/CH2/HY Term APEX-M2x Page 4.jpg)
3 Operating the APEX-M2X Exciter, DVB-T2 Mode

The APEXM2X_DVB-T2_REVU.S19 software, Harris part number 861-1135-362, was used in the creation of this chapter.

The M2X exciter requires an FPGA expansion board, part number 901-0215-155G, in order to operate using the DVB-T2 modulation system. FPGA. See Section 5.6, DVB-T2 FPGA Expansion Board Installation, on page 5-19 and refer to Figures 5-25 and 5-27 for views of the expansion board and how it is mounted in the exciter.

This software must be loaded in two parts.

• First load file APEXM2X_DVBT2_REVU_1.s19.
• Next load file APEXM2X_DVBT2_REVU_2.s19.

Software loading is covered in Section 5.2 on page 5-5.

3.1 GUI Screen Sections Within This Chapter

Section 3.3, Home Screen, on page 3-3
Section 3.4, Flow Chart For Home Screen, on page 3-7
Section 3.5, Setup Navigation Screen, on page 3-8
Section 3.5.4, Setup Navigation Flow Chart, on page 3-9
Section 3.6, User Settings Screen, Active Users, on page 3-10
Section 3.6.1, NetAdmin - User Management Screen, on page 3-11
Section 3.7, System Setup 1 Screen, on page 3-13
Section 3.8, System Setup 2 Screen, on page 3-15
Section 3.9, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17
Section 3.10, RTAC Setup Screen 2, Stored Correction Sets, on page 3-18
Section 3.11, RTAC Setup Screen 3, Peak Reduction, on page 3-19
Section 3.12, RTAC Setup Screen 4, RTAC Profiles and Special Modes, on page 3-22
Section 3.13, RTAC Setup Screen 5, Upconverter Correction, on page 3-25
Section 3.14, DVB-T2 Setup Screen 1, Transport Stream, on page 3-26
Section 3.15, DVB-T2 Setup Screen 2, Network Settings, on page 3-28
Section 3.16, DVB-T2 Setup Screen 3, Time, Frequency, and Power, on page 3-29
Section 3.17, DVB-T2 Setup Screen 4, Modulation Settings, on page 3-30
Section 3.18, DVB-T2 Setup Screen 5, PLP Modulation Parameters, on page 3-33
Section 3.19, DVB-T2 Setup Screen 6, PRBS, Verification, and Test Pattern, on page 3-35
Section 3.20, PFRU Setup Screen, on page 3-38
Section 3.21, Transmitter I/O Screen 1, on page 3-41
Section 3.22, Output Setup Screen, on page 3-43
Section 3.23, Remote Communications Setup Screen 1, Ethernet, on page 3-44
Section 3.24, Remote Communications Setup Screen 2, RS232 and CAN, on page 3-45
Section 3.25, Remote Communications Setup Screen 3, SNMP on page 3-47
3.2 Basic Operating Procedure

To operate this exciter, it must be connected to a computer through the exciter’s front or rear RJ45 ethernet connector. This is covered in Chapter 2, Connecting To The APEX-M2X Exciter.

The administrator login requires entry of the proper Username and Password followed by the pressing of the login soft key, see Figure 3-1. Default login Usernames and Passwords are: User 1 = admin, admin, User 2 = user2, pass2. An administrator is allowed to make changes or adjustments to the exciter. This is a security measure to prevent unauthorized personnel from accessing the exciter setup changes.

A guest can login by pressing the Skip Login soft key. This login has no time limit, and the user is limited to viewing any of the screens, but is not permitted to make any changes.

![Login Screen](Graphics_001_CH-3_Login_screen.jpg)

Figure 3-1 Login Screen
3.3 Home Screen

Figure 3-2 shows the Home screen for the exciter. This screen gives the basic command inputs, status outputs, analog output indications and chart graphics necessary for the day to day operation of the exciter. Descriptions of the various home screen indications are given in the following text.

![Exciter Home Screen](Graphics 001-CH-3\ Home-1,0-DVB.jpg (310))

3.3.1 Performance

The on air performance data comes from the Post HPF, and is not switchable.

**LSB** indicates the Lower Sideband intermodulation product level, in dBs, at the shoulder (first 0.25MHz into the lower adjacent channel) at the Post HPF, relative to center frequency.

**USB** indicates the Upper Sideband intermodulation product level, in dBs, at the shoulder (first 0.25MHz into the upper adjacent channel) at the Post HPF, relative to center frequency.

**Note**

The LSB, USB, and in band intermodulation products are caused mainly by the transmitter non-linear distortions of poor power amplifier linearity and phase distortion. They are mainly developed in the PA and IPA (or driver) stages. The shoulder levels with pre-correction will be typically between -47 dB (CH21) and 37dB (CH69).
3.3.2 Raising or Lowering Output Power

The average output power of the exciter in mW is displayed numerically and on a bar graph on the home screen. Exciter output power adjustment provision is included on the home screen.

1. Exciter output power is set by clicking in the white box below the exciter power display on the home screen.
   - The box turns yellow.

2. Using the computer keyboard, enter the new value for forward power in mW.
   - The output power can be set between 0 and 100 mW average power for digital operation.

3. Press Enter to activate the new power setting.

In most transmitters, exciter output power is controlled from the transmitter, with transmitter output power controlled locally or remotely by a circuit within the transmitter. In some transmitters the exciter output power control is the transmitter output power control, and is available by remote control.

3.3.3 Foldback (VSWR)

In some transmitter models, excessive reflected power coming back to the transmitter will cause the exciter RF output power to fold back. The level of power foldback is indicated on the foldback bargraph, shown at the top of each screen, and the resultant percent of exciter output power reduction is shown to the right of the bargraph.

Foldback setup is shown in Figure 3-26, Transmitter I/O 1 Screen, on page 3-41, and described in Section 3.21, Transmitter I/O Screen 1, on page 3-41.

3.3.4 Exciter Status Sub Window

The Exciter Status sub window includes four entries, they are:

- Exciter RF center frequency readout
- Main
- Mute
- OK

3.3.4.1 Exciter RF Center Frequency

The exciter RF output center frequency is a read only display. The exciter RF center frequency is set in the PFRU (precise frequency reference unit) Setup screen, which is found in Section 3.20, PFRU Setup Screen, on page 3-38.

3.3.4.2 Main or Standby

The status entry below the center frequency indication can be main or standby.

- Main, over a green background indicates that this is the on air exciter.
- Standby, over a blue background, indicates this exciter is not on the air. It will provide normal output power but the RTAC functions do not work, since the RTAC RF feedback samples are being generated by the main exciter.
3.3.4.3 Mute

The Mute sub window lights up green if the RF output is not muted and lights up red if the RF output is muted.

3.3.4.4 OK

The OK sub window lights up green if the system is OK, yellow if a parameter is in the warning state, and red if a parameter is faulted.

3.3.5 System Output Sub Window

The Chart, in the center of the Home screen shows the spectrum response of the transmitter after the high power band pass filter (HPF) located at the output of the transmitter power amplifier.

3.3.6 RTAC Status Sub Window

RTAC section of the main screen shows the operating status of its two correctors, which are:

- **Linear** (RF feedback sample taken after the high power filter)
- **Non Linear** (PA output feedback sample, taken before the high power filter).

Clicking in this sub window brings up Figure 3-11, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17.

The possible states for each corrector are:

- **Adapt**: This correction algorithm will continuously calculate and update correction as needed. When switching to this mode from any other mode, the correction algorithm is reset.
- **Hold**: The HOLD function keeps the last correction value for the selected mode. This is a short term option, its memory is lost when returning from an AC power loss. For long term use select Stored.
- **Stored**: The STORED option selects a pre saved correction algorithm from the selected Stored Correction Sets (set 1 through set 4).

Storing the current active RTAC filter setup or operating form a previously stored setup is covered in Section 3.10.1, Stored Correction Sets Window, on page 3-18.

- **Bypass**: Turns the selected corrector off.

This sub window is also a soft key which displays Figure 3-11, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17 when pressed. This is the screen where the above setups are selected.

3.3.7 Setup Soft Key

Pressing this soft key Displays Figure 3-4, Setup Navigation Screen, on page 3-8. This screen accesses the various setup screens for the exciter.
3.3.8 Status Soft Key

Pressing this soft key displays Figure 3-31, Status Navigation Screen, on page 3-48. This screen accesses the various status screens for the exciter.

3.3.9 Fault Log Soft Key

Pressing this soft key displays Figure 3-47, Fault Log Screen, on page 3-69. This screen provides a print out of the exciter faults.
3.4 Flow Chart For Home Screen

Figure 3-3 is a flow chart for the home screen. It shows the choices and locations for the screens which are activated by pressing the home screen soft keys.

![Flow Chart For Home Screen](image-url)

---

**Figure 3-3 Home Screen Flow Chart**
3.5 Setup Navigation Screen

This screen is the gateway to the various setup screens in the exciter. A flow chart for the setup screens is provided in Figure 3-5.

3.5.1 ISP Soft Key

The ISP (In Service programming) soft key is used to load software into the exciter, save the exciter configuration to a file, and to load a configuration file into the exciter, see Section 5.2 on page 5-5.

3.5.2 Status Soft Key

Pressing this soft key displays Figure 3-31, Status Navigation Screen, on page 3-48. This screen accesses the various status screens for the exciter.

3.5.3 Exciter Home Soft Key

Pressing this soft key displays Figure 3-2, Exciter Home Screen, on page 3-3. This screen accesses the various operation screens for the exciter.
**3.5.4 Setup Navigation Flow Chart**

This screen shows the results of pressing the soft keys of the Setup Navigation screen. It also shows the flow between screens where there are multiple screens within a single category.

---

**Figure 3-5 Setup Navigation Flow Chart**

---

**WARNING:** Disconnect primary power prior to servicing.
### 3.6 User Settings Screen, Active Users

When logged in as NetAdmin, the Edit soft key appears on the screen. Pressing the Edit soft key brings up the NetAdmin - User Management 2.1.2 screen, which is shown in Figure 3-7.

When logged in as NetAdmin, the Setup and Exciter Home soft keys are not shown. The user must log out and log in again as an engineer or monitor to access the other screens.

**Active Users:** This screen tells if someone is connected to the exciter through any of the three user accounts shown in Figure 3-6.

**Note**

Only one client can be logged into a user account at a time. The client must logout so that another client can log into that account. If the browser window is closed or a network interruption occurs then the user will be logged out after 5 minutes. During this time, no user can log into that account. To properly close a session and not lock up that account for 5 minutes, click in the word Logout, which is visible in the black margin above the top-right corner of the GUI screen.

- InActive Connection indicates no one is connected via that port.
- Actively Connected indicates someone is connected via the indicated port.

Possible users and the default passwords are as follows.

- NetAdmin: Default user name and password are netadmin, harris
- Engineer 1: Default user name and password are admin, admin.
- Engineer 2: Default user name and password are user 2, pass2

See Figure 3-7 for the NetAdmin - User Management screen when logged in as the NetAdmin (network administrator). This screen allows the network administrator to change the user name and password for the Engineer 1 and Engineer 2 logins, and also to set the login session time out.
3.6.1 NetAdmin - User Management Screen

This screen allows or forbids the following changes:

- The user names and passwords for Engineer 1 and Engineer 2 can be changed.
- The Session Time Out can be changed.
- The Administration Password cannot be changed via this screen.

3.6.1.1 Changing User Names and Passwords For Engineer 1 and 2

The process of changing user names and passwords for Engineer 1 and Engineer 2 is as follows.

1. In the NetAdmin - User Management screen, click in the white sub window for the item to be changed.
   - The box color should change to yellow.
2. Type in the new user name or password.
   - The user name or password must contain 1 to 9 characters, which can be alpha or numerics characters. The alpha characters are case sensitive.
3. Click anywhere outside the white sub window to activate the change.
   - The box color should change back to white.
4. Click in the next white sub window and repeat steps 1 - 3 to make the next change.
3.6.1.2 Changing User Names and Passwords For NetAdmin

The secure login name and password for the NetAdmin login is changed by an ethernet VT100 connection to the exciter using Tera Term or Hyperterminal. This connection is described in Section A.9, Ethernet Connection Via HyperTerminal, on page A-17 and Section A.10, Ethernet Connection Via Tera Term, on page A-19.

3.6.1.3 Changing User Session Time Out

User Session Time Out: This is the amount of time, after the last user entry or change, until the user login expires.

To enter a time out:
1 Click in the white box.
   A The box color should change to yellow.
2 Using the computer’s keyboard, type the time out value in minutes.
   A The allowable range is 0 to 1440 minutes.
3 Click enter.
   A The box color should change back to white.

3.6.1.3.1 Notes Concerning Time Out Entries

Time out values are entered in minutes, 0 minutes to 1440 minutes (24 hours).

- If a time out of 1 minute to 1440 minutes is entered, the server will automatically log out the user when the entered time out value is exceeded.
- If a time out of 0 minutes is entered, there can be no limit on the connection time as long as the user is requesting data, but the server will automatically log out the user if a request for data is not made for 5 minutes.

Each user now has two time stamps: “time logged in” and “last action time.” The last action time is updated each time the user requests data update or sends a command to make changes. If the last action time is greater that 5 minutes (user has not requested any data updates or made changes) then the user will be logged out automatically.

If the browser window is closed or a network interruption occurs the user will be logged out after 5 minutes. During this time, no user can log into that account. To properly close a session and not lock up that account, click in the word LOGOUT, which is visible above and to the right of the GUI display, see Figure 3-7.
3.7 System Setup 1 Screen

Figure 3-8 shows the first of two system setup screens. This screen provides setup inputs needed to control the exciter’s and the transmitter’s RF output when the exciter is first installed in a transmitter, or when a repaired exciter is reinstalled in the transmitter. Descriptions of the various inputs of this screen are given in the following text.

3.7.1 Page Title

A station name may be entered by clicking the in the white box. Use the computer keyboard to enter the desired name and then press the Enter key.

3.7.2 Feature Key

The feature key unlocks optional features or other modulation standards, it is an alpha-numeric number. Only needed if additional features or modulation standards are purchased. Harris will provide the required Feature Key Number. A new feature key is not required to reload existing software or to load a new version of the same software.

An incorrect feature key will render the exciter inoperative and is indicated by all of the LEDs in the home screen as well as the front panel to glow red.
3.7.3 Transmitter Type

Pressing the down arrow in the Transmitter Type sub window produces a drop down list of transmitter types. Click the transmitter model in which the exciter is to be operated. The exciter must be rebooted (powered down the powered up) to make the new selection active.

With ATSC Revision T software, an exciter which is not connected to a transmitter control system may come up in the Main or Standby mode, depending on the transmitter type selected in the System Setup 1 screen. Prior to Revision T, an exciter not connected to a transmitter control system would always come up in the Main mode. Table 3-1 lists the transmitter type selection and its default mode.

<table>
<thead>
<tr>
<th>Transmitter Type</th>
<th>Default Mode (see notes below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond CD</td>
<td>Main</td>
</tr>
<tr>
<td>Sigma CD</td>
<td>Main</td>
</tr>
<tr>
<td>Platinum CD</td>
<td>Main</td>
</tr>
<tr>
<td>Custom</td>
<td>Standby</td>
</tr>
<tr>
<td>Ranger</td>
<td>Main</td>
</tr>
<tr>
<td>PowerCD</td>
<td>Main</td>
</tr>
<tr>
<td>Atlas ATSC</td>
<td>Main</td>
</tr>
<tr>
<td>Platinumi</td>
<td>Main</td>
</tr>
<tr>
<td>Thales DCX</td>
<td>Main</td>
</tr>
<tr>
<td>LAX Lband</td>
<td>Standby</td>
</tr>
<tr>
<td>Maxiva ULX</td>
<td>Standby</td>
</tr>
<tr>
<td>Maxiva UAX</td>
<td>Standby</td>
</tr>
<tr>
<td>Platinum VAX</td>
<td>Standby</td>
</tr>
<tr>
<td>Platinum VLX</td>
<td>Main</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Default Mode</th>
<th>Transmitter Control Connector (UHF on rear of exciter)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UHF (25 Pin) Connector</td>
</tr>
<tr>
<td></td>
<td>Control pin</td>
</tr>
<tr>
<td>Main</td>
<td>10</td>
</tr>
<tr>
<td>Standby</td>
<td>14</td>
</tr>
</tbody>
</table>

The default mode is achieved with control pin high (open.)

Grounding control pin changes to the opposite mode (Standby or Main.)

An adaptor cable (Harris part number 922-1345-025) is available to convert the 25 pin male UHF connector to the 37 pin female VHF connector.
3.8 System Setup 2 Screen

Figure 3-9 shows the second of two system setup screens. Descriptions of the various screen entries are listed below.

When GPS is selected from the UTC Source drop down list, the NPT Server Settings sub window vanishes.

When None is selected, the screen in Figure 3-10 appears.

### 3.8.1 Time Server Settings

- **UTC Source:** Choices are None, GPS, or NTP. Time can be supplied by GPS (global positioning system) or NTP (network time protocol). Both systems provide a universal time signal, where the time is Coordinated Universal Time (UTC is the ITU abbreviation).

- **UTC Offset:** Offset range is -13 to +13 hours. This is the local time offset from the Coordinated Universal Time provided by the time server.

### 3.8.2 NTP Server Settings

If NTP time server is chosen, it is necessary to enter the NTP Server IP address in the white window. Click in the white window, it will turn yellow, and use the computer keyboard to enter the address. Press the enter key when finished.

When the NPT time server IP address has been entered, click the Set IP soft key to activate the address.
3.8.3 **System Time Adjustment For UTC Source None**

System Date and Time may be entered by clicking in each white box, shown in Figure 3-10. The date is entered month - day - year, and the time is entered in the 24 hour format. Enter the correct value in the window and then press the Enter key. When the time and date have been entered, press Set Time soft key to activate the new parameters into the system.
3.9 RTAC Setup Screen 1, RTAC Operating Modes

Figure 3-11 shows the first of five RTAC setup screens. This screen provides the choices for the linear and nonlinear RTAC operation.

![Figure 3-11 RTAC Setup Screen 1, RTAC Operating Modes](Graphics 001-CH-3: Setup-RTAC-2.8.1.jpg)

3.9.1 RTAC Setup Sub Windows

RTAC section of the main screen shows the operating status of its two correctors, which are:

- **Linear** (RF feedback sample taken after the high power filter)
- **Non Linear** (PA output feedback sample, taken before the high power filter).

The possible states for each corrector are:

- **Adapt**: Pressing the ADAPT soft key turns it green and turns the selected corrector on. The correction algorithm will continuously calculate and update correction as needed. When switching to this mode from any other mode, the correction algorithm is reset.
  
  When in the adapt mode, the right hand number above the operating selections indicates the number of times that corrector attempted to make its correction.
  
  When in the adapt mode, the left hand number indicates the number of times the corrector succeeded in making its correction.

- **Hold**: Pressing the HOLD soft key turns it green and keeps the last correction value for the selected mode. This is a short term option, the RTAC setup is held in volatile memory and is lost at an AC power fail. For long term use select Stored.
• **Stored:** Pressing the STORED soft key turns it green and selects an RTAC correction algorithm from one of the four pre loaded RTAC filter sets. The filter set to be loaded is selected from Section 3.10, RTAC Setup Screen 2, Stored Correction Sets, on page 3-18.

Storing the current active RTAC filter setup or operating from a previously stored setup is covered in Section 3.10, RTAC Setup Screen 2, Stored Correction Sets, on page 3-18.

• **Bypass:** Turns the selected corrector off.

### 3.10 RTAC Setup Screen 2, Stored Correction Sets

Figure 3-12 the second of the five RTAC setup screens. This screen gives the operating instructions for the stored Correction Sets, which are given in the following text.

![Figure 3-12 RTAC Setup Screen 2, Stored Correction Sets](Graphics/001-CH-3\Setup-RTAC-2.8.2.jpg)

#### 3.10.1 Stored Correction Sets Window

From the Stored Correction Sets screen, up to four RTAC correction setups can be saved in the four RTAC Filter Sets, Set 1 through Set 4. An option to rename the saved filter setups exists. The filter setup can be stored for many reasons, such as when the transmitter was first installed, after transmitter maintenance, and etc. It is good for comparative testing and for use as a setting for Power On - Stored RTAC mode correction.

Follow the procedure below to **save an RTAC Correction** setup.

1. The transmitter should be operating properly at 100% power.
2. In Figure 3-11, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17, for the on air exciter, set the linear and non-linear RTAC corrections to Adapt.
3 After a few minutes, numbers will appear above the RTAC linear and non-linear By-
pass selection soft keys in Figure 3-11. The right window indicates the number of at-
ttempts to achieve adaptive correction and the left window indicates the number of
successful adaptive corrections. Both the linear and non-linear correctors should show
four or more successful corrections before attempting to save them. Parameters will
improve during the first four successful adaptive corrections. The BER reading
should be at or below the limit and the shoulders should be at or below its limit.

4 After the RTAC adaption has been successful, press the RTAC linear and non-linear
Hold soft keys, in Figure 3-11, to hold the adaptive process steady.

5 Press the Store soft key to the right of the selection to store the RTAC setup.

6 The title of the selected filter set can be changed by clicking in the white box of the
desired filter set. The computer keyboard is used to enter the new name for the filter
set.

To operate from a stored set:

1 Press the Select soft key to the left of the desired set, see Figure 3-12.

2 In Figure 3-11, press the Stored soft key for the desired RTAC mode (Linear and/or
Nonlinear).

3 RTAC will now be operating from the selected stored set.

3.11 RTAC Setup Screen 3, Peak Reduction

Figure 3-13 shows the third of five RTAC Setup screens. This screen provides a choice of
peak power limitation values which are applied at the input (Non-Linear Range) and output
(Maximum Crest Factor) of the RTAC correction circuits.

![Figure 3-13 RTAC Setup Screen 3, Peak Reduction](Graphics 001-CH-3_Setup-RTAC-2,8,3.jpg)
3.11 Peak Reduction Sub Window

Peak reduction control shows if the Non-Linear Range or the Max Crest Factor controls are Enabled (over a green background) or Bypassed (over a red background). When the controls are enabled, the Peak Reduction screen limits the RF peak power output of the APEX-M2X exciter. Its main purpose is to provide optimum RTAC performance while preventing nuisance transmitter PA overdrive trips.

3.11.1 Non-Linear Range (dB)

The modulator occasionally generates peaks as high as 18 dB above the average output level. Peak stretch, caused by the modulator, can be limited at the modulator output by proper setting of the Non-Linear Range. The limited signal peak power level, above the average signal power level, ranges from 4dB to 8.5dB, with the default value being 8.5dB. Since this limitation takes place before the RTAC correction circuitry, only the range of magnitude up to this limit will be linearized by nonlinear RTAC correction.

- If this limit is too low, in-band and out of band intermodulation products will increase due to the signal clipping.
- If the limit is too high, the RTAC nonlinear corrector performance may be degraded due to high peak stretch. Also high peaks could cause nuisance overdrive faults in some transmitter systems.

Non-Linear Range Setup

1. In Figure 3-11, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17, set RTAC Linear and Non-Linear functions to bypass.
2. The exciter RF output should be set to the level required for transmitter operation.
3. In the Figure 3-13, RTAC Peak Reduction screen, set the Peak Reduction Control to Enabled.
   A The indicator in the Non-Linear Range sub window of Figure 3-13 will indicate Enabled and turn green.
4. In the Figure 3-13, start with the Non-Linear Range at 8.5 dB.
5. Monitor the output of the exciter with a spectrum analyzer and note the adjacent channel intermodulation level.
   A The front panel SMA RF output sample connector, behind the front panel door, can be used.
6. Lower the Non-Linear Range by 0.5dB intervals and stop when the adjacent channel intermodulation level starts to rise.
   A With Both RTAC correctors bypassed, the exciter RF output adjacent channel intermodulation products should be 50dB to 55dB below the in band signal level.
   B As the Non-Linear Range value is reduced, in 0.5 dB increments, the first sign of adjacent channel intermodulation product increase will be very subtle, often appearing as increased noise in the area just outside the in band channel bandpass.
   C If the adjacent channel intermodulation product level rises at the first 0.5dB reduction, try raising the Non-Linear Range value in 0.5 dB increments to see if the shoulder level drops.
7. The correct Non-Linear Range is 0.5dB above the point where the adjacent channel intermodulation products start to raise.

### 3.11.1.2 Maximum Crest Factor (dB)

The RTAC nonlinear corrector occasionally generates peaks as high as 18 dB above the average output level. Therefore, the peak power output from the exciter must be limited in order to protect the following amplifier stages.

**The Max (Maximum) Crest Factor** setting limits the peak to average RF output power ratio (8 to 11 dB) after the RTAC correction circuitry. The default value is 11 dB. This directly limits the exciter RF output peak to average power ratio with Non-Linear RTAC engaged. For example, if the maximum crest factor is set to 10 dB, the exciter will clip any peaks which are greater than 10 dB above the average output power level.

- If the limit is set too low, clipping will generate out-of-band intermodulation products in the exciter’s output and may affect the performance of the RTAC non-linear correction.
- If set too high, it could allow nuisance overdrive trips in some transmitter models, because the high amplitude peaks could overdrive the PA modules.

**Max Crest Factor Setup**

Nuisance overdrive trips, if they are occurring, can be avoided by programming the Max Crest Factor parameter of the Max Crest Factor sub window of Figure 3-13, the RTAC Peak Reduction screen.

Nuisance overdrive trips will typically occur within 30 minutes to 1 hour after transmitter operation with RTAC is first started. If this happens, perform the following:

1. This setup is performed with the transmitter operating at full power and RTAC Linear and Non-Linear functions set to Adapt.
2. Start with the Max Crest Factor at 11.5dB.
3. Reduce the Max Crest Factor by 0.25dB.
4. Wait for one hour to see if further overdrive trips occur.
   - If they do, reduce the Max Crest Factor by another 0.25 dB.
5. Repeat step 4 until overdrive trips cease.
6. Excessive Max Crest Factor reduction will effect the linearity correction of the transmitter.
   - After peak stretch has been adjusted, observe the adjacent channel response to ensure that it still exceed the transmitter output signal mask requirements.

### 3.11.1.3 Down Converter Bandpass Filter

Choices are Enabled or Disabled.

This is an IF bandpass filter in the RF Down Converter. It filters out mixing products from the down conversion. This filter has a slight frequency response which shows with the linear correction disabled. For UHF channels with no adjacent channels on the post-filter feedback, this filter can be disabled. For VHF channels, this filter must be enabled.
3.12 RTAC Setup Screen 4, RTAC Profiles and Special Modes

Figure 3-14 shows the fourth of five RTAC Setup screens. This screen provides choices for RTAC profiles used to pre load the correctors for various linear and nonlinear RTAC operating conditions. It also offers a choice for RTAC mode selection after an AC power loss.

3.12.1 RTAC Profiles

The profile choices for linear and non-linear correction are available to coarse tune the RTAC correction to a specific range for a given transmitter system. This will improve the RTAC function. When changing either linear and nonlinear profiles, wait several minutes to see changes.

Linear Profile Change

For linear RTAC correction, BASIC profile should be tried first. The least powerful profile is Basic, with the power increasing down the list to MAX OFFSET. The rule of thumb here is that more is not necessarily better, so only use as much profile power as is needed. The linear profile choices are:

- **BASIC.** This correction should be used for most standard mask filters.
- **SHORT.**
- **LONG.**
- **MAX.**
- **BASIC OFFSET.**
- **SHORT OFFSET.**
• **LONG OFFSET.** This correction should be used for sharp tuned mask filters, special mask filters, or when a two or more transmitters of different frequencies are being combined into a single output through 2 or more sharp tuned filters.

• **MAX OFFSET**

**Profile Nonlinear Change**

For non-linear RTAC correction, the named profiles should be tried before the numbered profiles. The least powerful profile is BASIC, with the power increasing down the list to PROFILE 9. Most transmitters should use BASIC or BASIC MEMORY. However, if they do not give satisfactory adjacent channel intermodulation performance, such as in an IOT transmitter or when OFDM modulation is used, a more powerful profile such as HIGH or HIGH MEMORY should be used. Profile Nonlinear choices are:

- BASIC
- BASIC MEMORY
- PROFILE 3
- PROFILE 4
- HIGH
- HIGH MEMORY
- PROFILE 7
- PROFILE 8
- PROFILE 9

### 3.12.2 Mode Selected After AC Mains Loss

#### 3.12.2.1 Power On Linear Mode

The RTAC Power On Linear Mode selection gives the customer the option of having the exciter's linear RTAC correction in the adapt, stored, or bypass mode.

**In the stored mode,** RTAC settings are obtained from previously stored values from one of the Filter Sets in the Stored Correction Sets, displayed in Figure 3-11, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17.

#### 3.12.2.2 Power On Nonlinear Mode

The RTAC Power On NonLinear Mode selection gives the customer the option of having the exciter's nonlinear RTAC correction in the adapt, stored, or bypass mode while the exciter is being powered up.

**In the stored mode,** RTAC settings are obtained from previously stored values from one of the Filter Sets in the Stored Correction Sets, displayed in Figure 3-11, RTAC Setup Screen 1, RTAC Operating Modes, on page 3-17.
3.12.3 Frequency Response Tilt

The purpose of this adjustment is a final touch-up to fine tune the transmitter’s RF output response, if after RTAC correction the response may not be an optimal. Any tilt in the response is due to variances in the RF sample as it travels through the path from the directional coupler through the down converter. Correction range is -10 dB to +10 dB with one decimal place is allowed.

A positive number introduces a downward tilt from low to high frequency. Figure 3-15 shows the effect of entering a positive 9.5 dB tilt. After entering the desired tilt number, RTAC must be re-engaged to realize any change.

Figure 3-15  DVB-T2 Response After a +9.5 dB Tilt Was Introduced
3.13 RTAC Setup Screen 5, Upconverter Correction

Figure 3-16 shows the fifth of five RTAC Setup screens. This screen provides operating instructions for up converter correction.

3.13.1 Up Converter Correction

Up converter Correction may be used to correct any linear frequency response in the exciter’s RF Up converter. This system operates in the same manner as RTAC (real time adaptive correction) for the transmitter system, except that it is applying its corrections to the exciter’s up converter. This calibration is only necessary if the frequency is changed. Operating instructions for Up converter Correction listed on screen, and are provided with additional detail here.

1. Operate Transmitter at 100% power with RTAC in adapt.
   A. Wait until RTAC has completed its adaption.

2. Press the Adapt soft key shown in Figure 3-16.
   A. The Adapt soft key sub window will turn green while the adaption process is in progress.
   B. When the adaption process is complete, the adapt soft key sub window will deactivate and return to its normal Grey Color.

3. When the adapt process deactivates, press the save soft key. This will save the adaption parameters in a non volatile memory.

4. Once saved, two modes of operation are provided, they are:
   A. Stored mode operation, started by pressing the Stored soft key. The stored soft key will turn green. In this mode, up converter correction will be applied.
   B. Bypass mode, entered by pressing the bypass soft key. The bypass soft key will turn green, and up converter correction will be deactivated.
3.14 DVB-T2 Setup Screen 1, Transport Stream

Figure 3-17 shows the DVB-T2 Transport Stream Setup screen. This is the first of six DVB-T2 setup screens. This screen provides control and indication of the transport stream inputs.

3.14.1 Transport Stream Inputs, Top Sub Window

The top sub window of Figure 3-17 shows the active transport stream input and the status of inputs ASI 1 and ASI 2. If the ASI input is present with no errors, a green box with the word PRES appears under the label. The area under the label remains blue if input is absent.

Figure 3-18 shows the Front panel indicators (left side) and the rear panel input connectors (right side). The correlation between the inputs listed in Figures 3-17 and 3-18 are as follows:

- ASI 1 (Primary) = top left LED and input of Figure 3-18.
- ASI 2 (Auxiliary) = bottom left LED and input of Figure 3-18.
ASI Input lights a green box with the word PRES under the label if the input is present and box remains blue if input is absent.

### 3.14.2 ASI Inputs, Bottom Sub Window

The ASI Input sub window, bottom of Figure 3-17, offers three programming setup choices, which consist of the following:

- **Power-On Input:** choices are ASI 1 or ASI 2. This determines which input will be selected first on power-up.
- **Active Input:** choices are ASI 1 or ASI 2. This determines which input is current modulation data source.
- **Switch Mode:** choices are Manual, Auto or Auto & Return switching of the ASI Transport stream.

  If the ASI switching mode is in Auto and the current ASI stream has an issue, or drops out, the system will switch to the Auxiliary ASI stream if it is valid and available.

  If the ASI switching mode is in Auto & Return, the ASI Transport stream will return to the selected active input, after a switch, when it again becomes valid.

- **Switching Return Time(s):** Enter value, range is 0 to 600 seconds. This entry sets the time before switching back to primary input is allowed.
- **Switch Maximum:** Choices are 1, 2, 5, 6, 10, 11, Infinite. This entry determines the maximum allowable number of automatic ASI input switches.
- **Input Buffer Enable:** Choices are Yes or No. The input buffer is only used in the MPEG-TS input mode. It reduces input packet jitter which can occur with certain MPEG transport links, such as, but not limited to ASI over IP or microwave links. The input buffer target level is 40 packets of 188 bytes per packet.
- **PRBS on Input Error:** Choices are No or Yes. This choice is for MPEG-TS mode only.

  Yes activates the PRBS stream in case of input error. No allows RF mute to occur in case of input error. PRBS Enable/Disable selection is found in DVB-T2 Setup screen 2.3.6, which is found in Figure 3-23, on page 3-35.

- **Input Mode,** choices are MPEG TS or T2-MI.

  T2-MI stands for DVB-T2 modulator interface. In MPEG-TS input mode there is only 1 PLP (physical layer pipe). In T2MI input mode there can be multiple PLPs, from 1 to 255.

- **T2-MI PID (decimal),** This value is used for encapsulation of T2-MI packets in MPEG transport stream.
3.15 DVB-T2 Setup Screen 2, Network Settings

Figure 3-19 shows the DVB-T2 Network Settings Setup screen. This is the second of six DVB-T2 setup screens.

![Figure 3-19 DVB-T2 Setup Screen 2, Network Settings](Setup-DVB-T2-2.3.2.jpg)

### 3.15.1 Network Settings

Refer to Figure 3-19.

- **Network Operation**: Choices are MFN (multiple frequency network) or SFN (single frequency network).
  
  In a multiple frequency network transmitters are on different frequencies, which does not require synchronization with the other transmitters in the network.
  
  In a single frequency network transmitters are on the same frequency, which requires synchronization with other transmitters in the network.
  
  **Note**: It is only possible to enter the SFN (single frequency network) mode if the Input Mode choices in the DVB-T2 Setup screen 1 is set to T2-MI mode.

- **TX ID**: Transmitter identifier used to address individual transmitters or modulators.

- **Cell ID Priority**: Choices are Local, T2MI L1PRE, or Indiv Address.

- **Cell ID (Hex)**: Identifies a geographic cell in a DVB-T2 network

- **Network ID (Hex)**: This field uniquely identifies the current DVB network.

- **T2 System ID (Hex)**: This uniquely identifies a T2 system within the DVB network.

- **SISO/MISO**: Choices are SISO (single input, single output) or MISO (multiple input, single output).

- **MISO Group Priority**: Choices are Local or TCM1.

- **MISO Group Number**: Choices are Group 1 or Group 2.
3.16 DVB-T2 Setup Screen 3, Time, Frequency, and Power

Figure 3-20 shows the DVB-T2 time, frequency, and power screen. This is the third of six DVB-T2 setup screens.

![DVB-T2 Setup Screen 3, Time, Frequency, and Power](image.jpg)

3.16.1 Screen 3 Settings

- **Time Delay Priority**: Choices are Local or T2-MI. When local is selected, user enters offset in SFN time offset field. When T2-MI is selected, offset comes from T2-MI packet.
  
  *Note:* This choice is greyed out if the exciter is in MFN (manual frequency network) mode and is active when the exciter is in SFN (single frequency network) mode. See Network Operation choices in the DVB-T2 Setup screen 2.

- **SFN Time Offset**: Enter appropriate delay value in microseconds when Time Delay Priority is in Local.

- **Use Frequency Offset**: Choices are Ignore or T2-MI. When ignore is selected, no offset is used. When T2-MI is selected, offset comes from T2-MI packet.
  
  *Note:* This choice is greyed out if the exciter is in MFN (manual frequency network) mode and is active when the exciter is in SFN (single frequency network) mode. See Network Operation choices in the DVB-T2 Setup screen 2.

- **T2-MI Frequency Offset**: 0.0 Hz displayed when Use Frequency Offset is set to Ignore. When it is set to T2-MI, the T2-MI packet offset is displayed.
  Value displayed in Hz, when Use Frequency Offset is set to T2-MI.
### 3.17 DVB-T2 Setup Screen 4, Modulation Settings

Figure 3-21 shows the DVB-T2 Modulation Settings Setup screen. This is the fourth of six DVB-T2 setup screens.

![DVB-T2 Setup Screen 4, Modulation Settings](Setup-DVB-T2-2.3.4.jpg)

#### 3.17.1 Modulation Settings

Refer to Figure 3-21.

- **FFT MODE**: Choices are 1K, 2K, 4K, 8K, 16K, or 32K.

This refers to the number of sub carriers in the RF output bandwidth, see Table 3-2. This table assumes a channel bandwidth of 8 MHz.

<table>
<thead>
<tr>
<th>FFT Mode (No. Carriers)</th>
<th>1K</th>
<th>2K</th>
<th>4K</th>
<th>8K</th>
<th>16K</th>
<th>32K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical Max. Carriers</td>
<td>1024</td>
<td>2048</td>
<td>4096</td>
<td>8192</td>
<td>16384</td>
<td>32768</td>
</tr>
<tr>
<td>No. Carriers Normal Mode</td>
<td>853</td>
<td>1705</td>
<td>3409</td>
<td>6817</td>
<td>13633</td>
<td>27265</td>
</tr>
<tr>
<td>No. Carriers Extended Mode</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6912</td>
<td>13920</td>
<td>27840</td>
</tr>
<tr>
<td>Spacing Between Carriers Hz.</td>
<td>8929</td>
<td>4464</td>
<td>2232</td>
<td>1116</td>
<td>558</td>
<td>279</td>
</tr>
<tr>
<td>Symbol Time, microseconds</td>
<td>112</td>
<td>224</td>
<td>480</td>
<td>896</td>
<td>1792</td>
<td>3584</td>
</tr>
</tbody>
</table>
APEX-M2X™ Exciter, DVB-T2 Mode
Operating the APEX-M2X Exciter, DVB-T2 Mode

DVB-T2 Setup Screen 4, Modulation Settings

- **Grd (Guard) Interval**: Choices are 1/4, 1/8, 1/16, 1/32, 1/128, 19/128, or 19/256.
  
  Guard intervals in microseconds for FFT size and guard interval fraction are given in Table 3-3.

  **Table 3-3  Guard Interval Duration Time In Microseconds**

<table>
<thead>
<tr>
<th>FFT Size</th>
<th>1/128</th>
<th>1/32</th>
<th>1/16</th>
<th>19/256</th>
<th>1/8</th>
<th>19/128</th>
<th>1/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>32K</td>
<td>28</td>
<td>112</td>
<td>224</td>
<td>266</td>
<td>448</td>
<td>532</td>
<td>N/A</td>
</tr>
<tr>
<td>16K</td>
<td>14</td>
<td>56</td>
<td>112</td>
<td>133</td>
<td>224</td>
<td>266</td>
<td>448</td>
</tr>
<tr>
<td>8K</td>
<td>7</td>
<td>28</td>
<td>56</td>
<td>66.5</td>
<td>112</td>
<td>133</td>
<td>224</td>
</tr>
<tr>
<td>4K</td>
<td>N/A</td>
<td>14</td>
<td>28</td>
<td>N/A</td>
<td>56</td>
<td>N/A</td>
<td>112</td>
</tr>
<tr>
<td>2K</td>
<td>N/A</td>
<td>N/A</td>
<td>7</td>
<td>N/A</td>
<td>28</td>
<td>N/A</td>
<td>56</td>
</tr>
<tr>
<td>1K</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>14</td>
<td>N/A</td>
<td>28</td>
</tr>
</tbody>
</table>

- **Pilot Pattern**: Choices are PP1, PP2, PP3, PP4, PP5, PP6, PP7, or PP8, see Table 3-4 for allowable combinations.

  **Table 3-4  Scattered Pilot Patterns Allowed for SISO Mode.**

<table>
<thead>
<tr>
<th>FFT Size</th>
<th>1/128</th>
<th>1/32</th>
<th>1/16</th>
<th>19/256</th>
<th>1/8</th>
<th>19/128</th>
<th>1/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>32K</td>
<td>PP7</td>
<td>PP4</td>
<td>PP2</td>
<td>PP2</td>
<td>PP8</td>
<td>PP2</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>PP6</td>
<td></td>
<td>PP8</td>
<td>PP8</td>
<td>PP4</td>
<td>PP8</td>
<td></td>
</tr>
<tr>
<td>16K</td>
<td>PP7</td>
<td>PP7</td>
<td>PP2</td>
<td>PP2</td>
<td>PP8</td>
<td>PP3</td>
<td>PP1</td>
</tr>
<tr>
<td></td>
<td>PP4</td>
<td>PP4</td>
<td>PP8</td>
<td>PP8</td>
<td>PP4</td>
<td>PP8</td>
<td>PP8</td>
</tr>
<tr>
<td></td>
<td>PP6</td>
<td>PP5</td>
<td>PP5</td>
<td>PP5</td>
<td>PP4</td>
<td>PP4</td>
<td>PP8</td>
</tr>
<tr>
<td>8K</td>
<td>PP7</td>
<td>PP7</td>
<td>PP8</td>
<td>PP8</td>
<td>PP5</td>
<td>PP5</td>
<td>PP1</td>
</tr>
<tr>
<td></td>
<td>PP4</td>
<td>PP4</td>
<td>PP5</td>
<td>PP5</td>
<td>PP4</td>
<td>PP4</td>
<td>PP1</td>
</tr>
<tr>
<td>4K, 2K</td>
<td>N/A</td>
<td>PP7</td>
<td>PP4</td>
<td>N/A</td>
<td>PP2</td>
<td>N/A</td>
<td>PP1</td>
</tr>
<tr>
<td></td>
<td>PP4</td>
<td>PP5</td>
<td>N/A</td>
<td>PP3</td>
<td>N/A</td>
<td>PP3</td>
<td></td>
</tr>
<tr>
<td>1K</td>
<td>N/A</td>
<td>N/A</td>
<td>PP4</td>
<td>N/A</td>
<td>PP2</td>
<td>N/A</td>
<td>PP1</td>
</tr>
</tbody>
</table>

- **Carrier Mode**: Choices are Normal or Extended.
  
  This refers to the actual number of carriers present for the various FFT Sizes, see Table 3-5 on page 3-32. The extended carriers are added on each side of the passband. Normal mode bandwidth is 7.61 MHz.

  Extended mode bandwidth is 7.71 MHz for the 8K carrier mode and 7.77 MHz for the 16K and 32K carrier modes.

- **Bandwidth**: Presently 5 MHz, 6MHz, 7 MHz, and 8 MHz, in the future 1.7 MHz bandwidth will be added.

- **L1 Mod (Modulation)**: Choices are BPSK, QPSK, 16QAM, or 64QAM.
  
  The L1 Mod referred to above gives a choice of the modulation constellation for the P2 symbol(s).

  L1 refers to the Layer 1 signalling within the T2 frame. L1 is split into three main sections: the P1 signalling, the L1-pre signalling and L1-post signalling. The the L1-pre and post signalling is carried by the P2 symbol(s), which may also carry data.
Note: Output signal modulation specifications are covered in Section 3.18, DVB-T2 Setup Screen 5, PLP Modulation Parameters, on page 3-33.

- **PAPR**: Choices are None, ACE, TR, or ACE & TR.

  PAPR = peak to average power ratio. This choice allows two methods of peak to average power ratio reduction.

  TR = Tone Reservation

  ACE = Active constellation extension, The active constellation extension technique should not be applied when rotated constellations are used or when MISO is used.

- **Data Symbols per T2 frame**: Programming range varies with the FFT size and the guard interval. The maximum number of data symbols per T2 frame is given in Table 3-5. An odd number must be entered when using the 32k FFT. If an even number or a number which is over the limit is entered, the exciter will mute.

  A larger number is more data efficient, but it also increases receiver lockup time.

<table>
<thead>
<tr>
<th>FFT Size</th>
<th>1/128</th>
<th>1/32</th>
<th>1/16</th>
<th>19/256</th>
<th>1/8</th>
<th>19/128</th>
<th>1/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>32K</td>
<td>67</td>
<td>65</td>
<td>63</td>
<td>63</td>
<td>60</td>
<td>60</td>
<td>N/A</td>
</tr>
<tr>
<td>16K</td>
<td>137</td>
<td>134</td>
<td>130</td>
<td>128</td>
<td>122</td>
<td>120</td>
<td>110</td>
</tr>
<tr>
<td>8K</td>
<td>274</td>
<td>268</td>
<td>260</td>
<td>257</td>
<td>245</td>
<td>240</td>
<td>221</td>
</tr>
<tr>
<td>4K</td>
<td>N/A</td>
<td>536</td>
<td>520</td>
<td>N/A</td>
<td>491</td>
<td>N/A</td>
<td>442</td>
</tr>
<tr>
<td>2K</td>
<td>N/A</td>
<td>1073</td>
<td>1041</td>
<td>N/A</td>
<td>983</td>
<td>N/A</td>
<td>884</td>
</tr>
<tr>
<td>1K</td>
<td>N/A</td>
<td>N/A</td>
<td>2082</td>
<td>N/A</td>
<td>1966</td>
<td>N/A</td>
<td>1768</td>
</tr>
</tbody>
</table>

- **T2 Frames per Superframe**: Programming range is 2 to 255.

  A Super-frame is composed of a set of T2-frames consisting of a particular number of consecutive T2-frames.

  **NOTE**: A super-frame may in addition include FEF (future extension frames) parts, two FEF parts can not be adjacent (must be separated by one or more T2 frames), and if FEFs are used, the super-frame ends with a FEF part.

  The maximum time for the super-frame length (TSF) is 64 seconds if FEFs are not used (equivalent to 255 T2 frames of 250 ms) and 128 seconds if FEFs are used. Note also that the maximum number of T2 frames are independent of the number of FEF parts used.
3.18 DVB-T2 Setup Screen 5, PLP Modulation Parameters

Figure 3-22 shows the DVB-T2 PLP (physical layer pipe) Modulation Parameters Setup screen. This is the fifth of six DVB-T2 setup screens.

![DVB-T2 PLP Modulation Parameters](Setup-DVB-T2-2.3.5.jpg)

3.18.1 PLP Modulation Parameters Setup

The programming choices are as follows:

- **Total PLPs**: Displays the number of PLPs presently being sent in the T2 transmission super-frame. In MPEG-TS input mode there is only 1 PLP. In T2MI input mode there can be multiple PLPs from 1 to 255.

- **PLP Number**: Enter the PLP number. In MPEG-TS mode the PLP Number is 0 fixed. In T2MI mode the user can select PLP Number from 0 to 254. This is the number of an individual PLP for parameter entry/display.

- **PLP ID (Hex)**: Enter value in white box. Range is 0 to 255.

- **Group ID**: This 8-bit field identifies the specific PLP group within the T2 system with which the current PLP is associated. This can be used by a receiver to link the data PLP to its associated common PLP, which will have the same PLP_GROUP_ID.

- **PLP Type**: PLP (physical layer pipe) are classified into 3 types, signalled in L1-post signalling field PLP_TYPE; common PLP, data PLP Type 1 and data PLP type 2. Common and Type 1 PLPs have exactly one sub-slice per T2-frame, whereas Type 2 PLPs have between 2 and 6480 sub-slices per T2-frame.

- **HEM**: Choices are Yes or No.
The mode adaptation module can process input data in one of two modes, normal mode (NM) or high efficiency mode (HEM). NM is in line with the Mode Adaptation in [i.3], whereas in HEM, further stream specific optimizations may be performed to reduce signalling overhead. The BBHEADER (see clause 5.1.7) signals the input stream type and the processing mode.

- **Code Rate:** Choices are 1/2, 3/5, 2/3, 3/4, 4/5, or 5/6.
  This refers to the forward error correction (FEC) which uses the LDPC (low density parity check) along with BCH code.
  1/2 code rate provides the most robust performance coincident with the lowers data efficiency.
  5/6 code rate provides the least robust performance coincident with the higher data efficiency.
  BCH performs the outer coding and LDPC performs the inner coding.

- **64k LDPC:** Choices are Yes or No. Yes indicates 64k LDPC is being used, No indicates that the 16k LDPC is being used.
  LDPC = Low Density Parity Check (codes) are part of the inner coding forward error correction (FEC). Two types of FEC can be used with the associated PLP, they are the 16k LDPC or the 64k LDPC.
  Long blocks or short blocks refer to the length of the FEC (forward error correction) Frame. A long (or normal) FEC Frame consists of 64800 bits and a short FEC Frame consists of 16200 Bits. An FEC Frame consists of a BBFrame (base band frame) plus two sets of parity check bits. The BCH outer code parity bits (referred to as BCH-FEC) and the LDPC inner code parity bits (referred to as LDPCFEC).

- **Constellation:** Choices are QPSK, 16 QAM, 64 QAM, or 256 QAM.
  This is the main modulation mode for all subcarriers except for those of the L1 mode, which is mentioned in Figure 3-21, on page 3-30.

- **Rotated QAM:** Choices are Yes or No. Yes is recommended state.
  The QAM constellations can be rotated off their normal axis up to 30 degrees in order to improve reception. Table 3-6 shows the rotation based on the constellation type.

<table>
<thead>
<tr>
<th>Table 3-6 Constellation Type and Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation</td>
</tr>
<tr>
<td>Phase Rotation (degrees)</td>
</tr>
</tbody>
</table>

- **TI Pi:** Enter value in white box. Range is 1 to 255.
  TI Pi is the number of T2 frames in an interleaving frame (when interleaver over multiple T2 frames, TI type = 1). TI Pi must be a factor of Ncells and must be less than or equal to the number of T2 frames per superframe.

- **TI Type:** Choices are 0 or 1.
  If the TI Type is set to the value '1', than there is one interleaving frame which spans multiple T2-frames. The number of T2-frames is indicated by TI Pi.
  If the TI Type is set to the value '0', then one interleaving frame corresponds to one T2-frame and contains one or more time interleaver blocks.

- **PCR Restamp:** Choices are Yes or No.
  PCR Restamp issued for transport interface. YES is required with transport input.
3.19  DVB-T2 Setup Screen 6, PRBS, Verification, and Test Pattern

Figure 3-23 shows the DVB-T2 PRBS, Verification, and Test Pattern Setup screen. This is the sixth of six DVB-T2 setup screens.

Figure 3-23  DVB-T2 Setup Screen 6, PRBS, Verification, and Test Pattern

3.19.1 PRBS (Pseudo random binary sequence) Top Sub Window

This window has 4 entries, which are as follows:

- **PRBS Enabled**: Choices are Yes or No.
  - When Yes is selected, the exciter will output RF without a transport stream input.
  - When No is selected, the exciter will mute without a transport stream input.

- **Add TS Header**: Choices are Yes or No.
  - When Yes is selected, a valid transport stream header is pre-pended to each packet.
  - When No is selected, a header is not added.

- **SFN P1 Symbol Deletion**: Choices are Yes or No. Selecting yes clears the P1 symbol, which allows comparison of timing of different transmitters in a SFN.

3.19.2 Verification, Middle Sub Window

- **Verification Mode Preset**: Enter value in white box. These are pre defined setups which can be applied by inputting the Verification Mode Preset number. Presently, usable Verification Mode Preset numbers are 1-17, and 19, these are SISO (single input single output modes), mode 18 is MIMO (multiple input single output). Tables 3-7 through 3-9 provide the parameters for the 19 Verification Mode Presets.
  - This mode is activated by selecting Yes in the Verification Mode Enabled selection shown below.
Verification Mode Enabled: Choices are Yes or No.

Entering Yes activates the Verification Mode Preset entry. This deactivates the various effected entries in the other DVB-T2 setup screens.

Entering No deactivates the Verification Mode Preset entry and activates the various effected entries in the other DVB-T2 setup screens.

<table>
<thead>
<tr>
<th>Verification Mode Preset Number</th>
<th>001</th>
<th>002</th>
<th>003</th>
<th>004</th>
<th>005</th>
<th>006</th>
<th>007</th>
</tr>
</thead>
<tbody>
<tr>
<td>VV Reference</td>
<td>CR35</td>
<td>CR35L</td>
<td>CR23</td>
<td>8KFFT</td>
<td>8KFFT</td>
<td>16KFFT</td>
<td>16KFFT</td>
</tr>
<tr>
<td>Rate</td>
<td>3/5</td>
<td>3/5</td>
<td>2/3</td>
<td>3/4</td>
<td>3/5</td>
<td>5/6</td>
<td>2/3</td>
</tr>
<tr>
<td>FEC Type</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
</tr>
<tr>
<td>Mode</td>
<td>HEM</td>
<td>HEM</td>
<td>HEM</td>
<td>HEM</td>
<td>HEM</td>
<td>HEM</td>
<td>HEM</td>
</tr>
<tr>
<td>Rotated QAM</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Modulation</td>
<td>256QAM</td>
<td>256QAM</td>
<td>256QAM</td>
<td>64QAM</td>
<td>256QAM</td>
<td>64QAM</td>
<td>16QAM</td>
</tr>
<tr>
<td>L1 Modulation</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
</tr>
<tr>
<td>FFTSIZE</td>
<td>32K</td>
<td>32K</td>
<td>32K</td>
<td>8K</td>
<td>8K</td>
<td>16K</td>
<td>16K</td>
</tr>
<tr>
<td>GI</td>
<td>1/128</td>
<td>1/128</td>
<td>1/128</td>
<td>19/256</td>
<td>1/16</td>
<td>1/4</td>
<td>19/128</td>
</tr>
<tr>
<td>Pilot Pattern</td>
<td>PP7</td>
<td>PP7</td>
<td>PP7</td>
<td>PP5</td>
<td>PP8</td>
<td>PP1</td>
<td>PP8</td>
</tr>
<tr>
<td>Extended Carrier Mode</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SISO/MISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
</tr>
<tr>
<td>PAPR</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Data Symbols</td>
<td>59</td>
<td>59</td>
<td>59</td>
<td>81</td>
<td>59</td>
<td>22</td>
<td>59</td>
</tr>
<tr>
<td>TiPi</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Ti Type</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Bit Rate (Mbps)</td>
<td>36.14</td>
<td>36.14</td>
<td>40.21</td>
<td>30.32</td>
<td>33.29</td>
<td>26.11</td>
<td>17.46</td>
</tr>
</tbody>
</table>
**Table 3-8 Verification Mode Preset, Numbers 8-14**

<table>
<thead>
<tr>
<th>Verification Mode Preset Number</th>
<th>008</th>
<th>009</th>
<th>010</th>
<th>011</th>
<th>012</th>
<th>013</th>
<th>014</th>
</tr>
</thead>
<tbody>
<tr>
<td>VV Reference</td>
<td>16KFFT</td>
<td>4KFFT</td>
<td>2KFFT</td>
<td>1KFFT</td>
<td>64QAM45</td>
<td>64QAM56</td>
<td>64QAM34</td>
</tr>
<tr>
<td>Rate</td>
<td>4/5</td>
<td>2/3</td>
<td>3/5</td>
<td>1/2</td>
<td>4/5</td>
<td>5/6</td>
<td>3/4</td>
</tr>
<tr>
<td>FEC Type</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
<td>64800</td>
</tr>
<tr>
<td>Mode</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>HEM</td>
<td>HEM</td>
<td>HEM</td>
</tr>
<tr>
<td>Rotated QAM</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Modulation</td>
<td>256QAM</td>
<td>64QAM</td>
<td>16QAM</td>
<td>QPSK</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
</tr>
<tr>
<td>L1 Modulation</td>
<td>64QAM</td>
<td>16QAM</td>
<td>QPSK</td>
<td>BPSK</td>
<td>64QAM</td>
<td>64QAM</td>
<td>64QAM</td>
</tr>
<tr>
<td>FFTSIZE</td>
<td>16K</td>
<td>4K</td>
<td>2K</td>
<td>1K</td>
<td>8K</td>
<td>8K</td>
<td>8K</td>
</tr>
<tr>
<td>GI</td>
<td>1/32</td>
<td>1/32</td>
<td>1/8</td>
<td>1/8</td>
<td>1/32</td>
<td>1/32</td>
<td>1/32</td>
</tr>
<tr>
<td>Pilot Pattern</td>
<td>PP6</td>
<td>PP7</td>
<td>PP2</td>
<td>PP3</td>
<td>PP7</td>
<td>PP7</td>
<td>PP7</td>
</tr>
<tr>
<td>Extended Carrier Mode</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SISO/MISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
<td>SISO</td>
</tr>
<tr>
<td>PAPR</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>TR</td>
<td>TR</td>
<td>TR</td>
</tr>
<tr>
<td>Data Symbols</td>
<td>100</td>
<td>100</td>
<td>983</td>
<td>1966</td>
<td>242</td>
<td>242</td>
<td>242</td>
</tr>
<tr>
<td>TiPi</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ti Type</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bit Rate (Mbps)</td>
<td>46.36</td>
<td>27.59</td>
<td>14.36</td>
<td>6.17</td>
<td>34.69</td>
<td>36.16</td>
<td>32.51</td>
</tr>
</tbody>
</table>

**Table 3-9 Verification Mode Preset, Numbers 15-19**

<table>
<thead>
<tr>
<th>Verification Mode Preset Number</th>
<th>015</th>
<th>016</th>
<th>017</th>
<th>018</th>
<th>019</th>
</tr>
</thead>
<tbody>
<tr>
<td>VV Reference</td>
<td>8KFFT</td>
<td>256QAM34</td>
<td>PAPRTR</td>
<td>MISO</td>
<td>NOROT</td>
</tr>
<tr>
<td>Rate</td>
<td>3/5</td>
<td>3/4</td>
<td>4/5</td>
<td>5/6</td>
<td>3/5</td>
</tr>
<tr>
<td>FEC Type</td>
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3.19.3 Test Pattern, Bottom Sub Window

Pressing the Single Tone soft key in the test pattern sub window causes a single tone, placed at the center of the spectrum, to be transmitted. It is used to measure the channel carrier frequency. The single tone signal is the same power as the exciter is putting out normally.

Normal transmission is resumed by pressing the Stop Test soft key.

3.20 PFRU Setup Screen

Figure 3-24 shows the PFRU (precise frequency reference unit) Setup screen. This screen provides a choice of the reference source for the 10 MHz reference oscillator, which is the reference frequency for the 1st and 2nd local oscillators. Descriptions of the PFRU setup screen selections are given in the following text.

3.20.1 Channel Setup, Setting RF Output and Offset Frequencies

This is the setup which determines the transmitter RF output frequency

- Click in the Center Frequency (MHz) window.
  - Type in the channel center frequency using the computer’s keyboard. The frequency must be in whole numbers.
  - If the exciter is in the SFN configuration, a frequency offset could be specified from the SFN adaptor and received by the exciter from the transport stream. This offset value (in units of Hz) will be displayed to the right of the SFN Offset (Hz) entry.

3.20.2 10 MHz OCXO Reference Sub Window, System Reference

System Reference (Source) choices include:

- Internal GPS (from internal GPS receiver).
• External 1PPS reference input.
• External 10 MHz reference input.
• Manual, See Section 3.20.5, Discipline Reference (For OCXO) on page 3-39.
• Auto 1PPS, See Section 3.20.6, PFRU 1PPS Auto-Switching on page 3-40.

The 10 MHz OCXO (oven controlled crystal oscillator) is the reference source for the 1st and 2nd local oscillators. It can be locked, via a PLL (phase locked loop), to an external 1PPS signal from a GPS receiver, to an external 10 MHz reference, or to the 1PPS signal from the internal GPS receiver. The 1st local oscillator is used, by the Signal Processor Board, in the creation of the 140 MHz IF signal. The 2nd local oscillator is used by the up and down converters.

3.20.3 Reference Loss Mute

Mute the exciter RF output if the 10 MHz OCXO oscillator is undisciplined (unlocked). These mute functions only operates when the exciter is in the SFN (single frequency network) mode. Choices are:

• No Mute On Loss (of OCXO discipline).
• Mute Immediately (of OCXO discipline).
• 20% GI (guard interval) Exceeded. The exciter’s RF output will be muted if the timing error, resulting from the OCXO being undisciplined (unlocked), exceeds 20% of the guard interval time. Guard Interval time is shown in Figure 3-21, DVB-T2 Setup Screen 4, Modulation Settings, on page 3-30.
• Time Out Exceeded, see Time Out value entered in Figure 3-24.

The RF mute commands described above will have no effect if the OCXO is operated in the manual mode.

3.20.4 Time Out (hours)

A time out value, from 1 hour to 100 hours, is entered into the Time Out (hours) window. This represents the maximum amount of time the exciter will operate after the 10 MHz OCXO losess its reference signal. The time remaining can be seen in the PFRU Status Screen 2, Figure 3-43, on page 3-63.

OCXO Stability doesn’t depend on this time out setting, OCXO oscillator stability is 3 ppb (parts per billion) per day.

3.20.5 Discipline Reference (For OCXO)

The OCXO Manual Setting is entered as a number, range of 0% to 100%, which provides a control voltage for the 10 MHz OCXO reference oscillator when Manual Setting of the System Reference is selected. This voltage replaces the phase detector output voltage which controls the 10 MHz OCXO reference oscillator when any of the other System Reference is selected.

The initial relationship between the number entered and the 10 MHz frequency is shown below, the actual frequency realized will vary over time due to crystal aging.

• 1% = 9.9999914 MHz.
• 50% = 10.0000008 MHz.
• 100% = 10.0000107 MHz.
3.20.6 PFRU 1PPS Auto-Switching

The Auto-switching feature allows the selection the Auto 1PPS mode for the System Reference. This mode will allow the M2X to seamlessly switch between the Internal 1PPS and External 1PPS and vice versa without a mute. Figure 3-25 shows the PFRU Setup screen with the System Reference entry set to Auto 1PPS, no switch has occurred in the left side view, and a switch has occurred in the right side view.

The following conditions must be valid for the Auto 1PPS switching function to operate:

- The backup 1PPS must be valid and present for 60 seconds.
  - A valid source is indicated when the 1PPS signal is within +/- 5 us of the internal synthesized 1PPS for 60 consecutive seconds.
- Current selected 1PPS signal must be missing for 10 consecutive seconds before a switch to a valid backup 1PPS will occur.
- Once switched to the backup 1PPS source the exciter will remain in that position until the primary 1PPS input is restored and valid for 60 consecutive seconds.

The exciter will provide an indication via the GUI fault log that a seamless 1PPS switch is possible.

When Auto 1PPS causes a 1PPS switch to occur, the following indicators will be present:

- The fault log will indicate, via a yellow (warning) entry, that a seamless switch has occurred.
- The PFRU screen’s Actual 1PPS Input entry will not agree with the Primary 1PPS Input entry, this is shown on the right side of Figure 3-25.
3.21 Transmitter I/O Screen 1

Figure 3-26 shows the Transmitter I/O Setup screen 1, the first of two transmitter interface screens.

![Transmitter I/O Screen 1](image)

**3.21.1 Transport Stream Active Monitor Output Sub Window**

This parameter is used to select the digital signal input which is to be applied to the TS (transport stream) Output connector. This output is available for monitoring purposes.

Input choices are shown below, rear panel connectors are shown to the right.

- ASI 1 (Primary) HP = top left LED and input.
- ASI 1 (Primary) LP = top right LED and input.
- ASI 2 (Auxiliary) HP = bottom left LED and input.
- ASI 2 (Auxiliary) LP = bottom right LED and input.
- ASI 1 HP is primary input in non-hierarchical mode.
- ASI 2 HP is auxiliary input in non-hierarchical mode.
- LP inputs are not used in non-hierarchical mode.
3.21.2 Foldback Setup Sub Window

In some transmitter models, excessive reflected power coming back to the transmitter will cause the exciter RF output power to reduce (fold back).

The Foldback (VSWR foldback setup) low and high thresholds, and the max F/B level setups listed below are used when the exciter RF output power control is used to control the RF output power of the transmitter. The Diamond and Platinum TV series transmitters are two which fall into this category.

The foldback parameters are entered by clicking in the appropriate box. The values are entered using the computer’s keyboard. When all values have been entered, touch the Apply soft key to activate the new values.

The VSWR foldback voltage comes from the transmitter control logic and enters the exciter via the Transmitter I/O Board on pin 12 of the bottom rear panel (Transmitter Interface) 25 Pin Male connector. The input voltage range is 0 to +5 Vdc and is shown on the Transmitter I/O 1 screen. The VSWR foldback voltage is shown in Figure 3-41, Transmitter I/O Status Screen, on page 3-60, and additional information is given in Section 3.34.2, Foldback Input Voltage, on page 3-60.

3.21.2.1 F/B Low Threshold

This is the voltage threshold (0 to 5 vdc range) at which RF output power foldback (RF output power reduction) first starts. It is typically set at 0.25 volts to prevent DAC noise from triggering an RF output power reduction (foldback). Refer to the transmitter technical manual for setup instructions for this parameter.

3.21.2.2 F/B High Threshold

This is the voltage threshold (0 to 5 vdc range) at which maximum RF output power foldback occurs. It is typically set between 4 or 5 volts, determined by the transmitter power control logic. Refer to the transmitter technical manual for setup instructions for this parameter.

3.21.2.3 Max F/B Level

This is the maximum amount of exciter RF output power reduction allowed, range is 0% to 100%. It occurs when the VSWR foldback high threshold, listed above, is reached. It allows the transmitter power amplifier(s) to operate at a safe, reduced output power level when maximum VSWR occurs. Refer to the transmitter technical manual for setup instructions for this parameter.

3.21.3 RF Cutoff Sub Window

When the exciter RF output level (in percent) is reduced to the value displayed here, it causes the transmitter control logic to switch to the backup exciter. The programable range is 0 to 100 mW. This switch is prevented if the backup exciter is faulted.
### 3.22 Output Setup Screen

Figure 3-27 shows the Output Setup screen. This entry sets a maximum exciter average output level (up to 100 mW). It is used to protect subsequent amplifiers from being overdriven, and to set a limit of transmitter output power.

![Output Setup Screen](Graphics/001-CH-3\ Setup-Output-2.5-NAN.jpg)

#### 3.22.1 Exciter Output Power, Upper Sub Window

Power Limit: Value 1 to 100 mW.
3.23 Remote Communications Setup Screen 1, Ethernet

Figure 3-28 shows the first of two remote communications screens, which shows the setups for the front and rear ethernet connectors.

This screen gives the basic inputs necessary to set up the rear ethernet port and use the front ethernet port. These setups are necessary when the exciter is first installed in a transmitter, when a repaired exciter is reinstalled in the transmitter, or when a change is needed in the setup of one of the communications ports.

3.23.1 Rear Ethernet Port

**Mac Address** is assigned at the time of manufacture and can not be changed. Each Mac Address is assigned to a specific unit, and can be tracked by serial number.

**Mode** (for the rear panel IP connector) can be set to DHCP (client) or Static mode. If it is set up in the DHCP client mode, the host network will assign it an IP address. If it is set up in the static mode, an appropriate IP address must be entered by the operator.

**IP address** can be obtained by either of two modes.

- If it is set up in the DHCP client mode, the host network will assign it an IP address.
- If it is set up in the static IP mode, an appropriate IP address must be entered by the operator.

**Gateway** If the computer is in DHCP mode, it will fill in automatically.

**Subnet Mask** If the computer is in DHCP mode, it will fill in automatically.

If the computer is in Static mode, see your IP department for the Gateway and Subnet Mask addresses.
### 3.23.2 Front Ethernet Connector

The front Ethernet connector is meant for walk-up technician access via laptop PC or standalone site PC and thus has a fixed, static IP address that cannot be changed by the user. This address is silk screened on the unit and is 192.168.117.88. This connector is driven by a DHCP server and will give an IP address to a computer connected to it, if the computer is set up in the DHCP client mode.

When connecting to the exciter front panel ethernet port, if the computer being used does not auto-detect for cross connection, a crossover cable must be used to connect the exciter front ethernet port to the computer.

### 3.24 Remote Communications Setup Screen 2, RS232 and CAN

Figure 3-29 shows the second of three remote communications screens, the RS232 and CAN setup screen. This screen gives the basic inputs necessary to set up the rear panel RS232 port connector, the rear panel CAN Bus connector, and the Java Remote GUI (eCDi). These setups are necessary when the exciter is first installed in a transmitter, when a repaired exciter is reinstalled in the transmitter, or when a change is needed in the setup of one of the communications ports.

![Figure 3-29 Remote Communications Setup Screen 2, RS232 and CAN](Graphics 001-CH-3\SetupRemoteCom-RS232-Can-2.6.2.jpg)
3.24.1 RS232 Setup

The following is a list of entries on the Serial setup screen. This port is used for exciter troubleshooting.

- **Baud Rate**: Enter the baud rate on the touch screen numeric key pad. Baud rate choices are 300, 600, 1200, 2400, 4800, 9600, 19.2k, 28.8k, 38.4k, 57.6k, and 115.2k, default is 115200.
- **Data Bits**: Choices are 7 or 8, default is 8.
- **Parity**: Choices are None, Odd, or Even, default is None.
- **Stop Bits**: Choices are 1 or 2, default is 1.

3.24.2 CAN Bus Setup

The CAN (controller area network) bus allows the exciter to communicate with the transmitter control logic or with the transmitter control unit. It has the following two settings.

- **Exciter ID** must be set to either Exciter A or Exciter B, depending on the position of the exciter, and must be set for Exciter A if only one exciter is included in the transmitter. This identifies the exciter so that the transmitter control logic can communicate with each exciter individually.
- **The CAN Baud Rate** must match the rate of the other terminals connected to the CAN bus. It is presently locked to the 250Khz rate.
3.25 Remote Communications Setup Screen 3, SNMP

Figure 3-29 shows the SNMP (simple network management protocol) setup screen.

![Figure 3-29](Graphics 001-CH-3\Setup-Remote Com-SNMP-2.6.3.jpg)

3.25.1 SNMP Setup

**Trap IP Address.** A trap is a list of variables which are sent to the trap IP address. Three trap IP addresses can be entered.

3.25.2 Lower Half of the SNMP Setup Screen

- **Read-Write Community,** This is a password which allows a set to be performed. See Set below.
- **SNMP Version,** choices are 1 of 2.
  
  Version 1: the trap which is sent tells of an occurrence of an event but gives no details.
  
  Version 2: this trap tells of an occurrence of an event and gives details concerning it.
- **Port,** enter the port number to be used. Choices are 161 and 8170 through 8179. Port 161 is the default.
- **Set,** choices are Off or On. Off prevents any change of any read/write configuration.
### 3.26 Status Navigation Screen

Figure 3-31 shows the status navigation screen. A flow chart for this screen is shown in Figure 3-32. The flow chart provides page numbers for the various status screens.

Figure 3-31 Status Navigation Screen
3.26.1 System Status Navigation Flow Chart

Figure 3-32 Status Navigation Screen Flow Chart
3.27 Signal Processor Status Screen 1

Figure 3-33 shows the Signal Processor status screen, the first of two screens. This screen gives the statuses and analog values of several of the signal processing functions of the exciter. Descriptions of the various signal processing screen indications are given in the following text.

![Figure 3-33 Signal Processor Status Screen 1](Graphics/001-CH-3\ Status-Signal Processor-3.2.1.jpg)

3.27.1 Signal Processor Statuses

Status level sub windows are Green for ok or Red for Fault.

**Left column, Modulator sub windows:**

- FPGA Programmed, Green = FPGA is programmed, Red = fault.
- FPGA Health, Green = serial communication with Modulator FPGA, Red = fault.
- Host Port Interface, Green = communication through the Modulator Host Port, Red = fault.
- DAC Clock, Green = DAC Clock is detected and deemed correct, Red = fault.
- Modulator Clock, Green = Modulator Clock is detected and deemed correct, Red = fault.
- 4X Clock, Green = Modulator 4X Clock is detected and deemed correct, Red = fault.
- 25MHz, this is a clock, Green = Modulator 4X Clock is detected and deemed correct, Red = fault.
- 54MHz, this is a clock, Green = Modulator 4X Clock is detected and deemed correct, Red = fault.
Right column, RTAC sub windows:

- FPGA Programmed, Green = DUC is programmed, Red = fault.
- FPGA Health, Green = serial communication with DUC FPGA, Red = fault.
- DCM Lock, digital clock manager, Green = DUC FPGA is locked, Red = fault.
- Input Buffer, Green = Input Buffer OK, Red = overflow or underflow.
- Sample Rate Converter Buffer, Green = Sample Rate Converter Buffer OK, Red = overflow or underflow.
- Adaptive DSP Health, Green = Controller is communicating with the Adaptive DSP, Red = fault.

3.28 Signal Processor Status Screen 2

Figure 3-34 shows the Signal Processor status screen, the second of two screens. Descriptions of the various signal processing screen indications are given in the following text.

3.28.1 Temperature (Signal Processor Degrees C) Sub Window

Modulator FPGA Temp -- Maximum temperature is 85 degrees C, above that temperature the FPGA de-programs.

RTAC FPGA Temp -- Maximum temperature is 85 degrees C, above that temperature the FPGA de-programs.

Ambient Temp -- Maximum temperature is 85 degrees C.

For the above three items, the warning temperature is 80 degrees C. The indication background is green if within limits, yellow for warning, and red is out of limits.
3.28.2 Fans Status Sub Window

This window gives the Tach 1 and Tach 2 speed. The minimum speed, for fault, is 2400 RPM. The indication background is green if the speed is above the minimum and red if below the minimum.

3.28.3 Power Supply (Voltage Reading) Sub Window

The minimum and maximum limits for these voltages are listed in the parenthesis, and the nominal voltage is listed next to the indication. The indication background is green if the voltage is within limits and red if out of limits.

3.29 DVB-T2 Modulator Status Screen 1

Figure 3-35 shows the DVB-T2 modulator status screen, the first of two screens. This screen indicates the transport stream status.

![Figure 3-35 DVB-T2 Modulator Status Screen 1](image)

3.29.1 Transport Stream Inputs, Top Sub Window

The top sub window of Figure 3-35 Shows the active transport stream input and the status of inputs ASI 1 and ASI 2. If the ASI input is present with no errors, a green box with the word PRES appears under the label. The area under the label remains blue if input is absent.

When an input is active, the number shown under that input indicates the transport stream bandwidth in Mbps (mega bits per second). This is the total ASI input stream bandwidth, which includes data packets and null packets.
Figure 3-36 shows the Front panel indicators (left side) and the rear panel input connectors (right side). The correlation between the inputs listed in Figures 3-35 and 3-36 are as follows:

- ASI 1 (Primary) = top left LED and input of Figure 3-36.
- ASI 2 (Auxiliary) = bottom left LED and input of Figure 3-36.

3.29.2 Other Parameters, Bottom Sub Window

- **Switch Elapsed Time (seconds):** This value is the elapsed time since the exciter automatically switched to the inactive input.
- **Switch Count:** This is the number of times the exciter has switch to the alternate input since it was last reset.
- **Timestamp Type:** Indicates mechanism for synchronizing output of transmitters signaled by T2 gateway. Only required in T2MI mode.
  - Relative = timestamp only contains time of emission relative to next 1 pps (sub seconds)
  - Absolute = timestamp includes absolute time of emission
  - Null = timestamp packet detected, but no timing alignment required
  - N/A = no timestamp packet required/detected (MPEG-TS mode)
- **Processing Time (microseconds):** This is the internal processing delay of the modulator. This value is used in planning of SFN network timing. Processing time is delay from reception of L1 packet (end of T2 frame) at transport input to I/Q data ready into SFN delay memory.
- **Reset Counts soft key:** Pressing this key resets the Switch Elapsed Time counts and the Switch Counts.
3.30 DVB-T2 Modulator Status Screen 2

Figure 3-37 shows the DVB-T2 modulator status screen, the second of two screens. This screen displays the calculated frame structure parameters and the PLP Parameters.

3.30.1 Calculated Frame Structure Parameters

Symbols Per Frame: The total number of symbols per T2 frame. This is data symbols plus P1 symbols.

Data Cells Per T2 Frame: Data cells per T2 frame < subcarriers per symbol X symbols per T2 frame. Maximum is 13920 X 138. This is reduced by pilot subcarriers and L1 signaling cells.

3.30.2 PLP (Physical Layer Pipes) Parameters

Total PLPs: Displays the number of PLPs presently being sent in the T2 transmission super-frame. In MPEG-TS input mode there is only 1 PLP. In T2MI input mode there can be multiple PLPs from 1 to 255.

PLP Number: Enter the PLP number. In MPEG-TS mode the PLP Number is 0 fixed. In T2MI mode the user can select PLP Number from 0 to 254. This is the number of an individual PLP for parameter entry/display.

PLP ID: Displays the PLP ID (identifier) number for the selected PLP Number. Range 0-254 set by T2 gateway.

PLP Bitrate: Displays the calculated payload bit rate for the selected PLP Number.

Max FEC Blocks: Displays the maximum number of forward error correction blocks per interleaver frame for the selected PLP number.
3.31 RTAC Status Screen 1, Down Converter Levels

Figure 3-38 shows the RTAC status screen. This screen gives the statuses and analog values of several of the down converter functions of the exciter. Descriptions of the various down converter screen indications are given in the following text.

3.31.1 Levels (RTAC RF Samples) Sub Window

- **Pre-Filter Level.** This is a bargraph indication which gives the pre-filter RTAC RF sample level.
- **Post Filter Level.** This is a bargraph indication which gives the post filter RTAC RF sample level.

The maximum signal level span is -20 dBm to +5 dBm, but, if possible, it is better to attempt to keep the RF sample levels between -10 dBm and -2 dBm. Since the sample levels at the sample cable outputs are usually too high, the level is adjusted by adding appropriate padding at the exciter sample input connectors.

Some transmitter power amplifiers consist of multiple power amplifier modules. Other transmitter systems consist of multiple PA cabinets. For these systems, the transmitter output power may vary due to failure or removal of PA modules, or because a PA cabinet was faulted off, turned off, or switched out of the combiner. For these transmitters, make sure the RTAC RF sample levels stay within the recommended power range for all expected transmitter output power levels and PA configurations.
3.31.2 Summary Error Sub Window

This sub window provides the status of the RTAC linear (after filter sample) and Non-Linear (pre filter sample).

- **Fault** with green background = no faults, red background = faults.
- **RF Level** with green background = level ok, yellow background = low RF level.

3.31.3 Down Converter Attenuation Sub Window

- IF (>6.5), 6.5 dB is the minimum allowable IF attenuation. The indication to the right is the actual value of IF attenuation, it should be greater than 6.5 dB.
- RF (>6.5), 6.5 dB is the minimum allowable RF attenuation. The indication to the right is the actual value of RF attenuation, it should be greater than 6.5 dB.
3.32 RTAC Status Screen 2, Down Converter Switch Mode

Figure 3-39 shows the RTAC status screen two of two. This screen gives the status of the down converter functions of the exciter. Descriptions of the various down converter screen indications are given in the following text.

3.32.1 Mode (Down Converter Switch Mode)

The down converter must switch between the various RF sample inputs so that the RTAC circuits can properly correct for linear and nonlinear transmitter distortions, the choices are:

- **Switch Mode:**
  
  **Automatic is the normal mode.** In this mode, the down converter input sample is automatically switched between Post High Power Filter or Pre High Power Filter to accommodate the needs of the RTAC (real time adaptive corrector) circuit. This mode will also switch in the exciter (internally connected) sample, although this sample is not used for the RTAC correction circuits.

  **Manual is a test mode,** in which the down converter input is locked to the Manual Select choice.

- **Manual Select** choice is available when the Switch mode is in the manual position. Choices from the drop down box are Post-Filter or Pre-Filter

- **Down Converter mode readout** is located below the Switch Mode Select choice. This tells which input is presently selected by the down converter.
3.33 Output Status Screen, Up Converter

Figure 3-40 shows the output status screen. This screen gives the statuses and analog values of several of the up converter functions of the exciter. Descriptions of the various up down converter screen indications are given in the following text.

![Output Status Screen]

3.33.1 Status Sub Window

The status sub window, top of output status screen, has two indication, which are:

- Alive, Green = UDC is communicating, Red is fault.
- RF Mute, Green = unmuted, Red = muted.

3.33.2 Levels Sub Windows

Green indication background is OK, red = fault.

- LO Level (in mV), range is 2222 to 2427.
- IF Level (in mV), range is 693 to 857.

3.33.3 Temperature Sub Window

Green indication background is OK, red = fault.

- Amp (amplifier) Temp. A temperature fault occurs at or greater than 70 degrees C.
3.33.4 Power Supply Sub Window

Green indication background is OK, red = fault.

- +12VDC -- The allowable range shown within the parenthesis.
- +20VDC -- The allowable range shown within the parenthesis.

3.33.5 Up Converter Attenuation Sub Window

- Up converter IF attenuator. The amount of IF attenuation is represented by the displayed value, which must be greater than 6.5 dB. 6.5 dB attenuation or less produces a fault.
- Up converter RF attenuator. The amount of RF attenuation is represented by the displayed value, which must be greater than 6.5 dB. 6.5 dB attenuation or less produces a fault.
3.34 Transmitter I/O Status Screen

Figure 3-41 shows the Transmitter I/O status screen. This screen gives the statuses and analog values of several of the Transmitter I/O functions of the exciter. Descriptions of the various Transmitter I/O screen indications are given in the following text.

3.34.1 Transmitter I/O Command Status

These inputs enter the exciter via the 25 Pin Male Transmitter Interface connector on the Transmitter I/O Board. The connector pin numbers are given below.

- Power Raise, green is active, blue is inactive, input on pin 1.
- Power Lower, green is active, blue is inactive, input on pin 2.
- RF Mute, green is active, blue is inactive, input on pin 6.
- Adaptive Reset, green is active, blue is inactive, input on pin 10.
- Adaptive Hold, green is active, blue is inactive, input on pin 11.

3.34.2 Foldback Input Voltage

The Foldback Input Voltage shown in this screen is a DC voltage which is proportional to the reflected power returning to the transmitter output (the transmitter VSWR). In some transmitter models, excessive reflected power coming back to the transmitter will cause the exciter RF output power to reduce. This is referred to as VSWR foldback. Figure 3-26, Transmitter I/O 1 Screen, on page 3-41 shows the low and high foldback threshold voltages and the maximum allowable RF output power reduction when the high foldback voltage threshold is reached.
Exciter controlled VSWR Foldback is only used when the exciter RF output power control is used to control the RF output power of the transmitter. The Diamond and Platinum TV series transmitters are the only two which fall into this category. See the Diamond and Platinum TV series transmitter technical manual for VSWR foldback setup instructions.

The VSWR foldback control voltage enters the exciter on pin 12 of the 25 Pin Male Transmitter Interface connector on the Transmitter I/O Board. This is an analog input which determines the percent of exciter output power foldback, typically due to transmitter PA VSWR exceeding a preset level. For more information, refer to Section 3.2.1.2, Foldback Setup Sub Window, on page 3-42.

3.35 PFRU Status Screen 1

Figure 3-42 shows the PFRU (precise frequency reference unit) status screen, the first of two screens. This screen gives the statuses and analog values of several of the precision frequency reference unit functions of the exciter. Descriptions of the various precision frequency reference unit screen indications are given in the following text.

3.35.0.1 General Window (top left side of screen)

FPGA Sub Window

- Programmed, Green = PFRU is programmed, Red = fault.
- Communication Health, Green = serial communication with PFRU FPGA, Red = fault.

System Reference Clocks Sub Window
• External 1PPS Present. This input is derived from the customer’s GPS receiver.
• External 10 MHz Present. This input can be derived from a variety of sources.
• Internal GPS 1PPS Present. This signal is derived from the exciter’s internal GPS receiver.

For above 3, Green = present, Blue = absent and not selected, Red = absent and selected.

PLL Reference Clocks Sub Window

• 54 MHz: A 54 MHz xtal is used in ATSC MFN and ISDB-T MFN applications as the clock reference for digital circuitry. It is 2 times the 27MHz clock used for ASI. Green = OK, Red = fault.
• 10MHz Clock: Present. This is an internal clock used to synchronize the phase lock loops in the precise frequency reference unit (PFRU). In SFN mode, the 10 MHz OCXO is locked to GPS is used to lock everything together. Green = OK, Red = fault.

PLL Status Sub Window

• RF LO PLL Lock. This reference output from this circuit is used by the up converter to set the exciter output to the correct frequency and is used by the down converter to heterodyne the RF output samples back to the IF frequency. Green = OK, Red = fault.
• IF LO PLL Lock. This PLL output is used as a reference by the FPGA Modulator, Digital Precorrection, and Digital to Analog Converter (DAC) to generate the to produce the 140 MHz analog IF output from the signal processor board. Green = OK, Red = fault.
• IF PLL Reference. This indicates the reference frequency used by the IF local oscillator.
3.36 PFRU Status Screen 2

Figure 3-43 shows the PFRU (precise frequency reference unit) status screen, the second of two screens. This screen shows the status of the internal GPS receiver. Descriptions of the various screen indications are given in the following text.

![PFRU Status Screen 2](image)

**Figure 3-43 PFRU Status Screen 2**

### 3.36.1 GPS Sub Window

- GPS Power Supply, Green = ok, Red = fault.
- Satellites Detected (number of) -- Need to detect three or more satellites for GPS lock and possible range.
- Satellite Time -- yy:yy:yy Time is GMT (Greenwich Mean Time).
- Latitude -- N yy degrees yy.yy minutes
- Longitude -- W yy degrees yy.yy minutes
- Altitude -- yyy.yyy meters.

Latitude, Longitude, Altitude, and Time indications appear when the internal GPS receiver is locked to three or more satellites.
3.36.2 Holdover Sub Window

Readiness (holdover Readiness bar graph) indicates the discipline of the OCXO (oven controlled crystal oscillator). If the graph is green and extends almost all of the way to the right of the white window, the 10 MHz OCXO PLL is locked to the 1PPS reference, from the internal GPS receiver or the external 1PPS input, and is fully disciplined. Under these conditions, it is capable of holdover (free running) and will remain within tolerance and allow transmitter operation for up to 100 hours.

The time out can be set from 1 hour to 100 hours in the PFRU Setup screen, which can be found in Figure 3-24, on page 3-38.

Time Remaining. When the 1PPS reference is lost the 10 MHz OCXO is free running and the OCXO holdover Readiness graph will start to diminish in accordance with the time remaining indication. The holdover Time Remaining indication, located in the Holdover sub window, starts to count down from the setting (1 to 100 hours) entered in the PFRU Setup screen, which can be found in Figure 3-24, on page 3-38. When its time reaches zero the exciter will mute, if it is in the SFN. OCXO stability does not depend on the Time Remaining value, OCXO oscillator stability is 3 ppb (parts per billion) per day.

When the reference is restored and the oscillator starts to lock, the OCXO Holdover Readiness graph indication will be green and start to increase. The exciter, if in the SFN mode, will remain muted until the OCXO is locked to the 1PPS signal. The indication of the locked status is when the Time Remaining window changes from showing zero time to some value of time remaining. As the green bar progresses to the right side of the window, the value shown in the time remaining window will increase. When the OCXO is fully disciplined, the time remaining value will be equal to the time set into the PFRU Setup screen (1 to 100 hours).

Additional information is given below.

- OCXO Holdover Readiness graph percentage represents the difference between the maximum and minimum oscillator control value over a 20 minute window, and is the indication of how well disciplined the oscillator is. If the holdover status value is above 90%, then the oscillator is only changing +/- 0.0003 Hz, and is good enough to use. The value will never reach 100%, but when well disciplined should be 90% or greater.

- The 10MHz OCXO is divided down to a 1Hz frequency and locked, via a phase locked loop, to a GPS 1PPS (pulse per second) reference signal. The purpose is to create a synthesized 1PPS signal which is used as a timing signal, for example, to synchronize a single frequency network. The 10 MHz OCXO signal is also used as a reference for the local oscillator, which determines the RF output frequency of the exciter.

- The synthesized 1PPS signal will be present even when the GPS 1PPS reference is missing. In that case, the 10 MHz OCXO holdover oscillator will be free running.

Holdover Time Remaining indicates the amount of time, in hours, minutes, and seconds, that the free running 10 MHz OCXO will remain within its frequency tolerance and the exciter, if in the SFN mode, will remain unmuted.
3.37 Battery Backup Status Screen

Figure 3-44 shows the battery backup status screens. These screens give the statuses and one analog value for the battery backup board of the exciter. Descriptions of the various battery backup screen indications are given in the following text.

Earlier Version: Keeps PFRU Active 15 Minutes.  
Current Version: Keeps Exciter active 1 minute and PFRU Active 15 Minutes.

Figure 3-44 Battery Backup Status Screens

3.37.1 Status Sub Window, Earlier Version

Present, Green background = battery backup present, Blue background = absent.

(Battery) Pack Fault, Blue background = OK, Red background = fault. 7.4 volt battery supplies battery backup circuit. Battery faults when its voltage drops to 6.4 volts (86.5% of its nominal voltage).

UPS Status Control (Battery), Blue background when battery backup disabled, When battery backup is enabled, Green background = ok and Red = fault.

Battery Charging, Green background = battery is charging, plain background = battery not charging (battery fully charged), red background = or battery not sufficiently charged.

Battery Backup Disable, Plain background = enabled. This is an input from the transmitter I/O. It is used to disable the backup battery. The input for this control is pin 9 of the UHF Transmitter Interface Connector, which is found on the transmitter I/O board option.

+12VDC Battery readout. A fault occur if the 12 volt output drops to 10 volts. The 7.4 volt output of the backup battery is inverted up to 12 VDC.

When installed, the UPS option always remains active. This includes exciter shipment or storage. When the backup battery voltage decreases to 86.5% of its nominal voltage (7.4 V to 6.4 V) the UPS option is disabled. When AC power is again applied to the exciter, the UPS option is again enabled and the backup battery is recharged. The backup battery recharge time is 5 to 8 hours.
### 3.37.2 Status Sub Window, Current Version

The battery backup is active when the battery is charged. This includes shipment and storage. When the battery backup voltage decreases to approximately 86.5% of its nominal voltage, the battery backup is disabled. When AC power is again applied to the LPU, the backup battery recharge time is two to three hours.

The Battery Backup screen gives status and information on the exciter battery backup board. Descriptions of the various battery backup screen indications are given in the following Paragraphs. More detailed descriptions of the battery back up option functionality can be found in Section 400 of this manual.

**Disabled:** This is an input from the transmitter I/O. It is used to disable the backup battery. The input for this control is pin 9 of the Transmitter Interface Connector, which is found on the transmitter I/O board option.

**Expired:** Battery is considered expired if either the three year expiration date has passed, or the Lifetime Discharge Remaining reaches zero.

**Lifetime Remaining:** When Lifetime Discharge Remaining reaches zero the battery has lost its ability to store charge and needs to be replaced.

**UPS Version:** UPS Version read from the micro on the power supply.

**Expiration:** This is the three year life expiration date for the battery.

**+12 VDC Battery:** A fault occurs if the +12 volt output drops to +10 volts. The +7.4 volt output of the backup battery is converted to +12 VDC. The fault occurs when the +7.4 VDC drops to 6.4 VDC.
3.38 Software Revisions, Status Screen 1

Figure 3-45 shows the Revisions 1 status screen.

The Build Version entry has two possible entries.

- If the exciter has been updated with the proper software build, the Harris part number for the complete software build and the REV (revision) level will appear, see example in the left side of Figure 3-45.
- If the exciter does not have all the proper software revisions installed for a particular build then “Customer Special” will be displayed.
- If part 1 of the DVB-T2 software has been loaded but part 2 of the software has not been loaded, the Build Version, shown in the right side of Figure 3-45, will read UPDATE NOT COMPLETE.
3.39 **Hardware Revisions, Status Screen 2**

Figure 3-46 shows the Revisions 2 status screen.

![Figure 3-46 Hardware Revisions, Status Screen 2](Status-Hardware Revisions-3.6.2.jpg)
3.40 Fault Log Screen

The Fault Log access soft key can be found on Figure 3-2, Exciter Home Screen, on page 3-3, and on the Figure 3-31, Status Navigation Screen, on page 3-48. The Fault Log screen is shown in Figure 3-47.

The fault log can be reset by pressing the Reset Log soft key.

Pressing the Active Faults soft key causes only the active faults to be displayed.

Next page and previous page allows the other faults in the fault log to be displayed.

Active warnings are highlighted yellow, active faults are highlighted red, inactive warnings and faults have a grey background.

![Figure 3-47 Fault Log Screen](Graphics 001-CH-3_Fault_log.jpg (310))
4 APEX-M2X™ Exciter Theory of Operation

4.1 General Description

A top view of the APEX-M2X exciter with the cover removed is shown in Figure 4-1.

This exciter can operate in the digital or analog mode. To operate in the analog mode, the Analog Input Board (AIB) is required. The analog input board provides the input connectors for the analog TV video and audio inputs.

The digital program input to the exciter is a data signal called the “Transport Stream” which can be coded in ASI (signal input 1 and LP 1) or SMPTE (signal input 2 and LP 2). These inputs have an impedance of 75 ohms. This form of coding allows the clock signal to be recovered from the data stream, instead of requiring separate clock and data paths.

The exciter processes its inputs into analog or digital on-channel transmission signals needed as drive for the transmitter power amplifiers. RTAC™ (Real Time Adaptive Correction) correction circuits in the exciter predistort the exciter’s digital RF output to compensate for errors which occur in the power amplifiers and the high level RF output mask filter. The purpose of the correction circuits is to produce a transmitter output signal with good EVM (error vector magnitude) or MER (modulation error rate), good digital signal to noise ratio and very low intermodulation (adjacent channel) products. RTAC™ processing, used in digital operating modes only, in the signal processing board continually monitors and trims exciter linear and nonlinear correction to maintain top performance.

Control and monitoring of the exciter is provided through an external computer which is linked to the exciter through an ethernet connection, refer to Chapter 2, Connecting To The APEX-M2X Exciter. In some transmitters exciter control is also extended to the transmitter control cabinet GUI (graphical user interface) display.

The APEX-M2X exciter performs the following general functions:

- ASI (signal 1 and LP 1) or SMPTE (signal 2 and LP 2) Input & Clock Distribution
- Data synchronization
- Channel encoding
- Pre-correction
- Nyquist filtering (spectral shaping)
- Up conversion
- RTAC™ (Real Time Adaptive Correction)

The on-channel RF signal is output through a 50-ohm SMA connector at the rear of the exciter. This output signal is suitable for amplification in subsequent high-power stages.
Figure 4-1 Top View Drawing Of APEX-M2X Exciter

See Figure 1-3, APEX Exciter Front Panel View, on page 1-3 for view of front panel LEDs, Switches and monitor connector access door.

WARNING: Disconnect primary power prior to servicing.
4.2 Transmitter Systems Block Diagram

Figure 4-2 is a block diagram which shows a digital transmitter with an APEX-M2X exciter. This diagram shows the transport stream input to the exciter, the exciter RF output signal connected to the transmitter IPA (or driver) input, and the two RF feedback signals from the transmitter RF output system to the exciter. These feedback signals are taken before and after the high power filter, which follows the PA, and are needed to perform the non-linear and linear RTAC precorrection of the exciter RF output signal.

The information contained in this overall system block diagram will be needed later, when a detailed study of the exciter block diagram is provided.

Additional exciter to transmitter systems interconnection information is covered in Appendix B, APEX-M2X Exciter Installation.

4.3 APEX-M2X Exciter Modulation Overview

Figure 4-3, on page 4-6 is an overall block diagram of the APEX-M2X exciter. Refer to it while studying the exciter digital assembly, also, refer to Figure 5-4, on page 5-3 for a view of the physical layout digital tray.

The exciter consists of 9 circuit boards, which are as follows.

- Signal Processor Board.
- Microprocessor Board, which is piggy backed on top of the Signal Processor Board in the right rear corner.
- Precise Frequency Reference Unit Board.
- Up Down Converter Board.
- Power Supply and Low Voltage Distribution Board.
- Battery Backup Option Board.
- Front Panel LED and Switch Board.
- Transmitter I/O Interface Board option is piggy backed under the right rear side of the signal processor board. This board can be inserted and removed through the rear panel of the exciter.
- Analog Transmitter Input Board option, piggy backed under the signal processor board. This board can be inserted and removed through the rear panel of the exciter.
Signal flow through the exciter may be followed by referring to Figure 4-3. The digital signal transport stream input or the analog video and audio inputs, via the optional analog input board, are applied to the FPGA modulator.

When operating in the digital mode, the data and the clock are recovered from the transport stream. The clocks required to synchronize several circuits in the signal processing board are phase locked to the recovered transport stream clock.

When operating in the analog mode, the analog video and audio are digitized, and the resulting digital data and clock are used to drive the circuits in the signal processing board.

### 4.3.1 The Modulation Process

During the modulation process the FPGA modulator adds forward error correction to the digitized signal. This forward error correction includes data randomization, Reed-Solomon coding, data interleaving, and trellis coding, and for some forms of modulation it may use frequency division multiplex, and for others may add segment sync and frame sync to the signal. The signal is also band-limited using a digital filter.

The FPGA modulator sends the digitized, processed, and bandpass filtered IF signal to the digital precorrector circuit.

In the digital mode, the precorrector uses RTAC to pre correct the digitized IF signal. It uses the down converted, digitized RF samples, from before and after the high power filter, to guide the precorrection.

In the analog mode, the precorrection is manually set from computer monitor.

The fully processed and precorrected digitized IF signal, resulting from analog or digital operating modes, is processed into a 140 MHz (center frequency) IF by the DAC (digital to analog converter).

The 140 MHz IF signal is sent to the up converter circuit of the up down converter board, where it is heterodyned up to the on channel frequency and amplified. The output level is 20 dBm (100 mW average) in any digital mode and 23 dBm (200 mW) peak of sync in the analog mode.

### 4.3.2 RF Sample Processing

The RTAC circuits compare the processed and filtered digitized IF signal from the FPGA modulator circuits to the digitized RF samples in order to precorrect its output signal. The RF samples for the RTAC circuits must be selected one at a time, the level set, the sample down converted to the 140 MHz IF frequency, and then digitized and sent to the digital precorrection circuit.

The input to the down converter is a four pole electronic switch, which is controlled by the signal processor board.

The level of the selected signal is next set to the optimum level for the down converter mixer by an attenuator, which is controlled by signal processing board.

The signal is next applied to a mixer, along with the local oscillator signal from the 2nd local oscillator phase lock loop circuit in the precise frequency reference board.
The resultant 140 MHz signal is then filtered, to remove mixing products, and sent to an attenuator, controlled from the signal processor board, where its level is set to optimum for its next destination, the ADC (analog to digital converter) in the signal processor board.

In the ADC, the IF signal is digitized and sent to the digital precorrector (RTAC) circuit.

The RTAC circuits in the digital precorrector performs both linear (response and group delay) and non-linear (phase and linearity) pre-correction on the signal.
Figure 4-3 APEX Exciter - Signal Flow Block Diagram
4.4 Low Voltage Power Supply And Optional Battery Backup

The low voltage power supply for the APEX-M2X exciter is mounted to the left inside wall of the exciter chassis, as shown in Figure 4-1, on page 4-2. The following items are mounted on the power supply board.

- The AC Input connector.
- A +5V, +24V, and -12V switching power supply, mounted towards the rear of the power supply board.
- A +12V switching power supply, mounted in the center of the power supply board.
- Provision for an optional battery backup board, mounted at the front of the power supply board.

Power Supplies outputs to exciter is via a ribbon cable to the signal processor board. Power to the other boards is supplied via the signal processing board. The block diagram of the low voltage power supply system is shown in Figure 4-4.

4.4.1 AC Input

The APEX-M2X exciter has a filtered IEC 320/C14 AC input connector. The LVPS Distribution board accepts AC voltages in the range of 100 - 240 Vac at 50-60 Hz. The inputs are fused at 4A 250V slow blow fuse. The maximum power for the exciter is 180 W.

4.4.2 LVPS

The AC input for each of the two low voltage power supplies listed below is 100 - 240 Vac at 50-60 Hz.

The ECM100UT32 power supply is capable of delivering +5.0V at 10A, +24.0V at 2A, and -12.0V at 0.8A.

The ECM60US12 power supply is capable of delivering +12.0V at 5A.

Both power supplies are mounted directly to the LVPS Distribution board by snap-top PEM standoffs.

4.4.3 Fans

The LVPS board will have provisions for two +12Vdc fans. The fans will be fused with a PTC at 1.35A and the dc input will be filtered.
4.4.4 Battery Backup

The battery backup board interfaces directly to the LVPS board. The LVPS board supplies a maximum of +12V at 1.3A to the battery backup. The battery backup supplies the LVPS board with +12Vbatt at 1A maximum. The board is mounted directly to the LVPS board using snap-top PEM standoffs. A block diagram of the battery backup module is shown in Figure 4-5.

The battery backup daughter board specifications are as follows.

- Battery backup powered off of four 1.2 volt 2700 mA-hr Ni-MH (Nickel Metal Hydride) batteries
- Includes trickle charger to maintain battery charge.
- Allows 15 minutes of backup at 1 amp (maximum backup current).
- The Battery Backup maintains power to the 10MHz and 1PPS Input circuitry on the Signal Processing board and the FPGA, OCXO and GPS circuitry on the PFRU. By powering these circuits the exciter can maintain the 10MHz OCXO discipline loop when the exciter loses power. The OCXO can take 3 minutes to stabilize from a cold start and the discipline loop itself can take an hour to reach the maximum precision; having the discipline loop active during a power outage enables the exciter to return to air faster with greater frequency accuracy. The battery backup is specified to hold the exciter up through 45 minute power outages.
4.5 PFRU (Precise Frequency Reference Unit) Board

The precise frequency reference unit (board) performs four functions through four circuits. They are as follows.

- Has provisions for an optional GPS unit.
- 10 MHz reference oscillator.
- 1st LO PLL
- 2nd LO PLL

4.5.1 PFRU Board 1st LO PLL for the DAC Clock Circuit

This PLL (phase lock loop) oscillator provides a clock to the IF DAC (digital analog converter). It is used to produce a 140 MHz analog IF output from the signal processor board.

Phase noise specification on DAC clock is given in Table 4-1.

<table>
<thead>
<tr>
<th>Hertz</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>-60 dBc/Hz</td>
</tr>
<tr>
<td>100</td>
<td>-90 dBc/Hz</td>
</tr>
<tr>
<td>1k</td>
<td>-95 dBc/Hz</td>
</tr>
<tr>
<td>10k</td>
<td>-100 dBc/Hz</td>
</tr>
<tr>
<td>100k</td>
<td>-117 dBc/Hz</td>
</tr>
<tr>
<td>1M</td>
<td>-135 dBc/Hz</td>
</tr>
</tbody>
</table>

4.5.1.1 DAC Clock Frequencies For 140 +/- 0.5 MHz IF

This clock is sent to the signal processing board where it is used to generate the 140 MHz IF output signal, which is fed to the up/down converter board. DAC clock frequencies for various modulation methods is shown in Table 4-2.
Each modulation method tends to produce an IF frequency which is equal to 1/4 of the DAC clock frequency for that modulation system. Therefore, an offset frequency is produced by the FPGA modulator to bring the IF frequency to 140 MHz. The required offset frequency for each modulating system can be calculated using the following formula.

\[
\text{Offset Frequency} = 140\text{MHz} - \frac{\text{DAC Clock Frequency}}{4}
\]

### Table 4-2 DAC Clock Frequencies

<table>
<thead>
<tr>
<th>Modulation</th>
<th>DAC Clock Freq.</th>
<th>Offset Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATSC</td>
<td>430.489 MHz</td>
<td>32.378 MHz</td>
</tr>
<tr>
<td>FLO</td>
<td>444.000 MHz</td>
<td>29.000 MHz</td>
</tr>
<tr>
<td>DVB-T/H</td>
<td>438.857 MHz</td>
<td>30.286 MHz</td>
</tr>
<tr>
<td>ISDB-T</td>
<td>445.823 MHz</td>
<td>28.544 MHz</td>
</tr>
<tr>
<td>DMB-T</td>
<td>453.600 MHz</td>
<td>26.600 MHz</td>
</tr>
<tr>
<td>NTSC/PAL</td>
<td>436.800 MHz</td>
<td>30.800 MHz</td>
</tr>
<tr>
<td>DAB</td>
<td>409.600 MHz</td>
<td>37.600 MHz</td>
</tr>
</tbody>
</table>

### Figure 4-6 DAC PLL (1st LO)

**4.5.2 PFRU Board Local Oscillator-2 Circuit, For UDC**

This circuit provides a local oscillator for the up/down converter. It is used to heterodyne the IF signal to the on channel RF frequency in the up converter and to heterodyne the RF sample back to the IF frequency in the down converter. The phase noise specification for local oscillator 2 (the RF UDC PLL) is given in Table 4-3.

### Table 4-3 Phase Noise Specification For RF PLL

<table>
<thead>
<tr>
<th>Hertz</th>
<th>BI, BIII, BIV,BV</th>
<th>L-Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>-57 dBc/Hz</td>
<td>-57 dBc/Hz</td>
</tr>
<tr>
<td>100</td>
<td>-87 dBc/Hz</td>
<td>-87 dBc/Hz</td>
</tr>
<tr>
<td>1k</td>
<td>-92 dBc/Hz</td>
<td>-92 dBc/Hz</td>
</tr>
<tr>
<td>10k</td>
<td>-97 dBc/Hz</td>
<td>-95 dBc/Hz</td>
</tr>
<tr>
<td>100k</td>
<td>-114 dBc/Hz</td>
<td>-114 dBc/Hz</td>
</tr>
<tr>
<td>1M</td>
<td>-132 dBc/Hz</td>
<td>-126 dBc/Hz</td>
</tr>
</tbody>
</table>

The block diagram of local oscillator 2 is shown in Figure 4-7. This circuit features an 800 to 1600 MHz voltage controlled oscillator, which is phase locked to a 10 MHz reference signal. The relationship between the various on channel frequency bands, the required local oscillator frequencies, and the status of the IF signal is given below and summarized in Table 4-4.
• For the L-band, the oscillator output is sent to the up/down converter board. The on channel output frequency is the sum of the IF and the local oscillator signals, therefore, the IF signal is not inverted.

• For band V and band IV, the oscillator output is divided by two, yielding an output range of 400 to 800 MHz. This signal is sent to the up/down converter board. For band V, the on channel output frequency is the sum of the IF and the local oscillator signals, therefore, the IF signal is not inverted. For Band IV, the on channel output frequency is the difference between the IF and the local oscillator signals, therefore, the IF signal must be inverted.

• For the upper half of Band I (60 to 88 MHz), and all of Band III, the oscillator output is divided by 4, yielding an output range of 200 to 400 MHz. This signal is sent to the up/down converter board. For these bands, the on channel output frequency is the difference between the IF and the local oscillator signals, therefore, the IF signal must be inverted.

• For the lower half of Band I (47 to 60 MHz) the oscillator output is divided by 8, yielding an output range of 100 to 200 MHz. This signal is sent to the up/down converter board. For this band, the on channel output frequency is the difference between the IF and the local oscillator signals, therefore, the IF signal must be inverted.

Table 4-4 RF UDC PLL Frequencies

<table>
<thead>
<tr>
<th>Band</th>
<th>Channel Frequency Range</th>
<th>Local Osc Frequency Range</th>
<th>IF Frequency Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>47 to 60 MHz</td>
<td>187 to 200 MHz in 0.125 MHz steps</td>
<td>Inverted</td>
</tr>
<tr>
<td>BI</td>
<td>60 to 88 MHz</td>
<td>200 to 228 MHz in 0.25 MHz steps</td>
<td>Inverted</td>
</tr>
<tr>
<td>BIII</td>
<td>174 to 230 MHz</td>
<td>314 to 370 MHz in 0.25 MHz steps</td>
<td>Inverted</td>
</tr>
<tr>
<td>BIV</td>
<td>470 to 606 MHz</td>
<td>610 to 746 MHz in 0.5 MHz steps</td>
<td>Inverted</td>
</tr>
<tr>
<td>BV</td>
<td>606 to 860 MHz</td>
<td>466 to 720 MHz in 0.5 MHz steps</td>
<td>Not Inverted</td>
</tr>
<tr>
<td>L-Band</td>
<td>1400 to 1492 MHz</td>
<td>1260 to 1352 MHz in 1.0 MHz steps</td>
<td>Not Inverted</td>
</tr>
</tbody>
</table>

The IF and local oscillator frequencies will vary somewhat to accommodate the various modulation methods used and the bandwidth of the output signal. Output signal bandwidth range is 5, 6, 7, or 8 MHz. The IF frequency tolerance of +/-0.5 MHz is needed to accommodate the various modulation methods used.
4.5.3 PFRU Board Reference Oscillator Circuit

The PFRU reference oscillator circuit, shown in Figure 4-8, provides four outputs, which are as follows.

- A 10 or 54 MHz reference for the DAC PLL oscillator
- A 10 MHz reference for the RF Up/Down Converter PLL oscillator
- A spare 10 MHz reference, at J3
- A 54 MHz reference to the level detector

4.5.4 PFRU Board GPS Circuit

The PFRU board includes a GPS receiver. The antenna input for the receiver is connector J8 on the PFRU board. A 50 ohm coax connects this connector to the GPS antenna input SMA connector on the exciter rear panel.
4.6 Up/Down Converter Board

This board consists of three major circuits, which are as follows.

- The Up Converter.
- The Down Converter.
- The Local Oscillator Distribution.

4.6.1 Up Converter Major Specifications

Frequency bands covered:

- BI 47 to 88 MHz
- BIII 174 to 240 MHz
- BIV 470 to 606 MHz
- BV 606 to 860 MHz
- L-Band 1400 to 1492 MHz

Output power maximum

- NTSC/Pal +23 dBm peak of sync
- DVB-T +20 dBm RMS

Includes a coupled RF output sample, available behind the door on the front panel.
4.6.2 Functional Description of Upconverter

Refer to Figure 4-9. The up-converter accepts a 140MHz IF from the Signal Processing board. The 140 MHz IF is filtered by a combination high-pass/low-pass filter, primarily by the low-pass portion which suppresses the unwanted DAC signals at 258MHz and above. The filtered IF is applied to a variable attenuator which is used to set the RMS level to the optimum level for the mixer, to minimize spurious mixing products. This attenuator is set to a specific fixed value by the system controller depending on the modulation format. A directional coupler applies a sample of the IF to an LT5534 detector IC, which provides a voltage output proportional to the RMS level of the IF. This voltage is A/D converted and utilized by the controller for diagnostic purposes, primarily to detect a low/missing input condition.

The IF at the main port output of the coupler is then buffered and applied to the mixer through a fixed pad and a bridged T network. This provides a very good match, from DC to very high frequencies, to the IF port of the mixer which helps to minimize 3rd order mixing products, i.e. (2*IF)-LO. With this conversion method, these mixing products fall in-band in VHF channels. The mixer output is buffered by a MMIC amplifier and bandpass filtered to remove the undesired mixing products.
The two sets of switchable VHF high band and low band bandpass filters, which follow the mixer and buffers, consist of cascaded high-pass/low-pass filters, while UHF is filtered using a tunable bandpass filter. All of the filter banks are appropriately padded so that the gain of any filter path is close to unity. The filtering is performed in two stages of 4-way filter banks.

The first filter bank consists of the following paths:

- Path 1: VHF Low Band LPF
- Path 2: VHF High Band LPF
- Path 3: UHF Tunable BPF
- Path 4: Bypass/Calibration path

The selected filter path is buffered to minimize interaction with the following stage and applied to filter bank two which consists of the following paths:

- Path 1: VHF Low Band HPF
- Path 2: VHF High Band HPF
- Path 3: UHF Tunable BPF
- Path 4: Bypass/Calibration path

This grouping was selected such that an offline calibration routine can automatically tune the UHF bandpass filters independently. By using a fixed ALC voltage and monitoring the output power detector, an algorithm can be implemented to first bypass one filter bank, tune the selected filter for maximum detected power and then find the center of the -1dB points. The process is repeated with the other filter bank, and then both are switched in.

This process is applied at power-on or anytime a UHF channel change is initiated.

The filtered RF is buffered by a MMIC amplifier. Since the UHF filters are inductively coupled, they exhibit greater high-side attenuation than low-side. A tunable low-side notch filter is included to provide additional suppression of the low-side image (f-280MHz).

The RF is then gain adjusted by a variable attenuator and applied to the output amplifier. The amplifier is followed by a low-loss directional coupler and low-loss RF relay. The coupled RF sample is split and one path is routed via embedded stripline to the down-converter so the adaptive pre-correction can compensate for imperfections of the analog filters. The other path is applied to an AD8362 demodulating detector IC. The output is applied to two paths. The first is a peak detector which provides peak of sync level for analog service. The other path is heavily low-pass filtered to provide average power measurement. The RF relay is a SPDT low-loss, high isolation (60dB @ 1.5GHz) microwave relay and is used to place the exciter “offline” for testing purposes. The default, de-energized state switches the exciter output into an on-board 50-Ohm resistive termination. This allows the RF output of the exciter to be muted while still keeping the signal chain active so internal tuning, diagnostics and correction can occur. When un-muted by the system controller, the RF relay switches the output to a right angle SMA bulkhead connector on the exciter rear panel.
4.6.3 Down Converter Major Specifications

Includes four selectable input samples, which are:

- Before high power mask filter.
- After high power mask filter.
- Upconverter RF output sample
- Spare input.

Down converter input specifications:

- Frequency range is 47 to 1492 MHz, same bands as the up converter.
- Input power range for NTSC/PAL -17 to +13 dBm
- Input power range for DVB-T -20 to +5 dBm

4.6.4 Down Converter

The down-converter accepts the following on-channel RF inputs:

- 1) Transmitter system PA (pre-filter) sample for non-linear estimation.
- 2) Transmitter system HPF (post-filter) sample for linear estimation.
- 3) Up-converter sample for linear estimation of the IF/RF filters.
- 4) Spare Input

The down-converter also has a provision for an external 140MHz IF input from an optional receiver card.
The four RF sample inputs are each applied to a high-isolation two-way switch IC. The selected sample is routed through its respective two-way switch to the final 4-way selector switch, while the undesired inputs are switched into resistive loads. This arrangement provides very good isolation of the signals and a good absorptive match to the inputs in the de-selected state.

The selected RF sample is variably attenuated, buffered, and split. One path feeds a power detector which provides a DC sample used by the controller to adjust the attenuator for optimum RF level into the mixer. The other path is amplified and applied to the mixer input. A higher level mixer (17dBm LO vs. 7dBm) is used in the down-converter because the mixer harmonics of low band VHF would fall within the 140 MHz region, and also to reduce the likelihood of IMD in the case of adjacent channels. The IF output of the mixer is applied to a bridged-T network and buffered by a MMIC amplifier, then low-pass filtered with a 225MHz Minicircuits chip low-pass filter. This filter removes components from UHF conversions while being transparent to the 140MHz IF in terms of amplitude response and group delay. This is necessary to enable calibration of the 140 MHz BPF. This IF is applied to one port of a two-way RF switch, with the other port fed from the optional receiver card. The selected 140MHz IF is again switched to either a bypass path (resistive pad) or the 140MHz BPF. This filter is a cascaded high-pass/low-pass and is required to remove mixing products at >170MHz and <108MHz. The bandwidth of this filter is approximately +/-10MHz to achieve the necessary attenuation, particularly the low-pass portion. This will impose a small amount of group delay which will need correction by the adaptive processing, and why the bypass path was included. This will enable complete calibration and correction of the up- and down-converters via an off-line routine.

The filtered IF is buffered and variably attenuated to allow the controller to optimize the level into the A/D converter on the signal processing board. A high linearity output amplifier drives the IF output to the ADC.

4.6.5 LO DISTRIBUTION

Part of the up/down converter.

---

**Figure 4-11** Up Down Converter Board, Local Oscillator Distribution Circuit Block Diagram
The LO input from the PFRU is 0+-2dBm, with harmonics of -10 to -15dBc. It utilizes a high frequency VCO (800-1600MHz) which is divided down to provide the LO frequencies required for the Up/Down Converter. This divided output is rich in harmonics, and if the input LO harmonics exceed -30dBc, they can begin to degrade mixer performance. For optimum mixing (i.e. lowest spurious products) the LO harmonics into the mixer should be quite low, also, for more consistent mixer performance, it is desirable to have tighter control of the LO level. A power detector was included for diagnostic purposes, to detect a missing input condition, and was used further with an integrator and variable attenuator to form a simple APC loop to maintain a constant LO input level to the distribution circuitry.

The gain adjusted LO is applied to a bank of selectable low-pass harmonic filters for low band, high band or UHF. A resistive two-way splitter follows the filters, with one path driving a detector IC used by the APC loop and also to provide LO level information to the system controller. The other path is split and amplified, the down converter path locally, and both paths at the mixer, to either +7dBm for the upconverter and +17dBm for the down converter.

### 4.6.6 UP Down Converter Board I/O Connector (J1)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Signal</th>
<th>PIN</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/UDC_RESET</td>
<td>21</td>
<td>UDC_SPARE_7</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>22</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>UDC_SPI_MISO</td>
<td>23</td>
<td>+24VDC</td>
</tr>
<tr>
<td>4</td>
<td>UDC_SPI_MOSI</td>
<td>24</td>
<td>GND</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>25</td>
<td>+24VDC Power</td>
</tr>
<tr>
<td>6</td>
<td>UDC_SPI_SCLK</td>
<td>26</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>/UDC_SPI_CS</td>
<td>27</td>
<td>Vbatt</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>28</td>
<td>GND</td>
</tr>
<tr>
<td>9</td>
<td>/RX_JTAG_MODE_SEL</td>
<td>29</td>
<td>+5VDC</td>
</tr>
<tr>
<td>10</td>
<td>/RX_CS</td>
<td>30</td>
<td>GND</td>
</tr>
<tr>
<td>11</td>
<td>GND</td>
<td>31</td>
<td>+5VDC</td>
</tr>
<tr>
<td>12</td>
<td>/JTAG_MODE_SEL</td>
<td>32</td>
<td>GND</td>
</tr>
<tr>
<td>13</td>
<td>MUTE</td>
<td>33</td>
<td>+12VDC</td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>34</td>
<td>GND</td>
</tr>
<tr>
<td>15</td>
<td>/RX_RESET</td>
<td>35</td>
<td>+12VDC</td>
</tr>
<tr>
<td>16</td>
<td>RX_MISO</td>
<td>36</td>
<td>GND</td>
</tr>
<tr>
<td>17</td>
<td>GND</td>
<td>37</td>
<td>-12VDC</td>
</tr>
<tr>
<td>18</td>
<td>RX_MOSI</td>
<td>38</td>
<td>GND</td>
</tr>
<tr>
<td>19</td>
<td>UDC_SPARE_6</td>
<td>39</td>
<td>+24VDC</td>
</tr>
<tr>
<td>20</td>
<td>GND</td>
<td>40</td>
<td>GND</td>
</tr>
</tbody>
</table>

**WARNING:** Disconnect primary power prior to servicing.
4.7 Signal Processing Board Overview

The signal processing board serves as a motherboard for the UEP exciter. The board interfaces to all the boards in the exciter.

The signal processing board also serves as the ASI input and output decoder and encoder, the modulator, the digital precorrector (RTAC circuit for digital modulation modes), and it contains the ADC and DAC interfacing to the up / down converter board. The signal processing board interfaces to the transmitter I/O Interface board, the analog input option board, the up / down converter board, the PFRU board, the front panel, and the LVPS.

Power for the signal processing board is derived from the LVPS, which delivers +5Vdc, +12Vdc, -12V, and +24Vdc. All other voltages necessary for the signal processing board are derived from these inputs. All boards within the exciter receive their power through the signal processing board.

Monitoring of the power supplies and ambient temperature are performed by the uC module, which is a daughter board mounted on the top right rear corner of the signal processor board. The uC module also initiates offline tests requested by the user, such as memory tests, serial channel loop back, predefined board level tests, and predefined exciter tests.

4.7.1 ASI / SMPTE 310 Inputs / Output

The modulator FPGA decodes the four transport stream inputs and modulates the active input stream with the selected standard. Transformers are used on the input of the ASI data for common mode rejection. Cable equalization circuitry is also used. The ASI inputs to the FPGA are at LVDS levels.

Input choices are shown below, rear panel connectors are shown to the right.

- ASI 1/HP 1 (top left connector)
- ASI 2/LP 1 (top right connector)
- SMPTE (310) 1/HP 2 (bottom left connector)
- SMPTE (310) 2/LP 2 (bottom right connector)

The modulator FPGA also provides an ASI monitor output. The ASI monitor output is at LVDS levels from the FPGA. It is then utilized an LVDS driver and transformer per the ASI specification.

The DUC FPGA is responsible for taking the modulated data and applying correction to it. The DUC FPGA output data is then transferred to the DAC to be converter to a 140 MHz IF, which is then up-converted to the on channel frequency.

4.7.1.1 DAC

The DUC writes the 16-bit I and Q data to the AD9779 DAC. The DAC will be clocked by the ~409 to 460 MHz clock from the PFRU. The 1/4 $F_{DAC}$ clock output of the DAC is used as a clock for the DUC FPGA and the RF Sample ADC. The DAC will provide the Up / Down Converter board with the 140MHz IF.
4.7.1.2 ADC

The AD9461 ADC will be clocked by the 1/4 FDAC clock. It will convert the 140 MHz IF from the down converter to a 16 bit sample provided to the DUC FPGA. The ADC will also provide the DUC FPGA with the Sample A/D clock.

4.8 Analog Input Board Overview

The analogue input board (AIB) is an option in the Harris APEX-M2X exciter and serves as analogue front end for main / aux video and main / aux audio signals. In addition it provides a composite audio input (BTSC system) and a video sync output (back porch pulses).

Video signals are conditioned and digitized with 12 bit resolution at 36.4 MHz sample rate, audio data are provided by 24 bit stereo audio ADC’s and the BTSC input signal is digitized with an 16 bit ADC. The clock signal for the audio ADC’s is provided by a PLL locked to the system clock of 36.4 MHz, which itself is locked to the exciter’s 10MHz reference.

For NICAM sound systems the aux audio inputs are used for modulating the NICAM carrier, whereas the main audio input data are fed to the analogue FM modulator.

4.9 DAB ETI Input Board

The M2X DAB modulation system requires the ETI Input Option board, part number 901-0215-211G, to be installed in the Input Option slot, see Figure 1-1, APEX - M2X Exciter Rear Panel View With Analog Input Board., on page 1-2.

Most of the digital TV standards utilize ASI as the transport stream into the exciter. DAB utilizes ETI (Ensemble Transport Interface) to send the data from the ensemble provider to the transmission network provider. So the ETI Input Option board has the following:

- 2 ETI inputs to receive the transport stream
- An ETI Monitor output which multiplexes between the inputs
- Sync ETI test signal output, on SMA connector.
- Sync OFDM test signal output, on SMA connector.
- 2.048 MHz output, on SMA connector.

The ETI Input Option board receives the ETI signal, extracts clock and data information, and passes the clock and data to the Signal Processing Board Modulator FPGA. In addition, the ETI board provides a 32.768MHz VCXO clock reference used to synchronize the exciter to the selected input transport stream.

4.10 Transmitter I/O Panel Overview

The Transmitter I/O board provides the parallel interface to the transmitter. It is a plug in module to the exciter and can be easily adapted to new transmitter technology. The board contains all the digital I/O and analog I/O inputs and outputs necessary to interface the exciter to the transmitter.

This document describes the functional and physical architecture for the Transmitter I/O board in the UEP exciter.
4.10.1 Transmitter I/O Board

The Transmitter I/O board will interface directly to the Harris transmitters through a stacked 25 pin D sub connector. Harris standard UHF transmitters will interface through a 25 position male D sub connector.

Alarm interfaces will also be available on the 25 position female D sub. The pin out of both these connectors is given in Section 1.7.1, Transmitter I/O Board Option Connectors on page 1-8.

The interface to VHF and analog transmitters will also utilize signals available on the 25 position female D sub connector, but a VHF to UHF Transmitter Interface Adaptor Cable is needed. Information concerning the adaptor cable is given in Section 4.10.4, VHF to UHF Transmitter Interface Adaptor Cable, on page 4-22.

Figure 4-12 Transmitter I/O Board Block Diagram

4.10.2 Analog Input A/D

Four analog inputs are provided on the Transmitter I/O board. Inputs are scaled 0 – 4.095Vdc. Channels 1 – 4 of the AD7888 A/D will be used for Analog Inputs 0 – 3 respectively. After decoding the Analog Input A/D register address the contents of the CPLD SPI bus will be routed directly to and from the AD7888.

Table 1: I/O Interface Specification

<table>
<thead>
<tr>
<th>Specification</th>
<th>Condition</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital I/O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Input</td>
<td>Digital output</td>
<td>-3.3Vdc to +15Vdc</td>
</tr>
<tr>
<td>Vih = 3.5Vdc min</td>
<td>3.3mA sink</td>
<td></td>
</tr>
<tr>
<td>Voh = 2.4Vdc min</td>
<td>2mA source</td>
<td></td>
</tr>
<tr>
<td>Vil = 1.35Vdc max</td>
<td>20mA sink</td>
<td></td>
</tr>
<tr>
<td>Vol = 1.1Vdc max</td>
<td>0.3Vdc to 15Vdc</td>
<td></td>
</tr>
<tr>
<td>Analog Out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5Vdc</td>
<td>2Kohm load min</td>
<td></td>
</tr>
<tr>
<td>Analog In</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5Vdc</td>
<td>Input impedance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-2Kohm</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4-12 Transmitter I/O Board Block Diagram

4.10.2 Analog Input A/D

Four analog inputs are provided on the Transmitter I/O board. Inputs are scaled 0 – 4.095Vdc. Channels 1 – 4 of the AD7888 A/D will be used for Analog Inputs 0 – 3 respectively. After decoding the Analog Input A/D register address the contents of the CPLD SPI bus will be routed directly to and from the AD7888.
4.10.3 Power Supply

Power for the VHF External I/O board is received from the Signal Processing board. +5Vdc is utilized and regulated to +3.3V. The +12V will be available for customer use and will be fused at 0.2A.

4.10.4 VHF to UHF Transmitter Interface Adaptor Cable

The APEX-M2X exciter Transmitter I/O Board Option contains two 25 pin D sub connectors. The top (male) connector is the transmitter interface, and the bottom (female) is the user remote connector. Harris VHF transmitters have a 37 pin D sub connector for their transmitter interface.

An interface cable is available which has a 37 pin female D sub connector to connect to the VHF transmitter exciter control cable. This cable terminates in a female 25 pin D sub connector for the exciter transmitter I/O board top connector and a male 25 pin D sub connector for the bottom transmitter I/O connector.

Table 1-5, VHF To UHF Interface Cable, on page 1-10 lists the pinout for this interface cable.
5 Maintenance and Troubleshooting

This section is a maintenance and troubleshooting guide to the APEX-M2X exciter. Trouble shooting is to the board level only, if a board is defective it should be replaced.

5.1 Exciter Maintenance

The APEX-M2X exciter is screwed into the transmitter cabinet and sits on slides. The rear panel cables must be disconnected to slide the exciter out of the cabinet.

The air intake for the exciter is located on the left and right sides of the front panel. The air filters are located behind the front decorative cover. To replace the filters, or to access the exciter’s rack mounting screws, the decorative front cover must be removed.

The front cover is held in place by snap posts and can be removed. It must be removed to access the screws which secure the exciter to the cabinet. To remove the front cover, pull it straight out equally from both ends. If one side only is removed, so that the front panel swings out, it can damage the LEDs and the panel mounting posts. Reinstall the front panel by pushing it straight in from both sides. Figure 5-1 is a front view of the exciter with its cover in place. Figure 5-2 is a front view of the exciter with the front cover removed.

Figure 5-1 View of Front Panel With Door Open

Figure 5-2 View of Front Panel With Front Cover Removed
The top cover can be removed to provide access to the circuit boards, see Figure 5-4. This drawing provides the names and locations of the various circuit boards, the ribbon cable board interconnections, and the RF cabling of the exciter. Figure 5-5 shows the connections between the rear panel transport stream input connectors and the Signal Processor board.

The exciter consists of 9 circuit boards, which are as follows.

- Signal Processor Board.
- Precise Frequency Reference Unit Board.
- Up Down Converter Board.
- Power Supply and Low Voltage Distribution Board.
- Battery Backup Option Board.
- Front Panel LED and Switch Board.
- Transmitter I/O Interface Board option, piggy backed under the right rear side of the signal processor board. This board can be inserted and removed through the rear panel of the exciter.
- Analog Transmitter (Video) Input Board option, piggy backed under the left rear side of the signal processor board. This board can be inserted and removed through the rear panel of the exciter.
- Analog Audio Input Board option, piggy backed under the analog transmitter (video) input board. This board can be inserted and removed through the rear panel of the exciter.

Figure 5-6 shows the rear panel of the exciter with its connectors.
WARNING: Disconnect primary power prior to servicing.

Figure 5-4 Top View of Exciter Showing Interconnection RF and Ribbon Cables
WARNING: Disconnect primary power prior to servicing.

Figure 5-5  *Top and Rear Inside View Showing Transport Stream Connections*

Inside view of rear panel transport stream input connectors.

Figure 5-6  *APEX-M2X Exciter Rear Panel View*

Rear Panel View.JPG (550 dpi)

Transmitter I/O Option Board

Analog Input Board (AIB) option
5.1 Cleaning

Occasionally the circuit boards of the exciter will need cleaning. All precaution against static should be observed. The technician should be grounded, either through conductive shoes or through a static grounding strap.

The exciter should be powered down before the cleaning process is started. A vacuum cleaner should be used to remove dust from the assemblies. A natural bristle brush with a metal band and a wooden handle (needed to ground static electricity) can be used to dislodge dust. A vacuum cleaner hose can develop static due to the air rushing through the hose. The hose should have a metal nozzle, which should be grounded.

Do not use compressed air to blow dirt from the exciter because the dirt will just settle back down on something else. Also, the fast moving air could damage or dislodge delicate circuit board components, and it could also accentuate static problems.

5.2 ISP (In Service Programming)

The ISP (In Service programming) function is used to load several types of software into the exciter, including:

- Loading new software into the exciter, see Section 5.2.1 on page 5-5.
- Uploading the exciter configuration file onto a computer, see Section 5.2.3 on page 5-10.
- Restoring the exciter configuration from a file, see Section 5.2.4 on page 5-13.

5.2.1 Loading New Software Using ISP

NOTE: When loading DVB-T2 software, refer to Section 5.2.2 on page 5-9 before starting this procedure

The APEX-M2X exciter software must be occasionally reloaded to update the software to the latest revision, or if the signal processor board has been changed and contains an incorrect version.


When the software file is obtained and saved on your computer, use the following instructions to load the software into the exciter.

1. Connect to the front or rear ethernet connector of the exciter. The front connector IP address is static and is set at 192.168.117.88.
   A Instructions for connecting directly to the exciter ethernet connectors or connecting through a network are giving in the following locations.
   • Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
   • Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4

2. When connection is completed, the APEX-M2X exciter login screen, shown in Figure 5-7, will appear.
   A Log in to the exciter.
3 In the home screen click the setup soft key located on the right side of the screen.
   A The Setup Navigation screen will appear
4 Click the ISP soft key located on the right side of the screen.
   A The In-System Programming screen, shown in Figure 5-8, left side, will appear.

5 In the ISP window, shown in Figure 5-8, left side, click on the browse button.
6 Navigate to the directory in which you stored the exciter software and select the exciter software file, see example in Figure 5-9.
7 When the correct file has been selected, click the Open soft key shown in Figure 5-9.
8 In the ISP window, shown in Figure 5-8, right side, click the Submit button.

9 The “Uploading File” message on the In-System Programming screen (1.3) will appear, as shown in Figure 5-10.
10 After several minutes, the screen shown in Figure 5-11, left side, will appear. Click the Program soft key.

A The warning screen shown in Figure 5-11, right side, will appear, click OK.

Module Program Software File.jpg (310) and Module Program Software File-A.jpg (450)

11 The Programming Flash screen, shown in Figure 5-12, will appear.

A This process will take from 5 to 20 minutes.

Programming Flash.jpg (310)
Once everything is complete the screen shown in Figure 5-13, left side, will appear and the exciter will reboot. The new code is now loaded.

A During the exciter reboot, the connection to the exciter will probably be lost, see Figure 5-13, right side. The connection to the exciter will have to be re-established.

After regaining connection to the exciter, check the Home > Status > Revisions > Software Revisions screen. The first entry, Build Version, should indicate a 10 digit part number, possibly followed by the modulation type, and ending with the revision level.

A For any modulation type, if the Build Version indicates Custom, there is an error in the software and it should be reloaded.

B For DVB-T2, if the message reads UPDATE NOT COMPLETE, it indicates that part 1 of the software is loaded but part two has not yet been loaded.

This completes the software download process.

First load the APEXM2X_DVBT2_REVU_1.s19 file, following the instructions in Section 5.2.1 on page 5-5.

After loading the DVB-T2 part 1 file, the Software Revisions screen, shown in Figure 5-14, displays the “Build Version UPDATE NOT COMPLETE message.

Next, load the APEXM2X_DVBT2_REVU_2.s19 in order to complete the download, following the instructions in Section 5.2.1 on page 5-5.

The DVB-T software download is now complete.

5.2.2 Loading DVB-T2 Software

This software contains two files, which must be downloaded sequentially. The last part of the file name will be REVX_1.s19 for the first part of the software and REVX_2.s19 for the second part. X stands for the revision level of the software, which can range from A to Z and then AA to AZ and etc.

First load the APEXM2X_DVBT2_REVU_1.s19 file, following the instructions in Section 5.2.1 on page 5-5.

After loading the DVB-T2 part 1 file, the Software Revisions screen, shown in Figure 5-14, displays the “Build Version UPDATE NOT COMPLETE message.

Next, load the APEXM2X_DVBT2_REVU_2.s19 in order to complete the download, following the instructions in Section 5.2.1 on page 5-5.

The DVB-T software download is now complete.
5.2.3 Uploading an Exciter Configuration File

The config (configuration) file contains all of the exciter’s setup information for the modulating system installed.

The config file can be saved in case of a problem with the exciter. The config file can be loaded, via ISP, to an exciter at a later date to restore it to the saved configuration. Another exciter can be “cloned” by using ISP to load the configuration file into it. That exciter will then act the same as the exciter that was the source of the config file. The instructions to save the exciter configuration to a file are given below, and the instructions to reload the exciter configuration from a saved file back to an exciter are given Section 5.2.4 on page 5-13.

5.2.3.1 Saving Exciter Configuration to a File

The procedure for saving the exciter configuration to a file is listed below.

1. Connect to the front or rear ethernet connector of the exciter. The front connector IP address is static and is set at 192.168.117.88.
   A. Instructions for connecting directly to the exciter ethernet connectors or connecting through a network are giving in the following locations.
      • Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
      • Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4.
2. When connection is completed, the APEX-M2X exciter login screen, shown in Figure 5-7, will appear.
A Log in to the exciter.

3 In the home screen, click the setup soft key located on the right side of the screen.

4 In the setup screen, click the ISP soft key located on the right side of the screen.

A The In-System Programming screen, shown in Figure 5-8 will appear.

5 In the In-System Programming screen, click the Save Settings button on the right side of the screen.

6 This should launch a new window, shown in Figure 5-15. It is an “s19” file which contains the contents of the EEPROM.

7 Click “File”, then click “Save As”. The location and file name can be set by the user, see example in Figure 5-16.

A Incase configuration files from several exciters are to stored on your PC, a unique file name can be used to identify the configuration file, as long as the extension (S19) is not changed. That file, with its unique name will reload into an exciter with no problems.

8 When the file location and name have been entered, click the save soft key shown in Figure 5-16.
WARNING: Disconnect primary power prior to servicing.

Figure 5-16  Location Where Configuration File Is To Be Saved

9 A copy of the EEPROM is now stored on your PC.
5.2.4 Restoring Exciter Configuration From a File

The procedure for restoring the exciter configuration from a stored file is listed below.

1. In the home screen, click the setup soft key located on the right side of the screen.
2. In the setup screen, click the ISP soft key located on the right side of the screen.
   A. The ISP window, shown in Figure 5-17, will appear.
3. In the ISP window, click on the “Browse” button.

![Figure 5-17 ISP (In Service Programming) Window](image)

4. Navigate to the directory in which you stored the exciter configuration and select the
   exciter configuration file, see example in Figure 5-18.
5. When the correct file has been selected, click the Open soft key shown in Figure 5-18.
   A. Configuration file name was originally named eeprom.s19, but that name
      may have been changed if several configuration files were stored. There is
      no need to change the file name, it will successfully load as long as the s19
      extension has not been changed.
Figure 5-18  Location of Exciter Configuration File

6 When the ISP window, shown in Figure 5-17, appears click the Submit button.

7 The “Uploading File” message on the In-System Programming screen will appear, as shown in Figure 5-19.

Figure 5-19  Uploading File Screen
8  When the In-System Programming screen appears with the “Program” message, as shown in Figure 5-20, click the Program soft key.

![Module Program Config File.jpg](image1)

**Figure 5-20  Module Programming Screen**

9  In about five minutes, the exciter screen shown in Figure 5-21 will appear. It states the programming is complete and the exciter is rebooting.

   A  During the exciter reboot, the connection to the exciter probably will be lost, and the connection to the exciter will have to be reestablished.

![Rebooting Exciter.jpg](image2)

**Figure 5-21  Rebooting Exciter Message**

10  The exciter should now use the new settings that were just downloaded.
## 5.3 Recovery From A Crashed Or Incomplete Software Download

Occasionally, during a software download, a power bump or other form crash may occur. If this happens, it will be impossible to connect to the exciter in the normal manner. In that case, the exciter bootloader’s ethernet downloader will have to be used. The bootloader is located in a protected area of flash so unless something truly catastrophic happened the bootloader should always be resident.

1. Open a web browser and type in the appropriate IP address followed by /ISP.
   A. Use the static IP from the front panel or network setting of the rear IP port, which may have been previously configured.
      1. Example, using the front panel address:
         192.168.117.88/isp
      2. The In-System Programming (ISP) screen will appear, see Figure 5-22.
   B. For assistance in concerning connecting to the exciter via ethernet:
      1. Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
      2. Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4.

The complete software can be downloaded again using the screen in shown in Figure 5-22.

## 5.4 Exciter Screen Captures

Exciter GUI screens can easily be captured using the Alt - Print Screen keys. The procedure is as follows.

1. Connect a computer to the exciter.
2. Select the screen to be captured.
3. Press and hold the Alt key while pressing the print screen key.
   A. Earlier Windows programs copied the captured screen to the clipboard.
   B. The Windows XP program opens a window which offers many choices including copying the captured screen to the clipboard or saving it as a file to a specified directory.
4 It may be necessary to change the computer screen resolution if a portion of the exciter GUI screen is cut off when it is captured.
5 If desired, the captured screen may be edited, using a user supplied program, to remove the undesired information which surrounds the captured screen.

5.5 Date and Time Battery

A 10mm 1025 coin cell date and time battery (Harris P/N: 6600093000) was used on M2X exciters which contain revisions A or B of 9010215181G and all revisions of 9010215011G Signal Processing boards.

To increase the hold over time of the real time clock in the M2X exciter, the date and time battery was updated to a CR2025 (Harris P/N: 6600068000) on revision C or greater of Signal Processing boards 9010215181G.

The new battery will allow the exciter to hold up the real time clock for 1600 days of AC off time. The battery is not used when the system has AC power applied.

5.5.1 Changing Date and Time Battery

1 Remove power from the exciter.
2 If exciter is in the transmitter, remove it and set it on a bench.
3 Remove the top cover.
4 Remove old battery and insert new battery with positive side up.
   A Battery slides out for under the clip, see Figures 5-23 and 5-24 for battery location.
5 Replace top of exciter and remount it in the transmitter.
6 Continue on to the next section to set the time and date.

The part number for the date and time battery is 660-0093-000.

5.5.2 Setting Date and Time After Battery Replacement

The date and time must be set in the exciter after the date and time battery has been installed. Use the following procedure to set the date an time.

1 Log in to the exciter using the front or rear ethernet connectors.
2 In the Exciter Home > Setup > Next > System Setup 2 screen, click in each box.
   A Use the computer’s keyboard to type in the value for that box, then press enter.
   B Repeat step A for each box.
   C The date format is entered in month - day - year.
   D The time is entered in the 24 hour format but read in the 12 hour format.
      1. The date and time are shown on the System Setup 2 screen above the date and time entry boxes.
**Top View of Rear Half of APEX-M2X Exciter**

![Diagram of APEX-M2X Exciter](Date and Time Bat Wide.jpg)

**Figure 5-23 Top View of Rear Half of Exciter Showing Date and Time Battery Location**

![Image of Date and Time Battery Location](Date and Time Bat Wide.jpg)

**Figure 5-24 Date and Time Battery Location**

---

**WARNING:** Disconnect primary power prior to servicing.
5.6 DVB-T2 FPGA Expansion Board Installation

A DVB-T2 FPGA expansion board, part number 901-0215-155G, is needed to enable an M2X exciter to operate in the DVB-T2 modulation mode. Figure 5-25 shows a top view of the FPGA expansion board.

Figure 5-26 shows the bottom view of the FPGA expansion board. Notice the tape fastened to the bottom of the board. It is necessary to prevent the board connections from shorting out against the heat sync below it on the signal processor board.

**Note:** The DVB-T2 software must be installed in the exciter before the FPGA expansion board is installed. Software loading is covered in Section 5.2.1, Loading New Software Using ISP, on page 5-5.

Use the following procedure to install the FPGA expansion board in the M2X exciter.

1. Turn off exciter by disconnecting the AC power cord from the rear of the exciter.
2. Remove top cover of exciter. See Figure 5-27 for a view of the exciter with the top cover removed.
3. Use a #1 Phillips screwdriver to remove plastic cover that is above the signal processor board. The board or plastic cover is mounted within the white rectangle in Figure 5-27. This clear plastic cover is attached to the six standoffs that will hold the FPGA expansion board. Note: this plastic cover should be retained in case the expansion board is removed later. Either the expansion board or the plastic cover must be installed during M2X operation in order to properly cool the FPGA.
4. Install the FPGA expansion board. See Figures 5-25 and 5-27. The board only fits on the standoffs in one position. The connectors on the back side of the expansion board must be aligned with and inserted into the connectors on the signal processor board. **CAUTION:** The back side of the FPGA expansion board must include a plastic shield in order to prevent pins from shorting out on the heat sink which lies below it. See Figure 5-26 for a view of the board with the tape attached.
5. Replace the top cover on the exciter.
WARNING: Disconnect primary power prior to servicing.

Figure 5-26  DVB-T2 FPGA Expansion Board, Bottom View
WARNING: Disconnect primary power prior to servicing.

Figure 5-27  DVB-T2 FPGA Expansion Board Mounted in Exciter
5.7 Fault Log Screen

The web browser can be used to access a listing of faults (both current and previous). The Fault Log access soft key can be found on the Exciter Home Screen and on the Status Navigation Screen. The Fault Log screen is shown in Figure 5-28.

Each fault log entry has the following parts:

- **Set** - This entry gives the time (24 hour format) and date (month, day, year) that the fault occurred.
- **Clear** - This give the time and date the fault was cleared, this entry will not be shown if the fault has not been cleared.
- **Name** - This entry gives the name and description of the fault.

The fault log can hold up to 500 faults, then it is FIFO (First In, First Out).

Pressing the Active Faults soft key causes only the active faults to be displayed.

From the Active Faults screen, pressing the All Faults soft key will display both the previous faults and the active faults.

Next page and previous page allows the other faults in the fault log to be displayed.

Active warnings are highlighted yellow, active faults are highlighted red, inactive warnings and faults have a grey background.

Fault logs can be exported from the exciter. The Export Flt (fault) soft key is located in the Status Navigation Screen and is discussed in Section 5.8, Export Fault Log, on page 5-22.

The fault log can be reset, eliminating the displayed faults, by pressing the Reset Log soft key.

5.8 Export Fault Log

The method of exporting a fault log is as follows.

1. In the Home > Status screen press the Export Flt Log soft key.
   A. The fault log appears as a spread sheet.
5.9 Fault Tables

The following tables provide a listing of Maxiva Transmitter faults along with a brief description, the fault level or threshold and the action taken by the transmitter.

### Table 5-1 UDC (Up Down Converter) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upconverter Not Alive</td>
<td>Indicates up/down converter in known good state</td>
<td>System and Mute LEDs red.</td>
<td>Data pattern written/read over SPI matches</td>
<td>Data pattern written/read over SPI does not match</td>
<td>Set fault and mute RF.</td>
<td>Status/U DC</td>
</tr>
<tr>
<td>Upconverter IF level</td>
<td>Indicates up/down converter IF level is out of range</td>
<td>Mute LED red. System and Mute LEDs red.</td>
<td>CW:875 Normal: 775</td>
<td>CW: &lt;793, &gt;957 Normal: &lt;693, &gt;857 Exception for ATSC pilot</td>
<td>Set fault and mute RF.</td>
<td>Status/U DC</td>
</tr>
<tr>
<td>Upconverter LO level</td>
<td>Indicates up/down converter LO level is out of range high</td>
<td>System and Mute LEDs red.</td>
<td>2345</td>
<td>&gt;2427</td>
<td>Set fault and mute RF.</td>
<td>Status/U DC</td>
</tr>
<tr>
<td>Upconverter LO Level</td>
<td>Indicates up/down converter LO level is out of range low</td>
<td>System and Mute LEDs red.</td>
<td>2345</td>
<td>&lt;2222</td>
<td>Set fault and mute RF.</td>
<td>Status/U DC</td>
</tr>
<tr>
<td>Upconverter RF Atten Out of Range</td>
<td>RF atten is out of range high</td>
<td>System LED red.</td>
<td>RF atten is within range (RF atten = 4095)</td>
<td>Set fault.</td>
<td>Status/U DC</td>
<td></td>
</tr>
<tr>
<td>Upconverter RF Atten Out of Range</td>
<td>RF atten is out of range low</td>
<td>System LED red.</td>
<td>RF atten is within range (RF atten = 0)</td>
<td>Set fault.</td>
<td>Status/U DC</td>
<td></td>
</tr>
<tr>
<td>Upconverter ALC Atten Threshold Unlock</td>
<td>RF level is below Low Calibration Point, and RF Atten calculated for ALC error is greater than or equal to the High Calibration Point. Possible cause: Invalid Forward Power Sample</td>
<td>System LED red.</td>
<td>RF level is within 10dB nominal system power</td>
<td>RF level is below Low Calibration Point, and new RF Attenuator value calculated for current ALC error is at or above the DAC value for the High Calibration Point. (Low Calibration Point is 10dB below the nominal system power. High Calibration Point is equal to nominal power for Tx Model plus 1dB of headroom for filter loss.)</td>
<td>Set fault; ALC will freeze at current level (will not attempt to adjust power until fault clears)</td>
<td>Status/U DC</td>
</tr>
</tbody>
</table>
### Table 5-1 UDC (Up Down Converter) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upconverter Temperature Fault</td>
<td>UDC Over Temperature Fault</td>
<td>System and Mute LEDs red.</td>
<td>UDC Temperature below 75.0°C</td>
<td>UDC Temperature &gt;= 75.0°C. Fault will not clear until temperature goes below 70.0°C</td>
<td>Set fault; mute RF; disable the +20VDC supply to the UDC output amplifier</td>
<td>Status/UDC</td>
</tr>
<tr>
<td>Upconverter Temperature Warning</td>
<td>UDC Over Temperature Warning</td>
<td>System LED orange.</td>
<td>UDC Temperature equal to or less than 72.5°C</td>
<td>UDC Temperature &gt; 72.5°C. Warning will clear if Fault goes active.</td>
<td>Set warning.</td>
<td>Status/UDC</td>
</tr>
<tr>
<td>ALC Limit Reached</td>
<td>UDC ALC is limiting because UDC ADC level is 2dB or more above High Calibration Point.</td>
<td>System LED orange.</td>
<td>RF level is below limit threshold</td>
<td>UDC ADC value is 2dB or more over high calibration power level, and ALC is attempting to adjust RF Attenuator to a higher value than the current setting. (Detected power level is below forward power reference)</td>
<td>Set warning and do not allow ALC adjustments that result in a higher RF Attenu value than current setting. Adjustments that result in a lower RF Attenu setting are allowed.</td>
<td>Status/UDC</td>
</tr>
</tbody>
</table>
### Table 5-2 MODFPGA (Modulator Field Programmable Gate Array) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulator Not Alive</td>
<td>Indicates MOD FPGA is in known good state</td>
<td>System and Mute LEDs red.</td>
<td>Data pattern written/read over HPI matches</td>
<td>Data pattern written/read over HPI does not match</td>
<td>Set fault and mute RF.</td>
<td>Signal Processor</td>
</tr>
<tr>
<td>Modulator Temperature</td>
<td>Indicates MOD FPGA is over temperature</td>
<td>System and Mute LEDs red.</td>
<td>Over temperature less than 4 times. 85 C limit.</td>
<td>Over temperature 4 times (no time limit). 85 C limit</td>
<td>Set fault, mute RF, and erase MOD and DUC FPGAs.</td>
<td>Status/Sig Processor</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulator DAC Clock</td>
<td>Indicates DAC clock is present in MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>DAC clock detected</td>
<td>DAC clock is not detected</td>
<td>Set fault and mute RF.</td>
<td>Signal Processor</td>
</tr>
<tr>
<td>Modulator Sample Clock</td>
<td>Indicates MOD clock is present in MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>Modulator sample clock and 10 MHz internal clock edges are both detected</td>
<td>Either modulator sample clock or 10 MHz internal clock edges are not detected</td>
<td>Set fault and mute RF.</td>
<td>Signal Processor</td>
</tr>
<tr>
<td>Modulator 4X Sample</td>
<td>Indicates MOD clock x4 is present in MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>Modulator 4 x sample clock edges are detected</td>
<td>Modulator 4 x sample clock edges are not detected</td>
<td>Set fault and mute RF.</td>
<td>Signal Processor</td>
</tr>
<tr>
<td>Clock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulator 25MHz Clock</td>
<td>Indicates 25 MHz clock is present in MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>25 MHz clock edges are detected</td>
<td>25 MHz clock edges are not detected</td>
<td>Set fault and mute RF.</td>
<td>Signal Processor</td>
</tr>
<tr>
<td>Modulator 54MHz Clock</td>
<td>Indicates 54 MHz clock is present in MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>54 MHz clock edges are detected</td>
<td>54 MHz clock edges are not detected</td>
<td>Set fault and mute RF.</td>
<td>Signal Processor</td>
</tr>
<tr>
<td>Modulator User</td>
<td>Indicates user has forced mute from GUI</td>
<td>System and Mute LEDs red.</td>
<td>Mute not selected on GUI</td>
<td>Mute selected on GUI</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Force Mute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-3 MODFPGA Modulation Specific Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DVB (modulation specific)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASI 1 HP</td>
<td>Indicates error on ASI 1 HP in MOD FPGA for DVB</td>
<td>System LED red.</td>
<td>No errors</td>
<td>Input present: Uncorrected byte errors, Corrected byte errors, Buffer overflow, MIP errors ((CRC error OR MIP missing) AND (SFN or MFN AND MIP control))</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>ASI 1 LP</td>
<td>Indicates error on ASI 1 LP in MOD FPGA for DVB</td>
<td>System LED red.</td>
<td>No errors</td>
<td>Input present: Uncorrected byte errors, Corrected byte errors, Buffer overflow</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>ASI 2 HP</td>
<td>Indicates error on ASI 2 HP in MOD FPGA for DVB</td>
<td>System LED red.</td>
<td>No errors</td>
<td>Input present: Uncorrected byte errors, Corrected byte errors, Buffer overflow, MIP errors ((CRC error OR MIP missing) AND (SFN or MFN AND MIP control))</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>ASI 2 LP</td>
<td>Error on ASI 2 LP in MOD FPGA for DVB</td>
<td>System LED red.</td>
<td>No errors</td>
<td>Input present: Uncorrected byte errors, Corrected byte errors, Buffer overflow</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Fault Log Message</td>
<td>Fault Description</td>
<td>Front Panel LEDs</td>
<td>Nominal Value/Scaling</td>
<td>Trip Level</td>
<td>Action</td>
<td>Screen/Tab</td>
</tr>
<tr>
<td>----------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------</td>
<td>-----------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Modulator Illegal Config Mute</td>
<td>Indicates illegal DVB configuration parameters in MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>DVB configuration parameters valid</td>
<td>DVB-T: MFN mode: 8k FFT AND 8k interleaver, MIP control AND MIP bad AND no_mip_no_mute = false SFN mode: MIP bad, 8k FFT and 8k interleaver Storage time &lt; 0.5 us</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Modulator Illegal FFT/Interleaver</td>
<td>Indicates illegal combination of 8k FFT and 8k interleaver in DVB</td>
<td>System LED red.</td>
<td>FFT size of 8k is not used with 8k interleaver mode</td>
<td>FFT size of 8k is set with 8k interleaver mode AND ERRF.MODFPGA.CO NFIG.MUTE = true</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator DVB Storage Time &lt; 0.5</td>
<td>Indicates input storage time too low in DVB SFN mode</td>
<td>System LED red.</td>
<td>Storage time &gt; 0.5 us</td>
<td>Storage time &gt;0.5 us AND ERRF.MODFPGA.CO NFIG.MUTE = true</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator DVB MIP Packet Error</td>
<td>Indicates required MIP packet is bad in DVB</td>
<td>System LED red.</td>
<td>MIP packet is good</td>
<td>MIP packet bad on selected input AND ERRF.MODFPGA.CO NFIG.MUTE = true</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input Frame Timing Unsync</td>
<td>Indicates input circuit has not synchronized in DVB MOD FPGA</td>
<td>System and Mute LEDs red.</td>
<td>DVB MOD FPGA output processing reset line low</td>
<td>DVB MOD FPGA output processing reset line high</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input A</td>
<td>Indicates input A is present in MOD FPGA. ATSC ASI HPA</td>
<td>System LED red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input A selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input C</td>
<td>Indicates input C is present in MOD FPGA. ATSC ASI LPB</td>
<td>System LED red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input C selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input B</td>
<td>Indicates input B is present in MOD FPGA. ATSC SMPTE A</td>
<td>System LED red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input B selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input D</td>
<td>Indicates input D is present in MOD FPGA. ATSC SMPTE B</td>
<td>System LED red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input D selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-3 MODFPGA Modulation Specific Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulator Input Signal Loss</td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>DVB-T: SFN mode AND hierarchy: Auto switch mode: HP or LP bad on both ASI 1 and ASI 2, Manual switch mode: HP or LP bad on selected input, SFN mode AND non-hierarchy: Auto switch mode: HP bad on both inputs, Manual switch mode: HP bad on selected input</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Modulation Mute</td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>DVB-T: Mute bit set in MOD FPGA</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>FLO (modulation specific)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>MUTE: PFRU Outside SFN Limit</td>
<td>Error of PFRU 1 pps relative to reference is too large</td>
<td>System LED red.</td>
<td>Error of 1 pps is within user limit (from GUI)</td>
<td>Error of 1 pps is above user limit (from GUI) AND SFN mode</td>
<td>Set fault.</td>
<td>Set fault.</td>
</tr>
<tr>
<td>MUTE: PFRU 1 PPS Missing</td>
<td>Required 1 pps reference is missing</td>
<td>System LED red.</td>
<td>1 PPS reference is present</td>
<td>Selected 1 PPS reference is missing (external or from GPS) AND automute = true AND SFN mode</td>
<td>Set fault.</td>
<td>Set fault.</td>
</tr>
<tr>
<td>MUTE: Holdover Timeout</td>
<td>Flywheel timeout exceeded</td>
<td>System LED red.</td>
<td>Within flywheel Timeout</td>
<td>(Flywheel time is above user limit (from GUI) or never disciplined) AND automute = true AND SFN mode</td>
<td>Set fault.</td>
<td>Set fault.</td>
</tr>
<tr>
<td>MUTE: Modulator Fatal Error</td>
<td>FPGA fatal error</td>
<td>System LED red.</td>
<td>FPGA fatal error bit not set</td>
<td>FPGA fatal error bit set AND automute = true AND SFN mode</td>
<td>Set fault.</td>
<td>Set fault.</td>
</tr>
<tr>
<td>MUTE: Modulator Core Stall</td>
<td>FPGA core stall</td>
<td>System LED red.</td>
<td>FPGA core stall bit not set</td>
<td>FPGA core stall bit set AND automute = true AND SFN mode</td>
<td>Set fault.</td>
<td>Set fault.</td>
</tr>
<tr>
<td>MUTE: SFN FIFO Sequence/Parity Error</td>
<td>FPGA SFN FIFO sequence or parity error</td>
<td>System LED red.</td>
<td>FPGA SFN FIFO sequence error and parity error bits not set</td>
<td>FPGA SFN FIFO sequence error or parity error bits set AND automute = true</td>
<td>Set fault.</td>
<td>Set fault.</td>
</tr>
</tbody>
</table>
### Table 5-3 MODFPGA Modulation Specific Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scalings</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUTE: SFN Buffer Underflow/Overflow</td>
<td>FPGA SFN FIFO overflow</td>
<td>System LED red.</td>
<td>FPGA SFN FIFO overflow or underflow bits not set</td>
<td>FPGA SFN FIFO overflow bit set AND automute = true</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>MUTE: SFN Buffer Underflow/Overflow</td>
<td>FPGA SFN FIFO underflow</td>
<td>System LED red.</td>
<td>FPGA SFN FIFO overflow or underflow bits not set</td>
<td>FPGA SFN FIFO underflow bit set AND automute = true</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>MUTE: Modulator Requested Mute</td>
<td>FPGA Modulator Requested Mute</td>
<td>System LED red.</td>
<td></td>
<td>(Modulator FPGA over 80 C OR Temperature reading error) AND ERRF_MODFPGA_FP GA_TEMP = false</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>Modulator Temperature Warning</td>
<td>Modulator FPGA Temperature over limit</td>
<td>System LED orange.</td>
<td>Modulator FPGA temperature less than 80 degrees C</td>
<td></td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>Modulator PRBS Enabled</td>
<td>Modulator FPGA PRBS mode enabled</td>
<td>System LED orange.</td>
<td>PRBS not enabled from GUI</td>
<td>PRBS enabled from GUI</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>Modulator Special Test Flag Enabled</td>
<td>Modulator FPGA special test mode enabled</td>
<td>System LED orange.</td>
<td>Special tests not enabled from GUI</td>
<td>Special tests sync or spectral null enabled from GUI</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input A</td>
<td>Indicates input A is present in MOD FPGA. ATSC ASI HPA</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input A selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input C</td>
<td>Indicates input C is present in MOD FPGA. ATSC ASI LPB</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input C selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input B</td>
<td>Indicates input B is present in MOD FPGA. ATSC SMPTE A</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input B selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input D</td>
<td>Indicates input D is present in MOD FPGA. ATSC SMPTE B</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input D selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input Signal Loss</td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>FLO:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-3 MODFPGA Modulation Specific Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation Mute</td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>FLO: Software initiated on start, (PRBS = false) AND (FLO_MUTE = false) AND ((MOD FPGA mute bit = true) OR (SFN limit error = true) OR (Mute delay error = true))</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>DAB (modulation specific)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulator No Timestamp (FF FFFF)</td>
<td>Indicates timestamp is missing on valid input 1</td>
<td>System LED red.</td>
<td>Timestamp is present</td>
<td>Input is present, but timestamp is missing on input 1</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator No Timestamp (FF FFFF)</td>
<td>Indicates timestamp is missing on valid input 2</td>
<td>System LED red.</td>
<td>Timestamp is present</td>
<td>Input is present, but timestamp is missing on input 2</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator PFRU Undisciplined</td>
<td>Indicates PFRU PLL is not disciplined for DAB</td>
<td>System LED red.</td>
<td>PFRU PLL is disciplined</td>
<td>PLL is undisciplined AND dynamic delay on AND PLL bypass off</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Modulator Unresolved ETI Timing</td>
<td>Indicates ETI timing unresolved</td>
<td>System LED red.</td>
<td>Current input = correct input</td>
<td>Current input = wrong input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>DAB: ETI Missing</td>
<td>DAB ETI input missing</td>
<td>System LED orange.</td>
<td>ETI input 1 and 2 present</td>
<td>ETI input 1 OR ETI input 2 missing</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>DAB: Seamless Not Possible</td>
<td>DAB Seamless switching not possible</td>
<td>System LED orange.</td>
<td>Total delay of input 1 and 2 are equal, Status of input 1 and 2 are equal</td>
<td>(total delay of input 1 and 2 are not equal) OR dynamic delay mode on AND (input status 1 and 2 are not equal)</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>Modulator Input Signal Loss</td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>DAB:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Modulation Mute</td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>DAB: Software initiated on reset, Mute bit set in MOD FPGA</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>CTTB (modulation specific)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulator Input A</td>
<td>Indicates input A is present in MOD FPGA. ATSC ASI HPA</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input A selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-3 MODFPGA Modulation Specific Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modulator Input C</strong></td>
<td>Indicates input C is present in MOD FPGA. ATSC ASI LPB</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input C selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input B</strong></td>
<td>Indicates input B is present in MOD FPGA. ATSC SMPTE A</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input B selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input D</strong></td>
<td>Indicates input D is present in MOD FPGA. ATSC SMPTE B</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input D selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input Signal Loss</strong></td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>CTTB: SFN mode AND unmute_nosip = false AND selected input not present</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulation Mute</strong></td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>CTTB:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>

### ATSC (modulation specific)

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modulator Input A</strong></td>
<td>Indicates input A is present in MOD FPGA. ATSC ASI HPA</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input A selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input C</strong></td>
<td>Indicates input C is present in MOD FPGA. ATSC ASI LPB</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input C selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input B</strong></td>
<td>Indicates input B is present in MOD FPGA. ATSC SMPTE A</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input B selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input D</strong></td>
<td>Indicates input D is present in MOD FPGA. ATSC SMPTE B</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input D selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input Signal Loss</strong></td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>ATSC:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulation Mute</strong></td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>ATSC:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>
### ISDB-T (modulation specific)

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modulator Input A</strong></td>
<td>Indicates input A is present in MOD FPGA. ATSC ASI HPA</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input A selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input C</strong></td>
<td>Indicates input C is present in MOD FPGA. ATSC ASI LPB</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input C selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input B</strong></td>
<td>Indicates input B is present in MOD FPGA. ATSC SMPTE A</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input B selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input D</strong></td>
<td>Indicates input D is present in MOD FPGA. ATSC SMPTE B</td>
<td>System LED red. TS Input LED yellow or red.</td>
<td>MPEG sync indicator = 1</td>
<td>MPEG sync indicator = 0 AND input D selected for primary or auxiliary input</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulator Input Signal Loss</strong></td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>ISDB-T:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulation Mute</strong></td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>ISDB-T:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>

### Analog (modulation specific)

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modulator Input Signal Loss</strong></td>
<td>Indicates required inputs are not present in MOD FPGA.</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Relevant inputs present.</td>
<td>Analog:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td><strong>Modulation Mute</strong></td>
<td>Indicates modulator FPGA has muted</td>
<td>System and Mute LEDs red.</td>
<td>Depends on modulation standard. Modulator not muted, other conditions ok</td>
<td>Analog:</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-4 EXT I/O & DUC Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXT I/O</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External IO Not Alive</td>
<td>Indicates external input option board is in known good state</td>
<td>System LED red.</td>
<td>Data pattern written/read over SPI matches</td>
<td>Data pattern written/read over SPI does not match AND Initial check did match</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Digital Upconverter Not Alive</td>
<td>Indicates digital upconverter FPGA is in known good state</td>
<td>System and Mute LEDs red.</td>
<td>Data pattern written/read over HPI matches</td>
<td>Data pattern written/read over HPI does not match</td>
<td>Set fault and mute RF.</td>
<td>Status/Sig Processor</td>
</tr>
<tr>
<td>Digital Upconverter Temperature</td>
<td>Indicates digital upconverter FPGA is over temperature</td>
<td>System and Mute LEDs red.</td>
<td>Over temperature less than 4 times. 85 C limit.</td>
<td>Over temperature 4 times (no time limit). 85 C limit</td>
<td>Set fault, mute RF, and erase MOD and DUC FPGAs.</td>
<td>Status/Sig Processor</td>
</tr>
<tr>
<td>Digital Upconverter Input Signal Zero</td>
<td>DUC input signal level is very low</td>
<td>System and Mute LEDs red.</td>
<td>RMS of signal greater than 0.1 (full scale = +/- 1.0) 5 times in a row (1 second interval)</td>
<td>RMS of signal less than 0.1 (full scale = +/- 1.0)</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Digital Upconverter Temperature Warning</td>
<td>DUC FPGA temperature over limit</td>
<td>UAX: System LED orange.</td>
<td>DUC FPGA temperature less than 80 degrees C</td>
<td>(DUC FPGA over 80 C OR Temperature reading error) AND ERRF_DUC_FPGA_TEMP = false</td>
<td>Set warning.</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5-5 DSP (Digital Signal Processor) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive Correction Linear</td>
<td>DSP reports HPF feedback invalid (required for linear RTAC)</td>
<td>System LED red.</td>
<td>DSP reports HPF feedback ok.</td>
<td>DSP reports HPF feedback invalid.</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Adaptive Correction Nonlinear</td>
<td>DSP reports HPA feedback invalid (required for non-linear RTAC)</td>
<td>System LED red.</td>
<td>DSP reports HPA feedback ok.</td>
<td>DSP reports HPA feedback invalid.</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Adaptive Correction Linear RF Level High</td>
<td>RF attenuator level is too high for linear</td>
<td>System LED red.</td>
<td>RF attenuator level &lt; 100%</td>
<td>RF attenuator level &gt; 100%</td>
<td>Set fault.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-5 DSP (Digital Signal Processor) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive Correction Nonlinear RF Level High</td>
<td>RF attenuator level is too high for non-linear</td>
<td>System LED red.</td>
<td>RF attenuator level &lt; 100%</td>
<td>RF attenuator level &gt; 100%</td>
<td>Set fault.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Adaptive Correction Linear RF Level Low</td>
<td>RF attenuator level is too low for linear</td>
<td>System LED orange.</td>
<td>RF attenuator level &gt; 60%</td>
<td>RF attenuator level &lt; 60%</td>
<td>Set warning.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Adaptive Correction Nonlinear RF Level Low</td>
<td>RF attenuator level is too low for non-linear</td>
<td>System LED orange.</td>
<td>RF attenuator level &gt; 60%</td>
<td>RF attenuator level &lt; 60%</td>
<td>Set warning.</td>
<td>Status/PFRU</td>
</tr>
</tbody>
</table>

### Table 5-6 PFRU (Precise Frequency Reference Unit) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Ref. Not Alive</td>
<td>Indicates PFRU is in known good state</td>
<td>System and Mute LEDs red.</td>
<td>Data pattern written/read over HPI matches and board ID is correct</td>
<td>Data pattern written/read over HPI does not match or board ID is not correct</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Frequency Ref. External 1PPS</td>
<td>External 1 pps is not present when it is required</td>
<td>System and Mute LEDs red.</td>
<td>External 1pps present</td>
<td>SFN mode and external 1pps not present when selected as reference</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Frequency Ref. External 10MHz</td>
<td>External 10 MHz is not present when it is required</td>
<td>System and Mute LEDs red.</td>
<td>External 10 MHz present</td>
<td>SFN mode and external 10 MHz not present when selected as reference</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Frequency Ref. GPS 1PPS</td>
<td>1pps from internal GPS is not present when it is required</td>
<td>System and Mute LEDs red.</td>
<td>1pps from internal GPS present</td>
<td>SFN mode and 1pps from internal GPS not present when selected as reference</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Frequency Ref. IF LO PLL Not Locked</td>
<td>PFRU DAC PLL lock state</td>
<td>System and Mute LEDs red.</td>
<td>DAC PLL lock bit from PFRU FPGA set</td>
<td>DAC PLL lock bit from PFRU FPGA not set</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Frequency Ref. RF LO PLL Not Locked</td>
<td>PFRU RF PLL lock state</td>
<td>System and Mute LEDs red.</td>
<td>RF PLL lock bit from PFRU FPGA set</td>
<td>RF PLL lock bit from PFRU FPGA not set</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
<tr>
<td>Frequency Ref. PLL Undisciplined</td>
<td>Selected reference for 10 MHz OCXO missing in DAB mode</td>
<td>System and Mute LEDs red.</td>
<td>Reference present</td>
<td>SFN mode and selected reference not present</td>
<td>Set fault and mute RF.</td>
<td>Status/PFRU</td>
</tr>
</tbody>
</table>
### Table 5-6  PFRU (Precise Frequency Reference Unit) Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Ref. 1PPS</td>
<td>External 1 pps is not present</td>
<td>System LED orange</td>
<td>External 1 pps present</td>
<td>External 1 pps not present when selected as reference</td>
<td>Set warning</td>
<td></td>
</tr>
<tr>
<td>Frequency Ref. 10MHz</td>
<td>External 10 MHz is not present</td>
<td>System LED orange</td>
<td>External 10 MHz present</td>
<td>External 10 MHz not present when selected as reference</td>
<td>Set warning</td>
<td></td>
</tr>
<tr>
<td>Frequency Ref. GPS 1PPS</td>
<td>1pps from internal GPS is not present</td>
<td>System LED orange</td>
<td>1pps from internal GPS present</td>
<td>1pps from internal GPS not present when selected as reference</td>
<td>Set warning</td>
<td></td>
</tr>
<tr>
<td>Frequency Ref. PLL Undisciplined</td>
<td>Selected reference for 10 MHz OCXO missing in DAB mode</td>
<td>System LED orange</td>
<td>Reference present</td>
<td>Selected reference not present</td>
<td>Set warning</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5-7  MCU & SYS Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCU</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Control application update count near limit.</td>
<td>Warning when number of copies of application code is exceeded</td>
<td>System LED orange</td>
<td>Copies &lt; 105</td>
<td>Copies &gt; 105</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td><strong>SYS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSTEM +1.4VDC</td>
<td>Fault if over voltage</td>
<td>System LED red.</td>
<td>+1.4 V DC</td>
<td>10% above nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +1.4VDC</td>
<td>Fault if under voltage</td>
<td>System LED red.</td>
<td>+1.4 V DC</td>
<td>10% below nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +3.3VDC</td>
<td>Fault if over voltage</td>
<td>System LED red.</td>
<td>+3.3 V DC</td>
<td>10% above nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +3.3VDC</td>
<td>Fault if under voltage</td>
<td>System LED red.</td>
<td>+3.3 V DC</td>
<td>20% below nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +5VDC</td>
<td>Fault if over voltage</td>
<td>System LED red.</td>
<td>+5 V DC</td>
<td>10% above nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +5VDC</td>
<td>Fault if under voltage</td>
<td>System LED red.</td>
<td>+5 V DC</td>
<td>20% below nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +12VDC</td>
<td>Fault if over voltage</td>
<td>System and Mute LEDs red.</td>
<td>+12 V DC</td>
<td>10% above nominal</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +12VDC</td>
<td>Fault if under voltage</td>
<td>System and Mute LEDs red.</td>
<td>+12 V DC</td>
<td>10% below nominal</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +24VDC</td>
<td>Fault if over voltage</td>
<td>System and Mute LEDs red.</td>
<td>+24 V DC</td>
<td>10% above nominal</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-7 MCU & SYS Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTEM +24VDC</td>
<td>Fault if under voltage</td>
<td>System and Mute LEDs red.</td>
<td>+24 V DC</td>
<td>10% below nominal</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM -12VDC</td>
<td>Fault if over voltage</td>
<td>System and Mute LEDs red.</td>
<td>-12 V DC</td>
<td>&lt; -14.4 V</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM -12VDC</td>
<td>Fault if under voltage</td>
<td>System and Mute LEDs red.</td>
<td>-12 V DC</td>
<td>&gt; -10.8 V</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>Battery Pack</td>
<td>Fault if over voltage</td>
<td>System LED red.</td>
<td>+12 V DC</td>
<td>10% above nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Battery Pack</td>
<td>Fault if under voltage</td>
<td>System LED red.</td>
<td>+12 V DC</td>
<td>20% below nominal</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Fan Tach below minimum RPM</td>
<td>Fan tach low for fan 1</td>
<td>System and Drive Chain LED red.</td>
<td>2400 rpm</td>
<td>&lt; 2400 rpm</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>Fan Tach below minimum RPM</td>
<td>Fan tach low for fan 2</td>
<td>System and Drive Chain LED red.</td>
<td>2400 rpm</td>
<td>&lt; 2400 rpm</td>
<td>Set fault.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM DVB-T MIP is not OK</td>
<td>DVB-T mode MIP packet missing</td>
<td>System and Mute LEDs red.</td>
<td>MIP packet present</td>
<td>MIP packet missing and DVB-T SFN mode and Unmute On MIP Bad = False</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Feature Key does not allow modulation</td>
<td>Modulation does not match feature key</td>
<td>All status LEDs red.</td>
<td>Modulation type read from modulator FPGA matches feature key</td>
<td>Modulation type read from modulator FPGA does not match feature key</td>
<td>Set fault, mute RF, and erase MOD and DUC FPGAs.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Feature Key does not allow UAX/VAX</td>
<td>System is UAX or VAX, but feature key is not correct</td>
<td>All status LEDs red.</td>
<td>System is UAX or VAX, and feature key is correct</td>
<td>Micron Front Panel detected, but UAX or VAX is not enabled in feature key.</td>
<td>Set fault, mute RF, and erase MOD and DUC FPGAs.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM FP FPGA programming error</td>
<td>System is UAX, but front panel is not programmed</td>
<td>All LEDs orange.</td>
<td>Front panel is programmed</td>
<td>System is UAX, but front panel programming fails. This is a UAX/VAX specific fault.</td>
<td>Set fault, mute RF, and erase MOD and DUC FPGAs.</td>
<td></td>
</tr>
<tr>
<td>Interlock broken</td>
<td>UAX/VAX System Interlock status</td>
<td>System LED red. Mute LED red.</td>
<td>System interlock status bit cleared</td>
<td>System interlock chain open. This is a UAX/VAX specific fault.</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>No valid Forward Cal Data for frequency</td>
<td>Forward power calibration data not valid for current frequency</td>
<td>System LED red. Mute LED red.</td>
<td>Forward power calibration data valid for current frequency</td>
<td>Forward power calibration data not valid for current frequency. This is a UAX/VAX specific fault.</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-7 MCU & SYS Faults

<table>
<thead>
<tr>
<th>Fault Log Message</th>
<th>Fault Description</th>
<th>Front Panel LEDs</th>
<th>Nominal Value/Scaling</th>
<th>Trip Level</th>
<th>Action</th>
<th>Screen/Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>No valid Reflected Cal Data for frequency</td>
<td>Reflected power calibration data not valid for current frequency</td>
<td>System LED red. Mute LED red.</td>
<td>Reflected power calibration data valid for current frequency</td>
<td>Reflected power calibration data not valid for current frequency. This is a UAX/VAX specific fault.</td>
<td>Set fault and mute RF.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM AC Loss. UPS Active</td>
<td>SYSTEM AC Loss. UPS Active</td>
<td>System and Mute LEDs red.</td>
<td></td>
<td></td>
<td>Set fault; mute RF; disable the +20VDC supply to the UDC output amplifier</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +12VDC Battery</td>
<td>Fault if over voltage</td>
<td>System LED orange.</td>
<td>+12 V DC</td>
<td>8% above nominal</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM +12VDC Battery</td>
<td>Fault if under voltage</td>
<td>System LED orange.</td>
<td>+12 V DC</td>
<td>18% below nominal</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Fan Tach below minimum RPM</td>
<td>Fan tach low for fan 1</td>
<td>System and Drive Chain LED orange.</td>
<td>Between 2880 rpm and 23040 rpm</td>
<td>(2400 rpm &lt; fan tach &lt; 2880 rpm) OR (fan tach &gt; 23040 rpm)</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Fan Tach below minimum RPM</td>
<td>Fan tach low for fan 2</td>
<td>System and Drive Chain LED orange.</td>
<td>Between 2880 rpm and 23040 rpm</td>
<td>(2400 rpm &lt; fan tach &lt; 2880 rpm) OR (fan tach &gt; 23040 rpm)</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Foldback active</td>
<td>Power fold back warning</td>
<td>System LED orange.</td>
<td>Power foldback = 0</td>
<td>Power foldback &gt; 0</td>
<td>Set warning. Xmr Home</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Temporary Feature Key Installed</td>
<td>Test Feature enabled in Feature Key.</td>
<td>System LED orange.</td>
<td>Test Feature disabled in Feature Key</td>
<td>Test Feature enabled in Feature Key.</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM Slave mode when TCU not present</td>
<td>Micron System is in slave mode and no TCU presence is detected.</td>
<td>System LED orange.</td>
<td>Micron System is in Master Mode, or system is in Slave Mode and TCU presence detected.</td>
<td>System is in Slave Mode, and TCU Present command not asserted on Pin 19 of the Top 25 pin Connector on the LPU. This is a UAX/VAX specific fault.</td>
<td>Set warning.</td>
<td></td>
</tr>
<tr>
<td>SYSTEM in Reduced Power Mode</td>
<td>% of FWD Power Reference setting &lt; 100%</td>
<td>System LED orange.</td>
<td>% of FWD Power Reference = 100%</td>
<td>% of FWD Power Reference setting &lt; 100% This is a UAX/VAX specific fault.</td>
<td>Set warning.</td>
<td></td>
</tr>
</tbody>
</table>
5.10 Technical Assistance

If a problem persists, contact Harris Customer Service for advice at 217 222 8200.
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### Table 6-1 EXCITER, APEX M2X (ATSC) - 995 0063 200 (?)

<table>
<thead>
<tr>
<th>Harris PN</th>
<th>Description</th>
<th>Qty</th>
<th>UM</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>9010215091G</td>
<td>PWA, BATTERY BACKUP</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>9010215101GT</td>
<td>PWA, UP/DOWN CONVERTER, TESTED</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>971 0035 011</td>
<td>ASM-SUB-TX/IO INTERFACE MODULE</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>981 0274 001</td>
<td>EXCITER, APEX M2X BASIC</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>971 0035 014</td>
<td>ASM-SUB-BLANK PANEL B</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>971 0035 013</td>
<td>ASM-SUB-BLANK PANEL A</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

### Table 6-2 EXCITER, APEX M2X BASIC - 981 0274 001 (J)

<table>
<thead>
<tr>
<th>Harris PN</th>
<th>Description</th>
<th>Qty</th>
<th>UM</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>026 6010 007</td>
<td>GROMMET STRIP, 0.063</td>
<td>.5 FT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>055 0100 005</td>
<td>*THERMAL COMPOUND, 8OZ JAR</td>
<td>0 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>086 0001 002</td>
<td>*ADHESIVE, THREADLOCK 242</td>
<td>0 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>086 0001 004</td>
<td>SEALANT, HIGH STRENGTH</td>
<td>0 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>252-808-000</td>
<td>COUNTERSUNK SCR A M3X6 H1 STAINLESS</td>
<td>28 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>256 0227 000</td>
<td>CABLE, FFC 40C, 2ROW 61MM LONG</td>
<td>3 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>302 0803 006</td>
<td>SCREW, MACH M3-0.5 X 6 SEMS</td>
<td>13 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>302 0804 008</td>
<td>SCREW, MACH M4-0.7 X 8 SEMS</td>
<td>8 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>303 4104 016</td>
<td>SCREW, MACH M4-0.7 X 16</td>
<td>1 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>303 4203 006</td>
<td>NUT, HEX KEPS M4 ZINC</td>
<td>4 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>303 4204 035</td>
<td>SCREW, MACH M4-0.7 X 35</td>
<td>4 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>304 0174 000</td>
<td>NUT, JAM, BRASS 1/2-28</td>
<td>7 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>306 0028 000</td>
<td>NUT, HEX KEPS M4 ZINC</td>
<td>10 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>307 0001 040</td>
<td>NUT, STD HEX M4-0.7 X 0.8H</td>
<td>2 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>314 0014 000</td>
<td>WASHER, INT LOCK 1/2</td>
<td>7 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>315 0023 040</td>
<td>WASHER, EXT LOCK M4</td>
<td>3 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33-351</td>
<td>EMI CLIP, SMALL SINGLE</td>
<td>19 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 36 1330 000</td>
<td>STDOFF-M/F-4.5MM HEX-M3X0.5X5L</td>
<td>13 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>337 0005 000</td>
<td>SCREW, SEMS M3 X 6 SKT HD, SST</td>
<td>3 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>35-733</td>
<td>STUD,BALL,TREELOCK</td>
<td>4 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>356 0216 000</td>
<td>CABLE TIE, 5.6&quot; NYLON NATURAL</td>
<td>3 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>358 1214 000</td>
<td>SCREWLOCK, M/F 4-40X3/16&quot;</td>
<td>2 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>410 0471 000</td>
<td>STANDOFF, HEX M3 X 16, M/F</td>
<td>6 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>426 0149 000</td>
<td>VIBRATION MOUNT M/F 0.375D X 0.625H</td>
<td>4 EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>430 0325-000</td>
<td>GUARD, FAN WIREFORM 80MM</td>
<td>2 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>430 0478 000</td>
<td>FAN, RADIAL, 12V 46.62CFM 80MM</td>
<td>2 EA</td>
<td>SMT</td>
<td></td>
</tr>
<tr>
<td>610 1425 003</td>
<td>RECP, 3C 1ROW VERTICAL</td>
<td>2 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>660 0068 000</td>
<td>BATTERY, 3V 20MM LITHIUM COIN</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>660 0093 000</td>
<td>BATTERY, 3V 10MM LITHIUM COIN</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>843 5588 001</td>
<td>WIRING DIAGRAM UEP</td>
<td>0 DWG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>843 5588 038</td>
<td>FAMILY TREE, UEP</td>
<td>0 DWG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>901 0213 011G</td>
<td>*PWA, MCF5484 UC MODULE</td>
<td>1 EA</td>
<td>SMT</td>
<td></td>
</tr>
<tr>
<td>901 0215 011G</td>
<td>*PWA, SIGNAL PROCESSOR (NOT FOR USE IN NEW DESIGN)</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>901 0215 101G</td>
<td>*PWA, UP/DOWN CONVERTER, TESTED</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>901 0215 181G</td>
<td><em>PWA, SIGNAL PROCESSOR</em>PWA, SIGNAL PROCESSOR</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>943 5588 002</td>
<td>CHASSIS_UEP</td>
<td>1 EA</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

**WARNING:** Disconnect primary power prior to servicing.
## Parts List

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>943 5588 020</td>
<td>HEATSINK, AMPLIFIER MODULE</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>943 5588 030</td>
<td>BLOCK-MOUNTING-PCA_UEP</td>
<td>6</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>943 5588 045</td>
<td>PANEL, DIVIDER</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>943 5588 062</td>
<td>BRACKET, AC CORD</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>943 5588 068</td>
<td>PLATE, TRAVEL LIMIT</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>952 9248 001</td>
<td>CABLE, KIT UEP</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 007</td>
<td>ASM-POWER MODULE</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 016</td>
<td>ASSY, M2X FRONT PANEL</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 018</td>
<td>ASSY, M2X PFRU</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 019</td>
<td>ASM-SUB-COVER-NONVENTED</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Table 6-3 EXCITER, APEX M2X SOFTWARE

<table>
<thead>
<tr>
<th>Harris PN</th>
<th>Description</th>
<th>Qty</th>
<th>UM</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>861-1135-132</td>
<td>ATSC &amp; MPH</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>861-1135-202</td>
<td>DVB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>861-1135-242</td>
<td>ATV</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>861-1135-252</td>
<td>FLO</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>861-1135-282</td>
<td>ISDBT</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>861-1135-302</td>
<td>CTTB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>861-1135-342</td>
<td>DAB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Table 6-4 EXCITER, APEX M2X OPTIONAL PWB & Backup Battery Replacement

<table>
<thead>
<tr>
<th>Harris PN</th>
<th>Description</th>
<th>Qty</th>
<th>UM</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>660 0113 000</td>
<td>BAT PACK 4.8V 4AA NIMH 2500MAH</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>901 0215 091G</td>
<td>PWA, BATTERY BACKUP</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>901 0215 171G</td>
<td>*PWA, L-BAND UP/DOWN CONVERTER</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>901 0215 221G</td>
<td>*PWA, SIGNAL PROCESSOR LX160 FPGA (Used For FLO)</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 011G</td>
<td>ASM-SUB-TX/IO INTERFACE MODULE</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 020G</td>
<td>ASSY, ATV INPUT OPTION</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
<tr>
<td>971 0035 032G</td>
<td>ASSY, DAB INPUT OPTION</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Table 6-5 EXCITER, APEX M2X Transmitter Control Connector 25 to 37 pin Interface

<table>
<thead>
<tr>
<th>Harris PN</th>
<th>Description</th>
<th>Qty</th>
<th>UM</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>922 1345 025</td>
<td>Cable, 25 to 37 Pin Interface</td>
<td>1</td>
<td>EA</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Appendix A  APEX-M2X Exciter Quick Start Guide

A.1  Introduction

This guide provides an outline of activities required to install and activate a M2X exciter in an existing Harris transmitter and in new Harris transmitter systems. This document is intended to be a guide to the initial programming of the exciter. It does not cover all of the exciter programming, but only that which could be detrimental to the operation of the transmitter.

Caution

This procedure is a general outline for activating a transmitter which includes the APEX-M2X exciter and is not intended to replace the more detailed information and procedures in the APEX-M2X exciter technical manual and the appropriate transmitter technical manuals. The transmitter and exciter technical manuals installation, adjustment and checkout procedures should be studied and thoroughly understood before attempting to setup and operate a new transmitter or exciter.

When retrofit into an existing transmitter, the APEX-M2X exciter on site checkout needs to be done in two parts.

- First it is necessary to bench test the exciter in order to verify its RF frequency, set its RF output power, and set the other more critical parameters.
- Next, it is installed in the transmitter to complete the exciter setup and monitor its performance.

A.2  Retrofit Kits For APEX-M2X Exciters

Exciters sold for retrofit into existing transmitter systems will require appropriate mounting hardware, and also requires two RF Output feedback samples.

A.2.1  CD-1A to APEX-M2X Exciter Retrofits

The following kits are required if retrofitting APEX-M2X exciters in place of one or two CD-1A exciters. These kits provide the materials necessary to retrofit two exciters, and are needed if both are CD-1A exciters or if the transmitter contains only one exciter (a CD-1A) and a space for a second CD-1A. The kit numbers are as follows.

- 971-0061-001, Field Upgrade Kit, APEX-M2X Exciter Into Platinum Tx.  
  Note: This upgrade does not apply to the Platinum i control cabinet, the Platinum i control cabinet was never fitted with CD-1A exciters.
- 971-0061-002, Field Upgrade Kit, APEX-M2X Exciter Into Diamond or Sigma Tx.

A.2.2  APEX-M2X Exciter Retrofit in a Ranger Transmitter

The exciter retrofit kit for a ranger transmitter is:

971-0061-005, Field Upgrade Kit, APEX-M2X Exciter Into Ranger Tx.

This kit is good when upgrading from either a CD-1A or Classic Apex exciter.
A.2.3 Classic APEX to APEX-M2X Exciter Retrofits

These kits are intended to provide the materials to retrofit one APEX-M2X exciter in place of one Classic APEX exciter. If two exciters are to be retrofitted, two kits will be needed.

Part numbers for the upgrade kits are as follows.

- 971-0061-005, Field Upgrade Kit, APEX-M2X Exciter Into Ranger Tx.
- 971-0061-007, Field Upgrade Kit, APEX-M2X Exciter Into Platinum Tx.
- 971-0061-008, Field Upgrade Kit, APEX-M2X Exciter Into Diamond or Sigma Tx.
- 971-0061-009, Field Upgrade Kit, APEX-M2X Exciter Into HTEL CD Tx.
- 971-0061-010, Field Upgrade Kit, APEX-M2X Exciter Into PowerCD Tx.
- 971-0061-011, Field Upgrade Kit, APEX-M2X Exciter Into ATLAS ATSC Tx.

A.3 UPS Option

When installed, the UPS option always remains active. This includes exciter shipment or storage. When the backup battery voltage decreases to 87.5% of its nominal voltage (48 V to 42 V) the UPS option is disabled. When AC power is again applied to the exciter, the UPS option is again enabled and the backup battery is recharged. The backup battery recharge time is 16 hours.

A.4 Installing Date and Time Battery, Start of the Bench Test

Exciters sold as a retrofit into existing transmitter systems, or one shipped as part of a transmitter will have to have its Date and Time battery installed and some setup performed.

1. Remove power from the M2X exciter.
2. If exciter is in the transmitter, remove it and set it on a bench.
3. Remove the top cover.
4. Remove old battery and insert new battery with the positive side up.
   A. Battery slides out from under the clip.
      1. See Figure A-1 for battery location. It is located in the left rear side of the exciter on the signal processor board.
      2. For Details, see Section 5.5, Date and Time Battery, on page 5-17 in the APEX-M2X technical manual.
5. Replace the top of the exciter.
6. Install exciter in transmitter or power it up while still on the bench.
7. Connect the system ethernet network to the rear ethernet port on the exciter.
8. Continue on to the next section to connect to the exciter.

The part number for the date and time battery is 660-0093-000.
WARNING: Disconnect primary power prior to servicing.

Figure A-1  Date and Time Battery Location
A.5 Initial Ethernet Connection to the APEX-M2X Exciter, Bench Test Continued

The APEX-M2X exciter is configured and operated from a computer which is connected to the APEX-M2X exciter front or rear panel RJ45 ethernet connectors.

A.5.1 Connection Through The Exciter Front Ethernet Connector

When connecting to the exciter front panel RJ45 connector, if the computer being used does not auto-detect for cross connection, a crossover cable must be used to connect the exciter front ethernet port to the computer.

The computer should be setup as a DHCP client. The DHCP server associated with the exciter front RJ45 port will assign an address (192.168.117.135) to the computer. This method of obtaining a computer address is described in Section 2.6.1, Obtaining Address With Computer in DHCP Client Mode, on page 2-3 in the exciter technical manual.

The front panel ethernet address is 192.168.117.88.

Connect to the exciter front panel ethernet port using the following procedure.

1. Connect an ethernet cable between the computer’s RJ45 connector and the exciter front panel RJ45 connector.
   A. If the computer being used does not auto-detect for cross connection, a crossover cable must be used to connect the exciter front ethernet port to the computer.
   B. It may be necessary to reboot the computer so that the exciter will assign it an appropriate address.

2. Go to Internet Explorer and type the exciter’s front connector address (192.168.117.88).

3. The Log In Screen should appear.

4. Log in using user name and password.
   A. For user1, the default user name is admin and the password is admin. For user2 the user name is user2 and the password is pass2.
   B. If an improper user name or password, each three or more characters with no spaces, is entered the monitor login is activated.
   C. Provisions to change the login user names and passwords are given in Section 2.4, Exciter Log In Authorization Levels, on page 2-2.

5. The exciter web GUI is now displayed and can be navigated as needed.

A.5.1.1 Obtaining Exciter Rear Ethernet Connector Address

An ethernet network which is driven by a DHCP server will supply the exciter rear ethernet connector with an appropriate IP address when the rear port is in the DHCP client mode.

The exciter rear RJ45 connector should have already been connected to the existing ethernet.

Connect a computer to the exciter front panel RJ45 connector and log in as shown above.

1. Make sure the M2X exciter rear ethernet port is connected to the local ethernet network.

2. Navigate to the Exciter Setup > Communications Tab.
WARNING: Disconnect primary power prior to servicing.

3 The rear panel ethernet connector address will be given on this page in the Ethernet #2 sub window.
4 The Ethernet #1 window gives the front ethernet port parameters.

A.5.2 Connecting To The Exciter Through An Existing Ethernet Network

When connecting to an exciter through an existing ethernet network, the connecting computer must be setup as a DHCP client so the network can assign it an address.
1 Connect the exciter rear RJ45 connector to the existing ethernet network.
2 Connect the computer to a connector on the existing ethernet network.
3 Go to Internet Explorer and type the exciter rear RJ45 connector address.
4 Log In Screen should appear.
5 Log in using the user name and password. The default login is admin, admin.
6 The exciter web GUI is now displayed and can be navigated as needed.

A.6 Initial APEX Exciter Programming, Bench Test Continued

It is desirable to check or set up the functions listed below while preforming the exciter bench test. These functions can be checked with the exciter mounted in and connected to the transmitter, but be sure not to set the transmitter to the transmit mode before checking these parameters.

A.6.1 Setting RF Output and Offset Frequencies

Before allowing the exciter to drive the transmitter RF amplifiers, its RF frequency should be checked. This can be accomplished by the following procedure.
1 Log into the exciter using an ethernet connection.
2 Navigate to the PFRU (precise frequency reference unit) Setup screen.
   A This screen is shown in Figure A-2.
3 Verify that the center frequency is correct.
   A If the frequency information is incorrect or if changes are desired, continue with the rest of this procedure.
4 Click in the Frequency window.
5 Type in the Frequency in MHz.
   A The Frequency limit is 57 to 1492 MHz.
   B For digital channels, this will be the channel center frequency.
   C For analog channels, this will be the visual carrier frequency.
6 If the exciter is in the SFN configuration, a frequency offset could be specified from the SFN adaptor and received by the exciter from the transport stream. This offset value (in units of Hz) will be displayed in the SFN offset window. The sum of the frequency entry and two offsets is displayed in the Adjusted Frequency window.
A.6.2 PFRU (Precise Frequency Reference Unit) Setup Screen

Figure A-2 shows the PFRU (precise frequency reference unit) Setup screen, the fourth of the four exciter setup screens. This screen provides a choice of the reference source for the 10 MHz reference oscillator, which is the reference frequency for the 1st and 2nd local oscillators. The 2nd local oscillator controls the RF output frequency of the exciter.

A.6.2.1 10 MHz OCXO Discipline Method Window

**Reference Source** choices include

- External 10 MHz reference input
- External 1PPS reference input
- Internal GPS (from internal GPS receiver)
- Manual Setting (control of 10 MHz reference oscillator from the OCXO Manual Setting window.)
- Auto 1PPS

The 10 MHz OCXO (oven controlled crystal oscillator) is the reference source for the 1st and 2nd local oscillators. It can be locked, via a PLL (phase locked loop), to an external 1PPS signal from a GPS receiver, to an external 10 MHz reference, or to the internal GPS receiver.

**OCXO Manual Setting** is entered as a percent number, range of 0 to 100%, which provides a control voltage for the 10 MHz OCXO reference oscillator when the Manual Setting of the Reference Source is selected. This voltage replaces the phase detector output.
voltage which controls the 10 MHz OCXO reference oscillator when any of the other Reference Source is selected. The OCXO frequency increases as the control number is increased.

The relationship between the number entered and the 10 MHz frequency is as follows.

- $0 = 9.99999140561$ MHz.
- $50\% = 10.0000008542$ MHz.
- $100\% = 10.0000107215$ MHz.

### A.6.2.2 RF Output If (OCXO) Undisciplined

Choices are Yes or No.

If no is selected, the exciter output will be muted if the 10 MHz OCXO reference oscillator looses lock. This can occur when the External 10 MHz reference, External 1PPS reference, or Internal GPS Reference choice is selected for the Reference source.

### A.6.3 System Setup 1 Screen

Figure A-3 shows the first of two system setup screens. This screen provides setup inputs needed to control the exciter’s and the transmitter’s RF output when the exciter is first installed in a transmitter, or when a repaired exciter is reinstalled in the transmitter. Descriptions of the various inputs of this screen are given in the following text.
A.6.3.1 Page Title

A station name may be entered by clicking the in the white box. Use the computer keyboard to enter the desired name and then press the Enter key.

A.6.3.2 Feature Key

The feature key unlocks optional features or other modulation standards, it is an alpha-numeric number. Only needed if additional features or modulation standards are purchased. Harris will provide the required Feature Key Number. A new feature key is not required to reload existing software or to load a new version of the same software.

An incorrect feature key will render the exciter inoperative and is indicated by all of the LEDs in the home screen as well as the front panel to glow red.

A.6.3.3 Transmitter Type

Pressing the down arrow in the Transmitter Type sub window produces a drop down list of transmitter types. Click the transmitter model in which the exciter is to be operated. The exciter must be rebooted (powered down the powered up) to make the new selection active.

With ATSC Revision T software, an exciter which is not connected to a transmitter control system may come up in the Main or Standby mode, depending on the transmitter type selected in the System Setup 1 screen. Prior to Revision T, an exciter not connected to a transmitter control system would always come up in the Main mode. Table 0-1 lists the transmitter type selection and its default mode.

<table>
<thead>
<tr>
<th>Transmitter Type</th>
<th>Default Mode (see notes below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond CD</td>
<td>Main</td>
</tr>
<tr>
<td>Sigma CD</td>
<td>Main</td>
</tr>
<tr>
<td>PlatinumCD</td>
<td>Main</td>
</tr>
<tr>
<td>Custom</td>
<td>Standby</td>
</tr>
<tr>
<td>Ranger</td>
<td>Main</td>
</tr>
<tr>
<td>PowerCD</td>
<td>Main</td>
</tr>
<tr>
<td>Atlas ATSC</td>
<td>Main</td>
</tr>
<tr>
<td>Platinumi</td>
<td>Main</td>
</tr>
<tr>
<td>Thales DCX</td>
<td>Main</td>
</tr>
<tr>
<td>LAX Lband</td>
<td>Standby</td>
</tr>
<tr>
<td>Maxiva ULX</td>
<td>Standby</td>
</tr>
<tr>
<td>Maxiva UAX</td>
<td>Standby</td>
</tr>
<tr>
<td>Platinum VAX</td>
<td>Standby</td>
</tr>
<tr>
<td>Platinum VLX</td>
<td>Main</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UHF (25 Pin) Connector</th>
<th>VHF (37 Pin) Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control pin</td>
<td>Ground Pins</td>
</tr>
<tr>
<td>Control pin</td>
<td>Ground Pins</td>
</tr>
</tbody>
</table>
A.6.4 System Setup 2 Screen

Figure A-4 shows the second of two system setup screens. Descriptions of the various screen entries are listed below.

Table 0-1 Transmitter Type Selection and Operating Mode

<table>
<thead>
<tr>
<th>Transmitter Type</th>
<th>Default Mode (see notes below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>10 22-25 18 23-26</td>
</tr>
<tr>
<td>Standby</td>
<td>14</td>
</tr>
</tbody>
</table>

The default mode is achieved with control pin high (open.)
Grounding control pin changes to the opposite mode (Standby or Main.)
An adaptor cable (Harris part number 922-1345-025) is available to convert the 25 pin male UHF connector to the 37 pin female VHF connector.

A.6.4.1 Time Server Settings

- **UTC Source**: Choices are None, GPS, or NTP. Time can be supplied by GPS (global positioning system) or NTP (network time protocol). Both systems provide a universal time signal, where the time is Coordinated Universal Time (UTC is the ITU abbreviation).

- **UTC Offset**: Offset range is -13 to +13 hours. This is the local time offset from the Coordinated Universal Time provided by the time server.
A.6.5  NTP Server Settings

If NTP time server is chosen, it is necessary to enter the NTP Server IP address in the white window. Click in the white window, it will turn yellow, and use the computer keyboard to enter the address. Press the enter key when finished.

When the NPT time server IP address has been entered, click the Set IP soft key to activate the address.

A.6.5.1  System Time Adjustment For UTC Source None

System Date and Time may be entered by clicking in each white box, shown in Figure A-5. The date is entered month - day - year, and the time is entered in the 24 hour format. Enter the correct value in the window and then press the Enter key. When the time and date have been entered, press Set Time soft key to activate the new parameters into the system.

A.6.6  Setting RF Output Level to Power Amplifier

The average output power of the exciter in mW is displayed numerically and on a bar graph on the home screen, shown in Figure A-6. Exciter output power adjustment provision is included on the home screen.

On the home screen, exciter output power can be changed by pressing the up or down arrows in the exciter power sub window, or it can be changed by writing the value in the white box.

1  Exciter output power is set by clicking in the white box above the forward power display on the home screen.

A  The computer keyboard can be used to enter the new power level (in mW).
In most transmitters, exciter output power is controlled from the transmitter, with transmitter output power controlled locally or remotely by a circuit within the transmitter. In some transmitters the exciter output power control is the transmitter output power control, and is available by remote control.

![Figure A-6 Home Screen](image)

**A.7 Installing Exciters In Transmitters**

If an exciter has been removed from the transmitter for shipment, the physical mounting hardware and connecting harness should already be in place in the transmitter. Install the exciter in the transmitter and connect the cables to the rear panel as marked.

The exciter should have been set up at the factory, and the settings recorded in the transmitter final test data. The information in Chapter 3 should be carefully studied before attempting to operate the exciter or check the exciter setup against the factory final test data.

**A.7.1 RF Sample Connections and levels**

The the RF feedback signals of a typical transmitter is shown in Figure A-7. The RF sample input connectors on the rear panel of the exciter are shown in Figure A-8, on page A-14 and Figure A-9, on page A-14.

- The HPF feedback sample is taken from the high power filter output coupler.
- The PA sample is taken from the cabinet combiner output coupler.
Note

If extra directional couplers at the high power filter input and output are not available, the samples can be taken by inserting in line directional couplers, as shown in Figure A-7.

- If the transmitter system has dual exciters, feedback samples for each exciter are obtained by splitting each sample cable, as shown in Figure A-7.
- After transmitter power up feedback signals at the exciter input should be padded to yield +5 dBm at the highest expected transmitter output power. The sample input power range is -20 to +5 dBm. This is covered in Section A.8, Initial Transmitter Power Up With the APEX-M2X Exciter Installed, on page A-15.

A.7.2 Signal Connections

Most of the input and output connections are at the rear of the exciter, as shown in Figures A-8 Through A-11 shows the rear panel connections.

Refer to Figures A-8 and A-9.

- GPS (SMA) is an input from a GPS antenna to the internal GPS receiver. Provides +5 VDC at 0.15 Amps maximum for an amplified GPS antenna. GPS receiver normal signal input level is -130 dBm to -100 dBm, its antenna input impedance is 50 ohms, and its center frequency is 1.57542 GHz.
- RF OUT (SMA) is the on-channel RF signal output from the exciter. Output level is adjustable up to 100 mW average.
- POST-FILTER (SMA) is the RTAC RF input signal connector for an RF sample from output of high power 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 -20 to +5 dBm. The input impedance is 50 ohms.
• PRE-FILTER (SMA) is the RTAC RF input signal connector for an RF sample from the output of the transmitter power amplifier, taken before the HPF. It is used by RTAC™ to correct for the nonlinear distortion caused by the power amplifier. Normal input signal range is -20 to +5 dBm. The input impedance is 50 ohms.

Refer to Figures A-8 and A-10.

• The RS232 connector is a female 9 Pin D sub connector. It is used to communicate with various computer applications.

• The CAN connector is a female 9 Pin D sub connector. This connector is used for the CAN (Controller Area Network) interface to some transmitters.

• 1 PPS INPUT (BNC) is the one pulse per second input from an external GPS receiver. This is a TTL pulse which is typically 100 nsec wide, and is read at the leading edge. Accuracy requirement is 15 nsec.

• 10MHZ REF INPUT (BNC) is the (Optional) 10 MHz reference frequency input. It is used when precise control of the exciter’s pilot frequency is required. Normal signal input range is -10 to +10 dBm. The input impedance is 50 ohms.

The following two items, shown in Figures A-8 and A-10, are on the optional Transmitter I/O board. It is required for Harris Diamond, Sigma, Platinum, HTel, or Ranger transmitters. It is optional for PowerCD or Atlas transmitters, which use the CAN bus.

• USER REMOTE (25 pin female D sub connector). This connector contains five NO/NC dry alarm relay contacts. For connector pin out, see Section 1.7.1.2, Top Rear Panel, User Remote Connector, on page 1-9.

• TRANSMITTER INTERFACE (25 pin male D sub connector). This is the interface to the control logic for Harris UHF transmitter systems. For connector pin out, see Section 1.7.1.1, Bottom Rear Panel, UHF Transmitter Interface Connector, on page 1-8.

Harris VHF transmitter interface connectors require a female 37 pin D sub connector. For the pin out for this cable, see Section 1.7.1.3, VHF to UHF Transmitter Interface Adaptor Cable, on page 1-10.

Refer to Figures A-8 and A-11.

• ASI MONITOR (BNC) is an output which is monitoring the on the air ASI or SMPTE signal

• HP A (BNC) is the input A high priority ASI digital TV input signal.

• LP A (BNC) is the input A low priority ASI digital TV input signal.

• HP B (BNC) is the input B high priority SMPTE digital TV input signal.

• LP B(BNC) is the input B low priority SMPTE digital TV input signal.

The input impedance of the above mentioned ASI or SMPTE inputs 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.

• 10/100 Base T (RJ45) is the rear panel ethernet connector. This connector is set to the DHCP mode.

• AC Line is a standard AC power input connector, see Figures A-8 and A-11. AC Power is applied through a standard power cord to this connector. The power supply will automatically select the AC input voltage in two ranges, which are 85 to 132 VAC or 170 to 264 VAC. Power line frequency can range from 47 to 63 hertz.

The following six items, shown in Figures A-8 and A-11, are on the optional Analog Input board (sometimes referred to as the AIB).
• AUDIO A (5 pin XLR) Input
• AUDIO B (5 pin XLR) Input
• AUDIO COMP (BNC)
• VIDEO (BNC) Input has a 75 ohm input impedance and requires a standard 1 volt peak to peak video input signal.
• BP SYNC (BNC)
• VIDEO AUX (BNC)

Figure A-8 APEX-M2X Exciter Rear View

Figure A-9 APEX-M2X Exciter Rear View, Left Side
A.8 Initial Transmitter Power Up With the APEX-M2X Exciter Installed

The exciter is now ready for the first power up as part of the transmitter. The critical programming has already been performed, but some fine tweaks and programming changes may be needed.

Caution

This procedure is a general outline for activating a transmitter which includes the APEX-M2X Exciter. The transmitter and exciter technical manuals installation, adjustment and checkout procedures should be studied and thoroughly understood before attempting to setup and operate a new transmitter or exciter.

The basic functions for the setup of this exciter and their associated screens are discussed in Chapter 3 of this manual. It is necessary to be familiar with these screens in order to configure the exciter. Most of the critical setup functions are found in the four setup screens associated with the Exciter Setup tab, with some setups associated with the modulation system used found in the various screens associated with the Modulation tab.
The initial transmitter power up is as follows.

1. Disconnect the pre and post filter RF sample lines at the exciter.
2. Energize the transmitter.
3. Set the output power to 100%.
   - For a retrofit exciter, it is assumed that the transmitter had been functioning correctly with the old exciter and its output power is correctly calibrated.
   - If the exciter has been shipped with a new transmitter, the exciter and transmitter have been set up in the factory and the only remaining tasks are the installation checkout, minor system tweaks, power calibration, setting the exciter's RTAC RF sample levels and the operational check remains.
4. Check the RF power level at the disconnected pre and post filter RF sample lines where they connect to the exciter.
   - Use pads to set the level within the -20 to +5 dBm range for each cable.
5. Connect the pre and post filter RF sample lines back to their connectors on the rear panel of the exciter.
6. In the exciter Home screen, set the Linear and Non-Linear RTAC functions to adapt.
   - It may take a few minutes for RTAC to adapt and correct the signal.
7. The engineer can now check the transmitter operation and record the data.

Some transmitters may experience nuisance overdrive trips which are caused by the Modulation peaks. These are caused by the modulation crest factor peaks and RTAC non-linear correction peak stretch capability. These two problems are corrected in the Exciter Setup > Adaptive Setup screen. Modulation crest factor peaks are limited by the “Max Crest Factor” value entered and RTAC non-linear correction peak stretch is limited by the “NonLinear Correction Range” value entered.
A.9 Ethernet Connection Via HyperTerminal

This mode of connection is used to change the user 1 and user 2 secure login name and password, see Section A.11, Changing the User Name and Password, on page A-20.

1. The computer must be capable of making an ethernet connection through the exciter’s front or rear RJ45 connectors.
   A. Connection through the exciter’s front connector is described in Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
   B. Connection through the exciter’s rear connector is described in Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4.

2. Open Hyperterminal on the computer.
   A. Starting in the lower left side of the screen, Select Start > Programs > Accessories > Communications > Hyperterminal, see Figure A-12.
   B. If the screen shown in the left side of Figure A-13 appears, click cancel.
   C. The New Connection screen, right side of Figure A-13, will appear.

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Figure A-12 Path To Hyperterminal
WARNING: Disconnect primary power prior to servicing.

Note

If a previous HyperTerminal connection has been saved, that connection can be recalled by pressing “File > Open” in the New Connection Window. A new window which displays previous saved connections will open. Click the desired connection and press the open soft key. That connection should be established.

3 In the New Connection screen select File > Properties.
   A The New Connection Properties window will appear.
4 In the New Connection Properties window, click on Connect using drop down arrow.
5 Select TCP/IP (Winsock) from the drop down list.
6 Type in the desired exciter ethernet port address for the port being used (front or rear).
7 Select the Setting tab in the New Connection Properties window.
   A The New Connection Properties Settings window, shown in Figure A-14, will open.
   B Press the Emulation drop down arrow and select VT100.
   C Configure the Settings widow like the one shown in Figure A-14.
   D Press OK.
8 To save the configuration, press File > Save in the New Connection window.
   A The Connection Description window, shown in Figure A-13, will appear.
   B Click in the name box and type in a name, such as “Apex-M2X Telnet”.
   C Press OK.
9 Connect by Clicking the phone icon or by using the menu selection “Call, Call.
10 When the connection is made, a window will appear with the words “Enter password”. Type the User1 or User2 password and hit enter.
11 If the password is accepted, a screen like that shown in Figure A-15 will appear.
A.10 Ethernet Connection Via Tera Term

This connection is mainly used to change the user 1 and user 2 name and password, see Section A.11, Changing the User Name and Password, on page A-20.
1. The computer must be capable of making an ethernet connection through the exciter’s front or rear RJ45 connectors.
   A. Connection through the exciter’s front connector is described in Section 2.6, Connection Through The Exciter Front Ethernet Connector, on page 2-3.
   B. Connection through the exciter’s rear connector is described in Section 2.7, Connecting Via The Exciter Rear Panel Ethernet Connector, on page 2-4.

2. Open Tera Term on the computer.


4. Select the TCP/IP choice. The Host sub window will become active.

5. Type the exciter’s IP address, for the RJ45 connector (front or rear) being used, in the Host sub window.

6. Press the OK soft key.

7. When the connection is made, a window will appear with the words “Enter password”. Type the User1 or User2 password and hit enter.

8. If the password is accepted, one of several screens will appear, see Figure A-16 for a typical screen view.
   A. This display has several pages. Use the left or right arrow key to change the page being viewed.

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**Figure A-16** APEX-M2X VT100 Presentation Page 4

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### A.11 Changing the User Name and Password

Three levels of login are available. They are:

- Two “Secure” level logins, which allow full access to the exciter programming functions.
- One monitor level login, which allows viewing only and no programming.
For the user 1 secure login, the default user name is admin and password is admin. For user 2 secure login the name is user 2 and the password is pass 2. If an improper user name or password, each having three or more characters, is entered, the monitor level login is activated.

The secure login names and passwords are changed by an ethernet VT100 connection to the exciter using Tera Term or Hyperterminal. These connections are described in Section A.9, Ethernet Connection Via HyperTerminal, on page A-17 and Section A.10, Ethernet Connection Via Tera Term, on page A-19.

The process of changing user names and passwords is as follows.

1. Perform an ethernet VT100 login to the exciter front or rear ethernet port.
2. Navigate to page 4, shown in Figure A-16.
   A. Use the left and right arrow keys to change pages.
3. Enter U, for users.
4. The “Enter user number” prompt appears. Enter the user login to be changed (1 or 2).
   A. Press Enter to show the existing user name and password for users 1 and 2.
   B. Enter 1 to change user 1 login or enter 2 to change user 2 login.
5. If the existing user 1 and 2 logins are displayed, the prompt “Press ‘Y’ for a new entry” appears.
   A. If Y is pressed, the “Enter user number” prompt reappears.
   B. Enter 1 to change user 1 login or enter 2 to change user 2 login.
6. The “enter user name” prompt appears.
   A. Type the new name, then hit enter.
7. The “enter user password” prompt appears
   A. Type the new password, then hit enter.
8. The new user name and password are displayed.
   A. This allows the operator to change user 1 or 2 logins or to view both logins.
Appendix B  APEX-M2X Exciter Installation

B.1  Introduction

Exciters sold as part of a transmitter will normally have been tested in the transmitter before shipment. The exciter may be removed for shipment, to be reinstalled after the transmitter is in place. Installation is a simple process, as described in Section B.3 below.

Exciters sold for use in test facilities can either be rack mounted or operated sitting on a work surface.

Exciters sold for retrofit into existing transmitter systems will not only require mounting and appropriate mounting hardware, but this exciter also requires two RF Output samples.

When retrofit into an existing transmitter, the APEX-M2X exciter on site checkout needs to be done in two parts.

- First it is necessary to bench test the exciter in order to verify its RF frequency, set its RF output power, and set the other more critical parameters.
- Next, it is installed in the transmitter to complete the exciter setup and monitor its performance.

B.2  Retrofit Kits For APEX-M2X Exciters

The following three parts of this section list retrofit kits for replacing the CD-1A exciters or Classic APEX exciters with APEX-M2X exciters. If the APEX-M2X exciter is to be installed in another brand of transmitter, a custom retrofit kit will be required.

B.2.1  CD-1A to APEX-M2X Exciter Retrofits

The following kits are required if retrofitting APEX-M2X exciters in place of one or two CD-1A exciters. These kits provide the materials necessary to retrofit two exciters, and are needed if both are CD-1A exciters or if the transmitter contains only one exciter (a CD-1A) and a space for a second CD-1A. The kit numbers are as follows.

- 971-0061-001, Field Upgrade Kit, 2-APEX-M2X Exciters Into Platinum transmitters. Note: This upgrade does not apply to the Platinum I control cabinet, the Platinum I control cabinet was never fitted with CD-1A exciters.
- 971-0061-002, Field Upgrade Kit, 2-APEX-M2X Exciter Into Diamond or Sigma transmitters.

B.2.2  APEX-M2X Exciter Retrofit in a Ranger Transmitter

971-0061-005, Field Upgrade Kit, APEX-M2X Exciter Into Ranger Tx.

This kit is good when upgrading from a Classic Apex exciter, but it lacks the 2-Way splitter and cables necessary to in make the non-linear RTAC connections when upgrading from a CD-1A exciter.
B.2.3 Classic APEX to APEX-M2X Exciter Retrofits

These kits are intended to provide the materials to retrofit one APEX-M2X exciter in place of one Classic APEX exciter. If two exciters are to be retrofitted, two kits will be needed.

Part numbers for the upgrade kits are as follows.
- 971-0061-005, Field Upgrade Kit, APEX-M2X Exciter Into Ranger Tx.
- 971-0061-007, Field Upgrade Kit, APEX-M2X Exciter Into Platinum Tx.
- 971-0061-008, Field Upgrade Kit, APEX-M2X Exciter Into Diamond or Sigma Tx.
- 971-0061-009, Field Upgrade Kit, APEX-M2X Exciter Into HTEL CD Tx.
- 971-0061-010, Field Upgrade Kit, APEX-M2X Exciter Into PowerCD Tx.
- 971-0061-011, Field Upgrade Kit, APEX-M2X Exciter Into ATLAS ATSC Tx.

B.3 Installing Exciters Removed for Shipment

If an exciter has been removed for shipment, the physical mounting hardware and connecting harness should already be in place in the transmitter. Install the exciter in the transmitter and connect the cables to the rear panel as marked.

The exciter should have been set up at the factory, and the settings recorded of the transmitter final test data. The information in Chapter 3 and Section B.7, Configuring the Exciter, on page B-16 should be carefully studied before attempting to operate the exciter or check the exciter setup against the factory final test data.

B.4 Signal Connections

Most of the input and output connections are at the rear of the exciter, only the RJ45 ethernet connections are available at the front and rear. Figures B-1 Through B-4 shows the rear panel connections.

Refer to Figures B-1 and B-2.
- GPS (SMA) is an input from a GPS antenna to the internal GPS receiver. Provides +5 VDC at 0.15 Amps maximum for an amplified GPS antenna. GPS receiver normal signal input level is -130 dBm to -100 dBm, its antenna input impedance is 50 ohms, and its center frequency is 1.57542 GHz.
- RF OUT (SMA) is the on-channel RF signal output from the exciter. Output level is adjustable up to 100 mW average for digital and up to 200 mW peak of sync for analog.
- POST-FILTER (SMA) is the RTAC RF input signal connector for an RF sample from output of high power 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 -20 to +5 dBm. The input impedance is 50 ohms.
- PRE-FILTER (SMA) is the RTAC RF input signal connector for an RF sample from the output of the transmitter power amplifier, taken before the HPF. It is used by RTAC to correct for the nonlinear distortion caused by the power amplifier. Normal input signal range is -20 to +5 dBm. The input impedance is 50 ohms.

Refer to Figures B-1 and B-3.
- The RS232 connector is a female 9 Pin D sub connector. It is used to communicate with various computer applications.
• The CAN connector is a female 9 Pin D sub connector. This connector is used for the CAN (Controller Area Network) interface to some transmitters.
• 1 PPS INPUT (BNC) is the one pulse per second input from an external GPS receiver.
• 10MHZ REF INPUT (BNC) is the (Optional) 10 MHz reference frequency input. It is used when precise control of the exciter’s pilot frequency is required. Normal signal input range is -10 to +10 dBm. The input impedance is 50 ohms.

The following two items, shown in Figures B-1 and B-3, are on the optional Transmitter I/O board. It is required for Harris Diamond, Sigma, Platinum, HTEL, or Ranger transmitters. It is not required for PowerCD or Atlas transmitters, which use the CAN bus.

• USER REMOTE (25 pin female D sub connector). This connector contains five NO/NC dry alarm relay contacts. For connector pin out, see Section 1.7.1.2, Top Rear Panel, User Remote Connector, on page 1-9.
• TRANSMITTER INTERFACE (25 pin male D sub connector). This is the interface to the control logic for Harris UHF transmitter systems. For connector pin out, see Section 1.7.1.1, Bottom Rear Panel, UHF Transmitter Interface Connector, on page 1-8.

Harris VHF transmitter interface connectors require a female 37 pin D sub connector. For the pin out for this cable, see Section 1.7.1.3, VHF to UHF Transmitter Interface Adaptor Cable, on page 1-10.

Refer to Figures B-1 and B-4.

• ASI MONITOR (BNC) is an output which is monitoring the on the air ASI or SMPTE signal
• HP A (BNC) is the input A high priority ASI digital TV input signal.
• LP A (BNC) is the input A low priority ASI digital TV input signal.
• HP B (BNC) is the input B high priority SMPTE digital TV input signal.
• LP B (BNC) is the input B low priority SMPTE digital TV input signal.

The input impedance of the above mentioned ASI or SMPTE inputs 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.
• 10/100 Base T (RJ45) is the rear panel ethernet connector. This connector is set to the DHCP mode.
• AC Line is a standard AC power input connector, see Figures B-1 and B-4. AC Power is applied through a standard power cord to this connector. The power supply will automatically select the AC input voltage in two ranges, which are 85 to 132 VAC or 170 to 264 VAC. Power line frequency can range from 47 to 63 hertz.

The following six items, shown in Figures B-1 and B-4, are on the optional Analog Input board (sometimes referred to as the AIB).

• AUDIO A (5 pin XLR) Input
• AUDIO B (5 pin XLR) Input
• AUDIO COMP (BNC)
• VIDEO (BNC) Input has a 75 ohm input impedance and requires a standard 1 volt peak to peak video input signal.
• BP SYNC (BNC)
• VIDEO AUX (BNC)
WARNING: Disconnect primary power prior to servicing.

**Figure B-1** APEX-M2X Exciter Rear View

**Figure B-2** APEX-M2X Exciter Rear View, Left Side

**Figure B-3** APEX-M2X Exciter Rear View, Center
B.5 Retrofitting Into Existing Transmitter System

One of the most important aspects of installing the exciter into an existing transmitter consists of providing the digital mode APEX-M2X exciter with the appropriate feedback signals. It is impractical to discuss every possible transmitter installation, the intent of this section is to provide enough information to the systems engineer to allow him to determine the optimum feed back arrangement. The discussions below will address the most common configurations.

B.5.1 APEX-M2X Exciter Operating In Analog Mode

The APEX-M2X exciter operates in the common mode only. It is not setup to operated in separate aural visual mode.

Also, RTAC pre correction does not operate in the analog mode, therefore, the RTAC RF feedback sample system shown in the following block diagrams is not needed.

B.5.2 Feed Back Requirements

The digital mode APEX-M2X Exciter accepts two feedback signals for the RTAC circuits. They are the pre-filter and post-filter RF samples.

The post-filter sample monitors the output of the Mask Filter. It uses this sample to characterize the amplitude response and group delay response of the filter. This filter can be a standard “D” Mask filter or “STF” (sharp tuned filter) for the ATSC system, other filters for various other systems, or a constant impedance type multi-channel combiner. After the filter has been characterized the APEX-M2X applies pre-correction such that the response and delay have been optimized at the filter output. In addition to characterizing the mask filter, any transmission line or antenna VSWR present at the monitoring point will also be compensated.

The pre-filter sample monitors the output of the final amplifying device. It uses this sample to characterize the AM to AM (linearity) and AM to PM (phase) distortions of the amplifier and apply pre-correction to optimize the spectrum response (adjacent channel shoulder level) at the amplifier output.
Each RTAC RF input accommodates an input level range of -20 to +5 dBm average digital power, but, if possible, it is better to attempt to keep the RF sample levels between -10 dBm and 0 dBm. Since the sample levels at the sample cable outputs are usually too high, the level is adjusted by adding appropriate padding at the sample input to the exciter.

Some transmitter power amplifiers consist of multiple power amplifier modules. Other transmitter systems consist of multiple PA cabinets. For these systems, the transmitter output power may vary due to failure or removal of PA modules, or because a PA cabinet was faulted off, turned off, or switched out of the combiner. For these transmitters, make sure the RTAC RF sample levels stay within the recommended power range for all expected transmitter output power levels.

### B.5.2.1 Feedback Signal Quality Requirements

The ability of the APEX-M2X exciter to correct transmitter system distortions depends on the quality of the feedback samples. Any frequency response errors introduced in the feedback system will degrade the main signal path. This will occur since the APEX-M2X compares the ideal signal in the exciter to the feedback signal presented to the rear panel. The correction algorithms, like any feedback loop, will drive the error to zero at the measurement point, which is at the rear panel. Use only a high quality 50-ohm coax such as RG223. Avoid the use of multiple lengths of cable; multiple connectors can cause response errors in the feedback path. Always terminate any unused ports on a coupler, splitter, combiner or other RF device. Poor digital performance can often be traced back to a faulty feedback path.

### B.5.3 Typical Transmitter Systems Block Diagrams

The block diagrams in Figures B-5 through B-10 show typical RF line-ups for various analog or digital transmitters. They will be helpful in determining how to configure the RTAC feedback signals for digital transmitter. The bold lines indicate the required transmitter additions. There is also a recommended list of required materials in Section B.6 on page B-15. **Analog transmitters do not require RTAC feedback signals and operate in common mode only.**

In most cases the required couplers are already installed in the main RF path for transmitter monitoring. These couplers can be used to provide the RTAC feedback samples to the APEX-M2X exciter. In the event that a given coupler is dedicated to a transmitter function, that sample can be split into two paths using a coupler, with the output port of the added coupler connected to the transmitter function input cable and the coupled port used for the APEX-M2X feedback signal.

If transmitter installations use multiple PA cabinets, the PA sample is taken after the PA combiner. The APEX-M2X corrects for the aggregate sum of the PA cabinets.

Some transmitter installations use multiple high power filters. In this case the HPF sample is taken after the combiner and the APEX-M2X corrects for the aggregate sum of the filters. Since there is no one sample available for the PA output, the individual samples must be combined and the aggregate sum fed back to the APEX-M2X.
B.5.4 Retrofiting The APEX-M2A Exciter Into Generic Transmitters

Most transmitters can be configured as digital or analog transmitters with one or more PA cabinets and single or dual exciters. The exception to this rule is the Diamond transmitter, which operates in the digital mode only. This gives rise to four digital feedback systems, as described below.

Analog transmitters do not require RTAC feedback systems, therefore, the block diagrams for common mode analog transmitters will look like the digital transmitter block diagrams but the RTAC RF sample feedback system will be removed.

B.5.4.1 Transmitters With One PA Cabinet and Exciter

In the existing system, shown in Figure B-5, the cabinet monitoring signals are taken from the PA cabinet coupler and high power filter output coupler. If no extra couplers are available, each of these signals are split with directional couplers, with the coupled outputs connected to the appropriate APEX-M2X exciter feedback input, as shown in Figure B-6.

If the cabinet and system monitoring outputs are not used, they should be terminated to prevent distortion of the APEX-M2X exciter feedback samples by the reflected signals.

The feedback signal at the exciter input should be padded to yield +5 dBm at the highest expected transmitter output power. The maximum input range is -20 to +5 dBm.

![Figure B-5 Transmitter with One Exciter and One PA Cabinet](image-url)
B.5.4.2 Transmitter With One PA Cabinet And Two Exciters

If the transmitter system shown above (with one PA cabinet) has dual exciters, as shown in Figure B-7, the feedback connections are modified from the connections shown in Figure B-6 by putting two-way, zero-phase splitters in each feedback sample line. The outputs of each splitter provide the appropriate feedback signal for each exciter, as shown in Figure B-8.

If the cabinet and system monitoring outputs are not used, they should be terminated to prevent distortion of the APEX-M2X exciter feedback samples by the reflected signals.

The feedback signal at the exciter input should be padded to yield +5 dBm at the highest expected transmitter output power. The maximum input range is -20 to +5 dBm.
B.5.4.3 Transmitter With Two or More PA Cabinets

When the Transmitter has two or more PA cabinets, the feedback signals are connected as shown in Figure B-9.

- The HPF feedback sample is taken from the high power filter output coupler.
- The PA sample is taken from the cabinet combiner output coupler.
- If the transmitter system has dual exciters, feedback samples for each exciter are obtained by splitting each sample cable, as shown in Figure B-10.
- If the cabinet and system monitoring outputs are not used, they should be terminated to prevent distortion of the APEX-M2X exciter feedback samples by the reflected signals.
- The feedback signals at the exciter input should be padded to yield +5 dBm at the highest expected transmitter output power. The sample input power range is -20 to +5 dBm.
B.5.5 Transmitter System RF Output Power Control

It should be noted here that the transmitters into which the APEX-M2X exciters are being retrofitted have two basic modes of RF output power control, which are as follows:

- Some transmitters, including, but not limited to the Diamond and Platinum series, use the exciter power control as the transmitter output power control. In these systems, raising or lowering the exciter output power causes the exciter output power to change.

Note 1. These two boxes represent the 2-way splitters that are installed for feeding the RTAC samples to dual exciters. Terminate the unused outputs in 50 ohms.

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**Figure B-9 Transmitter With Dual PA Cabinets And Single APEX-M2X Exciter**

**Figure B-10 Transmitter Modification for Dual APEX-M2X Exciters**
• Some transmitters, including, but not limited to the Sigma and PowerCD series, require a fixed output power from the exciter, with the power control circuitry located after the exciter switcher output.

Since this exciter will be retrofitted into a variety of transmitters, the installation engineer should be familiar with transmitter and exciter control systems.

**B.5.6 Diamond Transmitters**

Diamond transmitters can be configured as digital transmitters with one or more PA cabinets and single or dual exciters. The main difference between the Diamond transmitters and other transmitter models is that the Diamond transmitter has a driver associated with each exciter, as shown in Figure B-11. For these transmitters, the exciter switcher is located after the drivers.

The Diamond configuration places the driver module in the control cabinet. The driver output feeds one to five PA cabinets. If the transmitter system has dual exciters and drivers, the driver outputs are connected to a coax relay, which connects one exciter driver pair to a test load and the other exciter driver pair to drive the PA cabinets.

Note: If the Diamond transmitter has one PA cabinet with four PA modules, it will have no driver module. The exciter output will drive the PA module splitter in the PA cabinet directly.

*Figure B-11 Diamond Transmitter - Dual PA Cabinets and Dual APEX-M2X Exciters*
B.5.7 Sigma Transmitters

Sigma transmitters can be configured with one or more PA cabinets and single or dual exciters. Multiple PA cabinet systems can be configured with multiple high power filters. When retrofitting an APEX-M2X exciter into any Sigma transmitter, some of the unique features of the various Sigma transmitter models must be taken into account.

Sigma transmitters have several IPA (IOT driver) systems, which include the following:

- Early Sigmas had the Bipolar IPA and No Feed forward system.
- Later Sigmas had the Bipolar IPA and the IPA Feed forward system.
- These two above mentioned systems included the RF Corrector module, which contains the PA automatic power control and the PA linearization circuits.
  - Some of these Sigma models had their RF correctors replaced with AGC/UHF linearization modules. These modules provided improved performance over the RF correctors, but performed the same functions.
  - Later Sigmas with Bipolar IPAs with Feed Forward were all shipped with AGC/UHF linearization modules.
  - If only the APEX-M2X exciters are being used in the above mentioned Sigmas, the RF corrector or AGC/UHF linearizer must be retained because of its automatic power control function, but the correction should be switched out or adjusted to be transparent.
- The current generations of Sigma transmitters use the DHD Diamond IPA module. These models have the SD1 chassis which functions as the transmitter automatic power control (APC) and has circuits used to linearize the Diamond IPA module. These modules also have the UHF linearizer. It is connected before the SD1 module and serves to linearize the IOT.
  - If the transmitter is to be digital and one of the two exciters is still the CD-1 or CD1-A, see Figure B-12, the UHF linearizer must remain active and both the UHF linearizer and the SD1 must be adjusted to correct the transmitter for the benefit of the CD exciter.
  - If one or two APEX-M2X exciters are being used, see Figures B-13 and B-14, or if the two exciters consist of one APEX-M2X and the one original APEX exciter, see Figure B-14, the UHF linearizer can be removed and the SD1 will be the first module in the PA cabinet.

The RF corrector, AGC/UHF corrector, and the UHF corrector disposition has been dealt with above. In all of the above Sigma transmitters, the feed forward system (for Bipolar IPA Sigmas) or the SD1 chassis (for Diamond IPA Sigmas) must remain in the transmitters. They should be handled as follows:

- The feed forward system should be adjusted (with all exciter correction bypassed) to linearize the bipolar IPA.
- The SD1 must be adjusted to control the PA cabinet output power, and should also be adjusted to linearize the IPA.
WARNING: Disconnect primary power prior to servicing.

Note 1. These two boxes represent the 2-way splitters that are installed for feeding the RTAC samples to dual exciters. Terminate the unused outputs in 50 ohms.

Figure B-12 Sigma Transmitters With Single PA Cabinet and Exciter and the UHF Linearizer

Figure B-13 Sigma Transmitters - Single PA Cabinet and APEX-M2X Exciter

Figure B-14 Sigma Transmitter With Single PA Cabinet and One APEX-M2X and One APEX Exciter
B.5.8 PowerCD Transmitters

Retrofitting APEX-M2X exciters into a PowerCD transmitter should be similar to the procedures for the generic transmitters covered in Section B.5.4 on page B-7. This section is added to give the installers an a general description of the RF system of the PowerCD transmitter.

Refer to Figure B-15. The exciter outputs feed the RF unit. The RF unit has several functions, which include the following:

- The RF unit contains the exciter switcher.
- The RF unit sets the output power for each HPA (high power amplifier) system per the control voltage generated within the HPA controller automatic power control circuitry for that HPA system.
- The RF unit contains phase shifter circuitry to facilitate proper combining of two or more HPA systems.
- The RF unit provides the drive for the IPA (IOT driver) modules which are located in the driver (control) cabinet. There is one IPA module for each HPA system.

The HPA system is comprised of the power cabinet, the cooling cabinet, and the IOT cabinet. Each HPA system supports one IOT.

![Diagram of PowerCD Transmitter with Two Exciters and Two PA Cabinets](image-url)

*Figure B-15 PowerCD Transmitter With Two Exciters and Two PA Cabinets*
B.6 Typical Materials Needed

The following list represents the materials that may be used for the various field installs. Not all materials are required for every installation.

- Coupler, Mini Circuit, ZFDC-10-21, 50 ohm BNC, Harris part number 620-2969-000
  This coupler is used when a spare sample is not available. It is placed in line at the measurement point and the coupled port used for the feedback. The coupled port has a 10 dB attenuation from the input.
- Splitter, two port, Mini Circuits, ZFSC-2-2, zero phase, 50 ohm SMA, Harris part number 620-2964-000
  This splitter is used to split the feedback signals to two exciters.
- Splitter, two port, Mini Circuits, ZFSC-2-2, zero phase, 50 ohm BNC, Harris part number 620-1563-000
  This splitter is used to combine the PA feedback signal from two PA cabinets if separate mask filters are used for each PA.
- Splitter, four port, Mini Circuits, ZFSC-4-1, zero phase, 50 ohm BNC, Harris part number 620-2833-000
  This splitter is used to combine the PA feedback signal from three or four PA cabinets if separate mask filters are used for each PA. For combining samples from three PA cabinets, terminate unused input port.
- Adapters, N female to BNC male, Harris part number 620-0128-000
  Used to connect a BNC coupler directly to the N connector on the RF system.
- Adapter, BNC female to N male, Harris part number 620-0547-000
  Used to connect the original RF system cable to feedback coupler.
- Adapter, BNC male to BNC male, Harris part number 620-0564-000
  Used in Platinum transmitters to connect the feedback coupler directly to the RF sample coupler.
- Adapter TNC female to BNC male, Harris part number 620-2967-000
  Used in Sigma to connect the feedback coupler directly to the breakaway couplers.
- Adapter, BNC female to TNC male, Harris part number 620-2821-000
  Used in Sigma to connect original breakaway coupler cable to the feedback coupler.
- RF Cables, the number and type of each depends on transmitter type and installation. Depending on installation, other lengths and connector combinations may be needed.
  - 30 ft, RG223, 50 ohm, BNC male to SMA male
  - 30 ft, RG223, 50 ohm, BNC male to BNC male
  - 30 ft, RG223, 50 ohm, N male to BNC male
  - 30 ft, RG223, 50 ohm, N male to SMA male
  - 30 ft, RG223, 50 ohm, N male to N male
  - 10 ft, RG223, 50 ohm, BNC male to BNC male
  - 3 ft, RG223, 50 ohm BNC to BNC
  - 3 ft, RG223, 50 ohm BNC to SMA male
B.7 Configuring the Exciter

Refer to Appendix A, APEX-M2X Exciter Quick Start Guide for the first bench test powerup of the APEX-M2X exciter and then its subsequent installation into the transmitter.