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Sistemi Integrati

a Finmeccanica Company

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Operations and Maintenance Manual

Model 1118A Low Power DME
Model 1119A High Power DME

571118A-0001 Rev B August, 2006

SELEX Sistemi Integrati Inc.
11300 West 89th Street
Overland Park, KS U.S.A. 66214

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SAFETY SUMMARY

The following are general safety precautions that are unrelated to specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel should understand and apply during through the many phases of operation and maintenance.

ELECTROSTATIC SENSITIVE DEVICES PRECAUTIONS

Since most modules used in all models of equipment have Electrostatic Discharge (ESD) sensitive devices included in them, all modules should be considered sensitive to electrostatic discharge. Handling in the field shall be the same as in the factory. Each system is shipped with a wrist strap that must be worn while maintaining the equipment. The wrist strap shall be fastened to the equipment chassis either in the designated plug-in or attached to the equipment chassis with the alligator clip. The wrist strap must be used before any modules are removed from the equipment and at all times while handling the modules until they are placed in a protective environment such as an anti-static bag. Modules or boards must not be placed on any non-conducting surface such as wooden work benches, painted metal work benches, plastics, or technical manuals. Any work surface to be used must have a conducting mat placed on it and attached to earth ground. The mat and additional wrist straps can be obtained from SELEX Sistemi Integrati Inc.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Under no circumstances should any person remove any protective covers that expose lethal voltages. Do not replace components or make adjustments inside the equipment with primary power supply turned on. Under certain conditions, dangerous potentials may exist when the power is in the off position, due to charges retained by capacitors. To avoid casualties, always remove power and allow time for the capacitors to discharge before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

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SELEX Sistemi Integrati Inc.

This equipment is supplied by SELEX Sistemi Integrati Inc. For replacement parts and repair service, contact SELEX Sistemi Integrati Inc. using the contact information provided below.

HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, you should contact SELEX Sistemi Integrati Inc. by fax, phone or email. Please address the following items (as applicable) in your correspondence to enable us to provide the best possible service.

1. SELEX Sistemi Integrati Inc. model number, type and serial number of equipment.
2. Unit sub-assembly number (where applicable).
3. Item or reference symbol number from parts list or schematic.
4. SELEX Sistemi Integrati Inc. part number and description.
5. Manufacturer's code, name and part number (where applicable).
6. Quantity of each replacement part required.

HOW TO REQUEST REPAIR SERVICE

In order to ensure prompt attention, parts returned for repair should have the following:

1. RMA number (Return Material Authorization number), assigned prior to return when requesting repair service.
2. Unit part number
3. Site location
4. System information
5. Ship-to address for return
6. Contact name and number
7. Date and time of request

CONTACT INFORMATION

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MANUFACTURER'S WARRANTY
SELEX Sistemi Integrati Inc.

The following warranty is applicable in all cases, except where modified or superseded by specific contract terms. Contact SELEX Sistemi Integrati Inc. if clarification is required.

A. The Manufacturer warrants to the original Purchaser, subject to the limitations and exclusions stated below, that mechanical and electrical parts of products which it manufactures, (the "Products" will be free of defects in materials and workmanship for a period of (i) twelve (12) months from the date of Final Acceptance or (ii) eighteen (18) months from the date of shipment, whichever occurs first (the "Warranty Period").

B. If the Customer believes a Product is defective, notice thereof shall be provided to the Manufacturer's Customer Service Department at the address provided on the cover page and (if applicable) to the selling distributor. A defect in material and workmanship covered by this warranty shall be deemed to have occurred only if, and as of the time when, the Manufacturer is notified in writing by the Customer, within the Warranty Period, that the Product has become defective, and the Manufacturer's personnel verify that the said Product, in fact, does not comply with the warranty provided hereunder and it is determined that:

(i) The Products, during the entire Warranty Period, have been operated within normal service conditions, recommended by the Manufacturer and recognized in the industry, and

(ii) The Products have been installed and adjusted according to the Manufacturer's procedures as stated in the Instruction Manual or other instructions supplied in writing by the Manufacturer.

C. Failures caused by lightning or other acts of God, or power surges, are not considered to be defects in materials and workmanship and are not covered under this warranty. Routine Maintenance and calibration are also not considered to be defects in materials and workmanship and are not covered under this warranty. Any change, modification or alteration of the Manufacturer's Products not specifically authorized by the Manufacturer will void this warranty.

D. If it is determined that the conditions for warranty coverage, as described above, have been satisfied, the Manufacturer shall repair or replace the defective products or parts thereof in accordance with the following procedures:

(i) Customer will contact the Manufacturer's customer Service Department which will issue the Customer a Return Authorization (RA) number.

(ii) The Component, defective part, or Product, as appropriate, shall be returned to the Manufacturer for inspection, freight prepaid by the customer. The RA number must be clearly displayed on the exterior of the shipping container. No shipments will be accepted without a RA number. All custom duties, fees, etc. will be paid by the Customer.

(iii) If, upon inspection it is determined by Manufacturer's personnel that the Product or component thereof is indeed defective and covered by this warranty, then Manufacturer, at its option, may either repair the Product or defective components thereof and return the same to the Customer or ship a replacement for the defective Product or part thereof, freight paid. All customs duties, fees, etc. will be paid by the Customer. The Product or component thereof will be returned to the Customer utilizing a shipping mode similar to that used by Customer to ship the same to the Manufacturer.

(iv) If, upon inspection by Manufacturer, it is determined that the Product or component thereof was not defective or was not covered by this warranty, then the cost of all of Manufacturer's inspections and the return shipping charges will be charged to Customer.

MANUFACTURER'S WARRANTY (cont.)
SELEX Sistemi Integrati Inc.

E. The Manufacturer reserves the right to make modifications and alterations to Products without obligation to install such improvements on, in, or in place of theretofore manufactured products of Manufacturer.

F. Manufacturer does not warranty any Products, components, subassemblies, or parts not of its own manufacture. Manufacturer hereby transfers to Customer any and all warranties (if any) which it receives from its suppliers.

G. This warranty applies only to the original purchaser and, unless Customer receives the express written consent of an officer of Manufacturer, this warranty may not be assigned, transferred, or conveyed to any third party, even if the third party is a bon a fide purchaser of the Products.

H. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHETHER STATUTORY OR OTHERWISE, INCLUDING AN IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE FOR INDIRECT, INCIDENTAL, COLLATERAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES OF ANY KIND, WHETHER ARISING OUT OF CONTRACT, TORT, NEGLIGENCE, STRICT LIABILITY, OR OTHER PRODUCTS LIABILITY THEORY.

I. CUSTOMER'S SOLE REMEDY FOR ANY BREACH OF THE WARRANTY SHALL BE THE REPAIR OR REPLACEMENT OF THE PRODUCTS BY THE MANUFACTURER AS PROVIDED HEREIN, AND IN NO EVENT SHALL THE MANUFACTURER BE REQUIRED TO INCUR COSTS FOR THE REPAIR OR REPLACEMENT OF ANY PRODUCT IN EXCESS OF THE PURCHASE PRICE OF SUCH PRODUCT, PLUS ANY TRANSPORTATION CHARGES ACTUALLY PAID ATTRIBUTABLE TO SUCH PRODUCTS.

Table of Contents

Paragraph	Description	Page #
1.	GENERAL INFORMATION AND REQUIREMENTS.....	1-1
1.1	Introduction	1-1
1.2	Equipment Description	1-1
1.2.1	Electronics Cabinet.....	1-1
1.2.1.1	Local Control Unit (LCU)	1-9
1.2.1.2	High Power Amplifier Assembly (1119A DME only).....	1-9
1.2.1.3	Low Power Amplifier	1-9
1.2.1.4	Receiver Transmitter Controller Assembly.....	1-9
1.2.1.5	Monitor Interrogator Assembly	1-9
1.2.1.6	Remote Monitoring System (RMS) Processor CCA.....	1-9
1.2.1.7	Facilities CCA	1-9
1.2.1.8	Interface CCA.....	1-9
1.2.1.9	Battery Charging Power Supply (BCPS) Assembly	1-9
1.2.1.10	AC Monitor Assembly	1-10
1.3	General Design Features.....	1-10
1.3.1	Electronic Subsystem.....	1-10
1.3.2	Antenna Systems.....	1-10
1.3.3	Station Portable Maintenance Data Terminal (PMDT)	1-10
1.4	Monitoring System	1-11
1.4.1	Executive Alarm Functions.....	1-11
1.4.2	Maintenance Alarm Functions	1-11
1.4.3	Automatic Monitor Integrity	1-12
1.5	Station Identification	1-12
1.6	Station Control System	1-12
1.6.1	Control System Features	1-12
1.6.2	Station Control Sequences	1-13
1.6.2.1	Single equipment stations	1-13
1.6.2.2	Dual Equipment stations.....	1-13
1.7	Equipment Specification Data	1-14
1.8	Equipment and Accessories Supplied	1-23
2.	TECHNICAL DESCRIPTION.....	2-1
2.1	Introduction	2-1
2.2	DME Operation Principles	2-1
2.3	Theory of Operation	2-5
2.3.1	Simplified System Block Diagram Theory	2-5
2.3.2	Detailed Theory of Operation.....	2-9
2.3.2.1	Low Power Backplane CCA Block Diagram Theory	2-9
2.3.2.2	High Power Backplane CCA Block Diagram Theory.....	2-11
2.3.2.3	Low Power Amplifier Block Diagram Theory.....	2-13
2.3.2.3.1	Synthesizer CCA Block Diagram Theory.....	2-13
2.3.2.3.2	Low Power Modulator CCA Block Diagram Theory	2-14
2.3.2.3.3	RF Amplifier / Transmitter Assembly Theory.....	2-14
2.3.2.3.4	Pre-Driver and Driver CCA Block Diagram Theory	2-14
2.3.2.3.5	Final CCA Block Diagram Theory	2-14
2.3.2.4	Receiver Transmitter Controller Theory.....	2-16
2.3.2.4.1	CCA, Receiver Transmitter Controller Block Diagram Theory	2-16
2.3.2.4.2	CCA, Receiver RF Block Diagram Theory	2-19
2.3.2.5	Monitor Block Diagram Theory	2-20
2.3.2.5.1	DME Interrogator CCA Block Diagram Theory	2-23

Rev. B August, 2006

i

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Model 1118A/1119A DME

2.3.2.6 RMS Processor Block Diagram Theory	2-25
2.3.2.6.1 RMS CCA Detailed Theory	2-27
2.3.2.7 Facilities CCA Theory	2-29
2.3.2.7.1 Facilities CCA Detailed Theory	2-32
2.3.2.8 Interface CCA Theory	2-34
2.3.2.8.1 Interface CCA Detailed Theory	2-36
2.3.2.9 AC Monitor CCA Theory	2-37
2.3.2.10 Local Control Unit Simplified Theory	2-39
2.3.2.11 Local Control Unit Block Diagram Theory	2-39
2.3.2.11.1.1 DC to DC Converter	2-39
2.3.2.11.1.2 Power Fail Detectors	2-39
2.3.2.11.1.3 Key Switch Registers	2-40
2.3.2.11.1.4 Parallel Interface	2-40
2.3.2.11.1.5 1.8432MHz Oscillator/Divider Chains	2-40
2.3.2.11.2 Positive Alarm Register	2-41
2.3.2.11.3 Negative Alarm Register	2-41
2.3.2.11.4 20 Second Delay Counter	2-41
2.3.2.11.5 LCU Transfer Control State Machine #1 and #2 and Discrete Controls	2-41
2.3.2.11.6 LED Control	2-41
2.3.2.11.7 Audible Alarm	2-41
2.3.2.11.8 Monitor Alarm Interface	2-41
2.3.2.11.9 Station Control Logic	2-42
2.3.2.11.10 System Configuration Inputs	2-43
2.3.2.12 High Power Amplifier Theory	2-43
2.3.2.12.1 High Power Modulator CCA Block Diagram Theory	2-43
2.3.2.12.2 Power Supply CCA Block Diagram Theory	2-44
2.3.2.12.3 RF Amplifier / Transmitter Assembly Theory	2-44
2.3.2.12.4 HP Driver CCA Block Diagram Theory	2-44
2.3.2.12.5 HP Final CCA Block Diagram Theory	2-44
2.3.2.12.6 HP Output CCA Block Diagram Theory	2-44
2.3.2.13 Fan Control CCA Block Diagram Theory	2-46
2.3.2.14 BCPS Block Diagram Theory	2-47
2.3.2.15 Extender Board Block Diagram Theory	2-48
2.3.2.16 Low Noise Amplifier (LNA) Theory	2-48
3. OPERATION	3-1
3.1 Information	3-1
3.2 Remote Control Status Unit (RCSU)	3-1
3.3 Remote Status Unit (RSU)	3-1
3.4 Remote Status Display Unit (RSDU)	3-1
3.5 Portable Maintenance Data Terminal (PMDT)	3-1
3.5.1 Connecting the PMDT	3-2
3.5.2 Starting the PMDT Application	3-2
3.5.3 Turning On the DME	3-2
3.5.4 Equipment Shutdown	3-2
3.5.5 Equipment Turn Off	3-2
3.5.6 PMDT PC Turn Off	3-2
3.6 PMDT Screens	3-3
3.6.1 General	3-3
3.6.2 Menus	3-3
3.6.3 System Status at a Glance; Sidebar Status and Control	3-5
3.6.4 Screen Area	3-6
3.6.5 Configuring the PMDT	3-7
3.6.6 Connecting to the DME	3-8
3.6.6.1 Security Levels	3-8

3.6.6.2 PMDT Logon via Direct or Modem Connection	3-9
3.7 RMS Screens	3-12
3.7.1 RMS Status Screens	3-12
3.7.1.1 RMS Status	3-12
3.7.1.2 Monitor/Transmitter Status	3-13
3.7.2 RMS Data Screens	3-14
3.7.2.1 RMS Maintenance Alerts Screen	3-14
3.7.2.2 Power Supply Data Screen	3-15
3.7.2.3 Analog-to-Digital Data Screen	3-16
3.7.2.4 Digital I/O Data Screen	3-17
3.7.3 RMS Logs Screens	3-18
3.7.3.1 Operational Summary Screen	3-18
3.7.3.2 Alarms Log Screen	3-19
3.7.3.3 Maintenance Alerts Log Screen	3-20
3.7.3.4 Command Activity Screen	3-21
3.7.3.5 Parameter Change Log Screen	3-22
3.7.4 RMS Configuration Screens	3-23
3.7.4.1 General RMS Configuration Screen	3-23
3.7.4.2 Station Configuration Screen	3-25
3.7.4.3 Power Supply Limits Configuration Screen	3-26
3.7.4.4 A/D Limits Configuration Screen	3-27
3.7.4.5 Security Codes Configuration Screen	3-29
3.7.4.5.1 User Account Maintenance	3-29
3.7.4.5.2 Add a User's Account	3-30
3.7.4.5.3 Change a User's Password	3-30
3.7.4.5.4 Delete a User's Account	3-30
3.7.4.6 RMS Commands	3-31
3.7.5 Monitor Screens	3-33
3.7.5.1 All Monitor Data Screens	3-33
3.7.5.1.1 Integral All Monitor Data Screen	3-33
3.7.5.1.2 Standby All Monitor Data Screen	3-34
3.7.5.2 Monitor Configuration Screens	3-35
3.7.5.2.1 General Monitor Configuration Screen	3-35
3.7.5.2.2 Integral Monitor Configuration Screen	3-36
3.7.5.2.3 Standby Monitor Configuration Screen	3-37
3.7.5.3 Special Tests	3-38
3.7.5.4 Monitor Commands	3-40
3.7.6 Monitors 1 - 2 Screens	3-41
3.7.6.1 Monitor Data Screens	3-41
3.7.6.1.1 Integral Monitor Data Screen	3-41
3.7.6.1.2 Standby Monitor Data Screen	3-42
3.7.6.1.3 Monitor Maintenance Alerts Screen	3-43
3.7.6.1.4 Monitor Status Screen	3-44
3.7.6.2 Monitor Test Results Screens	3-45
3.7.6.2.1 Monitor Alarm Limits Integrity Results	3-45
3.7.6.2.2 Interrogator Test Results	3-47
3.7.6.2.3 Transponder Results	3-49
3.7.6.2.4 Decoder Results	3-51
3.7.6.3 Monitor Fault History Screens	3-53
3.7.6.3.1 Integral Monitor Fault History Screen	3-53
3.7.6.3.2 Standby Monitor Fault History Screen	3-54
3.7.6.3.3 LCU Fault History Screen	3-55
3.7.6.4 Monitor Offsets & Scale Factors Screens	3-56
3.7.6.4.1 Monitor Offsets & Scale Factors Screen	3-57

Model 1118A/1119A DME

3.7.6.4.2 Monitor Offsets & Scale Factors Calibration Screen	3-58
3.7.6.5 Trigger Selection Screen.....	3-59
3.7.7 Transmitters Data Screens	3-60
3.7.7.1 Transmitter Data Screen	3-60
3.7.7.2 Transmitter Configuration Screens	3-61
3.7.7.2.1 Nominal Configuration Screen	3-61
3.7.7.2.2 Transmitter Offsets & Scale Factors	3-63
3.7.7.3 Transmitter Commands.....	3-64
3.8 RMM	3-66
3.9 Controls and Indicators.....	3-66
3.10 Local Control Unit (LCU).....	3-66
3.10.1 LCU Display Messages.....	3-67
3.10.1.1 Integral Monitor.....	3-67
3.10.1.2 Standby Monitor	3-67
3.10.1.3 Triggers.....	3-68
4. STANDARDS AND TOLERANCES	4-1
4.1 Introduction	4-1
4.2 Standards and Tolerances	4-1
5. PERIODIC MAINTENANCE.....	5-1
5.1 Introduction	5-1
5.2 Performance Check Schedule	5-1
6. MAINTENANCE PROCEDURES	6-1
6.1 Introduction	6-1
6.2 Performance Check Procedures.....	6-1
6.2.1 Test equipment	6-1
6.2.1.1 Normal/Bypass State Definitions.....	6-2
6.2.2 Transmitter Frequency Performance Check.....	6-2
6.2.3 Receiver Frequency Performance Check.....	6-2
6.2.4 Interrogator Frequency Performance Check	6-3
6.2.5 Transmitter Pulse Performance Check.....	6-3
6.2.6 Transmitter Power Output Performance Check	6-3
6.2.7 Receiver and Decoder Performance Check	6-4
6.2.8 Transponder Reply Delay Performance Check.....	6-4
6.2.9 Identification Frequency Performance Check.....	6-5
6.2.10 Monitor Interrogator Performance Check.....	6-5
6.2.11 Monitor Shutdown/Transfer Control Performance Check	6-6
6.2.12 Monitor Alarm Integrity Performance Check	6-6
6.2.13 Power Supply and Battery Performance Check	6-6
6.2.14 Remote DME Certification Check.....	6-6
6.3 Other Maintenance Procedures.....	6-7
6.3.1 Visual Inspection of DME System.....	6-7
6.3.1.1 Site Inspection	6-7
6.3.1.2 Inspection of Antenna System	6-7
6.3.1.3 Equipment Inspection	6-7
6.3.1.4 Inspection of Battery Backup Unit	6-7
6.3.1.5 Maintenance of Fans and Air Filters (High Power DME Only).....	6-7
6.3.2 Monitor Alignment Procedures.....	6-7
6.3.2.1 Monitor Interrogation Level Calibration.....	6-7
6.3.3 Receiver/Transmitter Controller Alignment Procedures.....	6-8
6.3.3.1 Receiver Sensitivity Adjustment.....	6-8
6.3.3.2 Receiver Sensitivity Calibration	6-9
6.3.3.3 Transmitter LPA Low-Power Alert Alignment (High Power DME Only).....	6-9
6.3.3.4 On-Channel Gate Alignment.....	6-9
6.3.4 Battery Charging Power Supply (BCPS) Alignment Procedures.....	6-12

6.3.4.1 System AC Voltage Alignment.....	6-12
6.3.4.2 System AC Current Alignment.....	6-12
6.3.4.3 Obstruction Light AC Voltage Alignment.....	6-13
6.3.4.4 Obstruction Light AC Current Alignment.....	6-13
6.3.5 Alarm Volume Adjustment Procedure.....	6-14
6.3.6 RMS Facilities Exterior and Interior Temperature Calibration.....	6-14
6.3.7 DME Preselector Tuning.....	6-15
6.3.7.1 DME Preselector Tuning Using Presets.....	6-15
6.3.7.2 DME Preselector Tuning Using IF Peak Tuning.....	6-16
6.4 Special Maintenance Procedures.....	6-17
6.4.1 RMS Lithium Battery Check Procedure.....	6-17
6.4.2 Recording Wattmeter Reference Reading.....	6-17
6.4.3 Configuring Short and Long Distance Echo Suppression.....	6-18
6.4.4 Performing a Frequency Change or X/Y Conversion.....	6-18
6.4.5 Performing a Software Update.....	6-19
7. CORRECTIVE MAINTENANCE.....	7-1
7.1 Introduction.....	7-1
7.2 Test Equipment Required.....	7-1
7.3 Onsite Corrective Maintenance.....	7-1
7.3.1 General Troubleshooting Information.....	7-1
7.4 Maintenance Procedures for Replacement of Faulty Assemblies.....	7-2
7.4.1 Monitor Interrogator 1A11/1A15.....	7-2
7.4.2 Receiver/Transmitter Controller 1A10/1A16.....	7-2
7.4.3 Low Power Amplifier 1A9/1A17.....	7-2
7.4.4 High Power Amplifier 1A3/1A7.....	7-2
7.4.5 RMS Processor CCA 1A13.....	7-2
7.4.6 RMS Facilities CCA 1A14.....	7-2
7.4.7 BCPS CCA 1A20/1A21.....	7-2
7.4.8 Interface CCA 1A19.....	7-2
7.5 Useful Test Point Signals and Voltage Levels.....	7-3
8. PARTS LIST.....	8-1
8.1 Introduction.....	8-1
9. INSTALLATION, INTEGRATION AND CHECKOUT.....	9-1
9.1 Introduction.....	9-1
9.2 Site Information.....	9-1
9.2.1 Site Selection.....	9-1
9.2.1.1 Terrain Features.....	9-1
9.2.1.2 Obstructions.....	9-1
9.2.2 Shelter Requirements.....	9-3
9.3 Unpacking and Repacking.....	9-3
9.3.1 Environmental Considerations.....	9-3
9.4 Input Power Requirement Summary.....	9-3
9.5 Installation Procedures.....	9-3
9.5.1 Installation Tools and Test Equipment.....	9-3
9.5.2 Installation Kits.....	9-4
9.5.3 Shelter Foundation Installation.....	9-4
9.5.4 Shelter Installation.....	9-4
9.5.5 Tower Foundation and Tower Installation.....	9-4
9.5.6 Shelter and Tower Installation Grounding.....	9-4
9.5.7 Air Conditioner Installation.....	9-4
9.5.8 DME Cabinet Installation.....	9-7
9.5.9 Battery Backup Assembly Installation.....	9-7
9.5.10 Primary AC Power Installation.....	9-8
9.5.11 Shelter to Tower Conduit Connections.....	9-8

Rev. B August, 2006

v

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Model 1118A/1119A DME

9.5.12 Obstruction Light Installation and Wiring	9-8
9.5.13 DME Antenna Installation	9-10
9.5.14 DME Transmitter to Antenna Interconnect	9-12
9.5.15 Connecting VOR or ILS Keyer Wiring	9-12
9.5.16 RCSU and RMM Connections	9-12
9.6 Inspection	9-13
9.7 Initial Start-up and Preliminary Testing	9-13
9.7.1 Input Voltage Checks	9-13
9.7.2 Installing Modules in Transmitter Cabinet	9-13
9.7.3 Turn on Procedure	9-13
9.7.4 PMDT Hookup and Setup	9-13
9.7.5 Site Adjustments and Configurations	9-14
9.7.6 System Checkout	9-22
9.7.7 Performance Tuning During Flight Inspection	9-22
10. SOFTWARE	10-1
10.1 Introduction	10-1
11. TROUBLESHOOTING SUPPORT DATA	11-1
11.1 Introduction	11-1

List of Figures

Figure #	Description	Page #
Figure 1-1	Model 1118A Low Power DME	1-2
Figure 1-2	Model 1119A High Power DME	1-3
Figure 1-3	Model 1118A/1119A DME Antenna (typical)	1-4
Figure 1-4	Single Low Power DME Block Diagram	1-5
Figure 1-5	Dual Low Power DME Block Diagram	1-6
Figure 1-6	Single High Power DME Block Diagram	1-7
Figure 1-7	Dual High Power DME Block Diagram	1-8
Figure 2-1	Basic X-Channel DME System Block Diagram	2-2
Figure 2-2	DME Transponder Block Diagram	2-3
Figure 2-3	System Timing Diagram	2-5
Figure 2-4	DME Simplified Block Diagram	2-8
Figure 2-5	Low Power Backplane CCA Block Diagram	2-10
Figure 2-6	High Power Backplane CCA Block Diagram	2-12
Figure 2-7	Low Power DME Amplifier Block Diagram	2-15
Figure 2-8	Receiver Transmitter Controller Block Diagram	2-17
Figure 2-9	Receiver RF Block Diagram	2-19
Figure 2-10	Monitor CCA Block Diagram	2-21
Figure 2-11	DME Interrogator (RF) Block Diagram	2-24
Figure 2-12	RMS CCA Block Diagram	2-26
Figure 2-13	Facilities CCA Block Diagram	2-31
Figure 2-14	Interface CCA Block Diagram	2-35
Figure 2-15	AC Power Monitor Block Diagram	2-38
Figure 2-16	LCU Simplified Block Diagram	2-39
Figure 2-17	LCU Block Diagram	2-40
Figure 2-18	High Power Amplifier Block Diagram	2-45
Figure 2-19	Fan Control CCA Block Diagram	2-46
Figure 2-20	BCPS Block Diagram	2-47
Figure 2-21	Extender Board	2-48
Figure 3-1	Sidebar Status Panel (Dual Equipment shown)	3-5
Figure 3-2	PMDT Configuration Screen	3-7
Figure 3-3	DME System Directory Screen	3-9
Figure 3-4	PMDT Login Screen	3-10
Figure 3-5	Initial PMDT Screen (Dual Equipment shown)	3-11
Figure 3-6	RMS Status Screen (Dual Equipment shown)	3-12
Figure 3-7	Monitor/Transmitter Status Screen (Dual Equipment shown)	3-13
Figure 3-8	RMS Maintenance Alerts Screen (Dual Equipment shown)	3-14
Figure 3-9	RMS Power Supply Data Screen (Dual Equipment shown)	3-15
Figure 3-10	RMS A/D Data Screen (Dual Equipment shown)	3-16
Figure 3-11	RMS Digital I/O Data Screen (Dual Equipment shown)	3-17
Figure 3-12	Operational Summary Screen (Dual Equipment shown)	3-18
Figure 3-13	Alarms Log Screen (Dual Equipment shown)	3-19
Figure 3-14	Maintenance Alerts Log Screen (Dual Equipment shown)	3-20
Figure 3-15	Command Activity Log Screen (Dual Equipment shown)	3-21
Figure 3-16	Parameter change Log Screen (Dual Equipment shown)	3-22
Figure 3-17	General RMS Configuration Screen (Dual Equipment shown)	3-23
Figure 3-18	Station Configuration Screen (Dual Equipment shown)	3-25
Figure 3-19	Power Supply Limits Configuration Screen (Dual Equipment shown)	3-26
Figure 3-20	A/D Limits Configuration Screen (Dual Equipment shown)	3-27
Figure 3-21	DIP Switch Settings Screen	3-28
Figure 3-22	Security Codes Configuration Screen (Dual Equipment shown)	3-29

Rev. B August, 2006

vii

Figure 3-23 RMS Commands Menu.....	3-32
Figure 3-24 Integral All Monitor Data Screen (Dual Equipment shown).....	3-33
Figure 3-25 Standby All Monitor Data Screen.....	3-34
Figure 3-26 General Monitor Configuration Screen (Dual Equipment shown).....	3-35
Figure 3-27 Integral Monitor Configuration Screen (Dual Equipment shown).....	3-36
Figure 3-28 Standby Monitor Configuration Screen (Dual Equipment shown).....	3-37
Figure 3-29 Special Tests Screen.....	3-39
Figure 3-30 Monitor Commands.....	3-40
Figure 3-31 Integral Monitor Data Screen (Dual Equipment shown).....	3-41
Figure 3-32 Standby Monitor Data Screen (Dual Equipment shown).....	3-42
Figure 3-33 Monitor Maintenance Alerts Screen (Dual Equipment shown).....	3-43
Figure 3-34 Monitor Status Screen (Dual Equipment shown).....	3-44
Figure 3-35 Monitor Alarm Limits Integrity Test Results Screen (Dual Equipment shown).....	3-45
Figure 3-36 Interrogator Test Results Screen (Dual Equipment shown).....	3-47
Figure 3-37 Transponder Test Results Screen (Dual Equipment shown).....	3-49
Figure 3-38 Decoder Test Results Screen (Dual Equipment shown).....	3-51
Figure 3-39 Integral & Standby Monitor Fault History Screens (Dual Equipment shown).....	3-53
Figure 3-40 Standby Monitor Fault History Screen (Dual Equipment shown).....	3-54
Figure 3-41 LCU Fault History Screen (Dual Equipment shown).....	3-55
Figure 3-42 Monitor Offsets & Scale Factors Screen (Dual Equipment shown).....	3-57
Figure 3-43 Monitor Offsets & Scale Factors Calibration Screen (Dual Equipment shown).....	3-58
Figure 3-44 Monitor Offsets & Scale Factors Calibration Screen (Dual Equipment shown).....	3-59
Figure 3-45 Transmitter Data Screen (Dual Equipment shown).....	3-60
Figure 3-46 Nominal Configuration Screen (Dual Equipment shown).....	3-62
Figure 3-47 Transmitter Offsets & Scale Factors Screen (Dual Equipment shown).....	3-63
Figure 3-48 TX Commands Menu.....	3-64
Figure 3-49 Ident Commands Menu.....	3-64
Figure 3-50 Delay Control Menu.....	3-65
Figure 3-51 Local Control Unit (LCU).....	3-66
Figure 3-52 LCU Integral Monitor 1 Display.....	3-67
Figure 3-53 LCU Integral Monitor 2 Display.....	3-67
Figure 3-54 LCU Standby Monitor 1 Display.....	3-67
Figure 3-55 LCU Standby Monitor 2 Display.....	3-67
Figure 3-56 LCU Triggers Display.....	3-68
Figure 3-57 LCU Transmitter Controls and Indicators.....	3-70
Figure 3-58 LCU Monitor / System Controls and Indicators.....	3-70
Figure 3-59 High Power Amplifier.....	3-73
Figure 3-60 Low Power Amplifier.....	3-74
Figure 3-61 Receiver/Transmitter Controller (RTC) CCA.....	3-77
Figure 3-62 Monitor CCA.....	3-78
Figure 3-63 Remote Monitoring System (RMS) CCA.....	3-79
Figure 3-64 Facilities CCA.....	3-80
Figure 6-1 - Integral Delay with First Pulse Trigger.....	6-5
Figure 6-2 1A10/1A16 RTC Test Points for On-Channel Alignment.....	6-10
Figure 6-3 Proper On-Channel Alignment.....	6-11
Figure 6-4 Lagging On-Channel Alignment Error.....	6-11
Figure 6-5 Leading On-Channel Alignment Error.....	6-12
Figure 6-6 Preselector Assembly.....	6-15
Figure 7-1 CH1: Monitor, DETECTED VIDEO, normal delay trigger; CH2: LPA, DETECTOR.....	7-3
Figure 7-2 CH1: Monitor, DETECTED VIDEO, efficiency trigger; CH2: RTC, LOW VIDEO.....	7-3
Figure 7-3 CH1: Monitor, DETECTED VIDEO, normal delay trigger; CH2: RTC, LOW VIDEO.....	7-4
Figure 7-4 CH1: Monitor, DETECTED VIDEO, forward power trigger.....	7-4
Figure 7-5 CH1: Monitor, DETECTED VIDEO, reflected power trigger.....	7-5
Figure 7-6 CH1: RTC, LOW VIDEO; CH2: RTC, IRQ TP13;.....	7-5

Figure 9-1 Typical DME Site 9-2

Figure 9-2 Typical DME Tower Installation Diagram..... 9-5

Figure 9-3 Triangular Tower Adapter Plate..... 9-6

Figure 9-4 Typical DME Shelter and Tower Grounding Diagram 9-7

Figure 9-5 DME Obstruction Light Interconnect Diagram with Photo Sensor 9-9

Figure 9-6 DME Obstruction Light Interconnect Diagram without Photo Sensor 9-9

Figure 9-7 Typical Shelter to Tower Conduit Installation 9-10

Figure 9-8 Obstruction Light Installation Diagram..... 9-11

List of Tables

Table #	Description	Page #
Table 1-1	Equipment Specification Data for 1118A/1119A.....	1-14
Table 1-2	Equipment and Accessories that may be Supplied for DME.....	1-23
Table 3-1	Functions Available via PMDT.....	3-4
Table 3-2	DME Security Levels.....	3-8
Table 3-3	General Configuration Parameters.....	3-24
Table 3-4	Monitor System Level Settings.....	3-36
Table 3-5	Monitor Special Test Configuration.....	3-38
Table 3-6	Monitor Alarm Limit Integrity Test Criteria.....	3-46
Table 3-7	Interrogator Test Criteria.....	3-48
Table 3-8	Transponder Test Criteria.....	3-50
Table 3-9	Decoder Test Criteria.....	3-52
Table 3-10	Monitor Trigger Functions.....	3-59
Table 3-11	Transmitter Nominal Configuration.....	3-61
Table 3-12	Transmitter Offsets and Scale Factors.....	3-63
Table 3-13	Equipment Control Panel Functions.....	3-69
Table 3-14	Equipment Control Panel Functions.....	3-71
Table 3-15	Equipment Control Panel Functions.....	3-72
Table 3-16	Equipment Controls & Indicators.....	3-73
Table 3-17	Equipment Controls & Indicators.....	3-74
Table 3-18	Equipment Controls & Indicators.....	3-75
Table 3-19	Equipment Controls & Indicators.....	3-79
Table 3-20	Equipment Controls & Indicators.....	3-80
Table 4-1	System Standards and Tolerances.....	4-1
Table 5-1	Performance Checks.....	5-1
Table 6-1	List of Required Test Equipment.....	6-1
Table 6-2	List of Additional Recommended Test Equipment.....	6-1
Table 6-3	Preselector Preset Alignment Table.....	6-16
Table 6-4	Wattmeter Reference Readings.....	6-17
Table 8-1	Single Equipment Low Power DME System PN 001118A-0101.....	8-1
Table 8-2	Dual Equipment Low Power DME System PN 001118A-0102.....	8-2
Table 8-3	Single Equipment High Power DME System PN 001119A-0101.....	8-3
Table 8-4	Dual Equipment High Power DME System PN 001119A-0102.....	8-4
Table 9-1	Special Tools Required for Installation.....	9-3
Table 9-2	Component or Modification Kits Required to Install the DME.....	9-4
Table 9-3	Additional kits required to Install Shelter and Tower Grounding Systems.....	9-4
Table 9-4	External Keying Connection Locations.....	9-12
Table 9-5	DME Channel Frequency Allocation.....	9-14
Table 11-1	Schematic Diagrams.....	11-1

1. GENERAL INFORMATION AND REQUIREMENTS

1.1 Introduction

This manual provides the information required to operate and maintain the single or dual Model 1118A/1119A Distance Measuring Equipment (DME). [Figure 1-1](#) illustrates a dual 1118A Low Power DME cabinet and [Figure 1-2](#) illustrates the dual 1119A High Power DME cabinet. These figures provide the description and locations of the modules contained in the transmitter cabinet(s). [Figure 1-3](#) illustrates the DME Antenna.

Included within this manual are equipment description and specifications, block diagram theory of operation, operating procedures, standards and tolerances, periodic maintenance procedures, corrective maintenance procedures, parts list, installation procedures, schematics, and other diagrams.

1.2 Equipment Description

The DME system is comprised of a DME ground station and equipment on-board the aircraft. An interrogator in the aircraft transmits signals (pulses) to the ground station. The DME evaluates the interrogation signals and, if the signals are determined to be valid, transmits a reply on a different frequency. The interrogator measures the elapsed time for the round trip and converts this time to a distance indication (in nautical miles). An identification signal is then transmitted by the DME approximately every 30 seconds so that the pilot can positively identify the selected station. Each interrogator transmits interrogation pulse pairs at a constant rate and listens for replies from the ground station. Interrogations and replies have a time-distance relationship. For the airborne DME to display a distance, several successive time-distance interrogation replies must be received by the interrogator. When distance is displayed the system condition is known as "lock-on". Other interrogations will not affect the system because the time-distance relationship is not correct. The DME can be interrogated simultaneously by a maximum of 200 aircraft interrogators (within range and tuned to its channel).

The 1118A DME is normally collocated with an ILS Localizer or Glideslope or with a VOR for a terminal application. It may be collocated with a VOR for an en route application or may be operated independently. Identification of the DME is synchronized to the respective collocated facility or the DME may be configured to ident by itself through the use of a built-in keyer.

The 1119A DME is normally collocated with a VOR as an enroute navigation aid. It may be collocated with an ILS for a terminal application. Identification of the DME is synchronized to the respective collocated facility or the DME may be configured to ident by itself through the use of a built-in keyer.

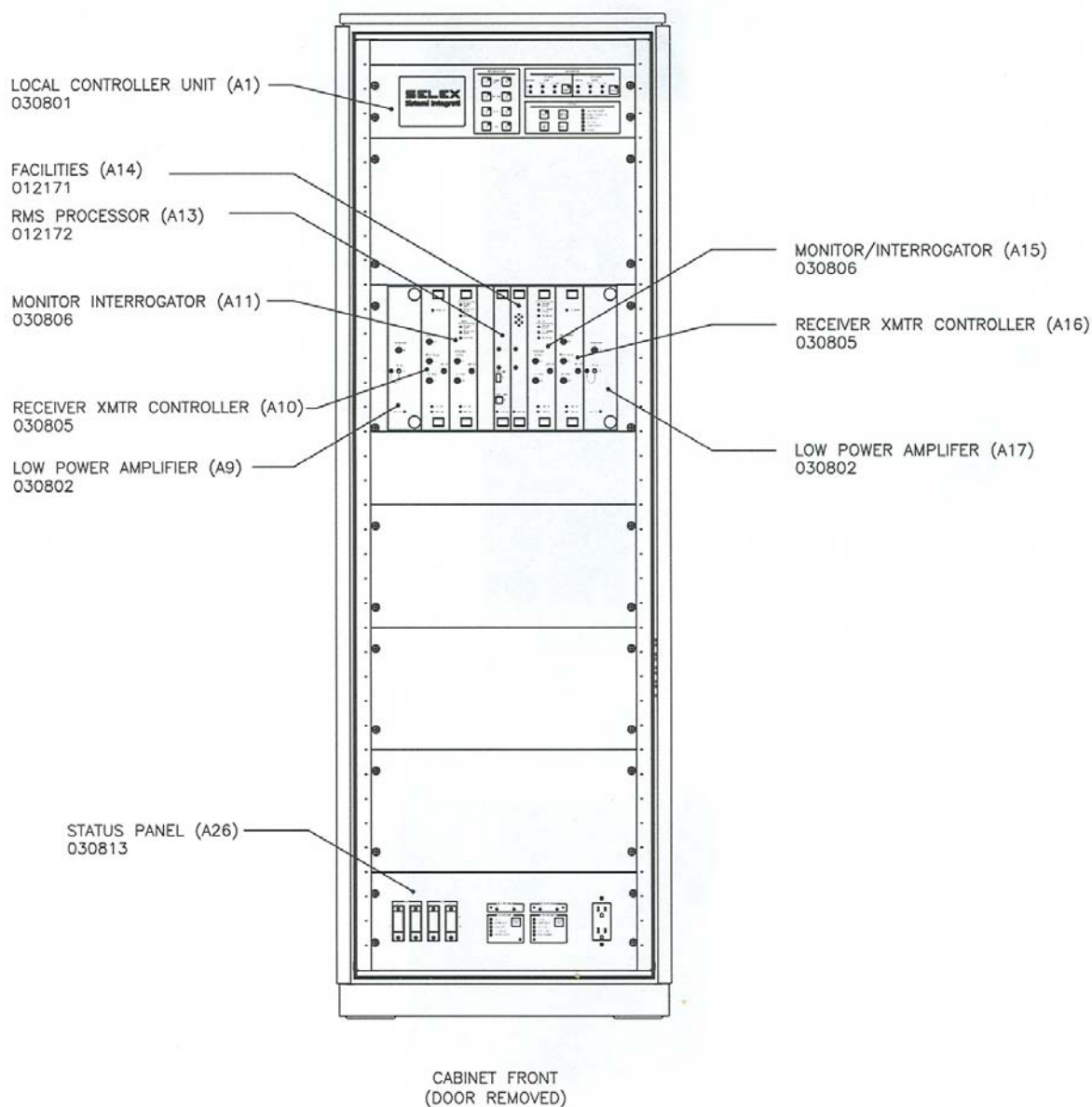
1.2.1 Electronics Cabinet

Refer to [Figure 1-1](#) and [Figure 1-2](#). The 1118A/1119A DME is contained in one (1) electronics cabinet measuring 24 inches wide, 24 deep and 72 inches high. It utilizes a standard 19" rack configuration with a front panel door that covers and protects the equipment. The Model 1118A/1119A is 100% solid-state. Its internal circuitry is contained on plug-in type printed circuit card assemblies (CCAs) and RF modules.

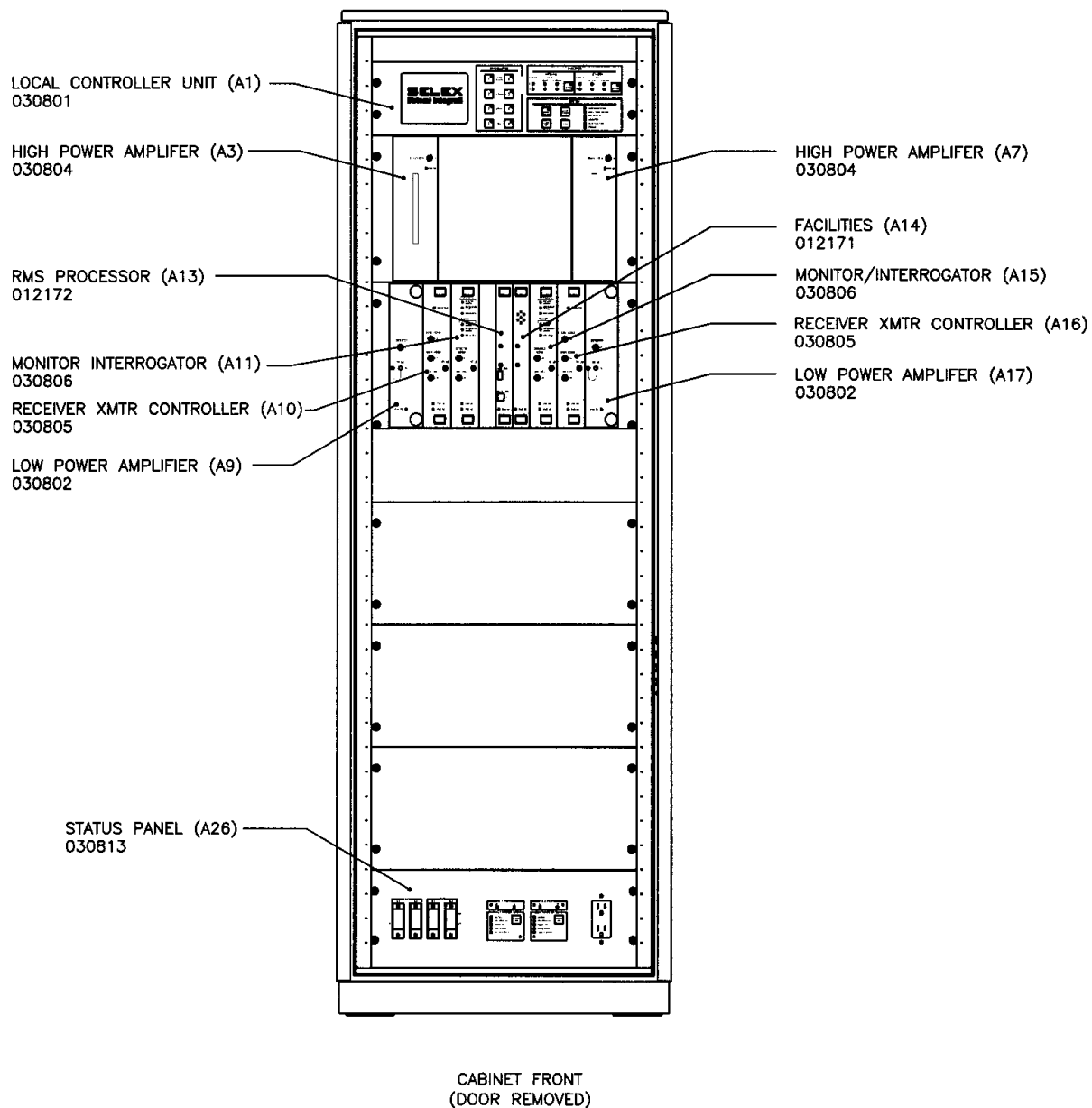
[Figure 1-1](#) shows the layout of the various modules within the Model 1118A Low Power DME cabinet. [Figure 1-2](#) shows the layout of the various modules within the Model 1119A High Power DME cabinet. The paragraphs on the following pages provide a brief description of each of the modules and its function in the system. Note that the cabinets shown are dual equipment systems.

Reference [Figure 1-4](#) and [Figure 1-5](#) for the Model 1118A Low Power DME system block diagrams. Refer to [Figure 1-6](#) and [Figure 1-7](#) for the Model 1119A High Power DME system block diagrams.

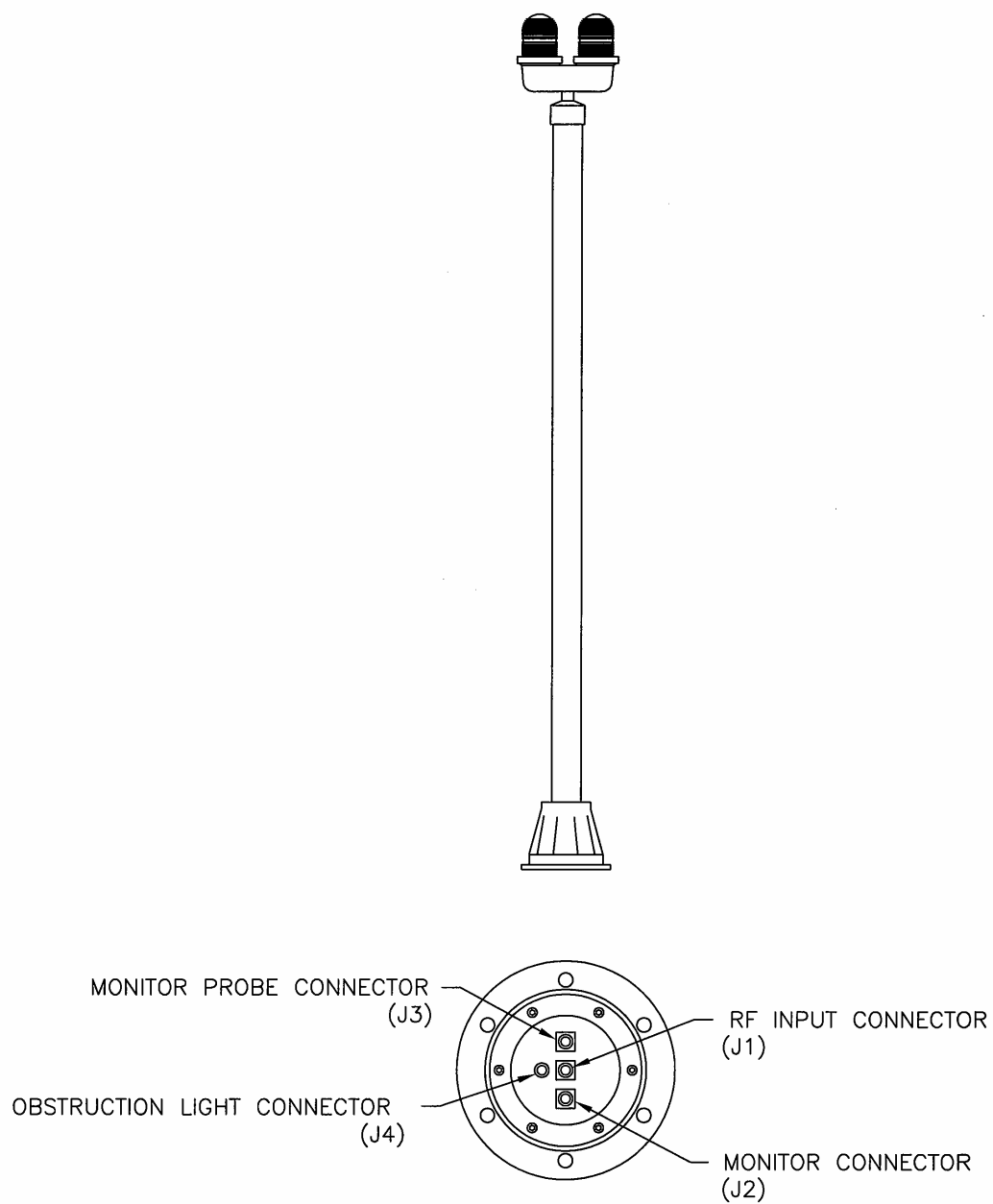
Model 1118A/1119A DME



**Figure 1-1 Model 1118A Low Power DME
(Dual Equipment Shown)**



**Figure 1-2 Model 1119A High Power DME
(Dual Equipment Shown)**



1118-029

Figure 1-3 Model 1118A/1119A DME Antenna (typical)

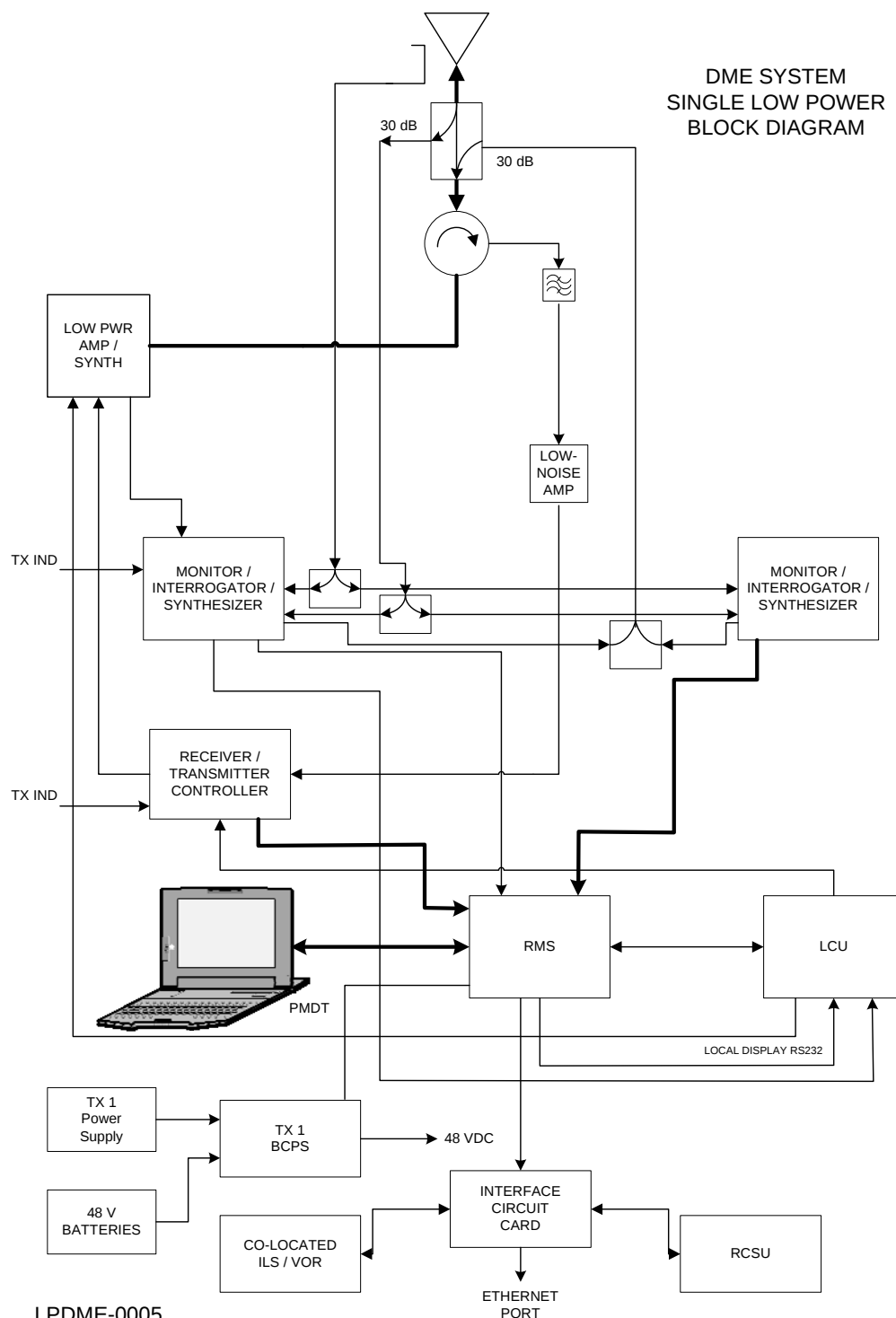


Figure 1-4 Single Low Power DME Block Diagram

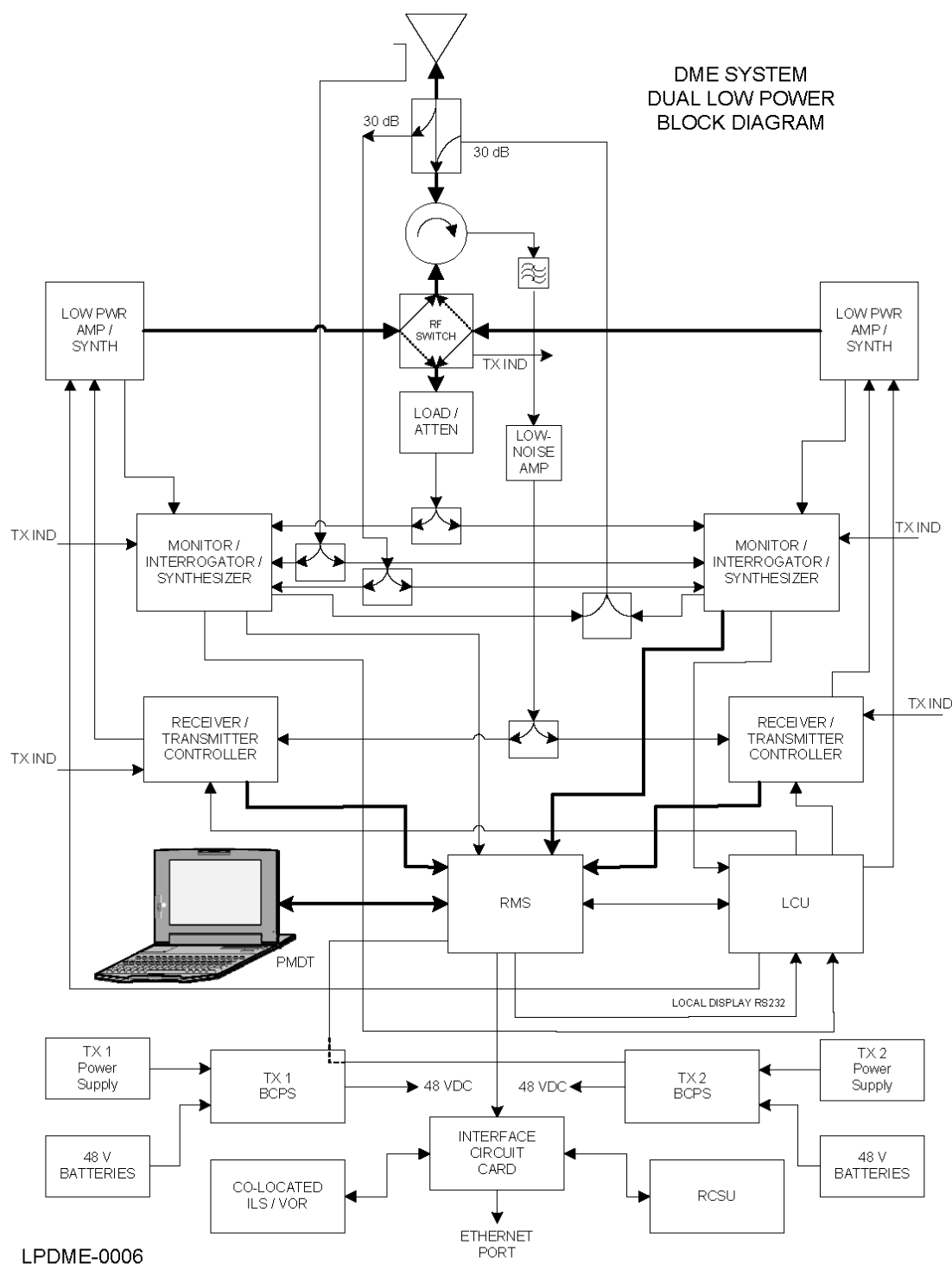


Figure 1-5 Dual Low Power DME Block Diagram

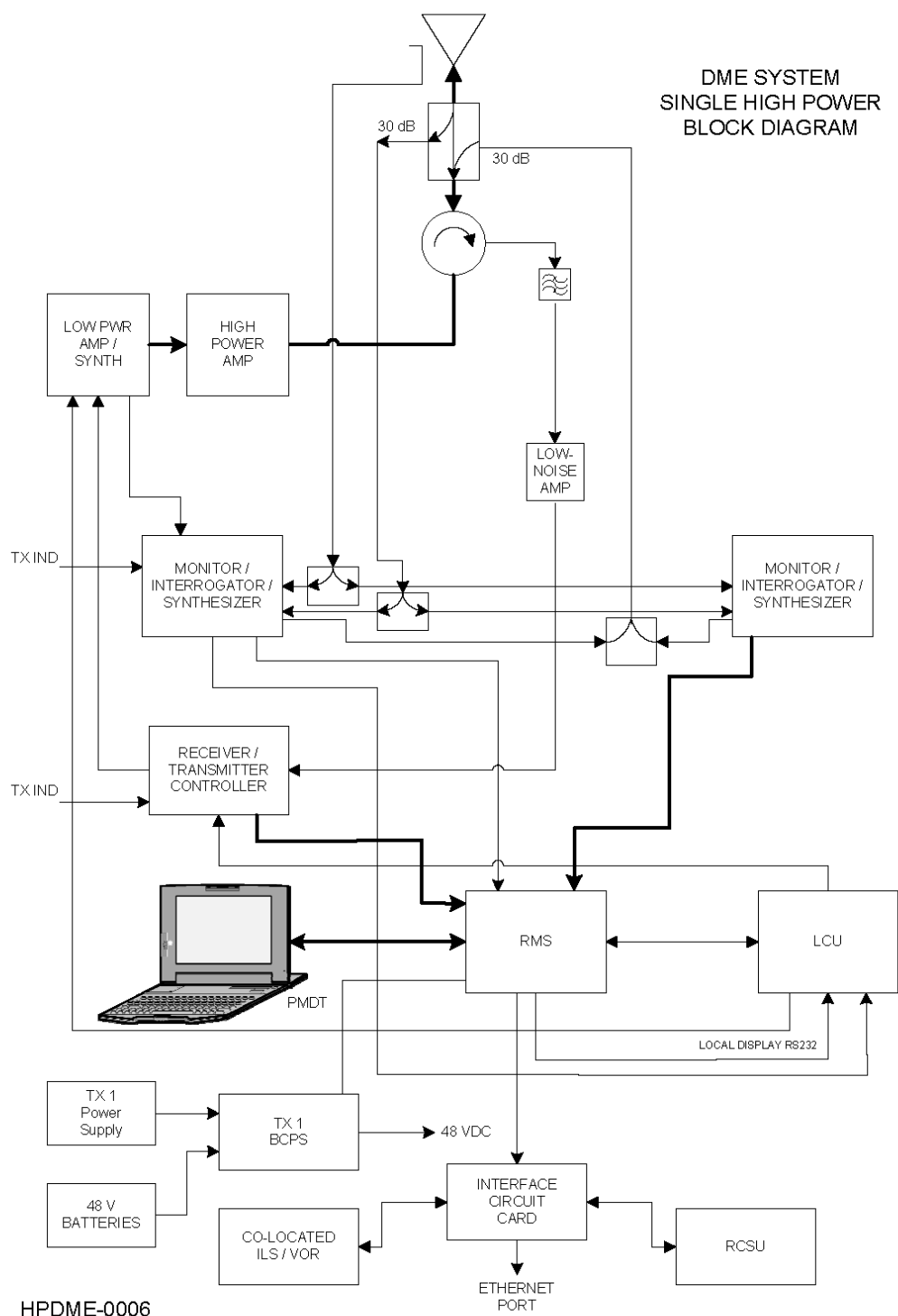


Figure 1-6 Single High Power DME Block Diagram

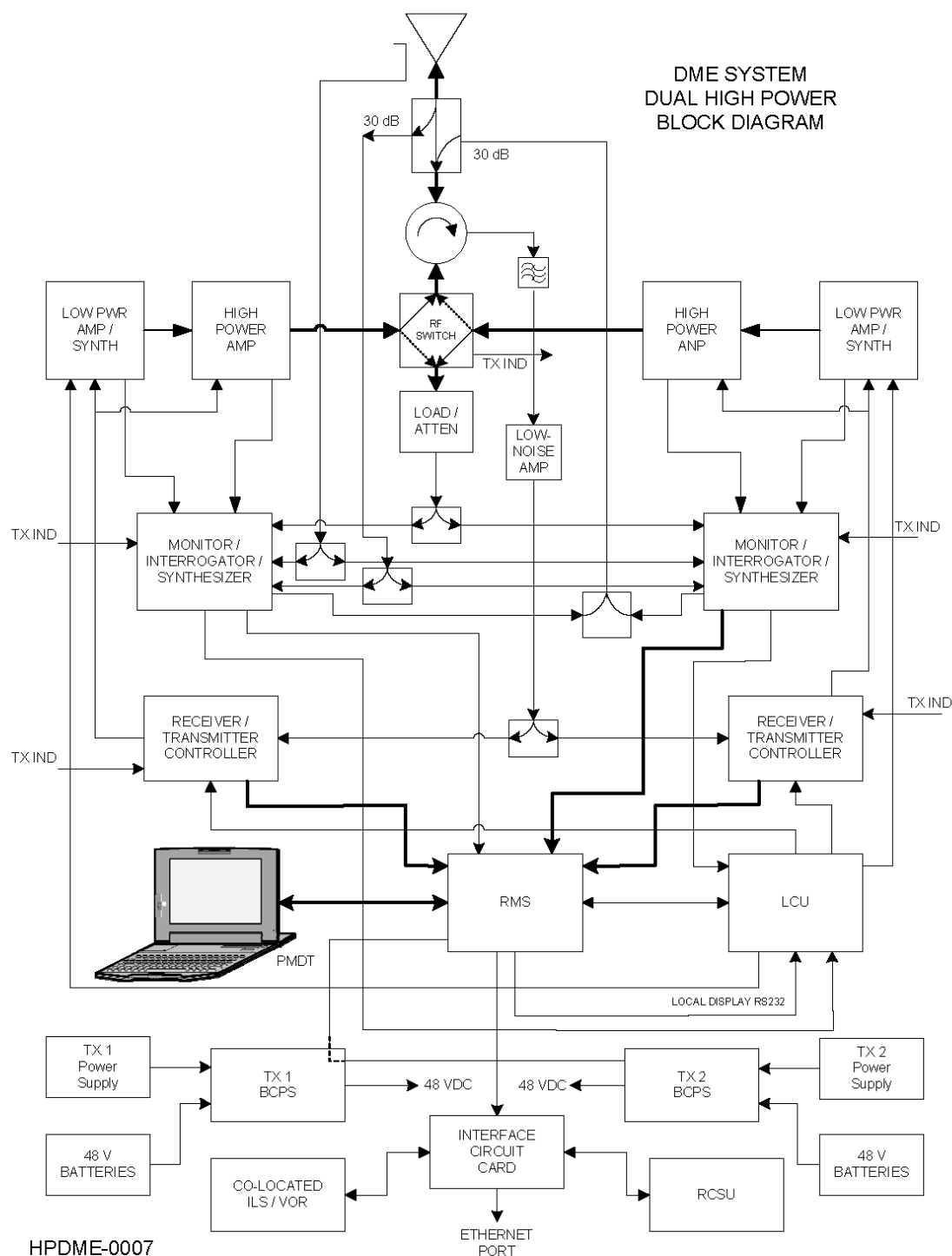


Figure 1-7 Dual High Power DME Block Diagram

1.2.1.1 Local Control Unit (LCU)

The Local Control Unit (LCU) is located in the upper portion of the DME cabinet providing station status information. LCU provides for Transmitter, Monitor and System setup, monitoring and control.

1.2.1.2 High Power Amplifier Assembly (1119A DME only)

The High Power Module has three major assemblies. The Modulator assembly board, which is also the module's I/O, processes the control signals from the RTC (Receiver Transmitter Controller) to properly control the desired output RF pulse shape and amplitude. The Power Supply assembly board contains the DC/DC converters and transmitter energy storage capacitors. The third assembly is the RF amplifier/transmitter portion of the module. It receives a "square wave" pulsed RF signal from the Low Power Amplifier Module and provides the necessary amplification and pulse shaping to obtain the output specifications. The High Power Module is used in both the High Power DME systems and TACAN systems with the differences between the DME and TACAN versions noted. Only minor changes are required for it to be able to be used in either system.

1.2.1.3 Low Power Amplifier

The Low Power Amplifier houses the Synthesizer assembly board which generates a pulsed RF signal for the DME transmitter. The RF amplifier/transmitter assembly boards provide the necessary amplification of the Synthesizer signal and the Modulator assembly board which processes the control signals from the RTC (Receiver Transmitter Controller) module to properly control the desired output RF pulse shape and amplitude.

1.2.1.4 Receiver Transmitter Controller Assembly

The Receiver Transmitter Controller (RTC) is an integral part of the DME dedicated to receiving aircraft interrogations and controlling the transmitter replies. All of the receiver hardware is contained on the RTC assembly except for the pre-selector filter that is tuned to the station frequency.

1.2.1.5 Monitor Interrogator Assembly

The Interrogator (RF board) has all the necessary circuitry to modulate the interrogations from the Monitor and demodulate the replies from the RTCs.

1.2.1.6 Remote Monitoring System (RMS) Processor CCA

The Remote Monitoring System (RMS) Processor CCA controls the transmitter and monitoring systems. The RMS CCA performs communications via thirteen serial ports plus a parallel port, and facilitates monitoring/control in a single or dual DME system. The RMS CCA receives battery-backed DC power from the BCPS.

1.2.1.7 Facilities CCA

The Facilities CCA provides system I/O for the Remote Monitoring System CCA. Many of the inputs and outputs of the Facilities CCA eventually connect to the Interface CCA after routing through the Low Power Backplane CCA. System battery-backed power supplies (nominally 48VDC) enter and are regulated down into several lower voltages; including +24V, ± 15 VDC, ± 12 VDC, +5VDC, and +3.3VDC.

1.2.1.8 Interface CCA

The Interface CCA provides interface connections between the RMS/Facilities/Low Power Backplane CCAs and the outside world. Examples include spare analog and digital inputs, spare digital outputs, temperature sensors, smoke detector, intrusion sensor, and a TACAN antenna controller. RS232 communications are provided to RCSU and PMDT terminals as well as an Ethernet module. All signals are protected by transient voltage suppression (TVS) devices on the Interface CCA before exiting.

1.2.1.9 Battery Charging Power Supply (BCPS) Assembly

This BCPS provides regulated voltage to the transmitter from either the AC to DC power supplies or the batteries. It is also responsible for charging the batteries when AC is present.

1.2.1.10 AC Monitor Assembly

The AC Power Monitor CCA provides a means for the DME system to measure the AC current and voltage levels of the obstruction lights and of the DME system itself. Provision for operating with a photo switch is incorporated. A capability to bypass the photo switch for the obstruction lights is provided.

1.3 General Design Features

The DME is of a solid state design and includes an electronic subsystem in either a single or dual equipment configuration, antenna system, shelter-to-antenna system cables, installation and interface kits, no-break battery backup system of the maintenance-free design, instruction manuals and necessary accessory items such as extender boards and cables. Additional interface kits are furnished as required when the DME is to be co-located with a VOR or ILS (Localizer or Glideslope) station.

The system uses microprocessor control and has been designed for ease of installation, high reliability, maximum attention to fail safe characteristics in the monitoring system, enhanced system security, a minimum number of required remote control and telephone lines and maximum attention to equipment and personnel safety. Circuit breakers and fuses on AC & DC power lines and internal circuits offer maximum protection for the equipment. The equipment cabinets and interior component layouts are designed for maximum protection against EMI. Standby battery backup systems utilize maintenance-free batteries which require no special venting.

1.3.1 Electronic Subsystem

The DME electronic subsystem consists of either a single or dual-equipment configuration of a modular design with either a single or dual monitor. Both single and dual equipment systems are housed in a single cabinet suitable for mounting on the floor of an equipment shelter. The cabinet is arranged such that all major modules and circuit card assemblies are readily accessible from the front for maintenance and replacement. Plug-in modules are utilized to the maximum extent possible for ease of replacement. Test points for troubleshooting measurements are located on the various modules.

1.3.2 Antenna Systems

Two versions of antenna systems are available for installation with the DME depending on customer requirements. The antennas are supplied with the necessary mounting structure required for the application. Systems located stand alone are furnished with a tower for installation next to the equipment shelter. Systems co-located with VOR's may be furnished with the necessary adapters for a co-axial installation above the VOR antenna.

1.3.3 Station Portable Maintenance Data Terminal (PMDT)

The standard PMDT consists of a laptop computer and is the input/output device for controlling and communicating with the DME system. Station control, adjustment and monitoring functions are available through the computer, and are accessed via a Windows-based operator interface. An optional external mouse may be used with the laptop computer for ease in operation. An optional desktop PC is available as a substitute for the standard laptop computer. Also, an optional printer is available for use with either the laptop or desktop PC.

Station security control is provided through a three-level password system. Complete access to the system for adjustments and measurements is provided at level 3. Modification of non-critical parameters is available at level 2, and read-only access is available at level 1.

All functions available on the local PMDT are available remotely via a modem and dial-up telephone line to an optional remote laptop or desktop PC running the PMDT software.

1.4 Monitoring System

A high integrity integral monitoring system incorporated in the DME station provides fault detection by monitoring the actual transmitted signal and initiating automatic station transfer/shutdown action in the event of an out-of-tolerance condition. A pickup device built into the transmitting antenna samples the transmitted signal.

Each monitor evaluates the signal in space and the standby transmitter. In the dual monitor configuration, the monitors vote in a selectable AND/OR mode to determine shutdown/transfer action during an alarm condition. When the standby system is operating in the "Hot Standby" mode, both monitors evaluate the signal being directed to the dummy load.

In addition, the system contains numerous internal sampling points to monitor essential operating and maintenance parameters. The functions listed below as "Executive" are in the station control path and an alarm will cause the station to initiate its shutdown/transfer and dial-out sequence. The functions listed as "Maintenance Alarms" are not in the control path and do not initiate the station shutdown/transfer sequence. Some maintenance alarms will initiate a dial-out to a remote maintenance terminal to alert the technician of the difficulty. Station control and alarm functions are accessible both through the dial-out feature as described and locally on the station terminal. In addition, the executive alarm status is indicated remotely on the optional Remote Status and Control (RSCU) and Remote Status (RSU) Units as well as on the optional Remote Receiver (off-the-air) Monitor. Remote station on-off control is provided on the RSCU.

The monitoring system includes a bypass capability to disable automatic station control action during adjustment and maintenance. A front panel bypass light is illuminated any time the monitoring system is bypassed.

Monitored and internally measured parameters are available for display via a front panel USB communications port. The system is password controlled such that adjustments to the monitoring system are not possible without entry of the proper security codes. The listings below summarize the various system monitoring parameters:

1.4.1 Executive Alarm Functions

Alarms which initiate system shutdown/transfer action and a dial-out to the remote maintenance terminal:

- a. Transmitter Pulse Spacing.
- b. Reply delay.
- c. Effective Radiated Power (ERP).
- d. Reply efficiency.
- e. Transmitter Pulse Count.
- f. Loss of or Continuous Station Identification.
- g. Transmitter Frequency
- h. Receiver Frequency

Each of the above functions is selectable as either "Primary" or "Secondary" through the PMDT. Also, an alarm LED is provided for Integral and Standby transmitter Primary and Secondary parameters. For dual equipment the Main and Standby units may be set for best available. When selected, parameters designated as Secondary will not cause the DME to shutdown thus increasing the availability of the DME.

1.4.2 Maintenance Alarm Functions

The following is a list of alarms which initiate a maintenance alert on the optional Remote Control and Status Unit (RCSU) without system shutdown/transfer action:

- a. Change in Transmitter Cabinet Temperature
- b. AC Power Failure (dial out)
- c. Operation on Batteries (dial out)
- d. Voltages or currents outside tolerance
- e. Disagreement between the station monitors
- f. System AC/DC Power Supply Failure

1.4.3 Automatic Monitor Integrity

The Automatic Monitor Integrity Test feature programs the Monitor Interrogator to apply alarm limit signals to the various executive monitor channels on both Monitor 1 and Monitor 2 to verify the ability of the monitors to detect out-of-tolerance conditions. Should either of the two monitors fail the integrity test, a monitor maintenance alert is generated.

1.5 Station Identification

Identification keying of the DME is accomplished via several methods to accommodate a wide variety of installations. For stand-alone operation, a built-in keyer supplies the necessary keying signal. When the DME is co-located with a VOR or an ILS installation, a keying input signal from the VOR or ILS Localizer is utilized for the identification to ensure proper synchronization. When collocated with an MLS, the DME may be set to be the Master and provide keying to the MLS. Depending on local practices, the DME keying system may be programmed for operation as follows:

- a. DME Identifies itself independently using its own internal keyer.
- b. DME is Identified by a signal from a co-located VOR or ILS Localizer station in one of the two following modes:
 1. DME reverts to its internal keyer for identification on loss of the keying signal from the co-located station and continues to operate. Normal synchronized identification operation resumes on return of the external keying signal.
 2. DME shuts down on loss of the external keying signal from the co-located station and resumes operation on return of the external signal.
- c. DME is a master and keys a collocated VOR, ILS or MLS.

Interface cabling and accessories for the DME keying signal are provided as required depending on the system co-location.

1.6 Station Control System

The station control system provides for manual control of the station during maintenance operations and for automatic control during unattended operation. During unattended operation, the system receives and acts on inputs from the monitoring system.

1.6.1 Control System Features

The control system provides the following features:

- a. Local on/off control and status indication of the transmitting equipment.
- b. Selection of which transmitting equipment is designated as Main and which is Standby in the control sequence for dual equipment stations.
- c. Operation of the Standby transmitter in either a "hot standby" or a "warm standby" mode for dual equipment stations. When not connected to the antenna, the standby transmitter is automatically connected to an attenuator for monitoring.
- d. Automatic shutdown of the station transmitting equipment (following an adjustable preset alarm delay period, 10-seconds nominal) in response to monitor executive alarms.
- e. Automatic transfer to the standby transmitting equipment for dual-equipment stations.

- f. Two automatic restart attempts of the transmitting equipment for single or dual equipment stations; the first after a delay period of 20 seconds following the shutdown and the second at 5-minutes. If either restart attempt is successful, the time delays are reset to their original no-alarm condition. If the alarm condition persists through the two restart attempts, the station will shut down and require a manual restart.
- g. Automatic station transfer to and from the no-break standby battery system in the event of primary AC power failure and subsequent restoration, and automatic turn-on following restoration of the AC power should the standby battery system be depleted. The batteries automatically recharge on restoration of primary power.
- h. Remote On/Off control and status indication via a two-wire dedicated telephone line to a Remote Control and Status Unit (RCSU) (optional) installed in a control tower equipment room. A slave Remote Status Unit (RSU) (optional) without the control functions is available for installation at a controller's position in the control tower cab.
- i. Remote control and monitoring (RMM) via Modem and dial-up telephone line. The system is programmed to dial the remote location in response to executive or maintenance alarm conditions.

1.6.2 Station Control Sequences

1.6.2.1 Single equipment stations

- a. Automatic shutdown (following an adjustable preset alarm delay period, 7-seconds nominal) in response to monitor executive alarms.
- b. Automatic restart following an adjustable preset delay period (20-seconds nominal).
- c. Continued normal operation if the alarm condition has cleared after restart. If the alarm condition persists, the transmitter will shut down again following the 7-second delay period.
- d. An additional restart attempt at 5-minutes.

1.6.2.2 Dual Equipment stations

- a. Automatic shutdown of the main transmitter (following a nominal 10-second programmed delay time) in response to monitor executive alarms.
- b. Automatic transfer to the standby transmitter.
- c. Continued normal operation of the standby transmitter if no alarm condition exists after the transfer. If an alarm condition exists the standby transmitter will shut down following the 7 second delay period and the system will attempt an additional restart at 5-minutes.

1.7 Equipment Specification Data

Table 1-1 contains the specification data for the Model 1118A and 1119A DME transponders.

Table 1-1 Equipment Specification Data for 1118A/1119A		
Parameter		Tolerance/Limit
1.0 General System Specifications		
1.1 DME System Power Requirements		
1.1.1	Primary Power	85 to 264 V AC, 47-63 Hz single phase
1.1.2	Standby Power	48 V DC no-break battery backup system consisting of 4 lead acid batteries with charger provides a minimum of 4-hours operation at 2700 PPPS. Battery life is dependant upon traffic loading. The system will automatically disconnect the batteries when the voltage reaches approximately 40V to guard against excessive discharge. Batteries are of the maintenance-free design. Each battery backup set is mounted in a floor mount battery rack. The standard battery rack uses 4 each 35 amp-hour batteries. The long run time battery rack uses 4-each 65 amp-hour batteries. The standard configuration is one set of four batteries for a dual DME. An additional set of 4 batteries for the second transmitter is available as an option.
1.1.3	Power Consumption	Low Power: 160 VA nominal High Power: 250 VA nominal
1.1.4	Duty Cycle	Continuous
1.2 Dimensional Data		
1.2.1	Size of Equipment Cabinet	72" H x 24" W x 24" D (183cm H x 61cm W x 61cm D)
	Weight of Cabinet	180 lb (81.7 kg) Low Power DME 210 lb (95.3 kg) High Power DME
	Mounting	Floor mount
1.3 Environmental Data		
1.3.1	a) Operating Temperature:	
	Indoor Equipment	-10° C to + 55° C
	Outdoor Equipment	-50° C to + 70° C
	b) Storage Temperature	-40° C to + 70° C

Table 1-1 Equipment Specification Data for 1118A/1119A		
Parameter		Tolerance/Limit
1.3.2	Relative Humidity	
	Indoor Equipment	to 95% (non-condensing) @ 50° C
	Outdoor Equipment	to 100% at +70° C
1.3.3	Wind and Ice	to 100 mph (161 km/h) with up to ½" (1.3 cm) accumulation of clear ice on all outdoor components
1.3.4	Altitude	To 15,000 ft MSL (4573 m)
1.4	MTBF (as calculated using MIL Handbook 217)	
	a) Low Power Stations	≥ 10,410 hours (single equipment) ≥ 20,480 hours (dual equipment)
	b) High Power Stations	≥ 10,080 hours (single equipment) ≥ 20,480 hours (dual equipment)
1.5	MTBO (as calculated using MIL Handbook 217)	
	a) Low Power Stations	≥ 16,480 hours (single equipment) ≥ 74,130 hours (dual equipment)
	b) High Power Stations	≥ 15,670 hours (single equipment) ≥ 74,060 hours (dual equipment)
2.0 Equipment Specifications		
2.1 Transmitter		
2.1.1	Frequency Range	Any of the 252 X or Y channels in the 960 to 1215 MHz frequency band.
2.1.2	Frequency Control	Crystal Referenced Synthesizer
2.1.3	Frequency Stability	± 0.0005%
2.1.4	Output Power	
	Low Power DME	100 Watts
	High Power DME	1000Watts
		(measured at the transmitter cabinet output connector)

Table 1-1 Equipment Specification Data for 1118A/1119A		
Parameter		Tolerance/Limit
2.1.5	Output Impedance	50 Ohms
2.1.6	Duty Cycle	Continuous
2.1.7	Transponder Capacity	200 Interrogators
2.1.8	Pulse Pair Spacing	X-Channel: $12 \pm 0.1 \mu\text{sec}$ Y-Channel: $30 \pm 0.1 \mu\text{sec}$
2.1.9	Pulse Shape	
	a) Width @ Half Amplitude	$3.5 \pm 0.5 \mu\text{sec}$
	b) Rise Time (10 to 90% points)	2.5 μsec initial, 1.5 - 3.0 μsec operating
	c) Decay Time (10 to 90% points)	2.5 μsec initial, 1.5 - 3.0 μsec operating
	d) Shape	The instantaneous amplitude of the pulse does not at any instant between the point on the leading edge which is 95% of the maximum amplitude and the point on the trailing edge which is 95% of the maximum amplitude fall below a value which is 95% of the maximum amplitude of the pulse
2.1.10	Pulse Count	700 PPS to 5400 PPS
2.1.11	System Time Reference	Selectable: 1st or 2nd Pulse (1st Pulse default)
2.1.12	System Time Delay	X-Channel: $50 \pm 0.25 \mu\text{sec}$ (nom) Y-Channel: $56 \pm 0.25 \mu\text{sec}$ (nom) Time delay is adjustable from the nominal to the nominal minus 15 μsec in 0.01 μsec steps through the PMDT interface
2.1.13	Transponder Accuracy	$\pm 0.0162 \text{ NM}$, (30 meters) ($\pm 0.2 \mu\text{sec}$)
2.1.14	Identification	1350 pps ± 10 pps ($740.7 \pm 5.4 \mu\text{sec}$). Equalizing pulses transmitted $100 \pm 10 \mu\text{sec}$ after each identity pair maintain a constant duty cycle. Ident code is generated by an internal keyer or from a co-located VOR or ILS Localizer facility. When using an external keyer, the system may be programmed to either revert to its internal keyer in the absence of the external keying input or to shut down. Keyer timing is as follows:

Table 1-1 Equipment Specification Data for 1118A/1119A	
Parameter	Tolerance/Limit
	One Dot = 115 ms One Dash = Three Dots Space between Dots & Dashes = One Dot Space between Letters = One Dash Identification signal is formed by a pair of equalizing pulses spaced at $100 \pm 10 \mu\text{sec}$ and repeated at intervals of $740.7 \mu\text{sec}$ (1350 Hz) Ident keying rate is 8 wpm (nominal) Total period of transmission of an Ident Code Group is 6 sec for 3 characters and 7 sec for 4 characters Identification is transmitted once in every 40 second interval.
2.1.15 Squitter Rate	$800 \pm 50 \text{ pps}$
2.1.16 Spectrum	The effective radiated power contained in a 0.5 MHz band centered on frequencies 0.8 MHz above and 0.8 MHz below the nominal channel frequency in each case does not exceed 200 mW, and the effective radiated power contained in a 0.5 MHz band centered on frequencies 2 MHz above and 2 MHz below the nominal channel frequency in each case does not exceed 2 mW. The effective radiated power contained within any 0.5 MHz band decreases monotonically as the band center frequency moves away from the nominal channel frequency.
2.1.17 Pulse Power Variation	The difference in the peak power of the constituent pulses of any pulse pair is $\leq 0.5 \text{ dB}$.
2.1.18 Spurious Radiation	During intervals between transmission of individual pulses, the spurious power received and measured in a receiver having the same characteristics as a transponder receiver, but tuned to any DME interrogation or reply frequency, is more than 80 dB below the peak pulse power received and measured in the same receiver tuned to the reply frequency in use during the transmission of the required pulses.
2.1.19 Out-of-Band Spurious Radiation	At all frequencies from 10 to 1800 MHz, but excluding the frequencies from 960 to 1215 MHz, the spurious output of the DME transmitter does not exceed -40 dBm in any 1 KHz of receiver bandwidth. The equivalent isotropically radiated power of CW harmonics of the carrier frequency on the DME operating channel does not exceed -10 dBm.

Table 1-1 Equipment Specification Data for 1118A/1119A		
Parameter		Tolerance/Limit
2.1.20	Reply Efficiency	≥70% at all values of transponder loading up to 200 interrogators and at the minimum sensitivity level of -94 dBm (-110 dBW/m ²).
2.2 Receiver		
2.2.1	Frequency Range	Any of the 252 X or Y channels in the 960 to 1215 MHz band.
2.2.2	Frequency Control	Crystal Referenced Synthesizer
2.2.3	Frequency Stability	± 0.0005 %
2.2.4	Input Impedance	50 Ohms
2.2.5	Receiver Sensitivity	70% replies to interrogations at a level of -124 dBW (-94 dBm, -110 dBW/m ²) as measured at the cabinet antenna connector.
2.2.6	Receiver Bandwidth	400 kHz (between 3 dB points) No transponder triggering (≤5 % replies) to signals at a level of -10 dBm at frequencies ≥ ± 900 kHz from the channel center frequency.
2.2.7	Dynamic Range	-110 dBW/m ² (-94dBm, -124dBW) to -22 dBW/m ² (-6dBm, -36dBW)
2.2.8	Adjacent Channel Rejection	80 dB (minimum)
2.2.9	IF Frequency Rejection	80 dB (minimum)
2.2.10	Spurious Rejection	75 dB (minimum) for spurious frequencies in the range of 962 to 1213 MHz.
2.2.11	Receiver Decodes	12 ± 1 μsec, Decode: 12 ± 2 μsec, Reject: X-Channel 36 ± 1 μsec, Decode: 36 ± 2 μsec, Reject: Y-Channel
2.2.12	Decoder Rejection	77 dB (minimum) (-35 dBW/m ² above sensitivity level) for an interrogation code error of ± 2 μsec.
2.2.13	Receiver Dead Time	60 μsec (nominal) (adjustable from 50 - 150 μsec.)
2.2.14	Echo Suppression	Long Range: On/Off Selectable (PMDT Selection) Threshold: -70 dBm nominal (PMDT adjustable from -10 to -80 dBm) Anti Echo Duration: 150 μsec nominal (PMDT adjustable from 50 to 350 μsec) Short Range: On/Off Selectable (PMDT selection)

Table 1-1 Equipment Specification Data for 1118A/1119A												
Parameter		Tolerance/Limit										
2.2.15	CW Desensitization	≤2 dB variation in receiver sensitivity for on - channel CW signals 10 dB below minimum receiver sensitivity ≤10% reduction in reply efficiency for on-channel CW signals 10 dB below the receiver input signal when the input signal is 20 dB above minimum receiver sensitivity										
2.2.16	Sensitivity Level Variation	≤1 dB for transmission rates from 0 to 90 % of maximum PRF and for pulse spacing variations of ± 1 u sec.										
2.2.17	Sensitivity Reduction											
	Gain Reduction	Sensitivity is reduced up to 50 dB when transponder loading exceeds 90% of maximum.										
	Noise Generated Pulse Pairs	≤ 5 % of maximum PRF (when the receiver is interrogated at a level of -94 dBm (-110 dBW/m ²) to produce a transmission rate equal to 90% of maximum).										
2.2.18	Recovery Time	Within 8 μsec of the reception of a signal between 0 and 60 dB above the minimum sensitivity level, the minimum sensitivity level of the transponder to a desired signal will be within 1 dB of the value obtained in the absence of such signals with echo suppression disabled.										
2.2.19	Spurious Radiation	During intervals between transmission of individual pulses, the spurious power received and measured in a receiver having the same characteristics as a transponder receiver, but tuned to any DME interrogation or reply frequency, is more than 80 dB below the peak pulse power received and measured in the same receiver tuned to the reply frequency in use during the transmission of the required pulses.										
2.2.20	Out-of-Band Spurious Radiation	At all frequencies from 10 to 1800 MHz, but excluding the frequencies from 960 to 1215 MHz, the spurious output of the DME does not exceed -40 dBm in any 1 KHz of receiver bandwidth. The equivalent isotropically radiated power of CW harmonics of the carrier frequency on the DME operating channel does not exceed -10 dBm.										
2.3	Monitor											
2.3.1	Interrogation Signal Generator											
	a) Frequency	<table><tr><td>f0 (center frequency)</td><td>± 0.0005%</td></tr><tr><td>f0 + 200 KHz</td><td>± 0.0005%</td></tr><tr><td>f0 - 200 KHz</td><td>± 0.0005%</td></tr><tr><td>f0 + 900 KHz</td><td>± 0.0005%</td></tr><tr><td>f0 - 900 KHz</td><td>± 0.0005%</td></tr></table>	f0 (center frequency)	± 0.0005%	f0 + 200 KHz	± 0.0005%	f0 - 200 KHz	± 0.0005%	f0 + 900 KHz	± 0.0005%	f0 - 900 KHz	± 0.0005%
f0 (center frequency)	± 0.0005%											
f0 + 200 KHz	± 0.0005%											
f0 - 200 KHz	± 0.0005%											
f0 + 900 KHz	± 0.0005%											
f0 - 900 KHz	± 0.0005%											

Table 1-1 Equipment Specification Data for 1118A/1119A		
Parameter	Tolerance/Limit	
b) Pulse Coding	$12 \pm 0.1 \text{ } \mu\text{sec}$, X-Channel $36 \pm 0.1 \text{ } \mu\text{sec}$, Y-Channel	
c) Pulse Spacing (automated tests)	X-Channel: Y-Channel: $12 \pm 0 \text{ } \mu\text{sec}$ $36 \pm 0 \text{ } \mu\text{sec}$ $12 \pm 0.5 \text{ } \mu\text{sec}$ $36 \pm 0.5 \text{ } \mu\text{sec}$ $12 \pm 1 \text{ } \mu\text{sec}$ $36 \pm 1 \text{ } \mu\text{sec}$ $12 \pm 2 \text{ } \mu\text{sec}$ $36 \pm 2 \text{ } \mu\text{sec}$ $12 \pm 3 \text{ } \mu\text{sec}$ $36 \pm 3 \text{ } \mu\text{sec}$	
d) Pulse Width	$3.5 \pm 0.5 \text{ } \mu\text{sec}$	
e) Pulse Rise Time	$2.5 \pm 0.5 \text{ } \mu\text{sec}$	
f) Pulse Decay Time	$2.5 \pm 0.5 \text{ } \mu\text{sec}$	
g) PRF	25 to 10,000 PPS (adjustable)	
h) Attenuation Range for Interrogation Signals	-10 to -100 dBm (adjustable)	
i) Monitor Triggering Rate	100 pps (nominal, dual equipment) 50 pps each Monitor	

Table 1-1 Equipment Specification Data for 1118A/1119A		
	Parameter	Tolerance/Limit
2.3.2	System Alarms	
	a) Pulse Spacing	X-Channel: $11.6 \pm 0.1 \mu\text{sec}$ and $12.4 \pm 0.1 \mu\text{sec}$ (adjustable) Y-Channel: $29.6 \pm 0.1 \mu\text{sec}$ and $30.4 \pm 0.1 \mu\text{sec}$ (adjustable) X-Channel: $49.4 \pm 0.1 \mu\text{sec}$ and $50.6 \pm 0.1 \mu\text{sec}$ (adjustable) Y-Channel: $55.4 \pm 0.1 \mu\text{sec}$ and $56.6 \pm 0.1 \mu\text{sec}$ (adjustable) -1 to -5 dB (-3 dB nominal) (adjustable) 70% replies @ 6dB from minimum sensitivity level (Adjustable from 60% to 80% in 0.1% steps) (detects a fall of 6dB or more in minimum receiver sensitivity)
	b) Reply Delay	< 700 pps and > 6000 pps (upper limit adjustable) Absence: > 65 sec $\pm$ 10% Continuous: >5 sec $\pm$ 10% Verification of Coding > 4.0:1
	c) Power Reduction	
	d) Efficiency/Sensitivity	$\leq \pm 20 \text{ ppm}$ $\leq \pm 20 \text{ ppm}$
	e) PRF	
	f) Identification	
	g) Antenna VSWR	
	h) Transmitter Frequency	
	i) Receiver Frequency	
2.3.3	Maintenance Alarm Parameters	Comprehensive List, Including: a) RMS Facility A/D, Power Supply and Digital I/O Parameters b) Integral/Standby Monitor Secondary Alarm Parameters c) Bite faults in RMS, Monitor, Receiver and Transmitter d) Smoke and Intrusion Detectors

Table 1-1 Equipment Specification Data for 1118A/1119A		
Parameter		Tolerance/Limit
2.3.4	Shutdown Delay Time	7 ± 1 seconds nominal (adjustable from 5 to 10 sec)
2.3.5	Auto Restart Delay	1 st at 50 sec nom. (adjustable 40-60 sec) 2 nd at 5 minutes
2.3.6	Auto Restart Attempts	two, as in 2.3.5
2.4 Controls and Indicators		
2.4.1	Power Panel Assembly	a) Transmitter #1 and #2 AC & DC Power Switches/circuit breakers & Charger Reset Switches b) Transmitter #1 & #2 Power Indicators: AC Fail Battery Fault On Battery Fast Charger Trickle Charger
2.4.2	Local Control Unit	a) Transmitter: #1 or #2 Main Select/Ind. #1 or #2 On Antenna Select/Ind. #1 or #2 On Load Select/Ind. #1 or #2 Off Select/Ind. b) Integral Monitors (#1 & #2): Normal Indicator Primary Alarm Indicator Secondary Alarm Indicator Bypass Select (with Indicator) c) Standby Monitors (#1 & #2) Normal Indicator Primary Alarm Indicator Secondary Alarm Indicator Bypass Select (with Indicator) d) System Controls: Local Control Select (w/Ind) Alarm Volume Alarm Silence Lamp Test Reset e) System Indicators: Maintenance Alert Remote Control Fault Battery Fault Interlocked Off LCU Power OK

1.8 Equipment and Accessories Supplied

Table 1-2 contains a list of the equipment and accessories that may be supplied with a 1118A/1119A DME depending on the customer configuration.

Table 1-2 Equipment and Accessories that may be Supplied for DME Systems Depending on Customer Configuration

<u>Quantity</u>	<u>Nomenclature</u>	<u>Part Number</u>
1	Accessory Kit	470622
1	Environmental Sensor Kit (optional)	470623
2	Operation and Maintenance Manual	571118A-0001
1	Battery Backup Kit, 35Ahr (standard)	470628
1	AC Power Kit	470627
1	Antenna Kit	470085
1	Civil Installation Kit	470252
1	PMDT Kit	470360
1	Radio Link Kit (optional)	470433

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2. TECHNICAL DESCRIPTION

2.1 Introduction

This section contains a technical description of the single and dual 1118A and 1119A DME. This includes, simplified system block diagram theory and block diagram and detailed circuit theory of the Circuit Card Assemblies (CCA) contained in the system.

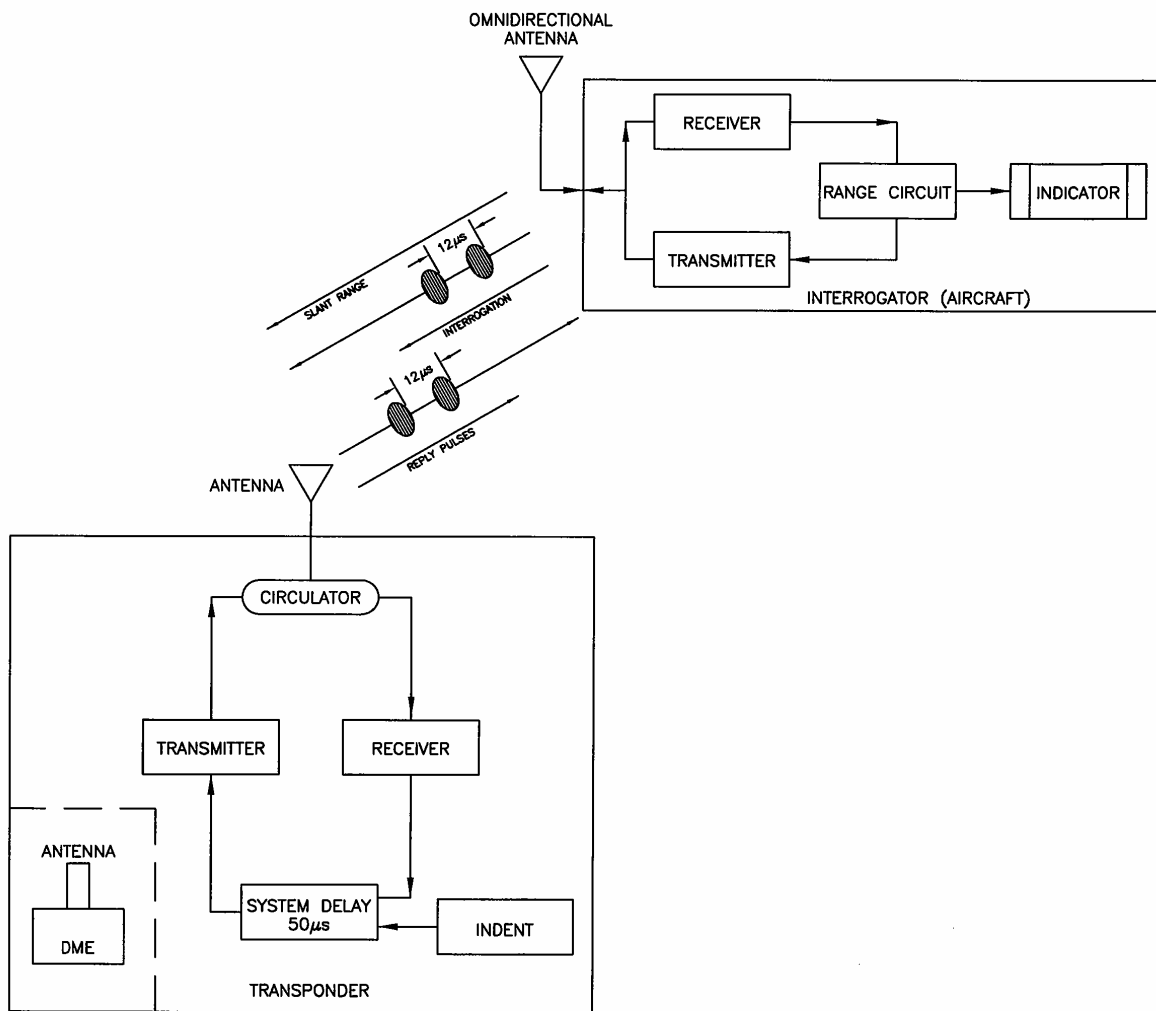
2.2 DME Operation Principles

Refer to [Figure 2-1](#). The DME system requires a single-channel receiver-transmitter combination (transponder beacon) in conjunction with a special omni-directional antenna as the ground station, and a multichannel receiver-transmitter combination (interrogator) on board the aircraft. One multichannel airborne receiver-transmitter (transmitting and receiving coded, pulsed information) provides both the distance and identification functions.

The DME system has 252 operating channels, with the adjacent channels spaced one megahertz apart. For air-to-ground transmission (interrogation), there are 126 channels within the frequency band of 1025 MHz to 1150 MHz. For ground-to-air transmission (reply), there are 63 channels in the frequency of 960 MHz to 1024 MHz, plus 63 channels in the frequency band of 1151 MHz to 1215 MHz.

The DME system utilizes pulse-coding techniques in the transmission of its intelligence. The transmissions are composed of pulse groups with a prearranged spacing between the pulses of the group. For X-Channels, the interrogation pulses and the transponder reply pulses are both spaced 12 μ s apart. For Y-Channels, the interrogation pulses are spaced at 36 μ s; and the transponder reply pulses are spaced at 30 μ s.

Both the interrogator and transponder receivers employ pulse decoders, which are set to pass only pulse pairs of the prescribed spacing. The purpose of the two-pulse technique is to increase the signal-to-noise ratio and to discriminate against pulse interference, such as might be produced by radar transmission and other extraneous sources of RF energy on the frequency. The intelligence supplied to the aircraft by the DME transponder is both identity and distance information. The identity information is necessary for the pilot to positively identify the station that has been selected. Identity information is provided to the aircraft approximately every 30 seconds. The distance information, however, is provided to the aircraft only upon demand. Each aircraft must interrogate the ground facility by means of the coded interrogation pulse pairs, before the transponder beacon can generate and transmit distance information.



1119-008

Figure 2-1 Basic X-Channel DME System Block Diagram

Refer to [Figure 2-2](#). As stated, the transponder beacon must be interrogated by the aircraft before the ground facility can transmit usable distance information. Assuming an aircraft has interrogated the ground facility; the interrogation signal is received at the beacon antenna, and then routed to the receiver through the Circulator and Preselector. The signal is then amplified and fed to the Receiver Transmitter Controller (RTC) for verification of proper pulse spacing. Once receive pulses are validated the RTC encodes a reply with the proper pulse spacing and delay.

The shaped pulses modulate the gated RF in the transmitter power amplifier (PA) to produce the RF output pulses. The output pulses are then sent to the antenna and radiated to the aircraft as reply pulse pairs.

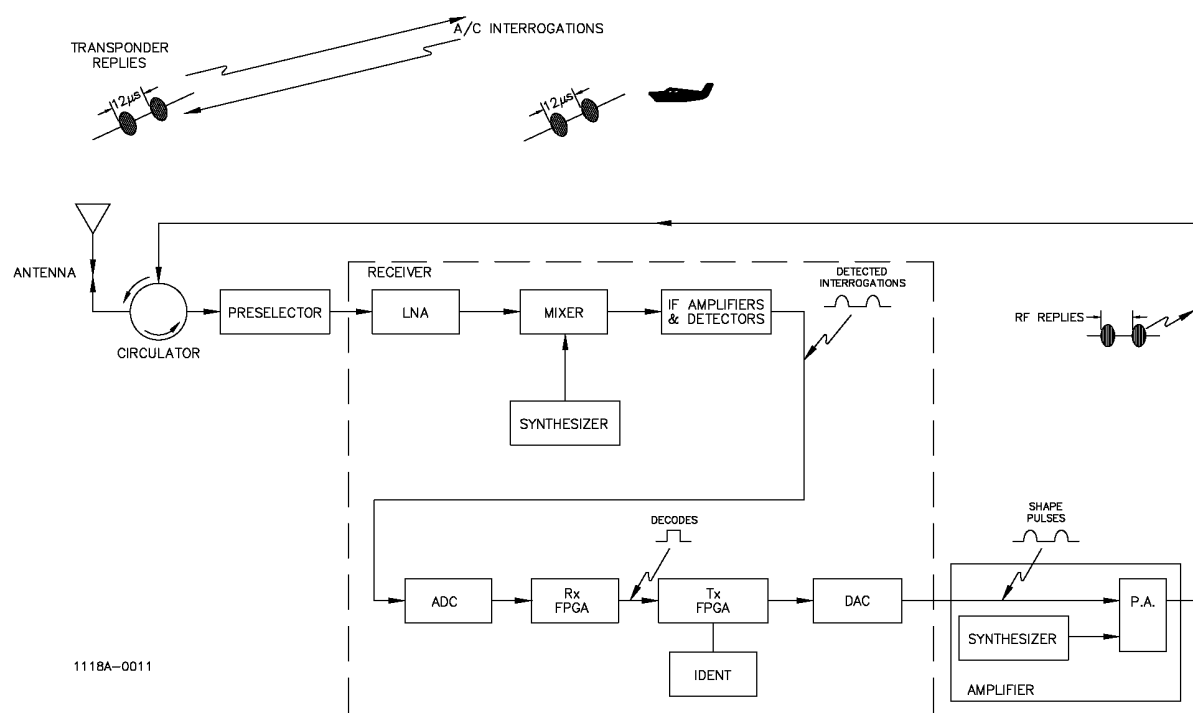


Figure 2-2 DME Transponder Block Diagram

Three separate signals are transmitted by the beacon as a train of pulse pairs. These signals, in order of priority, are: identification, replies to interrogations, and squitter pulse pairs (used as fill-in pulses). This priority system prevents any interference between the three signals in the overall pulse train.

The identification of the ground facility is important to the using aircraft; therefore, it has been assigned first priority in the priority system. The generation of identification intelligence is a function of the RTC. Identification is transmitted periodically in International Morse Code with the characters of the code consisting of a periodic train of pulse pairs. Identification keying occurs approximately every 30 seconds. When keyed, the priority logic circuit input is disabled; and the circuits will not accept any decodes from the receiver.

The replies to an interrogation signal are second in the order of priority. Their induction into the pulse train must be controlled (to prevent interference with the identity cycle and to establish priority over the squitter pulses). This is accomplished by allowing them to enter the pulse train only during a time interval not occupied by the identity cycle. This is a major portion of the time, since the identity cycle only occurs approximately every 30 seconds. Once the receiver accepts an interrogation and decodes it, a blanking gate is generated (the so-called dead-time gate). The dead-time gate is used to inhibit the transponder decoder for approximately 60 μ s. During this period, the decoded interrogation is delayed a predetermined amount of time and transmitted back as a reply. The total delay from the time of a received interrogation to transmission of a reply is typically set for 50 μ s for an X-Channel DME.

The squitter pulses are third in the order of priority. In the absence of interrogations or identity information, random squitter pulses are generated to maintain an average output pulse train of 800 Pulses Pairs Per Second (PPS). The purpose of transmitting squitter pulses is to stabilize the Automatic Gain Control (AGC) circuits in the aircraft interrogator.

The process of distance measuring originates in the airborne unit with the generation and transmission of pulse signals called interrogations. The airborne transmitter repeatedly initiates and transmits pulse signals consisting of pulse pairs having 12 μ s spacing, a pulse width of 3.5 μ s, and a Gaussian or sine-squared shape. These pulse pairs are recovered by the transponder beacon receiver, whose output triggers the associated transmitter into transmitting reply pulse pairs. The reply pulse pairs are received by the airborne receiver and timing circuits, which automatically measure round-trip travel time (the time interval between interrogation and reply pulses) and convert this time into the electrical signals that operate the distance meter.

Using the block diagram of the system in [Figure 2-2](#), the distance measurement function can be examined from the system stand point. The range circuits of the airborne interrogator initiate the distance measuring process. They formulate and transmit an interrogation pulse pair, which is received at a ground station antenna and sent to the RTC. The RTC then triggers the encoded pulse generator where the shaped pulses are amplified and routed to the PA for modulation of the gated RF. The output RF pulses are then radiated into space (as replies) via the antenna. The reply pulses are received by the aircraft, decoded by the airborne receiver, and examined by the range circuits for synchronism with the airborne unit's own randomly generated interrogation pulses.

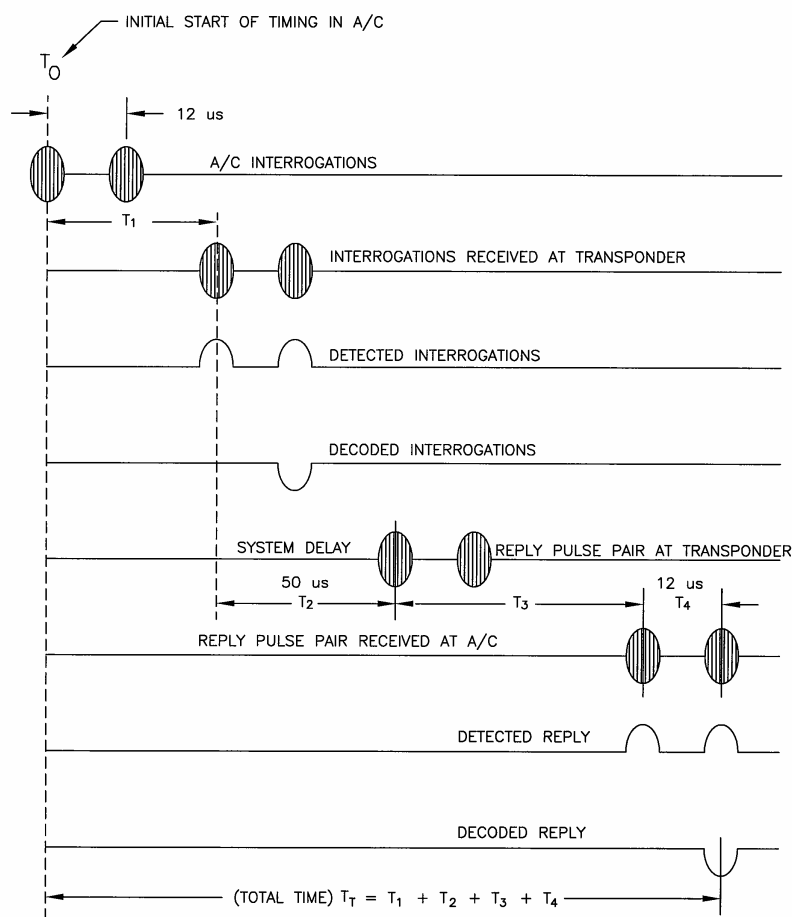
The airborne unit measures the elapsed time between the transmission of the interrogation pulse pair and the receipt of the reply pulse pair. It then, converts this time into a distance indication. In other words, the distance indication is a measurement of the range time of the pulse pairs. This timing sequence is easily seen by means of the system timing diagram of [Figure 2-3](#). Timing starts (in the range circuits of the airborne unit) with the first pulse of the interrogation pulse pair. After a time delay, depending upon the distance between the aircraft and the ground station, the interrogation pulses are received at the antenna of the ground transponder beacon. The interrogation pulses are decoded, and the reply is encoded and transmitted after a preset time delay (the reply delay of the ground station).

This nominal reply delay duration is 50 μ s, for which the airborne range circuits automatically account. Thus, the total time lapse for any interrogation response cycle is the sum of reply pulse spacing, the two-way transit time (range time), and the reply delay.

2.3 Theory of Operation

2.3.1 Simplified System Block Diagram Theory

Figure 2-4 is a simplified block diagram of the 1118A DME. The 1119A DME differs only by the addition of a high power amplifier module in the signal path between the low power amplifier / synthesizer and the output circulator. The Transponder portion of the DME consists of the Directional Coupler (1A6), Circulator, Low-Noise Amplifier (LNA), Receiver Transmitter Controller (RTC), and the Low Power Amplifier / Synthesizer (LPA). Aircraft interrogations are picked up by the antenna and routed through the Directional Coupler to the Circulator. Additional interrogations from the Monitor/Interrogator are injected into the Directional Coupler. The responses to these interrogations are sampled by the monitor port within the antenna and are used to monitor the reply delay and reply efficiency. The Directional Coupler also provides a sample of the transponder reply to the Monitor/Interrogator. The Monitor/Interrogator also uses these samples to provide power output measurement.



NOTES:

- T_1 = ONE WAY TRAVEL TIME FROM A/C TO STATION
- T_2 = SYSTEM DELAY (50 us).
- T_3 = ONE WAY TRAVEL TIME FROM STATION TO A/C.
- T_4 = REPLY PULSE SPACING AT A/C (12 us).
- RANGE TIME = $T_T - (T_2 + T_4)$
- DISTANCE IN NAUTICAL MILE = $\frac{\text{RANGE TIME}}{12.36\text{ us}}$

1119-010

Figure 2-3 System Timing Diagram

Model 1118A/1119A DME

The Circulator provides isolation between the transmitted and received signals, since a common antenna is used for both. Signals applied to any of the ports will experience the least insertion loss or minimum resistance when traveling to the adjacent port in a clockwise direction. Signals traveling in a counterclockwise direction will be attenuated by at least 20 dB. Aircraft interrogations and monitor interrogations arriving from the Directional Coupler are directed to the Preselector Assembly by the circulator.

The Preselector Assembly is a narrow-band, three-pole, mechanically-tuned filter that discriminates against undesired frequencies and provides additional attenuation of transmitter energy. From the Preselector, the received interrogations are directed to the receiver input of the Receiver Transmitter Controller (RTC) after being amplified by the Low Noise Amplifier (LNA).

Within the receiver is a low-noise high stability local oscillator that is generated by an internal synthesizer. This signal is mixed with the incoming RF to provide a 125 MHz first IF signal that is log detected and digitally processed for accurate interrogation time of arrival. The 125MHz IF is further down converted to a 10.7 MHz IF signal. This 10.7 MHz signal is narrow-band filtered and used to determine if the received interrogation was on-channel or from an adjacent channel.

The Low Power Amplifier Module delivers 125 watts peak Gaussian shaped pulses at the output connector when used in the Low Power DME. This translates to a minimum 100 W output at the antenna connector of the station allowing for normal losses in the connecting cables, directional couplers, etc. The output power is attainable on any DME channel from 960-MHz to 1215-MHz without requiring re-tuning of the amplifier. The Low Power Amplifier module provides in nearly 200 watts shaped pulses when used as the driver amplifier in either the 1119A High Power DME system, or the TACAN system.

The Low Power Amplifier Assembly consists of three major circuits: the transmitter RF synthesizer, the Modulator and the RF Amplifier. The RF synthesizer is programmed via a serial interface to the station transmit frequency. A sample of the CW output of the synthesizer is available on the front panel of the Low Power Amplifier module to allow verification of transmitter frequency by external test equipment. The CW output of the synthesizer is pulse modulated by an RF switch controlled by the gate pulses from the RTC, then amplified to 26.5 dBm at the output of the synthesizer CCA within the Low Power Amplifier module. The synthesizer assembly also contains a DC/DC converter to provide the high voltage (~51 volt) supply used within the Low Power Amplifier module. This DC/DC converter will operate over an input range in excess of 40 to 60 volts DC, providing a stable supply voltage for the RF amplifiers even when the DME system is operating on batteries and is nearing the end of the useful battery life.

The pulse modulated RF signal is then routed through a 4-stage RF amplifier to achieve the final output power of ≥ 200 watts peak. The Modulator CCA within the Low Power Amplifier assembly performs the required pulse shape modulation and output power control. The Gaussian shape desired when used as a stand-alone low power transmitter (1118A DME) is achieved by a linear modulator under control of the RTC module within the DME system. Detected output pulses from the low power amplifier module are routed to the RTC, where they are compared to the desired pulse shape, and pre-distorted Gaussian shaped control pulses are sent from the RTC to the Low Power Amplifier assembly where they control the outputs of the Modulator CCA. When the Low Power Amplifier module is used in either the 1119A High Power DME or the TACAN, the output is amplitude controlled by the RTC, and the pulse shaping is done in the low-power amplifier modulator.

The High Power Amplifier module (used only in the 1119A High Power DME and the TACAN, not shown in Figure 2-4) consists of three major circuits, the Modulator and the RF amplifier, and the DC/DC converter. There is a slight difference in the TACAN version of the High Power Amplifier RF Amplifier and the DME version of the High Power Amplifier. In the TACAN version, there is an additional driver amplifier stage to compensate for the reduction in input power because the output of the Low Power Amplifier is split 5-ways. In the DME application, the full output of the Low Power amplifier is applied to the input of the High Power amplifier, hence this additional stage is not needed. The DME version of the High Power Amplifier has two gain stages, a 500 watt amplifier followed by a 4-wide 2000 watt peak amplifier (4 x 500).

The modulator within the High Power Amplifier module operates in a similar fashion as the modulator in the low power amplifier above. It receives square-pulse input signals from the RTC, and provides the collector voltage modulation to achieve the final RF output pulse shaping. The High Power amplifier provides in excess of 2000 watts peak power across the full DME/TACAN transmitter band with no tuning required.

The DC/DC converter located within the High Power amplifier provides a constant high voltage power supply (approximately 53 volts) independent of the DME/TACAN system 48 volt power supply status. This allows full power operation, even when the system is operating on battery backup and is nearing the end of the batteries' useful life. Energy storage capacitance to provide the large peak current requirements of the RF amplifier stages is also located on the DC/DC converter CCA.

The Monitor portion of the DME consists of two major sections: the Interrogator (for interrogating the transponder) and the Monitor (to evaluate the reply parameters). Both of these functions are located on the Monitor/Interrogator/Synthesizer module in the 1118A/1119A DME system. The Monitor CCA is actually two separate printed wiring boards but they are plugged into the other, forming one module. The main board is dedicated mainly to digital circuitry and is the card-cage support of the module, going from the back plane to the front panel. The second board is dedicated to Interrogator (RF) circuitry.

Each monitor in the system is capable of monitoring all the critical parameters of two transponders on a dual DME, and is capable of performing monitor integrity. One monitor interrogator interrogates the transponders 50 times per second, therefore in a dual system the total rate is 100 interrogations on each transponder for monitor purposes. The interrogation signals are fed into the transponder via the directional coupler in the DME/TACAN system, and the transponder replies are routed to the monitor by the forward coupled transmitter RF signals from the system directional coupler. In dual-equipment stations, the Standby RF input is obtained from the output of the attenuator load connected to the transfer switch. The monitor can vary the signal level, the pulse shape and timing and the frequency of the interrogations, so the monitor sends different interrogations to measure different parameters. In normal mode different interrogations are mixed together to measure all the critical parameters, if any of these parameters are out of range for an amount of time, the condition is reported to the LCU using the alarm signals. Upon request from the RMS other parameters can be measured and reported to the RMS. While a monitor is disabled to interrogate the transponders (which is half of the time), the monitor uses this time to send certification signals to itself and verifies that the circuitry and the software are working properly.

The Monitor(s) measure the signals and compare against the operator set limits. If parameters fall outside the preset limits the alarm indication to the Local Control Unit (LCU) is changed. The LCU examines the outputs from the Monitor(s) and determine whether to transfer or shutdown the transmitter based on the present settings such as station bypass, and/or voting logic and whether the equipment is single or dual transmitter equipment.

The standard PMDT consists of a laptop computer and is the input/output device for controlling and communicating with the TACAN system. Station control, adjustment and monitoring functions are available through the computer, and are accessed via a Windows-based operator interface. An external mouse is supplied with the laptop computer for ease in operation. An optional desktop PC is available as a substitute for the standard laptop computer. Also, an optional printer is available for use with either the laptop or desktop PC.

Station security control is provided through a four-level password system. Complete access to the system for adjustments and measurements is provided at level 3. Modification of non-critical parameters is available at level 2, and read-only access is available at level 1. Password and account administration is accomplished at level 4.

All functions available on the local PMDT are available remotely via a modem and dial-up telephone line to an optional remote laptop or desktop PC running PMDT software.

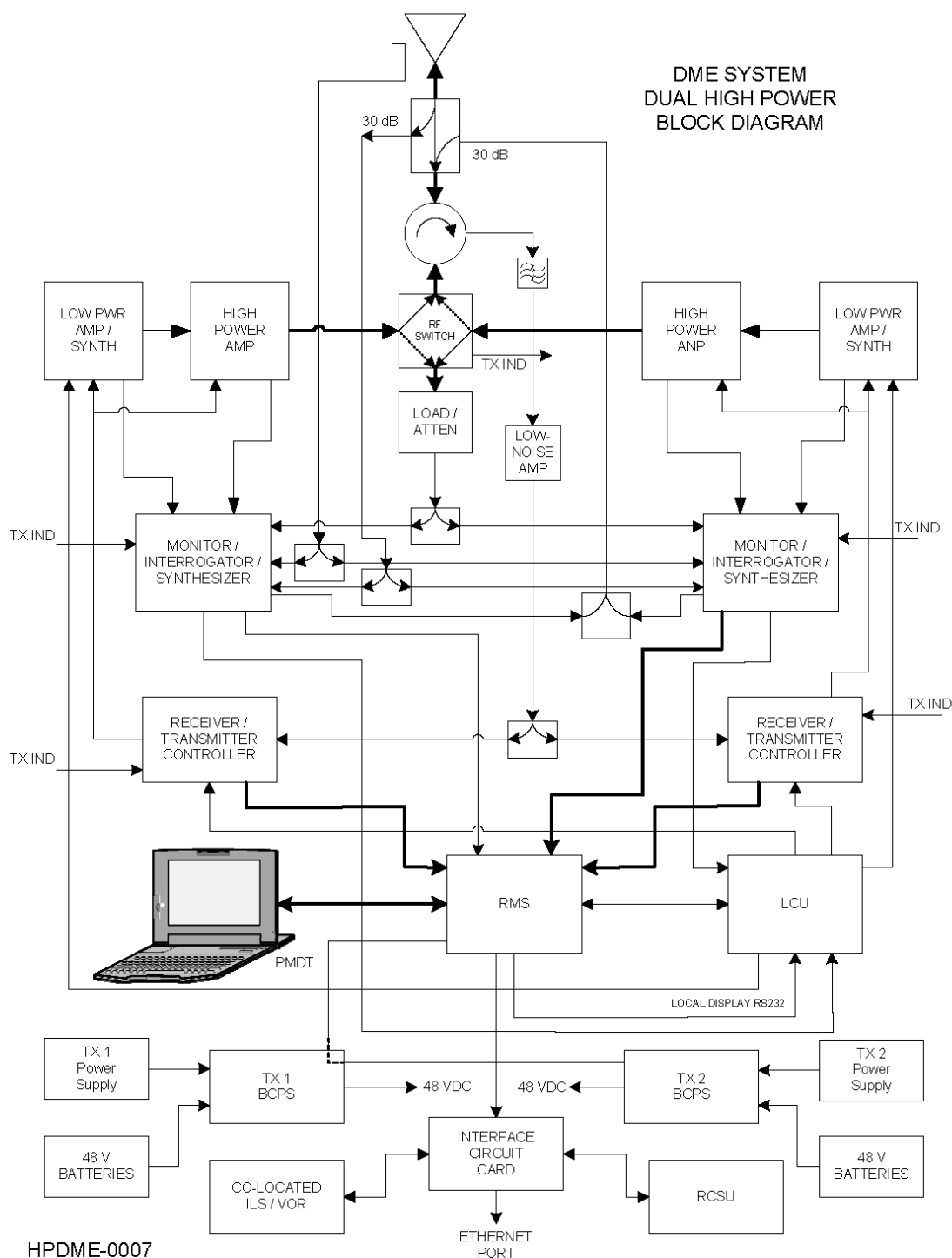


Figure 2-4 DME Simplified Block Diagram

2.3.2 Detailed Theory of Operation

2.3.2.1 Low Power Backplane CCA Block Diagram Theory

Refer to [Figure 2-5](#). The Low Power Backplane CCA provides interconnection and configuration for a Model 1118A/1119A DME System. The Low Power Backplane is an 84HP (approximately 16.8”) wide, 9 slot card cage intended to fit in a standard 19” rack. The Low Power Backplane will accommodate both a single or dual controlled/monitored DME system. It’s referred to as a Low Power Backplane because only low power amplifiers may be inserted, while a high power DME or TACAN will have a separate, dedicated High Power Backplane.

Configuration of the DME system resides on the Low Power Backplane CCA in the form of DIP switches. Sixteen individual switches determine system configuration and eight switches set operating frequency.

System1 and System2 Low Power Amplifiers (LPA) connect to the backplane via J1 and J16 DB37 connectors with blind mate adapters (BMA). Each LPA also has an RF_OUT signal which eventually connects to couplers for further processing.

The remaining circuit cards that insert into slots of the Low Power Backplane utilize both 96 pin and 60 pin DIN41612 connectors. The 60 pin connectors have openings for RF connectors which carry RF signals to and from the Monitor CCAs and RTC CCAs. For circuit cards such as the RMS and Facilities CCAs that do not have RF signals, these RF connector positions are not populated.

System1 and System2 Receiver/Transmitter Controller (RTC) CCAs connect via J2/J3 and J14/J15 as well as their RF connectors.

System1 and System2 Monitor / Interrogator CCAs connect to the backplane via J4/J5 and J12/J13 as well as their RF connectors.

The RMS CCA connects to the backplane via J8/J9 and the Facilities CCA connects to the backplane via J10/J11.

Connections between the Low Power Backplane CCA and a High Power Backplane CCA are accomplished by 50 pin headers P5 and P6.

The J17 DB9 connector facilitates interface between the Low Power Backplane CCA and the Battery Charge Power Supply (BCPS) modules for System1 and System2.

Power for the backplane enters via terminals E1 through E4 block TB1.

The LCU CCA is attached via 60 pin header P4.

The Interface CCA has two possible connections; the 60 pin header P1 for general purpose signals and the 40 pin header P1 if a TACAN antenna system must be controlled.

The Fan Control CCA is connected by 14 pin header P7.

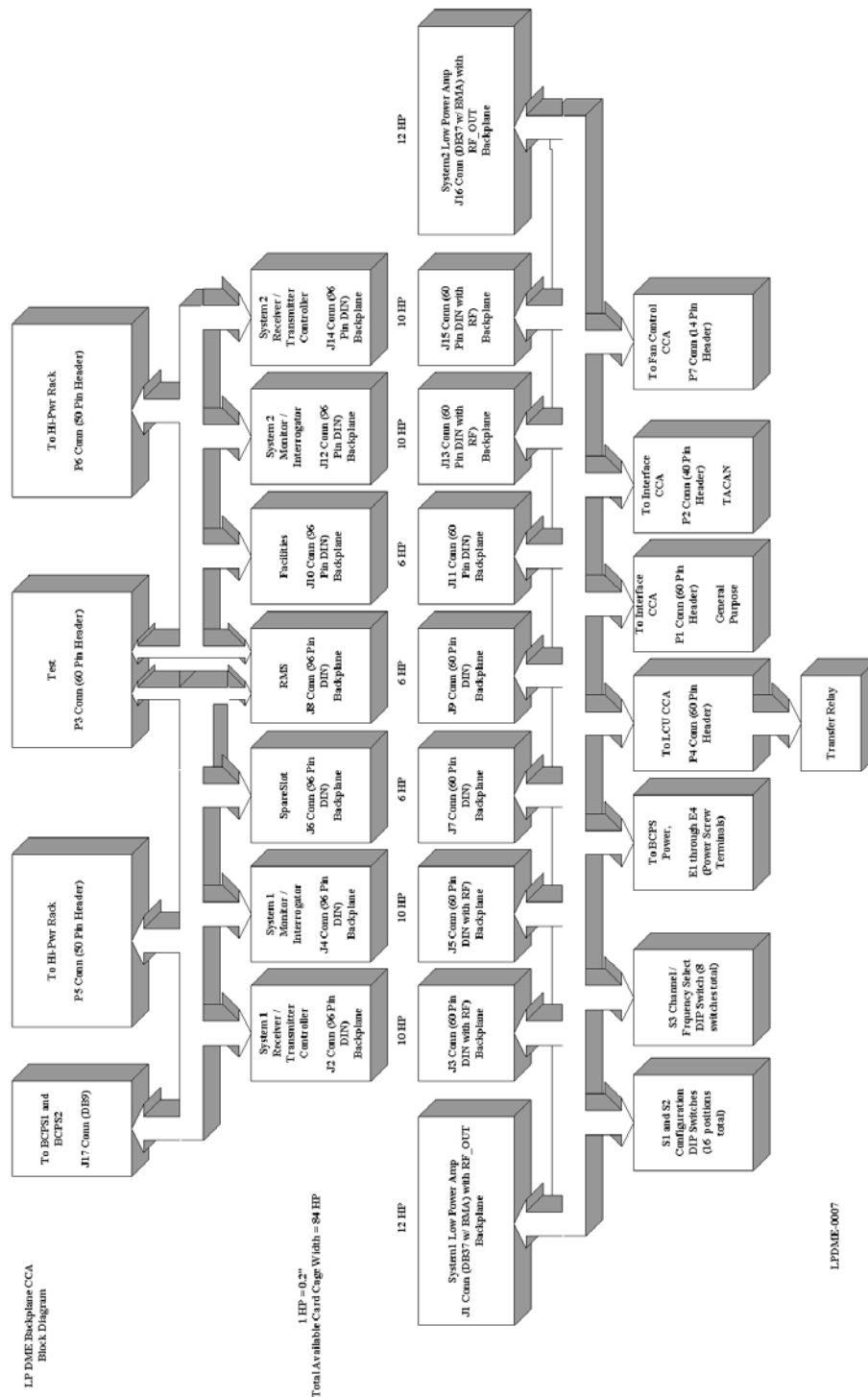


Figure 2-5 Low Power Backplane CCA Block Diagram

2.3.2.2 High Power Backplane CCA Block Diagram Theory

Refer to [Figure 2-6](#). The High Power Backplane CCA provides interconnection and configuration for a Model 1119A DME System. The High Power Backplane is an 84HP (approximately 16.8”) wide, 5 slot card cage intended to fit in a standard 19” rack. The High Power Backplane will accommodate up to five High Power Amplifier Assemblies.

Connections between the High Power Backplane CCA and the Low Power Backplane CCA are accomplished by 50 pin headers A2P1 and A2P2. These connectors are keyed to prevent incorrect installation.

The control signals of A2P1 and A2P2 are distributed to the five possible amplifier connectors A3P1 through A7P1. Connectors A3P1 through A7P1 are DB37 female connectors with blind-mate adapters (BMA).

+48 volts and ground power for each of the five possible amplifiers is routed via screw terminals A2E1 through A2E10. These terminals are each rated for 30 amps of continuous current.

Each amplifier has an RF_OUT signal, routed via connectors A3J2 through A7J2, which eventually connect to couplers for further processing.

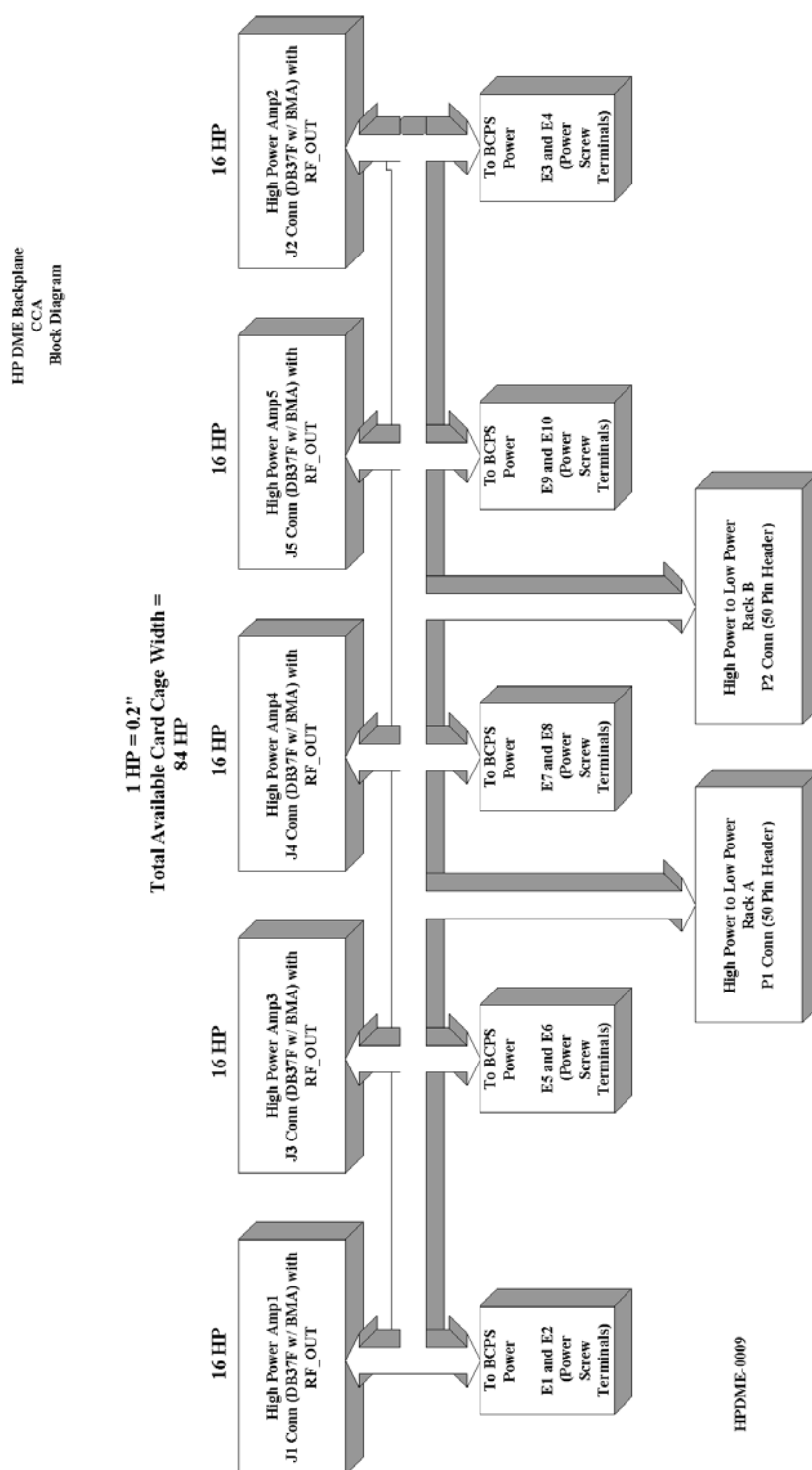


Figure 2-6 High Power Backplane CCA Block Diagram

2.3.2.3 Low Power Amplifier Block Diagram Theory

Refer to [Figure 2-7](#) for a block diagram of the Low Power Amplifier module. The 030802-0001 Low Power Module is used in the 1118A Low Power DME as the complete transmitter module, and in the 1119A High Power DME and the TACAN as the transmitter RF signal source/driver amplifier. It is comprised of three major sections. Within the module are the Synthesizer CCA which generates a pulsed RF signal for the DME/TACAN transmitters, the RF amplifier/transmitter assembly boards which provide the necessary amplification of the Synthesizer signal, and the Modulator CCA which processes the control signals from the RTC (Receiver Transmitter Controller) module to properly control the desired output RF pulse shape and amplitude. The synthesizer CCA also contains the DC/DC power supply which regulates the various supply voltages used within the module. Analog control signals from the RTC are routed via high speed differential analog paths through the low power backplane to the Low Power Amplifier. Differential analog signals are used to suppress the effects of common mode noise on the signal paths and to maintain the integrity of the analog control signals. Similarly, the detected video outputs of the Low Power Amplifier assembly are routed through similar high speed differential analog paths back to the RTC, for the same reasons.

2.3.2.3.1 Synthesizer CCA Block Diagram Theory

Refer to [Figure 2-7](#). The Synthesizer Assembly contains only one CCA which generates a pulsed RF signal across the full DME/TACAN transmit band. This CCA also provides a sample of the RF signal to the RTC for BITE considerations. The circuit card contains the Low Power Module's temperature sensor and all of the input/output control signals for this module.

The Synthesizer CCA contains a DC/DC converter which accepts an input voltage range of 40Vdc – 60VDC and generates a nominal output voltage of 51VDC using the converter's output "trim" pin to alter the output voltage. This nominal voltage is passed to the Modulator CCA for modulation and power control of the RF transistors. This nominal voltage is also DC/DC converted to 20VDC using an additional switching regulator. The other required DC voltages used within the module are linear regulated from the 20VDC voltage. The DC/DC converter and switching regulator voltages are monitored for proper DC levels using a window comparator circuit. This output signal from this comparator is sent to the RTC for BITE monitoring with a logic level "0" indicating a "POWER GOOD" condition. A front panel status LED is also illuminated green to indicate this power good condition. The LED can also be illuminated by the RMS for lamp test and troubleshooting purposes.

The RF synthesizer portion of this CCA generates a CW or pulsed RF output power of 26.5dBm $\pm$ 0.5dB on any DME ground station transmit frequency from 960 MHz to 1215 MHz. Synthesis of the transmit frequencies is accomplished by controlling the tuning voltage on a Voltage Controlled Oscillator (VCO). A phase lock loop is used to control the tuning voltage. The PLL uses an active gain loop filter and is frequency referenced to a 10 MHz standard provided by a temperature compensated crystal oscillator (TCXO). This TCXO reference provides the required transmitter frequency stability over all environmental conditions. Programming of the desired frequency is done through serial control lines from the RTC. The output RF signal from the VCO is buffered, amplified, and split three ways using a resistive divider.

One of these paths is used as feedback for the phase lock loop. The second path routes the signal to a fixed frequency divider. The output of this divider is monitored by the DME system for frequency integrity. The final RF signal path is amplified to the proper signal level, pulse modulated and is fed to the power amplifier. The CW RF signal is pulse modulated using a non-reflective switch by the gate controls from the RTC, and is fed to the Pre-Driver CCA (012175) of the power amplifier. Prior to the RF switch and the final gain block, a sample of the CW signal is provided for use by external test equipment via a resistive coupler. This port is AC coupled and is properly terminated internally (50 ohm load) to provide sufficient isolation to avoid disruption of the transmitted signal by external influences, and made available on a front panel connector.

The low power amplifier temperature sensor is mounted on the back side of the final RF amplifier stage transistor. It is in close proximity to the transistor in order to maximize heat transfer to the sensor. The sensor is equipped with a serial programmable interface (SPI). The temperature data from this sensor is processed by the RMS and used for amplifier protection in the event of over temperature.

2.3.2.3.2 Low Power Modulator CCA Block Diagram Theory

The Modulator CCA sends and receives control signals to the RTC (Receiver Transmitter Controller) via the Synthesizer CCA. This board controls the voltage to the RF amplifying transistors to obtain the proper transmitter power and pulse shape. The transmitter gate signal, supplied by the RTC, is applied to the first two RF amplifier stages through a high side MOSFET switch. The modulating transistor switches are controlled at two different voltage levels for a 3 dB transmitter power level change. The final two amplifying stages are also voltage controlled by a high side MOSFET, but these transistors are linear modulated with the signal from the RTC that is Gaussian shaped. The energy storage capacitor used to provide the short term peak current requirements of the RF amplifier stages is contained on the Modulator CCA board. The forward and reverse detected RF video outputs signals from the Final CCA (012184) are routed to the Modulator CCA where the signals are used to determine the RF pulse shape and level. These detected signals are also monitored on the Modulator CCA for excessive pulse width and high VSWR conditions. The output of the high pulse width and high VSWR monitor circuits are stretched and sent to the RTC for monitoring. In addition, in the event there is a detected pulse width fault or a high VSWR fault, the stretched outputs of these detectors will disable the Low Power Amplifier RF output for protection against damage. The forward detected video signal is also routed to the RTC to complete the control loop that provides the proper power level and pulse shape. The RTC compares this detected signal to the desired output pulse shape, calculates the necessary corrections, and pre-distorts the shaped pulse control signals used by the Low Power Amplifier module.

2.3.2.3.3 RF Amplifier / Transmitter Assembly Theory

The RF Amplifier/Transmitter portion of the LPA Module provides amplification of the pulsed RF signal from the synthesizer CCA, and is comprised of three assemblies. The first assembly is the pre-driver amplifier stage, and the second assembly is the driver amplifier stage. The last assembly contains the final RF amplifier stage along with an output low pass filter and a dual directional coupler. The pre-driver and the driver stage are all square wave modulated by the modulator CCA, while the final amplification stage is square wave modulated for TACAN and High Power DME configurations or Gaussian shape modulated for Low Power DME configuration. All the RF amplifying transistors are bi-polar junction transistors (BJT) and are operated in Class-C mode, common base configuration. The module is capable of transmitting 225W peak at the output port of the module in either a Gaussian shape or square wave modulation. The transmitter's circuit cards are described in the following paragraphs.

2.3.2.3.4 Pre-Driver and Driver CCA Block Diagram Theory

Refer to [Figure 2-7](#). The pre-driver is a single stage RF amplifier which receives a pulsed RF signal from the Synthesizer CCA. The RF signal is amplified and routed to the next stage, the "driver" CCA. The driver CCA contains two stages of RF amplification and feeds into an attenuator pad on the Final CCA. The voltage supplies of the transistors on the pre-driver and the driver stages are all square wave modulated in synchronization with the RF switch on the Synthesizer CCA, controlled by the gate pulses from the RTC. The pulse width, gain, and output RF signal level are controlled via the Modulator CCA.

2.3.2.3.5 Final CCA Block Diagram Theory

Refer to [Figure 2-7](#). The final stage of the RF transmitter includes the final RF amplifier stage, a low pass filter, and a dual directional coupler. The final transistor receives a square wave modulation signal and maintains a square wave output shape for the High Power DME and TACAN system configurations, or transforms the input signal into a Gaussian shaped RF signal for the Low Power DME system configuration. This shape is controlled by modulating the supply voltage of the final transistor. All modulation of the supply voltages are synchronized with the RF switch on the Synthesizer CCA. The signal shape and output level are controlled by the RTC via the Modulator CCA. An attenuator pad is used between the driver and the final RF amplifier stage in order to minimize voltage standing waves when modulating the input square wave into a Gaussian signal. This attenuator also provides impedance stability between these two RF amplifier stages.

The low pass filter is a lumped element design and is optimized for minimal insertion loss across the DME/TACAN transmitter band, while providing a nominal 40dB or more of attenuation for unwanted high frequency spurious signals. The filter is placed in a separate cavity for shielding purposes.

The output directional coupler is a discrete component with a nominal coupling of -20 dB and a minimum directivity of 20dB. The coupler is used to sample the transmitted RF signal and detect any reflected signals due to load mismatches. Both the forward and reflected signals are further attenuated by 10dB attenuators and are converted to video signals by differential diode detectors before being passed to the Modulator CCA. Both the forward and reflected detectors have 25dB of linearity. The coupler/detector section of this CCA is placed in a separate cavity for shielding purposes.

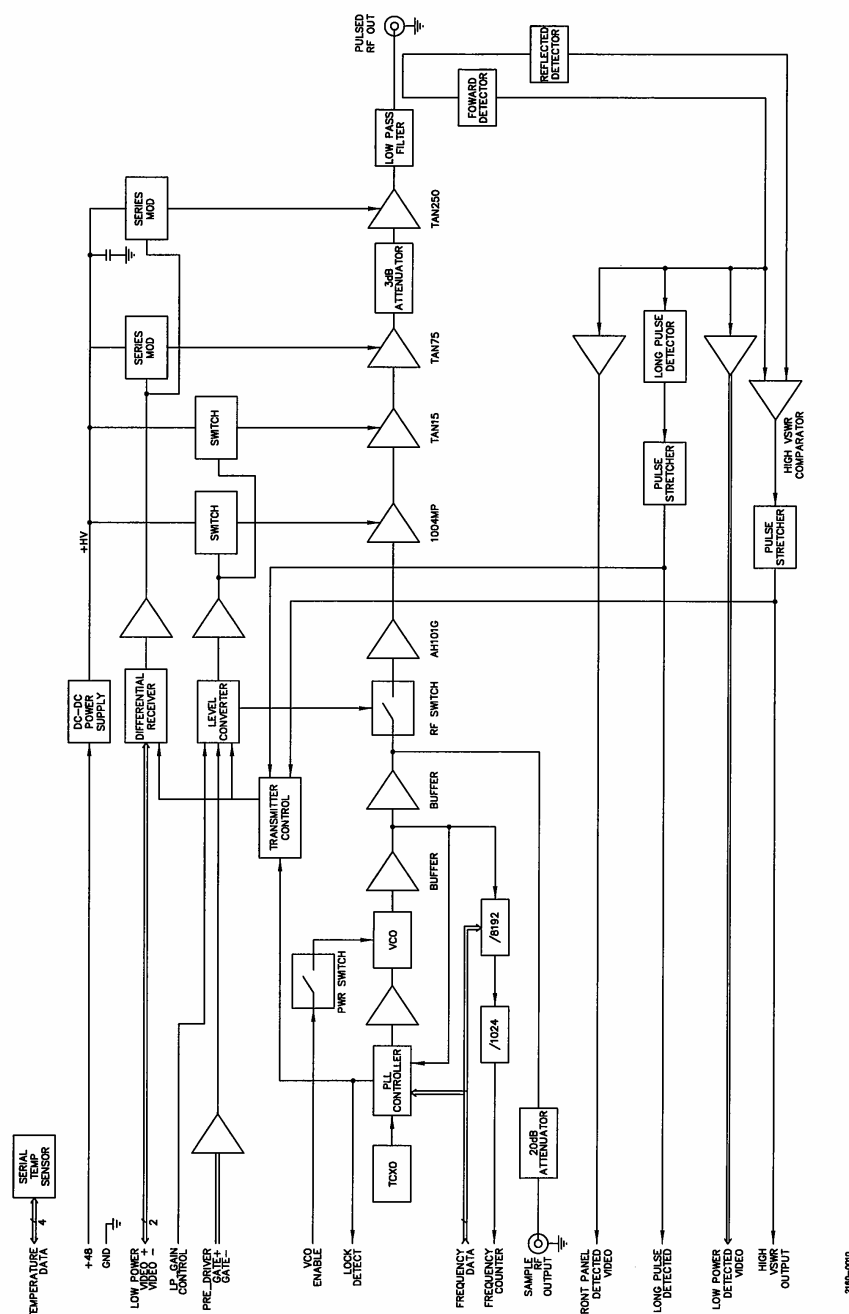


Figure 2-7 Low Power DME Amplifier Block Diagram

2.3.2.4 Receiver Transmitter Controller Theory

The Receiver Transmitter Controller (RTC) is an integral part of the DME dedicated to receiving aircraft interrogations and controlling the transmitter replies. All of the receiver hardware is contained on the RTC assembly except for the pre-selector filter that is tuned to the station frequency.

The RTC Assembly (030805-0001) consists of two circuit card assemblies (CCA). First is the RTC CCA (012168-1001) that slides into the card cage assembly and plugs into the motherboard for power and signal connections. The Receiver RF CCA (012180-0001) is a second circuit card that plugs into the side of the RTC CCA. Power and signal lines come from the stacked circuit card connectors while the receiver RF signal enters through a SMA connector. The RF signal is routed from the backplane connector on the RTC CCA to the Receiver RF CCA using conformable RF cable. The Receiver RF CCA is housed in a completely shielded enclosure consisting of a backing plate, fence, and cover.

2.3.2.4.1 CCA, Receiver Transmitter Controller Block Diagram Theory

This section describes the details of the RTC CCA. Throughout this section refer to [Figure 2-8](#) and 012169-9001 schematic.

A Digital Signal Processor (DSP) and two Field Programmable Gate Arrays (FPGA) comprise the heart of the RTC CCA. All of the timing critical functions of pulse reception and transmitter control are located in the FPGA hardware. Non critical tasks such as identification control, squitter/transmitter rate control, and transmitter pulse shaping are handled by the RTC software in the DSP. The DSP uses its speed to help the hardware handle tasks such as short and long distance echo suppression, decoder correlation, and CW desensitization.

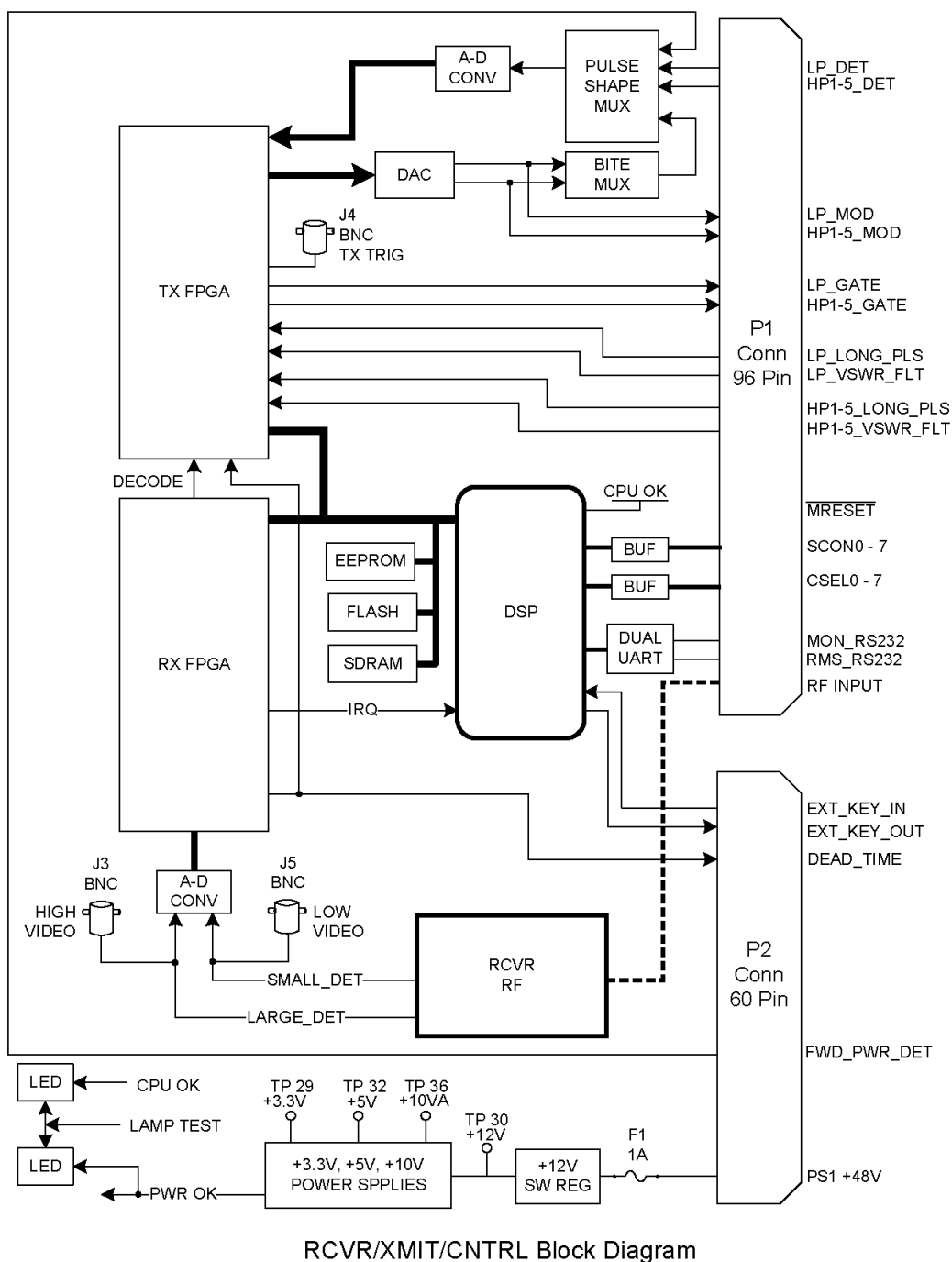
Control of the transmitter is accomplished by the RTC CCA. LVDS hardware on the board provides differential gate pulses that enable the RF modulators and apply the synthesizer RF output to the transistor amplifiers. Additionally the RTC CCA provides differential Gaussian shaped pulses used to control the RF modulator amplitudes. With each pulse transmitted the RTC CCA samples the detected RF output and determines what, if any, errors exist in the pulse shape parameters. The RTC CCA then modifies the output waveform before transmission of the next pulse. This N-1 pulse shaping algorithm is used to ensure the transmitter meets critical spectral requirements. Pulse shaping is one of the transmitter control loops in the DME/TACAN equipment and does not require any user intervention.

Each RTC CCA has an associated low power amplifier and synthesizer. For high power DME operation the LP amp is followed by a HP amplifier. In this case the RTC CCA drives the LP amp with a trapezoidal shape pulse and performs the final pulse shaping in the high power amplifier. When operating as a TACAN, up to five HP amps are summed together with a RF combiner. In this case the RTC CCA shapes each HP amp individually and monitors the composite detected RF envelop for pulse corrections using the forward power detector input signal.

In addition to driving the RF modulators, the RTC CCA controls the transmitter pulse pair spacing and transmission rate. The transmission rate is monitored in the FPGA hardware and randomly spaced pulse pairs are generated if necessary in order to meet a minimum transmission rate. When overloaded by too many aircraft interrogations, the RTC CCA limits the transmitter rate by reducing the receiver sensitivity.

Functions also accomplished by the RTC CCA include the decoder that correlates each received pulse with previous pulses to find a pair that meets the decoder aperture for the DME operation mode. Received pulse widths are monitored such that narrow radar pulses are rejected and wide out of tolerance pulses are rejected. The receiver also provides continuous wave (CW) interference rejection and suppression of transmission due to interrogation echoes.

Communications between the RTC CCA and the RMS is accomplished with a serial data link. Transmitter and receiver configurations are received from the RMS while operating data and maintenance alert signals are sent to the RMS for display on the PMDT. A serial data link between the RTC CCA and the Monitor CCA is provided so the RTC software can control the transmitter delay as well as provide a transmitter soft start feature that monitors the antenna VSWR while ramping up the output power. This helps protect the high power amplifiers from damage in case the antenna port is not properly terminated.



RCVR/XMIT/CNTRL Block Diagram

HPDME-0015

Figure 2-8 Receiver Transmitter Controller Block Diagram

Model 1118A/1119A DME

Multiple synthesizers are controlled by the RTC CCA. First is the transmitter synthesizer located on the LP amplifier that is serially loaded based on the backplane frequency select switches. Second is the receiver synthesizer that is loaded to provide an IF frequency of 125MHz. Output frequencies of both these synthesizers are checked by the Monitor CCA.

When operating as a TACAN the North, Aux, and Ident trigger signals from the TACAN antenna controller are converted to TTL signals using comparators located on the RTC CCA. These TTL signals are used by the FPGA hardware to transmit the North and Auxiliary burst sequences after a short delay. This delay will be configurable in order to support remote shifting of the azimuth angle as required for flight check operations. Both the trigger signals and the delayed triggers will be sent to the monitor for integrity alarm processing.

In addition to the LVDS gate and Gaussian modulation pulses, each power amplifier provides VSWR fault and long pulse fault signals to the RTC CCA. For the LP amplifier connection a synthesizer lock signal is also sampled. All of these signals are sent to the RMS where a maintenance alert is generated and detailed status can be displayed on the PMDT.

Morse code identification is controlled by the RTC CCA primarily by the RTC software. Identification keying can be sourced into the RTC from external equipment such as a VOR, Localizer, or Glideslope. Identification is fully configurable from the PMDT to allow such things as window keying, inverted input keying contacts, interlock-off upon external keying loss, etc. The RTC can even operate in a master mode where keying is output to external equipment.

Front panel test points are provided for inspection of the large and small signal IF waveforms after the signals leave the Receiver RF CCA. A BNC connector provides the transmitter trigger signal that can be used to trigger an external oscilloscope for inspection of the detected transmissions. LEDs on the front of the RTC CCA shown that the power supplies and RTC software are operating properly as well as indicate whenever the receiver has reduced the sensitivity due to traffic overloading or detection of CW.

On the board test points are available to inspect the Gaussian modulation pulses for each power amplifier. These modulation pulses are also multiplexed back into the sampling ADC for diagnostics purposes.

2.3.2.4.2 CCA, Receiver RF Block Diagram Theory

This section describes the details of the Receiver RF CCA. Throughout this section refer to [Figure 2-9](#) and 012181-9001 schematic.

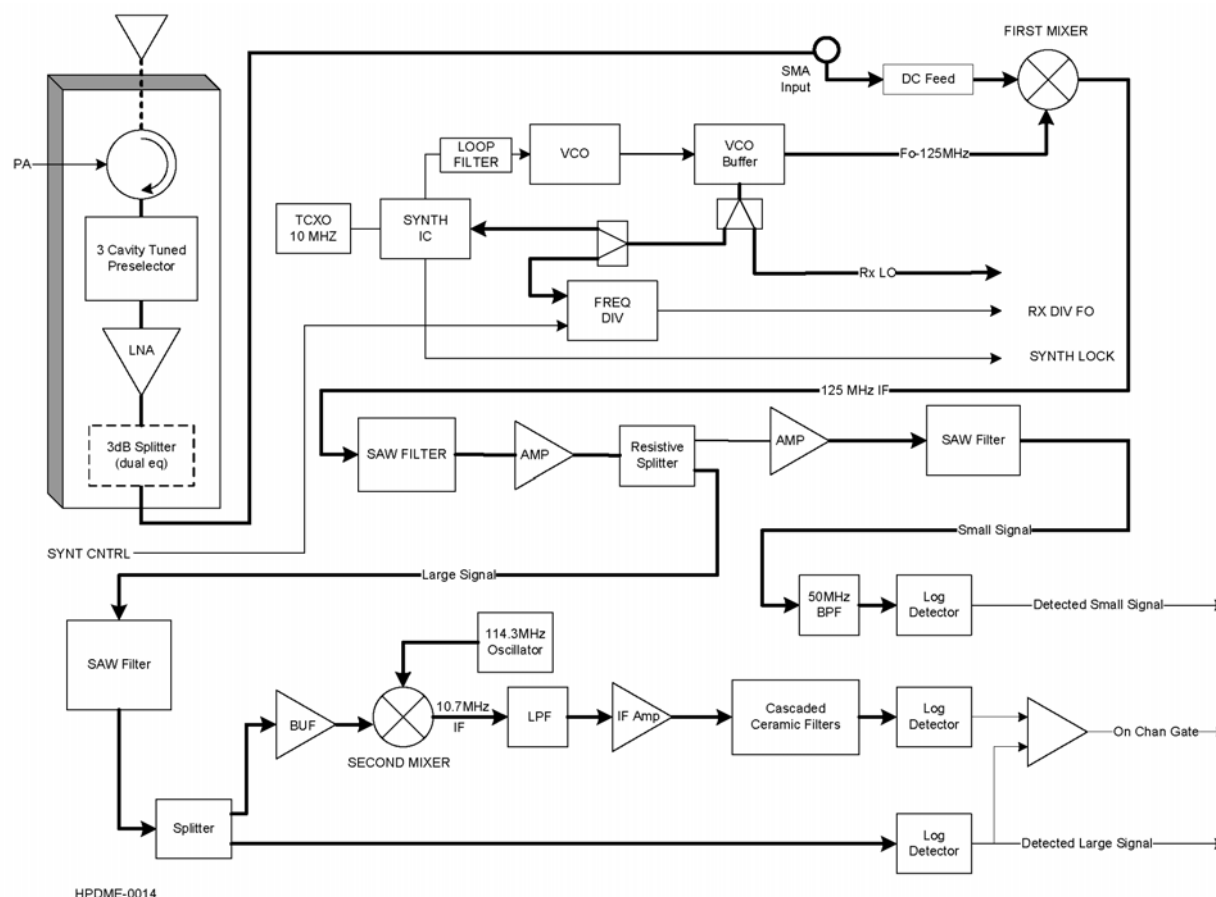


Figure 2-9 Receiver RF Block Diagram

The Receiver RF CCA uses a dual heterodyne receiver with a first intermediate frequency (IF) of 125MHz and second IF of 10.7 MHz. The receiver has a calculated noise figure of approximately 4dB which, when coupled with the external fixed-loss components such as the circulator, preselector, and power splitter provides a maximum receiver sensitivity of minus 94dBm.

The usable receiver sensitivity is configurable via the PMDT interface from -94dBm to -72dBm. This allows the installation to match the receiver range to the transmitter range. By default the receiver sensitivity is set to -82dBm for 100W stations and -87dBm for 1000W stations. These long-established settings ensure that the DME station only replies to aircraft within the working range of the transmitter operating power. For instance a 100W DME transmitter reply can only reach aircraft within a 40NMI radius; therefore the receiver would be unnecessarily overloaded with aircraft interrogations within 200NMI if the receiver sensitivity was maximized to -94dBm.

Model 1118A/1119A DME

Frequency selection of the receiver is accomplished with an independent synthesizer. Thus there are no RF cables interconnecting the interrogation synthesizer and transmitter synthesizer. This also allows use of commonly available IF filter products. The synthesizer output power is +17dBm in order to run a high IP3 mixer. A sampled output is provided on the front panel of the RTC Assembly for use with a frequency counter. A divided output clock signal is also provided for integrity monitoring by the Monitor CCA.

From the first mixer the 125MHz IF signal is bandpass filtered using a Surface Acoustic Wave (SAW) filter. Each SAW filter has approximately 825MHz bandwidth and provides excellent group delay flatness. When cascaded, they also provide more than 90dB image rejection of the final 10.7 MHz IF. After the SAW filter the IF signal is amplified then resistively split into the large signal and small signal path.

Each 125MHz path terminates with a log detector that provides almost 70dB of linear dynamic detection range. Operational amplifiers provide the final gain before conversion of the detected signals by the dual 12-bit ADC at a sampling rate of 25MHz. The receiver dynamic range is greatly increased by using two paths separated by approximately 25dB of signal strength. Internally the FPGA analyzes the two input signal and determines which signal is best for timing reception.

Inside the Receiver FPGA located on the RTC CCA, the two detected signals are resampled at 50MHz then low-pass filtered in order to reduce the noise bandwidth and eliminate the interpolated image. All of the half amplitude detection, including a 2 μ s delay line, is accomplished digitally inside the Receiver FPGA. This technique provides for superior receiver performance and stability.

For on-channel detection the large signal IF path is split before the log detector and down converted separately to 10.7 MHz using a second mixer driven from a 114.3MHz oscillator. This final 10.7MHz IF is narrow band filtered using cascaded ceramic filters then log detected. The resultant narrow-band signal is compared against the detected large signal and used by the Receiver FPGA to insure that received pulses are not from an adjacent DME channel.

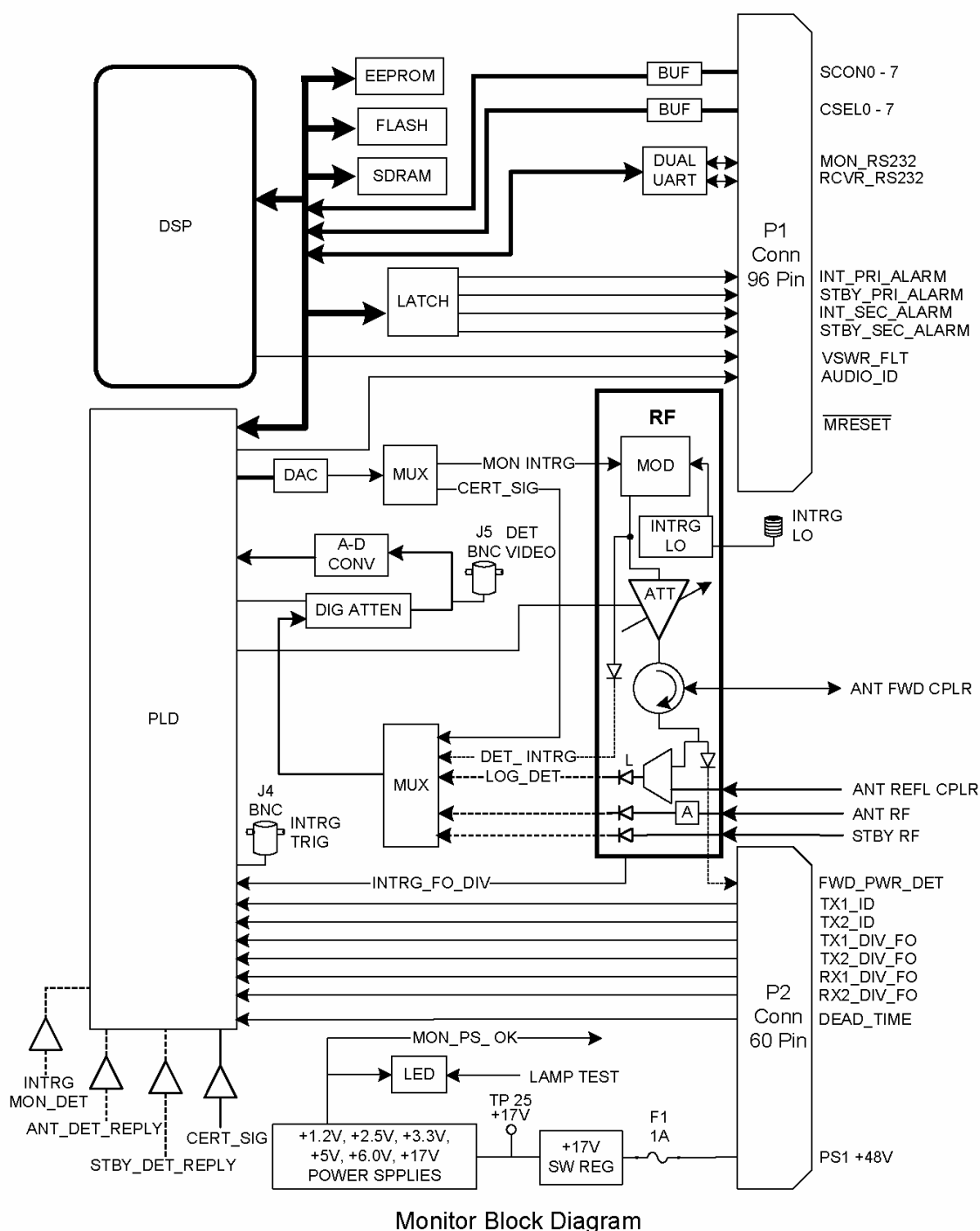
2.3.2.5 Monitor Block Diagram Theory

Refer to [Figure 2-10](#). The Monitor CCA performs supervision of critical DME/TACAN system parameters and also performs self-monitoring. The Monitor CCA is actually two separate printed wiring boards but they are plugged into each other, forming one module. The main board is dedicated mainly to digital circuitry and is the card-cage support of the module, going from the back plane to the front panel. The second board is dedicated to Interrogator (RF) circuitry.

The Monitor CCA is powered by a single +48V power supply coming from the back plane. Regulated +1.2V, +2.5V, and +3.3V supplies are generated from the +48V by the Monitor CCA for the digital circuitry. +5V regulated power is used for analog circuitry and +17V is used to power the Interrogator board. The PS_OK LED is on while all the internal supplies are within limits. This LED can be also be lighted by the ~TEST signal coming from the LCU.

The DSP coordinates all subsystems to measure the parameters, sends the measurements to the RMS using RS232 communications, and notifies the LCU when a critical parameter is out of range using the primary and secondary alarms. The DSP utilizes an external flash ROM for storage of the program and synchronous dynamic RAM (SDRAM) as well as non-volatile RAM (NVRAM) for data storage. The DSP peripherals include a voltage supervisor / watchdog, a dual UART, a programmable logic device with complex control circuitry, and input / output latches.

The voltage supervisor / watchdog resets all the digital circuitry when the +3.3V power supply is too low, when the LCU asserts the ~MRESET line, or when the DSP does not refresh the watchdog timer. The dual UART is used to communicate with the RTC and the RMS through the back plane. The configuration switches of the backplane determine if the Monitor is part of a high or low power DME; or if it's in TACAN mode. The ~LOCAL signal comes from the LCU and determines if the DME is being adjusted by a local operator. The ~OVERLOAD signal comes from the Receiver/Transmitter Controllers (RTCs) and is asserted when any RTC has reduced sensitivity because of the traffic load.



Monitor Block Diagram

HPDME-0013

Figure 2-10 Monitor CCA Block Diagram

Model 1118A/1119A DME

After a system reset, all the alarm latch outputs will be in the active state until updated by the DSP. The alarms are updated only when the DSP refreshes the voltage supervisor / watchdog. If there is a DSP failure, the alarms will remain in the last output state until watchdog time-out and the voltage supervisor / watchdog reset activates the alarms. During normal operation, the alarm outputs are read by the DSP using an input buffer to verify them. The LEDs are used to signal the alarms and pre-alarms conditions on the front panel and the external $\sim$ TEST signal coming from the LCU can light all LEDs to verify they have not failed.

The debug RS232 port is used only for factory purposes and will not be used by the customer in the field.

The 10MHz temperature-controlled crystal oscillator (TCXO) provides an accurate and reliable source of timing for the digital circuitry and the Interrogator sections.

The PLD is decoded into the DSP memory map. The PLD has complex circuitry for a programmable interrogator. The interrogator is enabled half of the time by the INT_EN_U signal coming from the LCU. When enabled, the interrogator uses a digital-to-analog converter (DAC) to generate interrogation pulses to the Interrogator board, which modulates and sends it to the RTCs. Simultaneously, the monitor interrogation is demodulated and sent to an analog-to-digital converter (ADC 1) via the MON_DET_INT signal. Once this sampling is finished, the interrogator controller switches to the ANT_DET_REPLY source or the STDBY_DET_REPLY source to complete the sampling with the reply from one RTC. The sampling is then shared with the DSP to measure the parameters.

The PLD uses the DONE signal to alert DSP once the sampled signal is ready. While the interrogator is disabled, the PLD sends a complete waveform with two interrogations pulses and two reply pulses through the DAC to ADC 1 by the CERT_SIGNAL to certify the alarm limits and the measurement circuitry. Also LOG_DET_MEAS is used to measure the antenna forward or reflected power while the interrogator is disabled, selecting with the FWD/ $\sim$ RFL $\sim$ _CTRL signal. The digital attenuator in the ANT_DET_REPLY signal is used to verify the alarm limits in the output power.

Since interrogator controls the synthesizer frequency of the RF board, it has the ability to change the frequency in real time and mix normal interrogations with out-of-frequency interrogations. The Monitor uses this capability to measure the RTCs rejection of out-of-frequency interrogations. The attenuation of each sample from the DAC can be controlled through the INT_ATT_CTRL signal.

Two BNC connectors are on the front panel. The INT_TRIGGER signal is the trigger for an oscilloscope and the INT_TRIGGER_U signal is the source. The PMDT can select which interrogations to display and the PLD triggers the oscilloscope when the selected type is been sent.

The ANT_DET_REPLY and STDBY_DET_REPLY contain only the shape of the reply pulses. These signals along with the CERT_SIGNAL go through comparators to form square-waves. The square-waves are used by the PLD to measure the pulse-rate frequency and the efficiency. The TX1_ANT indicates which RTC is connected to the antenna. TX1_ID and TX2_ID signals are asserted when each RTC is emitting identification pulses. With these signals and both the antenna and standby reply's, the PLD can monitor the identification code and frequency of both RTCs. An AUDIO_ID signal is also generated by the PLD to hear the Morse identification code of the DME.

The signal INT_F0 is the monitor's synthesizer signal divided by 2^{23} . This signal is used by the DSP to measure the frequency of the synthesizer. The same types of signals come from the DME transmitters and receivers. All of these signals are multiplexed by the PLD to the DSP timer to be measured. The monitor's synthesizer signal is also available on the monitor's front panel to be measured externally.

When working in TACAN mode, North and Aux Burst signals are used in conjunction with the peak-hold circuit and ADC 2 to measure 15 / 135 Hz modulation depth and phase accuracy. The North and Aux Trigger and Delay are used to measure the North and Aux Burst delay and length. There are no hardware differences between the DME and TACAN monitors; only the DSP software and PLD firmware are different.

2.3.2.5.1 DME Interrogator CCA Block Diagram Theory

Refer to [Figure 2-11](#). The Interrogator (RF board) has all the necessary circuitry to modulate the interrogations from the Monitor and demodulate the replies from the RTCs.

For DME systems, the ANTENNA_RF signal comes from the monitor port on the DME antenna. For dual DME systems, the monitor signal is split and run to each Monitor. For TACAN systems, this signal comes from a monitor antenna placed near the TACAN antenna. It is attenuated by a fixed 16dB attenuator and then by a digital attenuator controlled by the monitor DSP.

The digital attenuation stage setting depends on an initial calibration, which varies over antenna cable lengths and types. After the attenuators, the ANTENNA_RF signal is detected and the shapes of the pulses are sent as the ANT_DET_REPLY signal to be processed.

The STANDBY_RF signal only applies for dual equipment. It is derived from a 20dB or 30dB attenuator that is split for each Monitor, then is attenuated by 16dB and demodulated similar to the ANTENNA_RF signal.

The ANT_REFLECTED signal comes from the transmitter 30dB reflected coupler. For dual equipment it is split before routing to each Monitor. After an attenuation of 26dB, this signal is sent to a 45dB precision temperature-compensated logarithmic detector. It is used to shutdown the transmitter if the Monitor detects too much reverse power; which could be caused by an open or shorted antenna cable.

The signal FWD/~RFL_CTRL is controlled by the PLD 1 to switch the source of the logarithmic detector between the reflected and the forward coupler. An additional 10dB attenuation to both signals is applied before the logarithmic detector for High Power DME and TACAN systems; therefore the measurements are equal for low and high power equipment. The ~10DB_CTRL signal activates this additional attenuation when the Monitor is in a high power configuration.

The ANT_FORWARD signal is a bi-directional signal that comes from the transmitter 30dB forward coupler. For dual equipment it is split/combined from each Monitor. As an input, it is used to monitor the transmitter output power and calculate the antenna VSWR. To accomplish this, the signal runs through a circulator and then through a 6dB splitter. One of the split signals is attenuated by 20dB and then can be multiplexed to the 45dB logarithmic detector. The other split signal is attenuated by 10dB and then has an additional 10dB attenuation stage, which is only active in an HP DME or TACAN system. Finally, it is detected and the signal is sent in a differential pair to the RTC for feedback control of composite transmitted pulse shape for TACAN mode.

The Interrogator module has its own synthesizer for on and off-channel measurements. The reference frequency comes from the digital Monitor board and the accuracy of the synthesizer signal is ± 5 parts-per-million (ppm). The synthesizer signal is buffered and sent to the Monitor's front panel for external measurements. Also it is divided by 2^{23} to be measured by the Monitor's DSP.

The interrogation pulse shapes generated by the interrogator in the PLD 1 are modulated with the synthesizer signal and then run through three digital attenuation stages. The three attenuators are also controlled by the interrogator. These digital attenuators have a 95dB dynamic range. The resulting signal is multiplexed to the antenna after a low pass filter and the combiner or to the logarithmic detector after a 10dB attenuator; calibrating the power of the Monitor transmitter and consequently adjusting the interrogation attenuation to be equal over temperature.

This calibration is done periodically and is controlled by the PLD 1 interrogator using the INT_CAL signal. The monitor interrogation is demodulated again and sent to the digital board through the MON_INT signal to be used by the interrogator as previously explained.

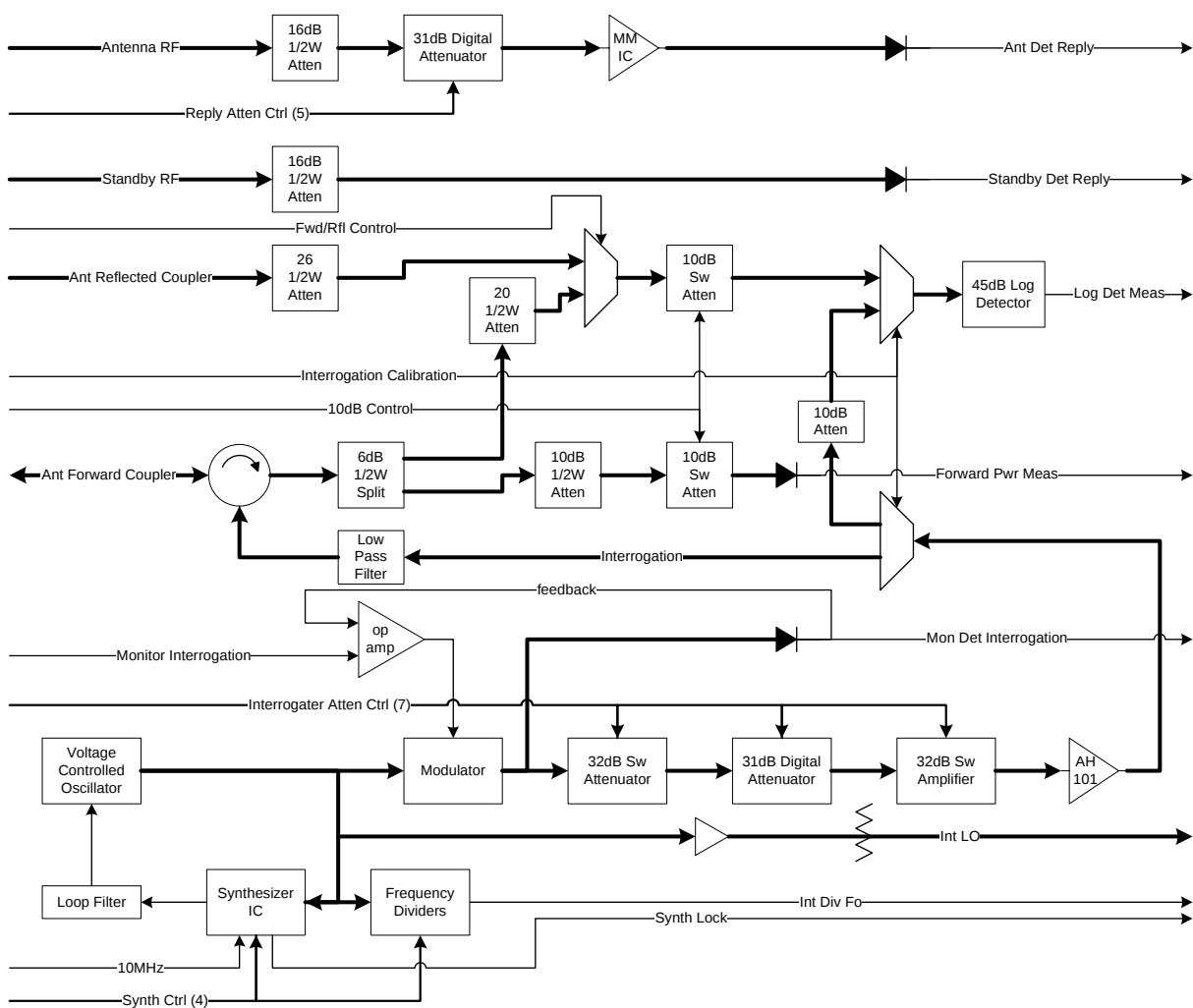


Figure 2-11 DME Interrogator (RF) Block Diagram

2.3.2.6 RMS Processor Block Diagram Theory

Refer to [Figure 2-12](#). The Remote Monitoring System (RMS) CCA performs communications via thirteen serial ports plus a parallel port, and facilitates monitoring/control in a single or dual DME system. The RMS CCA receives battery-backed DC power from the BCPS CCAs at connector J2, through OR'd diodes, and regulated to +5V and +3.3V supplies for use by the RMS CCA to power the microcontroller and all of its associated circuitry.

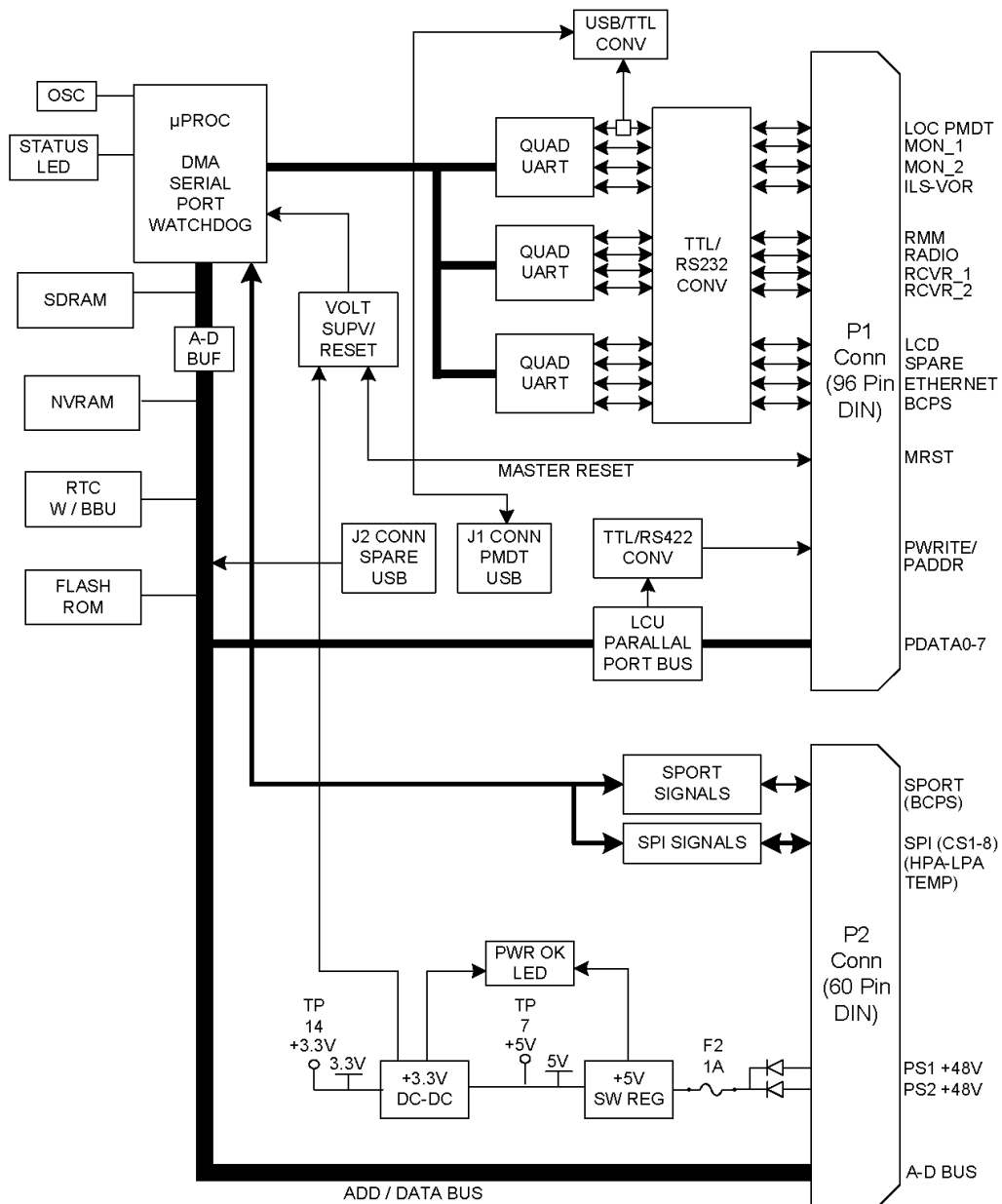
The U8 microcontroller utilizes external flash ROM, non-volatile RAM (NVRAM), synchronous dynamic RAM (SDRAM), a voltage supervisor/watchdog reset circuit, and an oscillator to form the core microcomputer. The U8 microcontroller also includes a direct memory access (DMA) controller, serial ports, and general purpose input/output (I/O). Microcomputer peripherals include a real-time clock (RTC), universal asynchronous receiver/transmitters (UARTs), a parallel port interface (PPI), a USB host port, a USB slave port, off-board bus buffers, and more general purpose I/O.

The U8 microcontroller's flash ROM is factory programmed using the J4 SPI boot header while factory debug is accomplished using the J3 emulator header, the JP3 debug header, and the JP4 PMDT RS232 header. None of the aforementioned connectors and headers will be used by the customer in the field.

RMS communication to the LCU CCA occurs via the parallel port established by U29 through U32 and connector P1. The LCU also returns system control signals through P1 such as *TEST (lamp test) and *MRESET (master reset). Configuration switches on the Backplane CCA define the system set-up to the RMS when it reads them via the Facilities CCA through the external address/data bus on connector P2.

The U8 microcontroller communicates serially through one internal and twelve external UARTs. The internal UART is the debug port of JP3. The other twelve UARTs control communications to Monitors 1 and 2, Receiver/Transmitter Controllers 1 and 2, Remote Maintenance Monitor (RMM), ILS/VOR, Radio Modem, LCD, BCPS, TACAN Antenna, Ethernet, and the PMDT. Two options are possible for local PMDT communications. The PMDT may be connected to USB connector J1 with header JP2 strapped for USB operation. The second option (in factory only) has the PMDT connected to RS232 header JP4 and header JP2 strapped for RS232 operation.

These eleven external UARTs (not including the PMDT) route to connectors P1 and P2. The host USB port of connector J2 is available for possible future options such as connection to a printer.



RMS CCA Block Diagram

HPDME-0012

Figure 2-12 RMS CCA Block Diagram

2.3.2.6.1 RMS CCA Detailed Theory

Battery-backed DC power 1_+48V and 2_+48V enter via connector P2-25 and P2-26, diode-OR'D by diodes CR13 and CR14, and fused by F2. This voltage is further regulated to +5V by DC-DC converter U39, diode CR15, and inductor L3. Over-voltage protection for the +5V is provided by SCR Q5, zener diodes CR19 and CR20, capacitor C115, and resistor R65. The +5V supply is further regulated by linear regulator U40 to create DVCC (+3.3V). The +5V is measurable at TP14 while DVCC is available at TP7.

The DVCC and +5V supplies power the U8 microcontroller and its peripherals. The U8 microcontroller acts as a DC-DC converter to create +1.2V (measurable at TP3) for powering its core (VDDINT) by pulse-width-modulating U8-4/5 and using transistor Q1, diode CR2, and inductor L1. Diode CR1 insures proper power supply sequencing during power-up/down.

The U8 microcontroller utilizes 512Kx16 of flash ROM (U1 and U2) for non-volatile program storage as well as 32Kx8 non-volatile RAM (U3) for variable storage. Oscillator Y2 provides the system clock for U8 as well as UARTs U16, U22, and U28 after buffering by U17. The system clock can be measured at test point TP1.

Data buffers U33/U34 and address buffers U35/U36 are decoded by AND gates U47:B, U47:C, and U47:D to activate the buffers only during a valid asynchronous memory select cycle. Resistor networks RN5 through RN9 act as pull-ups on these buffered bus lines. Only the bus lines between U8 and the 16Mx16 SDRAM (U4) are not buffered in some form. The U4 SDRAM is used for program and variable storage and has very fast access/refresh times.

The U8 microcontroller has direct control of the CPU_OK LED (CR5) by utilizing output PF8 (U8-36) and transistor Q2. The ~TEST signal, from the LCU via connector P2-B8, also can light the CR5 LED when active. Zener diode CR17 limits the maximum voltage while resistor R11 limits the maximum current of the CR5 LED.

Buffer U37 is used to buffer address lines A17, A18, and A19, control signals ~AOE and ~AWE, as well as the serial peripheral interface (SPI). The SCK, MISO, and MOSI SPI signals (U8-53, U8-54, and U8-55) along with ~SPI_CS0 (U8-49) are used in conjunction with the SPI Boot header J4 for in-factory programming of flash ROM. Latch U7 and inverter U10 combine to create the SPI chip select signals ~SPI_CS1 through ~SPI_CS8 for communications to off-board serial SPI devices through connector P2-A8 through P2-A16.

Real-time clock (RTC) U15 is clocked by oscillator U9 and battery-backed up by battery B1 if header JP1 is strapped between JP1-2 and JP1-3. The 512 Hertz heartbeat of RTC U15 can be measured at test point TP13. Oscillator U9 is a highly accurate temperature-compensated crystal oscillator (TCXO) whose accuracy eliminates the need for a potentiometer or adjustable capacitor.

Emulator header J3 is used for in-factory testing and development only.

The ~MRESET signal from the LCU enters via connector P2-B16 and is filtered by inductor FL1 and capacitor C39 to create reset signal ~EXT_RES. Signal ~EXT_RES is bi-directional in that either the LCU or the RMS can cause the signal to be active and reset the entire DME system.

When the LCU pulls ~MRESET (and subsequently ~EXT_RES) low, voltage supervisor / watchdog input U6-1 is low; causing output U6-7 to go low which resets the U8 microcontroller and on-board latch U7 immediately. UARTs U16, U22, and U28 as well as USB host U38 will also be immediately reset by the RESET output of inverter U17:A. Latch U29 will be reset after being delayed by inverters U45:A, U45:B, resistor R13, capacitor C114, and diode CR16.

The RMS can initiate a system reset by activating ARM_SYS_RES (U29-9) and stopping the periodic strobing of voltage supervisor / watchdog input U6-6. A reset from U6-7 will occur approximately one second after the last watchdog strobe; causing inverter U17:A, transistors Q4/Q3 and ~EXT_RES to become active. The reset will clear after ~DELAYED_RESET from U45:B clears latch U29-9 ARM_SYS_RES; which in turn shuts off transistor Q3 and releases ~EXT_RES.

Model 1118A/1119A DME

A reset can also be initiated by voltage supervisor / watchdog U6 when the power supply voltage on U6-2 drops too low; causing U6-7 to activate.

Latches U29 and U31, as well as buffer U32, establish an 8-bit parallel port for LCU communications. Latch U29 signals PWRITE, PADDR, ~PREAD_EN, and PIN/~POUT determine a read or write bus access. The PWRITE and PADDR signals are converted to RS422 by U30 before routing to connector P1.

Quad UART U16 provides four serial ports of the RMS CCA; the local PMDT, Monitor1, Monitor2, and ILS-VOR. The local PMDT has two possible connection means; either through USB connector J1 or RS232 header JP4. PMDT local select header JP2 must be strapped properly for either of them to operate. If the RS232 option is selected (normally only at the factory), U11 performs the RS232-TTL level conversions. If the USB option is selected, U20 performs the USB-TTL translations. U20 is clocked by crystal Y3 and serial EEPROM U5 may be used for USB ID storage. U20 also toggles LEDs CR6 and CR7 to indicate transmission and reception of USB data via the J1 USB-B connector. The ~TEST signal will also light these LEDs through CR8/CR11 when active.

Header JP3 has debug communications that originate as TTL at U8-81/82 before being converted to RS232 by U11. This header is typically used for factory debug / development only.

The Monitor1, Monitor2, and ILS-VOR serial ports from U16 are converted to RS232 by U11 and U12 before connection to P1. The interrupt outputs of quad UART U16 are pulled down by resistors R37, R38, R39, and R41 before being combined by OR gates U13:B, U13:C, and U13:A to create UART1_INT. All twelve interrupt outputs of quad UARTs U16, U22, and U28 are logically combined to eventually create UART_INT which connects to microcontroller U8-48. The U8 microcontroller determines the source of the interrupt by polling.

LED_PWR, which originates between diode CR13 fuse F1, sources zener CR22 through current-limit resistors R66, R67, and R68 to create a precision +10V that can be measured at TP15. The precision +10V powers “window” comparators U46:A and U46:B; which compare the +5DIG voltage at U46-4 and U46-7 to the trip points established by resistors R70, R71, and R72 at U46-5 and U46-6. The precision +10V also powers “window” comparators U46:C and U46:D; which compare the DVCC (+3.3V) voltage at U46-8 and U46-11 to the trip points established by resistors R73, R74, and R75 at U46-9 and U46-10.

As long as both the +5DIG and DVCC are within the “window” trip points; the U46-2, U46-1, U46-14, and U46-13 comparator outputs will be pulled-up to +10V through resistor R69; turning on both transistors Q6 and Q7. Transistor Q6 being on lights the PWR_OK LED (CR25) through current-limit resistor R76 and voltage-limit zener CR24. Transistor Q7 being on pulls the ~PWR_OK signal low through resistor R77. The ~PWR_OK signal is read at microcontroller U8-32 (PF12).

If either +5DIG or DVCC go above or below the “window” trip points, both transistors Q6 and Q7 will shut off; darkening the PWR_OK LED (CR25) and causing the ~PWR_OK signal to go high. The ~TEST signal (when active low) is guaranteed to light the PWR_OK LED (CR25) through diode CR23.

Quad UART U22 provides four more serial ports of the RMS CCA; the RMM, Radio, Receiver1 (RTC1), and Receiver2 (RTC2). These ports are converted to RS232 by U12 and U25 before routing to connector P1.

Quad UART U28 provides the final four serial ports of the RMS CCA; the LCD, the BCPS, the DME/TACAN, and the Ethernet. These ports are converted to RS232 by U25 and U26 before routing to connector P1.

The U38 USB host controller connects to the U8 microcontroller via an 8-bit asynchronous bus. The J2 USB-A connector is powered by filtered (L2) and fused (F1) supply +5DIG. The U38 USB host is clocked by oscillator Y4 and has transient voltage suppression (TVS) protection provided by U41.

Decoding of the address space used by the U8 microcontroller is provided by decoders U23, U24, U21, and U18. All decoder outputs are used for on-board devices except for U24-10, named $\sim\text{EXT_CS}$. This output defines the address space that is used to decode the Facilities CCA devices. Buffers U43 and U44 establish an 8-bit asynchronous bus for communications to/from the Facilities CCA. The inputs and outputs of buffers U43 and U44 as well as $\sim\text{EXT_CS}$ route to connector P2.

The U8 microcontroller has a synchronous serial port controller (SPORT) that is used for communications to the off-board battery charge / power supply controller or controllers (Spare Slot). The SPORT signals are buffered by U42 before connection to P2.

2.3.2.7 Facilities CCA Theory

Refer to [Figure 2-13](#). The Facilities CCA provides system I/O for the RMS CCA. Many of the inputs and outputs of the Facilities CCA eventually connect to the Interface CCA after routing through the Low Power Backplane CCA. System_1 and system_2 battery-backed power supplies (nominally 48VDC) enter connector P2 where they are diode-OR'D together and regulated down into several lower voltages; including +24V, $\pm 15\text{VDC}$, $\pm 12\text{VDC}$, +5VDC, and +3.3VDC.

U1 and U7 DC-DC converters regulate the +48V down to +24V and +5V respectively. The +24V supply is routed out connector P2 for powering the Interface CCA. The +5V supply powers several on-board digital and analog integrated circuits as well as powering DC-DC converter PS1 to create $\pm 15\text{VDC}$. Several linear regulators then create the $\pm 12\text{VDC}$ supplies from the $\pm 15\text{VDC}$ for powering RS232 integrated circuits and the analog signal processing system.

All power supplies, including the system_1 and system_2 supplies, can be monitored by the RMS CCA through the analog-digital converter. The RMS CCA will light on-board PWR_OK indicator CR24 if all supplies are within range. The $\sim\text{TEST}$ signal, which originates at the LCU CCA and enters on P2-B8, will light all on-board indicators when active. The $\sim\text{TEST}$ signal will also cause audio to be emitted from speaker SPK1 when active.

The $\sim\text{MRESET}$ signal, which originates at the LCU CCA and enters via P1-B16, resets U8 when active. U8 outputs $\sim\text{RESET}$, which clears the outputs of all on-board latches. $\sim\text{RESET}$ is also asserted by U8 if the +3.3V supply drops too low.

An asynchronous data and address bus provided by the RMS CCA enters via DIN41612 connector P2. The address bus is decoded into 10 segments for input buffers and output latches. Input buffers are the U27 A-D converter bus, U28 and U29 system configuration switches, U31 amplifier powers status, U32 monitor powers status, U18 frequency configuration switches, and U37 TACAN antenna status. The output latches are U22 A-D converter control, U23 Ident tone multiplexer control, and U38 TACAN antenna control.

As mentioned previously, all power supplies can be monitored by the RMS CCA through on-board U26 A-D converter as well as the U30 voltage reference, exterior and interior temperatures, ten spare analog inputs, and four spare digital inputs. Exterior and interior temperatures originate at the Interface CCA and are conditioned by U19:A and U19:B operational amplifiers. The spare analog inputs and spare digital inputs also originate at the Interface CCA. All of these analog signals are switched through U20 and U21 multiplexers to the single channel A-D converter and read digitally via buffer U27.

The system configuration switch signals, SCON0 through SCON15, originate on the Low Power Backplane CCA and enter via DIN41612 connector P1. Two of these configuration switches, DIALUP/ $\sim\text{EXT}$ and DED/ $\sim\text{RADIO}$, determine whether U12 and U14 on-board modems or external modems connected to the Interface CCA are active. If the U12 and U14 modems are selected, they communicate to the RMS CCA serially once their TTL signals are converted to RS232 by U11 and U13. The U12 and U14 modems each have a speaker output which is multiplexed through U16 to the U15 amplifier and SPK1 speaker. Both U12 and U14 modems have on-board tip and ring transient voltage suppression (TVS) before eventually routed to the Interface CCA and more TVS protection.

Model 1118A/1119A DME

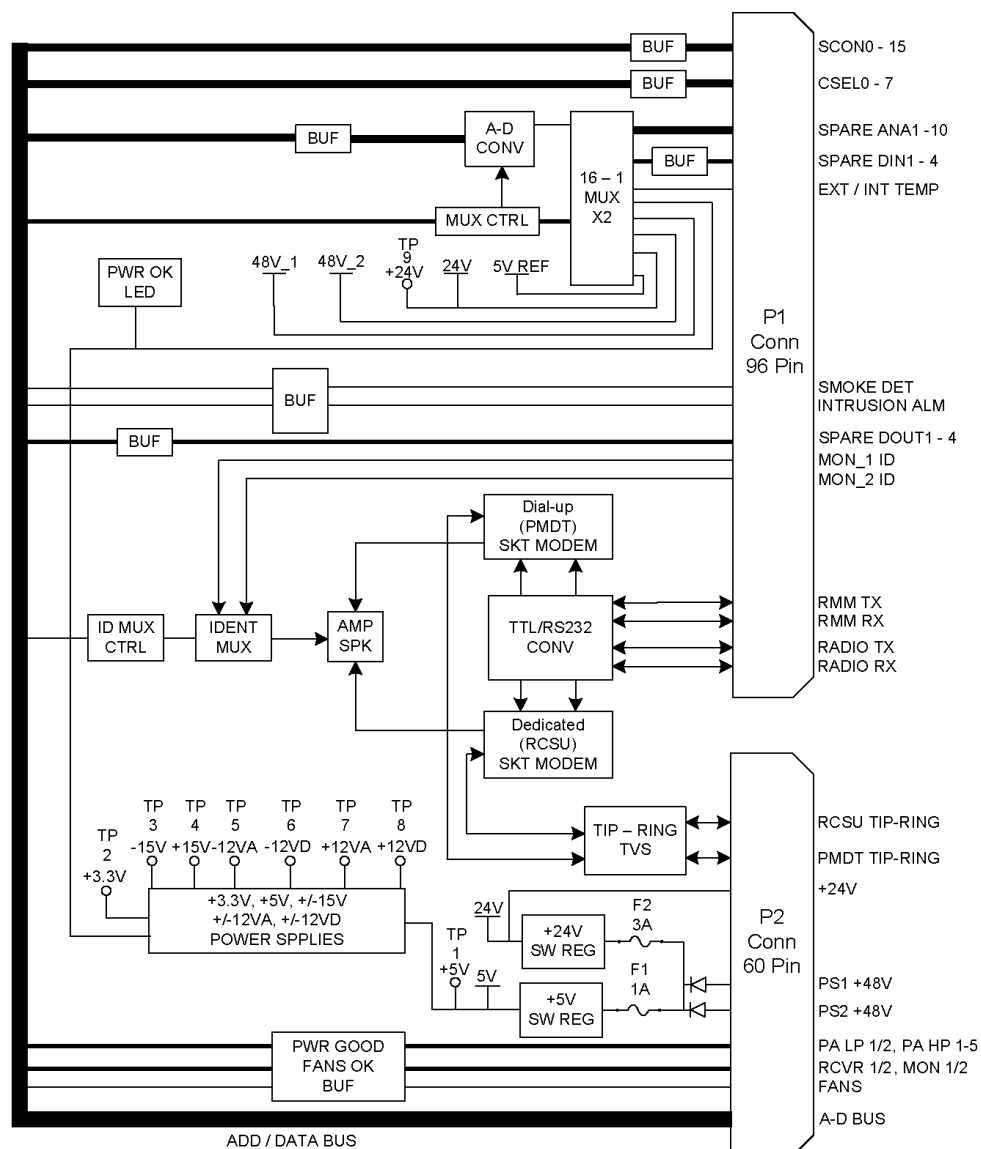
U31 and U32 buffer the power OK signals of up to seven Amplifier CCAs, two Monitor CCAs, and two Receiver/Transmitter Controller CCAs as well as the A-D status signal, the INTERLOCK signal, the ~FANS_OK signal, the SMOKE_DETECTOR signal, and the INTRUSION_SENSOR signal. All of these signals originate at various cards in the Low Power and High Power Backplanes except the last four signals, which originate at the Interface CCA.

The U18 buffer reads the frequency select switches, which reside on the Low Power Backplane CCA and determine the operating frequency of the DME system.

The U37 buffer reads TTL signals which originate at the TACAN antenna system controller, routed through the Interface CCA, and converted from RS422 by U34. The U38 output latch allows the RMS CCA to direct activity of the TACAN antenna system controller after the latch TTL signals are converted to RS422 by U35 and U36. The U38 loop-back signal may be used for fault-isolation purposes to buffer U37.

The U22 latch controls the 32 channels of analog signals through multiplexers U20 and U21 as well as A-D convert/address and PWR_OK indicator. The U23 latch provides the spare digital outputs of the Interface CCA after buffering by U24 as well as the Ident tone multiplexer control and the fans on/off signal through transistor Q2.

Test header J1 is used for factory testing only.



Facilities CCA Block Diagram

HPDME-0010

Figure 2-13 Facilities CCA Block Diagram

2.3.2.7.1 Facilities CCA Detailed Theory

System1 and System2 +48V power from connector P2-25 and P2-26 are scaled down by resistor networks RN1 and RN2 for input to the A-D converter as well as diode-OR'D by CR1 and CR2 to create the facilities +48V supply. This supply (also named LED_PWR) lights the CR24 PWR_OK LED when transistor Q1 is turned on under software control by U22-19; indicating all monitored power supplies are within range.

The facilities +48V is fused by F1 and regulated by regulator U1, L1, diode CR3, and C2 to create +5DIG. Zener CR36, R68, and SCR Q3 protect downstream circuitry in the event of an over-voltage event by opening fuse F1. Zener CR37 will short to ground and protect the downstream circuitry if the SCR/Fuse-blowing circuitry fails for any reason.

The +5DIG supply is further filtered and regulated by regulator U2 and capacitors C3 and C4 to create the +3.3V supply. The +5DIG supply is also input to DC-DC converter PS1 to create -15V and +15V supplies. The -15V is filtered and regulated by L2, C8, U3, and C9 to realize -12ANA and by C7, U4, and C10 for -12DIG. The +15V output is filtered and regulated by L3, C12, U5, and C13 to realize +12ANA and by C11, U6, and C14 for +12DIG.

The facilities +48V also feeds fuse F2 and regulator U7. Switching regulator U7, C15, L4, CR4, CR5, R10, C17, and R11 combine to convert 48 volts to +24V. Zener CR38, R69, and SCR Q4 protect downstream circuitry in the event of an over-voltage event by opening fuse F2. Zener CR39 will short to ground and protect the downstream circuitry if the SCR/Fuse-blowing circuitry fails for any reason.

The ~MRESET signal enters via P1-B16, is filtered by FL1/C19, diode-isolated by CR6, and resets U8 when active. U8 outputs ~RESET, which clears the outputs of on-board latches U22, U23, and U38. ~RESET is also asserted by U8 if the +3.3V supply drops too low after R14 and before U8-2.

The ~TEST signal enters on P2-B8 and will light on-board indicators CR13-CR21, and CR24 when active. The ~TEST signal will also cause audio to be emitted from speaker SPK1 when active. The ~TEST signal is transient-voltage-suppression (TVS) protected by CR40.

Asynchronous data and address busses provided by the RMS CCA enter via connector P2 and are pulled-up by resistor networks RN12 and RN13. The address bus is decoded into sixteen segments by U9 and U10; ten of which are used by the Facilities CCA.

The ten spare analog inputs (SPARE_ANA1 through SPARE_ANA10) and four spare digital inputs (SPARE_DIN1 through SPARE_DIN4) enter via connector P1 and are terminated to ground by resistor network RN3 before connection to analog multiplexers U20 and U21.

The DIALUP/~EXT control signal enters via P1-C26. When this signal is high, buffer/converter U11 is enabled and RMM_TX_232, RMM_RX_232, RMM_DTR_232, and RMM_DCD_232 signals will pass through U11 to Dial-up modem U12 to become ~DU_TXDD, ~DU_RXDD, ~DU_DTRD, and ~DU_DCDD. Components R19, R18, CR9, R20, R17, and CR10 convert +5V signal levels to +3.3V between U11 and U12. Dial-up modem U12 lights indicator CR13 when a RING is received. Dial-up modem U12 also lights indicators CR14 through CR17 when serial data and control signals are active.

The tip and ring signals from Dial-up modem U12 are TVS-protected and filtered by CR7, FL2 and FL3 before exiting connector P2-B14 and P2-B15. Audio from U12-64 is scaled by R29 and R31 before audio header JP1-1.

The DED/~RADIO control signal enters via P1-C25. When this signal is high, buffer/converter U13 is enabled and RADIO_TX_232, RADIO_RX_232, RADIO_DTR_232, and RADIO_DCD_232 signals will pass through U13 to Dedicated modem U14 to become ~DED_TXDD, ~DED_RXD, ~DED_DTRD, and ~DED_DCD. Components R22, R24, CR11, R23, R25, and CR12 convert +5V signal levels to +3.3V between U13 and U14. Dedicated modem U14 lights indicators CR18 through CR21 when serial data and control signals are active.

The tip and ring signals from dedicated modem U14 are isolated, TVS-protected, and filtered by T1, CR8, FL4, and FL5 before exiting connector P2-A14 and P2-A15. Audio from U14-64 is scaled by R28 and R30 before audio header JP1-3.

Three more sources of audio (other than the modems) are controlled by analog multiplexer U16. MON1_AUDIO_ID and MON2_AUDIO_ID from P1-C1 and P1-C2 (originally from the Monitor CCAs) connect to multiplexer U16-15 and U16-12. The third audio source is generated by 1KHz oscillator CR34, U17:A, C65, and R62 when the ~TEST signal is active. ID_MUX0 and ID_MUX1 (U16-11 and U16-10) select monitor audio through U16 except when ~TEST is active.

Resistors R39 and R38 scale the monitor or test audio output of U16-3 and feed it to AC-coupling capacitor C30. Amplifier U15 amplifies the sum of audio presented through R32, R33, and R34 and drives speaker SPK1 as determined by gain resistor R37. Amplifier U15 (and therefore all audio) is disabled if no jumper is present between audio header JP1-5 and JP1-6. Each modem's audio output can be disabled by either removing jumpers between audio header JP1-1 and JP1-2 or JP1-3 and JP1-4.

The exterior and interior temperature circuitry operate identically. Therefore only the exterior shall be discussed. The exterior temperature sensor signal (EXTERIOR_TEMP) from P1-A21 is converted from current to voltage by R41 and R43 before routing to buffer U19-3. The U19-1 buffered output (EXT_TEMP) is scaled by resistor network RN14-5/12 and RN14-6/11 before connection to the J1 test header and analog multiplexer U21-26 as ETMP_SCALED.

Test header J1 is used for factory testing only.

All on-board power supplies are scaled and presented to both the J1 test header and analog multiplexers U20 and U21. These supplies are DVCC (+3.3V), +5DIG, +12DIG, +12ANA, -12DIG, -12ANA, +15V, -15V, +24V, 1_+48V, and 2_+48V and are scaled by resistor networks RN14, RN4, RN5, RN1, and RN2. Other signals routed to the analog multiplexers are SPARE_ANA1 through SPARE_ANA10, SPARE_DIN1 through SPARE_DIN4, +5Vref created by U30, digital ground, and analog ground.

An individual channel of the 32 possible channels for the U20/U21 analog multiplexer pair is selected by MUX0 through MUX4 from latch U22. Inverter U17:B insures MUX4 enables only U20 or U21. The enabled U20 or U21 multiplexer passes its signal to buffer U25-3. Buffer output U25-6 passes the signal to A-D converter U26-14.

The U26 A-D converts the analog input signal to digital data outputs when commanded by latch U22-15. The end-of-conversion is signaled by U26-28; which is read through buffer U31-9. The digital data outputs of the A-D are pulled-up by RN6 and buffered through U27 to the data bus.

The system configuration switch signals (SCON0 through SCON15) enter via connector P1, are pulled-up by resistor networks RN7 and RN8, and then connect to buffers U28 and U29. Channel select inputs CSEL0 through CSEL7 enter via connector P1, are pulled-up by resistor network RN11, and are buffered to the data bus by U18.

Power OK signals from the Low Power Amplifiers, High Power Amplifiers, Monitor CCAs, and Receiver/Transmitter Controllers as well as status signals INTERLOCK and ~FANS_OK connect to buffers U31 and U32 and resistor networks RN9 and RN10. Resistors R16 and R26 provide a high current pull-up for SMOKE_DETECTOR and INTRUSION_SENSOR signals before buffer U32.

Latch U23 drives SPARE_DOU1 through SPARE_DOUT4 through buffer U24 to connector P1. Latch U23-12 drives the FANS_ON signal through inverter U17:C and transistor Q2 to connector P2-B16 while CR42 provides transient protection. Finally, latch U23 controls audio multiplexer U16 via ID_MUX0 and ID_MUX1 (discussed previously).

The U37 buffer reads TACAN antenna controller signals which enter through connector P1 and are converted to TTL by U34. The U38 output latch directs activity of the TACAN antenna controller after the U38 latch signals are converted to RS422 by U35 and U36. The U38-19 loop-back signal may be used for fault-isolation purposes to buffer U37-9. Latch U38-16 also controls ~TACAN_RESET though transistor Q5 and TVS diode CR42 before routing to P1-C8.

2.3.2.8 Interface CCA Theory

Refer to [Figure 2-14](#). The Interface CCA provides interface connections between the RMS/Facilities/Low Power Backplane CCAs and the outside world. Examples include spare analog and digital inputs, spare digital outputs, temperature sensors, smoke detector, intrusion sensor, and a TACAN antenna controller. RS232 communications are provided to RCSU and PMDT terminals as well as an optional Ethernet module. All signals are protected by transient voltage suppression (TVS) devices on the Interface CCA before exiting.

All connections between the Interface CCA and the RMS/Facilities/Low Power Backplane CCAs are accomplished via headers J1 and J2. The J2 and J3 connections will not be used in a DME system since there will not be a TACAN antenna system controller.

Connectors J5 and J6 are DB9-types which provide interface to the RCSU and PMDT terminals mentioned previously.

Connector J7 is an RJ11 phone jack provided for exterior temperature sensing.

Connector J8 is a header provided for in-factory test purposes.

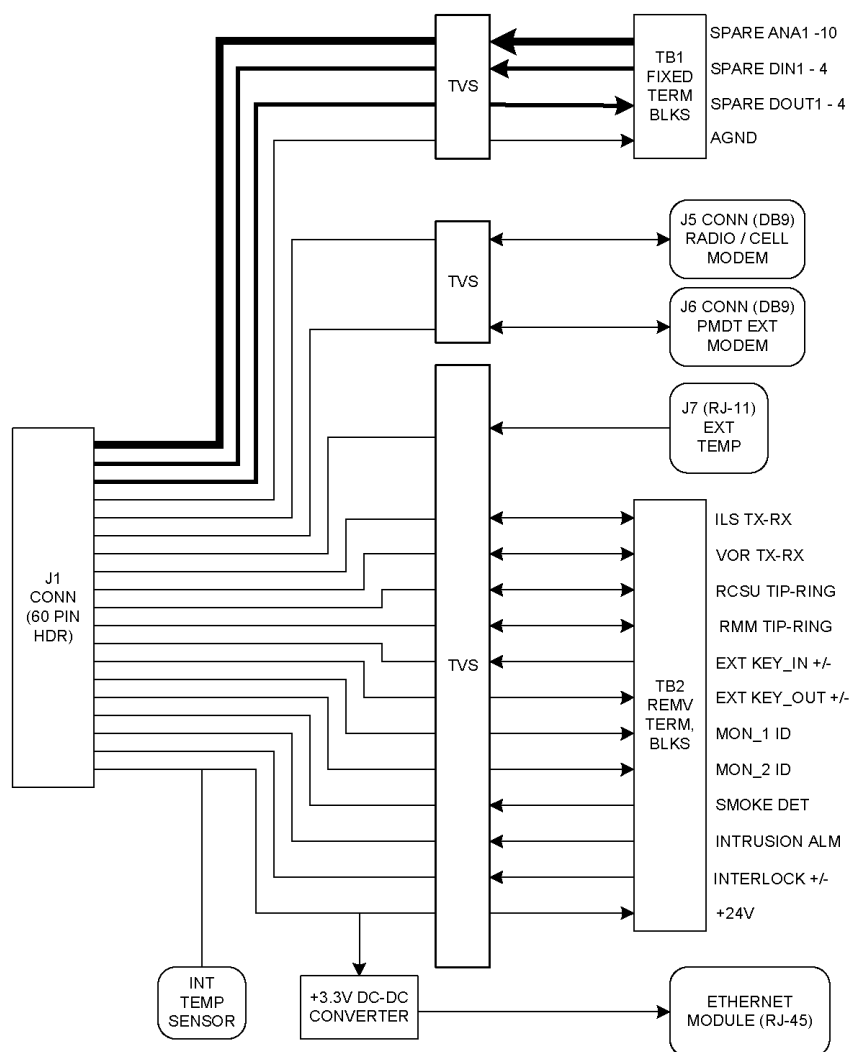
Connector J9 is an RJ45 jack intended for use as an Ethernet port. The port will be powered by a +3.3V DC-DC converter (PS1).

Terminal block TB1 facilitates connection of up to ten spare analog inputs, four digital inputs, and four digital outputs.

Terminal block TB2 allows connection of the RCSU and Dial-Up modem tip and ring signals. These signals are transient protected by common-mode chokes as well as spark-gaps, Sidactors, and power resistors. INTERLOCK and EXT_KEY_IN signals are TVS-protected and optically isolated. True isolation for these signals may be enabled or disabled depending on the strapping of JP1 and JP2. EXT_KEY_OUT signals are optically isolated and TVS-protected before exiting via TB2.

SMOKE_DETECTOR, INTRUSION_SENSOR, ILS-VOR_RX_232, and ILS-VOR_TX_232 signals are TVS-protected before further routing. DET_IDENT1 and DET_IDENT2 signals are scaled as well as TVS-protected before exiting via TB2.

Earth ground lug E1 provides a return path for all transient voltage protection devices on the Interface CCA.



Interface CCA Block Diagram

HPDME-0011

Figure 2-14 Interface CCA Block Diagram

2.3.2.8.1 Interface CCA Detailed Theory

The Interface CCA provides interface connections between the Backplane CCA and the outside world. All signals are protected by transient voltage suppression (TVS) devices. All connections between the Interface CCA and the Backplane CCA are accomplished via headers J1 and J2. The J2 and J3 connections will not be used in a DME system since there will not be a TACAN antenna system controller.

On-board sensor U1 provides interior (cabinet) temperature while an exterior sensor can be interfaced via RJ11 connector J7. Interior temperature sensor U1 is TVS-protected by diode CR68 while the exterior temperature signal is protected by diode CR29. Earth or chassis ground is connected by lug E1 and inductor L1. Circuit or analog ground is accessible at test points TP4 and TP5.

The +24VDC power, which originates at the Facilities CCA, is indicated present by LED CR71 and resistor R30. The +24VDC is TVS-protected by diode CR44 and available to be measured through resistor R28 and test point TP3. The +24VDC powers the INTERLOCK and EXT_KEY_IN opto-isolators, the optional Ethernet module J9, and an off-board radio/RF modem via terminal block TB2-9.

Optional Ethernet module J9 has an RJ45 connector, is TVS-protected by U4 through U6, is powered by DC-DC converter PS1, and has its TTL signals converted to RS232 by U7 before routing eventually to the RMS CCA. Diodes CR41 through CR43 insure the proper voltage level before entry into PS1. PS1 converts +24VDC to +3.3VDC and diode CR72 provide TVS protection.

All TACAN antenna system controller signals are TVS-protected by diodes CR45 through CR67 before routed to DB37 connector J3.

Test header J8 is used for factory testing.

The RCSU has two possible paths for communications; either tip-n-ring to terminal block TB2-1 and TB2-2 or RS232 to DB9 connector J5. The active path is configured by a system configuration DIP switch on the Low Power Backplane CCA. Diodes CR21 through CR24 provide TVS protection for the RS232 signals while resistors R21 through R24, spark-gap V2, sidactor Q3, and balun L2 provide the TVS protection for the tip and ring signals.

The PMDT also has two possible paths for communications; either tip-n-ring to terminal block TB2-3 and TB2-4 or RS232 to DB9 connector J6. The active path is configured by a system configuration DIP switch on the Low Power Backplane CCA. Diodes CR25 through CR28 provide TVS protection for the RS232 signals while resistors R17 through R20, spark-gap V1, sidactor Q2, and balun L3 provide the TVS protection for the tip and ring signals.

Spare I/O terminal block TB1 provides connection to ten spare analog inputs, four spare digital outputs, and four spare digital inputs. All of these signals are TVS-protected by diodes CR1 through CR18. All of these signals eventually route to the Facilities CCA.

External interconnect terminal block TB2 provides connection for the remainder of the signals of the Interface CCA. The SMOKE_DETECTOR and INTRUSION_SENSOR signals are TVS-protected by diodes CR37 and CR38. The ILS-VOR RS-232 signals are TVS-protected by diodes CR19 and CR20.

The INTERLOCK+ and INTERLOCK- signals are connected to opto-coupler U3:A. Full power supply isolation can be achieved by removing jumpers JP1A and JP1B from header JP1 if the customer is willing to provide an external supply. Current is set and steered through the LED of U3:A by resistors R14 through R15 and diodes CR36 and CR69. The transistor output of U3:A is TVS-protected by diode CR39.

The EXT_KEY_IN+ and EXT_KEY_IN- signals are connected to opto-coupler U3:B. Full power supply isolation can be achieved by removing jumpers JP2A and JP2B from header JP2 if the customer is willing to provide an external supply. Current is set and steered through the LED of U3:B by resistors R5 through R7 and diodes CR32 and CR70. The transistor output of U3:B is TVS-protected by diode CR40.

The EXT_KEY_OUT signal is TVS-protected by diode CR35 before routing to pull-down resistor R9 and transistor Q1. Resistors R10 and R11 bias the LED of opto-coupler U2 while diodes CR33 and CR34 transient protect the transistor outputs of opto-coupler U2. The transistor outputs are labeled EXT_KEY_OUT+ and EXT_KEY_OUT- before routed to terminal block TB1.

The MON1_AUDIO_ID and MON2_AUDIO_ID are transient protected by diodes CR30 and CR31 before being voltage-divided by resistors R1/R3 and R2/R4. The lower voltage level signals are called DET_IDENT1 and DET_IDENT2 before being routed to terminal block TB2.

2.3.2.9 AC Monitor CCA Theory

Refer to [Figure 2-15](#). The AC Power Monitor CCA provides a means for the DME system to measure the AC current and voltage levels of the obstruction lights and of the DME system itself. A photo switch bypass is also incorporated for the obstruction lights in the event manual operation is desired.

T1 is a current-sense transformer in series with the obstruction lights line supply from TB1-4 and TB1-5. AC current through the primary of T1 induces a current in the secondary. The secondary is connected to J1-3 and J1-4. A resistor on the BCPS CCA converts this current to voltage for measurement.

T3 is a voltage step-down transformer connected in parallel to the obstruction lights supply at TB1-4 and TB1-6. The transformer primary is strapped to accept a nominal 220 VAC. AC voltage on the primary is stepped-down on the secondary and current-limited by R1 and R2 in the unlikely event of an accidental short-circuit. The secondary is center-tapped and is routed to J1-1, J1-2, and J1-13.

T2 is a current-sense transformer in series with the DME's line supply from TB1-10 and TB1-11. AC current through the primary of T2 induces a current in the secondary. The secondary is connected to J1-7 and J1-8. A resistor on the BCPS CCA converts this current to voltage for measurement.

T4 is a voltage step-down transformer connected in parallel to the DME's supply at TB1-9 and TB1-10. The transformer primary is strapped to accept up to 220 VAC. AC voltage on the primary is stepped-down on the secondary and current-limited by R3 and R4 in the unlikely event of an accidental short-circuit. The secondary is center-tapped and routed to J1-5, J1-6, and J1-14.

An external SPDT switch is connected at TB1-1, TB1-2, and TB1-3. This switch in the OFF position allows an external photo switch to control the application of power to the obstruction lights. When in the ON position the obstruction lights are turned ON continuously.

Earth ground is also connected to the AC Monitor CCA via the board's mechanical mounting holes and TB1-12.

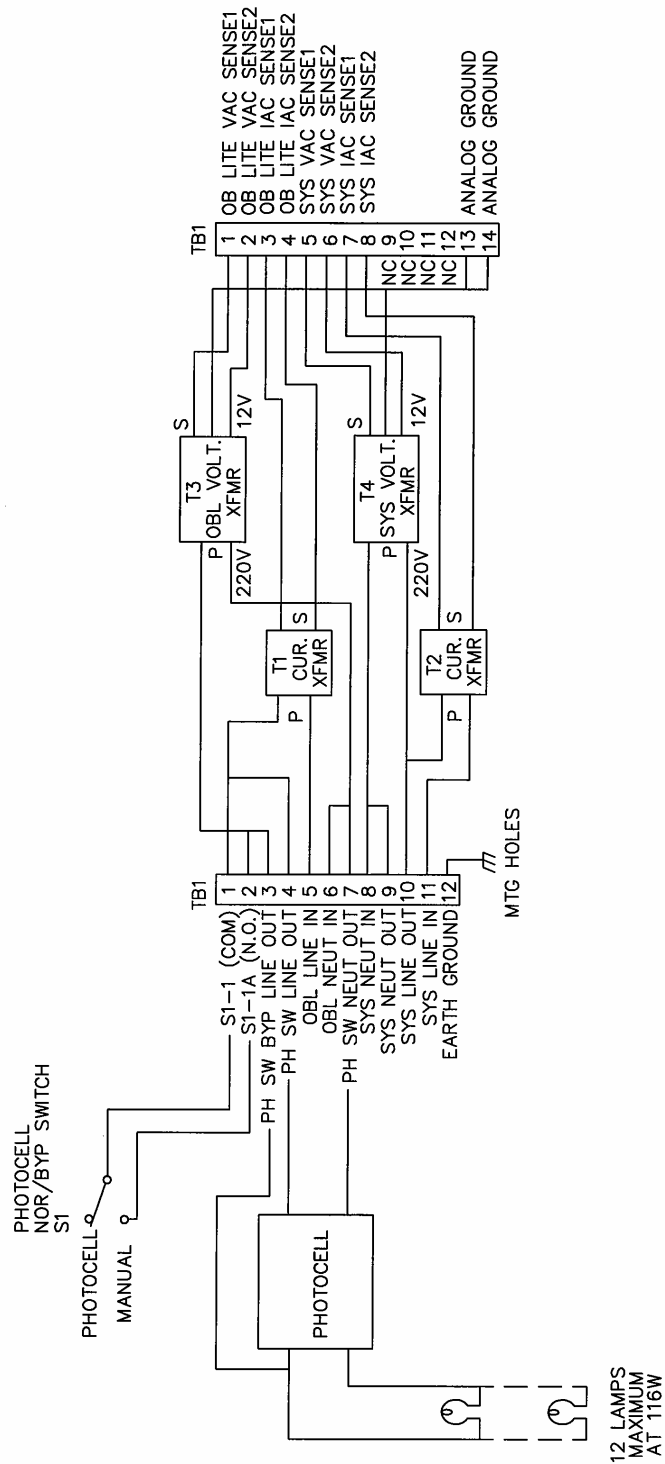


Figure 2-15 AC Power Monitor Block Diagram

2.3.2.10 Local Control Unit Simplified Theory

Refer to Figure 2-16. The Local Control Unit (LCU) controls the normal operation of the DME/TACAN. All operational functions are performed by the LCU and are controlled by either front panel keyboard when in the local mode or by the Remote Maintenance Subsystem (RMS) through the parallel interface. The LCU is controlled by the Portable Maintenance Data Terminal (PMDT), Remote Control Status Unit (RCSU) or Remote Status Unit (RSU) through the RMS for all remote operator intervention or by the RMS for automatic restart. The LCU receives the alarm outputs from the installed Monitor circuit card(s) and depending on the configuration of the system, uses the results of these signals to determine alarm status. If an alarm is detected, the LCU shuts down the system currently radiating and transfers to the standby system in accordance with the system configuration. The LCU also provides the ability to disable monitors and bypass alarms as required by the operator.

The LCU provides +24V to the two possible synthesizer VCO circuits, the +24V to activate the transfer switch, and the transmit enable clock to the installed RTCs.

Status is reported by LED's visible to operator standing in front of the DME/TACAN, or through the RMS to the PMDT/RCSU/RSU. An alarm shutdown is reported to the RMS as well as indicated by an audible alarm.

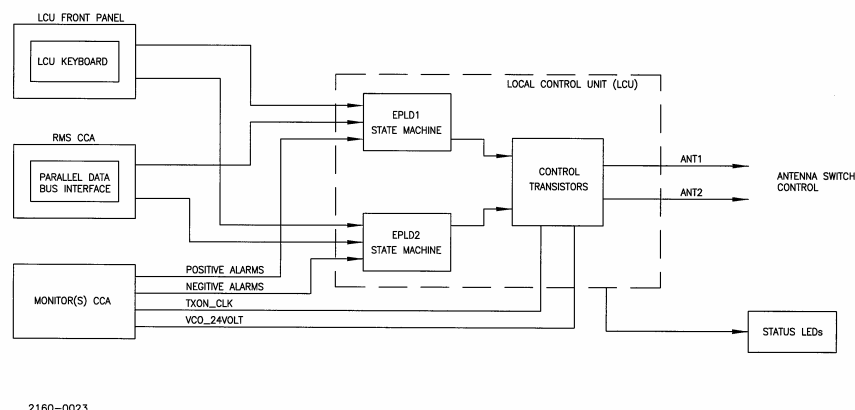


Figure 2-16 LCU Simplified Block Diagram

2.3.2.11 Local Control Unit Block Diagram Theory

Refer to Figure 2-17.

2.3.2.11.1 DC to DC Converter

The LCU receives +48V from the two independent system power supplies and diode OR's the two sources to provide input power to a DC to DC converter which supplies all required voltages for the LCU.

2.3.2.11.1.2 Power Fail Detectors

Each of the two independent +48V sources is monitored by a voltage comparator to monitor the health and availability of power from each of the sources. These signals are used to determine voting logic for the alarm registers and are reported back to the RMS via the parallel interface.

2.3.2.11.1.3 Key Switch Registers

Front panel switches are de-bounced and held in the Key Switch Registers pending processing by the LCU transfer state machines. Commands received from the RMS via the parallel interface also control the contents of the Key Switch Registers. The registers will hold the last command received until the LCU transfer state machine processes the command.

2.3.2.11.1.4 Parallel Interface

The interface to the RMS is via a parallel data bus consisting of eight (8) data bits, an Address Command line, a Write Command line, and a Read Command line. The sequence to access internal registers within the LCU consist of the address being placed on the data bus followed by the strobing of the Address Command line to latch the address into the internal address register. This is followed by the Read Command line driven true to facilitate a read from the latched address. For a write command, the address is followed by the data to be written to the LCU followed by strobing the Write Command line. Alarm Configuration, Bypass Commands, Key Commands, and basic LCU configuration are some of the bits controlled by the RMS via the parallel interface. State machine Status, Power-fail Status, System Configuration bits (SCON), and Local/Remote status are some of the status bits that are readable by the RMS via the parallel interface.

2.3.2.11.1.5 1.8432MHz Oscillator/Divider Chains

The LCU employs a 1.8432MHz crystal oscillator to produce all frequencies required by the design. The frequency is divided by 512 to produce 3600Hz used to produce the audible alarm tone and the Transmit On clocks driven back to the monitors. The signal is further divided by 8 to produce 450Hz used as the system clock within the design. This signal is divided by 45 to produce 10Hz used in the 20 second delay counter and the Key De-bounce circuits.

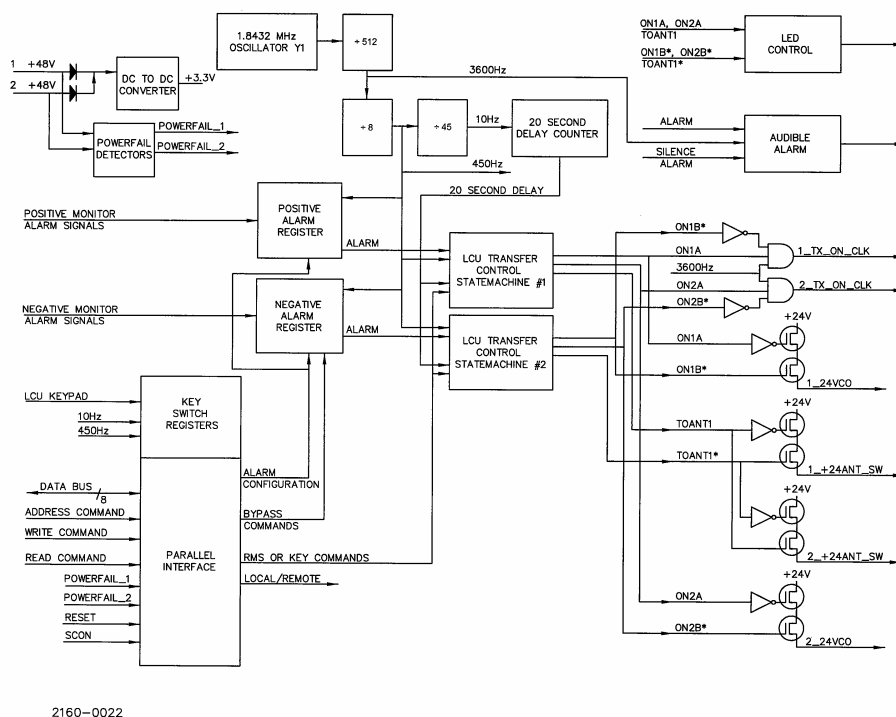


Figure 2-17 LCU Block Diagram

2.3.2.11.2 Positive Alarm Register

This register receives the positive (high True) alarms from the two potential monitors within a system. Depending on the configuration of the alarm voting and bypass logic, the Alarm Register will report an alarm to the transfer state machines if reported by the enabled monitors.

2.3.2.11.3 Negative Alarm Register

This register receives the negative (low True) alarms from the two potential monitors within a system. Depending on the configuration of the alarm voting and bypass logic, the Alarm Register will report an alarm to the transfer state machines if reported by the enabled monitors.

2.3.2.11.4 20 Second Delay Counter

The 20 second delay counter is activated whenever the system initially powers up or a transmitter has been shut down without transferring to a standby system to ensure that the system will not radiate any signal for a period of 20 seconds following the shutdown.

2.3.2.11.5 LCU Transfer Control State Machine #1 and #2 and Discrete Controls

The heart of the LCU is the two redundant transfer control state machines. These are configured by the RMS; receive key commands from the front panel or from the RMS, and process alarms reported by the monitors after being filtered by the Positive and Negative Alarm Registers. Once configured for on air, the state machines will drive out the required signals to enable the transmit on clocks (1_TX_ON_CLK, 2_TX_ON_CLK), enable the +24V power to the synthesizer VCO's (1_24VCO, 2_24VCO), and select the required system to be placed on the antenna (1_+24ANT_SW, 2_+24ANT_SW).

With the redundant state machines, detection of an error assures that the system generating the error will be removed from the air. The LCU transfers to the standby system if configured to do so either immediately for a Hot Standby system or after a 20 second delay for a Cold Standby system. If further alarms are detected, the LCU transfer state machines will shut the standby transmitter down and block any further transmission for a minimum of 20 seconds. Restarts are under the control of the RMS.

The LCU transfer control state machines report status back to the RMS indicating the state of the state machines, and any shutdowns that have occurred. The LEDs on the front panel reflect the current state of the state machines.

2.3.2.11.6 LED Control

Status is fed back to a local operator via the LED's on the front panel of the LCU. These reflect the state of the transmitters and the various alarms as reported by the monitors.

2.3.2.11.7 Audible Alarm

If an alarm as reported by the monitors is detected that is not bypassed, the audible alarm is generated. The audible alarm can be reset by pressing the Alarm Silence button on the front panel. In local mode, the audible alarm is disabled.

2.3.2.11.8 Monitor Alarm Interface

In order to insure that a monitor alarm signal is communicated to the control logic, redundancy is incorporated into the monitor alarm signals. Each alarm signal is sent as two signals, one active high and the other active low. In the LCU, resistors are used to pull each of their signals to their active (alarm) state. This insures that an alarm condition will be sensed if there is an open in either alarm line. If an alarm line is shorted to its inactive (non-alarm) state, the other line will communicate an alarm condition. If the 1_INT_ALARM+ signal is disconnected, a resistor will pull the input high resulting in an alarm condition being sent to the control logic in the EPLD U3. If the 1_INT_ALARM- signal is disconnected, a resistor will pull the input to a low logic level.

2.3.2.11.9 Station Control Logic

The station control logic is duplicated in both U1 and U3. The logic responds to local operator control through the pushbutton switch inputs as well as remote control through the parallel interface. The local operator can perform the following functions:

- a. Specify which DME/TACAN transmitter is to be designated as main.
- b. Turn either transmitter ON and connect it to the antenna.
- c. Turn either transmitter ON and connect it to the load.
- d. Turn either transmitter OFF.
- e. Toggle the bypass state of either of the monitored signal sources (Integral, Standby).
- f. Silence the aural alarm (until the next event causes it to sound).
- g. Toggle the state of local control. When local control is set, input from the keypad is enabled.

The following functions can be performed by the RMS through the parallel interface:

- a. Functions a-g listed above.
- b. Enable or disable the alarm signals from either one of the monitors. When a monitor's alarm signals are disabled, it is functionally equivalent to the monitor producing constant alarms.
- c. Set the "AND/OR" state of the alarm logic when it combines the alarm signals from Monitor 1 with the alarm signals from Monitor 2. When set to "AND", both monitors must provide an alarm from the same source to cause the station to transfer. When set to "OR", Monitor 1 signaling an alarm or Monitor 2 signaling an alarm will cause the station to transfer.
- d. Set the "Maintenance Alert" state. This lights the corresponding LED on the panel and sounds the aural alarm.
- e. Set the "Remote Control Fault" state. This lights the corresponding LED on the panel and sounds the aural alarm.

In the alarm logic circuitry, the alarms from Monitor 1 alarm status are displayed on the panel. Similarly, the alarms from Monitor 2 alarm status are displayed on the panel. If a given monitor's alarm signals are disabled by the RMS, it is equivalent to all of that monitor's alarm signals being asserted. The state of the AND/OR setting determines whether both or either of the Monitor 1 or Monitor 2 signals are required to produce a transfer condition. If one of the two +48V power fail logic signals goes active, the alarm logic will force an alarm condition for the monitor pair that is powered from the corresponding +48V supply. In order to avoid shutting the DME/TACAN station down, the alarm logic is forced to the AND state. This allows the other monitor to monitor the system.

The alarm signals from the monitors have already been given the appropriate transfer delay times within the monitors. This results in an immediate transfer when the combinatorial requirements of the alarm signals are met. When a transfer condition occurs, the present transmitter that is connected to the antenna system is taken off the air. The other transmitter is connected to the antenna system, and turned on (if it is not already on). If the transmitter, not designated as main connected to the antenna system when the transfer condition occurs, the control logic will enter the shutdown state and both transmitters are turned off. Once the control logic enters the shutdown state, no further transfer operations will take place until a local operator or the RMS turns one of the transmitters on and specifies that it is connected to the antenna system. The Station Control Logic controls which transmitter is connected to the antenna system by the status of the +24V ANT outputs.

2.3.2.11.10 System Configuration Inputs

In order to reduce the amount of effort required to program various modules within the DME/TACAN for the proper configuration, there are eight logic signals that are sent from the RMS to each module to specify the system configuration.

2.3.2.12 High Power Amplifier Theory

Refer to [Figure 2-18](#) for a block diagram of the High Power Amplifier module. The 030804-0001 High Power Module has three major assemblies. The Modulator CCA, which is also the module's input/output path, processes the control signals from the RTC (Receiver Transmitter Controller) to properly control the desired output RF pulse shape and amplitude. The Power Supply CCA contains the DC/DC converters and transmitter energy storage capacitors. The third assembly is the RF amplifier/transmitter portion of the module. It receives a square wave pulsed RF signal from the Low Power Amplifier Module and provides the necessary amplification and pulse shaping to obtain the desired output performance. Analog control signals from the RTC are routed via high speed differential analog paths through the high power backplane to the High Power Amplifier. Differential analog signals are used to suppress the effects of common mode noise on the signal paths and to maintain the integrity of the analog control signals. Similarly, the detected video outputs of the High Power Amplifier assembly are routed through similar high speed differential analog paths back to the RTC, for the same reasons.

The High Power Module is used in both the 1119A High Power DME systems and TACAN systems with the differences between the DME and TACAN versions noted below. Only minor changes are required for it to be able to be used in either system.

2.3.2.12.1 High Power Modulator CCA Block Diagram Theory

The Modulator CCA sends and receives control signals to the RTC (Receiver Transmitter Controller) in the DME/TACAN systems. In a dual equipment configuration, both the system 1 RTC and the system 2 RTC provide control signals to the High Power Amplifier module via the Modulator CCA. These input signals are routed through analog switches on the Modulator CCA. These switches are controlled by a main/secondary switch control input from the DME system, which tells the High Power Amplifier which set of input signals to respond to. In the single equipment configuration DME / TACAN stations, this main/secondary switch is always configured to the "main" state, and the amplifiers will respond to signals from the only RTC. In a dual 1119A High Power DME configuration station, with two separate high power amplifier modules, these input signals are configured to the "main" selection for system 1, and the "secondary" selection for system 2. The high power amplifier associated with system 1 will respond to signals from RTC1, while the high power amplifier associated with system 2 will respond to signals only from RTC2. In the dual TACAN configuration, where there is a common bank of 5 high power amplifier modules combined to make the final high power output, this main/secondary select input will be set to "main" when system 1 is on the antenna, and to "secondary" when system 2 is on the antenna. The detected forward RF video from the output directional coupler within the High Power Amplifier assembly is routed via two high-speed differential analog buffers to RTC1 and RTC2 simultaneously.

The modulator CCA controls the voltage to the RF amplifying transistors to obtain the proper transmitter power and shape. The transmitter gate signal, supplied by the RTC, is applied to the first one (two in the DME configuration of the amplifier) RF amplifier stage(s) through a high side MOSFET switch. Each transistor has an individual modulation MOSFET. The modulating transistor switches are controlled at two different voltage levels for a 6 dB transmitter power level change. The final amplifying stage consists of four transistor operating in parallel and each is controlled by a high side MOSFET. Each one of the transistors is linear modulated with the signal from the RTC that is Gaussian shaped. This determines the output pulse modulation shape and amplitude. The forward and reverse detected RF video outputs signals are sent from the Output CCA (012189) to the Modulator CCA where the signals are used to determine the RF pulse shape and level. These detected signals are also monitored on the Modulator CCA for excessive pulse width and high VSWR conditions. The output of the high pulse width and high VSWR monitor circuits are stretched and sent to the RTC for monitoring. In addition, in the event there is a detected pulse width fault or a high VSWR fault, the stretched outputs of these detectors will disable the High Power Amplifier RF output for protection against damage. The forward detected video signal is also routed to the RTC to complete the control loop that provides the proper power level and pulse shape. The RTC compares this detected signal to the desired output pulse shape, calculates the necessary corrections, and pre-distorts the shaped pulse control signals used by the High Power Amplifier module.

2.3.2.12.2 Power Supply CCA Block Diagram Theory

The Power Supply CCA within the High Power Amplifier assembly contains two of the same DC/DC converters used on the Low Power Amplifier Module running in parallel with the input voltages range of 36VDC to 60VDC. The nominal output voltage is 53.7VDC set by the Master converter with the second converter set as a Slave to share the load current. This nominal voltage is passed to the Modulator CCA (012178) for modulation and power control of the RF transistors. This nominal output voltage is also DC/DC converted to 12VDC using a switching regulator. The other required DC voltages used within the module are linear regulated from the 12VDC voltage. The DC/DC converter and switching regulator voltages are monitored for proper DC levels using a window comparator. This signal is sent to the RTC for “bite” monitoring with a logic level “0” indicating a “POWER GOOD” condition. A front panel status LED is provided, and is illuminated green to indicate this “power good” condition. The transmitter’s energy storage capacitors are contained on this circuit assembly.

2.3.2.12.3 RF Amplifier / Transmitter Assembly Theory

The transmitter portion of the HPA Module provides amplification of the RF signal and is comprised of three assemblies. The first assembly contains an attenuator pad, and one amplification stage for HP DME configuration or two amplification stages for TACAN use. The second assembly is comprised of four transistors in parallel. The last assembly board contains a low pass filter and a coupler. The transistors on the first assembly board all “square wave” modulated while the final transistors in parallel are “Gaussian pulsed” modulated regardless of High Power DME or TACAN configuration. All transistors are bi-polar junction transistors (BJT) and are operated in Class-C mode, common base. This module is capable of transmitting in excess of 1000W peak at the output port of the module in order to insure 1000 watt output power at the antenna connector at the top of the system cabinet. The transmitter is described in the following paragraphs.

2.3.2.12.4 HP Driver CCA Block Diagram Theory

Refer to [Figure 2-18](#). The input to the driver board receives a “square wave” input signal from the low power module. The signal is attenuated and then amplified by one or two stages depending upon configuration. The attenuator pad serves two purposes. The first is that it prevents the amplifier from being over-driven by the low power module, and the second is that it maintains impedance stability between modules. Depending upon the configuration, the “square wave” signal is then amplified by one stage in the DME configuration or by two stages in the TACAN configuration. The voltage supplies of the transistors are “square wave” modulated in synchronization with the Low Power Module. The pulse width, gain, and output signal level are controlled by its own modulator.

NOTE: The printed circuit board used is the same for both DME and TACAN; parts are simply added or removed during assembly of the DME and TACAN versions of the high power amplifier.

2.3.2.12.5 HP Final CCA Block Diagram Theory

Refer to [Figure 2-18](#). The final driver receives the “square wave” input signal and splits the signal into four transistors using multi-stages of 3dB hybrid couplers. At this point, the signal is amplified and converted into a “Gaussian pulse” by modulating the transistor’s voltage supplies. The hybrid couplers provide sufficient isolation among the four transistors and the driver to avoid instability when transforming the signal. The proper pulse shaping and output signal level is controlled by its own modulator circuit. The signals are recombined using multi-stage hybrid couplers. Once again the couplers provide adequate isolation among the transistors in case of a transistor malfunction or voltage standing waves.

2.3.2.12.6 HP Output CCA Block Diagram Theory

Refer to [Figure 2-18](#). The Output CCA contains a low pass filter and a coupler. The low pass filter is designed for minimal insertion loss through the transmitter band and provides a nominal 40dB of attenuation for unwanted high frequency spurious signals. The filter is shielded and uses both printed circuit and lumped elements in the design.

The coupler is a printed circuit “micro-strip” component with a nominal coupling of 30 dB and a minimum directivity of 15dB. The coupler is used to sample the transmitted signal and detect any reflected signals due to load mismatches. Both the forward and reflected signals are further attenuated by 10dB and are converted to video signals before being passed to the Modulator CCA. Both the forward and reflected detectors have about 25dB of linearity.

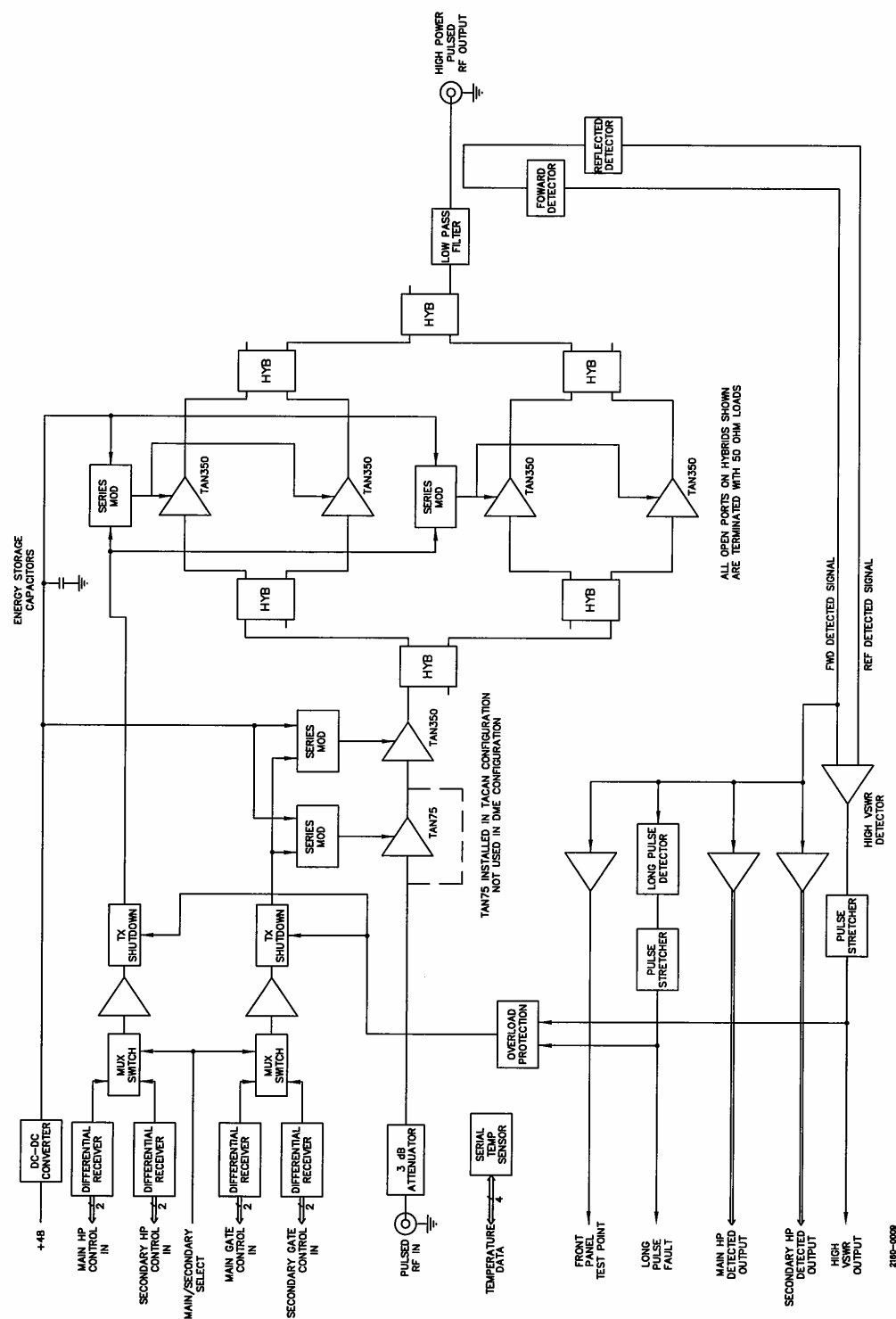


Figure 2-18 High Power Amplifier Block Diagram

2.3.2.13 Fan Control CCA Block Diagram Theory

Refer to Figure 2-19. The Fan Control CCA provides control and monitoring of up to two fans in a Model 1119A High Power DME System. The Facilities CCA has an open-drain FANS_ON signal which turns the fans on when high. The Facilities CCA monitors the active-low ~FANS_OK signal to verify both fans are operating properly. If ~FANS_OK is high, one or both of the fans need servicing.

The Fan Control CCA has three connectors. Power signals 1_+48V, 2_+48V, and ground from the Low Power Backplane CCA enter via header P1. The +48VDC signals are diode-OR'D, fused and filtered before routing to voltage regulator diodes and the fans power+ connections.

Two voltage regulator diodes create +10.2V and +5.1V supplies from the diode-OR'D +48V. The +10.2V regulator provides bias to the power transistor that is the on/off switch for the fans. The +5.1V regulator provides power to the watchdog circuitry for fan speed monitoring.

The Fan1 and Fan2 watchdog circuitry watch for tachometer pulses. If either fan's speed dips too low or stops entirely, the diode-AND output of the watchdog circuitry will go low; causing the ~FANS_OK transistor switch output to go high.

Terminal blocks TB1 and TB2 provide connections to the fans. Each fan has a power+, a power-, and a tachometer output. The power+ of both fans connects to the fused and filtered +48VDC supply while the power- of both fans are switched to ground by the power transistor switch whenever the FANS_ON signal is active. The tachometer outputs are connected to their individual fan watchdog circuitry.

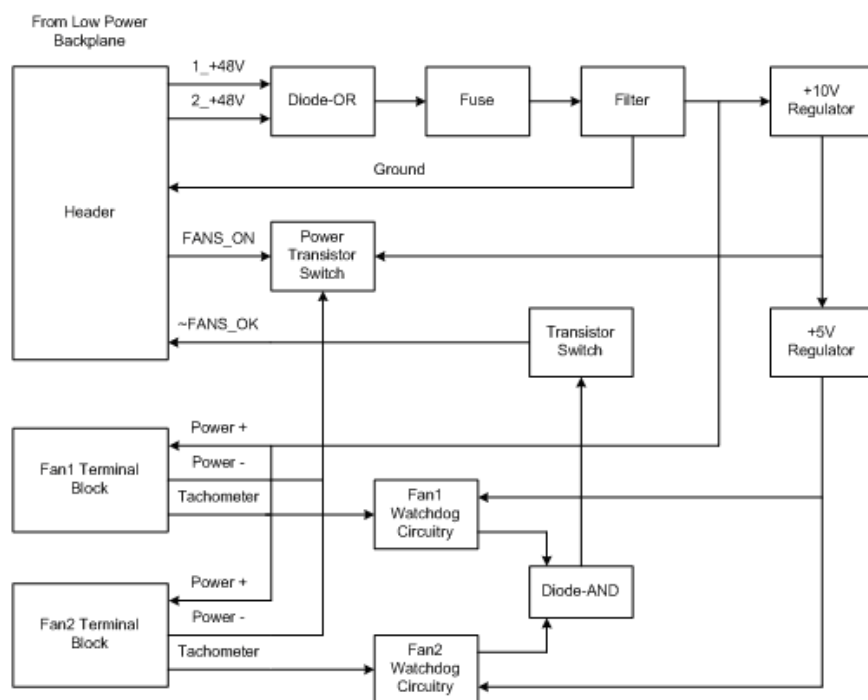


Figure 2-19 Fan Control CCA Block Diagram

2.3.2.14 BCPS Block Diagram Theory

Refer to Figure 2-20. The Battery Charger Power Supply (BCPS) monitors various system power levels and switches the sourced power between the commercial power and batteries to assure continued service. There are three basic blocks used to illustrate the functions within the BCPS; the Analog Multiplexer, PIC processor with A/D converter and the DC to DC converter.

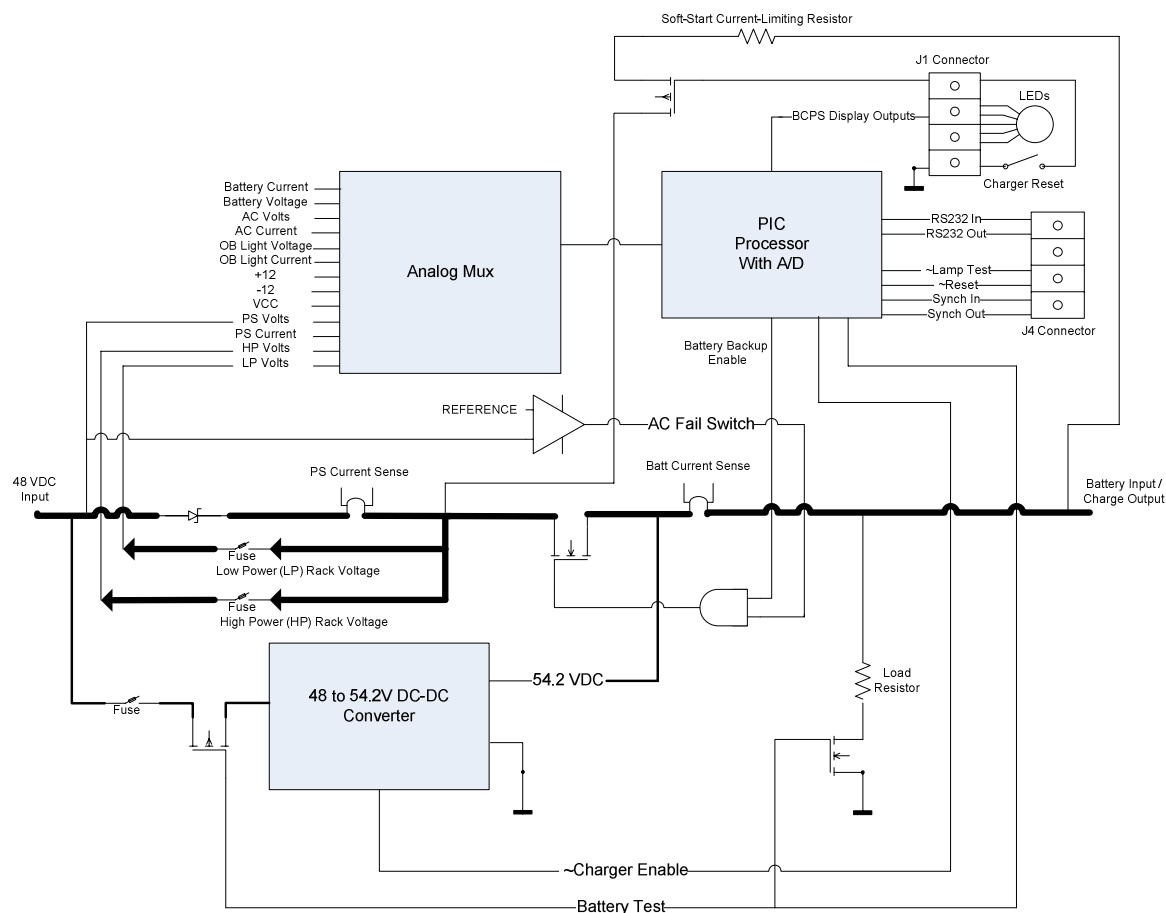


Figure 2-20 BCPS Block Diagram

2.3.2.15 Extender Board Block Diagram Theory

Refer to [Figure 2-21](#). The Extender (Logic) CCA provides the means for a service technician to extend an RMS, Facilities, Monitor/Interrogator, or RTC CCA outside of the Low Power Backplane card cage so that measurements can be taken.

The Extender (Logic) CCA extends a 96 pin DIN41612, a 60 pin hybrid DIN41612, and four RF signals through conformable conductors. The Extender (Logic) CCA can only extend the RMS, Facilities, Monitor/Interrogator, or RTC CCAs.

The 96 pin (P1 and P3) and 60 pin hybrid (P2 and P4) connectors are bussed straight across the CCA. The RF connectors (P2 and P4: D, E, F, and G) route straight across the CCA via conformable conductors.

Test points TP1 and TP2 allow test equipment connection to circuit ground.

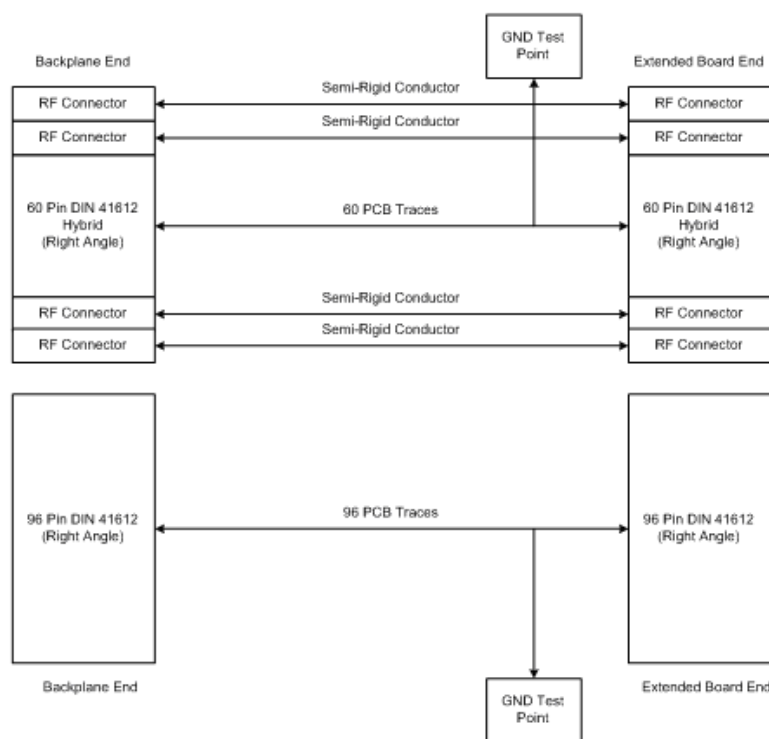


Figure 2-21 Extender Board

2.3.2.16 Low Noise Amplifier (LNA) Theory

Refer to [Figure 11-27](#). The low noise amplifier assembly consists of a single MMIC amplifier that is performance maximized for the RF band from 1025 to 1150 MHz. In the system it is located on the preselector filter output and helps to greatly reduce the receiver noise figure by amplifying the received interrogations before they are split and sent to the receivers. The module uses 5Vdc that is fed from either RTC down the RF coax cables.

3. OPERATION

3.1 Information

The operation of the Model 1118A/1119A DME is controlled by a system of local and remote controls and status displays that provides the following general capabilities:

- a. Control of operational parameters and comprehensive display of operational status through the use of user friendly Windows XP™ based PMDT application running on a standard PC or notebook computer.
- b. Control and display of equipment operation in the airport maintenance room and tower cab.
- c. Remote control and status via modem and dial-up telephone line with the same displays and control menus as are used with local control.

3.2 Remote Control Status Unit (RCSU)

This unit provides summary level control and status of the airport's navaid equipment. The RCSU is usually located in the airport equipment maintenance room. The controls and indicators on this panel are described in the RCSU manual (572238-0001) specific to this equipment.

3.3 Remote Status Unit (RSU)

This unit displays the same summary level status as the RCSU but on a smaller panel that is suitable for installation in a console in the tower cab. The only system control capability provided on this panel is to bypass a Localizer Far Field Monitor, and to select the active runway in an interlocked system. The controls and indicators on this panel are described in the RCSU manual (572238-0001) specific to this equipment.

3.4 Remote Status Display Unit (RSDU)

This unit displays the same summary level status as the RCSU, on a large touch-screen controlled display that is suitable for installation in various configurations in the tower cab. The controls and indicators on this touch-screen display are described in the 2238 RCSU manual (572238-0001) specific to this equipment.

3.5 Portable Maintenance Data Terminal (PMDT)

This subsystem is comprised of a standard PC or notebook computer and PMDT application software. The PMDT can be used in differing applications including:

- a. Local control and status of DME equipment in the equipment shelter. In this application the PMDT connects directly to the Remote Maintenance Subsystem (RMS) interface on the front of the equipment cabinet.
- b. Remote Maintenance Monitor (RMM). The same software and hardware used in the shelter for direct control of the equipment can be used remotely to control and monitor the equipment.

The PMDT uses software that allows the operator to easily select control parameters and monitor thresholds for display and change, and to select operation status parameters for display. The operator can control the operational state of the equipment for maintenance purposes.

Model 1118A/1119A DME

3.5.1 Connecting the PMDT

When connecting directly to the DME the PMDT PC connects to the J1 PMDT USB port on the front of the RMS CCA using a standard USB A/B cable from one of the PMDT PC's USB ports. This USB cable (SELEX-SI #950915-0000) is supplied with the PMDT PC.

When the PMDT is used as an RMM, the connection is made by connecting the PMDT's internal modem to the TELCO line and using the PMDT software to call the DME.

3.5.2 Starting the PMDT Application

To start the PMDT application double-click on the PMDT icon on the desktop or select the Start >> Programs >> SELEX-SI >> PMDT menu item.

Note that the PMDT application is best viewed on a monitor with a resolution of 1024x768 or larger, using Windows XP™'s "Windows Classic" theme and the "Normal (96DPI)" font size. Using the "Large size (120DPI)" Windows font will distort some PMDT screen controls making the data hard to read. Refer to the Microsoft Windows XP™ Display Properties screen for these settings.

3.5.3 Turning On the DME

Turn on both AC switches, and then both DC switches. The system will perform its initialization, delay 20 seconds and then start transmitting. Pressing the Local Mode button will abort the 20 second delay and start the transmitters immediately.

3.5.4 Equipment Shutdown

3.5.5 Equipment Turn Off

Log out of the PMDT by selecting System >> Logoff/Disconnect. If the DME is currently in a non-standard mode of operation, the user will be prompted to correct the issue(s) before continuing with the logoff. Once the PMDT is logged off, turn off both DC switches and then both AC switches.

3.5.6 PMDT PC Turn Off

The power to the PMDT PC should not be removed until the Windows Shutdown sequence has been performed. This is done by selecting Start >> Shut Down... >> Shut down >> OK. The PMDT PC should automatically power down.

3.6 PMDT Screens

This section describes each of the screens used by the PMDT operator to control and monitor the performance of the DME equipment.

3.6.1 General

The PMDT is a Microsoft Windows application requiring Windows XP™ or greater. Windows 98, Windows NT or Windows 2000 may be used for direct connections to the DME but the use of the PMDT over a modem will not be available on these systems.

The PMDT application contains three graphical sections; Menus, the Sidebar, and Screens. The screens are intended to be used with a mouse where the operator positions a cursor on a screen control symbol and clicks the left mouse button to activate the control. Clicking one of the menu items will cause the program to present screens associated with the broad category described by the function (RMS, Transmitter, Monitor, etc.).

NOTE

The DME allows configuration changes by PMDT with a local connection by default. The SCON5 "Remote Control Enable" switch on the Backplane may be closed to allow configuration change by remote connection also

3.6.2 Menus

The PMDT functions are arranged in hierarchical menus such that selecting one menu will cause a lower level menu of functions to drop down. A ">" symbol to the right of a menu item indicates that a lower level menu will appear if the cursor is briefly kept on the menu item, or if that menu is selected.

Each menu item contains an underlined character. The menu item can be selected from the keyboard without using the mouse by simultaneously pressing the "Alt" key and the underlined character. This provides an alternate method for making screen selections should a mouse not be available with the PMDT. Similarly, screens containing several controls can be negotiated through the use of the arrow keys, the "Tab" key, and the space bar.

Refer to [Table 3-1](#) for a list of functions available through the PMDT.

Note that throughout this manual, the nomenclature used to indicate the navigation through the PMDT application's menus and selections is as follows:

System >> Connect >> Navaid >> Direct

Using the mouse (left-click) or keyboard (highlight & press Enter), select the System menu, then the Connect menu item, then the Navaid menu item, then the Direct menu item.

Table 3-1 Functions Available via PMDT

System	
Logon RMS	Log on to the DME
Logoff/Disconnect	Logs off from the system. Also disconnects the RMM Modem
Configuration Save	Save the current configuration settings to a file
Configuration Load	Load the current settings from a file
Configuration Print	Prints the Configuration Data in a text-based format
PMDT Setup	Used to configure the various PMDT application preferences
Print Setup	Allows setup of the printer. Refer to the Windows XP™ help for printer setup
Exit PMDT	Exits PMDT Software to Windows
RMS	
Status	Selects RMS Status Screens
Data	Selects RMS Data Screens
Logs	Selects RMS Logs Screens
Configuration	Selects RMS Configuration Screens
Commands	Selects RMS Commands Screen
Config Restore	Restore data from EEPROM
Config Backup	Backup settings to EEPROM
Monitors	
Data	Displays the Integral & Standby Monitor data for both Monitors.
Configuration	Selects the Monitor Configuration Screens
Special Tests	Selects the Special Tests Screen
Commands	Selects Monitor Commands Screen
Monitor 1/Montior 2	
Data	Displays all data for the specified Monitor
Test Results	Displays the results of the last test for the specified Monitor
Fault History	Selects the Fault History Screens for the specified Monitor
Offsets/Scale Factors	Selects the Offsets & Scale Factors Screen for the specified Monitor
Trigger	Displays the Trigger Options
Transmitters	
Data	Selects Transmitters Data Screens
Configuration	Selects Transmitters Configuration Screens
Commands	Selects Transmitters Commands Screen
Info	
About	Displays the PMDT's version and other information.

3.6.3 System Status at a Glance: Sidebar Status and Control

The Sidebar status and control is presented on every screen as shown in Figure 3-1. The figure is annotated to describe the features of the display.

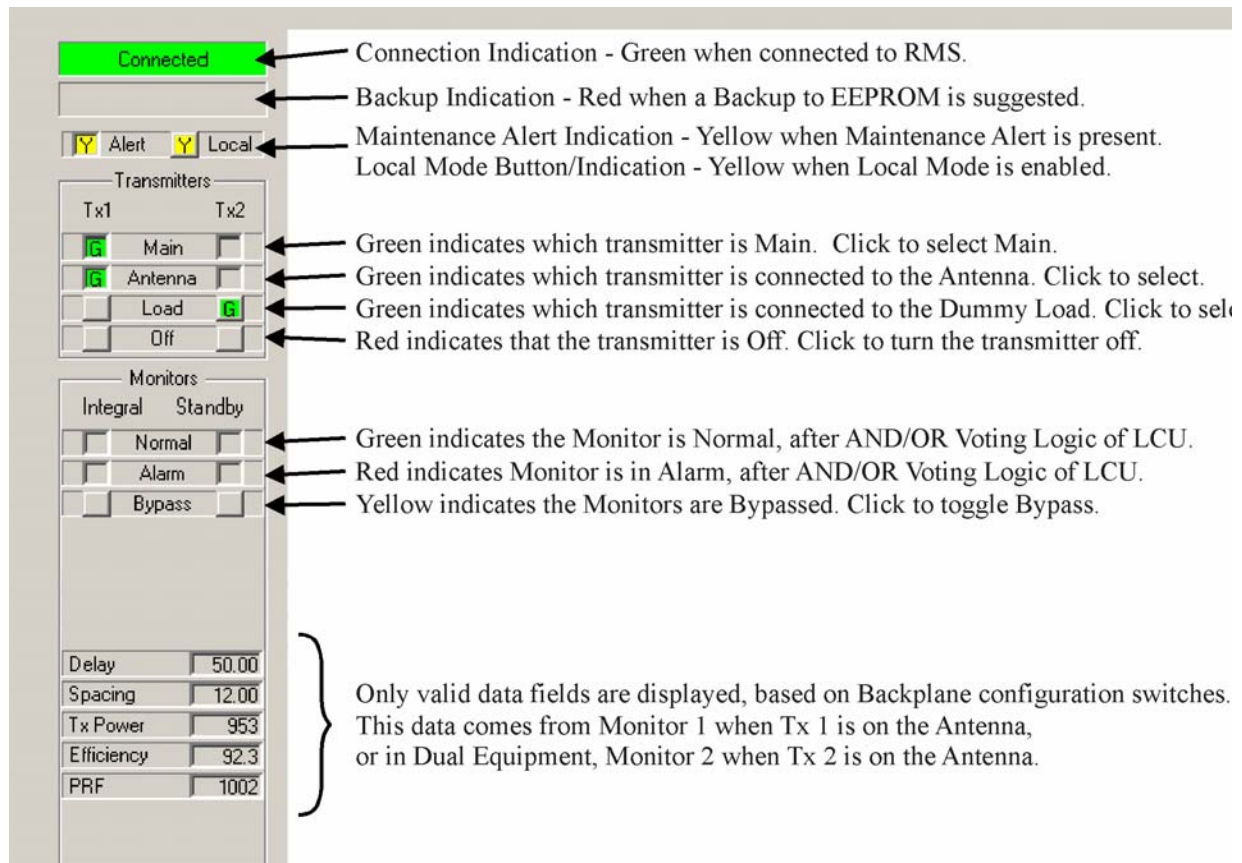


Figure 3-1 Sidebar Status Panel (Dual Equipment shown)

3.6.4 Screen Area

The screen area contains selected parameters and status data that are grouped together into a common display. The screen may present tabs and buttons that allow the operator to make further selections.

Keyboard shortcuts are available for the Next, Close, Apply, and Reset buttons. These buttons are enabled as applicable when navigating through the various PMDT screens. When they are enabled, pressing the following function key results in the specified action:

F5	Next	Move to the next screen in the current group.
F6	Close	Close the current group of screens.
F7	Apply	Save the changes made in the current screen.
F8	Reset	Cancels any changes to the current screen, leaving the data unchanged.

The main PMDT screen also contains two buttons that are used as follows:



Print Screen: Pressing this button sends an image of the current PMDT screen, including the Sidebar, to the default printer. The display can be either graphical, or text-based, based on the “Print Screens” option in the System>>PMDT Setup screen.



Copy Data to Clipboard: Available only when a block of text is displayed on a screen, such as in the RMS >> Logs screens. Pressing this button copies the text data to the Windows Clipboard, so that the user can “Paste” it into another Windows application.

3.6.5 Configuring the PMDT

The PMDT Configuration screen is used to configure the various PMDT application options, such as the Direct COM Port and the desired modem. To display the PMDT Configuration screen, select the System >> PMDT Setup menu item. The PMDT Configuration Screen shown in Figure 3-2 will be displayed.

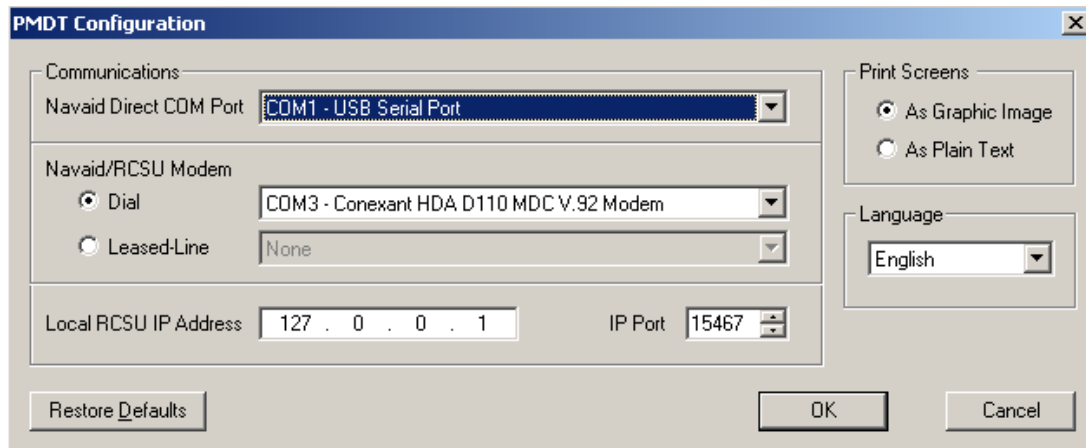


Figure 3-2 PMDT Configuration Screen

Set the "Navaid Direct COM Port" to the COM port associated with the navaid. For the DME, this will be the USB Serial Port that is automatically installed and activated when the PMDT's USB cable is connected to the DME system.

Select the desired modem for use when dialing in to either a navaid station or an RCSU. For a leased-line modem connection, select that option and the COM port associated with the external Leased-Line modem.

The Local RCSU IP Address port should typically not be changed from 127.0.0.1. This field provides some flexibility in connecting to an RCSU over a LAN. Similarly, the RCSU's IP Port should only be changed from its default of 15467 if the corresponding setting in the 2238 RCSU has been changed. Pressing the Restore Defaults button will reset these fields to their default values.

The Print Screens options control how the PMDT prints its screens, either as they appear on the Windows XP™ display (graphical) or in a text-based format.

The default language used within the PMDT application can be selected from the list. Changing this parameter will require the PMDT to be closed and restarted for the change to take effect.

3.6.6 Connecting to the DME

3.6.6.1 Security Levels

Access to the DME system via the PMDT is restricted through the use of four security levels. Level 1 is the lowest security level, and Level 4 is the highest security level. These security levels are accessed as shown in Table 3-3:

Table 3-2 DME Security Levels

Security Level	Accessed by	Permissions
Level 1	Logging on with either: User ID of "GUEST", without a password, or a valid Level 1 User ID and the corresponding Password.	System Status and Parameters – At this level, the user has display-only access to all screens except for the security codes screen. The user has no control over the system.
Level 2	Logging on with: A valid Level 2 User ID and the corresponding Password	Non-Critical Functions – At this level, the user has Level 1 access plus the issuance of discrete commands which do not modify the signal in space. For example, the user can turn the signal on/off, but cannot modify the transmitter parameters.
Level 3	Logging on with: A valid Level 3 User ID and the corresponding Password	Critical Functions (except Passwords) - The user has access to all functions that are available in the system, except for the Security Screen.
Level 4	Logging on from Level 1, 2 or 3 with: The valid Level 4 User ID and the corresponding password.	Critical Functions - The user has access to all functions that are available in the system, including assignment of User IDs, Passwords, and Security Levels in the Security Screen.

The default Level 4 user account information, which is case-sensitive, is:

User Name: SEC4
Password: FOUR

The default Level 3 user account information, which is case-sensitive, is:

User Name: SEC3
Password: THREE

To maintain system security, this default user account information should be changed by the authorized personnel.

NOTE

After 3 failed attempts to logon (i.e. invalid User ID or Password), further logon attempts will be blocked for a period of 5 minutes.

The PMDT software contains an Activity Detector feature that will automatically log off a user after 15 minutes of inactivity (either mouse or keyboard activity). This Activity Detector is ignored when the system is in Local Mode, allowing a technician to work on the system for an extended period without being automatically logged off.

3.6.6.2 PMDT Logon via Direct or Modem Connection

To log on to the equipment directly, select System >> Connect >> Navaid >> Direct. The PMDT Login screen (see Figure 3-4) will be displayed. Enter a valid User ID and the associated password and press OK.

To log onto the equipment remotely, select System >> Connect >> Navaid >> Modem. The System Directory will be displayed, as shown in Figure 3-3. This directory stores the Station Identifier and Phone Number for the last 50 navaid systems dialed, with the latest one at the top of the list. Either select an entry from the directory, or press the Add Entry button to enter the phone number for a new DME station to be dialed, and then press the Dial button to place the call.

The PMDT uses Windows' built-in modem configuration information system, referred to as Telephone API, or TAPI, to place the modem connection. This allows for the use of country codes, calling cards, PBX control tones, delays, etc. that may be required to complete the modem connection. All of this is configured through the standard Windows Dialing Properties and Modem Properties screens. For convenience, access to these configuration settings is provided on the System Directory screen by pressing either the Change Dialing Properties or Change Modem Properties buttons. The typical Modem Properties for the PMDT are shown in Figure 3-3a. Refer to the Windows Help documentation for further assistance in configuring these features.

Once the PMDT's modem connects to the DME's modem, the PMDT Login screen (Figure 3-4) will be displayed. Enter a valid User ID and the associated Password and press OK.

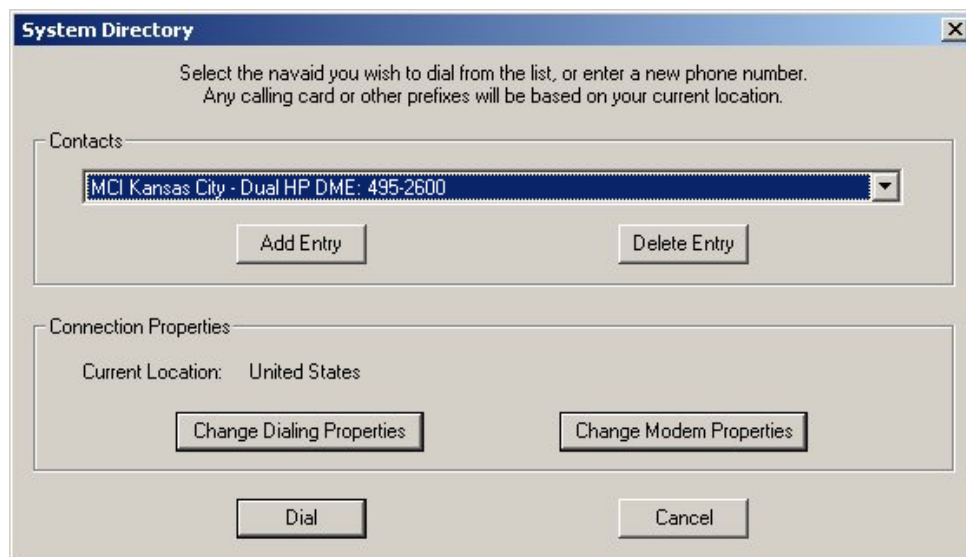


Figure 3-3 DME System Directory Screen

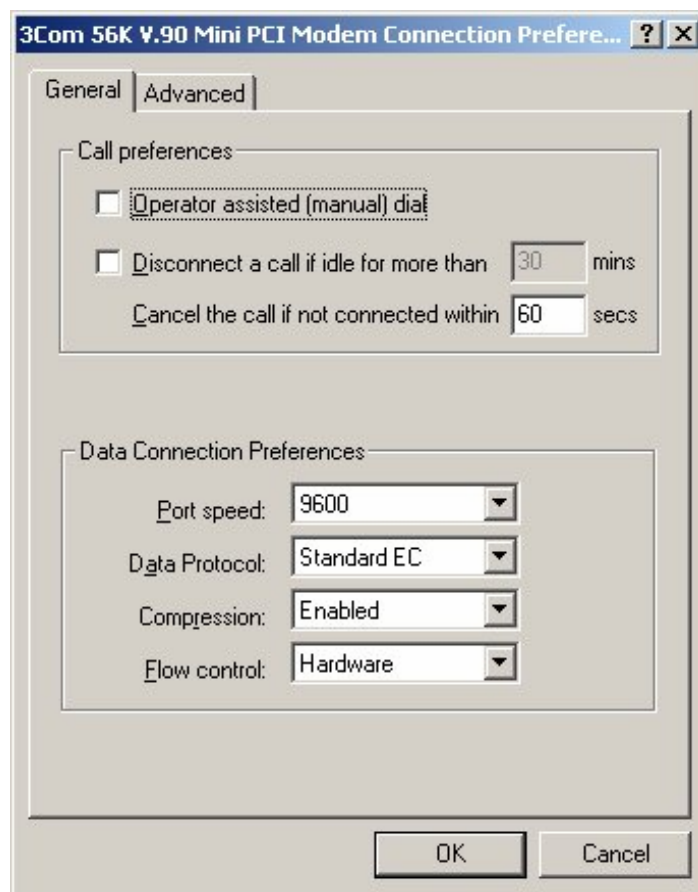


Figure 3-3a Modem Connection Preferences

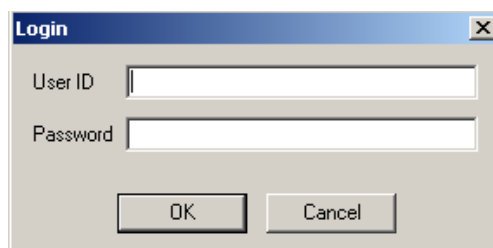


Figure 3-4 PMDT Login Screen

To obtain Security Level 4 access, select System >> Logon RMS and re-enter the Level 4 User ID and Password.

If the ID and Password were entered correctly, the Initial PMDT screen (Figure 3-5) will be displayed. If the logon attempt was not successful then the PMDT will display a message indicating an unsuccessful log-on and then display the PMDT Login screen again.

NOTE

Some Screens will not be displayed for Levels 1, 2 and 3. Some commands and controls will appear "grayed" to indicate that access to these controls is not available at the current password level.

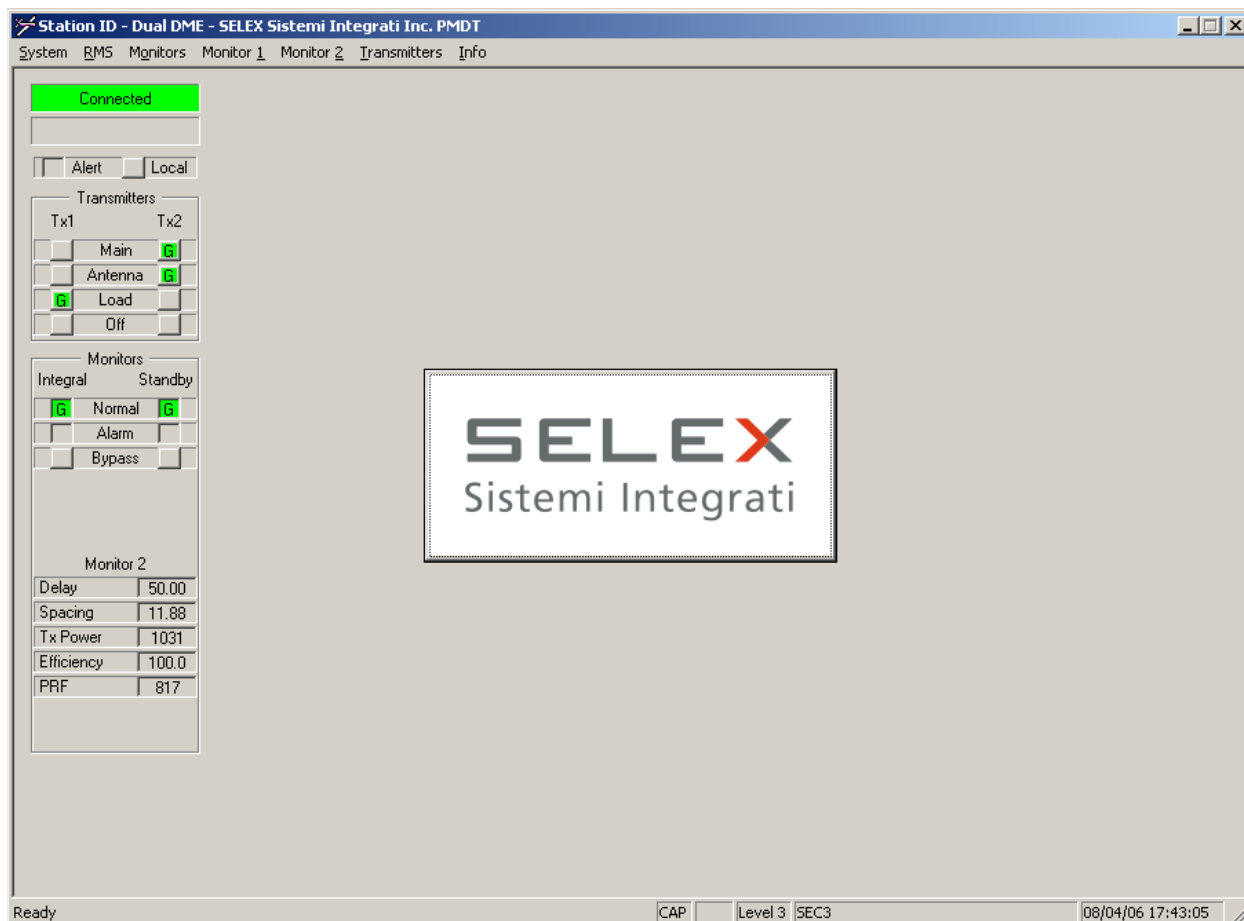


Figure 3-5 Initial PMDT Screen (Dual Equipment shown)

3.7 RMS Screens

3.7.1 RMS Status Screens

When first accessed, the RMS Status screen is as shown in [Figure 3-6](#). This screen contains indicators for status provided directly to the RMS.

3.7.1.1 RMS Status

The RMS status consists of indicators for Logon Level, Maintenance Alert, Power Status, RCSU communication, Local Control, Interlock and the associated system software Revision Levels.

The screenshot shows the 'Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT' window. The 'RMS Status' tab is active, displaying a date/time stamp of '08/04/06 17:43:17'. The interface is divided into several sections:

- Transmitters:** Includes Tx1 and Tx2 sections with checkboxes for Main, Antenna, Load, and Off. The 'Load' checkbox is checked.
- Monitors:** Includes Integral and Standby sections with checkboxes for Normal, Alarm, and Bypass. The 'Normal' checkbox is checked.
- Monitor 2:** A table showing parameters: Delay (50.00), Spacing (11.88), Tx Power (1030), Efficiency (100.0), and PRF (1265).
- System:** Includes fields for PMDT Logon Level (3), Local Control Mode, Maintenance Alert, On Battery, AC Failure, and Remote Control Enabled (checked).
- RCSU Connection:** Includes checkboxes for RCSU Connection Enabled, RCSU Communication Error, and Interlocked Off. The 'Approach Type' is set to Primary.
- Revision Levels:** A table listing software versions for RMS (1.1.0.6), Monitor 1 (1.1.0.6), Monitor 2 (1.1.0.6), RTC 1 (1.1.0.6), RTC 2 (1.1.0.6), BCPS 1 (1.0.1.0), BCPS 2 (1.0.1.0), and LCU (1.0).

The bottom status bar shows 'Ready', 'CAP', 'Level 3', 'SEC3', and the date/time '08/04/06 17:43:17'.

Figure 3-6 RMS Status Screen (Dual Equipment shown)

3.7.1.2 Monitor/Transmitter Status

The "Monitor/Transmitter Status" tab at the top of the screen allows the operator to select an additional screen shown in Figure 3-7. This screen provides summary level status for the Monitors, and the transmitter connection to antenna, assignment as Main or Standby and On status.

The "Next" button is used to toggle between the screens. The "Close" button closes the screen, displaying the initial PMDT screen.

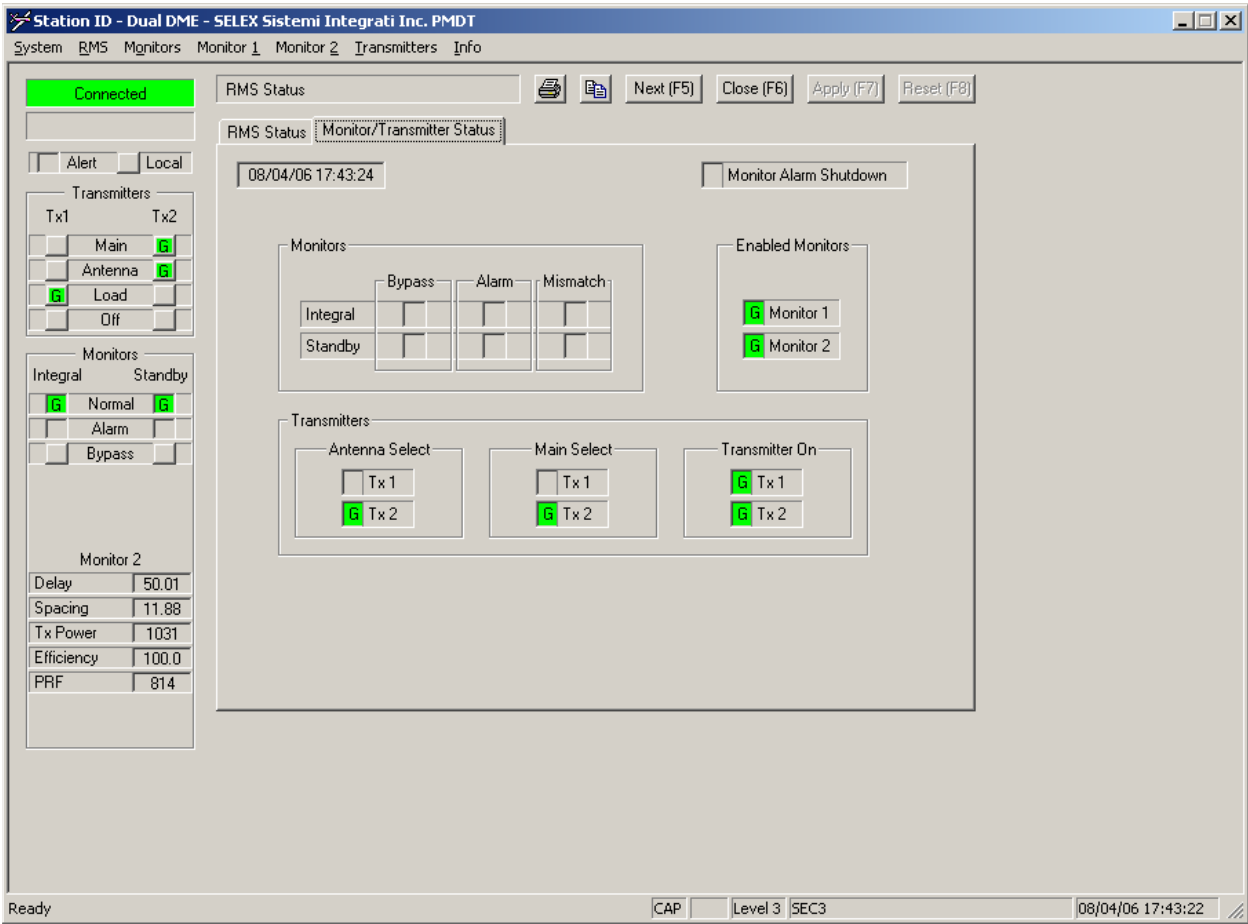


Figure 3-7 Monitor/Transmitter Status Screen (Dual Equipment shown)

3.7.2 RMS Data Screens

This set of four screens is accessed by selecting the tab for the screen or by clicking the "Next" button. These screens and their contents are described below.

3.7.2.1 RMS Maintenance Alerts Screen

Refer to [Figure 3-8](#). This screen shows the source of any maintenance alerts in the system. From this screen the operator can determine the alert/alarm and proceed to the associated screen to observe the specific data driving the alert/alarm. For example, if the RMS Digital I/O Data indicator was on, the operator would go to the RMS >> Data >> Digital Inputs screen to see which specific Digital I/O parameter was causing the alert.

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected

RMS Data [Print] [Copy] [Next (F5)] [Close (F6)] [Apply (F7)] [Reset (F8)]

Maintenance Alerts/Alarms | Power Supply Data | A/D Data | Digital I/O

08/04/06 17:43:35

General Alerts and Alarms

☐ Local Mode	☐ AC Power Failure	☐ LCU Config Mismatch
☐ RMS Power Supply Data	☐ LCD Comm Link Failed	☐ Integral Monitor Mismatch
☐ RMS A/D Data	☐ Sys 48 VDC PS 1 Fail	☐ Standby Monitor Mismatch
☐ RMS Digital I/O Data	☐ Sys 48 VDC PS 2 Fail	☐ Standby Tx on the Air
☐ RMS Diagnostics Fault		

Monitor/RTC Alerts and Alarms

	Monitor 1	Monitor 2	RTC 1	RTC 2
RMS Comm Link Failed	☒	☒	☐	☐
Mon-RTC Comm Link Failed	☐	☐	☐	☐
Integrity Test Failed	☒	☒	☐	☐
File System Fault	☒	☒	☐	☐
Backplane Switch Mismatch	☒	☒	☐	☐
Maintenance Alert	☐	☐	☐	☐
Pre-Alarm	☐	☐	☐	☐
Primary Alarm	☐	☐	☐	☐
Secondary Alarm	☐	☐	☐	☐

* Indicates this parameter can disable a monitor

Transmitters

Tx1 Tx2

☐ Main ☒ G

☐ Antenna ☒ G

☒ Load ☐

☐ Off

Monitors

Integral Standby

☒ G Normal ☒ G

☐ Alarm

☐ Bypass

Monitor 2

Delay 50.00

Spacing 11.89

Tx Power 1032

Efficiency 100.0

PRF 802

Ready [CAP] [Level 3] [SEC3] 08/04/06 17:43:35

Figure 3-8 RMS Maintenance Alerts Screen (Dual Equipment shown)

3.7.2.2 Power Supply Data Screen

Refer to [Figure 3-9](#). This screen shows the status and limits of each of the system's power supplies. If any parameter is enabled as a maintenance parameter in the associated RMS>>>Configuration screen, and its measured value falls outside of either the Alert Limits or Pre-Alert Limits, the parameter's value and limits will be colored yellow to indicate the alert condition.

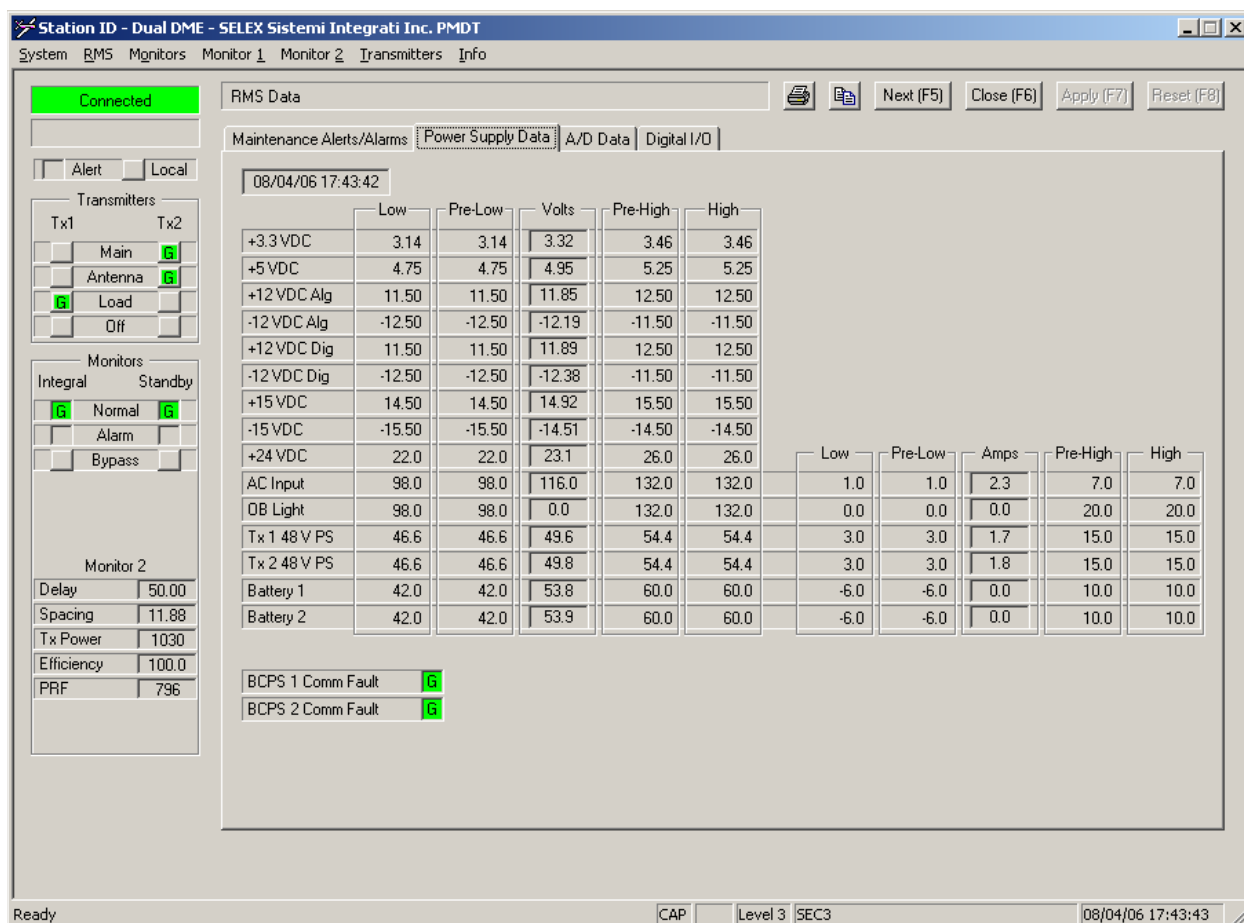


Figure 3-9 RMS Power Supply Data Screen (Dual Equipment shown)

3.7.2.3 Analog-to-Digital Data Screen

Refer to Figure 3-10. This screen shows the status and limits of each of the Spare Analog signals that are digitized for limit checking, as well as the various system temperature measurements. If any parameter is enabled as a maintenance parameter in the associated RMS>>Configuration screen, and its measured value falls outside of either the Alert Limits or Pre-Alert Limits, the parameter's value and limits will be colored yellow to indicate the alert condition.

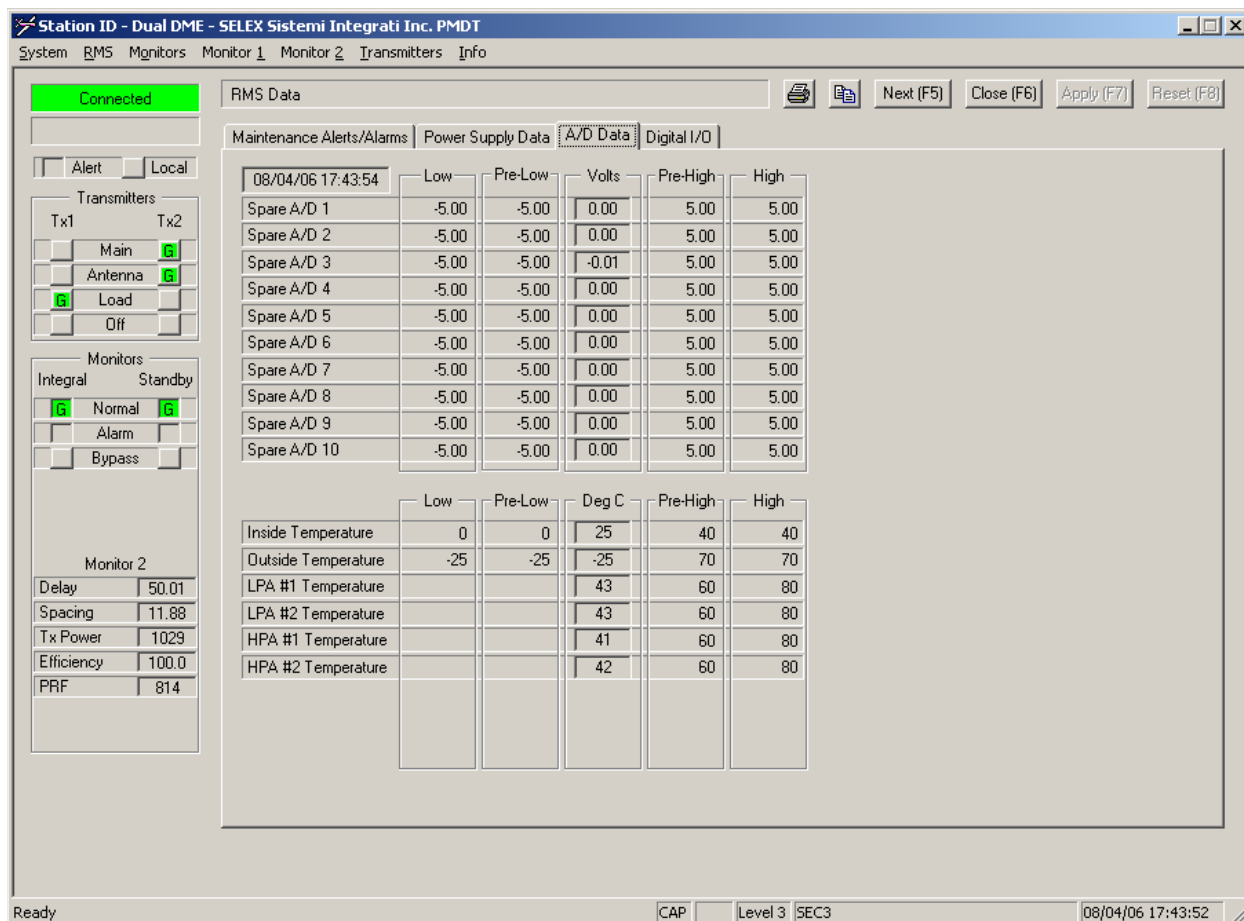


Figure 3-10 RMS A/D Data Screen (Dual Equipment shown)

3.7.2.4 Digital I/O Data Screen

Refer to [Figure 3-11](#). This screen displays the current status of the system's digital inputs and outputs. Any abnormal signal will be indicated in yellow.

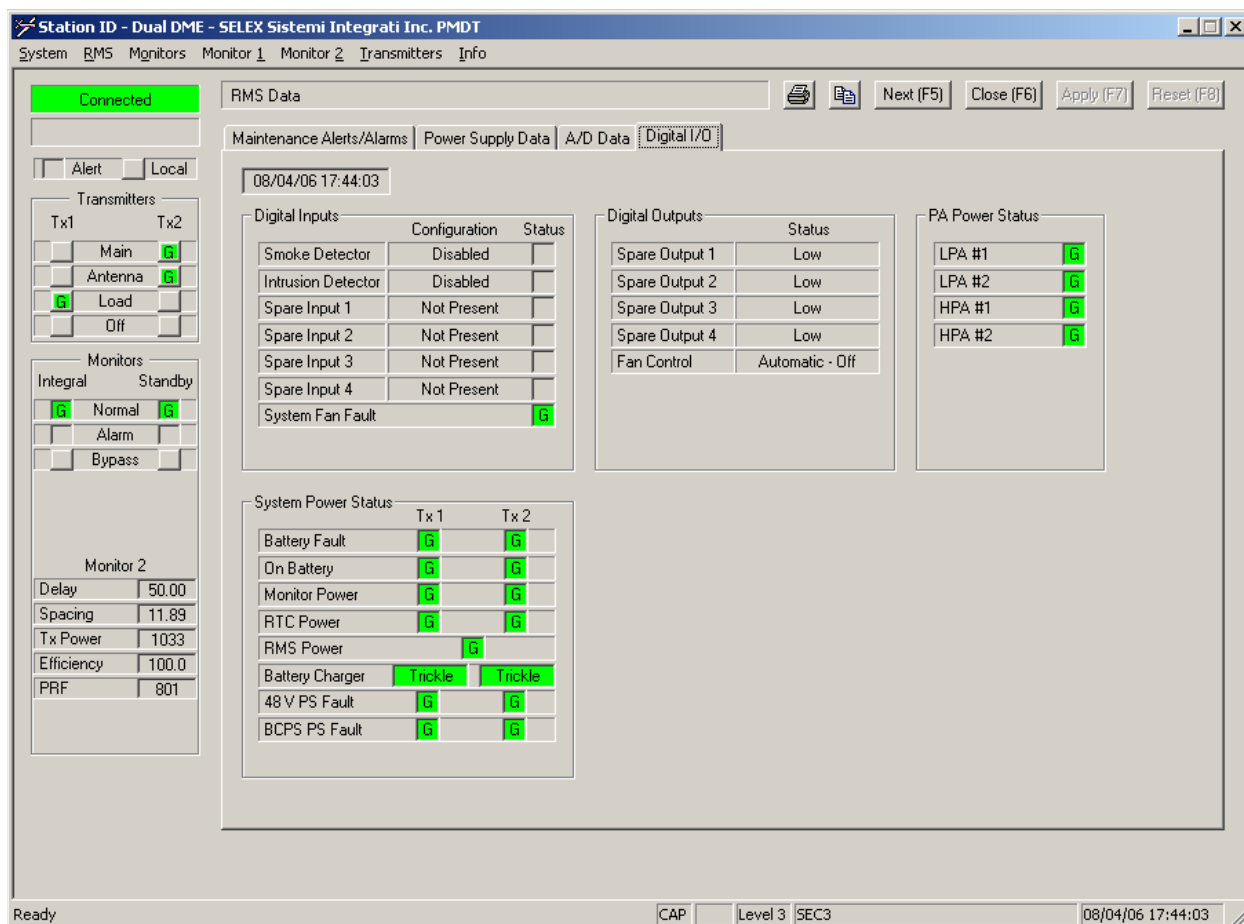


Figure 3-11 RMS Digital I/O Data Screen (Dual Equipment shown)

3.7.3 RMS Logs Screens

There are five log screens in the PMDT that serve the general purpose of providing time tagged records of changes in the system parameters and/or operating condition. These screens and their contents are described below.

3.7.3.1 Operational Summary Screen

Refer to [Figure 3-12](#). This screen presents the duration that each of the transmitters has spent in each operational condition. The Reset Operational Summary button restarts all of the Operational Summary timers.

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected

RMS Logs

Operational Summary Alarms Maintenance Alerts Command Activity Parameter Change

	Transmitter 1	Transmitter 2	
Normal Operation	0.05	0.06	Hours
Monitor Bypass	0.00	0.00	Hours
Monitor Alarm	0.00	0.00	Hours
Transmitter Off	0.02	0.03	Hours
Monitor/RTC Comm Fault	0.00	0.00	Hours
Hot Standby	0.05	0.03	Hours
Availability	82.5688	74.3119	%

Start Time 08/04/06 17:36:56

End Time 08/04/06 17:44:12

Hours Elapsed 0.1211

Reset Operational Summary

Transmitters

Tx1 Tx2

Main Antenna Load Off

Monitors

Integral Standby

Normal Alarm Bypass

Monitor 2

Delay 50.00

Spacing 11.88

Tx Power 1034

Efficiency 100.0

PRF 809

Ready CAP Level 3 SEC3 08/04/06 17:44:12

Figure 3-12 Operational Summary Screen (Dual Equipment shown)

3.7.3.2 Alarms Log Screen

Refer to Figure 3-13. This screen provides the latest 100 alarms that have occurred. When 100 or more alarms have occurred, subsequent alarms will replace the oldest alarms in the log. Entries in the log identify the date and time the alarm occurred, the type of alarm, the test that detected the alarm, and the current status of the alarm condition. The Update button reloads the log file from the RMS and updates the display with any new entries. The Reset button clears the log file in the RMS.

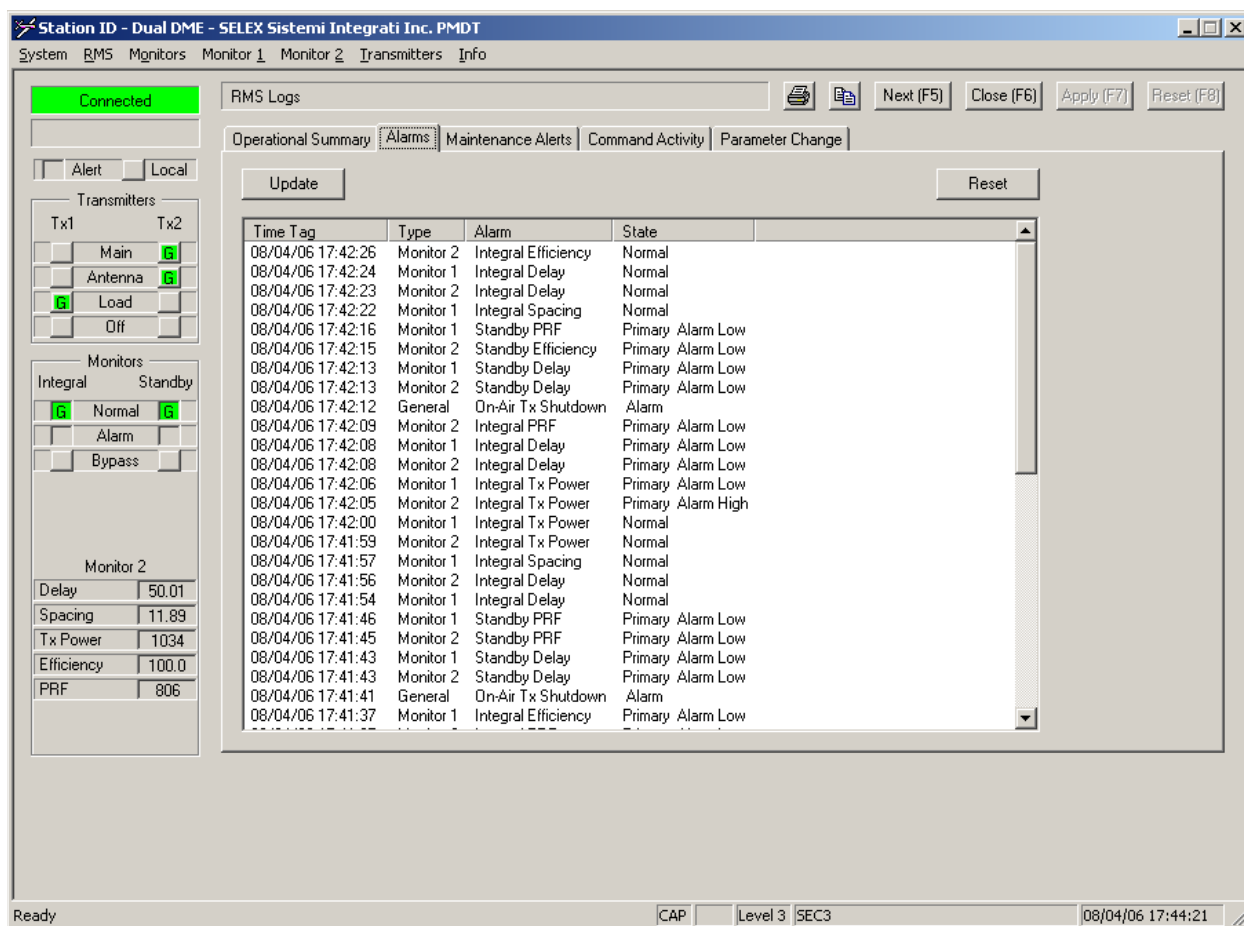


Figure 3-13 Alarms Log Screen (Dual Equipment shown)

3.7.3.3 Maintenance Alerts Log Screen

Refer to Figure 3-14. This screen provides the latest 100 maintenance alerts that have occurred. When 100 or more alerts have occurred, subsequent alerts will replace the oldest alerts in the log. Entries in the log identify the date and time the alert occurred, the type of alert, and a short description of the alert, and the current status of the alert condition. The Update button reloads the log file from the RMS and updates the display with any new entries. The Reset button clears the log file in the RMS.

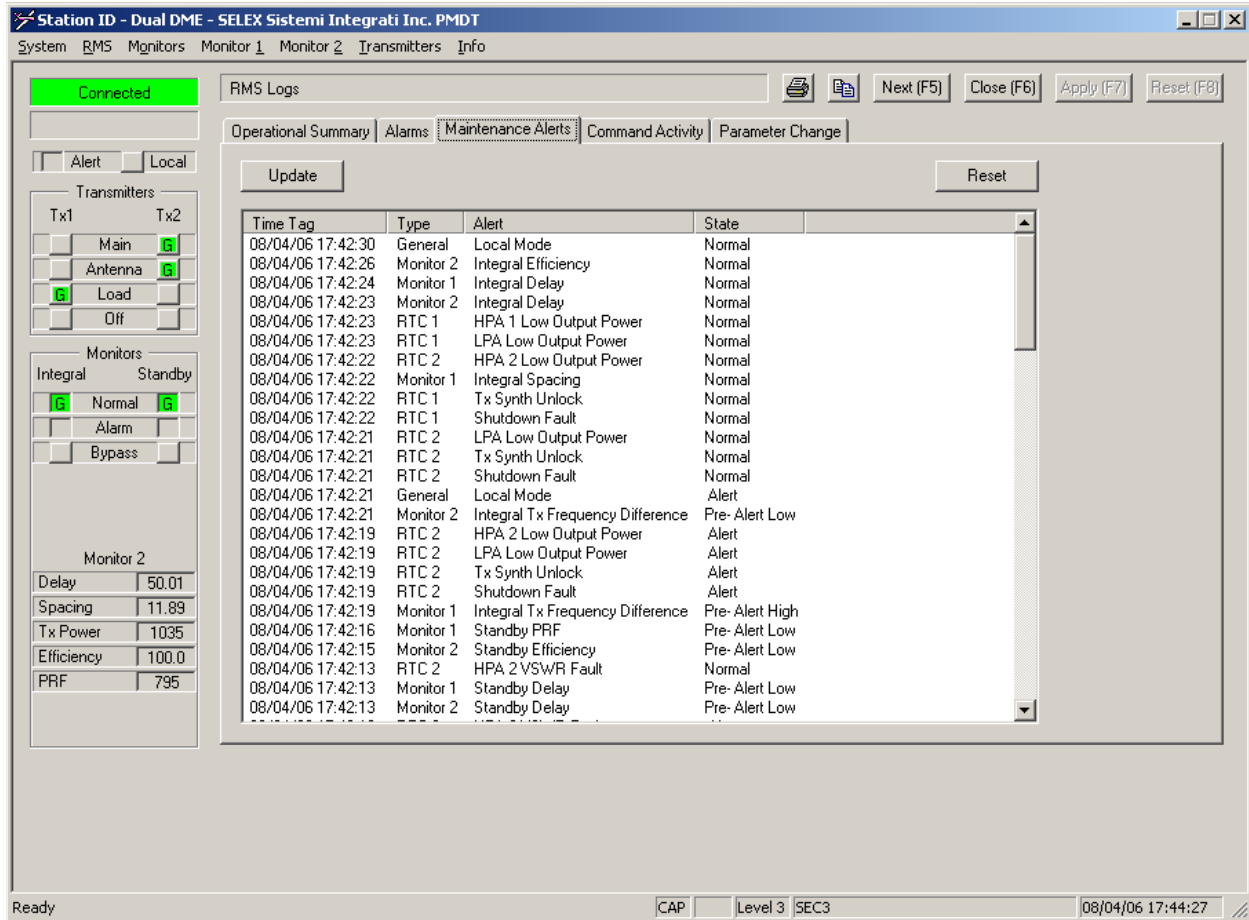


Figure 3-14 Maintenance Alerts Log Screen (Dual Equipment shown)

3.7.3.4 Command Activity Screen

Refer to [Figure 3-15](#). This screen provides the latest 100 commands issued. When 100 or more commands have been issued, subsequent commands will replace the oldest commands in the log. The Command Activity Log screen specifies the date and time, identifies the operator logged on to the system when the command was issued, and the command that was issued. In addition to the User IDs configured in the Security Screen, the User Name field includes the following names:

Local User	Commands issued through the buttons on the LCU front panel.
GUEST	Commands issued from the default Security Level 1 GUEST account.
RCSU	Commands issued from the Remote Control Status Unit.
Op System	Commands issued from the RMS's Operating System.

The Update button reloads the log file from the RMS and updates the display with any new entries. The Reset button clears the log file in the RMS.

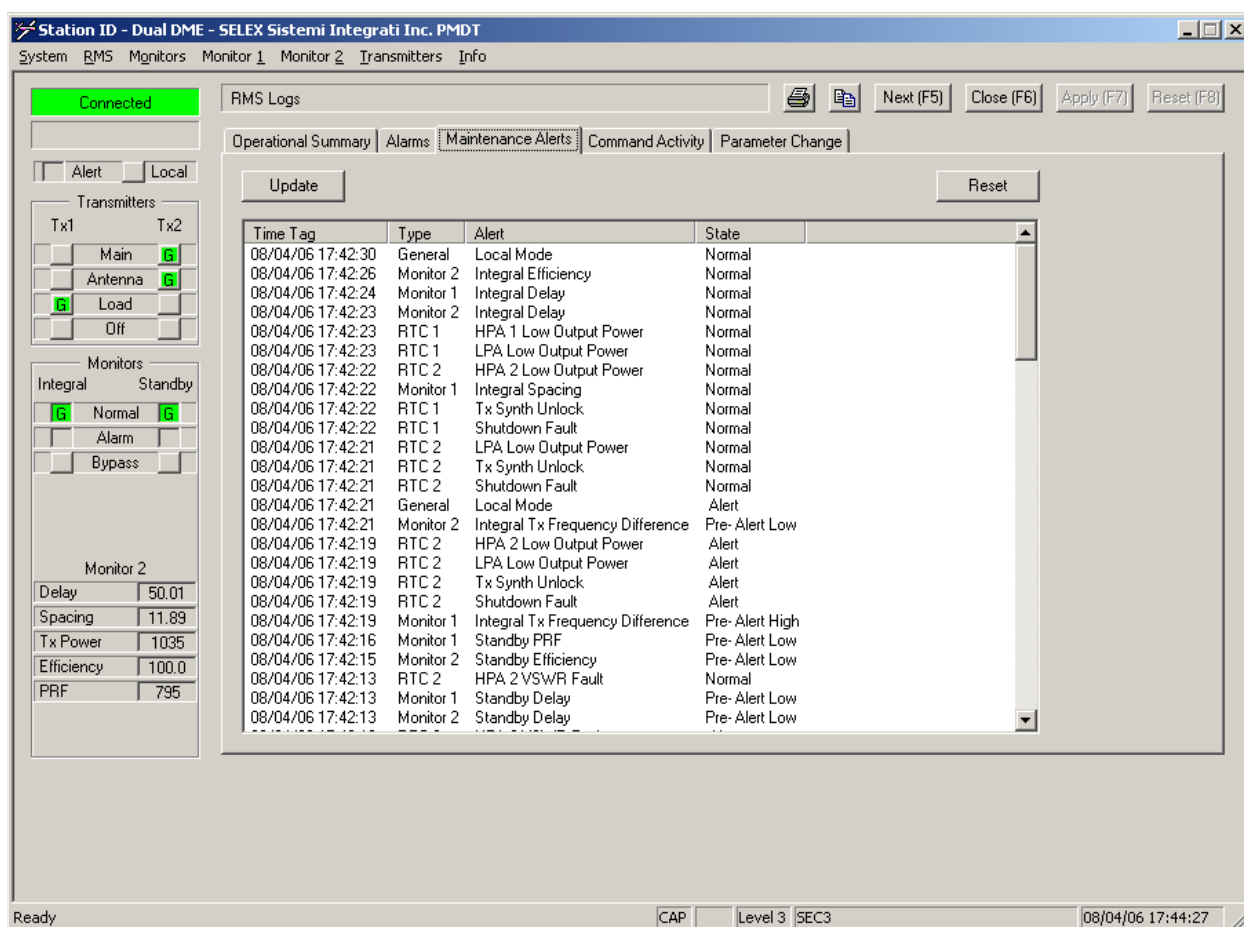


Figure 3-15 Command Activity Log Screen (Dual Equipment shown)

3.7.3.5 Parameter Change Log Screen

Refer to [Figure 3-16](#). This screen provides the latest 100 changes made in the operator parameters. When 100 or more changes have been made, subsequent changes will replace the oldest changes in the log. The Parameter Change screen specifies the date and time, identifies the operator logged on to the system when the change was made, and the file in which the data was changed. The Update button reloads the log file from the RMS and updates the display with any new entries. The Reset button clears the log file in the RMS.

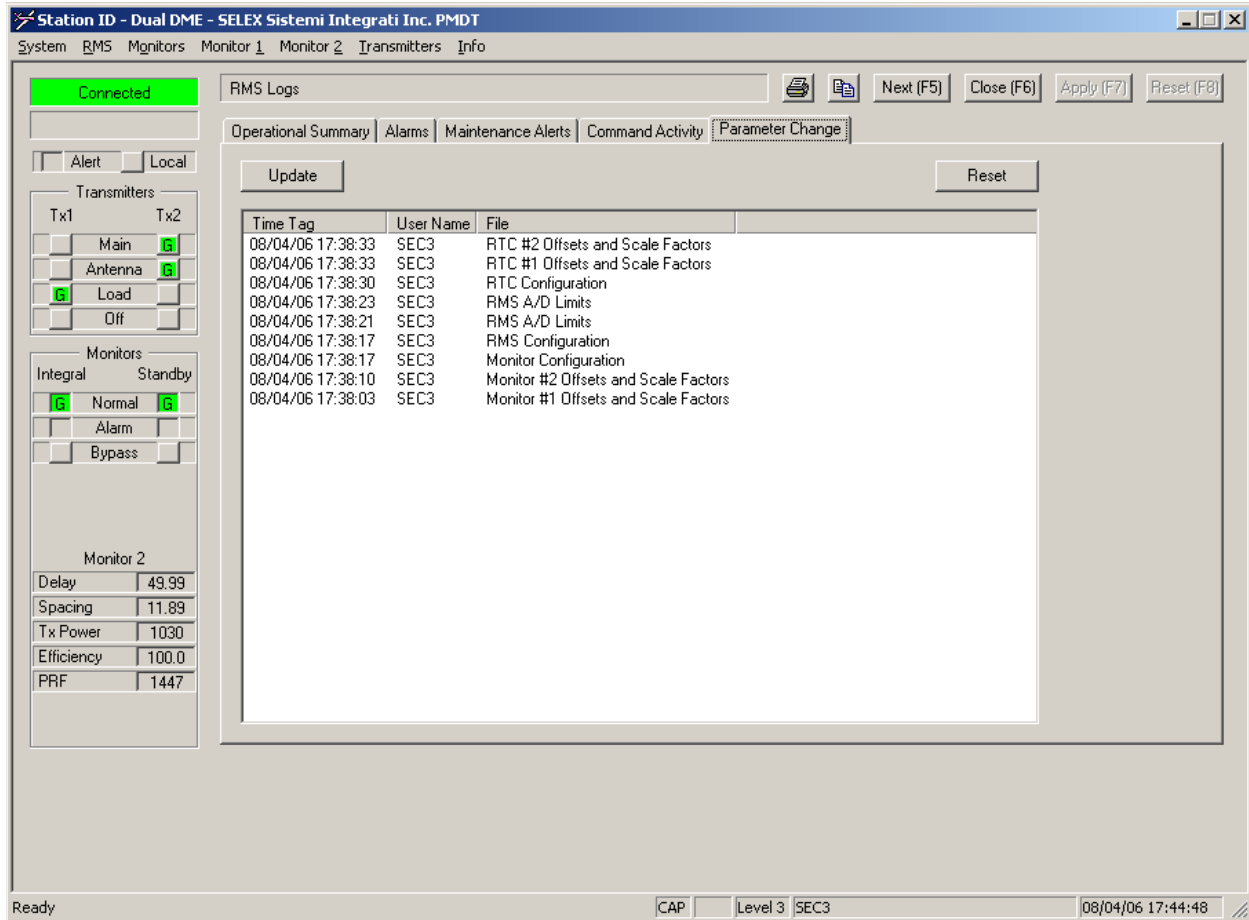


Figure 3-16 Parameter change Log Screen (Dual Equipment shown)

3.7.4 RMS Configuration Screens

The PMDT contains the following RMS Configuration Screens that are used to define the operating parameters for the RMS - General, Station, Power Supply Limits, A/D Limits and Security Codes. These screens and their contents are described below.

Any changes made to a configuration that should remain after a power cycle or Reset should be backed up.

To backup the current configuration stored in RAM for non-volatile storage in EEPROM, login to Security Level 3 or higher and select RMS >> Configuration Backup. Press OK at the prompt.

To save the current RMS configuration to a hard drive or a diskette, select System >> Configuration Save. Select the destination and file name and press Save.

To restore a configuration from disk select System >> Configuration Load, enter the file name and press Open. When completed, backup the configuration to EEPROM by selecting RMS >> Configuration Backup. Press OK at the prompt.

Note that the station's configuration can be printed in text form using the System >> Configuration Print menu option.

3.7.4.1 General RMS Configuration Screen

Refer to [Figure 3-17](#). This screen allows the operator to configure the general parameters of the DME system.

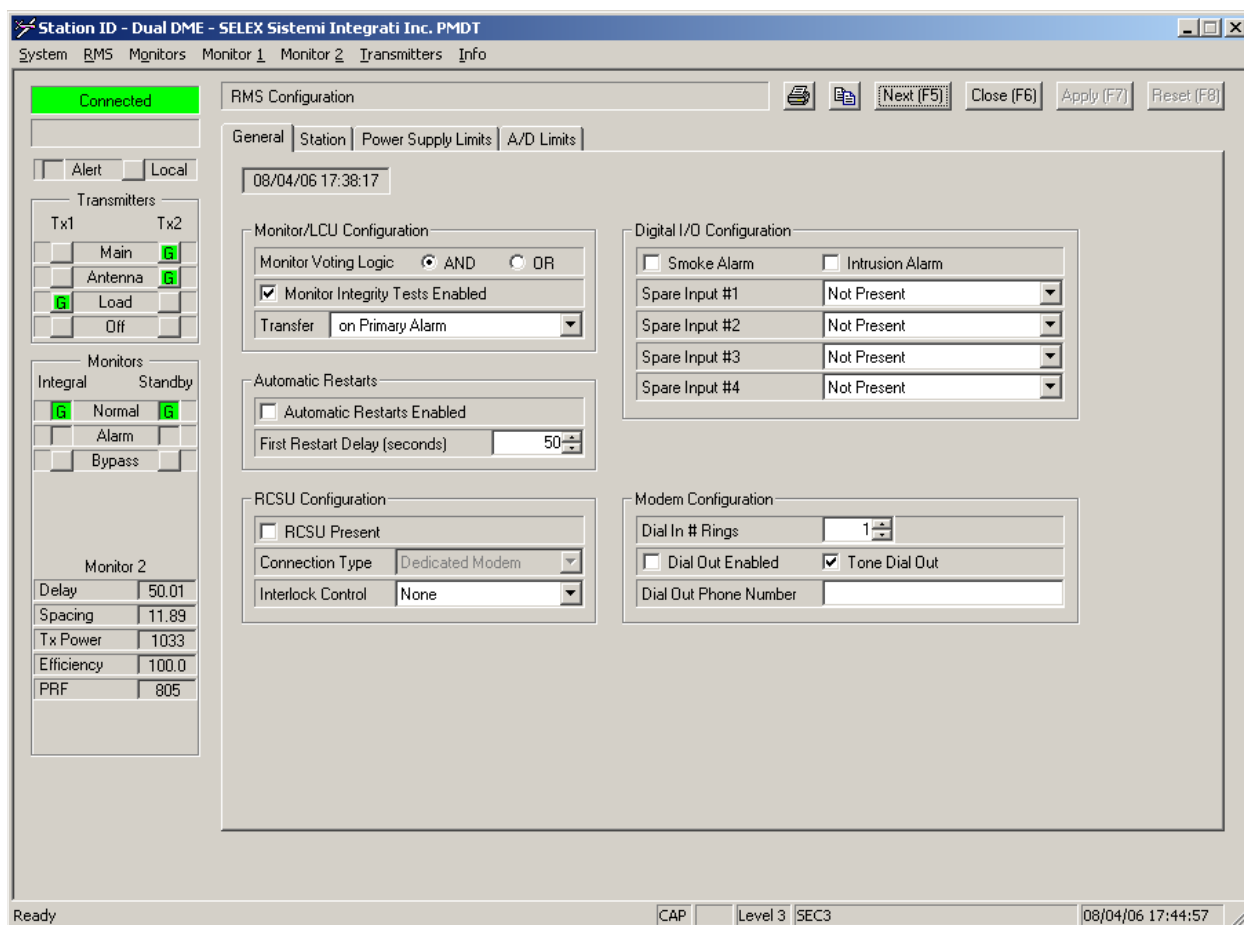


Figure 3-17 General RMS Configuration Screen (Dual Equipment shown)

The parameters in the General Configuration Screen must be set to correctly correspond to the equipment installation at each site. Refer to [Table 3-6](#) for details pertaining to each of the configurable parameters in the General Configuration Screen. Note that some parameters are only applicable to Dual Equipment. In Single Equipment systems, these parameters will not be displayed.

Table 3-3 General Configuration Parameters	
Parameter	Description
Monitor/LCU Configuration	
Monitor Voting Logic (Dual Equipment)	Selects either AND or OR voting logic for multiple monitor systems
Monitor Integrity Tests Enabled	Monitor Integrity test is enabled when checked.
Transfer Logic	Configures a dual system to transfer either on a Primary or Secondary Alarm, or for Best Availability.
Automatic Restarts	
Automatic Restarts Enabled	Both Automatic Restarts (adjustable and fixed) are enabled when the checkbox is checked, and disabled when it is not checked.
First Restart Delay (seconds)	Sets the delay following a shutdown until the system will automatically restart. The system also has an additional 5 minute (fixed) restart delay.
RCSU Configuration	
RCSU Present	When checked, the connection between the RCSU and RMS is enabled.
Connection Type	Set to “Dedicated Modem” when connecting to the RCSU via the DME’s embedded RCSU Modem. Set to “RF Modem/Fiber” when connecting to the RCSU via the External RCSU Modem port to a serial-based comm link, such as RF Modems, or Fiber Optic converters.
Interlock Control	For systems co-lactated with a VOR, or where no Interlock control is required, this should be set to “Not Applicable”. To enable the DME’s External Interlock Input, this should be set to “External Interlock Input”. To be controlled by the associated 2238 RCSU, this should be set to “From RCSU”.
Digital I/O Configuration	
Smoke Alarm	Smoke Alarm detection is enabled when checked.
Intrusion Alarm	Intrusion Alarm detection is enabled when checked.
Spare #1 Usage	Configures the Spare Input #1 Channel
Spare #2 Usage	Configures the Spare Input #2 Channel
Spare #1 Usage	Configures the Spare Input #3 Channel
Spare #2 Usage	Configures the Spare Input #4 Channel
Modem Configuration	
Dial in # Rings	Sets the ring number that the DME’s modem answers incoming calls.
Dial Out Enabled	DME dials out on alerts/alarms when checked.
Tone Dial Out	Tone dialing is used to dial out when checked. Pulse dialing is used to dial out when it is not checked.
Dial Out Phone Number	Stores the phone number used when dialing out.

3.7.4.2 Station Configuration Screen

Refer to [Figure 3-18](#). This screen is used to configure the various system-level parameters for the DME station: DME/TACAN, High/Low Power, Dual/Single, Hot Standby, and the station's Transmitter Frequency. The value for each of these settings currently stored in the RMS and the Monitors is also displayed for reference. Note that any changes under User Configuration do not take effect until the F7 "Apply" button is pressed.

Any discrepancies between the User Configuration, RMS, or Monitors will be indicated with a red background, and should be corrected by the user. This can be done by verifying the backplane DIP switch settings as detailed below, backing up the configuration (RMS >> Config Backup) followed by a system reset.

The screenshot displays the 'Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT' window. The 'RMS Configuration' tab is active, showing settings for General, Station, Power Supply Limits, and A/D Limits. The 'General' sub-tab is selected, displaying configuration options for User Configuration, RMS, and Monitors/RTCs. The 'User Configuration' section includes radio buttons for DME/TACAN, Low/High Power, Dual/Single Transmitter, Dual/Single Monitor, and a checked 'Hot Standby' option. The 'RMS' section shows 'DME', 'High', 'Dual', 'Dual', and 'Hot Standby'. The 'Monitors/RTCs' section shows settings for Monitor 1, Monitor 2, RTC 1, and RTC 2, all set to 'DME', 'High', and 'Dual'. The 'Station Identifier' field is empty. The bottom status bar shows 'Ready', 'CAP', 'Level 3', 'SEC3', and the date/time '08/04/06 17:45:07'.

Figure 3-18 Station Configuration Screen (Dual Equipment shown)

3.7.4.3 Power Supply Limits Configuration Screen

Refer to [Figure 3-19](#). This screen is used to configure the upper and lower alarm limits and enable limit checking for the various system power supply voltages and currents. The checkboxes are used to enable the corresponding parameter's Maintenance Alert. If the checkbox is checked, a Maintenance Alert will be generated when the parameter is out of the specified limits.

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected

RMS Configuration

General Station Power Supply Limits A/D Limits

08/04/06 17:38:23

☐ Alert ☐ Local

Transmitters

Tx1 Tx2

☐ Main ☒ G

☐ Antenna ☒ G

☒ Load ☐ Off

Monitors

Integral Standby

☒ Normal ☒ G

☐ Alarm ☐ Bypass

Monitor 2

Delay 50.01

Spacing 11.88

Tx Power 1033

Efficiency 100.0

PRF 812

	Low	Pre-Low	Pre-High	High
☐ +3.3 VDC	3.14	3.14	3.46	3.46
☐ +5 VDC	4.75	4.75	5.25	5.25
☐ +12 VDC Analog	11.50	11.50	12.50	12.50
☐ -12 VDC Analog	-12.50	-12.50	-11.50	-11.50
☐ +12 VDC Digital	11.50	11.50	12.50	12.50
☐ -12 VDC Digital	-12.50	-12.50	-11.50	-11.50
☐ +15 VDC	14.50	14.50	15.50	15.50
☐ -15 VDC	-15.50	-15.50	-14.50	-14.50
☐ +24 VDC	22.0	22.0	26.0	26.0

	Low	Pre-Low	Pre-High	High		Low	Pre-Low	Pre-High	High
☐ AC Input	98.0	98.0	132.0	132.0	☐	1.0	1.0	7.0	7.0
☐ OB Light	98.0	98.0	132.0	132.0	☐	0.0	0.0	20.0	20.0
☐ Tx 1 48 V PS	46.6	46.6	54.4	54.4	☐	3.0	3.0	15.0	15.0
☐ Tx 2 48 V PS	46.6	46.6	54.4	54.4	☐	3.0	3.0	15.0	15.0
☐ Battery 1	42.0	42.0	60.0	60.0	☐	-6.0	-6.0	10.0	10.0
☐ Battery 2	42.0	42.0	60.0	60.0	☐	-6.0	-6.0	10.0	10.0

Ready CAP Level 3 SEC3 08/04/06 17:45:12

Figure 3-19 Power Supply Limits Configuration Screen (Dual Equipment shown)

3.7.4.4 A/D Limits Configuration Screen

Refer to [Figure 3-20](#). This screen is used to configure the upper and lower alarm limits and enable limit checking for the Spare Analog voltages and system temperatures. The checkboxes are used to enable the corresponding parameter's Maintenance Alert. If the checkbox is checked, a Maintenance Alert will be generated when the parameter is out of the specified limits.

The RMS disables any PA if its temperature meets or exceeds the associated High Alert Limit. If the Automatic Fan Control is enabled the Fan On Temperature parameter sets the point at which the fan is activated, based on the Inside Temperature measurement.

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected RMS Configuration [Print] [Copy] [Next (F5)] [Close (F6)] [Apply (F7)] [Reset (F8)]

General Station Power Supply Limits **A/D Limits**

08/04/06 17:38:23

	Low	Pre-Low	Pre-High	High	
☐ Spare A/D 1	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 2	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 3	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 4	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 5	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 6	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 7	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 8	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 9	-5.00	-5.00	5.00	5.00	Volts
☐ Spare A/D 10	-5.00	-5.00	5.00	5.00	Volts
☐ Inside Temperature	0	0	40	40	°C
☐ Outside Temperature	-25	-25	70	70	°C
LPA Disable Temperature			60	80	°C
HPA Disable Temperature			60	80	°C
Fan On Temperature				50	°C

Transmitters

Tx1 Tx2

☐ Main ☒ 6

☐ Antenna ☒ 6

☒ Load ☐

☐ Off

Monitors

Integral Standby

☒ Normal ☒ 6

☐ Alarm

☐ Bypass

Monitor 2

Delay 50.01

Spacing 11.89

Tx Power 1032

Efficiency 100.0

PRF 805

Ready CAP Level 3 SEC3 08/04/06 17:45:23

Figure 3-20 A/D Limits Configuration Screen (Dual Equipment shown)

Once the user has set the User Configuration parameters as desired and pressed [F7] to "Apply", pressing the "Display DIP Switch Settings" button will display the corresponding backplane DIP switch settings for S1, S2, and S3 as shown in Figure 3-21. These DIP switches should be set according to the displayed information.

Backplane DIP Switches - Required Settings

S1

Switch	Setting
0	SCON 0 - Equipment Mode: Always On
1	SCON 1 - Equipment Mode: Always On
2	SCON 2 - Dual / ~Single Equipment
3	SCON 3 - Low Power / ~High Power
4	SCON 4 - Equipment Mode: Always On
5	SCON 5 - Remote Control: Disabled/~Enabled
6	SCON 6 - TACAN / ~DME
7	SCON 7

S2

Switch	Setting
0	SCON 8 - RCSU Modem: Dedicated / ~RF
1	SCON 9 - RMM Modem: Embedded / ~External
2	SCON 10
3	SCON 11
4	SCON 12
5	SCON 13
6	SCON 14
7	SCON 15

S3

Switch	Setting
0	CSEL 0 - Y Channel / ~X Channel
1	CSEL 1 *
2	CSEL 2 *
3	CSEL 3 *
4	CSEL 4 RF Channel Select
5	CSEL 5 *
6	CSEL 6 *
7	CSEL 7 *

Notes:

Switches indicated as or are not in the proper position. Correct this situation, and then press Update to refresh this display.

For switches indicated as refer to Section 9 in the Technical Manual.

For rocker-type DIP switches, the side indicated with should be depressed.

Buttons: OK, Update

Figure 3-21 DIP Switch Settings Screen

3.7.4.5 Security Codes Configuration Screen

Refer to Figure 3-22. This screen is used to configure the security access passwords for each user, including User ID, Password, and Security Level. This User ID/Password information is encrypted and stored in the non-volatile RAM (NVRAM) on the RMS CCA. This screen is only available to the Level 4 user.

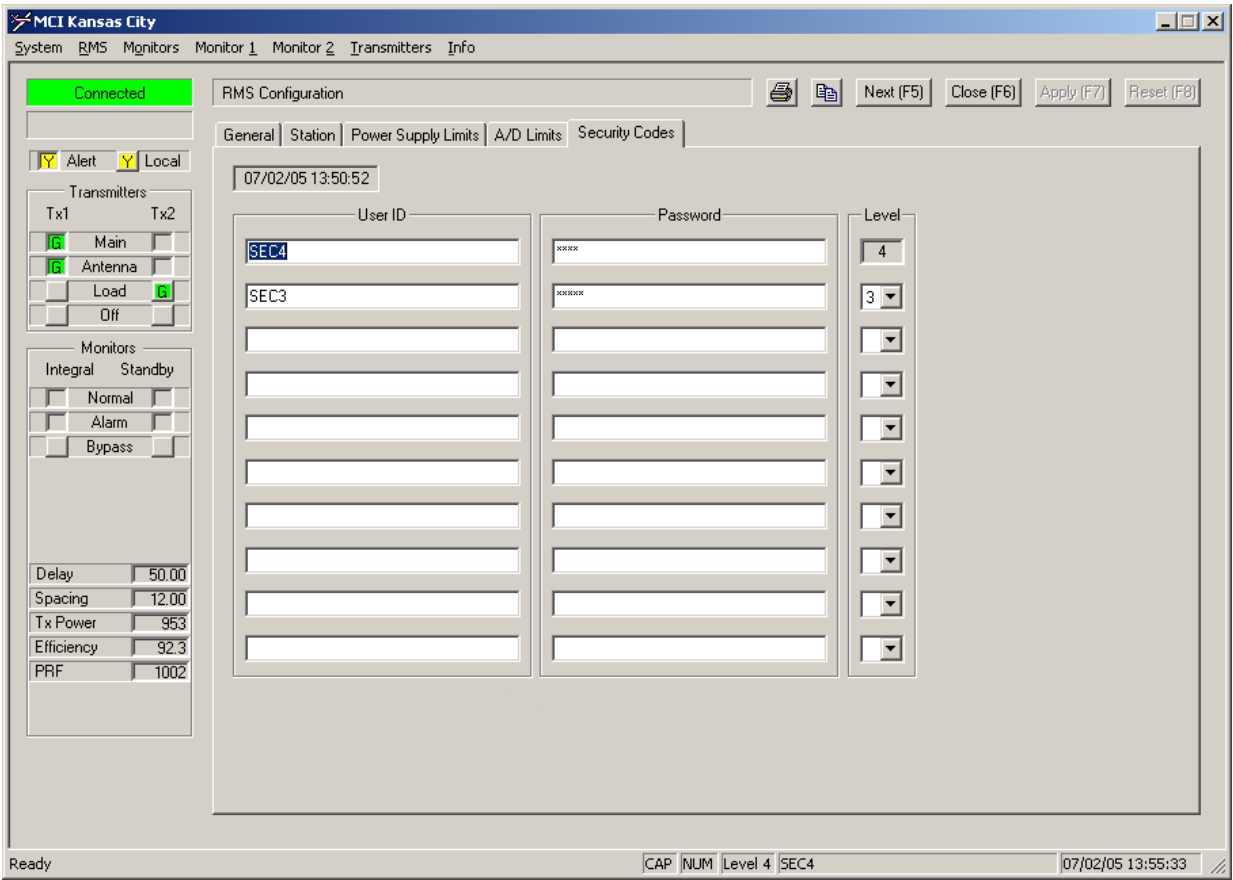


Figure 3-22 Security Codes Configuration Screen (Dual Equipment shown)

3.7.4.5.1 User Account Maintenance

As part of initial configuration, several user accounts should be setup, corresponding to the access levels required. User account maintenance can only be done through a direct connection (i.e. not via a remote modem) in the LOCAL mode, from within Security Level 4, with the exception of changing the current user's password. All users can change their own passwords, when connected directly and the system is in Local Mode, through the RMS >> Commands >> Change Password menu option. Refer to Figure 3-22 for the Security Codes Configuration Screen.

3.7.4.5.2 Add a User's Account

- a. Log on to Security Level 3 and select the RMS >> Configuration >> Security Codes screen.
- b. Click on any empty User ID field.
- c. Enter the desired User ID. Note that the User ID must be 4 to 32 characters in length, is case-sensitive, and can contain any alphanumeric characters.
- d. Press TAB to move to the associated Password field.
- e. Enter the desired Password. Asterisks will hide the password on the display. Note that the password must be 4 to 32 characters in length, is case-sensitive, and can contain any alphanumeric characters.
- f. Select the desired Security Level for this user.
- g. Repeat these steps for any additional users.
- h. When all users have been configured, press the [F7] Apply button to save the new User Account data. This will clear the asterisks in the password field to hide the length of the password.
- i. To store the new account information in the RMS's NVRAM, select RMS >> Config Backup. If this is not done, the user data will revert to the values stored in the NVRAM following the next system reset or power-cycle.

3.7.4.5.3 Change a User's Password

- a. All User account information, including passwords, is accessible from Security Level 4 as follows:
- b. Log on to Security Level 4 and select the RMS >> Configuration >> Security Codes screen.
- c. Select the Password field associated with the desired User ID.
- d. Enter the desired Password, which is case-sensitive. Asterisks will hide the password on the display. Note that the password must be 4 to 32 characters in length, and can contain any alphanumeric characters.
- e. Press the [F7] Apply button to save the new User Account data. This will clear the asterisks in the password field.
- f. To store the new account information in the RMS's NVRAM, select RMS >> Config Backup. If this is not done, the user data will revert to the values stored in the NVRAM following the next system reset or power-cycle.

From other Security Levels, only the current user's password can be changed. This is done as detailed below:

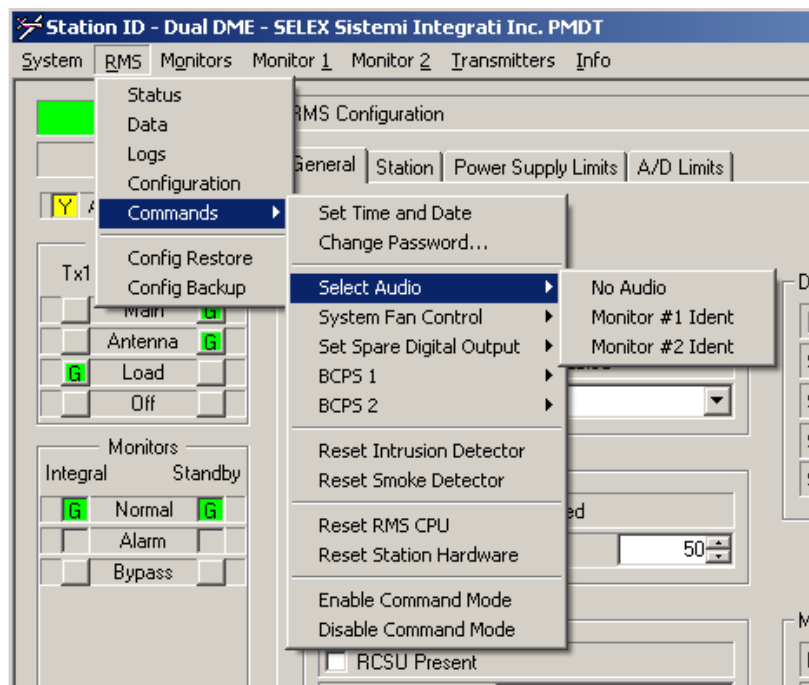
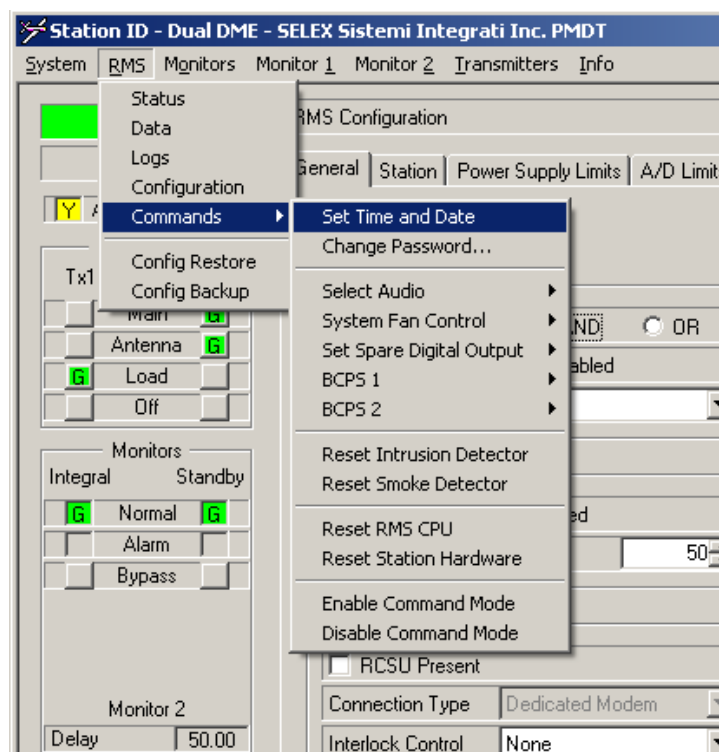
- a. Log on directly (not via a Modem connection) and press the Local Mode button on the LCU.
- b. Select the RMS >> Commands >> Change Password menu item.
- c. Enter the Current Password and press TAB to move to the next field.
- d. Enter the New Password, which is case-sensitive. Asterisks will hide the password on the display. Note that the password must be 4 to 32 characters in length, and can contain any alphanumeric characters. Press TAB to move to the next field.
- e. Re-enter the New Password and press OK to save the new password.
- f. A message box will be displayed, indicating that the password has been changed. Press OK to clear this message.

3.7.4.5.4 Delete a User's Account

- a. Log on to Security Level 4 and select the RMS >> Configuration >> Security Codes screen.
- b. Select the desired User ID field.
- c. Delete the User ID in this field, leaving it blank.
- d. Press the [F7] Apply button to save the new User Account data.
- e. To store the new account information in the RMS's NVRAM, select RMS >> Config Backup. If this is not done, the user data will revert to the values stored in the NVRAM following the next system reset or power-cycle.

3.7.4.6 RMS Commands

The RMS Commands menu, shown in Figure 3-23, provides system level controls for setting the time and date of the DME station to the PMDT PC's current settings, changing the current user's password, setting the system's Fan Control, setting the level of any of the Spare Digital Outputs, resetting the Intrusion and Smoke Detectors, and resetting the RMS hardware.



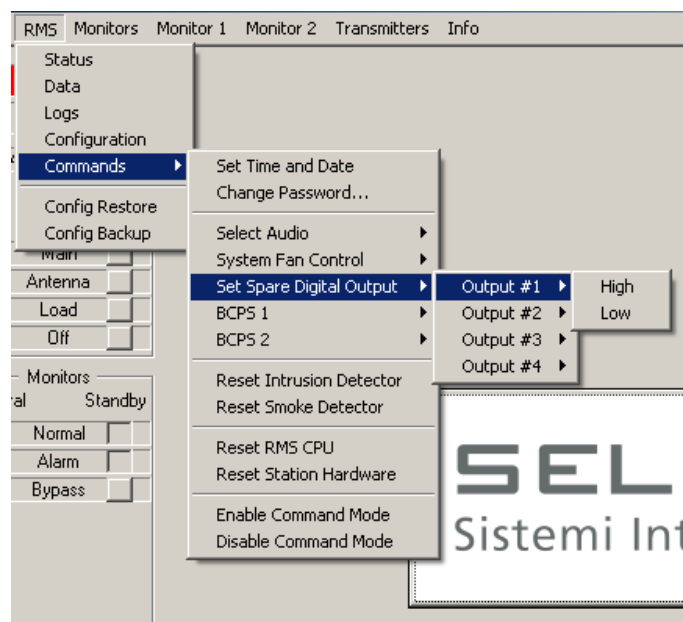
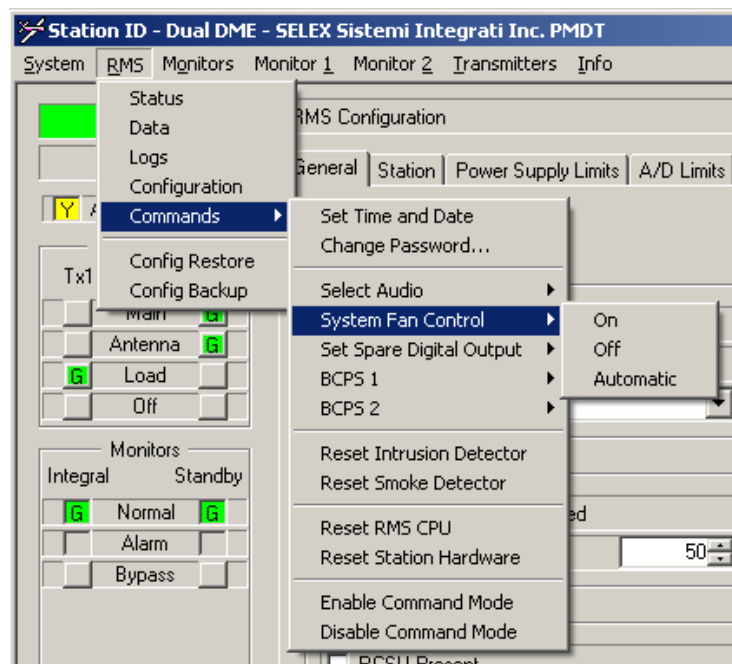


Figure 3-23 RMS Commands Menu

3.7.5 Monitor Screens

3.7.5.1 All Monitor Data Screens

3.7.5.1.1 Integral All Monitor Data Screen

Reference the Integral All Monitor Data screen shown in Figure 3-24.

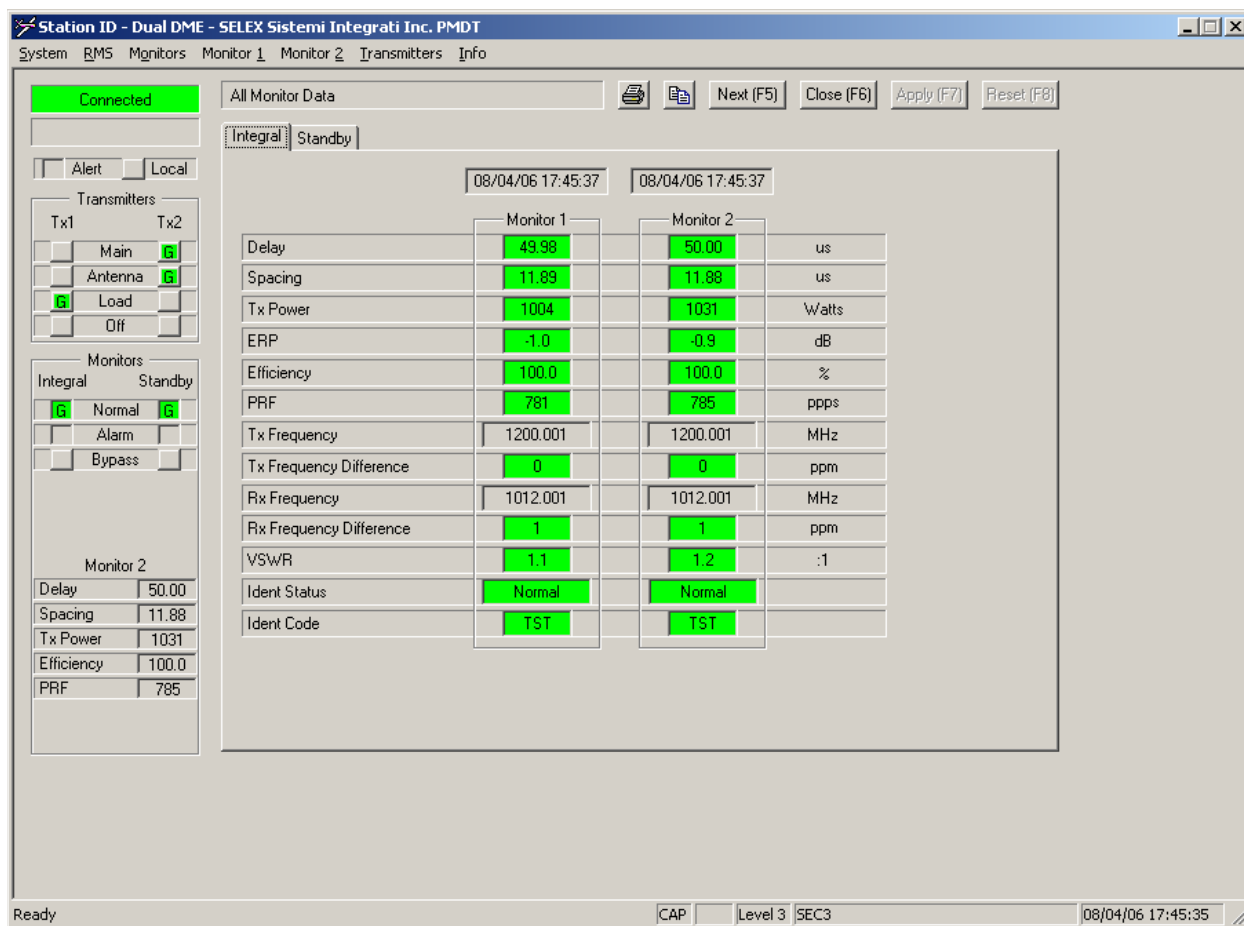


Figure 3-24 Integral All Monitor Data Screen (Dual Equipment shown)

3.7.5.1.2 Standby All Monitor Data Screen

Refer to Figure 3-25.

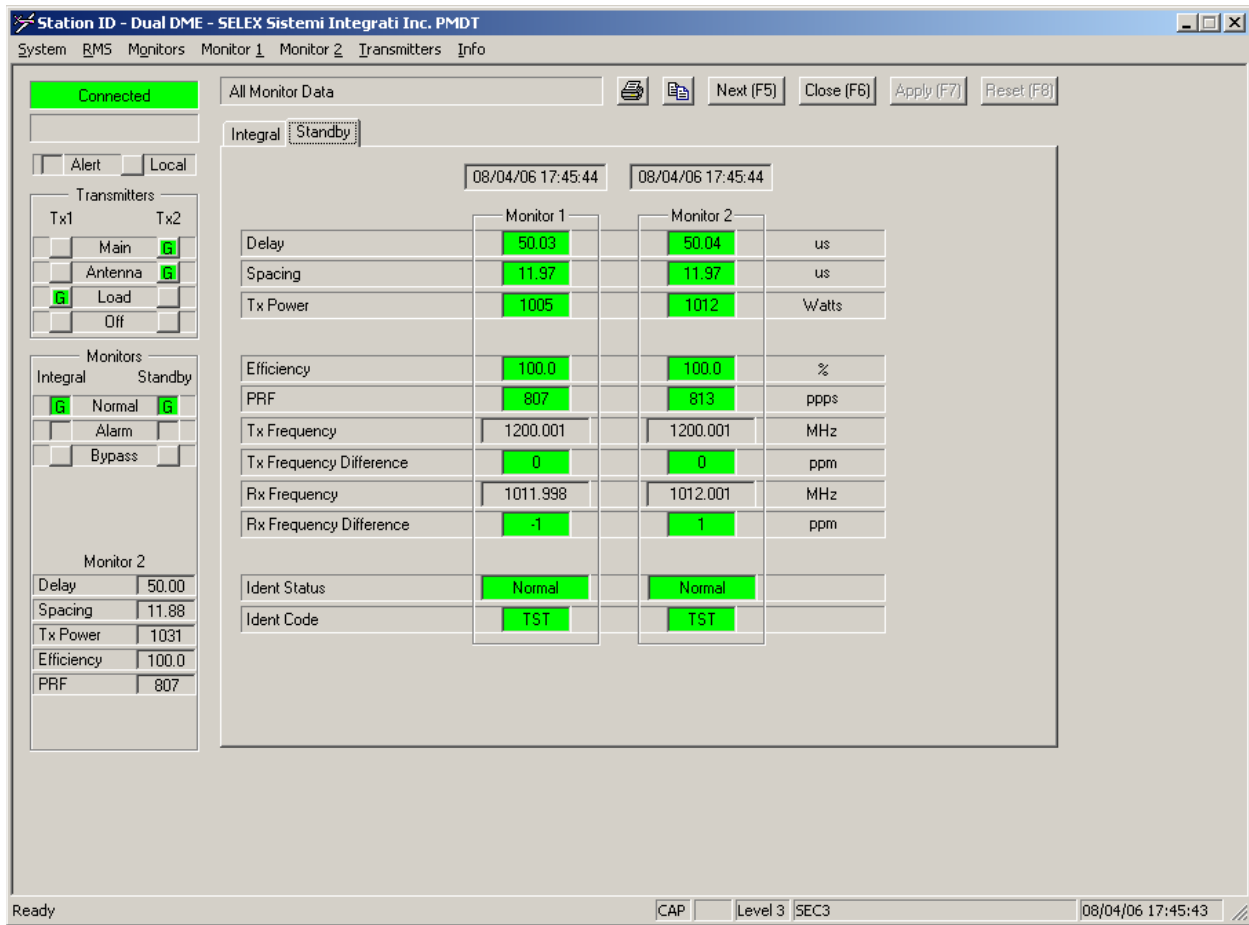


Figure 3-25 Standby All Monitor Data Screen

3.7.5.2 Monitor Configuration Screens

The PMDT contains the following Monitor Configuration Screens that are used to configure the DME's Monitors. The screens and their contents are described below.

Note that as a convenience, the current monitor data from both monitors in a dual DME are displayed within the same screen in the Monitors>>>Data screen shown below in [Figure 3-26](#). The Standby Monitor Data Screen (see is identical to the Integral Monitor Data Screen with the exception of the ERP and VSWR parameters, and is only available when a Hot Standby system is configured.

3.7.5.2.1 General Monitor Configuration Screen

Refer to [Figure 3-26](#). This screen is used to configure the general operation of the DME's Monitors. It contains controls used to enable the Executive Alarm for various monitored parameters. The user can select how each of the Executive parameters is classified, either as Primary Alarm or Secondary Alarm.

When the LCU's Transfer Logic is set for Transfer on Primary/Secondary Alarm, any out of tolerance condition of a Primary or Secondary Parameter will cause the system to be shutdown. Setting the LCU's Transfer Logic to "Best Availability" allows the LCU to keep the system operating in the event of only a Secondary Alarm.

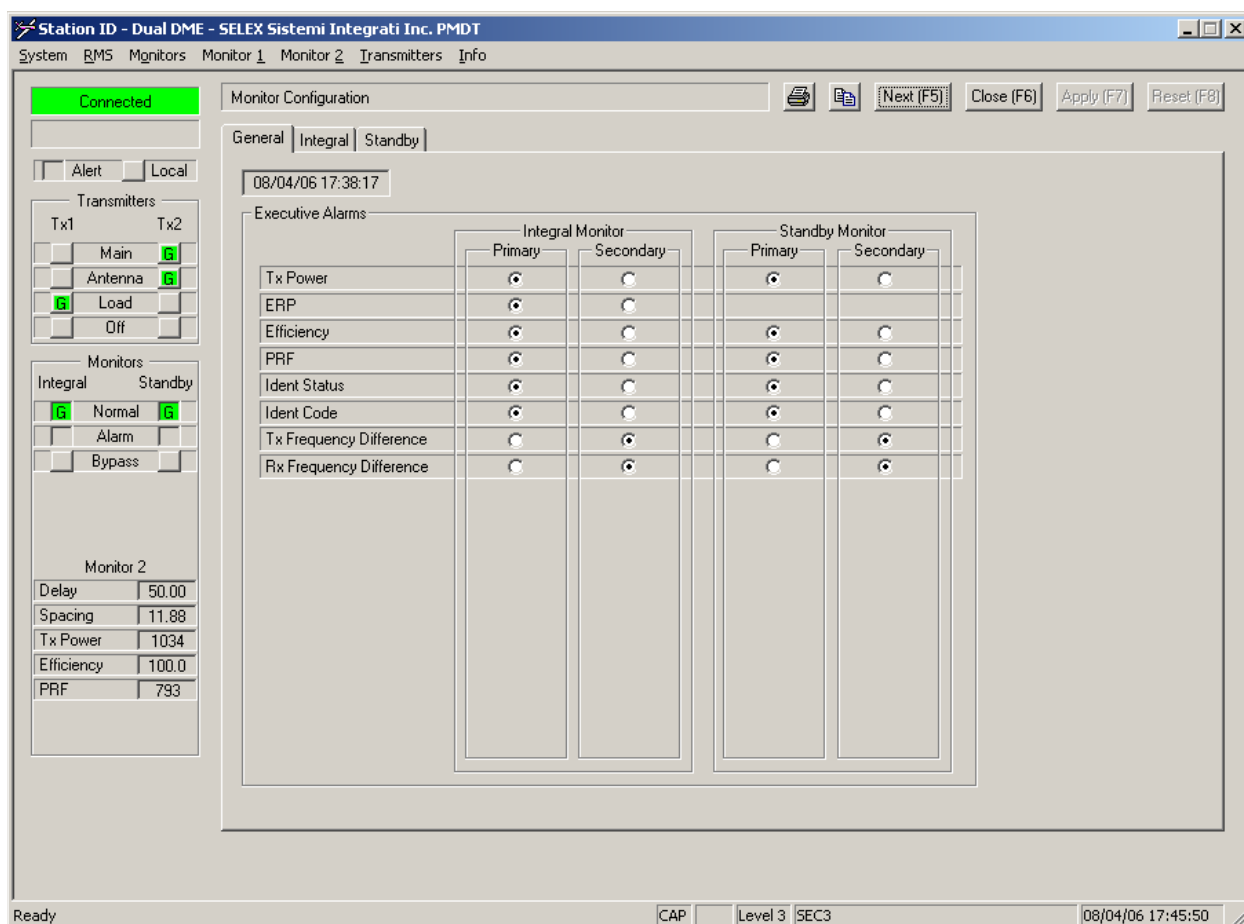


Figure 3-26 General Monitor Configuration Screen (Dual Equipment shown)

3.7.5.2.2 Integral Monitor Configuration Screen

Refer to Figure 3-27. These screens are used to configure the operation of the Integral and Standby Monitors. They contain the Shutdown Delay, the Ident Delays, and the Alarm and Pre-Alarm Limits, as well as the desired Nominal values for all of the monitored parameters.

Table 3-4 Monitor System Level Settings

Parameter	
Efficiency Certification Level	The minimum efficiency level for decoder aperture automated tests.
Monitor 1 Reply Attenuation	The attenuation for monitor 1 antenna (integral) reply detector.
Monitor 2 Reply Attenuation	The attenuation for monitor 1 antenna (integral) reply detector.
Direction Coupler Loss	The loss through the direction coupler for monitor interrogations.

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected

Monitor Configuration

General Integral Standby

08/04/06 17:38:17

	Alarm Low	PreAlarm Low	Nominal	PreAlarm High	Alarm High	
Delay	49.40	49.46	50.00	50.54	50.60	us
Spacing	11.60	11.64	12.00	12.36	12.40	us
Tx Power	500	550	1000	1225	1250	Watts
ERP	-3.0	-2.7	0	0.9	1.0	dB
Efficiency	70.0	73.0				%
PRF	720	730	800	2800	2800	ppps
Tx Frequency Difference	-20	-18	0	18	20	ppm
Rx Frequency Difference	-20	-18	0	18	20	ppm
VSWR			1.1	3.0	4.0	:1

Timers

Integral Shutdown Delay	7.0	Seconds
Continuous Ident	5.0	Seconds
No Ident	65.0	Seconds

System-Level Settings

Efficiency Certification Level	70	%
Monitor 1 Reply Attenuation	22	dB
Monitor 2 Reply Attenuation	22	dB
Directional Coupler Loss	-30.00	dB

Transmitters

Tx1 Tx2

Main Antenna Load Off

Monitors

Integral Standby

Normal Alarm Bypass

Monitor 2

Delay	50.00
Spacing	11.89
Tx Power	1036
Efficiency	100.0
PRF	776

Ready CAP Level 3 SEC3 08/04/06 17:46:01

Figure 3-27 Integral Monitor Configuration Screen (Dual Equipment shown)

3.7.5.2.3 Standby Monitor Configuration Screen
Refer to Figure 3-28.

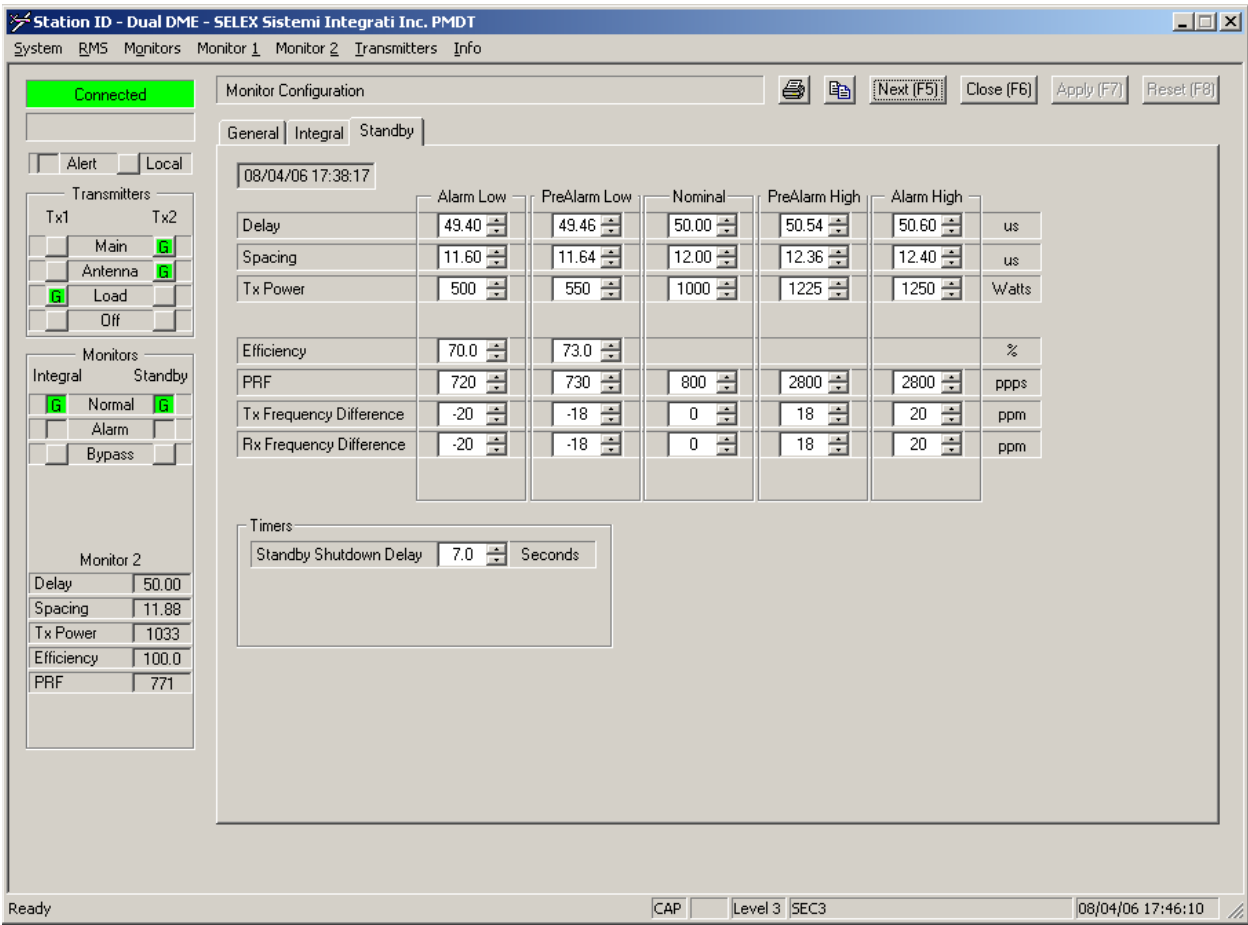


Figure 3-28 Standby Monitor Configuration Screen (Dual Equipment shown)

3.7.5.3 Special Tests

Refer to [Figure 3-30](#) for the path to the Special Tests Screen. Refer to [Figure 3-29](#). The monitor special test modes may be controlled from this screen. When a monitor enters special test mode, it must be restarted to exit. When in special test mode, the monitor will hold all alarm lines in alarm. The “start” button places the monitor in special test mode. Once started, the “start” button becomes a “stop” button. When the “stop” button is pressed, the DME restarts. In special test mode not all parameters are measured. Furthermore, normal real-time performance requirements are not held to. When in special test mode, the DME must be on a load.

Table 3-5 Monitor Special Test Configuration

Parameter	
Monitor Selection	In normal operation, only one monitor may interrogate the DME at a time. In “Monitor 1” or “Monitor 2” mode, the selected monitor will be enabled always and the other will be disabled. In both, both monitors are allowed to simultaneously interrogate.
Delay Level	Sets the interrogation level of interrogations intended for delay measurements.
Efficiency Level	Sets the interrogation level of interrogations intended for efficiency measurements.
Spacing	Sets the spacing of the interrogation pulses.
PRF Test	In this mode normal delay and efficiency measurements are made. The time between interrogations (normally 10ms) is adjusted to match the targeted PRF level. Two additional interrogators are activated to fill in the high rate (Triggers PRF1 and PRF2). They interrogate at the efficiency interrogation level. Note: because these interrogations are periodic and not random, they do not accurately simulate heavy aircraft loading.
Short Distance Echo	In short distance echo mode, the delay and efficiency interrogators are enabled. On top of the normal interrogation pulses, two echo pulses are overlaid. The relative echo level may be set from 0 to -10 dB from the main interrogation level. The echo delay in us may also be set. In SDES test mode it is recommended that the RTC delay loop be manually locked. This may be done by selecting “Transmitters”, “Commands”, “Transmitter 1/2”, “Delay”, “Lock”.
Long Distance Echo	In LDES mode, only the long distance echo interrogator is active. In LDES test mode it is recommended that the RTC delay loop be manually locked. This may be done by selecting “Transmitters”, “Commands”, “Transmitter 1/2”, “Delay”, “Lock”.
Recovery Pulse	N/A
CW Mode	When in CW (Carrier Wave) mode, the modulator is driven with a constant voltage and the switched attenuators/amplifiers remain fixed. The drive level and attenuator setting are determined by delay interrogation level. If monitor calibration is disabled on the “Monitor 1/2”, “Offset and Calibration”, “Calibration” screen, the delay interrogation level is not absolute and instead relative to the nominal interrogation level. An interrogation level of 0 dB will turn off all attenuators and amplifiers and an interrogation level of +32, -32, -16, -8, -4, -2, -1 will turn on only the +32 dB amplifier, and -32 through -1 attenuators respectively.
Sensitivity Test	In this mode the delay and efficiency interrogators are ran at the set levels. The interrogation frequency may offset by the “Interrogation Frequency” drop down.
Decoder Tests	In this mode the delay and decoder test interrogators are run at 1000 PRF. The decoder test will finish in approximately one minute rather than the usual 10 minutes.

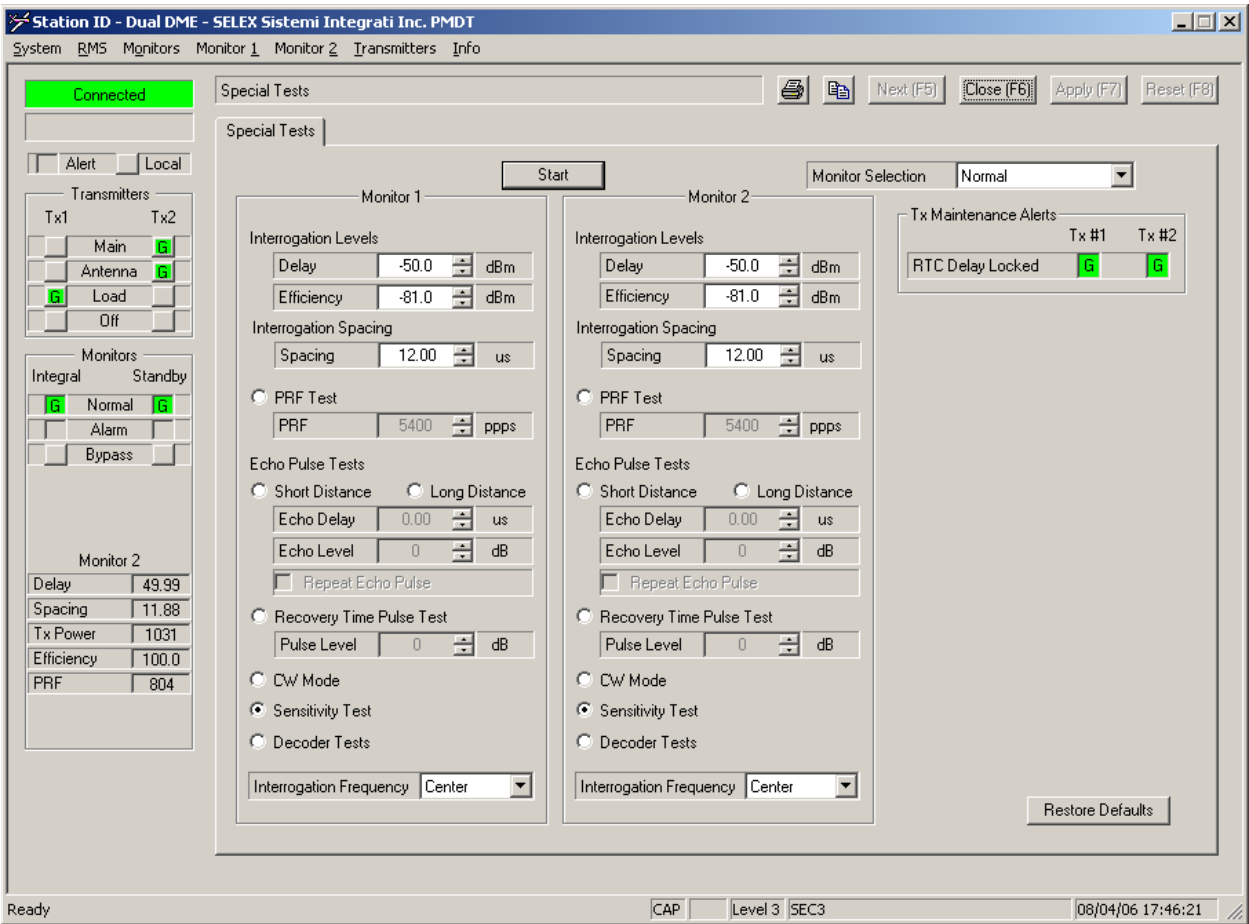


Figure 3-29 Special Tests Screen

3.7.5.4 Monitor Commands

Refer to [Figure 3-30](#). The Bypass state of the Integral and Standby Monitors can be changed using the corresponding command under the Monitors >> Commands menu, as well as by pressing the Bypass buttons on the Sidebar.

In addition to these commands, the Automatic Offset and Scale commands are available to users at Security Level 3 and higher. These commands are used to automatically calculate the Offsets and Scale Factors for the associated Monitor type (Integral, Standby, or All). The PMDT software averages multiple data samples from the monitor, then calculates the new Offsets, Scale Factors, and Reference Levels to achieve the "Nominal" values configured in the Monitor >> Configuration >> Integral/Standby screens.

Autoscaling should only be performed once the system is aligned and verified with external test equipment. In a dual system, both Main and Standby transmitters must be on. If the PMDT is unable to achieve the nominal value using the full range of the Offsets and Scale Factors, a warning message will be displayed, indicating the non-scaled parameters. If this occurs, verify the nominal settings, the system inputs (with Nominal Offsets), and the TX outputs are all correct.

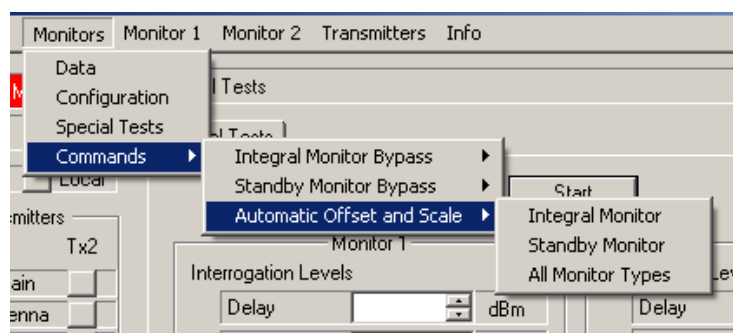


Figure 3-30 Monitor Commands

3.7.6 Monitors 1 - 2 Screens

The PMDT contains a set of screens for each of the two Monitor CCAs in the DME. These include Monitor Data, Monitor Test Results, Monitor Fault History, and Monitor Offsets and Scale Factors. Only the screens for Monitor 1 are discussed in this section; those for Monitor 2 in a Dual DME are identical.

3.7.6.1 Monitor Data Screens

The PMDT contains several Monitor Data Screens that are used to view the current status of the monitored parameters. The screens and their contents are described below.

3.7.6.1.1 Integral Monitor Data Screen

Refer to [Figure 3-31](#). These screens display the low and high alarm limits and pre-alarm limits with current operating values for the course and clearance transmitters. The Standby Monitor Data Screen is identical to the Integral Monitor Data Screen with the exception of the ERP and VSWR parameters, and is only available when a Hot Standby system is configured.

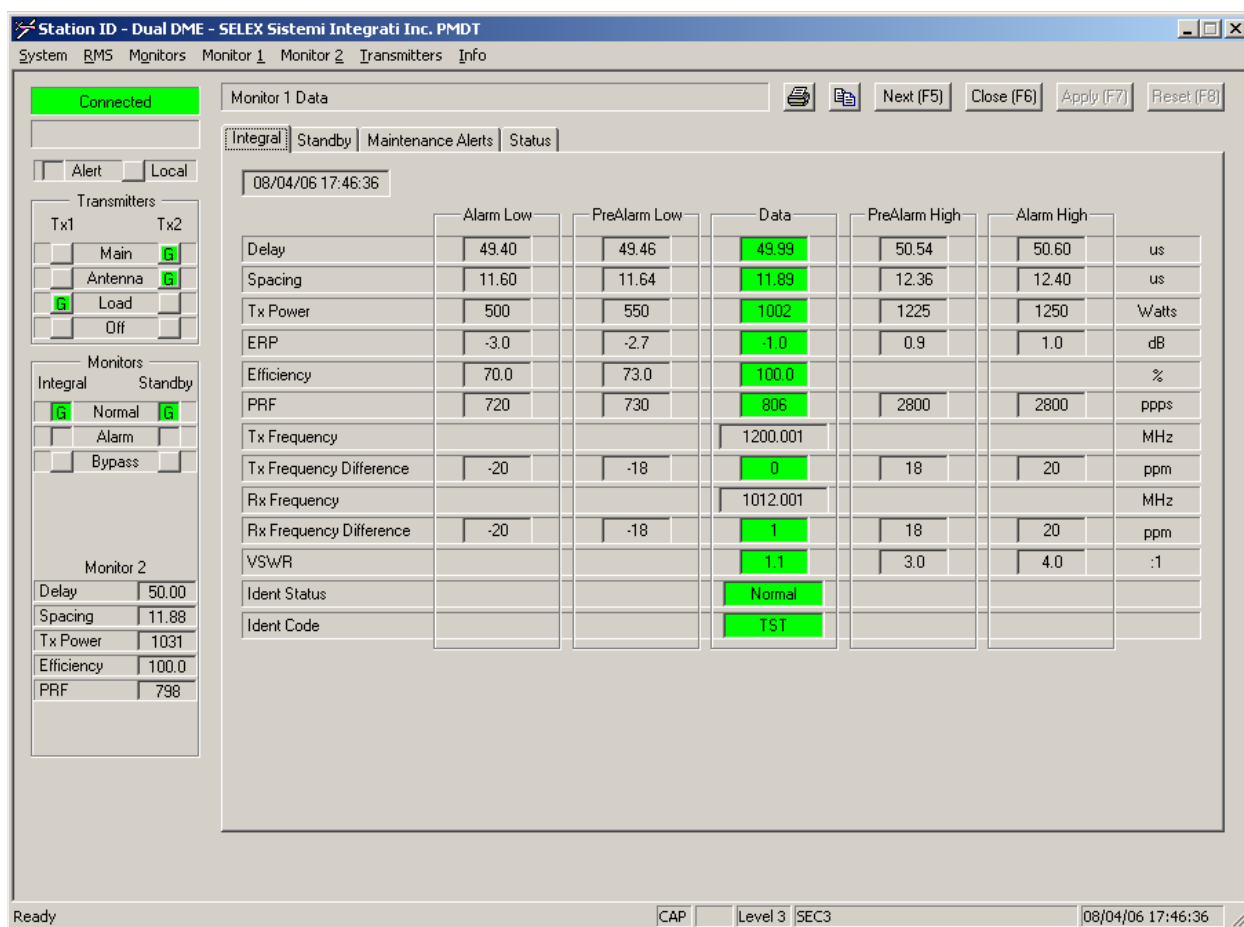


Figure 3-31 Integral Monitor Data Screen (Dual Equipment shown)

3.7.6.1.2 Standby Monitor Data Screen

Refer to Figure 3-32.

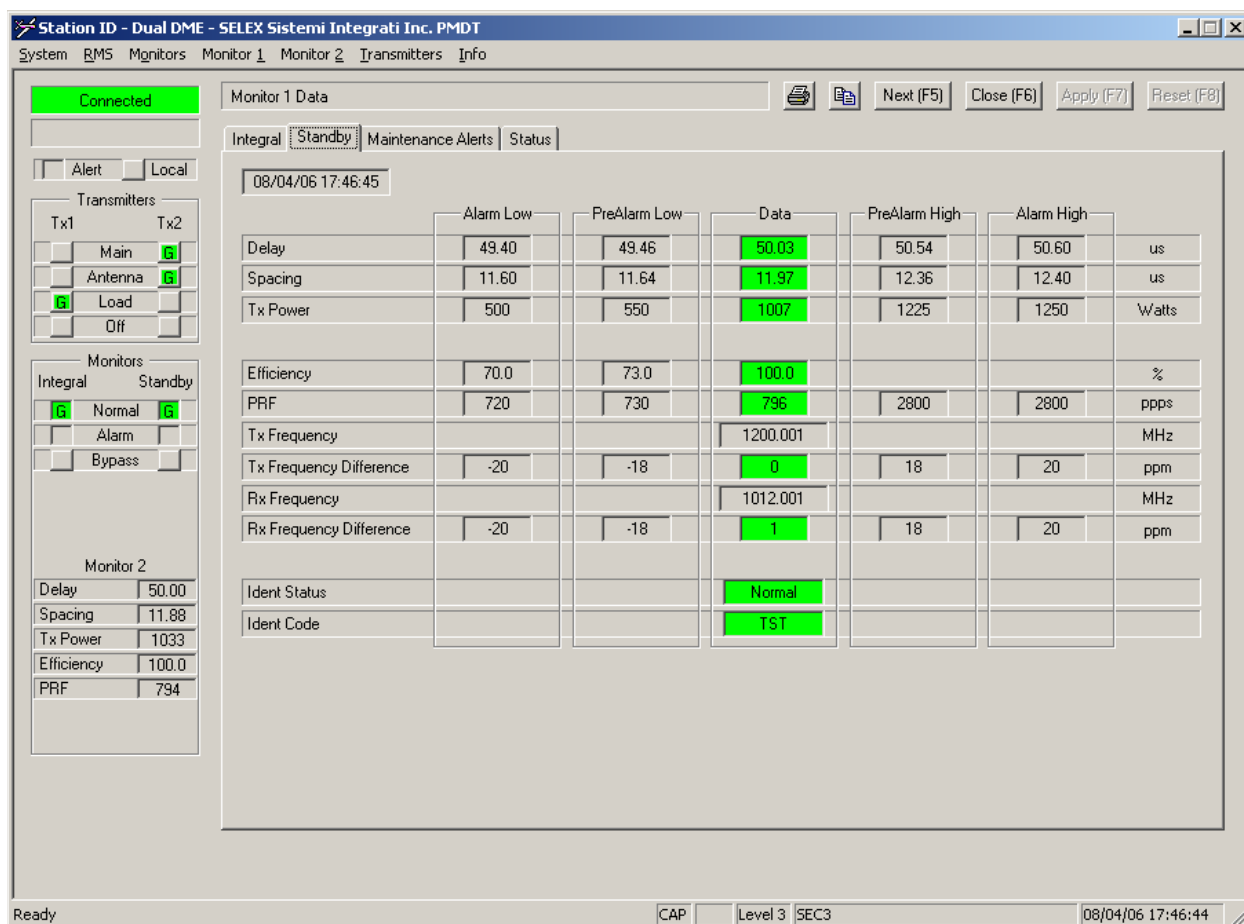


Figure 3-32 Standby Monitor Data Screen (Dual Equipment shown)

3.7.6.1.3 Monitor Maintenance Alerts Screen

Refer to Figure 3-33. This screen displays indicators of any Monitor Maintenance Alerts currently present. Note that a Maintenance Alert is also indicated when the system is in Local Mode.

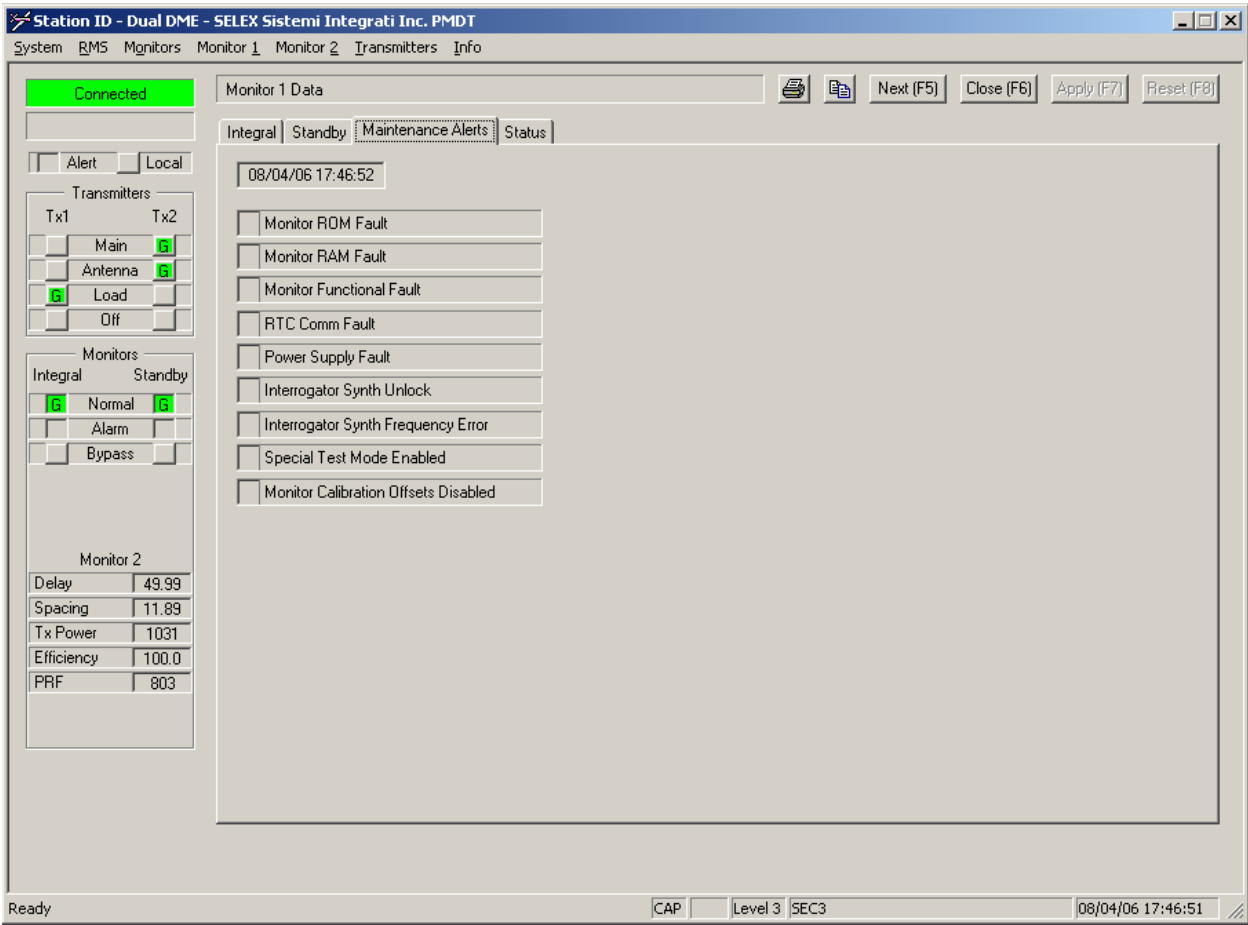


Figure 3-33 Monitor Maintenance Alerts Screen (Dual Equipment shown)

3.7.6.1.4 Monitor Status Screen

Refer to Figure 3-34. This screen displays the general status of the associated Monitor, including any Alarms, Pre-Alarms, Maintenance Alerts, Operating Mode and Diagnostic status.

The screenshot shows the 'Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT' interface. The top menu bar includes 'System', 'RMS', 'Monitors', 'Monitor 1', 'Monitor 2', 'Transmitters', and 'Info'. The main window is titled 'Monitor 1 Data' and contains several sections:

- Connected:** A green bar indicating the system is online.
- Alerts:** Includes 'Alert' and 'Local' checkboxes.
- Transmitters:** A section with 'Tx1' and 'Tx2' columns. Under 'Tx1', 'Main' and 'Antenna' are checked (green 'G' icons), while 'Load' and 'Off' are unchecked. Under 'Tx2', 'Main' and 'Antenna' are checked (green 'G' icons), while 'Load' and 'Off' are unchecked.
- Monitors:** A section with 'Integral' and 'Standby' columns. Under 'Integral', 'Normal' is checked (green 'G' icon), while 'Alarm' and 'Bypass' are unchecked. Under 'Standby', 'Normal' is checked (green 'G' icon), while 'Alarm' and 'Bypass' are unchecked.
- Monitor 2 Data:** A table showing parameters for Monitor 2:

Delay	50.00
Spacing	11.89
Tx Power	1029
Efficiency	100.0
PRF	803
- Alarm / Alerts:** A list of checkboxes for 'Primary Alarm', 'Secondary Alarm', 'Pre-Alarm', and 'Maintenance Alert', all of which are unchecked.
- Status:** A list of checkboxes for 'Remote Mode' (checked, green 'G'), 'Local Mode' (unchecked), 'Hot Standby Present' (checked, green 'G'), 'Interrogator Trigger Source' (unchecked), 'Integral Delay' (unchecked), 'Overload' (unchecked), 'Efficiency Alarm Suppressed' (unchecked), 'Integral Monitor Detector Clipped' (unchecked), 'Standby Monitor Detector Clipped' (unchecked), 'Integral Monitor Ident Gate Timeout' (unchecked), and 'Standby Monitor Ident Gate Timeout' (unchecked).
- Diagnostics:** A section with 'Diagnostics Test in Progress' (unchecked) and 'Shutdown Status' (Normal).
- Interrogator Synthesizer:** A section with 'Unlock' (unchecked), 'Frequency' (1137.002 MHz), and 'Frequency Error' (2 ppm).

The bottom status bar shows 'Ready', 'CAP', 'Level 3', 'SEC3', and the date/time '08/04/06 17:47:00'.

Figure 3-34 Monitor Status Screen (Dual Equipment shown)

3.7.6.2 Monitor Test Results Screens

The Automatic Monitor Integrity Test feature programs the Monitor Interrogator to apply alarm limit signals to the various executive monitor channels on both Monitor 1 and Monitor 2 to verify the ability of the monitors to detect out-of-tolerance conditions. Should either of the two monitors fail the integrity test, a monitor maintenance alert is generated. The results of the latest tests are provided in the following screens.

3.7.6.2.1 Monitor Alarm Limits Integrity Results

Refer to [Figure 3-35](#). This screen displays the results of the last Alarm Limit Integrity Test performed by the associated Monitor. It shows the measurements for the transmitter made in each integrity test, as well as the high and low alarm limits for each measurement.

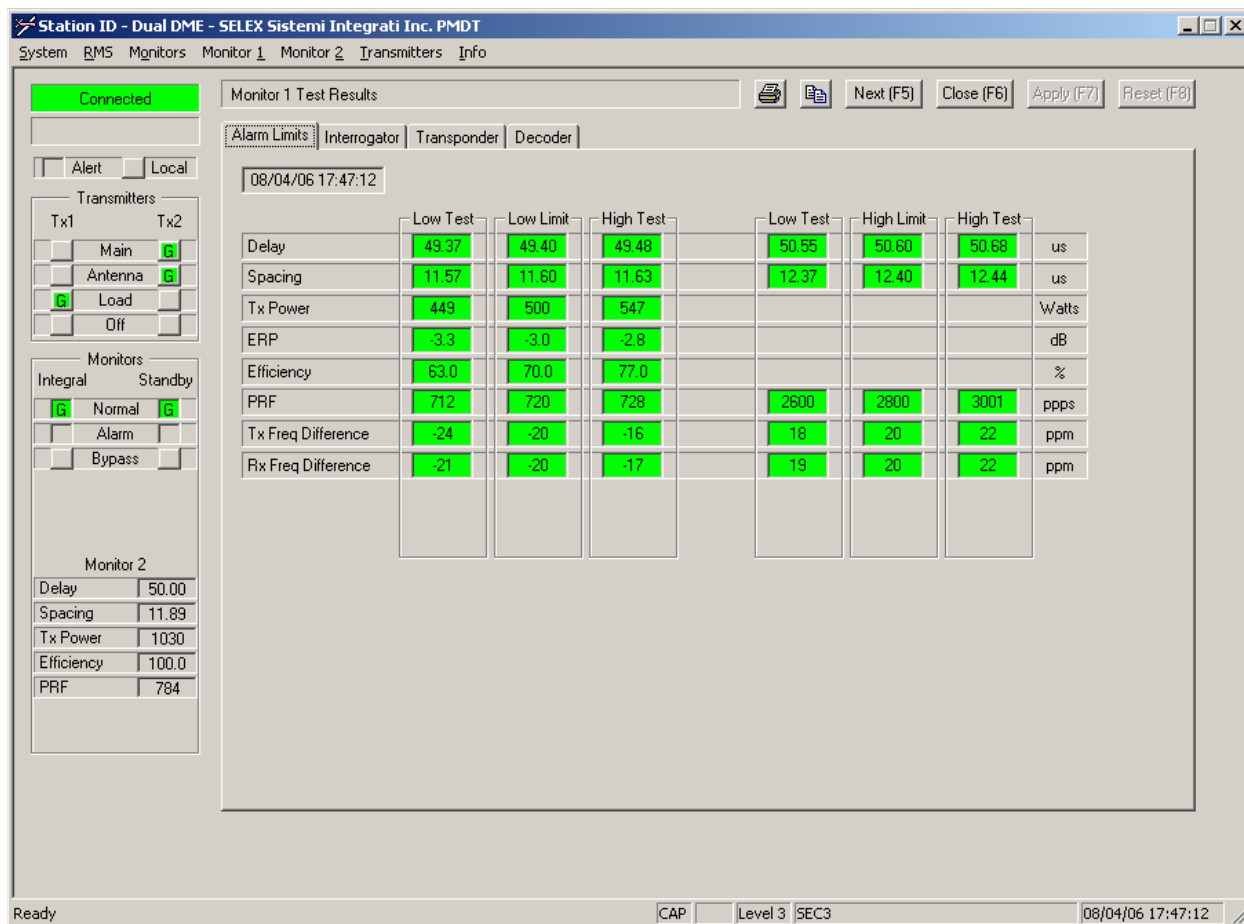


Figure 3-35 Monitor Alarm Limits Integrity Test Results Screen (Dual Equipment shown)

For each test case, the monitor samples the signal and tests each parameter. Table 3-4 indicates the limits used by the Monitor to declare a normal condition. If the Monitor finds that the parameter exceeds the tolerance then the parameter is declared in alarm and the Monitor x >> Data >> Test Results shows the background in red on the parameter that is out of tolerance.

When a Monitor indicates that a parameter in the Integrity Test Results is out of tolerance, the Monitor is disabled by the RMS through the LCU. The disabled Monitor is re-enabled by the RMS only following a successful Monitor Integrity cycle.

Table 3-6 Monitor Alarm Limit Integrity Test Criteria

Parameter	Lower Limit	Standard	Upper Limit
Reply Delay Low Alarm Limit Test	-0.2 us	Low Limit	+0.2 us
Reply Delay High Alarm Limit Test	-0.2 us	High Limit	+0.2 us
Pulse Spacing Low Alarm Limit Test	-0.2 us	Low Limit	+0.2 us
Pulse Spacing High Alarm Limit Test	-0.2 us	High Limit	+0.2 us
Reply Efficiency Low Alarm Limit Test	-10%	Low Limit	+5%
PRF Low Alarm Limit Test	-30 ppps	Low Limit	+30 ppps
PRF High Alarm limit Test	-30 ppps	High Limit	+30 ppps
Transmitter Power Low Alarm Limit Test	-5%	Low Limit	+5%
Transmitter Power High Alarm Limit Test	-5%	High Limit	+5%
ERP Low Limit Test	-.25 dB	Low Limit	+.25 dB
ERP High Limit Test	-.25 dB	High Limit	+.25 dB
Tx Frequency High Limit Alarm Test	+10 ppm	+15 ppm	+20 ppm
Tx Frequency Low Limit Alarm Test	-10 ppm	-15 ppm	-20 ppm
Rx Frequency High Limit Alarm Test	+10 ppm	+15 ppm	+20 ppm
Rx Frequency High Limit Alarm Test	-10 ppm	-15 ppm	-20 ppm

3.7.6.2.2 Interrogator Test Results

Refer to [Figure 3-36](#). This screen displays the results of the last Interrogator Test performed by the associated Monitor. It shows the measurements made in each test, as well as the expected results for each measurement.

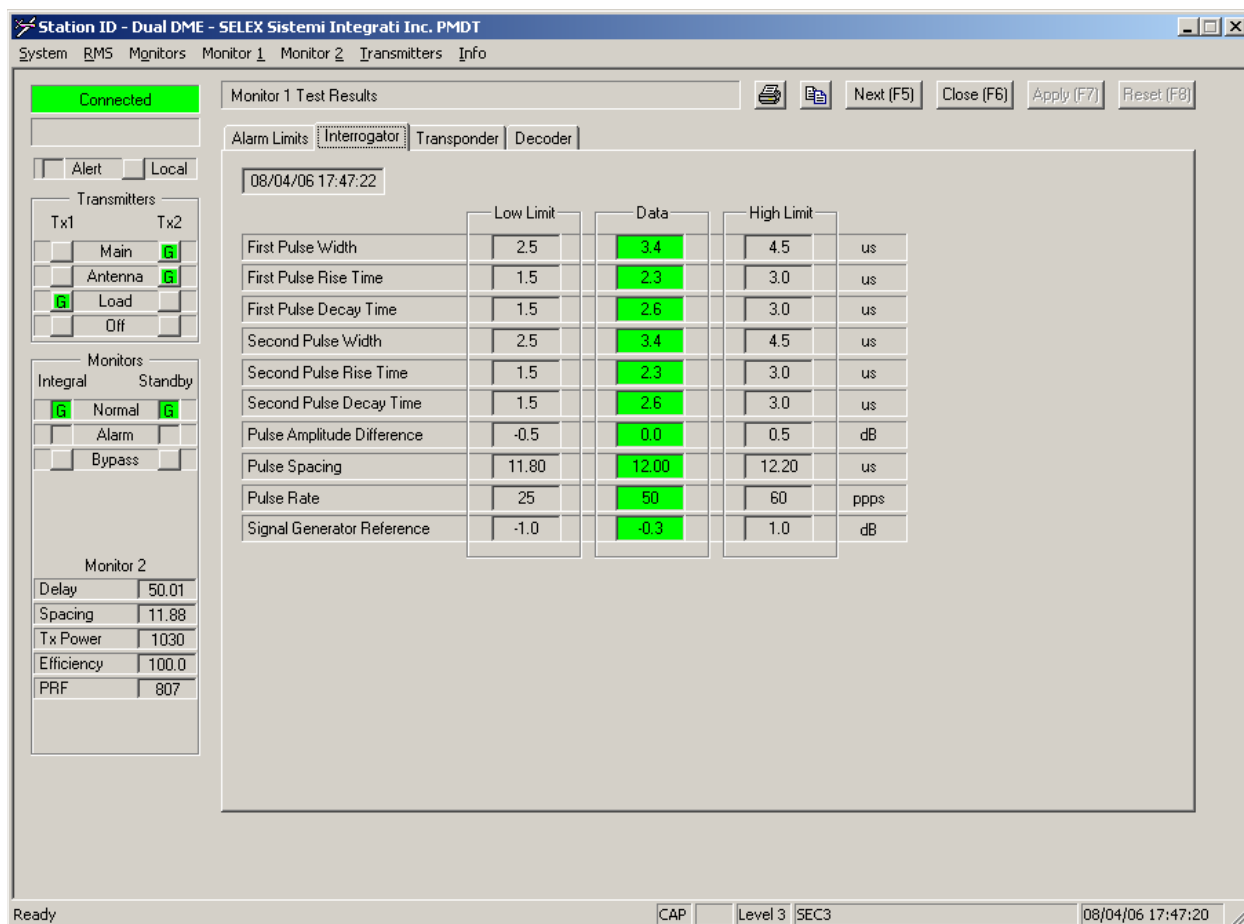


Figure 3-36 Interrogator Test Results Screen (Dual Equipment shown)

For each test case, the monitor samples the signal and tests each parameter. Table 3-5 indicates the limits used by the Monitor to declare a normal condition. If the Monitor finds that the parameter exceeds the tolerance then the parameter is declared in alert and the Monitor x >> Data >> Test Results shows the background in yellow on the parameter that is out of tolerance.

Table 3-7 Interrogator Test Criteria

Parameter	Lower Limit	Standard	Upper Limit
First Pulse Width	2.5 us	3.5 us	4.5 us
First Pulse Rise Time	1.5 us	2.5 us	3.0 us
First Pulse Decay Time	1.5 us	2.5 us	3.0 us
Second Pulse Width	2.5 us	3.5 us	4.5 us
Second Pulse Rise Time	1.5 us	2.5 us	3.0 us
Second pulse Decay Time	1.5 us	2.5 us	3.0 us
Pulse amplitude difference P1 to P2	-0.5 dB (Positive for P2>P1)	0 dB	+0.5 dB
Pulse Spacing	Established Value -0.2 us	Established Value	Established Value +0.2 us
Pulse Rate	25	50 (per monitor)	60
Signal Generator Reference	-1.0 dB	Established Value	+1.0 dB

3.7.6.2.3 Transponder Results

Refer to [Figure 3-37](#). This screen displays the results of the last Transponder Test performed by the associated Monitor. It shows the measurements made in each test, as well as the expected results for each measurement.

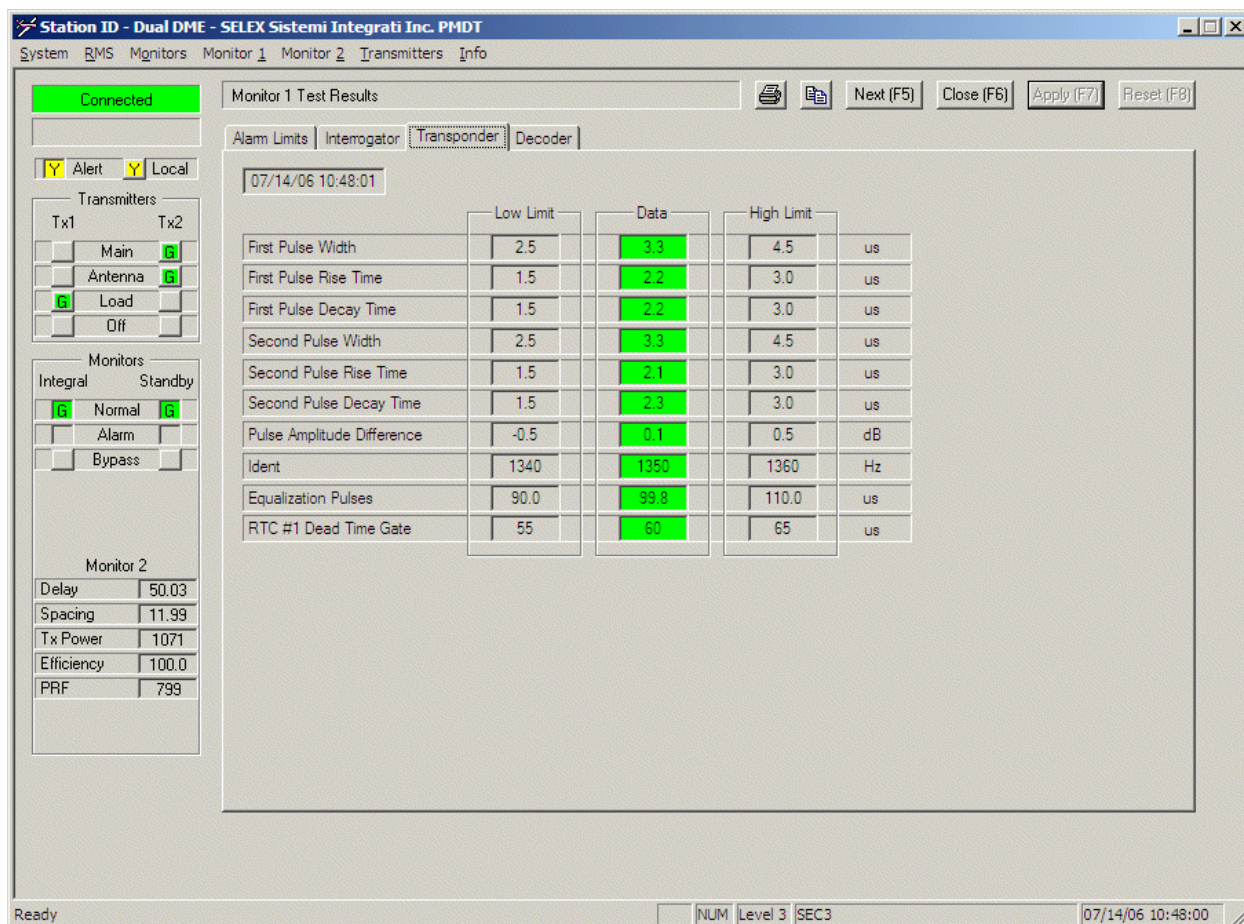


Figure 3-37 Transponder Test Results Screen (Dual Equipment shown)

For each test case, the monitor samples the signal and tests each parameter. Table 3-6 indicates the limits used by the Monitor to declare a normal condition. If the Monitor finds that the parameter exceeds the tolerance then the parameter is declared in alert and the Monitor x >> Data >> Test Results shows the background in yellow on the parameter that is out of tolerance.

Table 3-8 Transponder Test Criteria

Parameter	Lower Limit	Standard	Upper Limit
First Pulse Width	2.5 us	3.5 us	4.5 us
First Pulse Rise Time	1.5 us	2.5 us	3.0 us
First Pulse Decay Time	1.5 us	2.5 us	3.0 us
Second Pulse Width	2.5 us	3.5 us	4.5 us
Second Pulse Rise Time	1.5 us	2.5 us	3.0 us
Second pulse Decay Time	1.5 us	2.5 us	3.0 us
Pulse Amplitude Difference P1 to P2	-0.5 dB	0 dB	+0.5 dB (Positive for P2>P1)
Ident	- 10 Hz	Morse Code established at 1350 Hz	+10 Hz
Equalization Pulses	90.0 us	100.0 us	110.0 us
Dead Time Gate	Established Value -5.0 us	Established Value	Established Value +5.0 us

3.7.6.2.4 Decoder Results

Refer to [Figure 3-38](#). This screen displays the results of the last Decoder Test performed by the associated Monitor. It shows the measurements made in each test, as well as the expected results for each measurement.

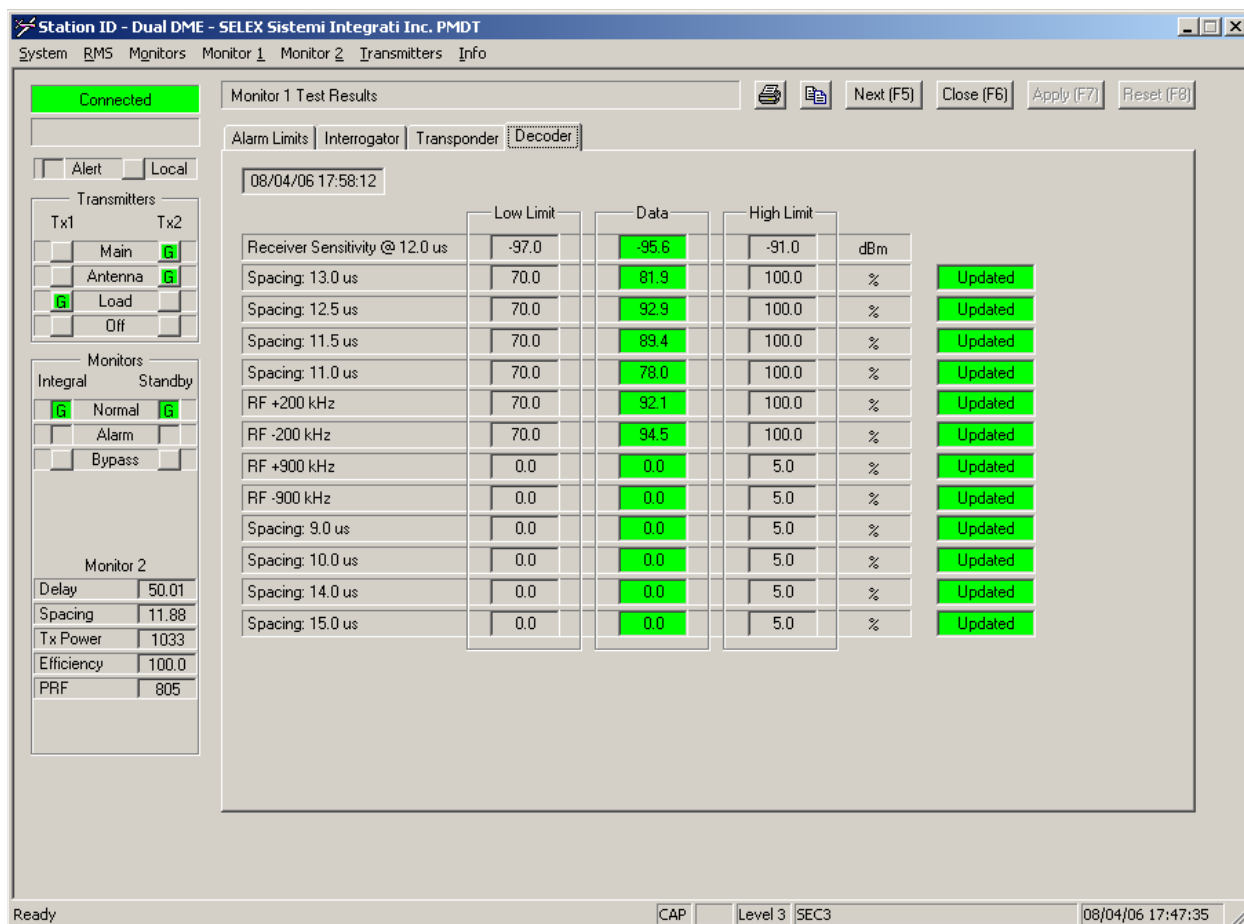


Figure 3-38 Decoder Test Results Screen (Dual Equipment shown)

For each test case, the monitor samples the signal and tests each parameter. Table 3-7 indicates the limits used by the Monitor to declare a normal condition. If the Monitor finds that the parameter exceeds the tolerance then the parameter is declared out of tolerance and the Monitor x >> Data >> Test Results shows the background in yellow on the parameter that is out of tolerance.

Table 3-9 Decoder Test Criteria

Receiver Decoder Parameters	Standards	Limits
Receiver Sensitivity @12 us	-94 dBm (ref)	± 3 dB
13 us(X), 37 us	100% decodes	$\geq 70\%$
12.5 us (X), 36.5 us (Y)	100% decodes	$\geq 70\%$
11.5 us (X), 35.5 us (Y)	100% decodes	$\geq 70\%$
11 us(X), 35 us	100% decodes	$\geq 70\%$
+200 kHz	100% decodes	$\geq 70\%$
-200 kHz	100% decodes	$\geq 70\%$
+900 kHz	0% decodes	$\leq 5\%$
-900 kHz	0% decodes	$\leq 5\%$
9.0 us (X), 33.0 (Y)	0% decodes	$\leq 5\%$
10.0 us (X), 34.0 (Y)	0% decodes	$\leq 5\%$
14.0 us (X), 38.0 (Y)	0% decodes	$\leq 5\%$
15.0 us (X), 39.0 (Y)	0% decodes	$\leq 5\%$

3.7.6.3 Monitor Fault History Screens

The PMDT contains several Monitor Fault History Screens that are used to view the last three faults recorded by the Integral and Standby Monitors, as well as the LCU. The screens and their contents are described below.

3.7.6.3.1 Integral Monitor Fault History Screen

Refer to [Figure 3-39](#). The Integral and Standby Monitor Fault History screens display the parameter measurements for the last three faults. The Pre-Alarm column contains the last good measurements made prior to the alarm condition which shutdown the system. The Alarm column contains a snapshot of the measurements at the time that the out-of-tolerance condition occurred.

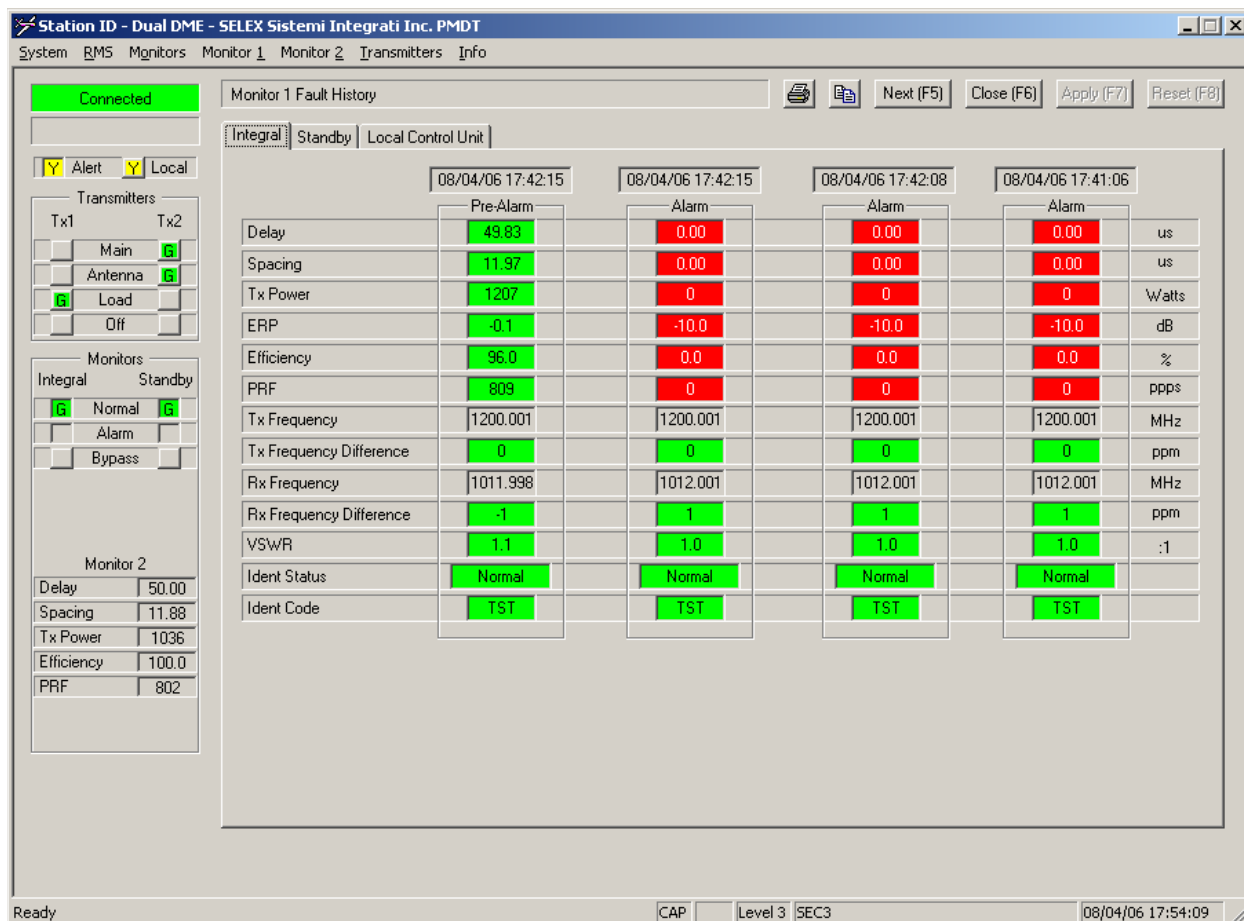


Figure 3-39 Integral & Standby Monitor Fault History Screens (Dual Equipment shown)

3.7.6.3.2 Standby Monitor Fault History Screen

Refer to Figure 3-40.

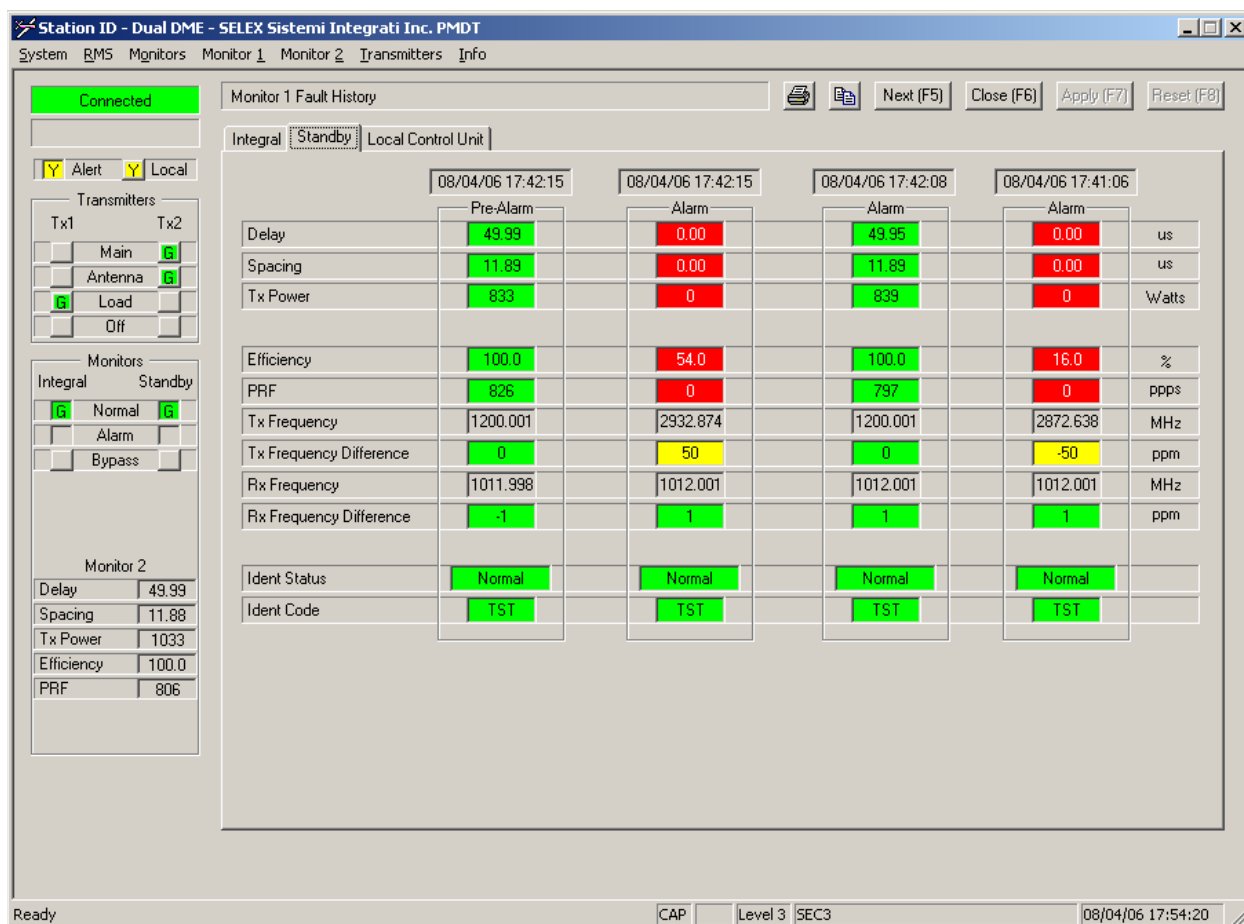


Figure 3-40 Standby Monitor Fault History Screen (Dual Equipment shown)

3.7.6.3.3 LCU Fault History Screen

Refer to Figure 3-41. This screen shows the LCU status and antenna configuration during the last three fault conditions.

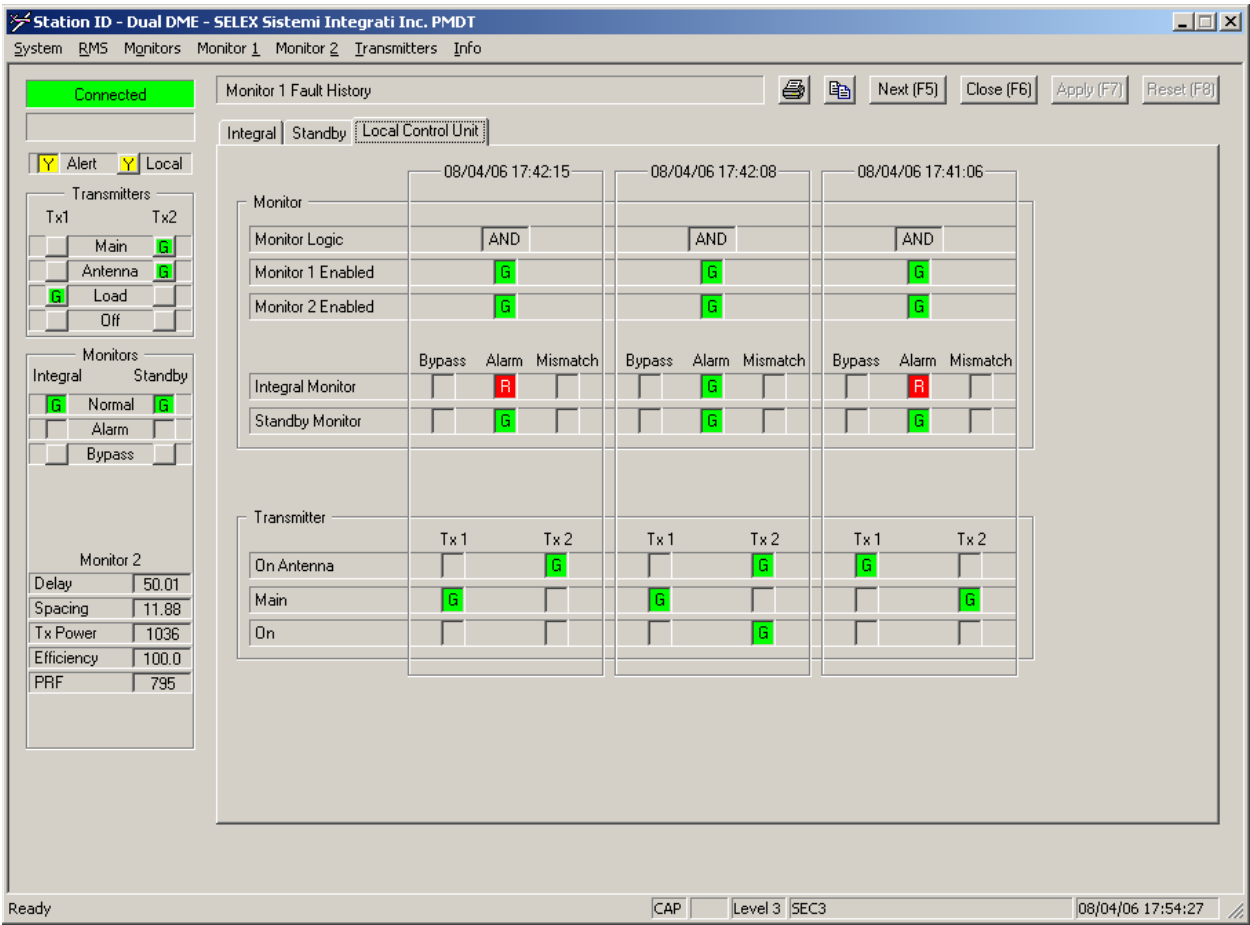


Figure 3-41 LCU Fault History Screen (Dual Equipment shown)

3.7.6.4 Monitor Offsets & Scale Factors Screens

The PMDT contains a Monitor Offsets and Scale Factor Screen that is used to calibrate each Monitor independently of the other. This screen and its contents are described below.

Any changes made to a configuration that should remain after a power cycle or Reset, should be backed up. To backup the current configuration in RAM to EEPROM, select RMS >> Configuration Backup. Press OK at the prompt.

To save the current configuration to hard drive or diskette select System >> Configuration Save. Select the destination and file name and press Save.

To restore a configuration from disk select System >> Configuration Load, enter the file name and press Open. The status of the restore will be displayed in the bottom left corner. When completed, backup the configuration to EEPROM by selecting RMS >> Configuration Backup. Press OK at the prompt.

3.7.6.4.1 Monitor Offsets & Scale Factors Screen

Refer to Figure 3-42. This screen shows the offsets and scale factors applied to the corresponding monitor (Integral or Standby) measurements.

The Copy button is used to quickly synchronize the Standby and Integral settings with those in the Integral Monitor column.

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected

Monitor 1 Offsets and Scale Factors

08/04/06 17:38:03

Copy -->

Parameter	Integral	Standby
Delay Offset	0.00 us	0.00 us
Spacing Offset	0.00 us	0.00 us
Tx Power Scale	142.0 %	142.0 %
Tx Power Offset	0 Watts	0 Watts
Efficiency Offset	0 %	0 %
PRF Offset	0 ppps	0 ppps
Tx Frequency Offset	0.0 ppm	0.00 ppm
Rx Frequency Offset	0.0 ppm	0.00 ppm
ERP Offset	0.0 dB	0.00 dB
Return Loss Offset	0.00 dB	0.00 dB

Transmitters

Tx1 Tx2

Main [G] [G]

Antenna [G] [G]

Load [G] [G]

Off [G] [G]

Monitors

Integral Standby

[G] Normal [G]

Alarm [G] [G]

Bypass [G] [G]

Monitor 2

Delay 50.00

Spacing 11.88

Tx Power 1033

Efficiency 100.0

PRF 1467

Ready CAP Level 3 SEC3 08/04/06 17:47:47

Figure 3-42 Monitor Offsets & Scale Factors Screen (Dual Equipment shown)

3.7.6.4.2 Monitor Offsets & Scale Factors Calibration Screen

Refer to Figure 3-43.

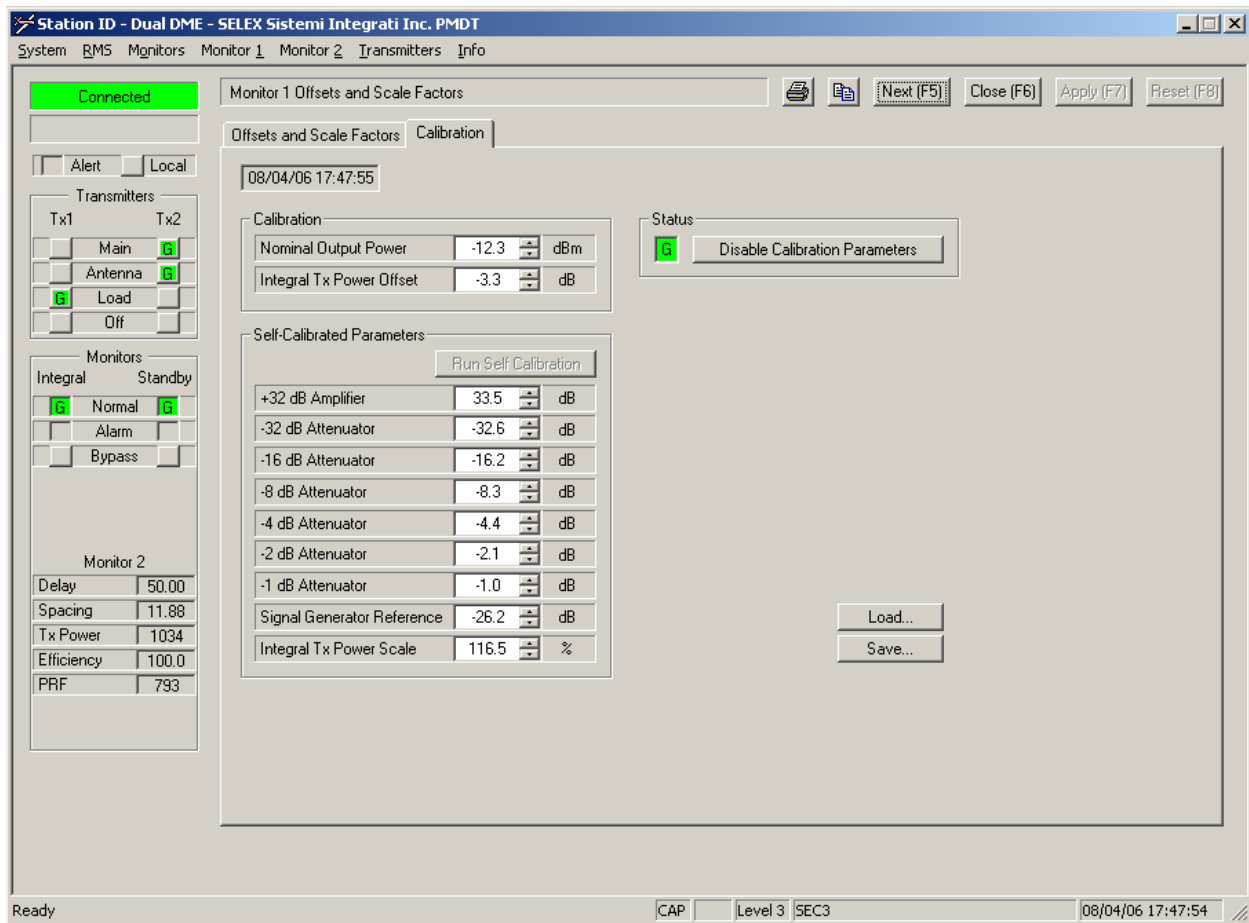


Figure 3-43 Monitor Offsets & Scale Factors Calibration Screen (Dual Equipment shown)

3.7.6.5 Trigger Selection Screen

Figure 3-44 shows the path to set the Monitor Trigger.

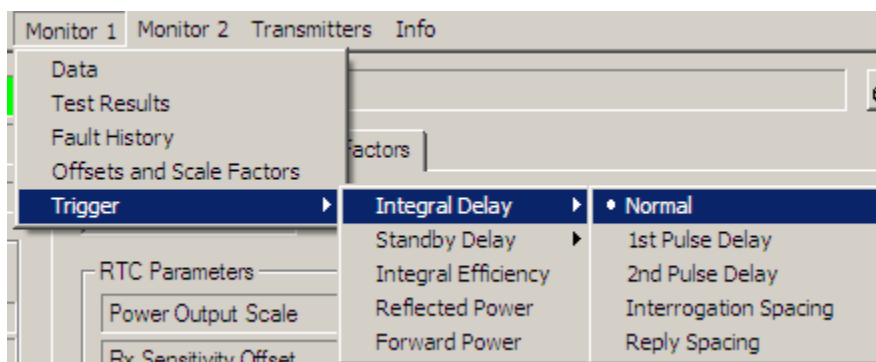


Figure 3-44 Monitor Offsets & Scale Factors Calibration Screen (Dual Equipment shown)

Table 3-10 Monitor Trigger Functions	
Trigger (Refer to Figure 3-5744)	
Integral/Standby Delay, Normal	Trigger on interrogations used to measure integral/standby delay.
Integral/Standby Delay, 1 st Pulse Delay	Trigger on interrogation used to measure delay. The trigger video will display the 50% gates of the first interrogation pulse and the first reply pulse.
Integral/Standby Delay, 2 nd Pulse Delay	Trigger on interrogations used to measure delay. The Trigger video will display the 50% gates of the second interrogation pulse and the second reply pulse.
Integral/Standby Delay, Interrogation Spacing	Trigger on interrogations used to measure delay. The Trigger video will display the 50% gates of the interrogation pulses.
Integral/Standby Delay, Reply Spacing	Trigger on interrogations used to measure delay. The Trigger video will display the 50% gates of the reply pulses.
Integral Efficiency	Trigger on interrogations used to measure integral AND standby efficiency. Only the integral reply pulse will be displayed on the monitor detected video. Standby replies may be seen on the standby PA detected video
Reflected Power	Display log detector video from the reflected power port. Reflected power is always measured on the second pulse of a pulse pair.
Forward Power	Display log detector video of the forward power port. Forward power is always measured on the second pulse of a pulse pair.

3.7.7 Transmitters Data Screens

There are three screens for the transmitter data as described below.

3.7.7.1 Transmitter Data Screen

Refer to [Figure 3-45](#). These screens display the Power Amplifier data and RTC Maintenance Alerts for the associated Transmitter. For Transmitter 2 Data, the status of LPA/HPA #2 is shown instead of LPA/HPA #1.

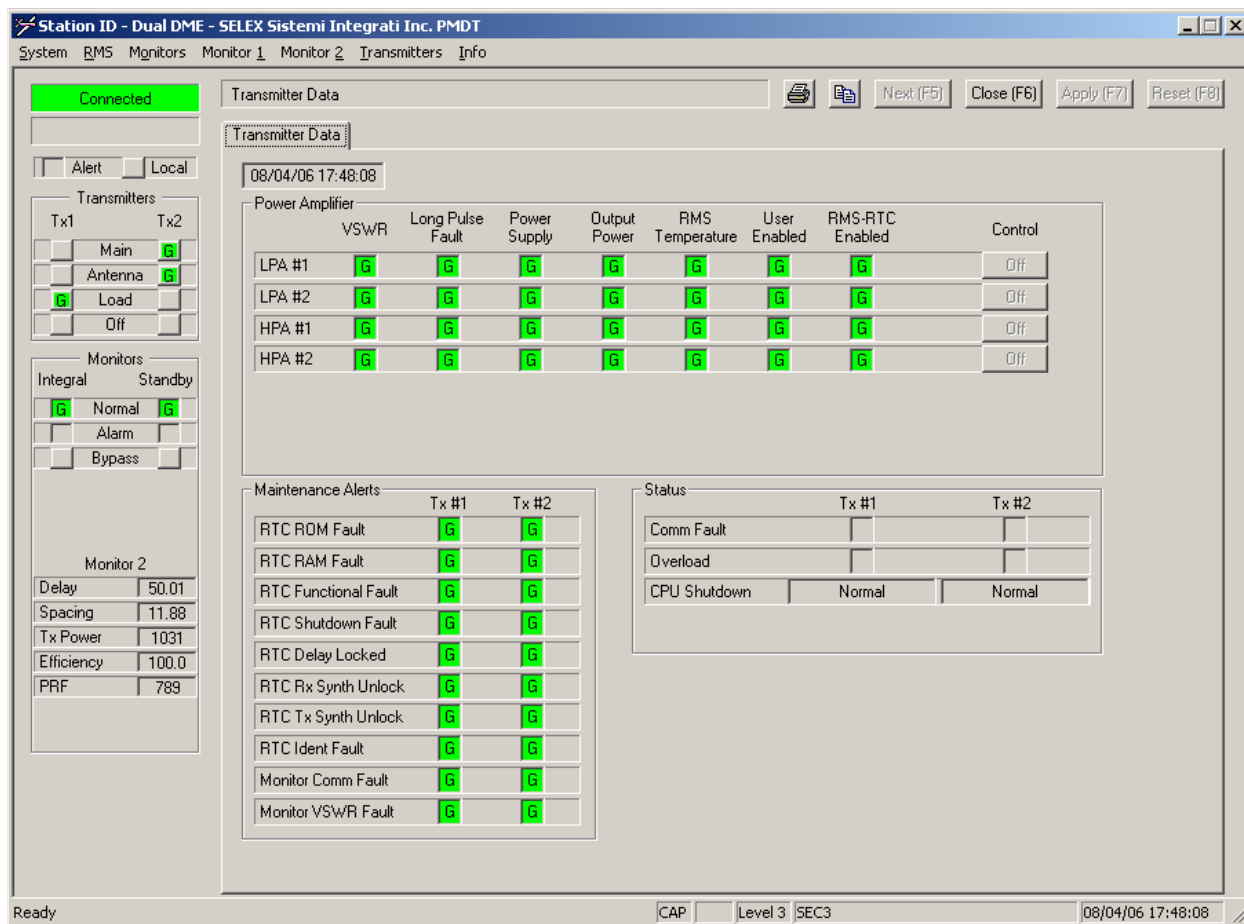


Figure 3-45 Transmitter Data Screen (Dual Equipment shown)

3.7.7.2 Transmitter Configuration Screens

There are two screens used for transmitter configuration, consisting of one to specify the nominal configuration, and one to configure the offsets and scale factors for each of the two transmitters in a Dual DME, independently of the other. These screens are detailed below.

If changes are made to a configuration that are to remain after a power cycle or Reset then the configuration should be backed up. To backup the current configuration in RAM to EEPROM select RMS >> Configuration Backup and press OK at the prompt.

To save the current configuration to a hard drive or diskette, select System>>Configuration Save and then select the destination and file name and press Save.

To restore a configuration from disk select System>>Configuration Load, enter the file name and press Open. The status of the restore will be displayed in the bottom left corner. When completed, backup the configuration to EEPROM by selecting RMS >> Configuration Backup. Press OK at the prompt.

3.7.7.2.1 Nominal Configuration Screen

Refer to [Figure 3-46](#). The Nominal Transmitter Configuration screen shown below is used to configure the operational parameters for the DME system, as well as manually enable/disable any of the installed PAs, and configure the Ident operation.

Table 3-11 Transmitter Nominal Configuration

Parameter	
Power Output	Sets the target for the RTC power control loop. If the RTC is unable to set the output power to at least this level minus two percent an "Output Power" alert is declared. If the DME is in a low power configuration then the low power amplifier is alerted, otherwise the high power amplifier is.
Minimum Squitter	Sets the target minimum PRF for the squitter control loop.
Maximum PRF	This sets the maximum transmit PRF rate for the DME. Automatic gain reduction starts at 90% of the Maximum PRF. The gain reduction control loop will target a PRF of 95% on the Maximum PRF at steady state. A hardware limit of 550 transmits per 100 ms (5500 per second) is not configurable.
LDES Window	Sets the length of the Long Distance Echo (LDES) suppression windows in microseconds. The LDES window starts from a success full decode with an interrogation level above the LDES threshold. Any subsequency interrogations during the window will not be decoded unless their interrogation level is 6 dB above the interrogation that triggered the window. If an interrogation pierces the 6 dB threshold, the window time is reset.
LDES Threshold	Set the minimum interrogation level to trigger long distance echo suppression. Interrogations below this level with not trigger LDES.
Dead Time	Set the minimum time after a successful interrogation that a subsequent interrogation can be decoded.
Reply delay Offset	Offsets the reply pulse pair in hundredths of microseconds.
Rx Sensitivity	Set the receiver sensitivity level.
Low Output Power Alert Limit	If in a high power DME configuration, sets the minimum level of the LPA output power before declaring an "Output Power" alert on the low power amplifier.
HPA #1/2 Disable	Disables a high power amplifier.
1 st /2 nd Pulse Timing	Sets if the delay control loop timing is measured from interrogation pulse one to reply pulse one or from interrogation pulse two to reply pulse two.
Squitter Enable	Turns off squitter pulses
SDES Enable	Turns on Short Distance Echo Suppression (SDES)
LDES Enable	Turns on Long Distance Echo Suppression (LDES)
Demand Mode Enable	When demand mode enable is set, the transmitter automatically shuts down when there

Model 1118A/1119A DME

	are no active aircraft interrogators. When an aircraft begins interrogating the transmitter is automatically restarted.
External Key Source Level	Keying is controlled from the external contacts
Key Input Level	If set to open, the DME keys when the external key contacts are open/not shorted. If set to closed, the DME keys when the external key contacts are shorted.
Window Keying Input	If set the DME initiates self keying on the logical rising edge on the external keying inputs.
Self-Key on loss	If set, the DME will switch to internal keying if the external keys has not been driven to a logical high in the last 60 seconds
Shutdown on loss	The DME automatically shuts down the transmitter when the external contacts have not moved in 60 seconds.
Restart on resume	The DME automatically restarts on resumption of external keying.
Internal Keying	The DME will self key.
Primary Ident Code	The IDENT code of the DME whether externally or internally keyed.
Secondary Ident Code	If the DME is configured to key with a primary and a secondary localizer, the alternate secondary localizer ident is set here.
Standby Ident	If the standby transmitter IDENT suffix is set here.

The screenshot displays the 'Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT' software interface. The main window is titled 'Transmitter Configuration' and is divided into several sections:

- Left Panel:** Contains status indicators (Connected, Alert, Local), Transmitters (Tx1, Tx2) with Main, Antenna, Load, and Off buttons, Monitors (Integral, Standby) with Normal, Alarm, and Bypass buttons, and Monitor 2 settings (Delay, Spacing, Tx Power, Efficiency, PRF).
- Top Bar:** Includes buttons for Next (F5), Close (F6), Apply (F7), and Reset (F8).
- RTC Parameters:** A table of real-time clock settings:

Power Output	41.0	%
Minimum Squitter	800	ppps
Maximum PRF	5400	ppps
LDES Window	150	us
LDES Threshold	-70	dBm
Dead Time	60	us
Reply Delay Offset	0.00	us
Rx Sensitivity	-90	dBm
- Power Amplifiers:**

Low Output Power Alert Limit	17.0	%
HPA #1 Enabled	☒	
HPA #2 Enabled	☒	
- Operation:**
 - Timing: ☒ 1st Pulse, ☐ 2nd Pulse
 - ☒ Squitter Enabled
 - ☐ SDES Enabled
 - ☐ LDES Enabled
 - ☐ Demand Mode Enabled
- Ident:**
 - Keyer Source: ☒ External Keying
 - Keyer Input Level: Active High/Open
 - ☐ Windowed Keying Input
 - ☐ Self-Key on Loss of Keyed Signal
 - ☐ Shutdown on Loss of Keyed Signal
 - ☐ Restart when Keyed Signal Resumes
 - ☒ Internal Keying
 - Primary Ident Code: TST
 - ☐ Secondary Ident Code: TST
 - Standby Ident: Same as Main Ident

The bottom status bar shows 'Ready', 'CAP', 'Level 3', 'SEC3', and the timestamp '08/04/06 17:48:15'.

Figure 3-46 Nominal Configuration Screen (Dual Equipment shown)

3.7.7.2.2 Transmitter Offsets & Scale Factors

Refer to [Figure 3-47](#). This screen is used to adjust the RTC parameters of each of the two transmitters independently of the other.

Table 3-12 Transmitter Offsets and Scale Factors

Parameter	
Power Output Scale	Scales the peak power target value to this RTC
RX Sensitivity Offset	Offset the receiver sensitivity to this RTC

Station ID - Dual DME - SELEX Sistemi Integrati Inc. PMDT

System RMS Monitors Monitor 1 Monitor 2 Transmitters Info

Connected

Transmitter Configuration

Nominal Offsets and Scale Factors

08/04/06 17:38:33

RTC Parameters

	Tx 1	Tx 2	
Power Output Scale	100.0	105.0	%
Rx Sensitivity Offset	0	0	dB

Transmitters

Tx1 Tx2

Main ☒ Antenna ☒ Load ☒ Off ☐

Monitors

Integral Standby

☒ Normal ☒ Alarm ☐ Bypass ☐

Monitor 2

Delay 50.00

Spacing 11.89

Tx Power 1033

Efficiency 100.0

PRF 804

Ready CAP Level 3 SEC3 08/04/06 17:48:25

Figure 3-47 Transmitter Offsets & Scale Factors Screen (Dual Equipment shown)

3.7.7.3 Transmitter Commands

The Transmitter Commands menu, shown in [Figure 3-48](#) and [Figure 3-49](#), provides direct control of transferring between the Main and Standby transmitters, as well as selecting either Transmitter 1 or Transmitter 2 specific commands, or Ident commands.

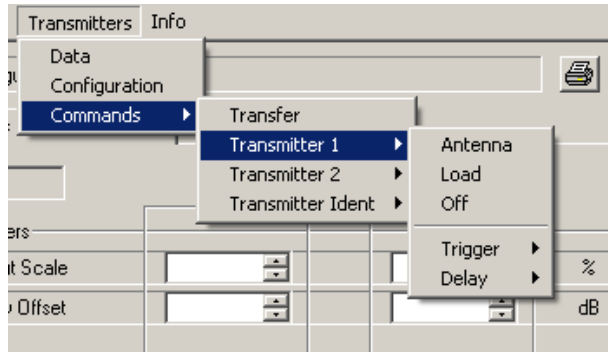


Figure 3-48 TX Commands Menu

The Transmitter 1 and 2 command menus provide the following commands for the corresponding transmitter:

- Switch to Antenna
- Switch to Load
- Turn Off
- Turn all Power Amplifiers On - See NOTE.
- Turn all Power Amplifiers Off
- Set Delay Unlock See NOTE.
- Set Delay Lock

NOTE

For the "PA Enable" command, the equipment must have either the Antenna or the Dummy Load selected.

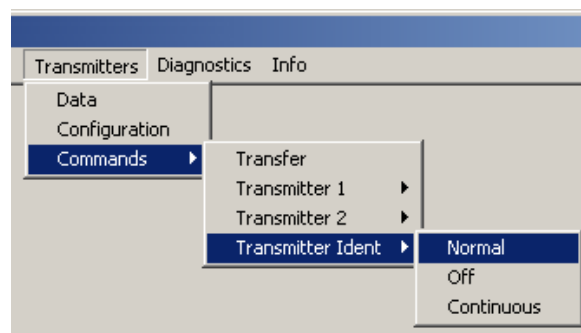


Figure 3-49 Ident Commands Menu

NOTE

Normal operation is for the delay to be Unlocked. When delay is unlocked the RTC automatic delay correction is in effect. When the delay is locked the current delay value is held and automatic correction is disabled.

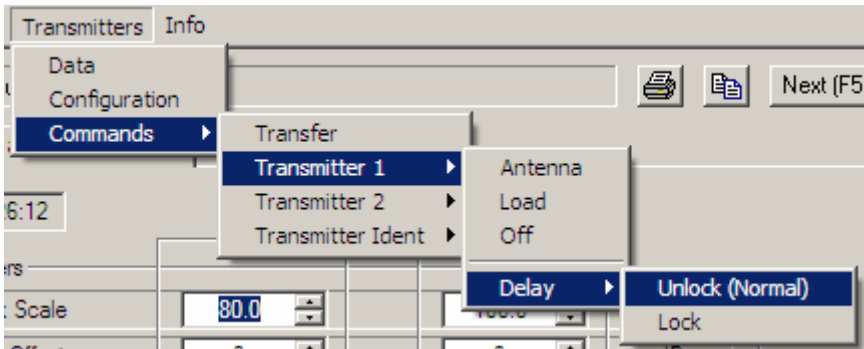
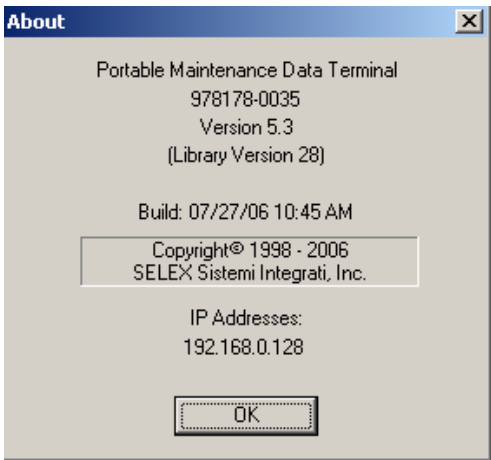


Figure 3-50 Delay Control Menu



3.8 RMM

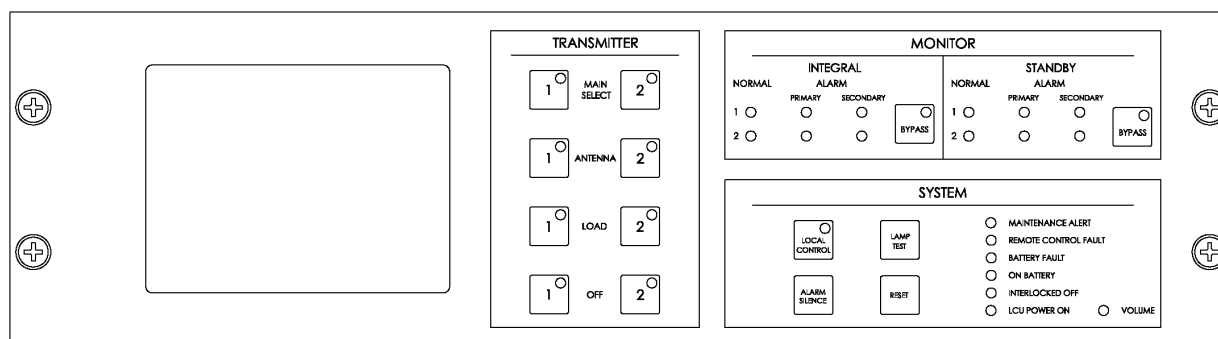
The RMM uses the same hardware and software as the PMDT but interconnects to the equipment via a modem and a telephone circuit. The software screens and operator selection of this usage of the PMDT are described above in the PMDT paragraphs. Note that while connected remotely, the user is only provided read-only access - parameters cannot be changed, unless the system's backplane "SCON5" DIP switch is set to the "Remote Control Enabled" position. This will allow the RMM user to press the "Local Mode" button on the PMDT sidebar, allowing parameter changes to be made remotely. Note that while the system is in Local Mode, a Maintenance Alert is generated. Also note that the system should not be left in Local Mode. Upon disconnecting from the system while it is in Local Mode, the user will be prompted to correct that situation.

3.9 Controls and Indicators

The locations, descriptions and functions of the 1118A/1119A DME Controls and indicators are described in [Figure 3-51](#) through [Figure 3-64](#) and [Table 3-13](#) thru [Table 3-20](#).

3.10 Local Control Unit (LCU)

The Local Control Unit mounts at the top of the DME rack stack. [Figure 3-51](#) shows the switches and indicators on the panel. The functions of each switch and indicator are described in [Table 3-13](#).



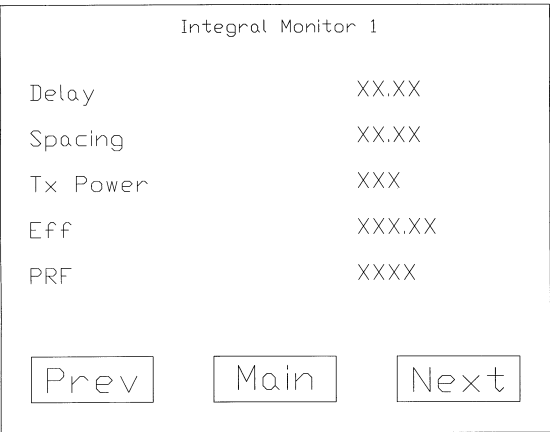
1118A-013

Figure 3-51 Local Control Unit (LCU)

3.10.1 LCU Display Messages

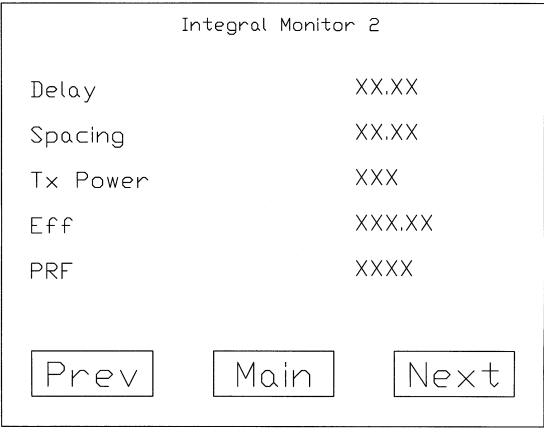
The LCU has a touch screen to display monitored information. Navigation between the screens is achieved by pressing the Prev (Previous) and Next buttons on the display.

3.10.1.1 Integral Monitor



HPDME-004

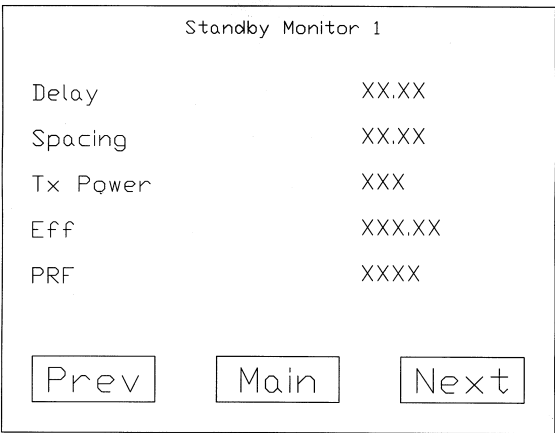
Figure 3-52 LCU Integral Monitor 1 Display



HPDME-005

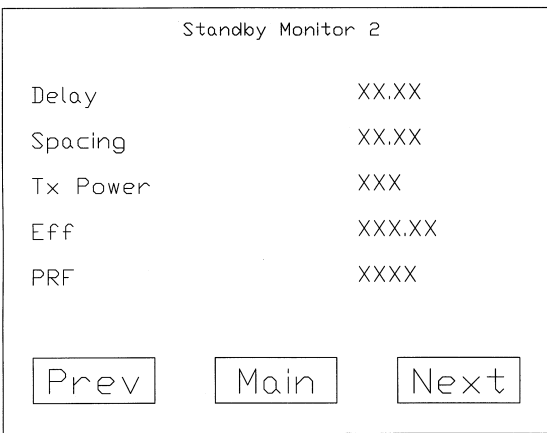
Figure 3-53 LCU Integral Monitor 2 Display

3.10.1.2 Standby Monitor



HPDME-006

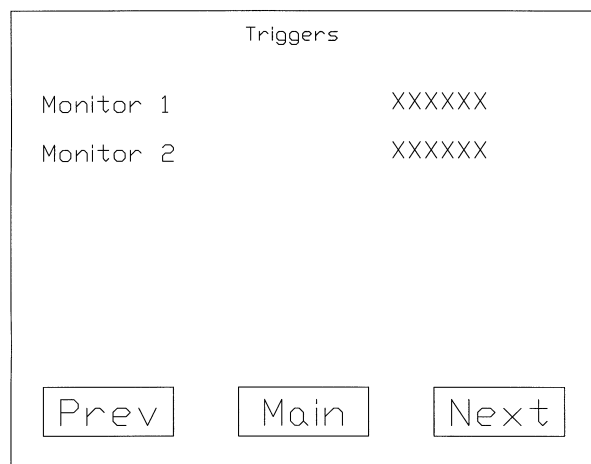
Figure 3-54 LCU Standby Monitor 1 Display
(Dual Systems Only)



HPDME-007

Figure 3-55 LCU Standby Monitor 2 Display
(Dual Systems Only)

3.10.1.3 Triggers

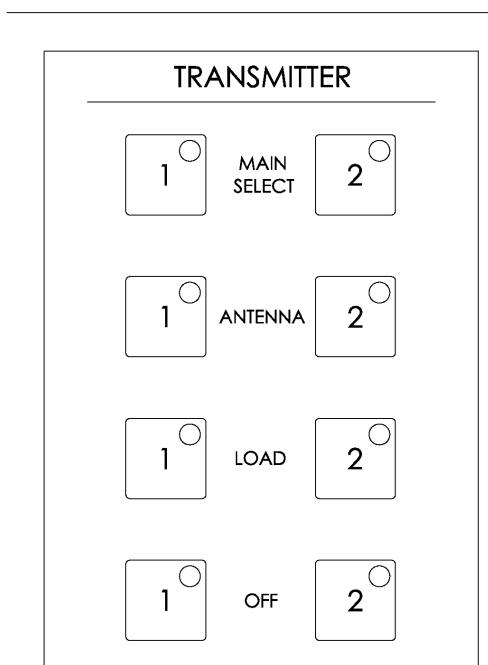


HPDME-008

Figure 3-56 LCU Triggers Display

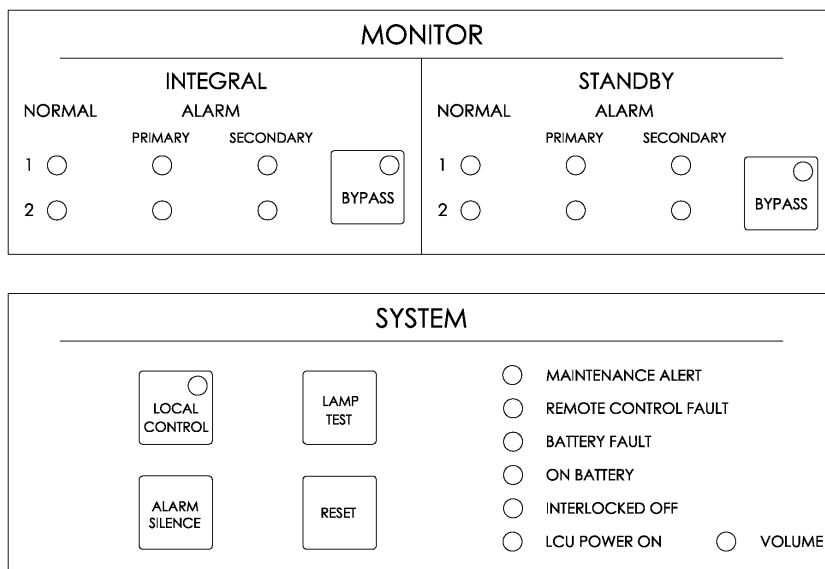
Table 3-13 Equipment Control Panel Functions

Table 3-13 Equipment Control Panel Functions	
TRANSMITTER (Refer to Figure 3-57)	
Main Select 1	When in Local Mode pressing Main Select 1 switch sets transmitter 1 as the main transmitter and places TX1 on the antenna and in the ON mode. If configured for Hot Standby, the TX2 is placed on load and in the ON mode.
Main Select 2	When in Local Mode pressing Main Select 2 switch sets transmitter 2 as the main transmitter and places TX2 on the antenna and in the ON mode. If configured for Hot Standby, the TX1 is placed on load and in the ON mode.
Antenna 1 and Indicator	When in Local Mode pressing Antenna 1 switch turns transmitter 1 ON and into the antenna. If configured for Hot Standby, the TX2 is placed on load and in the ON mode. The indicator in the switch illuminates to identify the transmitter connected to the antenna.
Antenna 2 and Indicator	When in Local Mode pressing Antenna 2 switch turns transmitter 2 ON and into the antenna. If configured for Hot Standby, the TX1 is placed on load and in the ON mode. The indicator in the switch illuminates to identify the transmitter connected to the antenna.
Load 1 and Indicator	When in Local Mode pressing Load 1 switch turns transmitter 1 ON and into the load. The indicator in the switch illuminates to identify the transmitter connected to the load.
Load 2 and Indicator	When in Local Mode pressing Load 2 switch turns transmitter 2 ON and into the load. The indicator in the switch illuminates to identify the transmitter connected to the load.
Off 1 and Indicator	When in Local Mode pressing Off 1 switch places transmitter 1 in the OFF mode without changing the relays. The indicator in the switch illuminates when the transmitter is OFF.
Off 2 and Indicator	When in Local Mode pressing Off 2 switch places transmitter 2 in the OFF mode without changing the relays. The indicator in the switch illuminates when the transmitter is OFF.



1118A-014

Figure 3-57 LCU Transmitter Controls and Indicators



1118A-015

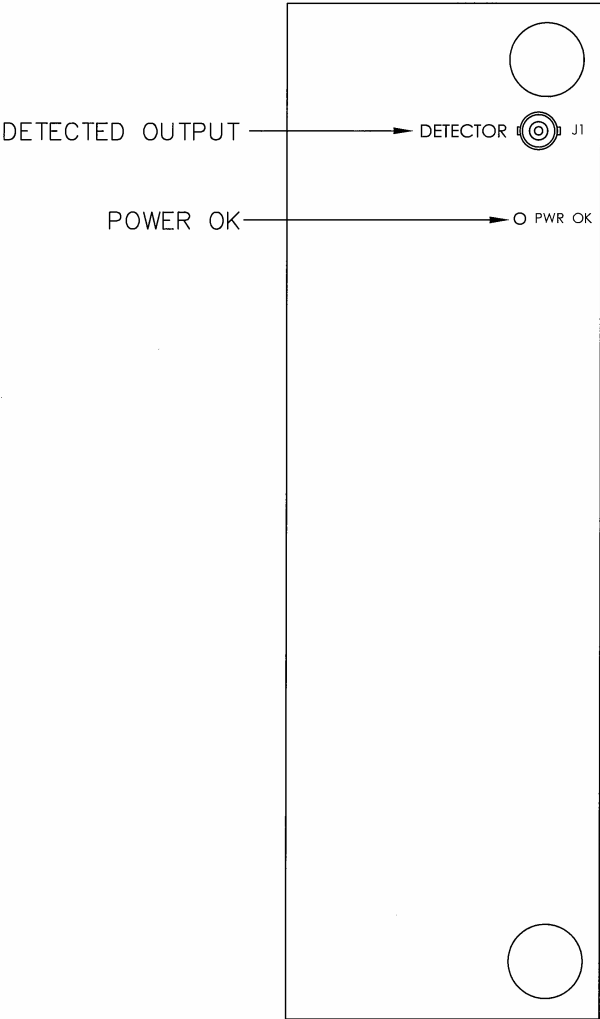
Figure 3-58 LCU Monitor / System Controls and Indicators

Table 3-14 Equipment Control Panel Functions

Table 3-14 Equipment Control Panel Functions	
MONITOR (Refer to Figure 3-58)	
Integral Normal 1 Indicators	Illuminates to indicate the normal condition of monitor 1 integral channel.
Integral Alarm 1 Indicators	Illuminates to indicate the alarm condition of monitor 1 integral channel after the programmed timeout has expired
Integral Normal 2 Indicators	Illuminates to indicate the normal condition of monitor 2 integral channel.
Integral Alarm 2 Indicators	Illuminates to indicate the alarm condition of monitor 2 integral channel after the programmed timeout has expired
Integral Bypass Switch and Indicator	When in Local Mode pressing the switch toggles the bypass condition of both integral monitors. The indicator illuminates when bypass is active.
Standby Normal1 Indicators	Illuminates to indicate the normal condition of monitor 1 standby transmitter monitor channel.
Standby Alarm 1 Indicators	Illuminates to indicate the alarm condition of monitor 1 standby transmitter channel after the programmed timeout has expired
Standby Normal 2 Indicators	Illuminates to indicate the normal condition of monitor 2 Standby transmitter channel.
Standby Alarm 2 Indicators	Illuminates to indicate the alarm condition of monitor 2 Standby transmitter channel after the programmed timeout has expired
Standby Bypass Switch and Indicator	When in Local Mode pressing the switch toggles the bypass condition of both integral monitors for the standby transmitter. The indicator illuminates when bypass is active.

Table 3-15 Equipment Control Panel Functions	
SYSTEM (Refer to Figure 3-58)	
Local Control, Switch and Indicator	Pressing the switch toggles Local Control Mode. The indicator illuminates when Local Control Mode is enabled. While in Local Control Mode, the BYPASS, MAIN SELECT, ANTENNA, LOAD and OFF switches are enabled. When in the remote mode these switches are disabled. Configuration changes via the PMDT are enabled only while in Local Control Mode. RCSU control of the DME is disabled while in the Local Control Mode.
Alarm Silence Switch	Pressing this switch turns off the alarm tone until a new alarm condition is detected.
Lamp Test Switch	Pressing this switch causes all indicators on the panel to illuminate.
Reset Switch	Pressing this switch resets the system to the power on condition. The LCU, RMS and all Monitors are reset.
Maintenance Alert Indicator	Illuminates to indicate the presence of a maintenance alert condition.
Remote Control Fault Indicator	Illuminates to indicate a failure condition in the communications link to the RCSU.
Battery Fault Indicator	Illuminates to indicate the presence of a short, open or Battery switch in the open position.
On Battery Indicator	Illuminates to indicate that the DME is operating on battery power.
Interlocked Off Indicator	Illuminates to indicate the DME has been turned OFF by the communications link to the RCSU. Attempts to turn ON the DME will be ignored.
Volume	This is a potentiometer control to adjust the level of the aural alarm indicator.

Table 3-16 Equipment Controls & Indicators	
High Power Amplifier (Refer to Figure 3-59)	
Detected Output	This is the detected video from the RF output. It allows the technician to observe output pulse timing, shape, and relative amplitude.
Power OK LED	This LED when lit (GREEN) indicates that the amplifier DC voltages are within tolerance.



2160-021

Figure 3-59 High Power Amplifier

Table 3-17 Equipment Controls & Indicators	
Low Power Amplifier (Refer to Figure 3-60)	
Detected Output	This is the detected video from the RF output. It allows the technician to observe output pulse timing, shape, and relative amplitude.
Transmitter Local Oscillator	This is the RF sample from the synthesizer for use by an external frequency counter to verify transmit frequency.
Power OK LED	This LED when lit (GREEN) indicates that the amplifier DC voltages are within tolerance.

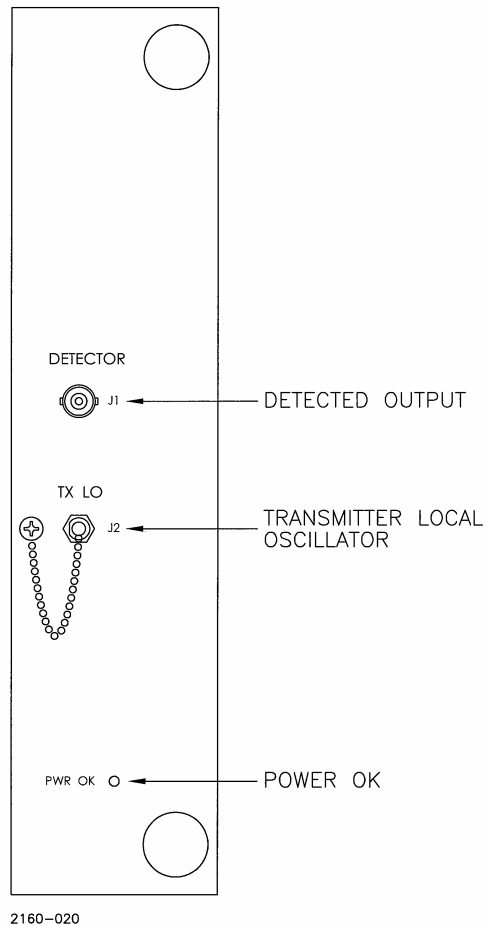


Figure 3-60 Low Power Amplifier

Table 3-18 Equipment Controls & Indicators

Table 3-18 Equipment Controls & Indicators	
Receiver CCA (Refer to Figure 3-61)	
Overload	This LED indicates that the PRF has increased to a level such that the minimum sensitivity level has been reduced.
Low Video	This is the low level detected video output.
High Video	This is the high level detected video output.
Receiver Local Oscillator	This is the output of the receiver local oscillator.
Transmitter Trigger	This output is used for scope trigger to view low and high video outputs.
Processor OK LED	This LED when lit (GREEN) indicates that the Receiver processor is operating normally.
Power OK LED	This LED when lit (GREEN) indicates that the module DC voltages are within tolerance.
Monitor CCA (Refer to Figure 3-62)	
Integral Primary Alarm LED	This LED when lit (RED) indicates that a primary parameter exceeds alarm limits for the transmitter on the antenna.
Integral Secondary Alarm LED	This LED when lit (RED) indicates that a secondary parameter exceeds alarm limits for the transmitter on the antenna.
Integral Pre-Alarm LED	This LED when lit (YELLOW) indicates that a primary parameter exceeds pre alarm limits for the transmitter on the antenna.
Standby Primary Alarm LED	This LED when lit (YELLOW) indicates that a primary parameter exceeds alarm limits for the standby transmitter.
Standby Secondary Alarm LED	This LED when lit (YELLOW) indicates that a secondary parameter exceeds alarm limits for the standby transmitter.
Standby Pre-Alarm LED	This LED when lit (YELLOW) indicates that a primary parameter exceeds pre alarm limits for the standby transmitter.
Detected Video	This is the detected video from the interrogator RF signal.

Table 3-18 Equipment Controls & Indicators	
Interrogator Local Oscillator	This is the RF sample from the synthesizer for use by an external frequency counter to verify transmit frequency.
Interrogator Trigger	This is the scope trigger for viewing the Detected Video.
Processor OK LED	This LED when lit (GREEN) indicates that the Monitor processor is operating normally.
Power OK LED	This LED when lit (GREEN) indicates that the module DC voltages are within tolerance.

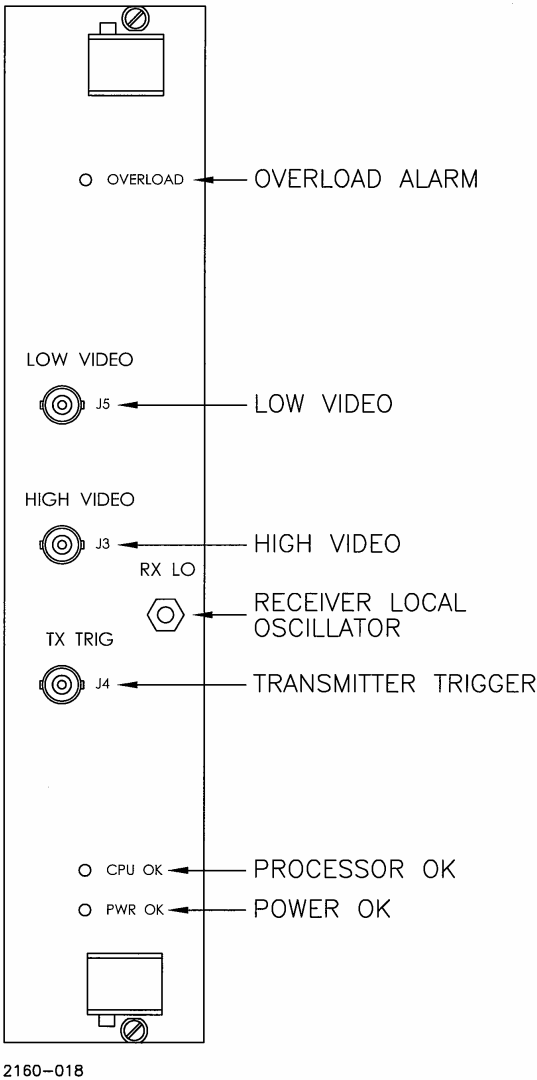


Figure 3-61 Receiver/Transmitter Controller (RTC) CCA

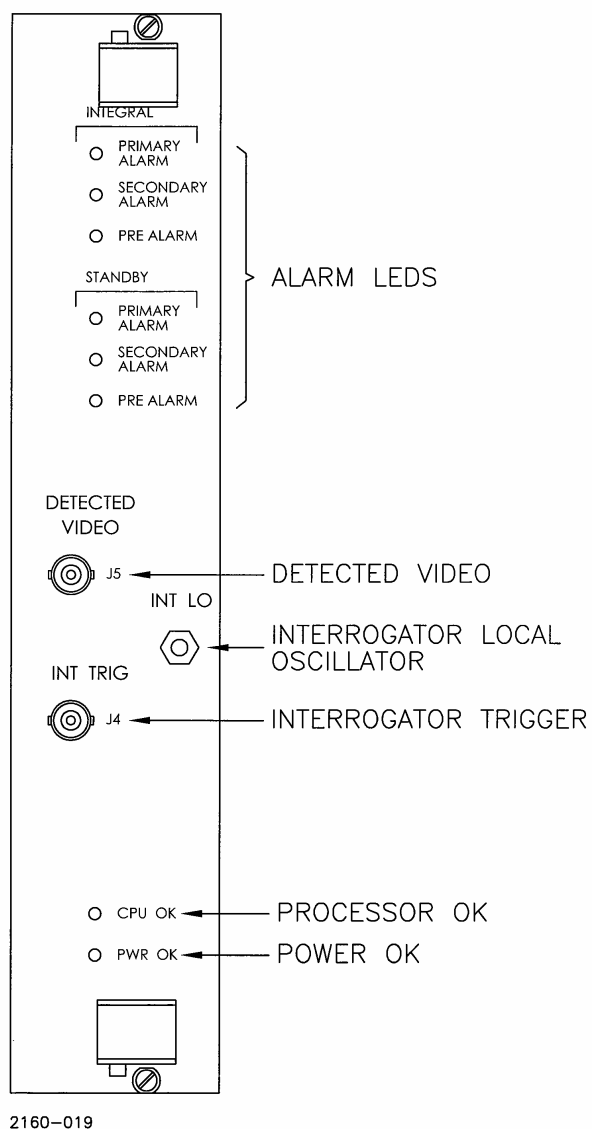


Figure 3-62 Monitor CCA

Table 3-19 Equipment Controls & Indicators	
Remote Monitoring System (RMS) CCA (Refer to Figure 3-63)	
Auxiliary USB	This port is reserved for future expansion.
PMDT USB	This port interfaces with an portable PC computer and associated control and monitoring software (Portable Maintenance Data Terminal).
RMS OK LED	This LED when lit (GREEN) indicates that the RMS is operating normally.

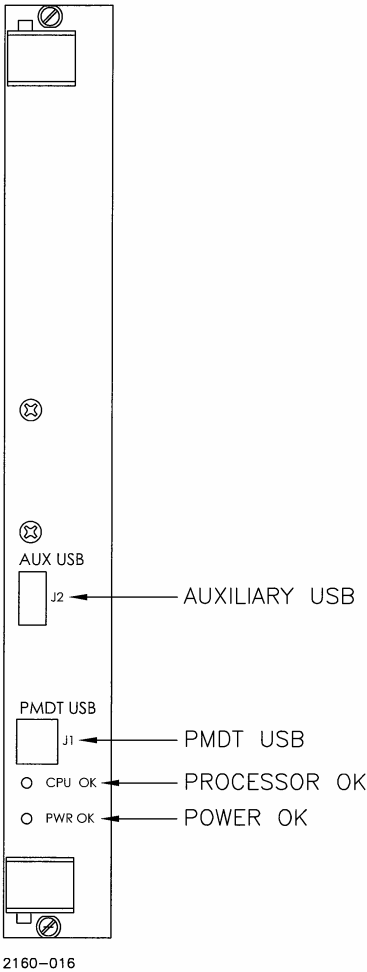


Figure 3-63 Remote Monitoring System (RMS) CCA

Table 3-20 Equipment Controls & Indicators	
Facilities CCA (Refer to Figure 3-64)	
Speaker	This output device allows the technician to hear the audio output from the device selected in the RMS >> Commands >> Select Audio. The possible choices are: DME 1 Ident, DME 2 Ident
Power OK LED	This LED when lit (GREEN) indicates that the DC voltages are within tolerance.

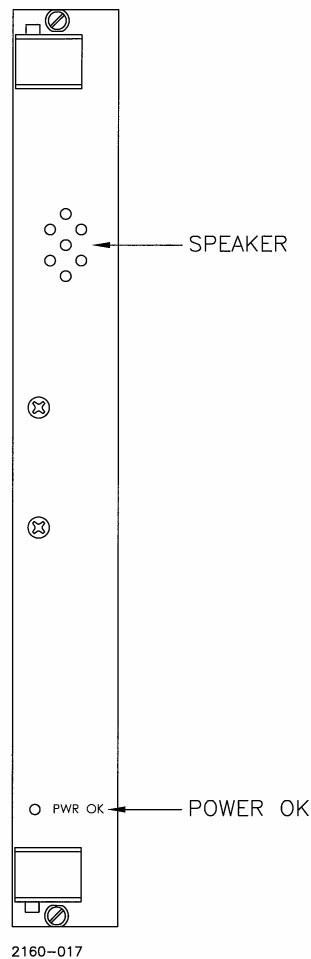


Figure 3-64 Facilities CCA

4. STANDARDS AND TOLERANCES

4.1 Introduction

Standards and tolerances for the 1118A/1119A DME are listed in [Table 4-1](#).

4.2 Standards and Tolerances

[Table 4-1](#) provides standards and tolerances for the performance checks and maintenance tasks scheduled in [section 5](#) and performed in [section 6](#). It follows the same format and references of [Table 1-1](#). In a few cases the tolerances in [Table 4-1](#) are not as tight as the equipment specification. This allows use of standard test equipment in the field that can be more inaccurate than the DME equipment itself.

Table 4-1 System Standards and Tolerances					
System Parameter	Reference	Lower Limit	Standard	Upper Limit	Tolerance
2.1 Transmitter					
2.1.3 Frequency Stability		-9.5KHz	Station Frequency	+9.5KHz	±0.001 %
2.1.4 Output Power					
Model 1118A DME (Terminal Facilities)		50 Watts	100 Watts	N/A	
Model 1119A DME (En Route Facilities)		500 Watts	1000 Watts	N/A	
2.1.8 Pulse Pair Spacing					
X-Channel:		11.9 µsec	12 µsec	12.1 µsec	± 0.1 µsec
Y-Channel:		29.9 µsec	30 µsec	30.1 µsec	± 0.1 µsec
2.1.9 Pulse Shape					
a) Width @ Half Amplitude		3.0 µsec	3.5 µsec	4.0 µsec	± 0.5 µsec
b) Rise Time (10 to 90% points)					
Initial:		N/A	2.5 µsec	N/A	
Operating:		1.5 µsec	2.25 µsec	3.0 µsec	± 0.75 µsec
c) Decay Time (10 to 90% points)					
Initial:		N/A	2.5 µsec	N/A	
Operating:		1.5 µsec	2.25 µsec	3.0 µsec	± 0.75 µsec

Table 4-1 System Standards and Tolerances					
System Parameter	Reference	Lower Limit	Standard	Upper Limit	Tolerance
2.1.10 Pulse Count			700 PPS to 5400 PPS		
2.1.12 System Time Delay					
X-Channel:		49.85 μ sec	50 μ sec	50.05 μ sec	-15 / +5 μ sec
Y-Channel:		55.75 μ sec	56 μ sec	56.25 μ sec	$\pm$ 0.25 μ sec
2.1.14 Identification					
Rate		1340 pps	1350 pps	1360 pps	$\pm$ 10 pps
Equalizing Pulse Pair Spacing		90 μ sec	100 μ sec	110 μ sec	$\pm$ 10 μ sec
Spacing Between Equalizing Pulse Pairs		735.3 μ sec	740.7 μ sec	746.1 μ sec	$\pm$ 5.4 μ sec
2.1.15 Squitter Rate		750 pps	800 pps	850 pps	$\pm$ 50 pps
2.1.20 Reply Efficiency			70%		
2.2 Receiver					
2.2.3 Frequency Stability		-9.5KHz	Station Frequency	+9.5KHz	$\pm$ 0.001 %
2.2.5 Receiver Sensitivity @ 70% replies to interrogations		N/A	$\leq$ -94 dBm	N/A	
2.2.8 Adjacent Channel Rejection		N/A	80 dB (minimum)	N/A	
2.2.11 Receiver Decodes					
X-Channel:					
Decode:		11.9 μ sec	12 μ sec	12.1 μ sec	$\pm$ 1 μ sec
Reject:		11.8 μ sec	12 μ sec	12.2 μ sec	$\pm$ 2 μ sec
Y-Channel:					
Decode:		35.9 μ sec	36 μ sec	36.1 μ sec	$\pm$ 1 μ sec
Reject:		35.8 μ sec	36 μ sec	36.2 μ sec	$\pm$ 2 μ sec

Table 4-1 System Standards and Tolerances					
System Parameter	Reference	Lower Limit	Standard	Upper Limit	Tolerance
2.2.12 Decoder Rejection			77 dB (minimum) (-35 dBW/m ² above sensitivity level) for an interrogation code error of ± 2 μ sec.		
2.2.14 Echo Suppression					
Long Range			On/Off Selectable (PMDT Selection) Threshold: -70 dBm nominal (PMDT adjustable from -10 to -80 dBm) Anti Echo Duration: 150 μ sec nominal (PMDT adjustable from 50 to 350 μ sec)		
Short Range			On/Off Selectable (PMDT selection)		
2.3 Monitor					
2.3.1 Interrogation Signal Generator					
a) Frequency		-9.5KHz	f0 (center frequency) f0 + 200 KHz $\pm 0.001\%$ f0 - 200 KHz $\pm 0.001\%$ f0 + 900 KHz $\pm 0.001\%$ f0 - 900 KHz $\pm 0.001\%$	+9.5KHz	$\pm 0.001\%$
b) Pulse Coding					
X-Channel:		11.9 μ sec	12 μ sec	12.1 μ sec	± 0.1 μ sec
Y-Channel:		35.9 μ sec	36 μ sec	36.1 μ sec	± 0.1 μ sec
c) Pulse Spacing (automated tests)			X-Channel: Y-Channel: 12 ± 0 μ sec 36 ± 0 μ sec 12 $\pm .5$ μ sec 36 $\pm .5$ μ sec 12 ± 1 μ sec 36 ± 1 μ sec 12 ± 2 μ sec 36 ± 2 μ sec 12 ± 3 μ sec 36 ± 3 μ sec		
d) Pulse Width		3.0 μ sec	3.5 μ sec	4.0 μ sec	± 0.5 μ sec
e) Pulse Rise Time		2.0 μ sec	2.5 μ sec	3.0 μ sec	± 0.5 μ sec
f) Pulse Decay Time		2.0 μ sec	2.5 μ sec	3.0 μ sec	± 0.5 μ sec

Table 4-1 System Standards and Tolerances					
System Parameter	Reference	Lower Limit	Standard	Upper Limit	Tolerance
g) PRF			25 to 10,000 PPS (adjustable)		
h) Attenuation Range for Interrogation Signals			-10 to -100 dBm (adjustable)		
i) Monitor Triggering Rate			100 pps (nominal, dual equipment) 50 pps each Monitor		
2.3.2 System Alarms					
a) Pulse Spacing					
X-Channel:					
Low Alarm:		11.6 μ sec	adjustable	N/A	$\pm 0.1 \mu$ sec
High Alarm:		N/A	adjustable	12.4 μ sec	$\pm 0.1 \mu$ sec
Y-Channel:					
Low Alarm:		29.6 μ sec	adjustable	N/A	$\pm 0.1 \mu$ sec
High Alarm:		N/A	adjustable	30.4 μ sec	$\pm 0.1 \mu$ sec
b) Reply Delay					
X-Channel:					
Low Alarm:		49.4 μ sec	adjustable	N/A	$\pm 0.1 \mu$ sec
High Alarm:		N/A	adjustable	50.6 μ sec	$\pm 0.1 \mu$ sec
Y-Channel:					
Low Alarm:		55.4 μ sec	adjustable	N/A	$\pm 0.1 \mu$ sec
High Alarm:		N/A	adjustable	56.6 μ sec	$\pm 0.1 \mu$ sec
c) Power Reduction			-3 dB (adjustable-1 to -5 dB)		

Table 4-1 System Standards and Tolerances					
System Parameter	Reference	Lower Limit	Standard	Upper Limit	Tolerance
d) Efficiency/Sensitivity			70% replies @ 6dB from minimum sensitivity level (Adjustable from 60% to 80% in 0.1% steps) (detects a fall of 6dB or more in minimum receiver sensitivity)		
e) PRF			< 700 pps and > 6000 pps (upper limit adjustable)		
f) Identification			Absence: > 65 sec $\pm$ 10% Continuous: >5 sec $\pm$ 10% Verification of Coding		
h) Transmitter Frequency			$\leq \pm 20$ ppm		
i) Receiver Frequency			$\leq \pm 20$ ppm		
2.3.4 Shutdown Delay Time			7 $\pm$ 1 seconds nominal (adjustable from 5 to 10 sec)		

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5. PERIODIC MAINTENANCE

5.1 Introduction

The schedule for performing the Performance Checks in Section 6 provided in this section. Section 5 indicates when these procedures are to be performed and the sequential order in which these checks are to be made. The tolerances for measurements are referenced to the Standards and Tolerances Table in Section 4.

The DME is capable of continuous unattended operation. Maintainability is based on a schedule consisting of quarterly, semi-annual and annual performance checks. The performance checks are described in the following paragraphs.

5.2 Performance Check Schedule

Table 5-1 is a summary of the performance checks and their recommended intervals. It follows the same format and references of Table 1-1. Supervising personnel are responsible for scheduling these checks based on the recommended intervals. Information contained in Table 5-1 is limited to equipment specifically covered in this manual.

Table 5-1 Performance Checks

Performance Check	Reference Paragraph	
	Standard & Tolerance	Maintenance Procedure
a. Quarterly		
At the DME site, the Remote RMM site, or other remote location perform the following checks:		
Remote DME Certification Check	Table 4-1 2.3.2 System Alarms	6.2.14
b. Annually		
At the DME site perform the following checks:		
Transmitter Frequency Performance Check	Table 4-1 2.1.3 Frequency Stability	6.2.2
Receiver Frequency Performance Check	Table 4-1 2.2.3 Frequency Stability	6.2.3
Interrogator Frequency Performance Check	Table 4-1 2.3.1 a) Frequency	6.2.4
Transmitter Pulse Performance Check	Table 4-1 2.1.9 Pulse Shape	6.2.5
Transmitter Power Output Performance Check	Table 4-1 2.1.4 Output Power	6.2.6
Receiver and Decoder Performance Check	Table 4-1 2.2.11 Receiver Decodes	6.2.7
Transponder Reply Delay Performance Check	Table 4-1 2.1.12 System Time Delay	6.2.8
Identification Frequency Performance Check	Table 4-1 2.1.14 Identification	6.2.9
Monitor Interrogator Performance Check	Table 4-1 2.3.1 Interrogation Signal Generator	6.2.10
Monitor Shutdown/Transfer Control Performance Check	Table 4-1 2.3.4 Shutdown Delay Time	6.2.11
Monitor Alarm Integrity Performance Check	Table 4-1 2.3.2 System Alarms	6.2.12
Power Supply and Battery Performance Check		6.2.13
Remote DME Certification Check	Table 4-1 2.3.2 System Alarms	6.2.14

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6. MAINTENANCE PROCEDURES

6.1 Introduction

This section provides the procedures required to accomplish the maintenance activities. It is divided into three parts; performance check procedures, other maintenance tasks, and special maintenance procedures.

The DME system provides continuous distance information to an aircraft during approach, departure, or en-route procedures according to the location of the DME. The ground equipment maintenance schedule is located in Section 5-2.

6.2 Performance Check Procedures

The procedures for completing the performance checks are provided in this section. Section 5 indicates when these procedures are to be performed and the order in which these checks are to be made. The tolerances for measurements are referenced to the Standards and Tolerances Table in Section 4.

6.2.1 Test equipment

Refer to [Table 6-1](#) for a list of suggested test equipment for use in maintaining DME facilities. In all cases equivalent test equipment may be used in place of the equipment listed. The minimum frequency range for the RF components is 960MHz to 1.215GHz.

Table 6-1 List of Required Test Equipment

Quantity	Equipment	Manufacturer	Model Number
1	Dual channel oscilloscope with probes	Tektronix	TDS1002
2	Test cable, BNC-male to BNC-male, RG223, 6ft	ITT-Pomona	BNC-C-60
1	Peak power meter	Bird	4314B-KT
1	250W Peak power wattmeter element for 100W DME	Bird	250J
	2500W Peak power wattmeter element for 1000W DME		2500J
1	30dB, 10W, 250W peak RF Attenuator for 100W DME	JFW Industries	50FH-30-10N
	30dB, 50W, 5000W peak RF Attenuator for 1000W DME	Weinschel	24-30-34
1	Frequency counter	BK Precision	1856D
1	Digital Volt Meter	Fluke	175
1	RF Cable, N-male to TNC-male, RG223, 2ft	SELEX	070282-0014
1	RF Cable, N-male to N-male, ¼" Heliax, 3ft	SELEX	070659-0007

Table 6-2 List of Additional Recommended Test Equipment

Quantity	Equipment	Manufacturer	Model Number
1	Digital peak power meter	Agilent	E4418A/N1911A
1	Peak power sensor	Agilent	E9323A/N1921A
1	30dB directional coupler calibrated at transmit frequency	Narda	3002-30
1	20dB attenuator calibrated at transmit frequency	Bird	5-A-MFN-20
1	Spectrum analyzer	Agilent	N1996A
1	Thermometer, $\pm 2^{\circ}\text{C}$ accurate	Any	

6.2.1.1 Normal/Bypass State Definitions

Throughout the maintenance procedures the term NORMAL STATE refers to the following settings:

- All AC and DC circuit breakers ON
- Main Select set to Transmitter 1
- Transmitter 1 ON into antenna
- Transmitter 2 ON into dummy load (if dual equipment, hot standby)
- No monitors bypassed
- Local Control mode OFF
- Not in Monitor Special Test mode
- Transmitter Ident Normal
- PMDT logged off

NOTE: These are the normal setting after pressing the RESET button when power is applied

The term BYPASS STATE refers to the following settings which can be accomplished by starting in the NORMAL STATE then performing the following steps:

- 1) Log on to the PMDT at Security Level 3 or higher. For reference the default user name is “SEC3” and password is “THREE”
- 2) Put the DME in local mode by pressing the LOCAL CONTROL button on the LCU
- 3) Bypass the integral monitor (and standby monitor if dual equipment)

6.2.2 Transmitter Frequency Performance Check

For a Single DME:

- a. Assure that the DME is in the NORMAL STATE.
- b. Connect the frequency counter to the TX1 Low Power Amplifier (1A9) J1 TX LO connector.
- c. Measure the frequency and verify that it is within the tolerance of [Table 4-1, 2.1.3 Frequency Stability](#)
- d. .

For a Dual DME:

- a. Assure that the DME is in the NORMAL STATE.
- b. Connect the frequency counter to the TX1 Low Power Amplifier (1A9) J1 TX LO connector.
- c. Measure the frequency and verify that it is within the tolerance of [Table 4-1, 2.1.3 Frequency Stability](#)
- d. .
- e. Connect the frequency counter to TX2 Low Power Amplifier (1A17) J1 TX LO connector.
- f. Measure the frequency and verify that it is within the tolerance of [Table 4-1, 2.1.3 Frequency Stability](#)
- g. .

6.2.3 Receiver Frequency Performance Check

For a Single DME:

- a. Assure that the DME is in the NORMAL STATE.
- b. Connect the frequency counter to Monitor Interrogator (1A11) INT LO connector.
- c. Measure and record the frequency.
- d. Connect the frequency counter to the Receiver Transmitter Controller (1A10) RX LO connector. This frequency is 125 MHz lower than the assigned receive frequency. Measure and verify the frequency is within the tolerance of [Table 4-1, 2.2.3 Frequency Stability](#).

For a Dual DME:

- a. Assure that the DME is in the NORMAL STATE.
- b. Connect the frequency counter to Monitor Interrogator (1A11) INT LO connector.
- c. Measure and record the frequency.
- d. Connect the frequency counter to Monitor Interrogator (1A15) INT LO connector.
- e. Measure and record the frequency.
- f. Connect the frequency counter to the Receiver Transmitter Controller (1A10) RX LO connector. This frequency is 125 MHz lower than the assigned receive frequency. Measure and verify the frequency is within the tolerance of [Table 4-1, 2.2.3 Frequency Stability](#).
- g. Connect the frequency counter to the Receiver Transmitter Controller (1A16) RX LO connector. This frequency is 125 MHz lower than the assigned receive frequency. Measure and verify the frequency is within the tolerance of [Table 4-1, 2.2.3 Frequency Stability](#).

6.2.4 Interrogator Frequency Performance Check

For a Single DME:

- a. Assure that the DME is in the NORMAL STATE.
- b. Connect a frequency counter to Monitor 1 (1A11) "INT LO".
- c. Measure the frequency and verify that it is within the tolerance of [Table 4-1, 2.3.1 a\) Frequency](#).

For a Dual DME:

- a. Assure that the DME is in the NORMAL STATE.
- b. Connect a frequency counter to Monitor 1 (1A11) "INT LO".
- c. Measure the frequency and verify that it is within the tolerance of [Table 4-1, 2.3.1 a\) Frequency](#).
- d. Connect a frequency counter to Monitor 2 (1A15) "INT LO".
- e. Measure the frequency and verify that it is within the tolerance of [Table 4-1, 2.3.1 a\) Frequency](#).

6.2.5 Transmitter Pulse Performance Check

- a. Put the DME into the BYPASS STATE.
- b. View Monitor 1 >> Test Results >> Transponder.
- c. Verify First and Second Pulse Width, Rise Time, and Decay Time are within the tolerances of [Table 4-1, 2.1.9 Pulse Shape](#) as indicated by green Data backgrounds.
- d. Verify Pulse Amplitude Difference is no more than ± 0.5 dB.
- e. If dual equipment, place transmitter 2 on the air and repeat steps b-d.
- f. Restore the DME to the NORMAL STATE.

6.2.6 Transmitter Power Output Performance Check

When using a wattmeter:

- a. Turn the DME transmitter AC and DC breakers off.
- b. Connect the wattmeter directly to the RF OUT port (1J1) on the top of the cabinet.
- c. Connect the 30dB attenuator between the wattmeter and the ANT MON1 port (1J2) on top of the cabinet.
- d. Insert the 250 Watt (LPDME) or 2500 Watt (HPDME) element into the wattmeter with the direction arrow pointing away from the transmitter output. NOTE: The same element used for the reference reading should be used for power verification.
- e. Put the DME is in the BYPASS STATE.
- f. Use the wattmeter to verify the transmitter power matches the reference reading taken during installation or the last flight check. NOTE: The ambient temperature in the shelter should be close to the temperature used when the reference reading was taken. This helps eliminate any wattmeter temperature variations.

Model 1118A/1119A DME

- g. If a change to output power is needed then refer to section 3.7.7.2.1 to change the Power Output setting.
- h. If dual equipment, put transmitter 2 on antenna and verify its power setting also matches the reference reading.
- i. If a change to transmitter 2 power setting is required, the Tx2 Power Output Scale factor shown in section 3.7.7.2.2 should be used.
- j. On the Monitors >> Data >> Integral screen verify the Tx Power reading is 100W (LP) or 1000W (HP) $\pm 10\%$.
- k. If an integral monitor reading change is required then adjust the Integral Tx Power Offset shown in section 3.7.6.4.2 for each monitor.
- l. For dual equipment, on the Monitors >> Data >> Standby screen verify the Tx Power reading is 100W (LP) or 1000W (HP) $\pm 10\%$.
- m. If a standby monitor reading change is required then adjust the Standby Tx Power Scale shown in section 3.7.6.4.1 for each monitor.
- n. Save any changes made to the DME configuration then turn off the DME and reconnect the antenna.
- o. Restore the DME to the NORMAL STATE.

When using a digital peak power meter:

- a. Turn the DME transmitter AC and DC breakers off.
- b. Connect the 30dB directional coupler to the RF OUT port (1J1) on the top of the cabinet.
- c. Connect the 30dB attenuator between the directional coupler output and the ANT MON1 port (1J2) on top of the cabinet.
- d. Using the 20dB attenuator, connect the peak power sensor to the coupled port of the directional coupler.
- e. Set the peak power meter offset to match the calibrated attenuation of the directional coupler and 20dB attenuator. If calibrated results are unknown then enter the default setting of 50dB (30dB coupler + 20dB attenuator).
- f. Set the peak power meter test frequency to the DME transmitter frequency then calibrate the meter.
- g. Put the DME is in the BYPASS STATE.
- h. Externally trigger the peak power meter with TX TRIG from RTC1 (1A10).
- i. Use the power meter to verify the transmitter power is within the tolerance stated in Table 4-1, 2.1.4 Output Power.
- j. If a change to output power is needed then refer to section 3.7.7.2.1 to change the Power Output setting.
- k. If dual equipment, put transmitter 2 on antenna and verify its performance meets Table 4-1, 2.1.4 Output Power.
- l. If a change to transmitter 2 power setting is required, the Tx2 Power Output Scale factor shown in section 3.7.7.2.2 should be used.
- m. On the Monitors >> Data >> Integral screen verify the Tx Power readings match the external power readings within $\pm 10\%$.
- n. If an integral monitor reading change is required then adjust the Integral Tx Power Offset shown in section 3.7.6.4.2 for each monitor.
- o. For dual equipment, on the Monitors >> Data >> Standby screen verify the Tx Power readings match the external power readings within $\pm 10\%$.
- p. If a standby monitor reading change is required then adjust the Standby Tx Power Scale shown in section 3.7.6.4.1 for each monitor.
- q. Save any changes made to the DME configuration then turn off the DME and reconnect the antenna.
- r. Restore the DME to the NORMAL STATE.

6.2.7 Receiver and Decoder Performance Check

- a. Put the DME into the BYPASS STATE.
- b. View Monitor 1 >> Test Results >> Decoder.
- c. Verify the receiver sensitivity, receiver bandwidth, and decoder aperture meet their performance as indicated by green backgrounds on all data parameters.
- d. For dual equipment, put transmitter 2 on antenna and repeat steps b-c.
- e. Restore the DME to the NORMAL STATE.

6.2.8 Transponder Reply Delay Performance Check

- a. Put the DME into the BYPASS STATE.

- b. Connect channel 1 of an oscilloscope to 1A11 Monitor 1 DETECTED VIDEO (1A11, J5)
- c. Connect channel 2 to the Monitor 1 INT TRIG (1A11, J4)
- d. Set the scope to trigger off the rising edge of channel 2 (Monitor 1 INT TRIG)
- e. With the PMDT select Monitor 1 >> Trigger >> Integral Delay >> Normal
- f. The scope should display as shown in [Figure 6-1](#). Note that the reply pulse-pair amplitude may be different and has no impact on monitor performance.

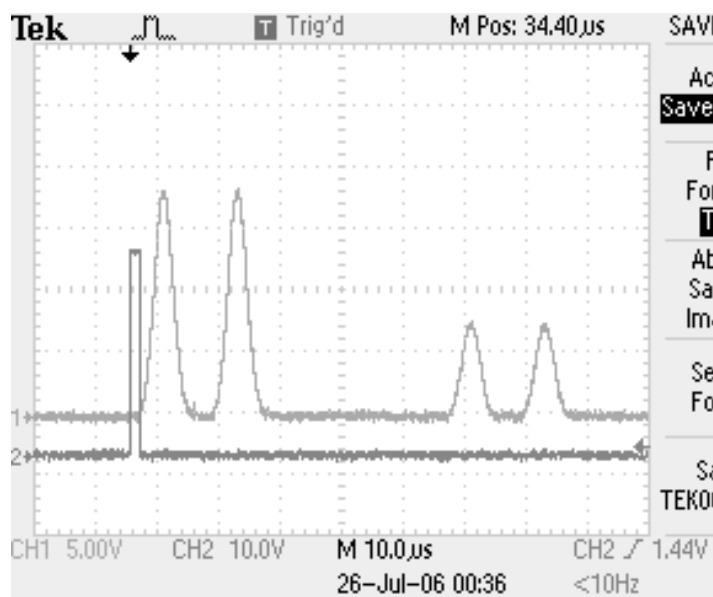


Figure 6-1 - Integral Delay with First Pulse Trigger

- g. Verify the time from the leading edge of the first interrogation pulse to the leading edge of the first reply pulse match Monitor 1 >> Data >> Integral >> Delay within $\pm 0.5\mu\text{s}$. (If second pulse timing is selected then the measurements should be done using the second interrogation and reply pulses.)
- h. For dual equipment, select Monitor 1 >> Trigger >> Standby Delay >> Normal.
- i. Verify the time from the leading edge of the first interrogation pulse to the leading edge of the first reply pulse match Monitor 1 >> Data >> Standby >> Delay within $\pm 0.5\mu\text{s}$. (If second pulse timing is selected then the measurements should be done using the second interrogation and reply pulses.)
- j. Repeat steps a through i for Monitor 2 (1A15).
- k. Restore the DME to the NORMAL STATE.

6.2.9 Identification Frequency Performance Check

- a. Put the DME into the BYPASS STATE.
- b. View Monitor 1 >> Test Results >> Transponder.
- c. Verify that the Ident and Equalization Pulses data parameters are within their tolerances as indicated by a green background.
- d. For dual equipment, put transmitter 2 on antenna and repeat step b-c.
- e. Restore the DME to the NORMAL STATE.

6.2.10 Monitor Interrogator Performance Check

- a. Put the DME into the BYPASS STATE.
- b. View Monitor 1 >> Test Results >> Interrogator.
- c. Verify the interrogator pulse shape, balance, spacing, rate, and level meet their performance as indicated by green backgrounds on all data parameters.

- d. For dual equipment, put transmitter 2 on antenna and repeat steps b-c.
- e. Restore the DME to the NORMAL STATE.

6.2.11 Monitor Shutdown/Transfer Control Performance Check

- a. Assure the DME is in the NORMAL STATE.
- b. Open the rear cover of the DME cabinet and locate the RF cable connecting the RF circulator to the receiver preselector filter. Refer to [Figure 6-6](#) to identify the preselector filter.
- c. Remove one end of that RF cable to create a transponder alarm condition.
- d. Verify transmitter 1 is shutdown in less than 10 seconds.
- e. For dual equipment, verify transmitter 2 is transferred to the antenna before it is shutdown.
- f. Reconnect the RF cable.
- g. Restore the DME to the NORMAL STATE.

6.2.12 Monitor Alarm Integrity Performance Check

- a. Put the DME into the BYPASS STATE.
- b. View Monitor 1 >> Tests >> Alarm Limits.
- c. Verify the monitor passes all Low Limit and High Limit certification tests as indicated by green backgrounds on all parameters.
- d. For dual equipment, view Monitor 2 >> Tests >> Alarm Limits and repeat step c.
- e. Restore the DME to the NORMAL STATE.

6.2.13 Power Supply and Battery Performance Check

- a. Put the DME into the BYPASS STATE.
- b. View RMS >> Data >> Power Supply Data.
- c. Verify “Tx1 48V PS”, “Volts” indicates $48\pm 2V$ and “Battery 1”, “Volts” indicates 52 to 56V when in trickle charge mode.
- d. For dual equipment verify “Tx2 48V PS”, “Volts” indicates $48\pm 2V$ and “Battery 2”, “Volts” indicates 52 to 56V when in trickle charge mode.
- e. Turn off AC breaker 1 and verify transponder 1 remains operational for at least 5 minutes.
- f. For dual equipment, Turn off AC breaker 2 and verify transponder 2 remains operational for at least 5 minutes.
- g. Restore the DME to the NORMAL STATE.

6.2.14 Remote DME Certification Check

These procedures are intended to provide a certification check of the DME system while it is still in service. They can be done locally or remotely using the RMM.

- a. Log on to the PMDT at Security Level 3 or higher.
- b. On the Monitors >> Data >> Integral screen verify all integral monitor parameters are within tolerance as indicated by a green background color.
- c. For dual, hot standby equipment select the Monitors >> Data >> Standby screen. Verify all standby monitor parameters are within tolerance as indicated by a green background color.
- d. On the Monitor 1 >> Test Results >> Alarm Limits screen verify Monitor 1 is passing its integrity tests as indicated by green backgrounds on all fields.
- e. For dual monitor equipment select the Monitor 2 >> Test Results >> Alarm Limits screen. Verify Monitor 2 is passing its integrity tests as indicated by green backgrounds on all fields.
- f. If parameters are out of tolerance then refer to [section 7](#) to perform fault isolation and corrective maintenance.
- g. Log off of the DME station.

6.3 Other Maintenance Procedures

6.3.1 Visual Inspection of DME System

6.3.1.1 Site Inspection

- a. Check that the site is clear of any new obstructions or materials which could affect the normal operation of the DME system.
- b. Check the shelter, inside and out, for any sign of water filtration, damage, or other deterioration.
- c. Check the condition of the air conditioner, shelter lighting, obstruction lights, baseboard heaters, electrical outlets, lightening arrestors, etc.

6.3.1.2 Inspection of Antenna System

- a. Check for antenna stability, and make sure it is securely affixed to its base or substructure.
- b. Inspect all ground cable connections to insure they are secure and in good condition.
- c. Check RF cables and connectors for breaks, cracks or corrosion.
- d. Check that the connectors are securely fastened, and inspect the remaining parts of the antenna for damage or signs of vermin infestation.

6.3.1.3 Equipment Inspection

- a. Visually inspect interconnecting wire harnesses, coaxial cables and connectors for corrosion, cracks, breaks, and burns.
- b. Insure all RF connectors are tightened.
- c. Check for functional operation of all indications by pressing the LAMP TEST button on the 1A1 Local Control Unit.

6.3.1.4 Inspection of Battery Backup Unit

- a. Place the DC circuit breakers in the OFF position.
- b. If using an external battery box then remove the cover from the battery box, otherwise open the rear door of the DME cabinet.
- c. Visually inspect the condition of each battery, and inspect the connectors and cables for any cracks, breaks, burns, or corrosion. Make sure that all connectors are fastened tightly to their terminals.
- d. Clean battery area as necessary.
- e. Close the battery cover and place the DC circuit breakers in the ON position.

6.3.1.5 Maintenance of Fans and Air Filters (High Power DME Only)

The DME fans use lifetime lubricated bearings and do not require maintenance.

- a. Open the rear door of the DME cabinet and inspect the air filter located on the right side panel
- b. Clean the air filter by removing it from its housing and shaking any out loose dirt and debris.
- c. Wash the filter with mild detergent and water.
- d. Dry the filter completely prior to replacing in the cabinet.

6.3.2 Monitor Alignment Procedures

6.3.2.1 Monitor Interrogation Level Calibration

When using a wattmeter:

- a. Put the DME into the BYPASS STATE.

Rev. B August, 2006

6-7

Model 1118A/1119A DME

- b. Select Monitor 1 >> Offsets and Scale Factors >> Calibration.
- c. Record -8.0 for single monitor or -11.3 for dual monitors in “Nominal Output Level”.
- d. Press the “Run Self Calibration” to calibrate the digital step attenuators, the log detector scale factor, and the signal generator reference level.
- e. For dual monitor equipment repeat steps b-d for Monitor 2.
- f. Select Monitors >> Configuration >> Integral.
- g. Open the rear door of the DME cabinet and locate the directional coupler at the top of the cabinet that feeds the Antenna RF connector (1J1).
- h. From the label attached to the coupler (DC1) find the attenuation corresponding to the closest interrogation frequency and enter the appropriate loss in “Direction Coupler Loss”. Alternately the attenuation at frequencies between calibrated values can be interpolated.
- i. Select RMS >> Config Backup to save changes.
- j. Restore the DME to the NORMAL STATE.

When using a digital peak power meter or spectrum analyzer:

- a. Put the DME into the BYPASS STATE.
- b. Open the rear door of the DME cabinet and locate the directional coupler (DC1) at the top of the cabinet that feeds the Antenna RF connector (1J1).
- c. Disconnect the RF cable DC1-J2 and connect the spectrum analyzer or power meter to the end of the cable.
- d. Calibrate and scale the external test equipment as necessary for the interrogation frequency with an input level of approximately -10dBm (0.1mW).
- e. Select Monitor 1 >> Offsets and Scale Factors >> Calibration.
- f. Press “Disable Calibration Parameters”.
- g. Select Monitors >> Special Tests.
- h. On the “Monitor Selection” drop down, select “Monitor 1”.
- i. In the Monitor 1 section select a 0 dBm Delay Interrogation Level and Select “CW Mode”.
- j. Press “Apply” then press the “Start” special tests button.
- k. Select Monitor 1 >> Offsets and Scale Factors >> Calibration.
- l. Record the signal level in “Nominal Output Level”. Note: The interrogation level should be approximately -11.3 dBm for dual monitors and approximately -8 dBm for single monitor.
- m. For dual monitor equipment repeat steps e-l for Monitor 2.
- n. On the Monitor >> Special Test screen press the “Stop” button. This will force the DME to restart.
- o. Reconnect the RF cable to DC1-J2.
- p. After the DME restarts put the DME into the BYPASS STATE.
- q. Select Monitor 1 >> Offsets and Scale Factors >> Calibration.
- r. Press the “Run Self Calibration” to calibrate the digital step attenuators, the log detector scale factor, and the signal generator reference level.
- s. For dual monitor equipment repeat steps q-r for Monitor 2.
- t. Select Monitors >> Configuration >> Integral.
- u. Open the rear door of the DME cabinet and locate the directional coupler at the top of the cabinet that feeds the Antenna RF connector (1J1).
- v. From the label attached to the coupler (DC1) find the attenuation corresponding to the closest interrogation frequency and enter the appropriate loss in “Direction Coupler Loss”. Alternately the attenuation at frequencies between calibrated values can be interpolated.
- w. Select RMS >> Config Backup to save changes.
- x. Restore the DME to the NORMAL STATE.

6.3.3 Receiver/Transmitter Controller Alignment Procedures

6.3.3.1 Receiver Sensitivity Adjustment

DME OPERATIONAL NOTICE: The usable receiver sensitivity is configurable via the PMDT interface from -94dBm to -72dBm. This allows the installation to match the receiver range to the transmitter range. By default the

receiver sensitivity is set to -82dBm for 100W stations and -87dBm for 1000W stations. These long-established settings ensure that the DME station only replies to aircraft within the working range of the transmitter operating power. For instance a 100W DME transmitter reply can only reach aircraft within a 40NMI radius; therefore the receiver would be unnecessarily overloaded with aircraft interrogations within 200NMI if the receiver sensitivity was maximized to -94dBm.

- a. Put the DME into the BYPASS STATE.
- b. Select Transmitters >> Configuration >> Nominal.
- c. Adjust “Rx Sensitivity” up or down as required for performance or to the level recorded during the last flight inspection.
- d. Select RMS >> Config Backup to save changes.
- e. Restore the DME to the NORMAL STATE.

6.3.3.2 Receiver Sensitivity Calibration

- a. Put the DME into the BYPASS STATE.
- b. Select Monitors >> Special Tests. Select Decoder Tests for Monitor 1 then press the “Apply” button followed by the “Start” button.
- c. On the Monitor 1 >> Test Results >> Decoder screen verify “Receiver Sensitivity, Data” matches the current “Rx Sensitivity” setting on the Transmitters >> Configuration >> Nominal screen within ± 1 dB
- d. If not then adjust the “Rx Sensitivity Offset” for Tx1 on the Transmitters >> Configuration >> Offsets and Scale Factors screen
- e. For dual equipment put Tx2 on antenna and repeat steps b-d using Monitor 2 and Tx2.
- f. Select RMS >> Config Backup to save changes.
- g. Restore the DME to the NORMAL STATE.

6.3.3.3 Transmitter LPA Low-Power Alert Alignment (High Power DME Only)

- a. Put the DME into the BYPASS STATE.
- b. Verify DME transmitter power is normal before changing the low-power alert.
- c. On the Transmitters >> Configuration >> Nominal screen set the “Low Output Power Alert Limit” to 100%.
- d. Select Transmitters >> Data to verify LPA #1 “Output Power” is in alert.
- e. Decrease the “Low Output Power Alert Limit” until the LPA #1 Output Power is no longer in alert.
- f. For dual equipment adjust the “Low Output Power Alert Limits” until LPA #2 Output Power is also not in alert.
- g. Decrease the “Low Output Power Alert Limits” setting an additional 5%.
- h. Select RMS >> Config Backup to save changes.
- i. Restore the DME to the NORMAL STATE.

6.3.3.4 On-Channel Gate Alignment

- a. Turn the AC and DC breakers off.
- b. Disconnect the antenna cable at the 1J1 RF OUT connector then connect the 30dB attenuator between the RF OUT port and 1J2 ANT MON1 port.
- c. Using ESD precautions pull out RTC1 (1A10) and place it on an extender card.
- d. Put the DME into the BYPASS STATE.
- e. Using a two channel oscilloscope with probes put CH1 on A1:TP8 (HALF_AMP) and CH2 on A2:TP2 (ON_CHAN_GATE) as shown in [Figure 6-2](#).
- f. Use an external trigger connected to Monitor 1 INT TRIG (1A11, J4).
- g. Initialize A2:R48 fully counter-clock-wise (CCW). If A2:R49 is installed set it fully CCW.
- h. Slowly adjust A2:R48 clock-wise until the ON_CHAN_GATE signal transitions from a TTL high to TTL low (excluding a few noise generated gates) in the regions before and after the RF interrogation pulses.
- i. Verify the rising edge of ON_CHAN_GATE (CH2) occurs 0 to 300ns before the rising edge of the HALF_AMP pulse (CH1) as shown in [Figure 6-3](#).
- j. Refer to [Figure 6-4](#) and [Figure 6-5](#) for on-channel gate misalignment examples.

Model 1118A/1119A DME

- k. On the PMDT sidebar verify the reply efficiency is nearly 100%.
- l. Turn the AC and DC breakers off and place RTC1 back into the rack.
- m. For dual equipment repeat steps c-l for RTC2 (1A16).
- n. Reconnect the antenna to the 1J1 RF OUT connector.
- o. Restore the DME to the NORMAL STATE.

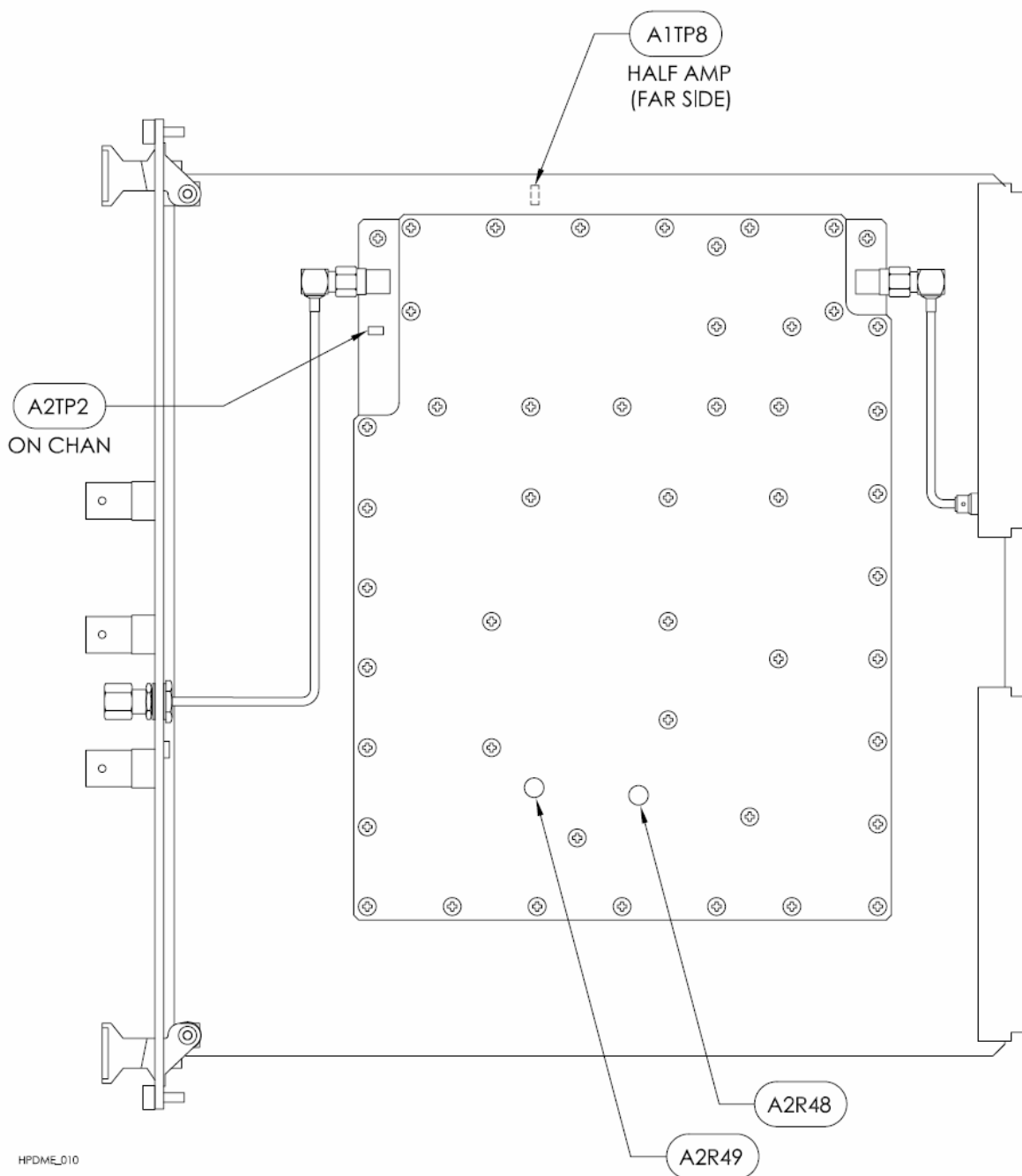


Figure 6-2 1A10/1A16 RTC Test Points for On-Channel Alignment

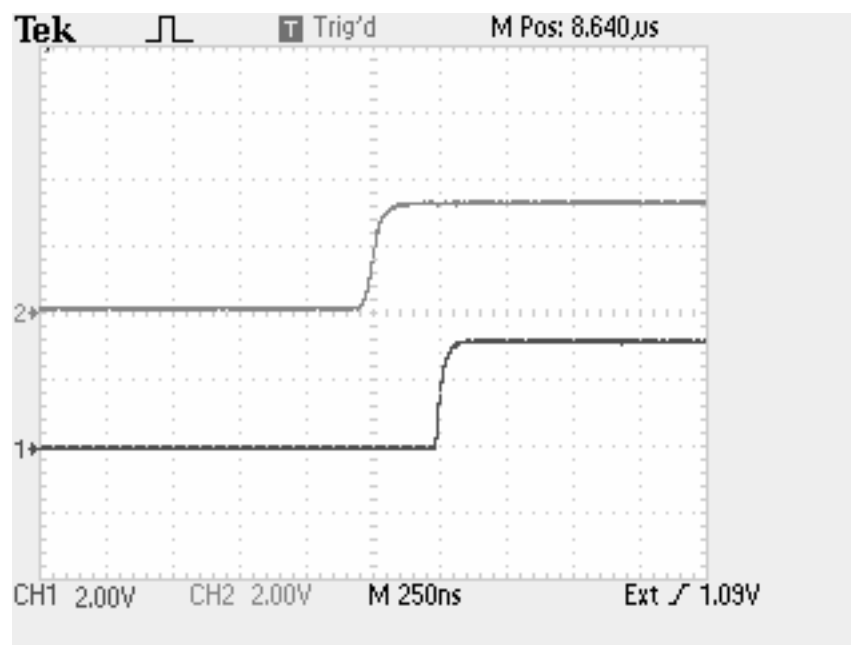


Figure 6-3 Proper On-Channel Alignment

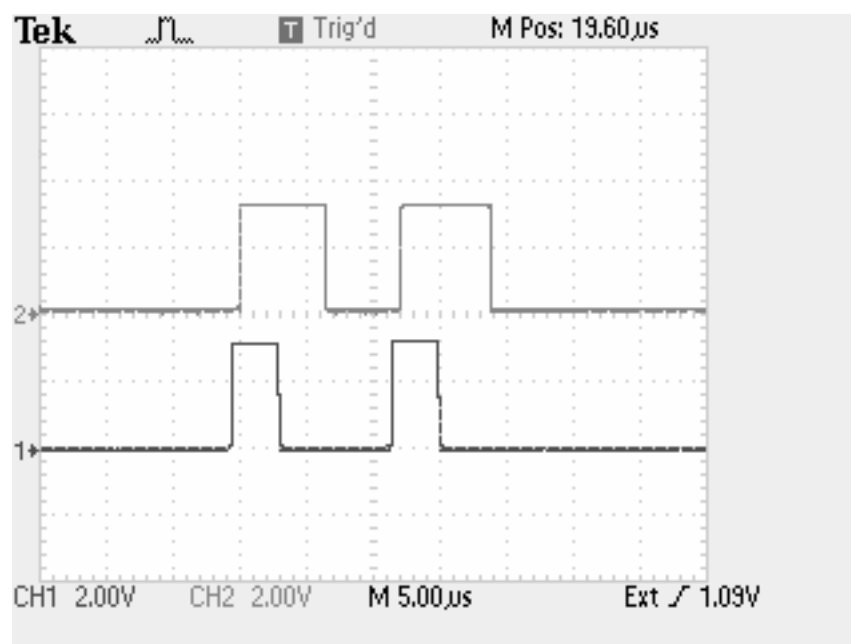


Figure 6-4 Lagging On-Channel Alignment Error

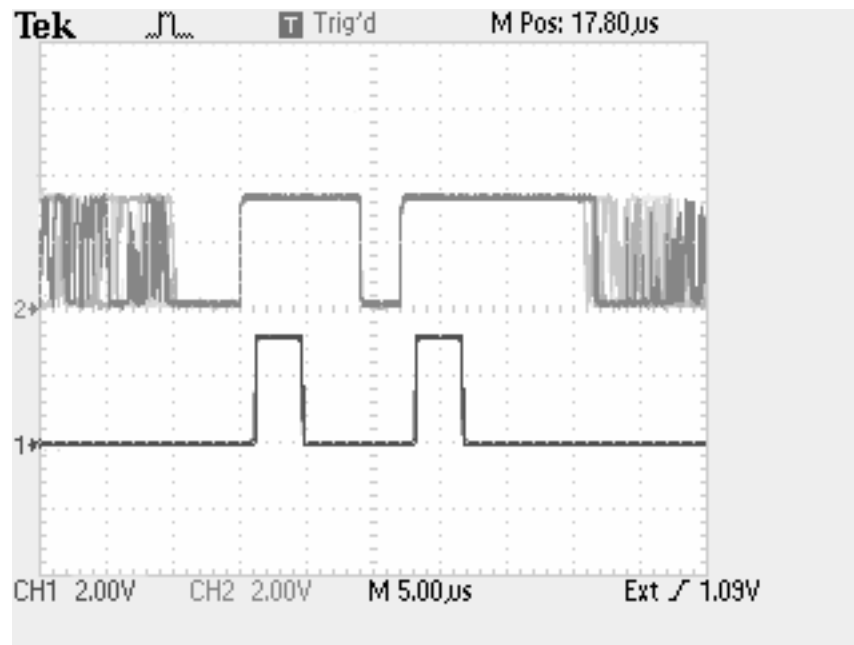


Figure 6-5 Leading On-Channel Alignment Error

6.3.4 Battery Charging Power Supply (BCPS) Alignment Procedures

6.3.4.1 System AC Voltage Alignment

- Put the DME into the BYPASS STATE.
- Use a Digital Volt Meter (DVM) to measure the AC input voltage from AC Monitor (1A22) TB3 terminal 1 to 2 (TX POWER, LINE and NEUTRAL).
- Use the PMDT to display RMS >> RMS Data >> Power Supply Data, AC Input volts and verify the reading is within 1 VAC of DVM measurement.
- If not within 1 VAC adjust 1A20 BCPS R30 so the RMS >> RMS Data >> Power Supply Data, AC Input volts is within 1 VAC of DVM measurement.
- For single transmitter equipment skip to step i.
- Turn off Transmitter 1 AC and DC breakers.
- Use the PMDT to display RMS >> RMS Data >> Power Supply Data, AC Input volts and verify the reading is within 1 VAC of DVM measurement.
- If not within 1 VAC adjust 1A21 BCPS R30 so the RMS>>RMS Data>> Power Supply Data, AC Input volts is within 1 VAC of DVM measurement.
- Restore the DME to the NORMAL STATE.

6.3.4.2 System AC Current Alignment

- Turn off AC and DC circuit breakers.
- At the shelter circuit breaker panel turn off AC power for the DME station.
- Connect a Digital Volt Meter (DVM) in line with the wire from AC Monitor (1A22) TB3 position 1 (TX POWER, LINE). Set the DVM to measure AC current using a 10A scale.
- Restore AC power to the DME at the circuit breaker panel.
- Put the DME into the BYPASS STATE.
- Use the PMDT to display RMS >> RMS Data >> Power Supply Data, AC Input Amps and verify the reading is within 0.2 amps of DVM reading.

- g. If not within 0.2 amps adjust 1A20 BCPS R56 so the RMS >> RMS Data >> Power Supply Data, AC Input Amps is within 0.2 amps.
- h. For single equipment skip to step l.
- i. Turn off Transmitter 1 AC and DC breakers.
- j. Use the PMDT to display RMS >> RMS Data >> Power Supply Data, AC Input Amps and verify the reading is within 0.2 amps of DVM reading.
- k. If not within 0.2 amps adjust 1A21 BCPS R56 so the RMS >> RMS Data >> Power Supply Data, AC Input Amps is within 0.2 amps.
- l. Turn off AC and DC circuit breakers.
- m. At the shelter circuit breaker panel turn off AC power for the DME station.
- n. Remove the DVM and reconnect the AC line wire to the AC Monitor (1A22) TB3 position 1.
- o. Restore AC power to the DME at the circuit breaker panel.
- p. Restore the DME to the NORMAL STATE.

6.3.4.3 Obstruction Light AC Voltage Alignment

- a. Put the DME into the BYPASS STATE.
- b. Use a Digital Volt Meter (DVM) to measure the AC input voltage from AC Monitor (1A22) TB1 terminal 1 to 3 (OB LITE, SENSE and NEUTRAL). Note that TB1-1 is normally jumpered to TB1-2 when a photo sensor is not used with the obstruction light. When using a photo sensor the light opening must be covered with an opaque object in order to force the obstruction light to turn on.
- c. Use the PMDT to display RMS >> RMS Data >> Power Supply Data, OB Light volts and verify the reading is within 1 VAC of DVM measurement.
- d. If not within 1 VAC adjust 1A20 BCPS R29 so the RMS >> RMS Data >> Power Supply Data, OB Light volts is within 1 VAC of DVM measurement.
- e. For single transmitter equipment skip to step i.
- f. Turn off Transmitter 1 AC and DC breakers.
- g. Use the PMDT to display RMS >> RMS Data >> Power Supply Data, OB Light volts and verify the reading is within 1 VAC of DVM measurement.
- h. If not within 1 VAC adjust 1A21 BCPS R29 so the RMS>>RMS Data>> Power Supply Data, OB Light volts is within 1 VAC of DVM measurement.
- i. Restore the DME to the NORMAL STATE.

6.3.4.4 Obstruction Light AC Current Alignment

- a. Disconnect any equipment connected to the AC convenience outlet on the 1A26 Status Panel.
- b. At the shelter circuit breaker panel turn off AC power for the DME obstruction lights.
- c. Connect a Digital Volt Meter (DVM) in line with the wire from AC Monitor (1A22) TB1 position 2 (OB LITE, LINE). Set the DVM to measure AC current using a 10A scale. Note when using a photo sensor the light opening must be covered with an opaque object in order to force the obstruction light to turn on.
- d. Restore AC power to the DME obstruction light at the circuit breaker panel.
- e. Put the DME into the BYPASS STATE.
- f. Use the PMDT to display RMS >> RMS Data >> Power Supply Data, OB Light Amps and verify the reading is within 0.2 amps of DVM reading.
- g. If not within 0.2 amps adjust 1A20 BCPS R44 so the RMS >> RMS Data >> Power Supply Data, OB Light Amps is within 0.2 amps.
- h. For single equipment skip to step l.
- i. Turn off Transmitter 1 AC and DC breakers.
- j. Use the PMDT to display RMS >> RMS Data >> Power Supply Data, OB Light Amps and verify the reading is within 0.2 amps of DVM reading.
- k. If not within 0.2 amps adjust 1A21 BCPS R44 so the RMS >> RMS Data >> Power Supply Data, OB Light Amps is within 0.2 amps.
- l. At the shelter circuit breaker panel turn off AC power for the DME obstruction lights.
- m. Remove the DVM and reconnect the OB LITE line wire to the AC Monitor (1A22) TB1 position 2.

Model 1118A/1119A DME

- n. Restore AC power to the DME obstruction light at the circuit breaker panel.
- o. Restore the DME to the NORMAL STATE.

6.3.5 Alarm Volume Adjustment Procedure

- a. Turn off the AC and DC breakers.
- b. Using ESD precautions pull out the 1A14 Facilities CCA and remove the jumper between JP1 pins 5-6.
- c. Put the 1A14 Facilities CCA back into the DME cabinet.
- d. Restore the DME to the NORMAL STATE.
- e. Locate the Volume adjust pot at the bottom right of the System Controls on the 1A1 LCU.
- f. Press the lamp test switch to activate the audio alarm.
- g. Using the adjustment tool provided with the accessory kit, adjust the volume pot clockwise to increase the volume or counterclockwise to lower the volume until the desired sound level is obtained.
- h. Turn off the AC and DC breakers.
- i. Using ESD precautions pull out the 1A14 Facilities CCA and restore the jumper between JP1 pins 5-6.
- j. Put the 1A14 Facilities CCA back into the DME cabinet.
- k. Restore the DME to the NORMAL STATE.

6.3.6 RMS Facilities Exterior and Interior Temperature Calibration

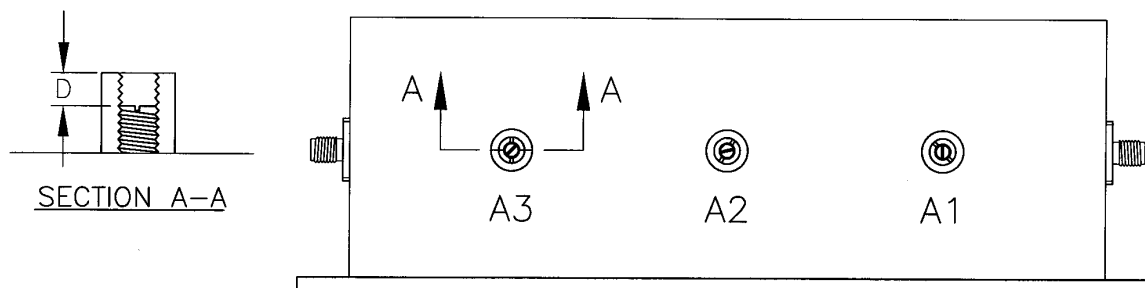
- a. If a precision thermometer is not available then skip this procedure.
- b. Put the DME into the BYPASS STATE.
- c. Select RMS >> DATA >> A/D DATA.
- d. If an external Temperature Sensor Assembly is connected to J7 of the 1A19 Interface CCA then and adjust 1A19R41 until the PMDT "Outside Temperature" display matches the temperature shown on an external thermometer as it is located near the Temperature Sensor Assembly.
- e. Adjust 1A19R42 until the "Inside Temperature" display matches the temperature shown on an internal thermometer as it is located near the 1A19 Interface CCA.
- f. Restore the DME to the NORMAL STATE.

6.3.7 DME Preset Tuning

6.3.7.1 DME Preset Tuning Using Presets

Presets are to be done only when the condition of the receiver is not known or when changing the station frequency without appropriate test equipment available. Normal routine maintenance and fine tuning do not require these presets.

Refer to [Figure 6-6](#) for the definition of the preset measurements. Using a set of calipers refer to [Table 6-3](#) to set the preselector tuning capacitor depths based on the closest interrogation frequency listed. These depths represent an initial starting point; the final tuning points will vary from these settings.



HPDME_005

Figure 6-6 Preset Tuning Assembly

Table 6-3 Preselector Preset Alignment Table

Freq (MHz)	A1&A3 (in)	A2 (in)	A1&A3 (mm)	A2 (mm)
1025	0.203	0.193	5.16	4.90
1030	0.200	0.189	5.08	4.80
1035	0.196	0.186	4.98	4.72
1040	0.193	0.183	4.90	4.65
1045	0.190	0.179	4.83	4.55
1050	0.186	0.176	4.72	4.47
1055	0.183	0.172	4.65	4.37
1060	0.179	0.169	4.55	4.29
1065	0.176	0.165	4.47	4.19
1070	0.172	0.161	4.37	4.09
1075	0.169	0.157	4.29	3.99
1080	0.165	0.152	4.19	3.86
1085	0.161	0.148	4.09	3.76
1090	0.157	0.143	3.99	3.63
1095	0.153	0.138	3.89	3.51
1100	0.148	0.133	3.76	3.38
1105	0.144	0.127	3.66	3.23
1110	0.139	0.121	3.53	3.07
1115	0.134	0.115	3.40	2.92
1120	0.128	0.108	3.25	2.74
1125	0.123	0.101	3.12	2.57
1130	0.117	0.094	2.97	2.39
1135	0.111	0.086	2.82	2.18
1140	0.104	0.078	2.64	1.98
1145	0.098	0.070	2.49	1.78
1150	0.091	0.061	2.31	1.55

6.3.7.2 DME Preselector Tuning Using IF Peak Tuning

This procedure should be done whenever performing a small change in interrogator frequency or to fine tune the preselector after tuning using presets.

- 1) Put the DME into the BYPASS STATE.
- 2) Connect channel 1 of a DC-coupled oscilloscope to RTC1 High Video (1A10, J3) front panel connector. Select Auto Triggering using channel 1.
- 3) From the PMDT select Monitors>>Special Tests
- 4) In the Monitor 1 section, set the Delay Interrogation Level to -10dBm and select "CW Mode"
- 5) In the Monitor Selection section pick "Monitor 1"
- 6) Press the Apply button then press the Start button
- 7) Starting at one end of the preselector, adjust each tuning capacitor successively to peak up the detected DC voltage at J3.

NOTE: Turning the capacitors clock-wise will lower the tuned frequency while turning counter-clock-wise will raise the tuned frequency.

- 8) Repeat adjustments as necessary. Verify the DC voltage at J3 is greater than 1.8V.
- 9) From the PMDT press the Stop button to terminate the CW test.
- 10) Restore the DME to the NORMAL STATE.

6.4 Special Maintenance Procedures

6.4.1 RMS Lithium Battery Check Procedure

- Turn the DME transmitter AC and DC breakers off.
- Observing ESD precautions pull out the 1A13 RMS CCA and place on an ESD protective surface.
- Verify JP1 is connected between pins 2-3 to enable battery backup.
- Measure the DC voltage across the lithium battery B1.
- Verify that the battery voltage is greater than or equal to 2.9 VDC at a room temperature of $20 \pm 5^\circ\text{C}$.
- Replace the battery if necessary.
- Place the RMS CCA into the rack and restore the DME to the NORMAL STATE.

6.4.2 Recording Wattmeter Reference Reading

All DME transmitters are factory calibrated to produce 100W (LPDME) or 1000W (HPDME) using a digital peak power meter with a total measurement uncertainty of ± 4.0 . By contrast a wattmeter has a measurement uncertainty of $\pm 8\%$ and does not track the peak power of a Gaussian pulse very well. Typically a wattmeter will read 1.75dB lower output power than a digital power meter and is sensitive to the transmission rate and temperature. For a 100W DME this equates to an average response to the peak pulse that is usually 30 to 40 watts less than the actual radiated power.

Consequently, when using a wattmeter, a reference power reading should be established at the time of installation. This reading should correspond to 100W (LPDME) or 1000W (HPDME) and may be recorded and confirmed as part of the annual inspection. To record a reference wattmeter reading:

- Turn the DME transmitter AC and DC breakers off.
- Connect the wattmeter directly to the RF OUT port (1J1) on the top of the cabinet.
- Connect the 30dB attenuator between the wattmeter and the ANT MON1 port (1J2) on top of the cabinet.
- Insert the 250 Watt (LPDME) or 2500 Watt (HPDME) element into the wattmeter with the direction arrow pointing away from the transmitter output.
- Put the DME in the BYPASS STATE.
- Use the wattmeter to measure the transmitter power. Record the reference reading in the table below.
- Record the interior temperature at the time of the test as displayed on the PMDT at RMS >> Data >> A/D Data, Inside Temperature, Deg C.
- Turn off the DME and reconnect the antenna.
- Remove the wattmeter element used for the reference reading and mark it with the DME station identifier so the same element can be used for all future measurements.
- Restore the DME to the NORMAL STATE.

Table 6-4 Wattmeter Reference Readings

Date	Channel	Reference Power (W)	Interior Temperature ($^\circ\text{C}$)	Comments

6.4.3 Configuring Short and Long Distance Echo Suppression

Short Distance Echo Suppression (SDES) is required for DME sites that experience airborne unlock conditions or experience a small error in slant range distance (<2NMI) caused by reflecting surfaces close to the DME ground antenna. To enable SDES:

- a. Put the DME into the BYPASS STATE.
- b. On the Transmitters >> Configuration >> Nominal screen check the box labeled SDES Enabled.
- c. If flight inspection reports that the unlock anomaly is gone then save the settings and restore the DME to the NORMAL STATE.
- d. Otherwise proceed with Long Distance Echo Suppression setup

Long Distance Echo Suppression (LDES) is required for DME sites that experience unlocks due to large errors in slant range distance (≥ 5 NMI) caused by reflecting surfaces far from the DME ground antenna. Normal use of LDES is undesirable because it blanks out the transponder receiver after each interrogation thus reducing the ground station's availability. Increasing the LDES threshold and decreasing the LDES window minimize this effect. To use LDES:

- a. Put the DME into the BYPASS STATE.
- b. On the Transmitters >> Configuration >> Nominal screen check the box labeled LDES Enabled and start with the default LDES settings of -70dBm threshold and 150 μ s window.
- c. If flight inspection reports that the unlock anomaly is gone then save the settings and restore the DME to the NORMAL STATE.
- d. If necessary or desired as to reduce the amount of time the receiver is blanked, the LDES parameters can be configured based on the following formula:

$$\text{LDES Window} = \text{SRE} * 12.36\mu\text{s}/\text{NMI} + 10\mu\text{s} \quad (\text{eq 6.1})$$

Where SRE = absolute maximum slant range error reported by flight inspection in NMI

$$\text{LDES Threshold} = -0.385\text{dBm}/\text{NMI} * \text{FUD} - 20\text{dBm} \quad (\text{eq 6.2})$$

Where FUD = first unlock distance in NMI

For instance if flight inspection encounters a range error of 21 NMI starting at 55 NMI from the ground station on an in-bound radial approach then:

$$\begin{aligned} \text{LDES Window} &= 21 * 12.36 + 10 = 269.56\mu\text{s}; \text{ therefore use } 270\mu\text{s} \text{ for the setting} \\ \text{LDES Threshold} &= -0.385 * 55 - 20 = -41.175\text{dBm}; \text{ therefore use } -41\text{dBm} \text{ for the setting} \end{aligned}$$

6.4.4 Performing a Frequency Change or X/Y Conversion

- a. Put the DME into the BYPASS STATE.
- b. View RMS >> Configuration >> Station.
- c. In the User Configuration section, change the Channel type (X or Y) and Channel Number as desired then press Apply (F7).
- d. Press the "Display DIP Switch Settings" button.
- e. Changes needed to the backplane switches are indicated with yellow backgrounds. On the Low Power Backplane (1A8A1) change the switches as indicated then press the Update button on the PMDT to verify all changes are complete.
- f. Close the DIP switch screen then backup the change using the RMS >> Config Backup command.
- g. Log off the PMDT then press the RESET button on the 1A1 LCU panel.
- h. If making an interrogation frequency change greater than 25 MHz then perform the procedures in [6.3.7.1DME Preselector Tuning Using Presets](#).
- i. Perform the procedures in [6.3.7.2DME Preselector Tuning Using IF Peak Tuning](#) to fine tune the preselector filter.
- j. Perform the procedures in [6.3.2.1Monitor Interrogation Level Calibration](#).

- k. If using a digital power meter, perform the procedures in [6.2.6 Transmitter Power Output Performance Check](#) then skip to step m.
- l. If using a wattmeter, install the meter per section [6.2.6 Transmitter Power Output Performance Check](#), scale the transmitter power to read 100W (LPDME) or 1000W (HPDME) on the Monitors >> Data >> Integral screen, then record a new wattmeter reference reading per section [6.4.2 Recording Wattmeter Reference Reading](#).
- m. Restore the DME to the NORMAL STATE

6.4.5 Performing a Software Update

During the product life cycle software updates may become available for the DME product in service. Please refer to the installation instructions accompanying the software update service bulletin for detailed software upgrade procedures.

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7. CORRECTIVE MAINTENANCE

7.1 Introduction

This section contains information necessary to troubleshoot and perform corrective maintenance at the DME site. Repairs to the DME are limited to module replacement.

7.2 Test Equipment Required

[Table 6-1](#) and [Table 6-2](#) are lists of the test equipment required and recommended to maintain the DME equipment. Although specific model numbers are listed, equivalent equipment may be substituted.

7.3 Onsite Corrective Maintenance

Corrective maintenance procedures in this section cover the DME station. The corrective maintenance procedures are intended only as a guide and do not give all possible symptoms or all possible causes of trouble. They are to be used in conjunction with figures and diagrams found within this manual and in [Section 11](#).

The first step in corrective maintenance is inspection of the equipment with the power OFF. It is good practice to perform visual inspections and basic continuity checks on the equipment whose condition is unknown. The major elements of inspection are:

- a. Electrical connections. (Cables and plug-in modules).
- b. Mechanical joints and linkages, including switches.
- c. Wiring condition. Water, heat or extreme cold can affect internal and external wiring. Look for frayed, broken or damaged wiring.
- d. Check all system fuses for proper ratings and condition.
- e. Incorrect repairs or recent modifications.
- f. Corrosion, broken, burnt, or missing parts.
- g. Build up of dirt, moisture, insect or rodent nesting.

After finding and correcting the trouble, perform adjustment procedures. Maintenance records are to be kept and as much data as possible recorded to assist in future repairs. List abnormal indications and what was done to correct the fault. Records are to include actual measurements taken before and after the repair to accumulate a work history. This practice will aid in identifying troubles before they interfere with equipment operation.

7.3.1 General Troubleshooting Information

- a. Identify the symptom.
- b. List the symptoms that you find or a field technician describes. If someone else describes the symptoms to you, check the symptoms yourself or have that person demonstrate the symptoms to make sure the problem is not an operator error.
- c. Carefully inspect the suspected assembly. Read the following suggestions before the inspection.
 1. Check for signs of excessive heat.
 2. Verify that all socketed integrated circuits are firmly seated in their sockets and that there are no bent pins.
 3. Check that printed circuit board connectors are clean and fully seated.
 4. Check the ribbon-cable connectors for proper connections.
- d. Check the power supplies. Power supplies are a very common source of problems. Low voltage or excessive ripple can cause a good component to appear to be defective. Each module in the DME system is fed from a common 48V bus then creates its own DC voltages using multiple stages of DC/DC and linear voltage regulators. Not only verify the 48V power supply but also the supplies located on each module.

Model 1118A/1119A DME

1. Measure the power supply voltages. Verify that they are within $\pm 10\%$ of the voltage listed in the silkscreen or listed on the schematic.
 2. Using an oscilloscope, ascertain that the power supply outputs are not excessively noisy.
- e. Using an oscilloscope, check waveforms of the suspected faulty assembly.
- f. Verify the clock signals. Using an oscilloscope, check that the clock signals are present and correct.

7.4 Maintenance Procedures for Replacement of Faulty Assemblies

7.4.1 Monitor Interrogator 1A11/1A15

- a. Inspect replacement Monitor Interrogator and verify revision
- b. Perform the following alignment(s): [6.3.2.1 Monitor Interrogation Level Calibration](#)

7.4.2 Receiver/Transmitter Controller 1A10/1A16

- a. Inspect replacement Receiver/Transmitter Controller and verify revision
- b. Perform the following alignment(s): [6.3.3.2 Receiver Sensitivity Calibration](#)

7.4.3 Low Power Amplifier 1A9/1A17

- a. Inspect replacement Low Power Amplifier and verify revision
- b. Perform the following alignment(s): [6.2.6 Transmitter Power Output Performance Check](#), [6.2.5 Transmitter Pulse Performance Check](#)

7.4.4 High Power Amplifier 1A3/1A7

- a. Inspect replacement High Power Amplifier and verify revision
- b. Perform the following alignment(s): [6.2.6 Transmitter Power Output Performance Check](#), [6.2.5 Transmitter Pulse Performance Check](#)

7.4.5 RMS Processor CCA 1A13

- a. Inspect replacement RMS Processor CCA and verify revision
- b. Perform the following alignment(s): None

7.4.6 RMS Facilities CCA 1A14

- a. Inspect replacement RMS Facilities and verify revision
- b. Perform the following alignment(s): [6.3.6 RMS Facilities Exterior and Interior Temperature Calibration](#)

7.4.7 BCPS CCA 1A20/1A21

- a. Inspect replacement BCPS CCA and verify revision
- b. Perform the following alignment(s): [6.3.4 Battery Charging Power Supply \(BCPS\) Alignment Procedures](#)

7.4.8 Interface CCA 1A19

- a. Inspect replacement Interface CCA and verify revision
- b. Perform the following alignment(s): none

7.5 Useful Test Point Signals and Voltage Levels

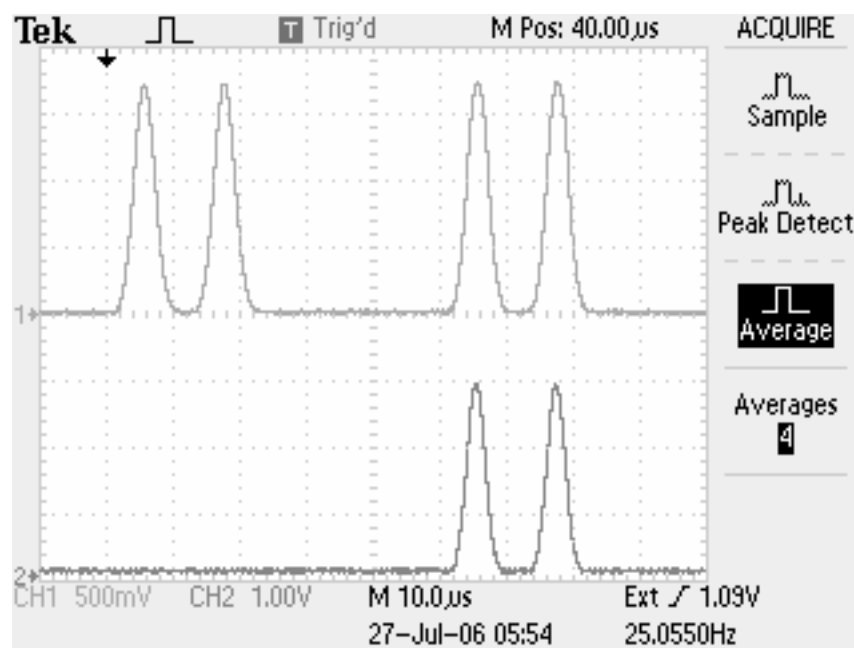


Figure 7-1 CH1: Monitor, DETECTED VIDEO, normal delay trigger; CH2: LPA, DETECTOR

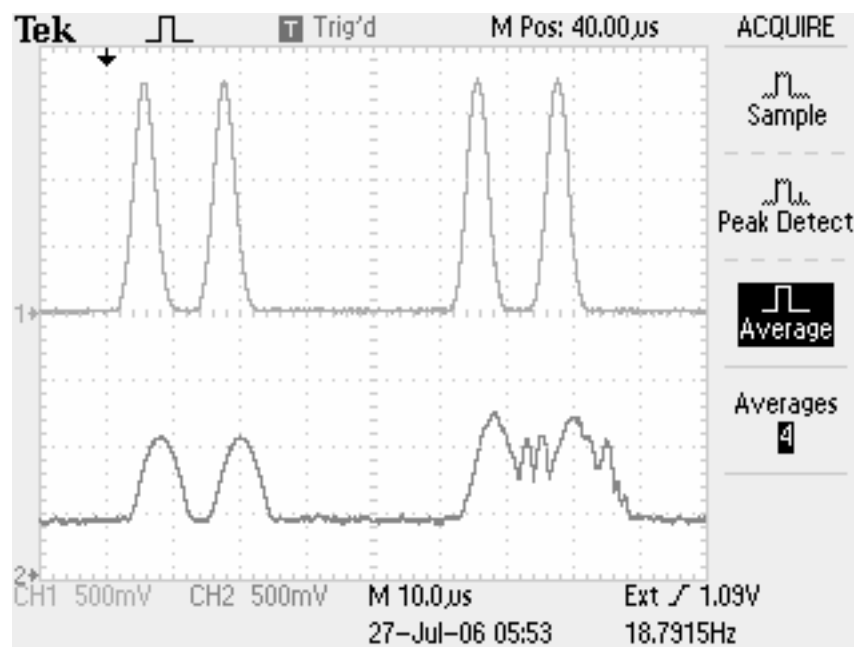


Figure 7-2 CH1: Monitor, DETECTED VIDEO, efficiency trigger; CH2: RTC, LOW VIDEO

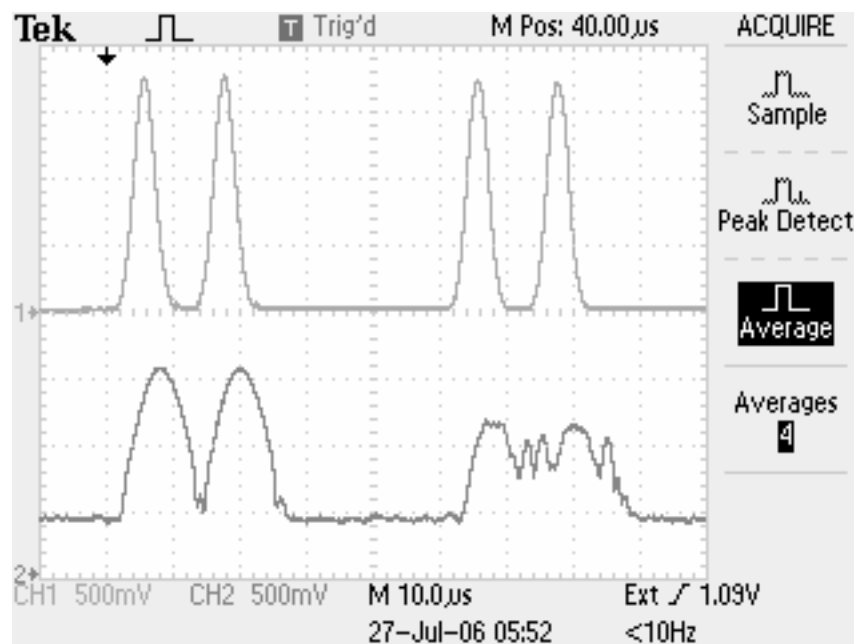


Figure 7-3 CH1: Monitor, DETECTED VIDEO, normal delay trigger; CH2: RTC, LOW VIDEO

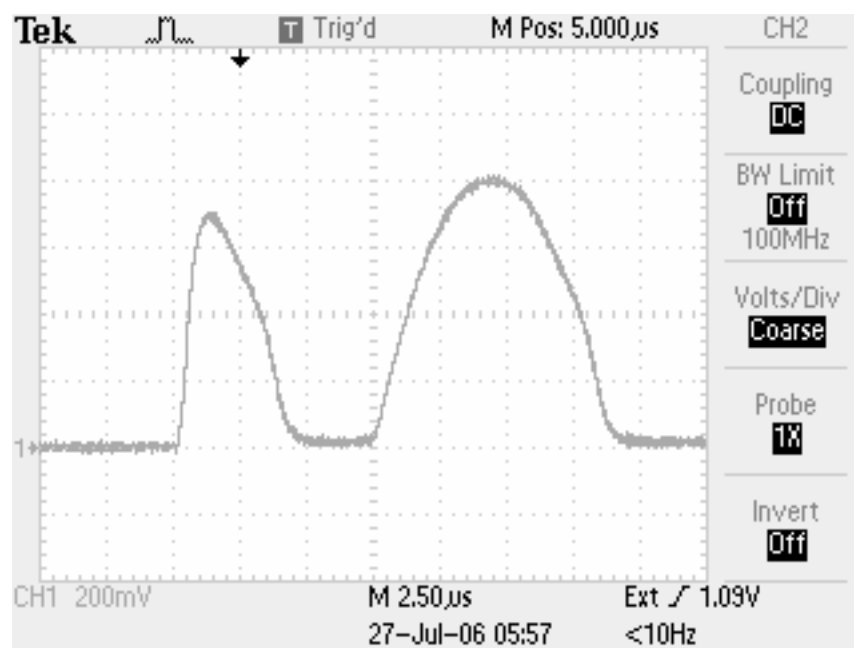


Figure 7-4 CH1: Monitor, DETECTED VIDEO, forward power trigger

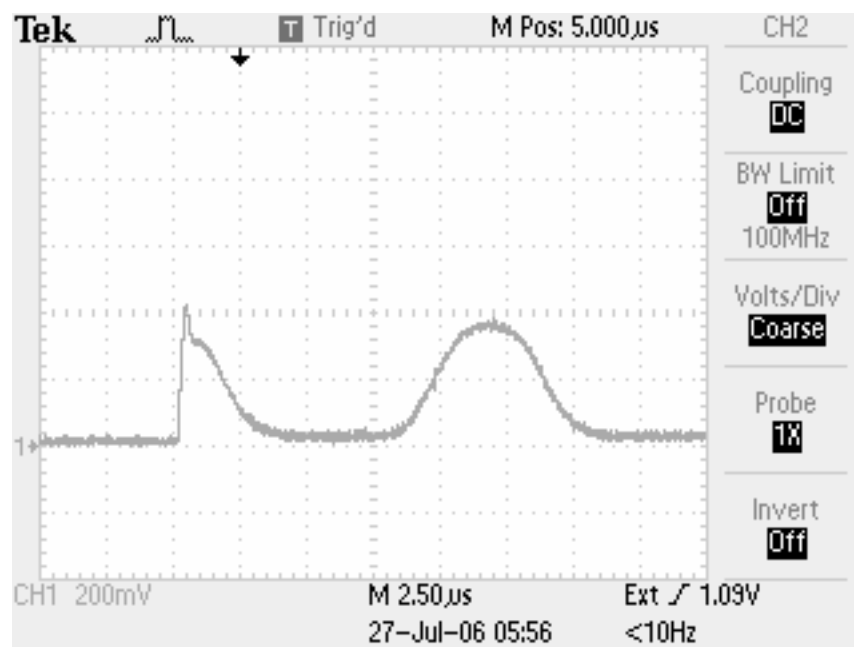


Figure 7-5 CH1: Monitor, DETECTED VIDEO, reflected power trigger

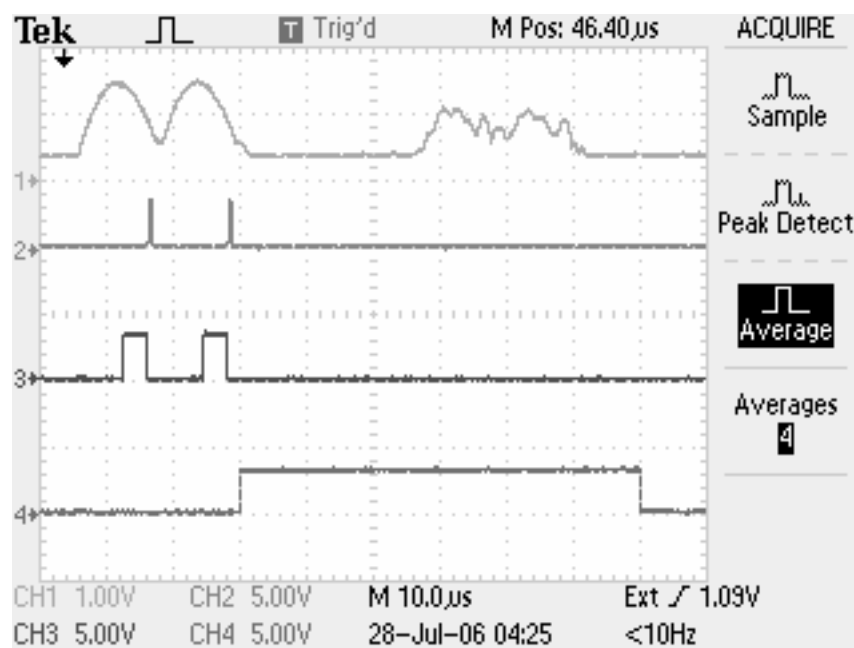


Figure 7-6 CH1: RTC, LOW VIDEO; CH2: RTC, IRQ TP13;

CH3: RTC, HALF AMP TP8; CH4: RTC, DEAD TIME TP6

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8. PARTS LIST

8.1 Introduction

Tables 8-1 and Table 8-2 contain the parts list for the Single and Dual Low Power DME. Tables 8-3 and Table 8-4 contain the parts list for the Single and Dual High Power DME.

Table 8-1 Single Equipment Low Power DME System PN 001118A-0101						
Lv	Part Number	Description 1	Description 2	Qty	U/M	Ref Des
1	030799-0001	Wired Cabinet Assy	Single	1.0	ea	
2	030815-0001	Common Cabinet Assy		1.0	ea	
2	030814-0001	BCPS Assembly		1.0	ea	
2	030801-0001	Local Control Unit Assembly		1.0	ea	1A1
3	012179-1001	Local Control Unit, CCA	(LCU)	1.0	ea	1A1A1
3	030800-0001	Low Power Rack Assembly		1.0	ea	1A8
4	012166-0001	Backplane, CCA	Low Power Rack	1.0	ea	1A8A1
2	012033-0001	LNA, CCA		1.0	ea	1A8A2
1	030802-0001	Low Power Amplifier Assy		1.0	ea	1A9
2	012173-0001	Synthesizer, CCA		1.0	ea	1A9A1
2	012174-0001	Modulator, CCA		1.0	ea	1A9A4
1	030805-0001	Rcvr/Xmtr Controller Assy		1.0	ea	1A10
2	012168-1001	Rcvr/Xmtr Control, CCA		1.0	ea	1A10A1
2	012180-0001	Receiver RF, CCA		1.0	ea	1A10A2
1	030806-0001	Monitor Interrogator Assy		1.0	ea	1A11
2	012169-1001	Monitor/Interrogator, CCA		1.0	ea	1A11A1
2	012181-0001	Monitor/Interrogator RF, CCA		1.0	ea	1A11A2
1	012172-1001	RMS Processor, CCA		1.0	ea	1A13
1	012171-0001	RMS Facilities, CCA		1.0	ea	1A14
3	012167-0001	Interface, CCA		1.0	ea	1A19
2	012170-1001	BCPS, CCA		1.0	ea	1A20
3	012186-0001	AC Monitor, CCA		1.0	ea	1A22
2	950739-0002	Power Supply	500W	1.0	ea	1A24
2	030813-0001	Status Panel Assembly		1.0	ea	1A26
3	012206-0001	Status Display, CCA		1.0	ea	1A26A1

Table 8-2 Dual Equipment Low Power DME System PN 001118A-0102						
Lv	Part Number	Description 1	Description 2	Qty	U/M	Ref Des
1	030799-0002	Wired Cabinet Assy	Dual	1.0	ea	
2	030815-0001	Common Cabinet Assy		1.0	ea	
2	030814-0003	BCPS Assembly		1.0		
1	030801-0001	Local Control Unit Assembly		1.0	ea	1A1
2	012179-1001	Local Control Unit, CCA	(LCU)	1.0	ea	1A1A1
3	030800-0001	Low Power Rack Assembly		1.0	ea	1A8
4	012166-0001	Backplane, CCA	Low Power Rack	1.0	ea	1A8A1
2	012033-0001	LNA, CCA		1.0	ea	1A8A2
1	030208-0002	Low Power Amplifier Assy		2.0	ea	1A9/1A17
2	012173-0001	Synthesizer, CCA		2.0	ea	1AXA1
2	012174-0001	Modulator, CCA		2.0	ea	1AXA4
1	030805-0001	Rcvr/Xmtr Controller Assy		2.0	ea	1A10/1A16
2	012168-1001	Rcvr/Xmtr Control, CCA		1.0	ea	1AXA1
2	012180-0001	Receiver RF, CCA		1.0	ea	1AXA2
1	030806-0001	Monitor Interrogator Assy		2.0	ea	1A11/1A15
2	012169-1001	Monitor/Interrogator, CCA		2.0	ea	1AXA1
2	012181-0001	Monitor/Interrogator RF, CCA		2.0	ea	1AXA2
1	012172-1001	RMS Processor, CCA		1.0	ea	1A13
1	012171-0001	RMS Facilities, CCA		1.0	ea	1A14
3	012167-0001	Interface, CCA		1.0	ea	1A19
2	012170-1001	BCPS, CCA		2.0	ea	1A20/1A21
3	012186-0001	AC Monitor, CCA		1.0	ea	1A22
2	950739-0002	Power Supply	500W	2.0	ea	1A24/1A25
2	030813-0002	Status Panel Assembly		1.0	ea	1A26
3	012206-0001	Status Display, CCA		2.0	Ea	1A26AX

Table 8-3 Single Equipment High Power DME System PN 001119A-0101

Lv	Part Number	Description 1	Description 2	Qty	U/M	Ref Des
1	030799-0003	Wired Cabinet Assy	Single	1.0	ea	
2	030815-0001	Common Cabinet Assy		1.0	ea	
2	030814-0001	BCPS Assembly		1.0	ea	
2	030801-0001	Local Control Unit Assembly		1.0	ea	1A1
3	012179-1001	Local Control Unit, CCA	(LCU)	1.0	ea	1A1A1
2	030807-0001	High Power Rack Assembly		1.0	ea	1A2
3	012176-0001	Backplane, CCA	High Power Rack	1.0	ea	1A2A1
3	012187-0001	Fan Controller, CCA		1.0	ea	1A2A2
1	030804-0001	High Power Amplifier Assy		1.0	ea	1A3
2	012178-0001	Modulator, CCA		1.0	ea	1A3A3
2	012177-0001	HP Amp Power Supply, CCA		1.0	ea	1A3A5
2	012194-0001	HP Amp, CCA	Front Panel Intfc	1.0	Ea	1A3A5
3	030800-0001	Low Power Rack Assembly		1.0	ea	1A8
4	012166-0001	Backplane, CCA	Low Power Rack	1.0	ea	1A8A1
2	012033-0001	LNA, CCA		1.0	ea	1A8A2
1	030802-0001	Low Power Amplifier Assy		1.0	ea	1A9
2	012173-0001	Synthesizer, CCA		1.0	ea	1A9A1
2	012174-0001	Modulator, CCA		1.0	ea	1A9A4
1	030805-0001	Rcvr/Xmtr Controller Assy		1.0	ea	1A10
2	012168-1001	Rcvr/Xmtr Control, CCA		1.0	ea	1A10A1
2	012180-0001	Receiver RF, CCA		1.0	ea	1A10A2
1	030806-0001	Monitor Interrogator Assy		1.0	ea	1A11
2	012169-1001	Monitor/Interrogator, CCA		1.0	ea	1A11A1
2	012181-0001	Monitor/Interrogator RF, CCA		1.0	ea	1A11A2
1	012172-1001	RMS Processor, CCA		1.0	ea	1A13
1	012171-0001	RMS Facilities, CCA		1.0	ea	1A14
3	012167-0001	Interface, CCA		1.0	ea	1A19
2	012170-1001	BCPS, CCA		1.0	ea	1A20
3	012186-0001	AC Monitor, CCA		1.0	ea	1A22
2	950909-0000	Power Supply	1500W	1.0	ea	1A24
2	030813-0001	Status Panel Assembly		1.0	ea	1A26
3	012206-0001	Status Display, CCA		1.0	ea	1A26A1

Table 8-4 Dual Equipment High Power DME System PN 001119A-0102

Lv	Part Number	Description 1	Description 2	Qty	U/M	Ref Des
1	030799-0004	Wired Cabinet Assy	Dual	1.0	ea	
2	030815-0001	Common Cabinet Assy		1.0	ea	
2	030814-0002	BCPS Assembly		1.0	ea	
2	030801-0001	Local Control Unit Assembly		1.0	ea	1A1
3	012179-1001	Local Control Unit, CCA	(LCU)	1.0	ea	1A1A1
2	030807-0001	High Power Rack Assembly		1.0	ea	1A2
3	012176-0001	Backplane, CCA	High Power Rack	1.0	ea	1A2A1
3	012187-0001	Fan Controller, CCA		1.0	ea	1A2A2
1	030802-0001	High Power Amplifier Assy		2.0	ea	1A3/1A7
2	012178-0001	Modulator, CCA		1.0	ea	1AXA3
2	012177-0001	HP Amp Power Supply, CCA		1.0	ea	1AXA5
2	012194-0001	HP Amp, CCA	Front Panel Intfc	1.0	ea	1AXA5
3	030800-0001	Low Power Rack Assembly		1.0	ea	1A8
4	012166-0001	Backplane, CCA	Low Power Rack	1.0	ea	1A8A1
2	012033-0001	LNA, CCA		1.0	ea	1A8A2
1	030802-0001	Low Power Amplifier Assy		2.0	ea	1A9/1A17
2	012173-0001	Synthesizer, CCA		2.0	ea	1AXA1
2	012174-0001	Modulator, CCA		2.0	ea	1AXA4
1	030805-0001	Rcvr/Xmtr Controller Assy		2.0	ea	1A10/1A16
2	012168-1001	Rcvr/Xmtr Control, CCA		2.0	ea	1AXA1
2	012180-0001	Receiver RF, CCA		2.0	ea	1AXA2
1	030806-0001	Monitor Interrogator Assy		2.0	ea	1A11/1A15
2	012169-1001	Monitor/Interrogator, CCA		2.0	ea	1AXA1
2	012181-0001	Monitor/Interrogator RF, CCA		2.0	ea	1AXA2
1	012172-1001	RMS Processor, CCA		1.0	ea	1A13
1	012171-0001	RMS Facilities, CCA		1.0	ea	1A14
3	012167-0001	Interface, CCA		1.0	ea	1A19
2	012170-1001	BCPS, CCA		2.0	ea	1A20/1A21
3	012186-0001	AC Monitor, CCA		1.0	ea	1A22
2	950909-0000	Power Supply	1500W	2.0	ea	1A24/1A25
2	030813-0002	Status Panel Assembly		1.0	ea	1A26
3	012206-0001	Status Display, CCA		1.0	ea	1A26A1
2	012205-0001	Interface, CCA	1500W PS	2.0	ea	1A27/1A28

9. INSTALLATION, INTEGRATION AND CHECKOUT

9.1 Introduction

This section contains installation information for the independently located DME. If the DME is to be collocated with VOR or ILS refer to the basic instructions in this section and to the installation instructions for the VOR or ILS equipment. With respect to general requirements, a good VOR or ILS site will satisfy the DME requirements as well. System performance must be verified by flight inspection. [Figure 9-1](#) shows a typical DME site.

NOTE

After flight inspections and prior to use by pilots, it is mandatory that the monitor be left in control of the facility and not in bypass.

9.2 Site Information

9.2.1 Site Selection

The signal radiated from the DME is affected by obstructions and terrain in the immediate vicinity of the antenna and by obstructions and terrain within the service range of the station. An ideal site would be the highest ground in the vicinity with level terrain, cleared of all objects for a radius of at least 3000 feet (915 meters), and with no obstructions extending above the horizontal plane of the antenna within the service range of the station. In most localities, it is not possible to satisfy the ideal site requirements. Every effort must be made to obtain the best site available. Although no absolute minimum requirements can be stated, a site is normally acceptable if it meets the recommendations contained in the following paragraphs.

9.2.1.1 Terrain Features

The terrain should be level within a radius of 200 feet (61 meters). In a radius between 200 and 1000 feet (61 and 305 meters), a downward slope is acceptable if (1) the rate of descent is not more than 4 feet in 100 feet (1.22 meters in 30.5 meters) and (2) contour lines are generally circular around the site. Beyond a radius of 1000 feet (305 meters), terrain should be below the horizontal plane of the antenna.

9.2.1.2 Obstructions

There should be no structures within 750 feet (229 meters) of the antenna. Metallic structures should not subtend vertical angles greater than 1.2 degrees as measured from the antenna. Wooden structures with negligible metal content should not subtend vertical angles greater than 2.5 degrees as measured from the antenna. Structures having considerable length (such as aircraft hangers or administration buildings) should be situated lengthwise on a radial from the antenna. Single trees less than 35 feet (11 meters) high may be tolerated beyond 750 feet. No group of trees or groves may be within 1000 feet. No overhead power or control lines are permissible within 750 feet of the antenna.

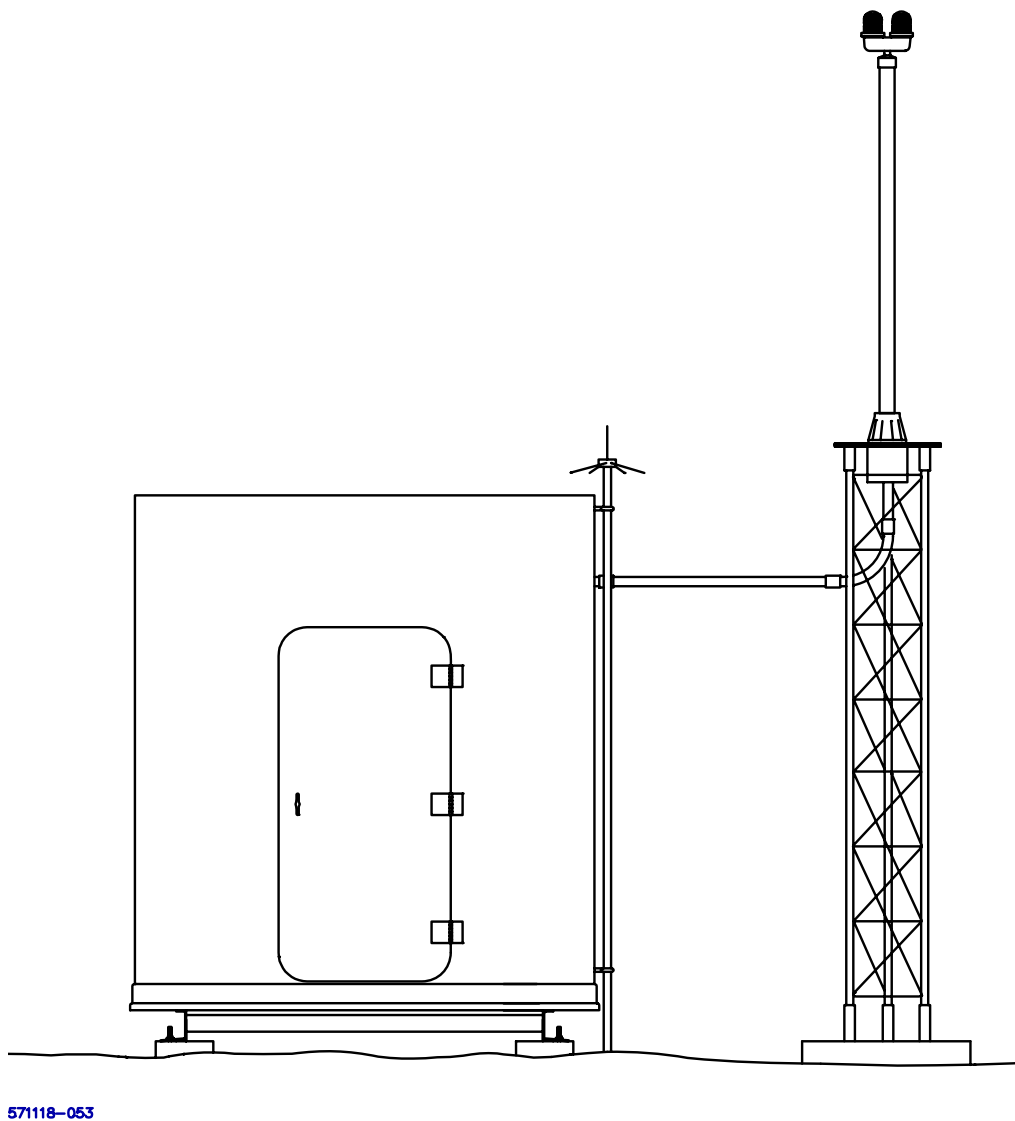


Figure 9-1 Typical DME Site

9.2.2 Shelter Requirements

The shelter location depends primarily on the maximum cable run allowed and on the desired location for the DME antenna. An RF transmission line of 1/2" foamflex cable (with Type N connectors at each end), one cable for the monitor antenna made up of 1/4" foamflex (with a Type N connector at one end and a TNC male connector at the opposite end), and one AC cable for the OB Lite may be supplied with the DME equipment. These cables are 35 feet long. When the requirements exceed 35 feet, company engineering personnel can provide the necessary planning to determine the requirements.

The DME ground equipment is designed to operate continuously and unattended, but space must be allocated for maintenance personnel and their equipment.

9.3 Unpacking and Repacking

The DME electronic subsystem is shipped unassembled. Only general precautions can be given because the crating and unpacking depends upon destination and what optional equipment is included. Most items are packed separately in individual containers; these are then grouped for crating. Each crate contains a packing list which details what equipment is enclosed in the crate. Unpack the equipment and visually inspect each item for accuracy and damage, but **DO NOT REMOVE** any ESD protective wrapping. Report any damage immediately. After inspection, repack each item to prevent damage. During installation, unpack items as they are needed.

9.3.1 Environmental Considerations

The environmental conditions must not exceed those listed in the Specifications of [Table 1-1 Environmental Data](#).

9.4 Input Power Requirement Summary

The requirements for input power must not exceed those listed in the Specification of [Table 1-1 Primary Power](#).

9.5 Installation Procedures

9.5.1 Installation Tools and Test Equipment

Refer to [Table 6-1](#) for a list of test equipment and [Table 9-1](#) for a list of special tools required for installation.

Table 9-1 Special Tools Required for Installation

<u>Description</u>
Tube Cutter
File
Knife
2-1/4" Hole Saw
Assorted Screw Drivers and Wrenches
Thread Tape

9.5.2 Installation Kits

Refer to [Table 9-2](#) for all component or modification kits required to install the DME station. Some kits listed are optional equipment. Kits ending with “X” have many different varieties and will vary depending on the site specific requirements. In all necessary cases installation drawings for each kit are provided with the kit hardware.

Table 9-2 Component or Modification Kits Required to Install the DME

<u>Part Number</u>	<u>Description</u>
470085-000X	DME Tower Antenna Kit
470561-0001	DME Unidirectional GS Tower Mount Antenna Kit
470628-000X	DME Battery Backup Kit, 35Ahr
470622-0001	DME Accessory Kit
470627-0001	DME AC Power/Installation Kit
470291-000X	DME OB Light Kit
470623-0001	Environmental Sensors Kit
470360-000X	PMDT Kit

Table 9-3 Additional kits required to Install Shelter and Tower Grounding Systems

<u>Part Number</u>	<u>Description</u>
470252-0002	Civil Install Kit, 45G Rohn Tower
470225-0001	Civil Install Kit, Shelter
470557-0001	Shelter Internal Grounding Kit

9.5.3 Shelter Foundation Installation

For shelters not supplied by SELEX Sistemi Integrati Inc., the manufacturer of the shelter will supply drawings for the site engineer.

9.5.4 Shelter Installation

- Use a crane and four nylon slings (20 feet long) to position the equipment shelter on the four concrete piers.
- Attach the shelter to the pier anchor bolts using appropriate hardware.

9.5.5 Tower Foundation and Tower Installation

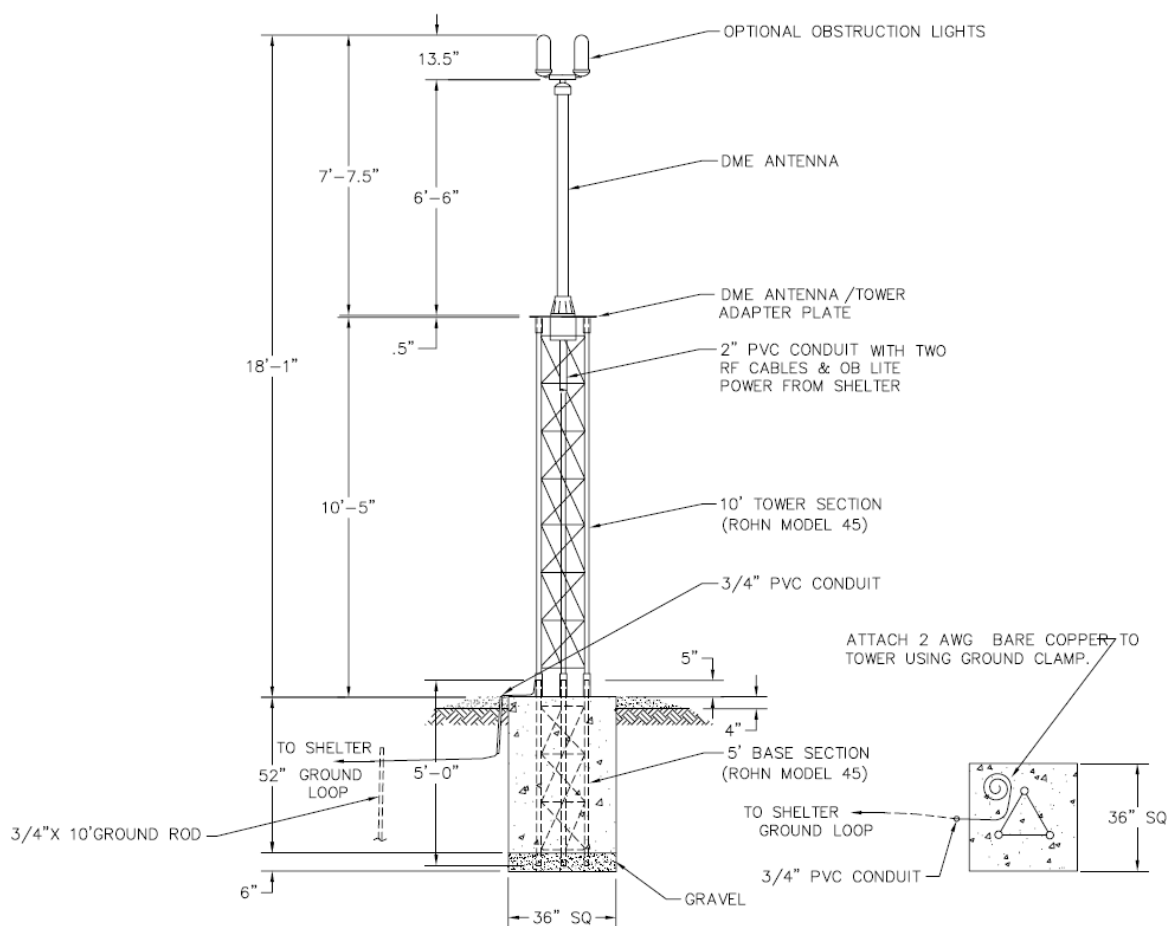
A triangular steel tower is available for use as a support for the DME antenna. [Figure 9-2](#) shows the installation details for this tower. [Figure 9-3](#) illustrates the triangular tower adapter plate required to mount the antenna to the DME tower.

9.5.6 Shelter and Tower Installation Grounding

- Install ground rods and ground wire as detailed in [Figure 9-2](#) and [Figure 9-4](#).
- Install the 470557 Shelter Internal Grounding Kit per the drawing provided with the kit.
- Verify the shelter grounding plate, AC wiring, lightning protection, RF tower, and telephone equipment all share a common grounding potential. The impedance between any of these items should be below 10Ω.

9.5.7 Air Conditioner Installation

If a wall mounted air conditioner is supplied, install the air conditioner in the wall opening and secure it in place using bracket supplied. Apply silicon seal around air conditioner and wall opening to maintain a weather tight seal.



TYPICAL DME TOWER & ANTENNA INSTALLATION

Figure 9-2 Typical DME Tower Installation Diagram

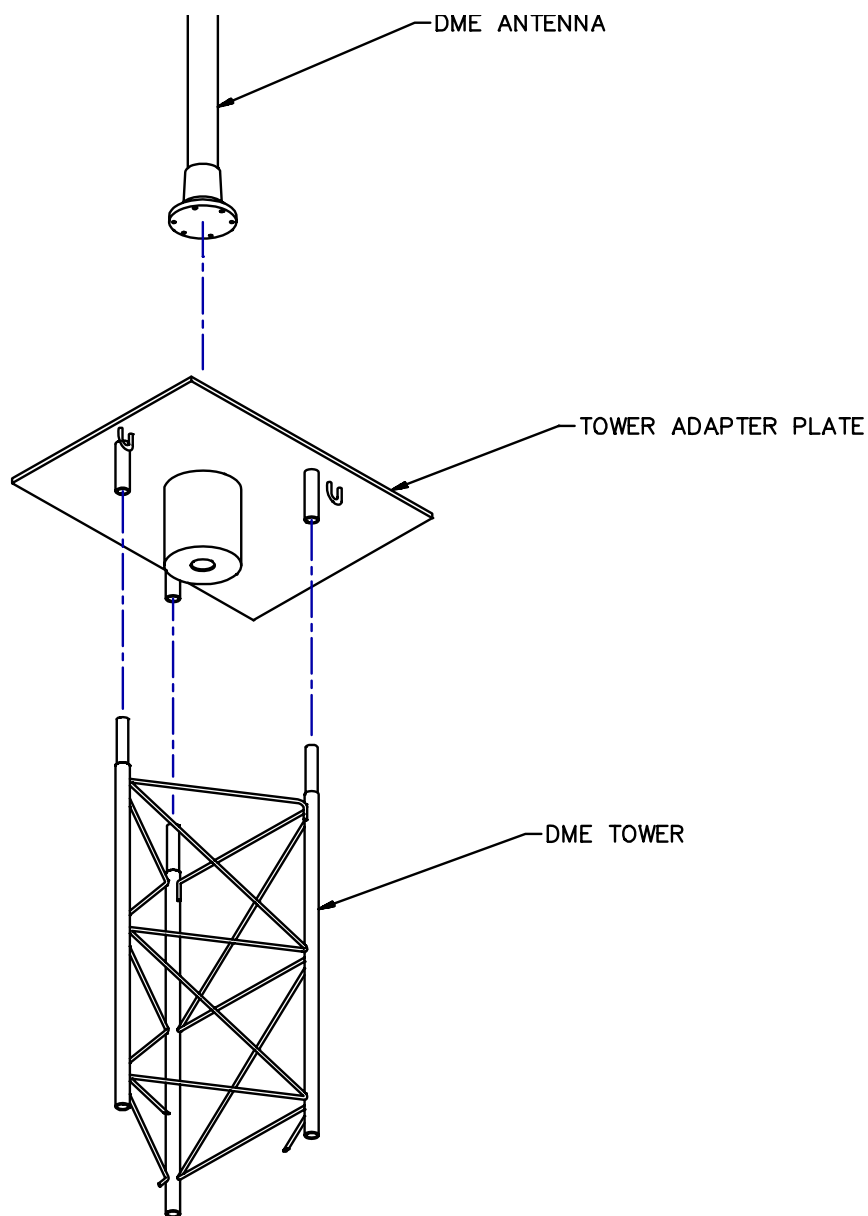
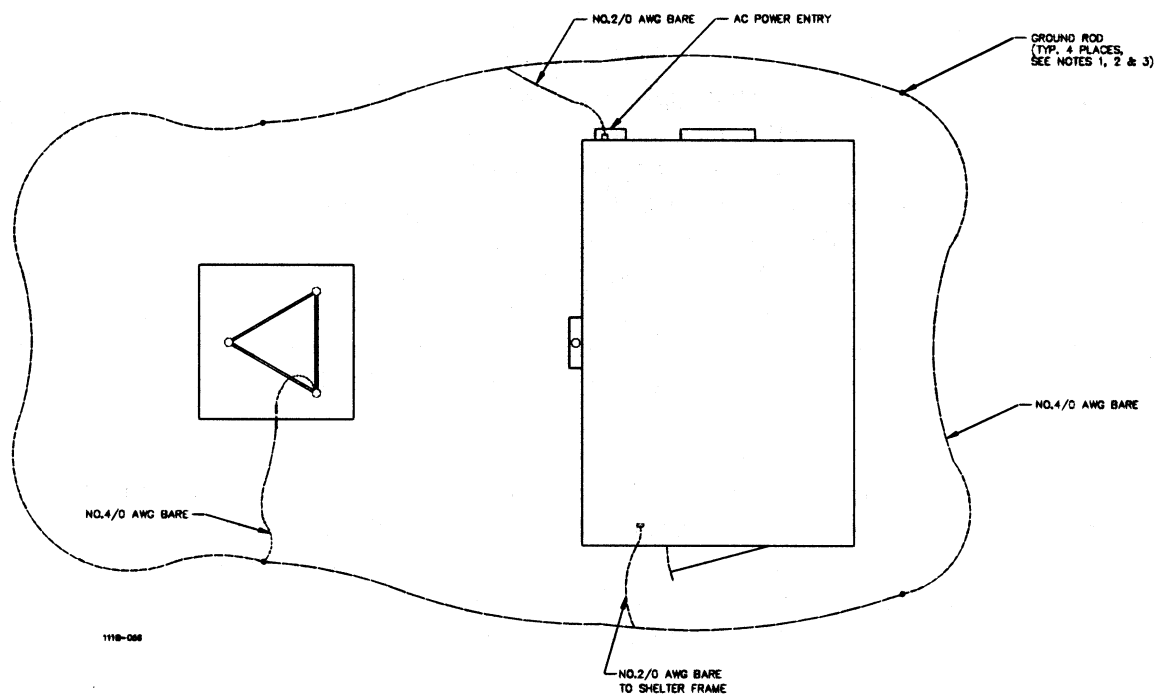


Figure 9-3 Triangular Tower Adapter Plate



NOTES:

1. ALL GROUND RODS SHALL BE 3/4" x 10' COPPER CLAD STEEL, DRIVEN TO 12" BELOW GRADE.
2. ALL BONDS BELOW GRADE SHALL BE EXOTHERMICALLY WELDED, UNLESS OTHERWISE NOTED.
3. ALL GROUND RODS SHALL BE AT LEAST 24" FROM ANY FOUNDATION (8" MAX.).

Figure 9-4 Typical DME Shelter and Tower Grounding Diagram

9.5.8 DME Cabinet Installation

- a. Unpack the DME 19" rack system and stand upright inside the equipment shelter.
- b. The rack can be located on an outside wall or in the center of the room; however the ventilation louvers located on the left side of the cabinet must not be obstructed.
- c. To level the rack use the adjustable feet then lock the feet positions using the jam nuts.
- d. If desired the front and rear doors can easily be removed by sliding up the three hinge pins on the left inside edge of each door. If the doors are removed be sure to replace them after installation.
- e. Use #6 grounding wire provided in the AC Power/Installation Kit (Figure 11-31) to connect from the DME grounding bus bar to the shelter grounding plate using the shortest path possible.

NOTE: Do not install any modules in the rack until it is properly grounded.

9.5.9 Battery Backup Assembly Installation

- a. Insure DME system AC and DC circuit breakers are in the OFF position.
- b. Construct battery backup unit as detailed in Figure 11-32 or per the drawing provided with supplied battery backup kit.
- c. Install the four twelve-volt batteries and connect batteries in series.

Rev. B August, 2006

9-7

Model 1118A/1119A DME

- d. Install battery backup wiring between the DME transmitter cabinet and the battery backup assembly. The battery ground lead should connect to the grounding bus bar and the battery hot wire (+48V) should connect to TX1 DC breaker located on the 1A26 Status Panel Assembly.
- e. When supplied with two battery kits then connect the hot wire (+48V) from the second battery set to the TX2 DC breaker; otherwise install the jumper wire between TX2 DC breaker and TX1 DC breaker as provided in the battery kit.
- f. Install safety cover(s) over batteries or lid(s) on battery backup box.

CAUTION: Shorting the battery leads can cause a fire or explosion.

9.5.10 Primary AC Power Installation

AC wiring for the DME will require a separate circuit breaker for the DME system and DME obstruction lights. The convenience outlet located on the front of the 1A26 Status Panel is powered from the obstruction light breaker.

- a. Insure DME system AC and DC circuit breakers are in the OFF position
- b. Insure that shelter DME system circuit breaker is in the OFF position.
- c. Connect primary AC power to DME as detailed in [Figure 11-31](#).

9.5.11 Shelter to Tower Conduit Connections

- a. Using a 2-1/4" hole saw, cut a hole in the wall between the DME transmitters and the antenna tower at a height above the top of the DME transmitter cabinet.
- b. Refer to [Figure 11-28](#). Slide 2" x 5" threaded conduit into hole. Install reducing washer and 2" locknut on each end of threaded conduit. Tighten locknut.
- c. Install protective bushing on exposed threaded conduit threads of interior shelter wall. Install 2" PVC female adapter on threaded conduit of outer shelter wall.
- d. Refer to [Figure 9-7](#). Cut 2" PVC appropriate length to center of tower directly under antenna.
- e. Install 2" PVC hole adapter in bottom of triangular tower adapter plate. Install reducing washer and 2" locknut onto hole adapter. Install protective bushing over exposed threads.
- f. Cut 2" PVC appropriate length to extend from triangular tower adapter plate to 2" PVC from shelter. Insure that 2" PVC from triangular tower adapter plate is cut so that PVC from shelter slopes slightly downward as it runs to tower.
- g. Install 2", 90 degree PVC connector and 2" conduit adapters between the two pieces of 2" PVC and insure that all pieces fit. Drill a 1/8" hole in the bottom of 2" 90 degree PVC connector. This will allow any water seepage to drain. Pre-fit all pieces to insure proper mating.

9.5.12 Obstruction Light Installation and Wiring

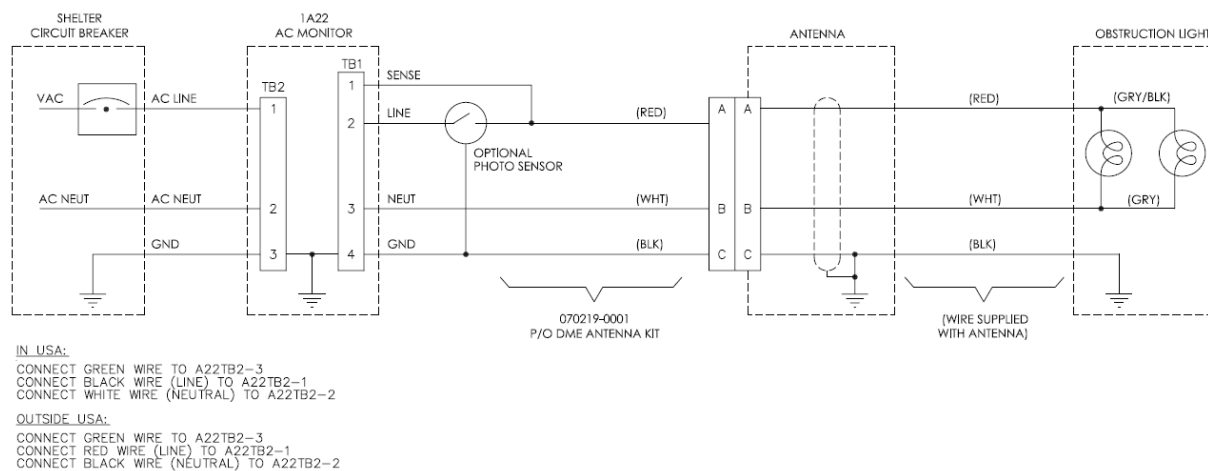
The obstruction light assembly is shipped separately from the DME antenna and it is necessary to attach the obstruction light to the top of the DME antenna; and the wiring that extends from the antenna must be connected to the bulb sockets. [Figure 9-8](#) shows the assembly details.

NOTE

The mounting hole on the top of the DME antenna is threaded for a 3/4" pipe thread. There are two versions of obstruction light assemblies available: one is threaded for a 3/4" pipe thread; the other is threaded for a 1" pipe thread. For the 3/4" pipe version, a 1" to 3/4" reducer and a 3/4" by 1-1/2" nipple stainless steel combination should be used.

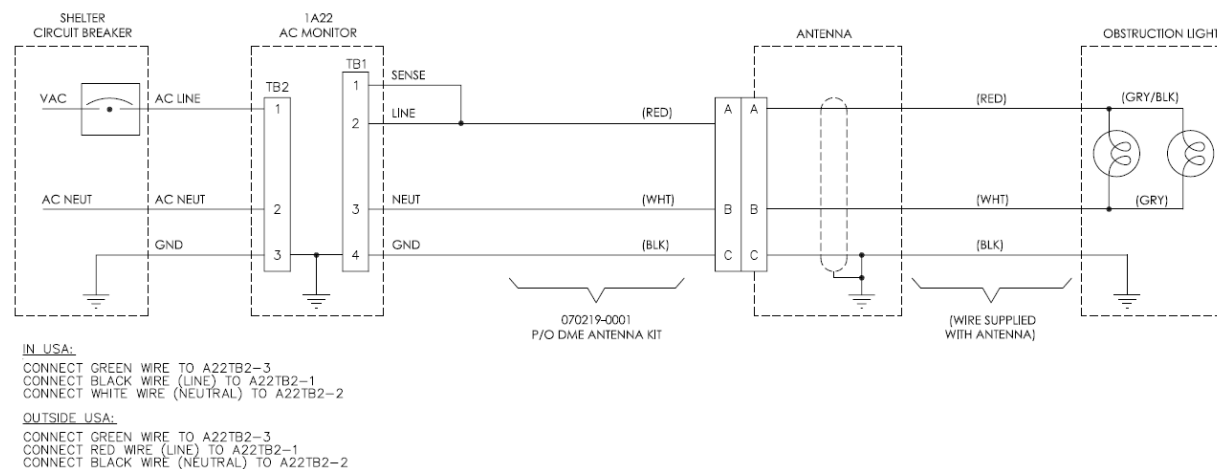
- a. Remove lens and bulbs.
- b. Remove the hole cap at the top of the DME antenna and fish out the AC wires using stiff wire bent into a hook.
- c. Route the three wire AC cable from the DME antenna through the required pipe adapters and into the bulb sockets.
- d. Thread the obstruction light assembly into the antenna. Use thread tape on all pipe threads to insure a water tight fit.
- e. Connect the three AC wires from the antenna to the bulb sockets, as shown in [Figure 9-5](#) or [Figure 9-6](#).

- f. Install the lighting rod to the obstruction light nipple as detailed in [Figure 11-28](#).
- g. Verify the obstruction light bulbs match the site AC voltage rating then install the bulbs and lens.
- h. After installing antenna to tower, connect remaining obstruction light power wires to DME cabinet and shelter circuit breaker box as shown in [Figure 9-5](#) or [Figure 9-6](#). Note that the 070219-0001 cable is located in the Antenna Kit ([Figure 11-28](#)).



HPDME_011

Figure 9-5 DME Obstruction Light Interconnect Diagram with Photo Sensor



HPDME_012

Figure 9-6 DME Obstruction Light Interconnect Diagram without Photo Sensor

9.5.13 DME Antenna Installation

- a. Use a crane and nylon slings to lift the DME antenna to the top of tower.
- b. Install DME antenna on triangular tower adapter plate as shown in [Figure 11-28](#). Orientation of the obstruction bulbs and lightning rod is not important.
- c. Secure antenna with appropriate hardware provided in the DME antenna kit.

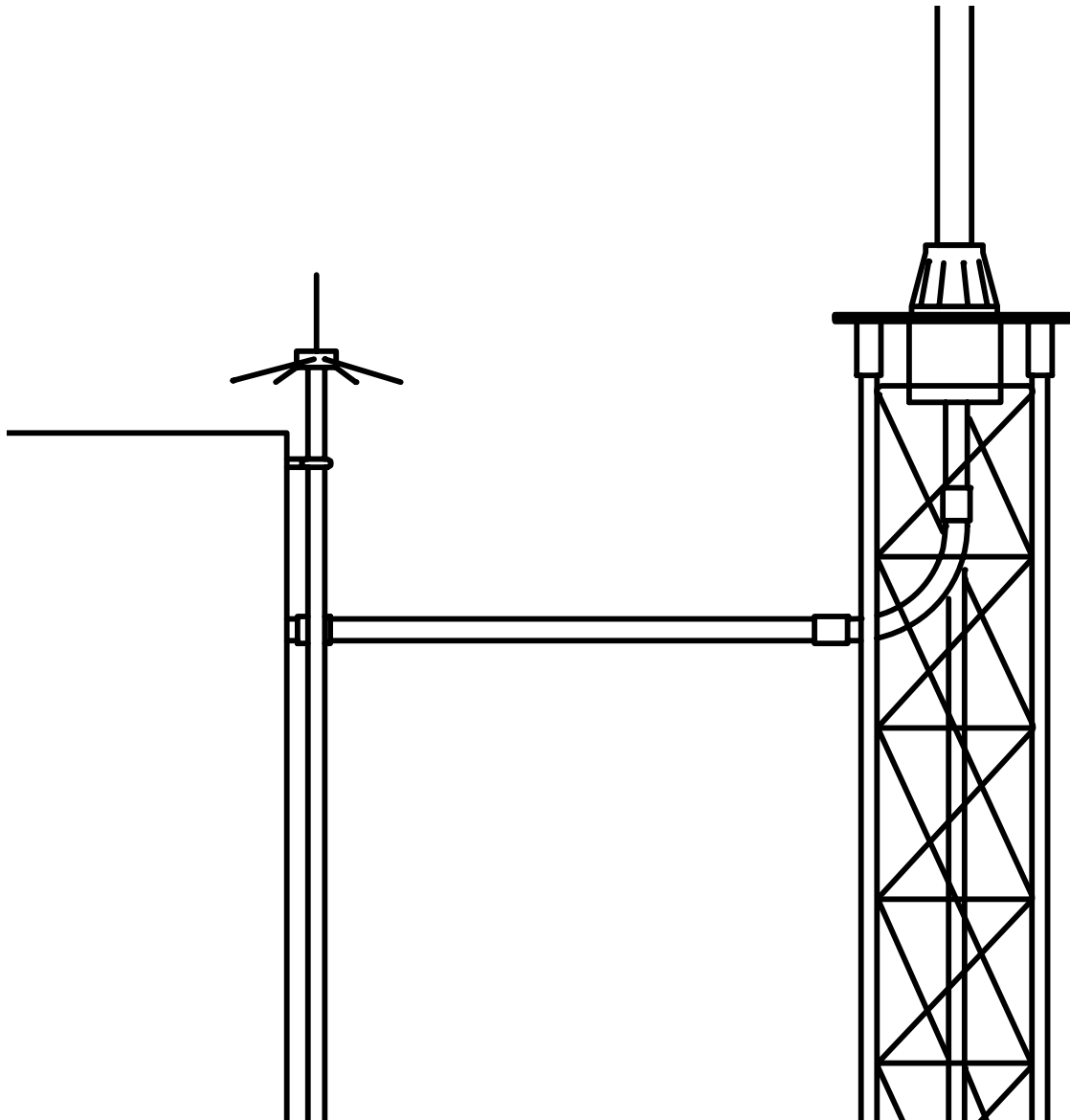
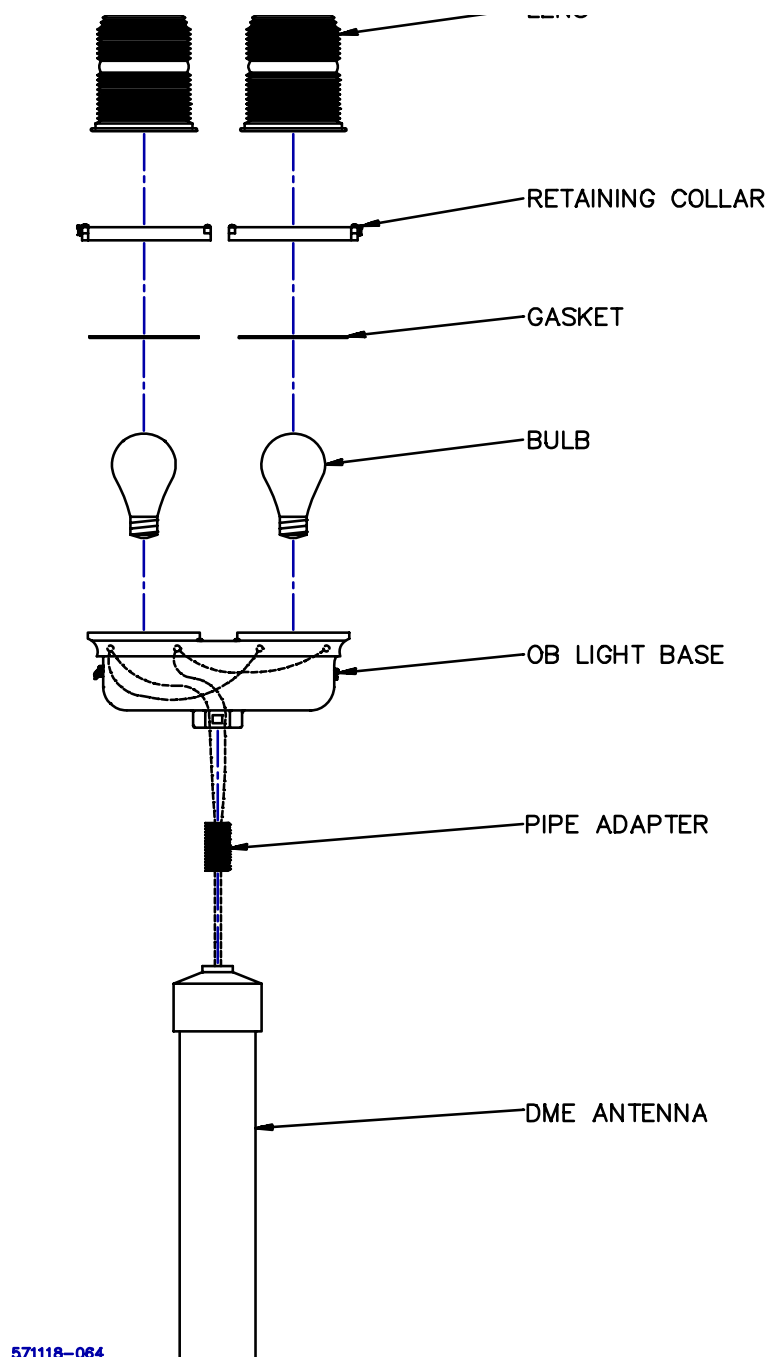


Figure 9-7 Typical Shelter to Tower Conduit Installation



571118-064

Figure 9-8 Obstruction Light Installation Diagram

9.5.14 DME Transmitter to Antenna Interconnect

- Refer to [Figure 9-7](#). Route ½” Heliax RF feedcable through conduit and connect to antenna connector J1 (RF INPUT).
- Route ¼” Heliax antenna monitor cable through conduit and connect to antenna connector J2 (RF MONITOR OUTPUT). Note that in most installations the J3 RF MONITOR OUTPUT port can be used instead of J2 however J2 is preferred.
- Route obstruction light power cable through conduit and to antenna connector J4 (OBSTN LT INPUT).
- Connect ½” Heliax RF feedcable to DME transmitter connector 1J1 (RF OUT).
- Connect ¼” Heliax antenna monitor cable to DME transmitter connector 1J2 (ANT MON1).
- Place obstruction light circuit breaker to the ON position. Verify obstruction lights illuminate.
- Using PVC cement, glue 2" PVC conduit connections previously installed.

9.5.15 Connecting VOR or ILS Keyer Wiring

- Verify that the primary AC power (located in the shelter main circuit breaker box), VOR equipment and DME equipment circuit breakers are in the OFF position.
- Using the two-conductor electrical cable and forked terminal lugs provided in the AC Power/Installation kit ([Figure 11-31](#)), connect KEY_OUT+ and KEY_OUT- signals from the 1A19 Interface CCA located in rear of the DME cabinet to the appropriate location as identified in [Table 9-4](#).

Note after equipment startup refer to section [3.7.7.2.1 Nominal Configuration Screen](#) to configure external keying.

Table 9-4 External Keying Connection Locations

SELEX Navaid	KEY_OUT+ (1A19TB2-14) Destination	KEY_OUT- (1A19TB2-15) Destination
1150 VOR	TB10-5	TB10-6
2100 Localizer	1A18TB4-1	1A18TB4-2
2110 Glideslope	1A18TB4-1	1A18TB4-2

9.5.16 RCSU and RMM Connections

- If the DME is provided with a 2238 RCSU then connect the copper wires from the RCSU to the 1A19TB2-1 and 1A19TB2-2 locations on the Interface CCA for a Dedicated Modem connection type. For a RF Modem/Fiber connection type, the RS232 connection should be made to the 1A19J5 DB9 connector. DIP switch S2-1 located on the 1A8A1 Low Power Backplane CCA should be set to match the Connection Type as well.
- If a telephone line is available for remote maintenance monitoring (RMM), connect the tip and ring wires from the telephone interface box to the 1A19 Interface CCA locations TB2-3 and TB2-4. Polarity is not important. DIP switch S2-2 located on the 1A8A1 Low Power Backplane CCA should be set to “DIAL-UP” when using this internal dial-up modem. Use the two-conductor electrical cable provided in the AC Power/Installation kit ([Figure 11-31](#)) for this connection.
- If the DME’s internal dial-up modem is unable to comply with local telephone requirements then connect the telephone line to an external modem and connect the external modem serial port to the 1A19 Interface CCA J6 connector. DIP switch S2-2 located on the 1A8A1 Low Power Backplane CCA should be set to “~EXTERNAL” when using an external dial-up modem. Reset the DME station after changing the S2-2 switch.
- DIP switch S1-6 located on the 1A8A1 Low Power Backplane CCA controls whether the DME station will allow remote configuration of transmitter and monitor parameters. When set to “RMT ALLOWED” a remote user logged into Security Level 3 can put the DME station in Local Mode from the PMDT and change all parameters as if connected directly to the cabinet in the shelter. When set to “~NOT ALLOWED” the system can not be put in Local Mode from the PMDT and remote parameter changes are blocked throughout the software.

9.6 Inspection

Prior to energizing the equipment, a visual inspection is made to eliminate circumstances that could cause power-up failures.

- a. Visually inspect wire, RF coaxial cables and connectors for corrosion, loose connectors and improperly assembled connectors.
- b. Insure all terminal boards are free of foreign objects such as pieces of wire or other objects that could cause electrical shorts within the equipment. Remove foreign objects as necessary.
- c. Inspect the battery backup units to ensure that all terminals and connectors are tight and that there are no metal shavings or other objects that could cause damage to the equipment.

9.7 Initial Start-up and Preliminary Testing

The following paragraphs detail the step-by-step procedures for initial start-up and preliminary testing of the DME.

9.7.1 Input Voltage Checks

After the AC and DC power has been connected to the DME transmitter. It is necessary to check the input power to insure the proper voltage is applied to the system.

- a. Assure that the DME AC and DC circuit breakers to the OFF position.
- b. Set the shelter primary AC power circuit breakers to the ON position.
- c. Using an AC voltmeter check voltage across the AC Monitor 1A22TB3-1 (LINE) to 1A22TB3-2 (NEUTRAL) terminals. Insure the voltage meets the range specified in section [Table 1-1 Primary Power](#).
- d. Turn on the DME DC circuit breaker while leaving the AC circuit breakers OFF.
- e. Using a DC voltmeter check voltage across 1A20 BCPS1 E7 (BATT_POS) to E9 (GND). Insure the voltage is 42 to 50Vdc.
- f. For dual equipment check voltage across 1A21 BCPS2 E7 (BATT_POS) to E9 (GND). Insure the voltage is 42 to 50Vdc.
- g. Turn DC circuit breakers to the OFF position.

9.7.2 Installing Modules in Transmitter Cabinet

Since the DME transmitter cabinet is shipped separately from its electronic modules, it will be necessary to install them into the transmitter equipment cabinet. Insure AC and DC circuit breakers are set to the OFF position.

CAUTION

Many of the modules used in the DME transmitter contain Electrostatic Discharge (ESD) sensitive components. ALWAYS wear protective wrist strap when installing modules or CCAs. Before modules are installed into transmitter cabinet, check modules or CCAs for cracked or broken connectors, bent pins, and loose hardware. Report any damage immediately.

9.7.3 Turn on Procedure

- a. Verify all assemblies are properly installed and are fully seated.
- b. Turn AC and DC circuit breakers to the ON position.
- c. Verify the PWR_OK LEDs are lit on all card cage modules.
- d. Verify the CPU_OK LEDs are lit on the RTC, Monitor, and RMS assemblies.

9.7.4 PMDT Hookup and Setup

- a. Unpack the PMDT laptop computer and follow the manufacturer's installation instructions to power-up the computer, create a user account, and logon to Windows™ as an administrator.
- b. Insert the 978178-XXXX PMDT CD-ROM into the laptop computer.

Model 1118A/1119A DME

- c. Select Start >> Run then type **D:\Setup.exe** to start the PMDT installation. Note if installation does not start then use the correct drive letter associated with the CD-ROM drive.
- d. Follow the default prompts for PMDT installation.
- e. In order for the PMDT controls to be properly displayed change the DPI Setting to “Normal (96 DPI)” in Windows on the Display Properties >> Settings >> Advanced >> General tab. Note that Display Properties can be accessed by right-clicking on the Windows background then selecting Properties.
- f. At the DME assure the AC and DC breakers are in the ON position.
- g. Plug the USB cord between the laptop computer and 1A13J1 (PMDT USB) located on the RMS CCA.
- h. Windows should detect the USB device and start installing a driver. If prompted for the USB driver files they are installed in the PMDT directory at C:\Program Files\SELEX-SI\PMDT\FTDI USB Driver.
- i. Start the PMDT application by double-clicking on the desktop icon named PMDT.
- j. Select System >> PMDT Setup.
- k. In the Navaid Direct COM Port control pick the COM port that contains “USB Serial Port” in the description.
- l. On the PMDT configuration screen, setup other options such as Language and Print Screen mode then select OK to save the changes.
- m. Refer to section [3.6.6.2 PMDT Logon via Direct or Modem Connection](#) to connect to the DME equipment at Security Level 3.

9.7.5 Site Adjustments and Configurations

- a. Press the LOCAL CONTROL button on the 1A1 LCU to put the DME into Local Mode.
- b. At the LCU bypass the Integral monitor and put Transmitter 1 on antenna.
- c. If the VSWR reading on the Monitors >> Data >> Integral screen is in alarm then shut down the DME and troubleshoot the RF feedcable to antenna connection before continuing. VSWR alerts detected by each power amplifier can also be found on the Transmitters >> Data >> Transmitter Data screen that indicate a faulty RF load.
- d. On the Monitors >> Data >> Integral screen note the ERP (Effective Radiated Power) value for each monitor.
- e. On the Monitors >> Configuration >> Integral screen change the Monitor 1 Replay Attenuation setting until the Monitor 1 EPR is 0 ± 1 dB.
- f. For dual monitor equipment change the Monitor 2 Replay Attenuation setting until the Monitor 2 EPR is 0 ± 1 dB.
- g. On the RMS >> Configuration >> Station screen verify the channel number and type (X or Y) match the site requirements and frequency paring requirements as identified in [Table 9-5](#). If corrections are needed then refer to section [6.4.4 Performing a Frequency Change or X/Y Conversion](#).
- h. While on the RMS >> Configuration >> Station screen type a Station Identifier message that will be used to uniquely identify the station when performing local or remote maintenance. It is suggested that the site name and runway identifier be included.
- i. If the DME is provided with a 2238 RCSU then on the RMS >> Configuration >> General screen check the RCSU Present box and configure the Connection Type and Interlock Control to match the installation requirements.
- j. Set the Primary Ident Code to the assigned station identifier as detailed in section [3.7.7.2.1 Nominal Configuration Screen](#). Also select the keying source and other keying options while on that screen.
- k. Select RMS >> Config Backup to save changes to the DME configuration.
- l. If using a wattmeter with removable elements for site maintenance then perform the procedure in section [6.4.2 Recording Wattmeter Reference Reading](#).

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
1X	-	-	-	1025	12	962	12	900
1Y	-	-	-	1025	36	1088	30	900
2X	-	-	-	1026	12	963	12	901

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
2Y	-	-	-	1026	36	1089	30	901
3X	-	-	-	1027	12	964	12	902
3Y	-	-	-	1027	36	1090	30	902
4X	-	-	-	1028	12	965	12	903
4Y	-	-	-	1028	36	1091	30	903
5X	-	-	-	1029	12	966	12	904
5Y	-	-	-	1029	36	1092	30	904
6X	-	-	-	1030	12	967	12	905
6Y	-	-	-	1030	36	1093	30	905
7X	-	-	-	1031	12	968	12	906
7Y	-	-	-	1031	36	1094	30	906
8X	-	-	-	1032	12	969	12	907
8Y	-	-	-	1032	36	1095	30	907
9X	-	-	-	1033	12	970	12	908
9Y	-	-	-	1033	36	1096	30	908
10X	-	-	-	1034	12	971	12	909
10Y	-	-	-	1034	36	1097	30	909
11X	-	-	-	1035	12	972	12	910
11Y	-	-	-	1035	36	1098	30	910
12X	-	-	-	1036	12	973	12	911
12Y	-	-	-	1036	36	1099	30	911
13X	-	-	-	1037	12	974	12	912
13Y	-	-	-	1037	36	1100	30	912
14X	-	-	-	1038	12	975	12	913
14Y	-	-	-	1038	36	1101	30	913
15X	-	-	-	1039	12	976	12	914
15Y	-	-	-	1039	36	1102	30	914
16X	-	-	-	1040	12	977	12	915
16Y	-	-	-	1040	36	1103	30	915
17X	-	-	108.0	1041	12	978	12	916
17Y	-	-	108.05	1041	36	1104	30	916
18X	108.1	334.7	-	1042	12	979	12	917
18Y	108.15	334.55	-	1042	36	1105	30	917
19X	-	-	108.2	1043	12	980	12	918
19Y	-	-	108.25	1043	36	1106	30	918

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
20X	108.3	334.1	-	1044	12	981	12	919
20Y	108.35	333.95	-	1044	36	1107	30	919
21X	-	-	108.4	1045	12	982	12	920
21Y	-	-	108.45	1045	36	1108	30	920
22X	108.5	329.9	-	1046	12	983	12	921
22Y	108.55	329.75	-	1046	36	1109	30	921
23X	-	-	108.6	1047	12	984	12	922
23Y	-	-	108.65	1047	36	1110	30	922
24X	108.7	330.5	-	1048	12	985	12	923
24Y	108.75	330.35	-	1048	36	1111	30	923
25X	-	-	108.8	1049	12	986	12	924
25Y	-	-	108.85	1049	36	1112	30	924
26X	108.9	329.3	-	1050	12	987	12	925
26Y	108.95	329.15	-	1050	36	1113	30	925
27X	-	-	109.0	1051	12	988	12	926
27Y	-	-	109.05	1051	36	1114	30	926
28X	109.1	331.4	-	1052	12	989	12	927
28Y	109.15	331.25	-	1052	36	1115	30	927
29X	-	-	109.2	1053	12	990	12	928
29Y	-	-	109.25	1053	36	1116	30	928
30X	109.3	332	-	1054	12	991	12	929
30Y	109.35	331.85	-	1054	36	1117	30	929
31X	-	-	109.4	1055	12	992	12	930
31Y	-	-	109.45	1055	36	1118	30	930
32X	109.5	332.6	-	1056	12	993	12	931
32Y	109.55	332.45	-	1056	36	1119	30	931
33X	-	-	109.6	1057	12	994	12	932
33Y	-	-	109.65	1057	36	1120	30	932
34X	109.7	333.2	-	1058	12	995	12	933
34Y	109.75	333.05	-	1058	36	1121	30	933
35X	-	-	109.8	1059	12	996	12	934
35Y	-	-	109.85	1059	36	1122	30	934
36X	109.9	333.8	-	1060	12	997	12	935
36Y	109.95	333.65	-	1060	36	1123	30	935
37X	-	-	110.0	1061	12	998	12	936

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
37Y	-	-	110.05	1061	36	1124	30	936
38X	110.1	334.4	-	1062	12	999	12	937
38Y	110.15	334.25	-					
39X	-	-	110.2	1063	12	1000	12	938
39Y	-	-	110.25	1063	36	1126	30	938
40X	110.3	335	-	1064	12	1001	12	939
40Y	110.35	334.85	-	1064	36	1127	30	939
41X	-	-	110.4	1065	12	1002	12	940
41Y	-	-	110.45	1065	36	1128	30	940
42X	110.5	329.6	-	1066	12	1003	12	941
42Y	110.55	329.45	-	1066	36	1129	30	941
43X	-	-	110.6	1067	12	1004	12	942
43Y	-	-	110.65	1067	36	1130	30	942
44X	110.7	330.2	-	1068	12	1005	12	943
44Y	110.75	330.05	-	1068	36	1131	30	943
45X	-	-	110.8	1069	12	1006	12	944
45Y	-	-	110.85	1069	36	1132	30	944
46X	110.9	330.8	-	1070	12	1007	12	945
46Y	110.95	330.65	-	1070	36	1133	30	945
47X	-	-	111.0	1071	12	1008	12	946
47Y	-	-	111.05	1071	36	1134	30	946
48X	111.1	331.7	-	1072	12	1009	12	947
48Y	111.15	331.55	-	1072	36	1135	30	947
49X	-	-	111.2	1073	12	1010	12	948
49Y	-	-	111.25	1073	36	1136	30	948
50X	111.3	332.3	-	1074	12	1011	12	949
50Y	111.35	332.15	-	1074	36	1137	30	949
51X	-	-	111.4	1075	12	1012	12	950
51Y	-	-	111.45	1075	36	1136	30	950
52X	111.5	332.9	-	1076	12	1013	12	951
52Y	111.55	332.75	-	1076	36	1139	30	951
53X	-	-	111.6	1077	12	1014	12	952
53Y	-	-	111.65	1077	36	1140	30	952
54X	111.7	333.5	-	1078	12	1015	12	953
54Y	111.75	333.35	-	1078	36	1141	30	953

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
55X	-	-	111.8	1079	12	1016	12	954
55Y	-	-	111.85	1079	36	1142	30	954
56X	111.9	331.1	-	1080	12	1017	12	955
56Y	111.95	330.95	-	1080	36	1143	30	955
57X	-	-	112.0	1081	12	1018	12	956
57Y	-	-	112.05	1081	36	1144	30	956
58X	-	-	112.1	1082	12	1019	12	957
58Y	-	-	112.15	1082	36	1145	30	957
59X	-	-	112.2	1083	12	1020	12	958
59Y	-	-	112.25	1083	36	1146	30	958
60X	-	-	-	1084	12	1021	12	959
60Y	-	-	-	1084	36	1147	30	959
61X	-	-	-	1085	12	1022	12	960
61Y	-	-	-	1085	36	1148	30	960
62X	-	-	-	1086	12	1023	12	961
62Y	-	-	-	1086	36	1149	30	961
63X	-	-	-	1087	12	1024	12	962
63Y	-	-	-	1087	36	1150	30	962
64X	-	-	-	1088	12	1151	12	963
64Y	-	-	-	1088	36	1025	30	963
65X	-	-	-	1089	12	1152	12	964
65Y	-	-	-	1089	36	1026	30	964
66X	-	-	-	1090	12	1153	12	965
66Y	-	-	-	1090	36	1027	30	965
67X	-	-	-	1091	12	1154	12	966
67Y	-	-	-	1091	36	1028	30	966
68X	-	-	-	1092	12	1155	12	967
68Y	-	-	-	1092	36	1029	30	967
69X	-	-	-	1093	12	1156	12	968
69Y	-	-	-	1093	36	1030	30	968
70X	-	-	112.3	1094	12	1157	12	969
70Y	-	-	112.35	1094	36	1031	30	969
71X	-	-	112.4	1095	12	1158	12	970
71Y	-	-	112.45	1095	36	1032	30	970
72X	-	-	112.5	1096	12	1159	12	971

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
72Y	-	-	112.55	1096	36	1033	30	971
73X	-	-	112.6	1097	12	1160	12	972
73Y	-	-	112.65	1097	36	1034	30	972
74X	-	-	112.7	1098	12	1161	12	973
74Y	-	-	112.75	1098	36	1035	30	973
75X	-	-	112.8	1099	12	1162	12	974
75Y	-	-	112.85	1099	36	1036	30	974
76X	-	-	112.9	1100	12	1163	12	975
76Y	-	-	112.95	1100	36	1037	30	975
77X	-	-	113.0	1101	12	1164	12	976
77Y	-	-	113.05	1101	36	1038	30	976
78X	-	-	113.1	1102	12	1165	12	977
78Y	-	-	113.15	1102	36	1039	30	977
79X	-	-	113.2	1103	12	1166	12	978
79Y	-	-	113.25	1103	36	1040	30	978
80X	-	-	113.3	1104	12	1167	12	979
80Y	-	-	113.35	1104	36	1041	30	979
81X	-	-	113.4	1105	12	1168	12	980
81Y	-	-	113.45	1105	36	1042	30	980
82X	-	-	113.5	1106	12	1169	12	981
82Y	-	-	113.55	1106	36	1043	30	981
83X	-	-	113.6	1107	12	1170	12	982
83Y	-	-	113.65	1107	36	1044	30	982
84X	-	-	113.7	1108	12	1171	12	983
84Y	-	-	113.75	1108	36	1045	30	983
85X	-	-	113.8	1109	12	1172	12	984
85Y	-	-	113.85	1109	36	1046	30	984
86X	-	-	113.9	1110	12	1173	12	985
86Y	-	-	113.95	1110	36	1047	30	985
87X	-	-	114.0	1111	12	1174	12	986
87Y	-	-	114.05	1111	36	1048	30	986
88X	-	-	114.1	1112	12	1175	12	987
88Y	-	-	114.15	1112	36	1049	30	987
89X	-	-	114.2	1113	12	1176	12	988
89Y	-	-	114.25	1113	36	1050	30	988

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
90X	-	-	114.3	1114	12	1177	12	989
90Y	-	-	114.35	1114	36	1051	30	989
91X	-	-	114.4	1115	12	1178	12	990
91Y	-	-	114.45	1115	36	1052	30	990
92X	-	-	114.5	1116	12	1179	12	991
92Y	-	-	114.55	1116	36	1053	30	991
93X	-	-	114.6	1117	12	1180	12	992
93Y	-	-	114.65	1117	36	1054	30	992
94X	-	-	114.7	1118	12	1181	12	993
94Y	-	-	114.75	1118	36	1055	30	993
95X	-	-	114.8	1119	12	1182	12	994
95Y	-	-	114.85	1119	36	1056	30	994
96X	-	-	114.9	1120	12	1183	12	995
96Y	-	-	114.95	1120	36	1057	30	995
97X	-	-	115.0	1121	12	1184	12	996
97Y	-	-	115.05	1121	36	1058	30	996
98X	-	-	115.1	1122	12	1185	12	997
98Y	-	-	115.15	1122	36	1059	30	997
99X	-	-	115.2	1123	12	1186	12	998
99Y	-	-	115.25	1123	36	1060	30	998
100X	-	-	115.3	1124	12	1187	12	999
100Y	-	-	115.35	1124	36	1061	30	999
101X	-	-	115.4	1125	12	1188	12	1000
101Y	-	-	115.45	1125	36	1062	30	1000
102X	-	-	115.5	1126	12	1189	12	1001
102Y	-	-	115.55	1126	36	1063	30	1001
103X	-	-	115.6	1127	12	1190	12	1002
103Y	-	-	115.65	1127	36	1064	30	1002
104X	-	-	115.7	1128	12	1191	12	1003
104Y	-	-	115.75	1128	36	1065	30	1003
105X	-	-	115.8	1129	12	1192	12	1004
105Y	-	-	115.85	1129	36	1066	30	1004
106X	-	-	115.9	1130	12	1193	12	1005
106Y	-	-	115.95	1130	36	1067	30	1005
107X	-	-	116.0	1131	12	1194	12	1006

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
107Y	-	-	116.05	1131	36	1068	30	1006
108X	-	-	116.1	1132	12	1195	12	1007
108Y	-	-	116.15	1132	36	1069	30	1007
109X	-	-	116.2	1133	12	1196	12	1008
109Y	-	-	116.25	1133	36	1070	30	1008
110X	-	-	116.3	1134	12	1197	12	1009
110Y	-	-	116.35	1134	36	1071	30	1009
111X	-	-	116.4	1135	12	1198	12	1010
111Y	-	-	116.45	1135	36	1072	30	1010
112X	-	-	116.5	1136	12	1199	12	1011
112Y	-	-	116.55	1136	36	1073	30	1011
113X	-	-	116.6	1137	12	1200	12	1012
113Y	-	-	116.65	1137	36	1074	30	1012
114X	-	-	116.7	1138	12	1201	12	1013
114Y	-	-	116.75	1138	36	1075	30	1013
115X	-	-	116.8	1139	12	1202	12	1014
115Y	-	-	116.85	1139	36	1076	30	1014
116X	-	-	116.9	1140	12	1203	12	1015
116Y	-	-	116.95	1140	36	1077	30	1015
117X	-	-	117.0	1141	12	1204	12	1016
117Y	-	-	117.05	1141	36	1078	30	1016
118X	-	-	117.1	1142	12	1205	12	1017
118Y	-	-	117.15	1142	36	1079	30	1017
119X	-	-	117.2	1143	12	1206	12	1018
119Y	-	-	117.25	1143	36	1080	30	1018
120X	-	-	117.3	1144	12	1207	12	1019
120Y	-	-	117.35	1144	36	1081	30	1019
121X	-	-	117.4	1145	12	1208	12	1020
121Y	-	-	117.45	1145	36	1082	30	1020
122X	-	-	117.5	1146	12	1209	12	1021
122Y	-	-	117.55	1146	36	1083	30	1021
123X	-	-	117.6	1147	12	1210	12	1022
123Y	-	-	117.65	1147	36	1084	30	1022
124X	-	-	117.7	1148	12	1211	12	1023
124Y	-	-	117.75	1148	36	1085	30	1023

Table 9-5 DME Channel Frequency Allocation								
DME Channel	ILS/VOR Frequency			Monitor Interrogator		Transmitter Reply		Receiver LO
	LOC (MHz)	GS (MHz)	VOR (MHz)	Freq (MHz)	Pulse Code μ s	Freq (MHz)	Pulse Code μ s	Freq (MHz)
125X	-	-	117.8	1149	12	1212	12	1024
125Y	-	-	117.85	1149	36	1086	30	1024
126X	-	-	117.9	1150	12	1213	12	1025
126Y	-	-	117.95	1150	36	1087	30	1025

9.7.6 System Checkout

- Bypass the Integral monitor and select Tx1 Main.
- For dual equipment bypass the Standby monitor and select Tx2 Load.
- If the DME station has an alarm condition, then refer to [section 7](#) to perform fault isolation and corrective maintenance.
- Perform [section 6.2.8 Transponder Reply Delay Performance Check](#) procedure.
- Perform [section 6.2.9 Identification Frequency Performance Check](#) procedure.
- Perform [section 6.2.11 Monitor Shutdown/Transfer Control Performance Check](#) procedure.
- Perform the SELEX-SI Site Acceptance Test (SAT) Procedure for the 1118A/1119A DME system. Note if this procedure is not available then perform all remaining performance checks in [section 6.2](#) of this manual.
- Save the final DME configuration to disk using the System >> Configuration Save command from the PMDT. It is recommended that a backup copy of the station configuration also be maintained off site.

9.7.7 Performance Tuning During Flight Inspection

- If the DME is not able to achieve usable distance then refer to [section 6.3.3.1 Receiver Sensitivity Adjustment](#) to adjust the receiver threshold.
- If flight inspection reports an unlock condition or a range error while on a radial approach then refer to [section 6.4.3 Configuring Short and Long Distance Echo Suppression](#) to configure echo suppression.
- If changes to the station are made during flight inspection then create a new station configuration file using the System >> Configuration Save command from the PMDT.

10. SOFTWARE

10.1 Introduction

Software documentation contains proprietary information and therefore is not included in this manual.

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11.TROUBLESHOOTING SUPPORT DATA

11.1 Introduction

This section contains a list of drawings useful during installation and maintenance. Drawings that are needed during installation are provided in paper form within the appropriate kit. Paper copies of all drawings can be purchased by contacting the SELEX Sistemi Integrati Inc. customer service.

Table 11-1 Schematic Diagrams			
Description	Schematic Number	Figure #	Page #
Schematic, Low Power DME	001118A-9102	11-1	11-3
Schematic, High Power DME	001119A-9102	11-2	11-11
Family Tree, Low Power DME	502077	11-3	11-19
Family Tree, High Power DME	502078	11-4	11-21
Backplane CCA (LP)	012166-9001	11-5	11-23
Interface CCA	012167-9001	11-6	11-31
Receiver/Transmitter Controller CCA	012168-9001	11-7	11-35
Monitor CCA	012169-9001	11-8	11-53
BCPS CCA	012170-9001	11-9	11-69
Facilities CCA	012171-9001	11-10	11-75
RMS CCA	012172-9001	11-11	11-83
DME Synthesizer CCA (LP)	012173-9001	11-12	11-93
DME Modulator CCA	012174-9001	11-13	11-99
Backplane CCA (HP)	012176-9001	11-14	11-109
Power Supply CCA (HP)	012177-9001	11-15	11-113
Modulator CCA (HP)	012178-9001	11-16	11-117
DME Local Control Unit CCA	012179-9001	11-17	11-131
Receiver RF CCA	012180-9001	11-18	11-139
Monitor Interrogator RF CCA	012181-9001	11-19	11-145
AC Monitor CCA	012186-9001	11-20	11-157
Fan Control CCA	012187-9001	11-21	11-159
Front Panel Interface CCA	012194-9001	11-22	11-161
1500W Power Supply CCA	012205-9001	11-23	11-165
Status Display CCA	012206-9001	11-24	11-167
DME Low Power Amp RF Boards	030802-9001	11-25	11-169
DME High Power Amp RF Boards	030804-9001	11-26	11-177
Low Noise Amplifier (LNA)	012033-9001	11-27	11-185
Antenna Kit	470085	11-28	11-185
Civil Installation Kit	470252	11-29	11-189
Radio Link Kit (optional)	470433	11-30	11-191
AC Power/Installation Kit	470627	11-31	11-199
Battery Backup Kit	470628	11-32	11-201

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