

TECHNICAL MANUAL

Project : Distance Measuring Equipment (DME) LDB-103

Program : Radio Navigation Systems

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1. INTRODUCTION

The DME Ground Beacon LDB-103 equipment is a radio navigation aid designed and manufactured to meet or exceed the specifications outlined in the ICAO, Annex 10, Volume 1 and Doc 8071, Volume I as well as in EUROCAE ED-57 and all European Directives applicable to radio navigation systems.

The DME (Distance Measuring Equipment) systems are navigation aids recommended by the ICAO and introduced internationally for short and medium range aircraft guidance.

2. **PURPOSE**

This document contains the Technical Manual of the Distance Measuring (DME) equipment series LDB-103, designed and manufactured by Indra.

In this document are described installation, operation and maintenance instructions and procedures.

3. **SCOPE**

Contents of this document are applicable to the Distance Measurement (DME) equipment series LDB-103:

P/N: 0063410000100

4. DOCUMENTS

The following documents, in the specified edition and revision, are part of this specification within the scope defined herein.

In the event of conflicts between the contents of any document below and this one, this document shall have precedence.

4.1 APPLICABLE DOCUMENTS

Ref.	Document title	Document code	Edition/ Revision
[AD.1]	Technical Specification. System Requirement Specification (SRS)	0063400000100ES00	A/0
[AD.2]	Indra Nav aids Environmental Specification	0066200000100ES06	A/0
[AD.3]	Test Method Standard for Environmental Engineering Considerations and Laboratory Test, US Department of Defense	MIL-STD-810F	January 2000
[AD.4]	International Standards and Recommended Practices, Aeronautical Telecommunications, Annex 10, Volume I (Radio Navigation Aids) to the Convention on International Civil Aviation, included Amendments 1-81	ICAO Annex 10	6 th Edition, July 2006
[AD.5]	Manual On Testing Of Radio Navigation Aids, International Civil Aviation Organization, Volume I, International Civil Aviation Organization,.	DOC 8071	Fourth Edition, 2000
[AD.6]	Minimum Operational Performance Specification for Distance Measuring Equipment (DME/N and DME/P) (Ground Equipment), The European Organisation for Civil Aviation Equipment	EUROCAE ED-57	Ed. 2, 26 th October 1992.
[AD.7]	Performance Specification Distance Measuring Equipment (DME), US Department of Transportation, Federal Aviation Administration	FAA-E-2996	1st April, 2008
[AD.8]	On radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive), European Parliament and the Council of the European Union	Directive 1999/5/EC	9 th March, 1999

Ref.	Document title	Document code	Edition/ Revision
[AD.9]	On the restriction of the use of certain hazardous substances in electrical and electronic equipment (RHS Directive). European Parliament and the Council of the European Union	Directive 2002/95/EC	27 th January, 2003
[AD.10]	On the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EC (EMC Directive), European Parliament and the Council of the European Union	Directive 2004/108/EC	15 th December, 2004
[AD.11]	On the interoperability of the European Air Traffic Management network (Interoperability Regulation Directive), European Parliament and the Council of the European Union,	Directive 2004/552/EC	January 10 th March, 2004
[AD.12]	Laying down common requirements for the provision of air navigation services, The Commission of the European Communities,.	CR 2005/2096/EC	25 th December, 2005
[AD.13]	Guidelines for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems Software Integrity Assurance, The European Organisation for Civil Aviation Equipment,.	EUROCAE ED-109	March 2002
[AD.14]	Systems and Software Engineering. Software life cycle processes, International Organization for Standardization	ISO/IEC 12207.0	R2004.
[AD.15]	Guidelines for ANS Software Safety Assurance, The European Organisation for Civil Aviation Equipment,.	EUROCAE ED-153	December 2008
[AD.16]	Safety Regulatory Requirement, Risk Assessment and Mitigation in ATM, Organisation for the Safety of Air Navigation,.	EUROCONTROL ESARR-4	Edition 1, April 2001
[AD.17]	Safety Regulatory Requirement, Software in ATM System, European Organisation for the Safety of Air Navigation,.	EUROCONTROL ESARR-6	Edition 1, November 2003

4.2 REFERENCE DOCUMENTS

Ref.	Document Title	Document Code	Edition/ Revision
[RD.1]	Family Tree	0063400000100AP00	A/0
[RD.2]	Quality Assurance Plan	0063400000100QA00	A/0
[RD.3]	External Interface Document (ICD)	0063400000100IC00	A/0
[RD.4]	Factory Acceptance Test Procedure (FAT)	0063400000100AT00	A/0
[RD.5]	Site Acceptance Test Procedure (SAT)	0063400000100AT05	A/0
[RD.6]	Environmental Conditions and Test Procedures for Airborne Equipment, Radio Technical Commission for Aeronautics (RTCA)	RTCA/DO-160E EUROCAE ED-14E	December 2004
[RD.7]	Reliability Prediction of Electronic Equipment, US Department of Defence, 28 th February, 1995.	MIL-HDBK-217F	28 th February, 1995
[RD.8]	Software Development and Documentation, US Department of Defense, 5 th December, 1994	MIL-STD-498	5 th December, 1994
[RD.9]	Defense Systems Software Development, US Department of Defense, 29 th February, 1988.	DOD-STD-2167A	29 th February, 1988
[RD.10]	Software Quality Evaluation, US Department of Defense, 29 th February, 1988.	DOD-STD-2168	29 th February, 1988.
[RD.11]	Safety requirements for radio transmitting equipment, European Standard, 1996.	EN 60215	1996
[RD.12]	Information technology equipment. Safety. General requirements, European Standard, 2006	EN 60950	2006

5. DEFINITIONS, ACRONYMS AND ABBREVIATIONS

5.1 DEFINITIONS

N/A

5.2 ACRONYMS AND ABBREVIATIONS

A	Amperes (unit of electric current)
A/D	Analogue to Digital
AC	Alternate Current
ADC	Analogue to Digital Converter
BIT	Built In Test
BITE	Built-In Test Equipment
CBIT	Continuous Built-In Test
CPU	Control Processor Unit
CMU	Control and Monitoring Unit
CR	Commission Regulation
CW	Continuous Wave
DAC	Digital to Analogue Converter
DME	Distance Measuring Equipment
DVI-D	Digital Visual Interface - Digital
DVOR	Doppler VHF Omnidirectional Radio Range
ePC	Embedded PC
ESD	Electrostatic Discharge
ETX	Embedded Technology eXtended
Ft	Feet, length unit.
FPGA	Field-Programmable Gate Array
GND	Ground
GUI	Graphic User Interface
HP	Horizontal Pitch
HPA	High Power Amplifier
HTTP	Hypertext Transfer Protocol
Hz	Hertz (unit of frequency)
IBIT	Initial BIT
ICD	Interface Control Document

ID	Identification
I/O	Inputs and Outputs
ISG	Interrogator Signal Generator
JTAG	Joint Test Action Group
LAN	Local Area Network
LCD	Liquid Crystal Display
LDES	Long Distance Echo Suppression
LDO	Low Dropout
LED	Light Emitting Diode
LHS	Left-Hand Side
LRU	Line Replaceable Unit
LVDS	Low-Voltage Differential Signalling
NARIC	Navigational Aid Remote Indication and Control
N/A	Not Applicable
NCO	Numeric Control Oscillator
NM	Nautical Mile
NMP	Network Management Processor
N/U	Not Used
MIB	Management Information Base
MTBF	Mean Time Between Failures
MTBMP	Mean Time Between Maintenance Periods
MTBO	Mean Time Between Outages
MTTR	Mean Time To Repair
MTU	Monitor Test Unit
PBIT	Power-up Built-In Test
PC	Personal Computer
PCB	Printed Circuit Board
PLL	Phase-Locked Loop
pp/s	pair of pulses per second
ppm	parts per million
ppps	pair of pulses per second
PSU	Power Supply Unit
RCA	Radio Corporation of America
RCU	Relay Changeover Unit

RF	Radiofrequency
RHS	Right-Hand Side
RMM	Remote Management Monitoring
RoHS	Restriction of Hazardous Substances
RTC	Remote Terminal Connection
RU	Rack Unit
RXU	Receiver Unit
s	Seconds (unit of time)
SBC	Single Board Computer
SGU	Signal Generation Unit
SNMP	Simple Network Management Protocol
SMA	Sub-Miniature A Connector
SMD	Surface Mount Device
S/PDIF	Sony/Philips Digital Interchange Format
TBC	To Be Confirmed
TBD	To Be Defined
TCP/IP	Transmission Control Protocol/Internet Protocol
TXU	Transmitter Unit
U	Rack Unit
USB	Universal Serial Bus
V	Volts (unit of voltage)
VAC	Volts of Alternate Current
VCA	Voltage Controlled Amplifier
VDC	Volts of Direct Current
VGA	Video Graphics Adapter
VOR	VHF Omnidirectional Radio Range
VPN	Virtual Private Network
VSWR	Voltage Standing Wave Ratio
W	Watts (unit of power)
Ω	Ohms (unit of electric resistance)

6. BRIEF SPECIFICATION

6.1 FUNCTIONAL DESCRIPTION

6.1.1 Introduction

This section introduces the Indra's Distance Measuring Equipment (DME) series LDB-103 type 0063400000100. It first explains the DME operation then how the LDB-103 implements these functions. Next, special features of the LDB-103 are described starting with mechanical description and ending with detailed specification.

The Distance Measuring Equipment (DME) Ground Beacon LDB-103 series equipments are designed and manufactured to meet the specifications outlined in ICAO Annex 10, ICAO Doc 8071, EUROCAE ED-57 and FAA-E-2996 requirements. Its main function is to provide automatic answer to DME interrogators, giving precise distance information through the reply to interrogations from airplanes under its coverage area, tuned in its working channel. The LDB-103 series equipments are capable of operating in the 252 possible X/Y DME/N channels.

6.1.2 Application

The DME system is a navigational system that provides slant-range distance information between aircraft and a ground station.

The system consists of a transmitter/receiver (interrogator) in the aircraft, and a receiver/transmitter (transponder) ground station. The interrogator transmits interrogation pulses to the transponder, which on receipt of the interrogation pulses is triggered to transmit a sequence of reply pulses which have a predetermined time delay. The time difference between interrogation and reply is measured in the interrogator and translated into a distance measurement which is presented on a digital display in the aircraft cockpit; this display is continuously updated.

6.1.3 DME System Operation

6.1.3.1 Distance Measuring Function

The DME system provides each aircraft with up-to-date information regarding the slant-range distance between the aircraft and the selected DME ground station. By using the correct airborne equipment is also possible for the interrogating aircraft to establish the rate of closure and the flight time to a ground station.

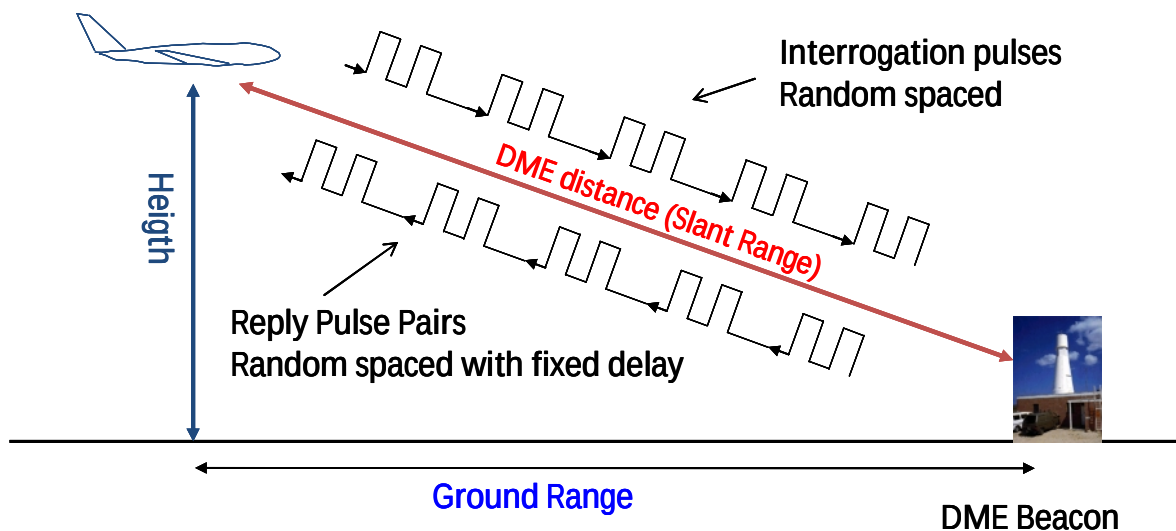
The DME system has a transmitter/receiver (interrogator) in the aircraft and a receiver/transmitter (transponder) operating as the ground beacon. The UHF DME operates in the L band, from 962 MHz to 1213 MHz. This band is divided into 126 1-MHz channels for interrogation, and 126 1-MHz channels for transponder replies with the interrogation frequency and reply frequency always differing by 63 MHz. The number of channels available is doubled by the use of X and Y channels which define the pulse separation for the interrogation and reply pulses.

Initially, the airborne equipment is set to the correct frequency for the desired ground station. The interrogator transmits pairs of pulses at the interrogation frequency at a repetition rate of approximately 120 pulse-pairs per second (pp/s) (this is called 'searching' mode). The transponder, having identified these pulses as valid interrogations, introduces a 50 microsecond delay after each

interrogating pulse-pair and transmits reply pulse-pairs at the reply frequency. The airborne interrogator automatically compares the lapsed time between transmission and reception, subtracts the 50 microsecond delay, and displays the result in nautical miles. Once the interrogator receives replies to its interrogations, the interrogator 'locks' onto the reply pulses and reduces its transmitted repetition rate to approximately 30 pp/s (this is called 'tracking' mode).

Main activities performed by the DME equipment include the following:

- ò Detection and analysis of interrogation pulses.
- ò Signal processing related with receiver function.
- ò Reply generation and timing.
- ò Squitter generation.
- ò Identity transmission.
- ò Transmitted pulse shape control.
- ò Monitor functions.
- ò Exchange of data for Local and Remote access.



$$SR = (T-D)/12.36$$

SR: Slant Range (NM)

T: Total delay between interrogation and reply (µs)

D: Transponder fixed delay (µs)

Figure 6.1.3-1. DME PRINCIPLE

6.1.3.2 DME pulse generation

The RF pulses transmitted by both the interrogator and the ground transponder consist of a pair of 'Gaussian-shaped' pulses; the separation between pulses depends on whether an X channel or a Y channel has been selected. The duration of the pulses is in all cases a nominal 3.5 microseconds as measured at the half-amplitude point. The pulse separation for X channels, for both interrogation and reply pulses, is 12 microseconds; for Y channels the pulse separation is 36 microseconds for interrogation pulses, and 30 microseconds for reply pulses.

The channel frequencies and spacings for all channels are shown in Appendix I.

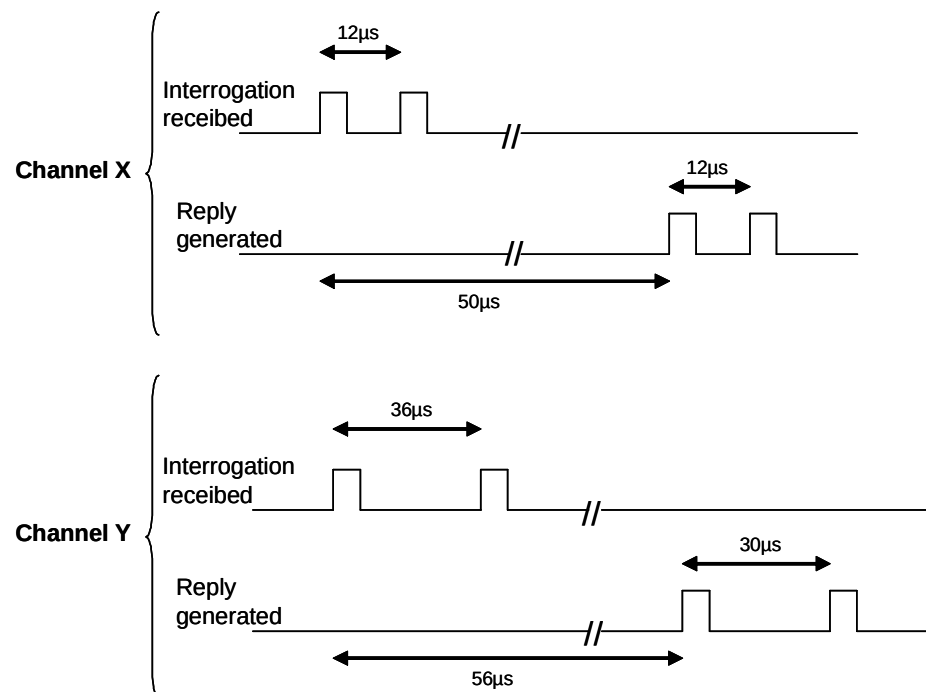


Figure 6.1.3.2-1. DME WAVEFORMS

6.1.3.3 System Squitter

Airborne DME receivers require a continuous stream of random pulses to ensure correct operation; however, unless there are interrogating aircraft present, the airborne receivers may not receive the required minimum pulse rate. To ensure that the airborne receivers always receive at least a minimum pulse rate, the DME transponder will generate 'extra' pulses in a random fashion at a minimum pulse rate of 945 pp/s. These extra random pulse-pairs are called squitter. At the time when no aircraft are interrogating, only the squitter is being transmitted, at an average rate of 945 pp/s; however, as the number of authentic interrogations increases the squitter rate is reduced, and becomes zero when the live interrogation rate reaches 945 pp/s.

6.1.3.4 Maximum Reply Rate

As the pulse rate of the interrogations increases, a limit is reached where the transponder will not allow further interrogations to be serviced. This limit is reached at a reply rate of approximately 5000 ppps, above which the transponder would become overloaded. To avoid overloading, the transponder detects the high rate of replies and causes the receiver automatic gain control to limit the gain of the receiver until the weaker, more distant, aircraft are excluded from the transponder, thus lowering the transponder loading. Should the system reply rate still exceed the 5000 ppps limit, video output pulses are randomly suppressed to limit the maximum reply rate to 5000 ppps.

6.1.3.5 Identification Message

Each operational DME is identified by a 2-character or 3-character Morse code message which is transmitted every 40 seconds. Each identification code (ident) is unique and identifies a specific DME site. The identification message code is programmed by preset controls within the equipment, and can be readily altered if the ident is required to be changed.

Frequently, DME is collocated with ILS or VOR equipment and for this reason the DME may operate either as a master or as a slave for the generation and transmission of the station identification message. When the DME is operating as a slave unit, any failure of the external ident generator will cause the DME to internally generate and transmit the ident in place of the failed unit.

6.1.3.6 Range and Echo

The normal slant range for a DME system operating in the ultra high frequency band is approximately 200 nautical miles (370 km) for good conditions at maximum transponder sensitivity. This maximum range may be seriously degraded, however, by the terrain surrounding the installation and by the maximum demands of interrogating aircraft.

A major contributing factor to distance accuracy degradation is the effect of echoes on the interrogation pulses arriving at the transponder. The shortest path is the direct line between the aircraft and ground transponder and thus the wave front taking this path arrives first. Other wave fronts may reflect off the terrain, buildings, and other objects, and thus arrive at any indeterminate time after the arrival of the direct pulse. Should the first pulse of a pulse-pair suffer such echo conditions it is possible that a reflection could arrive at the DME antenna at the same time as the direct second pulse of the interrogating pulse-pair; and the two pulses may arrive in any phase relationship. It is possible under these conditions for the second pulse of a pulse-pair to undergo distortion leading either to cancellation or to a shift in timing such that the transponder cannot recognise the receipt of a valid pulse-pair.

Short distance echo suppression is included within the LDB-103 to minimise the problems associated with such reflections. As well, long distance echo suppression is included to eliminate recognition of echoes that are synchronised with the interrogation pulses but arrive in the order of up to 320 microseconds late.

6.2 MECHANICAL DESCRIPTION

Refer to figures Figure 6.2-1, Figure 6.2-2, Figure 6.2-3, Figure 6.2-4 and Figure 6.2-5.

A single DME system model LDB-103, consists of one set of electronics equipment connected to its transmitting receiving antenna system. A dual DME system consists of two sets of electronic equipment and a transfer relay unit. The antenna system includes monitoring couplers that sense the transmitted signal. The equipment rack is normally housed inside its equipment shelter that may be located at some distance away from the antenna.

Both single and dual set of equipment are housed in one single 19" cabinet 33RU high. Both set of equipment are fitted in two sub-racks, one of 3RU high for common modules, and one of 6RU high, for system #1 modules, on the Left Hand Side, and system #2 modules, on the Right Hand Side.

The modules, visible from the front face of the cabinet are, from left to right:

- DME Subrack 1: LCU - RCU.
- DME Subrack 2, for system #1: HPA - TXU - RXU - MTU B - MTU A - CMU.
- DME Subrack 2, for system #2: CMU - MTU C - MTU D - RXU - TXU - HPA.

The two independent Power Supply Units (PSUs) for the 2 sets of equipment are placed below and the LCU with touch-screen control is located above the equipment sub-rack. There is enough space in the cabinet for standby battery of up to 8 hours of stand-alone operation without AC power supply.

All of the LRUs are hot-swappable and can be quickly diagnosed and replaced. Each module has its own LED status indicator and extensive built-in-test (BITE) circuitry providing simple and effective diagnostic of fault, both locally and remotely.

The equipment is operated from a mains power supply with a nominal output voltage of +24 VDC which is also used as a float charger for a standby battery supply.

The equipment is designed for unattended operation and may be controlled and monitored from a remote location. Connection to the remote site can be accomplished by multiple means including dial-up modem, leased-lines, radio, IP-based virtual private network (VPN), Ethernet, and cellular networks. The management and control of the equipment is by standardised protocols HTTP and SNMP over encrypted channels.

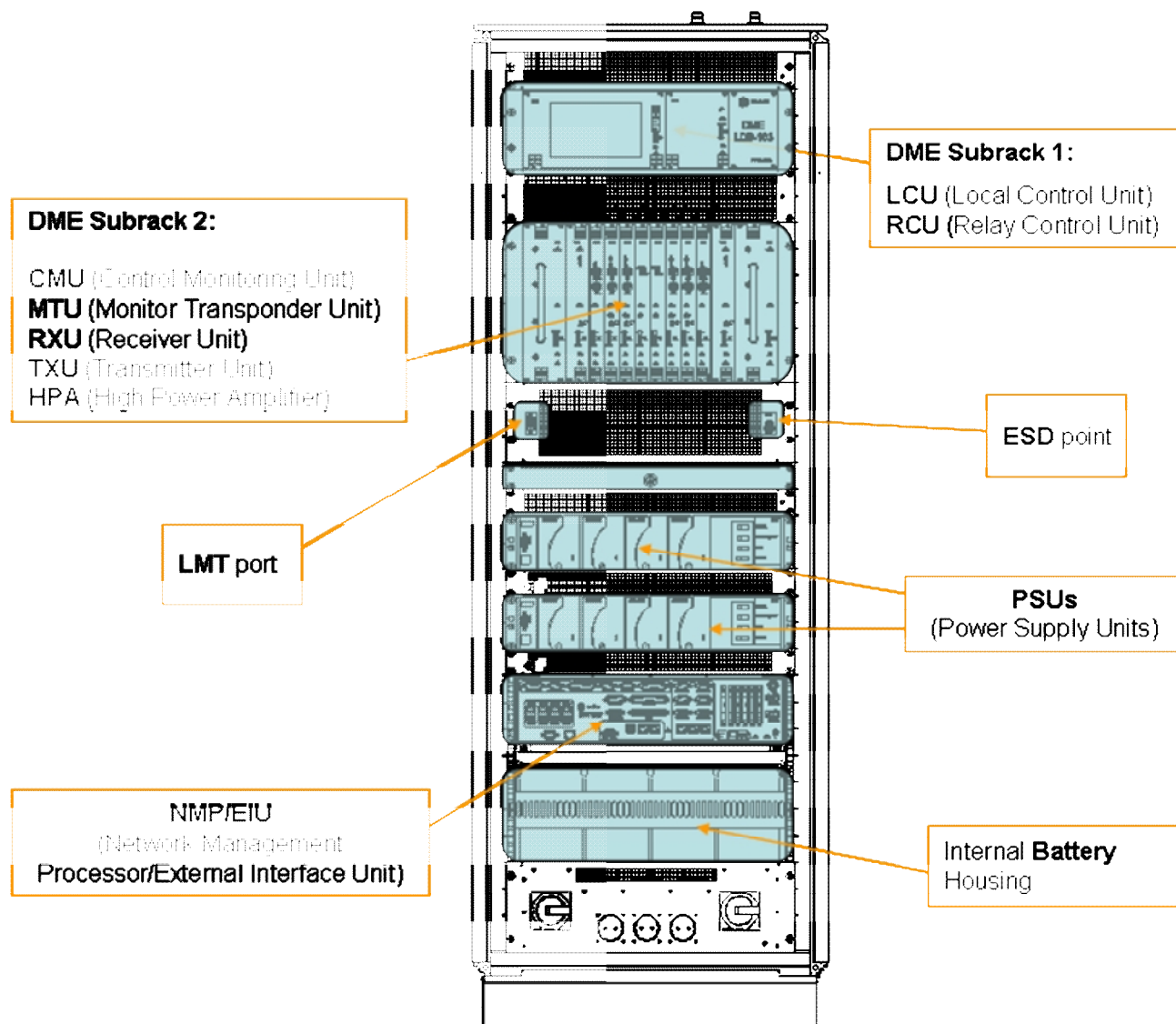


Figure 6.2-1. DME LDB-103 CABINET LAYOUT - FRONT VIEW

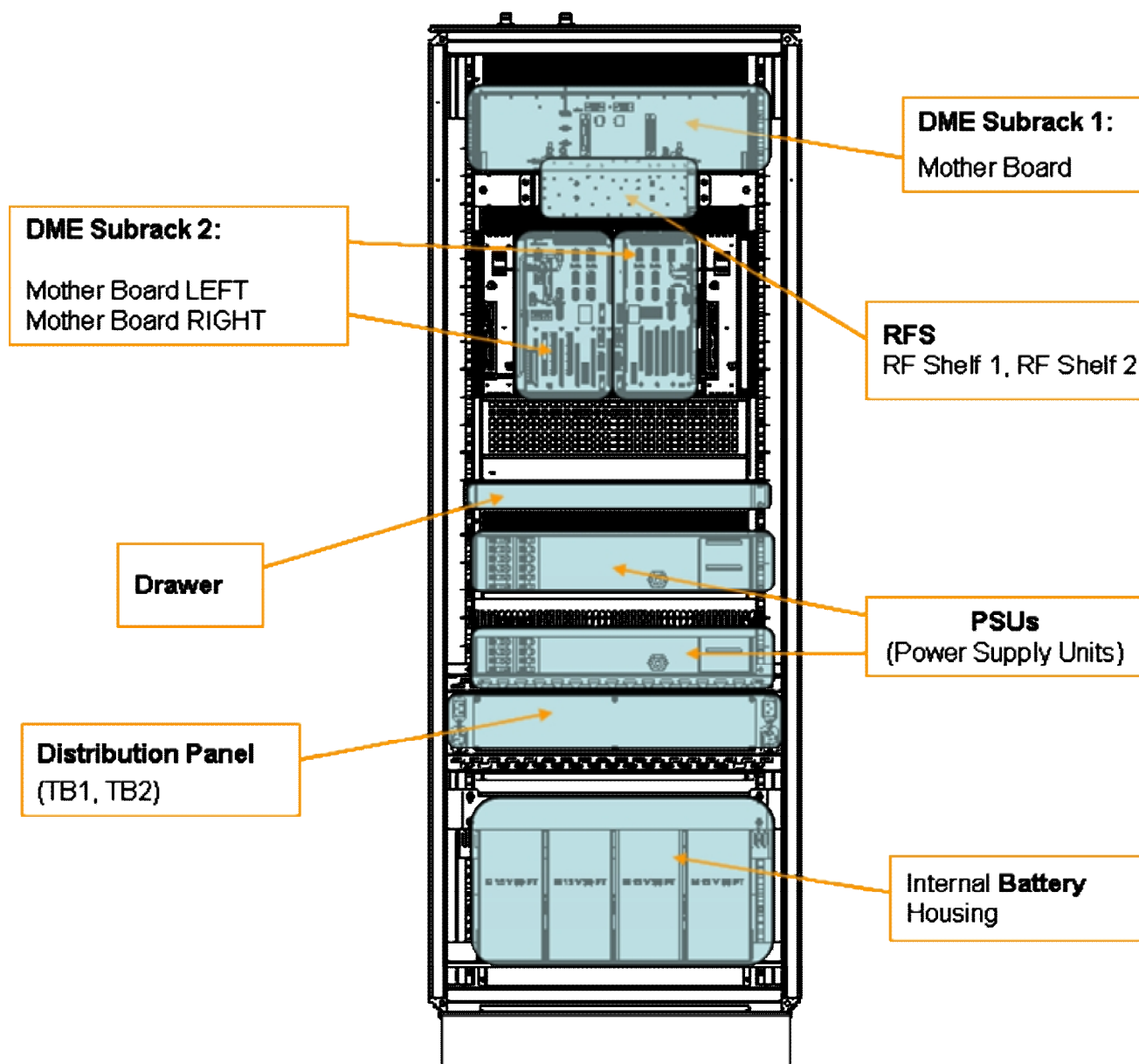


Figure 6.2-2. DME LDB-103 CABINET LAYOUT - REAR VIEW

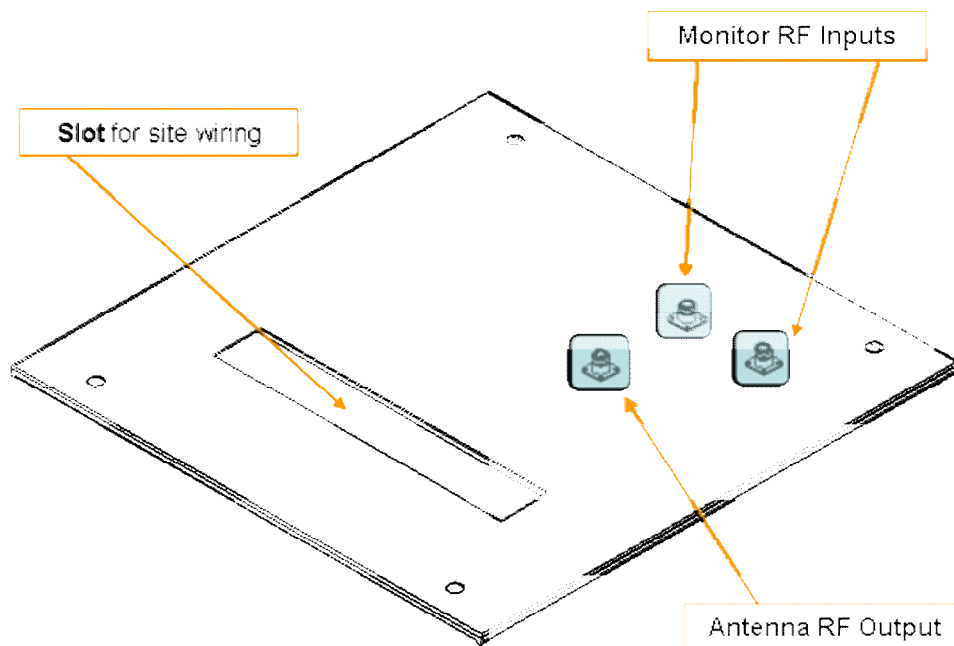


Figure 6.2-3. DME LDB-103 CABINET LAYOUT - TOP VIEW

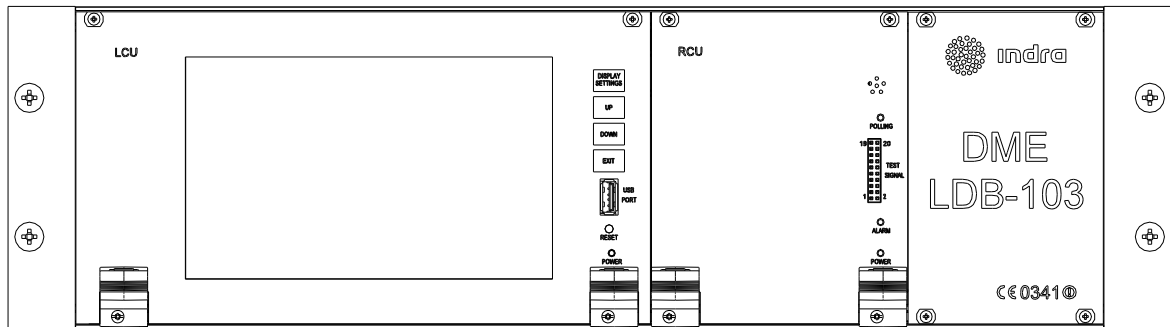


Figure 6.2-4. DME SUBRACK 1 LAYOUT - 3RU

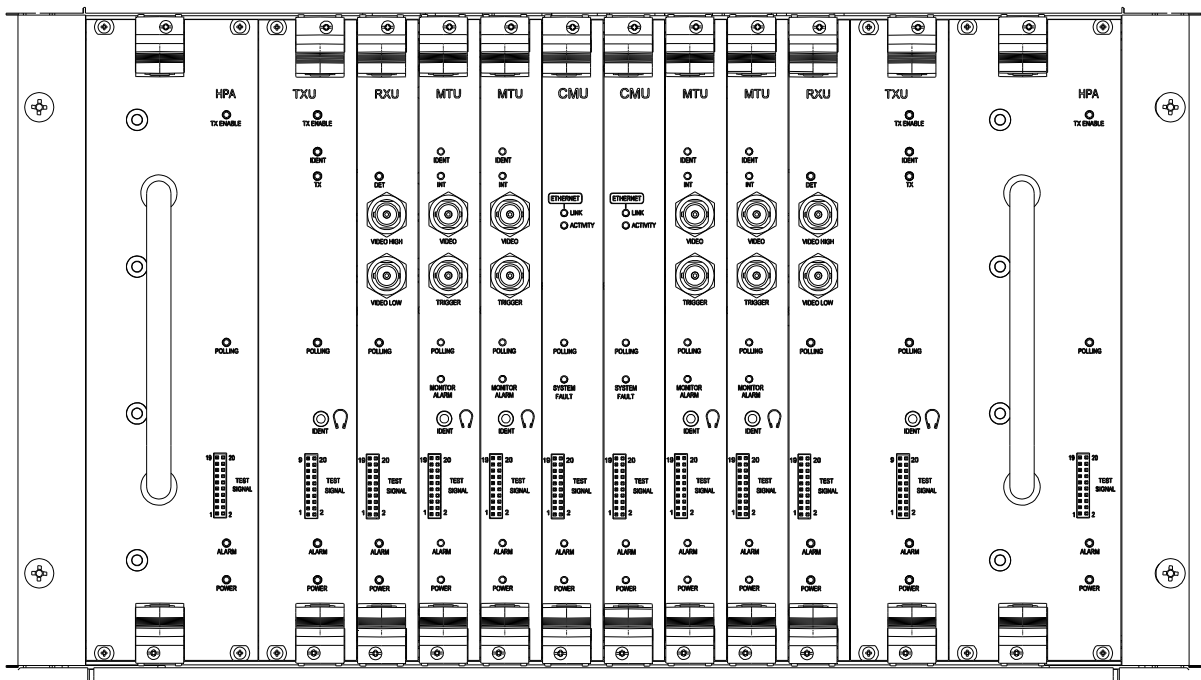


Figure 6.2-5. DME SUBRACK 2 LAYOUT - 6RU - DUAL CONFIGURATION

6.3 INTERFACES

This section describes the LDB-103 main interfaces. For further details refer to Indra document "LDB-103 External Interface Document", Indra code 0063400000100IC00.

The DME LDB_103 equipment external interfaces will be divided in the following functional groups:

- ò Mains Supply;
- ò Radiofrequency;
- ò Nav aids interface:
 - ñ Identification functions;
 - ñ Relay / Opto coupled input/outputs;
- ò Testing;
- ò Communications.

6.3.1 Mains Supply

This interface will be a +90 VAC to +276 VAC , 45 Hz to 70 Hz to supply the LDB-103 DME equipment.

6.3.2 Radiofrequency ports

This interface will be a radiofrequency interface for the transmission/reception and monitoring of the DME signals through the DME Antenna subsystem.

The RF interface with the Antenna subsystem will be composed of 3 coaxial ports:

- ò One transmission and reception port
- ò Two monitor probes

These three radiofrequency ports will be 50 Ω N-type female coaxial connectors.

The main port (transmission/reception) will be connected to the Relay Control Unit (RCU), which will perform the ON AIR TXP selection.

Monitor probes will be connected to the RF Shelf, which will split this signals obtaining 4 different monitor probes, one per Monitor Transponder Unit (MTU).

6.3.3 Identification Functions

The LDB-103 DME series equipments will have the following lines related with the Identification interface.

- ò 2 Key inputs
- ò 2 Key outputs
- ò 1 Key Bypass input.

6.3.4 Relay/Optocoupled i/o

The LDB-103 DME series equipments will have the following optocoupled inputs and relay outputs that can be used for alarm extension:

- ò 2 inputs to CMU;
- ò 4 inputs to MTU.

All of these optocoupled inputs will be configurable under software control.

- ò 5 NC relay outputs from CMU;
- ò 5 NO relay outputs from CMU;
- ò 4 NC relay outputs from MTU;
- ò 4 NO relay outputs from MTU;

All of these relay outputs will be configurable under software control. The relay output will be based on solid state devices.

Refer to Appendix C.

6.3.5 Testing

All LRU modules will have a test connector for maintenance purposes.

6.3.6 Communications

There will be at least two CAT5 Ethernet connections which will be used for local/remote access, remote control, management and monitoring of the system.

One of the CAT5 Ethernet connector will be placed in the front panel of the equipment allowing an easy connection with a Local Maintenance Terminal (LMT).

In case of the Network management Processor/External Interface Unit (NMP/EIU) is fitted into the rack, it will be this one which will supply the network interface of the equipment being connected to the LDB-103 DME equipment via an Ethernet connector. If the NMP is not fitted into the DME rack, the equipment will supply almost one CAT5 Ethernet connector in order to support remote connectivity

These interfaces will use standard HTTP and SNMP protocols over encrypted channels.

Site remote control will be able to be performed by a connection accomplished by multiple means including dial-up modem, leased lines, radio links, IP-based virtual private network, Ethernet, and cellular networks through the NMP/EIU.

Figure 6.3-1. LDB-103 EXTERNAL INTERFACES OVERVIEW

6.4 PERFORMANCE SPECIFICATION

The performance parameters of the major system functions and the location and functions of all system controls and indicators are given in the following tables.

6.4.1 System Performance

Table 6.4.1-1. SYSTEM PERFORMANCE

General Characteristics LDB-103	
Model	LDB-103
Configuration	Single or Dual
Coverage	100 W Model: > 60 NM 1 kW Model: > 200 NM
Aircraft Handling Capacity	> 200 interrogators
Frequency Range	960 MHz to 1215 MHz [126 X/Y channels]
Channel spacing	1 MHz
System Reply Delay	X Channel: Nominal: 50 μ s Adjustable: 35 μ s to 80 μ s Step: 0.05 μ s Y Channel: Nominal: 56 μ s Adjustable: 53 μ s to 80 μ s Step: 0.05 μ s
Reply Delay Times Stability (TXP Accuracy)	$\pm 0.20 \mu$ s (30 m; 0,016 NM) DME system accuracy depends aircraft to ground beacon distance.
Reply Efficiency	$\geq 70\%$
Status Indication	Full Local and remote indication
A/D - D/A Resolution	ADC: 12 bits DAC: 12 bits
Module Hot Replacement	Yes
System Monitoring (BITE)	Complete system level / Complete LRU level
Remote/Local Control Interface	Ethernet / RS-232 / RS-485
Reliability and maintainability	MTBF > 12,000 hrs. (single) MTBO > 20,000 hrs. (dual) MTTR < 30 min. (15 min. Typical)
Temperature (indoor equipment)	-20°C to +60°C
Relative Humidity (indoor equipment)	95% [-20°C to +35°C] / 60% [+35°C to +60°C]
Typical Consumption (Operating at 2700 ppps)	90 VA [100 W] / 200 VA [1 kW] (single) 170 VA [100 W] / 340 VA [1 kW] (dual - hot standby)
Typical Consumption (Operating at 2700 ppps) (charging 1 set of 90 Ah batteries)	270 VA [100 W] / 400 VA [1 kW] (single) 350 VA [100 W] / 520 VA [1 kW] (dual - hot standby)
Dimensions	600 x 600 x 1467 mm / 19" Standard rack - (33U)
Standard Compliance	ICAO Annex 10 and Doc 8071 / CE marking EUROCAE ED-57 / ED-109 / FAA-E-2996

6.4.2 Power Supply Characteristics

Table 6.4.2-1. AC POWER SUPPLY PERFORMANCES

Parameter	Value
Configuration	Triple Redundancy: Dual PSU; Dual internal AC/DC conversion; Dual battery banks.
Output Voltage Adjustment Range	+20 VDC to +29 VDC
Output Current Rating (2 rectifiers)	28 A max at +27VDC
Input Voltage Range	+90 VAC to +276 VAC & Soft Start
Ambient Temperature Range	-20°C to +60°C
Input Frequency	45 Hz to 70 Hz
Line Regulation	< $\pm 0.1\%$
Load Regulation	< $\pm 2\%$, 10% - 90% load step
Noise and Ripple	< 100 mVp-p up to 100MHz
Temp Coefficient, Output Voltage	< 100 ppm/°C
Temp Coefficient, Charging Voltage	Programmable
Transient Response	< 2 mS, 10% - 90% load step
Efficiency	> 90% at normal conditions
Cooling	Natural Convection
Protection	Over Current Over / Under Voltage Reverse Voltage Over Temperature Fold Back Limit Current then Shutdown Fuse Reduce output then Shutdown
Management	HTTP, SNMP
Control	Programmable Limits: Output Voltages & Current Output Power Alarm Limits Start Mode & Start Delay
Alarms	Programmable Under & Over Voltages Current Limit & Power Limit
Battery Supply Capability [100 W] (90 Ah battery housed in cabinet)	> 28.5h [100 W at 2700 ppps] > 23.5 [100 W at Maximum rate]
Battery Supply Capability [1 kW] (90 Ah battery housed in cabinet)	> 23h [1 kW at 2700 ppps] > 5.7h [1 kW at Maximum rate]

Table 6.4.2-2. DC POWER SUPPLY CHARACTERISTICS

PARAMETER	VALUE / LIMITS
Voltage Range	+21 VDC to +30 VDC
Normal operation	+27.25 VDC
Current Drain (Single equipment)	100 W: 3 Amperes 1 kW: 12 Amperes
In a Dual DME system, this power supply is required for each equipment	
Battery Supply Capability (housed in cabinet)	86 AH

6.4.3 Transmitter Characteristics

Table 6.4.3-1. TRANSMITTER PERFORMANCES

Transmitter	
Power Output	> 100 W / > 1 kW
Power Output Control	4 dB in 0.25 dB steps
Frequency Range	960 MHz to 1215 MHz
Frequency Control	By synthesizer
Frequency Stability	Better than ± 2 ppm (0.0002%)
Output Impedance	50 Ω
RF Pulse Spectrum	En-route [1 kW]: 47 dB at $\pm 0,8$ MHz 65 dB at ± 2 MHz Terminal [100 W]: 37 dB at $\pm 0,8$ MHz 55 dB at ± 2 MHz
Pulse Shape	Gaussian
Pulse Rise Time	2,5 (-1; +0,25) μ s
Pulse Fall Time	2,5 $\pm$ 0,5 μ s
Pulse Amplitude Stability	$\geq 95\%$
Pulse Width	3,5 $\pm$ 0,5 μ s
Pulse Pair Spacing	Channel X: 12 $\pm$ 0,1 μ s Channel Y: 30 $\pm$ 0,1 μ s
Peak power variation (between constituent pulses)	≤ 0.5 dB
Pulse Repetition Rate	up to 7000 pp/s
Spurious Radiation (between interrogations)	< -80 dB of Peak Output Power
Spurious Radiation (between interrogations)	< -80 dB of Peak Output Power (at least 1 μ s)

Table 6.4.3-1. TRANSMITTER PERFORMANCES

Transmitter	
Spurious Radiation (out of band. 10 to 1800 MHz)	< -40 dBm/kHz
CW EIRP	≤ -10 dBm
Squitter pulses	700 to 850 ppps
Squitter pulses with 90% load	< 5%
Reply Efficiency	≥ 70%
Transmission Priority	1. Identification Pulses 2. Reply Pulses 3. Squitter Pulses

Table 6.4.3-2. IDENTIFICATION CHARACTERISTICS

PARAMETER	VALUE
IDENT Signal	ICAO Annex 10 FAA-E-2996
Operation modes	Independent/associated
Associates operation modes	Master/Slave
IDENT Signal Pulse Rate	1350 ± 10 ppps
Transmission speed	≤ 8 words/minute
Number of characters	≤ 4
IDENT Transmission	at least one every 30 s
Dot length	Adjustable from 0.1 to 0.16 s Step: 0.05 s
Dash length	3 dots
Time between dots and/or dashes	1 dot ± 10%
Time between letters or numeral	≥ 3 dots
Identification code group	≤ 10 s
Keydown period	≤ 5 s

6.4.4 Receiver Characteristics

Table 6.4.4-1. RECEIVER PERFORMANCES

Receiver	
Frequency Range	1025 to 1150 MHz
Frequency Control	By synthesizer
Frequency Stability	Better than ± 2 ppm (0.0002%)
Input Impedance	50 Ω
Input Maximum Level (operational)	-5 dBm
Input Maximum Level (survival)	+20 dBm (1025 to 1150 MHz)
Transponder Sensitivity	-94 dBm
Sensitivity variation (TXP rate: 0 - 90% maximum load)	< 1dB
Automatic Sensitivity Variation (TXP load > 90%)	≥ 50 dB
Dynamic Range	-17 to -110 dBW/m ² at TXP antenna typical installation
Adjacent Channel Rejection	> 90 dB
Desensitization by Adjacent. Channel interrogation (± 900 kHz)	< 1 dB
Adjacent Channel Rejection (± 900 kHz)	> 90 dB
Intermediate Frequency Rejection	> 85 dB
Image frequency Rejection	> 75 dB
Receiver Bandwidth	$\geq \pm 100$ kHz
Decoding	X Channel: 12 ± 1 μ s Y Channel: 36 ± 1 μ s
Decoder rejection	± 2 μ s
Sensitivity variation with pulse spacing	< 1 dB ± 1 μ s > 85 dB ± 3 μ s
Pulse width rejection	> 70 dB for widths < 0.8 μ s
TXP Dead Time	Adjustable from: 50 to 150 μ s Step: 0.05 μ s
Recovery time (Sensitivity Threshold variation)	< 1dB at 8 μ s of undesired pulses up to 60 dB above threshold
Sensitivity Reduction by CW	< 2dB CW level 10 dB below sensitivity
Efficiency reduction by CW	< 10 % CW level 6 dB below interrogation level
Short Distance Echo Supression (SDES)	Yes
Long Distance Echo Supression (LDES)	Yes

Table 6.4.4-1. RECEIVER PERFORMANCES

Receiver	
LDDES length	Adjustable from 0 to 300µs (in addition to Dead time)
LDDES Trigger	Adjustable in all dynamic range
LDDES retrigger level	Adjustable from 0 to 10dB

6.4.5 Monitor Performances

Table 6.4-1. Monitor Performances

Monitor	
Configuration	2 independent monitors (up to 4) Single/Dual
TXP triggering	≤ 120 ppps
Voting	Configurable: AND / OR
Alarm configuration	Configurable between primary or secondary
Alarm delay	< 10 s, configurable
Pulse measurement accuracy	± 1 ppps
Reply Delay measurement accuracy	± 0.05 µs
Efficiency measurement accuracy	1 %
Power measurement accuracy	± 0.01 dB
Alarms	Delay Pulse Pair Spacing Reply Efficiency Transmission Rate Radiated power Transmitted power Frequency Ident Sensitivity (by means of reply efficiency)
Alarm Thresholds	Configurable

Table 6.4.5-2. MONITOR PERFORMANCES

Monitor	
Configuration	2 independent monitors (up to 4) Single/Dual
TXP triggering	≤ 120 ppps
Voting	Configurable: AND / OR
Alarm configuration	Configurable between primary or secondary

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Table 6.4.5-3. ALARMS THRESHOLDS

PARAMETER	VALUE
Receiver Frequency (deviation)	Nominal Value: 0.001% Adjustable margin: 0.0005 to 0.002 % Step: 0.0001%
Transmitter Frequency (deviation)	Nominal Value: 0.001% Adjustable margin: 0.0005 to 0.002 % Step: 0.0001%
Pulse Rise Time (deviation)	Nominal Value: > μ s Adjustable margin: > μ s Step: μ s
Pulse Decay time (deviation)	Nominal Value: > μ s Adjustable margin: > μ s Step: μ s
Pulse Width (deviation)	Nominal Value: > μ s Adjustable margin: > μ s Step: μ s
Constituent Pulses Power variation	Nominal Value: > 1dB Adjustable margin: > 0.5 to 2dB Step: 0.5 dB
IDENT. Frequency (deviation)	Nominal Value: > 10Hz Adjustable margin: > 10 to 50 Hz Step: 10 Hz
IDENT. Code groups length	Nominal Value: > 10s Adjustable margin: > 0 to 10 s Step: 1 s
IDENT. Absence	Nominal Value: > 30 s Adjustable margin: > 30 to 60 s Step: 1 s
IDENT. Key down period	Nominal value: > 5s Adjustable margin: > 0 to 5 s Step: 1s
Sensitivity	Nominal Value: -94 dBm Adjustable margin: -80 to -100 dBm Step: 1 dB

Table 6.4.5-4. SIGNAL GNERATOR PERFORMANCES

PARAMETER	VALUE
Interrogation Signals	ICAO Annex 10
Pulse Shape	Gaussian
Pulse Rise Time	2.5 $\pm$ 0.5 μ s
Pulse Fall Time	2.5 (+0.5 μ s; -1 μ s)

Table 6.4.5-4. SIGNAL GENERATOR PERFORMANCES

PARAMETER	VALUE
Pulse Amplitude Stability	$\geq 95\%$
Pulse Width	$3.5 \pm 0.5 \mu\text{s}$
Pulse Pair Spacing	X Channel: $12 \pm 0.2 \mu\text{s}$ Y Channel: $30 \pm 0.2 \mu\text{s}$
Peak power variation (between constituent pulses)	$\leq 0.5 \text{ dB}$
RF Pulse Spectrum	> 90% within 0.5 MHz centred on the interrogation frequency Remaining energy equally distributed on both sides of 0.5 MHz band
Out of band spurious radiation (10 to 1800 MHz) (excluding 1039 to 1085 MHz)	< -40 dBm/KHz
Spurious Radiation (between pulses)	$\leq -80 \text{ dBm}$
Power Output Control (at RXU connector)	-10 dBm to -111 dBm Step: 1 dB Accuracy: $\pm 1 \text{ dB}$
Pulse Spacing Control	Up to $\pm 3 \mu\text{s}$ Step: $0.1 \mu\text{s}$
Frequency Control	960 to 1215 MHz Step: 100 KHz
Transmission Rate (normal operation)	up to 120 pp/s per monitor
Transmission Rate Control	0 to 10000 pps Step: 10 ppps
CW capability	Yes
Frequency Stability	$\pm 1 \text{ ppm}$

6.4.6 Control System Features

Table 6.4.6-1: LOCAL / REMOTE MONITORING FACILITIES

PARAMETER	VALUE / LIMITS
Local Monitoring	LCP and/or laptop

Table 6.4.6-1: LOCAL / REMOTE MONITORING FACILITIES

PARAMETER	VALUE / LIMITS
Remote Monitoring	Laptop (via NMP)
Connectivity (with NMP)	RS-232/RS-485 RTC and cellular networks Leased Lines/ Fiber optic Radio links Ethernet/VPN
Management	HTTP / SNMP / SSH
Access Management	Five password level protection
Front Panel Status Indicators	Beacon status Maintenance Power status Battery status Alarm status Transmitter status
Control (including but not limited to)	Configuration settings On/Off – Changeover Monitor bypass RF Power level Ident code Ident code internal or external source. Fault levels and internal thresholds Alarm threshold levels Power supply controls Local/Remote
Monitored Parameters (system parameters)	Beacon delay Pulse pair spacing Transmitted power Efficiency TX & RF frequency Pulse characteristics Radiated power Transmission rate Identity code
Monitored parameters (module parameters)	VSWR Voltage Rails Temperatures Status Power Supply
Monitored Parameters (Static)	Hardware Built State Software Built-State Unit Status (Master or Slave) Calibration Information

7. TECHNICAL DESCRIPTION

This section contains detailed technical descriptions of the various modules and, sufficient to support operation, adjustment and repair of the system.

7.1 GENERAL

The Distance Measuring Equipment (DME) Ground Beacon LDB-103 series equipments are designed and manufactured to meet the specifications outlined in ICAO Annex 10, ICAO Doc 8071, EUROCAE ED-57 and FAA-E-2996 requirements. Its main function is to provide automatic answer to DME interrogators, giving precise distance information through the reply to interrogations from airplanes under its coverage area, tuned in its working channel. The LDB-103 series equipments are capable of operating in the 252 possible X/Y DME/N channels.

The DME LDB-103 series equipments have been designed using digital techniques in timing and waveform generation circuitry, and analogue techniques in power amplifying circuits. Timing and frequency generation by direct digital synthesizer are derived from a single stable temperature-compensated crystal clock circuit which ensures accurate clocking of all critical time-dependent pulse generation and measurement circuits.

The equipment employs state of the art technology ensuring high reliability in order to satisfy the highest requirements. Fundamental to the design concept of this unit are integrity, reliability, and maintainability. The equipment allows the access for control and status from local and remote terminals.

The DME LDB-103 series equipments has been developed following a modular design based on logical functional block concepts. All the functionalities are grouped in different modules, being easy to follow the signal flow in the equipment. Its modular design plus its powerful BITE and intensive use of digital techniques make easier the operation and maintenance of the equipment.

The DME LDB-103 is available in two different levels of nominal output power. A terminal DME with a 100 W amplifier and an en-route DME with a 1 KW amplifier. In both configurations is possible to control the output power in a range of 4 dB (0 to -4 dB) with a 0.25 dB step. It is possible to update a terminal DME (100W) to an en-route DME (1kW) only plugging an extra module into the rack (high power amplifier).

The DME beacon may be configured for single or dual operation. A dual beacon consists of two identical electronic equipment sets housed in a single 19" cabinet, operating into one antenna system via changeover relay. There is sufficient space within the 33RU cabinet to store the back up batteries for up to 8 hours minimum of operation.

The DME system consists of the following different parts or blocks:

- ò LDB-103 equipment cabinet (single or dual)
- ò DME Antenna
- ò LMT (Local Monitoring Terminal)
- ò NMP (Network Management Processor)
- ò RMM (Remote Maintenance and Monitoring)

Main functions of the DME equipment are:

- ò Detection and analysis of interrogation pulses
- ò Signal processing related with receiver function
- ò Reply generation and timing
- ò Squitter generation
- ò Identity transmission
- ò Transmitted pulse shape control
- ò Exchange of data with NMP/EIU (Network Management Processor/External Interface Unit) for Local and Remote access
- ò Monitor functions.

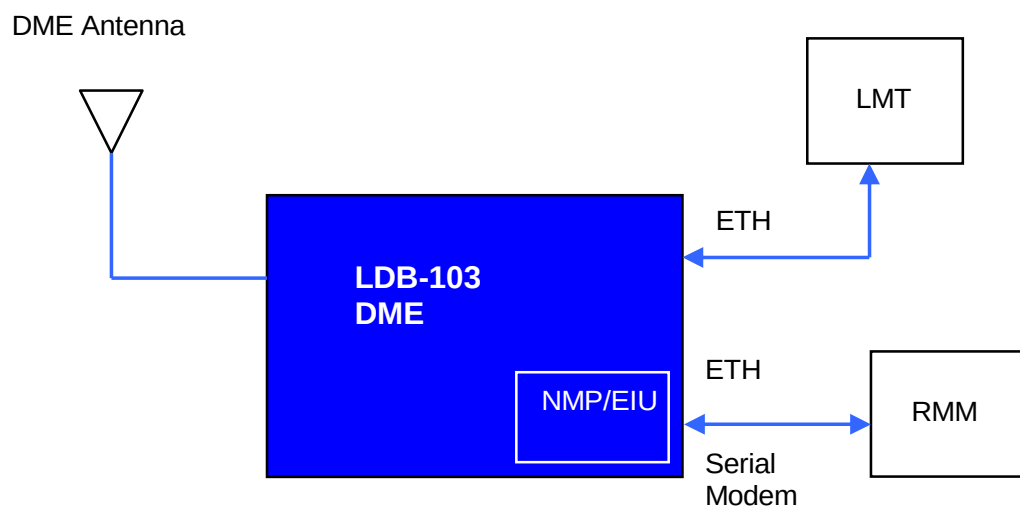


Figure 7.1-1. DME LDB-103 SYSTEM BLOCK DIAGRAM

7.1.1 Main Features

Among the salient characteristics of this new generation DME LDB-103 series equipment are:

- ò State-of-the-art technology design philosophy:
 - ñ Generation, modulation and transmitter control totally performed by HW;
 - ñ Continuous integrity monitoring performed totally by HW;
 - ñ Integrity and Local alarms no need SW to interpret states and demodulated data.
 - ñ Extensive use of digital technology:
 - ▣ Direct Digital Synthesizer (DDS);
 - ▣ Digital Signal Processing (DSP);
 - ▣ Digital Radio Techniques;
 - ▣ Control and programming by FPGA technology.
- ò Output power control of 4dB (0 to -4 dB) in 0.25dB steps in both 100 W and 1 KW DME.
- ò High level of redundancy: receivers, transmitters, integrity monitors, control modules and power supplies.
- ò Operational modes: Hot and Warm standby both in operational state.
- ò Extensive Monitoring and BIT (Built-In-Test) facilities to allow continuous, automatic testing and fault diagnostic down to LRU level.
- ò Most of the modules are hot swappable without damage
- ò Compact and modular mechanical design:
 - ñ Single cabinet 19" both single and dual configuration;
 - ñ Rack height 33UI max;
 - ñ Subrack modules IEC 60297;
 - ñ Internal battery allocation for, at least, 4 hours of operation in a dual system.
- ò CE marking certified product, fully compliance with the requirements of the applicable European Directives:
 - ñ 2004/552/EC (Interoperability)
 - ñ 1999/5/EC (R&TTE)
 - ñ 2004/108/EC and EN 301 489 -1 (EMC)
 - ñ Safety: Eurocontrol SAM methodology
 - ñ SW certification: ED-109
- ò Three level redundant power Supply configuration: Dual Power Supply Units (PSU), one per single DME equipment; two, up to four, redundant AC/DC converter modules per PSU in current sharing configuration; and dual battery banks with advanced battery facilities:

-
- Ñ Battery type: +24VDC maintenance free
 - Ñ Battery Temperature compensation;
 - Ñ Battery equalization and charging management;
 - Ñ Battery monitoring;
 - Ñ Advanced alarm management and power safe facilities allow improved operational efficiency when condition changes and rotate AC/DC modules in use periodically to share the service time.
 - ò Monitoring
 - Ñ Up to 4 independent monitors
 - Ñ Extended monitoring
 - Ñ Monitor auto-diagnosis test
 - Ñ Performance tests
 - ò High performances:
 - Ñ Accuracy: 37.5 m
 - Ñ Carrier frequency stability: ± 5 ppm, temperature and life without adjustment
 - Ñ Solid state amplifiers design, efficient and reliable
 - Ñ Hardware based monitoring function
 - ò Automatic calibration and commissioning facilities. Equipment for installation. Little or no specialised equipment for installation.
 - ò Environmental requirement based on MIL-810-F as guidance.
 - ò Local LCD display and control panel for system status indication, basic controls and measurement data indication of transmitter and monitor
 - ò Open standard approach of Indra's RMM system allowing integration of the navaid elements into the operators existing or preferred management platform. The use of SNMP Version 3 in the navaid equipment provides reliable connection orientated notifications, as well as the enhanced security this version provides.
 - ò Local and Remote Control and Monitoring Management facilities. HTTP/SNMP standards protocols facilities to integrate directly into a National monitoring network.
 - ò Global Connectivity for Control and Management. Local/Remote Control Interface Ethernet, LAN connectivity RS-232 / RS-485
 - ò User friendly interface.

7.1.2 Model Structures and Configurations

The LDB-103 series DME equipment is available in several standard configurations, depending on RF power, duplication and primary power requirements.

It is available as either a single equipment or dual equipment configuration; each of these may be fitted with either low power or high power RF amplifiers. The basic transponder provides modulation and RF drive to a power amplifier assembly which raises the power output to either 100 watts or 1kW.

Currently, the following different base models for the DME LDB-103 System are available:

- ò Model .05: DME LDB-103 1KW / DUAL System with 2 Monitors SP
- ò Model .06: DME LDB-103 1KW / DUAL System with 2 Monitors AU/NZ
- ò Model .07: DME LDB-103 100W / DUAL System with 2 Monitors SP
- ò Model .08: DME LDB-103 100W / DUAL System with 2 Monitors AU/NZ
- ò Model .09: DME LDB-103 1KW / DUAL System with 2 Monitors USA.
- ò Model .11: DME LDB-103 1kW / DUAL System with 2 Monitors UK
- ò Model .12: DME LDB-103 100W / DUAL System with 2 Monitors UK
- ò Model .13: DME LDB-103 100W / DUAL System with 2 Monitors USA
- ò Model .14: DME LDB-103 100W / DUAL System with 2 Monitors AU/NZ - AsA Contract
- ò Model .15: DME LDB-103 1kW / DUAL System with 2 Monitors AU/NZ - AsA Contract
- ò Model .20: DME LDB-103 1kW / DUAL System with 2 Monitors AU/NZ - AsA Test Rack

7.1.2.1 Single Transponder - Single Monitor

The basic transponder assembly consist of five modules, a control panel, an RF distribution panel (mounted behind the control panel), and a DC distribution panel. Low power and high power amplifier assemblies fed by a driver amplifier boosts the peak power to more than 100 watts for the low power version and more than 1kW for the high power version.

Aircraft interrogation signals from the antenna pass through the RF panel to the receiver and video circuits which process the signals. If the signals are valid interrogations, then a reply is initiated through the RF power amplifiers and RF panel back to the antenna for transmission.

A test interrogator, in conjunction with a monitor, continuously interrogates the transponder to check that it is performing correctly. These signals pass through the transponder in the same manner as those from aircraft, but now the replies are coupled from the beacon output and processed by the monitor to verify that the DME signal parameters are within tolerance. The monitor itself is automatically checked for correct operation.

An AC mains power supply, which converts the incoming AC supply voltage to a nominal +24 volts DC suitable for the rack as well as charging and standby battery bank, can be included.

7.1.2.2 Dual Transponder - Dual Monitor

To provide this configuration, a second transponder assembly of five modules is added along with a second RF power amplifier (100 watts or 1kW).

Additionally, a single RF panel is replaced by a dual version. A dual 1kW DME has the AC power supply/battery charger located outside the basic equipment rack.

7.1.3 Signal Flow

REFER Signal Flow Block Diagram,

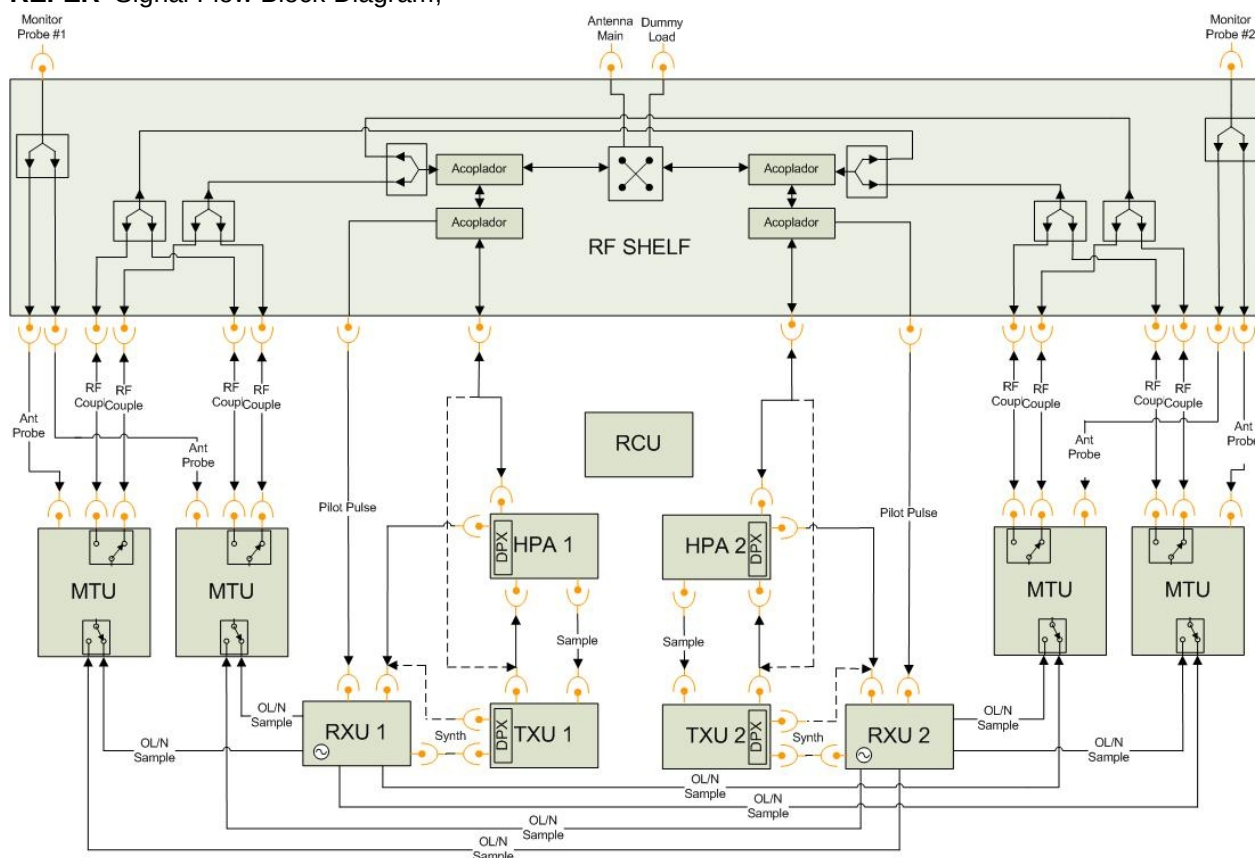


Figure 7.1.3-1.

The following description refers to a 1kW single system, the signal flow in a dual system being essentially the same for each of the transponders in the system.

Interrogation signals from an aircraft are received by the DME antenna which is connected to the RF panel in the DME equipment. In this assembly, the signals pass through a directional coupler and circulator to the preselector filter. The circulator prevents the transmitter output from coupling directly into the receiver. The preselector, comprising three coupled resonant cavities tuned to the receive frequency, reject the IF image frequency, rejects unwanted spurious frequencies and gives further attenuation to the transmitter output frequency. The interrogation signals then pass to the receiver video module.

The receiver video module detects and decodes on-channel interrogations and encodes the synchronous reply trigger pulse pair. Random reply pulse pairs are added, if necessary, to the synchronous replies to maintain a minimum reply rate of 945 Hz. The maximum reply rate is limited to a nominal 2800 Hz by reducing receiver sensitivity. The keyed identification signal (ident) occurs every 40 seconds, the 'mark' of the ident replacing normal reply pulses with a 1350 Hz pulse train.

Receiver output reply pulse pairs trigger the modulation generator in the transmitter driver module, producing RF pulses which are connected to the 1kW RF power amplifier module. The excitation frequency for the transmitter driver is provided by the local oscillator in the receiver video module.

The output from the power amplifier is connected back to the RF panel, where it passes through the circulator and directional coupler to the antenna for the reply transmission to the aircraft. In a dual system, the RF panel includes a coaxial transfer relay to connect either of the transponders to the antenna, the other being terminated in a dummy load.

The equipment also has a test interrogator and a monitor. These units are used together to check the performance of the DME. The test interrogator continuously interrogates the DME in a similar manner to an aircraft. This invokes the transponder to generate reply pulses; these are detected and processed by the monitor to verify that the signal parameters of the replies being generated by the transponder are within acceptable limits.

The test interrogators inject monitoring interrogating signals via a directional coupler in the main antenna line, and operate at a combined PRF of 100 Hz. In a dual system, two test interrogators are interconnected to prevent the interrogation of one falling in the transponder dead-time produced by the other. Efficiency is monitored at an RF level of -85 dBm, and transponder delay and reply pulse separation at an RF level of -70 dBm by successive interrogations. The signals pass through the circulator and preselector to the receiver video, where they are processed.

Transponder output pulses are sampled in the directional coupler and detected in the reply detector of the test interrogator module. Processing within the test interrogator separates out the synchronous replies from all other non-synchronous replies and squitter.

The monitor module processes output signals from the test interrogator and provides a pass or fail signal to the control and test unit for each monitored parameter. The monitor itself is periodically checked by a self-test function initiated by the control and test unit; this confirms that the monitor is capable of registering a fault for the two primary parameters of reply delay and pulse spacing.

7.1.4 Cabinet Description

The bulk of the electronics is contained within five modules each of 6 rack units height (267 mm) which plug into the transponder subrack and are secured by holding screws to the rack frame.

The 33RU high, 19" wide cabinet has lockable front and back doors (both doors perforated for optimum air flow). Included in the cabinet are:

- ò vertical mounting strips;
- ò braces and brackets;
- ò power terminal bar;
- ò battery terminal bar;
- ò battery tray;
- ò M6 case nuts at defined locations;
- ò 3RU high subrack assembly;
- ò 6RU high subrack assembly;
- ò Power cable loom

All the connections provided by this loom are listed in Appendix J.

The 6RU subrack assembly accommodates DME modules with sliding tracks and also contains the Backplanes PBA. A second subrack 3RU high contains the LCU and the RCU modules.

The cabinet together with locations for modules is shown in Figure 6.2-1 and Figure 6.2-2.

7.1.5 Contents of Equipment Cabinet

The arrangement of the LDB-103 rack fully fitted with electronics equipment is shown in Table 7.1.5-1 below. The cabinet contains the following modules, listed from top to bottom, left to right:

Table 7.1.5-1: LDB-103 MODULE CONTENTS

LOCATION	MODULE	PART NUMBER	NOTE
3RU SubRack from L to R	LCU	0063420003100	Local Control Interface
	RCU	0063420003200	Relay Control Unit
6RU SubRack from L to R	HPA1	0063420004500	System #1 (LHS group)
	TXU1	0063420004400	Default Main DME equipment
	RXU1	0063420004300	
	MTU – 1	0063420004200	
	MTU – 2	0063420004200	
	CMU A	0063420004100	
	CMU B	0063420004100	System #2 (RHS group)
	MTU - 3	0063420004200	Default Stand-By DME equipment
	MTU - 4	0063420004200	
	RXU2	0063420004300	
	TXU2	0063420004400	
	HPA2	0063420004500	
	Utility Space		
	PSU1 Main	0063420005000	
	PSU2 StandBy	0063420005000	
	NMP/EIU	0063420006100	
	Battery Compartment		

The LCU subrack located at the top houses the Local Control Unit itself on the LHS and and the Relay Control Unit (RCU) on the RHS. The LCU subrack is screwed to the rack and is 3 rack units (267 mm) high.

Behind the LCU subrack is the RF Shelf, one in single configuration, two in for dual equipments, including all directional coupler(s), dividers and other RF circuitry.

The HPA module is deployed only in the 1kW transponders. Unused space in the 6RU subrack is covered with a blank panels.

The AC power supply/battery charger each occupies 2 rack units (89 mm) height, and is 240 mm deep.

If standby batteries are used, there is sufficient space within the cabinet for dual 24Volt supply each having 90AH capacity. These are designed to operate a warm stand-by dual system for 8 hours without

AC support. For higher capacity, the batteries are housed in a separate, ventilated enclosure which may be either inside or outside the main equipment shelter.

The physical layout of the 1kW dual transponder, dual monitor, AC supply version is shown in Figure 6.2-1 to Figure 6.2-5.

Fort system interconnection diagrams, refer to Appendix J drawings.

7.1.6 Mode of Operation

The two standard modes of operation in a dual LDB-103 DME will be referred to as Hot Standby (default mode), and Warm Standby.

In the "Hot" mode, both sets of radiofrequency amplifiers will be kept active and the energy from the redundant amplifiers will be dissipated into 50 ohm loads attached to or contained in the Relay Control Unit (RCU).

In the "Warm" mode the Relay Control Unit will be configured to disable or left power down the Low and High Power Amplifiers in the unit that is acting as Standby DME. This saves power and will extend the time that the LDB-103 can operate off back-up batteries.

However, because the RCU doesn't have direct access to the PSU status, there is a special operating mode for the Master CMU module, referred as "Warm Standby on Battery Back-up". If this mode was in effect, the CMU would switch the RCU from Hot Standby (default mode) to Warm Standby when the system had switched over to battery operation due to an interruption in the mains power supply.

7.1.7 Module Interconnection

An asynchronous Master/Slave RS-485 bus will interconnect the different modules to set, extract and upload configuration and/or operating data. There will be only one RS-485 bus between all modules regardless of a single or dual system.

The Control and Monitoring Unit (CMU) primary role will be to gather information from each module in the system. There will be only one Master device on the bus, with all other modules being Slaves. By this, it is meant that only one device will be able to initiate data transfers, and all other devices will wait to be "polled" by the master.

In a single DME system, there will be only one CMU, and this will always be the Master device. In a dual DME system there will be two CMUs. Which CMU becomes the Master device on the RS485 bus will be resolved in the following manner: Upon power-up, or after a reset, each CMU will determine if it is inserted into the Left, or the Right side. The CMU on the Left sub-rack will wait a user-defined period. The CMU in the right sub-rack will also wait for a higher user-defined period. If no poll-requests are observed on the RS485 bus by the CMU at the end of its timeout, the CMU will automatically become the Master device by initiating poll requests. Thus if both CMUs were powered on, or reset, at the same time, the Left CMU will become the Master device if these timeouts are left in their default states. The Master CMU will stay as the bus Master until such time as it fails to get responses from more than 50% of the modules in both systems. In this instance, it will stop polling for one second (user settable) before starting the normal timeouts mentioned in the previous paragraph. If, poll requests are observed in this period, the CMU will assume it is no longer the Master CMU, but instead the Standby CMU. A Standby CMU will automatically become Master CMU, if it sees an absence of poll-requests for more than 1 second (by default). This

period is also user-settable.

7.1.8 Module Identification

Each physical module in the equipment will have a unique Identification code that will be able to be accessed by poll requests on the RS-485 bus that interconnects all the units in a system. Each poll response in the bus will include the module's unique identification code, and in this manner the Control and Monitoring unit will always know if a module in a system has been swapped with a new one.

In the case that any module is found to have an invalid Module Identification, a Secondary Alarm will be generated by the controlling CMU, and many operating parameters associated with that module will no longer be accessible by remote access.

At installation, or when replacing any module, the software in the Control and Monitoring Unit will need to be given keys for the modules supplied (including spares) so that they will activate when installed.

7.1.9 Built-In-Test (BIT) and Alarms Outputs

The LDB-103 will be provided with auto-diagnosis capability. Each part of the DME system will provided with a diagnosis system (BIT) for a rapidly identification of malfunctions and faulty elements.

The BIT (Built-In-Test) will consist of the following three levels:

- ò Power-up BIT (PBIT). After being energized, the DME will start the PBIT, ignoring any command to change to other mode of operation. When finished, the DME will operate as commanded.
- ò Continuous BIT (CBIT). Automatically performed when PBIT finishes, it will not interfere in the normal operation of the system. The CBIT will not require to be commanded.

Every module plugged into the system will be capable of generate alarm signals. The kind of alarms generated will depend on the module.

Every module plugged in the 6RU subrack will be able to generate both primary and secondary alarms, with the exception of the Control and Monitoring Unit (CMU), which will only be able to generate Secondary Alarms. These alarms will be read by the Relay Control Unit (RCU) so as to select the transponder connected the antenna (On air transponder).

There will be three kind of primary and secondary alarm signals:

- ò TXP alarm;
- ò Local Monitor Alarm;
- ò Executive Alarm.

The TXP Primary Alarm signal will be implemented by connecting a single data line to each module of the transponder (HPA, TXU and RXU). A TXP Primary alarm will be generated by driving this data line to ground. If the TXP primary alarm is no asserted, the line will be leave in an undriven state.

The Relay Control Unit (RCU) will have a pull-up on the TXP Primary Alarm signal and will be the one which read the status of the signal.

The TXP Secondary Alarm signal will be implemented in exactly the same way.

As part of the Monitor Transponder Unit's (MTU) Built-In-Test facilities, the MTU module will be capable of generate an independent LOCAL Primary Alarm or Secondary Alarm. It will do this by pulling one or both of these lines to ground in the same way as TXP alarm signals. These alarm signals will be independent, not being connected in an or-wired bus like the TXP alarm.

As well, the Monitor Transponder Unit (MTU) will be able to generate EXECUTIVE Primary and Secondary Alarms based on the radio signal that it is monitoring. As a consequence, the EXECUTIVE Primary and Secondary Alarms that are produced as a result of problems detected in the TXP generated signals will be separated from the alarm signals that arise from the TXPs. These signal will have the same characteristics that the Local Monitor Alarms.

The Relay Control Unit (RCU) will read all the primary and secondary alarm signals described above and will make the decision of which transponder connect to the antenna. This unit will also be able to generate primary and secondary alarm signals, connecting them to the TXP or-wired alarm bus. Note that in a dual system there will be two independent TXP alarm buses, formed by two different signal. Each transponder will have its own primary TXP alarm bus and its independent secondary TXP alarm bus.

7.1.10 Local and Remote Controls

The beacon will be designed for unattended operation and will be able to be controlled and monitored from a local or a remote location. The management and control of the equipment will be by standardized protocols HTTP and SNMP over encrypted channels.

Local control of the parameters can be performed in two ways:

- Basic control;
- Extended control.

Basic control will be made through buttons supplied by the Local Control Unit (LCU) touch screen display. For more information see LCU description (paragraph 7.3.2). These buttons will supply basic control functions (for example switch on and off each transponder in a dual equipment) to the user in an easy and intuitive way. These buttons will be focused to facilitate maintenance works and to supply high level control of the equipment.

To make a more powerful control of the equipment it will be necessary to make use of the extended control. An extended control of the beacon will be performed through network connections. In this case there will be other two possibilities:

- A laptop connected by a network cable to the front panel of the equipment.
- A laptop connected by a network cable to the NMP/EIU module.

Remote control can be performed by a connection accomplished by multiple means including dial-up modem, leased-lines, radio, IP-based virtual private network (VPN), Ethernet, and cellular networks.

A control access management based on five access levels will be implemented so that only one user at

once shall obtain the equipment control.

A technical and performance description specification of the NMP/EIU module and the Nav aids Local and Remote Maintenance Monitoring System (RMM) can be found in Indra documents 0063420006100HR00 0066910000100MA02, respectively.

Refer to Appendix C for more information.

7.1.11 Testability

Each module has been designed for testability. Where possible, each pin of relevant components can be tested for Stuck at One or a Stuck at Zero fault. An extensive BITE system is incorporated into each module. All relevant parameters including rail voltages, temperatures, current values of parameters, are measured and compared to preset limits. Appropriate alarms are next flagged as needed. Information thus available are reported when polled, either periodically or whenever requested. At a higher level, polled or reported information is logged to provide operational history of the equipment over a period of time.

7.1.12 Product Life Span

The DME has been designed for supported operation until at least the year 2020. Where single-sourced critical components have been used, certificates have been obtained from the manufacturers to guarantee availability through to 2020, or that an obsolescence plan is provided.

The obsolescence plan may acknowledge programs from the suppliers such as Last Time Buy notices.

7.1.13 Manufacturing Standards

Although the DME LDB-103 series is a Category 9 product and is, therefore, exempt from the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment 2002/95/EC, usually referred to as RoHS, the LDB-103 is fully compliant with RoHS normative.

7.1.14 Static Discharge Immunity

All backplane connections and front panel connections involving signals (not power) will have static discharge immunity meeting EN61000-4-2.

7.1.15 Security

The equipment operation is guarded against inadvertent changes to its intended operation with password security. There are five levels of password accessibility to the equipment. These are:

- ò Viewer
- ò Operator
- ò Manager
- ò Installer
- ò Administrator

At each of the five operation levels, one of the four levels of password complexity may be invoked. These are described in Appendix A, section A.4.3.

As the equipment is accessible via communication network, the concept of local or remote control is no longer clear cut. For example, an operator may be physically present at the site but may access the equipment via a WAN terminal, while another operator may be located at the Control Room, many kilometers away, but may access the equipment via a LAN terminal using dedicated cable or a radio link. To eliminate the possibility of having more than one operator modifying operational parameters at the same time, the user simply selects the “single user” option. The allocation of priority to a particular operator whether local (LAN) or remote (WAN), has user-settable automatic time-out. These are again explained in more details in Appendix A.

7.2 SUBSYSTEM DESCRIPTION

7.2.1 Introduction

To enable easier understanding of the LDB-103 DME system the description is split into six subsystems:

- ò Transponder subsystem;
- ò Relay control subsystem;
- ò Antenna subsystem;
- ò Monitoring subsystem;
- ò Management & Control subsystem;
- ò Power Supply subsystem;

Figure 7.1-1 below provides an overview of the LDB-103 functional block diagram in its dual configuration.

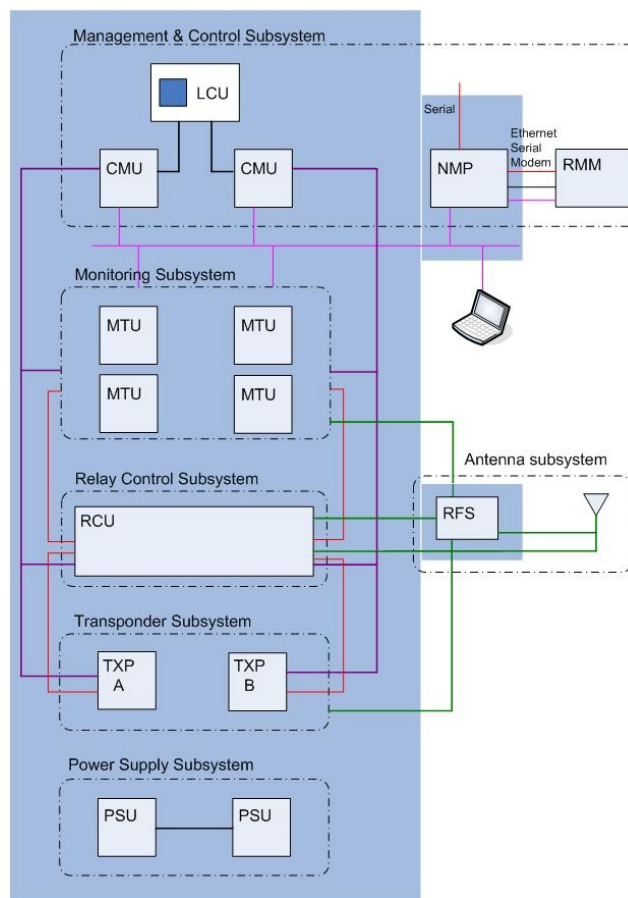


Figure 7.2.1-1. LDB-103 DME FUNCTIONAL BLOCK DIAGRAM

7.2.2 Transponder Subsystem

The transponder subsystem forms the core of the DME. It is responsible for the reception and decoding of the interrogation signal as well as generation and amplification of the navigational signals up to the required power levels to distribute them through the antenna subsystem.

The transponder functional block is divided into three different modules:

- o Receiver Unit (RXU) which manages all reception processes, making use of digital techniques as FPGA and DDS technology.
- o Transmitter Unit (TXU) which manages pulse generation processes, assuring the correct pulse shape characteristics and amplification up to 100 Watts. This module will also make use of digital techniques as FPGA and DDS technology.
- o High Power Amplifier (HPA), which amplifies the TXU output signal up to 1 kWatt.

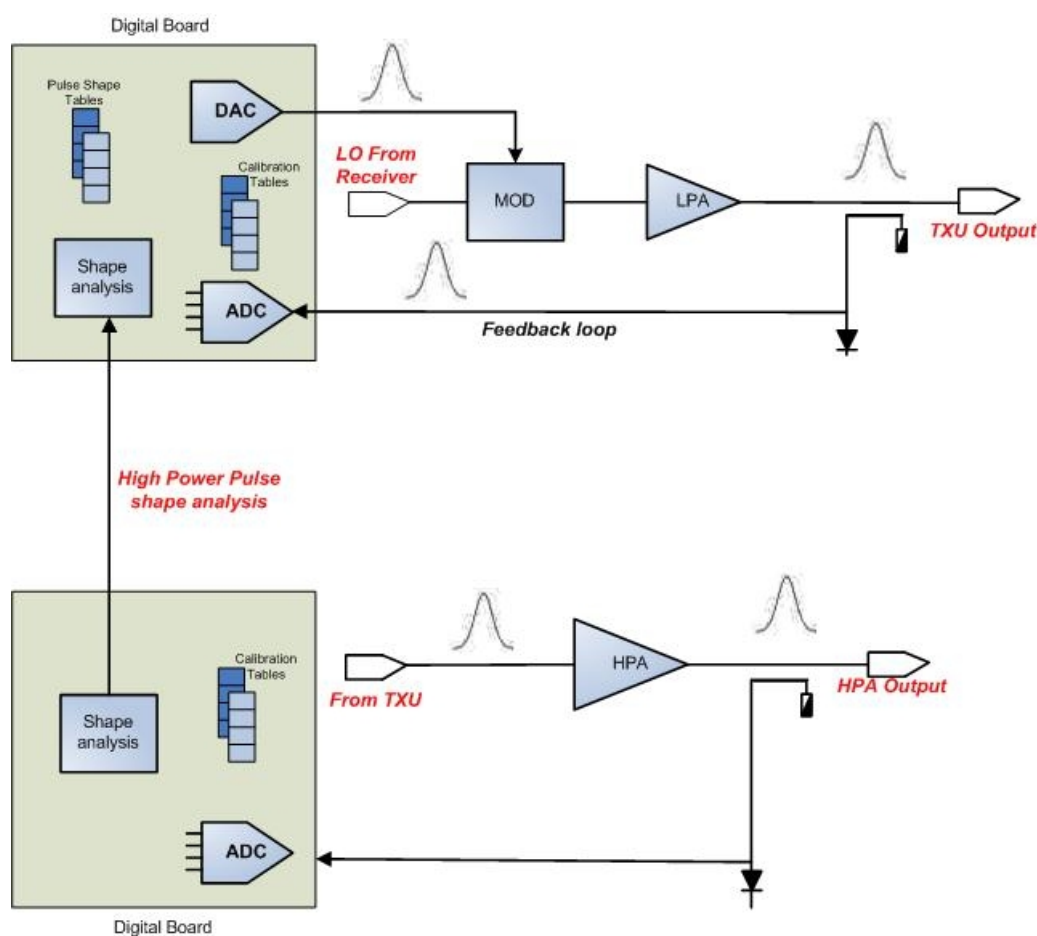


Figure 7.2.2-1. TRANSPONDER SUBSYSTEM - GENERATION AND AMPLIFICATION

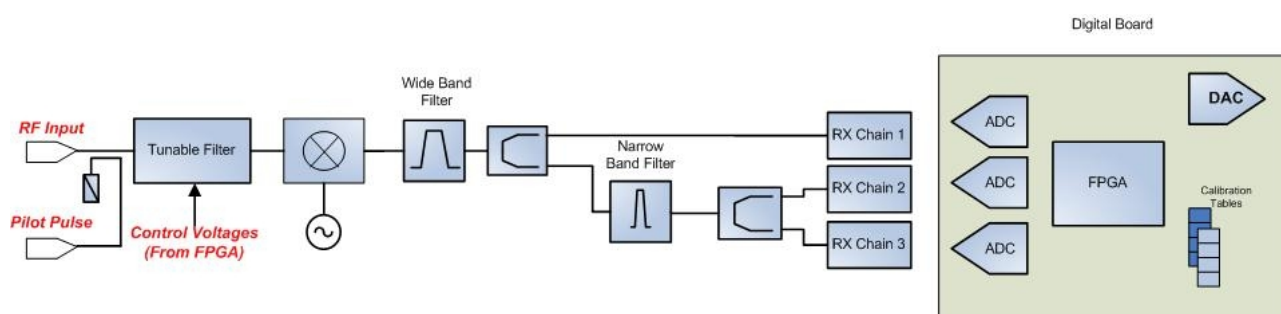


Figure 7.2.2-2. TRANSPONDER SUBSYSTEM - RECEIVER CHAIN

7.2.3 Relay Control Subsystem

The relay control subsystem consists of only one module: the Relay Changeover Unit (RCU).

In a dual DME, the Relay Control Unit (RCU) primary role is to analyse local alarms from each DME system, as well as the alarms from the Monitor Transponder Units (MTUs), and based on that information decide which, if any, system should be connected to the antenna. This subsystem will be based on a FPGA HW platform, not making use of any software in the changeover and shutdowns processes.

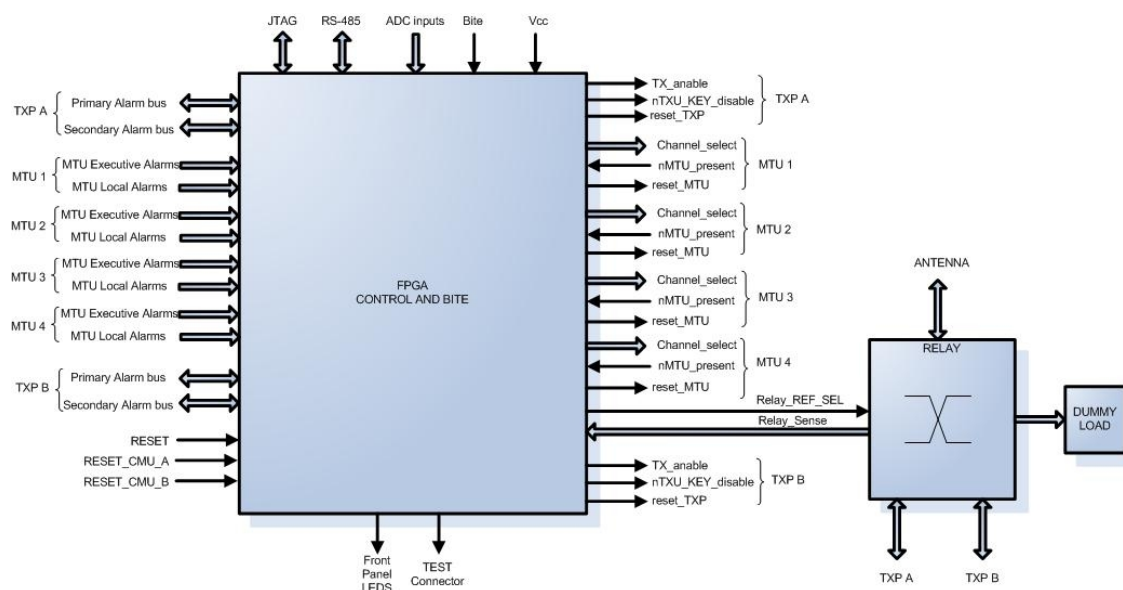


Figure 7.2.3-1. RELAY CONTROL SUBSYSTEM

7.2.4 Antenna Subsystem

The LDB-103 Antenna subsystem composes of two modules, the Radiofrequency Shelf (RFS) and the DME antenna.

The Radiofrequency Shelf (RFS) is a completely passive module which supplies radiofrequency connectivity between the different subsystems.

The DME antenna allows the reception and transmission of the DME navigational signals with the proper radiation pattern as well as it supplies two monitor probe ports.

7.2.5 Monitoring Subsystem

The Monitoring subsystem consists of a number of Monitor Transponder Units (MTUs) which is dependent on the DME configuration. A single DME is able to accommodate up to two independent monitors, a dual DME will be able to fit up two four.

This subsystem first simulates a distant aircraft sending DME interrogation signals. It then analyzes the subsequent replies of the DME beacon, determining whether the main parameters of the transmitted signal are within pre-set tolerances. A dedicated alarm signal will be driven in response to this result as well as other conditions. This signal disables the power supply to the final radiofrequency amplifiers in the Transmitter Unit (TXU) and High Power Amplifier (HPA) and hence stops the radiation of signal into space. Combinations of AND/OR voting settings are also allowed.

The monitoring capabilities form parts of the elements that ensure the safety of the navigation signal. The processing involved in order to determine if a navaid signal is invalid, is performed using only digital hardware FPGA technology. It is implemented by means of independent hardware. No processors or software is used in this part of the processing.

The Monitor Transponder Units (MTUs) makes use of the coupled signals provided by the radiofrequency shelf and the DME antenna.

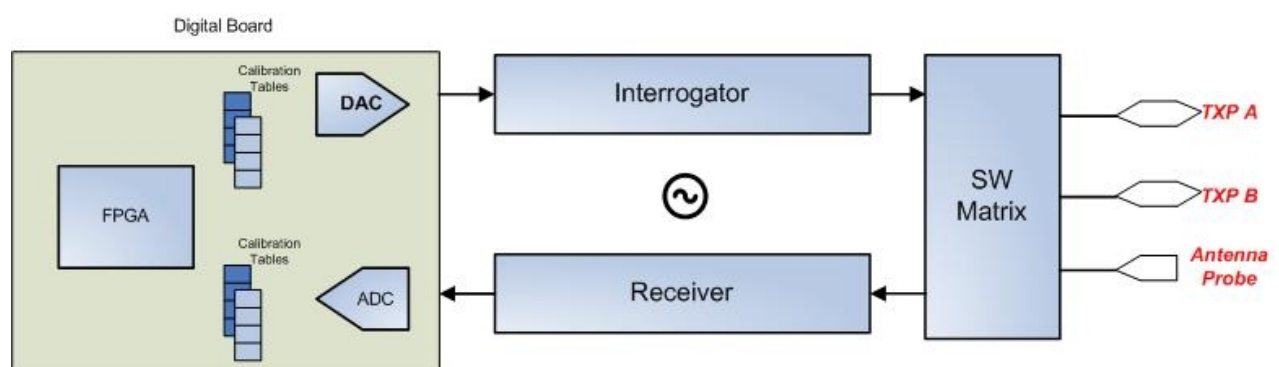


Figure 7.2.5-1. MONITORING SUBSYSTEM

7.2.6 Power Supply Subsystem

This subsystem converts the nominal 240 volts AC input into regulated DC supplies of nominally +27.25 VDC. This voltage is connected to each DME module where it is further converted to other voltage rails for use within that module.

The primary DC voltage source also provides charging current for the back-up batteries. The capacity of the rectifiers and the load demand of the equipment are such that with the equipment operating, there are 18 Amperes available for charging the batteries. For batteries having 86 AH capacity, it will take less than 4 hours to recharge the batteries from 60% down to fully charged. Together with the backup batteries, the power supply system used with the LDB-103 is a NBPS equivalent to a UPS.

The complete power supply unit (PSU) consists of a controller, a number of rectifier modules and a circuit breaker, all fitted in a 2RU 19" rack housing. The housing has connections for AC inputs, DC outputs and system communication.

The rectifier module uses a high frequency switch mode conversion technique to provide fully isolated DC power from AC source of nominal 90 to 280 VAC, 50/60 Hz Mains. Each rectifier module is capable of delivering up to 400 W (14 Amps at +27.25 VDC) and can be inserted or removed from the system without cutting power to or from the system or the load. The PSU has an extensive alarm system and is protected against overvoltage and short-circuited current. Details of the PSU is given in Appendix H.

The controller controls and monitors the power supply operation. Operating parameters for the power supply are user programmable. Default values for some major parameters are shown in the following table.

Within the equipment cabinet, there is sufficient space for storing the back-up batteries for a total of up to 8 hours of stand-alone operation.

7.2.7 Management & Control Subsystem

This functional block is subdivided into two subparts, unit or blocks, hardware and software, to configure the system and also monitor its performance for either Local or Remote Management Monitoring (RMM):

- The Control and Monitoring Unit, the CMU;
- The Remote Management Monitoring, named as RMM.

The CMU will be the principal access point for the other subsystems.

The primary function of the CMU, when a system powers up, will be to gather (and possibly distribute) configuration and status data from each module in the system. It will also allow local and remote access to operating parameters. Whilst a system is operational, or on standby, the CMU will poll performance data from each module. Although a CMU fails, this fact will not impact the DME system's ability to generate the appropriate signals for guidance operation, nor in the ability of the Monitor and Relay control subsystem to detect faults and shut-down the system upon a failure.

The CMU could be duplicated for redundancy. In that case, one CMU will act as default master to assuming responsibility for monitoring both Main system and Standby system, including the other CMU. The other CMU will listen to all polling activity and record all data observed on the common serial bus.

The CMU will also support monitoring, calibration and installation activities, because Software in the CMU will be able to cause the Monitor Transponder Unit (MTU) to generate custom test signals. The CMU will process and/or read the data extracted by the MTU as a consequence of the signals being generated by the transponder as a reply to the MTU interrogation signals.

The Management and Control subsystem will allow command and control of all nav aids at an specific site. Likewise, It will regularly collect operational and equipments status information to be stored and analysed in order to detect parameters varying outside drift and alarm limits (and if so, to provide notification to the Monitoring Centre).

This functional block includes:

- ò The managed elements in the LDB-103, which natively will support both SNMP and HTTP servers as the management protocols, inside the CMU modules;
- ò The Network Management Processor/External Interface Unit (NMP/EIU), to provide the gateway between the nav aid equipment and the remote site communications as well as protocol support for legacy nav aids;
- ò The Local Monitoring Terminal, when used, located at the Nav aid Site.
- ò The Remote Status Unit(s) (RSU), may be located in the Air Traffic Control (ATC) area to provide indications of the availability of nav aids;
- ò The Remote Control and Status Unit (RCSU) may be located in the Air Traffic Control (ATC) area to provide control and status information of the nav aids;
- ò The Communications Subsystem consisting in modems at both sites, if needed; and
- ò The Central Monitoring Terminal (CMT), including optional line terminators against transients.

The purpose of the NMP/EIU will be to provide a common management interface to various equipments. The range of equipment will include:

- ò Existing equipment mostly managed using proprietary protocols access via serial port;
- ò New equipment managed using standard protocols accessed by Ethernet interface where possible; and
- ò Third party equipment managed with either standard or proprietary protocols accessed by either serial or Ethernet interfaces.

The NMP/EIU will collect site-specific alarms and will provide the multiple communication interfaces for remote connection, such as traditional leased-line, radio and dial-up modems as well as cellular modems and direct Ethernet connection. The NMP/EIU module communication interface can be considered as the Wide Area Network (WAN) interface.

The Remote Maintenance and Monitoring System (RMM) can also be invoked by means of a relay-based interface providing on/off control and operation monitoring upon customer request. The operator console at the central site permits control of the DME in the same manner as that provided on the DME control panel.

The NMP/EIU module will also have a number of Local Area Network (LAN) interfaces to connect to the equipment in the shelter or site. The NMP will use standard TCP/IP routing technology, allowing not only Indra nav aids to be connected to the site's LAN, but 3rd party elements can also be easily integrated. LAN interfaces will include multiple 10/100BaseT Ethernet ports as well as multiple RS232/485 interfaces. The NMP/EIU element itself will be able to be managed using HTTP and SNMP.

For legacy nav aid equipment, the NMP/EIU module will convert any HTTP or SNMP requests to the proprietary legacy protocol, to ensure the network of nav aids is open standards compliant. This will allow for seamless management of networks of nav aids, whether consisting only new models, legacy models or a mixed network of both.

Refer to Appendix C for more information.

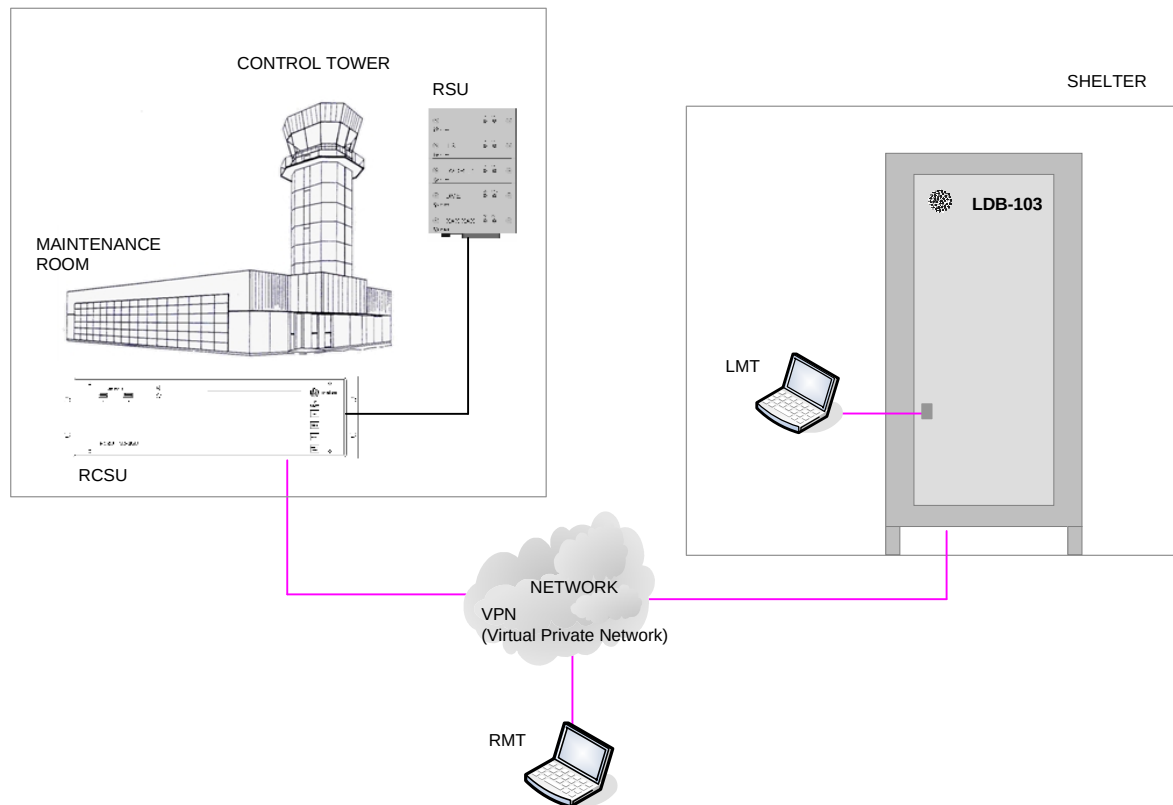


Figure 7.2.7-1. NAV Aids RMM COMPONENTS

7.3 DME LDB-103 DETAILED DESCRIPTION

Each single DME equipment will consist of a Control and Monitoring Unit (CMU), one or two Monitor Transponder Units (MTU), a Receiver Unit (RXU), a Transmitter Unit (TXU) and a Power Supply Unit (PSU). In case of an en-route DME (1KW), space in the cabinet is available to fit a High Power Amplifier (HPA) to provide the additional RF amplification.

Two single DME equipment are used to build up a dual redundant system, both fitted within one cabinet that still has space for the standbt batteries.

Common parts for both single equipments consist of three other modules: the RFS (RadioFrequency Shelf) will supply radiofrequency connectivity between modules; the RCU (Relay Control Unit) will make the decision of perform a changeover between equipments and will hold the transfer switch; and the LCU (Local Control Unit) wich will provide a Human Machine Interface, giving access to status information and basic control functions.

There will be no physical differences between the Main System and the Standby system in a dual DME LDB-103, and the user will be able to assign either system to be the "Main" system.

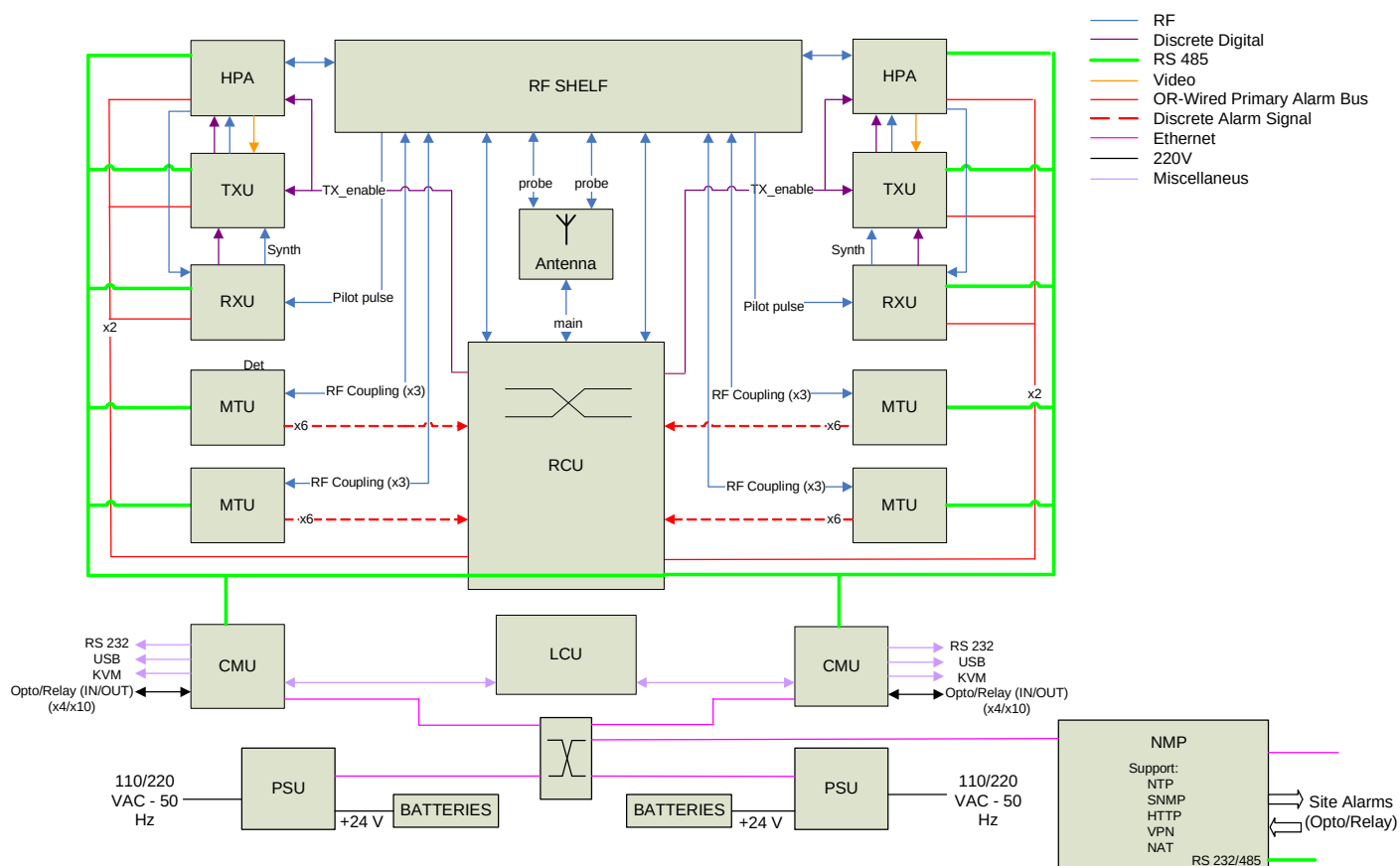


Figure 7.3-1. DETAILED FUNCTIONAL BLOCK DIAGRAM

The RadioFrequency Shelf (RFS) will provide RF connectivity between the antenna and the two single equipments, as well as radiofrequency connection between transponder and monitors and a coupled signal used as a pilot pulse in order to implement a beacon delay dynamic adjustment.

In case of a dual beacon, the Relay Control Unit (RCU) will be responsible of decide which transponder is the better one in order to connect it to the antenna, assuring a continuous operation of the system with the better signal in every moment. The RCU will accept alarm information from both transponders and based on this alarm information will connect either the Main or Standby transponder to the antenna.

While Receiver Unit (RXU) will perform the reception tasks of the transponder, like filtering and amplification of the received signal and digital signal processing, Transmitter Unit (TXU) will perform all the tasks related with signal generation, pulse shape control and radiofrequency amplification up to 100W.

In case of an en-route DME, it will be necessary to add an extra module namely the HPA (High Power Amplifier) which will amplify the radiofrequency signal up to 1 KW with the TXU in this case acting as a driver.

The equipment is able to be configured with up to 4 independent Monitor Transponder Units (MTUs), which ensure the proper operation of the system. Association between MTUs and transponders will be soft, with all the monitors being able to make a supervision of both transponders. Each monitor will receive signal from both transponders. With this configuration it is possible to improve the reliability and continuity of service for the system with judicious management of this functionality.

In a typical configuration, the LDB-103 DME equipment will have two transponders and four independent monitors, two of them supervising one of the transponder and the other two supervising the other one. The Relay Control Unit (RCU) will make the decision of performing a changeover between transponders, using a predetermined combination of monitor alarm evaluations with an AND or an OR logical function.

The Control & Monitoring Unit (CMU) will act as the master in the RS 485 bus which will interconnect most of the DME modules and will gather module information. In addition to this functionality, the CMU will be the main door for the system, acting as the external interface for Local and Remote access (in this case via the NMP/EIU).

7.3.1 RadioFrequency Shelf (RFS)

7.3.1.1 Functional description

RadioFrequency Shelf (RFS) primary role will be to provide radiofrequency connectivity between the antenna/dummy load and the modules of the transponder.

The RFS unit performs the following functions:

- ò RF connectivity between the antenna/dummy load and the modules of the transponders
- ò Radiofrequency connection between transponder and monitors
- ò RF connection between transponder and a coupled signal used as a pilot pulse in order to implement a beacon delay dynamic adjustment.

This module will be completely passive and will not have any intelligence. It will be formed by radiofrequency couplers and splitters.

Figure 7.3.1.1-1 shows the functional block diagram of the Radiofrequency Shelves (RFS) for a dual equipment configuration with all their radiofrequency ports.

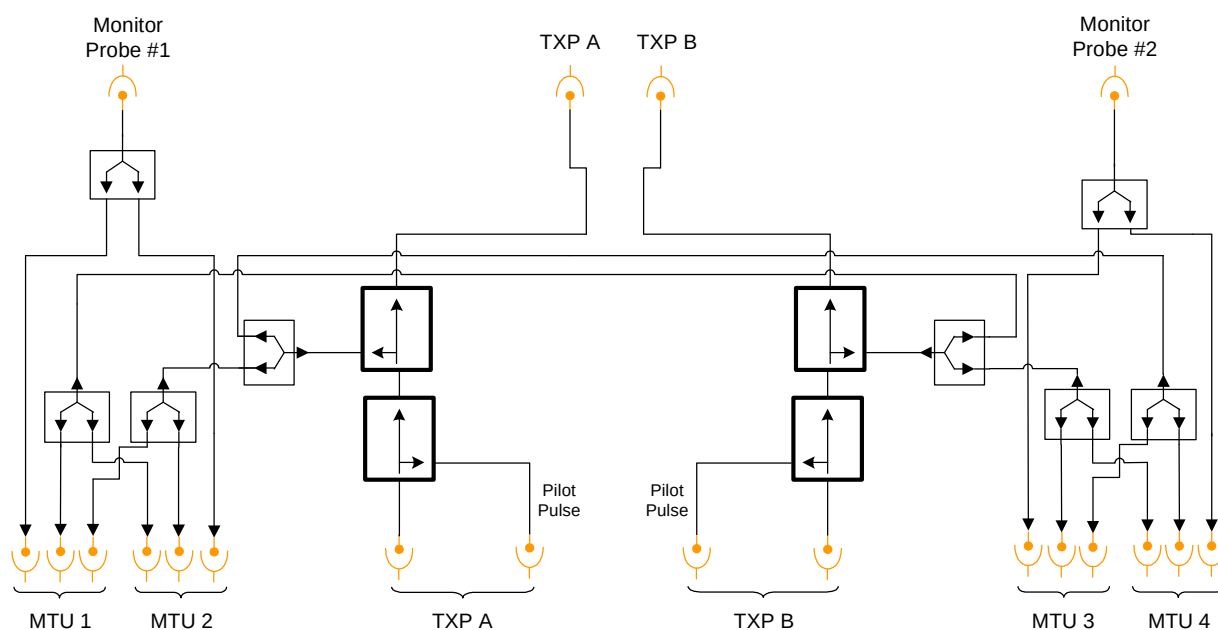


Figure 7.3.1.1-1. RFS FUNCTIONAL BLOCK DIAGRAM

As shown above, RF Shelf is symmetric, so in a single equipment only one half of this module will be used, compared to setup for the dual equipment RF shelf. In this case of single equipment, since the transfer switch is not fitted/ activated in the RCU, connections between the TXP and the antenna will be made directly straight through (for more information see 7.3.3.1).

Radiofrequency shelf will provide a coupled way in transmission so as to implement a pilot pulse algorithm with which the transponder will be able to adjust its own delay independently of monitor tasks and measures.

Radiofrequency connection between monitors and transponders will be done through the RF shelf, connecting both transponders to the four possible monitors plugged into the system.

External radiofrequency ports of the RF Shelf will be:

- ò RCU/Antenna Ports
 - ñ TXP A;
 - ñ TXP B.
- ò Monitor Probes (x2) (connected to antenna)
- ò TXP ports (x2)
 - ñ TXP;
 - ñ Pilot Pulse.
- ò Monitor ports (x4)
 - ñ Antenna monitor probes;
 - ñ TXP A;
 - ñ TXP B.

7.3.1.2 BIT facilities and Alarm management

Since the RF Shelf is a completely passive module, it will not be able to assert any alarm and it will not generate any BIT signal.

7.3.1.3 Programming and control information

RF Shelf will not be connected to the RS-485 bus.

7.3.1.4 Mechanical details

Radiofrequency Shelf circuit is based in strip line technology. Strip line technology uses a flat strip of metal which is sandwiched between two parallel ground planes. The insulating material of the substrate forms a dielectric. The width of the strip, the thickness of the substrate and the relative permittivity of the substrate determine the characteristic impedance of the strip which is a transmission line.

In RFS unit, substrate used is AD255A, two layers of which are sandwich clamped between two aluminium carriers. Twelve SMA coaxial launches are edge fitted to the aluminium housing.

Figure 7.3.1.4-1 shows the DME RFS module.

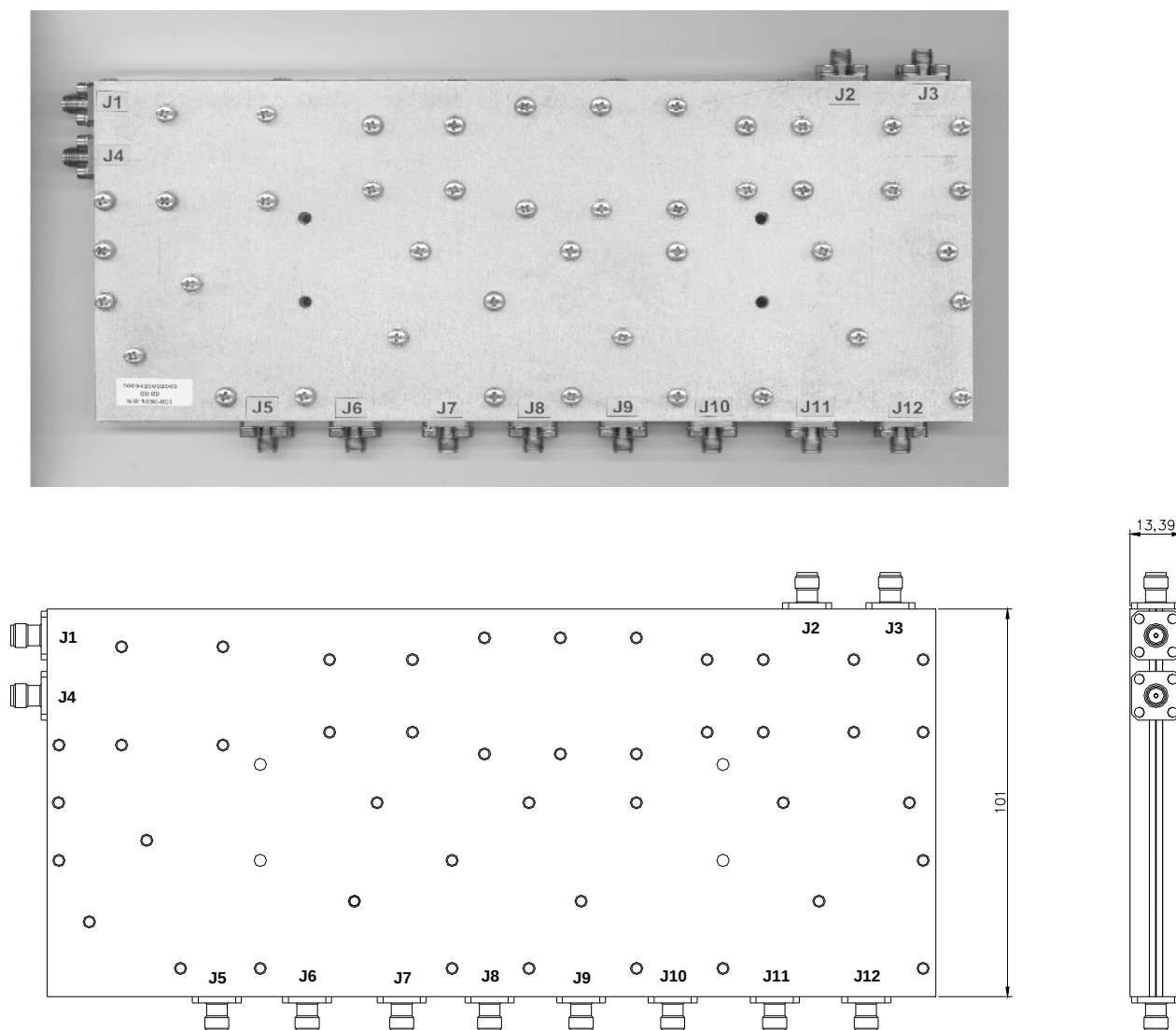


Figure 7.3.1.4-1. DME RFS ASSEMBLY

Dimensions: 230 x 100 x 13 mm, approximately

Weight: 0.7 Kgs, approximately.

Allocation of connectors is given the following table:

Table 7.3.1.4-1: RFS CONNECTORS ALLOCATION

REF	SIGNAL NAME	I/O	ORIGIN	DESTINATION
J1	PILOT	O	RFS	RXU
J2	TRANSFER_SWITCH	O/I	RFS/RCU	RCU/RFS
J3	ANTENNA_PROBE	I	ANTENNA	RFS
J4	TX	I	TXU	RFS
J5	RFS_I/O_1	I/O	RFS A/RFS B	RFS B/RFS A
J6	MTU2_A	O/I	RFS/MTU2	MTU2/RFS
J7	MTU1_A	O/I	RFS/MTU2	MTU2/RFS
J8	MTU2_B	O/I	RFS/MTU1	MTU1/RFS
J9	RFS_I/O_2	I/O	RFS A/RFS B	RFS B/RFS A
J10	MTU1_B	O/I	RFS/MTU1	MTU1/RFS
J11	MTU2_ANTENNA	O	RFS	MTU2
J12	MTU1_ANTENNA	O	RFS	MTU1

NOTE: The transfer switch and dummy load for a dual DME are not part of the RFS Shelf Module. They are allocated into the Relay Control Unit (RCU).

7.3.1.5 Front panel details

N/A

7.3.1.6 Hardware Implementation and Schematics

Radiofrequency Shelf (RFS) is fitted at the back of the cabinet where it is readily accessible to the RF I/O ports of the MTU, RXU, TXU and HPA. It does not have any front panel. The RFS schematics are given in Appendix J of this handbook which includes drawing 00634 3000 2000 for the RFS PBA.

7.3.2 Local Control Unit (LCU)

7.3.2.1 Functional description

The DME LDB-103 series equipments include a Local Control Unit (LCU) with a Thin Film Transistor (TFT) Color Liquid Crystal Display Module with a touch panel. This unit will provide a Human Machine Interface, giving access to status and alarm information and basic control functions in local environment in which the operator is situated at where the equipment cabinet is.

This unit acts as a slave of the Control and Monitoring Units (CMUs) present in the equipment, not having any internal intelligence. The information showed in the display is managed by the master CMU of the equipment. It also receives the commands introduced by the user through the touch screen. This unit transmits and receives information from the master CMU by means of VGA and USB serial connections.

Since the equipment can fit two CMUs in a dual system, the Local Control Unit (LCU) will have connectivity with both of them (2 VGA and 2 USB connectors), making an internal selection by means of a chip select signal sent by the Relay Control Unit (RCU), which knows which is the master CMU in the system.

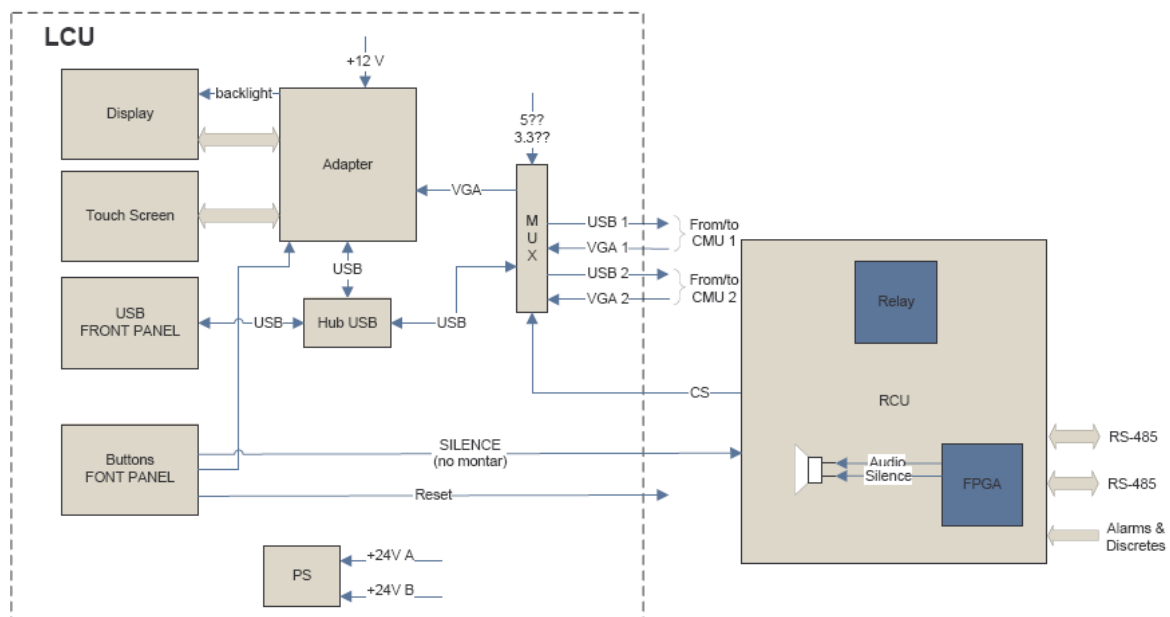


Figure 7.3.2.1-1. LOCAL CONTROL UNIT (LCU) FUNCTIONAL BLOCK DIAGRAM

The LCU shows:

- ò Basic Information: high level status;
- ò General system status: VOR monitored parameters;
- ò Module status to some details;
- ò Alarm status.

The LCU conduits selected commands entered through its touch screen to appropriate module for execution. These include:

- ò Mode selection: LOCAL/ REMOTE/ MAINTENANCE;
- ò Change-Over;
- ò MAIN/STANDBY selection;
- ò ON/ OFF/ Reset;
- ò Alarm Inhibit;
- ò Silence;
- ò Lamp test.

Status and alarm information will be always visible regardless of which the display screen the user is watching.

The local rest is a hardware reset button. This button will reset all the modules of the equipment except the power supplies and the Ethernet switch.

7.3.2.2 LCU software

The LCU software operates under Linux Hielos Operating System.

HIELOS operating system is designed to support LCU GUI without any other software component required apart from the already present in the system.

The LCU GUI is developed in C++ using the tools and libraries from the QT working environment. To simplify the software architecture, the QT components needed for the application execution are integrated in the HIELOS distribution.

In the same way, the libraries needed for the control of the touch panel are included in the operating system. HIELOS is a Linux distribution designed and maintained by Indra. It is specifically developed for the control and monitoring of a system.

The operating system architecture assures a steady, reliable and dynamic performance with the requirements of hardware components. The system integrates the libraries needed for the proper execution of the user interface applications.

7.3.2.3 Application Components

The application consists of four different software blocks within the LCU GUI, as shown in Figure 7.3.2.3-1, below:

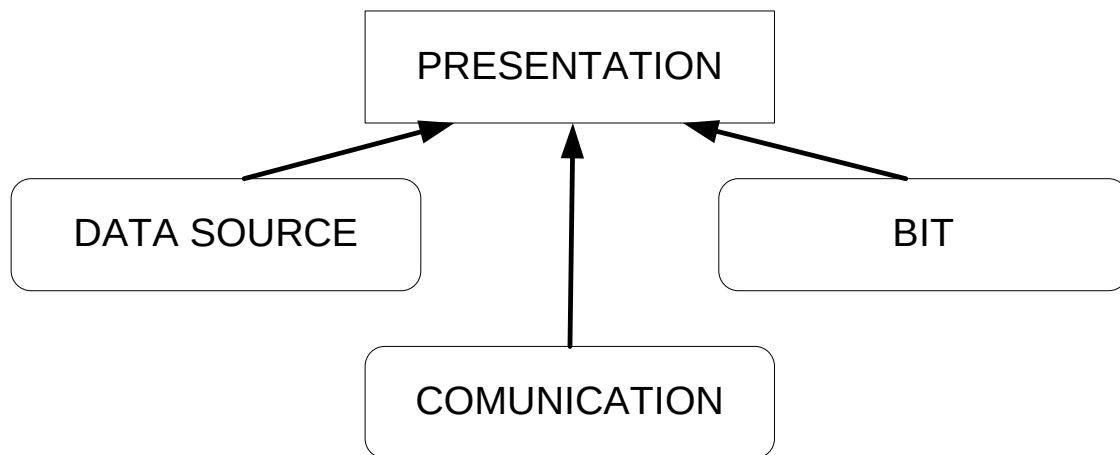


Figure 7.3.2.3-1. SOFTWARE BLOCK DIAGRAM FOR LCU GUI

The block diagram applies to all classes of equipment and all type of display panels and all applicable equipment parameters. Within the display screen, the status panel is located in the left side and the maintenance panel in the central part.

In the maintenance section, the selection panel is established where branching into deeper levels of maintenance can be accessed. In the DME LCU, tabs for GENERAL, DETAILED and ALARMS tabs are provided to access more intensive level of detailed information in the system.

7.3.2.4 Display content

The LCU display screen contains four areas:

- ò The vertical column on the LHS is the basic information block
- ò The top horizontal panel contains tab selection for general information, detailed information and alarm details.
- ò The bottom horizontal block contains the sliding panel for the LCU status.
- ò The remaining area contains the selected information for the navaid equipment.

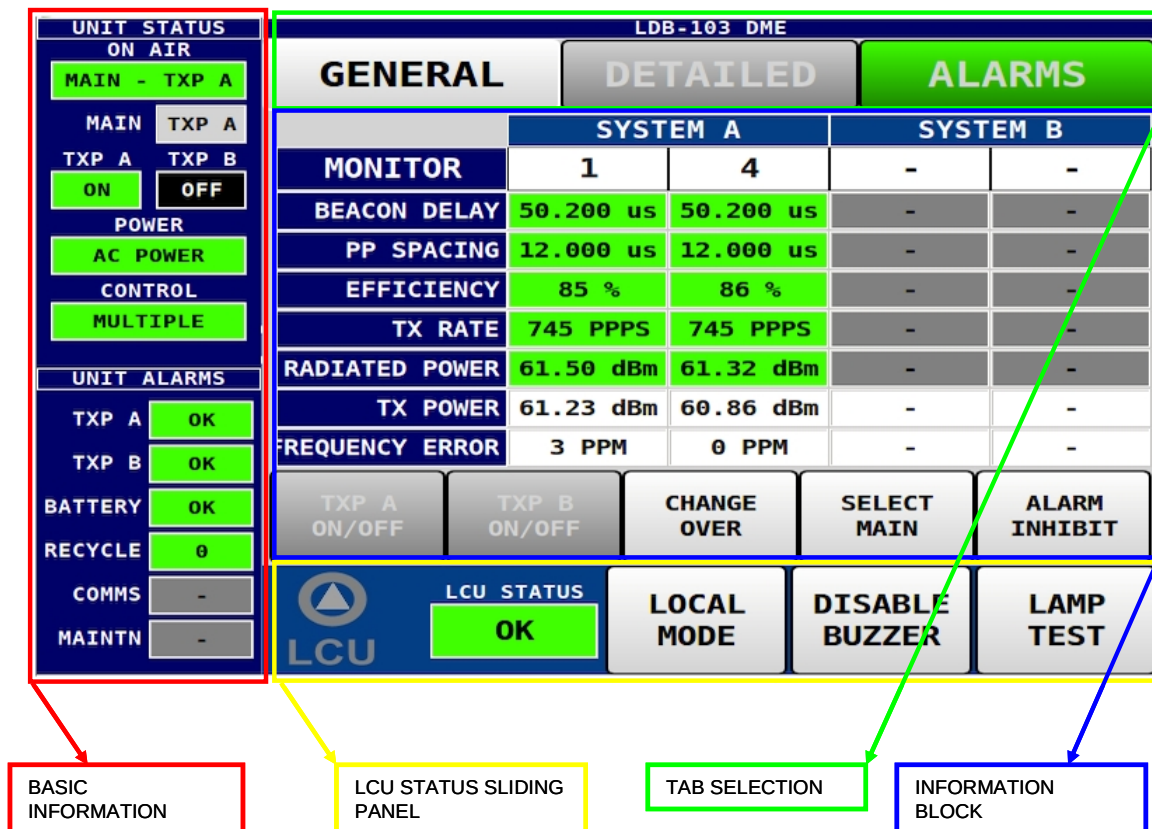


Figure 7.3.2.4-1. LCU SCREEN - DISPLAY AREAS



Figure 7.3.2.4-2. LCU SCREEN - LCU STATUS SLIDING PANEL INFORMATION

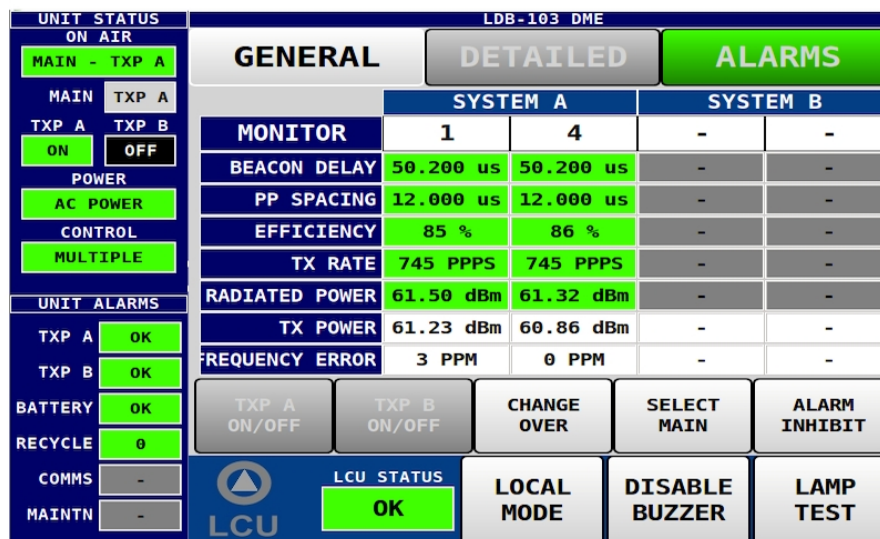


Figure 7.3.2.4-3. LCU SCREEN - GENERAL INFORMATION PANEL

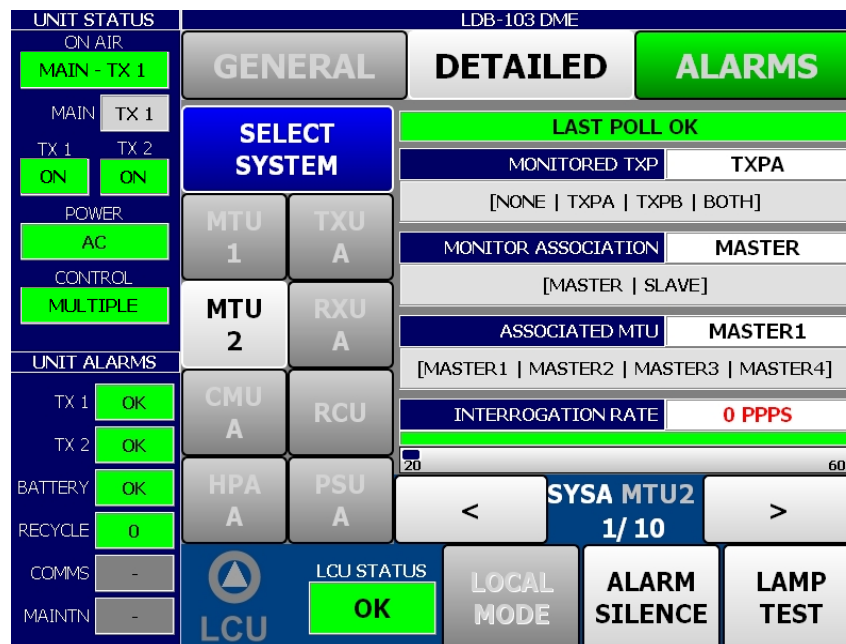


Figure 7.3.2.4-4. LCU SCREEN - DETAILED STATUS INFORMATION PANEL

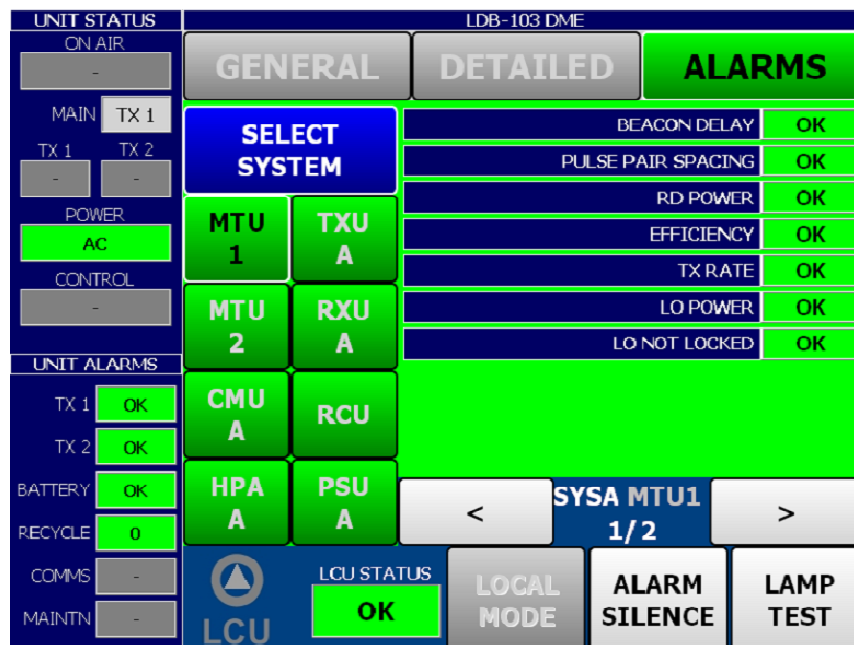


Figure 7.3.2.4-5. LCU SCREEN - ALARM INFORMATION PANEL

7.3.2.5 BIT facilities and alarm management

Since the Local Control Unit (LCU) is an slave unit of the master Control and Monitoring Unit (CMU) of the system, it will not be able to assert any alarm and it will not generate any BIT signal.

This unit will not take part on the regular work of the equipment, only showing status information and sending commands to the CMU.

A failure of this unit will not imply any system fault.

7.3.2.6 Programming and control information

All the information showed by the Local Control Unit (LCU) through the display, will be managed by the master Control and Monitoring Unit (CMU).

The communication between the LCU and the CMU will be by means of VGA and USB ports.

7.3.2.7 Mechanical details

The Local Control Unit (LCU) module has the following dimensions:

- ò Height: 3 U or 133.35 mm.
- ò Width: 240 mm
- ò Depth: 320 mm

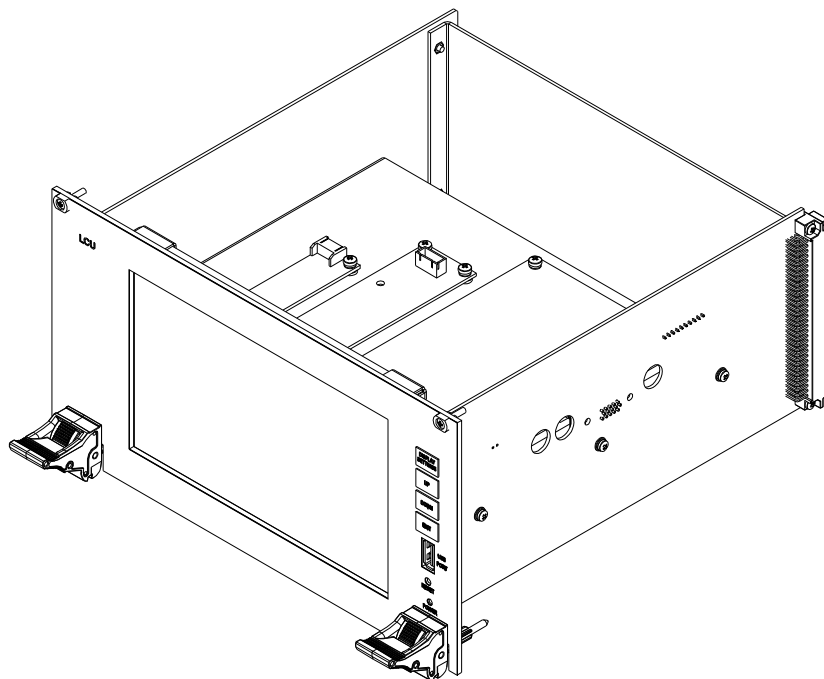


Figure 7.3.2.7-1. LOCAL CONTROL UNIT (LCU) ASSEMBLY

This module has sliding rails at top and bottom, allowing an easy insertion.

The LCU has one rear connector

- o P1: DIN41612 Type C (96 pins).

7.3.2.8 Front panel details

The Local Control Unit (LCU) has a 7" wide screen Thin Film Transistor (TFT) color Liquid Crystal Display Module with a touch panel.

The resolution of the display is 800x480.

In addition to the display the LCU has a hardware reset button which will reset all the modules of the equipment, except the power supplies and the Ethernet switch.

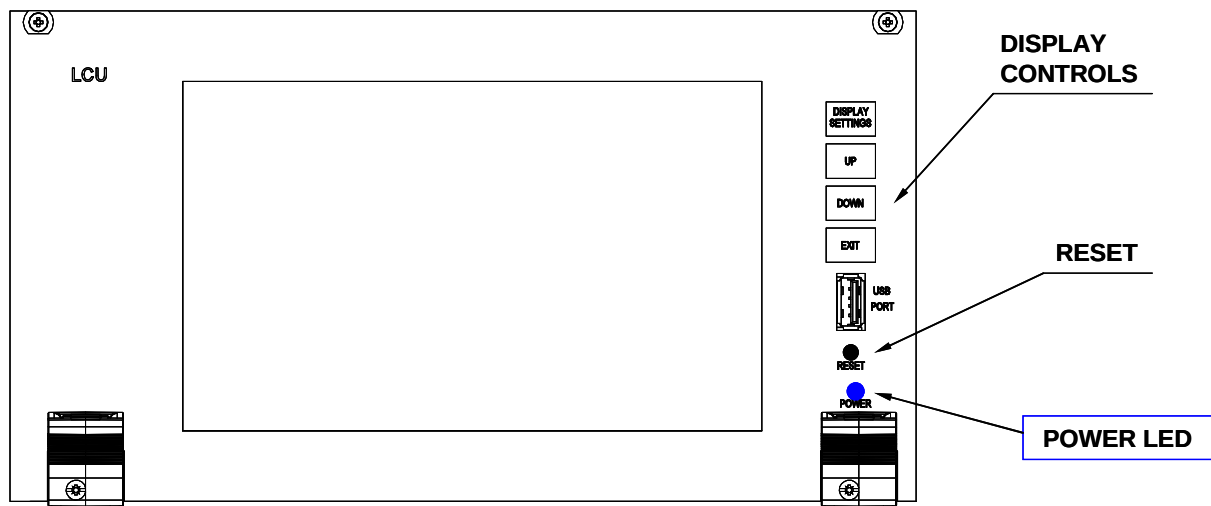


Figure 7.3.2.8-1. LOCAL CONTROL UNIT (LCU) - FRONT PANEL

7.3.2.9 Hardware Implementation and Schematics

The LCU module occupies the LH half of a 3RU high housing in the 19" racking system. It consists of a Back Plane PBA at the back, a main LCU PBA lying vertically at the side of the housing and a display unit in its front. Hardwares associated with the display panel are fitted in a horizontal carrier.

The LCU schematics are given in Appendix J of this handbook including drawing 00634 3000 3000 for the back plane and drawing 00634 3000 3100 for the LCU PBA.

7.3.3 Relay Control Unit (RCU)

7.3.3.1 Functional description

The primary role of the RCU is to analyze the local alarms from each transponder (RXU, TXU and HPA), as well as the integrity alarms (executive alarms) from the four possible Monitor Transponder Units (MTUs), and based on that information decide which, if any, system has to be connected to the antenna.

The Relay Control Unit (RCU) supports the transfer switch in case of a dual system. The RCU is able to command a changeover to the transfer switch and it produces a status indication, indicating which channel is currently connected to the antenna. This status indication is used for BITE purposes.

If the system is configured as a single DME, connection between transponder and antenna will be made directly, not using the RCU. In this case, the RCU will not mount the transfer switch, but it will still be fitted in the system, since it continues to provide the rest of the functionalities described in this paragraph.

LDB-103 DME transponder will be able to fit up to four independent monitors in a single rack for a dual equipment. The RCU is responsible for assigning monitors to each transponder. First, the RCU finds out how many MTUs are plugged into the subrack (there will be a hardware dedicated line indicating monitor presence), so as to decide the assignment between monitors and transponders. This assignment will be made with redundant dedicated hardware lines, avoiding incorrect assignment of monitors in presence of a single error.

In case of a system with two independent monitors, RCU configures both monitors so as to perform surveillance tasks over both transponders. Monitors will be able to split its time base, performing monitoring task over both transponders (for more information see 7.3.5.1).

If the system is fitted with four independent monitors, in an initial stage, association between monitors and transponders will be based on physical proximity, associating both monitors in the left part of the subrack with the left transponder and both monitors in the right part with the transponder plugged into the right part of the subrack. In case of failure of any one of the monitors, RCU will be able to reconfigure the monitor-transponder association, so as to maintain in every moment dual monitoring in both systems. After detect a Monitor Transponder Unit (MTU) failure, the RCU will switch off the faulty module and will reconfigure the monitor-transponder association if needed. A system with four monitors and at least one of them in a fault condition will behave like a system with only two monitors. The third monitor, which is working well, will be switched off temporarily until a new failure in other MTU makes necessary to switch it on to continue performing a dual monitoring. Note that a system with four monitors supports two monitor failures and still behaves like a two monitor system.

Main advantage of having four different monitors (MTUs) is to enhance availability of the equipment with dual monitoring. Even under failure of up to two MTUs, the system still maintains dual monitoring capacity.

The Relay Control Unit (RCU) will be also responsible for generating enable signal for each single transponder, based on the alarm information it receives. If there is a primary alarm in any module of the transponder the RCU will disable the whole transponder (RXU, TXU and HPA), independently of the changeover function, assuring a safe operational condition.

Since monitoring tasks are perform in a dual way (independently of the number of Monitor Transponder Units plugged into the subrack), alarm generation for changeover purposes is configurable between AND or OR mode of operation.

The Relay Control Unit (RCU) will also be able to reset all the modules related with transponder, monitor and control functions. In order to perform this functionality, the RCU will have the following reset outputs:

- ò TXP A reset
- ò TXP B reset
- ò MTU 1 reset
- ò MTU 2 reset
- ò MTU 3 reset
- ò MTU 4 reset
- ò CMU 1 reset
- ò CMU 2 reset

All these reset signals will be independent, being possible to set only one of them or combine them in all the possible ways. To ensure the right operation of the beacon, the RCU issues a reset command to all the modules during its start up process.

The RCU receives the following alarm signals:

- ò From TXP (x2 in dual system):
 - ñ TXP Primary Alarm
 - ñ TXP Secondary Alarm
- ò From MTU (x4 in a system with 4 MTUs):
 - ñ Monitor Primary Alarm
 - ñ Monitor Secondary Alarm
 - ñ Executive Primary Alarm TXP A
 - ñ Executive Secondary Alarm TXP A
 - ñ Executive Primary Alarm TXP B
 - ñ Executive Secondary Alarm TXP B
- ò From CMU (x2 in dual system)
 - ñ CMU Secondary Alarm

The RCU is able to be configured:

- ò To swap automatically Main and Standby systems at user-settable periodic rates.
- ò To wait a programmable time after the recycle count has reached a terminal value before automatically clearing the recycle count and initiating a start-up.
- ò To disable the transmitters of the standby unit to save power.

The Relay Control Unit (RCU) finds out which CMU is the master in the RS-485 bus, by means of the address of the polling packets. Once the RCU knows which CMU is the master, it issues a Chip Select

signal to the Local Control Unit (LCU). With this signal the LCU will select one of the sets of input/output signals (VGA/USB) it has, giving them the control of the LCU front panel (Touch screen).

The Relay Control Unit (RCU) also has a buzzer to raise an audio alert for an alarm condition.

The RCU further performs the following functions:

- o Generation of suitable voltage rails from both main +24VDC supplies.
- o Management of calibration and identification parameters.
- o Generation of required signals for BIT functions.

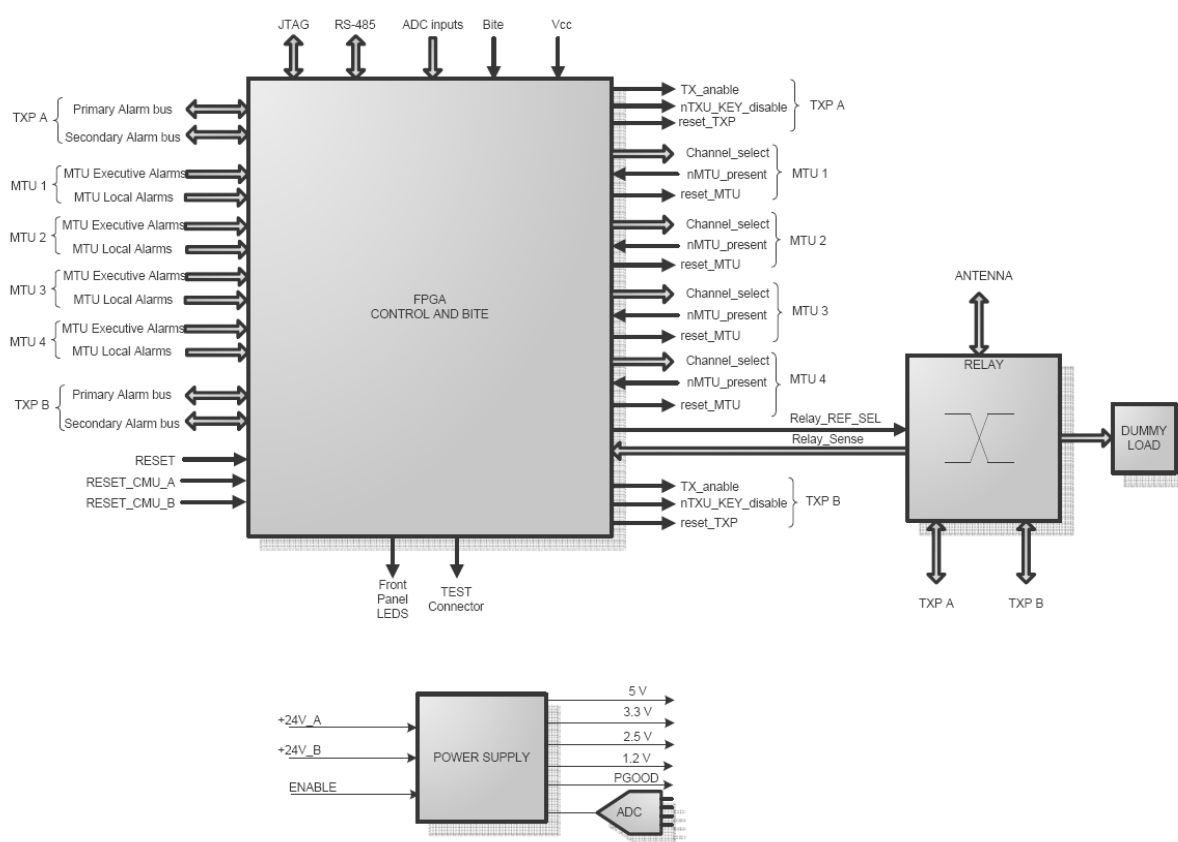


Figure 7.3.3.1-1. RELAY CONTROL UNIT (RCU) FUNCTIONAL BLOCK DIAGRAM

7.3.3.2 BIT facilities and alarm management

The monitored processes include +24VDC rail voltage coming from both sides of the equipment and main relay voltage rails.

The RCU includes multi-channel A/D converters to sense and monitor above mentioned magnitudes and processes for BIT purposes.

The A/D converters sample all of their inputs cyclically and continuously. The latest conversion results will be accessible by poll requests from the system RS-485 bus.

All operating voltages and/or the DC levels produced by these monitoring processes are presented on the front panel connector for test purposes.

The RCU will assert Local Primary and Secondary alarms on both, or either, system in the following scenarios:

- ò Any voltage rail out of user specified ranges.
- ò A failure of the FPGA configuration.
- ò Failure in transfer switch.
- ò No poll requests for a user-definable period.

7.3.3.3 Programming and control information

The RCU contains a non-volatile FLASH memory which will hold information about voltage thresholds, operating parameters and calibration data as well as internal FPGA configuration.

The RCU has an RS-485 interface to poll all these static and dynamic data.

RS-485 registers are divided in two different categories, status registers and configuration registers. First ones are "read only" registers on the RS-485 bus, while configuration registers are "read/write" registers.

Status registers, which are available by polling, include the following parameters:

- ò Board ID
- ò FPGA revision
- ò Board revision
- ò Status
- ò Alarm Status
- ò Detected voltages on each system
- ò Internal voltage rails
- ò Number of monitors plugged into the system
- ò Monitor 1 Configuration (which TXP is monitoring to)
- ò Monitor 2 Configuration (which TXP is monitoring to)
- ò Monitor 3 Configuration (which TXP is monitoring to)

- ò Monitor 4 Configuration (which TXP is monitoring to)
- ò TXP on antenna
- ò TXP A and B status (enable/disable)
- ò Transfer switch status

Configuration registers include the following parameters:

- ò Internal voltage rail thresholds to generate LOCAL Primary and Secondary Alarms (High and low)
- ò MAIN TXP definition
- ò Changeover
- ò Modules' reset.

7.3.3.4 Mechanical details

The Relay Control unit (RCU) has the following dimensions:

- ò Height: 3 U or 133.35 mm.
- ò Width: 180 mm
- ò Depth: 320 mm

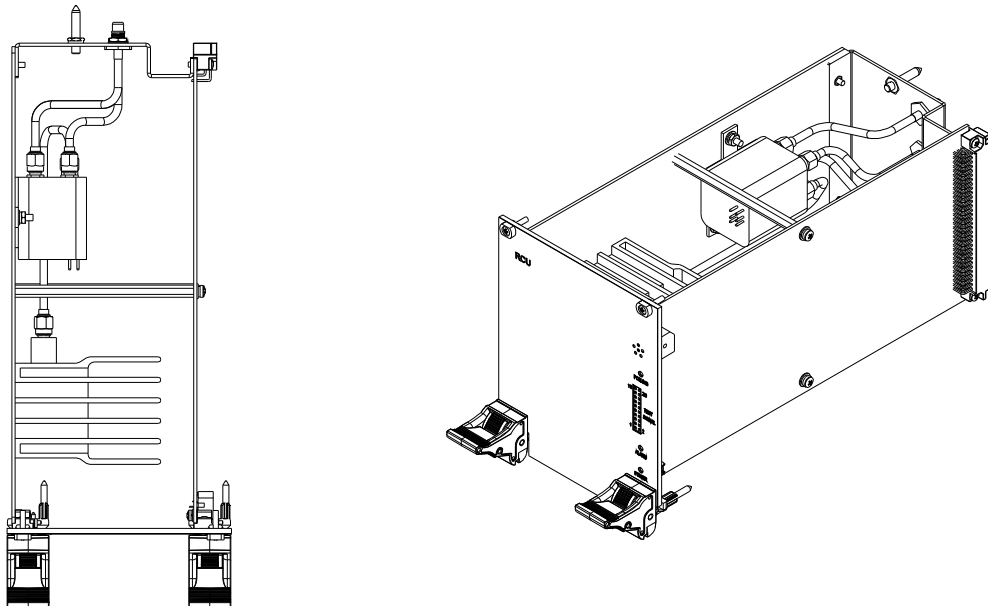


Figure 7.3.3.4-1. RELAY CONTROL UNIT (RCU) ASSEMBLY

This module will have rails at top and bottom, allowing an easy insertion.

The RCU will have one rear connector

- ò P1: DIN41612 Type C (96 pins)

The module has insertion/extraction levers, allowing its easy insertion and extraction. The levers also provide ESD protection (automatic connection with the rack ground) and hot swappable operation (automatic power supply disabled before extraction of the module).

7.3.3.5 Front panel details

On the front panel, the Relay Control Unit (RCU) has a 20 pin connector and three LEDs indicators.

The 20 pin connector gives access to critical analogue and digital signals such as alarm indications and internal voltage rails for test purposes. Digital signals present in test connector are selectable under software control.

The indicator LEDs are SMD, and make use of light pipes to direct the light through the front panel, as follows:

- ò POWER [Blue]: indicates that the unit has power.
- ò ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status; the LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ò POLLING [Yellow]: indicates polling requests.

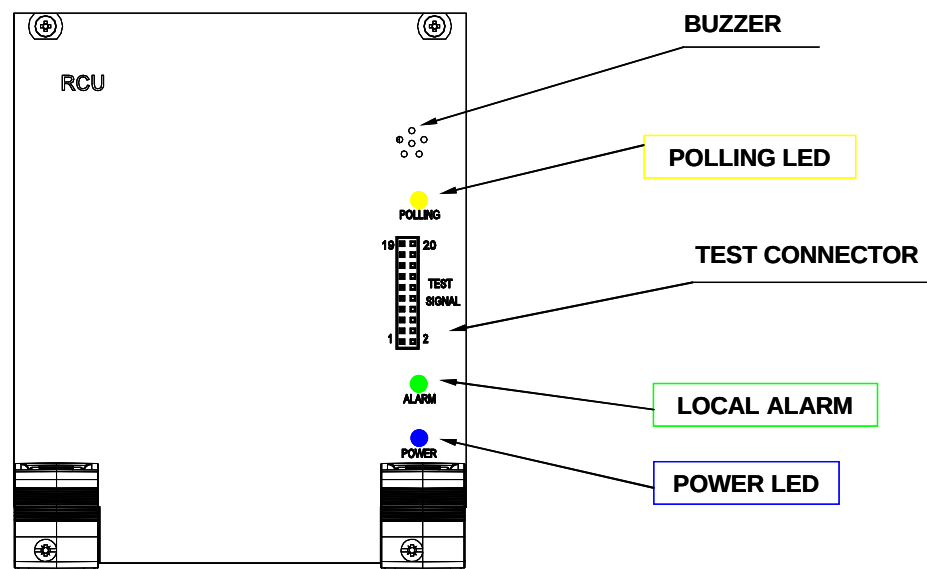


Figure 7.3.3.5-1. RELAY CONTROL UNIT (RCU) - FRONTAL PANEL

7.3.3.6 Hardware Implementation and Schematics

The RCU module occupies the RH half of a 3RU high housing in the 19" racking system. It consists of a Back Plane PBA at the back, a main RCU PBA lying vertically at the side the housing and a electromechanical transfer switch also at its side, near the center of the housing.

The RCU schematics are given in Appendix J of this handbook including drawing 00634 3000 3000 for the back plane and drawing 00634 3000 3200 for the RCU PBA.

7.3.4 Control & Monitoring Unit (CMU)

7.3.4.1 Functional description

The Control and Monitoring Unit (CMU) will be the principal access point to the DME LDB-103 system.

The CMU will performs the following functions:

- ò To gather and distribute performance data from each module in the system.
- ò To allow local and remote access to operating parameters.
- ò System pre-alarm checking.
- ò Remote communications management
- ò Generation of suitable voltage rails from main +24VDC supply.
- ò Generation of required signals for BIT functions.
- ò Secondary local alarms generation and management.
- ò Coordination of automatic calibration and installation functionalities.
- ò Manage of Monitor performance tests.

The CMU will take no role in detection, generation and monitoring processes of the DME once the latter have been set-up and configured.

The CMU will contain a CPU that will run a Linux operating system and which runs on a standard industrial Single Board Computer (SBC). The industrial CPU card will have an Industrial temperature range and require no fan.

The embedded Operating System will act as a Simple Network Management Protocol server that will give network access to the all the items, in all the modules, that have been defined above.

To support the embedded processing platform there will be a main I/O card.

The main I/O board will have circuitry capable of interfacing with two different remote temperature sensors.

The Control and Monitoring Unit (CMU) will be responsible for status indications to the remote management system. This unit will be able to be configured so as to send information to the remote management system at least in the following scenarios:

- ò Local Control request

- ò Maintenance
- ò Primary or secondary alarm condition
- ò Pre-alarm condition
- ò Periodic status report

The Control and Monitoring Unit (CMU) will be able to make a log of the status parameters of the equipment with a user-defined periodicity. This unit will have enough storage capability so as to store all the information of the last TBD hours.

7.3.4.2 BIT facilities and alarm management

The CMU will not assert a Local Primary Alarm.

The CMU will generate a local Secondary Alarm if:

- ò Any module in the system does not have a valid Module Identification
- ò A module is not responding to poll requests.
- ò Main and Standby systems had conflicting set-ups, e.g. the frequency of one was different to the other, the Ident codes were different, the power levels were different, etc.
- ò Its own power rails were outside user-defined thresholds.
- ò The temperature sensors were measuring temperatures outside user-specified thresholds.

The CMU will also implement pre-alarm checking in all the parameters that can trigger an alarm condition (both executive and local alarms). These parameters are defined in the previous paragraphs. The CMU will poll all the modules connected to the RS 485 bus, gathering the current values of the parameters. Then it will compare the current value of the parameters with a user defined pre-alarm threshold. If the current value of the parameter is out of the range defined by the thresholds, the CMU will trigger a pre-alarm signal. Note that pre-alarm signals will not have any effect on the changeover function of the transponder. Pre-alarm thresholds will be defined inside the CMU not affecting the rest of the modules. When a pre-alarm signal is triggered, the CMU will make a log of this condition storing the hour, the module and the value of the parameter that has trigger the pre-alarm. It will be possible to configure the CMU so as to send an indication to the remote control system upon a pre-alarm trigger. Pre-alarm signals will be used as maintenance alerts.

7.3.4.3 Programming and control information

The CMU will act as the master of the RS485 bus gathering the value of all the parameters of each of the modules.

The CMU will have a non volatile memory which hold information about pre-alarm thresholds and operating parameters of the system.

7.3.4.4 Mechanical details

The Control and Monitoring Unit (CMU) will have the following dimensions:

- Height: 6 U or 266.7 mm.
- Width: 5 HP or 25.4 mm.
- Depth: 300 mm

This module will have single card slides at top and bottom.

The CMU will have 2 rear connectors.

- P1: DIN41612 Type C (96 pins)
- P2: DIN41612 Type C (96 pins)

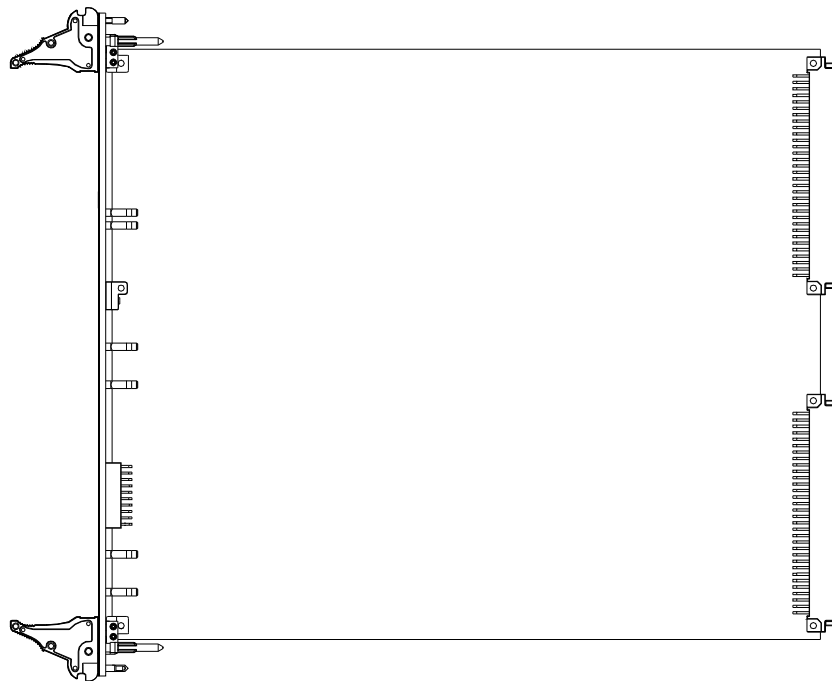


Figure 7.3.4.4-1. CONTROL AND MONITORING UNIT (CMU) ASSEMBLY

7.3.4.5 Front panel details

On the front panel, the Control & Monitoring Unit (CMU) will have a 20 pin connector, a USB connector and six LEDs indicators.

The 20 pin connector will give access to critical analogue and digital signals such as internal voltage rails for test purposes. Digital signals present in test connector will be selectable under software control.

The USB connector will give access to a USB port of the PC inside the module.

The LEDs will be SMD, and will use light pipes to direct the light through the front panel, as follows:

- ò POWER [Blue]: indicates that the unit has power.
- ò ALARM [Amber-Green]: indicates Secondary Alarm status; the LED will be amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ò SYSTEM FAULT [Red-Amber-Green]: indicates Primary and Secondary Alarm status of the beacon. The LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted
- ò POLLING [Yellow]: indicates polling requests.
- ò ETHERNET LINK [Yellow]
- ò ETHERNET ACTIVITY [Green].

This module will have two insertion/extraction handles (one at the top and one at the bottom of the front panel), allowing an easy insertion and extraction of the module. This handles will supply ESD protection (automatic connection with the rack ground) and hot swappable operation (automatic power supply disable before extraction of the module).

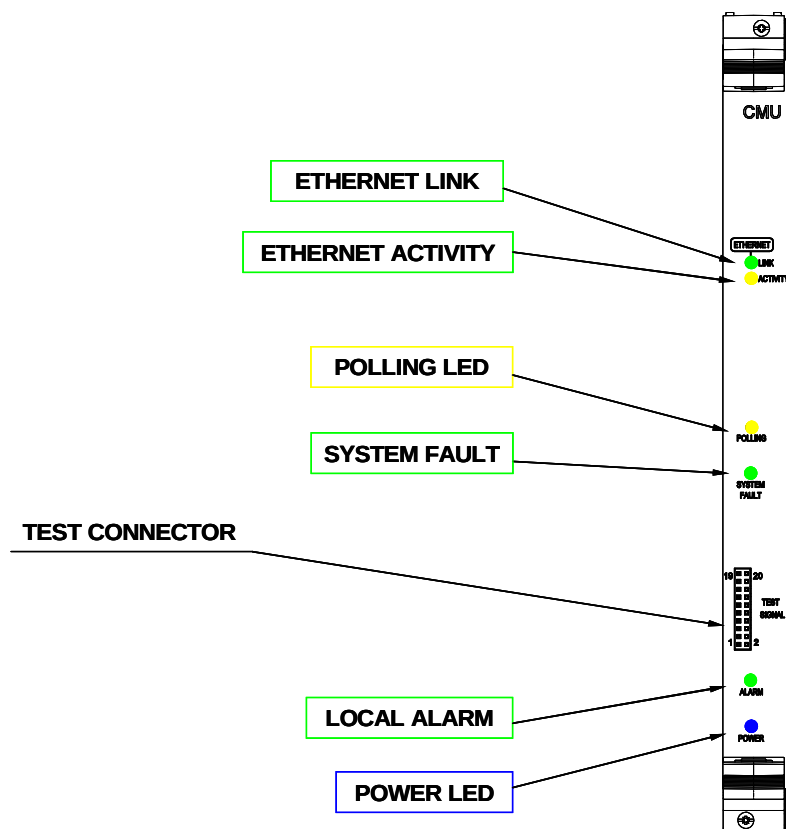


Figure 7.3.4.5-1. CONTROL AND MONITORING UNIT (CMU) - FRONTAL PANEL

7.3.4.6 Hardware Implementation and Schematics

The CMU module occupies the central vertical slots of the subrack, counting from either outside edge of the subrack. CMU A is at the Left Hand side and CMU B at the Right Hand side of the subrack.

The CMU schematics are given in Appendix J of this handbook including drawing 00634 3000 4100 for the main PBA

7.3.5 Monitor Transponder Unit (MTU)

7.3.5.1 Functional description

To ensure the correct operation and integrity of the transponder at all times, an embedded instrument, Monitor Transmitter Unit (MTU), will be used to constantly measure various parameters of the DME including, but not limited to, reply pulse characteristics, identification code group characteristics, transmit and receive frequencies, etc.

The monitor unit will be able to interrogate the DME associated with, and determine its working status. It will do this by simulating a distant aircraft interrogator unit, sending regular interrogation pulses. Monitor unit will look for the DME reply pulses, knowing the programmed reply delay of the DME transponder. If reply pulse parameters fall within user-defined thresholds, then no action is taken. If however, there is an absence of valid reply pulses or its characteristics are invalid, the monitor unit will flag up an alarm indicating that there is a fault.

The Monitor Transponder Unit (MTU) will perform all its digital signal processing with an FPGA based platform ensuring safety requirements.

The Monitor Transmitter Unit (MTU) will be failsafe: failure of any part of the Monitor Unit that is associated with alarm parameter checking will result in the alarm being triggered for that same parameter.

With the exception of identification alarms, delay between a fault condition and monitor alarm indication will be as low as possible, but not exceeding 10 seconds in any case. In case of absence of identification, the delay between the occurrence of a fault condition and monitor action will be always below 40 seconds.

The Monitor Transponder Units (MTUs) will not have hard-association with transponders, being possible to perform monitoring tasks over both transponders fitted in a dual DME cabinet. Relay Control Unit (RCU) will be which will configure the association between monitors and transponders, with dedicated lines to each MTU.

Monitor Transponder Unit (MTU) will be able to manage the following configurations:

- TXP A monitoring
- TXP B monitoring
- TXP A + TXP B monitoring
- OFF

The Monitor Transponder Units (MTUs) will also be able to coordinate with other MTUs so as to generate complex interrogation patterns as echoes or interfering signals, being possible to measure the performances of the transponder.

The Unit will have the following radiofrequency ports:

- o TXP A (RF shelf coupling)
- o TXP B (RF shelf coupling)
- o Probe antenna

TXP A and TXP B ports will be used both to inject interrogation signal to transponders and to receive a sample of the transmitted signal. Generated signals by the MTU will have the suitable level, frequency and pulse shape characteristics to measure the performance of the system. For detailed information see Table 6.4.5-4.

Probe antenna port will only be used to receive a sample of the radiated signal not being possible to inject any signal in this port.

TXP A and TXP B radiofrequency ports will share the same transmission and reception circuitry. The MTU will connect only one of them to the circuitry through a RF switch depending on the configuration given by the Relay Control Unit (RCU). Probe antenna port will have its own independent circuitry.

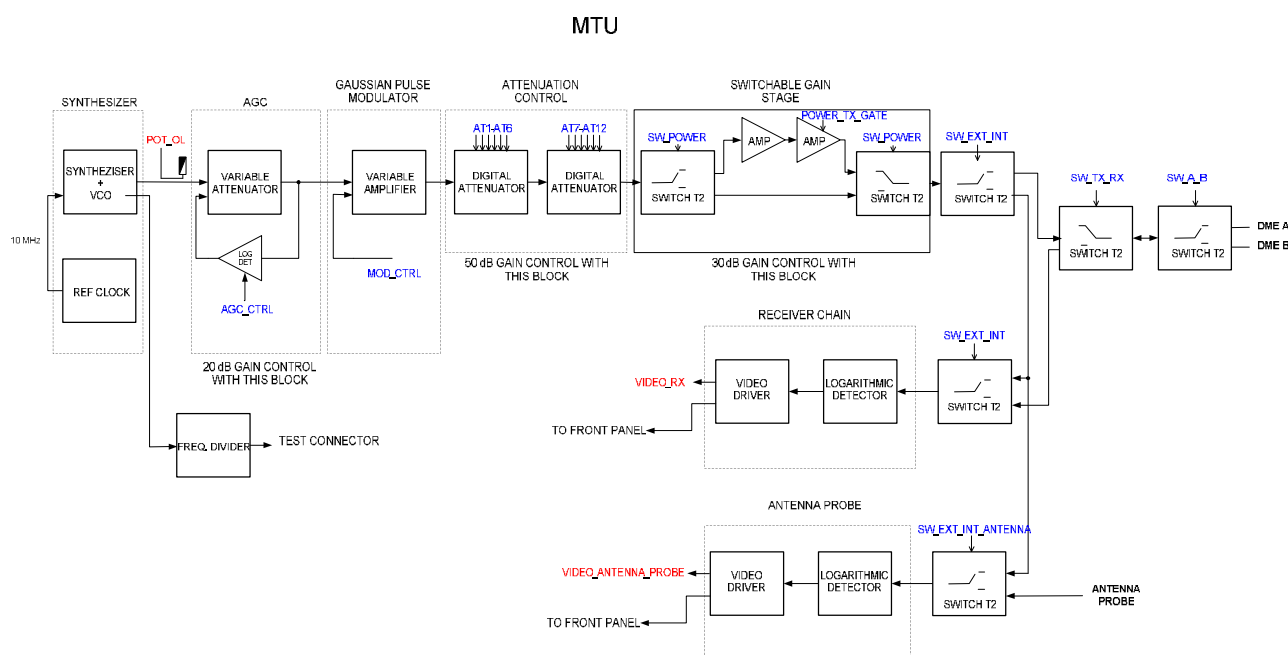


Figure 7.3.5.1-1. MONITOR TRANSPONDER UNIT (MTU) BLOCK DIAGRAM

The Monitor Transponder Unit (MTU) will supply the following output alarms:

- ò TXP A executive primary alarm
- ò TXP A executive secondary alarm
- ò TXP B executive primary alarm
- ò TXP B executive secondary alarm
- ò Local primary alarm
- ò Local secondary alarm

Monitor Transponder Unit (MTU) will perform the following kind of tests:

- ò Executive test
- ò Auto diagnosis test

During normal operation of transponders, monitor units will be performing executive and auto diagnosis tests.

In executive test, Monitor Transponder Unit (MTU) will generate interrogations with fixed parameters (ICAO Annex 10 parameters) and will analyze transponder replies, checking if it is necessary or not to set any Executive alarm. In this period, monitors will ensure proper operation of the transponder, measuring critical parameters of the system. All alarm thresholds will be configurable by the RS 485 bus and it will be possible to set an alarm condition as primary or secondary alarm. Executive test will inject test interrogation signals to the transponder with a maximum rate of 120 pair of pulses per second per transponder regardless of the number of MTUs plugged in the system.

Monitor Transponder Units (MTUs) will check its own threshold levels during auto diagnosis test, generating signals out of specification and injecting them to its own receiver. All executive test thresholds will be tested. In this case the MTU will measure its own alarm thresholds, checking them both in upper and lower limits. If the measured value falls out of the user-defined range, the MTU will generate a LOCAL primary or secondary alarm depending on the threshold is being tested (primary or secondary). Note that auto diagnosis test will not increase transponder load. During auto diagnosis test, MTU will implement a pilot pulse algorithm, being able to measure and auto-adjust its own delay.

The Monitor Transponder Unit (MTU) will be based in an FPGA. Note that all the monitor functions related with EXECUTIVE and AUTO-DIAGNOSIS test will be performed on a FPGA based platform not making use of the embedded processor. The FPGA embedded processor and hence its operating system will only take part in performance test which doesn't have any safety implication. Remember that performance test are made on the transponder connected to the dummy load or out of service.

MTU will also perform the following functions:

- ò Generation of suitable voltage rails from main +24VDC supply.
- ò Management of calibration and identification parameters.
- ò Generation of required signals for BIT functions.

MTU will not need any hardware adjustment depending on the output power configuration and the channel of operation.

7.3.5.2 BIT facilities and alarm management

MTU will be able to monitor the following parameters, so as to set an EXECUTIVE primary or secondary alarm:

- ò Measuring the RF Shelf coupling signal:
 - ñ Beacon delay
 - ñ Pulse pair spacing
 - ñ Transmitted power
 - ñ Efficiency
 - ñ Transmitter and receiver frequency
 - ñ First and second pulse characteristics:
 - ▣ Rise time (10% to 90%)
 - ▣ Decay time (90% to 10%)
 - ▣ Pulse width (50%)
 - ▣ Power variation (constituent pulses)
- ò Measuring the probe antenna signal:
 - ñ Radiated power
 - ñ Transmission rate
 - ñ MORSE code
 - ▣ Absence (excessive time between identification periods)
 - ▣ Code transmitted
 - ▣ Continuous keying
 - ▣ Dash/dot/space length

The above mentioned parameters will be monitored during normal operation of the transponder. Any value out of the specified range will trigger an EXECUTIVE alarm signal. There will be two different set of thresholds related with the above parameters.

- ò Fixed thresholds
- ò Configurable thresholds

The first set of thresholds (fix thresholds) will be stored in the Non Volatile Memory of the Monitor Transponder Unit (MTU). These values will be accessible only in read mode to the RS 485 bus, not being possible to change them. The only way to change these thresholds will be through the JTAG port of the module. These thresholds will mach the ICAO Annex X, ED-57 and FAA-2996 defined alarm thresholds. Regardless of the threshold value, it will be possible to configure all these parameters as primary or secondary alarms through the RS485 bus. Since it is not possible to change the value of these thresholds through the RS 485 bus, an erroneous configuration and hence a not-fulfilment of the normative is avoided.

The second set of thresholds will be configurable through the RS485 bus. In this case it will be possible to program both the thresholds and the alarm level (primary, secondary, no alarm). With this set of thresholds it will be possible to configure a more restrictive condition to set primary and secondary alarms.

Having both kind of thresholds, it is ensured the fulfilment of the normative in every moment and it is possible to configure a more restrictive condition. In regular working of the monitor, it will trigger an alarm with the most restrictive condition of both mentioned above. Note that it will be possible to configure one fixed threshold as a primary alarm and its equivalent configurable threshold as a secondary alarm, implementing a dual threshold for the same parameter.

The Monitor Transponder Unit (MTU) will be able to set a LOCAL primary or secondary alarm in the following conditions:

- Mismatch in monitor configuration between hardware dedicated lines and RS-485 registers
- Any voltage rail out of user specified ranges.
- Failure of the FPGA configuration.
- An absence of poll requests from the CMU
- Failure detected with Auto diagnosis test (thresholds)
 - ñ Beacon delay threshold
 - ñ Pulse pair spacing threshold
 - ñ Frequency difference threshold
 - ñ Efficiency threshold
 - ñ Transmitted power threshold
 - ñ Transmission rate
 - ñ Radiated Power threshold

The MTU will include multi-channel A/D converters to sense and monitor above mentioned magnitudes and processes for BIT purposes.

The A/D converters will sample all of their inputs cyclically and continuously. The latest conversion results will be accessible by poll requests from the system RS-485 bus.

All operating voltages and/or the DC levels produced by these monitoring processes will be presented on the front panel connector for test purposes

In performance test, the Monitor Transponder Unit (MTU) will be able to measure:

- One MTU alone:
 - ñ Reply delay vs. interrogation power level
 - ñ Through reply efficiency:
 - ▮ Sensibility
 - ▮ Receiver bandwidth

- ▮ Adjacent channel rejection
- ▮ Pulse pair spacing acceptance threshold
- ▮ Pulse pair spacing rejection threshold
- ▮ Simple pulse rejection
- ò And in collaboration with another MTU:
 - ñ Through reply efficiency:
 - ▮ Recovery time
 - ▮ Death time
 - ▮ CW interference
 - ▮ Short distance echo suppression performance
 - ▮ Long distance echo suppression performance

7.3.5.3 Programming and control information

MTU will contain a non-volatile FLASH memory which will hold information about thresholds, operating parameters, calibration and compensation data as well as its internal FPGA configuration.

MTU will have a RS-485 interface to poll all these static and dynamic data. :

RS-485 registers will be divided in two different categories, status registers and configuration registers. First ones will be "read only" registers on the RS-485 bus, while configuration registers will be "read/write" registers.

Among status registers, which will be available by polling, will be the following parameters:

- ò Board ID
- ò FPGA revision
- ò Board revision
- ò Status (enabled/disabled)
- ò Local alarm status
- ò Executive alarm status
- ò Monitored transponder (A, B or both)
- ò Internal voltage rails
- ò Fixed alarm thresholds
 - ñ High and low beacon delay alarm threshold
 - ñ High and low pulse pair spacing alarm threshold
 - ñ Transmitted power alarm threshold
 - ñ Efficiency alarm threshold

-
- Ñ High and low frequency difference alarm threshold
 - Ñ High and low transmission rate alarm threshold
 - Ñ Radiated Power threshold
 - Ñ MORSE code
 - Đ Absence threshold (time without identification signal)
 - Đ Continuous keying threshold
 - ò Measured TXP parameters (executive test):
 - Ñ Beacon delay
 - Ñ Pulse pair spacing
 - Ñ Transmitted power
 - Ñ Efficiency
 - Ñ Transmitter and receiver frequency
 - Ñ First and second pulse characteristics:
 - Đ Rise time (10% to 90%)
 - Đ Decay time (90% to 10%)
 - Đ Pulse width (50%)
 - Đ Power variation (constituent pulses)
 - Ñ Radiated power
 - Ñ Transmission rate
 - Ñ MORSE code
 - Đ Identification status (present/not-present)
 - Đ Absence
 - Đ Code transmitted
 - Đ Continuous keying
 - Đ Dash/dot/space length
 - Đ Identity code length
 - Đ Time between identification periods
 - ò Measured MTU thresholds (auto diagnosis test):
 - Ñ High and low beacon delay alarm threshold
 - Ñ High and low pulse pair spacing alarm threshold
 - Ñ High and low frequency difference alarm threshold
 - Ñ Efficiency alarm threshold
-

- ñ Transmitted power alarm threshold
- ñ High and low transmission rate alarm threshold
- ñ Radiated Power threshold
- ñ Ident counters
- ò Measured value in performance test:
 - ñ Efficiency
 - ñ Reply delay

Configuration registers will at least have the following parameters:

- ò Primary/Secondary alarm selection for fixed thresholds (executive alarm)
- ò Primary/Secondary alarm selection for configurable thresholds (executive alarm)
- ò Operating channel
- ò Calibration data
- ò Identity Code
- ò Monitor configuration
- ò Test modes enable
- ò Interrogation rate in executive test
- ò Thresholds to generate EXECUTIVE primary or secondary alarm (configurable thresholds)
 - ñ High and low beacon delay alarm threshold
 - ñ High and low pulse pair spacing alarm threshold
 - ñ Transmitted power alarm threshold
 - ñ Efficiency alarm threshold
 - ñ High and low frequency difference alarm threshold
 - ñ First and second pulse shape characteristics
 - ▣ High and low rise time threshold (10% to 90%)
 - ▣ High and low decay time threshold (90% to 10%)
 - ▣ High and low pulse width threshold (50%)
 - ▣ Power variation threshold (constituent pulses)
- ò High and low transmission rate alarm threshold
- ò Radiated Power threshold
- ò MORSE code
 - ▣ Absence threshold (time without identification signal)
 - ▣ Continuous keying threshold

- ▣ Dash/dot/space length threshold
- ▣ Identity code length threshold
- Thresholds to generate LOCAL primary and/or secondary alarm
 - ▣ Internal voltage rail thresholds (High and Low)
 - ▣ Auto diagnosis test thresholds:
 - ▣ High and low beacon delay alarm threshold
 - ▣ High and low pulse pair spacing alarm threshold
 - ▣ High and low frequency difference alarm threshold
 - ▣ Efficiency alarm threshold
 - ▣ Transmitted power alarm threshold
 - ▣ High and low transmission rate alarm threshold
 - ▣ Radiated Power threshold

Note that there is no need for configuration registers to be available in local or remote control. It will depend on Control & Monitoring Unit (CMU) configuration policy to give access to one or another parameter in local or remote control or let that parameter as only factory set parameter. All the parameters will be accessible by the RS-485 bus.

This unit will have a JTAG port plus an enable signal accessible through the backplane connector, so as to be able to program the FPGA inside the module from the Control & Monitoring Unit (CMU).

7.3.5.4 Mechanical details

The Monitor Transponder Unit (MT) will have the following dimensions:

- Height: 6 U or 266.7 mm.
- Width: 5 HP or 25.4 mm
- Depth: 300 mm
- Weight: 700 g.

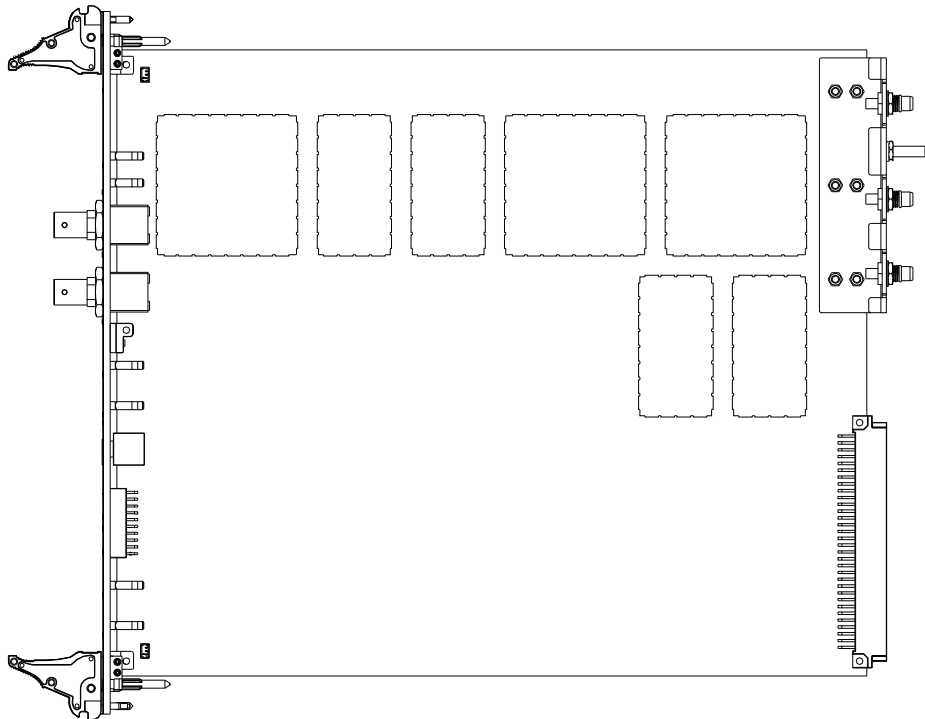


Figure 7.3.5.4-1. MONITOR TRANSPONDER UNIT (MTU) ASSEMBLY

This module will have single card slides at top and bottom.

The MTU will have 4 rear connectors.

- ò P1: DIN41612 Type C (96 pins);
- ò P2: RF BMA plug connector;
- ò P3: RF BMA plug connector;
- ò P4: RF BMA plug connector.

7.3.5.5 Front panel details

On the front panel, the Monitor Transponder Unit (MTU) will have a 20 pin connector, one jack socket, two 50 Ω BNC connectors and seven LEDs indicators.

The 20 pin connector will give access to critical analogue and digital signals such as synchronization signals and internal voltage rails for test purposes. Digital signals present in test connector will be selectable under software control.

There will be one female jack socket, where the user will be able to hear the IDENT code detected by the monitor. If the MTU is monitoring the standby equipment this connector will have no use (Standby TXU will not generate IDENT signal).

Front panel will support two 50Ω BNC connector:

- ò VIDEO. Video waveform corresponding in shape and time to the envelope of received RF signal.
- ò TRIGGER. Output pulse for triggering test equipment, providing accurate pulse timing.

LEDs will be SMD, and will use light pipes to direct the light through the front panel, as follows:

- ò POWER [Blue]: indicates that the unit has power.
- ò ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status. This LED refers to Local Alarm of the MTU. The LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ò MONITOR ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status of the beacon. This LED refers to beacon's alarms detected by the Monitor. The LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted
- ò POLLING [Yellow]: indicates polling requests.
- ò INT [Green]: this LED will turn on each time the MTU transmits a test interrogation to the TXP. In normal operation, users will see this LED on all the time.
- ò IDENT [Yellow]: indicates the presence of the IDENT tone; it will turn on and off in cadence with the dashes and dots of the Morse representation of the identification code detected by the MTU.

This module will have two insertion/extraction handles (one at the top and one at the bottom of the front panel), allowing an easy insertion and extraction of the module. This handles will supply ESD protection (automatic connection with the rack ground) and hot swappable operation (automatic power supply disable before extraction of the module).

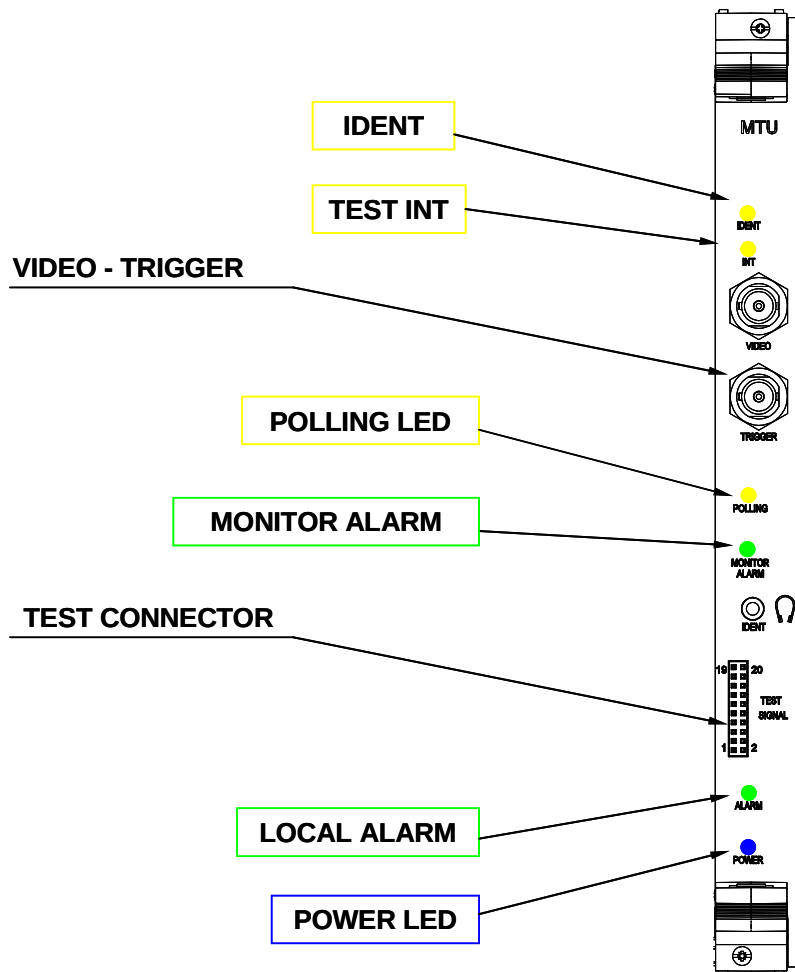


Figure 7.3.5.5-1. MONITOR TRANSPONDER UNIT (MTU) - FRONTAL PANEL

7.3.5.6 Hardware Implementation and Schematics

The MTU module occupies the four and fifth vertical slots of the subrack after the HPA. MTU 1 and 2 at the Left Hand side and MTU 3 and 4 at the Right Hand side of the Subrack.

The MTU schematics are given in Appendix J this handbook including drawing 00634 3000 4200 for the Main PBA and drawing 00634 3000 4700 for the Digital PBA.

7.3.6 Receiver Unit (RXU)

7.3.6.1 Functional description

The main function of the Receiver Unit (RXU) will be to detect DME valid interrogations in its assigned channel under its coverage area. To perform this functionality, Receiver Unit (RXU) will make the following processes:

- ò Select the working channel
- ò Amplify the received signal
- ò Down conversion to 63 MHz (intermediate frequency)
- ò Logarithmic envelope detection
- ò Video digitalization
- ò Digital signal processing

Channel selection will be made by electronic means, not being necessary to perform any physical adjustment on the module to change the operating channel. The module will be able to work all over the DME reception band from 1025 to 1150 MHz, giving service to the 252 possible X and Y DME channels.

The module will generate the suitable Local Oscillator (LO) signal to perform the down conversion to an intermediate frequency of 63 MHz according to the selected channel and will send it to the Transmitter Unit (TXU), so as to it generates the transmission signal. A sample of this signal (divided by a N factor) will also be sent to the Monitor Transponder Units (MTUs) so they can perform monitoring tasks over reception and transmission frequency of the beacon.

Once the signal has been converted to the intermediate frequency, the Receiver Unit (RXU) will perform all the necessary filtering to achieve the sensitivity level indicated in **¡Error! No se encuentra el origen de la referencia.** The module will be able to manage the input dynamic range shows in **¡Error! No se encuentra el origen de la referencia.** .

Receiver Unit (RXU) will perform a logarithmic envelope detection of the received signal, ensuring reception characteristics of the system all over the dynamic range. It will be used a Ferris discriminator to perform the adjacent channel rejection, achieving the values shows in **¡Error! No se encuentra el origen de la referencia..**

Received signal after logarithmic envelope detection will be digitalized to perform the suitable digital signal processing. All this digital signal processing will be performed on a FPGA based platform ensuring safety requirements. Among these process will be:

- ò Simple pulse detection
- ò Short Distance Echo Suppression (SDES)
- ò Pulse pair validation
- ò Dead time implementation
- ò Long Distance Echo Suppression (LDES)
- ò Automatic sensitivity control

ò CW detection.

Echo suppression will be configurable, being possible to adjust its values and enable or disable its functionality.

Receiver Unit (RXU) will perform an automatic sensitivity control in function of the measured load of the beacon. When the number of detected interrogations are above 90% of the maximum load of the beacon, the Receiver Unit will limit its own sensibility, ensuring the service to the interrogators that are closer to the beacon. Automatic sensibility control range will be according with **¡Error! No se encuentra el origen de la referencia..**

A pilot pulse algorithm will be implemented to perform an extended monitoring and adjustment of the beacon delay, regardless of the monitoring process of the MTUs. Receiver Unit (RXU) will start a pilot pulse transmission with a register defined periodicity. Receiver Unit (RXU) will decide a pilot pulse transmission and then it will start a counter. Pilot pulse indication to the Transmitter Unit (TXU) will be in the same way as the interrogation decode signal, so the TXU will start a pulse pair reply transmission. Since the RXU knows that the pilot pulse algorithm is now running it will perform a frequency conversion of the pilot pulse radiofrequency input, which is a sample of the transmitted signal, so as to put it in the same frequency as the received signal (63 MHz up or down conversion). This mixed signal, which will be similar to an interrogation pulse pair (pulse pair spacing could be different depending on the selected channel), will be handled by the receiver in the same way that the signal received through the antenna. After the pilot pulse pulse pair decoding, the RXU will stop the counter and then will know the whole internal delay of the beacon. The measured value will be compared with the nominal value of the beacon, and in case of mismatch between both values the corrective shift will be made auto-adjusting the beacon delay. Receiver Unit (RXU) will be able to generate a 63 MHz Local Oscillator (LO) signal so as to perform the frequency conversion, generating it by means of digital techniques. This Local Oscillator signal will only be generated during the time slots where pilot pulse algorithm is working, not being generated during normal operation of the receiver.

A pilot pulse transmission will be equivalent to a squitter transmission since the pulse pair transmission is not generated by a valid interrogation decoding.

Receiver Unit (RXU) will also perform the following functions:

- ò Generation of suitable voltage rails from main +24VDC supply
- ò Management of calibration and identification parameters
- ò Generation of required signals for BIT functions

Receiver Unit (RXU) will have the following RF ports:

- ò Radiofrequency input (from TXU or HPA)
- ò Pilot Pulse (from RF Shelf)
- ò Local Oscillator sample (To TXU).

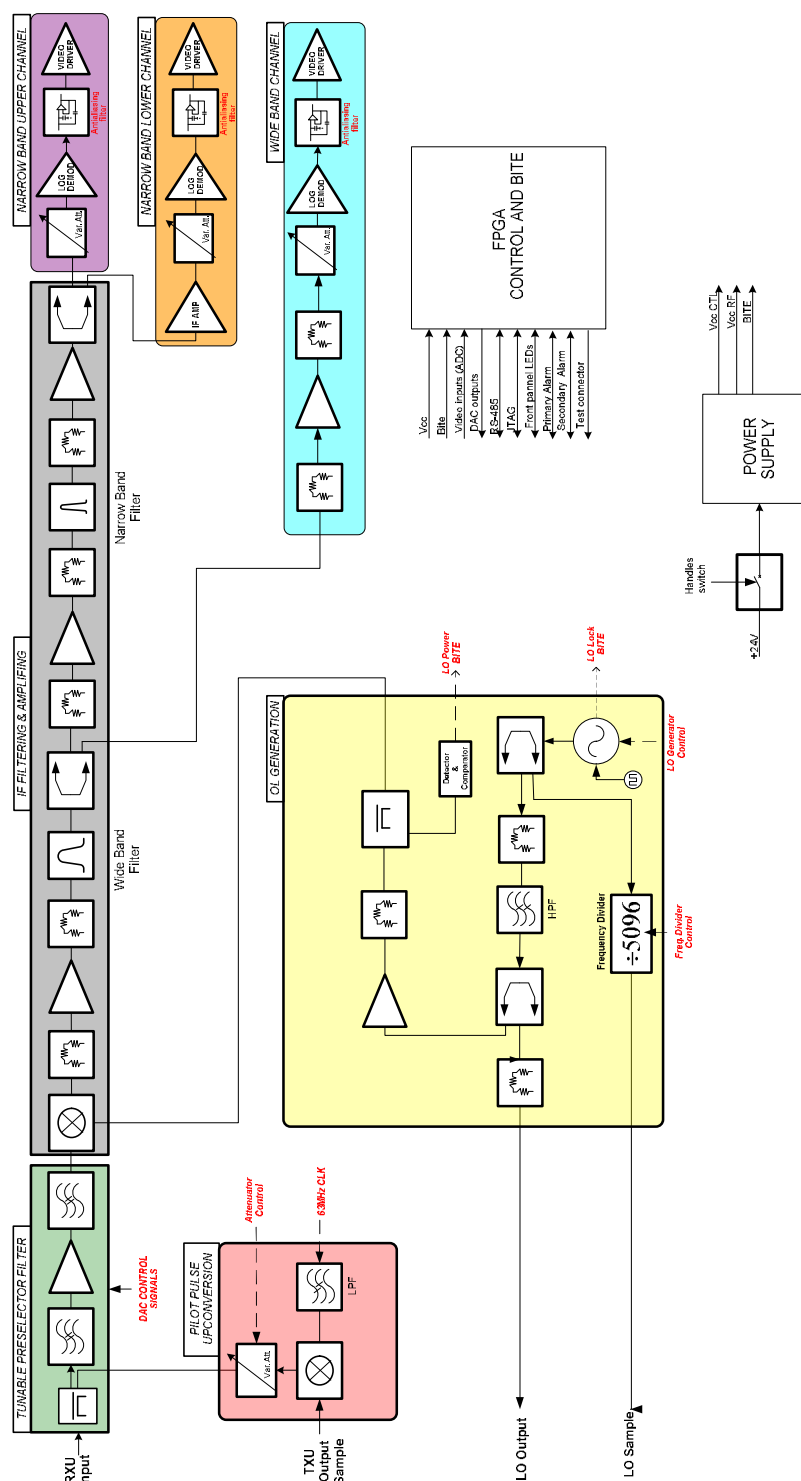


Figure 7.3.6.1-1. RECEIVER UNIT (RXU) FUNCTIONAL BLOCK DIAGRAM

7.3.6.2 BIT facilities and alarm management

Receiver Unit (RXU) will be able to generate the signals required for BIT purposes.

The following processes will be monitored:

- ò Local Oscillator radiofrequency signal
- ò All the important voltage rails.

RXU will include multi-channel A/D converters to sense and monitor above mentioned magnitudes and processes for BIT purposes.

The A/D converters will sample all of their inputs cyclically and continuously. The latest conversion results will be accessible by poll requests from the system RS-485 bus.

All operating voltages and/or the DC levels produced by these monitoring processes will be presented on the front panel connector for test purposes

RXU will assert Local Primary and Secondary alarms in the following scenarios:

- ò Any voltage rail out of specified ranges
- ò A failure of the FPGA configuration
- ò Local Oscillator radiofrequency signal out of user defined ranges
- ò An absence of poll requests from the CMU

7.3.6.3 Programming and control information

The RXU will contain a non-volatile FLASH memory which will hold information about thresholds, operating parameters, calibration and compensation data as well as internal FPGA configuration.

The RXU will have a RS-485 interface to poll all these static and dynamic data.

RS-485 registers will be divided in two different categories, status registers and configuration registers. First ones will be "read only" registers on the RS-485 bus, while configuration registers will be "read/write" registers.

Among status registers, which will be available by polling, will be the following parameters:

- ò Board ID
- ò FPGA revision
- ò Board revision
- ò Status (Enabled/Disabled)
- ò Alarm Status
- ò CW input level and internal associated alarm
- ò Local Oscilaltor (LO) current level
- ò Number of received pulses per second
- ò Number of erase pulses due to Short Distance Echo Suppression (SDES)

- ò Number of received interrogations per second
- ò Number of erase interrogations due to death time
- ò Number of erase interrogations due to Long Distance Echo Suppression (LDES)
- ò Number of decoded interrogations per second
- ò Automatic sensitivity reduction indication
- ò Current sensitivity level
- ò Beacon delay measurements made by the pilot pulse algorithm

Configuration registers will at least have the following parameters:

- ò Operating channel
- ò Calibration data
- ò Internal voltage rail thresholds to generate LOCAL Primary and Secondary Alarms (High and low)
- ò Local Oscillator (LO) level threshold to generate Primary and Secondary Alarms (High and low)
- ò Dead time configuration
- ò Short Distance Echo Suppression (SDES) configuration
- ò Long Distance Echo Suppression (LDES) configuration
- ò Pilot pulse algorithm configuration (enable/disable and periodicity)
- ò Sensitivity level
- ò Automatic sensitivity reduction configuration
- ò CW level threshold to generate an internal Alarm

Note that there is no need for configuration registers to be available in local or remote control. It will depend on Control & Monitoring Unit (CMU) configuration policy to give access to one or another parameter in local or remote control or let that parameter as only factory set parameter. All the parameters will be accessible by the RS-485 bus.

This unit will have a JTAG port plus an enable signal accessible through the backplane connector, so as to be able to program the FPGA inside the module from the Control & Monitoring Unit (CMU).

7.3.6.4 Mechanical details

The Receiver Unit (RXU) will have the following dimensions:

- ò Height: 6 U or 266.7 mm.
- ò Width: 5 HP or 25.4 mm.
- ò Depth: 300 mm
- ò Weight: 1 kg

This module will have single card slides at top and bottom.

The RXU will have 4 rear connectors.

- ò P1: DIN41612 Type C (96 pins)
- ò P2: RF BMA plug connector;
- ò J20: RF BMA plug connector;
- ò J21: RF BMA plug connector.

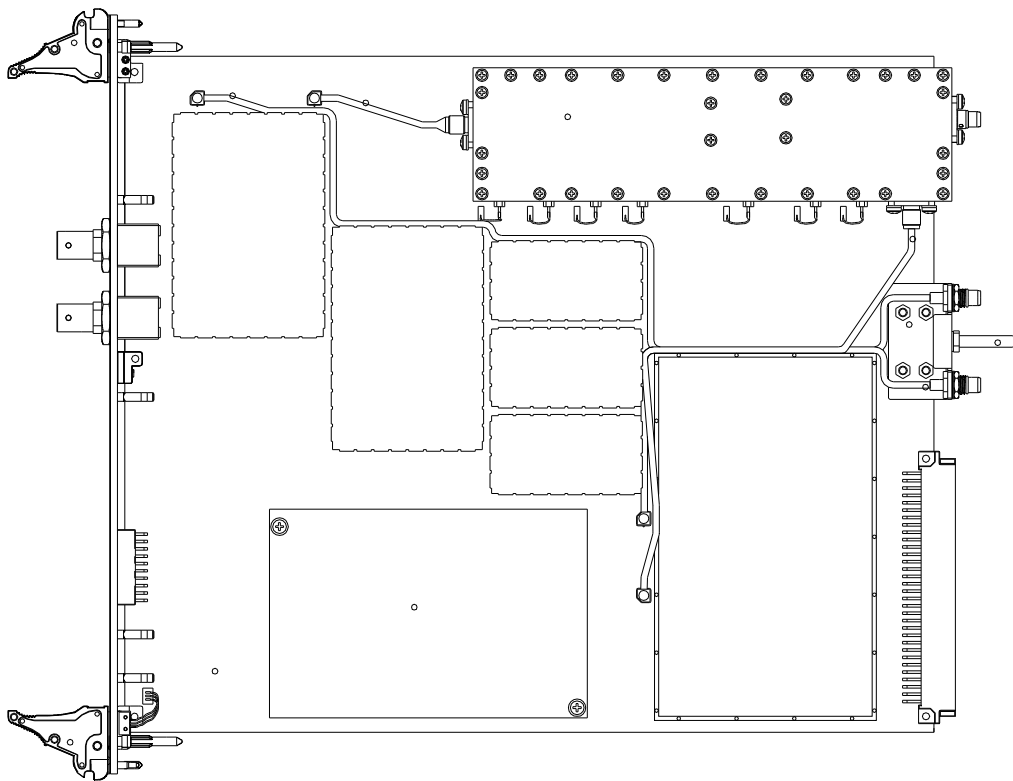


Figure 7.3.6.4-1. RECEIVER UNIT (RXU) ASSEMBLY

7.3.6.5 Front panel details

On the front panel, the Receiver Unit (RXU) will have a 20 pin connector, two BNC connector and four LEDs indicators.

The 20 pin connector will give access to critical analogue and digital signals such as synchronization signals and internal voltage rails for test purposes. Digital signals present in test connector will be selectable under software control.

BNC connectors in RXU front panel will give access to received pulse video signal. The impedance will be 50 Ω .

- ò VIDEO HIGH: high part of the receiver dynamic range
- ò VIDEO LOW: low part of the receiver dynamic range

LEDs will be SMD, and will use light pipes to direct the light through the front panel, as follows:

- ò POWER [Blue]: indicate that the unit has power.
- ò ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status; the LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ò POLLING [Yellow]: indicates polling requests.
- ò DET [Green]: this LED will turn on each time the TXP detects a valid interrogation.

This module will have two insertion/extraction handles (one at the top and one at the bottom of the front panel), allowing an easy insertion and extraction of the module. This handles will supply ESD protection (automatic connection with the rack ground) and hot swappable operation (automatic power supply disable before extraction of the module).

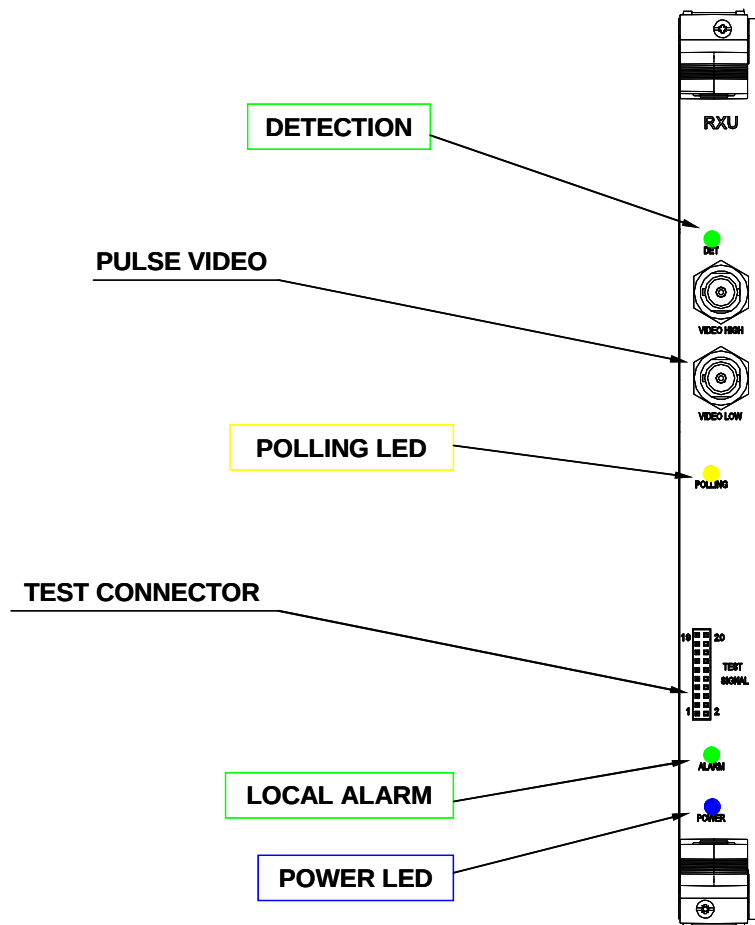


Figure 7.3.6.5-1. RECEIVER UNIT (RXU) - FRONT PANEL

7.3.6.6 Hardware Implementation and Schematics

The RXU module occupies the third vertical slot of the subrack after the HPA. RXU1 at the Left Hand side and RXU2 at the Right Hand side of the Subrack.

The RXU schematics are given in Appendix J of this handbook including the following drawings:

The HPA schematics are given in Volume 3 of this handbook which include drawings:

- ò 00634 3000 4300 for the Main PBA,
- ò 0634 3000 4700 for the Digital PBA.
- ò 0634 3000 3700 for the Preselector Filter.

7.3.7 Transmitter Unit (TXU)

7.3.7.1 Functional description

The Transmitter Unit (TXU) is in charge of all processes related with pulse generation. In case of a terminal DME (100W), the TXU power amplifier provides RF output at a level suitable for connecting to the antenna. In case of an en-route DME (1 KW), the TXU acts as a driver amplifier feeding the HPA. Upon reception of a pulse from the Receiver Unit (RXU) indicating a valid interrogation has been detected, the TXU generates a Gaussian shape pair of pulses, with the appropriate pulse pair spacing according to Table 7.3.7.1-1. All reply signals will be comprised of pairs of pulses with a defined spacing between the constituent pulses of each pair, depending on the channel suffix selected (X or Y).

The Transmitter Unit (TXU) generates a base band pre-distorted pulse pairs, which then modulate the Local Oscillator signal, received from the Receiver Unit (RXU) before driving the amplifier stages with this signal. The TXU will amplify pulse pairs up to the required level to transmit them through the antenna, keeping Gaussian pulse characteristics at its output. Nominal output power for this unit is >100 W at output cabinet connector.

In order to maintain Gaussian shape for the pulses regardless of temperature, frequency and operation conditions, the TXU will implement a feedback loop recalculating the pre-distorted base band pulses from the output pulse of the module. In case of a high power DME, the TXU will act as a driver of the High Power Amplifier (HPA) keeping the responsibility of maintain Gaussian pulse shape at the antenna input. In this case, the TXU will calculate the pre-distorted base band pulses from the output of the High Power Amplifier, maintaining in every moment Gaussian shape characteristics of the transmitted pulses. Feedback information from the HPA will be received as a digitalized video signal from the backplane connector. The TXU will know operation frequency and DME power configuration through dedicated registers of the RS 485 BUS.

Table 7.3.7.1-1. PULSE CODING CHARACTERISTICS

CHANNEL SUFFIX	OPERATING MODE	PULSE PAIR SPACING (μ s)		TIME DELAY (μ s)
		INTERROGATION	REPLY	
X	DME/N	12	12	50
Y	DME/N	36	30	56

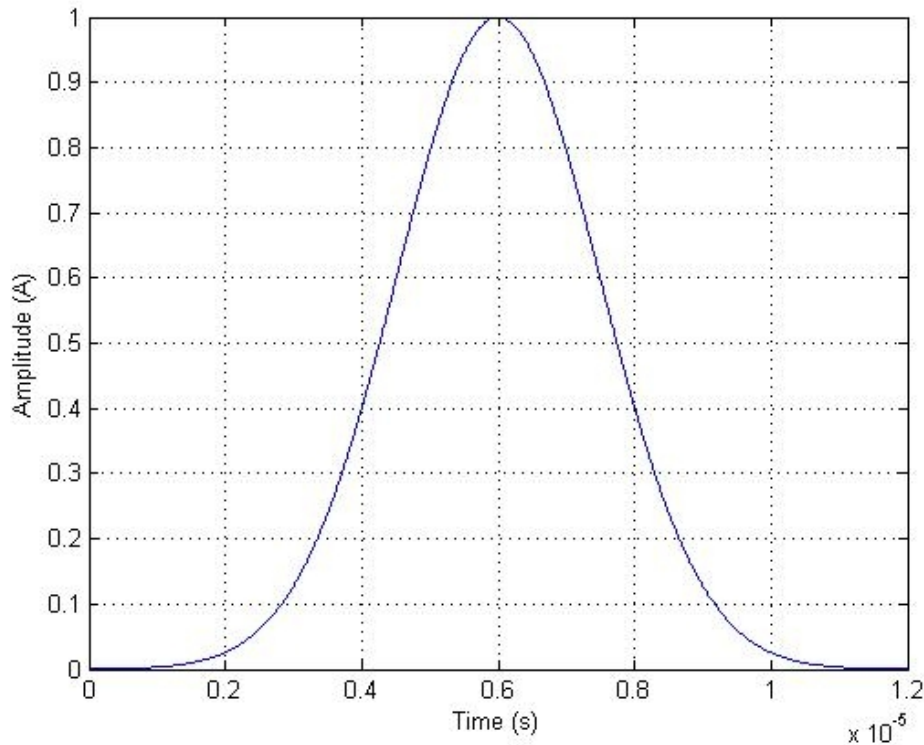


Figure 7.3.7.1-1. NOMINAL GAUSSIAN DME PULSE

The Transmitter Unit (TXU) will provide means to permit continuous adjustment of the RF output power in 0.25 dB steps from a preset level of 100 watts over the range of 0 to -4 dB.

This unit will also implement duplexer functionality, allowing transmission/reception switching.

Output signal characteristics will be maintain all around the whole transmission frequency band from 962 to 1213 MHz without need any extra adjustment.

The DME LDB-103 will be able to serve, simultaneously, more than 200 interrogators with a maximum transmission rate of 5000 ppps.

Transmitter Unit (TXU) will have the following RF ports:

- ò Main connector (connected to RF Shelf or HPA)
- ò Local oscillator (from RXU)
- ò Received signal (To RXU; duplexer output)

Transmitter Unit (TXU) is also in charge of squitter generation, so when the reply rate is insufficient to maintain a transmission rate of at least 700ppps, pulse pairs will be added at random basis to ensure that the minimum rate is maintained. In no case maximum squitter rate will exceed 850 ppps. The number of generated squitter pulses will depend on the number of interrogations decoded by the Receiver Unit (RXU), being the total amount of transmitted reply pulses as close as possible to 700 ppps. If reply rate due to decoded interrogation signal is above the range of 700 to 850 ppps, no squitter pulses will be added.

Transmitter Unit (TXU) is be responsible of Identity pulse generation. The identity signal will consist of the transmission of the beacon code in the form of dots and dashes (International Morse Code) of identity pulses. The signal for the identification coding will consist of the transmission of a series of paired pulses transmitted at a rate of 1350 (± 10) ppps and will temporarily replace all other pulses. Identity pulses will have the same characteristics that reply pulses, having the same shape and pulse pair spacing. During the identification key down periods, reply pulses will not be transmitted, but between key down periods, replies will be transmitted.

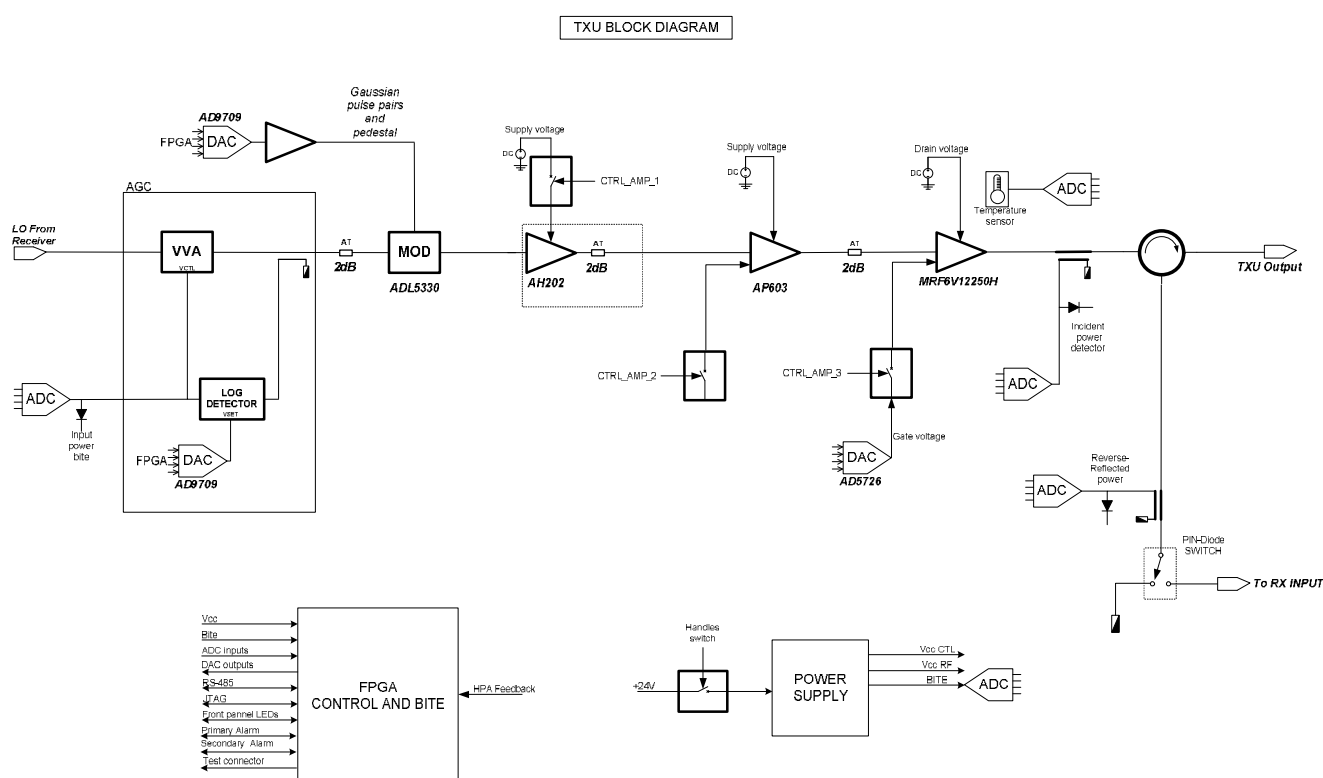


Figure 7.3.7.1-2. TRANSMITTER UNIT (TXU) FUNCTIONAL BLOCK DIAGRAM

The TXU includes circuitry so that it can either work as an independent beacon or associated to a VHF equipment (facilities are available to support connection to two different VHF facilities). When working as an associated beacon, the TXU is able to work as master or slave. When working as an associated master, the TXU is able to drive the associated VHF equipment with a synchronization pulse indicating the moment of identity transmission (trigger) or directly sending the keying signal (MORSE code). In the same way, when the DME is configured as a slave of a VHF equipment, TXU will be able to manage an input signal indicating the identity code transmission trigger or an input signal acting as a keyer. The following summarises all possible configurations:

- ò Independent operation
- ò Associated operation
 - ñ Master equipment
 - ▣ Trigger output signal
 - ▣ Keyer output signal (MORSE code)
 - ñ Slave equipment
 - ▣ Trigger input signal
 - ▣ Keyer input signal (MORSE code)

In independent operation, TXU will transmit the beacon MORSE code at least once every 30 seconds.

In associated operation, each 30 seconds interval will be divided into 4 equal periods with the transponder identification transmitted during one period only, and the associated VHF facility identification transmitted during the remaining periods. When the DME is operating as a slave unit, any failure of the external Ident generator will cause the DME to internally generate and transmit the transponder identity code in place of the failed unit.

The unit will allow to store two 4-character different identification codes. Characters will be letters or numbers, being the maximum length of a letter 4 symbols (combination of dots and dashes) and 5 symbols for numbers. Depending on the number of characters of the identity code and the periodicity of identity code transmission, the beacon will transmit with a different word rate, being 8 words per minute the maximum rate.

MORSE code identification signal will fulfil the following characteristics:

- ò The dot length will be user configurable between 0.1 and 0.16 second.
- ò The dash length will be 3 times the duration of a dot.
- ò The time duration between dots and/or dashes will be equal to 1 dot.
- ò The time duration between letters or numeral will not be less than one dash (three dots).
- ò The total period of transmission of an identification code group will not exceed 10 seconds.
- ò The total key down time will not exceed 5 seconds

The TXU is responsible for code length checking, calculating the key down length and the identification code group length depending on the programmed code and dot length, ensuring the user defined

characteristics match the specification of the system. If the user defined parameters generate an identity signal that is out of specification, the TXU notifies the user and will not save this configuration.

Facilities are provided for selecting the following identification conditions:

- ò NORMAL Identification
- ò Identification OFF
- ò TEST
- ò Continuous key down

During maintenance works, TXU will automatically change the transmitted identity coded to the TEST code, reporting this condition to the airplanes inside its coverage area. Continuous key down will consist of the continuous transmission of the identity tone of 1350 Hz, in order to facilitate its measure.

TXU unit also performs the following functions:

- ò Generation of suitable voltage rails from main +24VDC supply
- ò Management of calibration and identification parameters
- ò Generation of required signals for BIT functions.

7.3.7.2 BIT facilities and alarm management

The TXU generates the essential signals required for BIT purposes.

The following processes are monitored:

- ò Transmitted RF power
- ò Forward and reverse power
- ò Temperature
- ò Local Oscillator radiofrequency signal
- ò All the important voltage rails

The TXU internally includes a set of directional couplers, power detectors and multi-channel A/D converters to sense and monitor above mentioned magnitudes. It then processes the gathered information for BIT purposes.

The A/D converters sample all of their inputs cyclically and continuously. The latest conversion results will be accessible by poll requests from the system RS-485 bus.

All operating voltages and/or the DC levels produced by these monitoring processes are presented on the front panel connector for test purposes

The TXU asserts Local Primary and Secondary alarms in the following scenarios:

- ò Any voltage rail out of specified ranges
- ò A failure of the FPGA configuration
- ò Output power out of defined thresholds

- ò Reverse power above defined threshold
- ò Temperature out of defined thresholds
- ò Local Oscillator radiofrequency signal out of user defined ranges
- ò An absence of poll requests from the CMU

The module protects itself against reverse power at main connector, switching off automatically if the measured value is above a threshold defined in a register. This threshold will match with the reverse power primary alarm threshold. The module will try to re-start a number of times before switching itself off permanently until reset manually.

The module also protects itself against temperature, switching off in case the measured temperature is above a defined threshold kept in a register. Once it has shut down, the temperature will need to drop to another, lower, register set level before the transmitter can resume operation. In the same way manner as for reverse power, temperature primary alarm threshold will match with the switching off threshold.

7.3.7.3 Programming and control information

The TXU contains a non-volatile FLASH memory which will hold information about thresholds, operating parameters, calibration and compensation data as well as internal FPGA configuration.

For internal communication, the TXU has an RS-485 interface to poll all these static and dynamic data.

RS-485 registers are divided in two different categories, status registers and configuration registers. The first group contains "read only" registers on the RS-485 bus, while the second group, the configuration registers, are the "read/write" registers.

The following parameters contained in the status registers, are available by polling:

- ò Board ID
- ò FPGA revision
- ò Board revision
- ò Status (Enabled/Disabled)
- ò Alarm status
- ò Internal voltage rails
- ò Current temperatures
- ò Mean forward power levels
- ò Mean reverse power levels
- ò Recent peak reverse powers
- ò Local Oscillator (LO) level
- ò Number of pair of pulses transmitted per second
- ò Number of squitters transmitted per second
- ò Number of replies transmitted per second

Parameters contained in configuration registers include the following:

- ò Operating channel
- ò Calibration data and offsets for forward and reverse power detectors
- ò Internal voltage rail thresholds to generate LOCAL Primary and Secondary Alarms (High and low)
- ò Temperature thresholds to generate LOCAL Primary and Secondary Alarms
- ò Number of restart attempts after shutdown due to temperature
- ò Reverse power detector thresholds to generate LOCAL Primary and Secondary Alarms
- ò Restart timer after shutdown due to reverse power
- ò Number of restart attempts after shutdown due to reverse power
- ò Local Oscillator (LO) level threshold to generate Primary and Secondary Alarms
- ò Independent/Associated Operation
- ò Master/Slave when in Associated operating mode
- ò Key Input and Key output selection and control
- ò Identity Code
- ò Identity control (Normal, OFF, TEST, Continuous)
- ò Dot/Dash/Space length
- ò Squitter generation enable
- ò Squitter threshold

Note that there is no need for configuration registers to be available in local or remote control. It will depend on Control & Monitoring Unit (CMU) configuration policy to give access to one or another parameter in local or remote control or let that parameter as only factory set parameter. All the parameters will be accessible by the RS-485 bus.

The TXU also has a JTAG port plus an enable signal accessible through the backplane connector, to enable programming the FPGA inside the module from the Control & Monitoring Unit (CMU).

7.3.7.4 Mechanical details

Dimensions of the TXU module are as follows:

- ò Height: 6 U or 266.7 mm.
- ò Width: 8 HP or 40.64 mm.
- ò Depth: 300 mm
- ò Weight: 2 kg.

The module has single card slides at top and bottom.

The TXU has 4 rear connectors.

- o P1: DIN41612 Type C (96 pins);
- o P2: RF BMA plug connector;
- o P3: RF BMA plug connector;
- o P4: RF BMA plug connector.

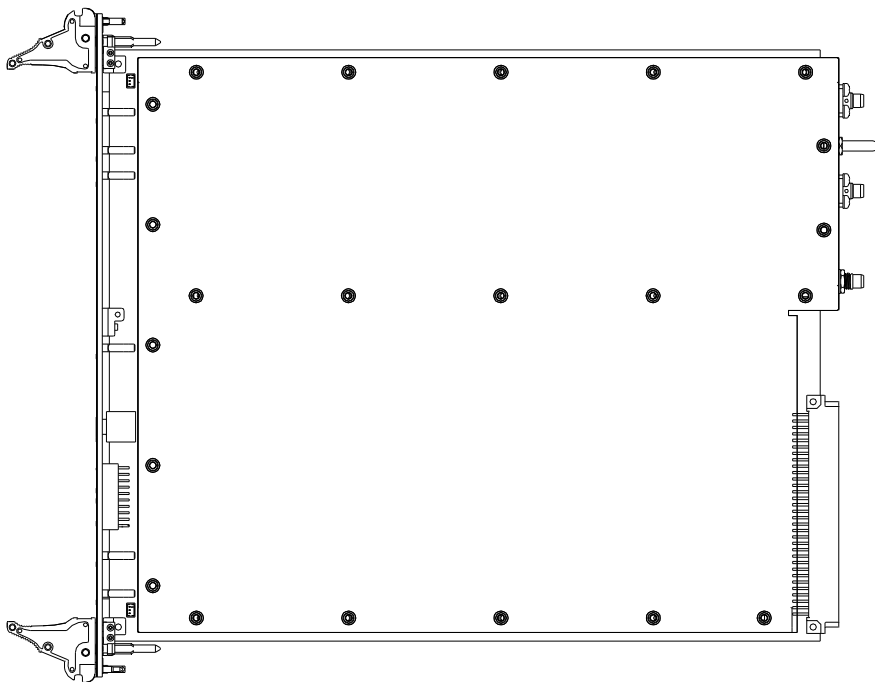


Figure 7.3.7.4-1. TRANSMITTER UNIT (TXU) ASSEMBLY

7.3.7.5 Front panel details

On the front panel, the Transmitter Unit (TXU) has a 20 pin connector, one jack socket, and six LEDs indicators.

The 20 pin connector provides access to critical analogue and digital signals such as synchronization signals and internal voltage rails for test purposes. Digital signals present in test connector will be selectable under software control.

There is a female jack socket, where user can hear the IDENT code being transmitted by the beacon. When the TXU is in standby mode no signal is present at this connector (Standby TXU does not generate IDENT signal).

The LEDs used are SMD, and light pipes are used to direct the light through the front panel, as follows:

- ò POWER [Blue]: indicates that the unit has power.
- ò ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status; the LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ò POLLING [Yellow]: indicates polling requests.
- ò TX [Green]: this LED will turn on each time the TXP transmits a pair of pulses. In normal operation, users will see this LED on all the time.
- ò IDENT [Yellow]: indicates the presence of the IDENT tone; it will turn on and off in cadence with the dashes and dots of the Morse representation of the identification code.
- ò TX_ENABLE [Red-Green]: this LED will be green when transmit enable is asserted and red when it is not.

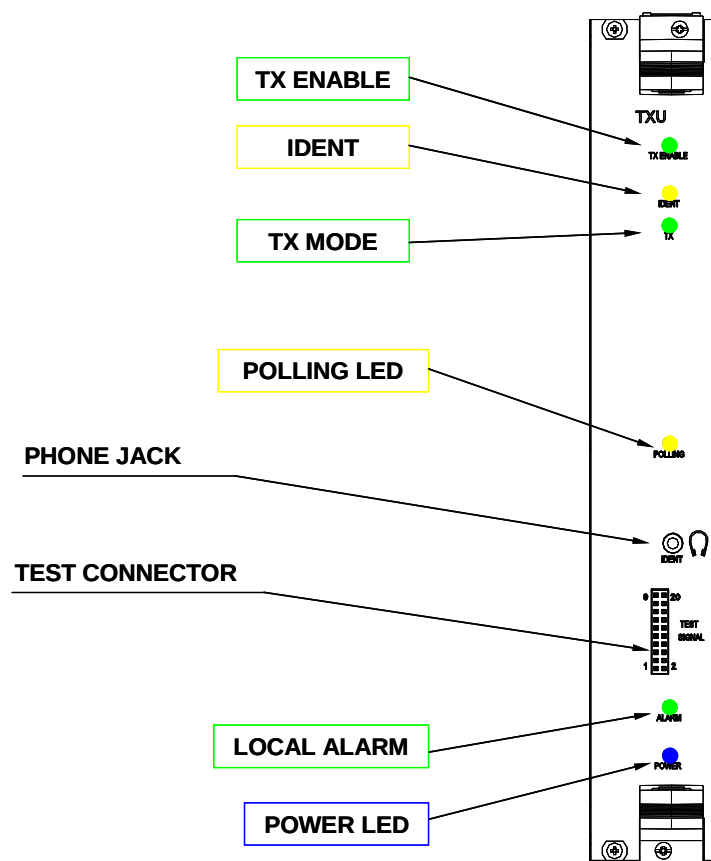


Figure 7.3.7.5-1. TRANSMITTER UNIT (TXU) - FRONT PANEL

This module has two insertion/extraction levers (one at the top and one at the bottom of the front panel), allowing easy insertion and extraction of the module. The handles will supply ESD protection (automatic connection with the rack ground) and hot swappable operation (automatic power supply disable before extraction of the module).

7.3.7.6 Hardware Implementation and Schematics

The TXU module occupies the second vertical slot of the subrack after the HPA. TXU1 at the Left Hand side and TXU2 at the Right Hand side of the Subrack.

The TXU schematics are given in Appendix J of this handbook including drawing 00634 3000 4600 for the Main PBA and drawing 00634 3000 4700 for the Digital PBA.

7.3.8 High Power Amplifier (HPA)

7.3.8.1 Functional description

A High Power Amplifier (HPA) is fitted into the equipment system to provide higher output power for an en-route DME. This module amplifies the radiofrequency signal provided by the Transmitter Unit (TXU) up to the required level to be transmitted through the antenna. Nominal output power for an en-route DME is more than 1 KW measured at cabinet connector.

Adjustment facility is provided to permit continuous variation of the RF output power in 0.25 dB steps from a preset level of 1KW over the range of 0 to -4 dB. The adjustment needs the collaboration from the TXU.

The High Power Amplifier (HPA) receives the pre-distorted Gaussian shape pulses from the Transmitter Unit (TXU) and amplifies them up to the nominal value. A sample of the transmitted signal will be sent to the Transmitter Unit (TXU) as digital video through a backplane connector in order to implement a feedback loop which controls the output pulse shape. This loop ensures that the Gaussian shape characteristics of the transmitted pulses are maintained over the transmission frequency band from 962 to 1213 MHz, and over the specified temperature range of operation.

The High Power Amplifier (HPA) contains the duplexer functionality on high power DMEs, allowing transmission/reception switching.

The High Power Amplifier (HPA) is capable of working with a transmission rate of up to 5000 ppps. This is sufficient to provide DME services to more than 200 interrogators simultaneously.

The High Power Amplifier (HPA) has the following RF ports:

- Main connector (connected to RF Shelf)
- Radiofrequency input (from TXU)
- Received signal (To RXU; duplexer output)

The High Power Amplifier (HPA) can support optional harmonics filtering.

The HPA also performs the following functions:

- o Generation of suitable voltage rails from main +24VDC supply
- o Management of calibration and identification parameters
- o Generation of required signals for BIT functions.

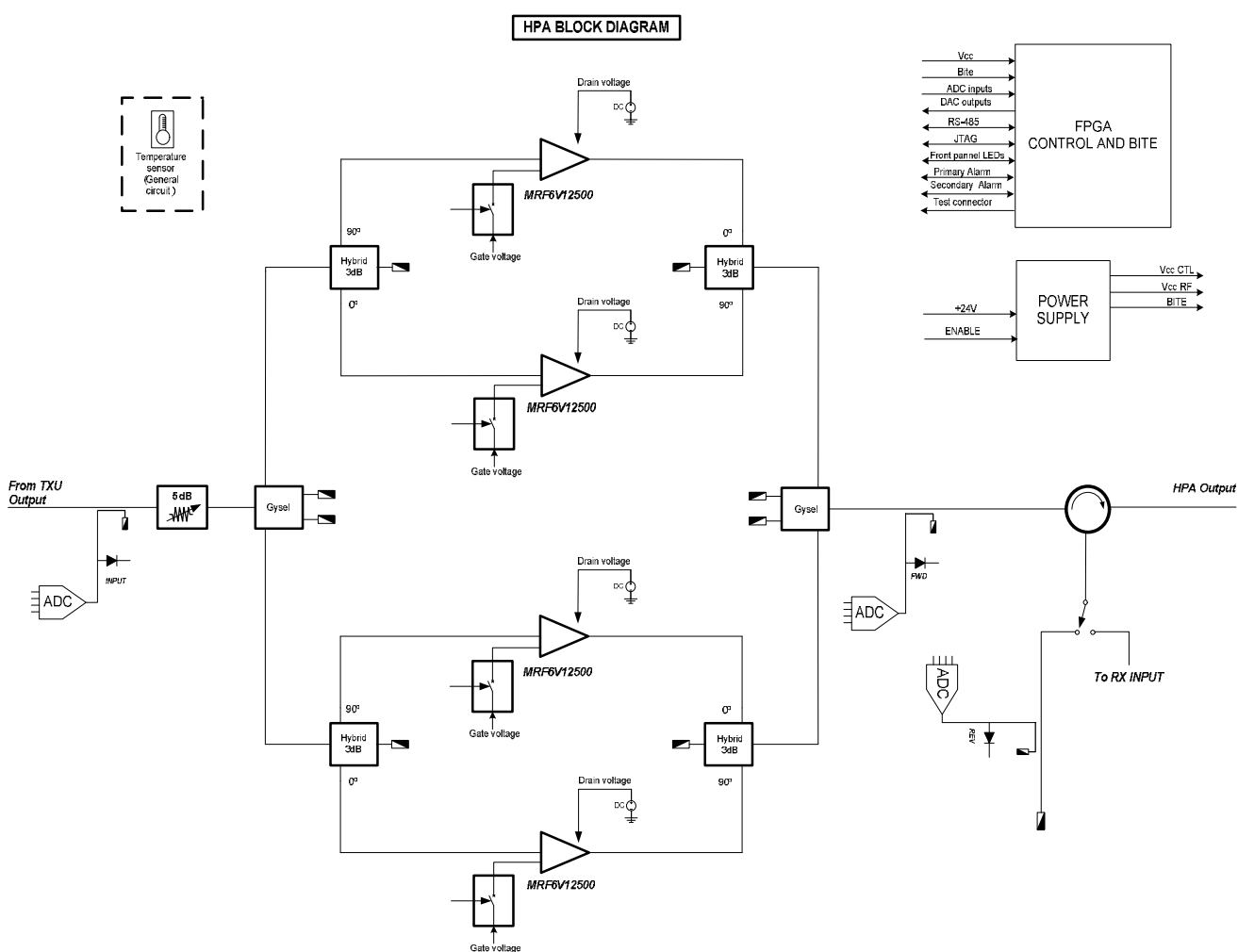


Figure 7.3.8.1-1. HIGH POWER AMPLIFIER (HPA) FUNCTIONAL BLOCK DIAGRAM

7.3.8.2 BIT facilities and alarm management

The HPA generates all essential signals required for BIT purposes.

The processes that are monitored, include the following:

- ò Transmitted RF power
- ò Forward and reverse power
- ò Input power from TXU
- ò Temperature
- ò All the important voltage rails.

The HPA includes a set of directional couplers, power detectors and multi-channel A/D converters to sense and monitor the above mentioned magnitudes and processes for BIT purposes.

The A/D converters sample all of their inputs cyclically and continuously. The latest conversion results are accessible by poll requests from the system RS-485 bus.

All operating voltages and/or the DC levels produced by these monitoring processes are available on the front panel connector for test purposes

The HPA asserts the Local Primary and Secondary alarms in the following scenarios:

- ò Any voltage rail out of specified ranges
- ò A failure of the FPGA configuration
- ò Output power out of defined thresholds
- ò Reverse power above defined threshold
- ò Temperature out of defined thresholds
- ò Input power form TXU out of threshold
- ò An absence of poll requests from the CMU
- ò Number of pair of pulses transmitted per second

The module protects itself against reverse power at main connector, switching off automatically if the measured value is above a threshold defined in a register. The module will try to re-start a number of times (pre-defined in a register) before switching itself off indefinitely until reset manually.

The module also protects itself against extreme temperature, switching off in case the measured temperature is above a register defined threshold. Once it has shut down, the temperature will need to drop to another, lower, register set level before the transmitter can resume operation. In the same way for reverse power, temperature primary alarm threshold matches with the switching off threshold.

7.3.8.3 Programming and control information

The HPA contains a non-volatile FLASH memory which holds information about thresholds, operating parameters, calibration and compensation data as well as internal FPGA configuration.

The HPA has an RS-485 interface to poll all these static and dynamic data.

RS-485 registers are divided in two different categories, status registers and configuration registers. The first group includes "read only" registers on the RS-485 bus, while the second group contains the configuration registers which are "read/write" registers.

The status registers that are available by polling include the following ones:

- ò Board ID
- ò FPGA revision
- ò Board revision
- ò Status (Enabled/Disabled)
- ò Alarm status
- ò Internal voltage rails
- ò Current temperatures
- ò Mean forward power levels
- ò Mean reverse power levels
- ò Recent peak reverse powers
- ò Mean radiofrequency input level
- ò Number of pair of pulses transmitted per second

Parameters contained in the configuration registers include the following:

- ò Operating channel
- ò Calibration data and offsets for forward and reverse power detectors
- ò Internal voltage rail thresholds to generate LOCAL Primary and Secondary Alarms (High and low)
- ò Temperature thresholds to generate LOCAL Primary and Secondary Alarms
- ò Number of restart attempts after shutdown due to temperature
- ò Reverse power detector thresholds to generate LOCAL Primary and Secondary Alarms
- ò Restart timer after shutdown due to reverse power
- ò Number of restart attempts after shutdown due to reverse power
- ò Input power threshold to generate Primary and Secondary Alarm.

Note that there is no need for configuration registers to be available in local or remote control. It will depend on Control & Monitoring Unit (CMU) configuration policy to give access to one or another parameter in local or remote control or let that parameter as only factory set parameter. All the parameters will be accessible by the RS-485 bus.

The HPA also has a JTAG port together with an enable signal accessible through the backplane connector. This enables programming of the FPGA inside the module from the Control & Monitoring Unit (CMU).

7.3.8.4 Mechanical details

Dimensions of the HPA module are as follows:

- ò Height: 6 U or 266.7 mm;
- ò Width: 14 HP or 71.12 mm;
- ò Depth: 402.75 mm without handle;
- ò Weight: 4,8 kg.

It is supported from underneath with 3 rails, and two rails at the top.

The module requires a heat sink for its thermal management.

The HPA has 4 rear connectors.

- ò J7: RF BMA plug connector;
- ò J8: RF BMA plug connector.
- ò J9: D-Sub 37p;
- ò J10: D-Sub 9p mixed 3W3 configuration.

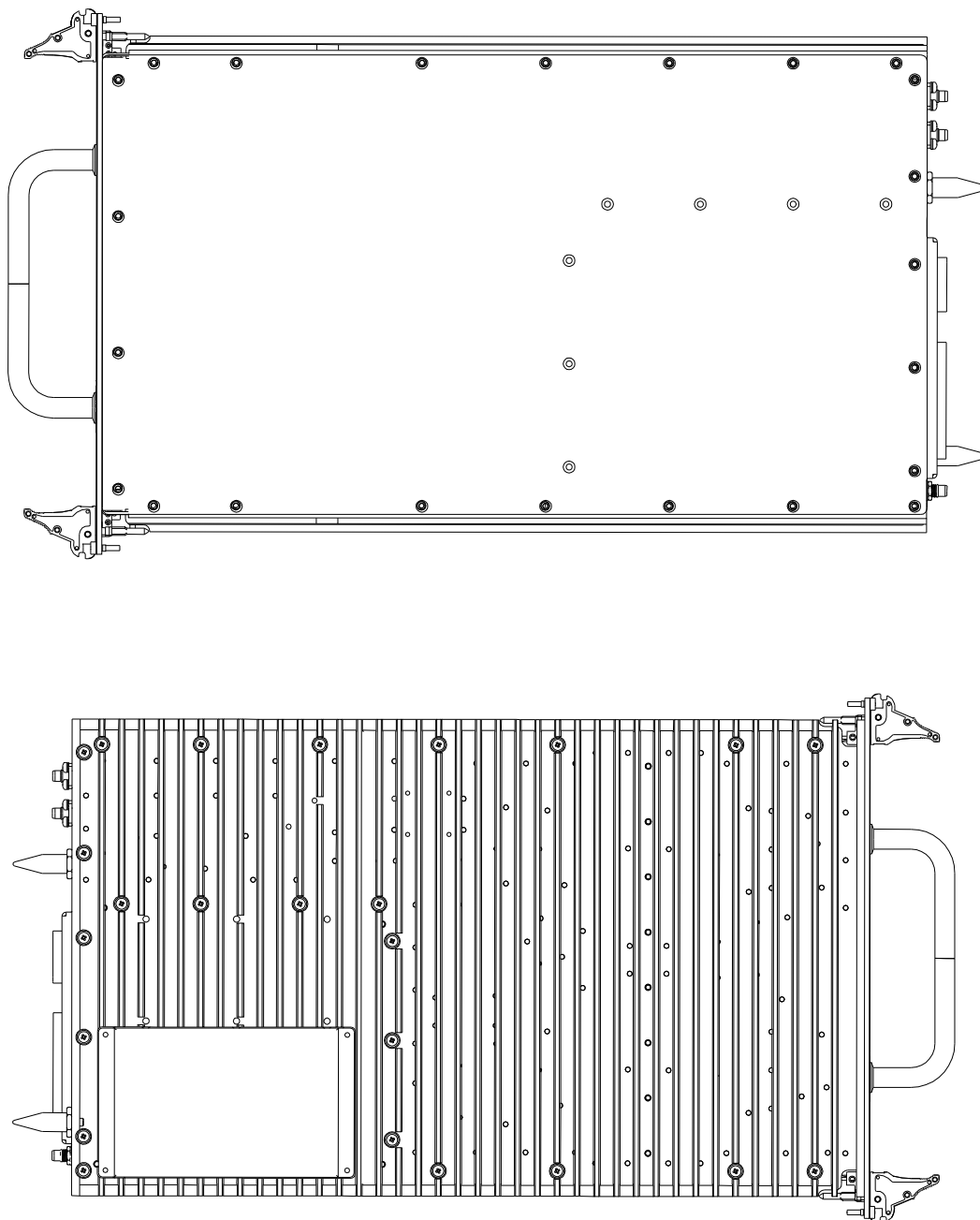


Figure 7.3.8.4-1. HIGH POWER AMPLIFIER (HPA) ASSEMBLY

7.3.8.5 Front panel details

On the front panel, the High Power Amplifier (HPA) has a 20 pin connector and four LEDs indicators.

The 20 pin connector provides access to critical analogue and digital signals such as synchronization signals and internal voltage rails for test purposes. Digital signals present in test connector are selectable under software control.

LEDs will be SMD, and will use light pipes to direct the light through the front panel, as follows:

- ò POWER [Blue]: indicates that the unit has power.
- ò ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status; the LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ò POLLING [Yellow]: indicates polling requests.
- ò TX_ENABLE [Red-Green]: this LED will be green when transmit enable is asserted and red when it is not

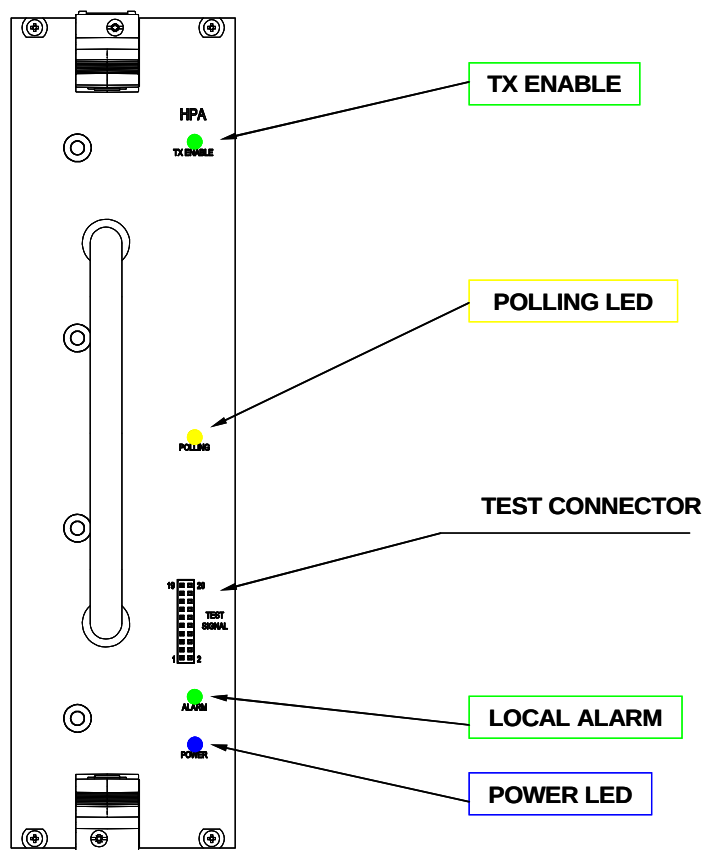


Figure 7.3.8.5-1. HIGH POWER AMPLIFIER (HPA) - FRONTAL PANEL

The module has one solid vertical handle allowing an easy insertion and extraction of the module. This handles will supply ESD protection (automatic connection with the rack ground) and hot swappable operation (automatic power supply disable before extraction of the module).

7.3.8.6 Hardware Implementation and Schematics

The HPA module occupies the first vertical slot, at the outside edge of the subrack. HPA1 is at the Left Hand side and HPA2 at the Right Hand side of the Subrack.

The HPA schematics are given in Appendix J of this handbook including the following drawings:

- ò 00634 3000 4800 for the RF PBA,
- ò 0634 3000 4900 for the Digital PBA.
- ò 0634 3000 5000 for the Front PBA.
- ò 0634 3000 5100 for the Power Supply PBA.

7.3.9 Power Supply Unit (PSU)

The equipment will be operated from a mains power supply with an output voltage of +24VDCs which will also be used as a float charger for a standby battery supply.

The input voltage of this Unit will be 90 VAC to +276 VAC.

7.3.9.1 Functional description

The Power Supply Unit will perform these three major functions:

- ò To provide power to each half of a dual TXP DME, or to the whole of a single TXP DME.
- ò To control the charge state on the backup bank of sealed lead-acid batteries.
- ò To automatically drain power from the battery bank when mains power is removed.

Every PSU will be composed of two but up to four hot-swappable rectifiers, a controller module and three circuit breakers. The rectifiers will be capable of supplying at least 400 W at +28VDC, that is 14 A each without the need for a fan, although there will be a derating over the whole temperature range.

The controller will activate alarm outputs when a fault is discovered in one of the rectifiers, a circuit breaker is tripped, an over-voltage occurs, an output voltage is below a user-specified level etc. In addition, the PSU will be failsafe on the failure of the controller itself. In this case, the rectifiers will continue to operate at their last set point. Thus any single failure in the power supply will be a secondary alarm and shouldn't require a switch-over.

The controller shall be able to apply temperature compensation to the output voltage for the battery output and/or the main output. The slope of the compensation shall be programmable.

The will be three circuit breakers and they will be rated as follows:

- ò 5 A for the digital control electronics;
- ò 15 A for the radiofrequency power amplifiers;
- ò And 60 A for the battery bank, due to these breaker must support the full-load when the batteries are supplying power, else 5 A where the return power from the battery bypasses the battery breaker.

Other PSU features will be:

- ò Battery Temperature Compensation.
- ò Battery Monitor and Charge Current Control.
- ò Low Voltage Disconnect operation.
- ò Cooling and protection adjustments.
- ò Alarm and signals management.
- ò Statistics and historical data, user definable alarms, data logging and event logging.
- ò Control and monitor via Internet Explorer browser (integrated SNMP).

The PSU arrangement will be a N+1 parallel configuration to share the load of each single DME TXP equipment, see

Figure 7.3.9.1-1, so the battery charging period could be increased, only. The standard configuration will provide two (but up to four) redundant hot-swappable rectifiers. Each one of this rectifier modules will be capable of supply enough power to operate a single DME TXP.

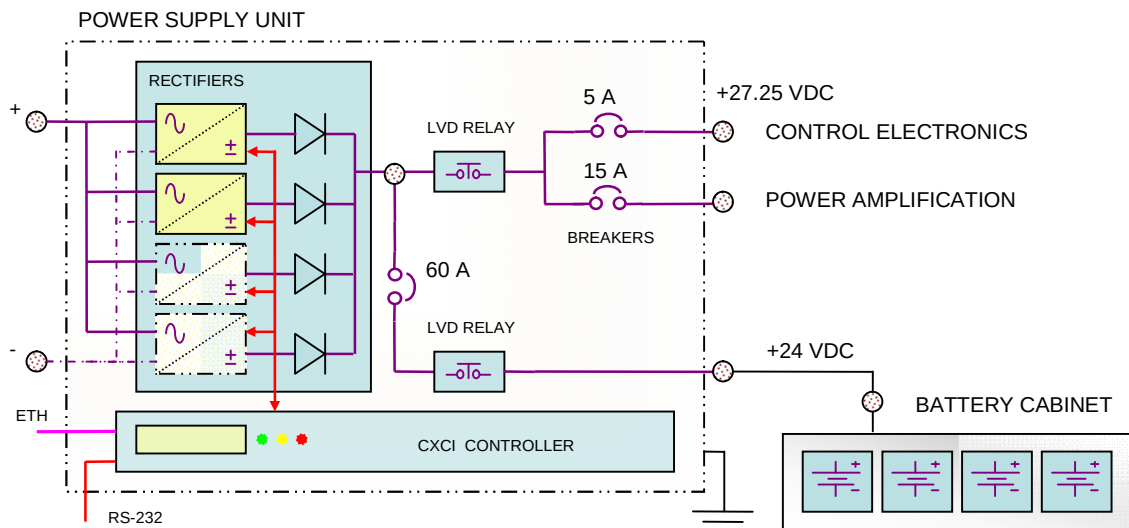


Figure 7.3.9.1-1. POWER SUPPLY UNIT (PSU) FUNCTIONAL BLOCK DIAGRAM

A dual system will be based on two PSU, one per single DME TXP equipment, two rectifier modules each. Thus a fully equipped dual DME beacon will have the following power supply levels of redundancy, increasing its reliability:

- ò AC redundancy: dual PSU modules run of dual AC sources, one per single DME equipment.
- ò AC/DC redundancy: every PSU has, at least, two rectifier modules, hence any faulty rectifier still means that the transmitters continue to operate.
- ò Battery redundancy: dual PSU allow dual battery banks and advanced battery charging options.

Table 7.3.9-1: POWER SUPPLY UNIT (PSU) DEFAUL PARAMETERS

SETTING	RANGE / NOTE	DEFAULT
Float Voltage (FL)	23.75 – 29.10 V	27.20 V
Equalize Voltage (EQ)	24.90 – 30.10 V	27.50 V
Battery Test Voltage (BT)	22.00 – 26.00 V	23.00 V
OverVolt Protect (OVP)	25.70 – 31.50 V	28.50 V
Current Limit (CL)	23 – 100%	100%
Power Limit (PL)	0 – 100%	100%
Module Start Delay	0 – 250 S	1 S
System Start Delay	0 – 600 S	0 S
Low Volt Alarm (LVA)	21.00 – 26.00 V	22.00 V
High Volt Alarm (HVA)	26.00 – 31.50 V	27.75 V
EQ Timeout	1 – 2399 h	30 h
BT Timeout	1 – 250 h	8 h
SoftStart Ramp Rate	Normal / Fast	Normal
CL/PL/Alarm	Enable / Disable	Enable
Remote ShutDown	Enable / Disable	Enable
Ramp Test	Enable / Disable	Enable
Battery Capacity		86 Ah
Temperature Coefficient		5.5 mV/C/cell
Charge Current Limit		10 A
K1 for internal LVD		NO
K2 for batt charger		NO
K3 for Load Voltage	Available at EIU (nc/c/no)	NO
K4 for Mains OK	Available at EIU (nc/c/no)	NO

7.3.9.2 BIT facilities and alarm management

The PSU will be able to generate the signals required for BIT purposes.

The monitored processes will include rectifier status and communication, battery capacity and charge, battery temperature, charge current, output voltage and load current.

The PSU will assert Local Primary (Major) and Secondary (Minor) alarms when there are conditions that are considered an immediate threat to the service, in the first case, or to be of a less serious nature in the second.

These alarms can be classified in:

- ò Rectifier alarms.
- ò Current alarms.
- ò Voltage alarms.
- ò Battery alarms.
- ò Temperature alarms
- ò Miscellaneous.
- ò Battery over temperature.
- ò Fuse alarm.
- ò High voltage and any voltage and rail out of user specified ranges

7.3.9.3 Programming and control information

The power supply system shall have a network (Ethernet) accessible port so that it can be controlled and monitored externally by utilizing TCP/IP technology through a Network Web Server or a Simple Network Management Server (SNMP).

Each power supply system shall have at least three relay based alarm outputs. The use of these alarm outputs shall be user-configurable.

7.3.9.4 Mechanical Details

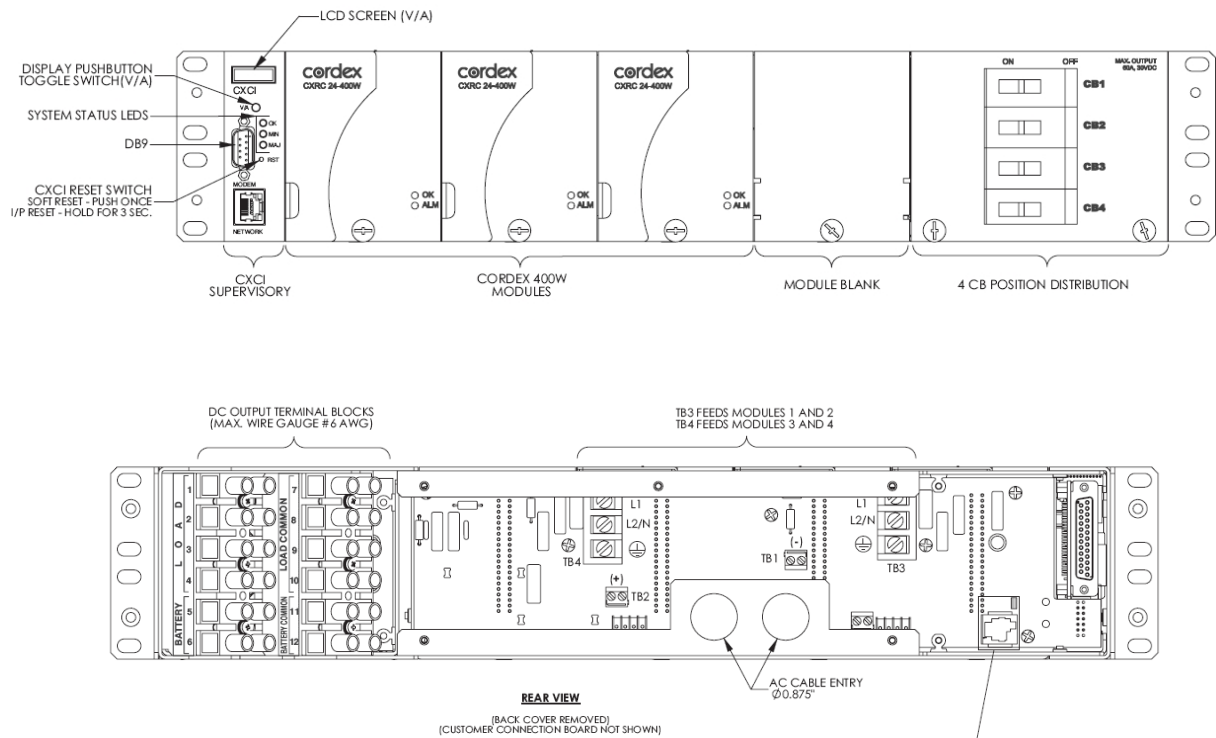


Figure 7.3.9.4-1. POWER SUPPLY UNIT (PSU) FRONT AND REAR VIEW

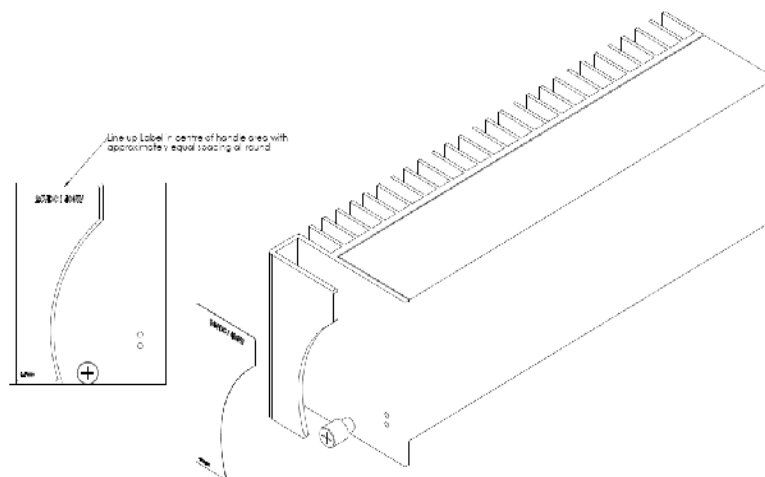


Figure 7.3.9.4-2. PSU RECTIFIER MODULE

7.3.9.5 Front panel details

On the front panel, the PSU will have seven LEDs, a small LCD display, a RJ45 connector and a DB9 connector for network and serial communications ports, respectively.

The LEDs indicators will show the operating and alarm status of the power supply system.

7.3.9.6 Hardware Implementation and Schematics

N/A.

7.3.10 Network Management Processor/External Interface Unit (NMP/EIU)

7.3.10.1 Functional description

The Network Management Processor/External Interface Unit (NMP/EIU) provides the gateway between the navaid equipment and the remote control and monitoring centres as well as supports the internal Local Area Network (LAN) of the DME beacon or protocol traslation for legacy navaid.

The NMP/EIU collects site and auxiliary signals or alarms providing multiple communication interfaces for remote connection, such as traditional leased-line, radio and dial-up modems as well as cellular modems and direct Ethernet connection.

The communication interface can be considered as the Wide Area Network (WAN) interface of the NMP/EIU module.

The NMP/EIU uses standard TCP/IP routing technology, allowing not only Indra navaid to be connected to the site LAN, but 3rd party elements can also be easily integrated. LAN interfaces include multiple 10/100BaseT Ethernet ports as well as multiple RS232/485 interfaces. The NMP/EIU element itself can be managed using HTTP and SNMP.

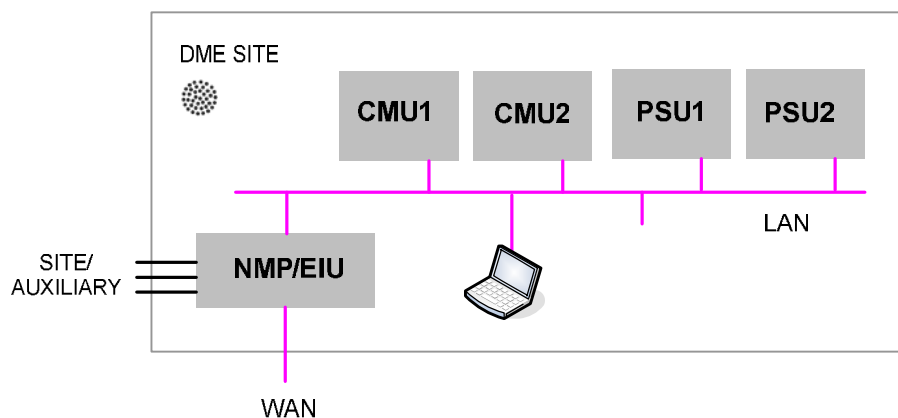


Figure 7.3.10.1-1. NMP/EIU MODULE - DME INTERNAL LAN

For legacy navaid equipment, the NMP/EIU module will proxy and convert any HTTP or SNMP requests to the proprietary legacy protocol, to ensure the network of navaids are open standards compliant. This allows for seamless management of networks of navaids, whether consisting only new models, legacy models or a mixed network of both.

The range of equipment includes:

- ò Existing equipment mostly managed using proprietary protocols access via serial port;
- ò New equipment managed using standard protocols accessed by Ethernet interface where possible; and
- ò Third party equipment managed with either standard or proprietary protocols accessed by either serial or Ethernet interfaces.

I/O front panel connectors provide a common location for the termination of external wiring to the DME installation and EMC protection.

7.3.10.2 BIT Facilities and alarm management

The Ethernet Switch has generic functionalities and can be a Commercial Off The Shelf (COTS) item. A suitable Ethernet switch provides eight 10/100BaseT(X) store-and-forward network ports. The unit uses redundant dual 24 VDC and has relay output warning for power failure and port break alarm.

7.3.10.3 Programming and control information

The NMP/EIU element can be managed using HTTP and SNMP protocols from a conventional browser.

7.3.10.4 Mechanical details

Dimensions of the NMP/EIU module are as follows:

- ò Height: 108.5 mm;
- ò Width: 449.0 mm;
- ò Depth: 305.6 mm;
- ò Weight: 3.6 kg.

It is supported from underneath by means of a mechanized custom shelf as a part of the DME cabinet.

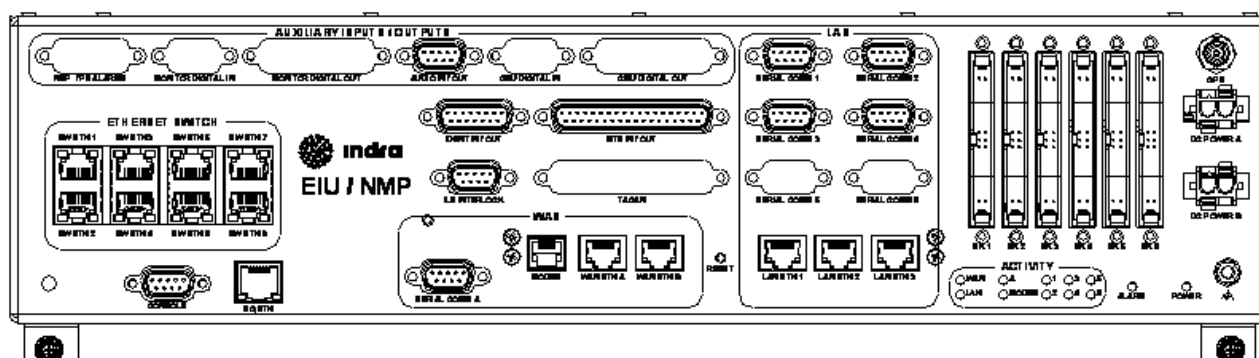


Figure 7.3.10.4-1. NMP/EIU ASSEMBLY

7.3.10.5 Front panel details

On the front panel, the NMP/EIU, apart from all interface connectors, has fourteen LEDs indicators. Figure 7.3.10.5-1 shows a diagram to identify all elements NMP/EIU front panel is composed of.

The NMP/EIU has, in its standar version, the following connectors, all accesible at the front panel:

- ò Interconnection and Power Supply area composed of 9 connectors as follows:
 - o 6 IDC 40p plug connectors [SK1 t oSK 6];
 - o 2 DC power supply connectors [DC A, DC B];
 - o 1 BNC connector for an optional GPS antenna.
- ò ETHERNET SWITCH area composed of 8 RJ45 connector to create the internal DME LAN;
- ò AUXILIARY INPUTS/OUTPUTS area composed as follows:
 - o 1 D-Sub 37p for SITE IN/OUT signals and alarms;
 - o 1 D-Sub 15p for IDENT IN/OUT funcionalities;
 - o 1 D-Sub 9p for ILS INTERLOCK funcionalities;
 - o 1 D-Sub 9p for AUDIO IN/OUT signals.
- ò LAN area:
 - o 4 D-Sub 9p (up to 6) for serial communications [COMM 1 to COMM 6].
 - o 3 RJ45 for ethernet network communications [LAN ETH 1 to ETH 3].
- ò WAN area:
 - o 1 RJ45 for standar network communications [WAN ETH A];
 - o 1 RJ11 for direct PTSN communications [MODEM];
 - o 1 D-Sub 9p for serial communications [COMM A].

The Auxiliary Input/Output connectivity can be extended upon customer request. For more information about this issue refer to Appendix C and D.

LEDs will be SMD, and will use light pipes to direct the light through the front panel, as follows:

- POWER [Blue]: indicates that the unit has power.
- ALARM [Red-Amber-Green]: indicates Primary and Secondary Alarm status; the LED will be red to indicate a Primary Alarm, amber to indicate a Secondary Alarm and green when no alarm is being asserted.
- ACTIVIVITY [Green]: indicating activity in the following situations:
 - WAN by ETH A, COMM A or MODEM ports;
 - LAN by ETH 1to3 or COMM 1 to COMM 6.

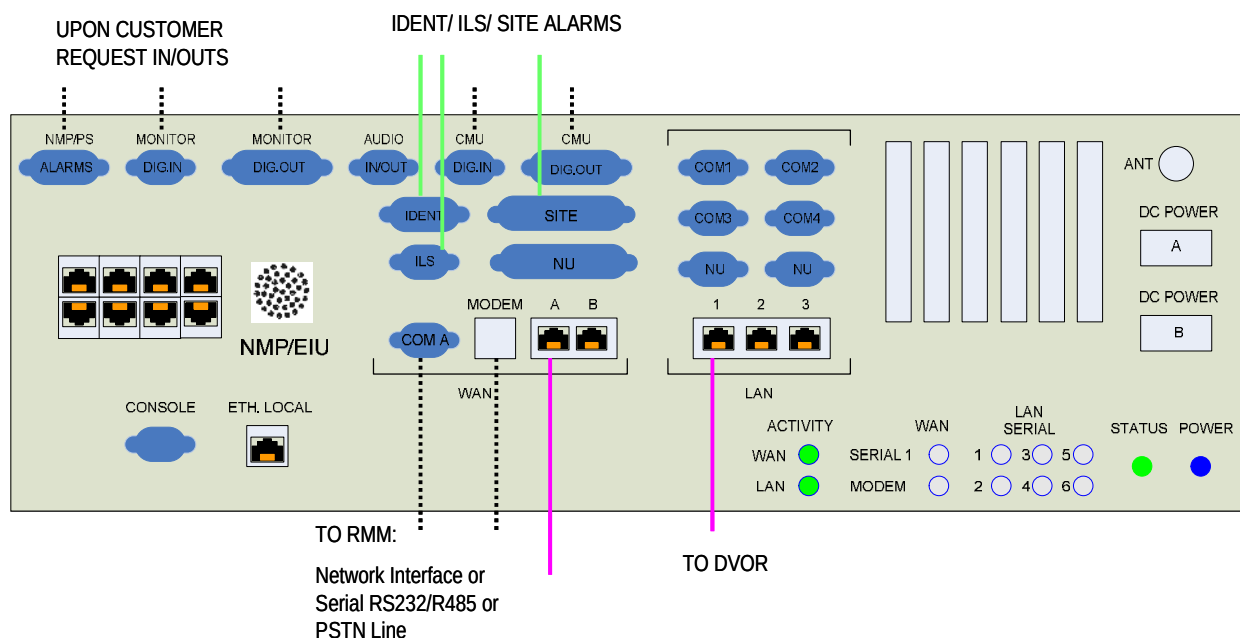


Figure 7.3.10.5-1. NMP/EIU FRONT PANEL

The NMP/EIU in its full wired version, upgrade the connectors accesible at the front panel as follows:

- AUXILIARY INPUTS/OUTPUTS area composed as follows:
 - 1 D-Sub 37p for AUXILIARY signals;
 - 1 D-Sub 15p for power supply monitoring functionalities;
 - 2 D-Sub 9p for remote control functionalities;
 - 2 D-Sub 25p for remote status monitoring functionalities.

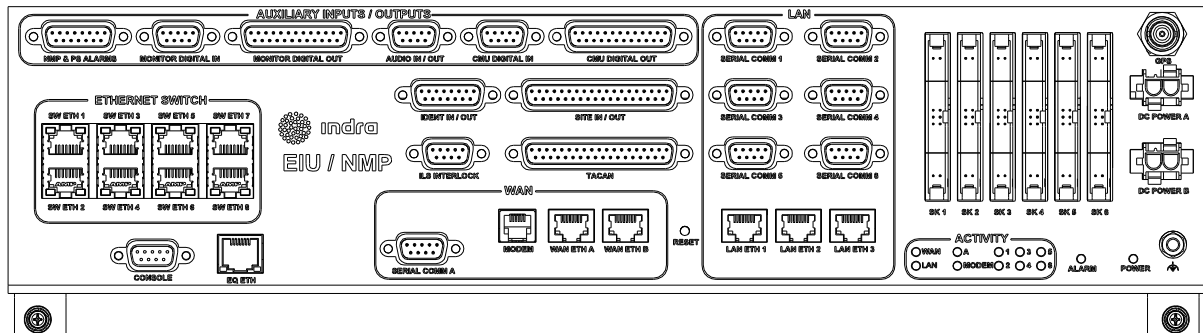


Figure 7.3.10.5-2. NMP/EIU ASSEMBLY FULL WIRED VERSION

7.3.10.6 Hardware Implementation and Schematics

The NMP/EIU module occupies the shelf behind the second PSU.

The NMP/EIU schematics are given in Appendix J of this handbook including the following drawings:

- ò 00634 3000 5300 for the NMP PBA;
- ò 00634 3000 5400 for the EIU PBA;
- ò 00634 3000 5500 for the Frontal PBA;
- ò 00634 3000 5600 for the EIU2 PBA.

8. CONFIGURATION AND VERIFICATION

This section contains detailed technical descriptions of the DME type LDB-103 at system, subsystem and module level, sufficient to support operation, adjustment and restoring service for the system

8.1 DEPOT PERFORMANCE CHECKS

8.1.1 Introduction

This section contains the alignment and testing procedures to be performed on an LDB-103 DME beacon when installed at a field site. These procedures are applicable to the alignment and checking of a DME immediately following installation, or for the periodic testing of a DME subsequent to its commissioning. The procedures assume that the DME is fully installed, with an antenna connected and with AC mains power applied to the equipment.

The DME rack should be in full working order before commencing final alignment (that is, free from any faults). If any faults are found in modules during these tests, then the defective unit should be replaced with a serviceable unit before the tests are continued.

The procedures described here mostly refer to a single DME transponder. For a dual beacon, the same series of procedures are performed on the second transponder, with some additional checks relating to the monitor and control system.

This section contains procedures applicable to two requirements:

1. **Testing procedures**, to be carried out during regular performance inspections of the DME. The abbreviated procedures forming the sub-set of checks that are applicable to equipment that previously has been aligned to the current operating channel.

These procedures are shown in normal (Helvetica) type.

2. **Alignment and testing procedures**, to be performed upon installation of the DME, for re-tuning the DME to a different operating channel, or after repair and replacement of a line-replaceable unit. For this application, the full procedures should be performed, including, as necessary, the detailed alignment procedures in Section 9.3.5.

The additional procedures required for full alignment are shown in italics.

For a comprehensive test of all aspects of the DME performance, refer to Section Section 8.1.

8.1.2 Test Equipment

The test equipment required to perform the procedures specified in this section is detailed in Section E.1.

8.1.3 General Requirements

Extensive use is made of the built-in test facility, located in the MTU, RCU and CMU modules. The operator should become familiar with its use and functions before commencing these procedures. Operation of the test facility is described in Section A.3.

Preset LMT software controls should not be touched unless the procedure contains instructions to do so.

CAUTION: NOTICES:	THE FOLLOWING PRECAUTIONARY REQUIREMENTS SHOULD BE OBSERVED AT ALL TIMES THROUGHOUT EQUIPMENT TESTING FAILURE TO OBSERVE THESE REQUIREMENTS MAY RESULT IN DAMAGE BEING CAUSED TO THE EQUIPMENT.
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Although the beacon includes protection to guard against excessive load mismatch, the transmitter must not be operated unless a suitable load is present at the **ANTENNA** output. The protection circuit is intended for accidental mismatching only.

The peak power from the transmitter is in excess of 1200 watts, which is too high for direct application to most test instruments. Therefore, care should be taken when connecting instruments to the transmitter output to ensure that a suitably rated attenuator or directional coupler is used to isolate the instruments from the high power.

Modules are all hot swappable so they can be removed or inserted with power applied.

Equipment repairs and tests should be performed only by personnel suitably qualified to the level of proficiency required by an equipment of this type and complexity.

8.1.4 Test Setup

LDB-103 series DME can be easily controlled via LCU module as a basic HMI for the operator or by means of the beacon Graphic User Interface (GUI) web page for extended control.

The PC computer is configured suitably for connection to the DUT's default IP address. This process is explained fully in the Appendix A.

8.1.4.1 Depot Test Benchs

Details of connections are given in Figure 8.1.4.1-1 and Figure 8.1.4.1-2.

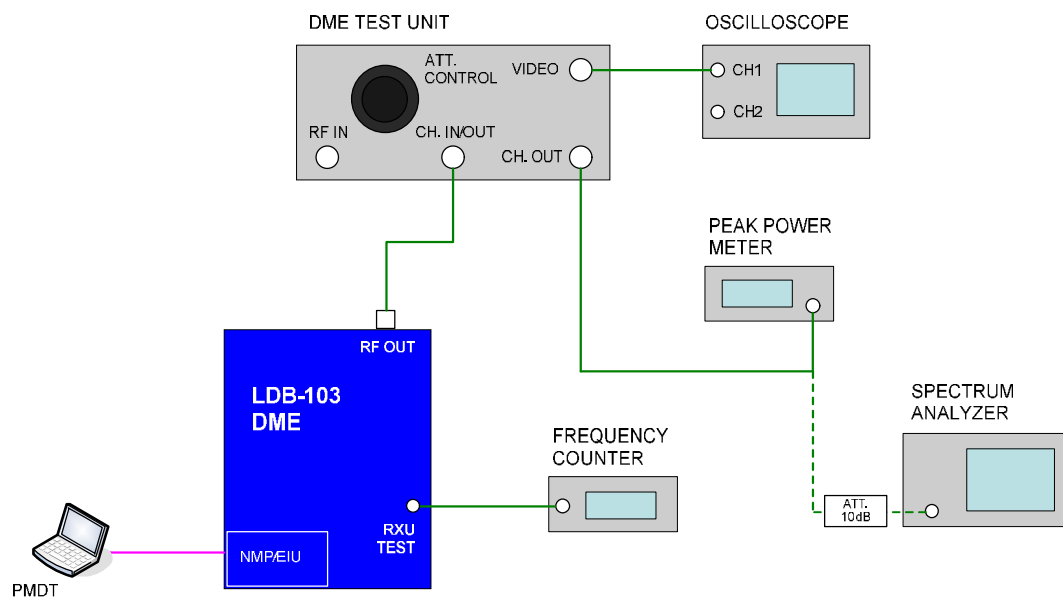


Figure 8.1.4.1-1. GENERAL DEPOT TEST BENCH I

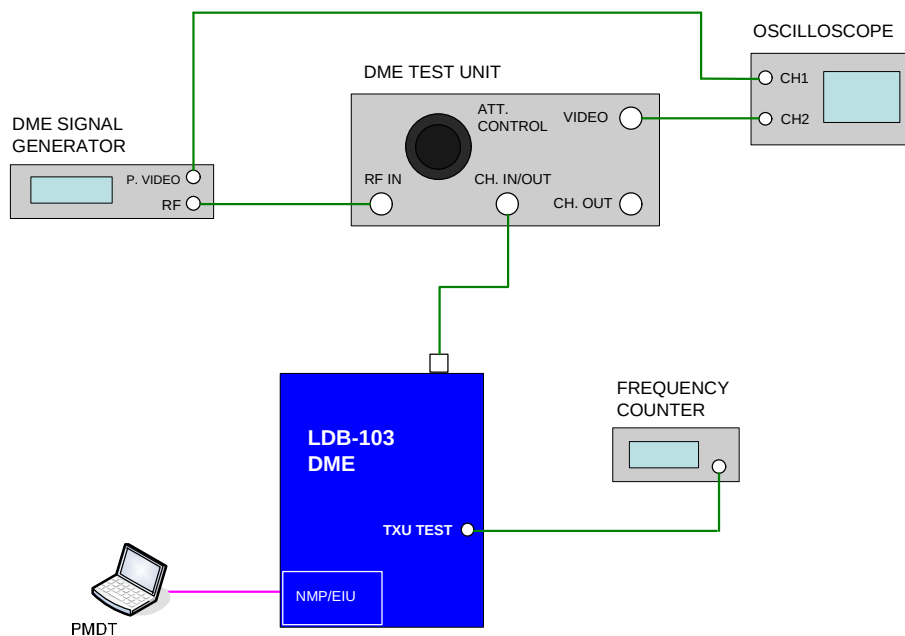


Figure 8.1.4.1-2. GENERAL DEPOT TEST BENCH II

8.1.5 Test Procedures

8.1.5.1 Mechanical checks

CONDITIONS:

N/A

PROCEDURE:

1. Check that the wired cabinet and all individual modules have been mechanically inspected as part of their own test procedures before being assembled into a complete rack.
2. Check that all sub-frames, those that are nominally 19" wide, are all correctly fitted.
3. Check that the module rear connectors are firmly fitted in their correct position, that their make-first-break-last pins are in correct location and that all press-in or solder joins are of satisfactory standard.
4. Check that all plug-in modules slide freely on their guides, that the connectors engage firmly and decisively to their connector sockets in the back plane and that they may be pushed fully home without hindrance.
5. Check that all modules are correctly aligned with their edges parallel to the vertical sides of the sub-rack frames.
6. Check that the module retaining screws align properly with the threaded holes in the nut strip.
7. Check that all brackets are securely fitted.
8. Check that the NMP/EIU and RFS assemblies are securely fitted.
9. Check the integrity of the cable looms for power, data signal and coaxial cabling system.
10. Check that there is no loose material accumulated in the grooves or angled tray. Check that there is no rattling noise emitted from the rack when it is reasonably shaken.
11. Check doors, side panels, hinges and latches for proper fitting and absence of deformity, scratches.

NOTES:

Record notes on main items in the Test Report

8.1.5.2 PSU Controller Operation

CONDITIONS:

N/A

PROCEDURE:

1. Plug the external AC supply into their respective socket.
2. Turn the AC switch ON for PSU1.
3. After a short delay, the rectifier modules turn on. Wait until the PSU performs the self-check.
4. Check LED indicators.
5. Check the LCD readout.
6. Configure a PC for communicating with the PSU1. The IP address of PSU1 is 10.6.0.139 / 255.255.255.0.
7. Connect the PC Ethernet port to the Local Access point of the rack.

8. Enter user name and password.
 - login: blank
 - password: 5678 for viewer - 1234 for administrator.
9. Verify that the PSU1, which is located at the higher location, is associated with the LHS equipment (front view).
10. Repeat steps 1 to 7 for PSU2 in a dual configuration. The IP address of PSU2 is 10.6.0.147 / 255.255.255.0.
11. Verify that the PSU2, which is located at the lower location, is associated with the RHS equipment /front view).

NOTES:

The distribution of the AC switches in the Power Distribution Bar is as follows:

- One on the RHS, associated with the top PSU1 for single DME or default Main equipment for Dual DME;
- One on the LHS, associated with the lower PSU2 for the default Stand-By equipment.

8.1.5.3 PSU Site Configuration

CONDITIONS:

N/A

PROCEDURE:

1. Connect the PC Ethernet port to the Local Access point of the rack. The IP address if PSU1 is 10.6.0.139.
2. Enter user name and password.
 - login: blank
 - password: 5678 for viewer - 1234 for administrator.
3. Select Rectifiers → Configure Rectifiers.
4. Check defaults values according to Appendix H.
5. Select Batteries → Configure Batteries - Battery properties
6. Check defaults values for the following parameters:
 - Battery Capacity
 - Temperature Coefficient
7. Select Batteries → Configure Batteries - Charge Current Control
8. Check defaults values for the following parameters:
 - Charge Current Limit.
9. Select Hardware - Configure Relays
10. Check defaults values and mapping for relays K1 to K4.
11. Configure and record those parameters specified as per work order for the particular site.
12. Repeat steps 1 to 11 for PSU2 in a dual configuration. The IP address of PSU2 is 10.6.0.147.

NOTES:

Procedure for Configuring Parameters for the PSU is given in the Equipment Hand Book.

Likely site specific parameters may include the following: Battery Capacity, Temperature Coefficient, Charge Current Limit, Contact Address etc.

8.1.5.4 PSU Operation**CONDITIONS:**

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the PSU1. Wait until the PSU performs the self-check.
3. Measure the voltage between the battery terminals (BATT1+ and BATT1-) located at the back of the cabinet. Verify that the voltages are as the specified float voltage. Use digital voltmeter.
4. Connect a computer web browser to the DUT. The default IP address is 10.6.0.132.
Login as factory setup:
 - username: *factorysetup*
 - password: *indra*
5. Using the GUI, select Status → PSU to check PSU1 consumption.
6. Repeat steps 2 to 4 for PSU2 and BATT2+ / BATT2- battery terminals in a dual configuration.
7. Power off both PSUs, PSU1 and PSU2.
8. Locate and disconnect terminal header P226 in the RHS Backplane (looking from the back).
9. Check for continuity between pins 1, 3 and 5 [V_{RF} group]; between pins 7 and 9 [V_{CTL} group] and between pins 2, 4, 6, 8 and 10 [GND]. Use a digital multimeter.
10. Check for isolation between V_{RF} and V_{CTL} groups and GND.
11. Repeat steps 7 to 9 for the LHS Backplane and terminal header P326 in a dual system.
12. Leave the equipments as they were before the test.

NOTES:

8.1.5.5 System Configuration

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Apply AC power to the PSU1. For Dual Configuration, apply AC power to both PSUs.
3. Power on the RHS System. First, the Control circuits, then RF circuits. For Dual Configuration, turn on both RHS and LHS systems.
4. Check and record Power Supply Voltages and Currents drawn.
5. Connect a computer web browser to the DUT. The default IP address is 10.6.0.132.
6. Login as factory setup:
 - username: *rest*
 - password: *nav*
7. Using the GUI, select Configuration → System to confirm the configuration settings.
8. Using the GUI, select Configuration → Installation to confirm the configuration settings.
9. Using the GUI, select Administration → Policies to confirm the configuration settings.
10. Leave the equipments as they were before the test.

NOTES:

1. "Alarm Inhibit" ignores alarms.
2. Alarm Delay set the time that elapses from occurrence of a monitor fault to registration of an alarm.

8.1.5.6 Transmission Frequency

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the equipment.
3. Connect a Frequency Counter to Pin 1 on the RXU Test Board
4. Measure the Frequency Counter reading and record the value multiplied by 5000.
5. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
6. Repeat for frequency set f_i if requested.
7. Leave the equipments as they were before the test.

NOTES:

1. The Transmission Frequency measured is the frequency from the OL divided by a fixed factor of 5000.
 2. Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.
- Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.7 Transmitted Spectrum

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the equipment.
3. Connect a Spectrum Analyzer at the CH. Out of the DME Test Unit
4. Configure the spectrum analyzer to display the spectrum for 2,5 MHz either side of the carrier.
 - Center Frequency = DME Channel
 - Span = 5 MHz
 - BW = 30 kHz.
5. Record the center frequency Amplitude
6. Measure and record the amplitude at $f_0 \pm 800$ KHz
7. Measure and record the amplitude at $f_0 \pm 2$ MHz

8. Configure the spectrum analyzer to display 10 MHz to 960 MHz and 1215 MHz to 1800 MHz as follows:
 - Start / Stop Frequency = 10 MHz / 960 MHz.
 - Start / Stop Frequency = 1215 MHz / 1800 MHz.
 - BW = 100 KHz.
9. Measure out of band spurious response.
10. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
11. Repeat for frequency set f_i if requested.
12. Leave the equipments as they were before the test.

NOTES:

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.8 Transmitted Output power

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the equipment.
3. Connect a Power Meter at the Sample output of the DME Test Unit.
4. Configure the Power Meter as follows:
 - Mode: Peak or pulse
5. Check the reading of the peak power meter.
6. Repeat for equipment set fitted at the RHS of the cabinet (for dual configuration).
7. Leave the equipments as they were before the test.

NOTES:

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.9 Reply Signal Characteristics

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the equipment.
3. Configure the Power Meter as follows:
 - Mode: Peak or pulse
4. Measure the pulse width of the 1st pulse at 50% of its amplitude
5. Measure the pulse width of the 2nd pulse at 50% of its amplitude.
6. Measure the rise time of 1st pulse.
7. Measure the rise time of 2nd pulse.
8. Measure the fall time of 1st pulse.
9. Measure the fall time of 2nd pulse.
10. Measure the space between the 1st and 2nd pulse
11. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
12. Repeat for frequency set f_i if requested.
13. Leave the equipments as they were before the test.

NOTES:

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.10 Reply Rate

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1
 2. Power on the equipment.
 3. Using the GUI, select Configuration → TXU to be sure the squitter transmission is enabled.
 4. Using the GUI, select Configuration → TXU to disable the Identification transmission.
 5. Connect the frequency counter to pin 18 of the TXU test connector.
 6. Check on the Frequency Counter that the TXP maintains a transmission rate of 775 ± 75 ppps.
 7. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
-

8. Repeat for frequency set f_i if requested.
9. Leave the equipments as they were before the test.

NOTES:

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.11 Reply Delay**CONDITIONS:**

N/A

PROCEDURE:

1. Connect the setup of Figure 8.3.4.1-1.
2. Power On the equipment.
3. Configure beacon in X Mode.
4. Connect the generator baseband Output to the channel 1 of the oscilloscope.
5. Connect Video output of the DME Test Unit to channel 2 of the oscilloscope.
6. Fix an output power of -60 dBm the DME Test Unit.
7. Configure the oscilloscope as follows:
 - Trigger: CH1.
 - Vertical Scale: 50 mV/div
 - Horizontal Scale: 10 μ s/div
8. Measure the reply delay between the 1st pulses on channel 1 and channel 2.
9. Configure beacon in Y Mode.
10. Measure the reply delay between the 1st pulses on channel 1 and channel 2.
11. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
12. Repeat for frequency set f_i if requested.
13. Leave the equipments as they were before the test.

NOTES:

At 50% amplitude points.

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.12 Identification Code

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the equipment.
3. Set the Ident Code to the standard letter for beacon testing, XP [· · _ / · _ _ ·].
4. Using the GUI, select Configuration → TXU to set the Identification mode to Continuous Keydown.
5. Configure the oscilloscope as follows:
 - Trigger: CH1
 - Vertical Scale: 50 mV/div
 - Horizontal Scale: 200 μ s/div
6. Check Ident Code LED in TXU and/or the audible output from the MTU for the Ident coded.
7. Check the Identification replies frequency on CH1.
8. Using the GUI, select Configuration → TXU to set the Identification control to Normal and Independent Mode.
9. Using the GUI, select Configuration → TXU to set dot length to 100 ms.
10. Check dot/dash and spaces length. Configure the oscilloscope with a Horizontal Scale of 1 s/div.
11. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
12. Repeat for frequency set f_i if requested.
13. Leave the equipments as they were before the test.

NOTES:

1. Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.
Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.13 Receiver Sensitivity

CONDITIONS:

N/A

PROCEDURE:

1. Connect the setup of Figure 8.1.4.1-2. GENERAL DEPOT TEST BENCH II Figure 8.1.4.1-2.
2. Power On the equipment
3. Using the GUI, select Configuration → TXU to disable the Squitter transmission.
4. Using the GUI, select Configuration → TXU to disable the transmission of Identification code.
5. Connect the frequency counter to pin 18 of the TXU test connector.
6. Set the the signal generator as follows:
 - Frequency = f_0 MHz.
 - Transmission Rate = 100 ppps.
 - Amplitude = calibrated
7. Fix an output power of -94 dBm the DME Test Unit.
8. Record the reading on the frequency counter.
9. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
10. Repeat for frequency set f_i if requested.
11. Leave the equipments as they were before the test.

NOTES:

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.14 Receiver Bandwidth

CONDITIONS:

N/A

PROCEDURE:

1. Connect the setup of Figure 8.1.4.1-2.
2. Power on the equipment
3. Using the GUI, select Configuration → TXU to disable the Squitter transmission.
4. Using the GUI, select Configuration → TXU to disable the transmission of Identification code.
5. Connect the frequency counter to pin 18 of the TXU test connector.
6. Set the the signal generator as follows:
 - Frequency = $f_0 \pm 100$ KHz.
 - Transmission Rate = 100 ppps.
 - Amplitude = calibrated.
7. Fix an output level ≥ 3 dB than Sensitivity value per FAT-013 in the DME Test Unit.
8. Record the reading on the frequency counter.
9. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
10. Repeat for frequency set f_i if requested.
11. Leave the equipments as they were before the test.

NOTES:

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.1.5.15 Filter Selectivity

CONDITIONS:

N/A

PROCEDURE:

1. Connect the setup of Figure 8.1.4.1-2.
2. Power on the equipment
3. Using the GUI, select Configuration → TXU to disable the Squitter transmission.
4. Using the GUI, select Configuration → TXU to disable the transmission of Identification code.
5. Connect the frequency counter to pin 18 of the TXU test connector.

SELECTIVITY FOR A 900 kHz SHIFT

6. Set the the signal generator as follows:
 - Frequency = $f_0 \pm 900$ KHz.
 - Transmission Rate = 100 ppps.
 - Amplitude = calibrated.
7. Fix an output level of -10 dBm in the DME Test Unit.
8. Check that the transponder does not reply at all.

INTERMEDIATE FREQUENCY REJECTION

9. Connect the oscilloscope to the *Video Low* output on the RXU front panel
10. Configure the oscilloscope as follows:
 - Trigger: CH1
 - Vertical Scale: 500 mV/div
 - Horizontal Scale: 5 μ s/div
11. Interrogate the DUT at the f_i [MHz] frequency and a level of -90 dBm.
12. Measure the voltage level on CH1 of the oscilloscope.
13. Interrogate the DUT at IF frequency increasing power level from -90 dBm.
14. Measure the voltage level on CH1 and record the value that equals the voltage in step 12.

IMAGE FREQUENCY REJECTION

15. Interrogate the DUT at the Image frequency increasing power level from -90 dBm.
16. Measure the voltage level on CH1 and record the value that equals the voltage in step 12.

SPURIOUS REJECTION

17. Set the the signal generator to a frequency $f_0 \pm 10$ MHz within the 962-1213 MHz range.
18. Interrogate the DUT increasing power level from -90 dBm.
19. Measure the voltage level on CH1 and record the value that equals the voltage in step 12.

NOT VALID PULSE REJECTION

20. Interrogate the DUT at the central frequency and a level of -70 dBm with pulses of 1.5 μ s width or less.
21. Check that the DME does not generate any reply.
22. Repeat steps for equipment set fitted at the RHS of the cabinet (for dual configuration).
23. Repeat for frequency set f_i if requested.
24. Leave the equipments as they were before the test.

NOTES:

IF [Intermediate Frequency] = 63 MHz.

Image Frequency = $LO \pm 63$ MHz.

Default frequency will be 1024 MHz or Site Frequency if It is known at this stage.

Test Frequencies f_i [MHz], where $i = 1 \dots 3$, can be extended to 962; 1086 [Site]; 1213;

8.2 VERIFICATION OF LRU PERFORMANCE

8.2.1 Introduction

8.2.1.1 Definition and Scope

A line replaceable unit is defined as the lowest-order subassembly that should be replaced during field maintenance to restore an equipment to service.

This section describes, for each line replaceable unit within the LDB-103 DME, the procedure to be followed to check the operational performance and characteristics of the unit. Such tests may typically be performed either to determine the degree of serviceability of a suspected faulty unit or to check the performance characteristics of a unit following repair.

All the tests and procedures within this section are designed to apply only with the two following prerequisite conditions:

1. That the unit to be tested is mounted in place of the existing equivalent unit in an operational equipment rack used as a test bed.
2. The supporting test equipment nominated for each procedure (and detailed in a consolidated list in Section E.3) or items having equivalent performance characteristics is available.

The Table 9.3-3 lists the equipment assembly/subassembly configuration.

8.2.1.2 DME Rack Operation

The LRU test procedures in this section require the availability of a fully functional DME rack, operating into a dummy load. For the operation and configuration of the rack, refer to the general operating instructions in Appendix A.

8.2.1.3 Test Equipment

A complete list of the test equipment and accessories required to conduct the range of test and alignment procedures for LRUs as specified in this section is contained in Appendix E.3. That list gives the required performance characteristics for each item of test equipment, and nominates a notional type (or types) which would be suitable for the range of procedures specified. The procedure for each LRU gives a summary list of test equipment items required.

It is assumed that the extenders, cables and other accessories contained in the DME Test and Accessory Kits, refer Appendix E, are available for all procedures; items contained in these kits are not repeated in the summary lists of items for each procedure.

8.2.2 Local Control Unit (LCU)

8.2.2.1 Test Equipment

Computer with browser

Digital Multimeter (DMM).

8.2.2.2 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 1 Mother Board.

8.2.2.3 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) to the unit.
2. Check front panel LED indicator: power.
3. Check LCU touch screen functionality and tab navigation.
4. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.3 Relay Control Unit (RCU)

8.2.3.1 Test Equipment

Computer with browser

Digital Multimeter (DMM).

8.2.3.2 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 1 Mother Board.

8.2.3.3 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) to the unit.
2. Check front panel LED indicator: power, polling, alarm.
3. Measure voltage rails available at Test Connector in the front panel. Verify that the voltages are within their allowable tolerance.
4. Check connectivity through LCU/CMU GUI. Perform a select MAIN command. Refer to Section 8.3.
5. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.4 Control & Monitor Module (CMU)

8.2.4.1 Function

The Control and Monitoring Unit (CMU) provides user access to all other units within the DME equipment. When the system is powered-up, it provides system calibration data. It does not contribute to signal generation and only contributes to configuration during setup.

The CMU contains a CPU that runs the Linux operating system residing on a standard industrial Single Board Computer (SBC). The file system for the operating system is based on a Compact Flash card. There is no a hard-drive.

8.2.4.2 Associated Documents

Refer to CMU hardware requirements specification (HRS) Indra code 00634200041000HR00.

Refer to CMU circuit schematics Indra code 0063430004100EQ00.

8.2.4.3 Test Equipment

Computer with browser

Oscilloscope

Digital Multimeter (DMM).

8.2.4.4 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 2 Mother Board LEFT/RIGHT.

8.2.4.5 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) supply to the unit.
2. Check front panel LED indicator: power, alarm, polling, sytem fault, network activity.
3. Measure voltage rails available at Test Connector in the front panel. Verify that the voltages are within their allowable tolerance.
4. Check connectivity through LCU/CMU GUI. Examine web page for absence of any anomalies. Refer to Section 8.3.
5. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.5 Monitor Module (MTU)

8.2.5.1 Function

The MTU performs three different functions:

- ò Antenna probe replies diagnostic and MORSE decoding.
- ò Replies monitoring where the monitor checks the Gaussian pulse pairs emitted by the transponder.
- ò Interrogation generation where the transponder is interrogated by test signals that simulate the air-to-ground interrogation.

8.2.5.2 Associated Documents

Refer to MTU hardware requirements specification (HRS) Indra code 0063420004200HR00.

Refer to MTU circuit schematics Indra code 006343004200EQ00.

8.2.5.3 Test Equipment

Computer with browser

Oscilloscope

Digital Multimeter (DMM).

8.2.5.4 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 2 Mother Board.

8.2.5.5 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) supply to the unit.
2. Check front panel LED indicator: power, alarm, monitor alarm, polling, interrogation, ident.
3. Measure voltage rails available at Test Connector in the front panel. Verify that the voltages are within their allowable tolerance.
4. Check connectivity through LCU/CMU GUI. Examine valid data and the absence of any anomalies. Refer to Section 8.3.
5. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.6 Receiver Module (RXU)

Computer with browser

Oscilloscope

Digital Multimeter (DMM).

8.2.6.1 Function

The RXU unit performs the following functions:

- ò Frequency tuning according to the selected DME channel.
- ò Amplification and down-conversion for post-processing at an IF of 63 MHz.
- ò Rejection of undesired signals - spurious, adjacent channel and image frequencies -.
- ò Local Oscillator generation used for both reception and transmission chains.
- ò Pulse detection.
- ò Pilot pulse generation for transmitter main delay self calibration purposes.
- ò Automatic sensitivity control in function of the measured load of the beacon.

8.2.6.2 Associated Documents

Refer to RXU hardware requirements specification (HRS) Indra code 0063420004300HR00.

Refer to RXU circuit schematics Indra code 006343004300EQ00.

8.2.6.3 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 2 Mother Board .

8.2.6.4 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) to the unit.
2. Check front panel LED indicator: power, alarm, polling, detection.
3. Measure voltage rails available at Test Connector in the front panel. Verify that the voltages are within their allowable tolerance.
4. Check detected video level at BNC connector in the front panel.
5. Check connectivity through LCU/CMU GUI. Examine valid data and the absence of any anomalies. Refer to Section 8.3.
6. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.7 Transmitter Module (TXU)

8.2.7.1 Test Equipment

Computer with browser

Oscilloscope

Digital Multimeter (DMM).

50 Ohm Load. 20W average, 200W peak

8.2.7.2 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 2 Mother Board.

8.2.7.3 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) to the unit.
2. Check front panel LED indicator: power, alarm, polling, tx mode, ident, tx_enable.
3. Measure voltage rails available at Test Connector in the front panel. Verify that the voltages are within their allowable tolerance.
4. Check connectivity through LCU/CMU GUI. Examine valid data and the absence of any anomalies. Refer to Section 8.3.
5. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.8 High Power Amplifier (HPA)

8.2.8.1 Test Equipment

Computer with browser

Oscilloscope

Digital Multimeter (DMM).

50 Ohm Load. 200W average, 2kW peak

8.2.8.2 Setup and Alignment

Check for absence of short circuit at the unit's power input pins.

Plug unit under test into the Subrack 2 Mother Board LEFT/RIGHT.

8.2.8.3 Test Procedure

1. Apply raw nominal +24VDC (+27.25VDC) to the unit.
2. Check front panel LED indicator: power, alarm, polling, tx_enable.
3. Measure voltage rails available at Test Connector in the front panel. Verify that the voltages are within their allowable tolerance.
4. Check connectivity through LCU/CMU GUI. Examine valid data and the absence of any anomalies. Refer to Section 8.3.
6. Verify that total current drain is less than 5 Amperes at squitter rate.

8.2.9 Power Supply Unit (PSU)

8.2.9.1 Test Equipment

Computer with browser

Oscilloscope.

Digital Multimeter (DMM).

8.2.9.2 Setup and Alignment

Connect AC source to the PSU.

Establish network connection with the PSU web page.

Verify / Configure the PSU as per Specification

8.2.9.3 Test Procedure

1. Establish power connection to the PSU with no load.
2. Check connectivity through LCU/CMU GUI. Examine valid data and the absence of any anomalies. Refer to Section 8.3.
3. Verify that current drain without load is less than 0.5 Amperes.
4. Verify that current drain with CTRL breaker on is less than 2 Amperes.
5. Verify that total current drain with CTRL and RF breakers on is less than 5 Amperes at squitter rate.

8.2.10 Network Management Processor/External Interface Unit (NMP/EIU)

8.2.10.1 Test Equipment

Computer with browser

Oscilloscope.

Digital Multimeter (DMM).

8.2.10.2 Setup and Alignment

Connect DC sources to the NMP/EIU module.

8.2.10.3 Test Procedure

1. Check front panel LED indicator: power, alarm, LAN activity, WAN activity.
2. Check LAN network connectivity with the NMP/EIU web page. Verify valid data and settings as site specification. Refer to Section 8.3.
3. Check WAN network connectivity to CMUs.

4. Check keyer input/output signal.

8.3 FIELD PERFORMANCE CHECKS

8.3.1 Introduction

This section contains the alignment and testing procedures to be performed on an LDB-103 DME beacon when installed at a field site. These procedures are applicable to the alignment and checking of a DME immediately following installation, or for the periodic testing of a DME subsequent to its commissioning. The procedures assume that the DME is fully installed, with an antenna connected and with AC mains power applied to the equipment.

The DME rack should be in full working order before commencing final alignment (that is, free from any faults). If any faults are found in modules during these tests, then the defective unit should be replaced with a serviceable unit before the tests are continued.

The procedures described here mostly refer to a single DME transponder. For a dual beacon, the same series of procedures are performed on the second transponder, with some additional checks relating to the monitor and control system.

This section contains procedures applicable to two requirements:

3. **Testing procedures**, to be carried out during regular performance inspections of the DME. The abbreviated procedures forming the sub-set of checks that are applicable to equipment that previously has been aligned to the current operating channel.

These procedures are shown in normal (Helvetica) type.

4. **Alignment and testing procedures**, to be performed upon installation of the DME, for re-tuning the DME to a different operating channel, or after repair and replacement of a line-replaceable unit. For this application, the full procedures should be performed, including, as necessary, the detailed alignment procedures in Section 9.3.5.

The additional procedures required for full alignment are shown in italics.

For a comprehensive test of all aspects of the DME performance, refer to Section 8.1.

8.3.2 Test Equipment

The test equipment required to perform the procedures specified in this section is detailed in Section E.1.

8.3.3 General Requirements

Extensive use is made of the built-in test facility, located in the MTU, RCU and CMU modules. The operator should become familiar with its use and functions before commencing these procedures. Operation of the test facility is described in Section A.3.

Preset LMT software controls should not be touched unless the procedure contains instructions to do so.

CAUTION: NOTICES:	THE FOLLOWING PRECAUTIONARY REQUIREMENTS SHOULD BE OBSERVED AT ALL TIMES THROUGHOUT EQUIPMENT TESTING FAILURE TO OBSERVE THESE REQUIREMENTS MAY RESULT IN DAMAGE BEING CAUSED TO THE EQUIPMENT.
------------------------------	--

Although the beacon includes protection to guard against excessive load mismatch, the transmitter must not be operated unless a suitable load is present at the **ANTENNA** output. The protection circuit is intended for accidental mismatching only.

The peak power from the transmitter is in excess of 1200 watts, which is too high for direct application to most test instruments. Therefore, care should be taken when connecting instruments to the transmitter output to ensure that a suitably rated attenuator or directional coupler is used to isolate the instruments from the high power.

Modules are all hot swappable so they can be removed or inserted with power applied.

Equipment repairs and tests should be performed only by personnel suitably qualified to the level of proficiency required by an equipment of this type and complexity.

8.3.4 Test Setup

LDB-103 series DME can be easily controlled via LCU module as a basic HMI for the operator or by means of the beacon Graphic User Interface (GUI) web page for extended control.

The PC computer is configured suitably for connection to the DUT's default IP address. This process is explained fully in the Appendix A.

8.3.4.1 Field Test Benchs

Details of connections are given in Figure 8.3.4.1-1 including an alternative bench to measure directly transmitter output power.

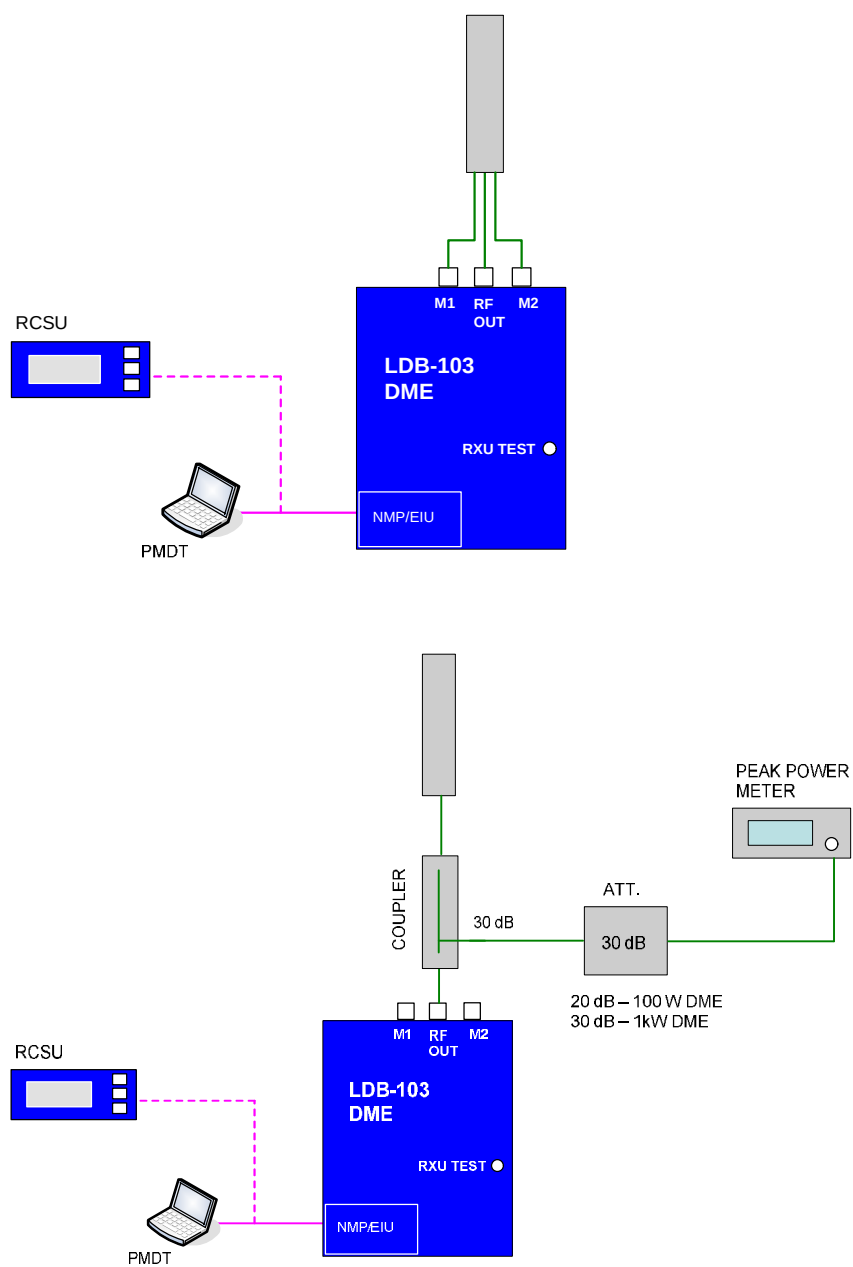


Figure 8.3.4.1-1. GENERAL FIELD TEST BENCH I

8.3.5 Test Procedures

8.3.5.1 Site Installation checks

CONDITIONS:

N/A

PROCEDURE:

1. Check that all the relevant items including those listed below have been satisfactorily attended to. Record notes on main items in the Test Report.
 - ò Site Clearance.
 - ò Reflectivity (as evidence by the design).
 - ò Antenna location (height, orientation, marking, etc.).
 - ò Installation of the Antenna.
 - ò Installation of RF cabling.
 - ò Installation of Earth stakes and earthing system..
2. Shelter construction (including floor): suitability for the purpose.
 - ò Layout of desk and chairs, telephone, power points, air conditioners, lighting, cabling inlets/ outlets.
 - ò Placement of equipment cabinet, connection to power source.
 - ò Earthing of equipment

NOTES:

Record notes on main items as listed in the Test Report

8.3.5.2 Mechanical checks

CONDITIONS:

N/A

PROCEDURE:

1. Check that the wired cabinet and all individual modules have been mechanically inspected as part of their own test procedures before being assembled into a complete rack.
2. Check that all sub-frames, those that are nominally 19" wide, are all correctly fitted.
3. Check that the module rear connectors are firmly fitted in their correct position, that their make-first-break-last pins are in correct location and that all press-in or solder joins are of satisfactory standard.
4. Check that all plug-in modules slide freely on their guides, that the connectors engage firmly and decisively to their connector sockets in the back plane and that they may be pushed fully home without hindrance.
5. Check that all modules are correctly aligned with their edges parallel to the vertical sides of the sub-rack frames.
6. Check that the module retaining screws align properly with the threaded holes in the nut strip.
7. Check that all brackets are securely fitted.

8. Check that the NMP/EIU and RFS assemblies are securely fitted.
9. Check the integrity of the cable looms for power, data signal and coaxial cabling system.
10. Check that there is no loose material accumulated in the grooves or angled tray. Check that there is no rattling noise emitted from the rack when it is reasonably shaken.
11. Check doors, side panels, hinges and latches for proper fitting and absence of deformity, scratches.

NOTES:

Record notes on main items in the Test Report

8.3.5.3 Power Supply Subsystem

CONDITIONS:

N/A

PROCEDURE:

PSU CONTROLLER OPERATION

1. Plug the external AC supply into their respective sockets. Turn ON the AC switch for the LHS.
2. After a short delay, the rectifier modules turn on. Wait until the PSU1 performs the self-check.
3. Check LED indicators. Check the LCD readout.
4. Configure a PC for communicating with the PSU1.
5. Connect the PC Ethernet port to the Local Access point of the rack.
6. Login PSU1 controller. Enter user name and password.
7. Verify that the PSU1, which is located at the higher location, is associated with the equipment fitted to the LEFT of the cabinet looking from the front.
8. Turn ON the AC switch for the RHS.
9. Repeat steps 2 to 6 for PSU2 in a dual configuration.
10. Verify that the PSU2, which is located at the lower location, is associated with the equipment fitted to the RIGHT of the cabinet looking from the front.

PSU SITE CONFIGURATION

11. Connect the PC Ethernet port to the Local Access point of the rack.
12. Login PSU1 controller. Enter user name and password.
13. Select Rectifiers → Configure Rectifiers.
14. Check defaults values according to Appendix H.
15. Select Batteries → Configure Batteries → Battery properties
16. Check defaults values for the following parameters:
 - Battery Capacity
 - Temperature Coefficient
17. Select Batteries → Configure Batteries → Charge Current Control

18. Check defaults values for the following parameters:
 - Charge Current Limit.
19. Select Hardware → Configure Relays
20. Check defaults values and mapping for relays K1 to K4.
21. Configure and record those parameters specified as per work order for the particular site.
22. Repeat steps 12 to 21 for PSU2 in a dual configuration.

PSU OPERATION

23. Ensure all PSUs breaker are in OFF state.
24. Measure the voltage between the battery terminals (BATT1+ and BATT1-) located at the back of the cabinet. Verify that the voltages are as the specified float voltage. Use digital voltmeter.
25. Turn ON the breaker designated as CTRL at circuit breaker located at PSU1.
26. Login PSU1 controller. Enter user name and password.
27. Verify on PSU1 GUI that delivered current is < 2 A and terminal voltage remains at the nominal value.
28. Turn ON the breaker designated as RF at circuit breaker located at PSU1.
29. Verify that for the delivered current is < 12 A and terminal voltage remains at the nominal value.
30. Repeat steps 23 to 29 for PSU2 in a dual configuration.

NOTES:

Likely site specific parameters may include the following:

Battery Capacity, Temperature Coefficient, Charge Current Limit, Contact Address etc.

Procedure for Configuring Parameters for the PSU is given in the Technical Manual, Appendix H.

The IP address of PSU1 is 10.6.0.139 / 255.255.255.0.

The IP address of PSU2 is 10.6.0.146 / 255.255.255.0.

PSU user name and password.

- login: blank

- password: 5678 for viewer - 1234 for administrator.

8.3.5.4 System configuration

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Apply AC power to the PSU1.
3. Power on PSU1 circuit breakers in the following sequence: First RF circuit; then CRTL circuit.
4. For a dual Configuration, repeat steps 2 and 3 for PSU2.
5. Connect a computer web browser to the DUT.
6. Login as factory setup:
 - username: *rest*
 - password: *nav*
7. Check general nav aids status and the absence of alarms on Status Bar.
8. Using the GUI, select Configuration → System to confirm the configuration settings.
9. Using the GUI, select Configuration → Installation to confirm the configuration settings.
10. Using the GUI, select Administration → Policies to confirm the configuration settings.
11. Check configuration data coherence on LCU general tab.
12. Attach screenshots to the test data sheets if required.
13. Leave the equipments as they were before the test.

NOTES:

The default IP address is 10.6.0.132 / 255.255.255.0 for master CMU.

8.3.5.5 Operating parameters

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1
2. Power on the equipment.
3. Connect a computer web browser to the DUT.
4. Login as factory setup:
 - username: *rest*
 - password: *nav*
5. Check general nav aids status and the absence of alarms on Status Bar.

6. Using the GUI, select Status → System, verify that all parameters are within their allowable tolerance.
7. Using the GUI, select Alarms → System, verify that there are no alarms present.
8. Repeat steps 6 and 7 for equipment set fitted at the RHS of the cabinet (for dual configuration).
9. Check data coherence on LCU General / Alarm tabs.
10. Attach screenshots to the test data sheets if required.
11. Leave the equipments as they were before the test.

NOTES:

The default IP address is 10.6.0.132 / 255.255.255.0 for master CMU.

Parameter alarms within allowable limits are indicated by a green background.

8.3.5.6 Monitor Functionality**CONDITIONS:**

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1
2. Power on the equipment.
3. Connect a computer web browser to the DUT.
4. Login as factory setup:
 - username: *rest*
 - password: *nav*
5. Check general nav aids status and the absence of alarms on Status Bar.
6. Using the GUI, select Status → MTUexec, verify all parameters are within their allowable tolerance.
7. Using the GUI, select Status → MTUautodiagnosis, verify all parameters are within their allowable tolerance.
8. Check data coherence on LCU General / Detailed / Alarm tabs.
9. Attach screenshots to the test data sheets if required.
10. Leave the equipments as they were before the test.

NOTES:

The default IP address is 10.6.0.132 / 255.255.255.0 for master CMU.

Parameters within allowable limits are indicated by a green background.

8.3.5.7 RMM & I/O Funcionalidad

CONDITIONS:

N/A

PROCEDURE:

1. Connect the test setup of Figure 8.3.4.1-1.
2. Power on the equipment.
3. Connect a computer web browser to the NMP/EIU LAN side.
4. Login NMP/EIU as factory setup:
 - username: *rest*
 - password: *nav*
5. Using GUI, select Status → Alarms, verify that all parameters are as expected.
6. Using GUI, select WAN → Ethernet, enable and configure IP WAN address.
7. Connect a computer web browser properly configured to the NMP/EIU WAN port.
8. Check connectivity loginning LDB-103 at WAN IP:34080.
9. Check connectivity, control capabilities and data coherence of a RCSU (when available/required)
10. Check the operability of the input ports KEYING 1 and KEYING 2 of IDENT IN/OUT connector.
11. Check the operability of the output ports KEYING 1 and KEYING 2 of IDENT IN/OUT connector
12. Leave the equipments as they were before the test.

NOTES:

The default NMP/EIU LAN side IP address is 10.6.0.97 / 255.255.255.0.

The default NMP/EIU WAN side IP address is 192.168.128.10 / 255.255.255.0.

CMU/ factory setup: [username: *rest* / password: *nav*]

8.3.5.8 Performance stability

CONDITIONS:

N/A

PROCEDURE:

1. Leave the equipment running continuously for 24 hours minimum (in auto mode for dual system) without intervention.
2. At the end of the period, inspect logging record for absence of primary alarms, re-starts and change-overs.
3. Attach logging record to the test data sheets if required.

NOTES:

The default IP address is 10.6.0.132 / 255.255.255.0 for master CMU.

8.3.5.9 Performance stability

CONDITIONS:

N/A

PROCEDURE:

1. Using the GUI, select Administration → Backup, save the configuration file in the equipment as well as in a computer.

NOTES:

Ensure sufficient information exists to identify the file, file name and date.

The default IP address is 10.6.0.132 / 255.255.255.0 for master CMU.

8.3.6 Typical screen snapshots

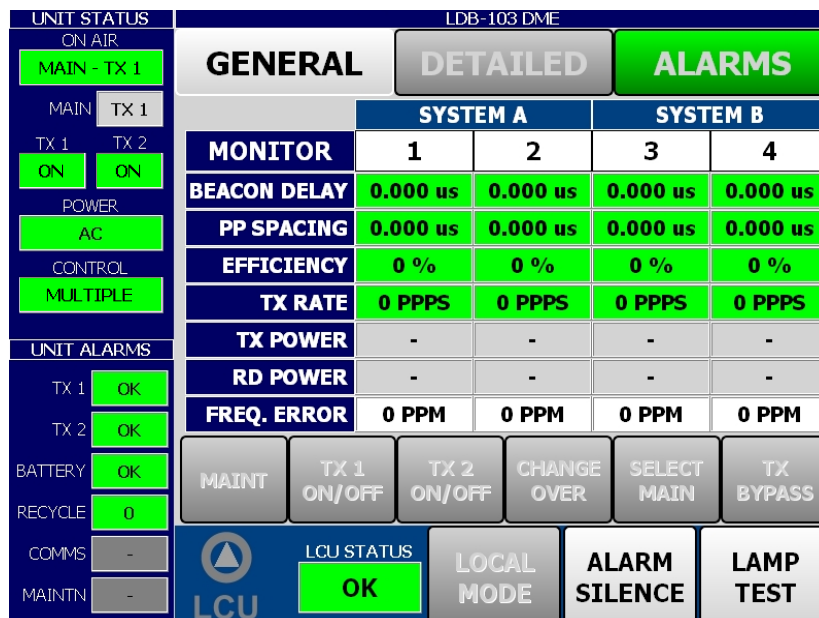


Figure 8.3.6-1. TYPICAL LCU SCREENSHOT - DUAL WARM CONFIGURATION

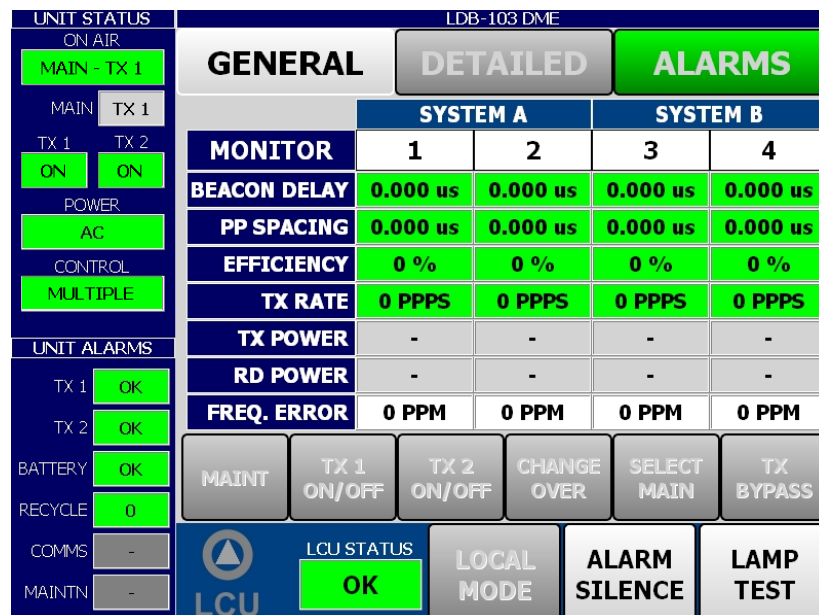


Figure 8.3.6-2. TYPICAL LCU SCREENSHOT - DUAL HOT CONFIGURATION

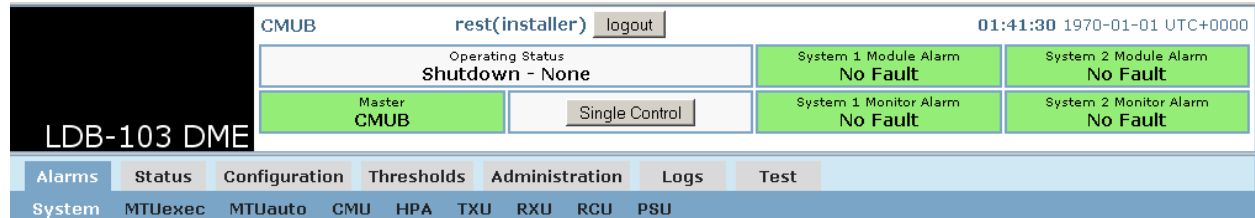


Figure 8.3.6-3. TYPICAL GENERAL STATUS BAR

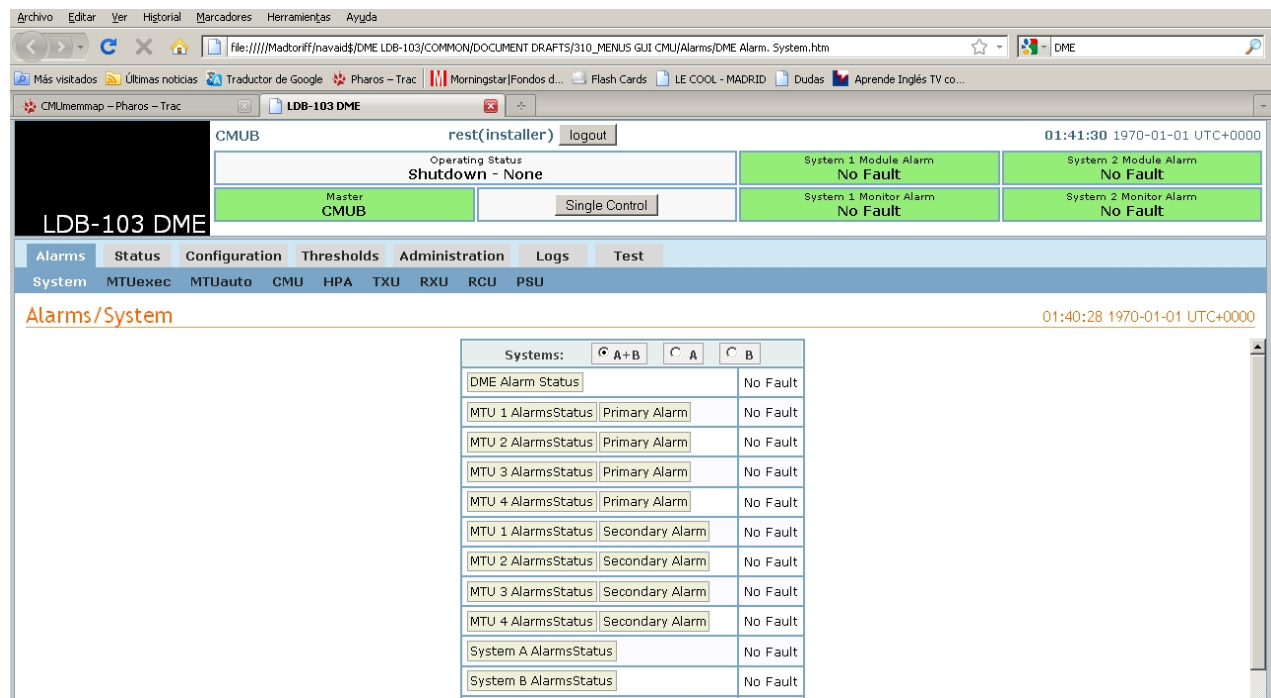


Figure 8.3.6-4. TYPICAL ALARMS → SYSTEM WEB PAGE

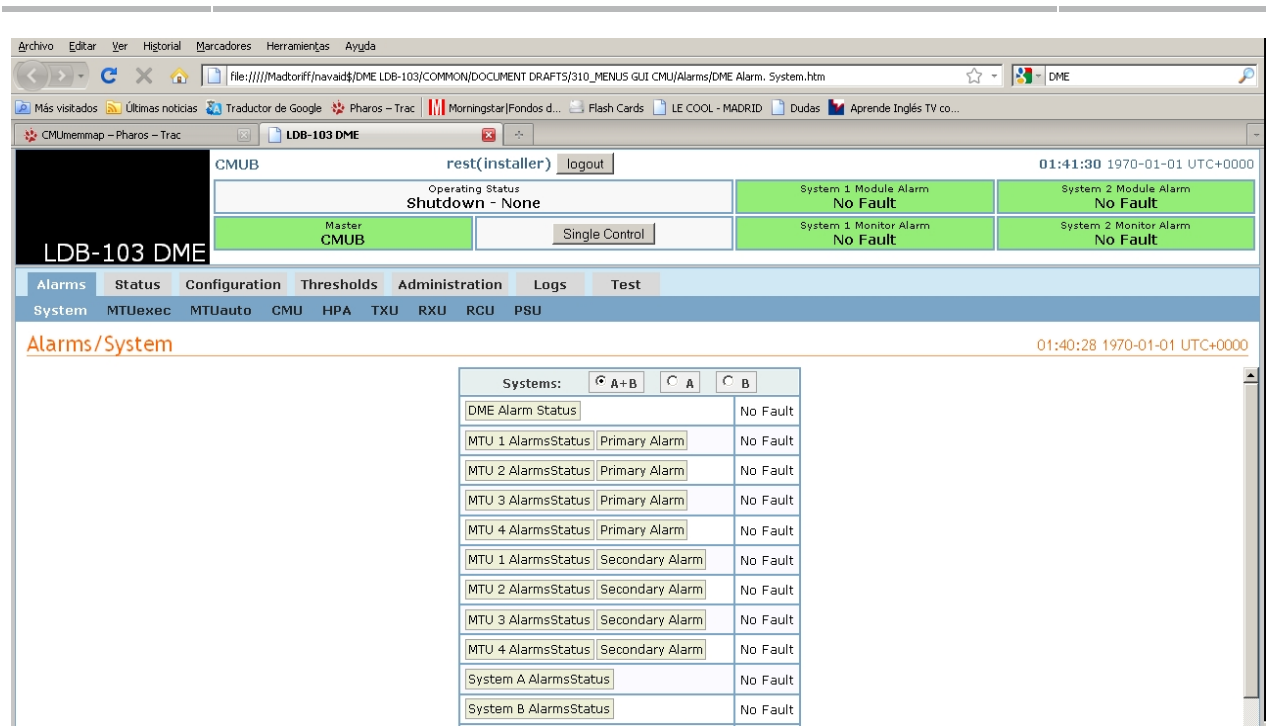


Figure 8.3.6-5. TYPICAL STATUS → SYSTEM WEB PAGE

8.4 BEACON ALIGNMENT

No alignment is needed to re-tune the LDB-103 DME to a different operating channel or after repair and replacement of a LRU.

Every module has its default valid configuration, although some parameters are site-dependant:

- ñ Cable losses.
- ñ Channel, Ident.
- ñ Echoes

All relevant controls accessible in Configuration → Installation. User with enough privileges can modify thresholds

MTU 1 Controls	Antenna Cable Losses	36.6 dB (0.0 – 150.0)	Apply
MTU 4 Controls	Antenna Cable Losses	35.8 dB (0.0 – 150.0)	Apply

Figure 8.4-1. CABLE LOSSES / ANTENNA COPULING SETTING

9. MAINTENANCE PROCEDURES

This section provides a general guidance for maintaining a DME installation. The recommended procedures are given with a view to match with maintenance period. As more experience is gained with the equipment, approved combinations of maintenance period with the associated maintenance procedure should produce optimum maintenance policy providing the correct level of assured serviceability.

9.1 INTRODUCTION

This section covers those topics related to the routine maintenance of a DME beacon as follows:

5. Routine Maintenance.

Section 9.2 contains fault location flow.

Section 9.3 contains instructions relating to the replacement of line placeable units (LRUs). This includes a list of recommended LRUs, removal instructions, and tests required following LRU replacement.

Section 9.4 comprises a table containing the waveforms and signals occurring at the various test points of a normal beacon.

Section 9.5 describes the test accessories supplied with the beacon.

9.2 FAULT LOCATION

According to the alarms double classification as Executive / BITE and Primary / Secondary, the uUser can locate an alarm in three ways:

- ò Front Panel;
- ò LCU;
- ò LMT/RMT.

9.2.1 Front Panel Fault Location

By means of the green/red leds on the modules front panels.

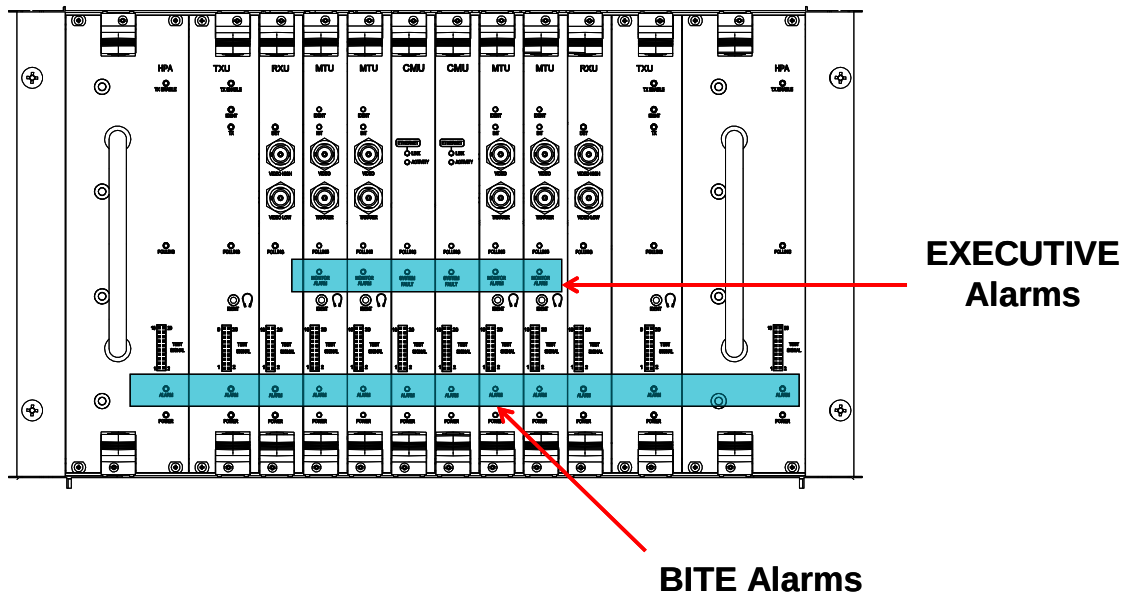


Figure 9.2.1-1. FRONT PANEL ALARMS LED INDICATIONS

9.2.2 LCU Fault Location

Using the LCU module the fault location flow is as follows:

- Ñ Step 1: ALARMS tab indication.
- Ñ Step 2: SELECT SYSTEM button.
- Ñ Step 3: Module selection and final fault location.

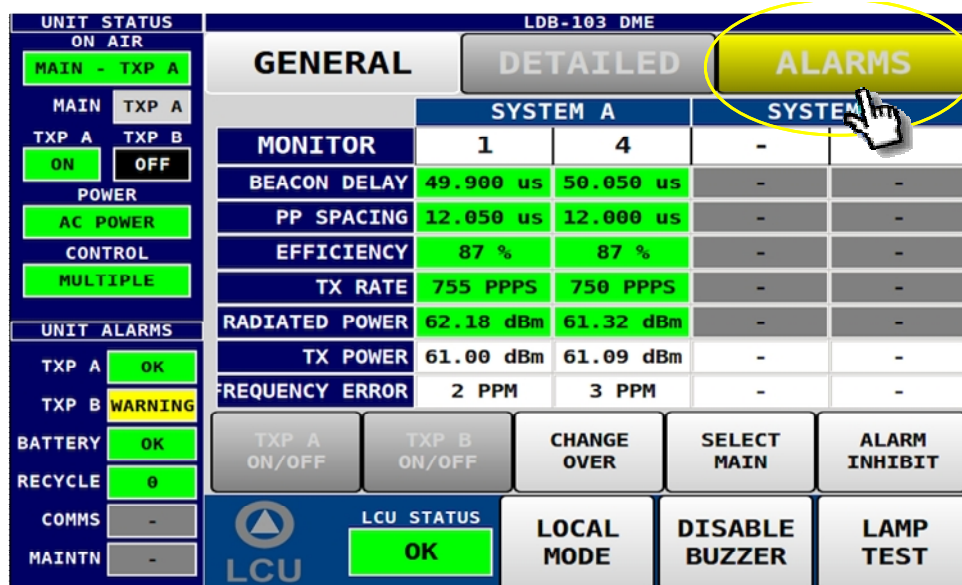


Figure 9.2.2-1. LCU FAULT LOCATION - STEP 1

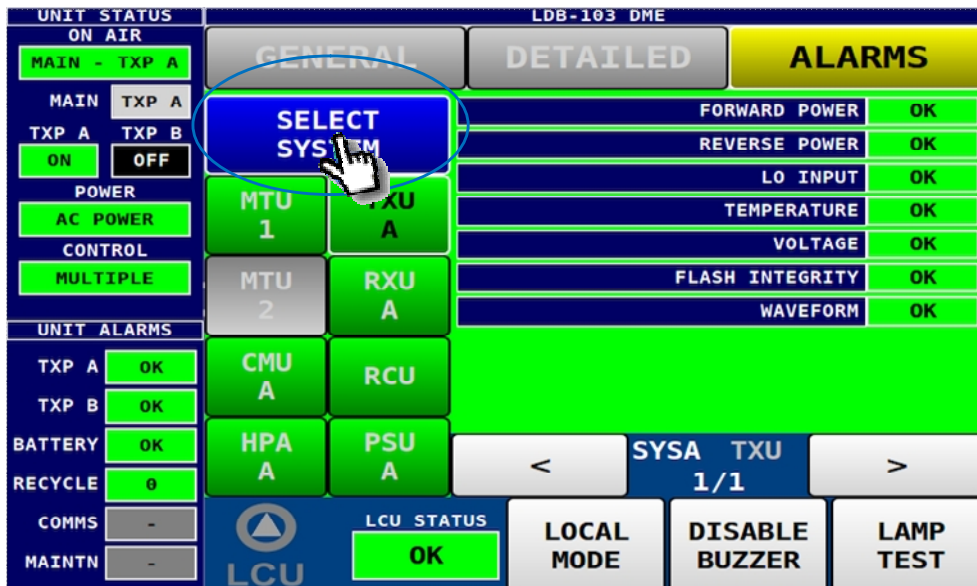


Figure 9.2.2-2. LCU FAULT LOCATION - STEP 2

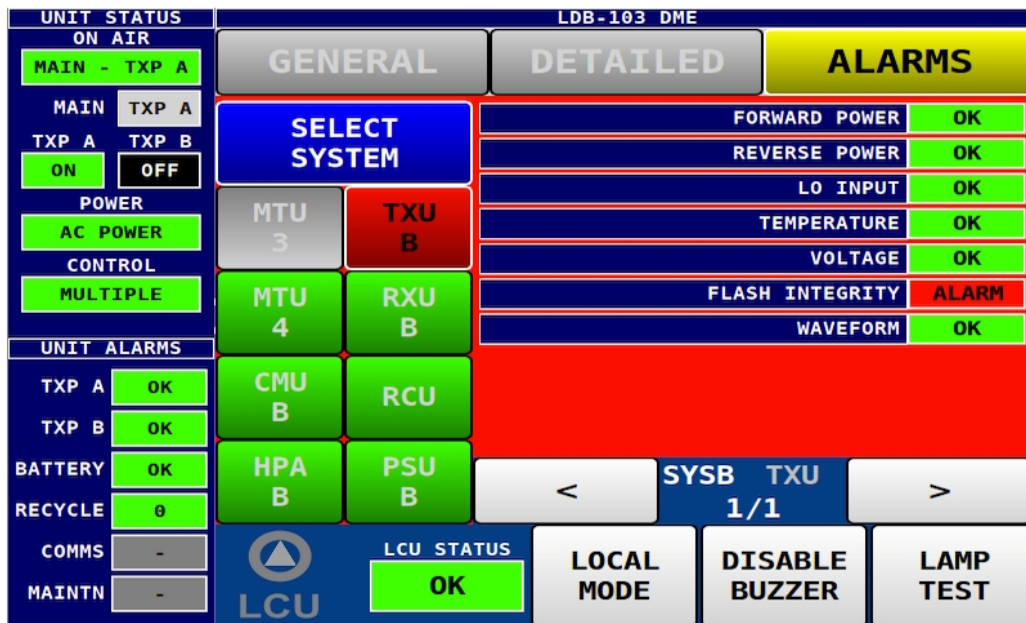


Figure 9.2.2-3. LCU FAULT LOCATION - STEP 3

In addition, the executive alarms are also checked in LCU general tab

The alarm detection flow for the executive signals is:

- Ñ Step 1: MTUs detect the Alarm condition.
- Ñ Step 2: Alarm source could be followed in ALARMS tab;
- Ñ Step 3: Changeover to Standby TXP.

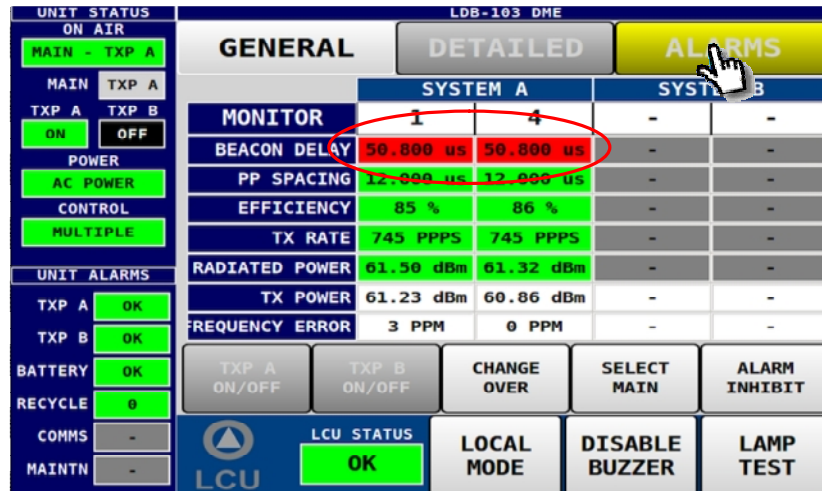


Figure 9.2.2-4. EXECUTIVE ALARM SIGNAL FLOW - STEP 1

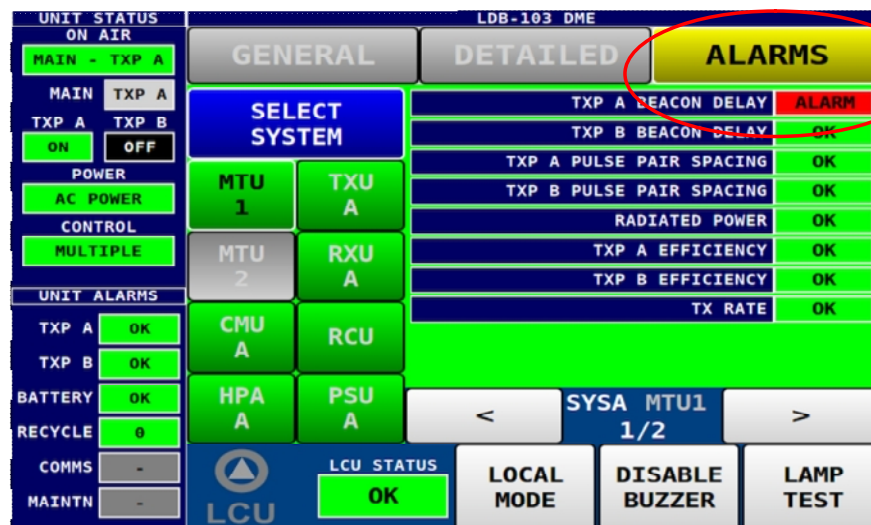


Figure 9.2.2-5. EXECUTIVE ALARM SIGNAL FLOW - STEP 2



Module alarm



Alarms

Status

Configuration

Thresholds

Administration

Logs

System

MTU Local

MTU Executive

MTU Autodiagnosis

CMU

HPA

TXU

RXU

RCU

PSU

Alarms/TXU

Systems:

☒ A+B
 ☐ A
 ☐ B

TXU A AlarmsStatus	Internal Voltage	No Fault
TXU B AlarmsStatus	Internal Voltage	Primary
TXU A AlarmsStatus	LO Input Power	No Fault
TXU B AlarmsStatus	LO Input Power	No Fault
TXU A AlarmsStatus	Forward Power	No Fault
TXU B AlarmsStatus	Forward Power	No Fault
TXU A AlarmsStatus	Reverse Power	No Fault
TXU B AlarmsStatus	Reverse Power	No Fault
TXU A AlarmsStatus	Temperature	No Fault
TXU B AlarmsStatus	Temperature	No Fault
TXU A AlarmsStatus	Flash Integrity	No Fault
TXU B AlarmsStatus	Flash Integrity	No Fault
TXU A AlarmsStatus	Polling	No Fault
TXU B AlarmsStatus	Polling	No Fault
TXU A AlarmsStatus	Waveform	No Fault
TXU B AlarmsStatus	Waveform	No Fault

Figure 9.2.3-2. LMT MODULE ALARM TABS

9.3 REPLACEMENT PROCEDURE FOR LINE REPLACEABLE UNITS

9.3.1 Introduction

This section contains information relating to the replacement of line replaceable units (LRUs) during field servicing. These LRUs are the modules or subassemblies that may be changed when faults occur in an operational beacon. Faulty units would normally be returned to a maintenance depot for repair. This section includes the following details:

- ò Section 9.3.2 contains a list of the recommended LRUs, and cross-referenced lists of modules and subassemblies, as an aid to identification of units.
- ò Section 9.3.3 contains removal/replacement instructions for LRUs.
- ò Section 9.3.4 contains guidance material to assist in the location of faulty units.
- ò Section 9.3.5 contains a list of the tests that are required following replacement of any LRU, and identifies the section of the handbooks in which each required test procedure is detailed.

9.3.2 Recommended Line Replaceable Units

This section lists the recommended line replaceable units required for the field servicing of a DME type LDB-103. Table 9.3.2-1 lists the LRUs for the equipment in single configuration while Table 9.3.2-2 lists those for the equipment in dual configuration.

The list of units includes all module assemblies that are considered to be LRUs and also some LRU sub-assemblies within a few modules that contain them. The criteria for selecting these LRUs are to optimise MTTR at the reasonable level of depot stocking.

The first table (Table 9.3.2-1) contains recommended LRUs for field servicing of a single DME installation. The list is necessarily longer than that of the dual equipment.

The second (Table 9.3.2-2) contains recommended LRUs for field servicing of a dual DME installation. As Dual Equipment contains duplicated set of modules, the standby set itself serves as the back-up in field service while the other unit is serviced.

The third table (Table 9.3-3) lists modules / subassemblies in configuration tree order of the unit identifier.

In all tables, the following apply:

- ñ The three-letter unit identifiers are shown thus - MTU.
- ñ Subassemblies contained within a main unit have the parent unit identifier shown in brackets, thus - [MTU].

Table 9.3.2-1: RECOMMENDED LRU SPARES FOR SINGLE DME (Qty. One each)

ASSEMBLY / SUBASSEMBLY

IDENTIFIER	NAME	TYPE No.
LCU	Local Control Unit	0063420003100
RCU	Relay Change-Over Unit	0063420003200
CMU	Control and Monitoring Unit	0063420004100
MTU	Monitor Transponder Unit	0063420004200
RXU	Receiver Unit	0066220004300
TXU	Transmitter Unit	0066220004400
HPA	High Power Amplifier	0066220004500
NMP/EIU	Network Management Processor/External Interface Unit	0066220006100

Table 9.3.2-2: RECOMMENDED LRU SPARES FOR A DUAL DME

ASSEMBLY / SUBASSEMBLY		
IDENTIFIER	NAME	TYPE No.
LCU	Local Control Unit	0063420003100
RCU	Relay Change-Over Unit	0063420003200
CMU	Control and Monitoring Unit	0063420004100
MTU	Monitor Transponder Unit	0063420004200
RXU	Receiver Unit	0066220004300
TXU	Transmitter Unit	0066220004400
HPA	High Power Amplifier	0066220004500
NMP/EIU	Network Management Processor/External Interface Unit	0066220006100
	Rectifier Module	0063420005500

Table 9.3-3: DME LDB-103 SYSTEM STRUCTURE

ITEM	REF.	LEVEL
DME LDB-103 SYSTEM	0063410000100.GG	EC
DME rack:	00634200001GG	-
DME Cabinet	0063420001000	-
DME RF Shelf [RFS]	0063420002000	LRU

Table 9.3-3: DME LDB-103 SYSTEM STRUCTURE

ITEM			REF.	LEVEL
		RFS PBA	0063430002000	
	Subrack 1 Mother Board		0063430003000	LRU
	Subrack 2 Mother Board		0063430005700	LRU
	Power Supply Unit Subrack [PSU]		0063420006200	LRU
	Rectifier Module		0063420005500	LRU
	Local Control Unit [LCU]		0063420003100	LRU
		LCU PBA	0063430003100	
	Relay Control Unit [RCU]		0063420003200	LRU
		RCU PBA	0063430003200	
	Subrack 1 Mother Board		0063430003000	LRU
	Control and Monitoring Unit [CMU]		0063420004100	LRU
		CMU PBA	0063430004100	
	Monitor Transponder Unit [MTU]		0063420004200	LRU
		MTU PBA	0063430004200	
		MTU Digital PBA	0063430004300	
	Receiver Unit [RXU]		0063420004300	LRU
		RXU PBA	0063430004400	
		RXU Digital PBA	0063430004500	
		Preselector Tunable Filter	0063420005700	
		Tunable Filter PBA	0063430003400	
	Transmitter Unit [TXU]		0063420004400	LRU
		TXU PBA	0063430004600	
		TXU Digital PBA	0063430004700	
	High Power Amplifier [HPA]		0063420004500	LRU
		HPA RF PBA	0063430004800	
		HPA Digital PBA	0063430004900	
		HPA Front PBA	0063430005000	
		HPA Power Supply PBA	0063430005100	
	Network Management Processor/External Interface Unit [NMP/EIU]		0063420006100	LRU
		NMP PBA	0063430005300	
		EIU PBA	0063430005400	
		Frontal PBA	0063430005500	
		EIU2 PBA	0063430005600	

Table 9.3-3: DME LDB-103 SYSTEM STRUCTURE

ITEM	REF.	LEVEL
DME antenna	0063420000300	EC
Installation Accessories	0063420000400	EC

9.3.3 Removal/Replacement Instructions for LRUs

9.3.3.1 Introduction

As listed in Table 9.3-3, modules generally contain an analog PBA which also generate the various supply voltage rails and a digital board. The HPA has a dedicated power supply PBA, the RXU has pre-selection filter and the digital board in the CMU is actually a Single Board Computer. Each unit has its own functional metal fitment.

The LCU and the RCU are housed in their own 3RU subrack (SubRack #1). The PSUs (qty 2 for dual system) have their own 2RU chassis but all other units are modules that slide into their position within the 6RU sub rack (SubRack #2).

Given the complexity in the assembling of the modules, it is recommended that their PBAs are not LRUs.

The LDB-103 then contains a number of line replaceable units (LRUs) which can be replaced during field servicing. Most of the units may be removed by using the procedures detailed in the section 9.3.3.2 below.

9.3.3.2 General Instructions

NOTE: These general instructions apply to all units for which special instructions are not specified. Units may be reassembled by reversing the order of actions used for their removal.

Separation of Modules from 3U or 6U Sub-Racks.

1. Loosen the captive retaining M2.5 screws. The HPA and the TXU have four retaining screws, all other modules have two each.
2. Disengage the module from the back plane by pressing the two levers outward: the top one upward and the bottom one downward.
3. Prepare to support the unit once it is out clear of the supporting subrack. Pull the unit out of the sub-rack, sliding on its guiding rails.
4. When refitting, be aware of the re-engagement of the multipin connectors at the back of the module to their counterparts in the back plane. Be sure to obtain a positive, firm plugging action.

WARNING: the HPA module weighs about 5 Kgs, and may be quite warm, prepare to support the unit when it is clear of the supporting subrack.

Separation of Module from Power Supply Unit.

The PSU has two LRUs: the Rectifier and the Circuit Breaker. For field serving purposes, the Controller is integrated to the PSU chassis

1. Loosen the captive retaining M4 screw. The Circuit Breaker has two retaining screws.
2. Prepare to support the unit once it is out clear of the supporting subrack. Pull the unit out of the sub-rack, sliding on its guiding rails.

WARNING: the rectifier modules weigh about 4 Kgs each, prepare to support the unit when it is clear of the supporting chassis.

9.3.4 Fault Location

A faulty DME beacon is serviced by replacing defective modules or subassemblies with corresponding operational spare units.

The following guidance information is given to assist technical personnel to locate a faulty module or subassembly after a beacon has shut down due to a failure. The four areas discussed below may be used either individually or in combination to isolate faulty units.

Ñ **System Block Diagrams.**

The block diagrams of the DME LDB-103 system the signal flow through the various subsystems. The block diagrams also indicate the divisions between modules and subassemblies, and the signal flow between them. By tracing a signal through a particular subsystem, aided by the block diagrams, the task of locating a faulty unit is simplified.

ò **Front Panel Test Jacks.**

Each DME LDB-103 module has a 20-way front panel test jack that allows easy checking of significant signals and voltages. In most cases, the information available at the test jacks is sufficient to determine if a module is functioning correctly.

A tabulation of test point signals is given in Section 9.4, showing the waveforms and voltages that should be found in a DME rack which is functioning normally. Comparison of the signals measured on the rack under test with those given in the table will help to isolate any faulty modules.

ò Alarm Register.

The LCU panel and the GUI includes a group of indicators via its web page to show which alarms are active or were present when a beacon was switched off. When technical personnel visits a beacon which has shut down due to a fault, the alarm register and sit logs should be examined before switching the beacon on again. The alarms indicated will show which parameters were out of tolerance, and this often suggests which subsystem is at fault.

ò Test Facility on the Graphic User Interface

The Test Facility in the STATUS page of the GUI allows the equipment to be put in a special test mode where a particular set of parameters is frozen so a specified measurement can be made. It also allows rapid access to measurements of the key beacon parameters, operational identities and the various regulated DC voltage rails. Refer to the appropriate test procedure in Section 9.3.5 to find the output level of the unit under test. Refer also to Section A.5 of Appendix A for operation of the Test Facility.

ò Adjustment

There is no hard wire adjustment in the LDB-103 DME that is recommended to be done in the field during maintenance visits. RF frequency may be checked to verify that it is within +/- 5ppm of the beacon frequency.

ò Refer to Appendix A for detailed exposition on fault identification activities during a site visit for any purpose, including routine and corrective maintenance.

9.3.5 LRU Replacement Tests

This section details the tests and/or adjustments required to be made to an operational beacon following the replacement of any module or subassembly. The information is presented in tabular form, as follows:

- ñ Column 1 lists the module or subassembly.
- ñ Column 2 contains a brief statement of the parameter or performance function required to be checked, or adjustments required to be made, as applicable.
- ñ Column 3 refers to the relevant section of this handbook where the detailed procedure for the required check, measurement, or adjustment may be found.

If any module or subassembly is replaced during servicing, then the procedures listed for that unit **MUST** be performed to restore the beacon to operational status. All other units in the beacon must be in normal working order.

Table 9.3.5-1: LRU REPLACEMENT TESTS

MODULE or SUBASSEMBLY	PARAMETER TO BE CHECKED or ADJUSTMENT TO BE MADE		REFER TO SECTION
0063420003100 Local Control Unit (LCU)	1	DC voltage rails at POWER LED	
	2	Tab navigation (touch screen functionality)	
	3	Control and data accuracy display - (connectivity)	
	4	Final check	
0063420003200 Relay Control Unit RCU	1	DC voltage rails at test jack	
	2	Connectivity Web Browser - LCU/CMU GUI	
	3	Switch Over activity	
	4	Alarm inhibit operation	
	5	Final check	

0063420004100 Control & Monitor Unit CMU	1	DC voltage rails at test jack	8.2.4
	2	Connectivity Web Browser - LCU/CMU GUI	
	3	Connectivity RJ45	
	4	Connectivity JTAG	
	5	Master/Slave switching	
	6	Down load system config file (for single DME)	
	7	Final check	
0063420004200 Monitor Transponder Unit MTU	1	DC voltage rails at test jack	8.2.5
	2	Connectivity Web Browser - LCU/CMU GUI	
	4	Set monitor signal levels	
	5	Set monitor level fault limits	
	6	Monitor Ident Detection	

Table 9.3.5-1: LRU REPLACEMENT TESTS

MODULE or SUBASSEMBLY		PARAMETER TO BE CHECKED or ADJUSTMENT TO BE MADE	REFER TO SECTION
	7	Final check	
0063420004300 Receiver Unit RXU	1	DC voltage rails at test jack	8.2.6
	2	Connectivity Web Browser - LCU/CMU GUI	
	3	LO sample at TP:1p	
	4	Change Mode	
	5	Change frequency	
	9	Final check	
0063420004400 Transmitter Unit TXU	1	DC voltage rails at test jack	8.2.7
	2	Connectivity Web Browser - LCU/CMU GUI	
	3	Change Mode	
	4	Change frequency	
	5	Ident Programming (Mode - chars)	
	6	Check power and pulse characteristics - LCU	
	7	Check spectrum (if 100 W model)	
	8	Final check	
0063420004500 High Power Amplifier HPA Module	1	DC voltage rails at test jack	8.2.8
	2	Connectivity Web Browser - LCU/CMU GUI	
	3	Check power and pulse characteristics - LCU	
	4	Check spectrum (id 1kW model)	
	5	Final check	

Table 9.3.5-1: LRU REPLACEMENT TESTS

MODULE or SUBASSEMBLY	PARAMETER TO BE CHECKED or ADJUSTMENT TO BE MADE		REFER TO SECTION
0063420004400 Power Supply Unit PSU	1	PSU connectivity - PSU or LCU/CMU GUI	8.2.9
	2	PSU Voltage	
	3	PSU Current	
	4	PSU configuration	
0063420006100 NMP/EIU Module	1	DC voltage rails at POWER LED	8.2.10
	2	LAN connectivity - NMP/EIU Web Browser	
	3	WAN connectivity - RMM - RCSU	
	4	Remote control and TeleSignalling	
	8	Final check	
0063420000300 DME Antenna	1	Verify coupling monitor paths	

9.4 TEST POINT SIGNALS

9.4.1 Introduction

This section contains a tabular listing of the typical waveforms and voltages that are found on many of the test points in a normal operating beacon. The tables include signals at all of the module front-panel test jacks, and signals at certain significant test pins inside the modules.

The test point signals in the table are intended to be used as a diagnostic aid to support the servicing of a beacon. By comparing the appropriate waveform or voltage with that in the table, information will be obtained which will help in locating a faulty module or subassembly.

To obtain the type number of any module or subassembly, refer to the cross-reference lists in Section 9.3.

9.4.2 Test Points and Waveforms

Test points are provided at the test port, a 20-way connector located at the front of each DME module.

Pin-out for the TP100 connector within each module is given in this manual and is also available on the GUI web page Test → <module>.

As all waveforms are digitally synthesized they are accessible only at I/O ports of some amplifiers and analog filters. As a result, test parameters available at test port TP100 for most modules are principally values of voltage rails and digital status of functional identities such as PLL locks etc.

Relevant waveforms whose appearances in shapes and magnitudes, should ensure proper operational status for the beacon. The actual waveforms shown include the following:

- ò MTU TRIGGER and VIDEO signal ;
- ò MTU local oscillator DIVIDED_FREQ;
- ò MTU INT FRAME TRIGGERS, PULSE DETECTION and REPLY DETECTION;

- ò RXU VIDEO;
- ò OL_SAMPLE;
- ò RXU INT DETECTION and PULSE DETECTION;

- ò SQUITTER REPLIES pulses;
- ò ALL REPLIES pulses;
- ò IDENT envelope.

Instrumentation for viewing and normalized amplitude of these waveforms provide indications for operational status of the equipment.

9.4.2.1 LCU Test Connector

N/A

9.4.2.2 RCU Test Connector

Table 9.4.2.2-1 lists RCU test connector pin allocation.

Table 9.4.2.2-1: RCU TEST CONNECTOR ALLOCATION

PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1	N/U	11	+5V
2	GND	12	+3.3V
3	N/U	13	+24B_CTRL
4	+2.5V	14	+24A_CTRL
5	N/U	15	+4.1V
6	+2.5V	16	N/U
7	+1.2V	17	N/U
8	VRLY (12V)	18	N/U
9	N/U	19	N/U
10	+24V_COMMON	20	GND

9.4.2.3 CMU Test connector

Table 9.4.2.3-1 lists CMU test connector pin allocation.

Table 9.4.2.3-1: CMU TEST CONNECTOR ALLOCATION

PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1	AGND	11	+24V
2	N/U	12	+5V
3	N/U	13	+3.3V
4	N/U	14	SPARE
5	N/U	15	+4.1V
6	AGND	16	N/U
7	PGOOD	17	N/U
8	+1.2V	18	N/U
9	+2.5V	19	N/U
10	+24V_RAW	20	AGND

9.4.2.4 MTU Test connector

Table 9.4.2.4-1 lists MTU test connector pin allocation.

Table 9.4.2.4-1: MTU TEST CONNECTOR ALLOCATION

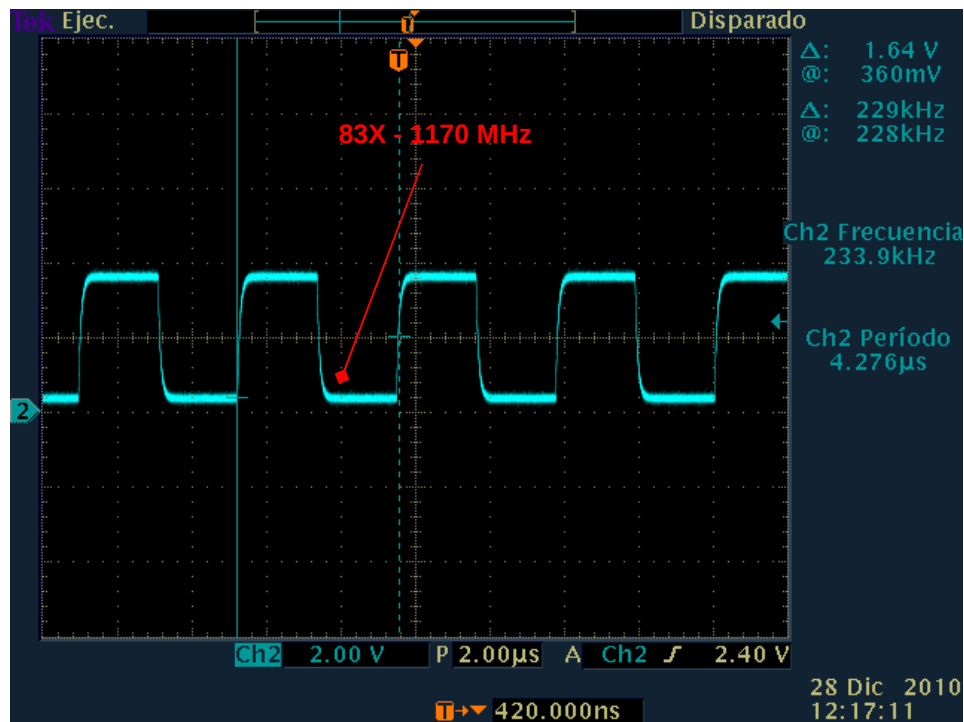
PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1	+24V_CTL	11	AGND
2	+24V_RF	12	VIDEO_ANTENNA_PROBE_TEST
3	AGC_CTRL_TEST	13	DIVIDED_FREQ
4	+5V_ANALOG	14	MOD_CTRL_TEST
5	+12V	15	INT FRAME TRIGGERS
6	-5V	16	PULSE DETECTION
7	+5V_DIG	17	REPLY DETECTION
8	+3.3V_DIG	18	REPLY GATE
9	+2.5V_DIG	19	N/U
10	+1.2V_DIG	20	DGND

9.4.2.5 RXU Test Connector

Table 9.4.2.5-1 lists RXU test connector pin allocation.

Table 9.4.2.5-1: RXU TEST CONNECTOR ALLOCATION

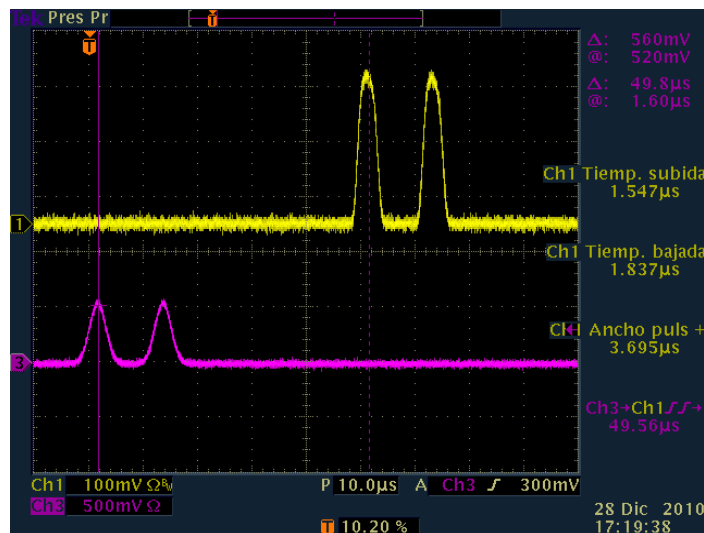
PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1	OL_SAMPLE	11	AGND
2	PGOOD	12	+3.3V_DIG
3	VIDEO_CH1	13	+3.3V_A
4	SPARE_1	14	+5V_DIG
5	INT DETECTION	15	+5V_A
6	PULSE DETECTION	16	+12V
7	SPARE_OUT3	17	+24V_CTL
8	+2.5V_TEST	18	+24V_RF
9	+1.2V_TEST	19	+28V
10	+3.3V_TEST	20	DGND



233,99962 kHz

PIN 1 - RXU TEST CONNECTOR [OL divided by 5000]

FREQ. COUNTER



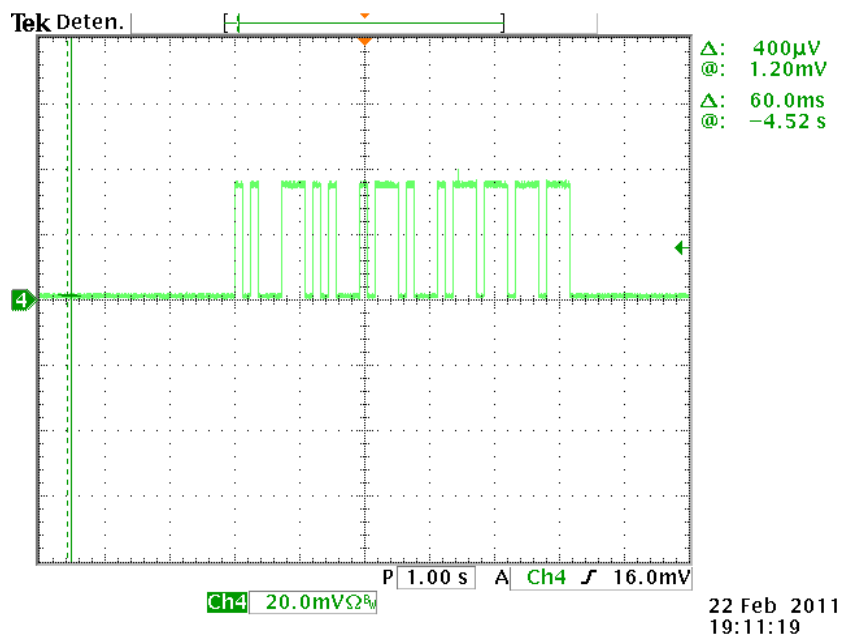
PIN 5 - RXU TEST CONNECTOR [INTERROGATION DETECTION]

9.4.2.6 TXU Test Connector

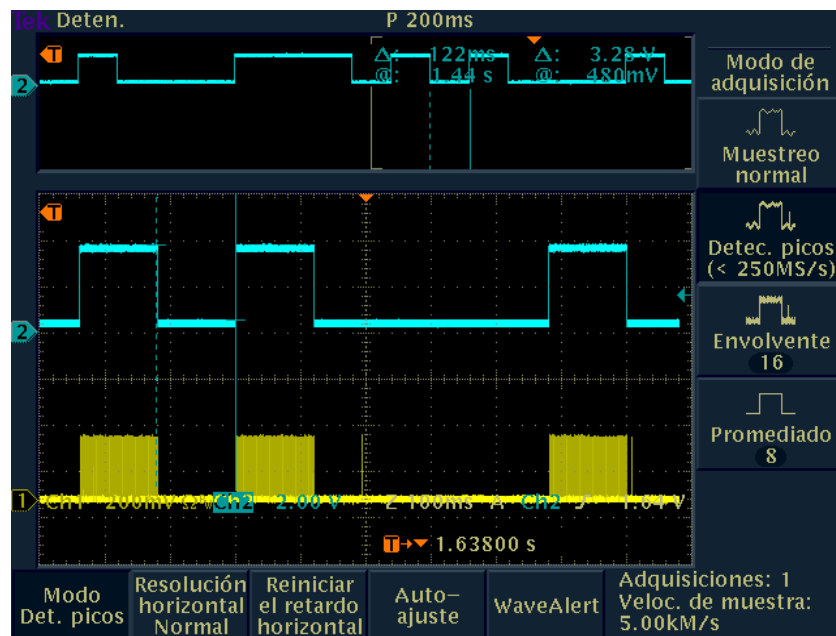
Table 9.4.2.6-1 lists TXU test connector pin allocation.

Table 9.4.2.6-1: TXU TEST CONNECTOR ALLOCATION

PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1	+24V_CTL	11	AGND
2	+24V_RF	12	VDETECT_RF_FWD
3	+48V	13	PULSE_GATE
4	+5VA	14	DETECT_IN
5	+12VA	15	TX_GATE
6	-5VA	16	SQUITTER REPLIES
7	+5V_DIG	17	IDENT ENVELOPE
8	+3.3V_DIG	18	ALL REPLIES
9	+2.5V_DIG	19	N/U
10	+1.2V_DIG	20	N/U



PIN 17 - TXU TEST CONNECTOR [IDENT ENVELOPE]



200 ms/div snapshot

PIN 17 - TXU TEST CONNECTOR [IDENT ENVELOPE]

[DOT/DASH Length]

9.4.2.7 HPA Test Connector

Table 9.4.2.7-1 lists HPA test connector pin allocation.

Table 9.4.2.7-1: HPA TEST CONNECTOR ALLOCATION

PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1	+24V_CTRL	11	GND
2	+24V_RF	12	VDETECT_RF_IN_TEST
3	+48V	13	VDETECT_RF_FWD_TEST
4	+5V	14	VDETECT_RF_REV_TEST
5	-5VA	15	CTRL_GATE_TEST
6	NO CONNECT	16	TX_GATE_TEST
7	+3.3V	17	N/C
8	+3.3V_DIG	18	N/C
9	+2.5V_DIG	19	N/C
10	+1.2V_DIG	20	GND

9.4.2.8 Low Power DME Pulse Characteristics

Typical Low Power Pulses Characteristics Figure 9.4.2.8-1 and Figure 9.4.2.8-2 show typical reply pulses response for a low power LDB-103.

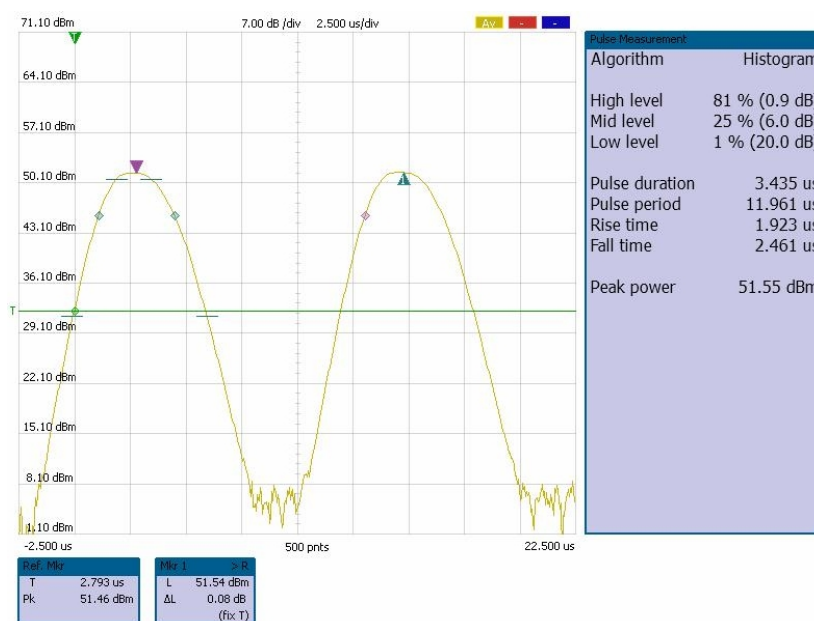


Figure 9.4.2.8-1. LOW POWER PULSES CHANNEL 1X - 962 MHz

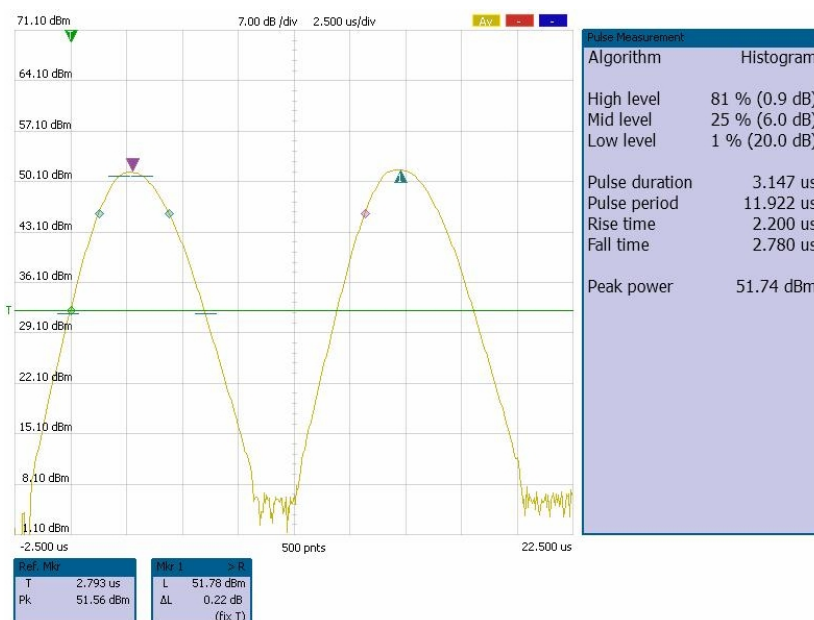


Figure 9.4.2.8-2. LOW POWER PULSES CHANNEL 126X - 1213 MHz

9.4.2.9 High Power DME Pulse Characteristics

Typical High Power Pulses Charateristics Figure 9.4.2.8-1 and Figure 9.4.2.9-2 show tipical reply pulses responde for a high power LDB-103.

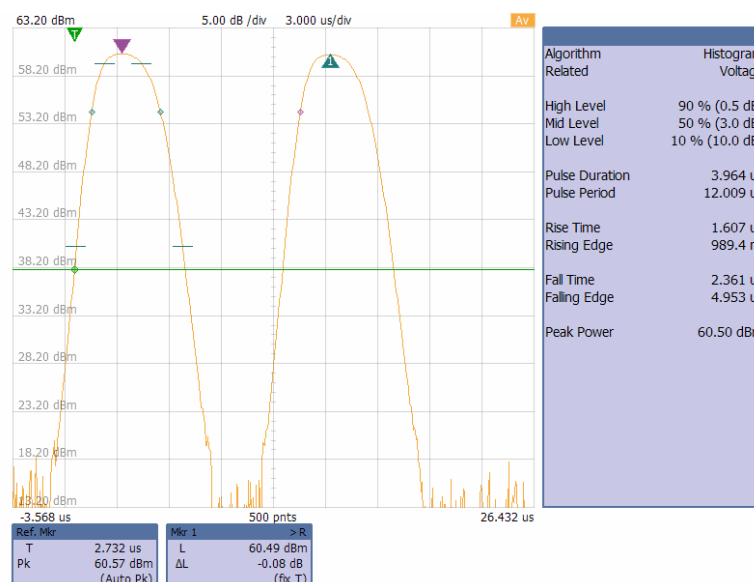


Figure 9.4.2.9-1. HIGH POWER PULSES CHANNEL 1X - 962 MHz

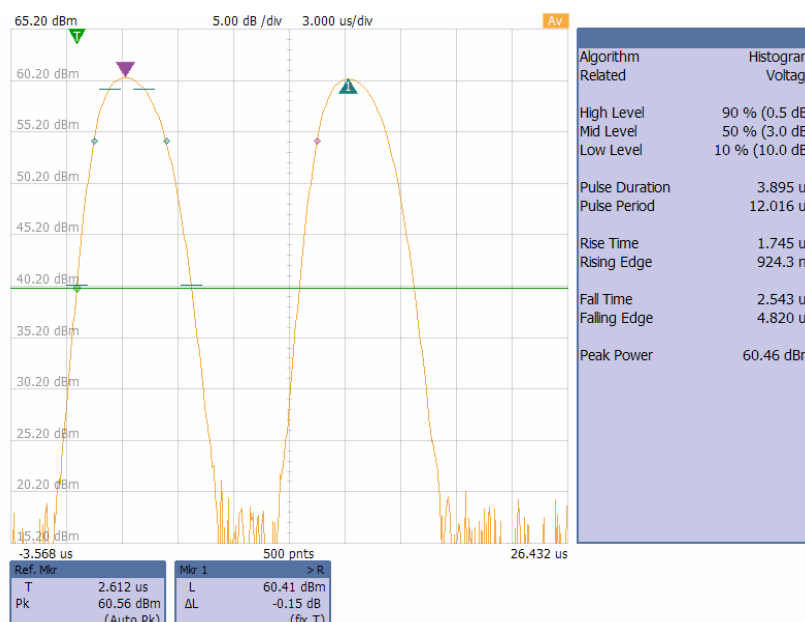


Figure 9.4.2.9-2. HIGH POWER PULSES CHANNEL 126X - 1213 MHz

9.4.2.10 Transmitted Spectrum - High Power DME

Figure 9.4.2.10-1 and Figure 9.4.2.10-2 show typical transmitted spectrums for a high power LDB-103.

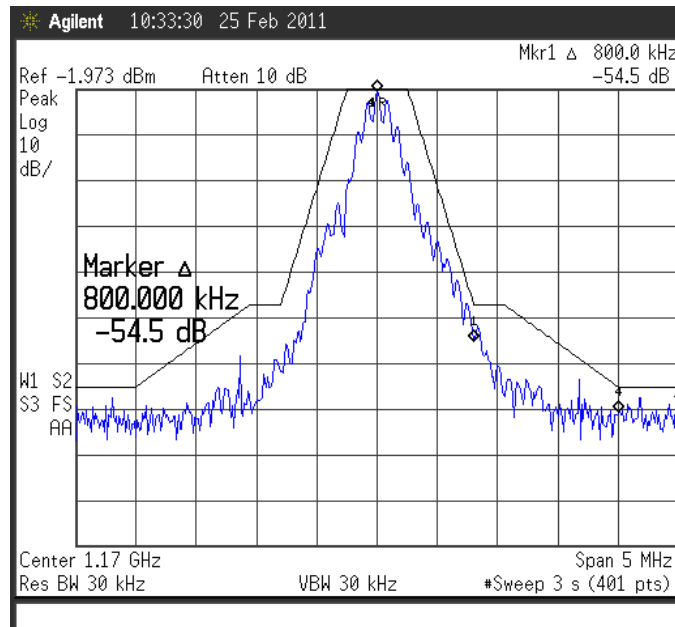


Figure 9.4.2.10-1. TRANSMITTED SPECTRUM - HIGH POWER LDB-103

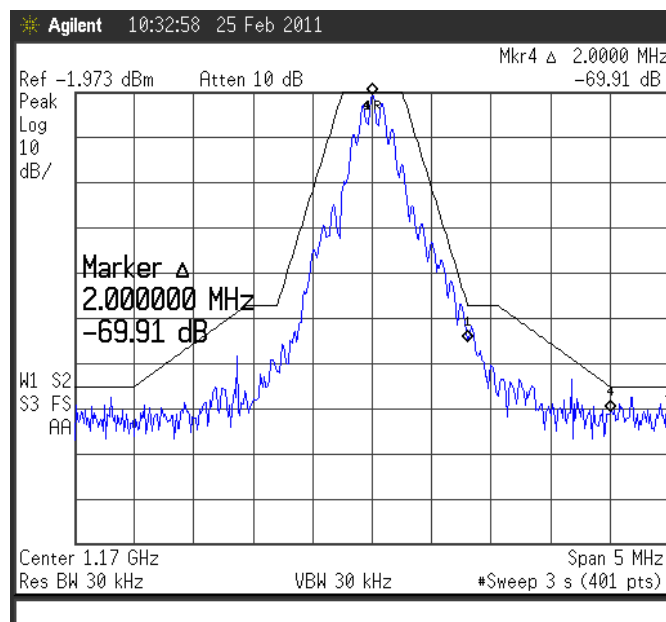


Figure 9.4.2.10-2. TRANSMITTED SPECTRUM - HIGH POWER LDB-103

9.4.2.11 Transmitted Spectrum - Low Power DME

Figure 9.4.2.11-1 and Figure 9.4.2.11-2 show typical transmitted spectrums for a low power LDB-103.

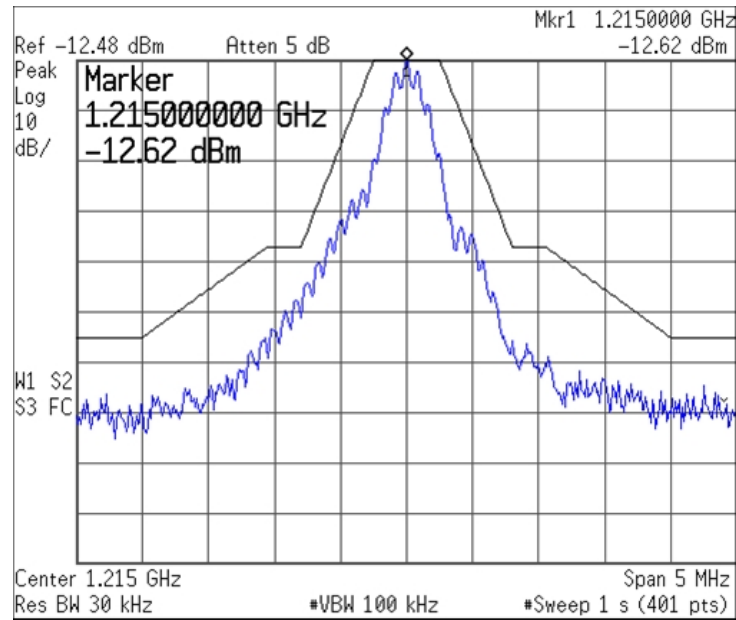


Figure 9.4.2.11-1. TRANSMITTED SPECTRUM - LOW POWER LDB-103

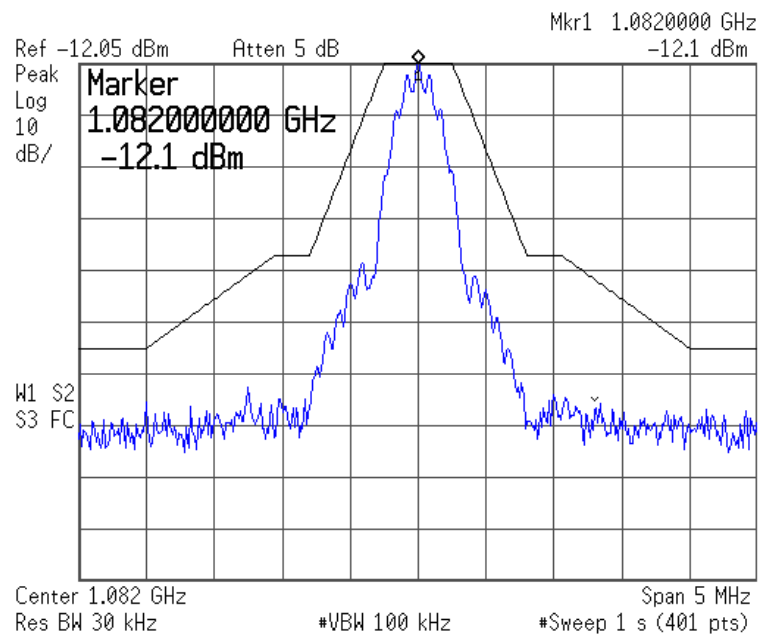


Figure 9.4.2.11-2. TRANSMITTED SPECTRUM - LOW POWER LDB-103

9.5 ACCESSORIES

The items described below are components of rack accessory kit. Refer to Appendix E and F for a detailed listing of the accessory kit components.

9.5.1 Extender Card

The extender card is used for facilitating access to individual pin of the 20-way test connector located in the front panel of the equipment modules. It is plugged into the 20-way socket and its pinning is defined by the module definition for its own 20-way connector pinning.

9.5.2 Test Cable Set

The extension cable set consists of a number of different types of cable assemblies, in the quantities shown, as follows:

Table 9.5.2-1: TEST CABLE SET

PART NUMBER	QUANTITY	DESCRIPTION AND INTENDED USAGE
-	4	Coaxial Cable, RG223, 1m6, SMAm-SMAm Used for feeding RF VOR signal to the MRU module.
-	1	Mains extension cable AC Power Supply when not in the rack.
-	2	Coaxial Cable, RG223, 1m6, Nm-Nm
-	2	Coaxial Cable, RG223, 1m6, SMAm-Nm
-	2	Coaxial Cable, RG223, 1m6, SMAm-BNCm
-	2	Coaxial Cable, RG223, 1m6, SMAm-SMAm
-	2	Coaxial Cable, RG223, 1m6, BNCm-BNCm

9.6 MAINTENANCE PROGRAM

This program recommends **nominal** schedule and procedure for inspection and test of the LDB-103 DME to ascertain the operability of the navaid equipment.

The **actual** activities and their frequency is dependent on the site authority, bearing in mind the recommendations prescribed by ICAO 8071 Vol.1 and the level of confidence in the site operation as well as the environmental conditions for the actual site.

These checks are for maintenance purposes, limits of measured values may deviate from ICAO Annex10 due to proximity of monitor or limitation of test equipment at site. Changes in the measured values may often be more relevant to the indication of changes in the site performance relative to that at the time of the site commissioning or at the time of the last calibration flight.

DAILY or WEEKLY:

Activity:

1. Log in the equipment.
2. Inspect for absence of "Fault" in the status summary (top horizontal panel). Note if the operating system of the previous inspection remain the operating system. Note the recycling number.
3. Navigate to "Logs" and display logs for the wanted time duration. Check for absence of anomalous messages.

Document: Task list, check sheet and record inspection activity to be generated by site authority as required. Assessment for any remedial activities to be listed.

Note that non-zero recycle number may simply relates to incidental occurrences (weather, power surges etc) and may not be material to the operation quality of the Navaid. Judicious assessment is required. Site visit is optional to check for intrusion of insect etc.

WEEKLY or MONTHLY:

Activity:

1. Log in the equipment.
2. Inspect for absence of "Fault" in the status summary (top horizontal panel). Note if the operating system of the previous inspection remain the operating system.
3. Navigate to "Status". Check for absence of anomalous parameters. Record power outputs.
4. Navigate to "Status/MTU Executive". Check for absence of anomalous parameters.

5. Navigate to “*Status/RCU*”. Inspect for the number of recycles during the last 24 hours. Reset to standard setup: Main, Standby, Zero cycle count as required.
6. Navigate to “*Logs*” and display logs for the wanted time duration. Check for absence of anomalous messages.

Visit the site.

1. Inspect cleanliness, neatness and fitting of equipment and facility (lighting, air conditioning etc) within the equipment area and within the shelter
2. Exercise the display LED test. Check for intrusion of insects etc.

Document: Task list, check sheet and record inspection activity to be generated by site authority as required. Assessment for any remedial activities to be listed.

THREE-MONTHLY:

Activity: Visit the site. For each equipment (in dual configuration):

1. Perform all eight tasks for monthly check as above.
2. Check beacon delay and pulse spacing.
3. Verification of the monitoring serviceability as prescribed in this document.
4. Optional: Select the alternate equipment as the “MAIN” equipment.

Document: Task list and check sheet and record of visit to be generated by site authority as required. Assessment for any remedial activities to be listed These are to be archived.

ANNUALLY:

Activity: Visit the site. For each equipment (in dual configuration):

1. Perform all the tasks for the 3-monthly visit as above.
2. Check Test Jack signals for the all modules.
3. Exercise Change-Over action.
4. Measure output power and pulse characteristics.
5. Measure OL sample in pin 1 - RXU Test Connector.

Document: Task list and check sheet and record of visit to be generated by site authority as required. Assessment for any remedial activities to be listed These are to be archived.

10. OBSERVATIONS

N/A