



Technical Specifications

MRM GPRM1-2 TDMA TNC



SIERRA
WIRELESS

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2.0
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Contents

CONTENTS	5
LIST OF FIGURES.....	9
LIST OF TABLES	10
1. INTRODUCTION	11
1.1. Scope	11
1.2. Notes on safety for the user	11
1.2.1. Electrical safety	11
1.2.2. Environments with explosive substances	11
1.2.3. Non-ionising radiation	11
1.2.4. WARNING for the mobile station designer	11
2. REFERENCE STANDARDS AND APPLICABLE DOCUMENTS.....	12
2.1. Reference standards	12
2.2. Applicable documents	13
3. MRM GENERAL PRODUCT DESCRIPTION.....	14
3.1. Introduction.....	14
3.2. Purpose of the MRM	14
3.3. System requirements	15
3.4. CE conformity	15
3.5. Content of the delivery	15
3.6. Packaging.....	15
4. HARDWARE CHARACTERISTICS	16
4.1. Mechanical Outline	16
4.1.1. Dimensions.....	16
4.1.2. Design	16
4.1.3. Weight	17
4.2. LABELS.....	17
4.2.1. Backplane Label.....	17
4.2.2. Warranty Seal	17
4.3. Connectors and LEDs	18
4.3.1. RF connectors.....	18
4.3.2. LED	18
4.3.3. Micro USB connector	19
4.3.4. Front-Plane data connector.....	19
4.3.5. Back-Plane connector	20
4.3.6. Internal SIM Card Reader	22
4.4. Connector Electrical Characteristics	22
4.4.1. RF Connector Electrical Interface	22
4.4.2. ERTMS Serial Data and Command Electrical Interface	22

4.4.3.	TDMA Bus Electrical Interface	24
4.4.4.	Audio Electrical Interface	26
4.4.5.	Module Management Electrical Interface.....	27
4.4.6.	Maintenance and Test Electrical Interface.....	28
4.4.7.	Front panel Ethernet Electrical Interface.....	29
4.4.8.	Front panel RS 232 Electrical Interface	29
4.4.9.	Front panel SD Card Reader Electrical Interface	29
4.4.10.	Front panel Micro USB Electrical Interface	30
4.4.11.	SIM Card Reader Electrical Interface	30
4.4.12.	Power supply electrical interface	31
4.4.13.	LED Management interface	32
4.5.	Power supply	32
4.5.1.	Power supply voltage	32
4.5.2.	Power consumption.....	33
4.5.3.	Power pattern	34
4.5.4.	Residual noise.....	35
4.5.5.	Rush of current – Switch-in current pulse	35
4.6.	Radio characteristics	35
4.6.1.	Frequency Band	35
4.6.2.	Output power.....	36
4.6.3.	Rx sensitivity	36
4.6.4.	Blocking.....	36
4.6.5.	Spurious emissions	36
4.6.6.	High Speed Requirements.....	37
4.6.7.	RF Input Max Level	37
4.7.	Vocoder	37
4.8.	Environmental constraints	37
4.8.1.	Operating Temperature	37
4.8.2.	Storage Temperature	38
4.8.3.	Gradient of temperature	38
4.8.4.	Altitude and pressure	38
4.8.5.	Relative humidity.....	38
4.8.6.	Shocks and Vibrations	39
4.8.7.	EMC	39
4.8.8.	Safety	40
4.8.9.	Other Physical conditions.....	40
4.8.10.	Compliance to EIRENE SRS V15.4.0 [1] for Environmental constraints	41
4.9.	Reliability	41
5.	INTERFACES	42
5.1.	Introduction	42
5.2.	RF interface	42
5.3.	LED interface.....	42
5.4.	ERTMS Serial Data and Command interface	43
5.4.1.	Serial interface signals	43
5.4.2.	Serial interface signal handling	43

5.4.3.	Data Rates	46
5.5.	TDMA BUS: multiplexed voice and data	46
5.5.1.	TDMA bus structure	47
5.5.2.	TDMA bus signals	47
5.5.3.	TDMA bus Time Slot Assignment	50
5.5.4.	Physical address	50
5.5.5.	Protocols over the TDMA bus channels.....	50
5.6.	Audio interface.....	51
5.7.	Module Management Interface.....	51
5.7.1.	Temperature sense output	52
5.7.2.	RESET and STANDBY command	52
5.7.3.	PTT (Push To Talk) command	52
5.7.4.	DOWNLOAD_ENABLE command	53
5.7.5.	ERTMS_ENABLE command.....	53
5.7.6.	Power Fail command	54
5.7.7.	RF_SELECT command.....	54
5.8.	Maintenance and Test Interface	54
5.8.1.	Serial Interface Signals	54
5.8.2.	Serial Interface Data Rates	55
5.9.	SIM Interface	55
5.10.	Front Panel Ethernet interface	55
5.11.	Back Panel Ethernet interface.....	55
5.12.	Front Panel Serial Data and Command Interface	56
5.13.	Front Panel SD Card Interface	56
5.14.	Front Panel Micro USB Interface.....	56
6.	FUNCTIONAL DESCRIPTION	57
6.1.	Factory Settings of the MRM.....	57
6.2.	AT Command interface	58
6.3.	Services.....	58
6.4.	EIRENE Railway Specific Services	58
6.4.1.	Functional Addressing.....	58
6.4.2.	Location Dependent Addressing.....	58
6.4.3.	Shunting Mode	58
6.4.4.	Multiple Driver Communications	59
6.4.5.	Railway Emergency Call	59
6.5.	Compliance to 3GPP 51.010-2 V7.5.0	59
6.5.1.	Mobile type	59
6.5.2.	Mobile Station Feature	64
6.5.3.	Teleservice	66
6.6.	Memory.....	66
6.7.	Software Downloading	66
6.8.	Diagnostic.....	67
6.8.1.	Diagnostic via the software of the MRM	67

6.8.2.	LED diagnostic	67
6.8.3.	Other diagnostic	67
6.9.	Trace Feature (Optionnal)	67
6.9.1.	Overview	67
6.9.2.	GSM-R Trace Tool	67
6.9.3.	Trace Feature summary.....	68
7.	ANNEX A: DELTA LIST BETWEEN MRM GPRM1-1 AND MRM GPRM1-2	70
8.	ANNEX B: MECHANICAL DRAWINGS AND PICTURES.....	71



List of Figures

Figure 1.	MRM Purpose Overview	14
Figure 2.	Mechanical Outline Overview	16
Figure 3.	Labels	17
Figure 4.	RF connector, LEDs and Data connectors overview	18
Figure 5.	Back-Plane connector overview	20
Figure 6.	Typical GSM power consumption.....	34
Figure 7.	Typical GPRS/EDGE multi slot power consumption	34
Figure 8.	DCR and RESET signal correlation	44
Figure 9.	DSR and internal reset	44
Figure 10.	DTR and call termination	45
Figure 11.	DTR and data rate	45
Figure 12.	DCD and data call	45
Figure 13.	Ring indicator timing	46
Figure 14.	Monitoring Tool screen shot	68



List of Tables

Table 1.	Reference standards	12
Table 2.	Applicable documents	13
Table 3.	RF Connector usage	18
Table 4.	LED behaviour definitions	18
Table 5.	Micro USB connector pin out.....	19
Table 6.	Front-Plane connector pin out.....	19
Table 7.	Back-Plane connector pin out	21
Table 8.	ERTMS Electrical Interface	22
Table 9.	TDMA Bus Electrical Interface	24
Table 10.	Audio Electrical Interface.....	26
Table 11.	Temperature Sensor Electrical Interface.....	27
Table 12.	Module Management Electrical Interface	27
Table 13.	Maintenance Electrical Interface	28
Table 14.	Serial Line RS 232 Input Electrical Interface.....	29
Table 15.	Serial Line RS 232 Output Electrical Interface	29
Table 16.	SD Card Reader Electrical Interface	29
Table 17.	Micro USB Electrical Interface.....	30
Table 18.	Power supply electrical interface.....	31
Table 19.	LED Management Interface	32
Table 20.	GPRS/EDGE power consumption.....	33
Table 21.	GSM Frequency band	35
Table 22.	Spurious specifications.....	36
Table 23.	GPRS/EDGE multislots class limitations	37
Table 24.	Operating altitude and pressure range.....	38
Table 25.	Operating sinusoidal vibration range.....	39
Table 26.	Shocks.....	39
Table 27.	Random vibrations	39
Table 28.	ERTMS serial interface signals	43
Table 29.	TDMA bus signals timings.....	49
Table 30.	Audio Interface	51
Table 31.	Module Management Interface.....	51
Table 32.	ERTMS enable	53
Table 33.	RF_SELECT	54
Table 34.	Maintenance Serial Interface.....	54
Table 35.	Front Panel Ethernet Interface	55
Table 36.	Back Panel Ethernet Interface.....	55
Table 37.	Delta list between MRM GPRM1-1 and MRM GPRM1-2	70



1. Introduction

1.1. Scope

The scope of this document is to describe the technical specifications of the MRM GPRM1-2.

This document describes all the features, functions and interfaces of the Sierra Wireless GSM-R 8 watts Mobile Radio Module MRM and states the requirements which apply in connection with the operation of the MRM.

The AT commands supported are described in the Sierra Wireless document "AT Command Set for MRM".

The options for diagnostics, safety precautions for users and technical data are included in this document.

Users of the MRM are expressly requested to begin by reading the safety precautions in the following chapter.

1.2. Notes on safety for the user

The following notes refer to the MRM and to applications based on the MRM. The manufacturer of an application based on the MRM must incorporate these safety precautions in the instruction manual.

1.2.1. Electrical safety

This note is applicable to certain classes of mobile units connected to power supply units or battery charger using voltages in excess of 50V (effective mean) alternating current or 75 V direct current. Consequently, it does not apply to the MRM which uses Safety Extra Low Voltage (SELV) - see 4.5 power supply chapter for details.

1.2.2. Environments with explosive substances

Users are advised not to use the device in automotive service stations.

Users are reminded of the necessity of complying with restrictions regarding the use of radio devices in fuel depots, chemical plants and locations where explosives are stored or ignited.

1.2.3. Non-ionising radiation

As it is the case with other mobile radio transmitters, users should note that, for the sake of satisfactory use of the devices and safety of the operating personnel, it is advisable to use the device only in the normal operating position.

1.2.4. WARNING for the mobile station designer

Since the maximum surface temperature of the module can rise up to 82.5°C, the cab designer has to foresee appropriate warnings concerning maintenance procedures for handling hot equipment.



2. Reference standards and applicable documents

2.1. Reference standards

Table 1. Reference standards

[1]	EIRENE SRS	15.4.0
[2]	EIRENE FRS	7.4.0
[3]	Sub System Requirements Specification SSRS MORANE A 04/22 T 6002	
[4]	FFFIS for Mobile Terminal Interface of the EIRENE Mobile Station MORANE F 12 T 7003	
[5]	Radio Transmission FFFIS for EURORADIO MORANE A 11 T 6001	12.4
[6]	EN 50081-2: "Electromagnetic compatibility – Generic emission standard – Part 2: Industrial environment"	December 1993
[7]	EN 50121-3-2: "Railway Applications - Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus"	November 2006
[8]	EN 50124: "Railway applications: Insulation Co-ordination"	2001
[9]	EN 50125: "Railway applications: Environmental Conditions for equipment on board rolling Stock"	1999
[10]	EN 50155/A1: "Railway applications: Electronic equipment used on rolling stock"	2007
[11]	IEC 297: "Dimensions of mechanical structures of the 482.6mm (19") series"	
[12]	IEC 603-2: "Connectors for frequencies below 3 MHz for use with printed boards"	
[13]	3GPP TS 05.05: "Radio Transmission and Reception"	v8.20.0 Release 1999
[14]	GSM 07.02: "Terminal Adaptation Functions (TAF) for Services Using Asynchronous Bearer Capabilities"	V7.0.0 Release 1998
[15]	ETSI TS 100 585 (GSM 07.05): "Use of Data Terminal Equipment – Data Circuit Terminating Equipment (DTE-DCE); Interface for Short Message Services (SMS) and Cell Broadcast Services (CBS)"	v7.0.1 Release 1998
[16]	ETSI TS 127 007 – 3GPP TS 27.007 V4.2.0 Release 4	2001
[17]	ETSI EN 301 515 – Requirements for GSM operation on railways	2.3.0
[18]	ETSI TR 102 281 – Detailed requirements for GSM operation on Railways	2.3.0 July 2013
[19]	ETSI ETS 300 641 - Digital cellular telecommunications system (Phase 2); Specification of the 3 Volt Subscriber Identity Module - Mobile Equipment (SIM-ME) interface	4.3.1 Mars 1998
[20]	IEEE 802.3	I
[21]	TIA 232	F

2.2. Applicable documents

Table 2. Applicable documents

[22]	MRM Compliance list to ESRS V15.4.0	MRM_Compliance_List_EIRENE_SRS_V15-4-0.xls
[23]	MRM Compliance list to EFRS V7.4.0	MRM_Compliance_List_EIRENE_SRS_V7-4-0.xls
[24]	AT Command Set for MRM	4112851 MRM GPRM1 AT Command Set – Rev8.0.pdf

3. MRM general product description

3.1. Introduction

The MRM (Mobile Radio Module) is a class 2 / E1 GSM-R, multi-slot class 10 GPRS/EDGE transceiver in a self-contained cassette. It is designed to be easily integrated in a standard 19" rack.

3.2. Purpose of the MRM

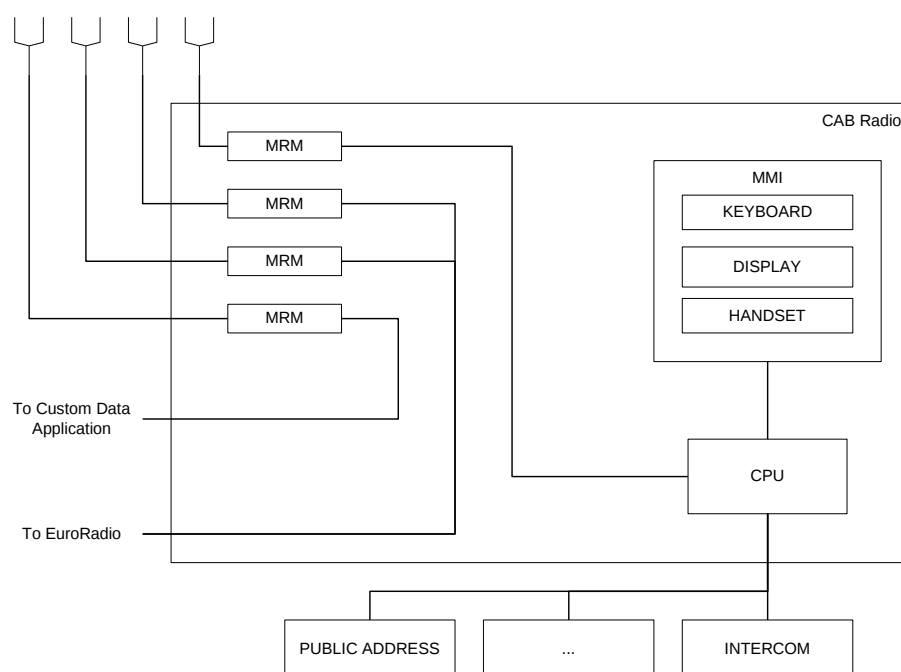


Figure 1. MRM Purpose Overview

The Mobile Radio Module (MRM) is an 8 watts GSM-R voice and data transceiver. It is designed as a module that can be embedded in various railway equipments to use the GSM-R radio link for voice and/or data exchange. Examples include:

- Engine CAB-radio telecommunications unit.
- Carriage remote management unit.
- Controller station.
- Track-side equipment remote management unit.

In addition, the MRM is designed as a transceiver and supports ASCI and EIRENE features at application level by implementation and processing the necessary AT commands. These features are provided by external equipment such as the CAB-radio computer, using the necessary AT commands.

3.3. System requirements

The MRM is designed for use in a system environment that includes a GSM-R mobile radio network with one or more network operators per country. A corresponding infrastructure using a configuration level suitable for the use of terminals with 8 watts transmitting power is a basic requirement.

The functional environment for the MRM includes a CAB-radio in most cases, or another kind of base unit, which supports the MRM interface. This environment must provide the MRM with the power supply, data and audio interfaces and connection to an external antenna, as well as the environmental conditions described throughout this technical documentation.

Other examples of base units can be, for example, vehicle telephone, vending machines, sales points, passenger information systems, automated systems or other devices that may use the MRM as a medium for transmitting voice, data or short messages (SMS).

3.4. CE conformity

The MRM bears the CE symbol of conformity. This symbol is a declaration that, based on the design and construction and proven by CE compliance tests, the MRM is in compliance with the currently valid versions of the following EC directives.

- EMC directive: **2004/108/EC**
- Low voltage directive: **2006/95/EC**
- Radio and Terminal Telecommunication Equipment directive (R&TTE) : **1999/5/EC**

Standards:

- EMC: **EN 301 489-1 V1.9.2 (2011-09)**
EN 301 489-7 V1.3.1 (2005-11)
EN 50121-3-2 (2006-11)
- Electrical Safety: **EN 60950-1 (2006+A1:2010 (incorporating A11:2009))**
- Radio: **EN 301 511 V9.0.2 (2003-03)**

3.5. Content of the delivery

The MRM is delivered without any accessories, cable or connector covers. It is delivered with a manufacturing test report.

3.6. Packaging

The MRM is delivered in a plastic, anti-static bag, enclosed in a protective cardboard box (sheath type).

The label on the box is identical to the back-plane label of the MRM. It indicates the MRM hardware type and version, part and serial number, software version and IMEI number (see 4.2 LABELS chapter).



4. Hardware characteristics

4.1. Mechanical Outline

Note: Dimensions are in mm, except where explicitly mentioned.

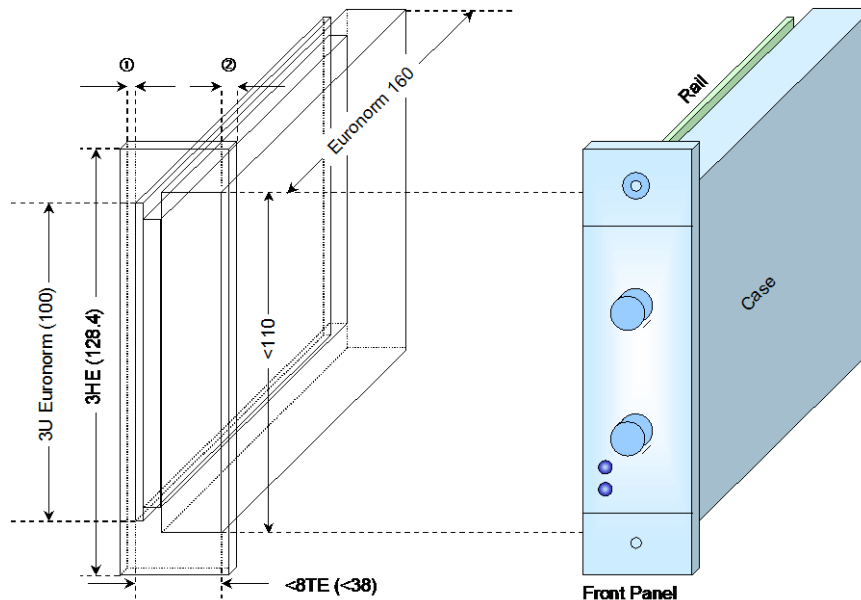


Figure 2. Mechanical Outline Overview

See pictures and mechanical drawings in annex B for details.

4.1.1. Dimensions

The MRM must be plugged in a standard 19" rack according to IEC 297-1/2 [11]/ DIN 41494.

The mechanical outline dimensions of the MRM are defined to fit in such rack in regards to the relative distance between the connector, front-panel and card guide as defined in NF C 20-152, HD 493-3, IEC 297-3 and DIN 41494 part 5.

- Thickness $\leq 8TE$.
- Height = Type 3U Euronorm.
- Depth = Type Euronorm 160 mm.

Minimum size of the MRM slot inside sub-rack is 8TE.

A removable front panel (not provided by Sierra Wireless) can be fixed on the MRM casket with screws.

4.1.2. Design

The MRM is not equipped with any screen, keypad, or speaker.

The MRM is equipped with a heat sink on one side (upper shell), and a flat surface on the other side (lower shell). The flat side of the lower shell has a flatness of maximum ± 0.3 mm and a roughness of $1.6 \mu\text{m}$, 2 thread holes for the mounting of a Peltier module in case active cooling is necessary.

4.1.3. Weight

The MT module weight is less than 1,7 kg.

4.2. LABELS

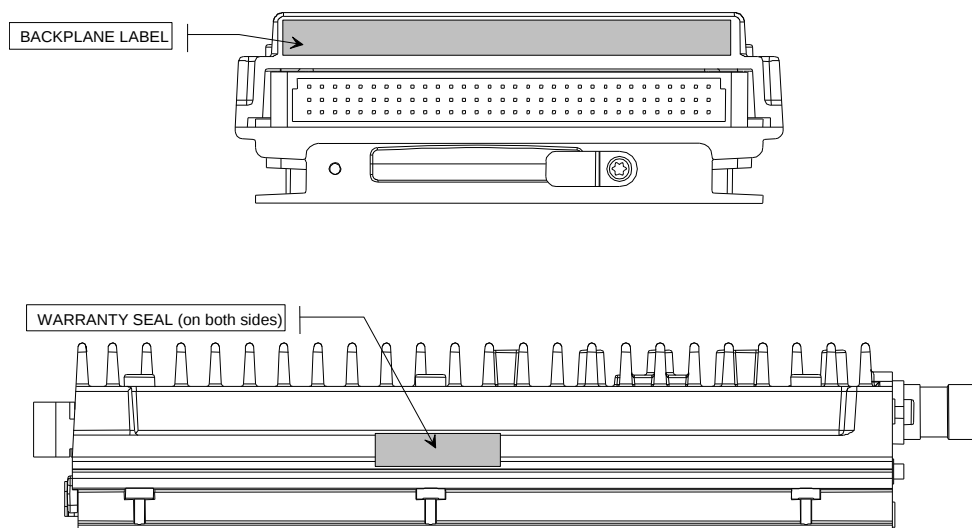


Figure 3. Labels

4.2.1. Backplane Label

2		4	6	8
1	3	5	7	

1. «Sierra Wireless logo»
2. <Hardware type> - <Hardware version>: Sierra Wireless and customer Hardware identification
3. <Part Number> - <Serial Number>: Sierra Wireless product identification numbers
4. reserved
5. <CE Marking>
6. <Software version>: Customer software
7. <IMEI Number>
8. "Made In France"

4.2.2. Warranty Seal

This label can be found on both sides of the MRM. This label is written in English.

WARNING! OPENING GIVES IRREVOCABLE FAILURE AND WARRANTY SUPPRESSION	
---	--

4.3. Connectors and LEDs

4.3.1. RF connectors

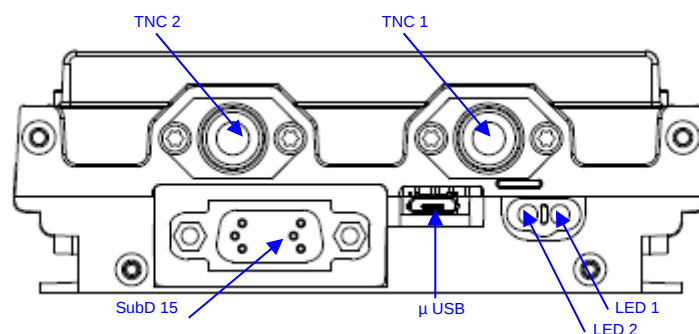


Figure 4. RF connector, LEDs and Data connectors overview

- 2 x TNC Female Connectors, 50 Ohms, center contact gold plated

Pin out:

Table 3. RF Connector usage

Connector	TX/RX	Comments
TNC 1	TX/RX in duplex mode or TX only	Used in standard as dual TX/Rx I/O
TNC 2	RX	Used in option as Rx input when TNC 1 is used as TX output only (see 5.2 RF Interface for details)

When not used, the TNC connectors should be equipped with a suitable cover for better protection (cover not provided by Sierra Wireless).

See 4.6 Radio Characteristics Chapter for more details.

4.3.2. LED

The MRM LEDs provide information about the state of the module.

Table 4. LED behaviour definitions

LED #	Name	Colour	Status	Meaning
1	Status	Green/Red	Green Green flashing Red Red flashing Off	Power ON and no alarm Waiting for PIN Alarm, reset* or software download SIM problem Power off
2	Network	Green/Red	Green Green flashing Alternating Red/Green Red Off	Network present Poor quality Network Network detected but not authorized Network not present Power off

The light guides of the LEDs stick out of the MRM (2 mm). The front face needs to have holes for the light guides as described in Annex A.

Note: The status information provided by the LEDs is available via AT commands.

Note: The LED status information described in the table is not applicable during downloading procedures.

- Reset status means: the reset signal on backplane has been activated.

Four lines are available on the backplane connector for the display board. See chapter 4.3.5.

4.3.3. Micro USB connector

- 1 x Micro USB

The micro USB connector is fitted for a USB line. The pin out for this connector is shown in Table 5.

Table 5. Micro USB connector pin out

Pin #	
1	Vbus
2	USB_DM
3	USB_DP
4	NC
5	Ground

4.3.4. Front-Plane data connector

- 1 x Sub-D 15 High density

The sub-D 15 connector provides the connectivity for an Ethernet line, the serial line interface RS232 and an SD Card interface. The pin out for this connector is shown in Table 6.

Table 6. Front-Plane connector pin out

Pin #	
1	Eth1 TX P
2	SD card Data 0
3	SD card Data 1
4	RX
5	TX
6	Eth1 TX N
7	Eth1 RX P
8	Ground
9	SD card CMD
10	SD card POWER
11	Eth1 RX N
12	SD card Data 2
13	SD card Data 3
14	Ground
15	SD card Clock

4.3.5. Back-Plane connector

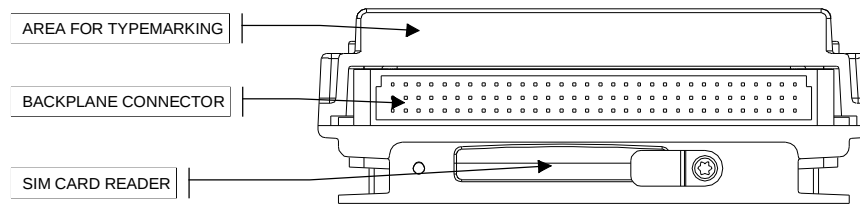


Figure 5. Back-Plane connector overview

- 1 x HE12 96 pin type C connector (DIN41612 / IEC 603-2), fixed on PCB

The back-plane connector provides connectivity for power supply signals, TDMA bus signals, MT data/command serial line (for ERTMS applications), Ethernet line and others. The pin out for this connector is shown in Table 7.

Table 7. Back-Plane connector pin out

Pin #	Row A	Row B	Row C
1	+5VDC	+5VDC	+5VDC
2	NC on MRM. ¹	NC on MRM.1	NC on MRM.1
3	Eth0 RX P	Eth0 GND	Eth0 TX P
4	Eth0 RX N	Eth0 GND	Eth0 TX N
5	SLOT CODE 3	NC on CU ²	NC on CU2
6	SLOT CODE 0	SLOT CODE 1	SLOT CODE 2
7	+12VDC	+12VDC	+12VDC
8	NC on MRM.1	NC on MRM.1	NC on MRM.1
9	NC on CU2	NC on CU2	LED_VIN
10	LED_ALARM	LED_SAFE	LED_ON
11	NC on CU2	NC on CU2	NC on CU2
12	ERTMS_ENABLE	STANDBY ³	RESET
13	TFE	POWER_FAIL	RF_SELECT
14	NC on CU2	NC on CU2	NC on CU2
15	NC on CU2	NC on CU2	NC on CU2
16	NC on CU2	NC on CU2	NC on CU2
17	TDMA_CLOCK_P	TDMA_GND	TDMA_GND
18	TDMA_CLOCK_N	NC on CU2	TDMA_DATA_P
19	TDMA_GND	TDMA_GND	TDMA_DATA_N
20	TDMA_SYNC_P	NC on CU2	TDMA_GND
21	TDMA_SYNC_N	NC on CU2	TDMA_GND
22	S-GND CT102	(reserved) 2	PTT
23	TXD CT103	RTS CT105	DTR CT108/2
24	RXD CT104	CTS CT106	DCD CT109
25	S-GND	DSR CT107	RI CT125
26	GND 12VDC	GND 12VDC	GND 12VDC
27	Temperature Sense	(reserved) 2	(reserved) 2
28	Signal GND	Signal GND	Download Enable
29	Audio IN Wire A	Audio OUT Wire A	S_GND
30	Audio IN Wire B	Audio OUT Wire B	RXD (Maintenance)
31	Signal GND	Signal GND	TXD (Maintenance)
32	GND 5VDC	GND 5VDC	GND 5VDC

1 +5VDC and +12VDC can be connected on the backplane of the CAB respectively for pins 2 and 8.

2 Pin mark as "NC on CU" or "(reserved)" shall be kept open.

3 Pin 12B (STANDBY) has the same operation mode than Pin 12C (RESET) See chapter **Error! Reference source not found.** Signals on pins 12B and 12C are "added" inside the MRM.

4.3.6. Internal SIM Card Reader

- 1 x SIM Card Reader, 3V SIM cards only

The MRM is equipped with an internal SIM Card Reader and accepts 3V SIM Cards only. The SIM card is inserted and removed from the MRM using a trap door located at the back of the MRM.

WARNING: To prevent damage to the SIM card, it is necessary to power off and to unplug the MRM before inserting or removing the SIM card.

The access to the SIM Card may require adequate standard tools and shall only be able to be removed by authorized maintenance staff. Please be careful to reposition the SIM card trap door lock correctly and securely.

4.4. Connector Electrical Characteristics

4.4.1. RF Connector Electrical Interface

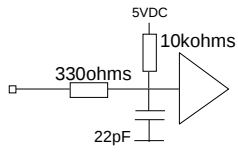
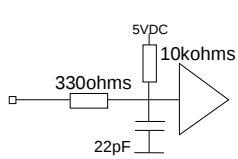
The RF connectors are TNC Female Connectors, 50 Ohms, center contact gold plated.

- Nominal Impedance for external access: 50 Ohms.
- Load mismatch withstanding:
 - VSWR < 1.7:1 at the TNC1 port.
 - VSWR < 2:1 at the TNC2 port.

4.4.2. ERTMS Serial Data and Command Electrical Interface

On back-plane connector:

Table 8. ERTMS Electrical Interface

PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level	Equivalent (open to evolution for improvement)
A12	ERTMS Enable	INPUT TTL Compatible (active low)	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
A22	S-GND CT102 Signal Ground	---	---	---	---	---	---	---	GND
A23	TxD CT103 Transmitted Data	INPUT TTL Compatible	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	

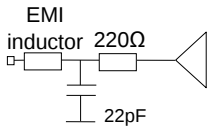
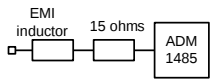
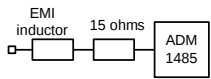
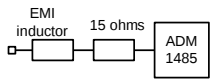
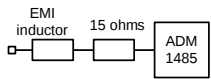
PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level	Equivalent (open to evolution for improvement)
A24	RxD CT104 Received Data	OUTPUT TTL Compatible Rload > 100 K Ω	---	---	---	+2.4V	+0.4V	HIGH when in HW reset or standby	EMI inductor 220 Ω 22pF
A25	S-GND CT102 Signal Ground	---	---	---	---	---	---	---	GND
B23	RTS CT105 Request To Send	INPUT TTL Compatible (Low state=RTS on)	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	5VDC 10kohms 330ohms 22pF
B24	CTS CT106 Clear To Send	OUTPUT TTL Compatible Rload > 100 K Ω	---	---	---	+2.4V	+0.4V	HIGH when in HW reset or standby	EMI inductor 220 Ω 22pF
B25	DSR CT107 Data Set Ready	OUTPUT TTL Compatible (Low state = AT commands can be channel led) Rload > 100 K Ω	---	---	---	+2.4V	+0.4V	HIGH when in HW reset or standby	EMI inductor 220 Ω 22pF
C23	DTR CT108/2 Data Terminal Ready	INPUT TTL Compatible (Low state = default data rate)	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	5VDC 10kohms 330ohms 22pF
C24	DCD CT109 Data Carrier Detect	OUTPUT TTL Compatible (Low state = data communication in progress) Rload > 100 K Ω	---	---	---	+2.4V	+0.4V	HIGH when in HW reset or standby	EMI inductor 220 Ω 22pF
C25	RI CT125 Ring Indicator	OUTPUT TTL Compatible (High state = ringing) Rload > 100 K Ω	---	---	---	+2.4V	+0.4V	LOW when in HW reset or standby	EMI inductor 220 Ω 22pF

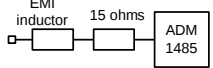
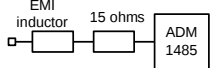
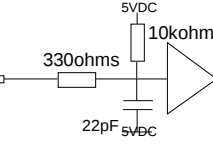
4.4.3. TDMA Bus Electrical Interface

The transceiver component handling all the differential signal is: ANALOG DEVICES – ADM1485.

On back-plane connector:

Table 9. TDMA Bus Electrical Interface

PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level	Equivalent (open to evolution for improvement)
A13	TDMA FRAME ENABLE	OUTPUT TTL Compatible (open collector and active low) Max current : +-10µA (open collector) 24mA when output low	---	---	---	--	+0.4V	Open collector when in HW reset or standby	
B17	TDMA_GND Signal Ground	---	---	---	---	---	---	---	GND
C17	TDMA_GND Signal Ground	---	---	---	---	---	---	---	GND
A19	TDMA_GND Signal Ground	---	---	---	---	---	---	---	GND
C18	TDMA_DATA_P	INPUT / OUTPUT (Data line TDMA Bus, differential signal line (+))	ADM1485 Analog Device specification rev A					In receive mode when open or in HW reset or standby	
C19	TDMA_DATA_N	INPUT / OUTPUT (Data line TDMA Bus, differential signal line (-))	ADM1485 Analog Device specification rev A					In receive mode when open or in HW reset or standby	
A20	TDMA_SYNC_P	INPUT (Synchronous line TDMA Bus, differential signal line (+))	ADM1485 Analog Device specification rev A					Always in receive mode	
A21	TDMA_SYNC_N	INPUT (Synchronous line TDMA Bus, differential signal line (-))	ADM1485 Analog Device specification rev A					Always in receive mode	

PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level	Equivalent (open to evolution for improvement)
A17	TDMA_CLOCK_P	INPUT (Clock line TDMA Bus, differential signal line (+))	ADM1485 Analog Device specification rev A					Always in receive mode	
A18	TDMA_CLOCK_N	INPUT (Clock line TDMA Bus, differential signal line (-))	ADM1485 Analog Device specification rev A					Always in receive mode	
A5 A6 B6 C6	SLOT_CODE_3 SLOT_CODE_0 SLOT_CODE_1 SLOT_CODE_2	INPUTs TTL Compatible	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
B19	TDMA_GND Signal Ground	---	---	---	---	---	---	---	GND
C20	TDMA_GND Signal Ground	---	---	---	---	---	---	---	GND
C21	TDMA_GND Signal Ground	---	---	---	---	---	---	---	GND

4.4.4. Audio Electrical Interface

The standard audio analogue interface is symmetric.

Table 10. Audio Electrical Interface

PIN	Circuit Name	I/O	Level	Characteristics
A28	S-GND Signal Ground	---	---	GND
A29 A30	AI WA Audio IN – Wire A AI WB Audio IN – Wire B	INPUT	LOW when OPEN	- Differential input impedance: 600Ω - Return loss: >20 dB between 500 and 3 400 Hz and >17 dB between 300 and 500 Hz - Coupling: AC coupling - Maximum differential input swing: 0.5 Vrms - Nominal differential input swing: 0.25 ± 0.05 Vrms - Transmission characteristics: "radio" loop at antenna: (audio in to audio out) - distortion ≤4% with 0.5 Vrms at 1 kHz "analog" loop after A/D uniform coder and before GSM speech encoder: (audio in to audio out) - distortion ≤2% with 0.5 Vrms at 1 kHz - Bandwidth 300-3 400 Hz 2 dB in the Band 400 – 3 000 Hz (± 2,5 dB between -20°C and -25°C)
A31	S-GND Signal Ground	---	---	GND
B28	S-GND Signal Ground	---	---	GND
B29 B30	AO WA Audio OUT – Wire A AO WB Audio OUT – Wire B	OUTPUT	LOW when in HW reset or standby	- Differential output impedance: ≤100 Ω - Coupling: AC coupling - Maximum differential output swing: 0.5 Vrms - Nominal differential output swing: 0.25 ± 0.05 Vrms (Max GSM codec level – 6dB) - Load: ≥ 600 Ω - Transmission characteristics : - See audio in (A29 – A30)
B31	S-GND Signal Ground	---	---	GND

4.4.5. Module Management Electrical Interface

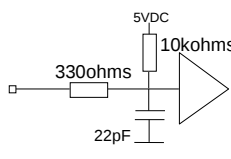
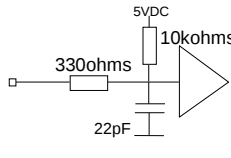
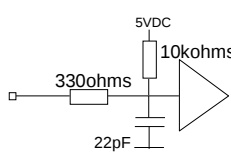
Table 11. Temperature Sensor Electrical Interface

PIN	Circuit Name	I/O	Level	Characteristics	Equivalent (open to evolution for improvement)
A27	TEMP. Temperature Sensor	OUTPUT	Active when in HW reset or standby	- Load Impedance: $\geq 2k\Omega^4$ - Source impedance: $< 5\Omega$ - Load capacity : $< 100pF$ - Offset voltage: 0.5V - Output voltage: 0.75V at 25°C - Scaling: 10 mV/°C - Measurement precision: $\pm 3^\circ C$ - Output noise: $\pm 30mV$ Max The temperature sensor is available on all the Temperature range Implementation of a low pass filter (bandwidth $< 3kHz$) on the cab side is recommended	

Table 12. Module Management Electrical Interface

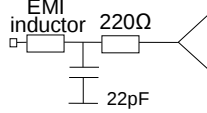
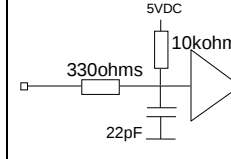
PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level when OPEN	Equivalent (open to evolution for improvement)
B12	STANDBY	INPUT TTL Compatible (To be connected to open collector output) (Active level = low)	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
C12	RESET	INPUT TTL Compatible (To be connected to open collector output) (Active level = low)	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
B13	POWER_FAIL	INPUT TTL Compatible	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	

⁴ 2kΩ is recommended to improve immunity to EMC perturbation and burst noise.

PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level when OPEN	Equivalent (open to evolution for improvement)
C13	RF_SELECT	INPUT TTL Compatible	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
C22	PTT Push To Talk	INPUT TTL Compatible (Active level = low) Will be disabled in TDMA mode	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
C28	Download Enable	INPUT TTL Compatible (Active level = low) Could be not used in TDMA mode	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	
C29	S-GND Signal Ground	---	---	---	---	---	---	---	GND

4.4.6. Maintenance and Test Electrical Interface

Table 13. Maintenance Electrical Interface

PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level	Equivalent (open to evolution for improvement)
C29	S-GND Signal Ground	---	---	---	---	---	---	---	GND
C30	RxD CT104 Received Data (Maintenance)	OUTPUT TTL Compatible (Rload > 100 kOhms)	---	---	---	+2.4V	+0.4V	HIGH when in HW reset or standb y	
C31	TxD CT103 Transmitted Data (Maintenance)	INPUT TTL Compatible	+2V	+0.8V	+5.5V	---	---	HIGH when OPEN	

4.4.7. Front panel Ethernet Electrical Interface

Ethernet interface as described in IEEE 802.3i [20].

4.4.8. Front panel RS 232 Electrical Interface

RS 232 interface as described in TIA-232 [21].

Table 14. Serial Line RS 232 Input Electrical Interface

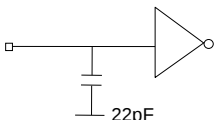
PIN	Circuit	I/O	VI Hi min	VI Lo max	VI Lo min	VI Hi max	Input Resistance (ON)	Level	Equivalent (open to evolution for improvement)
8	S-GND Signal Ground	---	---	---	---	---		---	GND
5	TxD Transmitted Data	INP UT	+2.0V	+0.8V	-25V	+25V	5 kΩ typ.	5 kΩ pull-down to GND	

Table 15. Serial Line RS 232 Output Electrical Interface

PIN	Circuit	I/O	Output voltage swing	Output short-circuit current	Level	Equivalent (open to evolution for improvement)
8	S-GND Signal Ground	---	---	---		GND
4	RxD Received Data	OUTPUT	±5.4 V typ.	±30 mA typ.	High Z in shutdown HIGH when input open	

4.4.9. Front panel SD Card Reader Electrical Interface

Table 16. SD Card Reader Electrical Interface

PIN	Circuit	I/O	Vmin	Vtyp	Vmax
14	Signal Ground	---	---	---	---
10	SD Card Power	O	2.7 V	2.8 V	2.95 V

PIN	Circuit	I/O	VI Hi min	VI Lo max	VO Hi min	VO Lo max
15	MMC_CLK SD Card Clock	O	---	---	2.35 V	0.4 V
9	MMC_CMD SD Card Command	I/O	1.75 V	0.7 V	2.35 V	0.4 V
2	MMC_DATA0 SD DATA 0	I/O	1.75 V	0.7 V	2.35 V	0.4 V
3	MMC_DATA1 SD DATA 1	I/O	1.75 V	0.7 V	2.35 V	0.4 V
12	MMC_DATA2 SD DATA 2	I/O	1.75 V	0.7 V	2.35 V	0.4 V
13	MMC_DATA3 SD DATA 3	I/O	1.75 V	0.7 V	2.35 V	0.4 V

4.4.10. Front panel Micro USB Electrical Interface

Table 17. Micro USB Electrical Interface

PIN	Circuit	I/O	Vmin	Vtyp	Vmax
5	Signal Ground	---	---	---	---
1	USB Power	O	4.4 V	5 V	5.25 V

PIN	Circuit	I/O	VI Hi min	VI Lo max	VO Hi min	VO Lo max
2	USB_DM USB data bus negative terminal	I/O	2 V	0.8 V	2.8 V	0.3 V
3	USB_DP USB data bus positive terminal	I/O	2 V	0.8 V	2.8 V	0.3 V

4.4.11. SIM Card Reader Electrical Interface

3V SIM Card interface as described in GSM 11.11 and GSM 11.12.

4.4.12. Power supply electrical interface

The MRM is powered by 5 and 12 VDC power supplies. See following chapter for details:

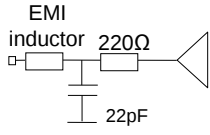
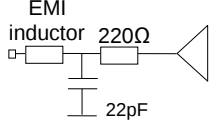
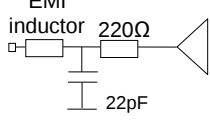
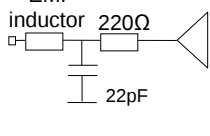
Table 18. Power supply electrical interface

PIN	Circuit	Input / Output
A 1	+5 VDC	Input
A 7	+12 VDC	Input
A 26	GND 12 VDC	---
A 32	GND 5 VDC	---
B 1	+5 VDC	Input
B 7	+12 VDC	Input
B 26	GND 12 VDC	---
B 32	GND 5 VDC	---
C 1	+5 VDC	Input
C 7	+12 VDC	Input
C 26	GND 12 VDC	---
C 32	GND 5 VDC	---

4.4.13. LED Management interface

The MRM status information provided by the LED management interface is the same as for the MRM LEDs and is described in section 4.3.2 of this document.

Table 19. LED Management Interface

PIN	Circuit	I/O	VI Hi min	VI Lo max	VI max	VO Hi min	VO Lo max	Level	Equivalent (open to evolution for improvement)
C9	Led_Vin	OUTPUT		---	---	+2.4V	+0.4V	LOW when in HW reset or standby	
A10	Led_Alarm	OUTPUT		---	---	+2.4V	+0.4V	HIGH when in HW reset or standby	
B10	Led_Safe	OUTPUT		---	---	+2.4V	+0.4V	LOW when in HW reset or standby	
C10	Led_On	OUTPUT		---	---	+2.4V	+0.4V	LOW when in HW reset or standby	

4.5. Power supply

4.5.1. Power supply voltage

MRM is powered from an external uninterrupted filtered power source, with two voltages:

- 12 VDC: Nominal 12.3 VDC $\pm 5\%$ (11.7 VDC to 12.9 VDC).
- 5 VDC: Nominal 5.0 VDC $\pm 5\%$ (4.75 VDC to 5.25 VDC).

MRM power supply inputs are equipped with an electronic circuit-breaker which protects against over-voltage (Max 16V permanent) and MRM internal short circuits.

The MRM is protected by Safety Extra Low Voltage (SELV) technology.

4.5.2. Power consumption

- Standby (IDLE): <0.120A, 12VDC <0.6A, 5VDC.
- RESET: <15 mA, 12VDC <35 mA, 5VDC.

* Reset status means a reset signal on the backplane has been activated.

4.5.2.1. GSM operating mode

Power consumption in communication is high during 1/8th of the time, every 4.615 ms (frame) and low otherwise. Typical values for one MRM when it is in communication at full power (8W) are:

- peak value (burst): 3.6A, 12VDC 1.5A, 5VDC.
- average value: 0.4A, 12VDC 0.7A, 5VDC.

4.5.2.2. GPRS/EDGE operating mode

Power consumption in communication at maximum performance may be high during 2/8th of the time, every 4.615 ms (frame) and low otherwise. Typical values for one MRM when it is in communication at full power (8W) are:

Table 20. GPRS/EDGE power consumption

Multislot (TX)		12VDC	5VDC
1	Peak	3.6 A	1.5 A
	Average	0.4 A	0.7 A
2	Peak	3.6 A	1.5 A
	Average	0.75 A	0.75 A

MRM power supply design

The GPRS/EDGE power consumption is not constant. The GPRS/EDGE power consumption is directly dependent of the number of TX timeslots assigned.

The maximum number of TX timeslots assigned is given by the multi-slot class of the MS.

The multi-slot class defined in 3GPP 45.002 § B.1 Release 6 allows at maximum 6 TX timeslot assignment (class 45).

4.5.3. Power pattern

4.5.3.1. GSM operating mode

Typical power consumption pattern for one MRM is as shown in the following diagram:

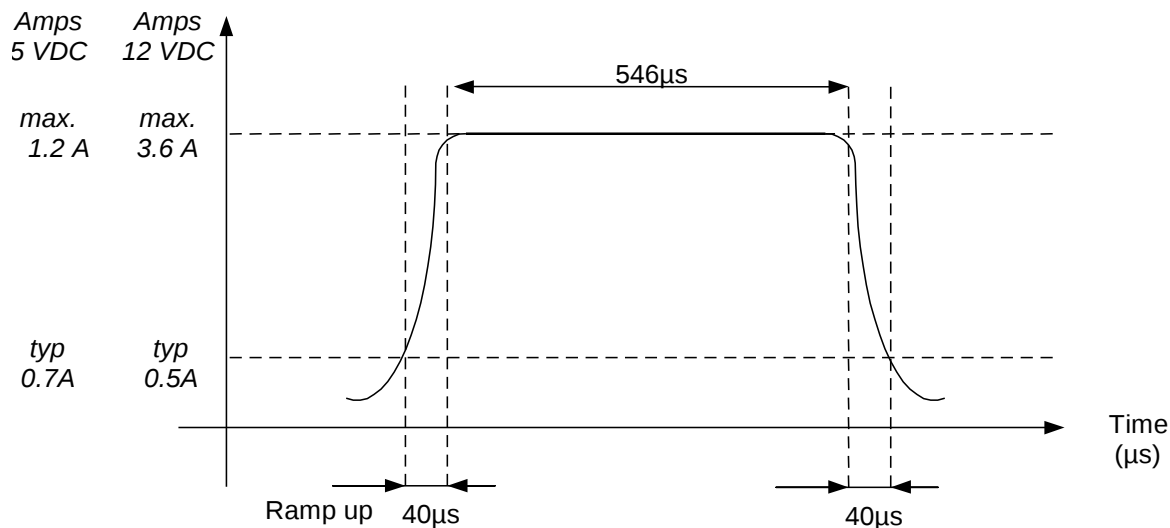


Figure 6. Typical GSM power consumption

External power supply for the MRM must be designed to withstand the above consumption pattern. Usually, this is done by means of adequate capacitors.

4.5.3.2. GPRS/EDGE operating mode

Typical power consumption pattern for one MRM is as shown on following diagram:

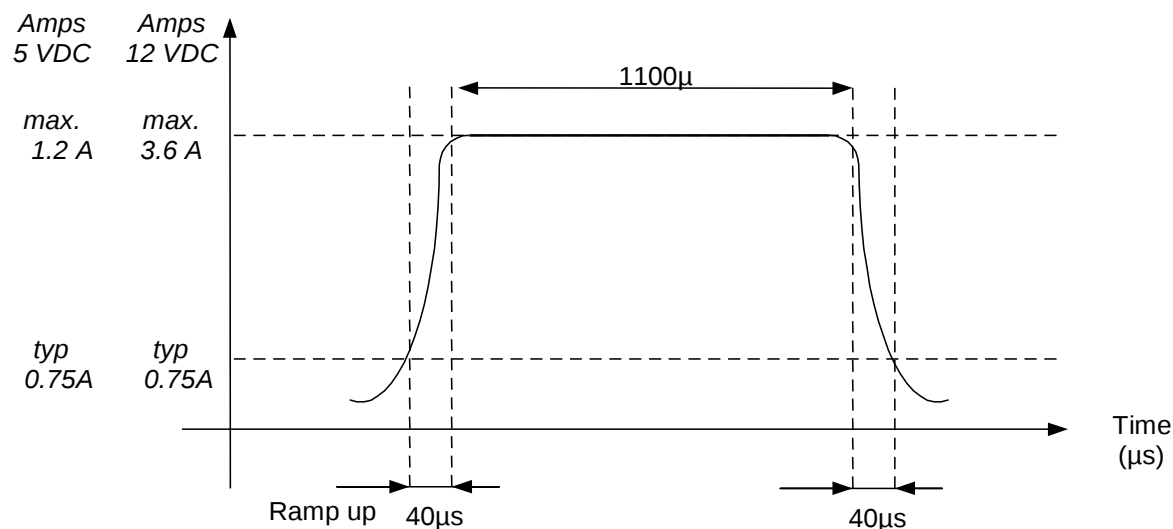


Figure 7. Typical GPRS/EDGE multi slot power consumption

External power supply for the MRM shall be designed to withstand the above consumption pattern. Usually, this is done by means of adequate capacitors.

4.5.4. Residual noise

The maximum amount of noise on the power supply inputs should be less than:

- Up to 200 kHz: 50mVpp on +5VDC, and 100mVpp on +12VDC.
- From 200 kHz to 1800 kHz: 10mVpp on +5VDC, and 10mVpp on +12VDC.
- Above 1 800 kHz: 5mVpp on +5VDC, and 5mVpp on +12VDC.

Source Impedance: < 0.1 Ω (for $\Delta I=3A$).

4.5.5. Rush of current – Switch-in current pulse

The rush of current when the MRM is powered on is:

- 12VDC: $\leq 15A$ for less than 100 μs , $\leq 6A$ for less than 3ms.

Note: The MRM can be powered on with 1A during 50ms, if the power supply has a current limitation.

- 5VDC: $\leq 10A$ for less than 1ms, $\leq 1A$ for less than 10ms.

ATTENTION: plugging and unplugging the MRM into/from the cab radio while power is ON could cause irrevocable failure.

4.6. Radio characteristics

Radio characteristics are compliant with the specifications:

- Class 2 / 8W in R-GSM band (including P-GSM & E-GSM).
- Class E1 / 2W in R-GSM band (including P-GSM & E-GSM).
- Multi-slot class 10.

Some specific points are repeated and completed below. "Normal conditions" are defined by 3GPP TS 05.05 [13] for the GSM 900 as: +15 to +35°C (with relative humidity of 25% to 75%). Outside these temperature and humidity ranges, conditions are considered extreme and the applicable tolerances are those defined by 3GPP TS 05.05 [13] for the GSM 900 assuming "extreme conditions".

Outside these temperature and humidity ranges, GPRS/EDGE operating may be degraded due to heat dissipation as explained below (cf. 4.8.1 Operating Temperature).

4.6.1. Frequency Band

MRM supports the Railway (R-GSM) band (including public E-GSM band).

Table 21. GSM Frequency band

Frequency Band Designation	UpLink (MS TX)	DownLink (MS RX)
R - GSM Band	876 - 915 MHz	921 - 960 MHz
E - GSM Band	880 - 915 MHz	925 - 960 MHz
P - GSM Band	890 - 915 MHz	935 - 960 MHz

4.6.2. Output power

The MRM is a Class 2 - 8W Mobile Station and Class E1 – 2W Mobile Station.

To achieve the best transfer performance in EDGE operating mode, the mobile station should use the 8PSK modulation scheme. When using this modulation scheme, the mobile station is class E1 – 2W (3GPP TS 05.05 [13]).

Nominal Maximum Output Power at the MRM RF connector (GSM 900):

- TX power 8W (39 dBm).
- Tolerance: ± 2 dB in normal conditions and in the UIC band (876 - 880 MHz). See note about normal conditions. The MRM is 3GPP TS 05.05 compliant in extreme conditions.

Note: Normal conditions are defined by 3GPP TS 05.05 [13] for the GSM 900 as: +15 to +35°C (with relative humidity of 25% to 75%). Outside these temperature and humidity ranges, conditions are considered extreme.

4.6.3. Rx sensitivity

Minimal receiver sensitivity level is defined by GSM standard sensitivity (3GPP TS 05.05 [13]).

Reference Sensitivity Level (dBm) at 2,439% RBER (class II)	Warranted (Normative)
	-104

4.6.4. Blocking

The MRM is compliant to the blocking criteria defined by the GSM standard.

4.6.5. Spurious emissions

The MRM is compliant to the spurious criteria defined by the GSM standard.

In the receive band (Rx), the MRM complies with the following table:

Table 22. Spurious specifications

Reception Bands	Spurious emissions for frequencies between 921 and 960 MHz, with a bandwidth of 100 kHz
R-GSM (railways channels)	<-75 dBm for emissions between 876 and 880 MHz <-60 dBm otherwise
E-GSM (Extended GSM channels)	<-67 dBm
P-GSM (GSM channels)	<-79 dBm

4.6.6. High Speed Requirements

At the radio link level, the digital signal processing chain of the module has standard performance, according to 3GPP TS 05.05.

At system level, the high speed performance depends on the infrastructures performance and on the engineering rules applied for the cellular design.

4.6.7. RF Input Max Level

Out of band maximum nondestructive level is 10dBm on the antenna port (receiver input).

4.7. Vocoder

The MRM supports FR, EFR and AMR Vocoders in Full Rate and Half Rate operation.

Note: In ASCII calls, only Speech codec V1 is supported.

4.8. Environmental constraints

Environmental constraints are given for MRM alone.

4.8.1. Operating Temperature

Normal operating conditions:

- +15°C / +35°C.

Extreme operating conditions:

- -25°C / +82,5°C (maximum skin temperature of MRM).

The radio type approval is done at temperature range of -25°C to +82,5°C (maximum skin temperature of the MRM).

Note: Normal operating conditions are defined by 3GPP TS 05.05 [13] for the GSM 900 (MS designed to be vehicle mounted) as: +15°C to +35°C (with relative humidity of 25% to 75%). Extreme conditions are defined by same standard as: -20°C to +55°C. Outside this temperature range the MS, if powered on, shall not make ineffective use of the radio frequency spectrum.

In GSM operating mode, the performances and the functionality of the MRM GPRM1-2 specified in 3GPP TS 05.05 are guaranteed in a temperature range of -25°C to +82.5°C. This means that the ETSI extreme temperature range is extended up [-25°C; +82.5°C].

The multi-slot Class 10 performances specified in 3GPP TS 05.05 are guaranteed in a temperature range of -25°C to +70°C.

Table 23. GPRS/EDGE multislot class limitations

T°C	Multislot Class	Downlink Slots	Uplink Slots	Active Slots
-25°C/+70°C	10	4	2	5

4.8.2. Storage Temperature

- Storage temperature: - 40°C / + 85°C.

Storage temperature: the MT is capable of being stored at temperatures from -40°C up to +85°C without any permanent damage [1].

4.8.3. Gradient of temperature

- Gradient of temperature: $\pm 1^{\circ}\text{C}/\text{min}$.

The MT is capable of coping with temperature variations of up to $\pm 1^{\circ}\text{C}/\text{minute}$ [1], both in normal operation and at the power-up.

4.8.4. Altitude and pressure

The MRM operates correctly at altitudes ranging from -120m to 2000m.

Table 24. Operating altitude and pressure range

	Maximum	Minimum
Altitude	2000m	-120m
Corresponding Pressure	70KPa	106KPa

4.8.5. Relative humidity

The MRM is compliant with [10]:

- $\leq 75\%$ relative humidity for yearly average.
- $\leq 95\%$ relative humidity for thirty consecutive days.
- 100% during a short period (couple of hours).

The maximum absolute humidity is $30 \text{ g}/\text{m}^3$.

In all cases, precautions must be taken to protect the connectors which are not watertight. Water intrusion must be avoided.

4.8.6. Shocks and Vibrations

The following is valid for the MRM in itself, not for an "EIRENE Application Module" including a MRM. The MRM is not designed to support free falls from any height.

The MRM is compliant with:

1. EN 50155 part 10.2.11
 - Sinusoidal vibrations:

Table 25. Operating sinusoidal vibration range

Location of Equipment	Frequency range (Hz)	Amplitude (mm)	Acceleration (g)
Vehicle interior cab	0 to 200	7,5 (peak to peak)	2 (peak)

Note: If the standard test sets do not permit testing between 0 and 5 Hz, the lower limit specification is 5Hz.

2. EIRENE SRS-15.4.0 (parts 4.5.16 to 4.5.20), except for free falls.
 - Shocks :

Table 26. Shocks

	Normal conditions*	Exceptional conditions*
Peak acceleration (g)	3	20
Duration of shocks (ms)	100	1

(*) The shocks are not repetitive (3 shocks in each direction)

- Random vibrations:

Table 27. Random vibrations

Vertical axis	1,4g
Transverse axis	0,7g
Longitudinal axis	0,3g

3. Morane SSRS A 04/22 – T 6002, except for free falls.
4. NF F 01-510 part 7 (application level = body).

4.8.7. EMC

In order to reproduce real life situations, all tests are done with shielded and grounded cables and connectors for the antenna and back-plane interfaces and also with the front plane of the MRM directly connected to ground.

Note: A 20cm distance must be maintained between the product antenna and any person.

4.8.7.1. Immunity

MRM is compliant with EN 50121-3-2 and CEI 61000-4-2 (Level 4 for the front plate of MRM and level 3 for the other parts of MRM).

MRM is compliant with EN 50121-3-2 and CEI 61000-4-9 (Level 5: 1000A/m).

MRM is compliant with CEI 61000-4-12 on antenna access with a level of 1kV common mode.

MRM is compliant with EN 50121-3-2 and CEI 61000-4 – 4 on antenna access with a level of ± 4 kV.

MRM is compliant with EN 301 489-1 and CEI 61000-4 – 4 on LAN/Serial access with a level of ± 0.5 kV.

MRM is compliant with CEI 61000-4-16 on antenna access:

- with level 4 for short duration perturbations,
- with level 1 for continuous perturbations and between 15 Hz and 150 kHz.

MRM is compliant with EN 50121-3-2 and CEI 61000-4 - 6: on antenna access with a level of 3 Vrms.

MRM is compliant with EN 50121-3-2 and CEI 61000-4-3 with a level of 20V/m and frequency ranges from 80 Mhz to 1GHz.

MRM is compliant with EN 50121-3-2 and CEI 61000-4-3 with a level of 10 V/m and frequency ranges from 1.4 GHz to 2 GHz.

MRM is compliant with EN 50121-3-2 and CEI 61000-4-3 with a level of 5 V/m and frequency ranges from 2 GHz to 2.7 GHz.

Note: GSM exclusion bands taken into account are described in ETSI ETS 300 342-1 §4.9 and 4.10.

Note: Narrow band responses, as described in ETSI ETS 300 342 –1 §4.11, are disregarded.

4.8.7.2. Emission

MRM is compliant with

- 3GPP TS 05.05 within the R-GSM band frequencies, EN 50121-3-2 with 3GPP TS 05.05 taking precedence and EN 50081-2 (EN 55022 class B).
- EN 301 511 V9.0.2 (EN 300 607-1 GSM 11-10).

MRM is compliant with EN 55022 (class B) on DC power input (12,3VDC, 5VDC, GND).

4.8.8. Safety

The MRM is compliant with EN 60950-1:2006 + A1:2010 (Incorporating A11:2009).

4.8.9. Other Physical conditions

The MRM is compliant with IP41 (EN 60529) except for the connectors. Connectors of MRM are not water tight and have to be protected against direct sprinkling.

4.8.9.1. Flammability

Connectors, printed boards, plastics are EN 45545-1 and EN 45545-2 (April 2013) compliant.

4.8.10. Compliance to EIRENE SRS V15.4.0 [1] for Environmental constraints

See "MRM_Compliance_List_EIRENE_SRS_V15-4-0.xls" [22].

4.9. Reliability

The MTBF is calculated according to UTEC 80810 (RDFO 2000) at operating temperature of 35°C (skin temperature of MRM) with an operating profile of 24 hours per day (steady state) and 2 cycles per day with a thermal amplitude of 11°C. With this profile, the MTBF of the MRM is 200 000 hours.

MTBF has to be re-evaluated if the real operating profile changes: on/off switches, number of thermal cycles per day, thermal amplitude of this cycles, operating temperature.

MTBF does not take into account failures due to:

- environmental constraints outside of those specified in §4.8,
- degradation of MRM shells,
- issues due to software which form the subject of a separate administration,
- system fault (no fault detected on MRM in after-sales service),
- bad configuration.

The real MTBF is evaluated every 6 months for the 6 month period.

>> 5. Interfaces

5.1. Introduction

MRM provides the following interfaces:

- RF Interface (external antenna input/output).
- LED Interface.
- Serial Data and command Interface.
- TDMA bus with multiplexed voice and data.
- Audio Interface.
- Module Management Interface.
- Maintenance and Test Interface.
- SIM interface.
- Front panel Ethernet Interface.
- Back panel Ethernet Interface.
- Front panel Serial Data and command Interface.
- Front panel SD Card Interface.
- Front panel Micro USB Interface.
- Power Supply Interface.

5.2. RF interface

The MRM is equipped with two antenna connectors that can be used as follows:

- **Combined TX/RX configuration** - Single access configuration (default configuration)
TNC 1: TX/RX in duplex mode
TNC 2: not used
- **Separated TX and Rx configuration** - Dual access configuration
TNC 1: TX only
TNC 2: Rx only

The switch between the two connectors is done thanks to the signal RF_SELECT available on the MRM back-plane connector (C13). It can also be done via an AT command: KRFSELECT (Refer to document [24] "AT Command Set for MRM").

The antenna and connecting cables are not provided by Sierra Wireless.

The MRM is compliant to the radio characteristics defined in chapter 4.6 for both configurations (combined and separated).

5.3. LED interface

See 4.3.2 MRM LED chapter for details.

5.4. ERTMS Serial Data and Command interface

The ERTMS Data and Command signals can be found on the 96 pin back-plane connector (see 4.3.5 Back-Plane connector chapter for details).

Data and Commands are exchanged with the MRM with a V24 serial interface. This serial interface can be used for:

- AT command interface.
- Software download (software update), maintenance and configuration.
- Data/SMS services.

The list of the AT commands supported by the MRM is provided in document [24] "AT Command Set for MRM".

The V24 interface is TTL compatible.

5.4.1. Serial interface signals

The V24 circuits of the MRM, as required ITU-T V25ter and GSM 07.07 (according to GSM 07.02 / 07.03), are:

Table 28. ERTMS serial interface signals

PIN	Circuit Number	Input / Output	Circuit Name	Abbreviation	Level When OPEN
A 22	CT 102	---	Signal Ground	S-GND	---
A 23	CT 103	Input	Transmitted Data	TxD	High
A 24	CT 104	Output	Received Data	RxD	
A 25	CT 102	---	Signal Ground	S-GND	---
B 23	CT 105	Input	Request to Send	RTS	High
B 24	CT 106	Output	Clear To Send	CTS	
B 25	CT 107	Output	Data Set Ready	DSR	
C 23	CT 108/2	Input	Data Terminal Ready	DTR	High
C 24	CT 109	Output	Data Carrier Detect	DCD	
C 25	CT 125	Output	Ring Indicator	RI	

5.4.2. Serial interface signal handling

- **RTS CT105:**

Signal handled by the host for local flow control on the serial interface.

Additional information: the TTL low level (OV), obtained when the circuit is closed (set by the host), corresponds to the information "Go ahead" from the host.

- **CTS CT106:**

Signal handled for local flow control on serial interface.

- **DSR CT107:**

When the DSR is set to ON (low state), it indicates that the MRM is ON and can accept and respond to AT commands.

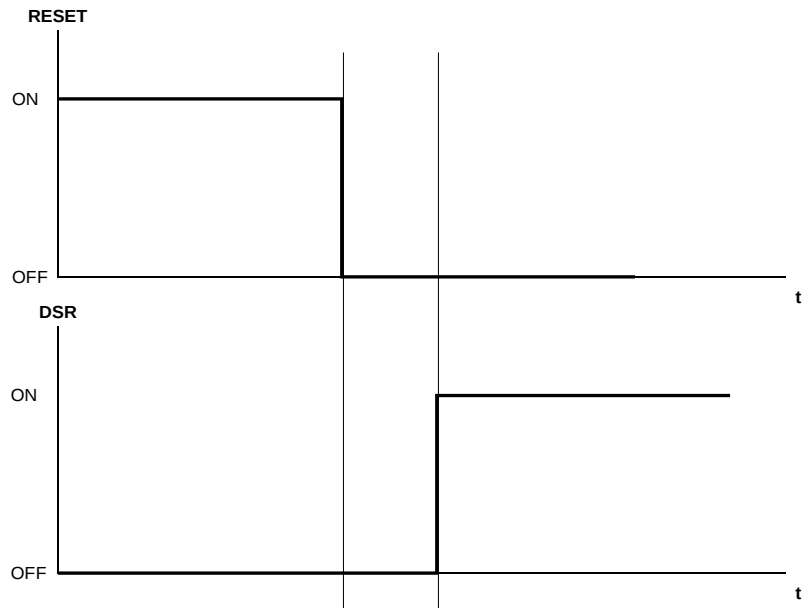


Figure 8. DCR and RESET signal correlation

This signal goes to OFF when:

- the RESET signal (active low state) is activated,
- the internal reset of the MRM,
- the MRM is powered down.

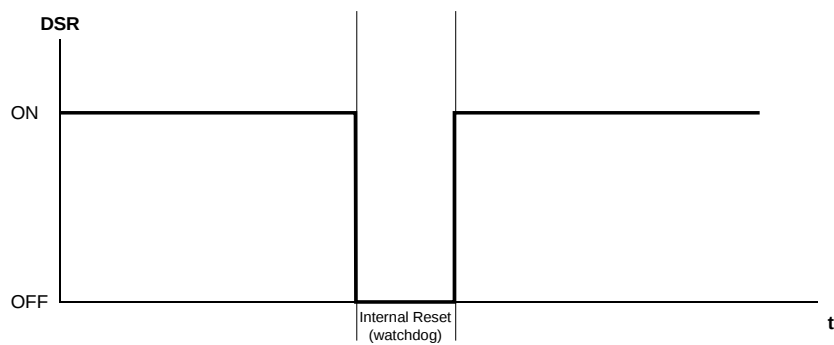


Figure 9. DSR and internal reset

There is no specific timing for this signal.

Note: In the case of a DSR signal not managed by the application, allow for a time-out of 20 seconds after power-on before the MRM responds to the first AT command.

- **DTR CT108/2:**

This signal is used to terminate calls (transition from ON to OFF) (active low state).

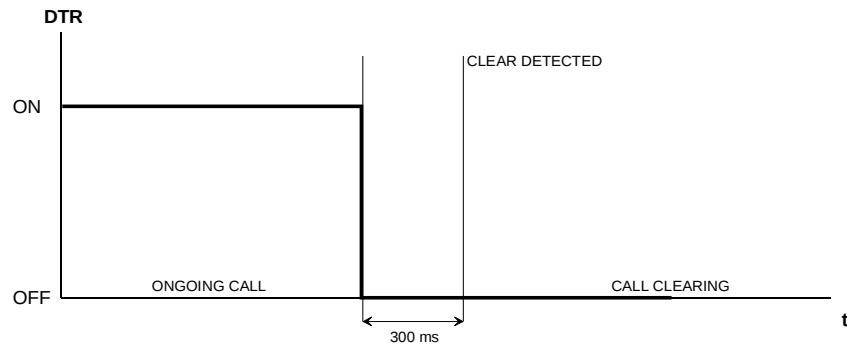


Figure 10. DTR and call termination

This signal is also used to reset the speed of the serial interface data rate to the default factory data rate value (transition from OFF to ON) depending on the MRM configuration (cf. AT command AT&D0).

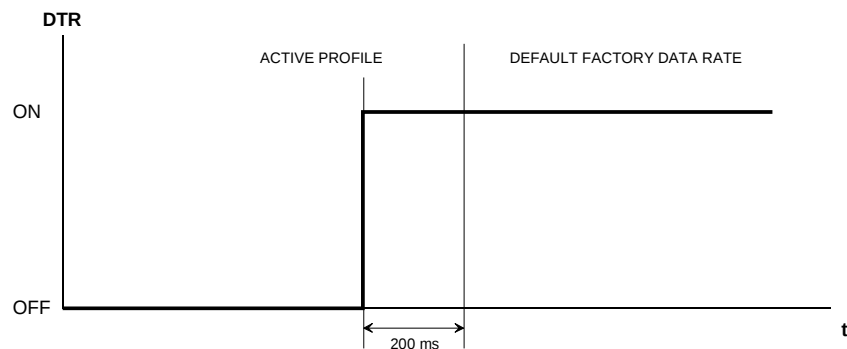


Figure 11. DTR and data rate

- **DCD CT109:**

The message "CONNECT" is sent after activation of the DCD signal (active low state).

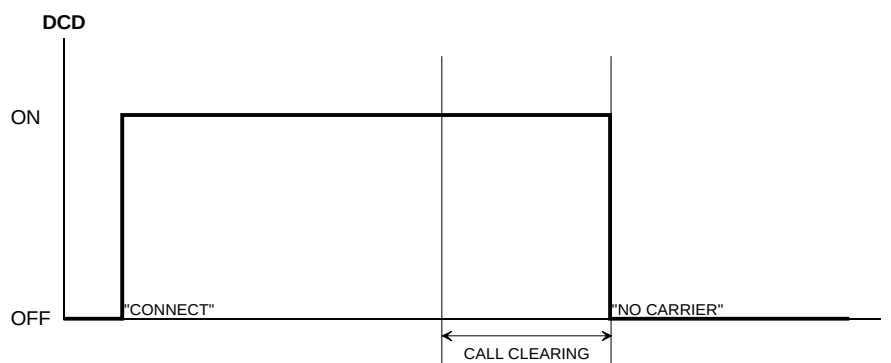


Figure 12. DCD and data call

There is no specific timing for this signal.

Note: For voice communication, there is no DCD.

- **RI CT125:**

RI changes to ON state during minimum 0.5 second at each return code "RING" (active High level).

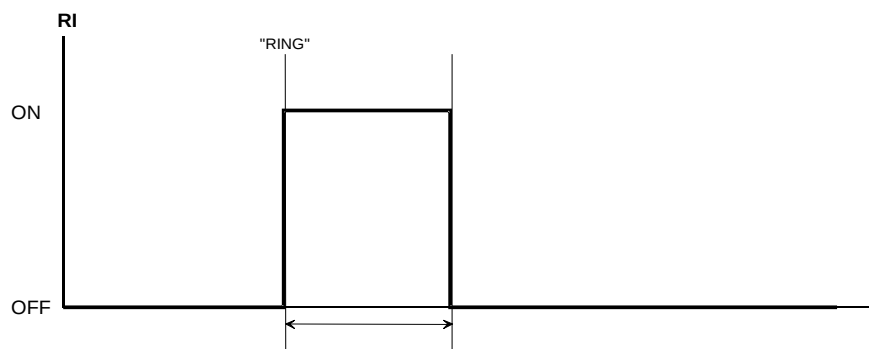


Figure 13. Ring indicator timing

5.4.3. Data Rates

- **AT Serial Interface**

The AT serial interface is a 2.4 to 115.2 Kbps asynchronous serial link. Downloading new software to the MRM is done through this link until 115.2 Kbps.

The default factory data rate for the serial interface is 9600 bps and is set at power on (this default rate may be modified, if explicitly requested by customer, and the value can be set by the factory or by the customer with Sierra Wireless proprietary personalization software).

Although it is possible to modify the active data rate using the +IPR AT command, it is not possible to save and store a different speed.

- **Air Interface**

The default factory data rate for the air interface is 4800 bps transparent (BS25 Transparent for full rate channels), the maximum air data rate is 9600 bps, minimum 2400 bps.

The stored user data rate of the air interface is set at power on.

When the data communication connection is set up, (after transmission of the "CONNECT {DATA_RATE}" message in transparent mode), the data rate of the serial data interface is automatically adapted to the speed of the air interface.

5.5. TDMA BUS: multiplexed voice and data

MRM provides an interface with a TDMA Data Bus.

This TDMA interface is used to multiplex:

- AT command interface
- maintenance and configuration information including software update
- Voice service
- Data/SMS services

The TDMA interface can be used under the following constraints:

- ERTMS interface and TDMA data service cannot be used simultaneously. MRM has to know if ERTMS interface is used or TDMA data service (signal ERTMS Enable). When ERTMS is used, the TDMA bus can always be used to perform signalling communication.
- Analog audio interface and TDMA voice channel cannot be used simultaneously.
- One single MT shall be able to perform both speech and data communication over the TDMA bus but not simultaneously.

5.5.1. TDMA bus structure

TDMA interface is organized in frames.

Each frame is 512 bits long.

The frame duration is 125 μ s, which results in a symbol rate (clock rate) of 4096 kHz.

Each frame is divided into 64 channels called Time Slot. The Time Slots are organized in groups of 4, named cluster. There are 16 clusters in a TDMA frame.

Each Time Slot is 8 bits long. The bit rate of each Time Slot is then 64kbps.

For data transmission (signalling channel and data channel), the transmission order on the 8-bits Time Slot is: LSB first.

For digitalized voice transmission, the transmission order on the 8-bits Time Slot is: MSB first.

5.5.2. TDMA bus signals

There are 4 bus data signals:

- Clock signal
- Frame synchronization signal
- Data signal
- TDMA Frame Enable (TFE)

These signals are available on the back-plane connector and their electrical interface is specified in section 4.4.3.

Signal timings are given:

- at CMOS input of the TDMA driver for signals transmitted by the module
- at CMOS output of the TDMA driver for signals received by the module

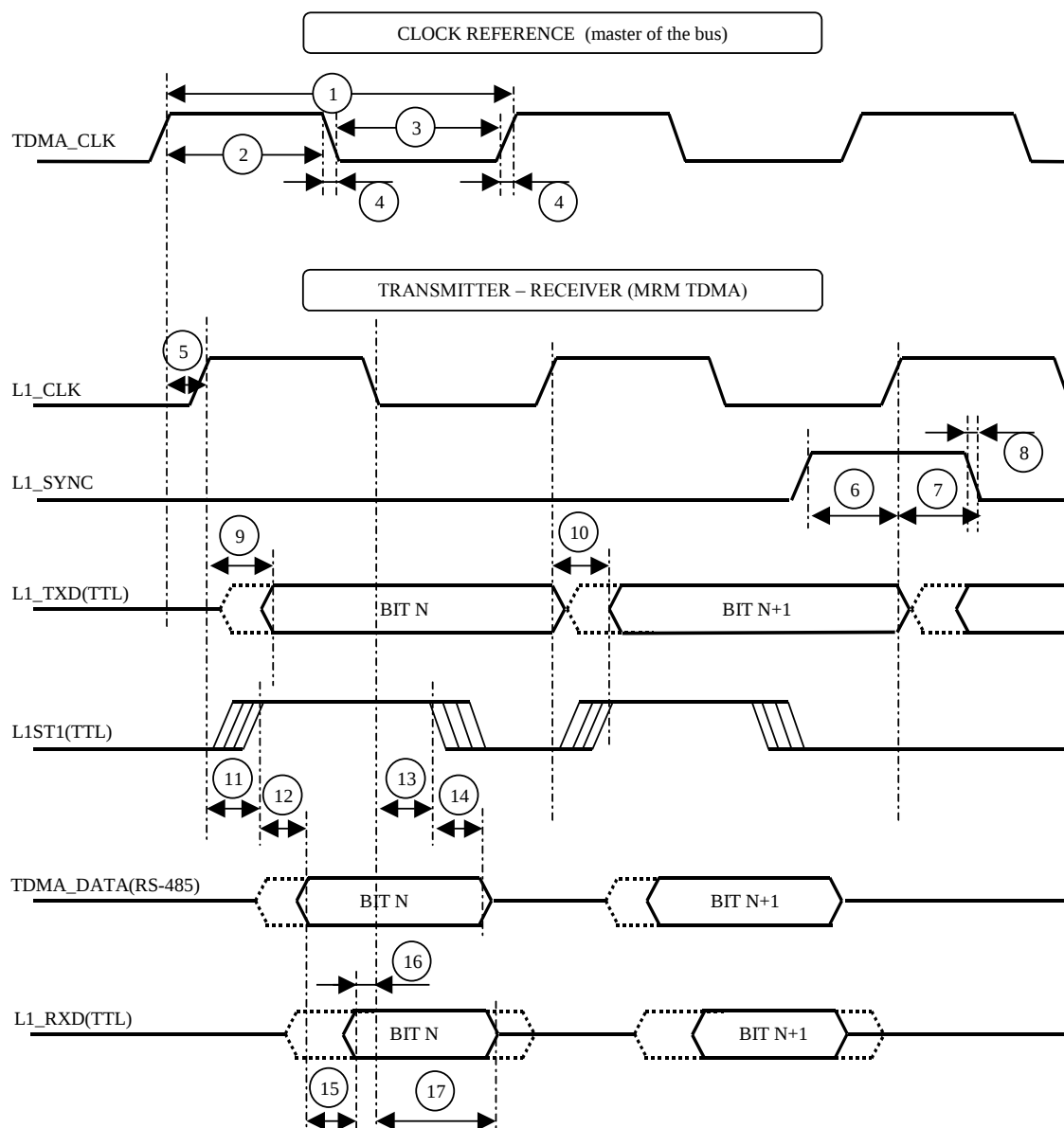


Table 29. TDMA bus signals timings

Param	Description	MIN	TYP	MAX	UNIT
1	Clock period		244		ns
2	Clock high pulse width	107	---	122	ns
3	Clock low pulse width	107	---	122	ns
4	Clock rise/fall time	---	---	15	ns
5	Receiver propagation delay for clock signal	18	25	40	ns
6	Synchronization setup time	20	---	---	ns
7	Synchronization hold time	35	---	---	ns
8	Synchronization rise/fall time	---	---	15	ns
9	Transmitted data valid	0	---	55	ns
10	Clock rising edge to transmitter in high impedance time	0	---	42	ns
11	Clock rising edge to TFE rising edge time	0	---	45	ns
12	TFE rising edge to data setup time (at RS-485 level)	10	---	25	ns
13	Clock falling edge to TFE falling edge time	0	---	45	ns
14	TFE falling edge to DATA in high impedance time (at RS-485 level)	0	---	42	ns
15	Receiver propagation delay for data signal	18	25	40	ns
16	Received DATA setup time	17	---	---	ns
17	Received DATA hold time	13	---	---	ns

- **Clock signal:** Clock signal has a typical period of 244,140625 ns.
- **Frame synchronization signal:**
 - The frame synchronization signal has a typical period of 125 μ s.
 - The frame synchronization signal is active high.
 - The frame synchronization signal is sampled on the rising of the clock
- **Data signal:**
 - TDMA data is received on the falling edge of the clock signal
 - TDMA data is transmitted on the rising edge of clock signal.
 - L1ST is the command signal that enables the TFE on the bus
- **TFE:** TFE signal is asserted when the MRM is accessing the TDMA bus in write mode.

5.5.3. TDMA bus Time Slot Assignment

The MRM uses three independent half duplex logical channels to exchange on the bus:

- Signalling information : one time slot to read and one other to write
- Data/commands : one time slot to read and one other to write
- Digitalized voice : one time slot to read and one other to write

The Time Slots that are written by the MRM all belong to the same cluster.

The cluster number corresponds to the physical address (see **Error! Reference source not found.**). It shall be between 6 and 9.

The first Time Slot of the cluster is used to transmit on the signalling channel. The second one is used to transmit on the data channel. The third one is used to transmit on the voice channel.

The Time Slots read by the MRM are organized as follows:

- The MRM always read Time Slot 0, i.e. the first Time Slot of the first cluster, in order to receive on the signalling channel.
- The MRM shall be able to read any Time Slot of the bus to receive voice service or data service (not simultaneously). The Time Slot number to be read is indicated through the signalling channel.

If the Time Slot used to receive data (respectively voice) is changed during a data communication (respectively a voice communication), the communication will be broken.

5.5.4. Physical address

The MRM is addressed by means of the 4 dedicated signals Slot Code 0 to Slot Code 3 specified in **Error! Reference source not found. Error! Reference source not found.**

Slot Code 0 on A6 pin (see **Error! Reference source not found. Error! Reference source not found.**) defines the LSB of the 4-bit slot code.

5.5.5. Protocols over the TDMA bus channels

- the protocol stack over the TDMA signalling channel is specified in the document 5529.1 – 014 – 66043 edition 01 “MRM Signalling Interface on TDMA bus”
- the protocol stack over the TDMA data channel is specified in the document 5529.1 – 013 – 66042 edition 01 “MRM Data Interface on TDMA bus”
- the protocol stack over the TDMA speech channel is specified in the document 5529.1 – 012 – 66041 edition 01 “MRM Voice Interface on TDMA bus”

5.6. Audio interface

The MRM provides an analogue Audio IN and Audio OUT interface, this is required to transfer speech between a remote speech application (e.g. handset, microphone, and speaker) and the MRM.

The MRM supports FR (Full speech Rate) and EFR (Enhanced Full speech Rate) and AMR Vocoders.

Note: In ASCII calls, only Speech codec V1 is supported.

The standard audio analogue interface is symmetric. It uses A28 + A29 + A30 + A31 for Input, and B28 + B29 + B30 + B31 for Output.

Table 30. Audio Interface

PIN	Circuit Name	Input / Output	Abbreviation
A 28	Signal Ground	---	S-GND
A 29	Audio IN – Wire A	Input	AI WA
A 30	Audio IN – Wire B	Input	AI WB
A 31	Signal Ground	---	S-GND
B 28	Signal Ground	---	S-GND
B 29	Audio OUT – Wire A	Output	AO WA
B 30	Audio OUT – Wire B	Output	AO WB
B 31	Signal Ground	---	S-GND

Levels when open of Audio IN Wire A and Audio IN Wire B are at level LOW.

5.7. Module Management Interface

For improved MRM management, additional signals are provided:

Table 31. Module Management Interface

PIN	Circuit Name	Input / Output	Abbreviation	Level When OPEN
A 27	Temperature Sensor	Output	TEMP.	---
B 12	STANDBY the MRM	Input	STANDBY	High
C 12	RESET of the MRM	Input	RESET	High
C 22	Push To Talk	Input	PTT	High
C 28	Download Enable	Input	DOWNLOAD	High
A 12	ERTMS Enable	Input	ERTMS	High
B 13	Power Fail	Input	POWER	High
C 13	RF_SELECT	Input	RF_SELECT	High
C 29	Ground	---	S-GND	---

5.7.1. Temperature sense output

Temperature sense is an analogue output that provides a voltage proportional to the temperature inside the MRM.

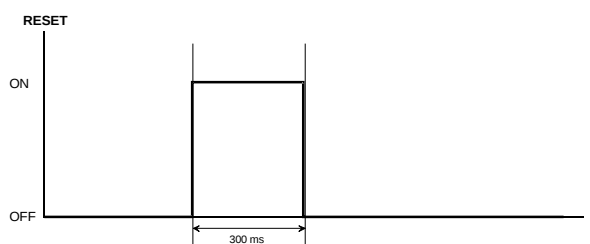
This sensor gives an indication of the temperature inside the MRM. It can be used as a means to prevent temperatures from going too low or too high. When the MRM reaches the limit of the operating temperature range, active cooling could be used to keep the MRM within that range. If active cooling is not possible, then the MRM could be powered down, or put in RESET mode (RESET signal active), until the temperature returns to normal.

5.7.2. RESET and STANDBY command

The RESET signal can be used to reset the MRM from outside. This action powers down all internal power sources, resulting in a complete reset of the MRM.

This signal must be used when resetting the MRM software stacks.

An upholding active on RESET of 300ms is needed for the Reset to be effective. The active state is ON (Low level).



If the MRM is reset by turning off the power supply, then it is necessary to wait at least 1 second before turning the power on again.

It is possible to keep the MRM in RESET mode for a longer time period by keeping the MRM RESET input signal active (when the RESET input is active, the MRM is internally powered down).

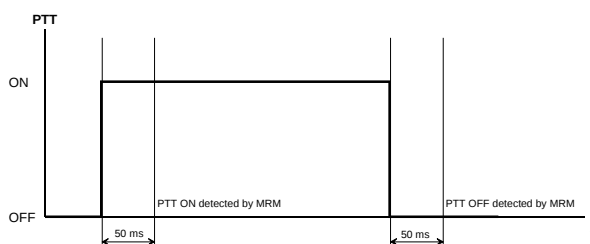
When the RESET is OFF, the MRM can answer correctly to commands when the DSR signal goes back to ON.

5.7.3. PTT (Push To Talk) command

The Push To Talk signal can be used to manage PTT functions instead of the corresponding AT command. The PTT signal is taken into account only for specific types of services such as VGCS. In other cases it is not handled.

When the PTT signal is used, no "uplink grant" acknowledgement is delivered by the MRM. The active state is ON (Low level).

An upholding active/inactive on PTT of 50ms is needed for the PTT to be registered by the MRM. After that, the MRM processes the information and sends the corresponding request to the network.



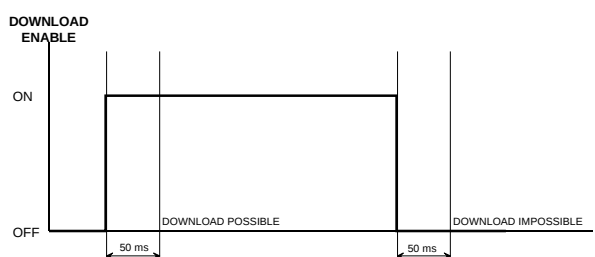
The push-to-talk function can be activated with the AT command +CAPTT. This command should be preferred to the use of the PTT signal.

Do not alternate the use of the PTT signal and AT command +CAPTT to manage push-to-talk feature. One method has to be chosen.

Note: It is the network that decides the attribution of the uplink, therefore activating the PTT does not necessarily lead to the attribution of the uplink to the MRM.

5.7.4. DOWNLOAD_ENABLE command

This signal is used to allow or forbid software download on maintenance interface (refer to 6.7 for details on downloading procedures). The active state is ON (LOW level).



It is possible to start the download procedure 50ms after the DOWNLOAD_ENABLE signal is ON. It is not possible to download 0ms after the DOWNLOAD_ENABLE signal is OFF.

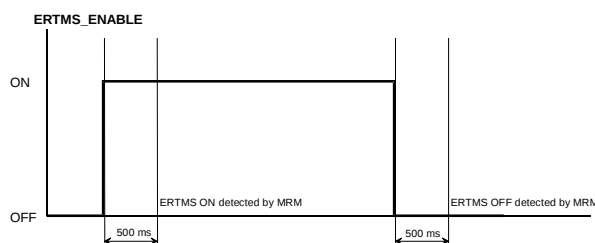
5.7.5. ERTMS_ENABLE command

ERTMS_ENABLE signal can be used to switch the AT commands interface and the Data/SMS GSM services from the TDMA data channel (see section **Error! Reference source not found.**) to the V24 RTMS-channel described in section **Error! Reference source not found.**

If such switching is performed during a Data/SMS communication or while the MRM is receiving AT commands, the communication will be lost and the AT commands won't be answered correctly by the MRM.

The active state is ON (Low level).

An upholding active/inactive on ERTMS_ENABLE of 500ms is needed for the ERTMS_ENABLE to be registered by the MRM.



After that, the MRM will process the information and switch the Data/SMS GSM services and the AT commands interface according to the following table:

Table 32. ERTMS enable

Command state	ACTIVE	INACTIVE
Channel for AT commands and Data/SMS GSM service	V24	TDMA data channel

5.7.6. Power Fail command

This signal is not used and is then not handled by the module and considered as reserved.

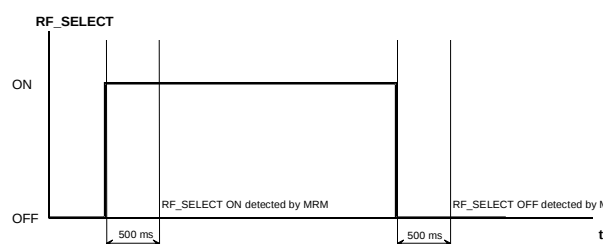
5.7.7. RF_SELECT command

The RF_SELECT signal can be used to configure the RF interface either in “combined TX/Rx” single access mode, or in “separated TX and Rx” dual access mode as described in section 5.2.

If such switching is performed during a communication, the communication will be lost.

The active state is ON (Low level).

An upholding active/inactive on RF_SELECT of 500ms is needed for the RF_SELECT to be registered by the MRM.



After that, the MRM will process the information and switch the configuration of the RF interface according to the following table:

Table 33. RF_SELECT

Command state	ACTIVE	INACTIVE
RF access mode	Dual	Single

5.8. Maintenance and Test Interface

The maintenance and test interface allows the connection of an external PC (not supplied) for maintenance, download, configuration and diagnostic. Whenever the MRM is integrated in an application, this interface should be made accessible from the outside for easier on-site diagnostic and maintenance, the interface needs to be properly protected.

5.8.1. Serial Interface Signals

This interface is composed of an asynchronous serial interface compliant with V24-ITU-T recommendation and provides CT103 (Tx) and CT104 (Rx) signals in the form of compatible TTL logic.

Table 34. Maintenance Serial Interface

PIN	Circuit Number	Input / Output	Circuit Name	Abbreviation	Level When OPEN
C 29	---	---	Signal Ground	S-GND	---
C 30	CT 104	Output	Received Data	RxD	
C 31	CT 103	Input	Transmitted Data	TxD	High

5.8.2. Serial Interface Data Rates

The RXD and TXD maintenance interface is a 2.4 to 115.2 kbps asynchronous serial link.

5.9. SIM Interface

The SIM interface is specified in ETSI ETS 300 641 (GSM 11.12 V4.3.1).

Note: The MRM supports 3V SIM cards only.

5.10. Front Panel Ethernet interface

The front panel Ethernet interface is specified in IEEE 802.3i [20].

This Ethernet interface must be used for short distance link and may not be connected to an Ethernet network which goes outside the building.

Note: The MRM supports 10Mb/s interface.

Table 35. Front Panel Ethernet Interface

PIN	Circuit Name	Input / Output	Abbreviation	Level When OPEN
7	Ethernet 1 RX+	Input	ETH0_RX_P	---
11	Ethernet 1 RX-		ETH0_RX_N	---
1	Ethernet 1 TX+	Output	ETH0_TX_P	---
6	Ethernet 1 TX-		ETH0_TX_N	---

5.11. Back Panel Ethernet interface

The back panel Ethernet interface is specified in IEEE 802.3i [20].

Note: The MRM supports 10Mb/s interface.

Table 36. Back Panel Ethernet Interface

PIN	Circuit Name	Input / Output	Abbreviation	Level When OPEN
A3	Ethernet 0 RX+	Input	ETH0_RX_P	---
A4	Ethernet 0 RX-		ETH0_RX_N	---
B3	Ethernet 0 GND	---	ETH0_GND	---
B4				
C3	Ethernet 0 TX+	Output	ETH0_TX_P	---
C4	Ethernet 0 TX-		ETH0_TX_N	---

5.12. Front Panel Serial Data and Command Interface

The Front panel Data signals can be transferred via the 15 pin front-plane connector (see 4.3.4 for details).

Data are exchanged with the MRM via a RS232 serial interface. This serial interface can be used for:

- AT command interface.
- Software download (software update), maintenance and configuration.
- Data/SMS services.

The list of the AT commands supported by the MRM is given in the document "AT Command Set for MRM".

5.13. Front Panel SD Card Interface

The Front panel SD Card signals can be transferred via the 15 pin front-plane connector (see 4.3.4 for details).

This SD Card interface can be used for trace feature.

5.14. Front Panel Micro USB Interface

The micro USB interface is only used by the factory. It allows the connection of an external PC for maintenance, download, configuration and diagnostic. Whenever the MRM is integrated in an application, this interface should be made accessible from the outside for easier on-site diagnostic and maintenance, the interface needs to be properly protected.



6. Functional Description

6.1. Factory Settings of the MRM

When the MRM is delivered, the module is configured with factory settings that are open to evolution or improvement. The current factory settings are:

- Air interface speed of 4800 bps B27
- Serial link speed of 9600 bps +IPR=9600 (may be modified on customer request)
- Transparent Mode \N0
- Echo ON E1
- Display messages on computer Q0
- Text Mode V1
- CONNECT message only \V0
- PDU mode +CMGF0
- Answer a call after 1 ring S00:001
- +++ inhibited S02:128
- Hardware flow control &K3
- DTR used &D2
- DCD used &C1
- Not extended format of RING +CRC0
- Automatic network selection +COPS=0
- Result code selection is active X1
- All intermediate (except CONNECT message) and unsolicited result codes are disabled:
 - +CCWA0
 - +CLIP0
 - +COLP0
 - +CREG0
 - +CR0
 - +CSSI0
 - +CSSU0
 - +CMER0
 - +CIEV0
 - +CKEV0
 - +CCCM1 (+CAOC1)
- Default IP address 10.10.10.3
- DHCP client disabled
- Gateway operating mode disabled
- GPRS default configuration disabled
- EDGE default configuration disabled

AT&F command recovers factory configuration.

ATZ command resets module to the stored profile. The module is stored to the user profile at start-up. The default settings are same for both factory and user profile when module is used for the first time.

Refer to 6.2 for more details on AT command.

6.2. AT Command interface

The operating functions of the MRM are implemented in the base unit in which the MRM is integrated. The description for each command is given in the document "AT Command Set for MRM". For a proper use of the MRM, an initialization sequence of AT commands must be sent to configure all the required settings.

6.3. Services

See MRM Compliance EIRENE SRS V15.4.0 [22] for further information.

6.4. EIRENE Railway Specific Services

The EIRENE features are designed to fulfill the requirements of Railway applications. These features are not handled directly by the MRM but by the base unit in which it is integrated, i.e. the CAB radio of locomotives or "EIRENE Application Module", using the appropriate AT commands.

All EIRENE specific information in the SIM card can be read/write using the appropriate AT command.

6.4.1. Functional Addressing

Implementation of functional numbering is based on GSM standard USSD and UUS1 features (air interface and AT command). There are no specific requirements for Functional Addressing in MRM terminals. Registration and de-registration of a functional number is made by the "EIRENE Application Module".

The MRM does not contain batteries. So, at the power down, the "EIRENE Applications Module" has to de-register all FN registered in the SIM card. To know which FN is present in the SIM card, the "EIRENE Applications Module" uses the appropriate AT command to read the list of FN in the SIM card. After reading this list, the "EIRENE Applications Module" has to de-register each FN (except the engine number).

At the power on, the "EIRENE Applications Module" has to verify that no FN is present in the list of FN of the SIM card. If it is not the case, the "EIRENE Applications Module" has to de-register each FN.

6.4.2. Location Dependent Addressing

The location of the caller is provided by the network or the "EIRENE Application Module", transparently for the MRM. No specific location device is supported by the MRM to indicate the location. Location dependent addressing is applicable to the "EIRENE Application Module" only, not to MRM.

6.4.3. Shunting Mode

The Shunting Mode function is managed by the "EIRENE Application Module" through the AT command set, not by the MRM.

Since shunting is based on GSM standard ASCI features, no specific feature or hardware is implemented in the MRM to support shunting. The Shunting Link Assurance Signal mechanism is still to be defined. Once it is defined, MRMs already manufactured may not support the Link Assurance Signal.

For shunting, there is only a standard functional approval by the customer, with no theoretical proof of safety required.

6.4.4. Multiple Driver Communications

This feature is managed by the "EIRENE Application Module" through the AT command set, and is based on GSM Multiparty Service.

6.4.5. Railway Emergency Call

This feature is handled by the "EIRENE Application Module" which is external to the MRM, through the AT command set, based on the GSM standard features. The confirmation of high priority calls is based on the UUS1 GSM supplementary services.

Note: No timing is managed by the MRM (time stamp of the call confirmation). The confirmation of high priority calls is not supported by the MRM.

6.5. Compliance to 3GPP 51.010-2 V7.5.0

6.5.1. Mobile type

Item	Release	Type of Mobile Station	Supported
1	Ph2	Standard GSM Band (P-GSM)	☐
2	Ph2	Extended GSM Band (E-GSM), (including standard Band)	☐
3	R96	R-GSM Band (including standard and E-GSM Band)	☒
4	Ph2	GSM 1800 band	☐
5	Ph2	Multiple-band, not simultaneously	☐
6	Ph2	Multiple-band, simultaneously	☐
7	Ph2	Small Mobile Station	☐
8	Ph2	GSM Power Class2	☒
9	Ph2	GSM Power Class3	☐
10	Ph2	GSM Power Class4	☐
11	Ph2	GSM Power Class5	☐
12	Ph2	DCS Power Class1	☐
13	Ph2	DCS Power Class2	☐
14	Ph2	DCS Power Class3	☐
15	R96	HSCSD Multislot MS	☐
16	R99	GSM 450 band	☐
17	R99	GSM 480 band	☐
18	R98	GSM 1900 band	☐
19	R98	GSM 1900 Power Class1	☐
20	R98	GSM 1900 Power Class2	☐
21	R98	GSM 1900 Power Class3	☐
22	R96	Multislot Class1	☐

Item	Release	Type of Mobile Station	Supported
23	R96	Multislot Class2	☐
24	R96	Multislot Class3	☐
25	R96	Multislot Class4	☐
26	R96	Multislot Class5	☐
27	R96	Multislot Class6	☐
28	R96	Multislot Class7	☐
29	R96	Multislot Class8	☐
30	R96	Multislot Class9	☐
31	R96	Multislot Class10	☐
32	R96	Multislot Class11	☐
33	R96	Multislot Class12	☐
34	R96	Multislot Class13	☐
35	R96	Multislot Class14	☐
36	R96	Multislot Class15	☐
37	R96	Multislot Class16	☐
38	R96	Multislot Class17	☐
39	R96	Multislot Class18	☐
40	R97	Multislot Class19	☐
41	R97	Multislot Class20	☐
42	R97	Multislot Class21	☐
43	R97	Multislot Class22	☐
44	R97	Multislot Class23	☐
45	R97	Multislot Class24	☐
46	R97	Multislot Class25	☐
47	R97	Multislot Class26	☐
48	R97	Multislot Class27	☐
49	R97	Multislot Class28	☐
50	R97	Multislot Class29	☐
51	R97	GPRS Multislot operation	☒
52	R99	EGPRS capable of 8PSK in Uplink, of all Multislot classes	☒
53	Rel-4	GSM 700 band	☐
54	Rel-4	GSM 750 band	☐
55	R99	GSM 850 band	☐
56	R99	Support of UTRAN Radio Access Technology	☐
57	R97	Support of GPRS Multislot class on the uplink	☒
58	R99	Support of COMPACT	☐
59	R99	DTM/GPRS Multislot Class1	☐
60	R99	DTM/GPRS Multislot Class5	☐
61	R99	DTM/GPRS Multislot Class9	☐
62	R99	Support of singleslot allocation in DTM/GPRS	☐
63	R99	Support of UTRAN FDD	☐
64	R99	Support of UTRAN TDD	☐
65	R98	Support of Conventional GPS	☐

Item	Release	Type of Mobile Station	Supported
66	R99	EGPRS Multislot operation	☒
67	R97	GPRS Multislot Class1	☐
68	R97	GPRS Multislot Class2	☐
69	R97	GPRS Multislot Class3	☐
70	R97	GPRS Multislot Class4	☐
71	R97	GPRS Multislot Class5	☐
72	R97	GPRS Multislot Class6	☐
73	R97	GPRS Multislot Class7	☐
74	R97	GPRS Multislot Class8	☐
75	R97	GPRS Multislot Class9	☐
76	R97	GPRS Multislot Class10	☒
77	R97	GPRS Multislot Class11	☐
78	R97	GPRS Multislot Class12	☐
79	R97	GPRS Multislot Class13	☐
80	R97	GPRS Multislot Class14	☐
81	R97	GPRS Multislot Class15	☐
82	R97	GPRS Multislot Class16	☐
83	R97	GPRS Multislot Class17	☐
84	R97	GPRS Multislot Class18	☐
85	R97	GPRS Multislot Class19	☐
86	R97	GPRS Multislot Class20	☐
87	R97	GPRS Multislot Class21	☐
88	R97	GPRS Multislot Class22	☐
89	R97	GPRS Multislot Class23	☐
90	R97	GPRS Multislot Class24	☐
91	R97	GPRS Multislot Class25	☐
92	R97	GPRS Multislot Class26	☐
93	R97	GPRS Multislot Class27	☐
94	R97	GPRS Multislot Class28	☐
95	R97	GPRS Multislot Class29	☐
96	R99	EGPRS Multislot Class1	☐
97	R99	EGPRS Multislot Class2	☐
98	R99	EGPRS Multislot Class3	☐
99	R99	EGPRS Multislot Class4	☐
100	R99	EGPRS Multislot Class5	☐
101	R99	EGPRS Multislot Class6	☐
102	R99	EGPRS Multislot Class7	☐
103	R99	EGPRS Multislot Class8	☐
104	R99	EGPRS Multislot Class9	☐
105	R99	EGPRS Multislot Class10	☒
106	R99	EGPRS Multislot Class11	☐
107	R99	EGPRS Multislot Class12	☐
108	R99	EGPRS Multislot Class13	☐

Item	Release	Type of Mobile Station	Supported
109	R99	EGPRS Multislot Class14	☐
110	R99	EGPRS Multislot Class15	☐
111	R99	EGPRS Multislot Class16	☐
112	R99	EGPRS Multislot Class17	☐
113	R99	EGPRS Multislot Class18	☐
114	R99	EGPRS Multislot Class19	☐
115	R99	EGPRS Multislot Class20	☐
116	R99	EGPRS Multislot Class21	☐
117	R99	EGPRS Multislot Class22	☐
118	R99	EGPRS Multislot Class23	☐
119	R99	EGPRS Multislot Class24	☐
120	R99	EGPRS Multislot Class25	☐
121	R99	EGPRS Multislot Class26	☐
122	R99	EGPRS Multislot Class27	☐
123	R99	EGPRS Multislot Class28	☐
124	R99	EGPRS Multislot Class29	☐
125	R99	GSM 850 Power Class2	☐
126	R99	GSM 850 Power Class3	☐
127	R99	GSM 850 Power Class4	☐
128	R99	GSM 850 Power Class5	☐
129	R99	8-PSK GSM Power ClassE1	☒
130	R99	8-PSK GSM Power ClassE2	☐
131	R99	8-PSK GSM Power ClassE3	☐
132	R99	8-PSK DCS Power ClassE1	☐
133	R99	8-PSK DCS Power ClassE2	☐
134	R99	8-PSK DCS Power ClassE3	☐
135	R99	8-PSK PCS Power ClassE1	☐
136	R99	8-PSK PCS Power ClassE2	☐
137	R99	8-PSK PCS Power ClassE3	☐
138	R99	8-PSK GSM 850 Power ClassE1	☐
139	R99	8-PSK GSM 850 Power ClassE2	☐
140	R99	8-PSK GSM 850 Power ClassE3	☐
141	R99	GSM850 and GSM1800 Band Interworking	☐
142	R99	GSM900 and GSM1900 Band Interworking	☐
143	R99	GSM850 and GSM900 Band Interworking	☐
144	R99	DTM/EGPRS Multislot Class1	☐
145	R99	DTM/EGPRS Multislot Class5	☐
146	R99	DTM/EGPRS Multislot Class9	☐
147	R99	Support of singleslot allocation in DTM/EGPRS	☐
148	R99	DTM/GPRS Multislot Class11	☐
149	Rel-5	GPRS Multislot Class30	☐
150	Rel-5	GPRS Multislot Class31	☐
151	Rel-5	GPRS Multislot Class32	☐

Item	Release	Type of Mobile Station	Supported
152	Rel-5	GPRS Multislot Class33	☐
153	Rel-5	GPRS Multislot Class34	☐
154	Rel-5	GPRS Multislot Class35	☐
155	Rel-5	GPRS Multislot Class36	☐
156	Rel-5	GPRS Multislot Class37	☐
157	Rel-5	GPRS Multislot Class38	☐
158	Rel-5	GPRS Multislot Class39	☐
159	Rel-5	GPRS Multislot Class40	☐
160	Rel-5	GPRS Multislot Class41	☐
161	Rel-5	GPRS Multislot Class42	☐
162	Rel-5	GPRS Multislot Class43	☐
163	Rel-5	GPRS Multislot Class44	☐
164	Rel-5	GPRS Multislot Class45	☐
165	Rel-5	EGPRS Multislot Class30	☐
166	Rel-5	EGPRS Multislot Class31	☐
167	Rel-5	EGPRS Multislot Class32	☐
168	Rel-5	EGPRS Multislot Class33	☐
169	Rel-5	EGPRS Multislot Class34	☐
170	Rel-5	EGPRS Multislot Class35	☐
171	Rel-5	EGPRS Multislot Class36	☐
172	Rel-5	EGPRS Multislot Class37	☐
173	Rel-5	EGPRS Multislot Class38	☐
174	Rel-5	EGPRS Multislot Class39	☐
175	Rel-5	EGPRS Multislot Class40	☐
176	Rel-5	EGPRS Multislot Class41	☐
177	Rel-5	EGPRS Multislot Class42	☐
178	Rel-5	EGPRS Multislot Class43	☐
179	Rel-5	EGPRS Multislot Class44	☐
180	Rel-5	EGPRS Multislot Class45	☐
181	---	Void	☐
182	Rel-7	GSM 710 band	☐
183	Rel-7	T GSM 810 band	☐
184	Rel-4	DTM/EGPRS Multislot Class11	☐
185	Rel-6	T-GSM 380 band	☐
186	Rel-6	T-GSM 410 band	☐
187	Rel-6	T-GSM 900 band	☐
188	R99	EGPRS Multislot Operation in Uplink Direction	☒

6.5.2. Mobile Station Feature

Item	Release	Mobile Station Feature	Supported
1	Ph2	Display of Called Number	☒
2	Ph2	Indication of Call Progress Signals	☒
3	Ph2	Country / PLMN Indication	☒
4	Ph2	Country / PLMN Selection	☒
5	Ph2	Keypad	☒
6	Ph2	IMEI	☒
7	Ph2	Short Message Overflow Indication	☒
8	Ph2	DTE /DCE Interface	☒
9	Ph2	ISDN "S" Interface	☒
10	Ph2	International Access Function	☒
11	Ph2	Service Indicator	☒
12	Ph2	Autocalling restriction capabilities	☒
13	Ph2	Dual Tone Multi Frequency function	☒
14	Ph2	Subscription Identity Management	☒
15	Ph2	On / Off switch	☒
16	Ph2	Subaddress	☐
17	Ph2	Support of Encryption A5/1	☒
18	---	Void	☐
19	Ph2	Short Message Service Cell Broadcast DRX	☐
20	Ph2	Abbreviated Dialling	☒
21	Ph2	Fixed Number Dialling	☒
22	Ph2	Barring of Outgoing Calls	☒
23	Ph2	DTMF Control Digits Separator	☒
24	Ph2	Selection of Directory No in Short Messages	☐
25	Ph2	Last Numbers Dialed	☒
26	Ph2	At least one autocalling feature	☒
27	Ph2	Alphanumeric display	☒
28	Ph2	Other means of display	☒
29	Ph2	Speech indicator	☒
30	R96	Support of the extended Short message cell broadcast channel	☐
31	R96	Support of Additional Call Set-up MMI Procedures	☐
32	R96	Network Identity and Timezone	☐
33	Ph2	Ciphering Indicator	☒
34	R96	Network's indication of alerting in the MS \$(NI Alert in MS)\$	☐
35	R96	ME-SIM lock	☒
36	R96	Service Dialling Numbers	☒
37	R99	Extended timing advance	☐
38	R98	Support of SoLSA	☐
39	R96	Audible Indication of Service Tones	☒
40	Ph2	Autocalling_Cause 27 Implemented in Cat 3	☒
41	R97	Support of GPRS	☒

Item	Release	Mobile Station Feature	Supported
42	R99	Support of EGPRS	☒
43	R98	Support of GPRS Encryption	☒
44	Ph2	Control of Supplementary Services	☒
45	Ph2	Short message	☒
46	Ph2	Emergency calls capabilities	☒
47	R97	GPRS operation mode class A	☐
48	R97	GPRS operation mode class B	☒
49	R97	GPRS operation mode class C	☐
50	R99	MS supporting SMS over GPRS	☐
51	---	void	☐
52	---	Void	☐
53	R99	Support of ECSD	☐
54	R97	GPRS test mode A	☒
55	R97	GPRS test mode B	☐
56	---	EGPRS test mode	☒
57	R98	Support of MS-Assisted E-OTD	☐
58	R97	Non-zero value of Non_DRX_Timer	☒
59	R98	Support of MS-Based GPS	☐
60	R98	Support of MS-Assisted GPS	☐
61	R98	Privacy Option Supported	☐
62	R99	Support of DTM/GPRS	☐
63	R98	Support MS Assisted EOTD Performance for GMSK	☐
64	R99	Support MS Assisted EOTD Performance for 8PSK	☐
65	R99	Support of EGPRS Packet Access enhancement	☒
66	---	void	☐
67	R99	Support of MT SMS over GPRS	☐
68	---	void	☐
69	R99	Support of DTM/EGPRS	☐
70	R99	Support of Extended dynamic allocation	☐
71	Rel-6	Support of GAN	☐
72	Rel-4	Support of GERAN FEATURE PACKAGE 1	☒
73	Rel-6	Support of Encryption A5/3	☒
74	Rel-4	Support of Fine Time Assistance	☐
75	R97	Support of Encryption GEA2	☒
76	Rel-6	Support of Encryption GEA3	☐
77	Ph2 up to R98	Use of R99 Emergency numbers	☒
78	Rel-5	Support of GERAN FEATURE PACKAGE 2	☐

6.5.3. Teleservice

Item	Release	Teleservice	Supported
1	Ph2	Telephony	☒
2	Ph2	Emergency Call	☒
3	Ph2	Short Message MT/PP	☒
4	Ph2	Short Message MO/PP	☒
5	Ph2	SMS Cell Broadcast	☒
6	Ph2	Teleservice Alternate Speech and G3 fax	☐
7	Ph2	Teleservice Automatic G3 fax	☐
8	R96	Voice Group Call Service (VGCS)	☒
9	R96	Voice Broadcast Service (VBS)	☒
10	R96	SMS description	☒

6.6. Memory

The MRM can store in its own internal memory (10 Mbytes) up to:

- 10 SMS Messages.
- 100 Numbers and Names Directory.
- 20 Last Numbers Used in a Scratch pad.

The MRM also stores parameters such as maximum temperature in a log.

This memory is retained even in case of a power failure.

6.7. Software Downloading

MRM software update/upgrade has to be done by an external device connected to the MRM. The MRM can be used as a modem to download a new version inside a base unit computer.

Software download can be handled via the AT, maintenance serial or Ethernet link, using a PC and a download software tool, delivered by Sierra Wireless. The signal "Download_Enable" shall be active for downloading on the maintenance serial link. This signal should be activated prior to the download and deactivated after. Downloading new software in the MRM via the AT or maintenance serial link is done at 115.2 kbps. Downloading new software in the MRM via the Ethernet link is done at 10 Mbps.

Note: The maintenance, test and Ethernet interface allows a direct connection to an external PC (not supplied) for maintenance, download, configuration and diagnostic by SIERRA WIRELESS experts. Whenever the MRM is integrated in an application, this interface should be made accessible from the outside for easier on-site diagnostic and maintenance.

During a software download, the MRM is in a specific "Download" state and cannot be used for communications. During a download, the MRM is not in operation, it is dedicated to the downloading procedure and cannot receive or initiate any communications, or respond to any commands unrelated to downloading.

The software downloading may be interrupted. The software update has therefore not take place and the download shall be performed again. Until the new software download is successfully completed, the MRM can be used but will perform using its current active software version.

6.8. Diagnostic

6.8.1. Diagnostic via the software of the MRM

Refer to document [24] "AT Command Set for MRM".

6.8.2. LED diagnostic

The status LED and Network LED can give information for diagnostic.

6.8.3. Other diagnostic

The AT<CR> command tests the serial interface of the MRM. If the MRM responds OK, the interface is considered to be in full working order.

Information on the status or operation of the antenna is not possible, because the RF field at the local site determines the result of any function query. If there is any reason to suspect that a poor reception or lack of reception is due to a defective antenna, this is easily checked by connecting a reference antenna. Alternatively, the antenna can be checked separately with a voltage standing wave ratio meter (VSWR meter).

6.9. Trace Feature (Optionnal)

6.9.1. Overview

A GSM-R Network monitoring feature can be activated to record GSM measurement and Layer 3 protocol messages. Serving and Neighbors cell parameters are collected periodically in idle mode, listener mode and dedicated mode whereas layer messages are logged synchronously.

The feature offers a record mode and a live tracing mode. Depending on the selected mode, collected data can be stored in an internal memory of 10 MBytes and recovered later by an FTP/serial link or transmitted in real time on serial/Ethernet/USB interfaces to a connected computer.

This feature uses a proprietary but fully documented protocol so that user can either use Sierra Wireless dedicated applications or build their own tool.

6.9.2. GSM-R Trace Tool

A PC Tool has been specially developed to provide an ergonomic, easy to use and complete toolbox to handle trace features and analyze network information collected during a trace session.

- Control of the MRM Trace feature.
- Trace file recovering, decoding and recording in clear text.
- Online and Offline trace analysis tool with dedicated screen and toolbox:
 - Periodic Layer 1 report Tab.
 - Layer 3 protocol messages with decoding facilities.
 - Graphical Signal Strength representation.
 - Significant event time stamped (communication state, Reselection, Network Loss...).

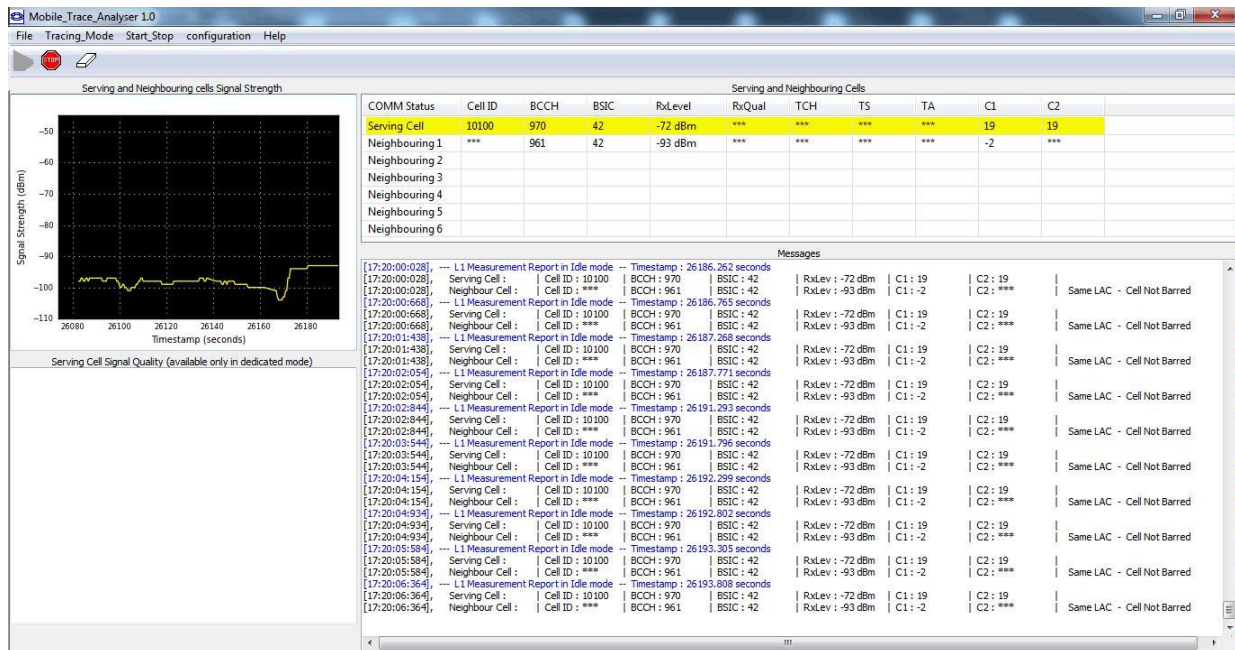


Figure 14. Monitoring Tool screen shot

6.9.3. Trace Feature summary

	GPRM1-1	GPRM1-2	Comments
Interface			
Serial Link	☒	☒	
Ethernet	☒	☒	
Usb	☐	☒	
Monitoring Capacity			
Cell ID	☒	☒	Serving Cell and 6 Neighbors
BCCH	☒	☒	Serving Cell and 6 Neighbors
BSIC	☒	☒	Serving Cell and 6 Neighbors
BCCH	☒	☒	Serving Cell and 6 Neighbors
RxLev	☒	☒	Serving Cell and 6 Neighbors
C1 and C2	☒	☒	Serving Cell and 6 Neighbors
Neighbor position	☒	☒	
Rxqual	☒	☒	Depend on communication state
Timing Advance	☒	☒	Depend on communication state
TCH	☒	☒	Depend on communication state
Time Slot	☒	☒	Depend on communication state
Layer 1 report Periode	☒	☒	2 s in idle, 500ms in dedicated mode
LAC	☒	☒	
MNC	☒	☒	
MCC	☒	☒	
Layer 3 messages	☒	☒	

	GPRM1-1	GPRM1-2	Comments
AT command	☒	☒	
Internal clock Time stamp	☒	☒	Tdma Tick (4,615ms)
Storage Capacity			
MRM Internal Memory	☒	☒	
Type	NOR Flash	NOR Flash	
Capacity	10MBytes	10MBytes	□ 10 hours of traces
Recover by FTP	☒	☒	
PC Tools	*		
Graphical presentation	☒	☒	
Report in clear text	☒	☒	
Tool box	☒	☒	



7. ANNEX A: Delta list between MRM GPRM1-1 and MRM GPRM1-2

The MRM GPRM1-2 is an evolution of the MRM GPRM1-1 product. It is designed to replace and be compatible with the MRM GPRM1-1.

The following differences are to be noted:

Table 37. Delta list between MRM GPRM1-1 and MRM GPRM1-2

Compatibility Issues	MRM GPRM1-2	MRM GPRM1-1
Front-Plane connector	Front plane connectors available for: • RS 232 serial line interface without flow control • Ethernet interface • SD Card interface • μUSB interface	Front plane connector available for: • RS 232 serial line interface with flow control • RS 422 serial line interface • Ethernet interface
Power consumption	Peak value : • 3.6A, 12VDC • 1.5A, 5VDC Average value : • 0.4A, 12VDC • 0.7A, 5VDC Standby(IDLE) : • <0.120A, 12VDC • <0.6A, 5VDC	Peak value : • 3.6A, 12VDC • 1.2A, 5VDC Average value : • 0.375A, 12VDC • 0.7A, 5VDC Standby(IDLE) : • <0.06A, 12VDC • <0.3A, 5VDC



8. ANNEX B: Mechanical drawings and pictures

