

# Cinterion<sup>®</sup> EGX81-W

Hardware Interface Description

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## 0 Document History

Preceding document: "Cinterion® EGX81-W Hardware Interface Description" Version 00.005

New document: "Cinterion® EGX81-W Hardware Interface Description " Version 00.006

Chapter	What is new
8	Added chapter Appendix (Hardware) Watchdog

Preceding document: "Cinterion® EGX81-W Hardware Interface Description" Version 00.004

New document: "Cinterion® EGX81-W Hardware Interface Description " Version 00.005

Chapter	What is new
1.3.1	Revised <a href="#">Table 4</a> for new safety standard EN 62386
1.3.2	Revised for new safety standard EN 62386
3.11	Revised AT command for LED control
3.5.1, 3.6.1	Revised chapter that power supply has to be compliant to EN 62368 and change value of the external fuse
5.2	Added note about mounting height

Preceding document: "Cinterion® EGX81-W Hardware Interface Description" Version 00.003

New document: "Cinterion® EGX81-W Hardware Interface Description " Version 00.004

Chapter	What is new
3.5.1, 3.6.1	Added information about max. cable length for power supply and control signals
4.1, 4.4.1, 4.4.2	Added information about max. cable length in <a href="#">Table 15</a> , <a href="#">Table 18</a> and <a href="#">Table 19</a>

Preceding document: "Cinterion® EGX81-W Hardware Interface Description" Version 00.002

New document: "Cinterion® EGX81-W Hardware Interface Description " Version 00.003

Chapter	What is new
1.3.1	Removed GNSS Standards in <a href="#">Table 4</a>
1.4	Revised Label in <a href="#">Figure 1</a>
2.1	Removed GNSS from Key Feature at a Glance
3.10	Removed support of 3V SIM cards
7	Removed SMARTEQ-MiniMAG Dualband antenna in <a href="#">Table 24</a>

Preceding document: "Cinterion EXS82T-W Hardware Interface Description" Version 00.001  
New document: "Cinterion® EGX81-W Hardware Interface Description " Version 00.002

Chapter	What is new
Throughout document	Product name and type changed
4.2	Added Thermal Resistance to <a href="#">Table 16</a>
5.1	Changed <a href="#">Figure 12</a>

New document: "Cinterion EXS82T-W Hardware Interface Description" Version 00.001

Chapter	What is new
---	Initial document setup.



# 1 Introduction

This document<sup>1</sup> describes the hardware of the Cinterion® EGX81-W LTE Gateway. The EGX81-W comes in two variants depending on the type of serial interface:

- EGX81-W RS232 implements a V.24 / V.28 RS-232 interface with a D-sub 9-pole female socket and a 6-pole Western jack as plug-in power supply connector.
- EGX81-W RS485 implements a 6-pin header for the RS-485 interface including power supply and ignition line.

Wherever necessary and appropriate this document distinguishes between these two variants.

The scope of this document includes interface specifications, electrical issues and mechanical characteristics of EGX81-W. It specifies standards pertaining to wireless applications and outlines requirements that must be adhered to for successful product design. The EGX81-W is a compact LTE/GSM Gateway for the transfer of data in LTE/GSM networks. Industrial standard interfaces and an integrated SIM card reader allow using EGX81-W easily as a LTE/GSM Gateway.

## 1.1 Related Documents

- [1] EXS82-W AT Command Set
- [2] EXS82-W Hardware Interface Description
- [3] EGX81-W Release Notes
- [4] Cinterion® IoT Module Services User Guide for EXSx2-W modules, v01

Prior to using the LTE/GSM Gateway read the latest product information provided in the Release Notes.

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<sup>1</sup> The document is effective only if listed in the appropriate Release Notes as part of the technical documentation delivered with your Thales product.

## 1.2 Terms and Abbreviations

**Table 1:** Terms and abbreviations

Abbreviation	Description
ARP	Antenna Reference Point
ATC	AT Command
BTS	Base Transceiver Station
CB	Cell Broadcast
CODEC	Coder-Decoder
DCE	Data Circuit terminating Equipment
DSR	Data Set Ready
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FDMA	Frequency Division Multiple Access
G.C.F.	GSM Conformity Forum
GSM	Global Standard for Mobile Communication
HW	Hardware
IC	Integrated Circuit
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identifier
I/O	Input/ Output
IGT	Ignition
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LVD	Low voltage Directive
Mbps	Mbits per second
MMI	Machine Machine Interface
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
NC	Not Connected
NTC	Negative Temperature Coefficient

## 1.2 Terms and Abbreviations

**Table 1:** Terms and abbreviations

<b>Abbreviation</b>	<b>Description</b>
PA	Power Amplifier
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCS	Personal Communication System
PD	Power Down
PDU	Protocol Data Unit
R&TTE	Radio and Telecommunication Terminal Equipment
RF	Radio frequency
RI	Ring Indication
RX	Receive direction
SIM	Subscriber Identification Module
SMS	Short Message Service
SW	Software
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TX	Transmit direction
UART	Universal Asynchronous Receiver and Transmitter


## 1.3 Regulatory and Type Approval Information

## 1.3 Regulatory and Type Approval Information

## 1.3.1 Directives and Standards

EGX81-W has been designed to comply with the directives and standards listed below.

**Table 2:** Directives

2014/53/EU	Directive of the European Parliament and of the council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/ 05/EC. The product is labeled with the CE conformity mark - see <a href="#">Section 6.3</a> .
2002/95/EC (RoHS 1) 2011/65/EC (RoHS 2)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) 
2002/96/EC	Directive of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE)
2003/108/EC	Directive of the European Parliament and of the Council of 8 December 2003 amending directive 2002/96/ec on waste electrical and electronic equipment (WEEE)

**Table 3:** Standards of North American type approval

CFR Title 47	"Code of Federal Regulations, Part 15 B, Part 22 and Part 24 (Telecommunications, PCS)"; US Equipment Authorization FCC
NAPRD.03 V5.41	"Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control" PCS Type Certification Review board (PTCRB)
RSS133	Canadian Standard
IEEE Std. C95.1-1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

**Table 4:** Standards of European type approval

3GPP TS 51.010-1	"Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification"
ETSI EN 301 511 V12.5.1	Global System for Mobile communications (GSM); Mobile Stations (MS) equipment; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
GCF-CC V3.75.0	Global Certification Forum - Certification Criteria
Draft ETSI EN 301 489-1 V2.2.0	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU

## 1.3 Regulatory and Type Approval Information

**Table 4:** Standards of European type approval


Draft ETSI EN 301 489-52 V1.1.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
ETSI EN 301 908-1: V13.1.1	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 1: Introduction and common requirements
ETSI EN 301 908-13: V13.1.1	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)
EN 62311-2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
EN 62368-1:2014 + A11:2017	Safety of information technology equipment

**Table 5:** Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes. EGX81-W complies with IP40.

1.3 Regulatory and Type Approval Information

**Table 6:** Standards of the Ministry of Information Industry of the People’s Republic of China

SJ/T 11363-2006	“Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products” (2006-06).
SJ/T 11364-2006	<p>“Marking for Control of Pollution Caused by Electronic Information Products” (2006-06).</p> <p>According to the “Chinese Administration on the Control of Pollution caused by Electronic Information Products” (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Hardware Interface Description.</p> <p>Please see <a href="#">Table 1.3.2</a> for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.</p> 

**Table 7:** Toxic or hazardous substances or elements with defined concentration limits






部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	○	○	○	○	○	○
电路模块 (Circuit Modules)	X	○	○	○	○	○
电缆及电缆组件 (Cables and Cable Assemblies)	○	○	○	○	○	○
塑料和聚合物部件 (Plastic and Polymeric parts)	○	○	○	○	○	○

O:  
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。  
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.




X:  
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。  
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

### 1.3.2 Safety Precautions

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating EGX81-W. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. THALES DIS AIS Deutschland GmbH assumes no liability for customer's failure to comply with these precautions.

	<p>When in hospitals or other health care facilities, observe the restrictions on the use of mobiles. Switch off the cellular terminal or mobile if to be instructed to do so by the guidelines posted in sensitive areas. Medical equipment may be sensitive to RF energy.</p> <p>The operation of cardiac pacemakers, other implanted medical equipment and hearing aids can be affected by interference from cellular terminals or mobiles placed close to the device. If in doubt about potential danger, contact the physician or the manufacturer of the device to verify that the equipment is properly shielded. Pacemaker patients are advised to keep their hand-held mobile away from the pacemaker, while it is on. This personal subgroup always should check the distance to the mobile.</p>
	<p>Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it cannot be switched on inadvertently. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communications systems. Failure to observe these instructions may lead to the suspension or denial of cellular services to the offender, legal action, or both.</p> <p>Check the local and actual laws about these themes.</p>
	<p>Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.</p>
	<p>Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. Remember that interference can occur if it is used close to TV sets, radios, computers or inadequately shielded equipment. Follow any special regulations and always switch off the cellular terminal or mobile wherever forbidden, or when you suspect that it may cause interference or danger.</p>
	<p>Road safety comes first! Do not use a hand-held cellular terminal or mobile while driving a vehicle unless it is securely mounted in a holder for speakerphone operation. Before making a call with a hand-held terminal or mobile park the vehicle. Speakerphones must be installed by qualified personnel. Faulty installation or operation can constitute a safety hazard.</p> <p>Check the actual and local laws about these themes.</p>

1.3 Regulatory and Type Approval Information

	<p><b>IMPORTANT!</b> Cellular terminals or mobiles operate using radio signals and cellular networks. In that case connections cannot be guaranteed at all times under all conditions. Therefore, you should never rely solely upon any wireless device for essential communications, for example emergency calls.</p> <p>Remember, in order to make calls or receive calls the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength.</p> <p>Some networks do not allow for emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may need to deactivate those features before you can make an emergency call. Some networks require a valid SIM card to be properly inserted in the cellular terminal or mobile.</p>
	<p>If a power supply unit is used to supply the device it must meet the demands placed on SELV circuits in accordance with EN62368. The maximum permissible connection length between the device and the supply source should not exceed 3m.</p>
	<p>According to the guidelines for human exposure to radio frequency energy, an antenna connected to the FME jack of the device should be placed at least 20cm away from human bodies.</p>



1.4 Product Label

1.4 Product Label

The label fixed to the bottom of the EGX81-W Gateway comprises the following information.

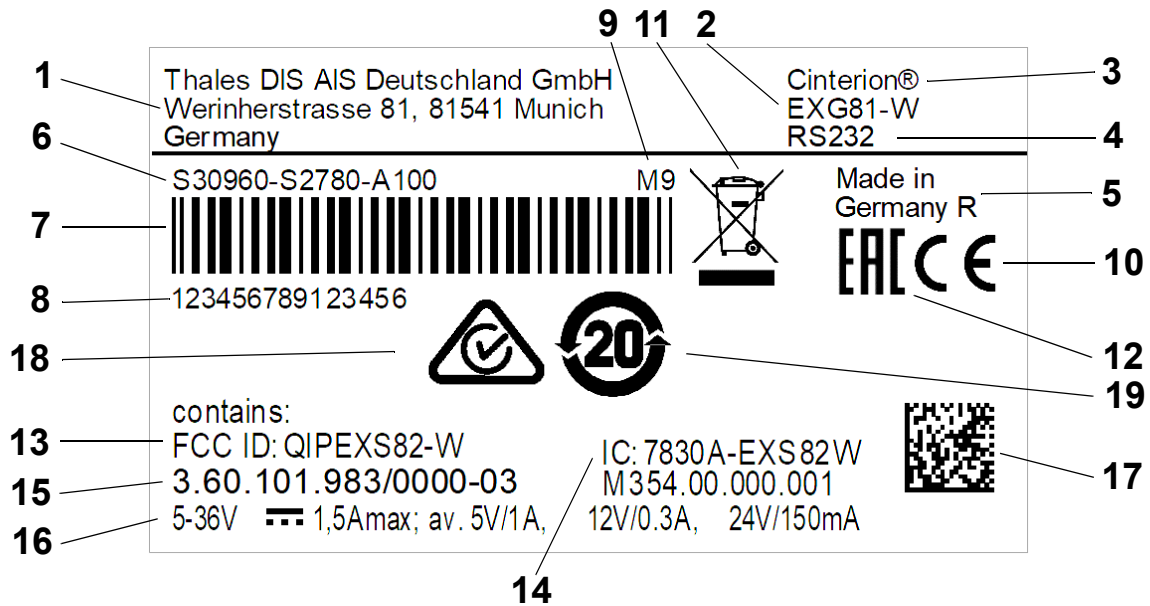


Figure 1: EGX81-W RS232 label

Table 8: EGX81-W label information

No.	Information
1	Manufacturer Name and Address
2	Product name
3	Cinterion Logo
4	Product variant (RS232 or RS485)
5	Marking "Made in Germany"
6	Product ordering number (see Section 7)
7	Barcode (Code128)
8	Product IMEI
9	Date code
10	CE logo (may be replaced for samples with "Not for sale")
11	WEEE symbol (see Table 2)
12	EAC Eurasian Conformity mark for Russia, Belarus, Armenia, Kazakhstan, Kyrgyzstan
13	FCC ID (see Section 6.5)
14	IC ID (see Section 6.5)
15	Manufacturer code
16	Power supply unit ratings
17	Manufacturer code
18	RCM compliance mark for Australian Market
19	Chinese RoHS symbol (see Table 6)

## 2 Product Concept

### 2.1 Key Features at a Glance

Feature	Implementation
<i>General</i>	
Incorporates EXS82-W module	The EXS82-W module handles all signal and data processing within the EGX81-W. Internal software runs the application interface and the complete LTE/GSM protocol stack.
Frequency bands	<p>GSM: 850/900/1800/1900</p> <p>LTE Cat M1: 700 (Bd12, Bd13, Bd28, Bd85), 800 (Bd18, Bd19, Bd20, Bd26, Bd27), 850 (Bd5), 900 (Bd8), AWS-3 (Bd66), AWS-1 (Bd4), 1800 (Bd3), 1900 (Bd2, Bd25), 2100 (Bd1)</p> <p>LTE Cat NB1/2: 600 (Bd71), 700 (Bd12, Bd13, Bd28, Bd85), 800 (Bd18, Bd19, Bd20, Bd26), 850 (Bd5), 900 (Bd8), AWS-3 (Bd66), AWS-1 (Bd4), 1800 (Bd3), 1900 (Bd2, Bd25), 2100 (Bd1)</p>
GSM class	Small MS
Output power (according to Release 7)	<p>GSM/GPRS: Class 4 (+33dBm ±2dB) for GSM850 and GSM900 Class 1 (+30dBm ±2dB) for GSM1800 and GSM1900 Class E2 (+27dBm ± 3dB) for GSM850 8-PSK and GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK and GSM1900 8-PSK</p>
Output power (according to 3GPP Release 13)	<p>LTE Cat M1: Class 5 (+20dBm ±2dB) for all supported LTE Cat M1 bands</p> <p>LTE Cat NB1/2: Class 5 (+20dBm ±2dB) for all supported LTE Cat NB1/2 bands</p>
Power supply	Single supply voltage 5V to 36V
Operating temperature (EXS82-W module)	<p>Normal operation: -30°C to +85°C Extended operation: -40°C to -30°C and +85°C to +90°C</p>
Physical	<p>Dimensions: 80.10mm x 56.21mm x 22.10mm (excluding antenna and serial interface connectors) Weight: 65g (approx.)</p>
RoHS, WEEE	All hardware components are fully compliant with the EU RoHS and WEEE Directives
<i>LTE features</i>	
3GPP Release 14	<p>LTE Cat M1 (HD-FDD) DL: max. 300kbps, UL: max. 1.1Mbps</p> <p>LTE Cat NB1 (HD-FDD) DL: max. 27kbps, UL: max. 63kbps</p> <p>LTE Cat NB2 (HD-FDD) DL: max. 124kbps, UL: max. 158kbps</p>

## 2.1 Key Features at a Glance

Feature	Implementation
<i>GSM/GPRS/EGPRS features</i>	
Data transfer	GPRS: <ul style="list-style-type: none"> <li>• Multislot Class 10</li> <li>• Full PBCCH support</li> <li>• Mobile Station Class B</li> <li>• Coding Scheme 1 – 4</li> </ul> EGPRS: <ul style="list-style-type: none"> <li>• Multislot Class 10</li> <li>• EDGE E2 power class for 8 PSK</li> <li>• Downlink coding schemes – CS 1-4, MCS 1-9</li> <li>• Uplink coding schemes – CS 1-4, MCS 1-9</li> <li>• SRB loopback and test mode B</li> <li>• 8-bit, 11-bit RACH</li> <li>• PBCCH support</li> <li>• 1 phase/2 phase access procedures</li> <li>• Link adaptation and IR</li> <li>• NACC, extended UL TBF</li> <li>• Mobile Station Class B</li> </ul>
SMS	Point-to-point MT and MO Text and PDU mode Storage: SIM card plus SMS locations in mobile equipment
<i>Software</i>	
AT commands	Hayes 3GPP TS 27.007, TS 27.005, Thales M2M AT Commands
SIM Application Toolkit	SAT Release 99
TCP/IP stack	Protocols: TCP server/client, UDP, HTTP, FTP, MQTT Access by AT commands
Firmware update	Upgradeable via serial interface or FOTA.
<i>Interfaces</i>	
Serial interface	EGX81-W RS232: <ul style="list-style-type: none"> <li>• RS-232 interface for AT commands and data</li> <li>• Supports RTS/CTS hardware handshake</li> <li>• Supports software XON/XOFF flow control</li> <li>• Multiplex ability according to GSM 07.10 Multiplexer protocol</li> <li>• Baud rates from 300bps to 921600bps</li> <li>•</li> </ul> EGX81-W RS485: <ul style="list-style-type: none"> <li>• RS-485 interface for AT commands and data</li> <li>• Baud rates from 300bps to 115200bps</li> </ul>
SIM card reader	Supported SIM cards:1.8V
Antenna	Antenna connected via female SMA connector
<i>Power on/off, Reset</i>	
Power on	EGX81-W RS232: <ul style="list-style-type: none"> <li>• DTR line at RS-232 interface or IGT_IN line at power connector</li> </ul> EGX81-W RS485: <ul style="list-style-type: none"> <li>• IGT_IN line at RS-485 interface</li> </ul>

## 2.1 Key Features at a Glance

Feature	Implementation
Power off	Normal switch-off by AT^SMSO or external On/Off push button Automatic switch-off in case of critical temperature and voltage conditions
Reset	Orderly shutdown and reset by AT command Emergency restart via RST_IN line at power connector (EGX81-W RS232 only)
<i>Special features</i>	
Real time clock	Timer functions via AT commands
Phonebook	SIM card and Gateway
Module Services (MODS)	<p>(Optionally) supports an IoT Service Agent based on the LWM2M protocol. The agent can be configured to collect diagnostic information about the module and cellular network and to send it periodically to the Cinterion® Module Services Platform, where it can be visualized for further analysis.</p> <p>Communication to Thales Device Management Hub is realized using a resource-efficient protocol specifically designed by Thales in order to keep the energy and data usage to a minimum. The protocol behavior may be influenced by means of configuration.</p> <p>Additionally, the service provides device control functionality. This includes remote flash file system management, module firmware over-the-air updates (FOTA) and remote configuration.</p> <p>MODS also generates alarms when a specific module or network parameter changes or exceeds a threshold. Alarms will be sent to the platform as soon as possible disregarding the connection interval. For more information, please refer to <a href="#">[4]</a>.</p>

## 3 Interface Description

### 3.1 Overview

EGX81-W provides the following interfaces for power supply, antenna, SIM card and data transfer:

- 6-pole Western connector (female) for power supply, ignition, power down signal (EGX81-W RS232 only)
- SMA antenna connector (female)
- SIM card reader
- 9-pole (female) D-sub connector for EGX81-W RS232 or 6-pin (female) connector for EGX81-W RS485

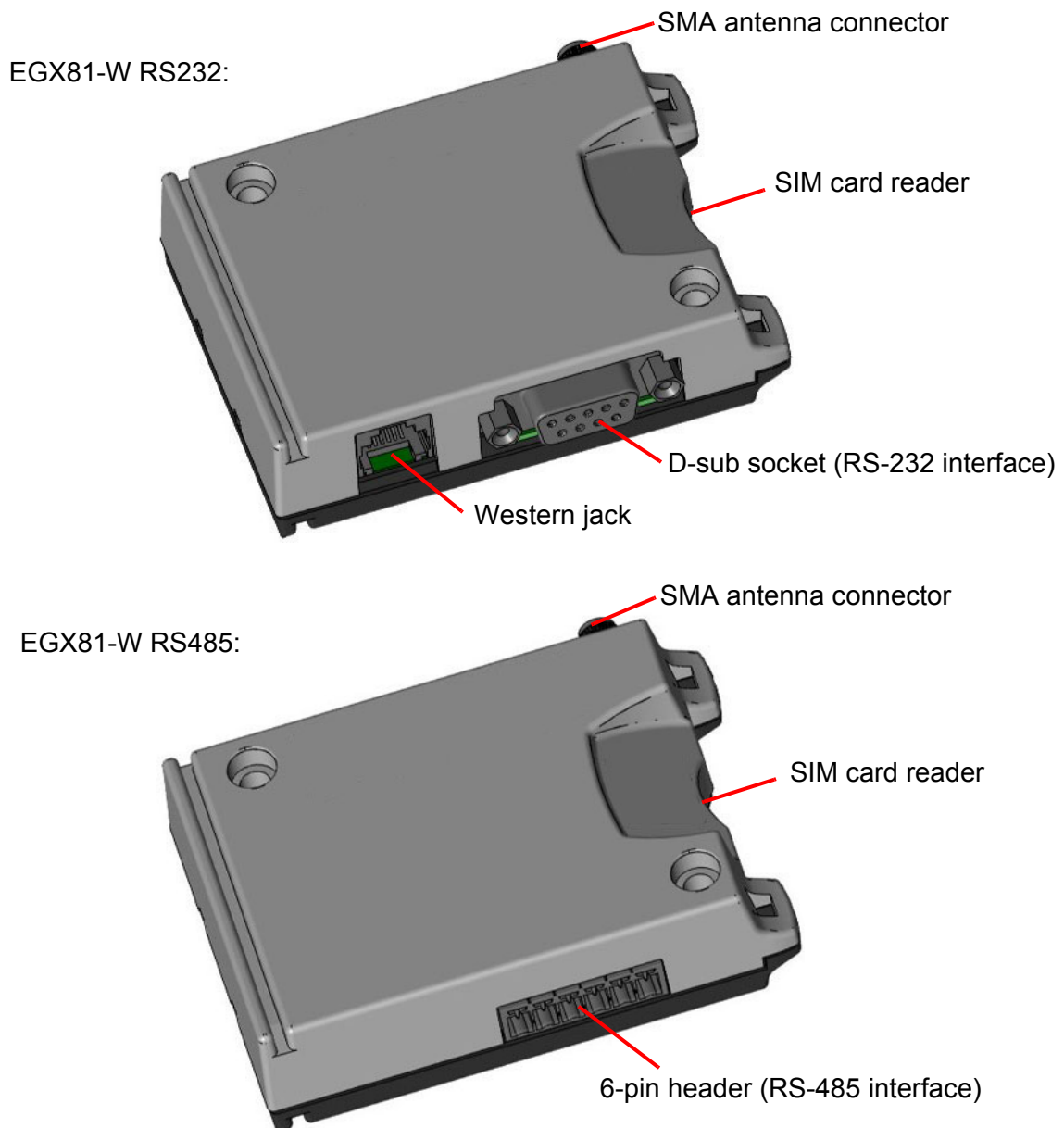


Figure 2: EGX81-W 3D view

### 3.2 Block Diagram

Figure 3 shows a block diagram of a sample configuration that incorporates a EGX81-W and typical accessories.

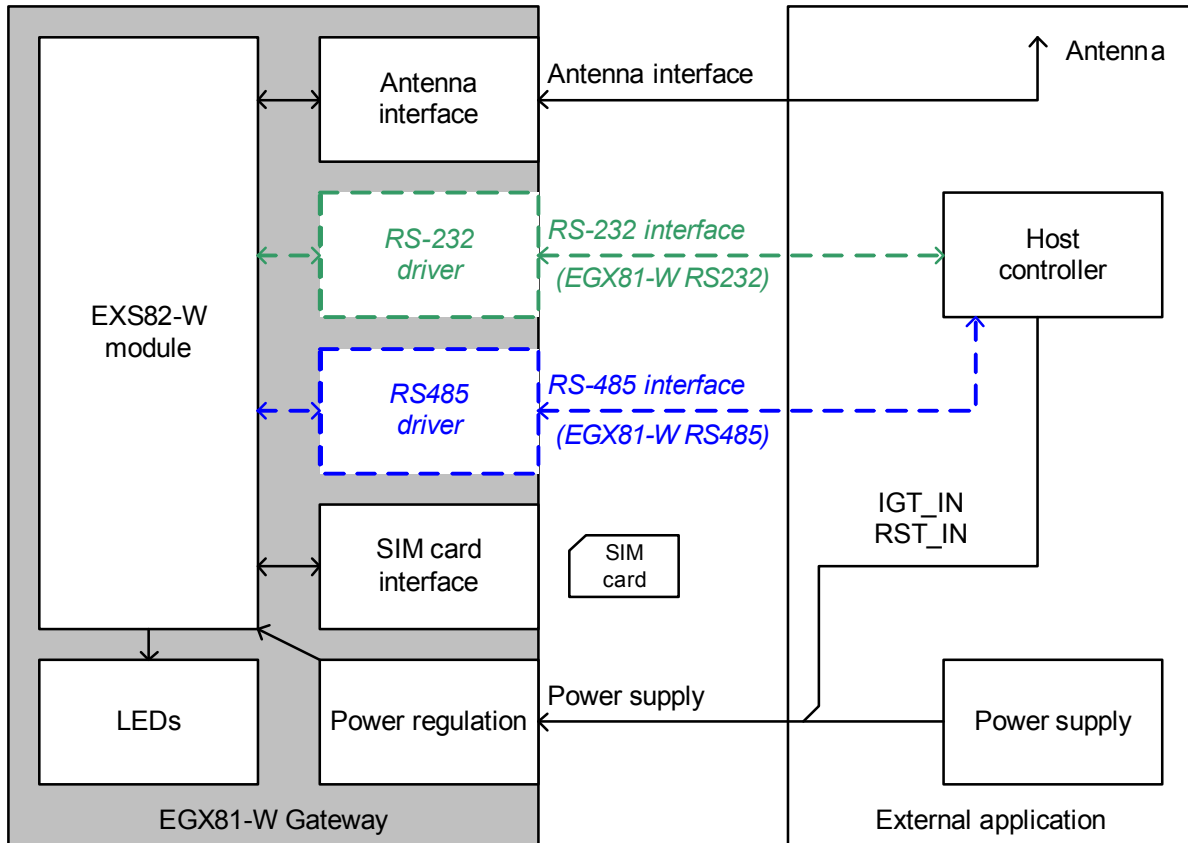


Figure 3: Block diagram

3.3 Gateway Circuit

3.3 Gateway Circuit

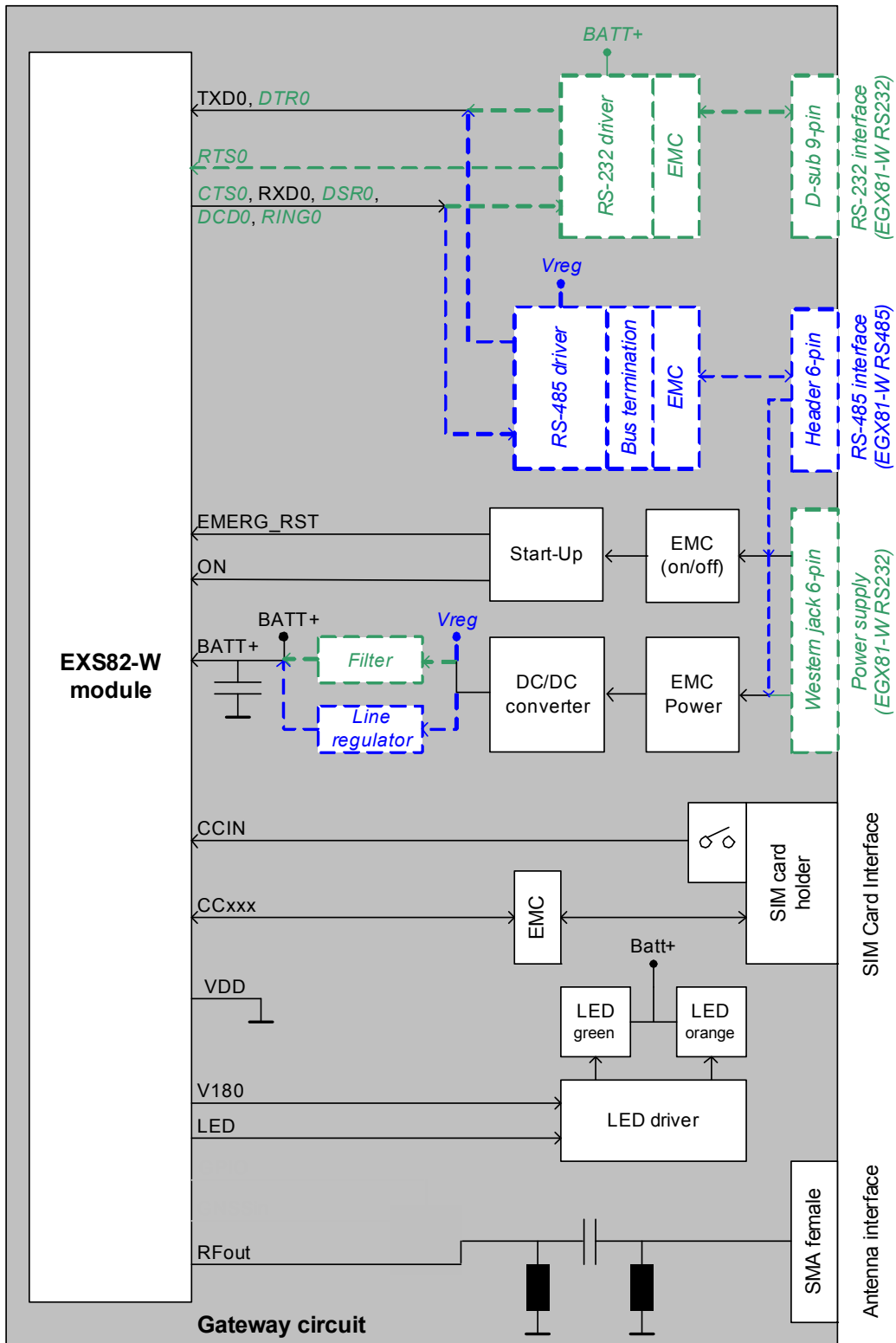


Figure 4: EGX81-W circuit block diagram

With EGX81-W RS232 there are separate connectors for data interface and power supply (D-sub RS-232 socket and Western jack). With EGX81-W RS485 there is a single connector for these interfaces (6-pin header socket).

## 3.4 Operating Modes

The table below briefly summarizes the various operating modes referred to in the following chapters.

**Table 9:** Overview of operating modes

Mode	Function	
Normal operation	Data transfer	GSM/(E)GPRS/LTE M1 NB1/2 data transfer in progress.
	Idle	Software and interfaces are active and ready to send and receive, but no GSM/(E)GPRS/LTE M1 NB1/2 data transfer is currently in progress.
SLEEP <sup>1</sup>	<p>Low power mode when no call is in progress and there is no active communication on any serial interface (ASC0, ASC1). During SLEEP mode, the module is in a low power consumption state depending on paging cycles based on network defined DRX values, and optionally network negotiated eDRX (extended DRX) as well as 3GPP PSM values. The firmware is active to a minimum extent, and preserves the state it was in before entering the SLEEP mode. The module stays registered to the network.</p> <p>SLEEP mode option can be enabled/disabled by AT command (see [1]: AT^SCFG parameter "MEopMode/PwrSave").</p>	
SUSPEND <sup>1</sup>	<p>Low power mode when almost all components are switched off - except for the internal RTC and interrupt triggered wake up mechanisms. The module keeps registered to the network. The module is in its lowest power consumption state. The module can only be woken up by the ON or EMERG_RST signal, or it may wake up and be reachable again after expiration of a 3GPP PSM (Power Saving Mode) periodic TAU cycle (i.e., network timer) that may include DRX and/or eDRX paging cycles for a certain inactivity period. The module wakes up with its signal states being the same as for the first startup configuration, and does not preserve the signal states it had in before entering SUSPEND mode.</p> <p>The SUSPEND mode option can be enabled/disabled by AT commands (see [1]: AT^SCFG "MEopMode/PowerMgmt/Suspend").</p>	
Airplane	<p>Restricted operating mode where the module's radio part is shut down, causing the module to log off from the GSM/(E)GPRS/LTE M1 NB1/2 network, and to disable all AT commands whose execution requires a radio connection. Airplane mode can be controlled by AT command (see [1]: AT+CFUN).</p>	
POWER DOWN	<p>State after normal shutdown by sending the switch off command (see [1]: AT^SMSO). Software is not active. Interfaces are not accessible. Operating voltage remains applied.</p>	

<sup>1</sup>. For details on the module's low power modes and their configuration, please refer to [2].



### 3.5 RS-232 Interface Variant

The RS-232 interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T V.24 Interchange Circuits DCE. It is configured for 8 data bits, no parity and 1 stop bit, and can be operated at bit rates from 1200bps to 921kbps

For more information see also [Section 3.5.1](#) and [Section 3.5.2](#).

#### 3.5.1 Power Supply

The power supply of EGX81-W RS232 has to be a single voltage source of  $V_{PLUS}=5V...36V$  capable of providing a peak current (pulsed 2x577ms at  $T=4.615ms$ ) of about 1.2A at 12V during an active transmission. The uplink burst causes strong ripple (drop) on the power lines. The drop voltage should not exceed 1V, but the absolute minimum voltage during drops must be  $>5V$ .

The EGX81-W is protected from supply voltage reversal. An external fast acting fuse 0.5A with melting integral  $I^2t$  (0.15 ... 0.25)A<sup>2</sup>s is necessary to use the EGX81-W at a 12V or 24V unlimited power supply system.

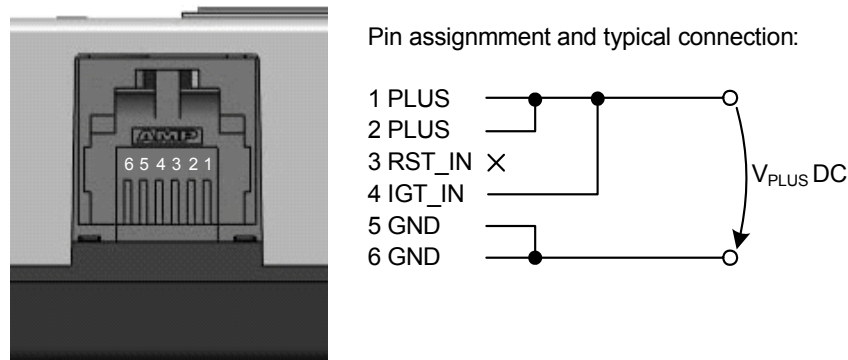
The power supply must be compliant to limited power source (LPS) according to EN62368 guidelines. A switching regulator regulates the input voltage for the internal supply.

When power fails for  $>1ms$ , EGX81-W resets or switches off. When power fails for  $>15s$  the RTC will be reset.

**Table 10:** Female 6-pole Western plug for power supply, ignition, power down

Pin	Signal name	Use	Parameters
1	PLUS	Power supply	5V – 36V DC, max. 39V for 1 min
2	PLUS	Power supply	
3	RST_IN	Signal for module reset	$U_{IH} \geq 5V$ for $t > 10ms$ resets the Gateway. $U_{IL} < 2V$ and low level for normal operation.
4	IGT_IN	Ignition	$U_{IH} \geq 5V$ Ignition $\geq 5V$ for more than 200ms switches the EGX81-W on. Ignition is activated only by a rising edge. The rise time is $< 20ms$
5	GND	Ground	0V
6	GND	Ground	

The maximum cable length for power supply and control signals should not exceed 3m.



**Figure 5:** 6-pole Western jack for power supply, ignition, reset, typical connection

Mains adapter: If it fits into the design of your wireless application we recommend the plug-in supply unit used with the type approved Thales reference setup. Ordering information can be found in [Chapter 7](#). This 12V mains adapter comes with a 6-pole Western plug and provides an internal connection between IGT\_IN pin and PLUS pin for auto ignition (power up).

### 3.5.1.1 Turn EGX81-W on

EGX81-W is turned on by plugging an appropriate power supply unit between PLUS and GND of the 6-pole Western jack.

While the RST\_IN pin (pin4) is not active (voltage <2V) you can start the EGX81-W by activating the RS-232 DTR line if in POWER DOWN mode.

The IGT\_IN signal (pin3) may be used to switch on EGX81-W if in POWER DOWN mode.

After startup of the EGX81-W the RS-232 lines are in an undefined state for approx. 900ms. This may cause undefined characters to be transmitted over the RS-232 lines during this period.

### 3.5.1.2 Reset EGX81-W

An easy way to reset the EGX81-W is entering the command AT+CFUN=x,1. For details on AT+CFUN please see [\[1\]](#).

As an alternative, you can shut down the EGX81-W as described in [Section 3.5.1.3](#) and then restart it as described in [Section 3.5.1.1](#).

### 3.5.1.3 Turn EGX81-W off

Normal shutdown:

- To turn off the EGX81-W use the AT^SMSO command, rather than disconnecting the mains adapter.

This procedure lets the EGX81-W log off from the network and allows the software to enter a secure state and save data before disconnecting the power supply. After AT^SMSO has been entered the EGX81-W returns the following result codes:

```
^SMSO: MS OFF
OK
^SHUTDOWN
```

The "^SHUTDOWN" result code indicates that the EGX81-W turns off in less than 1 second. After the shutdown procedure is complete the EGX81-W enters the POWER DOWN mode. The orange LED stops flashing (see [Section 3.11](#) for a detailed LED description). The RTC is still fed from the voltage regulator in the power supply ASIC. Please note that if there is an auto ignition connection between PLUS and IGT\_IN the module will restart automatically after a normal shutdown.

Emergency restart:

- In the event of software hang-ups etc. the EGX81-W can be restarted by applying a voltage >8V to the RST\_IN pin (pin 3) for more than 10ms. The RST\_IN signal restarts the EGX81-W.

Caution: Use the RST\_IN pin only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the RST\_IN pin causes the loss of all information stored in the volatile memory since power is cut off immediately. Therefore, this procedure is intended only for use in case of emergency, e.g. if EGX81-W fails to shut down properly.

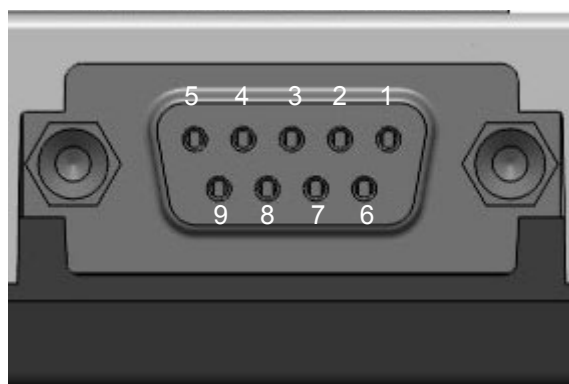
When the EGX81-W enters the POWER DOWN mode, e.g. after you have issued the AT^SMSO command or activated the RST\_IN signal, all RS-232 interface lines are active for a period of 50ms to max. 3.5s. This may cause undefined characters to be transmitted on the RS-232 lines which can be ignored.

### 3.5.1.4 Disconnecting power supply

Before disconnecting the power supply from the PLUS pin, make sure that the EGX81-W is in a safe condition. The best way is to wait 1s after the "^SHUTDOWN" result code has been indicated.

### 3.5.2 9-Pole D-sub Connector

Via RS-232 interface, the host controller controls the EGX81-W and transports data.



**Figure 6:** Pin assignment RS-232 (D-sub 9-pole female)

**Table 11:** 9-pole D-sub (female) RS-232

Pin no.	Signal name	I/O	Function
1	DCD	O	Data Carrier Detected
2	RXD	O	Receive Data
3	TXD	I	Transmit Data
4	DTR	I	Data Terminal Ready Attention: The ignition of EGX81-W is activated via a rising edge of high potential (+3 ... +15 V)
5	GND	-	Ground
6	DSR	O	Data Set Ready
7	RTS	I	Request To Send
8	CTS	O	Clear To Send
9	RING	O	Ring Indication

EGX81-W is designed for use as a DCE. Based on the conventions for DCE-DTE connections it communicates with the customer application (DTE) using the following signals:

- Port TxD @ application sends data to TXD of EGX81-W
- Port RxD @ application receives data from RXD of EGX81-W

Hardware handshake using the RTS and CTS signals and XON/XOFF software flow control are supported.

In addition, the modem control signals DTR, DSR, DCD and RING are available. The modem control signal RING (Ring Indication) can be used to indicate, to the cellular device application, that a call or Unsolicited Result Code (URC) is received. There are different modes of operation, which can be set with AT commands.

**Note:** The DTR signal will only be polled once per second from the internal firmware of EGX81-W.

### 3.6 RS-485 Interface Variant

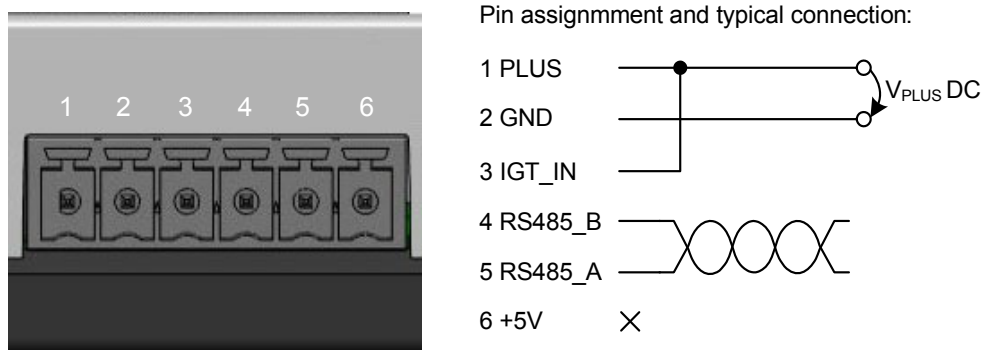
The RS-485 interface is based on the TIA/EIA-485 standard defining electrical characteristics of drivers and receivers for use in balanced multidrop communication systems. RS-485 is used in a lot of different fieldbus systems like Profibus, Interbus, Modbus and P-net.

RS-485 uses a shielded twisted pair cable where the shield is used as ground return, and the inner pairs are used for balanced communication. The two conductors in each pair are called A and B. RS-485 is usually half-duplex.

Data transmission speed depends on the length of the RS-485 bus cable and may be up to 115kbps.

#### 3.6.1 6-Pin Header and Power Supply

Via RS-485 interface, the host controller controls EGX81-W RS485 including power supply and data transmission.



**Figure 7:** Pin assignment RS-485 (6-pin header female), typical connection

**Table 12:** 6-pin header pin assignment

Pin	Signal name	Use	Parameters
1	PLUS	Power supply	5V-36V DC
2	GND	Ground	0V
3	IGT_IN	Ignition	$U_{IH} \geq 5V$ Ignition $\geq 5V$ for more than 200ms switches the EGX81-W on. Ignition is activated only by a rising edge. The rise time is $< 20ms$
4	RS485-B	Data transmission	Receive and transmit data for conductor B
5	RS485-A	Data transmission	Receive and transmit data for conductor A
6	+5V	Power output	Output: +5V, max. 200mA

The power supply of the EGX81-W has to be a single voltage source of  $V_{PLUS}=5V \dots 36V$  capable of providing a peak current (pulsed  $2 \times 577ms$  at  $T=4.615ms$ ) of about 1.2A at 12V during an active transmission. The uplink burst causes strong ripple (drop) on the power lines. The drop voltage should not exceed 1V, but the absolute minimum voltage during drops must be  $> 5V$ .

The EGX81-W is protected from supply voltage reversal. An external fast acting fuse 0.5A with melting integral  $I^2t$  (0.15 ... 0.25)A<sup>2</sup>s is necessary to use the EGX81-W at a 12V or 24V unlimited power supply system.

The power supply must be compliant to limited power source (LPS) according to EN62368 guidelines. A switching regulator regulates the input voltage for the internal supply. It is recommended that the power supply provides an internal connection between IGT\_IN pin and PLUS pin for auto ignition (power up).

The maximum cable length for power supply and control signal should not exceed 3m.

When power fails for >1ms, EGX81-W resets or switches off. When power fails for >15s the RTC will be reset.

### 3.6.1.1 Turn EGX81-W on

Before switching EGX81-W on the SIM should be inserted. Now, EGX81-W is turned on by connecting an appropriate power supply between PLUS and GND of the 6-pin header.

The IGT\_IN signal (pin3) may be used to switch on EGX81-W if in POWER DOWN mode.

After startup of the EGX81-W the RS-485 lines are in an undefined state for approx. 900ms. This may cause undefined characters to be transmitted over the RS-485 lines during this period.

### 3.6.1.2 Reset EGX81-W

As an alternative, EGX81-W can be shut down as described in [Section 3.5.1.3](#) and then restarted as described in [Section 3.5.1.1](#).

### 3.6.1.3 Turn EGX81-W off

Normal shutdown:

- To turn off the EGX81-W use the AT^SMSO command, rather than disconnecting the mains adapter. This procedure lets the EGX81-W log off from the network and allows the software to enter a secure state and save data before disconnecting the power supply. After AT^SMSO has been entered the EGX81-W returns the following result codes:

```
^SMSO: MS OFF
OK
^SHUTDOWN
```

The "^SHUTDOWN" result code indicates that the EGX81-W turns off in less than 1 second. After the shutdown procedure is complete the EGX81-W enters the POWER DOWN mode. The orange LED stops flashing (see [Section 3.11](#) for a detailed LED description). The RTC is still fed from the voltage regulator in the power supply ASIC. Please note that if there is an auto ignition connection between PLUS and IGT\_IN the module will restart automatically after a normal shutdown.

When the EGX81-W enters the POWER DOWN mode, e.g. after you have issued the AT^SM-

SO command or after emergency shutdown, all data transmission lines are active for a period of 50ms to max. 3.5s. This may cause undefined characters to be transmitted on the data transmission lines which can be ignored.

### 3.6.1.4 Disconnecting power supply

Before disconnecting the power supply lines, make sure that the EGX81-W is in a safe condition. The best way is to wait 1s after the "^SHUTDOWN" result code has been indicated.

## 3.7 Automatic thermal shutdown

An on-board NTC measures the temperature of the built-in EXS82-W module. If over- or undertemperature is detected on the module the EGX81-W automatically shuts down to avoid thermal damage to the system. [Table 16](#) specifies the ambient temperature threshold for the EGX81-W.

The automatic shutdown procedure is equivalent to the power-down initiated with the AT^SM-SO command, i.e. EGX81-W logs off from the network and the software enters a secure state avoiding loss of data. In IDLE mode it takes typically one minute to deregister from the network and to switch off.

Alert messages transmitted before the EGX81-W switches off are implemented as Unsolicited Result codes (URCs). For details see the description of AT^SCTM command provided in [\[1\]](#).

Thermal shutdown will be deferred if a critical temperature limit is exceeded, while an emergency call or a call to a predefined phone number is in progress, or during a two minute guard period after power up. See [\[1\]](#) for details.

## 3.8 Hardware Watchdog

The chipset of the internally used EXS82-W module features a built-in hardware watchdog. The watchdog is activated automatically after the module powers on. In case the watchdog will not be reset within 2.5 seconds, the module will send a shutdown notification on the serial interface and will shut down itself. The module's firmware is designed in such a way that all the main tasks register to the reset procedure of the watchdog. If one of these tasks is not responding, the module will be shutdown.

When using a power supply with the ignition line permanently active (as we use on our reference power supply) the EGX81-W will be restarted automatically after such as shutdown.

## 3.9 RTC

The internal Real Time Clock (RTC) of the EGX81-W retains the time and date and handles the alarm (reminder) function. The AT+CCLK command serves to set the time and date, and AT+CALA specifies a reminder message. See [\[1\]](#) for details.

A dedicated voltage regulator backs up the RTC even in POWER DOWN mode and enables EGX81-W to keep track of time and date.

However, please note that the Alarm mode described in [1], Section AT+CALA, is not intended for the EGX81-W. The AT+CALA command can only be used to set a reminder message, but not to configure the mobile to wake up from POWER DOWN mode into Alarm mode. Therefore, after setting a timer with AT+CALA be sure not to shut down the EGX81-W by AT^SMSO or RST\_IN signal (EGX81-W RS232 variant).



### 3.10 SIM Interface

The SIM interface is intended for 1.8V SIM cards in accordance with GSM 11.12 Phase 2. The card holder is a five wire interface according to GSM 11.11. A sixth pin has been added to detect whether or not a SIM card is inserted.

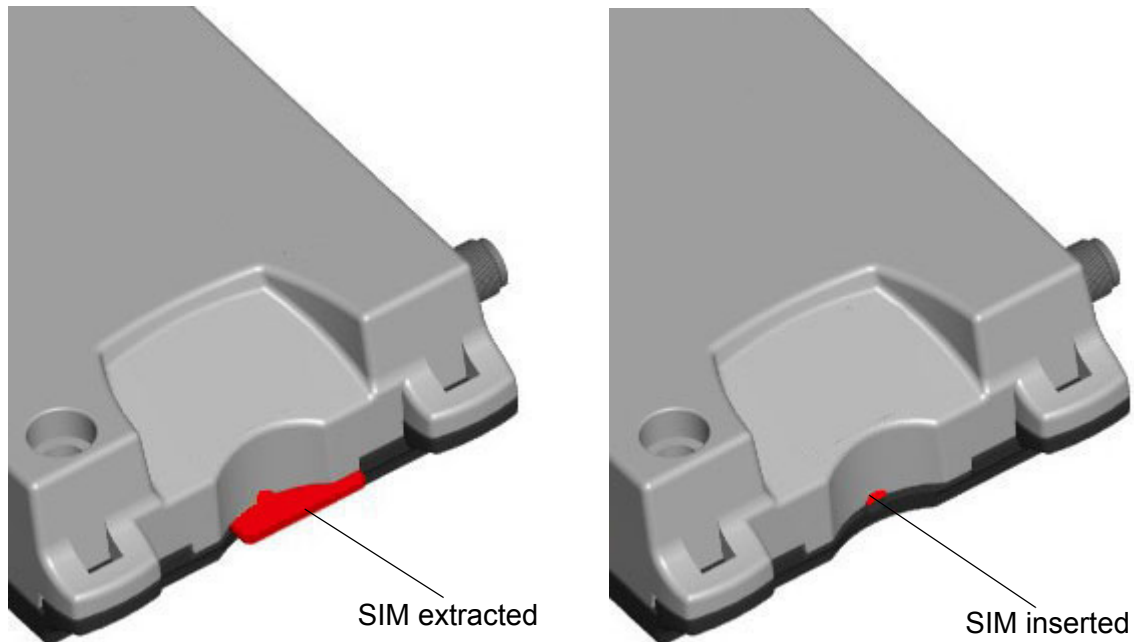


Figure 8: SIM interface

The SIM - with the circuit side facing towards the logo - is inserted by gently pushing it into the SIM card holder until it snaps hold. It is now protected from accidental removal. The SIM can be removed from the card holder by using a flat object such as a screwdriver to carefully press the inserted SIM until it snaps out again.

All signals of the SIM interface are protected from electrostatic discharge with spark gaps to GND and clamp diodes to 1.8V and GND.

Removing and inserting the SIM card during operation requires the software to be reinitialized. Therefore, after reinserting the SIM card it is necessary to restart EGX81-W.

**Note:** No guarantee can be given, nor any liability accepted, if loss of data is encountered after removing the SIM card during operation. Also, no guarantee can be given for properly initializing any SIM card that the user inserts after having removed a SIM card during operation. In this case, the application must restart the EGX81-W.

### 3.11 Status LEDs

EGX81-W has two LEDs indicating its operating states through the semitransparent casing:

- A green LED indicates whether the EGX81-W is ready to operate.
- An orange LED indicates the various operating states of the Gateway.

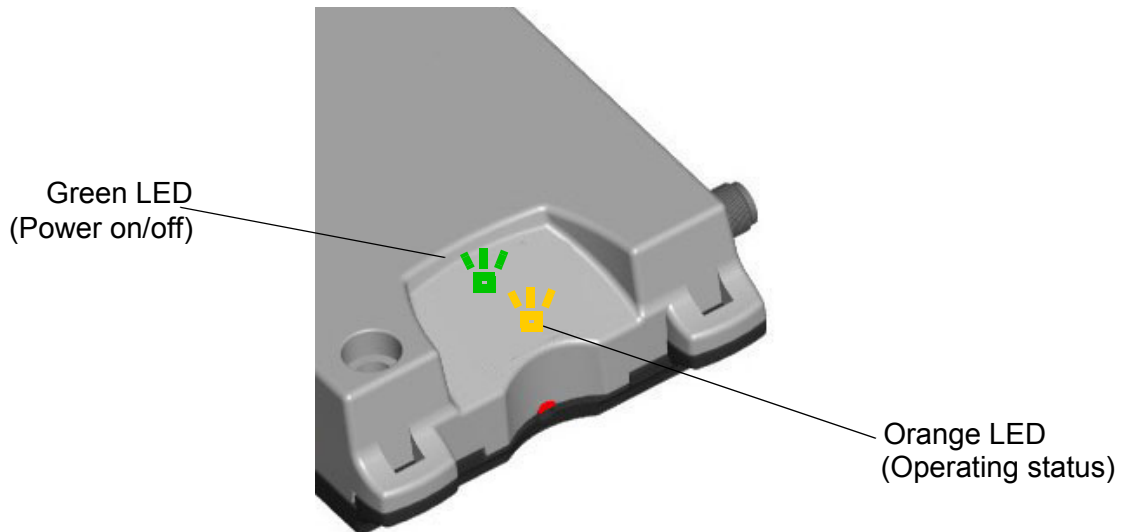


Figure 9: Status LED

The orange LED is driven by a line of the integrated EXS82-W module which can be configured by using the AT<sup>^</sup>SLED command. For the purpose of the EGX81-W it is recommended to retain the default setting of AT<sup>^</sup>SLED=1 or 2 (AT<sup>^</sup>SLED=0 is not applicable).

The following table lists the possible LED patterns and describes the operating status of the EGX81-W indicated by each pattern if AT<sup>^</sup>SLED=1.

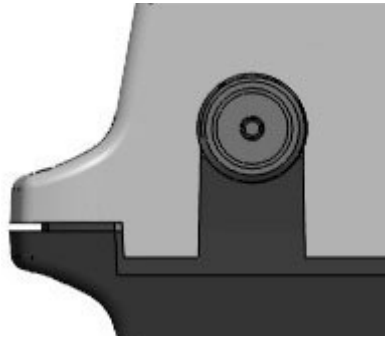
During the transition from one LED pattern to another the "on" and/or "off" periods of the LED may vary in length. This is because an event that triggers the change may occur any time and, thus, truncate the current LED pattern at any point.

Table 13: Coding of the orange status LED

LED mode	Operating status of EGX81-W
Permanently off	EGX81-W is in POWER DOWN mode
500 ms on / 500 ms off	Limited Network Service: No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.
Permanently on	UE registered to a network. No call, no data transfer or GSM PS /LTE data transfer

### 3.12 Antenna Interface

An external antenna is connected via the Gateway's female SMA connector that is also the antenna reference point (ARP).



**Figure 10:** Antenna connector

The system impedance is  $50\Omega$ . In any case, for good RF performance, the return loss of the customer application's antenna should be better than 10dB ( $VSWR < 2$ ). EGX81-W withstands a total mismatch at this connector when transmitting with power control level for maximum RF power.

Inside the EXS82-W module an inductor to ground provides additional ESD protection to the antenna connector. To protect the inductor from damage no DC voltage must be applied to the antenna circuit.

For the application it is recommended to use an antenna with an SMA (male) connector:

Please note that the Gateway should be installed and operated with a minimum distance of 20cm between the antenna connected to the Gateway and any human bodies. Also, the transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The allowed maximum antenna gain for stand-alone situation is 7.24dBi (<1GHz) and 3.30dBi for the high bands (>1.7GHz).

## 4 Electrical and Environmental Characteristics

### 4.1 Absolute Maximum Ratings

**Table 14:** Absolute maximum ratings

Parameter	Port / Description	Min.	Max.	Unit
Supply voltage	PLUS	-50	36	V
Overvoltage	PLUS / for 1min		39	V
Input voltage for on/off control lines	IGT_IN, RST_IN	-5	36	V
RS-232 input voltage range	TXD, DTR, RTS	-25	+25	V
RS-232 output voltage range	RXD, CTS, DSR, DCD, RING	-0.3	+4.3	V
RS-485 input voltage range	RS485-A, RS485-B	-8	+13	V
Immunity against discharge of static electricity	All interfaces (lines) Contact discharge Human body model	-8 -15	+8 +15	kV kV

**Table 15:** Operating supply voltage for EGX81-W

Parameter	Min	Typ	Max	Unit
Supply voltage PLUS measured at (6-pole) western jack plug (1 to 6)	5.0 lowest voltage (minimum peak) incl. all ripple and drops	12	36	V
Supply voltage PLUS for RS-485 at 6-pin header	5.0 lowest voltage (minimum peak) incl. all ripple and drops	12	36	V
LE <sub>Cable</sub>			3	m

## 4.2 Operating Temperatures

**Table 16:** Temperature characteristics

Parameter	Min	Typical	Max	Unit
Normal operation <sup>1</sup>	-30		+85	°C
Extended operation <sup>1,2</sup>	-40 to -30		+85 to +90	°C
Automatic thermal shutdown <sup>1,3</sup>	<-40		>+90	°C
Thermal resistance ( $R_{Th}$ ) <sup>4</sup> @ $P_{Th} = 0,85$ W		14		K/W

1. Board temperature of LTE module.

2. Extended operation allows normal mode speech calls or data transmission for limited time until automatic thermal shutdown takes effect. Within the extended temperature range (outside the normal operating temperature range) the specified electrical characteristics may be in- or decreased.

3. Due to temperature measurement uncertainty, a tolerance of  $\pm 3^{\circ}\text{C}$  on these switching thresholds may occur.

4. Thermal resistance ( $R_{Th}$ ) of the LTE Gateway at the highest possible thermal power ( $P_{Th}$ ) dissipation, i.e., at the worst possible network conditions. Measured in still air with an air gap of at least 100mm between the LTE Gateway and other objects.

Note: Within the specified operating temperature ranges the board temperature may vary to a great extent depending on operating mode, used frequency band, radio output power and current supply voltage. Note also the differences and dependencies that usually exist between board (PCB) temperature of the LTE Gateway and its ambient temperature.

## 4.3 Storage Conditions

## 4.3 Storage Conditions

Table 17: Storage conditions

Type	Condition	Unit	Reference
Air temperature: Low High	-30 +75	°C	ETS 300 019-2-1: T1.2, IEC 60068-2-1 Ab ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb
Humidity relative: Low High Condens.	10 90 at 30°C 90-100 at 30°C	%	--- ETS 300 019-2-1: T1.2, IEC 60068-2-56 Cb ETS 300 019-2-1: T1.2, IEC 60068-2-30 Db
Air pressure: Low High	70 106	kPa	IEC TR 60271-3-1: 1K4 IEC TR 60271-3-1: 1K4
Movement of surrounding air	1.0	m/s	IEC TR 60271-3-1: 1K4
Water: rain, dripping, icing and frosting	Not allowed	---	---
Radiation: Solar Heat	1120 600	W/m <sup>2</sup>	ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb
Chemically active substances	Not recommended		IEC TR 60271-3-1: 1C1L
Mechanically active substances	Not recommended		IEC TR 60271-3-1: 1S1
Vibration sinusoidal: Displacement Acceleration Frequency range	1.5 5 2-9 9-200	mm m/s <sup>2</sup> Hz	IEC TR 60271-3-1: 1M2
Shocks: Shock spectrum Duration Acceleration	semi-sinusoidal 1 50	ms m/s <sup>2</sup>	IEC 60068-2-27 Ea

The conditions stated above are only valid for devices in their original packed state in weather protected, non-temperature-controlled storage locations. Normal storage time under these conditions is 12 months maximum.

## 4.4 Electrical Specifications of the Application Interface

### 4.4.1 On/Off Control (EGX81-W RS232)

**Table 18:** RS-232 On/Off control line specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
$V_{high}$	Input voltage IGT_IN, RST_IN	active high	5			V
$V_{low}$						
$V_{high}$	Input voltage DTR	active high	3		+15	V
$V_{low}$						
$R_{IN}$	Input resistance of IGT_IN, RST_IN		1			M $\Omega$
$R_{IN}$	Input resistance of DTR		3	5	7	k $\Omega$
$LE_{Cable}$	Cable length for IGT_IN, RST_IN				3	m

### 4.4.2 On/Off Control (EGX81-W RS485)

**Table 19:** RS-485 On/Off control line specifications (requirements).

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
$V_{high}$	Input voltage IGT_IN	active high	5			V
$V_{low}$						
$R_{IN}$	Input resistance of IGT_IN		1			M $\Omega$
$LE_{Cable}$	Cable length for IGT_IN				3	m

## 4.4 Electrical Specifications of the Application Interface

## 4.4.3 RS-232 Interface

Table 20: RS-232 interface specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V <sub>OUT</sub>	Transmitter output voltage for RXD, CTS, DSR, DCD, RING	@ 3kΩ load	±5	±6	±7	V
R <sub>OUT</sub>	Transmitter output resistance RXD, CTS, DSR, DCD, RING		300			Ω
R <sub>IN</sub>	Resistance TXD, RTS, DTR		3	5	7	kΩ
V <sub>In</sub>	Receiver input voltage range TXD, RTS, DTR		-25		+25	V
V <sub>RIHYS</sub>	Input hysteresis			0.5		V
V <sub>llow</sub>	Input threshold low		0.6	1.2		V
V <sub>lhigh</sub>	Input threshold high			1.5	2.4	V
Baudrate		Autobauding	1.2		230	kbps
		Fixed range	1.2		230	kbps
LE <sub>Cable</sub>	Length of RS-232 cable			1.8	2	m

## 4.4.4 RS-485 Interface

Table 21: RS-485 interface specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V <sub>OUT</sub>	Transmitter output voltage for RS485-A, -B	R <sub>Diff</sub> = 100Ω	2		5	V
R <sub>IN</sub>	Resistance RS485-A, -B			48		kΩ
V <sub>In</sub>	Receiver input voltage range RS485-A, -B		-7		+12	V
V <sub>RIHYS</sub>	Input hysteresis			25		mV
Threshold voltage	Receiver diff. threshold voltage		-200		+200	mV
Bus termination				120		Ω
Baudrate		Autobauding	1.2		230	kbps
		Fixed range	1.2		230	kbps
LE <sub>Cable</sub>	Length of RS-485 indoor cable				10	m



## 4.5 Power Supply Ratings

## 4.5 Power Supply Ratings

Table 22: Current consumption ratings

Description		Conditions			V <sub>PLUS</sub>	Typical rating	Unit
I <sub>PLUS</sub>	Peak GPRS Current	GSM 850/900	33dBm	1 Tx, 4 Rx	@5V	1190	mA
					@12V	490	mA
					@30V	220	mA
				2 Tx, 4 Rx	@5V	1170	mA
					@12V	480	mA
					@30V	215	mA
Average GPRS Current	1 Tx, 4 Rx	@5V	245	mA			
		@12V	110	mA			
		@30V	51	mA			
	2 Tx, 4 Rx	@5V	385	mA			
		@12V	170	mA			
		@30V	78	mA			
Peak LTE Current @ RRC connected Active Transmission	Band 1	20dBm	4 RB UL/4 RB DL	@5V	310	mA	
				@12V	165	mA	
				@30V	82	mA	
Average LTE Current @ RRC connected Active Transmission	Band 1	20dBm	4 RB UL/4 RB DL	@5V	220	mA	
				@12V	110	mA	
				@30V	55	mA	

## 4.6 Antenna Interface

**Table 23:** RF Antenna interface GSM / LTE

Parameter	Conditions	Min.	Typical	Max.	Unit
LTE connectivity (Cat M1)	Band 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 27, 28, 66, 85				
LTE Cat M1: Receiver Input Sensitivity @NTNV BW: 5 MHz, UL: Modulation: QPSK; $N_{RB}=6$ ; DL: Modulation: QPSK; $N_{RB}=4$ ;	LTE 2100 Band 1	-103	-107		dBm
	LTE 1800 Band 2	-101	-106		dBm
	LTE 1900 Band 3	-100	-103		dBm
	LTE AWS-1 Band 4	-103	-107		dBm
	LTE 850 Band 5	-101.5	-103.5		dBm
	LTE 900 Band 8	-100.5	-105.5		dBm
	LTE 700 Band 12	-100	-108		dBm
	LTE 700 Band 13	-100	-106		dBm
	LTE 800 Band 18	-103	-105		dBm
	LTE 800 Band 19	-103	-107.5		dBm
	LTE 800 Band 20	-100.5	-107.5		dBm
	LTE 1900 Band 25	-101	-106.5		dBm
	LTE 800 Band 26	-101	-105		dBm
	LTE 800 Band 27	-101.5	-108		dBm
	LTE 700 Band 28	-101.5	-107.5		dBm
	LTE AWS-3 Band 66	-99	-107		dBm
LTE 700 Band 85	-99.2	-107.5		dBm	
LTE Cat M1: Power @ ARP with 50Ω Load, NTNV BW: 5 MHz, UL: Modulation: QPSK; $N_{RB}=1$ ;	LTE 2100 Band 1	+18	+20		dBm
	LTE 1800 Band 2	+18	+20		dBm
	LTE 1900 Band 3	+18	+20		dBm
	LTE AWS-1 Band 4	+18	+20		dBm
	LTE 850 Band 5	+18	+20		dBm
	LTE 900 Band 8	+18	+20		dBm
	LTE 700 Band 12	+18	+20		dBm
	LTE 700 Band 13	+18	+20		dBm
	LTE 800 Band 18	+18	+20		dBm
	LTE 800 Band 19	+18	+20		dBm
	LTE 800 Band 20	+18	+20		dBm
	LTE 1900 Band 25	+18	+20		dBm
	LTE 800 Band 26	+18	+20		dBm
	LTE 800 Band 27	+18	+20		dBm
	LTE 700 Band 28	+18	+20		dBm
	LTE AWS-3 Band 66	+18	+20		dBm
LTE 700 Band 85	+18	+20		dBm	
LTE connectivity (Cat NB1/2)	Band 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 71, 85				

## 4.6 Antenna Interface

Table 23: RF Antenna interface GSM / LTE

Parameter	Conditions	Min.	Typical	Max.	Unit
LTE Cat NB1/2: Receiver Input Sensitivity @NTNV DL: Modulation: QPSK; Subcarriers: 12; UL: Modulation: BPSK; Subcarrier spacing: 15KHz; N <sub>tones</sub> : 1@0	LTE 2100 Band 1	-108.2	-113		dBm
	LTE 1800 Band 2	-108.2	-113		dBm
	LTE 1900 Band 3	-108.2	-113.5		dBm
	LTE AWS-1 Band 4	-108.2	-113		dBm
	LTE 850 Band 5	-108.2	-113.5		dBm
	LTE 900 Band 8	-108.2	-113		dBm
	LTE 700 Band 12	-108.2	-114		dBm
	LTE 700 Band 13	-108.2	-114		dBm
	LTE 800 Band 18	-108.2	-113.5		dBm
	LTE 800 Band 19	-108.2	-113.5		dBm
	LTE 800 Band 20	-108.2	-113		dBm
	LTE 1900 Band 25	-108.2	-113		dBm
	LTE 800 Band 26	-108.2	-113.5		dBm
	LTE 700 Band 28	-108.2	-114		dBm
	LTE AWS-3 Band 66	-108.2	-113		dBm
	LTE 600 Band 71	-108.2	-112.5		dBm
LTE 700 Band 85	-108.2	-114		dBm	
LTE Cat NB1/2: Power @ ARP with 50Ω Load, NTNV Configuration ID: 1, UL: Modulation: BPSK; Subcarrier: 1; Subcarrier space: 3.75 kHz; N <sub>tones</sub> : 1@0	LTE 2100 Band 1	+18	+20		dBm
	LTE 1800 Band 2	+18	+20		dBm
	LTE 1900 Band 3	+18	+20		dBm
	LTE AWS-1 Band 4	+18	+20		dBm
	LTE 850 Band 5	+18	+20		dBm
	LTE 900 Band 8	+18	+20		dBm
	LTE 700 Band 12	+18	+20		dBm
	LTE 700 Band 13	+18	+20		dBm
	LTE 800 Band 18	+18	+20		dBm
	LTE 800 Band 19	+18	+20		dBm
	LTE 800 Band 20	+18	+20		dBm
	LTE 1900 Band 25	+18	+20		dBm
	LTE 800 Band 26	+18	+20		dBm
	LTE 700 Band 28	+18	+20		dBm
	LTE AWS-3 Band 66	+18	+20		dBm
	LTE 600 Band 71	+18	+20		dBm
LTE 700 Band 85	+18	+20		dBm	
GPRS coding schemes	Class 10, CS1 to CS4				
EGPRS	Class 10, MCS1 to MCS9				
GSM Class	Small MS				

## 4.6 Antenna Interface

Table 23: RF Antenna interface GSM / LTE

Parameter		Conditions	Min.	Typical	Max.	Unit
GPRS Static Receiver input Sensitivity @ PDTCH/CS-1		GSM 850/900	-104	-109		dBm
		GSM 1800/1900	-104	-108		dBm
RF Power @ ARP with 50Ω Load, (ROPR = 4, i.e. no reduction)	GSM 850/900	GPRS, 1 TX		32.5		dBm
		GPRS, 2 TX		32.5		dBm
		EDGE, 1 TX		27.0		dBm
		EDGE, 2 TX		27.0		dBm
	GSM 1800/1900	GPRS, 1 TX		29.5		dBm
		GPRS, 2 TX		29.5		dBm
		EDGE, 1 TX		26.0		dBm
		EDGE, 2 TX		26.0		dBm
RF Power @ ARP with 50Ω Load, (ROPR = 5)	GSM 850/900	GPRS, 1 TX		32.5		dBm
		GPRS, 2 TX		32.5		dBm
		EDGE, 1 TX		27.0		dBm
		EDGE, 2 TX		27.0		dBm
	GSM 1800/1900	GPRS, 1 TX		29.5		dBm
		GPRS, 2 TX		29.5		dBm
		EDGE, 1 TX		26.0		dBm
		EDGE, 2 TX		26.0		dBm
RF Power @ ARP with 50Ω Load, (ROPR = 6)	GSM 850/900	GPRS, 1 TX		32.5		dBm
		GPRS, 2 TX		30.5		dBm
		EDGE, 1 TX		27.0		dBm
		EDGE, 2 TX		27.0		dBm
	GSM 1800/1900	GPRS, 1 TX		29.5		dBm
		GPRS, 2 TX		27.5		dBm
		EDGE, 1 TX		26.0		dBm
		EDGE, 2 TX		26.0		dBm
RF Power @ ARP with 50Ω Load, (ROPR = 7)	GSM 850/900	GPRS, 1 TX		32.5		dBm
		GPRS, 2 TX		29.5		dBm
		EDGE, 1 TX		27.0		dBm
		EDGE, 2 TX		27.0		dBm
	GSM 1800/1900	GPRS, 1 TX		29.5		dBm
		GPRS, 2 TX		26.5		dBm
		EDGE, 1 TX		26.0		dBm
		EDGE, 2 TX		26.0		dBm

## 4.6 Antenna Interface

**Table 23:** RF Antenna interface GSM / LTE

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ω Load, ( <b>ROPR = 8</b> , i.e. maximum reduction)	GSM 850/900	GPRS, 1 TX		32.5		dBm
		GPRS, 2 TX		29.5		dBm
		EDGE, 1 TX		27.0		dBm
		EDGE, 2 TX		24.0		dBm
	GSM 1800/1900	GPRS, 1 TX		29.5		dBm
		GPRS, 2 TX		26.5		dBm
		EDGE, 1 TX		26.0		dBm
		EDGE, 2 TX		23.0		dBm

## 5 Mechanics, Mounting and Packaging

### 5.1 Mechanical Dimensions

Figure 11 shows a 3D view of the EGX81-W and provides an overview of the mechanical dimensions of the board. For further details see Figure 12. To allow for an easier mechanical implementation into an external application a set of 3D STP data for EGX81-W RS232 is attached to this PDF. Please open the [Attachments](#) navigation panel to view and save these files.

Length: 80.10mm (including fixtures for cable straps)  
Width: 56.21mm (excluding antenna and serial interface connectors)  
Height: 22.10mm  
  
Weight: 65g

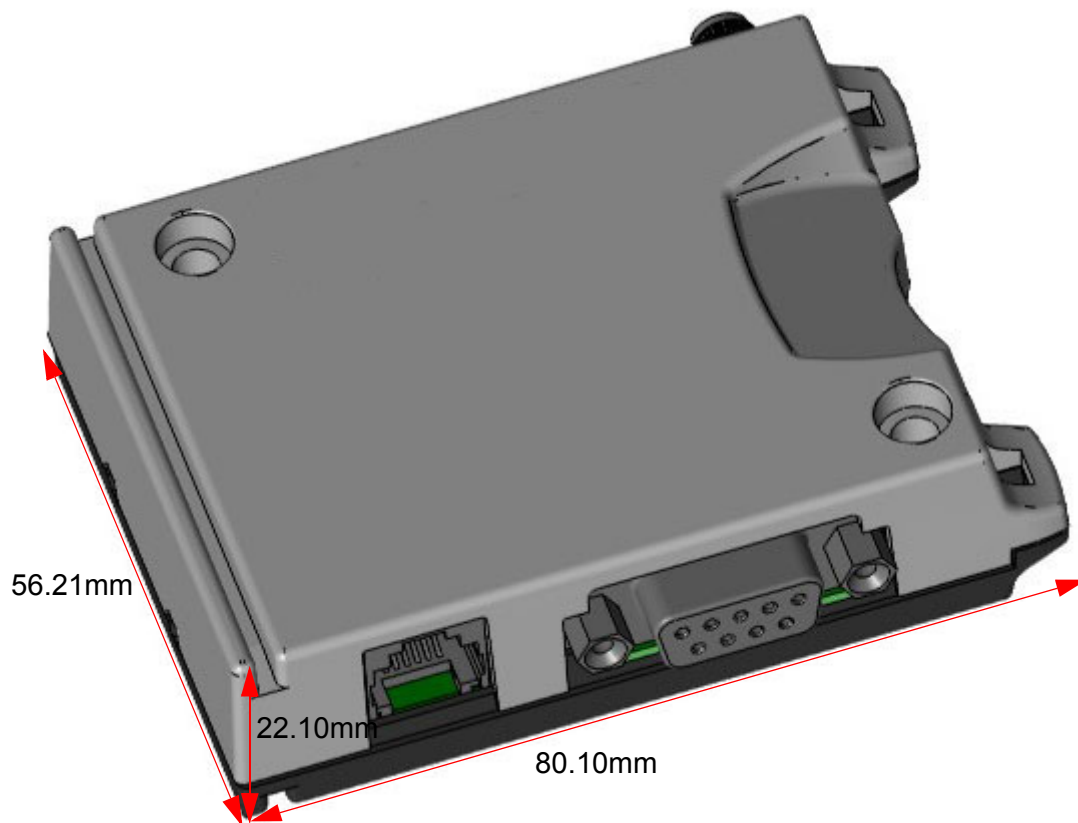


Figure 11: EGX81-W 3D overview

5.1 Mechanical Dimensions

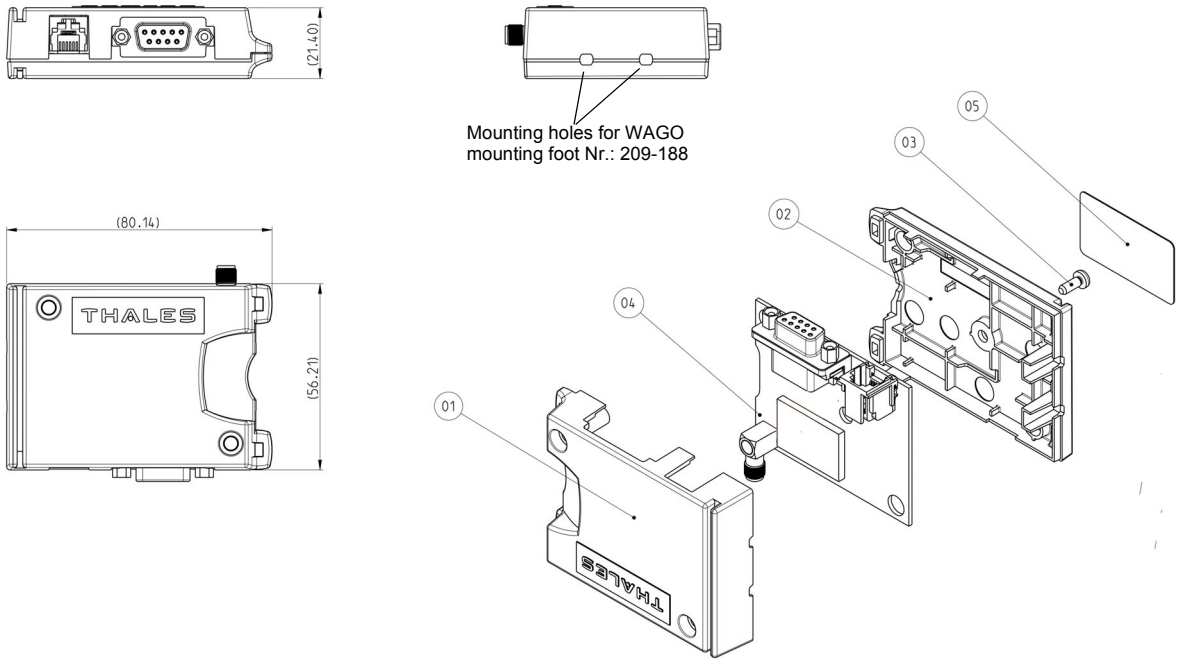


Figure 12: EGX81-W mechanical dimensions

## 5.2 Mounting the EGX81-W

There are a number of ways to mount the EGX81-W:

- EGX81-W can be attached to a rail installation or other surface using the two provided screw holes.
- EGX81-W can be fastened to a rack or holding using the two provided fixtures for cable straps.
- EGX81-W can be slid onto a specific DIN rail made according to DIN EN 60715 - C section, C30 format. A catch at the Gateway's bottom side will have to be removed to slide multiple Gateways onto a single rail.
- Using a Wago 209-188 mounting foot for terminal blocks the EGX81-W can be fitted onto another special type of DIN rail made according to DIN EN 60715 - Top hat section, 35mm (e.g., Wago 210-113 steel carrier rail).

The following figure shows the various possibilities provided to mount the EGX81-W.

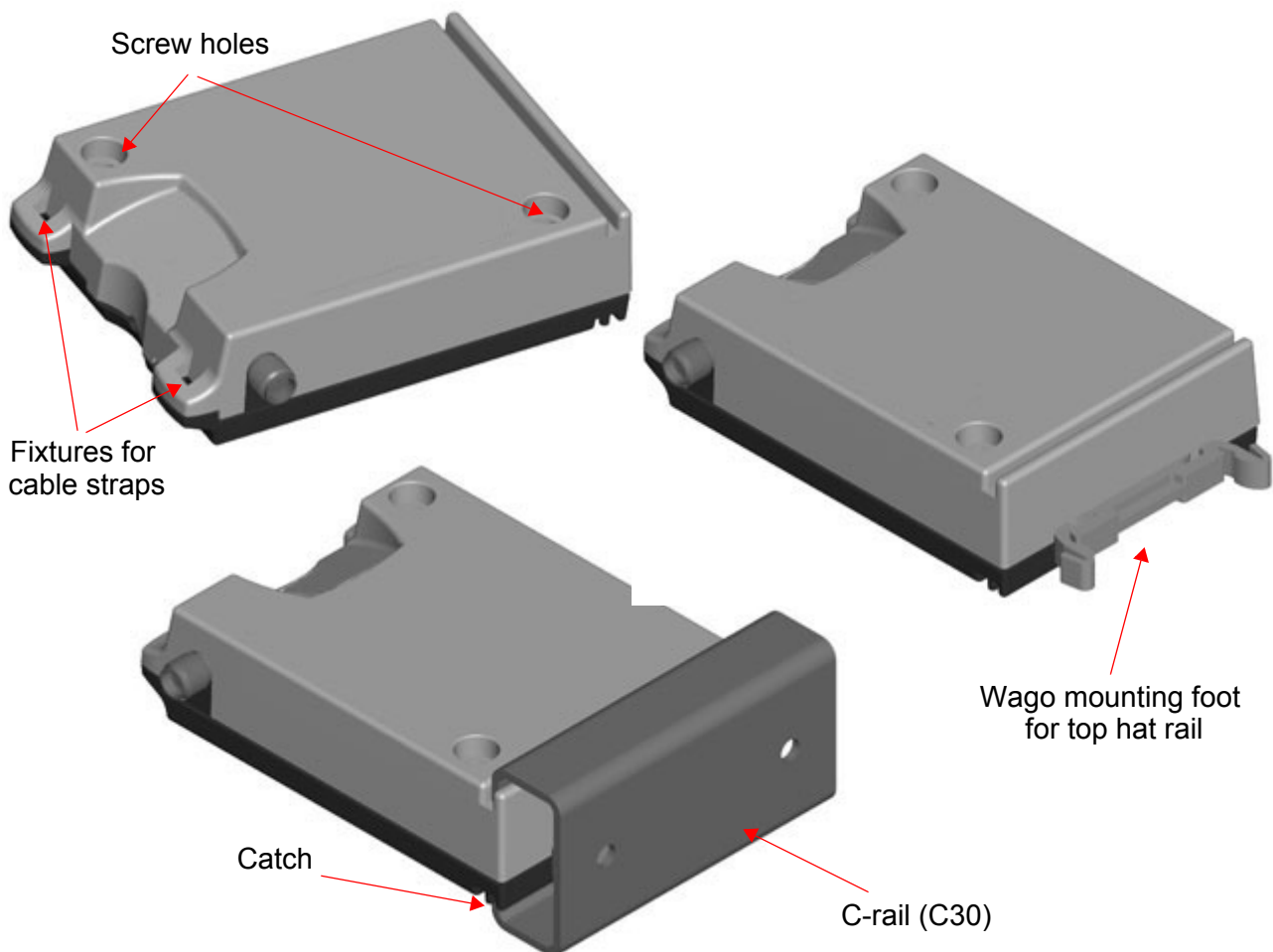


Figure 13: Mounting the EGX81-W

The various ways to mount the EGX81-W may be combined where appropriate. It is for example possible to slide the Gateway onto a DIN rail and in addition use cable straps to fasten it to a holding.

**Note:** The terminal should not be mounted more than 2 meters above floor for safety reasons.



## **5.3 Packaging**

EGX81-W comes in Gateway boxes and is shipped in transportation cardboards:

- Gateway box size: 35mm x 83mm x 67mm.
- Transportation cardboard size: 363mm x 353mm x 205mm.

Each transportation cardboard contains 100 Gateway boxes.

## 6 Full Type Approval

### 6.1 Thales M2M Reference Setup

The Thales reference setup submitted to type approve EGX81-W consists of the following components:

- EGX81-W with approved LTE module (EGX81-W RS232 or EGX81-W RS485)
- PC as MMI
- Power Supply

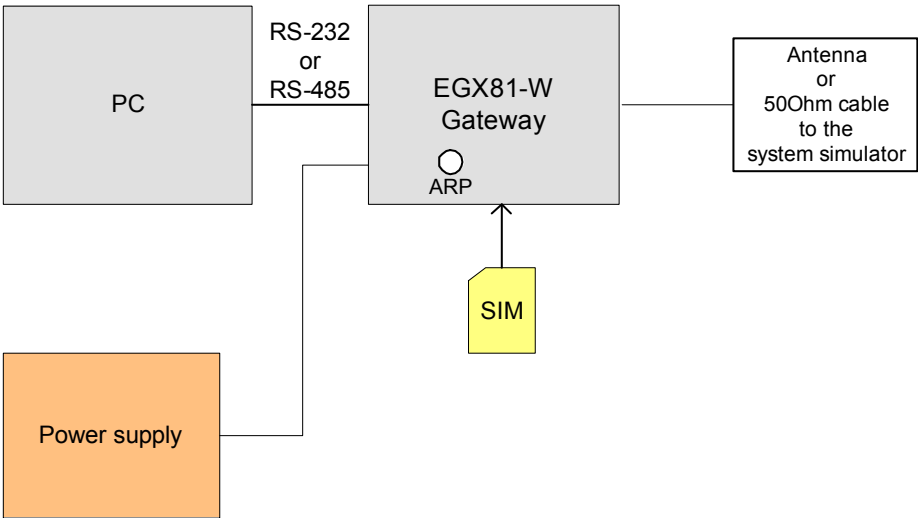


Figure 14: Reference equipment for approval

For ordering information please refer to [Chapter 7](#).

## 6.2 Restrictions

Later enhancements and modifications beyond the certified configuration require extra approvals. Each supplementary approval process includes submittal of the technical documentation as well as testing of the changes made.

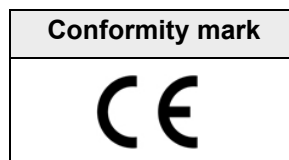
- No further approvals are required for customer applications that comply with the approved EGX81-W configuration.
- Extra approval must be obtained for applications using other accessories than those included in the approved EGX81-W configuration (power supply, MMI implementation supported by AT commands).

## 6.3 CE Conformity

The EGX81-W meets the requirements of the EU directives listed below:

- RED Directive 2014/53/EU

The EGX81-W is marked with the CE conformity mark (without a notified body number):



## 6.4 EMC

The EGX81-W complies with the equipment requirements specified in EN 301489-1,-13, -52, and is covered by the RED Directive. For details see [Section 1.3](#).

## 6.5 Compliance with FCC Rules and Regulations

As an integrated product, the EGX81-W is fully compliant with the grant of the FCC Equipment Authorization and the ISED Certificates issued for the built-in EXS82-W module, and therefore, bear the labels "Contains FCC ID QIPEXS82-W" and accordingly "Contains IC: 7830A-EXS82W".

The Equipment Authorization Certification for the EXS82-W module is listed under the following identifiers:

*FCC Identifier: QIPEXS82-W*

*ISED Certification Number: 7830A-EXS82W*

*Granted to THALES DIS AIS Deutschland GmbH*

### Notes (FCC):

Radiofrequency radiation exposure information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This terminal equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications made to this equipment not expressly approved by Gemalto M2M may void the FCC authorization to operate this equipment.

This device contains UMTS, GSM and GPRS class functions in the 900, 1800 and 2100MHz bands that are not operational in U.S. Territories. This device is to be used only for mobile and fixed applications.

Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance: For more information on the RF antenna interface please refer to [Section 3.12](#) and [Section 4.6](#).

Please contact us for more information on the FCC Compliance details mentioned above:

Thales  
Edgar Canizales  
Arboretum Plaza II  
9442 Capital of Texas Highway, Suite 400  
Austin, TX 78759  
Tel: +1 512 215 7326  
Email: edgar.canizales@thalesgroup.com

**Notes (ISED):**

(EN) This Class B digital apparatus complies with Canadian ICES-003 and RSS-210. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

(FR) Cet appareil numérique de classe B est conforme aux normes canadiennes ICES-003 et RSS-210. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférence et (2) cet appareil doit accepter toute interférence, notamment les interférences qui peuvent affecter son fonctionnement.

**(EN) Radio frequency (RF) Exposure Information**

The radiated output power of the Wireless Device is below the Innovation, Science and Economic Development Canada (ISED) radio frequency exposure limits. The Wireless Device should be used in such a manner such that the potential for human contact during normal operation is minimized.

This device has also been evaluated and shown compliant with the ISED RF Exposure limits under mobile exposure conditions. (antennas are greater than 20cm from a person's body).


**(FR) Informations concernant l'exposition aux fréquences radio (RF)**

La puissance de sortie émise par l'appareil de sans fil est inférieure à la limite d'exposition aux fréquences radio d'Innovation, Sciences et Développement économique Canada (ISDE). Utilisez l'appareil de sans fil de façon à minimiser les contacts humains lors du fonctionnement normal.

Ce périphérique a également été évalué et démontré conforme aux limites d'exposition aux RF d'ISED dans des conditions d'exposition à des appareils mobiles (les antennes se situent à moins de 20cm du corps d'une personne).

## 7 List of Parts and Accessories

**Table 24:** List of parts and accessories

Description	Supplier	Ordering information
EGX81-W	Thales	Ordering number EGX81-W RS232: L30960-N2780-A100 EGX81-W RS485: L30960-N2781-A100
Power supply unit Input: 100-240V / 50/60Hz / 500mA Output: 12V / 1,25A  	Thales	Power supply including 4 exchangeable AC plugs (EU, UK, US and AUS)  Ordering number: L36880-N8490-A82
Mounting foot (209-188) Top hat rail, i.e., 35mm DIN rail (210-113)	Wago	WAGO Kontakttechnik GmbH & Co. KG Hansastr. 27 32423 Minden Phone: +49-571-887-0 Fax: +49-571-887-169  Ordering number: 209-188  Email: <a href="mailto:info@wago.com">info@wago.com</a> Web: <a href="http://www.wago.com/">http://www.wago.com/</a>
LTE Broadband Antenna fitting to the used frequency bands, 50 Ohm, SMA connector (male)		
RS-232 cable with 9-pin D-sub connector (male)	Tecline	Ordering number: 300574 Tecline GmbH Behrener Straße 8 D-66117 Saarbrücken Phone: +49-681-926-78-70 Fax: +49-681-926-78-555 Web: <a href="http://www.tecline-edv.de/">http://www.tecline-edv.de/</a>
6-pin header connector (male) for RS-485 interface  	PHOENIX CONTACT	Ordering number: 1803617 PHOENIX CONTACT Deutschland GmbH Flachmarktstr. 8 D-32825 Blomberg  Phone: +49 52 35/3-1 20 00 Fax: +49 52 35/3-1 29 99  Email: <a href="mailto:iinfo@phoenixcontact.de">iinfo@phoenixcontact.de</a> Web: <a href="http://www.phoenixcontact.com">http://www.phoenixcontact.com</a>



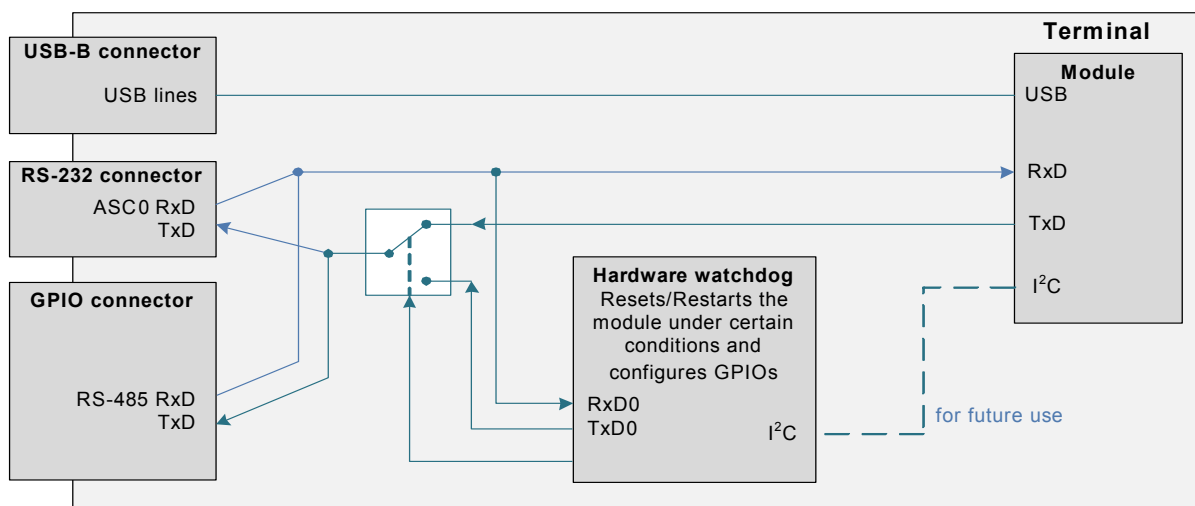
## 8 Appendix: (Hardware) Watchdog

The watchdog is part of the EGX81-W and connected to the module itself (see also [Figure 4](#)). It can be used to

- Safely reset the module in certain conditions
- Restart the module when it has turned off

The complete watchdog functionality can be configured by means of special watchdog configuration commands (i.e., WD commands) that are passed to the watchdog via the serial RXD0 line. For details on how to configure the complete watchdog functionality see [Section 8.3](#).

The below [Figure 15](#) illustrates the various ways the watchdog may be accessed and configured.



**Figure 15:** Hardware watchdog configuration



## 8.1 Reset Conditions

The watchdog implements two conditions, under which a reset of the module is automatically performed:

- Repetitive: A module reset is performed frequently and repetitive. This reset condition can be used to force the module to reconnect to the mobile network once in a while. Typical frequencies can be 24h or longer. This feature can be configured via the RST\_REP timeout.
- UART activity: The watchdog can be used to reset the module, when no response from the module on AT commands is recognized for a specified amount of time. To prevent the reset, the module has to be active frequently on the UART interface. This reset condition can be configured via the RST\_UART timeout, it is deactivated when timeout parameter = 0.

When the watchdog is enabled, it will observe the activities on the UART interface as well as the module status, depending on timeout parameter settings and perform frequent resets, if it is configured to do so.

### 8.1.1 Reset

Basically, there are up to two escalations during a module reset:

- First (regular fast shutdown): The watchdog shuts down the module via an internal fast shutdown signal. The fast shutdown procedure will then still finish any data activities on the module's flash file system, thus ensuring data integrity, but will no longer deregister gracefully from the network, thus saving the time required for network deregistration. Afterwards, i.e. after an internal signaling has gone low, the module is regularly restarted.
- Second (emergency restart): If the module can for some reasons not be switched off successfully during the first stage, the watchdog resets the module via an internal EMERG\_RST signal. The emergency restart procedure includes disconnecting the power supply lines, and causes the loss of all information stored in the module's volatile memory.

During the first stage the watchdog waits for up to three seconds for the internal signaling to go low. If the internal signaling does not change, the watchdog escalates to the second stage in order to switch off and restart the module.

The watchdog can also be configured to automatically switch on resp. power up the module following a shutdown and a configured delay time (always-on mode).

### 8.1.2 Reset Delay

The watchdog implements a protection mechanism to prevent too frequent module resets. When the delayed reset mechanism is enabled, the watchdog will start its activity only after the specified amount of time, MIN\_START\_TIME. A reasonable value for this timeout is 30 minutes. After the module has been started by the WD, no reset of the module is performed before the timeout of MIN\_START\_TIME. The reset delay mechanism may be useful for software updates.

## 8.2 Restart Conditions

When the watchdog is enabled, it will observe the modules on/off state. When it is configured to keep the module "always on", it will restart the module after the specified amount of time after it has discovered that the module has turned off. This important feature is useful in rough environments with often power losses and out-of-temperature conditions where it secures a safe module operation. The timeout condition for the restart feature is called ALWAYS\_ON.

## 8.3 Complete Watchdog Configuration

The complete hardware watchdog functionality can be configured via the TXD0 line of the serial interface ASC0 as described in this section.

The watchdog listens on the RXD0 line exclusively at the low baudrate 1200bps. This means that if using the watchdog this low baud rate is reserved and should not be configured for the module's asynchronous serial interface ASC0. The RXD0 line can be accessed either via RS-232 interface or via RS-485 interface (in conjunction with an RS232-to-RS485 adapter). Note if WD output signal via serial line is needed, it can be configured via TXD0 command. Commands are acknowledged by green ON LED - see [Section 8.3.1](#).

So, to control and configure the watchdog, a terminal program MUST be set to 1200bps, before a command can be sent to the watchdog. Otherwise the WD can not receive. [Section 8.3.1](#) for the watchdog's configuration command specification. Once completed, the terminal program should be changed to higher baud rates again to enable proper communication with the module. Note that the module has to be up and running for this type of configuration.

### 8.3.1 Watchdog (WD) Command Specification

The general watchdog command syntax is as follows:

```
WD=<command>,<argument>,<checksum><NL>
```

Where

- <command> specifies the command name
- <argument> gives the numeric argument
- <checksum> is the sum of the digits of the argument. (e.g. the argument 124 produces a checksum 7, because  $1+2+4=7$ ).

Whenever a non-volatile command is executed, it is saved in the watchdog's flash memory. At watchdog start, the last state is loaded from flash memory.

If a config command was successfully executed by the watchdog, the green ON LED flashes two times. The watchdog commands are implemented as text commands. In case a command error occurs - e.g., a checksum failure - the green ON LED flashes 4 times.

## 8.3 Complete Watchdog Configuration

The following watchdog configuration commands are available:

- Watchdog on/off - see [Section 8.3.1.1](#)
- Test mode - see [Section 8.3.1.2](#)
- Repetitive module reset - see [Section 8.3.1.3](#)
- UART reset - see [Section 8.3.1.4](#)
- Restart delay - see [Section 8.3.1.5](#)
- Always on - see [Section 8.3.1.6](#)
- Load default values - see [Section 8.3.1.7](#)
- TXD0 Control - see [Section 8.3.1.8](#)
- Print WD Configuration - [Section 8.3.1.9](#)

Note: Changing the watchdog configuration using any of the following commands disables the watchdog: Repetitive module reset, UART reset, Restart delay and Always on. With these commands the new configuration setting becomes effective only after the hardware watchdog is enabled again.

### 8.3.1.1 Watchdog On/Off

Command	ON
Parameter	<on off>
Type	Boolean
Range	0: Off (watchdog disabled) 1: On (watchdog enabled)
Default	0: Off
Non-volatile	Yes
Example	WD=ON,0,0 // disables the watchdog WD=ON,1,1 // enables the watchdog

This command is used to enable or disable the watchdog function. When disabled, all timers are stopped and the watchdog doesn't perform a module reset. When enabled, all configured timers start after a delay time of MIN\_START\_TIME. If MIN\_START\_TIME=0, all reset timers start immediately. Also, when the watchdog is enabled and ALWAYS\_ON>0, the watchdog observes the modules on/off state, and starts the module in case it detects that the module is off.

### 8.3.1.2 Test Mode

Command	TEST_MODE
Parameter	<on off>
Type	Boolean
Range	0: Off (Exit test mode) 1: On (Enter test mode)
Default	0: Off
Non-volatile	Yes
Example	WD=TEST_MODE,0,0 // Exit test mode WD=TEST_MODE,1,1 // Enter test mode

This commands configures the watchdog's test mode. In test mode the watchdog operates normally, but does not actually perform a module reset. Instead, it signals the (simulated) reset via the LED by flashing the green ON LED two times to visualize the watchdog trigger. Entering the test mode disables the actual watchdog functionality.

### 8.3.1.3 Repetitive Module Reset

Command	RST_REP
Parameter	<timeout>
Type	Milliseconds
Range	0 .. $2^{32}-1$
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD=RST_REP,1800000,9 // Reset every 30 minutes

This command configures a repetitive module resets, if the watchdog is enabled. The parameter sets the RST\_REP timeout value. If the watchdog is enabled, an unconditional module reset every RST\_REP milliseconds is performed.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again, and after the MIN\_START\_TIME has passed.

For normal operation, this value should be set to a value greater than 30 minutes, some use cases may even require a setting > 24h.

### 8.3.1.4 UART Reset

Command	RST_UART
Parameter	<timeout>
Type	Milliseconds
Range	0 .. $2^{32}-1$
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD=RST_UART,600000,6 // Resets the module if there was no activity on the RXD0 line for 10 minutes

This command configures a module reset, if no UART activity from the module was observed for the specified amount of time - RST\_UART. The module has to be active on the RXD0 signal within the specified time period; otherwise the watchdog will reset the module.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again, and after the MIN\_START\_TIME has passed.

For normal operation, this value should be set to a value greater than 10 minutes (600000).

### 8.3.1.5 Restart Delay

Command	MIN_START_TIME
Parameter	<timeout>
Type	Milliseconds
Range	0 .. $2^{32}-1$
Default	18000000ms (30 minutes)
Non-volatile	Yes
Example	WD=MIN_START_TIME,18000000,9 // Prevents module resets for 30 minutes after each module startup, and after the watchdog becomes active

This command configures the MIN\_START\_TIME timeout value. By setting the MIN\_START\_TIME, the watchdog no longer performs a module reset for the given amount of time, after module startup. Whenever the module has been reset and restarted, as well as after the watchdog has been enabled, the watchdog will wait for MIN\_START\_TIME before performing any (further) resets. The watchdog's reset timer only starts after the MIN\_START\_TIME has expired.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again.

It is strongly recommended to set this value to a time period of more than 30 minutes for normal operation. During development it may be set to values of less than 30 minutes, but should always be greater than the time the module needs for a complete start up including . Also, a module firmware or userware update right after startup should be taken into account which may take up to 15 min.

## 8.3 Complete Watchdog Configuration

**8.3.1.6 Always On**

Command	ALWAYS_ON
Parameter	<timeout>
Type	Milliseconds
Range	0 .. $2^{32}-1$
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD= ALWAYS_ON,60000,6 // Observes the module and restarts it 60 seconds after it has been turned off

This command configures the on/off-state observation of the module by specifying a timeout value for ALWAYS\_ON. If enabled, the watchdog observes the module's internal signalling. If the watchdog detects that the module is OFF, it will restart the module after the timeout of ALWAYS\_ON milliseconds.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled.

It is strongly recommended to set this value to a time period of more than 1 minute for normal operation to avoid oscillation in e.g. out-of-temperature events. In case of over/under temperature shut down it can be expected that the temperature does not change significantly within a minute. During development the timeout may be set to a period of less than 1 minute.

**8.3.1.7 Load Default Values**

Command	DFT_VAL
Parameter	<1>
Type	Fixed
Range	1
Default	---
Non-volatile	No
Example	WD= DFT_VAL,1,1 // Loads the default values

This command loads the default configuration values. This disables the watchdog. If the watchdog is enabled, the reset timeout values, the MIN\_START\_TIME timeout and the ALWAYS\_ON timeout become active. Other configuration values become active immediately. The loaded default values are also persistent, i.e. written to the flash memory.



### 8.3.1.8 TxD0 Control

Command	TXD0
Parameter	number
Type	Fixed
Range	0 (disable, non-volatile),1 (enable, volatile),2 (enable, non-volatile)
Default	0
Non-volatile	0: Yes, 1: No, 2: Yes
Example	WD=TXD0,1,1 // Activates the WD TxD signal volatile on the external connector.

This command controls the output line TXD0 of the watchdog. When enabled, the WD responses are transmitted to the serial lines RS-232 or RS-485.

### 8.3.1.9 Print WD Configuration

Command	PRINT
Parameter	<1>
Type	Fixed
Range	1
Default	--
Non-volatile	No
Example	WD=PRINT,1,1 // Print the current WD configuration via UART

This command shows the current WD configuration. TXD0 has to be activated before in order to get the response.



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