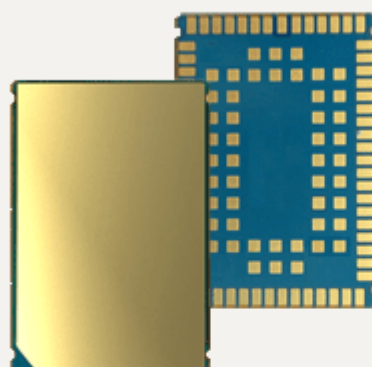


Cinterion[®] EXS82-W

Hardware Interface Overview

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1 Introduction

This document¹ describes the hardware of the Cinterion® EXS82-W module. It helps you quickly retrieve interface specifications, electrical and mechanical details and information on the requirements to be considered for integrating further components.

Note: This Hardware Interface Overview is an early draft version and as such subject to change depending on further implementation and measurements.

1.1 Product Variants

This document applies to the following Gemalto M2M module variants:

- Cinterion® EXS82-W

1.2 Key Features at a Glance

Feature	Implementation
<i>General</i>	
Frequency bands	GSM (EXS82-W only): 850/900/1800/1900 LTE Cat M1: 700 (Bd12, Bd13, Bd14, Bd28, Bd85), 800 (Bd18, Bd19, Bd20, Bd26, Bd27), 850 (Bd5), 900 (Bd8), 1700 (Bd66), AWS (Bd4), 1800 (Bd3), 1900 (Bd2, Bd25), 2100 (Bd1) LTE Cat NB1/2: 600 (Bd71), 700 (Bd12, Bd13, Bd28, Bd85), 800 (Bd18, Bd19, Bd20, Bd26), 850 (Bd5), 900 (Bd8), 1700 (Bd66), AWS (Bd4), 1800 (Bd3), 1900 (Bd2, Bd25), 2100 (Bd1)
GSM class	Small MS
Output power (according to Release 7)	GSM/GPRS (EXS82-W only): Class 4 (+33dBm $\pm$2dB) for GSM850 and GSM900 Class 1 (+30dBm $\pm$2dB) for GSM1800 and GSM1900 Class E2 (+27dBm $\pm$ 3dB) for GSM850 8-PSK and GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK and GSM1900 8-PSK
Output power (according to 3GPP Release 13)	LTE Cat M1: Class 5(+20dBm $\pm$2dB) for all supported LTE Cat M1 bands LTE Cat NB1/2: Class 5(+20dBm $\pm$2dB) for all supported LTE Cat NB1/2 bands

1. The document is effective only if listed in the appropriate Release Notes as part of the technical documentation delivered with your Gemalto M2M product.

1.2 Key Features at a Glance

Feature	Implementation
Power supply	Normal operation: EXS82-W: - LTE and GSM: 3.3V to 4.6V - LTE with GSM deactivated: 2.8V to 4.6V Extended operation: EXS82-W: - LTE with GSM deactivated: 2.5V to 4.8V
Operating temperature (board temperature)	Normal operation: -30°C to +85°C Extended operation: -40°C to +90°C
Operating temperature (ambient temperature)	Normal operation (GSM): -40°C to +60°C Normal operation (LTE): -40°C to +70°C
Physical	Dimensions: 27.6mm x 18.8mm x 2.3mm Weight: approx. 2.5g
RoHS	All hardware components fully compliant with EU RoHS Directive
LTE features	
3GPP Release 14	LTE Cat M1 (HD-FDD) DL: max. 300kbps, UL: max. 1.1Mbps LTE Cat NB1 (HD-FDD) DL: max. 27kbps, UL: max. 63kbps LTE Cat NB2 (HD-FDD) DL: max. 124kbps, UL: max. 158kbps
GSM/GPRS/EGPRS features	
Data transfer	GPRS (EXS82-W only): • Multislot Class 10 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS (EXS82-W only): • Multislot Class 10 • EDGE E2 power class for 8 PSK • Downlink coding schemes – CS 1-4, MCS 1-9 • Uplink coding schemes – CS 1-4, MCS 1-9 • SRB loopback and test mode B • 8-bit, 11-bit RACH • PBCCH support • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B
SMS	Point-to-point MT and MO Text and PDU mode Storage: SIM card plus SMS locations in mobile equipment
GNSS Features	
Protocol	NMEA (for GNSS related sentences)

1.2 Key Features at a Glance

Feature	Implementation
Modes	Standalone GNSS (GPS, GLONASS, BeiDou, Galileo)
General	Automatic power saving modes Power supply for active antenna
<i>Software</i>	
AT commands	Hayes 3GPP TS 27.007, TS 27.005, Gemalto M2M AT commands for RIL compatibility
SIM Application Toolkit	SAT Release 99
Firmware update	Firmware update from external application over ASC0 and ASC1 interface.
<i>Interfaces</i>	
Module interface	Surface mount device with solderable connection pads (SMT application interface). Land grid array (LGA) technology ensures high solder joint reliability and allows the use of an optional module mounting socket. For more information on how to integrate SMT modules see also [4] . This application note comprises chapters on mounting and application layout issues as well as on additional SMT application development equipment.
USB	USB 2.0 High Speed (480Mbit/s) device interface, Full Speed (12Mbit/s) compliant The USB interface is used for tracing purposes only.
2 serial interfaces	ASC0: 8-wire modem interface with status and control lines, unbalanced, asynchronous - Adjustable baud rates: 300bps to 921,600bps - Supports RTS0/CTS0 hardware flow control (as configuration option). ASC1: 4-wire, unbalanced asynchronous modem interface - Adjustable baud rates: 300bps to 921,600bps - Supports RTS1/CTS1 hardware flow control (as configuration option).
UICC interface	Supported SIM/USIM cards: 1.8V
Status	Supports status indication LED
Fast shutdown	Supports fast shutdown interrupt signal
SIM switch	Supports signal to switch between two externally connected SIMs.
Antenna interface pads	50Ω. GSM/LTE Main antenna, GNSS antenna
<i>Power on/off, Reset</i>	
Power on/off	Switch-on by hardware signal ON Switch-off by AT command and hardware signal FST_SHDN Automatic switch-off in case of critical voltage conditions
Reset	Orderly shutdown and reset by AT command Emergency reset by hardware signal EMERG_RST
<i>Special features</i>	
Approval	RED, CE, FCC, ISED, UL, EuP, RoHS, and REACH compliant GCF, PTCRB
Phonebook	SIM and phone

1.2 Key Features at a Glance

Feature	Implementation
<i>Evaluation kit</i>	
LGA DevKit	LGA DevKit designed to test Gemalto M2M LGA modules. For more information see also LGA DevKit details.
Evaluation module	EXS82-W module soldered onto a dedicated PCB that can be connected to the an approval adapter in order to be mounted onto the DSB75 or DSB-Mini.
DSB75	DSB75 Development Support Board designed to test and type approve Gemalto M2M modules and provide a sample configuration for application engineering. A special adapter is required to connect the EXS82-W evaluation module to the DSB75.

1.3 EXS82-W System Overview

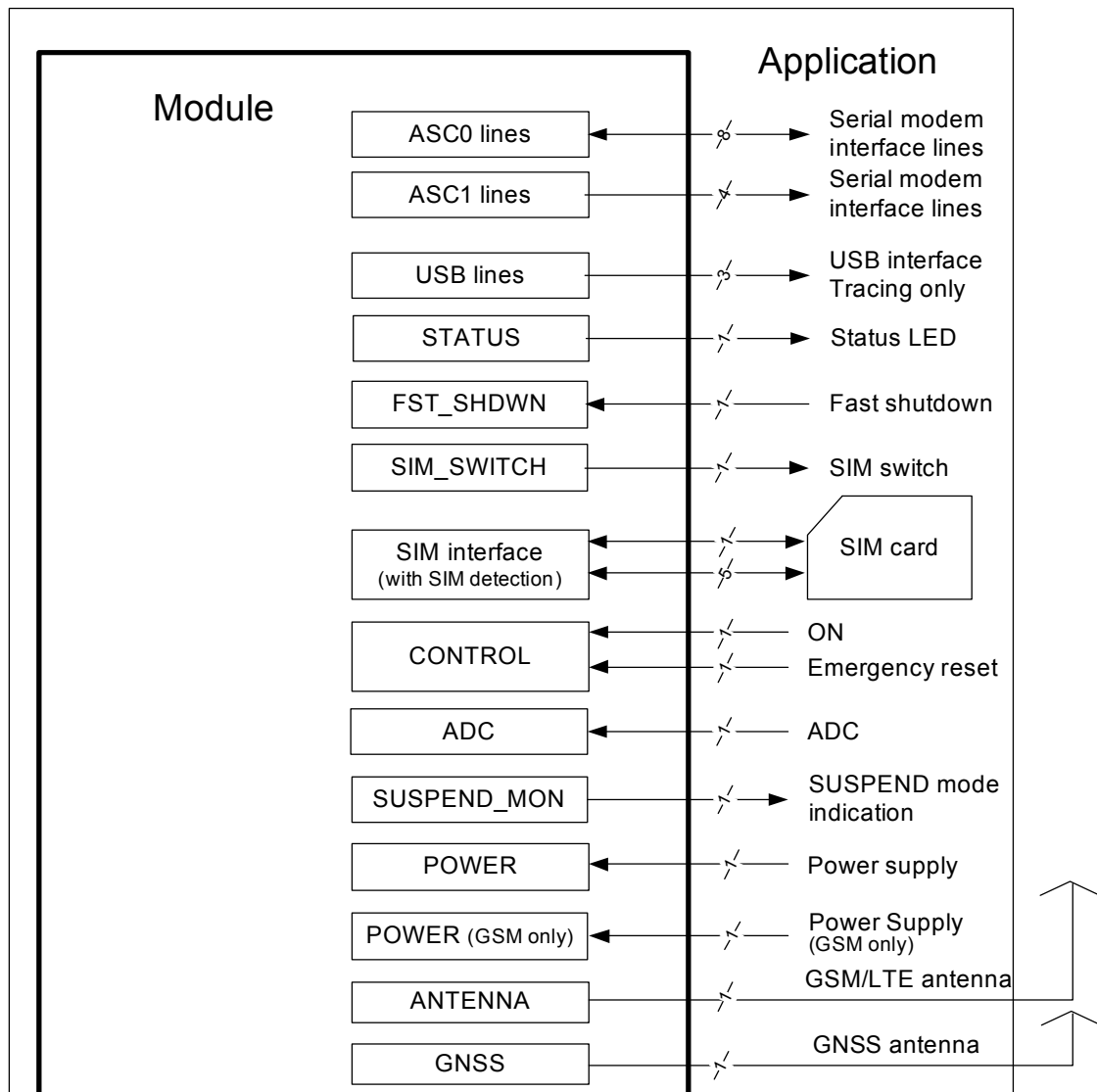


Figure 1: EXS82-W system overview

2 Interface Characteristics

EXS82-W is equipped with an SMT application interface that connects to the external application. The SMT application interface incorporates the various application interfaces as well as the RF antenna interface.

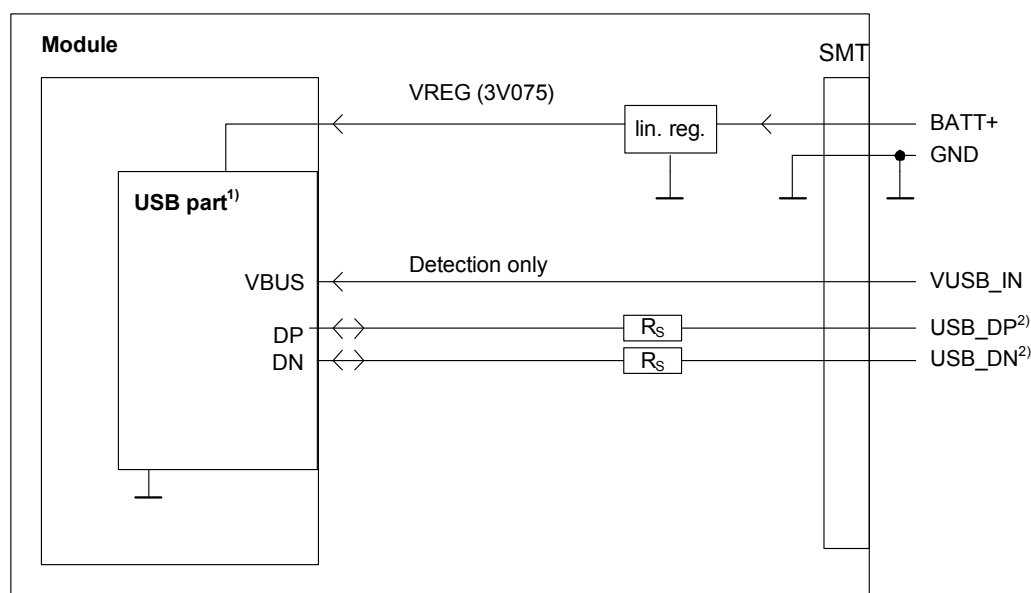
2.1 Application Interface

2.1.1 USB Interface

EXS82-W supports a USB 2.0 High Speed (480Mbit/s) device interface that is Full Speed (12Mbit/s) compliant.

Note: The USB interface is intended for use as a trace interface only.

The external application is responsible for supplying the VUSB_IN line. This line is used for cable detection only. The USB part (driver and transceiver) is supplied by means of BATT+. This is because EXS82-W is designed as a self-powered device compliant with the “Universal Serial Bus Specification Revision 2.0”¹.



¹⁾ All serial (including R_S) and pull-up resistors for data lines are implemented.

²⁾ If the USB interface is operated in High Speed mode (480MHz), it is recommended to take special care routing the data lines USB_DP and USB_DN. Application layout should in this case implement a differential impedance of 90 ohms for proper signal integrity.

Figure 2: USB circuit

To properly connect the module's USB interface to the external application, a USB 2.0 compatible connector and cable or hardware design is required. Furthermore, the USB modem driver distributed with EXS82-W needs to be installed.

1. The specification is ready for download on <https://www.usb.org/document-library/usb-20-specification>

2.1.2 Serial Interface ASC0

EXS82-W offers an 8-wire unbalanced, asynchronous modem interface ASC0 conforming to ITU-T V.24 protocol DCE signaling. The electrical characteristics do not comply with ITU-T V.28. The significant levels are 0V (for low data bit or active state) and 1.8V (for high data bit or inactive state).

EXS82-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 the module's TXD0 signal line
- Port RXD @ application receives data from the module's RXD0 signal line

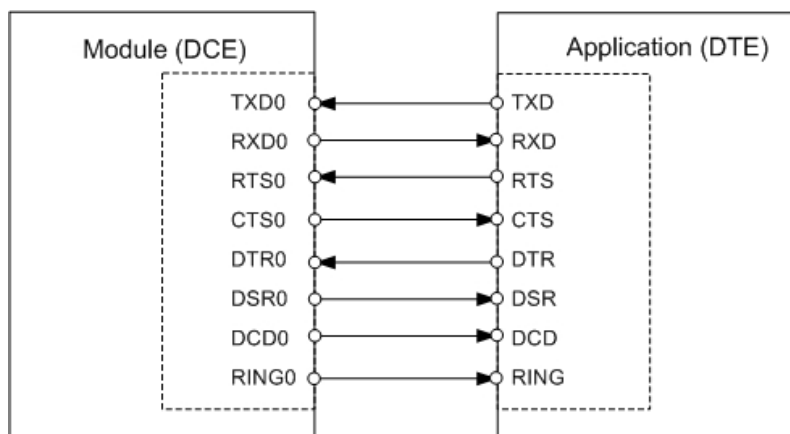


Figure 3: Serial interface ASC0

Features:

- Includes the data lines TXD0 and RXD0, the status lines RTS0 and CTS0 and, in addition, the modem control lines DTR0, DSR0, DCD0 and RING0.
- The RING0 signal serves to indicate incoming calls and other types of URCs (Unsolicited Result Code). It can also be used to send pulses to the host application, for example to wake up the application from power saving state.
- By default configured to 8 data bits, no parity and 1 stop bit.
- ASC0 can be operated at fixed bit rates from 300bps up to 921,600bps.
- Supports RTS0/CTS0 hardware flow control as a configuration option (see [1]). The hardware hand shake line RTS0 has an internal pull down resistor causing a low level signal, if the line is not used and open. Although hardware flow control is recommended, this allows communication by using only RXD and TXD lines.
- Wake up from SLEEP mode by RTS0 activation (high to low transition; see Section 3.3.1.1).

2.1.3 Serial Interface ASC1

EXS82-W provides a 4-wire unbalanced, asynchronous modem interface ASC1 conforming to ITU-T V.24 protocol DCE signaling. The electrical characteristics do not comply with ITU-T V.28. The significant levels are 0V (for low data bit or active state) and 1.8V (for high data bit or inactive state).

EXS82-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 module's TXD1 signal line
- Port RXD @ application receives data from the module's RXD1 signal line

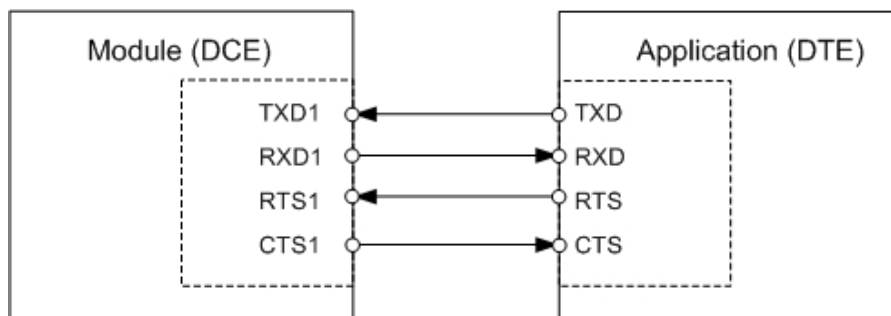


Figure 4: Serial interface ASC1

Features

- Includes only the data lines TXD1 and RXD1 plus RTS1 and CTS1 for hardware hand-shake.
- Configured for 8 data bits, no parity and 1 or 2 stop bits.
- ASC1 can be operated at fixed bit rates from 300bps to 921,600bps.
- Supports RTS1/CTS1 hardware flow as a configuration option (see [\[1\]](#)). The hardware hand shake line RTS0 has an internal pull down resistor causing a low level signal, if the line is not used and open. Although hardware flow control is recommended, this allows communication by using only RXD and TXD lines.

2.1.4 UICC/SIM/USIM Interface

EXS82-W has an integrated UICC/SIM/USIM interface compatible with the 3GPP 31.102 and ETSI 102 221. This is wired to the host interface in order to be connected to an external SIM card holder. Five pads on the SMT application interface are reserved for the SIM interface.

The UICC/SIM/USIM interface supports 1.8V SIM cards.

The CCIN signal serves to detect whether a tray (with SIM card) is present in the card holder. Using the CCIN signal is mandatory for compliance with the GSM 11.11 recommendation if the mechanical design of the host application allows the user to remove the SIM card during operation. To take advantage of this feature, an appropriate SIM card detect switch is required on the card holder. For example, this is true for the model supplied by Molex, which has been tested to operate with EXS82-W and is part of the Gemalto M2M reference equipment submitted for type approval. See [Section 7.1](#) for Molex ordering numbers.

Table 1: Signals of the SIM interface (SMT application interface)

Signal	Description
GND	Separate ground connection for SIM card to improve EMC. Gemalto recommends to use pad 83 or pad 84 as ground connection.
CCCLK	UICC clock
CCVCC	SIM supply voltage.
CCIO	Serial data line, input and output.
CCRST	UICC reset
CCIN	Input on the baseband processor for detecting a SIM card tray in the holder. If the SIM is removed during operation the SIM interface is shut down immediately to prevent destruction of the SIM. The CCIN signal is by default low and must change to high level if a SIM card is inserted. The CCIN signal is mandatory for applications that allow the user to remove the SIM card during operation. The CCIN signal is solely intended for use with a SIM card. It must not be used for any other purposes. Failure to comply with this requirement may invalidate the type approval of EXS82-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 the SIM card during operation. In this case, the application must restart EXS82-W.

The figure below shows a circuit to connect an external SIM card holder.

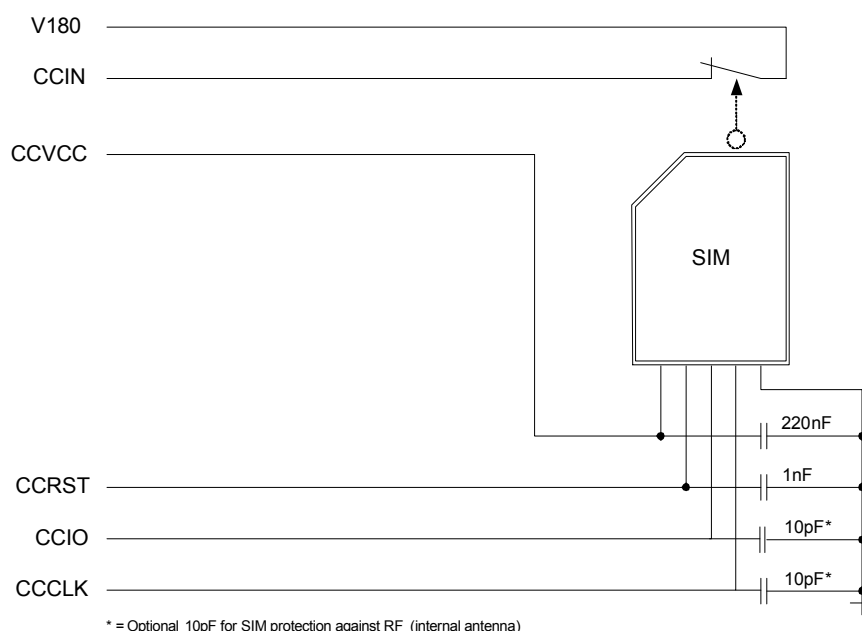


Figure 5: External UICC/SIM/USIM card holder circuit

The total cable length between the SMT application interface pads on EXS82-W and the pads of the external SIM card holder must not exceed 100mm in order to meet the specifications of 3GPP TS 51.010-1 and to satisfy the requirements of EMC compliance.

To avoid possible cross-talk from the CCCLK signal to the CCIO signal be careful that both lines are not placed closely next to each other. A useful approach is using a GND line to shield the CCIO line from the CCCLK line.

It is possible to connect the UICC/USIM/SIM interface lines to an external SIM card multiplexer controlled by the module's SIM_SWITCH signal. Thus, it becomes possible to switch between two networks/subscriptions each with its own UICC, and maybe different connection speeds. See also [Section 2.1.7](#).

2.1.5 Status LED

The STATUS line can be configured to drive a status LED that indicates different operating modes of the module. For details on how to configure status signaling please refer to [\[1\]](#).

2.1.6 Fast Shutdown

The configured FST_SHDN line is an active low control signal and must be applied for at least 15 milliseconds. If unused this line can be left open because of a configured internal pull-up resistor.

2.1.7 SIM Switch

The UICC/USIM/SIM interface lines may be connected to an external SIM card multiplexer controlled by the SIM_SWITCH signal. Thus, it becomes possible to switch between two networks/subscriptions each with their own UICC, and maybe different connection speeds.

2.1.8 SUSPEND Mode Indicator

When all conditions for entering into SUSPEND mode are fulfilled, the SUSPEND_MON signal changes from high to low, indicating that the module has entered its SUSPEND mode.

2.2 RF Antenna Interface

The RF interface has an impedance of 50Ω. EXS82-W is capable of sustaining a total mismatch at the antenna line without any damage, even when transmitting at maximum RF power.

The external antenna must be matched properly to achieve best performance regarding radiated power, modulation accuracy and harmonic suppression. Antenna matching networks are not included on the EXS82-W module and should be placed in the host application if the antenna does not have an impedance of 50Ω.

Regarding the return loss EXS82-W provides the following values in the active band:

Table 2: Return loss in the active band

State of module	Return loss of module	Recommended return loss of application
Receive	$\geq 8\text{dB}$	$\geq 12\text{dB}$
Transmit	not applicable	$\geq 12\text{dB}$
Idle	$\leq 5\text{dB}$	not applicable

2.2.1 Antenna Installation

The antennas is connected by soldering the antenna pads (RF_OUT, ANT_GNSS) and its neighboring ground pads directly to the application's PCB.

The distance between the antenna pads and their neighboring GND pads has been optimized for best possible impedance. On the application PCB, special attention should be paid to these pads, in order to prevent mismatch.

The wiring of the antenna connection line, starting from the antenna pad to the application antenna should result in a 50Ω line impedance. Line width and distance to the GND plane needs to be optimized with regard to the PCB's layer stack.

To prevent receiver desensitization due to interferences generated by fast transients like high speed clocks on the application PCB, it is recommended to realize the antenna connection line using embedded Stripline rather than Micro-Stripline technology.

For type approval purposes, the use of a 50Ω coaxial antenna connector (U.FL-R-SMT) might be necessary. In this case the U.FL-R-SMT connector should be placed as close as possible to EXS82-W's antenna pad.

2.2.2 RF Line Routing Design

2.2.2.1 Line Arrangement Examples

Several dedicated tools are available to calculate line arrangements for specific applications and PCB materials - for example from <http://www.polarinstruments.com/> (commercial software) or from <http://web.awrcorp.com/Usa/Products/Optional-Products/TX-Line/> (free software).

Embedded Stripline

This figure below shows a line arrangement example for embedded stripline with $65\mu\text{m}$ FR4 prepreg (type: 1080) and $710\mu\text{m}$ FR4 core (4-layer PCB).

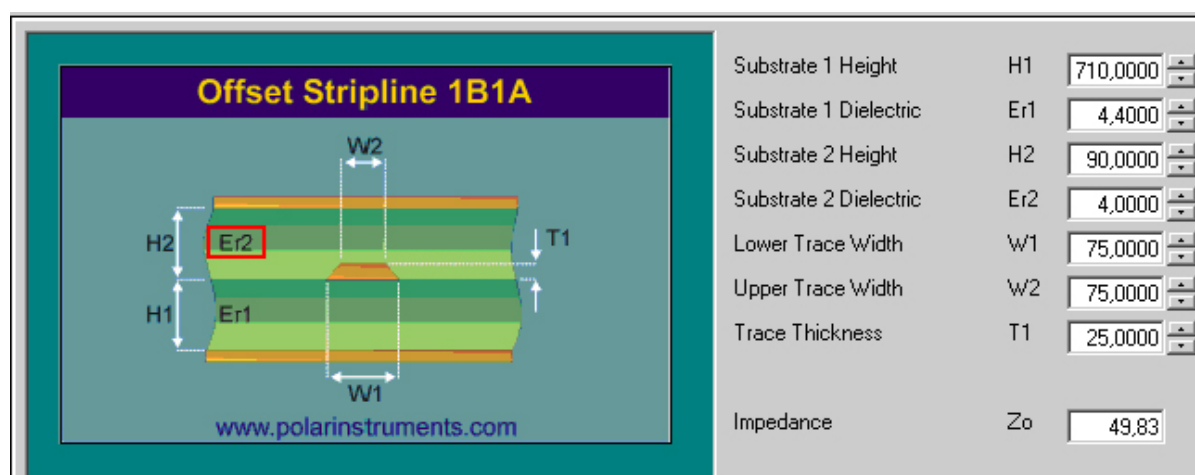


Figure 6: Embedded Stripline with $65\mu\text{m}$ prepreg (1080) and $710\mu\text{m}$ core

Micro-Stripline

This section gives two line arrangement examples for micro-stripline.

- Micro-Stripline on 1.0mm Standard FR4 2-Layer PCB
The following two figures show examples with different values for D1 (ground strip separation).



2.2 RF Antenna Interface

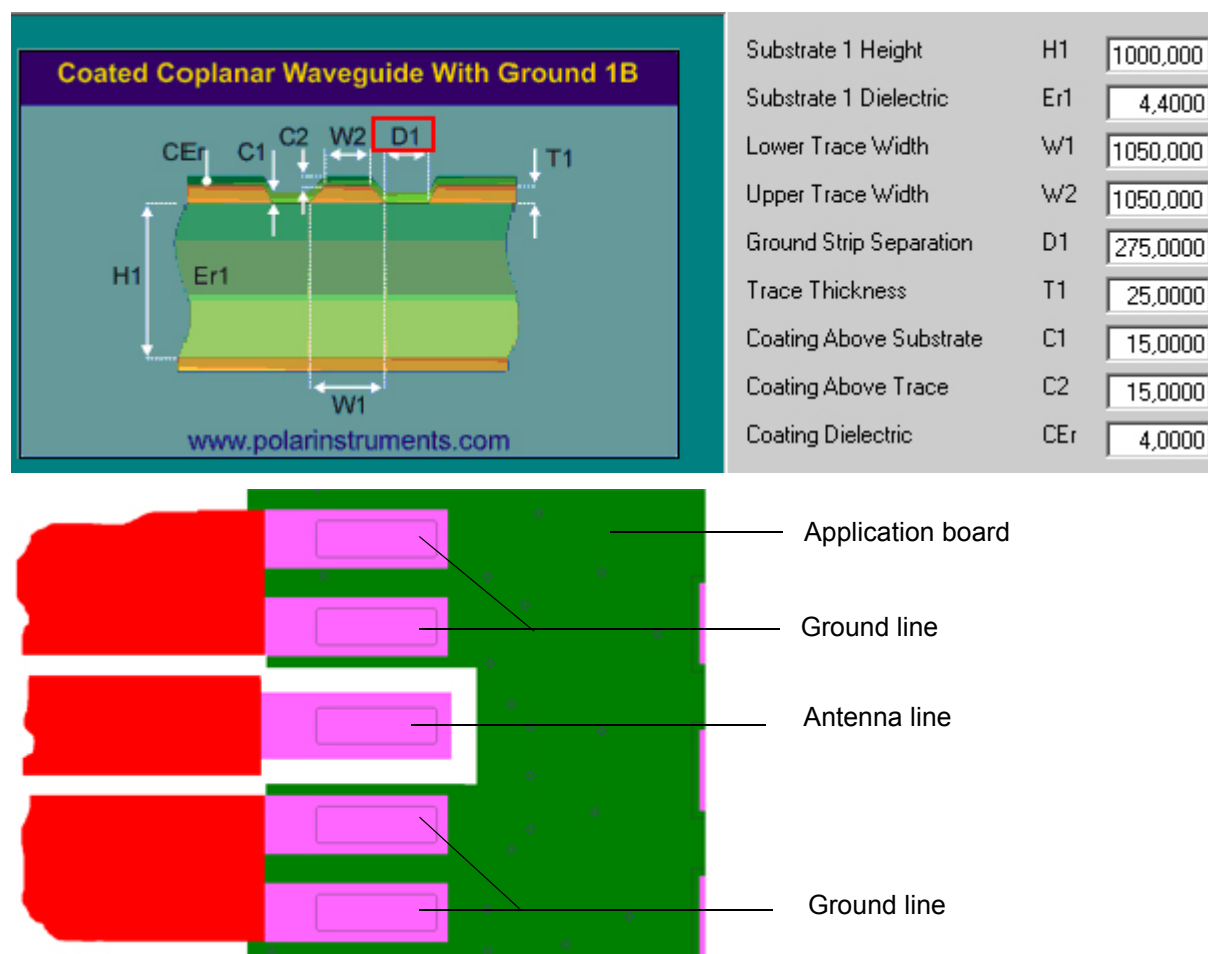


Figure 8: Micro-Stripline on 1.0mm Standard FR4 PCB - example 2

2.2 RF Antenna Interface

- Micro-Stripline on 1.5mm Standard FR4 2-Layer PCB
The following two figures show examples with different values for D1 (ground strip separation).

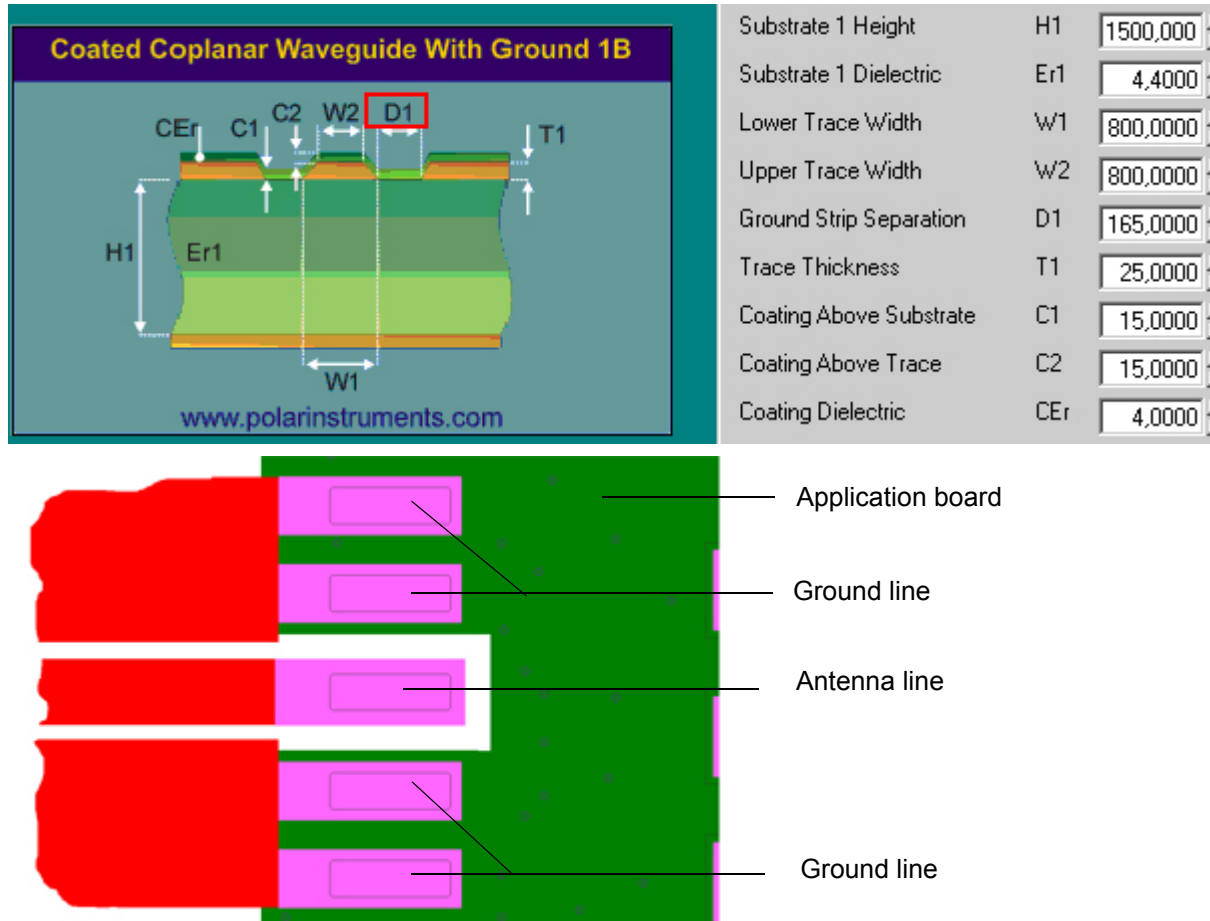


Figure 9: Micro-Stripline on 1.5mm Standard FR4 PCB - example 1

2.2 RF Antenna Interface

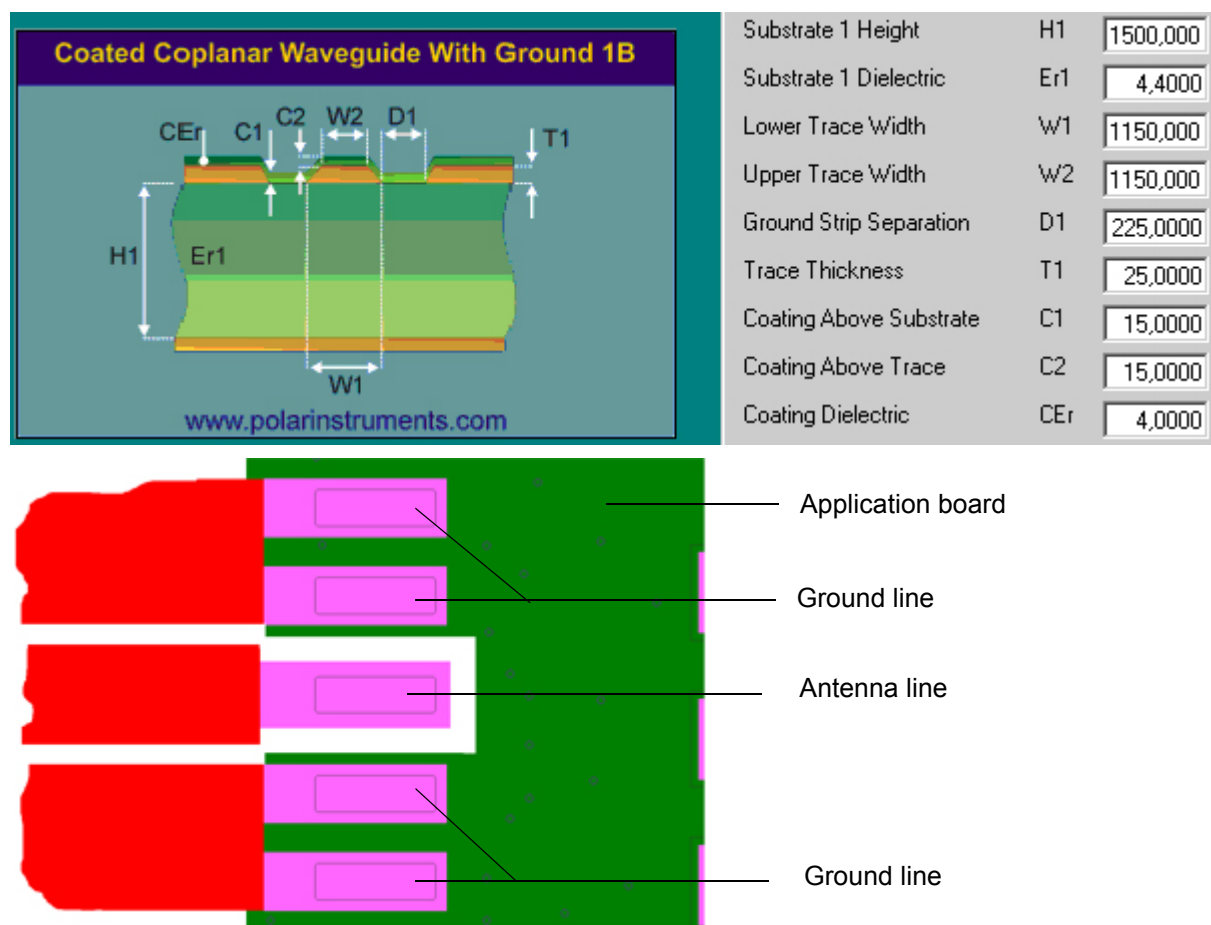


Figure 10: Micro-Stripline on 1.5mm Standard FR4 PCB - example 2

2.2.2.2 Routing Example

Interface to RF Connector

Figure 11 shows the connection of the module's antenna pad with an application PCB's coaxial antenna connector. Please note that the EXS82-W bottom plane appears mirrored, since it is viewed from EXS82-W top side. By definition the top of customer's board shall mate with the bottom of the EXS82-W module.

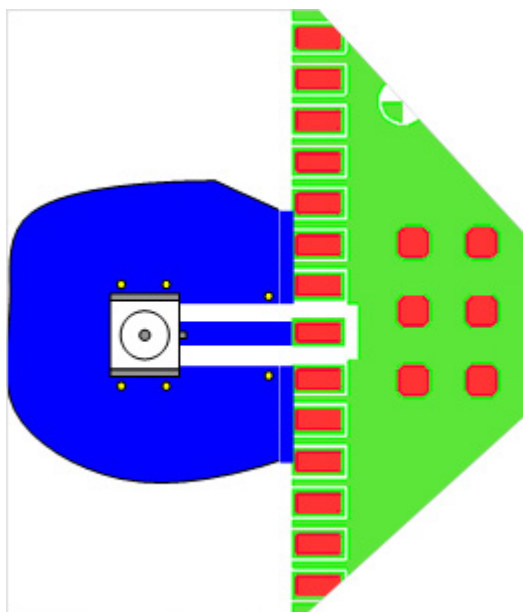


Figure 11: Routing to application's RF connector - top view

2.3 GNSS Interface

2.3.1 GNSS Receiver

EXS82-W integrates a GNSS receiver that offers the full performance of GPS/GLONASS/Bei-Dou/Galileo technology. The GNSS receiver is able to continuously track all satellites in view, thus providing accurate satellite position data.

The integrated GNSS receiver supports the NMEA protocol via ASC0 interface. NMEA is a combined electrical and data specification for communication between various (marine) electronic devices including GNSS receivers. It has been defined and controlled by the US based National Marine Electronics Association. For more information on the NMEA Standard please refer to <http://www.nmea.org>.

Depending on the receiver's knowledge of last position, current time and ephemeris data, the receiver's startup time (i.e., TTFF = Time-To-First-Fix) may vary: If the receiver has no knowledge of its last position or time, a startup takes considerably longer than if the receiver still has knowledge of its last position, time and almanac or has still access to valid ephemeris data and the precise time. Often, 2D measurements will be used over 3D depending on space vehicle (SV) locations as this will be just as accurate and faster.

By default, the GNSS receiver is switched off. It has to be switched on and configured using AT commands (AT+SGPSC; see [1]).

2.3.2 GNSS Antenna

In addition to the RF antenna interface EXS82-W also has a GNSS antenna interface. See [Section 2.1.1](#) to find out where the GNSS antenna pad is located. The GNSS installation is the same as for the RF antenna interface - see [Section 2.2.1](#).

It is possible to connect active or passive GNSS antennas. In either case the antennas must have 50Ω impedance. The simultaneous operation of GSM/LTE and GNSS has been implemented. Please note that the voltage for an active antenna has to be supplied by the external application as shown in [Figure 12](#).

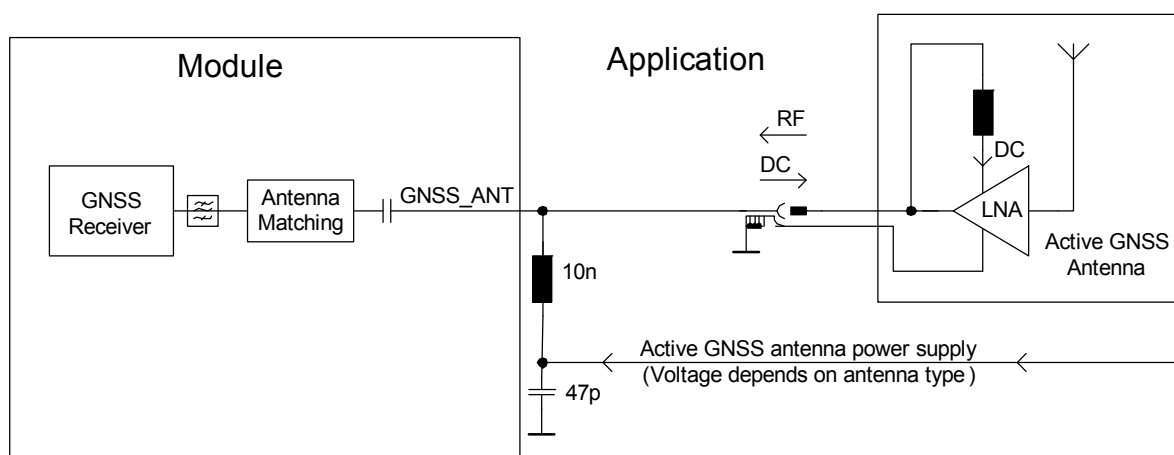


Figure 12: Sample supply voltage circuit for active GNSS antenna

2.4 Sample Application

Figure 13 shows a typical example of how to integrate a EXS82-W module with an application. Usage of the various host interfaces depends on the desired features of the application.

Note that the sample application is not optimized for low current consumption.

Because of the very low power consumption design, current flowing from any other source into the module circuit must be avoided, for example reverse current from high state external control lines. Therefore, the controlling application must be designed to prevent reverse current flow. Otherwise there is the risk of undefined states of the module during startup and shutdown or even of damaging the module.

Because of the high RF field density inside the module, it cannot be guaranteed that no self interference might occur, depending on frequency and the applications grounding concept. The potential interferers may be minimized by placing small capacitors (47pF) at suspected lines (e.g. RXD0, TXD0, and ON).

While developing SMT applications it is strongly recommended to provide test points for certain signals, i.e., lines to and from the module - for debug and/or test purposes. The SMT application should allow for an easy access to these signals. For details on how to implement test points see [4] and [5].

The EMC measures are best practice recommendations. In fact, an adequate EMC strategy for an individual application is very much determined by the overall layout and, especially, the position of components. For example, mounting the internal acoustic transducers directly on the PCB eliminates the need to use the ferrite beads shown in the sample schematic.

Depending on the micro controller used by an external application EXS82-W's digital input and output lines may require level conversion.

Disclaimer

No warranty, either stated or implied, is provided on the sample schematic diagram shown in Figure 13 and the information detailed in this section. Functionality and compliance with national regulations depend to a great amount on the used electronic components, and the individual application layout manufacturers are required to ensure adequate design and operating safeguards for their products using EXS82-W modules. Because of the number of frequencies used it is recommended to involve antenna vendors already quite early to maximize performance of the external application's layout.

2.4 Sample Application

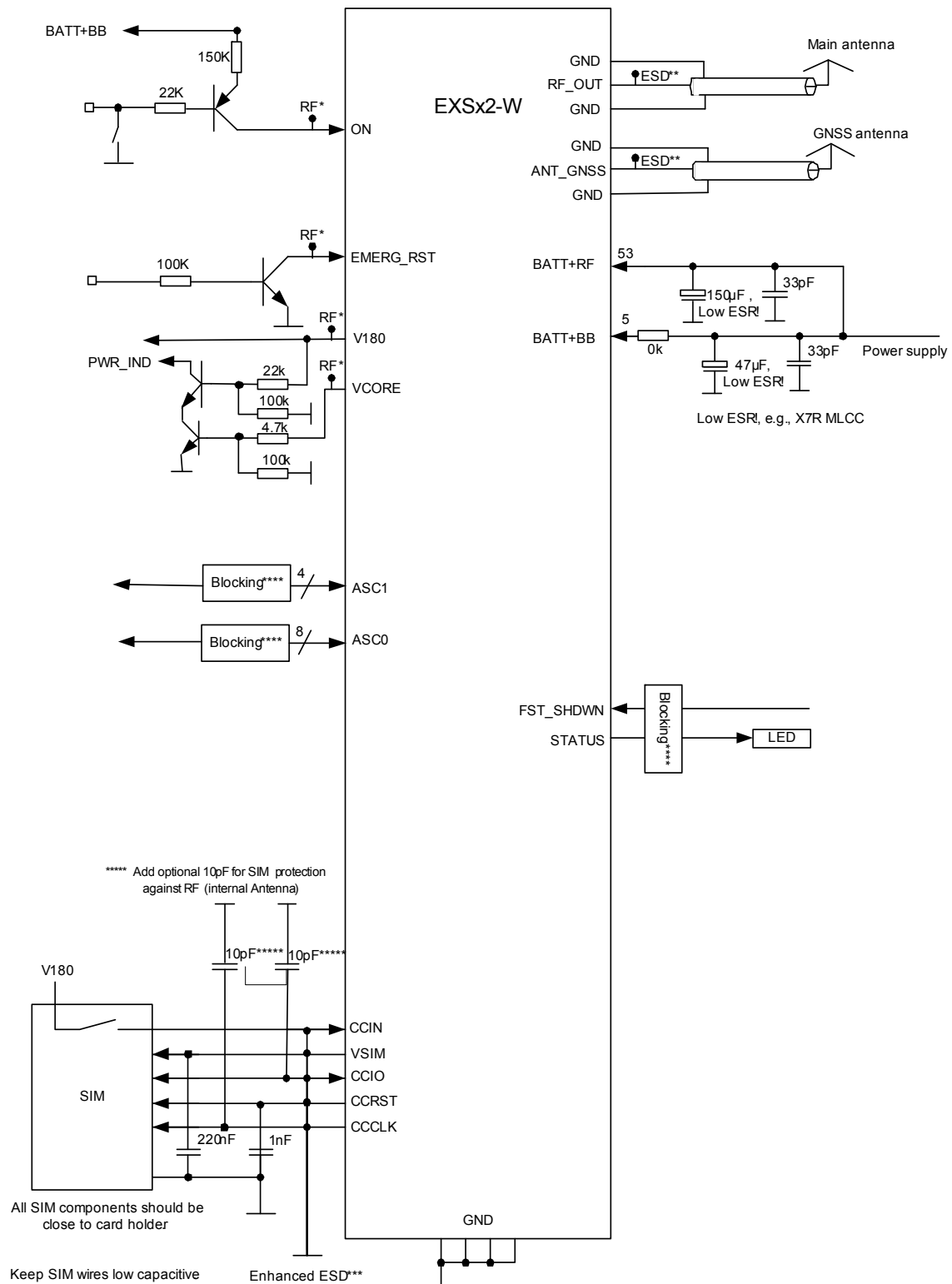


Figure 13: Schematic diagram of EXS82-W sample application

3 Operating Characteristics

3.1 Operating Modes

The table below briefly summarizes the various operating modes referred to throughout the document.

Table 3: 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	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. SLEEP mode option can be enabled/disabled by AT command (see [1]: AT^SCFG parameter "MEopMode/PwrSave").	
SUSPEND	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. The SUSPEND mode option can be enabled/disabled by AT commands (see [1]: AT^SCFG "MEopMode/PowerMgmt/Suspend").	
Airplane	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).	
POWER DOWN	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.	

3.2 Power Supply

EXS82-W needs to be connected to a power supply at the SMT application interface - 2 lines BATT+, and GND. There are two separate voltage domains for BATT+:

- BATT+_{BB} with a line mainly for the baseband power supply.
- BATT+_{RF} with a line for the GSM power amplifier supply. Please note that this line needs only be connected for GSM (2G/3G) availability.

Please note that BATT+ in this document refers to both voltage domains and power supply lines - BATT+_{BB} and BATT+_{RF}.

The power supply of EXS82-W has to be a single voltage source at BATT+_{BB} and BATT+_{RF}. It should be of type PS1, according to IEC 62368-1, and must be able to provide the peak current during the uplink transmission.

Suitable low ESR capacitors should be placed as close as possible to the BATT+ pads, e.g., X7R MLCC.

All key functions for supplying power to the device are handled by the power management IC. It provides the following features:

- Stabilizes the supply voltages for the baseband using low drop linear voltage regulators and a DC-DC step down switching regulator.
- Switches the module's power voltages for the power-up and -down procedures.
- SIM switch to provide SIM power supply.

4 Mechanical Dimensions, Mounting and Packaging

4.1 Mechanical Dimensions of EXS82-W

Figure 14 shows the top and bottom view of EXS82-W and provides an overview of the board's mechanical dimensions. For further details see Figure 15.

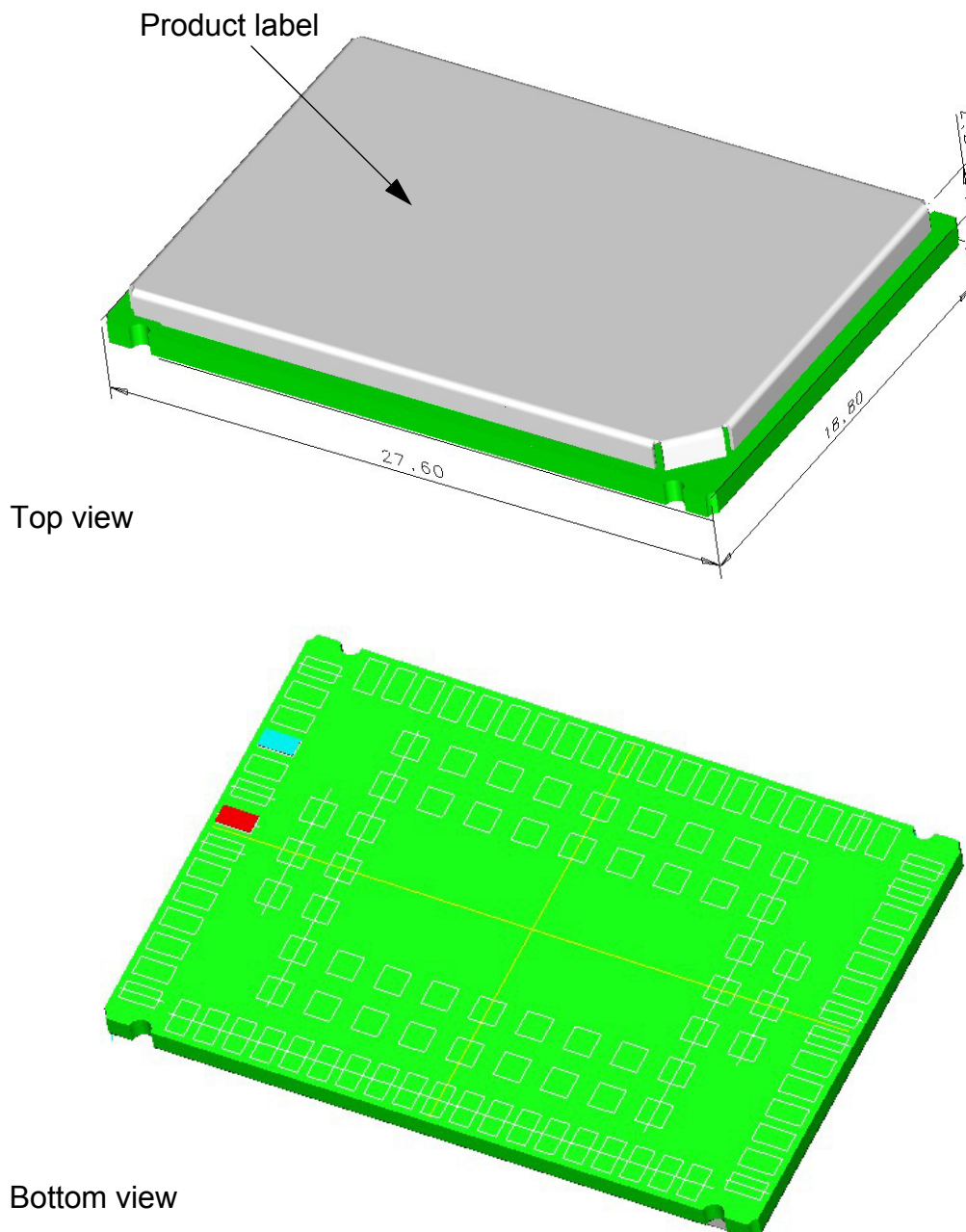
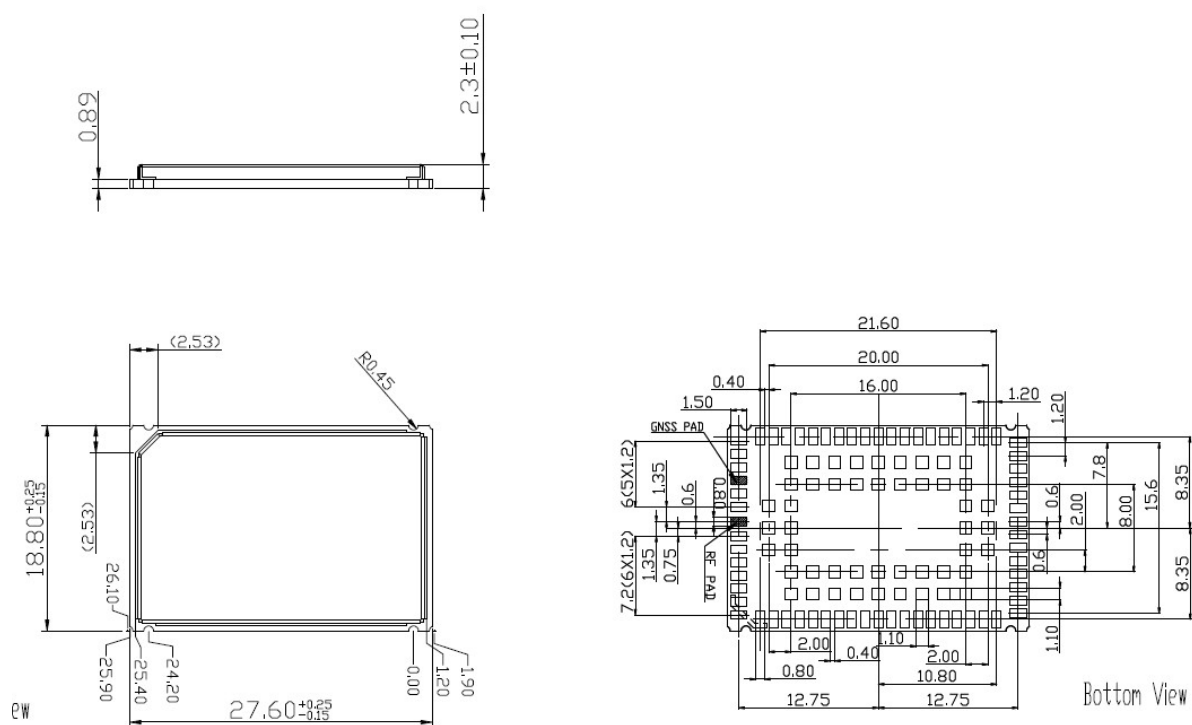


Figure 14: EXS82-W – top and bottom view

4.1 Mechanical Dimensions of EXS82-W

**Figure 15:** Dimensions of EXS82-W (all dimensions in mm)

5 Regulatory and Type Approval Information

5.1 Directives and Standards

EXS82-W is designed to comply with the directives and standards listed below.

It is the responsibility of the application manufacturer to ensure compliance of the final product with all provisions of the applicable directives and standards as well as with the technical specifications provided in the "EXS82-W Hardware Interface Description".¹

Table 4: Directives

2014/53/EU	Directive of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC. The product is labeled with the CE conformity mark 
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) 

Table 5: Standards of North American type approval

CFR Title 47	Code of Federal Regulations, Part 22 and Part 24 (Telecommunications, PCS); US Equipment Authorization FCC
OET Bulletin 65 (Edition 97-01)	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
UL 60 950-1	Product Safety Certification (Safety requirements)
NAPRD.03 V5.35	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS132 (Issue2) RSS133 (Issue5)	Canadian Standard

Table 6: Standards of European type approval

3GPP TS 51.010-1	Digital cellular telecommunications system (Release 7); Mobile Station (MS) conformance specification;
GCF-CC V3.71	Global Certification Forum - Certification Criteria
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
ETSI EN 301 908-1 V11.1.1	IMT cellular networks; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Introduction and common requirements

1. Manufacturers of applications which can be used in the US shall ensure that their applications have a PTCRB approval. For this purpose they can refer to the PTCRB approval of the respective module.

5.1 Directives and Standards

Table 6: Standards of European type approval

ETSI EN 301 908-2 V11.1.2	IMT cellular networks; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 2: CDMA Direct Spread (UTRA FDD) User Equipment (UE)
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
Draft ETSI EN 301 489-01 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
ETSI EN 301489-19 V2.1.0	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing positioning, navigation, and timing data; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
ETSI EN 303 413 V1.1.1	Satellite Earth Stations and Systems (SES); Global Navigation Satellite System (GNSS) receivers; Radio equipment operating in the 1 164 MHz to 1 300 MHz and 1 559 MHz to 1 610 MHz frequency bands; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
EN 60950-1: 2006 +A11:2009+A1:2010+A 12:2011+A2:2013	Safety of information technology equipment

Table 7: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)

Table 8: 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	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06). 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 Gemalto M2M Hardware Interface Description. Please see Table 9 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. 

5.1 Directives and Standards

Table 9: 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)	O	O	O	O	O	O
电路模块 (Circuit Modules)	X	O	O	O	O	O
电缆及电缆组件 (Cables and Cable Assemblies)	O	O	O	O	O	O
塑料和聚合物部件 (Plastic and Polymeric parts)	O	O	O	O	O	O
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 <i>might exceed</i> the limit requirement in SJ/T11363-2006.						

5.2 SAR requirements specific to portable mobiles

Mobile phones, PDAs or other portable transmitters and receivers incorporating a GSM module must be in accordance with the guidelines for human exposure to radio frequency energy. This requires the Specific Absorption Rate (SAR) of portable EXS82-W based applications to be evaluated and approved for compliance with national and/or international regulations.

Since the SAR value varies significantly with the individual product design manufacturers are advised to submit their product for approval if designed for portable use. For European and US markets the relevant directives are mentioned below. It is the responsibility of the manufacturer of the final product to verify whether or not further standards, recommendations or directives are in force outside these areas.

Products intended for sale on US markets

ES 59005/ANSI C95.1 Considerations for evaluation of human exposure to Electromagnetic Fields (EMFs) from Mobile Telecommunication Equipment (MTE) in the frequency range 30MHz - 6GHz

Products intended for sale on European markets

EN 50360	Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz - 3GHz)
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)

Please note that SAR requirements are specific only for portable devices and not for mobile devices as defined below:

- **Portable device:**
A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
- **Mobile device:**
A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location.

5.3 Reference Equipment for Type Approval

The Gemalto M2M reference setup submitted to type approve EXS82-W (including a special approval adapter for the DSB75) is shown in the following figure¹:

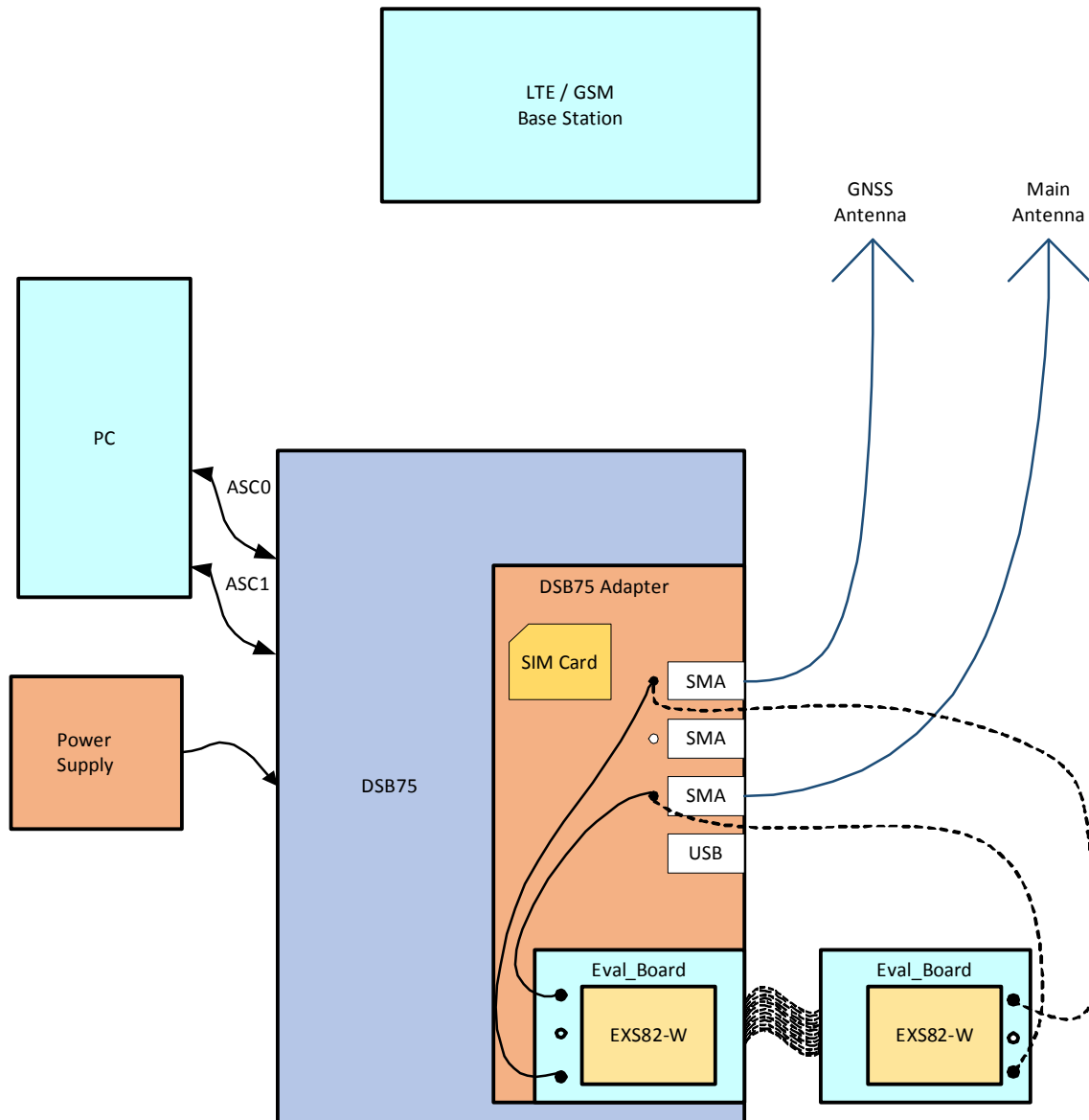


Figure 16: Reference equipment for type approval

1. For RF performance tests a mini-SMT/U.FL to SMA adapter with attached 6dB coaxial attenuator is chosen to connect the evaluation module directly to the GSM/GNSS test equipment instead of employing the SMA antenna connectors on the EXS82-W-DSB75 adapter as shown in Figure 16. The following products are recommended:

Hirose SMA-Jack/U.FL-Plug conversion adapter HRMJ-U.FLP(40)

(for details see <http://www.hirose-connectors.com/> or <http://www.farnell.com/>)

Aeroflex Weinschel Fixed Coaxial Attenuator Model 3T/4T

(for details see <http://www.aeroflex.com/ams/weinschel/pdfs/wmod3&4T.pdf>)

5.4 Compliance with FCC and ISED Rules and Regulations

The Equipment Authorization Certification for the Gemalto M2M reference application described in [Section 5.3](#) will be registered under the following identifier:

FCC Identifier: QIPEXS82-W

ISED Certification Number: 7830A-EXS82W

Granted to Gemalto M2M GmbH

Manufacturers of mobile or fixed devices incorporating EXS82-W modules are authorized to use the FCC Grants and ISED Certificates of the EXS82-W modules for their own final products according to the conditions referenced in these documents. In this case, an FCC/ IC label of the module shall be visible from the outside, or the host device shall bear a second label stating "Contains FCC ID: QIPEXS82-W" and "Contains IC: 7830A-EXS82W". The integration is limited to fixed or mobile categorized host devices, where a separation distance between the antenna and any person of min. 20cm can be assured during normal operating conditions. For mobile and fixed operation configurations the antenna gain, including cable loss, must not exceed the limits TBD. dBi (850MHz) and TBD. dBi (1900MHz).

IMPORTANT:

Manufacturers of portable applications incorporating EXS82-W modules are required to have their final product certified and apply for their own FCC Grant and ISED Certificate related to the specific portable mobile. This is mandatory to meet the SAR requirements for portable mobiles (see [Section 5.2](#) for detail).

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This 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 and with ISED license-exempt RSS standard(s). 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.

This Class B digital apparatus complies with Canadian ICES-003.

If Canadian approval is requested for devices incorporating EXS82-W modules the below notes will have to be provided in the English and French language in the final user documentation. Manufacturers/OEM Integrators must ensure that the final user documentation does not contain any information on how to install or remove the module from the final product. The module (Global LTE Cat.M1/LTE Cat.NB2/2G Data-Only Module & Global LTE Cat.M1/LTE Cat.NB2 Data-Only Module) is limited to OEM installation only.

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'ISDE dans des conditions d'exposition à des appareils mobiles (les antennes se situent à moins de 20cm du corps d'une personne).

6 Document Information

6.1 Revision History

Preceding document: "Cinterion® EXSx2-W Hardware Interface Overview" Version 00.020a

New document: "Cinterion® EXS82-W Hardware Interface Overview" Version 00.038

Chapter	What is new
1.2	Added ambient temperature.
--	Specify description for EXS82-W.

New document: "Cinterion® EXSx2-W Hardware Interface Overview" Version 00.020a

Chapter	What is new
--	Initial document setup.

6.2 Related Documents

- [1] EXS82-W AT Command Set
- [2] EXS82-W Release Note
- [3] Universal Serial Bus Specification Revision 2.0, April 27, 2000
- [4] Application Note 48: SMT Module Integration
- [5] Differences between Selected Cinterion® Modules, Hardware Migration Guide, v11

6.3 Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-digital converter
AGC	Automatic Gain Control
ANSI	American National Standards Institute
ARFCN	Absolute Radio Frequency Channel Number
ARP	Antenna Reference Point
ASC0/ASC1	Asynchronous Controller. Abbreviations used for first and second serial interface of EXS82-W
B	Thermistor Constant
BER	Bit Error Rate
BTS	Base Transceiver Station
CB or CBM	Cell Broadcast Message
CE	Conformité Européene (European Conformity)
CHAP	Challenge Handshake Authentication Protocol
CPU	Central Processing Unit
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DAI	Digital Audio Interface
dBm0	Digital level, 3.14dBm0 corresponds to full scale, see ITU G.711, A-law
DCE	Data Communication Equipment (typically modems, e.g. Gemalto M2M module)
DCS 1800	Digital Cellular System, also referred to as PCN
DRX	Discontinuous Reception
DSB	Development Support Box
DSP	Digital Signal Processor
DSR	Data Set Ready
DTE	Data Terminal Equipment (typically computer, terminal, printer or, for example, GSM application)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EIRP	Equivalent Isotropic Radiated Power
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ERP	Effective Radiated Power

6.3 Terms and Abbreviations

Abbreviation	Description
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HiZ	High Impedance
HR	Half Rate
I/O	Input/Output
IC	Integrated Circuit
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LED	Light Emitting Diode
Li-Ion/Li+	Lithium-Ion
Li battery	Rechargeable Lithium Ion or Lithium Polymer battery
LPM	Link Power Management
Mbps	Mbits per second
MMI	Man Machine Interface
MO	Mobile Originated
MS	Mobile Station (GSM module), also referred to as TE
MSISDN	Mobile Station International ISDN number
MT	Mobile Terminated
NTC	Negative Temperature Coefficient
OEM	Original Equipment Manufacturer
PA	Power Amplifier
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCM	Pulse Code Modulation
PCN	Personal Communications Network, also referred to as DCS 1800
PDU	Protocol Data Unit
PLL	Phase Locked Loop

6.3 Terms and Abbreviations

Abbreviation	Description
PPP	Point-to-point protocol
PSK	Phase Shift Keying
PSU	Power Supply Unit
PWM	Pulse Width Modulation
R&TTE	Radio and Telecommunication Terminal Equipment
RAM	Random Access Memory
RF	Radio Frequency
RLS	Radio Link Stability
RMS	Root Mean Square (value)
RoHS	Restriction of the use of certain hazardous substances in electrical and electronic equipment.
ROM	Read-only Memory
RTC	Real Time Clock
RTS	Request to Send
Rx	Receive Direction
SAR	Specific Absorption Rate
SAW	Surface Acoustic Wave
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SMD	Surface Mount Device
SMS	Short Message Service
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
TA	Terminal adapter (e.g. GSM module)
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TLS	Transport Layer Security
Tx	Transmit Direction
UART	Universal asynchronous receiver-transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio

6.4 Safety Precaution Notes

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating EXS82-W. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and to 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. Gemalto M2M assumes no liability for customer's failure to comply with these precautions.

	When in a hospital or other health care facility, observe the restrictions on the use of mobiles. Switch the cellular terminal or mobile off, if instructed to do so by the guidelines posted in sensitive areas. Medical equipment may be sensitive to RF energy. 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.
	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.
	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.
	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.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when 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.
	IMPORTANT! Cellular terminals or mobiles operate using radio signals and cellular networks. Because of this, connection 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. Remember, in order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. 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 that a valid SIM card be properly inserted in the cellular terminal or mobile.

7 Appendix

7.1 List of Parts and Accessories

Table 10: List of parts and accessories

Description	Supplier	Ordering information
EXS82-W	Gemalto M2M	Standard module Gemalto M2M IMEI: Packaging unit (ordering) number: L30960-N6200-A100 Module label number: S30960-S6200-A100-1.
EXS82-W Evaluation Module	Gemalto M2M	Ordering number: L30960-N6201-A100
DSB75 Evaluation Kit	Gemalto M2M	Ordering number: L36880-N8811-A100
DSB Mini Compact Evaluation Board	Gemalto M2M	Ordering number: L30960-N0030-A100
LGA DevKit	Gemalto M2M	LGA DevKit consists of Cinterion® LGA DevKit SM Base PCB: Ordering number: L30960-N0111-A100 Cinterion® LGA DevKit Socket SML: Ordering number: L30960-N0110-A100
EVAL DSB Adapter for mounting EXS82-W evaluation modules onto DSB75	Gemalto M2M	Ordering number: L30960-N0100-A100
SIM card holder incl. push button ejector and slide-in tray	Molex	Ordering numbers: 91228 91236 Sales contacts are listed in Table 11 .

7.1 List of Parts and Accessories

Table 11: Molex sales contacts (subject to change)

Molex For further information please click: http://www.molex.com	Molex Deutschland GmbH Otto-Hahn-Str. 1b 69190 Walldorf Germany Phone: +49-6227-3091-0 Fax: +49-6227-3091-8100 Email: mxgermany@molex.com	American Headquarters Lisle, Illinois 60532 U.S.A. Phone: +1-800-78MOLEX Fax: +1-630-969-1352
Molex China Distributors Beijing, Room 1311, Tower B, COFCO Plaza No. 8, Jian Guo Men Nei Street, 100005 Beijing P.R. China Phone: +86-10-6526-9628 Fax: +86-10-6526-9730	Molex Singapore Pte. Ltd. 110, International Road Jurong Town, Singapore 629174 Phone: +65-6-268-6868 Fax: +65-6-265-6044	Molex Japan Co. Ltd. 1-5-4 Fukami-Higashi, Yamato-City, Kanagawa, 242-8585 Japan Phone: +81-46-265-2325 Fax: +81-46-265-2365

About Gemalto

Since 1996, Gemalto has been pioneering groundbreaking M2M and IoT products that keep our customers on the leading edge of innovation.

We work closely with global mobile network operators to ensure that Cinterion® modules evolve in sync with wireless networks, providing a seamless migration path to protect your IoT technology investment.

Cinterion products integrate seamlessly with Gemalto identity modules, security solutions and licensing and monetization solutions, to streamline development timelines and provide cost efficiencies that improve the bottom line.

As an experienced software provider, we help customers manage connectivity, security and quality of service for the long lifecycle of IoT solutions.

For more information please visit

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