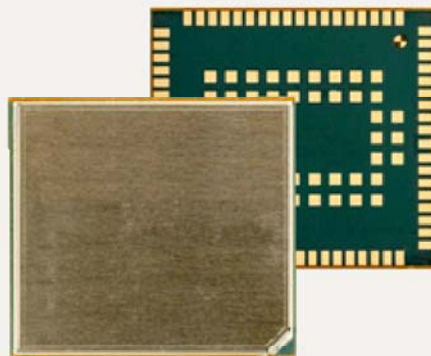


Cinterion[®] EHS8

Hardware Interface Overview

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1.1 Key Features at a Glance

1 Introduction

1 Introduction

This document¹ describes the hardware of the Cinterion® EHS8 module. It helps you quickly retrieve interface specifications, electrical and mechanical details and information on the requirements to be considered for integrating further components.

1.1 Key Features at a Glance

Feature	Implementation
<i>General</i>	
Frequency bands	GSM/GPRS/EDGE: Quad band 850/900/1800/1900MHz UMTS/HSPA+: Five band 800/850/900/1900/2100MHz
GSM class	Small MS
Output power	+33dBm ±1dB for EGSM850 +30dBm ±1dB for GSM1900 +27dBm ±1dB for EGPRS 850(8-PSK, 1 Tx slot) +24dBm ±1dB for EGPRS 850(8-PSK, 2 Tx slot) +22dBm ±1dB for EGPRS 850(8-PSK, 3 Tx slot) +21dBm ±1dB for EGPRS 850(8-PSK, 4 Tx slot) +26dBm ±1dB for GPRS 1900(8-PSK, 1 Tx slot) +23dBm ±1dB for EGPRS 1900(8-PSK, 2 Tx slot) +21dBm ±1dB for EGPRS 1900(8-PSK, 3 Tx slot) +20dBm ±1dB for EGPRS 1900(8-PSK, 4 Tx slot) +33dBm ±1dB for GPRS 850(GMSK, 1 Tx slot) +30dBm ±1dB for GPRS 850(GMSK, 2 Tx slot) +28dBm ±1dB for GPRS 850(GMSK, 3 Tx slot) +27dBm ±1dB for GPRS 850(GMSK, 4 Tx slot) +30dBm ±1dB for GPRS 1900(GMSK, 1 Tx slot) +27dBm ±1dB for GPRS 1900(GMSK, 2 Tx slot) +25dBm ±1dB for GPRS19050(GMSK, 3 Tx slot) +24dBm ±1dB for GPRS 1900(GMSK, 4Tx slot) +24dBm ±1dB for UMTS Band 2 +24dBm ±1dB for UMTS Band 5
Power supply	3.3V to 4.5V
Operating temperature (board temperature)	Normal operation: -30°C to +85°C Extended operation: -40°C to +90°C
Physical	Dimensions: 27.6mm x 25.4mm x 2.2mm Weight: approx. 3.5g

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.

RoHS	All hardware components fully compliant with EU RoHS Directive
<i>HSPA features</i>	
3GPP Release 6, 7	DL 7.2Mbps, UL 5.7Mbps HSDPA Cat.8 / HSUPA Cat.6 data rates Compressed mode (CM) supported according to 3GPP TS25.212
<i>UMTS features</i>	
3GPP Release 4	PS data rate – 384 kbps DL / 384 kbps UL CS data rate – 64 kbps DL / 64 kbps UL

Feature	Implementation
<i>GSM/GPRS/EGPRS features</i>	
Data transfer	GPRS: • Multislot Class 12 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS: • Multislot Class 12 • 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 CSD: • V.110, RLP, non-transparent • 9.6kbps • USSD
SMS	Point-to-point MT and MO Cell broadcast Text and PDU mode Storage: SIM card plus SMS locations in mobile equipment
<i>GPS Features</i>	
Protocol	NMEA
Modes	Standalone GPS Assisted GPS - Control plane - E911 - User plane
General	Automatic power saving modes Power supply for active antenna
<i>Software</i>	

1.1 Key Features at a Glance

AT commands	Hayes 3GPP TS 27.007, TS 27.005, Gemalto M2M AT commands for RIL compatibility
Java™ Open Platform	Java™ Open Platform with • Java™ profile IMP-NG & CLDC 1.1 HI • Secure data transmission via HTTPS/SSL • Multi-threading programming and multi-application execution Major benefits: seamless integration into Java applications, ease of programming, no need for application microcontroller, extremely cost-efficient hardware and software design – ideal platform for industrial GSM applications. The memory space available for Java programs is around 8 MB in the flash file system and around 6MB RAM. Application code and data share the space in the flash file system and in RAM.

1.1 Key Features at a Glance

Feature	Implementation
Microsoft™ compatibility	RIL for Pocket PC and Smartphone
SIM Application Toolkit	SAT Release 99
Firmware update	Generic update from host application over ASC0 or USB modem.
<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 provides the possibility to use an optional module mounting socket. For more information on how to integrate SMT modules see also [3]. This application note comprises chapters on module 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
2 serial interfaces	ASC0 (shared with GPIO lines): 8-wire modem interface with status and control lines, unbalanced, asynchronous - Adjustable baud rates: 1,200bps to 921,600bps - Autobauding: 1,200bps to 230,400bps - Supports RTS0/CTS0 hardware flow control. Multiplex ability according to GSM 07.10 Multiplexer Protocol. ASC1 (shared with GPIO lines): 4-wire, unbalanced asynchronous interface - Adjustable baud rates: 1,200bps to 921,60bps - Autobauding: 1,200bps to 230,400bps - Supports RTS1/CTS1 hardware flow control
Audio	1 digital interface (PCM), shared with GPIO lines
UICC interface	Supported SIM/USIM cards: 3V, 1.8V
GPIO interface	14 GPIO lines shared with ASC0 lines, LED signalling, PWM functionality, fast shutdown and pulse counter 4 GPIO lines shared with PCM interface 4 GPIO lines shared with ASC1, SPI and HSIC interfaces
I ² C interface	Supports I ² C serial interface
HSIC interface	High-Speed Inter-Chip (HSIC) interface for USB chip-to-chip interconnect including Link Power Management (LPM) lines shared with GPIO lines
SPI interface	Serial peripheral interface, shared with GPIO lines
Antenna interface pads	50
<i>Power on/off, Reset</i>	

1.1 Key Features at a Glance

Power on/off	Switch-on by hardware signal AUTO_ON and ON Switch-off by AT command Switch off by hardware signal FST_SHDN instead of AT command Automatic switch-off in case of critical temperature and voltage conditions
Feature	Implementation
Reset	Orderly shutdown and reset by AT command Emergency reset by hardware signal EMERG_RST
<i>Special features</i>	
Real time clock	Timer functions via AT commands
Phonebook	SIM and phone
TTY/CTM support	Integrated CTM modem
<i>Evaluation kit</i>	
Evaluation module	EHS8 module soldered onto a dedicated PCB that can be connected to an adapter in order to be mounted onto the DSB75.
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 EHS8 evaluation module to the DSB75.

1.2 EHS8 System Overview

1.2 EHS8 System Overview

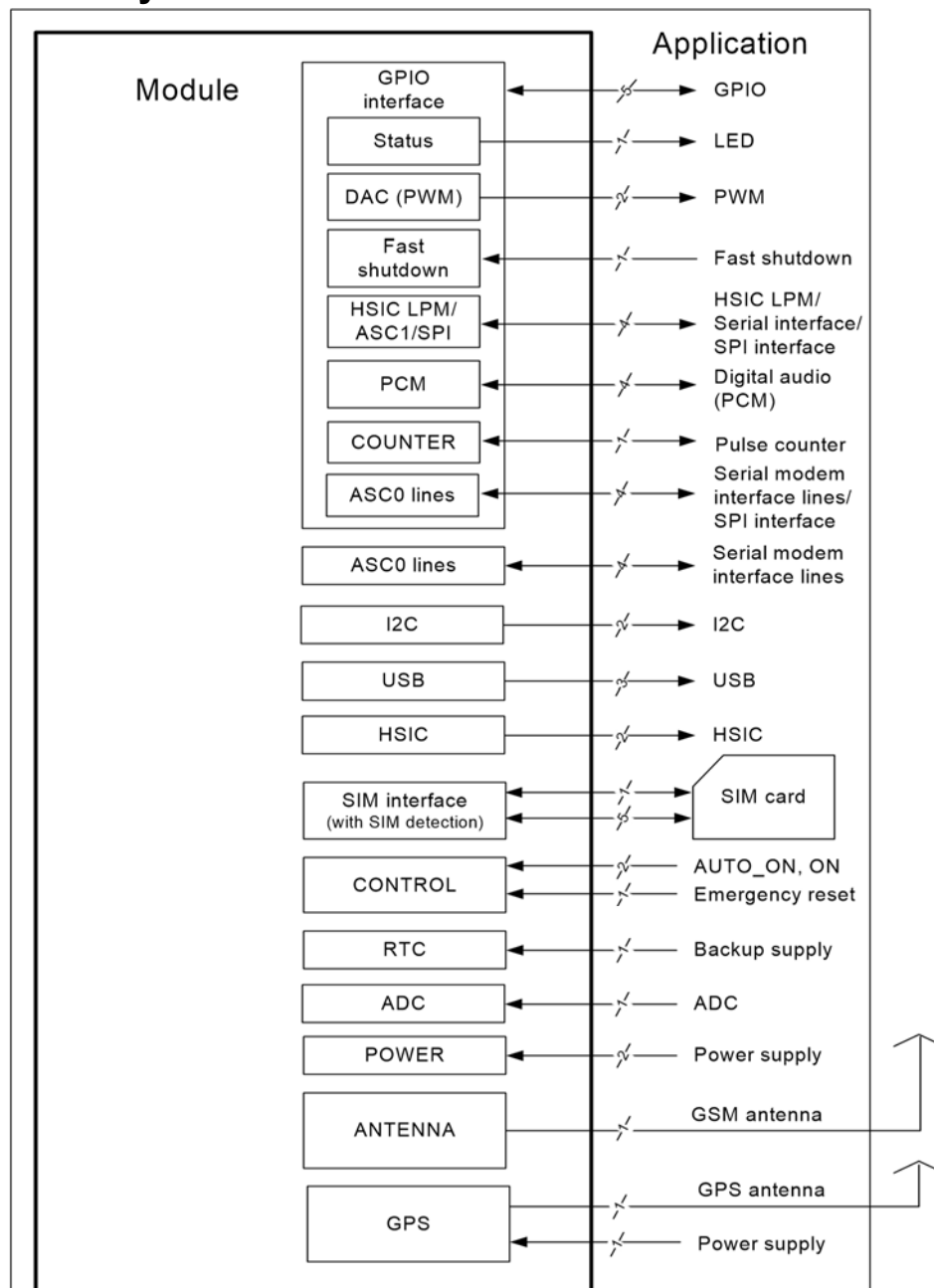


Figure 1: EHS8 system overview

2 Interface Characteristics

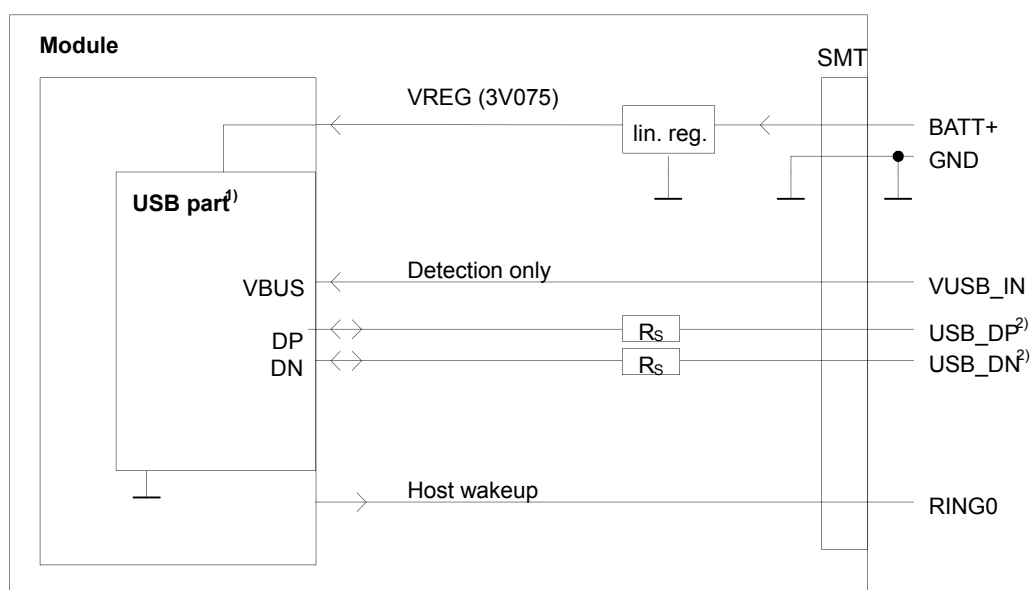
EHS8 is equipped with an SMT application interface that connects to the external application. The SMT application interface incorporates the various application interfaces as well as the RF antenna interface.

2.1 Application Interface

2.1.1 USB Interface

EHS8 supports a USB 2.0 High Speed (480Mbit/s) device interface that is Full Speed (12Mbit/s) compliant. The USB interface is primarily intended for use as command and data interface and for downloading firmware.

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 EHS8 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 EHS8 needs to be installed.

¹ . The specification is ready for download on <http://www.usb.org/developers/docs/>

2.1.2 Serial Interface ASC0

EHS8 offers an 8-wire unbalanced, asynchronous modem interface ASC0 conforming to ITUT V.24 protocol DCE signalling. 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).

EHS8 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

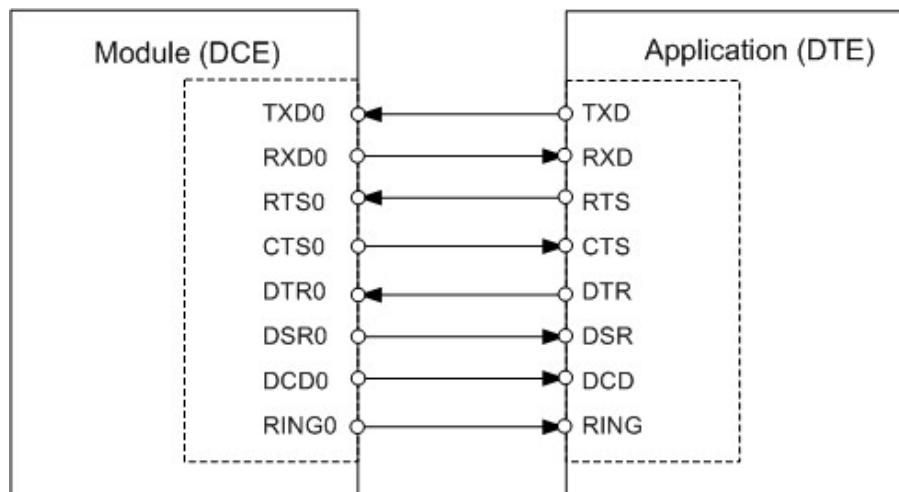


Figure 3: Serial interface ASC0

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.
- ASC0 is designed for controlling GSM/UMTS voice calls, transferring data and for controlling the module with AT commands.
- Full multiplexing capability allows the interface to be partitioned into virtual channels.
- 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.
- Configured for 8 data bits, no parity and 1 stop bit.
- ASC0 can be operated at fixed bit rates from 1,200bps up to 921,600bps.
- Autobauding supports bit rates from 1,200bps up to 230,400bps.
- Supports RTS0/CTS0 hardware flow control. 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).

2.1.3 Serial Interface ASC1

Four EHS8 GPIO lines can be configured as ASC1 interface signals to provide a 4-wire unbalanced, asynchronous modem interface ASC1 conforming to ITU-T V.24 protocol DCE signalling. 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).

2.1 Application Interface

EHS8 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

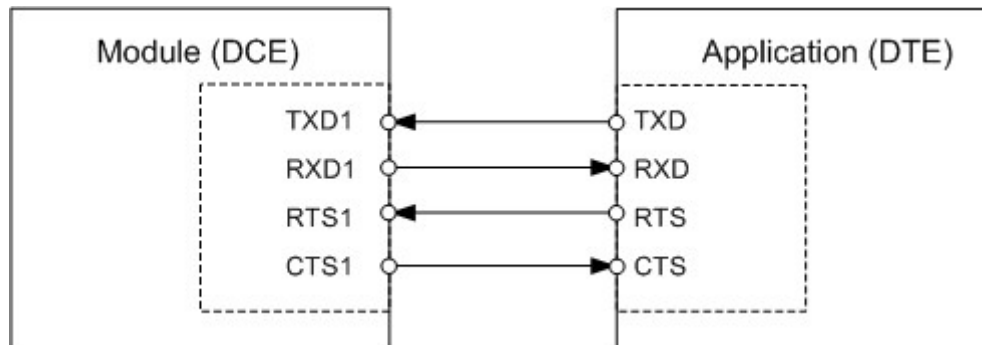


Figure 4: Serial interface ASC1

Features

- Includes only the data lines TXD1 and RXD1 plus RTS1 and CTS1 for hardware hand shake.
- On ASC1 no RING line is available.
- Configured for 8 data bits, no parity and 1 or 2 stop bits.
- ASC1 can be operated at fixed bit rates from 1,200 bps to 921,600 bps.
- Autobauding supports bit rates from 1,200bps up to 230,400bps.
- Supports RTS1/CTS1 hardware flow. 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

EHS8 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 3V and 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 EHS8 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.
CCCLK	Chipcard clock
CCVCC	SIM supply voltage.

2.1 Application Interface

CCIO	Serial data line, input and output.
CCRST	Chipcard 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 will 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 EHS8.

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 EHS8.

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

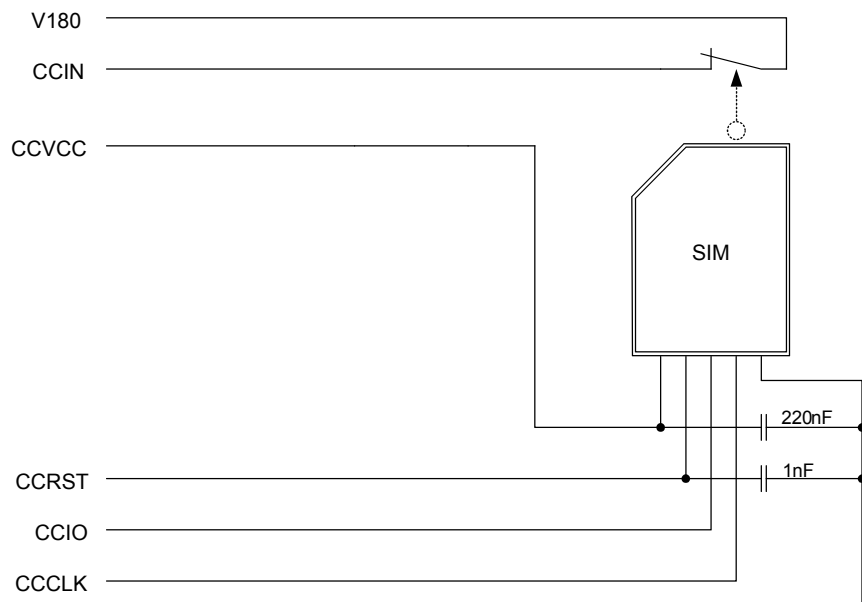


Figure 5: External UICC/SIM/USIM card holder circuit

The total cable length between the SMT application interface pads on EHS8 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.

2.1.5 Digital Audio Interface

EHS8's digital audio interface (DAI) can be used to connect audio devices capable of pulse code modulation (PCM).

2.1.6 GPIO Interface

EHS8 offers a GPIO interface with 22 GPIO lines. The GPIO lines are shared with other interfaces or functions: Fast shutdown (see [Section 2.1.13](#)), status LED (see [Section 2.1.12](#)), the PWM functionality (see [Section 2.1.10](#)), an pulse counter (see [Section 2.1.11](#)), ASC0 (see [Section 2.1.2](#)), ASC1 (see [Section 2.1.3](#)), an SPI interface (see [Section 2.1.8](#)), an HSIC interface (see [Section 2.1.9](#)) and a PCM interface (see [Section 2.1.10](#))

The following table shows the configuration variants for the GPIO pads. All variants are mutually exclusive, i.e. a pad configured for instance as Status LED is locked for alternative usage. **Table 2:** GPIO lines and possible alternative assignment

GPIO	Fast Shutdown	Status LED	PWM	Pulse Counter	ASC0	ASC1	SPI	HSIC	PCM
GPIO1					DTR0				
GPIO2					DCD0				
GPIO3					DSR0		SPI_CLK		
GPIO4	FST_SHDN								
GPIO5		Status LED							
GPIO6			PWM2						
GPIO7			PWM1						
GPIO8				COUNTER					
GPIO11									
GPIO12									
GPIO13									
GPIO14									
GPIO15									
GPIO16						RXD1	MOSI	AP_WAKEUP	
GPIO17						TXD1	MISO	HOST_ACTIVE	
GPIO18						RTS1		CP_WAKEUP	
GPIO19						CTS1	SPI_CS	SUSPEND	
GPIO20									TXDDAI

2.1 Application Interface

GPIO21									RXDDAI
GPIO22									TFSDAI
GPIO23									SCLK
GPIO24					RING0				

After startup, the above mentioned alternative GPIO line assignments can be configured using AT commands (see [1]). The configuration is non-volatile and available after module restart.

2.1.7 I²C Interface

I²C is a serial, 8-bit oriented data transfer bus for bit rates up to 400kbps in Fast mode. It consists of two lines, the serial data line I2CDAT and the serial clock line I2CCLK. The module acts as a single master device, e.g. the clock I2CCLK is driven by the module. I2CDAT is a bi-directional line. Each device connected to the bus is software addressable by a unique 7-bit address, and simple master/slave relationships exist at all times. The module operates as master-transmitter or as master-receiver. The customer application transmits or receives data only on request of the module.

The I²C interface can be powered via the V180 line of EHS8. If connected to the V180 line, the I²C interface will properly shut down when the module enters the Power Down mode.

Note: Good care should be taken when creating the PCB layout of the host application: The traces of I2CCLK and I2CDAT should be equal in length and as short as possible.

2.1.8 SPI Interface

Four EHS8 GPIO interface lines can be configured as Serial Peripheral Interface (SPI). The SPI is a synchronous serial interface for control and data transfer between EHS8 and the external application. Only one application can be connected to the SPI and the interface supports only master mode. The transmission rates are up to 6.5Mbit/s. The SPI interface comprises the two data lines MOSI and MISO, the clock line SPI_CLK as well as the chip select line SPI_CS.

2.1.9 HSIC Interface

The (USB) High Speed Inter Chip Interface can be used between the module and an external application processor and is compliant to the High Speed USB 2.0 interface with 480Mbit/s. The maximum distance between module processor and external application processor should not exceed 100mm.

The HSIC interface comprises 6 lines:

- Two signal lines (strobe - HSIC_STRB - and data - HSIC_DATA) are used in a source synchronous serial interface with a 240MHz clock to provide a 480Mbps USB interface. The HSIC_STRB and HSIC_DATA lines are high-speed signals and should be routed as 50

impedance traces. The trace length of these signals should be balanced to minimize timing skew and no longer as 100mm.

- Four signal lines for Link Power Management (LPM). For further power reduction, the USB HSIC interface supports LPM according to the USB 2.0 standard. The LPM defines power management states and mechanisms to affect state changes that are used by the AP_WAKEUP and CP_WAKEUP signal lines to efficiently manage bus and system power. To take advantage of the LPM feature, two further signals are needed to support power management state transitions - the SUSPEND and HOST_ACTIVE signals.

2.1.10 PWM Interfaces

The GPIO6 and GPIO7 interface lines can be configured as Pulse Width Modulation interface lines PWM1 and PWM2. The PWM interface lines can be used, for example, to connect buzzers. The PWM1 line is shared with GPIO7 and the PWM2 line is shared with GPIO6 (for GPIOs see [Section 2.1.6](#)). GPIO and PWM functionality are mutually exclusive.

2.1.11 Pulse Counter

The GPIO8 line can be configured as pulse counter line COUNTER. The pulse counter interface can be used, for example, as a clock (for GPIOs see [Section 2.1.6](#)).

2.1.12 Status LED

The GPIO5 interface line can be configured to drive a status LED that indicates different operating modes of the module (for GPIOs see [Section 2.1.6](#)). GPIO and LED functionality are mutually exclusive.

2.1.13 Fast Shutdown

The GPIO4 interface line can be configured as fast shutdown signal line FST_SHDN. The configured FST_SHDN line is an active low control signal and must be applied for at least 10 milliseconds. If unused this line can be left open because of a configured internal pull-up resistor.

2.2 RF Antenna Interface

The RF interface has an impedance of 50 Ω . EHS8 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 EHS8 module and should be placed in the host application if the antenna does not have an impedance of 50 Ω .

Regarding the return loss EHS8 provides the following values in the active band:

Table 3: 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	$\geq 12\text{dB}$

2.2.1 Antenna Installation

The antenna is connected by soldering the antenna pad (ANT_GSM, i.e., pad #59) and its neighboring ground pads (GND, i.e., pads #58 and #60) directly to the application's PCB. The antenna pad is the antenna reference point (ARP) for EHS8. All RF data specified throughout this document is related to the ARP.

The distance between the antenna ANT_GSM pad (#59) and its neighboring GND pads (#58, #60) has been optimized for best possible impedance. On the application PCB, special attention should be paid to these 3 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 50 Ω 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 50 Ω 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 EHS8's antenna pad.

2.3 GPS Interface

2.3.1 GPS Receiver

EHS8 integrates a GPS receiver that offers the full performance of GPS technology. The GPS receiver is able to continuously track all satellites in view, thus providing accurate satellite position data.

The integrated GPS receiver supports the NMEA protocol via ASC0 interface. NMEA is a combined electrical and data specification for communication between various (marine) electronic devices including GPS 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 has still knowledge of its last position, time and almanac or has still access to valid ephemeris data and the precise time.

2.3.2 GPS Antenna

In addition to the RF antenna interface EHS8 also has a GPS antenna interface. The GPS installation is the same as for the RF antenna interface, except for pad 224 instead of pad 59.

It is possible to connect active or passive GPSS antennas. For active antennas the power is supplied by ANT_GPS_PWR; see sample application given in [Figure 6](#). In either case the antennas must have 50 Ω impedance. The simultaneous operation of GSM and GPS has been implemented.

2.4 Sample Application

2.4 Sample Application

[Figure 6](#) shows a typical example of how to integrate a EHS8 module with an application. Usage of the various host interfaces depends on the desired features of the application.

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, RXT0, VDDL0, 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 [\[3\]](#).

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.

Note: EHS8 is not intended for use with cables longer than 3m.

Disclaimer

No warranty, either stated or implied, is provided on the sample schematic diagram shown in [Figure 6](#) and the information detailed in this section. As 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 EHS8 modules.

2.4 Sample Application

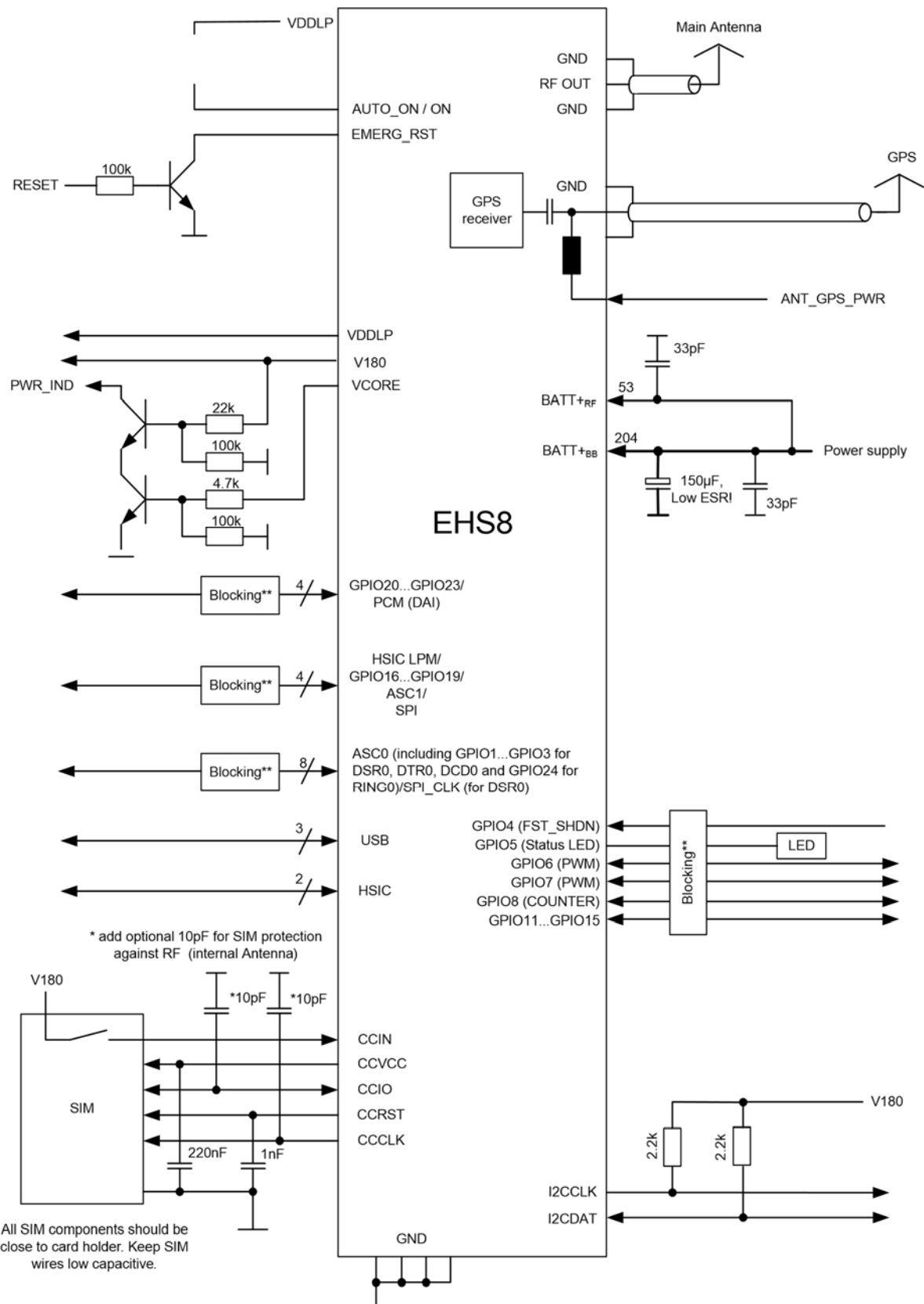


Figure 6: Schematic diagram of EHS8 sample application

3 Operating Characteristics

3 Operating Characteristics

3.1 Operating Modes

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

Table 4: Overview of operating modes

Mode	Function	
Normal operation	GSM / GPRS / UMTS / HSPA SLEEP	Power saving set automatically when no call is in progress and the USB connection is suspended by host or not present and no active communication via ASC0.
	GSM / GPRS / UMTS / HSPA IDLE	Power saving disabled or an USB connection not suspended, but no call in progress.
	GSM TALK/ GSM DATA	Connection between two subscribers is in progress. Power consumption depends on the GSM network coverage and several connection settings (e.g. DTX off/on, FR/EFR/HR, hopping sequences and antenna connection). The following applies when power is to be measured in TALK_GSM mode: DTX off, FR and no frequency hopping.
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and GPRS configuration (e.g. used multislot settings).
	EGPRS DATA	EGPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and EGPRS configuration (e.g. used multislot settings).
	UMTS TALK/ UMTS DATA	UMTS data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
	HSPA DATA	HSPA data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
Power Down	Normal shutdown after sending the power down command. Only a voltage regulator is active for powering the RTC. Software is not active. Interfaces are not accessible. Operating voltage remains applied.	
Airplane mode	Airplane mode shuts down the radio part of the module, causes the module to log off from the GSM/GPRS network and disables all AT commands whose execution requires a radio connection. Airplane mode can be controlled by AT command (see [1]).	

3.2 Power Supply

3.2 Power Supply

EHS8 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 for the general power management.
- BATT+_{RF} with a line for the GSM power amplifier supply.

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

The power supply of EHS8 has to be a single voltage source at BATT+_{BB} and BATT+_{RF}. It must be able to provide the peak current during the uplink transmission.

All the key functions for supplying power to the device are handled by the power management section of the analog controller. This IC 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 EHS8

Figure 7 shows the top and bottom view of EHS8 and provides an overview of the board's mechanical dimensions. For further details see Figure 8.

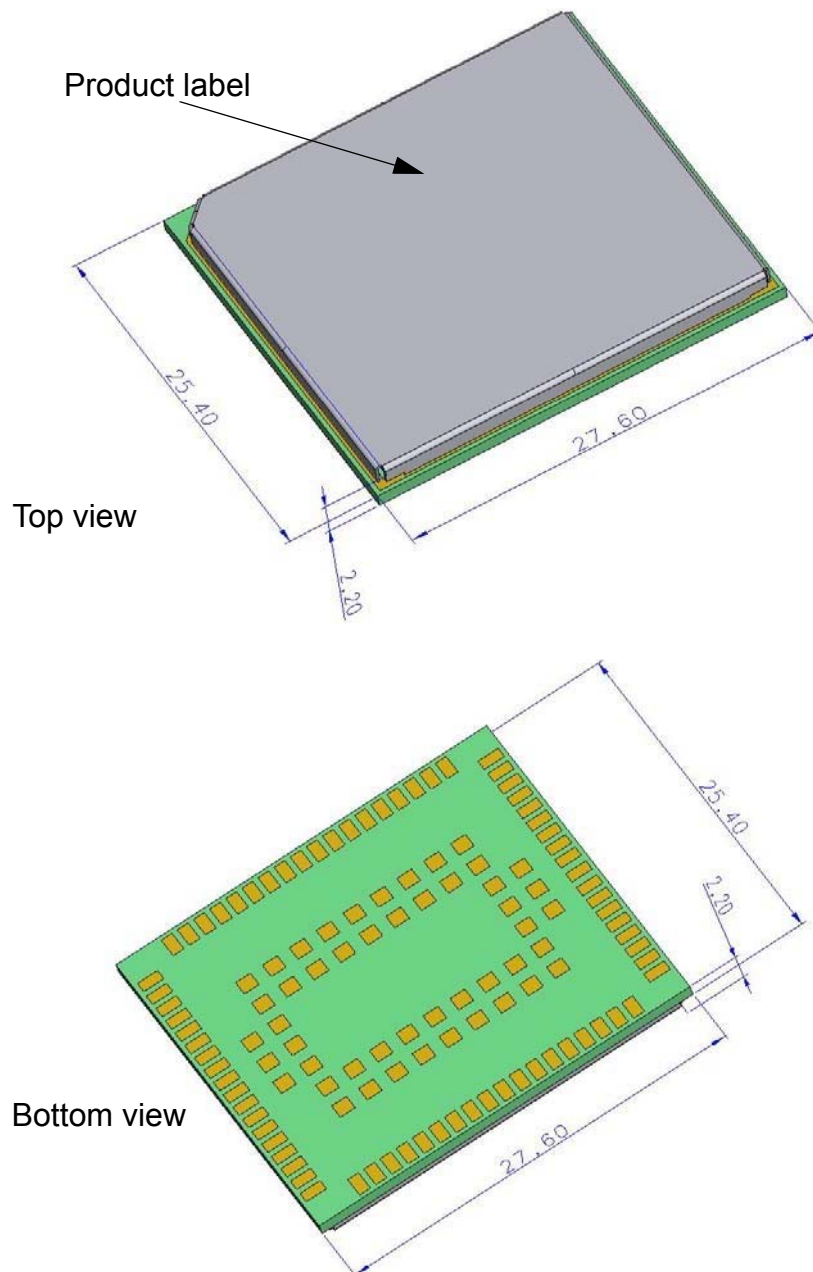


Figure 7: EHS8— top and bottom view

4.1 Mechanical Dimensions of EHS8

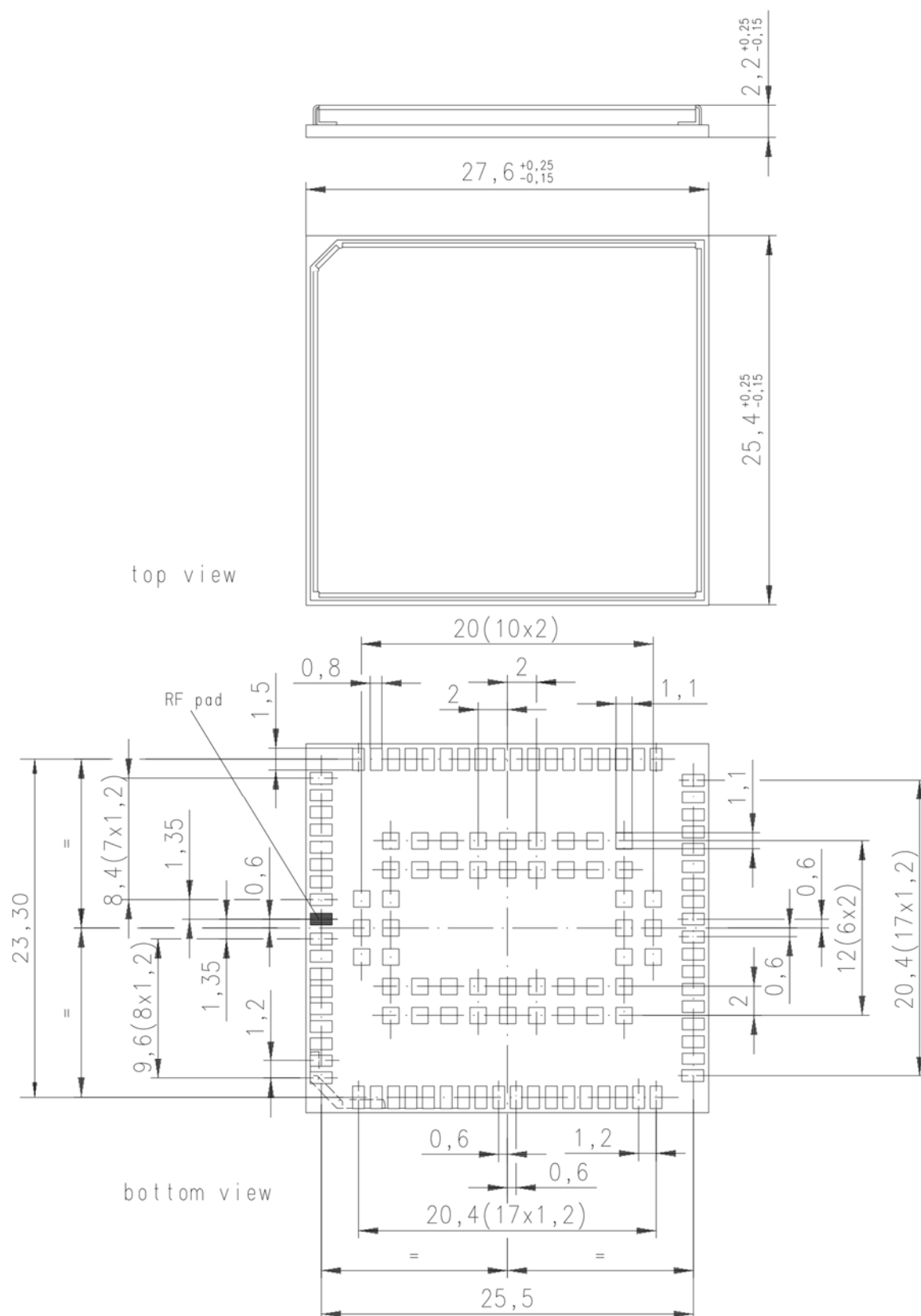


Figure 8: Dimensions of EHS8 (all dimensions in mm)

5 Regulatory and Type Approval Information

5 Regulatory and Type Approval Information

5.1 Directives and Standards

EHS8 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 "EHS8 Hardware Interface Description".¹

Table 5: Directives

1999/05/EC	Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC). The product is labeled with the CE conformity mark CE1588	
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 6: 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 V5.15	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 7: Standards of European type approval

3GPP TS 51.010-1	Digital cellular telecommunications system (Release 7); Mobile Station (MS) conformance specification;	
ETSI EN 301 511 V9.0.2	Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC)	
GCF-CC V3.49	Global Certification Forum - Certification Criteria	
ETSI EN 301 489-01 V1.9.2	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical 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 7: Standards of European type approval

ETSI EN 301 489-07 V1.3.1	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
ETSI EN 301 489-24 V1.5.1	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
ETSI EN 301 908-01 V5.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 1: Harmonized EN for IMT-2000, introduction and common requirements of article 3.2 of the R&TTE Directive
ETSI EN 301 908-02 V5.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
IEC/EN 60950-1:2006/ A1:2010+A12:2011 IEC 60950-1:2005/ A1:2009 (second edition)	Safety of information technology equipment

Table 8: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

Table 9: 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 10 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 10: 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 EHS8 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)

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

5.3 Reference Equipment for Type Approval

The Gemalto M2M reference setup submitted to type approve EHS8 (including a special approval adapter for the DSB75) is shown in the following figure¹:

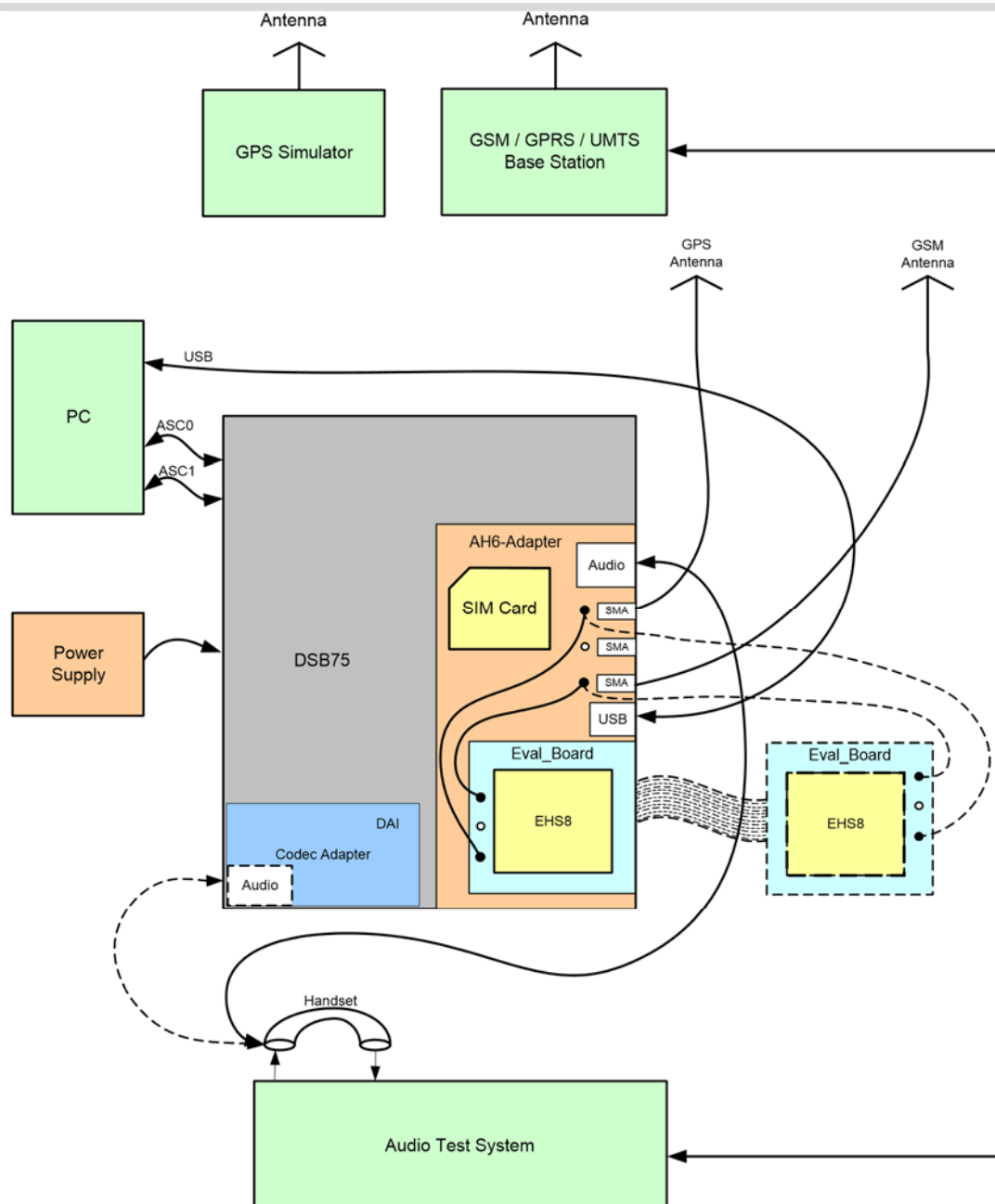


Figure 9: Reference equipment for Type Approval

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/UMTS/GPS test equipment instead of employing the SMA antenna connectors on the EHS8-DSB75 adapter as shown in Figure 9. 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 IC Rules and Regulations

5.4 Compliance with FCC and IC Rules and Regulations

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

*FCC Identifier: QIPEHS8 Industry Canada Certification Number: 7830A-EHS8
Granted to Gemalto M2M GmbH*

Manufacturers of mobile or fixed devices incorporating EHS8 modules are authorized to use the FCC Grants and Industry Canada Certificates of the EHS8 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 QIPEHS8", and accordingly "Contains IC 7830A-EHS8". The integration is limited to fixed or mobile categorised 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 2.15 (850 MHz) and 2.15 dBi (1900 MHz).

IMPORTANT:

Manufacturers of portable applications incorporating EHS8 modules are required to have their final product certified and apply for their own FCC Grant and Industry Canada 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 Industry Canada licence-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 EHS8 modules the above note 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.

6 Document Information

6 Document Information

6.1 Revision History

New document: "Cinterion® EHS8 Hardware Interface Overview" Version **02.770**

Chapter	What is new
--	Initial document setup.

6.2 Related Documents

- [1] EHS8 AT Command Set
- [2] EHS8 Release Note
- [3] Application Note 48: SMT Module Integration
- [4] Application Note 40: Thermal Solutions
- [5] Universal Serial Bus Specification Revision 2.0, April 27, 2000

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 EHS8
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

6.3 Terms and Abbreviations

Abbreviation	Description
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
ERP	Effective Radiated Power
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
GPIO	General Purpose Input/Output
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

6.3 Terms and Abbreviations

kpbs	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

Abbreviation	Description
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
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PLL	Phase Locked Loop
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)

6.3 Terms and Abbreviations

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

Abbreviation	Description
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

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 EHS8. 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 Appendix

7.1 List of Parts and Accessories

Table 11: List of parts and accessories

Description	Supplier	Ordering information
EHS8	Gemalto M2M	Standard module Gemalto M2M IMEI: Packaging unit (ordering) number: L30960-N2900-A300 Module label number: S30960-S2900-A300-1
DSB75 Evaluation Kit	Gemalto M2M	Ordering number: L36880-N8811-A100
Multi-Adapter R1 for mounting EHS8 evaluation modules onto DSB75	Gemalto M2M	Ordering number: L30960-N0010-A100
Approval adapter for mounting EHS8 evaluation modules onto DSB75	Gemalto M2M	Ordering number: L30960-N2301-A100
Evaluation Module	Gemalto M2M	Ordering number: L30960-N2901-A300 (EHS8)
Votronic Handset	Votronic / Gemalto M2M	Gemalto M2M ordering number: L36880-N8301-A107 Votronic ordering number: HH-SI-30.3/V1.1/0 Votronic Entwicklungs- und Produktionsgesellschaft für elektronische Geräte mbH Saarbrücker Str. 8 66386 St. Ingbert Germany Phone: +49-(0)6 89 4 / 92 55-0 Fax: +49-(0)6 89 4 / 92 55-88 Email: contact@votronic.com
SIM card holder incl. push button ejector and slide-in tray	Molex	Ordering numbers: 91228 91236 Sales contacts are listed in Table 12 .

7.1 List of Parts and Accessories

Table 12: 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
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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
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About Gemalto

Gemalto (Euronext NL0000400653 GTO) is the world leader in digital security with 2011 annual revenues of €2 billion and more than 10,000 employees operating out of 74 offices and 14 Research & Development centers, located in 43 countries.

We are at the heart of the rapidly evolving digital society. Billions of people worldwide increasingly want the freedom to communicate, travel, shop, bank, entertain and work - anytime, everywhere - in ways that are enjoyable and safe. Gemalto delivers on their expanding needs for personal mobile services, payment security, authenticated cloud access, identity and privacy protection, eHealthcare and eGovernment efficiency, convenient ticketing and dependable machine-to-machine (M2M) applications.

Gemalto develops secure embedded software and secure products which we design and personalize. Our platforms and services manage these secure products, the confidential data they contain and the trusted end-user services they enable. Our innovations enable our clients to offer trusted and convenient digital services to billions of individuals.

Gemalto thrives with the growing number of people using its solutions to interact with the digital and wireless world.

For more information please visit

m2m.gemalto.com, www.facebook.com/gemalto, or [Follow@gemaltom2m](https://twitter.com/gemaltom2m) on twitter.

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