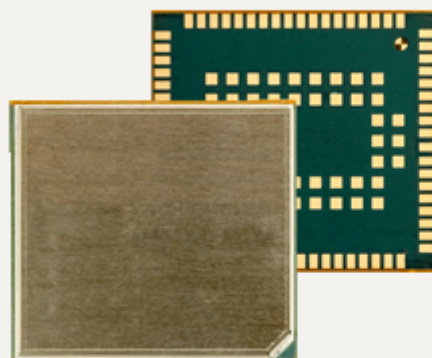


Cinterion[®] ELS61-US

Hardware Interface Overview

Version: 00.281
DocId: ELS61-US_HIO_v00.281



Document Name: **Cinterion® ELS61-US Hardware Interface Overview**

Version: **00.281**

Date: **2016-02-11**

DocId: **ELS61-US_HIO_v00.281**

Status **Confidential / Preliminary**

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Contents

1	Introduction	6
1.1	Key Features at a Glance	6
1.2	ELS61-US System Overview	9
2	Interface Characteristics	10
2.1	Application Interface	10
2.1.1	USB Interface.....	10
2.1.2	Serial Interface ASC0	11
2.1.3	Serial Interface ASC1	12
2.1.4	UICC/SIM/USIM Interface.....	13
2.1.5	GPIO Interface	15
2.1.6	I ² C Interface	16
2.2	SPI Interface	16
2.2.1	PWM Interfaces	17
2.2.2	Pulse Counter	17
2.2.3	Status LED.....	17
2.2.4	Fast Shutdown	17
2.3	RF Antenna Interface.....	18
2.3.1	Antenna Installation	19
2.4	Sample Application	20
3	Operating Characteristics	22
3.1	Operating Modes	22
3.2	Power Supply	23
4	Mechanical Dimensions	24
4.1	Mechanical Dimensions of ELS61-US	24
5	Regulatory and Type Approval Information	26
5.1	Directives and Standards.....	26
5.2	SAR requirements specific to portable mobiles	29
5.3	Reference Equipment for Type Approval.....	30
5.4	Compliance with FCC and IC Rules and Regulations	31
6	Document Information.....	33
6.1	Revision History	33
6.2	Related Documents	33
6.3	Terms and Abbreviations	34
6.4	Safety Precaution Notes	37
7	Appendix.....	38
7.1	List of Parts and Accessories.....	38

Tables

Table 1:	Signals of the SIM interface (SMT application interface)	13
Table 2:	GPIO lines and possible alternative assignment.....	15
Table 3:	Return loss in the active band.....	18
Table 4:	Overview of operating modes	22
Table 5:	Directives	26
Table 6:	Standards of North American type approval	26
Table 7:	Standards of European type approval.....	26
Table 8:	Requirements of quality	27
Table 9:	Standards of the Ministry of Information Industry of the People's Republic of China	27
Table 10:	Toxic or hazardous substances or elements with defined concentration limits	28
Table 11:	List of parts and accessories.....	38
Table 12:	Molex sales contacts (subject to change)	39

Figures

Figure 1:	ELS61-US system overview.....	9
Figure 2:	USB circuit	10
Figure 3:	Serial interface ASC0.....	11
Figure 4:	Serial interface ASC1.....	12
Figure 5:	External UICC/SIM/USIM card holder circuit	14
Figure 6:	Schematic diagram of ELS61-US sample application.....	21
Figure 7:	ELS61-US– top and bottom view	24
Figure 8:	Dimensions of ELS61-US (all dimensions in mm)	25
Figure 9:	Reference equipment for Type Approval	30

1 Introduction

This document¹ describes the hardware of the Cinterion® ELS61-US 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	UMTS/HSPA+: Triple band, 850 (BdV) / AWS (BdIV) / 1900MHz (BdII) LTE: Quad band, 700 (Bd12) / 850 (Bd5) / AWS (Bd4) / 1900MHz (Bd2)
Output power (according to Release 99)	Class 3 (+24dBm +1/-3dB) for UMTS 1900, WCDMA FDD BdII Class 3 (+24dBm +1/-3dB) for UMTS AWS, WCDMA FDD BdIV Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdV
Output power (according to Release 8)	Class 3 (+23dBm ±2dB) for LTE 1900, LTE FDD Bd2 Class 3 (+23dBm ±2dB) for LTE AWS, LTE FDD Bd4 Class 3 (+23dBm ±2dB) for LTE 850, LTE FDD Bd5 Class 3 (+23dBm ±2dB) for LTE 700, LTE FDD Bd12
Power supply	3.0V 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. TBD.g
RoHS	All hardware components fully compliant with EU RoHS Directive
<i>LTE features</i>	
3GPP Release 9	UE CAT 1 supported DL 10.2Mbps, UL 5.2Mbps
<i>HSPA features</i>	
3GPP Release 8	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

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.

1.1 Key Features at a Glance

Feature	Implementation
SMS	Point-to-point MT and MO Cell broadcast Text and PDU mode Storage: SIM card plus SMS locations in mobile equipment
<i>Software</i>	
AT commands	Hayes 3GPP TS 27.007, TS 27.005, 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 applications. The memory space available for Java programs is around 30MB in the flash file system and around 18MB RAM. Application code and data share the space in the flash file system and in RAM.
Microsoft™ compatibility	RIL for Pocket PC and Smartphone
SIM Application Toolkit	SAT letter classes b, c, e; with BIP
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 allows the use of 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. ASC1 (shared with GPIO lines): • 4-wire, unbalanced asynchronous interface • Adjustable baud rates: 1,200bps to 921,600bps • Autobauding: 1,200bps to 230,400bps • Supports RTS1/CTS1 hardware flow control
UICC interface	Supported SIM/USIM cards: 3V, 1.8V

1.1 Key Features at a Glance

Feature	Implementation
GPIO interface	22 GPIO lines comprising: 13 lines shared with ASC0, ASC1 and SPI lines, with network status indication, PWM functionality, fast shutdown and pulse counter 9 GPIO lines not shared
I ² C interface	Supports I ² C serial interface
SPI interface	Serial peripheral interface, shared with GPIO lines
Antenna interface pads	50Ω. UMTS/LTE main antenna, UMTS/LTE Rx Diversity antenna
<i>Power on/off, Reset</i>	
Power on/off	Switch-on by hardware signal 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 or voltage conditions
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
<i>Evaluation kit</i>	
Evaluation module	ELS61-US 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 ELS61-US evaluation module to the DSB75.

1.2 ELS61-US System Overview

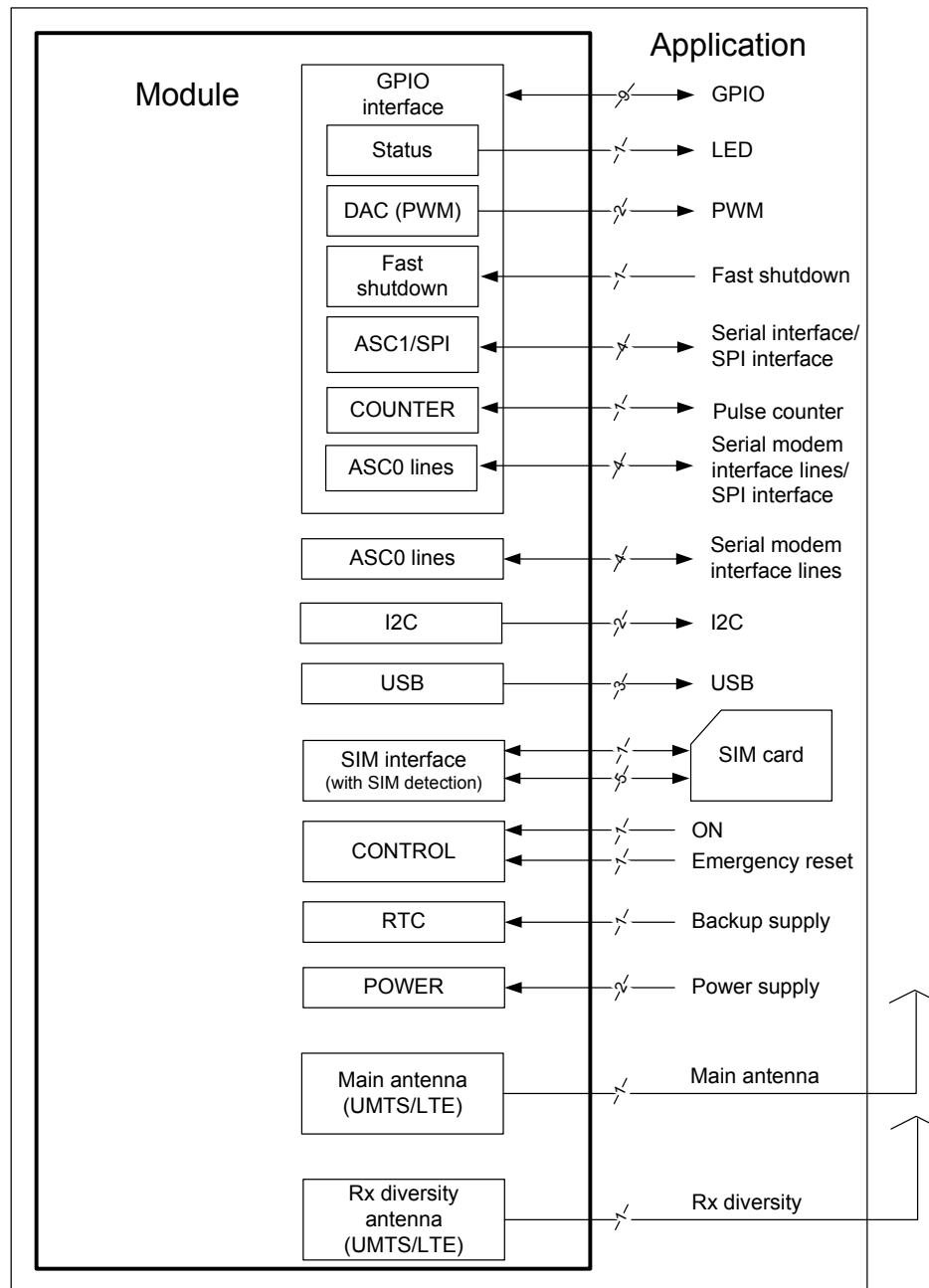


Figure 1: ELS61-US system overview

2 Interface Characteristics

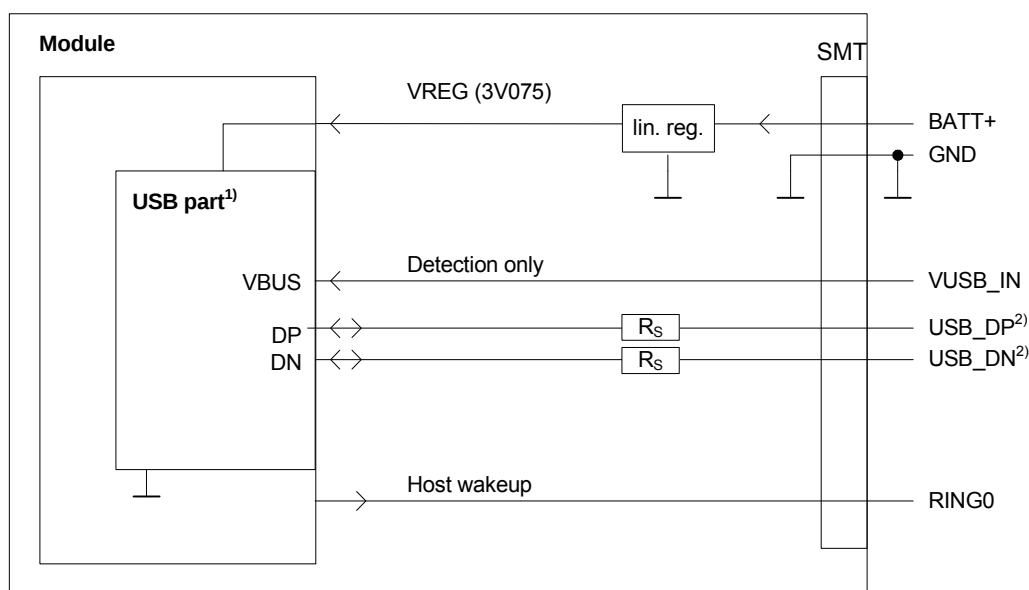
ELS61-US is equipped with an SMT application interface that connects to the external application. The SMT application interface incorporates the various application interfaces as well as the RF antenna interface.

2.1 Application Interface

2.1.1 USB Interface

ELS61-US 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 ELS61-US 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 ELS61-US needs to be installed.

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

2.1.2 Serial Interface ASC0

ELS61-US offers an 8-wire unbalanced, asynchronous modem interface ASC0 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).

ELS61-US 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

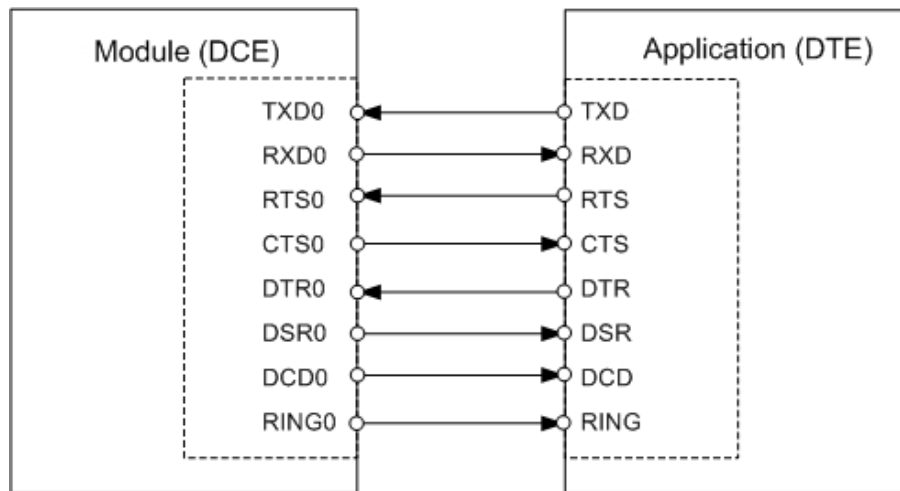


Figure 3: Serial interface ASC0

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.
- 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.

2.1.3 Serial Interface ASC1

Four ELS61-US 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).

ELS61-US 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

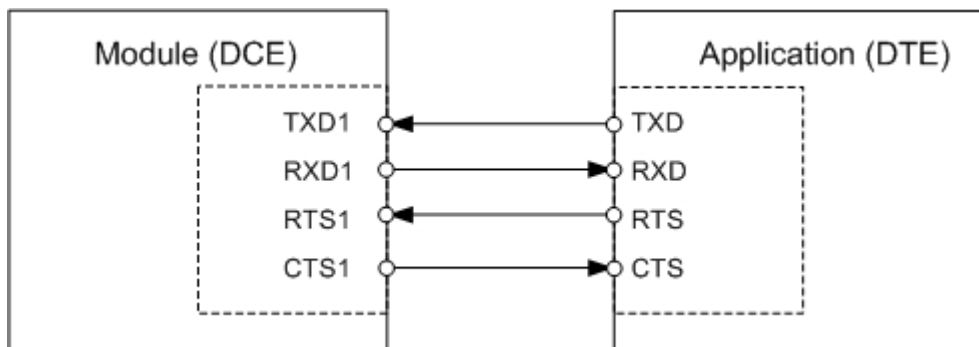


Figure 4: Serial interface ASC1

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

ELS61-US 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. 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 ELS61-US 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.
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 ELS61-US.

Note [1]: 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 ELS61-US.

Note [2]: On the evaluation board, the CCIN signal is inverted, thus the CCIN signal is by default high and will change to a low level if a SIM card is inserted.

2.1 Application Interface

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

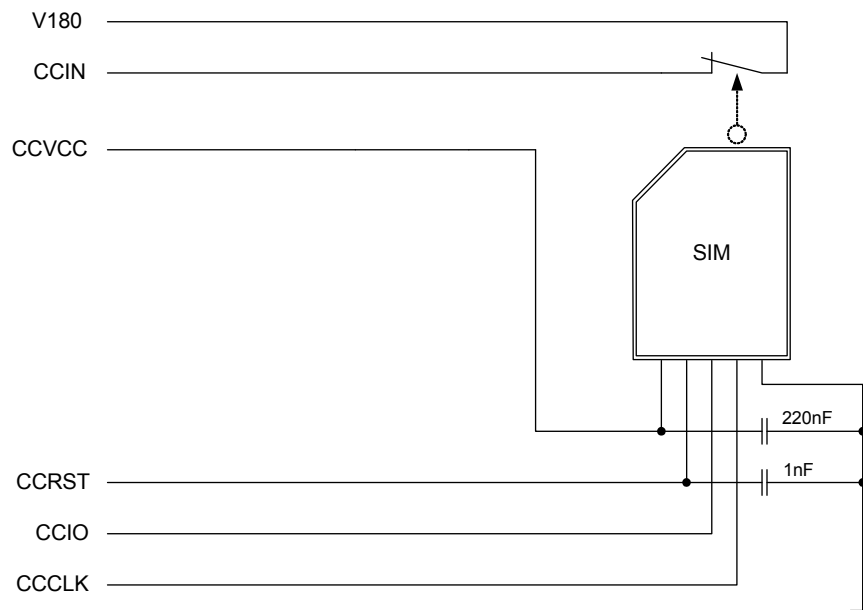


Figure 5: External UICC/SIM/USIM card holder circuit

The total cable length between the SMT application interface pads on ELS61-US 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 GPIO Interface

ELS61-US offers a GPIO interface with 22 GPIO lines. The GPIO lines are shared with other interfaces or functions: Fast shutdown (see [Section 2.2.4](#)), status LED (see [Section 2.2.3](#)), the PWM functionality (see [Section 2.2.1](#)), an pulse counter (see [Section 2.2.2](#)), ASC0 (see [Section 2.1.2](#)), ASC1 (see [Section 2.1.3](#)), an SPI interface (see [Section 2.2](#)).

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
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
GPIO17						TXD1	MISO
GPIO18						RTS1	
GPIO19						CTS1	SPI_CS
GPIO20							
GPIO21							
GPIO22							
GPIO23							
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.

2.1.6 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 ELS61-US. 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.

2.2 SPI Interface

Four ELS61-US GPIO interface lines can be configured as Serial Peripheral Interface (SPI). The SPI is a synchronous serial interface for control and data transfer between ELS61-US 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.

2.2.1 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 2.1.5](#)). GPIO and PWM functionality are mutually exclusive.

2.2.2 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 2.1.5](#)).

2.2.3 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 2.1.5](#)). GPIO and LED functionality are mutually exclusive.

2.2.4 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.

2.3 RF Antenna Interface

The ELS61-US UMTS/LTE antenna interface comprises a UMTS/LTE main antenna as well as a UMTS/LTE Rx diversity antenna to improve signal reliability and quality¹. The RF interface has an impedance of 50Ω. ELS61-US 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 ELS61-US module and should be placed in the host application if the antenna does not have an impedance of 50Ω.

Regarding the return loss ELS61-US 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	≥ 8dB	≥ 12dB
Transmit	not applicable	≥ 12dB

1. By delivery default the UMTS/LTE Rx diversity antenna is configured as available for the module since its usage is mandatory for LTE. Please refer to [\[1\]](#) for details on how to configure antenna settings.

2.3.1 Antenna Installation

The antenna is connected by soldering the antenna pad (ANT_MAIN or ANT_DRX) and its neighboring ground pads (GND) directly to the application's PCB. The antenna pads are the antenna reference points (ARP) for ELS61-US. All RF data specified throughout this document is related to the ARP.

The distance between the antenna pad and its neighboring GND pads has been optimized for best possible impedance. To prevent mismatch, special attention should be paid to these pads on the application's PCB.

The wiring of the antenna connection, starting from the antenna pad to the application's 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 external 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 ELS61-US's antenna pad.

2.4 Sample Application

[Figure 6](#) shows a typical example of how to integrate a ELS61-US 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, VDDL, 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.

Note: ELS61-US 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 ELS61-US modules.

2.4 Sample Application

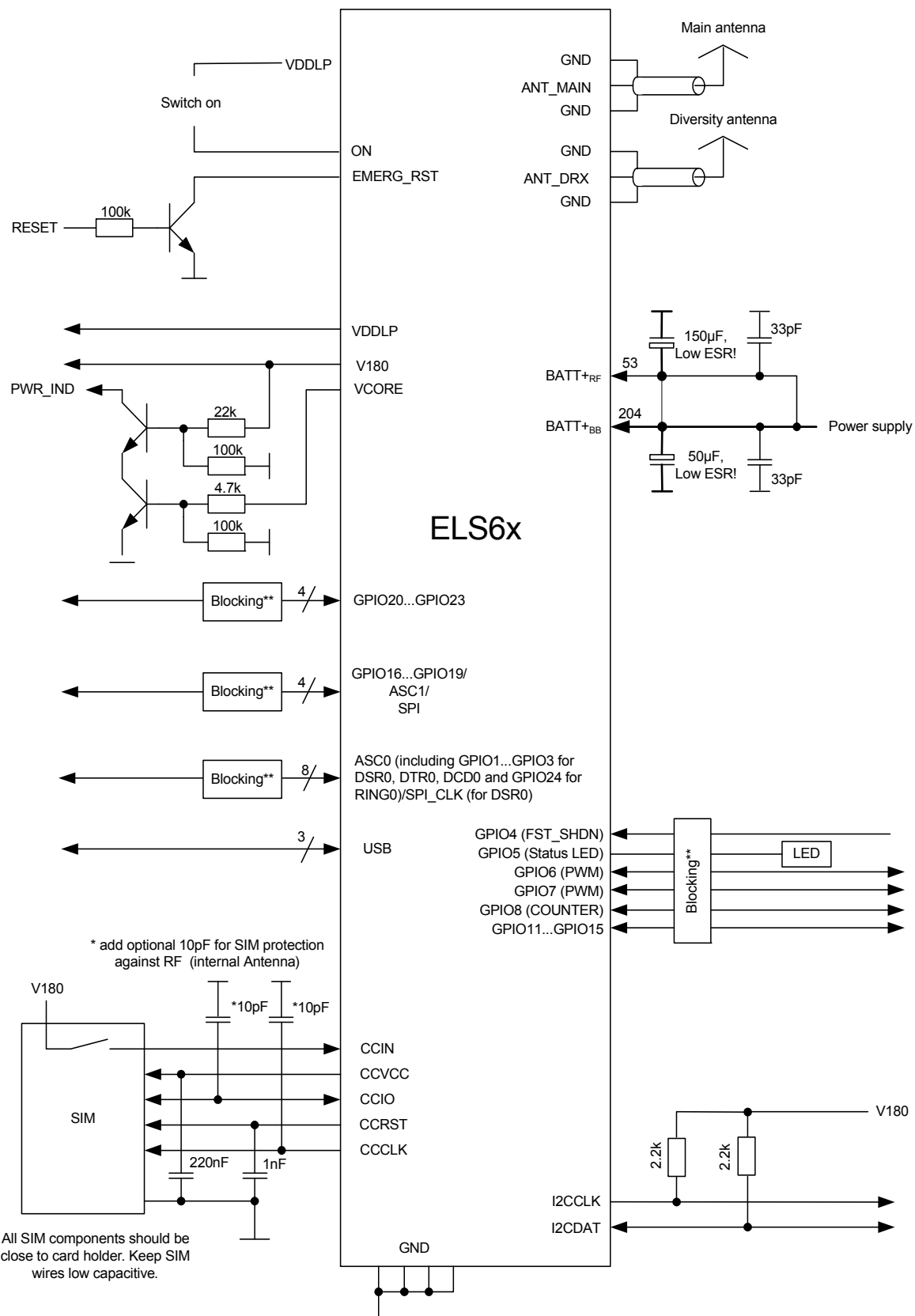


Figure 6: Schematic diagram of ELS61-US sample application

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	UMTS / HSPA / LTE 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.
	UMTS / HSPA / LTE IDLE	Power saving disabled or an USB connection not suspended, but no call in progress.
	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.
	LTE DATA	LTE 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 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

ELS61-US 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 UMTS/LTE 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 ELS61-US 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

4.1 Mechanical Dimensions of ELS61-US

Figure 7 shows the top and bottom view of ELS61-US and provides an overview of the board's mechanical dimensions. For further details see Figure 8.

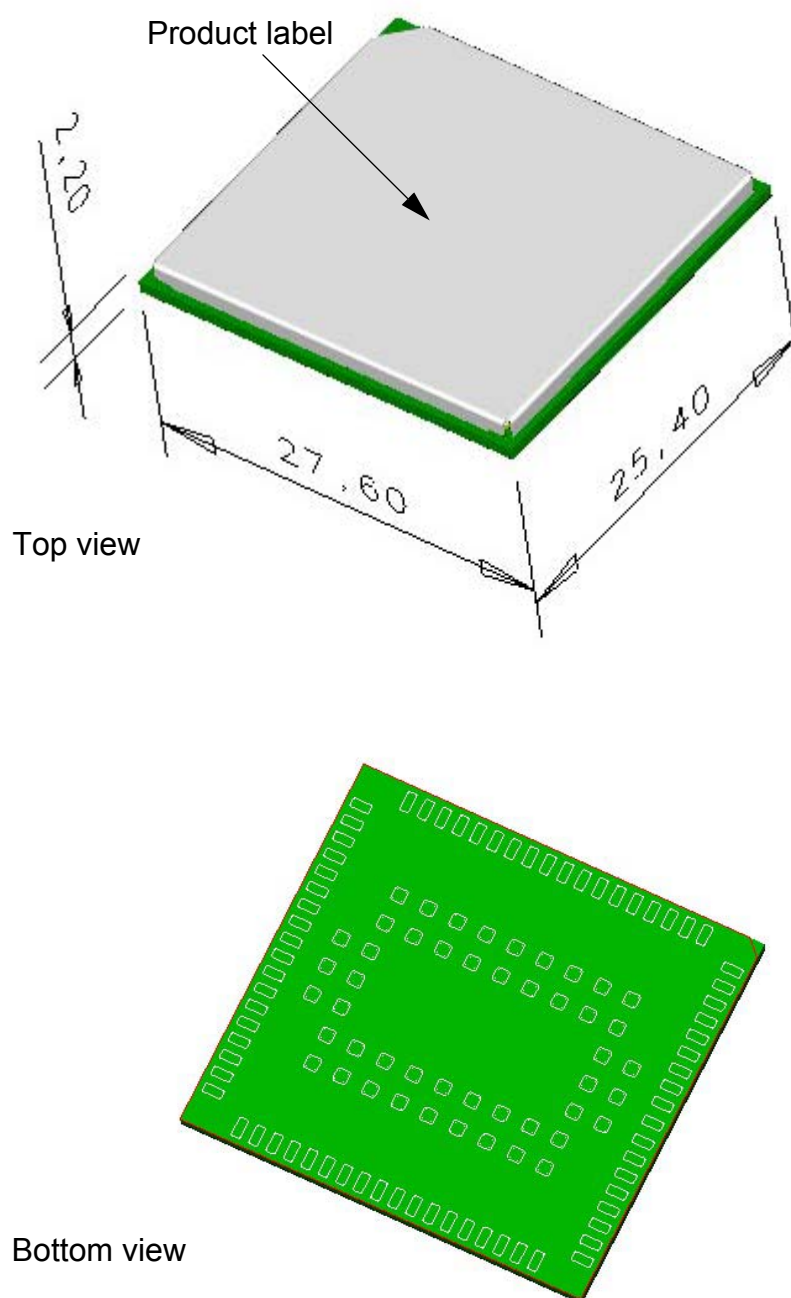


Figure 7: ELS61-US– top and bottom view

4.1 Mechanical Dimensions of ELS61-US

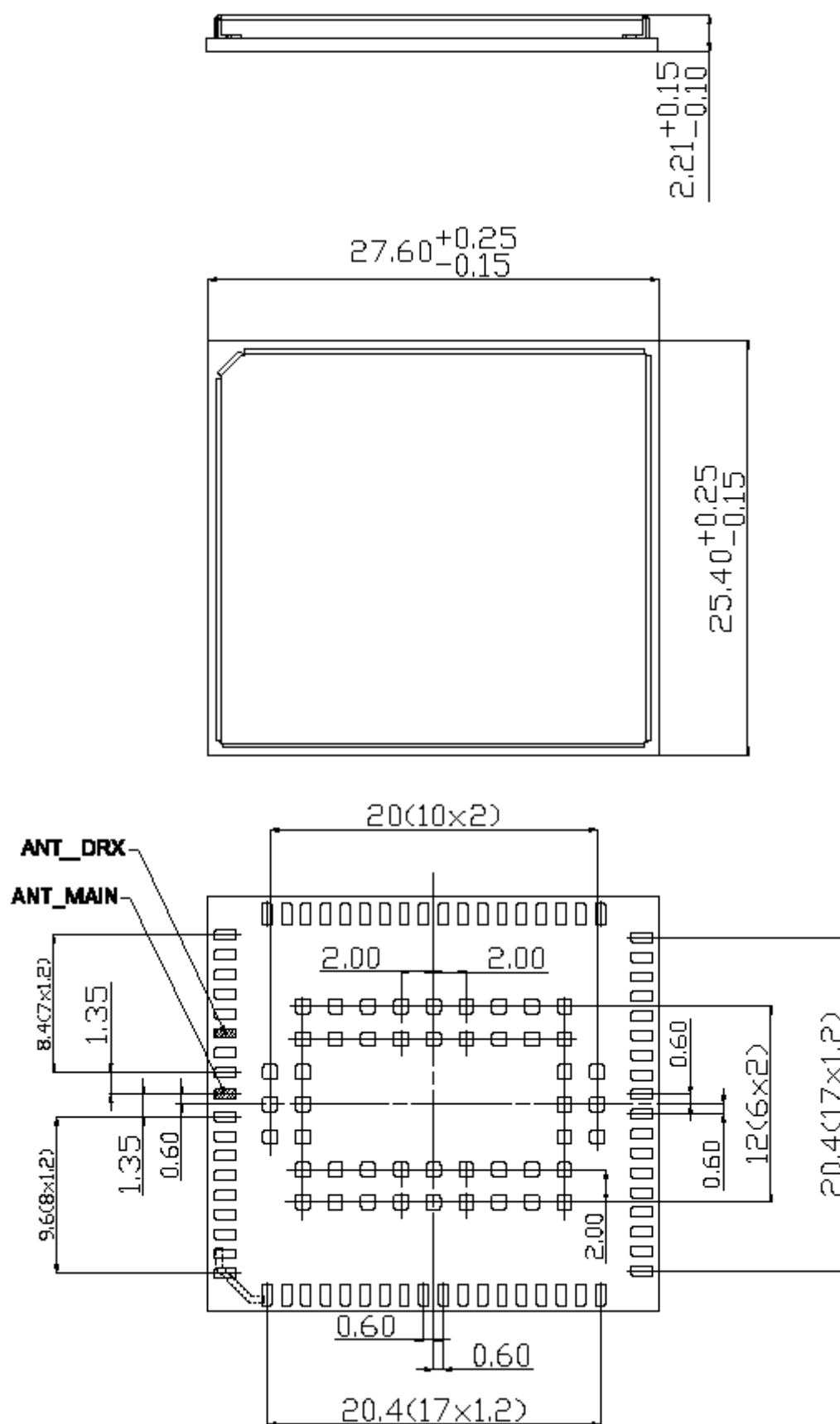


Figure 8: Dimensions of ELS61-US (all dimensions in mm)

5 Regulatory and Type Approval Information

5.1 Directives and Standards

ELS61-US 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 "ELS61-US 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 CE 0682
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;
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
ETSI EN 301 489-07 V1.3.1	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services;

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 301 489-24 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 UMTS module must be in accordance with the guidelines for human exposure to radio frequency energy. This requires the Specific Absorption Rate (SAR) of portable ELS61-US 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 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

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 ELS61-US (including a special approval adapter for the DSB75) is shown in the following figure¹:

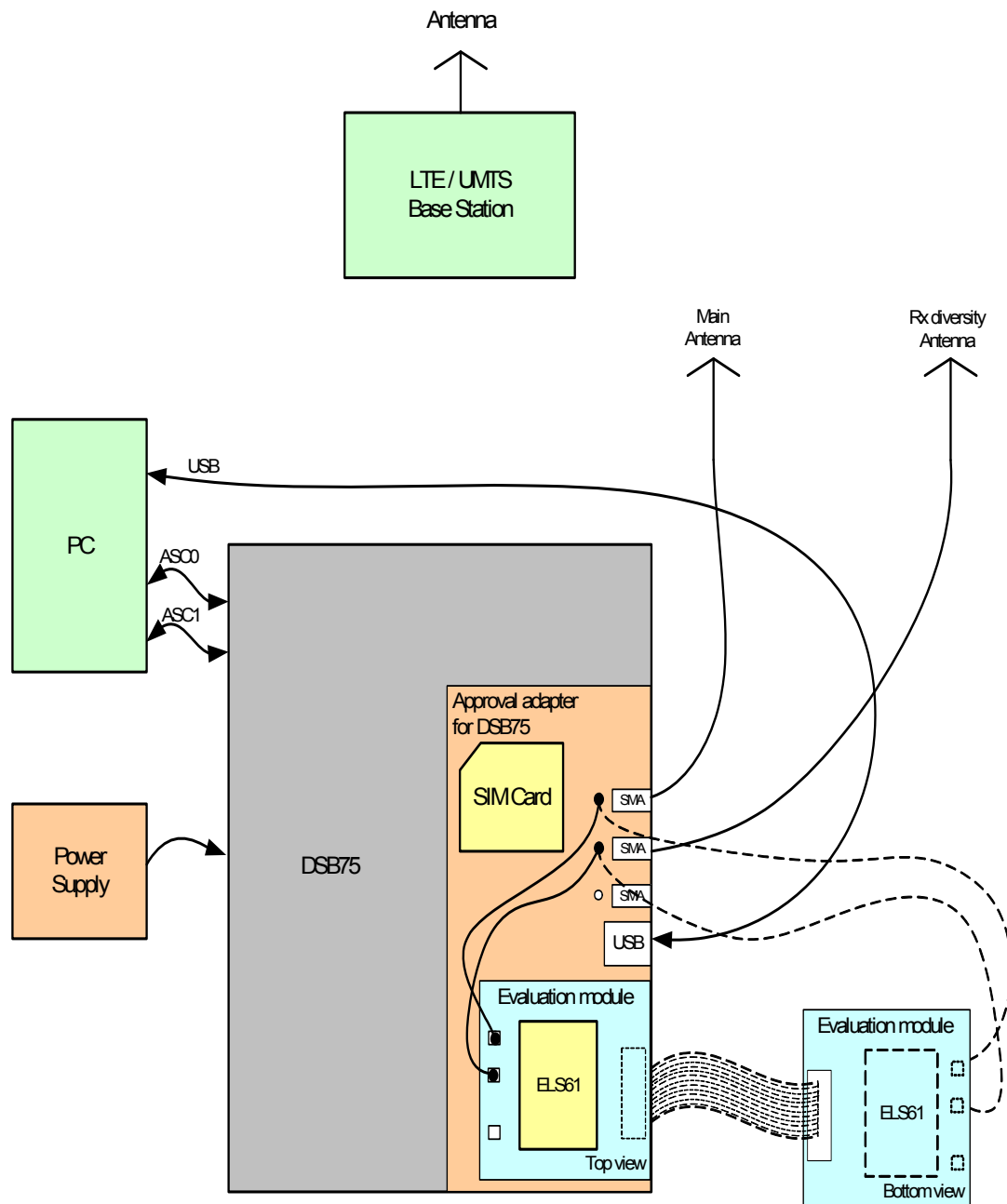


Figure 9: Reference equipment for Type Approval

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 UMTS test equipment instead of employing the SMA antenna connectors on the ELS61-US-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

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

FCC Identifier: QIPELS61-US

Industry Canada Certification Number: 7830A-ELS61US

Granted to Gemalto M2M GmbH

Manufacturers of mobile or fixed devices incorporating ELS61-US modules are authorized to use the FCC Grants and Industry Canada Certificates of the ELS61-US 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: QIPELS61-US", and accordingly "Contains IC: 7830A-ELS61US". 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 limit 2.15 dBi for 700MHz, 850MHz, 1700MHz and 1900MHz.

IMPORTANT:

Manufacturers of portable applications incorporating ELS61-US 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 ELS61-US 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.

Notes (IC):

(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 Industry Canada (IC) 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 IC 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'Industry Canada (IC). 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'IC 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

New document: "Cinterion® ELS61-US Hardware Interface Overview" Version 00.281

Chapter	What is new
--	Initial document setup.

6.2 Related Documents

- [1] ELS61-US AT Command Set
- [2] ELS61-US 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 ELS61-US
B	Thermistor Constant
BER	Bit Error Rate
BIP	Bearer Independent Protocol
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)
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, UMTS application)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EIRP	Equivalent Isotropic Radiated Power
EMC	Electromagnetic Compatibility
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard

6.3 Terms and Abbreviations

Abbreviation	Description
FCC	Federal Communications Commission (U.S.)
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GPIO	General Purpose Input/Output
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
kbits	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 (UMTS 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
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

6.3 Terms and Abbreviations

Abbreviation	Description
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 Accoustic 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. UMTS 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 ELS61-US. 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 11: List of parts and accessories

Description	Supplier	Ordering information
ELS61-US	Gemalto M2M	Standard module Gemalto M2M IMEI: Packaging unit (ordering) number: L30960-N4401-A100 Module label number: S30960-S4401-A100-1
ELS61-US Evaluation Module	Gemalto M2M	Ordering number: L30960-N4400-A100 (ELS61-US)
DSB75 Evaluation Kit	Gemalto M2M	Ordering number: L36880-N8811-A100
DSB Mini Compact Evaluation Board	Gemalto M2M	Ordering number: L30960-N0030-A100
Starter Kit B80	Gemalto M2M	Ordering Number L30960-N0040-A100
Multi-Adapter R1 for mounting ELS61-US evaluation modules onto DSB75	Gemalto M2M	Ordering number: L30960-N0010-A100
Approval adapter for mounting ELS61-US evaluation modules onto DSB75	Gemalto M2M	Ordering number: L30960-N2301-A100
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
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

Gemalto (Euronext NL0000400653 GTO) is the world leader in digital security with 2014 annual revenues of €2.5 billion and blue-chip customers in over 180 countries. Our 14,000 employees operate out of 99 offices, 34 personalization and data centers, and 24 research and software development centers located in 46 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.

Gemalto M2M GmbH
St.-Martin-Str. 60
81541 Munich
Germany