Cinterion® PLAS9-X

Hardware Interface Overview

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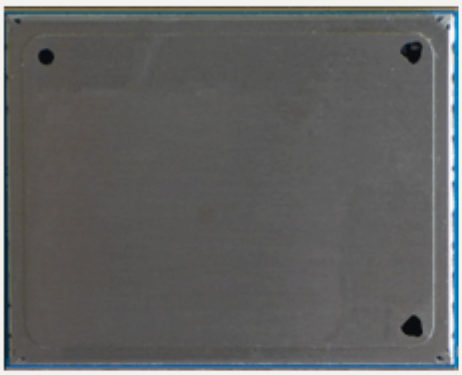

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1 Introduction

This document[1] describes the hardware of the Cinterion® PLAS9-X 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
General	
Frequency bands	GSM/GPRS/EDGE: Quad band, 850/900/1800/1900MHz UMTS/HSPA+: Triple band, 850 (BdV), 1700 (BdIV), 1900 (BdII) LTE (FDD): Six band, 700 (Bd12 <MFBI Bd17>, Bd13, Bd29 <supplementary downlink>), 850 (Bd5), 1700 (Bd4), 1900 (Bd2)
GSM class	Small MS
Output power (according to Release 99)	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 Class E2 (+27dBm ± 3dB) for GSM 850 8-PSK Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1900 8-PSK Class 3 (+24dBm +1/-3dB) for UMTS 1900,WCDMA FDD BdII Class 3 (+24dBm +1/-3dB) for UMTS 1700, WCDMA FDD BdIV Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdV
Output power (according to Release 8)	LTE (FDD): Class 3 (+23dBm +-2dB) for LTE 700, LTE FDD Bd12 <MFBI Bd17> Class 3 (+23dBm +-2dB) for LTE 700, LTE FDD Bd13 Class 3 (+23dBm +-2dB) for LTE 850, LTE FDD Bd5 Class 3 (+23dBm +-2dB) for LTE 1700, LTE FDD Bd4 Class 3 (+23dBm +-2dB) for LTE1900, LTE FDD Bd2
Power supply	$3.3V \leq V_{BATT+} \leq 4.2V$
Operating temperature (board temperature)	Normal operation: -30°C to +85°C Extended operation: -40°C to +95°C
Physical	Dimensions: 40mm x 32mm x 2.8mm Weight: approx. 6.5g
RoHS	All hardware components fully compliant with EU RoHS Directive

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.

Feature	Implementation
LTE features	
3GPP Release 10	Downlink carrier aggregation (CA) to increase bandwidth, and thereby increase bitrate: • Maximum aggregated bandwidth: 40MHz • Maximum number of component carriers: 2 • Inter-band FDD, non-contiguous • Intra-band FDD, contiguous, non-contiguous • Supported inter-band CA configurations: CA_2A-5A (with bandwidth combination set 0), CA_2A-12A (with bandwidth combination sets 0 and 1), CA_2A-29A (with bandwidth combination sets 0, 1 and 2), CA_4A-5A (with bandwidth combination sets 0 and 1), CA_4A-12A (with bandwidth combination sets 0, 1, 2, 3 and 4), CA_4A-29A (with bandwidth combination sets 0, 1 and 2) • Supported intra-band CA configurations: CA_4A-4A (with bandwidth combination set 0) CAT 6 supported DL 300Mbps, UL 50Mbps 2x2 MIMO in DL direction
HSPA features	
3GPP Release 9	UE CAT. 14, 24 DC-HSPA+ – DL 42Mbps HSUPA – UL 5.76Mbps Compressed mode (CM) supported according to 3GPP TS25.212
UMTS features	
3GPP Release 9	PS data rate – 384 kbps DL / 384 kbps UL
GSM / GPRS / EGPRS features	
Data transfer	GPRS: • Multislot Class 12 • 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 • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B
SMS	Point-to-point MT and MO, Cell broadcast, Text and PDU mode
Software	
AT commands	Hayes, 3GPP TS 27.007 and 27.005, and proprietary Gemalto M2M commands

Feature	Implementation
Firmware update	Generic update from host application over USB 2.0 High Speed device interface
Interfaces	
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.
Antenna	50Ω. GSM/UMTS/LTE main antenna, UMTS/LTE Diversity/MIMO antenna
USB	USB 2.0 High Speed (480Mbit/s) device interface or USB 3.0 Super Speed (5Gbit/s) device interface
UICC interface	2 UICC interfaces (switchable) Supported chip cards: UICC/SIM/USIM 3V, 1.8V
RING0	Signal line to indicate URCs.
Power on/off, Reset	
Power on/off	Switch-on by hardware signal IGT Switch-off by AT command (AT^SMSO) or IGT (option) Automatic switch-off in case of critical temperature or voltage conditions
Reset	Orderly shutdown and reset by AT command
Emergency-off	Emergency-off by hardware signal EMERG_OFF
Special Features	
Antenna	SAIC (Single Antenna Interference Cancellation) / DARP (Downlink Advanced Receiver Performance) Rx Diversity (receiver type 3i - 64-QAM) / MIMO
GPIO	10 I/O pins of the application interface programmable as GPIO. Programming is done via AT commands.
ADC inputs	Analog-to-Digital Converter with two unbalanced analog inputs for (external) antenna diagnosis
Evaluation kit	
Evaluation module	PLAS9-X module soldered onto a dedicated PCB that can be connected to the ALAS6A-DSB75 adapter in order to be mounted onto the DSB75.
ALAS6A-DSB75 adapter	A special adapter required to connect the PLAS9-X evaluation module to the DSB75.
DSB75	DSB75 Development Support Board designed to test and type approve Gemalto M2M modules and provide a sample configuration for application engineering.

1.2 PLAS9-X System Overview

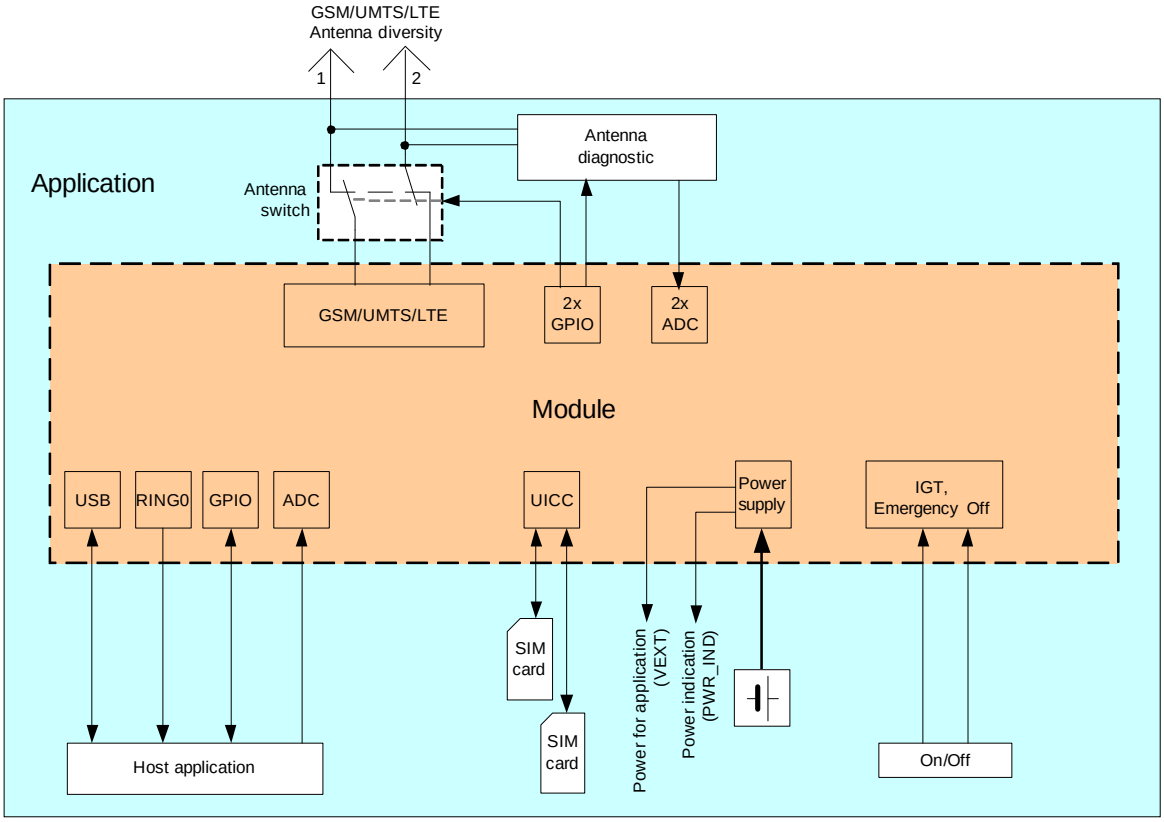


Figure 1: PLAS9-X system overview

2 Interface Characteristics

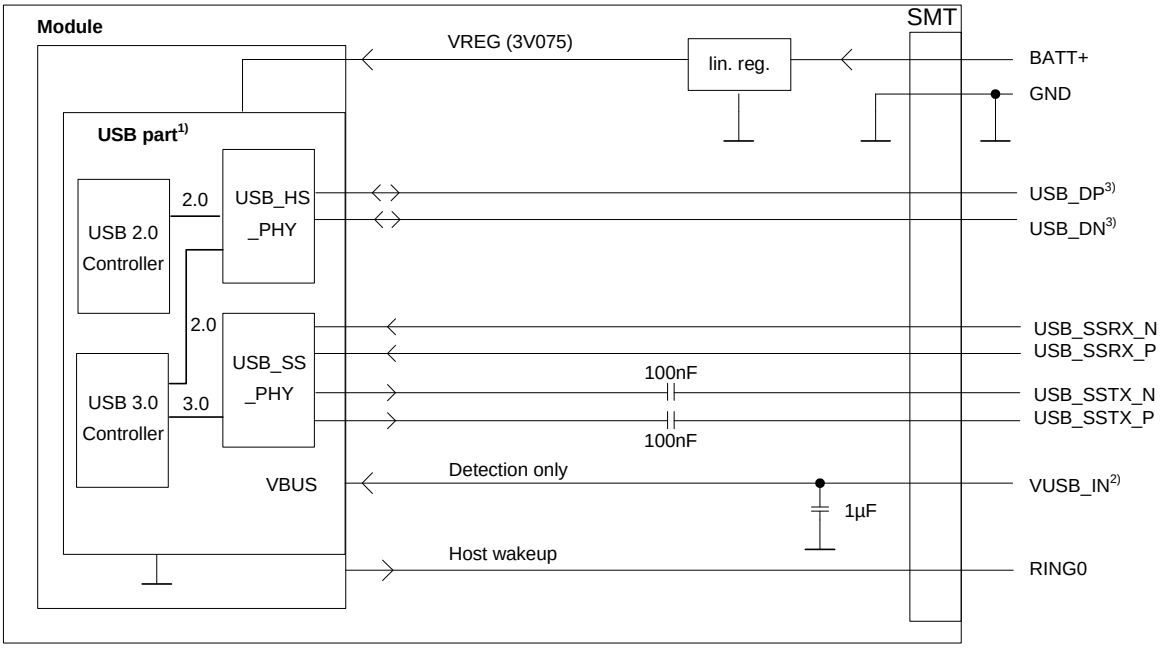
PLAS9-X is equipped with an SMT application interface that connects to the external application. The SMT application interface incorporates the various application interfaces as well as the RF antenna interface.

2.1 Application Interface

2.1.1 USB Interface

PLAS9-X supports a USB 3.0 Super Speed (5Gbps) device interface, and alternatively a USB 2.0 device interface that is High Speed and Full Speed compatible. The USB interface is primarily intended for use as command and data interface, and for downloading firmware[1].

The USB host is responsible for supplying the VUSB_IN line. This line is for voltage detection only. The USB part (driver and transceiver) is supplied by means of BATT+. This is because PLAS9-X is designed as a self-powered device compliant with the “Universal Serial Bus Specification Revision 3.0”[2].



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

2) Since VUSB_IN is used for detection only it is recommended not to add any further blocking capacitors on the VUSB_IN line.

3) 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 3.0 or 2.0 compatible connector and cable or hardware design is required. Furthermore, the USB modem driver distributed with PLAS9-X needs to be installed.

1. **Note:** For firmware download, the module enumerates new as a USB 2.0 device. Also, it is not possible to use the USB 2.0 High Speed device mode and the USB 3.0 Super speed device mode simultaneously.
2. The specification is ready for download on http://www.usb.org/developers/docs/

2.1.2 UICC/SIM/USIM Interface

PLAS9-X has two UICC/SIM/USIM interfaces compatible with the 3GPP 31.102 and ETSI 102 221. These are 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 each of the two SIM interfaces.

The UICC/SIM/USIM interface supports 3V and 1.8V SIM cards.

The CCINx signal serves to detect whether a tray (with SIM card) is present in the card holder. Using the CCINx 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 PLAS9-X and is part of the Gemalto M2M reference equipment submitted for type approval. See Chapter 7 for Molex ordering numbers.

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

Signal	Description
GND	Ground connection for SIM interfaces. Optionally a separate SIM ground line using e.g., pad P12, may be used to improve EMC.
CCCLK1 CCCLK2	Chipcard clock lines for 1st and 2nd SIM interface.
CCVCC1 CCVCC2	SIM supply voltage lines for 1st and 2nd SIM interface.
CCIO1 CCIO2	Serial data lines for 1st and 2nd SIM interface, input and output.
CCRST1 CCRST2	Chipcard reset lines for 1st and 2nd SIM interface.
CCIN1 CCIN2	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 CCINx signal is active low. The CCINx signal is mandatory for applications that allow the user to remove the SIM card during operation. The CCINx 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 PLAS9-X.

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 PLAS9-X.

By default, only the 1st SIM interface is available and can be used. Using the AT command AT^SCFG="SIM/CS" it is possible to switch between the two SIM interfaces. Command settings are non-volatile - for details see [1].

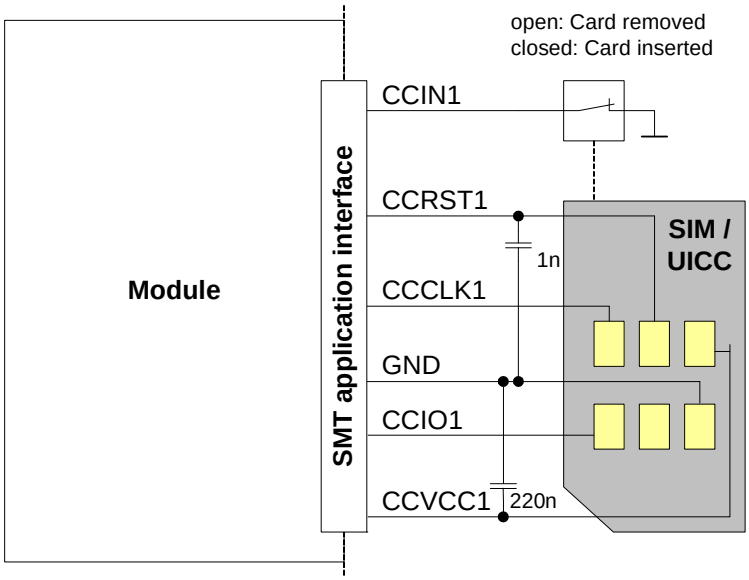


Figure 3: First UICC/SIM/USIM interface

The total cable length between the SMT application interface pads on PLAS9-X 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 CCCLKx signal to the CCIOx signal be careful that both lines are not placed closely next to each other. A useful approach is using the GND line to shield the CCIOx line from the CCCLKx line.

Note: Figure 3 shows how to connect a SIM card holder to the first SIM interface. With the second SIM interface some internally integrated components on the SIM circuit will have to be externally integrated as shown for the second SIM interface in Figure 4. The external components at CCIN2 should be populated as close as possible to the signal‘s SMT pad

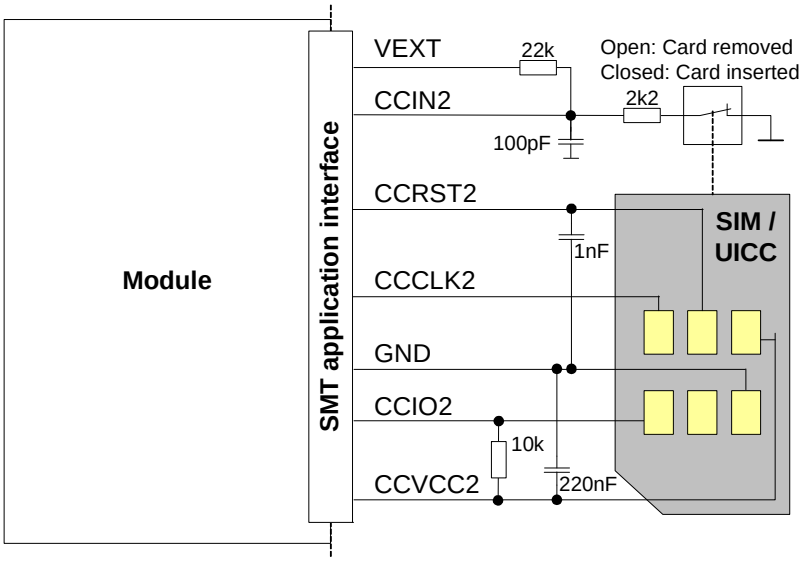


Figure 4: Second UICC/SIM/USIM interface

2.1.3 Analog-to-Digital Converter (ADC)

PLAS9-X provides two unbalanced ADC input lines: ADC1_IN and ADC2_IN. They can be used to measure two independent, externally connected DC voltages in the range of 0.05V to V_{BATT+}.

2.1.4 GPIO Interface

PLAS9-X has 10 GPIOs for external hardware devices. Each GPIO can be configured for use as input or output. All settings are AT command controlled.

GPIO1...GPIO10 may be configured as low current indicator signal (see Section 2.1.5.4), or may be set as remote host wakeup lines (see Section 2.1.5.3).

2.1.5 Control Signals

2.1.5.1 PWR_IND Signal

PWR_IND notifies the on/off state of the module. High state of PWR_IND indicates that the module is switched off. The state of PWR_IND immediately changes to low when IGT is pulled low. For state detection an external pull-up resistor is required.

2.1.5.2 Behavior of the RING0 Line

The RING0 line serves to indicate URCs (Unsolicited Result Code).

The RING0 line behavior and usage can be configured by AT command. For details see [1]: AT^SCFG.

2.1.5.3 Remote Wakeup

If no call, data or message transfer is in progress, the external host application may shut down its own module interfaces or other components in order to save power. If a call, data, or other request (URC) arrives, the external application can be notified of this event and be woken up again by a state transition of a configurable remote wakeup line. Available as remote wakeup lines are all GPIO signals as well as the RING0 line. Please refer to [1]: AT^SCFG: "RemoteWakeUp/..." for details on how to configure these lines for defined wakeup events on specified device interfaces.

2.1.5.4 Low Current Indicator

A low current indication is optionally available over a GPIO line. By default, low current indication is disabled and the GPIO pads can be configured and employed as usual.

For a GPIO pad to work as a low current indicator the feature has to be enabled by AT command (see [1]: AT^SCFG: MEopMode/PowerMgmt/LCI). By default, the GPIO6 pad is configured as LCI_IND signal.

If enabled, the GPIOx/LCI_IND signal is high when the module is sleeping.

2.2 GSM/UMTS/LTE Antenna Interface

The PLAS9-X GSM/UMTS/LTE antenna interface comprises a GSM/UMTS/LTE main antenna as well as a UMTS/LTE Rx diversity/MIMO antenna to improve signal reliability and quality[1]. The interface has an impedance of 50Ω. PLAS9-X is capable of sustaining a total mismatch at the antenna interface without any damage, even when transmitting at maximum RF power.

The external antennas must be matched properly to achieve best performance regarding radiated power, modulation accuracy and harmonic suppression. Matching networks are not included on the PLAS9-X PCB and should be placed in the host application, if the antenna does not have an impedance of 50Ω.

Regarding the return loss PLAS9-X provides the following values in the active band:

Table 2: Return loss in the active band

State of module	Return loss of module	Recommended return loss of application
Receive	≥ 8dB	≥ 12dB
Transmit	not applicable	≥ 12dB
Idle	≤ 5dB	not applicable

1. By delivery default the UMTS/LTE Rx diversity/MIMO 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.

2.2.1 Antenna Installation

The antenna is connected by soldering the antenna pads (ANT_MAIN; ANT_DRX_MIMO) and their neighboring ground pads directly to the application's PCB.

The distance between the antenna pads and their neighboring GND pads has been optimized for best possible impedance. To prevent mismatch, special attention should be paid to these pads on the application' PCB.The wiring of the antenna connection, starting from the antenna pad to the application's antenna must result in a 50Ω line impedance. Line width and distance to the GND plane need to be optimized with regard to the PCB's layer stack. Related instructions are given in Section 2.2.2.

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. Please see Section 2.2.2 for instructions of how to design the antenna connection in order to achieve the required 50Ω line impedance.

For type approval purposes (i.e., FCC KDB 996369 related to modular approval requirements), an external application must connect the RF signal in one of the following ways:

- Via 50Ω coaxial antenna connector (common connectors are U-FL or SMA) placed as close as possible to the module's antenna pad.
- By soldering the antenna to the antenna connection line on the application's PCB (without the use of any connector) as close as possible to the module's antenna pad.
- By routing the application PCB's antenna to the module's antenna pad in the shortest possible way.

2.2.2 RF Line Routing Design

2.2.2.1 Line Arrangement Instructions

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

Embedded Stripline
This below figure shows line arrangement examples for embedded stripline.

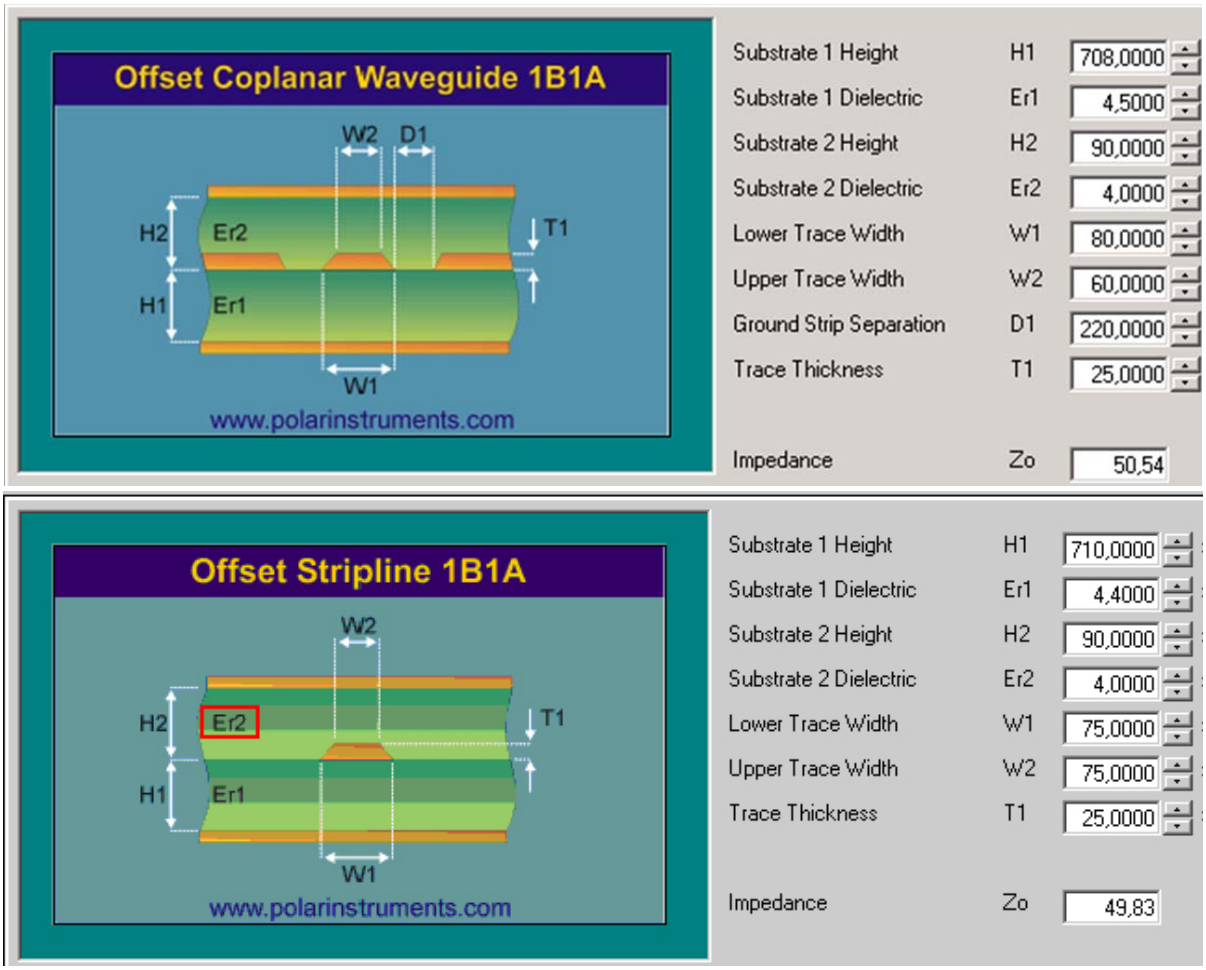


Figure 5: Embedded Stripline line arrangement

Micro-Stripline

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

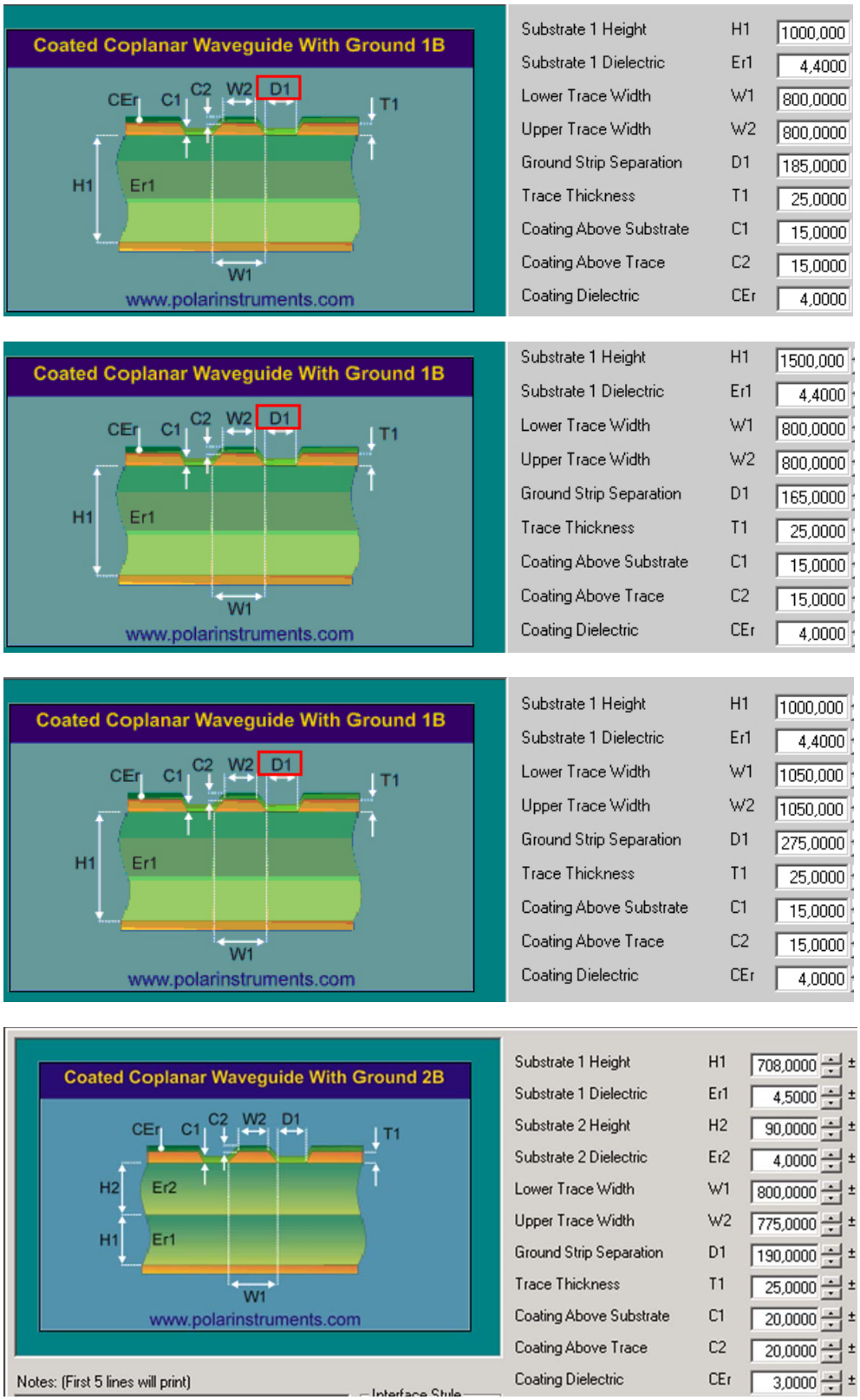


Figure 6: Micro-Stripline line arrangement samples

2.2.2.2 Routing Examples

Interface to RF Connector

Figure 7 shows a sample connection of a module‘s antenna pad at the bottom layer of the module PCB with an application PCB‘s coaxial antenna connector. Line impedance depends on line width, but also on other PCB characteristics like dielectric, height and layer gap. The sample stripline width of 0.40mm is recommended for an application with a PCB layer stack resembling the one of the PLAS9-X evaluation board. For different layer stacks the stripline width will have to follow stripline routing rules, avoiding 90 degree corners and using the shortest distance to the PCB’s coaxial antenna connector.

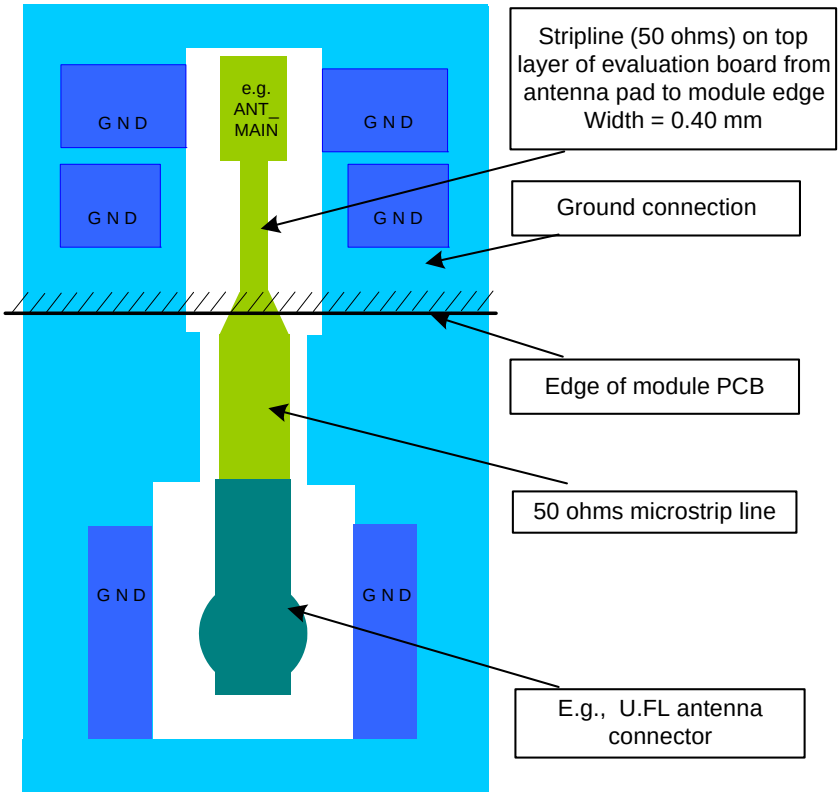


Figure 7: Routing to application‘s RF connector

Figure 8 shows a further sample connection of an evaluation module's antenna pad at the bottom layer of the PLAS9-X evaluation module PCB with the PCB's coaxial antenna connector. The PLAS9-X evaluation module is part of the reference equipment used by Gemalto M2M for type approval (see also Section 5.3).

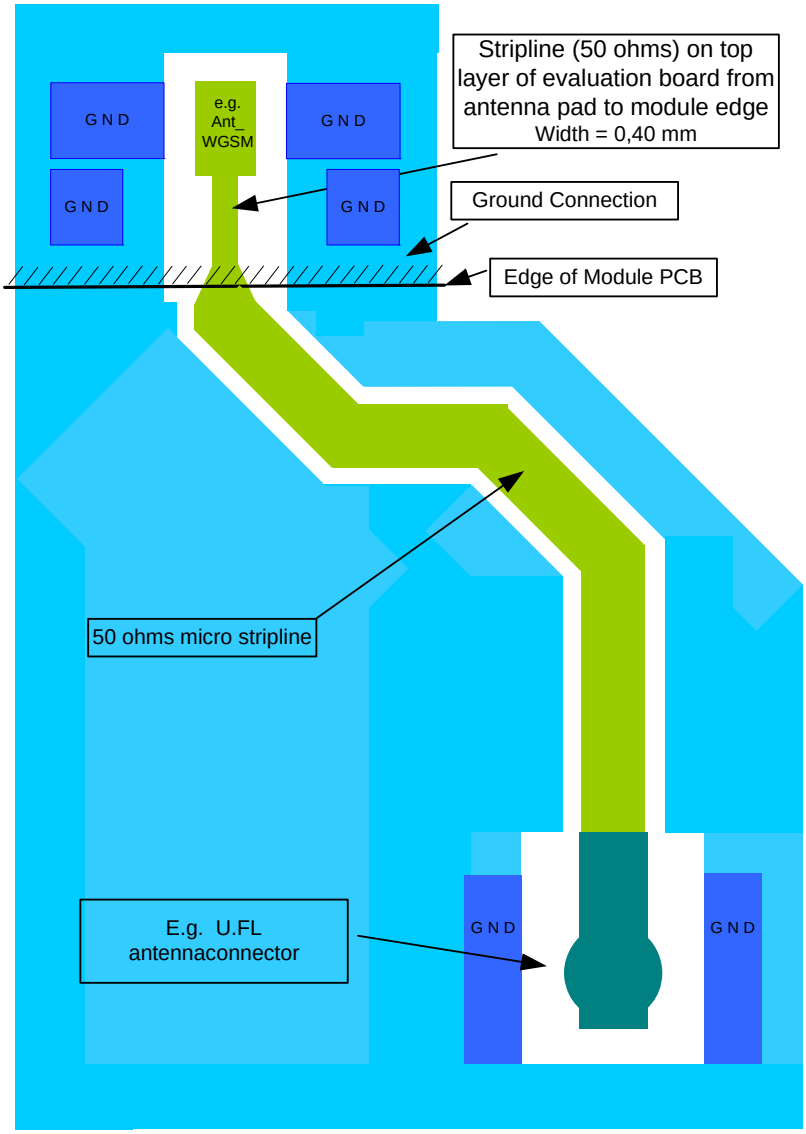


Figure 8: Routing to PLAS9-X evaluation module's RF connector

2.3 Sample Application

Figure 9 shows a typical example of how to integrate an PLAS9-X module with an application.

The PWR_IND line is an open collector that needs an external pull-up resistor which connects to the voltage supply VCC µC of the microcontroller. Low state of the open collector pulls the PWR_IND signal low and indicates that the PLAS9-X module is active, high level notifies the Power Down mode.

If the module is in Power Down mode avoid current flowing from any other source into the module circuit, for example reverse current from high state external control lines. Therefore, the controlling application must be designed to prevent reverse flow.

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.

Some LGA pads are connected to clocks or high speed data streams that might interfere with the module's antenna. The RF receiver would then be blocked at certain frequencies (self interference). The external application's PCB tracks connected to these pads should therefore be well shielded or kept away from the antenna. This applies especially to the USB and UICC/SIM interfaces.

Disclaimer:
No warranty, either stated or implied, is provided on the sample schematic diagram shown in Figure 9 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 PLAS9-X modules.

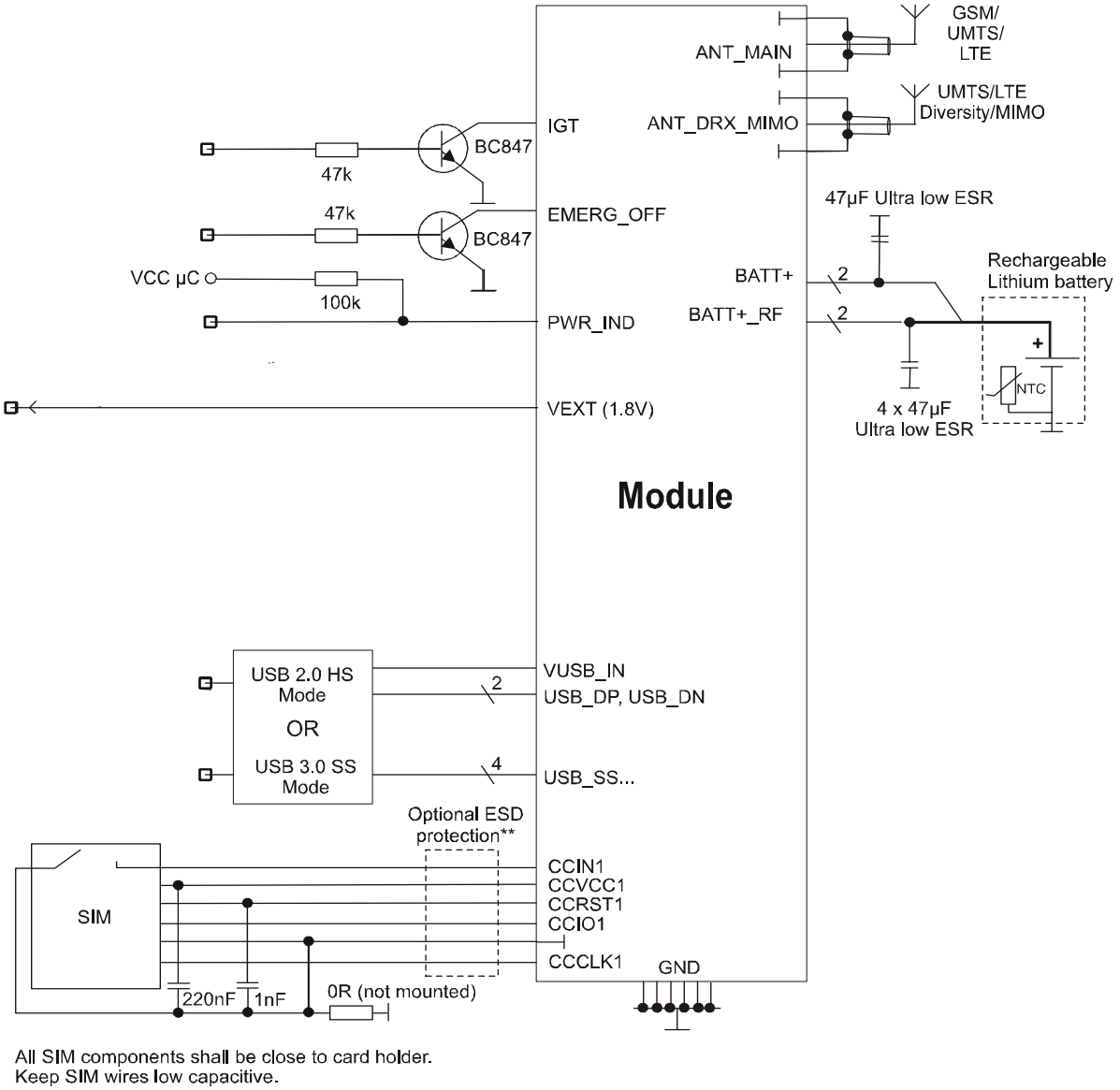


Figure 9: PLAS9-X sample application

3 Operating Characteristics

3.1 Operating Modes

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

Table 3: Overview of operating modes

Mode	Function	
Normal operation	GSM / GPRS / UMTS / HSPA / LTE SLEEP	Power saving set automatically when no call is in progress and the USB connection is detached.
	GSM / GPRS / UMTS / HSPA / LTE IDLE	Power saving disabled or an USB connection active, but no data transfer in progress.
	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 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 AT^SMSO command. Software is not active. Interfaces are not accessible. Operating voltage (connected to BATT+) remains applied. Only a voltage regulator is active for powering the RTC, as long as operating voltage applied at BATT+ does not drop below approx. 1.4V.	
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

PLAS9-X needs to be connected to a power supply at the SMT application interface - 4 lines BATT+, and GND. There are two separate voltage domains for BATT+:
- BATT+_RF with 2 lines for the RF power amplifier supply
- BATT+ with 2 lines for the general power management.

The main power supply from an external application has to be a single voltage source and has to be expanded to two sub paths (star structure). Each voltage domain must be decoupled by application with low ESR capacitors (≥ 47µF MLCC @ BATT+; ≥ 4x47µF MLCC @ BATT+_RF) as close as possible to LGA pads. Figure 10 shows a sample circuit for decoupling capacitors for BATT+.

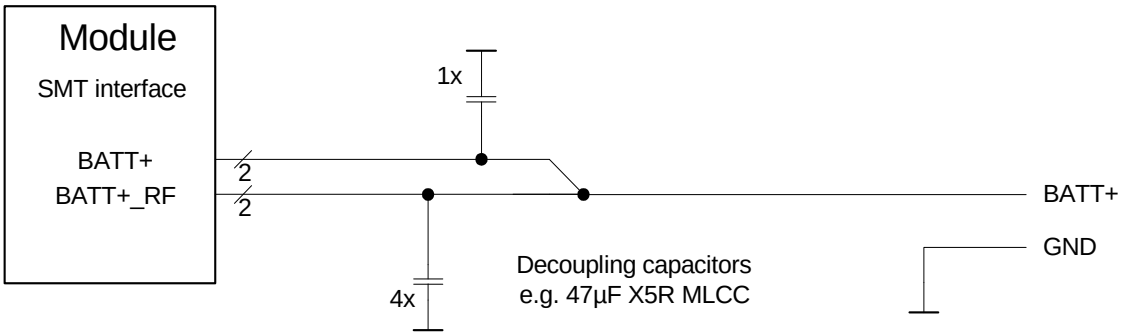


Figure 10: Decoupling capacitor(s) for BATT+

The power supply of PLAS9-X must be able to provide the peak current during the uplink transmission.

All key functions for supplying power to the device are handled by the power management IC. It provides the following features:
- Stabilizes the supply voltages for the baseband using switching regulators and low drop linear voltage regulators.
- Switches the module's power voltages for the power-up and -down procedures.
- Delivers, across the VEXT line, a regulated voltage for an external application.
- LDO to provide SIM power supply.

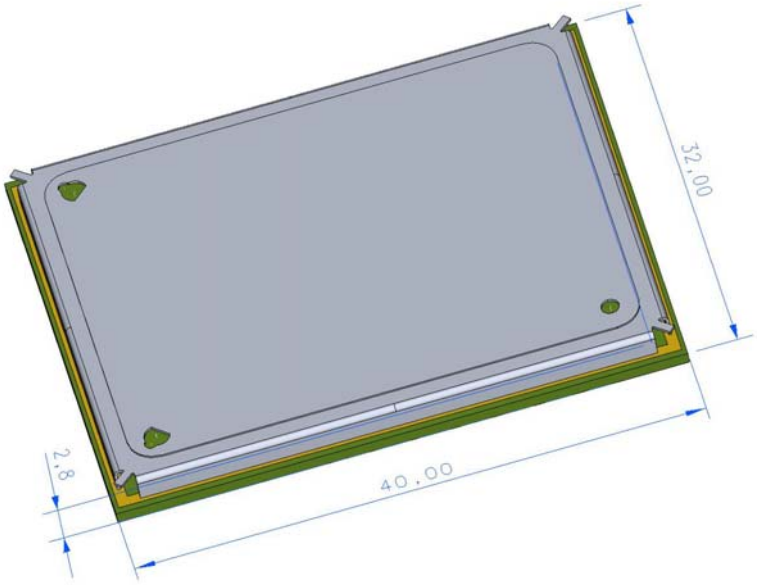
4 Mechanical Dimensions

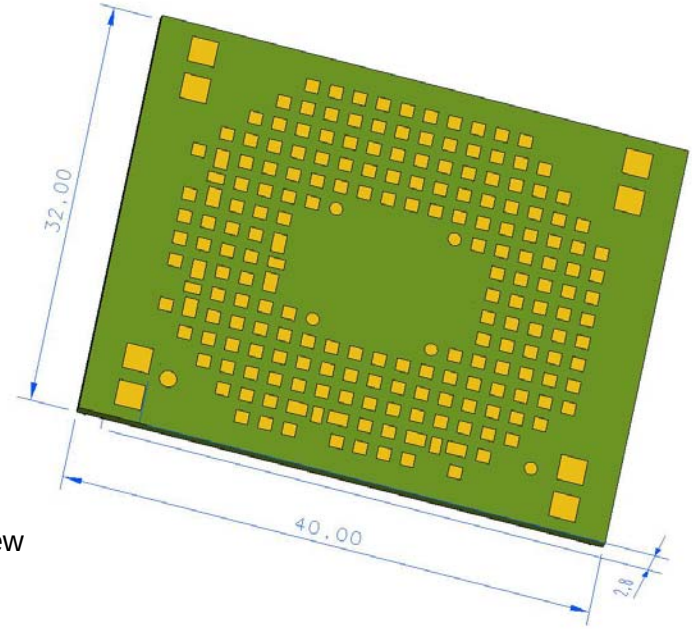
4.1 Mechanical Dimensions of PLAS9-X

Figure 11 shows a 3D view[1] of PLAS9-X and provides an overview of the board's mechanical dimensions. For further details see Figure 12.

Length: 40mm
Width: 32mm
Height: 2.8mm

Top view





Bottom view

Figure 11: PLAS9-X – top and bottom view

1. The coloring of the 3D view does not reflect the module's real color.

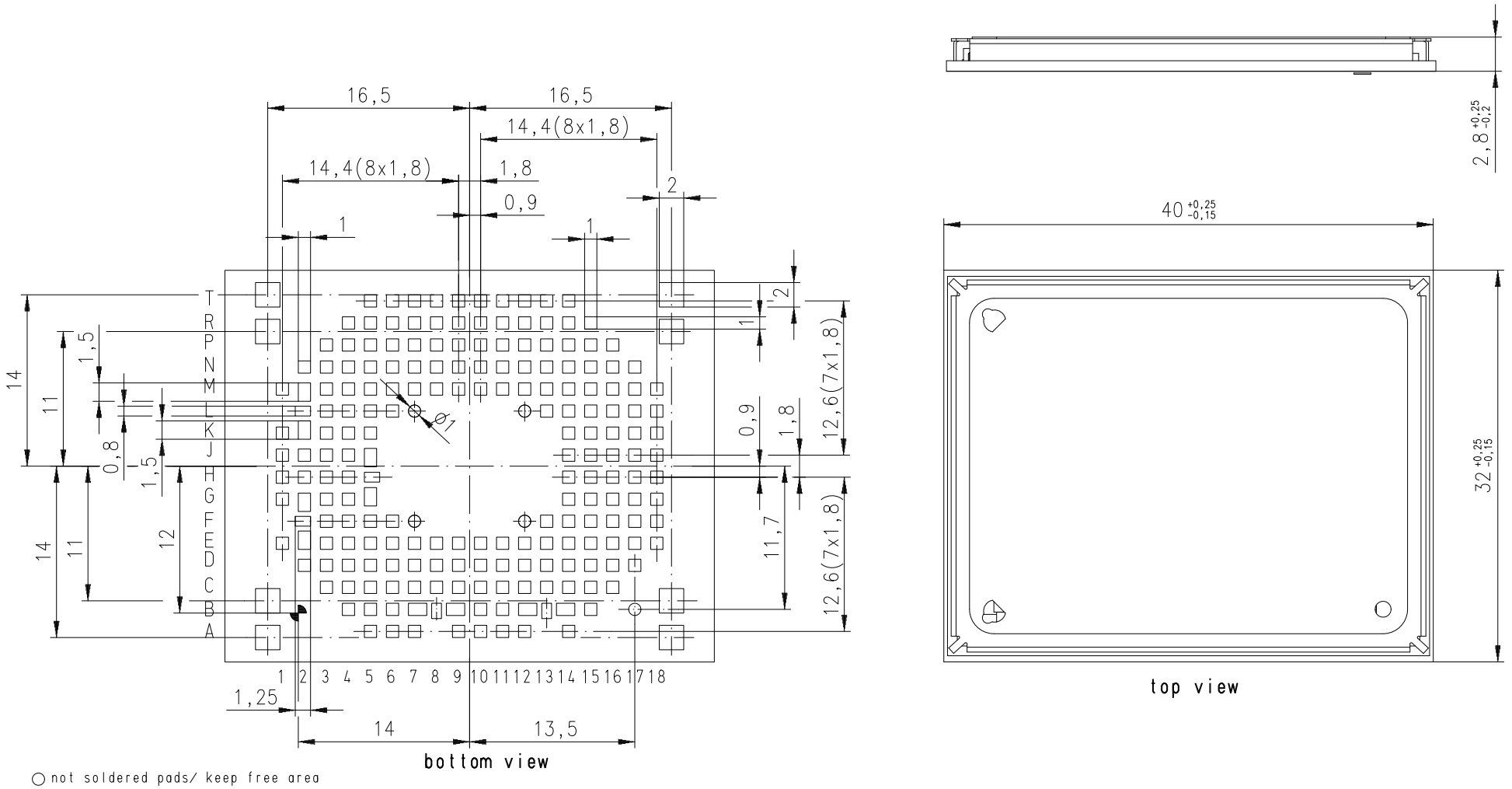


Figure 12: Dimensions of PLAS9-X (all dimensions in mm)

5 Regulatory and Type Approval Information

Note that some regulatory and type approval information is still to be defined.

5.1 Directives and Standards

PLAS9-X has been 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 "PLAS9-X Hardware Interface Description".[1]

Table 4: Directives

2002/95/EC (RoHS 1) 2011/65/EC (RoHS 2)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

Table 5: Standards of North American type approval

CFR Title 47	Code of Federal Regulations, Part 22, Part 24; 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 V5.32	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS132, RSS133, RSS139	Canadian Standard

Table 6: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

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.

Table 7: 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 Hardware Interface Description. Please see Table 8 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.

Table 8: 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 *might exceed* 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 PLAS9-X 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

IMPORTANT:
Manufacturers of portable applications based on PLAS9-X 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.

5.3 Reference Equipment for Type Approval

The Gemalto M2M general reference setup submitted to type approve PLAS9-X is shown in the figure below: Figure 13 illustrates the setup for general tests and evaluation purposes. The evaluation module can be plugged directly onto the ALAS6A-DSB75 adapter. The GSM/UMTS/ LTE test equipment is still connected via SMA connectors on the ALAS6A-DSB75 adapter. The PC is connected via USB interface.

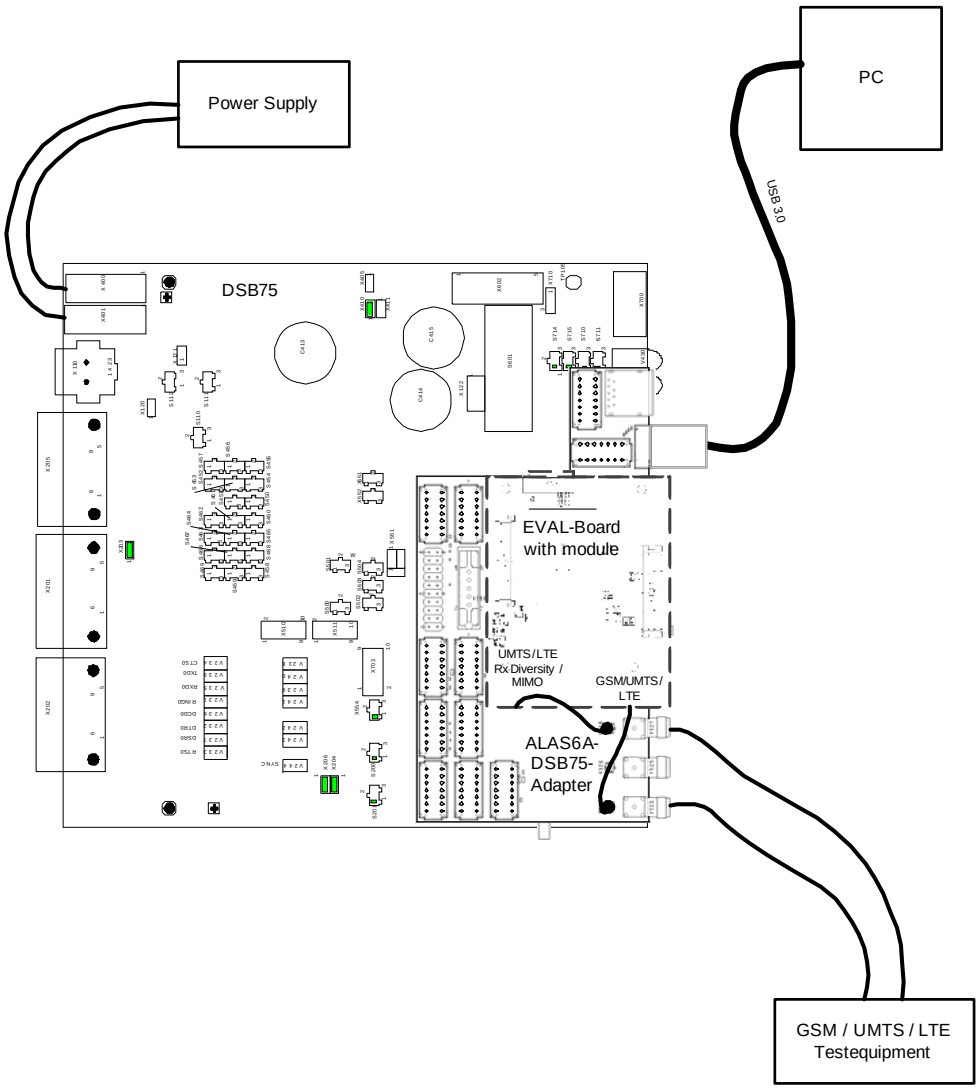


Figure 13: Reference equipment for type approval

Please note that for EMC and RF performance tests, slightly different reference equipment configurations are used. If necessary, please contact Gemalto for further details.

5.4 Compliance with FCC and IC Rules and Regulations

The Equipment Authorization Certification for the Gemalto M2M modules reference application described in Section 5.3 will be registered under the following identifiers:

- PLAS9-X:
  FCC Identifier QIPPLAS9-X
  Industry Canada Certification Number: 7830A-PLAS9X
  Granted to Gemalto M2M GmbH

Manufacturers of mobile or fixed devices incorporating PLAS9-X modules are authorized to use the FCC Grants and Industry Canada Certificates of the PLAS9-X modules for their own final products according to the conditions referenced in these documents. In this case, the FCC label of the module shall be visible from the outside, or the host device shall bear a second label stating "Contains FCC ID: QIPPLAS9-X" and accordingly “Contains IC: 7830A-PLAS9X“. The integration is limited to fixed or mobile categorized host devices, where a separation distance between the antenna and any person of min. 20cm can be assured during normal operating conditions.

For mobile and fixed operation configurations the antenna gain, including cable loss, must not exceed the limits listed in the following Table 9 for FCC and IC.

Table 9: Antenna gain limits for FCC and IC (TBD.)

Maximum gain in operating band	FCC limit	IC limit	Unit
Band12, Band13, Band 29 700MHz (LTE)			dBi
Band 5, 850MHz (GSM/WCDMA/LTE)			dBi
Band 4, 1700MHz (WCDMA/LTE)			dBi
Band 2, 1900MHz (GSM/WCDMA/LTE)			dBi

IMPORTANT:
Manufacturers of portable applications incorporating PLAS9-X 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 license-exempt RSS standard(s). These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

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

If Canadian approval is requested for devices incorporating PLAS9-X 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

6.1 Revision History

New document: "Cinterion® PLAS9-X Hardware Interface Overview" Version **00.044**

Chapter	What is new
--	Initial document setup.

6.2 Related Documents

[1] PLAS9-X AT Command Set
[2] PLAS9-X Release Note
[3] Application Note 48: SMT Module Integration
[4] Universal Serial Bus Specification Revision 3.0
[5] Universal Serial Bus Specification Revision 2.0

6.3 Terms and Abbreviations

Abbreviation	Description
ANSI	American National Standards Institute
ARP	Antenna Reference Point
CA	Carrier Aggregation
CE	Conformité Européene (European Conformity)
CS	Coding Scheme
CS	Circuit Switched
CSD	Circuit Switched Data
DL	Download
dnu	Do not use
DRX	Discontinuous Reception
DSB	Development Support Board
DTX	Discontinuous Transmission
EDGE	Enhanced Data rates for GSM Evolution
EGSM	Extended GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard

Abbreviation	Description
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission (U.S.)
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HiZ	High Impedance
HSDPA	High Speed Downlink Packet Access
I/O	Input/Output
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LED	Light Emitting Diode
LGA	Land Grid Array
LTE	Long term evolution
MBB	Moisture barrier bag
Mbps	Mbits per second
MCS	Modulation and Coding Scheme
MFBI	Multiple Frequency Band Indicator
MIMO	Multiple Input Multiple Output
MLCC	Multi Layer Ceramic Capacitor
MO	Mobile Originated
MS	Mobile Station, also referred to as TE
MSL	Moisture Sensitivity Level
MT	Mobile Terminated
nc	Not connected
NTC	Negative Temperature Coefficient
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PD	Pull Down resistor
PDU	Protocol Data Unit
PS	Packet Switched
PSK	Phase Shift Keying
PU	Pull Up resistor
QAM	Quadrature Amplitude Modulation

Abbreviation	Description
R&TTE	Radio and Telecommunication Terminal Equipment
RF	Radio Frequency
rfu	Reserved for future use
ROPR	Radio Output Power Reduction
RTC	Real Time Clock
Rx	Receive Direction
SAR	Specific Absorption Rate
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SMD	Surface Mount Device
SMS	Short Message Service
SMT	Surface Mount Technology
SRAM	Static Random Access Memory
SRB	Signalling Radio Bearer
TE	Terminal Equipment
TPC	Transmit Power Control
TS	Technical Specification
Tx	Transmit Direction
UL	Upload
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
USB	Universal Serial Bus
UICC	USIM Integrated Circuit Card
USIM	UMTS Subscriber Identification Module
WCDMA	Wideband Code Division Multiple Access

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 PLAS9-X. 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.
	IMPORTANT! Cellular terminals or mobiles operate using radio signals and cellular networks. Because of this, connection cannot be guaranteed at all times under all conditions. Therefore, you should never rely solely upon any wireless device for essential communications, for example emergency calls. Remember, in order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may need to deactivate those features before you can make an emergency call. Some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

7 Appendix

7.1 List of Parts and Accessories

Table 10: List of parts and accessories

Description	Supplier	Ordering information
PLAS9-X	Gemalto M2M	Standard module Gemalto M2M IMEI: Packaging unit (ordering) number: L30960-N5130-B100 Module label number: L30960-N5130-B100-1[1]
PLAS9-X Evaluation module	Gemalto M2M	Ordering number: TBD. (PLAS9)
DSB75 Support Box	Gemalto M2M	Ordering number: L36880-N8811-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 11.
U.FL antenna connector	Molex or Hirose	Sales contacts are listed in Table 11 and Table 12.

1. Note: At the discretion of Gemalto M2M, module label information can either be laser engraved on the module's shielding or be printed on a label adhered to the module's shielding.

Table 11: Molex sales contacts (subject to change)

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

Table 12: Hirose sales contacts (subject to change)

Hirose Ltd. For further information please click: http://www.hirose.com	Hirose Electric (U.S.A.) Inc 2688 Westhills Court Simi Valley, CA 93065 U.S.A. Phone: +1-805-522-7958 Fax: +1-805-522-3217	Hirose Electric Europe B.V. German Branch: Herzog-Carl-Strasse 4 73760 Ostfildern Germany Phone: +49-711-456002-1 Fax: +49-711-456002-299 Email: info@hirose.de
Hirose Electric Europe B.V. UK Branch: First Floor, St. Andrews House, Caldecotte Lake Business Park, Milton Keynes MK7 8LE Great Britain Phone: +44-1908-369060 Fax: +44-1908-369078	Hirose Electric Co., Ltd. 5-23, Osaki 5 Chome, Shinagawa-Ku Tokyo 141 Japan Phone: +81-03-3491-9741 Fax: +81-03-3493-2933	Hirose Electric Europe B.V. Hogehillweg 8 1101 CC Amsterdam Z-O Netherlands Phone: +31-20-6557-460 Fax: +31-20-6557-469

About Gemalto

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

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

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

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

For more information please visit
www.gemalto.com/m2m, www.facebook.com/gemalto, or Follow@gemaltoIoT on Twitter.

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