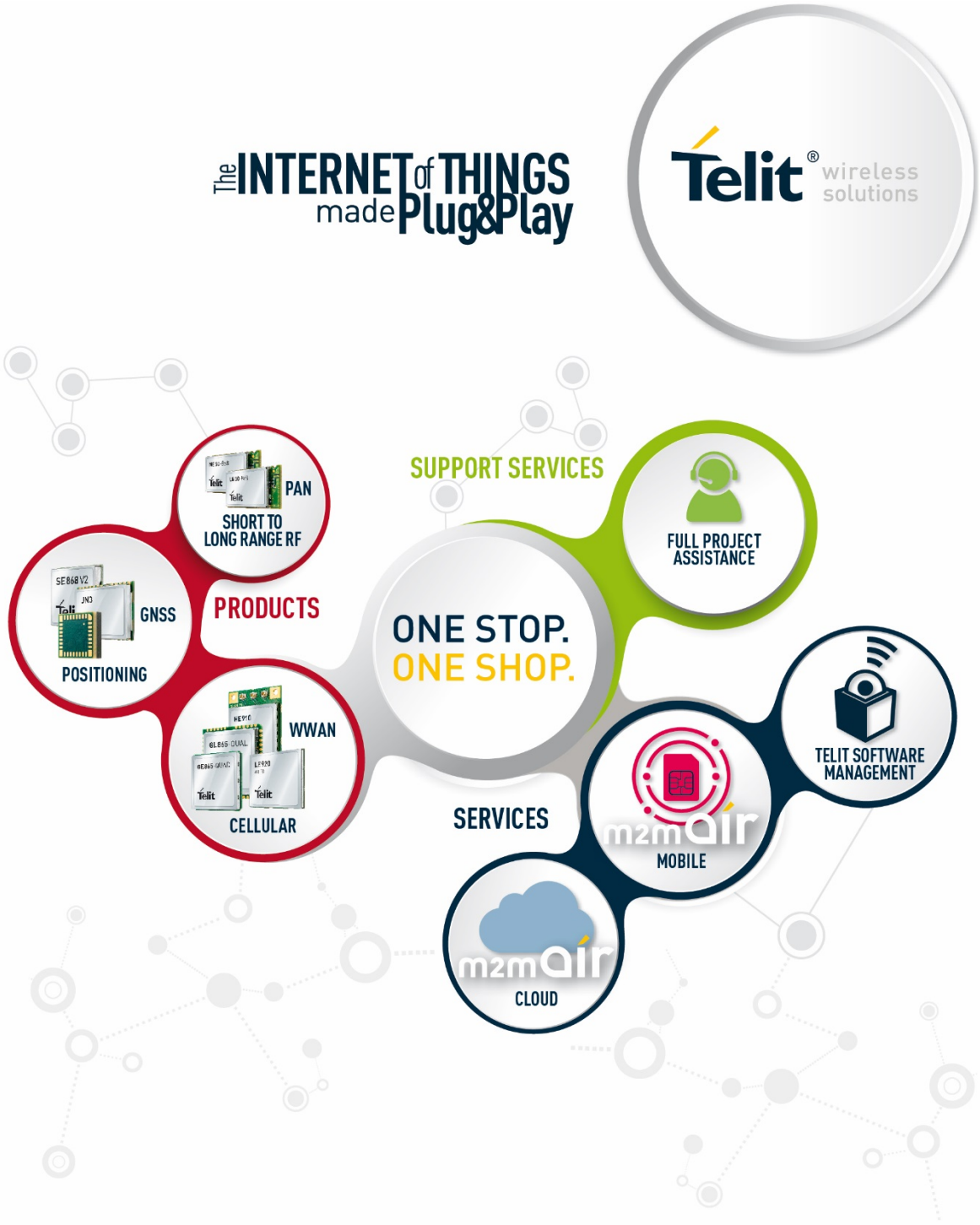

xE910 Global Form Factor Application Note

APPLICABILITY TABLE

PRODUCTS

- GE910-QUAD
- GE910-QUAD V3
- UE910 V2 SERIES
- UE910-EU V2 AUTO
- UE910 SERIES
- HE910 SERIES
- CE910-DUAL
- CE910-SC
- DE910-DUAL
- DE910-SC
- LE910 SERIES
- LE910 V2 SERIES

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CONTENTS

1 INTRODUCTION

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1.1 Scope

The aim of this document is the description of some hardware solutions useful for developing an application compatible with the products: Telit HE910, Telit DE910, Telit GE910, Telit GE910-V3, Telit CE910, Telit LE910, Telit LE910-V2 and Telit UE910-V2, and to highlight the minor differences between the above mentioned products.

1.2 Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:
TS-EMEA@telit.com
TS-AMERICAS@telit.com
TS-APAC@telit.com

Alternatively, use:
http://www.telit.com/support

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:
http://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.
Telit appreciates feedback from the users of our information.

1.3 Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.4 Related Documents

The following is a list of applicable documents downloadable from the Download Zone section of Telit's website http://www.telit.com

- GE910 Telit AT Commands Reference Guide (80000ST10025A)
- Telit 3G Modules AT Commands Reference Guide (80378ST10091A)
- DE910 AT Commands Reference Guide (30392NT110791A)
- CE910 AT Commands Reference Guide (80399ST10110A)
- UE910 V2 AT Commands Reference Guide (80419ST10124A)
- LE910 AT Commands Reference Guide (80407ST10116A)
- LE910-V2 AT Commands Reference Guide (80446ST10707A)

- GE910 Hardware User Guide (1vv0300962)
- HE910 Hardware User Guide (1vv0300925)
- DE910 Hardware User Guide (1vv0300951)
- CE910 Hardware User Guide (1vv0301010)
- UE910 Hardware User Guide (1VV0301012)
- UE910 V2 Hardware User Guide (1VV0301065)
- LE910 Hardware User Guide1vv030108)
- LE910-V2 Hardware User Guide (1VV0301200)

- GE910 Family Digital Voice Interface Application Note (80000NT10099A)
- HE/UE910 Digital Voice Interface Application Note (80000NT10050A)
- DE/CE910, UE910-V2 DVI Application Note (80000NT10101A)
- LE910 Digital Voice Interface Application Note (80000NT11246A)

- Telit Modules Software User Guide (1VV0300784)
- xE910 RTC Backup Application Note (80000NT10072A)
- Antenna Detection Application Note (80000NT10002A)
- Telit_HE_UE_UL_Family_Ports_Arrangements (1VV0300971)

2 OVERVIEW

In this document all the basic functions of a mobile phone will be taken into account; for each one of them a proper hardware solution will be suggested and eventually the wrong solutions and common errors to be avoided will be evidenced. Obviously, this document cannot embrace the whole hardware solutions and products that may be designed. The wrong solutions to be avoided shall be considered as mandatory, while the suggested hardware configurations shall not be considered mandatory, instead the information given shall be used as a guide and a starting point for properly developing your product with the described modules. For further hardware details that may not be explained in this document refer to the Telit Product Description documents where all the hardware information is reported.

The integration of the xE910 cellular module within user application shall be done according to the design rules described in this manual.

The Unified Form Factor (UFF) is a concept of a products family characterized by the same mechanical and electrical form factor with different radio access technology.

This new approach protects customer's investment by giving you the possibility to migrate with the simple plug-and-play switch of your module with other wireless modules in the Unified Form Factor range without changing your application. In this way, Telit offers easy access to different cellular technologies, certifications or bandwidth. For example if you develop applications based on today's mobile operator GSM/GPRS cellular technology if required it might be upgraded in the future to higher data speed capability such as UMTS/HSDPA or LTE.

The main advantages are summarized below:

- Increase of the efficiency in the use of the investments assigned to the development of the application (NRE), resulting in higher ROI, thus justifying the business choice of the UFF products;
- Products that are designed to bring technology enhancements to the integrators, such as higher data rates and new wireless standards while maintaining backwards compatibility in form factor and logical interfaces;
- Ease of integration;
- Telit as a single supplier of wireless modems;
- The customer can focus on its core business and application, not the management of operations and procurement required for wireless modems;

- One single application for different markets.

Telit, acknowledging the requirements of the developers, has taken great care to minimize any difference in the interface of the products with the Unified Form Factor; nevertheless some minor differences are still present. Differences are mainly due by the fact that different technologies have different electrical and mechanical characteristics, however, the application can, with some care, easily accommodate multiple wireless modems.

This document has been created to guide you when developing applications based on Unified Form Factor concept by pointing out module differences.

3 MECHANICAL DIMENSIONS

The Telit xE910 family overall dimensions are:

Module	Length [mm]	Width [mm]	Thickness [mm]
HE910	28.20	28.20	2.20
GE910	28.20	28.20	2.25
GE910-V3	28.20	28.20	2.25
DE910	28.20	28.20	2.05
CE910	28.20	28.20	2.05
UE910	28.20	28.20	2.20
LE910-V2	28.20	28.20	2.20
UE910-V2	28.20	28.20	2.20
LE910	28.20	28.20	2.20

In a common design application, which is going to use multiple models, we recommend to consider the highest dimensions as reference.

Note:
The 3D drawings/models versions are available separately, and they are provided in IGES format. Please contact the Telit Technical Support to get the models.

4 MODULE CONNECTIONS

4.1 Common PIN_OUT

Pin	Signal	I/O	Function	Type	Comment
USB HS Communication Port					
B15	USB_D+	I/O	USB differential Data (+)	USB 2.0	Not present in GE910-V3
C15	USB_D-	I/O	USB differential Data (-)	USB 2.0	Not present in GE910-V3
A13	VUSB	I	Power sense for the internal USB transceiver.	USB 2.0	Not present in GE910-V3
Main UART: Prog. / Data + HW Flow Control					
N15	C103/TXD	I	Serial data input from DTE	CMOS 1.8V	
M15	C104/RXD	O	Serial data output to DTE	CMOS 1.8V	
M14	C108/DTR	I	Input for (DTR) from DTE	CMOS 1.8V	
L14	C105/RTS	I	Input for Request to send signal (RTS) from DTE	CMOS 1.8V	
P15	C106/CTS	O	Output for Clear to Send signal (CTS) to DTE	CMOS 1.8V	
N14	C109/DCD	O	Output for (DCD) to DTE	CMOS 1.8V	
P14	C107/DSR	O	Output for (DSR) to DTE	CMOS 1.8V	
R14	C125/RING	O	Output for Ring (RI) to DTE	CMOS 1.8V	

Pin	Signal	I/O	Function	Type	Comment
Power Supply					
M1	VBATT	-	Main power supply (Baseband)	Power	
M2	VBATT	-	Main power supply (Baseband)	Power	
N1	VBATT_PA	-	Main power supply (Radio PA)	Power	
N1	VBATT_PA	-	Main power supply (Radio PA)	Power	
N1	VBATT_PA	-	Main power supply (Radio PA)	Power	
N1	VBATT_PA	-	Main power supply (Radio PA)	Power	
SIM Card Interface					
A3	SIMVCC	-	External SIM signal – Power supply for the SIM	1.8 / 3V	
A7	SIMRST	O	External SIM signal – Reset	1.8 / 3V	
A5	SIMIO	I/O	External SIM signal - Data I/O	1.8 / 3V	
A6	SIMCLK	O	External SIM signal – Clock	1.8 / 3V	
Miscellaneous Functions					
R11	VAUX/PWRMON	O	Supply Output for external accessories	1.8V	
R12	ON_OFF*	I	Switching power ON or OFF (toggle command)	Internally PU to VRTC	Connect in Open-Drain
R13	HW_SHUTDOWN*	I	HW unconditional shutdown (Active Low)	Internally PU	Connect in Open-Drain
C14	VRTC	-	RTC power supply input when VBATT is OFF and Regulated voltage output when VBATT is ON		

Pin	Signal	I/O	Function	Type	Comment
Digital Voice Interface (DVI)					
B9	DVI_WA0	I/O	Digital Audio Interface WA0	CMOS 1.8V	PCM
B6	DVI_RX	I	Digital Audio Interface RX	CMOS 1.8V	PCM
B7	DVI_TX	O	Digital Audio Interface TX	CMOS 1.8V	PCM
B8	DVI_CLK	I/O	Digital Audio Interface CLK	CMOS 1.8V	PCM
Telit GPIOs					
C8	GPIO_01	I/O	Telit GPIO_01 STAT_LED	CMOS 1.8V	
C9	GPIO_02	I/O	Telit GPIO_02	CMOS 1.8V	
C10	GPIO_03	I/O	Telit GPIO_03	CMOS 1.8V	
C11	GPIO_04	I/O	Telit GPIO_04	CMOS 1.8V	
B14	GPIO_05	I/O	Telit GPIO_05	CMOS 1.8V	
C12	GPIO_06	I/O	Telit GPIO_06	CMOS 1.8V	
C13	GPIO_07	I/O	Telit GPIO_07	CMOS 1.8V	
K15	GPIO_08	I/O	Telit GPIO_08	CMOS 1.8V	
L15	GPIO_09	I/O	Telit GPIO_09	CMOS 1.8V	
G15	GPIO_10	I/O	Telit GPIO_10	CMOS 1.8V	
RF SECTION					
K1	ANTENNA	I/O	Main RF Antenna	CMOS 1.8V	50 ohm
RESERVED					
C1, D1, C2, D2, C3, D3, E3, F3, G3, H3, J3, K3, L3, C4, C5, C6, C7, N7, P7, A8, N8, A9, N9, A10, B10, N10, A11, B11, N11, P11A12, B12, D12, N12, P12, F13, G13, H13, J13, K13, L13, M13, N13, A14, D14, F14, G14, J14, K14 , H14					
GROUND PINS					
E1, G1, H1, J1, L1, A2, E2, F2, G2, H2, J2, K2, L2, R2, M3, N3, P3, R3, M4, N4, P4, R4, N5, P5, R5, N6, P6, R6, P8, R8, P9, P10, R10, M12, B13, P13, E14					

Warning:
RESERVED pins reported above must not be connected.

Warning:
SIM signals for DE910 and CE910 are present only for future compatibility and support of Removable User Identity Module (R-UIM).

4.2 PIN-OUT differences

4.2.1 Analog Audio

On GE910, GE910-V3, CE910, UE910 and UE910-V2 an analog audio front-end port is present, the pinout is indicated in the following table:

Pin	Signal	I/O	Function	Type	Comment
Analog Voice Interface					
B2	EAR+	AO	Ear signal output, phase +		
B3	EAR-	AO	Ear signal output, phase +		
B4	MIC+	AI	Microphone signal input; phase +		
B5	MIC-	AI	Microphone signal input; phase -		

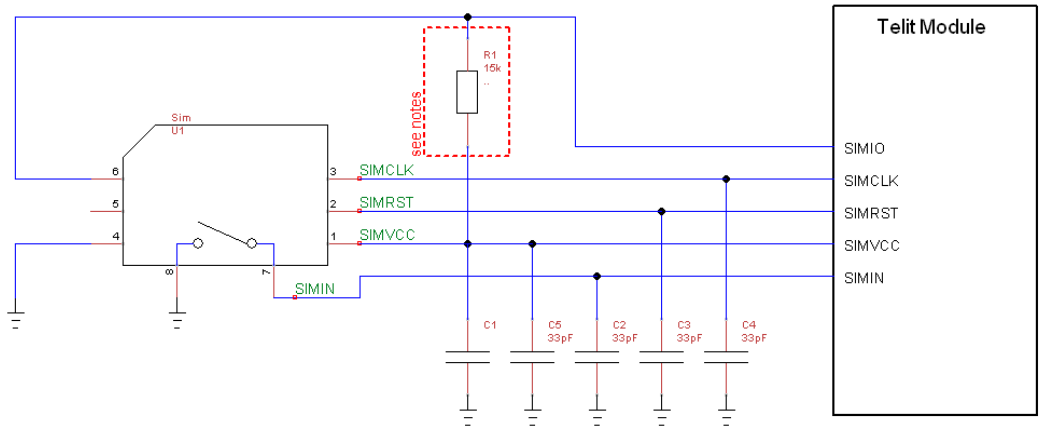
On HE910, DE910, LE910 and LE910-V2 the analog audio interface is not present; in order to keep the compatibility among all modems of the xE910 family you should predispose the digital audio interface.

4.2.2 SIM Connection

GSM, UMTS and LTE devices have SIM port interface; the pinout is reported in figure below. CDMA devices has variants that support RUIM (needed for some countries). SIM holder can be no-mount if CDMA devices, without RUIM support, are mounted.

Pin	Signal	I/O	Function	Type	Comment
Analog Voice Interface					
A6	SIMCLK	O	External SIM signal – Clock	1.8V/3V	
A7	SIMRST	O	External SIM signal – Reset	1.8V/3V	
A5	SIMIO	I/O	External SIM signal – Data I/O	1.8V/3V	
A4	SIMIN	I	External SIM signal – Presence (active low)	CMOS 1.8V	
A3	SIMVCC		External SIM signal – Power supply for the SIM	1.8V/3V	Automatic Voltage selection

The figure below illustrates in particular how the application side should be designed, and what values the components should have.



The minimum value of C1 can vary depending on the module; in the table below you have the recommended values. The maximum for all modems is 1uF.

Module	C1
HE910	100nF
DE910	-
GE910	220nF
GE910-V3	220nF
CE910	-
UE910	100nF
LE910-V2	100nF
UE910-V2	100nF
LE910	100nF

4.2.3 Antenna Diversity

On HE910, DE910, LE910 and LE910-V2 is present an input for a second RX antenna to improve the radio sensitivity. The function is called Antenna Diversity. In a xE910 common design in order to have the possibility to use the antenna diversity, you should route it to Pad F1. When other modems without antenna diversity are mounted this Pad becomes UNCONNECTED, which is totally isolated and then the connection will not cause any harm to the module.

Pin	Signal	I/O	Function	Type	Comment
RF Section					
F1	ANT_DIV	I	RF Antenna Diversity Input	RF	50 Ohm

As of dec. 2014, PTCRB updated PPMD document section 11.10.6 Feature/Function Set for Integrated Devices, and in the last revision the Diversity is not anymore among the exception features that may not match the modem capabilities. This means that if the assembled modem supports Diversity antenna, then in order to get PTCRB approval (and subsequent US carrier approval) the application MUST have a diversity antenna.

If the RX Diversity is not used/connected, disable the Diversity functionality using the AT#RXDIV command (ref to the AT User guide for the proper syntax) and leave the pad F1 unconnected.

4.2.4 GPS Antenna

On some GE910, HE910, DE910 and LE910 variants an internal GNSS receiver could be present. In a xE910 common design in order to have the possibility to use GPS features you should route GNSS antenna connection to Pad R9. When other modems are mounted the GNSS antenna track will be connected to an UNCONNECTED Pad which is totally isolated and then the connection will not cause any harm to the module.

Also the pad R7, GPS_LNA_EN, used only when GNSS is present, becomes UNCONNECTED and can be left connected in a xE910 common design.

Pin	Signal	I/O	Function	Type	Comment
GPS Section					
R9	ANT_GPS	I	GNSS Antenna		50 Ohm
R7	GPS_LNA_EN	O	Output enable for External LNA supply	CMOS 1.8V	

4.2.5 UART AUXILIARY

The Auxiliary serial port is present in all xE910 family products except for UE910-V2.

Pin	Signal	I/O	Function	Type	Comment
GPS Section					
D15	TX_AUX	O	Serial auxiliary data output from DCE (modem)	CMOS 1.8V	Shared with SPI_MOSI
E15	RX_AUX	I	Serial auxiliary data input to DCE	CMOS 1.8V	Shared with SPI_MISO

4.2.6 SPI PORT

4.2.6.1 Master mode

All xE910 family products **except CE910, DE910, GE910-V3 and UE910-V2** are provided by a standard 3 wire **master** SPI interface that shares the hardware resources with the AUX_UART port. To use either AUX_UART or SPI the AT#SPIOPEN, AT#SPIRW, AT#SPICLOSE commands should be used.

Pin	Signal	I/O	Function	Type	Comment
SPI					
D15	SPI_MOSI	O	SPI MOSI	CMOS 1.8V	Shared with TX_AUX
E15	SPI_MISO	I	SPI_MISO	CMOS 1.8V	Shared with RX_AUX
F15	SPI_CLK	O	SPI Clock	CMOS 1.8V	Shared with HSIC_HOST_WAKEUP

4.2.6.2 Slave mode

Only UE910 and HE910 are provided by a 5 wire IPC **slave** SPI hardware interface that shares the hardware resources with the AUX_UART port. To use either AUX_UART or SPI, AT#PORTCFG command should be used (see also Telit_HE_UE_UL_Family_Ports_Arrangements). It shall be noted that by default the hardware SPI port of the module differs from the standard SPI: this interface supports two handshake lines for flow control and mutual wake-up: SRDY (slave ready) and MRDY (master ready).

Pin	Signal	I/O	Function	Type	Comment
SPI					
D15	SPI_MOSI	I	SPI MOSI	CMOS 1.8V	Shared with TX_AUX
E15	SPI_MISO	O	SPI_MISO	CMOS 1.8V	Shared with RX_AUX
F15	SPI_CLK	I	SPI Clock	CMOS 1.8V	Shared with HSIC_HOST_WAKEUP
H15	SPI_MRDY	I	SPI_MRDY	CMOS 1.8V	Shared with HSIC_SLAVE_WAKEUP
J15	SPI_SRDY	O	SPI_SRDY	CMOS 1.8V	Shared with HSIC_HOST_ACTIVE

Due to the shared functions, when the SPI port is used, it is not possible to use the AUX_UART port and vice versa.

4.2.7 USB PORT

The USB port is present in all xE910 family products except for GE910-V3**.** All other modules include an integrated universal serial bus (USB) transceiver, compliant with USB 2.0 specifications and supporting the USB Full-Speed (12 Mb/s) mode. The HE910, DE910, UE910, LE910 LE910-V2 and UE910-V2 supports also High Speed (480Mb/s) mode, for this reason the signal traces should be routed carefully: trace lengths, number of vias and capacitive loading should be minimized and the characteristic impedance value should be as close as possible to 90 Ohms differential.

USB can be used for the following purposes: communication with external peripheral devices, debug monitor.

The following table is listing the available signals:

Pin	Signal	I/O	Function	Type	Comment
USB HS 2.0 Communication Port					
B15	USB_D+	I/O	USB differential Data (+)		90 Ohms differential
C15	USB_D-	I/O	USB differential Data (-)		90 Ohms differential
A13	VUSB	I	Power sense for the internal USB transceiver.		

VUSB pin is present on all modems supporting USB. It must be connected to +5V in order to activate the USB port. On GE910-V3, the A13 Pad is UNCONNECTED, so 5V signal could remain without damaging.

For more information about USB port, refer to the Hardware User Guide.

We recommend adding USB PCB connector pads for convenient access for network certification testing, firmware upgrade and module debug logs. The USB connector can be “DNP” until needed. This may be more convenient than just test points alone.

4.2.8 USB HSIC

The UE910 and HE910 modules have USB HSIC interface. The USB HSIC (High Speed Inter Processor) Interface allows supporting the inter-processor communication between an application processor (AP) – the host, and the modem processor (CP) – our modem.

Pin	Signal	I/O	Function	Type	Comment
USB HSIC					
A12	HSIC_USB_DATA	I/O	data signal	CMOS 1.2V	
A11	HSIC_USB_STRB	I/O	strobe signal	CMOS 1.2V	
H15	HSIC_SLAVE_WAKEUP	I	Slave Wake Up	CMOS 1.8V	Shared with SPI_MRDY
F15	HSIC_HOST_WAKEUP	O	Host Wake Up	CMOS 1.8V	Shared with SPI CLK
K15	HSIC_SUSPEND_REQUEST	O	Slave Suspend Request	CMOS 1.8V	Shared with GPIO_08
J15	HSIC_HOST_ACTIVE	I	Active Host Indication	CMOS 1.8V	Shared with SPI_SRDY

Due to the shared functions, when the USB HSIC port is used, it is not possible to use the SPI or GPIO_08 and vice versa

In a xE910 common design the USB HSIC port should not be used.

4.2.9 Other PINS

The following table shows other pin differences between the modules in xE910 family:

Pin	Signal	I/O	Function	Type	Comment
E13	VIO1_1V8 in **HE910** RESERVED in other products	O	VIO1 Supply output (1.8V)		In a xE910 common design **this pin must always be connected only to D13**
D13	VDD_IO1 in **HE910** RESERVED in other products	I	IO1 SUPPLY Input		In a xE910 common design **this pin must always be connected only to E13**
D4	RESERVED in **GE910,** GROUND in other products	-	GROUND		In a xE910 common design **connect to GROUND**.

Warning:

In a xE910 common we recommend connecting pin E13 to pin D13.

5 HARWARE CONTROLS

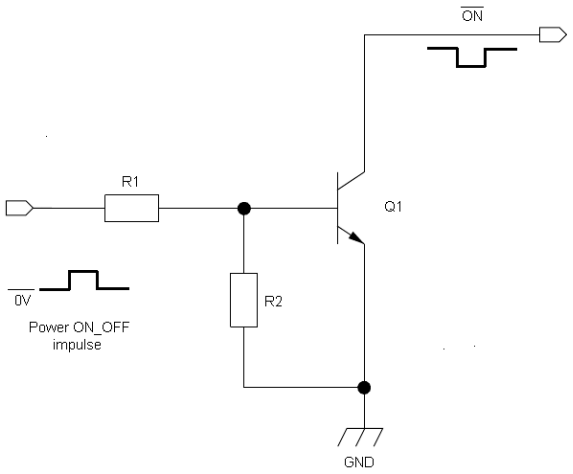
5.1 Hardware Unconditional Shutdown

The Hardware Unconditional Shutdown must not be used during normal operation of the device since it does not detach the device from the network. It shall be kept as an emergency exit procedure to be done in the rare case that the device gets stuck waiting for some network or SIM responses.

Do not use any pull up resistor or any totem pole digital output on pads R13 and R12. Using pull up resistor may bring to latch up problems on the module's power regulator and improper functioning of the module. The HW_SHUTDOWN# line must be connected only in open collector configuration.

The Hardware Unconditional Shutdown should be always implemented on the boards but the host software should use it as an emergency exit procedure only.

The HW_SHUTDOWN* pin must only be connected to OPEN-DRAIN outputs, if the MCU used don't have the possibility to configure the digital outputs as OPEN-DRAIN a simple circuit to do this it's the one in figure below:



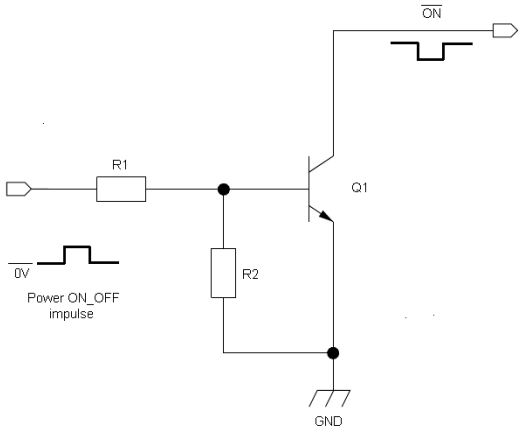
To unconditionally shutdown the xE910 family modems the Pad R13 must be tied low for at least 800 milliseconds and then released. **After this operation the module will stay OFF except when modem is connected in auto power on configuration, ON_OFF# pin tied to GND.**

Refer to xE910 Hardware User Guide for a detailed flow chart describing the right procedure to shut down the module.

5.2 Turning ON the xE910

To turn ON/OFF the xE910, Pad ON_OFF* must be tied low for at least 5 seconds and then released; the devices of xE910 family have a different minimum time the ON_OFF must be tied low in order to be sure that the module turns ON; with 5 seconds you can turn ON all xE910 products. Same procedure for Turning OFF.

The ON_OFF* pin must only be connected to OPEN-DRAIN outputs, if the MCU used don't have the possibility to configure the digital outputs as OPEN-DRAIN a simple circuit to do this it's the one in figure below:



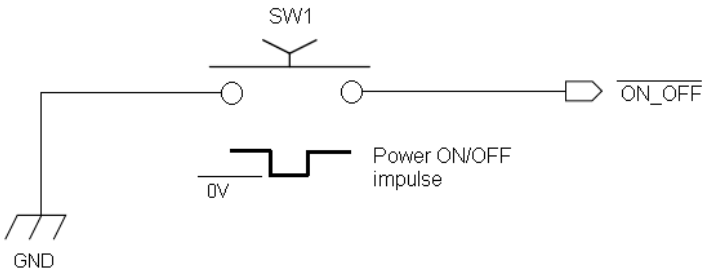
Don't use any pull up resistor on the ON_OFF* line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the HE910 power regulator and improper power on/off of the module. The line ON_OFF* must be connected only in open collector or open drain configuration.

To check if the device has powered on, the hardware line PWRMON should be monitored.

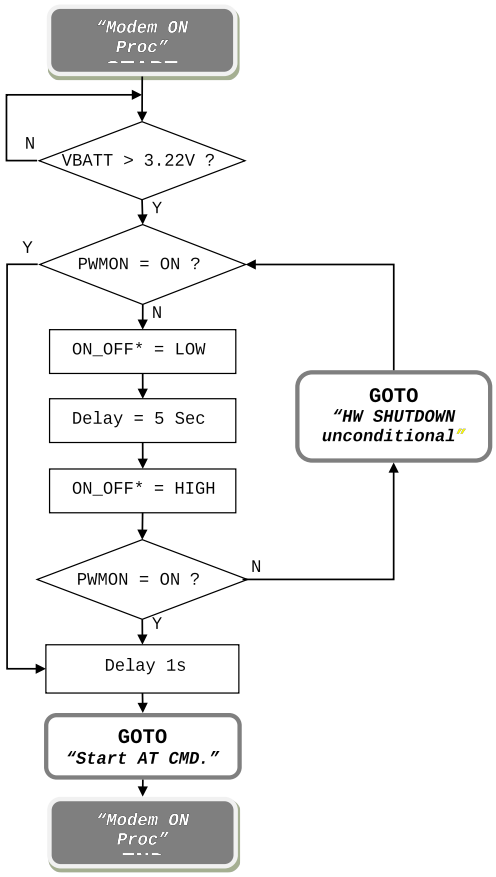
It is mandatory to avoid sending data to the serial ports during the first 200ms of the module start-up.

In order to avoid a back powering effect it is recommended to avoid having any HIGH logic level signal applied to the digital pins of the HE910 when the module is powered off or during an ON/OFF transition

The ON_OFF* pad can be connected directly to an ON/OFF button as showed in figure below:

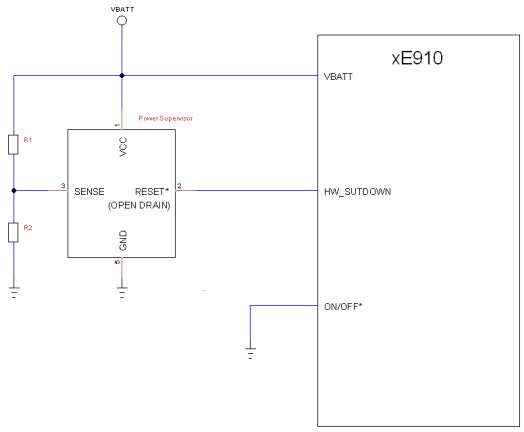


A flow chart of the procedure is shown in figure below:



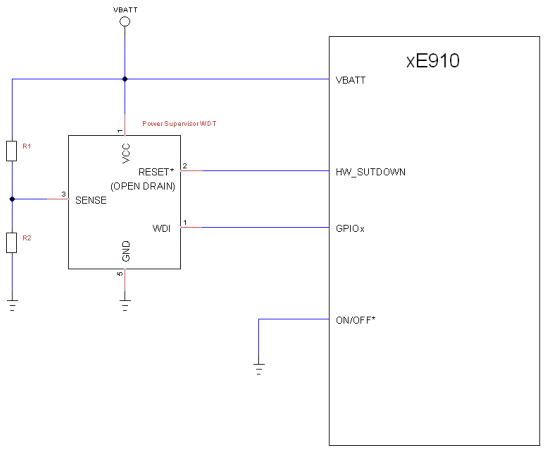
Warning:

For some xE910 family products it is recommended set the ON_OFF* line LOW to power on the module **only after VBATT is higher than 3.22V**. If you need the module automatically turn-on when VBATT is applied you can tie to ground the ON_OFF pin but in this case the slew-rate of VBATT must be > 150V/s. In this case the safest option is to use a power supply supervisor connected to the HW_SUTDOWN pin of the module as indicated in figure below:



This is just an example: R1 and R2 determine the threshold voltage at which the RESET* is released, R1 and R2 should be choose in order to have a threshold up to 3.22V.

If you need the module to automatically turn on and there isn't a MCU on the board, it is better having a power supervisor with WDT as indicated in the example below:

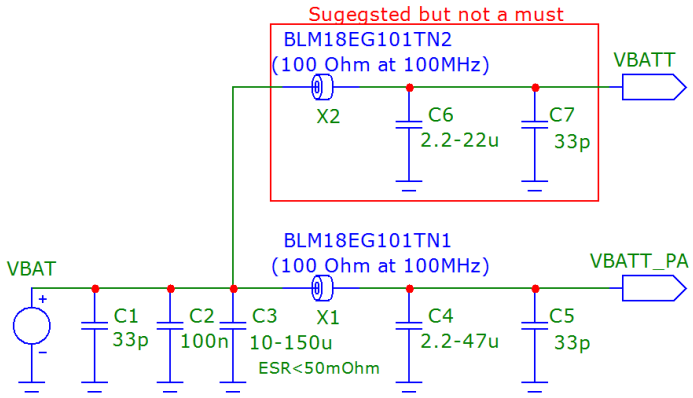


In this case you need a python script that toggles the GPIOx; in this way the module is reset in case it remains stuck for some reason.

6 POWER SUPPLY

The power supply circuitry and board layout are a very important part in the full product design and they strongly reflect on the product overall performances, hence read carefully the requirements and the guidelines that will follow for a proper design.

To improve EMI filtering an EMI suppression circuitry must be added on modem's VBATT_PA, and if possible also on VBATT. Follow schematic on figure below.



6.1 Power Supply Requirements

The external power supply must be connected to VBATT & VBATT_PA signals and must fulfill the following requirements:

Module	Nominal Supply Voltage	Normal Operating Voltage Range	Extended Operating Voltage Range
GE910/GE910-V3	3.8V	3.40V - 4.20V	3.10V* - 4.50V
DE910	3.8V	3.40V - 4.20V	3.30V - 4.50V
HE910	3.8V	3.40V - 4.20V	3.10V* - 4.50V
CE910	3.8V	3.40V - 4.20V	3.40V - 4.50V
UE910	3.8V	3.40V - 4.20V	3.10V* - 4.50V
LE910-V2	3.8V	3.40V - 4.20V	3.10V - 4.50V
UE910-V2	3.8V	3.40V - 4.20V	3.40V - 4.50V
LE910	3.8V	3.40V - 4.20V	3.30V - 4.20V

*On HE910, GE910, GE910-V3 and UE910 the Power supply must be higher than 3.22 V to power on the module, when the module is ON the voltage level on VBATT can go to 3.1V.

The Operating Voltage Range MUST never be exceeded; care must be taken in order to fulfil min/max voltage requirement.

Overshoot voltage (regarding MAX Extended Operating Voltage) and drop in voltage (regarding MIN Extended Operating Voltage) MUST never be exceeded; The “Extended Operating Voltage Range” can be used only with completely assumption and application of the HW User guide suggestions.

The electrical design for the Power supply should be made ensuring it will be capable of a peak current output of at least 2 A.

For a xE910 common design the voltage level of the power supply should stay in the **Normal Operating voltage Rate**.

In order to avoid latch-up issues we recommend particular care be taken such that no digital pins connected to the modem of the modem remain high when the modem is turned off.

7 LOGIC LEVEL SPECIFICATIONS

The following tables show the logic level specifications for xE910 family of products:

Absolute Maximum Ratings - Not Functional (Input level on any digital pin (CMOS 1.8V) with respect to ground)

Module	Min	Max
HE910	-0.3V	2.1V
DE910	-0.3V	2.3V
GE910	-0.3V	2.7V
GE910-V3	-0.3V	2.7V
CE910	-0.3V	2.3V
UE910	-0.3V	2.1V
LE910-V2	-0.3V	2.1V
UE910-V2	-0.3V	2.3V
LE910	-0.3V	2.16V

Operating Range - Interface levels (1.8V CMOS)

	Input LOW level		Input HIGH level		Output LOW level		Output HIGH level	
Module	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
HE910	0.0V	0.35V	1.5V	1.9V	0.0V	0.10V	1.6V	1.9V
DE910	0.0V	0.35V	1.5V	2.1V	0.0V	0.45V	1.35V	1.8V
GE910	0.0V	0.35V	1.5V	1.9V	0.0V	0.20V	1.6V	1.9V
GE910-V3	0.0V	0.35V	1.3V	1.9V	0.0V	0.20V	1.6V	1.9V
CE910	0.0V	0.35V	1.5V	2.1V	0.0V	0.45V	1.35V	1.8V
UE910	0.0V	0.35V	1.5V	1.9V	0.0V	0.10V	1.6V	1.9V
LE910-V2	0.0V	0.35V	1.5V	1.9V	0.0V	0.20V	1.6V	1.9V
UE910-V2	0.0V	0.35V	1.5V	2.1V	0.0V	0.45V	1.35V	1.8V
LE910	0.0V	0.35V	1.5V	2.1V	0.0V	0.45V	1.35V	1.8V

Current characteristics

Module	Output Current	Input Current
HE910	1mA	1µA
DE910	2mA	30µA
GE910	1mA	1µA
GE910-V3	1mA	1µA
CE910	2mA	30µA
UE910	1mA	1µA
LE910-V2	1mA	1µA
UE910-V2	2mA	30µA
LE910	1mA	1µA

8 SERIAL PORTS

Two serial ports are available in the modules except for UE910-V2. It supports only UART0.

- MODEM SERIAL PORT
- MODEM SERIAL PORT 2 (Auxiliary)

The serial port UART0 is the main serial interface between the module and OEM hardware it is a full UART with hardware flow control. Modem's main UART directions are referred to the Data Terminal Equipment (DTE) (external controller). TXD is an input and RXD is an output for Telit.

The second auxiliary UART port has only 2 signals, RX and TX and its baud rate is fix to 115200. The modem's auxiliary UART directions are referred to Data Communication Equipment (DCE) (modem). TX_AUX is an output and RX_AUX is an input for Telit.

PU/PD Resistor on UART pins are not necessary, and could have negative effects, since resistor divider will be created if we take into account PU/PD inside the modem.
Internal PU/PD may vary depending on modem used.

For deep power saving using *AT+CFUN=5*, the modem controls the DTR and VUSB status (only for products that support USB). Only when DTR is OFF, C108/DTR='HI' or floating, and VUSB is OFF, 'LOW' or floating, modem is allowed to enter into deep power saving mode; otherwise, if DTR is ON, C108/DTR='LOW', **OR** VUSB is ON, VUSB='HI'; modem remains always awake. **Avoid leaving both DTR and/or VUSB opened or tied to fixed values, we suggest connecting, at least one, to a controller and the other can be left floating**.

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9 GENERAL PURPOSE I/O

The general-purpose I/O pads can be configured to act in three different ways:

- Input
- Output
- Alternate function (internally controlled)

xE910 family of products use the same number of GPIOs with the same pin-out.

For some products at start-up during the BOOT of the software some GPIO can be set as output with LOW level for a small amount of time, for this reason a direct connection of any GPIO to an output that is HIGH when the module is turning ON is not recommended.

For complete information about GPIOs refer to the Hardware User Guides.

10 ADC CONVERTER

On xE910 family is available an ADC input, also useful for antenna detection purposes, see Antenna Detection Application Note. The following table is showing the electrical ADC characteristics for each modem:

	Input Voltage range		AD conversion	Resolution	Input Resistance
Module	**Min**	**Max**	**bit**	**Max**	**Min**
HE910	0.0V	1.2V	10	1.2mV	1MΩ
DE910	0.0V	1.2V	8	10mV	1MΩ
GE910	0.0V	1.3V	10	1.3mV	1MΩ
GE910-V3	0.0V	1.3V	10	1.3mV	1MΩ
CE910	0.0V	1.2V	12	1mV	1MΩ
UE910	0.0V	1.2V	10	1mV	1MΩ
LE910-V2	0.0V	1.2V	10	1.2mV	1MΩ
UE910-V2	0.0V	1.2V	8	10mV	1MΩ
LE910	0.0V	1.3V	10	1.3mV	1MΩ

In a common design limit maximum input voltage to 1.2V.

11 VAUX/PWRMON POWER OUTPUT

A regulated power supply output is provided in order to supply small devices from the module. This output is active when the module is ON and goes OFF when the module is shut down. The operating range characteristics are slightly different on the four products of the xE910 family, as reported below:

	Output Voltage			Output Current	Bypass capacitor inside the module
Module	**Min**	**Typ**	**Max**	**Max**	**Typ**
HE910	1.78V	1.80V	1.82V	60mA	1uF
DE910	1.77V	1.80V	1.83V	200mA	2.2uF
GE910	1.77V	1.80V	1.83V	50mA	1uF
GE910-V3	1.77V	1.80V	1.83V	50mA	1uF
CE910	1.77V	1.80V	1.83V	200mA	2.2uF
UE910	1.78V	1.80V	1.82V	60mA	1uF
LE910-V2	1.78V	1.80V	1.82V	60mA	1uF
UE910-V2	1.77V	1.80V	1.83V	200mA	1uF
LE910	1.75V	1.80V	1.85V	100mA	1uF

12 RTC BACKUP

The VRTC pin brings out the Real Time Clock supply, which is separate from the rest of the digital part, allowing having only RTC going on when all the other parts of the device are off.

To this power output pin, a backup circuit can be added in order to increase the RTC autonomy during power off of the battery. Devices must not be powered from this pin.

For more information see the document “xE910 RTC Backup Application Note 80000NT10072A”.

This feature is not available for CE910.

13 DOCUMENT HISTORY

Revision	Date	Changes
0	2011-12-01	First issue
1	2011-12-14	Layout review
2	2012-03-15	Added DE910
3	2012-04-10	Added CE910
4	2012-06-06	Added ADC, VAUX and thickness data for GE910, clarification on HW SHUTDOWN behavior, added SIMVCC C1 values, removed SPI reference for CDMA products.
5	2012-08-01	DVI for CE910 under development
6	2012-08-21	Added chapter for RTC backup, R12 and R13 type modification
7	2012-12-05	Digital Audio (Chapter 12.2) changed Updated 3 Mechanical Dimensions for CE910 Added in 4.1 Common Pin-out, pull up resistance information of SIMIN, ON_OFF*, HW_SHUTDOWN* for DE910/CE910. Added important note on USB access in Chapter 10
8	2013-03-25	Updated 4.2 Pin-out differences, SIMIN is reserved for DE/CE910 Digital Voice Interface is changed from Reserved to Supported for CE910 Updated 6.1 Power supply Requirements, added values of extended operating voltage range for DE/CE910
9	2013-08-30	Added UE910
10	2013-10-01	Added UE910 V2
11	2014-01-08	Changed GE910 A13 pin from RESERVED to VUSB Added warning for HE910 GPIOs
12	2014-04-24	Added LE910
13	2014-09-12	Updated 4.2 Pin-out differences, SIMIN description for LE910
14	2015-10-12	Layout review. Added chapter 5.2 (ON/OFF procedure). Added note in chapter 6.1 regarding the minimum voltage allowed for HE910, UE910 and GE910. Added notes in chapter 4.2.3. Added critical note in chapter 9 about GPIO behavior during boot process. Added LE910-V2 and GE910-V3.
15	2015-12-04	Modified Chapter 4.2.6 SPI PORT


Design Review
120°
180°
Process
Validation
240°
RF/EMC Pre-Certification
Module Selection
60°
300°
Approvals
Support
360°
Value Added Services & Connectivity
Enterprise Integration &
Application Enablement
m2mair