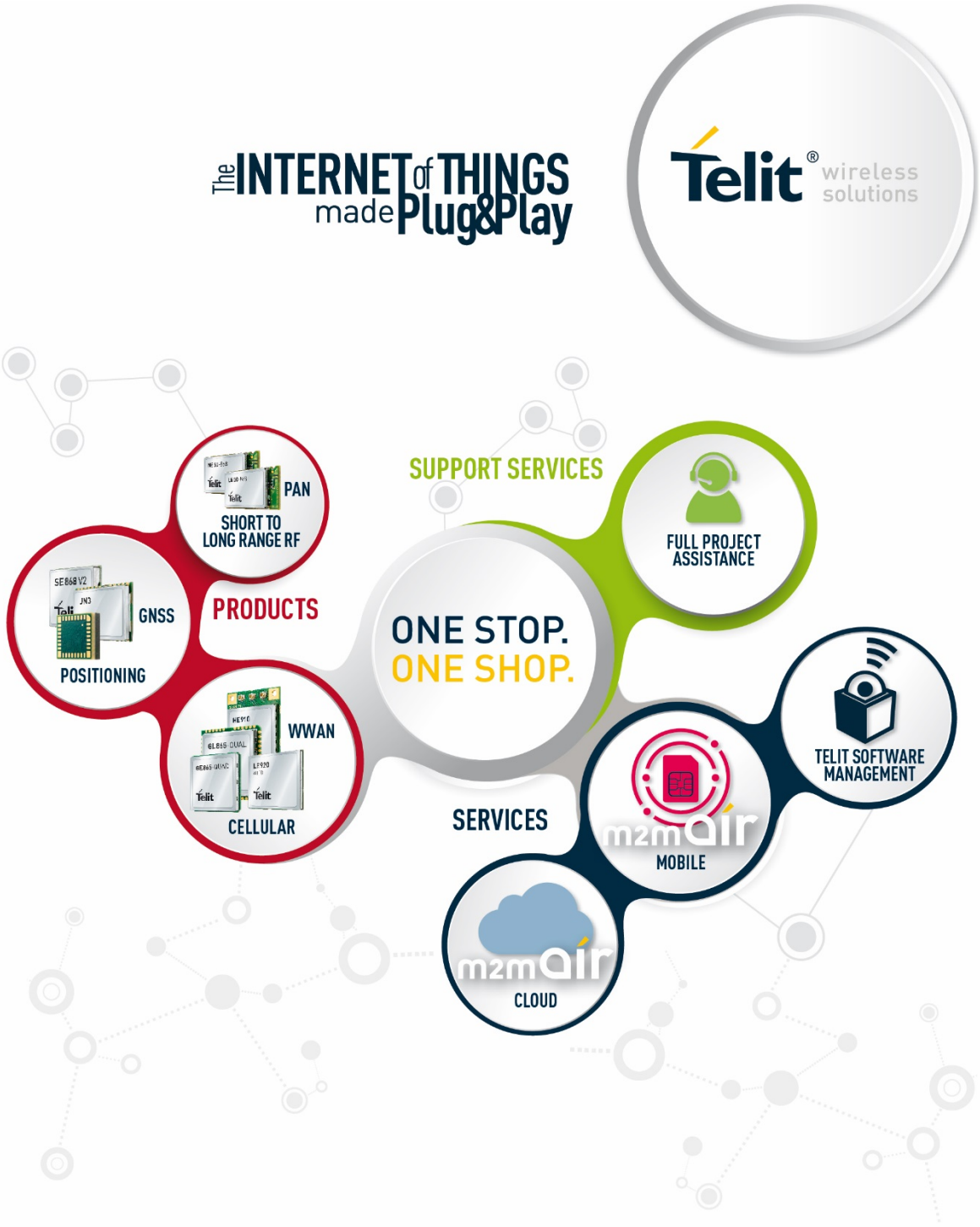

xE910 Global Form Factor Application Note

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
- LE910C1
- LE910D1
- ME910

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CONTENTS

INTRODUCTION

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Scope

The aim of this document is the description of some hardware solutions useful for developing an application compatible with the products: LE910C1, LE910D1 and ME910, in order to highlight the minor differences between the above mentioned products.

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.

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.

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)
- LE910Cx AT Commands Reference Guide (80490ST10778A)

- 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 Guide (1vv030108)
- LE910-V2 Hardware User Guide (1VV0301200)
- LE910-Cx Hardware User Guide (1VV0301298)

- 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)

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.

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
LE910C1	28.2	28.20	2.20
LE910D1-E1	28.20	28.20	2.10
ME910-C1	28.20	28.20	2.10

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.

MODULE CONNECTIONS

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; for LE910C1 Power is 2.5V – 5.5V
A14	USB_ID	AI	USB ID		Activated only for LE910C1
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	
P15	C106/CTS	O	Output for Clear to Send signal (CTS) to DTE	CMOS 1.8V	
L14	C105/RTS	I	Input for Request to send signal (RTS) from DTE	CMOS 1.8V	
P14	C107/DSR	O	Output for (DSR) to DTE	CMOS 1.8V	**For LE910C1 Alternate Fn GPIO_32**
M14	C108/DTR	I	Input for (DTR) from DTE	CMOS 1.8V	**For LE910C1 Alternate Fn GPIO_34**

N14	C109/DCD	O	Output for (DCD) to DTE	CMOS 1.8V	**For LE910C1 Alternate Fn GPIO_33**
R14	C125/RING	O	Output for Ring (RI) to DTE	CMOS 1.8V	**For LE910C1 Alternate Fn GPIO_31**
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	
N2	VBATT_PA	-	Main power supply (Radio PA)	Power	
P1	VBATT_PA	-	Main power supply (Radio PA)	Power	
P2	VBATT_PA	-	Main power supply (Radio PA)	Power	
SIM Card Interface 1					
A3	SIMVCC1	-	External SIM signal – Power supply for the SIM	1.8 / 3V	For LE910C1 1.8V\2.85V
A7	SIMRST1	O	External SIM signal – Reset	1.8 / 3V	For LE910C1 1.8V\2.85V
A5	SIMIO	I/O	External SIM signal - Data I/O	1.8 / 3V	For LE910C1x 1.8V\2.85V
A6	SIMCLK1	O	External SIM signal – Clock	1.8 / 3V	For LE910C1 1.8V\2.85V
A4	SIMIN1	I	External SIM signal – Presence (active low)	1.8V	For LE910C1 1.8V

SIM Card Interface 2 – Optional only for LE910C1					
C1	SIMCLK2	O	External SIM 2 signal - clk	1.8/2.85V	
D1	SIMRST2	O	External SIM 2 signal – reset	1.8/2.85V	
C2	SIMIO2	I\O	External SIM 2 signal – Data I\O	1.8/2.85V	
G4	SIMIN2	I	External SIM 2 signal – Presense	1.8/2.85V	
D2	SIMVCC2	-	External SIM 2 signal – Power supply for SIM 2	1.8/2.85V	
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 is reserved for: LE910D1\C1 and ME910 for all other xE910 Pin is used for xxxx
B1	ADC_IN1	AI	Analog/Digital Converter Input 1	Analog	
H4	ADC_IN2	AI	Analog/Digital Converter Input 2	Analog	
D7	ADC_IN3	AI	Analog/Digital Converter Input 3	Analog	
SGMII Interface					

E4	SGMII_RX_P	AI	SGMII receive – plus	PHY	Pin is active only for LE910C1
F4	SGMII_RX_M	AI	SGMII receive – minus	PHY	Pin is active only for LE910C1
D5	SGMII_TX_P	AO	SGMII transmit – plus	PHY	Pin is active only for LE910C1
D6	SGMII_TX_M	AO	SGMII transmit – minus	PHY	Pin is active only for LE910C1
HSIC Interface					
A12	HSIC_DATA	I/O	High-speed inter-chip interface - data	1.2V	
A11	HSIC_STB	I/O	High-speed inter-chip interface - strobe	1.2V	
H15	HSIC_SLAVE_WAKE UP	I	Slave Wake Up	1.8V	
F15	HSIC_HOST_WAKEU P	O	Host Wake Up	1.8V	
K15	HSIC_SUSPEND_RE QUEST	O	Slave Suspend Request	1.8V	
J15	HSIC_HOST_ACTIVE	I	Active Host Indication	1.8V	
D13	VDD_IO1	I	VDD_IO1 Input		Activated only for HE910
E13	1V8_SEL	O	1V8 SEL for VDD_IO1		Activated only for HE910
I2C Interface					
B11	I2C_SCL	I/O	I2C clock	1.8V	Activated for LE910C1 only for coded usage

B10	I2C_SDA	I/O	I2C Data	1.8V	Activated for LE910C1 only for coded usage
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
B12	REF_CLK	O	Reference clock for external Codec	CMOS 1.8V	Activated only for LE910C1
Analog Interface					
B2	EAR+	O	Analog Audio Interface (EAR+)		Not available on UE910-xxD/UE910-GL
B3	EAR-	O	Analog Audio Interface (EAR-)		Not available on UE910-xxD/UE910-GL
B4	MIC+	I	Analog Audio Interface (MIC+)		Not available on UE910-xxD/UE910-GL
B5	MIC-	I	Analog Audio Interface (MIC-)		Not available on UE910-xxD/UE910-GL
Telit GPIO's					
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	
D13	VDD_IO1	I	VDD_IO1 Supply Input		
E13	VIO_1V8	O	Supply for VDD_IO1 (1.8V)	1.8V	Activated only for LE910C1 and for HE910
RF SECTION					
K1	ANTENNA	I/O	Main RF Antenna	RF	
F1	ANT_DIV	I	Diversity Antenna Input (50 ohm)	RF	Reserved for: GE910; ME910; CE910
GPS SECTION					
R9	ANT_GPS	I	GPS antenna (50 Ohm)	RF	

R7	GPS_LNA_EN	O	Enables the external regulator for GPS LNA	1.8V	Reserved for CE910 and GE910-QuadV3
N9	GPS_SYNC	O	GPS sync signal for Dead Reckoning	1.8V	Activated only for LE910C1
J14	GNSS_NMEA_TX	O	UART NMEA Output	1.8V	Activated only for GE910-QUAD. For other xE910 modules - Reserved
K14	GNSS_NMEA_RX	I	UART NMEA Input	1.8V	Activated only for GE910-QUAD. For other xE910 modules - Reserved
WiFi (SDIO) Interface					
N13	WiFi_SD_CMD	O	WiFi SD Command	1.8V	WiFi enabled only for LE910C1
L13	WiFi_SD_CLK	O	WiFi SD Clock	1.8V	WiFi enabled only for LE910C1
J13	WiFi_SD_DATA0	I\O	WiFi SD Serial Data 0	1.8V	WiFi enabled only for LE910C1
M13	WiFi_SD_DATA1	I\O	WiFi SD Serial Data 1	1.8V	WiFi enabled only for LE910C1
K13	WiFi_SD_DATA2	I\O	WiFi SD Serial Data 2	1.8V	WiFi enabled only for LE910C1
H13	WiFi_SD_DATA3	I\O	WiFi SD Serial Data 03	1.8V	WiFi enabled only for LE910C1
L12	WiFi_SDRST	O	WiFi Reset/Power enable control	1.8V	WiFi enabled only for LE910C1
M11	WLAN_SLEEP_CLK	O	WiFi Sleep clock output	1.8V	WiFi enabled only for LE910C1
M10	RFCLK2_QCA	O	WiFi low noise RF clock ouput	1.8V	WiFi enabled only for LE910C1
LTE-WiFi co-existence					

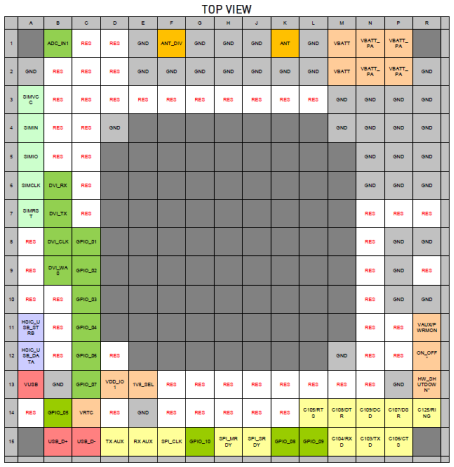
M8	WCI_TX	O	Wireless coexistence interface TXD	1.8V	WiFi enabled only for LE910C1
M9	WCI_RX	I	Wireless coexistence interface RXD		WiFi enabled only for LE910C1
SPI – Serial Peripheral Interface / AUX UART					
D15	SPI_MOSI/TX_AUX	O	Serial auxiliary data output from DCE (modem)	1.8V	Not available for: GE910-QUAD V3; CE910; LE910
E15	SPI_MISO/ RX_AUX	I	Serial auxiliary data input to DCE	1.8V	Not available for: GE910-QUAD V3; CE910; LE910
F15	SPI_CLK	O	SPI Clock output	1.8V	Not available for: GE910-QUAD V3; CE910; LE910
H14	SPI_CS/GPIO11	O	SPI Chip select output / GPIO11	1.8V	Activated for only for LE910C1
H15	SPI_MRDY				Activated for only for HE910
J15	SPI_SRDY				Activated for only for HE910
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.
SIM signals for DE910 and CE910 are present only for future compatibility and support of Removable User Identity Module (R-UIM).

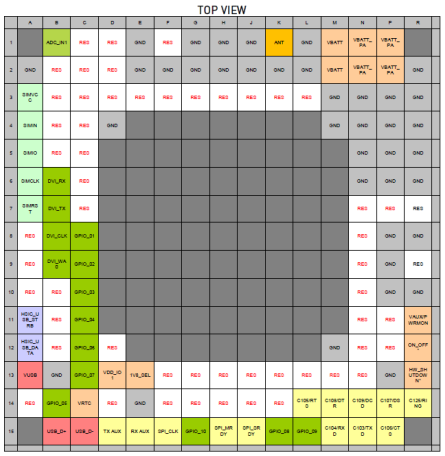
LE910C1 does npt support CFUN=5 (power save mode. In order to function power save mode LE910 DTR must be connected.

LE910C1 includes HW solution for dual SIM. Currently not support by SW.

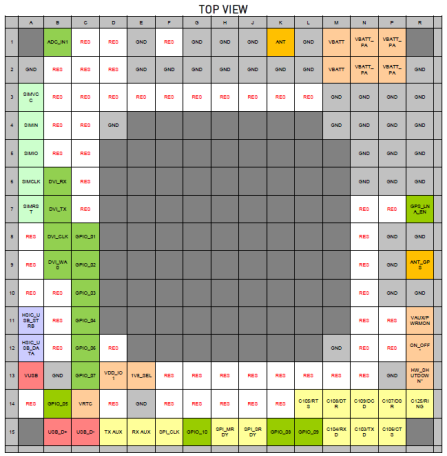
HE910-D



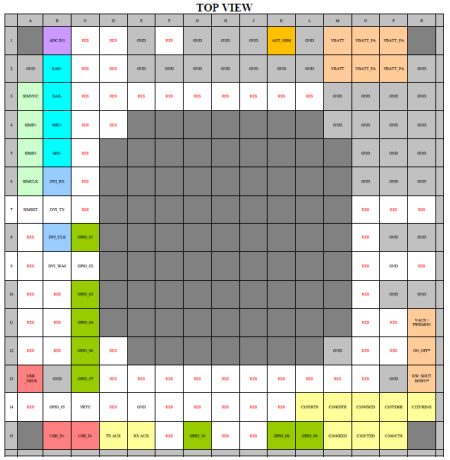
HE910-EUD\EUR\NAD\NAR\GL



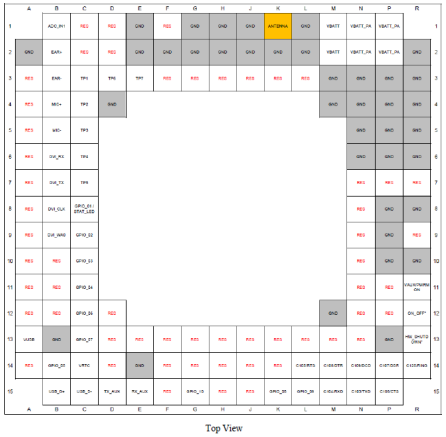
HE910-EUG\NAG



GE910-QUAD

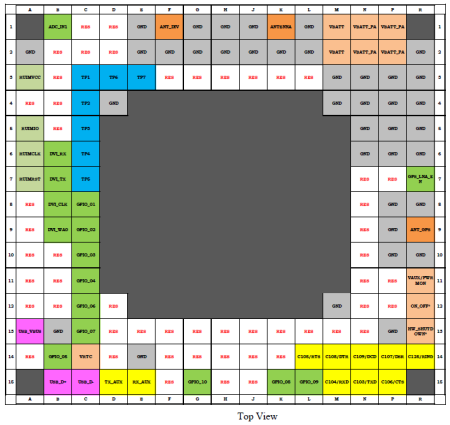


CE910- SL

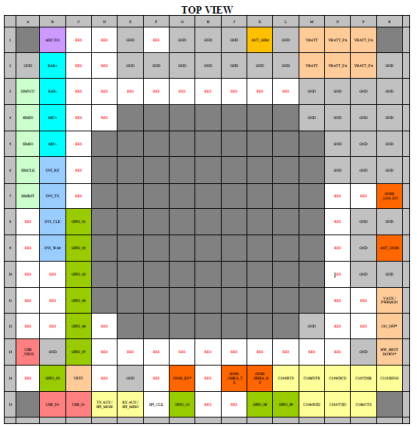


DE910-DUAL

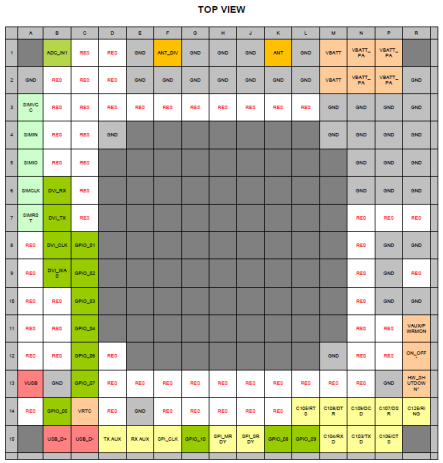
DE910-SC



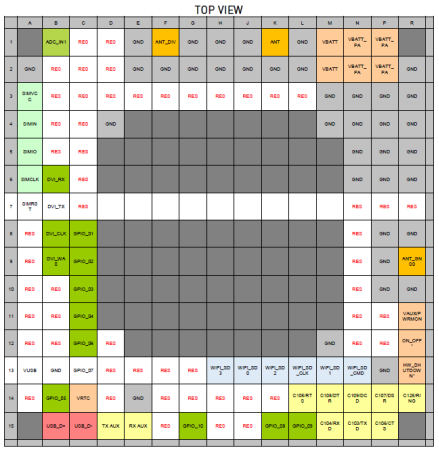
GE910-QUAD\V3\GNSS



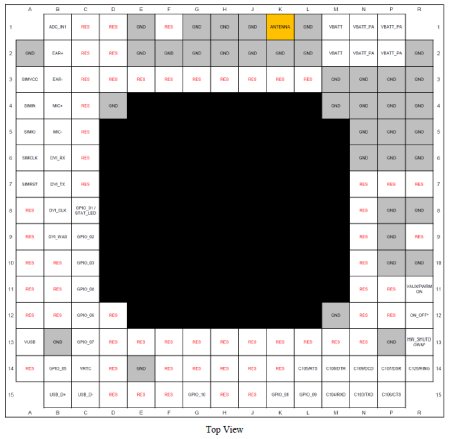
LE910-NA\SV V2



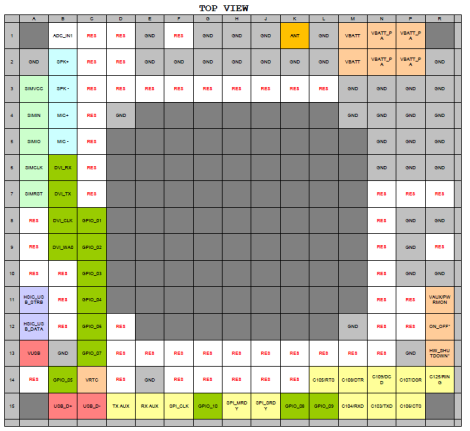
LE910-NAG\EUG\SVG\SKG



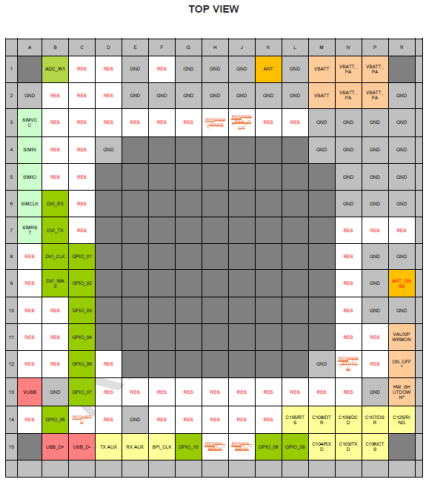
UE910-NA\SV V2



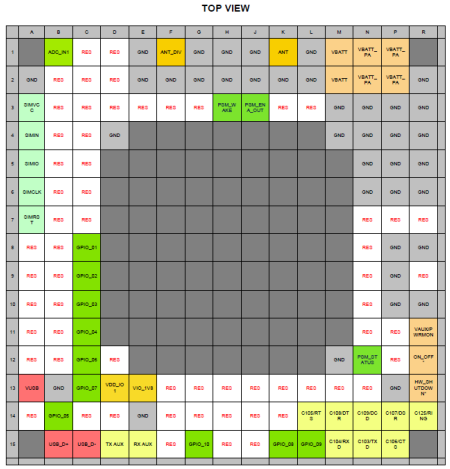
UE910-NAG\EUR\NAR\NAD\GL



ME910C1-NA\NV



LE910D1-E1



LE910C1

NOTE:

The following pins are unique for the LE910Cx and may not be supported on other (former or future) xE910 family. Special care must be taken when designing the application board if future compatibility is required

REF_CLK

SPI_CS

USB_ID

I2C_SCL

I2C_SDA

ADC_IN2

ADC_IN3

The LE910Cx is a new series in the xE910 form factor

The LE910Cx is fully backward compatible to the previous xE910 in terms of:

- Mechanical dimensions
- Package and pin-map

To support the extra features and additional interfaces, the LE910Cx introduces more pins compared to the xE910.

The extra pins of the LE910Cx can be considered as optional if not needed and can be left unconnected (floating) if not used.

In this case, the new LE910Cx can be safely mounted on existing carrier boards designed for the previous xE910.

The additional pins of the LE910Cx are shown in Figure 3 (marked as Green)

PIN-OUT differences

Digital\Analog Audio

xE910 family Audio is configured differently some of modules support only Analog Audio or Digital (DVI) and some of the modules support both configurations. For modules supporting Analog and Digital Intenal coded is included in module.

Digital (DVI) Pinout:

Pin	Signal	I/O	Function	Type	Comment
Digital Voice Interface					
B9	DVI_WAO	O	Ear signal output, phase +	B-PD 1.8V	PCM_SYNC
B6	DVI_RX	I	Ear signal output, phase +	B-PD 1.8V	PCM_DIN
B7	DVI_TX	O	Microphone signal input; phase +	B-PD 1.8V	PCM_DOUT
B8	MIC-	O	Microphone signal input; phase -	B-PD 1.8V	PCM_CLK
B12*	REF_CLK	O	Audio Master Clock	B-PD 1.8V	I2S_MCLK Activated for LE910C1 only

Analog Pinout:

Pin	Signal	I/O	Function	Type	Comment
Analog Voice Interface					
B2	EAR+	O	Analog Voice Interface (EAR+)		
B3	EAR-	O	Analog Voice Interface (EAR-)		
B4	MIC+	I	Analog Voice Interface (MIC+)		
B5	MIC-	I	Analog Voice Interface (MIC-)		

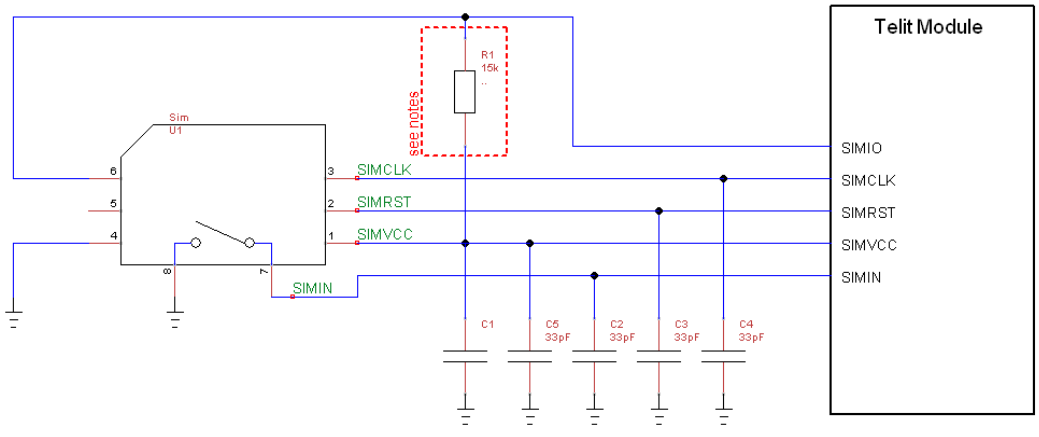
xE910 Audio configurations summary:

Module + Region Variant	Analog	Digital	Codec
LE910C1-NA\NS\AP	NA	Enabled – Pins:B6;B7;B8;B9; B12	External required
LE910D1	NA	NA	NA
HE190-D\GL EUR\EUG\EUD NAG\NAR\NAD	NA	Enabled – Pins:B6;B7;B8;B9	External required
CE910-B\DUAL CE910-SC	Enabled – Pins:B2;B3;B4;B5	Enabled – Pins:B6;B7;B8;B9	Internal
DE910-B\DUAL DE910-SC	NA	Enabled – Pins:B6;B7;B8;B9	External required
LE910 - EUG\NAG\NVG\ SVG\SKG	NA	Enabled – Pins:B6;B7;B8;B9	External required
LE910-NA\SV\EU _V2	NA	Enabled – Pins:B6;B7;B8;B9	External required
UE910- GL EUR\EUD\NAR\NAD	Enabled – Pins:B2;B3;B4;B5	Enabled – Pins:B6;B7;B8;B9	Internal
UE910-EU\V2	Enabled – Pins:B2;B3;B4;B5	Enabled – Pins:B6;B7;B8;B9	Internal
GE910-QUAD\V3\GNSS	Enabled – Pins:B2;B3;B4;B5	Enabled – Pins:B6;B7;B8;B9	Internal
ME910C1-NV\NA	NA	Enabled – Pins:B6;B7;B8;B9	External required

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.

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
LE910C1	100nF
LE910D1-E1	Cap value btw: 100nF to 1uF
ME910-C1	Cap value btw: 100nF to 1uF

Frequency Bands

xE910 family supports 2G, 3G and 4G technologies. Every module supports different band frequency hence in case of upgrading or changing between different modules better to verify supported bands for main and diversity ports.

Below are two summary tables for main and diversity:

Module + Region Variant	LTE FDD	LTE TDD	HSPA+	TD-SCDMA	2G	CDMA
LE910C1-NA	B2, B4, B12	N\A	B1, B2, B4, B5, B8	-	GSM850, 900 DCS, PCS	
LE910C1-NS	B2, B4, B5, B12, B25, B26	N\A	-	-	-	
LE910C1-AP	B1, B3, B5, B8, B28	N\A	B1, B5, B8	-	-	
LE910D1	B2O, B3, B31	N\A				
HE190-D\GL	N\A	N\A	B1, B2, B4, B5, B8		GSM 850, 900 DCS, PCS	
HE190-EUR\EUG\EUD	N\A	N\A			GSM 850, 900 DCS, PCS	
HE190-NAG\NAR\NAD	N\A	N\A			GSM 850, 900 DCS, PCS	
CE910-B\DUAL CE910-SC	N\A	N\A	N\A	N\A	N\A	800/1900MHz 800MHz
DE910-B\DUAL DE910-SC	N\A	N\A	N\A	N\A	N\A	800/1900MHz 800MHz
LE910-EUG	B20, B3, B7		B5,B8,B1		GSM 900, DCS	
LE910-NAG	B17, B5, B4, B2		B5, B2		GSM 850, PCS	
LE910-SVG	B13, B4	N\A	N\A	N\A	N\A	N\A
LE910-SKG	B3, B5					

LE910-NA_V2	B2, B4, B5, B12, B13		B2, B5			
LE910-SV_V2	B2, B4, B13					
UE910-EUR\EUD			B1, B8		GSM900, DCS	
UE910-NAR\NAD			B2, B5		GSM850, PCS	
UE910-GL			B1, B2, B5, B8		GSM 850, 900 DCS, PCS	
UE910-EU V2			B1, B8		GSM900, DCS	
UE910-NA V2			B2, B5		GSM850, PCS	
GE910-QUAD\V3					GSM 850, 900 DCS, PCS	
ME910C1-NV	B4,B13					
ME910C1-NA	B2,B4,B12					

Diversity

Module + Region Variant	LTE FDD	LTE TDD	HSPA+	TD-SCDMA
LE910C1-NA	B2, B4, B12	N\A	B1, B2, B4, B5, B8	
LE910C1-NS	B2, B4, B5, B12, B25, B26	N\A	-	
LE910C1-AP	B1, B3, B5, B8, B28	B38, B39, B40, B41	B1, B5, B8	
LE910D1	B2O, B3, B31			
HE190-D\GL			B1, B2, B5, B8 GSM850\900, DCS, PCS	
HE190-EUR\EUG\EUD			Not Supported	
HE190-NAG\NAR\NAD			Not Supported	
CE910-B\DUAL\SC			Not Supported	
DE910-B\DUAL\DSC			800/1900MHz 800MHz	
LE910-EUG	B2O, B3, B31		B1, B5, B8	
LE910-NAG	B2, B4, B5, B12, B17		B2, B5	
LE910-NVG	B4, B13		B2, B5	
LE910-SVG	B4, B13		Not Supported	
LE910-SKG	B3, B5			
LE910-NA_V2	B2, B4, B5, B12, B13		B2, B5	
LE910-SV_V2	B2, B4, B13		B2	
UE910-EUR\EUD			Not Supported	

UE910-NAR\NAD			Not Supported	
UE910-GL			Not Supported	
UE910-EU V2			Not Supported	
UE910-NA V2			Not Supported	
GE910-QUAD\V3\GNSS				Not Supported
ME910C1-NV	Not Supported			
ME910C1-NA	Not Supported			

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

GPS

xE910 family Modules support GNSS or GPS, GNSS\GPS RF port is Pin R9. xE910 GNSS Antenna configuration could be Passive or Active antenna, this depends on the Pin out configuration and is detailed at table below.

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

Module + Region Variant	Supported Mode	LNA Enable	Passive\ Active Ant.
LE910C1-NA\NS\AP	GNSS	Enabled	Active
LE910D1	NA	NA	NA
HE910-DG	GPS	Enabled	Both
HE910-D\GL	NA	NA	NA
HE910-EUR\EUG\EUD	GPS only for EUG	Enabled	Both
HE190-NAG\NAR\NAD	GPS only for NAG	Enabled	Both
CE910-B\DUAL\SC	NA	NA	NA
DE910-B\DUAL DE910-SC	GNSS	Enabled	Both
LE910 - EUG\NAG\NVG\ SVG\SKG	GNSS	Disabled	Passive
LE910-NA\SV_V2	NA	NA	NA
UE910-EUR\EUD\NAR\NAD\GL	NA	NA	NA
UE910-EU\NA V2	NA	NA	NA
GE910-QUAD\V3\GNSS	GNSS only for GE901-GNSS	Enabled	Both
ME910C1-NV\NA	GNSS	Disabled	TBD

Auxiliary Interface

General Pinout:

The Auxiliary serial ports are presented in all xE910 family products, except for UE910-V2.

Please refer to table below summarizing type of auxiliary interface.

Pin	Signal	I/O	Function	Type	Comment
SPI / AUX UART					
D15	SPI_MOSI/ TX_AUeX	O	Serial auxiliary data output from DCE (modem)	1.8V	Shared with SPI_MOSI
E15	SPI_MISO/ RX_AUX	I	Serial auxiliary data input to DCE	1.8V	Shared with SPI_MISO
F15	SPI_CLK	O	SPI Clock output	1.8V	Only for LE910C1
H15	SPI_CS/GPIO11	O	SPI Chip select output / GPIO11	1.8V	Only for LE910C1
J15					

Auxiliary Interface Summary:

Module + Region Variant	SPI	UART	Comments
LE910C1-NA\NS\AP	Enabled – Pins: D15;E15; F15; H15	Enabled – Pins: D15; E15	
LE910D1	Enabled – Pins: D15;E15;	Enabled – Pins: D15; E15	
HE190-D\GL	Enabled – Pins: D15;E15; F15; H15;J15	Enabled – Pins: D15; E15	Pins F15; H15; J15 are shared with HSIC USB ports
HE190-EUR\EUG\EUD	Enabled – Pins: D15;E15; F15; H15;J15	Enabled – Pins: D15; E15	Pins F15; H15; J15 are shared with HSIC USB ports
HE190-NAG\NAR\NAD	Enabled – Pins: D15;E15; F15; H15;J15	Enabled – Pins: D15; E15	Pins F15; H15; J15 are shared with HSIC USB ports
CE910-B\DUAL\SC	NA	Enabled – Pins: D15; E15	

DE910-B\DUAL DE910-SC	NA	Enabled – Pins: D15; E15	
LE910 - EUG\NAG\NVG \SVG\SKG	NA	Enabled – Pins: D15; E15	
LE910- NA\SV - V2	Enabled – Pins: D15;E15;F15	Enabled – Pins: D15; E15	
UE910 - EUR\EUD\NAR\ NAD\GL	Enabled – Pins: D15;E15; F15; H15;J15	Enabled – Pins: D15; E15	Pins F15; H15 are shared with HSIC USB ports
UE910- EU\NA V2	NA	NA	
GE910- QUAD\V3\GNSS	Enabled – Pins: D15;E15;F15	Enabled – Pins: D15; E15	
GE910- QUAD V3	NA	Enabled – Pins: D15; E15	
ME910C1-NV\NA	Enabled – Pins: D15;E15;F15	Enabled – Pins: D15; E15	

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

USB PORT

The USB port is presented in all xE910 family, several modules also support USB HSIC (High Speed). USB can be used for the following purposes: communication with external peripheral devices, debug monitor. Please refer to Pinout table and USB difference table summary.

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.		
A14		AI	USB ID		Enabled only for LE910C1

USB HSIC

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

USB interface summary table:

Module + Region Variant	USB	USB HSIC	Comments
LE910C1-NA\NS\AP	Enabled – Pins: B15; C15; A13; A14	Enabled – Pins: A12; A11	
LE910D1	Enabled – Pins: B15; C15; A13	NA	
HE190-D\GLEUR\EUG\EUD\NAG\NAR\NAD	Enabled – Pins: B15; C15; A13	Enabled – Pins: A12; A11; H15; F15; K15; J15; D13; E13	Pins F15; H15 and J15 are shared with SPI ports. K15 shared with GPIO8.
CE910-B\DUAL\SC	Enabled – Pins: B15; C15; A13	NA	
DE910-B\DUAL\SC	Enabled – Pins: B15; C15; A13	NA	
LE910 - EUG\NAG\NVG\SVG\SKG	Enabled – Pins: B15; C15; A13	NA	
LE910-NA\SV - V2	Enabled – Pins: B15; C15; A13	NA	
UE910 - EUR\EUD\NAR\NAD\GL	Enabled – Pins: B15; C15; A13	Enabled – Pins: A12; A11; H15; F15; K15; J15;	Pins F15; H15 and J15 are shared with SPI ports. K15 shared with GPIO8
UE910-EU\NA V2	Enabled – Pins: B15; C15; A13	NA	
GE910-QUAD\V3\GNSS	Enabled – Pins: B15; C15; A13	NA	

ME910C1-NV\NA	Enabled – Pins: B15; C15; A13	NA	

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.

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.

Power ON

To turn ON/OFF the xE910, Pad ON_OFF* must be tied low for few 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.

Module	Interval
HE910	5sec
DE910	1sec
GE910	5sec
GE910-V3	5sec
CE910	1.5sec
UE910	5sec
LE910-V2	5sec
UE910-V2	1sec
LE910	1sec
LE910C1	1sec
LE910D1-E1	1sec
ME910-C1	1sec

.

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.

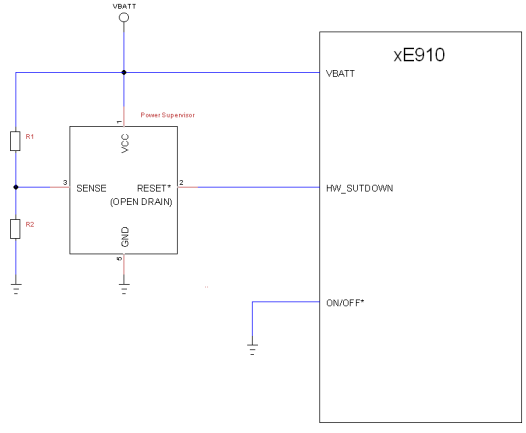
To check if the device has powered on, the hardware line PWRMON should be monitored.

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

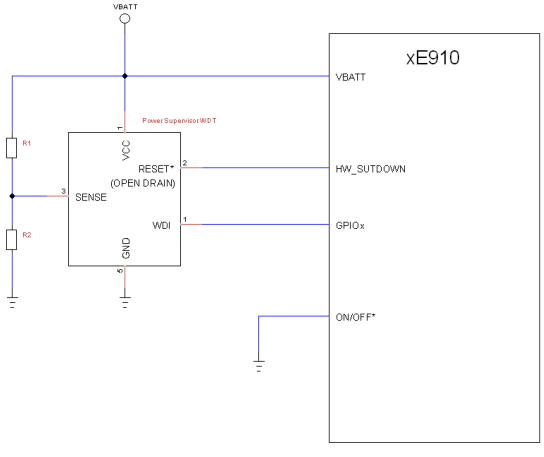
Warning:

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:

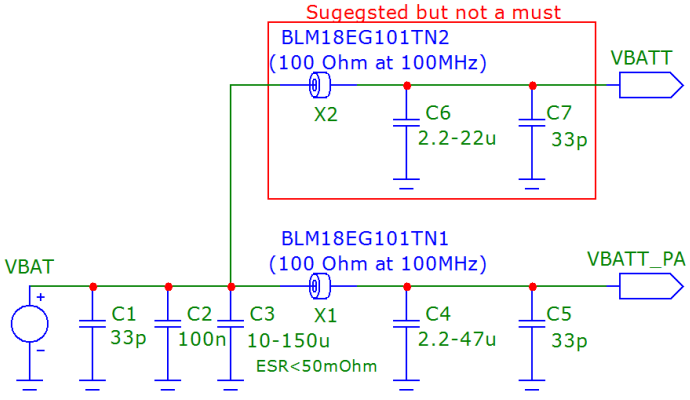


In this case you need a python script that toggles the GPIOx; in this way the module is reset in case it remains stuck for some reason.

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.



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	3.8V	3.40V - 4.20V	3.10V - 4.35V
LE910-V2	3.8V	3.40V - 4.20V	3.10V - 4.50V
UE910-V2	3.8V	3.40V - 4.20V	3.40V - 4.50V
LE910C1	3.8V	3.40V - 4.20V	3.30V - 4.20V
LE910D1	3.8V	3.40V - 4.20V	3.10V - 4.50V
ME910	3.8V	3.40V - 4.20V	3.10V - 4.50V

*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.

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	comment
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	
LE910C1	-0.3V	2.16V	
LE910D1	-0.3V	VDD_IO1 +0.3V	
ME910	-0.3V	2.1V	

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
LE910C1	0.0V	0.35V	1.5V	2.1V	0.0V	0.45V	1.35V	1.8V
LE910D1	0.0V	0.35V	1.55V	1.9V	0V	0.8V	1.35V	1.8V
ME910	0.0V	0.35V	1.5V	1.9V	0.0V	0.20V	1.6V	1.9V

	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
LE910C1	1mA	1µA
LE910D1	TBD	10µA
ME910	1mA	1µA

SERIAL PORTS

Two serial ports are available in the LE910C1, LE910D1 and ME910 modules. Two serial ports are available on the module:

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

Several configurations can be designed for the serial port on the OEM hardware, but the most common are:

- RS232 PC com port
- Microcontroller UART @ 1.8V (Universal Asynchronous Receive Transmit)
- Microcontroller UART @ 5V or other voltages different from 1.8V

Depending from the type of serial port on the OEM hardware a level translator circuit may be needed to make the system work. On the ME910C1 the ports are CMOS 1.8.

The main serial port UART is the 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 or 4 signals, for LE910D1 and ME910 only 2 signals including RX and TX and its baud rate is fix to 115200. For Module LE910C1 there are 4 signals, with extra of CLK and CS (Chip Select) on Rx and Tx. 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**.

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.

ADC CONVERTER

Modules LE910C1, LE910D1 and ME910 support 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
LE910C1	0.1v	1.7V	8	6.6mV	-
LE910D1	0V	1.2V	10	1.2mV	-
ME910	0V	1.2V	10	1.2mV	1MΩ

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

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
LE910C1	1.75V	1.80V	1.85V	100mA	1uF
LE910D1	1.78V	1.80V	1.82V	60mA	1uF
ME910	1.78V	1.80V	1.82V	60mA	1uF

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.

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
16	2017-04-06	Added LE910C1; LE910D1-E1 and ME910. In addition added summary tables for: • Bands – Main + Diversity • Audio configuration • USB Interface • Turn ON Interval • SPI\UART interface


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
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