HE910 V2 Hardware User Guide

1VV0301064 Rev.2 – 2013-11-27

Making machines talk.

APPLICABILITY TABLE

PRODUCT
HE910-EU V2
HE910-EUG V2
HE910-NA V2
HE910-NAG V2

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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Contents

1. Introduction

1.1. Scope

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE910-EU/EUG V2 HE910-NA/NAG V2 module. All the features and solutions detailed are applicable to all HE910 V2, whereas "HE910 V2" is intended the modules listed in the applicability table.

When a specific feature is applicable to a specific product, it will be clearly highlighted.

1.2. Audience

This document is intended for Telit customers who are about to implement their applications using our HE910 V2 modules.

1.3. Contact Information, Support

For general contact, technical support, to report documentation errors and to order manuals, contact Telit Technical Support Center (TTSC) at:

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
TS-APAC@telit.com

Alternatively, use:

http://www.telit.com/en/products/technical-support-center/contact.php

For detailed information about where to buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

To register for product news and announcements or for product questions contact Telit Technical Support Center (TTSC).

Our aim is to make this guide as helpful as possible. Please keep us informed of comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Document Organization

This document contains the following chapters:

Chapter 1: "Introduction" provides a scope for this document, target audience, contact and support information, and text conventions.

Chapter 2: "General Product Description" gives an overview of the features of the product.

Chapter 3: "HE910 V2 Module Connections" deals with the pin out configuration and layout.

Chapter 4: "Hardware Commands" How to operate the module via hardware.

Chapter 5: "Power supply" Power supply requirements and general design rules.

Chapter 6: "Antenna" The antenna connection and board layout design are the most important parts in the full product design.

Chapter 7: "USB Port" The USB port on the Telit HE910 V2 is the core of the interface between the module and OEM hardware.

Chapter 8: "Serial ports" Refers to the serial ports of the Telit HE910 V2.

Chapter 9: "Audio Section overview" Refers to the audio blocks of the Base Band Chip of the HE910 V2 Telit Module.

Chapter 10: "General Purpose I/O" How the general purpose I/O pads can be configured.

Chapter 11: "DAC and ADC section" Deals with these two kinds of converters.

Chapter 12: "Mounting the Module on the application board" Mechanical dimensions and recommendations on how to mount the module on the user's board.

Chapter 13: "Packing System" Deals with packing system.

Chapter 14: "Application Design Guide" Deals with the application design of host system.

Chapter 15: "Conformity Assessment Issues" provides some fundamental hints about the conformity assessment that the final application might need.

Chapter 16: "Safety Recommendation" provides some safety recommendations that must be followed by the customer in the design of the application that makes use of the Telit HE910 V2.

Chapter 17: "Document History"

1.5. 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.

1.6. Related Documents

- HE910 V2 Product Description, 80418ST10602A
- HE910 V2 Software User guide, 1vv0301071
- HE910 V2 AT command reference guide, 80428ST10592A
- HE910 V2 Digital Voice Interface Application Note, 80000NT10101A
- Telit EVK2 User Guide, 1vv0300704

2. General Product Description

2.1. Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE10 V2 module.

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 must be considered as mandatory, while the suggested hardware configurations must not be considered mandatory, instead the information given must be used as a guide and a starting point for properly developing your product with the Telit HE10 V2 module.

NOTE:

The integration of the GSM/GPRS/EGPRS/WCDMA/HSPA+ HE910 V2 cellular module within user application must be done according to the design rules described in this manual.

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2.2. HE910 V2 Product specification

HE910 V2 Variants							
Variant name	Upload HSUPA (Mbps)	Download HSDPA (Mbps)	Frequencies UMTS/HSPA+ bands(MHz)	Features GSM/GPRS/EDGE Quad-band	Data	Voice	GPS
EMEA/APAC/Latin American markets							
HE910-EU V2	5.76	14.4	900, 2100	■	■	■	
HE910-EUG V2	5.76	14.4	900, 2100	■	■	■	■
North American markets							
HE910-NA V2	5.76	14.4	850, 1900	■	■	■	
HE910-NAG V2	5.76	14.4	850, 1900	■	■	■	■

2.3. HE910 V2 Mechanical Dimensions

The Telit HE910 V2 module overall dimensions are:

- Length: 28.2 mm
- Width: 28.2 mm
- Thickness: 2.2 mm

2.4. Weight

The module weight of HE910 V2 is about 4.0 gram.

2.5. Environmental requirements

2.5.1. Temperature range

Operating Temperature Range	–40°C ~ +85°C
Storage and non-operating Temperature Range	–40°C ~ +90°C

2.5.2. RoHS compliance

As a part of Telit's corporate policy of environmental protection, the HE910 V2 complies with the RoHS (Restriction of Hazardous Substances) directive of the European Union (EU directive 2011/65/EU).

2.6. Operating Frequency

The operating frequencies in GSM850, EGSM900, DCS1800, PCS1900, WCDMA modes are conformed to the 3GPP specifications.

Mode	Freq. TX (MHz)	Freq. RX (MHz)	Channels	TX - RX offset
GSM850	824.2 ~ 848.8	869.2 ~ 893.8	128 ~ 251	45 MHz
EGSM900	890.0 ~ 914.8	935.0 ~ 959.8	0 ~ 124	45 MHz
	880.2 ~ 889.8	925.2 ~ 934.8	975 ~ 1023	45 MHz
DCS1800	1710.2 ~ 1784.8	1805.2 ~ 1879.8	512 ~ 885	95MHz
PCS1900	1850.2 ~ 1909.8	1930.2 ~ 1989.8	512 ~ 810	80MHz
WCDMA850 (HE910-NA/NAG V2 only)	826.4 ~ 846.6	871.4 ~ 891.6	Tx: 4132 ~ 4233 Rx: 4357 ~ 4458	45MHz
WCDMA900 (HE910-EU/EUG V2 only)	882.4 ~ 912.6	927.4 ~ 957.6	Tx: 2712 ~ 2863 Rx: 2937 ~ 3088	45MHz
WCDMA1900 (HE910-NA/NAG V2 only)	1852.4 ~ 1907.6	1932.4 ~ 1987.6	Tx: 9262 ~ 9538 Rx: 9662 ~ 9938	80MHz
WCDMA2100 (HE910-EU/EUG V2 only)	1922.4 ~ 1977.6	2112.4 ~ 2167.6	Tx: 9612 ~ 9888 Rx: 10562 ~ 10838	190MHz

3. HE910 V2 Module Connections

3.1. Pin-Out

Pin	Signal	I/O	Function	Type
USB HS 2.0 Communication Port				
B15	USB_D+	I/O	USB differential Data(+)	
C15	USB_D-	I/O	USB differential Data(-)	
A13	VBUS	I	Power sense for the internal USB transceiver	5V
Asynchronous 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 Data terminal ready signal (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 Data carrier detect signal (DCD) to DTE	CMOS 1.8V
P14	C107/DSR	O	Output for Data set ready signal (DSR) to DTE	CMOS 1.8V
R14	C125/RING	O	Output for Ring indicator signal (RI) to DTE	CMOS 1.8V
Asynchronous Auxiliary UART				
D15	TX_AUX	O	Auxillary UART (TX Data to DTE)	CMOS 1.8V
E15	RX_AUX	I	Auxillary UART (RX Data from DTE)	CMOS 1.8V
RUIM Card Interface(*)				
A3	SIMVCC	-	External SIM signal - Power supply for the SIM	1.8/2.85V
A4	SIMIN	I	External SIM signal – Presence(active low)	CMOS 1.8V
A5	SIMIO	I/O	External SIM signal – Data I/O	1.8/2.85V
A6	SIMCLK	O	External SIM signal - Clock	1.8/2.85V
A7	SIMRST	O	External SIM signal - Reset	1.8/2.85V
Digital Voice interface (DVI)				
B9	DVI_WA0	I/O	Digital Voice interface (WA0)	CMOS 1.8V
B6	DVI_RX	I	Digital Voice interface (RX)	CMOS 1.8V
B7	DVI_TX	O	Digital Voice interface (TX)	CMOS 1.8V
B8	DVI_CLK	I/O	Digital Voice interface (CLK)	CMOS 1.8V
Digital IO				
C8	GPIO_01	I/O	GPIO_01 / STAT LED	CMOS 1.8V
C9	GPIO_02	I/O	GPIO_02	CMOS 1.8V
C10	GPIO_03	I/O	GPIO_03	CMOS 1.8V
C11	GPIO_04	I/O	GPIO_04	CMOS 1.8V
B14	GPIO_05	I/O	GPIO_05	CMOS 1.8V
C12	GPIO_06	I/O	GPIO_06	CMOS 1.8V
C13	GPIO_07	I/O	GPIO_07 / DAC_OUT	CMOS 1.8V
K15	GPIO_08	I/O	GPIO_08	CMOS 1.8V
L15	GPIO_09	I/O	GPIO_09	CMOS 1.8V
G15	GPIO_10	I/O	GPIO_10	CMOS 1.8V
ADC Section				
B1	ADC_IN1	AI	Analog/Digital converter input	A/D

Pin	Signal	I/O	Function	Type
RF Section				
K1	ANTENNA	I/O	CDMA Antenna (50Ohm)	RF
GPS Section				
R9	ANT_GPS	I	GPS Antenna (50Ohm)	RF
R7	GPS_LNA_EN	O	Output enable for External LNA supply	CMOS 1.8V
Miscellaneous Function				
R13	HW_SHUTDOWN*	I	Hardware unconditional shutdown	CMOS 1.8V Open collector
R12	ON_OFF*	I	Input Command for Power ON/Software shutdown	CMOS 1.8V Open collector
C14	VRTC	I	VRTC Backup Capacitor	Power
R11	VAUX/PWRMON	O	Supply Output for external accessories / Power ON Monitor	1.8V
Power Supply				
M1	VBATT	-	Main Power Supply (Baseband)	Power
M2	VBATT	-	Main Power Supply (Baseband)	Power
N1	VBATT_PA	-	Main Power Supply (PAM)	Power
N2	VBATT_PA	-	Main Power Supply (PAM)	Power
P1	VBATT_PA	-	Main Power Supply (PAM)	Power
P2	VBATT_PA	-	Main Power Supply (PAM)	Power
E1	GND	-	Ground	
G1	GND	-	Ground	
H1	GND	-	Ground	
J1	GND	-	Ground	
L1	GND	-	Ground	
A2	GND	-	Ground	
E2	GND	-	Ground	
F2	GND	-	Ground	
G2	GND	-	Ground	
H2	GND	-	Ground	
J2	GND	-	Ground	
K2	GND	-	Ground	
L2	GND	-	Ground	
R2	GND	-	Ground	
M3	GND	-	Ground	
N3	GND	-	Ground	
P3	GND	-	Ground	
R3	GND	-	Ground	
D4	GND	-	Ground	
M4	GND	-	Ground	
N4	GND	-	Ground	
P4	GND	-	Ground	
R4	GND	-	Ground	
N5	GND	-	Ground	
P5	GND	-	Ground	
R5	GND	-	Ground	
N6	GND	-	Ground	

Pin	Signal	I/O	Function	Type
P6	GND	-	Ground	
R6	GND	-	Ground	
P8	GND	-	Ground	
R8	GND		Ground	
P9	GND	-	Ground	
P10	GND	-	Ground	
R10	GND	-	Ground	
M12	GND	-	Ground	
B13	GND	-	Ground	
P13	GND	-	Ground	
E14	GND	-	Ground	
Reserved				
C1	Reserved	-	Reserved	
D1	Reserved	-	Reserved	
B2	Reserved	-	Reserved	
C2	Reserved	-	Reserved	
D2	Reserved	-	Reserved	
B3	Reserved	-	Reserved	
C3	Reserved	-	Reserved	
D3	Reserved	-	Reserved	
E3	Reserved	-	Reserved	
F1	Reserved	-	Reserved	
F3	Reserved	-	Reserved	
G3	Reserved	-	Reserved	
H3	Reserved	-	Reserved	
J3	Reserved	-	Reserved	
K3	Reserved	-	Reserved	
L3	Reserved	-	Reserved	
B4	Reserved	-	Reserved	
C4	Reserved	-	Reserved	
B5	Reserved	-	Reserved	
C5	Reserved	-	Reserved	
C6	Reserved	-	Reserved	
C7	Reserved	-	Reserved	
N7	Reserved	-	Reserved	
P7	Reserved	-	Reserved	
A8	Reserved	-	Reserved	
N8	Reserved	-	Reserved	
A9	Reserved	-	Reserved	
N9	Reserved	-	Reserved	
A10	Reserved	-	Reserved	
B10	Reserved	-	Reserved	
B11	Reserved	-	Reserved	
N10	Reserved	-	Reserved	
A11	Reserved	-	Reserved	
N11	Reserved	-	Reserved	
P11	Reserved	-	Reserved	

Pin	Signal	I/O	Function	Type
A12	Reserved	-	Reserved	
B12	Reserved	-	Reserved	
D12	Reserved	-	Reserved	
N12	Reserved	-	Reserved	
P12	Reserved	-	Reserved	
D13	Reserved	-	Reserved	
E13	Reserved	-	Reserved	
F13	Reserved	-	Reserved	
G13	Reserved	-	Reserved	
H13	Reserved	-	Reserved	
J13	Reserved	-	Reserved	
K13	Reserved	-	Reserved	
L13	Reserved	-	Reserved	
M13	Reserved	-	Reserved	
N13	Reserved	-	Reserved	
A14	Reserved	-	Reserved	
D14	Reserved	-	Reserved	
F14	Reserved	-	Reserved	
G14	Reserved	-	Reserved	
H14	Reserved	-	Reserved	
J14	Reserved	-	Reserved	
K14	Reserved	-	Reserved	
F15	Reserved	-	Reserved	
H15	Reserved	-	Reserved	
J15	Reserved	-	Reserved	

WARNING:

Reserved pins must not be connected.

NOTE:

The following table is listing the main Pinout differences between the HE910 V2 variants.

Product	GPS	Notes
HE910-EUG V2	Yes	
HE910-EU V2	NO	Reserved pads: R7, R9
HE910-NAG V2	Yes	
HE910-NA V2	NO	Reserved pads: R7, R9

NOTE:

DTR pin must be connected in order to enter HE910 V2's power saving mode.

RI pin must be connected in order to wake up the host when a call is coming in sleep mode of host.

NOTE:

Almost all pins not in use must be left disconnected. The only exceptions are the following pins:

PAD	Signal	
M1,M2,N1,N2,P1,P2	VBATT&VBATT_PA	
E1,G1,H1,J1,L1,A2, E2,F2,G2,H2,J2,K2, L2,R2,M3,N3,P3,R3, D4,M4,N4,P4,R4,N5 ,P5,R5,N6,P6,R6,P8, R8,P9,P10,R10,M12, B13,P13,E14	GND	
R12	ON_OFF*	
R13	HW_SHUTDOWN*	
B15	USB_D+	If not used should be connected to a Test Point
C15	USB_D-	If not used should be connected to a Test Point
A13	VBUS	If not used should be connected to a Test Point
N15	C103/TXD	If not used should be connected to a Test Point
M15	C104/RXD	If not used should be connected to a Test Point
L14	C105/RTS	If the flow control is not used it should be connected to GND
P15	C106/CTS	If not used should be connected to a Test Point
D15	TXD_AUX	If not used should be connected to a Test Point
E15	RXD_AUX	If not used should be connected to a Test Point
K1	Main Antenna	
R9	ANT_GPS (If supported by the product)	If the GPS is not used it could be left unconnected

RTS must be connected to the GND (on the module side) if flow control is not used.

The above pins are also necessary to debug the application when the module is assembled on it so we recommend connecting them also to dedicated test point.

3.1.1. LGA Pads Layout (HE910-EUG V2 and HE910-NAG V2)

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	
1		ADC_IN1	RES	RES	GND	RES	GND	GND	GND	ANTENNA	GND	VBATT	VBATT_PA	VBATT_PA		1
2	GND	RES	RES	RES	GND	GND	GND	GND	GND	GND	GND	VBATT	VBATT_PA	VBATT_PA	GND	2
3	SIMVCC	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	GND	GND	GND	3
4	SIMIN	RES	RES	GND								GND	GND	GND	GND	4
5	SIMIO	RES	RES										GND	GND	GND	5
6	SIMCLK	DVI_RX	RES										GND	GND	GND	6
7	SIMRST	DVI_TX	RES										RES	RES	GPS_LNA_EN	7
8	RES	DVI_CLK	GPIO_01										RES	GND	GND	8
9	RES	DVI_WA0	GPIO_02										RES	GND	ANT_GPS	9
10	RES	RES	GPIO_03										RES	GND	GND	10
11	RES	RES	GPIO_04										RES	RES	VAUX/PWR MON	11
12	RES	RES	GPIO_06	RES								GND	RES	RES	ON_OFF*	12
13	USB_VBUS	GND	GPIO_07	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	HW_SHUTDOWN*	13
14	RES	GPIO_05	VRTC	RES	GND	RES	RES	RES	RES	RES	C105/RTS	C108/DTR	C109/DCD	C107/DSR	C125/RING	14
15		USB_D+	USB_D-	TX_AUX	RX_AUX	RES	GPIO_10	RES	RES	GPIO_08	GPIO_09	C104/RXD	C103/TXD	C106/CTS		15
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	

Top View

NOTE:

The pin defined as RES must be considered RESERVED and not connected on any pin in the application. The related area on the application has to be kept empty.

3.1.2. LGA Pads Layout (HE910-EU V2 and HE910-NA V2)

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	
1		ADC_IN1	RES	RES	GND	RES	GND	GND	GND	ANTENNA	GND	VBATT	VBATT_PA	VBATT_PA		1
2	GND	RES	RES	RES	GND	GND	GND	GND	GND	GND	GND	VBATT	VBATT_PA	VBATT_PA	GND	2
3	SIMVCC	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	GND	GND	GND	3
4	SIMIN	RES	RES	GND								GND	GND	GND	GND	4
5	SIMIO	RES	RES										GND	GND	GND	5
6	SIMCLK	DVI_RX	RES										GND	GND	GND	6
7	SIMRST	DVI_TX	RES										RES	RES	RES	7
8	RES	DVI_CLK	GPIO_01										RES	GND	GND	8
9	RES	DVI_WAO	GPIO_02										RES	GND	RES	9
10	RES	RES	GPIO_03										RES	GND	GND	10
11	RES	RES	GPIO_04										RES	RES	VAUX/PWR MON	11
12	RES	RES	GPIO_06	RES								GND	RES	RES	ON_OFF*	12
13	USB_VBUS	GND	GPIO_07	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	HW_SHUTDOWN*	13
14	RES	GPIO_05	VRTC	RES	GND	RES	RES	RES	RES	RES	C105/RTS	C108/DTR	C109/DCD	C107/DSR	C125/RING	14
15		USB_D+	USB_D-	TX_AUX	RX_AUX	RES	GPIO_10	RES	RES	GPIO_08	GPIO_09	C104/RXD	C103/TXD	C106/CTS		15
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	

Top View

NOTE:

The pin defined as RES must be considered RESERVED and not connected on any pin in the application. The related area on the application has to be kept empty.

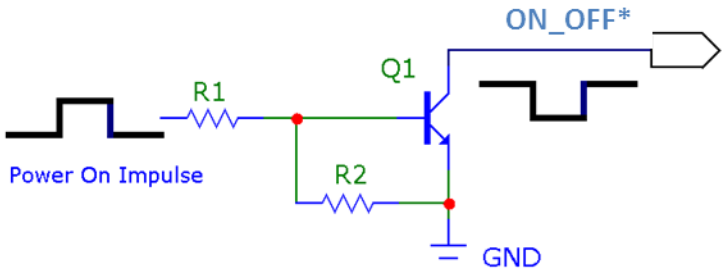
4. Hardware Commands

4.1. Turning on the HE910 V2 module

To turn on the HE910 V2, the pad ON_OFF* must be tied low for at least 1 second and then released.

The maximum current that can be drained from the ON_OFF* pad is 0.1 mA.

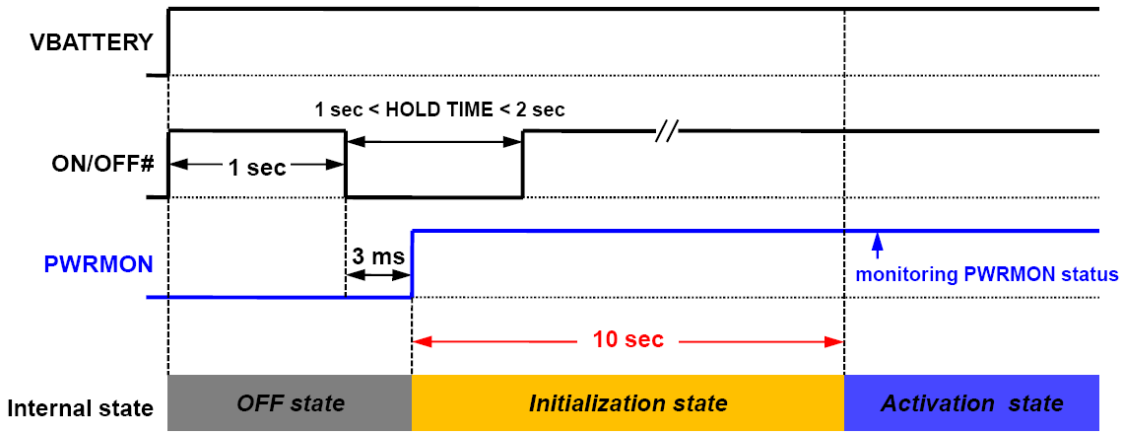
A simple circuit to power on the module is illustrated below:



4.1.1. Initialization and Activation State

Upon turning on HE910 V2 module, the HE910 V2 module is not active yet because the boot sequence of HE910 V2 is still executing internally. It takes about 10 seconds to complete the initialization of the module internally.

For this reason, it would be useless to try to access HE910 V2 during the Initialization state as below. The HE910 V2 module needs at least 10 seconds after the PWRMON goes High to become operational by reaching the activation state.



During the *Initialization state*, any kind of AT-command is not available. DTE must wait for the *Activation state* to communicate with HE910 V2.

To check if the HE910 V2 has powered on, the hardware line PWRMON must be monitored. When PWRMON goes high, the module has powered on.

NOTE:

Do not use any pull up resistor on the ON_OFF* line. It is pulled up internally. Using a pull up resistor may bring latch up problems on the HE910 V2 power regulator and improper power on/off of the module. The line ON_OFF* must be connected only in open collector configuration.

NOTE:

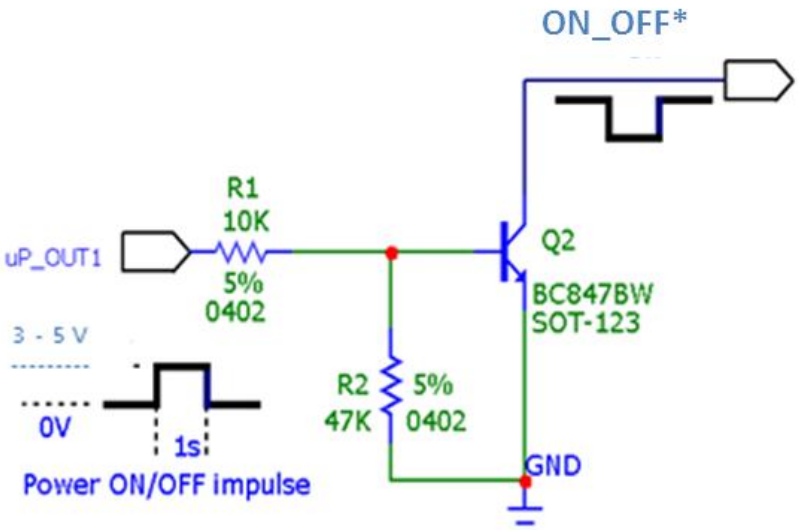
In this document all the lines are inverted. Active low signals are labeled with a name that ends with "*" or with a bar over the name.

NOTE:

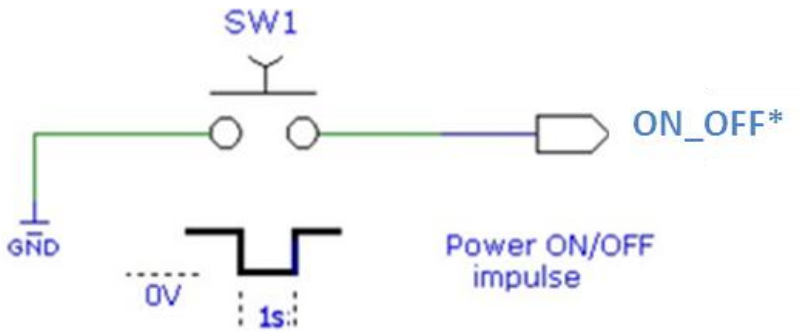
In order to avoid a back powering effect it is recommended to avoid having any HIGH logic level signal applied to the digital pins of the HE910 V2 module when the module is powered OFF or during an ON/OFF transition.

For example:

1. To drive the ON_OFF* pad with a totem pole output of a +3/5 V microcontroller (uP_OUT1):



2. To drive the ON_OFF* pad directly with an ON/OFF button:



4.2. Turning off the HE910 V2 module

Turning off the device can be done in two ways:

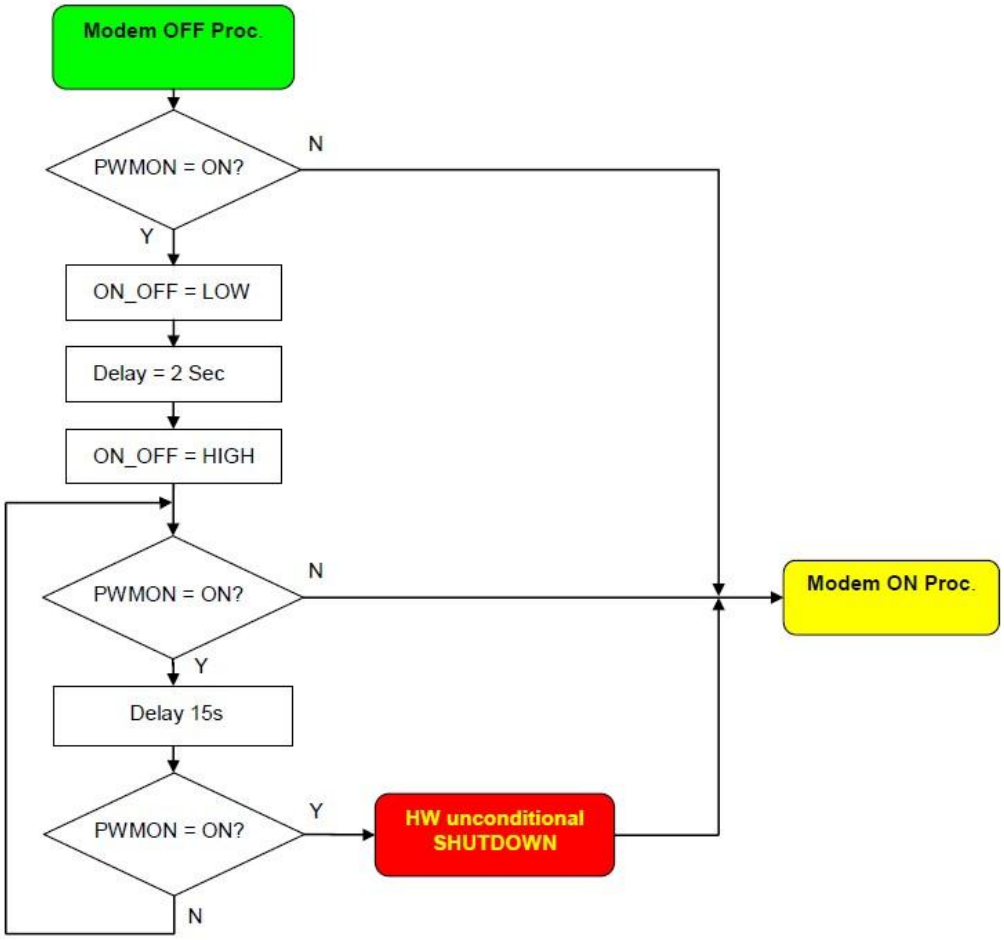
- By software command (see HE910 V2 Software User Guide)
- By hardware shutdown (pad ON_OFF*)

When the device is shut down by software command or by hardware shutdown, it issues a detach request to the network that informs the network that the device will no longer be reachable.

NOTE:

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 V2 when the module is powered OFF or during an ON/OFF transition.

The following flow chart shows the proper turnoff procedure:



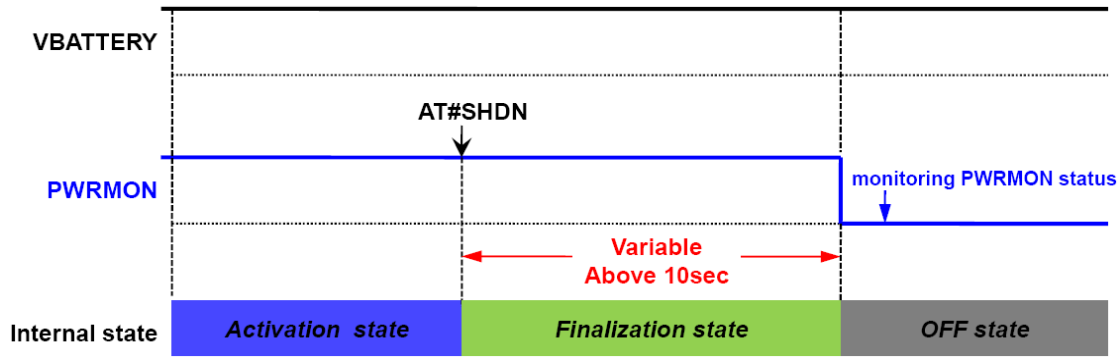
4.2.1. Shutdown by Software Command

The HE910 V2 can be shut down by a software command.

When a shutdown command is sent, the HE910 V2 goes into the finalization state and will shut down PWRMON at the end of this state.

The period of the finalization state can vary according to the state of the HE910 V2 so it cannot be fixed definitely.

Normally it will be above 10 seconds after sending a shutdown command and DTE should monitor the status of PWRMON to see the actual power off.



TIP:

To check if the device has powered off hardware line PWRMON must be monitored. When PWRMON goes low, the device has powered off.

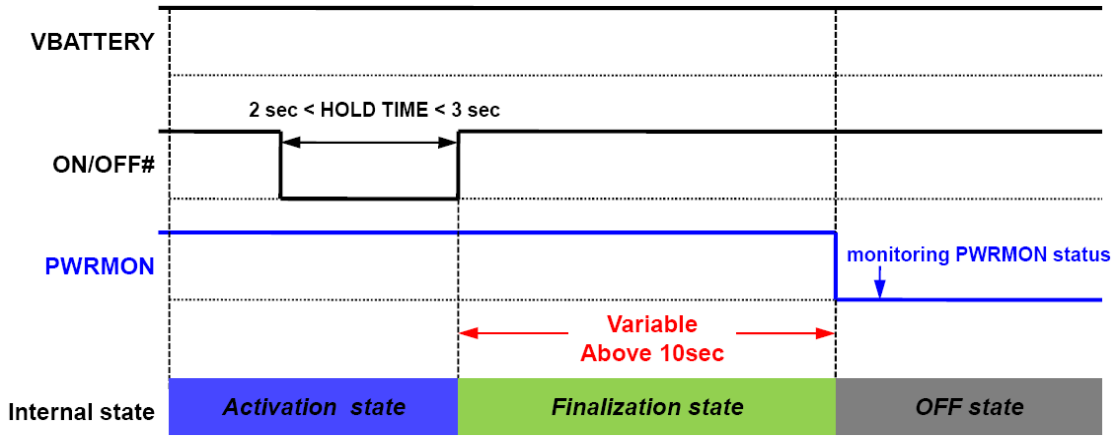
4.2.2. Hardware Shutdown

To turn OFF the HE910 V2 the pad ON_OFF* must be tied low for at least 2 seconds and then released. The same circuitry and timing for the power on must be used.

When the hold time of ON_OFF* is above 2 seconds, the HE910 V2 goes into the finalization state and will shut down PWRMON at the end of this state.

The period of the finalization state can vary according to the state of the HE910 V2 so it cannot be fixed definitely.

Normally it will be above 10 seconds after releasing ON_OFF* and DTE should monitor the status of PWRMON to see the actual power off.



TIP:

To check if the device has powered off, hardware line PWRMON must be monitored. When PWRMON goes low, the device has powered off.

4.3. Hardware Reset

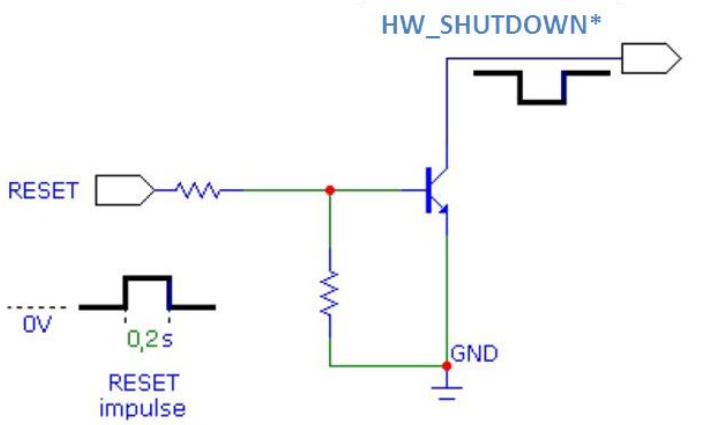
WARNING:

The Hardware Reset 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.

4.3.1. Hardware Unconditional Shutdown

To unconditionally shutdown the HE910 V2, the pad HW_SHUTDOWN* must be tied low for at least 200 milliseconds and then released.

A simple circuit to unconditionally shutdown the module is illustrated below:



NOTE:

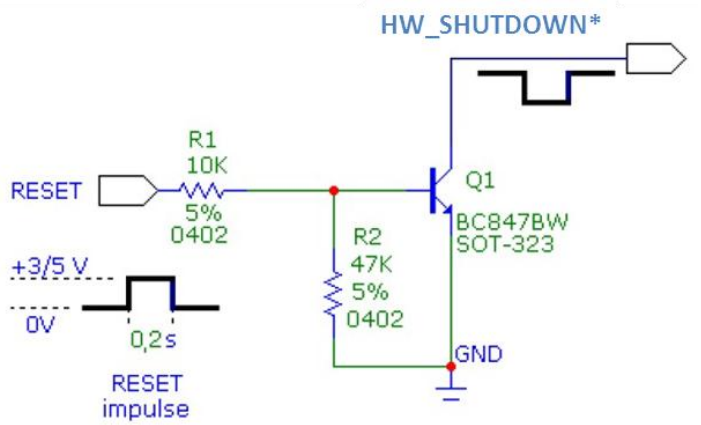
Do not use any pull up resistor on the HW_SHUTDOWN* line or any totem pole digital output. Using a pull up resistor may bring latch up problems on the HE910 V2 power regulator and result in improper functioning of the module. The line HW_SHUTDOWN* must be connected only in open collector configuration.

TIP:

The unconditional hardware Shutdown must always be implemented on the boards and the software must use it only as an emergency exit procedure.

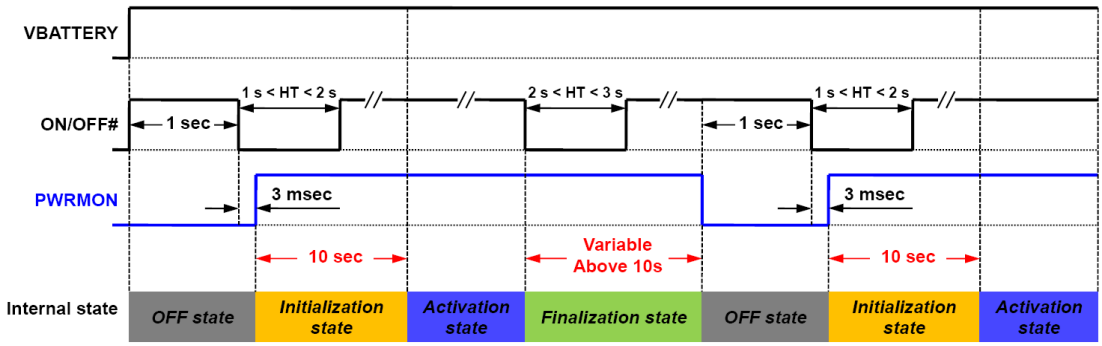
For example:

To drive the HW_SHUTDOWN* pad with a totem pole output of a +3/5 V microcontroller (uP_OUT2):



4.4. Summary of Turning ON and OFF the Module

The chart below describes the overall sequences for turning the module ON and OFF.



5. 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's overall performance. Read carefully the requirements and the guidelines that follow for a proper design.

5.1. Power Supply Requirements

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

Power Supply	
Nominal Supply Voltage	3.8V
Normal Operating Voltage Range	3.4V ~ 4.2V
Extended Operating Voltage Range	3.3V ~ 4.5V

HE910 V2			
Mode		**Average(mA)**	**Mode Description**
SWITCHED OFF			Module supplied but Switched Off
Switched Off		30uA (*[1])	
IDLE mode			Standby mode; no call in progress
AT+CFUN=1	WCDMA	15	Normal mode; full functionality of the module
	GSM	15	
AT+CFUN=4	WCDMA	13	Disabled TX and RX; modules is not registered on the network
	GSM	13	
AT+CFUN=0 or AT+CFUN=5	WCDMA	3.2 (512frame) 1.0 (64frame) (*[2])	Power saving; CFUN=0 module registered on the network and can receive voice call or an SMS; but it is not possible to send AT commands; module wakes up with an unsolicited code (call or SMS) or rising RTS line. CFN=5 full functionality with power saving; Module registered on the network can receive incoming call sand SMS
	GSM	3.2 (DRX2) 1.7 (DRX5) 1.3 (DRX9) (*[2])	
	GPRS	1.7 (DRX5) (*[3])	
WCDMA TX and RX mode			Operating mode
WCDMA Voice		630	WCDMA voice channel
HSPA		640	HSPA data channel
GSM TX and RX mode			Operating mode
GSM Voice(CSD)		230	GSM850/GSM900
		185	DCS1800/PCS1900
GPRS 2TX/3RX		390	GSM850/GSM900, class10
		300	DCS1800/PCS1900, class10

Mode		Average(mA)	Mode Description
GSM TX and RX mode			Operating mode
GPRS 4TX/2RX		600	GSM850/GSM900, class33
		450	DCS1800/PCS1900, class33
EDGE 4TX/2RX		400	GSM850/GSM900, class33
		350	DCS1800/PCS1900, class33
GSM peak current		1800	

(*1) The off current is the total supply current from the main battery with the PMIC off and the 32 kHz XTAL oscillator on.
(*2) Worst/best case depends on network configuration and is not under module control.
(*3) GPRS with PDP context active

NOTE:

The Operating Voltage Range MUST never be exceeded. Special care must be taken when designing the application's power supply section to avoid having an excessive voltage drop.

If the voltage drop is exceeding the limits it could cause a Power Off of the module.

Behavior in the extended operating voltage range might deviate from 3GPP3 specification.

NOTE:

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

In GSM/GPRS mode, RF transmission is not continuous and it is packed into bursts at a base frequency of about 216 Hz, and the relative current peaks can be as high as about 2A. Therefore the power supply has to be designed in order to withstand these current peaks without big voltage drops; this means that both the electrical design and the board layout must be designed for this current flow. If the layout of the PCB is not well designed, a strong noise floor is generated on the ground; this will reflect on all the audio paths producing an audible annoying noise at 216 Hz; if the voltage drops during the peak, current absorption is too much. The device may even shut down as a consequence of the supply voltage drop.

5.2. General Design Rules

The principal guidelines for the Power Supply Design embrace three different design steps:

- the electrical design
- the thermal design
- the PCB layout

5.2.1. Electrical Design Guidelines

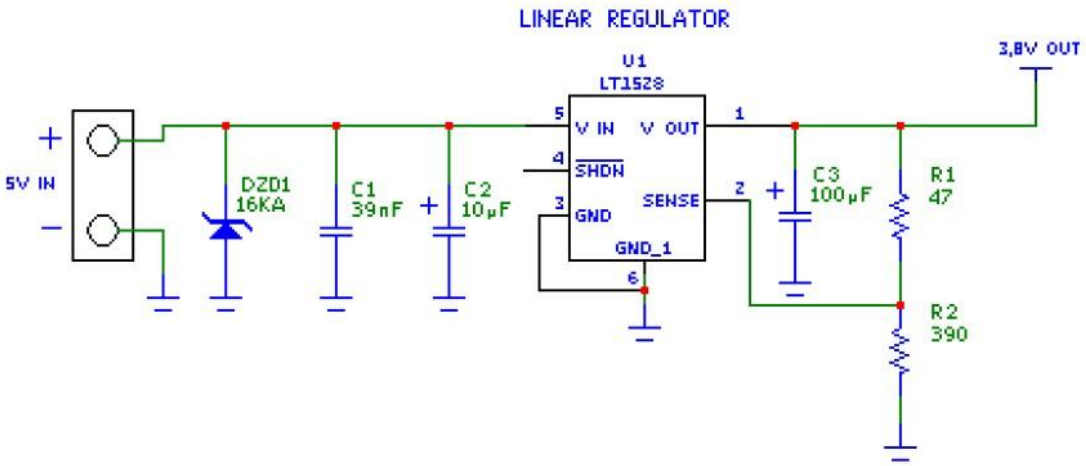
The electrical design of the power supply depends strongly on the power source where this power is drained. We will distinguish them into three categories:

- +5V input (typically PC internal regulator output)
- +12V input (typically automotive)
- Battery

5.2.1.1. + 5V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence there is not a big difference between the input source and the desired output so a linear regulator can be used. A switching power supply will not be suitable because of the low drop-out requirements.
- When using a linear regulator, a proper heat sink must be provided in order to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks close to the HE910 V2. A 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input in order to save the HE910 V2 from power polarity inversion.

An example of a linear regulator with 5V input:

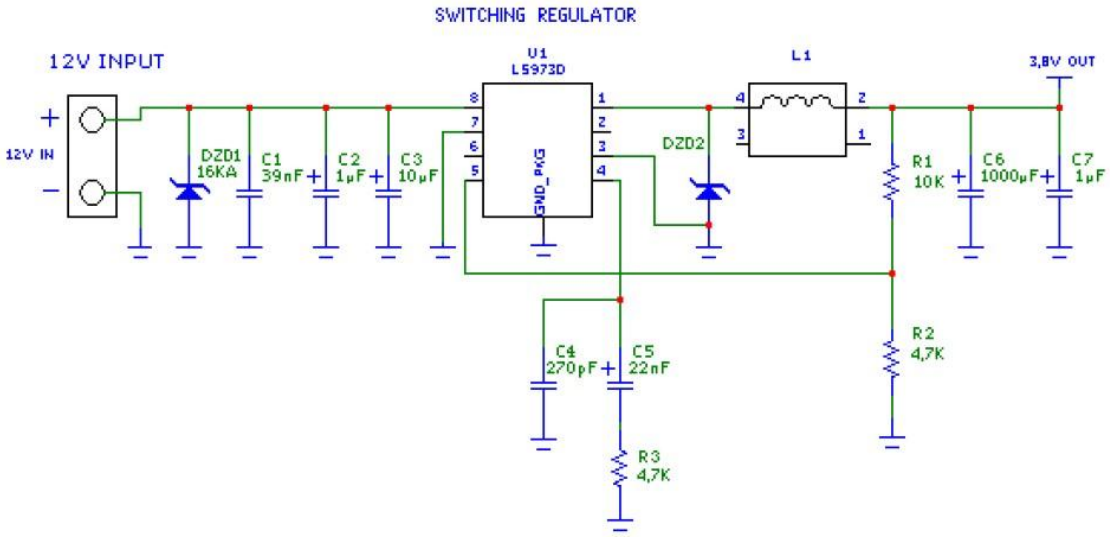


5.2.1.2. + 12V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence due to the big difference between the input source and the desired output, a linear regulator is not suited and must not be used. A switching power supply will be preferable because of its better efficiency especially with the 2A peak current load represented by HE910 V2.
- When using a switching regulator, a 500kHz or more switching frequency regulator is preferable because of its smaller inductor size and its faster transient response. This allows the regulator to respond quickly to the current peaks absorption.
- In any case, the frequency and Switching design selection is related to the application to be developed due to the fact the switching frequency could also generate EMC interferences.
- For car PB battery the input voltage can rise up to 15.8V and this must be kept in mind when choosing components: all components in the power supply must withstand this voltage.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks. A 100µF tantalum capacitor is usually suited for this.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode must be inserted close to the power input, in order to clean the supply from spikes.

- A protection diode must be inserted close to the power input, in order to save HE910 V2 from power polarity inversion. This can be the same diode as for spike protection.

An example of switching regulator with 12V input is in the schematic below:



5.2.1.3. Battery Source Power Supply Design Guidelines

The desired nominal output for the power supply is 3.8V and the maximum voltage allowed is 4.2V. A single 3.7V lithium-ion cell battery type is ideal to supply power to the Telit HE910 V2 module.

WARNING:

The three battery cells (Ni/Cd or Ni/MH 3.6V nom. battery types or 4V PB types) MUST NOT be used directly because their maximum voltage can rise over the absolute maximum voltage for the HE910 V2 and cause damage. USE only Li-Ion battery types.

NOTE:

Do not use any Ni-Cd, Ni-MH, and Pb battery types directly connected with HE910 V2. Their use can lead to overvoltage on HE910 V2 and damage it. Use only Li-Ion battery types.

- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks, a 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor (usually a tantalum one) is rated at least 10V.

- A protection diode must be inserted close to the power input, in order to save HE910 V2 from power polarity inversion. Otherwise the battery connector must be done in a way to avoid polarity inversions when connecting the battery.
- The battery capacity must be at least 500mAh in order to withstand the current peaks of 2A; the suggested capacity is from 500mAh to 1000mAh.

5.2.2. Thermal Design Guidelines

The thermal design for the power supply heat sink must be done with the following specifications:

- Average current consumption during HSPA transmission @PWR level max in HE910 V2: 640mA
- Average current consumption during class10 GPRS transmission @PWR level max: 390mA
- Average current consumption during class33 GPRS transmission @PWR level max: 600mA
- Average GPS current during GPS ON (Power Saving disabled) : 65mA

NOTE:

The average consumption during transmissions depends on the power level at which the device is requested to transmit via the network. The average current consumption hence varies significantly.

NOTE:

The thermal design for the Power supply must be made keeping an average consumption at the max transmitting level during calls of 640mA(HSPA)/600mA(class33 GPRS) /390mA(class10 GPRS) rms plus 65mA rms for GPS in tracking mode.

Considering the very low current during idle, especially if Power Saving function is enabled, it is possible to consider from the thermal point of view that the device absorbs current significantly only during calls.

If we assume that the device stays in transmission for short periods of time (let us say few minutes) and then remains for quite a long time in idle (let us say one hour), then the power supply has always the time to cool down between the calls and the heat sink could be smaller than the calculated for 640mA (HSPA)/ 600mA (class33 GPRS)/ 390mA (class10 GPRS) maximum RMS current. There could even be a simple chip package (no heat sink).

Moreover in average network conditions the device is requested to transmit at a lower power level than the maximum and hence the current consumption will be less than 640mA (HSPA) / 600mA (class33 GPRS) /390mA (class10 GPRS) (being usually around 250mA).

For these reasons the thermal design is rarely a concern and the simple ground plane where the power supply chip is placed can be enough to ensure a good thermal condition and avoid overheating.

For the heat generated by the HE910 V2, you can consider it to be during transmission 2W max during class10 GPRS/class33 GPRS upload. This generated heat will be mostly

conducted to the ground plane under the HE910 V2; you must ensure that your application can dissipate heat.

In the WCDMA/HSPA mode, since HE910 V2 emits RF signals continuously during transmission, you must pay special attention how to dissipate the heat generated.

The current consumption will be up to about 640mA in HSPA (630mA in WCDMA) continuously at the maximum TX output power (23dBm). Thus, you must arrange the PCB area as large as possible under HE910 V2 which you will mount. You must mount HE910 V2 on the large ground area of your application board and make many ground vias to dissipate the heat.

The peak current consumption in the GSM mode is higher than that in WCDMA. However, considering the heat sink is more important in case of WCDMA.

As mentioned before, a GSM signal is bursty, thus, the temperature drift is more insensible than WCDMA. Consequently, if you prescribe the heat dissipation in the WCDMA mode, you don't need to think more about the GSM mode.

5.2.3. Power Supply PCB Layout Guidelines

As seen in the electrical design guidelines, the power supply must have a low ESR capacitor on the output to cut the current peaks and a protection diode on the input to protect the supply from spikes and polarity inversion. The placement of these components is crucial for the correct working of the circuitry. A misplaced component can be useless or can even decrease the power supply performances.

- The Bypass low ESR capacitor must be placed close to the Telit HE910 V2 power input pads, or in the case the power supply is a switching type, it can be placed close to the inductor to cut the ripple if the PCB trace from the capacitor to HE910 V2 is wide enough to ensure a drop-less connection even during the 2A current peaks.
- The protection diode must be placed close to the input connector where the power source is drained.
- The PCB traces from the input connector to the power regulator. IC must be wide enough to ensure no voltage drops to occur when the 2A current peaks are absorbed. Note that this is not made in order to save power loss but especially to avoid the voltage drops on the power line at the current peaks frequency of 216 Hz that will reflect on all the components connected to that supply (also introducing the noise floor at the burst base frequency.) For this reason while a voltage drop of 300-400 mV may be acceptable from the power loss point of view, the same voltage drop may not be acceptable from the noise point of view. If your application does not have audio interface but only uses the data feature of the Telit HE910 V2, then this noise is not so disturbing and power supply layout design can be more forgiving.
- The PCB traces to HE910 V2 and the Bypass capacitor must be wide enough to ensure no significant voltage drops to occur when the 2A current peaks are absorbed. This is a must for the same above-mentioned reasons. Try to keep this trace as short as possible.

- The PCB traces connecting the Switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the diode very close to the power switching IC (only for switching power supply). This is done in order to reduce the radiated field (noise) at the switching frequency (usually 100-500 kHz).
- The use of a good common ground plane is suggested.
- The placement of the power supply on the board must be done in a way to guarantee that the high current return paths in the ground plane are not overlapped to any noise sensitive circuitry as the microphone amplifier/buffer or earphone amplifier.
- The power supply input cables must be kept separately from noise sensitive lines such as microphone/earphone cables.

6. Antenna (s)

The antenna connection and board layout design are the most important parts in the full product design and they strongly reflect on the product's overall performances. Read carefully and follow the requirements and the guidelines for a proper design.

6.1. GSM/WCDMA Antenna Requirements

The antenna for a Telit HE910 V2 device must fulfill the following requirements:

GSM / WCDMA Antenna Requirements		
Frequency range	Depending by frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)	
Bandwidth	**HE910-EU/EUG V2**	**HE910-NA/NAG V2**
	GSM850 : 70 MHz GSM900 : 80 MHz GSM1800(DCS) : 170 MHz GSM1900(PCS) : 140 MHz WCDMA band I(2100) : 250 MHz WCDMA band VIII(900) : 80 MHz	GSM850 : 70 MHz GSM900 : 80 MHz GSM1800(DCS) : 170 MHz GSM1900(PCS) : 140 MHz WCDMA band II(1900) : 140 MHz WCDMA band V(850) : 70 MHz
Impedance	50 Ohm	
Input power	> 33dBm(2 W) peak power in GSM > 24dBm Average power in WCDMA	
VSWR absolute max	<= 5:1(limit to avoid permanent damage)	
VSWR recommended	<= 2:1(limit to fulfill all regulatory requirements)	

When using the Telit HE910 V2, since there's no antenna connector on the module, the antenna must be connected to the HE910 V2 antenna pad (K1) by means of a transmission line implemented in the PCB.

In the case that the antenna is not directly connected at the antenna pad of the HE910 V2, then a PCB line is required in order to connect with it or with its connector.

This transmission line shall fulfill the following requirements:

Antenna Line on PCB Requirements	
Characteristic Impedance	50Ohm
Max Attenuation	0.3dB
Coupling with other signals shall be avoided	
Cold End (Ground Plane) of antenna shall be equipotential to the HE910 V2 ground pads	

Furthermore if the device is developed for the US and/or Canada market, it must comply with the FCC and/or IC approval requirements:

This device is to be used only for mobile and fixed application. In order to re-use the Telit FCC/IC approvals the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. If antenna is installed with a separation distance of less than 20 cm from all persons or is co-located or operating in conjunction with any other antenna or transmitter then additional FCC/IC testing may be required. End-Users must be provided with transmitter operation conditions for satisfying RF exposure compliance.

OEM integrators must ensure that the end user has no manual instructions to remove or install the HE910 V2 module. Antennas used for this OEM module must not exceed 7.43dBi gain for 850MHz bands and 3dBi for 1900MHz bands for mobile and fixed operating configurations.

6.2. GSM/WCDMA Antenna – PCB line Guidelines

- Make sure that the transmission line's characteristic impedance is 50ohm.
- Keep line on the PCB as short as possible since the antenna line loss shall be less than around 0.3dB.
- Line geometry should have uniform characteristics, constant cross section, avoid meanders and abrupt curves.
- Any kind of suitable geometry/structure can be used for implementing the printed transmission line afferent the antenna.
- If a Ground plane is required in line geometry, that plane has to be continuous and sufficiently extended so the geometry can be as similar as possible to the related canonical model.
- Keep, if possible, at least one layer of the PCB used only for the Ground plane; If possible, use this layer as reference Ground plane for the transmission line.
- It is wise to surround (on both sides) of the PCB transmission line with Ground. Avoid having other signal tracks facing directly the antenna line track.
- Avoid crossing any un-shielded transmission line footprint with other tracks on different layers.
- The Ground surrounding the antenna line on PCB has to be strictly connected to the main Ground plane by means of via holes (once per 2mm at least) placed close to the ground edges facing line track.
- Place EM noisy devices as far as possible from HE910 V2 antenna line.
- Keep the antenna line far away from the HE910 V2 power supply lines.
- If EM noisy devices are present on the PCB hosting the HE910 V2, such as fast switching ICs, take care of shielding them with a metal frame cover.
- If EM noisy devices are not present around the line use of geometries like Micro strip or Grounded Coplanar Waveguide are preferred since they typically ensure less attenuation when compared to a Strip line having same length.

6.3. GSM/WCDMA Antenna – Installation Guidelines

- Install the antenna in a place covered by the GSM/WCDMA signal.
- The Antenna shall be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter;
- If the device antenna is located greater then 20cm from the human body and there are no co-located transmitter then the Telit FCC/IC approvals can be re-used by the end product.
- If the device antenna is located less then 20cm from the human body or there are no co-located transmitter then the additional FCC/IC testing may be required for the end product (Telit FCC/IC approvals cannot be reused)
- Antenna shall not be installed inside metal cases;
- Antenna shall be installed also according Antenna manufacturer instructions.

6.4. GPS/GNSS Antenna Requirements

The use of an active GPS/GNSS antenna is required to achieve better performance.

The module is provided with a Digital Output signal to enable the external LNA (pad R7).

Parameter	Min	Max
Output high level	1.35V	1.8V
Output low level	0V	0.45V

6.4.1. Combined GPS/GNSS Antenna

The use of combined RF/GPS/GNSS antenna is NOT recommended. This solution could generate extremely poor GPS/GNSS reception and also the combined antenna requires additional diplexer and adds a loss in the RF route.

In addition, the combination of antennas requires an additional diplexer, which adds significant power losses in the RF path.

6.4.2. Linear and Patch GPS/GNSS Antenna

Using this type of antenna introduces at least 3dB of loss if compared to a circularly polarized (CP) antenna. Having a spherical gain response instead of a hemispherical gain response could aggravate the multipath behaviour & create poor position accuracy.

6.4.3. LNA and Front End Design Considerations

Depending on the characteristics and requirements unique to the customer's designs, the use of an external LNA or an external active antenna may be required to achieve best performance.

The optional external LNA should be dimensioned to avoid an excessive LNA gain that can introduce jamming, spurious, degrade IIP3, and saturate the receiver.

The configurations of an external device must fulfill the following requirements:

- An external passive antenna (GPS only)
- An external active antenna (GPS or GNSS)
- An external passive antenna, GNSS pre-Filter and GNSS LNA (GPS or GNSS)

NOTE:

The external GNSS LNA and GNSS pre-Filter shall be required for GLONASS application.

GNSS LNA requirement shall fulfill the following specifications.

- Frequency = 1565 – 1606MHz
- Power Gain$|S21|^2$ = 14 – 17dB
- NF < 1dB

GNSS pre-Filter requirement shall fulfill the following requirements.

- Source and Load Impedance = 50Ohm
- Insertion Loss (1575.42 – 1576.42MHz) = 1.4dB (Max)
- Insertion Loss (1565.42 – 1585.42MHz) = 2.0dB (Max)
- Insertion Loss (1597.5515 – 1605.886MHZ) = 2.0dB (Max)

WARNING:

The HE910 V2 software is implemented differently depending on the configurations of an external device. Please refer to the AT command User Guide in detail.

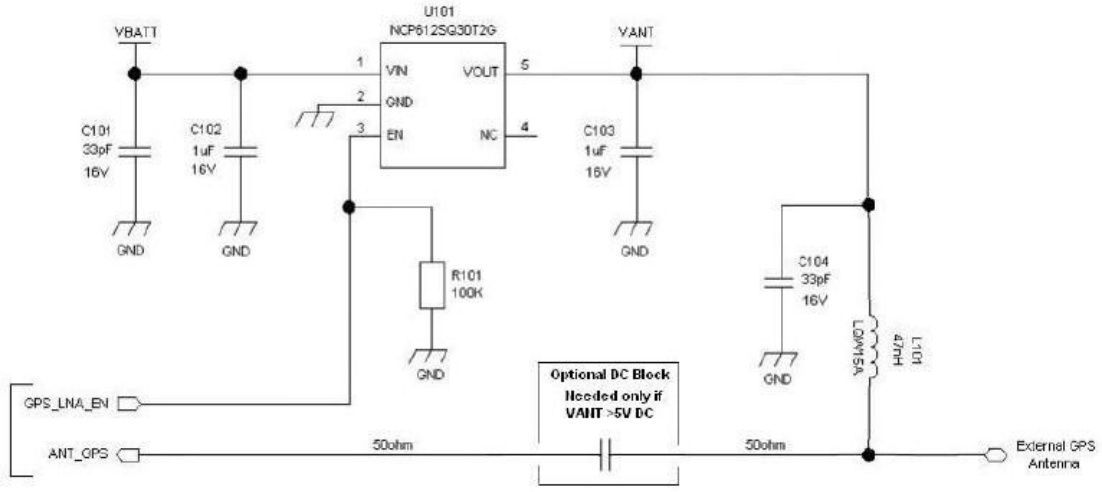
The external active antenna for the Telit HE910 V2 device must fulfill the following requirements:

ACTIVE GPS/GNSS Antenna Requirements	
Frequency range	GNSS(GPS L1 & GLONASS) : 1565 MHz ~ 1606 MHz GPS L1 : 1575.42MHz GLONASS : 1597.55 – 1605.89MHz
Bandwidth	GPS L1 : +/- 1.023MHz GLONASS : 8.34MHz
Impedance	50 Ohm
LNA NF	< 1dB
LNA Gain	14 ~ 17dB
LNA Input Voltage	3.0V or 5.0V

NOTE:

The maximum DC voltage applicable to ANT_GPS pin is 5V. In case this is exceeded, a series capacitor has to be included in the design to avoid exceeding the maximum input DC level.

An example of GNSS antenna supply circuit is shown in the following image:



When using the Telit HE910 V2, since there's no antenna connector on the module, the antenna must be connected to the HE910 V2 through the PCB with the antenna pad.

In the case that the antenna is not directly connected at the antenna pad of the HE910 V2, then a PCB line is required.

This line of transmission shall fulfill the following requirements:

Antenna Line on PCB Requirements	
Characteristic Impedance	50Ohm
Max Attenuation	0.3dB
Coupling with other signals shall be avoided	
Cold End (Ground Plane) of antenna shall be equipotential to the HE910 V2 ground pads	

Furthermore if the device is developed for the US and/or Canada market, it must comply with the FCC and/or IC requirements.

This device is to be used only for mobile and fixed application.

6.4.4. GPS/GNSS Antenna - PCB Line Guidelines

- Ensure that the antenna line impedance is 50ohm.
- Keep line on the PCB as short as possible to reduce the loss.
- Antenna line must have uniform characteristics, constant cross section, avoid meanders and abrupt curves.
- Keep one layer of the PCB used only for the Ground plane; if possible.
- Surround (on the sides, over and under) the antenna line on PCB with Ground. Avoid having other signal tracks directly facing the antenna line track.
- The Ground around the antenna line on PCB has to be strictly connected to the main Ground plane by placing vias once per 2mm at least.
- Place EM noisy devices as far as possible from HE910 V2 antenna line.
- Keep the antenna line far away from the HE910 V2 power supply lines.
- If EM noisy devices are around the PCB hosting the HE910 V2, such as fast switching ICs, take care of shielding of antenna line by burying it inside the layers of PCB and surround it with Ground planes; or shield it with a metal frame cover.
- If you do not have EM noisy devices around the PCB of HE910 V2, use a strip line on the superficial copper layer for the antenna line. The line attenuation will be lower than a buried one.

6.4.5. GPS/GNSS Antenna – Installation Guidelines

- The HE910 V2, due to its sensitivity characteristics, is capable of performing a fix inside buildings. (In any case the sensitivity could be affected by the building characteristics i.e. shielding)
- The Antenna must not be co-located or operating in conjunction with any other antenna or transmitter.
- Antenna shall not be installed inside metal cases.
- Antenna shall be installed also according antenna manufacture instructions.

7. USB Port

The HE910 V2 module includes a Universal Serial Bus (USB) transceiver, which operates at USB high-speed (480Mbits/sec).

It is compliant with the USB 2.0 specification and can be used for diagnostic monitoring, control and data transfers.

The table below describes the USB interface signals:

Pin	Signal	I/O	Function	Type
B15	USB_D+	I/O	USB differential Data(+)	
C15	USB_D-	I/O	USB differential Data(+)	
A13	VBUS	I	Power sense for the internal USB transceiver	5V

The USB_DPLUS and USB_DMINUS signals have a clock rate of 480MHz. The signal traces should be routed carefully. Trace lengths, number of vias and capacitive loading should be minimized. The impedance value should be as close as possible to 90 Ohms differential.

WARNING:

Consider a mechanical design and a low-capacitance ESD protection device to protect HE910 V2 or customer specific requirements from ESD event to USB lines (B15, C15 and A13).

8. Serial Port

The serial ports on the Telit HE910 V2 are the interface between the module and OEM hardware.

2 serial ports are available on the module:

- Modem Serial Port 1 (Main)
- Modem Serial Port 2 (Auxiliary)

Several configurations can be designed for the serial port on the OEM hardware.

The most common are:

- RS232 PC comport
- Microcontroller UART@1.8V(Universal Asynchronous Receiver Transmit)
- Microcontroller UART@5V or other voltages different from 1.8V

Depending on the type of serial port on the OEM hardware, a level translator circuit may be needed to make the system work.

Serial port 1 is a +1.8V UART with all the 7 RS232 signals.

Serial port 2 is a +1.8V Auxiliary UART.

The electrical characteristics of the serial port are explained in the following tables:

Absolute Maximum Ratings -Not Functional

Parameter	Min	Max
Input level on non-power pin with respect to ground	-0.3	+2.3V

Operating Range - Interface levels

Parameter	Min	Max
Input high level	1.5V	2.1 V
Input low level	-0.3V	0.35V
Output high level	1.35V	1.8V
Output low level	0V	0.45V

8.1. Modem Serial Port 1

Serial port 1 on the HE910 V2 is a +1.8V UART with all 7 RS232 signals.

It differs from the PC-RS232 in the signal polarity (RS232 is reversed) and levels.

Pin	Signal	I/O	Function	Type
N14	DCD - dcd_uart	O	Data Carrier Detect	1.8V
M15	RXD - Tx_uart	O	Transmit line *see Note	1.8V
N15	TXD - Rx_uart	I	Receive line *see Note	1.8V
M14	DTR - dtr_uart	I	Data Terminal Ready	1.8V
P14	DSR - dsr_uart	O	Data Set Ready	1.8V
L14	RTS - rts_uart	I	Request to Send	1.8V
P15	CTS - cts_uart	O	Clear to Send	1.8V
R14	RI - ri_uart	O	Ring Indicator	1.8V

NOTE:

For minimum implementation, only the TXD and RXD lines must be connected, the other lines can be left open provided a software flow control is implemented.

NOTE:

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 V2 when the module is powered off or during an ON/OFF transition.

NOTE:

According to V.24, RX/TX signal names are referred to the application side. Therefore, on the HE910 V2 side these signals are in the opposite direction: TXD on the application side will be connected to the receive line (here named TXD/ rx_uart) of the HE910 V2 serial port and vice versa for RX.

NOTE:

High-speed UART supports up to 4Mbps. Please refer to the AT command User Guide in detail.

WARNING:

Consider a mechanical design and a low-capacitance ESD protection device to protect HE910 V2 or customer specific requirements from ESD event to UART port (M15, N15, P15 and L14).

8.2. Modem Serial Port 2

Serial port 2 on the HE910 V2 is a +1.8V UART with only the RX and TX signals.

The signals of the HE910 V2 serial port are:

PAD	Signal	I/O	Function	Type
D15	TX_AUX	O	Auxillary UART (TX Data to DTE)	1.8V
E15	RX_AUX	I	Auxillary UART (RX Data from DTE)	1.8V

NOTE:

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 V2 when the module is powered off or during an ON/OFF transition.

8.3. RS232 Level Translation

In order to interface the Telit HE910 V2 with a PC com port or a RS232 (EIA/TIA-232) application, a level translator is required. This level translator must:

- Invert the electrical signal in both directions
- Change the level from 0/1.8V to +/-15V

Actually, the RS232 UART 16450, 16550, 16650 & 16750 chipsets accept signals with lower levels on the RS232 side (EIA/TIA-562), allowing a lower voltage-multiplying ratio on the

level translator. Note that the negative signal voltage must be less than 0V and hence some sort of level translation is always required.

The simplest way to translate the levels and invert the signal is by using a single chip level translator. There are a multitude of them, differing in the number of drivers and receivers and in the levels (be sure to get a true RS232 level translator not a RS485 or other standards).

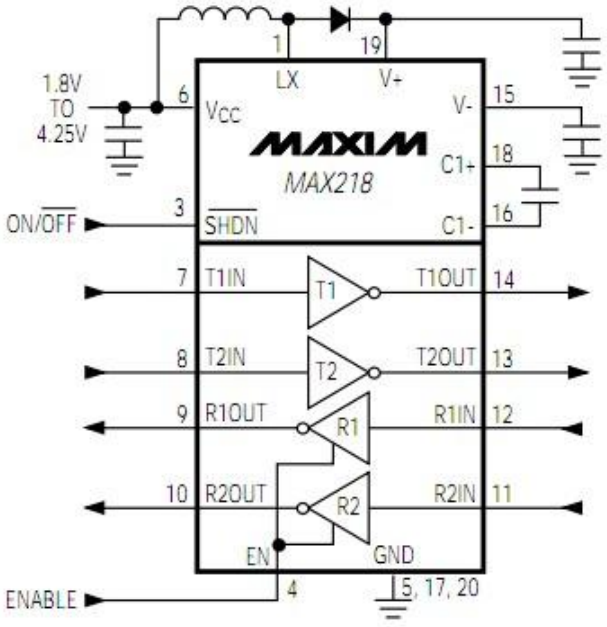
By convention the driver is the level translator from the 0-1.8V UART to the RS232 level. The receiver is the translator from the RS232 level to 0-1.8V UART.

In order to translate the whole set of control lines of the UART you will need:

- 5 drivers
- 3 receivers

An example of RS232 level adaption circuitry could be accomplished using a MAXIM transceiver (MAX218).

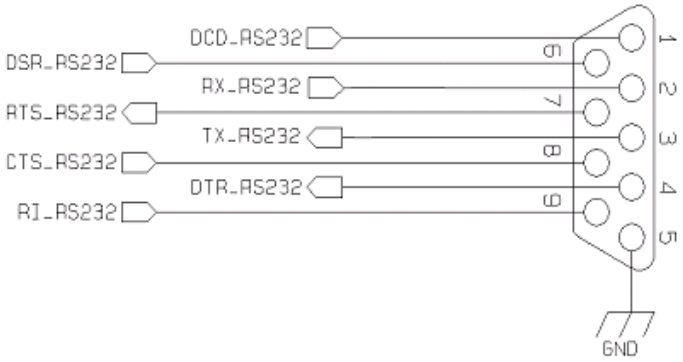
In this case the chipset is capable of translating directly from 1.8V to the RS232 levels (Example on 4 signals only).



NOTE:

In this case the length of the lines on the application has to be taken into account to avoid problems in case of High-speed rates on RS232.

The RS232 serial port lines are usually connected to a DB9 connector with the following layout:



9. Audio Section Overview

The HE910 V2 module doesn't support an analog audio interface and supports one Digital Audio bus.

In order to develop an application including an Analog Audio it is necessary to add a dedicated CODEC on the Application design.

For further information, please refer to the "Digital Voice Interface Application Note".

9.1. Electrical Characteristics

The product is providing one Digital Audio Interface (DVI) on the following Pins:

Pin	Signal	I/O	Function	Type
B9	DVI_WA0	I/O	Digital Voice interface (WA0)	1.8V
B6	DVI_RX	I	Digital Voice interface (RX)	
B7	DVI_TX	O	Digital Voice interface (TX)	
B8	DVI_CLK	I/O	Digital Voice interface (CLK)	

9.1.1. CODEC Example

Please refer to the Digital Voice Interface Application note.

10. 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)

Input pads can only be read and report the digital value (high or low) present on the pad at the read time.

Output pads can only be written to set the value of the pad or queried.

An alternate function pad is internally controlled by the HE910 V2 firmware and acts depending on the function implemented.

The following GPIOs are available on the HE910 V2.

Pin	Signal	I/O	Function	Drive Strength	Type
C8	GPIO_01	I/O	Configurable GPIO	2 mA	1.8V
C9	GPIO_02	I/O	Configurable GPIO	2 mA	1.8V
C10	GPIO_03	I/O	Configurable GPIO	2 mA	1.8V
C11	GPIO_04	I/O	Configurable GPIO	2 mA	1.8V
B14	GPIO_05	I/O	Configurable GPIO	2 mA	1.8V
C12	GPIO_06	I/O	Configurable GPIO	2 mA	1.8V
C13	GPIO_07	I/O	Configurable GPIO	2 mA	1.8V
K15	GPIO_08	I/O	Configurable GPIO	2 mA	1.8V
L15	GPIO_09	I/O	Configurable GPIO	2 mA	1.8V
G15	GPIO_10	I/O	Configurable GPIO	2 mA	1.8V

10.1. Logic Level Specification

Where not specifically stated, all the interface circuits work at 1.8V CMOS logic levels.

The following table shows the logic level specifications used in the HE910 V2 interface circuits:

Absolute Maximum Ratings -Not Functional

Parameter	Min	Max
Input level on any digital pin (CMOS 1.8) with respect to ground	-0.3V	2.3V

Operating Range - Interface levels (1.8V CMOS)

Parameter	Min	Max
Input high level	1.5V	2.1V
Input low level	0.0V	0.35V
Output high level	1.35V	1.8V
Output low level	0.0V	0.45V

Current characteristics

Parameter	Typical
Output Current	2mA
Input Current	30uA

10.2. Using a GPIO Pad as Input

The GPIO pads, when used as inputs, can be connected to a digital output of another device and report its status, provided this device has interface levels compatible with the 1.8V CMOS levels of the GPIO.

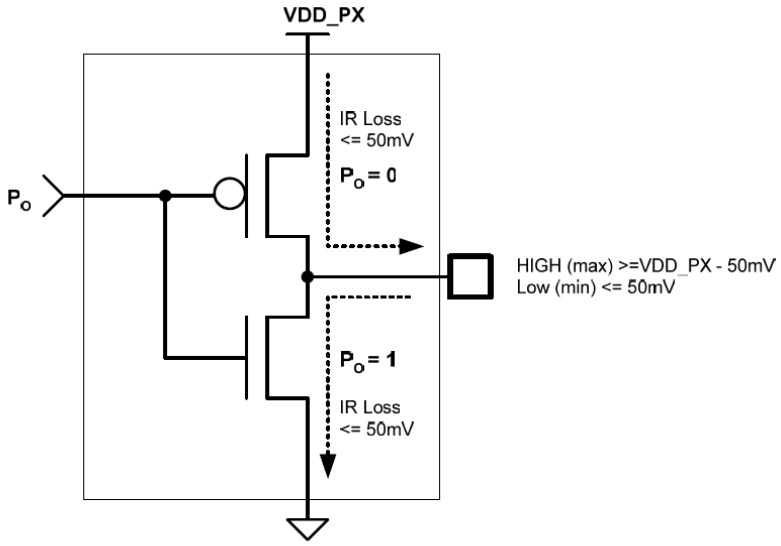
If the digital output of the device is connected with the GPIO input, the pad has interface levels different from the 1.8V CMOS. It can be buffered with an open collector transistor with a 4.7KΩ pull-up resistor to 1.8V.

NOTE:

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 module when it is powered OFF or during an ON/OFF transition.

10.3. Using a GPIO Pad as Output

The GPIO pads, when used as outputs, can drive 1.8V CMOS digital devices or compatible hardware. When set as outputs, the pads have a push-pull output and therefore the pull-up resistor may be omitted.



output PAD equivalent circuit

10.4. Using the Temperature Monitor Function

10.4.1. Short Description

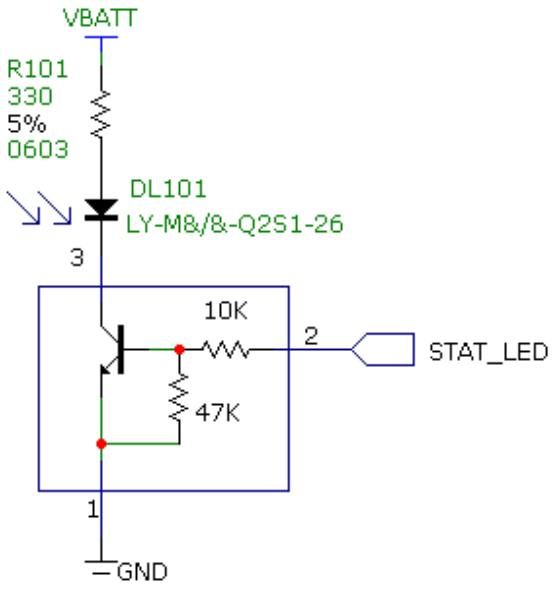
The Temperature Monitor is a function of the module that permits control of its internal temperature and if properly set (see the #TEMPMON command on AT Interface guide) raises to High Logic level a GPIO when the maximum temperature is reached.

10.5. Indication of Network Service Availability

The STAT_LED pin status shows information on the network service availability and Call status. In the HE910 V2 modules, the STAT_LED usually needs an external transistor to drive an external LED. Because of the above, the status indicated in the following table is reversed with respect to the pin status:

Device Status	LED status
Device off	Permanently off
Not registered	Permanently on
Registered in idle	Blinking 1 sec on + 2 sec off
Registered in idle + power saving	It depends on the event that triggers the wakeup (In sync with network paging)
Voice Call Active	Permanently on
Dial-Up	Blinking 1 sec on + 2 sec off

A schematic example could be:



10.6. RTC Bypass Output

The VRTC pin brings out the Real Time Clock supply, which is separate from the rest of the digital part, allowing only RTC to be active when all the other parts of the device are off. To this power output a backup capacitor can be added in order to increase the RTC autonomy during power off of the battery.

NOTE:

NO devices must be powered from this pin.

10.7. 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 of the supply are:

Operating Range – VAUX/PWRMON power supply

Parameter	Min	Typical	Max
Output voltage	1.77V	1.8V	1.83V
Output current			100mA
Output bypass capacitor (Inside the module)		1.0µF	

11. DAC and ADC section

11.1. DAC Converter

11.1.1. Description

The HE910 V2 module provides a Digital to Analog Converter. The signal (named DAC_OUT) is available on pin C13 of the HE910 V2 module and on pin 6 of PL302 on Interface Board (CS1467D).

The on board DAC is in the range from 0 to 1023. However, an external low-pass filter is necessary.

Parameter	Min	Max	Units
Voltage range (filtered)	0	1.8	Volt
Range	0	1023	Steps

The precision is 1023 steps, so since the maximum voltage is 2V, the integrated voltage could be calculated with the following formula:

Integrated output voltage = 2 * value / 1023

DAC_OUT line must be integrated (for example with a low band pass filter) in order to obtain an analog voltage.

11.1.2. Enabling DAC

An AT command is available to use the DAC function.

The command is: AT#DAC[=<enable>[,<value>]]

<value> - scale factor of the integrated output voltage (0..1023 ~ 10 bit precision)

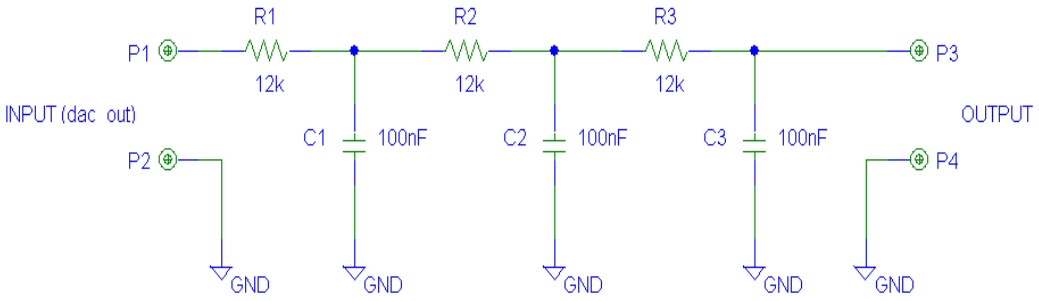
it must be present if <enable>=1

Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.

NOTE:

The DAC frequency is selected internally. D/A converter must not be used during POWERSAVING.

11.1.3. Low Pass Filter Example



11.2. ADC Converter

11.2.1. Description

The on board ADC is 8-bit converter. It is able to read a voltage level in the range of 0 ~ 1.2 volts applied on the ADC pin input and store and convert it into 8 bit word.

Parameter	Min	Max	Units
Input Voltage range	0	1.2	Volt
AD conversion	-	8	bits
Resolution	-	< 10	mV
Input Resistance	1		Mohm

The HE910 V2 provides one Analog to Digital Converter.

The input lines are:

ADC available on pin B1 and Pin 7 of PL102 on Interface Board (CS1467D)

11.2.2. Using ADC Converter

An AT command is available to use the ADC function.

The command is AT#ADC=1,2. The read value is expressed in mV

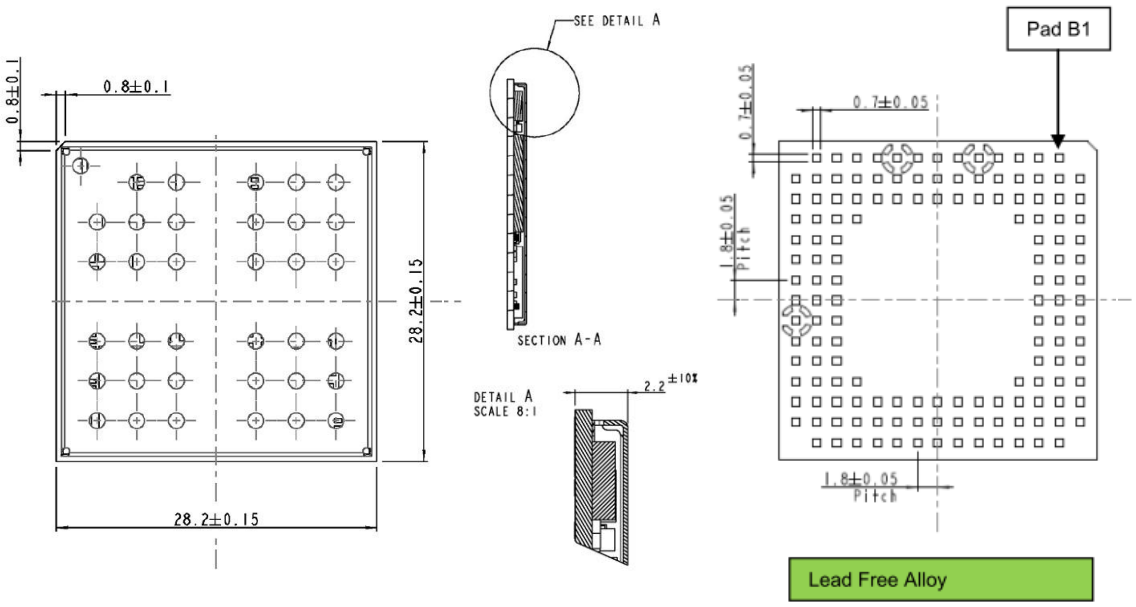
Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.

12. Mounting the Module on your Board

12.1. General

The HE910 V2 has been designed in order to be compliant with a standard lead-free SMT process.

12.2. Module Finishing & Dimensions

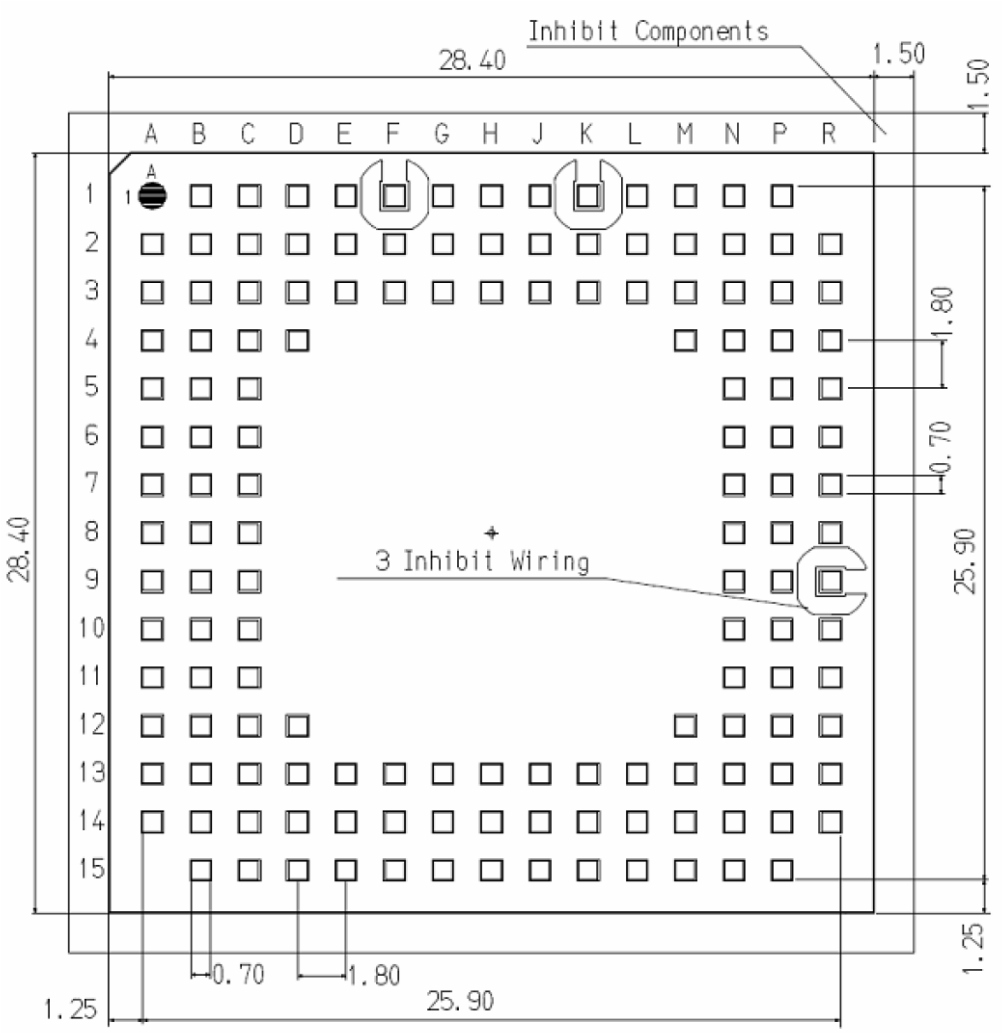


Top view

Bottom view

(Dimensions in mm)

12.3. Recommended foot print for the application



144 pins

< Top View >

In order to easily rework the HE910 V2 it is suggested to consider having a 1.5 mm placement inhibit area around the module on the application.

It is also suggested, as a common rule for an SMT component, to avoid having a mechanical part of the application in direct contact with the module.

NOTE:

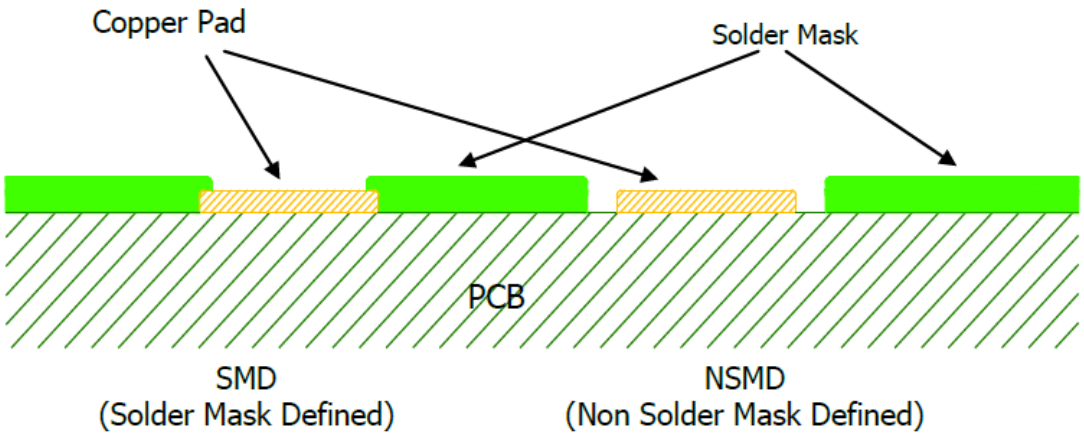
In the customer application, the region under WIRING INHIBIT (see figure) must be clear from signal or ground paths.

12.4. Stencil

Stencil's apertures layout can be the same as the recommended footprint (1:1), we suggest a thickness of stencil foil ≥ 120 µm.

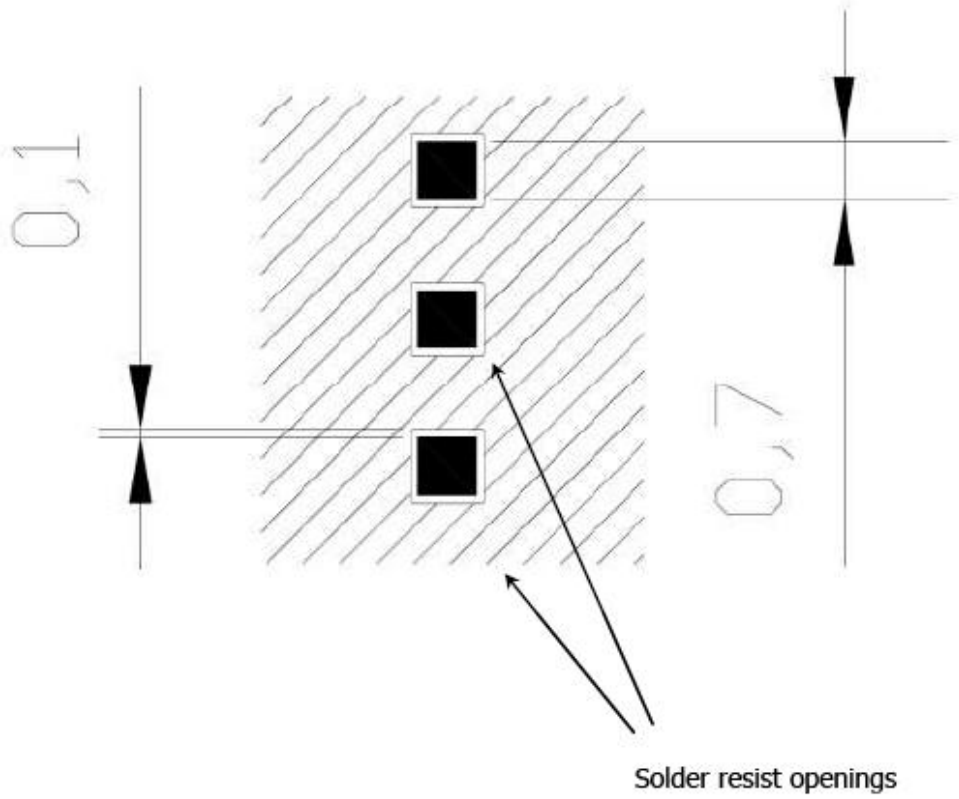
12.5. PCB Pad Design

Non solder mask defined (NSMD) type is recommended for the solder pads on the PCB.

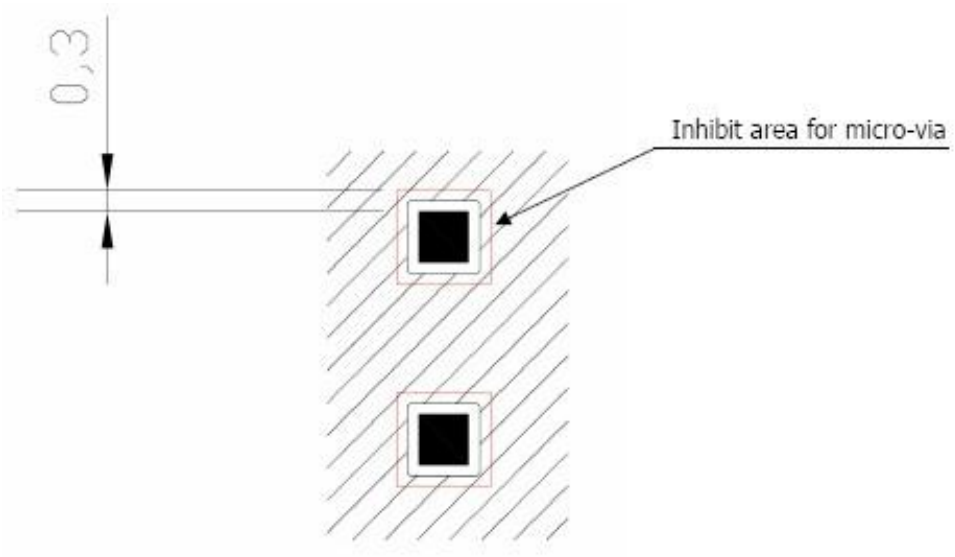


12.6. Recommendations for PCB Pad Dimensions (mm)

The recommendation for the PCB pads dimensions are described in the following image (dimensions in mm)



It is not recommended to place via or micro-via not covered by solder resist in an area of 0,3 mm around the pads unless it carries the same signal of the pad itself (see following figure).



Holes in pad are allowed only for blind holes and not for through holes.

Recommendations for PCB Pad Surfaces:

Finish	Layer thickness (um)	Properties
Electro-less Ni / Immersion Au	3 ~ 7 / 0.05 ~ 0.15	good solder ability protection, high shear force values

The PCB must be able to resist the higher temperatures which are occurring at the lead-free process. This issue should be discussed with the PCB-supplier. Generally, the wettability of tin-lead solder paste on the described surface plating is better compared to lead-free solder paste.

It is not necessary to panel the application's PCB, however in that case it is suggested to use milled contours and predrilled board breakouts; scoring or v-cut solutions are not recommended.

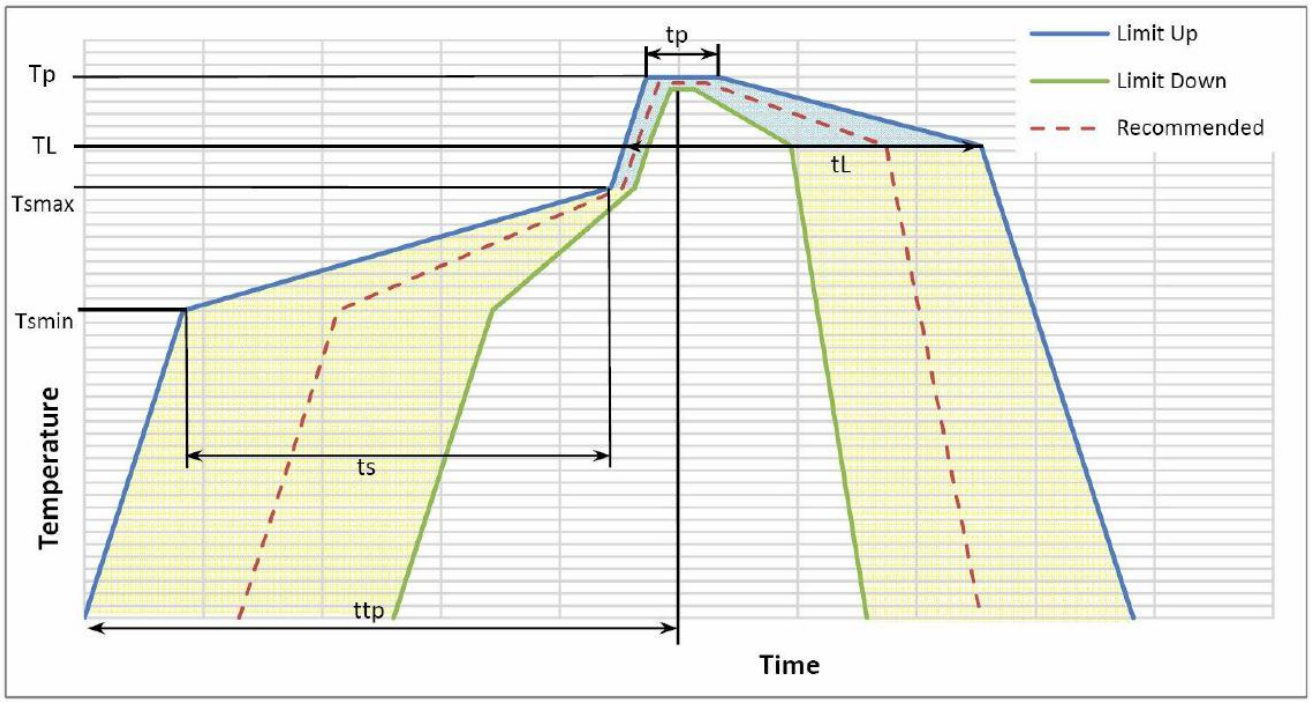
12.7. Solder Paste

	Lead free
Solder Paste	Sn/Ag/Cu

We recommend using only “no clean” solder paste in order to avoid the cleaning of the modules after assembly.

12.7.1. Solder Reflow

Recommended solder reflow profile:



Profile Feature	Pb-Free Assembly
Average ramp-up rate(T_L to T_P)	3℃/second max
Preheat - Temperature Min(Tsmin) - Temperature Max(Tsmax) - Time (min to max) (ts)	 150℃ 200℃ 60 - 180 seconds
Tsmax to TL - Ramp-up Rate	 3℃/second max
Time maintained above: - Temperature (TL) - Time(tL)	 217℃ 60 - 150 seconds
Peak Temperature (Tp)	245 +0/-5℃
Time within 5℃ of actual Peak Temperature(tp)	10 - 30 seconds
Ramp-down Rate	6℃/sec max
Time 25℃ to Peak Temperature	8 minutes max

NOTE:

All temperatures refer to topside of the package, measured on the package body surface.

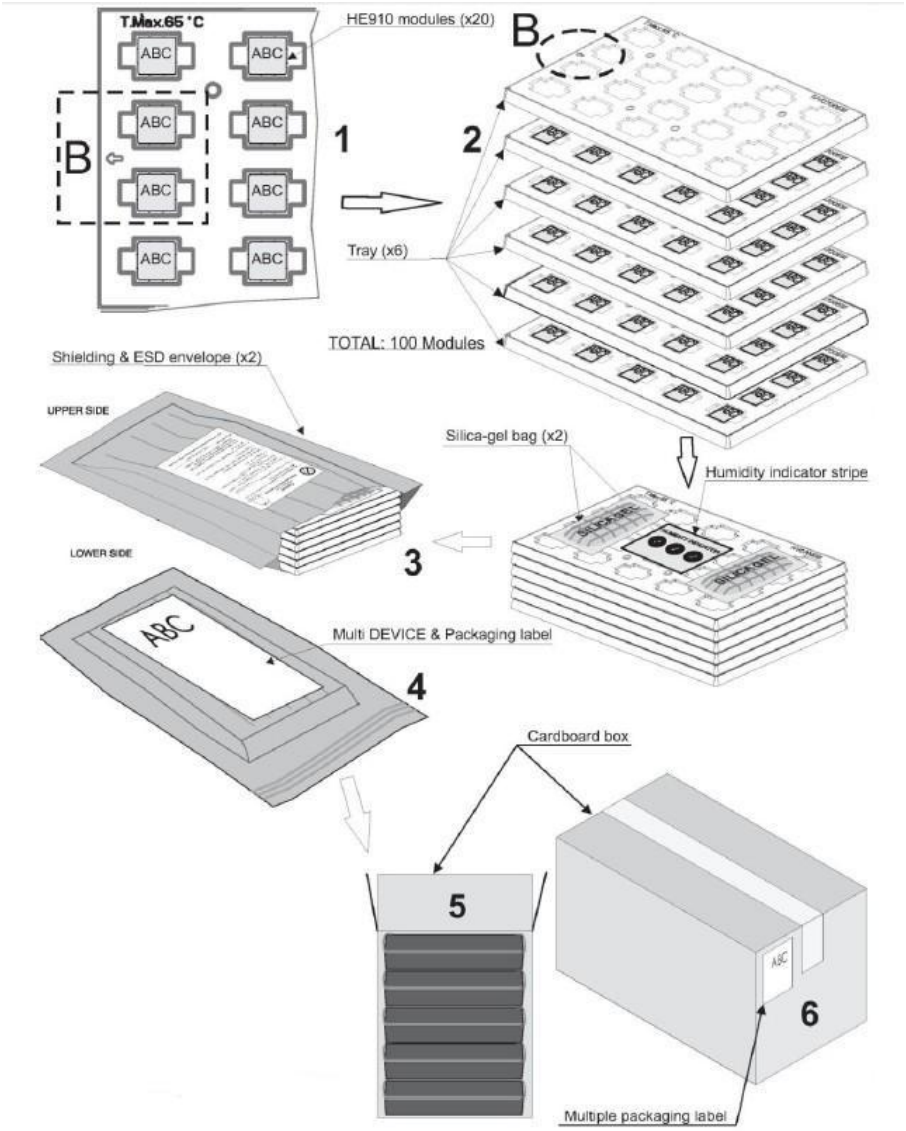
WARNING:

The HE910 V2 module withstands one reflow process only.

13. Packing System

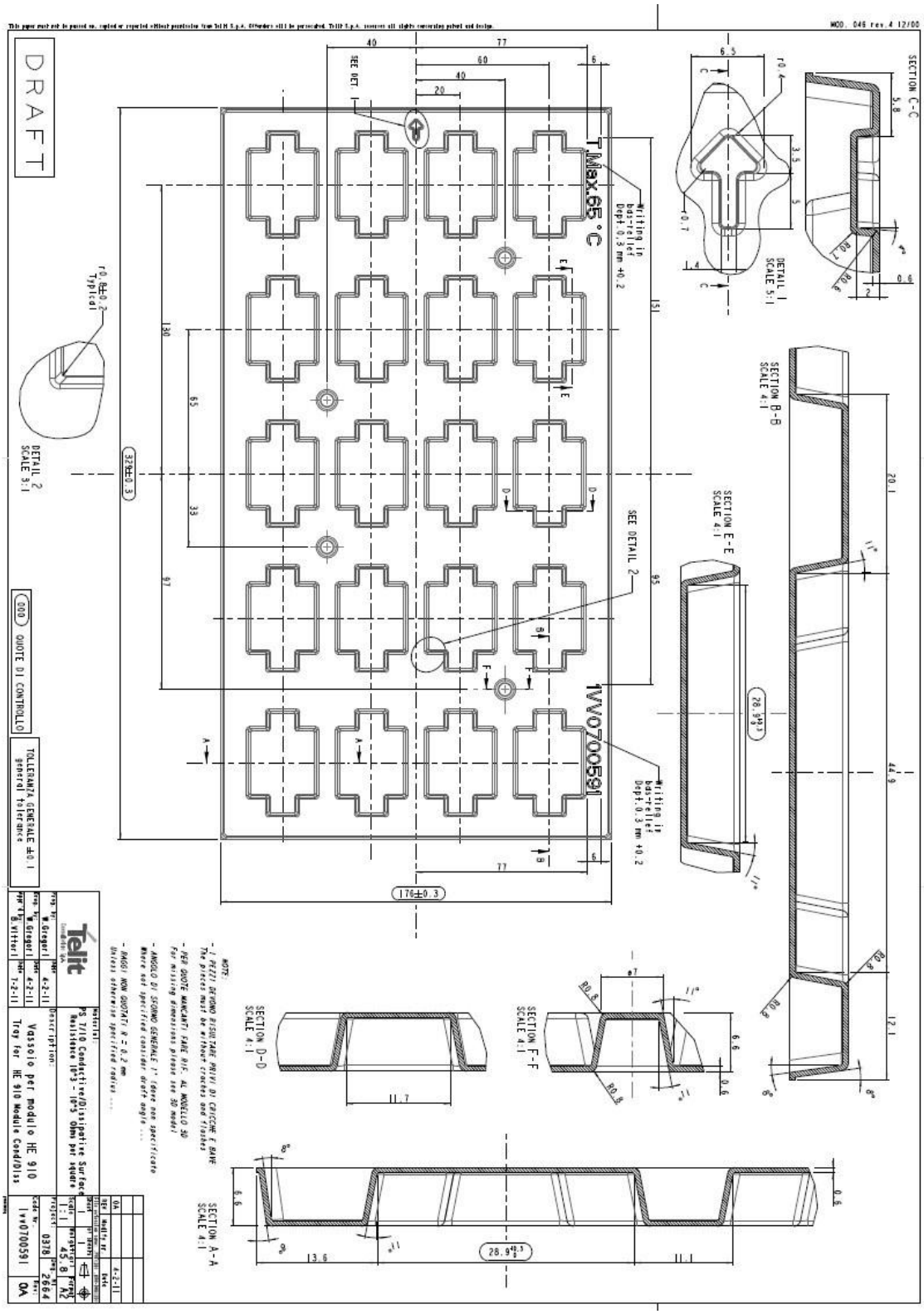
The HE910 V2 modules are packaged on trays of 20 pieces each. These trays can be used in SMT processes for pick & place handling.

13.1. Tray Drawing



WARNING:

These trays can withstand a maximum temperature of 65°C.



13.2. Moisture Sensibility

The HE910 V2 is a Moisture Sensitive Device level 3, in accordance with standard IPC/JEDEC J-STD-020, take care all the relatives requirements for using this kind of components.

Moreover, the customer has to take care of the following conditions:

a) Calculated shelf life in sealed bag: 12 months at <40℃ and <90% relative humidity (RH).

b) Environmental condition during the production: 30℃ / 60% RH according to IPC/JEDEC J-STD-033A paragraph 5.

c) The maximum time between the opening of the sealed bag and the reflow process must be 168 hours if condition b) "IPC/JEDEC J-STD-033A paragraph 5.2" is respected

d) Baking is required if conditions b) or c) are not respected

e) Baking is required if the humidity indicator inside the bag indicates 10% RH or more

14. Application Design Guide

14.1. Debug of the HE910 V2 in production

To test and debug the mounting of HE910 V2, we strongly recommend foreseeing test pads on the host PCB, in order to check the connection between the HE910 V2 itself and the application and to test the performance of the module connecting it with an external computer. Depending on the customer application, these pads include, but are not limited to the following signals:

- TXD
- RXD
- ON_OFF
- HW_SHUTDOWN
- GND
- VBATT and VBATT_PA
- TX_AUX
- RX_AUX
- VAUX/PWRMON
- VBUS
- USB_D+
- USB_D-

14.2. Bypass capacitor on Power supplies

When a sudden voltage is asserted to or cut from the power supplies,
The steep transition makes some reactions such as the overshoot and undershoot.
This abrupt voltage transition can affect the device not to work or make it malfunction.
The bypass capacitors are needed to alleviate this behavior and it can be affected differently according to the various applications. The customers have to pay special attention to this when they design their application board.
The length and width of the power lines need to be considered carefully and the capacitance of the capacitors needs to be selected accordingly.
The capacitor will also avoid the ripple of the power supplies and the switching noise caused in TDMA system like GSM.
Especially the suitable bypass capacitor must be mounted on the VBATT and VBATT_PA lines in the application board.

The recommended values can be presented as;

- 100uF for VBATT and VBATT_PA

But the customers still have to consider that the capacitance mainly depends on the conditions of their application board.
Generally more capacitance is required as the power line is longer.

14.3. SIM Interface

This section deals with the recommended schematics for the design of SIM interfaces on the application boards.

14.3.1. SIM schematic example

Figure 1 illustrates in particular how the application side should be designed, and what values the components should have.

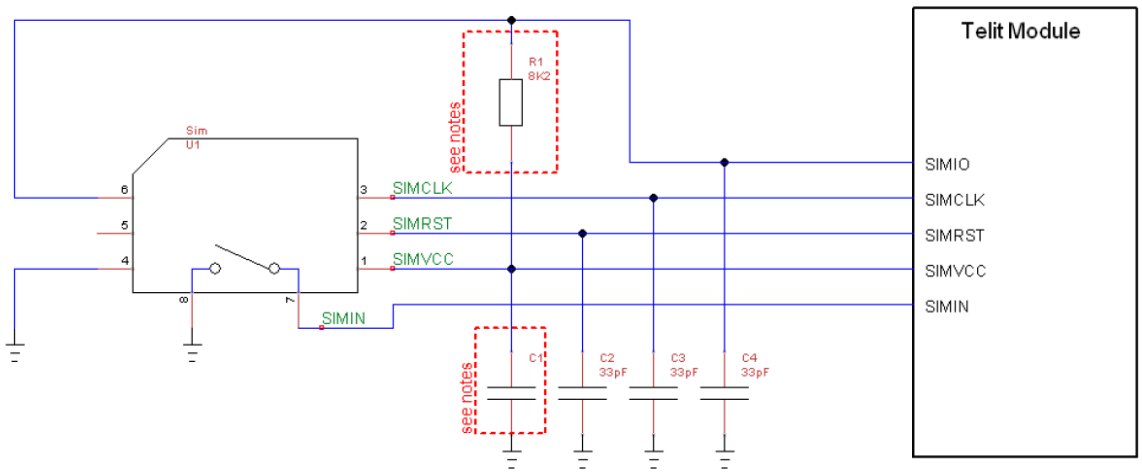


Figure 1

NOTE FOR R1:

The resistor value on SIMIO pulled up to SIMVCC should be defined accordingly in order to be compliant to 3GPP specification.

For HE910-EUG V2/NAG V2/EU V2/NA V2 contain an internal pull-up resistor on SIMIO.

However, the un-mounted option in application design can be recommended in order to tune R1 if necessary.

The following Table lists the values of C1 to be adopted with the HE910 V2 product:

Product P/N	C1 range (nF)
HE910-EUG/NAG V2	100 nF
HE910-EU/NA V2	

Refer to the following document for the detail;

- Telit_SIM_Integration_Design_Guide_Application_Note

14.4. Download and Debug Port

One of the following options should be chosen in the design of host system in order to download or upgrade the Telit's software and debug HE910 V2 when HE910 V2 is already mounted on a host system.

Users who use both of UART and USB interfaces to communicate HE910 V2

- Must implement a download method in a host system for upgrading HE910 V2 when it's mounted.

Users who use USB interface only to communicate HE910 V2

- Must arrange UART port in a host system for debugging or upgrading HE910 V2 when it's mounted.

Users who use UART interface only to communicate HE910 V2

- Must arrange USB port in a host system for debugging or upgrading HE910 V2 when it's mounted.

15. Conformity Assessment Issues

15.1. 1999/5/EC Directive

The HE910-EU V2 and HE910-EUG V2 modules have been assessed in order to satisfy the essential requirements of the R&TTE Directive 1999/05/EC (Radio Equipment & Telecommunications Terminal Equipments) to demonstrate the conformity against the harmonized standards with the final involvement of a Notified Body.

In order to satisfy the essential requirements of 1999/5/EC Directive, the HE910-EUG V2 is compliant with the following standards:

RF spectrum use (R&TTE art. 3.2)	EN 300 440-2 V1.4.1 EN 301 511 V9.0.2 EN 301 908-1 V5.2.1 EN 301 908-2 V5.2.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.9.2 EN 301 489-3 V1.4.1 EN 301 489-7 V1.3.1 EN 301 489-24 V1.5.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011+AC:2011

The HE910-EU V2 module is compliant with the following standards:

RF spectrum use (R&TTE art. 3.2)	EN 301 511 V9.0.2 EN 301 908-1 V5.2.1 EN 301 908-2 V5.2.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.9.2 EN 301 489-7 V1.3.1 EN 301 489-24 V1.5.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011+AC:2011

The conformity assessment procedure referred to in Article 10 and detailed in Annex IV of Directive 1999/5/EC has been followed with the involvement of the following Notified Body:

AT4 wireless, S.A.
Parque Tecnologico de Andalucía
C/ Severo Ochoa 2
29590 Campanillas – Málaga
SPAIN
Notified Body No: 1909

Thus, the following marking is included in the product:

CE 1909

The full declaration of conformity can be found on the following address:
http://www.telit.com
There is no restriction for the commercialization of the HE910-EU V2 and HE910-EUG V2 modules in all the countries of the European Union.
Final product integrating this module must be assessed against essential requirements of the 1999/5/EC (R&TTE) Directive. It should be noted that assessment does not necessarily lead to testing. Telit Communications S.p.A. recommends carrying out the following assessments:

RF spectrum use (R&TTE art. 3.2)	It will depend on the antenna used on the final product.
EMC (R&TTE art. 3.1b)	Testing
Health & Safety (R&TTE art. 3.1a)	Testing

Alternately, assessment of the final product against EMC (Art. 3.1b) and Electrical safety (Art. 3.1a) essential requirements can be done against the essential requirements of the EMC and the LVD Directives:

- Low Voltage Directive 2006/95/EC and product safety
- Directive EMC 2004/108/EC for conformity for EMC

15.2. FCC/IC Regulatory notices

Modification statement

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Telit n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

Interference statement

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. This Class B digital apparatus complies with Canadian ICES-0003.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Wireless notice

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body. Antenna gain must be below:

Frequency band	HE910-NA V2	HE910-NAG V2
GSM/GPRS850	7.43 dBi	7.43 dBi
FDD V	8.45 dBi	8.45 dBi
GSM/GPRS1900 / FDD II	3.0 dBi	3.0 dBi

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la IC pour un environnement non contrôlé. L'antenne doit être installé de façon à garder une distance minimale de 20 centimètres entre la source de rayonnements et votre corps. Gain de l'antenne doit être ci-dessous:

Bande de fréquence	HE910-NA V2	HE910-NAG V2
GSM/GPRS850	*7.43 dBi*	*7.43 dBi*
FDD V	*8.45 dBi*	*8.45 dBi*
GSM/GPRS1900 / FDD II	*3.0 dBi*	*3.0 dBi*

L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

FCC Class B digital device notice

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. 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.

Information To Be Supplied to the End User by the OEM or Integrator notice

Modular information form OEM Information to Be Supplied to the End User by the OEM or Integrator
The following regulatory and safety notices must be published in documentation supplied to the end user of the product or system incorporating an adapter in compliance with local regulations. Host system must be labeled with "Contains IC: 5131A-HE910NAV2 " or "Contains FCCID:RI7HE910NAV2 ", FCC ID/IC displayed on label.

16. Safety Recommendations

READ CAREFULLY

Be sure about that the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.
- Where there is risk of explosion such as gasoline stations, oil refineries, etc.

It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity.

We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations.

The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue, because the risk of disturbing the GSM network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force.

Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to be installed with the guarantee of a minimum 20 cm distance from the body. In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments introduced on the market. All the relevant information are available on the European Community website:

http://europa.eu.int/comm/enterprise/rtte/dir99-5.htm

The text of the Directive 99/05 regarding telecommunication equipments is available, while the applicable Directives (Low Voltage and EMC) are available at:

http://europa.eu.int/comm/enterprise/rtte/dir99-5.htm

17. Document History

Revision	Date	Changes
0	2013-05-14	First issue
1	2013-11-08	Updated 6.1 GSM/WCDMA Antenna Requirements Updated 8.1 Modem Serial Port 1 Updated 10.5 Indication of Network Service Availability Updated 14.3 SIM Interface Updated 15 Conformity Assessment Issues
2	2013-11-27	Updated 2.5 Environmental requirements Updated 6.1 GSM/WCDMA Antenna Requirements Updated 15.2 FCC/IC Regulatory notices