HE910 Hardware User Guide

1vv03700925 Rev.27 – 2015-05-25

Making machines talk.

Applicability Table

PRODUCT
HE910 (*)
HE910-D
HE910-GL
HE910-EUR
HE910-EUD
HE910-EUG
HE910-NAR
HE910-NAD
HE910-NAG

(*) HE910 is the “type name” of the products marketed as HE910-G & HE910-DG

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Notice

While reasonable efforts have been made to assure the accuracy of this document, Telit assumes no liability resulting from any inaccuracies or omissions in this document, or from use of the information obtained herein. The information in this document has been carefully checked and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies or omissions. Telit reserves the right to make changes to any products described herein and reserves the right to revise this document and to make changes from time to time in content hereof with no obligation to notify any person of revisions or changes. Telit does not assume any liability arising out of the application or use of any product, software, or circuit described herein; neither does it convey license under its patent rights or the rights of others.

It is possible that this publication may contain references to, or information about Telit products (machines and programs), programming, or services that are not announced in your country. Such references or information must not be construed to mean that Telit intends to announce such Telit products, programming, or services in your country.

Copyrights

This instruction manual and the Telit products described in this instruction manual may be, include or describe copyrighted Telit material, such as computer programs stored in semiconductor memories or other media. Laws in the Italy and other countries preserve for Telit and its licensors certain exclusive rights for copyrighted material, including the exclusive right to copy, reproduce in any form, distribute and make derivative works of the copyrighted material. Accordingly, any copyrighted material of Telit and its licensors contained herein or in the Telit products described in this instruction manual may not be copied, reproduced, distributed, merged or modified in any manner without the express written permission of Telit. Furthermore, the purchase of Telit products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Telit, as arises by operation of law in the sale of a product.

Computer Software Copyrights

The Telit and 3rd Party supplied Software (SW) products described in this instruction manual may include copyrighted Telit and other 3rd Party supplied computer programs stored in semiconductor memories or other media. Laws in the Italy and other countries preserve for Telit and other 3rd Party supplied SW certain exclusive rights for copyrighted computer programs, including the exclusive right to copy or reproduce in any form the copyrighted computer program. Accordingly, any copyrighted Telit or other 3rd Party supplied SW computer programs contained in the Telit products described in this instruction manual may not be copied (reverse engineered) or reproduced in any manner without the express written permission of Telit or the 3rd Party SW supplier. Furthermore, the purchase of Telit products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Telit or other 3rd Party supplied SW, except for the normal non-exclusive, royalty free license to use that arises by operation of law in the sale of a product.

Usage and Disclosure Restrictions

License Agreements

The software described in this document is the property of Telit and its licensors. It is furnished by express license agreement only and may be used only in accordance with the terms of such an agreement.

Copyrighted Materials

Software and documentation are copyrighted materials. Making unauthorized copies is prohibited by law. No part of the software or documentation may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, without prior written permission of Telit

High Risk Materials

Components, units, or third-party products used in the product described herein are NOT fault-tolerant and are NOT designed, manufactured, or intended for use as on-line control equipment in the following hazardous environments requiring fail-safe controls: the operation of Nuclear Facilities, Aircraft Navigation or Aircraft Communication Systems, Air Traffic Control, Life Support, or Weapons Systems (High Risk Activities"). Telit and its supplier(s) specifically disclaim any expressed or implied warranty of fitness for such High Risk Activities.

Trademarks

TELIT and the Stylized T Logo are registered in Trademark Office. All other product or service names are the property of their respective owners.

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 module.

1.2 Audience

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

1.3 Contact Information, Support

For general contact, technical support, to report documentation errors and to order manuals, contact Telit’s 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 you can 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’s Technical Support Center (TTSC).
Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.
Telit appreciates feedback from the users of our information.

1.4 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: "Overview" provides an overview of the document.

Chapter3: "HE910 Module Connections" deals with the pin out configuration and layout.

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

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

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

Chapter 7: "GPS Receiver" This section describes the GPS receiver.

Chapter 8: "Logic Level specifications" Specific values adopted in the implementation of logic levels for this module.

Chapter 9: "USB Port" The USB port on the Telit HE910 is the core of the interface between the module and OEM hardware

Chapter 10: "SPI port" Refers to the SPI port of the Telit HE910

Chapter 11: "USB HSIC" Refers to the USB HSIC port of the Telit HE910

Chapter 12: "Serial ports" Refers to the serial ports of the Telit HE910

Chapter 13: "Audio Section overview" Refers to the audio blocks of the Base Band Chip of the HE910 Telit Modules.

Chapter 14: "General Purpose I/O" How the general purpose I/O pads can be configured.

Chapter 15: "Mounting the HE910 on the application board" Mechanical dimensions and recommendations on how to mount the module on the user's board.

Chapter 16: "Safety Recommendations" Information related to the Safety topics.

Chapter 17: "Conformity Assessment Issues" Information related to the Conformity Assessments.

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

• Digital Voice Interface Application Note	80000NT10050A
• SPI Port Application Note	80000NT10053A
• Product description	80378ST10085A
• SIM Holder Design Guides	80000NT10001A
• USB HSIC Port Application Note	80000NT10071A
• AT Commands Reference Guide	80378ST10091A
• Telit EVK2 User Guide	1vv0300704

1.7 Document History

Revision	Date	Changes
0	2011-03-31	Preliminary Version
1	2011-05-19	Updated pinout on UART1
2	2011-05-25	Update chapter 13
3	2011-07-25	Added DVI app note references; chapter 4.1
4	2011-07-29	Updated audio, on_off/reset and digital sections
5	2011-10-18	Added STAT_LED info, Updated SPI pinout
6	2011-12-22	Pads A8, A9, D14, A14 now reserved Power supply extended to 3.3 V par 4.3 renamed as “unconditional shutdown” USIF0 USIF1 names added to Main and AUX serial ports Updated IO logic levels Updated module’s mechanical drawing IO levels selection 1.8/1.2 removed (now only 1.8)
7	2012-01-16	Added HE910-GA and –D; added Conformity assessment chapter
8	2012-02-03	Chapter 5.1 updated
9	2012-02-07	Chapter 4.2 updated
10	2012-03-16	Added ADC in pinout description; added GPS specification; updated Chapter 13 and 14;
11	2012-03-26	Chapter 2.1, 2.1.2, 3.3, 5.4, 14.9
12	2012-03-27	Added HE910-EU and NA products
13	2012-03-28	Updated paragraph 14.9
14	2012-05-08	Added EUR, EUD, NAR, NAD variants; added Sensitivity and TX Power Class specifications. Updated par 14.7.1 and 14.3
15	2012-05-30	Updated Chapter 16.2; 7.3.8
16	2012-06-06	Pin R13 renamed as HW_SHUTDOWN*, Pin P11 renamed
17	2012-06-14	Updated RTT&E info on HE910-NAG, NAR, NAD
18	2012-06-15	Updated RTT&E info on HE910-NAG, NAR, NAD ; updated par 3.1;
19	2012-06-26	Pin P11 now reserved; updated par 3.1; par 4.2
20	2012-08-09	Updated par 9,1 5.3.2, 13.4, 3.1, 13.5
21	2013-04-29	Updated par 3.1, 5.1, 5.3.2, 6.4, 7, 9.1 ; added 14.8
22	2013-08-02	Updated Chapter 4, 13.4
23	2013-08-30	Updated Chapter 3.1, 4.1, 5.2, 5.3.3, 8, 9.1, 11, 13.1
24	2013-12-20	Updated Chapter 4.1, 4.2, 5.3.1.1, 5.3.1.2, 8; added USB_HSIC, Updated the Stat Led schematic example; updated packaging tray drawing; added PCB Guidelines for FCC.
25	2015-03-03	Add new product HE910-GL
26	2015-04-09	Removed product HE910-GA
27	2015-05-25	Updated Chapter 15.8 Packing system (Tray)

2 Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE910 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 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 Telit HE910 module. For further hardware details that may not be explained in this document refer to the Telit HE910 Product Description document where all the hardware information is reported.

NOTICE:
(EN) The integration of the GSM/GPRS/WCDMA **HE910** cellular module within user application shall be done according to the design rules described in this manual.

(IT) L’integrazione del modulo cellulare GSM/GPRS/WCDMA **HE910** all’interno dell’applicazione dell’utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.

(DE) Die Integration des **HE910** GSM/GPRS/WCDMA Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Kunstruktionsregeln erfolgen.

(SL) Integracija GSM/GPRS/WCDMA **HE910** modula v uporabniški aplikaciji bo morala upoštevati projektna navodila, opisana v tem priročniku.

(SP) La utilización del modulo GSM/GPRS/WCDMA **HE910** debe ser conforme a los usos para los cuales ha sido deseñado descritos en este manual del usuario.

(FR) L’intégration du module cellulaire GSM/GPRS/WCDMA **HE910** dans l’application de l’utilisateur sera faite selon les règles de conception décrites dans ce manuel.

(HE) האינטגרטור מתבקש ליישם את ההנחיות המפורטות במסמך זה בתהליך האינטגרציה של המודם הסלולרי **HE910** עם המוצר.

The information presented in this document is believed to be accurate and reliable. However, no responsibility is assumed by Telit Communications S.p.A. for its use, nor any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent rights of Telit Communications S.p.A. other than for circuitry embodied in Telit products. This document is subject to change without notice.

3 HE910 module connections

3.1 PIN-OUT

PAD	Signal	I/O	Function	Type	COMMENT
USB HS 2.0 COMMUNICATION PORT					
B15	USB_D+	I/O	USB differential Data (+)		
C15	USB_D-	I/O	USB differential Data (-)		
A13	VUSB	I	Power sense for the internal USB transceiver.		
Asynchronous Serial Port (USIF0) - Prog. / Data + HW Flow Control					
N15	C103/TXD	I	Serial data input from DTE	CMOS 1.8V	
M15	C104/RXD	O	Serial data output to DTE	CMOS 1.8V	
M14	C108/DTR	I	Input for (DTR) from DTE	CMOS 1.8V	
L14	C105/RTS	I	Input for Request to send signal (RTS) from DTE	CMOS 1.8V	
P15	C106/CTS	O	Output for Clear to Send signal (CTS) to DTE	CMOS 1.8V	
N14	C109/DCD	O	Output for (DCD) to DTE	CMOS 1.8V	
P14	C107/DSR	O	Output for (DSR) to DTE	CMOS 1.8V	
R14	C125/RING	O	Output for Ring (RI) to DTE	CMOS 1.8V	
Asynchronous Auxiliary Serial Port (USIF1)					
D15	TX_AUX	O	Auxiliary UART (TX Data to DTE)	CMOS 1.8V	
E15	RX_AUX	I	Auxiliary UART (RX Data from DTE)	CMOS 1.8V	
USB HSIC					
A12	HSIC_USB_DATA	I/O	USB HSIC data signal	CMOS 1.2V	
A11	HSIC_USB_STRB	I/O	USB HSIC 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 GPIO08
J15	HSIC_HOST_ACTIVE	I	Active Host Indication	CMOS 1.8V	Shared with SPI_SRDY
D13	VDD_IO1	I	VDD_IO1 Input		To be connected to E13
E13	1V8_SEL	O	1V8 SEL for VDD_IO1		To be connected to D13
SIM card interface					
A6	SIMCLK	O	External SIM signal – Clock	1.8 / 3V	
A7	SIMRST	O	External SIM signal – Reset	1.8 / 3V	
A5	SIMIO	I/O	External SIM signal – Data I/O	1.8 / 3V	
A4	SIMIN	I	External SIM signal – Presence (active low)	CMOS 1.8	

A3	SIMVCC	-	External SIM signal – Power supply for the SIM	1.8 / 3V	
Digital Voice Interface (DVI)					
B9	DVI_WA0	I/O	Digital Audio Interface (WA0)	1.8V	16K pull down (typical at 1.8V) when in Input
B6	DVI_RX	I	Digital Audio Interface (RX)	1.8V	Input with 16K pull down (typical at 1.8V)
B7	DVI_TX	I/O	Digital Audio Interface (TX)	1.8V	16K pull down (typical at 1.8V) when in Input
B8	DVI_CLK	I/O	Digital Audio Interface (CLK)	1.8V	Input with 16K pull down (typical at 1.8V)
SPI					
D15	SPI_MOSI	I	SPI MOSI	CMOS 1.8V	Shared with TX_AUX
E15	SPI_MISO	O	SPI_MISO	CMOS 1.8V	Shared with RX_AUX
F15	SPI_CLK	I	SPI Clock	CMOS 1.8V	Shared with HSIC_HOST_WAKEUP
H15	SPI_MRDY	I	SPI_MRDY	CMOS 1.8V	Shared with HSIC_SLAVE_WAKEUP
J15	SPI_SRDY	O	SPI_SRDY	CMOS 1.8V	Shared with HSIC_HOST_ACTIVE
DIGITAL IO					
C8	GPIO_01	I/O	GPIO_01 /STAT LED	CMOS 1.8V	Alternate Function STAT LED
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	CMOS 1.8V	
K15	GPIO_08	I/O	GPIO_08	CMOS 1.8V	Shared with HSIC_SUSPEND_REQUEST
L15	GPIO_09	I/O	GPIO_09	CMOS 1.8V	
G15	GPIO_10	I/O	GPIO_10	CMOS 1.8V	
ADC					
B1	ADC_IN1	AI	Analog / Digital converter input	A/D	Accepted values 0 to 1.2V DC
RF SECTION					
K1	ANTENNA	I/O	GSM/EDGE/UMTS Antenna (50 ohm)	RF	
F1	ANT_DIV	I	Antenna Diversity Input (50 ohm)	RF	See NOTE 1
GPS SECTION (see NOTE1)					
R9	ANT_GPS	I	GPS Antenna (50 ohm)	RF	
R7	GPS_LNA_EN	O	Output enable for External LNA supply	CMOS 1.8V	
Miscellaneous Functions					
R13	HW_SHUTDOWN*	I	HW Unconditional Shutdown	1.8V	Active low
R12	ON_OFF*	I	Input command for power ON	1.8V	Active low
C14	VRTC	I	VRTC Backup capacitor	Power	backup for the embedded RTC supply (1.8V)

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 (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	
E1	GND	-	Ground	Power	
G1	GND	-	Ground	Power	
H1	GND	-	Ground	Power	
J1	GND	-	Ground	Power	
L1	GND	-	Ground	Power	
A2	GND	-	Ground	Power	
E2	GND	-	Ground	Power	
F2	GND	-	Ground	Power	
G2	GND	-	Ground	Power	
H2	GND	-	Ground	Power	
J2	GND	-	Ground	Power	
K2	GND	-	Ground	Power	
L2	GND	-	Ground	Power	
R2	GND	-	Ground	Power	
M3	GND	-	Ground	Power	
N3	GND	-	Ground	Power	
P3	GND	-	Ground	Power	
R3	GND	-	Ground	Power	
D4	GND	-	Ground	Power	
M4	GND	-	Ground	Power	
N4	GND	-	Ground	Power	
P4	GND	-	Ground	Power	
R4	GND	-	Ground	Power	
N5	GND	-	Ground	Power	
P5	GND	-	Ground	Power	
R5	GND	-	Ground	Power	
N6	GND	-	Ground	Power	
P6	GND	-	Ground	Power	
R6	GND	-	Ground	Power	
P8	GND	-	Ground	Power	
R8	GND	-	Ground	Power	
P9	GND	-	Ground	Power	
P10	GND	-	Ground	Power	

R10	GND	-	Ground	Power	
M12	GND	-	Ground	Power	
B13	GND	-	Ground	Power	
P13	GND	-	Ground	Power	
E14	GND	-	Ground	Power	
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		
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		
N8	RESERVED	-	RESERVED		
N9	RESERVED	-	RESERVED		
A10	RESERVED	-	RESERVED		
N10	RESERVED	-	RESERVED		
N11	RESERVED	-	RESERVED		
P11	RESERVED	-	RESERVED		
B12	RESERVED	-	RESERVED		
D12	RESERVED	-	RESERVED		
N12	RESERVED	-	RESERVED		
P12	RESERVED	-	RESERVED		
F14	RESERVED	-	RESERVED		
G14	RESERVED	-	RESERVED		
H14	RESERVED	-	RESERVED		

J14	RESERVED	-	RESERVED		
K14	RESERVED	-	RESERVED		
N13	RESERVED	-	RESERVED		
L13	RESERVED	-	RESERVED		
J13	RESERVED	-	RESERVED		
M13	RESERVED	-	RESERVED		
K13	RESERVED	-	RESERVED		
H13	RESERVED	-	RESERVED		
G13	RESERVED	-	RESERVED		
F13	RESERVED	-	RESERVED		
B11	RESERVED	-	RESERVED		
B10	RESERVED	-	RESERVED		
A9	RESERVED	-	RESERVED		
A8	RESERVED	-	RESERVED		
D14	RESERVED	-	RESERVED		
A14	RESERVED	-	RESERVED		

WARNING:

Reserved pins must not be connected.

NOTE 1:
The following table is listing the main Pinout differences between the HE910 variants

Product	GPS	Antenna Diversity	Notes
HE910 (*)	YES	YES	
HE910-D	NO	YES	Reserved Pads: R7, R9
HE910-GL	NO	NO	Reserved Pads:,F1, R7, R9
HE910-EUR	NO	NO	Reserved Pads:,F1, R7, R9
HE910-EUD	NO	NO	Reserved Pads:,F1, R7, R9
HE910-EUG	YES	NO	Reserved Pads: F1
HE910-NAR	NO	NO	Reserved Pads: F1, R7, R9
HE910-NAD	NO	NO	Reserved Pads: F1, R7, R9
HE910-NAG	YES	NO	Reserved Pads: F1

(*) HE910 is the “type name” of the products marketed as HE910-G & HE910-DG

NOTE:

If not used, almost all pins should be left disconnected. The only exceptions are the following pins:

PAD	Signal	Notes
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 or an USB connector
C15	USB_D-	If not used should be connected to a Test Point or an USB connector
A13	VUSB	If not used should be connected to a Test Point or an USB connector
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
D13	VDD_IO1	It has always to be connected to 1V8_SEL
E13	1V8_SEL	It has always to be connected to VDD_IO1
K1	MAIN ANTENNA	
F1	ANT_DIV (if supported by the product)	If not used it could left unconnected but has to be disabled by the related AT Command (AT#RXDIV); please refer to the At User guide for the related syntax
R9	ANT_GPS (if supported by the product)	If the GPS is not used it could be left unconnected

RTS pin should 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)

TOP VIEW

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
1		ADC_IN1	RES	RES	GND	ANT_DIV	GND	GND	GND	ANT	GND	VBATT	VBATT_PA	VBATT_PA	
2	GND	RES	RES	RES	GND	GND	GND	GND	GND	GND	GND	VBATT	VBATT_PA	VBATT_PA	GND
3	SIMVCC	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	GND	GND	GND
4	SIMIN	RES	RES	GND								GND	GND	GND	GND
5	SIMIO	RES	RES										GND	GND	GND
6	SIMCLK	DVI_RX	RES										GND	GND	GND
7	SIMRST	DVI_TX	RES										RES	RES	GPS_LNA_EN
8	RES	DVI_CLK	GPIO_01										RES	GND	GND
9	RES	DVI_WA0	GPIO_02										RES	GND	ANT_GPS
10	RES	RES	GPIO_03										RES	GND	GND
11	HSIC_USB_STRB	RES	GPIO_04										RES	RES	VAUX/PWRMON
12	HSIC_USB_DATA	RES	GPIO_06	RES								GND	RES	RES	ON_OFF*
13	VUSB	GND	GPIO_07	VDD_IO1	1V8_SEL	RES	RES	RES	RES	RES	RES	RES	RES	GND	HW_SHUTDOWN*
14	RES	GPIO_05	VRTC	RES	GND	RES	RES	RES	RES	RES	C105/RTS	C108/DTR	C109/DCD	C107/DSR	C125/RING
15		USB_D+	USB_D-	TX AUX	RX AUX	SPI_CLK	GPIO_10	SPI_MRDY	SPI_SRDY	GPIO_08	GPIO_09	C104/RXD	C103/TXD	C106/CTS	

NOTE:

The pin defined as RES has to be considered RESERVED and not connected on any pin in the application.

HE910 is the “type name” of the products marketed as HE910-G & HE910-DG.

3.1.2 LGA Pads Layout (HE910-D)

TOP VIEW

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
1		ADC_IN1	RES	RES	GND	ANT_DIV	GND	GND	GND	ANT	GND	VBATT	VBATT_PA	VBATT_PA	
2	GND	RES	RES	RES	GND	GND	GND	GND	GND	GND	GND	VBATT	VBATT_PA	VBATT_PA	GND
3	SIMVCC	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	GND	GND	GND
4	SIMIN	RES	RES	GND								GND	GND	GND	GND
5	SIMIO	RES	RES										GND	GND	GND
6	SIMCLK	DVI_RX	RES										GND	GND	GND
7	SIMRST	DVI_TX	RES										RES	RES	RES
8	RES	DVI_CLK	GPIO_01										RES	GND	GND
9	RES	DVI_WA0	GPIO_02										RES	GND	RES
10	RES	RES	GPIO_03										RES	GND	GND
11	HSIC_USB_STRB	RES	GPIO_04										RES	RES	VAUX/PWRMON
12	HSIC_USB_DATA	RES	GPIO_06	RES								GND	RES	RES	ON_OFF*
13	VUSB	GND	GPIO_07	VDD_IO1	1V8_SEL	RES	RES	RES	RES	RES	RES	RES	RES	GND	HW_SHUTDOWN*
14	RES	GPIO_05	VRTC	RES	GND	RES	RES	RES	RES	RES	C105/RTS	C108/DTR	C109/DCD	C107/DSR	C125/RING
15		USB_D+	USB_D-	TX AUX	RX AUX	SPI_CLK	GPIO_10	SPI_MRDY	SPI_SRDY	GPIO_08	GPIO_09	C104/RXD	C103/TXD	C106/CTS	

NOTE:

The pin defined as **RES** has to be considered RESERVED and not connected on any pin in the application.

3.1.3 LGA Pads Layout (HE910-EUD/EUR, HE910-NAD/NAR and HE910-GL)

TOP VIEW

	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	ANT	GND	VBATT	VBATT_PA	VBATT_PA	
2	GND	RES	RES	RES	GND	GND	GND	GND	GND	GND	GND	VBATT	VBATT_PA	VBATT_PA	GND
3	SIMVCC	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	GND	GND	GND
4	SIMIN	RES	RES	GND								GND	GND	GND	GND
5	SIMIO	RES	RES										GND	GND	GND
6	SIMCLK	DVI_RX	RES										GND	GND	GND
7	SIMRST	DVI_TX	RES										RES	RES	RES
8	RES	DVI_CLK	GPIO_01										RES	GND	GND
9	RES	DVI_WA0	GPIO_02										RES	GND	RES
10	RES	RES	GPIO_03										RES	GND	GND
11	HSIC_USB_STRB	RES	GPIO_04										RES	RES	VAUX/PWRMON
12	HSIC_USB_DATA	RES	GPIO_06	RES								GND	RES	RES	ON_OFF*
13	VUSB	GND	GPIO_07	VDD_IO1	1V8_SEL	RES	RES	RES	RES	RES	RES	RES	RES	GND	HW_SHUTDOWN*
14	RES	GPIO_05	VRTC	RES	GND	RES	RES	RES	RES	RES	C105/RTS	C108/DTR	C109/DCD	C107/DSR	C125/RING
15		USB_D+	USB_D-	TX AUX	RX AUX	SPI_CLK	GPIO_10	SPI_MRDY	SPI_SRDY	GPIO_08	GPIO_09	C104/RXD	C103/TXD	C106/CTS	

NOTE:

The pin defined as **RES** has to be considered RESERVED and not connected on any pin in the application.

3.1.4 LGA Pads Layout (HE910-EUG and HE910-NAG)

TOP VIEW

	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	ANT	GND	VBATT	VBATT_PA	VBATT_PA	
2	GND	RES	RES	RES	GND	GND	GND	GND	GND	GND	GND	VBATT	VBATT_PA	VBATT_PA	GND
3	SIMVCC	RES	RES	RES	RES	RES	RES	RES	RES	RES	RES	GND	GND	GND	GND
4	SIMIN	RES	RES	GND								GND	GND	GND	GND
5	SIMIO	RES	RES										GND	GND	GND
6	SIMCLK	DVI_RX	RES										GND	GND	GND
7	SIMRST	DVI_TX	RES										RES	RES	GPS_LNA_EN
8	RES	DVI_CLK	GPIO_01										RES	GND	GND
9	RES	DVI_WA0	GPIO_02										RES	GND	ANT_GPS
10	RES	RES	GPIO_03										RES	GND	GND
11	HSIC_USB_STRB	RES	GPIO_04										RES	RES	VAUX/PWRMON
12	HSIC_USB_DATA	RES	GPIO_06	RES								GND	RES	RES	ON_OFF*
13	VUSB	GND	GPIO_07	VDD_IO1	1V8_SEL	RES	RES	RES	RES	RES	RES	RES	RES	GND	HW_SHUTDOWN*
14	RES	GPIO_05	VRTC	RES	GND	RES	RES	RES	RES	RES	C105/RTS	C108/DTR	C109/DCD	C107/DSR	C125/RING
15		USB_D+	USB_D-	TX AUX	RX AUX	SPI_CLK	GPIO_10	SPI_MRDY	SPI_SRDY	GPIO_08	GPIO_09	C104/RXD	C103/TXD	C106/CTS	

NOTE:

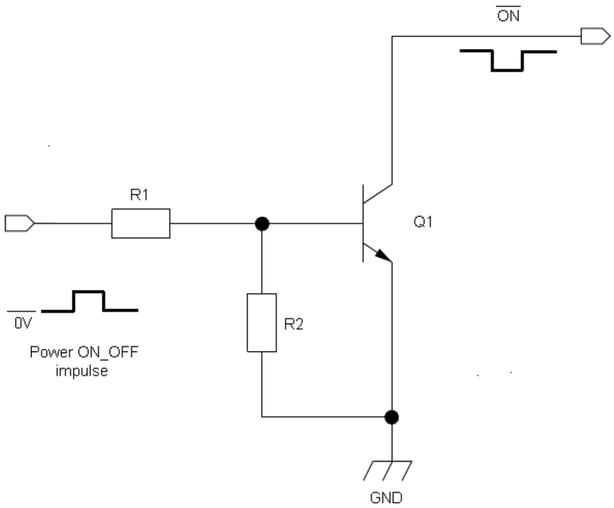
The pin defined as **RES** has to be considered RESERVED and not connected on any pin in the application.

4 Hardware Commands

4.1 Turning ON the HE910

To turn on the HE910 the pad ON_OFF* must be tied low for at least 5 seconds and then released.

The maximum current that can be drained from the ON_OFF* pad is 0,1 mA.
A simple circuit to do it is:



NOTE:

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.

NOTE:

In this document all the lines that are inverted, hence have active low signals are labelled with a name that ends with”#",”*” or with a bar over the name.

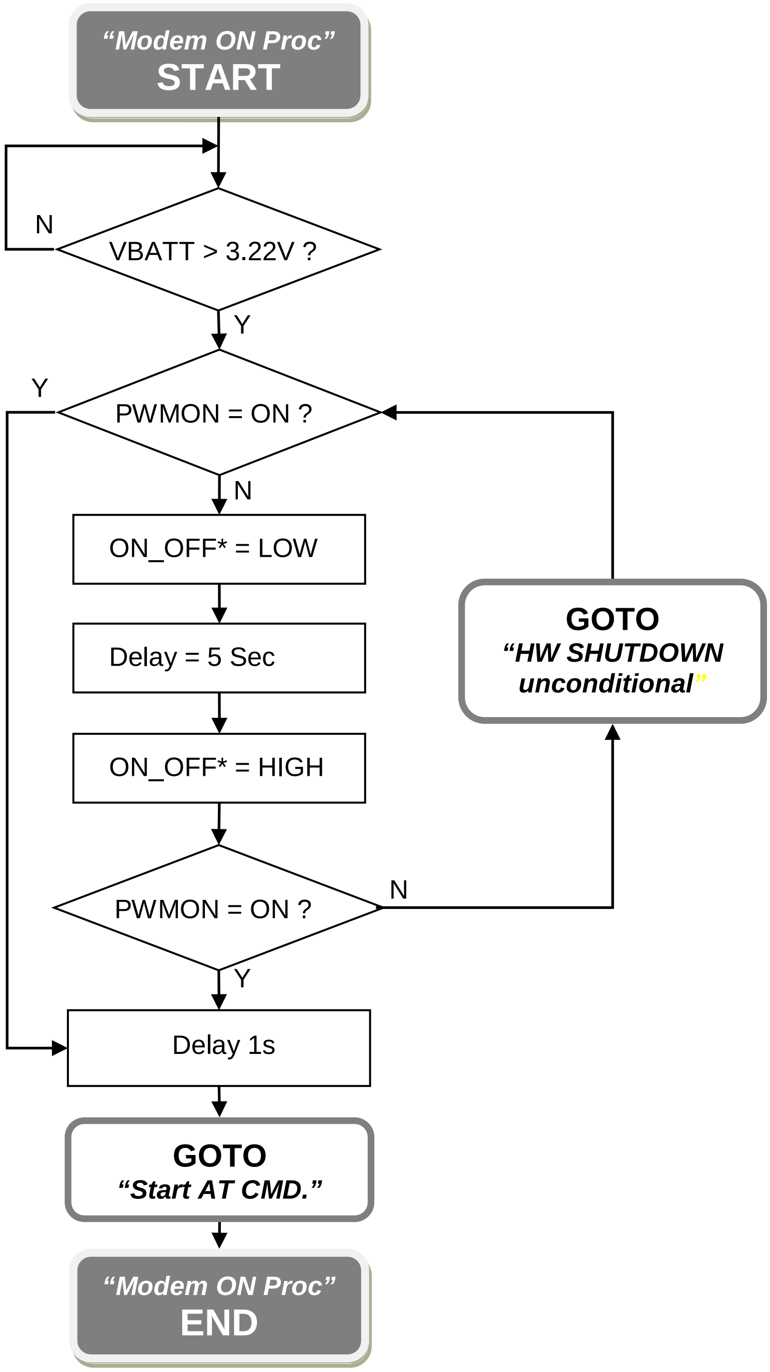
TIP:

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

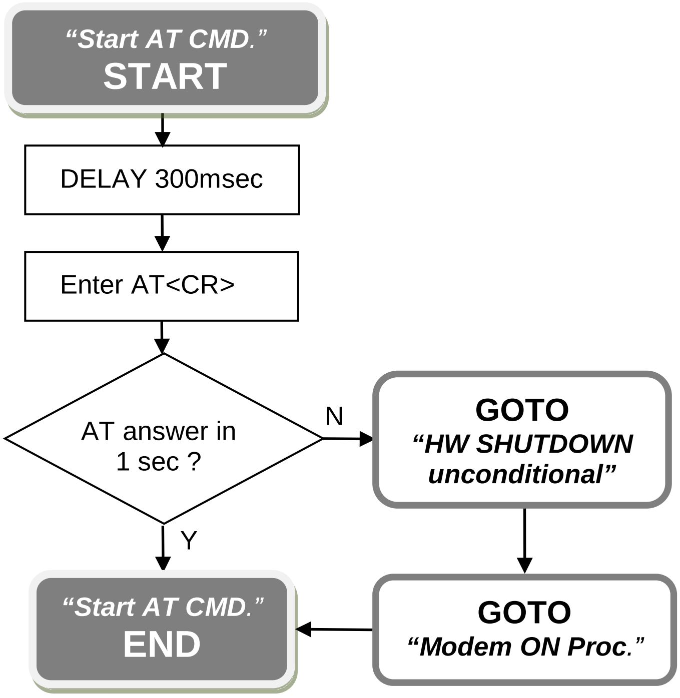
NOTE:

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

A flow chart showing the proper turn on procedure is displayed below:



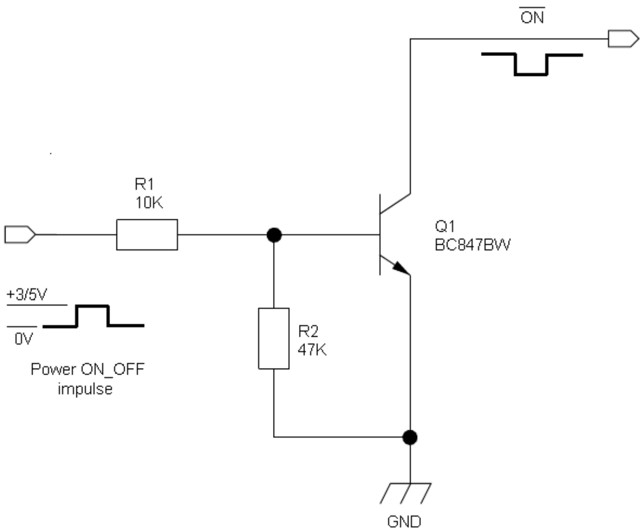
A flow chart showing the AT commands managing procedure is displayed below:



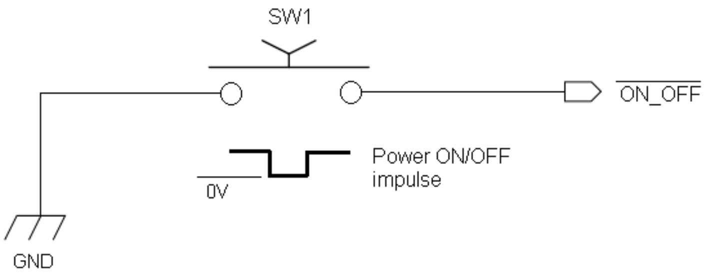
NOTE:

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

For example:
1- Let's assume you need to drive the ON_OFF* pad with a totem pole output of a +3/5 V microcontroller (uP_OUT1):

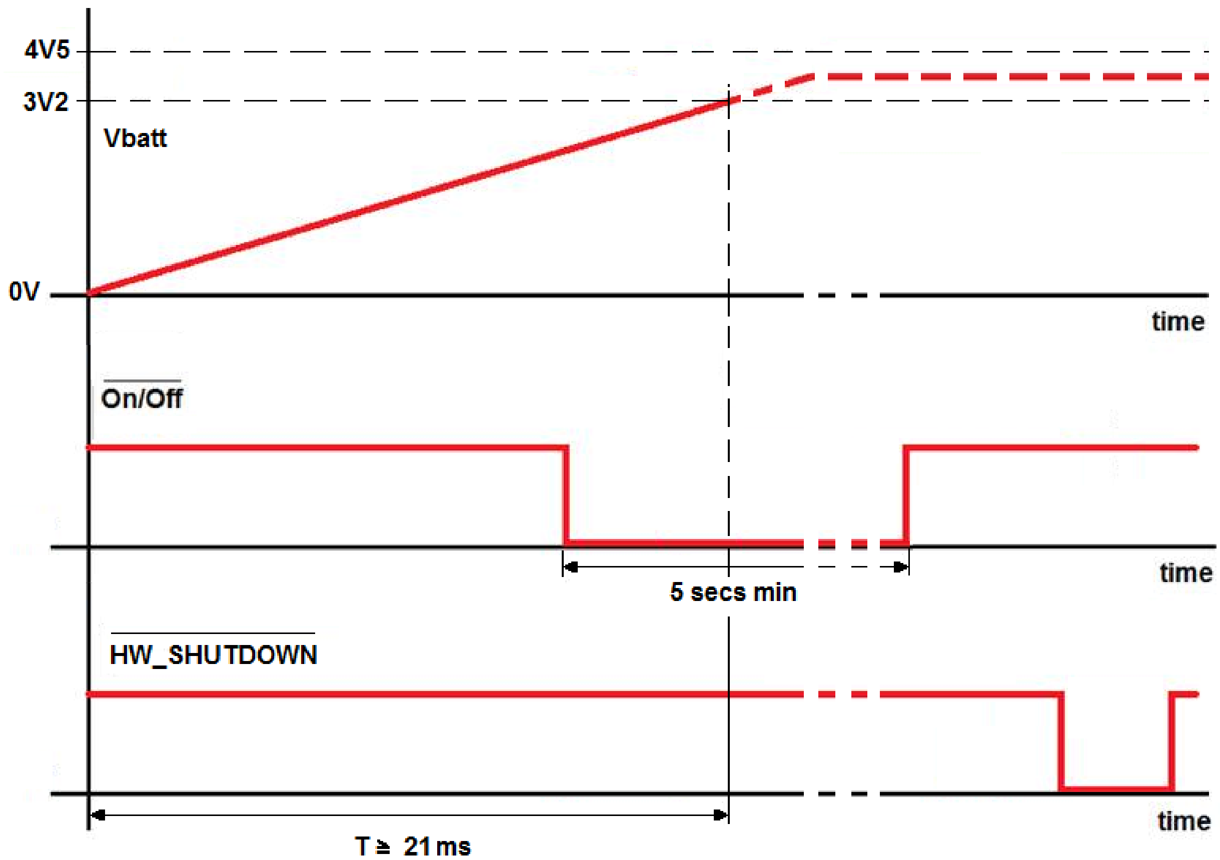


2- Let's assume you need to drive the ON_OFF* pad directly with an ON/OFF button:



WARNING
It is recommended to set the ON_OFF* line LOW to power on the module only after VBATT is higher than 3.22V.
In case this condition it is not satisfied you could use the HW_SHUTDOWN* line to recover it and then restart the power on activity using the ON_OFF * line.

An example of this is described in the following diagram:



After HW_SHUTSDOWN* is released you could again use the ON_OFF* line to power on the module.

4.2 Turning OFF the HE910

Turning off of the device can be done in two ways:

- via AT command (see HE910 Software User Guide, AT#SHDN)
- by tying low pin ON_OFF*

Either ways, the device issues a detach request to network informing that the device will not be reachable any more.
To turn OFF the HE910 the pad ON_OFF* must be tied low for at least 3 seconds and then released.

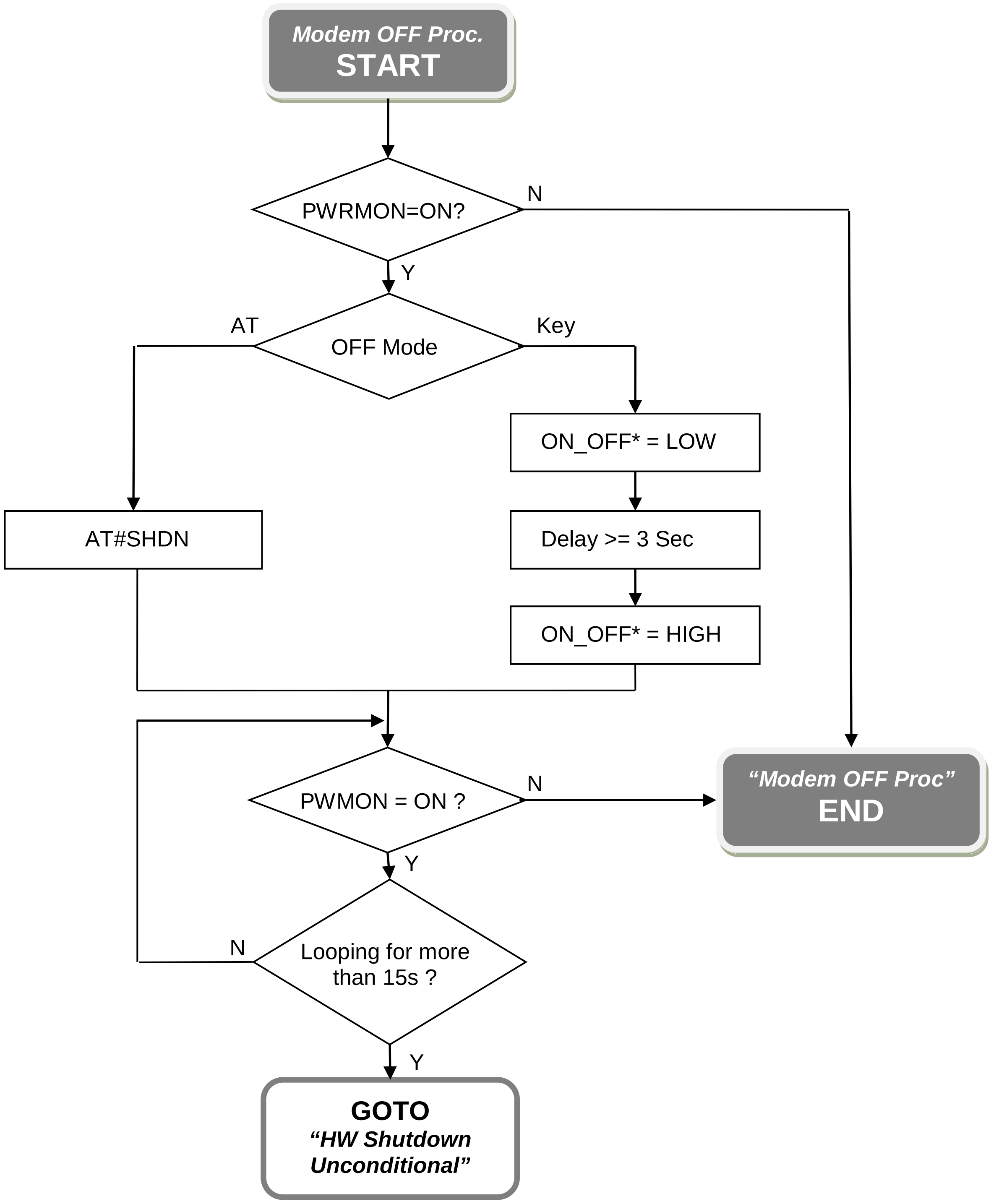
TIP:

To check if the device has been powered off, the hardware line PWRMON must be monitored. The device is powered off when PWRMON goes low.

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

The following flow chart shows the proper turn off procedure:



4.3 HE910 Unconditional Shutdown

The Unconditional Shutdown of the module could be activated using the HW_SHUTDOWN* line (pad R13).

WARNING:

The hardware unconditional Shutdown must not be used during normal operation of the device since it does not detach the device from the network. It shall be kept as an emergency exit procedure.

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

NOTE:

Do not use any pull up resistor on the HW_SHUTDOWN* line nor any totem pole digital output. Using pull up resistor may bring to latch up problems on the HE910 power regulator and improper functioning of the module. The line HW_SHUTDOWN* must be connected only in open collector configuration.

The HW_SHUTDOWN* is generating an unconditional shutdown of the module without an automatic restart.

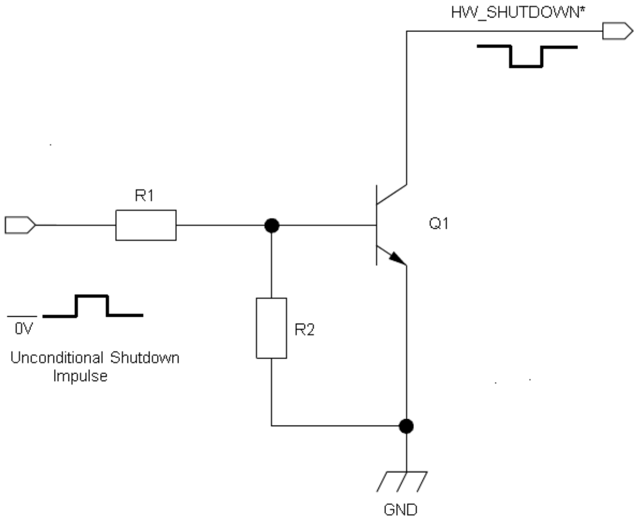
The module will shutdown, but will NOT perform the detach from the cellular network.

To proper power on again the module please refer to the related paragraph (“Powering ON the HE910”)

TIP:

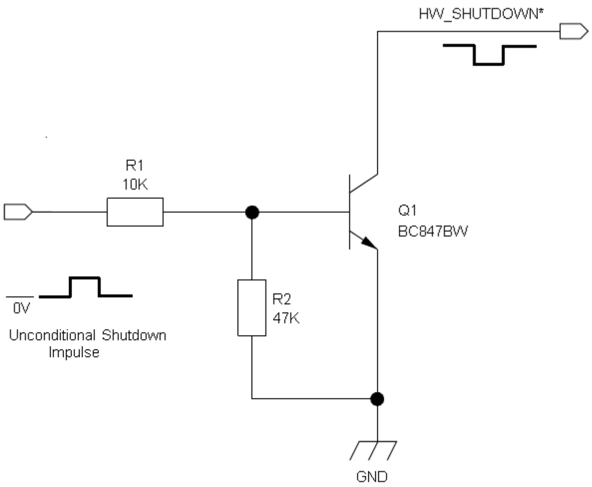
The unconditional hardware shutdown must always be implemented on the boards and should be used only as an emergency exit procedure.

A typical circuit is the following:



For example:

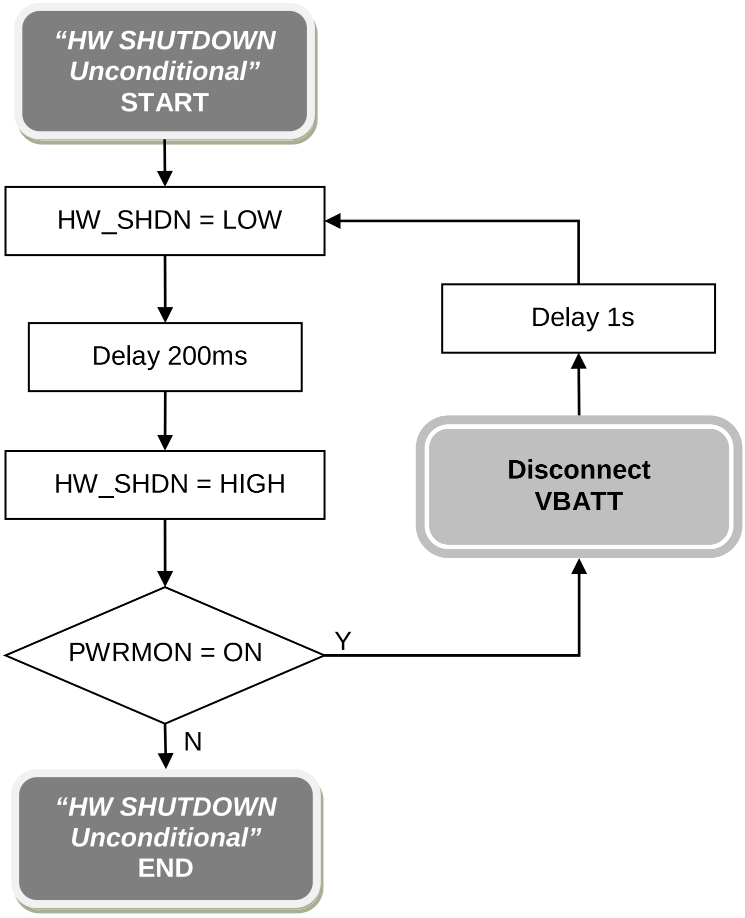
1- Let us assume you need to drive the HW_SHUTDOWN* pad with a totem pole output of a +3/5 V microcontroller (uP_OUT2):



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

In the following flow chart is detailed the proper restart procedure:



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 overall performances, hence read carefully the requirements and the guidelines that will follow for a proper design.

5.1 Power Supply Requirements

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

POWER SUPPLY	
Nominal Supply Voltage	3.8 V
Normal Operating Voltage Range	3.40 V÷ 4.20 V
Extended Operating Voltage Range	3.10 V÷ 4.50 V

NOTE:

The Operating Voltage Range MUST never be exceeded; 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.

The Power supply must be higher than 3.22 V to power on the module

NOTE:

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.

5.2 Power Consumption

HE910		
Mode	**Average (mA)**	**Mode description**
SWITCHED OFF		Module supplied but Switched Off
Switched Off	40uA	
IDLE mode (WCDMA)		
AT+CFUN=1	12.2	Normal mode: full functionality of the module
AT+CFUN=5	1.2	Full functionality with power saving; DRX7; Module registered on the network can receive incoming calls and SMS
IDLE mode (GSM/EDGE)		
AT+CFUN=1	19	Normal mode: full functionality of the module
AT+CFUN=4	16.5	Disabled TX and RX; module is not registered on the network
AT+CFUN=5	0.8	Full functionality with power saving; DRX9 (1.3mA in case of DRX5).
Operative mode (WCDMA)		
WCDMA Voice	152	WCDMA voice call (TX = 10dBm)
WCDMA HSDPA (0dBm)	187	WCDMA data call (Cat 14, TX = 0dBm)
WCDMA HSDPA (22dBm)	494	WCDMA data call (Cat 14, TX = 22dBm)
Operative mode (EDGE)		
EDGE 4TX+2RX		EDGE Sending data mode
GSM900 PL5	495	
DCS1800 PL0	484	
Operative mode (GSM)		
CSD TX and RX mode		GSM VOICE CALL
GSM900 CSD PL5	220	
DCS1800 CSD PL0	167	
GPRS 4TX+2RX		GPRS Sending data mode
GSM900 PL5	580	
DCS1800 PL0	438	

The GSM system is made in a way that the RF transmission is not continuous, else 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 with 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 and the supply; this will reflect on all the audio paths producing an audible annoying noise at 216 Hz; if the voltage drop during the peak current absorption is too much, then the device may even shutdown as a consequence of the supply voltage drop.

NOTE:

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.

5.3 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.

5.3.1 Electrical Design Guidelines

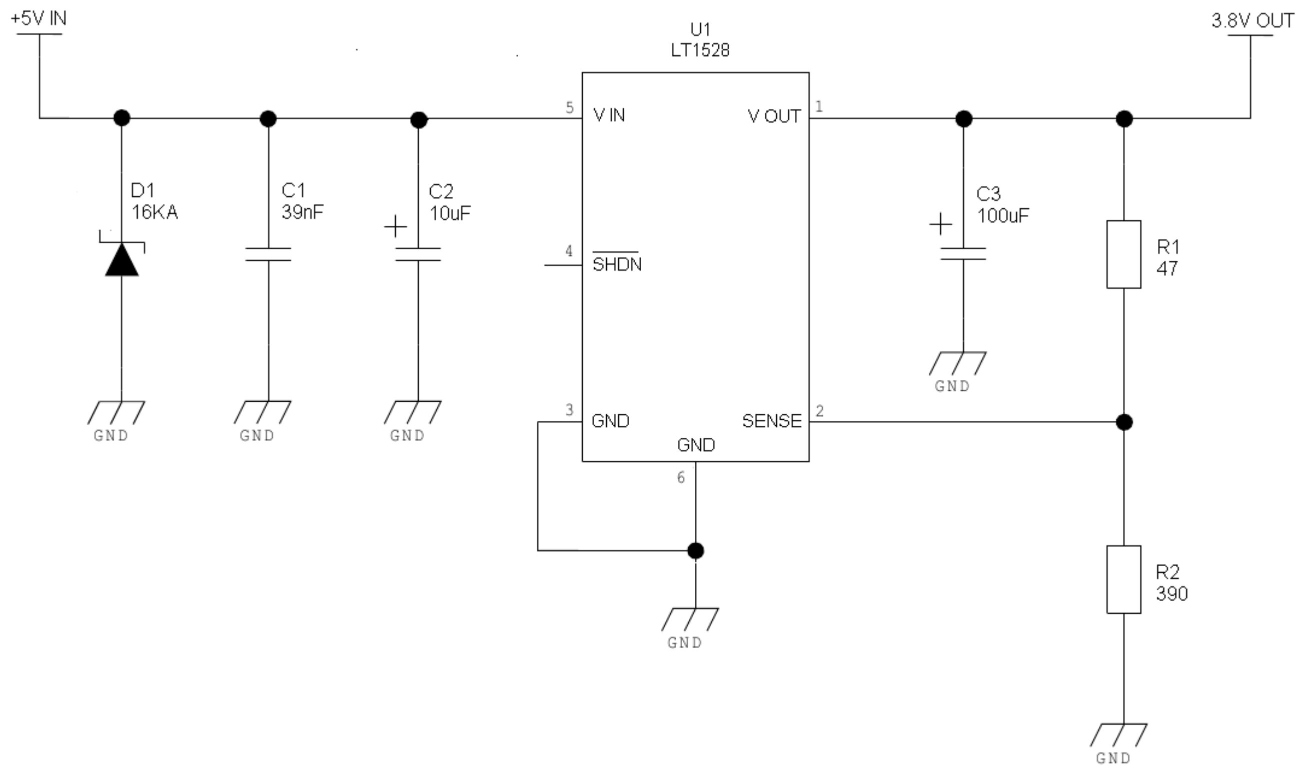
The electrical design of the power supply depends strongly from the power source where this power is drained. We will distinguish them into three categories:

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

5.3.1.1 + 5V input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence there's not a big difference between the input source and the desired output and a linear regulator can be used. A switching power supply will not be suited because of the low drop out requirements.
- When using a linear regulator, a proper heat sink shall 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, 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 should be inserted close to the power input, in order to save the HE910 from power polarity inversion.

An example of linear regulator with 5V input is:

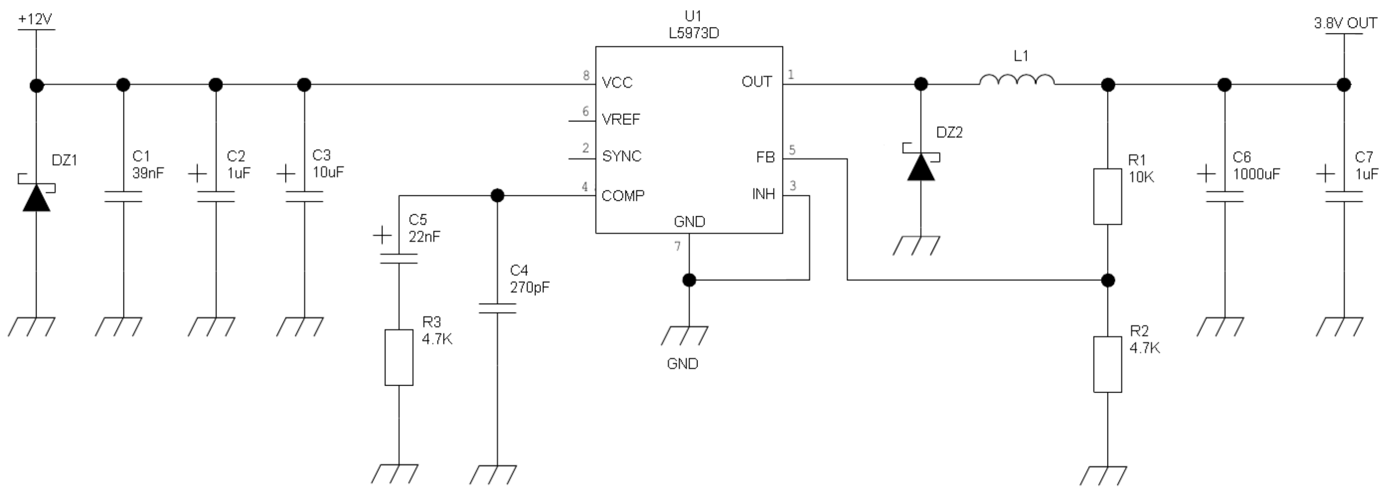


5.3.1.2 + 12V input Source Power Supply Design Guidelines

- 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 shall not be used. A switching power supply will be preferable because of its better efficiency especially with the 2A peak current load represented by the HE910.
- 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 should 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.
- 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 should be inserted close to the power input, in order to clean the supply from spikes.
- A protection diode should be inserted close to the power input, in order to save the HE910 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 below schematic:



5.3.1.3 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, hence a single 3.7V Li-Ion cell battery type is suited for supplying the power to the Telit HE910 module.

WARNING:

The three cells Ni/Cd or Ni/MH 3,6 V Nom. battery types or 4V PB types ***MUST NOT BE USED DIRECTLY*** since their maximum voltage can rise over the absolute maximum voltage for the HE910 and damage it.

NOTE:

DON'T USE any Ni-Cd, Ni-MH, and Pb battery types directly connected with HE910. Their use can lead to overvoltage on the HE910 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 should be inserted close to the power input, in order to save the HE910 from power polarity inversion. Otherwise the battery connector should 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.

5.3.2 Thermal Design Guidelines

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

- Average current consumption during HSDPA transmission @PWR level max :

  600 mA

- *Average current during idle:*
  1.5 *mA*

NOTE:

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

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 into transmission for short periods of time (let's say few minutes) and then remains for a quite long time in idle (let's 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 one for 600mA maximum RMS current, or even could be the simple chip package (no heat sink).
Moreover in the 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 the 600mA, being usually around 150mA.
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, you can consider it to be during transmission 1W max during CSD/VOICE calls and 2W max during GPRS upload.
This generated heat will be mostly conducted to the ground plane under the HE910; you must ensure that your application can dissipate it.

5.3.3 Power Supply PCB layout Guidelines

As seen on the electrical design guidelines the power supply shall 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 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 provided the PCB trace from the capacitor to the HE910 is wide enough to ensure a dropless 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 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, 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 doesn't have audio interface but only uses the data feature of the Telit HE910, then this noise is not so disturbing and power supply layout design can be more forgiving.

- The PCB traces to the HE910 and the Bypass capacitor must be wide enough to ensure no significant voltage drops occur when the 2A current peaks are absorbed. This is for the same reason as previous point. 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 (100-500 kHz usually).

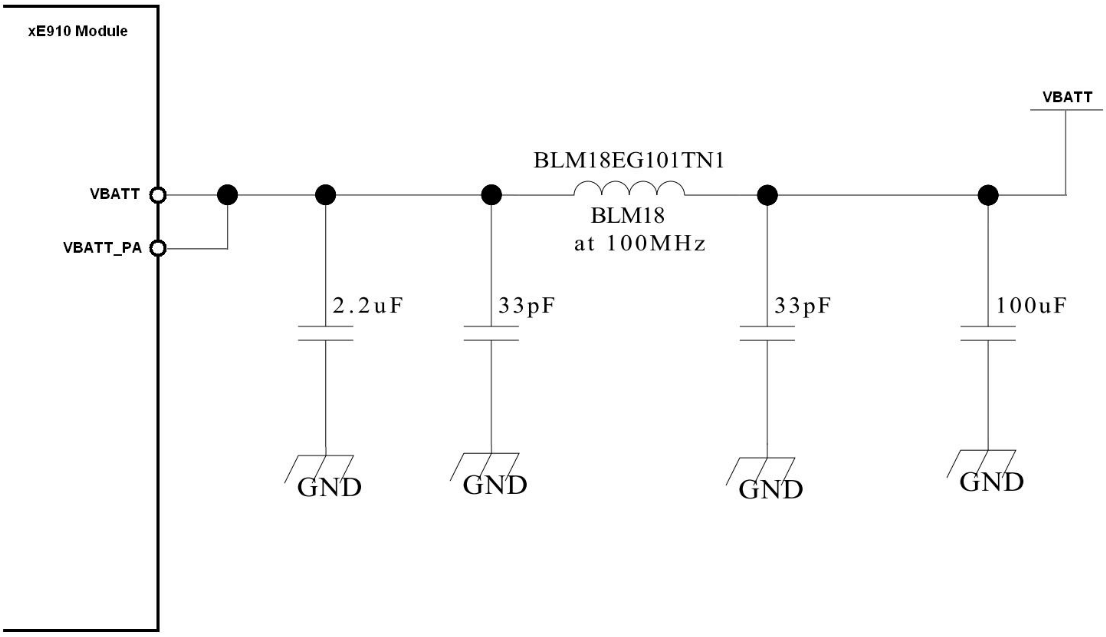
- The use of a good common ground plane is suggested.

- The placement of the power supply on the board should be done in such 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 should be kept separate from noise sensitive lines such as microphone/earphone cables.

- The insertion of EMI filter on VBATT pins is suggested in those designs where antenna is placed close to battery or supply lines.
  A ferrite bead like Murata BLM18EG101TN1 or Taiyo Yuden P/N FBMH1608HM101 can be used for this purpose.

  The below figure shows the recommended circuit:



6 GSM/WCDMA Radio Section

6.1 HE910 Product Variants

The following table is listing the main differences between the HE910 variants:

Product	Supported 2G Bands	Supported 3G bands	Antenna Diversity
HE910	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B4, B5, B8	FDD B1, B2, B5, B8 GSM 850, GSM 900, PCS 1900
HE910-D	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B4, B5, B8	FDD B1, B2, B5, B8 GSM 850, GSM 900, PCS 1900
HE910-GL	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B4, B5, B8	FDD B1, B2, B5, B8 GSM 850, GSM 900, PCS 1900
HE910-EUR	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B5, B8	NO
HE910-EUD	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B5, B8	NO
HE910-EUG	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B5, B8	NO
HE910-NAR	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B2, B4, B5	NO
HE910-NAD	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B2, B4, B5	NO
HE910-NAG	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B2, B4, B5	NO

6.2 TX Output Power

Band	Power Class
GSM 850 / 900	4 (2W)
DCS1800 / PCS 1900	1 (1W)
EDGE, 850/900 MHz	E2 (0.5W)
EDGE, 1800/1900 MHz	Class E2 (0.4W)
WCDMA FDD B1, B2, B4, B5, B8	Class 3 (0.25W)

6.3 Sensitivity

Band	Typical (without Diversity)	Note
GSM 850	-109.5 dBm	BER Class II <2.44%
GSM 900	-109 dBm	BER Class II <2.44%
DCS1800	-110 dBm	BER Class II <2.44%
PCS 1900	-109.5 dBm	BER Class II <2.44%
WCDMA FDD B1	-111 dBm	BER <0.1%
WCDMA FDD B2	-110 dBm	BER <0.1%
WCDMA FDD B4	-111 dBm	BER <0.1%
WCDMA FDD B5	-111 dBm	BER <0.1%
WCDMA FDD B8	-110 dBm	BER <0.1%

6.4 GSM/WCDMA Antenna Requirements

The antenna connection and board layout design are the most important aspect in the full product design as they strongly affect the product overall performances, hence read carefully and follow the requirements and the guidelines for a proper design.
The antenna and antenna transmission line on PCB for a Telit HE910 device shall fulfil the following requirements:

ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth (GSM/EDGE)	70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz PCS band
Bandwidth (WCDMA)	70 MHz in WCDMA Band V 80 MHz in WCDMA Band VIII 460 MHz in WCDMA Band IV 140 MHz in WCDMA Band II 250 MHz in WCDMA Band I
Impedance	50 ohm
Input power	> 33dBm(2 W) peak power in GSM > 24dBm Average power in WCDMA
VSWR absolute max	≤ 10:1 (limit to avoid permanent damage)
VSWR recommended	≤ 2:1 (limit to fulfil all regulatory requirements)

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

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

This transmission line shall fulfil the following requirements:

ANTENNA LINE ON PCB REQUIREMENTS	
Characteristic Impedance	50 ohm
Max Attenuation	0,3 dB
Coupling with other signals shall be avoided	
Cold End (Ground Plane) of antenna shall be equipotential to the HE910 ground pins	

Furthermore if the device is developed for the US market and/or Canada market, it shall 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.
Antennas used for this OEM module must not exceed the gains for mobile and fixed operating configurations as described in “FCC/IC Regulatory notices” chapter.

6.5 GSM/WCDMA - 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 0,3 dB;
- Line geometry should have uniform characteristics, constant cross section, avoid meanders and abrupt curves;
- Any kind of suitable geometry / structure (Microstrip, Stripline, Coplanar, Grounded Coplanar Waveguide...) 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) 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 signal tracks on different layers;

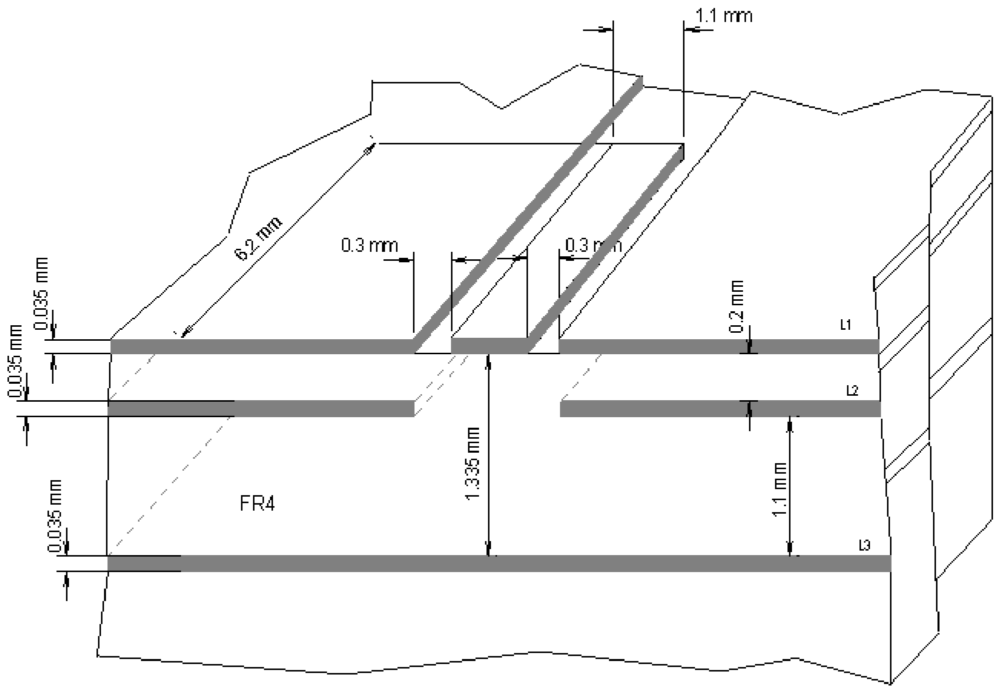
- The ground surrounding the antenna line on PCB has to be strictly connected to the main Ground Plane by means of via holes (once per 2mm at least), placed close to the ground edges facing line track;
- Place EM noisy devices as far as possible from HE910 antenna line;
- Keep the antenna line far away from the HE910 power supply lines;
- If EM noisy devices are present on the PCB hosting the HE910, such as fast switching ICs, take care of the shielding of the 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 EM noisy devices are not present around the line, the use of geometries like Microstrip or Grounded Coplanar Waveguide has to be preferred, since they typically ensure less attenuation if compared to a Stripline having same length;

6.6 PCB Guidelines in case of FCC certification

In the case FCC certification is required for an application using HE910, HE910-D, HE910-NAx, according to FCC KDB 996369 for modular approval requirements, the transmission line has to be similar to that implemented on module's interface board and described in the following chapter.

6.6.1 Transmission line design

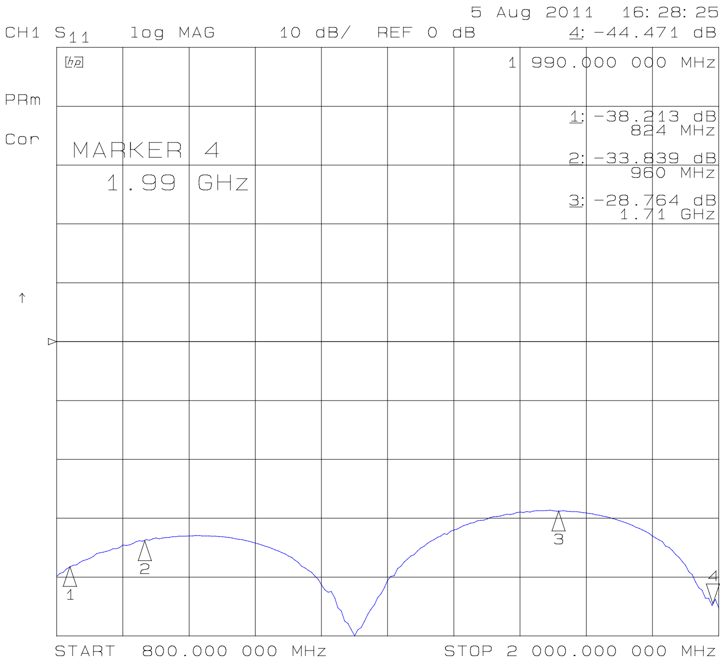
During the design of the interface board, the placement of components has been chosen properly, in order to keep the line length as short as possible, thus leading to lowest power losses possible. A Grounded Coplanar Waveguide (G-CPW) line has been chosen, since this kind of transmission line ensures good impedance control and can be implemented in an outer PCB layer as needed in this case. A SMA female connector has been used to feed the line.
The interface board is realized on a FR4, 4-layers PCB. Substrate material is characterized by relative permittivity ε_r = 4.6 ± 0.4 @ 1 GHz, TanD= 0.019 ÷ 0.026 @ 1 GHz.
A characteristic impedance of nearly 50 Ω is achieved using trace width = 1.1 mm, clearance from coplanar ground plane = 0.3 mm each side. The line uses reference ground plane on layer 3, while copper is removed from layer 2 underneath the line. Height of trace above ground plane is 1.335 mm. Calculated characteristic impedance is 51.6 Ω, estimated line loss is less than 0.1 dB. The line geometry is shown below:



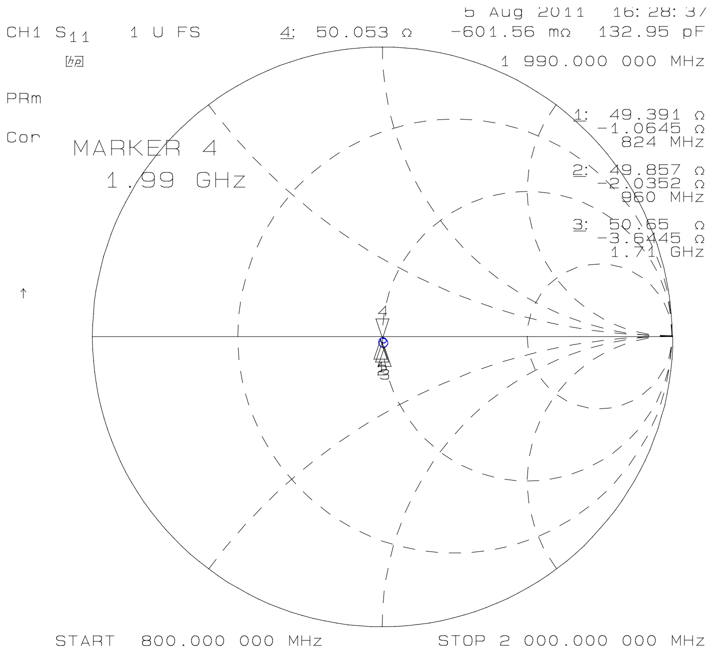
6.6.2 Transmission line measurements

HP8753E VNA (Full-2-port calibration) has been used in this measurement session. A calibrated coaxial cable has been soldered at the pad corresponding to RF output; a SMA connector has been soldered to the board in order to characterize the losses of the transmission line including the connector itself. During Return Loss / impedance measurements, the transmission line has been terminated to 50 Ω load.

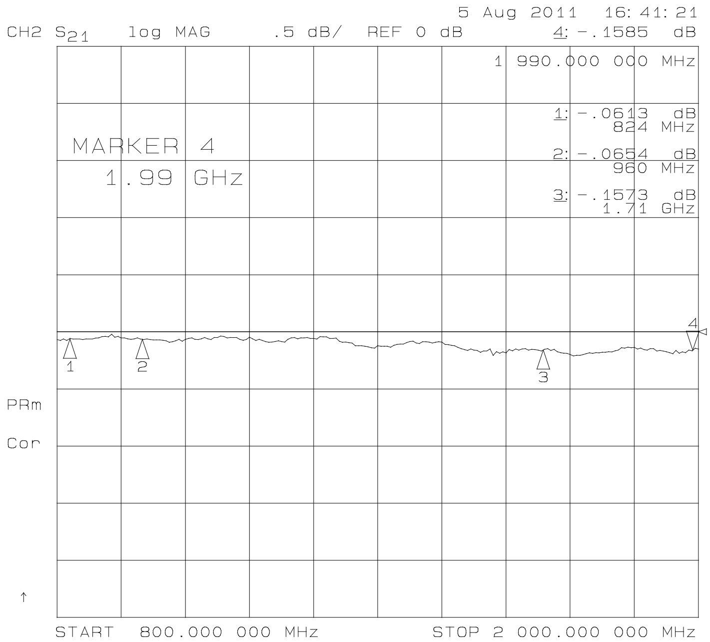
Return Loss plot of line under test is shown below:



Line input impedance (in Smith Chart format, once the line has been terminated to 50 Ω load) is shown in the following figure:



Insertion Loss of G-CPW line plus SMA connector is shown below:



6.7 GSM/WCDMA Antenna - Installation Guidelines

- Install the antenna in a place covered by the GSM signal.
- 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.

6.8 Antenna Diversity Requirements

This product is including an input for a second RX antenna to improve the radio sensitivity. The function is called Antenna Diversity.

ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth (GSM/EDGE)	70 MHz in GSM850, 80 MHz in GSM900 & 140 MHz PCS band
Bandwidth (WCDMA)	70 MHz in WCDMA Band V 80 MHz in WCDMA Band VIII 140 MHz in WCDMA Band II 250 MHz in WCDMA Band I
Impedance	50 ohm

When using the HE910, since there's no antenna connector on the module, the antenna must be connected to the HE910 antenna pad (F1) by means of a transmission line implemented on the PCB.

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

The second Rx antenna should not be located in the close vicinity of main antenna. In order to improve Diversity Gain, Isolation and reduce mutual interaction, the two antennas should be located at the maximum reciprocal distance possible, taking into consideration the available space into the application.

NOTE1:

The Diversity is not supported on DCS 1800 in 2G and FDD BAND IV in 3G

NOTE:

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.

7 GPS Receiver

The HE910 module is integrating a GPS receiver that could be used in Autonomous or in A-GPS (assisted GPS) mode.
With the help of advanced digital signal processing algorithms and the use of A-GPS data, the receiver is capable to achieve sensitivity values of better than -165 dBm as is required for indoor applications.

The following table is listing the HE910 variants that support the GPS receiver:

Product	GPS Receiver
HE910	YES
HE910-D	NO
HE910-GL	NO
HE910-EUR	NO
HE910-EUD	NO
HE910-EUG	YES
HE910-NAR	NO
HE910-NAD	NO
HE910-NAG	YES

7.1 GPS Performances

- Advanced real time hardware correlation engine for enhanced sensitivity (better than -165 dBm for A-GPS).
- Fast Acquisition giving rapid Time-to-First-Fix (TTFF)
- Capability to monitor up to 28 channels
- Stand Alone and Assisted mode
- Integrated LNA

The following Table is listing the main characteristics:

Characteristic	Typical Values
GPS RX Sensitivity	-164dBm
GPS Cold Start Autonomous	-147dBm
GPS Hot Start Autonomous	-161dBm
GPS tracking mode	-166 dBm
GPS Accuracy	3m
TTFF from Cold Start	42 sec
TTF from Warm Start	30sec
TTF from Hot Start	1.8 sec
Power Consumption in Acquisition	46.4 mA @3.8V
Power Consumption in Tracking	37.8 mA @3.8V
Power Consumption in Low Power Tracking	25.7 mA @3.8V

7.2 GPS Signals Pinout

The Pads related to this function are the following:

PAD	Signal	I/O	Function	Type
R9	ANT_GPS	I	GPS Antenna (50 ohm)	RF
R7	GPS_LNA_EN	O	Output enable for External LNA supply	CMOS 1.8V

7.3 RF Front End Design

The HE910 Module contains an integrated LNA and pre-select SAW filter. This allows the module to work well with a passive GPS antenna. If the antenna cannot be located near the HE910, then an active antenna (that is, an antenna with a low noise amplifier built in) can be used.

7.3.1 RF Signal Requirements

The HE910 can achieve Cold Start acquisition with a signal level of -147 dBm at its input. This means the GPS receiver can find the necessary satellites, download the necessary ephemeris data and compute the location within a 5 minute period.
In the GPS signal acquisition process, downloading and decoding the data is the most difficult task, which is why Cold Start acquisition requires a higher signal level than navigation or tracking signal levels. For the purposes of this discussion, autonomous operation is assumed, which makes the Cold Start acquisition level the important design constraint. If assistance data in the form of time or ephemeris aiding is available, then even lower signal levels can be used to compute a navigation solution.

Each GPS satellite presents its own signal to the HE910, and best performance is obtained when the signal levels are between -125 dBm and -117 dBm. These received signal levels are determined by :

- GPS satellite transmit power
- GPS satellite elevation and azimuth
- Free space path loss
- Extraneous path loss such as rain
- Partial or total path blockage such as foliage or building
- Multipath caused by signal reflection
- GPS antenna
- Signal path after the GPS antenna

The first three items in the list above are specified in IS-GPS-200E, readily available multiple sources online. IS-GPS-200E specifies a signal level minimum of -130 dBm will be presented to the receiver when using a linearly polarized antenna with 3 dBi gain.
The GPS signal is relatively immune to rainfall attenuation and does not really need to be considered.

However, the GPS signal is heavily influenced by attenuation due to foliage such as tree canopies, etc., as well as outright blockage caused by building, terrain or other items in the line of sight to the specific GPS satellite. This variable attenuation is highly dependent upon GPS satellite location. If enough satellites are blocked, say at a lower elevation, or all in a general direction, the geometry of the remaining satellites will result is a lower accuracy of position. The HE910 reports this geometry in the form of PDOP, HDOP and VDOP.
For example, in a vehicular application, the GPS antenna may be placed embedded into the dashboard or rear package tray of an automobile. The metal roof of the vehicle will cause significant blockage, plus any thermal coating applied to the vehicle glass can attenuate the GPS signal by as much as 15 dB. Again, both of these factors will affect the performance of the receiver.
Multipath is a phenomena where the signal from a particular satellite is reflected and is received by the GPS antenna in addition to or in place of the original line of sight signal. The multipath signal has a path length that is longer than the original line of sight path and can either attenuate the original signal, or if received in place of the original signal add additional error in determining a solution because the distance to the particular GPS satellite is actually longer than expected. It is this phenomena that makes GPS navigation in urban canyons (narrow roads surround by high rise buildings) so challenging. In general, the reflecting of the GPS signal causes the polarization to reverse. The implications of this are covered in the next section.

7.3.2 GPS Antenna Polarization

The GPS signal as broadcast is a right hand circularly polarized signal. The best antenna to receive the GPS signal is a right hand circularly (RHCP) polarized antenna.
Remember that IS-GPS-200E specifies the receive power level with a linearly polarized antenna. A linearly polarized antenna will have 3 dB loss as compared to an RHCP antenna assuming the same antenna gain (specified in dBi and dBic respectively).
An RHCP antenna is better at rejecting multipath than a linearly polarized antenna.
This is because the reflected signal changes polarization to LHCP, which would be rejected by the RHCP antenna by typically 20 dB or so. If the multipath signal is attenuating the line of sight signal, then the RHCP antenna would show a higher signal level than a linearly polarized antenna because the interfering signal is rejected.
However, in the case where the multipath signal is replacing the line of sight signal, such as in an urban canyon environment, then the number of satellites in view could drop below that needed to determine a 3D solution. This is a case where a bad signal may be better than no signal. The system designer needs to make tradeoffs in their application to determine which is the better choice.

7.3.3 GPS Antenna Gain

Antenna gain is defined as the extra signal power from the antenna as compared to a theoretical isotropic antenna (equally sensitive in all directions).
For example, a 25mm by 25m square patch antenna on a reference ground plane (usually 70mm by 70mm) will give an antenna gain at zenith of 5 dBic. A smaller 18mm by 18mm square patch on a reference ground plane (usually 50mm by 50mm) will give an antenna gain at zenith of 2 dBic.
While an antenna vendor will specify a nominal antenna gain (usually at zenith, or directly overhead) they should supply antenna pattern curves specifying gain as a function of elevation, and gain at a fixed elevation as a function of azimuth. Pay careful attention to the requirement to meet these specifications, such as ground plane required and any external matching components. Failure to follow these requirements could result in very poor antenna performance.
It is important to note that GPS antenna gain is not the same thing as external LNA gain. Most antenna vendors will specify these numbers separately, but some combine them into a single number. It is important to know both numbers when designing and evaluating the front end of a GPS receiver.
For example, antenna X has an antenna gain of 5 dBiC at azimuth and an LNA gain of 20 dB for a combined total of 25 dB. Antenna Y has an antenna gain of -5 dBiC at azimuth and an LNA gain of 30 dB for a combined total of 25 dB. However, in the system, antenna X will outperform antenna Y by about 10 dB (refer to next chapter for more details on system noise floor).
An antenna with higher gain will generally outperform an antenna with lower gain. Once the signals are above about -130 dBm for a particular satellite, no improvement in performance would be gained. However, for those satellites that are below about -125 dBm, a higher gain antenna would improve the gain and improve the performance of the GPS receiver. In the case of really weak signals, a good antenna could mean the difference between being able to use a particular satellite signal or not.

7.3.4 Active versus Passive Antenna

If the GPS antenna is placed near the HE910 and the RF traces losses are not excessive (nominally 1 dB), then a passive antenna can be used. This would normally be the lowest cost option and most of the time the simplest to use. However, if the antenna needs to be located away from the HE910 then an active antenna may be required to obtain the best system performance. The active antenna has its own built in low noise amplifier to overcome RF trace or cable losses after the active antenna.
However, an active antenna has a low noise amplifier (LNA) with associated gain and noise figure. In addition, many active antennas have either a pre-select filter, a post-select filter, or both.

7.3.5 GPS Antenna - PCB Line Guidelines

- Ensure that the antenna line impedance is 50ohm.
- Keep the antenna 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 facing directly the antenna line of track.
- The ground around the antenna line on PCB has to be strictly connected to the Ground Plane by placing vias once per 2mm at least.
- Place EM noisy devices as far as possible from HE910 antenna line.
- Keep the antenna line far away from the HE910 power supply lines.
- Keep the antenna line far away from the HE910 GSM RF lines.
- If you have EM noisy devices around the PCB hosting the HE910, such as fast switching ICs, take care of the shielding of the 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, use a strip-line on the superficial copper layer for the antenna line. The line attenuation will be lower than a buried one.

7.3.6 RF Trace Losses

RF Trace losses are difficult to estimate on a PCB without having the appropriate tables or RF simulation software to estimate what the losses would be. A good rule of thumb would be to keep the RF traces as short as possible, make sure they are 50 ohms impedance and don’t contain any sharp bends.

7.3.7 Implications of the Pre-select SAW Filter

The HE910 module contains a SAW filter used in a pre-select configuration with the built-in LNA, that is, the RF input of the HE910 ties directly into the SAW filter. Any circuit connected to the input of the HE910 would see complex impedance presented by the SAW filter, particularly out of band, rather than the relatively broad and flat return loss presented by the LNA. Filter devices pass the desired in band signal to the output, resulting in low reflected energy (good return loss), and reject the out of band signal by reflecting it back to the input, resulting in high reflected energy (bad return loss).

If an external amplifier is to be used with the HE910, the overall design should be checked for RF stability to prevent the external amplifier from oscillating. Amplifiers that are unconditionally stable at the output will be fine to use with the HE910.

If an external filter is to be connected directly to the HE910, care needs to be used in making sure neither the external filter nor the internal SAW filter performance is compromised. These components are typically specified to operate into 50 ohms impedance, which is generally true in band, but would not be true out of band. If there is extra gain associated with the external filter, then a 6 dB Pi or T resistive attenuator is suggested to improve the impedance match between the two components.

7.3.8 External LNA Gain and Noise Figure

The HE910 can be used with an external LNA such as what might be found in an active antenna. Because of the internal LNA, the overall gain (including signal losses past the external LNA) should not exceed 14 dB. Levels higher than that can affect the jamming detection capability of the HE910. If a higher gain LNA is used, either a resistive Pi or T attenuator can be inserted after the LNA to bring the gain down to 14 dB .

The external LNA should have a noise figure better than 1 dB. This will give an overall system noise figure of around 2 dB assuming the LNA gain is 14 dB, or if higher the low gain mode is automatically managed by the HE910 with its internal AGC.

The external LNA, if having no pre-select filter, needs to be able to handle other signals other than the GPS signal. These signals are typically at much higher levels. The amplifier needs to stay in the linear region when presented with these other signals. Again, the system designer needs to determine all of the unintended signals and their possible levels that can be presented and make sure the external LNA will not be driven into compression. If this were to happen, the GPS signal itself would start to be attenuated and the GPS performance would suffer.

7.3.9 Powering the External LNA (active antenna)

The external LNA needs a source of power. Many of the active antennas accept a 3 volt or 5 volt DC voltage that is impressed upon the RF signal line. This voltage is not supplied by the HE910, but can be easily supplied by the host design.

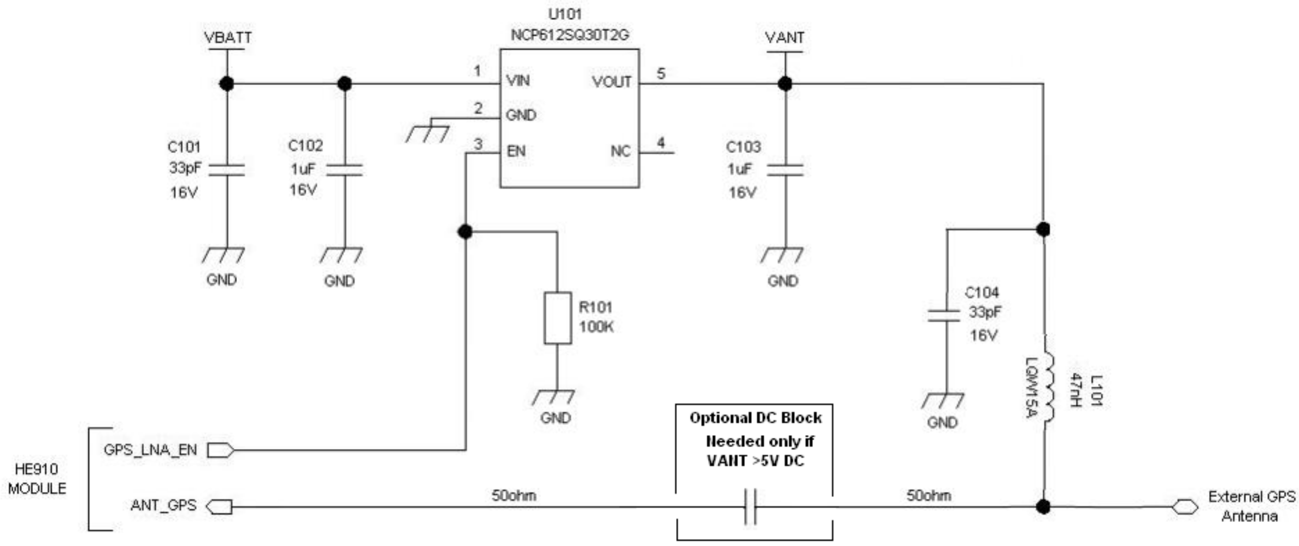
7.3.10 External LNA Enable

The HE910 is already provided by an internal LNA. In case the Application needs to include an additional LNA stage, the module is provided by a digital signal usable to enable the power supply of the external amplifier. The signal is set to High only when the GPS receiver is active.

The electrical characteristics of the GPS_LNA_EN signal are:

Level	Min	Max
Output high level	1.6V	1.9
Output low level	0V	0.2V

An example of GPS Antenna Supply circuit is shown in the following image:



NOTE:

The maximum DC voltage applicable to the 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.

7.3.11 Shielding

Shielding the RF circuitry generally is ineffective because the interference is getting into the GPS antenna itself, the most sensitive portion of the RF path. The antenna cannot be shielded because then it can’t receive the GPS signals.
There are two solutions, one is to move the antenna away from the source of interference or the second is to shield the digital interference to prevent it from getting to the antenna.

7.3.12 GPS Antenna - Installation

- The HE910 due to its characteristics of sensitivity is capable to perform a Fix inside the 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 must not be installed inside metal cases.
- Antenna must be installed also according to the Antenna manufacturer instructions.

8 Logic level specifications

The following table shows the logic level specifications used in the HE910 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	2.1V
Input level on any digital pin (CMOS 1.2) with respect to ground	-0.3V	1.4V

Operating Range - Interface levels (1.8V CMOS)

Level	Min	Max
Input high level	1.5V	1.9V
Input low level	0V	0.35V
Output high level	1.6V	1.9V
Output low level	0V	0.2V

Operating Range - Interface levels (1.2V CMOS)

Level	Min	Max
Input high level	0.9V	1.3V
Input low level	0V	0.3V
Output high level	1V	1.3V
Output low level	0V	0.1V

Current characteristics

Level	Typical
Output Current	1mA
Input Current	1uA

8.1 Unconditional Shutdown

Signal	Function	I/O	PAD
HW_SHUTDOWN*	Unconditional Shutdown of the Module	I	R13

HW_SHUTDOWN* is used to unconditionally shutdown the HE910. Whenever this signal is pulled low, the HE910 is reset. When the device is reset it stops any operation. After the release of the line, the HE910 is unconditionally shut down, without doing any detach operation from the network where it is registered. This behaviour is not a proper shut down because any GSM device is requested to issue a detach request on turn off. For this reason the HW_SHUTDOWN* signal must not be used to normally shutting down the device, but only as an emergency exit in the rare case the device remains stuck waiting for some network response.
The HW_SHUTDOWN* is internally controlled on start-up to achieve always a proper power-on reset sequence, so there's no need to control this pin on start-up.
It may only be used to reset a device already on that is not responding to any command.

NOTE:

Do not use this signal to power off the HE910. Use the ON/OFF signal to perform this function or the AT#SHDN command.

Unconditional Shutdown Signal Operating levels:

Signal	Min	Max
HW_SHUTDOWN* Input high	1.5V	1.9V
HW_SHUTDOWN* Input low	0V	0.35V

* this signal is internally pulled up so the pin can be left floating if not used.

If unused, this signal may be left unconnected. If used, then it **must always be connected with an open collector transistor**, to permit to the internal circuitry the power on reset and under voltage lockout functions.

9 USB Port

The HE910 includes one integrated universal serial bus (USB 2.0 HS) transceiver.

9.1 USB 2.0 HS Description

This port is compliant with the USB 2.0 HS.
The USB FS is supported for AT interface and data communication.

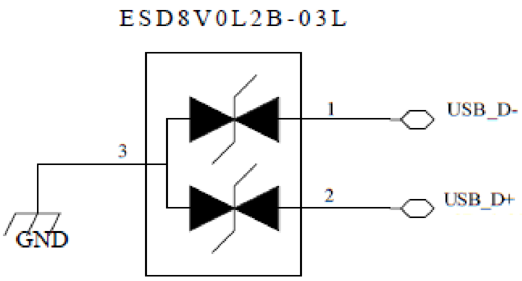
The following table is listing the available signals:

PAD	Signal	I/O	Function	Type	NOTE
B15	USB_D+	I/O	USB differential Data (+)	3.3V	
C15	USB_D-	I/O	USB differential Data (-)	3.3V	
A13	VUSB	AI	Power sense for the internal USB transceiver.	5V	Accepted range: 4.4V to 5.25V

The USB_DPLUS and USB_DMINUS signals have a clock rate of 480 MHz.

The signal traces should be routed carefully. Trace lengths, number of vias and capacitive loading should be minimized. The characteristic impedance value should be as close as possible to 90 Ohms differential.

In case there is a need to add an ESD protection the suggested connection is the following:



NOTE:

VUSB pin should be disconnected before activating the Power Saving Mode.

In case of a Firmware upgrade using the USB port, it could be done only using an USB 2.0 HS device.

10 SPI port

The HE910 Module is provided by one SPI interface.

The SPI interface defines two handshake lines for flow control and mutual wake-up of the modem and the Application Processor: SRDY (slave ready) and MRDY (master ready).

The AP has the master role, that is, it supplies the clock.

The following table is listing the available signals:

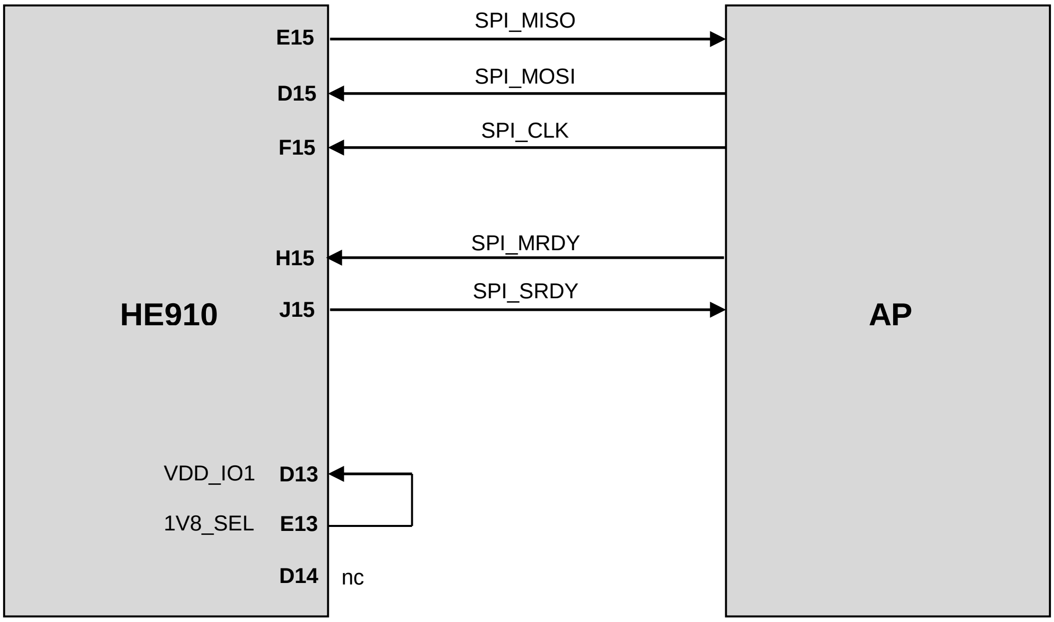
PAD	Signal	I/O	Function	Type	COMMENT
D15	SPI_MOSI	I	SPI MOSI	CMOS 1.8V	Shared with TX_AUX
E15	SPI_MISO	O	SPI MISO	CMOS 1.8V	Shared with RX_AUX
F15	SPI_CLK	I	SPI Clock	CMOS 1.8V	
H15	SPI_MRDY	I	SPI_MRDY	CMOS 1.8V	
J15	SPI_SRDY	O	SPI_SRDY	CMOS 1.8V	

The signal 1V8_SEL must be connected to the VDD_IO1 input pin to properly supply this digital section.

NOTE:

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

10.1 SPI Connections



11 USB HSIC

The HE910 Module is provided by one USB HSIC interface.
The USB HSIC (High Speed Inter Processor) Interface allows supporting the inter-processor communication between an application processor (AP) – the host, and the modem processor (CP) – the HE910.

The following table is listing the available signals:

Pad	Signal	Direction	Function	Type	COMMENT
A12	HSIC_USB_DATA	I/O	USB HSIC data signal	CMOS 1.2V	
A11	HSIC_USB_STRB	I/O	USB HSIC 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 GPIO08
J15	HSIC_HOST_ACTIVE	I	Active Host Indication	CMOS 1.8V	Shared with SPI_SRDY
D13	VDD_IO1	I	VDD_IO1 Input		To be connected to E13
E13	1V8_SEL	O	1V8 SEL for VDD_IO1		To be connected to D13

The signal 1V8_SEL must be connected to the VDD_IO1 input pin to properly supply this digital section.

For the detailed use of USB HSIC port please refer to the related Application Note.

NOTE:

Due to the shared functions, when the USB_HSIC port is used, it is not possible to use the SPI and the GPIO_08.

The USB_HSIC is not active by default but it has to be enabled using the AT#PORTCFG command (refer to the AT User guide for the detailed syntax description).

12 Serial Ports

The HE910 module is provided with by 2 Asynchronous serial ports:

- MODEM SERIAL PORT 1 (Main)
- 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 HE910 the ports are CMOS 1.8.

The electrical characteristics of the Serial ports are explained in the following tables:

Absolute Maximum Ratings -Not Functional

Parameter	Min	Max
Input level on any digital pin (CMOS 1.8) with respect to ground	-0.3V	2.1V

Operating Range - Interface levels (1.8V CMOS)

Level	Min	Max
Input high level	1.5V	1.9V
Input low level	0V	0.35V
Output high level	1.6V	1.9
Output low level	0V	0.2V

12.1 MODEM SERIAL PORT 1 (USIF0)

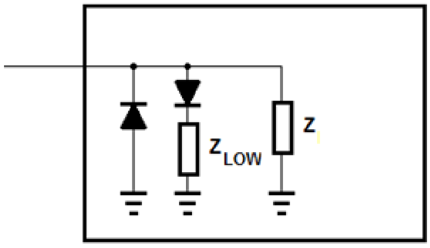
The serial port 1 on the HE910 is a +1.8V UART with all the 7 RS232 signals.
It differs from the PC-RS232 in the signal polarity (RS232 is reversed) and levels.

RS232 Pin #	Signal	HE910 Pad Number	Name	Usage
1	C109/DCD	**N14**	Data Carrier Detect	Output from the HE910 that indicates the carrier presence
2	C104/RXD	**M15**	Transmit line *see Note	Output transmit line of HE910 UART
3	C103/TXD	**N15**	Receive line *see Note	Input receive of the HE910 UART
4	C108/DTR	**M14**	Data Terminal Ready	Input to the HE910 that controls the DTE READY condition
5	GND	**M12, B13, P13, E14 …**	Ground	Ground
6	C107/DSR	**P14**	Data Set Ready	Output from the HE910 that indicates the module is ready
7	C106/CTS	**P15**	Clear to Send	Output from the HE910 that controls the Hardware flow control
8	C105/RTS	**L14**	Request to Send	Input to the HE910 that controls the Hardware flow control
9	C125/RING	**R14**	Ring Indicator	Output from the HE910 that indicates the incoming call condition

The following table shows the typical input value of internal pull-up resistors for RTS DTR and TXD input lines and in all module states:

STATE	RTS DTR TXD	
		Pull up tied to
ON	5K to 12K	1V8
OFF	Schottky diode	
RESET	Schottky diode	
POWER SAVING	5K to 12K	1V8

The input line ON_OFF and RESET state can be treated as in picture below



NOTE:

According to V.24, some signal names are referred to the application side, therefore on the HE910 side these signal are on the opposite direction:
TXD on the application side will be connected to the receive line (here named C103/TXD)
RXD on the application side will be connected to the transmit line (here named C104/RXD)

NOTE:

For a minimum implementation, only the TXD, RXD lines can 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 when the module is powered off or during an ON/OFF transition.

12.2 MODEM SERIAL PORT 2 (USIF1)

The secondary serial port on the HE910 is a CMOS1.8V with only the RX and TX signals.
The signals of the HE910 serial port are:

PAD	Signal	I/O	Function	Type	COMMENT
D15	TX_AUX	O	Auxiliary UART (TX Data to DTE)	CMOS 1.8V	SHARED WITH SPI_MTSR
E15	RX_AUX	I	Auxiliary UART (RX Data from DTE)	CMOS 1.8V	SHARED WITH SPI_MRST

The signal 1V8_SEL must be connected to the VDD_IO1 input pin in order to use this port.

NOTE:
Due to the shared pins, when the Modem Serial port is used, it is not possible to use the SPI functions.

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

12.3 RS232 level translation

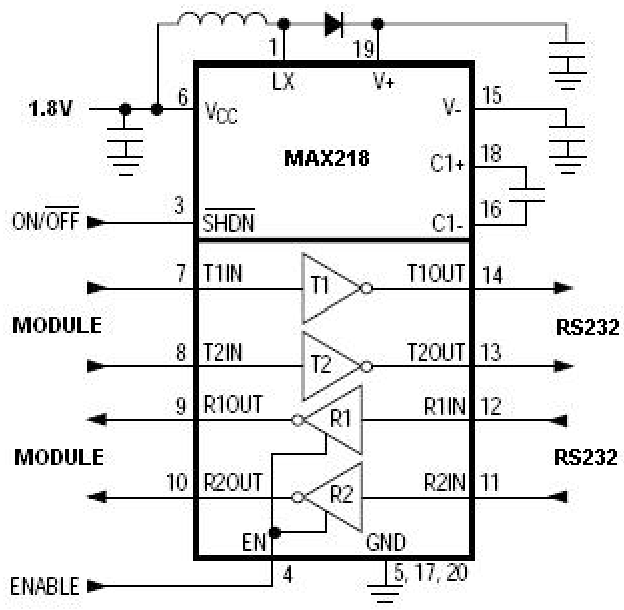
In order to interface the HE910 with a PC com port or a RS232 (EIA/TIA-232) application a level translator is required. This level translator must:

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

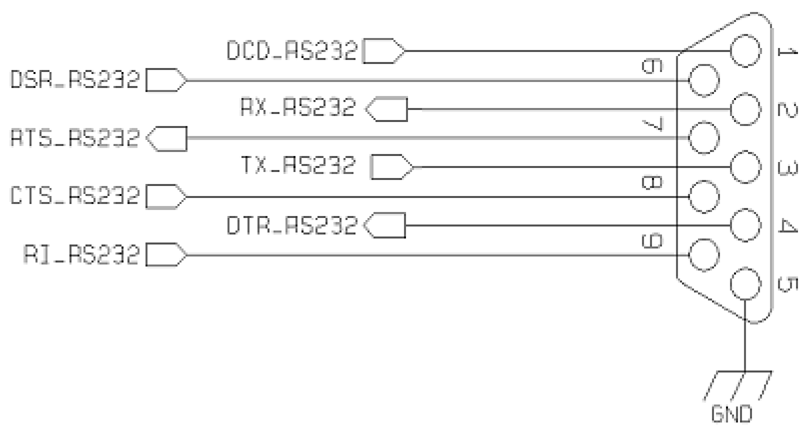
Actually, the RS232 UART 16450, 16550, 16650 & 16750 chipsets accept signals with lower levels on the RS232 side (EIA/TIA-562), allowing a lower voltage-multiplying ratio on the level translator. Note that the negative signal voltage must be less than 0V and hence some sort of level translation is always 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 adaptation circuitry could be done using a MAXIM transceiver (MAX218)
In this case the chipset is capable to translate directly from 1.8V to the RS232 levels (Example done on 4 signals only).



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



13 Audio Section Overview

The Audio of the HE910 Module is carried by DVI digital audio interface.
The audio port can be directly connected to end device using digital interface, or via one of the several compliant codecs (in case an analog audio is needed).

13.1 Electrical Characteristics

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

Digital Voice Interface (DVI)					
PAD	**Signal**	**I/O**	**Function**	**Note**	**Type**
B9	DVI_WA0	I/O	Digital Audio Interface (Word Alignment / LRCLK)		CMOS 1.8V
B6	DVI_RX	I	Digital Audio Interface (RX)		CMOS 1.8V
B7	DVI_TX	O	Digital Audio Interface (TX)		CMOS 1.8V
B8	DVI_CLK	I/O	Digital Audio Interface (BCLK)		CMOS 1.8V

13.1.1 CODEC Examples

Please refer to the HE910 Digital Audio Application note.

14 General Purpose I/O

The HE910 module is provided by a set of Digital Input / Output pins

Input pads can only be read; they report the digital value (high or low) present on the pad at the read time.
Output pads can only be written or queried and set the value of the pad output.
An alternate function pad is internally controlled by the HE910 firmware and acts depending on the function implemented.

The following table shows the available GPIO on the HE910:

PAD	Signal	I/O	Function	Type	Drive strength	Default State	Note
C8	GPIO_01	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	Alternate function STAT LED
C9	GPIO_02	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	
C10	GPIO_03	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	
C11	GPIO_04	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	
B14	GPIO_05	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	
C12	GPIO_06	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	
C13	GPIO_07	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	
K15	GPIO_08	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	VDD_IO1 has to be connected to 1V8_SEL
L15	GPIO_09	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	VDD_IO1 has to be connected to 1V8_SEL
G15	GPIO_10	I/O	Configurable GPIO	CMOS 1.8V	**1** mA	INPUT	VDD_IO1 has to be connected to 1V8_SEL

14.1 GPIO Logic levels

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 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	2.1V

Operating Range - Interface levels (1.8V CMOS)

Level	Min	Max
Input high level	1.5V	1.9V
Input low level	0V	0.35V
Output high level	1.6V	1.9
Output low level	0V	0.2V

14.2 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 to be connected with the GPIO input pad has interface levels different from the 1.8V CMOS, then it can be buffered with an open collector transistor with a 47K pull up 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 HE910 when the module is powered off or during an ON/OFF transition.

14.3 Using a GPIO Pad as OUTPUT

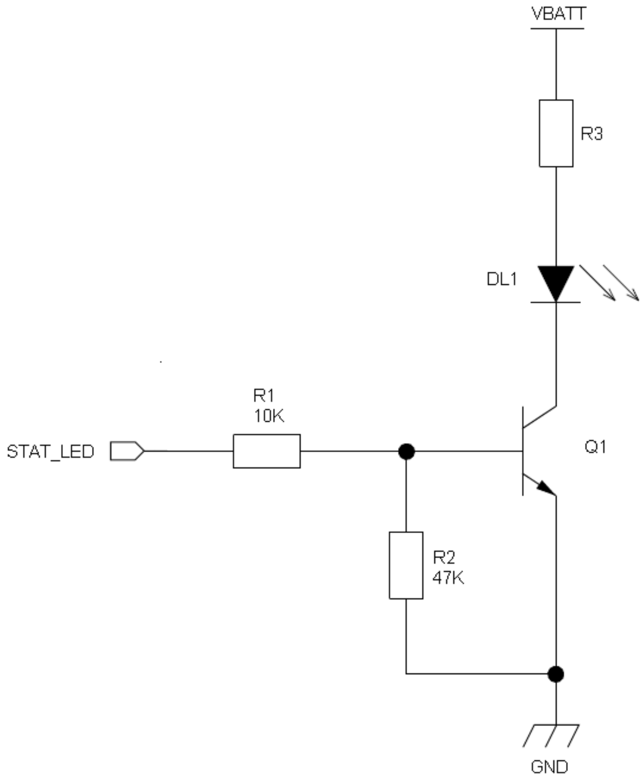
The GPIO pads, when used as outputs, can drive 1.8V CMOS digital devices or compatible hardware. When set as outputs, the pads have a push-pull output and therefore the pull-up resistor may be omitted.

14.4 Indication of network service availability

The STAT_LED pin status shows information on the network service availability and Call status. The function is available as alternate function of GPIO_01 (to be enabled using the AT#GPIO=1,0,2 command).
In the HE910 modules, the STAT_LED needs an external transistor to drive an external LED.
Therefore, 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 1sec 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:



14.5 RTC Bypass out

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 a backup capacitor can be added in order to increase the RTC autonomy during power off of the battery. NO Devices must be powered from this pin.

In order to keep the RTC active when VBATT is not supplied it is possible to back up the RTC section connecting a **backup circuit** to the related VRTC signal (pad C14 on module's Pinout).

For additional details on the Backup solutions please refer to the related application note (xE910 RTC Backup Application Note)

14.6 External SIM Holder Implementation

Please refer to the related User Guide (SIM Holder Design Guides, 80000NT10001a).

14.7 VAUX Power Output

A regulated power supply output is provided in order to supply small devices from the module.
The signal is present on Pad R11 and it is in common with the PWRMON (module powered ON indication) function.
This output is always active when the module is powered ON.

The operating range characteristics of the supply are:

Level	Min	Typical	Max
Output voltage	1.78V	1.80V	1.82V
Output current	-	-	60mA
Output bypass capacitor (inside the module)		1uF	

14.8 ADC Converter

14.8.1 Description

The HE910 is provided by one AD converter. It is able to read a voltage level in the range of 0÷1.2 volts applied on the ADC pin input, store and convert it into 10 bit word.
The following table is showing the ADC characteristics:

	Min	Typical	Max	Units
Input Voltage range	0	-	1.2	Volt
AD conversion	-	-	10	bits
Input Resistance	1	-	-	Mohm
Input Capacitance	-	1	-	pF

The input line is named as **ADC_IN1** and it is available on Pad **B1**

14.8.2 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

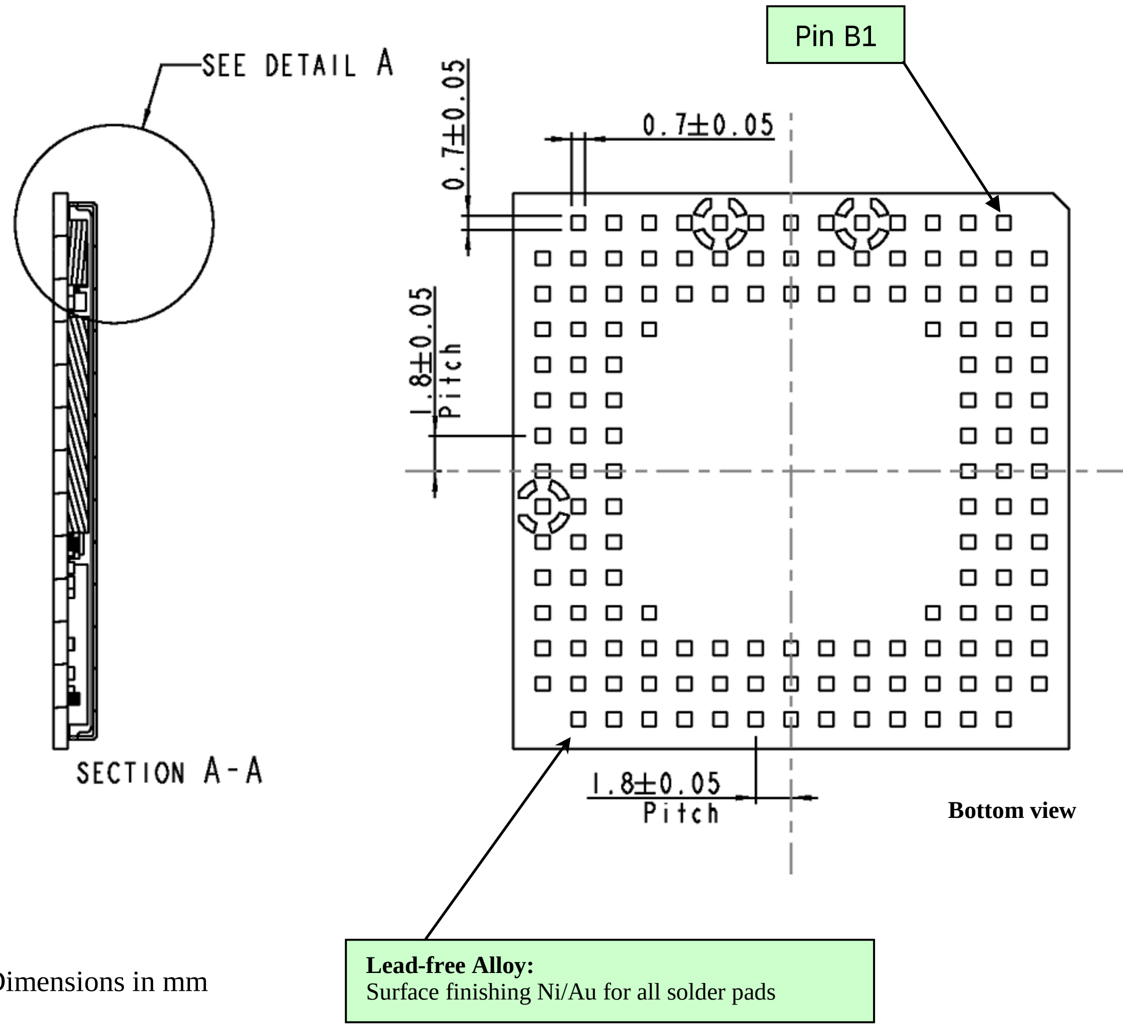
Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.

15 Mounting the HE910 on the application

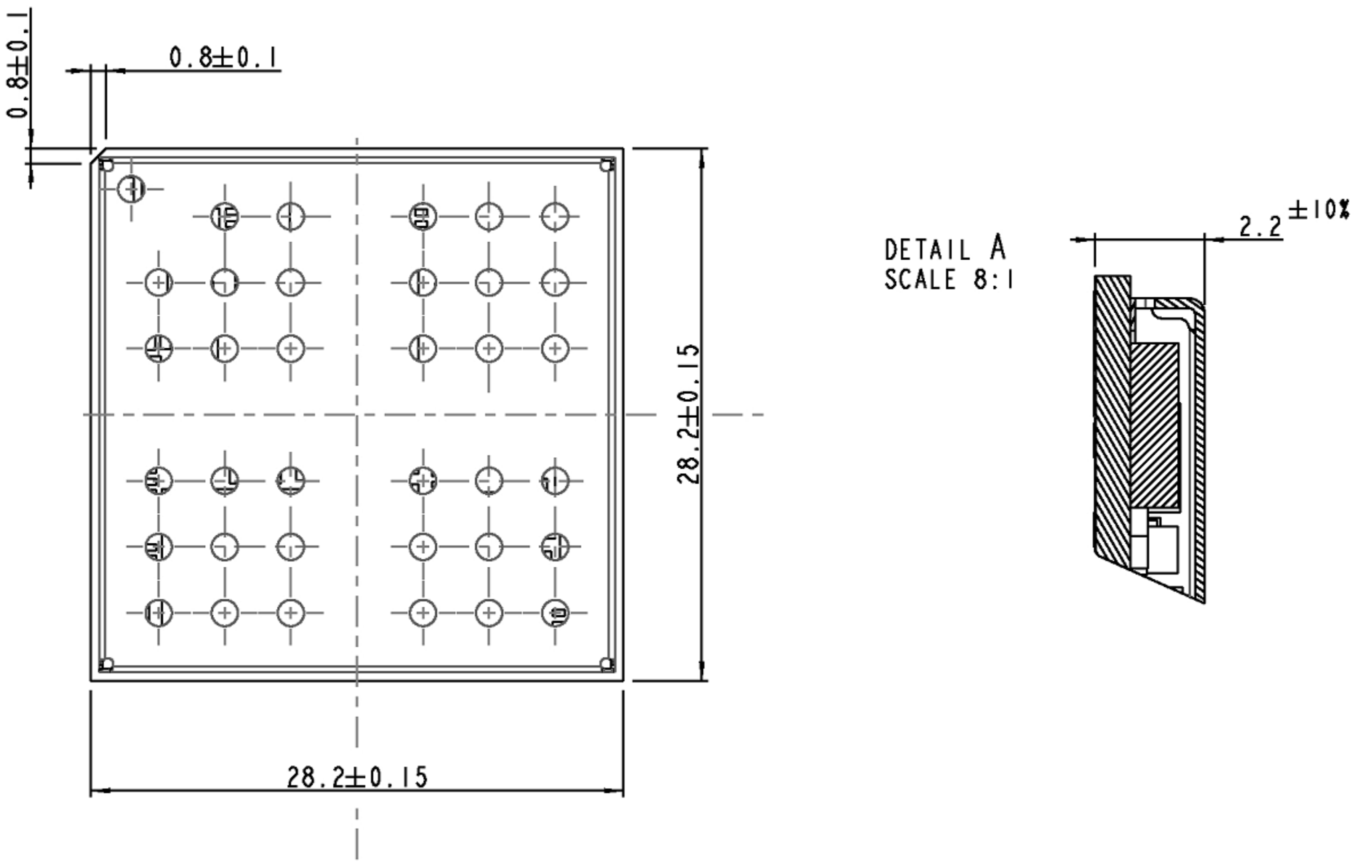
15.1 General

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

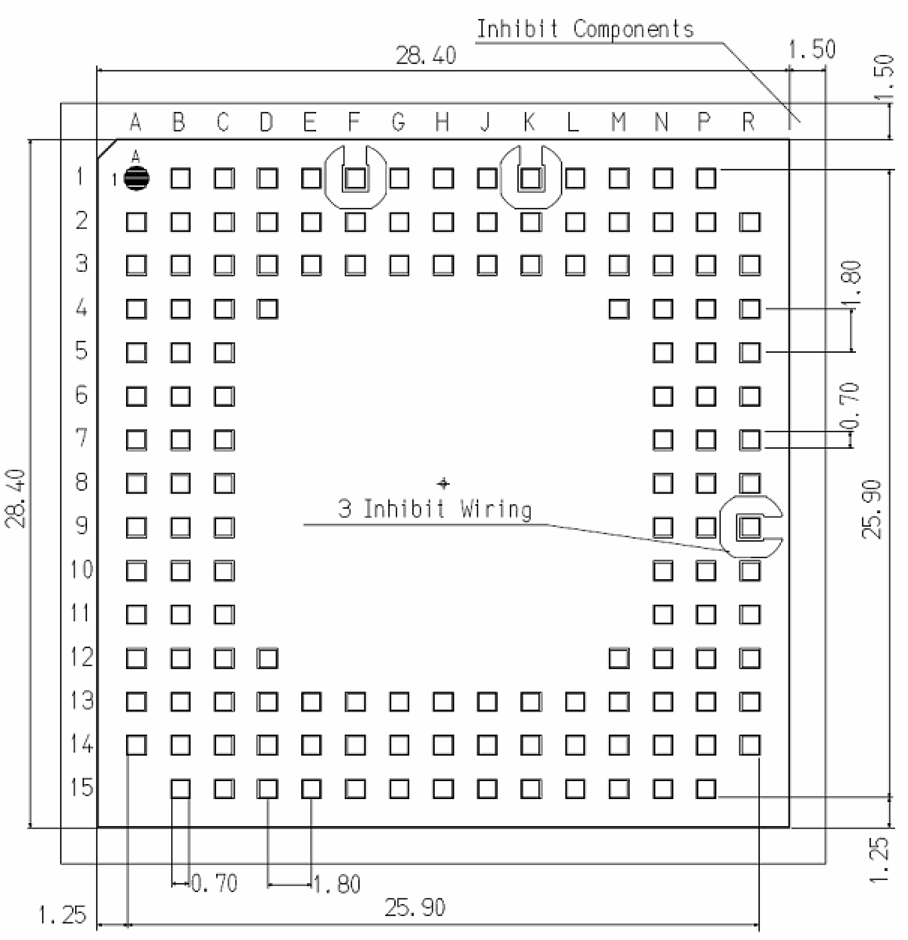
15.2 Module finishing & dimensions



Dimensions in mm


0.8±0.1
0.8±0.1
28.2±0.15
28.2±0.15
DETAIL A
SCALE 8:1
2.2 ±10%

15.3 Recommended foot print for the application



TOP VIEW

In order to easily rework the HE910 is suggested to consider on the application a 1.5 mm placement inhibit area around the module.
It is also suggested, as common rule for an SMT component, to avoid having a mechanical part of the application in direct contact with the module.

NOTE:

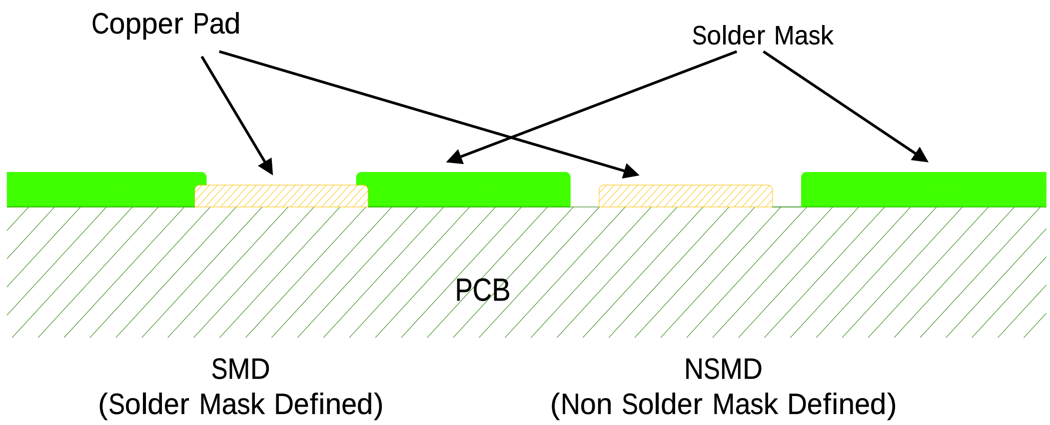
In the customer application, the region under WIRING INHIBIT (see figure above) must be clear from signal or ground paths.

15.4 Stencil

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

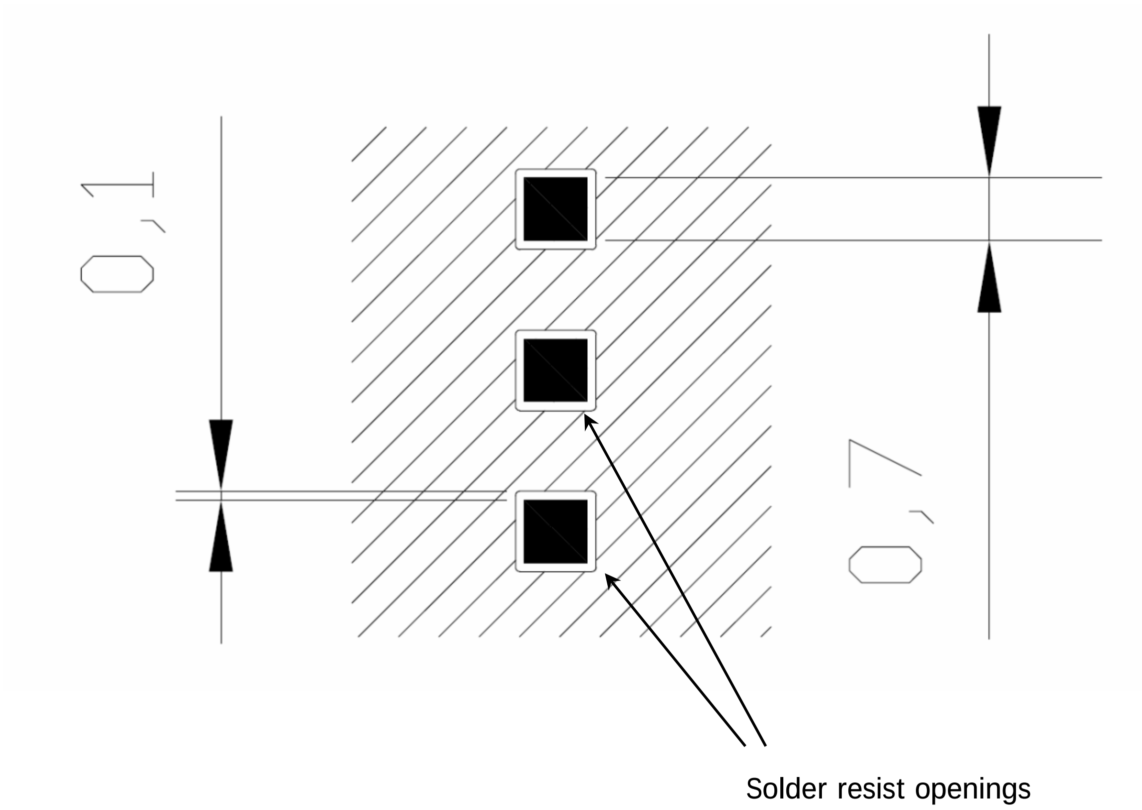
15.5 PCB pad design

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

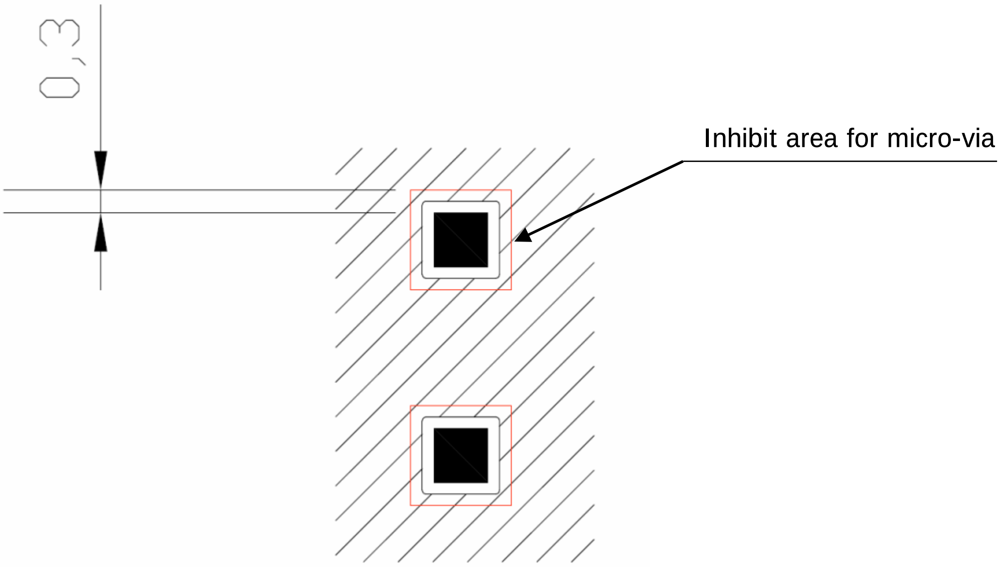


15.6 PCB pad dimensions

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 [µm]	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.

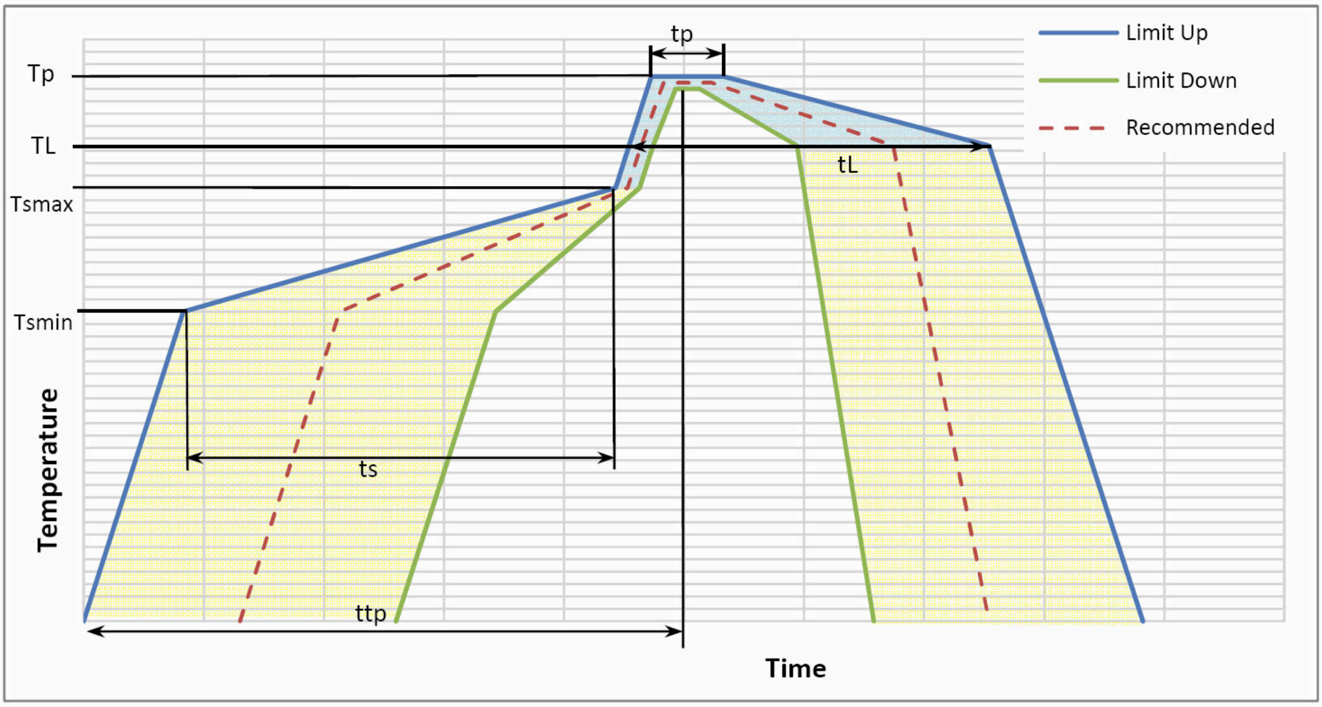
15.7 Solder paste

	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.

15.7.1 HE910 Solder reflow

Recommended solder reflow profile:



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

NOTE:

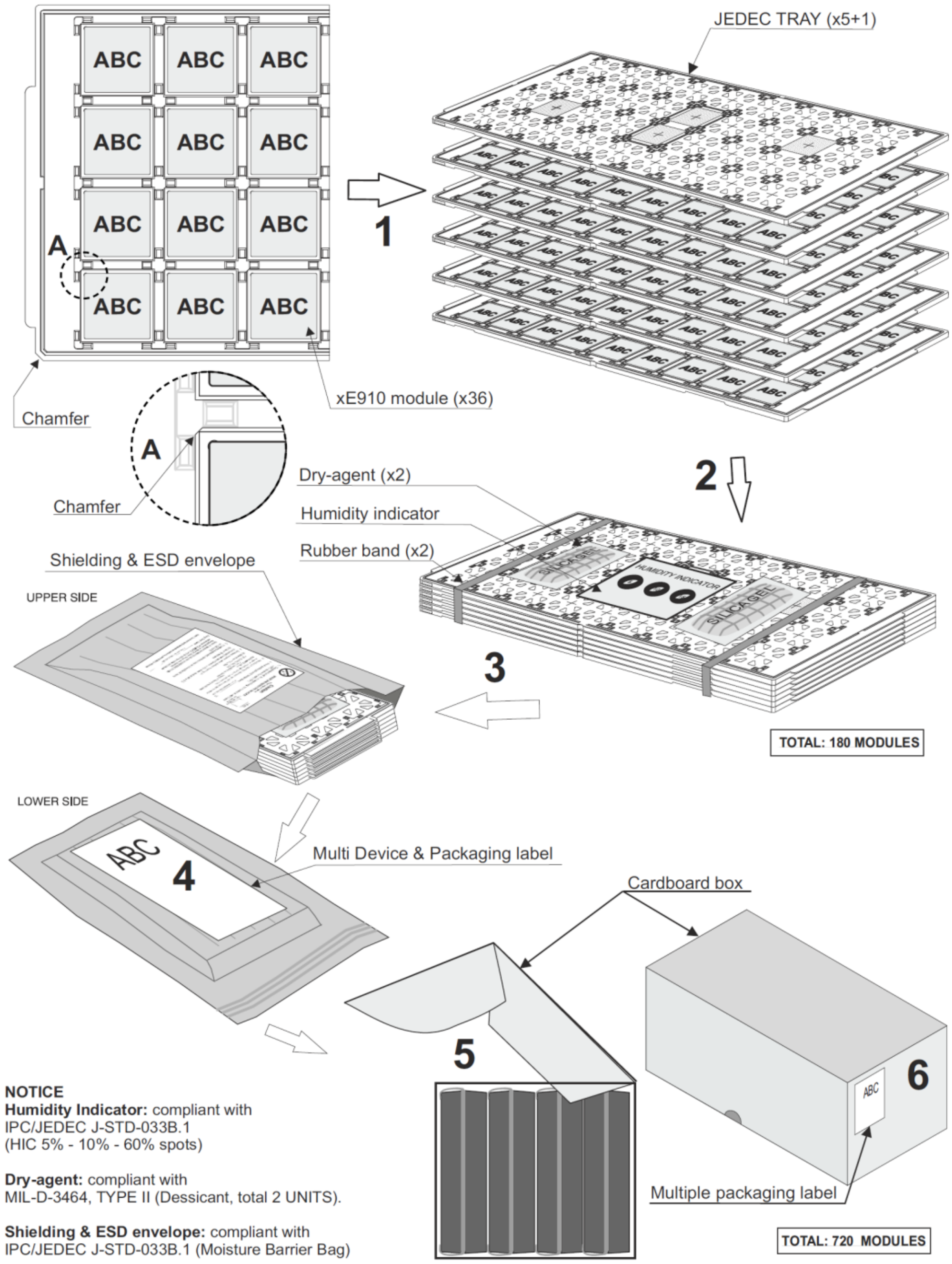
All temperatures refer to topside of the package, measured on the package body surface

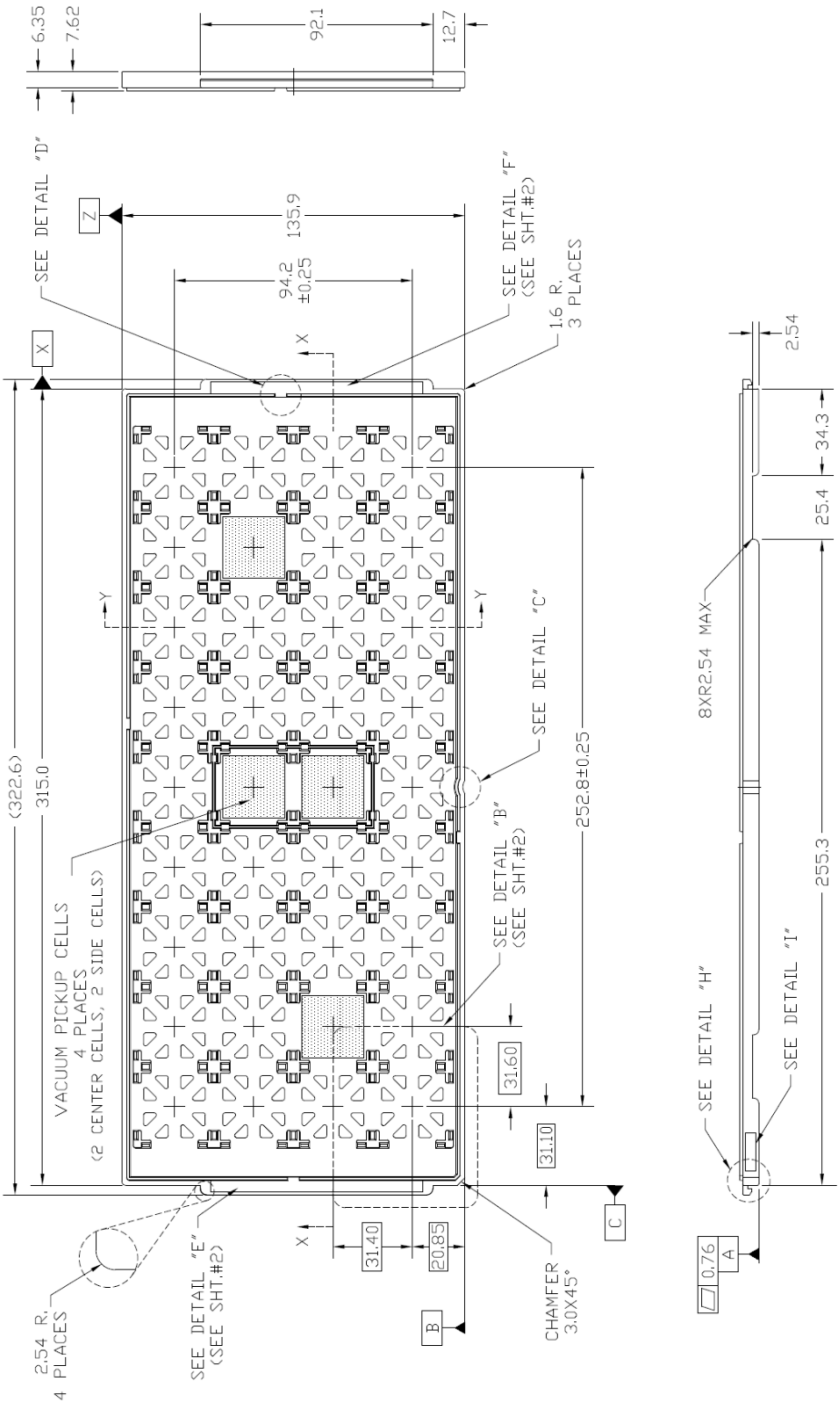
WARNING:

The HE910 module withstands one reflow process only.

15.8 Packing system (Tray)

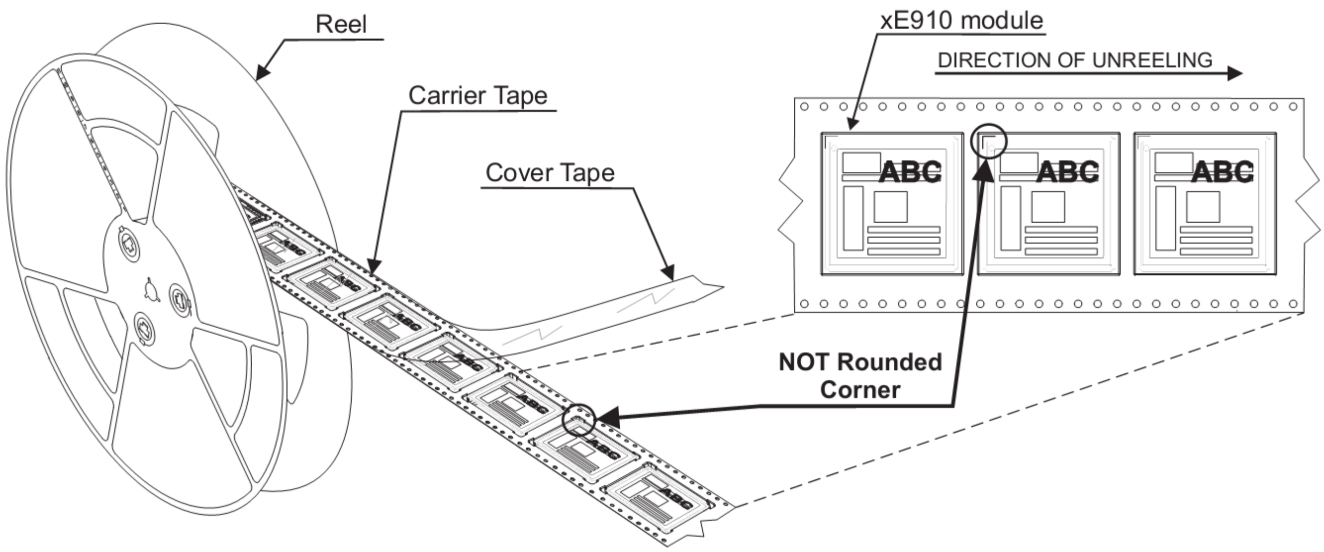
The HE910 modules are packaged on trays of 36 pieces each. These trays can be used in SMT processes for pick & place handling.



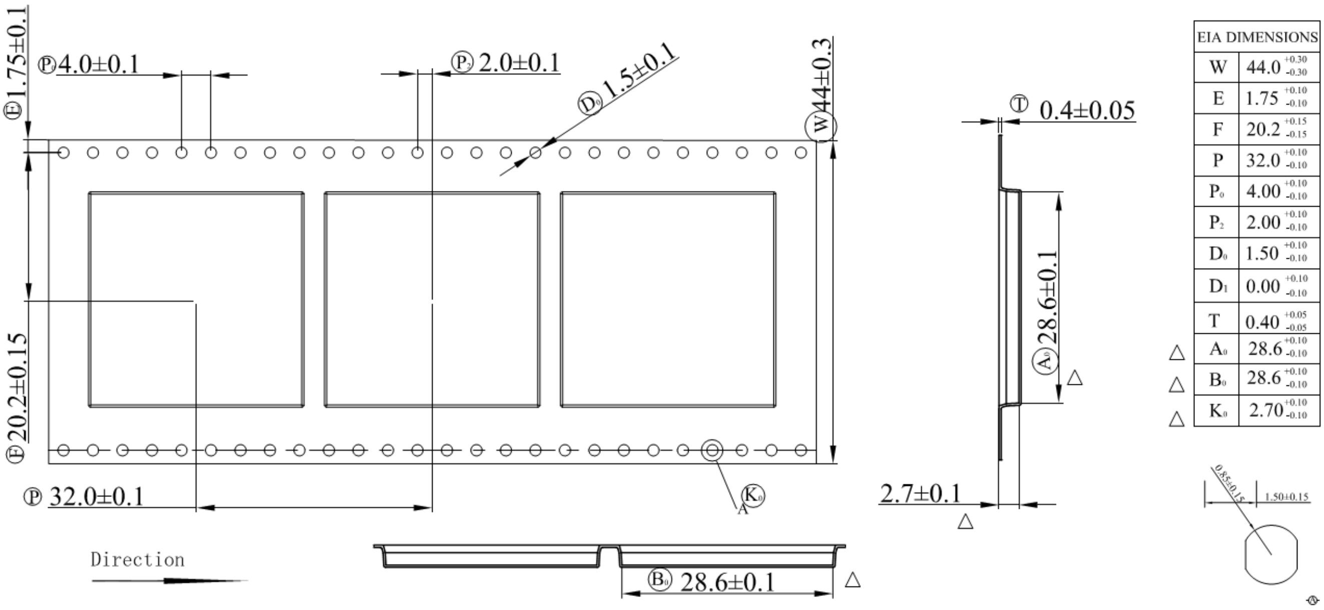

6.35
7.62
92.1
12.7
SEE DETAIL "D"
135.9
94.2 ±0.25
SEE DETAIL "F" (SEE SHT.#2)
1.6 R. 3 PLACES
2.54
34.3
25.4
8XR2.54 MAX
SEE DETAIL "C"
(322.6)
315.0
252.8±0.25
255.3
SEE DETAIL "B" (SEE SHT.#2)
VACUUM PICKUP CELLS 4 PLACES (2 CENTER CELLS, 2 SIDE CELLS)
SEE DETAIL "H"
SEE DETAIL "I"
31.60
31.10
31.40
20.85
0.76
CHAMFER 3.0X45°
SEE DETAIL "E" (SEE SHT.#2)
2.54 R. 4 PLACES

15.9 Packing System (Reel)

The HE910 can be packaged on reels of 200 pieces each.
See figure for module positioning into the carrier.

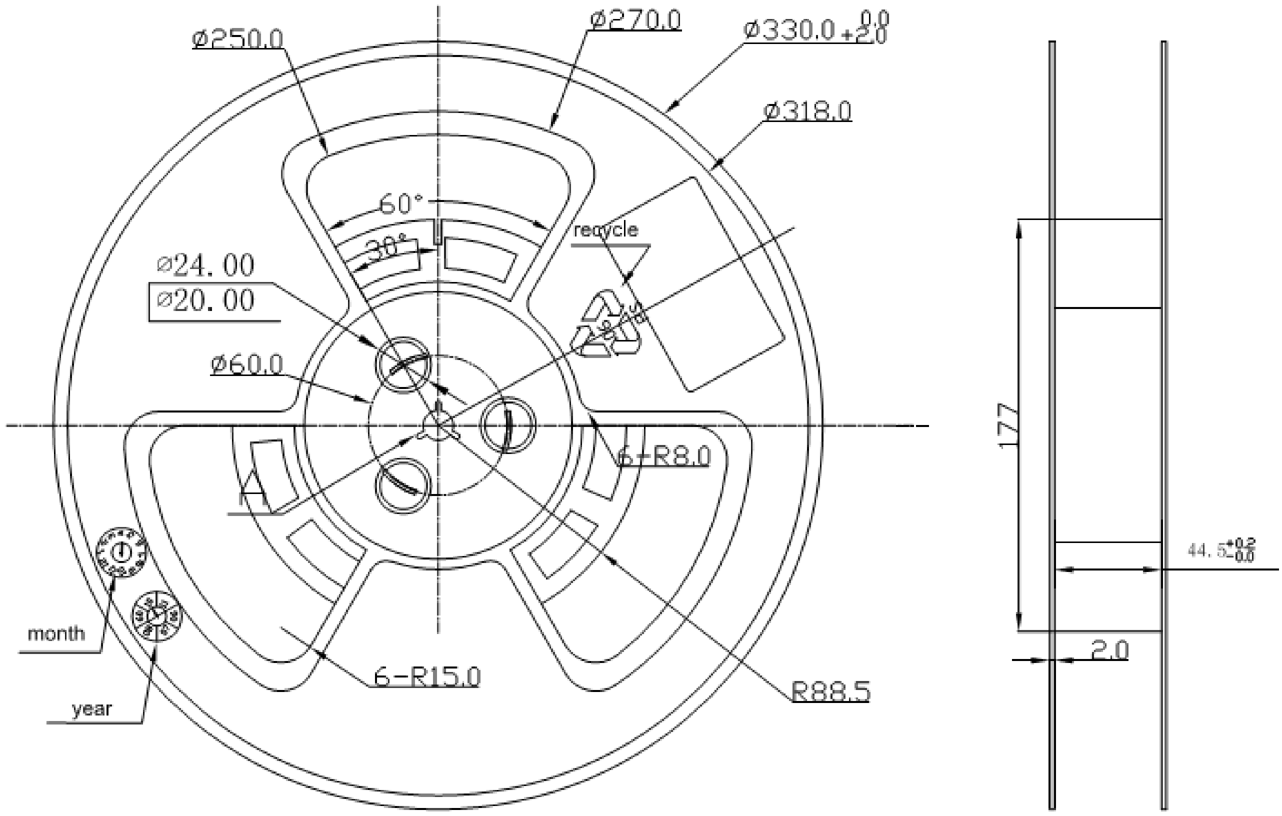


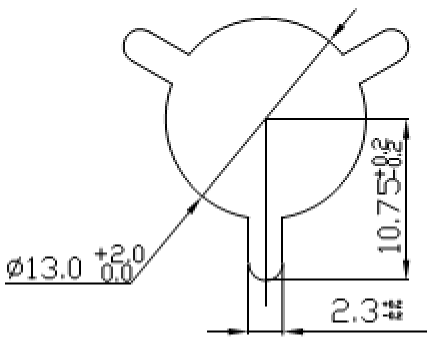
15.9.1 Carrier Tape Detail



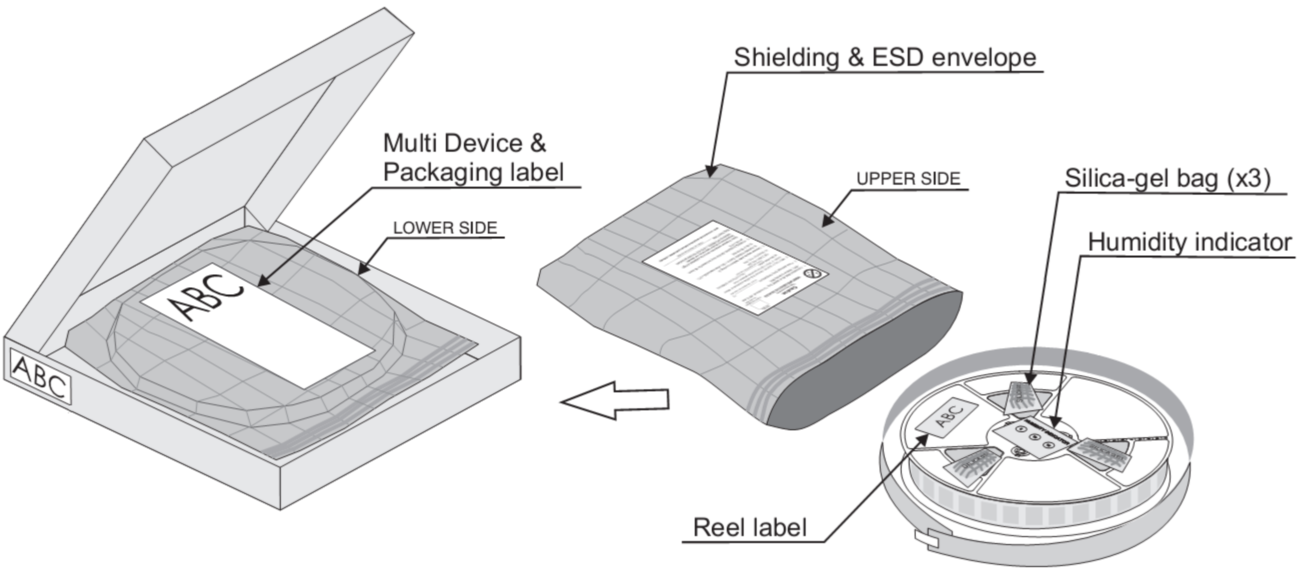
EIA DIMENSIONS	
W	44.0 +0.30 -0.30
E	1.75 +0.10 -0.10
F	20.2 +0.15 -0.15
P	32.0 +0.10 -0.10
P_0	4.00 +0.10 -0.10
P_2	2.00 +0.10 -0.10
D_0	1.50 +0.10 -0.10
D_1	0.00 +0.10 -0.10
T	0.40 +0.05 -0.05
△ A_0	28.6 +0.10 -0.10
△ B_0	28.6 +0.10 -0.10
△ K_0	2.70 +0.10 -0.10

15.9.2 Reel Detail





15.9.3 Packaging Detail



15.10 Moisture sensitivity

The HE910 is a Moisture Sensitive Device level 3, in according 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°C and <90% relative humidity (RH).
b) Environmental condition during the production: 30°C / 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

16 SAFETY RECOMMANDATIONS

READ CAREFULLY

Be sure the use of this product is allowed in the 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 guarantee a minimum distance from the body (20 cm). 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's 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/electr_equipment/index_en.htm

17 Conformity assessment issues

17.1 1999/5/EC Directive

The HE910, HE910-D, HE910-EUG, HE910-EUR, HE910-EUD, HE910-NAG, HE910-NAR, HE910-NAD modules have been evaluated against the essential requirements of the 1999/5/EC Directive.

Bulgarian	С настоящето Telit Communications S.p.A. декларира, че 2G/3G module отговаря на съществените изисквания и другите приложими изисквания на Директива 1999/5/EC.
Czech	Telit Communications S.p.A. tímto prohlašuje, že tento 2G/3G module je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Danish	Undertegnede Telit Communications S.p.A. erklærer herved, at følgende udstyr 2G/3G module overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
Dutch	Hierbij verklaart Telit Communications S.p.A. dat het toestel 2G/3G module in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.
English	Hereby, Telit Communications S.p.A., declares that this 2G/3G module is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Estonian	Käesolevaga kinnitab Telit Communications S.p.A. seadme 2G/3G module vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
German	Hiermit erklärt Telit Communications S.p.A., dass sich das Gerät 2G/3G module in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Telit Communications S.p.A. ΔΗΛΩΝΕΙ ΟΤΙ 2G/3G module ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ.
Hungarian	Alulírott, Telit Communications S.p.A. nyilatkozom, hogy a 2G/3G module megfelel a vonatkozó alapvetõ követelményeknek és az 1999/5/EC irányelv egyéb elõírásainak.
Finnish	Telit Communications S.p.A. vakuuttaa täten että 2G/3G module tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
French	Par la présente Telit Communications S.p.A. déclare que l'appareil 2G/3G module est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.
Icelandic	Hér með lýsir Telit Communications S.p.A. yfir því að 2G/3G module er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC
Italian	Con la presente Telit Communications S.p.A. dichiara che questo 2G/3G module è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Latvian	Ar šo Telit Communications S.p.A. deklarē, ka 2G/3G module atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lithuanian	Šiuo Telit Communications S.p.A. deklaruoja, kad šis 2G/3G module atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Maltese	Hawnhekk, Telit Communications S.p.A., jiddikjara li dan 2G/3G module jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC.
Norwegian	Telit Communications S.p.A. erklærer herved at utstyret 2G/3G module er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Polish	Niniejszym Telit Communications S.p.A. oświadcza, że 2G/3G module jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC
Portuguese	Telit Communications S.p.A. declara que este 2G/3G module está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Slovak	Telit Communications S.p.A. týmto vyhlasuje, že 2G/3G module spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovenian	Telit Communications S.p.A. izjavlja, da je ta 2G/3G module v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Spanish	Por medio de la presente Telit Communications S.p.A. declara que el 2G/3G module cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Swedish	Härmed intygar Telit Communications S.p.A. att denna 2G/3G module står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

In order to satisfy the essential requirements of 1999/5/EC Directive, the HE910, HE910-EUG modules are 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 V4.2.1 EN 301 908-2 V4.2.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.8.1 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

In order to satisfy the essential requirements of 1999/5/EC Directive, the HE910-NAG modules are 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
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.8.1 EN 301 489-3 V1.4.1 EN 301 489-7 V1.3.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011

The HE910-D, HE910-EUR, HE910-EUD modules are compliant with the following standards:

RF spectrum use (R&TTE art. 3.2)	EN 301 511 V9.02 EN 301 908-1 V4.2.1 EN 301 908-2 V4.2.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.8.1 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

The HE910-NAR, HE910-NAD modules are compliant with the following standards:

RF spectrum use (R&TTE art. 3.2)	EN 301 511 V9.02
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.8.1 EN 301 489-7 V1.3.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011

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 commercialisation of the HE910, HE910-D, HE910-EUG, HE910-EUR, HE910-EUD, HE910-NAG, HE910-NAR, HE910-NAD 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

17.2 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.

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, HE910-D	HE910-NAR, HE910-NAD, HE910-NAG
GSM 850/FDD V	5.22 dBi	5.29 dBi
PCS 1900/FDD II	3.31 dBi	4.02 dBi
FDD IV	6.45 dBi	6.32 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, HE910-D***	***HE910-NAR, HE910-NAD, HE910-NAG***
GSM 850/FDD V	*5.22 dBi*	*5.29 dBi*
PCS 1900/FDD II	*3.31 dBi*	*4.02 dBi*
FDD IV	*6.45 dBi*	*6.32 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.