HE920

Hardware User Guide

1vv0301014 Rev.9 – 2014-01-23

Making machines talk.

APPLICABILITY TABLE

PRODUCT
HE920-EU
HE920-NA

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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Contents

1. Introduction

1.1. Scope

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE920-EU/NA module. All the features and solutions detailed are applicable to all HE920, whereas "HE920" is intended the modules listed in the applicability table.

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

1.2. Audience

This document is intended for Telit customers, who are integrators, about to implement their applications using our HE920 module.

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

Chapter 3: "HE920 Module Connections" deals with the pin out configuration and layout.

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

Chapter 5: "Power Supply" deals on supply and consumption.

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

Chapter 7: "Logic Level specifications" Specific values adopted in the implementation of logic levels for this module.

Chapter 8: "USB Port"

Chapter 9: "Serial Ports"

Chapter 10: "Audio Section Overview"

Chapter 11: "General Purpose I/O" How the general purpose I/O pads can be configured.

Chapter 12 "DAC and ADC Section" Deals with these two kind of converters.

Chapter 13: "Mounting the module on your board"

Chapter 14: "Application Guides"

Chapter 15: "Packing System"

Chapter 16: "Conformity Assessments Issues"

Chapter 17: "Safety Recommendations"

Chapter 18: "Document History"

1.5. Text Conventions

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

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

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

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

1.6. Related Documents

- HE920 Product Description, 80404ST10112A
- HE920 Software User guide, 1vv0301015
- HE920 AT command reference guide, 80404ST10113A
- xE920_Audio_Settings_Application_Note, 80404NT10095A
- Telit_UE_HE910V2_DE_CE910_HE920_DVI_Application_Note, 8000010101A
- Telit EVK2 User Guide, 1vv0300704

2. General Product Description

2.1. Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE920 module.

In this document all the basic functions of a mobile phone will be taken into account; for each one of them a proper hardware solution will be suggested and eventually the wrong solutions and common errors to be avoided will be evidenced. Obviously this document cannot embrace the whole hardware solutions and products that may be designed. The wrong solutions to be avoided must be considered as mandatory, while the suggested hardware configurations must not be considered mandatory, instead the information given must be used as a guide and a starting point for properly developing your product with the Telit HE920 module.

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NOTICE:

The integration of the GSM/GPRS/EGPRS/WCDMA/HSPA+ HE920 cellular module within user application must be done according to the design rules described in this manual.

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2.2. HE920 Mechanical Dimensions

The Telit HE920 module overall dimensions are:

- Length: 34 mm
- Width: 40 mm
- Thickness: 2.8 mm

2.3. Weight

The module weight of HE920-EU/NA is about 9.0 gram.

2.4. Environmental requirements

2.4.1. Temperature range

		Note
Operating Temperature Range	–20°C ~ +55°C	The module is fully functional(*) in all the temperature range, and it fully meets the ETSI specifications.
	–40°C ~ +85°C	The module is fully functional(*) in all the temperature range. Temperatures outside of the range –20°C ÷ +55°C might slightly deviate from ETSI specifications.
Storage and non-operating Temperature Range	–40°C ~ +90°C	

(*)Functional: the module is able to make and receive voice calls, data calls and SMS.

2.4.2. RoHS compliance

As a part of Telit's corporate policy of environmental protection, the HE920 complies with the RoHS (Restriction of Hazardous Substances) directive of the European Union (EU directive 2011/65/EU).

2.5. Operating Frequency

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

Mode	Freq. TX (MHz)	Freq. RX (MHz)	Channels	TX - RX offset
GSM850	824.2 ~ 848.8	869.2 ~ 893.8	128 ~ 251	45 MHz
EGSM900	890.0 ~ 914.8	935.0 ~ 959.8	0 ~ 124	45 MHz
	880.2 ~ 889.8	925.2 ~ 934.8	975 ~ 1023	45 MHz
DCS1800	1710.2 ~ 1784.8	1805.2 ~ 1879.8	512 ~ 885	95MHz
PCS1900	1850.2 ~ 1909.8	1930.2 ~ 1989.8	512 ~ 810	80MHz
WCDMA850	826.4 ~ 846.6	871.4 ~ 891.6	Tx: 4132 ~ 4233 Rx: 4357 ~ 4458	45MHz
WCDMA900 (HE920-EU only)	882.4 ~ 912.6	927.4 ~ 957.6	Tx: 2712 ~ 2863 Rx: 2937 ~ 3088	45MHz
WCDMA(AWS) (HE920-NA only)	1712.4 ~ 1752.6	2112.4 ~ 2152.6	Tx: 1312 ~ 1513 Rx: 1537 ~ 1738	400MHz
WCDMA1900 (HE920-NA only)	1852.4 ~ 1907.6	1932.4 ~ 1987.6	Tx: 9262 ~ 9538 Rx: 9662 ~ 9938	80MHz
WCDMA2100 (HE920-EU only)	1922.4 ~ 1977.6	2112.4 ~ 2167.6	Tx: 9612 ~ 9888 Rx: 10562 ~ 10838	190MHz

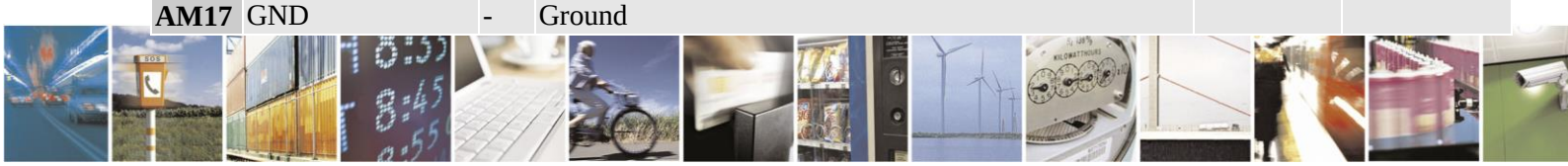
3. HE920 Module Connections

3.1. PIN-OUT

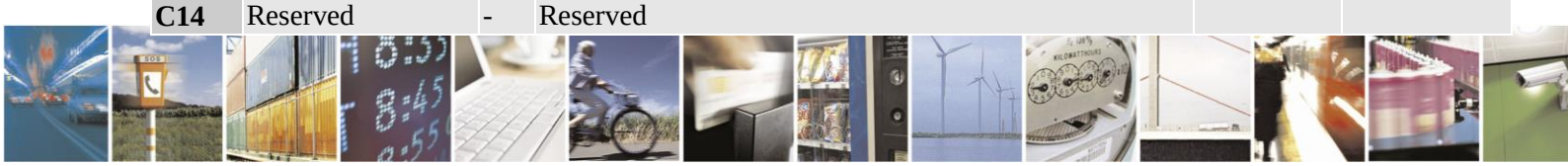
PAD	Signal	I/O	Function	Type	COMMENT
USB HS 2.0 Communication Port					
D19	USB_D+	I/O	USB differential Data(+)		
F19	USB_D-	I/O	USB differential Data(-)		
B19	USB_ID(TBD)	AI	Analog input used to sense whether a peripheral device is connected, and determine the peripheral type, a host or a peripheral	Analog	
A18	USB_VBUS	AI	Power sense for the internal USB transceiver	5V	
Asynchronous UART – Prog. / data +HW Flow Control					
AH19	C103/TXD	I	Serial data input (TXD) from DTE	1.8V	
AF19	C104/RXD	O	Serial data output to DTE	1.8V	
AC18	C108/DTR	I	Input for Data terminal ready signal (DTR) from DTE	1.8V	
AA18	C105/RTS	I	Input for Request to send signal (RTS) from DTE	1.8V	
AK19	C106/CTS	O	Output for Clear to send signal (CTS) to DTE	1.8V	
AE18	C109/DCD	O	Output for Data carrier detect signal (DCD) to DTE	1.8V	
AG18	C107/DSR	O	Output for Data set ready signal (DSR) to DTE	1.8V	
AJ18	C125/RING	O	Output for Ring indicator signal (RI) to DTE	1.8V	
Asynchronous Auxiliary UART					
AB19	TXD_AUX	O	Auxillary UART (TX Data to DTE)	1.8V	
AD19	RXD_AUX	I	Auxillary UART (RX Data from DTE)	1.8V	
SIM Card Interface					
A10	SIMCLK	O	External SIM signal – Clock	1.8/2.85V	
B11	SIMRST	O	External SIM signal – Reset	1.8/2.85V	
B9	SIMIO	I/O	External SIM signal - Data I/O	1.8/2.85V	
B7	SIMIN	I	External SIM signal - Presence (active low)	1.8V	
A8	SIMVCC	-	External SIM signal – Power supply for the SIM	1.8/2.85V	
Audio					
B5	EAR1_MT+	AO	Earphone signal output1, phase +	Audio	
A4	EAR1_MT-	AO	Earphone signal output1, phase -	Audio	
B3	MIC1_MT+	AI	Mic signal input1, phase +	Audio	
A2	MIC1_MT-	AI	Mic signal input1, phase -	Audio	
E2	EAR2_MT+	AO	Earphone signal output2, phase +	Audio	
D1	EAR2_MT-	AO	Earphone signal output2, phase -	Audio	
C2	MIC2_MT+	AI	Mic signal input2, phase +	Audio	
B1	MIC2_MT-	AI	Mic signal input2, phase -	Audio	
Digital Voice interface (DVI)					
D11	DVI_WA0	I/O	Digital Voice interface (WA0)	1.8V	

PAD	Signal	I/O	Function	Type	COMMENT
C8	DVI_RX	I/O	Digital Voice interface (RX)	1.8V	
D9	DVI_TX	I/O	Digital Voice interface (TX)	1.8V	
C10	DVI_CLK	I/O	Digital Voice interface (CLK)	1.8V	
Digital IO					
F9	GPIO_01	I/O	GPIO_01	1.8V	
E10	GPIO_02	I/O	GPIO_02	1.8V	
F11	GPIO_03	I/O	GPIO_03	1.8V	
E12	GPIO_04	I/O	GPIO_04	1.8V	
F13	GPIO_05	I/O	GPIO_05	1.8V	
E14	GPIO_06	I/O	GPIO_06 / DAC_OUT(PDM)	1.8V	
R18	GPIO_07	I/O	GPIO_07	1.8V	
S19	GPIO_08	I/O	GPIO_08	1.8V	
U19	GPIO_09	I/O	GPIO_09	1.8V	
W19	GPIO_10	I/O	GPIO_10	1.8V	
RF Section					
AD1	Antenna	I/O	GSM/EDGE/UMTS Antenna (50Ohm)	RF	
AU9	ANT_DIV	I	UMTS Antenna Diversity Input (50Ohm)	RF	
GPS Section					
S1	ANT_GPS	I	GPS Antenna (50Ohm)	RF	
V2	GPS_LNA_EN	O	Output enable for External LNA supply	1.8V	
Miscellaneous Function					
AP1	RESET*	I	Reset Input	1.8V	Active Low
AS1	ON_OFF*	I	Input Command for Power ON/OFF	1.8V	Active Low
F17	VRTC	AI	VRTC Backup Capacitor	Power	To be used to back up the RTC section
P17	VAUX/PWRMON	O	Supply Output for External Accessories / Power ON Monitor	1.8V	
D5	ADC_IN1	AI	Analog/Digital Converter Input 1	Analog	
E6	ADC_IN2	AI	Analog/Digital Converter Input 2	Analog	
AU3	STAT_LED	O	Status Indicator LED	1.8V	
AN10	SW_RDY	O	Indicates that the boot sequence completed successfully	1.8V	
AN12	SHDN*	I	Unconditional Shut down Input	1.8V	
M17	LED_DRV_EN	O	Enable for the external LED Driver circuit	1.8V	
Power Supply					
AP17	VBATT	-	Main Power Supply (Baseband)	Power	
AP19	VBATT	-	Main Power Supply (Baseband)	Power	
AR18	VBATT	-	Main Power Supply (Baseband)	Power	
AS17	VBATT_PA	-	Main Power Supply (PAM)	Power	
AS19	VBATT_PA	-	Main Power Supply (PAM)	Power	
AT18	VBATT_PA	-	Main Power Supply (PAM)	Power	

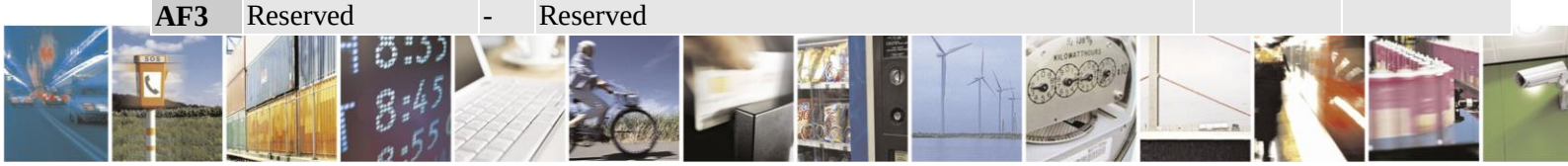
PAD	Signal	I/O	Function	Type	COMMENT
AU17	VBATT_PA	-	Main Power Supply (PAM)	Power	
AU19	VBATT_PA	-	Main Power Supply (PAM)	Power	
A6	GND	-	Ground		
A12	GND	-	Ground		
B13	GND	-	Ground		
B15	GND	-	Ground		
B17	GND	-	Ground		
C4	GND	-	Ground		
C6	GND	-	Ground		
D3	GND	-	Ground		
D7	GND	-	Ground		
E18	GND	-	Ground		
F1	GND	-	Ground		
G18	GND	-	Ground		
H19	GND	-	Ground		
M1	GND	-	Ground		
N2	GND	-	Ground		
P1	GND	-	Ground		
P3	GND	-	Ground		
R2	GND		Ground		
T2	GND		Ground		
T18	GND	-	Ground		
U1	GND	-	Ground		
V18	GND	-	Ground		
W1	GND	-	Ground		
X2	GND	-	Ground		
X18	GND	-	Ground		
Y1	GND	-	Ground		
Y19	GND		Ground		
AA2	GND	-	Ground		
AB1	GND	-	Ground		
AC2	GND	-	Ground		
AE2	GND	-	Ground		
AF1	GND	-	Ground		
AG2	GND	-	Ground		
AH1	GND	-	Ground		
AJ2	GND	-	Ground		
AK1	GND	-	Ground		
AK17	GND	-	Ground		
AL18	GND	-	Ground		
AM17	GND	-	Ground		



PAD	Signal	I/O	Function	Type	COMMENT
AM19	GND	-	Ground		
AN16	GND	-	Ground		
AN18	GND	-	Ground		
AP3	GND	-	Ground		
AP5	GND	-	Ground		
AP7	GND	-	Ground		
AP9	GND	-	Ground		
AP11	GND	-	Ground		
AP13	GND	-	Ground		
AP15	GND	-	Ground		
AR2	GND	-	Ground		
AR4	GND	-	Ground		
AR6	GND	-	Ground		
AR8	GND	-	Ground		
AR10	GND	-	Ground		
AR12	GND	-	Ground		
AR14	GND	-	Ground		
AR16	GND	-	Ground		
AS5	GND	-	Ground		
AS7	GND	-	Ground		
AS9	GND	-	Ground		
AS11	GND	-	Ground		
AS13	GND	-	Ground		
AS15	GND	-	Ground		
AT4	GND	-	Ground		
AT6	GND	-	Ground		
AT8	GND	-	Ground		
AT10	GND	-	Ground		
AT12	GND	-	Ground		
AT14	GND	-	Ground		
AT16	GND	-	Ground		
AU1	GND	-	Ground		
AU5	GND	-	Ground		
AU7	GND	-	Ground		
AU11	GND	-	Ground		
AU15	GND	-	Ground		
Reserved					
A14	Reserved	-	Reserved		
A16	Reserved	-	Reserved		
C12	Reserved	-	Reserved		
C14	Reserved	-	Reserved		



PAD	Signal	I/O	Function	Type	COMMENT
C16	Reserved	-	Reserved		
C18	Reserved	-	Reserved		
D13	Reserved	-	Reserved		
D15	Reserved	-	Reserved		
D17	Reserved	-	Reserved		
E4	Reserved	-	Reserved		
E8	Reserved	-	Reserved		
E16	Reserved	-	Reserved		
F3	Reserved	-	Reserved		
F5	Reserved	-	Reserved		
F7	Reserved	-	Reserved		
F15	Reserved	-	Reserved		
G2	Reserved	-	Reserved		
H1	Reserved	-	Reserved		
H3	Reserved	-	Reserved		
H17	Reserved	-	Reserved		
J2	Reserved	-	Reserved		
J18	Reserved	-	Reserved		
K1	Reserved	-	Reserved		
K3	Reserved	-	Reserved		
K17	Reserved	-	Reserved		
K19	Reserved	-	Reserved		
L2	Reserved	-	Reserved		
L18	Reserved	-	Reserved		
M3	Reserved	-	Reserved		
M19	Reserved	-	Reserved		
N18	Reserved	-	Reserved		
P19	Reserved	-	Reserved		
S3	Reserved	-	Reserved		
S17	Reserved	-	Reserved		
U3	Reserved	-	Reserved		
U17	Reserved	-	Reserved		
W3	Reserved	-	Reserved		
W17	Reserved	-	Reserved		
Y3	Reserved	-	Reserved		
Y17	Reserved	-	Reserved		
AB3	Reserved	-	Reserved		
AB17	Reserved	-	Reserved		
AD3	Reserved	-	Reserved		
AD17	Reserved	-	Reserved		
AF3	Reserved	-	Reserved		



PAD	Signal	I/O	Function	Type	COMMENT
AF17	Reserved	-	Reserved		
AH3	Reserved	-	Reserved		
AH17	Reserved	-	Reserved		
AK3	Reserved	-	Reserved		
AL2	Reserved	-	Reserved		
AM1	Reserved	-	Reserved		
AM3	Reserved	-	Reserved		
AN2	Reserved	-	Reserved		
AN4	Reserved	-	Reserved		
AN6	Reserved	-	Reserved		
AN8	Reserved	-	Reserved		
AN14	Reserved	-	Reserved		
AS3	Reserved	-	Reserved		
AT2	Reserved	-	Reserved		
AU13	Reserved	-	Reserved		

NOTE:

DTR pin must be connected in order to enter HE920's power saving mode.

NOTE:

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

NOTE:

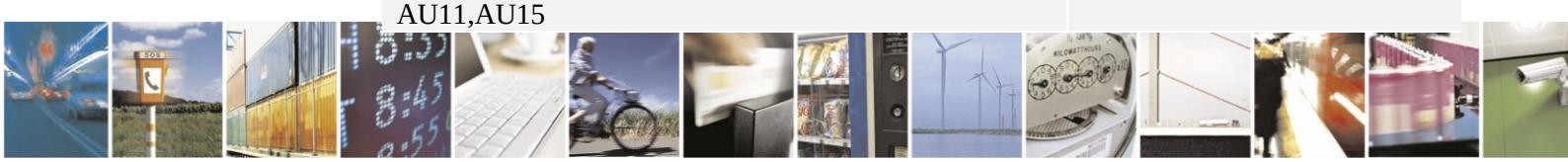
RESERVED pins must not be connected

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

NOTE:

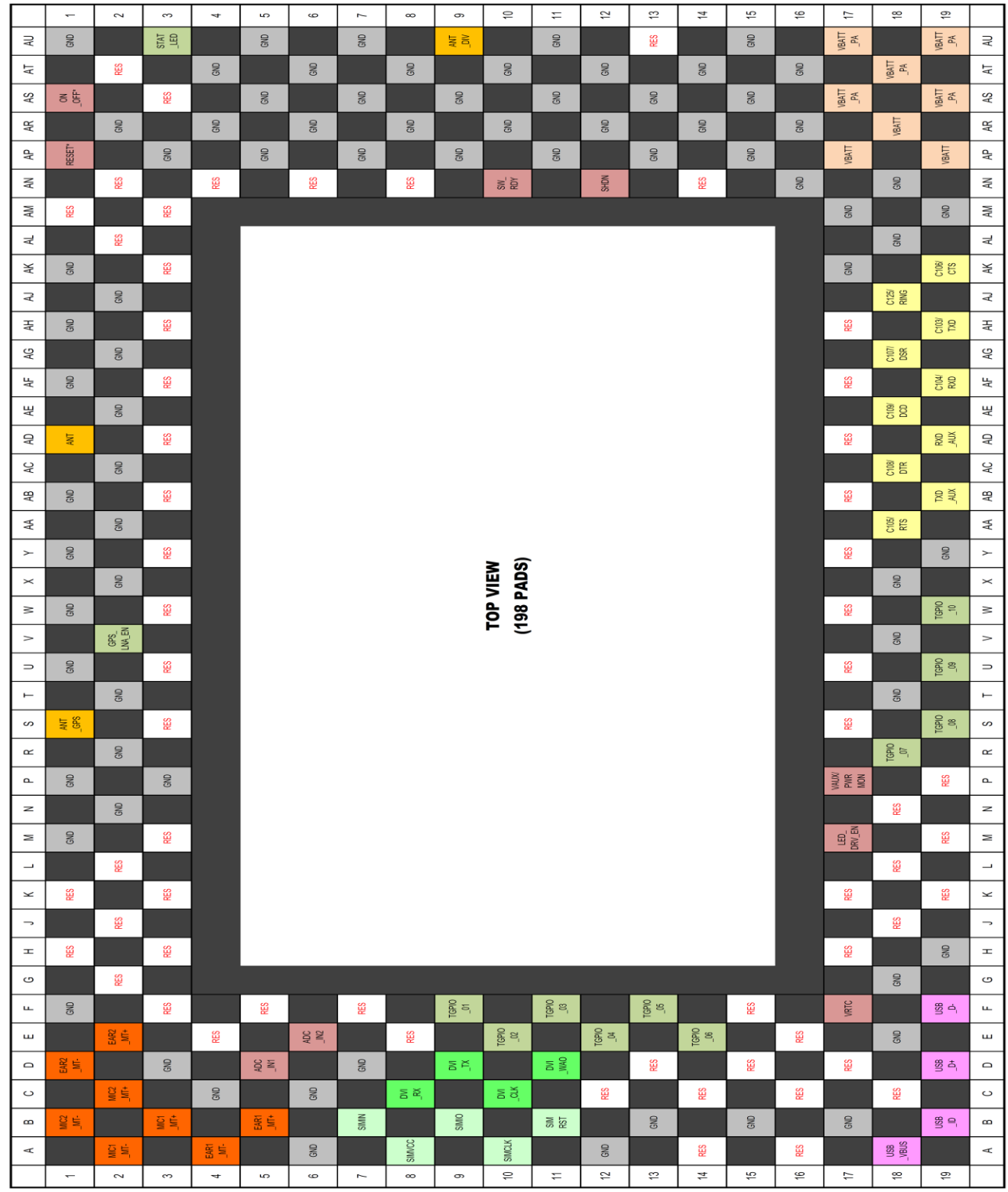
If not used, almost all pins must be left disconnected. The only exceptions are the following:

PAD	Signal
AP17,AP19,AR18,AS17,AS19,AT18,AU17,AU19	VBATT & VBATT_PA
A6,A12,B13,B15,B17,C4,C6,D3,D7,E18,F1,G18,H19, M1,N2,P1,P3,R2,T2,T18,U1,V18,W1,X2,X18,Y1,Y19, AA2,AB1,AC2,AE2,AF1,AG2,AH1,AJ2,AK1,AK17, AL18,AM17,AM19,AN16,AN18,AP3,AP5,AP7,AP9, AP11,AP13,AP15,AR2,AR4AR6,AR8,AR10,AR12, AR14,AR16,AS5,AS7,AS9,AS11,AS13,AS15,AT4, AT6,AT8,AT10,AT12,AT14,AT16,AU1,AU5,AU7, AU11,AU15	GND



AS1	ON/OFF*
AP1	RESET*
D19	USB_D+
F19	USB_D-
A18	USB_VBUS
AH19	C103/TXD
AF19	C104/RXD
AA18	C105/RTS
AK19	C106/CTS
AB19	TXD_AUX
AD19	RXD_AUX

3.1.1. LGA Pads Layout



NOTE:

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

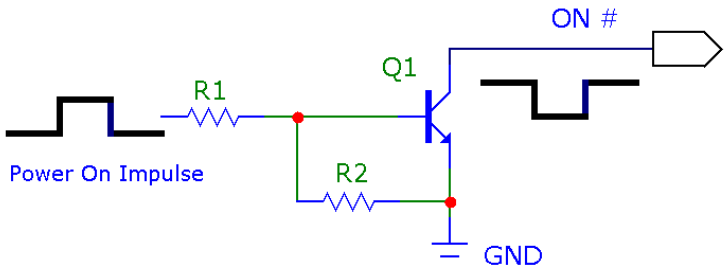
4. Hardware Commands

4.1. Turning ON the HE920

To turn on HE920, the pad ON_OFF* must be tied low for at least 1 second and then released.

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

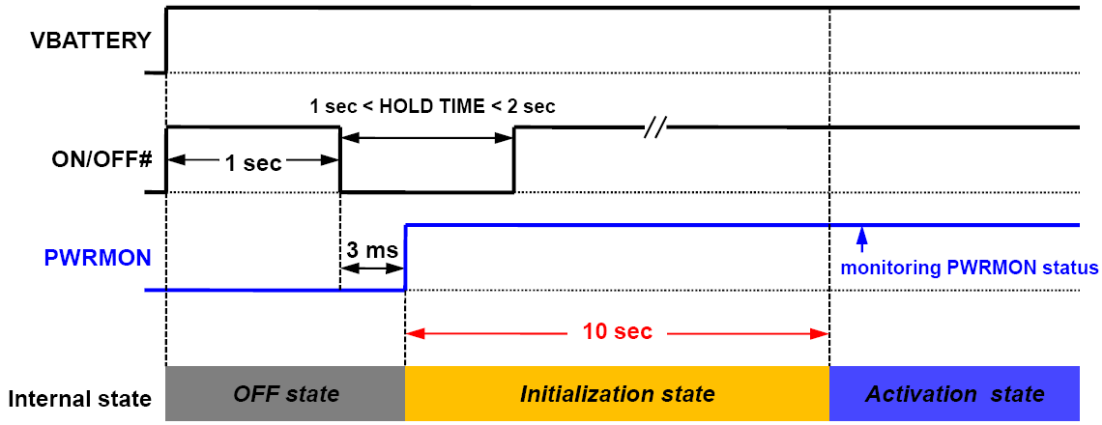
A simple circuit to power on the module is illustrated below:



4.2. Initialization and Activation state

Upon turning on HE920 module, The HE920 is not activated yet because the boot sequence of HE920 is still going on internally. It takes about 10 seconds to complete the initializing the module internally.

For this reason, it would be useless to try to access HE920 during the Initialization state as below. To get the desirable stability, The HE920 needs at least 10 seconds after the PWRMON goes High to become operational by reaching the activation state.



During the *Initialization state*, any kind of AT-command is not available. DTE must be waiting for the *Activation state* to communicate with HE920.

NOTE:

To check if the HE920 has powered on, the hardware line PWRMON must be monitored. When PWRMON goes high, the module has powered on.

NOTE:

Do not use any pull up resistor on the ON_OFF* line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the HE920 power regulator and improper power on/off of the module. The line ON_OFF* must be connected only in open collector configuration.

NOTE:

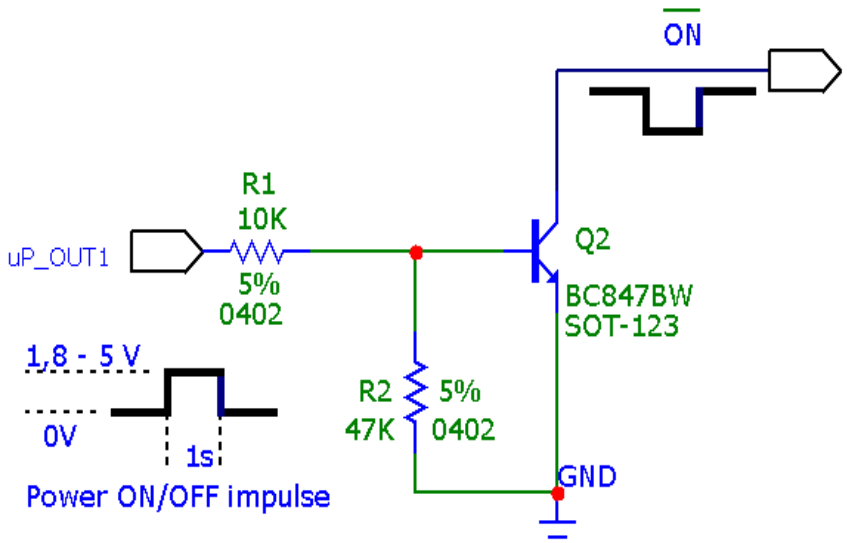
In this document all the lines are inverted. Active low signals are labeled with a name that ends with "#", "*" or with a bar over the name.

NOTE:

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

For example:

1- Let us assume you need to drive the ON_OFF* pad with a totem pole output of a +1.8/5 V microcontroller (uP_OUT1):



4.3. Turning OFF the HE920

Turning off the device can be done in two ways:

- by software command (see HE920 Software User Guide)
- by Hardware shutdown(pad ON_OFF*)

When the device is shut down by software command or by hardware shutdown(pad ON_OFF*), it issues to the network a detach request that informs the network that the device will not be reachable any more.

TIP:

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

NOTE:

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

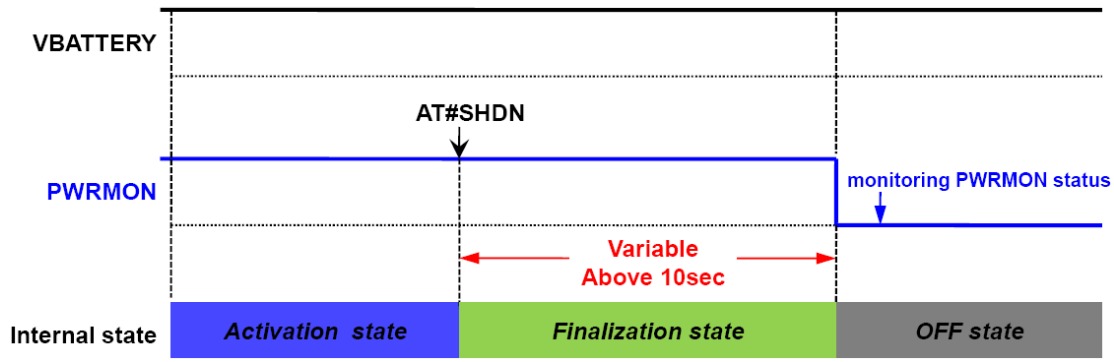
4.3.1. Shutdown by Software Command

HE920 can be shut down by a software command.

When a shut down command is sent, HE920 goes into the finalization state and finally will shut down PWRMON at the end of this state.

The period of the finalization state can differ according to the situation in which the HE920 is so it cannot be fixed definitely.

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



TIP:

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

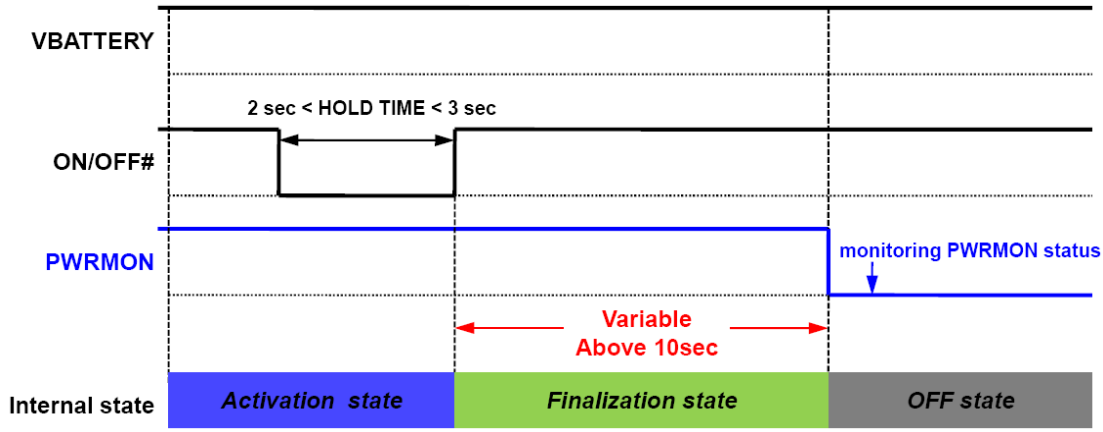
4.3.2. Hardware Shutdown

To turn OFF HE920 the pad ON_OFF* must be tied low for at least 2 seconds and then released. Same circuitry and timing for the power on must be used.

When the hold time of ON_OFF* is above 2 seconds, HE920 goes into the finalization state and finally will shut down PWRMON at the end of this state.

The period of the finalization state can differ according to the situation in which the HE920 is so it cannot be fixed definitely.

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



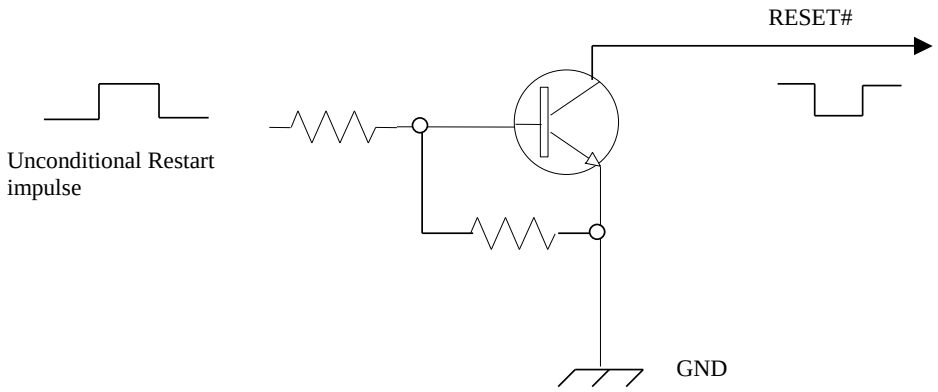
TIP:

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

4.4. Hardware Unconditional Restart (RESET)

To unconditionally restart HE920, the pad RESET* must be tied low for at least 200 milliseconds and then released.

A simple circuit to do it is:



NOTE:

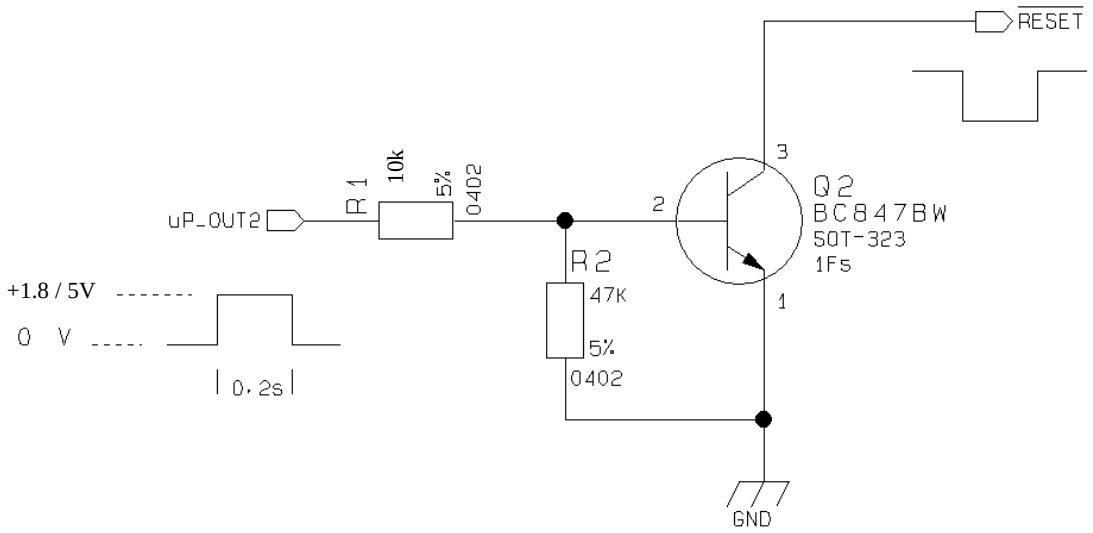
Do not use any pull up resistor on the RESET* line or any totem pole digital output. Using pull up resistor may bring to latch up problems on the HE920 power regulator and improper functioning of the module. The line RESET* must be connected only in open collector configuration.

TIP:

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

For example:

1- Let us assume you need to drive the RESET* pad with a totem pole output of a +1.8/5 V microcontroller (uP_OUT2):



4.5. Hardware Unconditional Shutdown (Power Off)

The Unconditional Shutdown of the module could be activated using the SHDN* line (pad AN12).

WARNIG:

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 HE920, the pad SHDN* must be tied low for at least 200 milliseconds and then released.

NOTE:

Do not use any pull up resistor on the SHDN* line nor any totem pole digital output. Using pull up resistor may bring to latch up problems on the HE920 power regulator and improper functioning of the module. The line SHDN* must be connected only in open collector configuration.

The SHDN* is generating an unconditional shutdown(power off) of the module without an automatic restart.

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

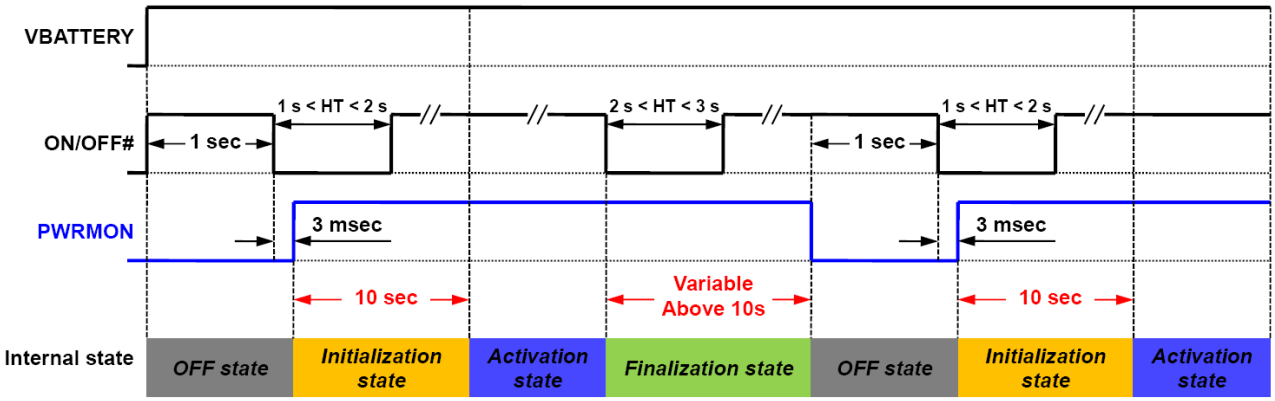
To proper power on again the module please refer to the related paragraph ("Turning ON the HE920")

TIP:

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

4.6. Summary of Turning ON and OFF the module

Below chart describes the overall sequences for Turning ON and OFF.



5. Power Supply

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

5.1. Power Supply Requirements

The HE920 power requirements are:

Power Supply	
Nominal Supply Voltage	3.8V
Max Supply Voltage	4.2V
Supply Voltage Range	3.4V – 4.2V

HE920			
Mode		**Average(mA)**	**Mode Description**
IDLE mode			Standby mode; no call in progress
AT+CFUN=1	WCDMA	15	Normal mode; full functionality of the module
	GSM	15	
AT+CFUN=4	WCDMA	13	Disabled TX and RX; modules is not registered on the network
	GSM	13	
AT+CFUN=0 or AT+CFUN=5	WCDMA	3.2/1.0*	Power saving; CFUN=0 module registered on the network and can receive voice call or an SMS; but it is not possible to send AT commands; module wakes up with an unsolicited code (call or SMS) or rising RTS line. CFN=5 full functionality with power saving; Module registered on the network can receive incoming call sand SMS
	GSM	3.2/1.3*	
WCDMA TX and RX mode			
WCDMA Voice		630	WCDMA voice channel
HSPA		640	HSPA data channel
GSM TX and RX mode			
GSM Voice		260	GSM voice channel
GPRS Class33		680	GPRS data channel
EDGE Class33		380	EDGE data channel
GPRS Class10		490	GPRS data channel
EDGE Class10		280	EDGE data channel

* Worst/best case depends on network configuration and is not under module control.

TIP:

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

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

5.2. General Design Rules

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

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

5.2.1. Electrical Design Guidelines

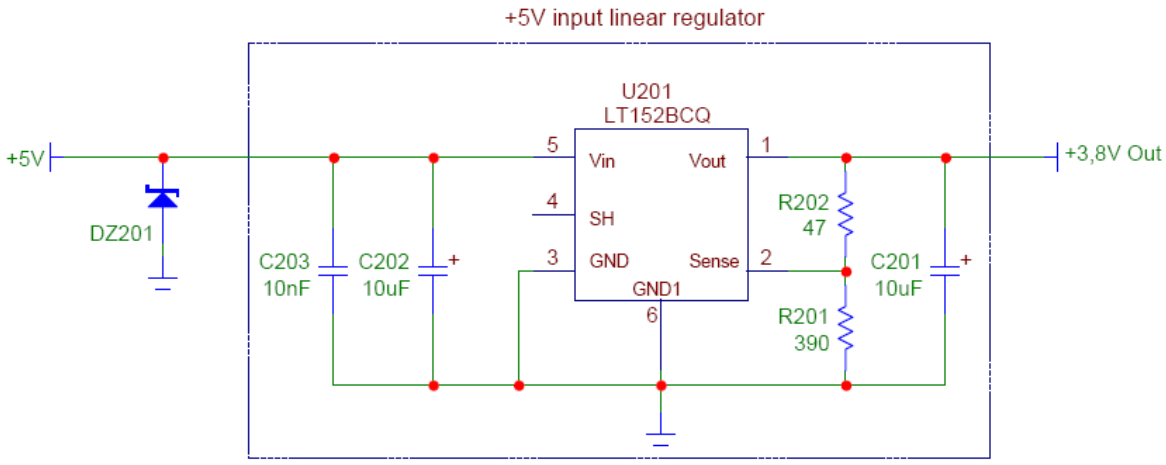
The electrical design of the power supply depends strongly on the power source where this power is drained. We will distinguish them into three categories:

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

5.2.1.1. + 5V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence there is not a big difference between the input source and the desired output 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 must be provided in order to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks close to HE920, a 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input, in order to save HE920 from power polarity inversion.

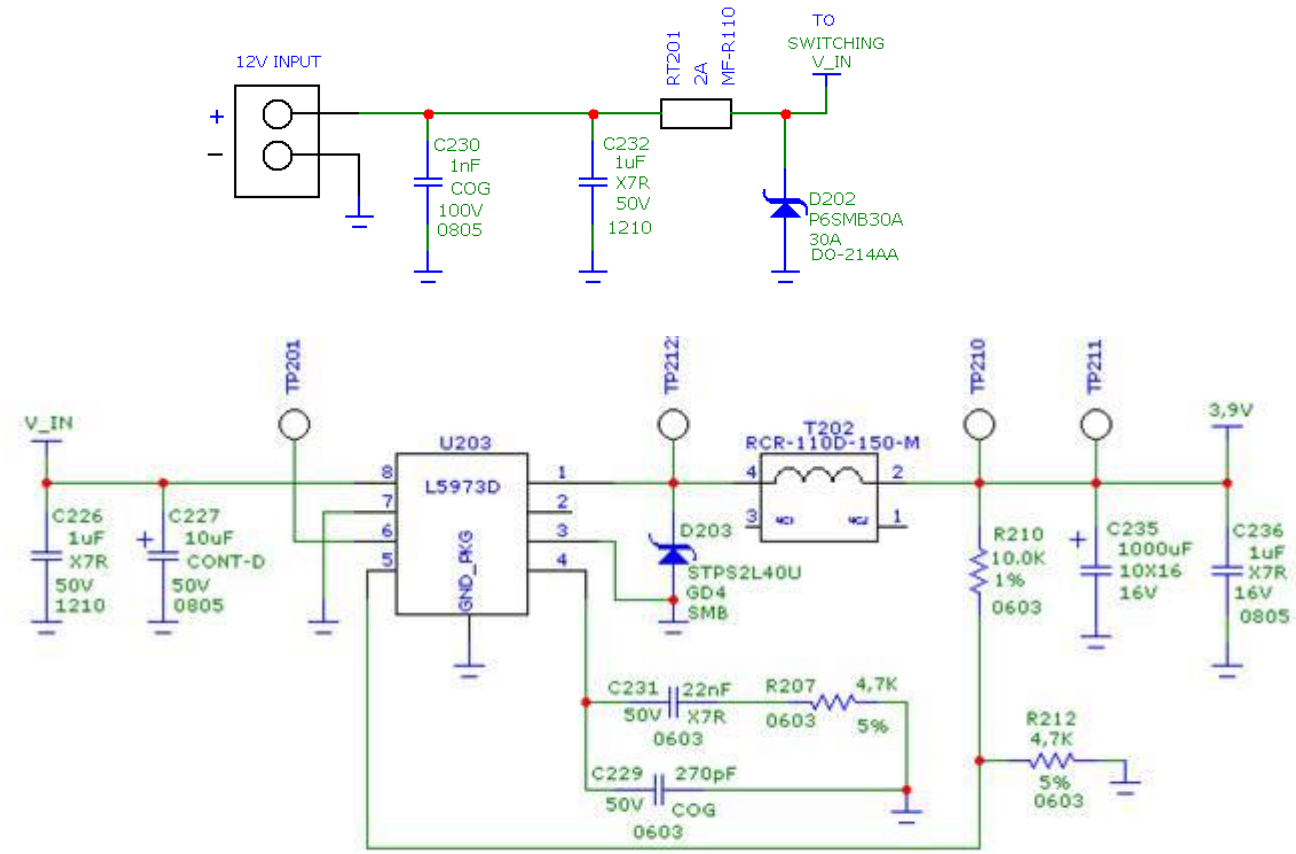
An example of linear regulator with 5V input is:



5.2.1.2. + 12V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence due to the big difference between the input source and the desired output, a linear regulator is not suited and must not be used. A switching power supply will be preferable because of its better efficiency especially with the 2A peak current load represented by HE920.
- When using a switching regulator, a 500kHz or more switching frequency regulator is preferable because of its smaller inductor size and its faster transient response. This allows the regulator to respond quickly to the current peaks absorption.
- In any case, the frequency and Switching design selection is related to the application to be developed due to the fact the switching frequency could also generate EMC interferences.
- For car PB battery the input voltage can rise up to 15.8V and this must be kept in mind when choosing components: all components in the power supply must withstand this voltage.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks. A 100µF tantalum capacitor is usually suited for this.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode must be inserted close to the power input, in order to clean the supply from spikes.
- A protection diode must be inserted close to the power input, in order to save HE920 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 (it is split in 2 parts):



Switching regulator

5.2.1.3. Battery Source Power Supply Design Guidelines

- The desired nominal output for the power supply is 3.8V and the maximum allowed voltage is 4.2V, hence a single 3.7V Li-Ion cell battery type is suited for supplying the power to the Telit HE920 module. 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 HE920 and damage it.

NOTE:

Do not use any Ni-Cd, Ni-MH, and Pb battery types directly connected with HE920. Their use can lead to overvoltage on HE920 and damage it. Use only Li-Ion battery types.

- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks, a 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input, in order to save HE920 from power polarity inversion. Otherwise the battery connector must be done in a way to avoid polarity inversions when connecting the battery.
- The battery capacity must be at least 500mAh in order to withstand the current peaks of 2A; the suggested capacity is from 500mAh to 1000mAh.

5.2.2. Thermal Design Guidelines

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

- Average current consumption during HSPA transmission @PWR level max in HE920: 640mA
- Average current consumption during class33 GPRS transmission @PWR level max: 680mA
- Average current consumption during class10 GPRS transmission @PWR level max: 490mA
- Average GPS current during GPS ON (Power Saving disabled) : 65mA

NOTE:

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

NOTE:

The thermal design for the Power supply must be made keeping an average consumption at the max transmitting level during calls of 640mA(HSPA)/680mA(GPRS) rms plus 65mA rms for GPS in tracking mode.

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

If we assume that the device stays in transmission for short periods of time (let us say few minutes) and then remains for quite a long time in idle (let us say one hour), then the power supply has always the time to cool down between the calls and the heat sink could be smaller than the calculated for 640mA (HSPA)/680mA (GPRS) maximum RMS current. There could even be a simple chip package (no heat sink).

Moreover in average network conditions the device is requested to transmit at a lower power level than the maximum and hence the current consumption will be less than 640mA (HSPA) /680mA (GPRS) (being usually around 250mA).

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

For the heat generated by the HE920, you can consider it to be during transmission 2W max during class33 GPRS upload. This generated heat will be mostly conducted to the ground plane under the HE920; you must ensure that your application can dissipate heat.

In the WCDMA/HSPA mode, since HE920 emits RF signals continuously during transmission, you must pay special attention how to dissipate the heat generated.

The current consumption will be up to about 640mA in HSPA (630mA in WCDMA) continuously at the maximum TX output power (23dBm). Thus, you must arrange the PCB

area as large as possible under HE920 which you will mount. You must mount HE920 on the large ground area of your application board and make many ground vias to dissipate the heat.

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

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

5.2.3. Power Supply PCB Layout Guidelines

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

- The Bypass low ESR capacitor must be placed close to the Telit HE920 power input pads, or in the case the power supply is a switching type, it can be placed close to the inductor to cut the ripple if the PCB trace from the capacitor to HE920 is wide enough to ensure a drop-less connection even during the 2A current peaks.
- The protection diode must be placed close to the input connector where the power source is drained.
- The PCB traces from the input connector to the power regulator. IC must be wide enough to ensure no voltage drops to occur when the 2A current peaks are absorbed. Note that this is not made in order to save power loss but especially to avoid the voltage drops on the power line at the current peaks frequency of 216 Hz that will reflect on all the components connected to that supply (also introducing the noise floor at the burst base frequency.) For this reason while a voltage drop of 300-400 mV may be acceptable from the power loss point of view, the same voltage drop may not be acceptable from the noise point of view. If your application does not have audio interface but only uses the data feature of the Telit HE920, then this noise is not so disturbing and power supply layout design can be more forgiving.
- The PCB traces to HE920 and the Bypass capacitor must be wide enough to ensure no significant voltage drops to occur when the 2A current peaks are absorbed. This is a must for the same above-mentioned reasons. Try to keep this trace as short as possible.
- The PCB traces connecting the Switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the diode very close to the power switching IC (only for switching power supply). This is done in order to reduce the radiated field (noise) at the switching frequency (usually 100-500 kHz).
- The use of a good common ground plane is suggested.
- The placement of the power supply on the board must be done in a way to guarantee that the high current return paths in the ground plane are not

overlapped to any noise sensitive circuitry as the microphone amplifier/buffer or earphone amplifier.

- The power supply input cables must be kept separately from noise sensitive lines such as microphone/earphone cables.

6. Antenna(s)

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

6.1. GSM/WCDMA Antenna Requirements

The antenna for a Telit HE920 device must fulfill the following requirements:

GSM / WCDMA Antenna Requirements		
Frequency range	Depending by frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)	
Bandwidth	**HE920-EU**	**HE920-NA**
	GSM850 : 70 MHz GSM900 : 80 MHz GSM1800(DCS) : 170 MHz GSM1900(PCS) : 140 MHz WCDMA band I(2100) : 250 MHz WCDMA band V(850) : 70 MHz WCDMA band VIII(900) : 80 MHz	GSM850 : 70 MHz GSM900 : 80 MHz GSM1800(DCS) : 170 MHz GSM1900(PCS) : 140 MHz WCDMA band II(1900) : 140 MHz WCDMA band IV(AWS) : 445 MHz WCDMA band V(850) : 70 MHz
Impedance	50 Ohm	
Input power	> 33dBm(2 W) peak power in GSM > 24dBm Average power in WCDMA	
VSWR absolute max	<= 5:1(limit to avoid permanent damage)	
VSWR recommended	<= 2:1(limit to fulfill all regulatory requirements)	

When using the Telit HE920, since there's no antenna connector on the module, the antenna must be connected to the HE920 antenna pad (AD1) by means of a transmission line implemented in the PCB.

In the case that the antenna is not directly connected at the antenna pad of the HE920, then a PCB line is required in order to connect with it or with its connector.

This transmission line shall fulfill the following requirements:

Antenna Line on PCB Requirements	
Characteristic Impedance	50Ohm
Max Attenuation	0.3dB
Coupling with other signals shall be avoided	
Cold End (Ground Plane) of antenna shall be equipotential to the HE920 ground pads	

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

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

OEM integrators must ensure that the end user has no manual instructions to remove or install the HE920 module. Antennas used for this OEM module must not exceed 6.79dBi gain for 850MHz bands, 3.01dBi gain for 1900MHz bands and 2.7dBi for 1700MHz bands for mobile and fixed operating configurations.

6.2. GSM/WCDMA Antenna – PCB line Guidelines

- Make sure that the transmission line's characteristic impedance is 50ohm.
- Keep line on the PCB as short as possible since the antenna line loss shall be less than around 0.3dB.
- Line geometry should have uniform characteristics, constant cross section, avoid meanders and abrupt curves.
- Any kind of suitable geometry/structure can be used for implementing the printed transmission line afferent the antenna.
- If a Ground plane is required in line geometry, that plane has to be continuous and sufficiently extended so the geometry can be as similar as possible to the related canonical model.
- Keep, if possible, at least one layer of the PCB used only for the Ground plane; If possible, use this layer as reference Ground plane for the transmission line.
- It is wise to surround (on both sides) of the PCB transmission line with Ground. Avoid having other signal tracks facing directly the antenna line track.
- Avoid crossing any un-shielded transmission line footprint with other tracks on different layers.
- The Ground surrounding the antenna line on PCB has to be strictly connected to the main Ground plane by means of via holes (once per 2mm at least) placed close to the ground edges facing line track.
- Place EM noisy devices as far as possible from HE920 antenna line.
- Keep the antenna line far away from the HE920 power supply lines.
- If EM noisy devices are present on the PCB hosting the HE920, such as fast switching ICs, take care of shielding them with a metal frame cover.
- If EM noisy devices are not present around the line use of geometries like Micro strip or Grounded Coplanar Waveguide are preferred since they typically ensure less attenuation when compared to a Strip line having same length.

6.3. GSM/WCDMA Antenna – Installation Guidelines

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

6.4. 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	**HE920-EU**	**HE920-NA**
	WCDMA band I(2100) : 60 MHz WCDMA band V(850) : 25 MHz WCDMA band VIII(900) : 35 MHz	WCDMA band II(1900) : 60 MHz WCDMA band IV(AWS) : 45 MHz WCDMA band V(850) : 25 MHz
Impedance	50Ω	

When using the Telit HE920, since there's no antenna connector on the module, the antenna must be connected to the HE920 antenna pad (AU9) by means of a transmission line implemented on the PCB.

In the case that the antenna is not directly connected at the antenna pad of the HE920, then a PCB line is required 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.

NOTE:

If the RX Diversity is not used/connected, disable the Diversity functionality using the AT#CRXD command and leave the pad AU9 unconnected. Please refer to the AT command User Guide in detail.

6.5. GPS/GNSS Antenna Requirements

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

The module is provided with a Digital Output signal to enable the external LNA (pad V2).

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

6.5.1. Combined GPS/GNSS Antenna

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

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

6.5.2. Linear and Patch GPS/GNSS Antenna

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

6.5.3. LNA and Front End Design Considerations

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

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

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

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

NOTE:

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

GNSS LNA requirement shall fulfill the following specifications.

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

GNSS pre-Filter requirement shall fulfill the following requirements.

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

WARNING:

The HE920 software is implemented differently depending on the configurations of an external device. Please refer to the AT command User Guide in detail.

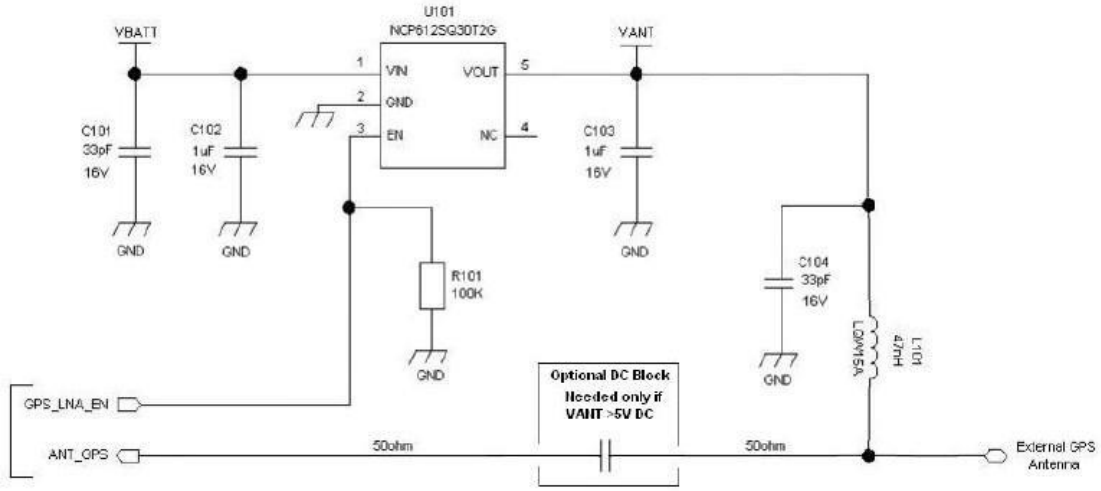
The external active antenna for the Telit HE920 device must fulfill the following requirements:

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

NOTE:

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

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



When using the Telit HE920, since there's no antenna connector on the module, the antenna must be connected to the HE920 through the PCB with the antenna pad.

In the case that the antenna is not directly connected at the antenna pad of the HE920, then a PCB line is required.

This line of transmission shall fulfill the following requirements:

Antenna Line on PCB Requirements	
Characteristic Impedance	50Ohm
Max Attenuation	0.3dB
Coupling with other signals shall be avoided	
Cold End (Ground Plane) of antenna shall be equipotential to the HE920 ground pads	

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

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

6.5.4. GPS/GNSS Antenna - PCB Line Guidelines

- Ensure that the antenna line impedance is 50ohm.
- Keep line on the PCB as short as possible to reduce the loss.
- Antenna line must have uniform characteristics, constant cross section, avoid meanders and abrupt curves.

- Keep one layer of the PCB used only for the Ground plane; if possible.
- Surround (on the sides, over and under) the antenna line on PCB with Ground. Avoid having other signal tracks directly facing the antenna line track.
- The Ground around the antenna line on PCB has to be strictly connected to the main Ground plane by placing vias once per 2mm at least.
- Place EM noisy devices as far as possible from HE920 antenna line.
- Keep the antenna line far away from the HE920 power supply lines.
- If EM noisy devices are around the PCB hosting the HE920, such as fast switching ICs, take care of shielding of antenna line by burying it inside the layers of PCB and surround it with Ground planes; or shield it with a metal frame cover.
- If you do not have EM noisy devices around the PCB of HE920, use a strip line on the superficial copper layer for the antenna line. The line attenuation will be lower than a buried one.

6.5.5. GPS/GNSS Antenna – Installation Guidelines

- The HE920, due to its sensitivity characteristics, is capable of performing a fix inside buildings. (In any case the sensitivity could be affected by the building characteristics i.e. shielding)
- The Antenna must not be co-located or operating in conjunction with any other antenna or transmitter.
- Antenna shall not be installed inside metal cases.
- Antenna shall be installed also according antenna manufacture instructions.

7. Logic Level Specifications

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 Telit HE920 interface circuits:

NOTE:

Do not connect HE920's digital logic signal directly to OEM's digital logic signal of with level higher than 2.7V for 1.8V CMOS signals.

For 1,8V CMOS signals:

Absolute Maximum Ratings -Not Functional

Parameter	HE920	
	Min	Max
Input level on any digital pin when on	-0.3V	+2.7V
Input voltage on analog pins when on	-0.3V	+2.7 V

Operating Range - Interface levels (1.8V CMOS)

Level	HE920	
	Min	Max
Input high level	1.5V	2.1V
Input low level	-0.3V	0.5V
Output high level	1.35V	1.8V
Output low level	0V	0.45V

7.1. Reset Signal(Module Restart)

Signal	Function	I/O	PAD Number
RESET*	Phone reset (restart)	I	AP1

RESET is used to reset the HE920 module. Whenever this signal is pulled low HE920 is reset (restart). When the device is reset it stops all operations. After the release of the reset HE920 is unconditionally shut down, without doing any detach operations from the network where it is registered. This behavior is not a proper shutdown because the device is requested to issue a detach request on turn off. For this reason, the Reset signal must not be used for 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 RESET is internally controlled on start-up to achieve always a proper power-on reset sequence. There is 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 HE920. Use the ON/OFF signal to perform this function or the AT#SHDN command.

Reset Signal Operating levels:

Signal	Min	Max
RESET Input high	1.5V*	2.1V
RESET Input low	0V	0.2V

* 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, it must always be connected with an open collector transistor to permit the internal circuitry the power on reset and under voltage lockout 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 module when is powered OFF or during an ON/OFF transition.

8. USB Port

The HE920 module includes a Universal Serial Bus (USB) transceiver, which operates at USB low-speed (1.5Mbits/sec), USB full-speed (12Mbits/sec) and USB high-speed (480Mbits/sec).

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

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

The table below describes the USB interface signals:

Pad No.	Signal	I/O	Function	Type	NOTE
A18	USB_VBUS	AI	Power sense for the internal USB transceiver.	5V	
F19	USB_D-	I/O	USB differential Data (-)		
D19	USB D+	I/O	USB differential Data (+)		
B19	USB_ID (for future use)				

TIP:

HE920 does NOT support host device operation at the moment, that is, it works as a slave device. Consequently USB_ID must be opened (not connected).

9. Serial Ports

The serial port on the Telit HE920 is the interface between the module and OEM hardware.

2 serial ports are available on the module:

- MODEM SERIAL PORT 1(Main)
- MODEM SERIAL PORT 2 (Auxiliary)

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

The most common are:

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

Depending on the type of serial port on the OEM hardware, a level translator circuit may be needed to make the system work. The only configuration that does not need a level translation is the 1.8V UART.

The serial port 1 on HE920 is a +1.8V UART with all the 7 RS232 signals. It differs from the PC-RS232 in signal polarity (RS232 is reversed) and levels.

The Serial port 2 is a +1.8V Auxiliary UART.

The levels for HE920 UART are the CMOS levels:

Absolute Maximum Ratings -Not Functional

Parameter	HE920	
	Min	Max
Input level on any digital pin when on	-0.3V	+2.7V
Input voltage on analog pins when on	-0.3V	+2.7 V

Operating Range - Interface levels

Level	HE920	
	Min	Max
Input high level	1.5V	2.1V
Input low level	-0.3V	0.5V
Output high level	1.35V	1.8V
Output low level	0V	0.45V

9.1. Modem Serial Port 1

Serial port 1 on the HE920 is a +1.8V UART with all 7 RS232 signals.

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

RS232 Pin Number	Signal	HE920 Pad Number	Name	Usage
1	DCD - dcd_uart	AE18	Data Carrier Detect	Output from the HE920 that indicates the carrier presence
2	RXD - Tx_uart	AF19	Transmit line *see Note	Output transmit line of the HE920 UART
3	TXD - Rx_uart	AH19	Receive line *see Note	Input receive of the HE920 UART
4	DTR - dtr_uart	AC18	Data Terminal Ready	Input to the HE920 that controls the DTE READY condition
5	GND	A6, A12, B13, B15….	Ground	ground
6	DSR - dsr_uart	AG18	Data Set Ready	Output from the HE920 that indicates the module is ready
7	RTS - rts_uart	AA18	Request to Send	Input to the HE920 that controls the Hardware flow control
8	CTS - cts_uart	AK19	Clear to Send	Output from the HE920 that controls the Hardware flow control
9	RI - ri_uart	AJ18	Ring Indicator	Output from the HE920 that indicates the Incoming call condition

NOTE:

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

TIP:

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

NOTE:

According to V.24, RX/TX signal names are referred to the application side, therefore on the HE920 side these signal are on the opposite direction: TXD on the application side will be connected to the receive line (here named TXD/ rx_uart) of the HE920 serial port and vice versa for RX.

9.2. Modem Serial Port 2

Serial port 2 on the HE920 is a +1.8V UART with only the RX and TX signals.

The signals of the HE920 serial port are:

PAD	Signal	I/O	Function	Type	COMMENT
AB19	TXD_AUX	O	Auxiliary UART (TX Data to DTE)	1.8V	
AD19	RXD_AUX	I	Auxiliary UART (RX Data to DTE)	1.8V	

NOTE:

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

9.3. RS232 Level Translation

In order to interface the Telit HE920 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

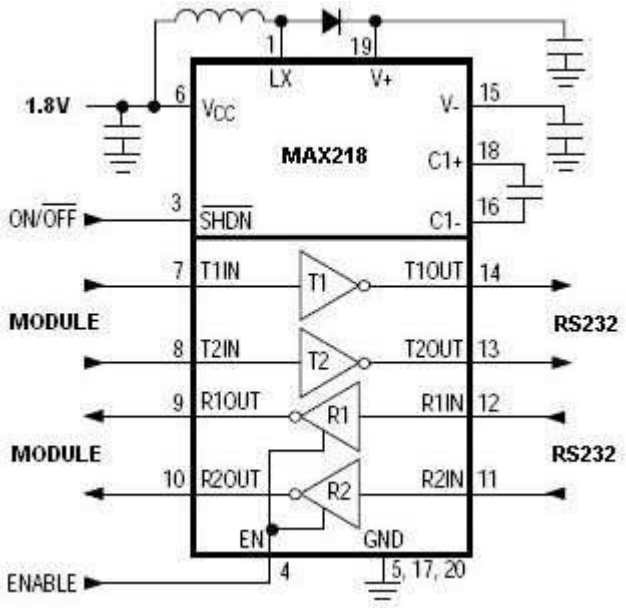
NOTE:

The digital input lines working at 1.8V CMOS have an absolute maximum input voltage of 2.7V; therefore the level translator IC shall not be powered by the +3.8V supply of the module. Instead, it must be powered from a +1.8V (dedicated) power supply.

This is because in this way the level translator IC outputs on the module side (i.e. HE920 inputs) will work at +3.8V interface levels, damaging the module inputs.

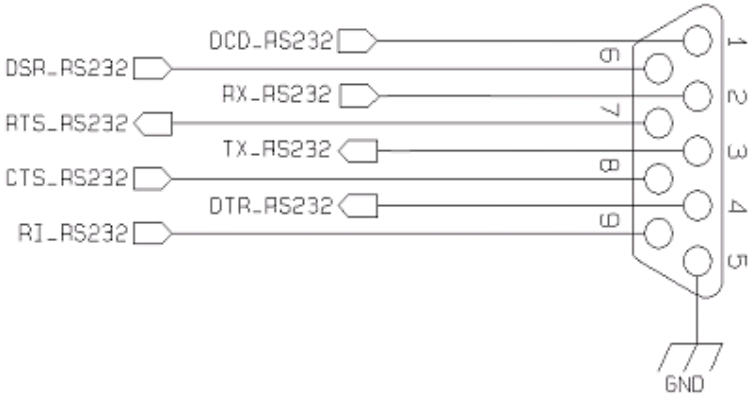
An example of RS232 level adaption circuitry could be accomplished using a MAXIM transceiver (MAX218).

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



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

The RS232 serial port lines are usually connected to a DB9 connector with the following layout: signal names and directions are named and defined from the DTE point of view



10. Audio Section Overview

The HE920 module supports an analog audio interface and digital audio interface.

10.1. Analog Audio

The HE920 module provides two analog audio paths transmitting and receiving.

Please refer to the xE920_Audio_Settings_Application_Note, 80404NT10095A

10.2. Digital Audio

HE920 module can be connected to external codec through digital interface.

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

PAD	Signal	I/O	Function	Type	COMMENT
D11	DVI_WA0	I/O	Digital Audio Interface (WA0)	B-PD 1.8V	
C8	DVI_RX	I	Digital Audio Interface (RX)	B-PD 1.8V	
D9	DVI_TX	O	Digital Audio Interface (TX)	B-PD 1.8V	
C10	DVI_CLK	I/O	Digital Audio Interface (CLK)	B-PD 1.8V	

10.2.1. CODEC Example

Please refer to the Telit_UE_HE910V2_DE_CE910_HE920_DVI_Application_Note.

11. General Purpose I/O

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

- input
- output
- alternate function (internally controlled)

Input pads can only be read and report the digital value (high or low) present on the pad at the read time; output pads can only be written or queried and set the value of the pad output; an alternate function pad is internally controlled by the HE920 firmware and acts depending on the function implemented.

The following GPIOs are available on the HE920.

PAD	Signal	I/O	Function	Type	Drive Strength
F9	GPIO_01	I/O	Configurable GPIO	B-PD 1.8V	2 mA
E10	GPIO_02	I/O	Configurable GPIO	B-PD 1.8V	2 mA
F11	GPIO_03	I/O	Configurable GPIO	B-PD 1.8V	2 mA
E12	GPIO_04	I/O	Configurable GPIO	B-PD 1.8V	2 mA
F13	GPIO_05	I/O	Configurable GPIO	B-PD 1.8V	2 mA
E14	GPIO_06	I/O	Configurable GPIO	B-PD 1.8V	2 mA
R18	GPIO_07	I/O	Configurable GPIO	B-PD 1.8V	2 mA
S19	GPIO_08	I/O	Configurable GPIO	B-PD 1.8V	2 mA
U19	GPIO_09	I/O	Configurable GPIO	B-PD 1.8V	2 mA
W19	GPIO_10	I/O	Configurable GPIO	B-PD 1.8V	2 mA

NOTE:

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

11.1. Logic Level Specifications

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 HE920 interface circuits:

For 1,8V signals:

Absolute Maximum Ratings -Not Functional

Parameter	HE920	
	Min	Max
Input level on any digital pin when on	-0.3V	+2.7V
Input voltage on analog pins when on	-0.3V	+2.7 V

Operating Range - Interface levels (1.8V CMOS)

Level	HE920	
	Min	Max
Input high level	1.5V	2.1V
Input low level	-0.3V	0.5V
Output high level	1.35V	1.8V
Output low level	0V	0.45V

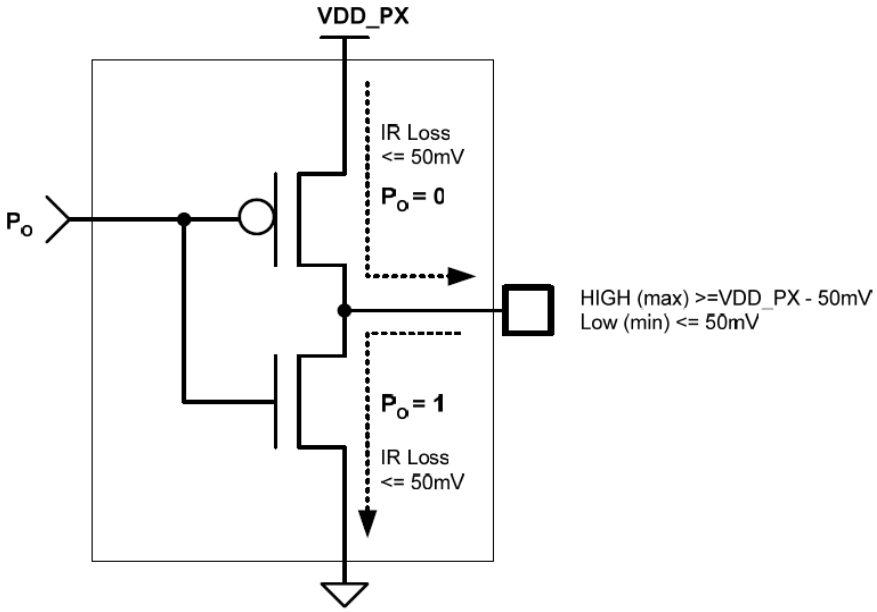
11.2. Using a GPIO Pad as Input

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

If the digital output of the device is connected with the GPIO input, the pad has interface levels different from the 1.8V CMOS. It can be buffered with an open collector transistor with a 47KΩ pull-up resistor to 1.8V.

11.3. Using a GPIO Pad as Output

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



output PAD equivalent circuit

11.4. Using the Temperature Monitor Function

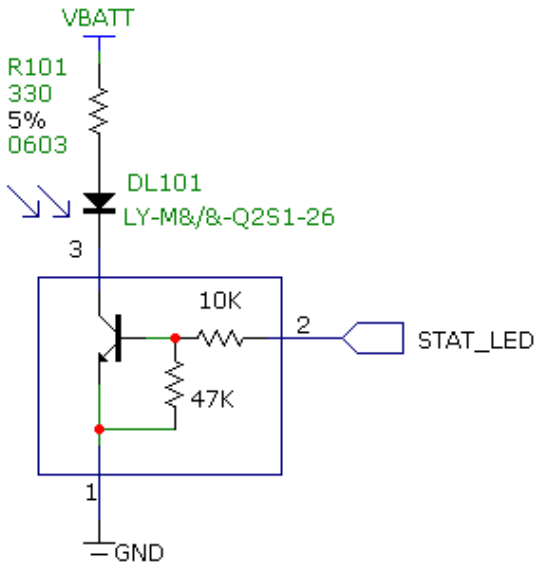
11.4.1. Short Description

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

11.5. Indication of Network Service Availability

The STAT_LED pin status shows information on the network service availability and Call status. In the HE920 modules, the STAT_LED usually needs an external transistor to drive an external LED. Because of the above, the status indicated in the following table is reversed with respect to the pin status:

LED status	Device Status
Permanently off	Device off
Fast blinking (Period 1s, Ton 0,5s)	Net search / Not registered / turning off
Slow blinking (Period 3s, Ton 0,3s)	Registered full service
Permanently on	a call is active



11.6. 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.

NOTE:

NO devices must be powered from this pin.

11.7. VAUX Power Output

A regulated power supply output is provided in order to supply small devices from the module. This output is active when the module is ON and goes OFF when the module is shut down. The operating range characteristics of the supply are:

Operating Range – VAUX power supply

	Min	Typical	Max
Output voltage	1.75V	1.80V	1.85V
Output current			100mA
Output bypass capacitor (Inside the module)			2.2µF

12. DAC and ADC section

12.1. DAC Converter

12.1.1. Description

The HE920 module provides a Digital to Analog Converter. The signal (named DAC_OUT) is available on pad E14 of the HE920 module.

The on board DAC is in the range from 0 to 1023.

However, an external low-pass filter is necessary.

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

The precision is 1023 steps, so if we consider that the maximum voltage is 1.8V, the integrated voltage could be calculated with the following formula:

Integrated output voltage = 1.8 * value / 1023

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

12.1.2. Enabling DAC

An AT command is available to use the DAC function.

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

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

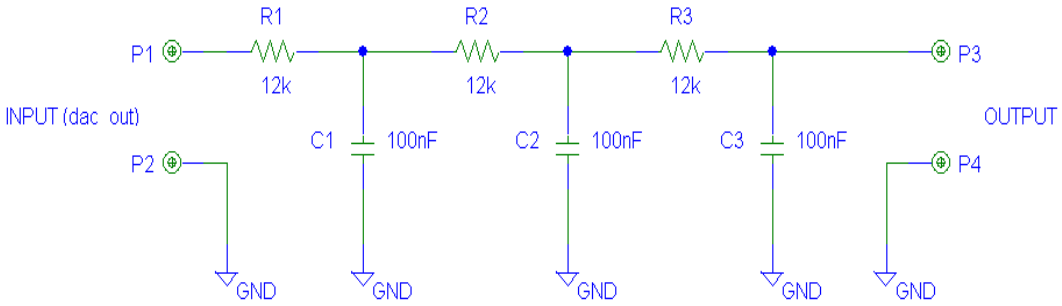
it must be present if <enable>=1

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

NOTE:

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

12.1.3. Low Pass Filter Example



12.2. ADC Converter

12.2.1. Description

The on board ADCs are 8-bit converters. They are able to read a voltage level in the range of 0-2 volts applied on the ADC pin input and store and convert it into 8 bit word.

	Min	Max	Units
Input Voltage range	0	2.0	Volt
AD conversion	-	8	bits
Resolution	-	< 8.6	mV

The HE920 module provides 2 Analog to Digital Converters.

12.2.2. Using ADC Converter

An AT command is available to use the ADC function.

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

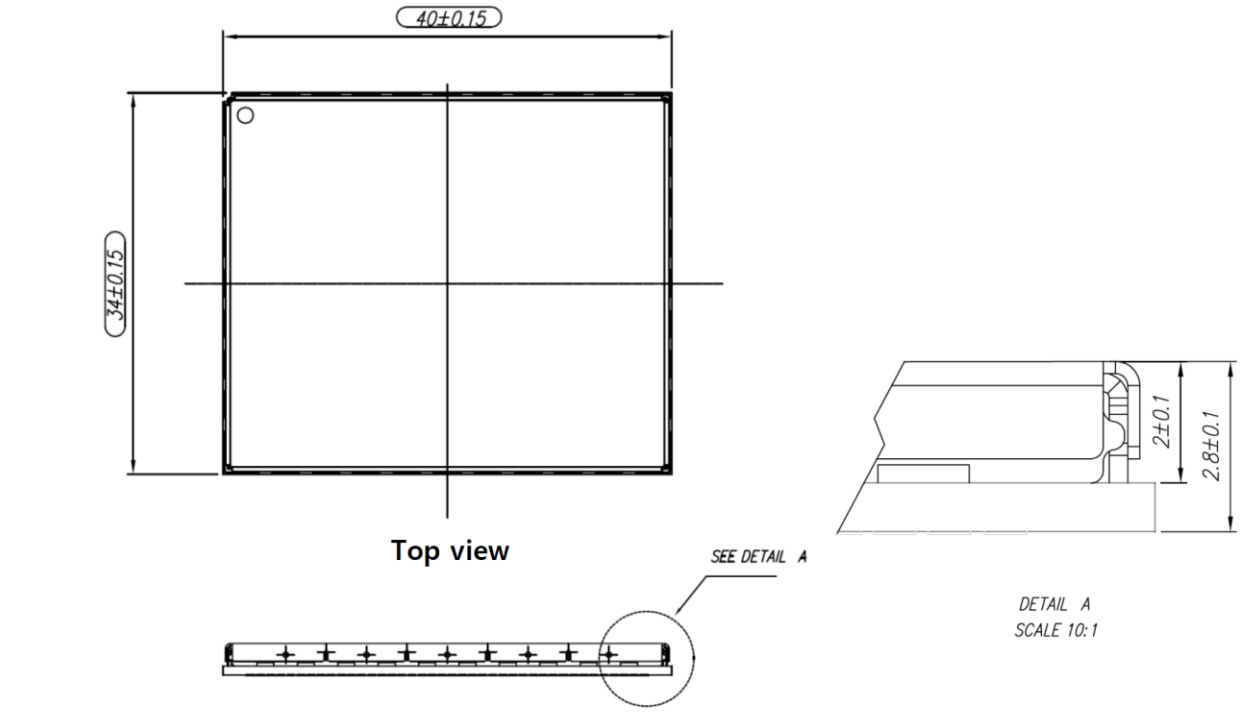
Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.

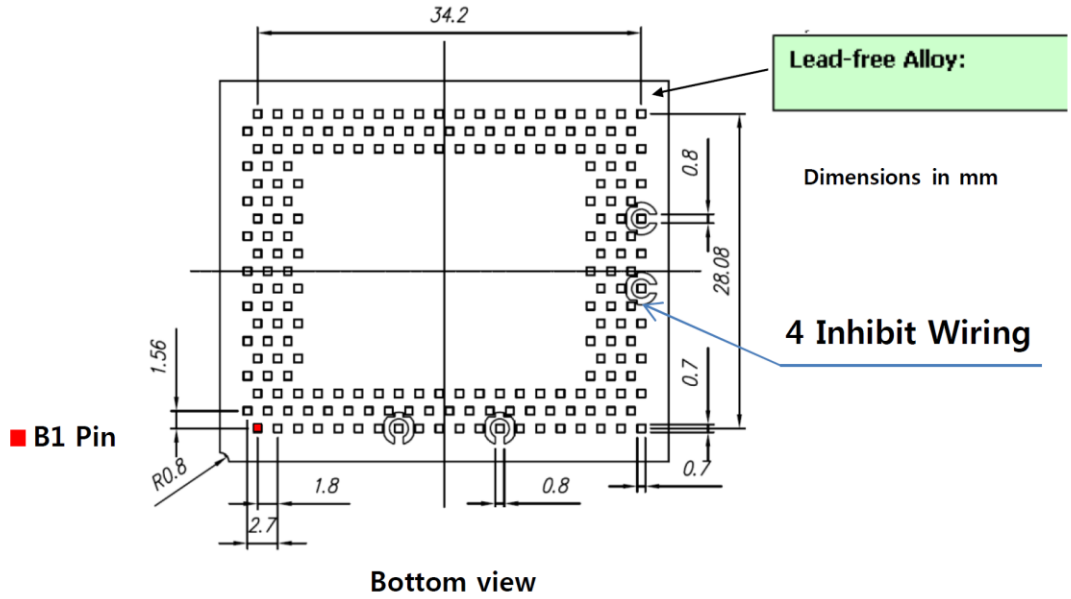
13. Mounting the module on your board

13.1. General

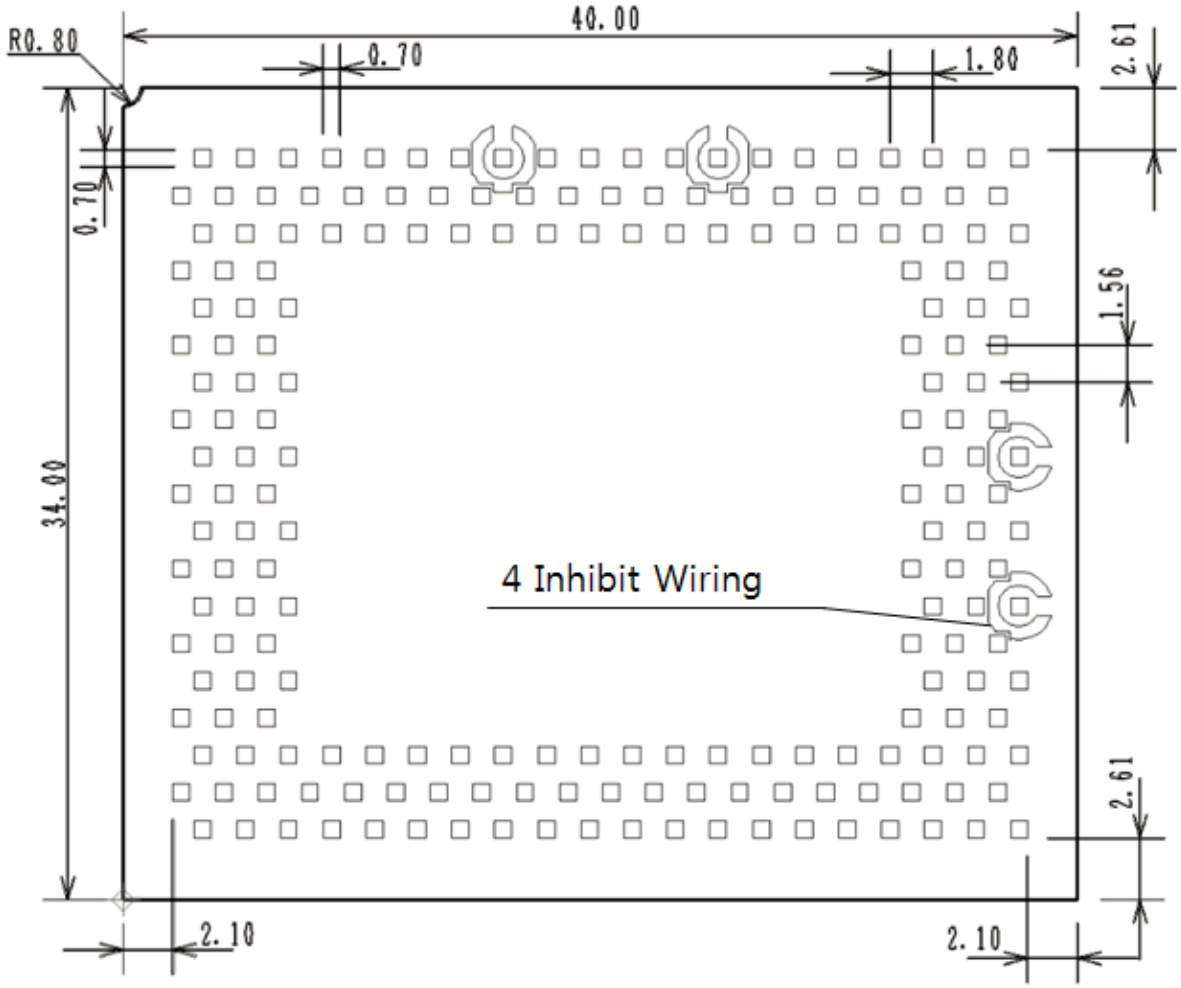
The HE920 modules have been designed in order to be compliant with a standard lead-free SMT process.

13.2. Module Finishing & Dimensions





13.3. Recommended foot print for the application



198 pads

Top View

In order to easily rework the HE920 it is suggested to consider on the application having a 1.5 mm placement inhibit area around the module.

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

NOTE:

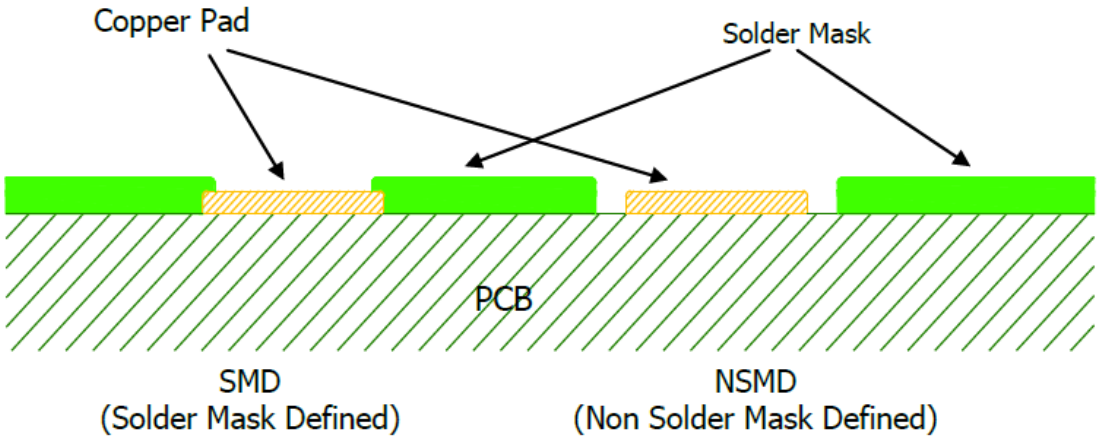
In the customer application, the region under WIRING INHIBIT (see figure above) must be clear from signal or ground paths.

13.4. Stencil

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

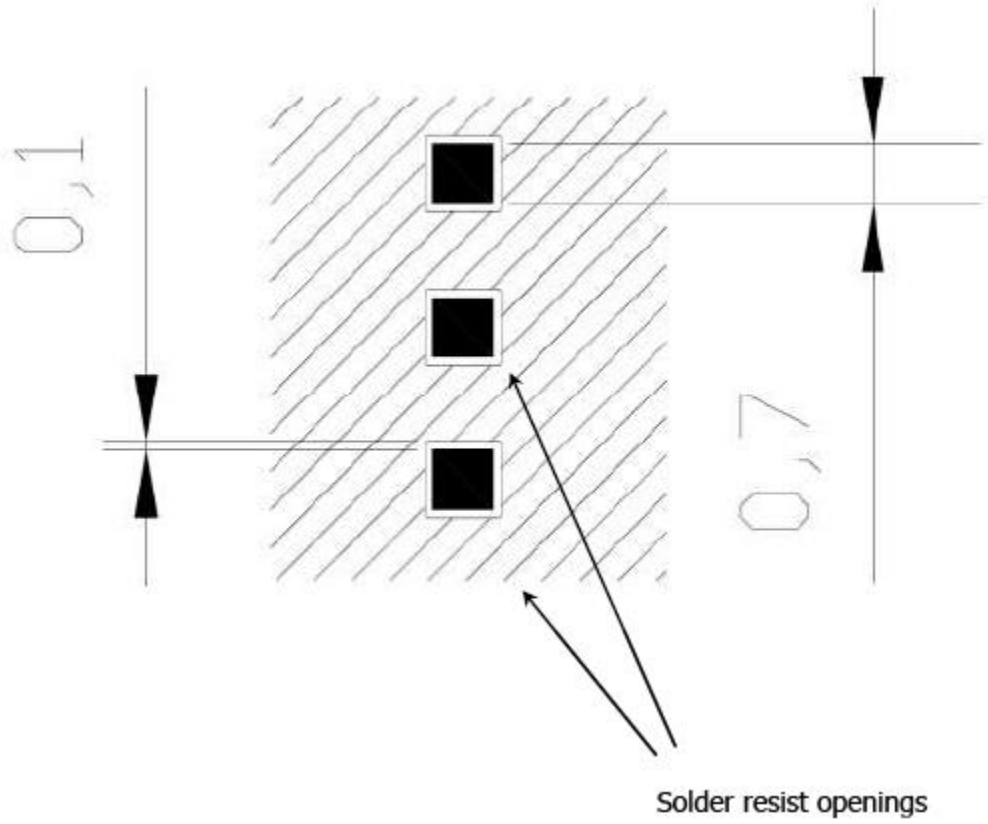
13.5. PCB Pad Design

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

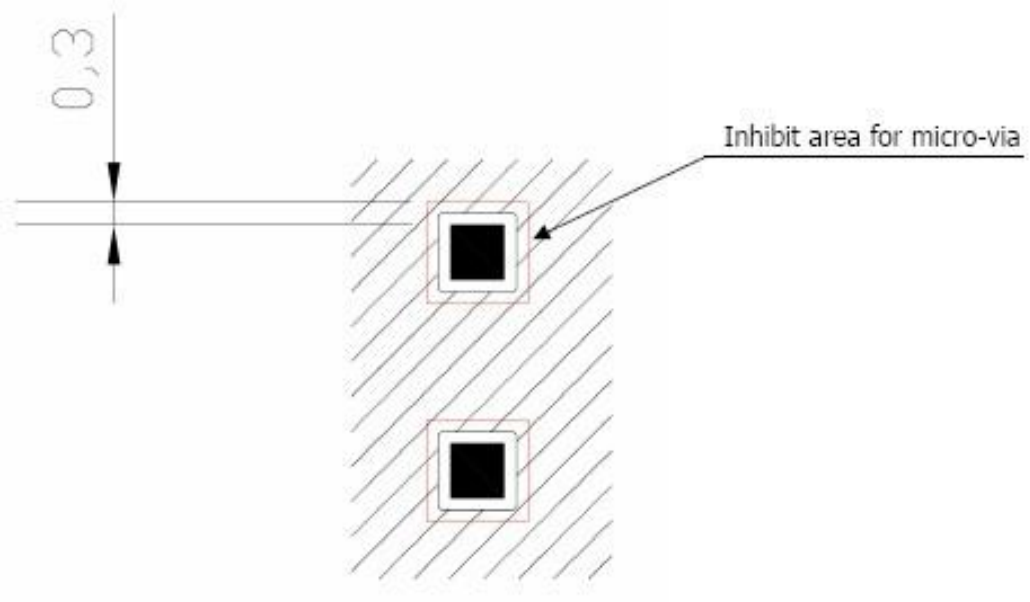


13.6. Recommendations for PCB Pad Dimensions (mm)

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



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



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

Recommendations for PCB Pad Surfaces:

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

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

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

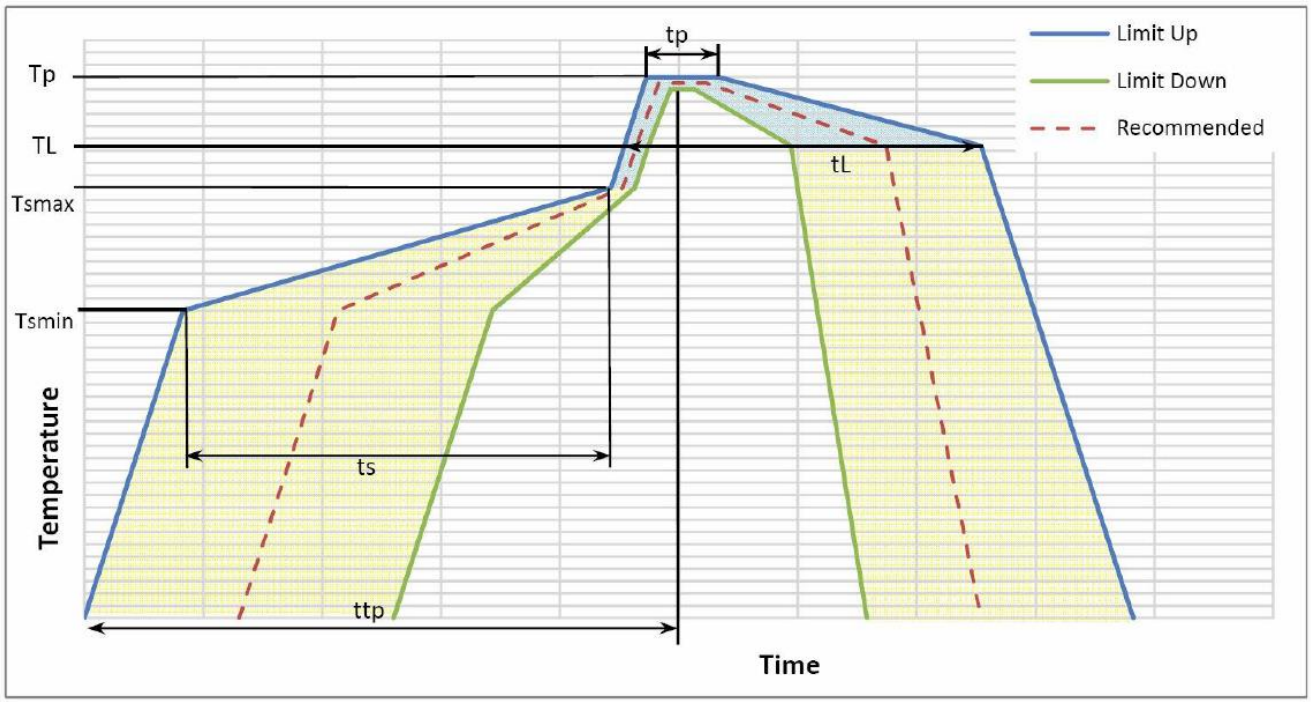
13.7. Solder Paste

	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.

13.7.1. Solder Reflow

Recommended solder reflow profile:



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

NOTE:

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

WARNIG:

The HE920 module withstands one reflow process only.

14. Application guide

14.1. Debug of the HE920 in production

To test and debug the mounting of HE920, we strongly recommend foreseeing test pads on the host PCB, in order to check the connection between the HE920 itself and the application and to test the performance of the module connecting it with an external computer. Depending on the customer application, these pads include, but are not limited to the following signals:

- TXD
- RXD
- ON/OFF
- RESET
- GND
- VBATT
- TX_TRACE
- RX_TRACE
- PWRMON
- USB_VBUS
- USB_D+
- USB_D-

14.2. Bypass capacitor on Power supplies

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

The recommended values can be presented as;

- 100uF for VBATT and VBATT_PA

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

14.3. SIM interface

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

14.3.1. SIM schematic example

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

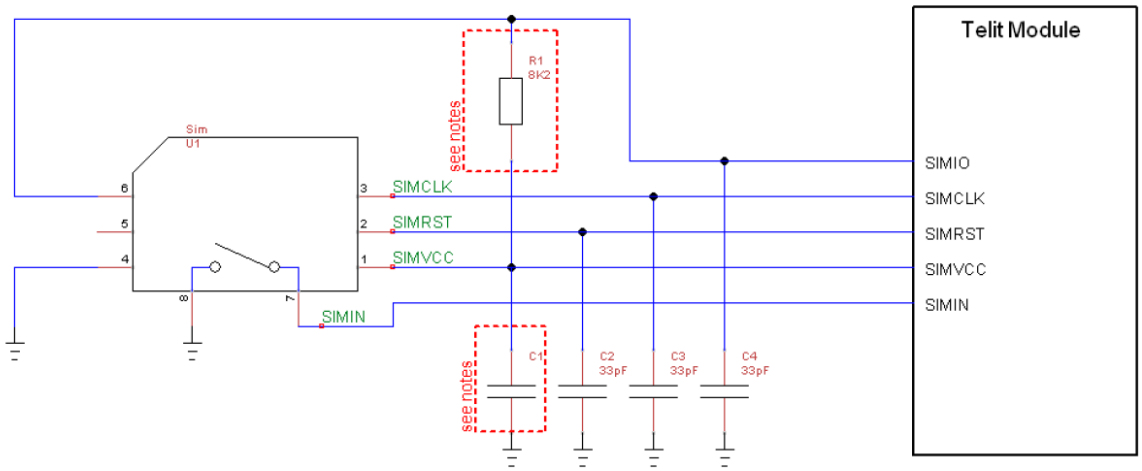


Figure 1

NOTE FOR R1:

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

For HE920-EU and HE920-NA contain an internal pull-up resistor on SIMIO.

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

The following Table lists the values of C1 to be adopted with the HE920 product:

Product P/N	C1 range (nF)
HE920-EU	100 nF
HE920-NA	

Refer to the following document for the detail;

- Telit_SIM_Integration_Design_Guide_Application_Note

14.4. EMC recommendations

HE920 signals are provided by some EMC protections. In any case the accepted levels are different on the pins. The characteristics are described in the following Table:

Pad	Signal	I/O	Function	Contact	Air
Power Supply					
AP17,AP19, AR18,AS17, AS19,AT18, AU17,AU19	VBATT_PA And VBATT	-	Main power supply	± 8KV	± 15KV
SIM Card Interface					
A8	SIMVCC	-	External SIM signal – Power supply for the SIM	± 8KV	± 15KV
B11	SIMRST	O	External SIM signal – Reset	± 8KV	± 15KV
B9	SIMIO	I/O	External SIM signal - Data I/O	± 8KV	± 15KV
A10	SIMCLK	O	External SIM signal – Clock	± 8KV	± 15KV
Miscellaneous Functions					
P17	VAUX	-	Power output for external accessories	± 8KV	± 15KV
AS1	ON/OFF	I	Input command for switching power ON or OFF (toggle command).	± 8KV	± 15KV
AP1	RESET	I	Reset input	± 8KV	± 15KV
F17	VRTC	AO	Power supply for RTC block	± 8KV	± 15KV
Antenna					
AD1,AU9,S1	Antenna Pad	AI	Antenna pad	± 8KV	± 15KV

All other pins have the following characteristics:

HBM JESD22-A114-B ± 2000 V
CDM JESD22-C101-C ± 500 V

Appropriate series resistors have to be considered to protect the input lines from overvoltage.

14.5. Download and Debug Port

One of the following options should be chosen in the design of host system in order to download or upgrade the Telit's software and debug HE920 when HE920 is already mounted on a host system.

Users who use both of UART and USB interfaces to communicate HE920

- Must implement a download method in a host system for upgrading HE920 when it's mounted.

Users who use USB interface only to communicate HE920

- Must arrange UART port in a host system for debugging or upgrading HE920 when it's mounted.

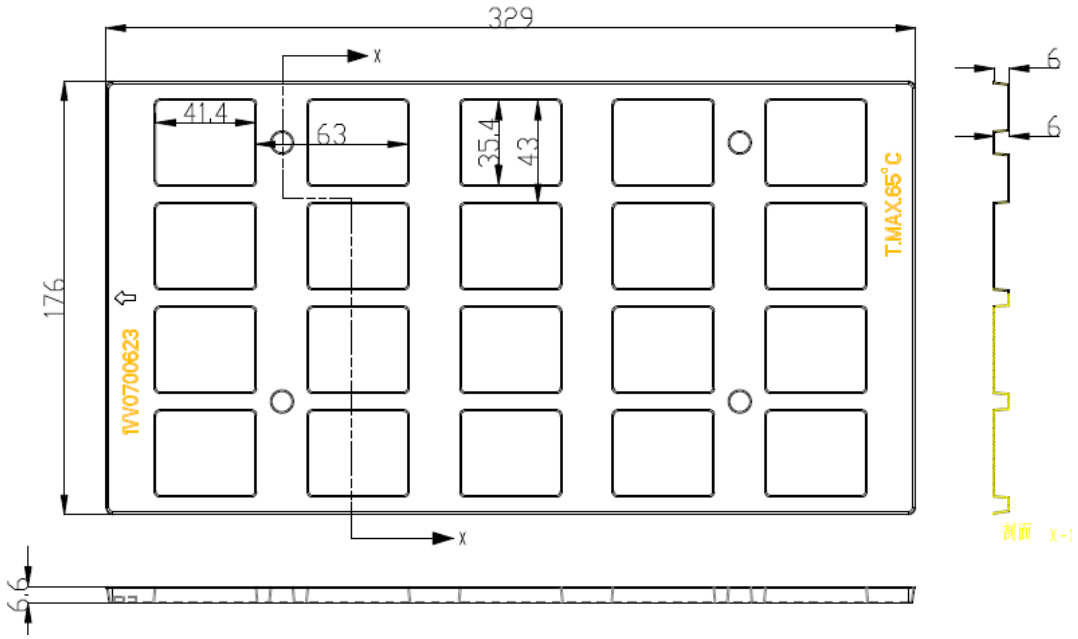
Users who use UART interface only to communicate HE920

- Must arrange USB port in a host system for debugging or upgrading HE920 when it's mounted.

15. Packing system

The Telit HE920 is packaged on trays. Each tray contains 20 pieces with the following dimensions:

15.1. Tray Drawing



(1VV0700623_DTS)

WARNIG:

These trays can withstand a maximum temperature of 65℃.

15.2. Moisture Sensibility

The HE920 is a Moisture Sensitive Device level 3, in accordance with standard IPC/JEDEC J-STD-020, take care all the relatives requirements for using this kind of components.

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

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

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

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

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

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

16. Conformity Assessment Issues

16.1. 1999/5/EC Directive

The HE920-EU module has been assessed in order to satisfy the essential requirements of the R&TTE Directive 1999/05/EC (Radio Equipment & Telecommunications Terminal Equipments) to demonstrate the conformity against the harmonized standards with the final involvement of a Notified Body.

In order to satisfy the essential requirements of 1999/5/EC Directive, the HE920-EU is compliant with the following standards:

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

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

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

Thus, the following marking is included in the product:

CE 1909

The full declaration of conformity can be found on the following address:
http://www.telit.com

There is no restriction for the commercialization of the HE920-EU module 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

16.2. FCC/IC Regulatory notices

Modification statement

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

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

Interference statement

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

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

Wireless notice

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

Frequency band	HE920-NA
GSM850 / FDD V	6.79 dBi
PCS1900 / FDD II	3.01 dBi
FDD IV	2.7 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	HE920-NA
GSM850 / FDD V	*6.79 dBi*
PCS1900 / FDD II	*3.01 dBi*
FDD IV	*2.7 dBi*

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

FCC Class B digital device notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

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

Modular information form OEM Information to Be Supplied to the End User by the OEM or Integrator
The following regulatory and safety notices must be published in documentation supplied to the end user of the product or system incorporating an adapter in compliance with local regulations. Host system must be labeled with "Contains IC: 5131A-HE920NA " or "Contains FCCID:RI7HE920NA ", FCC ID/IC displayed on label.

17. Safety Recommendations

READ CAREFULLY

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

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

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

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

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

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

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

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

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

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

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

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

18. Document History

Revision	Date	Changes
0	2012-02-02	First issue
1	2012-06-04	Renumbered chapters Updated 2.3 Weight Updated 3 HE920 Module Connections Updated 5.1 Power Supply Requirements Updated 6.5 GPS/GNSS Antenna Requirements Updated 9.2 Modem Serial Port 2 Updated 13.2 ADC Converter Updated 14.2 Module Finishing & Dimensions
2	2012-10-24	Updated 4 Hardware Commands Added 4.5 Hardware Unconditional Shutdown (Power Off) Updated 5.1 Power Supply Requirements Updated 5.2.2 Thermal Design Guidelines Updated 6.1 GSM/WCDMA Antenna Requirements Updated 7.1 Reset Signal Updated 8 USB Port Updated 13.2 Module Finishing & Dimensions Updated 14.2 Bypass capacitor on Power supplies Updated 14.4 EMC recommendations Updated 15.2 Moisture Sensibility
3	2012-11-14	Updated 5.1 Power Supply Requirements Updated 6.1 GSM/WCDMA Antenna Requirements
4	2013-01-02	Updated 5.1 Power Supply Requirements Updated 6 Antenna(s)
5	2013-03-21	Updated 6.1 GSM/WCDMA Antenna Requirements Added 16.1 1999/5/EC Directive Added 16.2 FCC/IC Regulatory notices
6	2013-05-14	Updated 1.6 Related Documents Updated 10.1 Analog Audio Updated 13.4 Stencil Updated 13.5 PCB Pad Design Updated 13.6 Recommendations for PCB Pad Dimensions (mm) Updated 13.7.1 Solder Reflow Updated 15.1 Tray Drawing
7	2013-11-08	Updated 6.5.3 LNA and Front End Design Considerations Updated 13.2 Module Finishing & Dimensions Updated 14.3 SIM Interface
8	2013-11-13	Updated 13.3 Recommended foot print for the application
9	2014-01-23	Updated 2.4.2 RoHS compliance Updated 6.1 GSM/WCDMA Antenna Requirements Updated 8 USB Port Updated 12.1 DAC Converter Updated 16.2 FCC/IC Regulatory notices