

GE/GC864-QUAD V2 and GE864-GPS Hardware User Guide

Ivv0300915 Rev.5 – 2011-10-03



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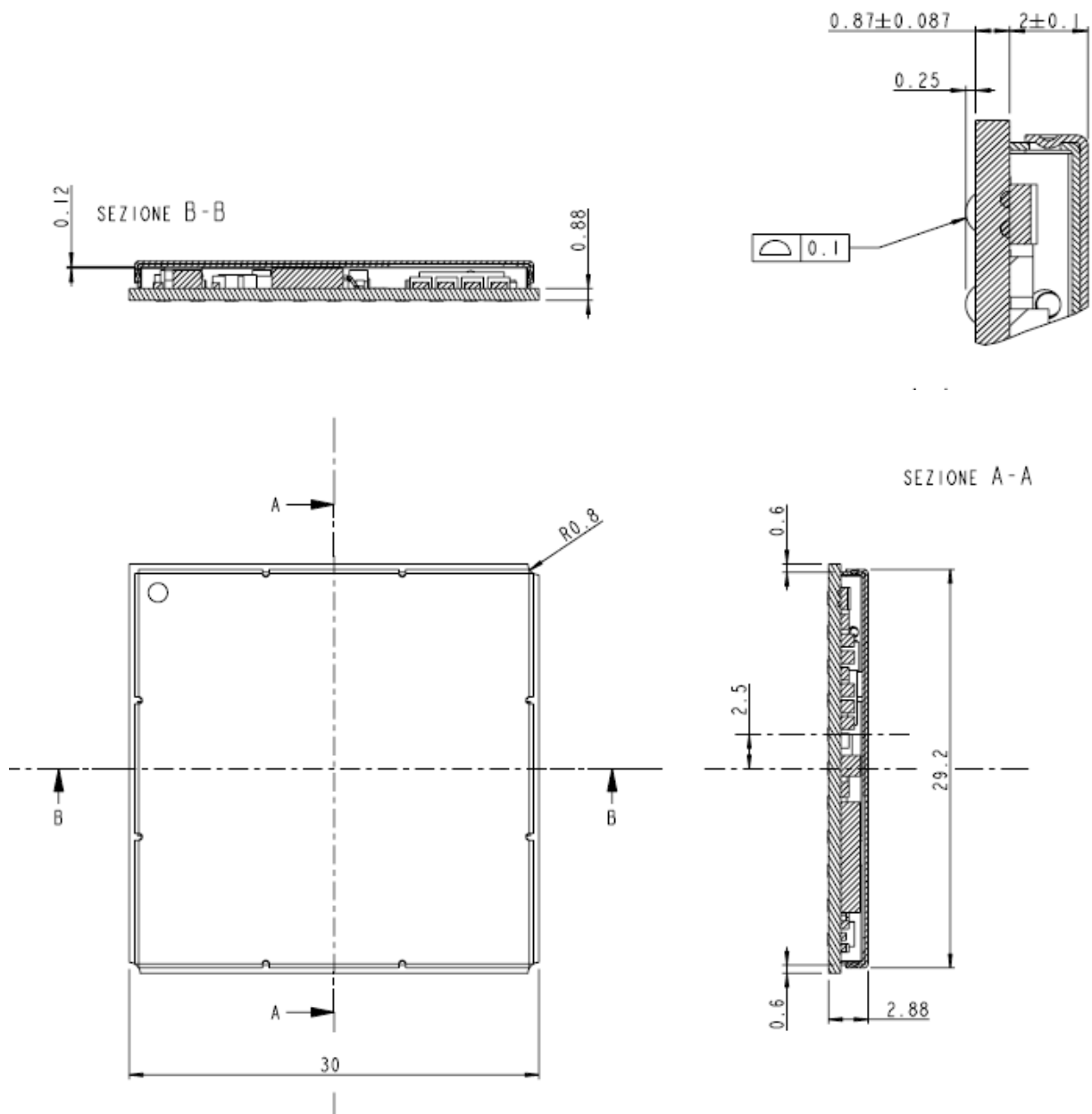


3. GE864-QUAD V2/GPS Mechanical Dimensions

3.1. GE864-QUAD V2/GPS

The Telit GE864-QUAD V2/GPS modules overall dimensions are:

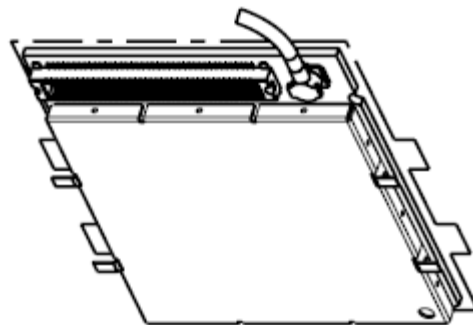
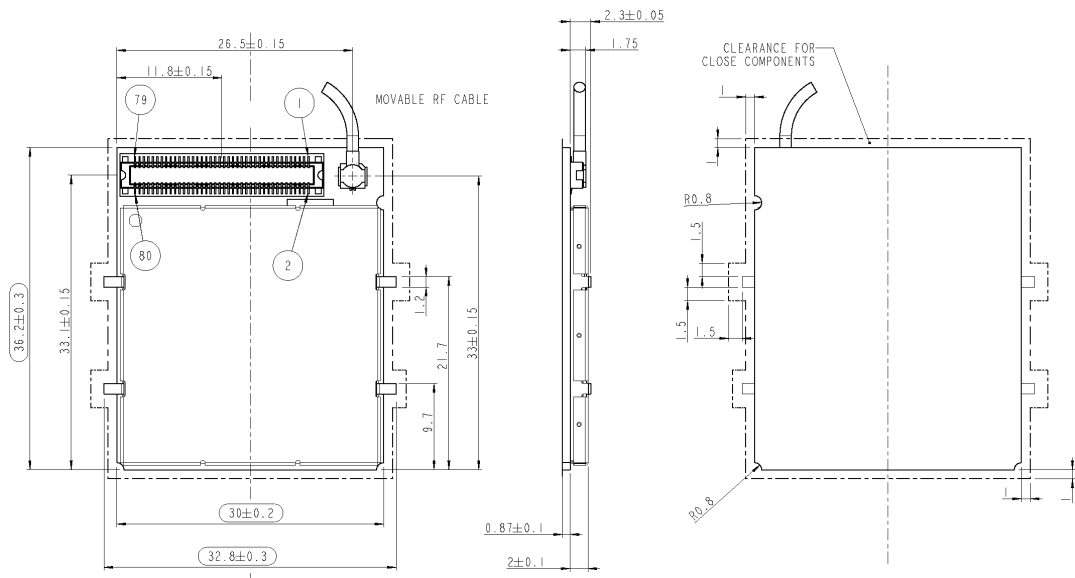
- Length: 30 mm
- Width: 30 mm
- Thickness : 2,9 mm
- Weight: 4.2g



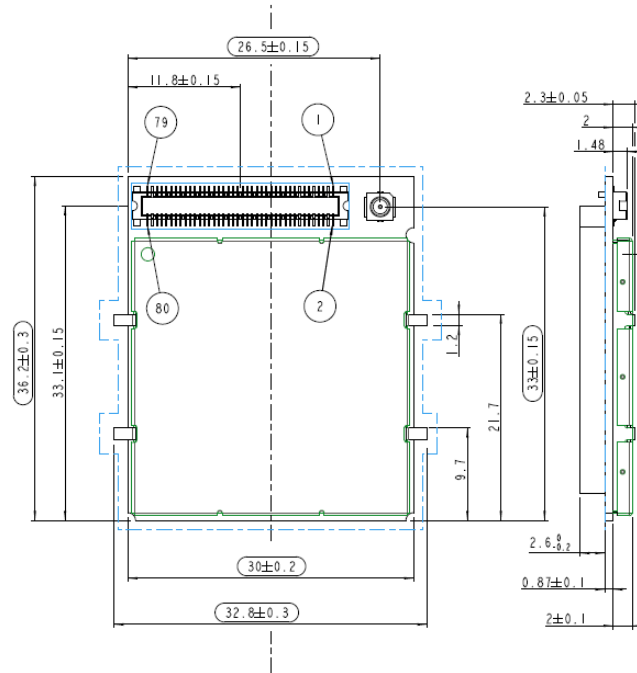
3.2. GC864-QUAD V2

The Telit GC864-QUAD V2 module overall dimensions are:

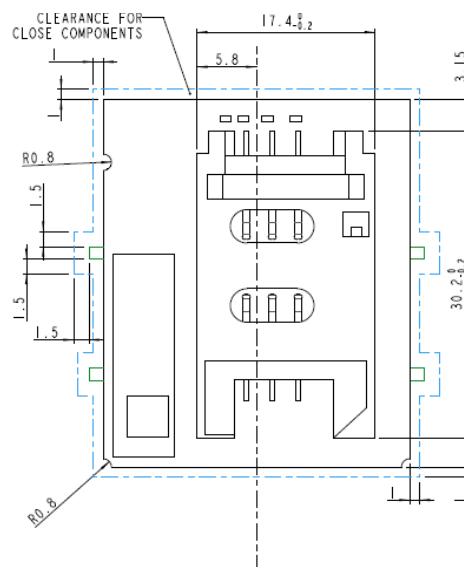
- Length: 36.2 mm
- Width: 30 mm
- Thickness: 3.2 mm
- Weight: 4.8g



3.3. Mechanical View of Telit GC864-QUAD V2 with SIM Holder



3.4. GC864-QUAD V2 Module Connections



4. Electrical Connections

4.1. GE864-QUAD V2/GPS

4.1.1. PIN-OUT

The GE864-QUAD V2/GPS use 11x11 array BGA technology connection

Ball	Signal	I/O	Function	Internal PULL UP	Type
Audio					
F9	AXE	I	Handsfree switching	100K	CMOS 2.8V
G8	MIC_HF+	AI	Handsfree mic. input; phase +, nom. level 3mVrms		Audio
G9	MIC_MT-	AI	Handset mic.signal input; phase-, nom. level 50mVrms		Audio
G10	EAR_MT+	AO	Handset earphone signal output, phase +		Audio
J8	MIC_MT+	AI	Handset mic.signal input; phase+, nom. level 50mVrms		Audio
J9	MIC_HF-	AI	Handsfree mic.input; phase -, nom. level 3mVrms		Audio
J10	EAR_HF-	AO	Handsfree ear output, phase -		Audio
H9	EAR_MT-	AO	Handset earphone signal output, phase -		Audio
H10	EAR_HF+	AO	Handsfree ear output, phase +		Audio
SIM card interface					
C10	SIMCLK	O	External SIM signal – Clock		1,8 / 3V
C11	SIMIN	I	External SIM signal - Presence (active low)	Pull up 47K	1,8 / 3V
D4	SIMVCC	-	External SIM signal – Power supply for the SIM		1,8 / 3V
D10	SIMIO	I/O	External SIM signal - Data I/O	Pull up 4.7K	1,8 / 3V
E9	SIMRST	O	External SIM signal – Reset		1,8 / 3V
Auxiliary UART/Trace					
D11	TX_AUX	O	Auxiliary UART (TX Data to DTE)		CMOS 2.8V
F10	RX_AUX	I	Auxiliary UART (RX Data from DTE)		CMOS 2.8V
H4	SERVICE	I	Service pin shall be used to upgrade the module from ASC1 (RX_TRACE, TX_TRACE). The pin shall be tied low to enable the feature only in case of a SW Update activity. It is required, for debug purpose, to be connected to a test pad on the final application.		CMOS 2.8V
Prog. / Data + HW Flow Control					
B6	C125/RING	O	Output for Ring indicator signal (RI) to DTE		CMOS 2.8V
B7	C108/DTR	I	Input for Data terminal ready signal (DTR) from DTE		CMOS 2.8V
D9	C109/DCD	O	Output for Data carrier detect signal (DCD) to DTE		CMOS 2.8V
E7	C103/TXD	I	Serial data input (TXD) from DTE		CMOS 2.8V
E11	C107/DSR	O	Output for Data set ready signal (DSR) to DTE		CMOS 2.8V
F7	C105/RTS	I	Input for Request to send signal (RTS) from DTE		CMOS 2.8V
F6	C106/CTS	O	Output for Clear to send signal (CTS) to DTE		CMOS 2.8V
H8	C104/RXD	O	Serial data output to DTE		CMOS 2.8V



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Ball	Signal	I/O	Function	Internal PULL UP	Type
DAC and ADC					
C7	DAC_OUT	AO	Digital/Analog converter output		D/A
J11	ADC_IN1	AI	Analog/Digital converter input		A/D
H11	ADC_IN2	AI	Analog/Digital converter input		A/D
Miscellaneous Functions					
A2	RESET#	I	Reset input		
D8	STAT_LED	O	Status indicator led		CMOS 1.8V
E2	VRTC	AO	VRTC		Power
J5	ON_OFF#	I	Input command for switching power ON or OFF (toggle command). The pulse to be sent to the GE864-QUAD V2 must be equal or greater than 1 second.	Pull up 47K	Pull up to VBATT
L8	PWRMON	O	PWRMON		CMOS 2.8V
L4	GSM Antenna	O	Antenna output – 50 ohm		RF
D5	VAUX ⁽¹⁾	AO	Auxiliary 2.8V Output		Power
Telit GPIO / DVI					
C1	GPIO_01	I/O	GPIO_01		CMOS 2.8V
E6	GPIO_02 / JDR	I/O	GPIO_02 / JDR		CMOS 2.8V
C2	GPIO_03	I/O	GPIO_03		CMOS 2.8V
B3	GPIO_04 / TX_DISABLE	I/O	GPIO_04 / TX_DISABLE		CMOS 2.8V
K8	GPIO_05 / RFTXMON	I/O	Telit GPIO05 Configurable GPIO / Transmitter ON monitor		CMOS 2.8V
B5	GPIO_06 / ALARM	I/O	Telit GPIO06 Configurable GPIO / ALARM		CMOS 2.8V
L9	GPIO_07 / BUZZER	I/O	Telit GPIO07 Configurable GPIO / Buzzer		CMOS 2.8V
K11	GPIO_08	I/O	GPIO_08		CMOS 2.8V
C9	GPIO_09	I/O	GPIO_09		CMOS 2.8V
H3	GPIO_10 / DVI_TX	I/O	GPIO_10 / DVI_TX- DVI audio ⁽¹⁾		CMOS 2.8V
K7	DVI_RX	I/O	DVI_RX - DVI audio ⁽¹⁾		CMOS 2.8V
D7	DVI_CLK	I/O	DVI_CLK - DVI audio ⁽¹⁾		CMOS 2.8V
H5	DVI_WA0	I/O	DVI_WA0 - DVI audio ⁽¹⁾		CMOS 2.8V
GPS⁽²⁾ (only for GE864-GPS)					
A7	GPS_EXT_LNA_EN ⁽¹⁾	O	External LNA Enable		CMOS 1.8V (GPS)
C8	GPS_PPS ⁽¹⁾	O	Pulse Per Second		CMOS 1.8V (GPS)
E10	GPS_RX ⁽¹⁾	I	Serial Data Input		CMOS 2.8V (GPS)
F8	GPS_TX ⁽¹⁾	O	Serial Data Output		CMOS 2.8V (GPS)
G2	GPS_WAKEUP ⁽¹⁾	O	Wake up output		CMOS 2.8V (GPS)
J4	GPS_ON_OFF ⁽¹⁾	I	GPS Power Control		CMOS 1.8V (GPS)
A10	GPS Antenna ⁽¹⁾	O	Antenna output – 50 ohm		RF
C6 ⁽¹⁾⁽²⁾	-	-	Diagnostic (to be connected to Vaux through a pull-up resistor ⁽²⁾⁽³⁾)		
G6 ⁽¹⁾⁽²⁾	-	-	Diagnostic (to be connected to ground ⁽²⁾⁽³⁾)		
Power Supply					
J1	VBATT	-	Main power supply		Power
K1	VBATT	-	Main power supply		Power
J2	VBATT	-	Main power supply		Power
K2	VBATT	-	Main power supply		Power



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Ball	Signal	I/O	Function	Internal PULL UP	Type
A1	GND	-	Ground		Power
A11	GND	-	Ground		Power
D6	GND	-	Ground		Power
F1	GND	-	Ground		Power
F11	GND	-	Ground		Power
H1	GND	-	Ground		Power
H2	GND	-	Ground		Power
J3	GND	-	Ground		Power
K3	GND	-	Ground		Power
K4	GND	-	Ground		Power
K5	GND	-	Ground		Power
K6	GND	-	Ground		Power
L1	GND	-	Ground		Power
L2	GND	-	Ground		Power
L3	GND	-	Ground		Power
L6	GND	-	Ground		Power
L11	GND	-	Ground		Power
A8	GND ⁽²⁾	-	Ground ⁽²⁾		Power
B8	GND ⁽²⁾	-	Ground ⁽²⁾		Power
B9	GND ⁽²⁾	-	Ground ⁽²⁾		Power
B10	GND ⁽²⁾	-	Ground ⁽²⁾		Power
B11	GND ⁽²⁾	-	Ground ⁽²⁾		Power
RESERVED					
A3	-	-	Reserved		
A4	-	-	Reserved		
A5	-	-	Reserved		
A6	-	-	Reserved		
A9	-	-	Reserved		
B1	-	-	Reserved		
B2	-	-	Reserved		
B4	-	-	Reserved		
C3	-	-	Reserved		
C4	-	-	Reserved		
C5	-	-	Reserved		
D1	-	-	Reserved		
D2	-	-	Reserved		
D3	-	-	Reserved		
E1	-	-	Reserved		
E3	-	-	Reserved		
E4	-	-	Reserved		
E5	-	-	Reserved		
E8	-	-	Reserved		
F2	-	-	Reserved		





NOTE:

If not used, pins must be left disconnected, **with the exceptions listed in the table below:**

Ball	Signal	Function
J1, J2, K1, K2	VBATT	Main power supply
A1, A8 ⁽²⁾ , A11, B8 ⁽²⁾ , B9 ⁽²⁾ , B10 ⁽²⁾ , B11 ⁽²⁾ , D6, F1, F11, H1, H2, J3, K3, K4, K5, K6, L1, L2, L3, L6, L11	GND	Ground
E7	C103/TXD	Serial data input (TXD) from DTE
H8	C104/RXD	Serial data output to DTE
F7	C105/RTS	Input for Request to send signal (RTS) from DTE
J5	ON/OFF#	Input command for switching power ON or OFF (toggle command).
A2	RESET#	Reset input
F10	RX_TRACE	RX Data for debug monitor
D11	TX_TRACE	TX Data for debug monitor
H4	SERVICE	SERVICE connection
B7	DTR	Input for Data terminal ready signal (DTR) from DTE
J4 ⁽²⁾	GPS_ON_OFF	GPS Power Control
G2 ⁽²⁾	GPS_WAKEUP	GPS Wake up output
E10 ⁽²⁾	GPS_RX	GPS Serial data input
F8 ⁽²⁾	GPS_TX	GPS Serial data output
C6 ⁽²⁾	-	Diagnostic
G6 ⁽²⁾	-	Diagnostic

(2) Available only on GE864-GPS (in case of GE864-QUAD V2 it has to be considered RESERVED)



NOTE:

Only for GE864-GPS, **do not leave** the GPS_ON_OFF (ball J4) input pin floating. It's suggested to connect them to a pull-down (e.g.: 100k).



4.1.2. BGA Balls Layout

TOP VIEW

	A	B	C	D	E	F	G	H	J	K	L
1	GND	-	GPIO_01	-	-	GND	-	GND	VBATT	VBATT	GND
2	RESET*	-	GPIO_03	-	VRTC	-	GPS_WAK EUP ¹	GND	VBATT	VBATT	GND
3	-	GPIO_04 / TX_DISABLE	-	-	-	-	-	GPIO_10 / DVI_TX	GND	GND	GND
4	-	-	-	SIMVCC	-	-	-	SERVICE	GPS_ON_ OFF ¹	GND	GSM Antenna
5	-	GPIO_06 / ALARM	-	VAUX ¹	-	-	-	DVI_WA0	ON_OFF*	GND	-
6	-	C125 / RING	Diagnostic	GND	GPIO_02 / JDR	C106 / CTS	Diagnostic	-	-	GND	GND
7	GPS_EXT LNA_EN ³	C108 / DTR	DAC_OUT	DVI_CLK	C103 / TXD	C105 / RTS	-	-	-	DVI_RX	-
8	GND ¹	GND ¹	GPS_PPS ¹	STAD_ LED	-	GPS_TX ¹	MIC_HF+	C104 / RXD	MIC_MT+	GPIO_05 / RFTXMON	PWRMON
9	-	GND ¹	GPIO_09	C109 / DCD	SIMRST	AXE	MIC_MT-	EAR_MT-	MIC_HF-	-	GPIO_07 / BUZZER
10	GPS Antenna ¹	GND ¹	SIMCLK	SIMIO	GPS_RX ¹	RX_AUX	EAR_MT+	EAR_HF+	EAR_HF-	-	-
11	GND ¹	GND ¹	SIMIN	TX_AUX	C107 / DSR	GND	-	ADC_IN2	ADC_IN1	GPIO_08	GND



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(1) Available only on GE864-GPS (in case of GE864-QUAD V2 it has to be considered RESERVED)

	AUDIO Signals balls
	SIM CARD interface balls
	AUX UART&SERVICE Signals balls
	Prog. / data + Hw Flow Control signals balls
	ADC signals balls
	MISCELLANEOUS functions signals balls
	TELIT GPIO balls
	GPS balls
	POWER SUPPLY VBATT balls
	POWER SUPPLY GND balls
	RESERVED



4.2. GC864-QUAD V2

4.2.1. PIN-OUT

The GC864-QUAD V2 uses an 80 pin Molex p.n. 53949-0878 male connector for the connections with the external applications. This connector matches the 54150-0878 models.

Pin	Signal	I/O	Function	Internal Pull up	Type
Power Supply					
1	VBATT	-	Main power supply		Power
2	VBATT	-	Main power supply		Power
3	VBATT	-	Main power supply		Power
4	VBATT	-	Main power supply		Power
5	GND	-	Ground		Power
6	GND	-	Ground		Power
7	GND	-	Ground		Power
Audio					
8	AXE	I	Handsfree switching	100K Ω	CMOS 2.8V
9	EAR_HF+	AO	Handsfree ear output, phase +		Audio
10	EAR_HF-	AO	Handsfree ear output, phase -		Audio
11	EAR_MT+	AO	Handset earphone signal output, phase +		Audio
12	EAR_MT-	AO	Handset earphone signal output, phase -		Audio
13	MIC_HF+	AI	Handsfree microphone input; phase		Audio
14	MIC_HF-	AI	Handsfree microphone input; phase		Audio
15	MIC_MT+	AI	Handset microphone signal input; phase+		Audio
16	MIC_MT-	AI	Handset microphone signal input; phase-		Audio
SIM Card Interface					
18 ¹	SIMVCC	-	External SIM signal – Power supply for the SIM		1.8 / 3V
19	SIMRST	O	External SIM signal – Reset		1.8 / 3V
20	SIMIO	I/O	External SIM signal - Data I/O		1.8 / 3V
21	SIMIN	I	External SIM signal - Presence (active low)	47K Ω	1.8 / 3V
22	SIMCLK	O	External SIM signal – Clock		1.8 / 3V

¹ On this line a maximum of 10nF bypass capacitor is allowed



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Pin	Signal	I/O	Function	Internal Pull up	Type
74	TGPIO_02 / JDR	I/O	Telit GPIO02 I/O pin / Jammer detect report		CMOS 2.8V
76	TGPIO_09	I/O	Telit GPIO9 Configurable GPIO		CMOS 2.8V
78	TGPIO_05/ RFTXMON	I/O	Telit GPIO05 Configurable GPIO / Transmitter ON monitor		CMOS 2.8V
RESERVED					
17	Reserved	-			
33	Reserved	-			
34	Reserved	-			
35	Reserved	-			
41	Reserved	-			
42	Reserved	-			
43	Reserved	-			
44	Reserved	-			
48	Reserved	-			
50	Reserved	-			
51	Reserved	-			
52	Reserved	-			
56	Reserved	-			
57	Reserved	-			
58	Reserved	-			
60	Reserved	-			
61	Reserved	-			
62	Reserved	-			
64	Reserved	-			
69	Reserved	-			
72	Reserved	-			
75	Reserved	-			
77	Reserved	-			
79	Reserved	-			
80	Reserved	-			



NOTE:

The GC864-QUAD V2 Modules has one DVI ports on the system interface.

NOTE:

Reserved pins must not be connected.

NOTE:

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



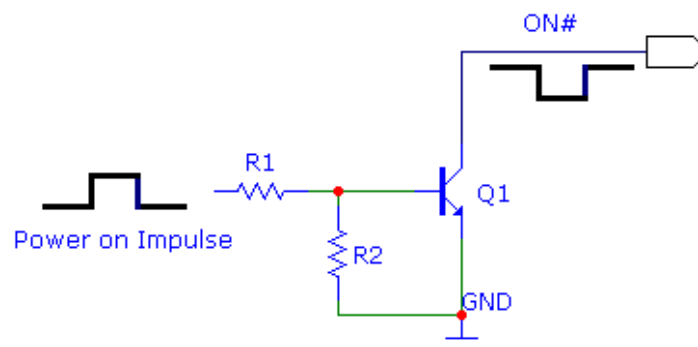
5. Hardware Commands

5.1. Turning ON the GE/GC864-QUAD V2 and GE864-GPS

To turn ON the GE/GC864-QUAD V2 AND GE864-GPS the pad ON# must be tied low for at least 1 second and then released. Pulse duration less than 1000ms should also start the power on procedure, but this is not guaranteed.

When the power supply voltage is lower than 3.4V the pad ON# must be tied low for at least 5 seconds.

The maximum current that can be drained from the ON# pad is 0.1 mA.
A simple circuit to do it is:



NOTE:

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



NOTE:

In this document all the lines that are inverted, hence have active low signals are labeled with a name that ends with a "#".





TIP:

To check if the device has powered on, the hardware line PWRMON should be monitored. After 1000ms the line raised up the device could be considered powered on.

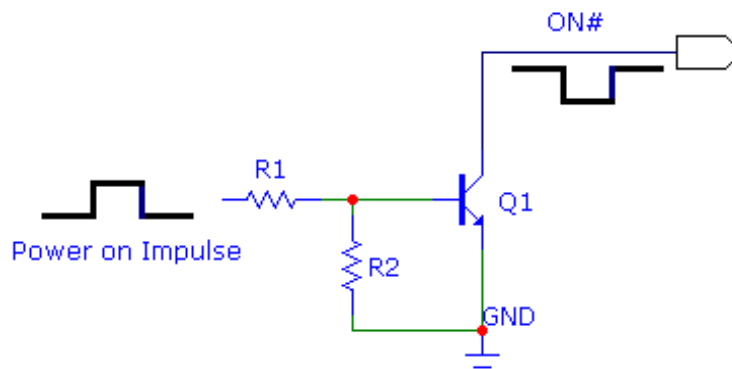


NOTE:

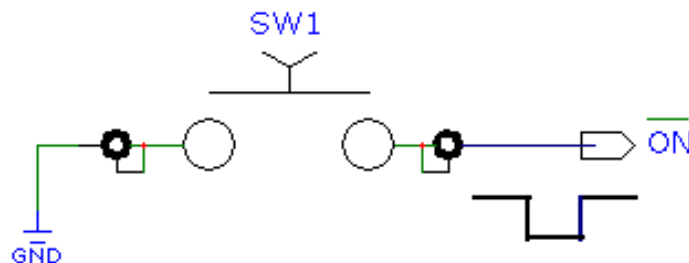
When the power supply voltage is lower than 3.4V, to turn ON the module, the pad ON# must be tied low for at least 3 seconds.

For example:

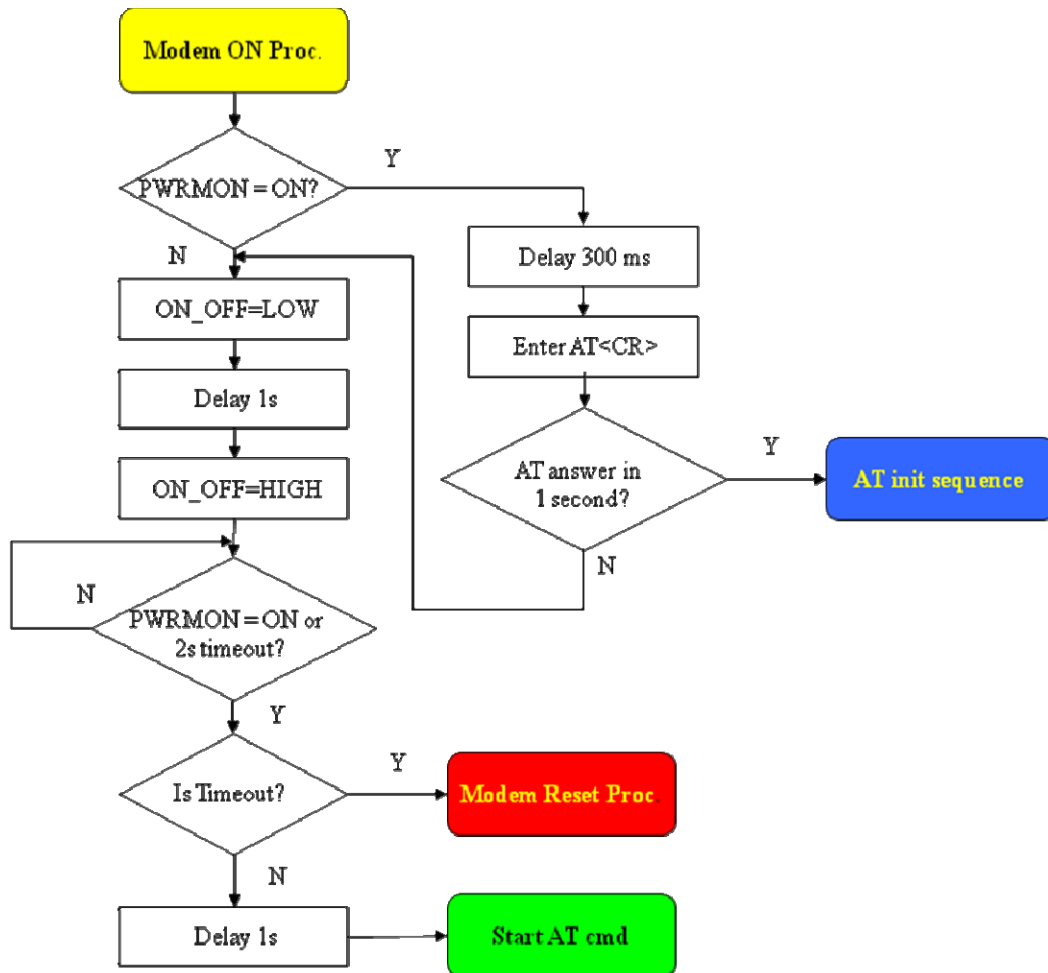
- 1- Let us assume you need to drive the ON# pad with a totem pole output from +1.8V up to 5V microcontroller:



- 2- Let us assume you need to drive the ON# pad directly with an ON/OFF button:



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

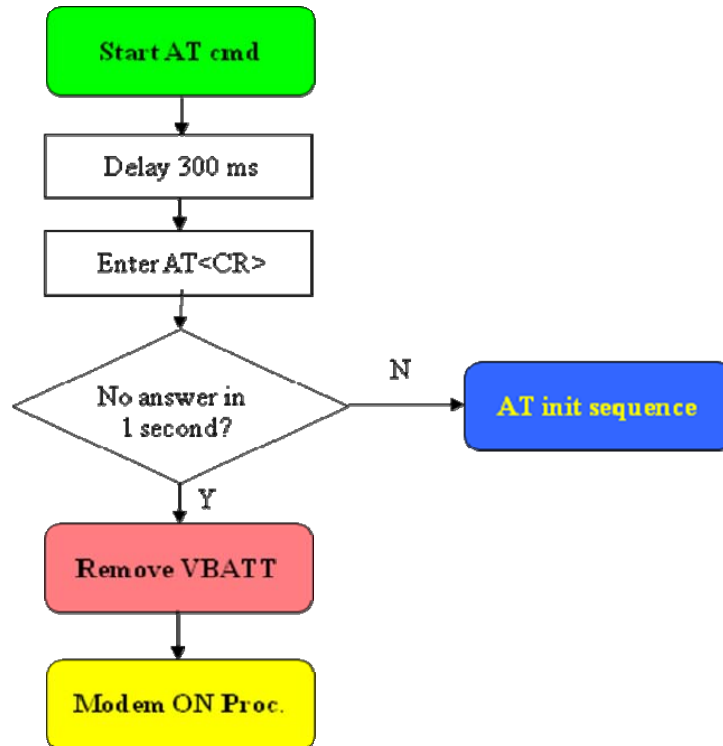


NOTE:

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



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



5.2. Turning OFF the GE/GC864-QUAD V2 and GE864 GPS

The turning off of the device can be done in two ways:

- via AT command (see Software User Guide AT#SHDN)
- by tying low pin ON#

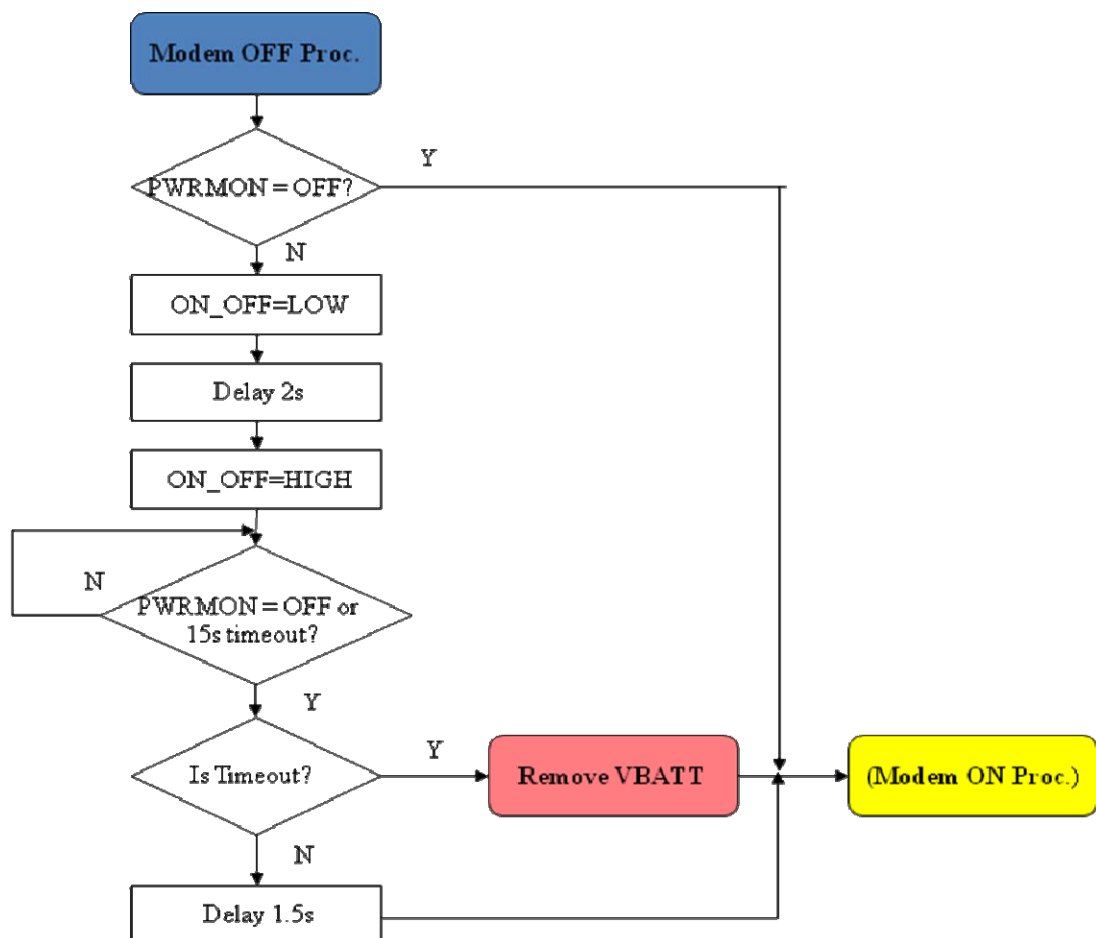
Either ways, when the device issues a detach request to the network informing that the device will not be reachable any more.

To turn OFF the module the pad ON# must be tied low for at least 2 seconds and then released.

The same circuitry and timing for the power on shall be used.

The device shuts down after the release of the ON# pad.

The following flow chart shows the proper turnoff procedure:



5.3. Hardware Unconditional Restart



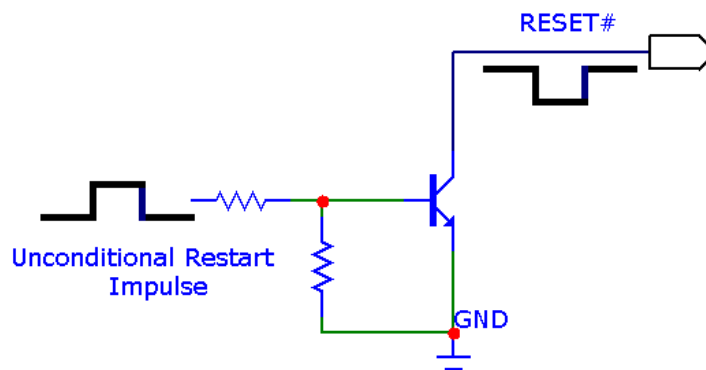
WARNING:

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

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

The maximum current that can be drained from the RESET# pad is 0.15 mA.

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 module power regulator and improper functioning of the module. The line RESET# must be connected only in open collector configuration.

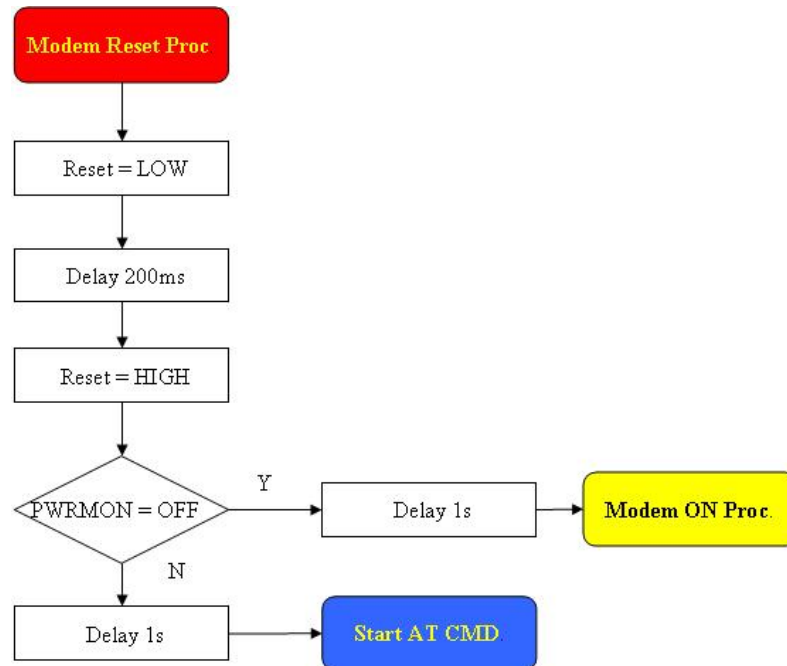




TIP:

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

The following flow chart shows the proper RESET procedure:



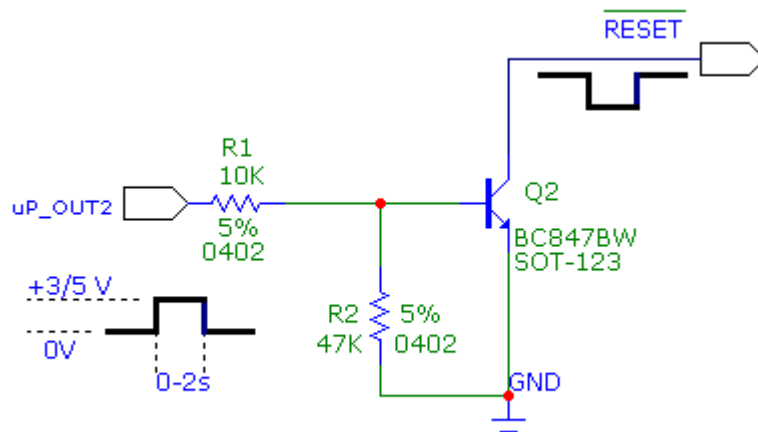
NOTE:

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:

Let us assume you need to drive the RESET# pad with a totem pole output from +1.8V up to 5V microcontroller



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



6.2. Power Consumption

The table below shows the power consumption of the GSM/GPRS section in different working modes (common for all the modules):

GE\GC864-QUAD V2 and GE864-GPS (GPS OFF)		
Mode	Average (mA)	Mode description
SWITCHED OFF		
Switched Off	<62 uA	Module supplied but Switched Off
IDLE mode		
AT+CFUN=1	16.0	Normal mode: full functionality of the module
AT+CFUN=4	16.0	Disabled TX and RX; module is not registered on the network
AT+CFUN=0 or =5	3.9	Paging Multiframe 2
	2.5	Paging Multiframe 3
	2.4	Paging Multiframe 4
	1.5	Paging Multiframe 9
CSD TX and RX mode		
GSM900 CSD PL5	240	GSM VOICE CALL
DCS1800 CSD PL0	175	
GPRS (class 10) 1TX		
GSM900 PL5	225	GPRS Sending data mode
DCS1800 PL0	160	
GPRS (class 10) 2TX		
GSM900 PL5	420	GPRS Sending data mode
DCS1800 PL0	290	

For the GE864-GPS, the additional current consumption of the GPS section in different operating modes is:

GE864-GPS (GPS ON)		
-Additional current -		
Mode	Average (mA)	Mode description
HIBERNATE	<0.045	only RTC and RAM supplied
Acquisition mode	45	
Tracking mode	37	



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, 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.



TIP:

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

6.3. 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.

6.3.1. 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

6.3.1.1. +5V input Source Power Supply Design Guidelines

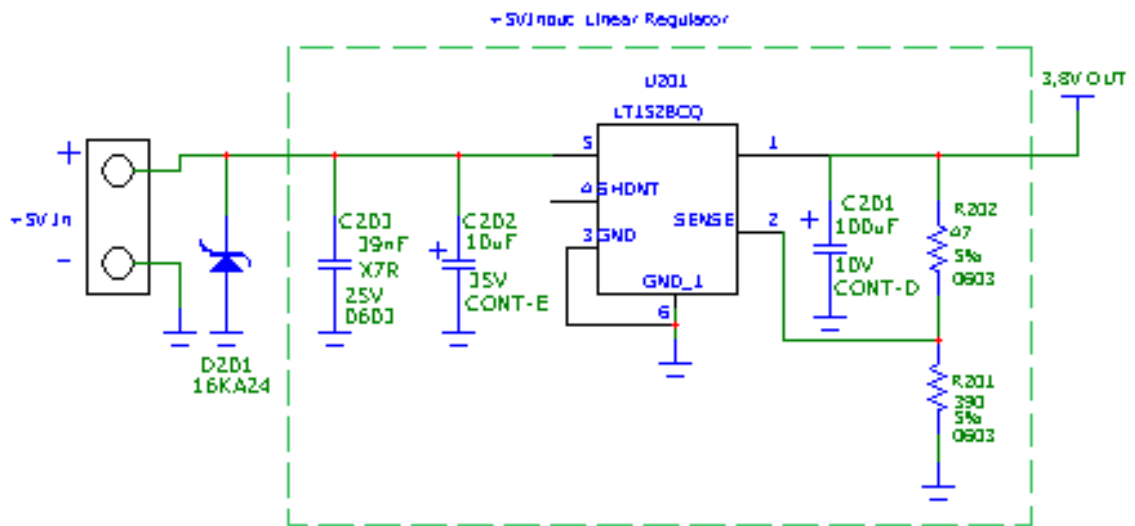
- The desired output for the power supply is 3.8V, hence there is no big difference between the input source and the desired output. A linear regulator can be used. A switching power supply will not be suited because of the low drop out requirements.
- When using a linear regulator, a proper heat sink 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 module, a 100µF tantalum capacitor is usually suited.



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- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode can be inserted close to the power input, in order to save the module from power polarity inversion.

An example of linear regulator with 5V input is:



6.3.1.2. +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 module.
- 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 that the switching frequency could also generate EMC interferences.

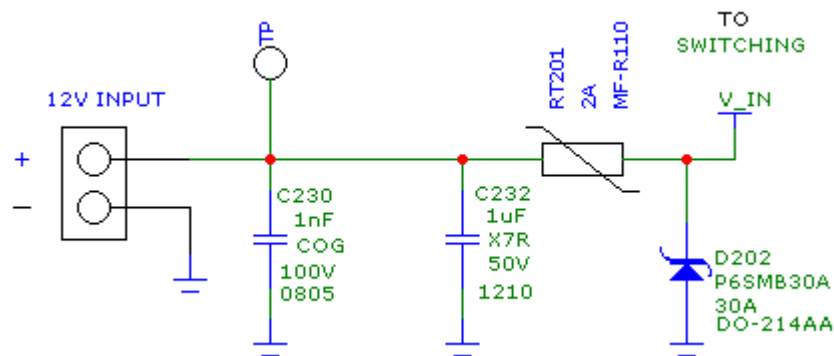


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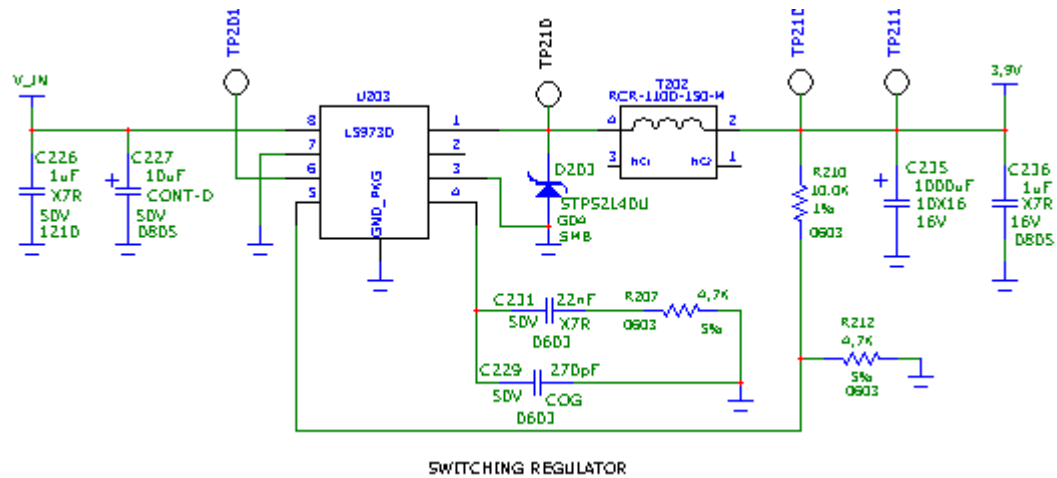
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- As far as car PB battery, the input voltage can rise up to 15.8V. This must be kept in mind when choosing components: all components in the power supply must withstand this voltage.
- A Bypass low ESR capacitor of adequate capacity must be provided, in order to cut the current absorption peaks. A 100 μ F tantalum capacitor is typically used.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- As far as 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 can be inserted close to the power input, in order to save the module from power polarity inversion. This can be the same diode used for spike protection.

An example of switching regulator with 12V input is in the schematic below (split in 2 parts):



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6.3.1.3. 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 GE/GC864-QUAD V2 AND GE864-GPSmodules.
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 module and damage it.



WARNING:

DON'T USE any Ni-Cd, Ni-MH, and Pb battery types directly connected with GE/GC864-QUAD V2 and GE864-GPS. Their use can lead to overvoltage on the module 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 module 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.



6.3.2. Thermal Design Guidelines

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

- Average current consumption during transmission @PWR level max: 500mA
- Average current consumption during transmission @ PWR level min: 100mA
- Average current during Power Saving (CFUN=5): from 1.5 to 3.9mA
- Average current during idle (Power Saving disabled): 16mA



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 us say few minutes) and then remains for a quite 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 one for 500mA 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, hence the current consumption will be less than 500mA, 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 grants a good thermal condition to avoid overheating as well.

As far as the heat generated by GC/GE864-QUAD V2 and GE864-GPS , you can consider it to be during transmissions of 1W max during CSD/VOICE calls and 2W max during class10 GPRS upload.

This generated heat will be mostly conducted to the ground plane under GC/GE864-QUAD V2 AND GE864-GPS ; you must ensure that your application can dissipate it.



6.3.4. Parameters for ATEX Applications

In order to integrate the Telit's modules into an ATEX application, the appropriate reference standard IEC EN xx and integrations shall be followed.

Below are listed parameters and useful information to integrate the module in your application:

GE864-QUAD V2

- Total capacity: 27.45 uF
- Total inductance: 55.20 nH
- No voltage upper than supply voltage is present in the module.
- No step-up converters are present in the module.

GC864-QUAD V2

- Total capacity: 27.45 uF
- Total inductance: 55.20 nH
- No voltage upper than supply voltage is present in the module.
- No step-up converters are present in the module.

GE864-GPS

- Total capacity: 33.26 uF
- Total inductance: 233 nH
- No voltage upper than supply voltage is present in the module.
- No step-up converters are present in the module.



7. Antenna

The antenna(s) connection and board layout design are the most important part in the full product design and they strongly reflect on the product overall performances, hence read carefully and follow the requirements and the guidelines for a proper design.

7.1. GSM Antenna (GE864-QUAD V2/GPS and GC864-QUAD V2)

7.1.1. GSM Antenna Requirements

As suggested on the Product Description the antenna for Telit GE/GC864-QUAD V2 and GE864-GPS devices shall fulfill 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	70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz PCS band
Gain	Gain < 1,4dBi in GSM 850 & 900 and < 3,0dBi DCS & PCS
Impedance	50 ohm
Input power	> 2 W peak power
VSWR absolute max	<= 10:1 (limit to avoid permanent damage)
VSWR recommended	<= 2:1 (limit to fulfill all regulatory requirements)

Furthermore if the devices are developed for the US market and/or Canada market, they shall comply to the FCC and/or IC approval requirements:

Those devices are to be used only for mobile and fixed application. 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. 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 GE/GC864-QUAD V2 AND GE864-GPS modules. Antennas used for those OEM modules must not exceed 3dBi gain for mobile and fixed operating configurations.

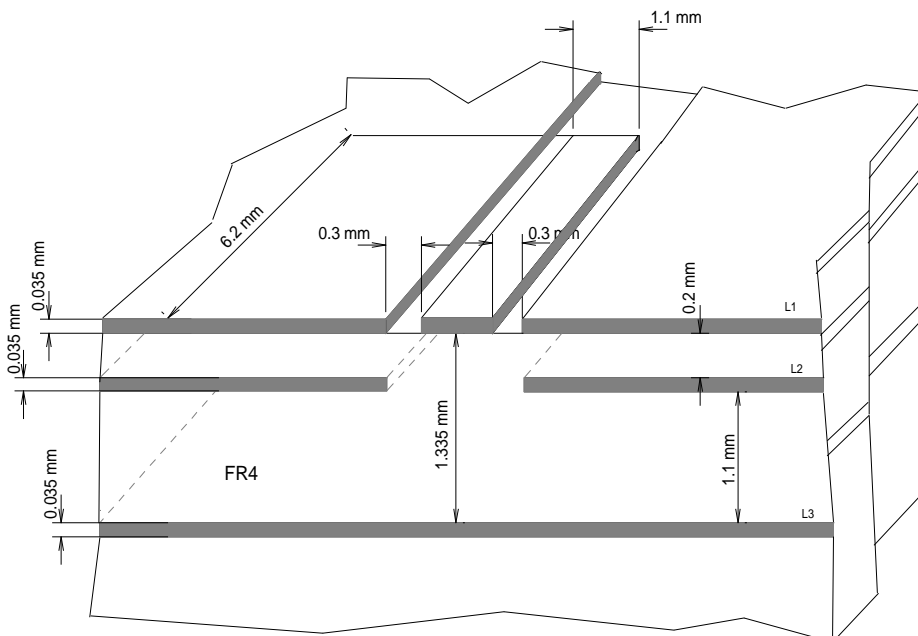


7.2. PCB Guidelines in case of FCC certification

In the case FCC certification is required for an application using GE864-QUAD V2 or GE864-GPS, according to FCC KDB 996369 for modular approval requirements, the transmission line has to be similar to that implemented on GE864-QUAD V2 or GE864-GPS interface board and described in the following chapter.

7.2.1. Transmission line design

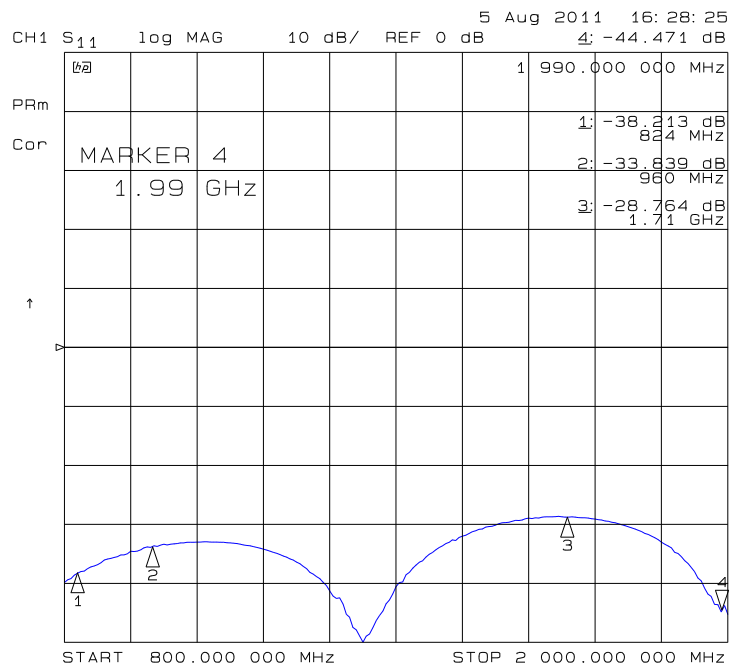
During the design of the GE864-QUAD V2 or GE864-GPS interface board, the placement of components has been chosen properly, in order to keep the line length as short as possible, thus leading to lowest power losses possible. A Grounded Coplanar Waveguide (G-CPW) line has been chosen, since this kind of 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 $\epsilon_r = 4.6 \pm 0.4 @ 1 \text{ GHz}$, $\text{TanD} = 0.019 \div 0.026 @ 1 \text{ GHz}$. A characteristic impedance of nearly 50Ω 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 51.6Ω , estimated line loss is less than 0.1 dB. The line geometry is shown below:



7.2.2. 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 GE864-QUAD V2 or GE864-GPS 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.

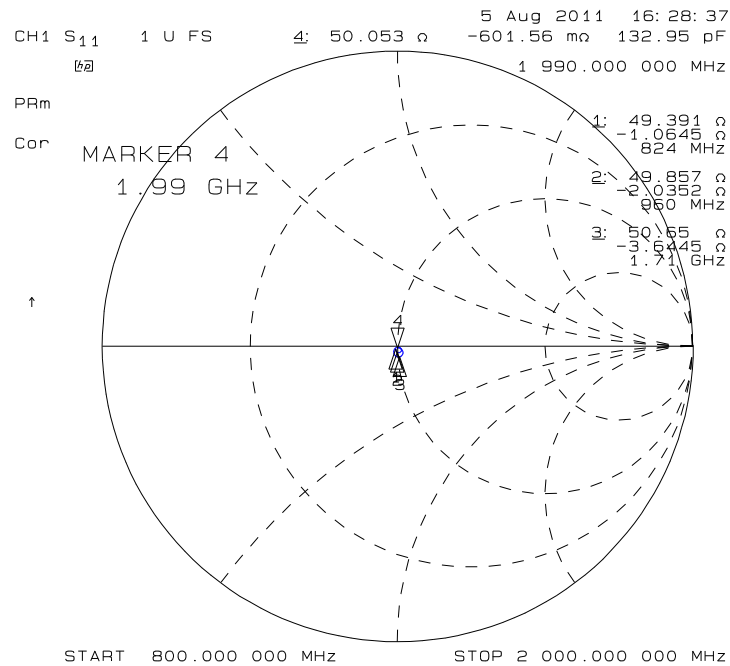
Return Loss plot of line under test is shown below:



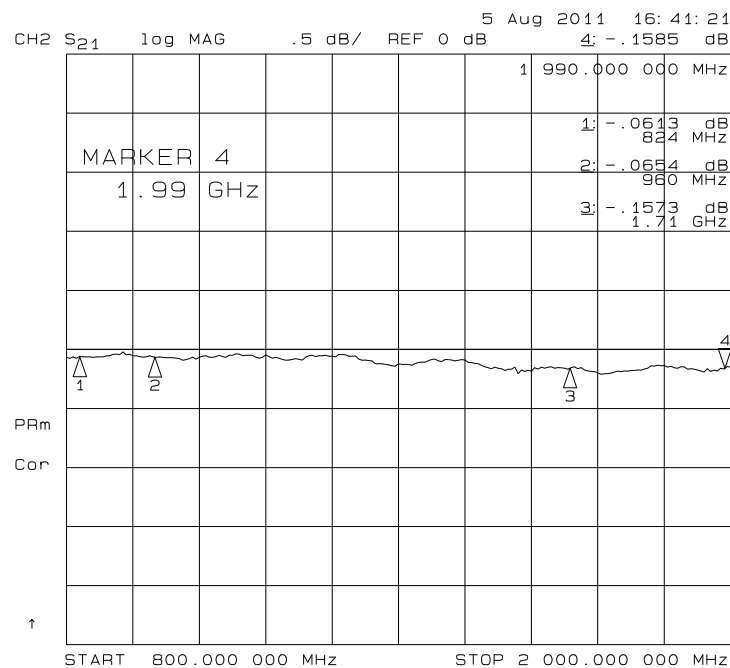
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Line input impedance (in Smith Chart format, once the line has been terminated to 50 Ω load) is shown in the following figure:



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



7.2.3. GSM Antenna – Installation Guidelines

- Install the antenna in a place covered by the GSM signal.
- The Antenna 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;
- Antenna shall not be installed inside metal cases
- Antenna shall be installed also according Antenna manufacturer instructions.

7.3. GPS Antenna (GE864-GPS only)

7.3.1. GPS Antenna Requirements

The GE864-GPS module is provided with an internal LNA amplifier with two selectable gain level. By default the GE864-GPS is configured in high gain mode (18dB with 2dB of noise figure).

If the external antenna is connected to the DUT with a long coax cable, the use of an external LNA close to the antenna feed point is recommended. In this case the module must be configured in low gain mode (8dB with 10dB of noise figure) through a specific AT command (refer to AT\$GPSAT on AT Commands Reference Guide, 80000ST10025a). The module provides a digital output signal (GPS_LNA_EN) used for RF power control that can be used to enable the external LNA.

NOTE: when the internal LNA is in high gain mode, the GPS_LNA_EN output is tied low (external LNA unused).

NOTE: The typical external gain range is 20 dB (when in low gain mode, not recommended in high gain mode)

NOTE: The absolute maximum rating for GPS RF input power is 10 dBm

7.3.2. Combined GPS Antenna

The use of combined GPS antennas is NOT recommended; this solution could generate an extremely poor GPS reception and also the combination antenna requires additional diplexer and adds a loss in the RF route.

7.3.3. Linear and Patch GPS Antenna

Using this type of antenna introduces at least 3 dB 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.



7.3.4. GPS Antenna - PCB Line Guidelines

- Ensure that the antenna line impedance is 50Ω.
- 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 GE864-GPS antenna line.
- Keep the antenna line far away from the GE864-GPS power supply lines.
- Keep the antenna line far away from the GE864-GPS GSM RF lines.
- If you have EM noisy devices around the PCB hosting the GE864-GPS, 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 GE864-GPS, use a strip-line on the superficial copper layer for the antenna line. The line attenuation will be lower than a buried one.

7.3.5. GPS Antenna - Installation Guidelines

- The GE864-GPS 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 Antenna manufacturer instructions.



8.1. Reset Signal

Signal	Function	I/O	Ball/Pin Number
RESET	Reset	I	A2 on GE864-QUAD V2/GPS 54 on GC864-QUAD V2

RESET is used to reset the GE/GC864-QUAD V2 and GE864-GPS modules. Whenever this signal is pulled low, the GE/GC864-QUAD V2 and GE864-GPS are reset. When the device is reset it stops any operation. After the release of the reset GE/GC864-QUAD V2 and GE864-GPS are unconditionally shut down, without doing any detach operation from the network where it is registered. This behavior is not a proper shut down because any GSM device is requested to issue a detach request on turn off. For this reason the Reset 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 RESET is internally controlled on start-up to achieve always a proper power-on reset sequence, so 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 GC/GE864-QUAD V2 and GE864-GPS . Use the ON/OFF signal to perform this function or the AT#SHDN command.

Reset Signal Operating Levels:

Signal	Min	Max
RESET Input high	2.0V*	2.2V
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, 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. Serial Ports

The serial port on the Telit GE864/GC864-QUAD V2 and GE864-GPS is the core of the interface between the module and OEM hardware.

2 serial ports are available on the GE864-QUAD/GC864-QUAD V2 modules:

- MODEM SERIAL PORT (Main, ASC0)
- MODEM SERIAL PORT 2 (Auxiliary, ASC1)

While another serial port is available on the GE864-QUAD V2/GPS module:

- GPS SERIAL PORT (NMEA)

9.1. MODEM SERIAL PORT

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

- RS232 PC com port
- microcontroller UART @ 2.8V – 3V (Universal Asynchronous Receive Transmit)
- microcontroller UART@ 5V or other voltages different from 2.8V

Depending from 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 2.8V UART.

The serial port on the GE/GC864-QUAD V2 and GE864-GPS a +2.8V UART with all the 7 RS232 signals. It differs from the PC-RS232 in the signal polarity (RS232 is reversed) and levels. The levels for the GE864-QUAD V2 UART are the CMOS levels:

Absolute Maximum Ratings –Not Functional

Parameter	Min	Max
Input level on any digital pad when on	-0.3V	+3.1V
Input voltage on analog pads when on	-0.3V	+3.0 V



Operating Range – Interface levels (2.8V CMOS)

Level			GPS signals	
	Min	Max	Min	Max
Input high level	2.1V	3.1V	1.82V	2.8V
Input low level	0V	0.5V	0V	0.98V
Output high level	2.2V	3.0V	2.4V	
Output low level	0V	0.35V		0.4V

The table below shows the signals of the GE/GC864-QUAD V2 AND GE864-GPSserial port:

RS232 Pin Number	Signal	GE864-QUAD V2 Pad Number	GC864-QUAD V2 Pad Number	Name	Usage
1	DCD – dcd_uart	D9	32	Data Carrier Detect	Output from the GE864-QUAD V2 that indicates the carrier presence
2	RXD – tx_uart	H8	26	Transmit line *see Note	Output transmit line of GE864-QUAD V2 UART
3	TXD – rx_uart	E7	25	Receive line *see Note	Input receive of the GE864-QUAD V2 UART
4	DTR – dtr_uart	B7	29	Data Terminal Ready	Input to the GE864-QUAD V2 that controls the DTE READY condition
5	GND	A1, F1, H1 L1, H2, L2, J3, K3....	5,6,7	Ground	ground
6	DSR – dsr_uart	E11	27	Data Set Ready	Output from the GE864-QUAD V2 that indicates the module is ready
7	RTS – rts_uart	F7	31	Request to Send	Input to the GE864-QUAD V2 that controls the Hardware flow control
8	CTS – cts_uart	F6	28	Clear to Send	Output from the GE864-QUAD V2 that controls the Hardware flow control
9	RI – ri_uart	B6	30	Ring Indicator	Output from the GE864-QUAD V2 that indicates the incoming call condition



NOTE:

According to V.24, RX/TX signal names are referred to the application side, therefore on the GE/GC864-QUAD V2 AND GE864-GPSside 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 GE/GC864-QUAD V2 AND GE864-GPSserial port and viceversa for RX





TIP:

For a 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:

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.

9.2. GE864-GPS Secondary Ports

9.2.1. Modem Serial Port 2 (GPS Control)

This port is the only communication interface with the GPS part. It is available on the following pins:

BALL	NAME	DESCRIPTION	TYPE
D11	TX_AUX	TX Data for GPS control	CMOS 2.8V
F10	RX_AUX	RX Data for GPS control	CMOS 2.8V

Please note that in order for GPS to be controlled by the GSM section, the GPS UART and some GPS control signals **have to be connected externally** to the GSM section according to the following table (see also chapter 12):

BALL	NAME		NAME	BALL
D11	TX_AUX	↔	GPS_RX	E10
F10	RX_AUX	↔	GPS_TX	F8
B3	GPIO4		GPS_ON_OFF	J4
C1	GPIO1		GPS_WAKE_UP	G2



9.2.2. GPS Serial Port (NMEA)

This port is carrying out the GPS navigation data in NMEA 0183 format. The default configuration is 4800 bps, 8, n, 1

It is available on the following pins:

BALL	NAME	DESCRIPTION	TYPE
F8	GPS TX	GPS TX Data (NMEA)	CMOS 2.8V (GPS)
E10	GPS RX	GPS RX Data (NMEA)	CMOS 2.8V (GPS)

GPS RX Lines and TX lines may need a dual supply isolation buffer like an FXLP34 to avoid CMOS high states while in POWER SAVING.

9.3. RS232 Level Translation

In order to interface the Telit GE/GC864-QUAD V2 AND GE864-GPS 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/+3V 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 for 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 driver and receiver 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/+3V UART level to the RS232 level, while the receiver is the translator from RS232 level to 0/+3V UART.

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

- 5 driver
- 3 receiver



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NOTE:

The digital input lines working at 2.8V CMOS have an absolute maximum input voltage of 3.0V; therefore the level translator IC shall not be powered by the +3.8V supply of the module. Instead, it must be powered from a +2.7V / +2.9V (dedicated) power supply.

This is because in this way the level translator IC outputs on the module side (i.e. GE/GC 864 inputs) will work at +3.8V interface levels, damaging the module inputs.



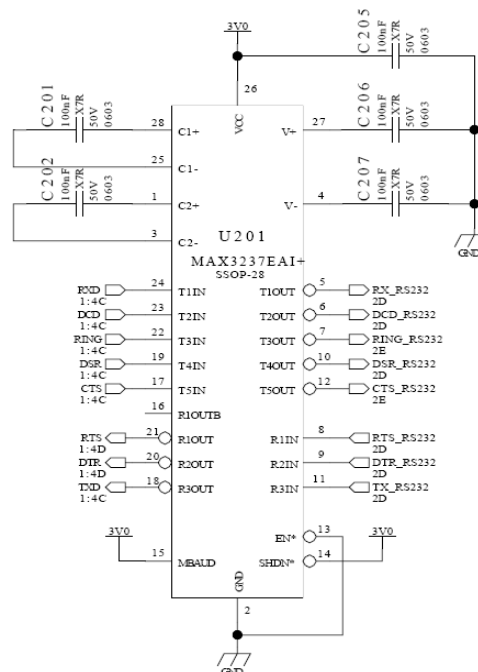
NOTE:

In order to be able to do in circuit reprogramming of the GE/GC 864 firmware, the serial port on the Telit GE/GC 864 shall be available for translation into RS232 and either it's controlling device shall be placed into tristate, disconnected or as a gateway for the serial data when module reprogramming occurs.

Only RXD, TXD, GND and the On/off module turn on pad are required to the reprogramming of the module, the other lines are unused.

All applicator shall include in their design such a way of reprogramming the GE/GC 864.

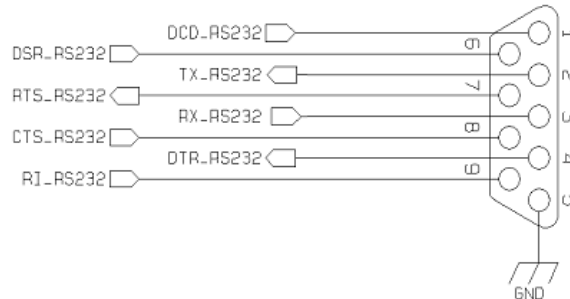
An example of level translation circuitry of this kind is:



RS232 LEVEL TRSANSULATOR

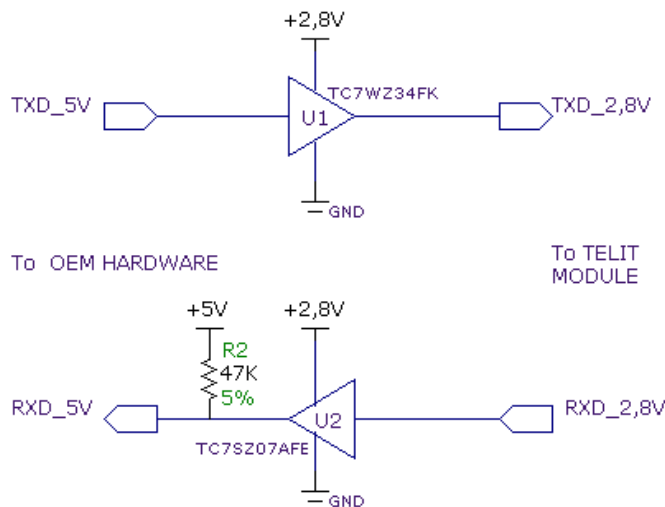


The RS232 serial port lines are usually connected to a DB9 connector with the following layout:



9.4. 5V UART Level Translation

If the OEM application uses a microcontroller with a serial port (UART) that works at a voltage different from 2.8 – 3V, then a circuitry has to be provided to adapt the different levels of the two set of signals. As for the RS232 translation there are a multitude of single chip translators. For example a possible translator circuit for a 5V TRANSMITTER/RECEIVER can be:

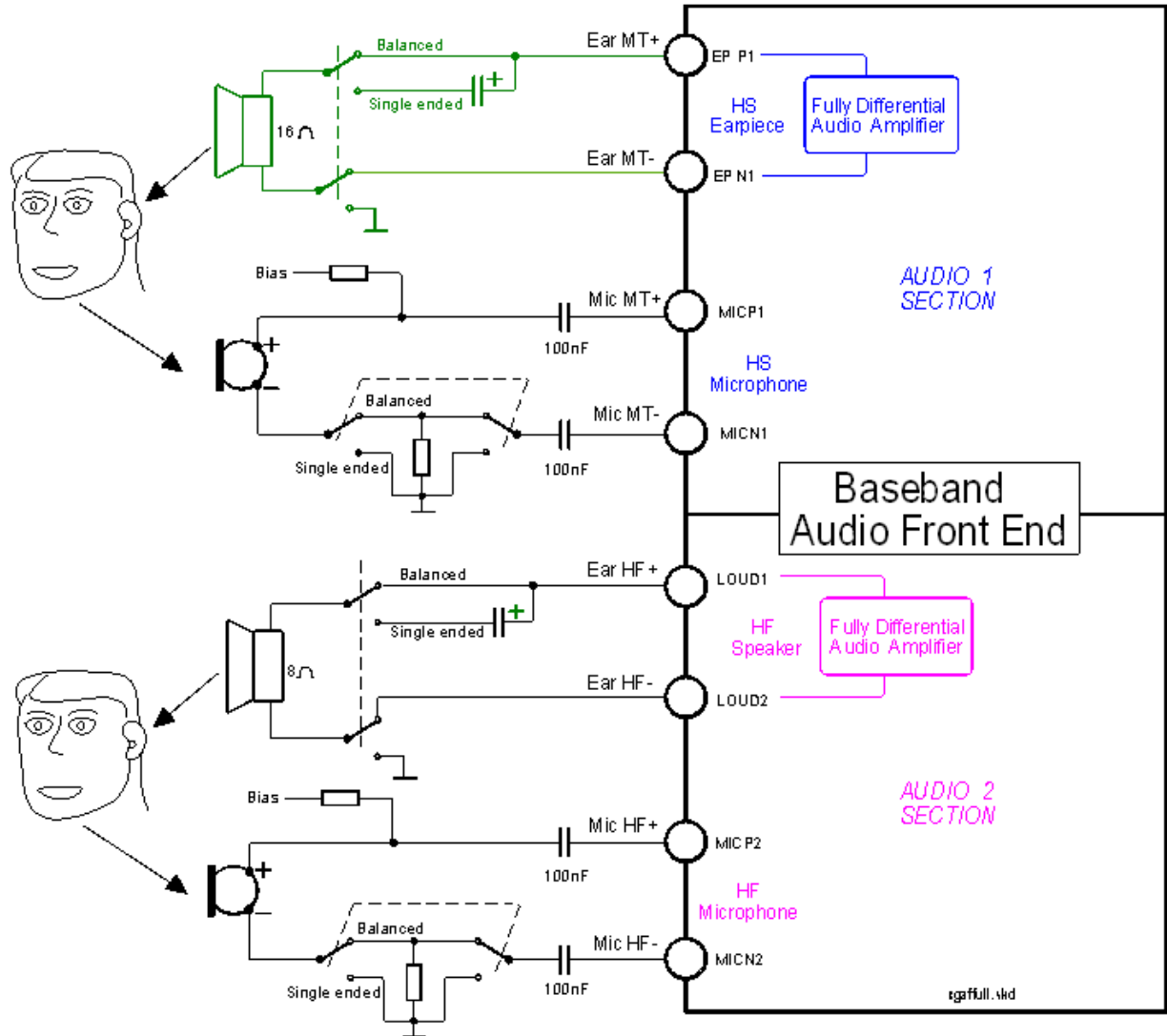


TIP:

Note that the TC7SZ07AE has open drain output; therefore the resistor R2 is mandatory.



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GE864-QUAD V2 Audio Front End Block Diagram



10.2. Electrical Characteristics



TIP:

Being the microphone circuitry the more noise sensitive, its design and layout must be done with particular care. Both microphone paths are balanced and the OEM circuitry must be balanced designed to reduce the common mode noise typically generated on the ground plane. However the customer can use the unbalanced circuitry for its particular application.

10.2.1. Input Lines Characteristics

"MIC_MT" and "MIC_HF" differential microphone paths	
Line Coupling	AC*
Line Type	Balanced
Differential input voltage	$\leq 1,03V_{pp}$ @ Mic G=0dB
Gain steps	7
Gain increment	6dB per step
Coupling capacitor	$\geq 100nF$
Differential input resistance	50K Ω
Input capacitance	$\leq 10pF$



(*) WARNING :

AC means that the signals from the microphone have to be connected to input lines of the module through capacitors which value has to be $\geq 100nF$. Not respecting this constraint, the input stages will be damaged.



WARNING:

when particular OEM application needs a *Single Ended Input* configuration, it is forbidden connecting the unused input directly to Ground, but only through a 100nF capacitor. Don't forget that the useful input signal will be halved in *Single Ended Input* configuration.



10.2.2. Output Lines Characteristics



TIP:

We suggest driving the load differentially from both output drivers, thus the output swing will double and the need for the output coupling capacitor avoided. However if particular OEM application needs also a *Single Ended circuitry* can be implemented, but the output power will be reduced four times.

The OEM circuitry shall be designed to reduce the common mode noise typically generated on the ground plane and to get the maximum power output from the device (low resistance tracks).



WARNING:

The loads are directly connected to the amplifier outputs when in *Differential* configuration, through a capacitor when in *Single Ended* configuration. Using a *Single Ended configuration*, the unused output line must be left open. Not respecting this constraint, the output stage will be damaged.



TIP :

Remember that there are slightly different electrical performances between the two internal audio amplifiers:

- the “*Ear_MT*” lines can directly drive a **16Ω load** at –12dBFS (**) in *Differential* configuration
- the “*Ear_HF*” lines can directly drive a **4Ω load** in *Differential* configurations
- There is no difference if the amplifiers drive an external amplifier

(**) *OdBFS* is the normalized overall Analog Gain for each Output channel equal to $3,7V_{pp}$ differential



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 GE/GC864-QUAD V2 and GE864-GPS firmware and acts depending on the function implemented.

The following GPIO are available on the GE/GC864-QUAD V2 and GE864-GPS:

Ball GE864	Pin GC864	Signal	I/O	Function	Type	Input / output current	Default state	ON_OF F state	During Reset state	Note
C1	70	TGPIO_01	I/O	GPIO01 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
E6	74	TGPIO_02 / JDR	I/O	GPIO02 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (JDR)
C2	66	TGPIO_03	I/O	GPIO03 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
B3	59	TGPIO_04 / TXCNTRL	I/O	GPIO04 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (RF Transmission Control)
K8	78	TGPIO_05 / RFTXMON	I/O	GPIO05 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (RFTXMON)
B5	68	TGPIO_06 / ALARM	I/O	GPIO06 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (ALARM)
L9	73	TGPIO_07 / BUZZER	I/O	GPIO07 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (BUZZER)
K11	67	TGPIO_08	I/O	GPIO08 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
C9	76	TGPIO_09	I/O	GPIO09 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
H3	63	TGPIO_10 / DVI_TX	I/O	GPIO10 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (DVI_TX)

Not all GPIO pads support all these three modes:

- GPIO2 supports all three modes and can be input, output, Jamming Detect Output (Alternate function)
- GPIO4 supports all three modes and can be input, output, RF Transmission Control (Alternate function)
- GPIO5 supports all three modes and can be input, output, RFTX monitor output (Alternate function)



This output can be used to power up the module controlling micro controller or application at the alarm time, giving you the possibility to program a timely system wake-up to achieve some periodic actions and completely turn off either the application and the module during sleep periods, dramatically reducing the sleep consumption to few μA .

In battery-powered devices this feature will greatly improve the autonomy of the device.



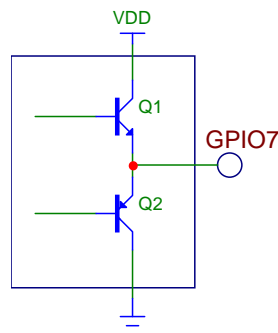
NOTE:

During RESET the line is set to HIGH logic level.

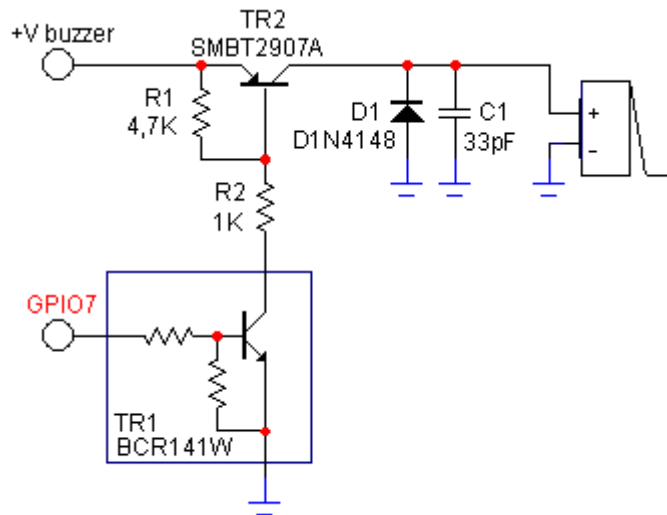
11.7. Using the Buzzer Output GPIO7

The GPIO7 pad, when configured as Buzzer Output, is controlled by the GE/GC 864 QUAD V2 module and will drive with appropriate square waves a Buzzer driver.

This permits to your application to easily implement Buzzer feature with ringing tones or melody played at the call incoming, tone playing on SMS incoming or simply playing a tone or melody when needed by your application.



A sample interface scheme is included below to give you an idea of how to interface a Buzzer to the GPIO7:



NOTE:

To correctly drive a buzzer a driver must be provided, its characteristics depend on the Buzzer and for them refer to your buzzer vendor.

11.8. Using the Temperature Monitor Function

11.8.1. 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 raise to High Logic level a GPIO when the maximum temperature is reached.

11.8.2. Allowed GPIO

Ball GE864	Pin GC864	Signal	I/O	Function	Type	Input / output current	Default state	ON_OF F state	During Reset state	Note
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C1	70	TGPIO_01	I/O	GPIO01 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
E6	74	TGPIO_02 / JDR	I/O	GPIO02 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (JDR)
C2	66	TGPIO_03	I/O	GPIO03 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
B3	59	TGPIO_04 / TXCNTRL	I/O	GPIO04 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (RF Transmission Control)
K8	78	TGPIO_05 / RFTXMON	I/O	GPIO05 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (RFTXMON)
B5	68	TGPIO_06 / ALARM	I/O	GPIO06 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (ALARM)
L9	73	TGPIO_07 / BUZZER	I/O	GPIO07 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (BUZZER)
K11	67	TGPIO_08	I/O	GPIO08 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
C9	76	TGPIO_09	I/O	GPIO09 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	
H3	63	TGPIO_10 / DVI_TX	I/O	GPIO10 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	0	0	Alternate function (DVI_TX)

The AT#TEMPMON set command could be used with one of the following GPIO:



NOTE:

If the set command is enable the alternate function is not usable.



11.9. Indication of Network Service Availability

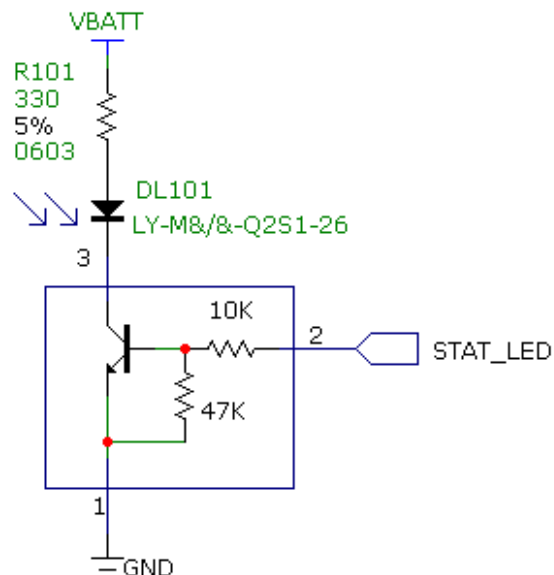
The STAT_LED pin status shows information on the network service availability and Call status.

In the GE/GC864-QUAD V2 and GE864-GPSmodules, the STAT_LED usually 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.

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

A schematic example could be:



13.1.2. Enabling DAC

The AT command below is available to use the DAC function:

AT#DAC[=<enable>[,<value>]]

<value> – scale factor of the integrated output voltage (0–1023, with 10 bit precision), and it must be present if <enable>=1.

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

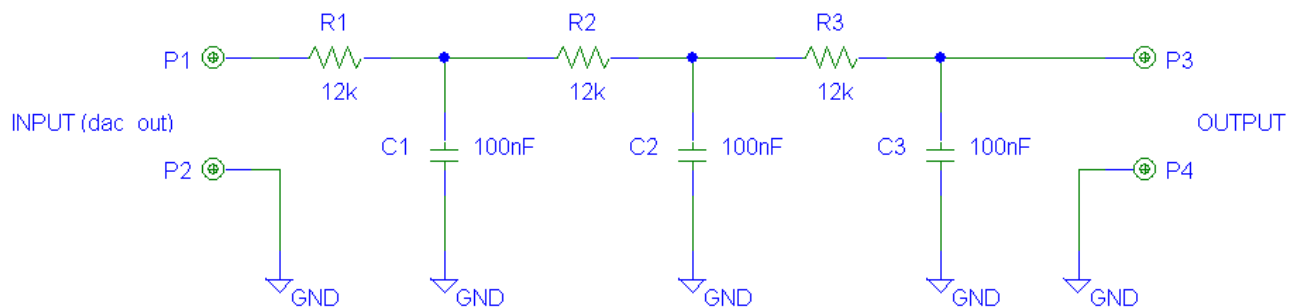
Refer to SW User Guide or AT Commands Reference Guide for the full description of this function.



NOTE:

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

13.1.3. Low Pass Filter Example





NOTE:

In order to easily rework the GE864-QUAD V2 module is suggested to consider on the application a 1.5mm inhibit area around the module.

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

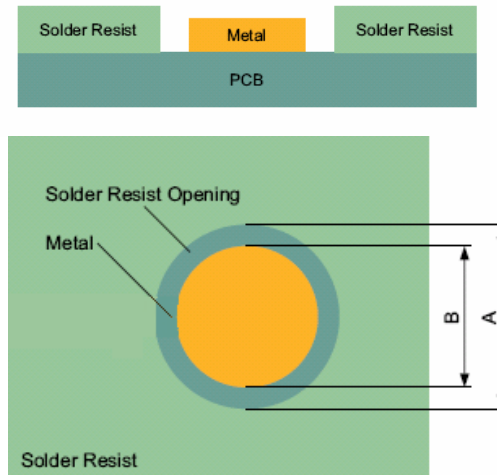
14.1.2. Stencil

Stencil apertures layout can be the same of the recommended footprint (1:1), we suggest a thickness of stencil foil $>120\mu\text{m}$.



14.1.3. PCB pad design

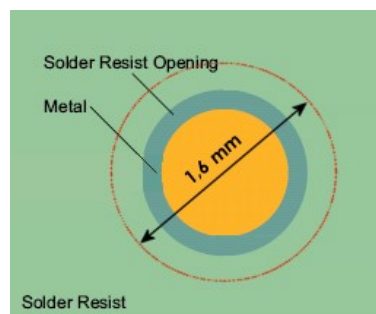
Non solder mask defined” (NSMD) type is recommended for the solder pads on the PCB.



Recommendations for PCB pad dimensions

Ball pitch [mm]	2,5
Solder resist opening diameter A [mm]	1,150
Metal pad diameter B [mm]	1 ± 0.05

It is recommended no microvia without solder resist cover under the module and no microvia around the pads (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.

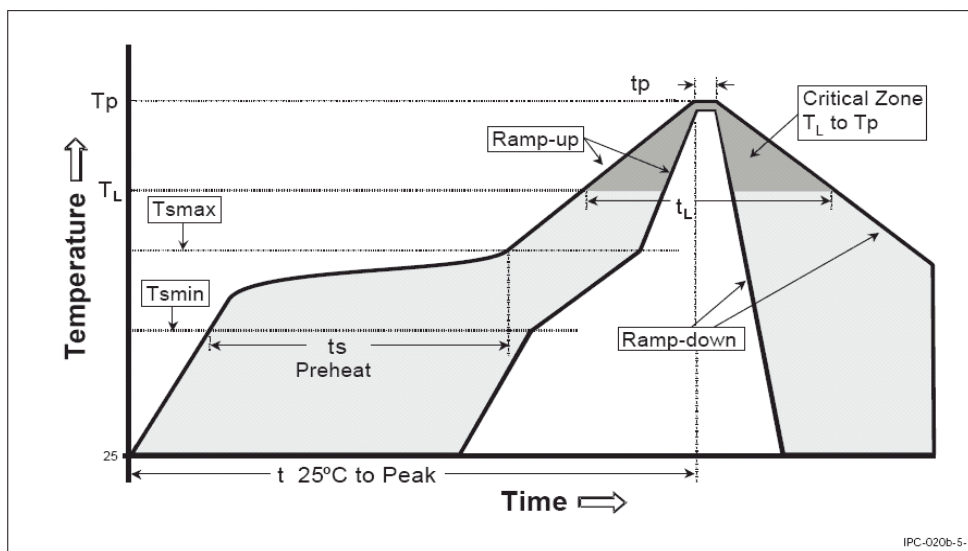
14.1.4. Solder paste

	Lead free
Solder paste	Sn/Ag/Cu

It is recommended to use only “no clean” solder paste in order to avoid the cleaning of the modules after assembly.

14.1.5. GE864-QUAD V2/GPS Solder reflow

The following is the recommended solder reflow profile

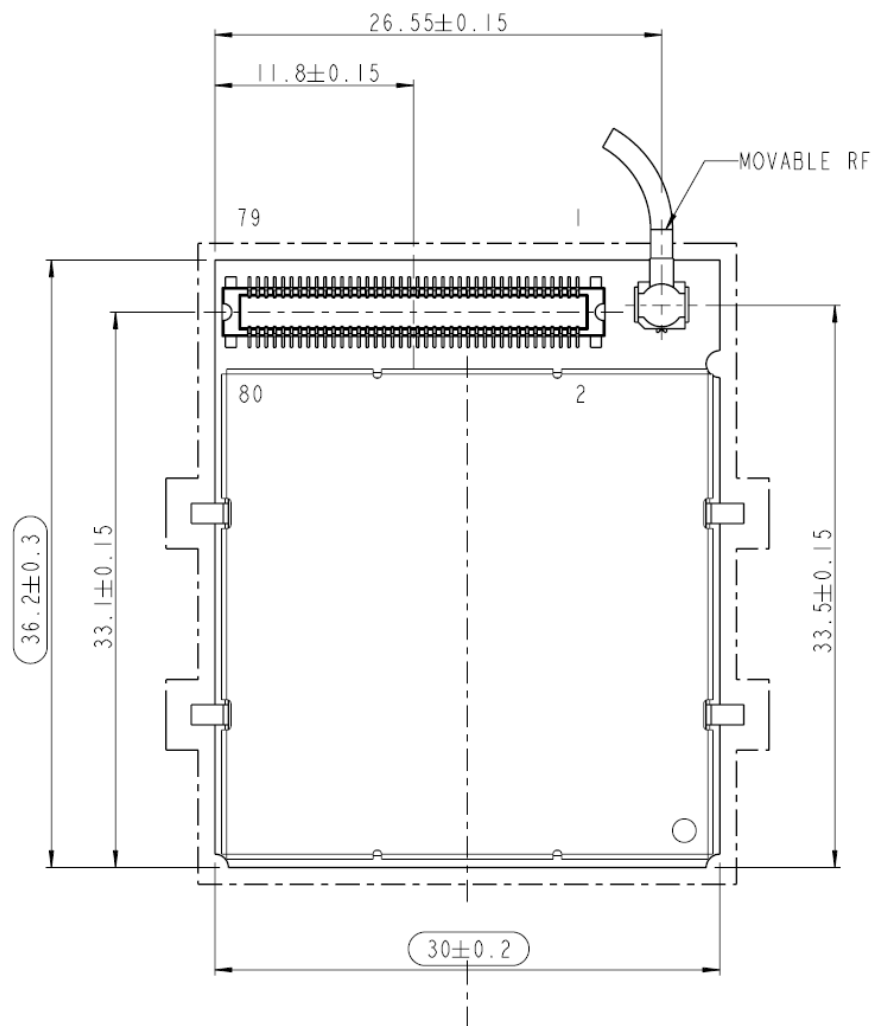


IPC-020b-5-1



14.2. Assembly the GC864-QUAD V2

The position of the Molex board to board connector and the pin 1 are shown in the following picture.



NOTE:

The metal tabs present on GC864-QUAD V2 must be connected to GND.

This module could not be processed with a reflow.



14.3. Debug of the GE/GC864-QUAD V2 AND GE864-GPS in Production

To test and debug the mounting of GC/GE864-QUAD V2 and GE864-GPS , we strongly recommend to foreseen test pads on the host PCB, in order to check the connection between the GE/GC864-QUAD V2 and GE864-GPS itself and the application and to test the performance of the module connecting it with an external computer. Depending by the customer application, these pads include, but are not limited to the following signals:

Ball GE864	Pin GC864	Signal	Function
J1, J2, K1, K2	1,2,3,4	VBATT	Main power supply
A1, A11, D6, F1, F11, H1, H2, J3, K3, K4, K5, K6, L1, L2, L3, L6, L11	5,6,7, 46	GND	Ground
E7	25	C103/TXD	Serial data input (TXD) from DTE
H8	26	C104/RXD	Serial data output (RXD) to DTE
L8	49	PRWMON	Power ON Monitor
J5	53	ON/OFF*	Input command for switching power ON or OFF (toggle command).
A2	54	RESET*	Reset input
F10	23	RX_AUX	Auxiliary UART (RX Data from DTE)
D11	24	TX_AUX	Auxiliary UART (TX Data to DTE)
H4	47	SERVICE	Service pin shall be used to upgrade the module from ASC1 (RX_TRACE, TX_TRACE). The pin shall be tied low to enable the feature only in case of a SW Update activity. It is required, for debug purpose, to be connected to a test pad on the final application.
J4 ³	N/A	GPS_ON_OFF ³	GPS Power Control
E10 ³	N/A	GPS_RX ³	GPS Serial data input
F8 ³	N/A	GPS_TX ³	GPS Serial data output
G2 ³	N/A	GPS_WAKEUP ₃	Wake up output ³

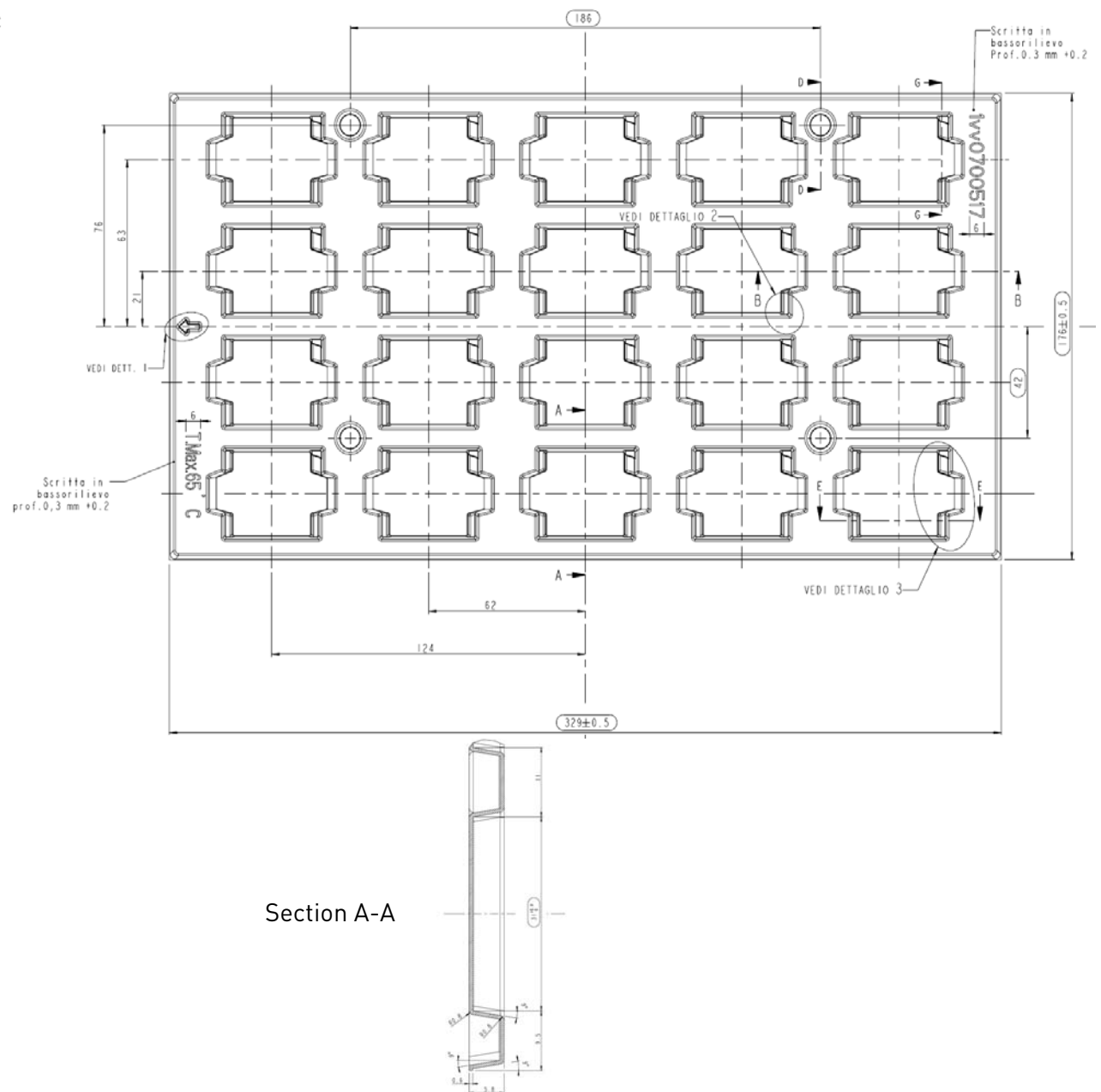
(3) Available only on GE864-GPS (in case of GE864-QUAD it has to be considered RESERVED)



15. Packing system

15.1. GE864-QUAD V2/GPS Packaging

The GE864-QUAD V2/GPS is packaged on trays of **20** pieces each. This is especially suitable for the GE864-QUAD V2/GPS according to SMT processes for pick & place

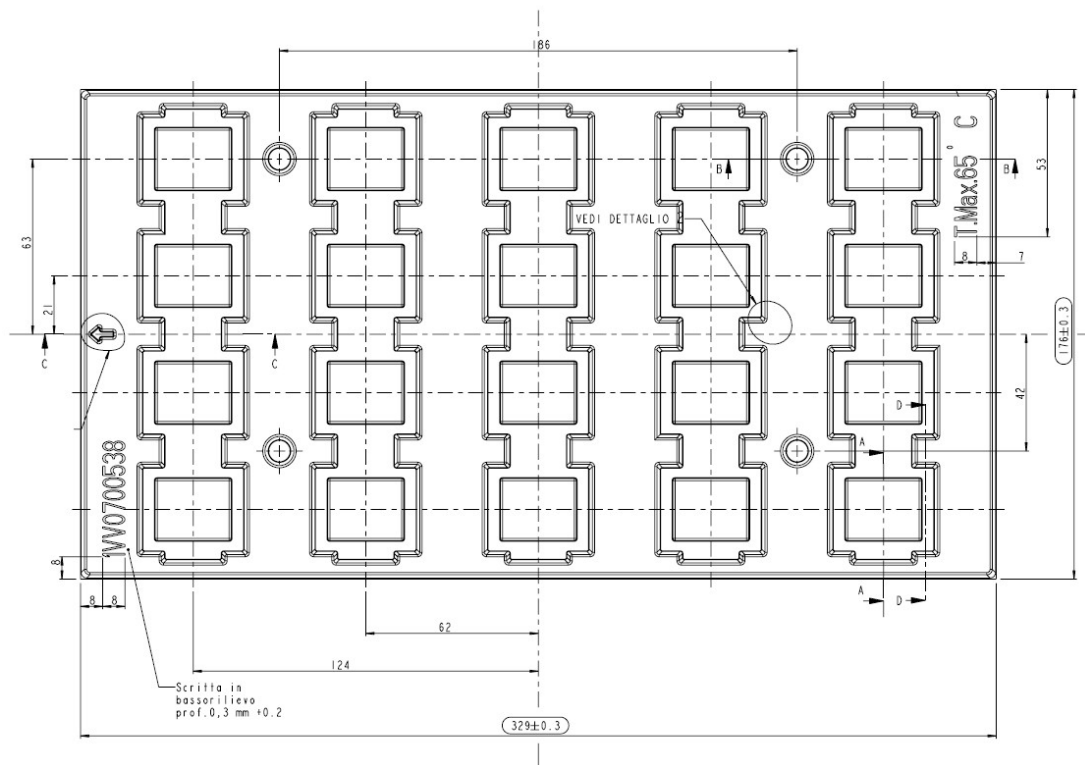


movement requirements. The size of the tray is: 329 x 176mm.



15.2. GE/GC864-QUAD V2 AND GE864-GPS Packaging

The **Telit GC864-QUAD V2** are packaged on trays of 20 pieces each.



The size of the tray is: 329 x 176mm.



WARNING:

These trays can withstand at the maximum temperature of 65° C.



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

<http://ec.europa.eu/enterprise/sectors/electrical>

FCC Regulatory Requirements

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

RF Exposure:

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

The system antenna(s) used for this module must not exceed 1,4dBi (850MHz) and 3.0dBi (1900MHz) for mobile and fixed or mobile operating configurations.

Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

A label containing the following information must be affixed to the outside of a host product which incorporates this module:

Label	Module type
Contains FCC ID: RI7GE86Q2	For GE864-QUAD V2
Contains FCC ID: RI7GC864Q2	For CE864-QUAD V2
Contains FCC ID: RI7GE864G2	For GE864-GPS

IC Regulatory Requirements

This device complies with Industry Canada license-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*



18. Document History

Revision	Date	Changes
Rev.0	2011-01-14	First preliminary release
Rev.1	2011-04-07	Updated power consumption for GE864-GPS and ATEX data for GE864-GPS
Rev.2	2011-06-15	Updated Pin Out GE864 QUAD/GPS Added “5.4 Turning ON/OFF the GPS (only GE864-GPS)” paragraph Updated GPS Antenna Requirements Updated Logic Level Specifications Added “11.12 VAUX Power Output (only for GE864-GPS)” paragraph Added “12. GPS Features (GE864-GPS only)” Chapter
Rev.4	2011-08-24	Added chapter 7.2 PCB guidelines in case of FCC certifications – updated with FCC requirements Added chapter 17. Safety Recommendations – updated with FCC and IC requirements
Rev.5	2011-10-03	Chapter 4: pin-out table, C6 and G6 rows moved under “GPS” category; notes re-organized; C6 and G6 pins added in the table at page 19; BGA balls layout, C6 and G6 balls colored in orange and wording “Diagnostic” added. Chapter 14.1.3 PCB pad design – table – ball pitch errata corrige from 2,4 to 2,5 Chapter 15.1.1 Moisture sensibility – add details Updated Chapter 5.1 Turning ON the Module – 5 second with VBATT< 3,4V

