





## Contents

<b>1</b>	<b>Overview</b> .....	<b>6</b>
<b>2</b>	<b>Mechanical Dimensions and Weight</b> .....	<b>7</b>
<b>3</b>	<b>Board to Board connector</b> .....	<b>8</b>
<b>3.1</b>	<b>PINOUT and functions</b> .....	<b>8</b>
<b>3.2</b>	<b>Pin mechanical position</b> .....	<b>9</b>
<b>4</b>	<b>Hardware Commands</b> .....	<b>11</b>
<b>4.1</b>	<b>Turning ON the GC864-C2</b> .....	<b>11</b>
<b>4.2</b>	<b>Turning OFF the GC864-C2</b> .....	<b>13</b>
4.2.1	Hardware shutdown.....	13
4.2.2	Hardware Unconditional Restart.....	13
<b>5</b>	<b>Power Supply</b> .....	<b>15</b>
<b>6</b>	<b>General Design Rules</b> .....	<b>16</b>
<b>7</b>	<b>Antenna</b> .....	<b>17</b>
<b>8</b>	<b>Serial Port</b> .....	<b>18</b>
<b>8.1</b>	<b>MODEM Serial Port</b> .....	<b>18</b>
<b>9</b>	<b>VAUX1 power output</b> .....	<b>20</b>
<b>10</b>	<b>Audio Section</b> .....	<b>21</b>
<b>10.1</b>	<b>Overview</b> .....	<b>21</b>
10.1.1	History.....	21
10.1.2	Actual.....	21
10.1.3	Block Diagram .....	22
<b>10.2</b>	<b>Input Lines Electrical Characteristics</b> .....	<b>23</b>
10.2.1	“Mic_MT” differential microphone path .....	23
10.2.2	“Mic_HF” single ended microphone path.....	23
10.2.3	Reminder .....	23
10.2.4	Input voltage vs Mic gain .....	23
<b>10.3</b>	<b>Output Lines Electrical Characteristics</b> .....	<b>24</b>
10.3.1	“Ear_MT” Differential <i>Line-out Drivers</i> Path .....	24
10.3.2	“Ear_HF” single ended <i>Power Buffers</i> path.....	24
10.3.3	Output amplifier selection .....	24
<b>10.4</b>	<b>Suggestions</b> .....	<b>25</b>
10.4.1	Microphone Biasing .....	25
10.4.1.1	On-board default biasing.....	25
10.4.1.2	External biasing network.....	26
10.4.2	Differential or Single Ended .....	26
10.4.2.1	Concepts.....	26
10.4.2.2	Differential Circuits: the benefits.....	27



**GC864-QUAD-C2/PY-C2 Hardware User Guide**

1vv0300744 Rev.4 - 12/11/07

10.4.2.3 Differential Circuits: the disadvantages .....27

**11 EVK2: the Evaluation Kit.....28**

**12 SIM Design Guides .....29**

**13 General Purpose I/O .....30**

**14 DAC and ADC section .....31**

**15 Conformity Assessment Issues .....32**

**16 SAFETY RECOMMANDATIONS.....33**

**17 Document Change Log .....34**



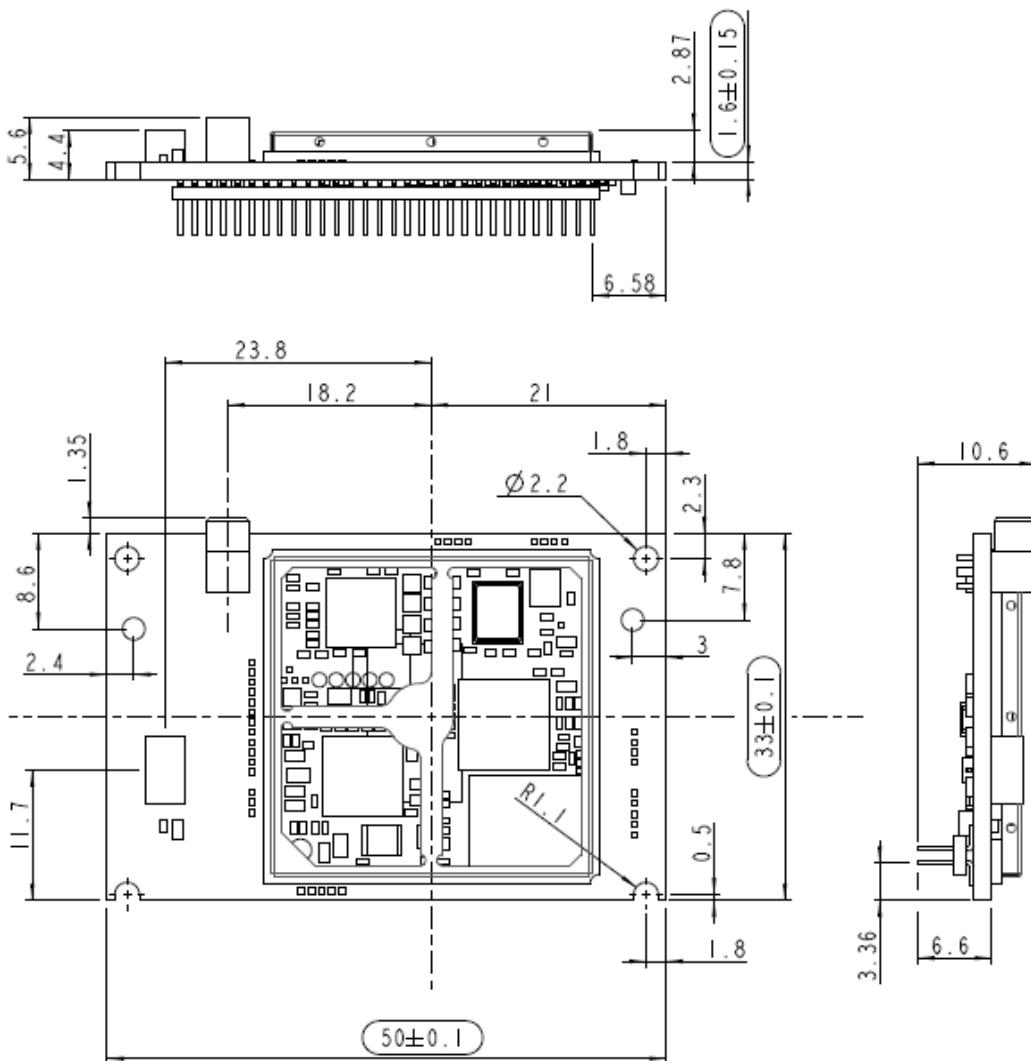




## 2 Mechanical Dimensions and Weight

The Telit **GC864-C2** module overall dimension are:

- **Length:** 50 mm
- **Width:** 33 mm
- **Thickness:** 5.6 mm
- **Weight:** 14gr



## 3 Board to Board connector

### 3.1 PINOUT and functions

Pin	Signal	Type	Function
1	VBATT	DC voltage	Power
2	GND	DC voltage	Power
3	VBATT	DC voltage	Power
4	GND	DC voltage	Power
5	VBATT	DC voltage	Power
6	GND	DC voltage	Power
7	VBATT	DC voltage	Power
8	GND	DC voltage	Power
9	VBATT	DC voltage	Power
10	GND	DC voltage	Power
11	VBATT	DC voltage	Power
12	GND	DC voltage	Power
13	NC	Don't connect	
14	ON_OFF*	DC voltage	Input command for switching power ON or OFF
15	SIMVCC	DC voltage	External SIM Power
16	SIMIN	DC voltage	External SIM inside detector
17	SIMRST	DC voltage	External SIM Reset
18	SIMIO	3V Only	External SIM Data I/O
19	SIMCLK	Digital Signal	External SIM Clock
20	DAC_OUT	Digital Output	Digital/ Analog converter output
21	TGPIO_01	Digital In/Out	General purpose
22	TGPIO_02/JDR	Digital In/Out	General purpose/Jammer detect report
23	TGPIO_03	Digital In/Out	General purpose
24	TGPIO_04	Digital In/Out	General purpose
25	VRTC	DC voltage	VRTC Backup capacitor
26	ADC_IN1	AC input	Analog/Digital converter input
27	ADC_IN2	AC input	Analog/Digital converter input
28	ADC_IN3	AC input	Analog/Digital converter input
29	-	-	RESERVED
30	-	-	RESERVED
31	TGPIO_07/BUZZER	Digital In/Out	General purpose/Buzzer
32	OUT	Digital Output	General purpose
33	LED	DC voltage	Status indicator led
34	VAUX1	DC voltage	Power output for external accessories
35	TGPIO_05/RFTXMON	Digital In/Out	General purpose/Transmitter ON monitor
36	C125/RING	Digital Output	Output for Ring indicator signal (RI) to DTE
37	C108/DTR	Digital Input	Input for Data terminal ready signal (DTR) from DTE
38	C109/DCD	Digital Output	Output for Data carrier detect signal (DCD) to DTE



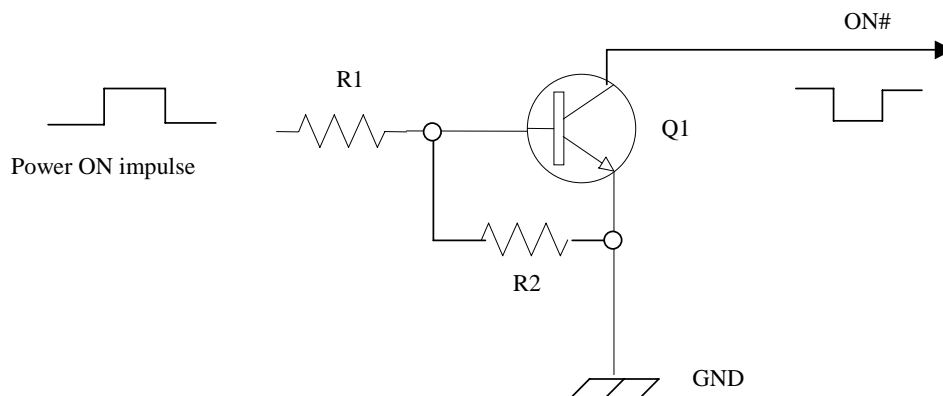




## 4 Hardware Commands

### 4.1 Turning ON the GC864-C2

To turn on the GC864-C2 the ON# line must be tied low for at least 1 second and then released. The maximum current that can be drained from the ON# line 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 GC864-C2 power regulator and improper power on/off of the module. The ON# line 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 "#" or with a bar over the name.*





## 4.2 Turning OFF the GC864-C2

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

- by software command (refer to *1vv0300745 Rev1 GC864-QUAD-C2 / PY-C2 Software User Guide*)
- by hardware shutdown
- by Hardware Unconditional Restart

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

### 4.2.1 Hardware shutdown

To turn OFF the module GC864-C2 the *ON#* line (pin2-PL101/pin14-PL103) must be tied low for at least 2 seconds and then released.

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

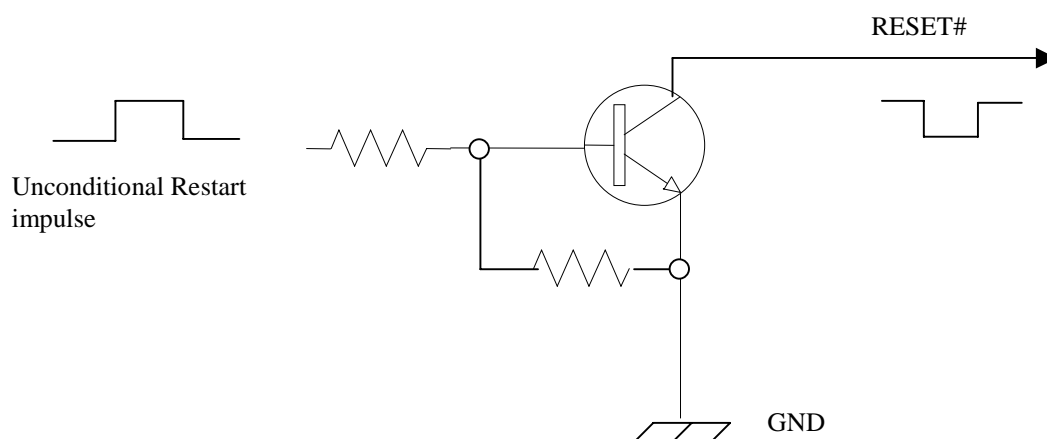
### 4.2.2 Hardware Unconditional Restart

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

To unconditionally restart the module GC864-C2, the *RESET#* line (pin2-PL102) must be tied low for at least 200 milliseconds and then released.

The maximum current that can be drained from the *RESET#* line is 0,15 mA.

A simple circuit to do it is:



## GC864-QUAD-C2/PY-C2 Hardware User Guide

1vv0300744 Rev.4 - 12/11/07



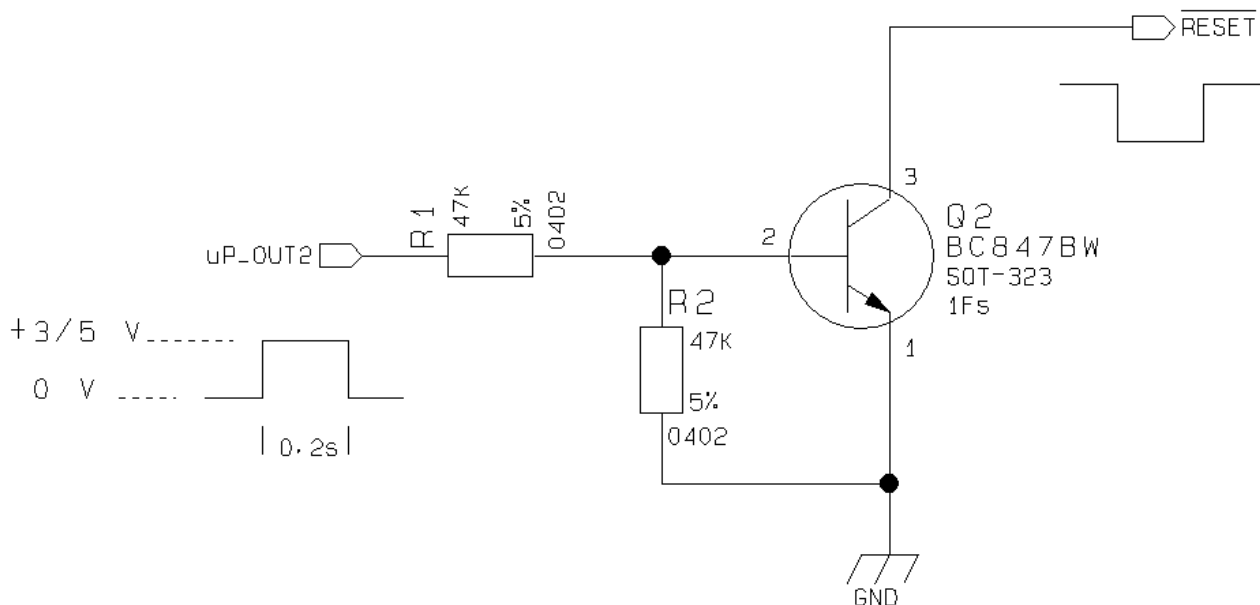
**NOTE:** don't use any pull up resistor on the RESET# line nor any totem pole digital output. Using pull up resistor may bring to latch up problems on the GC864-C2 power regulator and improper functioning of the module. The RESET# line must be connected only in open collector configuration.



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

For example:

1- Let's assume you need to drive the RESET# line with a totem pole output of a +3/5 V microcontroller (uP\_OUT2):



### Reset Signal Operating levels:

Signal	Min	Max
RESET Input high	2.2V*	3.3V
RESET Input low	0V	0.2V

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





## 6 General Design Rules

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

- electrical design
- thermal design
- PCB layout.

For more information about Electrical Design, Thermal Design, Power Supply PCB layout, please refer to 1vv0300694 GE864 Hardware User Guide.





## 8 Serial Port

The serial port on the Telit GC864-C2 is the core of the interface between the module and OEM hardware. 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

### 8.1 MODEM Serial Port

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 doesn't need a level translation is the 2.8V UART.

The serial port on the [GC864-C2](#) is a +2.8V UART with 6 RS232 signals at CMOS levels. It differs from the PC-RS232 in the signal polarity (RS232 is reversed) and levels.

#### Absolute Maximum Ratings -Not Functional

Parameter	Min	Max
Input level on any digital pad when on	-0.3V	+3.75V
Input voltage on analog pads when on	-0.3V	+3.0 V

#### Operating Range - Interface levels (2.8V CMOS)

Level	Min	Max
Input high level $V_{IH}$	2.1V	3.3V
Input low level $V_{IL}$	0V	0.5V
Output high level $V_{OH}$	2.2V	3.0V
Output low level $V_{OL}$	0V	0.35V



## GC864-QUAD-C2/PY-C2 Hardware User Guide

1vv0300744 Rev.4 - 12/11/07

The **GC864-C2** serial port signals at disposal are:

RS232 Pin Number	Signal	Name	Type	Function
1	DCD - dcd_uart	Data Carrier Detect	GC864-C2 Output	Presence of the carrier
2	RXD - tx_uart	Transmit line <sup>1</sup>	GC864-C2 Output transmit line	
3	TXD - x_uart	Receive line <sup>1</sup>	GC864-C2 Input receive line	
4	DTR - dtr_uart	Data Terminal Ready	GC864-C2 Input	DTE READY condition
5	GND	Digital GND	DC voltage	Ground
6	-----			
7	RTS - rts_uart	Request to Send	GC864-C2 Input	Hardware flow control
8	CTS - cts_uart	Clear to Send	GC864-C2 Output	Hardware flow control
9	RI - ri_uart	Ring Indicator	GC864-C2 Output	Incoming call condition

<sup>1</sup> According to V.24, RX/TX signal names are referred to the application side, therefore on the GC864-C2 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 GE864 serial port and viceversa for RX. 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.



## 9 VAUX1 power output

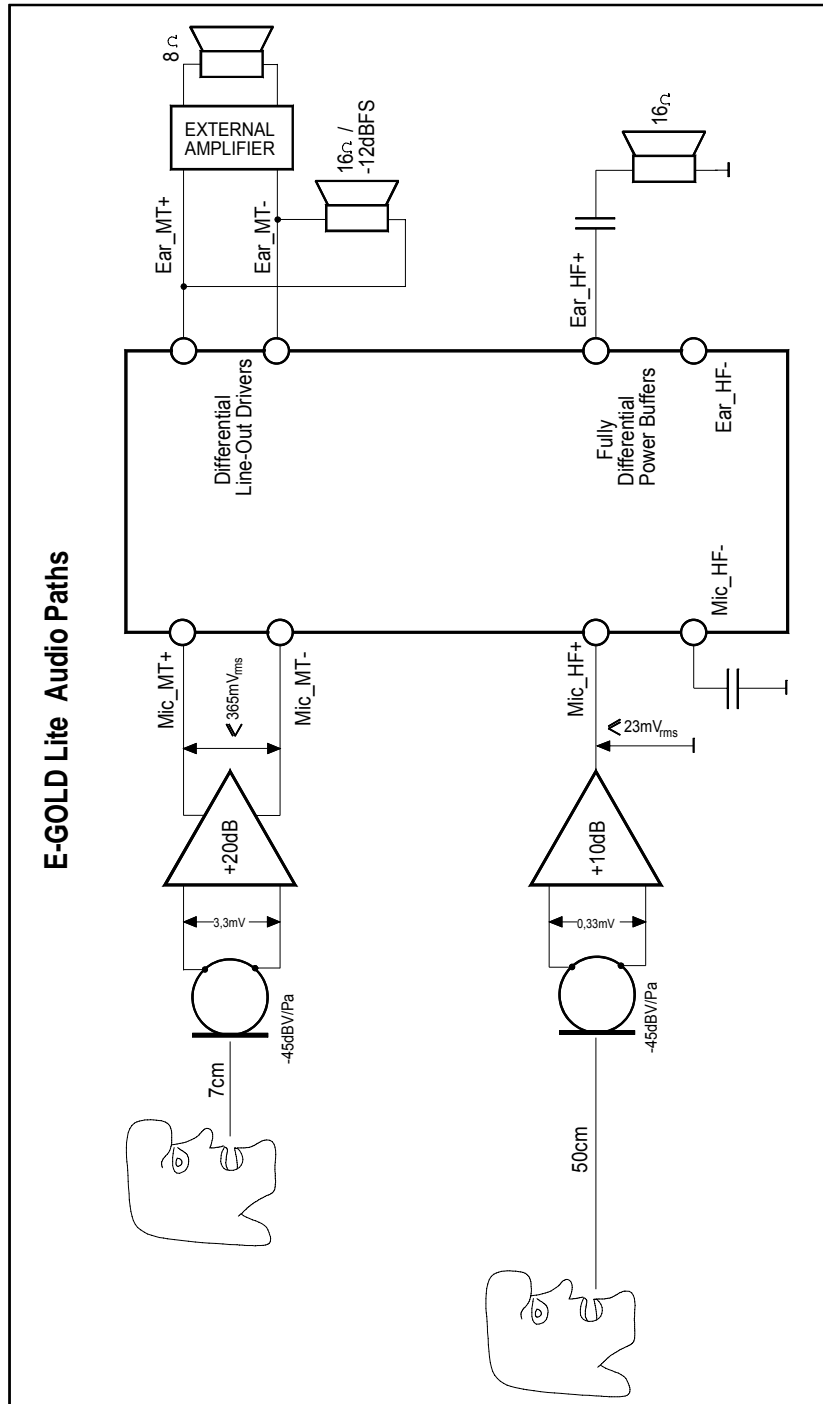
A regulated power supply output is provided in order to supply small devices from module. This output is active when the module is ON and goes off when module is shut down.

For more information about VAUX1 source please refer to *1vv0300694* GE864 Hardware User Guide.





### 10.1.3 Block Diagram



## 10.2 Input Lines Electrical Characteristics

### 10.2.1 “Mic\_MT” differential microphone path

- |  |   |
|--|---|
| • line coupling                        | AC  |
| • line type                            | balanced  |
| • coupling capacitor                   | $\geq 100\text{nF}$   |
| • differential input resistance        | $50\text{k}\Omega$  |
| • differential input voltage at MicG=0 | $\leq 1,03\text{V}_{\text{pp}}$ ( $365\text{mV}_{\text{rms}}$ ) |
| • microphone nominal sensitivity       | $-45\text{ dBV}_{\text{rms}}/\text{Pa}$                         |

### 10.2.2 “Mic\_HF” single ended microphone path

- |  |   |
|--|---|
| • line coupling                        | AC  |
| • line type                            | single ended  |
| • coupling capacitor                   | $\geq 100\text{nF}$   |
| • differential input resistance        | $50\text{k}\Omega$  |
| • differential input voltage at MicG=0 | $\leq 515\text{mV}_{\text{pp}}$ ( $182\text{mV}_{\text{rms}}$ ) |
| • microphone nominal sensitivity       | $-45\text{ dBV}_{\text{rms}}/\text{Pa}$                         |

### 10.2.3 Reminder

Do not forget that the GC864-C2 lacks the (MIC-) HF input, then the maximum useful input signal will be halved and a poorer noise rejection will result. This will happen also with particular OEM applications implementing the Single Ended connection in HS mode.  
In both cases the OEM circuitries shall be carefully designed to reduce the common mode noise.

### 10.2.4 Input voltage vs Mic gain

The Input Signal Level ( $M_{in}$ ) and Microphone Amplifiers Gain ( $M_g$ ) must respect the following law in order not to saturate the amplifier chains:

$$(M_{in}) \cdot (M_g) \leq 1,03\text{V}_{\text{pp}}$$

Let suppose to turn on the “*Mic\_HF*” lines.

Using an electret microphone with a sensitivity of  $45\text{ dBV}_{\text{rms}}/\text{Pa}$ , equivalent to  $S = (M_{in}) = 3.3\text{mV}_{\text{rms}}$ , the maximum gain will be:

$$(M_g) = 182/3,3 = 55,15 \equiv +34,8\text{dB} \rightarrow \text{HFMicG} = +30\text{dB}$$

Using a tone generator with signal amplitude of  $150\text{mV}_{\text{rms}}$  the maximum gain will be:

$$(M_g) = 182/150 = 1,213 \equiv +1,6\text{dB} \rightarrow \text{HFMicG} = +0\text{dB}$$



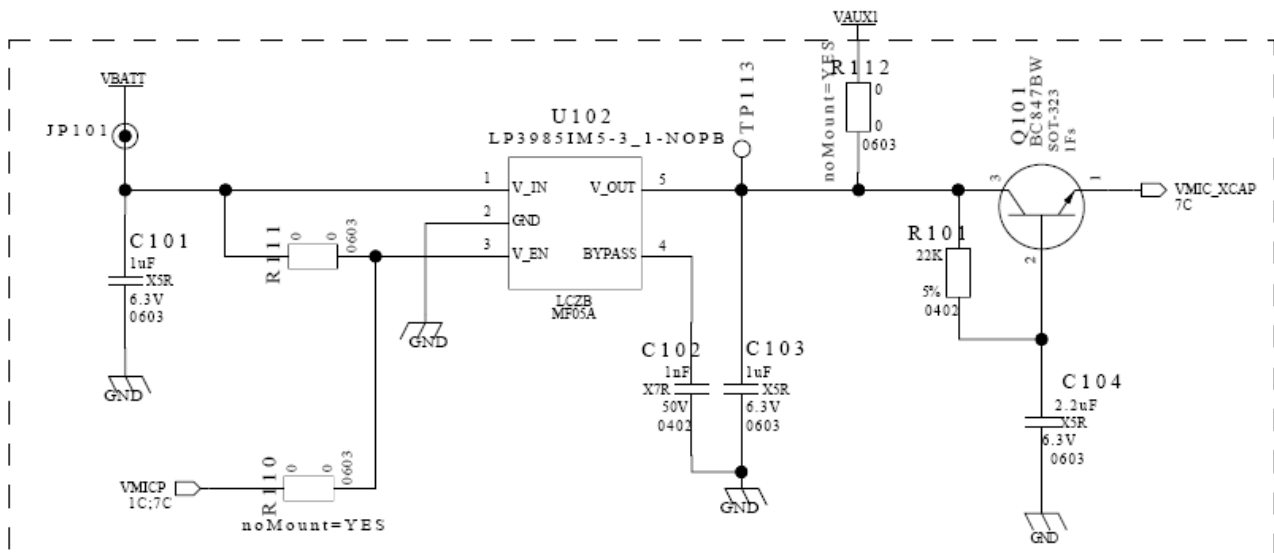


## 10.4 Suggestions

### 10.4.1 Microphone Biasing

The electret microphones usually need a biasing voltage to work properly. You can use the on-board circuitry on external biasing network.

#### 10.4.1.1 On-board default biasing



In order to eliminate the noise coming from the power lines, the microphone bias voltage is obtained from a voltage source filtered by a capacitor multiply circuit (Q101) and connected through **R104/R105** to **MIC\_MT+** line or **R104/R106** to **MIC\_HF+** line.

The voltage source could be:

- the dedicated voltage regulator (U102), supplied directly by VBATT.
- the inner VAUX1 source; in this case U102 must be removed and R112 inserted.





### 10.4.2.2 Differential Circuits: the benefits

Differential amplifiers are desirable to use, especially in audio applications where signal levels are very low such as those from microphones.

Classically, the benefits received from using differential amplification are:

- Increase of Common Mode Rejection Ratio (CMRR)  
*Differential inputs enable cancellation of any noise common on both inputs. Noise generated at the input of the amplifier has a greater effect than noise generated at the output, because any noise on the input is multiplied by the gain of the amplifier.*
- Increase Signal to Noise Ratio (SNR)  
*The inputs to the amplifier are especially sensitive to noise because they are typically not driven by a very low impedance source.*
- High Rejection in Electromagnetic Interference (EMI)  
*Noise immunity is very important in wireless phones because the RF signal is sent in bursts such that the frequency between bursts is in the audio band. RF rectification is such a problem that many manufacturers shield the audio portion of the phone.*
- Double Useful signals level  
*The signal levels from microphone and the voltage swing to the load are doubled. Then the AF power to the load it is 4 times the single-ended AFpower at the same voltage supply.*
- No output blocking capacitor is needed  
*Even if the differential outputs are biased at half-supply; no DC voltage exists across the load.  
 You do not need the big, expensive and heavy blocking capacitors (generally from 33  $\mu$ F to 1000  $\mu$ F), lowering the cost and saving PCB space  
 There is no frequency limiting effect due to the high pass filter network created with the speaker impedance and the coupling capacitance.*
- Less shielding is required from amplifier to load

### 10.4.2.3 Differential Circuits: the disadvantages

Mainly we have only one disadvantage: having an additional trace the routing of one more signal line requires more board space.



# 11 EVK2: the Evaluation Kit

Telit supplies the *Evaluation Kit for Telit modules (EVK2)* to assist the designer to develop his own applications based on GC864-C2 module.

A motherboard and a dedicated Telit module Interface Board, on which the module is fitted, compose the EVK2: it provides a fully functional solution for a complete data/phone application.

The motherboard has multiple power supply possibilities.

It is equipped with SIM card housing, RS 232 serial port level translator, direct USB1.1 connection, and two audio input/output paths.

Please refer to *1vv0300694 GE864 Hardware User Guide* and *1vv0300704 EVK2 User Guide* for more information about its use, audio characteristics and application notes.

Furthermore, the EVK2 allows benefiting of the special features of the new Telit Module versions with *PYTHON Script Interpreter*.





## 13 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)

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

The *Output* pads can only be written or queried and set the value of the pad output; the alternate function pad is internally controlled by the GC864-C2 firmware and acts depending on the function implemented.

The "*alternate function*" are supported only by *GPIO5* (which can be configured to become a RF Transmission monitor output reflecting the RF transmission activation) and *GPIO7* (which can be configured to become a Buzzer output pin).

For more information about level specifications and GPIO setting, please refer to *1vv0300694* GE864 Hardware User Guide and *1vv0300745* GC864-C2 Software User Guide.







# 16 SAFETY RECOMMENDATIONS

## READ CAREFULLY

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

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

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

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

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

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

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

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

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

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

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

[http://europa.eu.int/comm/enterprise/electr\\_equipment/index\\_en.htm](http://europa.eu.int/comm/enterprise/electr_equipment/index_en.htm)



# 17 Document Change Log

Revision	Date	Changes
ISSUE#0	29/09/06	Release First ISSUE# 0
ISSUE#1	24/10/06	Added product GC864-PY-C2 in the document Pag.2 Added product name and P/N for 3990250686 version 3 Board to Board Connector Pinout connections: updated table,changed signal,type and function of pin 29 and pin 30
ISSUE#2	16/03/07	Changed GC864-QUAD-C2/PY-C2 to GC864-C2 from page 7 to the end Pag.9 modified pin51 and pin52 description on table Pag.9 inserted the Pin Mechanical Position drawing From pag.20 to pag.26 modified AUDIO SECTION paragraphs
ISSUE #3	22/05/07	Added paragraph 8.1 MODEM Serial Port
ISSUE #4	12/11/07	Pag.7 changed mechanical drawing

