# GE864 and GC864 Product Description

GE864-QUAD, GE864-PY, GC864-QUAD, GC864-PY
80273ST10008a Rev. 8 - 09/02/07


Making machines talk.

This document is relating to the following products:


GE864-QUAD 3990250648
GE864-PY 3990250650


GC864-QUAD 3990250675
GC864-PY 3990250676

 

# Contents



 

 

 

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# 1 Overview

The Telit GE864 and GC864 modules are small, lightweight, low power consumption and RoHS compliant devices that allow digital communication services wherever a GSM 850, 900, DCS 1800 or PCS 1900 network is present.
The GE864 is a low cost connector-less best solution for medium to high quantity projects.

The GC864 is provided with a 80 pin Molex board to board connector and a 50 Ohm Murata RF connector.

The GE864-PY and GC864-PY models integrate the "***EASY SCRIPT"*** on top of all other features of the GE864-QUAD and GC864-QUAD. The Python, is an engine script interpreter, allowing self controlled operations. With the ***EASY SCRIPT*** feature the GE864-PY and GC864-PY become a finite product, they just needs your script to be run.

All GE864 and GC864 models includes features like GPRS Class 10, Voice, Circuit Switched Data transfer, Fax, Phonebook and SMS support, 'EASY GPRS' embedded TCP/IP stack and battery charging capabilities.

The GE864 and GC864 are specifically designed and developed by Telit for OEM usage and dedicated to portable data, voice and telemetric applications such as:

- **Telemetry and Telecontrol (SCADA applications)**
- **Security systems**
- **Automated Meter Reading (AMR)**
- **Vending machines**
- **POS terminals**
- **PDAs and Mobile Computing**
- **Phones and Payphones**
- **Automotive and Fleet Management applications**
- **Battery powered applications needing a battery charger**
- **Return channel for digital broadcasting**
- **Applications, where the external application processor can be replaced by the PYTHON engine provided by the GE864-PY or GC864-PY**

All four models support the following functionalities

- **EASY GPRS (AT driven embedded TCP/IP protocol stack)**
- **EASY SCAN (full GSM frequency scanning)**
- **JAMMING DETECT & REPORT (detect the presence of disturbing devices)**

From the interface point of view, the GE864 and GC864 provide the following:

- **Full RS232 UART, CMOS level (ASC0) interface for AT commands:**
  - **Autobauding from 2.4 up to 57.6 Kbps**
  - **Fixed baud rate up to 115.2 Kbps**
- **Two wires RS232, CMOS level (ASC1) for PYTHON debug:**
- **SIM card interface, 1.8 / 3 volts with auto-detection, hot insertion**
- **21 x GPIO ports (max)**
- **3 x A/D converters**
- **1 x D/A converter**
- **1 x buzzer output**
- **1 x vibrator motor driver output**
- **1 x single led supply output**

In order to meet the competitive OEM and vertical market stringent requirements, Telit supports its customers with a dedicated Support Policy with:

- Telit Evaluation Kit EVK2 to help you develop you application;
- A Website with all updated information available;
- an high level specialist technical support to assist you in your development;

For more updated information concerning product Roadmap and availability, technical characteristics, commercial and other issues, please check on the Telit website www.telit.com > Products > Modules.

**NOTE:** Some of the performances of the Telit modules depend on SW version installed on the module itself.
The Telit modules SW group is continuously working in order to add new features and improve the overall performances.
The Telit modules are easily upgradeable by the developer using the Telit Flash Programmer.
Furthermore, all the Telit modules have the conformity assessment against R&TTE.

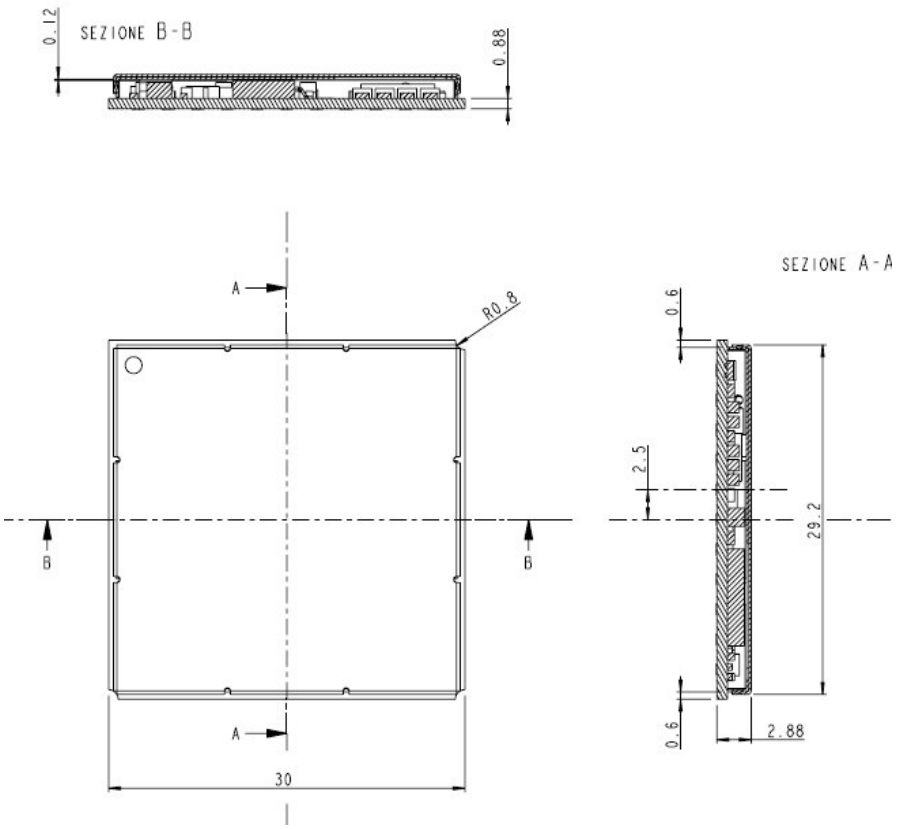
# 2 General Product Description

## 2.1 Dimensions

### 2.1.1 GE864

The **Telit GE864 module** overall dimension are:

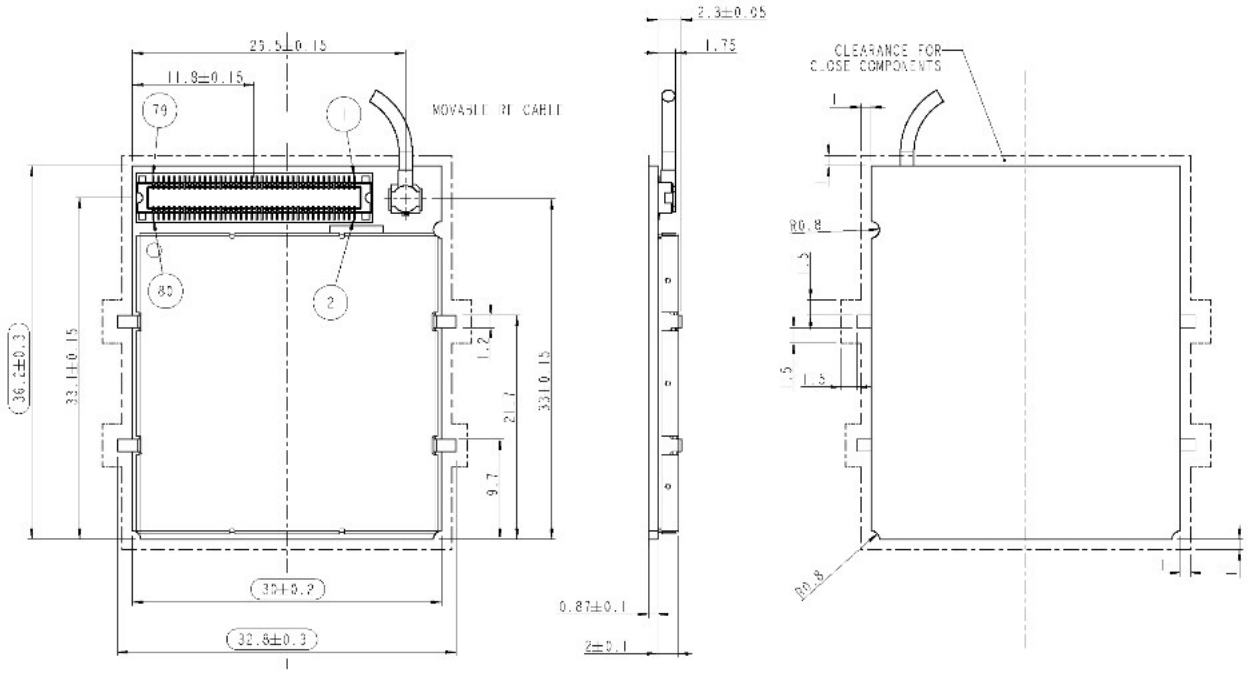
- **Length:** **30 mm**
- **Width:** **30 mm**
- **Thickness:** **2.8 mm**

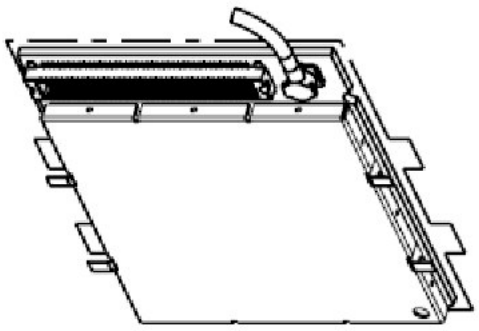



## 2.1.2 GC864

The **Telit GC864 module** overall dimensions are:

- **Length:** **36.2 mm**
- **Width:** **30 mm**
- **Thickness:** **3.2 mm**



## 2.2 Weight

| weight | |
|---|---|
| GE864 | 6 gr |
| GC864 | 6,1 gr |

## 2.3 Environmental requirements

The Telit GE864 and GC864 modules are compliant with the applicable ETSI reference documentation GSM 05.05 Release1998.

### 2.3.1 Temperature range

| | GE864-QUAD / GE864-PY | GC864-QUAD / GC864-PY |
|---|---|---|
| Temperature in normal operating conditions | –10°C ÷ +55°C | –10°C ÷ +55°C |
| Temperature in extreme operating conditions* | –30°C ÷ +80°C | –30°C ÷ +80°C |
| Temperature in storage conditions | –30°C ÷ +85°C | –30°C ÷ +85°C |

* Temperature exceeding the range of normal operating conditions can affect the sensitivity, the performance and the MTBF of the module.

### 2.3.2 Vibration Test (non functional)

- 10 ÷12Hz ASD = 1.92m 2 /s 3
- 12 ÷ 150Hz –3dB/oct

### 2.3.3 RoHS compliance

As a part of Telit corporate policy regarding environmental protection, the GE864 and GC864 comply with the RoHS (Restriction of Hazardous Substances) directive of the European Union (EU Directive 2002/95/EG).

## 2.4 Operating Frequency

The operating frequencies in GSM, DCS, PCS modes are conform to the GSM specifications.

| Mode | Freq. TX (MHz) | Freq. RX (MHz) | Channels (ARFC) | TX - RX offset |
|---|---|---|---|---|
| 850 | 824.2÷848.8 | 869.2÷893.8 | 0 ÷ 124 | 45 MHz |
| E-GSM-900 | 890.0 - 914.8 | 935.0 - 959.8 | 0 – 124 | 45 MHz |
| | 880.2 - 889.8 | 925.2 - 934.8 | 975 - 1023 | 45 MHz |
| DCS-1800 | 1710.2 - 1784.8 | 1805.2 - 1879.8 | 512 – 885 | 95 MHz |
| PCS-1900 | 1850.2 - 1909.8 | 1930.2 - 1989.8 | 512 - 810 | 80 MHz |

## 2.5 Transmitter output power

**GSM–850/900**
The Telit GE864 and GC864 transceiver modules in GSM–850/900 operating mode are **class 4** in accordance with the specifications which determine the nominal 2W peak RF power (+33dBm) on 50 Ohm.

**DCS–1800/PCS–1900**
The Telit GE864 and GC864 transceiver modules in DCS–1800/PCS–1900 operating mode are **class 1** in accordance with the specifications which determine the nominal 1W peak RF power (+30dBm) on 50 Ohm.

## 2.6 Reference sensitivity

**GSM–850/900**
The sensitivity of the Telit GE864 and GC864 modules according to the specifications for the class 4 GSM 850/900 portable terminals are **–107 dBm** typical in normal operating conditions.

**DCS–1800/PCS–1900**
The sensitivity of the Telit GE864 and GC864 module according to the specifications for the class 1 portable terminals DCS-1800/PCS 1900 are **–106 dBm** typical in normal operating conditions.

# 2.7 Antenna

The antenna that the customer chooses to use should fulfill the following 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** | 80 MHz in EGSM 900, 70 MHz if GSM 850, 170 MHz in DCS, 140 MHz PCS band |

For further information please refer to the GE864 and GC864 Hardware User Guide.

## 2.7.1 GC864 Antenna connector

The GC864 module is equipped with a 50 Ohm RF connector from Murata, GSC type P/N **MM9329-2700B**. The suitable counterpart is Murata **MXTK92** Type or **MXTK88** Type.

Moreover, the GC864 has the antenna pads on the back side of the PCB. This allows the manual soldering of the coaxial cable directly on the back side of the PCB. However, the soldering is not an advisable solution for a reliable connection of the antenna.

# 2.8 Supply voltage

The external power supply must be connected to VBATT signal and must fulfill the following requirements:

| | |
|---|---|
| **Nominal operating voltage** | 3.8 V |
| **Operating voltage range** | 3.4 V – 4.2 V |

**NOTE:** Operating voltage range must never be exceeded; care must be taken in order to fulfill min/max voltage requirements.

## 2.9 Power consumption

The typical current consumption of the **Telit GE864** and **GC864** are:

| | |
|---|---|
| **Power off current (typical)** | < 26 μA; |
| **Stand–by current (GSM Idle)** | < 22 mA (< 3 mA using command AT+CFUN=5) |
| **Operating current in voice channel** | <200 mA @ worst network conditions |
| **Operating current in GPRS class 10** | < 370 mA @ worst network conditions |

## 2.10 Embodied Battery charger

The battery charger is suited for 3.7V Li-Ion rechargeable battery (suggested capacity 500-1000mAH). The Charger needs only a CURRENT LIMITED power source input and charges the battery directly through VBATT connector pins.

| | |
|---|---|
| **Battery charger input pin** | CHARGE |
| **Battery pins** | VBATT, GND |
| **Battery charger input voltage min** | 5.0 V |
| **Battery charger input voltage typ** | 5.5 V |
| **Battery charger input voltage max** | 7.0 V |
| **Battery charger input current max** | 400mA |
| **Battery type** | Li-Ion rechargeable |

**NOTE**: If embodied battery charger is used, then a LOW ESR capacitor of at least 100μF must be mounted in parallel to VBATT pin.
**NOTE:** when power is supplied to the CHARGE pin, a battery must always be connected to the VBATT pin of the GE864 / GC864.

## 2.11 User Interface

The user interface is managed by AT commands specified on the ITU-T V.250, GSM 07.07 and 07.05 specifications.

### 2.11.1 Speech Coding

The GE864 and GC864 voice codec support the following rates:

- Half Rate
- Full rate
- Enhanced Full Rate
- Adaptive Multi Rate

### 2.11.2 SIM Reader

The GE864 and GC864 support phase 2 GSM11.14 - SIM 1.8V and 3V ONLY with an external SIM connector. For 5V SIM operation an external level translator can be added.

### 2.11.3 SMS

The GE864 and GC864 support the following SMS types:

- Mobile Terminated (MT) class 0 – 3 with signaling of new incoming SMS, SIM full, SMS read
- Mobile Originated class 0 – 3 with writing, memorize in SIM and sending
- Cell Broadcast compatible with CB DRX with signaling of new incoming SMS.

### 2.11.4 Real Time Clock and Alarm

The Telit GE864 and GC864 support the Real Time Clock and Alarm functions through AT commands, furthermore an alarm output pin (GPIO6) can be configured to indicate the alarm with a hardware line output.
Furthermore the Voltage Output of the RTC power supply is provided so that a backup capacitor can be added to increase the RTC autonomy.

### 2.11.5 Data/fax transmission

The Telit GE864 and GC864 support:

- GPRS Class 10, MS Class B
- CSD up to 14.4 Kbps
- Fax service, Class 1 Group 3

### 2.11.6 Local security management

The local security management can be done with the lock of Subscriber Identity module (SIM), and security code request at power–up.

### 2.11.7 Call control

The call cost control function is supported.

### 2.11.8 Phonebook

This function allows the storing of the telephone numbers in SIM memory. The capability depends on SIM version and embedded memory.

### 2.11.9 Characters management

The Telit GE864 and GC864 supports the IRA characters set (International Reference Alphabet), in TEXT and PDU mode.

### 2.11.10 SIM related functions

Activation and deactivation of the numbers stored in phone book FDN, ADN and PINs are supported. Extension at the PIN2 for the PUK2 insertion capability for lock condition is supported.

### 2.11.11 Call status indication

The call status indication by AT commands is supported.

### 2.11.12 Automatic answer (Voice, Data or FAX)

After a specified number of rings, the module will automatically answer with a beep. The user can set the number of rings by means of the command ATS0=<n>.

### 2.11.13 Supplementary services (SS)

The following supplementary services are supported:

- Call Barring,
- Call Forwarding,
- Calling Line Identification Presentation (CLIP),
- Calling Line Identification Restriction (CLIR),
- Call Waiting, other party call Waiting Indication,
- Call Hold, other party Hold / Retrieved Indication,
- Closed User Group supplementary service (CUG),
- Advice of Charge,
- Unstructured SS Mobile Originated (MO)

### 2.11.14 Acoustic signaling

The acoustic signaling of the **GE864** and **GC864** on the selected acoustic device are the following:

- Call waiting;
- Ringing tone;
- SMS received tone;
- Busy tone;
- Power on/off tone;
- Off Hook dial tone;
- Congestion tone;
- Connected tone;
- Call dropped;
- No service tone;
- Alarm tone.

### 2.11.15 Buzzer output

The General Purpose I/O pin GPIO7 can be configured to output the BUZZER output signal, with only an external MOSFET/transistor and a diode a Buzzer can be directly driven.
The ringing tone and the other signaling tones can be redirected to this Buzzer output with a specific AT command.

### 2.11.16 RF Transmission Monitor

As alternate function of the GPIO5, the **GE864** and **GC864** provide the RF transmission monitor. When the alternate function is activated, the pin of GPIO5 changes to HIGH every time the module transmits an RF signal and remains HIGH for the duration of the transmission sequence, i.e. it does not change with every GSM signal burst.

# 2.12 Logic level specifications

Where not specifically stated, all the interface circuits work at 2.8V CMOS logic levels. To get more detailed information about the logic level specifications used in the Telit GE864 and Telit GC864interface circuits please consult the Hardware User Guide.

## 2.12.1 Reset signal

| Signal | Function | I/O | GE864 ball | GC864 pin |
|---|---|---|---|---|
| RESET | Phone reset | I/O | A2 | 54 |

RESET is used to reset the GE864 and GC864. Whenever this signal is pulled low, the GE864 / GC864 is reset. When the device is reset it stops any operation and after the release of the reset it is unconditionally rebooted, without doing any detach operation from the network where it is registered to. This behavior is not like 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's no need to control this pin on start-up. It may only be used to reset a device already on that is not responding to any command.

***NOTE**: do not use this signal to power off the Telit GE864 / GC864 module. Use the ON_OFF* signal to perform this function or the AT#SHDN command.*

## 2.13 Audio levels specifications

The audio of the **GE864 / GC864** is organized into two main paths:

- internal path (called also MT)
- external path (called also HF)

These two paths are meant respectively for handset and headset/hands-free use. The **GE864 / GC864** has a built in echo canceller and a noise suppressor, tuned separately for the two audio paths; for the internal path the echo canceller parameters are suited to cancel the echo generated by a handset, while for the external audio path they are suited for a hands-free use.
For more information on the audio refer to the Hardware User Guide.

# 2.14 Converters

## 2.14.1 ADC Converter

The on board ADCs are 11-bit converter. They are able to read a voltage level in the range of 0÷2 volts applied on the ADC pin input, store and convert it into 11 bit word.

| | Min | Max | Units |
|---|---|---|---|
| Input Voltage range | 0 | 2 | Volt |
| AD conversion | - | 11 | bits |
| Resolution | - | < 1 | mV |
| Sampling rate | 1 (idle) | 60 (on traffic) | sec |

## 2.14.2 DAC Converter

The on board DAC is a 10 bit converter, able to generate an analogue value based a specific input in the range from 0 up to 1023. However, an external low-pass filter is necessary. See the HW User Guide for the details.

| | Min | Max | Units |
|---|---|---|---|
| Voltage range (filtered) | 0 | 2,6 | Volt |
| Range | 0 | 1023 | Steps |

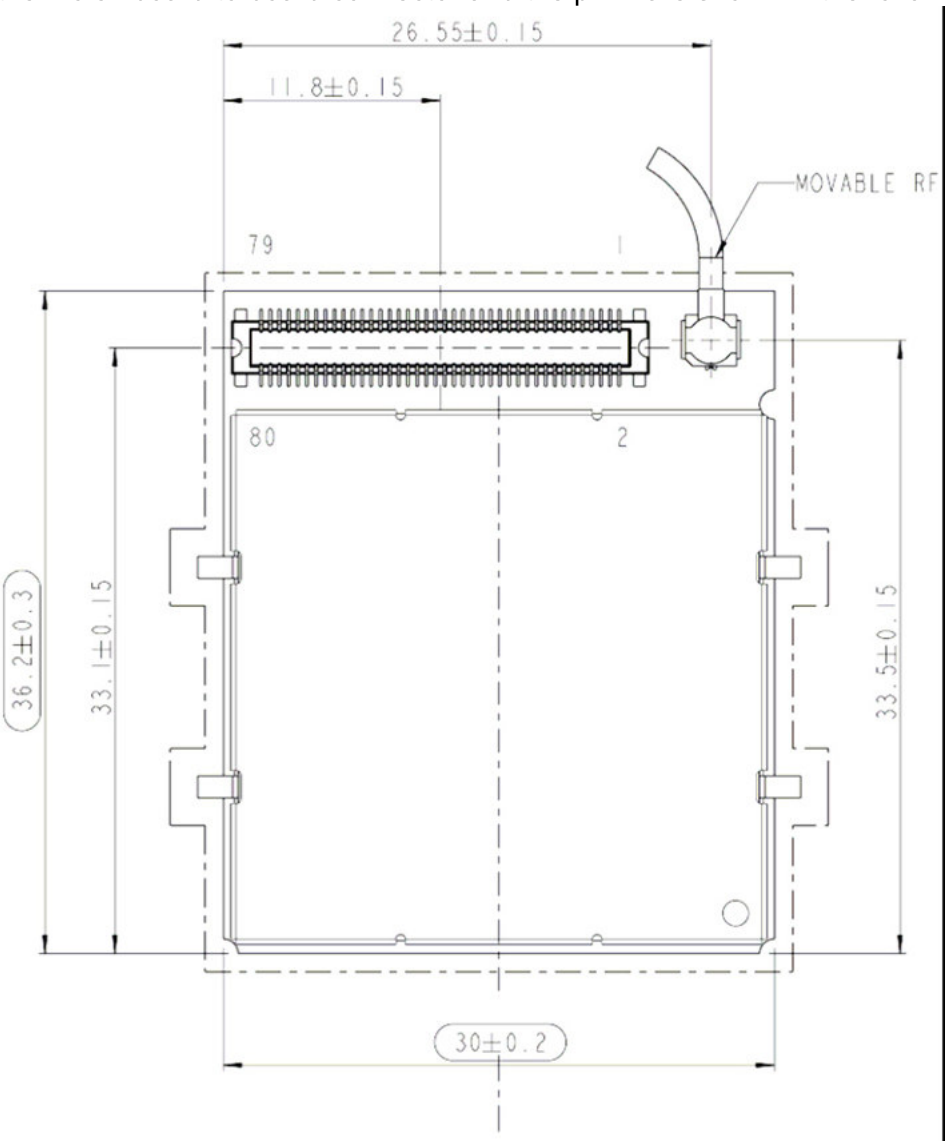
# 2.15 Mounting the GE864 on your Board

## 2.15.1 General

The **Telit GE864 modules** has been designed in order to be compliant with a standard lead-free SMT process. For detailed information about PCB pad design and conditions to use in SMT process please consult Hardware User Guide.

# 2.16 Mounting the GC864 on your board

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

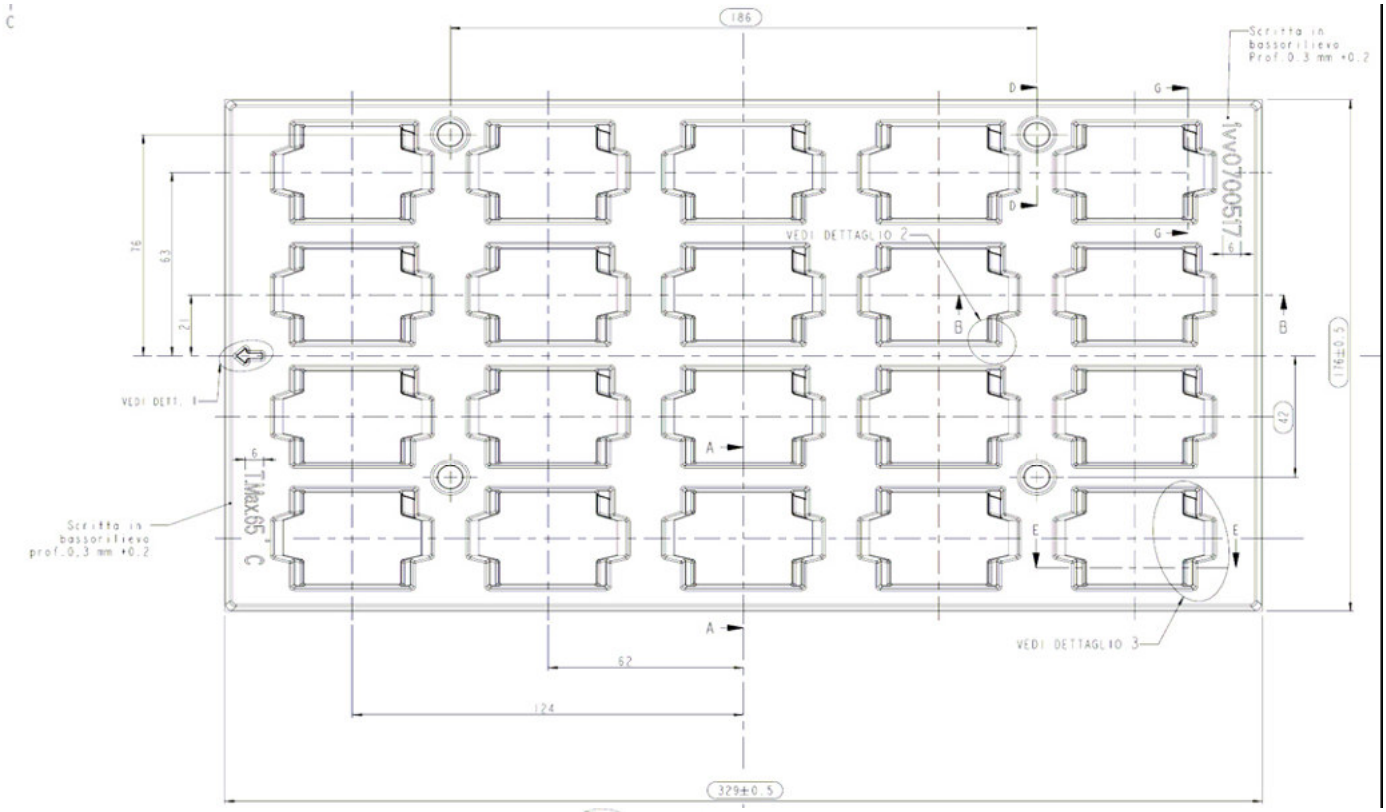


**NOTE:** metal tabs present on GC864 should be connected to GND

# 2.17 Packing system

The Telit GE864 and GC864 are packaged on trays of 20 pieces each. This is especially suitable for the GE864 according to SMT processes for pick & place movement requirements.

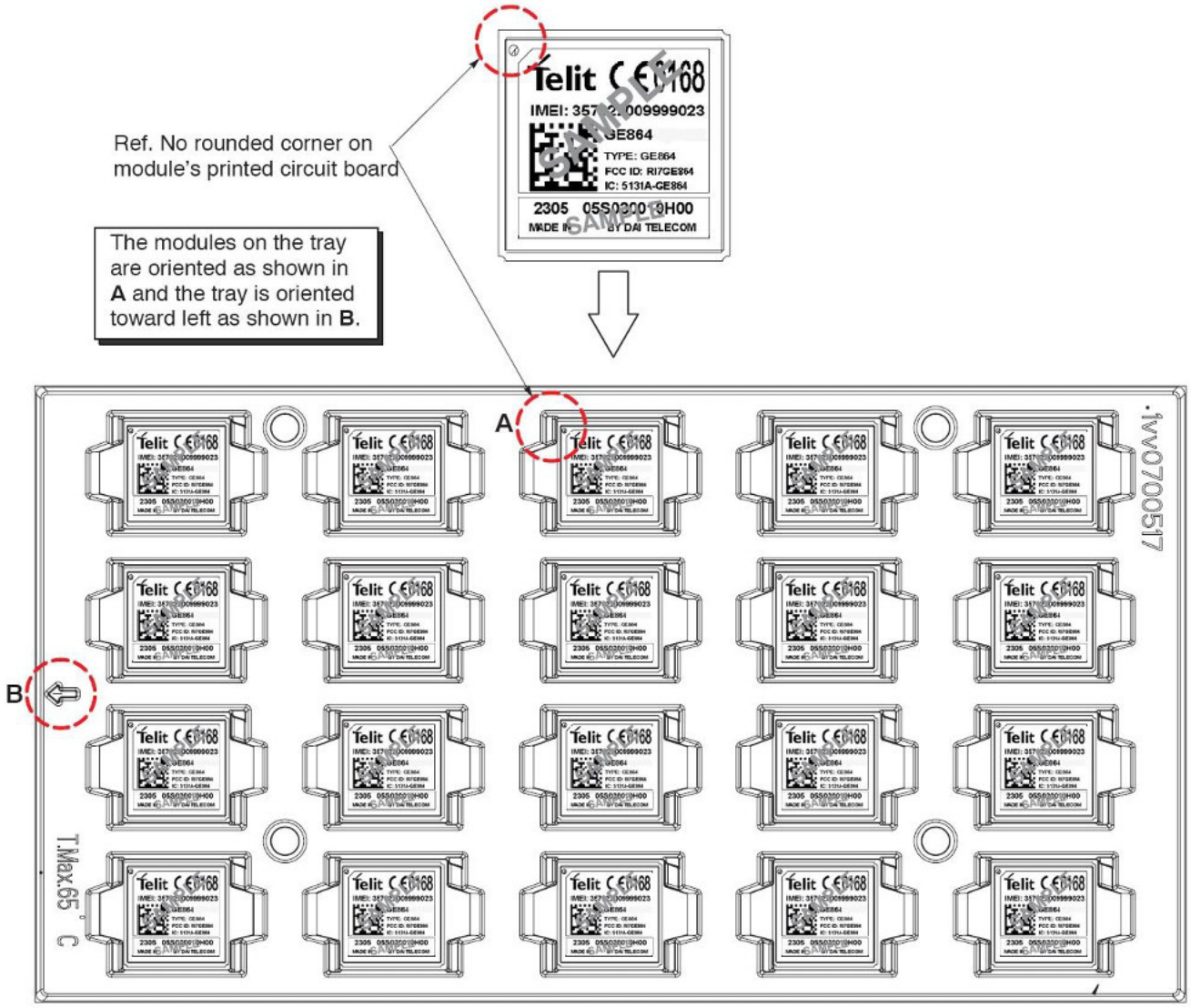



Section A-A

The size of the tray is: 329 x 176mm

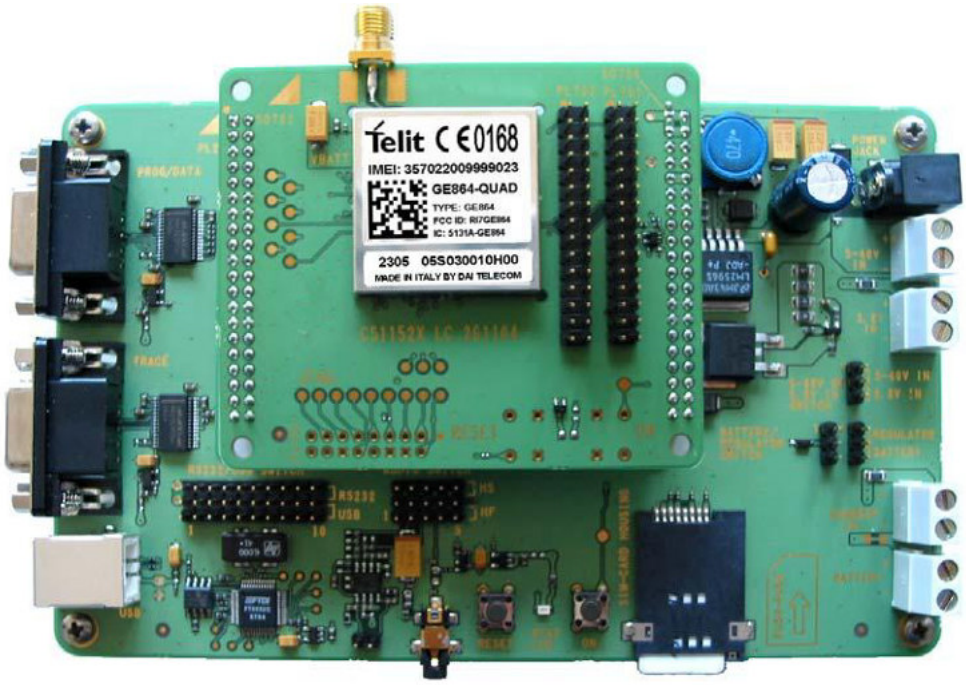
**NOTE**: These trays can withstand at the maximum temperature of 65° C.


Ref. No rounded corner on module's printed circuit board
The modules on the tray are oriented as shown in A and the tray is oriented toward left as shown in B.
A
B
T Max 65° C
SAMPLE

# 3 Evaluation Kit

In order to assist you in the development of your **Telit GE864 / GC864 module** based application, Telit can supply the **EVK2 Evaluation Kit** with appropriate power supply, SIM card housing, RS 232 serial port level translator, direct UART connection, Handset, Headset and Hands-free (car kit) audio, antenna.
The **EVK2** provides a fully functional solution for a complete data/phone application.
The standard serial RS232 9 pin connector placed on the **Evaluation Kit** allows the connection of the **EVK2** system with a PC or other DTE.
The development of the applications utilizing the **Telit GE864 / GC864 module** must present a proper design of all the interfaces towards and from the module (e.g. power supply, audio paths, level translators), otherwise a decrease in the performances will be introduced or, in the worst case, a wrong design can even lead to an operating failure of the module.
In order to assist the hardware designer in his project phase, the **EVK2** board presents a series of different solutions, which will cover the most common design requirements on the market, and which can be easily integrated in the OEM design as building blocks or can be taken as starting points to develop a specific one.




GE864 Evaluation Kit

For a detailed description of the **Telit Evaluation Kit** refer to the documentation provided with the Telit **GE864 / GC864** Hardware User Guide and EVK2 User Manual.

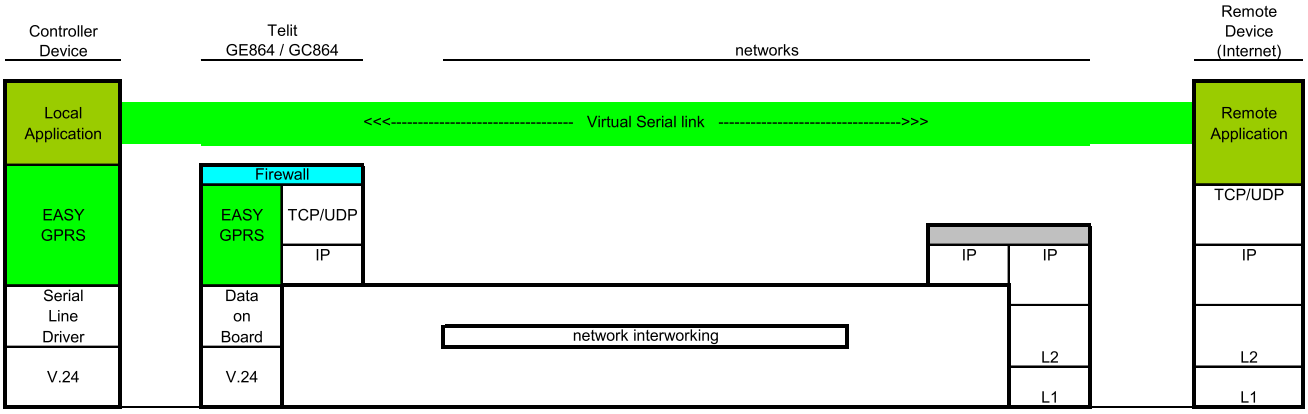
 

# 4 Software Features

## 4.1 Enhanced Easy GPRS Extension

### 4.1.1 Overview

The Easy GPRS feature allows the **Telit GE864 / GC864** user to contact a device in internet and establish with it a raw data flow over the GPRS and Internet networks.
This feature can be seen as a way to obtain a "virtual" serial connection between the Application Software on the Internet machine involved and the controller of the **Telit GE864 / GC864** module, regardless of all the software stacks underlying.
An example of the protocol stack involved in the devices is reported:




This particular implementation allows to the devices interfacing to the **Telit GE864 / GC864** module the use of the GPRS and Internet packet service without the need to have an internal TCP/IP stack since this function is embedded inside the module.
Easy GPRS overcomes some of the known limitations of the previous implementation and implements some new features such as:

- Keep the GPRS context active even after the closing of a socket, allowing the application to keep the same IP address;
- Also Mobile terminated (incoming) connections can be made, now it is possible to receive incoming TCP connection requests;

- A new internal firewall has been implemented in order to guarantee a certain level of security on internet applications.

### 4.1.2 Easy GPRS definition

The Easy GPRS feature provides a way to replace the need of an Internet TCP/IP stack at the terminal equipment side. The steps that will be required to obtain a virtual serial connection (that is actually a socket) to the Internet peer are:

- configuring the GPRS Access
- configuring the embedded TCP/IP stack behavior
- defining the Internet Peer to be contacted
- request the GPRS and socket connections to be opened (host is connected)
- exchange raw data
- close the socket and GPRS context

All these steps are achieved through AT commands.
As for common modem interface, two logical status are involved: command mode and data traffic mode.

- In Command Mode (CM), some AT commands are provided to configure the Data Module Internet stack and to start up the data traffic.
- In data traffic mode (Socket Mode, SKTM), the client can send/receive a raw data stream which will be encapsulated in the previously configured TCP / IP packets which will be sent to the other side of the network and vice versa. Control plane of ongoing socket connection is deployed internally to the module.

For more detailed information regarding GPRS please consult Easy GPRS User Guide and AT Commands Reference Guide.

## 4.2 Jammed Detect & Report Extension

### 4.2.1 Overview

The Jammed Detect & Report feature allows a **Telit GE864 / GC864** to detect the presence of a disturbing device such as a Communication Jammer and give indication to the user and/or send a report of that to the network.
This feature can be very important in alarm, security and safety applications that rely on the module for the communications. In these applications, the presence of a Jammer device can compromise the whole system reliability and functionality and therefore shall be recognized and reported either to the local system for countermeasure actions or to the network providing remote actions.
An example scenario could be an intrusion detection system that uses the module for sending the alarm indication for example with an SMS to the system owner, and a thief income using a Jammer to prevent any communication between the GSM module and the network.
In such a case, the module detects the Jammer presence even before the break in and can trigger an alarm siren, other communication devices (PSTN modem) or directly report this condition to the network that can provide further security services for example sending SMS to the owner or police. Obviously this last service depends also from network infrastructure support and it may not be supported by some networks.

# 4.3 CMUX

CMUX (Converter-Multiplexer) is a multiplexing protocol implemented in the Telit module that can be used to send any data, SMS, fax, TCP data.

## 4.3.1 Product architecture

The Multiplexer mode enables one serial interface to transmit data to four different customer applications. This is achieved by providing four virtual channels using a Multiplexer (Mux).

This is especially advantageous when a fax/data/GPRS call is ongoing. Using the Multiplexer features, e.g. controlling the module or using the SMS service can be done via the additional channels without disturbing the data flow; access to the second UART is not necessary.

Furthermore, several accesses to the module can be created with the Multiplexer. This is of great advantage when several independent electronic devices or interfaces are used.

To access the three virtual interfaces, both the GSM engine and the customer application must contain Mux components, which communicate over the multiplexer protocol.

In Multiplexer mode, AT commands and data are encapsulated into packets. Each packet has channel identification and may vary in length.

## 4.3.2 Implementation feature and limitation

- 7.10 CMUX Basic Option used
- CMUX implementation support four full DLCI (Serial Port)
- CMUX can operate only at Fixed rate, if AT+CMUX is sent with IPR=0 an Error is returned, with a maximum rate of 115200
- Every instance has its own user profile storage in NVM
- Independent setting of unsolicited message.
- In case of GPS product one serial port can be dedicated to NMEA output.
- Every Instance has its own independent flow control.

**NOTE**: More details about the Multiplexer mode are available in the Cmux Product Specification

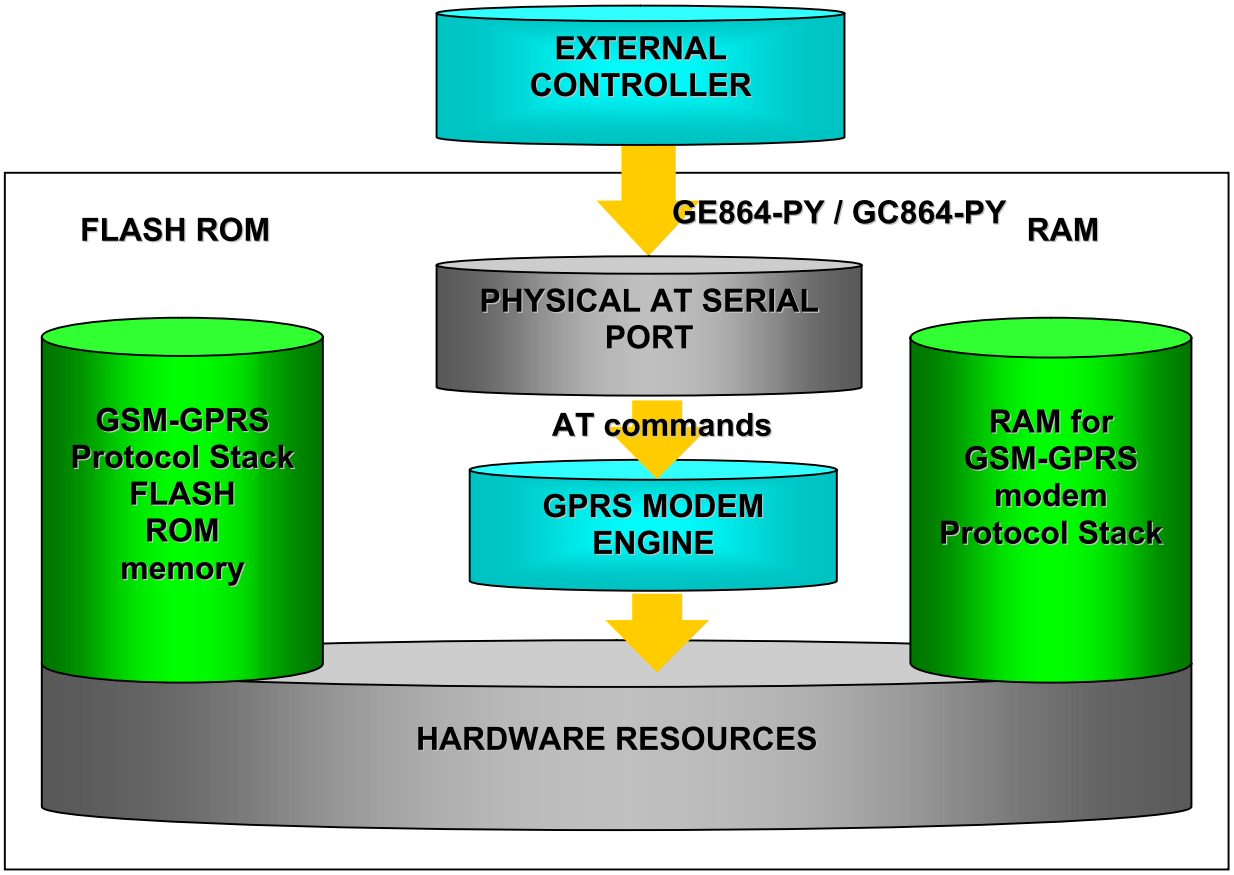
# 4.4 Easy Script Extension - Python interpreter

## 4.4.1 Overview

**NOTE**: This feature is available only for the **Telit GE864-PY and GC864-PY.**

The Easy Script Extension is a feature that allows driving the modem "internally", writing the controlling application directly in a nice high level language: Python.
The Easy Script Extension is aimed at low complexity applications where the application was usually done by a small microcontroller that managed some I/O pins and the GE864-PY and GC864-PY through the AT command interface.

A schematic of such a configuration can be:

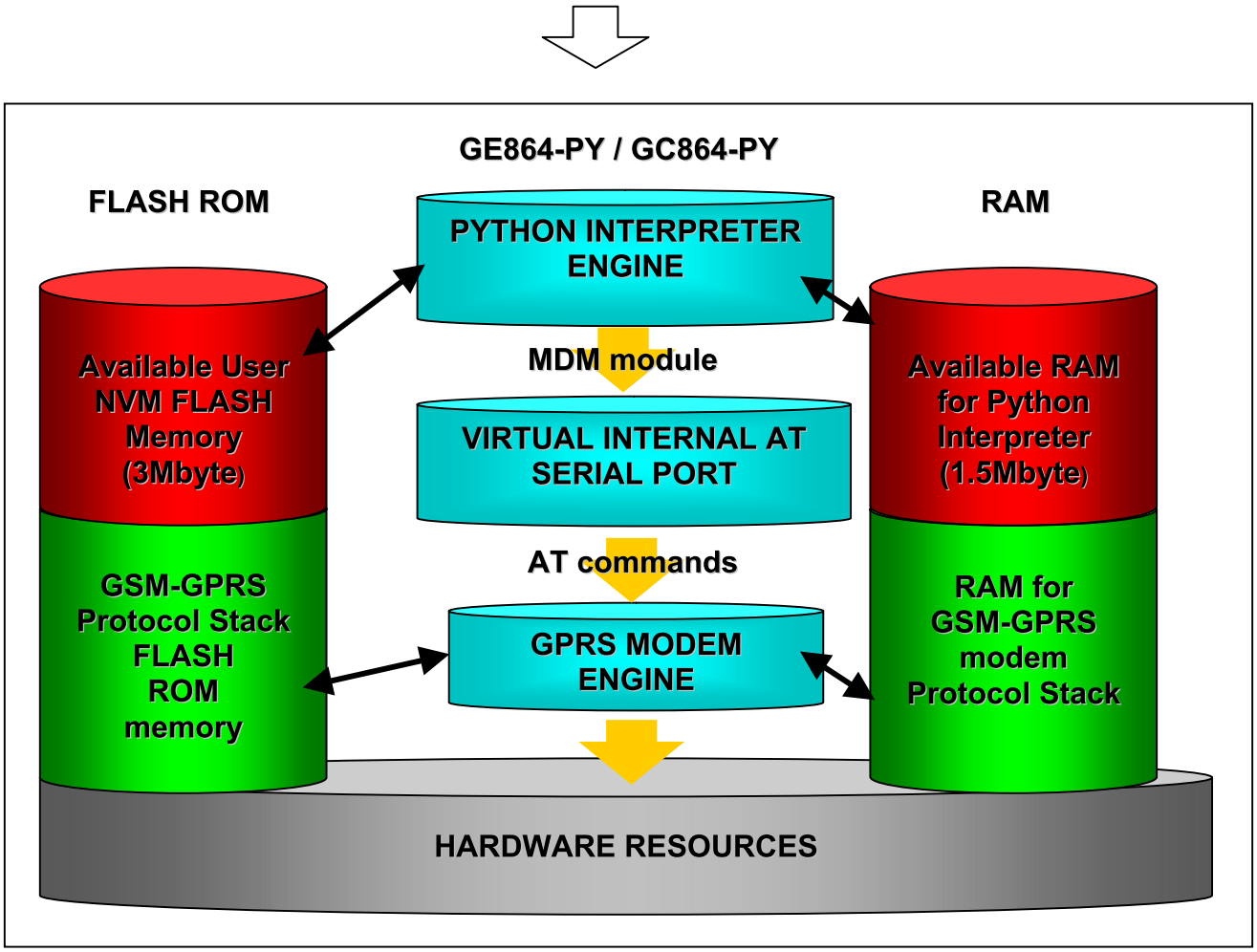


In order to eliminate this external controller, and further simplify the programming of the sequence of operations, inside the GE864-PY / GC864-PY it is included:

- **Python script interpreter engine v. 1.5.2+**
- **around 3MB of Non Volatile Memory room for the user scripts and data**
- **1.2 MB RAM reserved for Python engine usage**

A schematic of this approach is:



### 4.4.2 Python 1.5.2+ Copyright Notice

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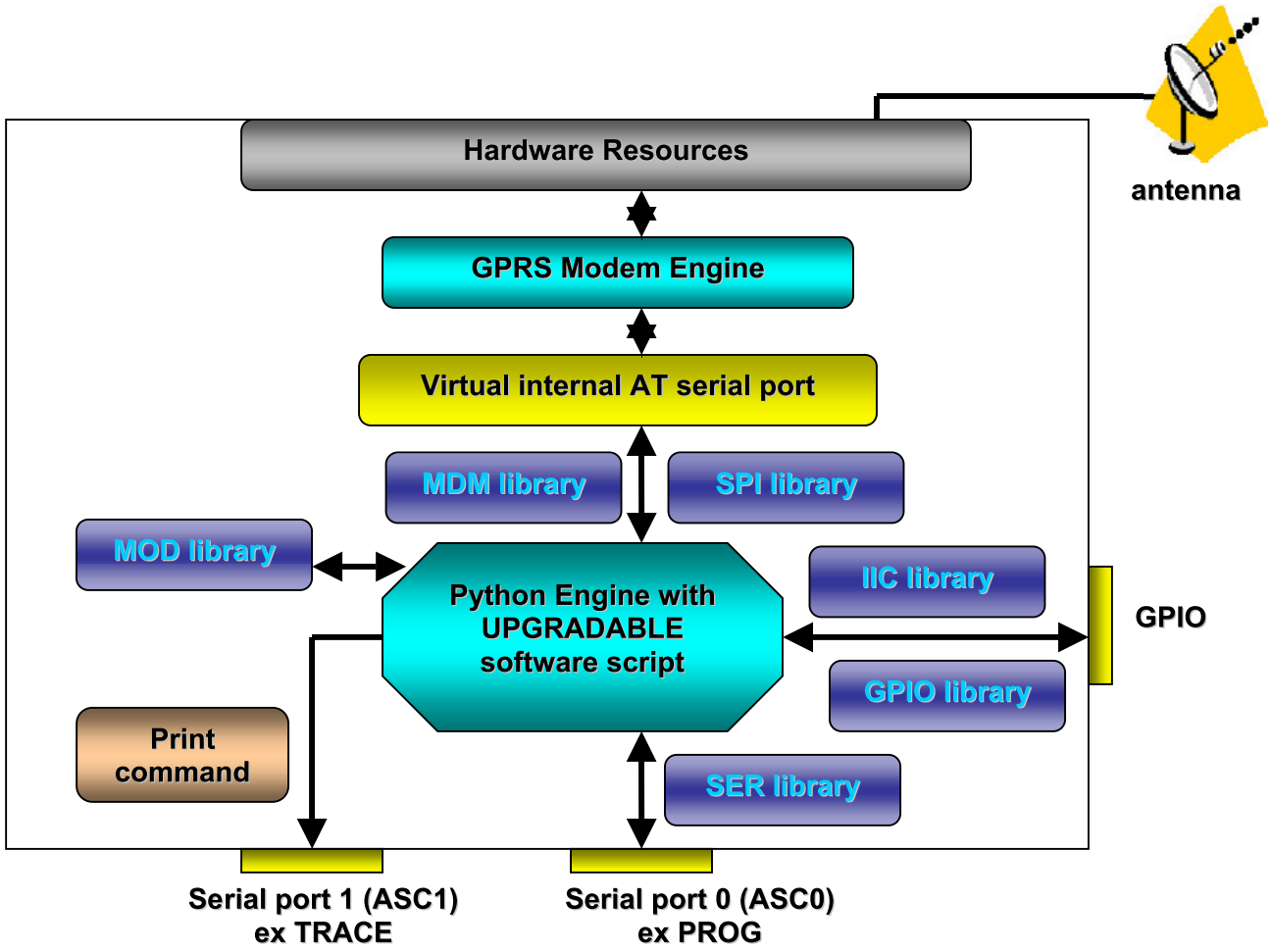
### 4.4.3 Python implementation description

Python scripts are text files stored in NVM inside the **Telit GE864-PY / GC864-PY**. There's a file system inside the module that allows to write and read files with different names on one single level (no subdirectories are supported).
**Attention**: it is possible to run only one Python script at the time.

The Python script is executed in a task inside the **Telit module** at the lowest priority, making sure this does not interfere with GSM/GPRS normal operations. This allows serial ports, protocol stack etc. to run independently from the Python script.
The Python script interacts with the **Telit module** functionality through four build-in interfaces.



- **The MDM interface** is the most important one. It allows Python script to send AT commands, receive responses and unsolicited indications, send data to the network and receive data from the network during connections. It is quite the same as the usual serial port interface in the **Telit module**. The difference is that this interface is not a real serial port but just an internal software bridge between Python and mobile internal AT command handling engine. All AT commands working in the **Telit module** are working in this software interface as well. Some of them have no meaning on this interface, such as those regarding serial port settings. The usual concept of flow control keeps its meaning over this interface, but it's managed internally.
- **The SER interface** allows Python script to read from and write to the *real*, physical serial port where usually the AT command interface resides, for example to read NMEA information from a GPS device. When Python is running this serial port is free to be used by Python script because it is not used as AT command interface since the AT parser is mapped into the internal virtual serial port. No flow control is available from Python on this port.
- **The GPIO interface** allows Python script to handle general purpose input output faster than through AT commands, skipping the command parser and going directly to control the pins.
- **The MOD interface** is a collection of useful functions.
- **The IIC interface** is an implementation on the Python core of the IIC bus Master. It allows Python to create one or more IIC bus on the available GPIO pins.
- **The SPI interface** is an implementation on the Python core of the SPI bus Master. It allows Python to create one or more SPI bus on the available GPIO pins.

For the debug, the print command is directly forwarded on the EMMI TX pin (second serial port) at baud rate115200bps 8N1.

### 4.4.4 Python core supported features

The Python core version is 1.5.2+ (string methods added to 1.5.2).
You can use all Python statements and almost all Python built-in types and functions.

.

| Built-in types and functions **not** supported | Available modules (all **others** are **not** supported) |
|---|---|
| complex | marshal |
| float | imp |
| long | _main_ |
| docstring | _builtin_ |
| | sys |
| | md5 |

### 4.4.5 Python Build-in Custom Modules

Several build in custom modules have been included in the python core, specifically aimed at the hardware environment of the module.

The build in modules included are:

| | |
|---|---|
| ***MDM*** | interface between Python and mobile internal AT command handling |
| ***SER*** | interface between Python and mobile internal serial port ASC0 direct handling |
| ***GPIO*** | interface between Python and mobile internal general purpose input output direct handling |
| ***MOD*** | interface between Python and mobile miscellaneous functions |
| ***IIC*** | custom software Inter IC bus that can be mapped on creation over almost any GPIO pin available |
| ***SPI*** | custom software Serial Protocol Interface bus that can be mapped on creation over almost any GPIO pin available |

**NOTE:** More details about the Python modules are available in the Easy Script in Python Guide.

# 4.5 SAP: SIM Access Profile

## 4.5.1 Product architecture

The SAP feature allows the module to use the SIM of a remote SIM Server. This feature is implemented using special AT Command on a Virtual circuit of the CMUX interface.

## 4.5.2 Implementation feature

- SAP is based on 7.10 CMUX Basic Option used
- Only SAP Client features
- Logic HW flow control is recommended on the Virtual instance selected for the SAP command.

## 4.5.3 Remote SIM Message Command Description

The module sends request commands to the client application through a binary message that is crowned in the CMUX message. The client application shall extract the message and send it to the SAP server, through the appropriate protocols (e.g. by RFCOMM, that is the Bluetooth serial port emulation entity).
The client application shall extract all the messages sent by SAP server and put them in the CMUX message, to sent to the module.

The module satisfies the following feature requirements:

- Connection management
- Transfer APDU
- Transfer ATR
- Power SIM on
- Report Status
- Error Handling

Every feature needs some procedures support:

| Feature | Procedure |
|---|---|
| Connection Management | Connect |
| | Report Status |

| | |
|---|---|
| | Transfer ATR |
| | Disconnection Initiated by the Client |
| | Disconnection Initiated by the Server |
| Transfer APDU | Transfer APDU |
| Transfer ATR | Transfer ATR |
| Power SIM on | Power SIM on |
| | Transfer ATR |
| Report Status | Report Status |
| Error Handling | Error Response |

Report Status, Disconnection Initiated by the Server and Error Response are independent messages sent by server. The other procedures consist of couples of messages, started by client.

**NOTE**: More details about the SAP are available in the SAP Product Specification

# 5 AT Commands

The Telit GE864 / GC864 module can be driven via the serial interface using the standard AT commands[1].
The Telit GE864 / GC864 module is compliant with:

1. Hayes standard AT command set, in order to maintain the compatibility with existing SW programs.
2. ETSI GSM 07.07 specific AT command and GPRS specific commands.
3. ETSI GSM 07.05 specific AT commands for SMS (Short Message Service) and CBS (Cell Broadcast Service)
4. FAX Class 1 compatible commands

Moreover the Telit GE864 / GC864 module supports also Telit proprietary AT commands for special purposes.
For a more information about AT commands supported by GE864/GC864 modules please refer to document AT Commands Reference Guide, code 80000ST10025a.

[1] The AT is an ATTENTION command and is used as a prefix to other parameters in a string. The AT command combined with other parameters can be set up in the communications package or typed in manually as a command line instruction.

# 6 Conformity Assessment Issues

The Telit GE864 and GC864 are assessed to be conform to the R&TTE Directive.
If the antenna connected to the module is conforming to the requirements specified under this document, it requires no further evaluation under **Article 3.2** of the R&TTE Directive and do not require further involvement of a R&TTE Directive Notified Body for the final product.
In all other cases, or if the manufacturer of the final product is in doubt then the equipment integrating the radio module must be assessed against **Article 3.2** of the R&TTE Directive**.**

In all cases assessment of the final product must be made against the Essential requirements of the R&TTE Directive **Articles 3.1(a)** and **(b)**, safety and EMC respectively, and any relevant **Article 3.3** requirements.

The Telit GE864 and GC864 are conforming to the following European Union Directives:

- R&TTE Directive 1999/5/EC (Radio Equipment & Telecommunications Terminal Equipments)
- Low Voltage Directive 73/23/EEC and product safety
- Directive 89/336/EEC for conformity for EMC

In order to satisfy the essential requisite of the R&TTE 99/5/EC directive, the GE864 module is compliant with the following standards:

- GSM (Radio Spectrum). Standard: EN 301 511 and 3GPP 51.010-1
- EMC (Electromagnetic Compatibility). Standards: EN 301 489-1 and EN 301 489-7
- LVD (Low Voltage Directive) Standards: EN 60 950

In this document and the Hardware User Guide, Software User Guide all the information you may need for developing a product meeting the R&TTE Directive is included.

Furthermore the Telit GE864 / GC864 module is FCC Approved as module to be installed in other devices. This device is to be used only for fixed and mobile applications. If the final product after integration is intended for portable use, a new application and FCC is required.
The Telit GE864 / GC864 is conforming with the following US Directives:

- Use of RF Spectrum. Standards: FCC 47 Part 24 (GSM 1900)
- EMC (Electromagnetic Compatibility). Standards: FCC47 Part 15

To meet the FCC's RF exposure rules and regulations:

- The system 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 3 dBi 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.

Manufacturers of mobile, fixed or portable devices incorporating this module are advised to clarify any regulatory questions and to have their complete product tested and approved for FCC compliance.

## 6.1 GE864-QUAD Conformity Assessment

**DECLARATION OF CONFORMITY**

We,
*Telit Communications S.p.A*

Of:
*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

declare under our sole responsibility that the product

***GE864-QUAD***

to which this declaration relates is in conformity with all the essential requirements of Directive 1999/05/EC

The conformity with the essential requirements of the European Directive 1999/05/EC has been verified against the following harmonized standards:

- ETSI EN 301 511 Mobile stations in GSM 900 and DCS1800;
- CENELEC EN 60950 Safety of information technology equipments;
- ETSI EN 301 489-7 EMC&ERM Specific for GSM and DCS telecommunications systems.

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:

***BABT, Balfour House, Churchfield Road, Walton-on-Thames, Surrey, KT12 2TD, United Kingdom***

Identification mark: **0168**

The technical documentation relevant to the above equipment will be held at:

*Telit Communications S.p.A*
*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

Trieste, ***08 february 2006***

Ing. Guido Walcher
Quality Assurance Director

06DOC04 MOD.003 02/06 REV.9

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PRODUCTS RvA C 276

BABT

# Certificate

This certificate is issued to

***TELIT Communications S.p.A.***

of

Viale Stazione di Prosecco 5/B
34010 Sgonico
Trieste
Italy

to certify that the Equipment known as

**GE864-QUAD**

as described in the Annex to this certificate
conforms to the essential requirements of Directive 1999/5/EC
of the European Parliament and European Council on the basis
of Technical Construction File number 22345_GE864-QUAD_rev1
in relation to the essential requirements of
Articles 3.1(a), 3.1(b) & 3.2 of the Directive.

Signed
On Behalf of BABT

Issue Date: 08 February 2006

Number: NC/12659 Issue: 01

This certificate is issued by BABT and represents a formal Notified Body opinion under Annex IV of Directive 1999/5/EC permitting the use of the BABT CE0168 mark on the equipment described above subject to the equipment meeting the compliance requirements of all applicable EU directives. This certificate is not transferable and remains the property of BABT.

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Balfour House • Churchfield Road • Walton-on-Thames • Surrey • KT12 2TD • United Kingdom

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## 6.2 GE864-PY Conformity Assessment

Telit Communications S.p.A.

**DECLARATION OF CONFORMITY**

We,

***Telit Communications S.p.A***

Of:

***Via Stazione di Prosecco, 5/b***
***34010 Sgonico (TRIESTE)***
***ITALY***

declare under our sole responsibility that the product

***GE864-PY***

to which this declaration relates is in conformity with all the essential requirements of Directive 1999/05/EC

The conformity with the essential requirements of the European Directive 1999/05/EC has been verified against the following harmonized standards:

- ETSI EN 301 511 v.9.0.2;
- CENELEC EN 60950:2001;
- ETSI EN 301 489-1: v.1.4.1;
- ETSI EN 301 489-7: v.1.2.1.

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:

***BABT, Balfour House, Churchfield Road, Walton-on-Thames, Surrey, KT12 2TD, United Kingdom***

Identification mark: **0168**

The technical documentation relevant to the above equipment will be held at:

***Telit Communications S.p.A***
***Via Stazione di Prosecco, 5/b***
***34010 Sgonico (TRIESTE)***
***ITALY***

Trieste, ***04 July 2006***

Ing. Guido Walcher
Quality Assurance Director

06DOC05 MOD.003 02/06 REV.9

 

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PRODUCTS RvA C 278

BABT

# Certificate

This certificate is issued to

***TELIT Communications S.p.A.***

of

Via Stazione di Prosecco 5/B
34010 Sgonico
Trieste
Italy

to certify that the Equipment known as

**GE864-PY**

as described in the Annex to this certificate
conforms to the essential requirements of Directive 1999/5/EC
of the European Parliament and European Council on the basis
of Technical Construction File number 24552_GE864-PY_rev1
in relation to the essential requirements of
Articles 3.1(a), 3.1(b) & 3.2 of the Directive.

Signed: A.J. Howell
On Behalf of BABT

Issue Date: 4th July 2006

Number: NC/12830 Issue: 01

This certificate is issued by BABT and represents a formal Notified Body opinion under Annex IV of Directive 1999/5/EC permitting the use of the BABT CE0168 mark on the equipment described above subject to the equipment meeting the compliance requirements of all applicable EU directives.
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# 6.3 GE863-QUAD/PY : RoHS certificate

Telit
Communications S.p.A.

## DECLARATION OF EU RoHS Compliance

We,

*Telit Communications S.p.A*

Of:

*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

declare under our sole responsibility that the products

***GE864-PY** (commercial name)*

*3990250650(internal code)*

&

***GE864-QUAD** (commercial name)*

*3990250648(internal code)*

to which this declaration relates, is in full compliance with EU Directive 2002/95/EC and subsequent amendments, on restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS).

The technical documentation or other information showing that electrical and electronic equipment which has put on the market, complies the requirements of regulation, will be held at:

*Telit Communications S.p.A*
*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

Trieste, *12 July 2006*

Ing. Sandro Spanghero
R&D Technical Director

Ing. Guido Walcher
Quality Assurance Director

 

## 6.4 GC864-QUAD: Conformity Assessment

**DECLARATION OF CONFORMITY**

We,
*Telit Communications S.p.A*

Of:
*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

declare under our sole responsibility that the product

***GC864-QUAD***

to which this declaration relates is in conformity with all the essential requirements of Directive 1999/05/EC

The conformity with the essential requirements of the European Directive 1999/05/EC has been verified against the following harmonized standards:

- ETSI EN 301 511 v.9.0.2;
- CENELEC EN 60950:2001;
- ETSI EN 301 489-1: v.1.4.1;
- ETSI EN 301 489-7: v.1.2.1.

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:

***BABT, Balfour House, Churchfield Road, Walton-on-Thames, Surrey, KT12 2TD, United Kingdom***

Identification mark: **0168**

The technical documentation relevant to the above equipment will be held at:

***Telit Communications S.p.A***
***Via Stazione di Prosecco, 5/b***
***34010 Sgonico (TRIESTE)***
***ITALY***

Trieste, ***28 July 2006***

Ing. Guido Walcher
Quality Assurance Director

06DOC10 MOD.003 02/06 REV.9

 

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# Certificate

This certificate is issued to

***TELIT Communications S.p.A.***

of

Via Stazione di Prosecco 5/B
34010 Sgonico
Trieste
Italy

to certify that the Equipment known as

**GC864-QUAD**

as described in the Annex to this certificate
conforms to the essential requirements of Directive 1999/5/EC
of the European Parliament and European Council on the basis
of Technical Construction File number 24383_GC864-QUAD_rev1
in relation to the essential requirements of
Articles 3.1(a), 3.1(b) & 3.2 of the Directive.

Signed: On Behalf of BABT

Issue Date: 28 July 2006

Number: NC/12869 Issue: 01

This certificate is issued by BABT and represents a formal Notified Body opinion under Annex IV of Directive 1999/5/EC permitting the use of the BABT CE0168 mark on the equipment described above subject to the equipment meeting the compliance requirements of all applicable EU directives. This certificate is not transferable and remains the property of BABT.

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# 6.5 GC864-PY: Conformity Assessment

## DECLARATION OF CONFORMITY

We,

***Telit Communications S.p.A***

Of:

***Via Stazione di Prosecco, 5/b***
***34010 Sgonico (TRIESTE)***
***ITALY***

declare under our sole responsibility that the product

***GC864-PY***

to which this declaration relates is in conformity with all the essential requirements of Directive 1999/05/EC

The conformity with the essential requirements of the European Directive 1999/05/EC has been verified against the following harmonized standards:

- ETSI EN 301 511 v.9.0.2;
- CENELEC EN 60950:2001;
- ETSI EN 301 489-1: v.1.4.1;
- ETSI EN 301 489-7: v.1.2.1.

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:

***BABT, Balfour House, Churchfield Road, Walton-on-Thames, Surrey, KT12 2TD, United Kingdom***

Identification mark: **0168**

The technical documentation relevant to the above equipment will be held at:

***Telit Communications S.p.A***
***Via Stazione di Prosecco, 5/b***
***34010 Sgonico (TRIESTE)***
***ITALY***

Trieste, ***28 July 2006***

Ing. Guido Walcher
Quality Assurance Director

06DOC11 MOD.003 02/06 REV.9

 

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BABT

# Certificate

This certificate is issued to

***TELIT Communications S.p.A.***

of

Via Stazione di Prosecco 5/B
34010 Sgonico
Trieste
Italy

to certify that the Equipment known as

**GC864-PY**

as described in the Annex to this certificate
conforms to the essential requirements of Directive 1999/5/EC
of the European Parliament and European Council on the basis
of Technical Construction File number 23546_GC864-PY_rev1
in relation to the essential requirements of
Articles 3.1(a), 3.1(b) & 3.2 of the Directive.

Signed: On Behalf of BABT

Issue Date: 28 July 2006

Number: NC/12870 Issue: 01

This certificate is issued by BABT and represents a formal Notified Body opinion under Annex IV of Directive 1999/5/EC permitting the use of the BABT CE0168 mark on the equipment described above subject to the equipment meeting the compliance requirements of all applicable EU directives. This certificate is not transferable and remains the property of BABT.

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# 6.6 GE863-QUAD/PY : RoHS certificate

Telit
Communications S.p.A.

## DECLARATION OF EU RoHS Compliance

We,

*Telit Communications S.p.A*

Of:

*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

declare under our sole responsibility that the products

***GC864-PY** (commercial name)*

*3990250676(internal code)*

*&*

***GC864-QUAD** (commercial name)*

*3990250675(internal code)*

to which this declaration relates, is in full compliance with EU Directive 2002/95/EC and subsequent amendments, on restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS).

The technical documentation or other information showing that electrical and electronic equipment which has put on the market, complies the requirements of regulation, will be held at:

*Telit Communications S.p.A*
*Via Stazione di Prosecco, 5/b*
*34010 Sgonico (TRIESTE)*
*ITALY*

Trieste, *12 July 2006*

Ing. Sandro Spanghero
R&D Technical Director

Ing. Guido Walcher
Qualiy Assurance Director

 

# 6.7 GE864-QUAD/PY: FCC Equipment Authorization

TCB

GRANT OF EQUIPMENT AUTHORIZATION

TCB

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

MET Laboratories, Inc.
914 W. Patapsco Avenue
Baltimore, MD 21230-3432

Date of Grant: 07/13/2006
Application Dated: 07/13/2006

Telit Communications S.p.A.
Viale Stazione di Prosecco 5/b
Trieste, 34010
Italy

Attention: Andrea Fragiacomo , Ing.

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: RI7GE864
Name of Grantee: Telit Communications S.p.A.
Equipment Class: PCS Licensed Transmitter
Notes: GSM 850/1900MHz Module

| Grant Notes | FCC Rule Parts | Frequency Range (MHZ) | Output Watts | Frequency Tolerance | Emission Designator |
|---|---|---|---|---|---|
| | 22H | 824.2 - 848.8 | 1.7 | 1.0 PM | 290KGXW |
| | 24E | 1850.2 - 1909.8 | 0.36 | 1.0 PM | 290KGXW |

Power Output is ERP for Part 22 and EIRP for Part 24. 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. Installers and end-users must be provided with installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

 

# 6.8 GC864-QUAD/PY: FCC Equipment Authorization

TCB

GRANT OF EQUIPMENT AUTHORIZATION

TCB

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

MET Laboratories, Inc.
914 W. Patapsco Avenue
Baltimore, MD 21230-3432

Date of Grant: 07/28/2006

Application Dated: 07/28/2006

Telit Communications S.p.A.
Viale Stazione di Prosecco 5/b
Trieste, 34010
Italy

Attention: Andrea Fragiacomo , Ing.

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: RI7GC864
Name of Grantee: Telit Communications S.p.A.
Equipment Class: PCS Licensed Transmitter
Notes: Quad-Band GSM/GPRS module - Type: GC864

| Grant Notes | FCC Rule Parts | Frequency Range (MHZ) | Output Watts | Frequency Tolerance | Emission Designator |
|---|---|---|---|---|---|
| | 22H | 824.2 - 848.8 | 1.56 | 1.0 PM | 290KGXW |
| | 24E | 1850.2 - 1909.8 | 0.27 | 1.0 PM | 290KGXW |

Power Output is ERP for Part 22 and EIRP for Part 24. 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. Installers and end-users must be provided with installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

 

# 6.9 GE864-QUAD/PY: IC Equipment Authorization

GRANT OF EQUIPMENT CERTIFICATION

THE FOLLOWING EQUIPMENT HAS BEEN TESTED
AND CERTIFIED UNDER
INDUSTRY CANADA
RSS 132 ISSUE 1 PROVISIONAL AUG. 2002, RSS 133 ISSUE 3, JUNE 2005

CB

Issued By:
MET Laboratories, Inc.
914 W. Patapsco Avenue
Baltimore, Maryland 21230
Laboratory Number: 2043

CB

Equipment Certification is hereby issued to the Identified Certificate Holder and is VALID ONLY for the equipment identified herein.
NOT TRANSFERABLE

**FILE/CERTIFICATE NUMBER: 074-07-2006-20240**

**CERTIFICATION NUMBER: 5131A-GE864**

| | | | |
|---|---|---|---|
| **Issued to:** | Telit Communications S.p.A | **Date of Grant:** | July 11, 2006 |
| **Address:** | Viale Stazione di Prosecco 5/B<br>I-34010 Trieste, Italy | | |

| | |
|---|---|
| **Nature of Application:** | Original |
| **Equipment Description:** | GSM 850/1900MHz Module |
| **Equipment Category:** | Category I |

**Model Number(s)**

GE864-QUAD
GE864-PY

| | |
|---|---|
| **Conducted RF Power or Field Strength:** | 1.7 Watts and 0.36 Watts |
| **Frequency Range:** | 824.2-848.8MHz and 1850.2-1909.8 MHz |
| **Bandwidth(s):** | 290 KHz |
| **Emission Designations:** | 290KGXW |
| **Antenna Information:** | NA |

**Test Lab:** Cetecom S.A. Parque Tecnologico de Andaluci, C/Severo Ochoa 2, 29590 Campanillas, Malaga, Spain
rorejas@cetecom.es Tel: 34-952-61-93-57
**Test Lab IC Site Number:** IC-4621

**Notes:** Power Output is ERP for Part 22 and EIRP for Part 24. 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. Installers and end-users must be provided with installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

Certification of equipment means only that the equipment met the requirements of the above noted specification(s). License applications, where applicable to use certified equipment, are acted on accordingly by the issuing office and will depend on the existing radio environment, service and location of operation. This certificate is issued on condition that the holder complies and will continue to comply with requirements and procedures issued by Industry Canada.

ISSUED UNDER THE AUTHORITY OF THE MINISTER OF INDUSTRY

Kevin Mehaffey
Manager, EMC Laboratory
Printed: July 11, 2006

DOC-ICR001 3/11/2005

# 6.10 GC864-QUAD/PY: IC Equipment Authorization

MET

**GRANT OF EQUIPMENT CERTIFICATION**

THE FOLLOWING EQUIPMENT HAS BEEN TESTED
AND CERTIFIED UNDER
INDUSTRY CANADA
RSS 132 ISSUE 1 PROVISIONAL AUG. 2002, RSS 133 ISSUE 3, JUNE 2005

CB

Issued By:
**MET Laboratories, Inc.**
914 W. Patapsco Avenue
Baltimore, Maryland 21230
Laboratory Number: 2043

CB

Equipment Certification is hereby issued to the Identified Certificate Holder and is VALID ONLY for the equipment identified herein.
La certification d'équipement est par ceci publiée au support identifié de certificate et est VALIDE SEULEMENT pour l'équipement identifié ci-dessus
NOT TRANSFERABLE / NON TRANSMISSIBLE

**FILE/CERTIFICATE NUMBER: 081-07-2006-20414**

**CERTIFICATION NUMBER: IC: 5131A-GC864**

| | | | |
|---|---|---|---|
| **Issued to/Délivré a:** | Telit Communications S.p.A | **Date of Grant:** | July 28, 2006 |
| **Address:** | Viale Stazione di Prosecco 5/B<br>I-34010 Trieste, Italy | | |

| | |
|---|---|
| **Nature of Application/Nature d'Application:** | Original |
| **Equipment Description/Genre de Matériel:** | Quad-Band GSM/GPRS module |
| **Equipment Category/Catégorie de Matériel:** | Category I |
| **Model Number(s)/Marque et Modele** | GC864-QUAD<br>GC864-PY |
| **Conducted RF Power or Field Strength/Puissance H.F.:** | 1.56 Watts(eirp) and 0.27 Watts(erp) |
| **Frequency Range/Bande de Fréquences:** | 824.2-848.8MHz and 1850.2-1909.8 MHz |
| **Bandwidth(s)/ largeurs de bande:** | 290 KHz |
| **Emission Designations/Genre D'Émission:** | 290KGXW |
| **Antenna Information/ l'information d'antenne:** | N/A |

**Test Lab:** rorejas@cetecom.es Tel: 34-952-61-93-57
IC-4621

**Notes:** Power Output is ERP for Part 22 and EIRP for Part 24. 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. Installers and end-users must be provided with installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

Certification of equipment means only that the equipment met the requirements of the above noted specification(s). License applications, where applicable to use certified equipment, are acted on accordingly by the issuing office and will depend on the existing radio environment, service and location of operation. This certificate is issued on condition that the holder complies and will continue to comply with requirements and procedures issued by Industry Canada.

L'homologation de matériel terminal signife seulement qu'il est conforme aux exigencies du cahier des charges mentionné ci-dessus. Les demandes de licence, le cas échéant en vue di l-utilisation de matériel cerifié seront traitées en conséquence par le bereau chargé de delivrer les dites licences, en tenant compte du milieu radioélectrique ambiant, du service radio existent et de l'emplacement de la station. Le présent certificate est délivré à condition que le détenteur se conforme et continue à se conformer aux cahiers des charges et procédures sur les norms radioélectriques publiées par le ministère.

ISSUED UNDER THE AUTHORITY OF THE MINISTER OF INDUSTRY
DELIVRE AVEC L'AUTORISATION DU MINISTRE DES INDUSTRIES

Kevin Mahaffey
Manager, EMC Laboratory
Printed: July 28, 2006

C MET

DOC-ICR.001 3/11/2005

# 7 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

 

# 8 GE864 and GC864 Technical Support

Telit's technical support to **GE864** and **GC864** wireless modems customers consists in:

• Technical documentation: available for download into the Website www.telit.com >Products >Modules > selected model.
• Engineering support: accessible via E-Mail service with 48 hr replies assured under normal conditions.

 

# 9 List of acronyms

| | |
|---|---|
| **ACM** | Accumulated Call Meter |
| **ASCII** | American Standard Code for Information Interchange |
| **AT** | Attention commands |
| **CB** | Cell Broadcast |
| **CBS** | Cell Broadcasting Service |
| **CCM** | Call Control Meter |
| **CLIP** | Calling Line Identification Presentation |
| **CLIR** | Calling Line Identification Restriction |
| **CMOS** | Complementary Metal-Oxide Semiconductor |
| **CR** | Carriage Return |
| **CSD** | Circuit Switched Data |
| **CTS** | Clear To Send |
| **DAI** | Digital Audio Interface |
| **DCD** | Data Carrier Detected |
| **DCE** | Data Communications Equipment |
| **DRX** | Data Receive |
| **DSR** | Data Set Ready |
| **DTA** | Data Terminal Adaptor |
| **DTE** | Data Terminal Equipment |
| **DTMF** | Dual Tone Multi Frequency |
| **DTR** | Data Terminal Ready |
| **EMC** | Electromagnetic Compatibility |
| **ETSI** | European Telecommunications Equipment Institute |
| **FTA** | Full Type Approval (ETSI) |
| **GPRS** | General Radio Packet Service |
| **GSM** | Global System for Mobile communication |
| **HF** | Hands Free |
| **IMEI** | International Mobile Equipment Identity |
| **IMSI** | International Mobile Subscriber Identity |
| **IRA** | International Reference Alphabet |
| **ITU** | International Telecommunications Union |
| **IWF** | Inter-Working Function |
| **LCD** | Liquid Crystal Display |
| **LED** | Light Emitting Diode |
| **LF** | Linefeed |
| **ME** | Mobile Equipment |
| **MMI** | Man Machine Interface |
| **MO** | Mobile Originated |
| **MS** | Mobile Station |

 

| | |
|---|---|
| **MT** | Mobile Terminated |
| **OEM** | Other Equipment Manufacturer |
| **PB** | Phone Book |
| **PDU** | Protocol Data Unit |
| **PH** | Packet Handler |
| **PIN** | Personal Identity Number |
| **PLMN** | Public Land Mobile Network |
| **PUCT** | Price per Unit Currency Table |
| **PUK** | PIN Unblocking Code |
| **RACH** | Random Access Channel |
| **RLP** | Radio Link Protocol |
| **RMS** | Root Mean Square |
| **RTS** | Ready To Send |
| **RI** | Ring Indicator |
| **SCA** | Service Center Address |
| **SIM** | Subscriber Identity Module |
| **SMD** | Surface Mounted Device |
| **SMS** | Short Message Service |
| **SMSC** | Short Message Service Center |
| **SS** | Supplementary Service |
| **TIA** | Telecommunications Industry Association |
| **UDUB** | User Determined User Busy |
| **USSD** | Unstructured Supplementary Service Data |

 

# 10 Document Change Log

| Revision | Date | Changes |
|---|---|---|
| DRAFT #0 | | Draft for comments |
| DRAFT #1 | 23/06/2005 | Updated Para 2.16 Interfaces on GE864 and Pins allocation<br>Added BGA Balls layout<br>Updated Para 2.17<br>Updated Para 2.18<br>Updated Para 3 |
| DRAFT #2 | 04/08/2005 | 1 Overview: updated<br>2.3 Environmental requirements: changed<br>2.6 reference sensitivity: updated<br>2.16: Interfaces on GE864 and Pins allocation: changed<br>2.17 with all info regarding the soldering process: changed<br>Disclaimer: added<br>Safety Recommendation: added<br>AT commands Availability table: added |
| ISSUE #3 | 25/01/2006 | GC864 drawings and size: added<br>GC864 Antenna connector: added<br>RF Transmission Monitor: added<br>DAC Converter: changed<br>GE864 balls allocation: E10 ball now reserved<br>GC864 pins allocation: added<br>Mounting the GC864 on your board: added<br>Conformity assessment Issues: changed<br>GE864-QUAD Conformity assessment: added<br>Safety Recommendations: changed<br>GE864 and GC864 Technical Support: changed |
| ISSUE #4 | 21/03/2006 | DAC converter Max voltage range filtered: changed<br>Debug of the GE864 in production: added<br>GC864 drawing: changed<br>Mounting the GC864 on your board: changed |
| ISSUE #5 | 04/05/2006 | 2.13.1 Reset signal: unconditionally rebooted page 20<br>2.19.3 Molex connector p/n: changed to LF<br>2.21.Mounting the GC864 on your board: metal tabs |
| ISSUE#6 | 04/08/2006 | 2.8 back layout of PCB with SIM pads<br>2.12.12 Indication of network service availability: changed text regarding pin START_LED<br>2.12.16 DTMF Tones: changed minimum duration of DTMF tone<br>2.19.1 GE864 balls allocation: update; added NOTE after the balls table (page 29); added note for the line SIMVCC (page 26)<br>2.19.2 GE864 BGA balls layout update<br>2.19.3 GC864 pins allocation: added NOTE after the pin table (page 34); added note for the line SIMVCC (page 32)<br>2.20.3 Recommended foot prints for the application (GE864): added |

 

| | | |
|---|---|---|
| | | 2.20.4 Debug of the GE864 in production (changed)<br>5.4 CMUX: new paragraph<br>5.4 SAP: new paragraph<br>6 AT commands: added AT commands (CMUX, SAP and others: see rows in yellow)<br>7.2 GE864-PY Conformity assessment added<br>7.3 GC864-QUAD Conformity assessment added<br>7.4 GC864-PY Conformity assessment added<br>7.5 GE864-QUAD/PY: FCC Equipment Authorization<br>7.6 GC864-QUAD/PY: FCC Equipment Authorization<br>7.7 GE864-QUAD/PY: IC Equipment Authorization<br>7.8 GC864-QUAD/PY: IC Equipment Authorization |
| ISSUE#7 | 23/10/2006 | 2.2 Weight: changed weight value for GC864<br>2.7 Antenna: changed bandwidth values<br>2.10 Power Consumption: updated operating current in GPRS<br>2.16 Audio levels specifications: updated microphone and speaker characteristics<br>2.19.3 GC864 pins allocation: pin 49 PWRMON changed in output (page 33)<br>2.22.1 GE864 orientation on the tray: updated module image<br>5.3 Easy Script Extension - Python Interpreter: updated schema<br>6 AT commands: cancelled AT commands table<br>7.3 GE864-QUAD/PY: RoHS certificate<br>7.6 GC864-QUAD/PY: RoHS certificate |
| ISSUE#8 | 08/02/2007 | 2.11 Power Consumption: updated operating current in GSM<br>general review of the document<br>complete revision of the document: removed camera, and come paragraphs transferred to the HW or SW User Guide |

 

# GC864 Hardware User Guide

1vv0300733 Rev.4 - 08/02/07


Making machines talk.

This document is relating to the following products:


GC864-QUAD 3990250675
GC864-PY 3990250676

 

# Contents



 

 

 

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# 1 Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit GC864-QUAD / PY module.
In this document all the basic functions of a mobile phone will be taken into account; for each one of them a proper hardware solution will be suggested and eventually the wrong solutions and common errors to be avoided will be evidenced. Obviously this document cannot embrace the whole hardware solutions and products that may be designed. The wrong solutions to be avoided shall be considered as mandatory, while the suggested hardware configurations shall not be considered mandatory, instead the information given shall be used as a guide and a starting point for properly developing your product with the Telit GC864-QUAD / PY module.
For further hardware details that may not be explained in this document refer to the Telit GC864-QUAD / PY Product Description document where all the hardware information is reported.

**NOTICE**

***(EN) The integration of the GSM/GPRS GC864-QUAD / PY cellular module within user application shall be done according to the design rules described in this manual.***

***(IT) L'integrazione del modulo cellulare GSM/GPRS GC864-QUAD / PY all'interno dell'applicazione dell'utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.***

***(DE) Die integration des GC864-QUAD / PY GSM/GPRS Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Kunstruktionsregeln erfolgen***

***(SL) Integracija GSM/GPRS GC864-QUAD / PY modula v uporabniški aplikaciji bo morala upoštevati projektna navodila, opisana v tem piročniku.***

***(SP) La utilización del modulo GSM/GPRS GC864-QUAD / PY debe ser conforme a los usos para los cuales ha sido deseñado descritos en este manual del usuario.***

***(FR) L'intégration du module cellulaire GSM/GPRS GC864-QUAD / PY dans l'application de l'utilisateur sera faite selon les règles de conception décrites dans ce manuel.***

(HE) האינטגרטור מתבקש ליישם את ההנחיות המפורטות במסמך זה בתהליך האינטגרציה של המודם הסלולרי GC864-QUAD / PY עם המוצר.

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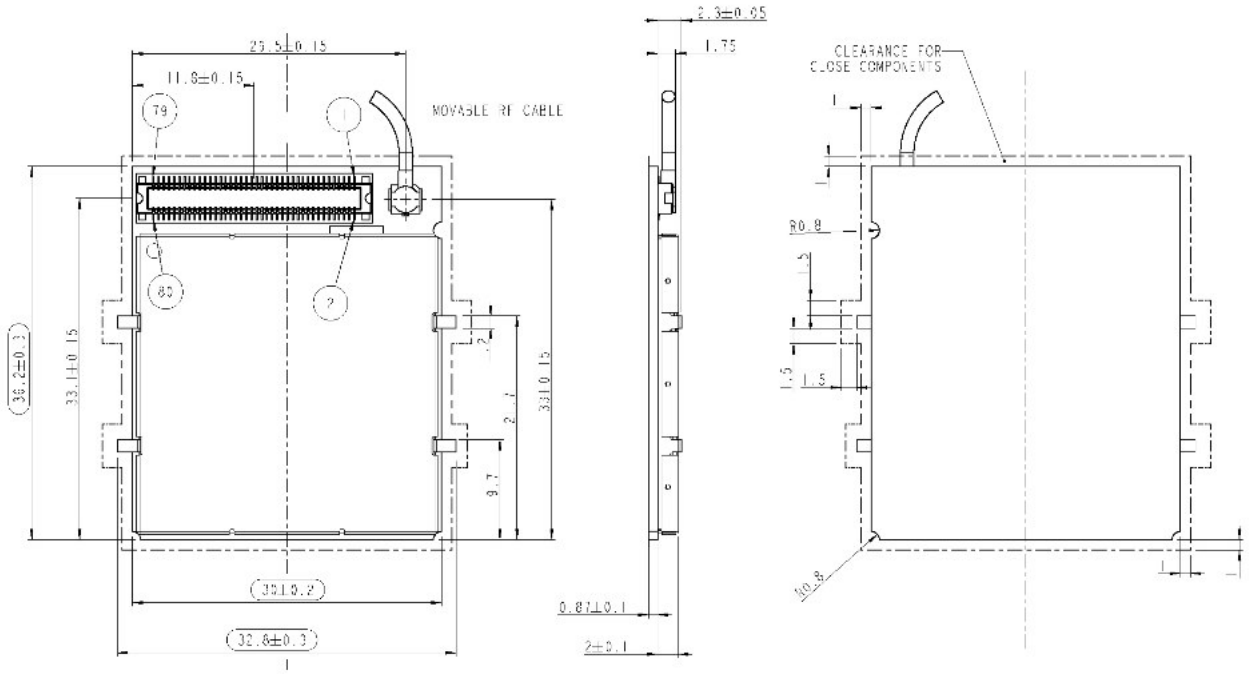
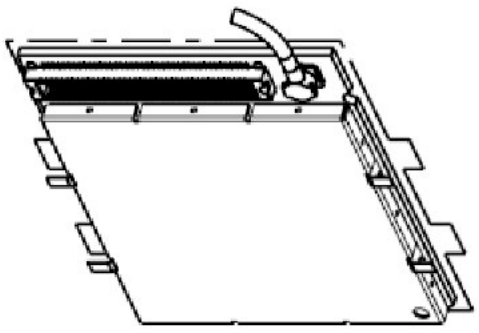
# 2 GC864 Mechanical Dimensions

The **Telit GC864 module** overall dimensions are:

- **Length:** **36.2 mm**
- **Width:** **30 mm**
- **Thickness:** **3.2 mm**



# 3 GC864 module connections

## 3.1 PIN-OUT

The GC864 uses a 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 | 100KΩ | 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 +, nominal level 3mVrms | | Audio |
| 14 | MIC_HF- | AI | Handsfree microphone input; phase -, nominal level 3mVrms | | Audio |
| 15 | MIC_MT+ | AI | Handset microphone signal input; phase+, nominal level 50mVrms | | Audio |
| 16 | MIC_MT- | AI | Handset microphone signal input; phase-, nominal level 50mVrms | | 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) | 47KΩ | 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

| Pin | Signal | I/O | Function | Internal Pull up | Type |
|---|---|---|---|---|---|
| | | | **Trace** | | |
| **23** | RX_TRACE | I | RX Data for debug monitor | | CMOS 2.8V |
| **24** | TX_TRACE | O | TX Data for debug monitor | | CMOS 2.8V |
| | | | **Prog. / Data + Hw Flow Control** | | |
| **25** | C103/TXD | I | Serial data input (TXD) from DTE | | CMOS 2.8V |
| **26** | C104/RXD | O | Serial data output to DTE | | CMOS 2.8V |
| **27** | C107/DSR | O | Output for Data set ready signal (DSR) to DTE | | CMOS 2.8V |
| **28** | C106/CTS | O | Output for Clear to send signal (CTS) to DTE | | CMOS 2.8V |
| **29** | C108/DTR | I | Input for Data terminal ready signal (DTR) from DTE | | CMOS 2.8V |
| **30** | C125/RING | O | Output for Ring indicator signal (RI) to DTE | | CMOS 2.8V |
| **31** | C105/RTS | I | Input for Request to send signal (RTS) from DTE | | CMOS 2.8V |
| **32** | C109/DCD | O | Output for Data carrier detect signal (DCD) to DTE | | CMOS 2.8V |
| | | | **DAC and ADC** | | |
| **37** | ADC_IN1 | AI | Analog/Digital converter input | | A/D |
| **38** | ADC_IN2 | AI | Analog/Digital converter input | | A/D |
| **39** | ADC_IN3 | AI | Analog/Digital converter input | | A/D |
| **40** | DAC_OUT | AO | Digital/Analog converter output | | D/A |
| | | | **Miscellaneous Functions** | | |
| **45** | STAT_LED | O | Status indicator led | | CMOS 1.8V |
| **46** | GND | - | Ground | | Ground |
| **49** | PWRMON | O | Power ON Monitor | | CMOS 2.8V |
| **50** | VAUX1 | - | Power output for external accessories | | - |
| **51** | CHARGE | AI | Charger input (*) | | Power |
| **52** | CHARGE | AI | Charger input (*) | | Power |
| **53** | ON/OFF* | I | Input command for switching power ON or OFF (toggle command). The pulse to be sent to the GC864 must be equal or greater than 1 second. | 47KΩ | Pull up to VBATT |
| **54** | RESET* | I | Reset input | | |
| **55** | VRTC | AO | VRTC Backup capacitor | | Power |
| | | | **Telit GPIO** | | |
| **56** | TGPIO_19 | I/O | Telit GPIO19 Configurable GPIO | | CMOS 2.8V |
| **57** | TGPIO_11 | I/O | Telit GPIO11 Configurable GPIO | | CMOS 2.8V |
| **58** | TGPIO_20 | I/O | Telit GPIO20 Configurable GPIO | | CMOS 2.8V |
| **59** | TGPIO_04 | I/O | Telit GPIO4 Configurable GPIO | | CMOS 2.8V |
| **60** | TGPIO_14 | I/O | Telit GPIO14 Configurable GPIO | | CMOS 2.8V |
| **61** | TGPIO_15 | I/O | Telit GPIO15 Configurable GPIO | | CMOS 2.8V |
| **62** | TGPIO_12 | I/O | Telit GPIO12 Configurable GPIO | | CMOS 2.8V |
| **63** | TGPIO_10 | I/O | Telit GPIO10 Configurable GPIO | | CMOS 2.8V |
| **64** | TGPIO_22 | I/O | Telit GPIO22 Configurable GPIO | | CMOS 1.8V |

| Pin | Signal | I/O | Function | Internal Pull up | Type |
|---|---|---|---|---|---|
| 65 | TGPIO_18 | I/O | Telit GPIO18 Configurable GPIO | | CMOS 2.8V |
| 66 | TGPIO_03 | I/O | Telit GPIO3 Configurable GPIO | | CMOS 2.8V |
| 67 | TGPIO_08 | I/O | Telit GPIO8 Configurable GPIO | | CMOS 2.8V |
| 68 | TGPIO_06 / ALARM | I/O | Telit GPIO6 Configurable GPIO / ALARM | | CMOS 2.8V |
| 70 | TGPIO_01 | I/O | Telit GPIO1 Configurable GPIO | | CMOS 2.8V |
| 71 | TGPIO_17 | I/O | Telit GPIO17 Configurable GPIO | | CMOS 2.8V |
| 72 | TGPIO_21 | I/O | Telit GPIO21 Configurable GPIO | | CMOS 2.8V |
| 73 | TGPIO_07 / BUZZER | I/O | Telit GPIO7 Configurable GPIO / Buzzer | | CMOS 2.8V |
| 74 | TGPIO_02 / JDR | I/O | Telit GPIO02 I/O pin / Jammer detect report | | CMOS 2.8V |
| 75 | TGPIO_16 | I/O | Telit GPIO16 Configurable GPIO | | CMOS 2.8V |
| 76 | TGPIO_09 | I/O | Telit GPIO9 Configurable GPIO | | CMOS 2.8V |
| 77 | TGPIO_13 | I/O | Telit GPIO13 Configurable GPIO | | CMOS 2.8V |
| 78 | TGPIO_05/ RFTXMON | I/O | Telit GPIO05 Configurable GPIO / Transmitter ON monitor | | CMOS 2.8V |
| | | | **RESERVED** | | |
| 17 | | - | | | |
| 33 | | - | | | |
| 34 | | - | | | |
| 41 | | - | | | |
| 42 | | - | | | |
| 43 | | - | | | |
| 44 | | - | | | |
| 47 | | - | | | |
| 48 | | - | | | |
| 79 | | - | | | |
| 69 | | - | | | |
| 80 | | - | | | |
| 35 | | - | | | |
| 36 | | - | | | |

# NOTE: RESERVED pins must not be connected

[1] RTS should be connected to the GND (on the module side) if flow control is not used

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

| Pin | Signal | Function |
|---|---|---|
| 1 | VBATT | Main power supply |
| 2 | VBATT | Main power supply |
| 3 | VBATT | Main power supply |
| 4 | VBATT | Main power supply |
| 5 | GND | Ground |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 46 | GND | Ground |
| 25 | C103/TXD | Serial data input (TXD) from DTE |
| 26 | C104/RXD | Serial data output to DTE |
| 31 | C105/RTS | Input for Request to send signal (RTS) from DTE |
| 53 | ON/OFF* | Input command for switching power ON or OFF (toggle command). |
| 54 | RESET* | Reset input |

### 3.1.1 GC864 Antenna connector

The GC864 module is equipped with a 50 Ohm RF connector from Murata, GSC type P/N **MM9329-2700B**.
The counterpart suitable is Murata **MXTK92** Type or **MXTK88** Type.

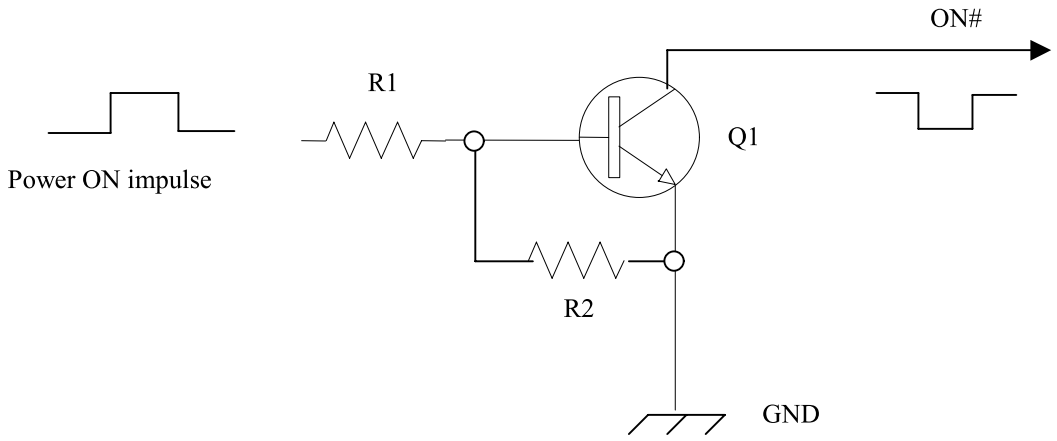
Moreover, the GC864 has the antenna pads on the back side of the PCB. This allows the manual soldering of the coaxial cable directly on the back side of the PCB. However, the soldering is not an advisable solution for a reliable connection of the antenna.

# 4 Hardware Commands

## 4.1 Turning ON the GC864-QUAD / PY

To turn on the GC864-QUAD / PY the pad ON# must be tied low for at least 1 seconds and then released.
The maximum current that can be drained from the ON# pad is 0,1 mA.
A simple circuit to do it is:



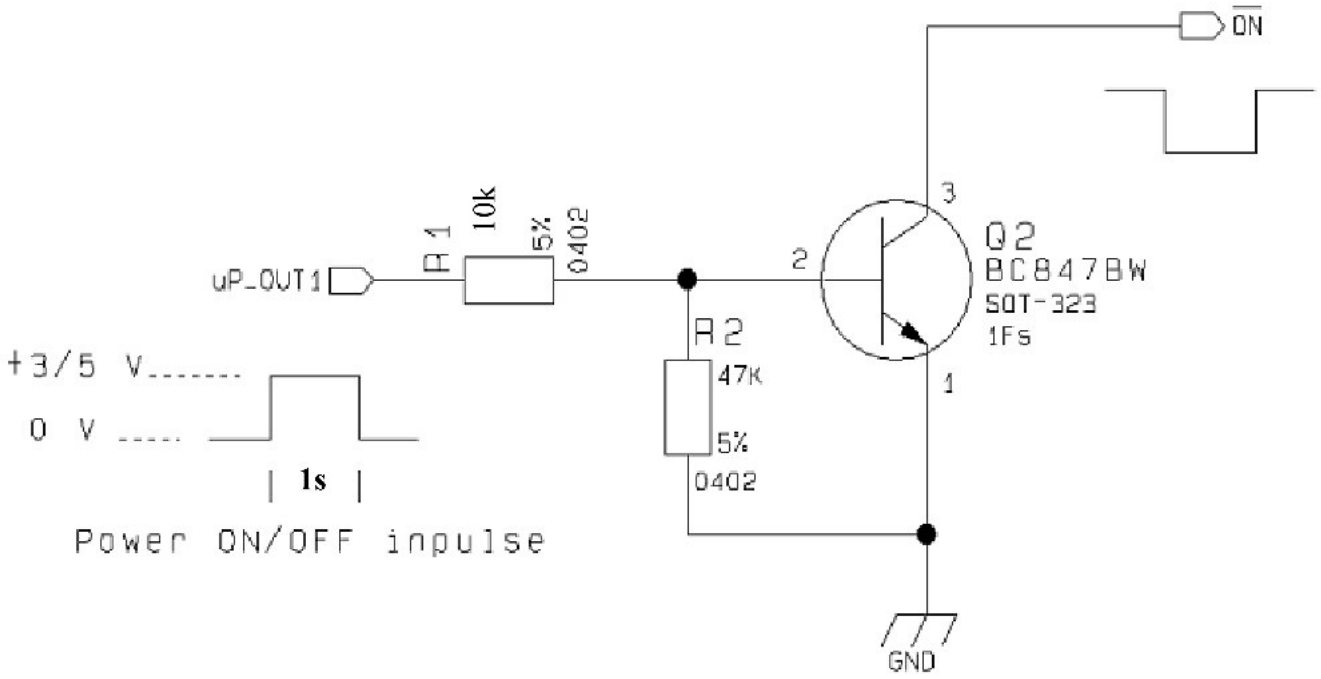

***NOTE: don't use any pull up resistor on the ON# line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the GC864-QUAD / PY power regulator and improper power on/off of the module. The line ON# must be connected only in open collector configuration.***

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

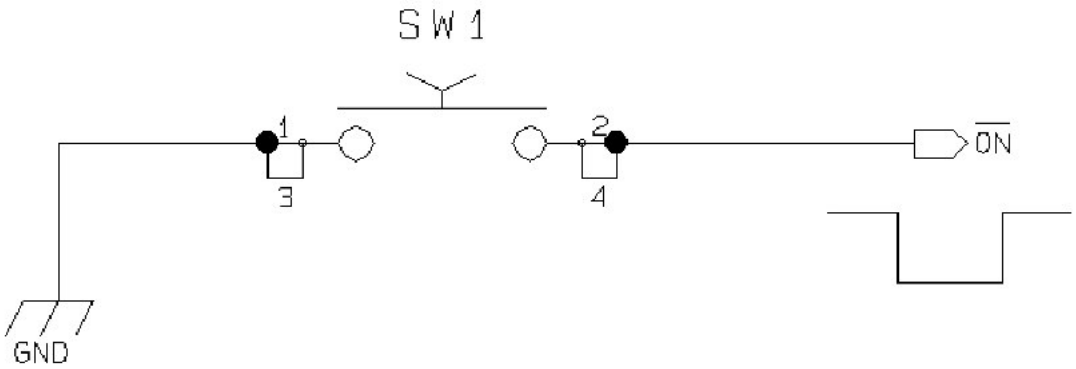
***NOTE: The GC864-QUAD / PY turns fully on also by supplying power to the Charge pad (provided there's a battery on the VBATT pads).***

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




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




# 4.2 Turning OFF the GC864-QUAD / PY

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

- by software command (see GC864-QUAD / PY 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.

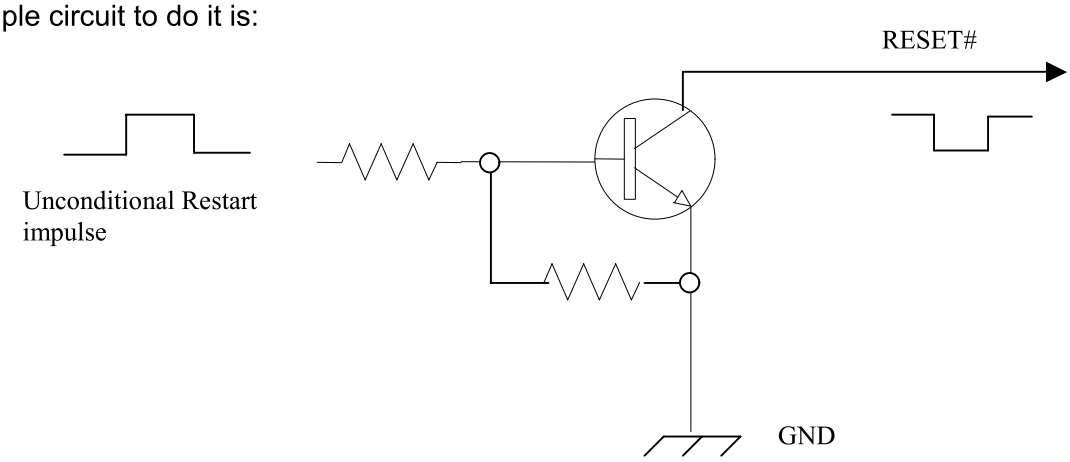
## 4.2.1 Hardware shutdown

To turn OFF the GC864-QUAD / PY 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.

***TIP: To check if the device has powered off, the hardware line PWRMON should be monitored. When PWRMON goes low, the device has powered off.***

## 4.2.2 Hardware Unconditional Restart

To unconditionally Restart the GC864-QUAD / PY, the pad RESET# must be tied low for at least 200 milliseconds and then released.
The maximum current that can be drained from the ON# pad is 0,15 mA.
A simple circuit to do it is:

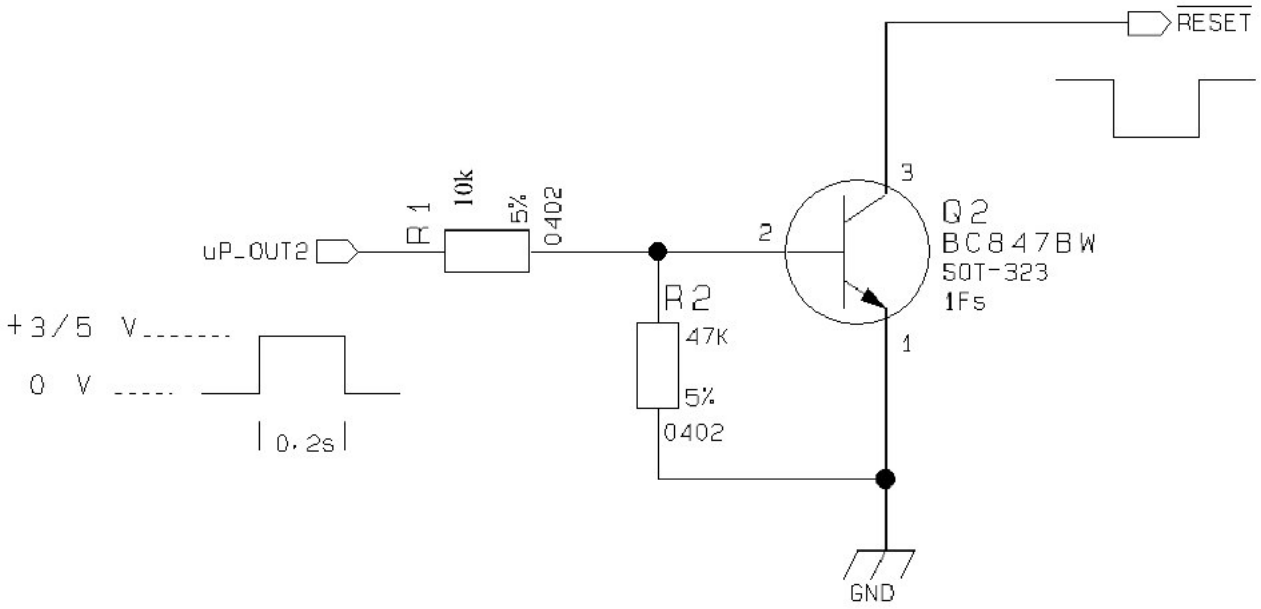


***NOTE: don't use any pull up resistor on the RESET# line nor any totem pole digital output. Using pull up resistor may bring to latch up problems on the GC864-QUAD / PY power regulator and improper functioning of the module. The line RESET# must be connected only in open collector configuration.***

***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# pad 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.

# 5 Power Supply

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

## 5.1 Power Supply Requirements

The GC864-QUAD / PY power requirements are:

- *Nominal Supply Voltage:* *3.8 V*
- *Max Supply Voltage:* *4.2 V*
- *Supply voltage range:* *3.4 V - 4.2 V*
- *Max Peak current consumption (impulsive):* *1.5 A*
- *Max Average current consumption during GPRS transmission:* *370 mA*
- *Max Average current consumption during VOICE/CSD transmission:* *200 mA*
- *Average current during Power Saving (with CFUN=5):* *≈ 3 mA*
- *Average current during idle (Power Saving disabled)* *≈ 22 mA*

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 2 A.***

## 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 from the power source where this power is drained. We will distinguish them into three categories:

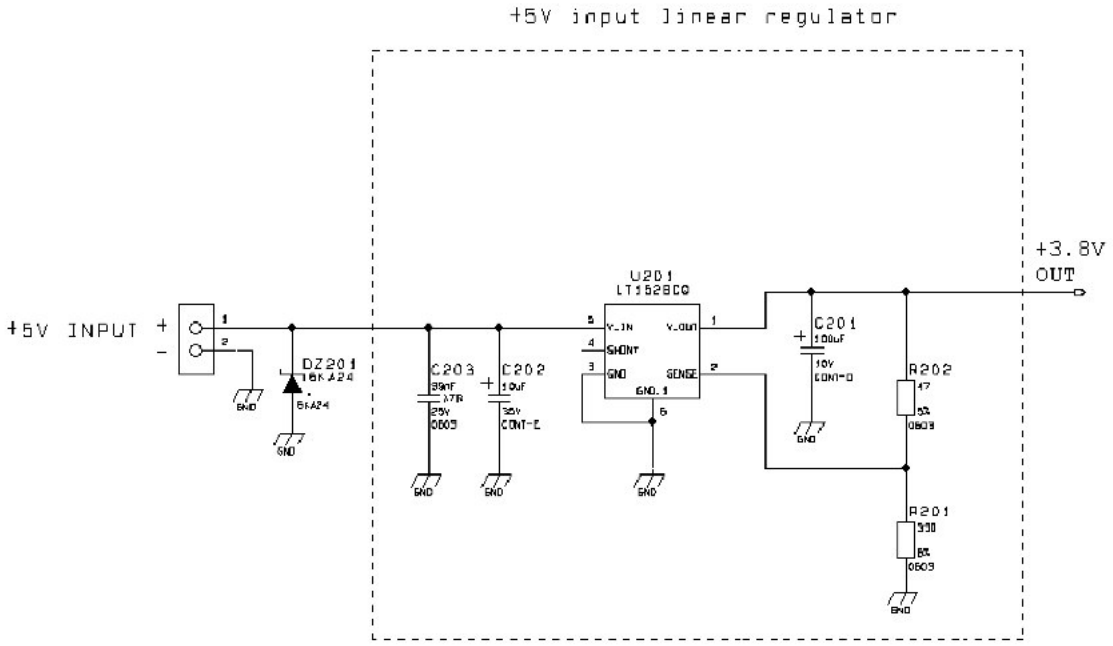
- +5V input (typically PC internal regulator output)
- +12V input (typically automotive)
- Battery

#### 5.2.1.1 + 5V input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence there's not a big difference between the input source and the desired output and a linear regulator can be used. A switching power supply will not be suited because of the low drop out requirements.
- When using a linear regulator, a proper heat sink shall be provided in order to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks close to the GC864-QUAD / PY, a 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode should be inserted close to the power input, in order to save the GC864-QUAD / PY from power polarity inversion.

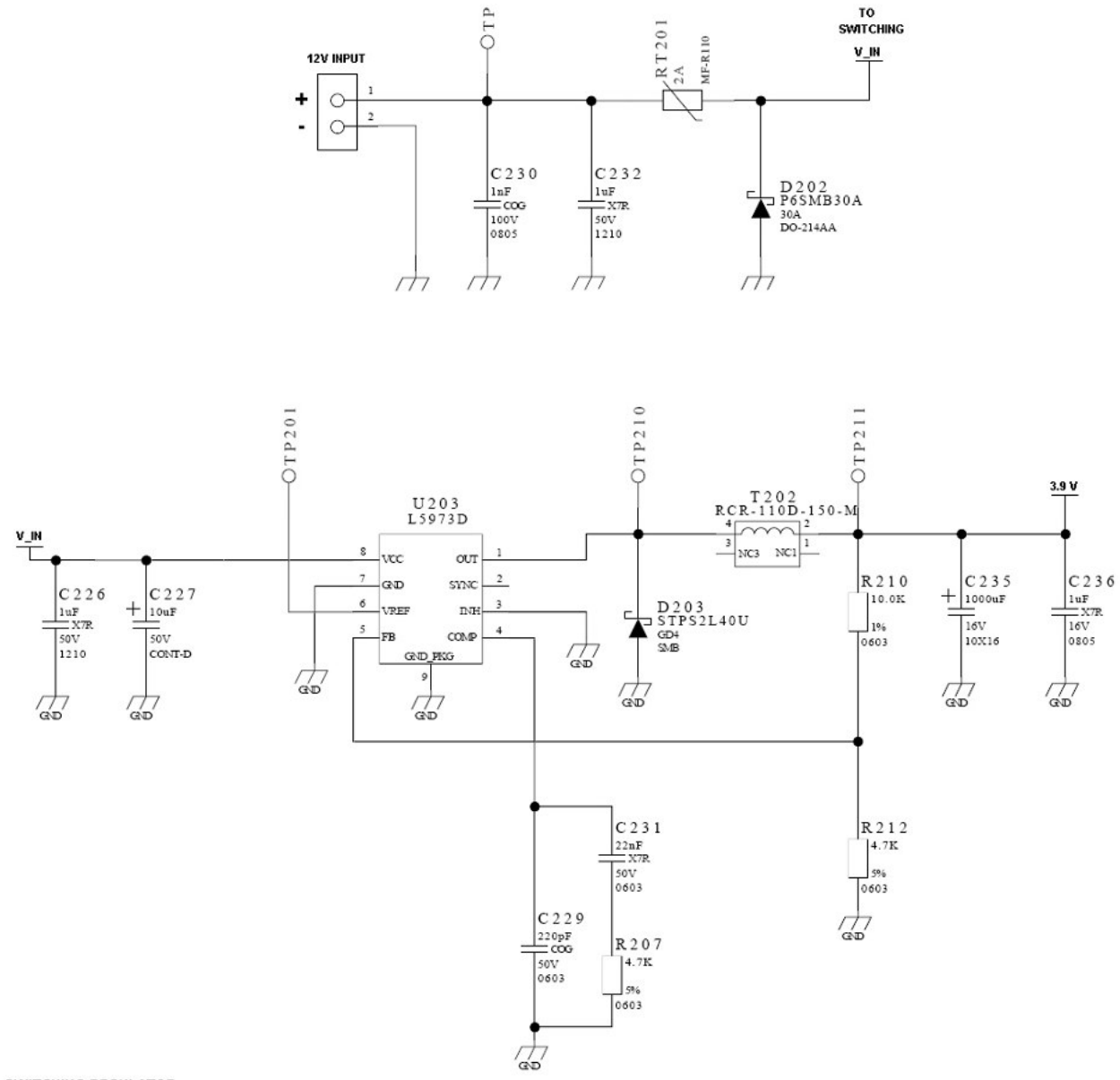
An example of linear regulator with 5V input is:




## 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 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 GC864-QUAD/PY.
- 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.
- For car PB battery the input voltage can rise up to 15,8V and this should be kept in mind when choosing components: all components in the power supply must withstand this voltage.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks, a 100µF tantalum capacitor is usually suited.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode should be inserted close to the power input, in order to clean the supply from spikes.
- A protection diode should be inserted close to the power input, in order to save the GC864-QUAD/PY 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 voltage allowed is 4.2V, hence a single 3.7V Li-Ion cell battery type is suited for supplying the power to the Telit GC864-QUAD/PY 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 the GC864-QUAD/PY and damage it.

***NOTE: DON'T USE any Ni-Cd, Ni-MH, and Pb battery types directly connected with GC864-QUAD/PY. Their use can lead to overvoltage on the GC864-QUAD/PY 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 GC864-QUAD/PY from power polarity inversion. Otherwise the battery connector should be done in a way to avoid polarity inversions when connecting the battery.
- The battery capacity must be at least 500mAh in order to withstand the current peaks of 2A; the suggested capacity is from 500mAh to 1000mAh.

### 5.2.1.4 Battery Charge control Circuitry Design Guidelines

The charging process for Li-Ion Batteries can be divided into 4 phases:

- Qualification and trickle charging
- Fast charge 1 - constant current
- Final charge - constant voltage or pulsed charging
- Maintenance charge

The qualification process consists in a battery voltage measure, indicating roughly its charge status. If the battery is deeply discharged, that means its voltage is lower than the trickle charging threshold, then the charge must start slowly possibly with a current limited pre-charging process where the current is kept very low with respect to the fast charge value: the trickle charging.
During the trickle charging the voltage across the battery terminals rises; when it reaches the fast charge threshold level the charging process goes into fast charge phase.
During the fast charge phase the process proceeds with a current limited charging; this current limit depends on the required time for the complete charge and from the battery pack capacity. During this phase the voltage across the battery terminals still raises but at a lower rate.
Once the battery voltage reaches its maximum voltage then the process goes into its third state: Final charging. The voltage measure to change the process status into final charge is very important. It must be ensured that the maximum battery voltage is never exceeded, otherwise the battery may be damaged and even explode. Moreover for the constant voltage final chargers, the constant voltage phase (final charge) must not start before the battery voltage has reached its maximum value, otherwise the battery capacity will be highly reduced.
The final charge can be of two different types: constant voltage or pulsed. GC864-QUAD/PY uses constant voltage.

The constant voltage charge proceeds with a fixed voltage regulator (very accurately set to the maximum battery voltage) and hence the current will decrease while the battery is becoming charged. When the charging current falls below a certain fraction of the fast charge current value, then the battery is considered fully charged, the final charge stops and eventually starts the maintenance.
The pulsed charge process has no voltage regulation, instead the charge continues with pulses. Usually the pulse charge works in the following manner: the charge is stopped for some time, let's say few hundreds of ms, then the battery voltage will be measured and when it drops below its maximum value a fixed time length charging pulse is issued. As the battery approaches its full charge the off time will become longer, hence the duty-cycle of the pulses will decrease. The battery is considered fully charged when the pulse duty-cycle is less than a threshold value, typically 10%, the pulse charge stops and eventually the maintenance starts.
The last phase is not properly a charging phase, since the battery at this point is fully charged and the process may stop after the final charge. The maintenance charge provides an additional charging process to compensate for the charge leak typical of a Li-Ion battery. It is done by issuing pulses with a fixed time length, again few hundreds of ms, and a duty-cycle around 5% or less.
This last phase is not implemented in the GC864-QUAD/PY internal charging algorithm, so that the battery once charged is left discharging down to a certain threshold so that it is cycled from full charge to slight discharge even if the battery charger is always inserted. This guarantees that anyway the remaining charge in the battery is a good percentage and that the battery is not damaged by keeping it always fully charged (Li-Ion rechargeable battery usually deteriorate when kept fully charged).
Last but not least, in some applications it is highly desired that the charging process restarts when the battery is discharged and its voltage drops below a certain threshold, GC864-QUAD/PY internal charger does it.

As you can see, the charging process is not a trivial task to be done; moreover all these operations should start only if battery temperature is inside a charging range, usually 5°C - 45°C.
The GC864-QUAD/PY measures the temperature of its internal component, in order to satisfy this last requirement, it's not exactly the same as the battery temperature but in common application the two temperature should not differ too much and the charging temperature range should be guaranteed.

***NOTE: For all the threshold voltages, inside the GC864-QUAD/PY all threshold are fixed in order to maximize Li-Ion battery performances and do not need to be changed.***

***NOTE: In this application the battery charger input current must be limited to less than 400mA. This can be done by using a current limited wall adapter as the power source.***

***NOTE: When starting the charger from Module powered off the startup will be in CFUN4; to activate the normal mode a command AT#CFUN=1 has to be provided.***

### 5.2.2 Thermal Design Guidelines

The thermal design for the power supply heat sink should 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):* *4mA*
- *Average current during idle (Power Saving disabled)* *23mA*

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

Considering the very low current during idle, especially if Power Saving function is enabled, it is possible to consider from the thermal point of view that the device absorbs current significantly only during calls.
If we assume that the device stays into transmission for short periods of time (let's say few minutes) and then remains for a quite long time in idle (let's say one hour), then the power supply has always the time to cool down between the calls and the heat sink could be smaller than the calculated one for 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 and hence the current consumption will be less than the 500mA, being usually around 150mA.
For these reasons the thermal design is rarely a concern and the simple ground plane where the power supply chip is placed can be enough to ensure a good thermal condition and avoid overheating.
For the heat generated by the GC864-QUAD / PY, you can consider it to be during transmission 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 the GC864-QUAD / PY; you must ensure that your application can dissipate it.

### 5.2.3 Power Supply PCB layout Guidelines

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

- The Bypass low ESR capacitor must be placed close to the Telit GC864-QUAD / PY power input pads or in the case the power supply is a switching type it can be placed close to the inductor to cut the ripple provided the PCB trace from the capacitor to the GC864-QUAD / PY is wide enough to ensure a dropless connection even during the 2A current peaks.
- The protection diode must be placed close to the input connector where the power source is drained.
- The PCB traces from the input connector to the power regulator IC must be wide enough to ensure no voltage drops occur when the 2A current peaks are absorbed. Note that this is not made in order to save power loss but especially to avoid the voltage drops on the power line at the current peaks frequency of 216 Hz that will reflect on all the components connected to that supply, introducing the noise floor at the burst base frequency. For this reason while a voltage drop of 300-400 mV may be acceptable from the power loss point of view, the same voltage drop may not be acceptable from the noise point of view. If your application doesn't have audio interface but only uses the data feature of the Telit GC864-QUAD / PY, then this noise is not so disturbing and power supply layout design can be more forgiving.
- The PCB traces to the GC864-QUAD / PY and the Bypass capacitor must be wide enough to ensure no significant voltage drops occur when the 2A current peaks are absorbed. This is for the same reason as previous point. Try to keep this trace as short as possible.
- The PCB traces connecting the Switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the diode very close to the power switching IC (only for switching power supply). This is done in order to reduce the radiated field (noise) at the switching frequency (100-500 kHz usually).
- The use of a good common ground plane is suggested.
- The placement of the power supply on the board should be done in such a way to guarantee that the high current return paths in the ground plane are not overlapped to any noise sensitive circuitry as the microphone amplifier/buffer or earphone amplifier.
- The power supply input cables should be kept separate from noise sensitive lines such as microphone/earphone cables.

# 6 Antenna

The antenna 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.

## 6.1 GSM Antenna Requirements

As suggested on the Product Description the antenna for a Telit GC864-QUAD / PY device 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 < 3dBi |
| **Impedance** | 50 ohm |
| **Input power** | > 2 W peak power |
| **VSWR absolute max** | <= 10:1 |
| **VSWR recommended** | <= 2:1 |

Furthermore if the device is developed for the US market and/or Canada market, it shall comply to the FCC and/or IC approval requirements:
*This device is 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 GC864-QUAD / PY module. Antennas used for this OEM module must not exceed 3dBi gain for mobile and fixed operating configurations.*

## 6.2 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 Logic level specifications

Where not specifically stated, all the interface circuits work at 2.8V CMOS logic levels. The following table shows the logic level specifications used in the **Telit GC864-QUAD / PY** interface circuits:

**Absolute Maximum Ratings -Not Functional**

| Parameter | Min | Max |
|---|---|---|
| Input level on any digital pin when on | -0.3V | +3.75V |
| Input voltage on analog pins when on | -0.3V | +3.0 V |
| Voltage on Buffered pins | -0.3V | 25V |

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

| Level | Min | Max |
|---|---|---|
| Input high level | 2.1V | 3.3V |
| Input low level | 0V | 0.5V |
| Output high level | 2.2V | 3.0V |
| Output low level | 0V | 0.35V |

For 2,0V signals:

**Operating Range - Interface levels (2.0V CMOS)**

| Level | Min | Max |
|---|---|---|
| Input high level | 1.6V | 3.3V |
| Input low level | 0V | 0.4V |
| Output high level | 1,65V | 2.2V |
| Output low level | 0V | 0.35V |

**Current characteristics**

| Level | Typical |
|---|---|
| Output Current | 1mA |
| Input Current | 1uA |

# 7.1 Reset signal

| Signal | Function | I/O | PIN Number |
|---|---|---|---|
| RESET | Phone reset | I | 54 |

RESET is used to reset the **GC864-QUAD / PY modules**. Whenever this signal is pulled low, the GC864-QUAD / PY is reset. When the device is reset it stops any operation. After the release of the reset GC864-QUAD / PY is unconditionally shut down, without doing any detach operation from the network where it is registered. This behaviour is not a proper shut down because any GSM device is requested to issue a detach request on turn off. For this reason the 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's no need to control this pin on start-up. It may only be used to reset a device already on that is not responding to any command.

***NOTE**: do not use this signal to power off the **GC864-QUAD / PY**. 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.

# 8 Serial Ports

The serial port on the Telit GC864-QUAD/PY is the core of the interface between the module and OEM hardware.
2 serial ports are available on the module:

- MODEM SERIAL PORT
- MODEM SERIAL PORT 2 (DEBUG)

## 8.1 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 doesn't need a level translation is the 2.8V UART.
The serial port on the GC864-QUAD/PY is 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 GC864-QUAD/PY UART are the CMOS 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 |

The signals of the GC864 serial port are:

| RS232 Pin Number | Signal | GC864-QUAD / PY Pad Number | Name | Usage |
|---|---|---|---|---|
| 1 | DCD - dcd_uart | 32 | Data Carrier Detect | Output from the GC864-QUAD / PY that indicates the carrier presence |
| 2 | RXD - tx_uart | 26 | Transmit line *see Note | Output transmit line of GC864-QUAD / PY UART |
| 3 | TXD - rx_uart | 25 | Receive line *see Note | Input receive of the GC864-QUAD / PY UART |
| 4 | DTR - dtr_uart | 29 | Data Terminal Ready | Input to the GC864-QUAD / PY that controls the DTE READY condition |
| 5 | GND | 5,6,7 | Ground | ground |
| 6 | DSR - dsr_uart | 27 | Data Set Ready | Output from the GC864-QUAD / PY that indicates the module is ready |
| 7 | RTS - rts_uart | 31 | Request to Send | Input to the GC864-QUAD / PY that controls the Hardware flow control |
| 8 | CTS - cts_uart | 28 | Clear to Send | Output from the GC864-QUAD / PY that controls the Hardware flow control |
| 9 | RI - ri_uart | 30 | Ring Indicator | Output from the GC864-QUAD / PY that indicates the incoming call condition |

***NOTE: According to V.24, RX/TX signal names are referred to the application side, therefore on the GC864 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 GC864 serial 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.***

# 8.2 RS232 level translation

In order to interface the Telit GC864 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:

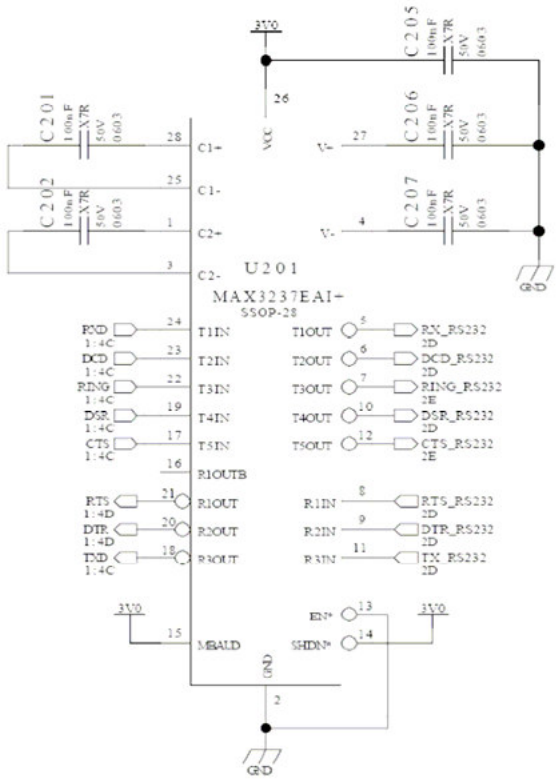
- 5 drivers
- 3 receivers

***NOTE: The digital input lines working at 2.8VCMOS have an absolute maximum input voltage of 3,75V; therefore the level translator IC shall not be powered by the +3.8V supply of the module. Instead it shall be powered from a +2.8V / +3.0V (dedicated) power supply.***
***This is because in this way the level translator IC outputs on the module side (i.e. GC864 inputs) will work at +3.8V interface levels, stressing the module inputs at its maximum input voltage.***
***This can be acceptable for evaluation purposes, but not on production devices.***

***NOTE: In order to be able to do in circuit reprogramming of the GC864 firmware, the serial port on the Telit GC864 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 GC864.***

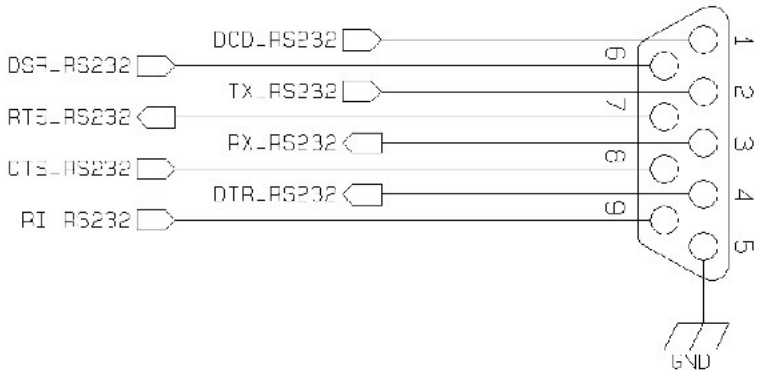
 

An example of level translation circuitry of this kind is:



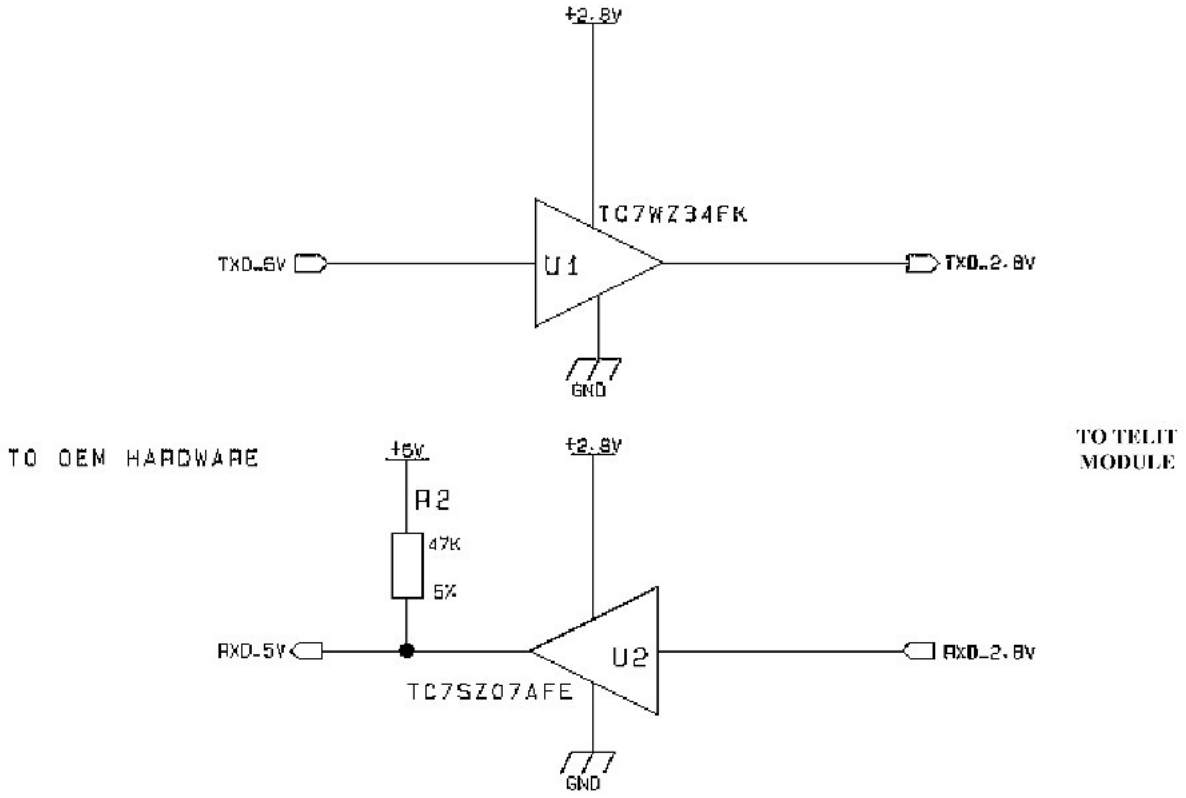

RS232 LEVEL TRSANSLATOR

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




# 8.3 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: This logic IC for the level translator and 2.8V pull-ups (not the 5V one) can be powered directly from PWRMON line of the GC864-QUAD / PY. Note that the TC7SZ07AE has open drain output, therefore the resistor R2 is mandatory.*

***NOTE: The UART input line TXD (rx_uart) of the GC864-QUAD / PY is NOT internally pulled up with a resistor, so there may be the need to place an external 47KΩ pull-up resistor, either the DTR (dtr_uart) and RTS (rts_uart) input lines are not pulled up internally, so an external pull-up resistor of 47KΩ may be required.***

A power source of the internal interface voltage corresponding to the 2.8VCMOS high level is available at the PWRMON pin on the connector, whose absolute maximum output current is 1mA.
A maximum of 9 resistors of 47 KΩ pull-up can be connected to the PWRMON pin, provided no other devices are connected to it and the pulled-up lines are GC864-QUAD / PY input lines connected to open collector outputs in order to avoid latch-up problems on the GC864-QUAD / PY.
Care must be taken to avoid latch-up on the GC864-QUAD / PY and the use of this output line to power electronic devices shall be avoided, especially for devices that generate spikes and noise such as switching level translators, micro controllers, failure in any of these condition can severely compromise the GC864-QUAD / PY functionality.

***NOTE: The input lines working at 2.8VCMOS can be pulled-up with 47KΩ resistors that can be connected directly to the PWRMON line provided they are connected as in this example.***
***NO OTHER devices than those suggested should be powered with the PWRMON line; otherwise the module functionality may be compromised.***

***It is important to consider that the added circuit must have consumption lower than 1mA.***
***In case of reprogramming of the module has to be considered the use of the RESET line to start correctly the activity.***

***The preferable configuration is having an external supply for the buffer.***

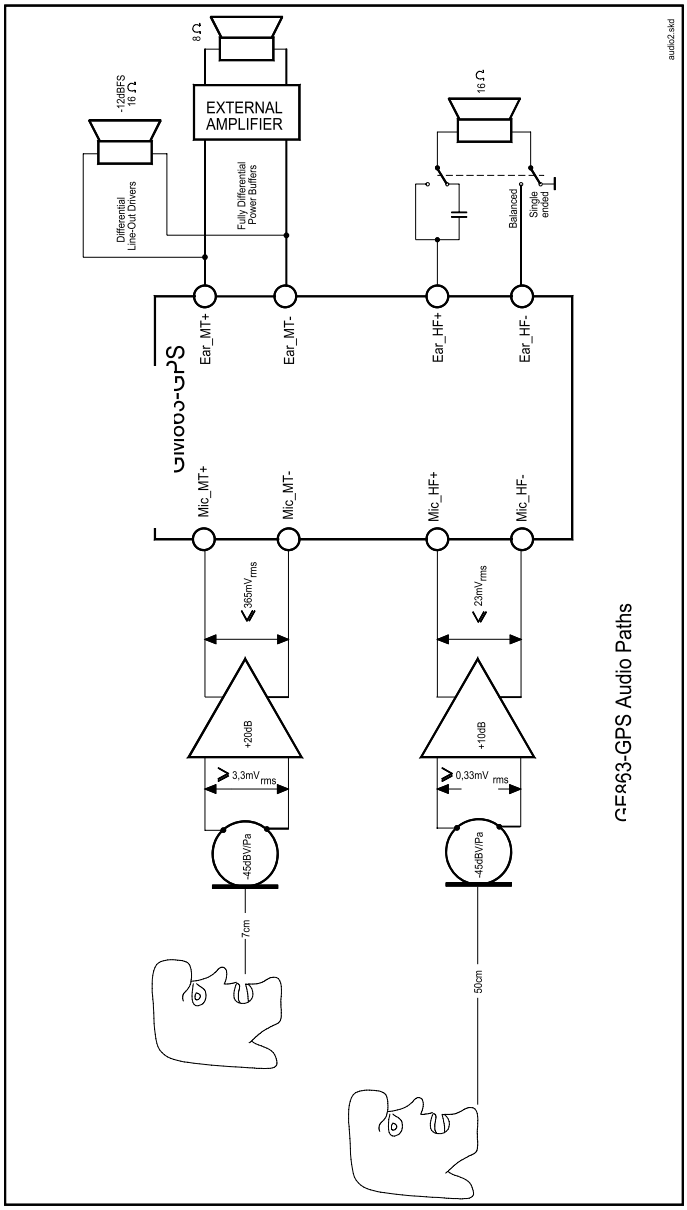
# 9 Audio Section Overview

The Base Band Chip of the GC864-QUAD / PY Telit Module provides two different audio blocks; both in transmit (*Uplink*) and in receive (*Downlink*) direction:

"*MT lines*" should be used for handset function,

"*HF lines*" is suited for hands -free function (car kit).

These two blocks can be active only one at a time, selectable by *AXE* hardware line or by AT command. The audio characteristics are equivalent in transmit blocks, but are different in the receive ones and this should be kept in mind when designing.



# 9.1 Microphone Paths Characteristic and Requirements

***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 should be balanced designed to reduce the common mode noise typically generated on the ground plane. However also an unbalanced circuitry can be used for particular OEM application needs .***

***TIP: due to the difference in the echo canceller type, the "Mic_MT" audio path is suited for Handset applications, while the "Mic_HF"audio path is suited for hands-free function (car kit). The Earphone applications should be made using the "Mic_HF" audio path but DISABLING the echo canceller by software AT command. If the echo canceller is left active with the Earphone, then some echo might be introduced by the echo cancel algorithm.***

***"Mic_MT" 1st differential microphone path***

- **line coupling** — **AC**
- **line type** — **balanced**
- **coupling capacitor** — **≥ 100nF**
- **differential input resistance** — **50kΩ**
- **differential input voltage** — **≤ 1,03$V_{pp}$ (365$mV_{rms}$)**
- **microphone nominal sensitivity** — **-45 $dBV_{rms}$/Pa**
- **analog gain suggested** — **+ 20dB**
- **echo canceller type** — **handset**

***"Mic_HF" 2nd differential microphone path***

- **line coupling** — **AC**
- **line type** — **balanced**
- **coupling capacitor** — **≥ 100nF**
- **differential input resistance** — **50kΩ**
- **differential input voltage** — **≤ 65$mV_{pp}$ (23$mV_{rms}$)**
- **microphone nominal sensitivity** — **-45 $dBV_{rms}$/Pa**

- **analog gain suggested** — **+10dB**
- **echo canceller type** — **car kit hands-free**

### *TIP: definition of the nominal sensitivity of the microphone lines .*

The nominal sensitivity of the microphone lines indicates the voltage level on the GC864-QUAD / PY pins present during "*normal spoken*" conditions.
For a handset , the "*normal spoken"* conditions take place when the talker mouth is 7cm far from the microphone ; under these conditions the voice will produce an acoustic pressure of *-4,7dBPa @1kHz* on the microphone membrane .

### *TIP: electrical equivalent signal and operating voice levels.*

At "*normal spoken*" conditions, a microphone having the suggested nominal sensitivity of -*45dBV$_{rms}$/Pa*, will produce

the electrical equivalent signal : $MicLevel = (-45) + (-4.7) = -49.7\ dB_{Vrms}$

that means : $MicVoltage = 10^{(-49.7/20)} = 3.3 * 10^{-3}\ V_{rms}$

During a call, this level varies according to the volume of the talker voice; usually the following rough thumb rule for the dynamic range may be used :

1) the talker is screaming . This is the *strongest voice level* condition: the signal increases by +20dB;
2) the talker is whispering. This is the *lowest voice level* condition: the voice level decreases by –50dB.

These changes must be considered for designing the external microphone amplifier.

### *TIP: example of external microphone amplifier calculation .*

Let's suppose to use the *1$^{st}$differential* microphone path .In this case the maximum differential input voltage to "*Mic_MT*" lines is 365mV$_{rms}$(1,03V$_{pp}$) corresponding to –8,76dBV.
Now we can calculate the maximum voltage gain of an external microphone amplifier $G_A$ :

$$[(MicLevel + 20dB) + G_A] = -8{,}76dBV$$

$$[-49{,}7 + 20 + G_A] = -8{,}76$$

$$-40{,}9 + 20 = -G_A$$

$$\boxed{G_A = 20{,}94dB} \longrightarrow$$ you can set $G_A$= ***+20dB*** to use standard resistor values .

### *TIP: environment consideration*

For *hands-free/car kit* microphone, you must take into account the voice attenuation, due to the distance between the microphone itself and the talker, when designing the external microphone amplifier.
Not only, you must consider that the microphone will pick up also ambient noise; to overcome this problem it is preferable to set the gain of the microphone *10dB* lower with respect to the calculated value for a nominal sensitivity. The corresponding reduction in signal level will be compensated by an increased voice volume of the talker which will speak louder because of the ambient noise.
For a car cabin usually the distance between the microphone itself and the talker is *40/50cm*; in these conditions the attenuation can be considered as a thumb rule around *20dB*.

For the earphone we shall distinguish two different types: the earphones having the microphone sustained close to the mouth and the ones having the microphone on the earpiece cable.
The same considerations for the additional voice attenuation due to the distance from the microphone and the noise pick up can be made for the earphone having the microphone on the earpiece cable, while the other kind of earphone shall be threaten as a handset.

### *TIP: how to compensate the losses in car cabin hands-free conditio .*

*The voice signal , that in the "normal spoken" conditions produces on the microphone membrane an acoustic pressure of -4,7dBPa at 1kHz , will have a further attenuation of 20dB due the 50cm distance .*

*Therefore a microphone having the suggested nominal sensitivity of -45dBV$_{rms}$/Pa,will produce a lower electrical*

*equivalent signal :* $MicLevel = ( -45) + (-4.7)-20 = -69.7$

*that means :* $MicVoltage = 10^{(-49.7 / 20)} = 0,33 * 10^{-3}$

*Setting the "microphone gain" at +10dB (3 times), the signal in the nominal conditions on the "Mic_HF" inputs s of GC864-QUAD / PY Telit Module will be :*

$$\text{"}\mathbf{Mic\_HF}\text{" } Level = 0,33 * 10^{-3} * 3 = 1 * 10^{-3}$$

Hence in these conditions the signal level on the"***Mic_HF***" input pads of the GC864-QUAD / PY is 10 dB (3 times) lower than the nominal, as suggested.

## 9.2 General Design Rules

There are several configurations for the audio paths, but the most effective difference is between balanced and unbalanced microphone configuration.
It is highly recommended to keep the whole microphone path balanced even if this means having 2 wires connecting the microphone instead of one needed (plus ground) in the unbalanced case. The balanced circuitry is more suited because of its good common mode noise rejection, reducing the *216 Hz* burst noise produced during the GSM transmissions.

- Where possible use balanced microphone circuitry
- Keep the microphone traces on the PCB and wires as short as possible.
- If your application requires an unbalanced microphone, then keep the lines on the PCB balanced and "unbalance" the path close to the microphone wire connector if possible.
- For the microphone biasing voltage use a dedicated voltage regulator and a capacitor multiply circuit.
- Make sure that the microphone traces in the PCB don't cross or run parallel to noisy traces (especially the power line)
- If possible put all around to the microphone lines a ground trace connected to the ground plane by several vias. This is done in order to simulate a shielded trace on the PCB.
- The biasing circuit and eventually the buffer can be designed in the same manner for the internal and external microphones.

## 9.3 Other considerations

If your application is a hands-free/car kit scenario, but you need to put microphone and speaker inside the same box:

- try to have the maximum possible distance between them, at least 7cm ;
- because the microphone type is very important, if you use an omni-directional one ( and this is the typical application) please seal it on the rear side (no back cavity) in order not to collect unwanted signals ;
- try to make divergent the main axes of the two devices .

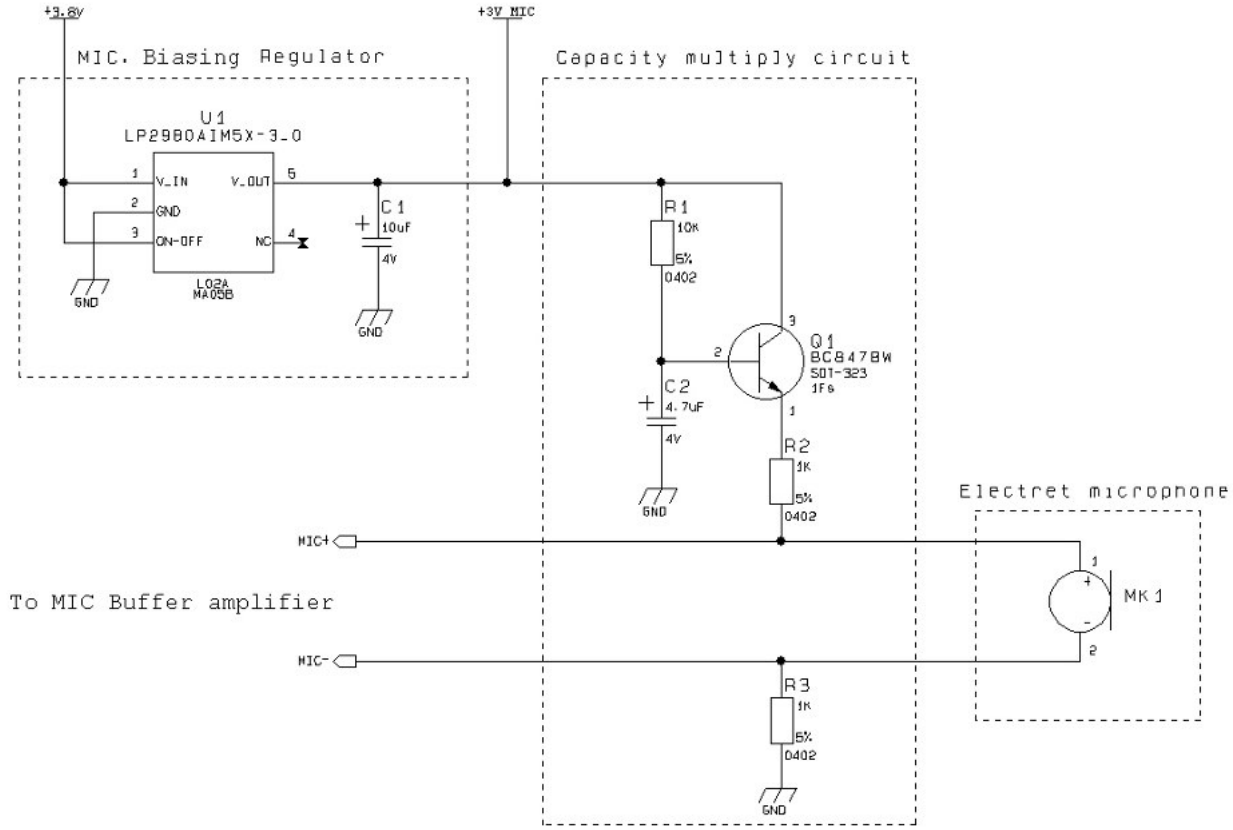
# 9.4 Microphone Biasing

The electret microphones usually need a biasing voltage to work properly. Refer to your microphone provider for the characteristics required.

***NOTE: The microphones have a hot wire were the positive biasing must be connected. Usually it is indicated by a + symbol or a red point. If the polarity of the bias is reversed, then the microphone will not work properly. For this reason be sure to respect the mic. biasing polarity.***

## 9.4.1 Balanced Microphone Biasing

The balanced microphone bias voltage should be obtained from a dedicated voltage regulator, in order to eliminate the noise present on the power lines. This regulator can be the same for all the audio paths. The microphone should be supplied from a capacitor multiply circuit.
For example a circuit for the balanced microphone biasing can be:



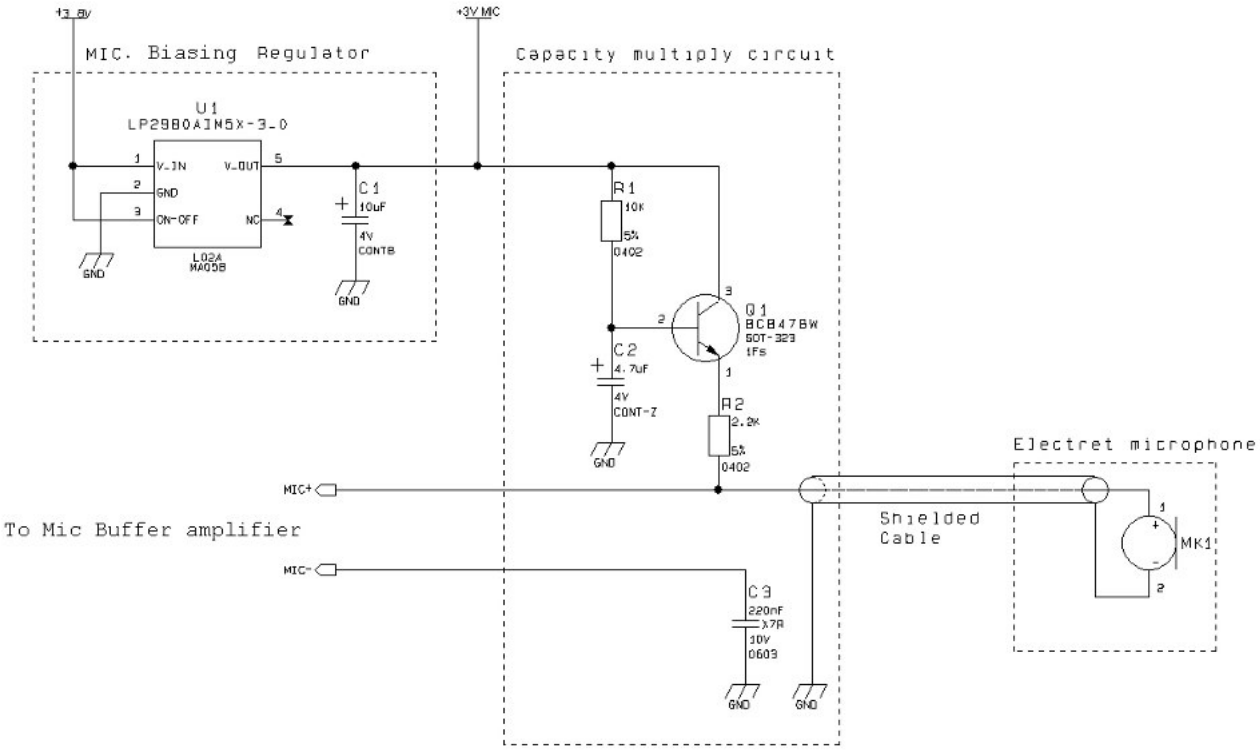
***NOTE: In the balanced application the resistors R2 and R3 must have the same value to keep the circuit balanced.***

***NOTE: The cable to the microphone should not be shielded, instead a twisted pair cable shall be used.***

***NOTE: The microphone sensitivity changes with the value of R2 and R3. Usually the microphones are characterized with 2kΩ biasing resistance, so try to keep the sum of R2 and R3 around 2kΩ. Refer to your microphone manufacturer for the mic. characteristics.***

## 9.4.2 Unbalanced Microphone Biasing

The unbalanced microphone biasing voltage should be obtained from a dedicated voltage regulator, in order to eliminate the noise present on the power lines. This regulator can be the same for all the audio paths. The microphone should be supplied from a capacitor multiply circuit.
For example a circuit for the unbalanced microphone biasing can be:




***NOTE: In the unbalanced application the capacitor C3 shall be > 200nF otherwise the frequency response will be cut at low band frequencies (down to 300Hz). This capacitor can be placed close to the MIC- pad (MIC_HF- or MIC_MT- depending on the audio path chosen) or if possible it should be placed close to the shielded cable connector. If the ground return path is well designed, then it is possible to eliminate the C3 capacitor, provided the buffer is close to the mic. input.***

***NOTE: The cable to the microphone should be shielded.***

***NOTE: The microphone changes with the value of R2. Usually the microphone sensitivity is characterized with 2kΩ biasing resistance, so try to keep the value of R2 around 2kΩ. For mic. characteristics refer to the manufacturer.***

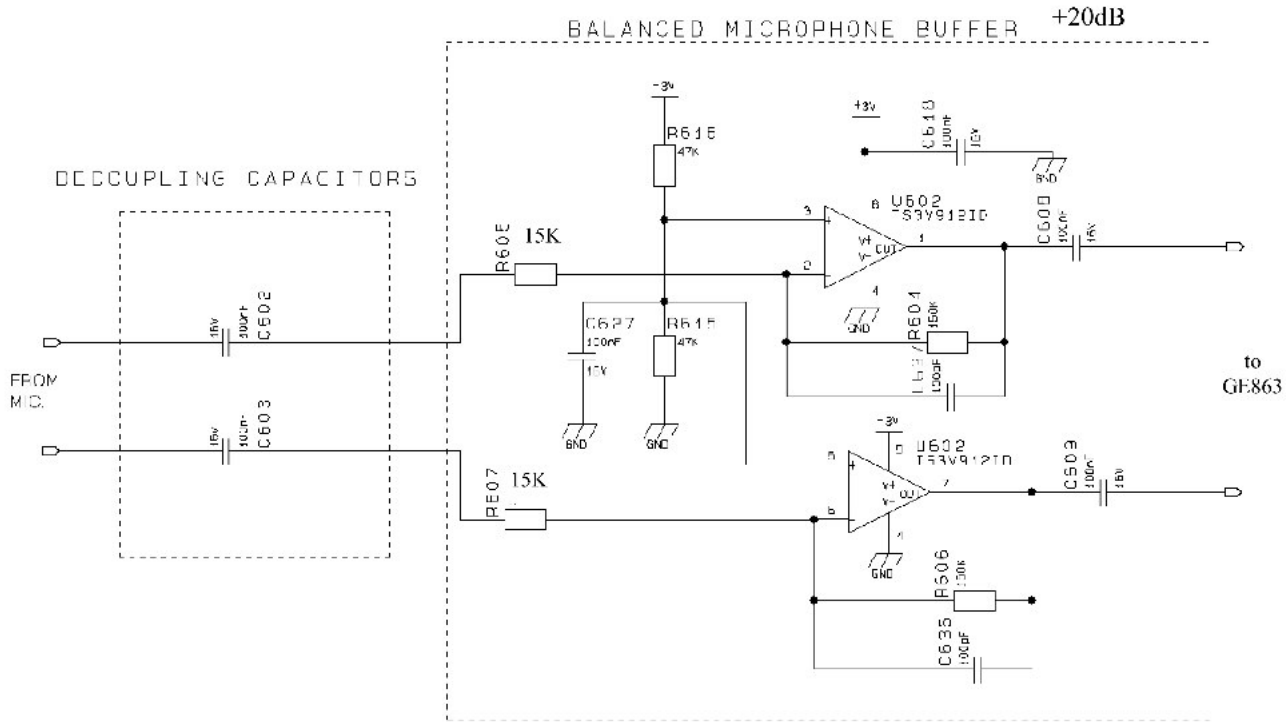
 

# 9.5 Microphone Buffering

As seen previously, a microphone shall be connected to the input pins of the GC864-QUAD / PY through a buffer amplifier that boosts the signal level to the required value.
Again the buffered microphone circuitry can be balanced or unbalanced: where possible it is always preferable a balanced solution. The buffering circuit shall be placed close to the microphone or close to the microphone wire connector.

## 9.5.1 Buffered Balanced Mic

A sample circuit can be:




This circuit has a gain of 10 times (+20 dB), and is therefore suited for the "***Mic_MT***" input if you have a microphone with a sensitivity close to the suggested one *(-45 dBV$_{rms}$/Pa)*. If your microphone has a different sensitivity or if the buffer is connected to the "***Mic_HF***" inputs , then a gain adjustment shall be done by changing resistors R604 and R606 ( if the required value is not a standard one , you can change R605 e R607 ) and as a consequence the capacitors C636 and C637 to maintain the bandwidth 150-4000Hz (at -3dB).

The buffer gain is given by the formula:

$$Gain = \frac{R604}{R605} = \frac{R606}{R607}$$

The C636 and C637 capacitors are placed in order to cut off the gain at higher frequencies than the transmitted GSM band, the cutoff frequency (-3dB) should be 3500Hz in order to have -1dB at 3kHz. The cutoff frequency is given by the formula:

$$freq. = \frac{1}{2\pi * R604 * C637} = \frac{1}{2\pi * R606 * C636} \text{ [Hz]}$$

***TIP: example of calculation .***

*Let's assume you have a microphone with a sensitivity of -45 dBV$_{rms}$/Pa and you want to use it in 1st differential microphone path ("**Mic_MT**" inputs) in "normal spoken" conditions at acoustic pressure of -4.7dBPa.*
*As reported at page 33 , the electrical level output from the microphone will be :*

$$MicLevel = (-45) + (-4.7) = -49.7\ dB_{Vrms}$$

*corresponding to:*

$$MicVoltage = 10^{(-49.7/20)} = 3.3 * 10^{-3}\ V_{rms}$$

*When the talker is screaming ,we will have a signal of 330 mV$_{rms}$ on the "**Mic_MT**" inputs due to a 20dB higher Mic Level (see TIP 1) with a buffer gain $G_A$ :*

***$G_A$** =20 log (AmplifierOutput / MicVoltage) =20 log (330 * 10$^{-3}$ )/( 33 * 10$^{-3}$ ) = 20 log 10=**20dB***

*The corresponding values for the resistors on the buffer could be ( if we keep the input resistance 10kΩ )*

$$R604 = R606 = gain * R607 = gain * R605 = 10 * 15 = 150\ k\Omega$$

*The commercial values of 150kΩ & 15kΩ are then chosen.*

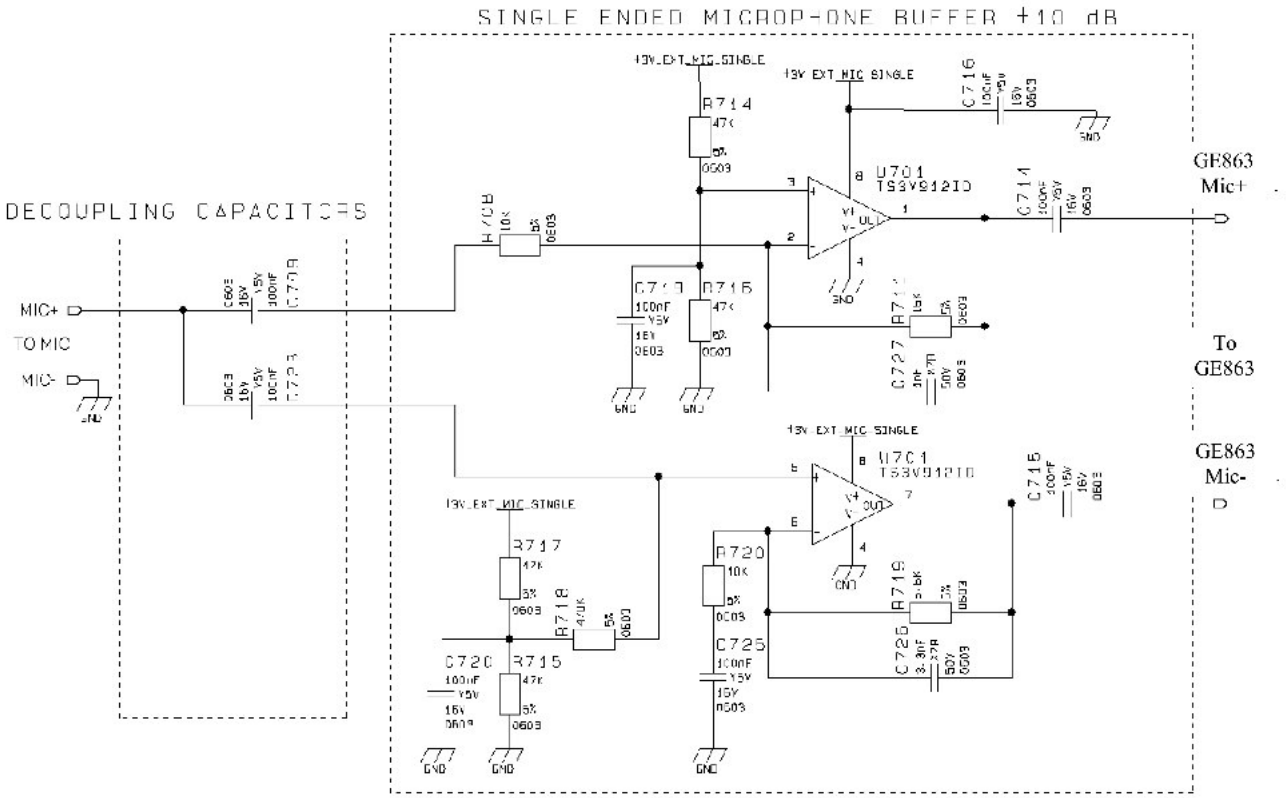
*As a consequence the values of the capacitors C636 and C637 shall be:*

$$C636 = C637 = 1/(2\pi * 4000 * R606) = 265 * 10^{-12}\ F$$

*A commercial value of 270pF gives a cutoff frequency of 3931Hz with an errorless than 1,8% .*

## 9.5.2 Buffered Unbalanced (Single Ended) Microphone .




The above schematic can be used for a single ended (*buffered unbalanced*) microphone; the required biasing circuitry is not included. Note also that the capacitor C3 is not needed
The gains of the two amplifiers are given by the formulas:

$$Gain(\text{not inverting buffer}) = 1 + \frac{R719}{R720} \qquad Gain(\text{inverting buffer}) = \frac{R711}{R708}$$

Assigning half of overall gain to each amplifier, you will obtain the requested gain because of doubling the microphone signal path; in fact by the use of two amplifiers (the upper as “inverting” and the lower as “not inverting” configuration) we obtain an additional +6dB gain (2 times).

Remember: the “not inverting “ amplifier section gain shall not be less than 1 .
Like for the balanced buffered microphone, the amplifier overall gain can be modify changing the value of resistor R719/R720 and R711 and as a consequence the capacitors C726 and C727. It is advisable to change R708 only if you have difficulty to find a commercial value for R711; in this case change R708 as little as possible.

The -3dB bandwidth is given by the approximated formula (considering C725 >> C726):

$$freq. = \frac{1}{2\pi * R719 * C726} = \frac{1}{2\pi * R711 * C727} \text{ [Hz]}$$

The buffer bandwidth at -3dB shall be 4KHz.
Note that the biasing of the operational amplifier is given for the inverting amplifier by the series divider R714-R715. The 100nF capacitor C719 is needed to filter the noise that could be coupled to that divider. For the not inverting operational amplifier the biasing is given by a different divider R715-R717 with the capacitor C720 and through a series resistor R718 of 470KΩ.

***TIP: example of calculation.***

*Llet's assume you have a microphone with a sensitivity of -45dBV$_{rms}$/Pa and you want to use it in 2nd differential microphone path ("**Mic_HF**" inputs) in "normal spoken" conditions at acoustic pressure of -4.7dBPa.*
*As reported at page XX , the electrical level output from the microphone will be :*

$$MicLevel = (-45) + (-4.7) = -49.7\ dBV_{rms}$$

*but we have to consider 20dB loss due to the higher distance from the mouth of the talker ( 50cm ) .*

$$MicLevel = (-49.7) + (-20) = -69.7\ dBV_{rms}$$

*corresponding to*

$$MicVoltage = 10^{(-69.7/20)} = 0{,}33 * 10^{-3}$$

*In order to have a signal of 1 mV$_{rms}$ at the **"Mic_HF"** inputs , as suggested at **TIP** "**environment consideration** ",*

*the buffer must have a gain* $G_A = \text{"Mic\_HF"} / MicVoltage = (1*10^{-3})/(0{,}33*10^{-3}) = 3$ *or +10 dB*

*Keeping in mind that " balancing the line will double the signal", to calculate the resistor values assign half of required gain $G_A$ to each amplifier section . And therefore $G_S$ =1,5times (or +3,52dB) .*

*Choosing as 10kΩ as the input resistance , the corresponding values for the resistors on the buffer will be :*

$$R711 = G_S * R708 = 1.5*10 = 15\ k\Omega$$

$$R719 = (G_S - 1) * R720 = (1.5 - 1)*10 = 5\ k\Omega$$

*The commercial values of **15kΩ** and **5.6kΩ** be accepted .*

*As a consequence of the assigned values of the resistors, the nominal values of C726 and C727 are :*

***C726**= 1/ (2π*4000*R719)= 7.10 *10 $^{-9}$ F*

***C727**= 1/ (2π*4000*R711)= 2,65 *10 $^{-9}$ F*

*modified in **6,8nF** ($f_{c1}$=4181Hz ) and **2,7nF** ($f_{c2}$=3931Hz) because of commercial values .*

# 10 OUTPUT LINES (Speaker)

## 10.1 Short description

The Telit GC864-QUAD / PY provides two audio paths in receive section. Only one of the two paths can be active at a time, selectable by *AXE* hardware line or by AT command.

You must keep in mind the different audio characteristics of the receive blocks when designing:

→ the *"**Ear_MT**"* lines *EPN1* and *EPP1* are the *Differential Line-Out Drivers* ; they can drive an external amplifier or directly a ***16 Ω earpiece*** at –12dBFS (*) ;
→ the "***Ear_HF***" lines *EPPA1_2* and *EPPA2* are the *Fully Differential Power Buffers ;* they can directly drive a *16**Ω** speaker* in differential (*balanced*) or single ended (*unbalanced*) operation mode .

(*) *FS*: acronym of *Full Scale.* It is equal to 0dB, the maximum Hardware Analog Receive Gain of BaseBand Chip.

The *"**Ear_MT**"* audio path should be used for handset function, while the "***Ear_HF***" audio path is suited for hands-free function (car kit).

Both receiver outputs are B.T.L. type (Bridged Tie Load) and the OEM circuitry shall be designed bridged to reduce the common mode noise typically generated on the ground plane and to get the maximum power output from the device; however also a single ended circuitry can be designed for particular OEM application needs.

# 10.2 Output Lines Characteristics

***"Ear_MT" Differential Line-out Drivers Path***

- line coupling: DC
- line type: bridged
- output load resistance : ≥ 14 Ω
- internal output resistance: 4 Ω (typical)
- signal bandwidth: 150 - 4000 Hz @ -3 dB
- max. differential output voltage 1310 $mV_{rms}$ (typ, open circuit)
- differential output voltage 328mVrms /16 Ω @ -12dBFS
- SW volume level step - 2 dB
- number of SW volume steps 10

***"Ear_HF" Power Buffers path***

- line coupling: DC
- line type: bridged
- output load resistance : ≥ 14 Ω
- internal output resistance: 4 Ω ( >1,7 Ω )
- signal bandwidth: 150 - 4000 Hz @ -3 dB
- max. differential output voltage 1310 $mV_{rms}$ (typ, open circuit)
- max. single ended output voltage 656 $mV_{rms}$ (typ, open circuit)
- SW volume level step - 2 dB
- number of SW volume steps 10

# 10.3 General Design Rules

There are several configurations for the audio output path, but the various design requirements can be grouped into three different categories:

- handset earphone (low power, typically a handset)
- hands-free earphone (low power, typically a earphone)
- car kit speakerphone (high power, typically a speaker)

The three groups have different power requirements, usually the first two applications need only few mW of power, which can be directly drained from the GC864-QUAD / PY pads, provided a suited speaker is used. This direct connect design is the cheaper and simpler solution and will be suited for the most of the earphone design requirements. There's no need to decouple the output ear lines if a suited earpiece is connected. For the last group, the speakerphone, a power amplifier is required to raise the output power up to 5-10W required in a car cabin application.
All the designs shall comply with the following guidelines:

- Where possible use a bridged earphone circuitry, to achieve the maximum power output from the device.
- Keep the earphone traces on the PCB and wires as short as possible.
- If your application requires a single ended earpiece and you want a direct connection, then leave one of the two output lines open and use only the other referred to ground. Remember that in this case the power output is 4 times lower than the bridged circuit and may not be enough to ensure a good voice volume.
- Make sure that the earphone traces in the PCB don't cross or run parallel to noisy traces (especially the power line)
- The cable to the speaker shall be a twisted pair with both the lines floating for the bridged output type, shielded with the shield to ground for the single ended output type.

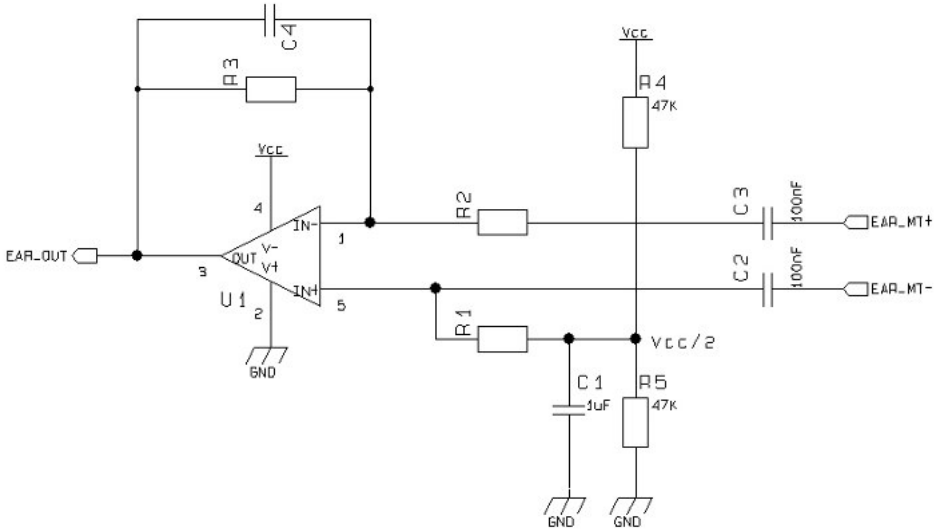
## 10.3.1 Noise Filtering

The I/O of the PCB should have a noise filter close to the connector, to filter the high frequency GSM noise. The filter can be a Π formed by 2 capacitor and a inductance, with the one capacitor of *39pF - 0603* case , and the other capacitor of *1nF - 0603*; the inductance shall have a value of *39µH* .

# 10.4 Handset Earphone Design

As seen previously, a 16Ω earpiece can be directly connected to the output pads EAR_MT+ and EAR_MT- of the *GC864-QUAD / PY*.
This solution is often the more cost effective, reducing the components count to a minimum. There are several limitations to the use of this solution: speaker direct connect imposes the speaker characteristics to be almost exactly the suggested ones, otherwise the power output may be reduced (if speaker impedance is bigger than 16Ω) or the *GC864-QUAD / PY* ear port may be damaged (if speaker impedance is less than 15Ω).
The other limitation of the speaker direct connection is the power output capability of the *GC864-QUAD / PY* which is limited and for some particular applications may not be enough.
For these reasons, when the power output of the *GC864-QUAD / PY* is not enough or if the speaker characteristics are different from the suggested, then it is preferable to use an amplifier to increase the power and current output capabilities.
Again the output from the *GC864-QUAD / PY* is bridged and both lines should be used, where possible, as inputs to the power amplifier. This ensures a higher common mode rejection ratio, reducing the GSM current busts noise on the speaker output.
In this case the "***EAR_MT***" lines from the *GC864-QUAD / PY* should be AC coupled with a ceramic capacitor of 100nF (or bigger) .
It is always desirable to have a mute control on the amplifier, in order to turn it off while the device is not sending signal to the output, in this manner the amplifier background noise which may be audible during idle conditions is cut off.
A principle schematic may be:

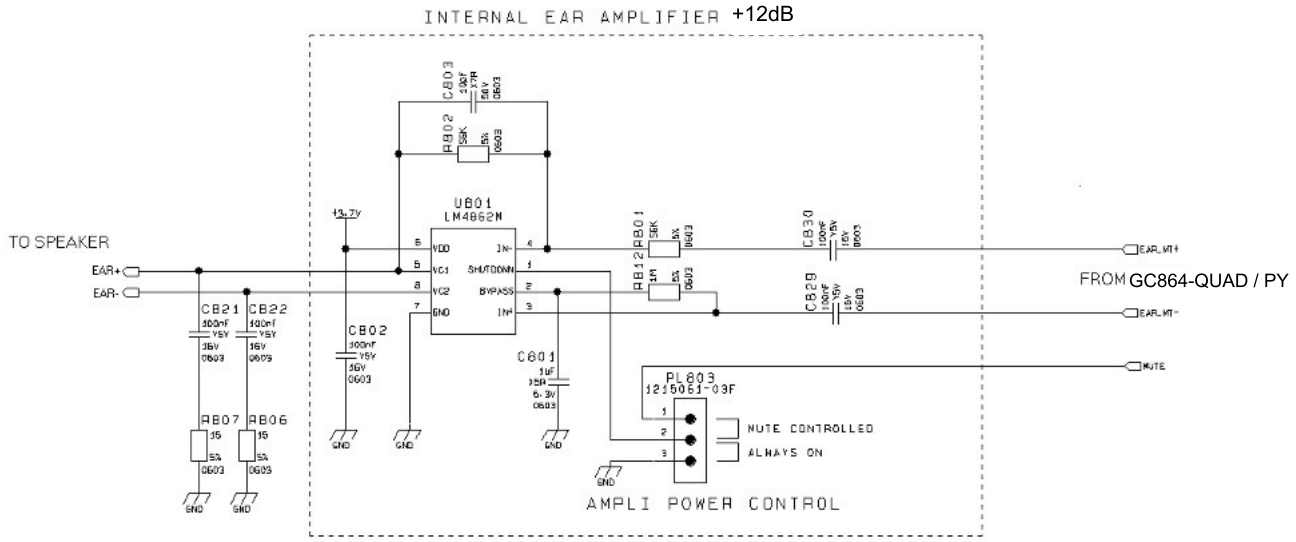



The resulting gain and high pass cut can be obtained with the formula:

$$Gain = \frac{R3}{R2}$$

$$freq. = \frac{1}{2\pi * R3 * C4} \text{ [Hz]}$$

And an example of internal Ear amplifier could be:




Some amplifier require a low impedance load at high frequency in order to avoid auto oscillation, this can be made with a capacitor (*100nF*) in series with a resistor (*15Ω*).

When designing your application, remember to provide an adequate bypass capacitor to the amplifier and place it close to the power input pin of the IC, keeping the traces as short as possible.

# 10.5 Hands-Free Earphone (Low Power) Design

The same design considerations made for the handset are valid for the hands-free earphone.

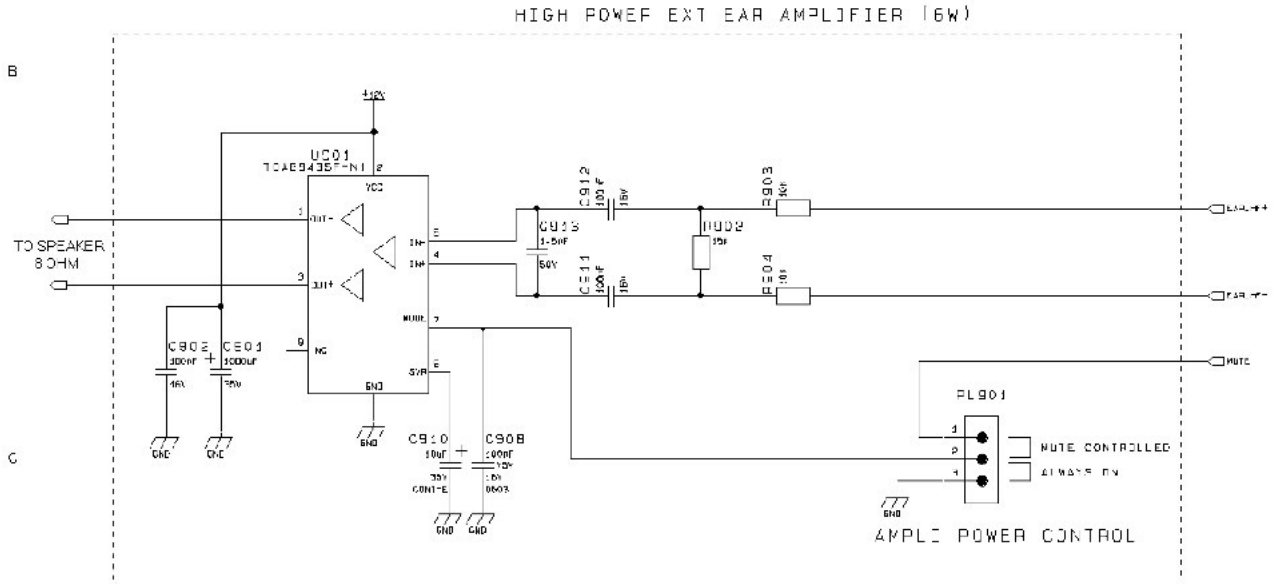
# 10.6 Car Kit Speakerphone Design

For the car kit speaker phone function the power output requirement is usually at least 4W, therefore an amplifier is needed to boost the *GC864-QUAD / PY* output.
The design of the amplifier shall comply with the following guidelines:

- The input to the amplifier MUST be taken from the "***Ear_HF***" audio path of the *GC864-QUAD / PY*, because of its echo canceller parameters suited to a car cabin use.
- The amplifier shall have a gain of 30-40 times (29-32 dB) to provide the desired output power of 5-10W with the signal from the *GC864-QUAD / PY* "***Ear_HF***" audio output lines.
- If the amplifier has a fixed gain then it can be adjusted to the desired value by reducing the input signal with a resistor divider network.
- The amplifier shall have a mute control to be used while not in conversation. This results in two benefits: eliminating the background noise when not in conversation and saving power.
- The power to the amplifier should be decoupled as much as possible from the *GC864-QUAD / PY* power supply, by either keeping separate wires and placing bypass capacitors of adequate value close to the amplifier power input pads.
- The biasing voltage of the amplifier shall be stabilized with a low ESR (e.g. a tantalum) capacitor of adequate value.

***NOTE: The GC864-QUAD / PY audio path connected to the car kit hands-free amplifier MUST be "Ear_HF" one, otherwise the echo cancellation will not be done due to the difference in the echo canceller characteristics of the GC864-QUAD / PY internal audio path from the external audio path.***

Example of car kit amplifier schematic.



# 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 GC864-QUAD / PY firmware and acts depending on the function implemented.

Not all GPIO pads support all these three modes:

- GPIO5 supports all three modes and can be input, output, RFTX monitor output (Alternate function)
- GPIO6 supports all three modes and can be input, output, alarm output (Alternate function)
- GPIO7 supports all three modes and can be input, output, buzzer output (Alternate function)

# 11.1 Logic level specifications

Where not specifically stated, all the interface circuits work at 2.8V CMOS logic levels.
The following table shows the logic level specifications used in the GC864 and GC864 interface circuits:

**Absolute Maximum Ratings -Not Functional**

| Parameter | Min | Max |
|---|---|---|
| Input level on any digital pin when on | -0.3V | +3.75V |
| Input voltage on analog pins when on | -0.3V | +3.0 V |

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

| Level | Min | Max |
|---|---|---|
| Input high level | 2.1V | 3.3V |
| Input low level | 0V | 0.5V |
| Output high level | 2.2V | 3.0V |
| Output low level | 0V | 0.35V |

For 2,0V signals:

**Operating Range - Interface levels (2.0V CMOS)**

| Level | Min | Max |
|---|---|---|
| Input high level | 1.6V | 3.3V |
| Input low level | 0V | 0.4V |
| Output high level | 1,65V | 2.2V |
| Output low level | 0V | 0.35V |

## 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 2.8V CMOS levels of the GPIO.
If the digital output of the device to be connected with the GPIO input pad has interface levels different from the 2.8V CMOS, then it can be connected to GPIO1 or can be buffered with an open collector transistor, provided a 47KΩ pull-up resistor is connected as seen in the paragraph **Error! Reference source not found. Error! Reference source not found.**.

## 11.3 Using a GPIO Pad as OUTPUT

The GPIO pads, when used as outputs, can drive 2.8V 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.

## 11.4 Using the RFTXMON Output GPIO5

The GPIO5 pin, when configured as RFTXMON Output, is controlled by the GC864-QUAD / PY module and will rise when the transmitter is active and fall after the transmitter activity is completed.
For example, if a call is started, the line will be HIGH during all the conversation and it will be again LOW after hanged up.

## 11.5 Using the Alarm Output GPIO6

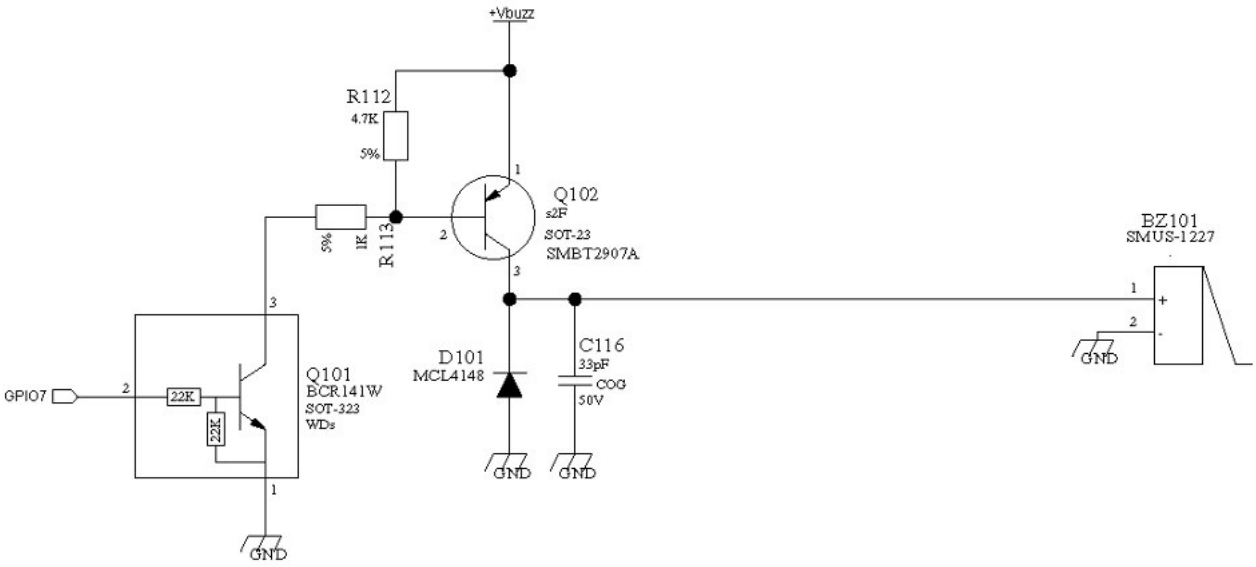
The GPIO6 pad, when configured as Alarm Output, is controlled by the GC864-QUAD / PY module and will rise when the alarm starts and fall after the issue of a dedicated AT command.
This output can be used to power up the GC864-QUAD / PY controlling microcontroller or application at the alarm time, giving you the possibility to program a timely system wake-up to achieve some periodic actions and completely turn off either the application and the GC864-QUAD / PY 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.***

# 11.6 Using the Buzzer Output GPIO7

The GPIO7 pad, when configured as Buzzer Output, is controlled by the GC864-QUAD / PY 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.



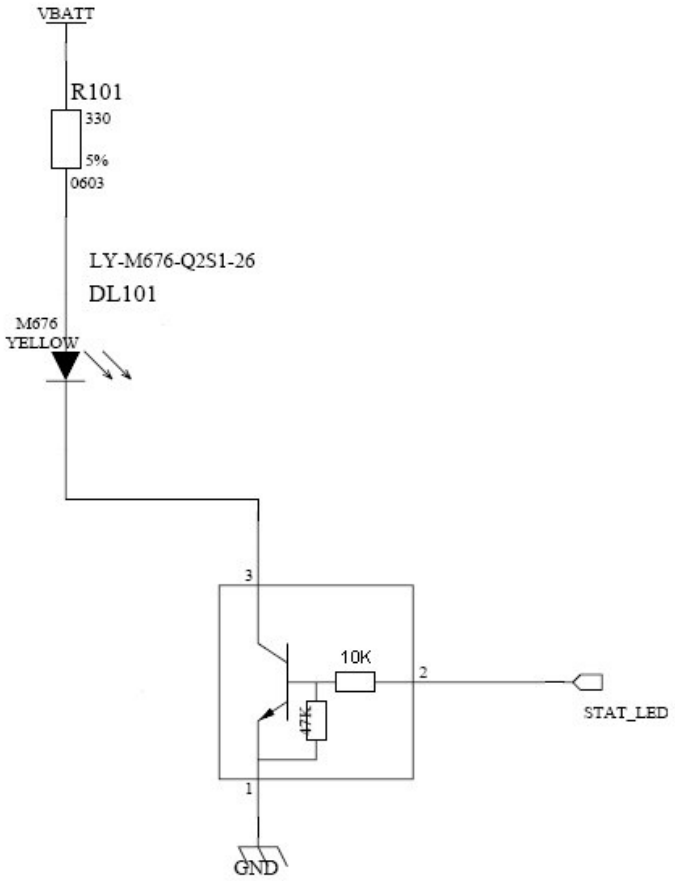

A sample interface scheme is included below to give you an idea of how to interface a Buzzer to the GPIO7:

***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.***

# 11.7 Indication of network service availability

The STAT_LED pin status shows information on the network service availability and Call status.
In the GC864 modules, 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<br>(Period 1s, Ton 0,5s) | Net search / Not registered / turning off |
| Slow blinking<br>(Period 3s, Ton 0,3s) | Registered full service |
| Permanently on | a call is active |



# 11.8 RTC Bypass out

The VRTC pin brings out the Real Time Clock supply, which is separate from the rest of the digital part, allowing having only RTC going on when all the other parts of the device are off.
To this power output a backup capacitor can be added in order to increase the RTC autonomy during power off of the battery. NO Devices must be powered from this pin.

# 11.9 VAUX1 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 – VAUX1 power supply**

| | Min | Typical | Max |
|---|---|---|---|
| **Output voltage** | 2.75V | 2.85V | 2.95V |
| **Output current** | | | 100mA |
| **Output bypass capacitor** | | | 2.2µF |

# 12 DAC and ADC section

## 12.1 DAC Converter

### 12.1.1 Description

The GC864-QUAD / PY module provides a Digital to Analog Converter. The signal (named DAC_OUT) is available on pin 40 of the GC864-QUAD / PY module and on pin 17 of PL102 on EVK2 Board (CS1203).
The on board DAC is a 10-bit converter, able to generate a analogue value based a specific input in the range from 0 up to 1023. However, an external low-pass filter is necessary

| | Min | Max | Units |
|---|---|---|---|
| Voltage range (filtered) | 0 | 2,6 | Volt |
| Range | 0 | 1023 | Steps |

The precision is 10 bits so, if we consider that the maximum voltage is 2V, the integrated voltage could be calculated with the following formula:

**Integrated output voltage = 2 * value / 1023**

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

### 12.1.2 Enabling DAC

An AT command is available to use the DAC function.
The command is **AT#DAC[=<enable>[,<value>]]**

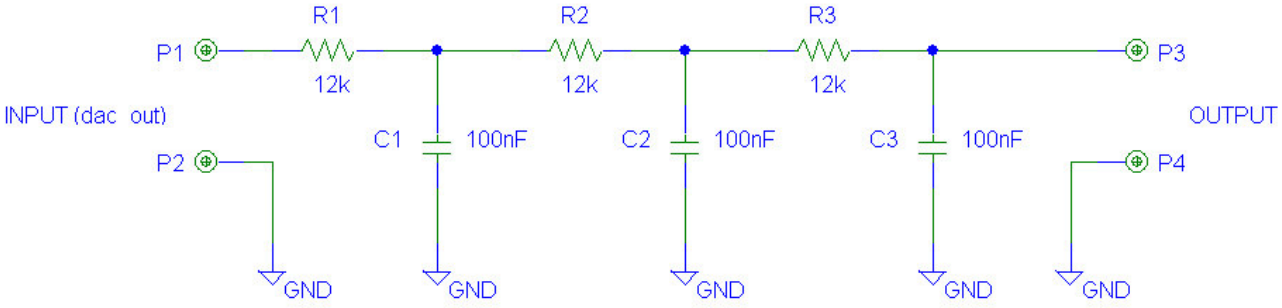
**<value>** - scale factor of the integrated output voltage (0..1023 - 10 bit precision)
it must be present if **<enable>=1**

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 A/D are 11-bit converter. They are able to read a voltage level in the range of 0÷2 volts applied on the ADC pin input, store and convert it into 11 bit word.

| | Min | Max | Units |
|---|---|---|---|
| Input Voltage range | 0 | 2 | Volt |
| AD conversion | - | 11 | bits |
| Resolution | - | < 1 | mV |

The GC864-QUAD / PY module provides 3 Analog to Digital Converters. The input lines are:

**ADC_IN1** available on Pin 37 and Pin 19 of PL102 on EVK2 Board (CS1203).
**ADC_IN2** available on Pin 38 and Pin 20 of PL102 on EVK2 Board (CS1203).
**ADC_IN3** available on Pin 39 and Pin 21 of PL102 on EVK2 Board (CS1203).

## 12.2.2 Using ADC Converter

An AT command is available to use the ADC function.

The command is **AT#ADC=1,2**

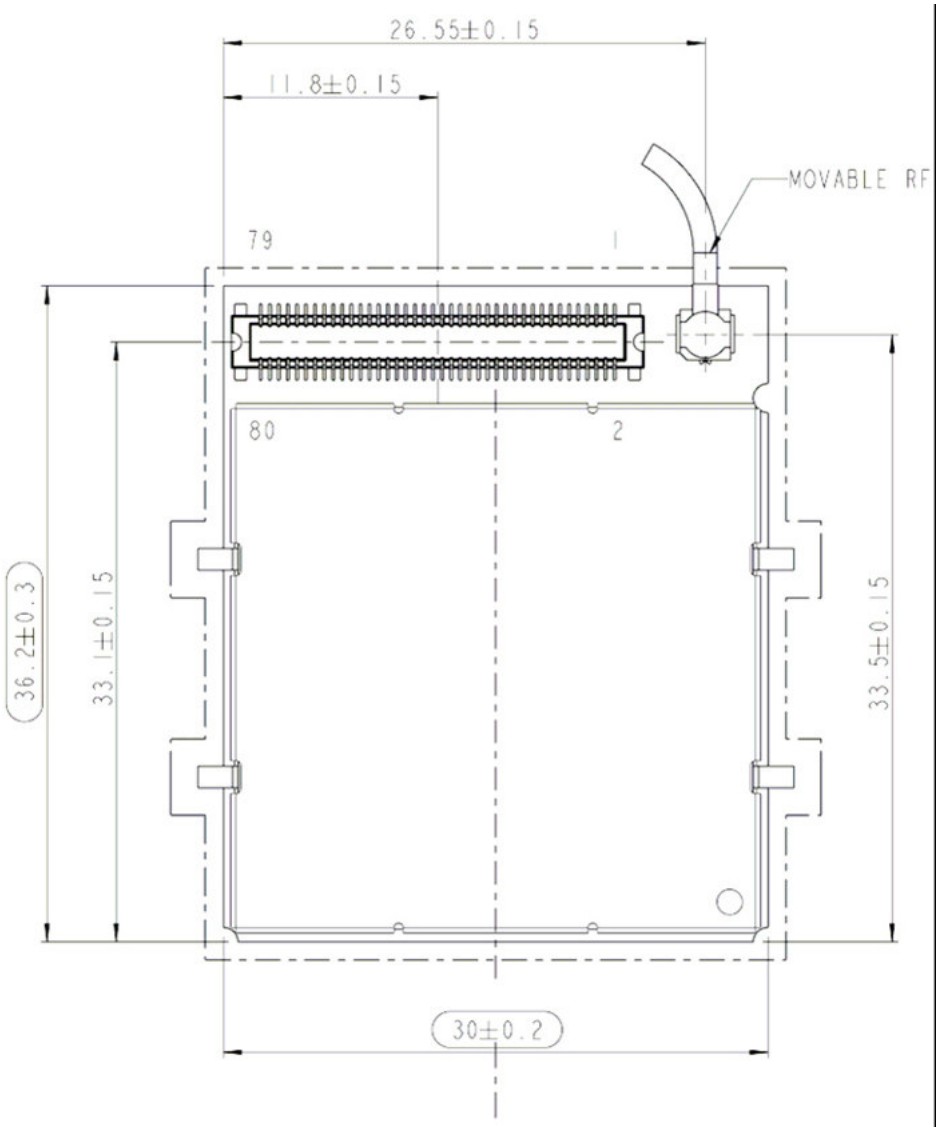
The read value is expressed in mV

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

# 12.3 Mounting the GC864 on your board

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




**NOTE:** metal tabs present on GC864 should be connected to GND

### 12.3.1 Debug of the GC864 in production

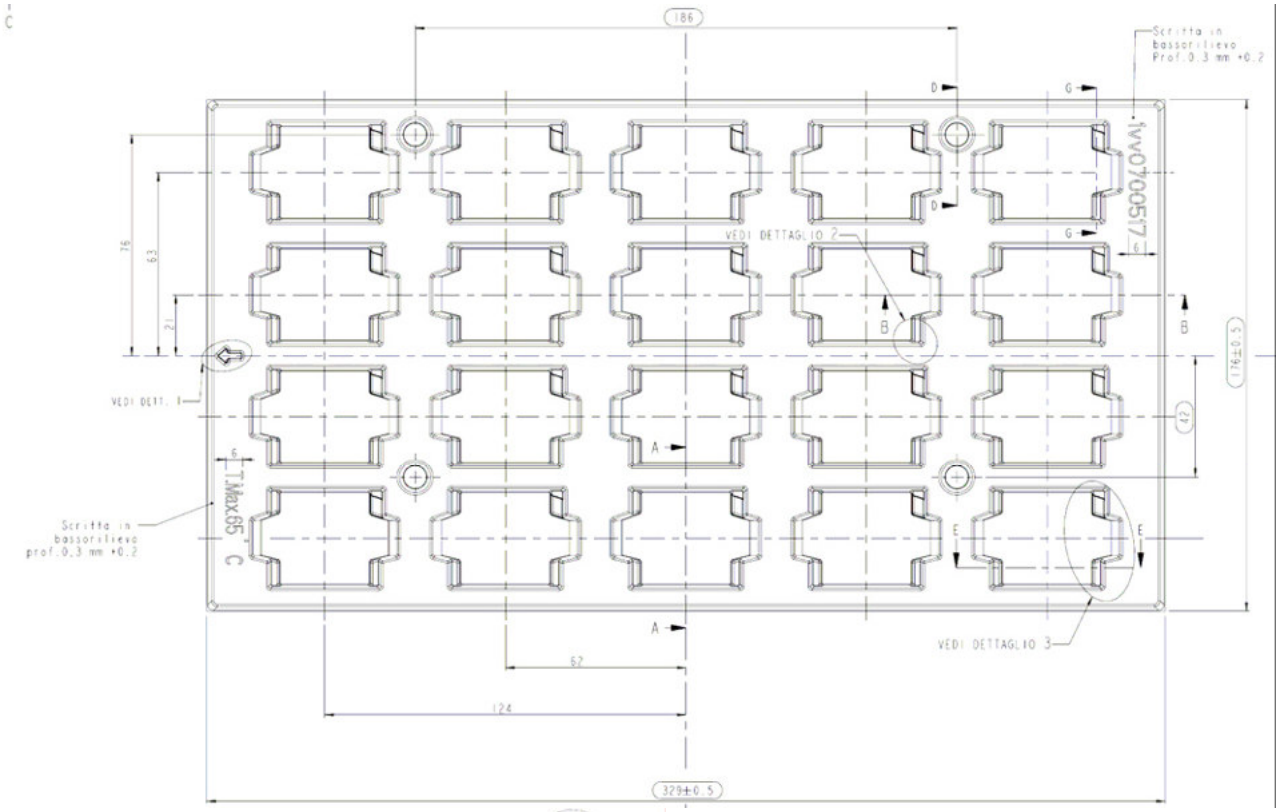
To test and debug the mounting of the GC864, we strongly recommend to foreseen test pads on the host PCB, in order to check the connection between the GC864 itself and the application and to test the performance of the module connecting it with an external computer. Depending by the customer application,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

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

# 12.4 Packing system

The Telit GC864 and GC864 are packaged on trays of 20 pieces each. This is especially suitable for the GC864 according to SMT processes for pick & place movement requirements.




Section A-A

The size of the tray is: 329 x 176mm

**NOTE**: that trays can withstand at the maximum temperature of 65° C.

# 13 Conformity Assessment Issues

The GC864-QUAD / PY module is assessed to be conform to the R&TTE Directive as stand-alone products, so If the module is installed in conformance with Dai Telecom installation instructions require no further evaluation under Article 3.2 of the R&TTE Directive and do not require further involvement of a R&TTE Directive Notified Body for the final product.

In all other cases, or if the manufacturer of the final product is in doubt then the equipment integrating the radio module must be assessed against Article 3.2 of the R&TTE Directive**.**
In all cases assessment of the final product must be made against the Essential requirements of the R&TTE Directive Articles 3.1(a) and (b), safety and EMC respectively, and any relevant Article 3.3 requirements.

The GC864-QUAD / PY module is conform with the following European Union Directives:

- R&TTE Directive 1999/5/EC (Radio Equipment & Telecommunications Terminal Equipments)
- Low Voltage Directive 73/23/EEC and product safety
- Directive 89/336/EEC for conformity for EMC

In order to satisfy the essential requisite of the R&TTE 99/5/EC directive, the GC864-QUAD / PY module is compliant with the following standards:

- GSM (Radio Spectrum). Standard: EN 301 511 and 3GPP 51.010-1
- EMC (Electromagnetic Compatibility). Standards: EN 301 489-1 and EN 301 489-7
- LVD (Low Voltage Directive) Standards: EN 60 950

In this document and the Hardware User Guide, Software User Guide all the information you may need for developing a product meeting the R&TTE Directive is included.

The GC864-QUAD / PY module is conform with the following US Directives:

- Use of RF Spectrum. Standards: FCC 47 Part 24 (GSM 1900)
- EMC (Electromagnetic Compatibility). Standards: FCC47 Part 15

To meet the FCC's RF exposure rules and regulations:

- The system 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 3 dBi 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.

Manufacturers of mobile, fixed or portable devices incorporating this module are advised to clarify any regulatory questions and to have their complete product tested and approved for FCC compliance.

# 14 SAFETY RECOMMANDATIONS

**READ CAREFULLY**

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

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

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

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

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

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

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

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

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

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

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

http://europa.eu.int/comm/enterprise/electr_equipment/index_en.htm

# 15 Document Change Log

| Revision | Date | Changes |
|---|---|---|
| ISSUE#0 | 12/06/06 | Release First ISSUE# 0 |
| ISSUE #1 | 07/09/06 | Full Review of the manual<br>Added ADC description<br>Added DAC description<br>Added Pinout and Process flow description<br>Added Packaging |
| ISSUE #2 | 03/10/06 | TGPIO23 now RESERVED |
| ISSUE #3 | 07/11/06 | 3.1 (table on page 12); PWRCTL must be PWRMON |
| ISSUE #4 | 08/02/07 | Pinout updated, Camera removed , Added Stat Led and GPIO5 description, added VAUX, schematics updated for On_off, reset, level adapter 5V, RS232 transceiver, Power supply. Modified Charger description. |
| | | |

# GC864-QUAD / PY SW USER GUIDE

GC864-QUAD / PY Software User Guide
1vv0300740 Rev. 1 - 05/02/07


Making machines talk.

This document is relating to the following products:


GC864-QUAD 3990250675
GC864-PY 3990250676

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# 1 Overview

The purpose of this document is the description of some common AT command procedures that may be used with the **Telit GC864-QUAD / PY module**.In this document, all the basic functions of a mobile phone will be taken into account and for each one of them, a proper command sequence will be suggested.In the Advanced operation section the more useful services and features of the GSM network supported by the **Telit GC864-QUAD / PY module** is taken into account and some command sequence and usage are provided for each one of them.This document and its suggested command sequences shall not be considered mandatory; instead, the information given shall be used as a guide for properly using the **Telit module**. For further commands and features that may not be explained in this document refer to the GC864-QUAD / PY Product Description document where all the supported AT commands are reported.

**NOTICE**

***(EN) The integration of the GSM/GPRS GC864-QUAD / PY cellular module within user application shall be done according to the design rules described in this manual.***

***(IT) L'integrazione del modulo cellulare GSM/GPRS GC864-QUAD / PY all'interno dell'applicazione dell'utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.***

***(DE) Die integration des GC864-QUAD / PY GSM/GPRS Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Kunstruktionsregeln erfolgen***

***(SL) Integracija GSM/GPRS GC864-QUAD / PY modula v uporabniški aplikaciji bo morala upoštevati projektna navodila, opisana v tem piročniku.***

***(SP) La utilización del modulo GSM/GPRS GC864-QUAD / PY debe ser conforme a los usos para los cuales ha sido deseñado descritos en este manual del usuario.***

***(FR) L'intégration du module cellulaire GSM/GPRS GC864-QUAD / PY dans l'application de l'utilisateur sera faite selon les règles de conception décrites dans ce manuel.***

(HE) האינטגרטור מתבקש ליישם את ההנחיות המפורטות במסמך זה בתהליך האינטגרציה של המודם הסלולרי GC864-QUAD / PY עם המוצר.

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# 2 Basic Operations

## 2.1 Command Syntax

In the next paragraphs the following notations are used:

<cr> represents the Carriage Return Character (13)

<lf> represents the Line Feed Character (10)

<xx> represents a parameter whatever name is in place of the xx. (< and > characters are only for delimiting the parameter and **must not** be issued to the terminal).

[<xx>] represents an optional parameter whatever name is in place of the xx. ([ and ] characters are only for delimiting the optional parameter and **must not** be issued to the terminal).

### 2.1.1 Interface Style

The GC864-QUAD / PY module is using an AT interface that is defined in the document 80000ST10025a
(AT Commands Reference Guide). The specification defines 3 possible AT interfaces:

0 - AT command interface of the products, to the GM862-GSM and GM862-GPRS interface style
1 – AT interface of the products, to the GM862-PCS, PYTHON, QUAD-PY, TRIZIUM and GE863-QUAD, PY interface style
2 - switches the AT command interface style of the product, to the new products like GC864, GC864 and the GPS products

The default interface for the GC864-QUAD / PY product is 2.

The switch between the different interfaces could also be performed with the **#SELINT** AT command. Refer to the AT Commands Reference Guide for the full command description.

All the AT commands described in this specification is related to SELINT 2

## 2.2 Command Response Timeout

Every command issued to the Telit GC864-QUAD / PY returns a result response if response codes are enabled (default) (see command ATQn). The time needed to process the given command and return the response varies from command to command and may depend also from the network on which the command may interact. As a result every command is provided with a proper timeout time, if this time elapses without any result from the operation, then the ERROR response is reported as if the operation was not successful.
The timeout time is quite short for commands that imply only internal set up commands, but may be very long for command that interact with the network (or even Networks).

***NOTE: In case no response is received after the timeout time has been elapsed, then try repeating the last command and if still no response is received until the timeout time, then an Unconditional Shutdown MUST be issued and then the device shall be powered ON again.***

In the table below are listed all the commands whose timeout differs from the default **100 ms** and their effective timeout is reported:

| Command | Time-Out (Seconds) |
|---|---|
| +CBST | 0.2 |
| +CR | 0.2 |
| +CRC | 0.2 |
| +CRLP | 0.2 |
| +CSCS | 0.2 |
| +CEER | 5 |
| +CGMI | 5 |
| +CGMM | 5 |
| +CGMR | 5 |
| +CGSN | 20 |
| +CIMI | 20 |
| +CNUM | 20 |
| +CREG | 5 |
| +COPS | 180 |
| +CLCK | 180 |
| @CLCK | 180 |
| +CPWD | 180 |
| +CLIP | 180 |
| +CLIR | 180 |
| +CCFC | 180 |
| +CCWA | 20 |
| +CHLD | 20 |
| +CUSD | 180 |
| +CAOC | 20 |
| +CSSN | 20 |

| Command | Time-Out (Seconds) |
|---|---|
| +CLCC | 20 |
| +CPAS | 5 |
| +CPIN | 20 |
| +CSQ | 5 |
| +CPBS | 5 |
| +CPBR | 20 |
| +CPBF | 20 |
| +CPBW | 20 |
| +CALM | 5 |
| +CRSL | 5 |
| +CLVL | 5 |
| +CMUT | 5 |
| +CACM | 20 |
| +CAMM | 20 |
| +CPUC | 20 |
| +CMEE | 5 |
| +VTS | 20 |
| +GMI | 5 |
| +GMM | 5 |
| +GMR | 5 |
| +GSN | 20 |
| I3 | 5 |
| I4 | 5 |
| I5 | 5 |
| +CSMS | 5 |
| +CPMS | 5 |
| +CMGF | 5 |
| +CSCA | 20 |
| +CSMP | 5 |
| +CSDH | 5 |
| +CSAS | 5 |
| +CRES | 5 |
| +CNMI | 5 |
| +CMGS | 180 / 5 for prompt”>” |
| +CMSS | 180 |
| +CMGW | 5 / 5 for prompt”>” |
| +CMGD | 5 |
| +CMGR | 5 |
| +CMGL | 5 |
| #CAP | 10 |
| #SRS | 10 |
| #SRP | 10 |
| #STM | 10 |
| #PCT | 10 |

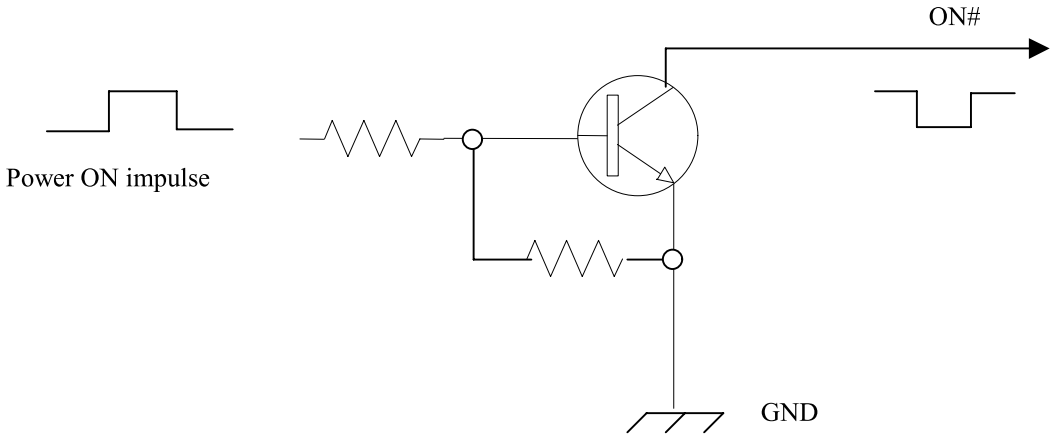
 

| Command | Time-Out (Seconds) |
|---|---|
| #SHDN | 10 |
| #QTEMP | 10 |
| #SGPO | 10 |
| #GGPI | 10 |
| #MONI | 10 |
| #CGMI | 5 |
| #CGMM | 5 |
| #CGMR | 5 |
| #CGSN | 20 |
| #CIMI | 5 |
| +CGACT | 180 |
| +CGATT | 180 |
| +CGDATA | 20 |
| +CGDCONT | 20 |
| +CGPADDR | 20 |
| +CGQMIN | 20 |
| +CGQREQ | 20 |

# 2.3 Turning ON the GC864-QUAD / PY

To turn on the GC864-QUAD / PY the pin ON# must be tied low for at least 1 second and then released.
A simple circuit to do it is:




***NOTE: don't use any pull up resistor on the ON# line. Using pull up resistor may bring to latch up problems on the GC864-QUAD / PY power regulator and improper power off of the module. The line ON# must be connected only in open collector configuration.***

***TIP: To check if power has raised it is possible to monitor the PWRMON line, when this line goes high the module is powered on, but before it remains on the device needs other 900 ms for software startup. Hence check the PWRMON line and 900 ms after its transition to high it is possible to release the ON# pin.***

# 2.4 Turning OFF the GC864-QUAD / PY

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

- by software command
- by hardware shutdown

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.

### 2.4.1.1 Software shutdown

- Send command **AT#SHDN<cr>**
- wait for **OK** response

The device shuts down with the following sequence of activities:

- Detach from the network
- Module Shutdown

In the case of Network unavailability the detach will be attempted few seconds (typical 6secs).
After this timeout the module will be shut down.

### 2.4.1.2 Hardware shutdown

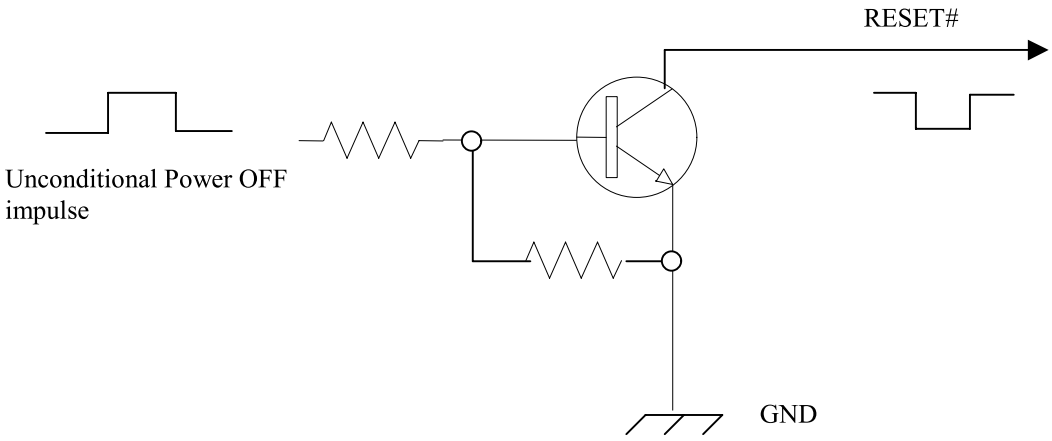
To turn OFF the GC864-QUAD / PY the pin ON# must be tied low for at least 2 second and then released.
The same circuitry for the power on can be used.
The device shuts down after the release of the ON# pin.

***TIP: To check if the device has powered off, the hardware line PWRMON should be monitored. When it goes low, the device has powered off.***

### 2.4.1.3 Hardware Unconditional RESTART

To unconditionally RESTART the GC864-QUAD / PY the pin RESET# must be tied low for at least 200 milliseconds and then released.
A simple circuit to do it is:




***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-QUAD / PY power regulator and improper functioning of the module. The line RESET# 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.***

# 2.5 Checking GSM device functionality

After a proper power on the device is ready to receive AT commands on the serial port.
Several things have to be checked in order to be sure that the device is ready to send and receive calls and SMS:

## 2.5.1 Autobauding

At startup it is necessary to send an AT command to make the device set the right speed and character format of the serial port. When this is done the device responds with OK. If no response is received within the timeout period of 200 ms retry.

- Send command **AT<cr>**
- wait for **OK** response

after this initial command, it is advisable to fix the port rate, in order to eliminate possible errors in detecting the serial speed rate:

- Send command **AT+IPR=<rate><cr>**
- wait for **OK** response

where rate is the port speed and can be 0, 300,1200,2400,4800,9600,19200,38400,57600,115200 bps.

If **<rate>** is set to 0, then automatic speed detection is enabled and also character format (see **+ICF**) is set to auto-detect. (default)
If **<rate>** is specified and not 0, **DTE-DCE** speed is fixed at that speed, hence no speed auto-detection (autobauding) is enabled.

***TIP: The serial port suggested setting is: port speed 38400, character format 8N1 (8 bit per char, No parity bit, 1 stop bit).***

## 2.5.2 SIM presence checking

After autobauding the first thing to check is the SIM presence and PIN code insertion, this can be done with the following commands:

### 2.5.2.1 Enable the Extended error result codes

- **send command AT+CMEE=1<cr>**
- wait for **OK** response

or if you prefer the verbose format instead of the numerical format then:

- **send command AT+CMEE=2<cr>**
- wait for **OK** response

### 2.5.2.2 Query SIM presence and status

- send command **AT+CPIN?<cr>**
- wait for response:

| Response | Reason | Action |
|---|---|---|
| +CPIN: SIM PIN | SIM is present and PIN is required to continue operations | Proceed to par. 2.5.2.3 |
| +CPIN: SIM PUK | SIM is present and 3 attempts to give SIM PIN have failed, so SIM PUK is required | Send command AT+CPIN=<SIM PUK> |
| +CPIN: READY | SIM is present and no PIN code is required to proceed | Proceed ahead |
| +CME ERROR: 10 | SIM not present | Insert SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CME ERROR: 13 | SIM defect | Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2 |
| +CME ERROR: 14 | SIM is busy | retry later |
| +CME ERROR: 15 | SIM is wrong type | Check SIM, it must be a GSM SIM. |

### 2.5.2.3 Provide SIM PIN (only if required see point 2.5.2.2)

- send command **AT+CPIN=****<cr>**

where **** stands for the SIM PIN code (e.g. 1234)

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | SIM PIN was correct | Proceed ahead |
| ERROR | the PIN code inserted is not correct | Retry from par. 2.5.2.2 |

***NOTE: When receiving the ERROR message, repeat Query SIM presence and status since after 3 failed attempts SIM PIN is not anymore requested, but SIM PUK is requested instead, hence you may need to go through procedure 2.5.2.4***

### 2.5.2.4 Provide SIM PUK (only if required see par. 2.5.2.2)

- send command **AT+CPIN=*******,<newpin><cr>**

where ******* stands for the SIM PUK code (e.g. 12345678) and <newpin> (e.g. 1234) will replace the old pin in the SIM.

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | SIM PUK was correct | Proceed ahead |
| ERROR | the SIM PUK code inserted is not correct | Retry from par. 2.5.2.4 |

***TIP: When receiving the ERROR message, be careful to check if the SIM PUK is correct before retrying, since after 10 failed attempts to provide the SIM PUK the SIM Card will lock and will not be usable anymore.***

## 2.5.3 Network checking

### 2.5.3.1 Query network status

- send command **AT+CREG?<cr>**
- wait for response:

| Response | Reason | Action |
|---|---|---|
| +CME ERROR: 10 | SIM not present or damaged | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CME ERROR: 11 | SIM is present and PIN is required to continue operations | Repeat par. 2.5.2.3 |
| +CREG: 0,0<br>or<br>+CREG: 1,0 | No GSM/DCS network is found | Check for antenna cable connection (antenna may be disconnected or damaged) or change position if the antenna is OK. Repeat par. 2.5.3.1 until a network is found. |
| +CREG: 0,1<br>or<br>+CREG: 1,1 | Mobile is registered on its home network. | Proceed ahead. Ready to call |
| +CREG: 0,2<br>or<br>+CREG: 1,2 | Mobile is currently not registered on any network but is looking for a suitable one to register. | Repeat procedure at par. 2.5.3.1 to see if it has found a suitable network to register in. |
| +CREG: 0,3<br>or<br>+CREG: 1,3 | Mobile has found some networks but it is not allowed to register on any of them, no roaming was allowed. | Try in another place, and repeat procedure at par.2.5.3.1 |
| +CREG: 0,4<br>or<br>+CREG: 1,4 | Mobile is in an unknown network status | Repeat procedure at par.2.5.3.1 to see if it has found a suitable network to register in |
| +CREG: 0,5<br>or<br>+CREG: 1,5 | Mobile has found some networks and is currently registered in roaming on one of them | Proceed ahead. Ready to call |

***TIP: When a response +CREG: x,1 or +CREG: x,5 is received, then the device is ready to place and receive a call or SMS. It is possible to jump directly to call setup procedures or SMS sending procedures.***

### 2.5.3.2 Network operator identification

Once the mobile has registered on some network (or even if it has returned +CREG:x,3), it is possible to query the mobile for network identifications codes an names:

- send command **AT+COPS=?<cr>**
- wait for response in the format:

**+COPS: [list of supported (<stat> ,<oper (in <format>=0)>,,**
**<oper (in <format>=2)>)s][,,(list of supported <mode>s),**
**(list of supported<format>s)]**

where:
**<stat>** - operator availability
0 - unknown
1 - available
2 - current
3 - forbidden

**<format>**
0 - alphanumeric long form (max length 16 digits)
2 - numeric 5 digits [country code (3) + network code (2)]
**<oper>**: network operator in format defined by **<format>** parameter.

**NOTE**: since with this command a network scan is done, this command may require some seconds before the output is given.

For example:
*command:*
AT+COPS=?<cr>
*Answer:*
+COPS: (2,"I WIND",,"22288"),(1,"SI MOBITEL GSM",,"29341"),(1,"vodafone IT",,"22210"),(1,"SI.MOBIL",,"29340"),(3,"I TIM",,"22201"),,(0-4),(0,2)

OK

In this case the mobile is registered on the network " I WIND " which is a network from Italy Nation code :222 and Network ID: 88. There is also another network available for registration:
"SI MOBITEL GSM" which is a network from Slovenia Nation Code:293 and Network ID: 41 ,
"SI.MOBIL" which is a network from Slovenia Nation Code:293 and Network ID: 40 and
Vodafone IT from Italy with Nation code 22 and Network 10.
The other network is not available for registration:
" I TIM " from Italy Nation code :222 and Network ID: 01 - FORBIDDEN

***TIP: In this case a "I TIM" logo might be reproduced on the MMI to give the user the information that is registered on that network.***

***NOTE: this command issues a network request and it may require a quite long time to respond, since the device has to wait the answer from the network (it can be as long as 60 seconds). Hence don't use it if not needed.***

### 2.5.3.3 Check for received signal strength & quality

Once the mobile has registered on one network, it may be useful to know the received signal strength & quality to give the user an indication of the reliability of the network.

- send command **AT+CSQ<cr>**
- wait for response in the format:

**+CSQ: <rssi>,<ber>**

**OK**

**where:**
<rssi> is an integer from 0 to 99 that indicates the received signal strength:

| <rssi> value | Signal strength | Indication |
|---|---|---|
| 0 | -113 dBm or less | Signal is VERY low: at the extreme sensibility limit |
| 1 | -111 dBm | MMI may indicate only 1 antenna bar |
| 2 | -109 dBm | MMI may indicate only 1 antenna bar |
| 3 | -107 dBm | MMI may indicate only 1 antenna bar |
| 4 | -105 dBm | MMI may indicate only 1 antenna bar |
| 5 | -103 dBm | MMI may indicate only 1 antenna bar |
| 6 | -101 dBm | MMI may indicate 2 antenna bars |
| 7 | -99 dBm | MMI may indicate 2 antenna bars |
| 8 | -97 dBm | MMI may indicate 2 antenna bars |
| 9 | -95 dBm | MMI may indicate 2 antenna bars |
| 10 | -93 dBm | MMI may indicate 3 antenna bars |
| 11 | -91 dBm | MMI may indicate 3 antenna bars |
| 12 | -89 dBm | MMI may indicate 3 antenna bars |
| 13 | -87 dBm | MMI may indicate 3 antenna bars |
| 14 | -85 dBm | MMI may indicate 3 antenna bars |
| 15 | -83 dBm | MMI may indicate 4 antenna bars |
| 16 | -81 dBm | MMI may indicate 4 antenna bars |
| 17 | -79 dBm | MMI may indicate 4 antenna bars |
| 18 | -77 dBm | MMI may indicate 4 antenna bars |
| 19 | -75 dBm | MMI may indicate 4 antenna bars |
| 20 | -73 dBm | MMI may indicate 4 antenna bars |
| 21 | -71 dBm | MMI may indicate 4 antenna bars |
| 22 | -69 dBm | MMI may indicate 4 antenna bars |
| 23 | -67 dBm | MMI may indicate 4 antenna bars |
| 24 | -65 dBm | MMI may indicate 4 antenna bars |

| | | |
|---|---|---|
| 25 | -63 dBm | MMI may indicate 4 antenna bars |
| 26 | -61 dBm | MMI may indicate 4 antenna bars |
| 27 | -59 dBm | MMI may indicate 4 antenna bars |
| 28 | -57 dBm | MMI may indicate 4 antenna bars |
| 29 | -55 dBm | MMI may indicate 4 antenna bars |
| 30 | -53 dBm | MMI may indicate 4 antenna bars |
| 31 | -51 dBm or more | MMI may indicate 4 antenna bars |
| 99 | not detected | MMI may indicate flashing antenna bars |

***NOTE: when <rssi> is less than 6, only 1 MMI antenna bar, the quality of a call will be poor and the call may even drop.***

<ber> is an integer from 0 to 7 and 99 that reports the received signal quality measured on the radio traffic channel.

***NOTE: The quality is measured on the traffic channel, hence it is available only during a conversation, in Idle the reported value must not be considered.***
***In conversation the quality decreases with the increase of the <ber> number.***

***NOTE: The <ber> value refers strictly to the GSM radio channel and is a very technical parameter, it can be used to monitor the voice call quality since the voice quality is inversely proportional to the <ber> number.***

***NOTE: For Data calls the signal quality reported is not directly connected to the connection quality. The reported signal quality refers only to the GSM radio channel link and not to the whole path from the caller to the receiver, so it may happen that the quality on the GSM radio link is very good and hence the reported <ber> is 0 (good quality) but the quality of the remaining path to the other party is very bad and hence the final data connection quality is very poor.***
***For this reason the signal quality indicator <ber> should not be taken into account to monitor data calls quality.***

### 2.5.3.4 Quick Network Status Checking

Once the mobile has registered on one network, it may be useful to know the received signal strength and the network on which the mobile is registered. These information can be gathered with the commands +CREG, +COPS and +CSQ, which are part of the standard ETSI GSM 07.07 commands as seen before, unfortunately these commands are not so fast in the response due to network response time, especially the +COPS command. If You want to keep your software as general as possible you can follow the indications given before and forget this part; instead if you need or want a faster way to check at the mobile network information, the GC864-QUAD / PY provides a special command ***#MONI*** which can be used to gather all the information needed in a faster and simpler way:

- **send command AT#MONI=0<cr>**
- wait for **OK** response

- send command **AT#MONI?<cr>**
- wait for response in the format:

**#MONI: <netname> BSIC:<bsic> RxQual:<qual> LAC:<lac> Id:<id> ARFCN:<arfcn> PWR:<dBm> dBmTA: <timadv>**

**OK**

or in the case the network name is not known:

**#MONI: Cc:<cc> Nc:<nc> BSIC:<bsic> RxQual:<qual> LAC:<lac> Id:<id> ARFCN:<arfcn> PWR:<dBm> dBm TA: <timadv>**

**OK**

**where:**
<netname> = name of network operator
<cc> = country code
<nc> = network operator code
<n> = progressive number of adjacent cell
<bsic> = base station identification code
<qual> = quality of reception (0-7) (same as <ber> of +CSQ command)
<lac> = localization area code
<id> = cell identifier
<arfcn> = assigned radio frequency channel
<dBm> = received signal strength in dBm (same as "decoded" rssi value)
<timadv> = timing advance

For example:
*command:*
AT#MONI=0<cr>
*Answer:*
OK
*command:*
AT#MONI?<cr>
*Answer:*
#MONI: I TIM BSIC:23 RxQual:7 LAC:AEAD Id:5265 ARFCN: 59 PWR: -80 dBm TA:0

OK

In this case the mobile is registered on the network "I TIM", the signal strength is -80dBm (MMI may indicate 4 antenna bars as reported on the table 5). The other information received is strictly technical and should not be given to the user.

For example2:
*command:*

AT#MONI=0<cr>
*Answer:*
OK
*command:*
AT#MONI?<cr>
*Answer:*
#MONI: Cc: 010 Nc: 03 BSIC:23 RxQual:7 LAC:0001 Id:0001 ARFCN: 60 PWR: -83 dBm TA:0

OK

In this case the mobile is registered on the network whose Country code is 010 and Network operator code is 03, the signal strength is -83dBm (MMI may indicate 4 antenna bars as reported on the table 5). The other information received is strictly technical and should not be given to the user.
The values reported are random and have no meaning they are used only to explain command usage.

***NOTE: This command should be used only to gather information on network name and signal strength, to check if mobile is registered or is looking for a suitable network to register to, use always the +CREG command. This is due to the fact that if the network signal is too weak and mobile looses the registration, until a new network is found the #MONI command reports the last measured valid values and not the real ones.***
***The TA (timing advance parameter) is valid only during a call.***

***TIP: To properly use this feature, check network registration with command +CREG as seen on par. 2.5.3.1 and when mobile is registered query the mobile for network operator name and signal strength with #MONI command.***

# 2.6 Placing a Voice call

Before a voice call can be placed, it is recommended to check if the mobile is registered on a network (see par. 2.5.3.1) and if the signal strength is enough to ensure a call can be made.

## 2.6.1 Voice call device set up

### 2.6.1.1 Set the device in voice mode

- Send command **AT+FCLASS=8<cr>**
- wait for **OK** response

**NOTE**: This command may be omitted if the modifier ";" is added at the end of the ATD command after the number to be dialed.

### 2.6.1.2 Set the desired audio path active

The GC864-QUAD / PY has two different audio paths:

- internal microphone/ear (MT)
- external microphone/ear (HF)

Usually the internal path is used for a handset function, while the external is used for handsfree function. There are two way to switch between these two paths:
- SOFTWARE: by using the command AT#CAP= <n> (with n=1 OR n=2)
- HARDWARE: by setting AT#CAP=0 and setting the AXE input high (internal MT) or low (external HF).

If only one path is needed, then it is preferable to use the internal one (MT).

***TIP: when Hardware control is not needed AXE pin can be left unconnected.***

***TIP: the audio paths can be switched also during a call in both ways.***

- Send command **AT#CAP=<n><cr>**

**where:**
<n> = 0 for HARDWARE control with AXE input
<n> = 1 for external HF path (regardless of the AXE input status)
<n> = 2 for internal MT path (regardless of the AXE input status)

- wait for **OK** response

For example:
1 - Let's assume that the desired audio path is always the internal MT

*Command:*
AT#CAP=2<cr>
*Answer:*
OK

2 - Let's assume that the desired audio path has to be determined by HARDWARE pin AXE

*Command:*
AT#CAP=0<cr>
*Answer:*
OK
Now set the hardware pin AXE in the desired status.

### 2.6.1.3 Set the desired volume on the active audio path speaker output

This setting is not strictly necessary; it is also possible to keep the default volume setting.

- Send command **AT+CLVL=<vol><cr>**

**where:**
**<vol> is a number between 0 and 10 representing the volume setting:**
0 – minimum volume
10 - maximum volume

- wait for **OK** response

***NOTE: The volume setting refers to the ACTIVE path ear line and is stored each time. When changing audio path the volume setting will be reset to the previously stored value for that audio path.***

#### 2.6.1.4 Check for microphone mute setting

The microphone of the active path can be muted with an AT command; to be sure that it is not muted, it is suggested to check it with this command:

- Send command **AT+CMUT?<cr>**
- wait for response in the format:

**+CMUT: <mute>**

**OK**

**where:**
<mute> is the muting setting for the microphone:
0 - microphone active
1 - microphone muted

***NOTE: The mute setting is different from Volume setting: it refers to both the audio paths, the mute setting will remain even when changing audio path.***

### 2.6.2 Phone number dialing

#### 2.6.2.1 Dial a given phone number

- Send command **ATD <PhoneNumber><cr>**

**where:**
**<PhoneNumber> is the phone number to be dialed**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | The call has been placed | Wait for the other party to lift the receiver |
| BUSY | The line called is busy | retry later |
| NO ANSWER | The receiver did not answer the call | retry later |
| NO CARRIER | Call placing has not been successful | check for mobile registration and signal strength |

For example:
1- Let's assume you have to call the national number 040 - 4192111,
*command:*
ATD 0404192111<cr>
*response*
OK

2- Let's assume you have to call the national number but in international format +39-40-4192111,
*command:*
ATD +39404192111<cr>
*response*
OK

3- Let's assume you have to call the international number +386-40-4192111 without previously setting the +FCLASS=8 (voice),
*command:*
ATD +386404192111;<cr>
*response*
OK

## 2.6.3 Closing the voice call

### 2.6.3.1 Hang up the voice call

- Send command **ATH<cr>**
- wait for response **OK**

***TIP: during the voice call the device remains in command mode, so the escape sequence (+++) must not be issued before sending commands.***

# 2.7 Placing a CSD Data call (not GPRS)

Before a data call can be placed, it is recommended to check if the mobile is registered on a network (see par. 2.5.3.1) and if the signal strength is enough to ensure that a call can be made.

## 2.7.1 Data call device set up

### 2.7.1.1 Set the device in data mode

- Send command **AT+FCLASS=0<cr>**
- wait for **OK** response

***TIP: The +FCLASS setting is maintained in memory, so there's no need to repeat this command if +FCLASS setting is not changed.***

### 2.7.1.2 Set the desired modulation and speed for the connection

The data connection can be made using different modulations at different speeds.
This connection mode can be selected with the command +CBST. The syntax for the command is:
AT+CBST=<mod>,0,<ce>
These parameters can be selected as seen in the table:

| Command | Modulation | Speed [bps] | Connection Element |
|---|---|---|---|
| AT+CBST==0, 0, 1 | Autobauding | ---- | non transparent |
| AT+CBST==1, 0, 1 | V.21 | 300 | non transparent |
| AT+CBST==2, 0, 1 | V.22 | 1200 | non transparent |
| AT+CBST==3, 0, 1 | V.23 | 1200/75 | non transparent |
| AT+CBST==4, 0, 1 | V.22Bis | 2400 | non transparent |
| AT+CBST==6, 0, 1 | V.32 | 4800 | non transparent |
| AT+CBST==7, 0, 1 | V.32 | 9600 | non transparent |
| AT+CBST==14, 0, 1 | V.34 | 14400 | non transparent |
| AT+CBST==65, 0, 1 | V.110 | 300 | non transparent |
| AT+CBST==66, 0, 1 | V.110 | 1200 | non transparent |
| AT+CBST==68, 0, 1 | V.110 / X.31 | 2400 | non transparent |
| AT+CBST==70, 0, 1 | V.110 / X.31 | 4800 | non transparent |
| AT+CBST==71, 0, 1 | V.110 / X.31 | 9600 | non transparent |
| AT+CBST==75, 0, 1 | V.110 / X.31 | 14400 | non transparent |
| AT+CBST==1, 0, 0 | V.21 | 300 | transparent |

| | | | |
|---|---|---|---|
| AT+CBST==2, 0, 0 | V.22 | 1200 | transparent |
| AT+CBST==3, 0, 0 | V.23 | 1200/75 | transparent |
| AT+CBST==4, 0, 0 | V.22Bis | 2400 | transparent |
| AT+CBST==6, 0, 0 | V.32 | 4800 | transparent |
| AT+CBST==7, 0, 0 | V.32 | 9600 | transparent |
| AT+CBST==65, 0, 0 | V.110 | 300 | transparent |
| AT+CBST==66, 0, 0 | V.110 | 1200 | transparent |
| AT+CBST==68, 0, 0 | V.110 / X.31 | 2400 | transparent |
| AT+CBST==70, 0, 0 | V.110 / X.31 | 4800 | transparent |
| AT+CBST==71, 0, 0 | V.110 / X.31 | 9600 | transparent |

Once selected the appropriate <mod > and <ce> parameters from the table:

- Send command **AT+CBST=<mod>,0,<ce><cr>**
- wait for **OK** response

## 2.7.2 Phone number dialing (data call)

### 2.7.2.1 Dial a given phone number

- Send command **ATD <PhoneNumber><cr>**

**where:**
**<PhoneNumber> is the phone number to be dialed**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| CONNECT 9600 | The called modem is now on line. | exchange data |
| BUSY | The line called is busy | retry later |
| NO ANSWER | The receiver did not answer the call | retry later |
| NO CARRIER | The modem handshaking has not been successful | check for mobile registration and signal strength and eventually retry. |

***TIP: The response to the ATD command is returned after the modem handshaking, this takes about 30 seconds, so allow this time before doing anything.***

***TIP: When the device is doing the handshake the issue of any character closes the handshake and aborts the call.***

For example:
1- Let's assume you have to call the national number 040 - 4192111,
*command:*
ATD 0404192111<cr>
*response*
CONNECT 9600

2- Let's assume you have to call the national number but in international format +39-40-4192111,
*command:*
ATD +39404192111<cr>
*response*
CONNECT 9600

3- Let's assume you have to call the international number +386-40-4192111,
*command:*
ATD +386404192111<cr>
*response*
CONNECT 9600

## 2.7.3 Closing the Data call

### 2.7.3.1 Exit the data mode and enter the command mode

- Send escape sequence **+++**
- wait the escape sequence pause time ( see S12 parameter)
- wait for response **OK**

***NOTE: After the Escape sequence and during the call the only command that is accepted by the GC864-QUAD / PY is the ATH. All the other commands are not supported during a call.***

***TIP: during the escape sequence pause time S12 no further characters should be sent to the device in order to enter the command mode.***

#### 2.7.3.2 Hang up the data call

- Send command **ATH<cr>**
- wait for response **NO CARRIER**

***TIP: during the data call the device remains in data (on line) mode, so the escape sequence (+++) must be issued before sending AT commands to the device.***

## 2.8 Answer an incoming Call

When an incoming call is detected the device reports an unsolicited code which may be:

| Unsolicited code | Reason |
|---|---|
| RING | The extended format of incoming call indication is disabled and a call (voice or data) is incoming. |
| +CRING: VOICE | The extended format of incoming call indication is enabled and a voice call is incoming. |
| +CRING: ASYNC | The extended format of incoming call indication is enabled and an asynchronous transparent data call is incoming. |
| +CRING: REL ASYNC | The extended format of incoming call indication is enabled and an asynchronous reliable (not transparent) data call is incoming. |
| +CRING: SYNC | The extended format of incoming call indication is enabled and a synchronous transparent data call is incoming. |
| +CRING: REL SYNC | The extended format of incoming call indication is enabled and a synchronous reliable (not transparent) data call is incoming. |
| +CRING: FAX | The extended format of incoming call indication is enabled and a fax call is incoming. |

To answer the call:

- Send command **ATA<cr>**
- wait for response:

| Response | Reason | Action |
|---|---|---|
| CONNECT 9600 | The incoming call was a DATA one and called modem is now on line. | exchange data |
| ERROR | No incoming call is found, call may have been lost | call lost |
| NO CARRIER | The incoming call was a DATA one and the modem handshaking has not been successful | check for mobile registration and signal strength and modem settings. |
| OK | The incoming call was a VOICE call and is now active. | proceed ahead |

***TIP: The call is answered with the appropriate type (VOICE or DATA) regardless of the +FCLASS setting active. To distinguish between Data and Voice see the command response or the extended format incoming call indication.***

# 3 Advanced Operations

## 3.1 Accessing the phonebook

The GC864-QUAD / PY can access the phonebook storage of the SIM card inserted, by using specific AT commands it is possible to store and recall phone numbers and their associated name.

### 3.1.1 Preliminary phonebook set up

The GC864-QUAD / PY supports several SIM phonebook storages:

- "SM" - SIM phonebook
This is the PB used to store and recall numbers during the normal operation of the device.

- "FD" - SIM fixed dialing-phonebook (only phase 2/2+ SIM)
This PB has several restrictions; to set it you need the PIN2 code and after having activated the FD only the calls to the numbers stored in the FD or their children are allowed, all the other calls are forbidden.

- "LD" - SIM last-dialing-list (+CPBW and +CPBF are not applicable for this storage)
This is the list of the last dialed numbers, it is updated automatically at each call originated and insertion or search on it is not possible, the only operations allowed are recall, read and delete.

- "MC" - SIM missed-calls-list (+CPBW and +CPBF are not applicable for this storage)
This is the list of the missed calls calling numbers, it is updated automatically at each call missed and insertion or search on it is not possible, the only operations allowed are recall, read and delete.

- "RC" - SIM received-calls-list (+CPBW and +CPBF are not applicable for this storage)
This is the list of the received calls calling numbers, it is updated automatically at each call received and insertion or search on it is not possible, the only operations allowed are recall, read and delete.

In order to access the storage you have to choose which one will be active. This must be the first PB operation always. Once selected storage, it is not anymore needed to select it again until the desired storage remains the one active and the device is not turned off.

#### 3.1.1.1 Selecting PB storage active

- Send command **AT+CPBS=<PB><cr>**

**where:**
**<PB> is the desired PB storage:**
SM – SIM phonebook
FD – fixed dialing phonebook
LD – last dialed calls list
MC – missed calls list
RC – received calls list

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | selected PB is now active | Proceed ahead |
| ERROR | some error occurred | Enable extended result codes (see par. 2.5.2.1) and retry. |
| +CME ERROR: 10 | SIM not present | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CMS ERROR: 310 | SIM not present | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CME ERROR: 11 | SIM is present and PIN is required to continue operations | insert SIM PIN (see par. 2.5.2.3) |
| +CMS ERROR: 311 | SIM is present and PIN is required to continue operations | insert SIM PIN (see par. 2.5.2.3) |
| +CME ERROR: 12 | SIM is present and PUK is required to continue operations | insert SIM PUK (see par.2.5.2.4) |
| +CMS ERROR: 316 | SIM is present and PUK is required to continue operations | insert SIM PUK (see par.2.5.2.4) |
| +CME ERROR: 13 | SIM defect | Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2 |
| +CMS ERROR: 313 | SIM defect | Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2 |
| +CME ERROR: 14 | SIM is busy | retry later |
| +CMS ERROR: 314 | SIM is busy | retry later |
| +CME ERROR: 15 | SIM is wrong type | Check SIM, it must be a GSM SIM. |
| +CMS ERROR: 315 | SIM is wrong type | Check SIM, it must be a GSM |

| | | |
|---|---|---|
| | | SIM. |
| +CME ERROR: 17 | PIN2 is required to continue operations, since FD facility is not enabled. | Enable FD facility with +CLCK (see par.3.1.1.2) and retry. |

***NOTE: After power up & PIN authentication the device reads all the SIM for a backup, hence SIM access is inhibited (SIM is busy after the issue of the PIN or after power up if PIN request is disabled) for a time varying from few seconds to about a minute, depending on the percentage of written records in the SIM phonebook. If Phonebook commands are issued during this time the device returns an error message. If this happens, retry the operations later.***

***NOTE: Due to the particular features of the FD storage, when selecting the FD storage, the PIN2 must have been inserted or the FD facility must have been enabled.***
***If +CPBS command reports +CME ERROR: 17 then enable the facility with command +CLCK (see par. 3.1.1.2)***

For example:
1- Let's assume you want to select the "SM" normal phonebook for operations,
*command:*
AT+CPBS="SM"<cr>
*response*
OK

2- Let's assume you want to select the "MC" missed calls list for operations,
*command:*
AT+CPBS="MC"<cr>
*response*
OK

### 3.1.1.2 Enable Fixed Dialing Phonebook facility (only for FD PB)

- Send command **AT+CLCK=FD,1,<PIN2><cr>**

**where:**
**<PIN2> is the PIN2 code of the SIM.**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | FD facility is now enabled | Return to select PB (see par. 3.1.1.1) |
| ERROR | some error occurred | Enable extended result codes (see par. 2.5.2.1), check if the PIN2 is correct |

| | | |
|---|---|---|
| | | and retry. |
| +CME ERROR: 16 | the inserted PIN2 is wrong | Check PIN2 code and retry. |

***NOTE: When receiving the ERROR or +CME ERROR message, repeat Query SIM presence and status since after 3 failed attempts SIM PIN2 is not anymore requested, but SIM PUK2 is requested instead, hence you may need to go through procedure 2.5.2.4 (but insert PUK2 instead of PUK1)***

## 3.1.2 Phonebook entry search by Name

As first thing, you must select the "SM" storage as active (see par.3.1.1.1).

- send command **AT+CPBF=<Name><cr>**

**where:**
**<Name> is the desired string to be found in the name field of the PB record.**

- wait for response in the format:

**+CPBF= <index>,"<number>",<type>,"<name>"**
**OK**

**where:**
**<index> is the record number on the PB;**
**<Number> is the phone number;**
**<type> is the type of number:**
145 – international numbering scheme
129 – national numbering scheme
**<Name> is the alphanumeric name associated with the number.**

or in the case no corresponding entries are found:

**+CME ERROR: 22** or simply **ERROR.**

***NOTE: The search for <name> string is not case sensitive and the string may or may not be included in double brackets.***

For example:
1- Let's assume you want to select the "SM" normal phonebook for operations,
*command:*
AT+CPBS="SM"<cr>
*response*
OK

- Now you might want to look for the entries with the name starting with: "FA"

*command:*
AT+CPBF="FA"<cr>
*the response may look like:*
+CPBF= 7,"+39404192369",145,"Fabio"

+CPBF= 9,"0404192111",129,"Fabrizio"

OK

- Now you might want to look for the entries with the name starting with: "FAUSTO" but no record contains this name:
*command:*
AT+CPBF="FAUSTO"<cr>
*response:*
+CME ERROR: 22
or if extended error codes are disabled simply
*response:*
ERROR

### 3.1.3 Phonebook entry read by Index

As first thing, you must select the desired storage as active (see par.3.1.1.1). Then:

- send command **AT+CPBR=<index><cr>**

**where:**
**<index> is the index number of the desired PB record to be read.**

- wait for response in the format:

**+CPBR= <index>,"<number>",<type>,"<name>"**
**OK**

**where:**
**<index> is the record number on the PB;**
**<Number> is the phone number;**
**<type> is the type of number:**
145 – international numbering scheme
129 – national numbering scheme
**<Name> is the alphanumeric name associated with the number.**

or in the case the index number does not correspond to a written record:

**+CME ERROR: 22** or simply **ERROR.**

For example:

1- Let's assume you want to select the "SM" normal phonebook for operations,
*command:*
AT+CPBS="SM"<cr>
*response*
OK

- Now you might want to look for the entry at the position index = 7
*command:*
AT+CPBR=7<cr>
*the response may look like:*
+CPBR= 7,"+39404192369",145,"Fabio"

OK

- Now you might want to look for the entries at the positions from 7 to 9 and for example the position at index 8 is empty
*command:*
AT+CPBR=7,9<cr>
*the response may look like:*
+CPBR= 7,"+39404192369",145,"Fabio"

+CPBR= 9,"0404192111",129,"Fabrizio"

OK

### 3.1.4 Phonebook entry Write

As first thing, you must select the desired storage as active (see par.3.1.1.1). Then:

- send command **AT+CPBW=<index>,<number>,<type>,<name><cr>**

**where:**
**<index> is the index number of the desired PB record to be written (may be omitted if any empty record number can be used).**
**<Number> is the phone number;**
**<type> is the type of number:**
145 – international numbering scheme (contains the character "+")
129 – national numbering scheme
**<Name> is the alphanumeric name associated with the number.**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Record has been successfully written | Proceed ahead |
| ERROR | some error occurred | Enable extended result codes |

| | | |
|---|---|---|
| | | (see par. 2.5.2.1), and retry. |
| +CME ERROR: 10 | SIM not present | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CMS ERROR: 310 | SIM not present | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CME ERROR: 11 | SIM is present and PIN is required to continue operations | insert SIM PIN (see par. 2.5.2.3) |
| +CMS ERROR: 311 | SIM is present and PIN is required to continue operations | insert SIM PIN (see par. 2.5.2.3) |
| +CME ERROR: 12 | SIM is present and PUK is required to continue operations | insert SIM PUK (see par.2.5.2.4) |
| +CMS ERROR: 316 | SIM is present and PUK is required to continue operations | insert SIM PUK (see par.2.5.2.4) |
| +CME ERROR: 13 | SIM defect | Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2 |
| +CMS ERROR: 313 | SIM defect | Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2 |
| +CME ERROR: 14 | SIM is busy | retry later |
| +CMS ERROR: 314 | SIM is busy | retry later |
| +CME ERROR: 15 | SIM is wrong type | Check SIM, it must be a GSM SIM. |
| +CMS ERROR: 315 | SIM is wrong type | Check SIM, it must be a GSM SIM. |
| +CME ERROR: 21 | invalid index | Change index number or leave it empty and retry. |
| +CME ERROR: 20 | memory full | PB storage is full. |
| +CMS ERROR: 322 | memory full | PB storage is full. |

For example:
1- Let's assume you want to select the "SM" normal phonebook for operations,
*command:*
AT+CPBS="SM"<cr>
*response*
OK

- Now you might want to write a new record on the PB:
*command:*
AT+CPBW=,"0404192123",129,"NewRecord"<cr>
*response:*
OK

-Now you may want to check if operation has really succeeded and where the new record has been written. (obviously operation was successful, since the device returned OK)
*command:*
AT+CPBF="NEW"<cr>
*response:*
+CPBF= 8,"0404192123",129,"NewRecord"
OK
The new record was written at the position index 8. (The first free record index found).

## 3.1.5 Phonebook entry Delete

As first thing, the desired storage must be active (see par.3.1.1.1). Then:

- send command **AT+CPBW=<index><cr>**

**where:**
**<index> is the index number of the desired PB record to be deleted.**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Record has been successfully deleted | proceed ahead |
| ERROR | some error occurred | Enable extended result codes (see par. 2.5.2.1), and retry. |
| +CME ERROR: 21 | invalid index, out of PB storage limits | check index number and retry. |
| +CME ERROR: 10 | SIM not present | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CMS ERROR: 310 | SIM not present | Check SIM or require SIM insertion and repeat from par. 2.5.2.2 |
| +CME ERROR: 11 | SIM is present and PIN is required to continue operations | insert SIM PIN (see par. 2.5.2.3) |
| +CMS ERROR: 311 | SIM is present and PIN is required to continue operations | insert SIM PIN (see par. 2.5.2.3) |
| +CME ERROR: 12 | SIM is present and PUK is required to continue operations | insert SIM PUK (see par.2.5.2.4) |
| +CMS ERROR: 316 | SIM is present and PUK is required to continue operations | insert SIM PUK (see par.2.5.2.4) |
| +CME ERROR: 13 | SIM defect | Check SIM insertion or require a new SIM not defected and repeat from par. 2.5.2.2 |
| +CMS ERROR: 313 | SIM defect | Check SIM insertion or require a new SIM not defected and |

| | | |
|---|---|---|
| | | repeat from par. 2.5.2.2 |
| +CME ERROR: 14 | SIM is busy | retry later |
| +CMS ERROR: 314 | SIM is busy | retry later |
| +CME ERROR: 15 | SIM is wrong type | Check SIM, it must be a GSM SIM. |
| +CMS ERROR: 315 | SIM is wrong type | Check SIM, it must be a GSM SIM. |

***TIP: The delete operation simply overwrites the record number <index> with an empty record. If the record to be deleted was already empty, no error messages will be shown, but it will be only filled again with empty values.***

## 3.1.6 Phonebook entry Dial

You may want to dial a number previously stored in the phonebook. As first thing, you must find the desired phone number index position, to do it use the +CPBF command. Once the <index> number is known set up the device for the type of call you want to dial. Then:

- send command **ATD> <index><cr>**

**where:**
**<index> is the index number of the desired PB record to be dialed.**

wait for response according to the call type you issued.

For example:
1- Let's assume you want to make a Voice call on the internal audio path MT to "Fabio" whose number is stored on the SIM PB:
- Select the PB as active storage
*command:*
AT+CPBS="SM"<cr>
*response*
OK

- Now find the index number where "Fabio" is recorded:
*command:*
AT+CPBF="Fabio"<cr>
*the response may look like:*
+CPBF= 7,"+39404192369",145,"Fabio"

OK
- the first field is the index position: 7 in this case.
- Now set up Voice call:

*command:*
AT+FCLASS=8<cr>
*response:*
OK
AT#CAP=2 <cr>
OK

AT+CLVL=8<cr>
OK

AT+CMUT? <cr>
+CMUT: 0

- and Dial:
ATD> 7<cr>
OK

# 3.2 Distinguish Calls

## 3.2.1 Identify the Call type

The GC864-QUAD / PY is able to identify the call type before answering it, it is so possible to have different ring indications (unsolicited codes) depending on the call type:

| Unsolicited code | Reason |
|---|---|
| RING | The extended format of incoming call indication is disabled and a call (voice or data) is incoming. |
| +CRING: VOICE | The extended format of incoming call indication is enabled and a voice call is incoming. |
| +CRING: ASYNC | The extended format of incoming call indication is enabled and an asynchronous transparent data call is incoming. |
| +CRING: SYNC | The extended format of incoming call indication is enabled and a synchronous transparent data call is incoming. |
| +CRING: REL ASYNC | The extended format of incoming call indication is enabled and an asynchronous not transparent data call is incoming. |
| +CRING: REL SYNC | The extended format of incoming call indication is enabled and a synchronous not transparent data call is incoming. |
| +CRING: FAX | The extended format of incoming call indication is enabled and a fax call is incoming. |

In order to use this feature you must enable the extended format of incoming calls

#### 3.2.1.1 Set the extended incoming call indication

- Send command **AT+CRC=<n><cr>**

**where:**
**<n> is the operation mode selected:**
0 – extended results Disabled (device reports RING only)
1 – extended results Enabled (device reports +CRING: <type> indication)
- wait for **OK** response

## 3.2.2 Identify the Caller

The GC864-QUAD / PY is able to identify the caller number and give indication of it before the call is answered.
The calling number is presented after each RING or +CRING indication in the format:
**+CLIP: "<number>",<type>[,"<subaddress>",<satype>[,"<alpha>"[,<CLI validity>]]]**

**OK**

**where:**
**<Number> is the phone number;**
**<type> is the type of number:**
145 – international numbering scheme
129 – national numbering scheme
**<subaddress> is the subaddress of the calling party**
**<satype> is the type of subaddress**
**<alpha> is an optional string type alphanumeric representation of <number> corresponding to the entry found in phonebook;**
**<CLI validity> is the validity status of CLI presentation:**
0 CLI valid.
1 CLI has been withheld by the originator.
2 CLI is not available due to interworking problems or limitation or originating network.

In order to use this feature you must enable the caller ID indication presentation, if feature is disabled then no CLI indication is given after the RING or +CRING code.

#### 3.2.2.1 Set Caller line ID indication presentation

- Send command **AT+CLIP=<n><cr>**

**where:**
**<n> is the operation mode selected:**
0 – Calling Line Indication Presentation Disabled
1 – Calling Line Indication Presentation Enabled

- wait for **OK** response

For example:
1- Let's assume you receive a call from the national number 1234567890 and extended incoming calls indication is disabled while CLIP is enabled, you'll see:
*ring indication:*
RING

+CLIP: "1234567890",129

2- Let's assume you receive a call from the international number +391234567890 and extended incoming calls indication is disabled while CLIP is enabled, you'll see:
*ring indication:*
RING

+CLIP: "+391234567890",145

**NOTE**: this does not mean that the incoming call is an international one, it simply means that the numbering scheme used to identify the caller is the international one.

### 3.2.3 Restricting Calling Line Indication

The GC864-QUAD / PY is able to send the calling line indication (CLI) to the other party through the network when an outgoing call is made. This indication can be restricted (CLIR) in various ways:

- CLI sent always
- CLI never sent
- CLI temporary sent (normally not sent)
- CLI temporary not sent (normally sent)

### 3.2.3.1 CLIR Service status query

- send command **AT+CLIR?<cr>**
- wait for response in the format:

**+CLIR: <n>,<m>**
**OK**

**where:**
**<n> is the facility status on the Mobile**
0 – CLIR facility according to CLIR service network status
1 – CLIR facility active (CLI not sent)
2 – CLIR facility not active (CLI sent)

**<m> is the facility status on the Network**
0 - CLIR service not provisioned (service unavailable)
1 - CLIR service provisioned (service available)
2 - unknown (e.g. no network present, etc.)
3 - CLI temporary mode presentation restricted
4 - CLI temporary mode presentation allowed

***NOTE: The <m> parameter reports the status of the service at network level.***
***If the CLIR service is not provisioned, then it is not possible to use this service and changing the first parameter <n> will not change the CLI presentation to the other party behavior of the network.***

For example:
1- Let's assume you want to check your CLIR settings:
*command:*
AT+CLIR? <cr>
*response:*
+CLIR: 2,4
In this case the CLIR service is temporary mode allowed on the network and the mobile sends the CLI when calling. (CLI Restriction not active).

#### 3.2.3.2 Restrict/Allow Caller line ID indication

- Send command **AT+CLIR=<n><cr>**

**where:**
**<n> is the operation mode selected:**
0 – Calling Line Indication to the other party According to Network service status.
1 – Calling Line Indication Restriction Enabled (CLI not sent)
2 – Calling Line Indication Restriction Disabled (CLI sent)

- wait for **OK** response

For example:
1- Let's assume you want to disable the CLI presentation to the other party permanently:
*command:*
AT+CLIR=1<cr>
*response:*
OK

## 3.2.4 Call Barring Control

The call Barring is a GSM service that allows the user to block certain types of calls:
- Barring All Outgoing Calls
- Barring Outgoing International Calls
- Barring Outgoing International Calls except to Home Country
- Barring All Incoming Calls
- Barring Incoming Calls when Roaming outside the home country
- All Barring services (applicable only for disabling command)
- All Outgoing barring services (applicable only for disabling command)
- All Incoming barring services (applicable only for disabling command)

The service can be queried, enabled and disabled.

***NOTE: The call Barring service is handled by the network, hence all the relative commands issue a network request and it may take several seconds to have the response from the network.***
***Furthermore, all the Call Barring service commands must be issued when the mobile is Registered on some Network, else an error code is returned ( no network service ).***

### 3.2.4.1 Call Barring Service status query

- send command **AT+CLCK=<fac>,2<cr>**

**where:**
**<fac> is the facility to be queried:**
AO - Barring All Outgoing Calls
OI - Barring Outgoing International Calls
OX- Barring Outgoing International Calls except to Home Country
AI - Barring All Incoming Calls
IR - Barring Incoming Calls when Roaming outside the home country
AB - All Barring services (applicable only for disabling command)
AG - All Outgoing barring services (applicable only for disabling command)
AC - All Incoming barring services (applicable only for disabling command)

- wait for response:

| Response | Reason | Action |
|---|---|---|
| +CLCK: 0 | facility is disabled | calls are allowed |
| +CLCK: 1 | facility is enabled | calls are barred |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax and service code |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |

***NOTE: The call Barring service is handled by the network, hence all the relative commands issue a network request and it may take several seconds to have the response from the network.***
***Furthermore all the Barring service commands must be issued when the mobile is Registered on some Network, else an error code is returned ( no network service ).***

For example:
1- Let's assume you want to check whether the incoming calls when roaming outside Home Country are barred or not:
*command:*
AT+CLCK=IR,2<cr>
*response:*
+CLCK: 0

In this case, the incoming (received) calls ARE NOT BARRED when in Roaming outside the Home Country.

2- Let's assume you want to check whether the Outgoing (originated) international calls are barred or not:
*command:*
AT+CLCK=OI,2<cr>
*response:*
+CLCK: 1

In this case, the outgoing international calls ARE BARRED.

### 3.2.4.2 Barring/Unbarring All Incoming Calls

- Send command **AT+CLCK=AI,<en>,<pwd><cr>**

**where:**
**<en> is the operation selected:**
0 – Call Barring Disable (Unbarring)
1 – Call Barring Enable (Barring)
**<pwd> is the network password required to change facility status**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Barring is now enabled/disabled | all incoming calls will be barred/unbarred |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |
| +CME ERROR: 16 | wrong network password | check network password and retry |

For example:
1- Let's assume you want to bar all the incoming calls and the network password of your operator is 0000:
*command:*
AT+CLCK=AI,1,0000<cr>
*response:*
OK

### 3.2.4.3 Barring/Unbarring Incoming Calls when in International Roaming

- Send command **AT+CLCK=IR,<en>,<pwd><cr>**

**where:**
**<en> is the operation selected:**
0 – Call Barring Disable (Unbarring)
1 – Call Barring Enable (Barring)
**<pwd> is the network password required to change facility status**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Barring is now enabled/disabled | all incoming calls when is international Roaming will be barred/unbarred |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |
| +CME ERROR: 16 | wrong network password | check network password and retry |

For example:
1- Let's assume you want to bar all the incoming calls when the mobile is roaming outside its home country and the network password of your operator is 0000:
*command:*

AT+CLCK=IR,1,0000<cr>
*response:*
OK

### 3.2.4.4 Barring/Unbarring All Outgoing Calls

- Send command **AT+CLCK=AO,<en>,<pwd><cr>**

**where:**
**<en> is the operation selected:**
0 – Call Barring Disable (Unbarring)
1 – Call Barring Enable (Barring)
**<pwd> is the network password required to change facility status**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Barring is now enabled/disabled | all outgoing calls will be barred/unbarred |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |
| +CME ERROR: 16 | wrong network password | check network password and retry |

For example:
1- Let's assume you want to bar all the outgoing calls (originated by mobile) and the network password of your operator is 0000:
*command:*
AT+CLCK=AO,1,0000<cr>
*response:*
OK

### 3.2.4.5 Barring/Unbarring All Outgoing International Calls

- Send command **AT+CLCK=OI,<en>,<pwd><cr>**

**where:**
**<en> is the operation selected:**
0 – Call Barring Disable (Unbarring)
1 – Call Barring Enable (Barring)
**<pwd> is the network password required to change facility status**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Barring is now enabled/disabled | all outgoing international calls will be barred/unbarred |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |
| +CME ERROR: 16 | wrong network password | check network password and retry |

For example:
1- Let's assume you want to bar all the outgoing international calls (originated by mobile and to a number outside the home country of the mobile) and the network password of your operator is 1234:
*command:*
AT+CLCK=OI,1,1234<cr>
*response:*
OK

### 3.2.4.6 Barring/Unbarring All Outgoing International Calls except to Home Country

- Send command **AT+CLCK=OX,<en>,<pwd><cr>**

**where:**
**<en> is the operation selected:**
0 – Call Barring Disable (Unbarring)
1 – Call Barring Enable (Barring)
**<pwd> is the network password required to change facility status**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Barring is now enabled/disabled | all outgoing international calls except to Home Country will be barred/unbarred |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |
| +CME ERROR: 16 | wrong network password | check network password and retry |

For example:
1- Let's assume you want to bar all the outgoing international calls except the ones towards the Home Country and the network password of your operator is 1234:
*command:*
AT+CLCK=OX,1,1234<cr>
*response:*
OK

### 3.2.4.7 Unbarring all the Calls

- Send command **AT+CLCK=AB,0,<pwd><cr>**

**where:**
**<pwd> is the network password required to change facility status**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Barring is now disabled | all calls will be allowed (unbarred) |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CME ERROR: 4 | operation not supported, the service required is not available | Check command syntax |
| +CME ERROR: 30 | no network service | Check for registration (see par. 2.5.3.1) and signal strength. |
| +CME ERROR: 16 | wrong network password | check network password and retry |

For example:
1- Let's assume you want to disable all the barring services you might have previously activated and the network password of your operator is 0000:
*command:*
AT+CLCK=AB,0,0000<cr>
*response:*
OK

# 3.3 DTMF tones

DTMF tones are managed by specific AT commands. These tones are generated with AT commands only during voice calls. The minimum duration of a DTMF tone can be set on 10 ms but it should be considered that this value can vary with the limitations on network.

| | **Group high** | | |
|---|---|---|---|
| **Group low** | 1209 Hz | 1336 Hz | 1477 Hz |
| 697 Hz | 1 | 2 | 3 |
| 770 Hz | 4 | 5 | 6 |
| 852 Hz | 7 | 8 | 9 |
| 941 Hz | * | 0 | # |

**NOTE**: The GSM system architecture defines that the audio signal of the DTMF tones is inserted by the network switches on commands sent by the Mobile Station (MS). Thus, the default duration parameters may vary from network to network. In case that the devices to be controlled by DTMF are sensitive related to the duration of the tones and timing of the sequences, dedicated investigations on the parameter settings have to be made.

# 3.4 GSM Power Saving function

The Telit GC864-QUAD / PY has a special function that reduces the power consumption during the idle time, thus allowing a longer standby time with a given battery capacity.
This function monitors the DTR line indicating that the OEM application is ready to send commands, when it goes high (3V on UART) then the OEM application is not going to send any commands and the GC864-QUAD / PY module can save energy by shutting down its internal serial port.
When the OEM application becomes again ready, then the line DTR is tied low (0V on UART); the GC864-QUAD / PY detects this condition and powers up the serial port.
If the power saving function is activated, then the serial port must support the DTR line since when this line is high (Data Terminal is NOT ready) the device goes into a sleep condition and will not respond to commands until the DTR is tied low (Data Terminal is ready).

***NOTE: The power saving function does not affect the network behavior of the GC864-QUAD / PY, even during the power save condition the module remains registered on the network and reachable for incoming calls or SMS. If a call income during the power save, then the module will wake up and proceed normally with the unsolicited incoming call code.***
***The DTR functionality is usable only when +CFUN=5 is selected.***

***TIP: When the GC864-QUAD / PY wakes up from the sleep mode, it takes a maximum of 150 milliseconds before it can exchange commands on the serial port. Hence place a delay of at least 150 ms between the port opening (DTR lowering) and command sending.***
***According to the V24 standard, when the module is not ready to receive commands it will tie up the CTS line, while it will pull it down when it's ready to receive commands; hence you can monitor the CTS line to ensure the GC864-QUAD / PY is ready for commands.***

### 3.4.1.1 Enabling/Disabling the power saving function

- send command **AT+CFUN=<fun><cr>**

**where:**
**<fun> is the power saving function mode, the supported values are:**
0 - minimum functionality, NON-CYCLIC SLEEP mode: in this mode, the AT interface is not accessible.
1 - mobile full functionality with power saving disabled (factory default)
2 - disable TX
4 - disable either TX and RX
5 - mobile full functionality with power saving enabled

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | The power save is now active | |
| ERROR | some error occurred | Enable extended result codes (see par. 2.5.2.1), and retry. |
| +CME ERROR: 4 | operation not supported | Check command syntax and <fun> value. |

***TIP: The power saving function is disabled by default when the device starts up, in order to guarantee that even without the DTR line support it is possible to exchange commands with the module; for this reason the power saving setting command shall be issued after every power up.***

# 3.5 SMS handling

The Telit GC864-QUAD / PY supports the Short Message Service, it is possible to store, delete, write, send and receive a SMS, which is a short text message up to 160 characters long.

## 3.5.1 SMS device setup

Before accessing the Short Message Service, the device has to be properly set up.

### 3.5.1.1 Select SMS format type.

The GC864-QUAD / PY supports SMS in two different formats:

- PDU
- Text

The difference is that in the PDU mode the device returns and receives SMS encoded in the format ready to be sent to the network; in TEXT mode the device converts automatically the read PDU into text and viceversa. By using TEXT mode the PDU data encoding knowledge is not needed and operations are easier. For this reason, we will use the TEXT mode to explain how to operate with SMS. If you are familiar with PDU encoding then you can operate with PDU by selecting that format and using appropriate command syntax.

- Send command **AT+CMGF=<mode><cr>**

**where:**
**<mode> is the SMS format type:**
0 – PDU
1 – Text

- wait for response **OK**

***TIP: This setting is stored and remains until the device is turned off. Hence, there's no need to issue it more than one time. For TEXT mode use <mode>=1.***

For example:
1- Let's assume you want to set TEXT format for the SMS:
*command:*
AT+CMGF=1<cr>
*response:*
OK

### 3.5.1.2 Check SMS Service Centre number

The SMS are sent by the GC864-QUAD / PY to a service centre (SMSC) where the message is dispatched towards its final destination or is kept until the delivery is possible. To ensure a correct behavior of this service the number of the service centre must be the one your network operator supports.
To check which number is stored as the SMSC:

- send command **AT+CSCA?<cr>**
- wait for response in the format:

**+CSCA: <number>,<type>**

**OK**
**where:**
**<number> is the SMSC number**
**<type> is the SMSC number type:**
145 – international numbering scheme (number begins with "+")
129 – national numbering scheme

***TIP: This settings remains stored in the SIM card until it is changed or deleted, so this operation may be done only once if the SIM Card is not changed. The setting is maintained even after power down.***

For example:
1- Let's assume you want to check your SMSC number:
*command:*
AT+CSCA? <cr>
*response:*
+CSCA: +393359609600

OK

### 3.5.1.3 Add SMS Service Centre number (only if required)

If your previously check for SMSC returned an empty field:
+CSCA: ,129
or if the SMSC number stored does not correspond to the desired one, then the new number has to be stored. In this way the previously stored number will be overwritten.

- send command **AT+CSCA=<number>,<type><cr>**

**where:**
**<number> is the desired SMSC number**
**<type> is the SMSC number type:**
145 – international numbering scheme (number begins with "+")
129 – national numbering scheme

- wait for **OK**

For example:
1- Let's assume your desired SMSC number is +39335123456 (stored in international format):
*command:*
AT+CSCA=+39335123456,145<cr>
*response:*
OK

### 3.5.1.4 Select New Messages indication behavior

When the device receives a new message a unsolicited indication is generated, this indication may be sent to the DTE, buffered if the DTE is busy (for example during a data call) or discarded.
To set the desired behavior:

- send command **AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr><cr>**

**where:**
Set command selects the behaviour of the device on how the receiving of new messages from the network is indicated to the **DTE**.

Parameter:
**<mode>** - unsolicited result codes buffering option
0 - Buffer unsolicited result codes in the **TA**. If **TA** result code buffer is full, indications can be buffered in some other place or the oldest indications may be discarded and replaced with the new received indications.
1 - Discard indication and reject new received message unsolicited result codes when **TA-TE** link is reserved, otherwise forward them directly to the **TE**.
2 - Buffer unsolicited result codes in the **TA** in case the **DTE** is busy and flush them to the **TE** after reservation. Otherwise forward them directly to the **TE**.
3 - if **<mt>** is set to 1 an indication via 100 ms break is issued when a SMS is received while the module is in GPRS online mode. It enables the hardware ring line for 1 s. too.
**<mt>** - result code indication reporting for SMS-DELIVER
0 - No SMS-DELIVER indications are routed to the **TE**.
1 - If SMS-DELIVER is stored into **ME/TA**, indication of the memory location is routed to the **TE** using the following unsolicited result code:
**+CMTI: <memr>,<index>**
where:
**<memr>** - memory storage where the new message is stored
"SM"
"ME"
**<index>** - location on the memory where SM is stored.
2 - SMS-DELIVERs (except class 2 messages and messages in the message waiting indication group) are routed directly to the **TE** using the following unsolicited result code:

**(PDU Mode)**
**+CMT: <alpha>,<length><CR><LF><pdu>**

where:
**<alpha>** - alphanumeric representation of originator/destination number corresponding to the entry found in **MT** phonebook
**<length>** - PDU length
**<pdu>** - PDU message

**(TEXT Mode)**

**+CMT:<oa>,<alpha>,<scts>*[,<tooa>,<fo>,<pid>,<dcs>,*
*<sca>,<tosca>,<length>]*<CR><LF><data>** (the information written in italics will be present depending on **+CSDH** last setting)
where:
**<oa>** - originating address, string type converted in the currently selected character set (see **+CSCS**)
**<alpha>** - alphanumeric representation of **<oa>**; used character set should be the one selected with either command **+CSCS** or **@CSCS**.
**<scts>** - arrival time of the message to the SC
***<tooa>*, <tosca>** - type of number **<oa>** or ***<sca>*:**
129 - number in national format
145 - number in international format (contains the "+")
***<fo>*** - first octet of GSM 03.40
***<pid>*** - Protocol Identifier
***<dcs>*** - Data Coding Scheme
***<sca>*** - Service Centre address, string type, converted in the currently selected character set (see **+CSCS**)
***<length>*** - text length
**<data>** - TP-User-Data

Class 2 messages and messages in the message waiting indication group (stored message) result in indication as defined in **<mt>=1**.
3 - Class 3 SMS-DELIVERs are routed directly to **TE** using unsolicited result codes defined in **<mt>=2**. Messages of other data coding schemes result in indication as defined in **<mt>=1**.
**<bm>** - broadcast reporting option
0 - Cell Broadcast Messages are not sent to the **DTE**
2 - New Cell Broadcast Messages are sent to the **DTE** with the unsolicited result code:

**(PDU Mode)**

**+CBM: <length><CR><LF><PDU>**
where:
**<length>** - PDU length
**<PDU>** - message PDU

**(TEXT Mode)**

**+CBM:<sn>,<mid>,<dcs>,<pag>,<pags><CR><LF><data>**
where:
**<sn>** - message serial number
**<mid>** - message ID

**<dcs>** - Data Coding Scheme
**<pag>** - page number
**<pags>** - total number of pages of the message
**<data>** - CBM Content of Message

**<ds>** - SMS-STATUS-REPORTs reporting option
0 - status report receiving is not reported to the **DTE**
1 - the status report is sent to the **DTE** with the following unsolicited result code:

**(PDU Mode)**

**+CDS: <length><CR><LF><PDU>**
where:
**<length>** - PDU length
**<PDU>** - message PDU

**(TEXT Mode)**

**+CDS: <fo>,<mr>,,,<scts>,<dt>,<st>**
where:
**<fo>** - first octet of the message PDU
**<mr>** - message reference number
**<scts>** - arrival time of the message to the SC
**<dt>** - sending time of the message
**<st>** - message status as coded in the PDU

2 - if a status report is stored, then the following unsolicited result code is sent:
**+CDSI: <memr>,<index>**
where:
**<memr>** - memory storage where the new message is stored
"SM"
**<index>** - location on the memory where SM is stored

**<bfr>** - buffered result codes handling method:
0 - **TA** buffer of unsolicited result codes defined within this command is flushed to the **TE** when **<mode>=1..3** is entered (**OK** response shall be given before flushing the codes)
1 - TA buffer of unsolicited result codes defined within this command is cleared when **<mode>=1..3** is entered.

**NOTE**: issuing **AT+CNMI<CR>** is the same as issuing the Read command.

**NOTE**: issuing **AT+CNMI=<CR>** is the same as issuing the command **AT+CNMI=0<CR>**.

- wait for **OK**

***TIP: In this command description the values that are always 0 are parameter reserved for future use, in the current software revision the only value supported is 0.***

For example:
1- Let's assume you want to eliminate all the unsolicited codes that may be sent when receiving SMS & Status Report:
*command:*
AT+CNMI= 0,0,0,0,0<cr>
*response:*
OK

For example about a new message indication:
1- Let's assume you receive a new SMS delivery (AT+CNMI=1,1,0,0,0) and this new message is stored on the SIM "SM" storage at the location number 7; the unsolicited code you will receive (if code is enabled) is:
*unsolicited code:*
+CMTI: "SM",7

2- Let's assume you receive a new SMS Status Report delivery (AT+CNMI=1,0,0,2,0) and this new message is stored on the SIM "SM" storage at the location number 8; the unsolicited code you will receive is:
*unsolicited code:*
+CDSI: "SM",8

### 3.5.1.5 Set Text Mode Parameters (only in TEXT mode)

When the device is set to operate with Text SMS not with PDU, the SMS parameters that usually reside on the header of the PDU must be set apart with the command +CSMP.
The parameters to be set are:

- Message Format
- Validity Period
- Protocol Identifier
- Data Coding Scheme

The meaning and format of the parameters is:

**- Message format**, like defined for the first octet of message according to GSM 3.40:
The format is an 8-bit parameter divided into 6 fields and then reported as an integer:

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| RP | UDHI | SRR | VPF | | RD | MTI | |

where
**MTI message type parameter:**
0 1 - SMS Submit (only value supported)

**RD reject duplicates parameter**
0 - don't reject duplicates SMS in SC
1 - reject duplicates on SC

**VPF validity period format**

0 0 - Validity period NOT present
1 0 - VP integer represented (relative)
1 1 - VP semi octet represented (absolute)
0 1 - reserved

**SRR status report request**

0 - status report not requested
1 - status report requested

**UDHI user data Header Information**

0 - No Header on PDU
1 - Header present on PDU

**RP reply path**

0 - RP not set
1 - RP set

- **Validity Period** numerical if in relative format or string if in absolute format

This parameter represents the validity period for the SMS after which the message should be disregarded instead of being delivered.
If in relative format (see VPF parameter) it is an integer:
0 to 143 – corresponding to (VP + 1) x 5 minutes
144 to 167 – corresponding to 12 hours + ((VP -143) x 30 minutes)
168 to 196 – corresponding to (VP - 166) x 1 day
197 to 255 – corresponding to (VP - 192) x 1 week
If in absolute format it is a string in the format:
"gg/MM/YY,hh:mm:ss±tz"
where
gg day of expiration (2 characters)
MM month of expiration (2 characters)
YY year of expiration (2 characters)
hh hour of expiration (2 characters)
mm minute of expiration (2 characters)
ss second of expiration (2 characters)
± sign of the time zone ( + or - )
tz time zone (2 characters)

- **Protocol Identifier** in numerical format:

This parameter identifies the protocol used by the receiver entity and informs the SC that the conversion from SMS to that protocol should be done while delivering the message.

| Protocol ID | Conversion towards |
|---|---|
| 0 | Implicit (default) |
| 33 | telex (or teletex reduced to telex format) |

| | |
|---|---|
| 34 | group 3 telefax |
| 35 | group 4 telefax |
| 36 | voice telephone (i.e. conversion to speech) |
| 37 | ERMES (European Radio Messaging System) |
| 38 | National Paging system (known to the SC) |
| 39 | Videotex (T.100/T.101) |
| 40 | teletex, carrier unspecified |
| 41 | teletex, in PSPDN |
| 42 | teletex, in CSPDN |
| 43 | teletex, in analog PSTN |
| 44 | teletex, in digital ISDN |
| 45 | UCI (Universal Computer Interface, ETSI DE/PS 3 01-3) |
| 46-47 | (reserved, 2 combinations) |
| 48 | a message handling facility (known to the SC) |
| 49 | any public X.400-based message handling system |
| 50 | Internet Electronic Mail |
| 51-55 | (reserved, 5 combinations) |
| 56-62 | values specific to each SC, usage based on mutual agreement between the SME and the SC (7 combinations available for each SC) |
| 63 | A GSM mobile station. The SC converts the SM from the received TP-Data-Coding-Scheme to any data coding scheme supported by that MS (e.g. the default). |
| 64 | Short Message Type 0 |
| 65 | Replace Short Message Type 1 |
| 66 | Replace Short Message Type 2 |
| 67 | Replace Short Message Type 3 |
| 68 | Replace Short Message Type 4 |
| 69 | Replace Short Message Type 5 |
| 70 | Replace Short Message Type 6 |
| 71 | Replace Short Message Type 7 |
| 72..94 | Reserved |
| 95 | Return Call Message |
| 96..126 | Reserved |
| 127 | SIM Data download |

**- Data coding Scheme** as defined by GSM 3.38 – in numerical format

The DCS is an 8-bit parameter reported as an integer, the default value is 0, otherwise for simplicity, we report only the most useful DCS, for further Schemes refer to GSM 3.38

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 0 | Alphabet | Class | |

where
**Alphabet**
0 - default Alphabet
1 - 8 bit

**Class**
0 0 - Class 0
0 1 - Class 1
1 0 - Class 2
1 1 - Class 3

***TIP: The default value for DCS = 0 represents the default SMS sent by a mobile. If you don't need any particular data coding scheme use DCS=0.***

***NOTE: Not all the DCS combinations described in the GSM 3.38 are supported, both by the network and by the Telit GC864-QUAD / PY. Some features may be not implemented at network level or at device level, resulting in a +CMS ERROR: 303 (operation not supported) result code. If this happens then use a different DCS.***

- send command **AT+CSMP=<fo>,<vp>,<pid>,<dcs><cr>**

**where:**
**<fo>: Message format**
**<vp>: Validity Period**
**<pid>: Protocol Identifier**
**<dcs>: Data coding Scheme**

- wait for **OK**

For example:
1- Let's assume you want to set the SMS parameters to the values:
- Message Format:
- SMS submit
- don't reject duplicates
- VP Format integer (relative)
- status report not requested
- No Header on PDU
- Reply path not set

Hence, the message format is the binary number 00010001 corresponding to the integer 17.

- Validity period 24 hours corresponding to an integer value 167.
  12 hours + ((167 -143) x 30 min) = 24 hours
- Protocol ID implicit (SMS sent to a mobile terminal) corresponding to a value 0.
- DCS default value 0.

*command:*
AT+CSMP= 17,167,0,0

*response:*
OK

2- Let's assume you want to set the SMS parameters to the values:
- Message Format:
  - SMS submit
  - don't reject duplicates
  - VP Format semi octet (absolute)
  - status report requested
  - No Header on PDU
  - Reply path not set

Hence, the message format is the binary number 00111001 corresponding to the integer 57.
- Validity period format is absolute, hence it represents the expiration date of the message and the desired expiration date is for example 29/06/02 at 02:20 in the time zone of Italy (+1).
  "29/06/02,02:20:00+1"
- Protocol ID implicit (SMS sent to a mobile terminal) corresponding to a value 0.
- Data Coding Scheme:
  - Default Alphabet
  - Class 0 (e.g. immediate display SMS)

Corresponding to the binary number 11110000 corresponding to the integer 240.

*command:*
AT+CSMP= 57,29/06/02,02:20:00+1,0,240

*response:*
OK

### 3.5.1.6 Select SMS Memory and check for memory space

There are various types of storage where the SMS can be stored, the Telit GC864-QUAD / PY provides two different storage:

"ME" - mobile equipment memory
"SM" - SIM Card memory

The SMS are usually stored (this is true for both the originated and the received SMS) in the SM storage, the "ME" storage is a read only one where the Class 0 messages received are stored (regardless of the selected active storage which may be "SM").
For this reason the "ME" storage can be selected to read the Class 0 messages.
The GC864-QUAD / PY allows the user to select a different storage for the read-delete, write-send, and reception-saving SMS operations.

- send command **AT+CPMS=<memr>,<memw>,<mems><cr>**

**where:**

**<memr>: memory storage for Read and Delete commands**
**- "SM"**
**- "ME" (No Delete operations allowed)**
**<memw>: memory storage for Write and Send commands**
**<mems>: memory storage for new incoming message saving**
**- "SM" only**

- wait for response in the format:

**+CPMS:<usedr>,<totalr>,<usedw>,<totalw>,<useds>,<totals>**

**OK**

**where**

<usedr> - number of SMS stored into <memr>
<totalr> - max number of SMS that <memr> can contain
<usedw> - number of SMS stored into <memw>
<totalw> max number of SMS that <memw> can contain
<useds> - number of SMS stored into <mems>
<totals> max number of SMS that <mems> can contain

From this response you can check if the selected storage has room for new SMSs, the free positions in the storage X (where X can be r,w,s ) are <totalX> -<usedX>.

## 3.5.2 IRA character set

The character set used in SMS text mode is the IRA.
This set defines each char as a 7-bit value, hence from 0x00 to 0x7F. The table below reports all the chars supported and their hexadecimal code. To obtain the code for a char in the table remember that in the row it is reported the least significant nibble (4 bits) and in the column the most significant nibble. The empty cells correspond to reserved combinations.

| | | Most Significant Nibble | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0x | 1x | 2x | 3x | 4x | 5x | 6x | 7x |
| Least Significant Nibble | x0 | | | SP[1] | 0 | @ | P | | p |
| | x1 | | | ! | 1 | A | Q | a | q |
| | x2 | | | " | 2 | B | R | b | r |
| | x3 | | | # | 3 | C | S | c | s |
| | x4 | | | $ | 4 | D | T | d | t |
| | x5 | | | % | 5 | E | U | e | u |
| | x6 | | | & | 6 | F | V | f | v |
| | x7 | | | ' | 7 | G | W | g | w |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | x8 | | | ( | 8 | H | X | h | x |
| | x9 | | | ) | 9 | I | Y | i | y |
| | xA | LF[2] | | * | : | J | Z | j | z |
| | xB | | | + | ; | K | | k | |
| | xC | | | , | < | L | | l | |
| | xD | CR[3] | | - | = | M | | m | |
| | xE | | | . | > | N | | n | |
| | xF | | | / | ? | O | £ | o | |

[1] - SP stands for space character
[2] - LF stands for Line Feed character
[3] - CR stands for Carriage Return character

For example:
1- Let's assume you want to find the IRA code for the character '&':
From the table you find:
- most significant Nibble: 2
- least significant Nibble: 6

Hence the IRA code for the '&' character is the hexadecimal 0x26.

2- Let's assume you have the IRA code 0x6B and you want to find the corresponding character:
From the table you find at the position
- most significant Nibble: 6
- least significant Nibble: B

Hence, the character corresponding to the 0x6B IRA code is 'k'.

***TIP: With the command AT+CSCS is possible to select the character set; the available types are:***
**"IRA" - ITU-T.50**
**"8859-1" - ISO 8859 Latin 1**
**"PCCP437" - PC character set Code Page 437.**
**"UCS2" - 16-bit universal multiple-octet coded character set (ISO/IEC10646)**
***Please refer to the AT command specification for the full command description***

### 3.5.3 Writing a New SMS to storage

A new SMS can be written in the selected storage <memw> (in the current SW version only "SM" is supported) and then can be sent to the desired destination.
To write the new SMS:

- send command **AT+CMGW="<da>"<cr>**

**where:**

**<da>: destination address**

- wait for prompt "**>**"
- send SMS text (MAX 160 characters)
- end command with CTRL-Z character (0x1A hexadecimal) or abort command with ESC character (0x1B hexadecimal)
- wait for response:

| Response | Reason | Action |
|---|---|---|
| +CMGW: <index><br><br>OK | Message has been successfully written in position number <index> | proceed ahead |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CMS ERROR: 330 | SMSC address unknown | Insert SMSC address (see par. 3.5.1.3) |
| +CMS ERROR: 322 | Memory Full | memory is full, hence delete some records and retry. |

**NOTE: if command is aborted with ESC character, then only the OK result code is returned.**

For example:
1- Let's assume you want to write a new SMS to the storage and the destination address is the number +39338123456789. We suppose you already have set up the device for text SMS mode as described on the previous paragraphs:

*command:*
AT+CMGW="+39338123456789"
*response:*
>
*now you can insert the message text in IRA format (note that the IRA format and ASCII format coincide for the alphabet characters but not for the other).*
…. here will be inserted the SMS message text….

*conclude text with the character CTRL-Z*
*response:*

+CMGW: 3

OK

In this case, the new SMS was successfully written to the location index 3 of the selected write memory (always "SM" SIM Card memory).

## 3.5.4 Sending an SMS previously stored

An already written SMS can be sent from the selected storage <memw> (in the current SW version only "SM" is supported).
To send the written SMS its location index is needed:

- send command **AT+CMSS=<index><cr>**

**where:**

**<index>: SMS location index**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| +CMSS: <mr><br><br>OK | Message has been successfully sent. <mr> represents the message reference number. | proceed ahead |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CMS ERROR: 330 | SMSC address unknown | Insert SMSC address (see par. 3.5.1.3) |
| +CMS ERROR: 41 | "Temporary Failure", may be that the device is not registered on any network | Check for signal strength and network registration |
| +CMS ERROR: 331 | No network service | Check for signal strength and network registration |
| +CMS ERROR: 1 | Unassigned number | The destination address number does not exist. Check it and repeat command. |
| +CMS ERROR: 42 | network congestion | Retry later |
| +CMS ERROR: 96 | Mandatory information missing | Check for destination address in the SMS, overwrite it and retry. |

For example:
1- Let's assume you want to send a SMS that was written to the storage index position number 3. We suppose you already have set up the device for text SMS mode as described on the previous paragraphs:

*command:*
AT+CMSS=3
*response:*
+CMSS: 1

OK

In this case, the SMS was successfully sent to the destination and its network message reference number is 1.

### 3.5.5 Sending a new SMS without storing it

A new SMS can be sent directly to the network without storing it.

- send command **AT+CMGS="<da>"<cr>**

**where:**

**<da>: destination address**

- wait for prompt "**>**"
- send SMS text (MAX 160 characters)
- end command with CTRL-Z character (0x1A hexadecimal) or abort command with ESC character (0x1B hexadecimal)
- wait for response:

| Response | Reason | Action |
|---|---|---|
| +CMGS: <mr><br><br>OK | Message has been successfully sent. <mr> represents the message reference number. | proceed ahead |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CMS ERROR: 330 | SMSC address unknown | Insert SMSC address (see par. 3.5.1.3) |
| +CMS ERROR: 41 | "Temporary Failure", may be that the device is not registered on any network | Check for signal strength and network registration |
| +CMS ERROR: 331 | No network service | Check for signal strength and network registration |
| +CMS ERROR: 1 | Unassigned number | The destination address number does not exist. Check it and repeat command. |

| | | |
|---|---|---|
| +CMS ERROR: 42 | network congestion | Retry later |
| +CMS ERROR: 96 | Mandatory information missing | Check for destination address in the SMS, overwrite it and retry. |
| OK | command aborted by user | you issued a ESC char |

For example:
1- Let's assume you want to directly send a new SMS to the destination address number +39338123456789. We suppose you already have set up the device for text SMS mode as described on the previous paragraphs:

*command:*
AT+CMGS="+39338123456789"
*response:*
>
*now you can insert the message text in IRA format (note that the IRA format and ASCII format coincide for the alphabet characters but not for the other).*
…. here will be inserted the SMS message text to be sent….

*conclude text with the character CTRL-Z*
*response:*
+CMGW: 4

OK

In this case, the new SMS was successfully sent to the SC and its network reference number is 4.
Do not confuse message reference with message index position, the first indicates the network reference for identifying the sent message (the eventually requested status report will have the same reference) while the second indicates the position where the message has eventually been stored in memory.

## 3.5.6 Deleting an SMS

An already written/received SMS can be deleted from the selected storage (in the current SW version only "SM" is supported).
To delete the SMS its location index is needed:

- send command **AT+CMGD=<index><cr>**

**where:**

**<index>: SMS location index**

- wait for response:

| Response | Reason | Action |
|---|---|---|
| OK | Message has been successfully deleted. | proceed ahead |
| ERROR | some error occurred | Enable the extended error codes report (see par.2.5.2.1) and retry. |
| +CMS ERROR: 321 | Invalid memory index<br>e.g. the given record was already empty | Check the <index> number and retry. |

For example:
1- Let's assume you want to delete a previously written SMS that was written to the storage index position number 3. We suppose you already have set up the device for text SMS mode as described on the previous paragraphs:

*command:*
AT+CMGD=3
*response:*
OK

In this case, the SMS was successfully deleted.

2- Let's assume you want to delete a received SMS that was stored to the index position number 7:

*command:*
AT+CMGD=7
*response:*
OK

## 3.5.7 Reading an SMS

A new SMS can be read with the command:

- send command **AT+CMGR=<index><cr>**

**where:**

**<index>: SMS location index**

- wait for response in the format:

*Output format for received messages* (the information written in italics will be present depending on **+CSDH** last setting)*:*
**+CMGR: <stat>,<oa>,<alpha>,<scts>*[,<tooa>,<fo>,<pid>,***
***<dcs>,<sca>,<tosca>,<length>]*<CR><LF><data>**

*Output format for sent messages:*
**+CMGR: <stat>,<da>,<alpha>*[,<toda>,<fo>,<pid>,<dcs>,,***
***<sca>,<tosca>,<length>]*<CR><LF><data>**

*Output format for message delivery confirm:*
**+CMGR: <stat>,<fo>,<mr>,,,<scts>,<dt>,<st>**

where:
**<stat>** - status of the message
"REC UNREAD" - new received message unread
"REC READ" - received message read
"STO UNSENT" - message stored not yet sent
"STO SENT" - message stored already sent
***<fo>*** - first octet of the message PDU
**<mr>** - message reference number
**<scts>** - arrival time of the message to the SC
**<dt>** - sending time of the message
**<st>** - message status as coded in the PDU
***<pid>*** - Protocol Identifier
***<dcs>*** - Data Coding Scheme
**<oa>** - Originator address, string type represented in the currently selected character set (see **+CSCS**)
**<da>** - Destination address, string type represented in the currently selected character set (see **+CSCS**)
**<alpha>** - string type alphanumeric representation of **<da>** or **<oa>**, corresponding to an entry found in the phonebook; used character set is the one selected with command **+CSCS**. *NB: this optional field is currently not supported.*
***<sca>*** - Service Centre number
***<tooa>,<toda >,<tosca>*** - type of number **<oa>**,**<da>**,***<sca>***
129 - number in national format

145 - number in international format (contains the "**+**")
***<length>*** - text length
**<data>** - TP-User_data

- If **<dcs>** indicates that GSM03.38 default alphabet is used , each character of GSM alphabet will be converted into current TE character set (see **+CSCS**)
- If **<dcs>** indicates that 8-bit or UCS2 data coding scheme is used, each 8-bit octet will be converted into two IRA character long hexadecimal number (e.g. octet 0x2A will be converted as two characters 0x32 0x41)

**NOTE**: in both cases if status of the message is 'received unread', status in the storage changes to 'received read'.

**NOTE**: an error result code is sent on empty record **<index>**.

For example:
1- Let's assume you want to read the SMS that is stored at the position index 4. We suppose you already have set up the device for text SMS mode as described on the previous paragraphs:

*command:*
AT+CMGR=4
*response:*
+CMGR: "STO UNSENT","+393351234565"
Telit Test Message for Text Mode SMS.
OK

In this case the SMS was successfully read, the text contained was:
" Telit Test Message for Text Mode SMS."
The message was written to the storage by user (STO) but still not sent (UNSENT) to the destination address that's the number +393351234565

2- Let's assume you want now to read the SMS that is stored at the position index 5:

*command:*
AT+CMGR=5
*response:*
+CMGR: "REC UNREAD","+393381234567890", ,"29/06/01,12:30:04+01"
Telit Test Message for Text Mode SMS RECEIVING.
OK

In this case the SMS was successfully read, the text contained was:
" Telit Test Message for Text Mode SMS RECEIVING."
The message was received (REC) from the number +393381234567890 at 12:30:04 the day 29/06/01 in the European time zone +1.
After this read command the message at index 5 becomes REC READ.

## 3.5.8 Listing a group of SMSs

The SMS can be grouped into 5 different groups depending on their status:

- REC UNREAD - received messages still not read
- REC READ - received messages already read
- STO UNSENT - written messages not yet sent
- STO SENT - written messages already sent
- ALL - all types of messages

It is possible to have the list of all the messages in one group:

- send command **AT+CMGL=<stat><cr>**

**where:**

**<stat> - status group of the message**

"REC UNREAD" - new message
"REC READ" - read message
"STO UNSENT" - stored message not yet sent
"STO SENT" - stored message already sent
"ALL" - all messages

- wait for response in the format:

***For every message in the group:***

**+CMGL: <index>,<stat>,<oa/da> [,,,<tooa/toda>,<length>]**
**<CR><LF><text>**

**where:**

**<index> - message index position on the storage**
**<stat> - status of the message**
**"REC UNREAD" - new message**
**"REC READ" - read message**
**"STO UNSENT" - stored message not yet sent**
**"STO SENT" - stored message already sent**
**<oa/da> - sender number/destination number**
**< tooa/toda > - type of number <oa/da>**
**145 - international number (contains "+" character)**
**129 - national number**
**<length> - length of the message text in characters**
**<text> - message text**

**NOTE**: If status of the message is 'received unread', status in the storage changes to 'received read'.

For example:
1- Let's assume you want to list all the SMS received read that are stored. We suppose you already have set up the device for text SMS mode as described on the previous paragraphs:

*command:*
AT+CMGL="REC READ"
*response:*
+CMGL: 5, "REC READ","+393381234567890"
Telit Test Message for Text Mode SMS RECEIVING.
+CMGL: 8, "REC READ","+393381234567890"
Telit Second Test Message for Text Mode SMS RECEIVING.
OK

In this case the SMS group was successfully read, the messages Received UNREAD were two in the position indexes 5 & 8. The optional parameters <tooa/toda> and <length> were not shown.

# 3.6 Using General Purpose Input/Output pins

The **Telit GC864-QUAD / PY** provides various General Purpose Input/Output pins, these pins can be configured via AT commands as Inputs, Outputs and two of them as "alternate function".
The "alternate function" are supported by pins GPIO5, which can be configured to become a RF Transmission monitor output pin that reflects the RF transmission activation, GPIO6, which can be configured to become an alarm output pin that reflects the alarm status, and GPIO7 which can be configured to become a buzzer output pin.
With these pins your application can control external hardware directly using the **Telit GC864-QUAD / PY** pins, with little or even no hardware added.

## 3.6.1 GPIO pin setup

Before using the GPIO pin, you must configure them to select their direction or alternate function

### 3.6.1.1 Setting GPIO pin as OUTPUT

When you set a GPIO as output, you must specify also the value that the pin output must take:

- Send command **AT#GPIO=<pin>,<value>,1<cr>**

**where:**
**<pin> is the GPIO pin number at which the command applies:**

| | |
|---|---|
| 1 – GPIO1 | 12 – GPIO12 |
| 2 – GPIO2 | 13 – GPIO13 |
| 3 – GPIO3 | 14 – GPIO14 |
| 4 – GPIO4 | 15 – GPIO15 |
| 5 – GPIO5 | 16 – GPIO16 |
| 6 – GPIO6 | 17 – GPIO17 |
| 7 – GPIO7 | 18 – GPIO18 |
| 8 – GPIO8 | 19 – GPIO19 |
| 9 – GPIO9 | 20 – GPIO20 |
| 10 – GPIO10 | 21 – GPIO21 |
| 11 – GPIO11 | 22 – GPIO22 |

**<value> is the GPIO pin value that the pin will assume:**
0 – LOW
1 – HIGH

- wait for response **OK**

***NOTE: The #GPIO setting is not saved and will be lost on power off, so at start-up repeat pin initialization commands. At start-up the setting for GPIO6 and GPIO7 instead is maintained even after a shutdown to permit alarm & buzzer feature to work always.***

For example:
1- Let's assume you want to set GPIO3 pin as Output and you want it to be in LOW status:
*command:*
AT#GPIO=3,0,1<cr>
*response:*
OK

In this case, the GPIO3 pin was successfully put in output direction and its status has been set to LOW.

### 3.6.1.2 Setting GPIO pin as INPUT

When you set a GPIO as input, you must specify also a dummy value for the pin state:

- Send command **AT#GPIO=<pin>,<dummy_value>,0<cr>**

**where:**
**<pin> is the GPIO pin number at which the command applies:**

| | |
|---|---|
| 1 – GPIO1 | 12 – GPIO12 |
| 2 – GPIO2 | 13 – GPIO13 |
| 3 – GPIO3 | 14 – GPIO14 |
| 4 – GPIO4 | 15 – GPIO15 |
| 5 – GPIO5 | 16 – GPIO16 |
| 6 – GPIO6 | 17 – GPIO17 |
| 7 – GPIO7 | 18 – GPIO18 |
| 8 – GPIO8 | 19 – GPIO19 |
| 9 – GPIO9 | 20 – GPIO20 |
| 10 – GPIO10 | 21 – GPIO21 |
| 11 – GPIO11 | 22 – GPIO22 |

**<value> is a dummy value can be either:**
0 – dummy value
1 – dummy value

- wait for response **OK**

***NOTE: The #GPIO setting for all GPIO except from GPIO6, GPIO7, is not saved and will be lost on power off, so at start-up repeat pin initialization commands.***
***At start-up all the GPIOs except from GPIO6 & GPIO7 are configured by default as INPUT, but the setting for GPIO6 and GPIO7 instead is maintained even after a shutdown to permit alarm & buzzer feature to work always.***

For example:
1- Let's assume you want to set GPIO4 pin as Input:
*command:*
AT#GPIO=4,0,0<cr>
*response:*
OK

In this case, the GPIO4 pin was successfully put in input direction.

## 3.6.2 GPIO pin use

After having set-up the GPIO pin direction you can query the input status of an INPUT pin or set the output status of an OUTPUT pin.

### 3.6.2.1 Querying GPIO pin status

To query for the pin status:

- Send command **AT#GPIO=<pin>,2<cr>**

**where:**
**<pin> is the GPIO pin number at which the command applies:**

| | |
|---|---|
| 1 – GPIO1 | 12 – GPIO12 |
| 2 – GPIO2 | 13 – GPIO13 |
| 3 – GPIO3 | 14 – GPIO14 |
| 4 – GPIO4 | 15 – GPIO15 |
| 5 – GPIO5 | 16 – GPIO16 |
| 6 – GPIO6 | 17 – GPIO17 |
| 7 – GPIO7 | 18 – GPIO18 |
| 8 – GPIO8 | 19 – GPIO19 |
| 9 – GPIO9 | 20 – GPIO20 |
| 10 – GPIO10 | 21 – GPIO21 |
| 11 – GPIO11 | 22 – GPIO22 |

- wait for response in the format:

**#GPIO: <dir>,<stat>**
**OK**

**where:**
**<dir> - GPIO<pin> direction setting**
**<stat> - status of the pin**
**0 - LOW**
**1 - HIGH**

***NOTE: In case the GPIO pin direction is set to ALTERNATE FUNCTION (2), then the reported <stat> has no meaning and shall not kept as valid, but shall be threaten as a dummy value.***

***TIP: The query reports depending on the pin direction:***
- ***the read pin status in case the direction is input;***
- ***the previously set pin status in case the direction is output.***

***In any case, you can know if the pin at the query moment is high or low and the pin direction.***

For example:
1- Let's assume you want to query the GPIO3 pin for its status:
*command:*
AT#GPIO=3,2<cr>
*response:*
#GPIO: 0,1
OK
In this case, the GPIO3 pin was set in input direction and its status has been measured to be HIGH.

2- Let's assume you want to query the GPIO4 pin for its status:
*command:*
AT#GPIO=4,2<cr>
*response:*
#GPIO: 1,0
OK
In this case, the GPIO4 pin was set in output direction and its status is LOW.

3- Let's assume you want to query the GPIO6 pin for its status:
*command:*
AT#GPIO=6,2<cr>
*response:*
#GPIO: 2,0
OK
In this case, the GPIO6 pin was set in "alternate function" direction and therefore works as alarm output. The reported status = LOW has no meaning.

### 3.6.2.2 Setting GPIO pin output status

To set the pin status (when pin is set as OUTPUT):

- Send command **AT#GPIO=<pin>,<value>,1<cr>**

**where:**
**<pin> is the GPIO pin number at which the command applies:**

| | |
|---|---|
| 1 – GPIO1 | 12 – GPIO12 |
| 2 – GPIO2 | 13 – GPIO13 |
| 3 – GPIO3 | 14 – GPIO14 |
| 4 – GPIO4 | 15 – GPIO15 |
| 5 – GPIO5 | 16 – GPIO16 |

6 – GPIO6
7 – GPIO7
8 – GPIO8
9 – GPIO9
10 – GPIO10
11 – GPIO11
17 – GPIO17
18 – GPIO18
19 – GPIO19
20 – GPIO20
21 – GPIO21
22 – GPIO22

**<value> is the pin value to be set and can be:**
0 – LOW
1 – HIGH

- wait for response **OK**

For example:
1- Let's assume you want to set the GPIO3 pin HIGH:
*command:*
AT#GPIO=3,1,1<cr>
*response:*
OK
In this case, the GPIO3 pin was set in output direction and its status has been set to HIGH.

### 3.6.2.3 Using GPIO5 pin as RFTXMON OUTPUT (alternate function)

When you set the GPIO5 pin as RFTXMON output function, the pin reports the Transmitter active status. To set the pin in alternate function you must specify also a dummy value for the pin state:

- Send command **AT#GPIO=5,<dummy_value>,2<cr>**

**where:**
**<value> is a dummy value can be either:**
0 – dummy value
1 – dummy value

- wait for response **OK**

***TIP: Remember that the alternate function places the GPIO5 pin always in OUTPUT direction.***

***NOTE: The #GPIO5 direction setting is saved and will be kept after a power off.***
***The saving can be applied only for the alternate mode.***

For example:
1- Let's assume you want to set GPIO5 pin as RFTXMON OUTPUT:
*command:*
AT#GPIO=5,0,2<cr>
*response:*
OK

In this case, the GPIO5 pin was successfully put in RFTXMON output direction.

### 3.6.2.4 Using GPIO6 pin as ALARM OUTPUT (alternate function)

When you set the GPIO6 pin as alarm output function, the pin reports the alarm state following the +CALA settings. To set the pin in alternate function you must specify also a dummy value for the pin state:

- Send command **AT#GPIO=6,<dummy_value>,2<cr>**

**where:**
**<value> is a dummy value can be either:**
0 – dummy value
1 – dummy value

- wait for response **OK**

***TIP: Remember that the alternate function places the GPIO6 pin always in OUTPUT direction and since the GPIO6 pin value is controlled by the internal software, the corresponding function (+CALA) must be setup properly.***

***NOTE: The #GPIO6 direction setting is saved and will be kept after a power off.***

For example:
1- Let's assume you want to set GPIO6 pin as ALARM OUTPUT:
*command:*
AT#GPIO=6,0,2<cr>
*response:*
OK

In this case, the GPIO6 pin was successfully put in alarm output direction.

### 3.6.2.5 Using GPIO7 pin as BUZZER OUTPUT (alternate function)

When you set the GPIO7 pin as buzzer output function, the pin will output a waveform suitable to drive a Buzzer, provided a simple external mosfet driver is developed and that the #SRP settings are adequate. To set the pin in alternate function you must specify also a dummy value for the pin state:

- Send command **AT#GPIO=7,<dummy_value>,2<cr>**

**where:**
**<value> is a dummy value can be either:**
0 – dummy value
1 – dummy value

- wait for response **OK**

***TIP: Remember that the alternate function places the GPIO7 pin always in OUTPUT direction and since the GPIO7 pin value is controlled by the internal software, the corresponding function (#SRP) must be setup properly.***

***NOTE: The #GPIO7 direction setting is saved and will be kept after a power off.***

For example:
1- Let's assume you want to set GPIO7 pin as BUZZER OUTPUT:
*command:*
AT#GPIO=7,0,2<cr>
*response:*
OK

In this case, the GPIO7 pin was successfully put in buzzer output direction.

# 3.7 Clock/Alarm function

The **Telit GC864-QUAD / PY** provides a Real Time Clock and Alarm embedded in the product; it is therefore possible to set-up the proper time, check the actual time, set-up an alarm time at which the alarm will be triggered with various behavior depending on the +CALA setting.
The only requirement is that the power input to the **Telit GC864-QUAD / PY** has to be guaranteed without interruptions, the **Telit GC864-QUAD / PY** has no backup battery; therefore it will lose the time setting if its power supply is interrupted.

On Alarm trigger the **Telit GC864-QUAD / PY** can:

- automatically Wake-up fully operative from shutdown as if the ON/OFF
- automatically Wake-up from shutdown in a special status namely "alarm status" where it will not look for or try to register into any network, as if it would be off, except from the fact that it proceeds with the alarm action and it can receive commands to return completely operative or shutdown immediately.
- If already ON at alarm trigger time, simply proceed with the Alarm action

Once Woken-up the **Telit GC864-QUAD / PY** proceeds with the chosen action that can be

- issue an unsolicited code "+ALARM: <user_text>" on the serial port until a 90s timeout expires or a special Wake-up command is received
- play an Alarm tone until a 90s timeout expires or a special Wake-up command is received
- rise the pin GPIO6 until a 90s timeout expires or a special Wake-up command is received
- any combination of these actions

With these features, the **Telit GC864-QUAD / PY** for example can:

- Wake-up itself and its controlling hardware by using the GPIO6 pin at the desired time, so timely surveys can be programmed without the need to keep the any hardware on and therefore reducing power consumption to a minimum.
- Activate some special hardware on time trigger event with the GPIO6 pin.
- Alert the controlling application that the alarm time has come with the unsolicited code "+ALARM:<user_text>"
- Alert the user with the alarm tone played

## 3.7.1 Clock date/time

Before using the Alarm feature, you must regulate the internal clock.

### 3.7.1.1 Regulate the Clock

- Send command **AT+CCLK="<time>"<cr>**

**where:**

**<time>** - current time as quoted string in the format : "yy/MM/dd,hh:mm:ss±zz"
yy - year (two last digits are mandatory), range is 00..99
MM - month (two last digits are mandatory), range is 01..12
dd - day (two last digits are mandatory), range is 01..31 (if the month MM has less than 31 days, the clock will be set for the next month)
hh - hour (two last digits are mandatory), range is 00..23
mm - minute (two last digits are mandatory), range is 00..59
ss - seconds (two last digits are mandatory), range is 00..59
±zz - time zone (indicates the difference, expressed in quarter of an hour, between the local time and GMT; two last digits are mandatory), range is -47..+48

**NOTE**: If the parameter is omitted the behaviour of Set command is the same as Read command.

- wait for response **OK**

***TIP: Remember that the string time has to be encapsulated in double brackets.***

***NOTE: The time will start immediately after the time setting command.***

For example:
1- Let's assume you want to regulate your clock to 7 November 2002 at 12h 24m 30s for the time zone +01h central Europe:
*command:*
AT+CCLK="02/11/07,12:24:30+04"<cr>
*response:*
OK
In this case, the time was successfully set.

### 3.7.1.2 Read the current date/time

- Send command **AT+CCLK?<cr>**

- wait for response in the format:

**+CCLK: <time>**
**OK**

**NOTE**: the three last characters of **<time>** are not returned by **+CCLK?** because the **ME** doesn't support time zone information.

For example:
1- Let's assume you want now to read the current time:
*command:*
AT+CCLK?<cr>
*response:*
+CCLK="02/11/07,12:26:47"<cr>
OK
In this case the current date/time is: 7 November 2002 12h 26m 47s

## 3.7.2 Alarm function

Once the current time has been set, the alarm function can be setup.

### 3.7.2.1 Regulate the Alarm time & behavior

- Send command **AT+CALA="<time>",0,<type>,"<text>"<cr>**

**where:**

**<time> is the Alarm time string in the same format of the clock setting command:**

yy/MM/dd,hh:mm:ss±zz
where:
yy : two digits year (00-99)
MM : two digits month (01-12)
dd : two digits day (01-31)
hh : two digits hour (00-24)
mm : two digits minute (00-60)
ss : two digits seconds (00-60)
±zz: signed two digits timezone (-11 - +11)

**<type> is the Alarm behavior:**

0 - reserved for other equipment use.
1 - the MODULE simply wakes up fully operative as if the **ON/OFF** button had been pressed. If the device is already **ON** at the alarm time, then it does nothing.
2 - the MODULE wakes up in "alarm mode" if at the alarm time it was off, otherwise it remains fully operative. In both cases the MODULE issues an unsolicited code every 3s:
**+ALARM: <text>**
where **<text>** is the **+CALA** optional parameter previously set.

The device keeps on sending the unsolicited code every 3s until a **#WAKE** or **#SHDN** command is received or a 90s timeout occurs. If the device is in "alarm mode" and it does not receive the **#WAKE** command within 90s then it shuts down. (default)

3 - the MODULE wakes up in "alarm mode" if at the alarm time it was off, otherwise it remains fully operative. In both cases the MODULE starts playing the alarm tone on the selected path for the ringer (see command **#SRP**)
The device keeps on playing the alarm tone until a **#WAKE** or **#SHDN** command is received or a 90s timeout occurs. If the device is in "alarm mode" and it does not receive the **#WAKE** command within 90s then it shuts down.

4 - the MODULE wakes up in "alarm mode" if at the alarm time it was off, otherwise it remains fully operative. In both cases the MODULE brings the pin **GPIO6** high, provided its **<direction>** has been set to alarm output, and keeps it in this state until a **#WAKE** or **#SHDN** command is received or a 90s timeout occurs. If the device is in "alarm mode" and it does not receive the **#WAKE** command within 90s then it shuts down.

5 - the MODULE will make both the actions as for **<type>=2** and **<type>=3**.

6 - the MODULE will make both the actions as for **<type>=2** and **<type>=4**.

7 - the MODULE will make both the actions as for **<type>=3** and **<type>=4**.

**<text>** - unsolicited alarm code text string. It has meaning only if **<type>** is equal to 2 or 5 or 6.

- wait for response **OK**

***TIP: Remember that the string time has to be encapsulated in double brackets, furthermore the Alarm time will not be computed for different timezone, therefore the alarm time will always refer to the same timezone as the clock setting regardless the timezone set in the +CALA command.***

***NOTE: if you use the GPIO6 pin as ALARM OUTPUT, then you MUST set its direction to "alternate function" (see par. 3.6.2.4) otherwise the pin will not respond to the alarm settings. In case the alarm mode is equal to 1,3,7 then a dummy empty text shall be inserted "".***

***NOTE: if you use the unsolicited codes +ALARM: <text>, then you must fix the port speed rate (see par. 2.5.1) and store it in the active profile (see command &W), in order to make the Telit GC864-QUAD / PY boot with the desired port speed, otherwise at the alarm wakeup, the module will start with the default port speed that may differ from yours.***

### 3.7.2.2 Stop the Alarm activity

When the alarm time expires, the module starts the alarm activity according to the alarm behavior parameter <type> selected.
To stop the Alarm activity there are three ways, you can either decide to exit from alarm and shutdown the device or exit from alarm and entering the normal operational status; otherwise you can leave the alarm go on until the 90s timeout is reached.

#### *3.7.2.2.1 Exit from the alarm status and shutdown*

- Send command **AT#SHDN<cr>**
- wait for response **OK**

At the OK result code, the device will end alarm activity and shutdown.

#### *3.7.2.2.2 Exit from the alarm status and enter the normal operating mode*

- Send command **AT#WAKE=0<cr>**
- wait for response **OK**

At the OK result code, the device will end alarm activity and enter normal operating mode. If the device was already in normal operating mode (alarm has started when the module was already ON), then with the command only the alarm activity is terminated.

### 3.7.2.3 Querying the Alarm status

When the device awakes by means of an alarm time expire, the module starts the alarm activity but not the network activity, permitting some operations to be done by the controlling application without registering the mobile in the network.
To check if the mobile is in the "alarm status" and therefore no network activity is done or if the device is in the normal operating status:

- Send command **AT#WAKE?<cr>**
- wait for response in the format:

**+WAKE: <status>**
**OK**

**where:**
**<status> is the operating mode:**
0 - normal operating mode
1 - alarm mode

***NOTE: if the device is in the alarm mode no network activity is done, therefore the only commands that are accepted are the #WAKE and #SHDN ones.***
***When in the alarm mode, no operation is allowed towards the network, therefore it is not possible to receive or send calls, SMS and whatever GSM/GPRS services.***

#### 3.7.2.3.1 Alarm operation example

For example:
1- Let's assume you have a battery powered device, a meteorological unit that measures every hour the conditions and therefore needs to send a new SMS every hour to the central server, for example indicating the whether status just measured. Let say your application shall consume the absolute minimum power to achieve the job, since it will be placed in a remote position where its battery shall last as long as possible and therefore it should shutdown completely and wake up every hour for just the time needed to measure & send the whether, successively shutdown.

- set up the time in the internal clock (only the first time..)
*command:*
AT+CCLK="02/11/07,12:24:30+01"<cr>
*response:*
OK

- set up the next alarm in order to raise the GPIO6 pin to power up the controlling application too.
*command:*
AT+CALA="02/11/07,13:24:30+01",0,6,"TIME TO MEASURE & SMS…!"<cr>
*response:*
OK
- shutdown the GC864-QUAD / PY and successively the controlling application.
*command:*
AT#SHDN<cr>
*response:*
OK

… after an hour..
The GC864-QUAD / PY will turn itself ON in "Alarm Mode" and contemporarily both rise the GPIO6 pin which turns on the power to the controlling application and issue every 3s an unsolicited code +ALARM: TIME TO MEASURE & SMS…!
- turn on the keep alive line in the controlling application that keeps itself ON.
- stop the alarm activity in the GC864-QUAD / PY (recognized by the +ALARM unsolicited code) and bring the GC864-QUAD / PY in operating mode
*command:*
AT#WAKE=0<cr>
*response:*
OK

- take the whether measure
- send the SMS with the whether data (see Sending a new SMS without storing it par. 3.5.5).

- read the current time.
*command:*
AT+CCLK?<cr>

*response:*
+CCLK="02/11/07,13:24:47"<cr>
OK

- calculate & set up the next alarm in order to raise the GPIO6 pin to power up the controlling application too.
*command:*
AT+CALA="02/11/07,14:24:47+01",0,6,"TIME TO MEASURE & SMS…!"<cr>
*response:*
OK
- shutdown the GC864-QUAD / PY and successively the controlling application.
*command:*
AT#SHDN<cr>
*response:*
OK

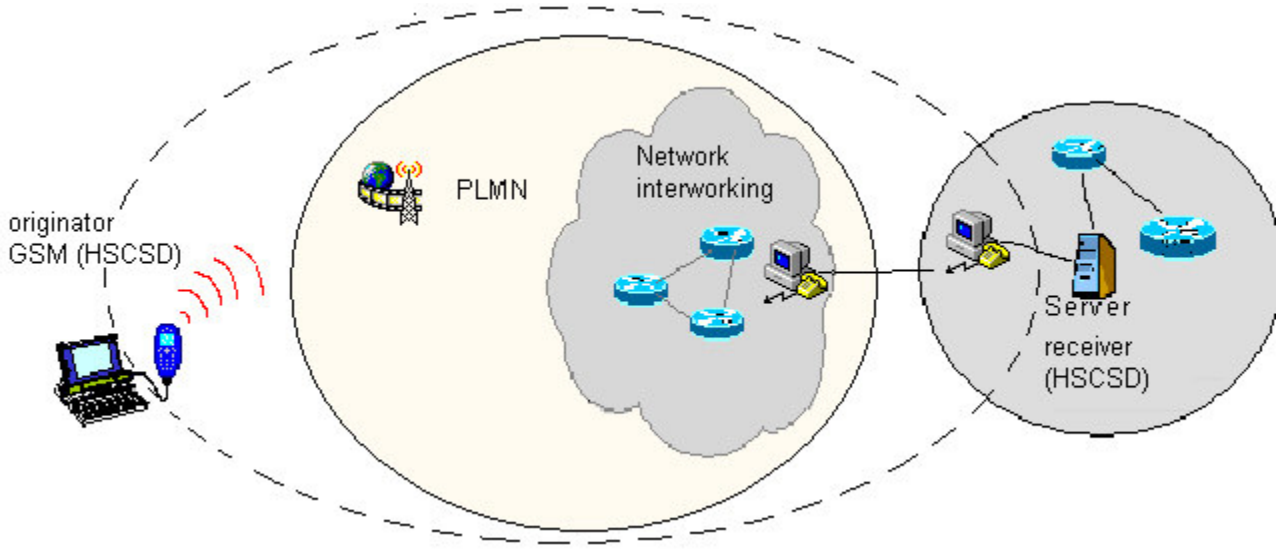
 

# 4 GPRS operations

## 4.1 Introduction

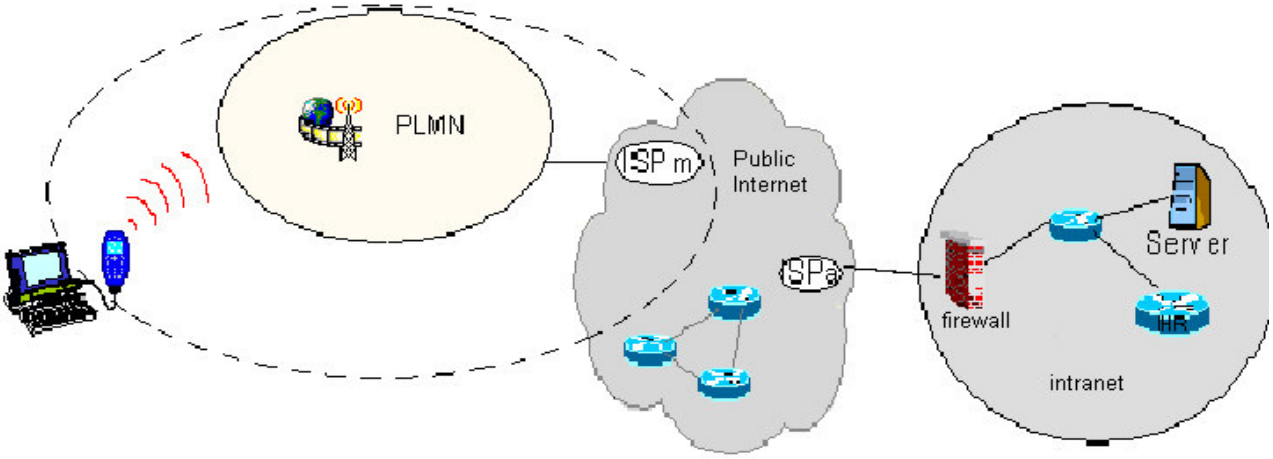
The General Packet Radio Services (GPRS) standard permits DATA transfers in a completely different way with respect to previous point to point communications made with Circuit Switch Data (CSD) GSM modems.
In CSD operations the modem establishes a connection with the other party (another modem) in such a way that all the Network devices in between are transparent to the data exchanged, simulating a real point to point connection, just as if the other party is directly connected with the controlling application of the modem. The other party can be either an Internet Service Provider (ISP) or a private server, but in any case, the arrival point must have a modem to connect to (Landline, ISDN or GSM CSD). The connection establishment procedure defines a particular path where all the information exchanged between the two peers flows and this path is reserved for exclusive use of these 2 peers for all the time the connection is active.
This approach has the drawbacks of a long time to set-up the link between the two peers (up to a minute) and a time counting bill which proceeds even if no data is exchanged because the path resources are reserved anyway; furthermore the speed of the data transfer is limited to 14400 bps.
An example of this kind of operation is shown in the following picture, where the point to point connection is between the two peers as if all the devices inside the dashed line are not present:




*CSD interconnectivity*

In GPRS operations instead, the connection is made directly towards internet as if the GPRS modem was a network IP socket interface. There's no data path reserved for the data exchange between the two peers, instead the resources are allocated dynamically on demand and the data exchanged is organized into packets typically TCP/IP, furthermore the maximum transfer speed can be much faster than GSM CSD.
An example of GPRS connection is shown in the following picture, where the GPRS connection is between the GPRS modem and the internet as if all the devices inside the dashed line are not present:




*GPRS interconnectivity*

Due to this kind of connection, when activating the GPRS connection you must provide the network parameters to enter through the internet point of the GPRS network ISP (Internet Service Provider) and not the phone number to be dialed; therefore it is not possible to establish a direct point to point GPRS connection between two modems as in CSD case, instead an internet tunneling must be done to achieve a point to point connection between two peers.

This approach as the immediate advantage of projecting the controlling application of the GPRS modem directly on the internet, ready to be accessed virtually from anywhere in the world at the same cost on the GPRS; actually the billing of the GPRS connection is based on the amount of data exchanged (number of packets transferred) independently from the time the connection is active or where these packet must be delivered. Therefore, it is possible to leave the controlling application always connected and ready to receive/send data on demand, while paying only for the data really exchanged.

The drawback of the GPRS connection is that the controlling application must have its own TCP/IP protocol stack embedded to decode the packets that arrive from GPRS and encode the ones to be sent through the internet.

There are few considerations than must be done on the GPRS connections:

- the GPRS connection speed with a GPRS class 10 multislot device is asymmetrical, 3 time slots in reception (43200 bps max) and 2 time slot in sending (28800 bps max).
- The controlling application of the module must have a TCP/IP - PPP software stack to interface with the GPRS modems.
- The controlling application must relay on some ISP that may be the Network Operator of the SIM to gain access to the internet through the GPRS connection.
- Because of the point before, the receiving application must have internet access either.
- Since the communication is based upon TCP/IP packets, then it is possible to talk contemporarily with more than one peer.
- When required, the data security in internet shall be guaranteed by security protocols over the TCP/IP that must be managed by the controlling application.

# 5 Service and firmware update

The Telit GC864 modules firmware can be updated through the same serial interface, which is used normally for the AT commands. Since the software group is continuously working, in order to improve the overall performances and introduce new features on the product, we suggest, in order to keep updated the module's firmware, to foreseen an external access to that interface with level converters to RS232, which allows connecting a Windows-based PC, since it is normally not possible to disconnect a GC864 module already soldered on the PCB of the application. It shall be possible to start the update procedure at POWER OFF condition of the module and then switch it ON to continue.

During the application development or evaluation phase of the GC864 module, the RS232 interface with the level converters or the USB port implemented on the **Telit Evaluation Kit EVK2** can be used to connect to a Windows-based PC on which the specific program for updating the Software (TFI) can be run.

## 5.1 Step-by-Step upgrade procedure

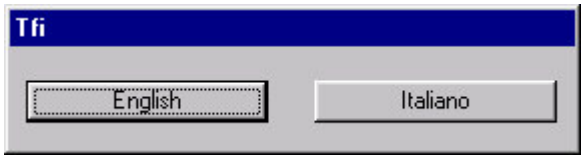
The firmware update can be done with a specific software tool provided by Telit that runs on Windows based PCs.

First the program will erase the content of flash memory, then the program will write on the flash memory. To update the firmware of the module, we suggest the following procedure:

1. Collect information about the Hardware and implemented version of Software by the command
   - AT+CGMR<enter>, which returns the Software version information;
   - AT+CGMM<enter>, which returns the Model Identification.

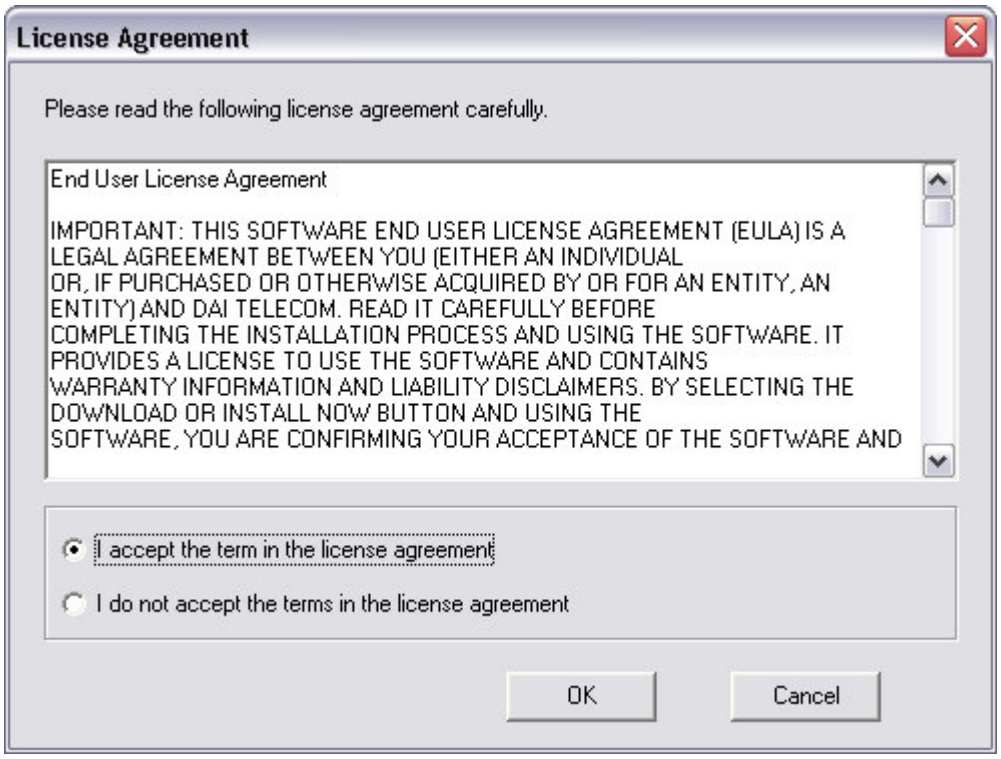
2. Switch OFF the module.

3. Run the file *TFI_xxxx.exe*. The following window should be displayed, Select the language preferred by pressing the correspondent button.




4. The End User License Agreement will appear. Please, read it and accept the terms if you are going to proceed.

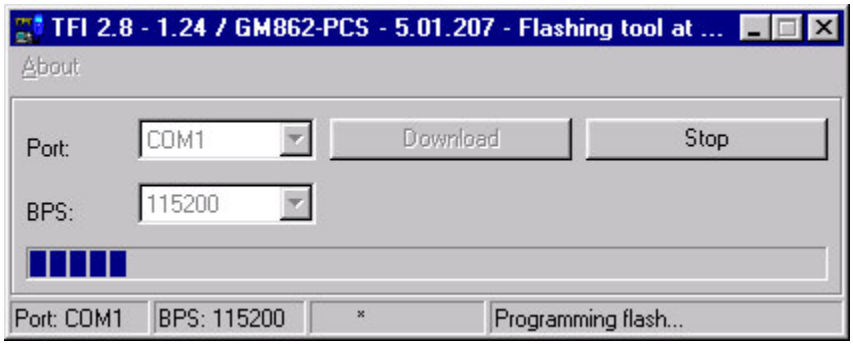



5. Press OK to the initial message.

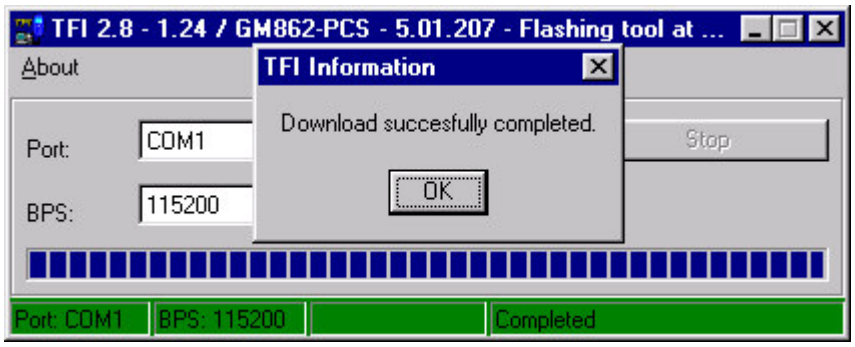

**NOTE**: In connection with the GC864 modules, charged battery has to be understood that the power supply must not be disconnected during the firmware update.

6. Select the right COM port and speed. Note that to go faster than 115200 you need a special hardware on the PC. Then Press the Download button and within 5 seconds power-on the GC864.




***Wait for the end of programming green message OK***




The **Telit GC864 module** is now programmed with the new firmware.

**NOTE**: the above pictures show how the application dialogs appear for the GM862 product. The GC864 TFI application will look similar.

# 6 Document Change Log

| Revision | Date | Changes |
|---|---|---|
| ISSUE #0 | 28/08/06 | First release |
| ISSUE #1 | 05/02/07 | Camera removed; GPRS removed; added Software and firmware update; added DTMF |
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