GE863-PRO^3
Hardware User Guide

1vv0300773 Rev. 6 -2010-09-20

Making machines talk.

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APPLICABLE PRODUCTS

PRODUCT
GE863-PRO^3

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1. Introduction

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1.1. Scope

The scope of this document is the description of some hardware solutions useful for developing a product with the **Telit GE863-PRO^3 module**.

This user guide serves the following purpose:

- Provides details about the **GE863-PRO^3** hardware integration.
- Describes how hardware developers may connect the **GE863-PRO^3** hardware resources and system peripherals, along with guidelines for electrical and thermal design.

1.2. Audience

This User Guide is intended for software developers who develop applications on the ARM processor of **GE863-PRO^3** module.

1.3. Contact Information, Support

For general contact, technical support, to report documentation errors and to order manuals, contact Telit Technical Support Center (TTSC) at:

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
TS-APAC@telit.com

Alternatively, use:
http://www.telit.com/en/products/technical-support-center/contact.php
For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:
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Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.
Telit appreciates feedback from the users of our information.

1.4. Text Conventions

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

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

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

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

1.5. Related Documents

The following documents are related to this user guide:

[1] TelitGE863PRO3 Product Description 1vv0300773a
[2] TelitGE863PRO3 EVK-GE863-PRO³ User Guide 1VV0300776
[3] Telit Audio Settings Application Note 80000nt10007a

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1.6. Document History

Revision	Date	Changes
ISSUE #0	2008-01-21	First release
ISSUE #1	2008-06-10	3.1 Ball-out updated 8 Audio Section updated 10 GSM/GPRS engine GPIO updated 11 – Power outputs added 12 - Mounting the GE863-PRO^3 on the Application Board – updated 13 - Conformity Assessment Issues updated
ISSUE #2	2008-11-04	Updated Pinout Updated ARM power consumption Updated 6.4 Electro Magnetic Interference – Guidelines Eliminated Packaging paragraph already present in Product Description 5.3 VRTC Backup supply updated with the new instruction how to use RTC
ISSUE #3	2008-12-12	Added new paragraph: 3.3.1. Pin Usage Recommendations Updated 5.1 GSM Power Supply Requirements
ISSUE #4	2009-08-03	Updated 10.4 RFTXMON output GPIO5 12.1.4 PCB pad Design: clarification on recommendations 5.1 Power supply requirements 8 Audio section 9 EVK-PRO3 Added 4.5 Wakeup ARM 5.4.1.5 SDIO and SPI guidelines
ISSUE #5	2010-04-12	Updated 3.1BALL-OUT Restyling, chapters shifted by one accordingly Updated paragraphs 4.3.1, 4.4 and 7.5 Corrected JTAGSEL reference voltage in the ball-out table Updated chapter 15 safety recommendations
ISSUE #6	2010-09-20	Corrected par.5 (missing ARM section)

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2. Overview

In this document all the basic functions of a M2M device 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 GE863-PRO^3 module**.

NOTE:

The integration of the GSM/GPRS GE863-PRO^3 cellular module within user application shall be done according to the design rules described in this manual.

The **GE863-PRO^3** module contains a fully featured GSM/GPRS communications section, compatible with the other Telit GSM/GPRS modules, but also incorporates a standalone ARM9 CPU and memories, dedicated to user applications.

This eliminates the need for an external host CPU in many applications, bringing true real-time and multi tasking capabilities to an embedded module.

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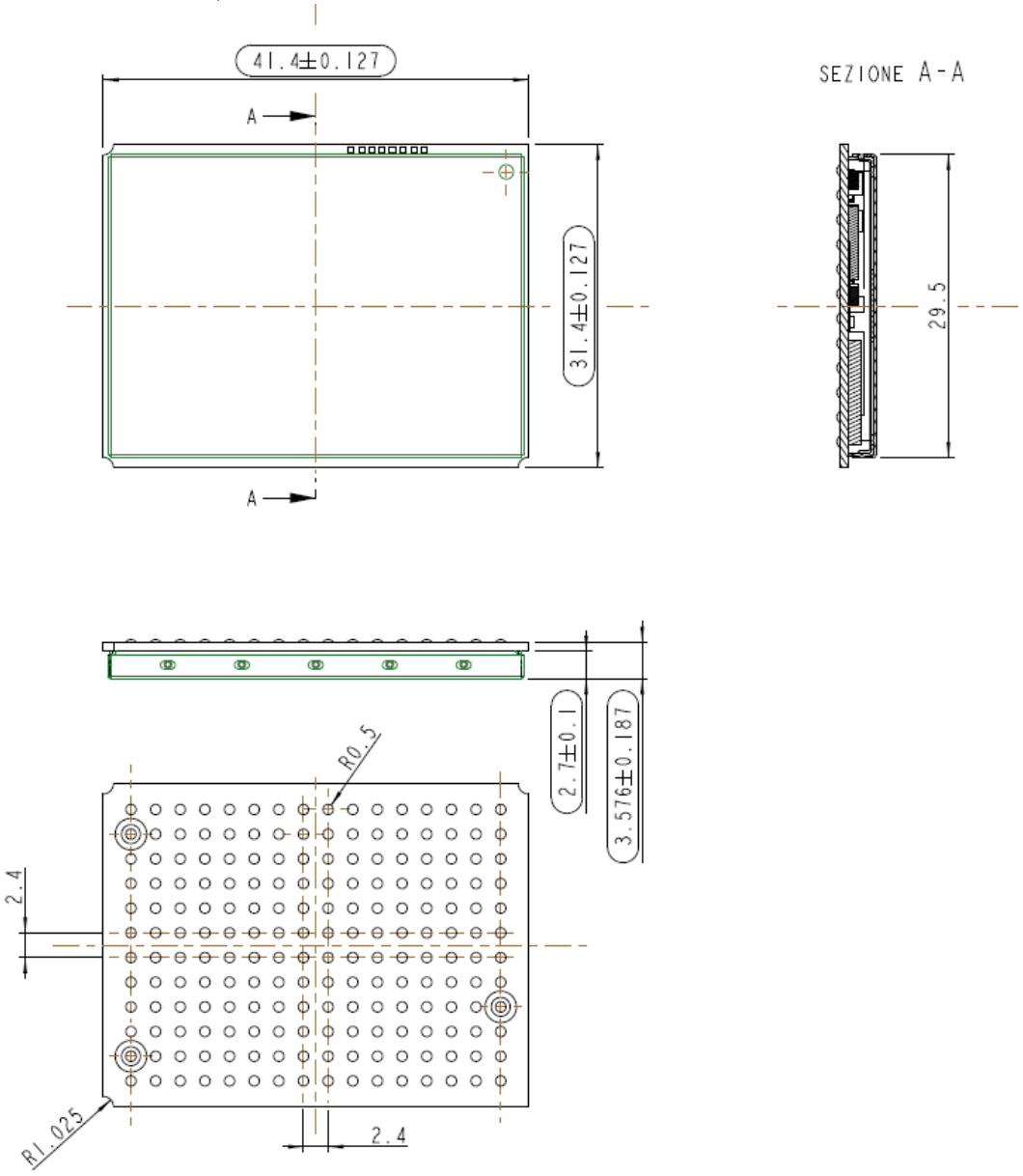
3. GE863-PRO^3 Mechanical Dimensions

The **Telit GE863-PRO^3 module** overall dimension are:

- Length: 41,4 mm
- Width: 31,4 mm
- Thickness: 3,6 mm



4. GE863-PRO^3 module connections

The GE863-PRO^3 features a 189 Balls Grid Array: in the following sections a description of the available signals and their position in the balls layout is presented.

4.1. BALL-OUT

Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
A1	RESERVED	-	RESERVED (3)	-	-	-
A2	GND	-	Ground	-	-	Power
A3	ANTENNA	O	GSM Antenna output - 50 ohm	-	GSM	RF
A4	RESERVED	-	RESERVED (3)	-	-	-
A5	GND	-	Ground	-	-	Power
A6	EAR_HF+	AO	Handsfree ear output, phase +		GSM	Audio
A7	EAR_HF-	AO	Handsfree ear output, phase -		GSM	Audio
A8	EAR_MT+	AO	Handset earphone signal output, phase -		GSM	Audio
A9	EAR_MT-	AO	Handset earphone signal output, phase +		GSM	Audio
A10	TX_TRACE	O	TX Data for Debug	-	GSM	CMOS 2.8V
A11	RX_TRACE	I	RX Data for Debug	-	GSM	CMOS 2.8V
A12	GND	-	Ground	-	-	Power
B1	RESERVED	-	RESERVED (3)	-	-	-
B2	GND	-	Ground	-	-	Power
B3	GND	-	Ground	-	-	Power
B4	GND	-	Ground	-	-	Power
B5	GND	-	Ground	-	-	Power
B6	MIC_HF+	AI	Handsfree microphone input; phase +		GSM	Audio
B7	MIC_HF-	AI	Handsfree microphone input; phase -		GSM	Audio
B8	MIC_MT+	AI	Handset microphone signal input; phase+		GSM	Audio
B9	MIC_MT-	AI	Handset microphone signal input; phase-		GSM	Audio
B10	GPIO7 / BUZZER	I/O	GPIO7 / BUZZER output		GSM	CMOS 2.8V

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Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
B11	STAT_LED	O	Status indicator led		GSM	CMOS 1.8V
B12	SIMIN	I/O	External SIM signal - Presence (active low)	47KΩ	GSM	CMOS 2.8V
C1	VBATT	-	Main GSM power supply		GSM	Power
C2	VBATT	-	Main GSM power supply		GSM	Power
C3	VRTC	AO	VRTC Backup capacitor		GSM-ARM	Power
C4	C125/RING	O	Output for Ring indicator signal (RI) to DTE		GSM	CMOS 2.8V
C5	C107/DSR	O	Output for Data set ready signal (DSR) to DTE		GSM	CMOS 2.8V
C6	C108/DTR	I	Input for Data terminal ready signal (DTR) from DTE		GSM	CMOS 2.8V
C7	C109/DCD	O	Output for Data carrier detect signal (DCD) to DTE		GSM	CMOS 2.8V
C8	C105/RTS	I	Input for Request to send signal (RTS) from DTE		GSM	CMOS 2.8V
C9	C106/CTS	O	Output for Clear to send signal (CTS) to DTE		GSM	CMOS 2.8V
C10	GPIO4/ RFTXDISABLE	I/O	GPIO4 / RFTXDISABLE		GSM	CMOS 2.8V
C11	SIMRST	O	External SIM signal – Reset		GSM	1.8/3V ONLY
C12	SIMIO	I/O	External SIM signal - Data I/O		GSM	1.8/3V ONLY
D1	CHARGE	AI	Charger input		GSM	Power
D2	VAUX1	-	Power output for external accessories		GSM	-
D3	RESERVED	-	RESERVED (3)	-	-	-
D4	PB25	I/O	ARM PIO Controller B pin 25		ARM	CMOS 3.1V
D5	PB22	I/O	ARM PIO Controller B pin 22		ARM	CMOS 3.1V
D6	PB24	I/O	ARM PIO Controller B pin 24		ARM	CMOS 3.1V
D7	PB23	I/O	ARM PIO Controller B pin 23		ARM	CMOS 3.1V
D8	PB26	I/O	ARM PIO Controller B pin 26		ARM	CMOS 3.1V
D9	PB27	I/O	ARM PIO Controller B pin 27		ARM	CMOS 3.1V
D10	GND	-	Ground	-	-	Power
D11	SIMVCC	-	External SIM signal – Power (2)		GSM	1.8/3V ONLY
D12	SIMCLK	O	External SIM signal – Clock		GSM	1.8/3V ONLY
E1	GND	-	Ground	-	-	Power
E2	PWRMON	O	Power ON Monitor		GSM	CMOS 2.8V
E3	RESERVED	-	RESERVED (3)	-	-	-

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Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
E4	ON/OFF*-GSM	I	Input command for switching power ON or OFF to GSM/GPRS Engine (toggle command).	47KΩ	GSM	Pull up to VBATT
E5	RESET*-GSM	I	GSM Engine Reset input		GSM	
E6	GPIO2 / JDR	I/O	GPIO2 Configurable general purpose I/O pin / Jammer Detect Output (2)		GSM	CMOS 2.8V
E7	GPIO6 - ALARM	I/O	GPIO6 Configurable general purpose I/O pin		GSM	CMOS 2.8V
E8	GPIO5 / RFTXMON	I/O	GPIO5 Configurable general purpose I/O pin /		GSM	CMOS 2.8V
E9	C103/TXD	I	Serial data input (TXD) from DTE		GSM	CMOS 2.8V
E10	C104/RXD	O	Serial data output to DTE		GSM	CMOS 2.8V
E11	PB8	I/O	ARM PIO Controller B pin 8		ARM	CMOS 3.1V
E12	PB9	I/O	ARM PIO Controller B pin 9		ARM	CMOS 3.1V
F1	PB13	I/O	ARM PIO Controller B pin 13		ARM	CMOS 3.1V
F2	PC30	I/O	ARM PIO Controller C pin 30		ARM	CMOS 1.8V-A
F3	PC21	I/O	ARM PIO Controller C pin 21		ARM	CMOS 1.8V-A
F4	PC28	I/O	ARM PIO Controller C pin 28		ARM	CMOS 1.8V-A
F5	PC29	I/O	ARM PIO Controller C pin 29		ARM	CMOS 1.8V-A
F6	NRST	I	RESET ARM	1 KΩ	ARM	CMOS 3.1V
F7	ON/OFF*-AP	I	Input command for turning power ON or OFF to ARM Engine (active high command).	47KΩ	ARM	Pull up to VBATT2
F8	SHDN	O	Shutdown Control Output	1.5MΩ	ARM	CMOS VRTC
F9	PB4	I/O	ARM PIO Controller B pin 4		ARM	CMOS 3.1V
F10	PB5	I/O	ARM PIO Controller B pin 5		ARM	CMOS 3.1V
F11	PC8	I/O	ARM PIO Controller C pin 8		ARM	CMOS 1.8V-A
F12	PC10	I/O	ARM PIO Controller C pin 10		ARM	CMOS 1.8V-A
G1	PB12	I/O	ARM PIO Controller B pin 12		ARM	CMOS 3.1V
G2	RESERVED	-	RESERVED (3)	-	-	-
G3	PC31	I/O	ARM PIO Controller C pin 31		ARM	CMOS 1.8V-A
G4	GPIO1 / PCMCLK	I/O	GPIO1 Configurable general purpose I/O pin	4.7KΩ	GSM	CMOS 2.8V
G5	GPIO9 / PCMWAO	I/O	GPIO9 Configurable general purpose I/O pin		GSM	CMOS 2.8V
G6	GPIO8 / PCMTX	I/O	GPIO8 Configurable general purpose I/O pin		GSM	CMOS 2.8V
G7	GPIO3 –	I/O	GPIO3 Configurable general		GSM	CMOS 2.8V

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Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
	PCMRX		purpose I/O pin			
G8	AP_WKUP	I	ARM Wake Up pin (4)(5)	100KΩ	ARM	CMOS VRTC
G9	PA5	I/O	ARM PIO Controller A pin 5		ARM	CMOS 3.1V
G10	PA4	I/O	ARM PIO Controller A pin 4		ARM	CMOS 3.1V
G11	PB10	I/O	ARM PIO Controller B pin 10		ARM	CMOS 3.1V
G12	PB11	I/O	ARM PIO Controller B pin 11		ARM	CMOS 3.1V
H1	PB6	I/O	ARM PIO Controller B pin 6		ARM	CMOS 3.1V
H2	PB29	I/O	ARM PIO Controller B pin 29		ARM	CMOS 3.1V
H3	GND	-	Ground	-	-	Power
H4	PB20	I/O	ARM PIO Controller B pin 20		ARM	CMOS 3.1V
H5	PB21	I/O	ARM PIO Controller B pin 21		ARM	CMOS 3.1V
H6	PB19	I/O	ARM PIO Controller B pin 19		ARM	CMOS 3.1V
H7	PB18	I/O	ARM PIO Controller B pin 18		ARM	CMOS 3.1V
H8	RESERVED	-	RESERVED (3)	-	-	-
H9	PC18	I/O	ARM PIO Controller C pin 18		ARM	CMOS 1.8V-A
H10	PB0	I/O	ARM PIO Controller B pin 0		ARM	CMOS 3.1V
H11	PB2	I/O	ARM PIO Controller B pin 2		ARM	CMOS 3.1V
H12	PB1	I/O	ARM PIO Controller B pin 1		ARM	CMOS 3.1V
J1	PB7	I/O	ARM PIO Controller B pin 7		ARM	CMOS 3.1V
J2	PB28	I/O	ARM PIO Controller B pin 28		ARM	CMOS 3.1V
J3	RESERVED	-	RESERVED (3)	-	-	-
J4	PB16	I/O	ARM PIO Controller B pin 16		ARM	CMOS 3.1V
J5	PB17	I/O	ARM PIO Controller B pin 17		ARM	CMOS 3.1V
J6	PC15	I/O	ARM PIO Controller C pin 15		ARM	CMOS 1.8V-A
J7	RESERVED	-	RESERVED (3)	-	-	-
J8	RESERVED	-	RESERVED (3)	-	-	-
J9	PC4	I/O	ARM PIO Controller C pin 4		ARM	CMOS 1.8V-A
J10	PC5	I/O	ARM PIO Controller C pin 5		ARM	CMOS 1.8V-A
J11	PC19	I/O	ARM PIO Controller C pin 19		ARM	CMOS 1.8V-A
J12	PC20	I/O	ARM PIO Controller C pin 20		ARM	CMOS 1.8V-A
K1	PA23	I/O	ARM PIO Controller A pin 23		ARM	CMOS 3.1V
K2	PA29	I/O	ARM PIO Controller A pin 29		ARM	CMOS 3.1V
K3	TMS	I	JTAG ARM - Test Mode Select	Pull Down	ARM	CMOS 3.1V
K4	TCK	I	JTAG ARM – Test Clock		ARM	CMOS 3.1V
K5	RTCK	O	JTAG ARM – Returned Test Clock		ARM	CMOS 3.1V
K6	PA25	I/O	ARM PIO Controller A pin 25		ARM	CMOS 3.1V

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Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
K7	RESERVED	-	RESERVED (3)	-	-	-
K8	PC6	I/O	ARM PIO Controller C pin 6		ARM	CMOS 1.8V-A
K9	PC7	I/O	ARM PIO Controller C pin 7		ARM	CMOS 1.8V-A
K10	PB3	I/O	ARM PIO Controller B pin 3		ARM	CMOS 3.1V
K11	HDMA	A	USB Host Port A Data -		ARM	USB
K12	HDPA	A	USB Host Port A Data +		ARM	USB
L1	PA24	I/O	ARM PIO Controller A pin 24		ARM	CMOS 3.1V
L2	OSCSEL	I	Slow Clock Oscillator Selection	Pull Down	ARM	CMOS VRTC
L3	NTRST	I	JTAG ARM - Test Reset	Pull Up	ARM	CMOS 3.1V
L4	TDI	I	JTAG ARM - Test Data Input		ARM	CMOS 3.1V
L5	TDO	O	JTAG ARM - Test Data Output		ARM	CMOS 3.1V
L6	JTAGSEL	I	JTAG ARM – JTAG Type Selection	Pull Down	ARM	CMOS VRTC
L7	PA28	I/O	ARM PIO Controller A pin 28		ARM	CMOS 3.1V
L8	PA27	I/O	ARM PIO Controller A pin 27		ARM	CMOS 3.1V
L9	PA26	I/O	ARM PIO Controller A pin 26		ARM	CMOS 3.1V
L10	GND	-	Ground	-	-	Power
L11	HDMB	A	USB Host Port B Data -		ARM	USB
L12	HDPB	A	USB Host Port B Data +		ARM	USB
M1	XIN32	I	Slow Clock Oscillator Input		ARM	CMOS VRTC
M2	XOUT32	O	Slow Clock Oscillator Output		ARM	CMOS VRTC
M3	RESERVED	-	RESERVED (3)	-	-	-
M4	RESERVED	-	RESERVED (3)	-	-	-
M5	PB14	I/O	ARM PIO Controller B pin 14		ARM	CMOS 3.1V
M6	PB15	I/O	ARM PIO Controller B pin 15		ARM	CMOS 3.1V
M7	PC22	I/O	ARM PIO Controller C pin 22		ARM	CMOS 1.8V-A
M8	PC9	I/O	ARM PIO Controller C pin 9		ARM	CMOS 1.8V-A
M9	PA3	I/O	ARM PIO Controller A pin 3		ARM	CMOS 3.1V
M10	PA2	I/O	ARM PIO Controller A pin 2		ARM	CMOS 3.1V
M11	PA1	I/O	ARM PIO Controller A pin 1		ARM	CMOS 3.1V
M12	PA0	I/O	ARM PIO Controller A pin 0		ARM	CMOS 3.1V
N1	PA11	I/O	ARM PIO Controller A pin 11		ARM	CMOS 3.1V
N2	PA10	I/O	ARM PIO Controller A pin 10		ARM	CMOS 3.1V
N3	PA9	I/O	ARM PIO Controller A pin 9		ARM	CMOS 3.1V
N4	PA31	I/O	ARM PIO Controller A pin 31		ARM	CMOS 3.1V
N5	PA30	I/O	ARM PIO Controller A pin 30		ARM	CMOS 3.1V
N6	PB31	I/O	ARM PIO Controller B pin 31		ARM	CMOS 3.1V

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Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
N7	GND	-	Ground	-	-	Power
N8	PC16	I/O	ARM PIO Controller C pin 16		ARM	CMOS 1.8V-A
N9	PC17	I/O	ARM PIO Controller C pin 17		ARM	CMOS 1.8V-A
N10	RESERVED	-	RESERVED (3)	-	-	-
N11	DDM	A	USB Device Port Data -		ARM	USB
N12	DDP	A	USB Device Port Data +		ARM	USB
P1	PA6	I/O	ARM PIO Controller A pin 6		ARM	CMOS 3.1V
P2	PA7	I/O	ARM PIO Controller A pin 7		ARM	CMOS 3.1V
P3	PA8	I/O	ARM PIO Controller A pin 8		ARM	CMOS 3.1V
P4	PC12	I/O	ARM PIO Controller C pin 12		ARM	CMOS 1.8V-A
P5	PB30	I/O	ARM PIO Controller B pin 30		ARM	CMOS 3.1V
P6	PC0	I/O	ARM PIO Controller C pin 0		ARM	CMOS 3.1V
P7	PC1	I/O	ARM PIO Controller C pin 1		ARM	CMOS 3.1V
P8	PC2	I/O	ARM PIO Controller C pin 2		ARM	CMOS 3.1V
P9	PC3	I/O	ARM PIO Controller C pin 3		ARM	CMOS 3.1V
P10	PA22	I/O	ARM PIO Controller A pin 22		ARM	CMOS 3.1V
P11	3.1V_OUT	OA	ARM 3.1V Power Output		ARM	-
P12	VBATT2	-	Main ARM Power Supply		ARM	Power
R1	GND	-	Ground	-	-	Power
R2	GND	-	Ground	-	-	Power
R3	GND	-	Ground	-	-	Power
R4	PA21	I/O	ARM PIO Controller A pin 21		ARM	CMOS 3.1V
R5	PA18	I/O	ARM PIO Controller A pin 18		ARM	CMOS 3.1V
R6	PA17	I/O	ARM PIO Controller A pin 17		ARM	CMOS 3.1V
R7	PA19	I/O	ARM PIO Controller A pin 19		ARM	CMOS 3.1V
R8	PA16	I/O	ARM PIO Controller A pin 16		ARM	CMOS 3.1V
R9	RESERVED	-	RESERVED (3)	-	-	-
R10	GND	-	Ground	-	-	Power
R11	GND	-	Ground	-	-	Power
R12	GND	-	Ground	-	-	Power
S1	RESERVED	-	RESERVED (3)	-	-	-
S2	RESERVED	-	RESERVED (3)	-	-	-
S3	GND	-	Ground	-	-	Power
S4	PA20	I/O	ARM PIO Controller A pin 20		ARM	CMOS 3.1V
S5	PA14	I/O	ARM PIO Controller A pin 14		ARM	CMOS 3.1V
S6	PA15	I/O	ARM PIO Controller A pin 15		ARM	CMOS 3.1V
S7	PA12	I/O	ARM PIO Controller A pin 12		ARM	CMOS 3.1V
S8	PA13	I/O	ARM PIO Controller A pin 13		ARM	CMOS 3.1V

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Ball	Signal	I/O	Main Function	Internal Pull up	ARM/ GSM	Type
S9	RESERVED	-	RESERVED (3)	-	-	-
S10	GND	-	Ground	-	-	Power
S11	RESERVED	-	RESERVED (3)	-	-	-
S12	RESERVED	-	RESERVED (3)	-	-	-

(1) For the exclusive use of the Technical Support Service
(2) On this pin a maximum of 10nF bypass capacitor is allowed.
(3) Reserved Pins must be left UNCONNECTED
(4) External Pull-UP not recommended: pin should be either left floating or tied low to ground
(5) This pin is available only on GE863-PRO^3 128/64 version

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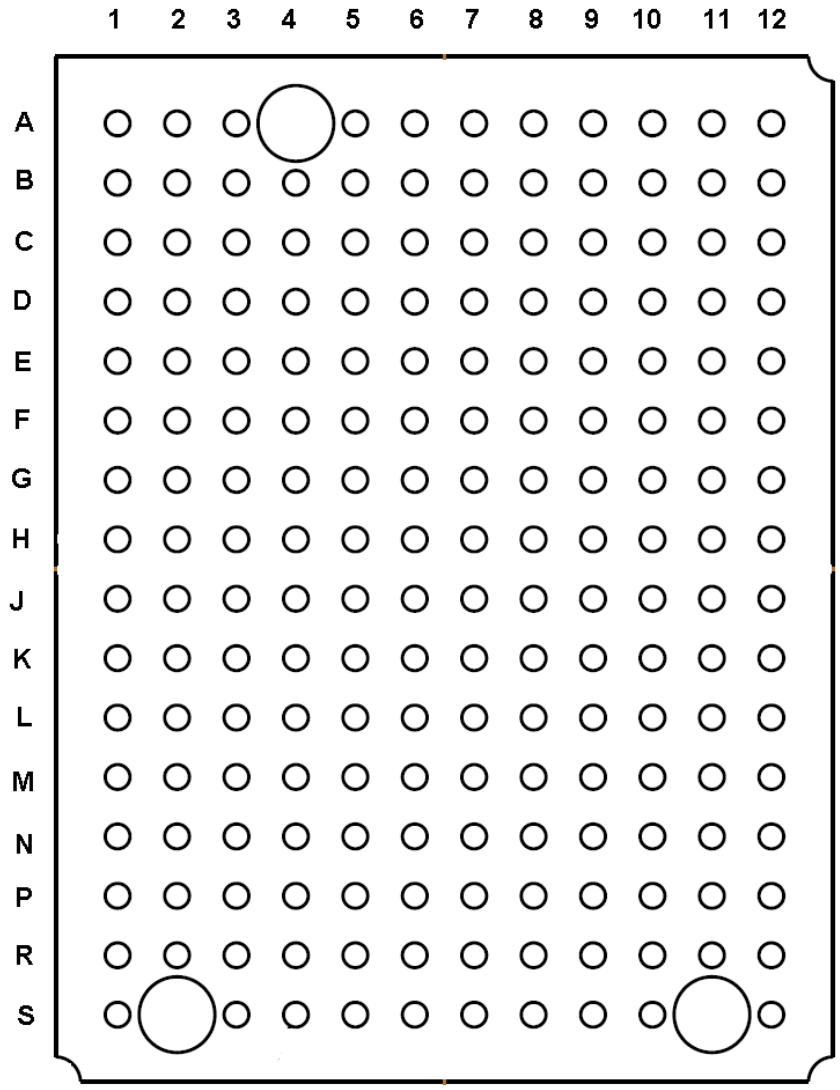
4.2. BALLS LAYOUT

TOP VIEW



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4.3. ARM Port IO multiplexing

ARM PIO Controller A multiplexing

IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
PA0	SPI0_MISO	MCDB0	Connected to internal dataflash SO (1)	I/O	SPI0_MISO
PA1	SPI0_MOSI	MCCDB	Connected to internal dataflash SI (1)	I/O	SPI0_MOSI
PA2	SPI0_SPCK		Connected to internal dataflash CLK (1)	I/O	SPI0_SPCK
PA3	SPI0_NPCS0	MCDB3		I/O	SPI0_NPCS0
PA4	RTS2	MCDB2		I/O	I with Pull-up
PA5	CTS2	MCDB1		I/O	I with Pull-up
PA6	MCDA0			I/O	I with Pull-up
PA7	MCCDA			I/O	I with Pull-up
PA8	MCCK			I/O	I with Pull-up
PA9	MCDA1			I/O	I with Pull-up
PA10	MCDA2	ETX2		I/O	I with Pull-up
PA11	MCDA3	ETX3		I/O	I with Pull-up
PA12	ETX0			I/O	I with Pull-up
PA13	ETX1			I/O	I with Pull-up
PA14	ERX0			I/O	I with Pull-up
PA15	ERX1			I/O	I with Pull-up
PA16	ETXEN			I/O	I with Pull-up
PA17	ERXDV			I/O	I with Pull-up
PA18	ERXER			I/O	I with Pull-

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IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
					up
PA19	ETXCK			I/O	I with Pull-up
PA20	EMDC			I/O	I with Pull-up
PA21	EMDIO			I/O	I with Pull-up
PA22	ADTRG	ETXER		I/O	I with Pull-up
PA23	TWD	ETX2		I/O	I with Pull-up
PA24	TWCK	ETX3		I/O	I with Pull-up
PA25	TCLK0	ERX2		I/O	I with Pull-up
PA26	TIOA0	ERX3		I/O	I with Pull-up
PA27	TIOA1	ERXCK		I/O	I with Pull-up
PA28	TIOA2	ECRS		I/O	I with Pull-up
PA29	SCK1	ECOL		I/O	I with Pull-up
PA30	SCK2	RXD4		I/O	I with Pull-up
PA31	SCK0	TXD4		I/O	I with Pull-up

ARM PIO Controller B multiplexing

IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
PB0	SPI1_MISO	TIOA3		I/O	I with Pull-up
PB1	SPI1_MOSI	TIOB3		I/O	I with Pull-up
PB2	SPI1_SPCK	TIOA4		I/O	I with Pull-up
PB3	SPI1_NPCS0	TIOA5		I/O	I with Pull-up

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IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
PB4	TXD0			I/O	I with Pull-up
PB5	RXD0			I/O	I with Pull-up
PB6	TXD1	TCLK1		I/O	I with Pull-up
PB7	RXD1	TCLK2		I/O	I with Pull-up
PB8	TXD2			I/O	I with Pull-up
PB9	RXD2			I/O	I with Pull-up
PB10	TXD3	ISI_D8		I/O	I with Pull-up
PB11	RXD3	ISI_D9		I/O	I with Pull-up
PB12	TXD5	ISI_D10		I/O	I with Pull-up
PB13	RXD5	ISI_D11		I/O	I with Pull-up
PB14	DRXD			I/O	DRXD
PB15	DTXD			I/O	DTXD
PB16	TK0	TCLK3		I/O	I with Pull-up
PB17	TF0	TCLK4		I/O	I with Pull-up
PB18	TD0	TIOB4		I/O	I with Pull-up
PB19	RD0	TIOB5		I/O	I with Pull-up
PB20	RK0	ISI_D0		I/O	I with Pull-up
PB21	RF0	ISI_D1		I/O	I with Pull-up
PB22	DSR0	ISI_D2		I/O	I with Pull-up
PB23	DCD0	ISI_D3		I/O	I with Pull-up
PB24	DTR0	ISI_D4		I/O	I with Pull-up

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IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
PB25	RI0	ISI_D5		I/O	I with Pull-up
PB26	RTS0	ISI_D6		I/O	I with Pull-up
PB27	CTS0	ISI_D7		I/O	I with Pull-up
PB28	RTS1	ISI_PCK		I/O	I with Pull-up
PB29	CTS1	ISI_VSYNC		I/O	I with Pull-up
PB30	PCK0	ISI_HSYNC		I/O	I with Pull-up
PB31	PCK1	ISI_MCK		I/O	I with Pull-up

ARM PIO Controller C multiplexing

IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
PC0	SCK3	AD0		I/O	I with Pull-up
PC1	PCK0	AD1		I/O	I with Pull-up
PC2	PCK1	AD2		I/O	I with Pull-up
PC3	SPI1_NPCS3	AD3		I/O	I with Pull-up
PC4	A23	SPI1_NPCS2		A23	I with Pull-up
PC5	A24	SPI1_NPCS1		A24	I with Pull-up
PC6	TIOB2	CFCE1		I/O	I with Pull-up
PC7	TIOB1	CFCE2		I/O	I with Pull-up
PC8	NCS4/CFCS0	RTS3		I/O	I with Pull-

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IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
					up
PC9	NCS5/CFCS1	TIOB0		I/O	I with Pull-up
PC10	A25/CFRNW	CTS3		A25	I with Pull-up
PC11	NCS2	SPI0_NPCS1	Connected to internal dataflash CS line NOT AVAILABLE on the Balls	I/O	SPI0_NPCS1
PC12	IRQ0	NCS7		I/O	I with Pull-up
PC13	FIQ	NCS6	NOT AVAILABLE on the Balls	I/O	I with Pull-up
PC14	NCS3/NANDCS	IRQ2	NOT AVAILABLE on the Balls	I/O	I with Pull-up
PC15	NWAIT	IRQ1		I/O	I with Pull-up
PC16	D16	SPI0_NPCS2		I/O	SPI0_NPCS2 with pull-up
PC17	D17	SPI0_NPCS3		I/O	SPI0_NPCS3 with pull-up
PC18	D18	SPI1_NPCS1		I/O	I with Pull-up
PC19	D19	SPI1_NPCS2		I/O	I with Pull-up
PC20	D20	SPI1_NPCS3		I/O	I with Pull-up
PC21	D21	EF100		I/O	I with Pull-up
PC22	D22	TCLK5		I/O	I with Pull-up
PC23	D23		Enable of 6MHz internal ARM Oscillator (active High) NOT AVAILABLE on the Balls	I/O	O HIGH
PC24	D24		NOT AVAILABLE on the Balls	I/O	-
PC25	D25		NOT AVAILABLE on the Balls	I/O	-
PC26	D26		NOT AVAILABLE on the Balls	I/O	-
PC27	D27		NOT AVAILABLE on the Balls	I/O	-
PC28	D28			I/O	I with Pull-up
PC29	D29		GPIO that goes High and can be	I/O	O HIGH

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IO line	Peripheral A	Peripheral B	Comments	Reset State	Boot State
			connected externally to keep ARM powered ON		
PC30	D30			I/O	I with Pull-up
PC31	D31			I/O	I with Pull-up

TIP:

For further documentation on ARM processor refer to ATMEL AT91SAM9260 datasheet

4.3.1. Pin Usage Recommendations

It is recommended to avoid using pins PC18, PC19 and PC20 as output or SPI_NPCSx, these pins can be replaced with either PC3, PC4 or PC5 for SPI_NPCS feature or any other GPIO for a general usage. If the two pins PC19, PC20 must be used as outputs, then it is recommended to configure them as OPEN DRAIN without internal pull-up but with an external pull-up to 1.8V. Furthermore, for better performances and noise response, we recommend avoiding the use of PC29, PC30 and PC31 signals.

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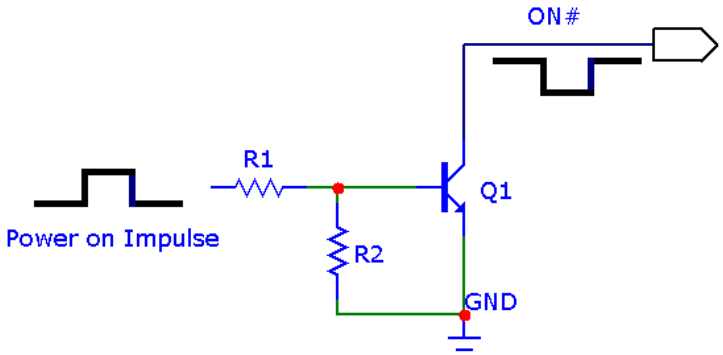
5. Hardware Commands

5.1. Turning ON the GE863-PRO^3 GSM

To turn on the GE863-PRO^3 the pad ON# must be tied low for at least 1 second 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:

Do not 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 GE863-PRO^3 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 GE863-PRO^3 turns fully on also by supplying power to the Charge pad (Module provided with a battery on the VBATT pads).

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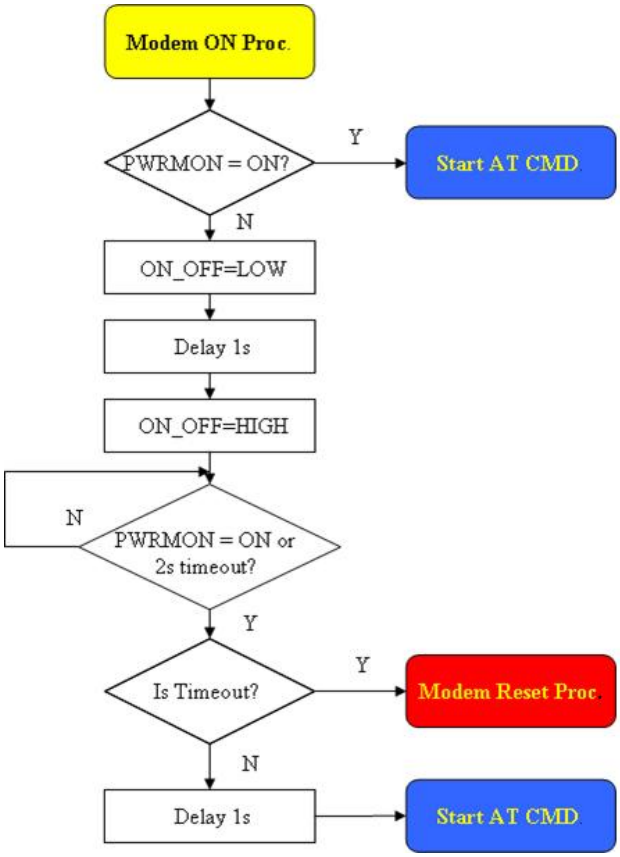
A flow chart showing the proper turn on procedure is displayed below:



TIP:

To check if the device has powered on, the hardware line PWRMON must be monitored. After 900ms the line raised up the device could be considered powered on.

PWRMON line rises up also when supplying power to the Charge pad

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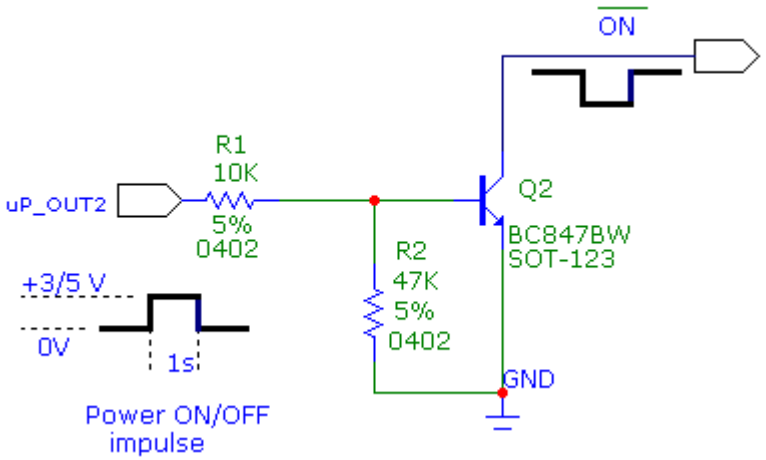
For example:

Let us assume you need to drive the ON# pad with a totem pole output of a +3/5 V micro controller (uP_OUT1):



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

5.2. Turning OFF the GE863-PRO^3 GSM

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

- via AT command (see GE863-PRO^3 Software User Guide)
- by tying low pin ON#

Either ways, when the device issues a detach request to the network informing that the device will not be reachable any more.
To turn OFF the GE863-PRO^3 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.

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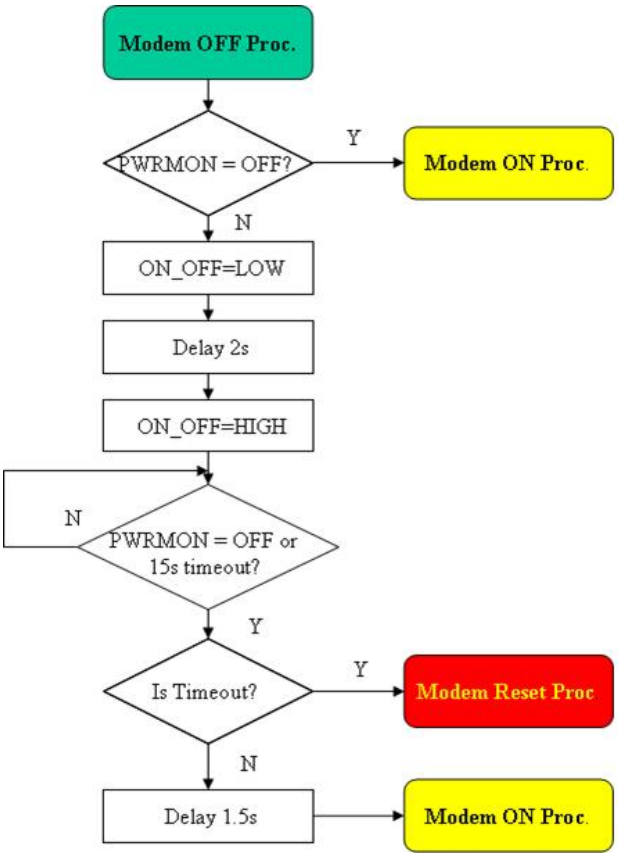

TIP:

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

5.2.1. Hardware Unconditional Restart

WARNING:

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

To unconditionally restart the GE863-PRO3, 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.

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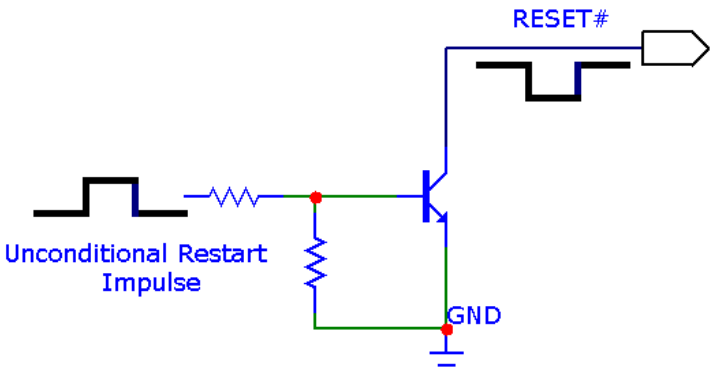
A simple circuit to do it is:



NOTE:

Do not 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 GE863-PRO^3 power regulator and improper functioning of the module. The line RESET# must be connected only in open collector configuration.

TIP:

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

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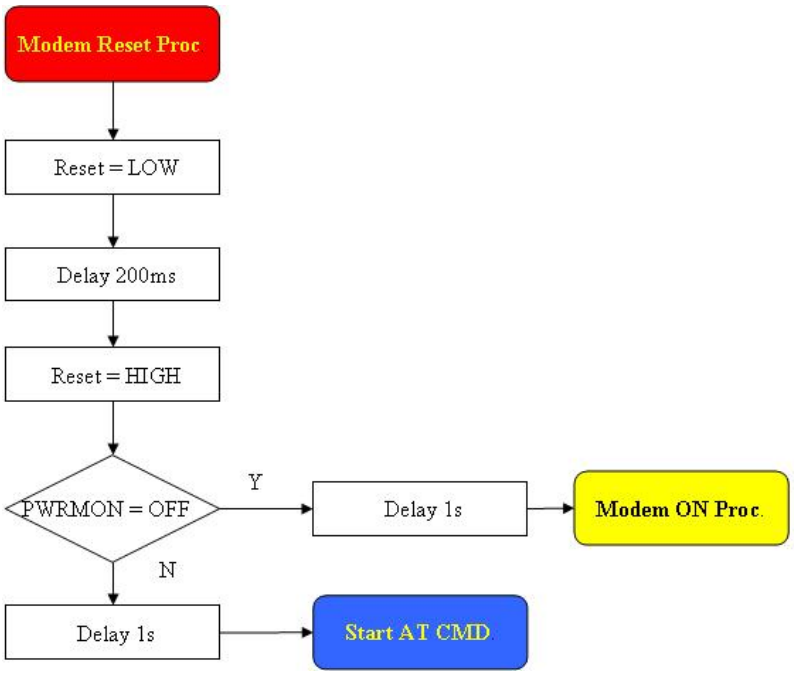
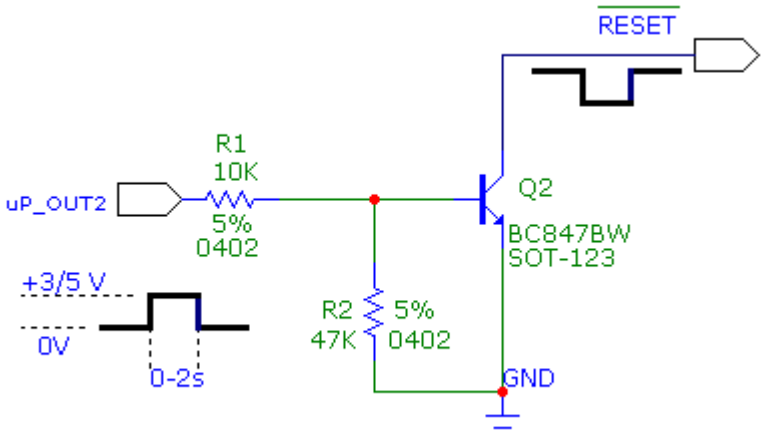
The following flow chart shows the proper Reset procedure:



For example:
Let us assume you need to drive the RESET# pad with a totem pole output of a +3/5 V microcontroller (uP_OUT2):

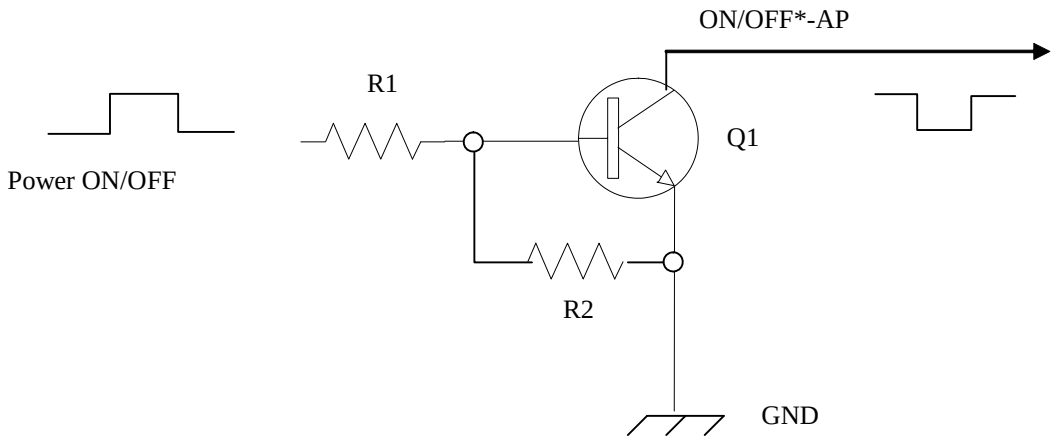


This signal is internally pulled up so the pin can be left floating if not used.

5.3. Turning ON/OFF the GE863-PRO3 ARM

To turn on the GE863-PRO3 ARM the pad ON/OFF*-AP must be tied low and kept low, when pin is raised (released) the ARM will shutdown.
The maximum current that can be drained from the ON/OFF*-AP pad is 0,1 mA.

A simple circuit to do it is:



NOTE: don't use any pull up resistor on the ON/OFF*ARM line, it is internally pulled up to VBATT2. Using pull up resistor may bring to latch up problems on the GE863-PRO3 power regulator and improper power on/off of the module. The line ON/OFF*-ARM must be connected only in open collector configuration or tied to ground (if ARM needs to stay always on).

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.

TIP: To check if the device has powered on, the hardware line 3.1V_OUT can be monitored.

It is possible to use also the SHDN line to turn ON the device with the ARM RTT trigger by connecting it to the ON/OFF*-ARM pin through a transistor buffer.
After the Initial bootstrap, the line PC29 goes HIGH allowing the device to keep itself on;

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If you need a toggle command to turn on/off the device, then you can use the line PC29 to keep the ARM on after it's start-up and connect the on/off button to the ON/OFF*ARM pin through a buffer transistor while connecting it to a GPIO to sense it's toggling (e.g. PC31) for shutting down the ARM by lowering the PC29 pin.

TIP: To Keep the ARM ON you can use the PC29 pin that goes high right after the bootstrap

5.4. Waking up the GE863-PRO^3 ARM (128/64 version only)

NOTE: This feature applies to GE863-PRO3 128 MB Flash + 64 MB SDRAM version On 4 MB Flash + 8 MB SDRAM and 4 MB Flash + 64 MB SDRAM versions, the pin shall be left disconnected.

To wake up the GE863-PRO^3 ARM the pad AP_WKUP* must be tied low, and it should be left floating in normal operations. Example schematics for wakeup signal driving can be found in §5.1.

TIP: For further documentation on ARM wakeup behavior please refer to ATMEL AT91SAM9260 datasheet

NOTE: don't use any pull up resistor on the ON/OFF*-GSM line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the GE863-PRO3 power regulator and improper power on/off of the module. The line ON/OFF*-GSM must be connected only in open collector configuration.

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6. 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.
In the GE863-PRO^3 the power supply inputs of the GSM/GPRS engine and the ARM processor part have been kept separate, VBATT is the input for the GSM part, VBATT2 is the input for ARM.
It is possible to connect together the two power inputs since they have compatible ranges, but if it is desired the two power supplies can be kept separate.
The only power supply in common between the ARM and GSM engine is the RTC voltage which is generated by the GSM/GPRS engine from VBATT power source and supplies both the GSM RTC and the ARM VDDBU part including the shutdown controller, RTT, 32 KHz oscillator. For this reason if it is planned to remove VBATT power supply, then a backup battery shall be provided on VTRC pin that guarantees that VRTC is still available.

NOTE:
if you plan to remove VBATT power source, then you must provide an appropriate backup battery/capacitor on the VRTC pin in order to be able to turn on properly the ARM part when supplying VBATT2 only power pin.

6.1. GSM Power Supply Requirements

POWER SUPPLY (SW release 7.02.xx4 or older)	
Nominal Supply Voltage	3.8 V
Normal Operating Voltage Range	3.4 V ÷ 4.2 V

POWER SUPPLY (SW release 7.03.x04 or newer)	
Nominal Supply Voltage	3.8 V
Normal Operating Voltage Range	3.4 V ÷ 4.2 V
Extended Operating Voltage Range	3.22 V ÷ 4.5 V

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NOTE:
The Operating Voltage Range MUST never be exceeded; care must be taken in order to fulfil min/max voltage requirement.

NOTE:
Overshoot voltage (regarding MAX Extended Operating Voltage) and drop in voltage (regarding MIN Extended Operating Voltage) MUST never be exceeded. The "Extended Operating Voltage Range" can be used only with completely assumption and application of the HW User guide suggestions.

GE863-PRO3 GSM Engine		
Mode	Average (mA)	Mode description
SWITCHED OFF		Module supplied but switched off
Switched Off	< 30 uA	
IDLE mode		
AT+CFUN=1	19.0	Normal mode: full functionality of the module
AT+CFUN=4	18.2	Disabled TX and RX; module is not registered on the network
AT+CFUN=0 or AT+CFUN=5	6.6	Paging Multiframe 2
	4.5	Paging Multiframe 4
	3.3	Paging Multiframe 6
	3.2	Paging Multiframe 8
	3.3	Paging Multiframe 9
CSD TX and RX mode		GSM voice call
GSM900 CSD PL5	325.0	
DCS1800 CSD PL0	302.2	
GPRS (class 10) 1TX		GSM Sending data mode
GSM900 CSD PL5	264.0	
DCS1800 CSD PL0	176.0	
GPRS (class 10) 2TX		GPRS Sending data mode
GSM900 CSD PL5	473.8	
DCS1800 CSD PL0	307.8	

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

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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.

6.2. ARM Power Supply Requirements

POWER SUPPLY	
Nominal Supply Voltage	3.8 V
Operating Supply voltage range	3.4 V - 4.2 V
Absolute Maximum voltage range	3.30 – 4.5 V

GE863-PRO3		
Mode	Typical Average (mA)	Mode description
Off	2 µA	
Full Speed	87	ARM is operational at full speed 200MHz CPU Clock , Main Clock 100 MHz and all peripherals active
Slow Clocking	< 1	ARM is running on slow clock with peripherals disabled

6.3. VRTC Backup supply

The RTC of the GPRS Engine and the RTT & Shutdown controller of the ARM part are supplied by VRTC. This voltage supply is generated by a low quiescent current regulator inside the module that takes its power from VBATT pins. Since this voltage supply is needed to correctly boot the ARM part, if it is planned to remove the VBATT supply and still turn on the ARM part supplied by VBATT2, then an appropriate power supply must be provided to the VRTC pin.
NO Devices must be powered from this pin

To obtain several working years for the Real Time Clock of the GSM/GPRS engine and the RTT[1], 32KHz oscillator & Shutdown controller of the ARM part without VBATT power

[1] For the uboot ver previous to 19.00.0000 ARM RTT will start from the zero on every boot; for this reason we recommend to use GSM RTC

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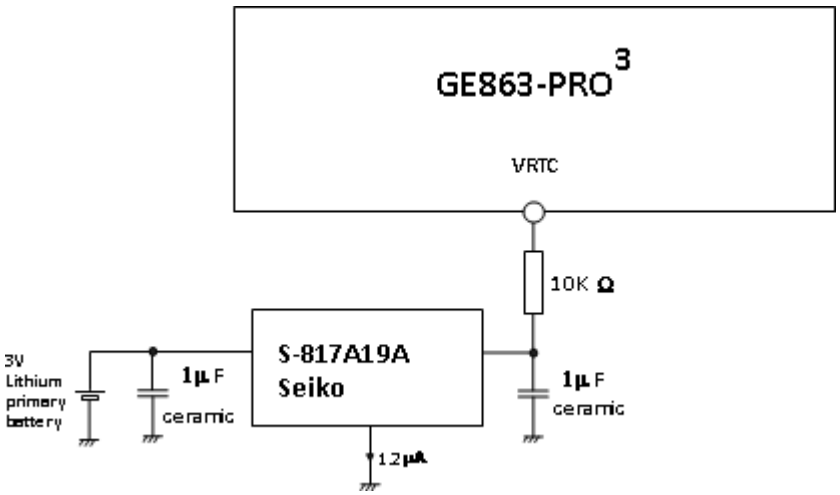
supply voltage, it is needed to make use of a lithium primary battery to supply the RTC circuits in the Telit Module.

The operative voltage for VRTC is lower than the voltage of primary lithium battery (3V nominal).
It is therefore necessary to put a LDO voltage regulator in the circuit.
The suggested circuit is:



The quoted current intensity is without VBATT power supply for the module.
The S-817A19A Seiko LDO has a value of **1.2µA Typ** for the quiescent current. Without VBATT power supply voltage, the VRTC Reverse Current is **7- 8 µA Typ**. (depending on OSCSEL pin status)
At ambient temperature 20°C, the BR2032 coin type (Panasonic 190 mAh) should be sufficient for 2-3 years with **typical current intensity**. The CR2032 coin type Panasonic 220 mAh) has an improved behaviour at low and high temperatures.
When the VBATT voltage is present, the VRTC voltage exceeds the S-817 output voltage, so the current from the Lithium Primary Battery is only **1.2µA Typ (or less)**.

NOTE:

the 2-3 years are given considering the worst case (VBATT always off)

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6.4. General Design Rules

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

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

6.4.1. Electrical design Guidelines

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

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

6.4.1.1. + 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 GE863-PRO3, 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 GE863-PRO3 from power polarity inversion.

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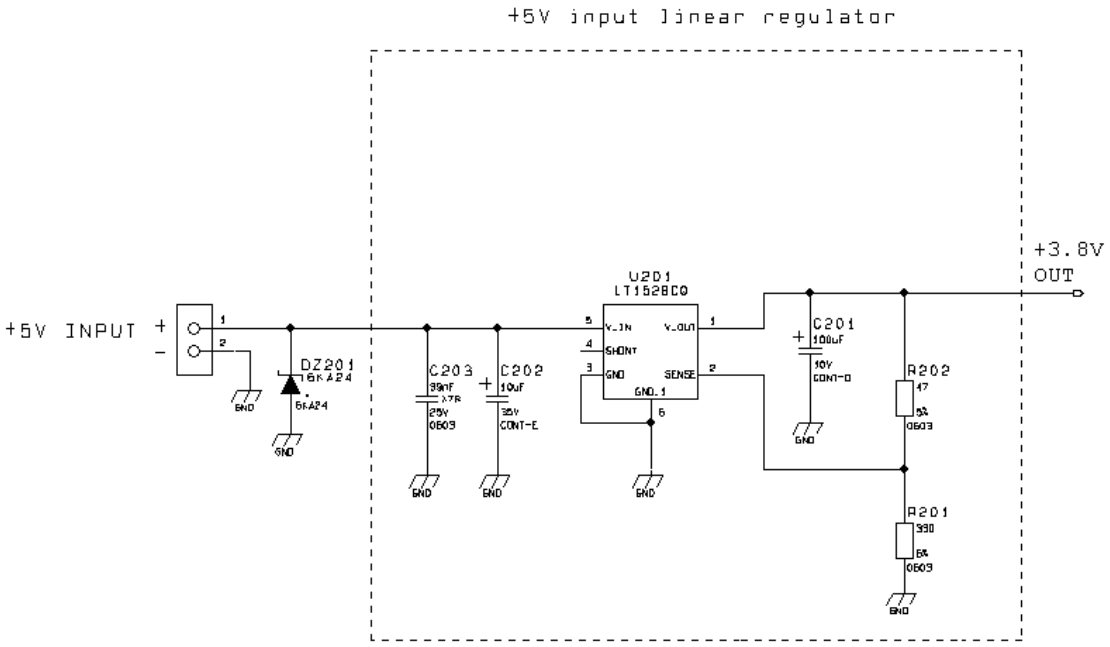
An example of linear regulator with 5V input is:



6.4.1.2. + 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 GE863-PRO^3.
- 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.

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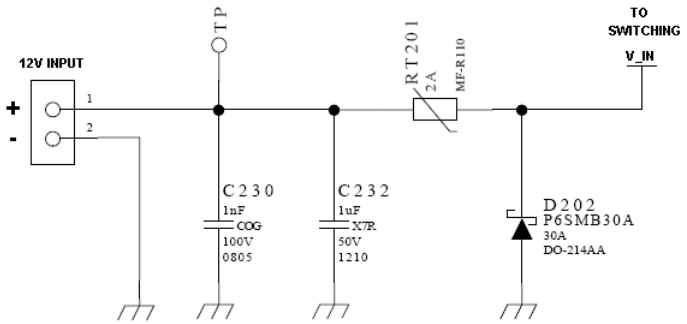
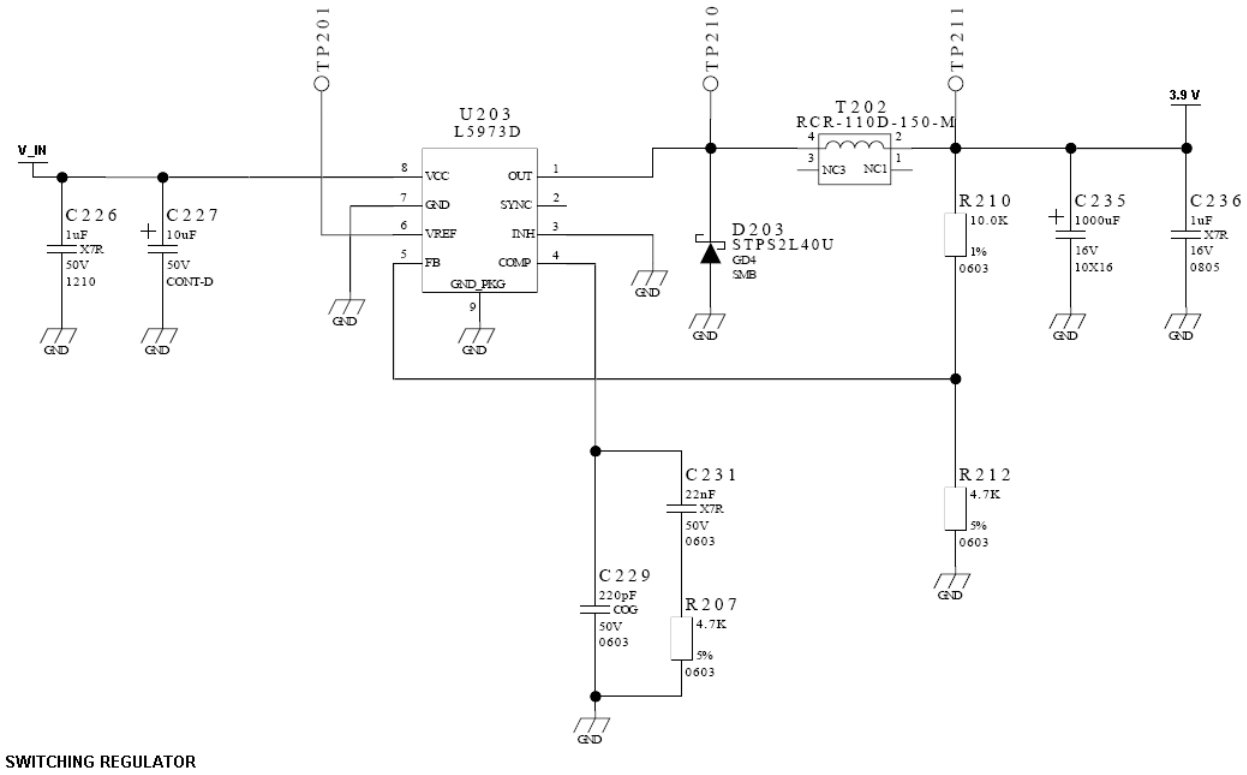
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode should be inserted close to the power input, in order to clean the supply from spikes.
- A protection diode should be inserted close to the power input, in order to save the GE863-PRO^3 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

6.4.1.3. 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 GE863-PRO^3 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 GE863-PRO^3 and damage it.

NOTE:

DON'T USE any Ni-Cd, Ni-MH, and Pb battery types directly connected with GE863-PRO^3. Their use can lead to overvoltage on the GE863-PRO^3 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.

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- A protection diode should be inserted close to the power input, in order to save the GE863-PRO^3 from power polarity inversion. Otherwise the battery connector should be done in a way to avoid polarity inversions when connecting the battery.
- The battery capacity must be at least 500mAh in order to withstand the current peaks of 2A; the suggested capacity is from 500mAh to 1000mAh.

6.4.1.4. 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. GE863-PRO^3 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

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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 GE863-PRO^3 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, GE863-PRO^3 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 GE863-PRO^3 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 GE863-PRO^3 all thresholds 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.

There is also the possibility to activate the normal mode using the ON_OFF* signal.

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In this case, when HW powering off the module with the same line (ON_OFF*) and having the charger still connected, the module will go back to CFUN4.

6.4.1.5. SPI and SDIO Design Guidelines

In order to avoid interferences it is recommended to insert in series 22kΩ 5% resistors to the lines of SDIO and SPI buses, specified below:

SDIO
- MCCDA
- MCCK
- MCDA0
- MCDA1
- MCDA2
- MCDA3

SPI0
- SPI0_MISO
- SPI0_MOSI
- SPI0_CLK

SPI1
- SPI1_MISO
- SPI1_MOSI
- SPI1_CLK

For example schematics please refer to **Error! Reference source not found.**

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6.4.2. 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:
  4mA
- Average current during idle (Power Saving disabled)
  60mA
- Average current consumption of ARM@ full speed
  130mA

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 GE863-PRO^3, 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 GE863-PRO^3; you must ensure that your application can dissipate it.

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6.4.3. 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 GE863-PRO^3 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 GE863-PRO^3 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 a minimum voltage drop 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 GE863-PRO^3, then this noise is not so disturbing and power supply layout design can be more forgiving.
- The PCB traces to the GE863-PRO^3 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.

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7. 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.

7.1. GSM Antenna Requirements

The antenna and antenna line on PCB for a Telit GE863-PRO^3 device shall fulfil the following requirements:

ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth	70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz PCS band
Gain	Gain < 3dBi
Impedance	50 Ω
Input power	> 2 W peak power
VSWR absolute max	<= 10:1
VSWR recommended	<= 2:1

When using the Telit GE863-PRO^3, since there's no antenna connector on the module, the antenna must be connected to the GE863-PRO^3 through the PCB with the antenna pad using a 50 Ω transmission line.

In the case that the antenna is not directly developed on the same PCB, hence directly connected at the antenna pad of the GE863-PRO^3, then a PCB line is needed in order to connect with it or with its connector.

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This line of transmission shall fulfil the following requirements:

ANTENNA LINE ON PCB REQUIREMENTS	
Impedance	50 ohm
Max Attenuation	0,3 dB
No coupling with other signals allowed	
Cold End (Ground Plane) of antenna shall be equipotential to the GE863-PRO3 ground pins	

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. OEM integrators must ensure that the end user has no manual instructions to remove or install the GE863-PRO3 module. Antennas used for this OEM module must not exceed 3dBi gain for mobile and fixed operating configurations.

7.2. GSM Antenna - PCB line Guidelines

- Ensure that the antenna line impedance is 50 ohm;
- Keep the antenna line on the PCB as short as possible, since the antenna line loss shall be less than 0,3 dB;
- Antenna line must have uniform characteristics, constant cross section, avoid meanders and abrupt curves;
- Keep, if possible, one layer of the PCB used only for the Ground plane;
- Surround (on the sides, over and under) the antenna line on PCB with Ground, avoid having other signal tracks facing directly the antenna line track;
- The ground around the antenna line on PCB has to be strictly connected to the Ground Plane by placing vias once per 2mm at least;
- Place EM noisy devices as far as possible from GE863-PRO3 antenna line;
- Keep the antenna line far away from the GE863-PRO3 power supply lines;
- If you have EM noisy devices around the PCB hosting the GE863-PRO3, such as fast switching ICs, take care of the shielding of the antenna line by burying it inside the layers of PCB and surround it with Ground planes, or shield it with a metal frame cover.
- If you don't have EM noisy devices around the PCB of GE863-PRO3 , by using a strip-line on the superficial copper layer for the antenna line, the line attenuation will be lower than a buried one;

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7.3. GSM Antenna - installation Guidelines

- Install the antenna in a place covered by the GSM signal.
- The Antenna must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter;
- Antenna shall not be installed inside metal cases
- Antenna shall be installed also according Antenna manufacturer instructions.

7.4. Electro Magnetic Interference - Guidelines

The GE863-PRO^3 has been particularly designed in order to keep to a minimum the Electro Magnetic Interferences between the ARM part and the GSM/GPRS engine, however especially the ARM part remains a noisy device that must be threaten with care in order to avoid that its EMI affect the GPRS part through an external coupling.

Therefore:

- Keep fast ARM lines far away from Antenna line in order to avoid direct coupling;
- Keep fast ARM lines buried in the inner layers, with Ground Layers [fenced with vias] on the top/bottom layers;
- If your lines are long, place a series resistor [in the range of 47Ω – 1KΩ] close to the GE863-PRO^3 ARM ball to reduce the ringing and the EM emissions of the signal
- If your PCB lines are very long, place a terminator resistor close to the device line end.

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7.5. 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 GE863-PRO^3** interface circuits:

Absolute Maximum Ratings -Not Functional

Parameter	Min	Max
Input level on any digital pin when on	-0.3V	+3.6V
Input voltage on analog pins when on	-0.3V	+3.0 V
Voltage on Buffered pins	-0.3V	25V

Operating Range - Interface levels (CMOS 2.8V)

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

Operating Range - Interface levels (CMOS 1.8V)

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

Operating Range - Interface levels (CMOS 3.1V)

Level	Min	Max
Input high level	2.0V	3.4V
Input low level	-0.3V	0.8V
Output high level	2.7V	3.2V
Output low level	0V	0.4V

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Operating Range - Interface levels (CMOS 1.8V-A)

Level	Min	Max
Input high level	1.26V	2.1V
Input low level	-0.3V	0.54V
Output high level	1.35V	1.9V
Output low level	0V	0.45V

Operating Range - Interface levels (CMOS VRTC)
T_A=25°C, unless otherwise specified

Level	Conditions	Min	Max
Input high level	Internal VRTC source	1.3V	1.8V
	External 1.9V VRTC source applied	1.3V	1.7V
Input low level		-0.3V	0.5V
Output high level	Internal VRTC source	1.4V	1.8V
	External 1.9V VRTC source applied	1.3V	1.7V
Output low level		0V	0.4V

GSM GPIO Current characteristics

Level	Typical
Output Current	1mA
Input Current	1uA

CMOS 3.1V Current characteristics

Level	Typical
Max Output Current	16 mA
Input Current	1uA

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CMOS 1.8V-A Current characteristics

Level	Typical
Max Output Current	4 mA
Input Current	1uA

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7.5.1. GSM Reset signal

Signal	Function	I/O	Bga Ball
RESET*-GSM	Phone reset	I	E5

RESET*-GSM is used to reset the **GE863-PRO3**. Whenever this signal is pulled low, the GSM/GPRS engine is reset. When the device is reset it stops any operation. After the release of the reset the GSM/GPRS engine 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/GPRS 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*-GSM 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 **GE863-PRO3**. Use the ON/OFF*-GSM 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.

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8. Serial Ports

The serial port on the Telit GE863-PRO3 is the core of the interface between the module engine and the ARM processor.

2 serial ports are available on the module engine:

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

6+1(DBG) serial ports are available on the ARM part.

No direct connection is present between the two parts, on the hosting PCB the two serial ports need to be interconnected. It is up to the user to select whatever serial port is most suited on the ARM part to exchange data with the GSM/GPRS engine; however the USART0 port on the ARM is the only supporting the full RS232 line signaling and should be preferred.

In the ball-out of the GE863-PRO3 the balls of the MODEM SERIAL port and ARM USART0 are placed one next the other, allowing an easy routing of the connection.

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 – 3.1V (Universal Asynchronous Receive Transmit)

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 – 3.1V UART and hence the GE863-PRO3 GSM/GPRS engine can be directly connected with the ARM serial port @ 3.1V CMOS.
The serial port on the GE863-PRO3 GPRS engine is a +2.8V UART with all the 7 RS232 signals, While the serial ports on the ARM part are +3.1V UART.
GE863-PRO3 serial ports differ from the PC-RS232 in the signal polarity (RS232 is reversed) and levels. The levels for the GE863-PRO3 UART are the CMOS levels:

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The signals of the GE863-PRO3 GSM/GPRS engine serial port are:

RS232 Pin Number	Signal	GE863-PRO3 Ball	Name	Usage
1	DCD - dcd_uart	C7	Data Carrier Detect	Output from the GE863-PRO3 GSM/GPRS engine that indicates the carrier presence
2	RXD - tx_uart	E10	Transmit line *see Note	Output transmit line of GE863-PRO3 GSM/GPRS engine
3	TXD - rx_uart	E9	Receive line *see Note	Input receive of the GE863-PRO3 GSM/GPRS engine
4	DTR - dtr_uart	C6	Data Terminal Ready	Input to the GE863-PRO3 GSM/GPRS engine that controls the DTE READY condition
5	GND	All GND	Ground	Ground
6	DSR - dsr_uart	C5	Data Set Ready	Output from the GE863-PRO3 GSM/GPRS engine that indicates the module is ready
7	RTS - rts_uart	C8	Request to Send	Input to the GE863-PRO3 GSM/GPRS engine that controls the Hardware flow control
8	CTS - cts_uart	C9	Clear to Send	Output from the GE863-PRO3 GSM/GPRS engine that controls the Hardware flow control
9	RI - ri_uart	C4	Ring Indicator	Output from the GE863-PRO3 GSM/GPRS engine that indicates the incoming call condition

NOTE:
According to V.24, RX/TX signal names are referred to the application side, therefore on the GE863-PRO3 GSM/GPRS engine side these signal are on the opposite direction: TXD on the ARM application side will be connected to the receive line (here named TXD/ rx_uart) of the GE863-PRO3 GSM/GPRS engine 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.

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8.2. RS232 level translation

In order to interface the Telit GE863-PRO^3 with a PC com port or a RS232 (EIA/TIA-232) application a level translator is required. This level translator must

- invert the electrical signal in both directions
- change the level from 0/3V to +15/-15V

Actually, the RS232 UART 16450, 16550, 16650 & 16750 chipsets accept signals with lower levels on
the RS232 side (EIA/TIA-562) , allowing for a lower voltage-multiplying ratio on the level translator. Note that the negative signal voltage must be less than 0V and hence some sort of level translation is always required.
The simplest way to translate the levels and invert the signal is by using a single chip level translator. There are a multitude of them, differing in the number of driver and receiver and in the levels (be sure to get a true RS232 level translator not a RS485 or other standards).
By convention the driver is the level translator from the 0-3V UART level to the RS232 level, while the receiver is the translator from RS232 level to 0-3V UART.

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

- 5 driver
- 3 receiver

NOTE:
The digital input lines working at 2.8V/3.1VCMOS 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 / +3.1V (dedicated or 3.1V_OUT) power supply.
This is because in this way the level translator IC outputs on the module side (i.e. GE863-PRO^3 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 GE863-PRO^3 GPRS firmware, the serial port on the Telit GE863-PRO^3 shall be available for translation into RS232 and either it's controlling ARM 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*-GSM 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 GE863-PRO^3.

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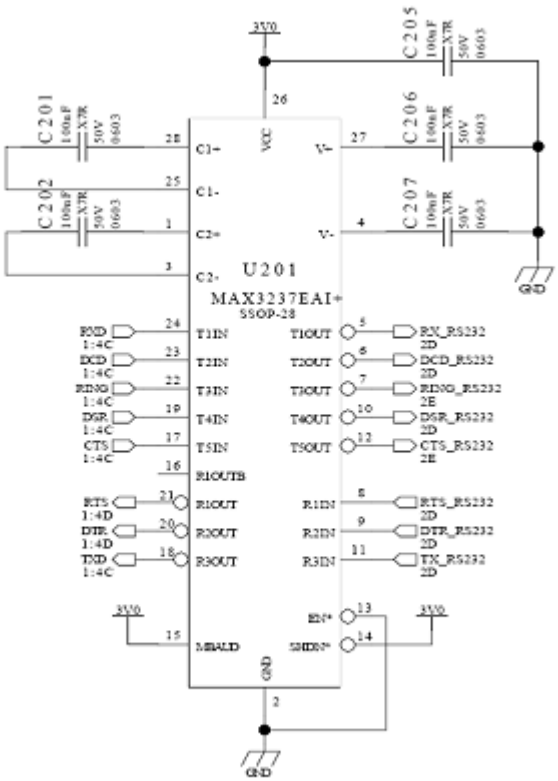
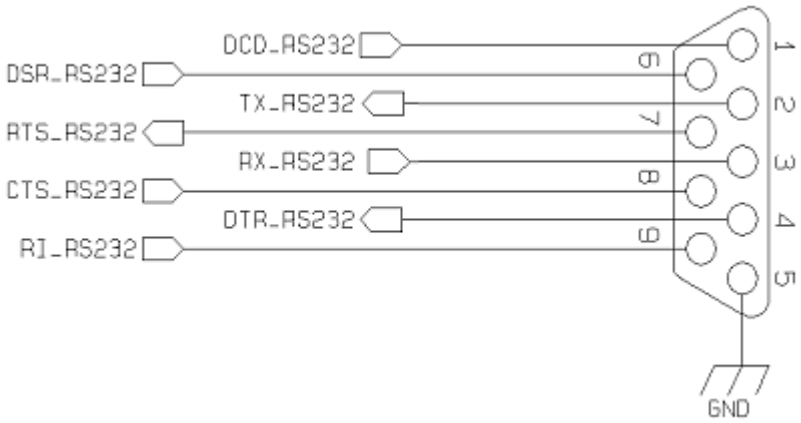
NOTE:
In order to be able to do in circuit reprogramming of the GE863-PRO^3 ARM Application software, the serial port DEBUG on the Telit GE863-PRO^3 shall be available for translation into RS232 when module reprogramming occurs.
Only DRXD, DTXD, GND and the On/off*-AP module turn on pad are required to the reprogramming of the module, the other lines are unused.
All applicator shall include in their design such a way of reprogramming the GE863-PRO^3.

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:



9. Audio Section Overview

The Baseband chip of GE863-PRO^3 was developed for the cellular phones, which needed two separated amplifiers both in RX and in TX section.
A couple of amplifiers had to be used with internal audio transducers while the other couple of amplifiers had to be used with external audio transducers.
To distinguish the schematic signals and the Software identifiers, two different definitions were introduced, with the following meaning:

- internal audio transducers HS/MT (from HandSet or MicroTelephone):
- external audio transducers HF (from HandsFree)

Actually the acronyms have not the original importance.
In other words this distinction is not necessary, being the performances between the two blocks like the same.
Only if the customer needs higher output power to the speaker , he has a constraint. Otherwise the choice could be done in order to overcome the PCB design difficulties.
For these reasons we have not changed the HS and HF acronyms, keeping them in the Software and on the schematics.
The Base Band Chip of the GE863-PRO^3 Telit Module maintains the same architecture.
For more information refer to Telit document **Error! Reference source not found.**.

9.1.1. Selection mode

Only one block can be active at a time , and the activation of the requested audio path is done via hardware by AXE line or via software by *AT#CAP* command .
Moreover the *sidetone* functionality could be implemented by the amplifier fitted between the transmit path and the receive path, enabled at request in both modes.

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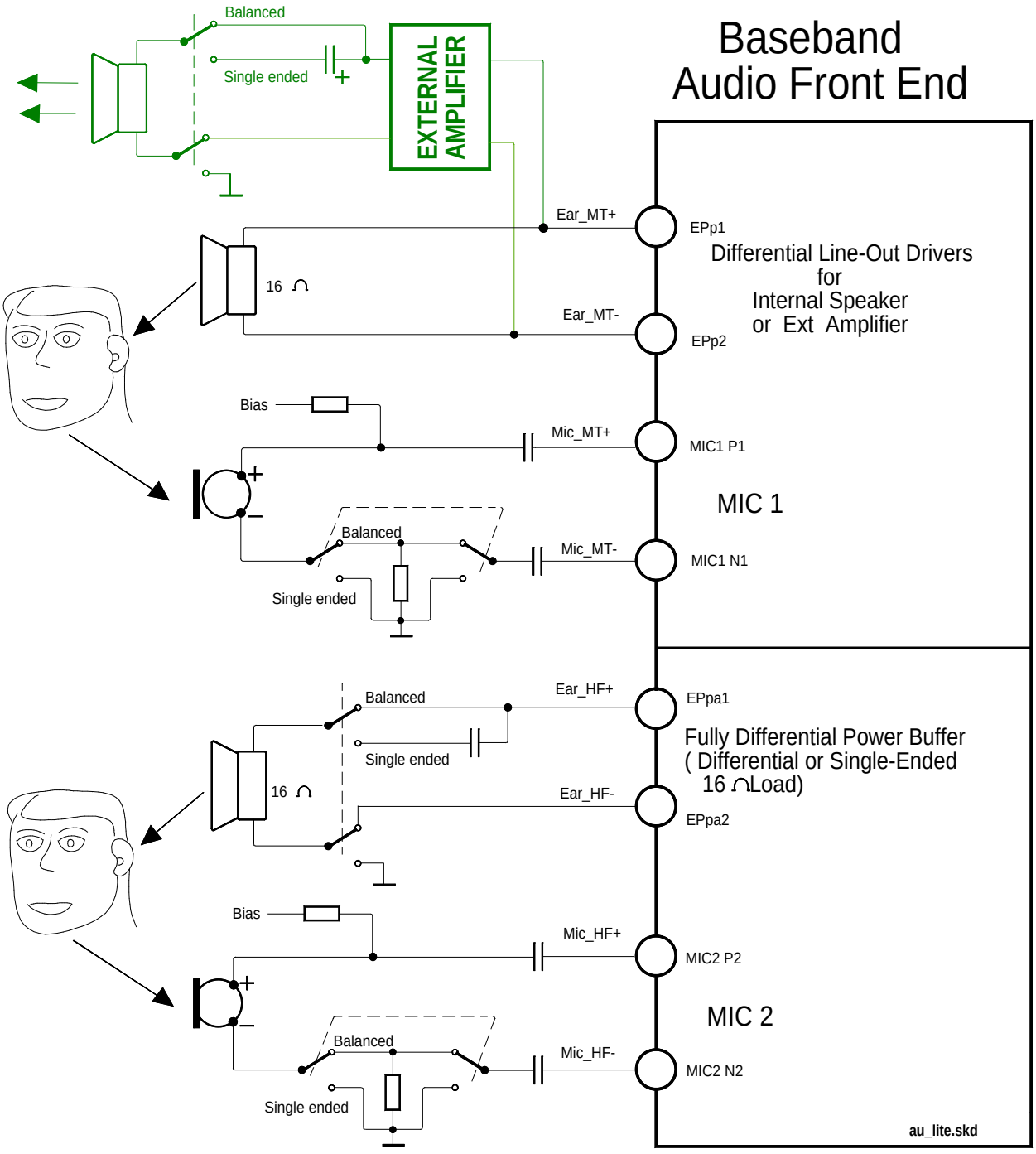

Audio section block diagram

9.2. Electrical Characteristics

TIP:

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

9.2.1. Input Lines Characteristics

"MIC_MT" and "MIC_HF" differential microphone paths	
Line Coupling	AC
Line Type	Balanced
Coupling capacitor	≥ 100nF
Differential input resistance	50KΩ
Differential input voltage	≤ 1,03V_{pp} @ *MicG=0dB*

DANGER :
AC means that the signals from the microphone have to be connected to input lines of the module through capacitors whose value have to be ≥ 100nf.
The input stages will be damaged if this constraint is not observed.

DANGER:
when particular OEM application needs a Single Ended Input configuration, it is forbidden to connect the unused input directly to Ground, please use a 100nF capacitor. Also, do not forget that in Single Ended configuration the useful input signal will be halved, and performances may be degraded.

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9.2.2. Output Lines Characteristics

TIP:

We suggest driving the load differentially from both output drivers, thus the output swing will double and the need for the output coupling capacitor is avoided. If particular OEM application needs Single Ended circuitry, please consider that the output power will be reduced four times.

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

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

TIP:

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

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

(**) *0dBFS* is the normalized overall Analog Gain for each Output channel equal to $3,7V_{pp}$ differential

"EAR_MT" Output Lines	
line coupling	AC single-ended DC differential
output load resistance	≥ 14 Ω
internal output resistance	4 Ω (typical)
signal bandwidth	150 - 4000 Hz @ -3 dB

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max. differential output voltage	1.31 V_{rms} (typical, open circuit)
differential output voltage	328mV_{rms} /16 Ω /@ -12dBFS
volume increment	2 dB per step
volume steps	10

"EAR_HF" Output Lines	
line coupling:	AC single-ended DC differential
output load resistance :	≥ 14 Ω
internal output resistance:	4 Ω (>1,7 Ω)
signal bandwidth:	150 - 4000 Hz @ -3 dB
max. differential output voltage	1.31 V_{rms} (typical, open circuit)
max. S.E. output voltage	656 mV_{rms} (typical, open circuit)
volume increment	2 dB per step
volume steps	10

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10. The Evaluation Kit for Telit GE863-PRO^3 Modules

10.1.1. Short Description

Telit supplies the Evaluation Kit **EVK-PRO3** for **Telit GE863-PRO^3** module to assist the designer in developing his own applications based on GE863-PRO^3 Telit module.

The **EVK-PRO3** is formed by a motherboard and a dedicated Telit module Interface Board with RF antenna connectors.
It provides a fully functional solution for a complete M2M application development.
The motherboard has a power supply and is equipped with SIM card housing, RS 232 serial port level translator, direct USB2.0 Host & Device connection, Smartcard ISO7816 slot, SD-MMC Card slot and 10/100 Mb Ethernet.

To start developing applications on **EVK-PRO3** you need only:

1. a personal computer or microcontroller with USB / RS232 ports;
2. a SIM card with a valid Network subscription;
3. a power supply

The connection between the **EVK-PRO3** and your PC (or other DTE) is made by standard *RS232* ports.

The communications between the application ARM and Telit GSM/GPRS engine is done connecting the Asynchronous Serial Interfaces of the module's ARM&GSM/GPRS by setting appropriately the Jumpers.
Furthermore the communications between ARM and GSM/GPRS can be analyzed with two "sniffed" serial ports that can report both sides of the ARM-GSM/GPRS serial channel.
For further information regarding **EVK-PRO3** please refer to **Error! Reference source not found.**

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11. GSM/GPRS General Purpose I/O

The general-purpose I/O pads of the GSM/GPRS engine can be configured to act in three different ways:

- input
- output
- alternate function (internally controlled)

The following GSM/GPRS engine GPIO are available on the GE863-PRO^3:

Ball	Signal	I/O	Function	Type	Input / output current	Default State	ON_OFF state	State during Reset	Note
G4	GPIO1	I/O	GPIO1 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	HIGH	HIGH	Alternate function (PCMCLK) 4.7K Pull Up
E6	GPIO2	I/O	GPIO2 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (JDR)
G7	GPIO3	I/O	GPIO3 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (PCMRX)
C10	GPIO4	I/O	GPIO4 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (RFTXDIS)
E8	GPIO5	I/O	GPIO5 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (RFTXMON)
E7	GPIO6	I/O	GPIO6 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (ALARM)
B10	GPIO7	I/O	GPIO7 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (BUZZER)
G6	GPIO8	I/O	GPIO8 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (PCMTX)
G5	GPIO9	I/O	GPIO9 Configurable GPIO	CMOS 2.8V	1uA / 1mA	INPUT	LOW		Alternate function (PCMWA0)

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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 GE863-PRO3 firmware and acts depending on the function implemented.

All GSM/GPRS engine GPIO pads are 2.8V CMOS signals and their interface levels are the same specified in the paragraph 7.5.

11.1. 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 buffered with an open collector transistor with a 47K pull up to 2.8V.

11.2. 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.

11.3. Using the RF Transmission Control GPIO7

The GPIO7 pin, when configured as RF Transmission Control Input, permits to disable the Transmitter when the GPIO is set to Low by the application.

11.4. Using the RFTXMON Output GPIO5

The GPIO5 pin, when configured as RFTXMON Output, is controlled by the GE863-PRO3 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.

The line rises up 300ms before first TX burst and will became again LOW from 500ms to 1sec after last TX burst.

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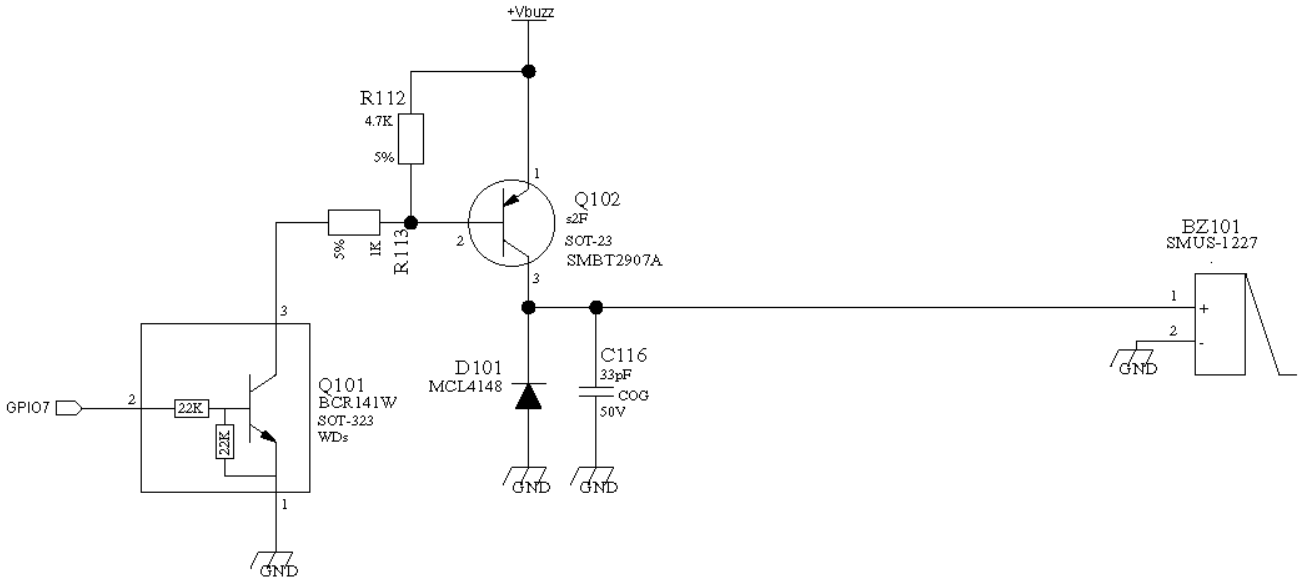
11.5. Using the Alarm Output

The GSM/GPRS Engine GPIO pads, when configured as Alarm Output, can be controlled by the GE863-PRO^3 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 GE863-PRO^3 application processor at the alarm time, giving you the possibility to program a timely system wake-up to achieve some periodic actions and completely turn off both the application processor and the GE863-PRO^3 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.

11.6. Using the Buzzer Output GPIO4

The GPIO4 pad, when configured as Buzzer Output, is controlled by the GE863-PRO^3 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:



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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.

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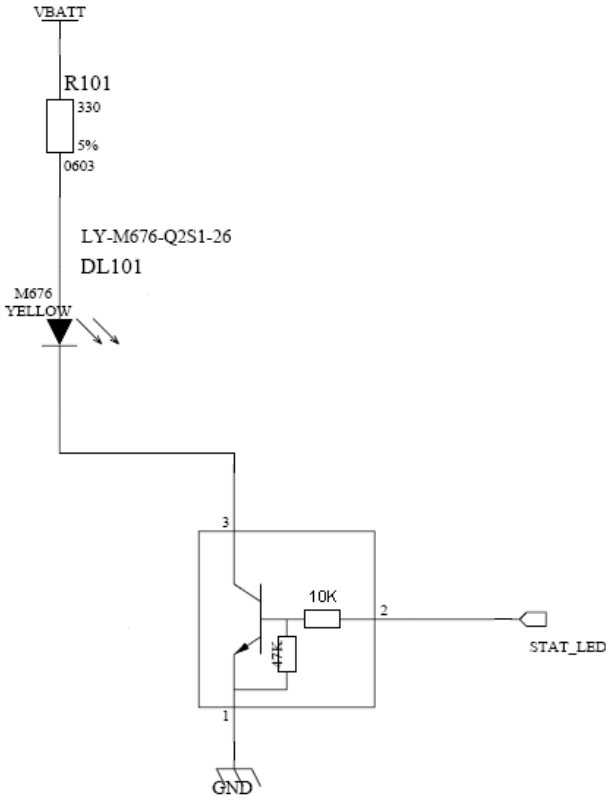
11.7. Indication of network service availability

The STAT_LED pin status shows information on the network service availability and Call status.
In the GE863 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 (Period 1s, Ton 0,5s)	Net search / Not registered / turning off
Slow blinking (Period 3s, Ton 0,3s)	Registered full service
Permanently on	a call is active



12. Power outputs

12.1. 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 GSM/GPRS engine 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

12.2. 3.1V_OUT power output

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

Operating Range – VAUX1 power supply

	Min	Typical	Max
Output voltage	3.05V	3.10V	3.15V
Output current			100mA
Output bypass capacitor			4.7µF

This regulator output is internally powering the ARM part and pins.
The output current that can be drained outside specified above is taking into account the ARM CPU and memory consumption with all the PIO pins of the ARM unloaded.
If considerable current is drained from PIO pins of the ARM the output current above specified shall be decreased accordingly.

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13. Mounting the GE863-PRO^3 on the Application Board

13.1. General

The **Telit GE863-PRO^3 module** has been designed in order to be compliant with a standard lead-free SMT process.

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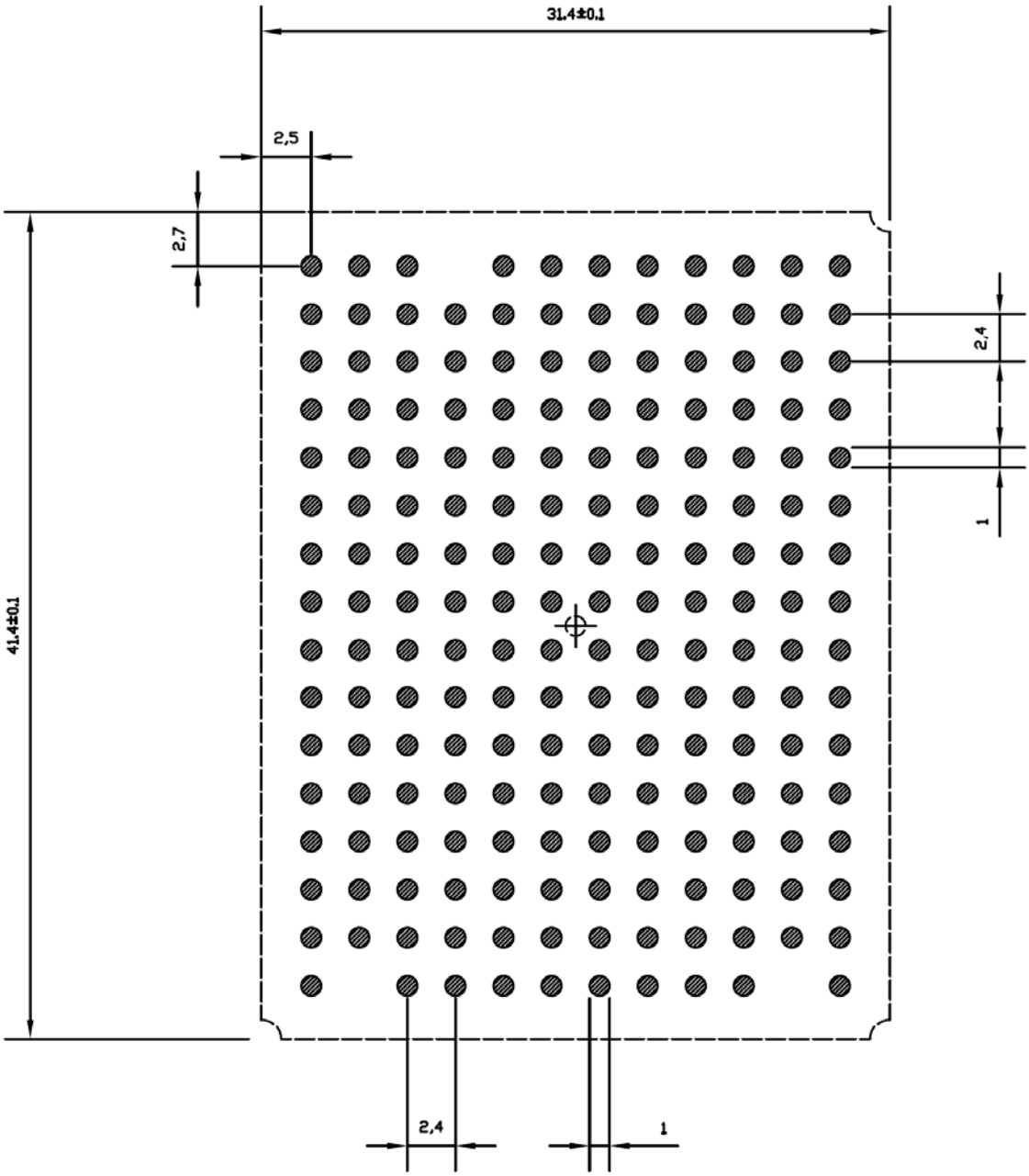
13.1.1. Recommended footprint for the application



SOLDER RESIST= +0.1 mm clear of pad

SOLDER PASTE= pad dimension

TOP VIEW

13.1.2. Suggested Inhibit Area

In order to easily rework the GE863-PRO^3 it is suggested to consider on the application a 1.5mm Inhibit area around the module.

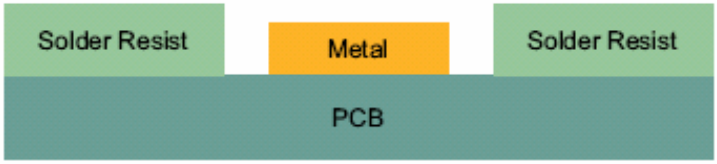
It is also suggested, as common rule for an SMT component, to avoid having a mechanical part of the
application in direct contact with the module.

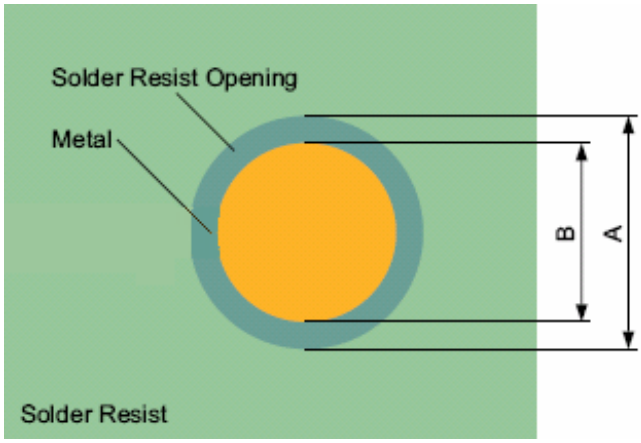
13.1.3. Stencil

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

13.1.4. PCB pad Design

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





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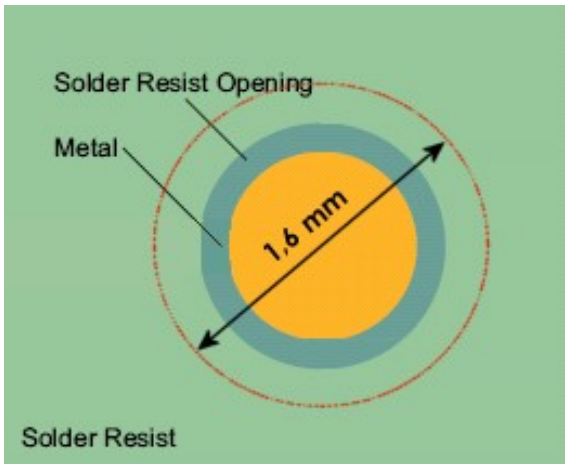
Recommendations for PCB pad dimensions

Ball pitch [mm]	2,4
Solder resist opening diameter A [mm]	1,10
Metal pad diameter B [mm]	1 ± 0.05

Placement of microvias not covered by solder resist is not recommended, unless the microvia carries the same signal of the pad itself.



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

Recommendations for PCB pad surfaces:

Finish	Layer tickness [um]	Properties
Electro-less Ni / Immersion Au	3-7 / 0,05-0,15	good solder ability protection, high shear force values

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

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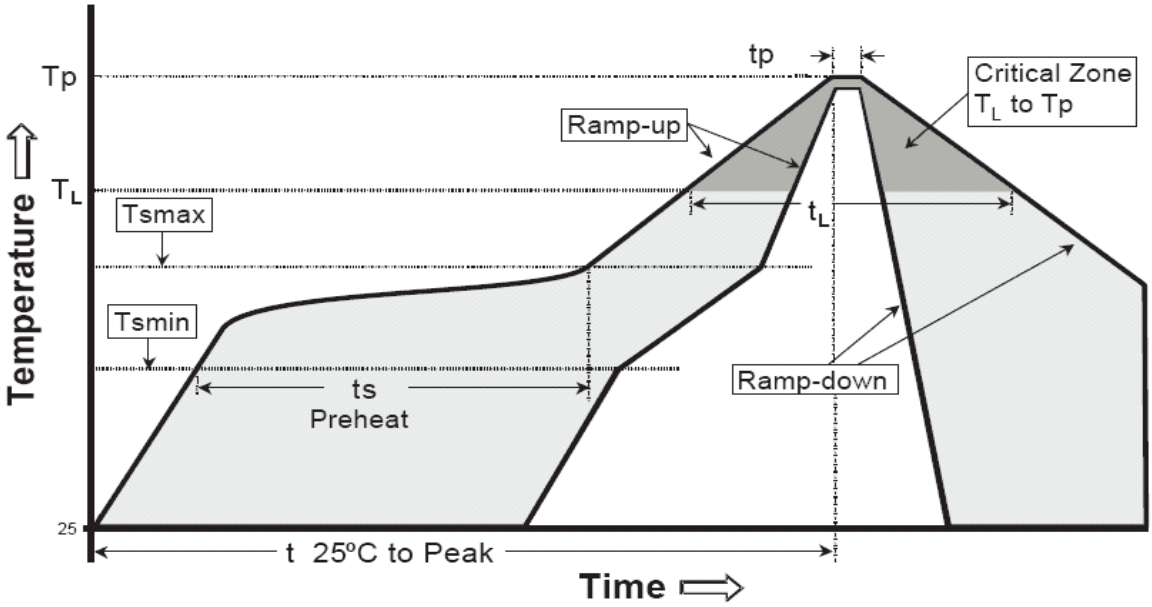
13.1.5. Solder paste

	Lead free
Solder paste	Sn / Ag / Cu

13.1.6. GE863-PRO3 Solder Reflow

The following is the recommended solder reflow profile



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

NOTE:

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

WARNING:

GE863-PRO^3 module can accept only one reflow process

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13.1.7. Moisture Sensitivity

The level of moisture sensibility of **Telit modules** is "3", according with standard IPC/JEDEC J-STD-020, take care of all the relative requirements for using this kind of components.

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

a) The shelf life of GE863 inside of the dry bag shall be 12 month from the bag seal date, when stored in a non-condensing atmospheric environment of <40°C / 90% RH

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

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

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

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

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14. Conformity Assessment Issues

The **Telit GE863-PRO^3** module has been assessed in order to satisfy the essential requirements of the R&TTE Directive 1999/05/EC (Radio Equipment & Telecommunications Terminal Equipments) to demonstrate the conformity against the harmonized standards with the final involvement of a Notified Body.

If the module is installed in conformance to the Telit installation manuals, no further evaluation under Article 3.2 of the R&TTE Directive and do not require further involvement of an 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 the 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

This Hardware User Guide, the Product Description and Software User Guide contain all the information you may need for developing a product meeting the R&TTE Directive.

The GE863-PRO^3 module is conforming 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 GE863-PRO^3 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 Product Description, all the information you may need for developing a product meeting the R&TTE Directive is included.

Furthermore the **Telit GE863-PRO^3 modules** module is FCC Approved as module to be installed in other devices. This device is to be used only for fixed and mobile

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applications. If the final product after integration is intended for portable use, a new application and FCC is required..

The GE863-PRO^3 module is conforming with the following US Directives:

- Use of RF Spectrum. Standards: FCC 47 Part 24 (GSM850 - GSM 1900)
- EMC (Electromagnetic Compatibility). Standards: FCC47 Part 15

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

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 1.4dBi (850MHz) and 3.0dBi (1900MHz) for mobile and fixed or mobile operating configurations.
- Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

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.

For questions regarding your product or this FCC declaration, contact:

Telit wireless solutions Inc.
Americas

3131 RDU Center Drive,
USA – 27560 Morrisville, NC 27560, USA
Phone: +1 888 846 9773
Fax: + 1 888 846 9774
e-mail: americas.info@telit.com

To identify this product, refer to the Part, Series, or Model number found on the product.

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15. 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 EN 50360.

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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://ec.europa.eu/enterprise/sectors/rtte/documents/

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

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

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