

## APPLICABLE PRODUCT

| PRODUCT   |
|-----------|
| HE863-EUD |
| HE863-EUR |
| HE863-EUG |
| HE863-NAD |
| HE863-NAR |
| HE863-NAG |
| HE863-AUD |
| HE863-AUG |



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## 1. Introduction

### 1.1. Scope

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE863-EUD/NAD/AUD/EUG/NAG/AUG/EUR/NAR module. All the features and solutions detailed are applicable to all HE863 family, whereas “family” is intended the modules listed in the applicability table.

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

### 1.2. Audience

This document is intended for Telit customers, who are integrators, about to implement their applications using our HE863-EUD/NAD/AUD/EUG/NAG/AUG/EUR/ NAR module.

### 1.3. Contact Information, Support

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

[TS-EMEA@telit.com](mailto:TS-EMEA@telit.com)  
[TS-NORTHAMERICA@telit.com](mailto:TS-NORTHAMERICA@telit.com)  
[TS-LATINAMERICA@telit.com](mailto:TS-LATINAMERICA@telit.com)  
[TS-APAC@telit.com](mailto:TS-APAC@telit.com)

Alternatively, use:

<http://www.telit.com/en/products/technical-support-center/contact.php>

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

<http://www.telit.com>

To register for product news and announcements or for product questions contact Telit’s Technical Support Center (TTSC).

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.



## 1.4. Document Organization

This document contains the following chapters:

Chapter 1: “Introduction” provides a scope for this document, target audience, contact and support information, and text conventions.

Chapter 2: “Overview” provides an overview of the document.

Chapter 3: “HE863 Family Mechanical Dimensions” deals with the layout.

Chapter 4: “HE863 Family Module Connections”

Chapter 5: “Hardware Commands” How to control the module via hardware

Chapter 6: “Power Supply” deals on supply and consumption.

Chapter 7: “Antenna(s)” The antenna connection and board layout design are the most important parts in the full product design

Chapter 8: “Logic Level specifications” Specific values adopted in the implementation of logic levels for this module.

Chapter 9: “Serial ports”

Chapter 10: “USB Port”

Chapter 11: “Audio Section” Refers to the audio blocks and electrical characteristics of the Base Band Chip .

Chapter 12: “General Purpose I/O” How the general purpose I/O pads can be configured.

Chapter 13 “DAC and ADC Section” Deals with these two kind of converters.

Chapter 14 “GPS and Accelerometer(HE863-EUG/NAG/AUG only)”

Chapter 15 “Mounting the HE863 Family on your board”

Chapter 16 “Application Design Guidelines”

Chapter 17: “Conformity Assessments Issues” provides some fundamental hints about the conformity assessment that the final application might need.



Chapter 18: “Safety Recommendations” provides some safety recommendations that must be followed by the customer in the design of the application that makes use of the HE863 Family.

Chapter 19: “Document History” contains the history of the present document.

## 1.5. Text Conventions



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



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



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

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

## 1.6. Related Documents

- HE863 Product Description
- HE863 AT Command Manual
- HE863 SW User Guide



## 2. Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the Telit HE863 Family module.

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 must be considered as mandatory, while the suggested hardware configurations must not be considered mandatory, instead the information given must be used as a guide and a starting point for properly developing your product with the Telit HE863 Family module.



### NOTICE:

The integration of the GSM/GPRS/EDGE/UMTS/HSPA HE863 Family cellular module within user application must be done according to the design rules described in this manual.

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## 2.1. HE863 Family Product Specification

| ITEM          | FEATURE                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
|               | HE863-EUD                                                                                                                                                                                                                                                                                                                                                                                                                           | HE863-EUR                                                                                                               | HE863-EUG                                                                                                                                       | HE863-NAD                                                                                                                                  | HE863-NAR                                                                                                               | HE863-NAG                                                                                                                                       |
| Air interface | <ul style="list-style-type: none"> <li>Dual-band UMTS/HSPA 2100/900</li> <li>Quad-Band GSM850/900 /1800/1900</li> <li>Data only</li> </ul>                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>Dual-band UMTS/HSPA 2100/900</li> <li>Quad-Band GSM850/900 /1800/1900</li> </ul> | <ul style="list-style-type: none"> <li>Dual-band UMTS/HSPA 2100/900</li> <li>Quad-Band GSM850/900 /1800/1900</li> <li>Standalone GPS</li> </ul> | <ul style="list-style-type: none"> <li>Dual-band UMTS/HSPA 1900/850</li> <li>Quad-Band GSM850/900 /1800/1900</li> <li>Data only</li> </ul> | <ul style="list-style-type: none"> <li>Dual-band UMTS/HSPA 1900/850</li> <li>Quad-Band GSM850/900 /1800/1900</li> </ul> | <ul style="list-style-type: none"> <li>Dual-band UMTS/HSPA 1900/850</li> <li>Quad-Band GSM850/900 /1800/1900</li> <li>Standalone GPS</li> </ul> |
| Size          | 41.4(L)X31.4(W)X2.9(T)                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
| Data Service  | <ul style="list-style-type: none"> <li>HSPA UL 5.8Mbps, DL 7.2Mbps</li> <li>EDGE UL 118kbps, DL 236.8Kbps,</li> <li>GPRS UL 42.8kbps, DL 85.6 Kbps</li> </ul>                                                                                                                                                                                                                                                                       |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
| Interface     | <ul style="list-style-type: none"> <li>189 Balls Grid Array interface</li> <li>22 general I/O ports maximum including multi-functional I/Os</li> <li>Status LED output</li> <li>3 A/D converters</li> <li>1 D/A converter (PWM output)</li> <li>Full RS232 CMOS UART: baud rate up to 6Mbps</li> <li>Reserved two wires CMOS UART for debugging</li> <li>USB 2.0, baud rate up to 480Mbps</li> <li>1.8V/3V SIM interface</li> </ul> |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
| Antenna       | External Antenna                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
| Audio         | <ul style="list-style-type: none"> <li>2 pairs of analog audio interface</li> <li>PCM interface for Digital audio (Audio only for HE863-EUG/EUR/NAG/NAR/AUG)</li> </ul>                                                                                                                                                                                                                                                             |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
| Message       | SMS (MO/MT)                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |
| SIM Card      | Support 1.8 and 3V UICC                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                         |                                                                                                                                                 |                                                                                                                                            |                                                                                                                         |                                                                                                                                                 |



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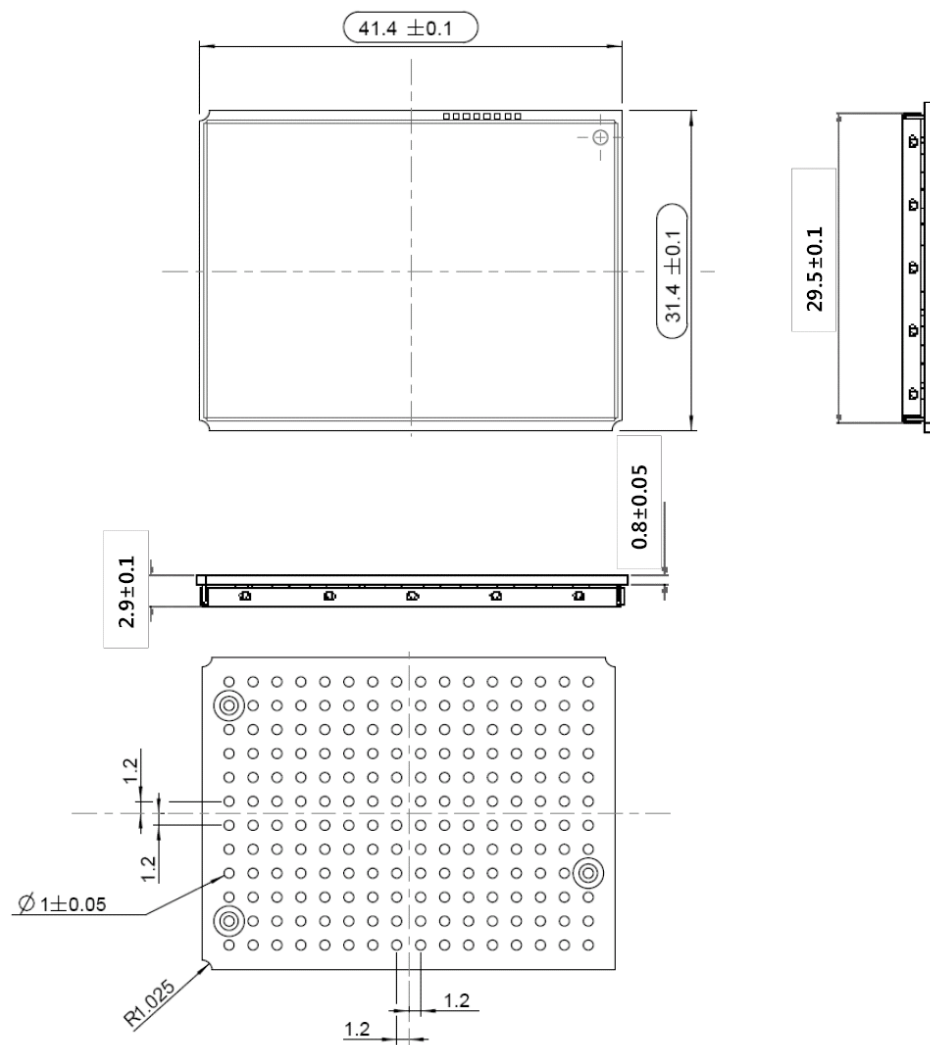
| ITEM          | FEATURE                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                       |  |  |  |  |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
|               | HE863-AUD                                                                                                                                                                                                                                                                                                                                                                                                                                             | HE863-AUG                                                                                                                                             |  |  |  |  |
| Air interface | <ul style="list-style-type: none"> <li>▪ Dual-band UMTS/HSPA 2100/850</li> <li>▪ Quad-Band GSM850/900 /1800/1900</li> <li>▪ Data only</li> </ul>                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>▪ Dual-band UMTS/HSPA 2100/850</li> <li>▪ Quad-Band GSM850/900 /1800/1900</li> <li>▪ Standalone GPS</li> </ul> |  |  |  |  |
| Size          | 41.4(L)X31.4(W)X2.9(T)                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                       |  |  |  |  |
| Data Service  | <ul style="list-style-type: none"> <li>▪ HSPA UL 5.8Mbps, DL 7.2Mbps</li> <li>▪ EDGE UL 118kbps, DL 236.8Kbps,</li> <li>▪ GPRS UL 42.8kbps, DL 85.6 Kbps</li> </ul>                                                                                                                                                                                                                                                                                   |                                                                                                                                                       |  |  |  |  |
| Interface     | <ul style="list-style-type: none"> <li>▪ 189 Balls Grid Array interface</li> <li>▪ 22 general I/O ports maximum including multi-functional I/Os</li> <li>▪ Status LED output</li> <li>▪ 3 A/D converters</li> <li>▪ 1 D/A converter (PWM output)</li> <li>▪ Full RS232 CMOS UART: baud rate up to 6Mbps</li> <li>▪ Reserved two wires CMOS UART for debugging</li> <li>▪ USB 2.0, baud rate up to 480Mbps</li> <li>▪ 1.8V/3V SIM interface</li> </ul> |                                                                                                                                                       |  |  |  |  |
| Antenna       | External Antenna                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                       |  |  |  |  |
| Audio         | <ul style="list-style-type: none"> <li>▪ 2 pairs of analog audio interface</li> <li>▪ PCM interface for Digital audio (Audio only for HE863-EUG/EUR/NAG/NAR/AUG)</li> </ul>                                                                                                                                                                                                                                                                           |                                                                                                                                                       |  |  |  |  |
| Message       | SMS (MO/MT)                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                       |  |  |  |  |
| SIM Card      | Support 1.8 and 3V UICC                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                       |  |  |  |  |



### 3. HE863 Family Mechanical Dimensions

The Telit HE863 Family module overall dimensions are:

- Length: 41.4 mm
- Width: 31.4 mm
- Thickness: 2.9 mm



The HE863 Family 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.

| Ball                           | Signal                    | I/O | Function                                                                                                  | Internal | Type      |
|--------------------------------|---------------------------|-----|-----------------------------------------------------------------------------------------------------------|----------|-----------|
|                                |                           |     |                                                                                                           | Pull up  |           |
| SIM card interface             |                           |     |                                                                                                           |          |           |
| H11                            | SIMCLK                    | O   | External SIM signal – Clock                                                                               |          | 1.8 / 3V  |
| G12                            | SIMRST                    | O   | External SIM signal – Reset                                                                               |          | 1.8 / 3V  |
| F12                            | SIMIO                     | I/O | External SIM signal - Data I/O                                                                            |          | 1.8 / 3V  |
| E12                            | SIMIN                     | I   | External SIM signal – Presence (active low)                                                               | Pull up  | CMOS 1.8V |
| H12                            | SIMVCC                    | -   | External SIM signal – Power supply for the SIM                                                            |          | 1.8 / 3V  |
| Trace                          |                           |     |                                                                                                           |          |           |
| N4                             | TX_TRACE                  | O   | Tx data for diagnostic monitor                                                                            |          | CMOS 1.8V |
| N3                             | RX_TRACE                  | I   | Rx data for diagnostic monitor                                                                            |          | CMOS 1.8V |
| Prog. / Data + HW Flow Control |                           |     |                                                                                                           |          |           |
| M4                             | C125/RING                 | O   | Output for Ring indicator signal (RI) to DTE                                                              |          | CMOS 1.8V |
| M3                             | C109/DCD                  | O   | Output for Data set ready signal (DSR) to DTE                                                             |          | CMOS 1.8V |
| L3                             | C108/DTR                  | I   | Input for Data terminal ready signal (DTR) from DTE                                                       |          | CMOS 1.8V |
| L4                             | C107/DSR                  | O   | Output for Data set ready signal (DSR) to DTE                                                             |          | CMOS 1.8V |
| K4                             | C106/CTS                  | O   | Output for Clear to send signal (CTS) to DTE                                                              |          | CMOS 1.8V |
| K3                             | C105/RTS                  | I   | Input for Request to send signal (RTS) from DTE                                                           |          | CMOS 1.8V |
| J4                             | C104/RXD                  | O   | Serial data output to DTE                                                                                 |          | CMOS 1.8V |
| J3                             | C103/TXD                  | I   | Serial data input (TXD) from DTE                                                                          |          | CMOS 1.8V |
| USB                            |                           |     |                                                                                                           |          |           |
| S8                             | USB_VBUS                  |     | Power supply for the internal USB transceiver                                                             |          | 5V        |
| S9                             | USB_ID<br>(Not supported) | AI  | It's for USB OTG but not supported.<br>HE863 family supports a slave mode only.<br>This pin should be NC. |          | Analog    |
| R9                             | USB_D+                    | I/O | USB differential Data (+)                                                                                 |          | 3.3V      |
| R8                             | USB_D-                    | I/O | USB differential Data (-)                                                                                 |          | 3.3V      |



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|                 |          |  |                                                                                                                                                                                                                                                                                                                          |  |       |
|-----------------|----------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
|                 | GND      |  | 52 pins for Ground<br>(A2,A5,A12,B2,B3,B4,B5,B9,C2,<br>C10,D6,D9,E1,E6,E11,F1,F6,G10,<br>H5,H6,H7,H8,H9,H10,J5,J10,J12,<br>K5,K10,L5,L6,L7,L8,L9,L10,M2,<br>M5,M10,N6,N7,P8,P9,R1,R2,R3,<br>R7,R10,R11,R12,S3,S7,S10)                                                                                                    |  | Power |
| <b>Reserved</b> |          |  |                                                                                                                                                                                                                                                                                                                          |  |       |
|                 | RESERVED |  | 83 pins reserved<br>(D3,E3,F3,G3,H3,D2,E2,F2,C4,C3,<br>H2,J2,G2,K2,L1,K1,G1,J1,L2,H1,<br>P5,P3,P2,M1,N1,N2,P1,G7,E7,D7,<br>D8,E8,F8,G8,D11,F7,C5,B8,C7,C8,<br>B7,C6,A7,A8,C12,J9,A1,A6,A9,A10,<br>A11,B1,B6,B12,D12,H4,P4,S12,F11,G11,<br>F4,D4,F5,E4,D5,C11,P7,R6,P6,S6,<br>G6,N8,N9,S1,J8,J7,J6,K9,K8,K7,<br>K6,N5,M6) |  |       |



**NOTE:**

RESERVED Pins must be UNCONNECTED to any circuit in a host system but be SOLDERED.

**NOTE:**

If not used, almost all pins must be left disconnected.



| Ball                                  | Signal            | I/O | Function                                            | Internal | Type      |
|---------------------------------------|-------------------|-----|-----------------------------------------------------|----------|-----------|
|                                       |                   |     |                                                     | Pull up  |           |
| <b>Audio</b>                          |                   |     |                                                     |          |           |
| J6                                    | EAR_MT+           | AO  | Earphone signal output, phase +                     |          | Audio     |
| J7                                    | EAR_MT-           | AO  | Earphone signal output, phase -                     |          | Audio     |
| J8                                    | EAR_HF+           | AO  | Handsfree signal output, phase + (Single ended)     |          | Audio     |
| K6                                    | MIC_MT+           | AI  | Mic signal input, phase +                           |          | Audio     |
| K7                                    | MIC_MT-           | AI  | Mic signal input, phase -                           |          | Audio     |
| K8                                    | MIC_HF+           | AI  | Handsfree mic signal input, phase +                 |          | Audio     |
| K9                                    | MIC_HF-           | AI  | Handsfree mic signal input, phase -                 |          | Audio     |
| N5                                    | AXE               | I   | Input for handsfree switching                       |          | CMOS 1.8V |
| <b>PCM interface</b>                  |                   |     |                                                     |          |           |
| M7                                    | TGPIO_17/PCM_SYNC | I/O | GPIO 17/PCM sync signal of digital voice interface  |          | CMOS 1.8V |
| M6                                    | PCM_CLOCK         | I/O | PCM clock of digital voice interface                |          | CMOS 1.8V |
| M8                                    | TGPIO_10/PCM_TX   | I/O | GPIO10/PCM data output of digital voice interface   |          | CMOS 1.8V |
| M9                                    | TGPIO_18/PCM_RX   | I/O | gpio18/PCM data input of digital voice interface    |          | CMOS 1.8V |
| <b>SIM card interface</b>             |                   |     |                                                     |          |           |
| H11                                   | SIMCLK            | O   | External SIM signal – Clock                         |          | 1.8 / 3V  |
| G12                                   | SIMRST            | O   | External SIM signal – Reset                         |          | 1.8 / 3V  |
| F12                                   | SIMIO             | I/O | External SIM signal - Data I/O                      |          | 1.8 / 3V  |
| E12                                   | SIMIN             | I   | External SIM signal – Presence (active low)         | Pull up  | CMOS 1.8V |
| H12                                   | SIMVCC            | -   | External SIM signal – Power supply for the SIM      |          | 1.8 / 3V  |
| <b>Trace</b>                          |                   |     |                                                     |          |           |
| N4                                    | TX_TRACE          | O   | Tx data for diagnostic monitor                      |          | CMOS 1.8V |
| N3                                    | RX_TRACE          | I   | Rx data for diagnostic monitor                      |          | CMOS 1.8V |
| <b>Prog. / Data + HW Flow Control</b> |                   |     |                                                     |          |           |
| M4                                    | C125/RING         | O   | Output for Ring indicator signal (RI) to DTE        |          | CMOS 1.8V |
| M3                                    | C109/DCD          | O   | Output for Data set ready signal (DSR) to DTE       |          | CMOS 1.8V |
| L3                                    | C108/DTR          | I   | Input for Data terminal ready signal (DTR) from DTE |          | CMOS 1.8V |
| L4                                    | C107/DSR          | O   | Output for Data set ready signal (DSR) to DTE       |          | CMOS 1.8V |



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RESERVED Pins must be UNCONNECTED but be SOLDERED.



If not used, almost all pins must be left disconnected.

| Ball                      | Signal            | I/O | Function                                           | Internal | Type      |
|---------------------------|-------------------|-----|----------------------------------------------------|----------|-----------|
|                           |                   |     |                                                    | Pull up  |           |
| <b>Audio</b>              |                   |     |                                                    |          |           |
| J6                        | EAR_MT+           | AO  | Earphone signal output, phase +                    |          | Audio     |
| J7                        | EAR_MT-           | AO  | Earphone signal output, phase -                    |          | Audio     |
| J8                        | EAR_HF+           | AO  | Handsfree signal output, phase + (Single ended)    |          | Audio     |
| K6                        | MIC_MT+           | AI  | Mic signal input, phase +                          |          | Audio     |
| K7                        | MIC_MT-           | AI  | Mic signal input, phase -                          |          | Audio     |
| K8                        | MIC_HF+           | AI  | Handsfree mic signal input, phase +                |          | Audio     |
| K9                        | MIC_HF-           | AI  | Handsfree mic signal input, phase -                |          | Audio     |
| N5                        | AXE               | I   | Input for handsfree switching                      |          | CMOS 1.8V |
| <b>PCM interface</b>      |                   |     |                                                    |          |           |
| M7                        | TGPIO_17/PCM_SYNC | I/O | GPIO 17/PCM sync signal of digital voice interface |          | CMOS 1.8V |
| M6                        | PCM_CLOCK         | I/O | PCM clock of digital voice interface               |          | CMOS 1.8V |
| M8                        | TGPIO_10/PCM_TX   | I/O | GPIO10/PCM data output of digital voice interface  |          | CMOS 1.8V |
| M9                        | TGPIO_18/PCM_RX   | I/O | gpio18/PCM data input of digital voice interface   |          | CMOS 1.8V |
| <b>SIM card interface</b> |                   |     |                                                    |          |           |
| H11                       | SIMCLK            | O   | External SIM signal – Clock                        |          | 1.8 / 3V  |
| G12                       | SIMRST            | O   | External SIM signal – Reset                        |          | 1.8 / 3V  |



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|                                       |                           |     |                                                                                                     |         |           |
|---------------------------------------|---------------------------|-----|-----------------------------------------------------------------------------------------------------|---------|-----------|
| F12                                   | SIMIO                     | I/O | External SIM signal - Data I/O                                                                      |         | 1.8 / 3V  |
| E12                                   | SIMIN                     | I   | External SIM signal – Presence (active low)                                                         | Pull up | CMOS 1.8V |
| H12                                   | SIMVCC                    | -   | External SIM signal – Power supply for the SIM                                                      |         | 1.8 / 3V  |
| <b>Trace</b>                          |                           |     |                                                                                                     |         |           |
| N4                                    | TX_TRACE                  | O   | Tx data for diagnostic monitor                                                                      |         | CMOS 1.8V |
| N3                                    | RX_TRACE                  | I   | Rx data for diagnostic monitor                                                                      |         | CMOS 1.8V |
| <b>Prog. / Data + HW Flow Control</b> |                           |     |                                                                                                     |         |           |
| M4                                    | C125/RING                 | O   | Output for Ring indicator signal (RI) to DTE                                                        |         | CMOS 1.8V |
| M3                                    | C109/DCD                  | O   | Output for Data set ready signal (DSR) to DTE                                                       |         | CMOS 1.8V |
| L3                                    | C108/DTR                  | I   | Input for Data terminal ready signal (DTR) from DTE                                                 |         | CMOS 1.8V |
| L4                                    | C107/DSR                  | O   | Output for Data set ready signal (DSR) to DTE                                                       |         | CMOS 1.8V |
| K4                                    | C106/CTS                  | O   | Output for Clear to send signal (CTS) to DTE                                                        |         | CMOS 1.8V |
| K3                                    | C105/RTS                  | I   | Input for Request to send signal (RTS) from DTE                                                     |         | CMOS 1.8V |
| J4                                    | C104/RXD                  | O   | Serial data output to DTE                                                                           |         | CMOS 1.8V |
| J3                                    | C103/TXD                  | I   | Serial data input (TXD) from DTE                                                                    |         | CMOS 1.8V |
| <b>USB</b>                            |                           |     |                                                                                                     |         |           |
| S8                                    | USB_VBUS                  |     | Power supply for the internal USB transceiver                                                       |         | 5V        |
| S9                                    | USB_ID<br>(Not supported) | AI  | It's for USB OTG but not supported. HE863 family supports a slave mode only. This pin should be NC. |         | Analog    |
| R9                                    | USB_D+                    | I/O | USB differential Data (+)                                                                           |         | 3.3V      |
| R8                                    | USB_D-                    | I/O | USB differential Data (-)                                                                           |         | 3.3V      |
| <b>DAC and ADC</b>                    |                           |     |                                                                                                     |         |           |
| S4                                    | DAC_OUT                   | AO  | Digital/Analog converter output                                                                     |         | Analog    |
| S5                                    | ADC_IN3                   | AI  | Analog/Digital converter input 3                                                                    |         | Analog    |
| R5                                    | ADC_IN2                   | AI  | Analog/Digital converter input 2                                                                    |         | Analog    |
| R4                                    | ADC_IN1                   | AI  | Analog/Digital converter input 1                                                                    |         | Analog    |
| <b>Miscellaneous Functions</b>        |                           |     |                                                                                                     |         |           |
| G5                                    | RESET#                    | I   | Reset input                                                                                         | Pull up | 2.3V      |
| C9                                    | VRTC_2V3                  | AO  | VRTC Backup capacitor                                                                               |         | Power     |
| B11                                   | STAT_LED                  | O   | Status indicator LED                                                                                |         | CMOS 1.8V |
| G4                                    | ON/OFF#                   | I   | Input command for switching power ON or OFF (toggle command)                                        | Pull up | 2.3V      |
| D10                                   | PWRMON                    | O   | Power ON Monitor                                                                                    |         | CMOS      |



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|                     |                 |     |                                                                |  |           |
|---------------------|-----------------|-----|----------------------------------------------------------------|--|-----------|
|                     |                 |     |                                                                |  | 1.8V      |
| A3                  | RF_ANT          | -   | Antenna for GSM/WCDMA – 50 ohm                                 |  | RF        |
| S1                  | GPS_ANT         | -   | Antenna for GPS – 50 ohm<br>GPS_ANT for HE863-EUG/NAG/AUG only |  | RF        |
| E5                  | VAUX1           | -   | Power output for external accessories                          |  | Power     |
| <b>GPIO</b>         |                 |     |                                                                |  |           |
| L11                 | TGPIO_22        | I/O | Configurable GPIO #22                                          |  | CMOS 1.8V |
| K12                 | TGPIO_21        | I/O | Configurable GPIO #21                                          |  | CMOS 1.8V |
| M11                 | TGPIO_20        | I/O | Configurable GPIO #20                                          |  | CMOS 1.8V |
| P10                 | TGPIO_19        | I/O | Configurable GPIO #19                                          |  | CMOS 1.8V |
| N10                 | TGPIO_16        | I/O | Configurable GPIO #16                                          |  | CMOS 1.8V |
| M12                 | TGPIO_15        | I/O | Configurable GPIO #15                                          |  | CMOS 1.8V |
| P11                 | TGPIO_14        | I/O | Configurable GPIO #14                                          |  | CMOS 1.8V |
| N11                 | TGPIO_13        | I/O | Configurable GPIO #13                                          |  | CMOS 1.8V |
| L12                 | TGPIO_12        | I/O | Configurable GPIO #12                                          |  | CMOS 1.8V |
| P12                 | TGPIO_11        | I/O | Configurable GPIO #11                                          |  | CMOS 1.8V |
| N12                 | TGPIO_09        | I/O | Configurable GPIO #09                                          |  | CMOS 1.8V |
| B10                 | TGPIO_08        | I/O | Configurable GPIO #08                                          |  | CMOS 1.8V |
| E9                  | TGPIO_07        | I/O | Configurable GPIO #07                                          |  | CMOS 1.8V |
| E10                 | TGPIO_06/ ALARM | I/O | Configurable GPIO #06/ ALARM                                   |  | CMOS 1.8V |
| F10                 | TGPIO_05        | I/O | Configurable GPIO #05                                          |  | CMOS 1.8V |
| F9                  | TGPIO_04        | I/O | Configurable GPIO #04                                          |  | CMOS 1.8V |
| K11                 | TGPIO_03        | I/O | Configurable GPIO #03                                          |  | CMOS 1.8V |
| G9                  | TGPIO_02        | I/O | Configurable GPIO #02                                          |  | CMOS 1.8V |
| J11                 | TGPIO_01        | I/O | Configurable GPIO #01                                          |  | CMOS 1.8V |
| <b>Power Supply</b> |                 |     |                                                                |  |           |
| C1                  | VBATT           |     | Main power supply                                              |  | Power     |
| D1                  | VBATT           |     | Main power supply                                              |  | Power     |



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|          |          |  |                                                                                                                                                                                                                                                                                        |  |       |
|----------|----------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
|          | GND      |  | 52 pins for Ground<br>(A2,A5,A12,B2,B3,B4,B5,B9,C2,<br>C10,D6,D9,E1,E6,E11,F1,F6,G10,<br>H5,H6,H7,H8,H9,H10,J5,J10,J12,<br>K5,K10,L5,L6,L7,L8,L9,L10,M2,<br>M5,M10,N6,N7,P8,P9,R1,R2,R3,<br>R7,R10,R11,R12,S3,S7,S10)                                                                  |  | Power |
| Reserved |          |  |                                                                                                                                                                                                                                                                                        |  |       |
|          | RESERVED |  | 73 pins reserved<br>(D3,E3,F3,G3,H3,D2,E2,F2,C4,C3,<br>H2,J2,G2,K2,L1,K1,G1,J1,L2,H1,<br>P5,P3,P2,M1,N1,N2,P1,G7,E7,D7,<br>D8,E8,F8,G8,D11,F7,C5,B8,C7,C8,<br>B7,C6,A7,A8,C12,J9,A1,A6,A9,A10,<br>A11,B1,B6,B12,D12,H4,P4,S12,F11,G11,<br>F4,D4,F5,E4,D5,C11,P7,R6,P6,S6,<br>G6,N8,N9) |  |       |



### NOTE:

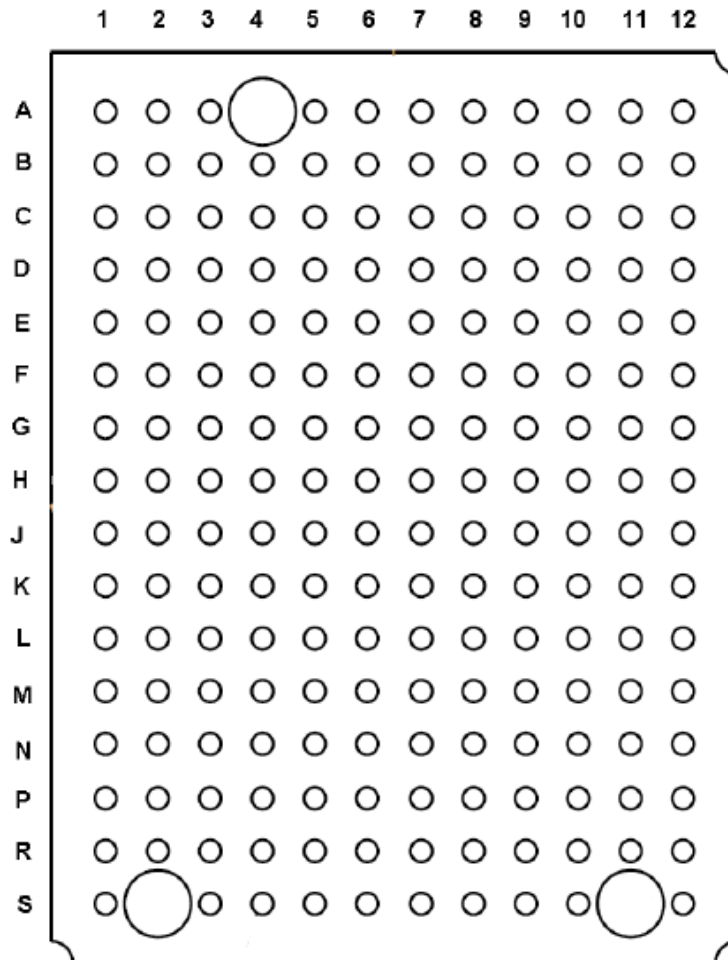
RESERVED Pins must be UNCONNECTED but be SOLDERED.

### NOTE:

If not used, almost all pins must be left disconnected.



## 4.4. BALLS LAYOUT



TOP VIEW



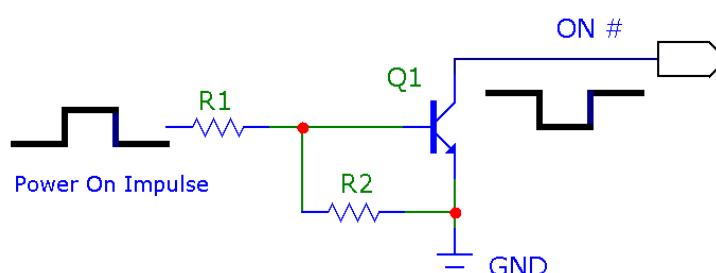
## 5. Hardware Commands

### 5.1. Turning ON the HE863

To turn on HE863 Family, the pad ON/OFF# must be tied low for at least 1 second and then released.

The maximum current that can be drained from the ON/OFF# pad is 0.1 mA.

A simple circuit to do it is:



#### NOTE:

The HE863 Family turns fully on by supplying power more than 3.2V to the VBATT pads because of the first connect power on feature. This feature could be done only when Vbatt equals to almost 0V at the beginning. Normally the high value capacitor will be mounted on Vbatt line so the user should have a wait enoughly since vbatt is disabled till the remaining voltage on Vbatt is fully discharged in order to do re-start by this feature.

Because the discharge time depends upon the capacitance on Vbatt in the application it should be definitely considered in the application side.

HE863 Family has dozens uF on Vbatt line inside.



#### NOTE:

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



## 5.2. Initialization and Activation state

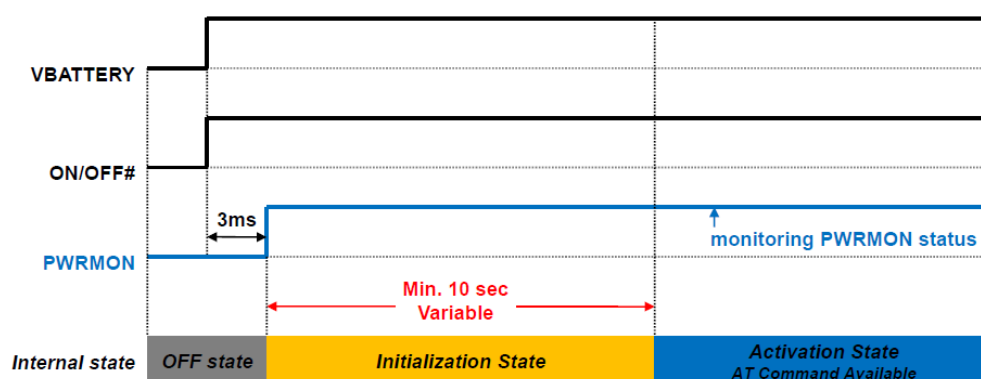
Upon turning on HE863 Family, HE863 Family is not activated yet because the boot sequence of HE863 Family is still going on internally. It may take more than about 10 seconds to complete the initializing the module internally.

For this reason, it would be useless to try to access HE863 Family during Initialization state as below. To get the desirable stability, HE863 Family needs at least 10 seconds after the PWRMON goes High.

Following time charts can be referred according to the application design.

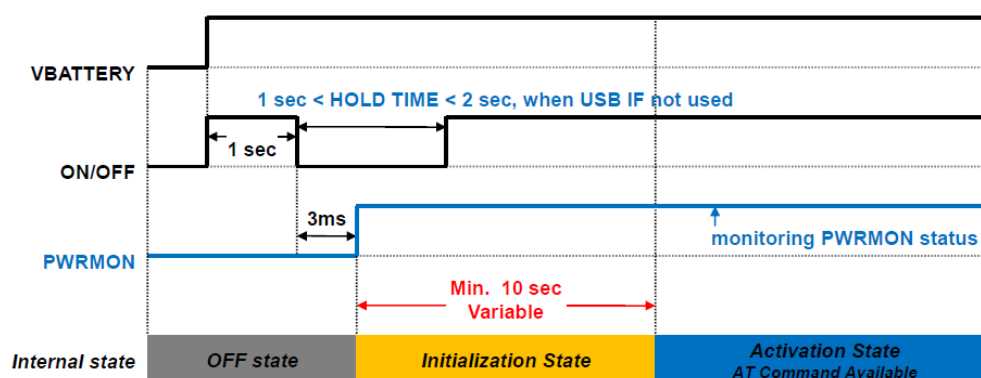
### i. First time supplying the power more than 3.2V to Vbatt

By only first time supplying the power to Vbatt line, the HE863 Family will power on without toggling ON/OFF# pin.

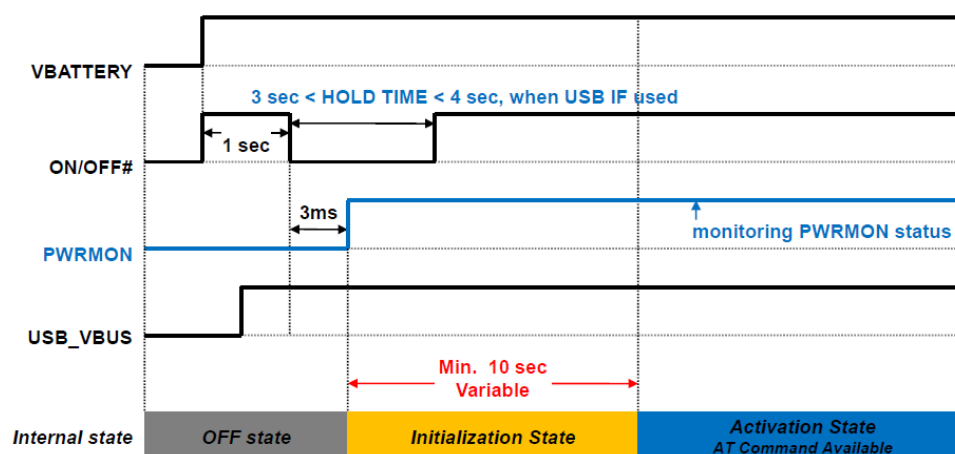


### ii. Using ON/OFF key when USB interface is not used

If the application will not use the usb interface of HE863 Family, that is, actually the usb interface is not connected between the devices, the hold time to tie ON/OFF# to GND should be 1 ~ 2 sec to make it powering on.



If the application will use the usb interface of HE863 Family, that is, actually the usb interface is correctly connected between the devices and USB\_VBUS is asserted, the hold time to tie ON/OFF# to GND should be 3 ~ 4 sec to make it powering on.



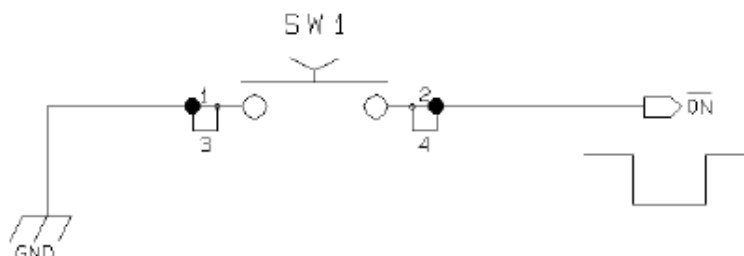
To check if the HE863 Family has powered on, the hardware line PWRMON must be monitored. When PWRMON goes high, the module has powered on.

Do not use any pull up resistor on the ON/OFF# line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the HE863 Family power regulator and improper power on/off of the module. The line ON/OFF# must be connected only in open collector configuration.

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



- 1- Let us assume you need to drive the ON/OFF# pad with a totem pole output of a +1.8/5 V microcontroller (uP OUT1):

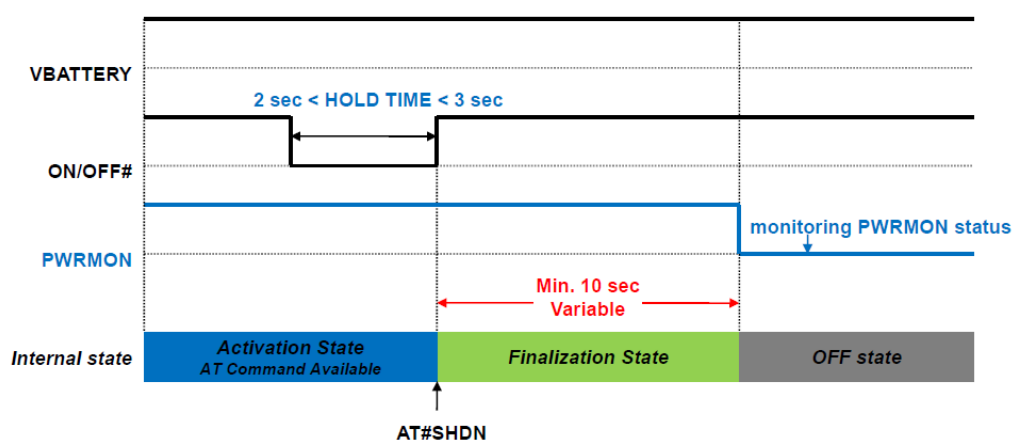


- via AT command (see HE863 Software User Guide)
- by tying low the ON/OFF# pad for at least 2 seconds.

To turn OFF HE863 Family the pad ON/OFF# must be tied low for at least 2 seconds and then released.



Normally it will take above 10 seconds later from releasing ON/OFF# and DTE should monitor the status of PWRMON to see the actual power off.



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



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



### 5.3.1. Hardware Unconditional Restart

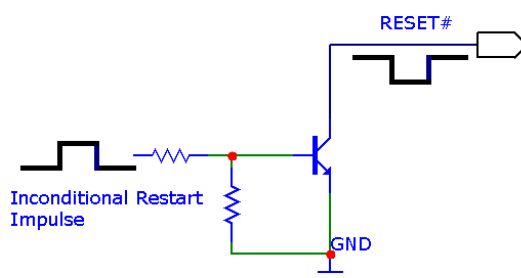


#### WARNING:

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 HE863 Family, the pad RESET# must be tied low for at least 200 milliseconds and then released.

A simple circuit to do it is:



#### NOTE:

Do not use any pull up resistor on the RESET# line or any totem pole digital output. Using pull up resistor may bring to latch up problems on the HE863 Family power regulator and improper functioning of the module. The line RESET# must be connected only in open collector configuration

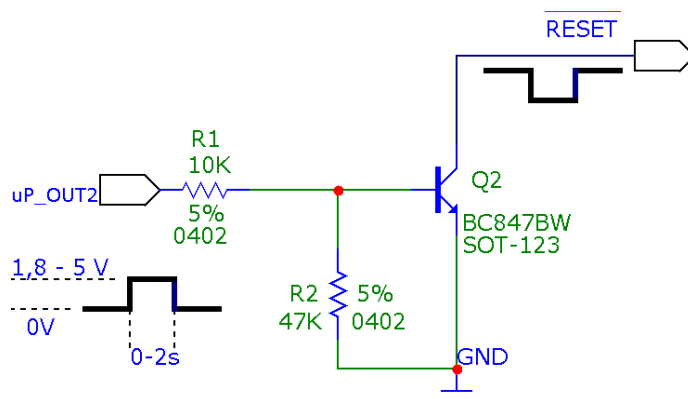
#### TIP:

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



For example:

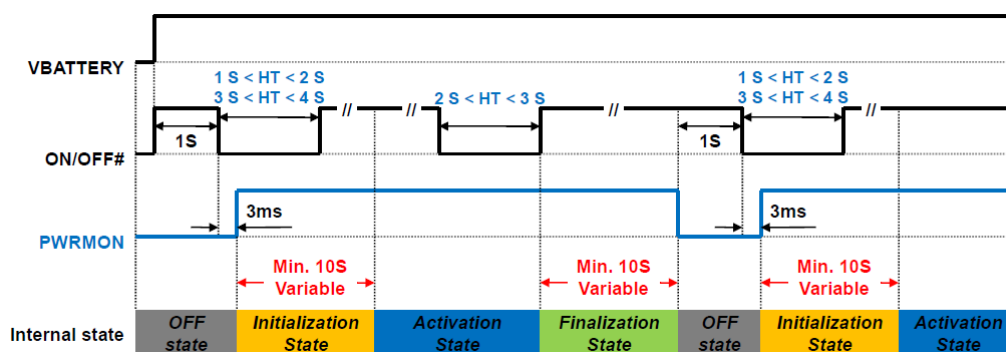
- 1- Let us assume you need to drive the RESET# pad with a totem pole output of a +1.8/5 V microcontroller (uP\_OUT2):



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

## 5.4. Summary of Turning ON and OFF the HE863

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



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

The HE863 Family power requirements are:

| HE863-EUD/NAD/AUD/EUG/NAG/AUG/EUR/NAR |       |             |                                                                                                                   |
|---------------------------------------|-------|-------------|-------------------------------------------------------------------------------------------------------------------|
| Mode                                  |       | Average(mA) | Mode Description                                                                                                  |
| IDLE mode                             |       |             | Standby mode; no call in progress;<br>GPS OFF (GPS for HE863-EUG/NAG/AUG only)                                    |
| AT+CFUN=0                             | -     | 60uA        | Shutdown mode(Power off)                                                                                          |
| AT+CFUN=1                             | WCDMA | 34          | Normal mode; full functionality of the module                                                                     |
|                                       | GSM   | 33          |                                                                                                                   |
| AT+CFUN=4                             | WCDMA | 33          | Disabled TX and RX; modules is not registered on the network                                                      |
|                                       | GSM   | 33          |                                                                                                                   |
| AT+CFUN=5                             | WCDMA | 4/2*        | CFN=5 full functionality with power saving;<br>Module registered on the network can receive incoming call and SMS |
|                                       | GSM   | 4/2*        |                                                                                                                   |
| WCDMA TX and RX mode with GPS OFF     |       |             | GPS OFF (GPS for HE863-EUG/NAG/AUG only)                                                                          |
| WCDMA Voice                           | 600   |             | WCDMA voice channel                                                                                               |
| WCDMA data                            | 600   |             | WCDMA data channel                                                                                                |
| HSDPA                                 | 680   |             | HSDPA data channel                                                                                                |
| HSUPA                                 | 610   |             | HSUPA data channel                                                                                                |
| GSM TX and RX mode with GPS OFF       |       |             | GPS OFF (GPS for HE863-EUG/NAG/AUG only)                                                                          |
| GSM Voice                             | 250   |             | GSM voice channel                                                                                                 |
| GPRS Class12                          | 650   |             | GPRS data channel                                                                                                 |
| EDGE Class12                          | 470   |             | EDGE data channel                                                                                                 |

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



| HE863-EUG/NAG/AUG only                            |             |                     |
|---------------------------------------------------|-------------|---------------------|
| Mode                                              | Average(mA) | Mode Description    |
| IDLE mode with GPS ON full power mode*            |             |                     |
| AT+CFUN=1                                         | WCDMA       | 62                  |
|                                                   | GSM         | 61                  |
| AT+CFUN=4                                         | WCDMA       | 61                  |
|                                                   | GSM         | 61                  |
| AT+CFUN=5                                         | WCDMA       | 54/53*              |
|                                                   | GSM         | 54/53*              |
| WCDMA TX and RX mode with GPS ON full power mode* |             |                     |
| WCDMA Voice                                       | 630         | WCDMA voice channel |
| WCDMA Data                                        | 630         | WCDMA data channel  |
| HSDPA                                             | 710         | HSDPA data channel  |
| HSUPA                                             | 630         | HSUPA data channel  |
| GSM TX and RX mode with GPS ON full power mode*   |             |                     |
| GSM Voice                                         | 280         | GSM voice channel   |
| GPRS Class12                                      | 670         | GPRS data channel   |
| EDGE Class12                                      | 500         | EDGE data channel   |

\* except external active GPS antenna



#### TIP:

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

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

## 6.2. General Design Rules

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



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

## 6.2.1. Electrical Design Guidelines

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

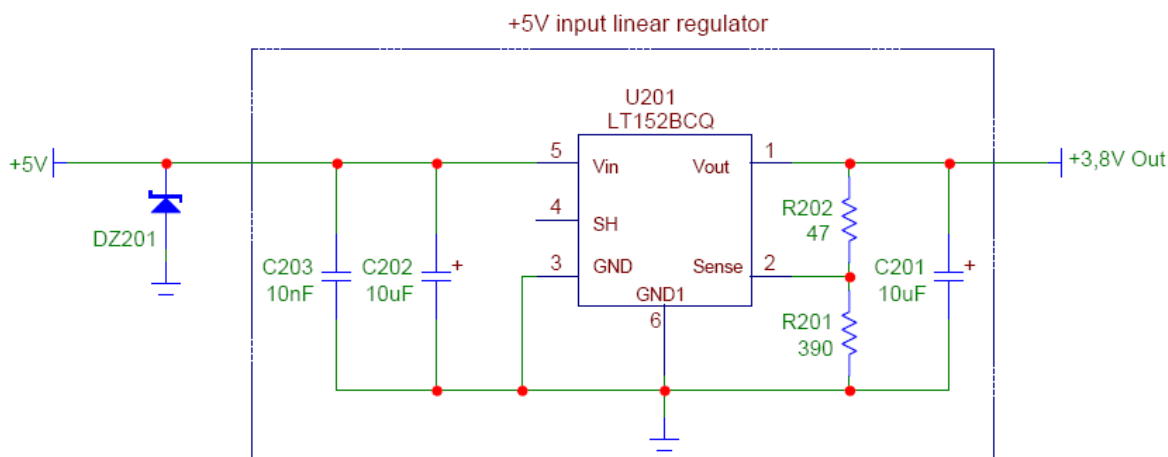
- +5V input (typically PC internal regulator output)
- +12V input (typically automotive)

### 6.2.1.1. + 5V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence there is not a big difference between the input source and the desired output and a linear regulator can be used. A switching power supply will not be suited because of the low drop-out requirements.
- When using a linear regulator, a proper heat sink must be provided in order to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks close to HE863 Family, a 100 $\mu$ F tantalum capacitor is usually suited.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- A protection diode must be inserted close to the power input, in order to save HE863 Family from power polarity inversion.

An example of linear regulator with 5V input is:





#### 6.2.1.2. +12V Input Source Power Supply Design Guidelines

- The desired output for the power supply is 3.8V, hence due to the big difference between the input source and the desired output, a linear regulator is not suited and must not be used. A switching power supply will be preferable because of its better efficiency especially with the 2A peak current load represented by HE863 Family.
- When using a switching regulator, a 500 kHz or more switching frequency regulator is preferable because of its smaller inductor size and its faster transient response. This allows the regulator to respond quickly to the current peaks absorption.
- In any case, the frequency and Switching design selection is related to the application to be developed due to the fact the switching frequency could also generate EMC interferences.
- For car PB battery the input voltage can rise up to 15.8V and this must be kept in mind when choosing components: all components in the power supply must withstand this voltage.
- A Bypass low ESR capacitor of adequate capacity must be provided in order to cut the current absorption peaks. A 100µF tantalum capacitor is usually suited for this.
- Make sure the low ESR capacitor on the power supply output (usually a tantalum one) is rated at least 10V.
- For Car applications a spike protection diode must be inserted close to the power input, in order to clean the supply from spikes.

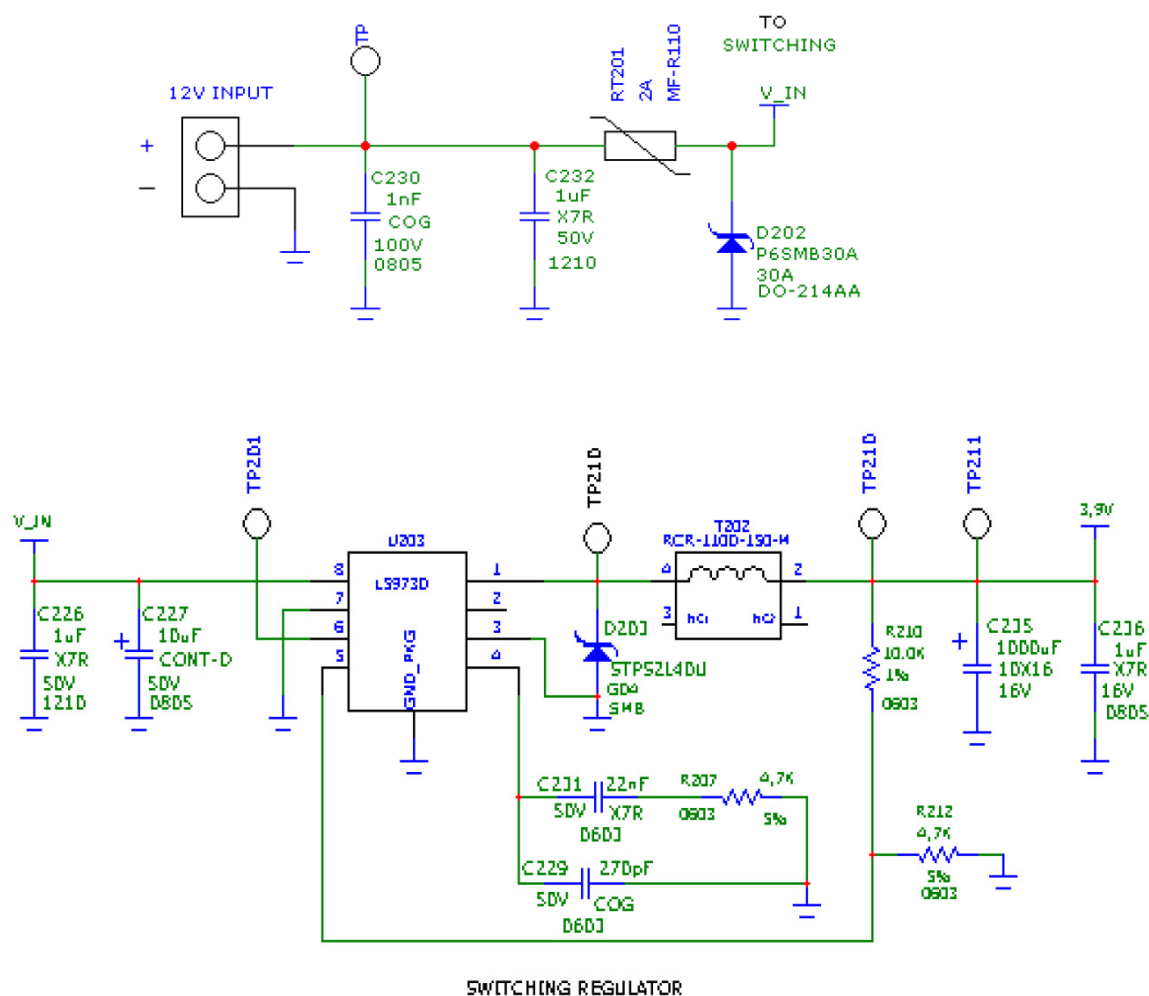


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- A protection diode must be inserted close to the power input, in order to save HE863 Family from power polarity inversion. This can be the same diode as for spike protection.

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



## 6.2.2. Thermal Design Guidelines

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

- Average current consumption during WCDMA/HSPA transmission @PWR level max : 710mA
- Average current consumption during class12 GPRS transmission @PWR level max : 670mA
- Average GPS current during GPS ON (Power Saving disabled) in HE863-EUG/NAG/AUG : 55mA



### NOTE:

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

### NOTE:

The thermal design for the Power supply must be made keeping an average consumption at the max transmitting level during calls of 750mA rms plus 100mA rms for GPS in tracking mode in HE863-EUG/NAG/AUG.

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

If we assume that the device stays in transmission for short periods of time (let us say few minutes) and then remains for quite a long time in idle (let us say one hour), then the power supply has always the time to cool down between the calls and the heat sink could be smaller than the calculated for 850mA maximum RMS current. There could even be a simple chip package (no heat sink).

Moreover in average network conditions the device is requested to transmit at a lower power level than the maximum and hence the current consumption will be less than 850mA (being usually around 200mA).

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 HE863 Family, you can consider it to be during transmission 1W max during CSD/VOICE calls and 2W max during class12 GPRS upload. This generated heat will be mostly conducted to the ground plane under the HE863 Family; you must ensure that your application can dissipate the heat.

In the WCDMA/HSPA mode, since HE863 Family emits RF signals continuously during transmission, you must pay special attention how to dissipate the heat generated.



The current consumption will be up to about 710mA in HSPA continuously at the maximum TX output power (23dBm). Thus, you must arrange the PCB area as large as possible under HE863 Family which you will mount.

You must mount HE863 Family on the large ground area of your application board and make many ground vias to dissipate the heat.

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

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

### 6.2.3. Power Supply PCB Layout Guidelines

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

- The Bypass low ESR capacitor must be placed close to the Telit HE863 Family power input pads, or in the case the power supply is a switching type, it can be placed close to the inductor to cut the ripple if the PCB trace from the capacitor to HE863 Family is wide enough to ensure a drop-less connection even during the 2A current peaks.
- The protection diode must be placed close to the input connector where the power source is drained.
- The PCB traces from the input connector to the power regulator. IC must be wide enough to ensure no voltage drops to occur when the 2A current peaks are absorbed. Note that this is not made in order to save power loss but especially to avoid the voltage drops on the power line at the current peaks frequency of 216 Hz that will reflect on all the components connected to that supply (also introducing the noise floor at the burst base frequency.) For this reason while a voltage drop of 300-400 mV may be acceptable from the power loss point of view, the same voltage drop may not be acceptable from the noise point of view. If your application does not have audio interface but only uses the data feature of the Telit HE863 Family, then this noise is not so disturbing and power supply layout design can be more forgiving.
- The PCB traces to HE863 Family and the Bypass capacitor must be wide enough to ensure no significant voltage drops to occur when the 2A current peaks are absorbed. This is a must for the same above-mentioned reasons. Try to keep this trace as short as possible.
- The PCB traces connecting the Switching output to the inductor and the switching diode must be kept as short as possible by placing the inductor and the



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diode very close to the power switching IC (only for switching power supply). This is done in order to reduce the radiated field (noise) at the switching frequency (usually 100-500 kHz).

- The use of a good common ground plane is suggested.
- The placement of the power supply on the board must be done in a way to guarantee that the high current return paths in the ground plane are not overlapped to any noise sensitive circuitry as the microphone amplifier/buffer or earphone amplifier.
- The power supply input cables must be kept separately from noise sensitive lines such as microphone/earphone cables.



## 7. Antenna(s)

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

### 7.1. GSM/WCDMA Antenna Requirements

As suggested on the Product Description, the antenna for a Telit HE863 Family device must fulfill the following requirements:

| GSM / WCDMA Antenna Requirements |                                                                                                                                         |                                                                                                                 |                                                                                                                 |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Frequency range                  | Depending by frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s) |                                                                                                                 |                                                                                                                 |
| Bandwidth                        | HE863-EUD/EUR/EUG                                                                                                                       | HE863-NAD/NAR/NAG                                                                                               | HE863-AUD/AUG                                                                                                   |
|                                  | 70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz in PCS<br>80 MHz in WCDMA900, 250 MHz in WCDMA2100                         | 70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz in PCS<br>70 MHz in WCDMA850, 140 MHz in WCDMA1900 | 70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz in PCS<br>70 MHz in WCDMA850, 250 MHz in WCDMA2100 |
| Gain                             | Gain < 4dBi                                                                                                                             |                                                                                                                 |                                                                                                                 |
| Impedance                        | 50 Ohm                                                                                                                                  |                                                                                                                 |                                                                                                                 |
| Input power                      | > 33dBm(2 W) peak power in GSM<br>> 24dBm Average power in WCDMA                                                                        |                                                                                                                 |                                                                                                                 |
| VSWR absolute max                | <= 10:1                                                                                                                                 |                                                                                                                 |                                                                                                                 |
| VSWR recommended                 | <= 2:1                                                                                                                                  |                                                                                                                 |                                                                                                                 |

When using the Telit HE863 Family, since there's no antenna connector on the module, the antenna must be connected to the HE863 Family through the PCB with the antenna pad using a 50 Ohm 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 HE863 Family, then a PCB line is needed in order to connect with it or with its connector.



This line of transmission shall fulfill the following requirements:

| ANTENNA LINE ON PCB REQUIREMENTS                                                                  |        |
|---------------------------------------------------------------------------------------------------|--------|
| <b>Impedance</b>                                                                                  | 50 ohm |
| <b>Max Attenuation</b>                                                                            | 0,3 dB |
| <b>No coupling with other signals allowed</b>                                                     |        |
| <b>Cold End (Ground Plane) of antenna shall be equipotential to the HE863 Family ground pins.</b> |        |

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

*This device is to be used only for mobile and fixed application. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-Users must be provided with transmitter operation conditions for satisfying RF exposure compliance. OEM integrators must ensure that the end user has no manual instructions to remove or install the HE863 Family module. Antennas used for this OEM module must not exceed 4dBi gain for mobile and fixed operating configurations.*

## 7.2. GSM/WCDMA Antenna – PCB line Guidelines



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- 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 via holes once per 2mm at least;
- Place EM noisy devices as far as possible from HE863 Family antenna line;
- Keep the antenna line far away from the HE863 Family power supply lines;
- If you have EM noisy devices around the PCB hosting the HE863 Family, such as fast switching ICs, take care of shielding it with a metal frame cover.

HE863 Family can only be used with a host antenna circuit trace layout according to below guidelines and a host system designer must follow the guidelines to keep the original Grant of HE863 Family.

OEM, host system designer has to know that the strict compliance to the layout reference design which Telit will provide is required to ensure that only approved antenna shall be used in the host system.

If in a host system there is any difference from the trace layout already approved, OEM host system designer has to know that it requires a Class II permissive change or a new grant as appropriate as FCC defines.

Compliance of this device in all final host configurations is the responsibility of the Grantee.

Here is the information of Telit's approved interface board layout and please see carefully the pictures extracted from the gerber files for respective layer as attached below.

This guidance should be referenced by OEM host.

Telit EVK for HE863 Family has a structure of six pcb layers.

### Layer1, Top layer:

The ball in blue circle is A3 which is assigned to the RF\_ANT in the HE863 Family. It is the starting point from the HE863 Family to an Antenna connector in a host

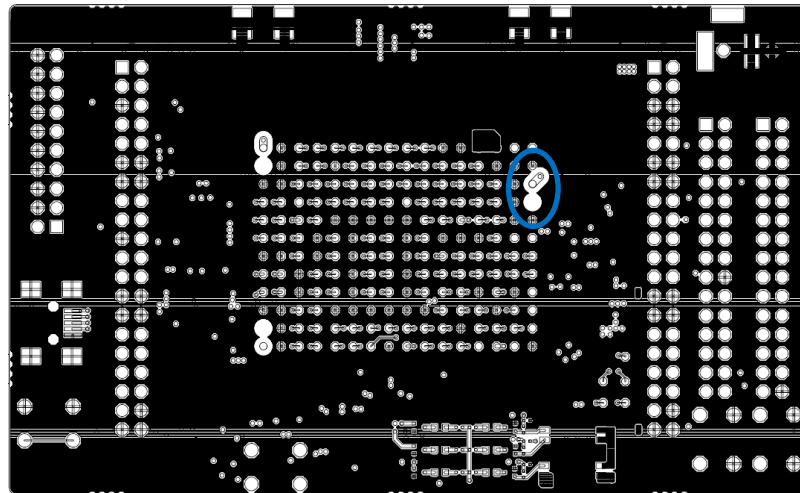


system.

The trace info as;

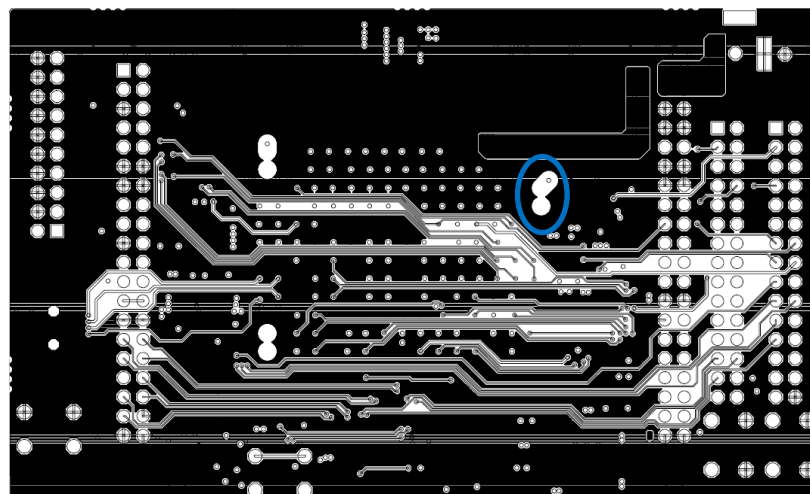
|             |                          |
|-------------|--------------------------|
| Thickness = | 0.035 mm                 |
| Width =     | 1.0 mm                   |
| Length =    | 1.414 mm                 |
| Clearance = | 0.775 mm (Signal to GND) |

The actual trace limits in a host system should be calculated to correspond to 50ohm and it may be provided by the pcb maker.



#### Layer2, inner layer:

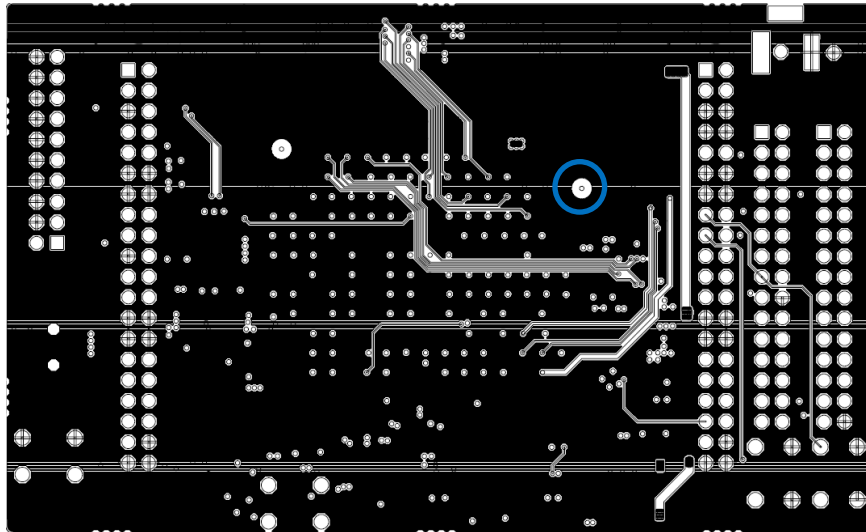
It needs a cut-out on layer2 to meet 50ohm.



#### Layer3, inner layer:

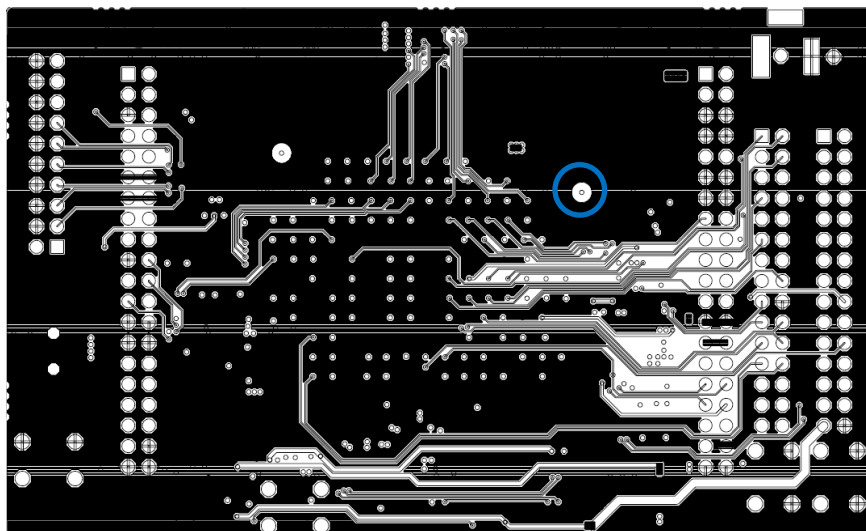
There is no cut-out. The related via remains only.





**Layer4, inner layer:**

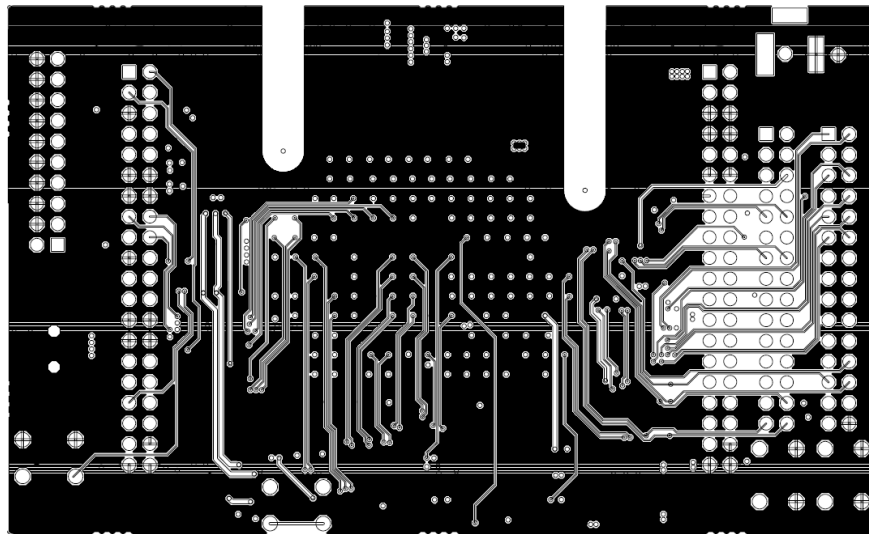
There is no cut-out. The related via remains only.



**Layer5, inner layer:**

Same cut-out with layer 6's should be applied to match 50ohm.



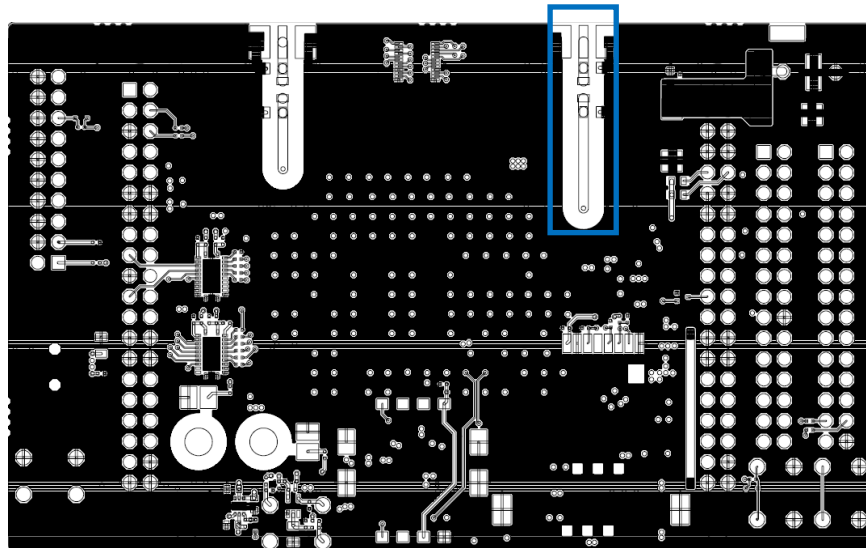


#### Layer6, Bottom layer:

The trace info as;

|             |                        |
|-------------|------------------------|
| Thickness = | 0.035 mm               |
| Width =     | 1.2 mm                 |
| Length =    | 18.42 mm               |
| Clearance = | 2.0 mm (Signal to GND) |

The actual trace limits in a host system should be calculated to correspond to 50 ohm which may be provided by the pcb maker.



### 7.3. GSM/WCDMA Antenna – Installation Guidelines

- Install the antenna in a place covered by the GSM/WCDMA signal.



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- 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.
- FCC Section 15.203 describes that the use of a standard antenna jack or electrical connector is prohibited.

Do NOT use this type of connector on the host system and the host system should have one of special ones.

The host system designers should keep in mind this information before they start their actual design.

Below descriptions will make it clearer.

According to the FCC requirement, SMA type is prohibited because it is one of standard types but

the system designer can adopt RP-SMA type which is considered a special type.

RP-SMA represents “Reversed Polarized SMA”.

Useful pictures below;



SMA Male

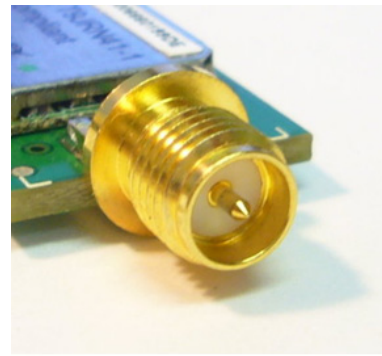


SMA Female





RP-SMA Male



RP-SMA Female

## 7.4. GPS Antenna Requirements (HE863-EUG/NAG/AUG only)

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

The module is provided of an Antenna supply circuit with the following characteristics:

- Supply voltage referred to VBATT (Must accept values from 3.4 to 4.2 V DC)
- Supply enable controlled internally by the BB.

When using the Telit HE863-EUG/NAG/AUG, since there's no antenna connector on the module, the antenna must be connected to the HE863-EUG/NAG/AUG through the PCB with the antenna pad using a 50 Ohm 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 HE863-EUG/NAG/AUG, then a PCB line is needed in order to connect with it or with its connector.

This line of transmission shall fulfill the following requirements:

| ANTENNA LINE ON PCB REQUIREMENTS                                                                |        |
|-------------------------------------------------------------------------------------------------|--------|
| Impedance                                                                                       | 50 ohm |
| No coupling with other signals allowed                                                          |        |
| Cold End (Ground Plane) of antenna shall be equipotential to the HE863-EUG/NAG/AUG ground pins. |        |

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

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



## 7.5. GPS Antenna-PCB Line Guidelines (HE863-EUG/NAG/AUG only)

- Ensure that the antenna line impedance is 50 ohm;
- Keep the antenna line on the PCB as short as possible to reduce the loss.
- Antenna line must have uniform characteristics, constant cross section, avoid meanders and abrupt curves;
- Keep, 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 HE863-EUG/NAG/AUG antenna line;
- Keep the antenna line far away from the HE863-EUG/NAG/AUG power supply lines;
- Keep the antenna line far away from the HE863-EUG/NAG/AUG WCDMA/GSM RF lines;
- If you have EM noisy devices around the PCB hosting the HE863-EUG/NAG/AUG, 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 HE863-EUG/NAG/AUG, by using a strip-line on the superficial copper layer for the antenna line, the line attenuation will be lower than a buried one;



Here is the guidance for GPS antenna path.

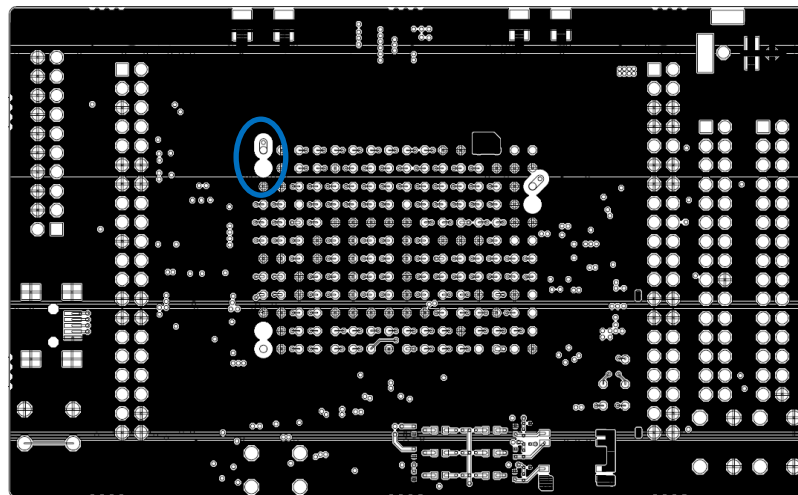
### Layer1, Top layer:

The ball in blue circle is S1 which is assigned to the GPS\_ANT in the HE863 Family. It is the starting point from the HE863 Family to an Antenna connector in a host system.

The trace info as;

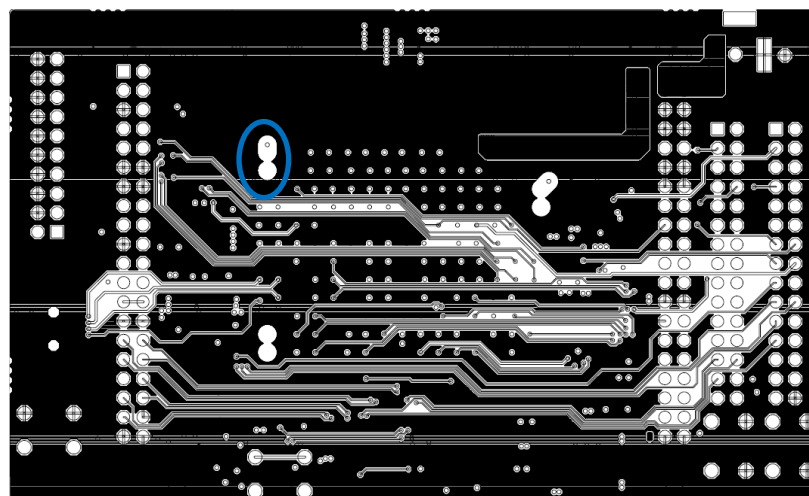
|             |                          |
|-------------|--------------------------|
| Thickness = | 0.035 mm                 |
| Width =     | 1.0 mm                   |
| Length =    | 1.025 mm                 |
| Clearance = | 0.775 mm (Signal to GND) |

The actual trace limits in a host system should be calculated to correspond to 50ohm and it may be provided by the pcb maker.



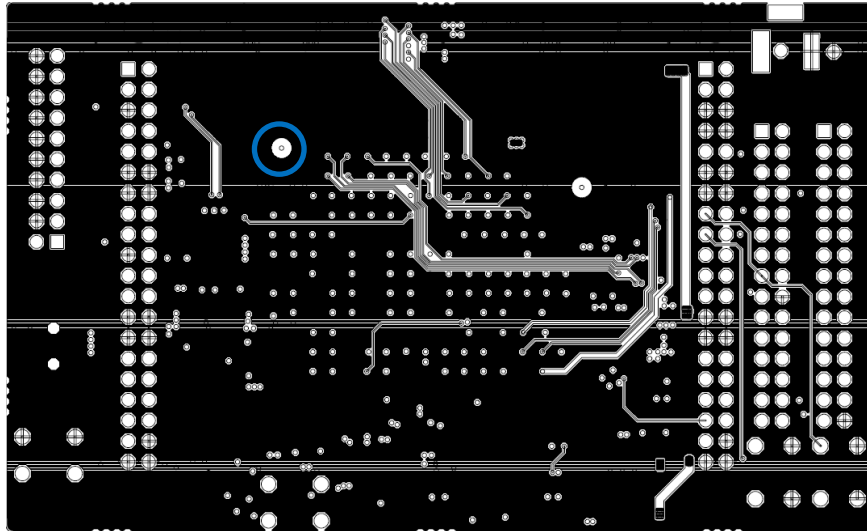
### Layer2, inner layer:

It needs a cut-out on layer2 to meet 50ohm.



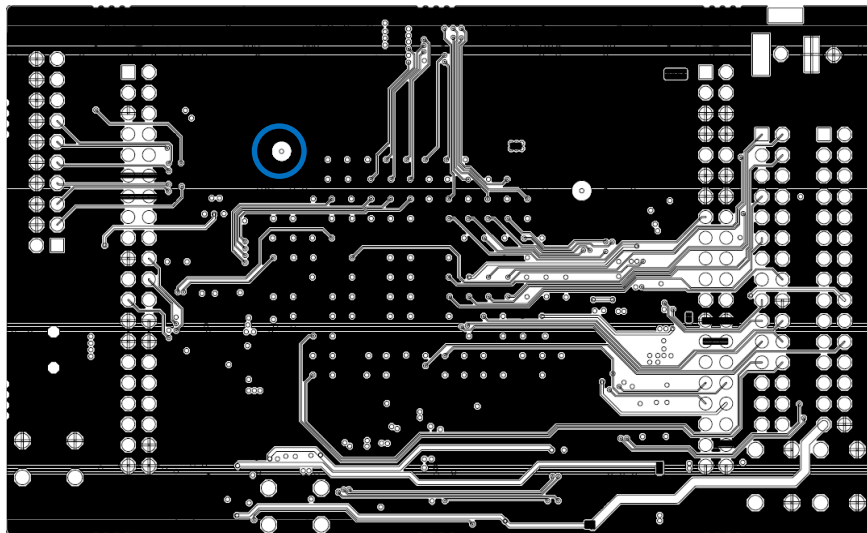
**Layer3, inner layer:**

There is no cut-out. The related via remains only.



**Layer4, inner layer:**

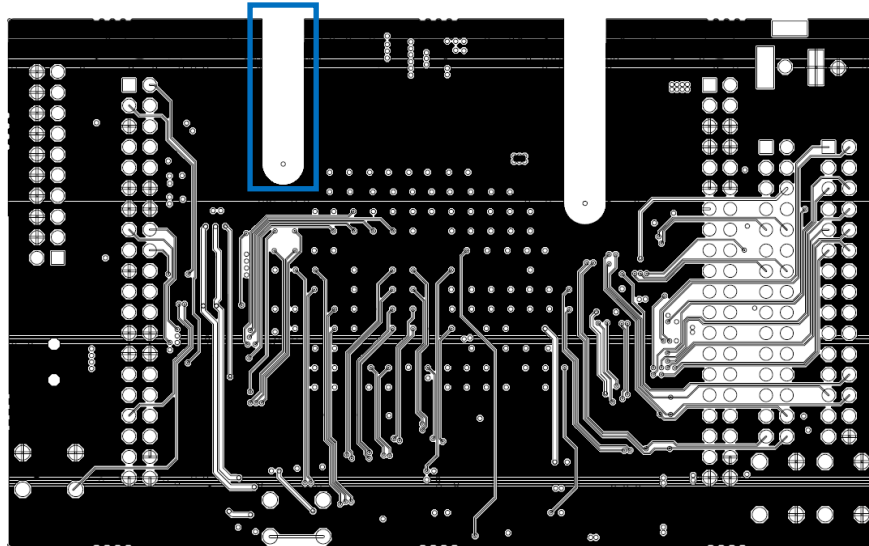
There is no cut-out. The related via remains only.



**Layer5, inner layer:**



Same cut-out with layer 6's should be applied to match 50ohm.

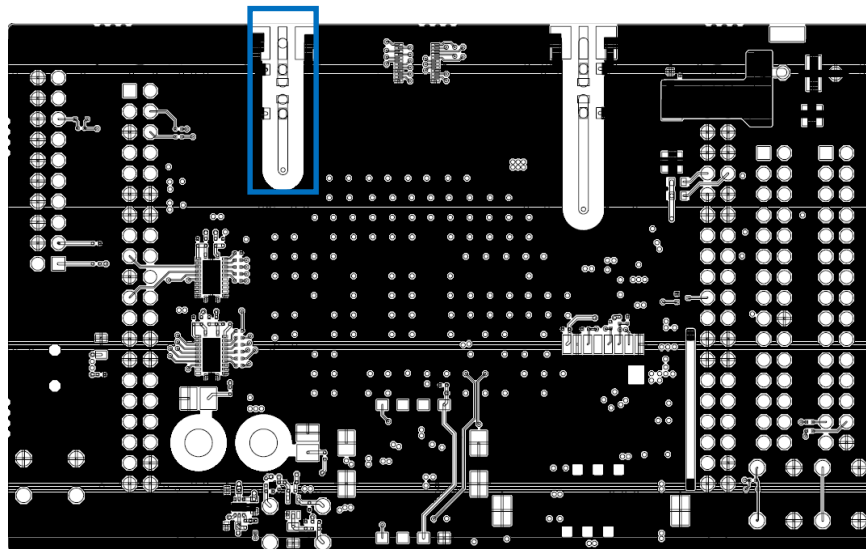


**Layer6, Bottom layer:**

The trace info as;

|             |                        |
|-------------|------------------------|
| Thickness = | 0.035 mm               |
| Width =     | 1.2 mm                 |
| Length =    | 13.395 mm              |
| Clearance = | 2.0 mm (Signal to GND) |

The actual trace limits in a host system should be calculated to correspond to 50 ohm which may be provided by the pcb maker.



## 7.6. GPS Antenna-Installation Guidelines (HE863-EUG/NAG/AUG only)

- The HE863-EUG/NAG/AUG due to its characteristics of sensitivity is capable to perform a Fix inside the buildings. (In any case the sensitivity could be affected by the building characteristics i.e. shielding)
- The Antenna must not be co-located or operating in conjunction with any other antenna or transmitter;
- Antenna shall not be installed inside metal cases
- Antenna shall be installed also according Antenna manufacturer instructions.



## 8. Logic Level Specifications

Where not specifically stated, all the interface circuits work at 1.8V CMOS logic levels. The following table shows the logic level specifications used in the Telit HE863 Family interface circuits:

For 1.8V CMOS signals:

### 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   | -0.15V | +3.0 V |

### Operating Range - Interface levels

| Level             | Min   | Max   |
|-------------------|-------|-------|
| Input high level  | 1.26V | 2.0 V |
| Input low level   | -0.2V | 0.36V |
| Output high level | 1.6V  | 1.8V  |
| Output low level  | 0V    | 0.2V  |



| Signal | Function    | I/O | BGA Ball |
|--------|-------------|-----|----------|
| RESET# | Phone reset | I   | G5       |

The RESET# is internally controlled on start-up to achieve always a proper power-on reset sequence. There is no need to control this pin on start-up. It may only be used to reset a device already on that is not responding to any command.



Use AT#SHDN command to perform this function.



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

| Signal           | Min   | Max  |
|------------------|-------|------|
| RESET Input high | 2.0V* | 2.6V |
| RESET Input low  | 0V    | 0.2V |

If unused, this signal may be left unconnected. If used, it must always be connected with an open collector transistor to permit the internal circuitry the power on reset and under voltage lockout functions.



## 9. Serial Ports

The serial port on the Telit HE863 Family is the interface between the module and OEM hardware.

2 serial ports are available on the module:

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

### 9.1. Modem Serial Port

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

- RS232 PC com port;
- microcontroller UART @ 1.8V – 2.0V (Universal Asynchronous Receive Transmit) ;

Depending on the type of serial port on the OEM hardware, a level translator circuit may be needed to make the system work. The only configuration that does not need a level translation is the 1.8V – 2.0V UART.

The serial port on HE863 Family is a +1.8V UART with all the 7 RS232 signals. It differs from the PC-RS232 in signal polarity (RS232 is reversed) and levels. The levels for HE863 Family UART are the CMOS levels:

**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   | -0.15V | +3.0 V |

**Operating Range - Interface levels**

| Level             | Min   | Max   |
|-------------------|-------|-------|
| Input high level  | 1.26V | 2.0 V |
| Input low level   | -0.2V | 0.36V |
| Output high level | 1.6V  | 1.8V  |
| Output low level  | 0V    | 0.2V  |



The signals of the HE863 Family serial port are:

| RS232 Pin Number | Signal         | HE863 Family Ball | Name                    | Usage                                                                   |
|------------------|----------------|-------------------|-------------------------|-------------------------------------------------------------------------|
| 1                | DCD - dcd_uart | M3                | Data Carrier Detect     | Output from the HE863 Family that indicates the carrier presence        |
| 2                | RXD - Tx_uart  | J4                | Transmit line *see Note | Output transmit line of HE863 Family UART                               |
| 3                | TXD - Rx_uart  | J3                | Receive line *see Note  | Input receive of the HE863 Family UART                                  |
| 4                | DTR - dtr_uart | L3                | Data Terminal Ready     | Input to the HE863 Family that controls the DTE READY condition         |
| 5                | GND            | All GND           | Ground                  | ground                                                                  |
| 6                | DSR - dsr_uart | L4                | Data Set Ready          | Output from the HE863 Family that indicates the module is ready         |
| 7                | RTS - rts_uart | K3                | Request to Send         | Input to the HE863 Family that controls the Hardware flow control       |
| 8                | CTS - cts_uart | K4                | Clear to Send           | Output from the HE863 Family that controls the Hardware flow control    |
| 9                | RI - ri_uart   | M4                | Ring Indicator          | Output from the HE863 Family that indicates the Incoming call condition |



**TIP:**

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

**NOTE:**

According to V.24, RX/TX signal names are referred to the application side, therefore on the HE863 Family side these signal are on the opposite direction: TXD on the application side will be connected to the receive line (here named TXD/ rx\_uart ) of the HE863 Family serial port and vice versa for RX.



**NOTE:**

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



## 9.2. RS232 Level Translation

In order to interface the Telit HE863 Family with a PC com port or a RS232 (EIA/TIA-232) application a level translator is required. This level translator must:

- invert the electrical signal in both directions;
- Change the level from 0/1.8V to +15/-15V.

Actually, the RS232 UART 16450, 16550, 16650 & 16750 chipsets accept signals with lower levels on the RS232 side (EIA/TIA-562), allowing a lower voltage-multiplying ratio on the level translator. Note that the negative signal voltage must be less than 0V and hence some sort of level translation is always required.

The simplest way to translate the levels and invert the signal is by using a single chip level translator. There are a multitude of them, differing in the number of drivers and receivers and in the levels (be sure to get a true RS232 level translator not a RS485 or other standards).

By convention the driver is the level translator from the 0-1.8V UART to the RS232 level. The receiver is the translator from the RS232 level to 0-1.8V UART.

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

- 5 drivers
- 3 receivers



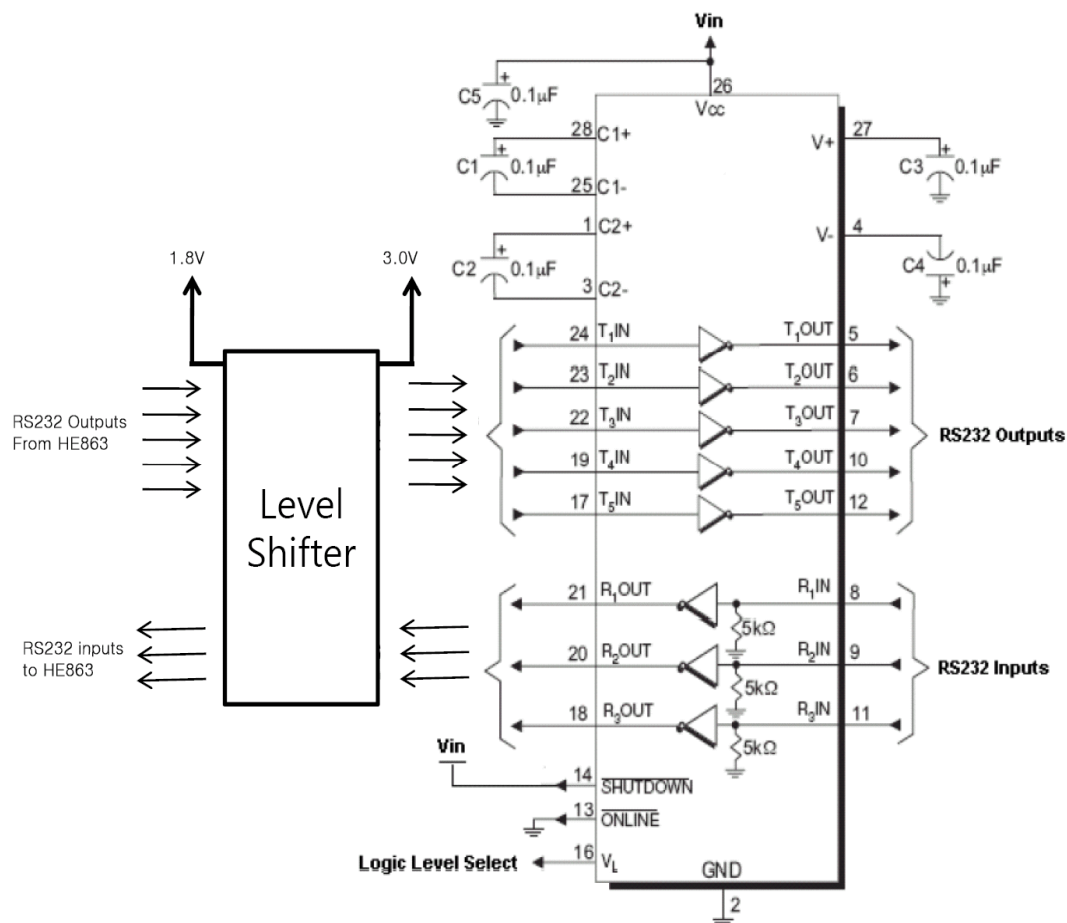
### NOTE:

The digital input lines working at 1.8V CMOS have an absolute maximum input voltage of 3.6V; therefore the level translator IC shall not be powered by the +3.8V supply of the module. Instead, it must be powered from a +1.8V / +2.0V (dedicated) power supply.

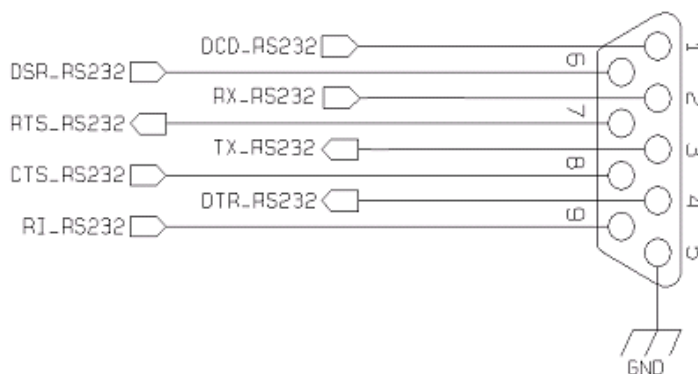
This is because in this way the level translator IC outputs on the module side (i.e. HE863 Family inputs) will work at +3.8V interface levels, damaging the module inputs.



An example of level translation circuitry of this kind is:



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



## 10. USB Port

The HE863 Family module includes a Universal Serial Bus (USB) transceiver, which operates at USB low-speed (1.5Mbits/sec), USB full-speed (12Mbits/sec) and USB high-speed (480Mbits/sec).

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

The table below describes the USB interface signals:

| Signal                    | HE863 Family Ball | Usage                                                                                                                                                                |
|---------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| USB_VBUS                  | S8                | Power supply for the internal USB transceiver. This pin is configured as an analog input or an analog output depending upon the type of peripheral device connected. |
| USB_D-                    | R8                | Minus (-) line of the differential, bi-directional USB signal to/from the peripheral device                                                                          |
| USB D+                    | R9                | Plus (+) line of the differential, bi-directional USB signal to/from the peripheral device                                                                           |
| USB_ID<br>(Not supported) | S9                | HE863 Family does support a slave mode only and USB_ID is not available for the application design.                                                                  |



### TIP:

The HE863 Family does NOT support a host device operation, that is, it works as a slave device only.



## 11. Audio Section (HE863-EUR/EUG/NAR/NAG/AUG only)

The *Baseband* chip 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 differential/Single ended type** (from *HandSet* or *MicroTelephone* )
- external audio transducers → **HF only single-ended output type** (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.

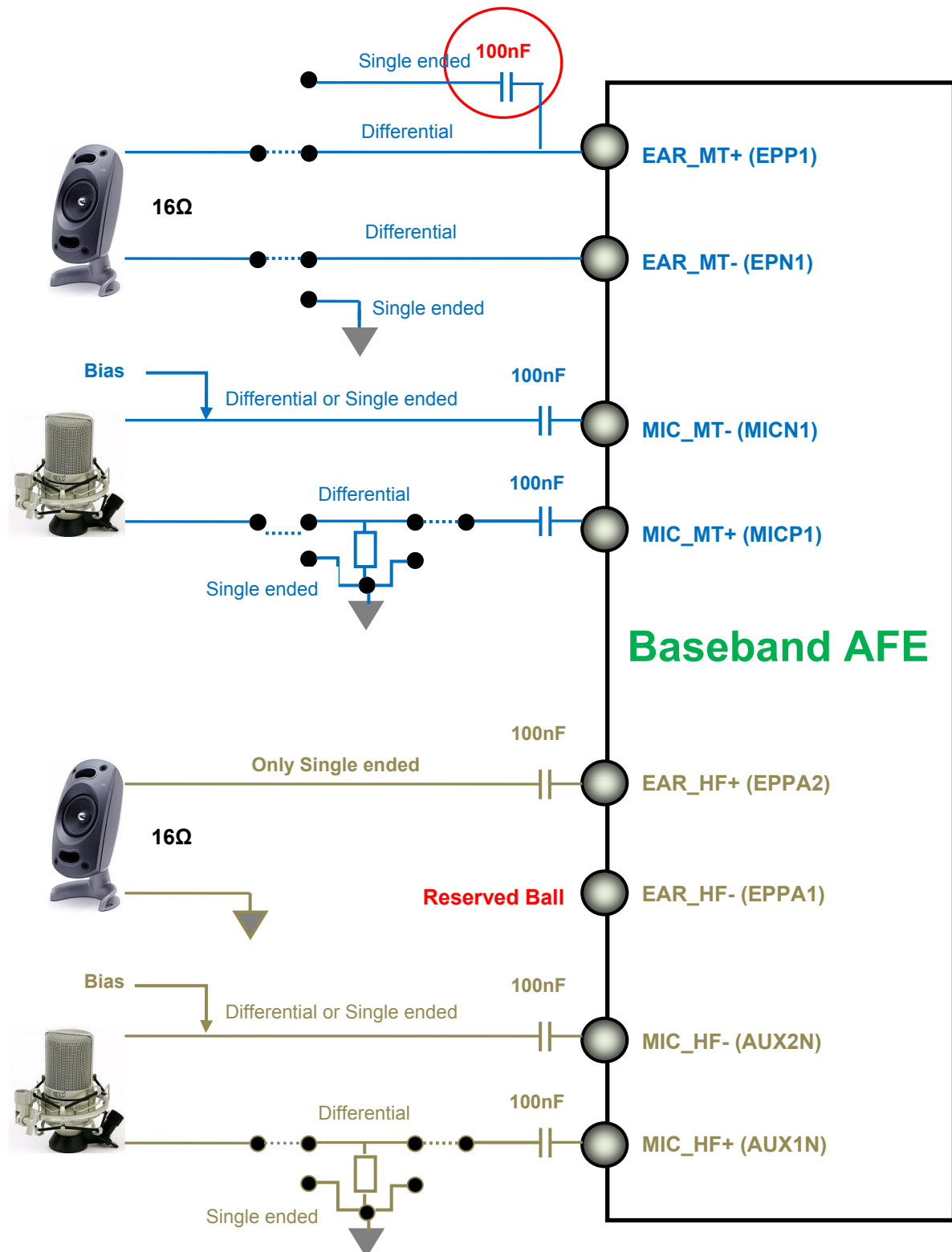
For these reasons we have not changed the *HS* and *HF* acronyms, keeping them in the Software and on the schematics.

### 11.1. 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.





## 11.2. Microphone Characteristics



### TIP:

Being the microphone circuitry the more noise sensitive, its design and layout must be realized 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.

### 11.2.1. Input Lines (*MT and HF*) Characteristics

|                              |                     |
|------------------------------|---------------------|
| Line coupling                | AC(*)               |
| Line type                    | Balanced/Unbalanced |
| Coupling capacitor           | $\geq 100\text{nF}$ |
| Differential input impedance | 50K $\Omega$        |
| Differential input voltage   | Max 0.8Vpp          |
| input capacitance            | 5pF(typ.)           |



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

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

## 11.3. OUTPUT LINES (*Speaker*)

We suggest driving the load differentially from both output drivers, thus the output swing will double and the need for the output coupling capacitor avoided.

If a particular OEM application needs a *Single Ended Output* configuration the output power will be reduced four times.

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





**(\*) WARNING:**

Using single ended configuration, the unused output line must be left open.  
Not respecting this constraint, the output stage will be damaged.



**DANGER:**

Using HS/MT, the serial capacitors below 100nF must be connected in the output lines.

The handsfree mode only supports single ended type and reserved HF- Ball must be opened.

### 11.3.1. Output Lines Characteristic

|                                    |                              |                                                                           |
|------------------------------------|------------------------------|---------------------------------------------------------------------------|
| Line coupling                      | differential<br>single-ended | DC                                                                        |
|                                    |                              | AC                                                                        |
| Output load impedance              | differential                 | 16 $\Omega$                                                               |
| Signal bandwidth                   |                              | 150 - 4000 Hz @ -3 dB                                                     |
| Differential output voltage (typ.) |                              | 3700 mV <sub>pp</sub> /Full scale<br>differential open<br>circuit voltage |
| Max Output Power                   | @ 16 $\Omega$                | 100mW                                                                     |
| Output load resistance             |                              | 14 $\Omega$                                                               |

Table 3. “*Ear\_MT*” Output (*EAR\_EPx1* differential amplifier)

|                       |              |                             |
|-----------------------|--------------|-----------------------------|
| Line coupling         | single-ended | DC                          |
|                       |              | AC                          |
| Output load impedance | single-ended | 16 $\Omega$                 |
| S.E. output impedance |              | $\leq 0,5 \Omega$ @ 1.02kHz |



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|                                    |                                                                                   |
|------------------------------------|-----------------------------------------------------------------------------------|
| signal bandwidth                   | 150 - 4000 Hz @ -3 dB                                                             |
| Single ended output voltage (max.) | 2000 mV <sub>pp</sub> /Full scale single ended open circuit voltage, bipolar mode |
| Max Output Power @ 16Ω             | 30mW                                                                              |
| Output load resistance             | 14 Ω                                                                              |

Table 4. *“Ear\_HF” Output* (EAR\_EPPA2 amplifiers)



### TIP:

If you need to raise the output power of HF, you should use an external Amplifier.



## 12. General Purpose I/O

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

- input
- output
- alternate function (internally controlled)

Input pads can only be read and report the digital value (high or low) present on the pad at the read time; output pads can only be written or queried and set the value of the pad output; an alternate function pad is internally controlled by the HE863 Family firmware and acts depending on the function implemented.

The following GPIOs are available on the HE863 Family.

| Ball | Signal   | I/O | Function                 | Type      | Drive strength | Default State | ON_OFF State | Note                        |
|------|----------|-----|--------------------------|-----------|----------------|---------------|--------------|-----------------------------|
| J11  | TGPIO_01 | I/O | GPIO01 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| G9   | TGPIO_02 | I/O | GPIO02 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| K11  | TGPIO_03 | I/O | GPIO03 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| F9   | TGPIO_04 | I/O | GPIO04 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| F10  | TGPIO_05 | I/O | GPIO05 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| E10  | TGPIO_06 | I/O | GPIO06 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          | Alternate function (ALARM)  |
| E9   | TGPIO_07 | I/O | GPIO07 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| B10  | TGPIO_08 | I/O | GPIO08 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| N12  | TGPIO_09 | I/O | GPIO09 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          |                             |
| M8   | TGPIO_10 | I/O | GPIO10 Configurable GPIO | CMOS 1.8V | 2mA            | INPUT         | LOW          | Alternate function (PCM_TX) |



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|     |          |     |                                |              |     |       |      | -R/-G only                                            |
|-----|----------|-----|--------------------------------|--------------|-----|-------|------|-------------------------------------------------------|
| P12 | TGPIO_11 | I/O | GPIO11<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| L12 | TGPIO_12 | I/O | GPIO12<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| N11 | TGPIO_13 | I/O | GPIO13<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| P11 | TGPIO_14 | I/O | GPIO14<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| M12 | TGPIO_15 | I/O | GPIO15<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| N10 | TGPIO_16 | I/O | GPIO16<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| M7  | TGPIO_17 | I/O | GPIO17<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  | Alternate<br>function<br>(PCM_SYN<br>C)<br>-R/-G only |
| M9  | TGPIO_18 | I/O | GPIO18<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  | Alternate<br>function<br>(PCM_RX)<br>-R/-G only       |
| P10 | TGPIO_19 | I/O | GPIO19<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| M11 | TGPIO_20 | I/O | GPIO20<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |
| K12 | TGPIO_21 | I/O | GPIO21<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | HIGH |                                                       |
| L11 | TGPIO_22 | I/O | GPIO22<br>Configurable<br>GPIO | CMOS<br>1.8V | 2mA | INPUT | LOW  |                                                       |

Not all GPIO pads support all these three modes:

- GPIO6 supports all three modes and can be input, output, alarm output (Alternate function)

Some alternate functions for HE863 Family may be added if needed.



## 12.1. Logic Level Specifications

Where not specifically stated, all the interface circuits work at 1.8V CMOS logic levels.

The following table shows the logic level specifications used in the HE863 Family interface circuits:

For 1.8V CMOS signals:

**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   | -0.15V | +3.0 V |

**Operating Range - Interface levels**

| Level             | Min   | Max   |
|-------------------|-------|-------|
| Input high level  | 1.26V | 2.0 V |
| Input low level   | -0.2V | 0.36V |
| Output high level | 1.6V  | 1.8V  |
| Output low level  | 0V    | 0.2V  |

## 12.2. Using a GPIO Pad as Input

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

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



### NOTE:

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



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

The GPIO6 pad, when configured as Alarm Output, is controlled by the HE863 Family module and will rise when the alarm starts and fall after the issue of a dedicated AT command.

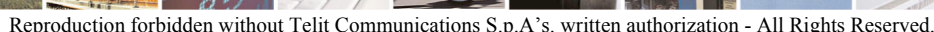
In battery-powered devices this feature will greatly improve the autonomy of the device.

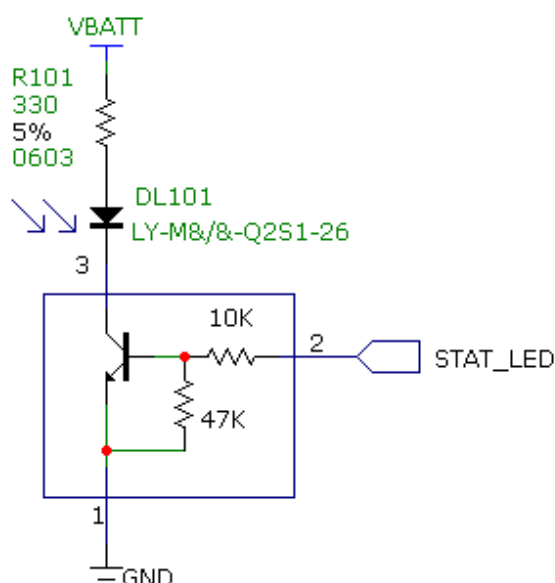


During RESET the line is set to HIGH logic level.

The STAT\_LED pin status shows information on the network service availability and Call status. In the HE863 Family modules, the STAT\_LED usually needs an external transistor to drive an external LED. Because of the above, the status indicated in the following table is reversed with respect to the pin status:

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





## 12.6. RTC\_Bypass Out

The VRTC pin brings out the Real Time Clock supply, which is separate from the rest of the digital part, allowing having only RTC going on when all the other parts of the device are off. To this power output a backup capacitor can be added in order to increase the RTC autonomy during power off of the battery.



### NOTE:

NO devices must be powered from this pin.

## 12.7. VAUX1 Power Output

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

Operating Range – VAUX1 power supply

|                                                | Min   | Typical | Max   |
|------------------------------------------------|-------|---------|-------|
| Output voltage                                 | 1.75V | 1.8V    | 1.85V |
| Output current                                 |       |         | 100mA |
| Output bypass capacitor<br>(Inside the module) |       |         | 1µF   |



## 13. DAC and ADC section

### 13.1. DAC Converter

#### 13.1.1. Description

The HE863 Family module provides a Digital to Analog Converter. The signal (named DAC\_OUT) is available on BGA Ball S4 of the HE863 Family module.

The on board DAC is a 16-bit converter, able to generate an analogue value based on a specific input in the range from 0 up to 65535 but recalibrated in the range from 0 to 1023. However, an external low-pass filter is necessary.

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

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

Integrated output voltage =  $1.8 * \text{value} / 1023$

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

#### 13.1.2. Enabling DAC

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

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

it must be present if <enable>=1

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

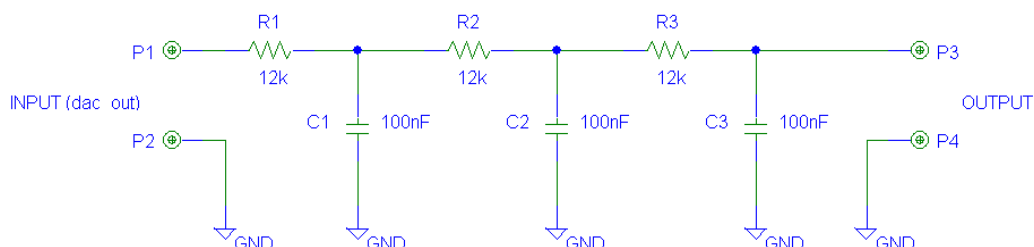


#### NOTE:

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



### 13.1.3. Low Pass Filter Example



## 13.2. ADC Converter

### 13.2.1. Description

The on board ADCs are 10-bit converters. They are able to read a voltage level in the range of 0-1.2 volts applied on the ADC pin input and store and convert it into 10 bit word.

|                     | Min | Max   | Units |
|---------------------|-----|-------|-------|
| Input Voltage range | 0   | 1.2   | Volt  |
| AD conversion       | -   | 10    | bits  |
| Resolution          | -   | < 1.2 | mV    |

The HE863 Family module provides 3 Analog to Digital Converters. The input lines are:

ADC\_IN1 is available on BGA Ball R4 of the HE863 Family module.

ADC\_IN2 is available on BGA Ball R5 of the HE863 Family module.

ADC\_IN3 is available on BGA Ball S5 of the HE863 Family module.

### 13.2.2. Using ADC Converter

An AT command is available to use the ADC function.

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

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



## **14. GPS and Accelerometer (HE863-EUG/NAG/AUG only)**

### **14.1. GPS(Global Positioning System)**

#### **14.1.1. Description**

HE863-EUG/NAG/AUG have an embedded standalone GPS as one of GNSS(Global Navigation Satellite System).

By using AT command the customers can enable or disable this function and will be able to get some NMEA data too whenever it's needed.

Please refer to the "HE863 AT Command Manual" for the detailed use.

Acquisition sensitivity : -145dBm, the level to satisfy TTFF < 300sec under cold start

Tracking sensitivity : -159dBm, the level to maintain location fix once attained

### **14.2. Accelerometer**

#### **14.2.1. Description**

HE863-EUG/NAG/AUG have a tri-axial, low-g acceleration sensor IC; BMA150, BOSCH product.

It can sense the factors such as tilt, motion and shock vibration so on.

Please refer to the "HE863 AT Command Manual" for the detailed use.



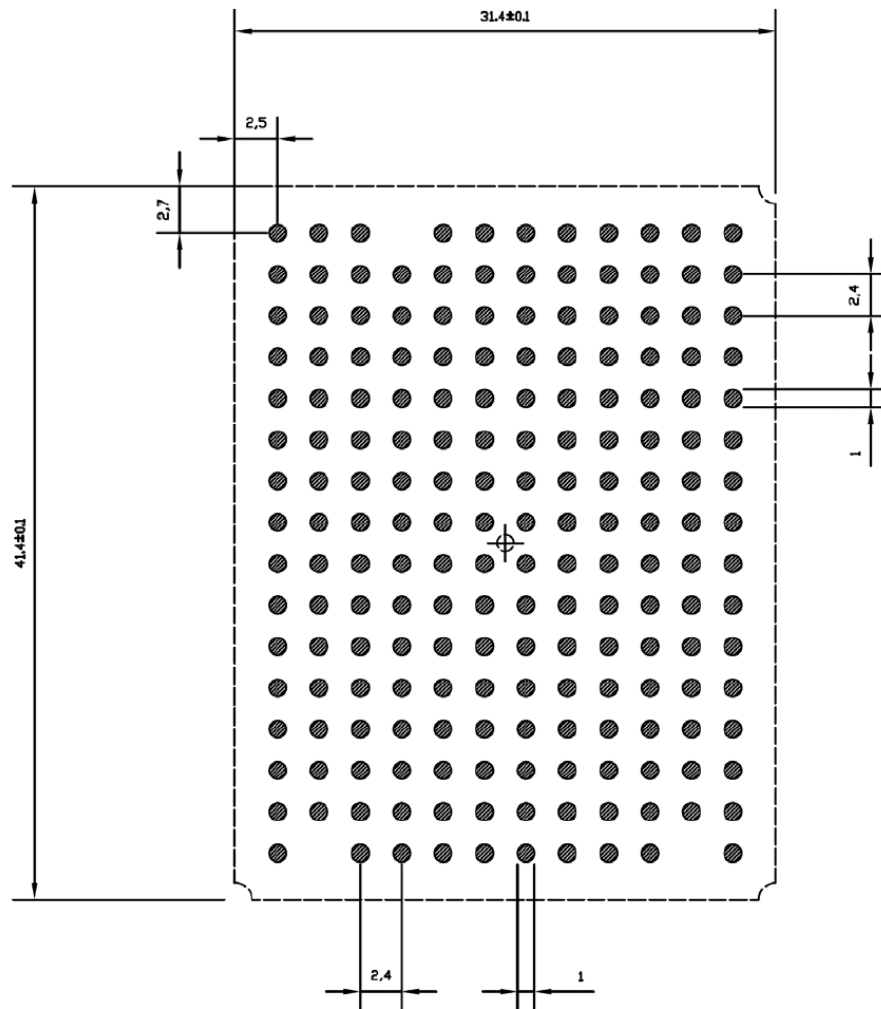
## 15. Mounting the HE863 Family on your board

### 15.1. General

The Telit HE863 Family module has been designed in order to be compliant with a standard lead-free SMT process.



### 15.1.1. Recommended footprint for the application



SOLDER RESIST= +0.1 mm clear of pad

SOLDER PASTE= pad dimension

TOP VIEW

### 15.1.2. Suggested Inhibit Area

In order to easily rework the HE863 Family 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.

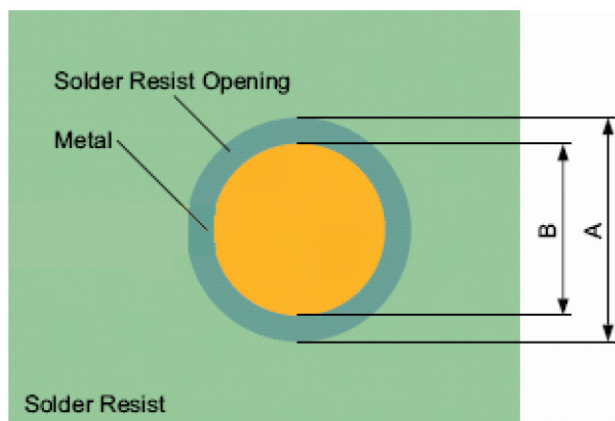
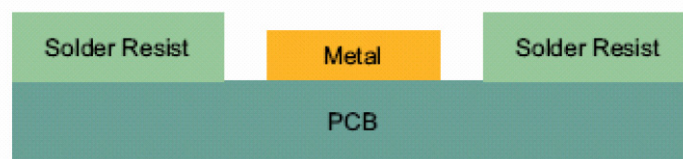


### 15.1.3. Stencil

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

### 15.1.4. PCB Pad Design

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

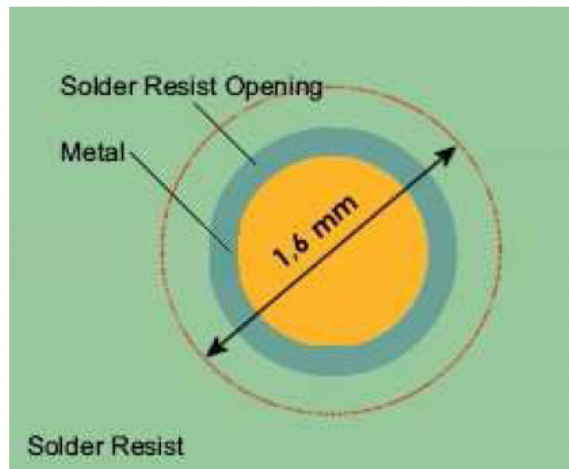


Recommendations for PCB pad dimensions

|                                       |              |
|---------------------------------------|--------------|
| Ball pitch [mm]                       | 2,4          |
| Solder resist opening diameter A [mm] | 1,10         |
| Metal pad diameter B [mm]             | $1 \pm 0.05$ |

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 /<br>Immersion Au | 3-7 /<br>0,05-0,15  | good solder ability protection,<br>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.

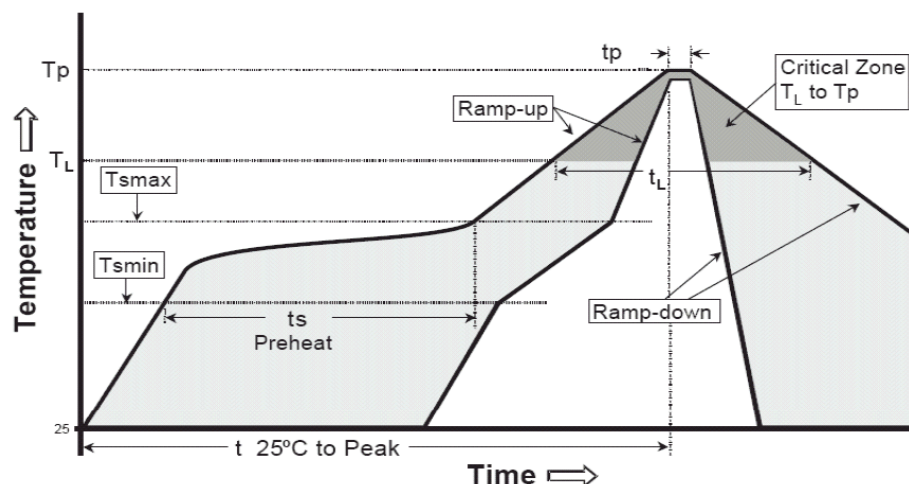
### 15.1.5. Solder paste

|              |              |
|--------------|--------------|
|              | Lead free    |
| Solder paste | Sn / Ag / Cu |



## 15.1.6. HE863 Family Solder Reflow

The following is the recommended solder reflow profile



| Profile Feature                                                                                                   | Pb-Free Assembly                 |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Average ramp-up rate ( $T_L$ to $T_P$ )                                                                           | 3°C/second max                   |
| Preheat:<br>– Temperature Min ( $T_{smin}$ )<br>– Temperature Max ( $T_{smax}$ )<br>– Time (min to max) ( $t_s$ ) | 150°C<br>200°C<br>60-180 seconds |
| $T_{smax}$ to $T_L$ :<br>– Ramp-up Rate                                                                           | 3°C/second max                   |
| Time maintained above:<br>– Temperature ( $T_L$ )<br>– Time ( $t_L$ )                                             | 217°C<br>60-150 seconds          |
| Peak Temperature ( $T_P$ ):                                                                                       | 245 $\pm$ 0/-5°C                 |
| Time within 5°C of actual Peak Temperature ( $t_p$ )                                                              | 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:

HE863 Family module can accept only one reflow process.



## 15.2. Debug of the HE863 Family in Production

To test and debug the mounting of HE863 Family, we strongly recommend foreseeing test pads on the host PCB, in order to check the connection between the HE863 Family itself and the application and to test the performance of the module connecting it with an external computer. Depending on the customer application, these pads include, but are not limited to the following signals:

### Basic signals for power on/off

- VBATT
- ON/OFF\*
- RESET\*
- GND
- PWRMON

### Traces using UART interface

- TXD
- RXD
- TX\_TRACE
- RX\_TRACE

### Traces using USB interface

- USB\_VBUS
- USB\_D+
- USB\_D-



## 16. Application Design Guidelines

### 16.1. Bypass capacitor on Power supplies

When a sudden voltage is asserted to or cut from the power supplies, the steep transition makes some reactions such as the overshoot and undershoot.

This abrupt voltage transition can affect the device not to work or make it malfunction.

The bypass capacitors are needed to alleviate this behavior and it can be affected differently according to the various applications.

The customers have to pay special attention to this when they design.

The length and width of the power lines need to be considered carefully and the capacitance of the capacitors need to be selected accordingly.

The capacitor will also avoid the ripple of the power supplies and the switching noise causing in TDMA system like GSM.

Specially the bypass capacitor must be mounted on the Vbatt (Ball no. C1,D1) and USB\_VBUS (Ball no. S8) lines in the application board.

Telit recommends that the capacitance on Vbatt and USB\_VBUS should be at least above 100uF respectively.

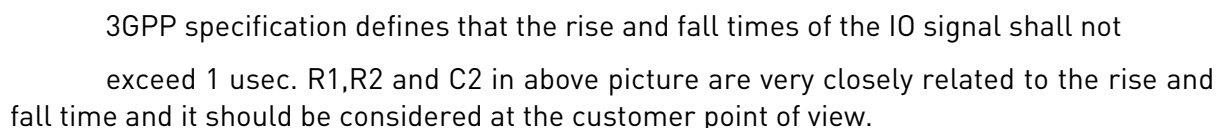
But the customers still have to consider that the capacitance depends on the conditions of the application.

Generally more capacitance is requested as the length of the power line is longer.





When designing SIM interface on the application board, the following descriptions can be referred to.



It means that the values of R2,C1,C2,C3,C4,C5 may be necessary to be optimized in the application design. But in general there will be no issue if above schematics were made on the application board. All components should be reserved for any possible debugging in future and those can be DNI if not needed.

HE863 Family modules already have 4.7kohm pull up resistor on SIMIO line internally.  
So generally R2 in the application will not be necessary.

The following assumes that the application is using a commonly found 10K $\Omega$  DC terminated antenna.

The figure below outlines the reference implementation, please keep in mind that these components are in the RF path and care must be taken when implementing this circuit.



The Vaux is an 1.8V regulated power source output from the module.

ADC is a 0 ~ 1200mV 10-bit Analog to Digital Converter input.

The software assumes the use of the ADC1 input and GPIO13 port of the module for this purpose.

For the detailed operation of this function, please find AT#GSMAD command in the HE863 AT Command Manual.

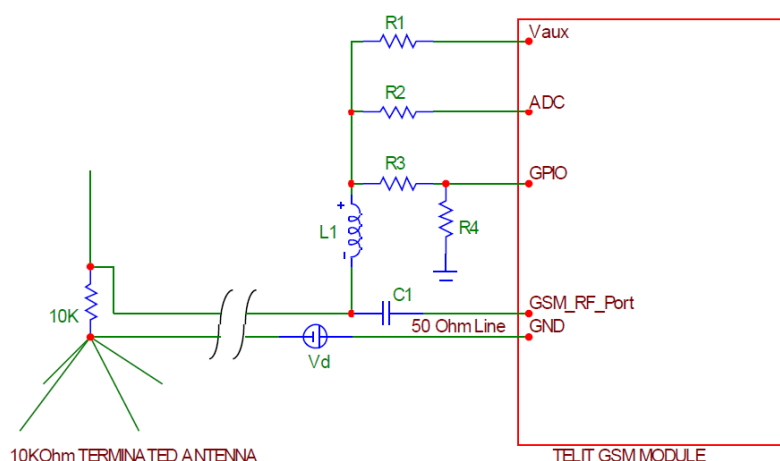


Figure 1, Antenna Diagnostics reference schematic.

| Component | Value        |
|-----------|--------------|
| R1        | 68K $\Omega$ |
| R2        | 15K $\Omega$ |
| R3        | 68K $\Omega$ |
| R4        | 68K $\Omega$ |
| L1        | 47nH         |
| C1        | 33pF         |

## 16.4. Download and Debug Port

One of the following options should be chosen in the design of host system in order to download or upgrade the Telit's software and debug HE863 when HE863 is already mounted on a host system.

### Users who use both of UART and USB interfaces to communicate HE863

- Must implement a download method in a host system for upgrading HE863 when it's mounted.

### Users who use USB interface only to communicate HE863



- Must arrange UART port in a host system for debugging or upgrading HE863 when it's mounted.

#### Users who use UART interface only to communicate HE863

- Must arrange USB port in a host system for debugging or upgrading HE863 when it's mounted.

## 16.5. ESD Protection

Telit recommends that the TVS diodes or varistor should be used to protect HE863 Family from ESD.



#### NOTE:

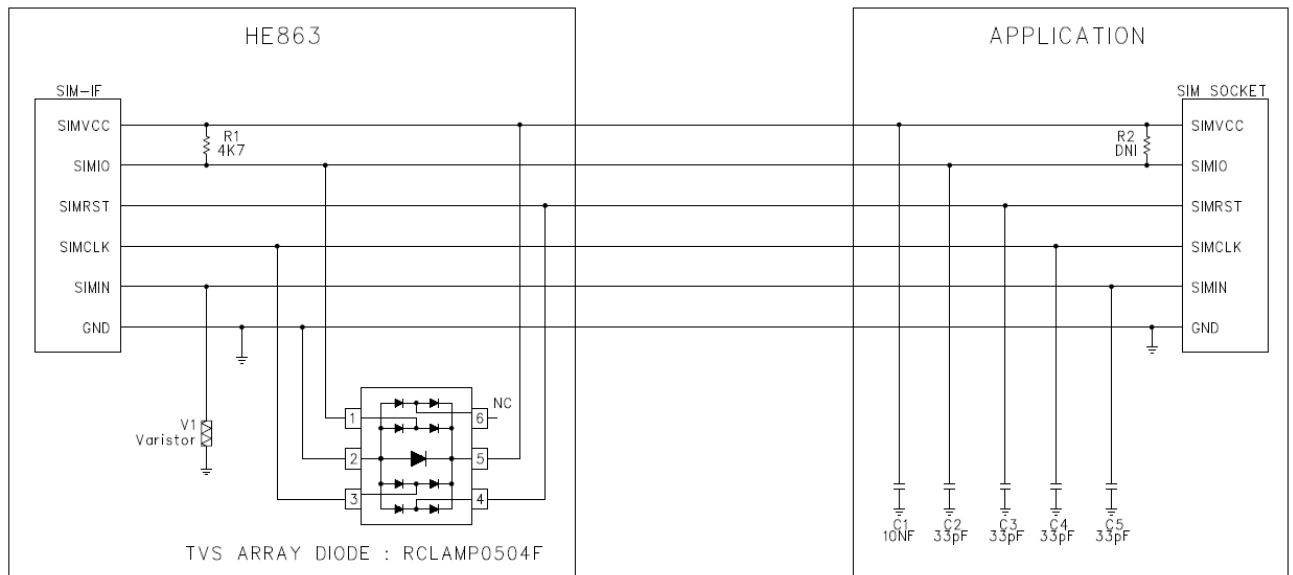
The HE863 Family is provided with an internal ESD protection for SIM interface, USB interface and some additional lines.

### 16.5.1. ESD Protection for SIM interface

Following description represents ESD protection for SIM interface of HE863 Family.



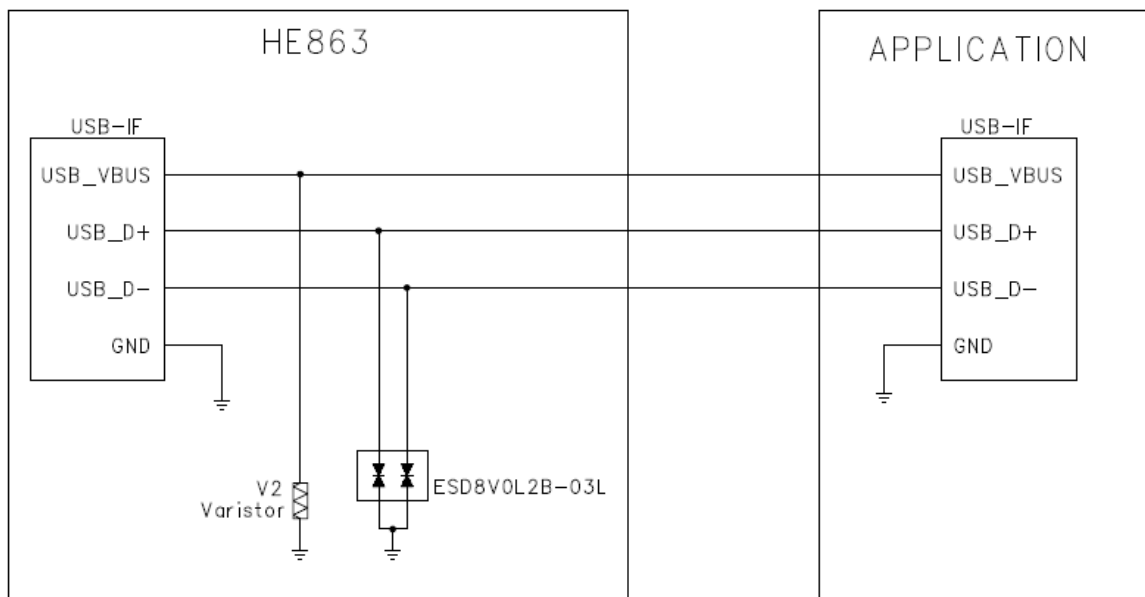
HE863 Family already has a tvs array diode inside so without any special reason the applications will not need additional protectors on their design.



### 16.5.2. ESD Protection for USB interface

Following description represents ESD protection for USB interface of HE863 Family. HE863 Family already has a tvs array diode for data lines and a varistor for USB\_VBUS inside so without any special reason the applications will not need additional protectors on their design.





### 16.5.3. ESD Protection for Additional lines

HE863 Family already has several varistors inside for esd protections of following signal lines.

- VBATT
- VAUX1
- VRTC\_2V3
- ON/OFF\*
- RESET\*



## 17. Conformity Assessment Issues

The Telit HE863 Family have 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.

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If the module is installed in conformance to the Telit installation manuals, no further evaluation under **Article 3.2** of the R&TTE Directive is needed and it is not required for further involvement of a R&TTE Directive Notified Body for the final product.

In all other cases, or if the manufacturer of the final product is in doubt, then the equipment integrating the radio module must be assessed against **Article 3.2** of the R&TTE Directive.

In all cases 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.

The Product Description, the Hardware User Guide and Software User Guide contain all the information the customer may need for developing a product meeting the R&TTE Directive. The HE863 Family is FCC/IC Approved as module to be installed in other devices.

This device should be used only for fixed and mobile applications and if the final product after integration is intended for portable use, a new application and FCC is required.

The user is cautioned that this device should be used only as specified within this manual to meet RF exposure requirements.

Use of this device in a manner inconsistent with this manual could lead to excessive RF exposure conditions.

The HE863 Family is conforming to the following US Directives:

- Use of RF Spectrum. Standards: FCC47 Part 22&24
- EMC 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, including interference that may cause undesired operation of the device.

The user must refer to below information to meet the FCC/IC's RF exposure rules and regulations when they design:



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- 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 4dBi 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.
- HE863 Family is intended for the OEM integrator only.
- The user is required to see the Grant of Equipment document for other restrictions.
- HE863 Family must be operated and used with a locally approved access point.
- The radio transmitter(IC ID:5131A-HE863NA & IC ID: 5131A-HE863NAG) has been approved by Industry Canada to operate with the antenna type listed in this manual with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

The following regulatory and safety notices must be published in documentation supplied to the end user of the product or system incorporating an adapter in compliance with local regulations.

- Host system including HE863-NAD must be labeled with  
“Contains transmitter module with  
FCC ID:RI7HE863NA and IC ID:5131A-HE863NA”.
- Host system including HE863-NAR must be labeled with  
“Contains transmitter module with  
FCC ID:RI7HE863NA and IC ID:5131A-HE863NA”.
- Host system including HE863-NAG must be labeled with  
“Contains transmitter module with  
FCC ID:RI7HE863NAG and IC ID:5131A-HE863NAG”.
- Host system including HE863-EUD must be labeled with  
“Contains transmitter module with FCC ID:RI7HE863EU”.



## 18. Safety Recommendations

Read carefully!

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

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

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

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

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

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

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

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

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

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

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

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



## 19. Document History

| Revision | Date       | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rev.0    | 2010-07-23 | First issue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Rev.1    | 2010-07-27 | Updated 4 HE863-EUD Modules Connections<br>Updated 4.1 PIN-OUT<br>Updated 5.2 Initialization and Activation state(TBD)<br>Updated 5.3 Turning off the HE863-EUD<br>Updated 5.4 Summary of Turning ON and OFF the HE863-EUD(TBD)<br>Updated 8.1 Reset Signal<br>Updated 14 SIM holder design guides<br>Removed 17.1 The schematics of the HE863 interface board                                                                                                                                                                                                                                                                 |
| Rev.2    | 2010-10-13 | Added HE863-NAD/AUD/EUG/NAG/AUG characteristics<br>Added 2.1 HE863 Family Product Specification<br>Added 7.4 GPS Antenna Requirements(HE863-EUG/NAG/AUG only)<br>Added 7.5 GPS Antenna-PCB Line Guidelines(HE863-EUG/NAG/AUG only)<br>Added 7.6 GPS Antenna-Installation Guidelines(HE863-EUG/NAG/AUG only)<br>Added 11 AUDIO Section(HE863-EUG/NAG/AUG only)<br>Added 13 DAC and ADC section<br>Updated 4 HE863 Family Modules Connections<br>Updated 5.2 Initialization and Activation state<br>Updated 6.1 Power Supply Requirements<br>Updated 7 Antenna(s)<br>Updated 9.2 RS232 Level Translation<br>Renumbered chapters. |
| Rev.3    | 2010-11-24 | Added HE863-EUR/NAR<br>Updated 1 Introduction<br>Updated 2.1 HE863 Family Product Specification<br>Updated 4 HE863 Family Modules Connections<br>Updated 6.1 Power Supply Requirements<br>Updated 7 GSM/WCDMA Antenna Requirements<br>Updated 11 AUDIO Section(HE863-EUR/EUG/NAR/NAG/AUG only)                                                                                                                                                                                                                                                                                                                                 |
| Rev.4    | 2011-02-23 | Updated 4.1 HE863-EUD/NAD/AUD PIN-OUT<br>Updated 4.2 HE863-EUR/NAR PIN-OUT<br>Updated 4.3 HE863-EUG/NAG/AUG PIN-OUT<br>Updated 5.1 Turning On the HE863<br>Removed 5.4 Summary of Turning ON and OFF<br>Updated 6.1 Power Supply Requirements<br>Updated 6.2.2 Thermal Design Guidelines<br>Updated 8.1 Reset Signal<br>Updated 11 Audio Section<br>Updated 12 General Purpose I/O<br>Updated 13 DAC And ADC Section<br>Updated 15.2 SIM interface<br>Added 16 Antenna detection design guide                                                                                                                                  |
| Rev.5    | 2011-07-06 | Updated 4.1 HE863-EUD/NAD/AUD PIN-OUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



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|       |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |            | Updated 4.2 HE863-EUR/NAR PIN-OUT<br>Updated 4.3 HE863-EUG/NAG/AUG PIN-OUT<br>Updated 5.1 Turning ON the HE863<br>Updated 5.2 Initialization and Activation state<br>Updated 5.3 Turning OFF the HE863<br>Added 5.4 Summary of Turning ON and OFF<br>Updated 7.2 GSM/WCDMA Antenna – PCB line Guidelines<br>Updated 7.3 GSM/WCDMA Antenna – Installation Guidelines<br>Updated 7.5 GPS Antenna – PCB line Guidelines(HE863-EUG/NAG/AUG only)<br>Updated 8.1 Reset Signal<br>Updated 9.1 Modem Serial Port<br>Updated 11.2.1 Input Lines (MT and HF)Characteristics<br>Updated 11.3.1 Output Lines Characteristics<br>Updated 12.2 Using a GPIO Pad as Input<br>Updated 15.2 Debug of the HE863 Family in Production<br>Added 16 Application Design Guidelines<br>Added 16.1 Bypass Capacitor On Power Supplies<br>Added 16.2 SIM Holder Design Guide<br>Added 16.3 Antenna Detection Design Guide<br>Added 16.4 Download And Debug Port<br>Added 16.5 ESD Protection<br>Updated 17 Conformity Assessment Issues |
| Rev.6 | 2012-01-31 | Updated 6.2.1.2 +12V Input Source Power Supply Design Guidelines<br>Updated 14.1 GPS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

