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### APPLICABILITY TABLE

**PRODUCTS**

- GE864-QUAD V2
- GE864-QUAD AUTO V2
- GE864-GPS
- GE865-QUAD
- GE866-QUAD
- GE910-QUAD
- GE910-GNSS
- GE910-QUAD AUTO
- GE910-QUAD V3
- GL865-DUAL
- GL865-DUAL V3
- GL865-QUAD
- GL865-QUAD V3
- GL865-QUAD V4
- GL868-DUAL
- GL868-DUAL V3
- UE910-EU V2 AUTO
- UL865 SERIES
- UL865-N3G
- UE910 SERIES
- UE866 SERIES
- HE920 AUTO SERIES
- HE910 SERIES
- HE910 MINI PCIE
- LE866 SERIES
- LE910 SERIES
- LE920 AUTO SERIES
- LE910 V2 SERIES
- LE910 CAT.1 SERIES
- GE310-GNSS
1. INTRODUCTION

1.1. Scope
Scope of this document is to give an overview of the fonts, styles and general structure -- first chapter included -- to use when writing hardware user guides.

1.2. Audience
This document is intended for editors who are about to write or edit documentation for Telit.

1.3. Contact Info and Support
For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com

Alternatively, use:

http://www.telit.com/support

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

http://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.
Telit appreciates feedback from the users of our information.
1.4. Text Conventions

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

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

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

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

- GE865-QUAD Hardware User Guide, 1vv0300799
- GE/GC864-QUAD-V2 and GE864-GPS Hardware User Guide, 1vv0300915
- GE864-QUAD ATEX Hardware User Guide, 1vv0300879
- GE864-QUAD AUTOMOTIVE V2 Hardware User Guide, 1vv0300840
- GE866-QUAD Hardware User Guide, 1vv0301051
- GL865-DUAL/QUAD Hardware User Guide, 1vv0300910
- GL865-DUAL/QUAD V3 Hardware User Guide, 1vv0301018
- UC864-E/G/WD/E-DUAL Hardware User Guide, 1vv0300766
- GE910 Hardware User Guide, 1vv0300962
- GE910-QUAD AUTO Hardware User Guide, 1vv0301088
- UL865 Hardware User Guide, 1vv0301050
- UE910 Hardware User Guide, 1vv0301012
- HE910 Hardware User Guide, 1vv0300925
- HE920 Hardware User Guide, 1vv0301014
- HE910 V2 Hardware User Guide, 1vv0301064
- UE910 V2 Hardware User Guide 1vv0301065
- UE866 HARDWARE USER GUIDE 1vv0301157
- LE920 Hardware User Guide, 1vv0301026
- LE910 Hardware User Guide 1vv03701089
- LE866 Hardware User Guide 1vv0301210
- GL865-QUAD V4 Hardware User Guide 1VV0301518
- GE310-GNSS Hardware Design Guide 1VV0301564
2. **OVERVIEW**

In Telit modules there are four pins for SIM card holder connection; these lines are:

- **SIMVCC** (SIM Power supply)
- **SIMRST** (SIM Reset)
- **SIMIO** (SIM Data)
- **SIMCLK** (SIM Clock)

On the modules supporting Hot Insertion/removal of the SIM there is an additional pin for sensing SIM presence:

- **SIMIN** (SIM Presence/Absence)

On the modules not supporting Hot Insertion/removal of the SIM, SIM is queried at Startup.

SIM connection design must take in account these general rules:

1) Data Integrity: standard rules for digital layout and routing must be followed taking in consideration that SIMCLK has frequency of 3.57 MHz and SIMIO baud rate is greater or equal than 9600Bps

2) EMI/EMC: this is a key aspect to consider designing an application based on TELIT modules with internal antenna and/or without a proper shielded box. Some of these conditions may occur:
   - antenna picks-up digital noise coming from SIM card lines
   - antenna radiated field may interfere digital lines
   - digital lines (in particular clock) may radiate spurious in the surrounding space

To overcome all these potential problems, connection lines must be kept as short as possible and shielded and SIM-holder position has to be as far as possible from antenna.

Besides RF bypass capacitors (10 pF ... 33 pF) closed to SIM card SIM-holder are another good care.

When connection is not short, insertion of 10 ... 47 Ohm resistor with 10 ... 33 pF capacitor (RC filter) is a good caution to improve EMI from SIMCLK line.

On SIMRST and SIMIO lines is allowed to insert 10 ... 100 Ohm resistor with 10 ... 33 pF capacitor (RC filter) to improve the EMI measurements.

Do not insert resistors on SIMVCC, their use is not supported by SIM electrical interface.

3) ESD: take ESD caution if application based on TELIT module has SIM holder with contacts reachable from human body. Refer to chapter 5
SIM card is detected inserted when SIMIN line is shorted to ground. If in the application the SIM holder doesn’t foresee the switch for the presence/absence of the SIM card, the SIMIN line can be connected to ground or the SIM can be selected as present with the following AT command:

AT#SIMDET=1

On xL865 and xE866 there is no dedicated SIMIN pin. To use the feature, SIMIN pin has to be configured with the AT command AT#SIMINCFG=<GPIO_pin> among the available GPIOs. Be careful because in some products not all GPIOs can be configured for SIMIN function; you can find the suitable GPIOs in the Hardware User Guide of the single devices or in their Global Form Factor application note.

On GL865-QUAD V4 and GE310-GNSS there is no dedicated SIMIN pin. Hot Insertion/removal of the SIM is not supported.

2.1. Typical SIM Connection Schematic Example

Figure 2-1 illustrates in particular how the application should be designed and what values the components should have.
3. PCB LAYOUT

In this section general rules are given on how to place and connect the components on the PCB in order to obtain the better results on the EMI side.

The placement of the 33 pF filtering capacitors is very important in order to maximize their effectiveness; the capacitors should be placed as closest as possible to the SIM pins and intercepting the tracks that goes to the module. Figure 3-1 and Figure 3-2 show wrong PCB designs:

![Figure 3-1 PCB Layout 1](image1)
![Figure 3-2 PCB Layout 2](image2)

The following Figure 3-3 shows a better design:

![Figure 3-3 PCB Layout 3](image3)
4. ESD PROTECTION

If the SIM is accessible to the customer use TVS diodes or varistors to protect Telit modules from Electrostatic discharge.

4.1. ESD protection for SIM interface

It's possible to use dedicate ESD protection chips with integrated EMI filter designed for the SIM like ECLAMP2465T or TPD3F303. If these components are used it's possible avoid mounting the 33pF capacitors indicated in Figure 2-1, only the 1uF capacitor must remain, we suggest to leave the solder pads in order to have the possibility to mount the 33pF capacitors if necessary.
5. DUAL SIM SELECTION

The Telit modules can already support more than one SIM card, in the following Figure 5-1 is showed a schematic example of dual SIM connection:

![Figure 5-1 Dual SIM](image)

SIM A is enabled using this AT command sequence:

- AT#GPIO=X,1,1
- AT#GPIO=Z,0,1
- AT#GPIO=Y,0,1
- AT#SIMDET=0
- (5 seconds of pause)
- AT#SIMDET=2

SIM B is enabled using this AT command sequence:

- AT#GPIO=X,0,1
- AT#GPIO=Z,1,1
- AT#GPIO=Y,1,1
- AT#SIMDET=0
- (5 seconds of pause)
- AT#SIMDET=2
If the user doesn't need SIM hot removal he can ground SIMIN pin on module side, in this case the AT command sequence change a bit because AT#SIMDET has to be set to 1 and not to 2:

SIM A is enabled using this AT command sequence:

- AT#GPIO=X,0,1
- AT#GPIO=Z,1,1
- AT#GPIO=Y,0,1
- AT#SIMDET=0
- (5 seconds of pause)
- AT#SIMDET=1

SIM B is enabled using this AT command sequence:

- AT#GPIO=X,1,1
- AT#GPIO=Z,0,1
- AT#GPIO=Y,1,1
- AT#SIMDET=0
- (5 seconds of pause)
- AT#SIMDET=1

The P-Channel MOSFETS should have a Ron typical around 0.5Ω and must never exceed 1Ω.

On xL865 and xE866 families there is no dedicated SIMIN pin and AT#SIMDET=1 is the default value. To use the configuration showed in Figure 5-1 the SIMIN pin has to be configured with: AT#SIMINCFG=<GPIO_pin> (stored in NVM) and AT#SIMDET=2 (stored in the extended profile AT&P). Be careful because in some products not all GPIOs can be configured for SIMIN function; you can find the suitable GPIOs in the Hardware User Guide of the single devices or in their Global Form Factor application note.

On GL865-QUAD V4 and GE310-GNSS in the Dual SIM Selection circuit shown here, the switch IC must be controlled by an external processor and module shall be rebooted after SIM switching.
It's also possible to use a dedicated IC switch with a low Ron channel for SIMVCC such as FSA2567:

![Figure 5-2 switch with a low Ron channel for SIMVCC](image)

SIM A is enabled using this AT command sequence:
- AT#GPIO=X,0,1
- AT#SIMDET=0
- (5 seconds of pause)
- AT#SIMDET=1

SIM B is enabled using this AT command sequence:
- AT#GPIO=X,1,1
- AT#SIMDET=0
- (5 seconds of pause)
- AT#SIMDET=1
On xL865 and xE866 families there is no dedicated SIMIN pin and AT#SIMDET=1 is the default value. To use the configuration showed in Figure 5-1 the SIMIN pin has to be configured with: AT#SIMINCFG=<GPIO_pin> (stored in NVM) and AT#SIMDET=2 (stored in the extended profile AT&P). Be careful because in some products not all GPIOs can be configured for SIMIN function; you can find the suitable GPIOs in the Hardware User Guide of the single devices or in their Global Form Factor application note.

On GL865-QUAD V4 and GE310-GNSS in the Dual SIM Selection circuit shown here, the switch IC must be controlled by an external processor and module shall be rebooted after SIM switching.
6. SIM-ON-CHIP

In the M2M applications, there are several cases where the SIM Card will never be changed once installed, also it would be preferable if it shouldn’t be possible to remove it at all; furthermore the SIM Card is required to work in a more harsh environment with respect to standard mobile phones SIM Cards. In order to address these kinds of application the SIM On Chip have been developed; they are basically a special SIM Card chip packaged as a surface mount assembly device that is then assembled together with the modem at the factory and will be never removed from the application.

This approach results in a great advantage in terms of long term reliability because the contacting issues that can arise due to moisture, vibrations and harsh environmental conditions with standard SIM holders are avoided by design since the SIM On Chip is soldered on the application PCB.

The Telit modules support the usage of M2M SIM-On-Chip and their usage is exactly the same as for conventional SIM Cards.

SIM On Chip are interfaced with the same lines as for standard SIM:

- SIMVCC
- SIMIO
- SIMRST
- SIMCLK

and shall be connected and decoupled in the same way as the standard SIM Card holder as shown in the chapter 3.1. An example of SIM On Chip connection is shown in the following schematic:

![Figure 6-1 SIM On Chip connection](image)

Since the SIM On Chip are not removable, it is possible to tie SIMIN to GND and eventually use the AT command AT#SIMDET to simulate insertion/removal.

Furthermore if the SIM On Chip is shielded inside the application box and cannot be subject to ESD discharges, the ESD protections can be omitted.

If there is the need to have both a SIM On Chip and a backup SIM Holder, then a dual SIM approach can be followed and the connections shall be the same as for chapter 5.
7. 3GPP POWER SAVING MODE (PSM)

Only for LE866, in order to ensure the 3GPP Rel 12 compliance when using the SIM in PSM states, it is suggested to use two latches on the SIM_RST and SIM_CLK lines.

The two latches are enabled by the PSM_STATUS line as indicated in figure below:

![Figure 7-1 PSM Status](image-url)
8. **GLOSSARY AND ACRONYMS**

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<th>Description</th>
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<tr>
<td>Telit Technical Support Centre</td>
<td>TTSC</td>
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<tr>
<td>Universal Serial Bus</td>
<td>USB</td>
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<tr>
<td>High Speed</td>
<td>HS</td>
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<td>Data Terminal Equipment</td>
<td>DTE</td>
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<td>Universal Mobile Telecommunication System</td>
<td>UMTS</td>
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<tr>
<td>Wideband Code Division Multiple Access</td>
<td>WCDMA</td>
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<td>High Speed Downlink Packet Access</td>
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<td>High Speed Uplink Packet Access</td>
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<tr>
<td>Universal Asynchronous Receiver Transmitter</td>
<td>UART</td>
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<td>High Speed Inter Chip</td>
<td>HSIC</td>
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<tr>
<td>Subscriber Identification Module</td>
<td>SIM</td>
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<tr>
<td>Serial Peripheral Interface</td>
<td>SPI</td>
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<td>Analog – Digital Converter</td>
<td>ADC</td>
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<td>Digital – Analog Converter</td>
<td>DAC</td>
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<td>Input Output</td>
<td>I/O</td>
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<tr>
<td>General Purpose Input Output</td>
<td>GPIO</td>
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<td>Complementary Metal – Oxide Semiconductor</td>
<td>CMOS</td>
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<td>Master Output – Slave Input</td>
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<td>Master Input – Slave Output</td>
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<td>Clock</td>
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<td>Master Ready</td>
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<td>Slave Ready</td>
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<td>Chip Select</td>
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<td>Power Saving Mode according to 3GPP rel. 12</td>
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<td>Printed Circuit Board</td>
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<td>Equivalent Series Resistance</td>
<td>ESR</td>
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<td>Voltage Standing Wave Radio</td>
<td>VSWR</td>
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<td>Vector Network Analyzer</td>
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## 9. DOCUMENT HISTORY

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