SIM INTEGRATION DESIGN GUIDE

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TELIT
TECHNICAL
DOCUMENTATION

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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
- 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

CONTENTS

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
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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:

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

Telit appreciates feedback from the users of our information.

1.4.   Text Conventions

STOP

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.

ℹ

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

2.   OVERVIEW

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

- SIMVCC   (SIM Power supply)
- SIMRST   (SIM Reset)
- SIMIO   (SIM Data)
- SIMIN   (SIM Presence/Absence)
- SIMCLK   (SIM Clock)

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.

2.1. SIM Connection Schematic Example

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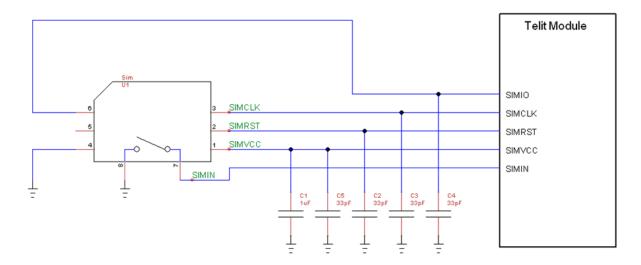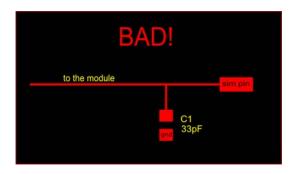

Figure 2-1 SIM connection

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:
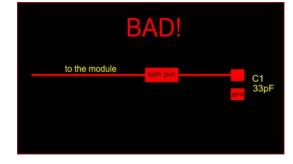

Figure 3-1 PCB Layout 1

Figure 3-2 PCB Layout 2

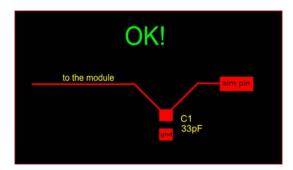The following Figure 3-3 shows a better design:

Figure 3-3 PCB Layout 3

4. ESD PROTECTION

⚠️ If the SIM is accessible to the customer use TVS dioses 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:
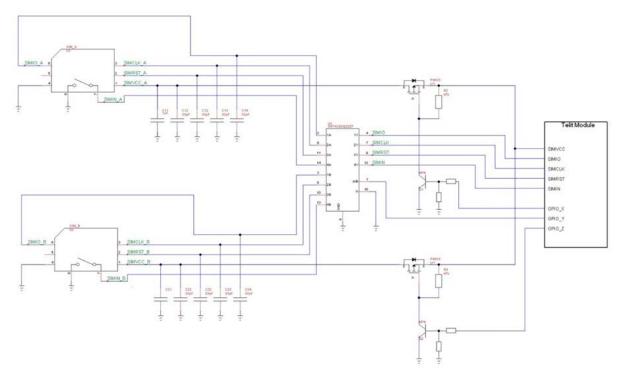

Figure 5-1 Dual SIM

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.

It's also possible use a dedicated IC switch with a low Ron channel for SIMVCC such as FSA2567:
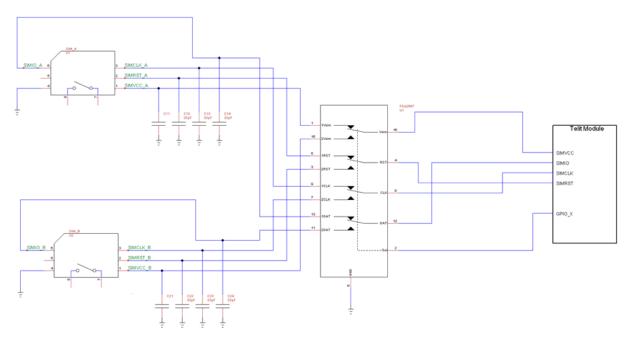

Figure 5-2 switch with a low Ron channel for SIMVCC

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

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:
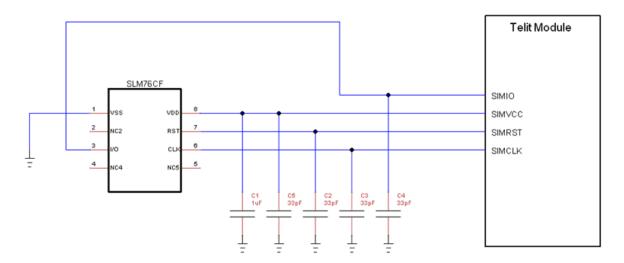

Figure 6-1 SIM On Chip connection

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.

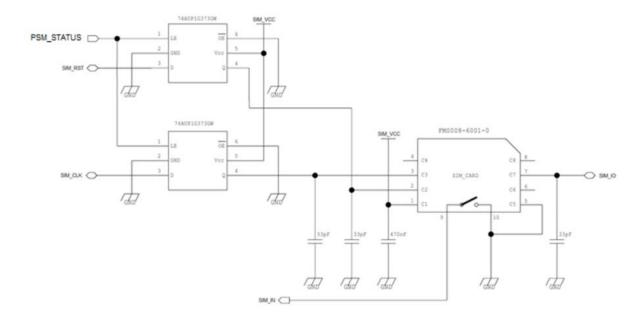The two latches are enabled by the PSM_STATUS line as indicated in figure below:

Figure 7-1 PSM Status

8. GLOSSARY AND ACRONYMS

Description

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

9. DOCUMENT HISTORY

Revision	Date	Changes
0	2006-09-29	First issue
1	2007-09-04	Updated applicability table
2	2009-05-29	Applied new layout Updated applicability table
3	2010-09-01	Updated capacitor value on SIMVCC Updated applicability table
4	2010-10-04	Added GL865-DUAL to applicability table
5	2011-02-03	Added Dual SIM selection Added schematics and layout suggestions
6	2011-06-01	Added HE910 to applicability table
7	2012-02-03	Removed par 3.2; corrected note in par 3.1
8	2012-03-08	Added SIM ON CHIP information, updated par. 6 and 5.1
9	2012-06-19	Added GE910, changed SIM ON CHIP pinout.
10	2013-11-12	Removed GM862-GPS and GE863. Added LE920, HE920, HE910 V2, UE910 V2, UL865, GL865-V3, GE910 V3 and GE910 AUTO to the applicability table Updated Par. 3.1 SIM Schematic Example Updated Par. 3.2 Component's value Table 3 Updated Par. 6 Dual SIM selection differentiating the design for GPIOs at 1.8V and 2.8V
11	2016-09-21	Updated applicability table, document layout changed PSM chapter added
12	2017-01-04	Added note for GPIOs suitable for SIMIN function on xL865 and xE866 family Document Layout changed Updated applicability table
13	2017-02-14	2017 Template applied

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