Making machines talk.®

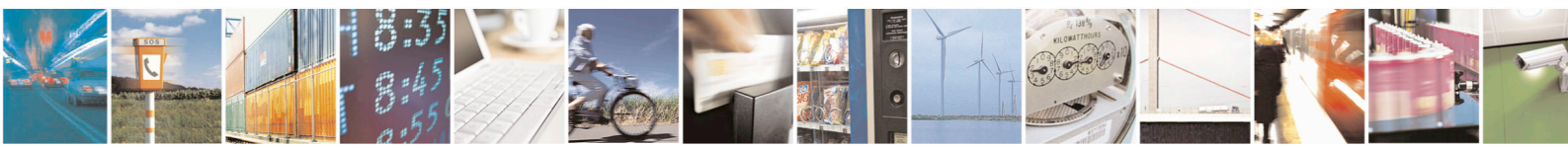
SIM integration design guide

80000NT10001a Rev.10 – 2013-11-12

Making machines talk.

APPLICABILITY TABLE

PRODUCT
GC864-QUAD V2
UC864-E
UC864-G
UC864-WD
UC864-WDU
GE864-QUAD V2
GE864-QUAD AUTOMOTIVE V2
GE864-QUAD ATEX
GE864-GPS
GE865-QUAD
GE866-QUAD
GL865-DUAL/QUAD
GL865-DUAL/QUAD V3
GE910-QUAD/GNSS
GE910-QUAD V3
GE910-QUAD AUTO
UL865 Series
HE910/UE910 Series
HE910 V2/UE910 V2 Series
UE910 V2 AUTO
HE920 AUTO Series
LE920 AUTO Series



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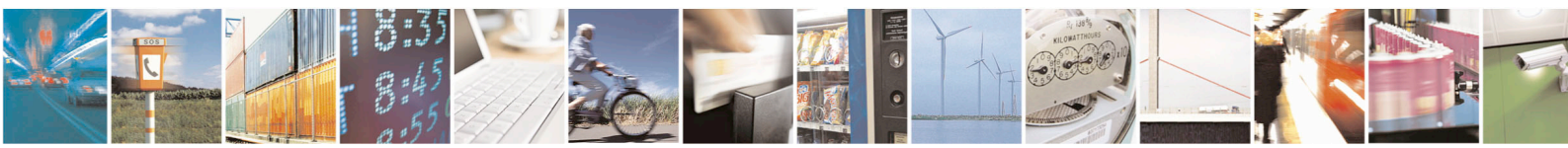

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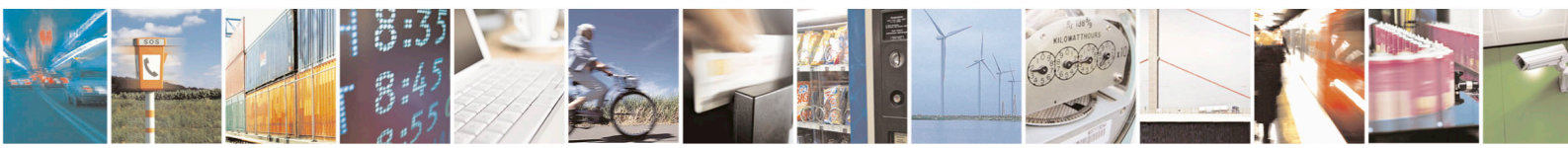
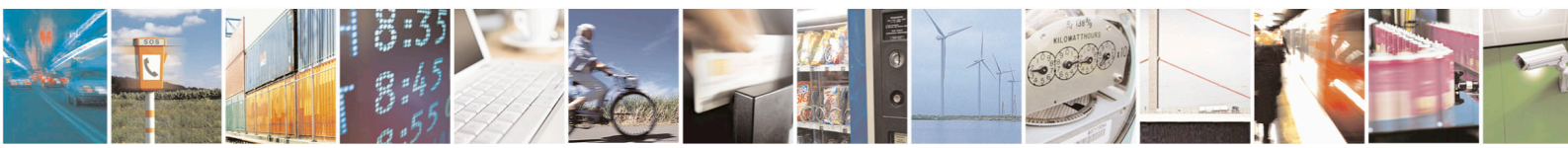


Contents



1. Introduction

1.1. Scope

Aim of this document is to give basic design guide lines to integrate a SIM holder in applications that uses Telit modules.

1.2. Audience

This document is intended for Telit customers, who are integrators, about to add SIM holder functionality on their applications.

1.3. Contact Information, Support

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

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

Alternatively, use:

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

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

http://www.telit.com

To register for product news and announcements or for product questions contact Telit 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.

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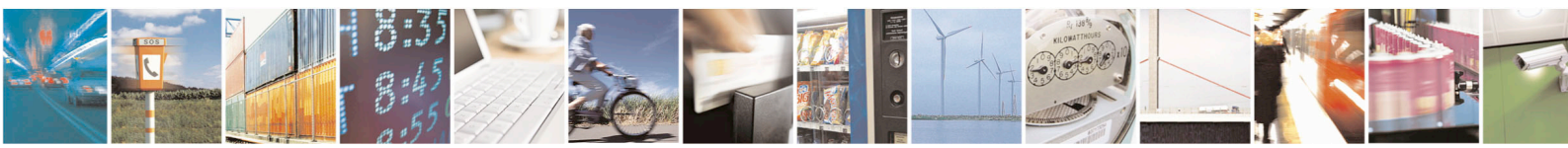


1.4. Document Organization

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 a quick SIM contacts explanation.

Chapter 3: "Schematics " provides connection schematics

Chapter 4: "Layout " provides layout suggestions

Chapter 5: "ESD Protection "provides ESD Protection suggestions

Chapter 6: "Dual SIM selection with GPIOs at 2.8V" provides suggestions about integration of 2 SIM

Chapter 7: "Dual SIM selection with GPIOs at 1.8V" provides suggestions about integration of 2 SIM

Chapter 8: "SIM-On-Chip " provides suggestions about SIM-On-Chip integration

Chapter 9: "List of acronyms"

Chapter 10: "Document History"

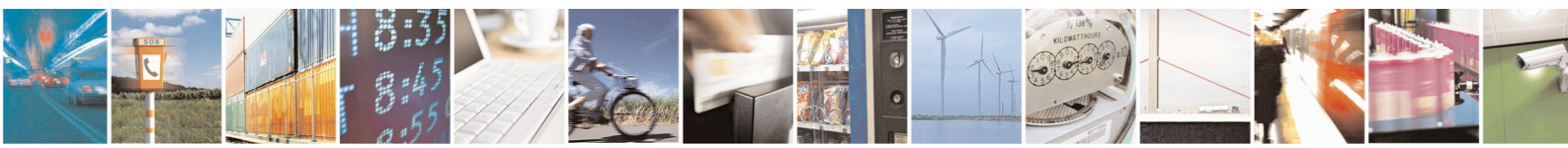
1.5. Text Conventions

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.

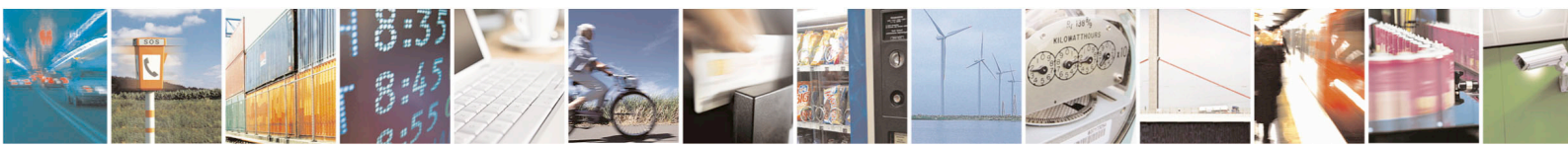
Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

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



1.6. Related Documents

- 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
- LE920 Hardware User Guide, 1vv0301026



2. Overview

In all 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

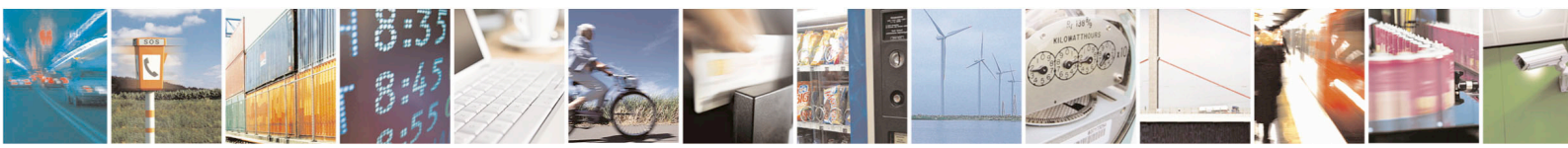
   To overcome all these potential problems, connection lines must be kept as short as possible and shielded and SIM-holder position has to be as far as possible from antenna.
   Besides RF bypass capacitors (10 pF ... 33 pF) closed to SIM card SIM-holder are another good care.

   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.



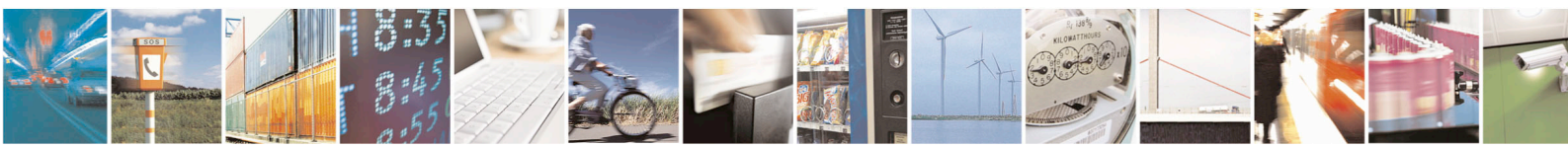
NOTE:

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 must be connected to ground.

NOTE:

On xL865 there isn't a dedicated SIMIN pin. To use it, SIMIN pin has to be configured with the AT command AT#SIMINCFG=<GPIO_pin>.



3. Schematics

This section deals with the recommended schematics for the design of SIM interfaces on the application boards.

3.1. SIM Schematic example

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

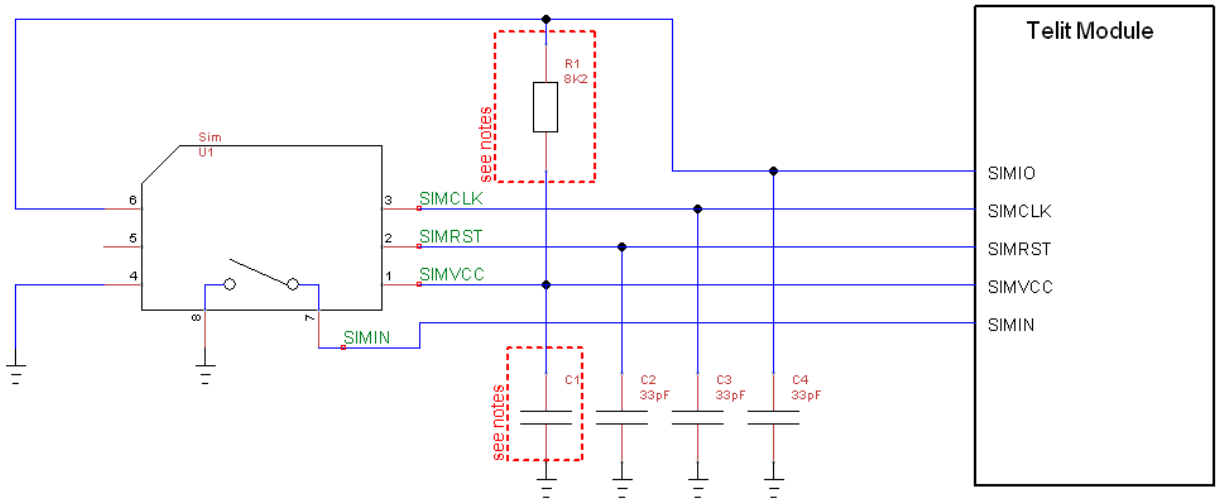


Figure 1

NOTE FOR R1:

Products different from UC864-E/G/WD/WDU do not require any pull-up resistor (R1) for SIMIO, however the un-mounted option in application design can be recommended in order to tune R1 if necessary.

For UC864-E/G/WD/WDU products special attention should be paid to the value of resistor R1. 3GPP specifications define that the rise time and the fall time of the IO signal shall not exceed 1 µs. Resistor R1 is very closely related to the rise time and the fall time of the SIMIO signal. To verify the appropriate specifications for your design of UC864 products refer to Table 1.

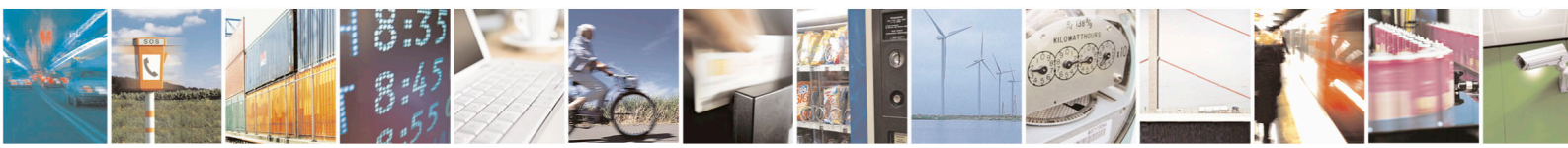
3.2. Component's Values

Values reported on Table 1 are based on the UC864-E/G/WD/WDU used in conjunction with the Telit EVK and representing the deviation by R1 regarding the rise time and the fall time of SIMIO signal. For products different from UC864-E/G/WD/WDU, R1 should NOT be mounted.

	Resistor R1	1.8V		3.0V	
		Rising time max. [µs]	Falling time max. [µs]	Rising time max. [µs]	Falling time max. [µs]
3GPP spec		1. 000	1.000	1.000	1.000
1	15K	1.225	0.026	1.295	0.150
2	10K	1.008	-	1.058	-
3	8K2	0.900	-	0.903	-
4	6K8	0.793	0.025	0.795	0.015

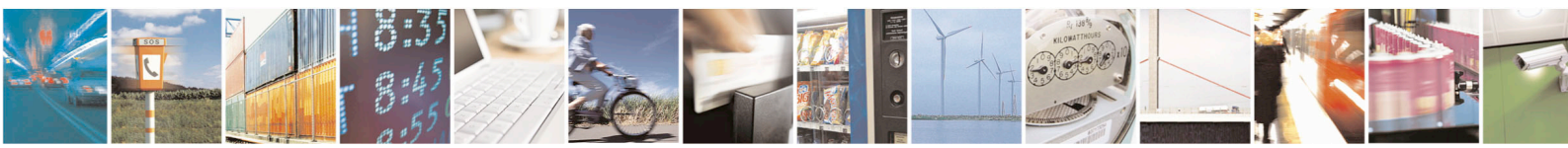
Table 1

The following Table, lists the value of C1 to be adopted with the different products:



Product Name	C1 value
HE910 UE910 HE910-V2 UE910-V2 HE920 LE920 UL865	100 nF
GC864 GE864 GE865 GL865-V2	1000 nF
GE910-V3 GL865-V3 GE866	470 nF
GE910	220 nF
UC864	10 nF

Table 2



4. 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 2 and Figure 3 show wrong PCB designs:

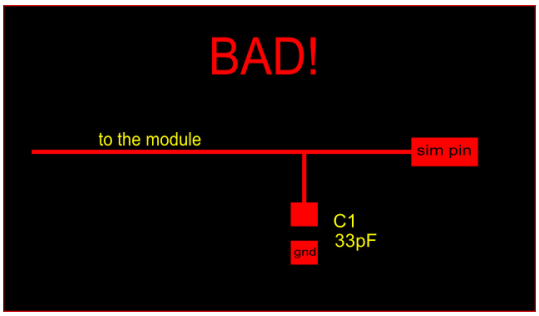


Figure 2

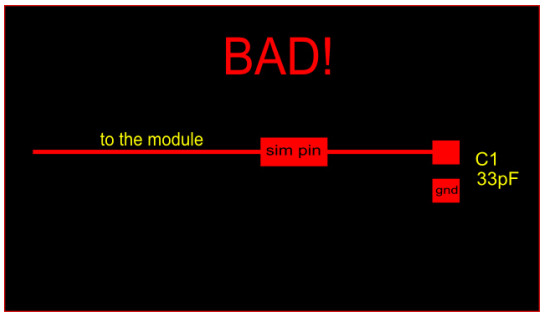


Figure 3

The following Figure 4 shows a better design:

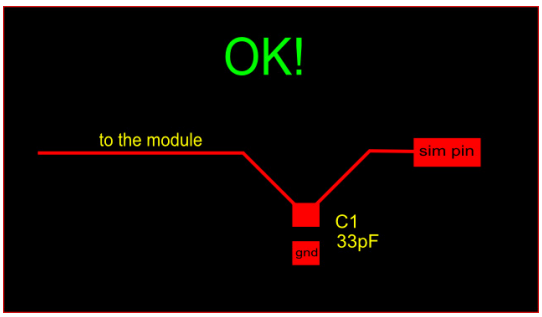
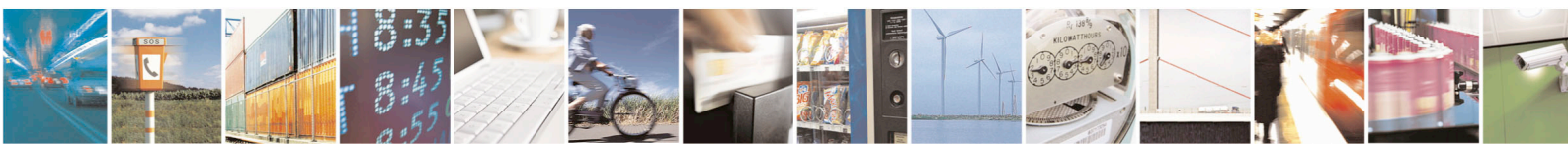


Figure 4



5. ESD Protection

WARNING:

Do use TVS diodes or varistors to protect Telit modules from Electrostatic discharge.

5.1. ESD protection for SIM interface

The following schematics (Figure 5) are recommended for the SIM interface. A single TVS diode or varistor can be used on the respective pins and the VTS should clamp at 3.5V and the total capacity on each line shall be maximum 33pF.

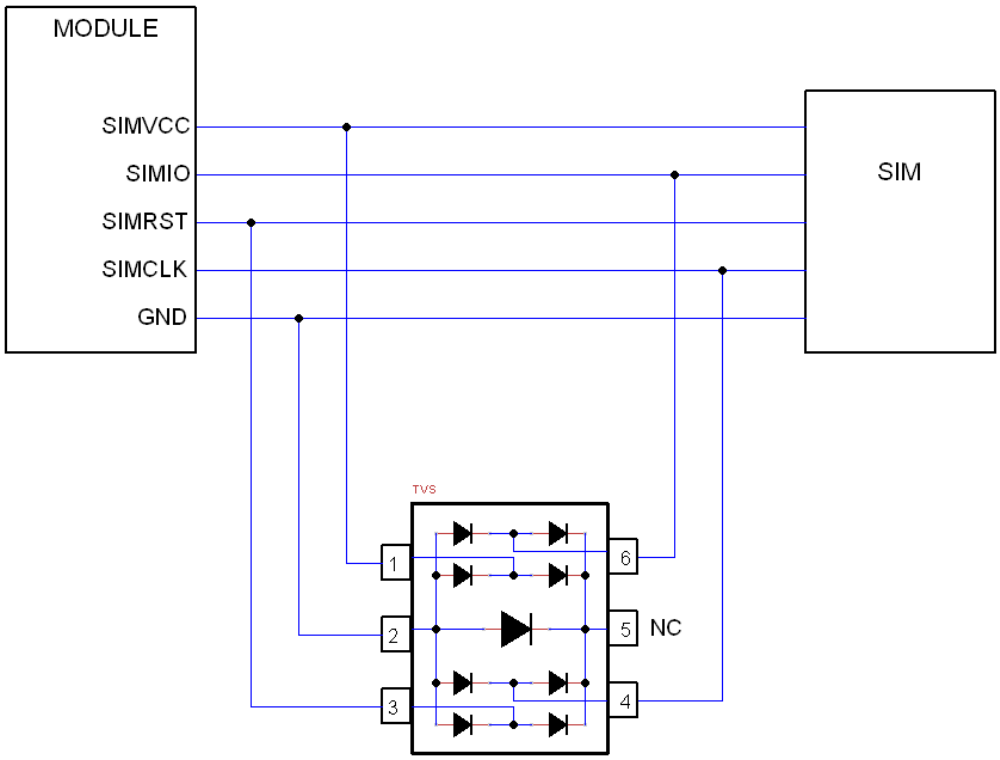


Figure 5

6. Dual SIM selection with GPIOs at 2.8V

The Telit modules can already support more than one SIM card. The SIM selection circuit, described below, can be applied to Telit modules that provide 2.8V GPIOs.
It is suggested to use 3 distinct 2.8V GPIOs (X, Y, Z) to have full control of VCCSIM supplies and SIM selection on the multiplexer.
In the following Figure 6 is showed a schematic example of dual SIM connection.

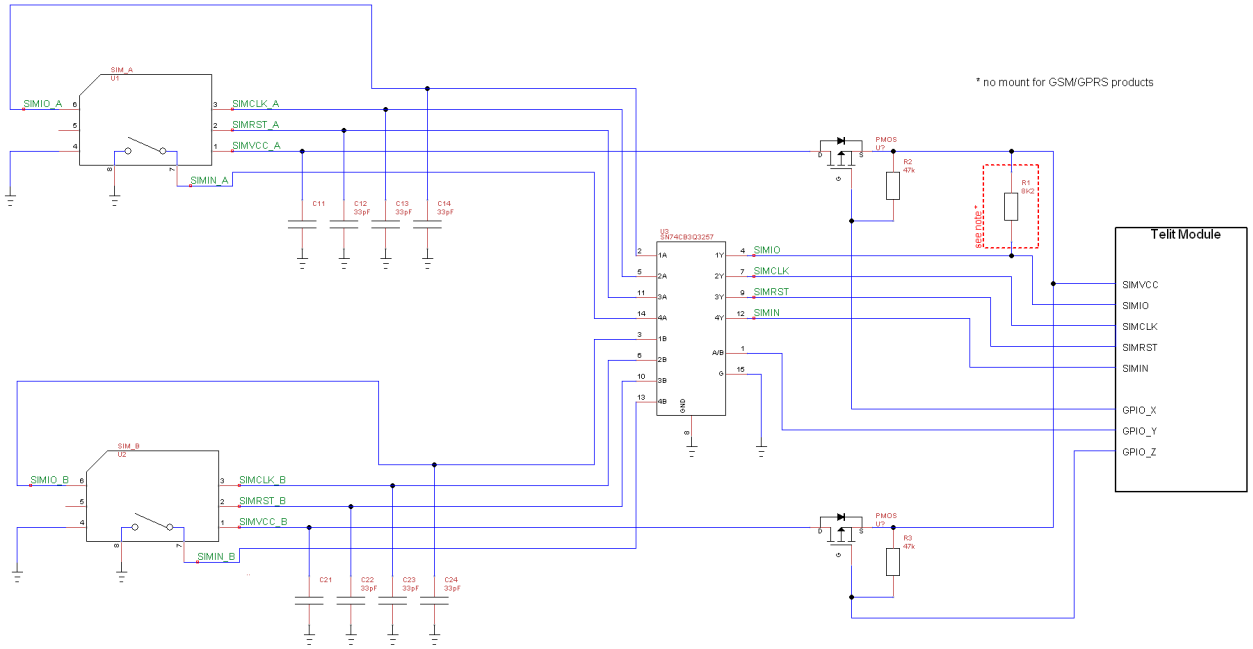
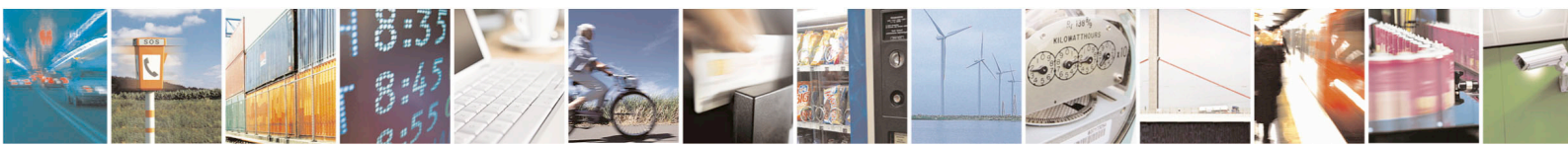


Figure 6

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=2



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=2

If the user doesn't need SIM hot removal he can ground SIMIN pin on module side as showed in the schematic in Figure 7.

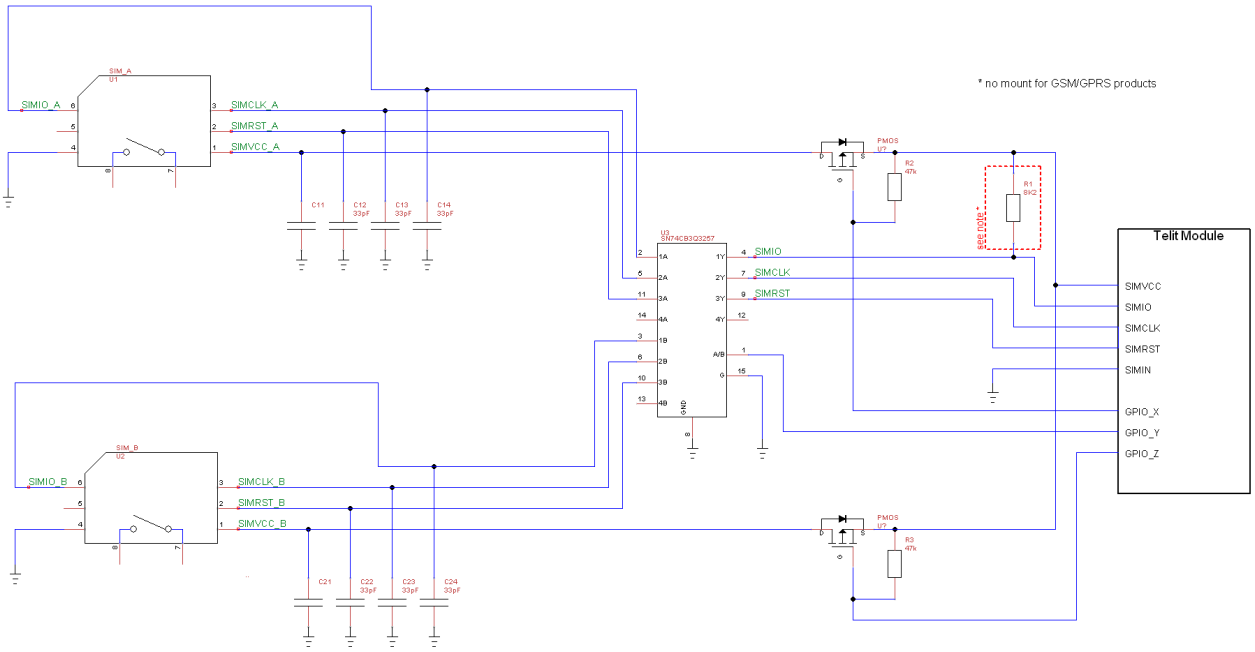
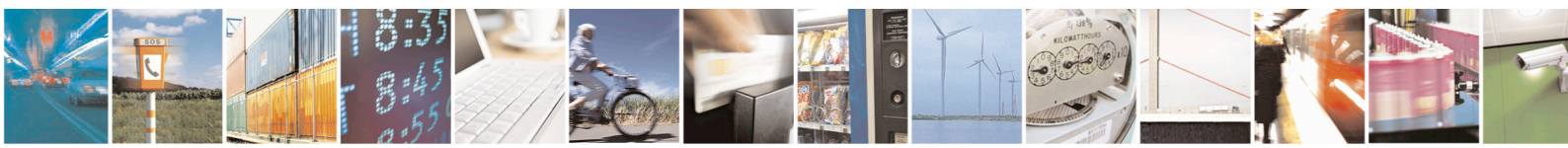


Figure 7

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
```

NOTE:

These solutions cannot be applied to devices with only 1.8V GPIO such as xE910, xE910-V2, xE920, GL865-V3, GE866 since they cannot correctly drive the Mosfet on SIMVCC. For 1.8V GPIO devices either a level shifter is required or we suggest using a dedicated component such as the FSA2567 low power dual SIM Card analog switch as shown in the Par. 7.

NOTE:

These solutions cannot be applied to GC864 with SIM holder when internal SIM holder is used.

NOTE:

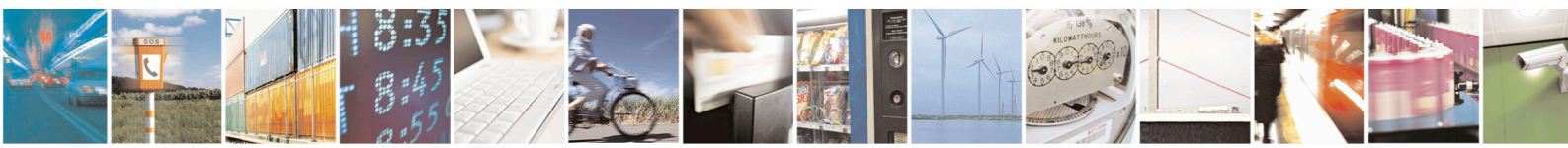
The P-Channel MOSFETS should have a Ron typical around 0.5Ω and must never exceed 1Ω.

NOTE:

On xL865 family there isn't a dedicated SIMIN pin and AT#SIMDET=1 is the default value. To use the configuration showed in Figure 6 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).

NOTE:

Products different from UC864-E/G/WD/WDU do not require any pull-up resistor (R1) for SIMIO, however the un-mounted option in application design can be recommended in order to tune R1 if necessary.



7. Dual SIM selection with GPIOs at 1.8V

The SIM selection circuit, described below (Figure 8), using a dedicated IC such as FSA2567, can be applied to Telit modules that provide 1.8V GPIOs.

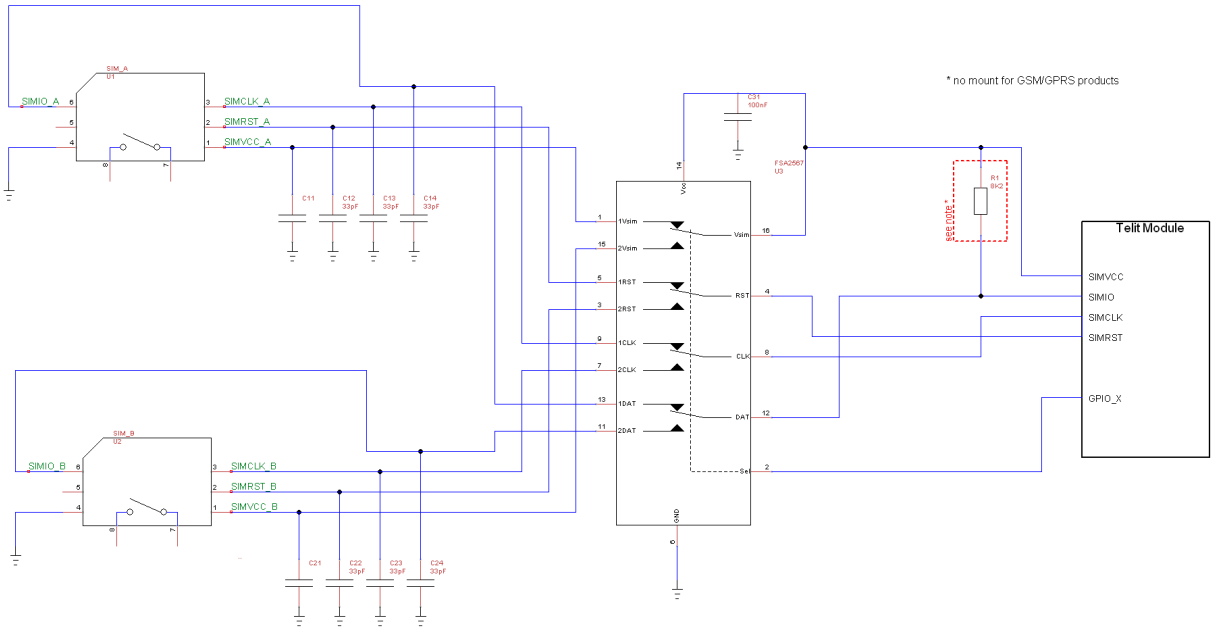


Figure 8

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:

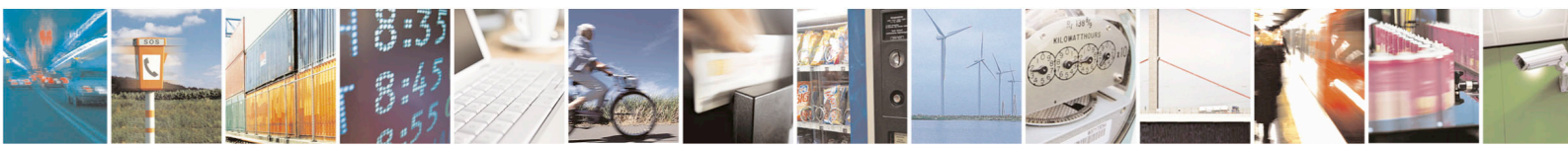
AT#GPIO=X,1,1
AT#SIMDET=0
(5 seconds of pause)
AT#SIMDET=1

NOTE:

The Dual SIM selection solution is not supported by LE920.

NOTE:

Products different from UC864-E/G/WD/WDU do not require any pull-up resistor (R1) for SIMIO, however the un-mounted option in application design can be recommended in order to tune R1 if necessary.

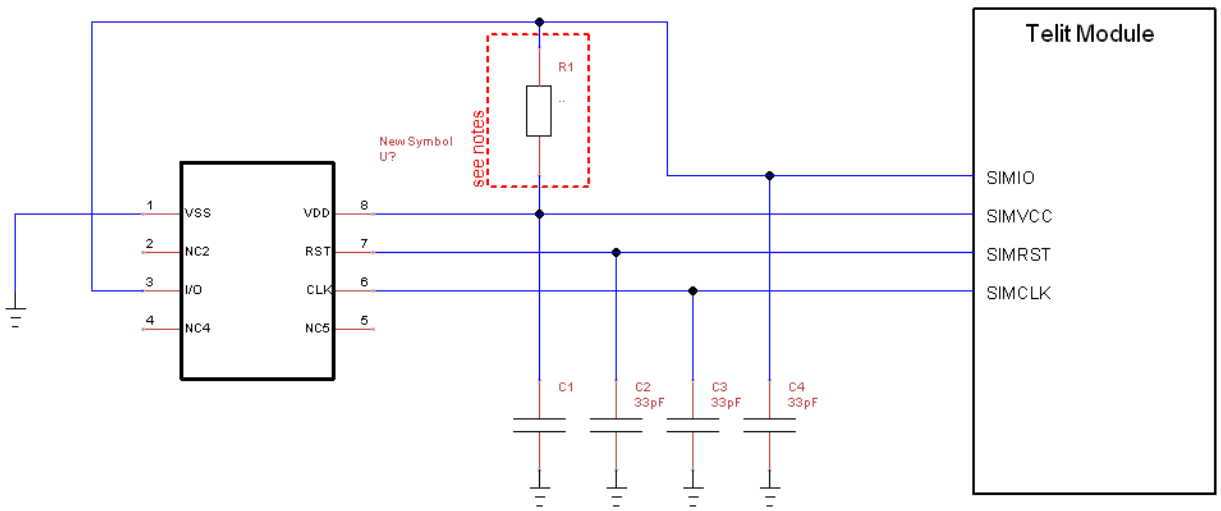


8. SIM-On-Chip

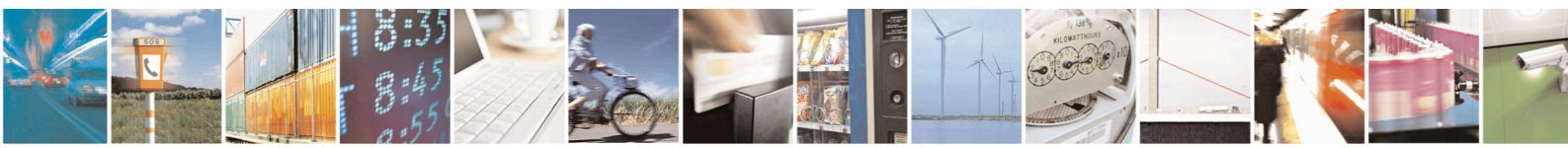
In the M2M applications, there are several cases where the SIM Card will never be changed once installed, also it would be preferable if it shouldn't be possible to remove it at all; furthermore the SIM Card is required to work in a more harsh environment with respect to standard mobile phones SIM Cards. 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

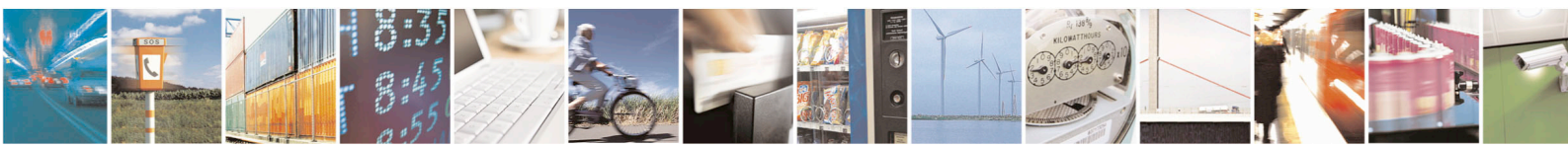
and shall be connected and decoupled in the same way as the standard SIM Card holder as shown in the chapter 3.1. An example of SIM On Chip connection is shown in the following schematic:



For the values of R1 and C1 refer to Table 1 and Table 2.

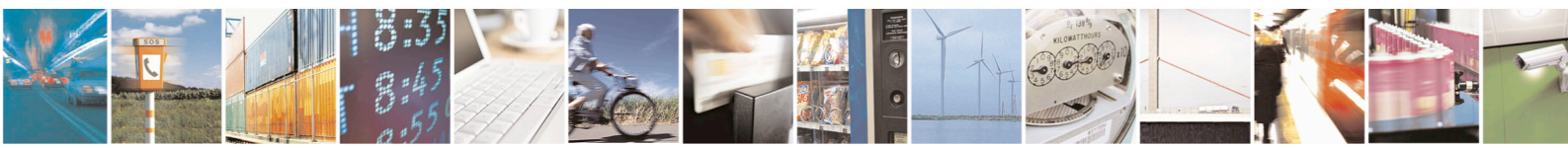


Since the SIM On Chip are not removable, it is possible to tie SIMIN to GND and eventually use the AT command AT#SIMDET to simulate insertion/removal.
Furthermore if the SIM On Chip is shielded inside the application box and cannot be subject to ESD discharges, the ESD protections can be omitted.
If 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 Par. 6 or Par. 7.



9. List of acronyms

SIM:	Subscriber Identity Module
EMI:	Electromagnetic Interference
EMC:	Electromagnetic Compatibility
ESD:	Electrostatic Discharge
M2M	Machine to Machine



10. Document History

Revision	Date	Changes
ISSUE#0	2006-09-29	Release First ISSUE# 0
ISSUE#1	2007-09-04	Updated applicability table
ISSUE#2	2009-05-29	Applied new layout Updated applicability table
ISSUE#3	2010-09-01	Updated capacitor value on SIMVCC Updated applicability table
ISSUE#4	2010-10-04	Added GL865-DUAL to applicability table
ISSUE#5	2011-06-01	Added Dual SIM selection Added schematics and layout suggestions
ISSUE#6	2011-02-03	Added HE910 to applicability table
ISSUE#7	2011-02-03	Removed par 3.2; corrected note in par 3.1
ISSUE#8	2012-03-08	Added SIM ON CHIP information, updated par. 6 and 5.1
ISSUE#9	2012-06-19	Added GE910, changed SIM ON CHIP pinout.
ISSUE#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