RTC Backup Application Note

80000NT10054A Rev.0 – 2011-09-22

Making machines talk.

APPLICABILITY TABLE

PRODUCT
GC864-QUAD V2
GC864-DUAL V2
GE864-QUAD AUTOMOTIVE V2
GE864-QUAD ATEX
GE864-QUAD V2
GE864-GPS
GE865-QUAD
GL865-DUAL
GL868-DUAL

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Contents

1. Introduction

1.1. Scope

Scope of this document is to give an overview of how to implement in a customer's application a backup battery/capacitor on the Telit modules..

1.2. Audience

This document is intended for customers designing with Telit modules.

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.

Telit appreciates feedback from the users of our information.

1.4. Document Organization

This document contains the following chapters (sample):

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

"Chapter 2: "Overview" gives an overview of the features of the product.

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 and GE864-GPS Hardware User Guide, 1vv0300915
- GE864-QUAD Automotive V2 Hardware User Guide, 1vv0300840
- GE864 QUAD ATEX Hardware User Guide, 1vv0300879
- GL865 Hardware User Guide, 1vv0300910
- GL868 DUAL Hardware User Guide, 1vv0300896

2. Overview

This application note describes how to implement in a customer's application a backup battery/capacitor on the Telit modules.
The backup battery is necessary if is needed to maintain active the RTC (real time clock) settings if the main power supply of the module (VBATT) is switched off.

2.1. Pin out

The pin for the RTC backup is present on all the products reported below where electrical characteristics are showed.

2.1.1. GE865

The signal is present on the BGA BALL reported on the relative Telit Hardware User Guide.

Parameter	Symbol	Limit Values			Unit	Remark
		min.	typ.	max.		
Output Voltage	VRTC	1.86	2.05	2.14	V	
Output current	IRTC	2			mA	VBATT > 3.0 V; VRTC=2.1V
Reverse Current(*)	IRev		10		µA	VBATT = 0V
Minimum RTC voltage	VRTC min		1.1		V	

(*)VBATT has to be connected at least one time

2.1.2. GL865-QUAD/GL865-DUAL

The signal is present on the PAD reported on the relative Telit Hardware User Guide.

Parameter	Symbol	Limit Values			Unit	Remark
		min.	typ.	max.		
Output Voltage	VRTC	1.86	2.05	2.14	V	
Output current	IRTC	2			mA	VBATT > 3.0 V; VRTC=2.1V
Reverse Current(*)	IRev		20		µA	VBATT = 0V
Minimum RTC voltage	VRTC min		1.1		V	

(*)VBATT has to be connected at least one time

2.1.3. GE864-QUAD/GE864-QUAD-V2/GE864-QUAD AUTOMOTIVE V2/GE864-QUAD ATEX/GE864-GPS/GC864-QUAD/GC864-QUAD-V2

The signal is present on the BGA BALL/PIN reported on the relative Telit Hardware User Guide.

Parameter	Symbol	Limit Values			Unit	Remark
		min.	typ.	max.		
Output Voltage	VRTC	1.86	2.05	2.14	V	
Output current	IRTC	2			mA	VBATT > 3.0 V; VRTC=2.1V
Reverse Current(*)	IRev		40		µA	VBATT = 0V
Minimum RTC voltage	VRTC min		1.1		V	

(*)VBATT has to be connected at least one time

2.2. Backup Capacitor

The first solution for the RTC backup is adding a capacitor to the VRTC pin.

2.2.1. Calculating Backup Capacitor

In order to define the backup capacitor value for the RTC, knowing the time, we have to consider the following parameters:

- VRTC – The Starting voltage of the capacitor (Volt)
- $VRTC_{MIN}$ – The minimum voltage acceptable for the RTC circuit. (Volt)
- IRev (Ampere) – The current consumption of the RTC circuitry when VBATT = 0
- B_{Time} - Backup Time (Hours)

If we assume that the RTC draws a constant current while running from VRTC (VBATT=0), then calculating the backup capacitor in Farad would use the formula:

$$C = \frac{B_{Time} * IRev}{VRTC - VRTC_{MIN}} * 3600$$

If we have the capacitor value and we want to calculate the Backup Time the formula will be:

$$B_{Time} = \frac{C * (VRTC - VRTC_{MIN})}{IRev * 3600}$$

For example if we have the following data:

- VRTC = 2.05 V
- $VRTC_{MIN}$ = 1.1V
- IRev = 10 µA
- B_{Time} = 23 hours

The necessary capacitor will be around 0.9F.

On Figure 1 is reported a simple example of Backup Capacitor connection where capacitor Cooper/Bussmann KR-5R5H105-R is used.

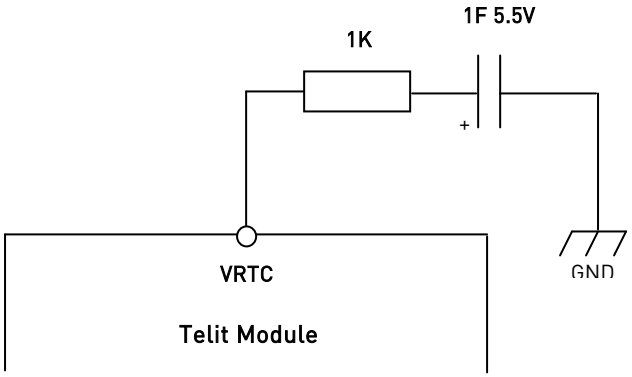


Figure 1

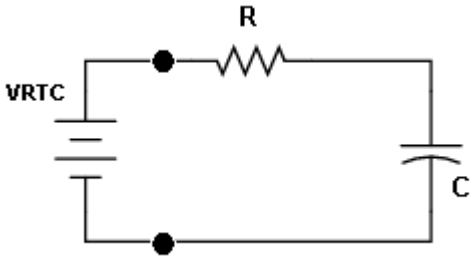
NOTES:

With ON/OFF line connected to GND the IRev will be around 110 µA. Please consider this for the backup time calculation.

2.2.2. Charging the Backup Capacitor

In order to define the Charging time of the RTC's Backup capacitor we have to consider the following parameters:

- Capacitor Value (e.g. 1 F)
- Capacitor Starting Voltage (e.g. 0V)
- Series Resistor



The time constant of the circuit is R*C. We could consider the capacitor charged after a period of 5T.

WARNING:
In order to guarantee the correct module start-up, the current drawn by VRTC pin don't must exceed 2mA. For this reason, the minimum required series resistor is **1K Ohm**. This guarantee the correct module start-up even if the backup capacitor is completely discharged (voltage on capacitor=0V).

Starting with a 0 volts on capacitor , the voltage drop for the RTC circuit is :

VRTC = 2mA *1K Ohm = 2V.

This voltage allows supplying the RTC part.

When the RTC is supplied only by the capacitor, the voltage drop over the 1K resistor is:

Vr= 1K Ohm * (10 uA) = 10 mV.

This voltage drop is negligible and doesn't affect the circuit functionality.

Considering the above considerations the charging time will be: 5 * 1K Ohm * 1F = 5000 sec (1,38 hours)

2.3. Backup Battery

The second solution for the RTC backup is using a lithium primary battery. The operative voltage for VRTC is lower than the voltage of primary lithium battery (3V nominal). It is necessary to put a LDO voltage regulator in the circuit. The suggested circuit is reported on Figure 2.

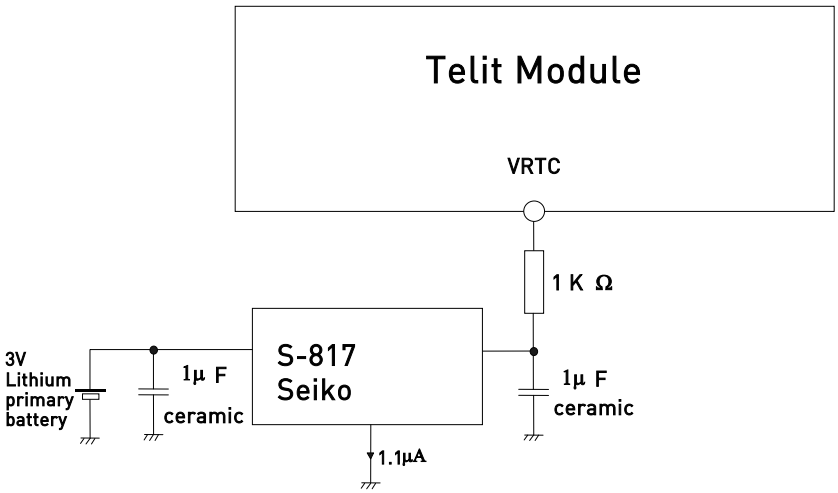


Figure 2

The S-817 Seiko Instruments Inc. LDO has a typical quiescent current value of 1.1 µA. When VBATT is not applied the VRTC Reverse Current (IRev) is 10 uA (see Paragraph 2.1.1). Considering a typical capacity of 220 mAh for a Lithium Primary we can calculate briefly the life time of the battery when VBATT is not applied.

$$\frac{220000\ \mu Ah}{(1.1+10)\mu A} = 19820\ hours \rightarrow more\ than\ 2\ years$$

When VBATT voltage is present, the VRTC voltage exceeds the S-817 output voltage, so the current for the Lithium Primary Battery is typically 1.1 µA and the Lithium Primary Battery duration will be increased.

NOTES:

With ON/OFF line connected to GND the IRev will be around 110 µA. Please consider this for the backup time calculation.

WARNING:

In this configuration VBATT has to be applied at least one time to setup the RTC circuit of the modem.

3. Document History

Revision	Date	Changes
ISSUE#0	2011-08-09	First ISSUE