

congatec Application Note #9

Affected Products	All congatec products featuring RTC
Subject	Calculate the lifetime of RTC battery
Confidential/Public	Public
Author	SDA

Revision History

Revision	Date (yyyy-mm-dd)	Author	Changes
1.0	2006-10-04	RCH	Initial Release
1.1	2017-03-14	SDA	Completely revised
1.2	2022-10-04	ZZD	Corrected units

Preface

This application note is a short example of how to calculate the maximum battery service time when a specific RTC circuit battery type must be used. Additionally, it also describes how to determine the required RTC circuit battery capacity when a specific battery service time is required.

Software Licenses

Notice regarding Open Source software

The congatec products contain Open Source software that has been released by programmers under specific licensing requirements such as the "General Public License" (GPL) Version 2 or 3, the "Lesser General Public License" (LGPL), the "ApacheLicense" or similar licenses.

You can find the specific details at <https://www.congatec.com/en/licenses/>. Search for the revision of the BIOS/UEFI or Board Controller Software (as shown in the POST screen or BIOS setup) to get the complete product related license information. To the extent that any accompanying material such as instruction manuals, handbooks etc. contain copyright notices, conditions of use or licensing requirements that contradict any applicable Open Source license, these conditions are inapplicable.

The use and distribution of any Open Source software contained in the product is exclusively governed by the respective Open Source license. The Open Source software is provided by its programmers without ANY WARRANTY, whether implied or expressed, of any fitness for a particular purpose, and the programmers DECLINE ALL LIABILITY for damages, direct or indirect, that result from the use of this software.

OEM/ CGUTL BIOS

BIOS/UEFI modified by customer via the congatec System Utility (CGUTL) is subject to the same license as the BIOS/UEFI it is based on. You can find the specific details at <https://www.congatec.com/en/licenses/>.

Disclaimer

The information contained within this Application Note, including but not limited to any product specification, is subject to change without notice.

congatec GmbH provides no warranty with regard to this Application Note or any other information contained herein and hereby expressly disclaims any implied warranties of merchantability or fitness for any particular purpose with regard to any of the foregoing. congatec GmbH assumes no liability for any damages incurred directly or indirectly from any technical or typographical errors or omissions contained herein or for discrepancies between the product and the Application Note. In no event shall congatec GmbH be liable for any incidental, consequential, special, or exemplary damages, whether based on tort, contract or

otherwise, arising out of or in connection with this Application Note or any other information contained herein or the use thereof.

Intended Audience

This Application Note is intended for technically qualified personnel. It is not intended for general audiences.

Electrostatic Sensitive Device

All congatec GmbH products are electrostatic sensitive devices and are packaged accordingly. Do not open or handle a congatec GmbH product except at an electrostatic-free workstation. Additionally, do not ship or store congatec GmbH products near strong electrostatic, electromagnetic, magnetic, or radioactive fields unless the device is contained within its original manufacturer's packaging. Be aware that failure to comply with these guidelines will void the congatec GmbH Limited Warranty.

Technical Support

congatec GmbH technicians and engineers are committed to providing the best possible technical support for our customers so that our products can be easily used and implemented. We request that you first visit our website at www.congatec.com for the latest documentation, utilities and drivers, which have been made available to assist you. If you still require assistance after visiting our website then contact our technical support department by email at support@congatec.com

Symbols

The following are symbols used in this application note.



Notes call attention to important information that should be observed.



Cautions warn the user about how to prevent damage to hardware or loss of data.



Warnings indicate that personal injury can occur if the information is not observed.

Copyright Notice

Copyright © 2021, congatec GmbH. All rights reserved. All text, pictures and graphics are protected by copyrights. No copying is permitted without written permission from congatec GmbH.

congatec GmbH has made every attempt to ensure that the information in this document is accurate yet the information contained within is supplied “as-is”.

Trademarks

Product names, logos, brands, and other trademarks featured or referred to within this user’s guide or the congatec website, are the property of their respective trademark holders. These trademark holders are not affiliated with congatec GmbH, our products, or our website.

Terminology

Term	Description
RTC	Real Time Clock – battery backed circuit in PC-AT systems that keeps system time and date as well as certain system setup parameters. when the computer is not powered. It is normally supplied by a battery.

1 Introduction

The following sections describe how to calculate:

- the lifetime of the installed RTC battery.
- the required RTC battery capacity when a specific life expectancy of the battery must be obtained.

For detailed information about the power consumption of the RTC circuit on the various congatec products, refer to respective User's Guide on the congatec website at www.congatec.com.

The RTC Battery Power Consumption value is a measured value and may differ from the value listed in the chipset datasheet. The measurement for computer-on-modules (COM) is carried out with a congatec evaluation carrier board and therefore only valid with this setup.

To get the most accurate value for the RTC Battery Power Consumption, it is recommended to perform the measurement with customer's carrier board and in worst case situation. This means you should measure the value when the board is in G3 mode (mechanical off – no AC power connected), at highest specified ambient temperature and when a new battery is connected.

2 How to Calculate

Section 2.1 shows how to calculate the maximum battery lifetime with a specific battery. Section 2.2 shows how to determine the nominal capacity when a specific battery lifetime has to be reached.

2.1 Calculating the maximum battery lifetime

The maximum lifetime of a battery supplying the RTC circuitry when AC power is switched off can be calculated by using following formula:

$$t_{\max} = \frac{Bat_{\text{NomCap}}}{24 \times 365 \times I_{\text{BatMax}}} \times 0.8$$

t_{\max} :	Maximum battery lifetime [years].
Bat_{NomCap} :	Nominal capacity of the installed battery [Ah].
I_{BatMax} :	Maximum RTC battery current [A].

 **Note**

Factor 0.8 considers the external impacts that can affect the battery lifetime. This factor can vary from 0.7 to 0.9 depending on the battery and operating conditions.

 **Caution**

The lifetime of the battery begins at the date of manufacturing. The RTC starts as soon as the battery is installed to the system. Additionally the battery will discharge even when it is not installed to a system. If a battery is not installed to a system the nominal capacity will be decreased by approximately 1% per year.

2.2 Calculating the nominal battery capacity

The nominal capacity of the battery supplying the RTC circuitry when AC power is switched off can be calculated by using following formula:

$$Bat_{NomCap} = t_{min} \times 24 \times 365 \times I_{BatMax} \times 1.2$$

Bat_{NomCap} : Nominal capacity of the installed battery [Ah].

t_{min} : Minimum battery lifetime [years].

I_{BatMax} : Maximum RTC battery current [A].



Note

Factor 1.2 considers the external impacts that can affect the battery lifetime. This factor can vary from 1.1 to 1.3 depending on the battery and operating conditions.

3 Examples

The following examples are based upon typical values. The first example determines the maximum battery lifetime for a specified battery type. The second example shows how to calculate the nominal battery capacity for a defined battery lifetime.

3.1 Example for specified battery lifetime

Battery type:	CR 2032
Nominal battery voltage :	3V
Nominal capacity Bat_{NomCap} :	230 mAh
Maximum RTC battery current:	2.5 μ A

$$t_{max} = \frac{Bat_{NomCap}}{24 \times 365 \times I_{BatMax}} \times 0.8$$

$$t_{max} = \frac{230 * 10^{-3}}{24 \times 365 \times 2.5 * 10^{-6}} \times 0.8$$

$$t_{max} = 8.4 \text{ years}$$

3.2 Example for specified service time

Required service time for battery:	15 years
Nominal battery voltage:	3V
Maximum RTC battery current:	3 μ A

$$Bat_{NomCap} = t_{min} \times 24 \times 365 \times I_{BatMax} \times 1.2$$

$$Bat_{NomCap} = 15 \times 24 \times 365 \times 3 * 10^{-6} \times 1.2$$

$$Bat_{NomCap} = 0.47304 \text{ Ah} = 473.04 \text{ mAh}$$

→ The battery should have a nominal capacity equal to or greater than 473.04 mAh (i.e. the Panasonic CR2477).

Note

If you plan to use batteries for a longer service time, ensure that the battery is new and has its full nominal capacity. Batteries stored for a long time should not be used.