# BlueMod+S42
# Hardware User Guide

1VV0301303 Rev.3 – 2016-08-22

# APPLICABILITY TABLE

| PRODUCT |
| --- |
| |
| BlueMod+S42/AI |

Table 1 Product Applicability

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# 1 Introduction

## 1.1 Scope

This document provides information how the BlueMod+S42/AI can be integrated into customer systems. It addresses hardware specifications of the BlueMod+S42/AI and requirements of the hardware environments for the BlueMod+S42/AI.

**NOTE:**

The description text "BlueMod+S42" refers to all modules listed in the Table 1 Product Applicability

## 1.2 Audience

This document is intended for Telit customers, especially system integrators, about to implement Bluetooth modules in their application.

## 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

or

TS-SRD@telit.com for global Bluetooth support

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:

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

“Chapter 3: General Product Description” gives an overview of the features of the product.

“Chapter 3: Application Interface” describes in details the interfaces of the product.

“Chapter 4: Module Pins” describes the signal mapping and specification.

“Chapter 5: Electrical Characteristics” describes in details the characteristics of the product.

“Chapter 6: Mechanical Characteristics” describes the mechanical characteristics.

“Chapter 8: “Compliances” provides some fundamental information on conformity and compliances.

“Chapter 11: “Safety Recommendation” provides some safety recommendations that must be follow by the customer in the design of the application that makes use of the BlueMod+S42.

## 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

- Nordic: nRF52_Series_Reference_Manual
- Nordic: nRF52832_PS v1.0.pdf (Product Specification)
- BlueMod+S42\Central AT Command Reference, 80512ST10771A
- BlueMod+S42 Software User Guide, 1VV0301318
- UICP_UART_Interface_Control_Protocol, 30507ST10756A
- BlueMod+S42 Testmode Reference, 80512NT11496A
- Bluetooth SIG Core Specification V4.2

# 2 General Product Description

## 2.1 Feature Summary

- Bluetooth specification V4.2 compliant
- Supports Bluetooth low energy
- Fully qualified Bluetooth V4.2 Single Mode LE
- CE certified
- FCC and IC certified
- Nordic nRF52832 inside
- Fast Connection Setup
- RF output power -20 up to +4dBm EIRP
- RF output power -40dBm EIRP in Whisper Mode
- RSSI detector on board
- High sensitivity design
- Supply voltage range 1,7V to 3,6V
- Internal crystal oscillator (32 MHz)
- LGA Surface Mount type. BlueMod+S42: 17 x 10 x 2.6 $mm^3$
- Pin compatible to Telit BlueMod+S BLE and BlueMod+SR dual mode module
- Shielded to be compliant to FCC full modular approval
- Flexible Power Management
- 128-bit AES encryption
- NFC peripheral communication signal interface type A with 106 kbps bit rate
- High-speed UART interface
- $I^2C$ Master
- SPI Master/Slave interface
- Low power comparator
- Real Time Counter
- Up to 19 digital IO’s for individual usage by embedded software
- Up to 8 analog inputs for individual usage by embedded software
- 8/9/10bit ADC
- Arm® Cortex™-M4 core for embedded profiles or application software
- Manufactured in conformance with RoHS2
- Operating temperature -40 ... +85 °C
- Weight: 0,7 g

## 2.2 Applications

The BlueMod+S42 is designed to be used in low power applications, like sensor devices. Some typical applications are described in this chapter.

Supported profiles are:

- Terminal I/O
- GATT based LE-profiles

**NOTE:**

**Support for any additional profile is possible on request**

## 2.3 General Cable Replacement

In case there is no standardized application specific profile available the BlueMod+S42 offers Telit’s Terminal I/O profile, which allows transparent data transfer over UART and supports Secure Simple Pairing, making the pairing process easy and the connection secure. Terminal I/O is available for iOS and Android as well as implemented in Telit’s dual mode module BlueMod+SR.

### 2.3.1 Industry

BlueMod+S42 can be used to monitor and control motors, actuators, values and entire processes.

### 2.3.2 POS/Advertising

BlueMod+S42 supports iBeacon or similar applications.

### 2.3.3 Healthcare and Medical

Usage of Bluetooth is aimed mainly at devices that are used for monitoring vital data. Typical devices are blood glucose meter, blood pressure cuffs and pulse ox meters. Bluetooth BR/EDR and low energy were chosen by the Continua Health Alliance as transports for interoperable end to end communication.

### 2.3.4 Sports and Fitness

In the sports and fitness segment the BlueMod+S42 is used in devices for positioning as well as monitoring vital data. Typical devices in this market are heart rate monitors, body temperature thermometers, pedometers, cadence meters, altimeter, positioning / GPS tracking and watches displaying information from sensors.

### 2.3.5 Entertainment

Bluetooth technology is already used in a wide variety of devices in the entertainment sector, namely set-top boxes / gaming consoles. BlueMod+S42 is especially suited for use in remote controls, gaming controller and wireless mouse/keyboard applications.

## 2.4 Block Diagram

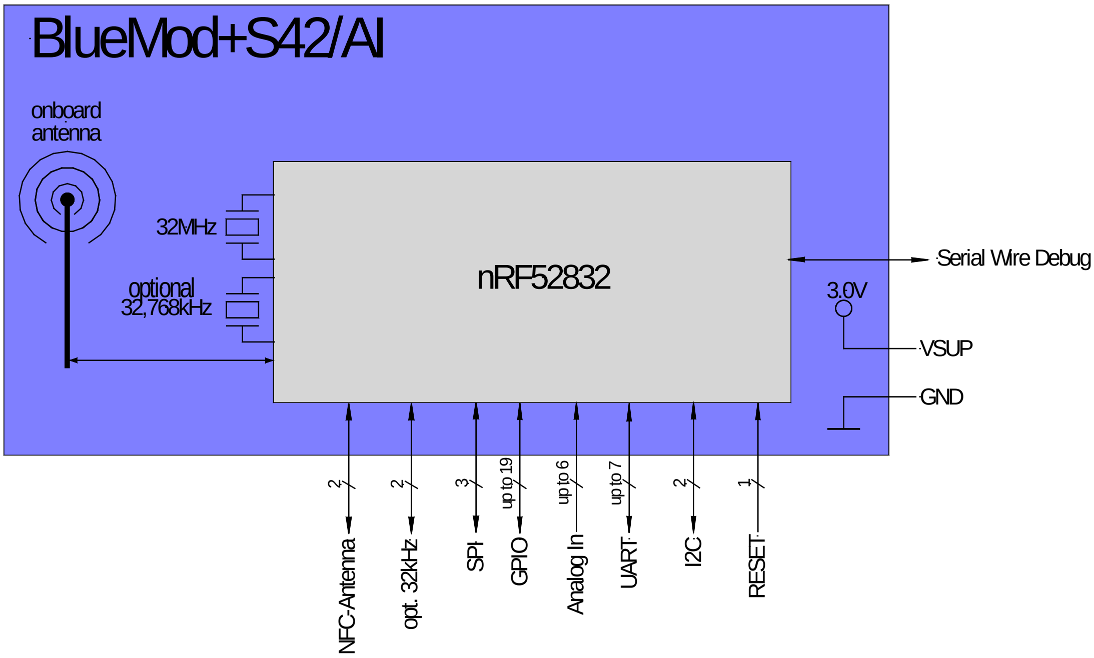



Figure 1: BlueMod+S42/AI Block Diagram

# 3 Application Interface

## 3.1 Power Supply

BlueMod+S42 require a power supply with the following characteristics:

Typical: 3,0$V_{DC}$, min.: 1,7$V_{DC}$, max.: 3,6$V_{DC}$, thereby delivering > 25 mA peak

BlueMod+S42 is designed to be powered from 3V coin cell batteries e.g. CR2032 directly, or any other power source complying with the given requirements. For optimal performance, a stable supply is recommended. Furthermore, it is recommended to place a capacitor in parallel to the CR2032 3V coin cell battery in order to prolong battery lifetime, by compensating the effects of the rising source resistance of the battery to pulsed loads. Since the isolation resistance of this capacitor will discharge the battery in a not insignificant scale, the capacitor should be chosen under consideration of the following rules:

- capacitance as small as necessary
- nominal voltage as high as possible
- case size as large as possible
- use X7R instead of X5R

In case of using an NFC antenna in conjunction with batteries attend to chapter 3.7.1 Power Back feeding.

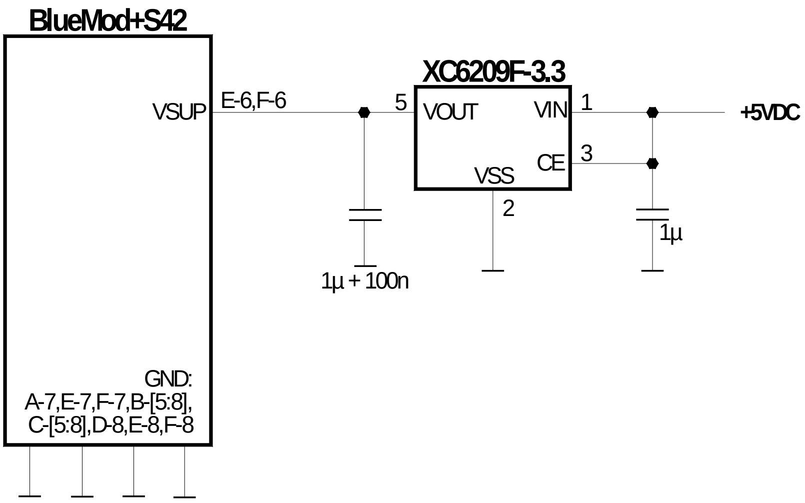



Figure 2: BlueMod+S42 Example Power Supply with LDO

### 3.1.1 Power-up Slew-Rate

| Parameter | Min | Max | Unit |
|---|---|---|---|
| VSUP rise time rate (1) | 0 | 60 | ms |

(1) 0V to 1,7V

Table 2: Power up Rise Time Requirements

## 3.2 Reset

BlueMod+S42 are equipped with circuitry for generating reset from three sources:

- A reset is held active, when VSUP falls below the threshold of the brownout detector ($V_{BOR}$ = 1,2V … 1,7V), and is released when VSUP rises above $V_{BOR}$ + $V_{HYST}$ . The brownout detector also holds the reset active during power up, until VSUP > $V_{BOR}$.
- A reset is generated, when VSUP is > $V_{BOR}$ and increases 300 mV or more, within 300 ms or less.
- By holding pin B-1 (EXT-RES#) at ≤ VSUP*0,3V for $t_{HOLDRESETNORMAL}$ ≥ 0,2µs, an external reset (*pin reset*) is generated. This pin has a fixed internal pull-up resistor ($R_{PU}$ = 11kΩ ... 16kΩ). EXT-RES# may be left open if not used.

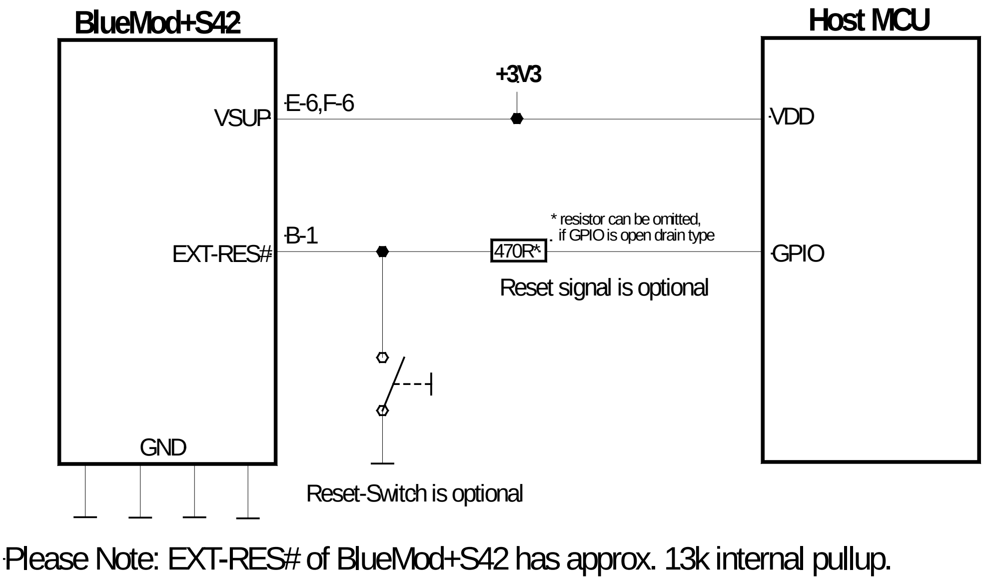



Figure 3: BlueMod+S42 Example Reset

The following table shows the pin states of BlueMod+S42 during reset active.

| Pin Name | State: BlueMod+S42 |
|---|---|
| EXT-RES# | Input with pull-up (1) |
| XL-IN | Input floating (disconnected) |
| XL-OUT | Input floating (disconnected) |
| UART-TXD | Input floating (disconnected) |
| UART-RXD | Input floating (disconnected) |
| UART-RTS# | Input floating (disconnected) with pull-up resistor 470kΩ (2) |
| UART-CTS# | Input floating (disconnected) |
| IUR-OUT# | Input floating (disconnected) |
| IUR-IN# | Input floating (disconnected) |
| GPIO[0:14] | Input floating (disconnected) |
| TESTMODE# | Input floating (disconnected) |
| BOOT0 | Input floating (disconnected) |
| SWDIO | Input with pull-up (1) |
| SWCLK | Input with pull-down (1) |

(1) pull-up, pull-down: $R_{PU,}$ $R_{PD}$ is typ. 13kΩ (11kΩ to 16kΩ)

(2) a discrete resistor is used

Table 3: Pin States during Reset

The pin states as indicated in Table 3 are kept until hardware initialization has started.

## 3.3 Serial Interface

The serial interface of BlueMod+S42 is a high-speed UART interface supporting RTS/CTS flow control and interface-up/down mechanism according to the UICP+ protocol (refer to UICP_UART_Interface_Control_Protocol, 30507ST10756A). Electrical interfacing is at CMOS levels (defined by VSUP; see chapter 5.4.1).

Transmission speeds are 9600 – 921600 bps and 1Mbps (asynchronous)

Character representation: 8 Bit, no parity, 1 stop bit (8N1)

Hardware flow-control with RTS and CTS (active low)

**NOTE:**

Transmission speed may be limited by firmware. See corresponding command reference **BlueMod+S42\Central AT Command** Reference for further information.

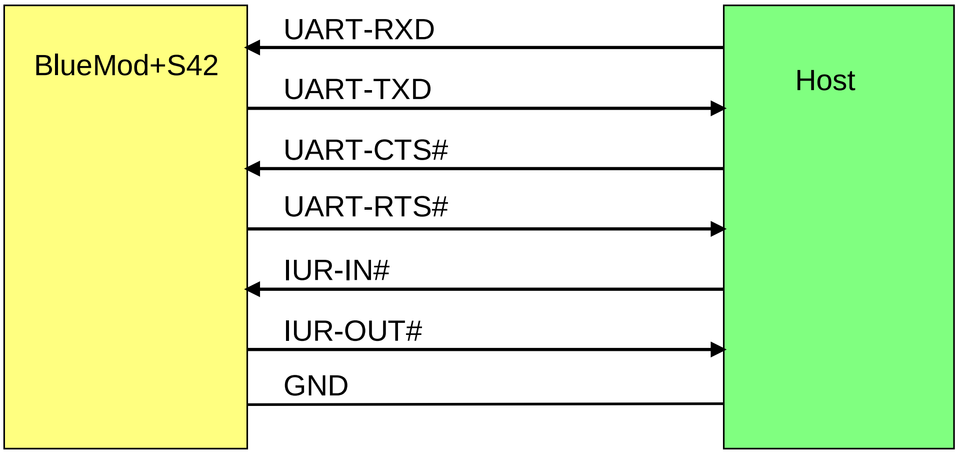



Figure 4: Serial Interface Signals

The basic serial interface (with RTS/CTS flow control) uses only four signal lines (UART-RXD, UART-TXD, UART-CTS#, UART-RTS#) and GND. IUR-IN#, IUR-OUT# and GPIO[4] (see below) can be left unconnected.

A substantially saving of power during idle phases can be achieved (see 5.5.1) when the UICP protocol is used (refer to UICP_UART_Interface_Control_Protocol, 30507ST10756A). This protocol should be implemented on the host side as well. Signals IUR-IN# and IUR-OUT# should be connected to the host (see Figure 4: Serial Interface Signals) and may be mapped to DSR and DTR, if an RS232-style (DTE-type) interface is used (see Figure 6).

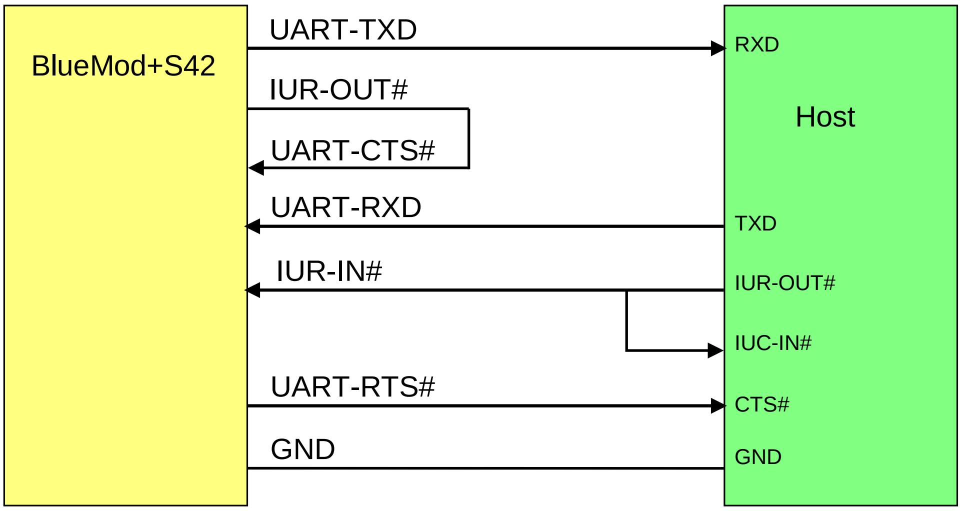



Figure 5: Five Wire Interface supporting UICP (Minimum Signals needed)

Figure 5 shows the minimal configuration to use UICP for both directions RxD and TxD. To use this scheme, the user has to implement UICP on host side for the transmitter only to wake up the BlueMod+S42 receiver.

When using the TIO firmware and applications, call control can be supported by GPIO[4]. Driving GPIO[4] to logic High level during a data transfer phase will “hang up” the connection and disconnect the Bluetooth link. This signal may be mapped to DSR, if an RS232-style (DTE-type) interface is used. Please refer to BlueMod+S42\Central AT Command Reference for a functional specification. GPIO[4] can be left unconnected if this feature is not used.

### 3.3.1 4-Wire Serial Interface

If the host in question is sufficiently fast, a four-wire scheme may be successful. Connect the serial lines UART-RXD, UART-TXD as well as UART-RTS# and GND; leave UART-CTS# open. The host is required to stop sending data within a short time after de-assertion of UART-RTS# (there is room for up to 4 more characters at the time RTS# drops).

**Attention**: UICP has to be deactivated permanently in this configuration, because signal UART-CTS# and IUR-IN# become inputs with no PU or PD if UICP is active. This would cause floating CMOS inputs.

**NOTE:**

It is strongly recommended to use hardware flow control in both directions. Not using flow control can cause a loss of data.

### 3.3.2 UART Example Circuits

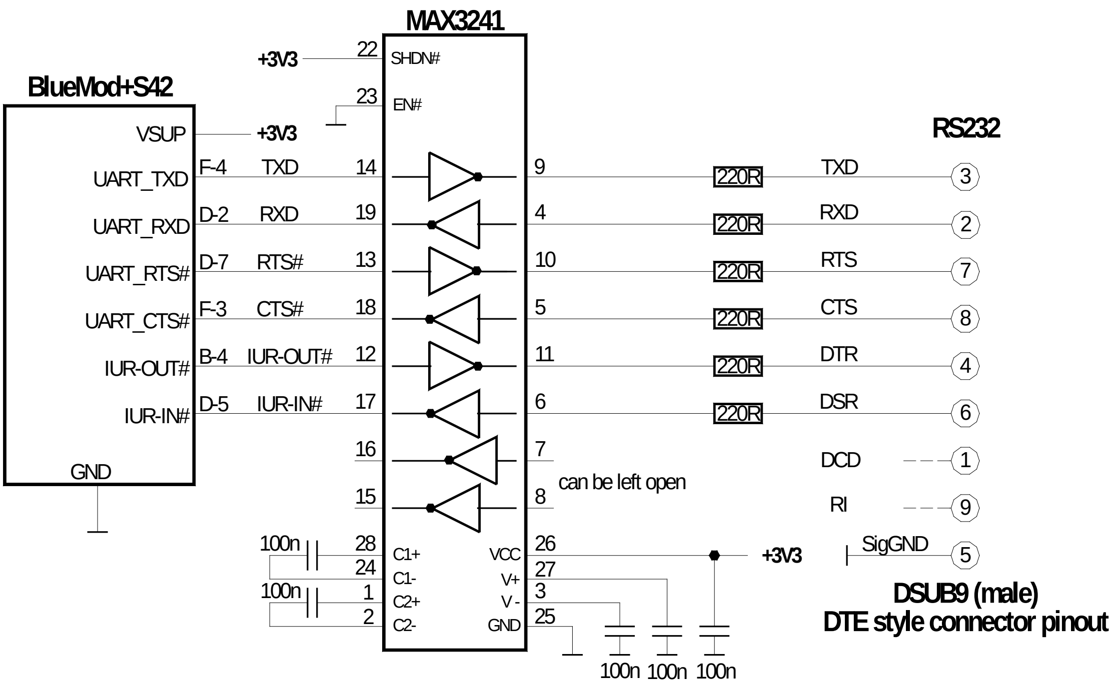



Figure 6: BlueMod+S42 Example Serial Interface (RS-232) Supporting UICP

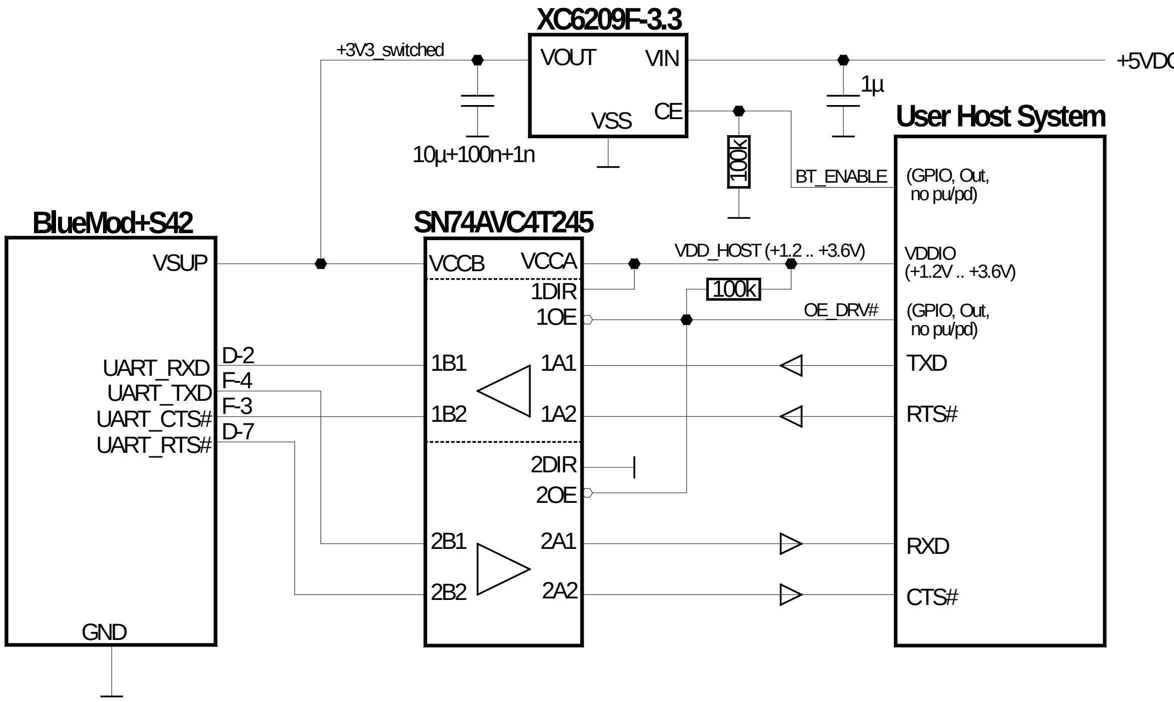



Figure 7: BlueMod+S42 Example Serial Interface (Mixed Signal Level)

### 3.3.3 Baud Rate Deviation

The following table shows the deviation in percent of the standard data rates. The deviation may be caused by the inaccuracy of the crystal oscillator or granularity of the baud rate generator.

| **Baud Rate nominal** | **Baud Rate actual** | **Deviation [%]** |
|---|---|---|
| 9600 | 9598 | -0,02 |
| 14400 | 14401 | 0,01 |
| 19200 | 19208 | 0,04 |
| 28800 | 28777 | -0,08 |
| 38400 | 38369 | -0,08 |
| 57600 | 57554 | -0,08 |
| 76800 | 76923 | 0,16 |
| 115200 | 115108 | -0,08 |
| 230400 | 231884 | 0,64 |
| 250000 | 250000 | 0,00 |
| 460800 | 457143 | -0,79 |
| 921600 | 921176 | -0,05 |

Table 4: Deviation of Baud rates

*Note: The total deviation of sender and receiver shall not exceed 2.5% to prevent loss of data.*

### 3.3.4 Dynamic I/O Signal Type Changes depending on the UICP status

In order to allow customers to use the serial interface with the minimal signal count on the one side and to reduce current consumption when using UICP on the other side, the BlueMod+S42 FW supports the following dynamic I/O signal type changes depending on the UICP activated resp. deactivated status.

| Signal | UICP deactivated | UICP activated |
|---|---|---|
| UART-CTS# | I-PD | I-FLOAT |
| IUR-IN# | I-DIS | I-FLOAT |
| IUR-OUT# | I-DIS | O-PP |

Legend: I-PD = Input with pull-down resistor, I-DIS = Input disconnected, I-FLOAT = input floating, O-PP = Output push-pull

Signal types I-PD, I-DIS and O-PP may be left open. I-FLOAT has to be driven to GND or VCC to avoid open CMOS input oscillation.

If UICP is deactivated the pull-down resistor on UART-CTS# helps to keep the serial interface active if UART-CTS# is open.

If UICP is active and the serial interface is down, UART-CTS# has to be held at VCC and thus the pull-down would cause an unwanted permanent current drain. Therefore the pull-down is switched off in this mode.

## 3.4 GPIO Interface

It is possible to use the programmable digital I/Os GPIO[0:14] on the BlueMod+S42. Their behavior has to be defined project specific in the firmware.

Unused GPIO pins shall be left unconnected to stay compatible. There may be functions assigned to some in future versions of the firmware.

## 3.5 I$^2$C Interface[1]

The I$^2$C bus interface serves as an interface between the internal microcontroller and the serial I$^2$C bus. BlueMod+S42 is the master and controls all I$^2$C bus specific sequencing, protocol and timing. It supports standard (100kHz) and fast (400kHz) speed modes. The BlueMod+S42 as an I$^2$C master must be the only master of the I$^2$C bus (no *multimaster* capability). Clock stretching is supported.

GPIO[1]/I2C-SDA and GPIO[0]/I2C-SCL can be used to form an I$^2$C interface. It is required to connect 4k7 pull-up resistors on I2C-SCL and I2C-SDA when this interface is used.

[1] subject to firmware support, contact Telit for current status

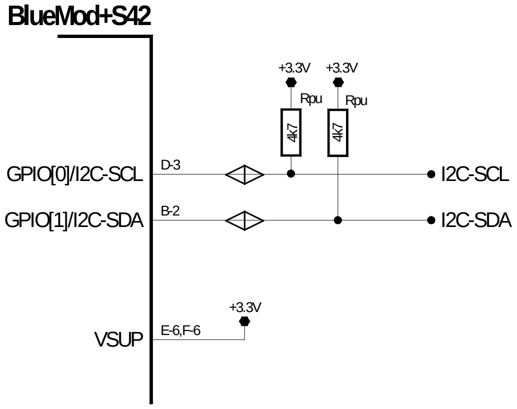



Figure 8: BlueMod+S42 $I^2C$ Interface

## 3.6 SPI Serial Peripheral Interface

The serial peripheral interface (SPI) allows for full-duplex, synchronous, serial communication with external devices. The interface can be configured as the *master* and then provides the communication clock (SCK) to the external slave device(s), or as the *slave*. The SPI Interface supports SPI-modes 0 through 3. Module pins are used as follows:

- GPIO[2]: SPI-MOSI
- GPIO[5]: SPI-MISO
- GPIO[8]: SPI-SCK

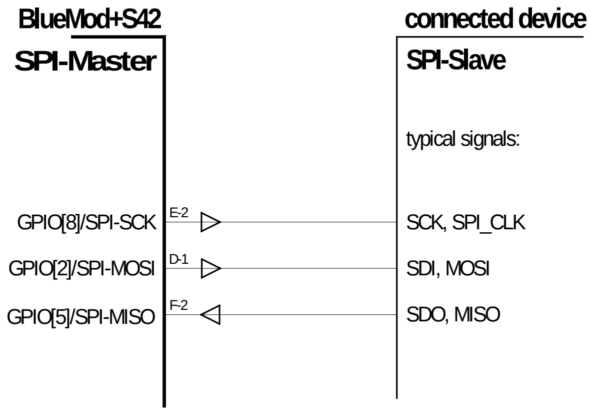



Figure 9: BlueMod+S42 SPI Interface (Example: Master Mode)

## 3.7 Bluetooth Radio Interface

The BlueMod+S42/AI includes an integrated ceramic antenna.

## 3.8 NFC Function

The NFCT peripheral supports communication signal interface type A and 106 kbps bit rate from the NFC Forum.

With appropriate software, the NFC peripheral can be used to emulate the listening device NFC-A as specified by the NFC Forum.

Main features for the NFC peripheral:

- NFC-A listen mode operation
- 13.56 MHz input frequency
- Bit rate 106 kbps
- Wake-on-field low power field detection (SENSE) mode
- Frame assemble and disassemble for the NFC-A frames specified by the NFC Forum
- Programmable frame timing controller

- Integrated automatic collision resolution, CRC and parity functions

### 3.8.1 NFCT Antenna Recommendations

The NFCT antenna coil must be connected differential between NFCANT1 and NFCANT2 pins of BlueMod+S42.

Two external capacitors $C_{tune1/2}$ connected between the NFCANTx pins and GND should be used to tune the resonance of the antenna circuit to 13.56 MHz.

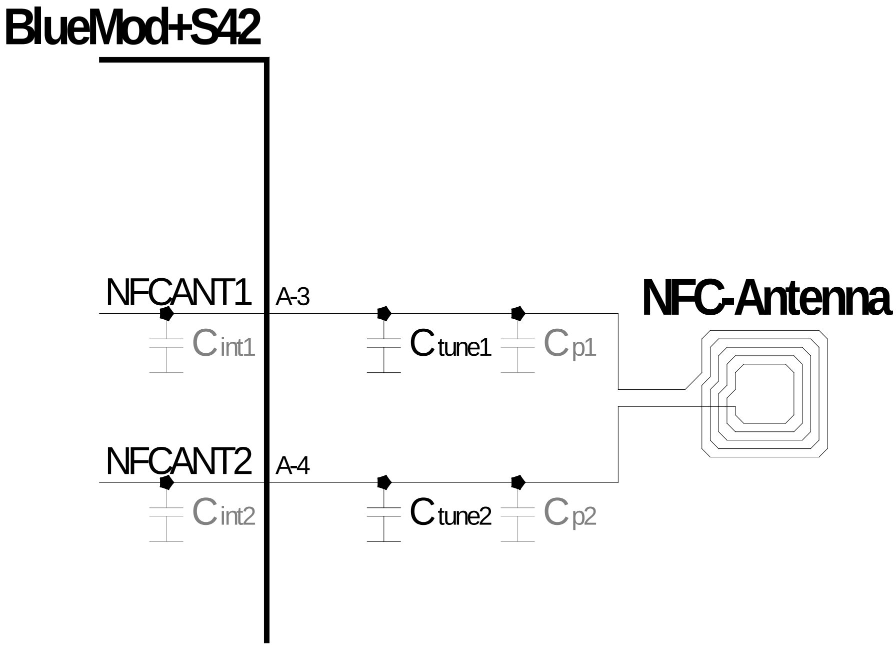



Figure 10: BlueMod+S42 NFC Antenna Tuning

$$C_{tune} = \frac{2}{(2\pi \times 13{,}56MHz)^2 \times L_{ant}} - C_p - C_{int}$$

$$C_{tune} = C_{tune1} = C_{tune2}$$

$$C_p = C_{p1} = C_{p2} \ (antenna\ track\ capacitance)$$

$$C_{int} = C_{int1} = C_{int2} = 4pF$$

### 3.8.2 Power Back feeding

If the NFC antenna is exposed to a strong NFC field, power back feeding may occur. That means, current may flow in the opposite direction on the supply due to parasitic diodes and ESD structures.

If a battery is used that does not tolerate return current, a series diode must be placed between the battery and the BlueMod+S42 in order to protect the battery. An ultra-low forward voltage schottky diode should be chosen to keep the battery life reduction as small as possible.

## 3.9 Slow Clock Interface

Even though an external slow clock is not required for BLE operation, consumption of power during power-down modes can be reduced by connecting an XTAL (32,768kHz) and two capacitors C1, C2 at pins XL-IN and XL-OUT.

### 3.9.1 32,768 kHz Crystal Oscillator Specification (32k XOSC)

| Symbol | Item | Condition | Limit | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $f_{NOM}$ | Crystal Frequency | $T_{amb}$ = 25°C | | 32,768 | | kHz |
| $f_{TOL}$ | Frequency Tolerance for BLE applications | including temperature and aging (1) | | | +/-250 | ppm |
| $C_L$ | Load Capacitance | | | | 12,5 | pF |
| C0 | Shunt Capacitance | | | | 2 | pF |
| $R_S$ | Equivalent Series Resistance | | | | 100 | kΩ |
| $P_D$ | Drive Level | | | | 1 | µW |
| $C_{pin}$ | Input Cap. On XL-IN and XL-OUT | | | 4 | | pF |

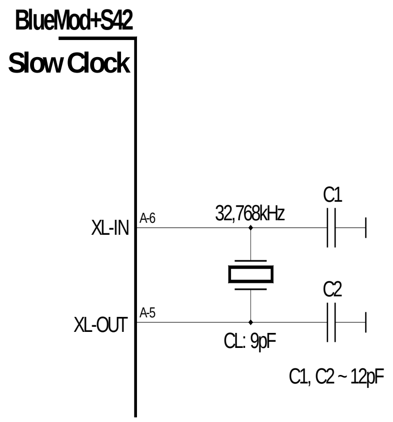
(11) adjust crystal frequency by choosing correct value for C1, C2 (value depends on $C_L$ of crystal and layout)

Table 5: 32,768kHz Crystal Oscillator

The module’s firmware will detect the presence of a slow clock during the boot process and switch behavior appropriately.

### 3.9.2 Connection of an External 32,768 kHz Crystal

Connect the 32,768 kHz crystal and two capacitors C1, C2 at pins A-6 (XL-IN) and A-5 (XL-OUT). The crystal has to comply with specifications given in Table 5. The exact value of C1 and C2 depends on the crystal and the stray capacitance of the layout. Select C1, C2 such that the slow clock oscillator operates at the exact frequency at room temperature (25°C). C1 and C2 shall be of equal capacity. The crystal and the capacitors shall be located as close as possible to pins A-5, A-6.




$C_L$ = (C1+$C_{pin}$+$C_s$) * (C2+$C_{pin}$+$C_s$) / (C1+C2+2*$C_{pin}$+2*Cs), or

C1, C2 = (2*$C_L$ – $C_{pin}$ – $C_s$)

$C_{pin}$: see Table 5

$C_s$: stray capacitance, depends on layout

Figure 11: BlueMod+S42 connection of external XTAL

## 3.10 Test Mode

For homologation purposes the ability of test mode operation like “BlueMod+S42_Testmode” or “Direct two wire UART Testmode” (DTM) is mandatory. The Direct Test Mode (as defined by the Bluetooth SIG) and BlueMod+S42_Testmode are part of the BlueMod+S42 TIO-Firmware. Please refer to tbd.

For enabling the different test modes the BlueMod+S42 provides two IO pins.

- The pin Testmode is low active. Active in the following table means connect to GND.
- The pin Boot0 is high active. Active in the following table means connect to VDD.
- The other two combinations start the bootloader for firmware update of the programmed firmware. These two modes are not scope of this document.

Table 6 shows the possible combinations:

| Testmode# | Boot0 | Mode |
|---|---|---|
| Active | Inactive | Testmode |
| Active | Active | DTM |
| Inactive | Active | Start Bootloader |
| Inactive | Inactive | Firmware Update |

Table 6: Testmode# / Boot0 Logic

To enter and use BlueMod+S42 Testmode or DTM, access to the following signals is required:

- BOOT0
- TESTMODE#
- UART-RXD
- UART-TXD
- UART-RTS#
- UART-CTS#
- GND

These pins shall be routed to some test pads on an outer layer, but can be left open during normal operation when not used.

Please note the UART is required for operation of test modes. During the homologation process, UART-RXD, UART-TXD, UART-RTS# and UART-CTS# must be freely accessible.

## 3.11 Operating in a Power-Switched Environment

A potential "back feeding" problem may arise, if the module is operated in an environment where its power supply (VSUP) is switched off by the application. This might be done to save some power in times Bluetooth is not needed.

As stated in Table 9, the voltage on any I/O pin must not exceed VSUP by more than 0,3V at any time. Otherwise some current $I_{INJ}$ flows through the internal protection diodes. This may damage the module (please refer to chapter 5.1 for limits).

There is no problem if the application circuit design and programming can assure that all signals directed towards BlueMod+S42are set to low (U < 0,3V) before and while VSUP is turned off. If this is not guaranteed, at least a series resistor (about 1k) must be inserted into each signal path. This does protect the module but obviously cannot prevent from an unwanted, additional current flow in case of such signal being at high-level. It may be necessary to use driver chips in such applications, that gate off these signals while VSUP is not present.

## 3.12 Serial Wire Debug Interface

The Serial Wire Debug (SWD) interface (signals SWDIO, SWCLK) is normally not used in a customer's product. It is reserved for debugging purposes.

Leave SWDIO, SWCLK unconnected. Only if you intend to use them for debugging purposes, make them available.

## 3.13 DC/DC Converter

The BlueMod+S42 contains a buck DC/DC converter and an LDO for supplying the radio circuit.

Switching between DC/DC converter and LDO is done automatically based on load to maximize efficiency.

Used with a 3V coin-cell battery, the peak current drawn from the battery is reduced by at least 25% by use of the DC/DC converter.

# 4 Module Pins

## 4.1 Pin Numbering

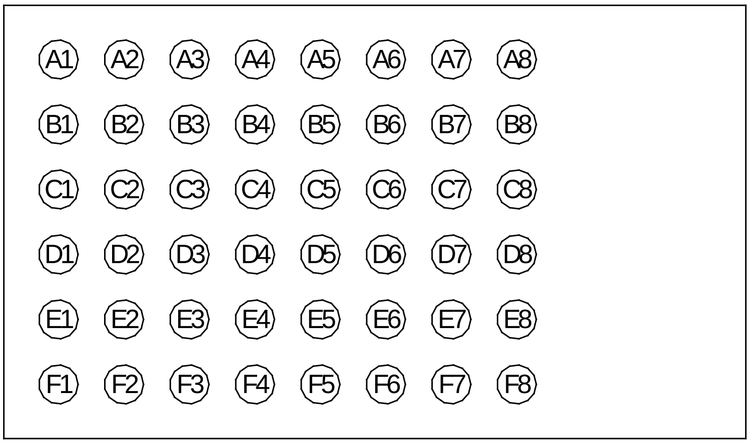



Figure 12: BlueMod+S42 Pin Numbering (Top View)

# 4.2 Pin Description

## 4.2.1 General Pin Description

Type: PU – pull-up; PD – pull-down; PWR – Power; I – Input; O – Output; I/O – bidir.; OD – open drain; PP – push/pull;
RF: RadioFreq; I-DIS – Input Buffer Disconnected

| Pin Name | Signal | Type | Act | Function | Alternate Function | Notes |
|---|---|---|---|---|---|---|
| E-6 | VSUP1 | PWR | | +3,0V nom. | | |
| F-6 | VSUP2 | PWR | | +3,0V nom | | |
| C-1 | not connected | | | none | | |
| A-7, E-7, F-7, B-[5,6,7,8], C-[5,6,7,8], D-8, E-8, F-8 | GND | PWR | | Ground<br>All GND pins must be connected | | |
| A-8 | ANT PIN | | | none | reserved for ext. antenna | (4,9) |
| B-1 | EXT-RES# | I-PU | L | User Reset | | |
| A-6 | XL-IN | I/O | | XTAL | | |
| F-4 | UART-TXD | O-PP | | Serial Data OUT | | (6) |
| D-2 | UART-RXD | I | | Serial Data IN | | (6) |
| D-7 | UART-RTS# | O-PU (1) | L | Flow Control/IUC | | (1,6) |
| F-3 | UART-CTS# | I-PD | L | Flow Control/IUC | | (6,8) |
| B-4 | IUR-OUT# | O-PP | L | UICP Control | | (8) |
| D-5 | IUR-IN# | I-DIS | L | UICP Control | | (8) |
| D-3 | GPIO[0] | I/O | | GPIO | I2C-SCL, AIN7, AREF1 | (3,5) |
| B-2 | GPIO[1] | I/O | | GPIO | I2C-SDA, AIN6 | (3,5) |
| D-1 | GPIO[2] | I/O | | GPIO | SPI-MOSI | (3,5) |
| E-4 | GPIO[3] | I/O | | GPIO | | (3,5) |
| D-4 | GPIO[4] | I/O | | GPIO | | (3,5) |
| F-2 | GPIO[5] | I/O | | GPIO | SPI-MISO, AREF0 | (3,5) |
| C-4 | GPIO[6] | I/O | | GPIO | | (3,5) |
| C-3 | GPIO[7] | I/O | | GPIO | | (3,5) |
| E-2 | GPIO[8] | I/O | | GPIO | SPI-SCK, AIN2 | (3,5) |
| A-3 | NFCANT1 | RF | | NFC-Antenna | | |
| A-1 | GPIO[10] | I/O | | GPIO | | (3,5) |
| A-4 | NFCANT2 | RF | | NFC-Antenna | | |
| A-2 | GPIO[9] | I/O | | GPIO | | (3,5) |
| F-1 | TESTMODE# | I-PU (7) | L | Testmode Enable | AIN3 | (6) |
| E-1 | BOOT0 | I-PD (7) | | reserved | AIN4 | (6) |
| E-3 | SWDIO | I/O-PU | | Serial Wire Debug (data) | | |
| D-6 | SWCLK | I-PD | | Serial Wire Debug (clock) | | |
| C-2 | GPIO[13] | I/O | | GPIO | | (3,5) |
| B-3 | GPIO[11] | I/O | | GPIO | AIN5 | (3,5) |
| A-5 | XL-OUT | I/O | | XTAL | | |
| F-5 | GPIO[14] | I/O | | GPIO | | (3,5) |
| E-5 | GPIO[12] | I/O | | GPIO | | (3,5) |

Notes:
(1) a discrete pull up resistor is used
(3) function depends on firmware
(4) DNU: Do Not Use, Do Not Connect
(5) GPIO pin. These pins may be programmed as analog-in, i-disconnected, i-float, i-pu, i-pd, o-pp (output push/pull), o-od (output open drain), o-os (output open source) or some alternate function;
(6) signal must be accessible for homologation purposes. Refer to 3.9 Test Mode
(7) signals sampled at startup time. TESTMODE# is I-PU, BOOT0 is I-PD during sampling time only, I-DIS otherwise
(8) Pin Type depends on UICP status. Refer to 3.3.4 Dynamic I/O Signal Type Changes depending on the UICP status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 7: General Pin Assignment

## 4.2.2 Application Specific Pin Description

### 4.2.2.1 TIO Pin Configuration

Type: PU – pull-up; PD – pull-down; PWR – Power; I – Input; O – Output; I/O – bidir.; OD – open drain; PP – push/pull;
RF: RadioFreq; I-DIS – Input Buffer Disconnected

| Pin Name | Signal | TIO-Function | Type | Act | Description | Note |
|---|---|---|---|---|---|---|
| E-6 | VSUP1 | Power | PWR | | +3,3V nom. | |
| F-6 | VSUP2 | Power | PWR | | +3,3V nom | |
| C-1 | not connected | | | | | |
| A-7,E-7,F-7, B-[5,6,7,8], C-[5,6,7,8], D-8, E-8, F-8 | GND | GND | PWR | | Ground<br>All GND pins must be connected | |
| A-8 | ANT PIN | none | | | leave open (reserved for ext. antenna) | (4,9) |
| B-1 | EXT-RES# | Reset | I-PU | L | User Reset | |
| A-6 | XL-IN | XTAL | | | leave open if no ext. XTAL is connected | |
| F-4 | UART-TXD | TXD | O-PP | | Serial Data OUT | (6) |
| D-2 | UART-RXD | RXD | I | | Serial Data IN | (6) |
| D-7 | UART-RTS# | /RTS | O-PP | L | Flow Control/IUC; refer to | (1,6) |
| F-3 | UART-CTS# | /CTS | I-PD | L | Flow Control/IUC; refer to | (6,8) |
| B-4 | IUR-OUT# | /IUR-OUT | O-PP | L | UICP Control; refer to | (3,8) |
| D-5 | IUR-IN# | /IUR-IN | I | L | UICP Control; refer to **UICP**_UART_Interface_Control_Protocol, 30507ST10756A | (3,8) |
| D-3 | GPIO[0] | GPIO[0] | I/O | | GPIO [I2C-SCL] | (3) |
| B-2 | GPIO[1] | GPIO[1] | I/O | | GPIO [I2C-SDA] | (3) |
| D-1 | GPIO[2] | IOC | I/O | | GPIO [SPI-MOSI] | (3) |
| E-4 | GPIO[3] | IOB | I/O | | GPIO | (3) |
| D-4 | GPIO[4] | HANGUP | I-PD | | optional; refer to | |
| F-2 | GPIO[5] | IOD | I/O | | GPIO [SPI-MISO] | (3) |
| C-4 | GPIO[6] | reserved | I-DIS | | GPIO | (3) |
| C-3 | GPIO[7] | GPIO7 | I-DIS | | GPIO | (3) |
| E-2 | GPIO[8] | IOA | I/O | | GPIO [SPI-SCK] [DEVICE READY#] | (3) |
| A-3 | NFCANT1 | NFC | RF | | | |
| A-1 | GPIO[10] | DNU | I-DIS | | leave open | (4) |
| A-4 | NFCANT2 | NFC | RF | | | |
| A-2 | GPIO[9] | DNU | I-DIS | | leave open | (4) |
| F-1 | TESTMODE# | reserved | I-PU | L | connect to test pad | (6,7) |
| E-1 | BOOT0 | reserved | I-PD | | connect to test pad | (6,7) |
| E-3 | SWDIO | reserved | I/O-PU | | leave open (Serial Wire Debug) | |
| D-6 | SWCLK | reserved | I-PD | | leave open (Serial Wire Debug) | |
| C-2 | GPIO[13] | DNU | I-DIS | | leave open | (4) |
| B-3 | GPIO[11] | DNU | I-DIS | | leave open | (4) |
| A-5 | XL-OUT | XTAL | | | leave open if no ext. XTAL is connected | |
| F-5 | GPIO[14] | DNU | I-DIS | | leave open | (4) |
| E-5 | GPIO[12] | DNU | I-DIS | | leave open | (4) |

Notes:
(1) a discrete pull up resistor is used
(3) function depends on firmware
(4) DNU: Do Not Use, Do Not Connect
(6) signal must be accessible for homologation purposes. Refer to 3.9 Test Mode
(7) signals sampled at startup time. TESTMODE# is I-PU, BOOT0 is I-PD during sampling time only, I-DIS otherwise
(8) Pin Type depends on UICP status. Refer to 3.3.4 Dynamic I/O Signal Type Changes depending on the UICP status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 8: Application Specific Pin Assignments, TIO

## 4.3 Handling of Unused Signals

Depending on the application, not all signals of BlueMod+S42 may be needed. The following list gives some hints how to handle unused signals.

- EXT-RES# If no external Reset is needed: Leave open
- BOOT0 leave open (1)
- XL-IN If no external XTAL is connected: Leave open
- XL-OUT If no external XTAL is connected: Leave open
- UART-RXD, UART-TXD If UART is not used: On UART-RXD, add a pullup (e.g.100kΩ) to VSUP (1); leave UART-TXD open (1)
- UART-RTS#, UART-CTS# If neither flow control nor UICP is used: Leave open (1)(2)
- IUR-OUT#, IUR-IN# If UICP is not used: leave open
- NFCANT1, NFCANT2 If no NFC antenna is connected: Leave open
- TESTMODE# Leave open (1)
- unused GPIOs Leave open
- SWDIO, SWCLK Leave open. Only needed for debug purposes.

Please note, to keep compatibility with future feature enhancements, unused signals shall not be connected directly to VSUP or GND. Leave open.

Notes:

(1) *Signals must be accessible during the homologation process, refer to 3.9 Test Mode.*

(2) It is strongly recommended to use hardware flow control in both directions.
Not using flow control can cause a loss of data.

# 5 Electrical Characteristics

## 5.1 Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “Electrical Requirements” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

| Item | Symbol | Absolute Maximum Ratings | Unit |
|---|---|---|---|
| Supply voltage | VSUP | -0,3 to +3,9 | V |
| Voltage on any pin | $V_{Pin}$ | -0,3 to VSUP+0,3 and <3,9 | V |
| RF input level | | 10 | dBm |
| NFC antenna pin current | $I_{NFC1/2}$ | 80 | mA |

Table 9: Absolute Maximum Ratings

## 5.2 Operating Conditions

$T_{amb}$ = 25°C

| Item | Condition | Limit | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| Supply voltage VSUP | normal mode (DC/DC not enabled) | 1,7 | 3,0 | 3,6 | $V_{DC}$ |
| Supply voltage VSUP | DC/DC mode (DC/DC enabled) | 1,7 | 3,0 | 3,6 | $V_{DC}$ |
| Supply rise time | 0V to 1,7V | | | 60 | ms |

Important: The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

Table 10: DC Operating Conditions

## 5.3 Environmental Requirements

| Item | Symbol | Absolute Maximum Ratings | Unit |
|---|---|---|---|
| Storage temperature range | $T_{stg}$ | -40 to +125 | °C |
| Operating temperature range | $T_{op}$ | -40 to +85 | °C |

Table 11: Environmental Requirements

## 5.4 DC Parameter

All Module I/O pins are connected directly to the Nordic nRF52832 chip without signal conditioning except for some pull-up/pull-down resistors (as indicated). Therefore the electrical characteristics are as documented in the Nordic nRF52832 data sheet Nordic: nRF52_Series_Reference_Manual.

### 5.4.1 General Purpose I/O (GPIO)

$T_{amb}$ = 25°C

| Symbol | Item | Condition | Limit | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{IL}$ | Low-Level Input Voltage | VSUP = 1,7 to 3,6V | VSS | - | VSUP * 0,3 | V |
| $V_{IH}$ | High-Level Input Voltage | VSUP = 1,7 to 3,6V | VSUP * 0,7 | - | VSUP | V |
| $V_{OL}$ | Low-Level Output Voltage | $I_{OL}$ = 0,5mA (1)<br>$I_{OL}$ = 5,0mA (2), (3) | VSS<br>VSS | - | VSS + 0,4<br>VSS + 0,4 | V |
| $V_{OH}$ | High-Level Output Voltage | $I_{OH}$ = -0,5mA (1)<br>$I_{OH}$ = -5,0mA (2), (3) | VSUP - 0,4<br>VSUP - 0,4 | - | VSUP<br>VSUP | V |
| $I_{OL}$ | Low –Level Output Current | $V_{OL}$ ≤ VSS + 0,4V | - | - | -0,5mA (1)<br>-5,0mA (2), (3) | mA |
| $I_{OH}$ | High-Level Output Current | VSUP-0,3V ≤ $V_{OH}$ ≤ VSUP | - | - | 0,5mA (1)<br>5,0mA (2), (3) | mA |
| $R_{PU}$ | pull-up resistor | | 11 | 13 | 16 | kΩ |
| $R_{PD}$ | pull-down resistor | | 11 | 13 | 16 | kΩ |
| $C_I$ | Pad Capacitance | | | 3,0 | | pF |

(1) drive = std
(2) drive = hi
(3) maximal number of pins (per package) with high drive is 3

Table 12: DC Characteristics, Digital IO

### 5.4.2 EXT-RES#

Input EXT-RES# has a Schmitt-Trigger characteristic and an internal pull-up resistor.

$T_{amb}$ = 25°C

| Symbol | Item | Condition | Limit | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{IL}$ | Low-Level Threshold | VSUP = 1,7 to 3,6V | | 0,34*VSUP | | V |
| $V_{IH}$ | High-Level Threshold | VSUP = 1,7 to 3,6V | | 0,62*VSUP | | V |
| $V_{HYST}$ | Hysteresis | VSUP = 3,0V | | 800 | | mV |
| $R_{PU}$ | pull-up resistor | | 11 | 13 | 16 | kΩ |
| $C_I$ | Input Capacitance | | | 2,5 | | pF |

Table 13: DC Characteristics, EXT-RES#

### 5.4.3 Analog Digital Converter (ADC)

#### 5.4.3.1 Input Voltage Range

It is very important to configure the ADC, so the input voltage range and the ADC voltage range are matching.

- If the input voltage range is lower than the ADC voltage range, the resolution will not be fully utilized.
- If the input voltage range is higher than the ADC voltage range, all values above the maximum ADC voltage range will be limited to the maximum value, also called the saturation point.

Input voltage range and saturation point depend on the configured ADC reference voltage (see 5.4.4) and the chosen prescaling.

Input Voltage Range = ADC Reference Voltage / Prescaler

Limitation for maximum input voltage is described in 5.4.5

### 5.4.4 ADC Reference Voltage

ADC Reference voltage can be obtained from:

- Internal band gap reference: 1,2V ± 1,5%

or

- External reference pin AREF: min. 0,83V typ. 1,2V max. 1,3V

Source Impedance: <5kΩ

### 5.4.5 Analog ADC Input AIN

When the ADC is not sampling the AIN input pin has very high impedance and can be regarded as open circuit.

Table 14 shows the internal impedance for AIN during sampling for different prescaler settings.

This impedance has to be taken into account when using additional external voltage dividers.

| Prescaler | Impedance $R_{AIN}$ | | | Unit |
|---|---|---|---|---|
| | min. | typ. | Max. | |
| 1 / 1 | 120 | 130 | 140 | kΩ |
| 2 / 3 | 180 | 195 | 210 | kΩ |
| 1 / 3 | 365 | 390 | 415 | kΩ |

Table 14: Input Impedance for AIN

Maximum allowed input voltage at AIN:

(Both of the following rules have to be fulfilled)

- The ADC may not be exposed to voltages >2,4V after the AIN prescaler

and

- The AIN pin must not be exposed to voltages >VDD + 0,3V

# 5.5 Power Consumption and Power-Down Modes

## 5.5.1 Terminal I/O Configuration

The following values are typical power consumption values in the different states.

VSUP = 3,0V, $T_{amb}$ = 25°C, all GPIOs open, UART inputs at VSUP or GND, SLCK: 32,768 kHz

| **Condition**<br>**Radio inactive** | **Note** | **Slow clock SLCK** | **Current Consumption** | **Unit** |
|---|---|---|---|---|
| | | | $I_{Avg}$ | |
| Advertising Off, UICP not active or serial interface up | | internal<br>Crystal | 1,2<br>1,2 | mA |
| Advertising Off, UICP active, serial interface down | (1) | internal<br>Crystal | 9<br>7 | µA |
| Device in reset | (2) | any | 0,44 | mA |
| System off | (1,2) | | 1,2 | µA |

(1) UART-RXD, IUR-IN# and UART-CTS# signals connected to CMOS high level
(2) same current consumption w. internal or external slow clock

Table 15: Supply Current Sleep Modes, no Radio Activity

The following table shows the average power consumption of BlueMod+S42operating in the peripheral device role.

VSUP = 3,0V, $T_{amb}$ = 25°C, all GPIO lines left open, SLCK: 32,768 kHz

| **Condition** **Radio active** | **Note** | **Slow clock SLCK** | **Current Consumption** Tx power (dBm) [8] max (+4) $I_{Avg}$ | **Current Consumption** Tx power (dBm) [8] min (-20) $I_{Avg}$ | **Unit** |
|---|---|---|---|---|---|
| Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP not active *or* serial interface up | (5) | internal (7<br>ext. Crystal | 1,2<br>1,2 | 1,2<br>1,2 | mA |
| Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP active *and* serial interface down | (1) | internal (7)<br>ext. Crystal | 17,6<br>16,0 | 14,5<br>12,9 | µA |
| Connected, connection interval: 1,28s,UICP not active *or* serial interface up, no data traffic | (5) | internal (7)<br>ext. Crystal | 1,2<br>1,2 | 1,2<br>1,2 | mA |
| Connected, connection interval: 1,28s,UICP active *and* serial interface down | (1) | internal (7)<br>ext. Crystal | 10,4<br>8,7 | 10,1<br>8,4 | µA |
| Connected, connection interval: 7,5 ms, no data traffic | (2,3,6) | | 1,6 | 1,5 | mA |
| Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, central to peripheral | (2,6,9) | | tbd | tbd | mA |
| Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, peripheral to central | (2,6,9) | | tbd | tbd | mA |
| Connected, connection interval: 40 ms, no data traffic | (2,4,6) | | 1,3 | 1,3 | mA |
| Connected, connection interval: 37,5ms, data traffic 115 kbit/s at the serial port, peripheral to central | (2,4,6, 9) | | tbd | tbd | mA |

*Notes*
*(1) UART-CTS#, IUR-IN#, UART-RXD driven to CMOS high level, all UART output lines left open*
*(2) connection parameters are setup by the central device when connection is established*
*(3) no data to be transmitted, central device sends an empty packet (80 bit) peripheral device answers (empty packet: 80 bit)*
*(4) these are a typical connection parameters used by an iPhone, iPad or iPad mini device in the central device role*
*(5) UART-inputs connected to GND or VSUP; UART output lines left open*
*(6) same current consumption w. internal or external slow clock*
*(7) RC oscillator internal to nRF52832, periodically trimmed by S-device*
*(8) TX power as set by AT command*
(9) Effective Data throughput lower due to flow control in older FW versions → lower current consumption BlueMod+S

Table 16: Supply Current BLE Terminal I/O Profile, Peripheral Device Role

# 5.6 RF Performance

## 5.6.1 BLE Receiver

VSUP = 1,7V to 3,6V, $T_{amb}$ = +20°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

| Receiver | Frequency [GHz] | Min | Typ | Max | BT Spec | Unit |
|---|---|---|---|---|---|---|
| Sensitivity at 30,8% PER | 2,402 | | -92,5 | -70 | ≤ -70 | dBm |
| | 2,440 | | -93,0 | -70 | | |
| | 2,480 | | -93,5 | -70 | | |
| Reported PER during PER report integrity test | 2,426 | 50 | 50 | 65,4 | 50 < PER < 65,4 | % |
| Maximum received signal at 30,8% PER | | -10 | 0 | | ≥ -10 | dBm |
| Continuous power required to block Bluetooth reception at -67dBm with 0,1% BER | 0,030 – 2,000 | -30 | | | -30 | dBm |
| | 2,000 – 2,400 | -35 | | | -35 | |
| | 2,500 – 3,000 | -35 | | | -35 | |
| | 3,000 – 12,75 | -30 | | | -30 | |
| C/I co-channel | | | 10 | 21 | ≤21 | dB |
| Adjacent channel Selectivity C/I | F = F0 + 1 MHz | | 1 | 15 | ≤15 | dB |
| | F = F0 - 1 MHz | | 1 | 15 | ≤15 | dB |
| | F = F0 + 2 MHz | | -25 | -17 | ≤-17 | dB |
| | F = F0 - 2 MHz | | -25 | -15 | ≤-15 | dB |
| | F = F0 + 3 MHz | | -51 | -27 | ≤-27 | dB |
| | F = F0 - 5 MHz | | -51 | -27 | ≤-27 | dB |
| | F = Fimage | | -30 | -9 | ≤-9 | dB |
| Maximum level of intermodulation interferers | | -50 | -36 | | ≥-50 | dBm |

VSUP = 1,7V to 3,6V, $T_{amb}$ = -40°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

| Receiver | Frequency [GHz] | Min | Typ | Max | BT Spec | Unit |
|---|---|---|---|---|---|---|
| Sensitivity at 30,8% PER | 2,402 | | -93,0 | -70 | ≤ - 70 | dBm |
| | 2,440 | | -93,5 | -70 | | |
| | 2,480 | | -94,0 | -70 | | |

VSUP = 1,7V to 3,6V, $T_{amb}$ = +85°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

| Receiver | Frequency [GHz] | Min | Typ | Max | BT Spec | Unit |
|---|---|---|---|---|---|---|
| Sensitivity at 30,8% PER | 2,402 | | -93,0 | -70 | ≤ . 70 | dBm |
| | 2,440 | | -93,5 | -70 | | |
| | 2,480 | | -94,0 | -70 | | |

Table 17: RF Performance BLE Receiver

### 5.6.2 BLE Transmitter

VSUP = 1,7V to 3,6V, $T_{amb}$ = +20°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

| Transmitter | Frequency [GHz] | Min | Typ | Max | BT Spec | Unit |
|---|---|---|---|---|---|---|
| RF Transmit Power | 2,402 | | 4,9 | | -20 to +10 | dBm |
| | 2,440 | | 5,1 | | | |
| | 2,480 | | 5,0 | | | |
| Programmable RF Transmit Power Range (at+RFMAXTXPWR) | 2,402 – 2,480 | -20 | | +4 | N/A | dBm |
| RF Transmit Power Whisper | 2,402 – 2,480 | | -40 | | N/A | dBm |
| ACP | F = F0 ± 2MHz | | -48 | | ≤ -30 | dBm |
| | F = F0 ± 3MHz | | -55 | | ≤ -30 | |
| | F = F0 ± > 3MHz | | <-60 | | ≤ -30 | |
| ∆f1avg maximum modulation | | 225 | 255 | 275 | 225 < f1avg < 275 | kHz |
| ∆f2max minimum modulation (test threshold 185 kHz) | | 99,9 | 100 | | ≥ 99,9 | % |
| ∆f2avg / ∆f1avg | | 0,8 | 1,0 | | ≥ 0,8 | |
| Frequency Offset | | -150 | ±20 | +150 | ± 150 | kHz |
| Carrier drift rate | | | 5 | 20 | ≤ 20 | kHz/50µs |
| Carrier drift | | | 5 | 50 | ≤ 50 | kHz |

VSUP = 1,7V to 3,6V, $T_{amb}$ = -40°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

| Transmitter | Frequency [GHz] | Min | Typ | Max | BT Spec | Unit |
|---|---|---|---|---|---|---|
| RF transmit Power | 2,402 | | 6,2 | | -20 to +10 | dBm |
| | 2,440 | | 6,0 | | | |
| | 2,480 | | 6,2 | | | |
| ACP | F = F0 ± 2MHz | | -45 | | ≤ -30 | dBm |
| | F = F0 ± 3MHz | | -50 | | ≤ -30 | |
| | F = F0 ± > 3MHz | | <-60 | | ≤ -30 | |
| Frequency Offset | | -150 | ±35 | +150 | ± 150 | kHz |
| Carrier drift rate | | | 10 | 20 | ≤ 20 | kHz/50µs |
| Carrier drift | | | 20 | 50 | ≤ 50 | kHz |

VSUP = 1,7V to 3,6V, $T_{amb}$ = +85°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

| Transmitter | Frequency [GHz] | Min | Typ | Max | BT Spec | Unit |
|---|---|---|---|---|---|---|
| RF transmit Power | 2,402 | | 4,0 | | -20 to +10 | dBm |
| | 2,440 | | 4,0 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2,480 | | 4,0 | | | |
| ACP | F = F0 ± 2MHz | | -45 | -20 | ≤ -30 | dBm |
| | F = F0 ± 3MHz | | -50 | -40 | ≤ -30 | |
| | F = F0 ± > 3MHz | | <-55 | -30 | ≤ -30 | |
| Frequency Offset | | -150 | ±35 | +150 | ± 150 | kHz |
| Carrier drift rate | | | 10 | 20 | ≤ 20 | kHz/ 50µs |
| Carrier drift | | | 20 | 50 | ≤ 50 | kHz |

Table 18: RF Performance BLE Transmitter

### 5.6.3 Antenna-Gain and Radiation Pattern

If BlueMod+S42/AI is integrated into an end product while the recommendations depicted in 6.4 Placement Recommendation are maintained, the following typical antenna radiation patterns can be expected.

Radiation Pattern will depend on the end products PCB size, masses in the antenna environment, housing material and geometrics. Typical antenna gain is about +2dBi.

Antenna patterns will be updated in final document

.

Figure 13: Typical Antenna Radiation Pattern at 2402MHz

.

Figure 14: Typical Antenna Radiation Pattern at 2441MHz

Figure 15: Typical Antenna Radiation Pattern at 2480MHz

## 5.7 Power-Up Time

The time until the BlueMod+S42is able to accept link requests or serial data depends on the firmware version and on the source for the slow clock. Using TIO firmware version , the device is ready (as indicated by GPIO IOA, measured from the release of EXT_RES# or VSUP rising above 1,7V) as follows:

- $t_{DeviceReady}$ 0,9s (typ.) if an external 32,768kHz crystal is connected.
- $t_{DeviceReady}$ 1,7s (typ.) if no external signal is provided so the internal RC is used.

# 6 Mechanical Characteristics

## 6.1 Dimensions

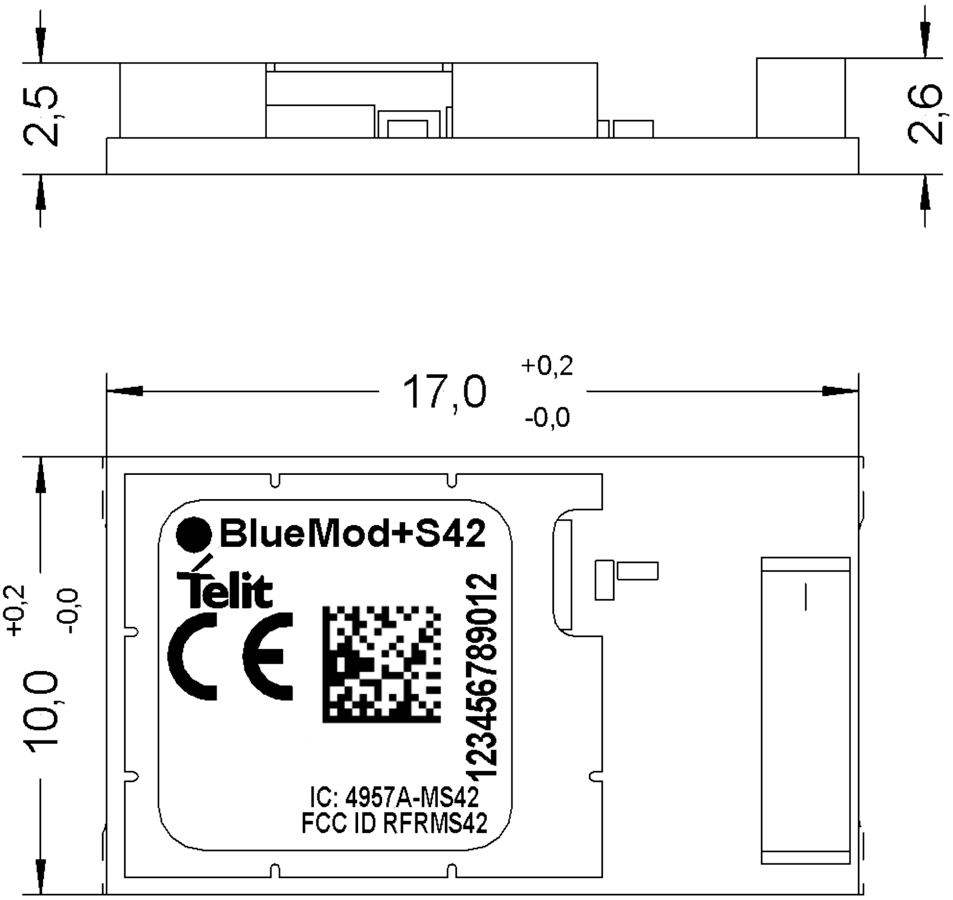



Figure 16: BlueMod+S42/AI Dimensions

## 6.2 Recommended Land Pattern

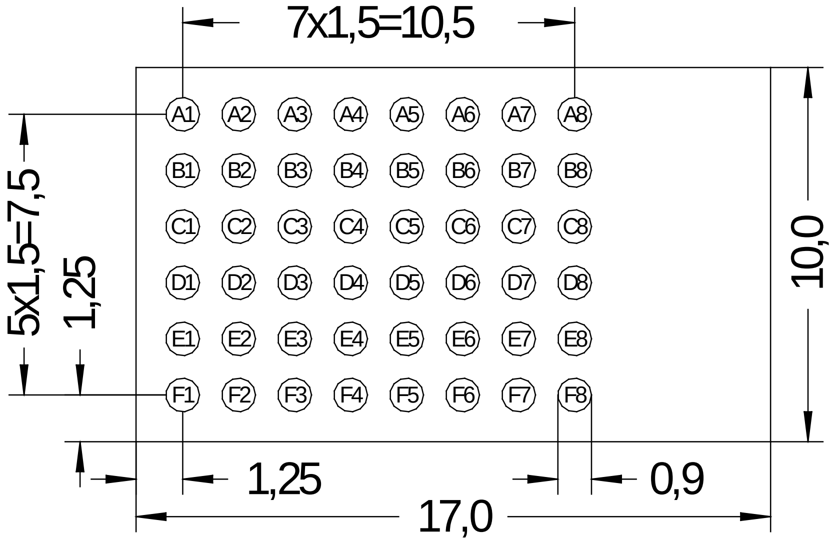



Figure 17: BlueMod+S42 Land Pattern **TOP VIEW**

Note: *All dimensions are in mm.*

## 6.3 Re-flow Temperature-Time Profile

The data here is given only for guidance on solder and has to be adapted to your process and other re-flow parameters for example the used solder paste. The paste manufacturer provides a re-flow profile recommendation for his product.

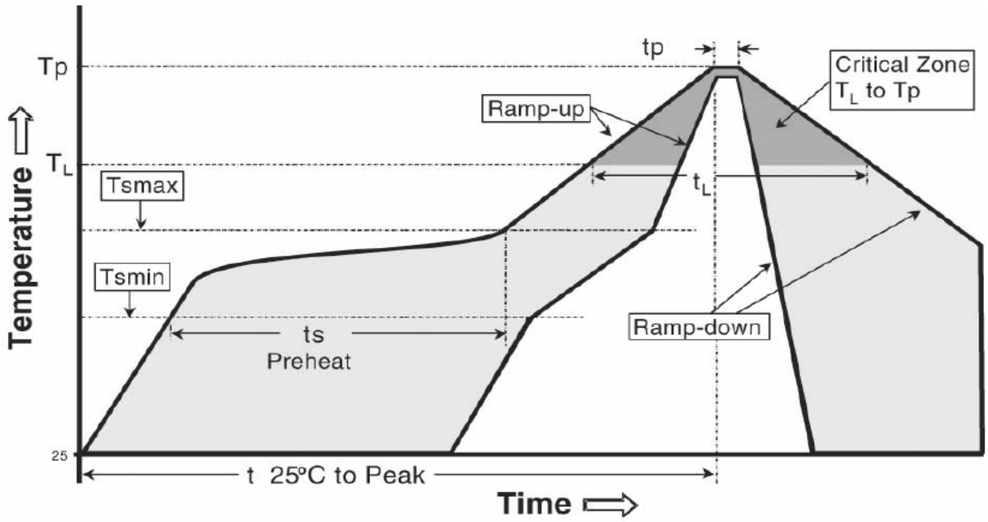



Figure 18: Soldering Temperature-Time Profile (For Reflow Soldering)

| Preheat | | Main Heat | | Peak | |
|---|---|---|---|---|---|
| tsmax | | tLmax | | tpmax | |
| Temperature | Time | Temperature | Time | Temperature | Time |
| [°C] | [sec] | [°C] | [sec] | [°C] | [sec] |
| 150 | 100 | 217 | 90 | 260 | 10 |
| | | 230 | 50 | | |
| | | | | | |
| Average ramp-up rate | | [°C / sec] | 3 | | |
| Average ramp-down rate | | [°C / sec] | 6 | | |
| Max. Time 25°C to Peak Temperature | | [min.] | 8 | | |

Opposite side re-flow is prohibited due to module weight.

Devices will withstand the specified profile and will withstand up to 1 re-flows to a maximum temperature of 260°C. The reflow soldering profile may only be applied if the BlueMod+S42resides on the PCB side looking up. Heat above the solder eutectic point while the BlueMod+S42is mounted facing down may damage the module permanently.

## 6.4 Placement Recommendation

To achieve best radio performance for BlueMod+S42/AI, it is recommended to use the placement shown in Figure 19. This is a “corner placement” meaning the BlueMod+S42/AI is placed such that the antenna comes close to the corner of the application PCB (red area). So, the yellow area is outside the PCB and regards to the housing, too (refer to 6.5).

Please note that for best possible performance the antenna should be directed away from the application PCB as shown in Figure 19.

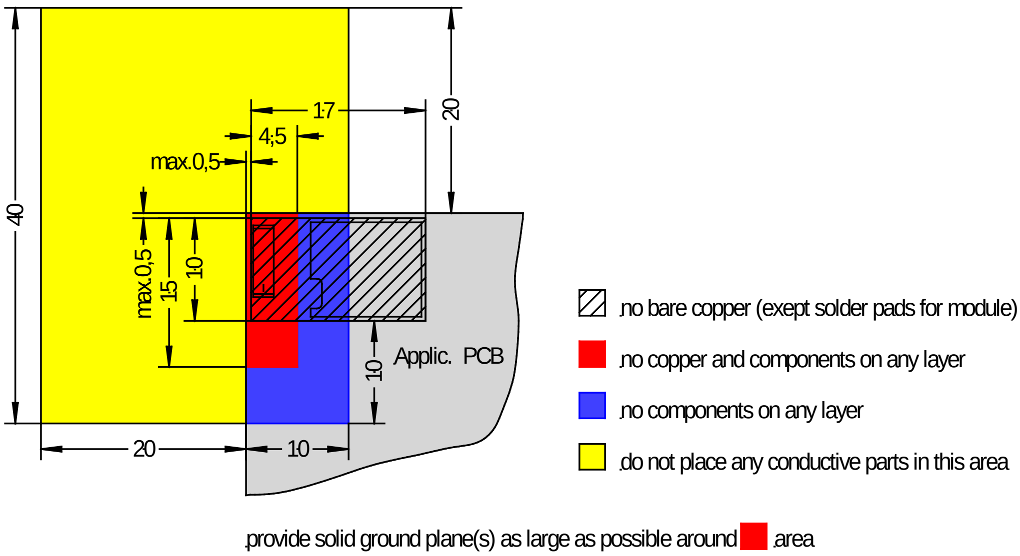


Figure 19 : BlueMod+S42/AI Placement Recommendation

## 6.5 Housing Guidelines

The individual case must be checked to decide whether a specific housing is suitable for the use of the internal antenna. A plastic housing must at least fulfill the following requirements:

Non-conductive material, non-RF-blocking plastics

No metallic coating

ABS is suggested

## 6.6 Antenna Issues

BlueMod+S42/AI comprises a ceramic antenna which as a component is soldered to the circuit board. This solution is functional for a BlueMod+S42/AI integrated into a plastic housing.

The performance of the antenna has to be checked within the final integration environment. Adjacent PCBs, components, cables, housings etc. could otherwise influence the radiation pattern or be influenced by the radio wave energy. It must be ensured that the antenna is not co-located or operating in conjunction with any other antennas, transmitters, cables or connectors.

## 6.7 Safety Guidelines

According to SAR regulation EN 62479:2010 the BlueMod+S42is not intended to be used in close proximity to the human body. Please refer to above-mentioned regulation for more specific information.

In respect to the safety regulation EN60950-1: 2006 + A11: 2009 + A1: 2010 + AC: 2011 all conductive parts of the BlueMod+S42are to be classified as SELV circuitry. OEM's implementing the BlueMod+S42in their products should follow the isolation rules given in regulation EN 60950-1: 2006.

The PCB material of the BlueMod+S42 is classified UL-94V0.

## 6.8 Cleaning

In general, cleaning the modules mounted on the host board is strongly discouraged. Residues between module and host board cannot be easily removed with any cleaning method..

- Cleaning with water or any organic solvent can lead to capillary effects where the cleaning solvent is absorbed into the gap between the module and the host board. The combination of soldering flux residues and encapsulated solvent could lead to short circuits between conductive parts. The solvent could also damage any labels.
- Ultrasonic cleaning could damage the module permanently. Especially for crystal oscillators the risk of damaging is very high.

# 7 Application Diagram

The following schematic shows a typical application of BlueMod+S42. The module is connected to some MCU running the application layer. MCU and BlueMod+S42use the same 3,3V power supply. The serial interface has RTS/CTS flow control and UICP support in this example. The optional hangup feature to close down the link is provided. As an option to save power an external slow clock crystal may be used. The 32,768kHz crystal can be placed on customers HW or may be optionally on module. Contact Telit sales. All other module pins may be left unconnected.

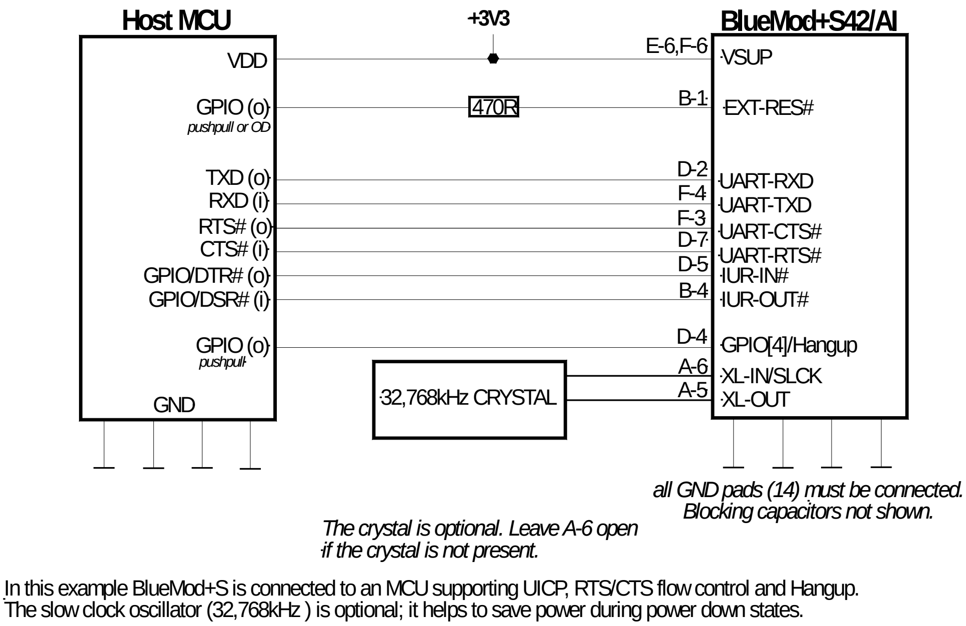



Figure 20: Typical Application Schematics

# 8 Compliances

The BlueMod+S42/AI has been tested to comply to the appropriate EU, FCC, IC and KCC directives.
CE testing is intended for end products only. Therefore CE testing is not mandatory for a Bluetooth Module sold to OEM’s. However Telit E+V GmbH provides CE tested Modules for customers in order to ease CE compliance assessment of end products and to minimize test effort.

## 8.1 Declaration of Conformity CE

The BlueMod+S42/AI fully complies with the essential requirements of the following EU directives:

- R&TTE 1999/5/EC
- RoHS 2011/65/EC

The actual version of EU Declaration of Conformity (EU DoC) can be downloaded from the Telit download zone.

The CE compliance declaration is in progress.

The above link may expire, because a new version of the EU DoC is available. Please look up the EU DoC from the Telit web site directly then.

## 8.2 FCC Compliance

The BlueMod+S42/AI has been tested to fulfill the FCC requirements. Test reports are available on request. Grants of the Full Modular Approval is shown below.

The FCC Certification is in progress: FCC ID will be RFRMS42

### 8.2.1 FCC Grant

### 8.2.2 FCC Statement

This device complies with 47 CFR Part 2 and Part 15 of the FCC Rules and with.

Operation is subject to the following two conditions:

this device my not cause harmful interference, and this device must accept any interference received, including interference that may cause undesired operation.

### 8.2.3 FCC Caution

**WARNING:**

Changes or modifications made to this equipment not expressly approved by Telit may void the FCC authorization to operate this equipment.

### 8.2.4 FCC Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

### 8.2.5 FCC RF-exposure Statement

The BlueMod+S42/AI complies with the FCC/IC RF radiation exposure limits set forth for an uncontrolled environment.

The output power is < 10mW *EIRP* and therefore according to “FCC KDB 447498 D01 General RF Exposure Guidance v05” Appendix A, table “SAR Exclusion Threshold”, excluded from SAR testing for test separation distances ≥ 5mm and if it is not used in co-locations with other antennas. If the product implementing the BlueMod+S42/AI has other antennas in co-location or separation distances < 5mm an FCC TCB should be asked for a Class II Permissive Change.

### 8.2.6 FCC Labeling Requirements for the End Product

Any End Product integrating the BlueMod+S42/AI must be labeled with at least the following information:

This device contains transmitter with

FCC ID: RFRMS42

IC: 4957A-MS42

## 8.3 IC Compliance

The BlueMod+S42/AI will been tested to fulfill the IC requirements. Test reports RSS-210 of Industry Canada are available on request. Grant of the Full Modular Approval is shown below.

The IC Certification is in progress: FCC ID will be 4957A-MS42

### 8.3.1 IC Grant

### 8.3.2 IC Statement

(11) Ce dispositif doit être installé et exploité dans une enceinte entièrement fermée afin de prévenir les rayonnements RF qui pourraient autrement perturber la navigation aéronautique. L'installation doit être effectuée par des installateurs qualifiés, en pleine conformité avec les instructions du fabricant.

(ii) Ce dispositif ne peut être exploité qu'en régime de non-brouillage et de non-protection, c'est-à-dire que l'utilisateur doit accepter que des radars de haute puissance de la même bande de fréquences puissent brouiller ce dispositif ou même l'endommager. D'autre part, les capteurs de niveau à propos desquels il est démontré qu'ils perturbent une exploitation autorisée par licence de fonctionnement principal doivent être enlevés aux frais de leur utilisateur.

This device complies with Industry Canada license-exempt RSS standard(s).
Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

***NOTICE:***

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

### 8.3.3 IC Caution

**WARNING:**

Changes or modifications made to this equipment not expressly approved by Telit may void the IC authorization to operate this equipment.

### 8.3.4 IC RF-exposure Statement

This equipment is portable device. According to RSS-102 Issue 5 §2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation Table 1, the allowed distances to the human body for products implementing the BlueMod+S42 can be calculated as follows. If the intended use of the end product asks for smaller distances a SAR evaluation has to be made with the end product.

- Max. RF output power: Occurs at -40°C at 2402MHz to 2480MHz with +6dBm
- Antenna peak Gain is +2dBi
- Resulting max. RF output power is +8dBm = 6,3mW < 7mW
- Table 1 shows that for 2450MHz the distance at 7mW should be ≥ 10mm

### 8.3.5 IC Labeling Requirements for the End Product

Any end product integrating the BlueMod+S42/AI must be labeled with at least the following information:

This device contains transmitter with

FCC ID: RFRMS42

IC-ID: 4957A-MS42

### 8.3.6 IC Label Information BlueMod+S42

The BlueMod+S42 shows IC-ID on the product label,

| | |
|---|---|
| Model: | BlueMod+S42 |
| **The IC-ID is:** | **IC. 4957A-MS42** |

## 8.4 KCC Certification

The BlueMod+S42/AI will be certified in Korea under the Clause 2, Article 58-2 of Radio Waves Act.

KCC Certification is in progress

### 8.4.1 KCC Certificate

## 8.5 Bluetooth Qualification

The BlueMod+S42 will be  a qualified design according to the Bluetooth Qualification Program Reference Document (PRD) V2.3.

The BTSIG qualification is in progress

The Declaration ID is:

The Qualified Design ID is:

**tbd**

For further information about marking requirements of your product attention should be paid the Bluetooth Brand Usage Guide at https://www.bluetooth.org/en-us/bluetooth-brand/bluetooth-brand

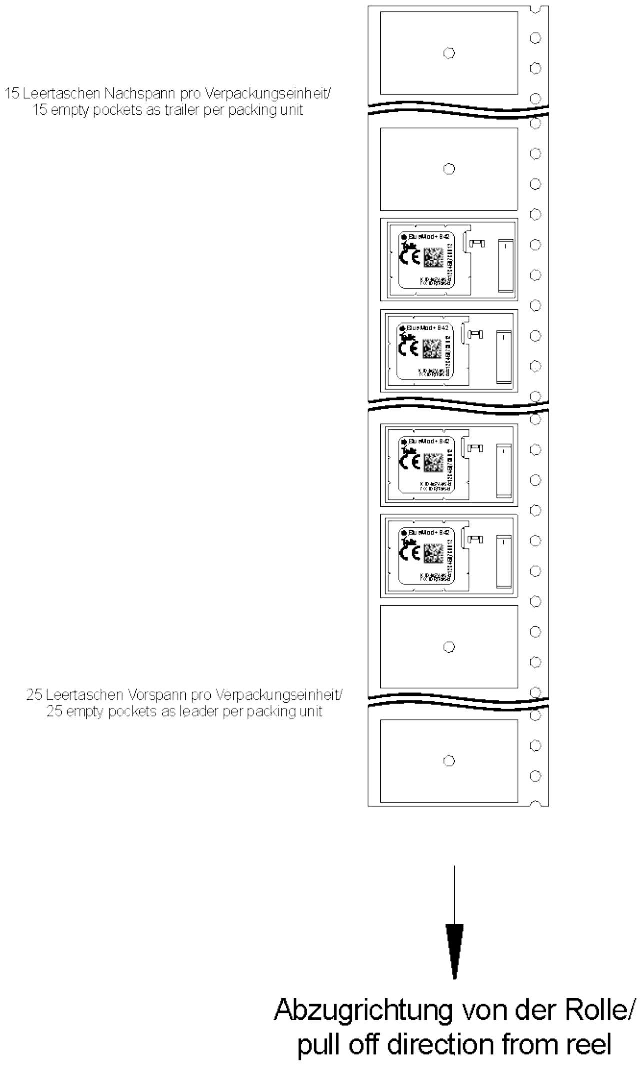
According to the Bluetooth SIG rules (Bluetooth Declaration Process Document – DPD) you must complete a Product Listing and Declaration of Compliance (DoC) referencing the Qualified Design (QDID) for your product. For further information see www.Bluetooth.org or contact Telit.

## 8.6 RoHS Declaration

RoHS evaluation is in progress

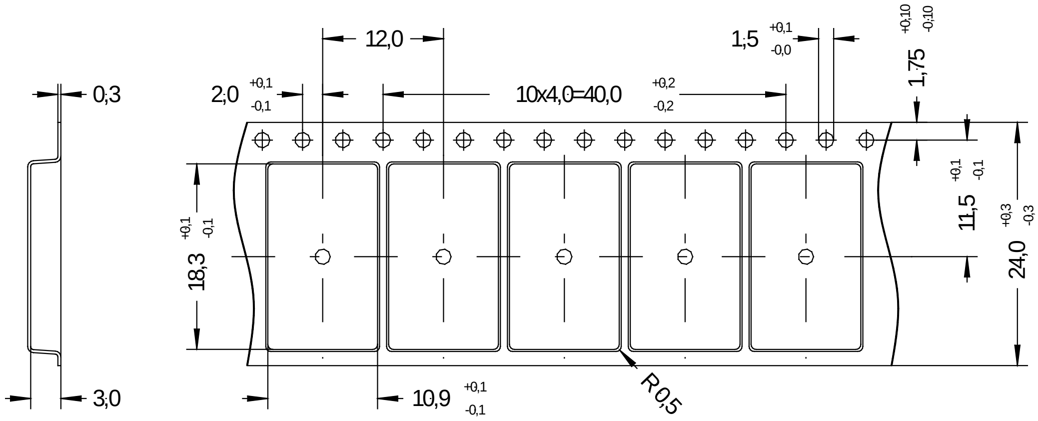
# 9 Packing

The BlueMod+S42 modules are packed using carrier tape.



## 9.1 Tape

The dimensions of the tape are shown in the drawing below (values in mm):




## 9.2 Reel

tbd

## 9.3 Package Label

Package box, dry shield bag and reel are each marked with the following label:

| Field | Description |
|---|---|
| name | Name of product |
| p/n | Product number |
| firmware | Firmware version |
| fw p/n | Product number of firmware |
| trace | [Manufacturer m (optional)]Date (CalendarWeekYear) wwyy |
| quantity | Number of contained modules |

If the label on the package box is different to the label described please contact Telit for detailed information.

# 10 Ordering Information

## 10.1 Part Numbers

BlueMod+S42 is available in the following variants:

| Name | Antenna | Firmware Version | Order No. | MOQ / units | Comments |
|---|---|---|---|---|---|
| BlueMod+S42/AI/Central | Internal | | 53346-xx | tbd | |
| BlueEva+S42/Central | Internal | 2.xxx | 53352-xx | 1 | Evaluation Kit |

Other variants on request, please contact Telit sales department.

## 10.2 Standard Packing Unit

The standard packing units are 1000 pieces on Tape and Reel

## 10.3 Evaluation Kit

The kit BlueEva+S42 is available to evaluate functionality and start your firmware implementation.

# 11 Safety Recommendations

READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.

Where there is risk of explosion such as gasoline stations, oil refineries, etc. It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself.

The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue, because the risk of disturbing external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments

introduced on the market. All the relevant information's are available on the European Community website:

http://ec.europa.eu/enterprise/sectors/rtte/documents/

The text of the Directive 99/05 regarding telecommunication equipments is available,

while the applicable Directives (Low Voltage and EMC) are available at:

http://ec.europa.eu/enterprise/sectors/electrical/

# 12 Document History

| Revision | Date | Changes |
|---|---|---|
| 0 | 2016-07-16 | First preliminary issue |
| 1 | 2016-08-12 | Fixed wrong chapter numbers<br>Add picture to chapter 3.8.2 Connection of an External 32,768 kHz Crystal<br>Added Tx power and Rx sensivity values at +25 °C<br>Added some power consumption values<br>Removed all references to extern SCLK signal |
| 2 | 2016-08-22 | Added associated Telit ref numbers in related documents list<br>Chap. 2.1: Corrected value from -30dBm to -20dBm for power control range and added Whisper Mode with -40dBm<br>Chap. 2.4: Added new block diagram with 32MHz crystal and optional 32,768kHz crystal<br>Chap. 6.1: Added new label to drawing<br>Chap. 7: Additionally 32,768kHz signal feeding option removed, only 32,768 crystal possible with nRF52832<br>Chap. 8: Formatting header 2 corrected, FCC and IC ID’s added (multiple times), progress notes added for CE, FCC, IC, KCC, BTSIG, RoHS |
| 3 | | Added ITA information |