BlueMod+S42
Hardware User Guide

1VV0301303 Rev.9 – 2018-08-06

APPLICABILITY TABLE

PRODUCTS

- BLUEMOD+S42/AI/CEN
- BLUEMOD+S42/AI/ATEX
- BLUEMOD+S42/AI/ADC/LUA
- BLUEMOD+S42/AI/ADC/TWI

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Contents

Figures

Tables

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 applicability table.

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-AMERICAS@telit.com

TS-APAC@telit.com

or

TS-SRD@telit.com for global Bluetooth support

Alternatively, use:

https://www.telit.com/contact-us

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

https://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 2: 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 7: Application Diagramm" describes a typical application of BlueMod+S42.

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

"Chapter 9: Packing" describes the Tape&Reel and the tray packing of BlueMod+S42.

"Chapter 10: Evaluation Kit" contains a reference on the availability of BlueEva+S42 evaluation kit.

"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

- [1] Nordic: nRF52_Series_Reference_Manual
- [2] Nordic: nRF52832_PS v1.x.pdf (Product Specification)
- [3] BlueMod+S42/Central AT Command Reference, 80512ST10771A
- [4] BlueMod+S42 Software User Guide, 1VV0301318
- [5] UICP_UART_Interface_Control_Protocol, 30507ST10756A
- [6] BlueMod+S42 Testmode Reference, 80512NT11496A
- [7] Bluetooth SIG Core Specification V4.2
- [8] BlueMod+S42/Central AT Command Reference 80512ST10771A
- [9] BlueMod+S42/ADC/TWI AT Command Reference 80512ST10874A
- [10] BlueMod+S42/ADC/LUA AT Command Reference 80512ST10860A
- [11] BlueMod+S42 Lua API Documentation 30512ST10861A

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
- 8/9/10/12bit ADC
- Arm® Cortex™-M4F 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

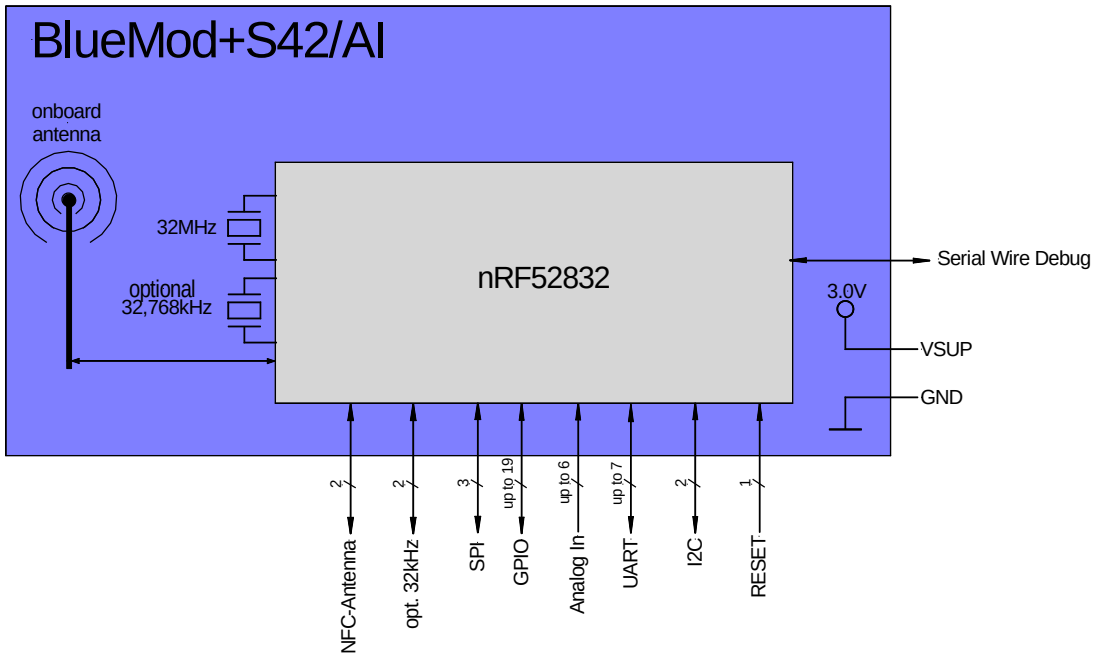


Figure 1: BlueMod+S42/AI Block Diagram

3 Application Interface

3.1 Power Supply

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

Typical: 3,0V_{DC}, min.: 1,7V_{DC}, max.: 3,6V_{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 3.8.2 Power Back Feeding.

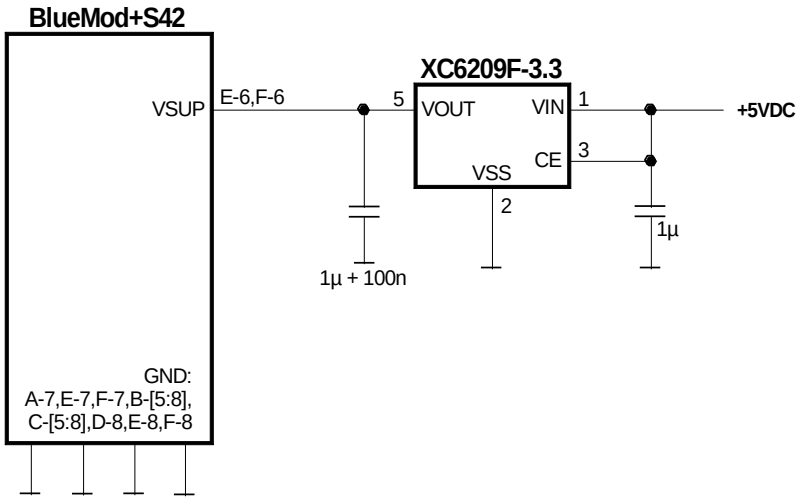


Figure 2: BlueMod+S42 Example Power Supply with LDO

3.1.1 Power-up Slew-Rate

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

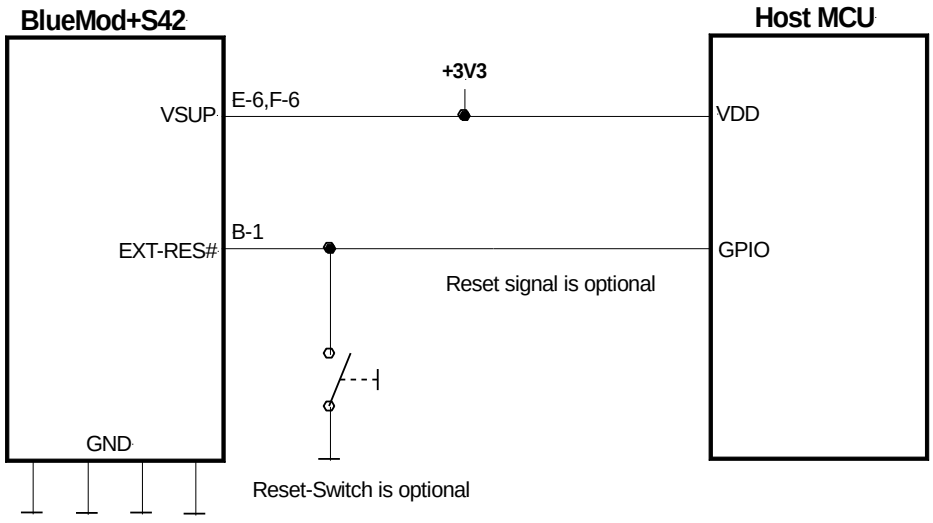
(1) 0V to 1,7V

Table 1: 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*0,25V for $t_{HOLDRESETNORMAL} \geq 0{,}2\mu s$, an external reset (*pin reset*) is generated. EXT-RES# may be left open if not used. This pin has:
  - for all the variants except **BlueMod+S42/AI/ATEX** a fixed internal pull-up resistor (R_{PU} = 11kΩ ... 16kΩ) and a series resistor of 470Ω
  - for **BlueMod+S42/AI/ATEX** a fixed internal pull-up resistor (R_{PU} = 11kΩ ... 16kΩ). A series resistor less than 560Ω should be added externally.



Please Note: EXT-RES# of BlueMod+S42 has approx. 13k internal pullup.

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 2: Pin States during Reset

The pin states as indicated in Table 2 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 [5]).

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 AT command reference [3] for further information.

NOTE:

Connecting Bluetooth module and host CPU via an UART interface.

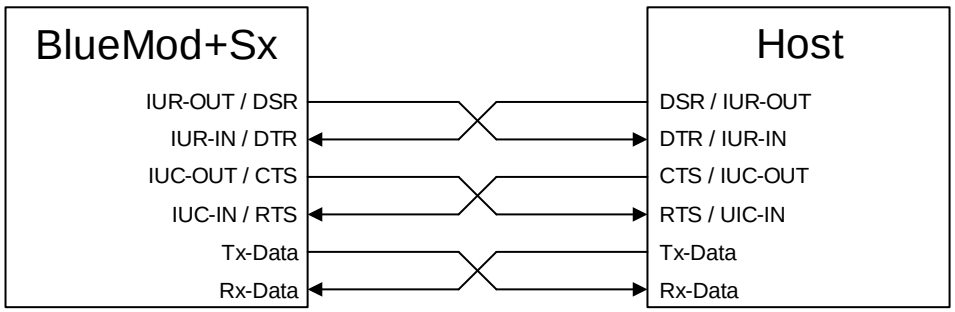


Figure 4: Connection BlueMod+Sx to Host

All signal pairs,

- TX-Data / RX-Data,
- (IUC_IN/RTS) / (IUC-OUT/CTS)
- (IUR-IN/DTR) / (IUR-OUT/DSR)

must be connected crosswise between the 2 devices.

NOTE:

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

3.3.1 Serial Interface HW Configuration for Power Management

NOTE:

It is strongly recommended NOT to switch the module power supply on/off while other parts of the circuitry stay powered. This mostly leads to hardly controllable back-feeding issues. Back-feeding occurs due to connected signal line(s) being >0,3V while the module power is switched off. Then the I/O protection diodes, integrated in the I/O ports of the BT IC, will feed the VSUP "backwards", which means that the modules power supply is fed via the I/O lines instead via the power supply. Due to the ultra-low power design a few µAmps are enough to raise VSUP to an undefined state, which may cause a hang-up deadlock when then power is switched on again.

Any I/O pin at a voltage > 0,3V while the supply VSUP is at 0V violates the abs. max. ratings given in chapter 5.1 Absolute Maximum Ratings.

It is instead recommended to use the advanced power management features, which may reduce the supply current to 300nA.

Deep Sleep power saving could be achieved by using the AT+SYSTEMOFF command. Wake-up from deep sleep after AT+SYSTEMOFF always includes a reset cycle and a loss of the previous operation environment. If it is desired to keep the operation environment during power down UICP SW should be implemented in the host CPU.

If using the AT+SYSTEMOFF command in combination with wake-up via GPIO, a host could wake-up the BlueMod+Sx using the UICP schemes. Alternatively, the wake-up source ext. RESET could be configured, which results in the least possible current consumption. See chapters 3.3.5 Dynamic I/O Signal Type Changes Depending on UICP Status.

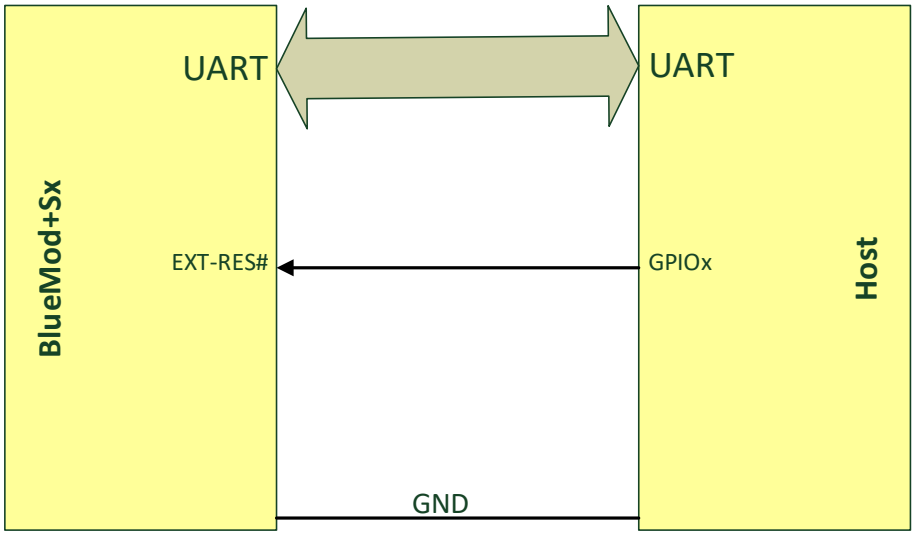


Figure 5: Host wake-up from deep-sleep via RESET

3.3.1.1 Wake-Up Sources AT+SYSTEMOFF

The wake-up sources are FW dependent and programmable. For detailed information please see correspomding FW documentation. The following table gives a rough overview.

WAKE-UP SOURCE	FW CEN	FW ADC/TWI	FW ADC/LUA	Deep Sleep Current
PIN RESET#	YES	YES	YES	0.3µA
CTS#	YES	YES 1)	YES 1)	1.2µA
IUR-IN#	YES 2)	YES 2)	NO	1.2µA
HANGUP#	YES	NO	NO	1.2µA
DIOx	NO	YES 3)	YES 3	1.2µA

Table 3: Wake-Up Sources AT+SYSTEMOFF

Notes:

1) Only available if UART is active
2) Only available if UICP is active
3) Only if DIOx is enabled as input

3.3.1.2 Serial Interface for UICP Power Management

A substantially saving of power during idle phases can be achieved (see 5.5.1) when the UICP protocol is used (refer to [5]). This protocol should be implemented on the host side as well. Signals IUR-IN# and IUR-OUT# should be connected to the host and may be mapped, if connected to a standard RS232 COM port, to DSR and DTR (see Figure 10).

Using UICP reduces the supply current from the mA range to the µA range in idle phases which are normally the highest percentage of the use time, depending on the use case scenario. This comes at the cost of 2 additional I/O lines, whereas 1 I/O line has been saved by not switching the module power on/off. Therefore, only 1 additional I/O line is required to make the power management much smarter and reliable.

Further advantages compared to SYSTEMOFF

- The Module can maintain volatile configuration while in power down state
- The Module can be visable and connectable (advertisements enabled) while in power down state
- The Module can be connected (BT connected, no data exchange) while in power down state

There are 2 signals changing functionality depending on the UICP state.

➔ IUC_OUT#/RTS# and IUC_IN#/CTS# become RTS#/CTS# after wake-up

➔ IUC_OUT#/RTS# and IUC_IN#/CTS# become IUC_OUT#/IUC_IN# after power-down

Please refer to the UICP specification [5] for detailed information.

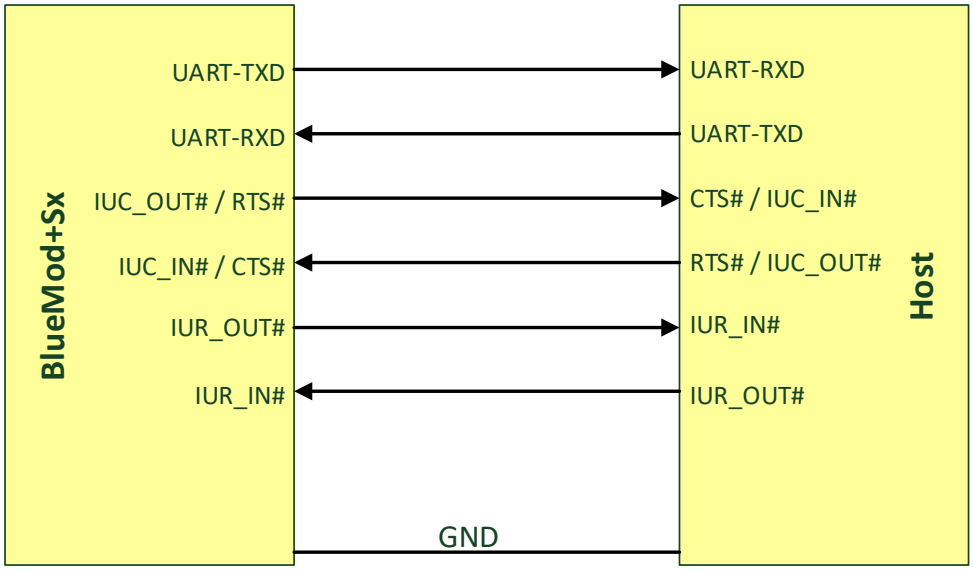


Figure 6: UART Interface with UICP Signals 7-wire (incl. GND)

If I/O line availability at the host side is extremely tight, 2 I/O lines could be saved by using the following scheme. This would come at the cost of

- The host is not allowed to enter sleep mode.
- The host must accept in coming data at all times and is not able to stop the BlueMod+Sx sending data. This may be difficult to control for all scenarios and adds the risk that data gets lost.
- The host doesn't implement UICP, but wake-up BT via GPIO

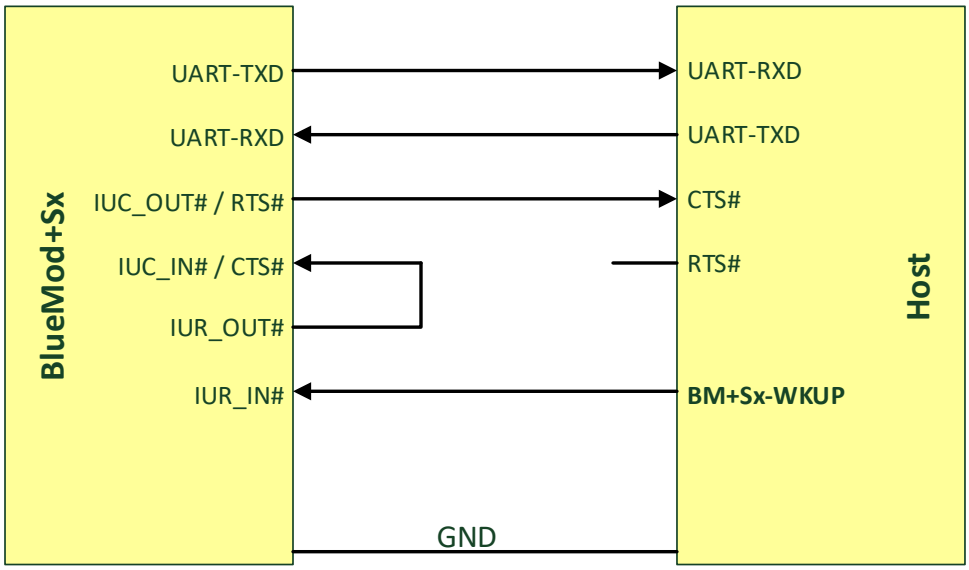


Figure 7: 5-Wire (incl. GND) Interface supporting UICP (min. signals needed)

3.3.1.3 Serial Interface without UICP Power Management

If power management with maintaining the operational environment is not necessary, the serial interface could be designed with less I/O lines.
This saves 2 I/O lines at the cost that dynamic power management with maintaining the operation environment cannot be used. UICP has to be disabled.

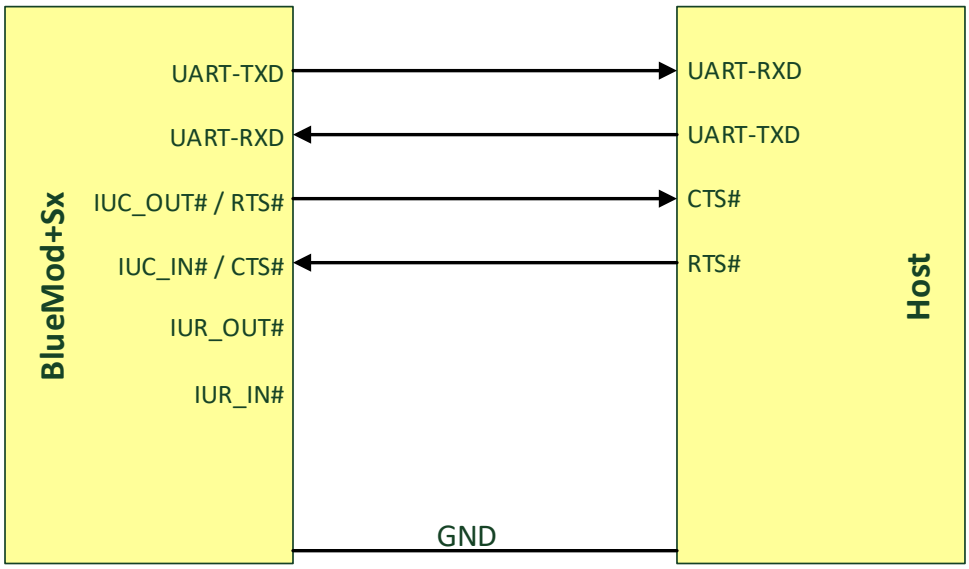


Figure 8: UART Interface without UICP Signals (5-wire incl. GND)

NOTE:

In order to support operation with the BlueMod+Sx pin CTS# left open, a pulldown resistor (typ. 13kΩ) is programmed to this pin if UICP is disabled.
Therefore, if AT+SYSTEMOFF is issued while UICP is disabled, it is necessary that the host keeps CTS# at logic low or leaves this pin floating.
Otherwise the supply current drawn in the deep sleep mode increases by VSUP/13kΩ, which would be at 3V 231µA, 770 times the expected 0,3µA. This would reduce the life time of a coin cell significantly.

3.3.2 4-Wire Serial Interface

If the host in question is sufficiently fast, a 4-wire (incl. GND) 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).

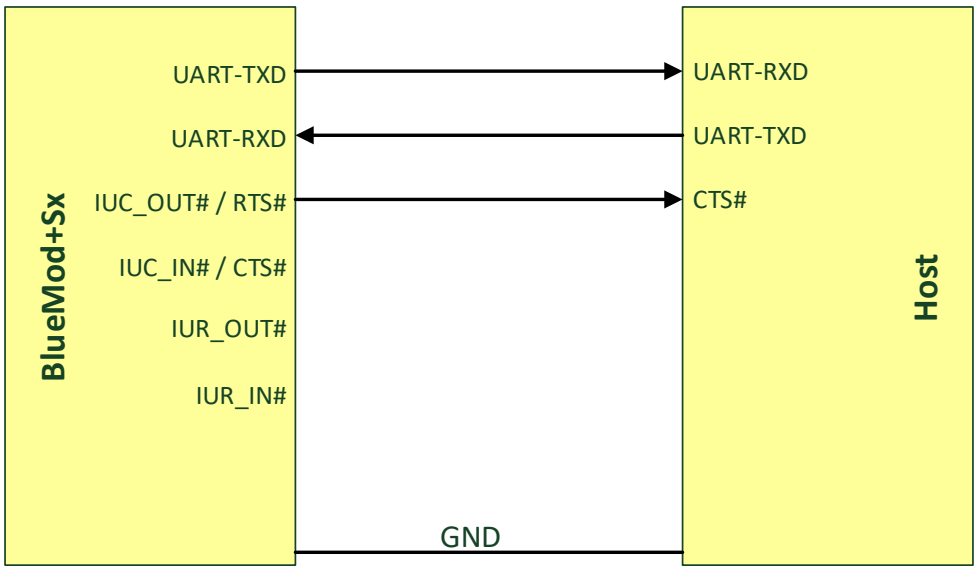


Figure 9: UART Interface without UICP Signals 4-wire (incl. GND)

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:

This configuration is not recommended because it may cause a loss of data.

NOTE:

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

3.3.3 UART Example Circuits

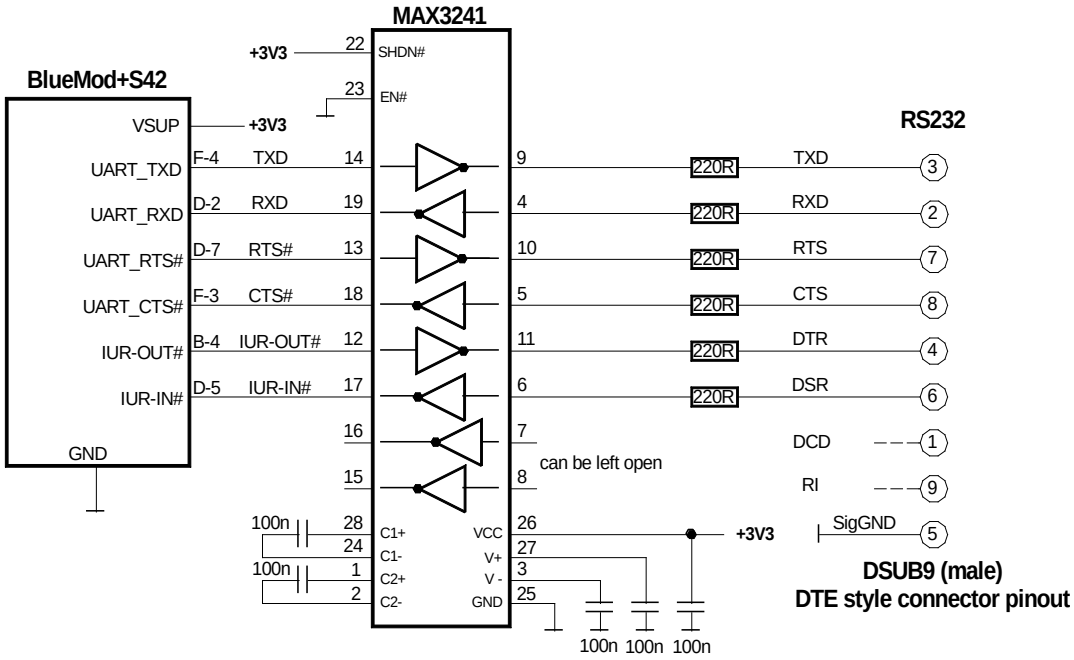


Figure 10: BlueMod+S42 Serial Interface (RS-232 COM Port) Supporting UICP

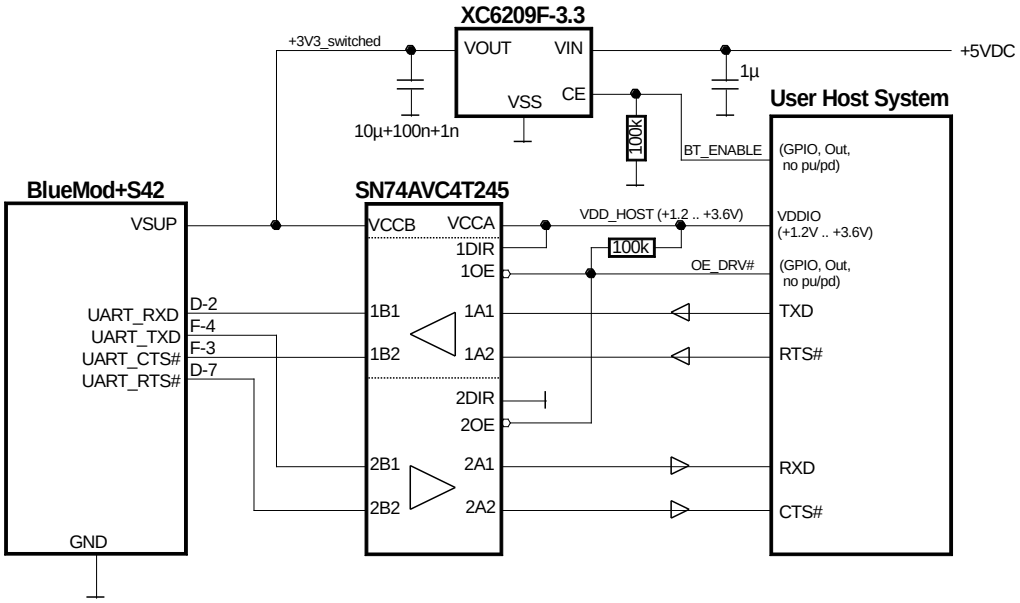


Figure 11: BlueMod+S42 Example Serial Interface (Mixed Signal Level)

3.3.4 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 [%]
1200	1205	+0,42
2400	2396	-0,17
4800	4808	+0,17
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
1000000	1000000	0,00

Table 4: Deviation of Baud rates

NOTE:

The total deviation of sender and receiver shall not exceed 2,5% to prevent loss of data.

NOTE:

Baud rates <9600bps are not supported while UICP is enabled.

3.3.5 Dynamic I/O Signal Type Changes Depending on 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.

3.3.6 Additional I/O Signals for Serial Interface Functionality

If CEN firmware is used see [3], BlueMod+S42/Central AT Command Reference, 80512ST10771A, for the configuration possibilities of additional signals support further function for the serial interface. For other firmware version refer to the specific at command reference.

3.3.6.1 Hang-up via GPIO Signal

When using the CEN 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 [3] for a functional specification. GPIO[4] can be left unconnected if this feature is not used.

3.3.6.2 GPIO'S IO[A, B, C, D]

When using the CEN firmware these GPIO's may be configured via AT commands to add further functionality to the serial interface.

Signal	Optional Function	Comment
IOA	DEVICEREADY#	Low active signal indicating that the initialization has been finished and the device is ready to process commands after start-up
IOB	CONNECTED#	Low active signal indicating that a CEN connection to a remote peer has been established (DCD like)
IOC	TBD	Reserved for future use
IOD	TBD	Reserved for future use

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 used.

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 I²C Interface

The I²C bus interface serves as an interface between the internal microcontroller and the serial I²C bus. BlueMod+S42 is the master and controls all I²C bus specific sequencing, protocol and timing. It supports standard (100kHz) and fast (400kHz) speed modes. The BlueMod+S42 as an I²C master must be the only master of the I²C bus (no *multimaster* capability). Clock stretching is supported.

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

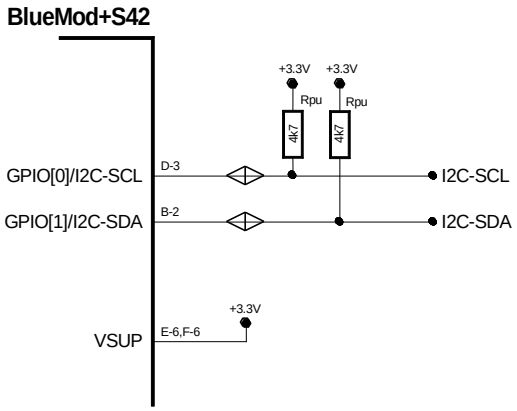


Figure 12: BlueMod+S42 I²C Interface

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

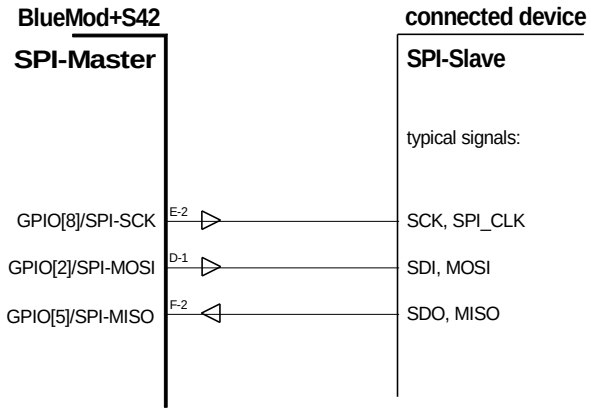


Figure 13: BlueMod+S42 SPI Interface (Example: Master Mode)

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.

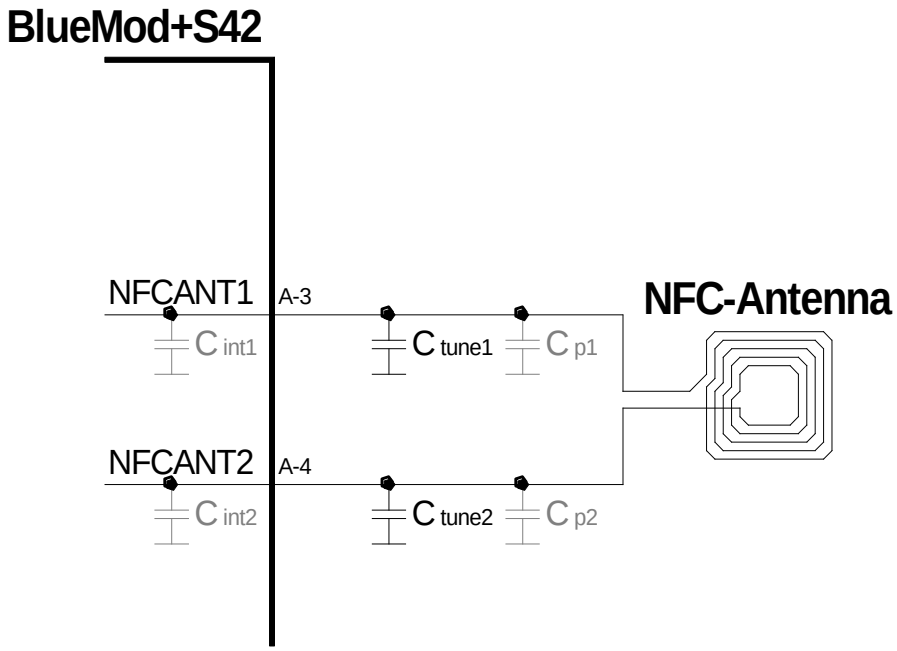


Figure 14: BlueMod+S42 NFC Antenna Tuning

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

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

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

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

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.

In case no external XTAL is present, the BlueMod+S42 will use an internal slow clock instead for low power operations.

Please note that the Telit EVK Board for the BlueMod+S42 has an XTAL circuitry populated.

In case an evaluation without XTAL is intended please refer to EVK Documentation how to disable the XTAL.

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

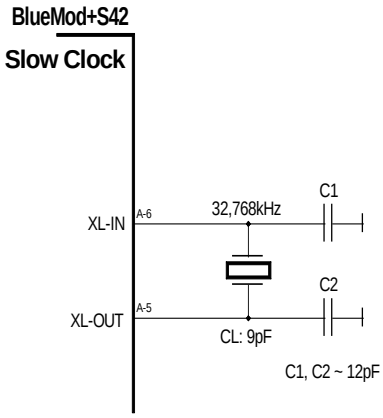
(1) adjust crystal frequency by choosing correct value for C1, C2 (value depends on C_L of crystal and layout)

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 15: 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 firmware. Please refer to [6] and [7]. For EMC measurements the use of the BlueMod+S42 Testmode is recommended.

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	Bootloader
Inactive	Inactive	Firmware

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 13, 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.

NOTE:

It is strongly recommended NOT to switch the module power supply on/off while other parts of the circuitry stay powered. This mostly leads to hardly controllable back-feeding issues. Back-feeding occurs due to connected signal line(s) being >0,3V while the module power is switched off. Then the I/O protection diodes, integrated in the I/O ports of the BT IC, will feed the VSUP “backwards”, which means that the modules power supply is fed via the I/O lines instead via the power supply. Due to the ultra-low power design a few µAmps are enough to raise VSUP to an undefined state, which may cause a hang-up deadlock when then power is switched on again.

Any I/O pin at a voltage > 0,3V while the supply VSUP is at 0V violates the abs. max. ratings given in chapter 5.1 Absolute Maximum Ratings.

It is instead recommended to use the advanced power management features, which may reduce the supply current to 300nA.

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.

3.14 Analog/Digital Converter (ADC)

The ADC functionality is FW dependent.

Firmware	ADC Functionality
CEN	No ADC Support
ADC/TWI	Single ended AIN, 1 Channel, 15µs sampling rate
ADC/LUA	Single ended AIN, 1 Channel, 3µs sampling rate
CUSTOM	Full set of nRF52832 features, depending on pin mapping nRF52 to module pins. Please contact Telit for pin mapping information. For contact data see chapter 1.3 Contact Information, Support 1x8 Channel ADC 1 Analog Comparator or 1 Low-Power Analog Comparator

Table 7: ADC Functionality versus Firmware

The ADC supports

- 8/10/12-bit resolution, 14-bit resolution with oversampling
- full swing operation 0V to VSUP
- and up to 200kHz sample rate
- Limit event monitoring
- 2 sources for ADC reference voltage 600mV REF or VSUP/4
- Prescaler [1/6, 1/5, 1/4, 1/3, 1/2, 1, 2, 4]

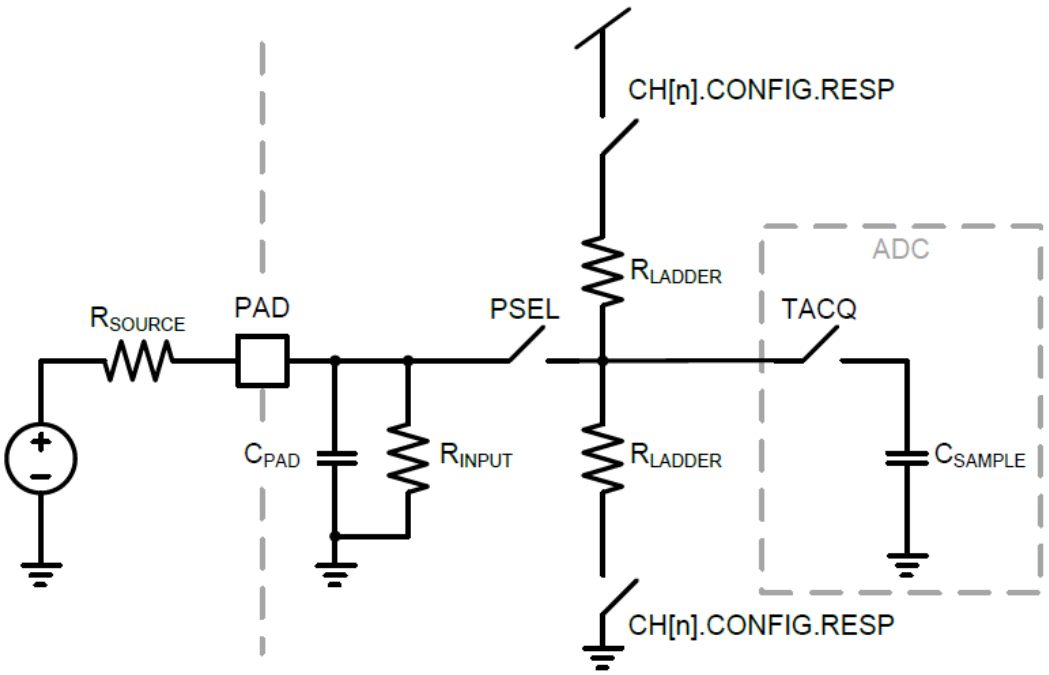


Figure 16: ADC Signal Input Structure

The ADC signal conversion is splitted into 2 phases, sample and convert. In the sampling phase the capacitor C_{SAMPLE} is charges to the analog source voltage for t_{ACQ}, by closing the TACQ switch for the acquisition time. In the conversion phase the TACQ is opened again and the voltage on C_{SAMPLE} is converted to a digital value. Therefore

$F_{SAMPLE} < 1/ (t_{ACQ} + t_{CONV})$ has to be maintained

The time necessary to load C_{SAMPLE} with sufficient preciseness to V_{SOURCE} depends on the values of C_{SAMPLE}, known 2,5pF typ., and the source resistance of V_{SOURCE}, e.g. a potentiometer.

Therefore the max. allowed source resistance of V_{SOURCE} depends on the programmed acquisition time.

TACQ /µs	Max. resistance VSOURCE /kΩ
3	10
5	40
10	100
15	200
20	400
40	800

Table 8: T_{ACQ} versus R(V_{SOURCE}) max.

Firmware ADC/TWI

The FW ADC/TWI uses a fix acquisition time of 15µs and increases the resolution by oversampling. The sample rate is programmable via at-command in the range of 5ms to 2000ms. Therefore this ADC is meant for measuring DC sources. The max. allowed change rate is the max. ΔV of a 100Hz sine wave with full swing input amplitude.
Please refer to [9] for programming the ADC and to Chapter 4.4 Application Specific ADC/TWI Pin Configuration for ADC module pin mapping.

Firmware ADC/LUA

The FW ADC/LUA uses a fix acquisition time of 3µs and increases the resolution by oversampling.
Please refer to [11] BlueMod+S42 Lua API Documentation 30512ST10861A for programming the ADC and to Chapter 4.5 Application Specific ADC/LUA Pin Configuration for ADC/LUA module pin mapping.

4 Module Pins

4.1 Pin Numbering

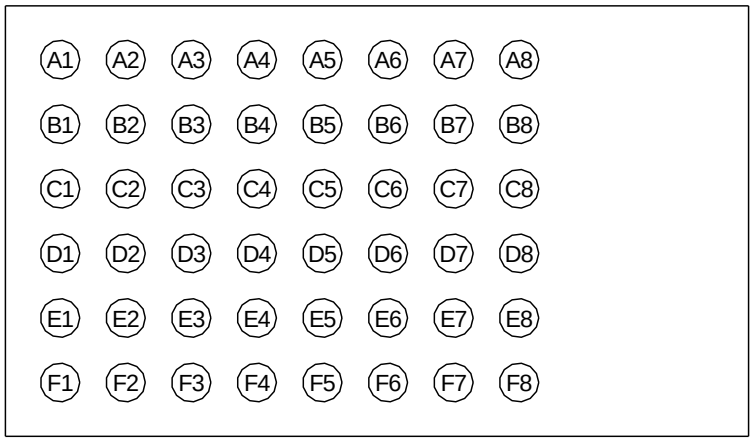


Figure 17: BlueMod+S42 Pin Numbering (Top View)

4.2 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: Radio; 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	May be connected to VSUP	
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 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 32,768kHz		
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	(AIN2)	(8)
D-5	IUR-IN#	I-DIS	L	UICP Control	(AIN5)	(8)
D-3	GPIO[0]	I/O		GPIO	I2C-SCL	(3,5)
B-2	GPIO[1]	I/O		GPIO	I2C-SDA, AIN7	(3,5)
D-1	GPIO[2]	I/O		GPIO	SPI-MOSI	(3,5)
E-4	GPIO[3]	I/O		GPIO	AIN0	(3,5)
D-4	GPIO[4]	I/O		GPIO	AIN6	(3,5)
F-2	GPIO[5]	I/O		GPIO	SPI-MISO, AIN3	(3,5)
C-4	GPIO[6]	I/O		GPIO	AIN1	(3,5)
C-3	GPIO[7]	I/O		GPIO	AIN4	(3,5)
E-2	GPIO[8]	I/O		GPIO	SPI-SCK	(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		(6)
E-1	BOOT0	I-PD (7)		reserved		(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		(3,5)
A-5	XL-OUT	I/O		XTAL 32,768kHz		
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 470k 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; refer to [1], [2]
(6) signal must be accessible for homologation purposes. Refer to 3.10 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 3.3.5 Dynamic I/O Signal Type Changes Depending on UICP Status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 9: General Pin Assignment

4.3 Application Specific CEN Pin Configuration

Pin Types: PU – pull-up; PD – pull-down; PWR – Power; I – Input; O – Output; I/O – bidir.; OD – open drain; PP – push/pull;
RF: RadioFreq; DIS –Disconnected; LFXO Low Frequency Crystal I/O

Pin Name	Signal	CEN-Function	Type	Act	Description	Notes
E-6	VSUP1	Power	PWR		+3,0V nom.	
F-6	VSUP2	Power	PWR		+3,0V nom	
C-1	not connected				May be connected to VSUP	
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 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/ SCLK	XTAL/SCLK	LFXO		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 [5]	(1,6)
F-3	UART-CTS#	/CTS	I / I-PD	L	Flow Control/IUC; refer to [5]	(6,8)
B-4	IUR-OUT#	/IUR-OUT	O-PP / DIS	L	UICP Control; refer to [5]	(3,8)
D-5	IUR-IN#	/IUR-IN	I / DIS	L	UICP Control; refer to [5]	(3,8)
D-3	GPIO[0]		DIS		GPIO [I2C-SCL]	(3)
B-2	GPIO[1]		DIS		GPIO [I2C-SDA]	(3)
D-1	GPIO[2]	IOC	DIS		GPIO [SPI-MOSI]	(3)
E-4	GPIO[3]	IOB	O / DIS		GPIO	(3)
D-4	GPIO[4]	HANGUP	I-PD		optional; refer to [3]	
F-2	GPIO[5]	IOD	DIS		GPIO [SPI-MISO]	(3)
C-4	GPIO[6]	reserved	DIS		GPIO	(3)
C-3	GPIO[7]	DNU	DIS		GPIO	(3)
E-2	GPIO[8]	IOA	O / DIS		GPIO [SPI-SCK] [DEVICE READY#]	(3)
A-3	NFCANT1	NFC	RF			
A-1	GPIO[10]	DNU	DIS		leave open	(4)
A-4	NFCANT2	NFC	RF			
A-2	GPIO[9]	DNU	DIS		leave open	(4)
F-1	TESTMODE#	reserved	I-PU / DIS	L	connect to test pad	(6,7)
E-1	BOOT0	reserved	I-PD / DIS		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	DIS		leave open	(4)
B-3	GPIO[11]	DNU	DIS		leave open	(4)
A-5	XL-OUT	XTAL SCLK	LFXO		leave open if no ext. XTAL is connected	
F-5	GPIO[14]	DNU	DIS		leave open	(4)
E-5	GPIO[12]	DNU	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 3.10 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 3.3.5 Dynamic I/O Signal Type Changes Depending on UICP Status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 10: Application Specific Pin Assignments, CEN

4.4 Application Specific ADC/TWI Pin Configuration

Pin Types:
PU – pull-up; PD – pull-down; PWR – Power; I – Input; O – Output; I/O – bidir.; OD – open drain;
PP – push/pull; RF: RadioFreq; DIS –Disconnected; LFXO Low Frequency Crystal I/O

Pin Name	Signal	ADC/TWI Function	Type	Act	Description	Note
E-6	VSUP1	Power	PWR		+3,0V nom.	
F-6	VSUP2	Power	PWR		+3,0V nom	
C-1	not connected				May be connected to VSUP	
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 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/SLCK	SLCK / XTAL	LFXO		32,768kHz Slow Clock crystal (optional, leave open without crystal)	
F-4	UART-TXD	TXD	O-PP DIS		Serial Data OUT	(6)
D-2	UART-RXD	RXD	I DIS		Serial Data IN	(6)
D-7	UART-RTS#	/RTS	O-PP DIS	L	Flow Control/IUC; refer to [3]	(1,6)
F-3	UART-CTS#	/CTS	I I-PD DIS	L	Flow Control/IUC; refer to [3]	(6,8)
B-4	IUR-OUT#	/IUR-OUT	O-PP DIS	L	UICP Control; refer to [3]	(3,8)
D-5	IUR-IN#	/IUR-IN	I DIS	L	UICP Control; refer to [3]	(3,8)
D-3	GPIO[0]	I2C-SCL	I/O- PU/OD DIS		TWI-SCL	(3)
B-2	GPIO[1]	AIN I2C-SDA	Analog I/O- PU/OD DIS		Analog Input 1 TWI-SDA	(3)
D-1	GPIO[2]		DIS		Could be SPI-MOSI	(3)
E-4	GPIO[3]	CNF_RES#	I-PU	L	Configuration Restore	(3)
D-4	GPIO[4]	DIO0	I/O DIS		Digital In-/Output 0	(3)
F-2	GPIO[5]		DIS		Could be SPI-MISO	(3)
C-4	GPIO[6]	DIO1	I/O DIS		Digital In/Output 1	(3)
C-3	GPIO[7]	DIO2	I/O DIS		Digital In/Output 2	(3)
E-2	GPIO[8]	IOA	O DIS		Could be SPI-SCK	(3)

Pin Name	Signal	ADC/TWI Function	Type	Act	Description	Note
A-3	NFCANT1	NFC	RF			
A-1	GPIO[10]	OTA-CMD-EN#	I-PU DIS	L		(3,7)
A-4	NFCANT2	NFC	RF			
A-2	GPIO[9]	DIO3	I/O DIS		Digital In-/Output 3	(3)
F-1	TESTMODE#	reserved	I-PU DIS	L	connect to test pad	(6,7)
E-1	BOOT0	reserved	I-PD DIS		connect to test pad	(6,7)
E-3	SWDIO	reserved	I/O-PU		leave open (Serial Wire Debug)	(4)
D-6	SWCLK	reserved	I-PD		leave open (Serial Wire Debug)	(4)
C-2	GPIO[13]	DIO6	I/O DIS		Digital In-/Output 6	(3)
B-3	GPIO[11]	DIO4	I/O DIS		Digital In-/Output 4	(3)
A-5	XL-OUT	XTAL	LFXO		32,768kHz Slow Clock crystal (optional, leave open without crystal)	
F-5	GPIO[14]	DIO7	I/O DIS		Digital In-/Output 7	(3)
E-5	GPIO[12]	DIO5	I/O DIS		Digital In-/Output 5	(3)

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 1.6 Related Documents [6] BlueMod+S42 Testmode Reference
(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 1.6 Related Documents [5] UICP_UART_Interface_Control_Protocol
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 11: Application specific pin assignments, ADC/TWI

4.5 Application Specific ADC/LUA Pin Configuration

Pin Types:
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 –Disconnected; LFXO Low Frequency Crystal I/O

Pin Name	Signal	ADC/LUA Function	Type	Act	Description	Note
E-6	VSUP1	Power	PWR		+3,0V nom.	
F-6	VSUP2	Power	PWR		+3,0V nom	
C-1	not connected				May be connected to VSUP	
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 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/SLCK	SLCK / XTAL	LFXO		32,768kHz Slow Clock crystal (optional, leave open without crystal)	
F-4	UART-TXD	TXD	O-PP DIS		Serial Data OUT	(6)
D-2	UART-RXD	RXD	I DIS		Serial Data IN	(6)
D-7	UART-RTS#	/RTS	O-PP DIS	L	Flow Control; refer to [3]	(1,6)
F-3	UART-CTS#	/CTS	I-PD DIS	L	Flow Control; refer to [3]	(6,8)
B-4	IUR-OUT#		DIS	L	UICP Control; refer to [3]	(3,8)
D-5	IUR-IN#		DIS	L	UICP Control; refer to [3]	(3,8)
D-3	GPIO[0]	I2C-SCL	O-PU/OD DIS		TWI Clock	(3)
B-2	GPIO[1]	AIN1 I2C-SDA	Analog I/O- PU/OD DIS		Analog Input 1 TWI-SDA	(3)
D-1	GPIO[2]	SPI-MOSI	O-PP DIS		SPI-MOSI	(3)
E-4	GPIO[3]		DIS	L		(3)
D-4	GPIO[4]	AIN2 DIO1	Analog I/O DIS		Analog Input 2 Digital In-/Output 1	(3)
F-2	GPIO[5]	SPI-MISO	I DIS		SPI-MISO	(3)
C-4	GPIO[6]	AIN3 DIO2	I/O DIS		Analog Input 3 Digital In/Output 2	(3)
C-3	GPIO[7]	AIN4 DIO3	I/O DIS		Analog Input 4 Digital In/Output 3	(3)
E-2	GPIO[8]	SPI-SCK	O-PP DIS		SPI Clock	(3)

Pin Name	Signal	ADC/LUA Function	Type	Act	Description	Note
A-3	NFCANT1	NFC	RF			
A-1	GPIO[10]	SPI_CS	O-PP DIS	L	SPI Chip select	(3)
A-4	NFCANT2	NFC	RF			
A-2	GPIO[9]	DIO4	I/O DIS		Digital In-/Output 4	(3)
F-1	TESTMODE#	reserved	I-PU DIS	L	connect to test pad	(6,7)
E-1	BOOT0	reserved	I-PD DIS		connect to test pad	(6,7)
E-3	SWDIO	reserved	I/O-PU		leave open (Serial Wire Debug)	(4)
D-6	SWCLK	reserved	I-PD		leave open (Serial Wire Debug)	(4)
C-2	GPIO[13]	DIO7	I/O DIS		Digital In-/Output 7	(3)
B-3	GPIO[11]	DIO5	I/O DIS		Digital In-/Output 5	(3)
A-5	XL-OUT	XTAL	LFXO		32,768kHz Slow Clock crystal (optional, leave open without crystal)	
F-5	GPIO[14]	DIO8	I/O DIS		Digital In-/Output 8	(3)
E-5	GPIO[12]	DIO6	I/O DIS		Digital In-/Output 6	(3)

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 1.6 Related Documents [6] BlueMod+S42 Testmode Reference
(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 1.6 Related Documents [5] UICP_UART_Interface_Control_Protocol
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 12: Application specific pin assignments, ADC/LUA

4.6 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 3.10 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 13: 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 14: 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 15: 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 [2].

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) I_{OL} = 5,0mA (2), (3)	VSS VSS	-	VSS + 0,4 VSS + 0,4	V
V_{OH}	High-Level Output Voltage	I_{OH} = -0,5mA (1) I_{OH} = -5,0mA (2), (3)	VSUP - 0,4 VSUP - 0,4	-	VSUP VSUP	V
I_{OL}	Low –Level Output Current	V_{OL} ≤ VSS + 0,4V	-	-	-0,5mA (1) -5,0mA (2), (3)	mA
I_{OH}	High-Level Output Current	VSUP-0,3V ≤ V_{OH} ≤ VSUP	-	-	0,5mA (1) 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 16: 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		0,25*VSUP		V
V_{IH}	High-Level Threshold	VSUP = 1,7 to 3,6V		0,75*VSUP		V
R_{PU}	pull-up resistor		11	13	16	kΩ
C_I	Input Capacitance			3		pF

Table 17: DC Characteristics, EXT-RES#

5.4.3 Analog Digital Converter (ADC)

5.4.3.1 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 $R_{IN} > 1M\Omega$ when not sampling..

The conversion time T_{CONV} is < 2µs, the minimun acquisition time is 3µs, therefore the max. sample rate

$F_{SAMPLE\_MAX} = 1/ (t_{ACQ\_MIN} + t_{CONV\_MAX}) = 1 (3\mu s + 2\mu s) = 200khz$

This sample rate, allowing to capture AC signals with a max. frequency content of 100kHz, is only available with custom FW.

ADC/TWI and ADC/LUA FW versions are made for capturing DC signals and increase resolution by oversampling.

Please refer to

[1] Nordic: nRF52_Series_Reference_Manual and
[2] Nordic: nRF52832_PS v1.x.pdf (Product Specification)

For detailed information according the pin mapping documentation Nordic nRF52 pins to module pins, please contact Telit using the information given in chapter 1.6 Related Documents.

The max. allowed source resistance of V_{SOURCE} is limited in dependency of the acquisition time.

T_{ACQ} /µs	Max. resistance V_{SOURCE} /kΩ
3	10
5	40
10	100
15	200
20	400
40	800

5.5 Power Consumption and Power-Down Modes

5.5.1 Power Consumption BlueMod+S42/AI CEN FW

5.5.1.1 Power Consumption BlueMod+S42/AI

The BlueMod+S42/AI uses a DC/DC converter for feeding the radio and CPU with 1,3V DC. The DC/DC converter may be disabled and replaced by a linear regulator by the PMU (PowerManagementUnit) if the current consumption is low. This further saves battery power, because at low current consumption the DC/DC converter efficiency decreases, because the influence of the switching losses increases.

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 Radio inactive	Note	Slow clock SLCK	Current Consumption	Unit
			I_{Avg}	
Advertising Off, UICP not active or serial interface up		internal Crystal	1,2 1,3	mA
Advertising Off, UICP active, serial interface down	(1)	internal Crystal	9,1 8,0	µA
Device in reset	(2)	any	0,44	mA
System off / wake-up RESET	(1,2,3)		0,3	µA
System off / wake-up GPIO	(1,2,3)		0,3	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
(3) If UICP was disabled before AT+SYSTEMOFF, keep UART-CTS# at logic low or leave it floating

Table 18: Supply Current Sleep Modes, no Radio Activity

The following table shows the average power consumption of BlueMod+S42 operating 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		Unit
			Tx power (dBm) [8]		
			max (+4)	min (-20)	
			I_{Avg}	I_{Avg}	
Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP not active *or* serial interface up	(5)	internal [7] ext. Crystal	1,2 1,3	1,2 1,2	mA
Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP active *and* serial interface down	(1)	internal [7] ext. Crystal	17,6 19,1	14,5 12,9	µA
Connected, connection interval: 1,28s,UICP not active *or* serial interface up, no data traffic	(5)	internal [7] ext. Crystal	1,2 1,2	1,2 1,2	mA
Connected, connection interval: 1,28s,UICP active *and* serial interface down	(1)	internal [7] ext. Crystal	10,4 13,6	10,1 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)		2,5	2,4	mA
Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, peripheral to central	(2,6, 9)		2,2	2,0	mA
Connected, connection interval: 40 ms, no data traffic	(2,4, 6)		1,3	1,3	mA
Connected, connection interval: 37,5 ms, data traffic 115 kbit/s at the serial port, peripheral to central	(2,4, 6,9)		1,6	1,4	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 19: Supply Current BLE Terminal I/O Profile, Peripheral Device Role

5.5.1.2 Power Consumption BlueMod+S42/AI/ATEX

The pupose of the product variant BlueMod+S42/AI/ATEX is to enable customers to create ATEX compliant products implementing Bluetooth technology. For ATEX compliance energy carrying parts, causing risk of generating sparks, have to be removed from the design. Therefore, the energy storing coil of the DC/DC has been removed and the DC/DC converter is permantely disabled for the /ATEX variant.

Caution:

The BlueMod+S42/AI/ATEX is not ATEX certified on its own, but designed such, that an end product implementing the BlueMod+S42/AI/ATEX can pass A certification. The total capacitance on the BlueMod/S42/AI/ATEX is 6,0µF 10%. The inductance is neglectable, 3,9nH for antenna matching.

For the ATEX operation with DC/DC converter disabled the current consumption values given in 5.5.1.1 Power Consumption BlueMod+S42/AI have to be replaced by the following values.

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

Condition Radio inactive	Note	Slow clock SLCK	Current Consumption I_{Avg}	Unit
Advertising Off, UICP not active or serial interface up		internal Crystal	2,2 2,2	mA
Advertising Off, UICP active, serial interface down	(1)	internal Crystal	9,7 9,9	µA
Device in reset	(2)	any	0,45	mA
System off / wake-up RESET	(1,2,3)		0,3	µA
System off / wake-up GPIO	(1,2,3)		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
(3) If UICP was dsabled before AT+SYSTEMOFF, keep UART-CTS# at logic low or leave it floating

Table 20: Supply Current Sleep Modes, no Radio Activity, ATEX

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		Unit
			Tx power (dBm) [8]		
			max (+4)	min (-20)	
			I_{Avg}	I_{Avg}	
Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP not active *or* serial interface up	(5)	internal [7 ext. Crystal	2,2 2,2	2,2 2,2	mA
Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP active *and* serial interface down	(1)	internal [7] ext. Crystal	29,7 27,6	23,6 21,6	µA
Connected, connection interval: 1,28s,UICP not active *or* serial interface up, no data traffic	(5)	internal [7] ext. Crystal	2,56 2,56	2,56 2,56	mA
Connected, connection interval: 1,28s,UICP active *and* serial interface down	(1)	internal [7] ext. Crystal	23,1 21,5	22,8 20,6	µA
Connected, connection interval: 7,5 ms, no data traffic	(2,3, 6)		2,9	2,8	mA
Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, central to peripheral	(2,6, 9)		5,5	5,1	mA
Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, peripheral to central	(2,6, 9)		5,7	4,3	mA
Connected, connection interval: 40 ms, no data traffic	(2,4, 6)		2,3	2,3	mA
Connected, connection interval: 37,5 ms, data traffic 115 kbit/s at the serial port, peripheral to central	(2,4, 6,9)		3,0	2,5	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 21: Supply Current BLE Terminal I/O Profile, Peripheral Device Role, ATEX

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		-93,0	-70	≤ -70	dBm
	2,440		-93,0	-70		
	2,480		-93,0	-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		-93,0	-70		
	2,480		-93,0	-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		-93,0	-70		
	2,480		-93,0	-70		

Table 22: 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		6,0		-20 to +10	dBm
	2,440		6,0			
	2,480		6,0			
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 23: 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.

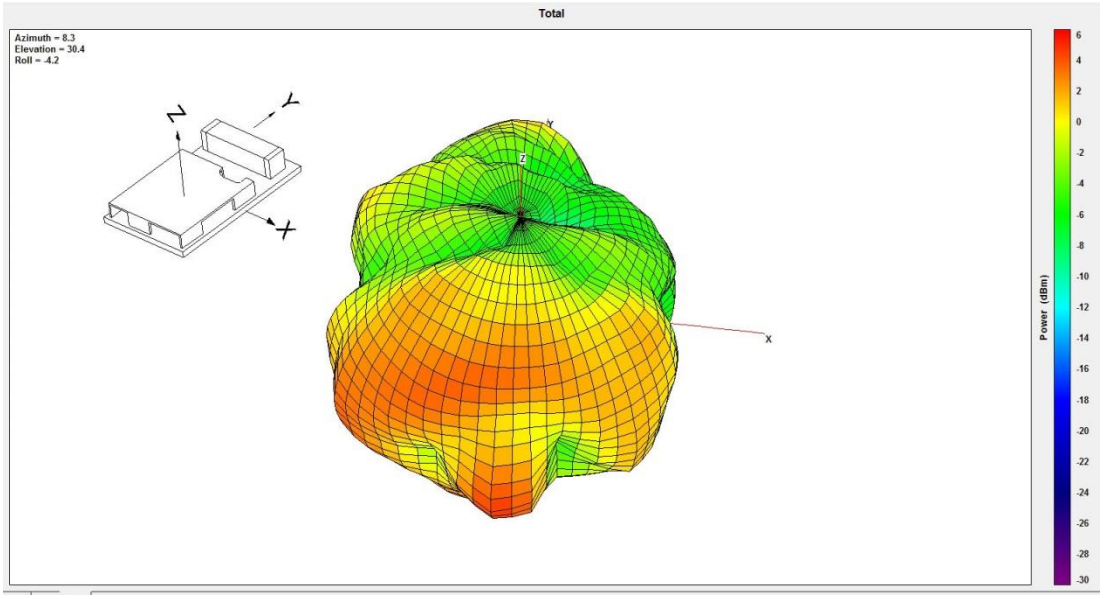


Figure 18: Typical Antenna Radiation Pattern at 2402MHz

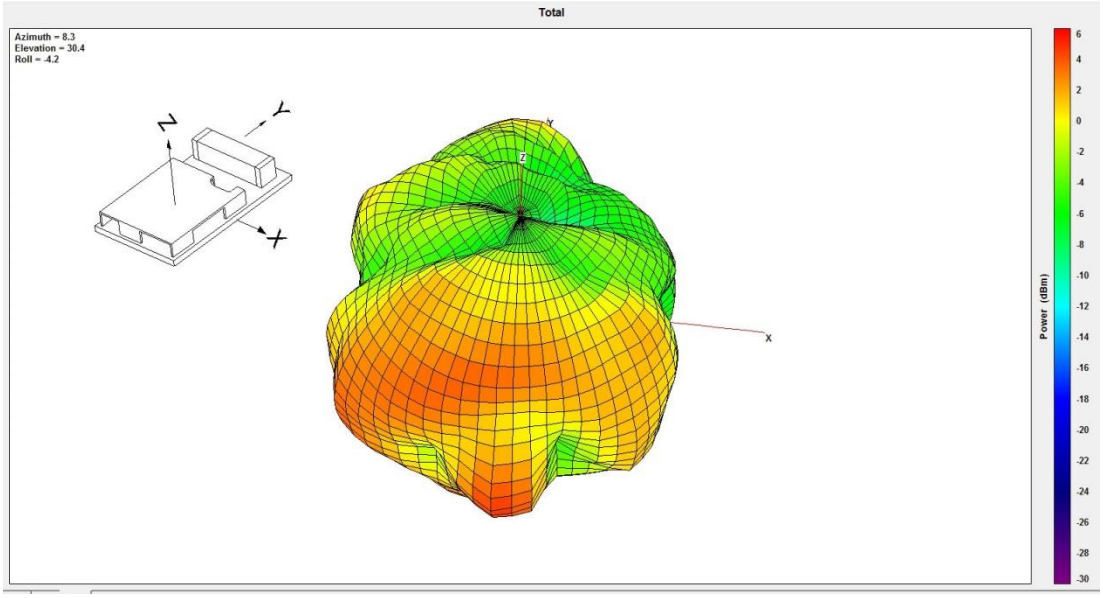


Figure 19: Typical Antenna Radiation Pattern at 2441MHz

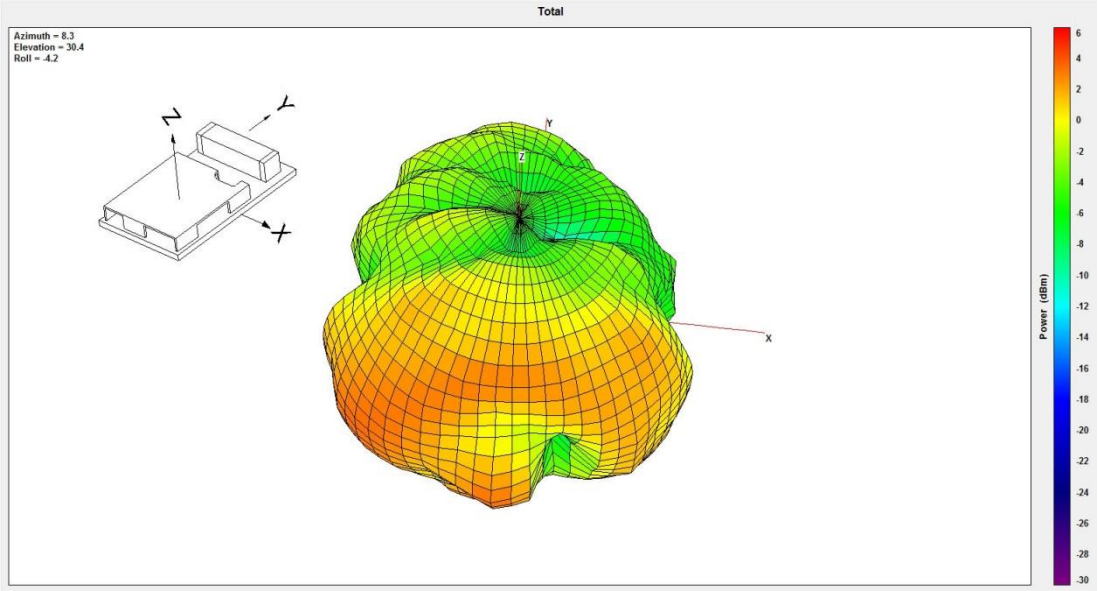


Figure 20: Typical Antenna Radiation Pattern at 2480MHz

5.7 Power-Up Time

The time until the BlueMod+S42 is able to accept link requests or serial data depends on the firmware version and on the source for the slow clock. Using CEN 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

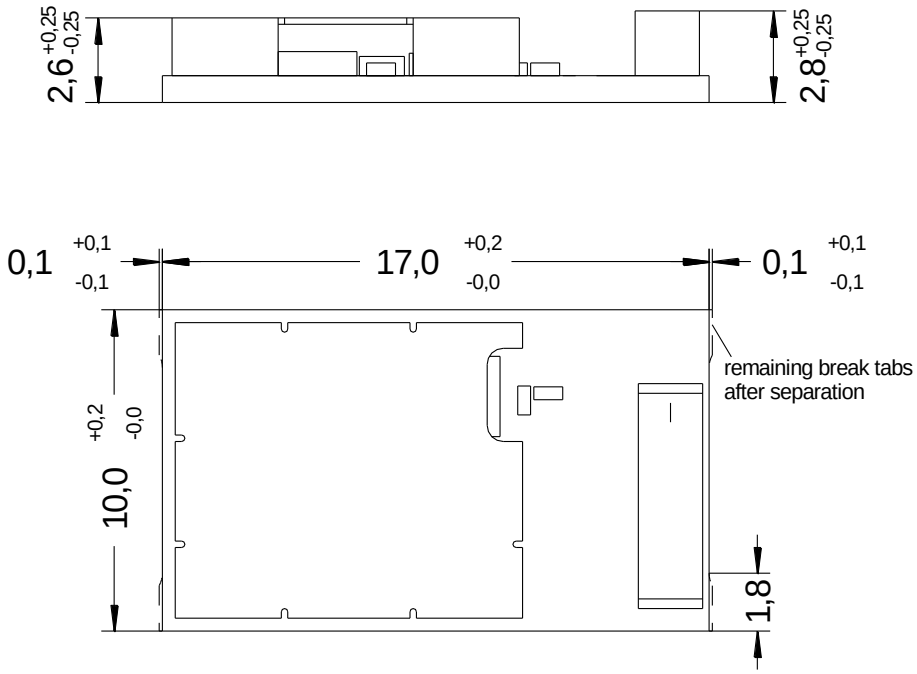


Figure 21: BlueMod+S42/AI Dimensions

6.2 Recommended Land Pattern

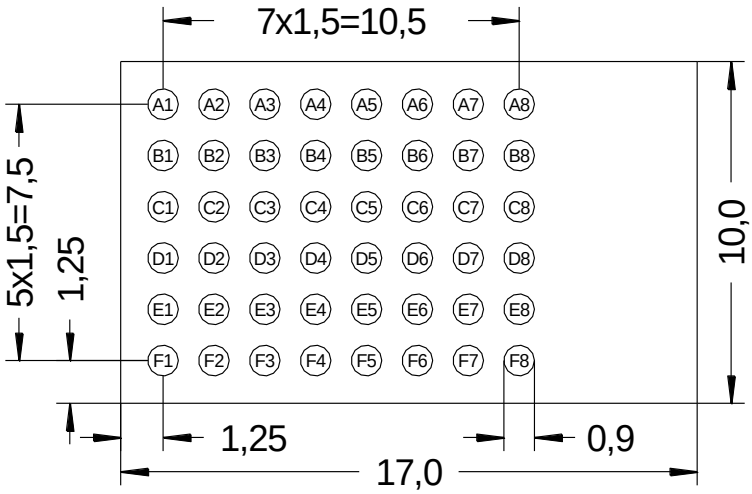


Figure 22: BlueMod+S42 Land Pattern **TOP VIEW**

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.

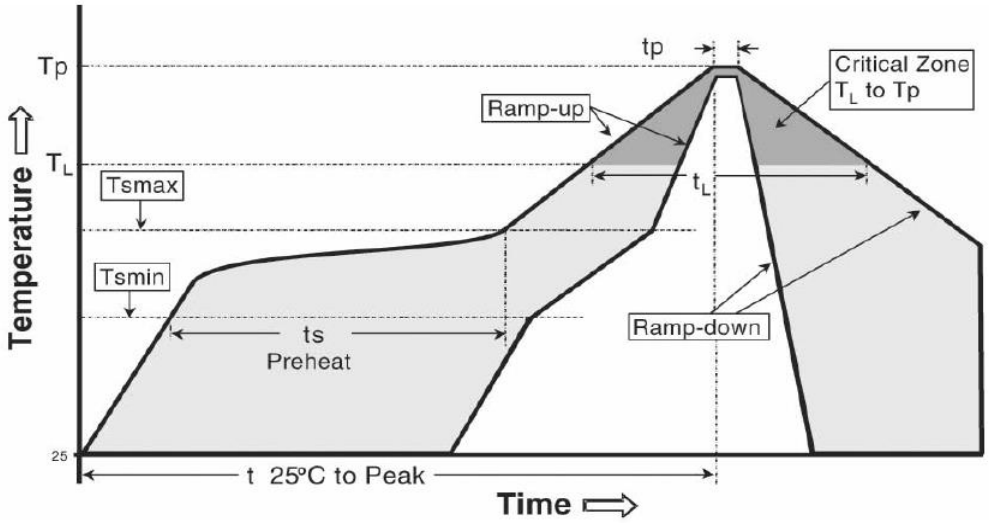


Figure 23: Soldering Temperature-Time Profile (for reflow soldering)

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 one 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 24. 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 24.

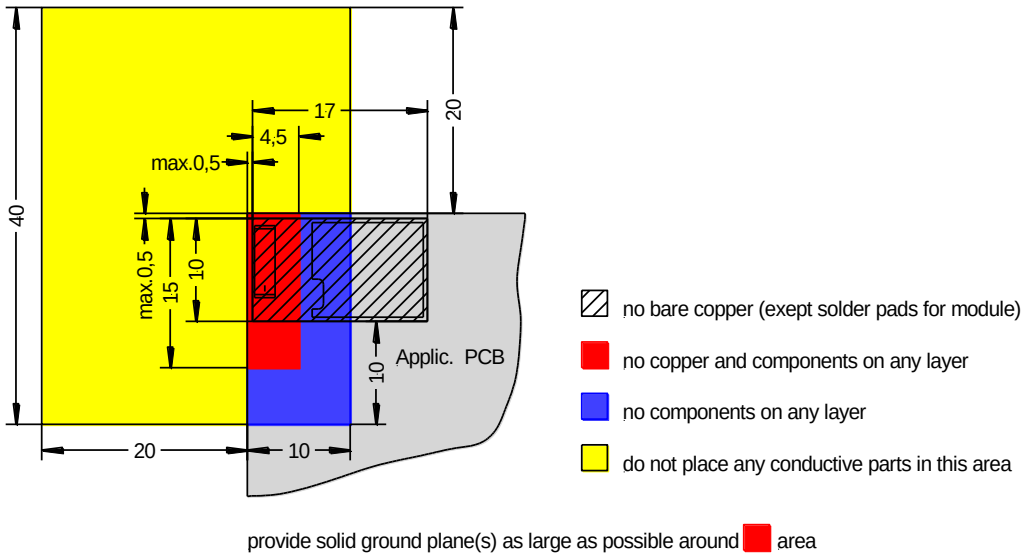


Figure 24: BlueMod+S42/AI Placement Recommendation

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.

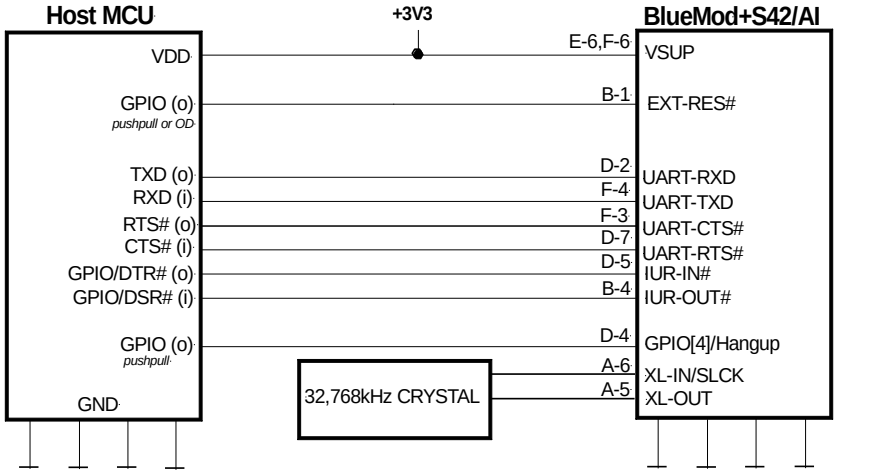
6.8 Cleaning

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 hosted application of BlueMod+S42. The module is connected to some MCU running the application layer. MCU and BlueMod+S42 use 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.



In this example BlueMod+S is connected to an MCU supporting UICP, RTS/CTS flow control and Hangup.
The slow clock oscillator (32,768kHz) is optional; it helps to save power during power down states.

Figure 25: Typical Application Schematics

8 Compliances

The BlueMod+S42/AI has been tested to comply with 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 provides CE tested modules for customers in order to ease CE compliance assessment of end products and to minimize test effort.

NOTE:

All certifications and declarations, except RoHS and ReacH, are only valid for the BlueMod+S42 running with Telit FW. If the FLASH is erased and a customer specific FW is loaded all certifications have to be re-evaluated or renewed.

8.1 Declaration of Conformity CE

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

- RED 2014/53/EU
- RoHS 2011/65/EC

The actual version of EU Declaration of Conformity (EU DoC) can be downloaded from

http://www.telit.com/RED

8.2 FCC Compliance

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

8.2.1 FCC Grant

TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6-10
66117 Saarbruecken,
Germany

Date of Grant: 09/08/2016

Application Dated: 09/08/2016

Telit Wireless Solutions GmbH
Mendelssohnstrasse 15
Hamburg, 22761
Germany

Attention: Jens Jensen

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: RFRMS42
Name of Grantee: Telit Wireless Solutions GmbH
Equipment Class: Digital Transmission System
Notes: Bluetooth LE Module
Modular Type: Single Modular

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	2402.0 - 2480.0	0.0029		

Output Power listed is peak conducted.

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:

(1) this device my not cause harmful interference, and

(2) 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 has 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.

8.3.1 IC Grant

TECHNICAL ACCEPTANCE CERTIFICATE
Canada

CETECOM™

CETECOM ICT Services GmbH
CAB Identification Number DE0001
authorized by the German Government
to act as CAB (Conformity Assessment Body)
in accordance with the MRA EU-Canada
of 1st November 1998.
Bundesnetzagentur
BNetzA-CAB-03/22-51

Certificate Holder	**Telit Wireless Solutions GmbH** Mendelssohnstrasse 15d 22761 Hamburg Germany
IC Certification Number	**4957A-MS42**
Product Description	**Bluetooth LE Module**
CETECOM Registration No.	**1540**
OATS Facility	**CETECOM ICT Services GmbH** Untertuerkheimer Str. 6 -10 66117 Saarbruecken Germany Phone: +49 681 598-0 Fax: +49 681 598-8775 Email:
OATS Facility ID	**3462C-1**

Certification of equipment means only that the equipment has met the requirements of the above-noted specification. License applications, where applicable to use certified equipment, are acted on accordingly by the Industry Canada issuing office and will depend on the existing radio environment, service and location of operation. This certificate is issued on condition that the holder complies and will continue to comply with the requirements and procedures issued by Industry Canada. The equipment for which this certificate is issued shall not be manufactured, imported, distributed, leased, offered for sale or sold unless the equipment complies with the applicable technical specifications and procedures issued by Industry Canada.

La certification du matériel signifie seulement que le matériel a satisfait aux exigences de la norme indiquée ci-dessus. Les demandes de licences nécessaires pour l'utilisation du matériel certifié sont traitées en conséquence par le bureau de délivrance d'Industrie Canada et dépendent des conditions radio ambiantes, du service et de l'emplacement d'exploitation. Le présent certificat est délivré à la condition que le titulaire satisfasse et continue de satisfaire aux exigences et aux procédures d'Industrie Canada. Le matériel à l'égard duquel le présent certificat est délivré ne doit pas être fabriqué, importé, distribué, loué, mis en vente ou vendu à moins d'être conforme aux procédures et aux spécifications techniques applicables publiées par Industrie Canada.

I hereby attest that the subject equipment was tested and found in compliance with the above-noted specification.
J'atteste par la présente que le matériel a fait l'objet d'essai et jugé conforme à la spécification ci-dessus.

Place, date of issue
Saarbrücken, 09/08/2016

CETECOM ICT Services GmbH
cn=Gerald Schmidt, o=CETECOM ICT Services GmbH, ou=SCT-130201, email=gerald.schmidt@cetecom.com, c=DE
2016.09.08 14:40:58 +02'00'

FOREIGN CERTIFICATION BODY
FOREIGN CERTIFICATION BODY

Telecommunication Certification Body

This certificate becomes valid when published in REL at :
Le présent certificat n'entre en vigueur qu'après être publié en REL sur :
https://sms-sgs.ic.gc.ca/equipmentSearch/searchRadioEquipments

CETECOM ICT Services GmbH - Untertuerkheimer Str. 6-10
DE 66117 Saarbruecken - TCB@cetecom.com - www.cetecom.com

TECHNICAL ACCEPTANCE CERTIFICATE
Canada

Product Marketing Name	**BlueMod+S42**
HardwareVersion ID No.	**BlueMod+S42**
Firmware Version ID No.	**-/-**
Host Marketing Name	**-/-**
Equipment Categories	Modular Approval Bluetooth Device
Standards & Specifications	**RSS-247, Issue 1, May 2015**
Antenna Information	**Integrated Antenna**

Frequency Range	Emission Designator	RF Power or Field Strength	Remark
2402 - 2480 MHz	1M05FXD	0.0029 W	

CETECOM ICT Services GmbH - Untertuerkheimer Str. 6-10
DE 66117 Saarbruecken - TCB@cetecom.com - www.cetecom.com

This certificate becomes valid when published in REL at :
Le présent certificat n'entre en vigueur qu'après être publié en REL sur :
https://sms-sgs.ic.gc.ca/equipmentSearch/searchRadioEquipments

8.3.2 IC Statement

(i) 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 of RSS-102 Issue 5 §2.5.1 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,

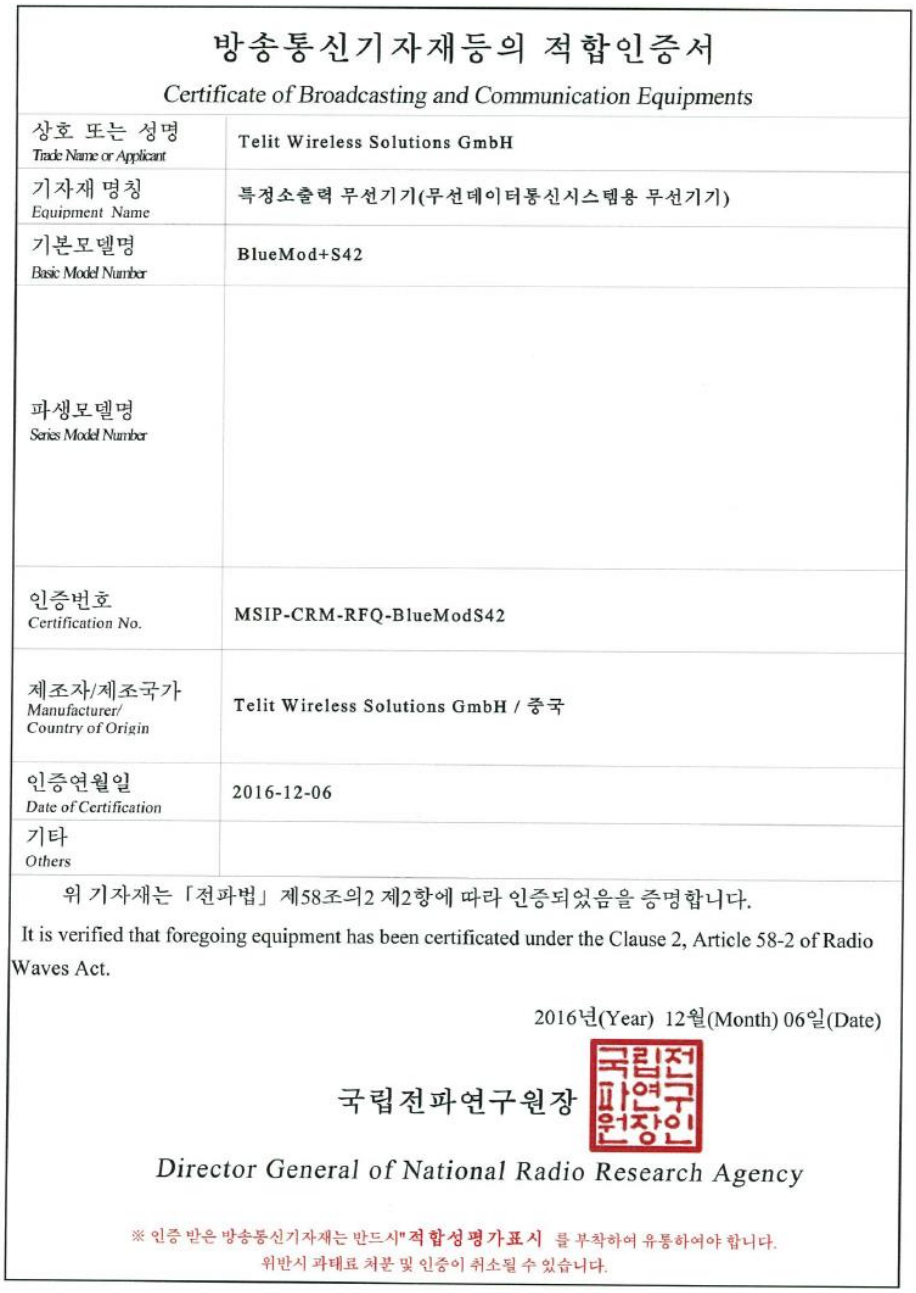
Model: BlueMod+S42

The IC-ID is: 4957A-MS42

8.4 KC Certification

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

8.4.1 KC Certificate



방송통신기자재등의 적합인증서

Certificate of Broadcasting and Communication Equipments

상호 또는 성명 Trade Name or Applicant	Telit Wireless Solutions GmbH
기자재 명칭 Equipment Name	특정소출력 무선기기(무선데이터통신시스템용 무선기기)
기본모델명 Basic Model Number	BlueMod+S42
파생모델명 Series Model Number	
인증번호 Certification No.	MSIP-CRM-RFQ-BlueModS42
제조자/제조국가 Manufacturer/ Country of Origin	Telit Wireless Solutions GmbH / 중국
인증연월일 Date of Certification	2016-12-06
기타 Others	

위 기자재는 「전파법」 제58조의2 제2항에 따라 인증되었음을 증명합니다.

It is verified that foregoing equipment has been certificated under the Clause 2, Article 58-2 of Radio Waves Act.

2016년(Year) 12월(Month) 06일(Date)

국립전파연구원장 국립전파연구원장인

Director General of National Radio Research Agency

※ 인증 받은 방송통신기자재는 반드시 "적합성평가표시" 를 부착하여 유통하여야 합니다.
위반시 과태료 처분 및 인증이 취소될 수 있습니다.

8.4.2 KC Mark

8.5 MIC Certification

The BlueMod+S42/AI has been tested to fulfill the Japanese MIC requirements. **Please note that the Japanese Certificates are only valid for the variants using the internal ceramic antenna, denoted by the string "AI" in the product name.**

Japanese Radio Law.
日本の電気通信事業法と電気通信事業法の基準
This device is granted pursuant to the Japanese Radio Law (電波法)
本製品は、電波法と電気通信事業法に基づく適合証明を受けております。
This device should not be modified (otherwise the granted designation number will become invalid)
本製品の改造は禁止されています。（適合証明番号などが無効となります。）

8.5.1 MIC Certificate

CTC advanced GmbH
Untertürkheimer Strasse 6-10, D-66117 Saarbrücken, Germany

CETECOM ICT Services
CTC advanced

Conformity Assessment Body
Recognized Certification Body for Japan

認証書 TYPE - BASED CERTIFICATE

Approval Holder 認証を受けた者	**Telit Wireless Solutions GmbH** **Mendelssohnstr. 15d** **22761 Hamburg** **Germany**
Manufacturer Name 製造者名	**Telit Wireless Solutions GmbH** **Mendelssohnstr. 15d** **22761 Hamburg** **Germany**
Model Name 型式又は名称	**BlueMod+S42** *Module approval* *Each addition Host-equipment may not cause harmful interference!*
Classification of Specified Radio equipment 特定無線設備の種類	**Ordinance concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment** **特定無線設備の技術基準適合証明等に関する規則** **Article 2, clause 1, Item 19** Low Power data communication system in the 2.4GHz band
Type of Emissions, Frequency and Antenna Power 電波の形式、周波数 及び空中線電力	**F1D** **2402 ~ 2480MHz (2MHz separation, 40 channels)** **0.002W**
Certified Number 認証番号	**202-LSE137**
Certified Date 認証をした年　月　日	**2016-12-16**

上記のとおり、電波法第 38 条の 24 第 1 項の規定に基づく認証を行ったものであることを証する。
This is to certify that the above-mentioned certification by type has been granted in accordance with the provisions of Article 38-24, Paragraph 1 of the Radio Law.

Recognized by
The Ministry of Internal Affairs and Communications (MIC)
via

Bundesnetzagentur

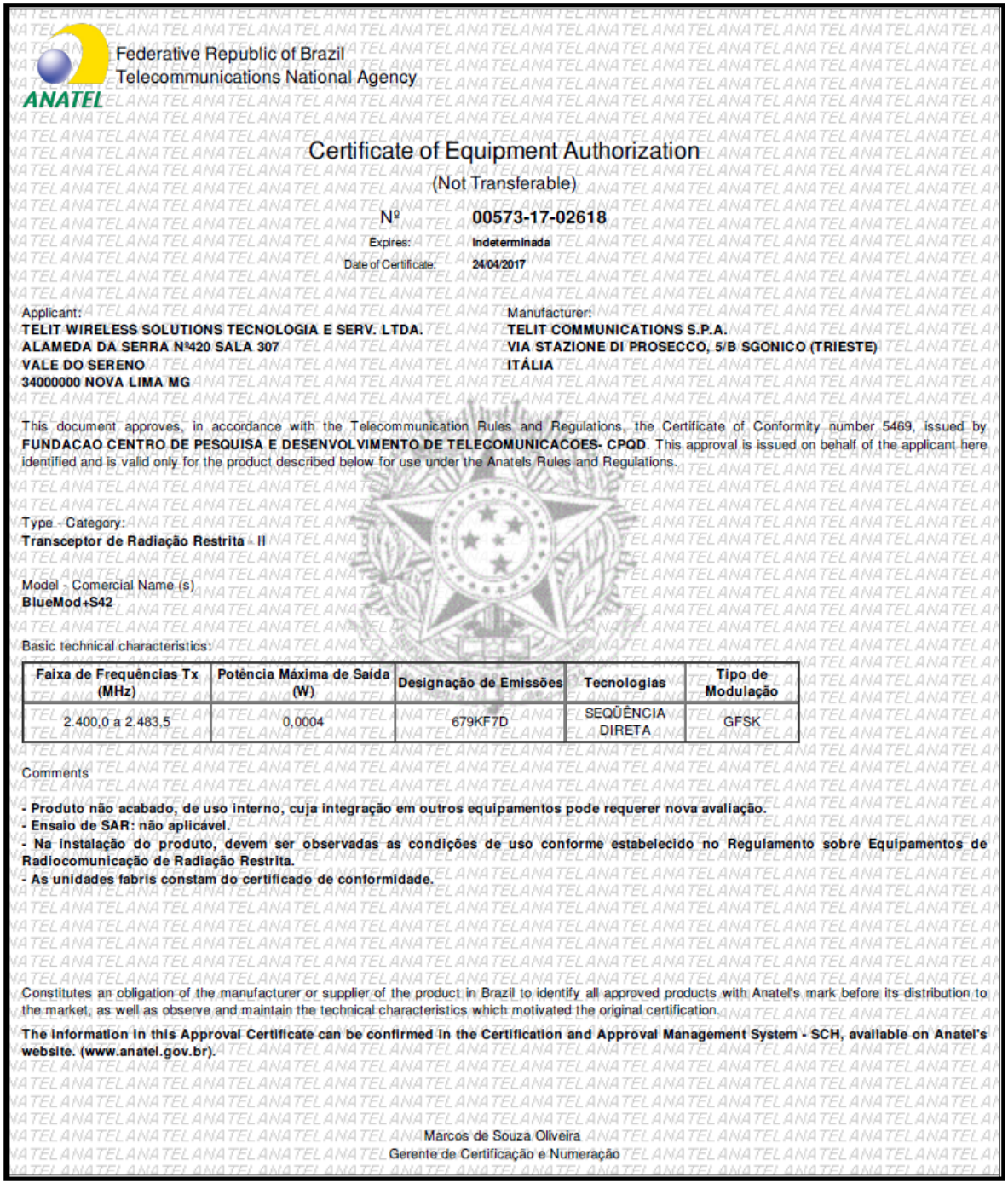
BNetzA-CAB-03/25-51/5

CTC advanced GmbH
Lothar Spitzer

Signature

8.6 Anatel Certification

The BlueMod+S42/AI has been certified in Brazil by Anatel.



Federative Republic of Brazil
Telecommunications National Agency

ANATEL

Certificate of Equipment Authorization
(Not Transferable)

Nº 00573-17-02618

Expires: Indeterminada

Date of Certificate: 24/04/2017

Applicant:
TELIT WIRELESS SOLUTIONS TECNOLOGIA E SERV. LTDA.
ALAMEDA DA SERRA Nº420 SALA 307
VALE DO SERENO
34000000 NOVA LIMA MG

Manufacturer:
TELIT COMMUNICATIONS S.P.A.
VIA STAZIONE DI PROSECCO, 5/B SGONICO (TRIESTE)
ITÁLIA

This document approves, in accordance with the Telecommunication Rules and Regulations, the Certificate of Conformity number 5469, issued by **FUNDACAO CENTRO DE PESQUISA E DESENVOLVIMENTO DE TELECOMUNICACOES- CPQD**. This approval is issued on behalf of the applicant here identified and is valid only for the product described below for use under the Anatels Rules and Regulations.

Type - Category:
Transceptor de Radiação Restrita - II

Model - Comercial Name (s)
BlueMod+S42

Basic technical characteristics:

Faixa de Frequências Tx (MHz)	Potência Máxima de Saída (W)	Designação de Emissões	Tecnologias	Tipo de Modulação
2.400,0 a 2.483,5	0,0004	679KF7D	SEQÜÊNCIA DIRETA	GFSK

Comments

- Produto não acabado, de uso interno, cuja integração em outros equipamentos pode requerer nova avaliação.
- Ensaio de SAR: não aplicável.
- Na instalação do produto, devem ser observadas as condições de uso conforme estabelecido no Regulamento sobre Equipamentos de Radiocomunicação de Radiação Restrita.
- As unidades fabris constam do certificado de conformidade.

Constitutes an obligation of the manufacturer or supplier of the product in Brazil to identify all approved products with Anatel's mark before its distribution to the market, as well as observe and maintain the technical characteristics which motivated the original certification.

The information in this Approval Certificate can be confirmed in the Certification and Approval Management System - SCH, available on Anatel's website. (www.anatel.gov.br).

Marcos de Souza Oliveira
Gerente de Certificação e Numeração

8.7 Australian RCM Mark

Telit is registered supplier at ACN with the following ABN:

Name:	TELIT WIRELESS SOLUTIONS (AUSTRALIA) PTY LIMITED
ACN:	155 224 123
ABN:	16 155 224 123
Registration date:	19/01/2012
Next review date:	19/01/2018
Status:	Registered
Type:	Australian Proprietary Company, Limited By Shares
Locality of registered office:	CHATSWOOD NSW 2067
Regulator:	Australian Securities & Investments Commission

View Summary (PDF)

A SDoC for the BlueMod+S has been issued and is available on request.

8.8 Bluetooth Qualification

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

The Declaration ID is:

D032121

The Qualified Design ID is:

88139

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.


QDL Bluetooth® qualified design listing

The Bluetooth SIG Hereby Recognizes

Telit Wireless Solutions GmbH
Member Company

BlueMod+S42
Qualified Design Name

Declaration ID: D032121
Qualified Design ID: 88139
Specification Name: 4.2
Project Type: End Product
Model Number: Mod+S42
Listing Date: 23 September 2016
Assessment Date: 22 September 2016
Hardware Version Number:
Software Version Number:

This certificate acknowledges the *Bluetooth*® Specifications declared by the member are achieved in accordance with the Bluetooth Qualification Process as specified within the Bluetooth Specifications and as required within the current PRD

Bluetooth®

8.9 RoHS Declaration

The BlueMod+S42/AI fully complies with the EU RoHS directive:

- RoHS 2011/65/EC

The actual version of RoHS Declaration of Conformity (EU DoC) can be downloaded from the Telit Download Zone:

https://www.telit.com/support-training/download-zone

Take note that you have to register to get access to the Download Zone.

9 Packing

The BlueMod+S42 modules are packed either as Tape&Reel or as tray packing.

9.1 Tape&Reel Packing

The BlueMod+S42 modules are packed using carrier tape in this orientation

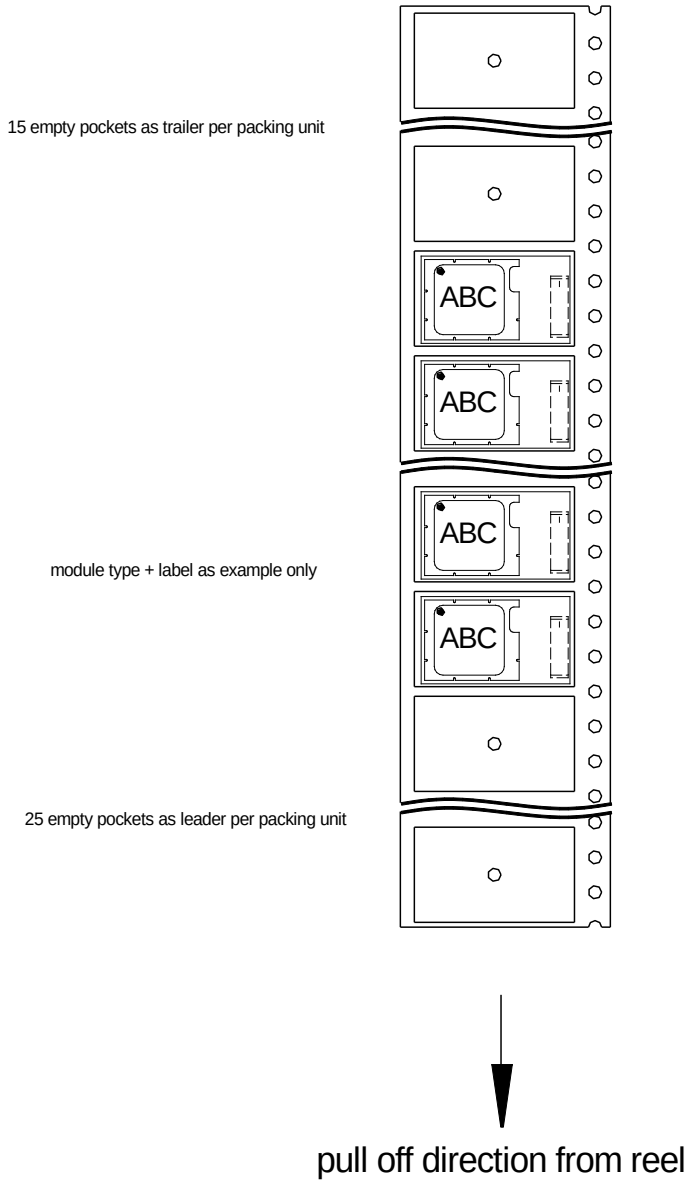


Figure 26: Module Orientation in Carrier Tape

9.1.1 Tape

The dimensions of the tape are shown in Figure 27 (values in mm):

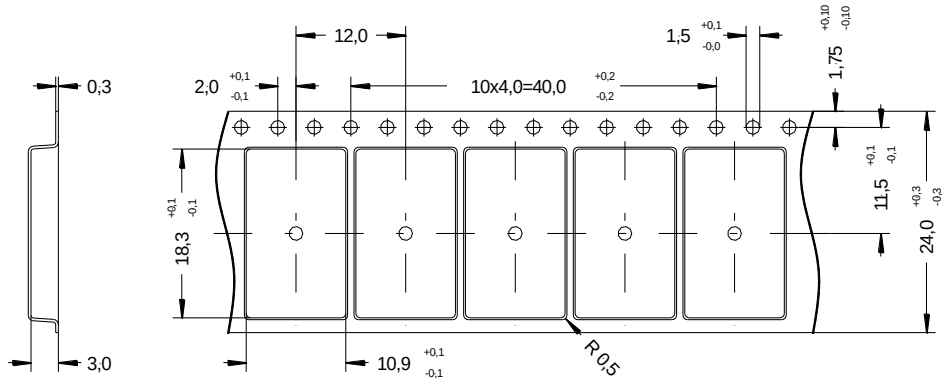


Figure 27: Carrier Tape Dimensions

9.1.2 Reel

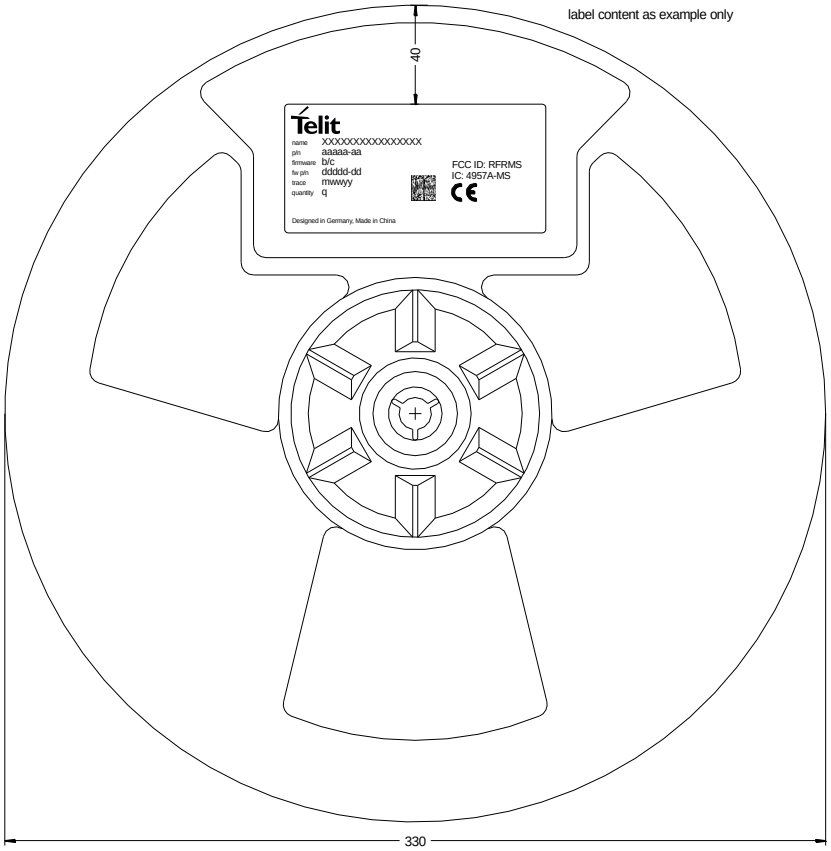


Figure 28: Reel Dimensions

9.2 Tray Packing

9.2.1 Module Orientation

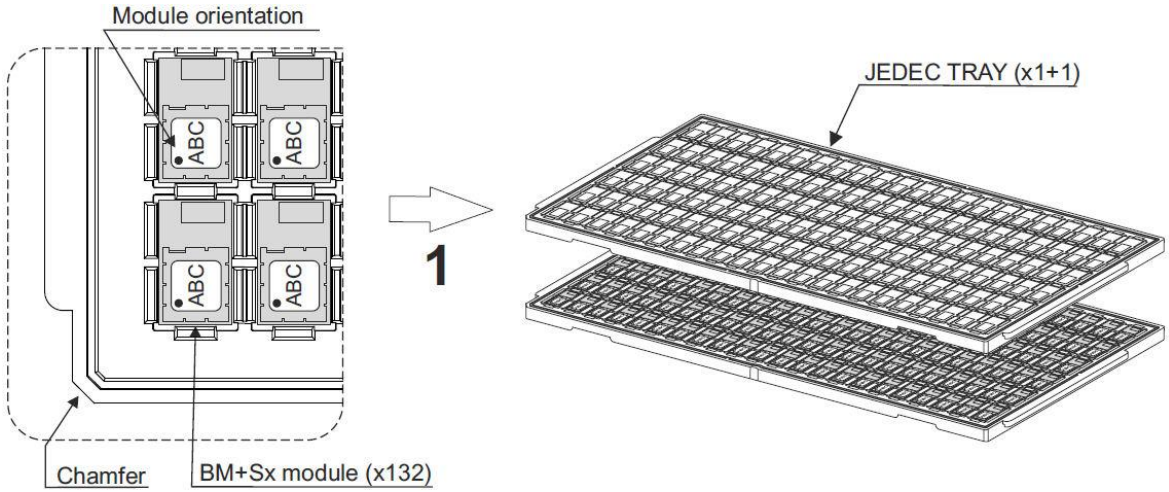


Figure 29: Module Orientation on Tray

9.2.2 Tray Dimensions

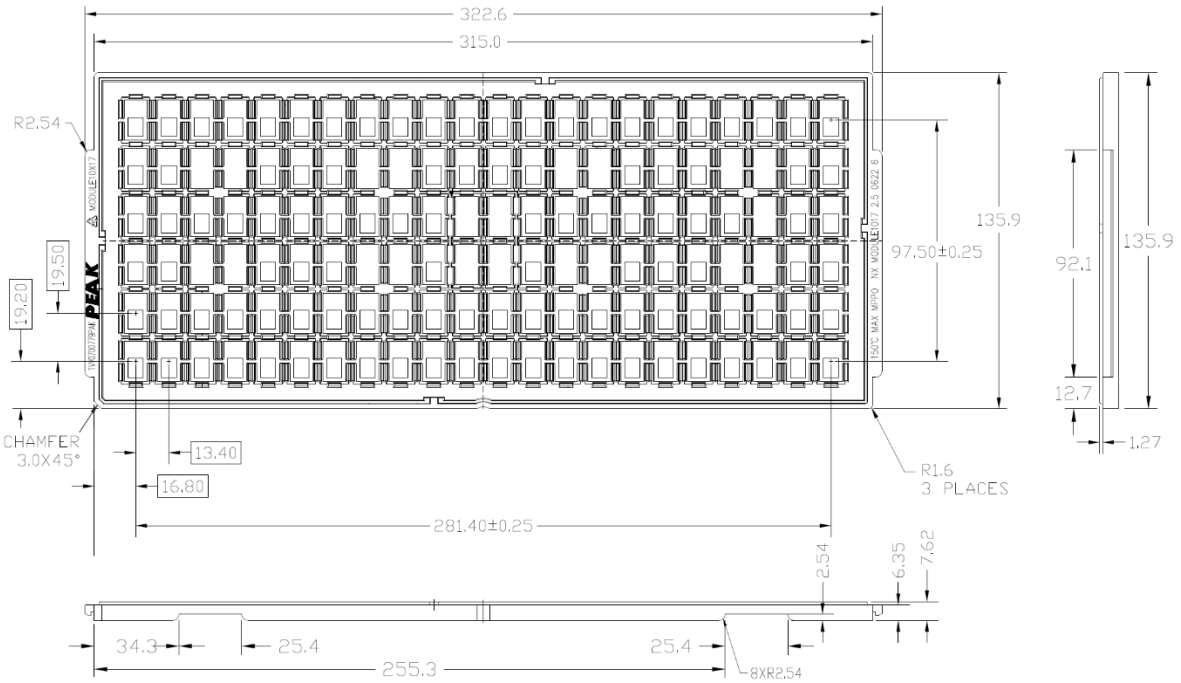


Figure 30: Tray Dimensions

9.3 Moisture Sensitivity Level

Moisture Sensitivity Level (MSL) for BlueMod+S42 is 3.

10 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 Add picture to chapter 3.9.2 Connection of an External 32,768 kHz Crystal Added Tx power and Rx sensivity values at +25 °C Added some power consumption values Removed all references to extern SCLK signal
2	2016-08-22	Added associated Telit ref numbers in related documents list Chap. 2.1: Corrected value from -30dBm to -20dBm for power control range and added Whisper Mode with -40dBm Chap. 2.4: Added new block diagram with 32MHz crystal and optional 32,768kHz crystal Chap. 6.1: Added new label to drawing Chap. 7: Additionally, 32,768kHz signal feeding option removed, only 32,768 crystal possible with nRF52832 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	2016-09-30	Chapter 5.6 RF Performance revised, Chapter 5.5 Power Consumption and Power-Down Modes revised, Chapter 8 Compliances revised, Chapter 9.4 MSL added
4	2016-12-14	Figure 16 module height changed to worst case values Chapter 8.4 KC Certification added
5	2017-04-12	3.2 Reset Chapter revised 5.4.2 EXT-RES# DC Parameter revised 8.1 Declaration of Conformity CE added Note on RED 8.5 MIC Certification Chapter added 8.6 Anatel Certification Chapter added 8.7 Australian RCM Mark Chapter added 7 Application Diagram revised 4.2 General Pin Description Note Pin C-1 added 4.3Application Specific CEN Pin Note Pin C-1 added 9. New drawings for Tape&Reel, tray packing introduced, Dry Bag Label deleted 10. Ordering Information deleted
6	2017-06-07	8.1 Declaration of Conformity CE updated to RED 8.6 Anatel Certification updated 8.9 RoHS Declaration updated 3.10 Test Mode for EMC BlueMod+S42 Testmode recommended

7	2017-11-17	General: TIO replaced by CEN General: Appliability Table extended 4.4 Application Specific ADC/TWI Pin Configuration added 4.5 Application Specific ADC/LUA Pin Configuration added 3.3 Serial Interface revised 5.5 Power Consumption and Power-Down Modes revised 4.2 General Pin Description Alternate Functions revised 5.5.1 Power Consumption BlueMod+S42/AI CEN FW Chapter for ATEX Variant added 8 Compliances Note added compliance only valid for Telit FW 3.14 Analog/Digital Converter (ADC) chapter added 5.4.3.1 Analog ADC Input AIN Chapter revised
8	2018-08-06	Updated Application Specific ADC/LUA Pin Configuration Updated power consumption values
9	2019-03-07	Updated Chapter 3.2 Reset