HW User Guide

1VV0301275, Rev. 06 – 2016-12-15

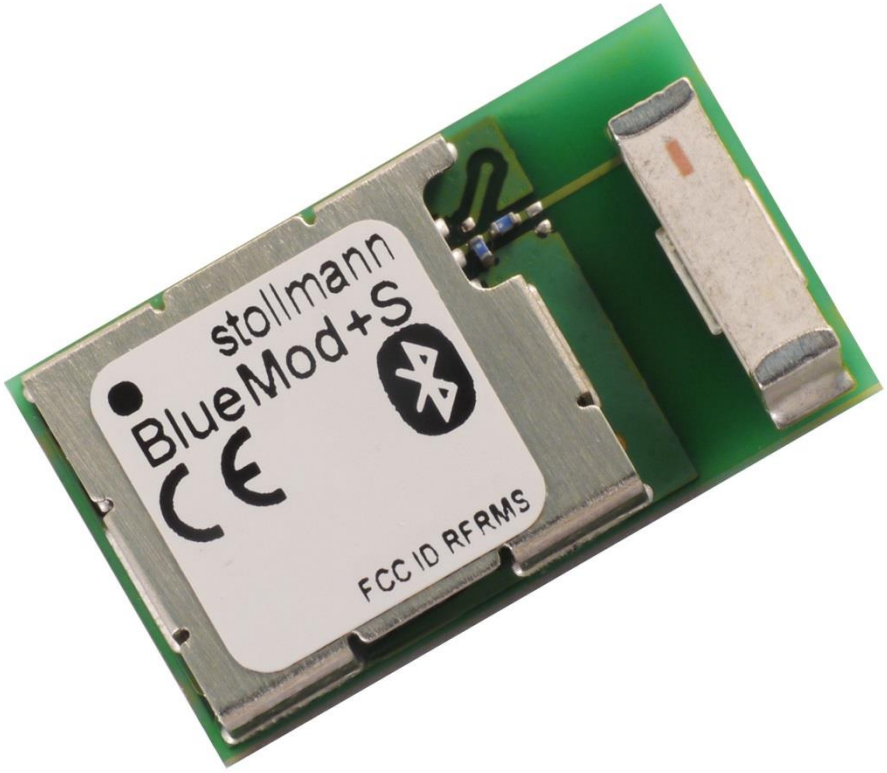
TELIT
TECHNICAL
DOCUMENTATION

Stollmann is a Telit brand.

BlueMod+S/AI

Hardware Reference

Release r06



Bluetooth® SMART

Note

This device was developed for the purpose of communication in an office environment. It is intended solely for our industrial clients for physical integration into their own technical products after careful examination by experienced technical personnel for its suitability for the intended purpose. The device was not developed for or intended for use in any specific customer application. The firmware of the device may have to be adapted to the specific intended modalities of use or even replaced by other firmware in order to ensure flawless function in the respective areas of application. Performance data (range, power requirements, etc.) may depend on the operating environment, the area of application, the configuration, and method of control, as well as on other conditions of use; these may deviate from the technical specifications, the Design Guide specifications, or other product documentation. The actual performance characteristics can be determined only by measurements subsequent to integration. Variations in the performance data of mass-produced devices may occur due to individual differences between such devices. Device samples were tested in a reference environment for compliance with the legal requirements applicable to the reference environment. No representation is made regarding the compliance with legal, regulatory, or other requirements in other environments. No representation can be made and no warranty can be assumed regarding the suitability of the device for a specific purpose as defined by our customers. Telit reserves the right to make changes to the hardware or firmware or to the specifications without prior notice or to replace the device with a successor model. Of course, any changes to the hardware or firmware of any devices for which we have entered into a supply agreement with our customers will be made only if, and only to the extent that, such changes can reasonably be expected to be acceptable to our customers. No general commitment will be made regarding periods of availability; these must be subject to individual agreement.

Trademarks

The Bluetooth® word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Telit is under license. Other trademarks and trade names are those of their respective owners.

Table of contents

List of Figures

List of Tables

1 Introduction

This Hardware Reference documents how the BlueMod+S/AI can be integrated into customer systems. It addresses hardware specifications of the BlueMod+S/AI and requirements of the hardware environments for the BlueMod+S/AI.

Notation: The term *BlueMod+S* refers to the BlueMod+S/AI and is used as an abbreviation.

The BlueMod+S is delivered in two different hardware versions: with (as of Q4/2015) and without (until Q4/2015) DC-DC converter on the module. Wherever required the variant with DC-DC is named BlueMod+S/DC-DC in this document. Furthermore a firmware version V2.xxx or newer is required to support the DC-DC converter. See also chapter 11 Ordering Information

For detailed information about software interfaces refer to [5].

For the latest version of this document please check the following URL:

http://www.telit.com/bluetooth/bluemod-s/

1.1 Feature Summary

- Bluetooth specification V4.1 compliant
- Supports Bluetooth low energy
- Fully qualified Bluetooth V4.1 Single Mode LE
- CE certified
- FCC and IC certified
- KCC certified
- Nordic nRF51822 inside
- Fast Connection Setup
- RF output power -30 up to +5dBm EIRP
- RSSI detector on board
- High sensitivity design
- Supply voltage range 1,8V to 3,6V
- Internal crystal oscillator (16 MHz)
- LGA Surface Mount type. BlueMod+S: 17 x 10 x 2.6 mm^3
- Pin compatible to Telit´s BlueMod+SR dual mode module
- Shielded to be compliant to FCC full modular approval
- Flexible Power Management
- 128-bit AES encryption
- 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 6 analog inputs for individual usage by embedded software
- 8/9/10bit ADC
- Arm® Cortex™-M0 core for embedded profiles or application software
- Manufactured in conformance with RoHS2
- Operating temperature -25 ... +75 °C
- Weight: 0,7 g

1.2 Applications

The BlueMod+S 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

Support for any additional profile is possible on request.

1.2.1 General Cable Replacement

In case there is no standardized application specific profile available the BlueMod+S offers Stollmann'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 the dual mode module BlueMod+SR.

1.2.2 Industry

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

1.2.3 POS/Advertising

BlueMod+S supports iBeacon or similar applications.

1.2.4 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.

1.2.5 Sports and Fitness

In the sports and fitness segment the BlueMod+S 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.

1.2.6 Entertainment

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

2 Block Diagram

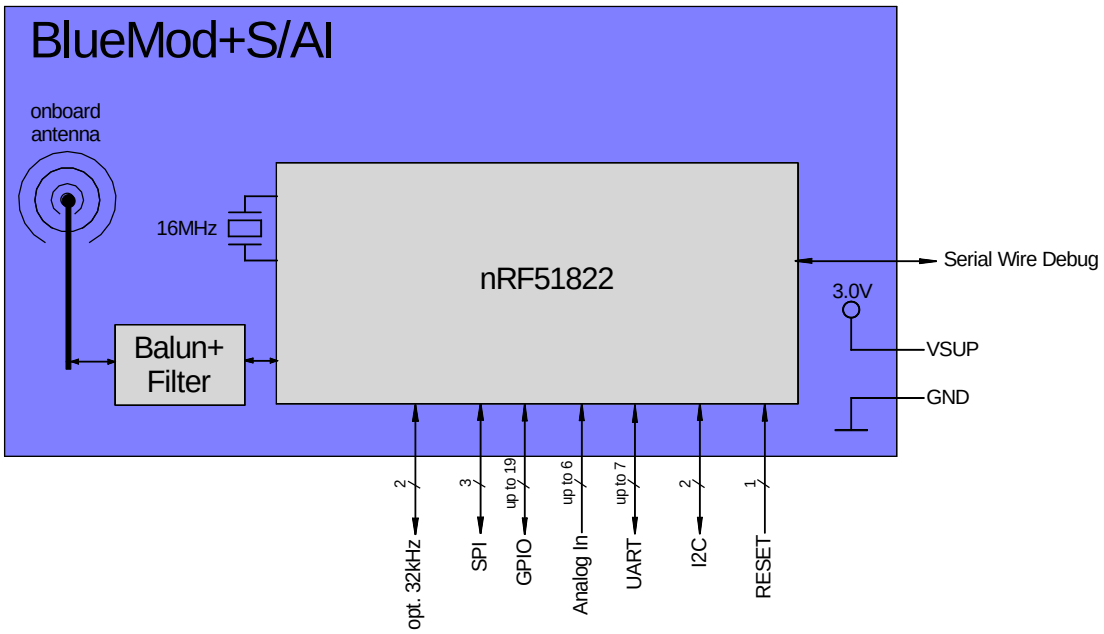


Figure 1: BlueMod+S/AI Block Diagram

3 Application Interface

3.1 Power Supply

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

Typical: 3,0V_{DC}, min.: 1,8V_{DC}, max.: 3,6V_{DC}, thereby delivering > 25 mA peak

BlueMod+S 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

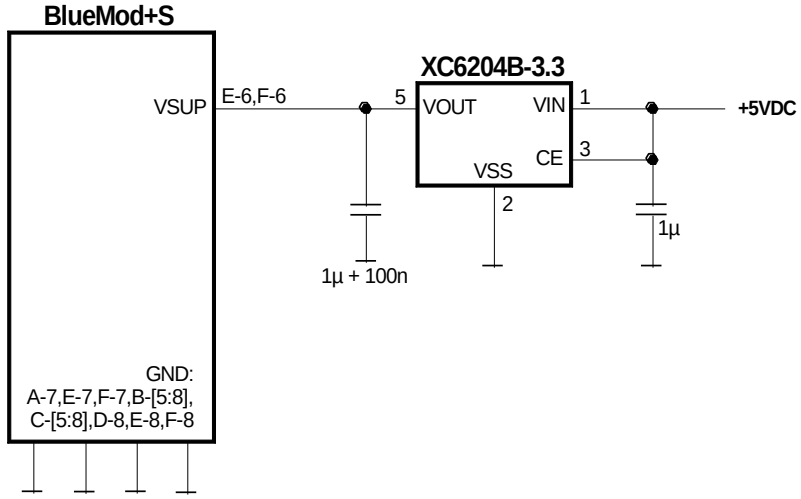


Figure 2: BlueMod+S Example Power Supply with LDO

3.2 Power-up Slew-Rate

Parameter	Min	Max	Unit
VSUP rise time rate (1), (2)	0	100	ms

(1) 0V to VDDV

(2) The on-chip power-on reset circuitry may not function properly for rise times outside the specified interval

Table 1: Power up Rise Time Requirements

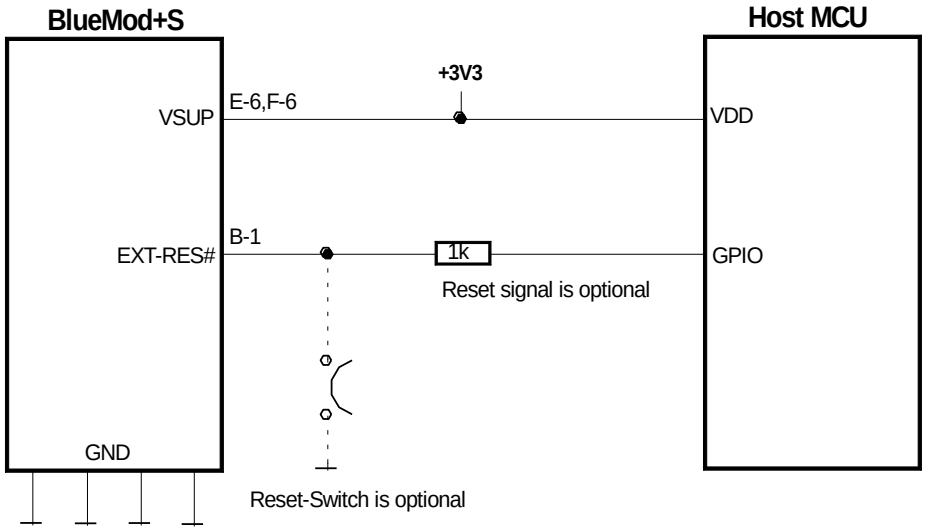
3.3 Reset

BlueMod+S are equipped with circuitry for generating power-up reset from the supply voltage VSUP, as well as brownout detection.

During power-up, reset is kept active until the supply voltage VSUP has reached the minimal operating voltage. VSUP rise time has to comply with Table 1 for power-up reset to function properly. A reset is also generated when VSUP falls below the threshold of the brownout detector (1,6V .. 1,7V with a hysteresis of about 30mV), and is released when VSUP rises above that threshold.

By holding pin B-1 (EXT-RES#) at ≤ VSUP*0,3V for $t_{HOLDRESETNORMAL}$ ≥ 0,2µs, an external reset (*pin reset*) is generated. This pin has a fixed internal pull-up resistor (R_{PU} = 11kΩ ... 16kΩ). EXT-RES# may be left open if not used.

Note:
The reset-functionality associated with pin EXT-RES# is shared with the serial wire debug feature (refer to 3.12). Inside the BlueMod+S module, EXT-RES# is connected to SWDIO via a 150R resistor. During a debug session the external reset function is not available; asserting of EXT-RES# to *any* level should be avoided.



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

Figure 3: BlueMod+S Example Reset

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

Pin Name	State: BlueMod+S
EXT-RES#	Input with pull-up (1)
XL-IN/SLCK	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.

3.4 Serial Interface

The serial interface of BlueMod+S is a high-speed UART interface supporting RTS/CTS flow control and interface-up/down mechanism according to the UICP+ protocol (refer to [3]). Electrical interfacing is at CMOS levels (defined by VSUP; see chapter 5.4.1).

- Transmission speeds are 9600 – 921600 bps and 1Mbps (asynchronous)
- Character representation: 8 Bit, no parity, 1 stop bit (8N1)
- Hardware flow-control with RTS and CTS (active low)

Note: Transmission speed may be limited by firmware. See corresponding command reference [5] for further information.

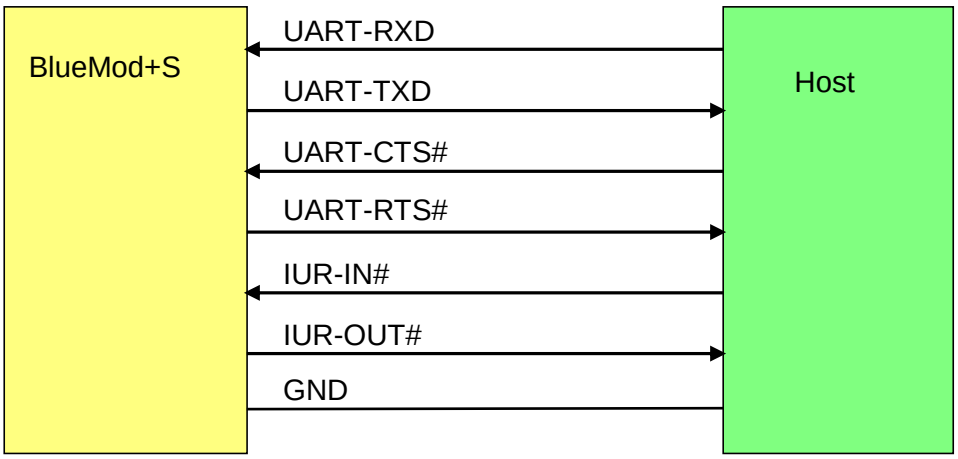


Figure 4: Serial Interface Signals

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

A substantially saving of power during idle phases can be achieved (see 5.5.1) when the UICP protocol is used (refer to [3]). This protocol should be implemented on the host side as well. Signals IUR-IN# and IUR-OUT# should be connected to the host (see Figure 4: Serial Interface Signals) and may be mapped to DSR and DTR, if an RS232-style (DTE-type) interface is used (see Figure 6).

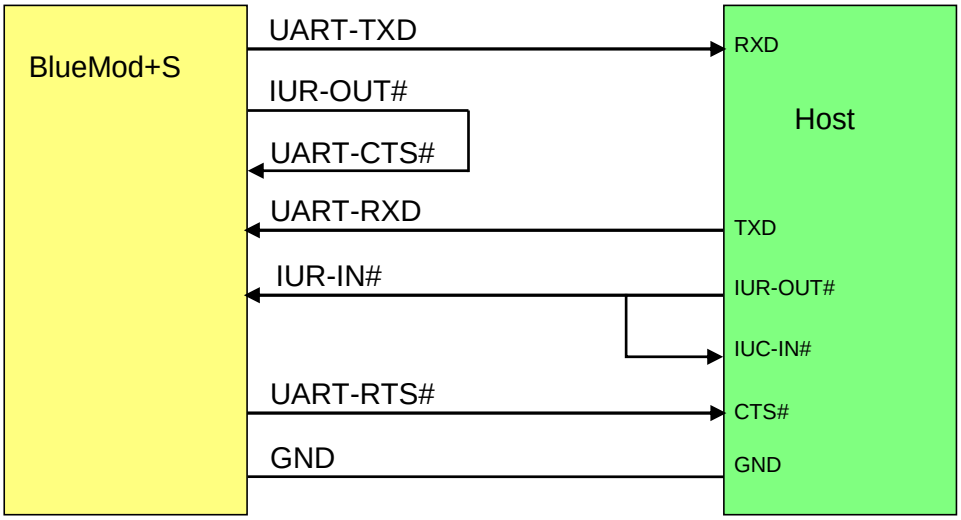


Figure 5: Five Wire Interface supporting UICP (Minimum Signals needed)

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

When using the TIO firmware and applications, call control can be supported by GPIO[4]. Driving GPIO[4] to logic High level during a data transfer phase will “hang up” the connection and disconnect the Bluetooth link. This signal may be mapped to DSR, if an RS232-style (DTE-type) interface is used. Please refer to [5] for a functional specification. GPIO[4] can be left unconnected if this feature is not used.

3.4.1 4-Wire Serial Interface

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

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

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

3.4.2 UART Example Circuits

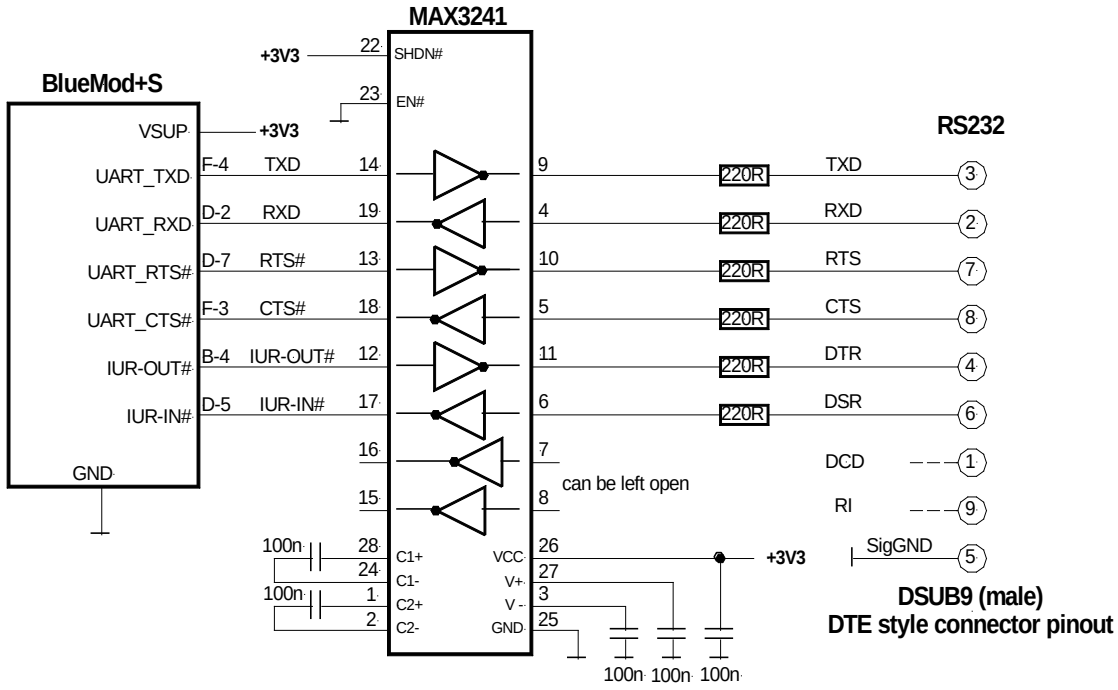


Figure 6: BlueMod+S Example Serial Interface (RS-232) Supporting UICP

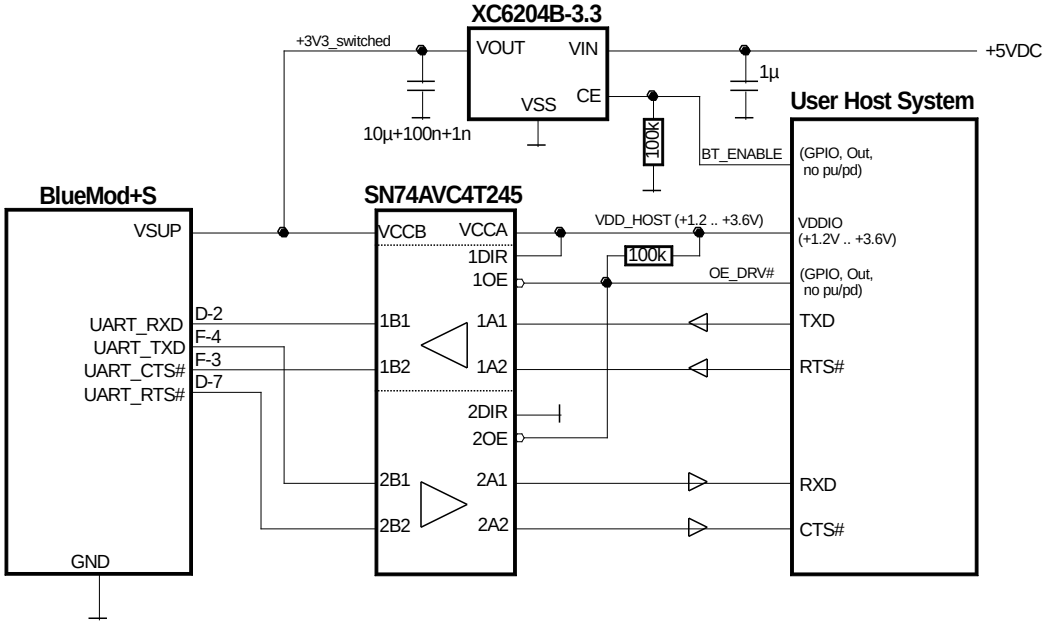


Figure 7: BlueMod+S Example Serial Interface (Mixed Signal Level)

3.4.3 Baud Rate Deviation

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

Data Rate (bits/s)	Deviation (%)
9600	±1%
19200	
38400	
57600	
115200	
230400	
460800	
921600	
1000000	

Table 3: Deviation of Baud rates

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

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

In order to allow customers to use the serial interface with the minimal signal count on the one side and to reduce current consumption when using UICP on the other side, the BlueMod+S 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 the pull-down would cause an unwanted constant current drain. Therefore it is switched off in this mode.

3.5 GPIO Interface

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

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

3.6 I²C Interface[1]

The I²C bus interface serves as an interface between the internal microcontroller and the serial I²C bus. BlueMod+S is the master and controls all I²C bus specific sequencing, protocol and timing. It supports standard (100kHz) and fast (400kHz) speed modes. The BlueMod+S 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.

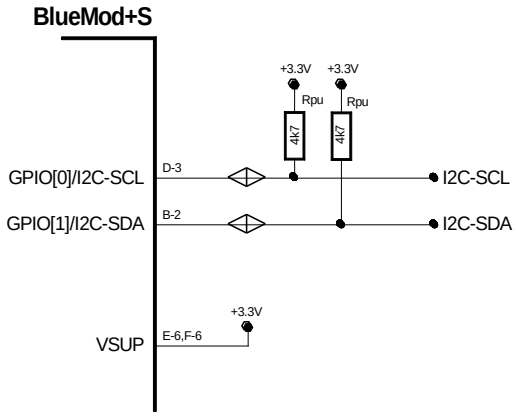


Figure 8: BlueMod+S I²C Interface

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

3.7 SPI Serial Peripheral Interface[2]

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

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

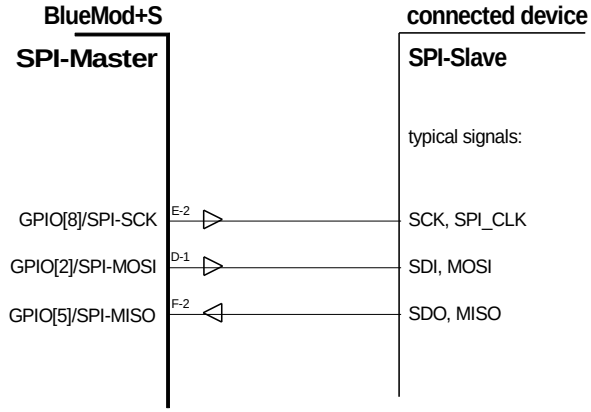


Figure 9: BlueMod+S SPI Interface (Example: Master Mode)

3.8 Bluetooth Radio Interface

The BlueMod+S/AI presents an integrated ceramic antenna.

It is highly recommended that you follow the design rule given in the Stollmann Application Note on Antenna design [4].

[2] subject to firmware support, contact Stollmann for current status

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 feeding the module with an optional 32,768 kHz slow clock at pin XL-IN/SLCK, or connecting an XTAL (32,768kHz) and two capacitors C1, C2 at pins XL-IN and XL-OUT.

3.9.1 SLCK Specification (External Supplied Signal)

- 32,768 kHz +/-250ppm; duty cycle 30...70%.
- Signal may be a sine wave, a clipped sine wave, a square wave or a rail-to-rail digital signal. The amplitude must be at least 200mV$_{pp}$. DC offset is not an issue as long as the input voltage is between VSS and VSUP at all times.
- connect signal SLCK to XL-IN/SLCK (A6) and leave XL-OUT (A5) open

3.9.2 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			9	12,5	pF
C0	Shunt Capacitance				2	pF
R_S	Equivalent Series Resistor			50	80	kΩ
P_D	Drive Level				1	µW
C_{pin}	Input Cap. on XL-IN and XL-OUT			4		pF

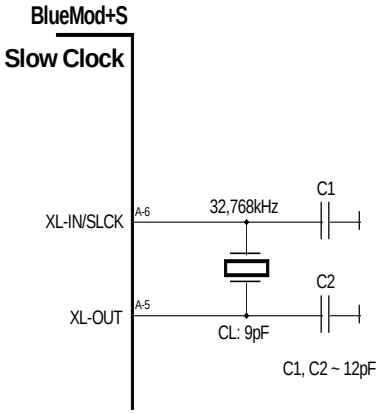
(1) adjust crystal frequency by choosing correct value for C1, C2 (value depends on C_L of crystal and layout)

Table 4: 32,768kHz Crystal Oscillator

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

3.9.3 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/SLCK) and A-5 (XL-OUT). The crystal has to comply with specifications given in Table 1. 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 close to pins A-5, A-6. Avoid long signal traces.



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

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

C_{pin}: see Table 4

C_s: stray capacitance, depends on layout

Figure 10: BlueMod+S connection of external XTAL

3.10 Test Mode

For homologation purposes the ability of test mode operation like "BlueMod+S_Testmode" or "Direct two wire UART Testmode" (DTM) is mandatory. The Direct Test Mode (as defined by the Bluetooth SIG) and BlueMod+S_Testmode are part of the BlueMod+S TIO-Firmware. Please refer to [6] and [7].

For enabling the different test modes the BlueMod+S 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 5 shows the possible combinations:

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

Table 5: Testmode# / Boot0 Logic

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

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

These pins shall be routed to some test pads on an outer layer, but can be left open during normal operation when not used.
Please note the UART is required for operation of test modes. During the homologation process, UART-RXD, UART-TXD, UART-RTS# and UART-CTS# must be freely accessible.

3.11 Operating in a Power-Switched Environment

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

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

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

3.12 Serial Wire Debug Interface

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

Leave SWDIO, SWCLK unconnected. Only if you intend to use them for debugging purposes, make them available. Please be aware of the nRF51822 pin sharing SWDIO/nRESET (refer to [1]). On the BlueMod+S module, pin EXT-RES# is decoupled from SWDIO by a 150 Ω resistor; SWDIO is connected directly to pin SWDIO/nRESET of the nRF51822 chip. Nevertheless, avoid *driving* EXT-RES# to any logic level while in debug mode, since EXT-RES# will also be driven by the BlueMod+S or the debugger, when SWDIO is driven by either of these.

During any debugging session the external pushbutton reset functionality is not available. Please use the correct reset options of your serial wire debugger. Alternatively, power-off the system, remove the debugger and power-up again (refer to [1], Chapter 10 Debugger Interface (DIF)).

3.13 DC/DC Converter

The product variant BlueMod+S/DC-DC with FW > V2.003 supports a buck DC/DC converter for supplying the radio circuit. Used with a 3V coin-cell battery, the peak current drawn from the battery is reduced by approximately 25%.

The DC/DC converter only works in the supply voltage range 2,1V_{DC} to 3,6V_{DC}, whereas the BlueMod+S/DC-DC is specified to operate in the supply voltage range of 1,8V_{DC} to 3,6V_{DC}. In order to fulfill this requirement the DC/DC converter is switched off automatically by FW if the supply voltage drops below 2,3V_{DC} with 5% tolerance. In this situation a LDO regulator will supply the radio circuit. The DC/DC converter is switched on again after a RESET sequence if the supply voltage is > 2,3$_{DC}$.±5%.

In chapter 5.5 Power Consumption and Power-Down Modes the parameters will be given for operation with and without the DC/DC converter enabled.

Switching off the DC/DC converter, when the supply voltage drops below 2,3V_{DC}, doesn't reduce power efficiency significantly, because the DC/DC conversion factor is close to 1 in this supply voltage region.

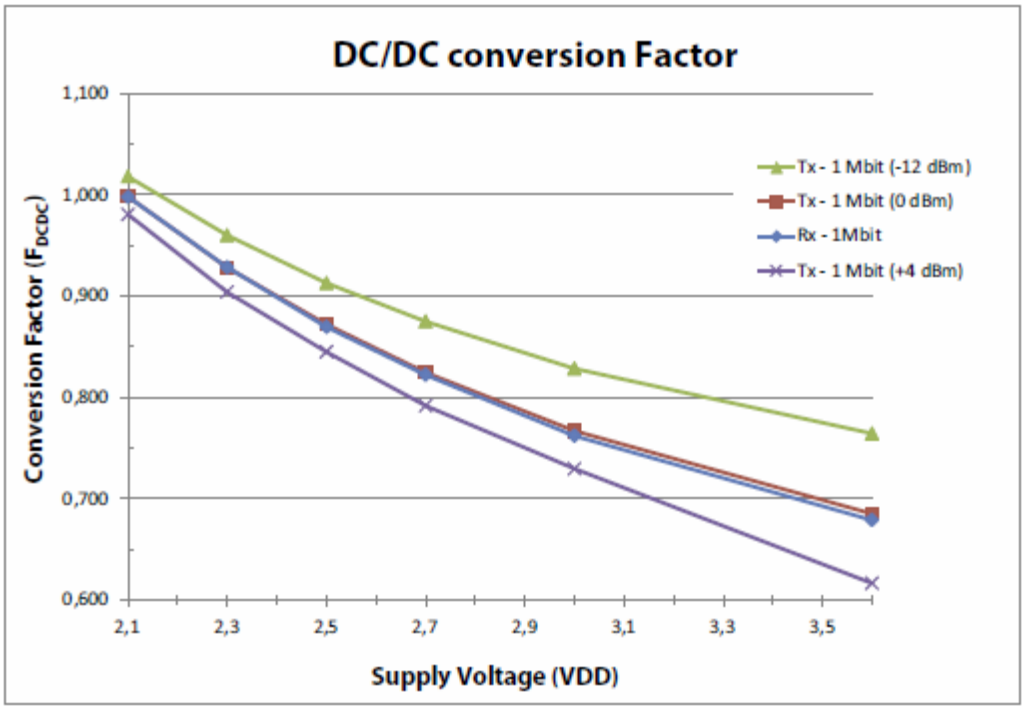


Figure 11: DC/DC Conversion Factor F_{DCDC} versus Supply Voltage

The DC/DC conversion factor F_{DCDC} is the ratio between the supply current drawn by the radio circuit with DC/DC enabled versus LDO(DC/DC disabled). $F_{DCDC} = I_{RADIO}(DCDC)/I_{RADIO}(LDO)$.

F_{DCDC} = 1 means that the DC/DC converter has no effect, whereas F_{DCDC} = 0,7 means 30% less current consumption. If F_{DCDC} becomes > 1, the operation of the DC/DC converter causes more current consumption.

4 Module Pins

4.1 Pin Numbering

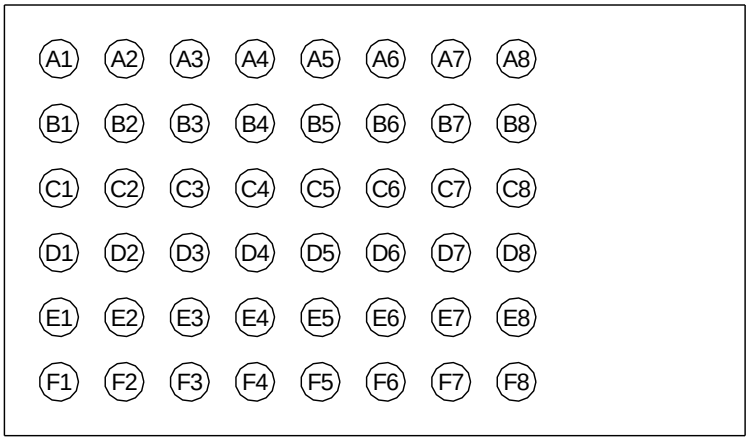


Figure 12: BlueMod+S Pin Numbering (Top View)

4.2 Pin Description

4.2.1 General Pin Description

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

Pin Name	Signal	Type	Act	Function	Alternate Function	Notes
E-6	VSUP1	PWR		+3,0V nom.		
F-6	VSUP2	PWR		+3,0V nom		
C-1	not connected			none		
A-7, E-7, F-7, B-[5,6,7,8], C-[5,6,7,8], D-8, E-8, F-8	GND	PWR		Ground 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/SLCK	I/O		32,768kHz Slow Clock / XTAL	AIN1	(5)
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	L	Flow Control/IUC		(1,6)
F-3	UART-CTS#	I-PD	L	Flow Control/IUC		(6,8)
B-4	IUR-OUT#	O-PP	L	UICP Control		(8)
D-5	IUR-IN#	I-DIS	L	UICP Control		(8)
D-3	GPIO[0]	I/O		GPIO	I2C-SCL, AIN7, AREF1	(3,5)
B-2	GPIO[1]	I/O		GPIO	I2C-SDA, AIN6	(3,5)
D-1	GPIO[2]	I/O		GPIO	SPI-MOSI	(3,5)
E-4	GPIO[3]	I/O		GPIO		(3,5)
D-4	GPIO[4]	I/O		GPIO		(3,5)
F-2	GPIO[5]	I/O		GPIO	SPI-MISO, AREF0	(3,5)
C-4	GPIO[6]	I/O		GPIO		(3,5)
C-3	GPIO[7]	I/O		GPIO		(3,5)
E-2	GPIO[8]	I/O		GPIO	SPI-SCK, AIN2	(3,5)
A-3	not connected			none		
A-1	GPIO[10]	I/O		GPIO		(3,5)
A-4	not connected			none		
A-2	GPIO[9]	I/O		GPIO		(3,5)
F-1	TESTMODE#	I-PU	L	Testmode Enable	AIN3	(6)
E-1	BOOT0	I-PD		reserved	AIN4	(6)
E-3	SWDIO	I/O-		Serial Wire Debug (data)		
D-6	SWCLK	I-PD		Serial Wire Debug (clock)		
C-2	GPIO[13]	I/O		GPIO		(3,5)
B-3	GPIO[11]	I/O		GPIO	AIN5	(3,5)
A-5	XL-OUT	I/O		GPIO / ext. XTAL 32,768kHz	AIN0	(3,5)
F-5	GPIO[14]	I/O		GPIO		(3,5)
E-5	GPIO[12]	I/O		GPIO		(3,5)

Notes:
(1) a discrete pull up resistor is used
(3) function depends on firmware
(4) DNU: Do Not Use, Do Not Connect
(5) GPIO pin. These pins may be programmed as analog-in, i-disconnected, i-float, i-pu, i-pd, o-pp (output push/pull), o-od (output open drain), o-os (output open source) or some alternate function; 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 3.4.4 Dynamic I/O Signal Type Changes depending on the UICP status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 6: General Pin Assignment

4.2.2 Application Specific Pin Description

4.2.2.1 TIO Pin Configuration

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

Pin Name	Signal	TIO-Function	Type	Act	Description	Note
E-6	VSUP1	Power	PWR		+3,3V nom.	
F-6	VSUP2	Power	PWR		+3,3V nom	
C-1	not connected					
A-7,E-7,F-7, B-[5,6,7,8], C-[5,6,7,8], D-8, E-8, F-8	GND	GND	PWR		Ground 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	I		32,768kHz Slow Clock (optional)	
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 [3]	(1,6)
F-3	UART-CTS#	/CTS	I-PD	L	Flow Control/IUC; refer to [3]	(6,8)
B-4	IUR-OUT#	/IUR-OUT	O-PP	L	UICP Control; refer to [3]	(3,8)
D-5	IUR-IN#	/IUR-IN	I	L	UICP Control; refer to [3]	(3,8)
D-3	GPIO[0]	GPIO[0]	I/O		GPIO [I2C-SCL]	(3)
B-2	GPIO[1]	GPIO[1]	I/O		GPIO [I2C-SDA]	(3)
D-1	GPIO[2]	IOC	I/O		GPIO [SPI-MOSI]	(3)
E-4	GPIO[3]	IOB	I/O		GPIO	(3)
D-4	GPIO[4]	HANGUP	I-PD		optional; refer to [5]	
F-2	GPIO[5]	IOD	I/O		GPIO [SPI-MISO]	(3)
C-4	GPIO[6]	reserved	I-DIS		GPIO	(3)
C-3	GPIO[7]	GPIO7	I-DIS		GPIO	(3)
E-2	GPIO[8]	IOA	I/O		GPIO [SPI-SCK] [DEVICE READY#]	(3)
A-3	not connected					
A-1	GPIO[10]	DNU	I-DIS		leave open	(4)
A-4	not connected					
A-2	GPIO[9]	DNU	I-DIS		leave open	(4)
F-1	TESTMODE#	reserved	I-PU	L	connect to test pad	(6,7)
E-1	BOOT0	reserved	I-PD		connect to test pad	(6,7)
E-3	SWDIO	reserved	I/O-PU		leave open (Serial Wire Debug)	
D-6	SWCLK	reserved	I-PD		leave open (Serial Wire Debug)	
C-2	GPIO[13]	DNU	I-DIS		leave open	(4)
B-3	GPIO[11]	DNU	I-DIS		leave open	(4)
A-5	XL-OUT	XTAL	I-DIS		leave open if no ext. XTAL is connected	
F-5	GPIO[14]	DNU	I-DIS		leave open	(4)
E-5	GPIO[12]	DNU	I-DIS		leave open	(4)

Notes:
(1) a discrete pull up resistor is used
(3) function depends on firmware
(4) DNU: Do Not Use, Do Not Connect
(6) signal must be accessible for homologation purposes. Refer to 3.10 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 3.4.4 Dynamic I/O Signal Type Changes depending on the UICP status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 7: Application Specific Pin Assignments, TIO

4.2.2.2 ADC Pin Configuration

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

Pin Name	Signal	ADC-Function	Type	Act	Description	Note
E-6	VSUP1	Power	PWR		+3,3V nom.	
F-6	VSUP2	Power	PWR		+3,3V nom	
C-1	not connected	none				
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	I		32,768kHz Slow Clock (optional)	
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 [3]	(1,6)
F-3	UART-CTS#	/CTS	I-PD	L	Flow Control/IUC; refer to [3]	(6,8)
B-4	IUR-OUT#	/IUR-OUT	O-PP	L	UICP Control; refer to [3]	(3,8)
D-5	IUR-IN#	/IUR-IN	I	L	UICP Control; refer to [3]	(3,8)
D-3	GPIO[0]	AREF	Analog		ADC Reference Voltage	(3)
B-2	GPIO[1]	AIN	Analog		ADC Analog Input	(3)
D-1	GPIO[2]	SPI-MOSI	I/O		SPI-MOSI	(3)
E-4	GPIO[3]	CNF_RES#	I-DIS	L	Configuration Restore	(3)
D-4	GPIO[4]	DIO0	I/O		Digital In-/Output 0	(3)
F-2	GPIO[5]	SPI-MISO	I/O		SPI-MISO	(3)
C-4	GPIO[6]	DIO1	I/O		Digital In-/Output 1	(3)
C-3	GPIO[7]	DIO2	I/O		Digital In-/Output 2	(3)
E-2	GPIO[8]	SPI-SCK/IOA	I/O		SPI-SCK / IOA	(3)
A-3	not connected					
A-1	GPIO[10]	OTA-CMD-EN#	I-PU	L	OTA Command Interface Enable	(3,7)
A-4	not connected					
A-2	GPIO[9]	DIO3	I-DIS		Digital In-/Output 3	(3)
F-1	TESTMODE#	reserved	I-PU	L	connect to test pad	(6,7)
E-1	BOOT0	reserved	I-PD		connect to test pad	(6,7)
E-3	SWDIO	reserved	I/O-PU		leave open (Serial Wire Debug)	(4)
D-6	SWCLK	reserved	I-PD		leave open (Serial Wire Debug)	(4)
C-2	GPIO[13]	DIO6	I-DIS		Digital In-/Output 6	(3)
B-3	GPIO[11]	DIO4	I-DIS		Digital In-/Output 4	(3)
A-5	XL-OUT	XTAL	I-DIS		leave open if no ext. XTAL is connected	
F-5	GPIO[14]	DIO7	I-DIS		Digital In-/Output 7	(3)
E-5	GPIO[12]	DIO5	I-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 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 3.4.4 Dynamic I/O Signal Type Changes depending on the UICP status
(9) for compatibility to BlueMod+SR this pin is reserved for an external antenna and must be left open

Table 8: Application Specific Pin Assignments, ADC

4.3 Handling of Unused Signals

Depending on the application, not all signals of BlueMod+S 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/SLCK — If no external slow clock is provided: 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
- 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 +3,6	V
Voltage on any pin	V_{Pin}	-0,3 to VSUP+0,3	V
Injected current into any GPIO pin Max. per package	I_{INJ} $I_{INJ\_package}$	40 100	mA mA

Table 9: Absolute Maximum Ratings

5.2 Operating Conditions

T_{amb} = 25°C

Item	Condition	Limit			Unit
		Min	Typ	Max	
Supply voltage VSUP	normal mode (DC/DC not enabled)	1,8	3,0	3,6	V_{DC}
Supply voltage VSUP	DC/DC mode (DC/DC enabled)	2,1	3,0	3,6	V_{DC}

Table 10: DC Operating Conditions

Note: FW2.x disables the DC/DC converter automatically if VSUP < 2,3V ± 5%

5.3 Environmental Requirements

Item	Symbol	Absolute Maximum Ratings	Unit
Storage temperature range	T_{stg}	-40 to +85	°C
Operating temperature range	T_{op}	-25 to +75	°C

Table 11: Environmental Requirements

5.4 DC Parameter

All Module I/O pins are connected directly to the Nordic nRF51822 chip without signal conditioning except for some pull-up/pull-down resistors (as indicated). Therefore the electrical characteristics are as documented in the Nordic nRF51822 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 = 1,8 to 3,6V	VSS	-	VSUP*0,3	V
V_{IH}	High-Level Input Voltage	VSUP = 1,8 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	-	0,3 0,3	V
V_{OH}	High-Level Output Voltage	I_{OH} = -0,5mA (1) I_{OH} = -5,0mA (2), (3)	VSUP-0,3 VSUP-0,3	-	VSUP VSUP	V
I_{OL}	Low -Level Output Current	V_{OL} ≤ 0,3V	-	-	-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
I_{lc}	I/O pad leakage current		-3,5	0,01	+3,5	nA
C_I	Input Capacitance			2,5		pF

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

Table 12: DC Characteristics, Digital IO

5.4.2 EXT-RES#

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

T_{amb} = 25°C

Symbol	Item	Condition	Limit			Unit
			Min	Typ	Max	
V_{IL}	Low-Level Threshold	VSUP = 1,8 to 3,6V		0,34*VSUP		V
V_{IH}	High-Level Threshold	VSUP = 1,8 to 3,6V		0,62*VSUP		V
V_{HYST}	Hysteresis	VSUP = 3,0V		800		mV
R_{PU}	pull-up resistor		11	13	16	kΩ
C_I	Input Capacitance			2,5		pF

Table 13: DC Characteristics, EXT-RES#

5.4.3 External Slow Clock SLCK

The following table is applicable if an external slow clock signal is fed into XL-IN/SLCK. This may be a square wave, a clipped sine wave, a sine wave or a rail-to-rail digital signal. Frequency must be 32,768kHz +/-250ppm (refer to 3.9). DC offset is not an issue as long as the input voltage is between VSS and VSUP at all times. Firmware will detect presence of external slow clock signal at startup; signal has to stay active as long as the BlueMod+S is powered.

T_{amb} = 25°C

Symbol	Item	Condition	Limit			Unit
			Min	Typ	Max	
V_{SLCKL}	Low-Level Input Voltage	VSUP = 1,8 to 3,6V	0,0	-	VSUP-V_{SLCK}	V
V_{SLCKH}	High-Level Input Voltage	VSUP = 1,8 to 3,6V	VSUP-V_{SLCK}	-	VSUP	V
V_{SLCK} (1)	Amplitude (peak_peak)	VSUP = 1,8 to 3,6V	0,2	-	VSUP	V
C_I	Input Capacitance			4		pF

(1) input voltage required between VSS and VSUP at all times

Table 14: DC Characteristics, SLCK

5.4.4 Analog Digital Converter (ADC)

5.4.4.1 Input Voltage Range

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

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

Input voltage range and saturation point depend on the configured ADC reference voltage (see 5.4.4.2) and the chosen prescaling.

Input Voltage Range = ADC Reference Voltage / Prescaler

Limitation for maximum input voltage is described in 5.4.4.3

5.4.4.2 ADC Reference Voltage

ADC Reference voltage can be obtained from:

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

or

- External reference pin AREF: min. 0,83V typ. 1,2V max. 1,3V
  Source Impedance: <5kΩ

5.4.4.3 Analog ADC Input AIN

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

Table 15 shows the internal impedance for AIN during sampling for different prescaler settings.

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

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

Table 15: Input Impedance for AIN

Maximum allowed input voltage at AIN:
(Both of the following rules have to be fulfilled)

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

and

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

5.5 Power Consumption and Power-Down Modes

5.5.1 Terminal I/O Configuration

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

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

Condition Radio inactive	Note	Slow clock SLCK	Current Consumption BlueMod+S	Current Consumption BlueMod+S/DC-DC FW 1.x (DC/DC OFF)	Current Consumption BlueMod+S/DC-DC FW 2.x (DC/DC ON)	Unit
			I_{Avg}	I_{Avg}	I_{Avg}	
Advertising Off, UICP not active or serial interface up		internal ext. sig. Crystal	1,2 1,1 1,2	1,0 1,0 1,0	1,0 1,0 1,0	mA
Advertising Off, UICP active, serial interface down	(1)	internal ext. sig. Crystal	10 3,5 4	8 3 4	5 3 3	µA
Device in reset	(2)	any	0,625	0,600	0,600	mA
System off	(1,2)		N/A	N/A	0,6	µA

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

Table 16: Supply Current Sleep Modes, no Radio Activity

The following table shows the average power consumption of BlueMod+S 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 BlueMod+S**		**Current Consumption BlueMod+S/DC-DC FW 1.x (DC/DC OFF)**		**Current Consumption BlueMod+S/DC-DC FW 2.x (DC/DC ON)**		**Unit**
			Tx power (dBm) [8]		Tx power (dBm) [8]		Tx power (dBm) [8]		
			max (+4)	min (-30)	max (+4)	min (-30)	max (+4)	min (-30)	
			I_{Avg}	I_{Avg}	I_{Avg}	I_{Avg}	I_{Avg}	I_{Avg}	
Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP not active *or* serial interface up	(5)	internal [7] ext. sig. Crystal	1,2 1,1 1,2	1,2 1,1 1,2	1,0 1,0 1,0	1,0 1,0 1,0	1,0 1,0 1,0	1,0 1,0 1,0	mA
Standby, Advertising on 3 channels, advertising interval: 1,28s,UICP active *and* serial interface down	(1)	internal [7] ext. sig. Crystal	33 26 28	26 20 25	28 24 25	21 17 18	21 20 20	16 15 15	µA
Connected, connection interval: 1,28s,UICP not active *or* serial interface up, no data traffic	(5)	internal [7] ext. sig. Crystal	1,1 1,1 1,1	1,1 1,1 1,1	1,0 1,0 1,0	1,0 1,0 1,0	1,0 1,0 1,0	1,0 1,0 1,0	mA
Connected, connection interval: 1,28s,UICP active *and* serial interface down	(1)	internal [7] ext. sig. Crystal	25 20 23	25 19 22	23 18 18	19 14 15	19 17 17	15 13 13	µA
Connected, connection interval: 7,5 ms, no data traffic	(2,3,6)		2,2	1,95	1,9	1,7	1,8	1,6	mA
Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, central to peripheral	(2,6,9)		5,2	4,7	4,8	4,3	4,5	4,2	mA
Connected, connection interval: 7,5 ms, data traffic 115 kbit/s at the serial port, peripheral to central	(2,6,9)		3,4	3,2	5,4	4,2	4,6	3,9	mA
Connected, connection interval: 37,5ms, no data traffic	(2,4,6)		1,4	1,4	1,2	1,1	1,1	1,1	mA
Connected, connection interval: 37,5ms, data traffic 115 kbit/s at the serial port, peripheral to central	(2,4,6, 9)		2,0	1,9	2,9	2,5	2,7	2,3	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 nRF51822, 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 17: Supply Current BLE Terminal I/O Profile, Peripheral Device Role

5.6 RF Performance

5.6.1 BLE Receiver

VSUP = 1,8V 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		-88,5	-70	≤ -70	dBm
	2,440		-88,5	-70		
	2,480		-88,5	-70		
Reported PER during PER report integrity test	2,426	50	50	65,4	50 < PER < 65,4	%
Maximum received signal at 30,8% PER		-10	0		≥ -10	dBm
Continuous power required to block Bluetooth reception at -67dBm with 0,1% BER	0,030 - 2,000	-30			-30	dBm
	2,000 - 2,400	-35			-35	
	2,500 - 3,000	-35			-35	
	3,000 - 12,75	-30			-30	
C/I co-channel			10	21	≤21	dB
Adjacent channel Selectivity C/I	F = F_0 + 1 MHz		1	15	≤15	dB
	F = F_0 - 1 MHz		1	15	≤15	dB
	F = F_0 + 2 MHz		-25	-17	≤-17	dB
	F = F_0 - 2 MHz		-25	-15	≤-15	dB
	F = F_0 + 3 MHz		-51	-27	≤-27	dB
	F = F_0 - 5 MHz		-51	-27	≤-27	dB
	F = F_{image}		-30	-9	≤-9	dB
Maximum level of intermodulation interferers		-50	-36		≥-50	dBm

VSUP = 1,8V to 3,6V, T_{amb} = -25°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		-88,5	-70	≤ - 70	dBm
	2,440		-88,5	-70		
	2,480		-88,5	-70		

VSUP = 1,8V to 3,6V, T_{amb} = +75°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		-88,5	-70	≤ . 70	dBm
	2,440		-88,5	-70		
	2,480		-88,5	-70		

Table 18: RF Performance BLE Receiver

5.6.2 BLE Transmitter

VSUP = 1,8V 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		2,6		-20 to +10	dBm
	2,440		3,0			
	2,480		2,8			
Programmable Transmit Power Range (at+RFMAXTXPWR)	2,402 – 2,480	-30		+4	N/A	dBm
ACP	F = F_0 ± 2MHz		-42		≤ -30	dBm
	F = F_0 ± 3MHz		-50		≤ -30	
	F = F_0 ± > 3MHz		<-55		≤ -30	
Δf_{1avg} maximum modulation		225	246	275	225 < f_{1avg} < 275	kHz
Δf_{2max} minimum modulation (test threshold 185 kHz)		99,9	100		≥ 99,9	%
Δf_{2avg} / Δf_{1avg}		0,8	0,91		≥ 0,8	
Frequency Offset		-150	±20	+150	± 150	kHz
Carrier drift rate			9	20	≤ 20	kHz/ 50µs
Carrier drift			16	50	≤ 50	kHz

VSUP = 1,8V to 3,6V, T_{amb} = -25°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	-20	3,0	10	-20 to +10	dBm
	2,440	-20	3,5	10		
	2,480	-20	3,1	10		
ACP	F = F_0 ± 2MHz		-37		≤ -30	dBm
	F = F_0 ± 3MHz		-46		≤ -30	
	F = F_0 ± > 3MHz		<-51		≤ -30	
Frequency Offset		-150	±35	+150	± 150	kHz
Carrier drift rate			10	20	≤ 20	kHz/ 50µs
Carrier drift			25	50	≤ 50	kHz

VSUP = 1,8V to 3,6V, T_{amb} = +75°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	-20	1,5	10	-20 to +10	dBm
	2,440	-20	1,9	10		
	2,480	-20	1,7	10		
ACP	F = F_0 ± 2MHz		-42	-20	≤ -30	dBm
	F = F_0 ± 3MHz		-50	-40	≤ -30	
	F = F_0 ± > 3MHz		<-53	-30	≤ -30	
Frequency Offset		-150	±35	+150	± 150	kHz
Carrier drift rate			10	20	≤ 20	kHz/ 50µs
Carrier drift			20	50	≤ 50	kHz

Table 19: RF Performance BLE Transmitter

5.6.3 Antenna-Gain and Radiation Pattern

If BlueMod+S/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.

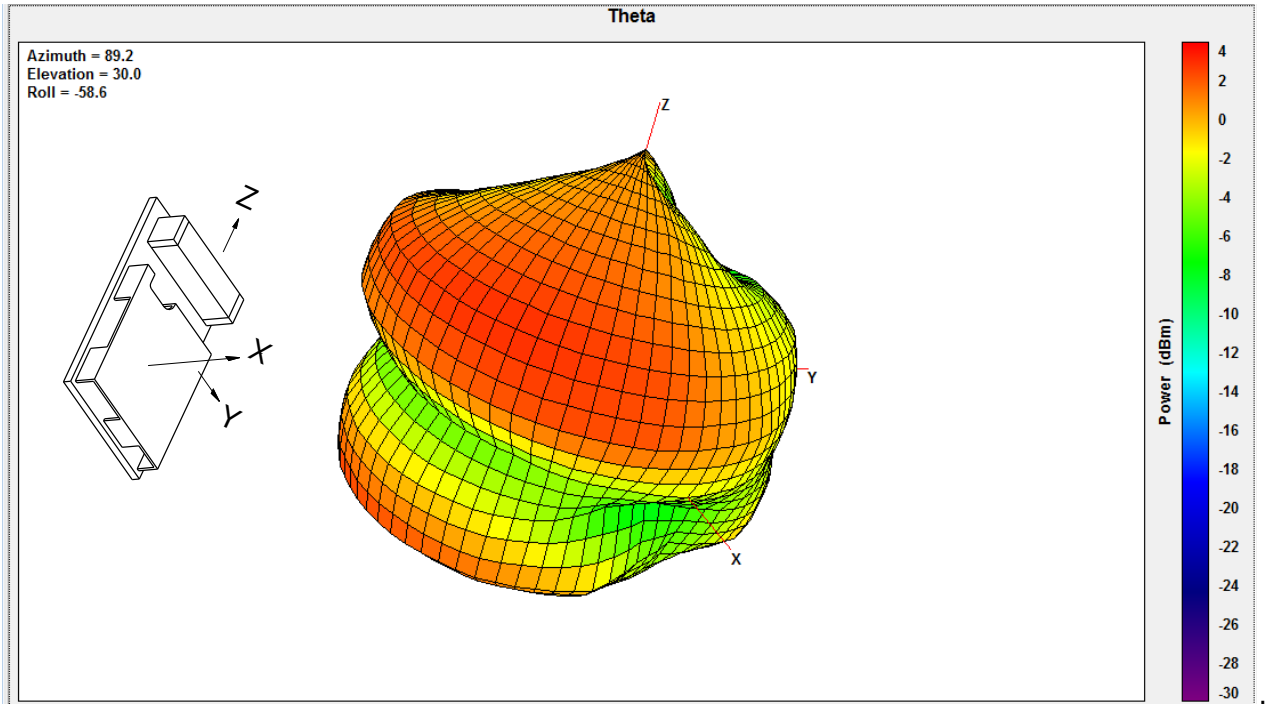


Figure 13: Typical Antenna Radiation Pattern at 2402MHz

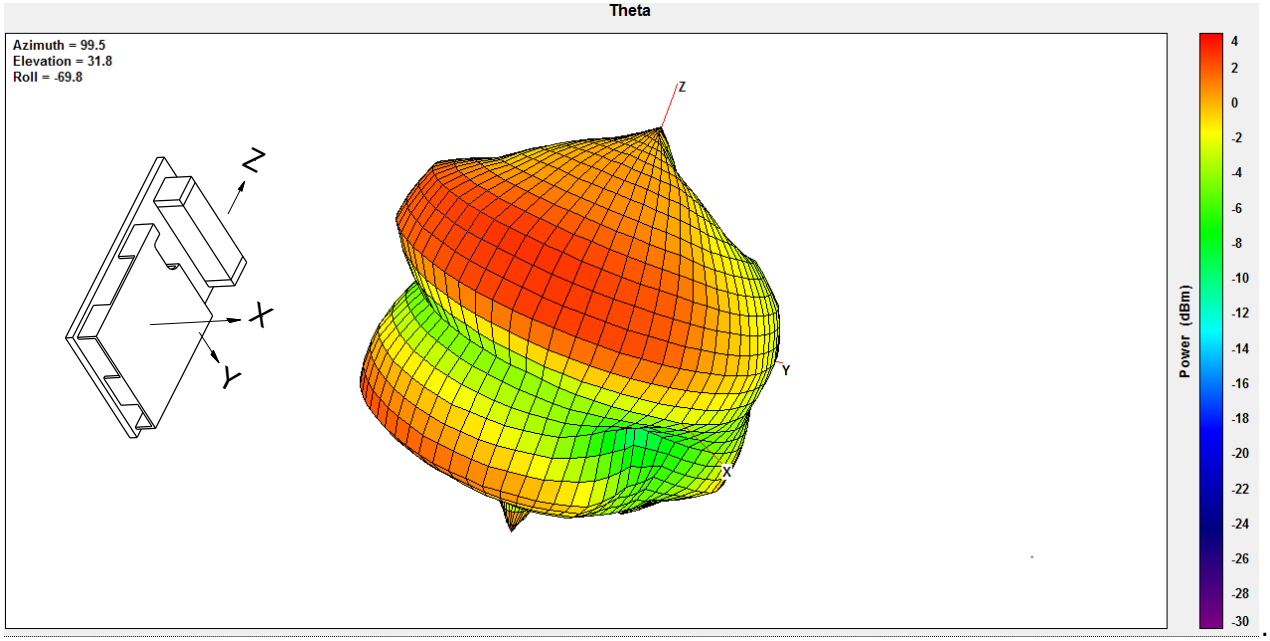


Figure 14: Typical Antenna Radiation Pattern at 2441MHz

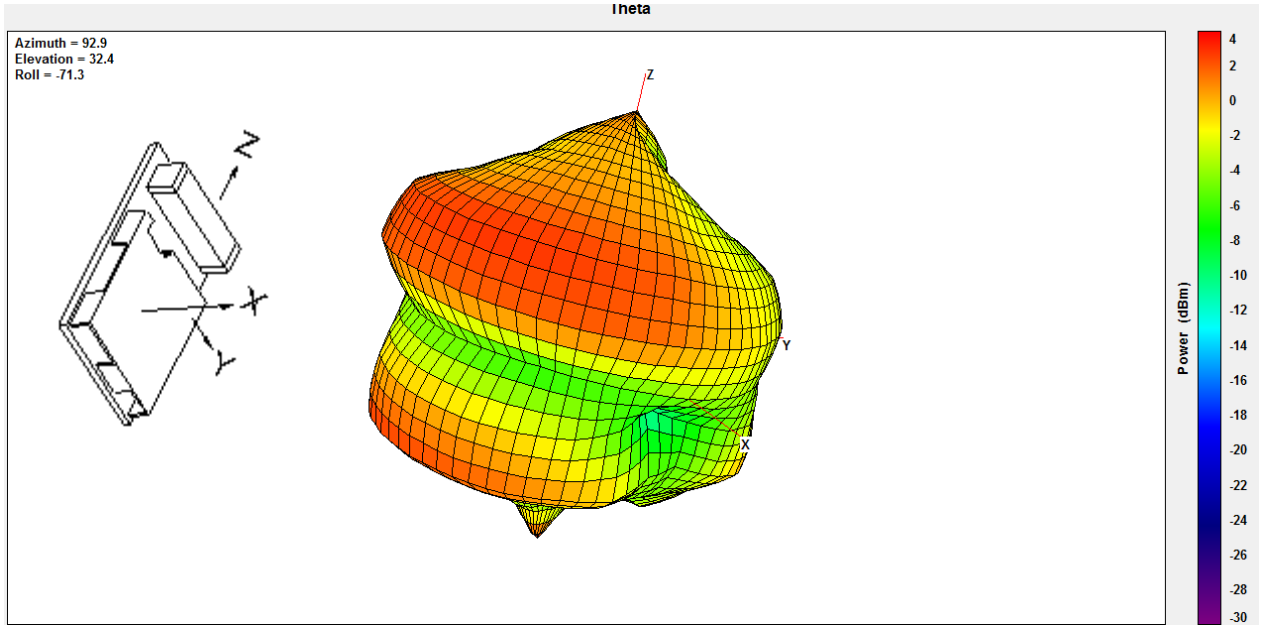


Figure 15: Typical Antenna Radiation Pattern at 2480MHz

5.7 Power-Up Time

The time until the BlueMod+S is able to accept link requests or serial data depends on the firmware version and on the source for the slow clock. Using TIO firmware version V1.009, the device is ready (as indicated by GPIO IOA, measured from the release of EXT_RES# or VSUP rising above 1,8V) as follows:

- $t_{DeviceReady}$ 0,7s (typ.) if an external slow clock signal is provided.
- $t_{DeviceReady}$ 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.

Note: For further information refer to the document BlueMod+S_Startup_Timing

6 Mechanical Characteristics

6.1 Dimensions

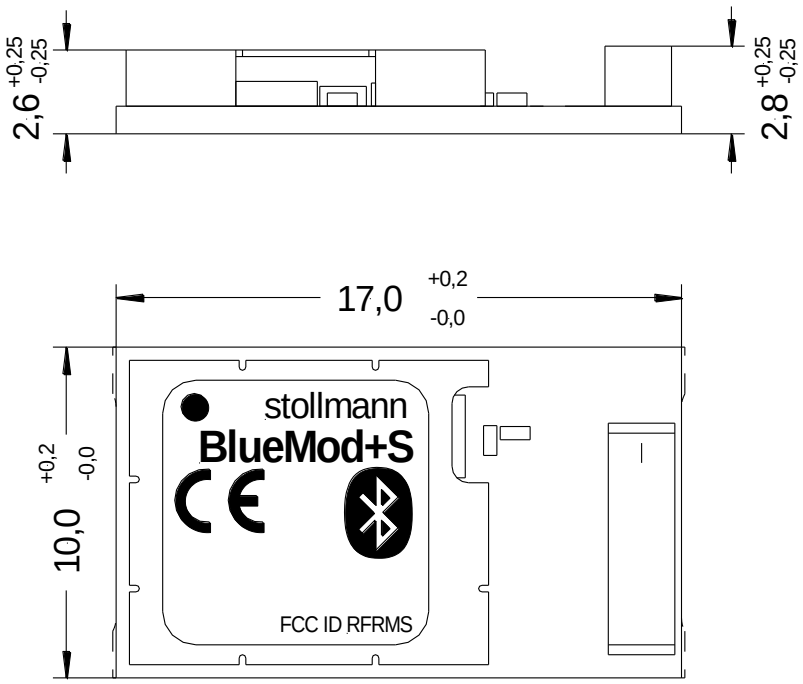


Figure 16: BlueMod+S/AI Dimensions

6.2 Recommended Land Pattern

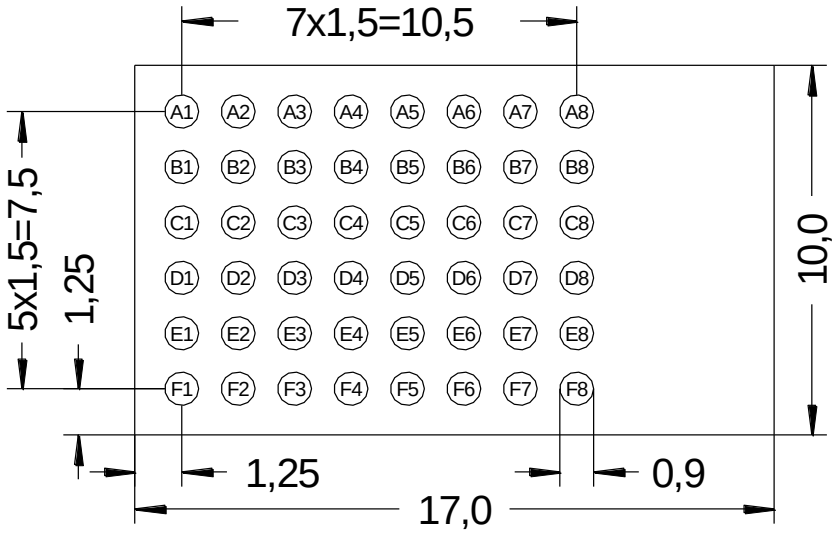


Figure 17: BlueMod+S Land Pattern **TOP VIEW**

Note: *All dimensions are in mm*.

6.3 Re-flow Temperature-Time Profile

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

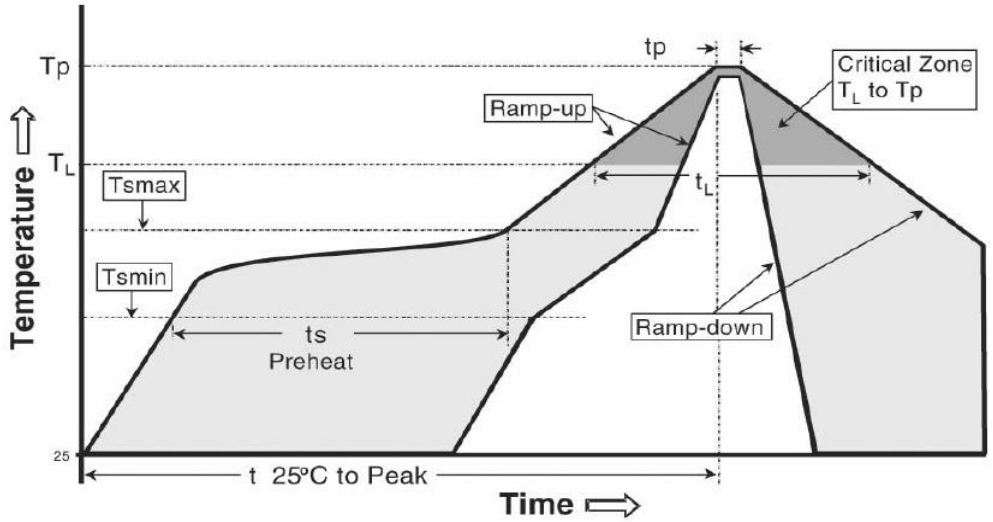


Figure 18: Soldering Temperature-Time Profile (For Reflow Soldering)

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

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

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

6.4 Placement Recommendation

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

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

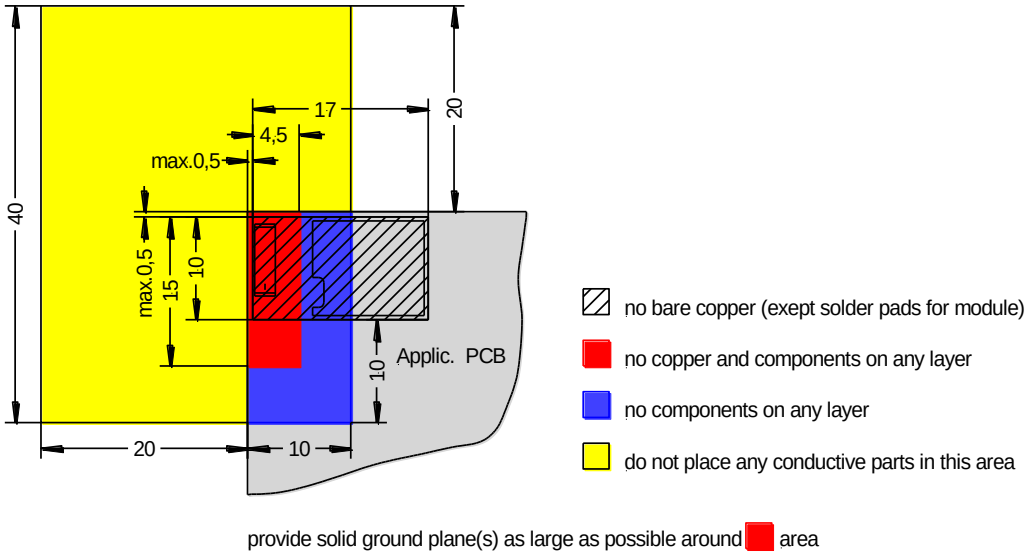


Figure 19: BlueMod+S/AI Placement Recommendation

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+S/AI comprises a ceramic antenna which as a component is soldered to the circuit board. This solution is functional for a BlueMod+S/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+S is 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+S are to be classified as SELV circuitry. OEM's implementing the BlueMod+S in their products should follow the isolation rules given in regulation EN 60950-1: 2006.

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

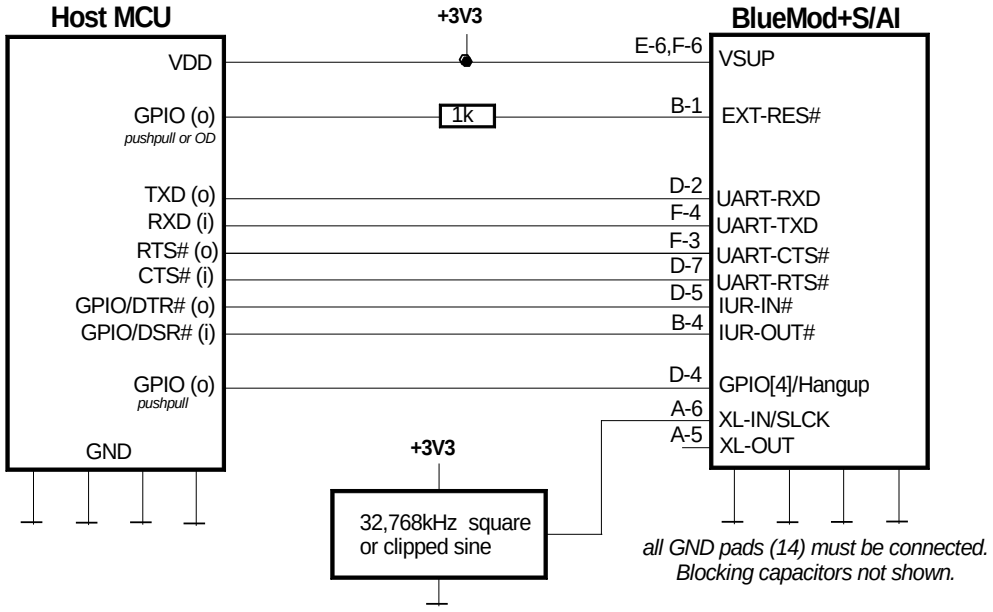
6.8 Cleaning

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

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

7 Application Diagram

The following schematic shows a typical application of BlueMod+S. The module is connected to some MCU running the application layer. MCU and BlueMod+S 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, there is an external slow clock oscillator. All other module pins may be left unconnected.



The oscillator is optional. Leave A-6 open if the oscillator is not present.
You can also connect an 32,768kHz XTAL and two capacitors at A-6 and A-5.

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 20: Typical Application Schematics

8 Approvals/Certifications

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

8.1 Declaration of Conformity CE

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

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

The actual version of EU Declaration of Conformity (EU DoC) can be downloaded from the qualification section on the product page via the following link:

http://www.stollmann.de/en/support/downloads/bluetooth-adapters/bluemod-s.html

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

8.2 FCC Compliance

The BlueMod+S/AI has been tested to fulfill the FCC requirements. Test reports are available on request. Grants 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

MET Laboratories, Inc.
914 W. Patapsco Avenue
Baltimore, MD 21230-3432

Date of Grant: 03/14/2014
Application Dated: 03/14/2014

Stollmann E+V 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: RFRMS
Name of Grantee: Stollmann E+V 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	0.0025		

Output power listed is conducted. Modular approval. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. OEMs and installers must be provided with antenna installation and transmitter operating conditions for satisfying RF exposure compliance.

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 Stollmann Entwicklungs- und Vertriebs- GmbH 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+S/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+S/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+S/AI must be labeled with at least the following information:

This device contains transmitter with
FCC ID: RFRMS
IC: 4957A-MS

8.3 IC Compliance

The BlueMod+S/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

GRANT OF EQUIPMENT CERTIFICATION

THE FOLLOWING EQUIPMENT HAS BEEN TESTED
AND CERTIFIED UNDER
INDUSTRY CANADA
RSS-210, ISSUE 8 DEC. 2010
RSS-GEN, ISSUE 3, DECEMBER 2010

CB Issued By: CB

MET Laboratories, Inc.
914 W. Patapsco Avenue
Baltimore, Maryland 21230
Laboratory Number: 2043A

Equipment Certification is hereby issued to the Identified Certificate Holder and is VALID ONLY for the equipment identified herein.
La certification du matériel est distribuée à la Société identifiée et est VALIDE SEULEMENT pour l'équipement identifié ci-dessous.
NOT TRANSFERABLE / PAS TRANSMISSIBLE

FILE/CERTIFICATE NUMBER: 412-3-2014-41461

CERTIFICATION NUMBER: IC: 4957A-MS

Issued to/Délivré a: Stollmann E+V GmbH
Address: Mendelssohnstrasse 15
Hamburg, Germany

Date Issued: 3/14/2014

Nature of Application/Nature d'Application:	Original
Equipment Description/Genre de Matériel:	Bluetooth LE module
Type of Radio Equipment:	Low Power Device (2400 – 2483.5 MHz); Modular Approval; Spread Spectrum/Digital Device (2400-2483.5 MHz)
Equipment Category/Catégorie de Matériel:	Category I
Model Number(s)/Modele	BlueMod+S

Conducted RF Power or Field Strength/Puissance H.F.:	0.0025 W
Frequency Range/Bande de Fréquences:	2402 – 2480 MHz
Bandwidth(s)/ largeurs de bande:	1082.3 kHz
Emission Designations/Genre D'Émission:	F1D
Antenna Information/ l'information d'antenne:	Integral chip antenna

Test Lab: Shenzhen MORLAB Commmication Technologies Co. Ltd., Fl. 3, Bldg A, FeiYang Science Park, Block 67, BoaAn District, Shenzhen, 518101 P.R. China
Tel: +86 755 36698555; Fax: +86 755 36698614
Test Lab IC Site Number: IC: 7183A-2

Notes: Output power listed is conducted. Modular approval. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. OEMs and installers must be provided with antenna installation and transmitter operating conditions for satisfying RF exposure compliance.

Certification of equipment means only that the equipment has met the requirements of the above-noted specification. Licence 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 materiel signifie seulement que le materiel 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 procedures d'Industrie Canada. Le materiel à l'egard duquel le présent certificat est délivré ne doit pas être fabriqué, importé, distribué, loué, mis en vente ou vendu a moins d'être conforme aux procedures 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 materiel a fait l'objet d'essai et jugé conforme a la spécification ci-dessus.

Authorized MET Representative Signature:
Printed: 3/13/2014 Shawn McMillen

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 Stollmann Entwicklungs- und Vertriebs-GmbH may void the IC authorization to operate this equipment.

8.3.4 IC RF-exposure Statement

This equipment is portable device. The output power of this device is less than 20mW.
The SAR test is not required.

8.3.5 IC Labeling Requirements for the End Product

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

This device contains transmitter with	
FCC ID:	RFRMS
IC-ID:	4957A-MS

8.3.6 IC Label Information BlueMod+S

The BlueMod+S shows no IC-ID on the product label, because there is no space available. IC allows on request to state the IC-ID in the product manual. This product has been granted to do so.

Model:	BlueMod+S
The IC-ID is:	**4957A-MS**

8.4 KCC Certification

The BlueMod+S/AI has been certified in Korea under the Clause 2, Article 58-2 of Radio Waves Act. Certificate is shown below with MSIP-CRM-Rfr-BlueModS

8.4.1 KCC Certificate

76BE-6B07-3BE8-24D5

방송통신기자재등의 적합인증서

Certificate of Broadcasting and Communication Equipments

상호 또는 성명 *Trade Name or Applicant*	Stollmann E+V GmbH
기자재 명칭 *Equipment Name*	특정소출력 무선기기(무선데이터통신시스템용 무선기기)
기본모델명 *Basic Model Number*	BlueMod+S
파생모델명 *Series Model Number*	
인증번호 *Certification No.*	MSIP-CRM-Rfr-BlueModS
제조자/제조국가 *Manufacturer/ Country of Origin*	Stollmann E+V GmbH / 독일
형식기호 *Type Identification*	LARN8-IO2S2402/2480TR0.0001F1D40
인증연월일 *Date of Certification*	2014-05-29
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.

2014년(Year) 05월(Month) 29일(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.

8.5 Bluetooth Qualification

The BlueMod+S **Error! Unknown document property name.**is a qualified design according to the Bluetooth Qualification Program Reference Document (PRD) V2.3.

The Declaration ID is:

D023133

The Qualified Design ID is:

57830

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 Stollmann.

QDL Bluetooth® Qualified Design Listing

The Bluetooth SIG Hereby Recognizes

Stollmann E+V GmbH
Member Company

BlueMod+S
Qualified Design Name

Declaration ID: D023133
Qualified Design ID: 57830
Specification Name: 4.1
Product Type: End Product
Model Number: BlueMod+S
Listing Date: 05 June 2014
Assessment Date: 05 June 2014
Hardware Version Number: V1
Software Version Number: V1

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

Bluetooth® SPECIAL INTEREST GROUP

8.6 RoHS Declaration

The actual version of RoHS Supplier Declaration according to the EU Directive 2011/65/EC can be downloaded from the qualification section on product web site via the following link:

http://www.stollmann.de/en/support/downloads/bluetooth-adapters/bluemod-s.html

9 Related Documents

[1] nordic: nRF51_Series_Reference_Manual_v3.0.pdf (nRF51822_Reference)

[2] nordic: nRF51822_PS v3.1.pdf (nRF51822_Datasheet)

[3] Stollmann: UICP_UART_Interface_Control_Protocol.pdf

[4] Stollmann: AppNote_B0601_Antenna_Design_V.pdf

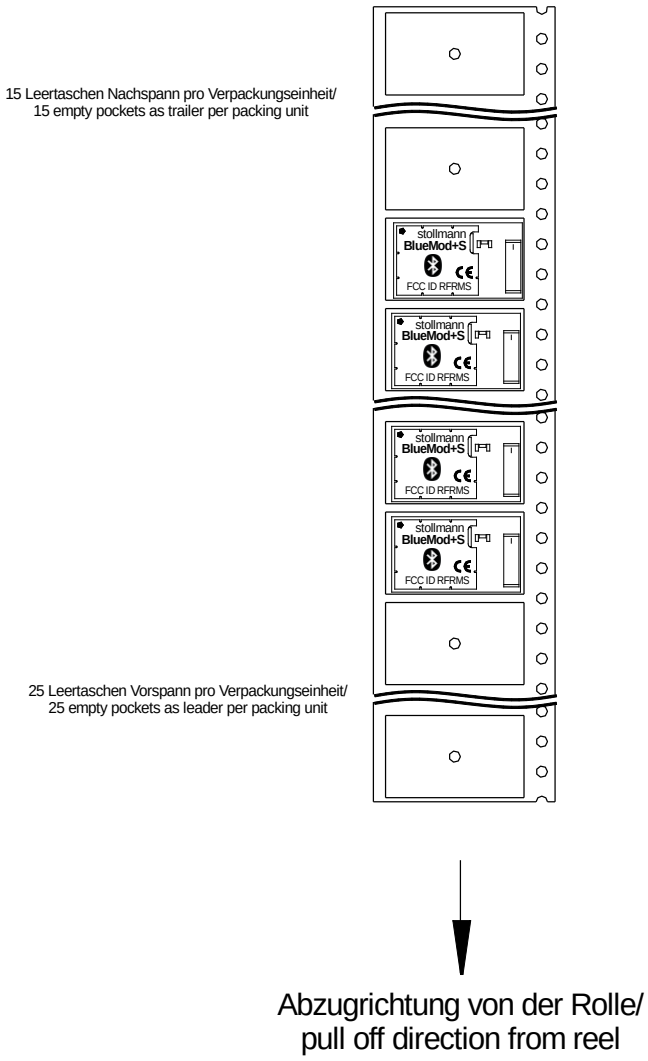
[5] Stollmann: BlueMod+S_AT_Command_Reference.pdf

[6] Stollmann: BlueMod+S_Testmode_Reference.pdf

[7] Bluetooth SIG: Core_v4.1.pdf

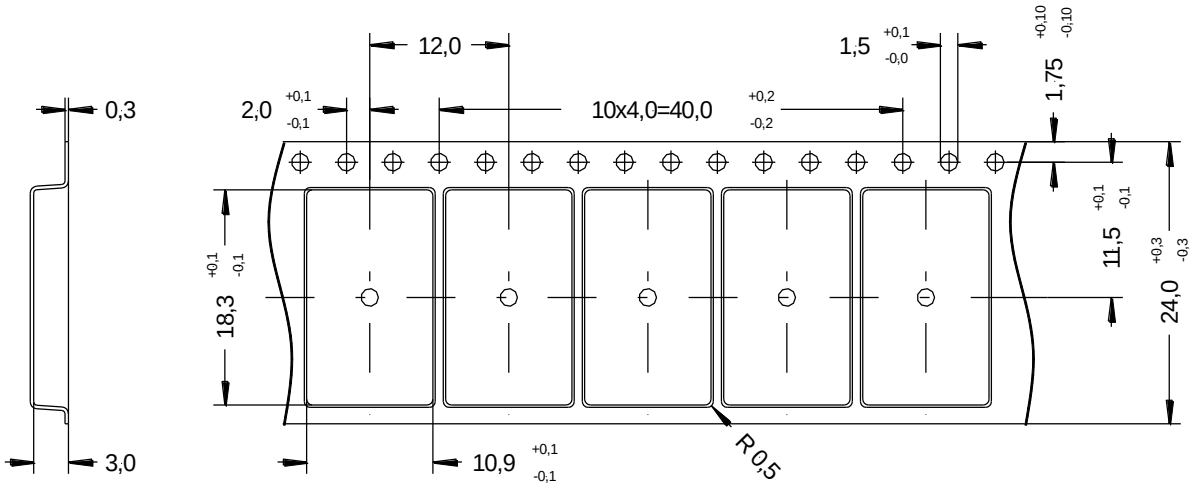
10 Packing

The BlueMod+S modules are packed using carrier tape.



10.1 Tape

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

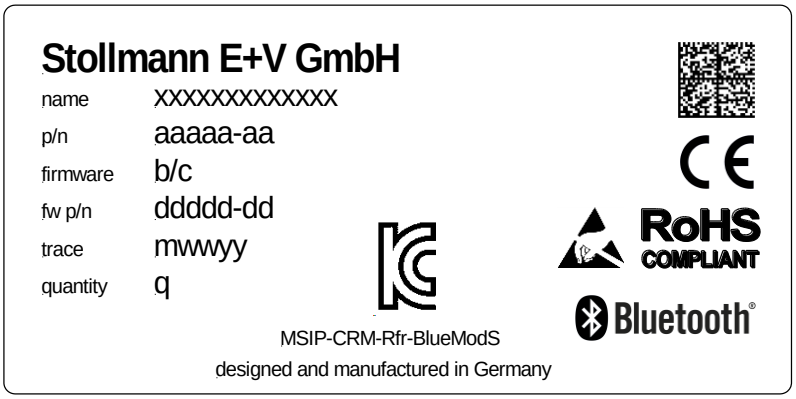


10.2 Reel

tbd

10.3 Package Label

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



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

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

10.4 Moisture Sensitivity Level

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

11 Ordering Information

11.1 Part Numbers

BlueMod+S is available in the following variants:

Name	Antenna	Firmware Version	DC-DC	Order No.	MOQ / units	Comments
BlueMod+S/AI/TIO	internal	1.xxx	no	53275-xx	50	
BlueMod+S/AI/TIO	internal	2.xxx	no	53312-xx	50	
BlueMod+S/AI/TIO	internal	1.xxx	no[3]	53315-xx	50	
BlueMod+S/AI/TIO	internal	2.xxx	yes	53316-xx	50	
BlueMod+S/AI/ADC	internal	2.xxx	yes	53330-xx	50	
BlueMod+S/Central	Internal	2.xxx	yes	53332-xx	50	
BlueEva+S	Internal	2.xxx	no	53314-00	1	Evaluation Kit
BlueEva+S	Internal	2.xxx	yes	53314-xx[4]	1	Evaluation Kit
BlueEva+S/ADC	Internal	2.xxx	yes	53327-xx	1	Evaluation Kit
BlueEva+S/Central	Internal	2.xxx	yes	53342-xx	1	Evaluation Kit

Other variants on request, please contact Stollmann sales department.

11.2 Standard Packing Unit

The standard packing units are 400 or 1000 pieces on Tape and Reel

11.3 Evaluation Kit

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

[3] firmware V1.xxx does not support the DC-DC functionality

[4] with xx = 01 or higher

12 History

Version	Release Date	By	Change description
r01	03.03.2014	MW/JW	First preliminary release
r02d01		JJ MW	Chapter 5.6.3 Antenna-Gain and Radiation Pattern, added pattern Chapter 5.7 Power-Up Time revised
r02		MW JJ	Chapter 3.4 Serial Interface, added 5-wire minimum UICP scheme Chapter 3.4.1 4-Wire Serial Interface, chapter revised and renamed Chapter 3.4.2 UART Example Circuits, added title Chapter 4.3 Handling of Unused Signals updated Table 6: General Pin Assignment updated and reformatted Table 7: Application Specific Pin Assignments, TIO updated and reformatted Table 17: Supply Current BLE Terminal I/O Profile, Peripheral Device Role: Standby current (UICP,down, external slow clock signal) corrected. Added measurements for connected state Figure 20: Typical Application Schematics, DSR#, DTR# at host side corrected Chapter 8.2.1 FCC Grant added Chapter 8.3.1 IC Grant added Chapter 8.4 KCC Certification added Chapter 8.5 Bluetooth Qualification updated 10.3 Package Label updated to version with KCC ID and logo
r03		JW JJ GJ	Chapter 1 Introduction versions and variants overview added 3.2 Power-up Slew-Rate Parameter changed according to Nordic PCN92 5.6.2 BLE Transmitter Transmit Power Specification detailed 5.2 Operating Conditions Supply range with DCDC ON added Chapter 6.8 Cleaning added Chapter 3.13 DC/DC Converter added Cover Sheet photo updated to new label Chapter 5.5 Power Consumption and Power-Down Modes reworked 3.4.1 4-Wire Serial Interface Attention “UICP has to be deactivated” added 4.2 Pin Description UICP influence on Signal type note added 6.1 New drawing with label 11.1 Part Numbers updated
r04	22.01.2016	GJ	1.1 Feature Summary updated (BT4.1, KCC) 3.1 Added rules for selection of coin cell capacitor Fig. 2 Recommended output capacitor of LDO changed to 1uF 3.10 Chapter renamed, Testmode#/Boot0 logic added 4.2.2.2 ADC Pin Configuration added 5.4.4 Analog Digital Converter (ADC) added 11.1 Part Numbers, BlueMod+S/AI/ADC added
r05	23.05.2016	BG	Telit cover page added
r06	09.09.2016 02.12.2016 15.12.2016	GJ GJ TA	10.4 MSL added Figure 16 module height changed to worst case values Adjusted download link in introduction

Telit Wireless Solutions GmbH
Mendelssohnstraße 15D
22761 Hamburg
Germany

Phone: +49 (0)40 890 88-0
Fax: +49 (0)40 890 88-444
E-mail: ts-srd@telit.com
www.telit.com

SUPPORT INQUIRIES

Link to **www.telit.com** and contact our technical support team for any questions related to technical issues.

www.telit.com

Telit Communications S.p.A.
Via Stazione di Prosecco, 5/B
I-34010 Sgonico (Trieste), Italy

Telit IoT Platforms LLC
5300 Broken Sound Blvd, Suite 150
Boca Raton, FL 33487, USA

Telit Wireless Solutions Inc.
3131 RDU Center Drive, Suite 135
Morrisville, NC 27560, USA

Telit Wireless Solutions Co., Ltd.
8th Fl., Shinyoung Securities Bld.
6, Gukjegeumyung-ro8-gil, Yeongdeungpo-gu
Seoul, 150-884, Korea

Telit Wireless Solutions Ltd.
10 Habarzel St.
Tel Aviv 69710, Israel

Telit Wireless Solutions
Technologia e Servicos Ltda
Avenida Paulista, 1776, Room 10.C
01310-921 São Paulo, Brazil

[04.2016]