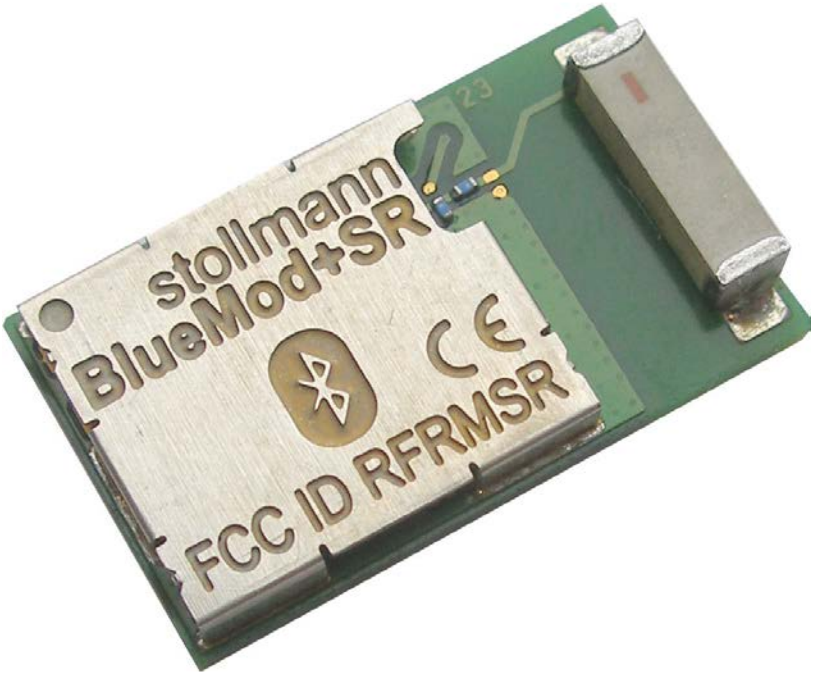
BlueMod+SR/AI
BlueMod+SR/AP

Hardware Reference

Release r04d01



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. Stollmann 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. All agreements are subject to our Terms and Conditions for Deliveries and Payments, a copy of which is available from Stollmann.

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1 Introduction

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

Notation: The term *BlueMod+SR* refers to both the BlueMod+SR/AI and the BlueMod+SR/AP.

For detailed information about software interfaces refer to [5]

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

http://www.stollmann.de/en/support/downloads/bluetooth-adapter/bluemod-sr.html

1.1 Feature Summary

- Bluetooth specification V4.0 compliant
- Supports BR/EDR/LE
- Supports Dual Mode
- Fully qualified Bluetooth V4.0 Dual Mode BR/EDR/LE
- CE certified
- FCC and IC certified
- CSR8811 BlueCore08 and Application Processor inside
- Complete Co-location and Co-existence with 802.11 (AFH, Unity 3e+)
- Fast Connection Setup
- RF output power up to +7dBm with power control
- Supply Voltage range 2,5V to 3,6V, typical 3.3V
- Internal crystal oscillator (26 MHz and 14,7456 MHz)
- LGA Surface mount type: BlueMod+SR: 17 x 10 x 2.6 mm^3
- Shielded to be compliant to FCC full modular approval
- Bluetooth enhanced data rate up to 2178kbps asymmetric
- Support for all Bluetooth power saving modes (Park, Sniff, Hold)
- Optional support for ultra-low-power mode
- Full 8- to 128-bit encryption
- High sensitivity design
- High-speed UART interface
- I^2C interface
- SPI interface
- Up to 11 digital IO's for individual usage by embedded software
- Cortex-M3 STM32F103 core for embedded profiles or application software
- Manufactured in conformance with RoHS2
- Operating temperature -30 ... +85 °C

1.2 Applications

The BlueMod+SR can be used in different applications. Regardless if the application requires high throughput or low energy consumption, BlueMod+SR offers the best of both worlds. Some typical applications are described in this chapter.

Supported profiles are:

BR/EDR:

- SPP

LE:

- Terminal IO
- any GATT based LE-profile

Support for any additional profile is possible on request.

1.2.1 General Cable Replacement

The Serial Port Profile (SPP) on the BlueMod+SR can be used for UART data transfer. The connection is transparent for the user application and supports Secure Simple Pairing, making the pairing process easy and the connection secure.

1.2.2 Industry

Typical Bluetooth application include scanner, printer as well as automation controls. In the automation application area Bluetooth is mainly used for transport of I/O signals. Bluetooth low energy can be used to monitor and control motors, actuators, values and entire processes.

1.2.3 Automotive

Modules are mainly used in aftermarket application like personal navigation devices, head units or audio applications. These applications are typically Bluetooth BR/EDR only.

1.2.4 Healthcare and Medical

The healthcare and medical market offers a lot of possible application for Bluetooth BR/EDR and Bluetooth Low Energy. 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 Bluetooth 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. Bluetooth low energy is expected to further increase the use of Bluetooth technology in devices like TV / DVD / STB / Media Player, remote controls, gaming controller, wireless mouse/keyboard.

2 Block Diagram

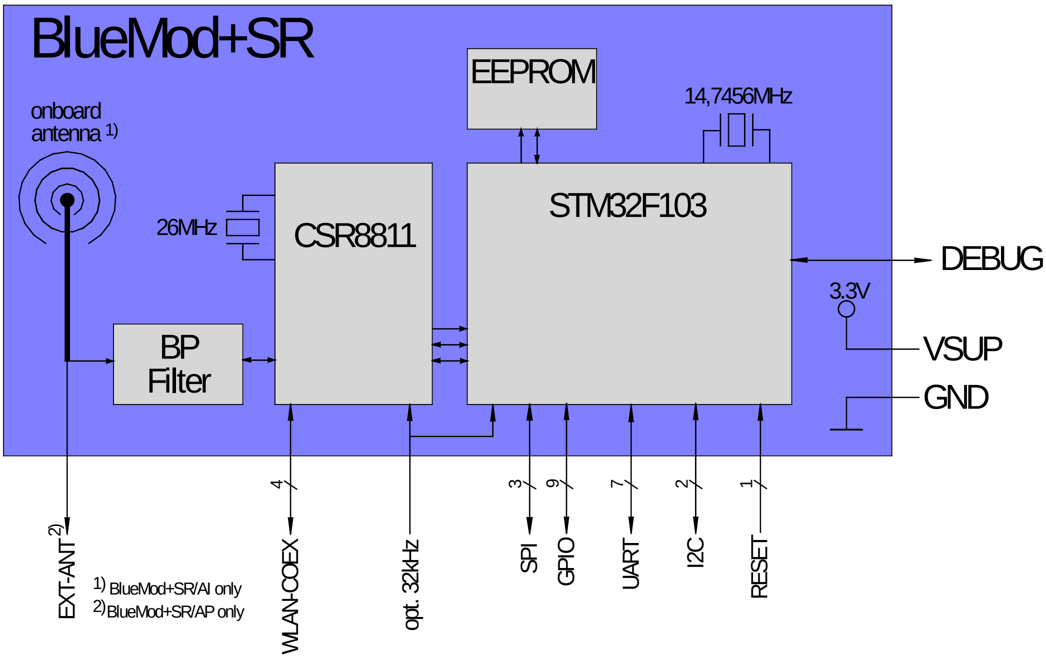


Figure 1: BlueMod+SR Block Diagram

Note:

BlueMod+SR/AI has an internal ceramic antenna whereas BlueMod+SR/AP provides for an 50Ω RF interface

3 Application Interface

3.1 Power Supply

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

Typical: 3,3V_{DC}, min.: 2,5V_{DC}, max.: 3.6V_{DC}, low noise (≤ 10mV_{rms}), > 80mA peak

For optimal performance a stable supply is recommended. If a regulator is to be used, it should be a fast linear regulator placed as close as possible to the VSUP pins (E-6, F-6). Functionality has been verified with the following types: TOREX: XC6204x332xx or XC6401xx42xx.

If the regulator cannot be placed close to the BlueMod+SR, it is recommended to place an additional low ESR capacitor with at least 10µF as close as possible to the VSUP pins (E-6, F-6 or C-1).

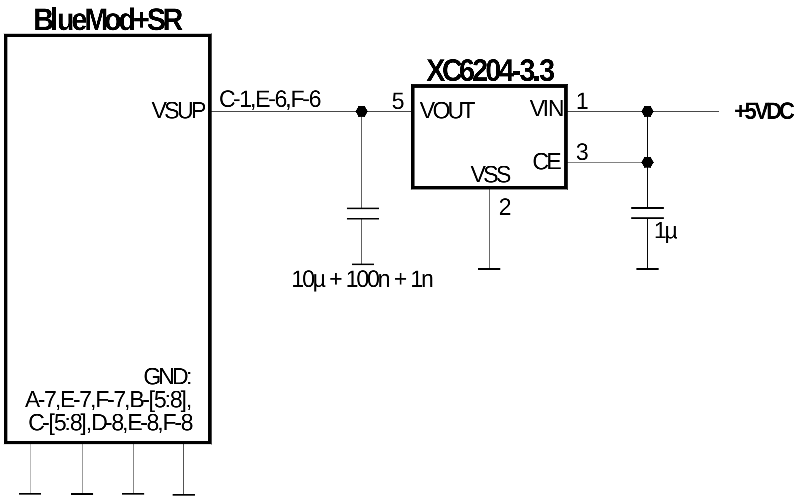


Figure 2: BlueMod+SR Example Power Supply

3.2 Power-up / -down Slew-Rate

Parameter	Min	Max	Unit
VSUP rise time rate	0	∞	µs/V
VSUP fall time rate	20	∞	

Table 1: Power up/down Slew Rate Requirements

3.3 Reset

BlueMod+SR are equipped with circuitry for generating Power ON Reset from the internal core voltage. A reset is generated when the core voltage falls below typically 1,88V and is released when it rises above typically 1,92V.

By holding pin B-1 (EXT-RES#) at ≤ 0,5V for ≥ 5ms, an external reset is generated. This pin has a fixed internal pull-up resistor (R_{PU} = 30kΩ ... 50kΩ) and a capacitor to GND (100n) which acts as debounce filter. If EXT-RES# is not used, it may be left open.

Note:

EXT-RES# pin can also be output. Use an open drain device or push button to drive it low. EXT-RES# must not be connected to VSUP or driven to logic high-level directly. Provide for an 1kΩ series resistor when driving EXT-RES# from a CMOS output.

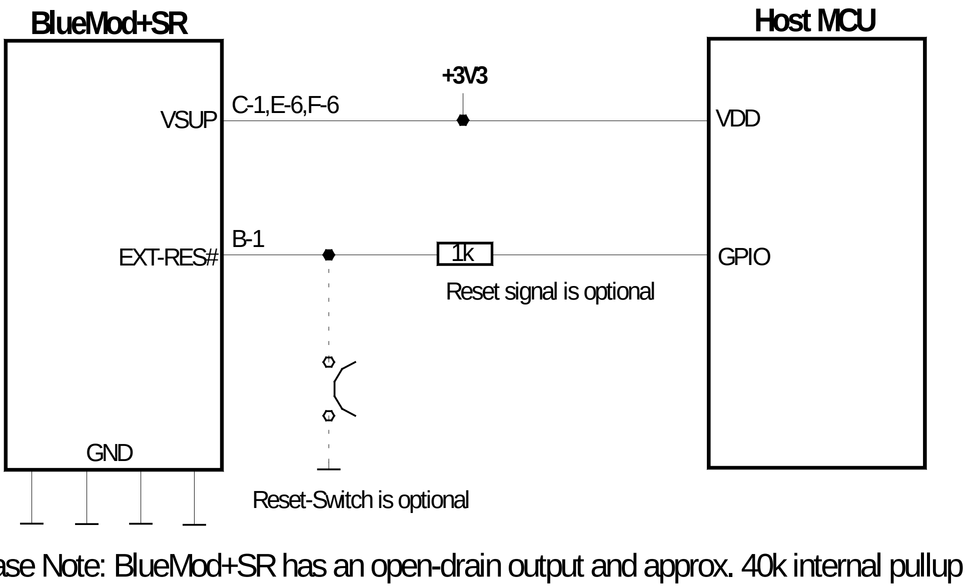


Figure 3: BlueMod+SR Example Reset

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

Pin Name	State: BlueMod+SR
EXT-RES#	I/O with pull-up [(1)] and 100n to GND – use open drain
SLCK	Input with weak pull-down [(2)]
UART-TXD	Input floating
UART-RXD	Input floating
UART-RTS#	Input with pull-up resistor 470kΩ [(4)]
UART-CTS#	Input floating
IUR-OUT#	Input with pull-up resistor 470kΩ [(4)]
IUR-IN#	Input floating
GPIO[0:4, 6:7]	Input floating
GPIO[5]	Input with pull-up [(1)]
GPIO[8]	Output (JTDO)
BT-ACT	Input with weak pull-up [(2)]
BT-STAT	Input with weak pull-up [(2)]
WLAN-DNY	Input with weak pull-up [(2)]
BT-PER	Input with weak pull-up [(2)]
TESTMODE#	Input floating
BOOT0	Input with pull-down resistor 100kΩ [(4)]
SWDIO	Input with pull-up [(1)]
SWCLK	Input with pull-down [(1)]

[(1)] pull-up, pull-down: R_{PU}, R_{PD} is typ. 40kΩ (30kΩ to 50kΩ)

[(2)] weak pull-up, pull-down: See Table 12: DC characteristics, digital IO (CSR8811 related)

[(3)] strong pull-up, pull-down: See Table 12: DC characteristics, digital IO (CSR8811 related)

[(4)] 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 Supply Voltage Monitor

Supply-under-voltage detection is implemented using the STM32 embedded supply voltage monitor PVD. When VSUP falls below a threshold V_{PVD} (programmed to 2,38V ± 0,1V), a system reset will be asserted.

3.5 Serial Interface

The serial interface of BlueMod+SR 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).

- Transmission speeds are 9600 – 921600 bps (asynchronous)
- Character representation: 8 Bit, no parity, 1 stop bit
- 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.

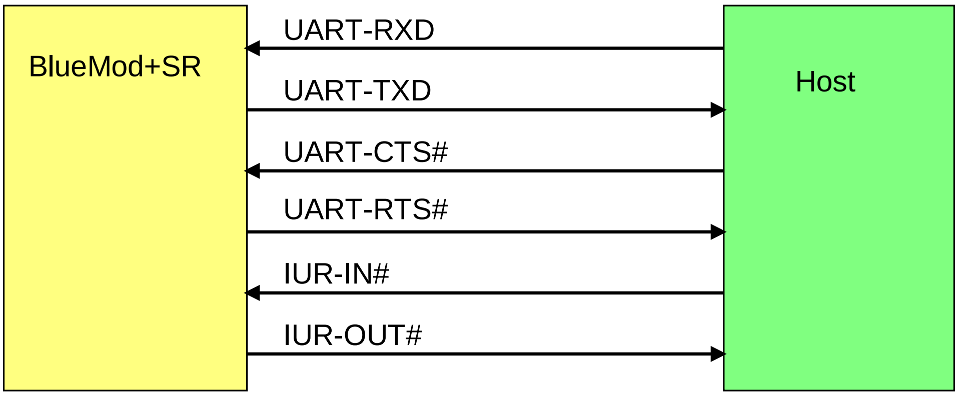


Figure 4: Serial Interface Signals

The basic serial interface (with RTS/CTS flow control) uses only four signal lines (UART-RXD, UART-TXD, UART-CTS#, UART-RTS#). 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 5.6.1) when the UICP protocol is used (refer to [3]). This protocol has to be complemented on the host side as well. Signals IUR-IN# and IUR-OUT# should be connected to the host and may be mapped to DSR and DTR, if an RS232-style (DTE-type) interface is used (see Figure 5).

When using the SPP 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.

3.5.1 3-Wire Serial Interface

When using only GND and UART-RXD, UART-TXD serial lines, leave UART-RTS# and UART-CTS# open

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

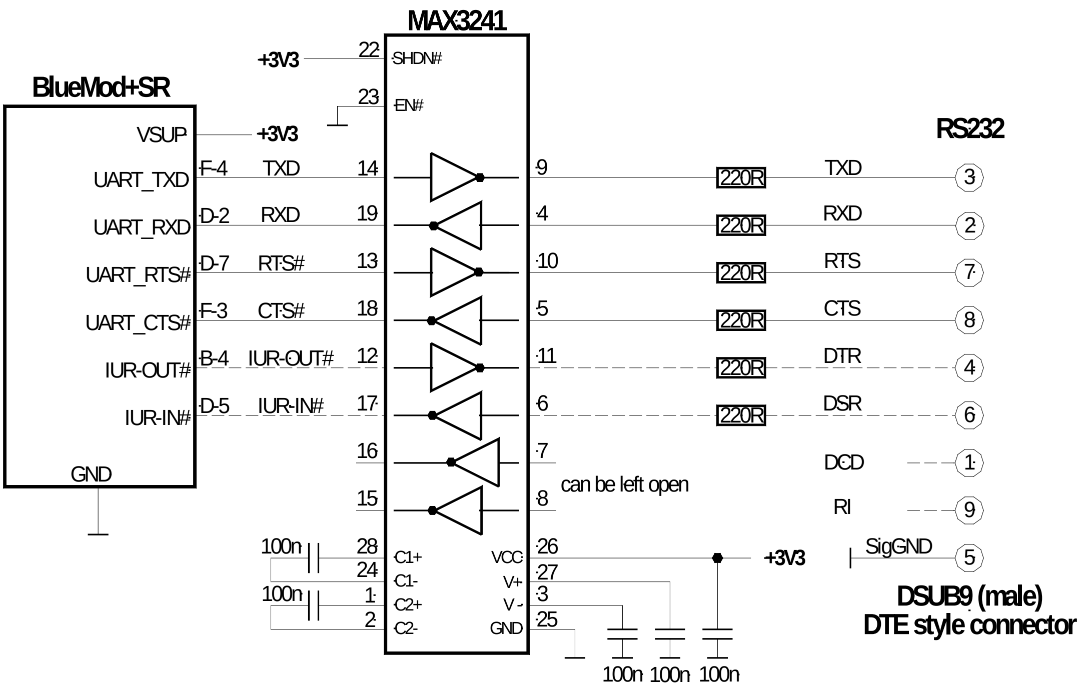


Figure 5: BlueMod+SR Example Serial Interface (RS-232) Supporting UICP

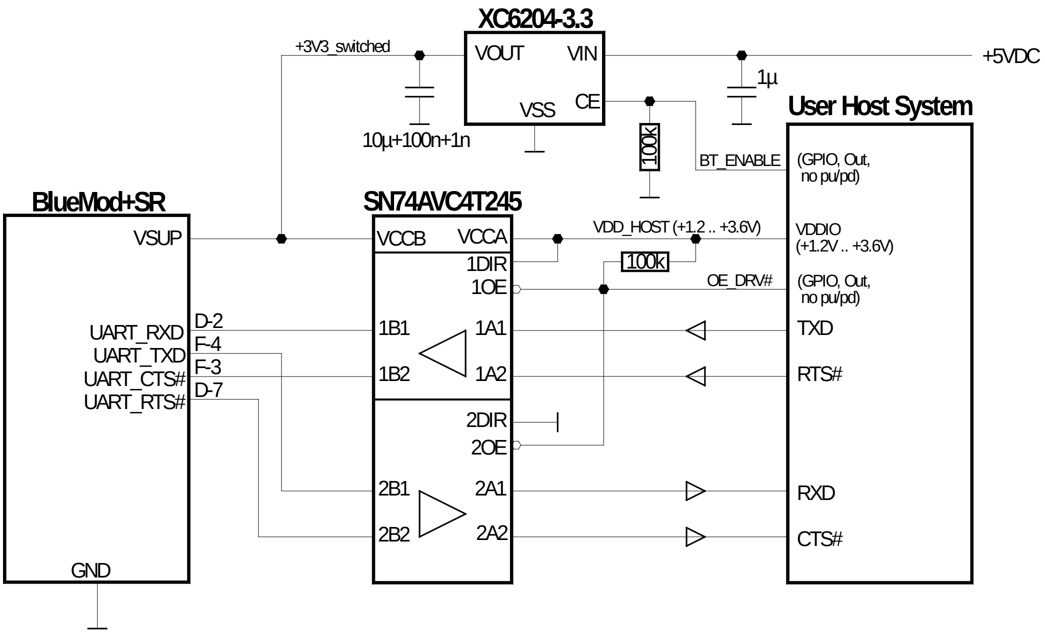


Figure 6: BlueMod+SR Example Serial Interface (Mixed Signal Level)

3.5.2 Baudrate 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	

Table 3: Baudrates and Deviations

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

3.6 GPIO Interface

It is possible to use the programmable digital I/Os GPIO[0:8] on the BlueMod+SR. Their behavior has to be defined project specific in the firmware.

Unused GPIO pins can be left unconnected.

3.7 I²C Interface[1]

The I²C bus interface serves as an interface between the internal microcontroller and the serial I²C bus. It provides multimaster capability, and controls all I²C bus specific sequencing, protocol, arbitration and timing. It supports standard (100kHz) and fast (400kHz) speed modes.

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.

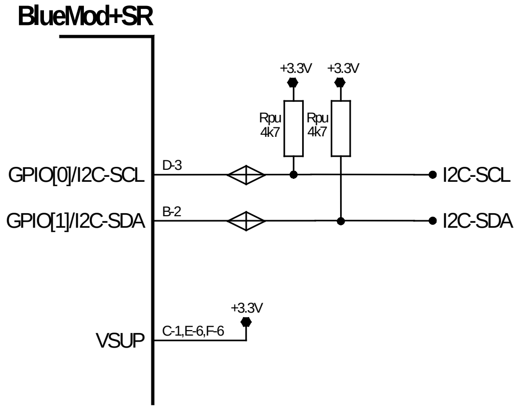


Figure 7: BlueMod+SR I²C Interface

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

3.8 SPI Serial Peripheral Interface[2]

The serial peripheral interface (SPI) allows half/full-duplex, synchronous, serial communication with external devices. The interface can be configured as the master and in this case it provides the communication clock (SCK) to the external slave device. The interface is also capable of operating in multi master configuration. It may be used for a variety of purposes, including simplex synchronous transfer on two lines with a possible bidirectional data line or reliable communication using CRC checking. Module pins are used as follows:

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

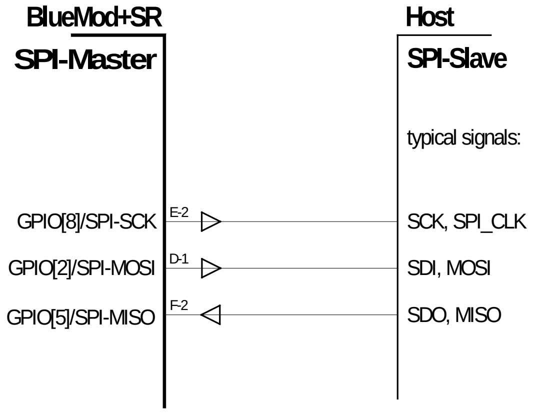


Figure 8: BlueMod+SR SPI Interface e.g. in Master Mode

3.9 Bluetooth Radio Interface

- The BlueMod+SR/AI presents an integrated ceramic antenna.
- The BlueMod+SR/AP presents no integrated ceramic antenna whereas provides a 50Ω RF interface.

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

3.10 WLAN Coexistence Interface[3]

For implementing WLAN Coexistence with CSR's Wi-Fi solution the Unity 3e+ solution is implemented. For non-CSR WiFi solutions only the 3 Signals BT_ACTIVE (BT-ACT), BT_STATUS (BT-STAT) and WLAN_DENY (WLAN-DNY) are used.

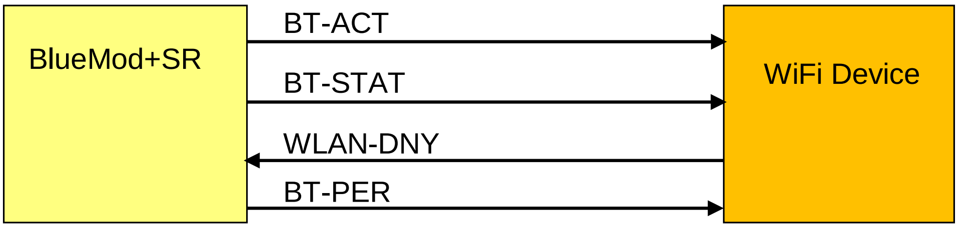


Figure 9: Unity 3e+ Coexistence

If this interface is not used, these signals may be left unconnected.

If your application needs to use these signals, ask Stollmann for support.

3.11 Slow Clock Interface

Consumption of power during power-down modes can be reduced by feeding the module with a 32,768 kHz slow clock at pin SLCK.

SLCK specification:

- 32,768 kHz typ., 30 kHz min., 35 kHz max. Duty cycle 30...70%.
- Signal must be square wave, at VSUP-level (see note below) and present as long as VSUP is powered.

The module's firmware will detect the presence of a slow clock during the boot process and switch behavior appropriately. This check does only apply for presence of some clock; it is not checked if the clock frequency is in the valid range required by CSR8811 (30kHz ... 35kHz).

If this signal is not used, to minimize risk of erroneous pulse detection in noisy environments, Stollmann recommends the connection of A-6 to GND (direct connection or pull-down resistor).

Note: Since SLCK is fed to both the STM32 and the CSR8811, the electrical characteristics as described in Table 11 (V_{LSEH}) and Table 12 (V_{IH}) apply at the same time.

3.12 Test Mode Enable

This functionality is reserved. Leave pin TESTMODE# open.

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

3.13 Pin Strapped System Memory Boot Mode Invocation

Asserting BOOT0 “high” will invoke the system memory bootloader at start-up. This is required for firmware update. Thus, access to this signal and a means to drive it at high level should be foreseen by the customer’s hardware. While not in use, this signal can be left open or driven to logic low level.

To connect to the module during system memory boot mode, an RS232 serial interface has to be directly linked to the UART-TXD (F-4) and UART_RXD (D-2) pins.

The bootloader is stored in the internal boot ROM memory (system memory) of MCU. It is programmed during production. Its main task is to upgrade the firmware to the internal Flash memory. A communication protocol is defined with a specific command set and sequences.

The firmware upgrade will be done by either

- a Stollmann provided firmware update tool. This is a Windows program that contains the firmware and uses a PC with a serial port for the update
- implementing the system memory boot mode protocol on the host system.

If firmware update shall be performed from a host MCU, signals BOOT0 and EXT-RES# both must be controlled by that host MCU (GPIO ports). Please note that EXT-RES# must not be driven directly from a push-pull signal (see chapter 3.3).

3.14 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 6, the voltage on any I/O pin must not exceed VSUP by more than 0,4V at any time. Otherwise some current I_{INJECT} flows through the internal protection diodes. This may damage the module.

There is no problem if the application circuit design and programming can assure that all signals directed towards BlueMod+SR 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 the 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.

3.15 Serial Wire Interface

The Serial Wire interface 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 it for debugging purposes, make it available and connect SWDIO via a pullup resistor 100kΩ to VSUP (refer to [1]).

4 Module Pins

4.1 Pin Numbering

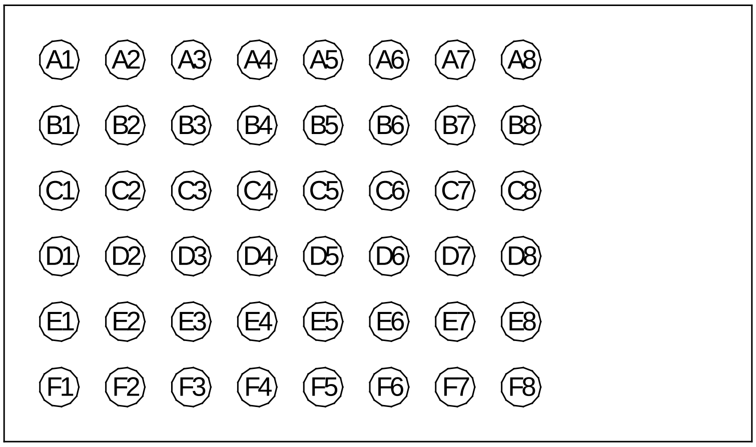


Figure 10: BlueMod+SR Pin Numbering (Top View)

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

Pin Name	Signal	Type	Act	Function	Alternate Function
E-6	VSUP1	PWR		+3.3V nom.	
F-6	VSUP2	PWR		+3,3V nom	
C-1	VSUP3	PWR		+3,3V nom	
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	
A-8	ANT	RF		n.c. (AI-Variant)	RF (AP-Variant)
B-1	EXT-RES#	I/O-PU	L	User Reset	
A-6	SLCK	I-PD		32kHz Slow Clock	
F-4	UART-TXD	O-PP		IUR Data OUT	
D-2	UART-RXD	I-PD		IUR Data IN	
D-7	UART-RTS#	O-PU (1)	L	Flow Control/IUC	
F-3	UART-CTS#	I-PD	L	Flow Control/IUC	
B-4	IUR-OUT#	O-PU (1)	L	UICP Control	
D-5	IUR-IN#	I-PD	L	UICP Control	
D-3	GPIO[0]	I/O (5)		GPIO (3)	I2C-SCL
B-2	GPIO[1]	I/O (5)		GPIO (3)	I2C-SDA
D-1	GPIO[2]	I/O (5)		GPIO (3)	SPI-MOSI
E-4	GPIO[3]	I/O (5)		GPIO (3)	
D-4	GPIO[4]	I/O (5)		GPIO (3)	
F-2	GPIO[5]	I/O (5)		GPIO (3)	SPI-MISO
C-4	GPIO[6]	I/O (5)		GPIO (3)	Debug UART TXD
C-3	GPIO[7]	I/O (5)		GPIO (3)	Debug UART RXD
E-2	GPIO[8]	I/O (5)		GPIO (3)	SPI-SCK
A-3	BT-ACT	O		WLAN coexistence	
A-1	BT-STAT	O		WLAN coexistence	
A-4	WLAN-DNY	I-PD		WLAN coexistence	
A-2	BT-PER	O		WLAN coexistence	
F-1	TESTMODE#	I-PU	L	Testmodi	
E-1	BOOT0	I-PD (1)		System memory bootloader	
E-3	SWDIO	I-PU (6)		serial wire	
D-6	SWCLK	I-PD		serial wire	
C-2	DNU (4)			reserved	
B-3	DNU (4)			reserved	
A-5	DNU (4)			reserved	
F-5	DNU (4)			reserved	
E-5	DNU (4)			reserved	
(1) a discrete resistor is used					

Table 4: General Pin Assignment

Notes:

(1) a discrete 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-float, i-pu, i-pd, o-pp (output push/pull), o-od (output open drain) or some alternate function; refer to [1], [2]
(6) if the serial wire interface is used, a pull-up resistor 100kΩ has to be connected to VSUP. Please refer to chapter 3.15 and [1]

4.2.2 Application Specific Pin Description

4.2.2.1 SPP 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

Pin Name	Signal	SPP-Function	Type	Act	Description
E-6	VSUP1	Power	PWR		+3,3V nom.
F-6	VSUP2	Power	PWR		+3,3V nom
C-1	VSUP3	Power	PWR		+3,3V nom
A-7,E-7,F-7, B-[5,6,7,8], C-[5,6,7,8], D-8, E-8, F-8	GND	Power	PWR		Ground
A-8	ANT	Antenna	RF		n.c. (/AI) or RF (/AP)
B-1	EXT-RES#	Reset	I/O-PU	L	User Reset
A-6	SLCK	SLCK	I-PD		32,768kHz Slow Clock (optional)
F-4	UART-TXD	TXD	O-PP		IUR Data OUT
D-2	UART-RXD	RXD	I-PD		IUR Data IN
D-7	UART-RTS#	/RTS	O-PP (1)	L	Flow Control/IUC; refer to [3]
F-3	UART-CTS#	/CTS	I-PD	L	Flow Control/IUC; refer to [3]
B-4	IUR-OUT#	/IUR-OUT	O-PP (1)	L	UICP Control; refer to [3]
D-5	IUR-IN#	/IUR-IN	I-PD	L	UICP Control; refer to [3]
D-3	GPIO[0]	GPIO0	I		GPIO (3)
B-2	GPIO[1]	GPIO1	I		GPIO (3)
D-1	GPIO[2]	IOC	I/O		User IO
E-4	GPIO[3]	IOB			User IO
D-4	GPIO[4]	HANGUP	I-PD		optional; refer to [5]
F-2	GPIO[5]	IOD	I/O		User IO
C-4	GPIO[6]	reserved	O-PP		Debug UART TXD
C-3	GPIO[7]	GPIO7	I-PD		GPIO (3)
E-2	GPIO[8]	IOA	I/O		User IO
A-3	BT-ACT	WLAN coexistence	O		
A-1	BT-STAT	WLAN coexistence	O		
A-4	WLAN-DNY	WLAN coexistence	I-PD		
A-2	BT-PER	WLAN coexistence	O		
F-1	TESTMODE#	reserved	I-PU	L	leave open

E-1	BOOT0	r	I-PD (2)		system memory bootloader
E-3	DNU (4)	reserved			leave open (serial wire)
D-6	DNU (4)	r			leave open (serial wire)
C-2	DNU (4)	reserved			leave open
B-3	DNU (4)	reserved			leave open
A-5	DNU (4)	reserved			leave open
F-5	DNU (4)	reserved			leave open
E-5	DNU (4)	reserved			leave open

Table 5: Application Specific Pin Assignments, SPP

Notes:
(1) a discrete pull-up resistor is used
(2) a discrete pull-down resistor is used
(3) function depends on firmware
(4) DNU: Do Not Use, Do Not Connect

4.3 Handling of Unused Signals

Depending on the application, not all signals of BlueMod+SR 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]
- SLCK — If no external slow clock is provided: Leave open or tie to GND
- UART-RTS#, UART-CTS# — If neither flow control nor UICP is used: Leave open
- IUR-OUT#, IUR-IN# — If UICP is not used: leave open
- BT-ACT, BT-STAT, BT-PER, WLAN-DNY — If there is no WLAN device on the same PCB: Leave open
- TESTMODE# — Leave open
- unused GPIOs — Leave open
- SWDIO, SWCLK — Leave open. Only needed for debug purposes.

(*) for being able to update the firmware, it is strongly recommended to provide for a means to set BOOT0 temporarily to logic high level, and to reset the module; see chapter 3.13.

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 +0,4	V

Table 6: Absolute Maximum Ratings

5.2 Electrical Requirements

VSUP = 3,3V, T_{amb} = 25°C if nothing else stated

Item	Condition	Limit			Unit
		Min	Typ	Max	
Frequency Range		2400		2483.5	MHz
Load impedance	Measured with network analyzer in the frequency range at antenna pin		50		Ohm
Output return loss	Receive Mode to 50Ω load Transmit Mode to 50Ω load	-10 -10			dBm

Table 7: Electrical Requirements

5.3 Operating Conditions

T_{amb} = 25°C

Item	Condition	Limit			Unit
		Min	Typ	Max	
Supply voltage VSUP		2,5	3,3	3,6	V_{DC}
Ripple on VSUP	Ripple frequency ≤10MHz			10	mV_{rms}

Table 8: DC Operating Conditions

5.4 Environmental Requirements

Item	Symbol	Absolute Maximum Ratings	Unit
Storage temperature range	T_{stg}	-40 to +85	°C
Operating temperature range	T_{op}	-30 to +85	°C

Table 9: Environmental Requirements

5.5 Digital I/O Including EXT-RES#

STM32 MCU and CSR8811 do have different electrical I/O characteristics.
All Module I/O pins are connected directly to these chips without signal conditioning except for some pull-up/pull-down resistors (as indicated). Therefore the electrical characteristics are split in different tables.

STM-Related Signals:

- EXT-RES# (additional filter-C 100n to GND)
- UART-TXD, UART-RXD, UART-CTS#
- UART-RTS# (pull-up resistor 470kΩ)
- IUR-IN#
- IUR-OUT# (pull-up resistor 470kΩ)
- GPIO[0..8], TESTMODE#
- BOOT0 (pull-down resistor 100kΩ)

T_{amb} = 25°C

Symbol	Item	Condition	Limit			Unit
			Min	Typ	Max	
V_{IL}	Low-Level Input Voltage	VSUP = 2,5 to 3,6V	-0,3	-	0,9	V
V_{IH}	High-Level Input Voltage	VSUP = 2,5 to 3,6V	2,0	-	VSUP+0,3	V
V_{OL}	Low-Level Output Voltage	I_{OL} = 4mA	-	-	0,4	V
V_{OH}	High-Level Output Voltage	I_{OH} = -4mA	VSUP-0,4	-	-	V
I_{OL}	Low -Level Output Current	V_{OL} = 0,4V	-	-	8	mA
I_{OH}	High-Level Output Current	2, V_{OH} = 2.3V	-	-	-8	mA
R_{PU}	weak pull-up resistor	V_{IN} = V_{SS}	30	40	50	kΩ
R_{PD}	weak pull-down resistor	V_{IN} = V_{DD}	30	40	50	kΩ
I_{lc}	I/O pad leakage current		-3	0	+3	µA
C_I	Input Capacitance			5		pF

Table 10: DC Characteristics, Digital IO (STM32-related)

External Slow Clock SLCK:

T_{amb} = 25°C

Symbol	Item	Condition	Limit			Unit
			Min	Typ	Max	
V_{LSEL}	Low-Level Input Voltage	VSUP = 2,5 to 3,6V	0,0	-	0,3	V
V_{LSEH}	High-Level Input Voltage	VSUP = 2,5 to 3,6V	0,7xVSUP	-	VSUP	V
I_{lc}	I/O pad leakage current	VSS ≤ VIN ≤ VSUP	-1	-	+1	µA
C_I	Input Capacitance			5		pF

Table 11: DC Characteristics, SLCK (STM32 Backup Domain)

Note: Signal at SLCK is also fed to CSR8811 and has to comply to Table 12, too.

CSR8811 Related Signals:

- BT-ACT, BT-STAT, WLAN-DNY, BT-PER
- SLCK (caution: also connected to STM-32!)

T_{amb} = 25°C

Symbol	Item	Condition	Limit			Unit
			Min	Typ	Max	
V_{IL}	Low-Level Input Voltage	VSUP = 3,3V	- 0,4	-	0,4	V
V_{IH}	High-Level Input Voltage		0,7xVSUP	-	VSUP+0,4	V
V_{OL}	Low-Level Output Voltage	I_{OL} = 4mA	-	-	0,4	V
V_{OH}	High-Level Output Voltage	I_{OH} = -4mA	0,75xVSUP	-	-	V
I_{sp-u}	Input-current	Strong pull-up	-150	-40	-10	µA
I_{sp-d}	Input-current	Strong pull-down	+10	+40	-+150	µA
I_{wp-u}	Input-current	Weak pull-up	-5,0	-1,0	-0,33	µA
I_{wp-d}	Input-current	Weak pull-down	+0,33	-1,0	+5,0	µA
I_{lc}	I/O pad leakage current			n.a.		µA
C_I	Input Capacitance		1,0	-	5,0	pF

Table 12: DC Characteristics, Digital IO (CSR8811 Related)

Note: SLCK is connected to both STM32 and CSR8811 so has to fit to STM32 and CSR8811 requirements at the same time.

5.6 Power Consumption and Power Down Modes

5.6.1 SPP Configuration

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

VSUP = 3,3V, T_{amb} = 25°C, all GPIOs and UART lines open, SLCK: 32,768 kHz

Condition	**Note**	**Current Consumption**		**Unit**
		Slow clock		
		Extern	Intern	
		I_{Avg}	I_{Avg}	
standby, no page scan, no inquiry scan			3,7	mA
standby, no page scan, no inquiry scan, UICP active Interface down	(1)	0,21	0,36	mA
device in reset	(2)	2,7		mA

Table 13: Supply Current SPP Standby Modes no Radio Activity

Notes:

(1) IUR-IN# and UART-CTS# signals connected to VSup
(2) Valid for HW V3, higher in Hw Version < 3

VSUP = 3,3V, T_{amb} = 25°C, Tx Power = 7 dBm, all GPIOs and UART lines open

Condition	**Note**	**Current Consumption**		**Unit**
		Slow clock		
		Extern	Intern	
		I_{Avg}	I_{Avg}	
standby, page scan & inquiry scan interval 1.28s		4,0	4,2	mA
standby, page scan & inquiry scan interval 1.28s,UICP active serial Interface down	(1)	0,8	1,0	mA
Bluetooth connected, no data traffic – close range (Slave)	(2)	14,4	14,4	mA
Bluetooth connected, data traffic 115 kbit/s – close range (Slave)	(2)	21,1	21,1	mA

Table 14: Supply Current, SPP Bluetooth Classic

Notes:

(1) IUR-IN# and UART-CTS# signals connected to VSup
(2) about 2 meters through the air

The following table shows the average power consumption of BlueMod+SR in LE-mode operating in the peripheral device role.

VSUP = 3,3V, T_{amb} = 25°C, Tx power = +7 dBm, all GPIOs and UART lines open

Condition	Note	Current Consumption		Unit
		Slow clock		
		Extern	Intern	
		I_{Avg}	I_{Avg}	
Idle, Advertising on 3 channels, advertising interval: 1,28s		3,5	3,7	mA
Idle, Advertising on 3 channels, advertising interval: 1,28s, UICP active serial Interface down		0,31	0,46	mA
Connected, connection interval: 40ms, no data traffic	(2,3)	4,8	5,0	mA
Connected, connection interval: 37,5ms, no data traffic	(2,4)	5,3	5,4	mA
Connected, connection interval: 37,5ms data traffic	(2,4)	Tbd	Tbd	mA

Table 15: Supply Current BLE Peripheral Device Role

Notes:

(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) then 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

5.7 RF Performance

5.7.1 GFSK, PI/4 DQPSK, 8DPSK Receiver

VSUP = 2,5V to 3,6V, Tamb = 20°C

Measured conducted according to BT specification v1.2/2.0/2.0 + EDR/2.1/2.1 + EDR/3.0/3.0 + HS/4.0

Receiver	Frequency [GHz]	Limit			BT	Unit
		Min	Typ	Max	Spec	
Sensitivity at 0.1% BER DH1	2.402		-84	-80	≤-70	dBm
	2.441		-88	-84		
	2.480		-88	-84		
Sensitivity at 0.1% BER DH5	2.402		-84	-80	≤-70	dBm
	2.441		-88	-84		
	2.480		-88	-84		
Sensitivity at 0.1% BER EDR2, PI/4 DQPSK	2.402		-87	-70	≤-70	dBm
	2.441		-91	-70		
	2.480		-91	-70		
Sensitivity at 0.1% BER EDR3, 8DPSK	2.402		-78	-70	≤-70	dBm
	2.441		-82	-70		
	2.480		-82	-70		
Maximum received signal at 0.1% BER with DH1		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER with DH5		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER with EDR2, PI/4 DQPSK		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER with EDR3, 8DPSK		-20	0		≥-20	dBm
C/I co-channel GFSK			8	11	≤ 11	dB
Adjacent channel selectivity C/I $f = f_0 + 1MHz$ GFSK			-2	0	≤ 0	dB
Adjacent channel selectivity C/I $f = f_0 - 1MHz$ GFSK			-1	0	≤ 0	dB
Adjacent channel selectivity C/I $f \geq f_0 + 2MHz$ GFSK			-39	-30	≤ -30	dB
Adjacent channel selectivity C/I $f \leq f_0 - 2MHz$ GFSK			-30	-30	≤ -20	dB
Adjacent channel selectivity C/I $f \geq f_0 + 3MHz$ GFSK			-45	-40	≤ -40	dB
Adjacent channel selectivity C/I $f \leq f_0 - 5MHz$ GFSK			-46	-40	≤ -40	dB
Adjacent channel selectivity C/I $f = f_{image}$ GFSK			-25	-9	≤ -9	dB
C/I co-channel PI/4 DQPSK			12	13	≤ 13	dB
Adj. channel selectivity C/I f = f0 + 1MHz π/4 DQPSK			-7	0	≤ 0	dB
Adj. channel selectivity C/I f = f0 - 1MHz π/4 DQPSK			-4	0	≤ 0	dB
Adj. channel selectivity C/I f ≥ f0 + 2MHz π/4 DQPSK			-40	-30	≤ -30	dB
Adj. channel selectivity C/I f ≤ f0 - 2MHz π/4 DQPSK			-36	-20	≤ -20	dB
Adj. channel selectivity C/I f ≥ f0 + 3MHz π/4 DQPSK			-48	-40	≤ -40	dB
Adj. channel selectivity C/I f ≤ f0 - 5MHz π/4 DQPSK			-50	-40	≤ -40	dB
Adj. channel selectivity C/I f = fimage π/4 DQPSK			-22	-7	≤ -7	dB
C/I co-channel 8DPSK			18	21	≤ 21	dB

Receiver	Frequency [GHz]	Limit			BT	Unit
		Min	Typ	Max	Spec	
Adj. channel selectivity C/I f = f0 + 1MHz 8DPSK			-4	5	≤ 5	dB
Adj. channel selectivity C/I f = f0 - 1MHz 8DPSK			-1	5	≤ 5	dB
Adj. channel selectivity C/I f ≥ f0 + 2MHz 8DPSK			-36	-25	≤ -25	dB
Adj. channel selectivity C/I f ≤ f0 - 2MHz 8DPSK			-31	-13	≤ -13	dB
Adj. channel selectivity C/I f ≥ f0 + 3MHz 8DPSK			-42	-33	≤ -33	dB
Adj. channel selectivity C/I f ≤ f0 - 5MHz 8DPSK			-43	-33	≤ -33	dB
Adj. channel selectivity C/I f = fimage 8DPSK			-14	0	≤ -0	dB

VSUP = 2,5V to 3,6V, T_{amb} = -30°C
Measured conducted according to BT specification v1.2/2.0/2.0 + EDR/2.1/2.1 + EDR/3.0/3.0 + HS/4.0

Receiver	**Frequency [GHz]**	**Limit**			**BT**	**Unit**
		Min	**Typ**	**Max**	**Spec**	
Sensitivity at 0.1% BER DH1	2.402		-84	-80	≤-70	dBm
	2.441		-88	-84		
	2.480		-88	-84		
Sensitivity at 0.1% BER DH5	2.402		-84	-80	≤-70	dBm
	2.441		-88	-84		
	2.480		-88	-84		
Sensitivity at 0.1% BER EDR2, PI/4 DQPSK	2.402		-88	-70	≤-70	dBm
	2.441		-91	-70		
	2.480		-91	-70		
Sensitivity at 0.1% BER EDR3, 8DPSK	2.402		-78	-70	≤-70	dBm
	2.441		-82	-70		
	2.480		-82	-70		
Maximum received signal at 0.1% BER DH1		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER PI/4 DQPSK		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER 8DPSK		-20	0		≥-20	dBm

VSUP = 2,5V to 3,6V, T_{amb} = +85°C
Measured conducted according to BT specification v1.2/2.0/2.0 + EDR/2.1/2.1 + EDR/3.0/3.0 + HS/4.0

Receiver	**Frequency [GHz]**	**Limit**			**BT**	**Unit**
					Spec	
Sensitivity at 0.1% BER DH1	2.402		-84	-80	≤-70	dBm
	2.441		-88	-84		
	2.480		-88	-84		
Sensitivity at 0.1% BER DH5	2.402		-84	-80	≤-70	dBm
	2.441		-88	-84		
	2.480		-88	-84		
Sensitivity at 0.1% BER EDR2, PI/4 DQPSK	2.402		-87	-70	≤-70	dBm
	2.441		-90	-70		
	2.480		-90	-70		
Sensitivity at 0.1% BER EDR3, 8DPSK	2.402		-78	-70	≤-70	dBm
	2.441		-80	-70		
	2.480		-80	-70		
Maximum received signal at 0.1% BER DH1		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER PI/4 DQPSK		-20	0		≥-20	dBm
Maximum received signal at 0.1% BER 8DPSK		-20	0		≥-20	dBm

Table 16: RF Performance GFSK, PI/4 DQPSK, 8DPSK Receiver

Notes:
(b) For calculating true performance add product specific antenna gain

5.7.2 GFSK, PI/4 DQPSK, 8DPSK Transmitter

VSUP = 2,5V to 3,6V, T_{amb} = +20°C

Measured conducted according to BT specification v1.2/2.0/2.0 + EDR/2.1/2.1 + EDR/3.0/3.0 + HS/4.0

Transmitter	Frequency [GHz]	Limit			BT	Unit
RF transmit power 50 Ω load, at antenna Class 1 device GFSK b)	2.402	2,7	5,5		0 to 20	dBm
	2.441	4,7	7,5			
	2.480	5,7	8,5			
RF transmit power 50 Ω load, at antenna Class 1 device EDR2, π/4 DQPSK b)	2.402 GFSK		2,0		ΔTX = -4 to 1	dBm
	2.402 π/4 DQPSK		0,9			
	2.441 GFSK		4,7			
	2.441 π/4 DQPSK		3,7			
	2.480 GFSK		5,6			
	2.480 π/4 DQPSK		4,6			
RF transmit power 50 Ω load, at antenna Class 1 device EDR3, 8DPSK b)	2.402 GFSK		2,1		ΔTX = -4 to 1	dBm
	2.402 8DPSK		1,0			
	2.441 8GFSK		4,8			
	2.441 8DPSK		3,7			
	2.480 GFSK		5,6			
	2.480 8DPSK		4,6			
RF power control range		16	30		≥16	dB
RF power range control resolution		2	4	8	2 to 8	dB
20 dB bandwidth for modulated carrier			925	1000	≤1000	kHz
ICFT		-75	±25	+75	≤ ±75	kHz
Carrier frequency drift (packet DH1)			7	25	≤ 25	kHz
Drift Rate			5	20	≤ 20	kHz/ 50µs
$\Delta f1_{avg}$ "Maximum Modulation"		140	164	175	≥140 to ≤175	kHz
$\Delta f2_{max}$ "Minimum Modulation"		115	140		>115	kHz
$\Delta f2_{avg} / \Delta f1_{avg}$		0,8	0,91		≥ 0,8	

VSUP = 2,5V to 3,6V, T_{amb} = -30°C
Measured conducted according to BT specification v1.2/2.0/2.0 + EDR/2.1/2.1 + EDR/3.0/3.0 + HS/4.0

Transmitter	Frequency [GHz]	Limit			BT	Unit
RF transmit power 50 Ω load, at antenna Class 1 device GFSK [b)]	2.402	2,7	3,5		0 to 20	dBm
	2.441	4,7	6,5			
	2.480	5,7	7,5			
RF transmit power 50 Ω load, at antenna Class 1 device EDR2, π/4 DQPSK [b)]	2.402 GFSK		-0,5		ΔTX = -4 to 1	dBm
	2.402 π/4 DQPSK		-1,9			
	2.441 GFSK		2,5			
	2.441 π/4 DQPSK		1,2			
	2.480 GFSK		4,0			
	2.480 π/4 DQPSK		2,8			
RF transmit power 50 Ω load, at antenna Class 1 device EDR3, 8DPSK [b)]	2.402 GFSK		-0,5		ΔTX = -4 to 1	dBm
	2.402 8DPSK		-1,7			
	2.441 GFSK		2,5			
	2.441 8DPSK		1,2			
	2.480 GFSK		4,0			
	2.480 8DPSK		2,8			
20 dB bandwidth for modulated carrier			925	1000	≤1000	kHz
Initial carrier frequency tolerance		-75	10	+75	≤ ±75	kHz
Carrier frequency drift (packet DH1)			6	25	≤ 25	kHz
Drift Rate			5	20	20	kHz/ 50µs
$\Delta f1_{avg}$ "Maximum Modulation"		140	164	175	≥140 to ≤175	kHz
$\Delta f2_{max}$ "Minimum Modulation"		115	142		≥ 115	kHz
$\Delta f2_{avg} / \Delta f1_{avg}$		0,8	0,92		≥ 0,8	

VSUP = 2,5V to 3,6V, Tamb = +85°C
Measured conducted according to BT specification v1.2/2.0/2.0 + EDR/2.1/2.1 + EDR/3.0/3.0 + HS/4.0

Transmitter	**Frequency [GHz]**	**Limit**			**BT**	**Unit**
RF transmit power 50 Ω load, at antenna Class 1 device GFSK [b)]	2.402	1,8	4,0		0 to 20	dBm
	2.441	3,8	6,0			
	2.480	4,8	7,0			
RF transmit power 50 Ω load, at antenna Class 1 device EDR2, π/4 DQPSK [b)]	2.402 GFSK		0,3		ΔTX = -4 to 1	dBm
	2.402 π/4 DQPSK		-0,8			
	2.441 GFSK		2,8			
	2.441 π/4 DQPSK		1,7			
	2.480 GFSK		4,0			
	2.480 π/4 DQPSK		2,9			
RF transmit power 50 Ω load, at antenna Class 1 device EDR3, 8DPSK [b)]	2.402 GFSK		0,3		ΔTX = -4 to 1	dBm
	2.402 8DPSK		-0,8			
	2.441 GFSK		2,8			
	2.441 8DPSK		1,7			
	2.480 GFSK		4,0			
	2.480 8DPSK		2,9			
20 dB bandwidth for modulated carrier			925	1000	≤1000	
Initial carrier frequency tolerance		-75	10	+75	≤ ±75	
Carrier frequency drift (packet DH1)			7	25	≤ 25	
Drift Rate			5	20	20	
$\Delta f1_{avg}$ "Maximum Modulation"		140	164	175	≥140 to ≤175	
$\Delta f2_{max}$ "Minimum Modulation"		115	140		≥ 115	kHz
$\Delta f2_{avg} / \Delta f1_{avg}$		0,8	0,91		≥ 0,8	

Table 17: RF Performance GFSK, PI/4 DQPSK, 8DPSK Transmitter

Notes:

(b) For calculating true performance add product specific antenna gain

5.7.3 BLE Receiver

VSUP = 2,5V to 3,6V, T_{amb} = +20°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

Receiver	Frequ /GHz	Min	Typ	Max	BT Spec	Unit
Sensitivity at 30,8% PER	2,402		-87	-83	≤ -70	dBm
	2,440		-90	-86		
	2,480		-90	-86		
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%PER	0,030 - 2,000	-30	> 0		-30	dBm
	2,000 - 2,400	-35	0		-35	
	2,500 -3,000	-35	0		-35	
	3,000 . 12,75	-30	>0		-30	
C/I co-channel			8	21	≤21	dB
Adjacent channel Selectivity C/I	F = F_0 + 1 MHz		1	15	≤15	dB
	F = F_0 - 1 MHz		-9	15	≤15	dB
	F = F_0 + 2 MHz		-27	-17	≤-17	dB
	F = F_0 - 2 MHz		-19	-15	≤-15	dB
	F = F_0 + 3 MHz		-43	-27	≤-27	dB
	F = F_0 - 5 MHz		-49	-27	≤-27	dB
	F = F_{image}		-24	-9	≤-9	dB
Maximum level of intermodulation interferers		-50	-18		≥-50	dBm

VSUP = 2,5V to 3,6V, T_{amb} = -30°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

Receiver	Frequ /GHz	Min	Typ	Max	BT Spec	Unit
Sensitivity at 30,8% PER	2,402		-87	-83	≤ . 70	dBm
	2,440		-90	-87		
	2,480		-90	-87		
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

VSUP = 2,5V to 3,6V, T_{amb} = +85°C

Measured conducted according to BT specification RF-PHY.TS/4.0.1

Receiver	Frequ /GHz	Min	Typ	Max	BT Spec	Unit
Sensitivity at 30,8% PER	2,402		-87	-83	≤ . 70	dBm
	2,440		-89	-85		
	2,480		-89	-85		
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

Table 18: RF Performance BLE Receiver

5.7.4 BLE Transmitter

VSUP = 2,5V to 3,6V, T_{amb} = +20°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

Transmitter	Frequ /GHz	Min	Typ	Max	BT Spec	Unit
RF Transmit Power	2,402	2,0	5,5	10	-20 to +10	dBm
	2,440	4,0	7,5	10		
	2,480	5,0	8,5	10		
ACP	$F = F_0 \pm 2MHz$		-28	-20	≤ -30	dBm
	$F = F_0 \pm 3MHz$		-38	-30	≤ -30	
	$F = F_0 \pm > 3MHz$		<-60	-30	≤ -30	
Δf_{1avg} maximum modulation		225	268	275	225 < f_{1avg} < 275	kHz
Δf_{2max} minimum modulation		185	214		≥ 185	kHz
$\Delta f_{2avg} / \Delta f_{1avg}$		0,8	0,83		≥ 0,8	
Frequency Offset		-95	±25	+95	± 150	kHz
Carrier drift rate			4	20	≤ 20	kHz/ 50µs
Carrier drift			5	50	≤ 50	kHz

VSUP = 2,5V to 3,6V, T_{amb} = -30°C
Measured conducted according to BT specification RF-PHY.TS/4.0.1

Transmitter	Frequ /GHz	Min	Typ	Max	BT Spec	Unit
RF transmit Power	2,402	0,5	4,0	10	-20 to +10	dBm
	2,440	2,5	6,5	10		
	2,480	3,5	7,5	10		
ACP	$F = F_0 \pm 2MHz$		-28	-20	≤ -30	dBm
	$F = F_0 \pm 3MHz$		-35	-30	≤ -30	
	$F = F_0 \pm > 3MHz$		<-60	-30	≤ -30	
Δf_{1avg} maximum modulation		225	266	275	225 < f_{1avg} < 275	kHz
Δf_{2max} minimum modulation		185	225		≥ 185	kHz
$\Delta f_{2avg} / \Delta f_{1avg}$		0,8	0,85		≥ 0,8	
Frequency Offset		-95	±25	+95	± 150	kHz
Carrier drift rate			4	20	≤ 20	kHz/ 50µs
Carrier drift			5	50	≤ 50	kHz

VSUP = 2,5V to 3,6V, T_{amb} = +85°C

Measured conducted according to BT specification RF-PHY.TS/4.0.1

Transmitter	**Frequ /GHz**	**Min**	**Typ**	**Max**	**BT Spec**	**Unit**
RF transmit Power	2,402	1,0	4,0	10	-20 to +10	dBm
	2,440	3,0	6,0	10		
	2,480	4,0	7,0	10		
ACP	F = F_0 ± 2MHz		-30	-20	≤ -30	dBm
	F = F_0 ± 3MHz		-42	-40	≤ -30	
	F = F_0 ± > 3MHz		<-60	-30	≤ -30	
Δf_{1avg} maximum modulation		225	267	275	225 < f_{1avg} < 275	kHz
Δf_{2max} minimum modulation		185	214		≥ 185	kHz
Δf_{2avg} / Δf_{1avg}		0,8	0,83		≥ 0,8	
Frequency Offset		-95	±25	+95	± 150	kHz
Carrier drift rate			5	20	≤ 20	kHz/ 50µs
Carrier drift			5	50	≤ 50	kHz

Table 19: RF Performance BLE Transmitter

5.7.5 Antenna-Gain and Radiation Pattern

If BlueMod+SR/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.

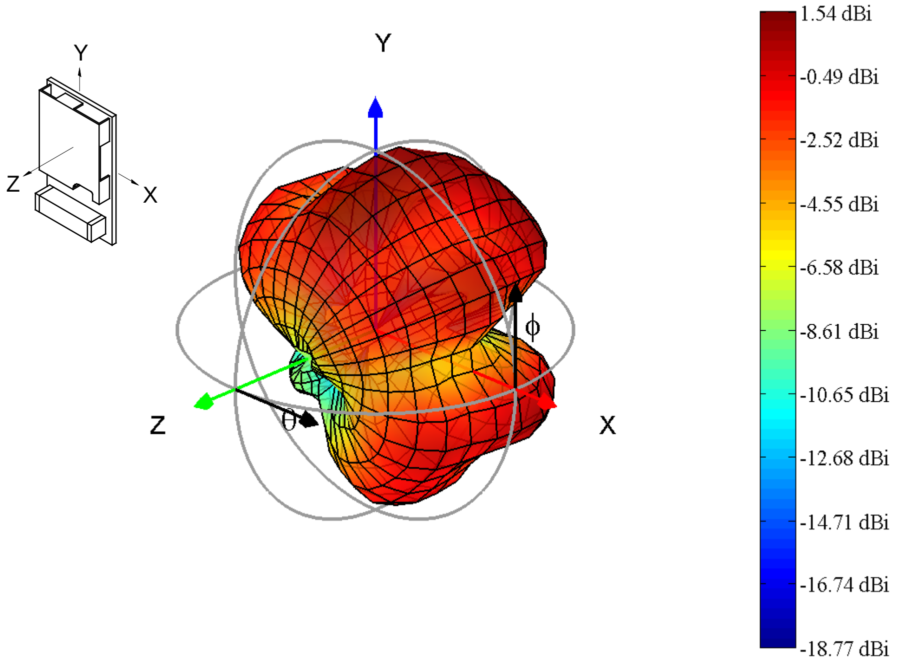


Figure 11: Typical Antenna Radiation Pattern at 2402MHz

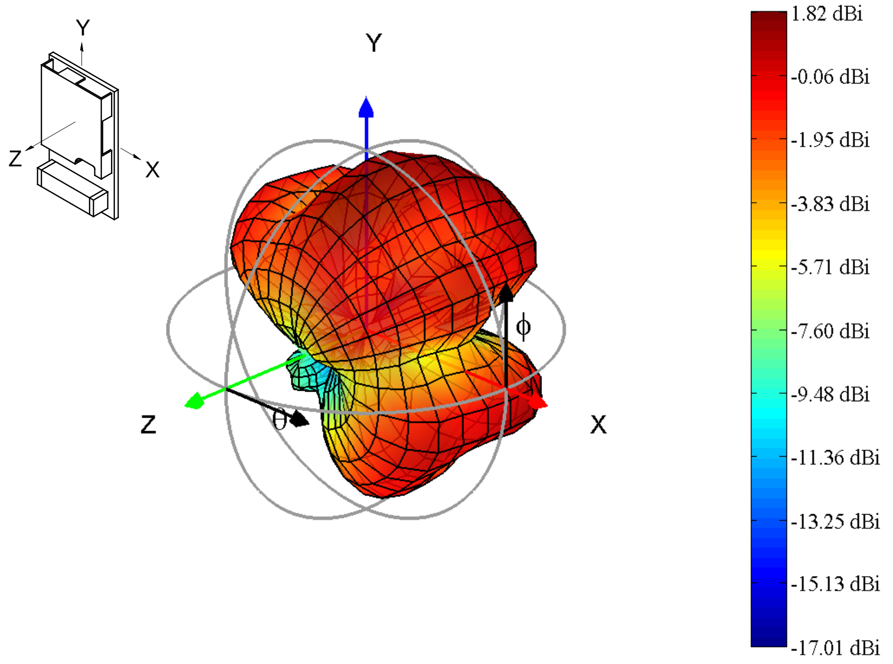


Figure 12: Typical Antenna Radiation Pattern at 2441MHz

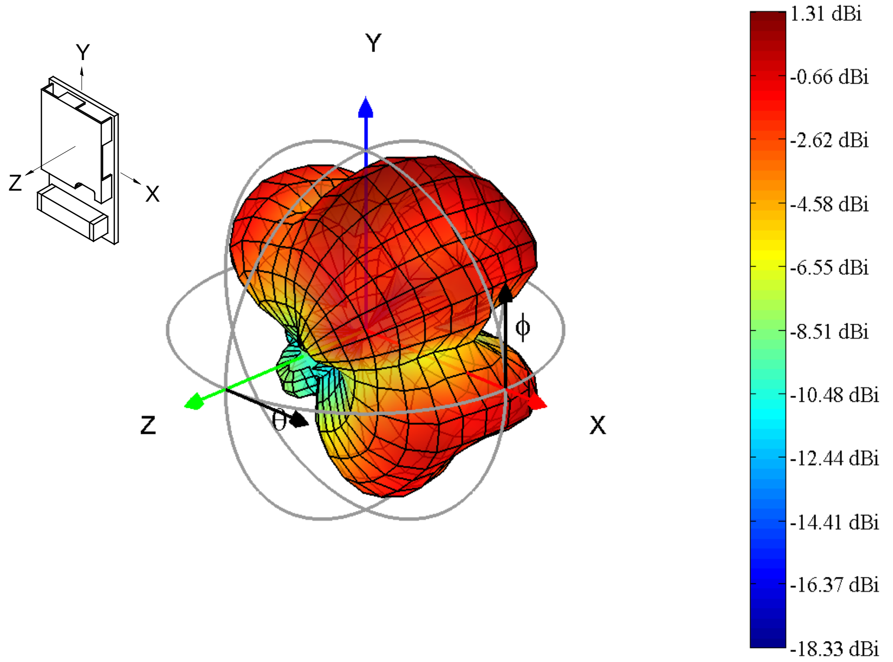


Figure 13: Typical Antenna Radiation Pattern at 2480MHz

5.8 Power-Up Time

The time until the BlueMod+SR is able to accept link requests or serial data depends on the firmware version. In the SPP firmware version 1.103 the module is command ready after at least 1,1 s. Bluetooth links are accepted tbd s after reset.

Note: For further information refer to the document BlueMod+SR_Startup_Timing_r01 [6]

6 Mechanical Characteristics

6.1 Dimensions

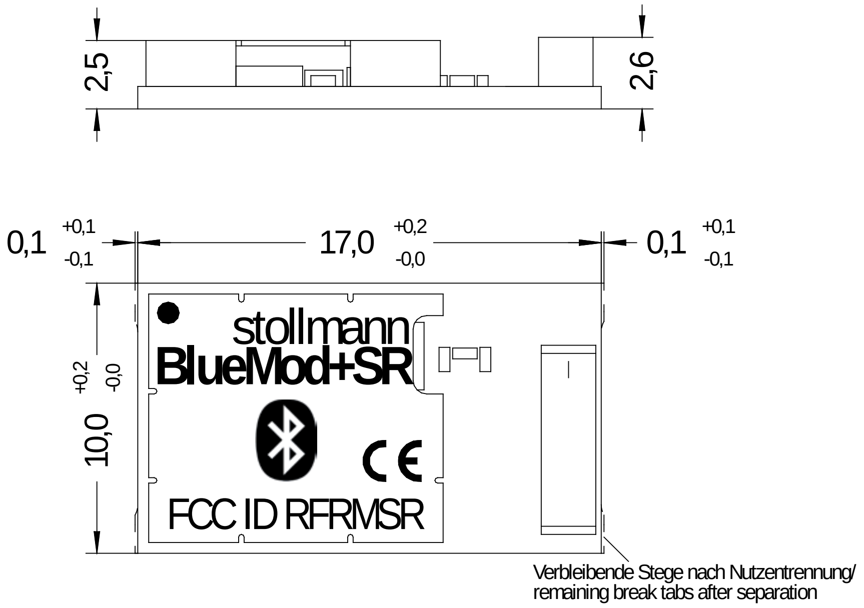


Figure 14: BlueMod+SR/AI dimensions

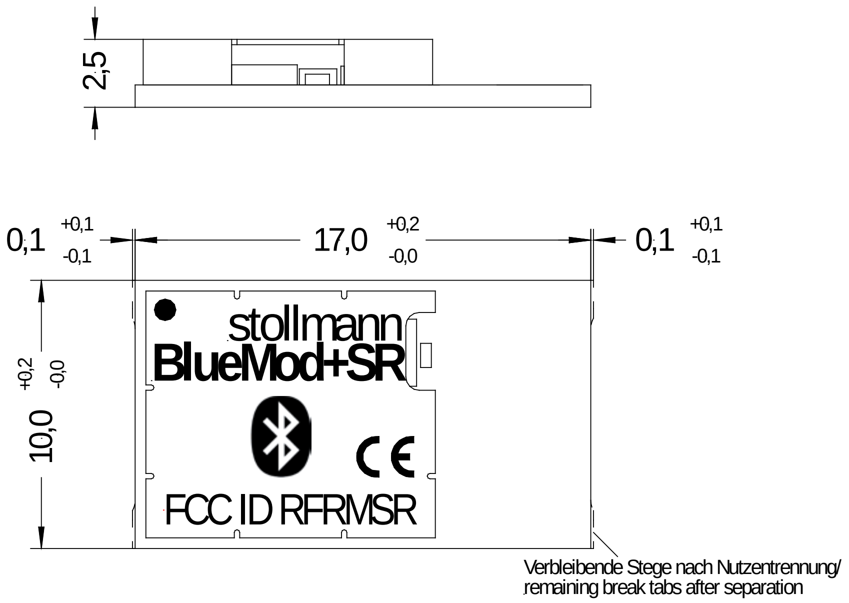


Figure 15: BlueMod+SR/AP Dimensions

6.2 Recommended Land Pattern

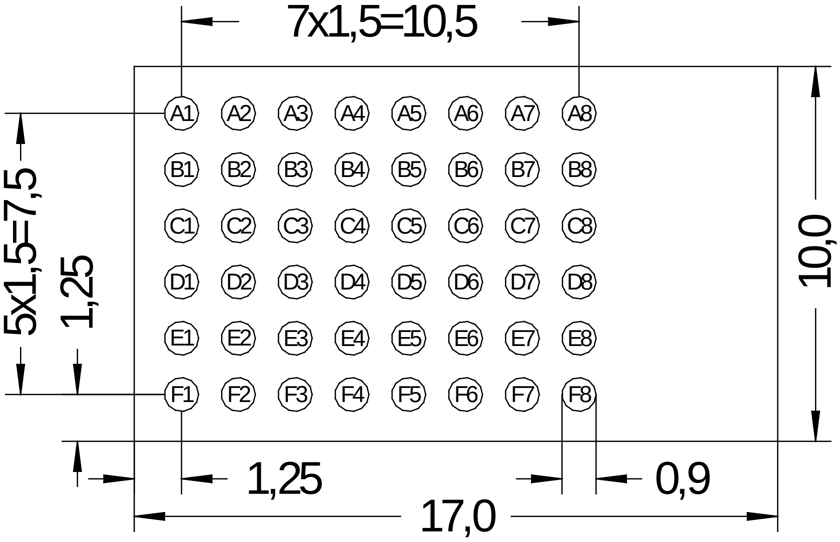


Figure 16: BlueMod+SR Land Pattern

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.

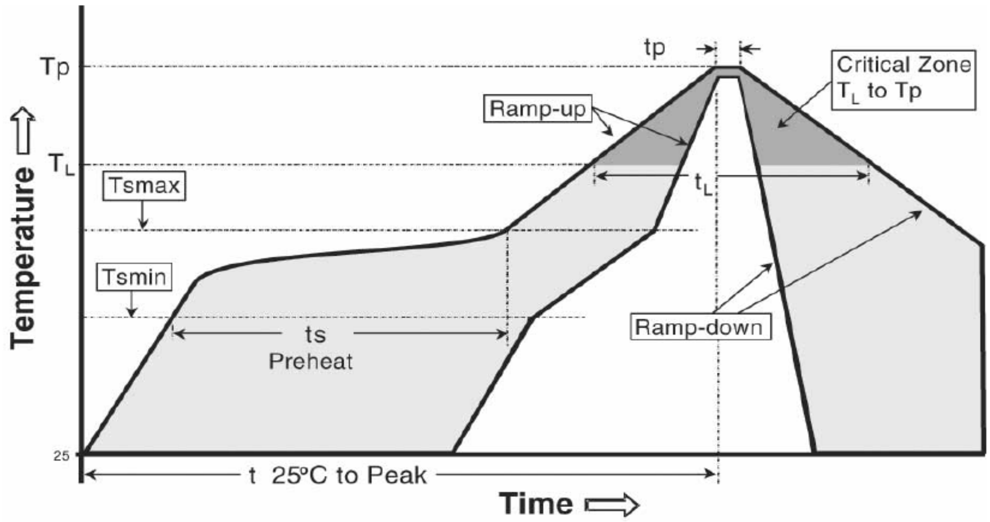


Figure 17: Soldering Temperature-Time Profile (For Reflow Soldering)

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+SR resides on the PCB side looking up. Heat above the solder eutectic point while the BlueMod+SR is mounted facing down may damage the module permanently.

6.4 Placement Recommendation

To achieve best radio performance for BlueMod+SR/AI, it is recommended to use the placement shown in Figure 18.

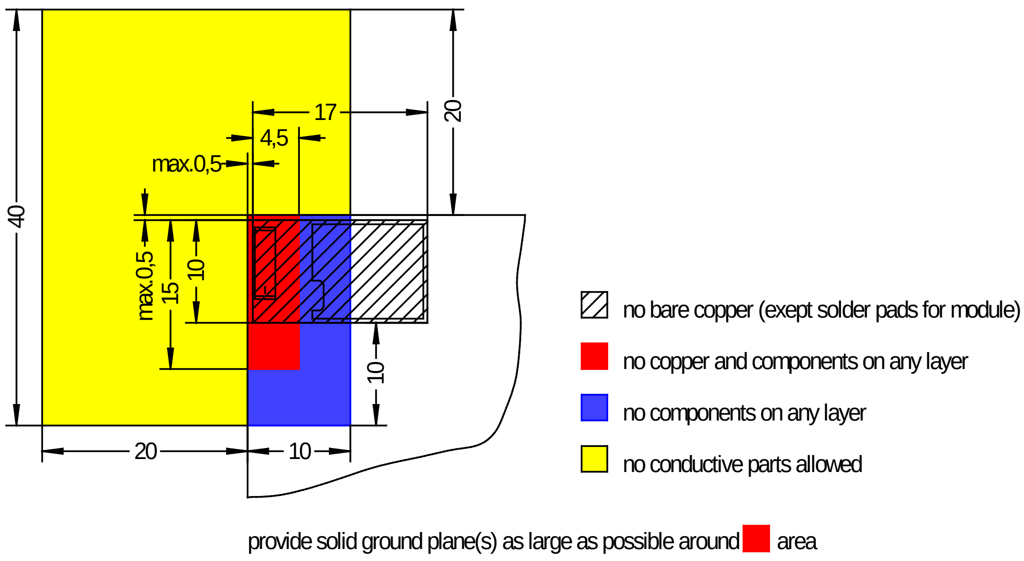


Figure 18: BlueMod+SR/AI Placement Recommendation

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+SR is shipped with 2 different antenna designs:

- BlueMod+SR/AI comprises a ceramic antenna which as a component is soldered to the circuit board. This is functional for a BlueMod+SR/AI integrated into a plastic housing. No additional antenna is required.

For an external antenna to be set in, e.g. because the BlueMod+SR is integrated into a metal housing, the ceramic antenna is replaced.

- BlueMod+SR/AP routes the antenna signal to pin A-8

The gain of the external antenna shall not exceed +2dBi.

When using an external Antenna the antenna is fixed and cannot be removed or replaced by the end user. The performance of the internal antenna respectively the external antenna has in any case 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. When the internal ceramic antenna is used, certain restrictions are to be considered.

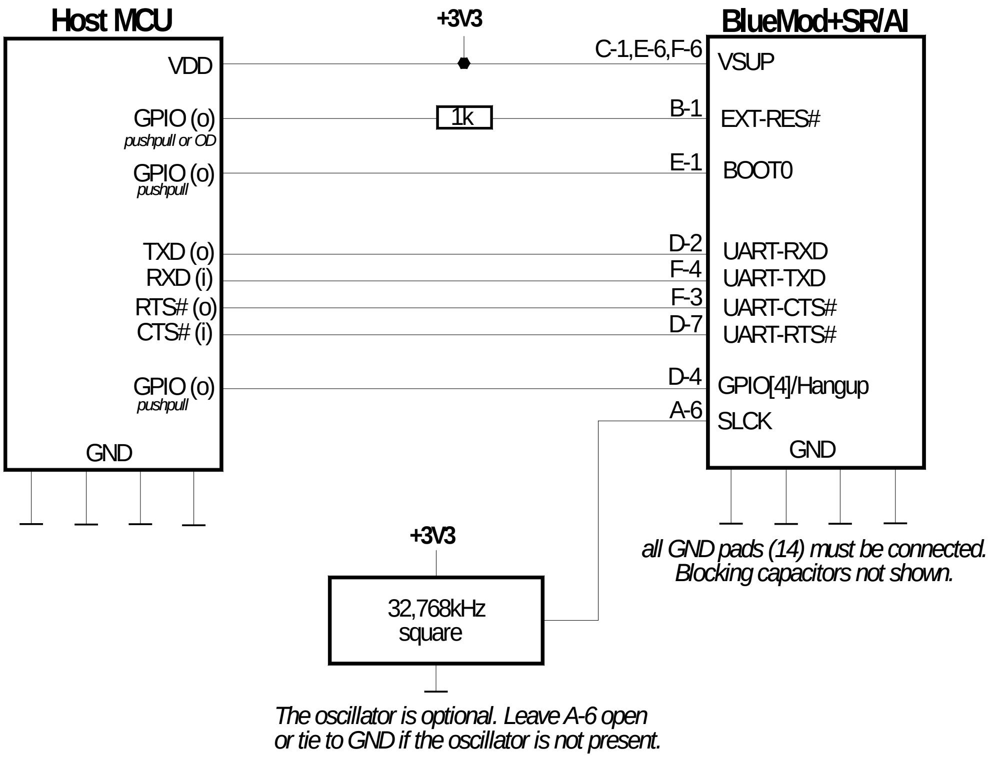
tbd

6.7 Safety Guidelines

tbd

7 Application Diagram

The following schematic shows a typical application of BlueMod+SR. The module is connected to some MCU running the application layer. MCU and BlueMod+SR use the same 3,3V power supply. Provisions are made for upgrading the firmware (BOOT0 and EXT-RES# are managed by the MCU). The serial interface has RTS/CTS flow control but no UICP support in this example. The 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.



In this example BlueMod+SR is connected to an MCU supporting RTS/CTS flow control and Hangup.
Firmware update is supported (BOOT0, EXT-RES# connected).
The slow clock oscillator (32,768kHz) is optional; it helps to save power during power down states.

Figure 19: Typical Application Schematics

8 Approvals/Certifications

The BlueMod+SR/AI has been tested to comply to the appropriate EU, FCC and IC directives. CE testing is intended for end products only. Therefore CE testing is not mandatory for a Bluetooth Module sold to OEM's. 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

tbd

8.2 FCC Compliance

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

For selling products implementing the BlueMod+SR/AP in the USA you'll have to apply for a Class II Permissive Change from the FCC authorities. Depending on antenna gain and other factors the FCC TCB will issue a reduced test plan for re-testing. Stollmann can assist customers with conducting this procedure on request. Especially the test plan reduction and cost optimization may be items worth to look at.

8.2.1 FCC Grant

Tbd

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

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

RF exposure evaluation of devices implementing the BlueMod+SR/AP should be done with the collaboration of the FCC TCB working on the Class II Permissive Change Request.

8.2.6 FCC Labeling Requirements for the End Product

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

This device contains transmitter with	
FCC ID:	RFRMSR
IC:	4957A-MSR

8.3 IC Compliance

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

For selling products implementing the BlueMod+SR/AP in Canada you'll have to apply for a Class II Permissive Change from the IC authorities. Depending on antenna gain and other factors the IC TCB will issue a reduced test plan for re-testing. Stollmann can assist customers with conducting this procedure on request. Especially the test plan reduction and cost optimization may be items worth to look at.

8.3.1 IC Grant

tbd

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.

RF exposure evaluation of devices implementing the BlueMod+SR/AP should be done with the collaboration of the IC TCB working on the Class II Permissive Change Request.

8.3.5 IC Labeling Requirements for the End Product

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

This device contains transmitter with	
FCC ID:	RFRMSR
IC:	4957A-MSR

8.3.6 IC Label Information BlueMod+SR

The BlueMod+SR 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.

The IC-ID is: 4957A-MSR

8.4 Bluetooth Qualification

The BlueMod+SR is a qualified design according to the Bluetooth Qualification Program Reference Document (PRD) V2.1. The Qualified Design ID (QDID) is:

tbd

For further information about marking requirements of your product attention should be paid the Bluetooth Product Marking Guide at
https://www.bluetooth.org/Download/Marking_Guide_20060601.pdf

According to the Bluetooth SIG rules (Qualification Program Reference Document – PRD V2.1) you are required to perform the mandatory End Product Listing (EPL) for your product. For further information see www.Bluetooth.org or contact Stollmann.

8.5 RoHS Declaration

Declaration of environmental compatibility for supplied products:

Hereby we declare to our best present knowledge based on declaration of our suppliers that this product do not contain by now the following substances which are banned by Directive 2011/65/EU (RoHS 2) or if contain a maximum concentration of 0,1% by weight in homogeneous materials for

- Mercury and mercury compounds
- Chromium (VI)
- PBB (polybrominated biphenyl) category
- PBDE (polybrominated biphenyl ether) category
- And a maximum concentration of 0,01% by weight in homogeneous materials for
- Cadmium and cadmium compounds

9 Related Documents

[1] CD00171190.pdf Oct. 2011 Rev 14 (STM32_Reference)

[2] CD00191185.pdf April 2011 Rev 8 (STM32_datasheet)

[3] Stollmann: UICP_UART_Interface_Control_Protocol_r01.pdf

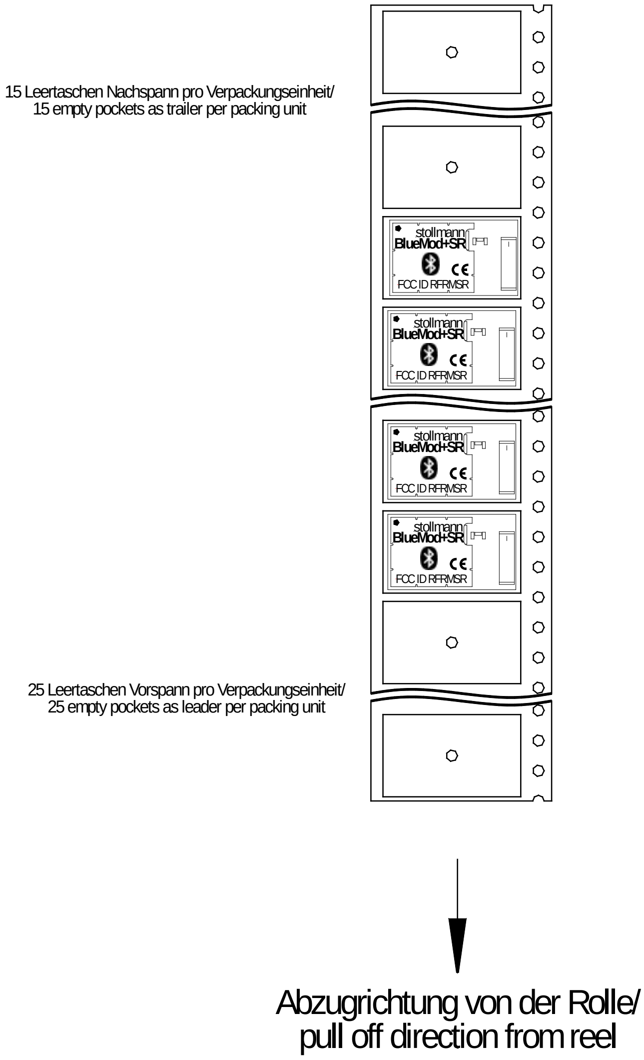
[4] Stollmann: AppNote_B0601_Antenna_Design_V1_0.pdf

[5] Stollmann: BlueMod+SR AT Command Reference

[6] Stollmann: BlueMod+SR_Startup_Timing_r01.pdf

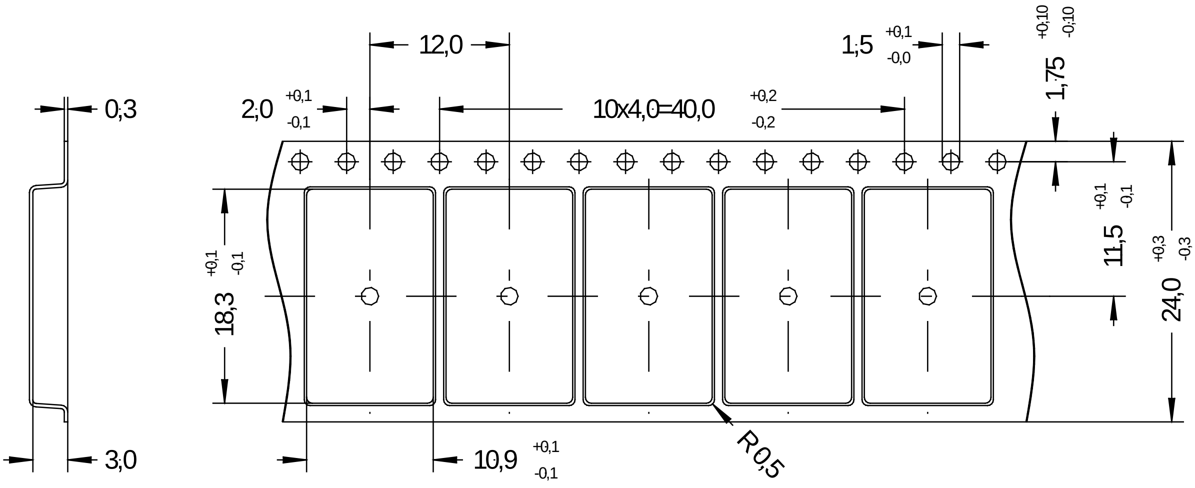
10 Packing

The BlueMod+SR modules are packed using carrier tape.



10.1 Tape

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

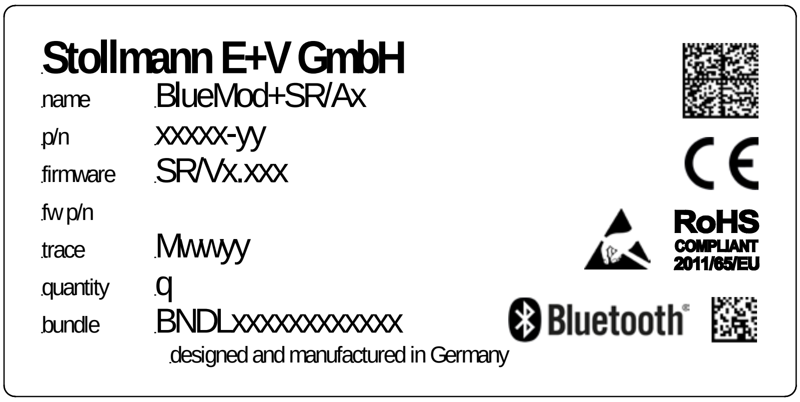


10.2 Reel

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 (YearCalendarWeek) YYWW
quantity	Number of contained modules

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

11 Ordering Information

11.1 Part Numbers

BlueMod+SR is available in the following variants:

Name	Antenna	Order No.	MOQ / units	Comments
BlueMod+SR/AI	internal	53231-xx	50	
BlueMod+SR/AP	external	53252-xx	500	
BlueEva+SR	Internal	53249-xx	1	Evaluation Kits

Other variants on request, please contact Stollmann sales department.

11.2 Standard Packing Unit

The standard packing unit is 500 pieces Tape and Reel

11.3 Evaluation Kit

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

History

Version	Release Date	By	Change description
r02	04.02.2013	MW/JW	First preliminary release
r03	21.02.2013	MW/GJ GJ JW FH	signal naming conventions harmonized signals in tables re-sorted corrected some typos updated dimension drawing (with new antenna) added land pattern drawing renamed chapter “Restricted Area” into “Placement Recommendation” and replaced text with drawing Figure 10 “Pin Numbering” added Added current consumption for standby mode Chapter 1 Introduction revised
r04d01	22.02.2013 06.03.2013 19.04.2013 ff.	JW MW	Spelling and formatting Chapter 3, Application Examples added to several sub chapters Chapter 3.1 Power Supply, requirements lowered Chapter 3.3 allowed to use series resistor to connect external low-active reset Chapter 3.5 Serial Interface updated, UICP included Chapter 3.6 renamed to GPIO Interface Chapter 3.10 minor changes in text Enhanced chapter 3.13 Pin Strapped System Memory Boot Mode Invocation New chapter 3.15 Serial Wire Interface Chapter 4.2 Pin Description, tables updated and corrected, removed signals “/BT-CONNECTED” and “STM32-WAKEUP” New chapter 4.3 Handling of unused Signals Chapter 5.6 Power Consumption Tables updated Chapter 5.7 RF parameter updated Chapter 5.7.5 Antenna Gain and Radio Pattern updated Chapter 6.3 updated New chapter 7 Application Diagram

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