

# BlueMod+C11/G2

Hardware Reference

Release r06



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## Note

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## 1 Introduction

This Hardware Reference Guide documents how BlueMod+C11/G2 can be integrated into customer systems.

It addresses developers of hardware environments for BlueMod+C11/G2.

For detailed information about software interfaces refer to the software reference manual.

The BlueMod+C11/G2 is available with EDR functionality disabled and enabled. For the product with EDR disabled all information given in the following chapters regarding EDR performance and functionality is not valid. Information regarding EDR performance and functionality applies only to the BlueMod+C11/G2 with EDR functionality enabled.

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

<http://www.stollmann.de/en/modules/bluetooth-products/bluemod-c11g2/>

### 1.1 Feature Summary

- Bluetooth specification V2.0+EDR
- EDR compliant with V2.0 of specification for 2Mbps and 3Mbps modulation modes
- Full Speed Bluetooth Operation with Full Piconet Support
- Scatternet Support
- Complete Co-location and Co-existence with 802.11 (AWMA, AFH and SFH)
- Fast Connection Setup
- RF output power class 1 with power control
- Supply Voltage 3.0V to 3.6V
- Internal crystal oscillator (26 MHz BC04 and 14,7456MHz for ARM7)
- Full Bluetooth data rate up to 2178 kbps asymmetric
- Support for very low-power modes (sleep and deep sleep)
- Full 8- to 128-bit encryption
- High sensitivity design ( -87 dBm typ.)
- Extra ARM7TDMI CPU for embedded profiles and/or application software
- Up to 17 GPIO lines
- USB 2.0 Full Speed Device Interface
- Master/Slave SPI
- Synchronous Serial Controller
- PWM Controller

- 
- 10 bit A/D Converter
  - Power control
  - 5V tolerant I/Os
  - -40°C to +85°C industrial operating temperature range
  - RoHS Compliant

## 1.2 Applications

BlueMod+C11/G2 can be used in different applications.

Available applications are

- Bluetooth SPP
- BlueMux Point to Multipoint SPP
- BlueCluster Adhoc Networking

Please refer the software reference and interface specifications for further information.



## 3 Application Interface

### 3.1 Power Supply

The BlueMod+C11/G2 has two power supply rails, which always should be kept on the same voltage level. Although we recommend using two different power rails, it is as well possible to feed both rail from a single supply.

Pin #	Signal	Usage
C-13	3V3	Supply for digital and low power RF circuitry,
C-16	3V3-PA	Supply for RF Amplifier
C-14	GND	Reference Supply
C-15	GND	Reference Supply

The pin order is made such that on the customer hardware directly at the pins of each supply pair pins (C-13/C14) and pins (C-16/C-15) a 10uF X5R ceramic capacitor with for example a 1206 footprint can be placed for decoupling. It is recommended to add further smaller value ceramic capacitors. These values depend on noise frequencies on the supply rail. The following picture shows a sample layout with two linear regulators in SOT23-5 housings and various capacitors in SMT shapes 0402, 0805 and 1206.

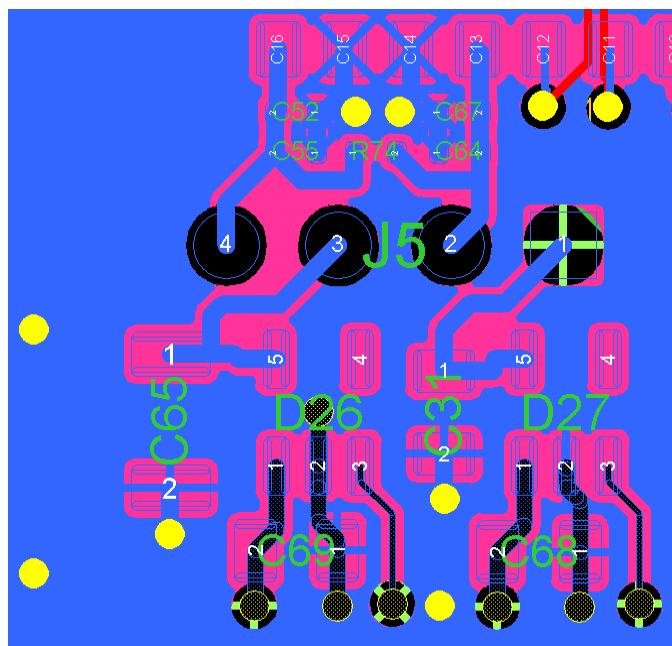


Fig. 2 Sample Layout Power Supply

Each supply rail should be fed with 3,3V, Range 3,0V to 3,6V incl. Noise, low noise from a linear regulator with fast transient response. Stollmann suggest using two pcs.

TOREX: XC6204B332MR

regulators, so that the fast current transients of the class1 RF power amplifier do not interfere with sensitive PLL circuitry of the low power RF circuitry.

For layout guidelines please see sample implementation Stollmann reference design BlueMod+Eval/C11/G2.

Excessive noise or too slow current transient response on the supply rails may have an impact on the RF performance.

### 3.2 Power-up slew-rate

The Power up slew-rate for the BlueMod+C11/G2 must be more then 6V/ms for proper startup of the AT91SAM7S Controller used on the BlueMod+C11/G2.

Figure 3 shows an example circuit for a power supply. The Output Voltage of the Regulator is enabled by the Threshold Voltage of a RESET-Circuit, when VCC Star-tup ramp reaches a valid Voltage.

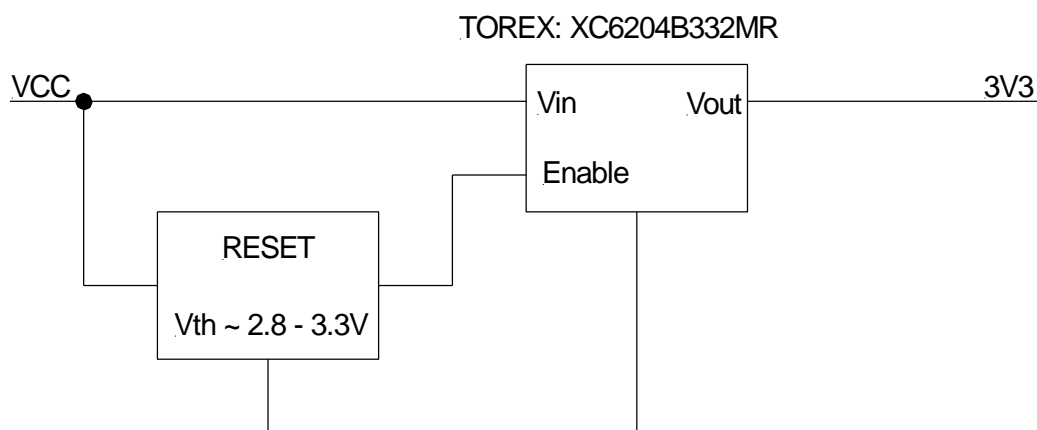


Figure 3 power supply example circuit

### 3.3 Power-On-Reset

The BlueMod+C11/G2 is equipped with circuitry for generating Power-On Reset and to provide under-voltage supervision. An integrated circuit type Maxim DS1818R provides this functionality.

A reset is generated if the 3.3V supply rail including noise falls below 2,8V to 2,97V.

Via Pin A-1 an external reset can be generated by holding EXT-RES# at  $\leq 0.3V$  for  $\geq 10ms$ . A 74LVC14 Schmitt Trigger gate with a 1kR5/10nF low-pass filter at the input is implemented to avoid false reset pulse recognition due to EMC effects.

If EXT-RES# is not used, it may be left open or tied to VCC.

### 3.4 Serial Interface

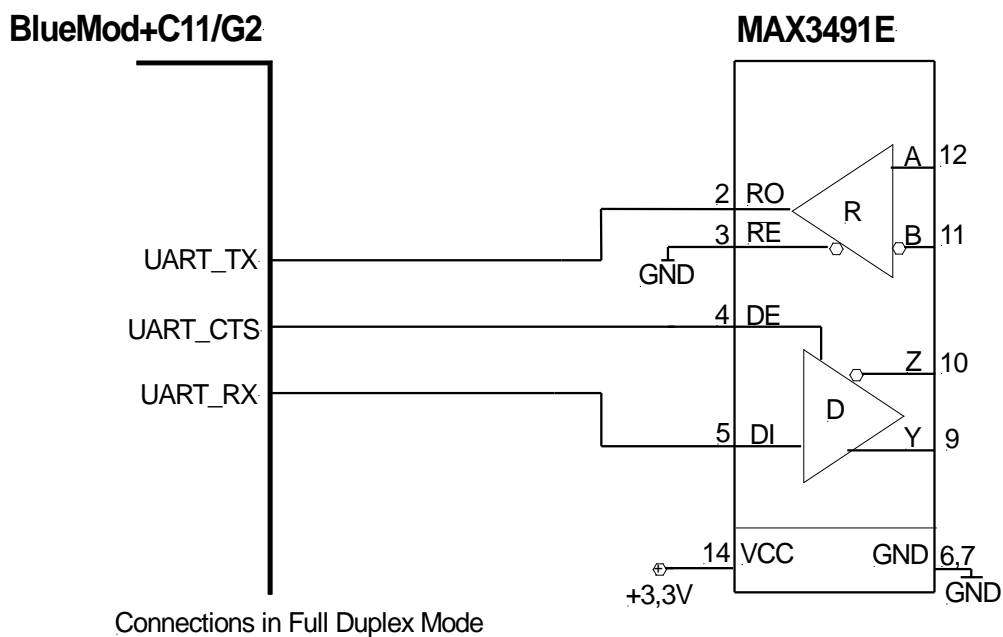
The interface functionally corresponds to the norm V.24 / RS-232 but has TTL-level.

- Transmission speeds 300 bps – 921600 bps (asynchronous)
- Character representation: 7 to 9 Bit, even, odd, mark, space or no Parity, 1, 1.5 or 2 stop bits
- Half duplex or full duplex
- Hardware flow-control (RTS/CTS)

*Note: All signals of the serial interface are named according to the EIA232 DTE definition.*

#### 3.4.1 RS-485 Support

For RS-485 support the serial interface has to be connected to an external Transceiver, we suggest the MAX3491E from Maxim Integrated Products, due to it supports full duplex transmissions.



## BlueMod+C11/G2

## MAX3491E

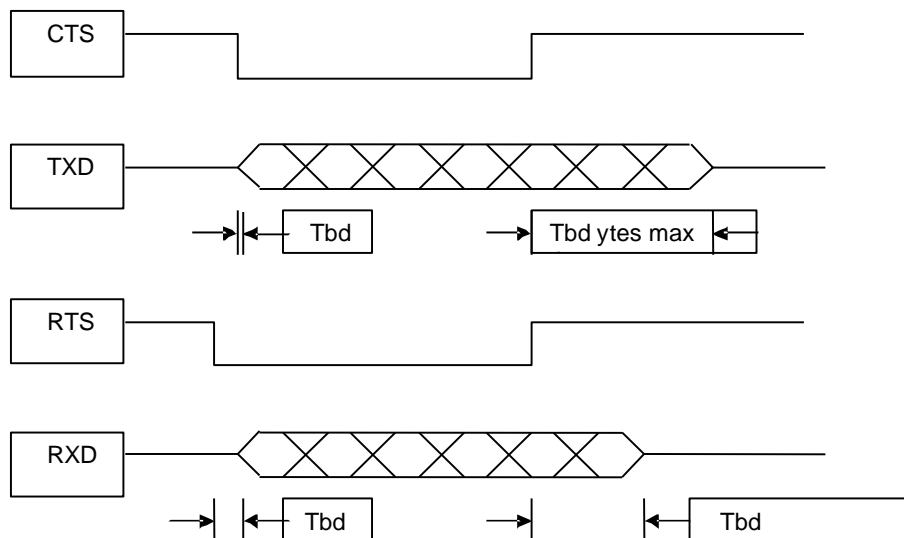
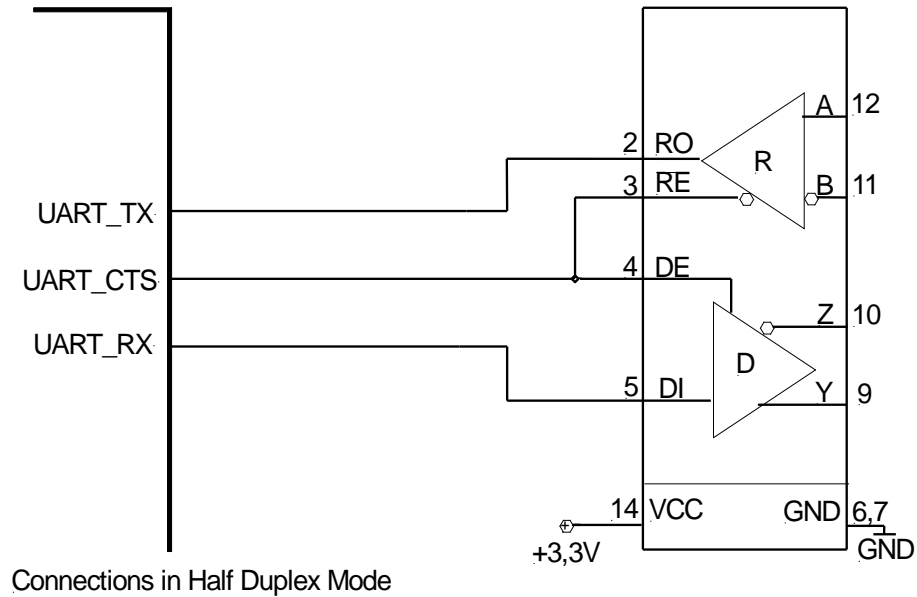


Figure 4. UART Timing Diagram

### 3.5 GPIO Interface

All user signals, except for EXT-RES#, which is routed via an Schmitt Trigger gate, are connected directly to port pins of the ATMEL AT91SAM7S256 CPU. Except for USB signals DP, DM and GPIO(4), no additional pull-up or down resistors are implemented, so that the I/O characteristics of the ATMEL CPU apply. These are

- 3V3 logic 5V tolerant
- $V_{IL} \max = 0.8V$ ,  $V_{IH} \min = 2.0V$ ,  $V_{IH} \max = 5.5V$
- $V_{OH} \min = VCC - 0.4V @ I_O = 8mA$ ,  $V_{OL} < 0.4V @ I_O = 8mA$
- LED's can be driven directly on specific GPIO lines when  $I_o$  stays below 8mA  
All current consumption data in this document are given with  $I_o(\text{GPIO}) = 0mA$   
See chapter 5 Electrical Characteristics for detailed information.
- All I/O signals except USB, GPIO(4) and JTAG are connected directly from the AT91SAM7S pins to the user accessible stamp pins. Therefore, the electrical characteristics of the I/O pins are programmable in regard to direction, pull-up resistor, function, push-pull or open drain. Please see specific application software documentation for details. After reset, all GPIOs have pull-ups activated. GPIO10, GPIO8 and TXD have 50kR to 300kR pull-ups, all other I/Os have 5kR to 20kR pull-ups

### 3.6 Alternate GPIO/IO Functions

Application specifically dedicated GPIO or IO pins can be programmed to alternative functionalities. Then pin functionality and direction are fixed for the activated function block. Many GPIOs are used by the SPP application. See chapter [SPP Configuration](#). Probably some of them can be released for use by other function blocks. Co-functionality of blocks has to be carefully considered, because pin multiplexing possibilities are fixed by the ATMEL AT91SAM7S CPU and using a function block often causes that other function blocks can't be used at the same time. Please refer to the ATMEL data sheet AT91SAM7Sxxx Rev. F for complete information. The possibilities depicted in the following chapters are a subset only.

The following function blocks may be usable on the BlueMod+C11/G2:

#### 3.6.1 Master/Slave SPI Interface

Pin #	GPIO# IO Name	Alternative Signal Name	Description	Direction	
				Master	Slave
A5	GPIO1	MISO	Master In Slave Out	IN	OUT
A4	GPIO0	MOSI	Master Out Slave In	OUT	IN
A3	GPIO3	SPCK	Serial Clock	OUT	IN
A6	GPIO2	NPCS0	Peripheral. Chip Select	OUT	IN

Clock polarity and phase are programmable. The chip select signal is low active.

### 3.6.2 Synchronous Serial Interface

The Synchronous Serial Interface is capable of handling the protocols I2S, Short Frame Sync, Long Frame Sync and other Telecom protocols. Receiver and transmitter do act independently. Due to multiplexing interdependencies, the SSC is only available with the Transmitter clock signal TK used for both directions if the UART IF is enabled. JTAG reset, signal /ATRST, is also not available, if the SSC signal RF, Receiver Frame Sync is used.

Pin #	GPIO# IO Name	Alternative Signal Name	Description	Direction	
				Case 1	Case 2
A16	/ATRST	RF	Receiver Frame Sync	IN	OUT
A12	GPIO10	RD	Receiver Data	IN	IN
C7	TXD	RK	Receiver Clock	IN	OUT
A13	GPIO7	TF	Transmitter Frame Sync	IN	OUT
A11	GPIO8	TD	Transmitter Data	OUT	OUT
A14	GPIO9	TK	Transmitter Clock	IN	OUT

### 3.6.3 Multi Channel PWM Controller

Each PWM channel can be programmed individually in regard to IO pin assignment and PWM functionality. Therefore, PWM application designers can choose a proper channel and pin for their application with the chance not to interfere with other necessary interfaces.

Pin #	GPIO# IO Name	Alternative Signal Name	Description	Direction
A6	GPIO2	PWM0	PWM Waveform Out CH0	OUT
C9	GPIO5	PWM0	PWM Waveform Out CH0	OUT
C5	/CTS	PWM1	PWM Waveform Out CH1	OUT
A5	GPIO1	PWM1	PWM Waveform Out CH1	OUT
A5	GPIO1	PWM1	PWM Waveform Out CH1	OUT
C2	GPIO15	PWM1	PWM Waveform Out CH1	OUT
C4	/RTS	PWM2	PWM Waveform Out CH2	OUT
A4	GPIO1	PWM2	PWM Waveform Out CH2	OUT
C8	GPIO6	PWM2	PWM Waveform Out CH2	OUT
A3	GPIO3	PWM3	PWM Waveform Out CH3	OUT

### 3.6.4 Analog to Digital Converter

Three ADC channels with 8 to 10bit resolution in reference to 1.8V are available. A wide range of trigger sources and programmable S&H timing are available.

Pin #	GPIO# IO Name	Alternative Signal Name	Description	Direction
A16	JTAG-RES#	AD3	ADC channel 3	In analogue
A12	GPIO10	AD0	ADC channel 0	In analogue
A11	GPIO8	AD1	ADC channel 1	In analo- gue

### 3.7 Bluetooth radio Interface

The BlueMod+C11/G2 offers three population variants for the antenna

- 1) The BlueMod+C11/G2/AE variant presents a 50 $\Omega$  impedance antenna interface on a Radiall UMP connector, type R107103020. See <http://www.radiall.com/>
- 2) The BlueMod+C11/G2/AI variant presents an integrated ceramic antenna.

In both cases the Pins A-26 – A-28 can be left unconnected.

- 3) The BlueMod+C11/G2/AP variant presents a 50 $\Omega$  impedance antenna interface on pin A-27 with adjacent GND pins A-26 and A-28. In this case Pin A-26 and A28 shall be connected directly to the reference GND plane. Signal routing of the RF signal on customer PCB has to be implemented with 50R micro-strip line technique.

If the antenna performance does not meet your requirements or you need antenna support, please contact Stollmann.

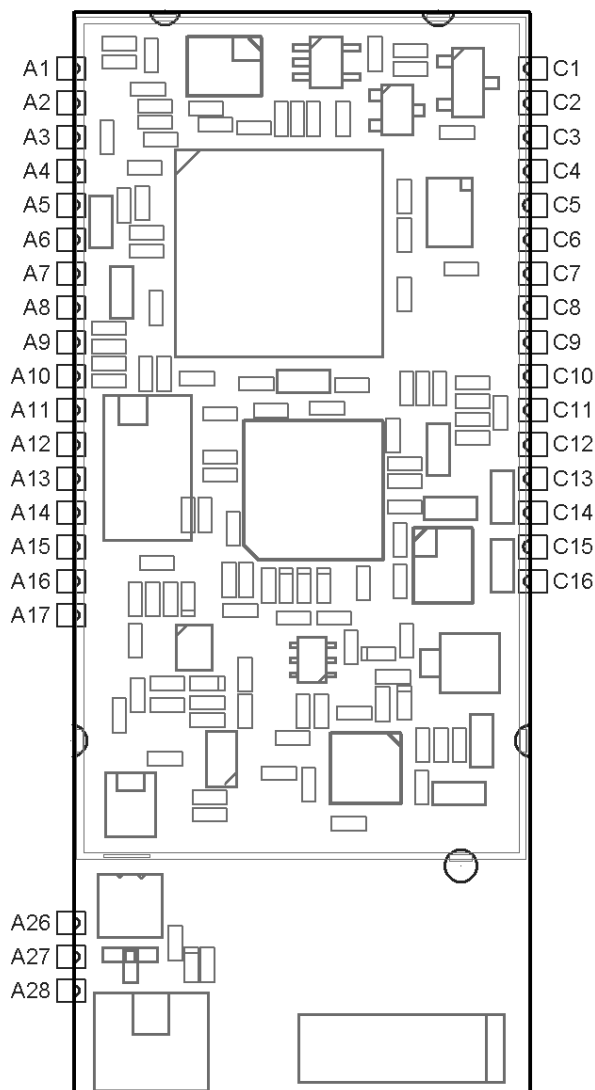
### 3.8 JTAG

For software development purposes a full JTAG interface, connected to the ATMEL MCU is available.

## 4 Pin Description

The BlueMod+C11/G2 module is soldered on customers PCB via stamp pins located on the module PCB edges.

### 4.1 Pin Numbering



Top View

## 4.2 Pin Description

### 4.2.1 General Pin Description

Pin	Signal	Type	Active	Description
A1	/EXT_RES	I-PU	L	Reset low active internal 47k pull-up
A2	GPIO11 (DTXD)	I/O-PU		General Purpose IO – Debug Uart Output
A3	GPIO3	I/O-PU		General Purpose IO
A4	GPIO0	I/O-PU		General Purpose IO
A5	GPIO1	I/O-PU		General Purpose IO
A6	GPIO2	I/O-PU		General Purpose IO
A7	ATDO	O		JTAG test data output
A8	ATCK	I-PU		JTAG clock
A9	ATMS	I-PU		JTAG mode select
A10	ATDI	I-PU		JTAG test data input
A11	GPIO8	I/O-PU		General Purpose IO
A12	GPIO10	I/O-PU		General Purpose IO - internal 10k pull-up
A13	GPIO7	I/O-PU		General Purpose IO
A14	GPIO9	I/O-PU		General Purpose IO
A15	GPIO12 (DRXD)	I/O-PU		General Purpose IO – Debug Uart Input
A16	GPIO16	I/O-PU	L	General Purpose IO
A17	reserved			do not connect-
A26	ANT_GND <sup>a)</sup>			Antenna ground, connect directly to plane
A27	ANT <sup>a)</sup>			50 Ohm Rx/Tx connection to antenna
A28	ANT_GND <sup>a)</sup>			Antenna ground, connect directly to plane
C1	GPIO14	I/O-PU		General Purpose IO
C2	GPIO15	I/O-PU		General Purpose IO
C3	GPIO13	I/O-PU		General Purpose IO
C4	/RTS	I-PU	L	Request to send
C5	/CTS	O	L	Clear to send
C6	RXD	O		Receive Data
C7	TXD	I-PU		Transmit Data
C8	GPIO6	I/O-PU		General Purpose IO
C9	GPIO5	I/O-PU		General Purpose IO
C10	GPIO4	I/O-PD		General Purpose IO - internal 47k pull-down
C11	USB_DM	I/O		USB D-, Data pin
C12	USB_DP	I/O		USB D+, Data pin
C13	VCC	P		+3.3V Power digital and low power RF
C14	GND	P		GND
C15	GND	P		GND
C16	VCC	P		+3.3V Power RF amplifier

Type: PU – pulled up on Module; PD pulled down on Module

Notes:

a) refer to Chapter 3.7

## 4.2.2 Application Specific Pin Description

### 4.2.3 SPP Configuration

Pin	Pin Name	SPP function	Type	Active	Description
A11	GPIO8	Reserved	I-PU		
A12	GPIO10	Reserved	I-PU		
A13	GPIO7	/LED1	O	L	Device ready
A14	GPIO9	/LED2	O	L	Bluetooth connected. Active if a Bluetooth connection exists. Inactive in idle state. Flashes during startup.
C1	GPIO14	/RTC-OUT	O	L	DSR in DCE mode DTR in DTE mode
C2	GPIO15	/DCD	I/O-PU	L	Data Carrier Detect input in DTE mode, output in DCE mode
C3	GPIO13	/RTC-IN	I-PU	L	DTR in DCE mode DSR in DTE mode
C4	/RTS		I-PU	L	Request to send
C5	/CTS		O	L	Clear to send
C6	RXD		O		Receive Data
C7	TXD		I		Transmit Data
C8	GPIO6	/RI	I/O-PU		Ring Indicator input in DTE mode, output in DCE mode
C9	GPIO5	Reserved	I-PU		
C10	GPIO4	DTE-/DCE	I-PD	47k PD	DTE DCE mode selector
C13	VCC	VCC	P		+3.3V Power
C14	GND	GND	P		GND
C15	GND	GND	P		GND
C16	VCC	VCC	P		+3.3V Power
A1	/EXT_RES	/EXT_RES	I	L	Reset low active
C11	USB_DM				Do not connect
C12	USB_DP				Do not connect

## 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	$V_{cc}$	3,7V with respect to GND to - 0,4V with respect to GND	V
Voltage on any pin	$V_{Pin}$	VCC + 0,4V with respect to GND to - 0,4V with respect to GND	V
Input RF level	$P_{max}$	0	dBm
ESD on any pin	$V_{ESD}$	This device is ESD sensitive. Handling and assembly of this device should be at ESD protected workstations.	

### 5.2 Environmental Requirements

Item	Symbol	Absolute Maximum Ratings	Unit
Storage temperature range	$T_{stg}$	-40 to +105	°C
Operating temperature range	$T_{op}$	-40 to +85	°C

## 5.3 Operating Conditions

### 5.3.1 RF and Supply Connections

$V_{cc} = 3.0V$  to  $3.6V$ ,  $T_{amb} = -40^{\circ}C$  to  $+85^{\circ}C$

Item	Condition	Limit			Unit
		Min	Typ	Max	
Frequency Range Pin A-27		2400		2483.5	MHz
Load impedance Pin A-27 or UMP connector	Measured with network analyzer in the frequency range at antenna pin		50		$\Omega$
Output return loss Pin A-27 or UMP connector	Receive Mode to $50\Omega$ load Transmit Mode to $50\Omega$ load	-10 -10			dBm
Supply voltage Pin C-13 and Pin C-16	The typical voltage is recommended $V_{cc}$ at voltage pin (incl. ripple)	3.0	3.3	3.6	Vdc
Ripple on $V_{cc}$	Ripple frequency $\geq 200kHz$ Ripple frequency $< 200kHz$			20 20	mVrms

### 5.3.2 GPIO, JTAG; Serial IF and Test Pins

$V_{CC} = 3.3V$ ,  $T_{amb} = -40^{\circ}C$  to  $+85^{\circ}C$

Symbol	Item	Condition	Limit		Unit
			Min	Max	
$V_{IL}$	Low-Level Input Voltage		-0.3	0.8	V
$V_{IH}$	High-Level Input Voltage		2.0	5.5	V
$V_{OL}$	Low-Level Output Voltage	$I_{OL} < 8mA$	-	0.4	V
$V_{OH}$	High-Level Output Voltage	$I_{OH} < 8mA$	$V_{CC}-0.4$	-	V
$I_{O1}$	Output Current GPIO(5,6,15)		-	16	mA
$I_{O2}$	Output Current GPIO(10,8), TXD, /JTAG-RES		-	2	mA
$I_{O3}$	Output Current Other PIO except USB			8	

*Note: Please refer to ATMEL AT91SAM7S data sheet for more specific information*

### 5.3.3 USB Pins

$V_{CC} = 3.3V$ ,  $T_{amb} = -40^{\circ}C$  to  $+85^{\circ}C$

Symbol	Item	Condition	Limit		Unit
			Min	Max	
$V_{IL}$	Low-Level Input Voltage			0.8	V
$V_{IH}$	High-Level Input Voltage		2.0		V
$V_{DI}$	Diff. Input Sensitivity		0.2		V
$V_{CM}$	Common Mode Range		0.8	2.5	V
$V_{OL}$	Low-Level Output Voltage	$R_L = 1.425k$ to $3V6$	0.0	0.3	V
$V_{OH}$	High-Level Output Voltage	$R_L = 14.25k$ to GND	2.8	3.6-	V

## 5.4 Power consumption and power down modes

To reduce power consumption of the BlueMod+C11/G2 power down modes can be activated automatically by the BlueMod+C11/G2 (controlled by parameter settings).

If no Bluetooth connection is established, the following states are implemented, the activation of these states can be controlled by the parameters *bpsm* and *pwd*.

For more details please refer to the BlueMod+C11/G2 software manual.

## 5.4.1 SPP configuration

### 5.4.1.1 Deep Sleep state

The Bluetooth RF is completely deactivated; no paging requests from other Bluetooth devices will be recognized. Only rising control line DTR will activate the BlueMod+C11/G2 and may initiate a Bluetooth link dependent on other parameters.

Note: In Deep Sleep state the AT command set is not active, CTS line is low

### 5.4.1.2 Power down state

The Bluetooth RF is activated every 1.25 seconds, paging requests from other Bluetooth devices will be recognized after that intervals and accepted if allowed. Additionally rising control line DTR will activate the BlueMod+C11/G2 and may initiate a Bluetooth link dependent on other parameters.

Note: In Power down state the AT command set is not active, CTS line is low

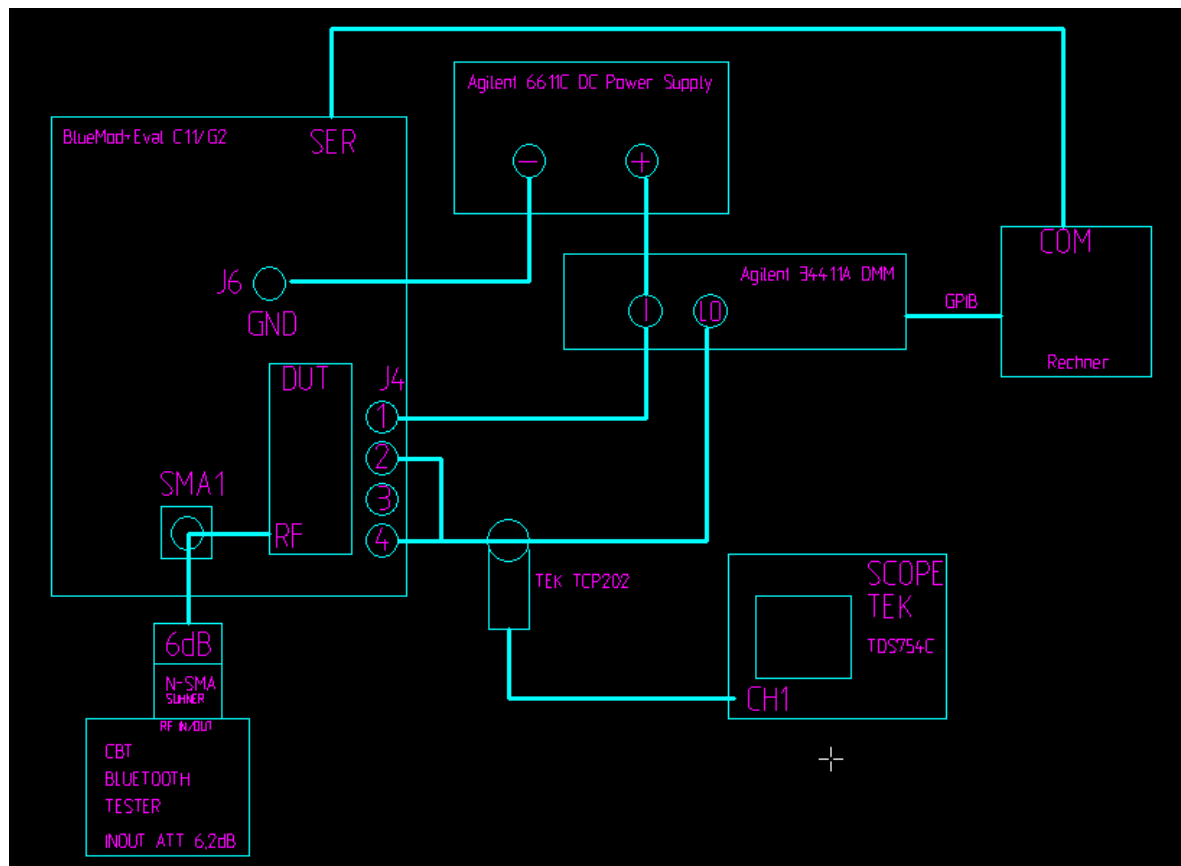
### 5.4.1.3 Idle state

The Bluetooth RF is activated every 1.25 seconds, paging requests from other Bluetooth devices will be recognized after that intervals and accepted if allowed. Additionally rising control line DTR will activate the BlueMod+C11/G2 and may initiate a Bluetooth link dependent on other parameters

### 5.4.1.4 Power Consumption

$V_{CC} = 3.3V$ ,  $T_{amb} = 20^{\circ}C$

Condition	Current Consumption		Unit
	$I_{MEAN}$	$I_{PEAK}$	
RESET	28,3	28,3	mA
Deep sleep	3,41	11	mA
Power down	7,1	57,7	mA
Idle, all functions available, no Bluetooth link	8	62	mA
Page Scan	12,1	101,0	mA
Inquiry and Page Scan	12,4	101,0	mA
Bluetooth connected, no data traffic, max. TX PWR (Slave)	34,7	185,0	mA
ACL connected DH5 max PWR, shortest Poll Period (Slave)	133,3	175,0	mA
ACL connected DH5 min PWR, shortest Poll Period (Slave)	57,5	99,0	mA
ACL connected DH1 max PWR, shortest Poll Period (Slave)	59,0	175,0	mA
ACL connected DH1 min PWR, shortest Poll Period (Slave)	55,0	110,0	mA



## 5.5 RF performance

V<sub>cc</sub> = 3.0V to 3.6V, T<sub>amb</sub> = - 40°C to +85°C

Receiver	Frequency [GHz]	Limit			BT Spec	Unit
		Min	Typ	Max		
Sensitivity at 0.1% BER DH1	2.402	-80,0	-90,0		≤-70	dBm
	2.441	-80,0	-90,0			
	2.480	-80,0	-90,0			
Sensitivity at 0.1% BER DH5	2.402	-80,0	-90,0		≤-70	dBm
	2.441	-80,0	-90,0			
	2.480	-80,0	-90,0			
Sensitivity at 0.1% BER EDR2, PI/4 DQPSK	2.402	-80,0	-88,0		≤-70	dBm
	2.441	-80,0	-88,0			
	2.480	-80,0	-88,0			
Sensitivity at 0.1% BER EDR3, 8DPSK	2.402	-74,0	-82,0		≤-70	dBm
	2.441	-74,0	-82,0			
	2.480	-74,0	-82,0			
Maximum received signal at 0.1% BER with DH1		-20,0	>10		≥-20	dBm
Maximum received signal at 0.1% BER with DH5		-20,0	>10		≥-20	dBm
Maximum received signal at 0.1% BER with EDR2, PI/4 DQPSK		-20,0	-12,0		≥-20	dBm
Maximum received signal at 0.1% BER with EDR3, 8DPSK		-20,0	-18,0		≥-20	dBm
C/I co-channel <sup>a)</sup>			8	11	≤ 11	dB
Adjacent channel selectivity C/I f = f <sub>0</sub> + 1MHz <sup>a)</sup>			-6	0	≤ 0	dB
Adjacent channel selectivity C/I f = f <sub>0</sub> - 1MHz <sup>a)</sup>			-4	0	≤ 0	dB
Adjacent channel selectivity C/I f ≥ f <sub>0</sub> + 2MHz <sup>a)</sup>			-38	-30	≤ -30	dB
Adjacent channel selectivity C/I f ≤ f <sub>0</sub> - 2MHz <sup>a)</sup>			-24	-20	≤ -30	dB
Adjacent channel selectivity C/I f ≥ f <sub>0</sub> + 3MHz <sup>a)</sup>			-45	-40	≤ -40	dB
Adjacent channel selectivity C/I f ≤ f <sub>0</sub> - 5MHz <sup>a)</sup>			-45	-40	≤ -40	dB
Adjacent channel selectivity C/I f = f <sub>image</sub> <sup>a)</sup>			-21	-9	≤ -9	dB

Notes:

a) For BER less then 0,1%. Applies according to BT Test Specification Ver. 1.2/2.0/2.0 + EDR only for T<sub>amb</sub> = 20°C

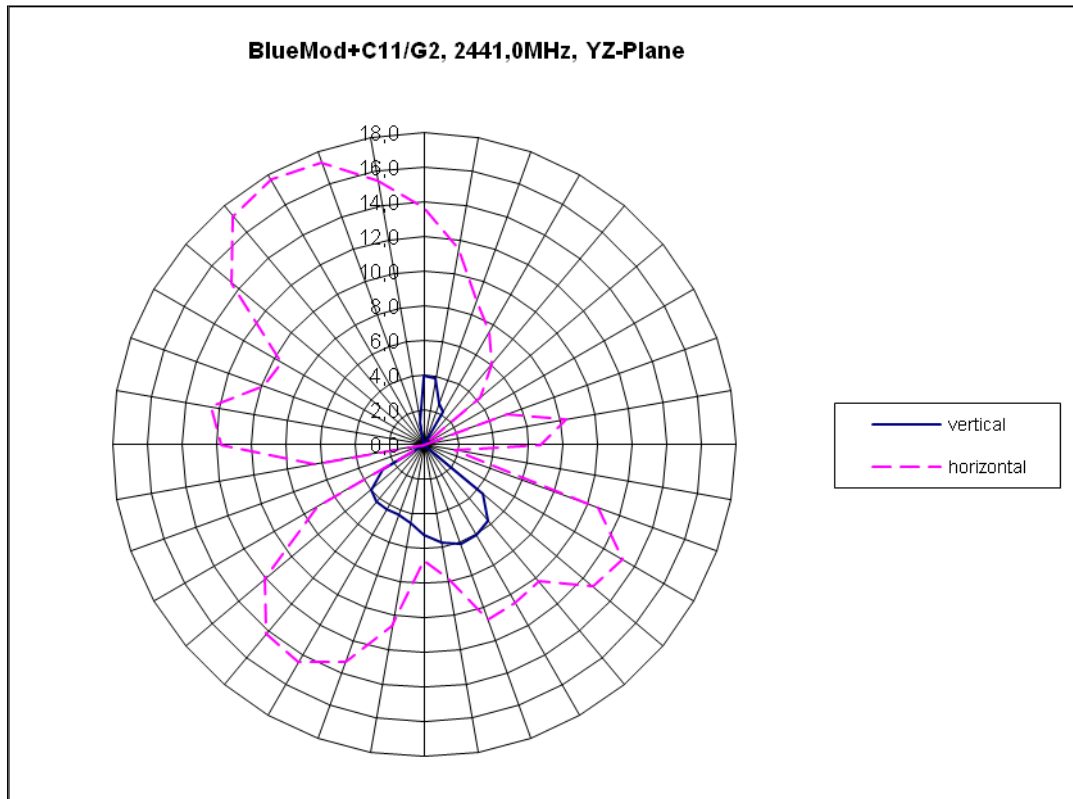
Vcc = 3.0V to 3.6V, Tamb = - 40°C to +85°C

Transmitter	Frequency [GHz]	Limit			BT Spec	Unit
		Min	Typ	Max		
RF transmit power 50 $\Omega$ load, at antenna Class 1 device GFSK <sup>b)</sup>	2.402	16,0	18,5	19,0	+4 to +20	dBm
	2.441	16,0	18,5	19,0		
	2.480	16,0	18,5	19,0		
RF transmit power 50 $\Omega$ load, at antenna Class 1 device EDR2, PI/4 DQPSK <sup>b)</sup>	2.402 GFSK		4,5			dBm
	2.402 DPSK		3,2			
	2.441 GFSK		4,4			
	2.441 DPSK		3,1			
	2.480 GFSK		4,2			
	2.480 DPSK		2,8			
RF transmit power 50 $\Omega$ load, at antenna Class 1 device EDR3, 8DPSK <sup>b)</sup>	2.402 GFSK		4,6			dBm
	2.402 DPSK		3,2			
	2.441 GFSK		4,4			
	2.441 DPSK		3,1			
	2.480 GFSK		4,2			
	2.480 DPSK		2,9			
RF power control range			17			dB
RF power range control resolution			4		2 to 8	dB
20 dB bandwidth for modulated carrier			780	1000	$\leq 1000$	kHz
Initial carrier frequency tolerance			5	30	$\leq \pm 75$	kHz
Carrier frequency drift (packet DH1)			7	25	$\leq \pm 25$	kHz
Drift Rate			6	20	20	kHz/ 50 $\mu$ s
$\Delta f_{1\text{avg}}$ "Maximum Modulation"		140	165	175	$\geq 140$ to $\leq 175$	kHz
$\Delta f_{2\text{avg}}$ "Minimum Modulation"		115	154		$\geq 115$	kHz

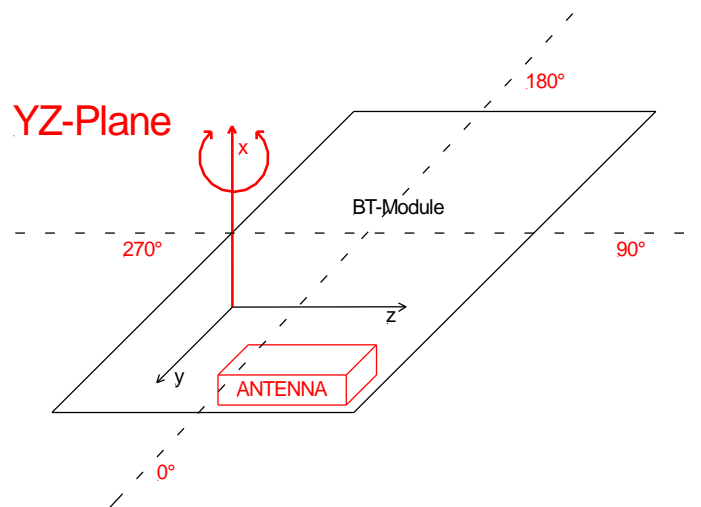
Notes: b) Including +2dBi antenna gain

### 5.5.1 Antenna-Gain and Radiation-Pattern

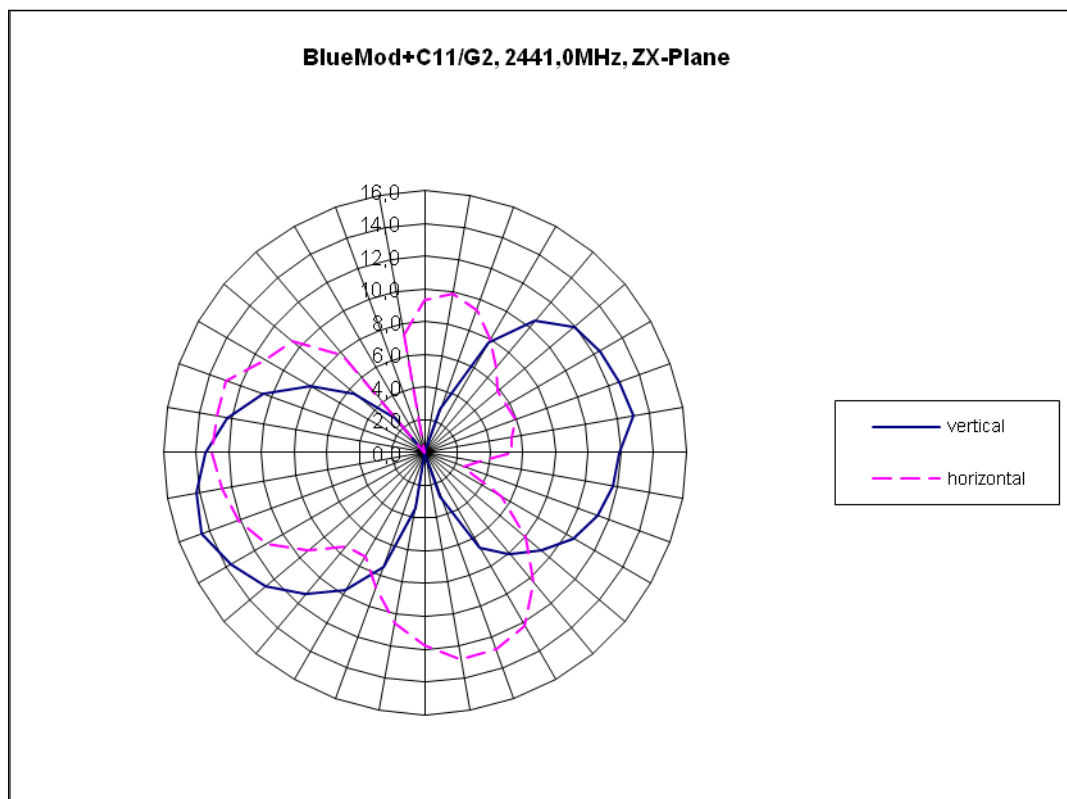
Peak Antenna-Gain = 2dBi



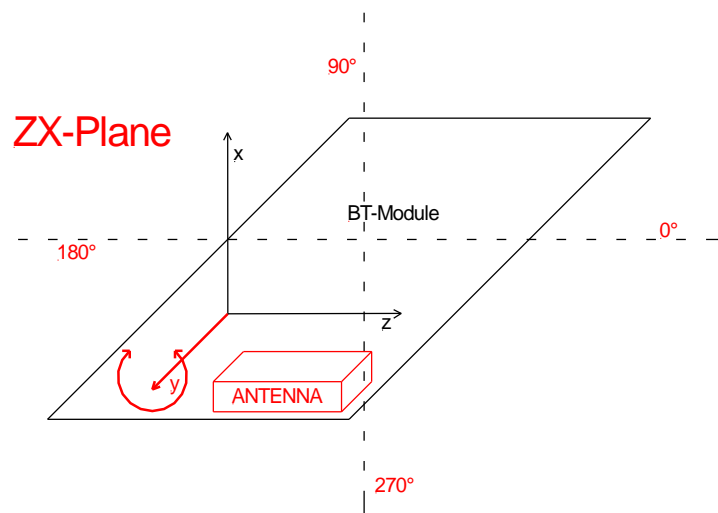
Rotation Axis is X



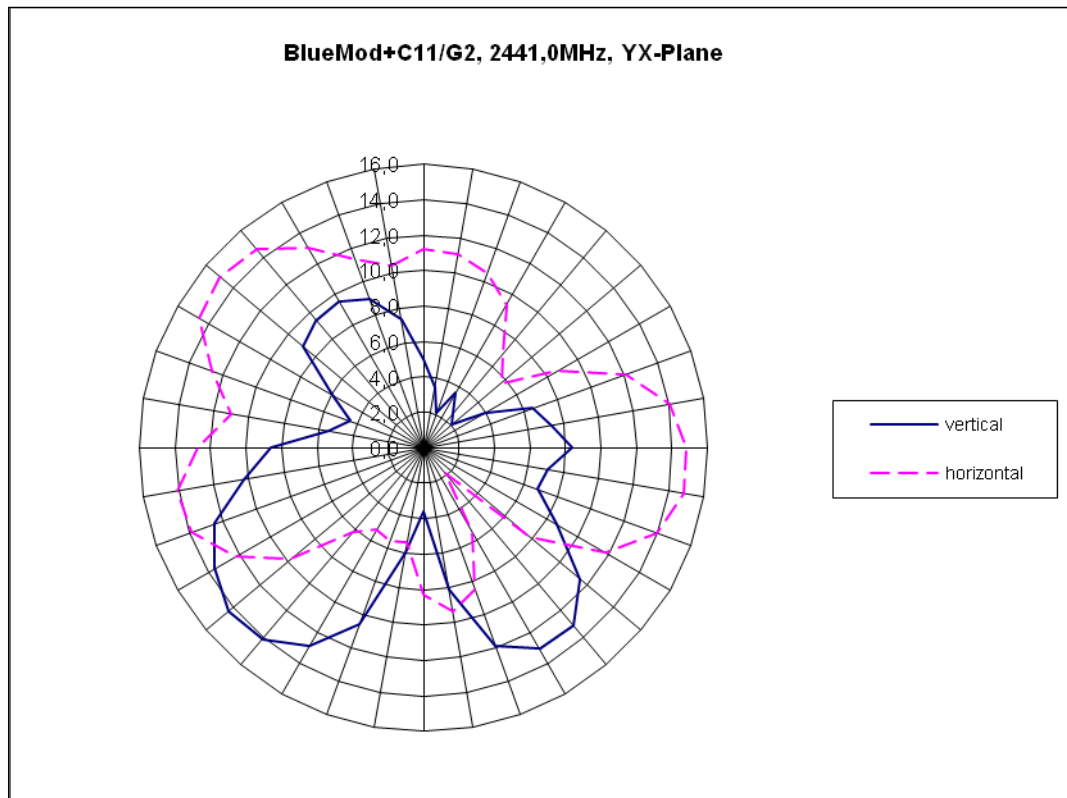
YZ-Plane Drawing, 0° is y-axis, 90° is z-axis



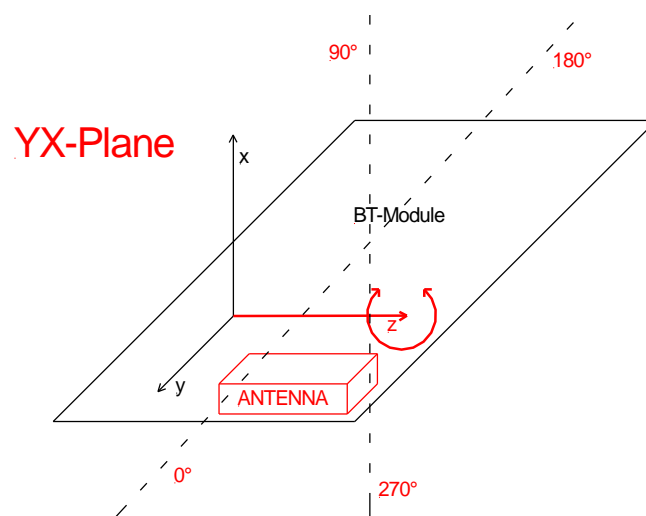
Rotations Axis is Y



ZX-Plane Drawing, 0° is z-axis, 90° is x-axis



Rotations Axis is Z



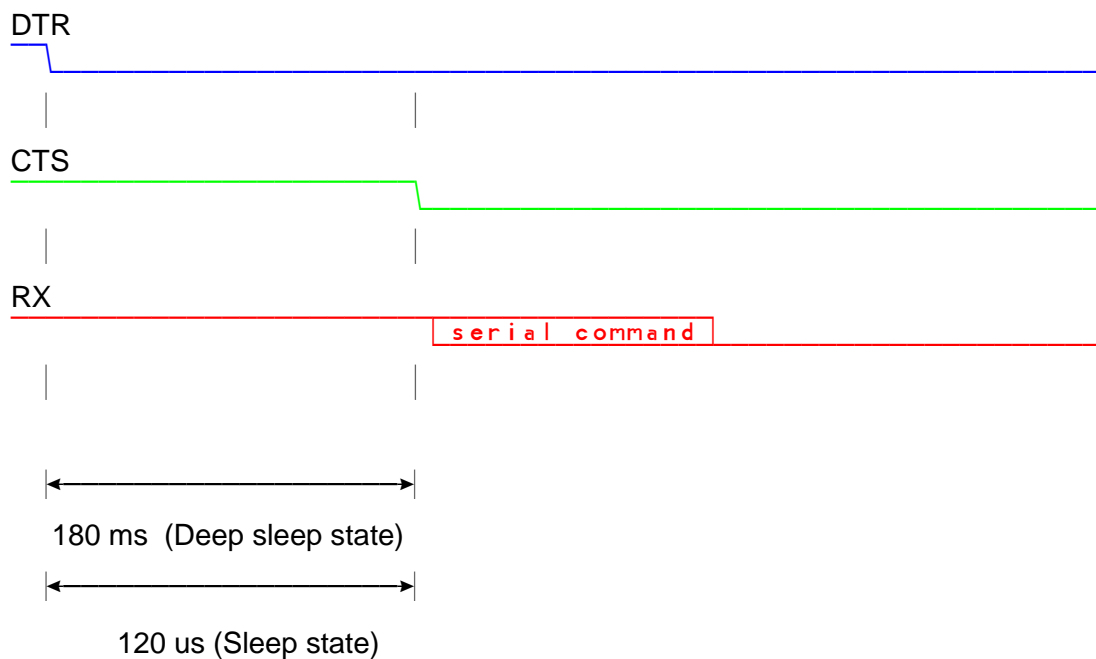
YX-Plane Drawing, 0° is y-axis, 90° is x-axis

## 5.6 Power-up Time

The time until the BlueMod+C11/G2 is able to accept link requests or serial data is about 4 seconds after power-up. This time can be reduced to approx. 1.5 seconds by parameter change.

## 5.7 Wake-up Time

The time until the BlueMod+C11/G2 is able to process commands coming from a sleep state / deep sleep state.

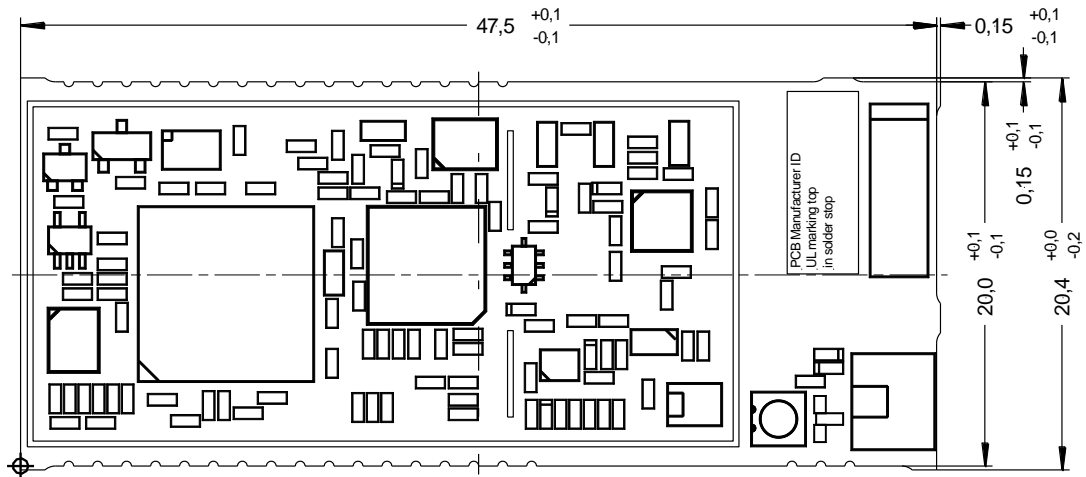


The module processes commands after 180ms coming from deep sleep state and accordingly after 120us coming from sleep (power-down) state.

Serial commands can be sent directly after CTS is active(low).

## 6 Mechanical Characteristics

### 6.1 Dimensions



Module Height: 3,3 –0/+0,1 mm

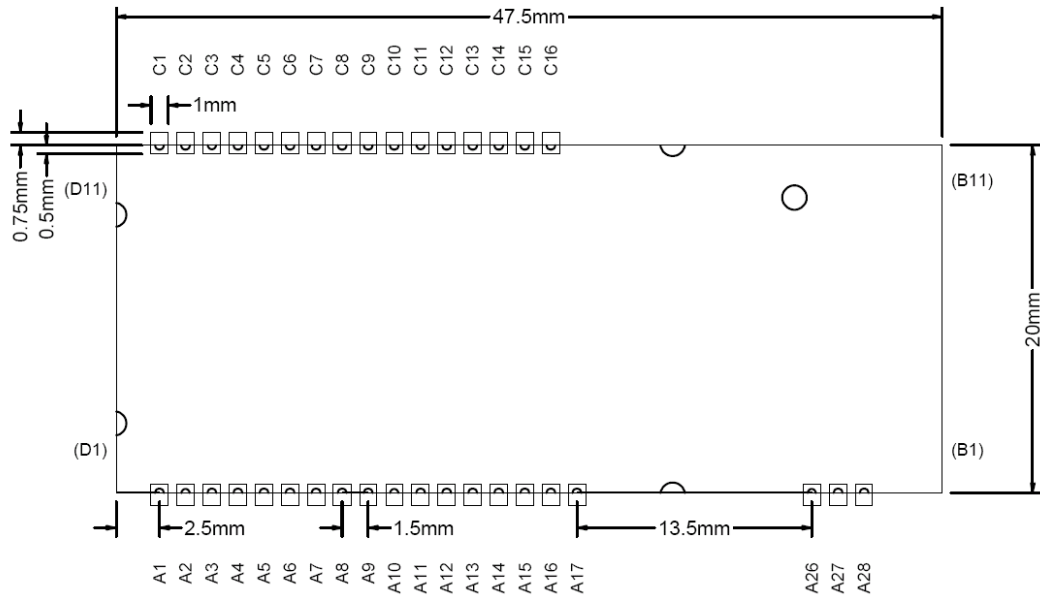
### 6.2 Connectors

Except for the stamp pins A-[1-17,26-28] and C-[1-16] and the UMP antenna connector no user accessible connectors are implemented.

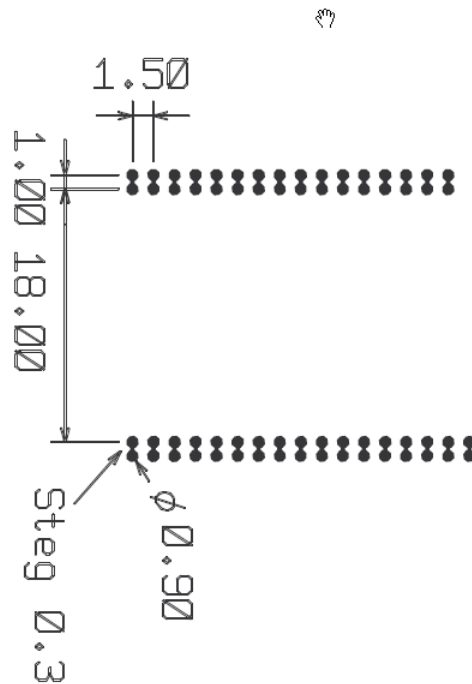
If the use of the UMP antenna connector is considered, please contact Stollmann for information on accessories like cables, plugs etc. Or look at [www.radiall.com](http://www.radiall.com) for the UMP type family. On the BlueMod+C11/G2 the following receptacle will be populated for RF signal routing, if the BlueMod+C11/G2/AE variant is ordered.

Manufacturer	Type
Radiall	RADIALL: R107103020 UMP connector receptacle

### 6.3 Recommended Land Pattern



Land pattern recommended for manual soldering

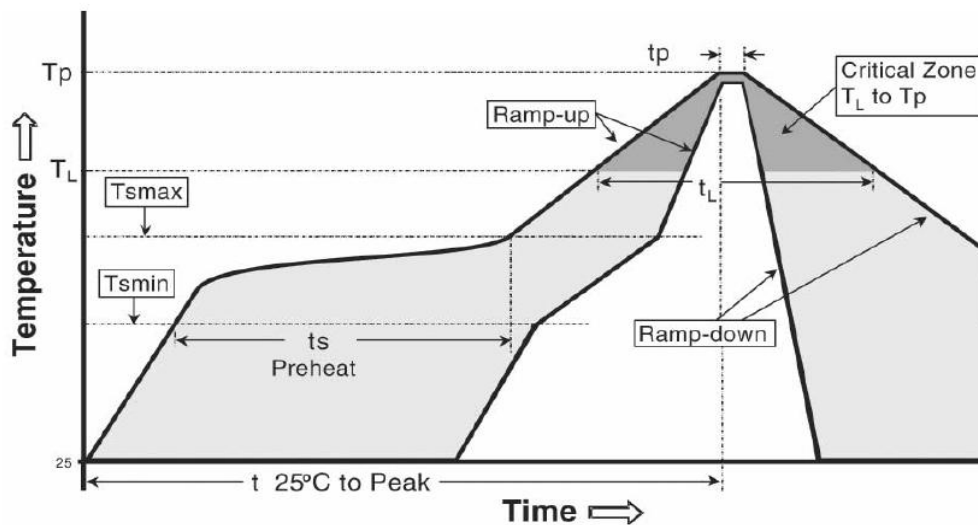


Alternative land pattern recommended for reflow soldering (preliminary)

## 6.4 Soldering Temperature-Time Profile (for lead-free re-flow soldering)

The data here is given only for guidance on solder and has to be adopted 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.

### For lead-free solder



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	90	217	90	260	10
		230	30		
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 lead-free re-flows to a maximum temperature of 260°C.

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## 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

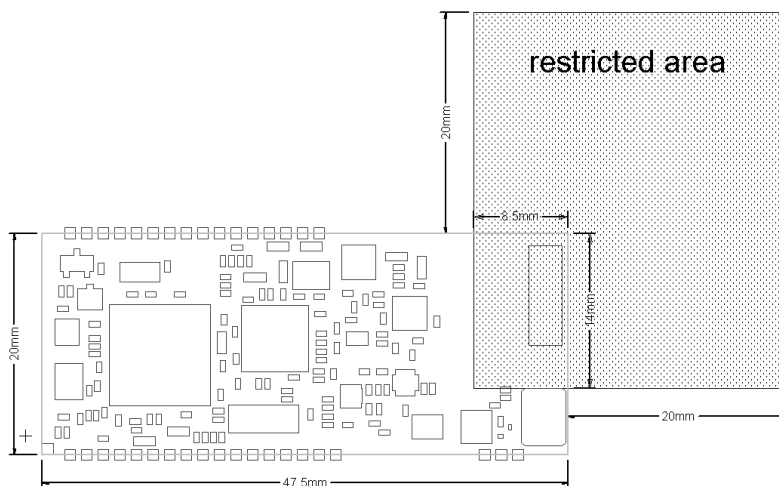
BlueMod+C11/G2 is shipped with 3 different antenna designs:

- BlueMod+C11/G2/-AI comprises a ceramic antenna which as a component is soldered to the circuit board. This is functional for a BlueMod+C11/G2/-AI integrated into a plastic housing. No additional antenna is required.  
For an external antenna to be set in, e.g. because the BlueMod+C11/G2 is integrated into a metal housing, the ceramic antenna is replaced by 2 alternative solutions
- BlueMod+C11/G2/AE has a UMP connector (50 Ohm technology) populated as Antenna Interface
- BlueMod+C11/G21/AP routes the antenna signal to pin A27.

The gain of the external antenna shall not exceed  $+2\text{dB}_i$ .

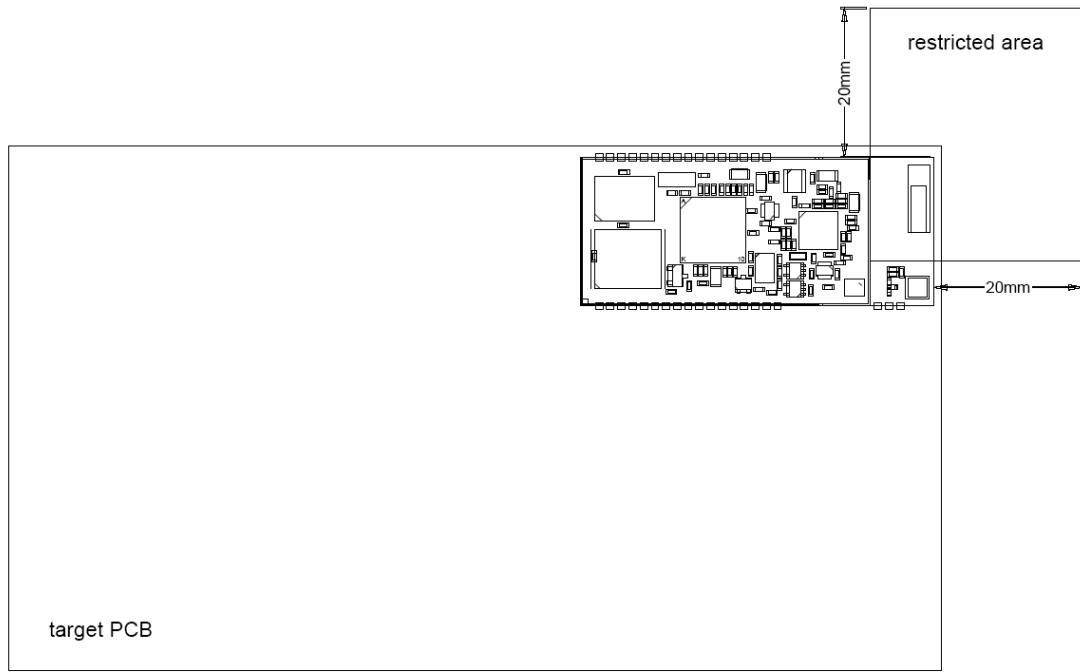
When using an external Antenna the antenna is fixed and cannot be removed or replaced by the end user. The performance of the internal antenna respectively the external antenna has in any case to be checked within the final integration environment. Adjacent PCBs, components, cables, housings etc. could 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.



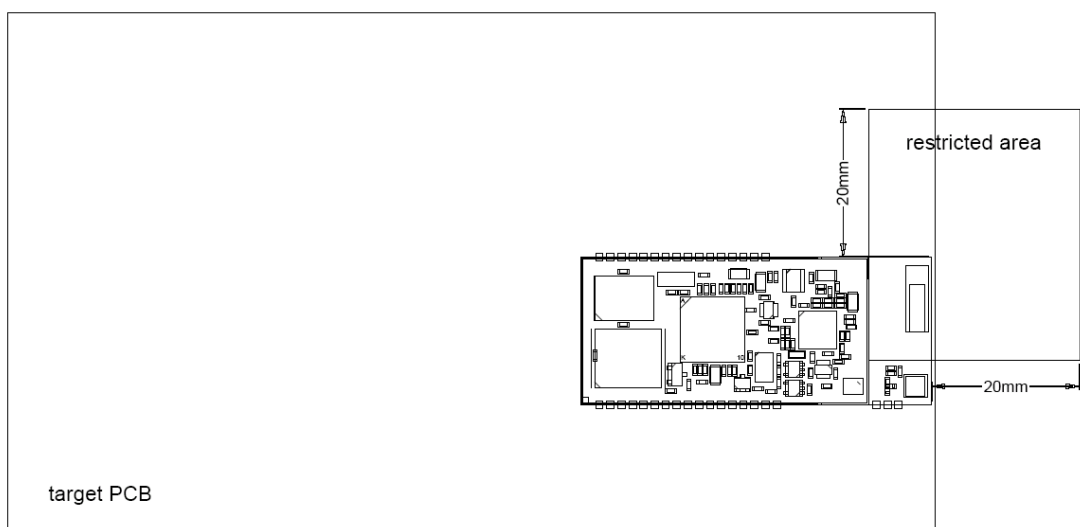
Antenna – recommended restricted area

To give an optimized antenna performance the restricted area having no ground or power planes, traces or parts should be widened. The following dimensions should be implemented, depending on your possible space.



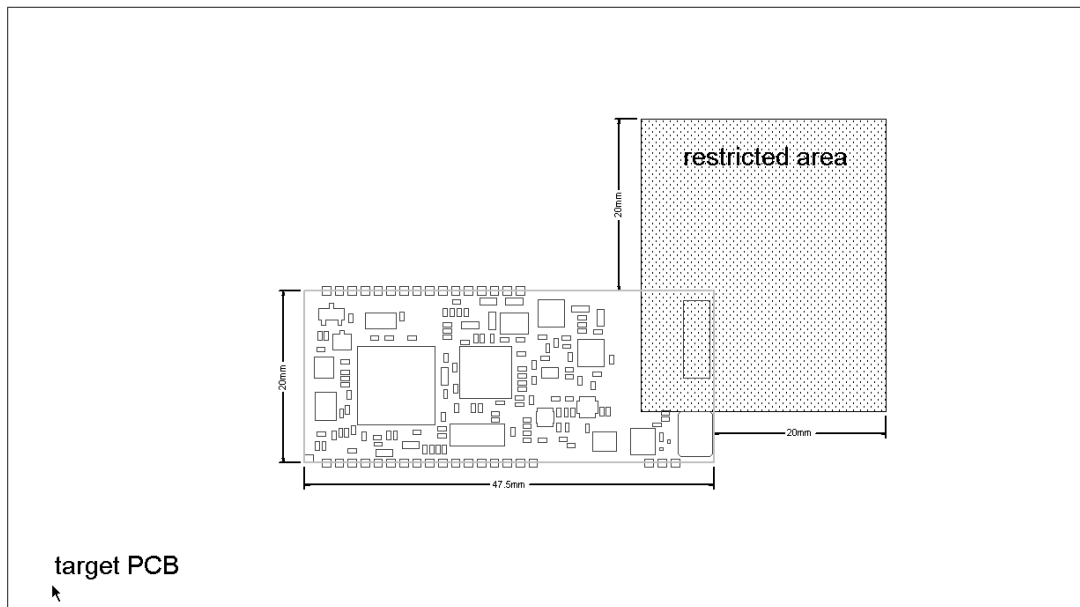
#### Optimal placement

The best position to place the **BlueMod+C11/G2** on the target PCB is in the upper right corner. This position is optimal concerning antenna interference; radiation pattern and PCB space that has to be keep free for the restricted area.



#### recomendable placement

When placing the BlueMod+C11/G2 at the right edge of the PCB ensure that the restricted area on the target PCB is free of planes, traces and parts.



acceptable, but not optimal placement

When placing the BlueMod+C11/G2 on other positions than the right side the complete restricted area should be kept free of planes, traces and parts.

## 6.7 Safety Guidelines

According to SAR regulation EN 50371-2002 the BlueMod+C11/G2 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 EN 60950-1: 2001 all conductive parts of the BlueMod+C11 are to be classified as SELV circuitry. OEM's implementing the BlueMod+C11/G2 in their products should follow the isolation rules given in regulation EN 60950-1: 2001.

The PCB material of the BlueMod+C11/G2 is classified UL-94V0.

## **7 Approvals/Certifications**

### **7.1 Declaration of conformity**

tbd

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## 7.2 FCC Compliance and FCC Statement

This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada.

Operation is subject to the following two conditions:

This device may not cause harmful interference, and

This device must accept any interference received, including interference that may cause undesired operation.

### 7.2.1 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.

### 7.2.2 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.

The radiated output power of BlueMod+C11/G2 is far below the FCC radio frequency exposure limits. Nevertheless, the BlueMod+C11/G2 shall be used in such a manner, that the potential for human contact during normal operation is minimized.

### 7.2.3 RF-exposure Statement

The BlueMod+C11/G2 contains a modular transmitter. Thus it must have a separation of at least 20 cm between the antenna and the body of the user or nearby persons, excluding hands, wrists, feet, and ankles.

The rating of this distance depends on the intended use. Wall mounted or table desk devices are assumed to fulfill this requirement. If the intended use is to wear the portable modular transmitter close to the body, e.g. pocket device or head set a TCB should be consulted. Rules can be found via

<http://www.fcc.gov/oet/ea/eameasurements.html>

Any notification to the end user of installation or removal instructions about the integrated radio module is **not** allowed.

#### 7.2.4 Labelling and re-test requirements for the End Product

Any End Product integrating the BlueMod+C11/G2 must be labeled with at least the following information:

This device contains transmitter with	
FCCID:	RFR- C11G2
IC ID:	4957A-C11G2

Since the BlueMod+C11/G2 is a module to be integrated into a for the FCC authority unknown end product, the FCC approval under this ID is a “Limited Modular Approval”, also called LMO. This implies that all OEM's incorporating the BlueMod+C11/G2 in their end product and wanting to ship to the USA or Canada have to measure spurious emissions according to FCC Part 15.247 in a FCC accredited EMC lab and have to keep the test report in their technical compliance folder ready for being checked by US/CA market authorities.

### 7.3 Bluetooth Qualification

The BlueMod+C11/G2 is a qualified design according to the Bluetooth Qualification Program Reference Document (PRD) V2.0. The Qualified Design ID (QDID) is:

**B012419**

For further information about marking requirements of your product attention should be paid the Bluetooth Product Marking Guide at

[https://programs.bluetooth.org/Download/Marking\\_Guide\\_20060601.pdf](https://programs.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](http://www.Bluetooth.org) or contact Stollmann.

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## 7.4 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 2002/95/EC (RoHS) or if contain a maximum concentration of 0,1% by weight in homogeneous materials for

- Lead and lead compounds
- 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

## 8 Related Documents

- ATMEL data sheet AT91SAM7Sxxx Rev. F
- CSR product data book BlueCore™4-ROM BC41B143A April 2006
- Radiall UMP MMP Introduction
- Radiall data sheet UMP R107.103.020Stollmann BlueRS+ - SPP
- Stollmann AT Command Reference
- Bluetooth SIG RF\_TS\_EDR.pdf test specification

## 9 Ordering Information

The BlueMod+C11/G2 is available in the following variants:

Name	Antenna	Art No.
BlueMod+C11/G2/AI/SPP	Internal	52672
BlueMod+C11/G2/AE/SPP	External	52733
BlueMod+C11/G2/AP/SPP	External	52742
SPP Evaluation Kit BlueEva+C11/G2/SPP,	Internal	52743

Other variants on request, please contact Stollmann sales department.

## 10 History

Version	Release Date	By	Change description
0.1	20.10.2006	JJ	Initial Document - preliminary
0.2	27.10.2006	JJ	Updated Alternative GPIO Functionality, Name correction
1.0	20.02.2007	JJ	Updated to evaluated data
1.1	15.03.2007	JW	General revision, First final version
r02	29.08.2007	BG	New template
r03	17.09.2008	HB	5.7 Wake-up Time: chapter added 5.2 Environmental Requirements: chapter moved 6.1 Dimensions: Added module height 3.4.1RS-485 Support: chapter added
	11.12.2008	AA	3.2 Power-up slew-rate new chapter 5.5.1 Antenna-Gain and Radiation-Pattern added 6.4 Soldering Temperature-Time Profile (for lead-free re-flow soldering) corrected
r04	23.03.2009	JJ	7.1.4 RF Exposure Info 20cm instead of 2,5cm FCC PCC1
	15.04.2009	AA	5.5 Receiver Sensitivity min. Value 6.4 Soldering Temperature-Time Profile (for lead-free re-flow soldering) in accordance with IPC
	20.04.2009	JW	corrected product name in 2 Block Diagram added EPL statement in chapter 7.3 Bluetooth Qualification URL link to active document version added in chapter 1 Introduction
r05	04.09.2009	AA	changed requirements for GND pins in chapter 3.7 Bluetooth radio Interface and 4.2.1General Pin Description
		JW	updated chapter 7.1 Declaration of conformity
r06	03.12.2010	HB	Initial Version for HW V5 / TCB upload removed PCM Interface changed mechanical characteristics changed radiation pattern changed title picture

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