

Bluetooth Module

User's Guide

Version 1.0

Federal Communication Commission Interference Statement

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 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE:

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20cm may be maintained between the antenna and users (for example access points, routers, wireless ADSL modems, and similar equipment). The final end product must be labeled in a visible area with the following: “[Contains TX FCC ID: PANBT0002M](#)”.

Manual Information That Must be Included

The users manual for end users must include the following information in a prominent location “ **IMPORTANT NOTE:** To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This is modular approval and only two antennas have been tested with this device. Only those antennas tested in the certification application are authorized. Any other antenna used with the module may require a separate authorization and ID number.

Tested to Comply with FCC Standards FOR HOME OR OFFICE USE

1. General Description

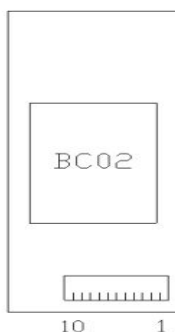
CC&C BT-0002M Bluetooth module class II is powered by CSR BlueCore2, which with RF and baseband function been integrated in a single chip and was designed for Bluetooth 2.4 GHz wireless applications. With band-pass filter, balun, crystal and flash memory built on, it can reduce external components and provide a hardware engineer with a speed and convenient way to complete their designs. Because of compact sizes, they can easily design into customers' target devices. For instance, they can be used for PDA, notebook, tablet PC, keyboard and mouse as an internal module. The BT-0002M develops the Bluetooth protocol stacks, profiles and with a plenty of software development and integration experiences, CC&C can help customer to design a specific device.

2. General Specification

Model Name	BT-0002M
Product Name	BT Module (CSRBC02)-Class II
Size	52x19x2.7mm
Weight	2.8 gram
Specification	Bluetooth spec. 1.1
Antenna terminal	50 Ohm
Power Class	Class-II
Digital interface	Board to board connector for USB interface or UART interface
Operating Voltage	3.3V +/- 0.3V ; 5V (USB)
Operating Current	TBD
Operating Temp.	-10 ~ 70°C

3. Pin assignment

BT-0002M



1. 3V-IN
2. USB_D-
3. USB_D+
4. BT_ON#
5. DETACH
6. RESET#
7. WAKE_UP
8. SOFT_KEY#
9. BT_PRESS#
10. GND

4. General Radio Characteristics

<i>Transmitter</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>	<i>Remarks</i>
Maximum RF Output Power		-2	0	3.23	dBm	
RF Power control range			25		dBm	
Modulation Characteristics		±140		±175	kHz	11110000mod
		±115			kHz	1010mod
Initial Carrier Freq accuracy				±25	kHz	PRBS9
Carrier Freq drift	DH1			±25	kHz	
				±20	kHz/50us	Drift Rate
	DH3			±40	kHz	
				±20	kHz/50us	Drift Rate
	DH5			±40	kHz	
				±20	kHz/50us	Drift Rate
20dB bandwidth for modulated carrier						

In-band spurious emissions	M-N =2				-20	dBm	
	M-N >=3				-40	dBm	
<i>Receiver</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>	<i>Remarks</i>	
<i>Sensitivity</i>	<i>DH1, DH3, DH5</i>	-	-75	-	dBm		
Interference Performance	C/I _{CO-Channel}	TBD		11	dB		
	C/I _{1MHz}	TBD		0	dB		
	C/I _{2MHz}	TBD		-30	dB	*1	
	C/I _{2MHz}	TBD		-40	dB	*1	
	C/I _{Image}	TBD		-9	dB		
	C/I _{Image}	TBD		-20	dB	*1	
Intermodulation Characteristics		TBD			dBm		
Out-of-band Blocking	30MHz-2000MHz	-10			dBm		
	2000-2399MHz	-27			dBm		
	2498-3000MHz	-27			dBm		
	3GHz-12.75GHz	-10			dBm		

5. BlueCore 2-External Data

1) Device Features

- Low power 1.8V operation
- Small footprint in 96-Ball VFBGA Package (6x6mm)
- Fully qualified Bluetooth component
- 0.18µm CMOS technology
- Full speed class 2 Bluetooth operation with full 7 slave piconet support
- Support for 8Mbit external Flash
- Minimum external components
- Operates over full industrial temperature range ($-40 \leq T \leq 105^{\circ} \text{ C}$)

2) General Description

BlueCore2-External is a single chip radio and baseband IC for Bluetooth 2.4GHz radios implemented in CMOS technology. When used with external ROM containing the CSR Bluetooth software stack, it provides a fully compliant Bluetooth system for data and voice communications.

3) Applications

The design is optimised to require few external RF components to facilitate rapid design of the application printed circuit board and therefore the fastest possible time to market and lowest overall cost. Included in the device are auto-calibration and built-in-self-test (BIST) routines to simplify development, type approval and production test. All hardware and device firmware is fully compliant with the Bluetooth specification.

- PC Notebooks
- Cellular Handsets
- Cordless Headsets
- Personal Digital Assistants (PDAs)
- Computer Accessories (Compact Flash, PCMCIA and SD cards)

4) Description of Functional Blocks

Radio Transceiver and Synthesiser

The receiver features a near-zero IF architecture that allows the channel filters to be integrated on to the die. Sufficient out-of-band blocking specification at the LNA input allows the radio to be used in close proximity to GSM and W-CDMA cellular phone transmitters without being de-sensitised. The use of a digital FSK discriminator means that no discriminator tank is needed and its excellent performance in the presence of noise allows BlueCore2-External to exceed the Bluetooth requirements for co-channel and adjacent channel rejection. Fast AGC is implemented by measuring the RSSI on a slot-by-slot basis and adjusting the front-end LNA gain to keep the first mixer input signal within a limited range. This improves the dynamic range of the receiver in interference-limited environments.

The transmitter features a direct IQ modulator to minimise the frequency drift during a transmit timeslot and results in a well controlled modulation index. A digital baseband transmit filter provides the required spectral shaping.

The maximum transmit power of +7dBm allows BlueCore2-External to be used in Class 2 and Class 3 radios and its support for transmit power control allows a simple implementation for Class 1 with an external RF power amplifier.

The radio synthesiser is fully integrated with no requirement for an external VCO screening can, varactor tuning diodes or LC resonators.

The radio has several built-in automatic calibration routines to maintain the radio performance within specification across temperature and ageing. No LNA, PA or TX/RX switch is required for Class 2 operation across the device's full operating temperature range.

Auxiliary Features

The device contains two clock sources: one reference oscillator for the RF carrier frequency and one low frequency clock oscillator that is used as an interval timer during sleep modes, i.e., Sniff, Hold or Park.

The reference oscillator requires an external crystal. Alternatively, the crystal terminals can be driven from an external reference clock. The reference frequency can be in the range of 8-32MHz in multiples of 250kHz.

The low frequency clock oscillator requires no external components. It is calibrated automatically and maintains an accuracy of better than 250ppm. This oscillator consumes less than 2µA and is permanently enabled.

Physical Layer DSP Hardware Engine

Dedicated logic is used for forward error correction, header error control, cyclic redundancy check, encryption, data whitening, access code correlation and audio transcoding to translate between A-law, μ -law and linear voice data from the host and A-law, μ -law and Continuously Variable Slope Delta (CVSD) voice data over the air, voice interpolation for lost packets and rate mismatches are performed by the software.

Burst Mode Controller

During radio transmission the Burst Mode Controller (BMC) constructs a packet from header information previously loaded into memory-mapped registers by the software and payload data/voice taken from the appropriate ring buffer in RAM. During radio receptions, the burst mode controller stores the packet header in memory-mapped registers and the payload data in the appropriate ring buffer in RAM. This architecture minimises the intervention required by the processor during transmission and reception.

Micro-controller, Interrupt Controller and Event Timer

The micro-controller, interrupt controller and event timer run the Bluetooth software stack and control the radio and host interfaces. A 16-bit RISC micro-controller is used for low power consumption and efficient use of memory.

Memory Management Unit

The memory management unit provides a number of dynamically allocated ring buffers that hold the data which is in transit between the host and the air or vice versa. The dynamic allocation of memory ensures efficient use of the available RAM and is performed by a hardware memory management unit to minimise the overheads on the processor during data/voice transfers.

RAM

32Kbytes of on-chip RAM is provided and is shared between the ring buffers used to hold voice/data for each active connection and the general purpose memory required by the Bluetooth stack.

ROM

Up to 8Mbits of external Flash or masked programmed ROM (16 bit data words) can be attached giving maximum flexibility for running complete applications on chip. The ROM can be programmed over the synchronous serial/UART or USB interfaces after the device is mounted in the target application.

5) CSR Bluetooth Software Stack

BlueCore2-External is supplied with Bluetooth stack firmware that runs on its microcontroller and is resident in the external Flash memory. The stack occupies 4Mbits of storage.

The BlueCore Stack Software is compliant with the Bluetooth v1.1 specification. It implements all the features described in the specification, including optional features.

Piconets: up to seven slaves.

Power Saving: Hold, Sniff and Park

Data integrity: Channel Quality Driven Data Rate (CQDDR) and RSSI

Audio: full support for SCO

Role Switch: can reverse master/slave relationship

Device Firmware Upgrade

BlueCore2-External is supplied with boot loader software which implements a standard Device Firmware Upgrade (DFU) capability. This allows new firmware to be uploaded to the external Flash memory through BlueCore2-External's UART/USB ports.

Additional Software for Host Implementation

A companion device, BlueCore2-PC can be ordered which includes software for a full Windows 98/ME or Windows 2000 Bluetooth host-side stack and application together with the IC hardware described in this datasheet. Contact CSR for more details.

Additional Software for Other Embedded Applications

When the upper layers of the Bluetooth protocol stack are run as firmware on BlueCore2-External a UART software driver is supplied that presents the HCI, L2CAP, RFCOMM and Service discovery APIs to higher Bluetooth stack layers running on the host. The code is provided as .C. source or object code. Other software drivers can be developed on request. Contact CSR Sales for more information.

Casira Development System

This is available to allow the evaluation of BlueCore2- External hardware and software and as the base of a toolkit for developing host software. Contact CSR Sales for more information.

Profiles Supported Via HCI

The supplied software stack is a full implementation of Bluetooth up to and including HCI, so all profiles and associated applications are supported.

Application Specific Software Development Environment

Firmware supplied with BlueCore2-External contains a protected user software execution environment as a Virtual Machine (VM). The user may write custom application code to run on the BlueCore VM using the BlueLab software development kit, available separately from CSR. This code will then execute alongside the main BlueCore firmware. The user is able to make calls to the BlueCore firmware for various operations.

The execution environment is structured so the user application does not adversely affect the main software routines, thus ensuring that the Bluetooth stack software component does not need re-qualification when the application is changed.

Using the VM and BlueLab, the user is able to develop applications such as a cordless headset or other profiles without the requirement of a host controller. BlueLab is supplied with example code, including a full implementation of the headset profile.

6) External Interfaces

Transmitter/Receiver Inputs/Output

Terminals TX_A and TX_B form a balanced current output. They require a DC connection to VDD and should be connected through a balun to the antenna. The output impedance is capacitive and remains constant irrespective of whether the transmitter is enabled or disabled. For Class 2 operation these terminals also act as differential receive input terminals with an internal TX/RX switch. For Class 1 operation the RF_IN ball is provided, which is single-ended and presents a capacitive input. A swing of up to 0.5V rms can be tolerated at this terminal. An external antenna switch can be connected to RF_IN.

Asynchronous Serial Data Port (UART) and USB Port

UART_TX, UART_RX, UART_RTS, and UART_CTS form a conventional asynchronous data serial port. The interface is designed to operate correctly when connected to other UART devices such as the NS16550A. The signalling levels are 0V and VDD_PADS. The interface is programmable over a variety of bit rates; no, even or odd parity; one or two stop bits and hardware flow control on or off. The default condition on power-up is pre-assigned in the external Flash memory.

The maximum UART data rate is 1.5Mbit/s. Two-way hardware flow control is implemented by UART_RTS and UART_CTS. UART_RTS is an output and is active low. UART_CTS is an input and is active low. These signals operate according to normal industry

convention.

The port carries a number of logical channels: HCI data (both SCO and ACL), HCI commands and events, L2CAP API, RFCOMM API, Service Discovery API and device management. For the UART, these are combined into a robust tunneling protocol, BlueCore Serial Protocol (BCSP), where each channel has its own software flow control and cannot block other data channels. In addition, the Bluetooth specification part H4 format is supported.

Alternatively a firmware version is available to support full speed (12Mbit/s) USB. USB_D+ and USB_D- are available on dedicated terminals. Both Open Host Controller Interface (OHCI) and Upper Host Controller Interfaces (UHCI) are supported.

The firmware in Flash can be downloaded through this port by DFU if the CSR-supplied boot loader is first programmed.

Firmware shipped with BlueCore2-External includes security features to prevent misuse of this upgrade facility.

PCM Codec Interface

PCM_OUT, PCM_IN, PCM_CLK, PCM_SYNC carry up to three bidirectional channels of voice data, each at 8 ks/s. The format of the PCM samples can be 8-bit A-law, 8-bit μ -law, 13-bit linear or 16-bit linear. The PCM_CLK and PCM_SYNC terminals can be configured as inputs or outputs depending on whether BlueCore2-External is the master or slave of the PCM interface.

BlueCore2-External interfaces directly to PCM audio devices such as the:

Qualcomm MSM 3000 series and MSM 5000 series CDMA devices,

OKI MSM7705 four channel μ /A-law codec,

Motorola MC145481 8-bit μ /A-law codec,

Motorola MC145483 13-bit linear codec and the

Mitel MT93LI6 Echo cancelling codec.

BlueCore2-External is also compatible with the

Motorola SSITM interface.

Synchronous Serial Port

BlueCore2-External is a slave device using terminals SPI_MOSI, SPI_MISO, SPI_CLK and SPI_CSB. This interface is used for program emulation/debug and IC test. It is also the means by which the external Flash ROM may be programmed .in situ. before any 'boot' program is loaded. The designer should be aware that no security protection is built into the hardware or firmware associated with this port.

Parallel PIO Port

Fifteen lines of programmable bidirectional I/O are provided. PIO[11:0] are powered

from VDD_PIO and AIO[2:0] are powered from VDD_MEM. PIO[0] and PIO[1] are normally dedicated to TXEN and RXEN, but they are available for general use. Any of the PIO lines can be configured as interrupt request lines or as wake-up lines from sleep modes. PIO[6] can be configured as a request line for an external clock source. This is useful when the clock to BlueCore2- External is provided from a system ASIC.

I²C Interface

PIO[3] and PIO[2] can be used to form a master I2C interface. The interface is formed using software to drive these lines and is thus suited only to relatively slow functions such as driving a dot matrix LCD display, a keyboard scanner or an EEPROM.