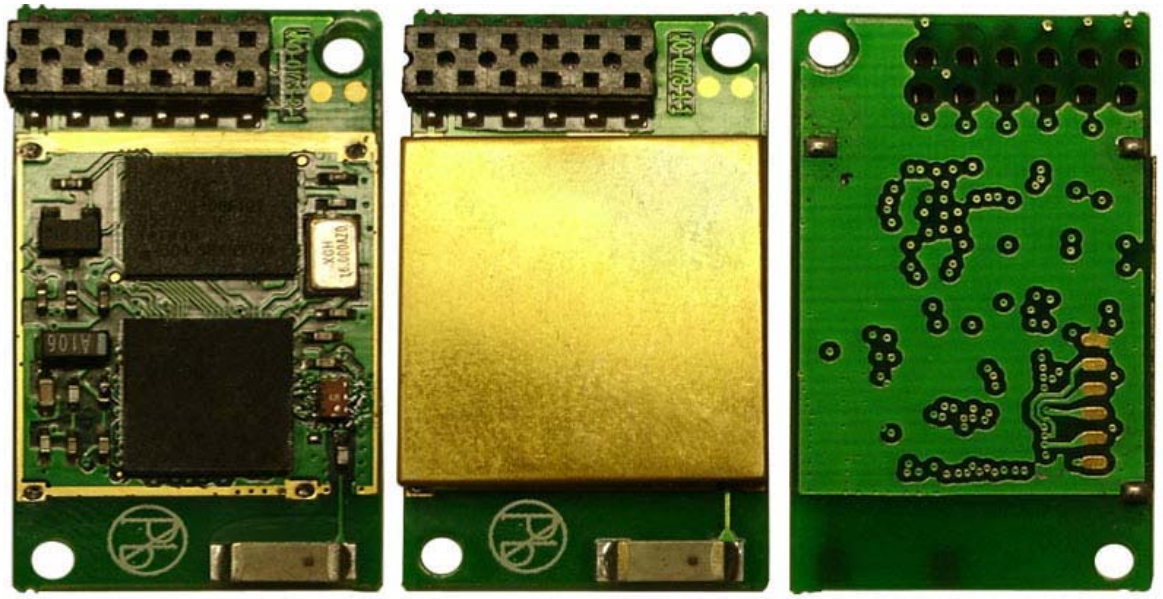
ZBA, Inc.

ZBA Bluetooth 2.0 Module with on board antenna.

Assembly No. BC04-191



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"Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

"This device complies with Part 15 of the FCC rules. Operations 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."

"This equipment complies with FCC radiation exposure limits set forth for an unctrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. To maintain compliance with FCC RF exposure compliance requirements, please follow operation instruction as documented in this manual. "

"The final end product must be labeled in a visible area with the following: Contains FCC ID: VMTZBA-BT44."

"The end user manual shall include all required regulatory information/warning as show in this manual."

Table of Contents

1 Document Status 4
2 Scope 5
3 Bluetooth Assembly Description: 5
4 Features 5
5 Applications 6
6 Block Diagram 6
7 Specifications 7
7.1 Pin Configurations & Dimensions 7
7.2 Dimensional drawing 9
7.3 General Specifications 10
7.4 Electrical Characteristics 10
7.4.1 Absolute Maximum Ratings 10
7.4.2 Radio Characteristics 10
7.4.3 Power Consumption 13
7.4.3.1 Current measurements on the BC04-191 13
7.4.3.2 Datasheet specification of the BC04 External Module 13
8 Serial Port Profile 14
8.1 Default Configuration 14
8.2 Configuration Command Set-up & Procedures 14
8.2.1 Entering the Set-up Mode 15
8.2.2 Testing the Communication Link 15
8.2.3 Command list 15
8.2.4 Set RS232 Baud Rate (bps) 15
8.2.5 Set/inquired UART Parameters 16
8.2.6 Set Authentication 16
8.2.7 Set Password 16
8.2.8 Set Device Name 17
8.2.9 Set Device Type 17
8.2.10 Set Master/Slave Mode 17
8.2.11 Clear Paired Device Address 18
8.2.12 Set Sniff Power Saving Mode 18
8.2.13 Set Sniff Power Saving Mode—Extended 18
8.2.14 Reset to Factory Default 18
8.2.15 Set/Inquire Scan Time 18
8.2.16 Set/Inquire Paired Device 19
8.2.17 Inquire Version 19
8.2.18 Inquired remote device Address 19
8.2.19 Set/Inquired Paired Device Address 20
8.2.20 Inquired Device BD Address 20
8.2.21 Software Reset 20
8.2.22 Set/Inquire about Low power mode 20
8.2.23 Set/ Inquire about Data processing mode in the condition of disconnecting. 21
8.2.24 Set/ Inquire about Flow control mode 21
8.2.25 Exiting the Set-up Mode 21

9 Low power modes 21
9.1 Park & Sniff 21
10 Mounting recommendations 23
11 Ordering Information 24

List of Figures

Figure 1 Block Diagram of the BT Module 6
Figure 2 Top and Side View of module indicating the Pin directions 7
Figure 3 Input circuit of Module power control (pin10) 8
Figure 4 Dimensional drawing of the BC04-191 9
Figure 5 Cross-section of recommended mounting of the BT module 23
Figure 6 Bottom View of PCB indicating where there shouldd be NO Ground Plane 23

1 Document Status

Date	Comments
June 6, 2006	First draft
April 2007 June 2007 August 2007	Add AT command set http://www.bluetoothmodules.net publication Update current measurements

To make a request for change, correction, additions or information on references, please contact:

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2 Scope

The intention of this specification is to provide general guidelines on the integration of the BC04-191 Bluetooth assembly. This product, which complies with Bluetooth Specification 12.0, is designed to help companies offer Bluetooth enabled products by speeding their development processes with a ready to integrate Bluetooth assembly with external antenna attachment.

3 Bluetooth Assembly Description:

The BC04-191 is a general purpose Bluetooth module incorporating an on-board meandering line antenna designed to be incorporated into an end product. The BC04-191 Bluetooth Module is a Class 2 Bluetooth module using BlueCore4-External chipset from Cambridge Silicon Radio, a leading Bluetooth chipset supplier. It provides a fully compliant Bluetooth system for data and voice communications. The module and device firmware is fully compliant with the Bluetooth specification V2.0.

The Bluetooth assembly is available in two different variants:
1) UART transport with serial port emulation (Serial Port Profile)
2) UART transport with HCI interface (only upon special request)

4 Features

- Operating Frequency Band 2.40 GHz~2.48GHz unlicensed ISM Band
- Class 2 type Output Power
- RF Shielding can constructed of non-ferrous metals.
- Support Firmware Upgrade (via The UART)
- 12 pin 2mm board to board connector (top or bottom connections)
- Active Bluetooth Connections signal
- Built-in Power control for turning off the Module
- Support Piconet, up to 7 Slaves
- Scatternet Support
- PCM Audio Interface
- Low Voltage Power Supply, 2.7V to 3.6V
- Built-in 8Mbit Flash Memory
- Low Power Modes Available: Park, Sniff, Hold and Deep Sleep
- Dimensions: 30mm X 17.5mm X 3.15 mm
- Development board available.

5 Applications

- ⌘ PCs, PDAs
- ⌘ Computer Accessories (CF Cards, USB Dongles
- ⌘ PCMCIA, RS232 Adaptors, etc.)
- ⌘ Mice, Keyboard, Joysticks
- ⌘ Cordless Phone
- ⌘ FAX, Printer Adaptors
- ⌘ Digital Camera
- ⌘ Access Points to LAN and/or Dial-up network

6 Block Diagram

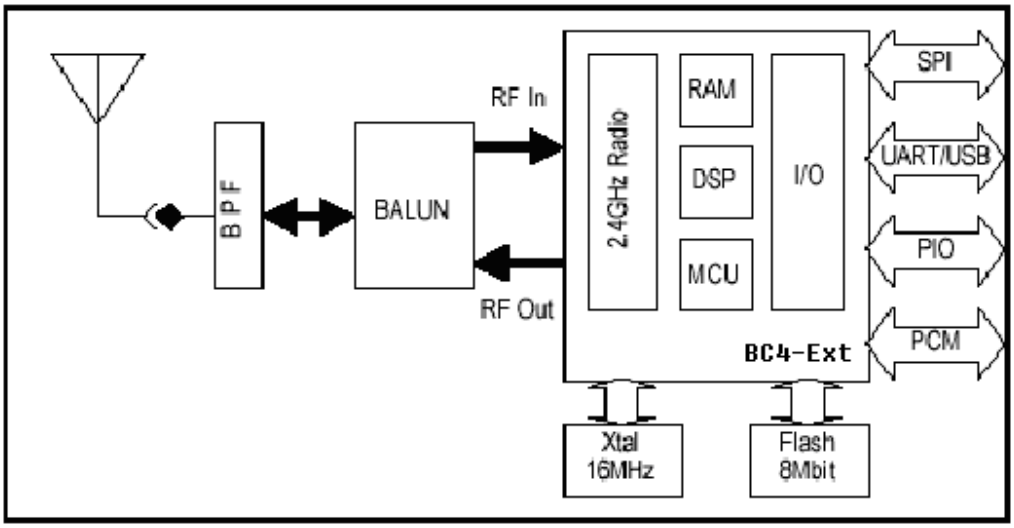


Figure 1 Block Diagram of the BT Module

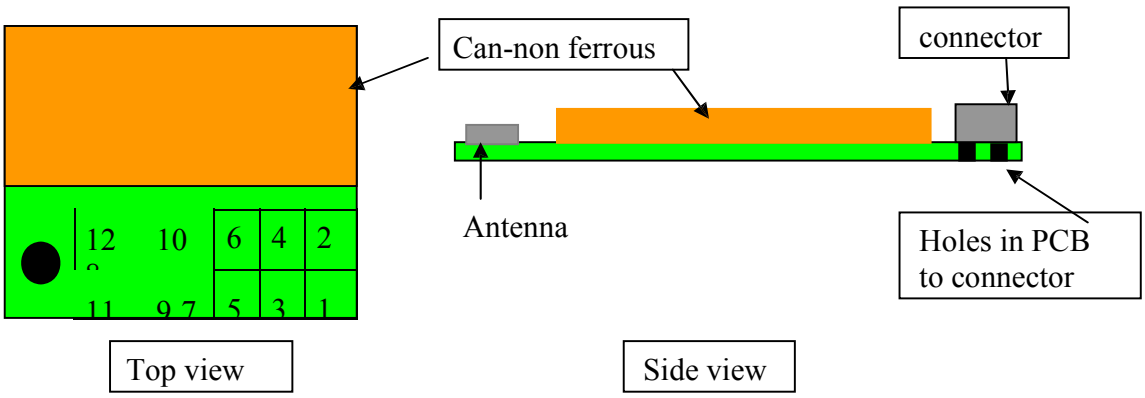
7 Specifications

7.1 Pin Configurations & Dimensions

Pin-out 12 pin 2mm dual row connector (SAMTEC CLT106-02-L-D or equiv.)

Pin 1 = Vcc (3.3 Volts regulated)
Pin 2 = GND
Pin 3 = RxD
Pin 4 = TxD
Pin 5 = CTS
Pin 6 = RTS
Pin 7 = GND Zero (0) ohm Jumper internal to module to GND
Pin 8 = Reserved (connected to PIO for future use)
Pin 9 = NCONN Output from module indicating the module is connected (lo = connected)
Pin 10 = NPWR - PFET-gate w/10K resistor to GND. (Module is powered-on if left floating)
Pin 11 = Reserved (connected to PIO for future use)
Pin 12 = Reserved (connected to PIO for future use)

2) **Pin outline**:



Note: The PCB board has 12 holes to accommodate connecting the module via 2mm dual row pins through the PCB from the bottom.

Figure 2 Top and Side View of module indicating the Pin directions

3) Input Circuit of **Pin 10**

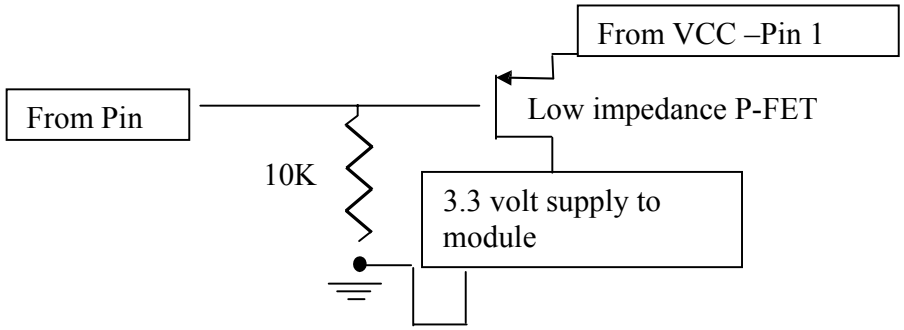


Figure 3 Input circuit of Module power control (pin10)

7.2 Dimensional drawing

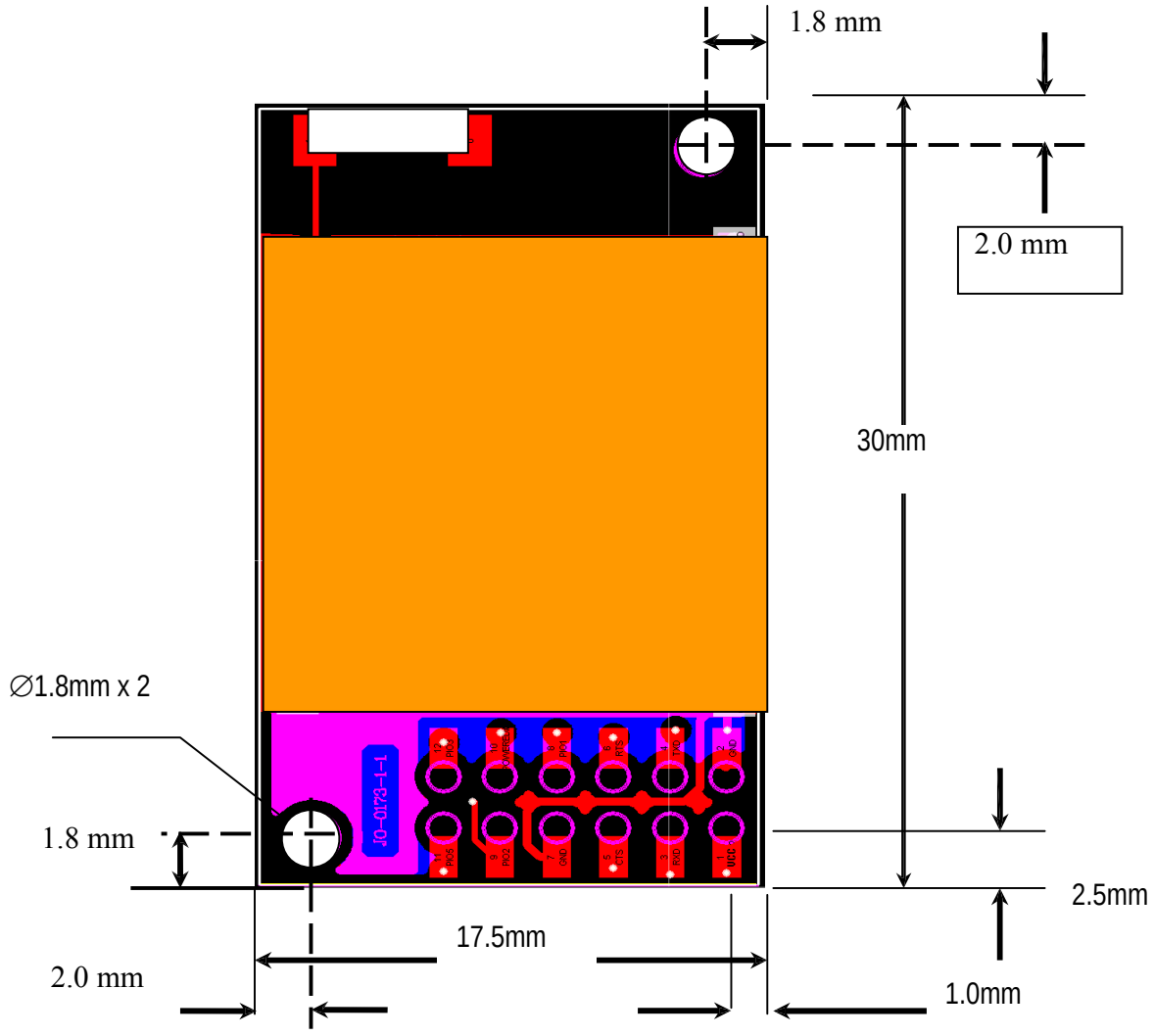


Figure 4 Dimensional drawing of the BC04-191

7.3 General Specifications

Item	Specification
Carrier Frequency	2400MHz to 2483.5MHz
Modulation	GFSK, 1Mbps, 0.5BT Gaussian
Channel Intervals	1MHz
Number of Channels	79
Frequency Hopping	1600hops/sec, 1MHz channel space
Receive Sensitivity	-82 dBm typ. @0.1% BER
Transmission Power	+4dBm max.
Output Interface	Full speed UART,
Power Supply	3.3V ±10%
Operating Temperature Range	-20°C to 85°C
Storage Temperature Range	-40°C to 85°C
Dimensions	30mm X 17mm X 3.15 mm
Antenna	Ceramic

7.4 Electrical Characteristics

7.4.1 Absolute Maximum Ratings

Absolute maximum ratings for supply voltage and voltages on digital and analogue pins of the Module are listed below; exceeding these values will cause permanent damage

Voltage	
Voltage Range -Power Pins	2.7 to 3.6V
Voltage Range –Digital Pins	-0.3V to 3.6V
Storage Conditions	
Storage Temperature	-40°C to 150°C (ambient)
Storage Humidity	0-90% RH
Operating Conditions	
Temperature Range	-20°C< T_A<95°C
Peak Power supply current	75 mA

7.4.2 Radio Characteristics

Temperature = -20°C						
Receiver	**Frequency (GHz)**	**Min**	**Typ**	**Max**	**Bluetooth Specification**	**Unit**
Sensitivity at 0.1%	2.402	-	-84	-80	≤-70	dBm

	2.441	-	-84	-80	BER	dBm
	2.480	-	-84	-80		dBm
Maximum received signal at 0.1% BER		0	10	-	≤-20	dBm
Transmitter	**Frequency (GHz)**	**Min**	**Typ**	**Max**	**Bluetooth Specification**	**Unit**
RF transmit power (1)(2)	2.402	0	2.5	4	-6 to +4 (3)	dBm
	2.441	0	2.5	4		dBm
	2.480	0	2.5	4		dBm
RF power control range		-	35	-	≥16	dB
RF power range control resolution		-	1.8	-	-	dB
20 dB bandwidth for modulated carrier		-	800	-	1000	KHz
Initial carrier frequency tolerance		-	±25	-	≤ ±75	KHz
Drift		-	±15	-	≤ ±25	KHz
Drift Rate		-	±20	-	400	Hz/μs
$\Delta f1_{avg}$ "Maximum Modulation"		-	165	-	$140<\Delta f1_{avg}<175$	KHz
$\Delta f2_{avg}$ "Minimum Modulation"		-	150	-	115	KHz

Notes:

(1) BlueCore4 firmware maintains the transmit power to be within the FCC Limits

(2) Measurement made using a PSKEY_LC_MAX_TX_POWER setting corresponds to a PSKEY_LC_POWER_TABLE power table entry of 63.

Temperature = +20°C

Receiver	**Frequency (GHz)**	**Min**	**Typ**	**Max**	**Bluetooth Specification**	**Unit**
Sensitivity at 0.1% BER	2.402	-	-82	-80	≤-70	dBm
	2.441	-	-84	-80		dBm
	2.480	-	-84	-80		dBm

Maximum received signal at 0.1% BER		0	-	-	≥-20	dBm
Transmitter	**Frequency (GHz)**	**Min**	**Typ**	**Max**	**Bluetooth Specification**	**Unit**

RF transmit power	2.402	0	2.5	4	-6 to +4	dBm
	2.441	0	2.5	4		dBm
	2.480	0	2.5	4		dBm
RF power control range		-	35	-	≥16	dB
RF power range control resolution		-	1.8	-	-	dB
20 dB bandwidth for modulated carrier		-	800	-	1000	kHz
Initial carrier frequency tolerance		-	±25	-	≤ ±75	kHz
Drift		-	±15	-	≤ ±25	kHz
Drift Rate		-	±20	-	400	Hz/μs
$\Delta f1_{avg}$ "Maximum Modulation"		-	165	-	$140<\Delta f1_{avg}<175$	kHz
$\Delta f2_{avg}$ "Minimum Modulation"		-	150	-	115	kHz
C/I co-channel		-	10	11	≤ 11	dB
Adjacent channel selectivity C/I $f=f_0 \pm 1MHz$		-	-4	0	≤ 0	dB
Adjacent channel selectivity C/I $f=f_0 \pm 2MHz$		-	-35	-30	≤ -30	dB
Adjacent channel selectivity C/I $f \geq f_0+3MHz$		-	-45	-	≤ -40	dB
Adjacent channel selectivity C/I $f \leq f_0-3MHz$		-	-45	-	≤ -40	dB
Adjacent channel selectivity C/I $f=f_{image}$		-	-18	-9	≤ -9	dB
Adjacent channel transmit power $f=f_0 \pm 2MHz$		-	-35	-20	≤ -20	dBc
Adjacent channel transmit power $f=f_0 \pm 3MHz$		-	-35	-40	≤ -40	dBc

Maximum received signal at 0.1% BER		0	-	-	≥-20	dBm
Transmitter	**Frequency (GHz)**	**Min**	**Typ**	**Max**	**Bluetooth Specification**	**Unit**
RF transmit power	2.402	0	1	4	-6 to +4	dBm
	2.441	0	1	4		dBm
	2.480	0	1	4		dBm
RF power control range		-	35	-	≥16	dB
RF power range control resolution		-	1.8	-	-	dB
20 dB bandwidth for modulated carrier		-	800	-	1000	kHz

Initial carrier frequency tolerance	-	±25	-	≤ ±75	kHz
Drift	-	±15	-	≤ ±25	kHz
Drift Rate	-	±20	-	400	Hz/µs
$\Delta f1_{avg}$ "Maximum Modulation"	-	165	-	$140<\Delta f1_{avg}<175$	kHz
$\Delta f2_{avg}$ "Minimum Modulation"	-	150	-	115	kHz

7.4.3 Power Consumption

7.4.3.1 Current measurements on the BC04-191

Description	Value	Units	Comments
I_{pd}	**300**	**uA**	**Power down- NPWR= hi, Mode: not connectable**
I_{dis}	**24**	**mA**	**Mode Discovery & connecting, Average current**
$I_{conn-ps}$	**1.32**	**mA**	**Connected, Mode park & sniff, no data transmitted, No LED indicator (Nconn= hi)**
I_{conn-t}	**24**	**mA**	**Connected Mode= Slave, transmitting data Comm = 9600,N,8,1**
I_{conn-r}	**23.5**	**mA**	**Connected: Mode= Slave; Receiving data Comm = 9600,N,8,1**

Note 1: For measurement above the distance between the master and slave = 1 meter

7.4.3.2 Datasheet specification of the BC04 External Module

Operation Mode	Connection Type	UART Rate (kbps)	Average	Unit
Page scan	----	115.2	- 0.42	mA
Inquiry and page scan	-	115.2	0.76	mA
ACL No traffic	Master	115.2	4.60	mA
ACL With file transfer	Master	115.2	10.3	mA
ACL No traffic	Slave	115.2	17.0	mA
ACL With file transfer	Slave	115.2	24.7	mA
ACL 40ms sniff	Master	38.4	2.40	mA
ACL 1.28s sniff	Master	38.4	0.37	mA
SCO HV1	Master	38.4	39.2	mA

SCO HV3	Master	38.4	20.3	mA
SCO HV3 30ms sniff	Master	38.4	19.8	mA
ACL 40ms sniff	Slave	38.4	2.11	mA
ACL 1.28s sniff	Slave	38.4	0.42	mA
Parked 1.28s beacon	Slave	38.4	0.20	mA
SCO HV1	Slave	38.4	39.1	mA
SCO HV3	Slave	38.4	24.8	mA
SCO HV3 30ms sniff	Slave	38.4	19.0	mA
Standby Host connection(a)	-	38.4	40	uA
Reset (RESETB low)(a)	---	---	34	uA

(a) Low power mode on the linear regulator is entered and exited automatically when the chip enters/leaves Deep Sleep mode .

8 Serial Port Profile

When shipped with the on-board Serial Port Profile (SPP), the module's firmware emulates the function of a serial port. When connected to the host microprocessor via the UART transport, the module appears as a COM port. This makes it easy for designers to write software to utilize Bluetooth wireless communication. The SPP profile embedded within
the module provides a menu for making configuration changes utilizing AT commands described below in section 8.2:

8.1 Default Configuration

- UART Baud Rate: 9600 baud
- Number of Bits: 8
- Stop bit: One
- Parity: None
- H/W Flow Control: Disable
- PIN: 1111
- Device Name: ZBA-SPP
- Mode: Slave
- Sleep Mode: Deep sleep when ever possible.
- Partner pairing is dropped at power off or un-pairing by master.

8.2 Configuration Command Set-up & Procedures

PC interface: If you wish to connect the module to a PC's comm. port it is necessary to include a level shifter between the module and the PC. A recommended interface IC would be the MAX3232 RS232 driver IC (or equiv.) and a 3.3 Volt voltage regulator.

Please contact ZBA for details on purchasing a development board to interface the module to the PC.

Microcontroller Interface: The UART of the Bluetooth module can directly connect to the microprocessors UART. The Microprocessor must have an I/O that will operate from 0 to 3.3 Volts or the appropriate level shifter circuitry must be used as to not overstress the I/O of either device.

Please note. The modules will only response the host set-up commands after the module has entered the command mode. For module to enter in the command mode, the host must send a single character **ESC <0x1b>** within 5 second after the unit has been powered on. If the **ESC** character is not sent within the specified 5 second window then the module will automatically enter the SPP mode and any information sent to the UART will be treated as data to be transmitted over a Bluetooth link.

Note: **All Commands except the first <ESC> command contain a suffix of <CR><LF>.**

8.2.1 Entering the Set-up Mode

Command	Response	Parameter
ESC	<CR> OPEN:num<CR><LF>	Num= 0: device is not paired Num= 1 Device is currently paired

8.2.2 Testing the Communication Link

Command	Response	Parameter
AT	OK	None

8.2.3 Command list

Command	Response	Parameter
ATZ?	List of Commands	None

8.2.4 Set RS232 Baud Rate (bps)

Command	Response	Parameter

AT+BAUD= <Para1>	OK	Para1 = 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400
AT+BAUD?	OK +BAUD <para1>	

Note: The default baud rate is 9600bps

8.2.5 Set/inquired UART Parameters

Command	Response	Parameter
AT+UARTMODE=<Para1>,<Para2>	OK	<Para1>= Stop-bit <Para1> 0 = 1 Stop bit 1 = 2 Stop bits <Para2> Parity-bit 0 = None 1 = ODD 2 = EVEN
AT+ UARTMODE?	OK UARTMODE <Para1>,<Para2>	

Note: the default UARTMODE parameters are N, 8, 1 and the overall comm. Default Parameters are 9600,N,8,1

8.2.6 Set Authentication

Command	Response	Parameter
AT+AUTH=<Para1>	OK	Para1 = Authentication 0 = disable 1= enable Authentication enabled
AT+AUTH?	OK AUTH<Para1>	

Note: The default authentication mode is Authentication enabled.

8.2.7 Set Password

Command	Response	Parameter
AT+PASSWORD= < Para1>	OK	Para1 Password

AT+PASSWORD?	OK +PASSWORD: < Para1>	Default = 1111

Note: The default authentication password = 1111

8.2.8 Set Device Name

Command	Response	Parameter
AT+NAME= < Para1>	OK	Para1= Device name Default= ZBA-SPP
AT+NAME?	OK +NAME <Para1>	

Note: The default Device name = ZBA-SPP.

8.2.9 Set Device Type

Command	Response	Parameter
AT+CLASS=< Para1>	OK	Para1 Device type (Length must = 6 characters) default = 000000
AT+CLASS?	OK CLASS<Para1>	

8.2.10 Set Master/Slave Mode

Command	Response	Parameter
AT+ROLE=< Para1>	OK	Para1 Slave = 0, Master = 1 Default = 0, Slave
AT+ROLE?	OK ROLE <Para1>	

Note:1 The default mode is Slave.
Note2: While in Master Mode the module will respond with
+INQRES: remote BTADDR
for each of the Bluetooth devices that are in the neighbourhood

To connect to a particular device you will need to type
AT+RADDR= BT address (the specific device you wish to pair determined from the AT+INQ? Command).

Command	Response	Parameter
AT+CLEARADDR	OK	None

Note: This command will clear any remote device address that the module has been paired to.

8.2.12 Set Sniff Power Saving Mode

Command	Response	Parameter
AT+SNIFF=<Para1>,<Para2>,<Para3>,<Para4>	OK	Para1 Maximum Para2 Minimum Para3 test Para4 Over time
AT+SNIFF?	OK +SNIFF<Para1>,<Para2>,<Para3>,<Para4>	

Default = 1024.512,1024,512 number in decimal mode

8.2.13 Set Sniff Power Saving Mode—Extended

Command	Response	Parameter
AT+SNIFFEX=<Para1>,<Para2>,<Para3>,<Para4>	OK	Para1 Maximum Para2 Minimum Para3 test Para4 Over time Para5 Sniff timeout
AT+SNIFFEX?	OK SNIFF<Para1>,<Para2>,<Para3>,<Para4>	

Default = 1024.512,1024,512,10 number in decimal mode

8.2.14 Reset to Factory Default

Command	Response	Parameter
AT+RESET	OK	None

8.2.15 Set/Inquire Scan Time

Command	Response	Parameter
AT+SCANTIME=<Para1>,<Para2>,<Para3>,<Para4>	OK	Para1= Scan interval time Para2=Scan time-out Para3=Inquiry interva

AT+SCANTIME?	OK +SCAN<Para1>,<Para2>,<Para3>,<Para4>	Para4=Inquiry time-out

Note: The default Value (in decimal = N* 625 us)
Para1= 2048,
Para1= 18,
Para1= 2048,
Para1= 18,

8.2.16 Set/Inquire Paired Device

Command	Response	Parameter
AT+BIND= < Para1>	OK	Para1 0 =Always paired 1 = Drop pair Default=1 Drop pairing
AT+BIND?	OK +BIND<Para1>	

Note: The default mode is to drop pair. The drop pair function occurs when the module is power-off then back on or the master drops pairing. This will allow another master to commence a discovery process and connect to the module (slave) device.
If the device is set-up as always paired then the module will **only** communicate with the specific master whose address it has been bonded to even after power off and power-on. This mode is useful for application where a cable replacement function is the required. To communicate to a different master the module must have the bonded address cleared. This is accomplished by running the **AT+CLEARADDR** command.

8.2.17 Inquire Version

Command	Response	Parameter
AT+VERSION	OK +VERSION<Para1>	Para1 version #

Note: This command will return the firmware version of the module. .

8.2.18 Inquired remote device Address

Command	Response	Parameter
AT+INQ?	OK + BT address+BT Name	

Note: This command commences the discovery process to detect any BT device in the neighborhood.

8.2.19 Set/Inquired Paired Device Address

Command	Response	Parameter
AT+RADDR=<Para1>	OK	Para1 Paired device address
AT+ RADDR?	OK RADDR<Para1>	

Example to set-up the Module to communicate with one specific BT device whose BT address is currently unknown.

First type:

AT+INQ? What is returned are the BT addresses of the devices in the BT neighbourhood.

Then type

AT+RADDR= BT address (the specific device you wish to pair determined from the AT+INQ? Command).

The module will remain bound to this address until the **AT+CLEARADDR** is run or the module is powered off and then back on again.

8.2.20 Inquired Device BD Address

Command	Response	Parameter
AT+LADDR?	OK LADDR<Para1>	Para1 Device address

Note: This command returns the (local) BT address of the module.

8.2.21 Software Reset

Command	Response	Parameter
AT+ RESTART	OK	None

8.2.22 Set/Inquire about Low power mode

Command	Response	Parameter
AT+LOWPOWER=<Para1>	OK	<Para1>: 0: low power disabled 1: Low power mode Enabled
AT+ LOWPOWER?	OK +LOWPOWER: <Para1>	

8.2.23 Set/ Inquire about Data processing mode in the condition of disconnecting

Command	Response	Parameter
AT+ DATAMODE=<Para1>	OK	<Para1>: 0：Data hold into buffer, It will be sent to the other device after connect successfully. 1：Data will be throw away in the condition of disconnecting
AT+ DATAMODE?	OK ＋DATAMODE：<Para1>	

8.2.24 Set/ Inquire about Flow control mode

Command	Response	parameter
AT+ FLOWCONTROL=<Para1>	OK	<Para1>: 0: No Flowcontrol 1：Use hardware Flowcontrol
AT+ FLOWCONTROL?	OK ＋FLOWCONTROL：<Para1>	

8.2.25 Exiting the Set-up Mode

Command	Response	Parameter
AT+EXIT	None	None

Note: This command returns the module to SPP mode.

9 Low power modes

9.1 Park & Sniff

The module will automatically go into a reduced power mode if there is no UART activity and no RF activity. The Device will sniff in order to maintain synchronization with the Master.

To save maximum power then it is possible to completely turn-off the power to the module. When operating in this mode the Master/ Slave must then proceed through the Discovery phase (consuming time and energy) before a connection can be re-established. This mode is

only recommended if there are very, very long periods of inactivity and the battery power is of the utmost concern.

10 Mounting recommendations

For maximized performance please orient the device with the antenna as close to the outside of the housing as possible. Best performance will occur if the underlying PCB does not have a ground plane under the area where the antenna is located. The nearest ground plane should be at least 3mm away from any point on the antenna.

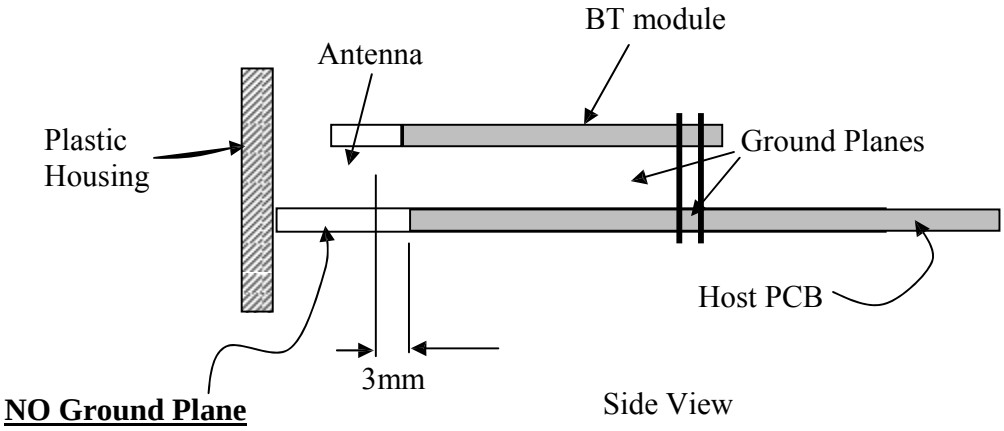


Figure 5 Cross-section of recommended mounting of the BT module

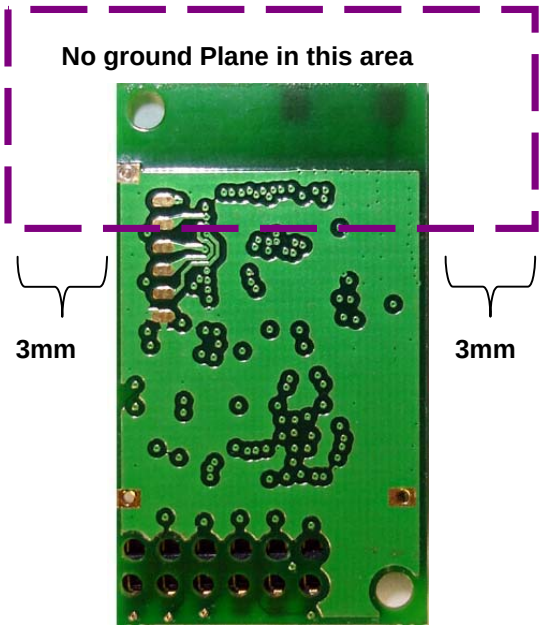


Figure 6 Bottom View of PCB indicating where there should be NO Ground Plane

End