

Bluetooth Module Specification

Raw Serial Modules

Revision 0.7

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Regulatory Compliance

The Socket Bluetooth module is designed to be compliant with the rules and regulations in locations where they are sold and will be labeled as required. This product is type approved — users are not required to obtain license or authorization before using.

Radio Frequency Interference Requirements

This device complies with part 15 of the FCC rules. Operation is subject to the following 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 is also ETS 300 328, ETS 300 826 and C-TICK compliant. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

This equipment generates and radiates radio-frequency energy. To comply with FCC RF exposure compliance requirements, the following antenna installation and device operating configurations must be satisfied: (1) Users are not permitted to make changes or modify the system in any way, and (2) connecting external antennas to the card is prohibited. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 may try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna of the radio or television.
- Increase the distance separating the equipment and the receiver.
- Connect the equipment to an outlet on a different branch circuit than that of the receiver.
- Consult the dealer or an experienced radio/TV technician for help.

The user may find the following booklet helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402.

U.S. Regulatory Wireless Notice

This product emits radio frequency energy, but the radiated output power of this device is far below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact with the antenna during normal operation is minimized.

Radio Frequency Interference Requirements – Canada

This Class B digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations. Cet appareil numérique de la Classe B respecte toutes les exigences du Règlement sur le Matériel Brouilleur du Canada.

Canadian Regulatory Wireless Notice

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.

To prevent radio interference to the licensed service, this device is intended to be operated indoors and away from windows to provide maximum shielding. Equipment (or its transmit antenna) that is installed outdoors is subject to licensing.

The term “IC:” before the certification/registration number only signifies that the Industry Canada technical specifications were met.

CE Marking & European Union Compliance

Products intended for sale within the European Union are marked with a CEMark which indicates compliance to applicable Directives and European Normes (EN), as follows. Amendments to these Directives or ENs are included: Normes (EN), as follows:

European Union Notice



Products bearing the CE marking comply with the R&TTE Directive (1999/5/EC), EMC Directive (89/336/EEC), and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (in parentheses are the equivalent international standards and regulations):

- EN 55022 (CISPR 22)—Electromagnetic Interference
- EN 55024 (IEC61000-4-2, 3, 4, 5, 6, 8, 11)—Electromagnetic Immunity
- EN61000-3-2 (IEC61000-3-2)—Power Line Harmonics
- EN61000-3-3 (IEC61000-3-3)—Power Line Flicker
- EN 60950 (IEC 60950)—Product Safety
- EN 300 328—Technical requirements for radio equipment
- ETS 300 826 or EN 301 489-17—General EMC requirements for radio equipment

This product may be used in all EU and EFTA countries.

Applicable Standards:

- EN 55 022 – Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.
- EN 50 082-1 – Electromagnetic Compatibility – General Immunity Standard, Part 1: Residential, Commercial, Light Industry.
- IEC 801.2 – Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 2: Electrostatic Discharge Requirements.
- IEC 801.3 – Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3: Radiated Electromagnetic Field Requirements.
- IEC 801.4 - Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 4: Electrical Fast Transients Requirements.
- EN 60 950 + Amd 1 + Amd 2 – Safety of Information Technology Equipment Including Business Equipment.

Revision Table

Revision	Date	Who	Comments
0.1	Feb 28, 2003	Charles Ader	Create Spec
0.2	Mar 21, 2003	Charles Ader	Add ref to Bluetooth documents
0.6	Mar 28, 2003	Charles Ader	Harmonize with dongle spec
0.7	Apr 1, 2003	Charles Ader	Correct description of PIO3

Table of Contents

1. Introduction.....	1
1.1. Product definition.....	1
1.2. Feature List	1
1.3. Notation.....	1
2. Physical/Environmental	2
3. Electrical Requirements	3
3.1. Average Power Consumption	4
3.2. Peak Current Consumption	4
4. Hardware Interface	5
4.1. Module Pin Assignments	5
5. Hardware Interface Protocol.....	6
5.1. Initialization status	6
5.2. Connection enable.....	6
5.3. Connection Status	6
5.4. RTS Flow Control Management.....	6
5.5. CTS Flow Control Management.....	7
6. Command.....	8
6.1. User configuration methods.....	9
6.2. Operating Modes.....	9
6.3. Command and Control Modes	9
6.3.1. Query Mode Commands	10
6.3.2. Set Local Bluetooth Device Name	11
6.3.3. Set Serial Line Parameters	11
6.3.4. Set Class of Device/Service field	12
6.3.5. Set Service Name	12
6.3.6. Set Sniff Parameters	12
6.3.7. Connectable on/off: "ON" or "OFF"	13
6.3.8. Specify Page Scan Timing	13
6.3.9. Enable Discoverable.....	13
6.3.10. Specify Inquiry Scan Timing	13
6.3.11. Set Encryption/Authentication: "PIN CODE"	14
6.3.12. Set Connectable Device Bluetooth Address.....	14
6.3.13. Set CONNECT / DICSONNECT event enable	15
6.3.14. Disable Encryption/Authentication	15
6.3.15. Read module Version	15
6.3.16. Read local device address	16
6.3.17. Read local device role	16
6.4. EVENTS	16
6.4.1. Link Connect.....	16

6.4.2. Link Disconnect	17
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List of Tables

Table 1: Ratings2

Table 2: Operating Conditions.....3

Table 3: Input/Output Terminal Characteristics3

Table 4: Average Power Consumption4

Table 5: Peak Power Consumption.....4

Table 6: Module Pin Assignment5

1. Introduction

1.1. Product definition

In the Module product line there will be 2 versions of products:

Raw Serial Module – External Power - Provide a basic Serial Cable replacement function with some user accessible command modes

Bluetooth HCI module – Provide Host Command Interface for Bluetooth stack implemented on an external local host processor.

This document will describe only the Raw Serial Module.

1.2. Feature List

- Very small size
- Low Cost
- Socket Cost : External Power Version: \$30-35 range
- Industrial Application target design
- Initially offered in Class 2 BT Radio but will offer Class 1 later
- External Power device will run off 3.3 external power
- Firmware and module code upgradeable in the field via programming interface
- Security and bonding supported
- Low power Bluetooth modes: Sniff, Park and Hold
- Not suitable for Baud Rates below 9600 Baud

1.3. Notation

Numbers are in decimal except:

- Numbers with an “h” suffix are in hexadecimal.
- Numbers with a “0x” prefix are in hexadecimal.
- Numbers with a “b” suffix are in binary.

2. Physical/Environmental

Description	Min		Max	Unit
Operating Temperature	-20		+85	deg.C
Storage Temperature	-40		+85	deg.C
Supply Voltage VDD	-0.4		3.6	V

Table 1: Ratings

Humidity: 5% to 95% (non-condensing)

3. Electrical Requirements

Description	Min	Typ	Max	Unit
Operating Temperature	-20	+25	+85	deg.C
Supply Voltage, VDD	2.7	3.0	3.6	V

Table 2: Operating Conditions

	Min	Typ	Max	Unit
Input Voltage				
VIL input logic level low (VDD=3.0V)	-0.4		+0.8	V
VIH input logic level high	0.7VDD		VDD+0.4	V
Output voltage				
VOL output logic level low, (IO = 4.0mA), VDD=3.0V	-	-	0.2	V
VOH output logic level high, (IO = -4.0mA), DD=3.0V	VDD-0.2	-	-	V
Input and Tristate Current with:				
Strong pull-up	-100	-20	-10	μA
Strong pull-down	+10	+20	+100	μA
Weak pull-up	-5	-1	0	μA
Weak pull-down	0	+1	+5	μA
I/O pad leakage current	-1	0	+1	μA
Ci Input Capacitance	2.5	-	10	pF

Table 3: Input/Output Terminal Characteristics

3.1. Average Power Consumption

Maximum current draw and power consumption of the *Raw Serial Module* is shown in the following table. Expect $\pm 10\%$ variation over temperature.

$T_{\text{ambient}} = +20^{\circ}\text{C}$

Mode		Typ		Units
ACL data transfer, 115.2kbps, UART (Master)		15.0		mA
ACL connection Sniff Mode, 40ms interval, 38.4kbps UART		6		mA
ACL connection Sniff Mode, 1.28s interval, 38.4kbps UART		4		mA
Parked Slave, 1.28s beacon interval, 38.4kbps UART		4		mA
ACL data transfer 720kbps USB (Slave)		53.0		mA
ACL data transfer 720kbps USB (Master)		53.0		mA
Standby mode (Connected to host no RF activity)		50		μA

Table 4: Average Power Consumption

3.2. Peak Current Consumption

$T_{\text{ambient}} = +20^{\circ}\text{C}$

Mode		Typ	Max	Units
Deep Sleep Mode		20.0	50	μA
Peak current during TX burst (+4 dBm)		70.0	80	mA
Peak current during TX burst (0 dBm)		60.0	70	mA
Peak current during RX burst (-85 dBm)		50.0	70	mA

Table 5: Peak Power Consumption

4. Hardware Interface

4.1. Module Pin Assignments

Signal Name	Function	Direction	Pin #
GROUND	Power supply return		1
PCM_OUT	Serial data from audio CODEC	IN	2
PCM_IN	Serial data to audio CODEC	OUT	3
PIO_1	Generic I/O local host	OUT	4
PIO_4	Generic I/O local host RS232 (DTR)	OUT	5
UART_RXD	Serial data from local host RS232 (RXD)	IN	6
UART_TXD	Serial data to local host RS232 (TXD)	OUT	7
RESET	Reset module when HIGH	IN	8
PIO_3	Generic I/O local host RS232 (DSR)	IN	9
SPI_CSB	SPI chip select	IN	10
GROUND	Power supply return		11
UART_RTS	Local host must not send when HIGH	OUT	12
SPI_CLK	SPI Clock	IN	13
UART_CTS	Module must not send when HIGH	IN	14
PCM_SYNC	Audio CODEC signal	OUT	15
PIO_2	Generic I/O local host RS232 (DCD)	IN	16
SPI_MOSI	SPI master out slave in	IN	17
PCM_CLK	Audio CODEC signal	OUT	18
SPI_MISO	SPI master in slave out	OUT	19
VCC_3.3V	Power supply		20

Table 6: Module Pin Assignment

5. Hardware Interface Protocol

5.1. Initialization status

Hardware line Pin 4 (PIO_1) is used as a status indicator. This line is LOW (zero) indicates that the module has not completed initialization. This line HIGH (one) indicates that the module has completed its initialization and is ready to accept commands or Bluetooth connections.

5.2. Connection enable

Hardware line Pin 9 (PIO_3), can be used to enable the module's connectability and discoverability.

If the module is configured in software to be a slave device, when this line is high the module is not discoverable or connectable, regardless of the software settings. When this line is low the module *can* be discoverable and connectable, depending on the software settings. If this line is changed from low to high, any existing connections are dropped and the module will not be discoverable or connectable.

If the module is configured in software to be a master device, when this line is high the module will not attempt to connect to its 'slave' device (if it has one). When this line is low the module will attempt to connect to its slave device.

5.3. Connection Status

Hardware line Pin 5 (PIO_4) is used by the local host to determine the modules current connection state. When this pin is low, there is an active connection. When this pin is high, there is no connection currently active. This pin can be used by the host to determine when the module is in BT Link Active state or BT Link Inactive state.

5.4. RTS Flow Control Management

Hardware line Pin 12, RTS is used by the module to hold of data or command transmissions from the host. When RTS is LOW, data or commands can be sent to the module, when RTS is HIGH, data or commands should not be sent to the module.

When the module is starting up after power up, RTS may go inactive for a short time. It will return to active when ready to receive control commands or data.

5.5. CTS Flow Control Management

Hardware line Pin 14, CTS is used to control data flow from the module to the local host. When this line is low the module will not send data to the local host. When this line is high the module will send any available data to the local host.

6. Command

All printable characters can be entered directly via the keyboard. Any non-printable characters are entered in binary data format.

Binary data format:

Any non seven-bit ASCII data to be transmitted to the module will be encoded in the internet 'percent' notation. Any hex byte to be transmitted is preceded by the '%' sign and encoded in hex ASCII. Thus, to send the value 0xF5, the following bytes would be transmitted: "%F5". To send the '%' character is always transmitted as "%25". Thus, a Bluetooth address 'could' be transmitted as "%00%E0%03%45%F4%6D".

Generic format:

<command character><command type><command payload><CR>

<command character> is one character from the set: [A-Z]

<command type> is one character for the set: [0-9]

<command payload> is variable in length.

<CR> is the command terminator.

The <command payload> is formed from printable ASCII characters from the code range 0x20 to 0x7E. Codes outside of this range are escaped using the percent (%) character followed by two hexadecimal digits.

The percent character is always represented by the three characters: %25

The command terminator is character code 0x13 (carriage return), or character code 0x10 (line feed), or character codes 0x13, 0x10 (carriage return, line feed)

An example command to set the friendly name to "Len's 100% serial module":

F0Len's 100%25 serial module<CR>

Character codes outside of the range of 0x20 to 0x7E are ignored.

When using percent (%) to form hexadecimal character codes there must be exactly two hex digits using characters: [0-9, A-F, a-f].

Characters outside of this range cause the command to fail.

Commands that fail return the four character sequence: NAK<CR>

Commands that are accepted return the four character sequence: ACK<CR>

Commands that return payload data use the format:

<command character><command type><command payload><CR>

<command character> is one character from the set: [a-z]

<command type> is one character for the set: [0-9]

<command payload> is variable in length.

<CR> is the command terminator.

The command character is the "lower case" version of the local host command.

6.1. User configuration methods

The user can interface with the Raw Serial Module in three distinct ways:

- Dumb Terminal – debug environment or field updates
- Windows GUI/Application – debug mode or field upgrade
- Batch mode – manufacturing environment usage

6.2. Operating Modes

The module interface has two modes:

- BT Link Active state: In this case the Serial Interface looks like a raw serial port (TxD,RxD,CTS, etc. and GND). There is no intelligence in the BT module present from the Serial Interface perspective. This mode does not support the command and control modes described below.
- BT Link Inactive state: this mode exists when a BT link is not existent: In this case the Serial Interface looks like a serial port that supports a number of command and control modes.

Upon reset the unit comes up in “BT Link Inactive State”. After the first Bluetooth connection, the unit goes into “BT Link Active State”. It will stay in this state until the link is lost because the Master shuts it down, or there is an out-of-range condition. At this point it will return to the “BT Link Inactive State”.

6.3. Command and Control Modes

Note that these commands are only available over the serial link, not over the air and are not available when the device is in the BT Link Active state.

6.3.1. Query Mode Commands

?<CR> Read ACK
?F0<CR> Read Friendly Name
?L<CR> Read Encryption and Authentication mode
?C0<CR> Read Connectable mode
?C1<CR> Read Page Scan Timing
?D0<CR> Read Discoverable mode
?D1<CR> Read Inquiry Scan Timing
?S1<CR> Read Class Of Device
?S2<CR> Read Service Name
?S3<CR> Read Sniff configuration
?S4<CR> Read PIN Code
?S5<CR> Read Connectable BDADDR
?S6<CR> Read CONNECT / DISCONNECT event enable

Examples:

Command: "?<CR>"

Reply: "ACK<CR>"

Command: "?F0<CR>"

Reply: "f0MyFriendlyName<CR>"

Command: "?L<CR>"

Reply: "l0<CR>" no Encryption or Authentication
"l1<CR>" Encryption
"l2<CR>" Authentication
"l3<CR>" Encryption and Authentication

Command: "?C0<CR>"

Reply: "c0ON<CR>"

Command: "?C1<CR>"

Reply: "c11024,512<CR>"

Command: "?D0<CR>"

Reply: "d0ON<CR>"

Command: "?D1<CR>"

Reply: "d11024,512<CR>"

Command: "?S1<CR>"

Reply: "s1001F00<CR>"

Command: "?S2<CR>"

Reply: "s2MyServiceName<CR>"

Command: "?S3<CR>"

Reply: "s3800,80,8,8<CR>"

Command: "?S4<CR>"

Reply: "s4MyPinCode<CR>"

Command: "?S5<CR>"

Reply: "s5%00%00%00%00%00%00<CR>"

Command: "?S6<CR>"

Reply: "s6ON<CR>"

6.3.2. Set Local Bluetooth Device Name

F0<Device Friendly Name><CR>

"Device Name" - String up to 254 bytes long

Default is "Socket Serial Module"

Example: "F01Len's 100%25 serial module<CR>"

This sets the name to "Len's 100% serial module"

6.3.3. Set Serial Line Parameters

S0Baud,<Data><Parity><Stop>,<Flow Control>

This command sets the serial line parameters that the Raw Serial Module should use. The command sends the ACK<CR> at the current baud rate. All data is ignored from the serial interface for 100 milliseconds. During this "black out" period the serial port is reconfigured to the new serial line parameters.

Mandatory:

Baud – 9600, 19200, 38400, 56000, 115200, 230400

Optional:

Data – 8

Parity – N, E, O

Stop – 2, 1

Flow – CTS

Default is "115200,8N1,CTS"

Example:

“S019200,8N2, CTS<CR>”

6.3.4. Set Class of Device/Service field

Set Class of Device/Service field value

S1< Class of Device/Service field >

The Class of Device/Service (CoD) field is a 24 bit field defined in the Bluetooth Assigned Numbers document. See <http://www.bluetoothsig.org/assigned-numbers/baseband.htm> for up to date information on how to compose this value. This field is sent in a HEX ASCII format and sent most significant byte first.

Example: “S1001F00<CR>” is a common Class of Device value for a basic serial device.

6.3.5. Set Service Name

Set the service friendly name to be sent to the remote Bluetooth device in response to a service discovery request. The length of the service name is limited to 32 bytes.

S2<Service Name>

Profile Name – Text name entered into the SDP record for the serial port profile.

Default: “Socket Serial Port”

Example:

“S3Acme Serial Port<CR>”

6.3.6. Set Sniff Parameters

Set sniff mode parameters. This command will enable Bluetooth sniff mode. Sniff mode is described in the Bluetooth V1.1 Core Specifications for up to date information see: <http://www.bluetoothsig.org/specifications.htm>

S3<Sniff_Max_Interval>,<Sniff_Min_Interval>,<Sniff_Attempt>,<Sniff_Timeout>

Example: “S3256, 100, 8, 8<CR>”

To disable sniff mode, send the command with parameters:
“S3OFF”

6.3.7. Connectable on/off: "ON" or "OFF"

Set the device into 'connectable' mode

C0 <ON|OFF><CR>

Example:

"C0OFF<CR>" – Become non-connectable

"C0ON<CR>" – Become connectable

6.3.8. Specify Page Scan Timing

Set the Page Scan timing parameters

C1<Page_Scan_Interval>,<Page_Scan_Window><CR>

Default: 4096,18

Example:

"C11024,512<CR>"

Note:

To enable scanning the values for Interval and Window must be in the range of 18 to 4096. The Window value must be less than the Interval value. Both values must be zero to disable scanning.

Page scan timing is described in the Bluetooth V1.1 Core Specifications for up to date information see: <http://www.bluetoothsig.org/specifications.htm>

6.3.9. Enable Discoverable

Set the device into 'discoverable' mode

D0 <ON|OFF><CR>

Example:

"D0OFF<CR>" – Become non- discoverable

"D0ON<CR>" – Become discoverable

6.3.10. Specify Inquiry Scan Timing

Set the Inquiry Scan timing parameters

D1<Inquiry_Scan_Interval>,< Inquiry_Scan_Window><CR>

Default: 4096,18

Example:

“D11024,512<CR>”

Note:

To enable scanning the values for Interval and Window must be in the range of 18 to 4096. The Window value must be less than the Interval value. Both values must be zero to disable scanning.

Inquiry scan timing is described in the Bluetooth V1.1 Core Specifications for up to date information see: <http://www.bluetoothsig.org/specifications.htm>

6.3.11. Set Encryption/Authentication: "PIN CODE"

S4<PIN code>

PIN code – Pin code can be NULL and as long as 16 characters

Default: NULL PIN code

Example:

“S4MyPinCode <CR>”

Note:

6.3.12. Set Connectable Device Bluetooth Address

This command forces the Module to only allow only the device of the specified Bluetooth address to connect to it. This value is saved in the module until RESET by this command.

Note: A value of "000000000000" means allow any device to connect.

S5<BDADDR>

BDADDR – Bluetooth device address of device that will be allowed to connect

Default: %00%00%00%00%00%00

Example:

“S5%01%00%55%0C%00%1B <CR>”

Note:

6.3.13. Set CONNECT / DISCONNECT event enable

S6<ON|OFF><CR>

Example:

“S6OFF<CR>” – Do not send CONNECT / DISCONNECT events.

“S6ON<CR>” – Send CONNECT / DISCONNECT events.

6.3.14. Disable Encryption/Authentication

L0 Disable encryption and authentication

L1 Enable encryption

L2 Enable authentication

L3 Enable encryption and authentication

Example:

“L3<CR>”

Note:

6.3.15. Read module Version

Display the firmware build version currently running

V0<CR>

Example:

“V0<CR>”

Returns:

"v1yyyymmddHHMM<CR>"

Note: This command responds with the requested data only not the “ACK<CR>”

Example:

Sent: “V0<CR>”

Received: “v0200212312359<CR>”

6.3.16. Read local device address

Display the local device address

V1<CR>

Returns:

“v1%xx%xx%xx%xx%xx%xx<CR>”

Note: This command responds with the requested data only not the “ACK<CR>”

Example:

Sent: “V1<CR>”

Received: "v1%00%2C%C6%03%45%39"

6.3.17. Read local device role

Display the local device role

V2<CR>

Example:

“V2<CR>”

Returns:

“v2SLAVE<CR>” – When module is configured for Bluetooth slave mode.

“v2MASTER<CR>” – When module is configured for Bluetooth master mode.

Note: This command responds with the requested data only not the “ACK<CR>”

6.4. EVENTS

6.4.1. Link Connect

Send “CONNECT %xx%xx%xx%xx%xx%xx<CR>” to local host when link is established.

The Bluetooth device address of the remote device is supplied as ASCII hex characters following the word CONNECT.

6.4.2. Link Disconnect

Send “DISCONNECT<CR>” to local host when link is broken.