

# Product Specification

RF Module

## R8001

(RIOTEC)

Version:1.4

## Revision History

Edition #	Reason for revision	Issue Date	Written by
1.0	Initial Document	2009/7/20	Kevin Shen
1.1	Modify SPEC & Add Software & Operation Mode	2012/8/24	Kevin Shen
1.2	Modify PIN Define	2012/8/28	Joan Hsieh
1.3	Add FCC Interference Statement	2012/9/5	Joan Hsieh
1.4	Add SSP and iOS soft keypress description	2012/10/4	Kevin Shen

# Index

<b>1. PRODUCT INFORMATION .....</b>	<b>4</b>
<b>2. TECHNICAL INFORMATION .....</b>	<b>5</b>
2.1 MODULE PINOUT .....	5
2.2 MECHANICAL SPECIFICATION .....	7
2.3 BLOCK DIAGRAM.....	7
2.4 ELECTRICAL CHARACTERISTICS .....	8
2.5 RADIO CHARACTERISTICS.....	9
<b>3. SOFTWARE &amp; OPERATION MODE .....</b>	<b>10</b>
3.1 SCANNER ROLE .....	10
3.2 CRADLE ROLE .....	14
<b>APPENDIX A: AT COMMAND .....</b>	<b>15</b>
A.1. AT COMMAND FORMAT .....	15
A.2. AT COMMAND RESPONSE FORMAT .....	15
A.3. SET COMMANDS .....	17
A.4. GET COMMANDS.....	17
A.5. ACTION COMMANDS .....	18

## 1. Product Information

■ Product Name : BT-1041

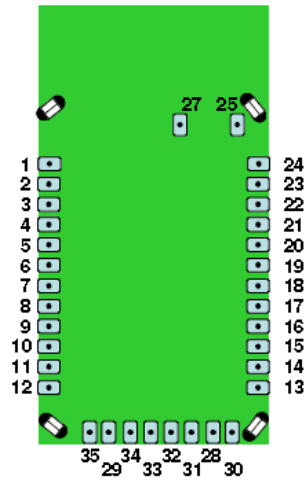
■ Product Description: Class1 BT v2.0 Module with Antenna

■ Product Features:

Chips	CSR BlueCore-04 External
Flash	8MB
Host Interface	UART/USB
Standard	Bluetooth v2.0
RF band	2.4~2.4835GHz ISM band
RF Output Power	Class I (12 dBm)
Sensitivity	<-70dBm
Antenna	Chip antenna
Power voltage	3.3V
Dimension	13.4x25.8x2mm

## 2. Technical Information

### 2.1 Module Pinout

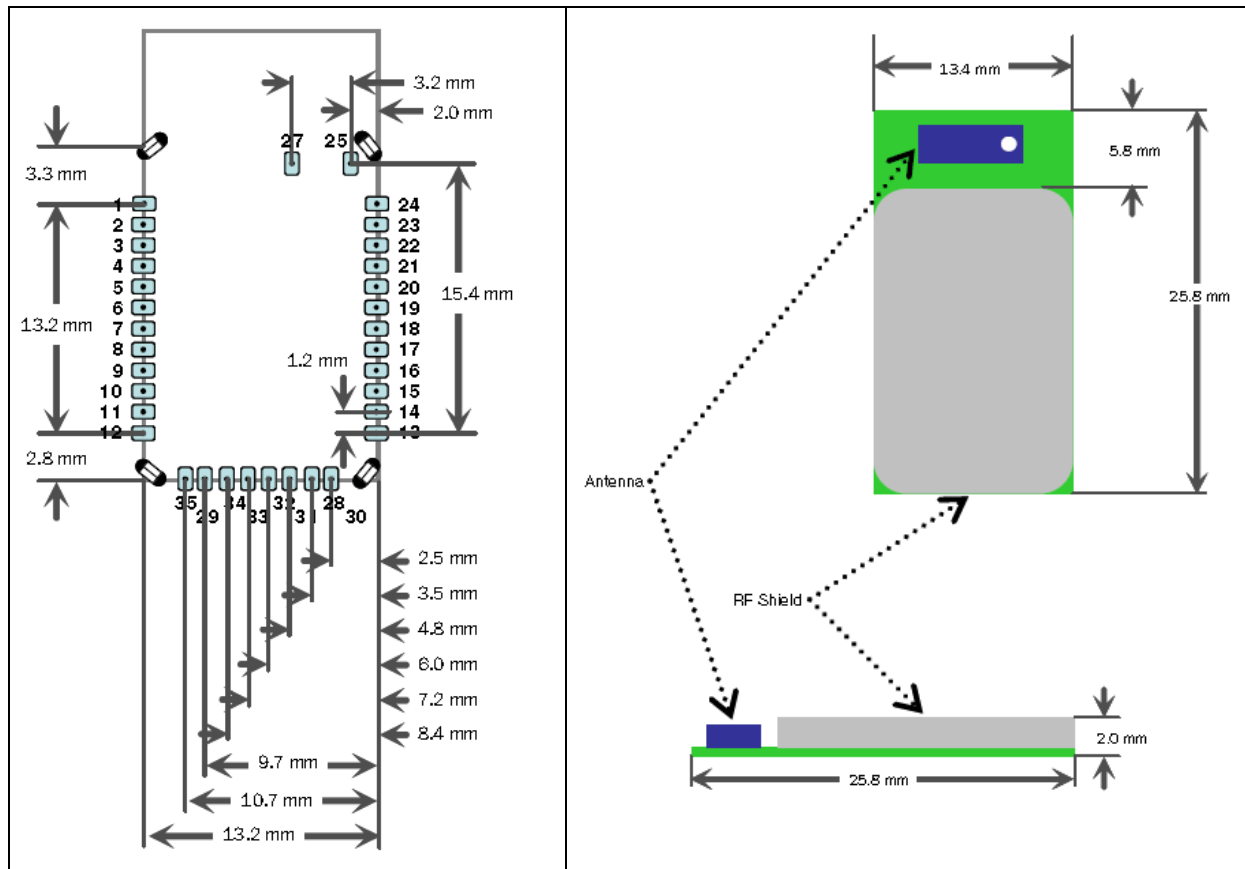


### TOP VIEW

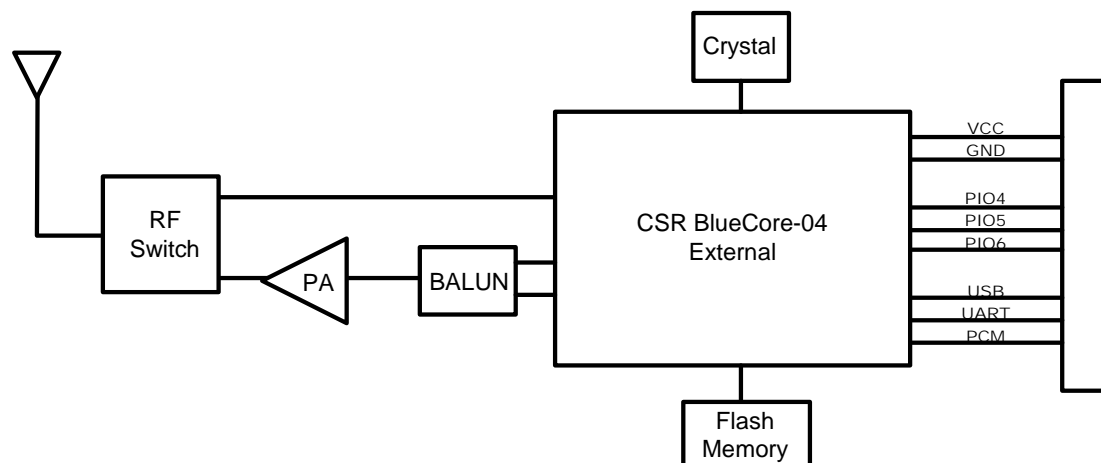
Pin	Name	Description	Default
1	GND		
2	SPI MOSI	Programming only	No Connect
3	PIO6	General Purpose I/O	
4	PIO7	General Purpose I/O	
5	RESET	Active LOW reset	Input with 1K pull-up
6	SPI_CLK	Programming only	No Connect
7	PCM_CLK	PCM interface	No Connect
8	PCM_SYNC	PCM interface	No Connect
9	PCM_IN	PCM interface	No Connect
10	PCM_OUT	PCM interface	No Connect
11	VDD	3.3V regulated power input	
12	GND		
13	UART_RX	UART receive Input	Input
14	UART_TX	UART transmit output	High level output
15	UART_RTS	UART RTS, goes HIGH to disable host transmitter	Low level output
16	UART_CTS	UART CTS, if set HIGH, disables transmitter	Low level input
17	USB_D+	USB port	No Connect
18	USB_D-	USB port	No Connect

19	PIO2	General Purpose I/O	Output
20	PIO3	General Purpose I/O	Output
21	PIO5	General Purpose I/O	
22	PIO4	General Purpose I/O	
23	SPI_CSB	Programming only	No Connect
24	SPI_MISO	Programming only	No Connect
25	GND		
26	RF I/O	Radio frequency signal Input/Output	
27-29	GND		
30	AIO0		
31	PIO8	General Purpose I/O	
32	PIO9	General Purpose I/O	
33	PIO10	General Purpose I/O	
34	PIO11	General Purpose I/O	
35	AIO1		

## 2.2 Mechanical Specification



## 2.3 Block Diagram



## 2.4 Electrical Characteristics

	Min	Typ.	Max.	Unit
Supply Voltage	3.0	3.3	3.6	V
RX Supply Current	-	35	60	mA
TX Supply Current	-	70	130	mA
<b>Average power consumption</b>				
Standby/Idle (default settings)	-	25	-	mA
Connected (normal mode)	-	30	-	mA
Connected (low power Sniff)	-	8	-	mA
Standby/Idle (Deep sleep enabled)	250uA	-	-	uA

## ■ Operating Conditions

Voltage Range	3.3V±0.3V
Operating Temperature Range	-20 °C ~ 60 °C
Storage Temperature Range	-20 °C ~ 80 °C
Relative Humidity (Operating)	≤90%
Relative Humidity (Storage)	≤90%



## 2.5 Radio Characteristics

	Frequency (GHz)	Min	Typ	Max	BT Spec.	Unit
Sensitivity at 0.1%BER	2.402	-	-70	-75	$\leq -70$	dBm
	2.441	-	-70	-75		dBm
	2.480	-	-70	-75		dBm
RF Transmit Power	2.402	11.0	12.0	-	$\leq 15$	dBm
	2.441	11.0	12.0	-		dBm
	2.480	11.0	12.0	-		dBm
Initial Carrier Frequency Tolerance	2.402	-	5	75	75	kHz
	2.441	-	5	75		kHz
	2.480	-	5	75		kHz
20dB bandwidth for modulated carrier		-	900	1000	$\leq 1000$	kHz
Drift (Five slots packet)		-	15	-	40	kHz
Drift Rate		-	13	-	20	kHz
$\Delta f_{1\text{avg}}$ "Maximum Modulation"	2.402GHz	140	165	175	$140 < \Delta f_{1\text{avg}}$	kHz
	2.441GHz	140	165	175		kHz
	2.480GHz	140	165	175		kHz
$\Delta f_{2\text{max}}$ "Minimum Modulation"	2.402GHz	115	190	-	115	kHz
	2.441GHz	115	190	-		kHz
	2.480GHz	115	190	-		kHz

### 3. Software & Operation Mode

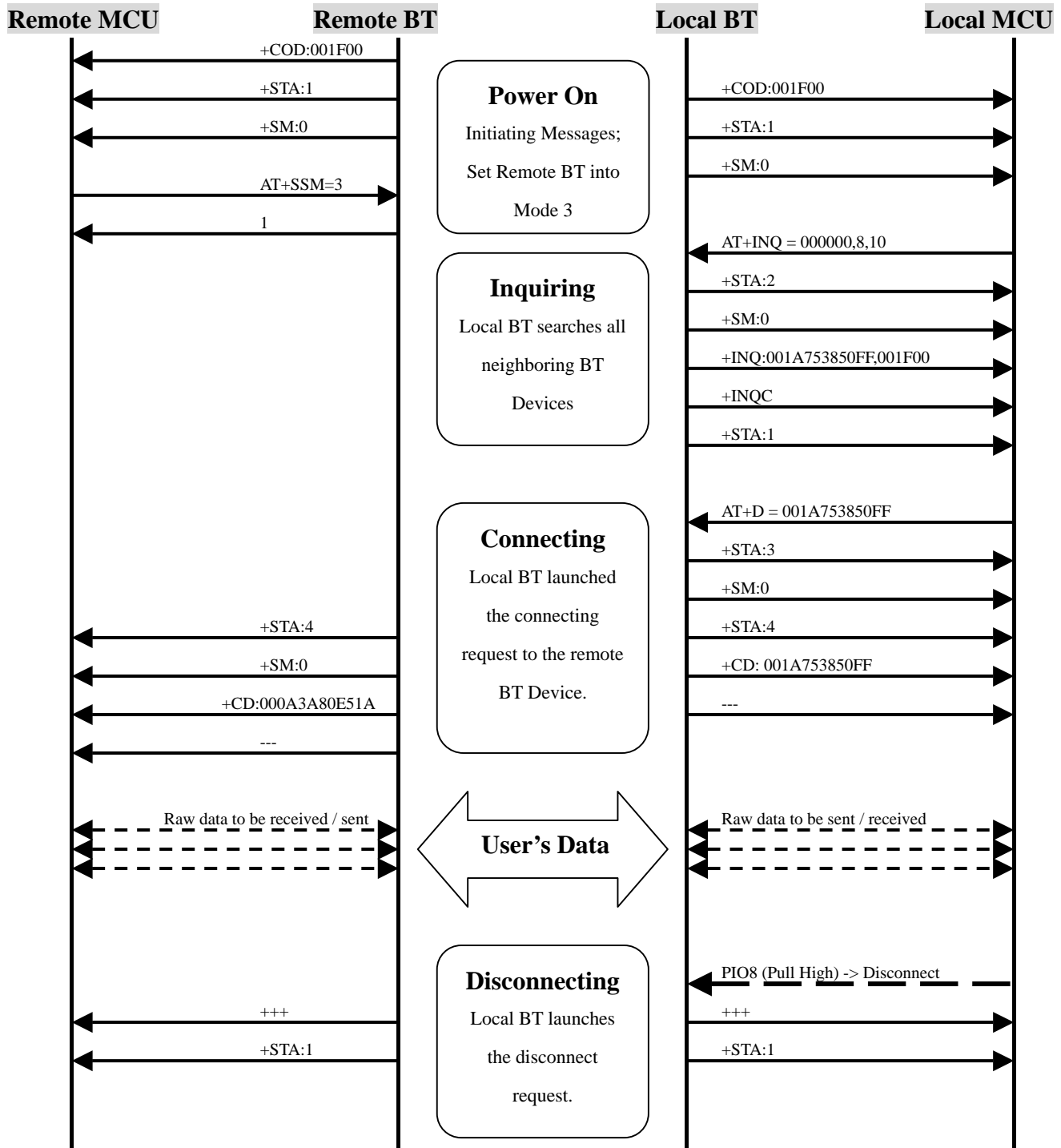
#### 3.1 Scanner Role

- Device Name: RIOTEC-6 碼 BD\_ADDR
- PIN Code: 1234
- Baudrate: 115200, 8, n, 1
- HW Flow Control: Disable
- PIO Definition in SPP/HID mode :

Pins	Type	Function	Descriptions
<b>PIO 2</b>	(Out)	Discoverable	0: Not Discoverable; 1: Discoverable
<b>PIO 3</b>	(Out)	Connected	0: Normal; 1: Connected
<b>PIO 4</b>	(Out)	Connecting	0: Normal; 1: Indicates that the scanner is try to connect to the cradle.
<b>PIO 5</b>	(Out)	Link loss	0: Normal; 1: Indicates unintended connection loss due to bad RF signal or uninformed disconnected. The signal state will change back to 0 if BT-1041 receives the AT+D=xxxxxxxxxxx command.
<b>PIO 6</b>	(In)	Mode Switch	0:HID; 1:SPP; Drive to proper line state to switch between operation modes.
<b>PIO 7</b>	(In)	Unplut(HID mode) / Reset baud(SPP mode)	HID mode : Unplug / SPP mode : Set baud-rate 115200
<b>PIO 8</b>	(In)	Bluetooth Disconnect (SPP mode only)	0:Normal; 1: Disconnect; Drive high for at least 30mS to disconnect
<b>PIO 9</b>	(Out)	NUM_LOCK (HID mode only)	0: Num Lock OFF; 1: Num Lock ON
<b>PIO 10</b>	(Out)	CAPS_LOCK (HID mode only)	0: Caps Lock OFF; 1: Caps Lock ON
<b>PIO 11</b>	(Out)	Bluetooth Status LED	In Connected state, the LED is always OFF. For other states, the LED pattern consists of an 100ms on and a specified period off, The period of Ready / Idle state is 6000ms The period of Inquiry / Discoverable state is 200ms The period of Connecting state is 200ms

### ■ SPP Connection Example

The following example describes simple initial, inquiring, connecting, data-sending/receiving and disconnecting process by using AT Command set in BT-1041.



## ■ HID Operation Mode

HID operation mode is dedicated for a user's device to be emulated as a **Bluetooth Keyboard**. After being connected, the HID report package can be transferred through the UART interface to a remote platform, such as a PC/Laptop. In this mode, AT Commands are not allowed. Using the following PIO table, BT-1041 can operate whole activities during the HID operation mode.

## ■ HID Connection Procedures

### ➤ Step1. Power On

After power on BT-1041, the paired BT-1041 is in the **“Connecting mode”** to continue re-connecting the existed paired remote device. If BT-1041 is un-paired with any remote device, BT-1041 will be in **“Discoverable mode”**.

### ➤ Step2. Data Transfer

After connection is created, BT-1041 can accept HID report packages through the UART interface. While BT-1041 is in **“Connected mode”**, BT-1041 reports the **“Link Quality”** message (0x00~0xFF) every second to indicate Bluetooth connection quality. The larger value indicates the better link quality. Value **0xD5** is a recommended value to stop sending HID report packages.

### ➤ Step3. Disconnected

If the connection is interrupted (either normal or abnormal), BT-1041 will still continue re-connecting the paired remote device.

### ➤ Step4. Discoverable

When **Unplug/re-pair** button (**PIO7**) is pressed, BT-1041 will disconnect the existing connection and/or stop any re-connecting action to be in **“Discoverable mode”**.

## ■ HID Package Format

The packet format for data written into the UART is effectively a HID report with an additional header. The protocol only checks that the packet matches the header and does not valid the HID Report. It is the responsibility of the designer to make sure that the HID Reports send to the UART match those defined in the HID Descriptor in the SDP service record.

A HID device may need to send different reports depending on whether the device is in HID Boot Protocol or HID Report protocol. If this is needed, then additional signaling between the BC4 VM application and the external processor may be needed - perhaps using a PIO line.

Byte	Description
0	Length of packet in bytes (including this byte)
1	Type of packet: 0 - Forward HID Report.
2 to n	The HID Report including header.

Below is an example packet for a Boot Keyboard Report:

Note: For devices that requiring PIN entry to be made by pressing the keys on the keyboard.

Keyboard reports must be sent using the HID Keyboard Boot Report format so that the HID library intercept these packets and extract the keycodes during pairing.

Byte	Value	Description
0	0x0c	Length of packet (12)
1	0x00	Forward HID Report.
2	0xa1	HID Input Report Header
3	0x01	Keyboard Report ID
4	0x00	Modifier Keys (none pressed)
5	0x00	Reserved
6	0x04	Keycode 1 ('A' key pressed on USA keyboard)
7	0x00	Keycode 2 (not pressed)
8	0x00	Keycode 3 (not pressed)
9	0x00	Keycode 4 (not pressed)
10	0x00	Keycode 5 (not pressed)
11	0x00	Keycode 6 (not pressed)

**Note:**

To show/hide the virtual keyboard on an iOS device after connection in HID mode. Host must send the particular package composed of 0x05 0x00 0xa1 0x02 0x01 0x05 0x00 0xa1 0x02 0x00.

### 3.2 Cradle Role

■ PIO Definition in SPP mode:

Pins	Type	Function	Descriptions
<b>PIO 2</b>	(Out)	CONNECTION_IND	Connected : High, otherwise : Low
<b>PIO 3</b>	(In)	BTN_DISCONNECT	Pulled high to disconnect SPP connection.
<b>PIO 4</b>	(In)	BTN_DISCOVERABLE	High: Discoverable, Low(default): Connectable
<b>PIO 5</b>	(Out)	N/A	
<b>PIO 6</b>	(In)	N/A	
<b>PIO 7</b>	(In)	N/A	
<b>PIO 8</b>	(In)	N/A	
<b>PIO 9</b>	(Out)	N/A	
<b>PIO 10</b>	(Out)	N/A	
<b>PIO 11</b>	(Out)	N/A	

## Appendix A: AT Command

The modem-like AT Command set of BT-1041 is based on Command/Response handshake. The following sections describe syntax and commands used in command interface for the user to configure and control BT-1041.

### A.1. AT Command Format

The AT command format is:

**AT<cmd><cr> or AT<cmd>=<value><cr>**

\*\*\* <cmd> represents *specified command*; <cr> represents \r

Format	Example	Example
AT+<cmd><cr>	AT + GLN \r	Host send Get local name command
AT+<cmd>=<value><cr>	AT + PIN = 12345678 \r	Host send Set pin code command

### A.2. AT Command Response Format

The AT command response format is:

**<cr><lf><Response Code><cr><lf>**

\*\*\* <cr> represents \r; <lf> represents \n

There are two categories of Response Code:

#### ■ Category 1 Response Code:

Example	Meaning	Condition & Notes
\r \n 1 \r \n	OK	
\r \n 2 \r \n	ERROR	ie, AT+INQ = 000000, <b>15</b> ,10 \r (1 <= maxResponses <= <b>10</b> )
\r \n 3 \r \n	UNKNOWN	ie, AT+ <b>ABC</b> \r (command ABC is not available)
\r \n 4 \r \n	FAILED	ie, command/response successfully finished; result to be no match

#### ■ Category 2 Response Code:

Example	Meaning	Condition & Notes
\r \n +STA:state \r \n	<b>STATE:</b> to indicate current status	<b>state:</b> 1 : sppDevReady 2 : sppDevInquiring 3 : sppDevConnecting 4 : sppDevConnected
\r \n +SM:scanMode \r \n	<b>SCANMODE:</b> to indicate current scan mode	<b>scanMode:</b> 0 : hci_scan_enable_off 1 : hci_scan_enable_inq 2 : hci_scan_enable_page 3 : hci_scan_enable_inq_and_page
\r \n +INQ:address, classOfDevice \r \n	<b>INQUIRY</b> result	<b>address:</b> 12 hexadecimal <b>classOfDevice:</b> 6 hexadecimal
\r \n +INQC \r \n	<b>INQUIRYCOMPLETE</b>	
\r \n +COD: classOfDevice \r \n	to indicate class of device (local device)	<b>classOfDevice:</b> 6 hexadecimal
\r \n +LA:address \r \n	LocalAddress	<b>address:</b> 12 hexadecimal
\r \n +LN:name \r \n	Local Name: Return code of get local name command	User friendly name of the local device
\r \n +SCM:securityMode \r \n	Ssecuritymode: to indicate current security mode	<b>securityMode:</b> 0 : security_off, encryption_off 1 : security_on, encryption_off 2 : security_on, encryption_on
\r \n +RN:address,name \r \n	Remote Name: Return code of get remote name command	<b>address:</b> 12 hexadecimal <b>name:</b> user friendly name of the remote device
\r \n +SSPP:address,result \r \n	SEARCHSPP : Return code of search SPP profile command	<b>address:</b> 12 hexadecimal <b>Result:</b> 0 : SPP profile not found 1 : SPP profile found
\r \n +CD:address \r \n	CONNECTED : Indication of SPP connection	<b>address:</b> 12 hexadecimal
\r \n --- \r \n	Connected : The last result code before entering data mode	
\r \n +++ \r \n	Disconnected : The first result code after returning to command mode	



### A.3. Set Commands

The Set commands are for the user to set the BT-1041 configuration.

SET Commands	Command Set	Conditions & Notes
Set inquiry scan and page scan mode command	AT + SSM = scanMode \r	<b>scanMode:</b> 0 : hci_scan_enable_off 1 : hci_scan_enable_inq 2 : hci_scan_enable_page 3 : hci_scan_enable_inq_and_page
Set pin code command	AT + PIN = pinCode \r	<b>pinCode:</b> default: 0000 4< pincode length <16
Set local name command	AT + SLN = localName \r	1 <= local name length <= 16
Set Baud rate command	AT + SBR = baudRate \r	<b>baudRate:</b> <b>Default = 9k6 bps</b> UART Baud rate =baudRate/0.004096 Some common values are: 9k6 baud - 39 19k2 baud - 79 38k4 baud - 157 57k6 baud - 236 115k2 baud - 472 230k4 baud - 944 460k8 baud - 1887 921k6 baud - 3775 1382k4 baud - 5662
Set class of device command	AT + SCOD = classOfDevice \r	<b>classOfDevice:</b> 6 hexadecimal class of device
Delete all authorized devices command	AT + DA \r	

### A.4. Get Commands

GET Commands	Command Set	Conditions & Notes
--------------	-------------	--------------------

<b>Get inquiry scan and page scan mode command</b>	<b>AT + GSM \r</b>	
<b>Get local name command</b>	<b>AT + GLN \r</b>	
<b>Get class of device command</b>	<b>AT + GCOD \r</b>	
<b>Get local address command</b>	<b>AT + GLA \r</b>	
<b>Get remote name command</b>	<b>AT + GRN = address \r</b>	<b>address:</b> 12 hexadecimal Bluetooth Device Address
<b>Get state command</b>	<b>AT + STA \r</b>	

### A.5. Action Commands

The actions commands are for the users to control the BT-1041 to do certain actions. The defined actions are: Inquiry, Connect, Reset and Search SPP profile.

<b>ACTION Commands</b>	<b>Command Set</b>	<b>Conditions &amp; Notes</b>
<b>Inquiry command</b>	<b>AT + INQ = CLASSOFDEVICE, MAXRESPONSES, TIMEOUT \R</b>	<b>classOfDevice:</b> 6 hexadecimal class of device filter set 000000 -- notified of all devices within range regardless of their class of device. audio/ video to be 000400 ; headset to be 200404 <b>maxResponses:</b> 1 <= maxResponses <= 10 <b>timeout:</b> 1(1.28 seconds) <= timeout <= 48(61.44 seconds)
<b>Connect command</b>	<b>AT + D = address \r</b>	<b>address:</b> 12 hexadecimal Bluetooth Device Address
<b>Reset command</b>	<b>AT + RST \r</b>	
<b>Search SPP profile command</b>	<b>AT + SSPP = address \r</b>	<b>address:</b> 12 hexadecimal Bluetooth Device Address

**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 UNDESIRE OPERATION.**

**Federal Communications Commission Requirements**

The equipment has been tested and found to comply with the limits for 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 instruction, may cause harmful interference to radio communication. 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 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. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and receiver.

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

**FCC Radiation Exposure Statement**

The equipment complies with FCC radiation exposure limits set forth for uncontrolled equipment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65. The equipment has very low levels of RF energy that it is deemed to comply without testing of specific absorption ratio (SAR).

**Modular approval RF Exposure statement :**

This equipment must be installed and operated in accordance with provided instructions and the antenna(s) 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. End-users and installers must be provide with antenna installation instructions and consider removing the no-collocation statement.

**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. The final end product must be labeled in a visible area with the following:

"Contains FCC ID: V3DR8001 ".

**Manual Information To the End User**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.