

# ***Radicom Research, Inc.***

*Designers Guide for the*

## ***RB4000 H400CE RB4000HM MDK4000 Kit***

***RoHS Serial TTL Bluetooth Modules***



RB4000



RB4000HM



RoHS Compliant



April 18, 2012

## ***Table of Contents***

Introduction	3
Features	4
Specifications	5
Model and Ordering Information	6
FCC& IC Label and Model Identification	7
Important Regulatory Compliance and User Information	8
CE Declaration of Conformity	10
Layout Design Suggestions	10
RB4000 Pad Size	11
RB4000 Mechanical Diagram & Pin Assignments	12
RB4000 Interface Signal Level Definitions	13
RB4000HM Mechanical Diagram & Pin Assignments	14
RB4000HM Switch settings	15
RB4000HM Interface Signal Level Definitions	15
RB4000MB Carrier Board RS232 DB 9 Pin Definitions	16
LED Operation	16
Connecting to Your System	17
Limited Warranty	18
Contacting Radicom Research	20

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## ***Introduction***

Thank you for purchasing Radicom Research's RB4000 Bluetooth Module. We are committed to providing you quality service and technical support. The RB4000 and RB4000HM Bluetooth modules are designed to meet OEM's needs of embedding short-range wireless data connectivity to their products. The RB4000 family offers a quick and simple solution for wireless point-to-point Bluetooth communications.

The RB4000 series are Class 2 Bluetooth modules using BlueCore4-External Chipset from CSR, the leader in Bluetooth chipsets. These embedded modules are Bluetooth V.2.0 + EDR (Enhanced Data Rate) compliant that increase throughput, reduce battery consumption and improve security. It provides faster pairing and allows superior performance in the presence of interference from 802.11 WiFi wireless devices and other 2.4GHz radios.

The RB4000 series has 8Mbits flash memory on board for upgrading the modules firmware. OEM specific parameters and settings can be loaded into these modules. Radicom can modify the firmware to meet OEM requirements and create custom Bluetooth functionality to meet your specific needs.

The RB4000 Series supports Serial Port Profile functionality for setting up virtual serial ports on two devices (e.g. PCs) and connecting the two devices using the RB4000 Bluetooth modules to emulate a RS232 serial cable between the two devices.

There are 4 models available, RB4000, H4000CE, RB4000HM-a, and RB4000HM-c. The RB4000 and H4000CE are surface mount PCB Bluetooth modules with on-board antenna. The RB4000 and H4000CE are identical except for the name that was changed for marketing reasons. The RB4000HM-a is serial through-hole Bluetooth module with an on board antenna. The RB4000HM-c is serial through-hole Bluetooth module with an U.FL connector for an external antenna to provide the flexibility for placing antennas in a desired location. For evaluation purposes we offer kits for both the onboard and external antenna versions of the modules. Each kit will include one each SPP-A Initiator and SPP-B Acceptor Bluetooth module installed into carrier boards with a RS232 Serial connector. Upon receipt of the Evaluation kits, the user can immediately connect the carrier boards to any standard serial port to evaluate the Bluetooth modules.

## ***Features***

- Bluetooth 2.0+EDR support
- Small sizes: 0.57" x 1.26" x 0.08" (RB4000) or 1" x 1.26" x 0.2" (RB4000HM)
- Class 2 radio, 4dBm transmission power
- Serial Port Profile (SPP) support
- Secure simple pairing support
- Link Data Rate 2.1Mbps Max
- SPP/ UART data rates: 115.2Kbps
- GAP (Generic Access Protocol)
- SDP (Service Discovery Protocol)
- L2CAP (Logical link control and adaptation protocol)
- RFCOMM embedded stack profiles support
- 8Mbits flash memory on board
- Secure communications with 128-bit encryption
- Onboard antenna or with an U.FL connector for external antenna
- Supports 802.11 wireless co-existence
- Custom application specific Firmware is possible. Contact Radicom Research, Inc.
- Available as either SPP-A Initiator and SPP-B Acceptor Bluetooth module
- RTS/CTS Flow Control (Hardware Flow Control) Supported





## **Approvals**



- FCC Part 15: FCC OET 65 Supplement C (SAR), 47 CFR FCC Part 15 Subpart C 15.247, 47 CFR FCC Part 15 Subpart B 2009 (Class B)
- IC RSS-102, IC ES-003 issue 4, IC RSS-210 issue 8:2010
- RoHS Compliant
- CE Marked: EN 61000-3-2:2006+A2:2009, EN 62311:2008, EN 300 328 V1.7.1, EN 301 489-1, V1.8.1, EN 61000-3-3:2008, EN 301 489-17 V2.1.1)
- EN 60950-1:2006+A11:2009+A1:2010+A12:2011

## *Specifications*

<b>Dimensions</b>	RB4000: 0.57"x1.26"x0.08" ???? RB4000HM: 1" x 1.26" x 0.2" ?????
<b>Device Type</b>	Embedded Bluetooth OEM module
<b>Interface</b>	Serial
<b>Data Link Protocol</b>	Bluetooth 2.0+EDR
<b>Frequency</b>	ISM 2.4 GHz short-range radio frequency band
<b>Frequency Range</b>	2,402 – 2,483.5 MHz
<b>Max Transmit Power</b>	+4dBm
<b>Receive Sensitivity</b>	-89dBm
<b>Bluetooth Class</b>	Class 2
<b>Link Data Transfer Rate</b>	2.1Mbps Max
<b>UART /SPP Data Transfer Rate</b>	115.2Kbps
<b>Sustained Data Through-put</b>	720Kbps
<b>Flow Control</b>	RTS/CTS Hardware
<b>Range</b>	Up to 20 meters (60 feet, basic rate, line of sight)
<b>On Board Flash</b>	8Mbits
<b>Compliant Standards</b>	Bluetooth 1.1, 1.2, and 2.0
<b>Security</b>	128-bit encryption
<b>Supply Voltage: VDD</b>	2.2V to 4.2V (RB4000) or 3.15V ~ 3.45V (RB4000HM)
<b>Current Consumption</b>	<div style="display: flex; justify-content: space-around;"> <div>SPP-A Code</div> <div>SPP-B Code</div> </div> <div>Before connection: 40mA 38mA</div> <div>Connected (Sniff Mode): 7mA 15mA</div> <div>Connected (full TX/RX): 11mA 35mA</div>
<b>Antenna</b>	On-board antenna or with an U.FL connector for external antenna
<b>On-Board Antenna Gain</b>	1 dBi
<b>External Antenna Gain</b>	2 dBi
<b>Baseband Crystal OSC</b>	16MHz
<b>RF Input Impedance</b>	50 ohms
<b>Receiver IF Frequency</b>	1.5MHz
<b>Receiving Signal Range</b>	-80 to -20dBm typical
<b>Hopping</b>	1600hops/sec, 1MHz channel space
<b>Operating Temperature</b>	-40°C to +85°C
<b>Environmental</b>	RoHS compliant

## ***Model and Ordering Information***

Model Number	Description
<b>RB4000 or H4000CE</b> 	<p>0.57" x 1.26" x 0.08" surface mount, short range Bluetooth module with on-board antenna</p> <p>Model: RB4000</p> <p>The RB4000 is the same as the H4000CE. The name is different for marketing purposes only.</p> <p>Available as either SPP-A Initiator and SPP-B Acceptor Bluetooth module</p>
<b>RB4000HM (-a + -c)</b> 	<p>1.0" x 1.26" x 0.2" dual-in-line, through-hole Bluetooth module</p> <p>Model: RB4000HM-a - PCB antenna on-board.</p> <p>Model: RB4000HM-c - With on-board U.FL antenna connector for external antenna</p>
<b>RB4000MB</b> 	<p>RB4000MB Carrier board with Bluetooth Module installed, USB Type B receptacle for power, DB9M connector and AC power receptacle installed for optional AC power adapter</p>
<b>MDK4000</b> 	<p>RB4000 Development Kit. Each kit consists of the following components:</p> <ol style="list-style-type: none"> <li>1. 2ea Carrier Boards with Bluetooth Modules (Pair of modules configured as SPP-A for Initiator and SPP-B for Acceptor each installed into RB4000MB Carrier Board)</li> <li>2. 2ea. 6 feet USB Power cables (A to B)</li> <li>3. 2ea. Null modem cables (DB9F to DB9F)</li> <li>4. 2ea AC Power adapters (optional required if USB power unavailable)</li> <li>5. 2ea external antennas (optional for RB4000HM-c)</li> <li>6. 2ea antenna cables (optional for RB4000HM-c)</li> </ol>

<b>ATN-2d-RP-SMA</b> 	Replacement antenna, 2.4GHz, 2dBi, RP-SMA, Omni-directional.
<b>AC6i-RP-SMA</b> 	6" U.FL. to RP-SMA female connector antenna cable

### ***FCC & IC Label and Model Identification***

The RB4000 module family is FCC Part 15 and IC (Industry Canada) certified. The RB4000 is also CE marked. The modules are labeled with the appropriate RB4000 module model number and FCC Part 15 ID, IC registration number and CE mark. The label can be found on top of the metal shielding on the RB4000 Module.

**Radicom Research Inc.**

**Model: RB4000**

**FCC ID: K7T-RB4000**

**IC: 2377A-RB4000**



Note: Models RB4000HM-a and RB4000HM-c will have an additional Product ID label containing the HM model numbers.



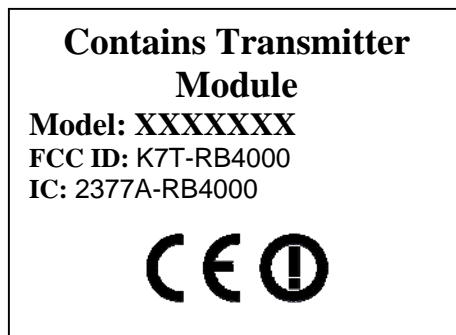
## ***Important Regulatory Compliance and User Information***

The final product with the modules installed needs to be tested for FCC Part 15, IC (Industry Canada) CE, EMI/RFI compliance. Radicom certification documentation will help streamline the final product approval process. Contact Radicom for more information. To maintain compliance in the finished product, carefully follow guidelines in this section. This device is intended only for OEM integrators under the following condition:

The transmitter module may not be co-located with any other transmitter or antenna. As long as this condition is met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with the module installed (for example, digital device emissions, PC peripheral requirements, etc). **IMPORTANT NOTE:** In the event that this condition cannot be met then the FCC authorization is no longer considered valid and the FCC ID cannot 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.

### **Host (End Product) Labeling Requirements**

To maintain compliance, the end product hosting the module must be properly labeled to identify that this module is installed. The final end product must have a label located in a visible area with the following information:



XXXXXXX is for the model of the RB400HM used in the end equipment. The XXXXXXXX will be RB4000, H4000CE, RB4000HM-a or RB4000HM-c. The label shall be securely affixed to a permanently attached part of the device, in a location where it is visible or easily accessible to the user, and shall not be readily detachable. The label shall be sufficiently durable to remain fully legible and intact on the device in all normal conditions of use throughout the device's expected lifetime. These requirements may be met either by a separate label or nameplate permanently attached to the device or by permanently imprinting or impressing the label directly onto the device. The label text shall be legible without the aid of magnification, but is not required to be larger than 8-point font size.

## End User Information

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF Exposure compliance. The end user should NOT be provided any instructions on how to remove or install the device. The users manual for end users must include the following information in a prominent location

### FCC RF Radiation Exposure Statement

**IMPORTANT NOTE:** To comply with the FCC RF exposure compliance requirements, this device must not be co-located or operating in conjunction with any antenna or transmitter. This device contains a low power transmitter. When this device is operational, use only with the supplied, or recommended antenna. Unauthorized antenna, modification, or attachments could damage the transmitter and may violate FCC regulations. Changes or modifications not expressly approved by the manufacturer or party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement

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

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 and radiates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. 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 assistance.

### IC (Industry Canada) Statement:

"This device complies with Industry Canada license-exempt RSS standard(s). 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"

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## ***CE Declaration of Conformity***

For the following equipment:

Radicom Research Inc. Bluetooth Module

Model(s): RB4000, H4000CE, RB4000HM-a, and RB4000HM-c

are herewith confirmed to comply with the requirements set out in the Council (European parliament) Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility of Radio and Telecom device (1999/5/CE). For the evaluation regarding this Directive, the following standards were applied:

EN 61000-3-2:2006+A2:2009, EN 300 328 V1.7.1, EN 62311: 2008,  
EN 301 489-1, V1.8.1, EN 61000-3-3:2008, EN 301 489-17 V2.1.1  
EN 60950-1:2006+A11:2009+A1: 2010+A12:2011



This equipment is marked with the  and can be used throughout the European community.

France – 2.4GHz for Metropolitan France:

In all Metropolitan departments, wireless LAN frequencies can be used under the following conditions, either for public or private use:

- Indoor use: maximum power (EIRP\*) of 100 mW for the entire 2400-2483.5 MHz frequency band
- Outdoor use: maximum power (EIRP\*) of 100 mW for the 2400-2454 MHz band and with maximum power (EIRP\*) of 10 mW for the 2454-2483 MHz band

### **Europe – R&TTE Compliance Statement:**

Hereby, Radicom Research Inc. declares that this equipment complies with the essential requirements and other relevant provisions of DIRECTIVE 1999/5/CE OF THE EUROPEAN PARLIAMENT AND THE COUNCIL of March 9, 1999 on radio equipment and telecommunication terminal Equipment and the mutual recognition of their conformity (R&TTE).

## ***Layout Design Suggestions***

• **General Layout Rules-** All Printed Circuit Boards must comply with UL94V0 standard for flammability. Always use RoHS compliant Parts and materials.

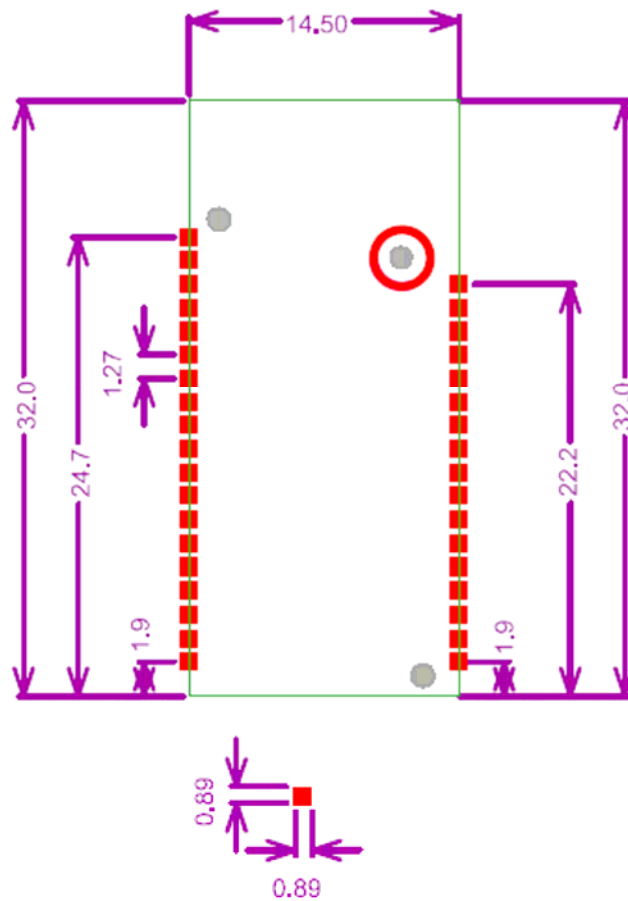
• **Suggestions for Layout:**

1. Do not place Power circuit, X'tal, Inductor, etc near RF area.

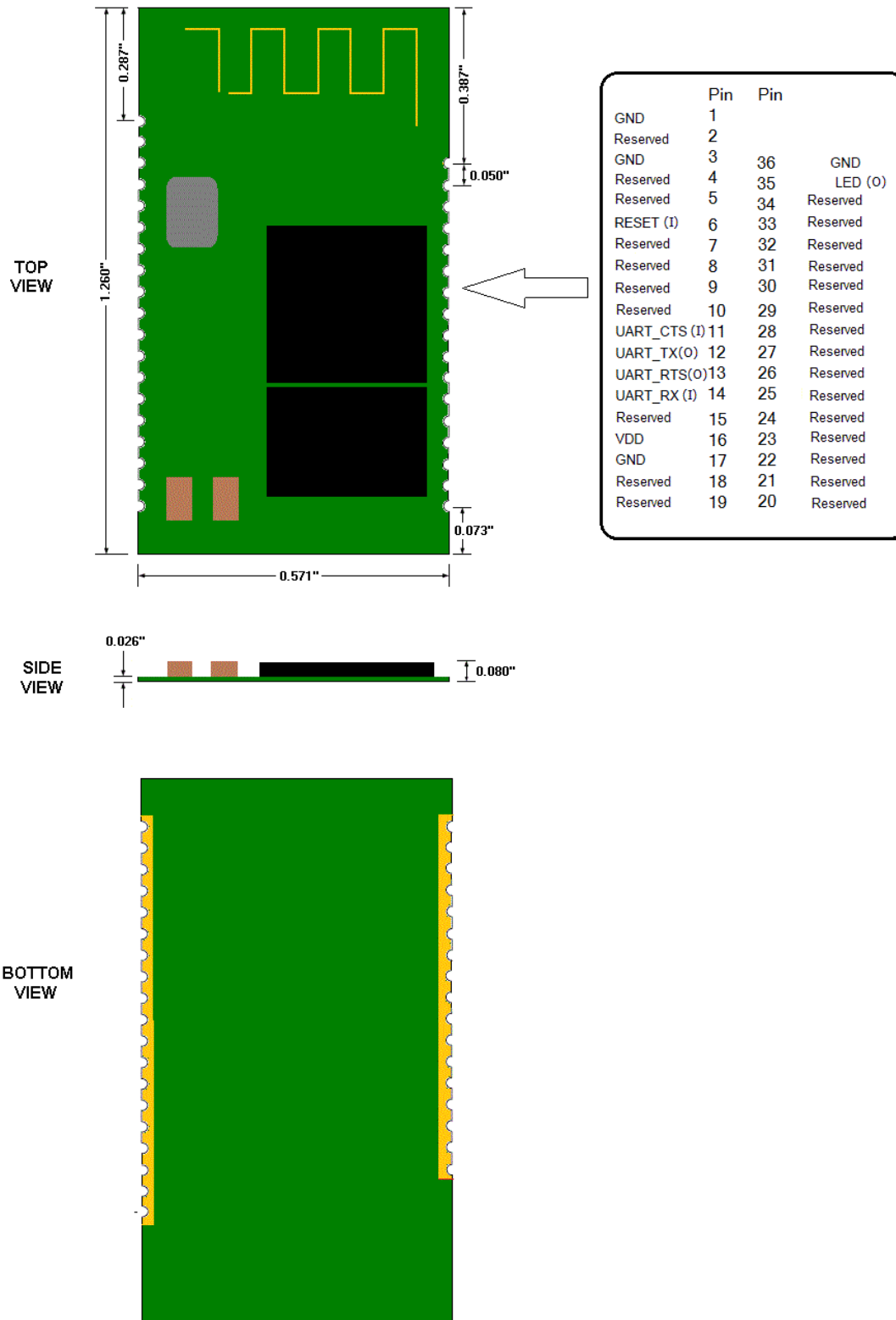
2. The bigger Antenna clearance area, the better. The Antenna itself needs to stay away from any circuit or component at least 2mm. Antenna clearance area means Top and Bottom both required to be cleared.
3. Do not use metal materials on design where near Antenna area. For example, battery snaps, USB connector, iron case, etc.
4. For RB4000HM-c model (external antenna type), when RF trace meets a turning point, try to make the RF trace as smooth as you can't use right angle trace.

These guidelines are for design reference; real performance still depends on actual design.

### ***RB4000 Pad Size (mm)***



## RB4000 Mechanical Diagram (inches) & Pin Assignments

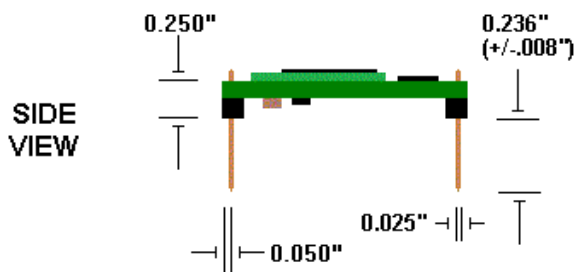
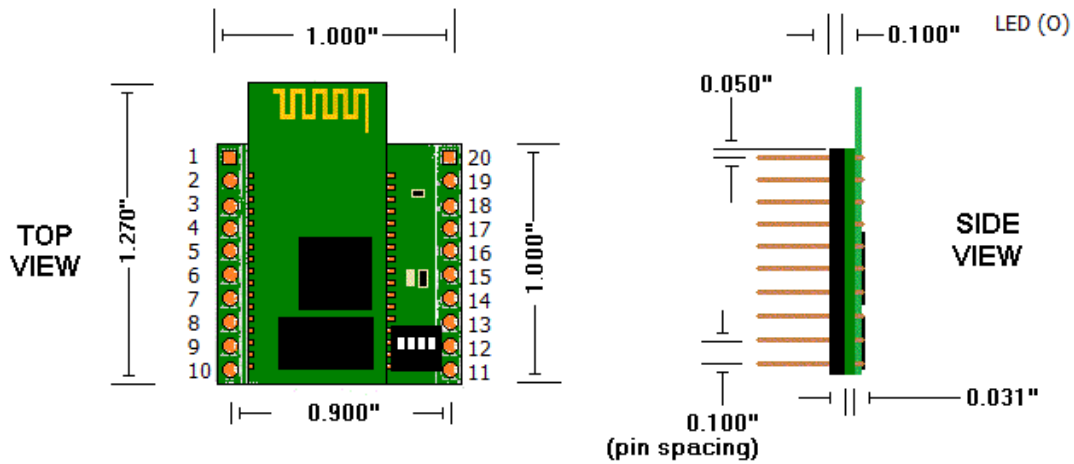


## ***RB4000 Interface Signal Level Definitions***

**Note: I/O is DTE not DCE. RTS and CTS functionality is for Hardware Flow Control.**

Pin #	Pin Name	Type	Description	I/O Voltage Range
1	GND	-	Ground	-
2	Reserved	-		
3	GND	-	Ground	-
4	Reserved	-		
5	Reserved	-		
6	RESET	I	Reset if low for more than 5ms	Vil: 0V ~ 0.3 x VDD Vih: 0.7 x VDD
7	SPI_MISO	O	Synchronous serial interface data output	Vol: 0V ~ 0.2V Voh: VDD – 0.2V ~ VDD
8	SPI_CSB	I	Chip select for Synchronous Serial Interface active low	Vil: 0V ~ 0.3 x VDD Vih: 0.7 x VDD
9	SPI_CLK	I	Synchronous serial interface clock	Vil: 0V ~ 0.3 x VDD Vih: 0.7 x VDD
10	SPI_MOSI	I	Synchronous serial interface data input	Vil: 0V ~ 0.3 x VDD Vih: 0.7 x VDD
11	UART_CTS	I	UART clear to send active low	Vil: 0V ~ 0.3 x VDD Vih: 0.7 x VDD
12	UART_TX	O	UART data output	Vol: 0V ~ 0.2V Voh: VDD – 0.2V ~ VDD
13	UART_RTS	O	UART request to send active low	Vol: 0V ~ 0.2V Voh: VDD – 0.2V ~ VDD
14	UART_RX	I	UART data input	Vil: 0V ~ 0.3 x VDD Vih: 0.7 x VDD
15	Reserved	O		
16	VDD	PWR	Supply voltage	2.2V ~ 4.2V
17	GND	-	Ground	
18	Reserved	-		
19	Reserved	-		
20	Reserved	-		
21	Reserved	-		
22	Reserved	-		
23	Reserved	-		
24	Reserved	-		
25	Reserved	-		
26	Reserved	-		
27	Reserved	-		
28	Reserved	-		
29	Reserved	-		
30	Reserved	-		
31	Reserved	-		
32	Reserved	-		
33	Reserved	-		
34	Reserved	-		
35	LINK LED	O	Link LED Output	Vol: 0V ~ 0.2V Voh: VDD – 0.2V ~ VDD
36	GND	-	Ground	-

## RB4000HM Mechanical Diagram & Pin Assignments



	PIN	PIN	
KEY	1	20	Reserved
Not Used	2	19	_RX (I)
LED (O)	3	18	_TX (O)
3_3V (P)	4	17	_RTS (I)
_RESET (I)	5	16	Reserved
GND (P)	6	15	Reserved
Reserved	7	14	_CTS (O)
Reserved	8	13	Reserved
Reserved	9	12	Reserved
Reserved	10	11	Reserved

I: Input to RB4000HM  
 O: Output from RB4000HM  
 P: Power

### Notes:

1. Pin spacing is 0.100 inch from center to center.
2. Suggested mating female connector:  
 Samtec P/N. #SSW-110-21-G-S (RoHS Thru-Hole)  
 Samtec P/N. #SSW-110-22-G-S-VS (RoHS SMT)
3. Square pins - 0.025" x 0.025"

### ***RB4000HM Switch settings:***

This Switch is reserved for future use. Do not change. They all should be set to the OFF position.

DTE Speed	1	2	3
115200 (Default)	OFF	OFF	OFF

### ***RB4000HM Interface Signal Level Definitions***

Pin #	Pin Name	Type	Description	I/O Voltage Range
1	KEY	-		
2	Not Used	-	No connection	
3	LINK LED	O	Link LED output	Vol: 0V ~ 0.2V Voh: 2.8V ~ 3.3V
4	3.3 VDD	PWR	Supply voltage	3.15V ~ 3.45V
5	_RESET	I	Reset if low for more than 5ms	Vil: 0V ~ 0.99V Vih: 2.31V ~ 3.3V
6	GND	-	Ground	
7	Reserved	-		
8	Reserved	-		
9	Reserved	-		
10	Reserved	-		
11	Reserved	-		
12	Reserved	-		
13	Reserved	-		
14	_CTS	I	UART clear to send active low	Vil: 0V ~ 0.99V Vih: 2.31V ~ 3.3V
15	Reserved	-		
16	Reserved	-		
17	_RTS	O	UART request to send active low	Vol: 0V ~ 0.2V Voh: 2.8V ~ 3.3V
18	_TX	O	UART data output	Vol: 0V ~ 0.2V Voh: 2.8V ~ 3.3V
19	_RX	I	UART data input	Vil: 0V ~ 0.99V Vih: 2.31V ~ 3.3V
20	Reserved	-		

**Note:** I/O is DTE not DCE. RTS and CTS functionality is for Hardware Flow Control.

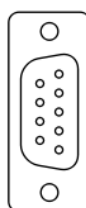
## ***RB4000MB Carrier Board RS232 DB 9 Pin Definitions***

The pin definitions of DB9 used on the RB4000MB RS232 Serial Connector are as follows:

1. DCD: Input, Carrier Detect
2. RXD: Input, Received Data
3. TXD: Output, Transmit data
4. DTR: Output, Data Terminal ready
5. GND: Ground
6. DSR: Input, Data Set Ready
7. RTS: Output, Request to Send
8. CTS: Input, Clear to Send
9. RI: Input, Ring Indicator



6 DSR  
7 RTS  
8 CTS  
9 RI



1 CD  
2 RXD  
3 TXD  
4 DTR  
5 GND

## ***LED Operation***

The modules have an On Board LED to indicate the Bluetooth Connection Status. The LED will start blinking after power is applied (once every two seconds). The module is ready to establish a connection. Once a connection is established, the Acceptor Module LED will flash twice every 2 seconds and the Initiator Module LED will be ON continuously.

Mode	RB4000MB-SPP-A Initiator	RB4000MB SPP-B Acceptor
Searching	LED status 700ms on, 700ms off	LED flashing once every 2 seconds
Connect	Always ON	Flashes twice every 2 seconds

The modules also have an I/O Pin to add the LED to your design. The RB4000-HM LED output is Pin 3 and the RB4000 LED output is Pin 35.

## *Connecting to Your System*



**NOTE:** Do Not Plug in the USB cable and AC power adapter at the same time. Only use one or the other. Plugging in both the USB cable and AC power adapter may damage the USB port on your PC or USB device.

Below is a simple example to show how the Radicom Bluetooth modules work. This example demonstrates how the Bluetooth Modules can connect to each other.

1. RB4000MB-SPP-A Initiator setup: Open HyperTerminal and select an available Serial Comport. Set the DTE speed to 115200bps, 8 Data bit, No Parity bit, One Stop bit and No Flow control.
2. Connect one end of the RS232 Null modem cable (DB9 Female to DB9 Female) to the Serial Comport and the other end of the cable to the RB4000MB-SPP-A
3. Apply power using either a USB cable or Optionally provided AC power adapter to RB4000MB-SPP-A. The modules Firmware message should show up on the HyperTerminal screen and the LED on the RB4000MB-SPP-A should be ON.
4. RB4000MB-SPP-B setup: Open HyperTerminal and select an available Serial Comport. Set the DTE speed to 115200bps, 8 Data bit, No Parity bit, One Stop bit and No Flow control.
5. Connect one end of the RS232 Null modem cable (DB9 Female to DB9 Female) to the Serial Comport and the other end of the cable to the RB4000MB-SPP-B.
6. Apply power using either a USB cable or Optionally provided AC power adapter to RB4000MB-SPP-A. The modules Firmware message should show up on the HyperTerminal screen and the LED on the RB4000MB-SPP-B then start blinking.
7. When both Modules are powered-up, they should automatically connect to each other as long as the modules are within acceptable distance, for example, 10m in home or office).
8. The on board LEDs will show the modules Connect Status.

Note(s): They further apart the modules are, the longer it may take to connect and the slower the data transfers will be. If the modules do not connect make sure that the firmware displayed reflects that one module contains Initiator firmware and the other module contains Acceptor firmware. For example, the Initiator should display SPP-B XXX and the Acceptor should display SPP-A XXX where XXX is the firmware version.

Note: When Connected and no data activity, the modules will enter lower power Sniff Mode after 5 to 7 seconds of inactivity. Any transmitted or received data will cause the module to exit Sniff Mode and resume normal operation.

## ***Limited Warranty***

### **Warranty Coverage and Duration**

Radicom Research, Inc. ("RRI") warrants to the original purchaser its RRI-manufactured products ("Product") against defects in material and workmanship under normal use and service for a period of one year from the date of delivery.

During the applicable warranty period, at no charge, RRI will, at its option, either repair, replace or refund the purchase price of this Product, provided it is returned in accordance with the terms of this warranty to RRI. Repair, at the option of RRI, may include the replacement of parts, boards or other components with functionally equivalent reconditioned or new parts, boards or other components. Replaced parts, boards or other components are warranted for the balance of the original applicable warranty period. All replaced items shall become the property of RRI.

**RRI MAKES NO GUARANTEE OR WARRANTY THAT THE PRODUCT WILL PREVENT OCCURRENCES, OR THE CONSEQUENCES THEREOF, WHICH THE PRODUCT IS DESIGNED TO DETECT.**

This expressed limited warranty is extended by RRI to the original end-user purchaser only, and is not assignable or transferable to any other party. This is the complete warranty for the Product manufactured by RRI, and RRI assumes no obligation or liability for additions or modifications to this warranty. In no case does RRI warrant the installation, maintenance or service of the Product.

RRI is not responsible in any way for any ancillary equipment not furnished by RRI that is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because of wide variations in topographical and atmospheric conditions, which may require availability of repeater stations or of particular radio frequencies, RRI assumes no liability for range, coverage or suitability of the Product for any particular application. Buyer acknowledges that RRI does not know a particular purpose for which buyer wants the product, and that buyer is not relying on RRI's skill and judgment to select or furnish suitable goods.

### **What this Warranty does NOT Cover:**

- (a) Defects or damage resulting from use of the Product in other than its normal and customary manner.
- (b) Defects or damage from misuse, accident or neglect.
- (c) Defects of damage from improper testing, operation, maintenance, installation, alteration, modification or adjustment.
- (d) Disassembly or repair of the Product in such a manner as to adversely affect performance or prevent adequate inspection and testing to verify any warranty claim.
- (e) Any Product that has had its serial number or date code removed or made illegible.

**How to Receive Warranty Service:**

To obtain warranty service, contact RRI by phone (408)-383 9006 for RMA Department or email to [rma@radi.com](mailto:rma@radi.com) for an RMA (Return Merchandise Authorization) number. Deliver or send the Product, transportation and insurance prepaid to RRI, with the RMA number clearly marked on the outside of the package.

**General Provision**

This warranty sets forth the full extent of RRI's responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at RRI's option, is the exclusive remedy.

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