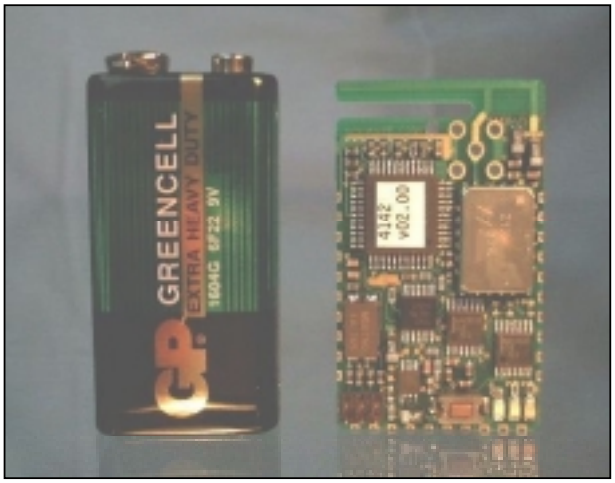
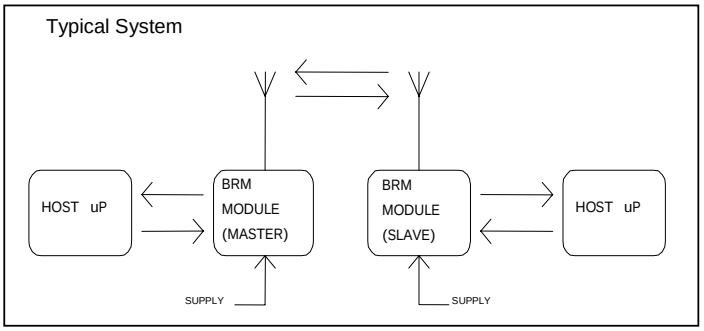
- Plug And Play 'Transparent' Radio Link
- Uses Class 1 Bluetooth™ Radio module
- Simultaneous Data and Full-Duplex Voice (with external CODEC)
- 1Mb/s Symbol Rate
- 100mW Transceiver
- Transparent Wireless Link
- Authentication and Encryption
- Frequency Hopping
- Simple 4 Wire Serial Interface
- Built In or Approved External Antenna
- Small Size (45mm x 28mm x 3mm)
- Supply Voltage 4V to 5.5V
- Onboard 10-bit ADCs/GPIO ports
- Simple "press-to-connect" facility
- On Board Status LEDs



Applications

- Serial Cable Replacement
- Telemetry
- Process Control
- Robotics
- Internet Access
- File Transfer
- Remote Terminal
- Remote Control



Overview

The coherenceRF BRM is a 2.4GHz frequency hopping PCB-mountable radio module which requires only a 5V supply and a serial data source. The radio protocol is Bluetooth™-based which provides all the low-level radio link management and error correction functions - these are transparent to the user. The maximum transmit data rate is 460.8kb/sec which can be achieved in both directions.

The BRM has been designed to be integrated into industrial controllers, wireless modems, security systems and other wireless equipment. Using a Bluetooth™ qualified Class 1 radio module the carrier frequency hops at 1600 hops/sec and thus ensures excellent resistance to jamming from interferers.

With the addition of an external CODEC the unit can simultaneously provide a data channel and a full-duplex 64kb/s voice link. The modules are designed to withstand the harsh environments of both factory and outdoor applications. The modules can be operated in point-to-point, point-to-multipoint and multipoint-to-multipoint architectures. Range is upto 200m (line-of-sight) using the built-in antenna, for extended range an external antenna can be fitted.

Ordering Information

Part Number	Description
BRM001	BRM Transceiver 2.4 GHz

Technical Specifications

Physical

Size:	45mm x 28mm x 3mm with internal antenna 40mm x 28mm x 3mm without internal antenna
Connections:	Direct to PCB via solder wells on 2.54mm pitch (SMT) Optional SMA, SMB, SMC or MCX RF connector

Radio

Maximum output power:	100mW (+20dBm)
RF Frequency range:	2.400Ghz to 2.480Ghz
RF Channels:	79, 1MHz channel spacing
Frequency Hopping:	1600 hops/sec (625uS dwell time)
Over Air Data Rate:	1Mb/s
Achievable Range:	200m Line-of-sight using internal antenna

Interfacing

Power Supply:	Voltage: 4V to 5.5V, Supply Current: <250mA peak (@ max TX o/p power), 20mA Idle
Serial Interface:	CMOS logic or optional RS232 levels
Control Lines:	CMOS compatible
Antenna:	Integrated F type or approved external (via optional SMA RF connector)

This Specification is PRELIMINARY and may be changed without prior notice

For more information or general enquiries, please contact our official UK distributor;

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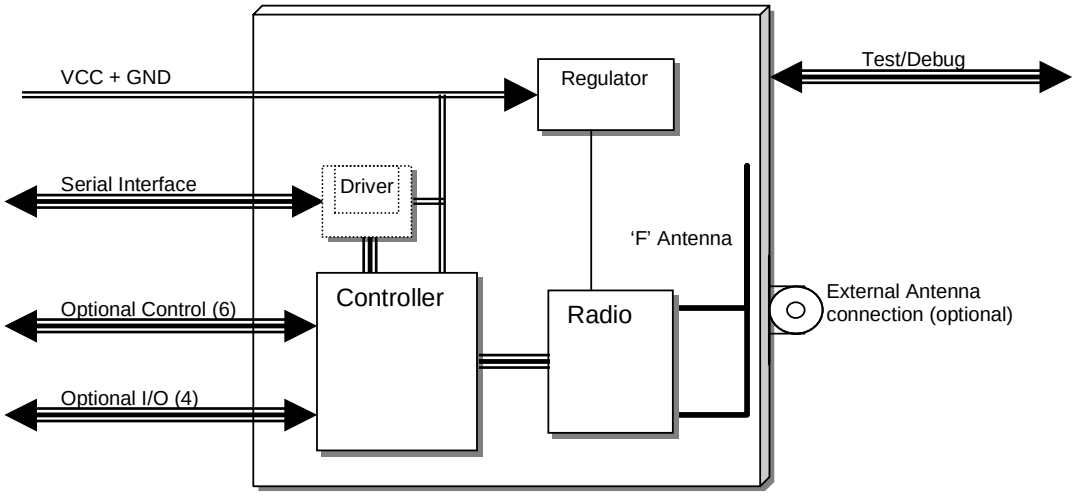
RF Solutions is a member of the Low Power Radio Association

Contents

Description

The BRM enables designers to easily add wireless to their products without the need for RF and Antenna design expertise. The BRM fulfils a large number of applications requirements, ranging from basic point to point connectivity to the more complex multi-point process control functions.

BLOCK DIAGRAM



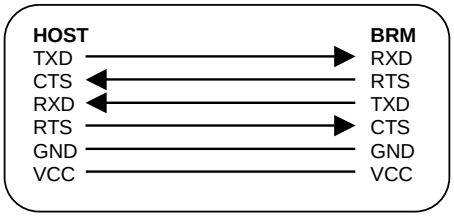
Optional RS232 Driver

The BRM can be supplied with or without a built-in RS232 interface driver. When this option is present it allows the BRM to be connected directly to a PC COM port or similar device. The baud rate is limited by the driver to 230.4kb/s in this case. This is generally not an issue when used in conjunction with personal computers, since they normally support a maximum baud rate of 115.3kb/s.

Interfacing To Host

The host may be any suitable device capable of sending and/or receiving serial data using RTS/CTS handshaking. This might be for example, a handheld microprocessor controlled data terminal or personal computer.

The minimum requirements are for a 4-wire interface (plus power and ground) from the host device. This interface is shown below.



/TXD – Transmit Data output providing transmit data from the BRM
/CTS – Clear to Send. If this input goes false, the BRM will stop transmitting at the end of the current byte
/RXD – Receive Data. Receive data input from the host
/RTS – Request to Send. When this output is true, the host may send data to the BRM
GND – Ground **VCC** – 4.0V to 5.5V Power supply

Indicators

For convenience three LEDs provide visual indication of operating status. The equivalent logic outputs are also available externally. The LED functions are given in the table below:

LED	State	Meaning
RED	Off	no power or error, perform reset to recover
	Flashing (0.5Hz)	virgin device, learning of remote device required
	On	power-on-self test successful
GREEN	Off	no link
	On	link present
AMBER	Off	no activity
	Flickering	transmit or receive activity

Learn/CLM Button (SW1)

This button ensures extremely easy setup for use in basic applications and testing. After connecting to a power supply for the first time, devices can be rapidly bonded to each other by performing the 'Mutual Learning' procedure, to provide point to point connectivity. No external hardware or software is required in order to perform this operation.

This button also provides access to the 'Command Line Menu', which allows more complex functions to be manually administered using a terminal emulator such as 'HyperTerminal' or similar.

The equivalent logic input is also available externally for use by the customer's application.

Mode Selection Jumpers

The mode selection Jumpers J1, J2 and J3 provide a simple means of pre-selecting the most common operating modes for the BRM without having to issue commands or re-program the device. Each Jumper connection is also brought out for activation by the customer's application.

The jumper functions are given in the table below:

Designation	Not Fitted (Default)	Fitted	BRM Pin No
J1	SW1 = Learn	SW1 = CLM	8
J2	TBD		9
J3	TBD		10

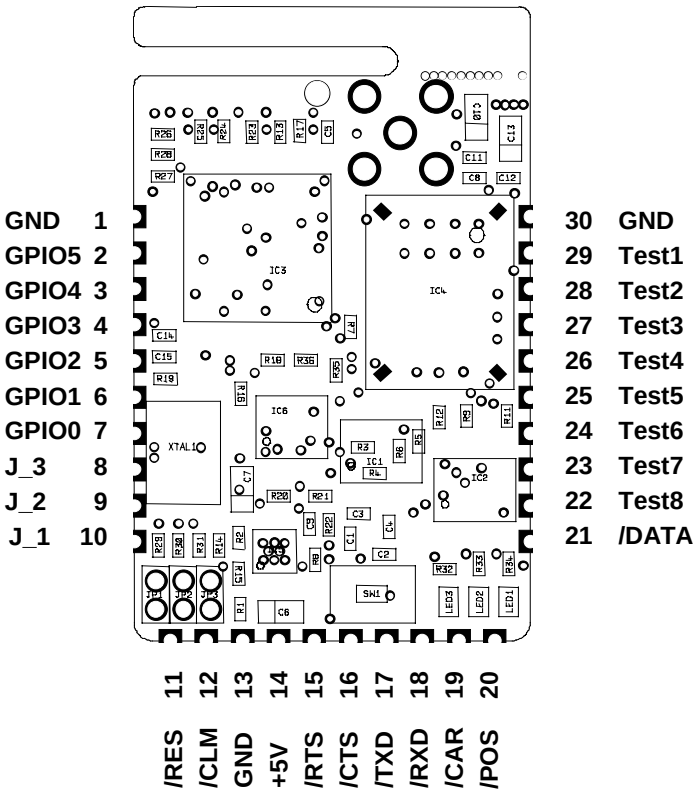
GPIO Connections

These are 5 General Purpose Input Ouput lines which provide the customer with the option to interface sensors or other devices to the BRM. These lines with some exceptions can be programmed as digital inputs, digital outputs or analogue to digital convertor inputs with 10-bit resolution.

The GPIO bit together with the GPIO Mode byte determines whether the GPIO is operational and its settings.

Package Layout

The BRM package is shown below scaled at 2:1 (A4)



The module layout ensures that most of the common interconnects are physically co-located. For simple applications only pins 11 to 20 may be required.

Pinouts

PIN NAME	DIRECTION	PIN NUMBER	DESCRIPTION
GND		1, 13, 30	System Ground 0V
+5V		14	Power Supply to unit. Range is from 4V to 5.5V
/RES	IN	11	Reset. This is an active low intput which allows the host to reset the BRM to power-on-reset condition.
/TXD	OUT	17	Transmit Data output providing transmit data from the BRM
/RTS	OUT	15	Request to Send. When this output goes false (high), the host must stop sending data to the BRM at the end of the current byte.
/RXD	IN	18	Receive Data. Receive data input from the host
/CTS	IN	16	Clear to Send. If this input goes false (high), the BRM will stop transmitting at the end of the current byte.
/CAR	OUT	18	Connected/Carrier. This is an active low output which indicates when a connection is present.

PIN NAME	DIRECTION	PIN NUMBER	DESCRIPTION
			This output is capable of sinking up to 20mA and is therefore suitable for directly driving an LED via suitable series resistor.
/DATA	OUT	21	Data. This active low output indicates data activity present and can be used to directly drive an LED via a suitable series resistor.
/POS	OUT	20	Power-On-Self test out. This active low output indicates successful completion of the power-on-self test sequence.
/CLM	IN	12	Command Line Mode. This active low input has multiple funtions depending upon J1 setting. This input is wire Ored with switch SW1. J1 not fitted - /CLM functions as the Learn function. J1 fitted - /CLM activates the Command Line Interface.
J_1	IN	8	Mode selection input 1
J_2	IN	9	Mode selection input 2
J_3	IN	10	Mode selection input 3
GPIO0	I/O	7	Auxillary I/O lines. These lines allow the designer to implement a simple control/aquisition system with the minimum of external circuitry. Each line can be programmed to perform the following functions: ▪ Digital Input ▪ Digital Output (GPIO4 open drain) ▪ Analogue Input (not GPIO4)
GPIO1	I/O	6	
GPIO2	I/O	5	
GPIO3	I/O	4	
GPIO4	I/O	3	
GPIO5	I/O	2	
TEST1	N/C	29	These pins are reserved for testing and should not be connected.
TEST2	N/C	28	
TEST3	N/C	27	
TEST4	N/C	26	
TEST6	N/C	25	
TEST7	N/C	24	
TEST8	N/C	23	

Operating Modes

Two operating modes are available. These are described in the following sections:

Basic mode

This is the default operating mode. In this mode each BRM establishes a dedicated point to point link with another remote BRM device and all data is sent transparently. Before a connection can be setup and data transferred, each device must first learn the other. This can be very easily achieved by performing a Mutual Learning procedure, or direct entry using the Command Line Menu (CLM). Packet data headers are not used in this mode of operation. Raw data input at the local BRM's serial input causes a connection to be setup to the remote BRM, after which data can be sent and received transparently between the devices. Each block of data sent, is broken down into smaller packets before being sent. This helps reduce potential dead time at the end of each transmission, as the length of each transmission block is unknown in this mode. The interface baud rate is initially set to 115.2kb/s to ensure compatibility.

Mutual Learning Procedure

The mutual learning procedure allows two BRMs to be up and communicating with each other in less than a minute of powering up for the first time. This involves each BRM wirelessly swapping parameters with one another. Once performed, these parameters are stored in E^2 memory and remain even when the power is removed. Mutual Learning involves two identical operations and since actions are required to be performed simultaneously on both BRMs this procedure is very secure.

Both devices must be within radio range of one another. J1, J2, J3 must not be fitted (default)

Step #	BRM Device A (learning B)	BRM Device B
1	Apply power, RED LED on	Apply power, RED LED on
2	Press and release the LEARN button twice	Press and release the LEARN button once
3	RED LED remains on. Amber LED flashes 2 times if successful.	AMBER LED remains on for ~30 seconds, or until cancelled by pressing the LEARN button during this time.
4	Repeat if necessary	Repeat if necessary
5	Reverse the roles of devices A and B and repeat steps 1 to 4 B learning A	
6	Ready to send and receive data!	

Enhanced mode

Enhanced mode of operation allows more complex applications to be supported. A BRM may be a pseudo master device, enabling it to address more than one remote target BRM. Simple control commands may also be issued in this mode. One or more header bytes are used to define either the command or remote target index and any required parameters.

Addressing

Addressing is selected by setting bit 7 of the 1st header byte. In this case bits 4:0 correspond to the index Id of the remote device. This is used to index a unique BRM Address to which to target the accompanying data. Each BRM stores a device list internally in E^2 PROM and a valid device address corresponding to the given index Id must be present in the device list for the transaction to be successful. Up to 32 devices can be enabled for connection by adding them to the device list. An incoming connection request from a remote device will not be accepted unless the remote device exists in the local device list.

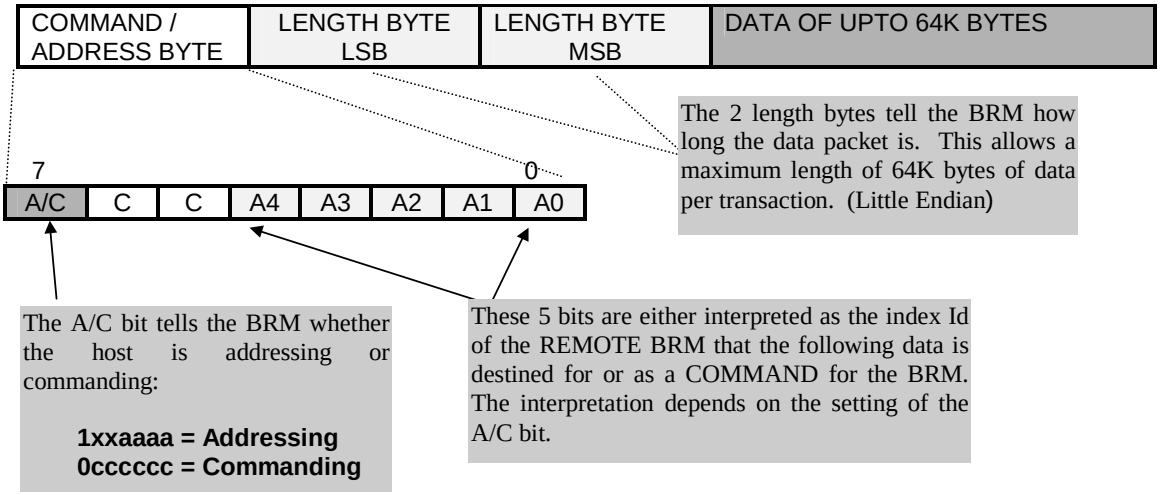
The 2nd and 3rd header bytes represent the length of the data to follow in little endian format. Therefore up to 64kbytes of data may be sent in each transaction. The target BRM may be set to Basic or Enhanced mode.

The table below shows the relationship between the index Id and BRM Address:

Id:0	BRM Address: 0x000000000001	BRM Name: "Sensor 5 Temp
Id:1	BRM Address: 0x000209000002	BRM Name: "Sensor 7 Temp
Id:2	BRM Address: 0x005910345000	BRM Name: "Sensor 1 Temp
Id:3	BRM Address: 0x012345678900	BRM Name: "Sensor 6 Temp
Id:4	BRM Address: 0xAABBCCDDEEFF	BRM Name: "Sensor 9 Temp
Id:5	BRM Address: 0x999000777666	BRM Name: "Sensor 2 Temp
Id:..	BRM Address: 0xc3c45c679084	BRM Name: "Sensor 4 Temp
Id:31	BRM Address: 0xAABBCCDDEEFF	BRM Name: "Sensor 9 Temp

Sending Data

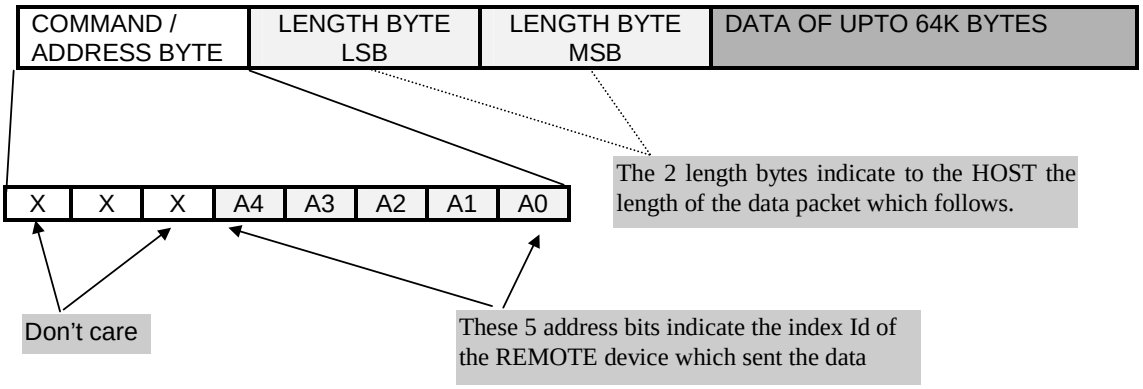
A data packet of variable length sent from the HOST to the BRM is automatically transmitted to the device addressed by its index. The data sent by the HOST to the BRM follows the following format.



Data packets received from the HOST by the BRM are stored in a packet buffer and are transmitted to the REMOTE address automatically i.e. there is no requirement for a TX/RX line to tell the BRM to transmit. There is no requirement for the host to re-transmit data, since error correction and retransmission is handled by the BRM.

Receiving Data

When the BRM has received data for the HOST from a REMOTE device, it will be passed to the host providing that the host indicates that the BRM is clear to send. If the remote device is also operating in enhanced mode, the data will be presented to the HOST is in the format given below.



If the remote device is operating in basic mode, then no header bytes will be present.

Example addressing data:

0x84, 0xFF01, 0xdd, ……0xdd

Send to device Id:4, 511bytes, Data dd

Bits 6:5 of the 1st header byte are reserved for future use and must always set to 0 when addressing. Note the little endian format of the length parameters.

The target device must also have the sending BRM's Address in its device list for the transaction to be successful. This can be achieved using the CLM or by following the Mutual Learning procedure.

If for any reason a transaction fails then "ERROR" is returned.

Commanding

Commands are selected when bit 7 of the 1st header byte is 0. This allows up to 128 different commands to be issued. The number of parameter bytes to follow depends on the command.

Example command data:

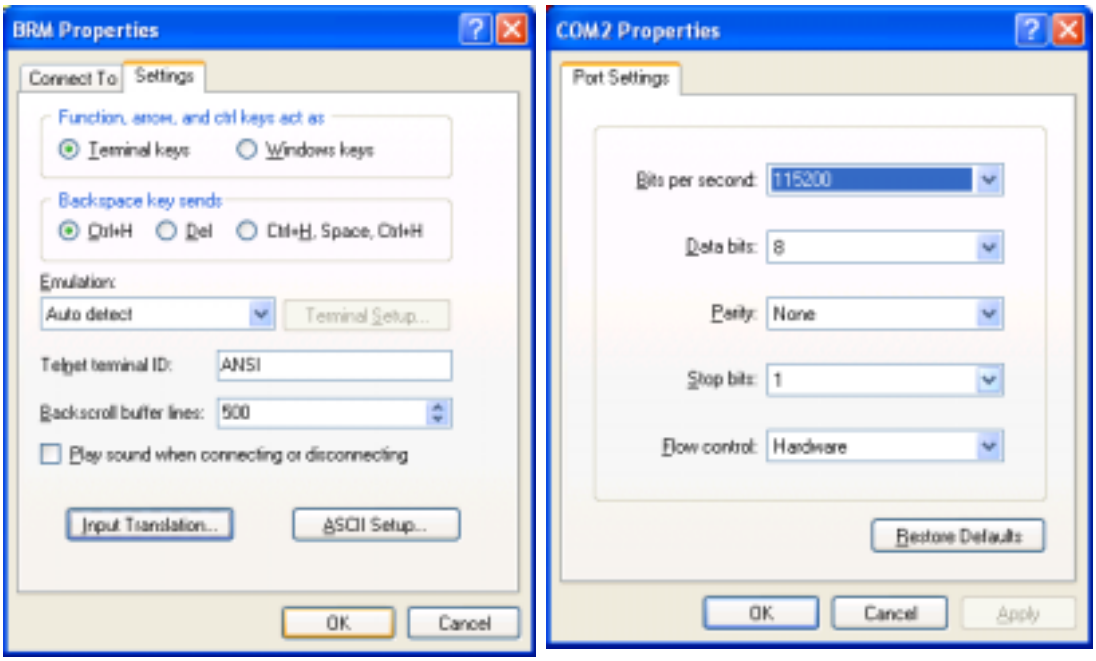
0x00 Reset the local BRM
0x4D Enter Command Line Mode ….see CLM section for parameters
0x61, 0x0123456789ab, 0x0e Add BRM Address 0x0123456789ab at index Id d14

Unknown, failed or invalid commands result in "ERROR" being returned. A complete list of supported commands is available in the in the "BRM Programmers Guide" (PG-BRM-232-xxx).

Command Line Menu

The command line menu provides a simple menu driven interface to most features of the BRM. The menu is built into the BRM and hence only requires a serial terminal connected to the host interface. This could be one of the many available emulators for the PC such as HyperTerminal which is readily available.

The required HyperTerminal properties are shown below:



The CLM can be initiated in two ways:

1. Fit Jumper J1 and Press the Learn/CLM button.
2. In Enhanced mode type “M” from a terminal.

The CLM MMI looks similar to below:

```
BRM:001 -  0x031BD0304BB coherenceRF –  'Expertise in Wireless Design'

Menu 0 (Main)   Choose an option:

        1 = Settings
        2 = Devices
        3 = Security
        4 = Debug

        ESC = Quit

>1
```



```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Menu 1 (Settings)       Choose an option:

        1 = Enhanced Mode
        2 = GPIO Mode On
        3 = BAUD Rate 115000
        4 = Local Name
        5 = Idle Timer Off

        ESC = Back

>
```

```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Menu 2 (Devices)        Choose an option:

        1 = List
        2 = Remove
        3 = Add

        ESC = Back

>1
```

```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Device List...

       Id   Address           Name
       00   0002C7A048F0      Not Found
       01   0002C7A04F50      Zone1 Temp

        3 = Add
        ESC = Back

>3
```



```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Enter Device Address (0-9,A-F): >010203040506

        Store at index (00-1F) > 03
```

```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Device List...

       Id   Address           Name
       00   0002C7A048F0      Not Found
       01   0002C7A04F50      Zone1 Temp
       03   010203040506      Zone3 Temp

        3 = Add
        ESC = Back

>
```

```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Menu 3 (Security)       Choose an option:

        1 = None
        2 = Pin Code
        3 = Encryption

        ESC = Back

>
```

```
BRM:001 -  0x031BD0304BB      coherenceRF –  'Expertise in Wireless
Design'

Menu 4 (Debug)  Choose an option:

        1 = Messages Off
        2 = Power-on Reset
        3 = Unlearn

        ESC = Back

>
```

