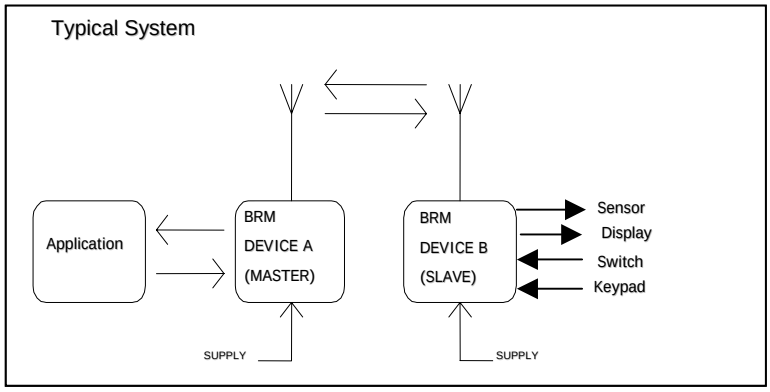
2.4GHz Bluetooth Transceiver Module BRM01

Features

- Plug And Play
- Small Size (45mm x 28mm x 3mm)
- Simple 4 Wire Serial Interface
- 100mW Transceiver
- Onboard 10-bit ADCs/GPIO ports
- Automatic RF Power Control
- Frequency Hopping
- Authentication and Encryption
- Single and Multiple End Points
- 1Mb/s Symbol Rate
- Built In or Approved External Antenna
- Full Duplex Voice (with external codec)
- Supply Voltage 4V to 5.5V
- Low Power

Applications

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



Overview

The Basic Radio Modem (BRM) radio telemetry module is a self-contained PCB-mountable radio module which requires only a 4V to +5.5V supply and serial data source. The built-in radio protocol provides all the low-level radio link management and error correction functions. These are completely transparent to the user. A maximum practical data rate of 115.2kb/s is possible in either direction. Achievable range is typically 200m line-of-sight and there is no licensing requirement for usage of devices on these frequencies. RF Solutions Ltd can provide versions of firmware to support customer specific applications using the onboard ADCs and GPIOs.

An evaluation system is also available consisting of a motherboard which can be powered from either batteries or mains adapter. A 9-way D-type connector allows direct interfacing to a PC COM port for testing and evaluation. Access to all BRM ports is provided via pin headers. Please see datasheet DS362 for more information on this product.

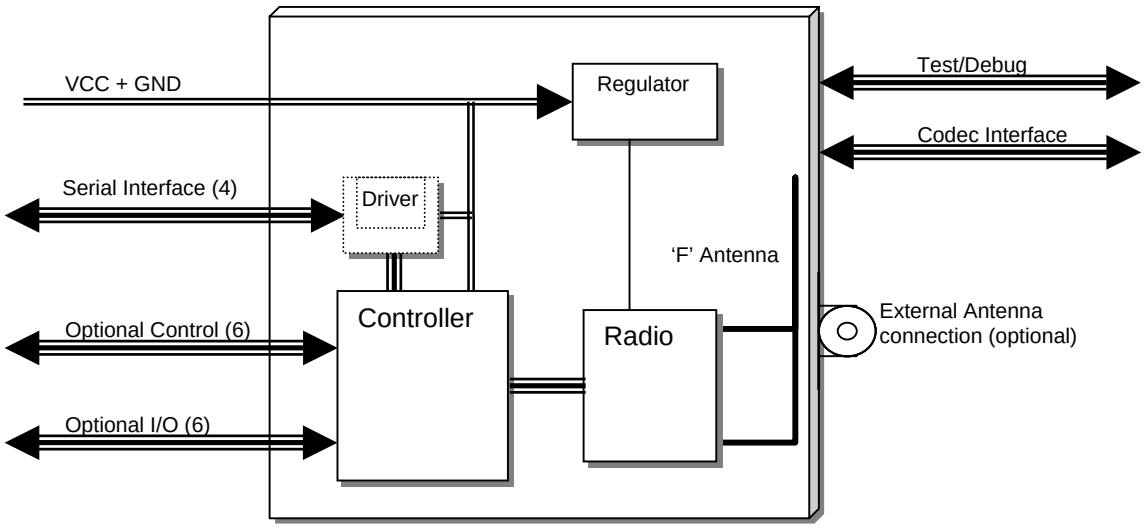
Ordering Information

Part Number	Description
BRM01	BRM transceiver 2.4GHZ

Version Information

This datasheet refers to BRM01 modems with firmware versions 0.29 or later. The firmware version is labelled on the modem.

Table Of 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 application requirements, ranging from basic point to point connectivity to more complex multi-point process control functions.

Technical Specifications

Dimensions

	Length	Width	Depth	Units
With Internal Antenna	45	29	3	mm
Without Internal Antenna	40	29	3	mm

Radio

	Min	Typical	Max	Units
RF Output Power			100	mW
RF Frequency Range	2.400		2.480	GHz
RF Channels		79		at 1 MHz Spacing
Frequency Hopping		1600		hops/sec
Over Air Data Rate		1		Mb/s
Range (line of sight, with internal antenna)			200	Metres

Interfacing

	Min	Typical	Max	Units
Supply Voltage	4	5	5.5	V
Supply Current: Idle		14		mA
Supply Current: Transmitting		100	350	mA
Supply Current: Sleep Mode			1	mA
All module Pins (CMOS Logic Level)		5		V
All module Pins (2.54mm Pitch)		0.8mm		PTH
RS232 Driver Output		± 12		V
Analogue I/O		10		Bit ADC

RS232 Driver

The standard BRM01 device is supplied with a built-in RS232 interface driver. This option allows the BRM to be connected directly to a PC COM port or similar device. The theoretical maximum baud rate of the module is 460Kb/s, this is limited by the driver to 230.4kb/s. This is generally not an issue when used in conjunction with personal computers, since they normally support a maximum baud rate of only 115.2kb/s. Custom versions of the BRM01 module can be supplied without the RS232 driver, please contact RF Solutions Ltd for more information.

Antenna

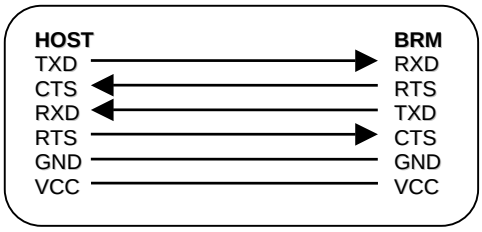
The Standard BRM01 module is supplied fitted with an integrated F type Antenna. Custom versions of the BRM01 module can be supplied without the internal antenna and with a range of RF connectors for fitting external antennas, please contact RF Solutions Ltd for more information.

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 shown 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 (ready)
GREEN	Off	no link
	On	link present (connected)
AMBER	Off	no activity
	Flickering	transmit or receive activity

Learn/CLM Button (SW1)

This momentary switch ensures extremely easy setup for use in basic point to point applications and for 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 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:

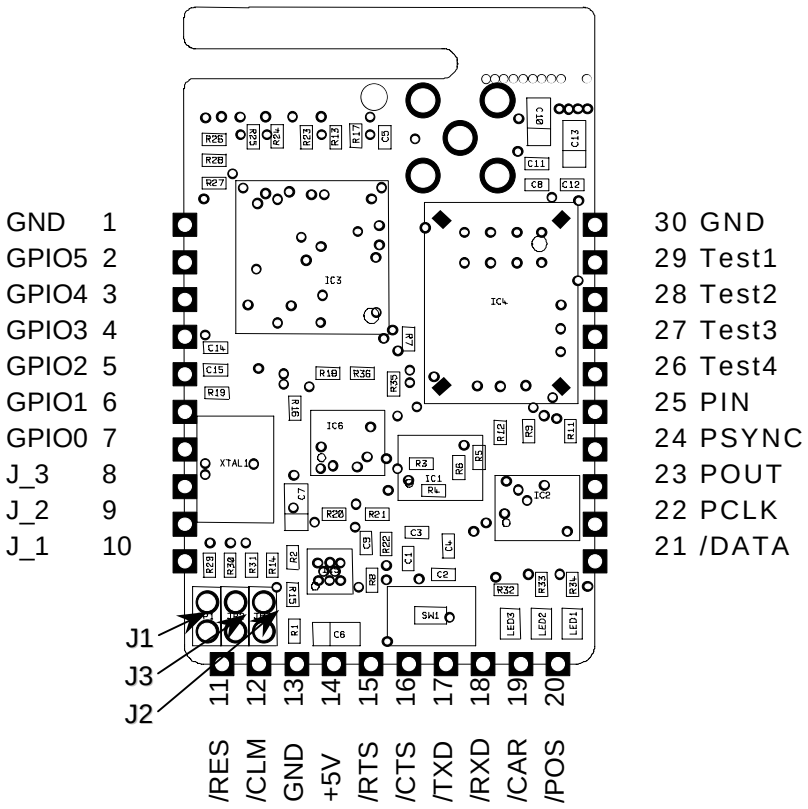
Designation	Not Fitted (Default)	Fitted	BRM Pin No
J1	SW1 = Learn	SW1 = CLM	10
J2		SW1 = Data Connect Id 0	9
J3		SW1 = Voice/Data Connect Id 0	8

Note: If a connection is present, pressing SW1 will always cause the connection to be broken.

GPIO Connections

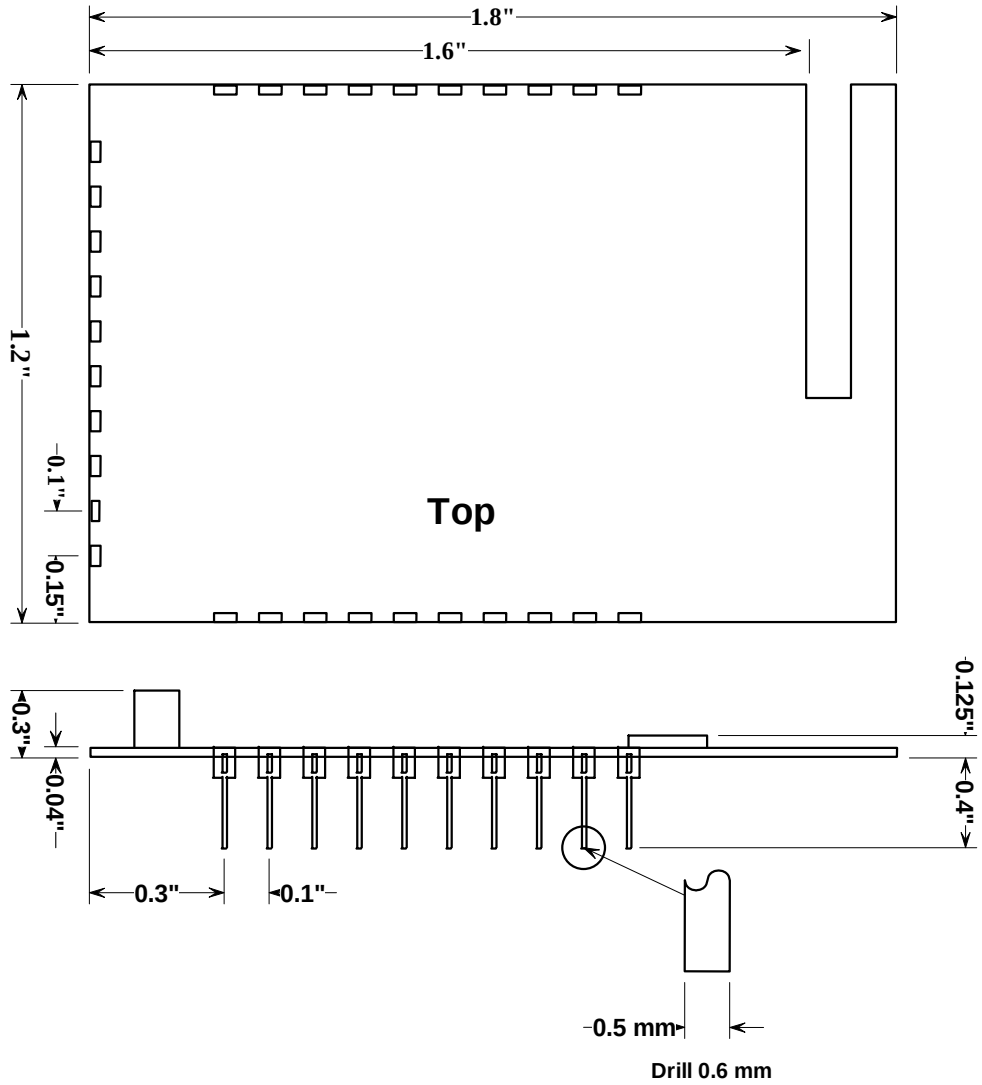
There are 6 General Purpose Input Ouput lines which allow the customer to interface sensors or other devices to the BRM. These lines with some exceptions can be programmed as digital inputs, digital outputs or analogue to digital convertor inputs with 10-bit resolution.
The GPIO enable option together with 2 GPIO Mode bytes determine whether the GPIO is operational and the function of each pin.

Package Layout



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

Physical Dimensions



Pin Descriptions

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. 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,J2,J3 settings. This input is wire Ored with switch SW1. J1 not fitted - /CLM functions as the Learn function. J1 fitted - /CLM activates the Command Line Menu.
J_1	IN	10	Mode selection input 1
J_2	IN	9	Mode selection input 2
J_3	IN	8	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	
PIN	IN	25	Interface to external CODEC for voice applications. Note these are at 0 - 3.3V levels.
PSYNC	IN	24	
POUT	OUT	23	
PCLK	OUT	22	

* Note: These have 47kΩ pull-up resistors to VCC

Operating Modes

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

Basic mode

This is the default operating mode and is selected when Jumper J1 is not present (logic 1 on Pin 10). In this mode the BRM establishes a dedicated point to point link with single 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 the Mutual Learning procedure, or by 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 RXD input causes a connection to be setup (if not already present) to the remote BRM, after which data can be sent and received transparently between the devices. Each block of data to be sent is first broken down into smaller packets. This helps reduce potential dead time at the end of each transmission, as the number of bytes to be transmitted is unknown in this mode. The default interface baud rate is set to 115.2kb/s to ensure compatibility. Data packets smaller than the BRM buffer size are released after expiry of the TX_Timeout timer.

Mutual Learning Procedure

The mutual learning procedure allows two BRMs to be communicating in less than a minute from supplying powering 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. Enhanced mode is selected by fitting J1 (logic 0 on pin 10). In this mode 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. One or more header bytes are used to define either the command, or remote target index together with 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. These 5 bits are 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 also 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 its local device list.

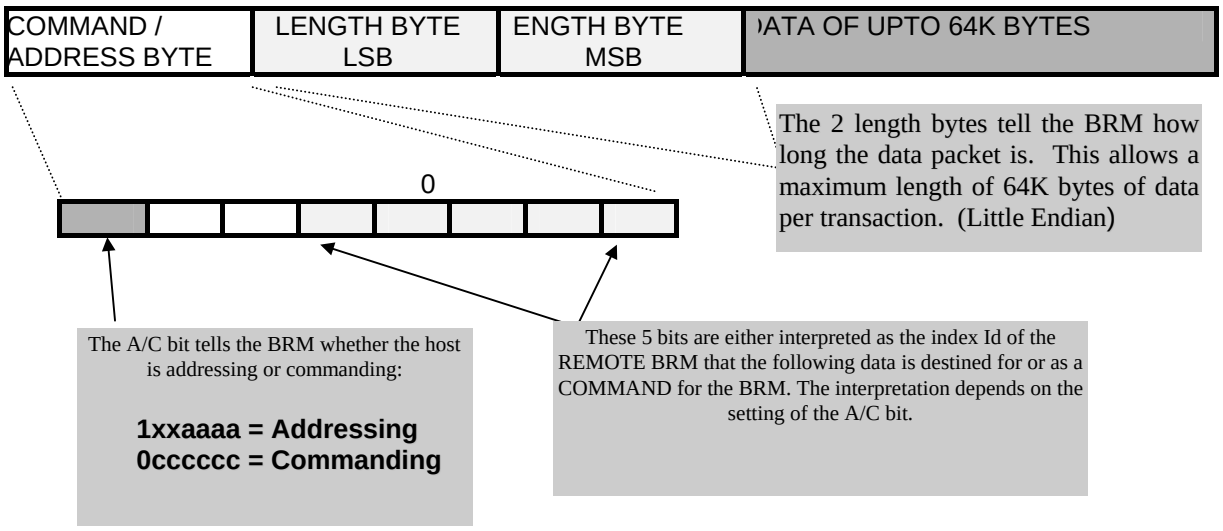
The 2nd and 3rd header bytes represent the length of the data to follow in little endian format. Therefore up to 64kbytes of data may be sent in each transaction. The target BRM may be set to Basic or Enhanced mode.

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:1F	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 receives 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. No header information is provided.

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 by using the Add Device command, the CLM or by performing a Mutual Learning procedure.

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:

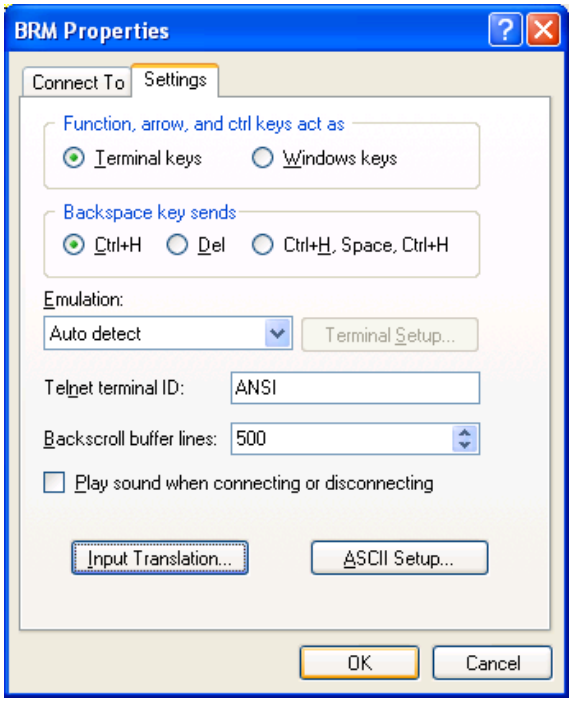
"R" Reset the local BRM
"A0123456789ab14" Add BRM Address 0x0123456789ab at index Id 0x14

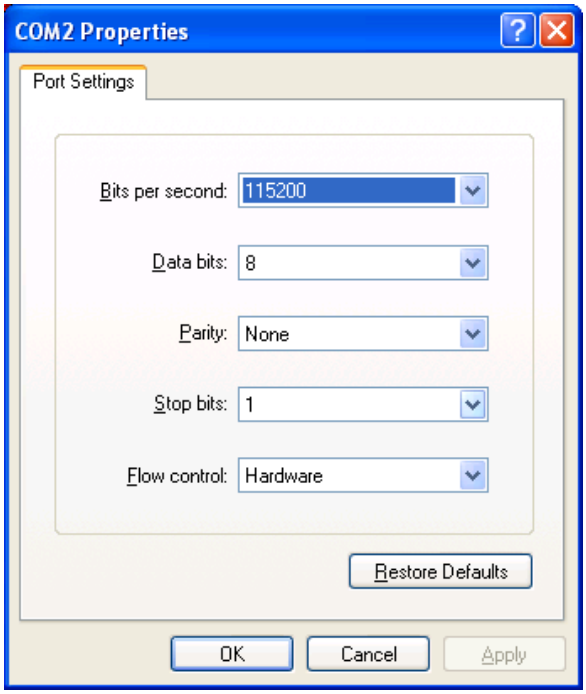
Unknown, failed or invalid commands result in a non "00" status code being returned. A complete list of supported commands is given in the in the "BRM Programmers Guide" (DS361).

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 is initiated as follows:

- Enable Enhanced mode by fitting Jumper J1 (or /J1 mode input low) and Press the Learn/CLM button (or toggle /CLM input low).

The Command Line Main Menu is shown below:

```
CLM V0.29 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Menu 0 (Main)   Choose an option:

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

        ESC = Quit

>1
```

Settings Menu

To select the settings menu press '1' from the Main Menu. The following screen will appear:

```
CLM V0.29 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Menu 1 (Settings)       Choose an option:

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

        ESC = Back

>
```

'1' Toggles the operating mode between Normal and MiniVoice mode. MiniVoice is a special mode which enables the BRM to work as a full duplex intercom.

'2' Toggles GPIO Mode On and Off. When set to Off the BRM will not respond to GPIO commands.

'3' Selects the next baud rate from the list 4800, 9600, 19200, 38400, 57600, 115200, 230400. At the highest setting, the baud rate wraps back to the beginning. **Important** – be sure to select the correct baud rate! At next reset the selected baud rate will come into operation.

'4' Allows the local name for the BRM to be changed. This is the friendly name which is visible to other BRMs. The name entered is always preceded with "BRM:" The name entered may be upto 16 characters long.

'5' Toggles the Idle Timer On an Off. When the timer is set to 'On', the current connection is broken if no data has been sent or received for 10 seconds unless a voice link is currently active. When the timer is set to 'Off', the current connection remains active regardless of activity (default).

Devices Menu

To select the Devices Menu press '2' from the Main Menu. The following screen will appear:

```
CLM V0.29 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Menu 2 (Devices)        Choose an option:

        1 = List
        2 = Remove
        3 = Add

        ESC = Back
```

Option '1' Lists the remote BRM devices currently stored in memory and displays the local name if the device is within range.

```
CLM V0.29 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Device List...

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

       2 = Remove
       3 = Add
       ESC = Back

>?
```

Option '2' Allows a device to be removed from memory as shown below:

```
CLM V0.29 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Device List...

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

       2 = Remove
       3 = Add
       ESC = Back

>Remove Which Device? (00-1F):01
```

Option '3' Allows a device to be added to memory and its index to be defined as shown below:

```
CLM V0.29 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Device List...

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

       2 = Remove
       3 = Add
       ESC = Back

>Enter Device Address (0-9,A-F): 0123456789ABC Store at index (00-1F):
```

Security Menu

The Security menu is option 3 from the main menu. This allows various security options to be set. By default no security is enabled. The security menu is shown below:
Note: This feature is not currently implemented.

```
CLM V0.25 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Menu 3 (Security)       Choose an option:

        1 = None
        2 = Pin Code
        3 = Encryption

        ESC = Back

>
```

Debug Menu

The Debug menu provides the facility for debugging various options. The debug screen is shown below:

```
CLM V0.25 - coherenceRF - 'Expertise in Wireless Design'

BRM:001     - 0x0002C7A063E2

Menu 4 (Debug)  Choose an option:

        1 = Messages Off
        2 = Power-on Reset
        3 = Unlearn
        4 = Host CTS On

        ESC = Back

>
```

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