BISM2™ Bluetooth Version 2.0 Serial Module

Hardware Integration Guide
Version 2.5

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Embedded Wireless Solutions Support Center: http://ews-support.lairdtech.com
Americas: +1-800-492-2320
Europe: +44-1628-858-940
Asia: +852-2923-0610
www.lairdtech.com/bluetooth

REVISION HISTORY

Revision	Date	Description	Approved By
1.0		Initial Release	Jonathan Kaye
2.0	29 July 2103	Converted to Laird formatting	Sue White
2.1	31 Oct 2013	Updated maximum multipoint connections (from 7 to 3)	Jonathan Kaye
2.2	16 Jan 2014	Separated manual into two documents: User Guide and Hardware Integration Guide	Sue White
2.3	06 Feb 2014	Updated Bluetooth SIG Qualification section. Updated DoC section.	Jonathan Kaye
2.4	27 Feb 2014	Added overall mechanical dimensions in Physical Dimensions.	Jonathan Kaye
2.5	14 April 2014	Updated Bluetooth EPL Link	Jonathan Kaye

CONTENTS

1 General Description

Laird's BISM2 Bluetooth Serial Module is a fully integrated and qualified Class 1 Bluetooth solution designed for the lowest integration cost and ownership for designers wishing to incorporate Bluetooth functionality into their products. The module is qualified to Bluetooth Version 2.0.

The BISM2 Bluetooth Serial Module is one of the most compact complete Bluetooth solutions, making it ideal to integrate into handheld devices. Another version of the BISM2 module is available that retains the same board size, mounting holes, and connector as the previous Bluetooth module from Laird, allowing users to access the improved radio performance and functionality without the need for any PCB modifications.

The BISM2 module is based on Cambridge Silicon Radio's BlueCore 04 chipset. The module contains all of the hardware and firmware for a complete Bluetooth solution, requiring no further components. The module has an integrated, high performance antenna which is matched with the Bluetooth RF and baseband circuitry. The firmware integrated into the BC04 chipset implements the higher layer Bluetooth protocol stack, up to and including the Generic Access Profile (GAP), Service Discovery Profile (SDAP), Serial Port Profile (SPP), Dial Up Networking (DUN) profile, Headset Profile (HSP), Hands Free Profile (HFP), File Transfer Profile (FTP) and Audio Gateway. A virtual processor within the BC04 implements an AT command processor. This interfaces to the host system over a straight forward serial port using an extensive range of AT commands. The AT command set abstracts the Bluetooth protocol from the host application, saving many months of programming and integration time. It provides extremely short integration times for data-oriented cable replacement and voice applications. A low cost development system is available for fast product evaluation and development.

An alternative version of firmware is available that provides multi-point programming support.

The module can be configured so that it can attach to a 'dumb' terminal or attach to a PC or PDA for cable replacement applications.

In addition to the Bluetooth functionality, The BISM2 module provides access to 9 General I/O lines and 2 analogue input and output lines. These can be configured to provide connection to simple devices, such as switches or LEDs, without requiring any external processing. Both the GPIO and ADC lines can be accessed either via the wired host UART connection, or remotely over the Bluetooth link.

The BISM2 module is supplied in a small form factor PCB (22.0 mm x 34.0 mm x 7.6 mm), that connects to a main PCB using a 40-way Hirose connector. The interface is compatible with the BISM1 module. The module includes a high sensitivity, high gain antenna which provides excellent range. Typical open field performance provides ranges of over 250 metres at transmit powers of 4 mW.

Support is provided for low power modes that make the BISM2 particularly applicable to battery powered installations.

The BISM2 module is lead-free, RoHS compliant, and supports an industrial temperature range of -40°C to +85° C.

1.1 Applications

- POS equipment
- Medical equipment
- Telematics
- Voice applications
- Industrial automation
- Automotive applications

2 SPECIFICATIONS

2.1 Detailed Specifications

Features	Implementation
Bluetooth Transmission	Class 1
Fully Bluetooth pre-qualified	Bluetooth 2.0
Range	250 metres typical (free space)
Frequency	2.4000 – 2.485 GHz
Max Transmit Power	+6 dBm
Min Transmit Power	-27 dBm
Receive Sensitivity	Better than -86 dB
Data Transfer Rate	Up to 300 Kps
Serial Interface	RS232 bi-directional for commands and data using AT commands
Serial Parameters	Default 9600, n, 8, 1 – Configurable from 1200 bps to 961200 bps
	Support DTR, DSR, DCD, RI, RTS, CTS
Physical Size	22.8 x 33.8 x 7.6 mm, 8 g
	24.0 x 69.0 x 7.6 mm, 9 g (BISM1 Form Factor)
Current Consumption	Typically 22 mA during data transfer in standard power mode. Lower powers are attainable with a configurable low power mode.
Low Power Sniff Mode	2.5 mA typ
Temperature Mode	Normal operation: -40° C to +85° C
Supply Voltage	3.6 V – 7.0 V
Brown-out	Integrated brown-out detection
Interface Levels	3.3 V Logic
Audio	Audio can be transferred over SCO channels through the PCM interface at 64 kbps. PCM can be configured as a master or slave.
Profiles	FTP Server, SPP, DUN, FTP, Audio Gateway, Headset, Handsfree
Multipoint	Max 3 slaves
Field Upgradable	Over UART
Protocols	AT commands control and configure single point firmware. Standard multipoint firmware uses a simple packet based protocol and requires a host to enable the module to function effectively. Single point only allows a point-to-point connection, whereas multipoint allows more than one simultaneous connection.
GPIO	9 x digital
	2 x analogue (8 bit resolution)
Indicators	1 x programmable LED (small form factor board only)
Lead free	Lead free and RoHS compliant.

3 FUNCTIONAL BLOCK DIAGRAM

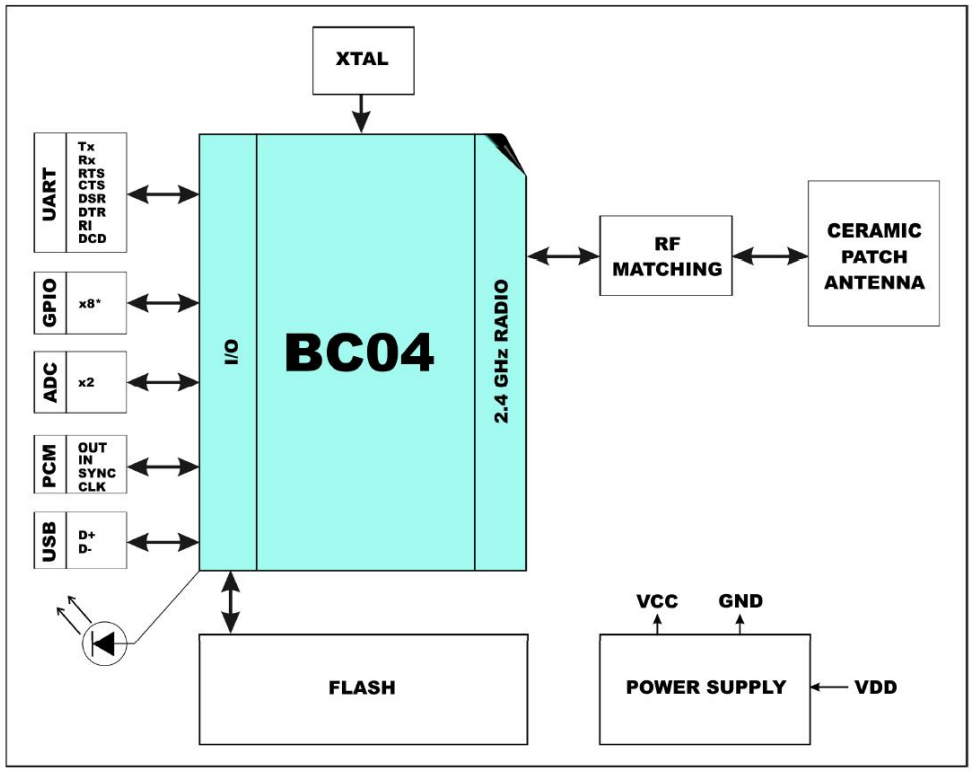


Figure 3-1: Block diagram

3.1 Connection Diagram

The module is equipped with a 40-pin 0.5 mm pitch board-to-board connector that connects to the application platform.

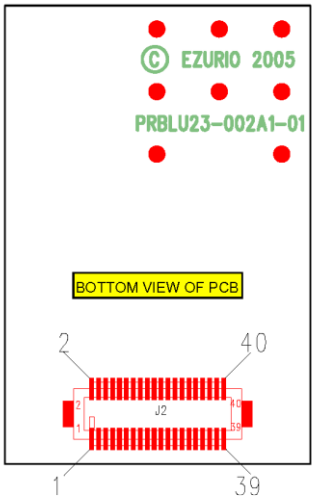


Figure 3-2: Connection diagram

3.2 Pin Descriptions

The Hirose DF12C board-to-board connector on the module is a 40-pin double-row receptacle.

The table below defines the pin functions. Note that this pin-out is as viewed from the underside of the module.

Pin No.	Signal	Description
1	Analogue 0	1.8 v max
3	Analogue 1	1.8 v max
5	SPI_MISO	SPI bus serial O/P
7	SPI_CSB	SPI bus chip select I/P
9	SPI_CLK	SPI bus clock I/P
11	GND	
13	RESET	Reset I/P*
15	GND	
17	SPI_MOSI	SPI bus serial I/P
19	UART_CTS	Clear to Send I/P
21	UART_TX	Transmit Data O/P
23	UART_RTS	Request to Send O/P
25	UART_RX	Receive Data I/P
27	VCC_3V3	3.3 V monitor
29	VCC_5V	3.6 V < VIN < 7.0 V
31	N/C	
33	GPIO6**	I/O for host
35	GPIO7**	I/O for host
37	GPIO8**	I/O for host
39	GPIO9**	I/O for host

Pin No.	Signal	Description
2	GPIO1	I/O for Host
4	GPIO2	I/O for Host
6	UART_RI	'Ring' Input or Output
8	UART_DCD	Input or Output
10	UART_DSR	Input
12	GPIO3/UART_DTR	I/O for Host
14	GPIO4	I/O for Host & LED
16	GPIO5	I/O for host
18	GND	
20	PCM_CLK	PCM Clock I/P
22	PCM_IN	PCM Data I/P
24	PCM_SYNC	PCM Sync I/P
26	PCM_OUT	PCM Data O/P
28	N/C	
30	GND	
32	USB/RESERVED	Do not connect
34	USB/RESERVED	Do not connect
36	GND	
38	GND	
40	N/C	

Notes:

* The reset circuitry within the BISM serial modules now incorporates a brown-out detector within the module. Customers migrating from previous modules should check their implementation, as they may be able to simplify their external power supply design. The reset line has a fixed 10kOhm pull down resistor to ground.

** Pins 33, 35 and 37 were N/C on BISM1. Pin 39 was a 1V8 monitor. Designers migrating between designs should be aware that these are now available as I/O. Default configuration is as an input PIO lines can be configured through software to be either inputs or outputs with weak or strong pullups or pull-downs. At reset, all PIO lines are configured as inputs with weak pull-downs.

UART_RX, UART_TX, UART_CTS, UART_RTS, UART_RI, UART_DCD and UART_DSR are all 3.3v level logic. For example, when RX and TX are idle they will be sitting at 3.3V. Conversely for handshaking pins CTS, RTS, RI, DCD, DSR a 0v is treated as an assertion.

Pin 6 (UART_RI) is active low. It is normally 3.3v. When a remote device initiates a connection, this pin goes low. This means that when this pin is converted to RS232 voltage levels it will have the correct voltage level for assertion.

Pin 8 (UART_DCD) is active low. It is normally 3.3v. When a connection is live this pin is low. This means that when this pin is converted to RS232 voltage levels it will have the correct voltage level for assertion.

Pin 10 (UART_DSR) is an input, with active low logic. It should be connected to the DTR output of the host. When the BISM2 module is in high speed mode (See definition for S Register 507), this pin should be asserted by the host to ensure that the connection is maintained. A deassertion is taken to mean that the connection should be dropped, or an online command mode is being requested.

Pin 27 (VCC_3V3 monitor) may only be used for monitoring purposes. It must not be used as a current source.

The GPIO pins can be accessed using S Registers 621 to 628. GPIO4 is connected to an LED on the module. If these I/O pins are set for input, then the LED will be driven by the host and appropriate drive current requirements must be satisfied. A Logic 1 switches on the LED. GPIO3 is also used for DTR output (active low). See S Register 552 & 553.

Analogue 0 and 1 should not exceed 1.8v and S Registers 701 and 702 are used to access them.

3.3 Electrical Specifications

3.3.1 Absolute Maximum Ratings

Absolute maximum ratings for supply voltage and voltages on digital and analogue pins of the module are listed below.

WARNING: Exceeding these values causes permanent damage to the module.

Parameter	Min	Max	Unit
Peak current of power supply	0	100	mA
Voltage at digital pins	-0.3	3.7	V
Voltage at POWER pin	3.6	7	V

3.3.2 Recommended Operating Parameters

3.3.2.1 Power Supply

Signal Name	Pin No.	I/O	Voltage Level	Comments
Vcc	29	I	3.6 V to 7.0 V	I_{typ} – 30 mA
GND	11, 15, 18, 30, 36, 38			6 Ground terminals to be attached in parallel
VCC_3V3	27	O	3.3 V typical	For monitoring only. No current source.

3.3.2.2 RS232 Interface

Signal Name	Pin No.	I/O	Voltage Level	Comments
UART_TX	21	O	V_{OL}max = 0.2 V V_{OH}min = 2.8 V	I_{typ} – 30 mA
UART_RX	25	I	V_{IL}max = 0.8 V	6 Ground terminals to be attached in parallel

Signal Name	Pin No.	I/O	Voltage Level	Comments
			V_{IH}max = 2.1 V V_{IH}max = 3.7 V	
UART_CTS	19	O	V_{IL}max – 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	
UART_RTS	23	O	V_{OL}max = 0.2 V V_{OH}min = 2.8 V	
UART_DSR	10	I	V_{IL}max = 0.2 V V_{IH}min = 2.8 V V_{IH}max = 3.7 V	
UART_DTR	12	O	V_{OL}max = 0.2 V V_{OH}min = 2.8 V	Shared with GPIO3
UART_RI	6	I or O	O/P:V_{OL}max = 0.2 V V_{OH}min = 2.8 V I/P: V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	Direction may be programmed
UART_DCD	8	I or O	O/P:V_{OL}max = 0.2 V V_{OH}min = 2.8 V I/P: V_{IL}max = 0.8 V V_{IH}min = 0.8 V V_{IH}max – 3.7 V	Direction may be programmed

3.3.2.3 SPI Bus

Signal Name	Pin No.	I/O	Voltage Level	Comments
SPI_MOSI	17	I	V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	Used to reprogram Flash
SPI_MISO	5	O	V_{OL}max = 0.2 V V_{OH}min = 2.8 V	
SPI_CSB	7	I	V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	
SPI_CLK	9	I	V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	

3.3.2.4 PCM Interface

Signal Name	Pin No.	I/O	Voltage Level	Comments
PCM_CLK	20	I or O	O/P: V_{OL}max = 0.2 V V_{OH}min = 2.8 V I/P: V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	If unused, keep lines open.
PCM_IN	22	I	V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 2.7 V	
PCM_SYNC	24	I or O	O/P: V_{OL}max = 0.2 V V_{OH}min = 2.8 V I/P: V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	
PCM_OUT	26	O	V_{OL}max = 0.2 V V_{OH}min = 2.8 V	

3.3.2.5 General Purpose I/O and ADC

Signal Name	Pin No.	I/O	Voltage Level	Comments
GPIO 1 – 9	2, 4, 12, 14, 16, 33, 35, 37, 39	I or O	O/P: V_{OL}max = 0.2 V V_{OH}min = 2.8 V I/P: V_{IL}max = 0.8 V V_{IH}min = 2.1 V V_{IH}max = 3.7 V	
AIO_0, AIO_1	1, 3	I	Range 0 – 1.8 V	

3.3.2.6 Miscellaneous

Signal Name	Pin No.	I/O	Voltage Level	Comments
Reserved	USB D-	I	V_{IL}max = 0.3 vdd_usb V_{IH}min = 0.7 vdd_usb	Normally inactive. Pull to GND through 10K.
Reserved	USB D+	I	VILmax = 0.3 vdd_usb VIHmin = 0.7 vdd_usb	Normally inactive. Pull to GND through 10K.
Reset	RESET	I	Threshold 2.6 V	Active HIGH.

Terminology: USB Signal Levels. vdd_usb refers to the internal voltage generated by the LDO regulator on the module, which is typically 3.3 V. Hence 0.3 vdd_usb and 0.7 vdd_usb correspond to 1.0 V to 2.3 V. If Vcc falls below the recommended 3.6 V minimum, these values are reduced.

4 I/O CHARACTERISTICS

4.1 Power Consumption

The current drain from the Vcc power input line is dependent on various factors. The three most significant factors are the voltage level at Vcc, UART baudrate, and the operating mode.

The module's hardware specification allows for a voltage range of 3.6 to 7.0 at Vcc. Tests have shown that there is no significant difference in current draw when Vcc is 5 or 6 V. Therefore the data presented below pertains to Vcc levels of 3.6 and 5 V only. Tests have shown that where power drain is an issue, it is best to keep Vcc at the lower end of the range.

The UART baudrate has a bearing on power drain because as is normal for digital electronics, the power requirements increase linearly with increasing clocking frequencies. Hence higher baudrates result in a higher current drain.

With regards to operating mode, the significant modes are: Idle, Waiting for a connection, Inquiring, Initiating a connection, Sniff, and Connected.

With connected mode, it is also relevant to differentiate between no transferring data and when data is transfers at the maximum rate possible. The AT command set document describes how to configure the module for optimal power performance.

		Baud			
		9,600	38,400	115,200	460,800
Idle Mode, S512 = 1	3.6 V	1.60	1.80	1.96	3.00
	5.0 V	2.00	2.10	2.30	3.40
Wait for connection or Discoverable Mode, AT+BTP S508 = S510= 640, S409= S511 = 11*	3.6 V	59.00	59.00	59.00	59.00
	5.0 V	65.00	65.00	65.00	65.00
Wait for Connection or Discoverable Mode, AT+BTP S508=S510=1000, S509 = S511 = 11*	3.6 V	2.75	2.94	3.10	4.12
	5.0 V	3.26	3.36	3.55	4.63
Inquiring Mode, AT+BTI	3.6 V	50.00	50.00	50.00	50.00
	5.0 V	54.00	54.00	54.00	54.00
Connecting Mode (ATDxxx)	3.6 V	50.00	50.00	50.00	50.00
	5.0 V	54.00	54.00	54.00	54.00
Connected Mode (No Data Transfer)	3.6 V	6.00	6.10	6.40	7.20
	5.0 V	7.20	7.20	7.40	8.20
Connected Mode (Max Data Transfer)	3.6 V	21.50	22.50	24.50	32.50
	5.0 V	24.50	26.00	28.00	36.00

** Calculated figures*

Note: **These figures were obtained with pre-production firmware. Production values are typically 20% lower.**

5 DC CHARACTERISTICS

5.1 RF Performance

5.1.1 Transmit Power

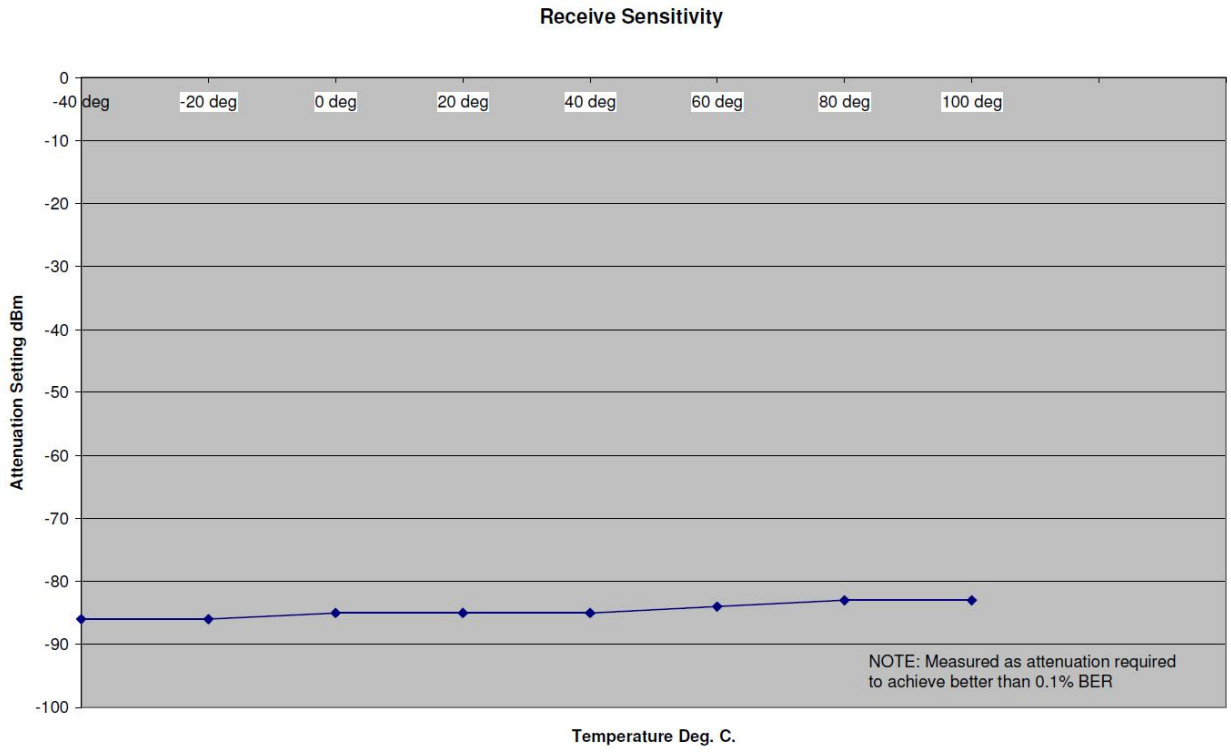
Conducted Transmit Power	Min: 1.0 mW (0dBm)	Max: 4 mW (6 dBm)
Antenna Gain	+2 dBi typ.	
Effective Transmit Power	Min: 0 dBm	Max: +6 dBm

Reduce output power by program control.

5.1.2 Receive Sensitivity

Receive Sensitivity	-86 dBm (at 25° C)
Antenna Gain	+2 dBi typ.
Effective Transmit Power	-88 dBm (at 25° C)

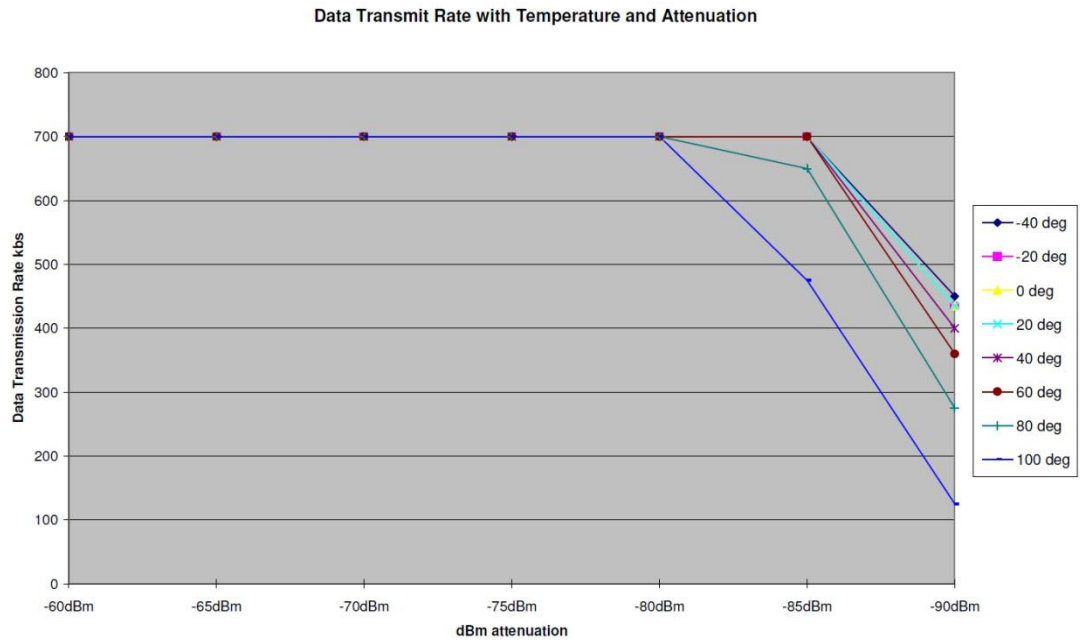
5.1.3 RF Performance Data



5.2 Range

See the data transfer rate vs. distance graph below. The data throughput of the module is limited to 280 Kbps by the parsing of the data transferring through the RFCOMM stack. The graph below shows the typical data throughput. Distances are measured in free space between two modules.

5.3 Temperature Performance



6 FUNCTIONAL DESCRIPTION

The BISM2 Bluetooth module is a self-contained Bluetooth product and requires only power to implement full Bluetooth communication. The integrated, high performance antenna together with the RF and base-band circuitry provides the Bluetooth wireless link. The UART interface provides a connection to the host system.

The variety of interfaces and the AT command set allow the BISM2 module to be used for a wide number of short range wireless applications, from simple cable replacement to complex multipoint applications where multiple radio links are active at the same time.

The complexity and flexibility of configuration are made simple for the design engineer by the integration of an extremely comprehensive set of AT commands, supplemented with a range of "S" registers which are used for non-volatile storage of system parameters. These are fully documented in the "Blu2i AT Command Reference Manual".

To provide the widest scope for integration, Laird provides a range of different physical host interfaces.

6.1 Interfaces

6.1.1 UART Interface

UART_TX, UART_RX, UART_RTS, and UART_CTS form a conventional asynchronous serial data port with handshaking. The interface is designed to operate correctly when connected to other UART devices such as the 16550A. The signalling levels are nominal 0 V and 3.3 V and are inverted with respect to the signalling on an RS232 cable. The interface is programmable over a variety of bit rates: no, even or odd parity, stop bit, and hardware flow control. The default condition on power-up is pre-assigned in the external Flash. Two-way hardware flow control is implemented by UART_RTS and UART_CTS. UART_RTS is an output and is active low. UART_CTS is an input and is active low. These signals operate according to normal industry convention.

By writing different values to the relevant S register, the UART_RI can be continuously polled to detect incoming communication. The UART_RI signal serves to indicate incoming calls.

UART_DSR is an active low input. It should be connected to DTR output of the host. When the module is running in high speed mode (see definition for S Reg 507), this pin should be asserted by the host to ensure connection maintains. A de-assertion means that the connection should be dropped, or an online command mode is being requested.

The module communicates with the customer application using the following signals:

- RS-232
- Port /TXD @ application sends data to the module's UART_RX signal line
- Port /RXD @ application receives data from the module's UART_TX signal line

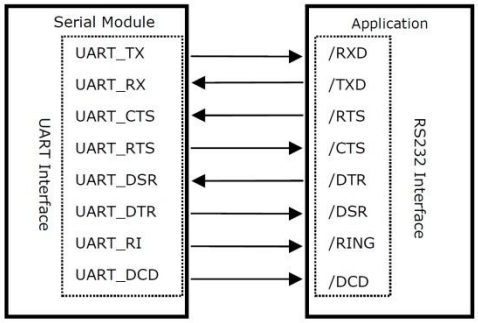


Figure 6-1: UART interfaces

Note: **The serial module output is at 3.3V CMOS logic levels. Level conversion must be added to interface with an RS-232 level compliant interface.**

6.1.2 SPI Bus

The module is a slave device that uses terminals SPI_MOSI, SPI_MISO, SPI_CLK and SPI_CSB. This interface programs firmware updates at the factory.

Laird supplies a PC based utility to allow firmware upgrade over the UART port. It is highly recommended that customers use this method for updating firmware.

Note: **The designer should be aware that no security protection is built into the hardware or firmware associated with this port, so the terminals should not be permanently connected in a PC application.**

6.1.3 GPIO Port

Eight lines of programmable bi-directional input/outputs (I/O) are provided that can be accessed either via the UART port, or Over The Air (OTA) from a second Bluetooth unit. These can be used as data inputs or to control external equipment. By using these in OTA mode, a BISM module can control and data acquisition without the need for any additional host processor.

Each of the GPIO [1:8] ports can be independently configured to be either an Input or Output. A selection of ports can be accessed synchronously.

GPIO 1 and 2 can be configured as event counters.

The ports are powered from Vcc. The mode of these lines can be configured and you can access the lines via S Registers 621 to 628.

Low latency I/O can be accessed by using Laird's I/O via an enhanced inquiry process.

6.1.4 PCM CODEC Interface

PCM_OUT, PCM_IN, PCM_CLK and PCM_SYNC carry up to three bi-directional channels of voice data, each at 8 k samples/s. The format of the PCM samples can be 8-bit A-law, 8-bit µ-law, 13-bit linear, or 16-bit linear. The PCM_CLK and PCM_SYNC terminals can be configured as inputs or outputs, depending on whether the module is the Master or Slave of the PCM interface. Please contact a Laird FAE for further details.

The module is compatible with the Motorola SSI TM interface and interfaces directly to PCM audio devices including the following:

Compatible Codec Chips

- Winbond W61360 13-bit linear CODEC (Motorola MC145483 compatible)
- OKI MSM7702 single channel A-law and µ-law CODEC
- OKI MSM7705 four channel A-law and µ-law CODEC

The default codec support is for the Winbond W61360

Note: Codec development boards that mate with the Laird Wireless Developers Kit are available for each of the three codecs listed above.

6.1.5 ADC

The BISM2 provides access to two 8-bit ADCs. These provide an input range of 0 mV to 1,800 mV, which can be read using the S registers 701 and 702.

Suitable external scaling and over-voltage protection should be incorporated in your design. The module provides 5 samples per second at the UART with a baud rate of 115200 or above.

Low latency access of the upper 6 bits of the ADCs can be obtained by using Laird's I/O via an enhanced inquiry process.

6.1.6 LED

A single LED provides information on the status of the module. It is controlled by an S register to display the status of various parameters and is useful for debug and test.

7 APPLICATION INFORMATION

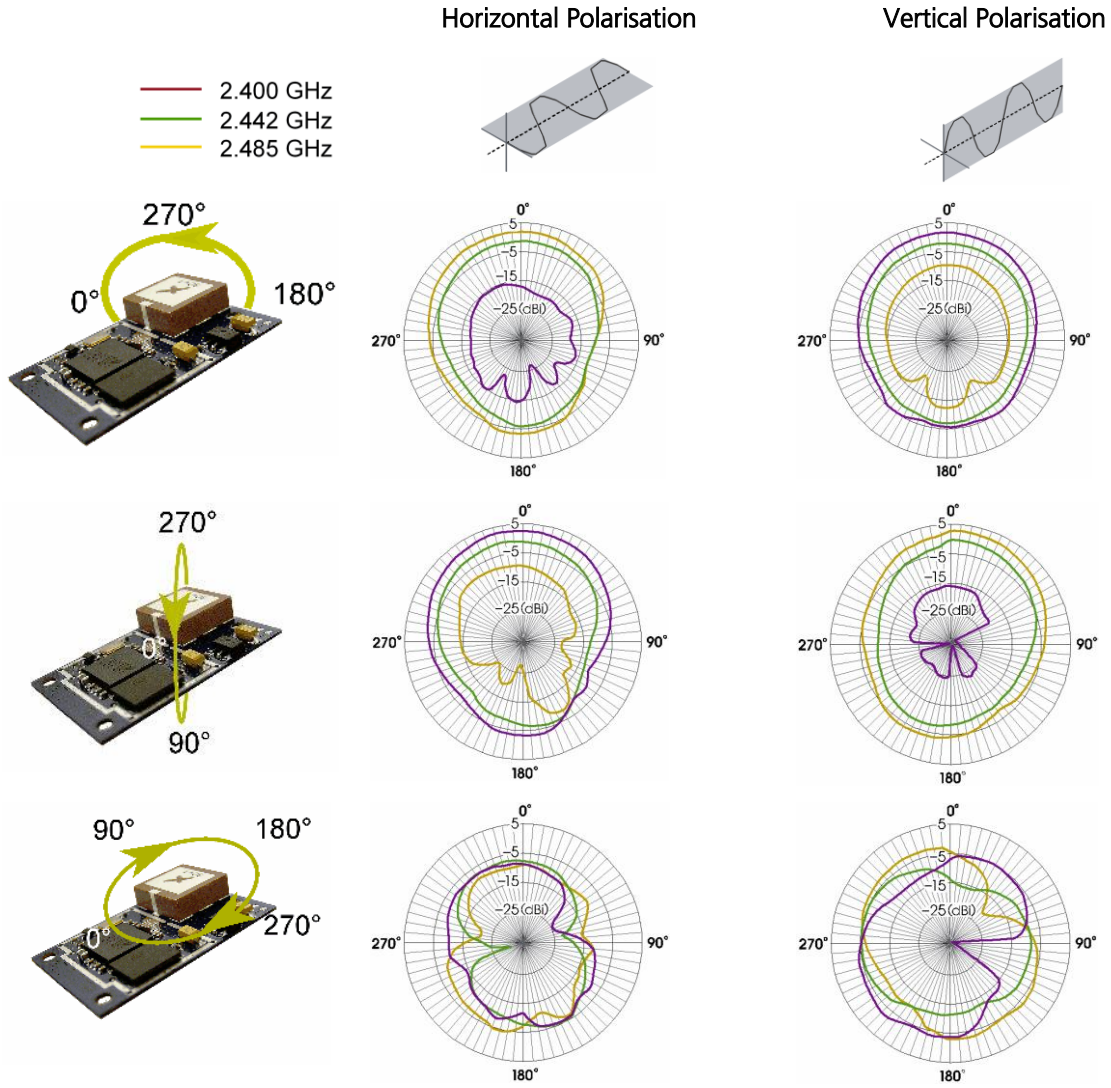
7.1 Antenna Position

The antenna used on the BISM2 Bluetooth module is designed to be largely immune from the effects of proximity detuning. Normally, antennas operating at 2.4GHz are affected by their surroundings, so that great care is needed in their placement and orientation.

The BISM2 can be used in most locations and orientations and is only marginally affected by the presence of a significant ground plane in close proximity.

The antenna distribution is close to isotropic, which means that the orientation of mounting has only a limited effect on the overall range. However the optimum range is achieved when the two antennae are directly facing each other.

Example of Radiation Characteristics:



Typical Radiation Characteristics. Measured at 2.5metres from a standard dipole.

The module should not be located in a sealed metal enclosure, as this will act as a Faraday cage and severely attenuate the radio signal.

The antenna finish may tarnish as a result of environmental effects and handling. This is a cosmetic effect and does not affect the RF performance.

7.2 Power Supply Considerations

The power supply for the module has to be a single voltage source of Vcc within the range of 3.6 V to 7.0 V. It must be able to provide sufficient current in a transmit burst. This can rise to 65mA.

The module includes regulators to provide local 3.3V. This rail is accessible on connector J2 for monitoring purposes only. Under no circumstances should this pin be used to source current. Power (Vcc) can be provided via the board-to-board connector Pin 29 on J2.

7.3 Power-on-Reset (Power Cycling and Brown Out Considerations)

The module is provided with an active high reset pin (Hirose 40way DF12C connector pin 13). Upon the application of power, the Power On Reset circuit built into the module will ensure that the unit starts correctly. There is no need for an external power reset monitor.

Note: **The previous version of the Bluetooth serial module required an external Brown Out circuit to ensure correct operation. This circuitry has now been incorporated into the module. The power supply has been designed to work with previous versions of customer circuitry that may or may not have external brown-out implementations. Customers migrating from a BISM1 to BISM2 module may be able to simplify their power supply circuitry as a result.**

7.4 RF Shield

To meet FCC requirements, all modules are supplied with a soldered RF shield. This meets the requirement that users may not be able to access RF circuitry without special tools. Removal of the shield may negate RF approvals.

7.5 Mounting the Module onto the Application Platform

There are many ways to properly install the module in the host device. An efficient approach is to mount the PCB to a frame, plate, rack or chassis. Fasteners can be M1.8 or M2 screws plus suitable washers, circuit board spacers, or customized screws, clamps, or brackets in 2.2mm diameter holes. Note that care should be taken to ensure the head of the fixing does not interfere with the circuit. Nylon fixings are recommended. In addition, the board-to-board connection can also be utilized to achieve better support.

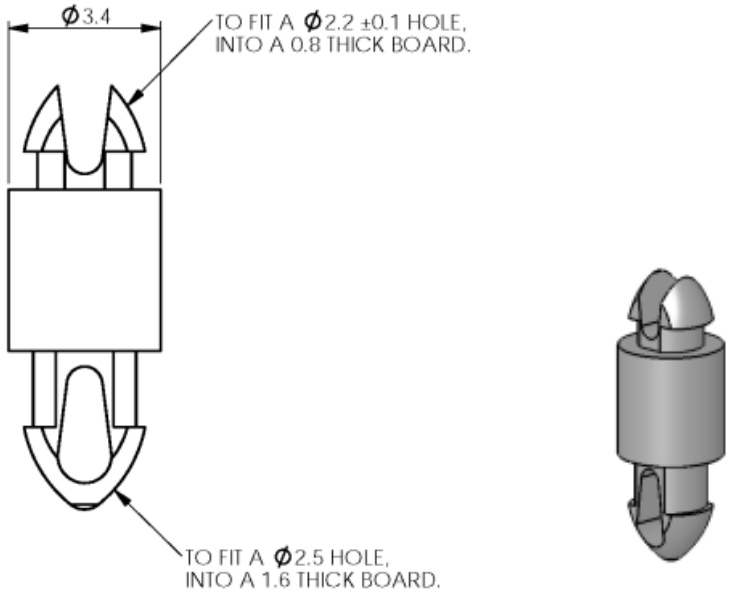
The antenna (brown square component on top side of PCB) must not be influenced by any other PCBs, components or by the housing of the host device. The proximity of the antenna to large metallic objects can affect the range and performance of the system. Designers should carefully consider the location of the module and the type of enclosure material that is used.

To prevent mechanical damage, be careful not to force, bend or twist the module. Be sure it is positioned flat against the host device.

7.5.1 Fixing Pillars

Laird in conjunction with Richco has designed a mounting pillar for use with the Bluetooth serial module. This allows the module to be securely held to a primary pcb using snap fit details. A variety of different heights are available to accommodate different variants of Hirose stacked connectors. Pillars supporting a 3.5mm stacked board height can be supplied by Laird. These and alternative spacings can also be ordered directly from Richco.

Customer designs using these pillars should use 2.5mm diameter holes on a 1.6mm thick PCB. In conjunction with the 3.6 mm stacked height Hirose if they are to take advantage of this.



Board Spacing	Part Number	Source	Matching HRS PCB Socket
3.6 mm	NPR2005-153-3.6	Laird / Richco	CL537-0032-4-86
4.1 mm	NPR2005-153-4.1	Richco	CL537-0057-5-86
5.1 mm	NPR2005-153-5.1	Richco	CL537-0157-0-86

8 BOARD TO BOARD CONNECTOR

This chapter provides specifications for the 40-pin board-to-board connector which serves as physical interface to the host application. The receptacle assembled on the module is Hirose type DF12C.

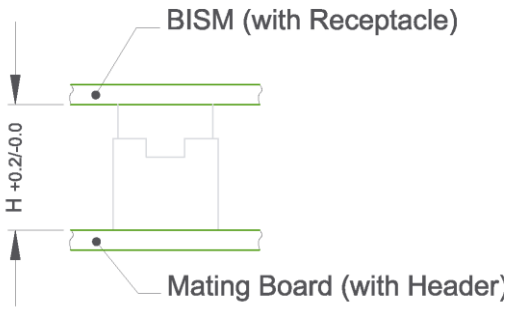
8.1 Stacking Height

Mating headers from Hirose are available in different stacking heights, allowing the spacing between the BISM2 and carrier pcb to be changed from 3.5mm to 5.0mm.

Item	Part Number	Stacking Height	HRS Number
Receptacle on module	DF12C-40DS-0.5V(86)	3.5 mm – 5 mm	CL537-0007-7-86
Headers DF12 series	DF12(3.5)-40DP-0.5V(86)	3.5 mm	CL537-0032-4-86
	DF12(4.0)-40DP-0.5V(86)	4.0 mm	CL537-0057-5-86
	DF12(5.0)-40DP-0.5V(86)	5.0 mm	CL537-0157-0-86

Note: The headers listed above are with boss and metal fitting.
Suffix -86 denotes RoHS compliance.

H = Stacking Height (mm)



8.2 Hirose Connector General Specification

Parameter	Specification (40 pin board to board connector)
Number of Contacts	40
Quantity Delivered	2000 connectors per tape & reel
Voltage	50 V
Current Rating	0.5 A max per contact
Resistance	0.05 Ohm per contact
Dielectric Withstanding Voltage	500 V RMS min
Operating Temperature	-45° C to +125°
Contact Material	Phosphor bronze (surface: gold plated)
Insulator	Material PA, beige natural
Stacking Height	3.0 mm; 3.5 mm; 4.0 mm; 5.0 mm

Parameter	Specification (40 pin board to board connector)
Insertion Force	21.8 N
Withdrawal Force 1st	10 N
Withdrawal force 50th	10 N
Maximum Connection Cycles	50

9 QUALIFICATION

9.1 Bluetooth Qualification Process

The following safety precautions must be observed during all phases of the operation, usage, service, or repair of any application incorporating this module. Manufacturers of the RF equipment are advised to convey the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. **Failure to comply with these precautions violates safety standards of design, manufacture, and intended use of the product.** Laird assumes no liability for customer failure to comply with these precautions.

9.2 Safety Information

Switch off the Bluetooth device before boarding an aircraft. Make sure it cannot be switched on inadvertently. To prevent interference with communications systems, the operation of wireless appliances in an aircraft is forbidden by many airlines. Applications that could result in use on aircraft should carry appropriate warnings.

9.3 Qualifications

9.3.1 RF Approvals

The module is listed as a Bluetooth Product in terms of the Bluetooth SIG Program Reference Document (PRD). This means that it can be integrated into end products without further testing or approval listing. The manufacturer must state the Laird part number and product reference in his literature in order to meet the requirements of the Bluetooth and regulatory approvals.

Laird provides a list of the countries where the module is approved as required. As a minimum, the product is listed in Europe, Scandinavia, and USA. Laird assumes no liability for customer failure to comply with national RF approvals.

9.3.1.1 EMC Emissions

EN 300 328 V1.5.1 (2004-08)

9.3.1.2 EMC Immunity

EN 301 489-1 V1.4.1 (2002-08)

9.3.1.3 FCC

FCC Part 15.247:2004 (Subpart C)

FCC ID: PI401B

9.4 Safety and Regulatory Statements

9.4.1 Europe – EU Declaration of Conformity

Manufacturer	Laird Technologies
Product	TRBLU23-00200 / TRBLU23-00300
EU Directive	RTTE 1999/5/EC
Conformity Assessment	Annex IV

Reference standards used for presumption of conformity:

Article Number	Requirement	Reference standard(s):
3.1a	Health and Safety	IEC 60950-1:2005 (2nd Ed); Am 1:2009 EN 60950-1:2006+A11:2009 a+A1:2010+A12:2011
3.1a	RF Exposure	EN 62479:2010
3.1b	Protection requirements with respect to electromagnetic compatibility	EN 301 489-1 V1.9.2 (2011-09) EN 301 489-17 V2.2.1 (2012-09) Emissions: EN55022:2010 /A1:2011, Class B Immunity: EN61000-4-2:2009 EN61000-4-3:2006 /A1:2008/A2:2010
3.2	Means of the efficient use of the radio frequency spectrum	EN 300 328 V1.8.1 (2012-06)

Declaration: We, Laird, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Directive 1999/5/EC, when used for its intended purpose.

Place of Issue:	Laird Technologies Saturn House, Mercury Park Wooburn Green HP100HH, United Kingdom tel: +44 (0)1628 858 940 fax: +44 (0)1628 528 382
Date of Issue:	February 2014
Name of Authorised Person:	Andrew Dobbing, Engineering Manager
Signature: 	

9.4.2 FCC and Industry Canada Statements

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 undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

9.4.2.1 FCC Labelling Requirement

If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: PI401B" or "Contains FCC ID: PI401B." Any similar wording that expresses the same meaning may be used.

10 BLUETOOTH SIG QUALIFICATION

The BISM2 module is listed on the Bluetooth SIG website as qualified End Products.

Design Name	Owner	Declaration ID	Link to listing on the SIG website
BISM2	Laird Technologies	B0245600	https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=10650

It is a mandatory requirement of the Bluetooth Special Interest Group (SIG) that every product implementing Bluetooth technology has a Declaration ID. Every Bluetooth design is required to go through the qualification process, even when referencing a Bluetooth Design that already has its own Declaration ID. The Qualification Process requires each company to registered as a member of the Bluetooth SIG – www.bluetooth.org

The following link provides a link to the Bluetooth Registration page:
https://www.bluetooth.org/login/register/

For each Bluetooth Design it is necessary to purchase a Declaration ID. This can be done before starting the new qualification, either through invoicing or credit card payment. The fees for the Declaration ID will depend on your membership status, please refer to the following webpage:
https://www.bluetooth.org/en-us/test-qualification/qualification-overview/fees

For a detailed procedure of how to obtain a new Declaration ID for your design, please refer to the following SIG document:
https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=283698&vId=317486

To start the listing, go to: https://www.bluetooth.org/tpg/QLI_SDoc.cfm.

In step 1, select **Reference a Qualified Design** and enter 245600 in the End Product table entry. You can then select your pre-paid Declaration ID from the drop down menu or go to the Purchase Declaration ID page, (please note that unless the Declaration ID is pre-paid or purchased with a credit card, it will not be possible to proceed until the SIG invoice is paid.

Once all the relevant sections of step 1 are finished, complete steps 2, 3, and 4 as described in the help document. Your new Design will be listed on the SIG website and you can print your Certificate and DoC.

For further information please refer to the following training material:
https://www.bluetooth.org/en-us/test-qualification/qualification-overview/listing-process-updates

10.1 Additional Assistance

Please contact your local sales representative or our support team for further assistance:

Laird Technologies Connectivity Products Business Unit
Support Centre: http://ews-support.lairdtech.com

Email: wireless.support@lairdtech.com

Phone: Americas: +1-800-492-2320 Option 2
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

Web: http://www.lairdtech.com/bluetooth

11 ENVIRONMENTAL

11.1 Operating Temperatures

Parameter	Min	Typ	Max	Unit
Operating temp (standard product)	-40	25	+85	ºC

11.2 Storage Temperatures

Parameter	Min	Max	Unit
Storage temp	-40	+125	ºC

11.3 Reliability

Parameter	Test	Comment
Thermal Shock	200 cycles -40° C / +85° C 30 min	1 cycle/hour
Vibration	Continuous operation at 60 Hz, 2 mm stroke	15 g max sine wave, 12 hours
Shock	50 G 11 ms Half Sine Wave	6 axis x 3 cycles each axis
Moisture Resistance		
High Temp Storage	85° C, 360 hours	
Low Temp Storage	-40° C, 240 hours	
High Temp/ Humidity Operation	60° C, 90% RH, 360 hours	
Thermal Shock	-40 to +60° C in 30 min	200 cycles with continuous operation
Electrostatic Discharge	EN55024:1998 & IEC61000-4-3	
Drop Test	75 cm to concrete, 3 axis x 2 cycles per corner	

12 PHYSICAL DIMENSIONS

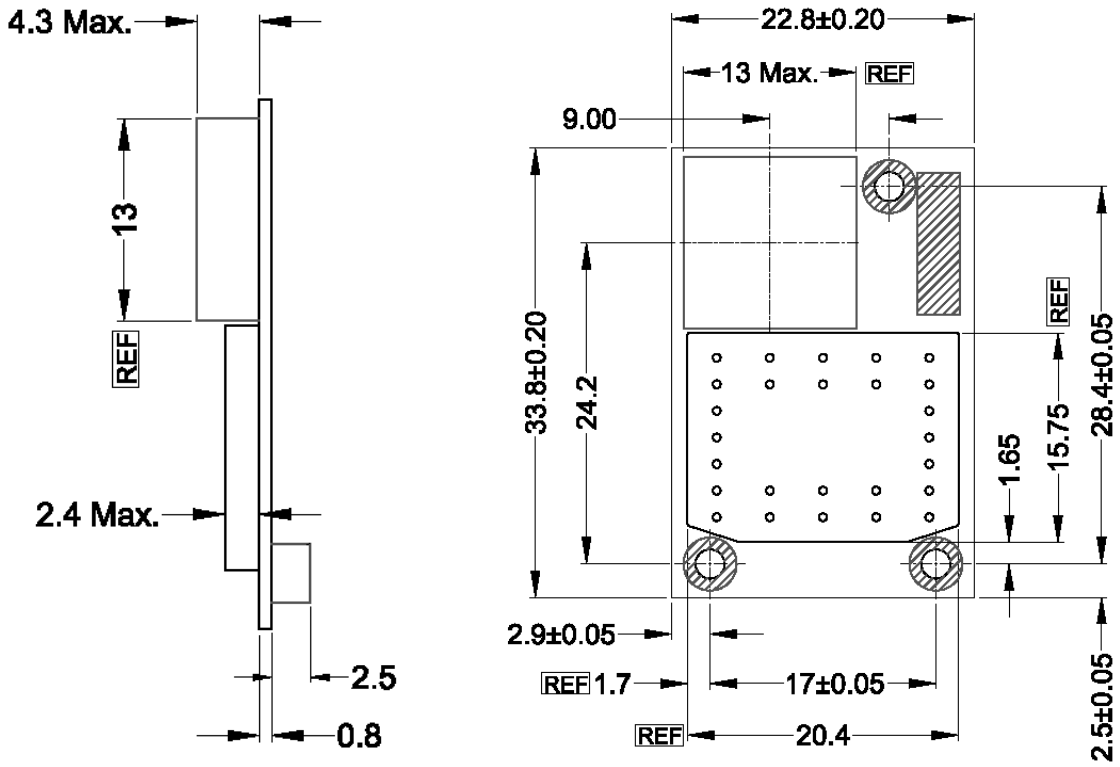
12.1 Mechanical Dimensions

12.1.1 Standard Module

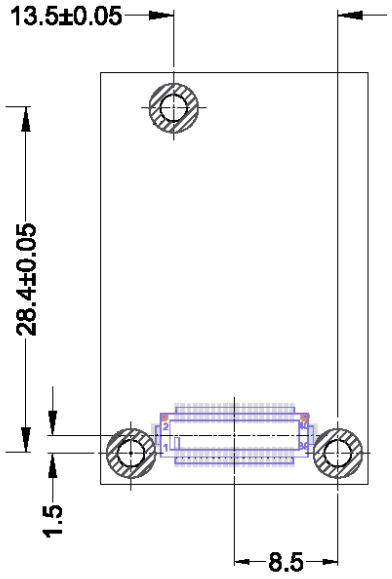
All dimensions in mm.

Table 1: Overall dimensions

Physical Dimensions	22.8 x 33.8 z 7.6mm, 8g
	24.0 x 69.0 x 7.6mm, 9g (BISM1 Form Factor)



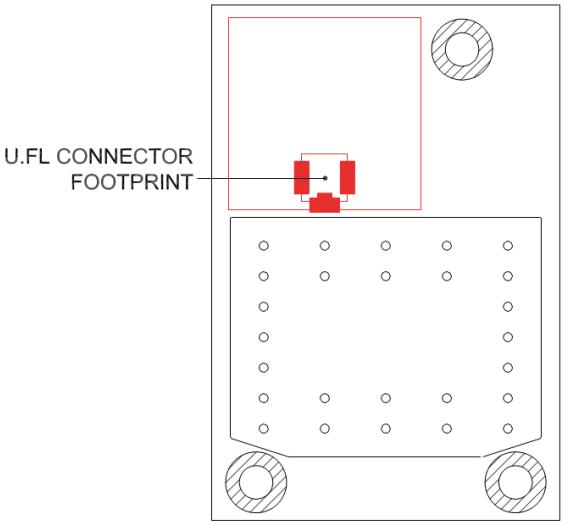
Location of connector (bottom view):



12.2 BISM2 Module without Antenna (special order)

The dimensions for this module are identical to the standard BISM2 illustrated above, but a U.FL connector replaces the antenna.

Top view:



The external antenna used must not result in an increased output power, i.e. the total gain of mating connector, cable, and antenna must not exceed +2 dB. If a higher gain antenna is connected, it will invalidate the RF and Bluetooth approvals for the module. The external antenna must provide 50 Ohm impedance.

The antenna connector is a U.FL connector, supplied by Hirose. Mating connectors with cables are available from Hirose and their distributors, and also from other cable suppliers. The data sheet for the connector series is available at http://www.hirose.co.jp/cataloge_hp/e32119372.pdf.

12.2.1 External Antennae

A variety of manufacturers can supply external antennae suitable for use with the BISM2 module without antenna. Users should be aware that the choice of antenna may affect the qualification of the module.

To ensure that the qualification is not affected, the TOTAL GAIN of the external antenna, including insertion loss of the connectors and cable, must be less than 2 dBi. If employing a higher gain, then the pre-qualified status of the module will be lost. It is the customer's responsibility to ensure that an external antenna does not negate the qualification.

Centurion (www.centurion.com) manufactures a snap-in external connector of the form generally known as a "rubber duck" with a 100 mm captive lead terminated in a U.FL connector that is particularly appropriate for use with the BISM2 module.

The part number is WCR 2400-IP.

NovaETS (www.novaets.com) in the UK supplies a rubber duck antenna with U.FL connection.

The ordering information is W-154C 2dB Wireless LAN Antenna (2.4 GHz) Assembled with U.FL (iPX) Connector.

Reel – Rienheimer Elektronic (www.reel-gmbh.de) manufactures a wide range of antennae, including their planTEc roof antennae, that are ideal for vehicle mounting.

Part Number M70CXR 0300 00 XX XX

Contact Reel for the availability of a U.FL connection and exact part number.

Pacific Wireless (www.pacwireless.com) supplies a wide range of antennae, including high gain antennae. Although these will require requalification, they may be appropriate for longer range applications. The RooTenna is a good solution for IP65 applications.

U.FL to SMA adaptors / pigtails

Other antennas can be used with a pigtail that goes from the U.FL connection on the BISM2 to the appropriate antenna connection, most commonly a reverse SMA. These are available from a variety of sources; a good range is supplied by:

http://jefatech.com/category/cable_assemblies.ufl

High volume quantities can be obtained from Hirose.

When connecting to SMA antennae, please check whether your antenna is a normal or reverse thread.

12.3 BISM1 Compatible Module (special order)

The BISM1 Compatible format version of the BISM2 Bluetooth Serial Module preserves all of the mechanical mounting detail and dimensions of the earlier module design.

This is a special order module for customers who are currently in production with the BISM1, but want to migrate to the additional features of the BISM2. It is not recommended for new designs.

Note: All dimensions are in mm.

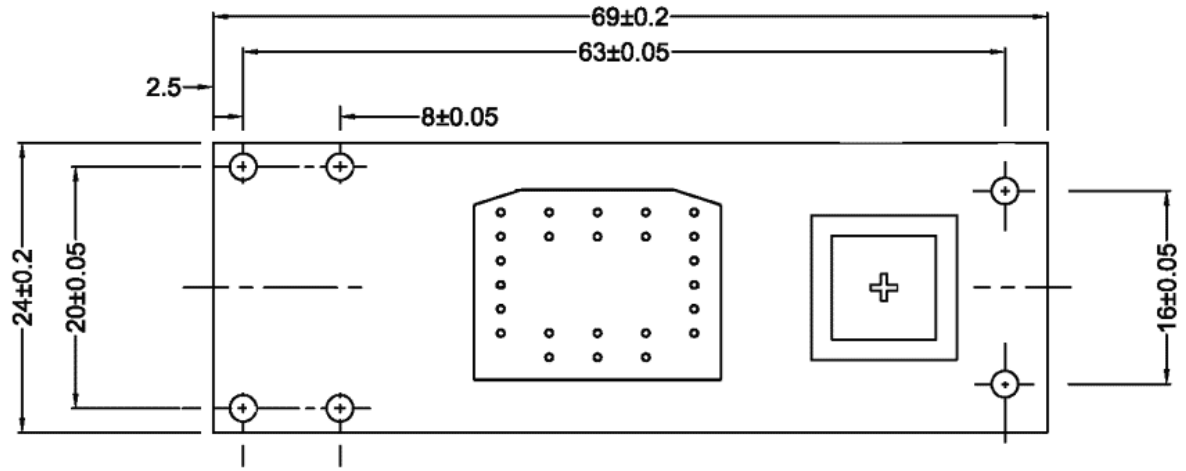


Figure 12-1: Top view

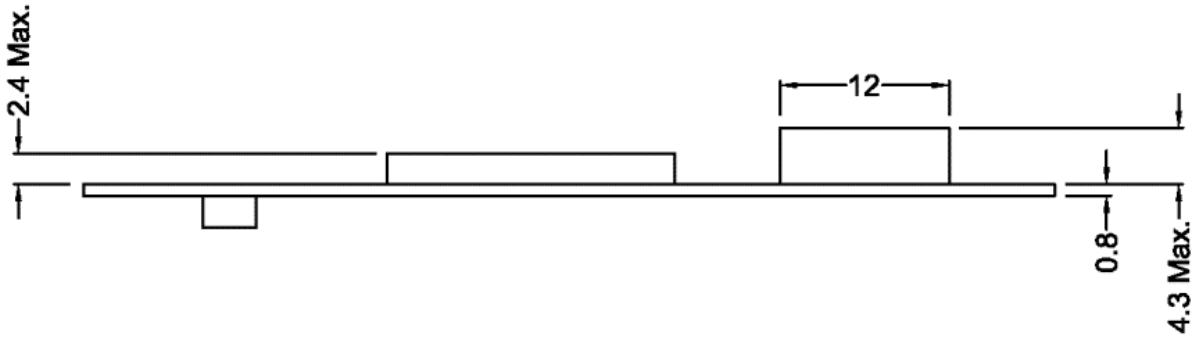


Figure 12-2: Side view

12.4 Labelling

The label contains the part number and the module's unique Bluetooth address.

12.5 Ordering Information

The BISM2 is available with different variants of engineering or production firmware. Ordering information is provided below:

Part Number	Description	Firmware Version
TRBLU23-00200	BISM2 with integrated ceramic antenna and standard AT firmware	Version 7.18.0

The following parts are available to special order. Please contact your Laird representative:

Part Number	Description	Firmware Version
TRBLU23-002MP	BISM2 with integrated ceramic antenna and standard Multipoint firmware	Version 5.13.ES
TRBLU23-002HC	BISM2 with integrated ceramic antenna and standard HCI firmware	Version 00056-01
TRBLU23-00300	BISM2 with U.FL jack and standard AT firmware	Version 2.11.0
TRBLU23-003MP	BISM2 with U.FL jack and standard Multipoint firmware	Version 5.13.ES
TRBLU23-003HC	BISM2 with U.FL jack and standard HCI firmware	Version 00056-01

13 Related Documents

The following BISM2 technical documents are also available from the Laird BISM2 product page under the Documentation tab:

- Product Brief
- User Guide
- AT Command Set User Guide
- Development Kit User Guide
- Firmware Release Notes
- AT Commands Quick Start Guide
- Multipoint Firmware User Guide

- Bluetooth Core 2.0 Specification – www.bluetooth.org

The following downloads are also available from the Laird RM024 product page:

- Laird (EZURIO) Terminal v6.9.0.zip
- Laird UWTerminal Version 6.60.zip
- Laird MpBtHost v3.5.0.zip

14 Differences from Previous Modules

The BISM2 is designed to be a drop in replacement for previous BISM modules from TDK Systems and Laird. However, some additional features have been made. This section lists all of these changes. More details can be found in the relevant section of the data sheet.

- Significant additions have been made to the AT command set.
- Pin 27 is now marked as RESERVED instead of VCC_3V3. It can no longer be relied to provide a 3.3v regulated output.
- Pins 33, 35 & 37 are now GPIO instead of N/C. The default state is configured as an input.
- Pin 39 is now allocated as GPIO9 which defaults as an input line instead of a "VCC_1V8" monitor. This change was made to increase the I/O capability and to prevent noise injecting onto the 1V8 rail.
- The module is physically smaller, so the fixing holes no longer align with those of the previous module.
- A brown-out circuit is now incorporated on the module. Reset functionality remains the same.
- The Oscillator output is now available.

15 DISCLAIMERS

LAIRD'S BLUETOOTH PRODUCTS ARE NOT AUTHORISED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE MANAGING DIRECTOR OF LAIRD LTD.

The definitions used herein are:

a) Life support devices or systems are devices which (1) are intended for surgical implant into the body, or (2) support or sustain life and whose failure to perform when properly used in accordance with the instructions for use provided in the labelling can reasonably be expected to result in a significant injury to the user.

b) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. Laird does not assume responsibility for use of any of the circuitry described, no circuit patent licenses are implied and Laird reserves the right at any time to change without notice said circuitry and specifications.

15.1 Data Sheet Status

Laird reserves the right to change the specification without notice in order to improve the design and supply the best possible product.

Please check with Laird for the most recent data before initiating or completing a design.

Where reference is made to related products from other suppliers, Laird takes no responsibility for the information, availability or performance of such products.

15.2 Warranty

Laird warrants that its products shall conform to Laird's published specifications and remain free from defects in materials and workmanship under normal, proper and intended use for a period of two (2) years from date of purchase, provided that proof of purchase be furnished with any returned equipment.

If during the warranty period any component part of the equipment becomes defective by reason of material or workmanship and Laird is immediately notified of such defect, Laird shall at its option supply a replacement part or request return of equipment, freight prepaid, to its designated facility for repair. In the event no trouble is found on products returned for repair, Laird reserves the right to charge the customer its standard published repair charge.

This warranty shall not apply to any products that have been subject to misuse, bending, twisting, neglect, alteration, improper installation, testing or unauthorized repair performed by anyone other than a Laird designated repair facility. Any non-warranty repairs or maintenance shall be at Laird's standard rates in effect at the time.

This warranty is in lieu of all other warranties, whether expressed, implied, or statutory, including but not limited to, implied warranties or merchantability and fitness for a particular purpose. In no event shall Laird be liable, whether in contract, in part, or on any other basis, for any damage sustained by its customers or any other person arising from or related to loss of use, failure or interruption in the operation of any products, or delay in maintenance, or for incidental, consequential, in direct, or special damages or liabilities, or for loss of revenue, loss of business, or other financial loss arising out of or in connection with the sale, lease, maintenance, use, performance, failure, or interruption of these products.