

EZURiO

Embedded USB / HCI *Bluetooth*™ Module

Part Numbers: TRBLU024-00100, TRBLU024-00200, TRBLU024-00300, TRBLU024-00400

1. General Description

Ezurio's Embedded Intelligent *Bluetooth* Serial Module is a fully integrated and qualified Class 1 *Bluetooth* solution designed for lowest cost of integration and ownership for designers wishing to include *Bluetooth* functionality in their products. The module is qualified to *Bluetooth* Version 2.0.

The Embedded Intelligent *Bluetooth* Serial Module is designed to give a rugged solution that is ideal for industrial automation and ruggedised handheld devices. It works over a wide temperature range of -40°C to +85°C. The physical form of the module allows designers to mount the antenna section of the module outside a screened enclosure.

The Embedded Intelligent Serial Module is based on Cambridge Silicon Radio's BlueCore4 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 module implements the higher layer *Bluetooth* protocol stack, up to and including the Generic Access Profile (GAP), Service Discovery Profile (SDAP), Serial Port Profile (SPP) and Audio Gateway. A virtual processor is used within the BC04 to implement 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 and integrated RS232 products with the same firmware are available for fast product evaluation and development.

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

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

In addition to the *Bluetooth* functionality, The Embedded Intelligent Serial Module provides access to 6 General I/O lines and one ADC input. These can be configured to extend the UART control or to provide connection to simple devices such as switches or LEDs without requiring any external processing. The GPIO lines can be accessed either via the wired host UART connection, or remotely over the *Bluetooth* link. Support is also provided for a PCM connection to an external audio codec.

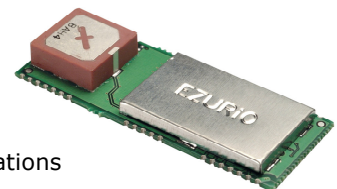
The Embedded Intelligent *Bluetooth* Module is supplied in a small form factor PCB (17.7mm x 46.0mm x 5.0mm), that solders directly. The module includes a high sensitivity, high gain antenna which provides excellent range. Typical open field performance provides ranges of over 250 metres at transmit powers of 4mW.

Support is provided for low power modes that make the Embedded Intelligent *Bluetooth* Module particularly applicable to battery powered installations.

The Embedded Intelligent *Bluetooth* Module is Lead-free and RoHS compliant and supports an industrial operating temperature range of -40°C to +85°C.

1.1 Applications

- POS Equipment
- Industrial Automation
- Vending Equipment
- Windows CE solutions
- Audio Applications
- Automotive Applications
- Telematics
- Medical
- Embedded Windows XP Applications

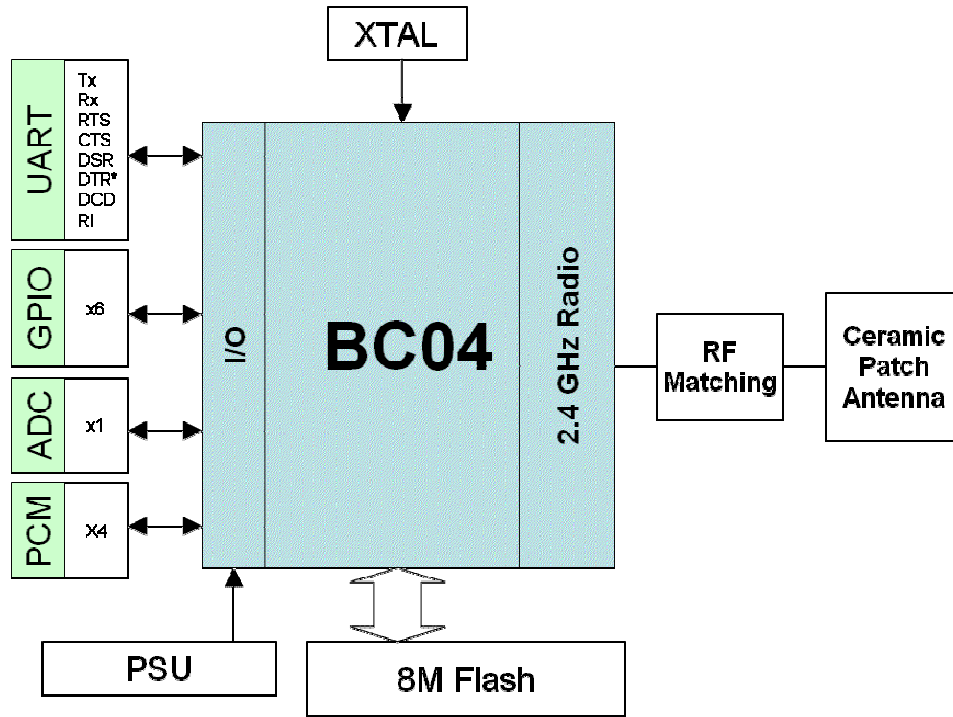


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2. Features

Feature	Implementation
Bluetooth Transmission	Class 1
Fully Bluetooth pre-qualified	Bluetooth 2.0
Range	250 metres typical (free space)
Frequency	2.400 – 2.485 GHz
Max Transmit Power	+6dBm
Min Transmit Power	-27dBm
Receive Sensitivity	Better than -86dB
Data Transfer rate	2.1 Mbps max data rate. 3.0 Mbps symbol,rate
Serial Interface	USB 1.2 compliant HCI interface
Physical size	17.7mm x 46.0mm x 5.0mm, 8g
Current consumption	Less than 36mA during data transfer in standard power mode. Lower powers are attainable with a configurable low power mode.
Low power sniff mode	2.5mA typ
Temperature Range	Normal operation: -40°C to +85°C
Supply Voltage	3.3V – 7.0V
Audio	Audio can be transferred over SCO channels through the PCM interface at 64kbps. PCM can be configured as master or slave. Support for dual slave PCM connections.
Profiles	Server - SPP (Full), DUN, Audio Gateway, Headset, Handsfree Client - All RFCOMM based profiles
Multipoint	Max 7 slaves with multipoint
Field upgradeable	Over USB interface
GPIO	6 x digital (DTR can also be allocated as GPIO)
ADC	1 x 8 bit
Indicators	Pads for 2 programmable LEDs
Lead free	Lead-free and RoHS compliant

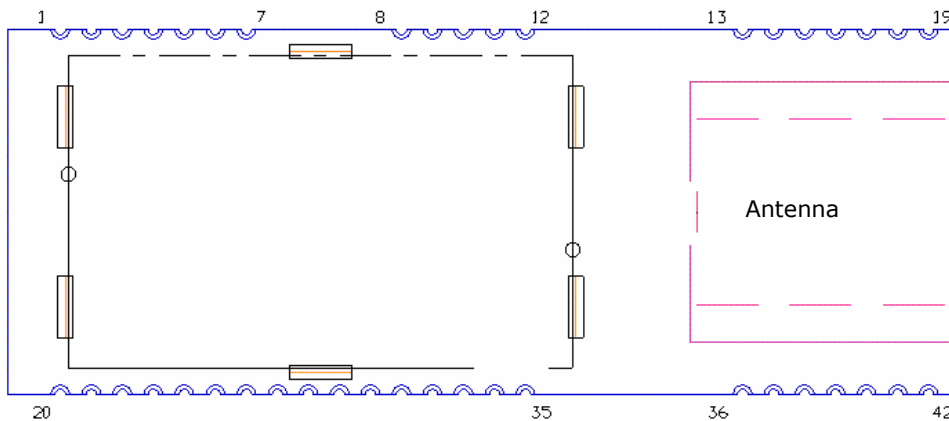
3. Functional Block Diagram



* DTR can be configured as a seventh GPIO

3.1 Connection Diagram

The Module is connected to a "mother" PCB by direct soldering to edge pads. Pads adjacent to the antenna do not provide an electrical connection, but are used for additional mechanical stability.



3.2 Pin Descriptions

The table below defines the pin functions. Refer to the previous section for the pin location.

Pin No.	Signal	Description	Pin No.	Signal	Description
1	Vcc		2	USB	D+
3	USB	D-	4	GND	
5	RESET	Reset I/P *	6-19	N/C	Do not Connect
20	GND		21-33	N/C	Do not Connect
34	MPIO_10 (LED1)	I/O for Host	35	MPIO_11 (LED2)	I/O for Host
36-42	N/C	Do not Connect			

* The reset line has a fixed 10kOhm pull up resistor to ground.

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; exceeding these values will cause permanent damage.

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

Absolute maximum ratings for supply voltage and voltages on digital and analogue pins of the Module are listed below; exceeding these values will cause permanent damage.

Parameter	Min	Max	Unit
Peak current of power supply	0	100	mA
Voltage at digital pins	-0.3	3.3	V
Voltage at POWER pin	3.3	7	V

3.3.2.2 Power Supply

Signal Name	Pin No	I/O	Voltage level	Comments
Vcc	1	I	3.3V to 7.0V	I _{typ} = 30mA
GND	4, 20, 29			

The module contains a power on reset circuit that ensures the module is reset at power on. The internal reset circuit is triggered when the input voltage to the module drops below $\sim 1.7V$ and is hence only suitable for providing a power on reset signal. If the supply voltage to the module can drop below the minimum voltage level in normal operation, then it is recommended that an external brownout circuit is provided to assert the module reset and to ensure that the module is reset when the module supply voltage drops below 3.1V.

This will ensure that the module will return to an operational state when the supply voltage comes back within specification. For example, if the module supply can drop to 2.7V and then be restored to 3.3V there is no guarantee that the module will still be operational unless the reset signal has been asserted.

3.3.2.3 UART Specific Recommendations

Function	Signal Name	Pin No	I/O	Signal level	Comments
USB	D-	3	I	$V_{ILmax} = 0.3vdd_usb$ $V_{IHmin} = 0.7vdd_usb$	Normally inactive. Pull to GND through 10K
USB	D+	2	I	$V_{ILmax} = 0.3vdd_usb$ $V_{IHmin} = 0.7vdd_usb$	Normally inactive. Pull to GND through 10K
Reset	RESET	5	I	Threshold 2.6V	Active LOW

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

3.3.2.4 General Purpose I/O and ADC

Signal Name	Pin No	I/O	Signal level	Comments
GPIO 4, 5, 6, 7, 8, 9	36, 35, 6, 7, 38, 34	I or O	O/P : $V_{OLmax} = 0.2V$ $V_{OHmin} = 2.8V$ I/P : $V_{ILmax} = 0.8V$ $V_{IHmin} = 2.1V$ $V_{IHmax} = 3.4V$	GPIO_4 and 5 are shared with the onboard LED pads. GPIO_9 is also used for PCM_SLVCLK.
GPIO 3	27	I or O	O/P : $V_{OLmax} = 0.2V$ $V_{OHmin} = 2.8V$ I/P : $V_{ILmax} = 0.8V$ $V_{IHmin} = 2.1V$ $V_{IHmax} = 3.4V$	Shared with DTR
ADC 0	37	I	Range 0 – 1.8V	ADC

PIO lines can be configured through software to be either inputs or outputs with weak or strong pull-ups or pull-downs. At reset, all PIO lines are configured as inputs with weak pull-downs.

3.3.2.5 PCM Interface

Signal Name	Pin No	I/O	Signal level	Comments
PCM_CLK	32	I or O	O/P : $V_{OLmax} = 0.2V$ $V_{OHmin} = 2.8V$ I/P : $V_{ILmax} = 0.8V$ $V_{IHmin} = 2.1V$ $V_{IHmax} = 3.4V$	If unused keep pins open
PCM_IN	31	I	$V_{ILmax} = 0.8V$ $V_{IHmin} = 2.1V$ $V_{IHmax} = 3.4V$	
PCM_SYNC	30	I or O	O/P : $V_{OLmax} = 0.2V$ $V_{OHmin} = 2.8V$ I/P : $V_{ILmax} = 0.8V$	

			$V_{IHmin}=2.1V$ $V_{IHmax}=3.4V$	
PCM_OUT	33	O	$V_{OLmax}=0.2V$ $V_{OHmin}=2.8V$	
PCM_SLV_CLK (GPIO9)		O	O/P : $V_{OLmax}=0.2V$ $V_{OHmin}=2.8V$	Available as a clock when two connected devices are both in PCM slave mode. Shared with GPIO_9

4. I/O Characteristics

4.1 Power Consumption

The hardware specification for the Module allows for a voltage range of 3.3 to 7.0 at Vcc. Tests have shown that there is no significant difference in current draw when Vcc is 5 or 6V. Tests have shown that where power drain is an issue, it is best to keep Vcc at the lower end of the range.

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 data being transferred and when data is being transferred at the maximum rate possible.

The firmware within the USB/HCI module will always attempt to place the module into the lowest possible power configuration.

5. DC Characteristics

5.1 RF Performance

5.1.1 Transmit Power

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

Output power can be reduced by program control via the HCI interface

5.1.2 Receive Sensitivity

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

6. Functional Description

The Embedded USB / HCI Bluetooth module is a fully featured HCI Bluetooth product and requires only power and an external higher layer Bluetooth stack to implement full Bluetooth communication.

The integrated, high performance antenna together with the RF and Base-band circuitry provides the Bluetooth wireless link and the USB interface provides a connection to the host system.

6.1 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, an embedded *Bluetooth* Serial module can be used for control and data acquisition without the need for any additional host processor. A further line can be used as an input.

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

The ports are powered from V_{CC} . The mode of these lines can be configured and the lines are accessed via S Registers in the range 623 to 629.

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

6.2 PCM CODEC Interface

PCM_OUT, PCM_IN, PCM_CLK and PCM_SYNC carry up to three bi-directional channels of voice data, each at 8ksamples/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.

In applications where the PCM master cannot supply a clock signal, the module can be configured to generate a clock signal on this GPIO: PCM_SLVCLK. Please contact an Ezurio FAE for further details.

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

6.2.1 Compatible Codec Chips

PCM_OUT, PCM_IN, PCM_CLK and PCM_SYNC carry up to three bi-directional channels of voice data, each at 8ksamples/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 an Ezurio FAE for further details.

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

- 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

- *Codec development boards that mate with the EZURiO Wireless Developers Kit are available for each of the three codecs listed above.*

6.3 ADC

The module provides access to one 8-bit ADC. This provides an input range of 0mV to 1,800mV, which can be read using S register 701.

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 115,200 or above.

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

6.4 LEDs

Pads are provided to allow two LEDs to be added for diagnostic purposes. They are controlled by an S registers 624 and 625 to display the status of various parameters and are useful for debug and test.

7. Integrated Firmware

7.1 Bluetooth Stacks

Most users will use the Embedded USB / HCI Bluetooth module with a pre-qualified Bluetooth stack. The USB interface has been configured to present the device as a generic Bluetooth module. This allows it to be plugged directly into most upper layer Bluetooth stacks, where it will enumerate and start operating.

The module has been tested with the following stacks and requires no further drivers for these.

- Windows XP SP1 (we recommend the use of SP2)
- Windows XP SP2
- Windows XP embedded
- Windows CE
- Windows Vista (beta)

Ezurio can supply a Widcomm Windows stack that runs on Windows 98, 2000, ME and XP and which provides a wider range of profiles than the Microsoft stacks. There is an additional per machine license for the Widcomm stack.

7.1.1 Features of the HCI Stack

7.1.1.1 Standard Bluetooth v2.0 + EDR mandatory functionality:

- Adaptive frequency hopping (AFH), including classifier
- Faster connection - enhanced inquiry scan (immediate FHS response)
- LMP improvements
- Parameter ranges

7.1.1.2 Optional Bluetooth v2.0 + EDR functionality supported:

- Adaptive Frequency Hopping (AFH) as Master and Automatic Channel Classification
- Fast Connect - Interlaced Inquiry and Page Scan plus RSSI during Inquiry
- Extended SCO (eSCO), eV3 +CRC, eV4, eV5
- SCO handle
- Synchronisation

7.1.1.3 Standard Bluetooth components:

- Baseband (including LC)
- LM
- HCI
- Standard USB v1.1 HCI Transport Layer
- All standard radio packet types
- Full Bluetooth data rate, enhanced data rates of 2 and 3Mbps⁽¹⁾
- Operation with up to seven active slaves⁽¹⁾
- Scatternet v2.5 operation
- Maximum number of simultaneous active ACL connections: 7⁽²⁾
- Maximum number of simultaneous active SCO or eSCO connections: 3⁽²⁾
- Operation with up to three SCO / eSCO links, routed to one or more slaves
- All standard SCO voice coding, plus transparent SCO
- Standard operating modes: Page, Inquiry, Page-Scan and Inquiry-Scan
- All standard pairing, authentication, link key and encryption operations
- Standard Bluetooth power saving mechanisms: Hold, Sniff and Park modes, including Forced Hold
- Dynamic control of peers' transmit power via LMP
- Master/Slave switch
- Broadcast
- Channel quality driven data rate
- All standard Bluetooth test modes

(1) This is the maximum allowed by Bluetooth v2.0 + EDR specification.

(2) Supports all combinations of active ACL and SCO channels for both master and slave operation, as specified by the Bluetooth v2.0 + EDR specification.

7.2 Additional Stack Functionality

The firmware extends the standard Bluetooth functionality with the following features:

Hardware low power modes: Shallow Sleep and Deep Sleep. The chip drops into modes that significantly reduce power consumption when the software goes idle.

8. Interfaces

8.1 USB Interface

The embedded USB / HCI module contains a full speed (12Mbps/s) USB interface that is capable of driving a USB cable directly. No external USB transceiver is required. The device operates as a USB peripheral, responding to requests from a master host controller such as a PC. Both the OHCI and the UHCI standards are supported. The set of USB endpoints implemented can behave as specified in the USB section of the Bluetooth specification v2.0+EDR. The module only operates as a USB slave.

The module contains inline resistors to provide a match for the characteristic impedance of a USB cable as defined by the USB standard.

The module contains a USB pull-up resistor. This pulls the USB+ pin weakly high when the USB interface is ready to enumerate. It signals to the USB host that it is a full speed (12Mbit/s) USB device. This pull-up is implemented as a current source, and is compliant with section 7.1.5 of the USB specification v1.2. It pulls USB+ high to at least 2.8V when loaded with a 15k Ω 5% pull-down resistor (in the hub/host) when VCC is 3.6V or higher. This presents a Thevenin resistance to the host of at least 900 Ω .

8.1.1 USB Enumeration

The embedded USB / HCI module enumerates with the following information:

Device Descriptor:

```

bcdUSB:          0x0200
bDeviceClass:    0xE0
bDeviceSubClass: 0x01
bDeviceProtocol: 0x01
bMaxPacketSize0: 0x40 (64)
idVendor:        0x04BF
idProduct:       0x0320
bcdDevice:       0x2652
iManufacturer:   0x01
iProduct:        0x02
iSerialNumber:   0x00
bNumConfigurations: 0x01
Current Config Value: 0x01
Device Bus Speed: Full
Device Address:  0x03
Open Pipes:      5

```

Endpoint Descriptor:

```

bEndpointAddress: 0x81
Transfer Type: Interrupt
wMaxPacketSize: 0x0010 (16)
bInterval:        0x01

```

Endpoint Descriptor:

```

bEndpointAddress: 0x02
Transfer Type: Bulk
wMaxPacketSize: 0x0040 (64)
bInterval:        0x01

```

Endpoint Descriptor:

```

bEndpointAddress: 0x82
Transfer Type: Bulk
wMaxPacketSize: 0x0040 (64)
bInterval:        0x01

```

Endpoint Descriptor:

```

bEndpointAddress: 0x03
Transfer Type: Isochronous
wMaxPacketSize: 0x0000 (0)
bInterval:        0x01

```

Endpoint Descriptor:

bEndpointAddress: 0x83
 Transfer Type: Isochronous
 wMaxPacketSize: 0x0000 (0)
 bInterval: 0x01

9. Low Power Modes

The embedded USB / HCI module supports all of the standard low power modes as specified by the Bluetooth 2.0 + EDR standard.

In addition the firmware contains power management which will automatically place the device in sleep modes whenever there is a period of inactivity.

9.1 Low Power Modes using Sniff

Bluetooth connections are master/slave in nature. A master sends packets and a slave has to acknowledge that packet in the next timeslot. Timeslots in *Bluetooth* are 625 microseconds wide. This implies that a master will always know when packets will be sent and received, which further means it is able to optimise power usage by switching on power hungry circuitry only when needed.

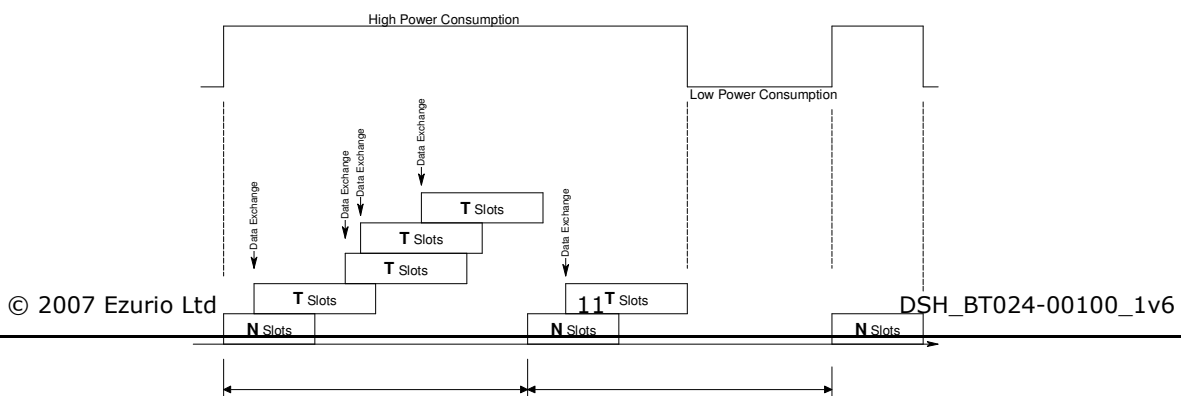
A slave on the other hand does NOT have prior knowledge of when a packet will be received and has to assume that a packet will be received from a master on every receive slot. This means that it has to leave its receiving circuitry on for most of the receive slot duration. The result of this is high power consumption, where a slave with no data transmission still consumes around 31mA whereas a master consumes only 6mA.

This problem was identified very early in the evolution of *Bluetooth* (especially since headsets spend all their time as a slave in a *Bluetooth* connection) and it was solved by having a mode called Sniff, with appropriate lower layer negotiating protocol.

Sniff mode during connection is basically an agreement between the slave and its master that data packets will only be exchanged for N timeslots every M slots. The slave can then assume that it will never be contacted during N-M slots, and so can switch its power hungry circuitry off. The specification goes further by also specifying a third parameter called 'timeout' (T) which specifies 'extra' timeslots that the slave will agree to listen for after receiving a valid data packet. Put another way, if a data packet is received by the slave, then it knows that it MUST carry on listening for at least T more slots. If within that T slot time period another data packet is received, then the timer is restarted. This mechanism ensures low power consumption when there is no data transfer – at the expense of latency. When there is a lot of data to be transferred, it acts as if sniff mode were not enabled.

It is stated above that during sniff mode, a slave listens for N slots every M slots. The *Bluetooth* specification states that a master can have up to 7 slaves attached to it with all slaves having requested varying sniff parameters. It may therefore be impossible to guarantee that each slave gets the M parameter it requested. In light of this, the protocol for enabling sniff mode specifies that a requesting peer specify the M parameter as a minimum and maximum value. This will allow the master to interleave the sniff modes for all slaves attached. This is illustrated in the diagram below.

For this reason, the sniff parameters are specified in the Embedded Intelligent *Bluetooth* Module via four S registers. S Register 561 is used to specify 'N', S Register 562 is used to specify 'T' and S Registers 563/564 are used to specify minimum 'M' and maximum 'M' respectively. Although the specification defines these parameters in terms of timeslots, the S register values have to be specified in units of milliseconds and the firmware does the necessary translation to timeslots.



10. Enhanced Data Rate

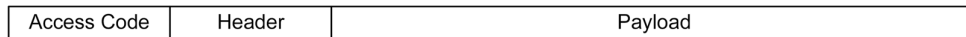
EDR has been introduced with Version 2.0 of the Bluetooth standard to provide 2x and 3x⁽¹⁾ data rates with minimal disruption to higher layers of the Bluetooth stack. Ezurio's embedded USB/HCI module provides support for both of these new data rates and is compliant with the Bluetooth v2.0+EDR specification.

At the baseband level EDR utilises both the same 1.6kHz slot rate and the 1MHz symbol rate as defined for the basic data rate. Where EDR differs is that each symbol in the payload portion of a packet represents 2 or 3-bits. This is achieved using two new distinct modulation schemes. These are summarised below. Link Establishment and management are unchanged and still use GFSK for both the header and payload portions of these packets.

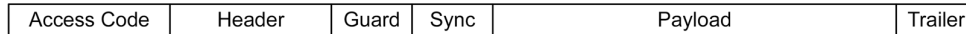
(1) The inclusion of 3x data rates is optional.

Date Rate Scheme	Bits Per Symbol	Modulation
Basic Data Rate	1	GFSK
EDR	2	$\pi/4$ DQPSK
EDR	3	8DPSK (Optional)

Basic Rate



Enhanced Data Rate



Basic Rate and Enhanced Data Rate Packet Structure

11. Application Information

11.1 Antenna Position

The antenna used on the Embedded USB/HCI 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 Embedded USB/HCI Module 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

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. A distance of 6mm has been allowed between the metal shield and the antenna to allow the antenna to protrude through a slot in a metal enclosure.

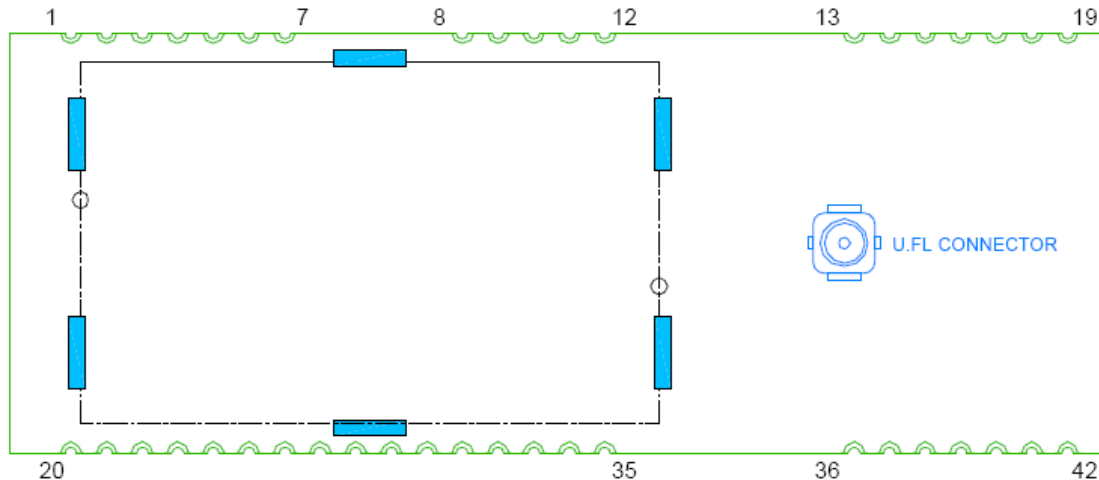
The antenna finish may tarnish as a result of environmental effects and handling. This is a cosmetic effect and does not affect the RF performance.

11.2 External Antenna Module

The dimensions for this module are identical to the Surface Mount Module, but the antenna is replaced with a U.FL connector.

The module is certified for use with the EZURiO external antenna ACC-008. If an alternative antenna is connected, it will invalidate the RF and Bluetooth approvals for the module.

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/catalogue_hp/e32119372.pdf



11.3 Power Supply Considerations

The power supply for the Module has to be a single voltage source of Vcc within the range of 3.3V to 70 V. It must be able to provide sufficient current in a transmit burst. This can rise to 65mA.

11.4 Power-On-Reset (Power Cycling and Brown Out considerations).

The Module is provided with an active low reset pin. Upon the application of power, the Power On Reset circuit built into the Module will ensure that the unit starts correctly. The internal reset circuit is triggered when the input voltage to the module drops below $\sim 1.7V$ and is hence only suitable for providing a power on reset signal. If the supply voltage to the module can drop below the minimum voltage level in normal operation, then it is recommended that an external brownout circuit is provided to assert the module reset and to ensure that the module is reset when the module supply voltage drops below 3.1V.

This will ensure that the module will return to an operational state when the supply voltage comes back within specification. For example, if the module supply can drop to 2.7V and then be restored to 3.3V there is no guarantee that the module will still be operational unless the reset signal has been asserted.

11.5 RF Shield

To meet FCC requirements and to facilitate IR soldering, 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.

11.6 Mounting the Module onto the application platform

The antenna (Brown square component on top side of PCB) is designed to minimise detuning effects from nearby components and metalwork. However, it is good design practise to ensure that other active circuitry is kept away from the antenna.

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.

No tracks should be present on the top layer of the board on which the module is soldered, as these may cause inadvertent connections to test pads. The recommended land pattern for the mother PCB is detailed below

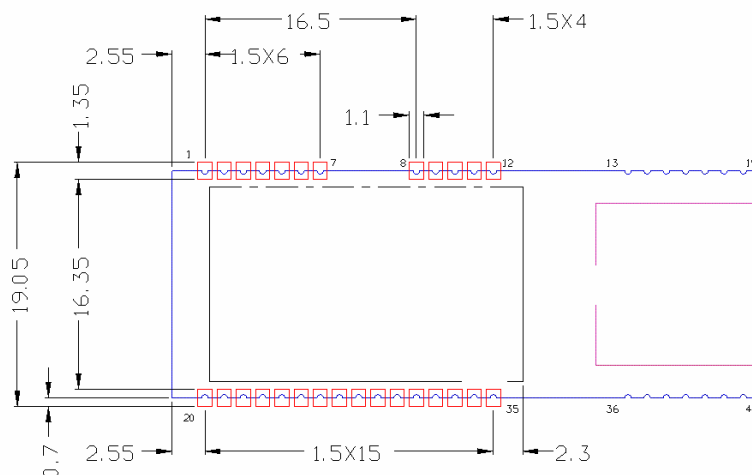
12. Qualification

12.1 Bluetooth Qualification Process

The following safety precautions must be observed during all phases of the operation, usage, service or repair. It is advised that these precautions are followed to ensure compliance with applicable regulatory requirements. Failure to observe these precautions may result in damage to the module and/or the application platform. The user is advised to consult the user manual for more information. The user is advised to consult the user manual for more information. The user is advised to consult the user manual for more information.

12.2

Switch off the power to the module to prevent inadvertent connections to test pads. Some air



NOTES

- 1] MOTHERBOARD TO HAVE NO COPPER OR SOLDER RESIST BENEATH MODULE
- 2] N/C PINS SHOULD BE ISOLATED FROM MODULE - MECHANICAL JOINT ONLY

12.3 Qualifications

12.3.1 RF approvals

The Embedded USB/HCI Bluetooth Module is qualified as a Bluetooth Subsystem. This means that if it is combined with a higher level Bluetooth stack that is also qualified as a Subsystem, then no further qualification is required. Final products incorporating Bluetooth technology should be listed with the Bluetooth qualification body according to the guidelines available on www.bluetooth.org.

The manufacturer must state the Ezurio part number and product reference in his literature in order to meet the requirements of the Bluetooth and regulatory approvals.

A list of the countries where the Module is approved will be provided by Ezurio as required. As a minimum the product is listed in Europe, Scandinavia and USA. Ezurio assumes no liability for customer failure to comply with national RF approvals.

12.3.1.1 Radio.

R&TTE EN 300 328-2 V1.1.1 (2000-07)

EN 301 489-1 V1.3.1 (2001-09)

12.3.1.2 EMC Emissions.

FCC15B Class B

EN55022 Class B

12.3.1.3 EMC Immunity.

EN55024 Class

12.3.1.4 Environmental.

EN300 019-2-4 v2.2.2 (2003-2004)

12.3.1.5 Medical

EN60601-1-2

12.3.1.6 Automotive

SAE1455:REVAug94 Paragraph 4.10.4 (shock)

SAE1455:REVAug94 Paragraph 4.9.4.2 (random)

Emission test to 95/54/EC

12.4 Safety and Regulatory Statements

12.4.1 Europe – EU Declaration of Conformity

EZURiO

DECLARATION OF CONFORMITY

In accordance with Annex IV of the EU directive 1999/5/EC

Ezurio declare under our responsibility that the Bluetooth Module

complies with the appropriate essential requirements of the Article 3 of the R&TTE and the other relevant provisions, when used for its intended purpose.

Health and Safety requirements contained in Article 3 (1) a)

EN 60 950: 1992 Safety of information technology equipment + Amendment A1:1993, Amendment A2:1993, Amendment A3:1995, Amendment A4:1997, Amendment A11:1997

EN 50371: Generic standard to demonstrate the compliance of low-power electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (10 MHz - 300 GHz) – General public

Protection requirements with respect to electromagnetic compatibility Art.3 (1) b)

EN 301489-17 V1.1.1 (09-2000), Electromagnetic Compatibility and radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for wideband data HiperLAN equipment

Means of the efficient use of the radio frequency spectrum

EN 300328-2 V1.2.1 (11-2001), Radio Equipment and Systems (RES); Wideband transmission systems; Technical characteristics and test conditions for data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques. Part 2: Harmonized EN covering essential requirements under article 3(2) of the R&TTE directive.

Registered in England

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No. 5178293

12.4.2 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.

12.4.2.1 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.

13. Environmental

13.1 Operating temperatures

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

13.2 Storage temperature

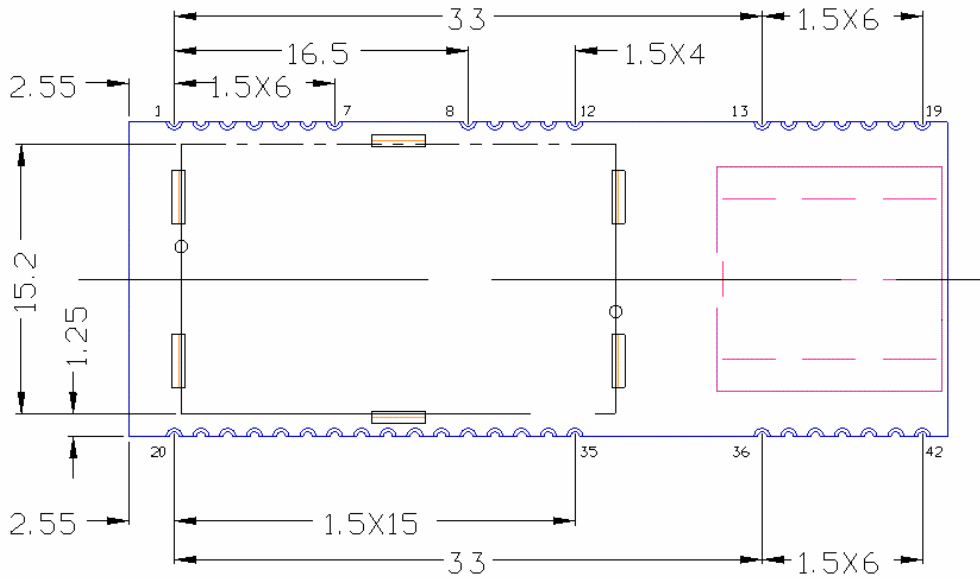
Parameter	Min	Max	Unit
Storage temp	-40	+125	°C

13.3 Reliability

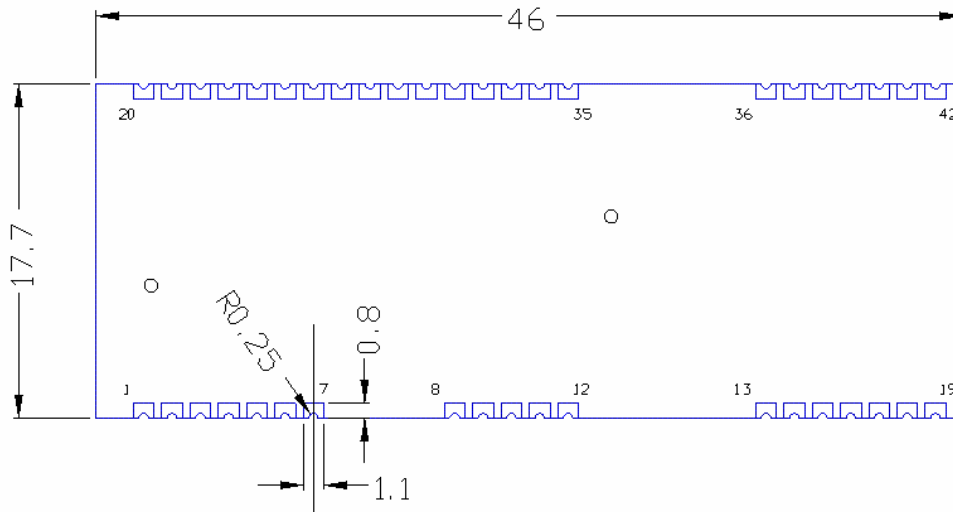
Parameter	Test	Comment
Thermal Shock	200 cycles -40°C /+85°C 30 min	1 cycle/hour
Vibration	Continuous operation at 60 Hz, 2mm stroke	15g max sine wave, 12 hours
Shock	50G 11ms Half Sine Wave	6 axis x 3 cycles each axis
Moisture Resistance		
High Temp Storage	125°C, 360 hours	
Low Temp Storage	-40°C, 240 hours	
High Temp/Humidity Operation	60°C, 90%RH, 360 hours	
Thermal shock	-40 to 60°C in 30min	200 cycles with continuous operation
Electro Static Discharge	EN55024:1998 & IEC61000-4-3	
Drop Test	75cm to concrete, 3 axis x 2 cycles per corner	

14. Physical Dimensions (all dimensions in mm)

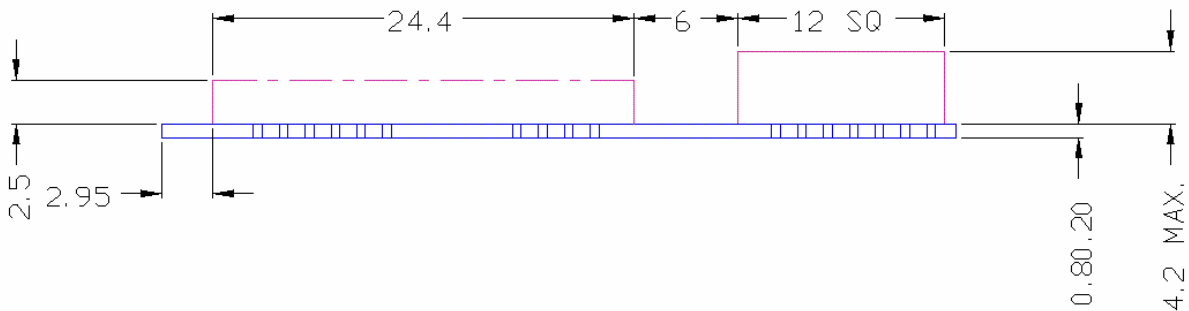
14.1 Top View



14.2 Bottom View



14.3 Side View



14.4 Labelling

The module has a label indicating the part number and the unique Bluetooth address of the module.

14.5 Ordering Information

Part Number	Description
TRBLU024-00100	Embedded Module with integrated ceramic antenna and HCI firmware
TRBLU024-00200	Embedded Module with integrated ceramic antenna and H4 firmware
TRBLU024-00300	Embedded Module with integrated ceramic antenna and H5 firmware
TRBLU024-00400	Embedded Module with integrated ceramic antenna and BCSP firmware
TRBLU024-001NA	Embedded Module with no antenna and HCI firmware
TRBLU024-002NA	Embedded Module with no antenna and H4 firmware
TRBLU024-003NA	Embedded Module with no antenna and H5 firmware
TRBLU024-004NA	Embedded Module with no antenna and BCSP firmware

15. Related Documents

The firmware incorporated into the Embedded HCI/USB Bluetooth Module is more fully described in Firmware release notes available from Cambridge Silicon Radio. Details of the HCI interface are provided in the Bluetooth specification.

- Bluetooth Core 2.0 Specification – www.bluetooth.org
- Bluecore4-External Datasheet for BC417143B-IQN-E4 July 2005 - CSR

16. Disclaimers

EZURIO'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 EZURIO 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.

Ezurio does not assume responsibility for use of any of the circuitry described, no circuit patent licenses are implied and Ezurio reserves the right at any time to change without notice said circuitry and specifications.

16.1 Data Sheet Status

This data sheet contains data from the Preliminary specification. Supplementary data will be published at a later date. Ezurio Ltd reserves the right to change the specification without notice in order to improve the design and supply the best possible product.

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

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

16.2 Warranty

Ezurio warrants that its products shall conform to Ezurio'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 Ezurio is immediately notified of such defect, Ezurio 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, Ezurio 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 an Ezurio designated repair facility. Any non-warranty repairs or maintenance shall be at Ezurio'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 Ezurio 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.