ZEAL-C02

Bluetooth Class 2 Complete Module

Hardware Specifications
Rev.2

Oct.3, 2011

ADC Technology Inc.
Wireless Division

For Safety Design

ADC Technology Inc. endeavors to improve quality and reliability of the product. However, as a nature of semiconductor product, the product may accidentally fail or malfunction. We ask customers to make a safety design, such as having a reasonable margin, avoiding spread of flame and having a malfunction preventive measure, for preventing a personal injury, a fire hazard, and social damage as a result of such accidental failure or malfunction.

Indemnity

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ADC is totally not liable for damage caused by customer not following the specification items.

ADC is totally not liable for damage caused by malfunction resulting from wrong connection of the product to equipment which ADC is not involved with or wrong combination of the software with software which ADC is not involved with.

The items listed in this specification sheets are cautiously prepared for rightness and ADC holds not liable for damage if it should happen as a result of erroneous description of the specifications.

Labeling of Certification

The product is certified as conforming to technical standards of the Japanese Radio Act (certified as a construction type), and the product is also certified as radio equipment of a small power data communication system. It is unnecessary for this product to be certified again when it is used.

However, the following acts may be legally penalized:

- Altering the product
- Removing the certification label from the product.

Revision History

Revision	Dates	Content
Firsrt Edition	April 25, 2011	Released for production
Rev.2	Oct.3, 2011	Amendment made due to release of firmware ver.2.1.3.41; ・updated measurements ・modified statup operations ・slight modifications made on several items

Contents

Introduction

The ZEAL-CO2 is a Bluetooth complete module. The product conforms to Bluetooth version 2.1+EDR (class 2) and is certified by Bluetooth Product Certification. The module is also certified by the Japanese Radio Law as a construction type. It is unnecessary for the module to be recertified after it is installed in a development prototype or in a finished product.

The module has URT interface, a connector connection type interface, with which the module is easily assembled into assembling products. The ZEAL-CO2 is a generation of ZEAL-CO1 Bluetooth Class 2 module, the production of which has been completed. It has an identical size, a connector and a pin arrangement, with which it is replaceable with CO-1 without changing the PC pattern. (Note 1)

Profile and protocol are stacked on the module, making Bluetooth communication easy with AT command-like a simple operation. By utilizing the automatic mode, automatic connection to a specific partner device at power input and automatic scanning after the power input are made possible.

The module installs SPP (serial port profile), with which ordinary serial data communications are easily converted to Bluetooth wireless communications. It also installs DUN (dial up network profile), with which dial up network connection with Bluetooth installed phone is possible.

Note 1: Software is partially modified with SEAL-CO2, and the specifications and commands are somewhat different from ZEAL-C01. The product is also pin-compatible with Class 1 module ZEAL-S01.

Performance and Characteristics

- Bluetooth Ver2.1+EDR(Class 2) compliant
- Bluetooth Product Certified
- Japanese Radio Law certified (certified as a construction type)
- SPP (Serial Port Profile) installed
- DUN (Dial Up Profile) installed (DT only)
- Integrated Chip Antenna
- Easy operation with BT command
- Connector connection
- Pin compatible with ZEAL-C01 and ZEAL-S01
- RoHS compliant

General Specifications

The specifications are subject to change without prior notice

Item		Specification.
Model		ZEAL
Type No.		C02
Bluetooth I/F	Certification	BluetoothVer.2.1+EDR compliant Certified by Japanese Radio Act (Certified as a Construction Type)□
	Profile	SPP, DUN (DT only)
	Frequency	2402 to 2480MHz
	Modulation Scheme	GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
	Spectrum Spread Method	Frequency Hopping
	Channel Spacing	1MHz
	Number of Channels	79ch.
	Data Rate	3Mbps(X) (Note 1)
	Receptiing Sensitivity	-70dBm
	Transmission Power	+4dBm(X) Bluetooth TX power class 2
UART I/F	Protocol	Asynchronous Serial Communication Hardware flow control needed (RTS and CTS to be effected)
	Signal Level	Power Voltage
	Beau Rate	Default 9.6 kbps
Power	Voltage	3.3V (DC Single Power)
RESET		Bluetooth module internal self Power on RESET (External RESET input is possible)
Green Procurement		RoHS Compliant
Outlines	Dimensions	15.0×20.0×4.9mm
	Weight	Approx. 1g

Note 1: It is wireless transmitter's maximum data transmission rate including protocol.

Measurements Data

Measurements are made per ADC's measuring conditions. The values may be different when the specifications are changed.

- Measurements were made between ZEAL-CO2's (firmware are both ver.2.1.3.41)
- M: Master, S: Slave
- BTLJO: Average Power Level, BTLJ1: Low Power Level (the other side is BTLJ0)

□ Power Consumption

Command Status	Condition	BTL J	Average (mA)	Maximum (mA)	Minimum (mA)
Command Waiting		0	2.5	17.5	1.3
		1	2.5	17.6	1.3
Inquring		0	40.1	46.6	26.5
		1	39.9	46.2	33.2
Scanning state (Standby)	BTLL33 and BTLA1 or BTLA2 Responding to Inquiry, Connectable	0	21.1	49.2	1.4
		1	22.0	48.8	1.4
	BTLLFF and BTLA1 or BTLA2 Not Responding to Inquiry, Connectable	0	2.7	45.0	1.3
		1	2.4	48.3	1.3
	BTLL33 and BTLA0 Responding to Inquiry, Not Connectable	0	21.0	48.7	1.3
		1	21.0	48.7	1.3
On-Line State (Connected)	No Data Transmitted	0	M 13.3	M 49.5	M 2.3
			S 25.4	S 48.8	S 2.5
		1	M 7.4	M 52.5	M 2.6
			S 3.7	S 49.1	S 2.3
	Two Way Data Transmitted (Baud Rate 9.6 kbps)	0	M 28.2	M 65.7	M 2.3
			S 28.8	S 63.8	S 17.8
		1	M 23.0	M 63.4	M 2.3
			S 27.8	S 65.3	S 2.3
	Two Way Data Transmitted (Baud Rate 15.2kbps)	0	M 28.7	M 66.3	M 2.7
			S 31.1	S 66.0	S 16.7
		1	M 27.2	M 65.9	M 2.8
			S 30.5	S 66.2	S 4.6
	Two Way Data Transmitted (Baud Rate 921.6kbps)	0	M 34.5	M 66.7	M 4.2
			S 33.2	S 66.5	S 12.6
		1	M 28.0	M 66.4	M 4.2
			S 33.3	S 66.2	S 10.2

※ When command is BTLL and parameter FF is designated, power consumption under scanning is controlled low. Details may be referred to the "Command Reference".

※ When command is BTLJ1 and the status is **"connected (on-line) but no data is transmitted for a certain period of time",** the module automatically goes into "**sniff mode (sleeping state)"**, saving power consumption. The "certain period of time" depends on how the other phone is set up. It is 0.5 sec. in the case of ZEAL-CO2. When data transmission is resumed, the module automatically returns from the sleeping state, however, the latency becomes longer by the time needed for returning process from the sleeping state.

□ Latency

BTLJ	Transmission	Min(ms)	Max(ms)
0	M→S	20	50
	S→M	40	90
1	M→S	140	540
	S→M	140	840

□ When BTLJ1 is commanded and when "connected but no data is transmitted for a certain period of time", the sniff mode may start working, automatically going into the sleeping state. In this case, the latency is longer than that of BTLJ0. The data transmission timing is controlled by the Bluetooth chip and is random.

□ Inquiry Time

This is the time for device inquiring, time needed till a specific partner device is identified. The measurements are the time required from executing BTI command till BD address of the other device is displayed.

Baud Rate (kbps)	BTLJ	Average Time Required	Maximu Time Required	Minimum Time Required	Trial Times (Frequency)
9.6	0	2090 ms	5828 ms	531 ms	100
	1	2324 ms	6578 ms	531 ms	
19.2	0	1379 ms	5656 ms	500 ms	
	1	1495 ms	6187 ms	516 ms	
38.4	0	1526 ms	6485 ms	343 ms	
	1	1708 ms	5453 ms	344 ms	
57.6	0	1934 ms	4329 ms	328 ms	
	1	2585 ms	6828 ms	344 ms	
115.2	0	1610 ms	5984 ms	343 ms	
	1	1785 ms	6109 ms	469 ms	
230.4	0	965 ms	6062 ms	328 ms	
	1	1065 ms	3719 ms	343 ms	
460.8	0	1724 ms	6781 ms	344 ms	
	1	1559 ms	6297 ms	328 ms	
921.6	0	1997 ms	5890 ms	485 ms	
	1	1720 ms	5906 ms	328 ms	

□ Connecting Time

It is the time required for Bluetooth connection. The measurements are specifically the time required from executing BTC command till CONN is output.

I. Initial Connection (for pairng and connection)

Since link key generation process is added at intial connection, a longer connection time is required than ordinary connection.

Rate (kbps)	BTLJ	Average Time Required	Maximum Time Required	Minimium Time Required	Traial Times (Frequency)
9.6	0	8874 ms	11672 ms	6906 ms	100
	1	9235 ms	12813 ms	7031 ms	
19.2	0	9140 ms	11532 ms	7031 ms	
	1	9316 ms	12110 ms	7172 ms	
38.4	0	9108 ms	12610 ms	7016 ms	
	1	8980 ms	11921 ms	7141 ms	
57.6	0	9717 ms	12953 ms	7125 ms	
	1	9717 ms	12687 ms	7141 ms	
115.2	0	8938 ms	11672 ms	7109 ms	
	1	9154 ms	12640 ms	7094 ms	
230.4	0	10439 ms	12188 ms	7546 ms	
	1	9901 ms	12375 ms	7422 ms	
460.8	0	10052 ms	12359 ms	7219 ms	
	1	9877 ms	13016 ms	7032 ms	
921.6	0	9680 ms	11406 ms	7157 ms	
	1	9869 ms	11906 ms	7203 ms	

II. Ordinary Connection

Baud Rate (kbps)	BTLJ	Average Time Required	Maximum Time Required	Minimium Time Required	Trial Times (Frequency)
9.6	0	3772 ms	5563 ms	1625 ms	100
	1	3882 ms	5609 ms	1563 ms	
19.2	0	3914 ms	5563 ms	1594 ms	
	1	3664 ms	5547 ms	1594 ms	
38.4	0	3637 ms	5562 ms	1593 ms	
	1	3631 ms	5578 ms	1610 ms	
57.6	0	3971 ms	5610 ms	1625 ms	
	1	4294 ms	5578 ms	1625 ms	
115.2	0	3493 ms	5579 ms	1578 ms	
	1	3838 ms	5562 ms	1593 ms	
230.4	0	5129 ms	5578 ms	1610 ms	
	1	4384 ms	5609 ms	1594 ms	
460.8	0	4421 ms	5563 ms	1610 ms	
	1	4528 ms	5594 ms	1610 ms	
921.6	0	4407 ms	5610 ms	1640 ms	
	1	4382 ms	5594 ms	1609	

□ Cut Off Time

It is the time required from Bluetooth connection (on-line state) till the connection is cut off. The measurements are specifically the time required from executing BTD command till DISC is output.

Baud Rate (kbps)	BTLJ	Average Time Required	Maximum Time Required	Minimium Time Required	Trial Times (Frequency)
9.6	0	700 ms	781 ms	640 ms	100
	1	792 ms	953 ms	656 ms	
19.2	0	701 ms	766 ms	640 ms	
	1	789 ms	922 ms	672 ms	
38.4	0	690 ms	765 ms	640 ms	
	1	801 ms	953 ms	672 ms	
57.6	0	694 ms	750 ms	640 ms	
	1	794 ms	969 ms	641 ms	
115.2	0	687 ms	766 ms	625 ms	
	1	790 ms	938 ms	641 ms	
230.4	0	689 ms	766 ms	640 ms	
	1	779 ms	906 ms	641 ms	
460.8	0	691 ms	765 ms	625 ms	
	1	780 ms	922 ms	640 ms	
921.6	0	675 ms	750 ms	625 ms	
	1	785 ms	937 ms	625	

□

□ Throughput

It is a throughput (an effective rate) of Bluetooth communication using the ZEAL. A text file is sent from one end, and the throughput is calculated by the time required from start of sending the text file till transmission is completed and the size of the file.

- M→S: File is sent from Master to Slave.
- S→M: File is sent from Slave to Master.
- Ordinary Mode: ZEAL is started with ordinary mode and then Bluetooth connected.
- Automatic Mode: ZEAL is Bluetooth connected with automatic mode.
- Trial times are 100 and the average throughput is calculated.

I. ZEAL-CO2 vs ZEAL-CO2

Baud Rate (kbps)	BTLJ	Average Throughput			
		Ordinarly Mode		Automatic Mode	
		M→S	S→M	M→S	S→M
9.6	0	7.5 kbps	7.49 kbps	7.51 kbps	7.51 kbps
	1	7.45 kbps	7.5 kbps	7.51 kbps	7.51 kbps
19.2	0	15.04 kbps	14.98 kbps	15.07 kbps	15.06 kbps
	1	14.8 kbps	14.99 kbps	15.07 kbps	15.06 kbps
38.4	0	30.42 kbps	30.38 kbps	30.43 kbps	30.43 kbps
	1	24.53 kbps	30.39 kbps	30.43 kbps	30.42 kbps
57.6	0	45.58 kbps	45.19 kbps	45.63 kbps	45.65 kbps
	1	32.01 kbps	45.28 kbps	45.6 kbps	45.64 kbps
115.2	0	84.88 kbps	76.31 kbps	90.39 kbps	90.37 kbps
	1	55 kbps	76.85 kbps	90.38 kbps	90.37 kbps
230.4	0	132.6 kbps	131.09 kbps	174.54 kbps	177.43 kbps
	1	100.2 kbps	133.35 kbps	174.39 kbps	177.06 kbps
460.8	0	215.29 kbps	197.55 kbps	327.19 kbps	319.19 kbps
	1	166.2 kbps	205.45 kbps	327.08 kbps	320.12 kbps
921.6	0	239.31 kbps	205.43 kbps	418.8 kbps	391.3 kbps
	1	189.3 kbps	215.11 kbps	416.82 kbps	392.18 kbps

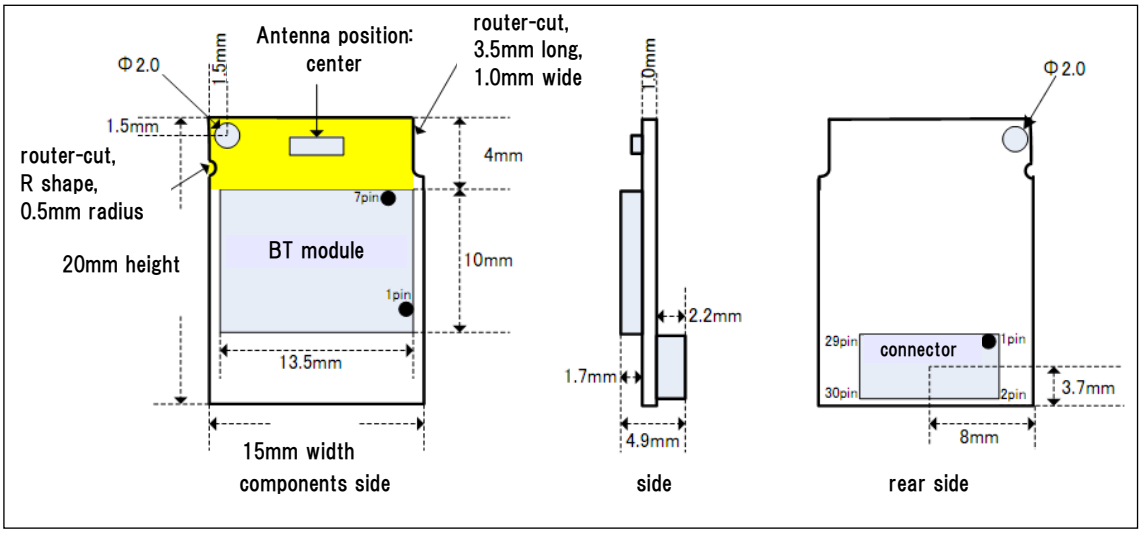
II. ZEAL-CO2 vs USB DONGLE (Toshiba stack)

This is a throughput (an effective rate) wherein the partner device is USB DONGLE.

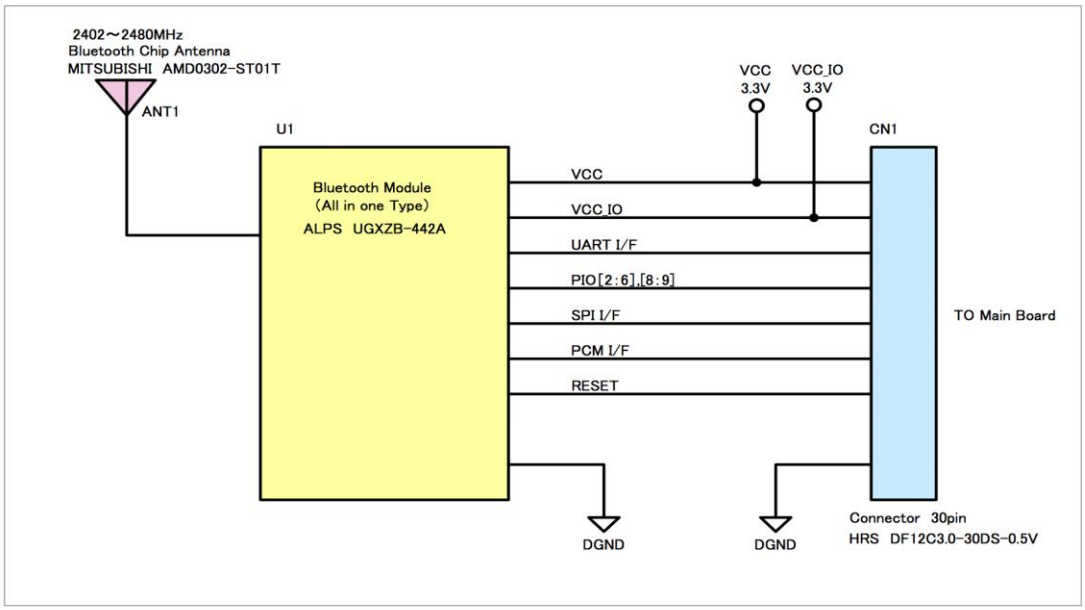
- ✧ ZEAL is used as Slave (USB DONLE is Master)
- ✧ USB DONGLE is Bluetooth Ver. 2.1＋EDR compliant (which is an attachment to ZEAL development kit)
- ✧ USB DONGLE uses Toshiba's stack.

Baud Rate (kbps)	BTLJ	Average Throughput			
		Ordinarly Mode		Automatic Mode	
		M→S	S→M	M→S	S→M
9.6	0	7.66 kbps	7.57 kbps	7.66 kbps	7.57 kbps
	1	7.6 kbps	7.57 kbps	7.66 kbps	7.57 kbps
19.2	0	15.27 kbps	15.24 kbps	15.28 kbps	15.28 kbps
	1	15.08 kbps	15.28 kbps	15.28 kbps	15.27 kbps
38.4	0	30.67 kbps	30.4 kbps	30.68 kbps	30.53 kbps
	1	24.44 kbps	30.52 kbps	30.67 kbps	30.53 kbps
57.6	0	46.04 kbps	45.5 kbps	46.05 kbps	45.81 kbps
	1	32.23 kbps	45.81 kbps	46.05 kbps	45.81 kbps
115.2	0	91.55 kbps	89.62 kbps	91.87 kbps	91.13 kbps
	1	55.29 kbps	91.11 kbps	91.89 kbps	91.12 kbps
230.4	0	154.6 kbps	175.73 kbps	182.19 kbps	179.82 kbps
	1	112.1 kbps	179.73 kbps	182.33 kbps	179.58 kbps
460.8	0	256.16 kbps	305.21 kbps	360.21 kbps	344.5 kbps
	1	202.5 kbps	339.64 kbps	360.44 kbps	344.32 kbps
921.6	0	310.88 kbps	406.36 kbps	595.81 kbps	552.21 kbps
	1	304.29 kbps	525.87 kbps	580.37 kbps	569.61 kbps

Dimensions, Connector Position, and Hole Position



Block Diagram



Electrical Performance and Temperature Characteristics

The product is warranted within the following electrical and temperature characteristics. Use outside the specifications, including the use under over-current, overvoltage and reversed connection may cause damage to the Bluetooth module IC, and which is outside the warranty. Use within the warranted specifications is recommended.

At instantaneous power off, power becomes OFF because Bluetooth module IC is not tolerable. However, it returns operable when the power off status ends (power restoration after Power on RESET).

□ External Input Power

3.3V DC single power (power is divided into VCC and VCC_IO patterns at the connector portion of the module PCB).

Symbol	Item	Min.	Max.	Unit
V_{IL}	LOW Input		0.8	V
V_{IH}	HIGH Input	2.31		V
V_{OL}	LOW Output Voltage		0.4	V
V_{OH}	HIGH Output Voltage	3.1		V

□ Absolute Maximum Rating

Symbol	Item	Min.	Max.	Unit
V_{DD_X}- V_{SS_X}	Power Voltage	-0.4	3.5	V

□ Operating Conditions

Symbol	Item	Min.	Max.	Unit
V_{DD}	Power Voltage	2.4	3.4	V
T_A	Temperature	-20	75	C°

Note 1. In a case compatibility with ZEAL-C01 and ZEAL-S01 is needed, use power voltage of 3.3V.

Note 2. Absolute maximum rating, operating conditions and electrical performance are reproduction of components catalogue specifications, not the value measured with ZEAL module. They are warranted values for designing purpose.

Connector Table

・Zeal side: Connector type, DF12C3.0-30DS-0.5V(manufactured by Hirose)
・PC side: Matching Connector DF12(3.0)-30DP-0.5V(86)(by Hirose)

Pin Name	Pin No.		Pin Name
GND	1	2	GND
GND	3	4	DSI
RESET	5	6	
	7	8	
	9	10	
	11	12	
	13	14	VDD
VDD	15	16	VDD
VDD	17	18	
CTS	19	20	BOOT0 (Note 1)
TX	21	22	BOOT1 (Note 1)
RX	23	24	MODE0
RTS	25	26	MODE1
STO	27	28	GND
GND	29	30	GND

Note 1: With ZEAL-CO1, pin 20 and 22 are BOOT pins to be connected to GND. When replacing ZEAL-CO1, connect pin 20 and 22 GND. With ZEAL-S01 and ZEAL-C02, the pins may be left unconnected.

Startup Operation

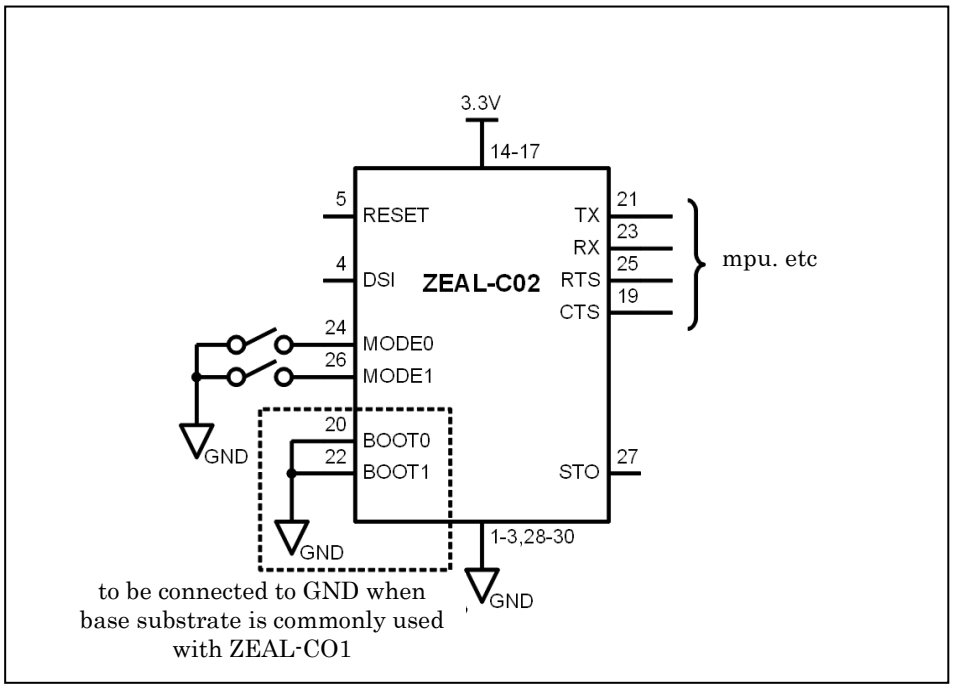
After releasing RESET, it will take 600ms until BT command is accepted at designated baud rate (at UART). Meanwhile, command should not be sent to ZEAL. It will take 1.1second until the device is totally initialized.

Pin Functions

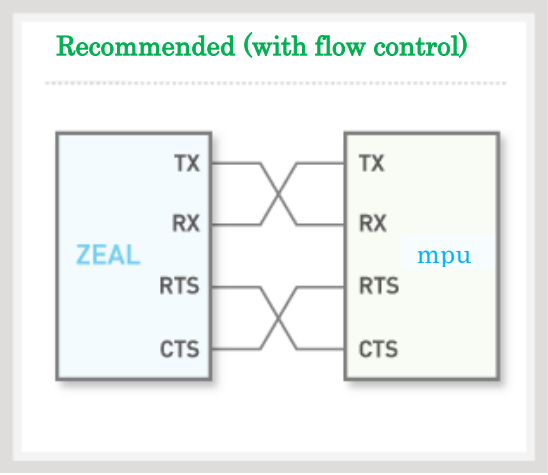
<table>
<tr><th>Pin Name</th><th>Function</th><th>I/O</th><th>Logic</th><th>Function</th></tr>
<tr><td>VDD</td><td>Power</td><td></td><td></td><td>Supplying 3.3V.
To keep compatibility with ZEAL-C01 and ZEAL-S01, supply 3.3V.</td></tr>
<tr><td>GND</td><td>Power</td><td></td><td></td><td>To be grounded</td></tr>
<tr><td>RESET</td><td>Reset</td><td>I</td><td>Neg.</td><td>Upon inputting LOW, module is reset. RESET is incorporated in Bluetooth chip, the pin is used to reset explicitly from outside. The pin is pulled up in the chip.</td></tr>
<tr><td>MODE (0 : 1)</td><td>Mode</td><td>I</td><td></td><td>Start up mode is determined by the pin state when power is input (RESET). The pin is pulled up with I/O setting of the chip. When starting up the module with ordinary mode, the pin may be unconnected. When the mode pin is desired to be LOW, connect the pin to GND. When controlling with mpu, input LOW/HIGH through I/O pin. (Note).
<table>
<tr><th>MODE0</th><th>MODE1</th><th>Mode</th></tr>
<tr><td>HIGH</td><td>HIGH</td><td>Ordinary mode</td></tr>
<tr><td>LOW</td><td>HIGH</td><td>Sstart up mode with default value</td></tr>
<tr><td>HIGH</td><td>LOW</td><td>Automatic mode</td></tr>
<tr><td>LOW</td><td>LOW</td><td>Firmware rewriting mode</td></tr>
</table></td></tr>
<tr><td>TX</td><td>Transmit Data</td><td>O</td><td>Pos.</td><td>UART's transmission data from ZEAL</td></tr>
<tr><td>RX</td><td>Receive Data</td><td>I</td><td>Pos.</td><td>UART's reception data to ZEAL</td></tr>
<tr><td>RTS</td><td>Request to Send</td><td>O</td><td>Neg.</td><td>Signal requesting UART to transmit the data from ZEAL</td></tr>
<tr><td>CTS</td><td>Clear to Send</td><td>I</td><td>Neg.</td><td>Signal clearing UART to receive the data to ZEAL</td></tr>
<tr><td>STO</td><td>Status</td><td>O</td><td></td><td>Output connection status; LOW at connected and HIGH at unconnected.</td></tr>
<tr><td>BOOT (0 : 1)</td><td>Boot</td><td>I</td><td></td><td>To be connected to GND when PCB is commonly used with ZEAL-CO1</td></tr>
<tr><td>DSI</td><td>Low Power Control</td><td>I</td><td>Neg.</td><td>May be expanded to deep sleep interface pin.</td></tr>
</table>

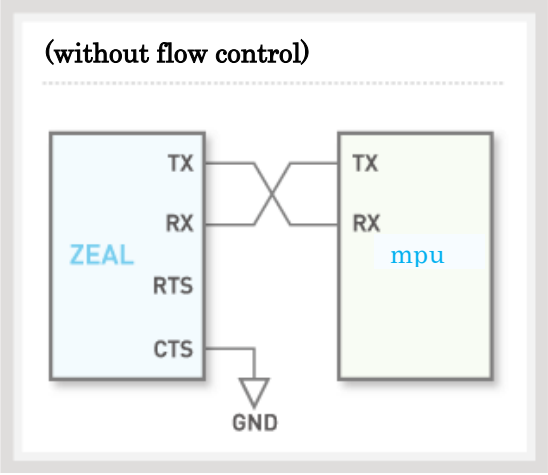
Note: I/O pin is not 5V tolerant.

Connection Example



Hardware Flow Control



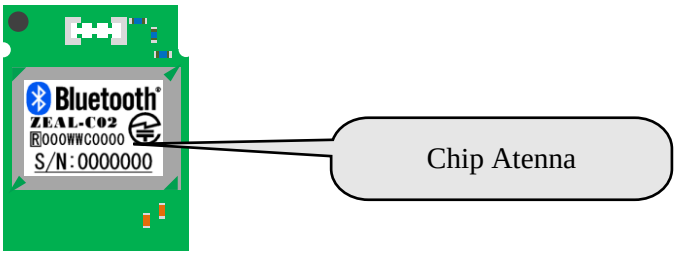


When using the module without flow control (not recommended), leave RTS open and ground CTS to GND.

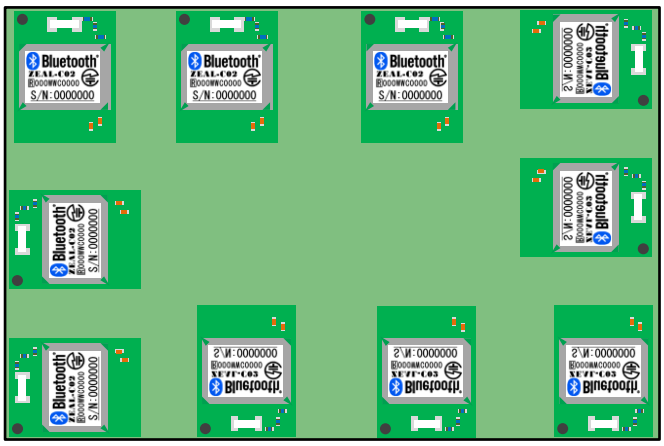
The Bluetooth SPP (serial port profile) assumes that the hardware flow control is made. If the module is used without the flow control, some data might be dropped when electromagnetic environment becomes worse. **The ZEAL itself also assumes the hardware flow control is made. Some function may fail to function normally if the flow control is not made**. Please be careful when using the module without flow control.

Caution for Designing PCB

It is recommended the antenna is directed toward outside of the development board.



(Constellation example)



Metal around the antenna badly affects the electrical performance of the antenna. Metal shall be placed away from the antenna, recommemdably more than 2mm.

Electromagnetic wave hardly permeates metal plate. It is recommended no solid pattern be formed on PCB around the antenna.

For Safety Use of the Product

● With regard to Wireless Devices
- When using the product in medical institution, follow instruction and direction of the institution.
- When using the product in transportation facility, follow instruction and direction of the facility.

● With regard to Installation, Storage and Handling
- Refrain from using outside the specified operational environment.
- Use in an environment free from smoke and or dust.
- Refrain from using under a strong electric field and or under strong magnetic field.
- Use in an environment without corrosive gas
- Use in an environment without vibration and or shock
- Refrain from using near heater and or in direct sunlight
- Refrain from using in a frosting environment
- Refrain from using in an environment where severe temperature fluctuation exists.
- Do not disassemble or alter the product
- Do not store in a humid or dusty place
- Do not use in physically unstable environment.
- Keep out of static electricity.
- Do not drop or give a shock

● Others
- This product shall be used in Japanese market. When using outside the country, certification of Radio Law in the respective country shall be required.
- This product is designed for a general public use, not for automotive, medical or the like where an extreme higher safety and a high reliability are required. Please fully examine and evaluate the usage environment and how the product might be actually used.