

# BLE Module Specification

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Revision: 20130109

PCB board number: ACEBLE/AU4X

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**Ace Sensor Inc.**

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Every reasonable effort has been made to ensure the information and procedures detailed in this guide are complete and accurate at the time of printing. However, information contained in this guide is subject to change without notice.

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## 1. Abstract

This document describes the BLE (Bluetooth Low Energy, part of Bluetooth 4.0) module (ACEBLE103/AU4X-P/AU4X-C/AU4X-U) and its functions.

## 2. Introduction

ACEBLE/BLE-AU4X series are Bluetooth Low Energy modules, completed with PCB, ceramic chip or external antenna. The series include the following models with different antenna design.

- AU4X-P: PCB antenna, 15mm\*20mm
- AU4X-C: Ceramic chip antenna, 15mm\*22.5mm
- AU4X-U: UFL antenna, 15mm\*22.5mm



This document describes the ACEBLE103/AU4X-P/AU4X-C/AU4X-U BLE modules based on TI CC2540/2541 BLE and CC2530 Zigbee chips. Technical details of TI CC2540/2541/2530 can be found at

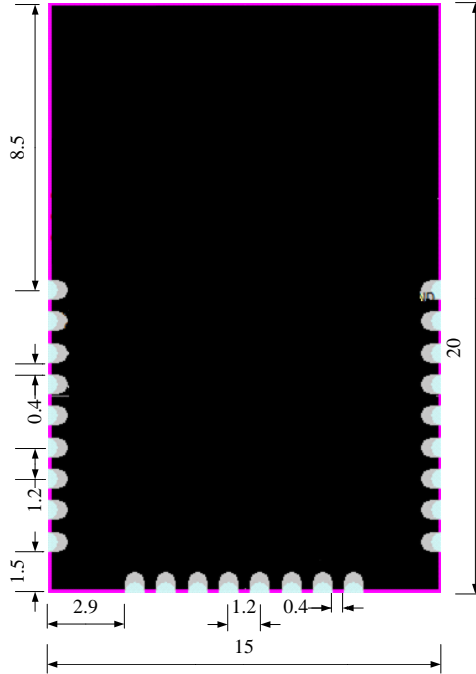
<http://www.ti.com/general/docs/lit/getliterature.tsp?genericPartNumber=cc2540&fileType=pdf>

<http://www.ti.com/general/docs/lit/getliterature.tsp?genericPartNumber=cc2541&fileType=pdf>

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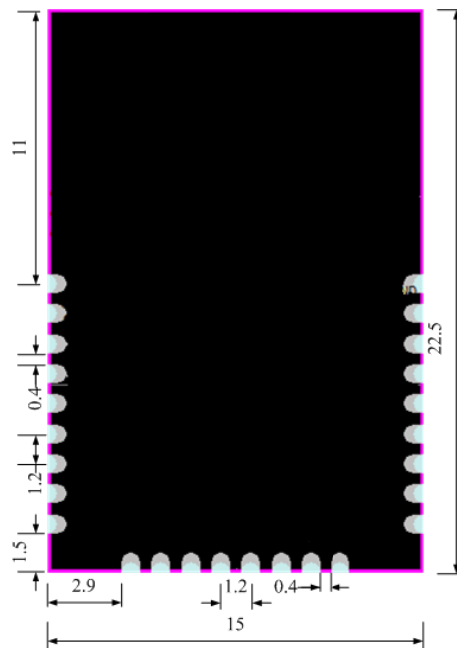
### 3. BLE Module Physical Layout

#### 3.1. AU4X-P Physical dimensions .



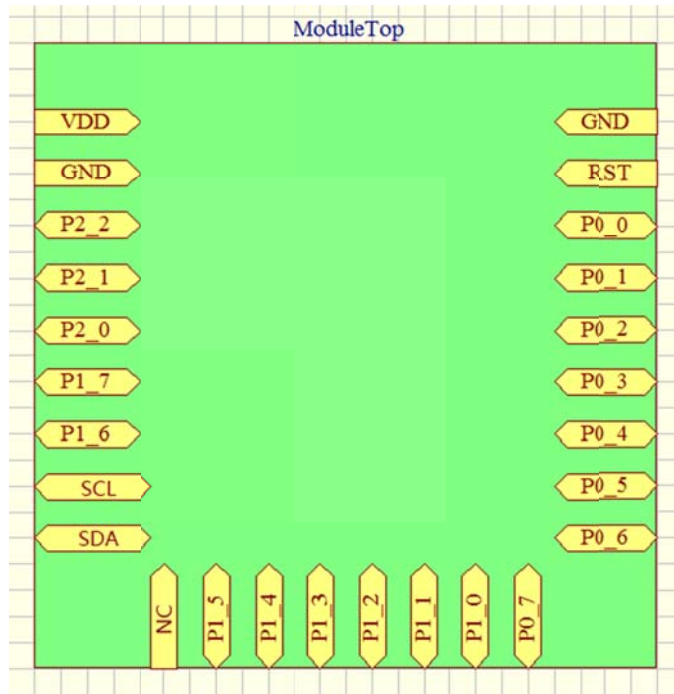
Physical dimensions of AU4X-P (in millimeters)

#### 3.2. AU4X-C/ AU4X-U Physical dimensions .

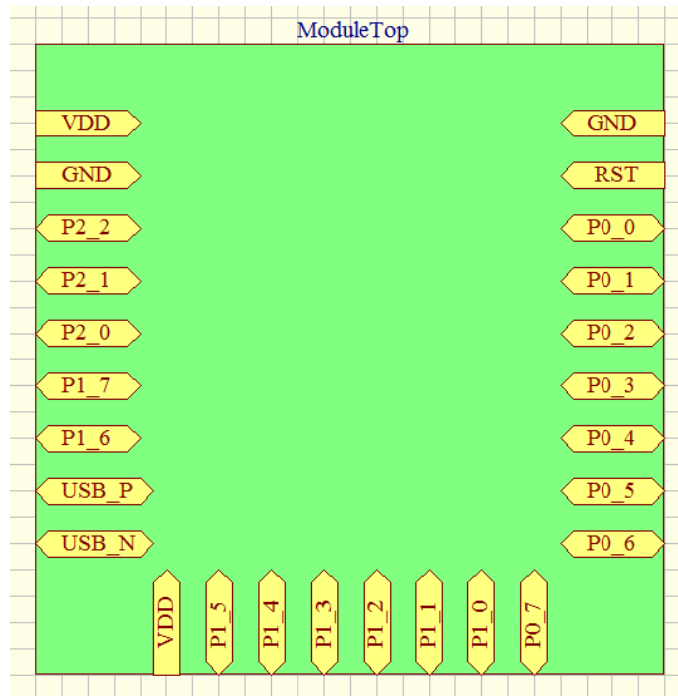


Physical dimensions of AU4X-C/AU4X-U (in millimeters)

### 3.3. BLE(CC2541/CC2540) Module Pin Labels

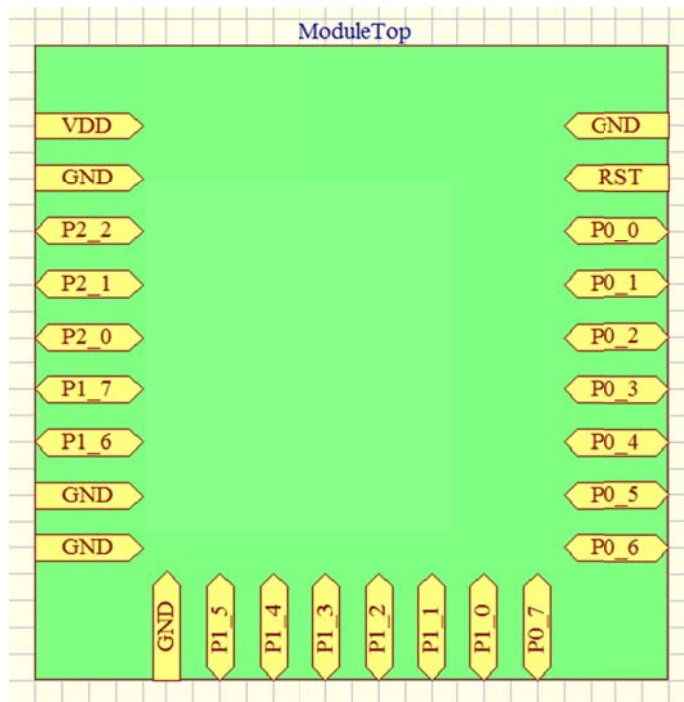


**CC2541 based module**



**CC2540 based module**

### 3.4. Zigbee(CC2530 Module Pin Labels)



**CC2530 based module**

### 3.5. Pin Definitions

PIN-NAME	PIN-TYPE	DESCRIPTION
VDD	Power	Voltage 2V – 3.6V
GND	Ground	Ground
NC	Not used	Not used
P2_2	Data I/O	Configurable I/O port
P2_1	Data I/O	Configurable I/O port
P2_0	Data I/O	Configurable I/O port
P1_7	Data I/O	Configurable I/O port
P1_6	Data I/O	Configurable I/O port
SCL	I2C clock or data I/O	I2C clock or data I/O on CC2541 module
SDA	I2C clock or data I/O	I2C clock or data I/O on CC2541 module
USB_N	Digital I/O	USB N on CC2540 module
USB_P	Digital I/O	USB P on CC2540 module
P1_5	Data I/O	Configurable I/O port
P1_4	Data I/O	Configurable I/O port
P1_3	Data I/O	Configurable I/O port
P1_2	Data I/O	Configurable I/O port
P1_1	Data I/O	Configurable I/O port (driving current 20mA)
P1_0	Data I/O	Configurable I/O port (driving current 20mA)
P0_7	Data I/O	Configurable I/O port
P0_6	Data I/O	Configurable I/O port
P0_5	Data I/O	Configurable I/O port
P0_4	Data I/O	Configurable I/O port
P0_3	Data I/O	Configurable I/O port
P0_2	Data I/O	Configurable I/O port
P0_1	Data I/O	Configurable I/O port
P0_0	Data I/O	Configurable I/O port
RST	RESET	Effective when at low voltage



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### 3.6. GPIO Mapping

PERIPHERAL / FUNCTION	P0								P1								P2		
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	2	1	0
ADC	A7	A6	A5	A4	A3	A2	A1	A0											
Operational amplifier						0	1	+											
Analog comparator			+	-															
USART 0 SPI Alt. 2			C	SS	MO	MI					MO	MI	C	SS					
USART 0 UART Alt.2			RT	CT	TX	RX					TX	RX	RT	CT					
USART 1 SPI Alt.2			MI	MO	C	SS					MI	MO	C	SS					
USART 1 UART Alt.2			RX	TX	RT	CT					RX	TX	RT	CT					
TIMER 1 Alt.2		4	3	2	1	0											3	4	
TIMER 3 Alt.2												1	0						
TIMER 4 Alt.2															1	0			0
DEBUG																		DC	DD
OBSSEL											5	4	3	2	1	0			

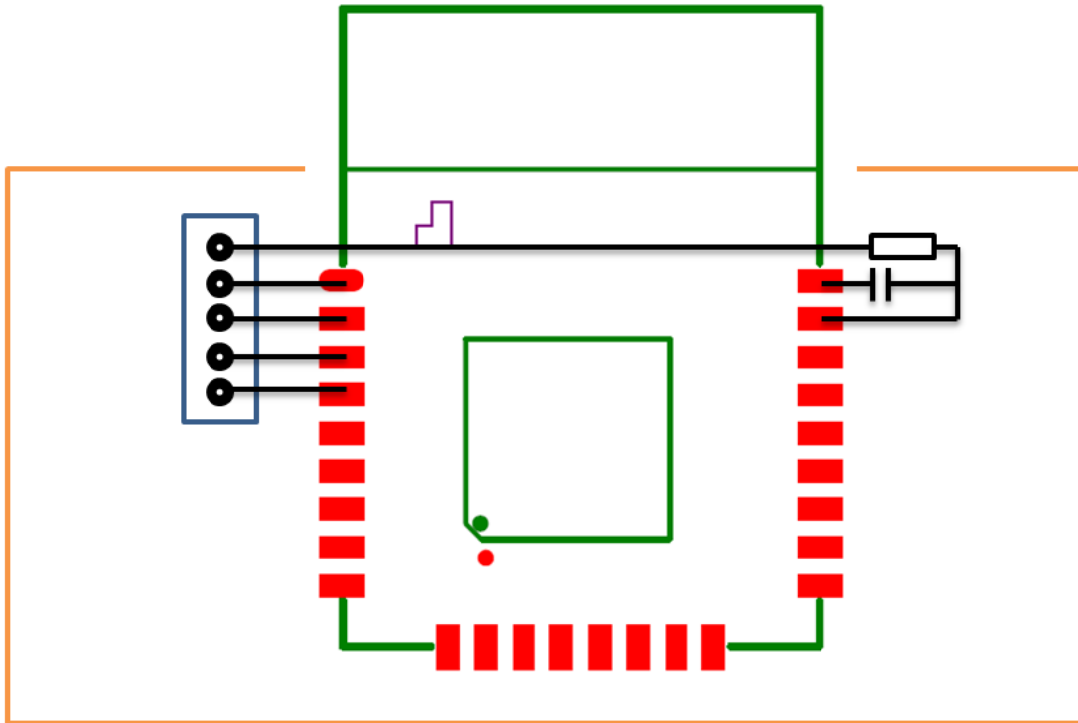


## 4. Programming & Debugging Interface

The BLE module includes the original TI CC254x/CC2530 chip which comes with blank firmware. In order to program the TI CC254x/CC2530 chip, a programming and debugging interface needs to be built. With the interface, the TI CC254x/CC2530 chip can be programmed using TI's CC Debugger hardware and accompanying software. Please find the details of the CC Debugger here: <http://www.ti.com/tool/cc-debugger>

The following is a reference design of the programming and debugging interface. A 5-pin debugging interface is provided with the pins for: Reset, VDD, GND, P2\_2, P2\_1. Distance between the pins is 2mm. Through holes dimension is 0.3-0.4mm. Reset resistor: 2K7, capacitor: 1N.

Standard 2mm touch-pin connection can be used to connect to the debugging interface. This debugging interface can be used to reprogram the firmware using TI's CC Debugger and related software.



## 5. Best Practices

When designing with the ACEBLE/AU4X BLE modules, please pay attention to the following recommendations.

- The module's voltage requirement is 2.0-3.6V. If the power supply is over 3.3V, please use a voltage regulator.
- If the communicating host uses a different voltage than the BLE module, please make sure that the voltage matches on the communication ports.
- If AU4X-P PCB antenna module is used, for best wireless signal, it's recommended to have the antenna part sticking out without touching the main PCB board.
- For best wireless signal, please avoid packing the antenna close to metal parts or case.

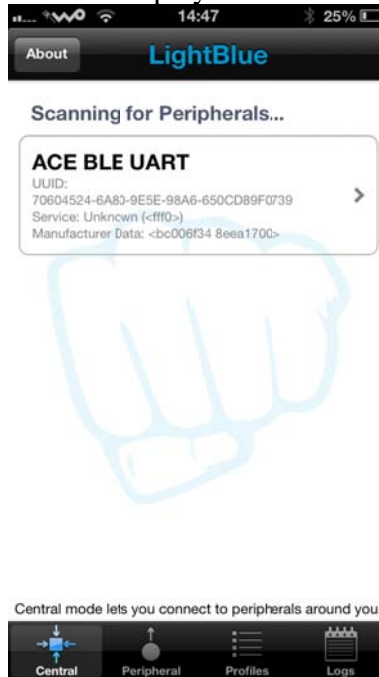
## 6. UART Communication Firmware

The ACEBLE/AU4X BLE modules can be shipped with a serial UART communication firmware. This firmware can be used for initial testing the BLE connectivity and simple communication with the host. You’ll need an iOS device supporting BLE, e.g. iPhone 4S/5, iPad 3/4/mini or iPod Touch 5<sup>th</sup> generation.

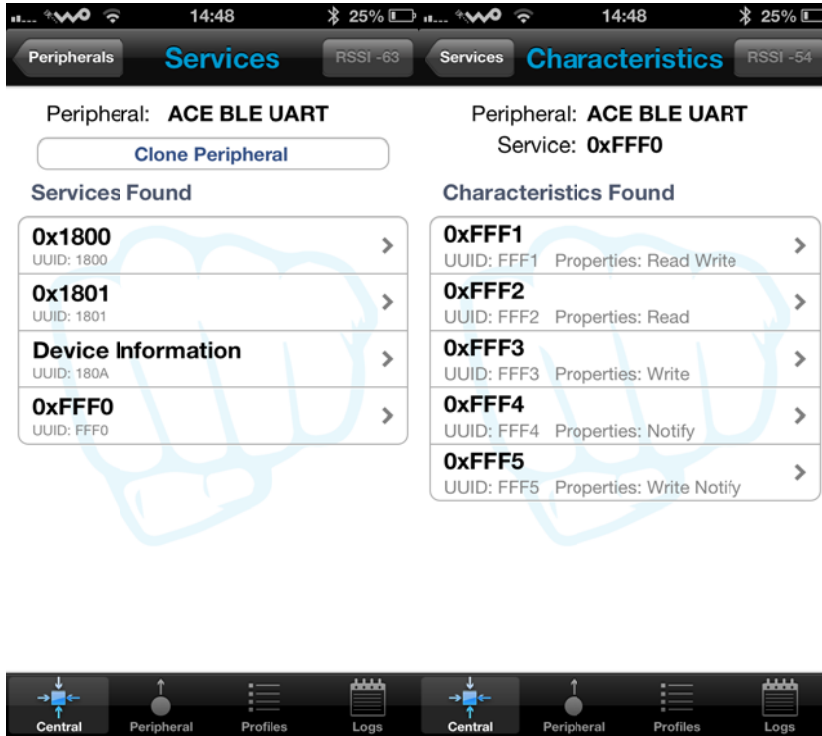
Please install the Lightblue app available at Apple iTunes App store  
<https://itunes.apple.com/app/lightblue/id557428110>

Following the steps below to test the BLE module

1. Power the module. Connect the VDD and GND pins to a power source with the appropriate voltage.
2. After powering the module, please launch Lightblue app. The app should be able to discover the BLE module and display the UUID and its services, see below.

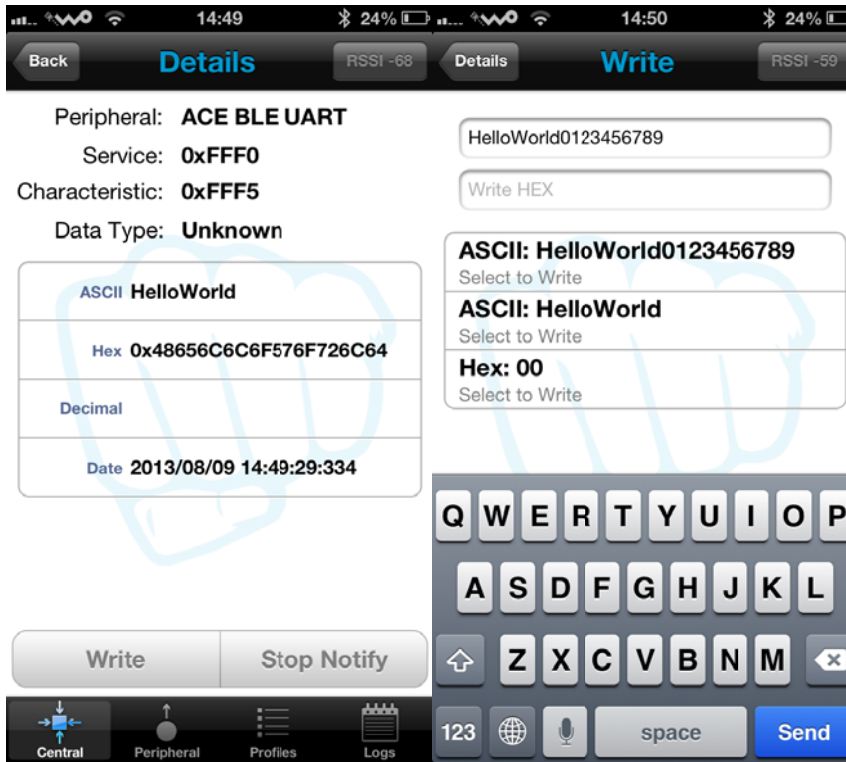


3. After successful completion of the 2<sup>nd</sup> step, a simple serial communication can be conducted with 4 pins: VDD, GND, P0.2(RX), P0.3(TX), referring to the pin layout diagram in previous sections. Once the pins are connected, you can use the Lightblue app to perform serial communication as follows. Select the 0xFFFF0 service in the “Services Found”. In “Characteristics”, select 0xFFFF5. You can then test serial communication. Please note that the Baud rate is 115200bps. Each data packet should not be over 20bytes. Please refer to screenshots below for operations on Lightblue.



Services Found in LightBlue

Service 0xFFFF0



Characteristic: 0xFFFF5

Send data over serial