inovatink

WIB Module Datasheet

January 2019, v1.0

Contents

1 Module Description

WIB is a Smart IoT Module that enables out-of-the-box Cloud services and data analytics to silo IoT application developers and smart product manufacturers. The module synergizes enterprise-grade, secure WiFi and Bluetooth connectivity, high performance dual core processor, rich set of analog/digital/communication peripherals and robust and compact design. WIB is optimized for cost, low power consumption and fast integration into manufacturer's products. Modules default firmware incorporates all of the common IoT functions; management, security, computation, diagnostics and Cloud communication.

WIB offers advantages to manufacturers such as low cost, zero touch setup, fast integration, ready certification and Day One Cloud connectivity. The module can be integrated into original equipment manufacturer products in areas such as logistics, industrial equipment, consumer electronics, small/major home appliances, remote monitoring and control and smart home.

Module's architecture is shown in Figure 1. Module integration is done through exposed header pins. For operational purposes, WIB module needs to be placed on an application board as described in Mechanical Guidelines section. Electrical characteristics and power requirements of the module are given in Electrical Guidelines section. In order for module to exchange data and signals with application board Software Guidelines section need to be followed. Finally, integration scenarios are discussed in Integration Guidelines section.

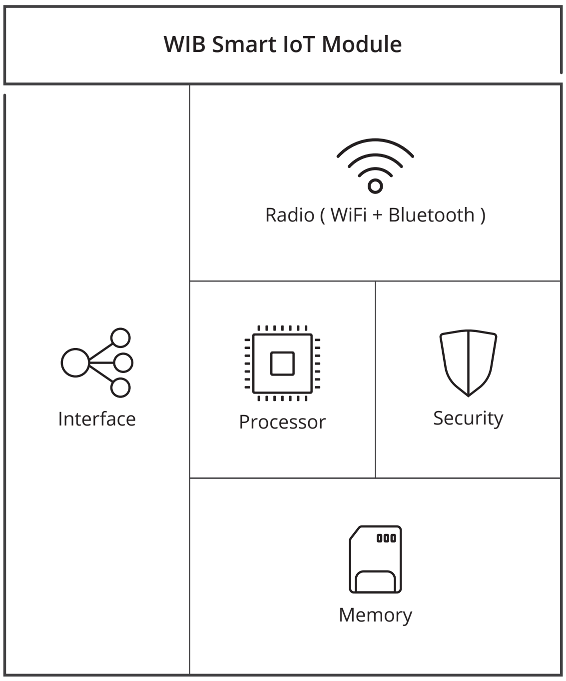

Figure 1: WIB Module's Architecture

2 Mechanical Guidelines

WIB is shown in Figure 2. The mechanical overview of the module is given in Figure 3.

Figure 2: WIB Module

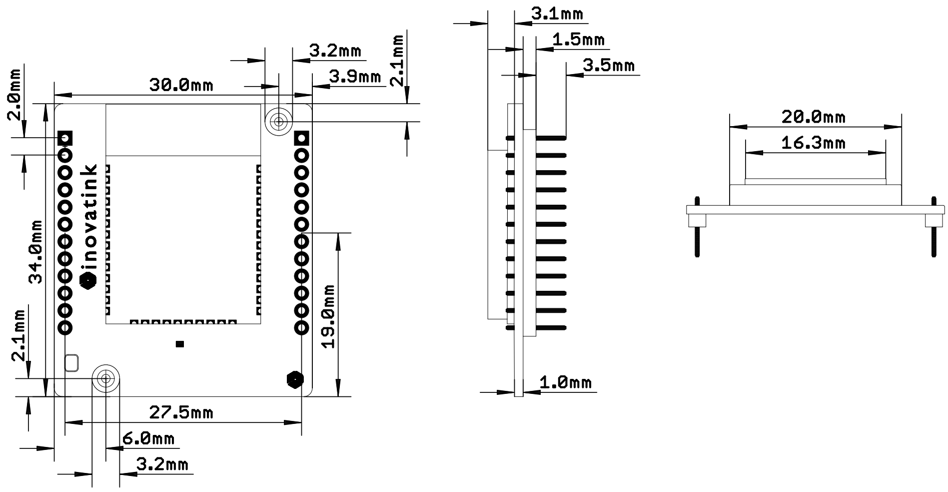

Figure 3: WIB Module's Dimensions

WIB module has two 12-pin, single row, 2-mm pitched male connectors for interface with the application board. All of the pins should be hosted by socket on the application board for increased stability. The module can additionally be stabilized with screws using two holes at two diagonal corners as seen in the Figure 3. The pins provide friction based stability and the use of screws is not necessary for stationary applications. In the scenarios where module is exposed to prolonged vibrations, screws must be used to avoid mechanical instability.

Module can be placed anywhere on the application board, in any desired orientation, as long as the hosting connectors can maintain geometric relation as shown in Figure 3. Recommended sockets for application board are Harwin's M22-7131242 or equivalent.

3 Electrical Guidelines

Pinout of WIB module is shown in Figure 4. Terminal description of module pins is given in Table 1.

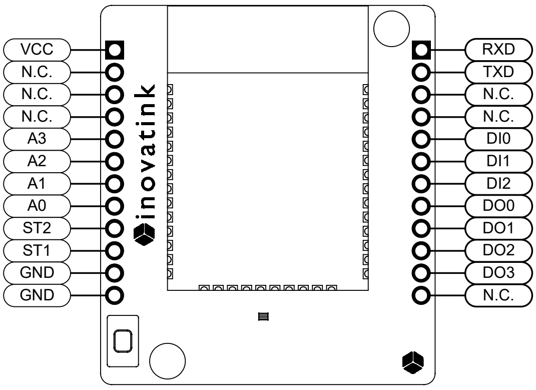

Figure 4: WIB Pinout

Table 1 - Terminal Description of Pins		
Pin	Type	Terminal Characteristics
A0...A3	Analog in	$V_{min} = 0V \quad V_{max} = VCC$
DI0...DI2	Digital in	$0 <= V_{IL} <= 0.25VCC \quad 0.75VCC < V_{IH} <= VCC$
DO0...DO3	Digital out	$0 <= V_{OL} <= 0.10VCC \quad 0.80VCC < V_{OH} <= VCC$
ST1 & ST2	Status	$0 <= V_{OL} <= 0.10VCC \quad 0.80VCC < V_{OH} <= VCC$
TXD	Serial TX	$0 <= V_{OL} <= 0.10VCC \quad 0.80VCC < V_{OH} <= VCC$
RXD	Serial RX	$0 <= V_{IL} <= 0.25VCC \quad 0.75VCC < V_{IH} <= VCC$
VCC	Power Supply	$2.5V <= VCC <= 3.5V \quad (3.3V)^* \quad I_{avg} = 0.5A$
GND	Ground	
N.C.	Do not connect	

$*$ recommended

WIB module requires single power supply on the VCC pin. VCC power supply is powering on-board microcontroller, WiFi/BT radio and auxiliary digital and analog circuitry. Supplied power needs to be low ripple and properly decoupled for increased reliability and low EMC. VCC characteristics are summarized in Table 2.

Table 2 - VCC Characteristics	
Voltage	3.3V
Current (peak)	700 mA
Current (average)	500 mA
Decoupling	$47\mu F^* \parallel 0.47\mu F^\dagger$

$*$ ceramic X7R or tantalum $\quad\dagger$ ceramic X5R or better

3.1 Antenna

WIB module comes with two antenna options, trace and external. Module with external antenna option has a snap-on u.FL, ultra miniature coaxial, TE Connectivity 1909763-1 (male) connector. Connector of the external antenna should be matching u.FL female 50 Ω type. Any 2.4 GHz WiFi/BT antenna can be used as long as the mechanical, electrical and RF conditions are satisfied for given application.

Due to the possible RF radiation do not place any sensitive analog and digital electronics right under the module. If placement of sensitive analog and digital electronics is absolutely necessary make sure to use RF shields to preserve signal integrity of your electronics.

3.2 Interfaces

Analog Input Interface

WIB module has 4 analog inputs (A0...A3). These inputs are connected directly to 12-bit SAR ADC with simultaneous sampling and conversion for all of the pins. Analog pins to be used must be configured before use from Cloud UI. The interface on analog pins should follow standard analog design rules for SAR ADC.

Digital IO Interface

WIB module has 7 digital pins. Three of these pins are designated as input (DI0...DI2) and other four are output (DO0...DO3). Digital pins must be configured from Cloud UI before use. The output pins are configured as push-pull pins with no internal pull-ups or pull-downs. All of the necessary pin configuring resistors must be placed on the application board.

Status pins

Module has two status pins ST1 & ST2. Status pins inform the application board electronics about the current status of the module. These status pins are standard push-pull digital output pins. The meaning of these pins is discussed in the Software Guidelines section.

Serial Interface

Serial interface between application card and WIB module is based on UART. UART communication setting should be done according to Table 3.

Table 3 - UART Settings

Parameter	Value
Serial Frame	8 bits
Stop Bit	1
Parity	None
Flow Control	None
Baudrate	38.400 bps*

∗ can be set to higher value upon request

4 Software Guidelines

WIB module has been designed to fit into applications with a microcontroller or microprocessor. In an operational scenario, application processor sends application data to Cloud through designated serial interface. WIB Module is also capable of providing extended flexibility by directly sampling analog sensors supplied through analog input pins (A0...A3). Additionally, module provides configurable digital interface with 3 inputs (DI0..DI2) and 4 outputs (DO0...DO3). Serial interface doesn't require any prior configuration. The use of analog and digital pins must be preceded by their configuration from the Cloud UI.

4.1 Module Operation

The module operation is given in Figure 5 by the state diagram. Apart from initialization and configuration states, module operates in periodic fashion with sample period *sp*, going through Sample - Serialize - Cloud - Idle cycle. The configuration state occurs in aperiodic manner upon the configuration request from Cloud.

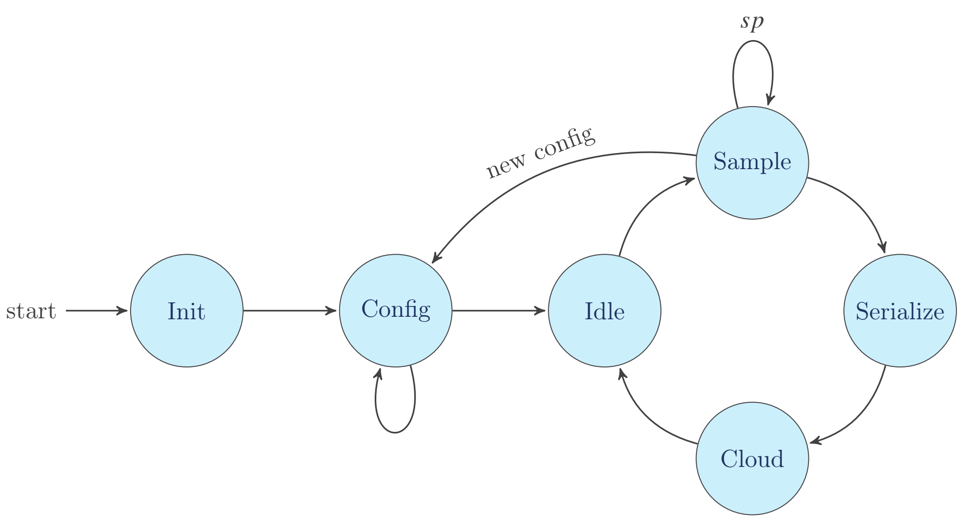

Figure 5: State diagram of module operation

Initialization - immediately after power up, or reset, the module is initialized. During initialization, module is "unresponsive" to any input (see Table 4).

Configuration - after initialization and in the case of configuration change, module is put into configuration state. Configuration state is indicated by status pins.

Idle - module is idle between ending of Cloud communication and next sampling period. Idle state is indicated by status pins.

Sample - module samples analog and digital inputs, processes data received at the serial port and controls digital pins in periodic fashion with configurable period. In between discrete sampling times, the serial interface is active, however, at the sampling time only data last sent to serial interface is processed and sent to Cloud.

Serialize and Cloud - after sample operation is done, data is put into correct format and communication with Cloud is done. Sampling period can be assumed constant while time for the data to reach Cloud varies with network conditions.

Status pins are summarized in Table 4.

Table 4 - Status pins description

Status	ST1	ST2
Unresponsive	0	0
Configuration	0	1
Busy	1	0
Idle	1	1

In addition to status pins there is an RGB LED that visually indicates module status. Configuration state is indicated by white color. "Breathing" light blue color indicated Cloud connection in progress. Green color is an indication of Idle state and normal operation. During the module's software update LED is "breathing" magenta color. Indication scheme is given in Table 5.

Table 5 - RGB LED indication

Status	Color
Configuration	WHITE
Connecting to Cloud	LIGHT-BLUE Breathing
Normal operation	GREEN
Software update	MAGENTA Breathing

4.2 Serial interface operation

Serial interface is used as a medium for application processor and WIB module to exchange messages. Messages are formatted as shown in Figure 6. The detailed explanation of packet format is given in Table 6.

MT(15:8)	MT(7:0)	Len(7:0)	AR(15:7)	AR(7:0)	PL(x:(x-7))	···	PL(7:0)

Figure 6: Message Format

Table 6 - Packet format description

Symbol	Description	Length
MT	Message Type	2 bytes
Len	Payload Length	1 byte
AR	Action Register	2 bytes
PL	Payload	1-64 bytes

Application processor can send different types of messages to WIB module. The message types and corresponding serial packets are summarized in Table 7. One byte long Length denotes the payload length. Action register can take different values. Each bit of AR(15:0) denotes the active channel both for sensor values and for attributes. If multiple sensors/attributes need to be sent, action registers are bitwise OR-ed and final register is sent through serial interface. Action register values are summarized in Table 9.

Table 7 - Message Types

Message Type	Value	Description
Sensor	MT(15:8) = 0x53 & MT(7:0) = 0x53	Sensor value update message
Attribute	MT(15:8) = 0x41 & MT(7:0) = 0x41	Attribute update message

Table 8 - Action Register Values

Message Type	Action Register	Description
Sensor / Attribute	AR(15:8) = 0x00 & AR(7:0) = 0x01	Sensor/attribute 1 active
	AR(15:8) = 0x00 & AR(7:0) = 0x02	Sensor/attribute 2 active
	AR(15:8) = 0x00 & AR(7:0) = 0x04	Sensor/attribute 3 active
	AR(15:8) = 0x00 & AR(7:0) = 0x08	Sensor/attribute 4 active
	AR(15:8) = 0x00 & AR(7:0) = 0x10	Sensor/attribute 5 active
	AR(15:8) = 0x00 & AR(7:0) = 0x20	Sensor/attribute 6 active
	AR(15:8) = 0x00 & AR(7:0) = 0x40	Sensor/attribute 7 active
	AR(15:8) = 0x00 & AR(7:0) = 0x80	Sensor/attribute 8 active
	AR(15:8) = 0x01 & AR(7:0) = 0x00	Sensor/attribute 9 active
	AR(15:8) = 0x02 & AR(7:0) = 0x00	Sensor/attribute 10 active
	AR(15:8) = 0x04 & AR(7:0) = 0x00	Sensor/attribute 11 active
	AR(15:8) = 0x08 & AR(7:0) = 0x00	Sensor/attribute 12 active
	AR(15:8) = 0x10 & AR(7:0) = 0x00	Sensor/attribute 13 active
	AR(15:8) = 0x20 & AR(7:0) = 0x00	Sensor/attribute 14 active
	AR(15:8) = 0x40 & AR(7:0) = 0x00	Sensor/attribute 15 active
	AR(15:8) = 0x80 & AR(7:0) = 0x00	Sensor/attribute 16 active

Payload contains values of the sensors or attributes indicated by action register. Sensor/attribute value consists of 4 bytes of data. It can be used as any data structure as it is preferred. Customization and data scheme must be shared with Inovatink to implement data parser mechanism at the Cloud.

Table 9 - Payload content summary

MT	AR	PL	Description
0x53 0x53	0x00 0x01	PL(31:0)	Sensor 1 data
	... ...	PL(31:0)	Sensor ... data
	0x80 0x00	PL(31:0)	Sensor 16 data
0x41 0x41	0x00 0x01	PL(31:0)	Attribute 1 data
	... ...	PL(31:0)	Attribute ... data
	0x80 0x00	PL(31:0)	Attribute 16 data

4.3 Example serial communication packets

Examples of serial communication packets are given in the figures below. SDK written in C is supplied on our Github page (click to see)

0x53	0x53	0x04	0x00	0x01	0x41	0xa4	0x00	0x00
MT		LEN	AR		PL			
sensor		4 B	sensor 1		sensor 1 value=20.5			

Figure 7: Sensor update for sensor 1 with 20.5 value

0x41	0x41	0x04	0x00	0x01	0x44	0x9a	0x40	0x00
MT		LEN	AR		PL			
attribute		4 B	attribute 1		attribute 1 value=1234			

Figure 8: Attribute update for attribute 1 with 1234 value

0x53	0x53	0x08	0x00	0x11	0x40	0x48	0xf5	0xc3	0x40	0x2d	0x70	0xa4
MT		LEN	AR		PL				PL			
sensor		8 B	sensor 1&5		sensor 1 value=3.14				sensor 5 value=2.71			

Figure 9: Update sensor 1 with 3.14 value and sensor 5 with 2.71

0x41	0x41	0x08	0x00	0x11	0x40	0x00	0x00	0x00	0x40	0xa0	0x00	0x00
MT		LEN	AR		PL				PL			
attribute		8 B	attribute 1&5		attribute 1 value=2				attribute 5 value=5			

Figure 10: Update attribute 1 with 2 value and attribute 5 with 5

5 Integration Guidelines

WIB module has all of the necessary out of the box IoT functionality to act as fully managed and maintained part of connected devices. The module and corresponding Cloud service have been designed to act as, easy to use, "bridge" between applications (data generation) and analytics services (data consumption). Our recommendation is to integrate WIB module to the intended application hardware without need to develop any networking code or learn how to provision a cloud service (integration scenario 1).

Despite module's default (recommended) mode of operation, it can also be used without Inovatink's firmware. Module is equipped with ESP32-WROOM-32 and can be programmed using open source firmware development framework (ESP-IDF) or Amazon's FreeRTOS distribution and can be connected to AWS IoT Core or any other Cloud service (integration scenario 2).

Both scenarios can be tested with WIB module evaluation kit. Please see products section of inovatink.com for more details.

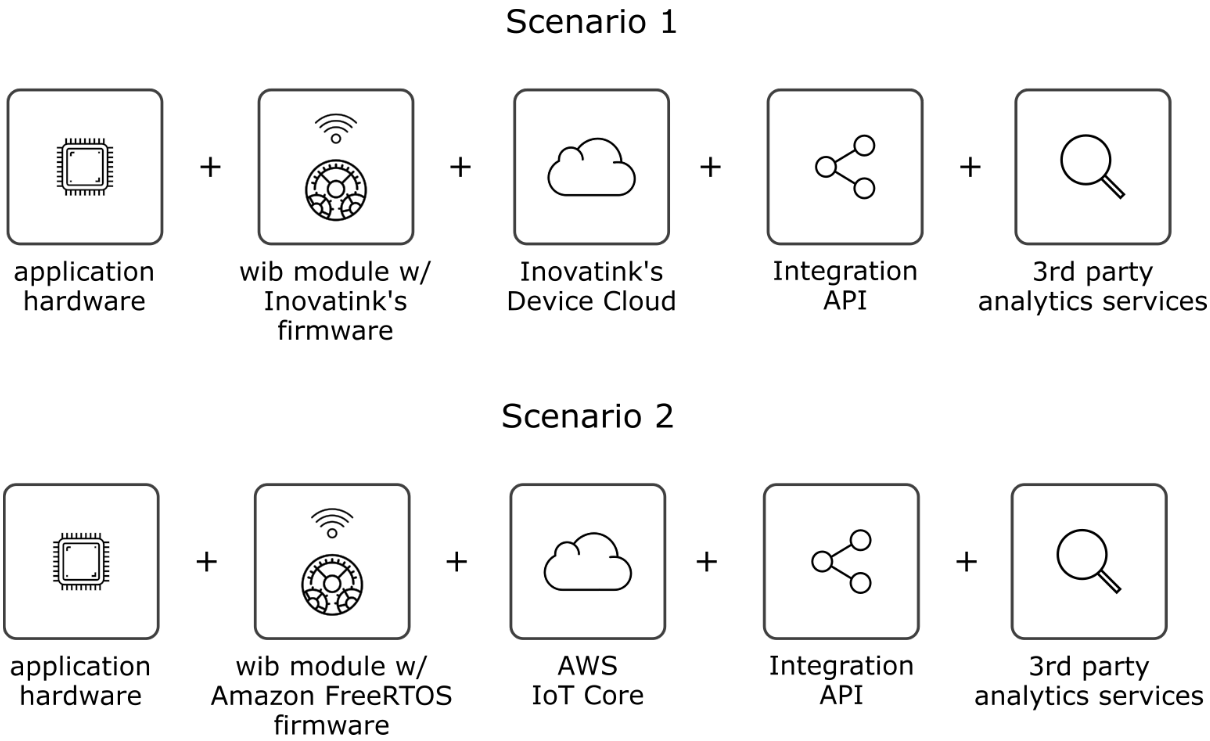

Figure 11: Integration scenarios

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