ALPW-BLETAG001 Datasheet 1.0
Bluetooth Low Energy Sensor Platform

FEATURES

- Ready-to-use Bluetooth® low energy sensor platform
- Small form factor : 28mm
- Supplied with one CR2032
- Ultra Low Power consumption
- EM9301 2.4Ghz Bluetooth® low energy controller
- Provided with a qualified Bluetooth® Low Energy protocol stack
- Provided with a complete SDK
- 128kByte Ultra Low Power Cortex M3 processor

APPLICATIONS

- Weather Station
- Proximity Detection
- Light Control
- Wireless Sensors
- Consumer Electronics
- Monitoring and Control
- Remote control

DESCRIPTION

The ALPW-BLETAG001 is an universal single-mode *Bluetooth*® low energy sensors platform.
It supports Bluetooth Low Energy Specification from the *Bluetooth* SIG inc., and can be a reference design useful for targeted products like accessories.

The TAG communicates with standard terminals, smartphone, tablet, PC... through a wireless *Bluetooth® low energy* radio link. Alpwise provides the necessary firmware to enable the development of your applications, including sensors drivers and the Bluetooth® low energy protocol stack.

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1 Product Description

The ALPW-BLETAG001 TAG combines UltraLow Power hardware components as:

- the EM9301 2.4 Ghz *Bluetooth*® low energy controller
- the Ultralow power ARM® Cortex™-M3 core with MPU, the STM32L152 MCU

supporting a complete *Bluetooth*® low energy protocol stack, sensors firmware and handling user application, consumption optimized by low power modes.

The ALPW-BLETAG001 accelerates development of *Bluetooth* low energy sensor applications.

The ALPW-BLETAG001 TAG makes the link between the sensor network to Smarphone, tablets Applications and the Cloud Computing, making possible for users to access their information from anywhere at any time.

This TAG includes all kinds of sensors enabling the development of various applications such as a weather station, dimmer, fall detection, motion capture, or any other functions a designer can imagine by using onboard sensors: temperature, humidity, air pressure, 3D accelerometer, 3D gyroscope, 3D magnetometer, ambient lighting ...

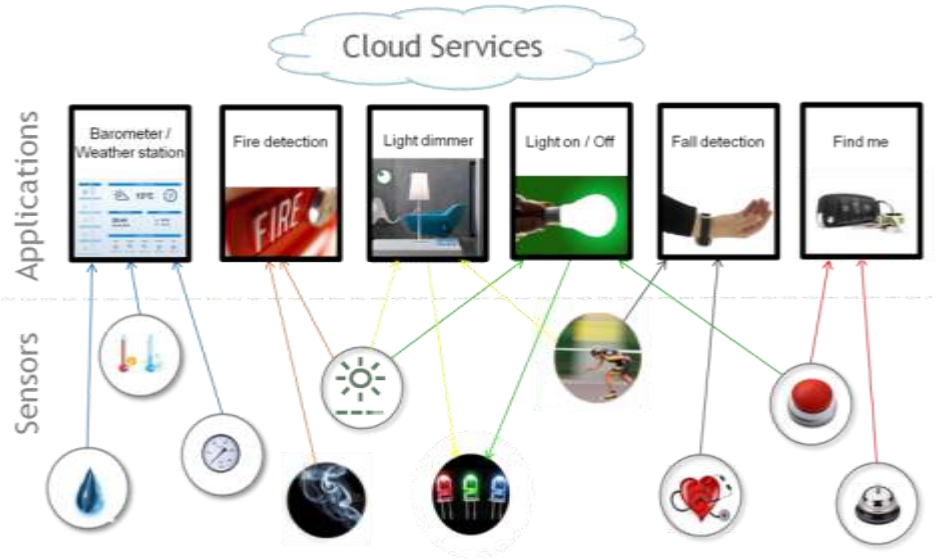


Figure1.: Clouding applications overview

1.1 Functional Block Diagram

Below is a functional block diagram:

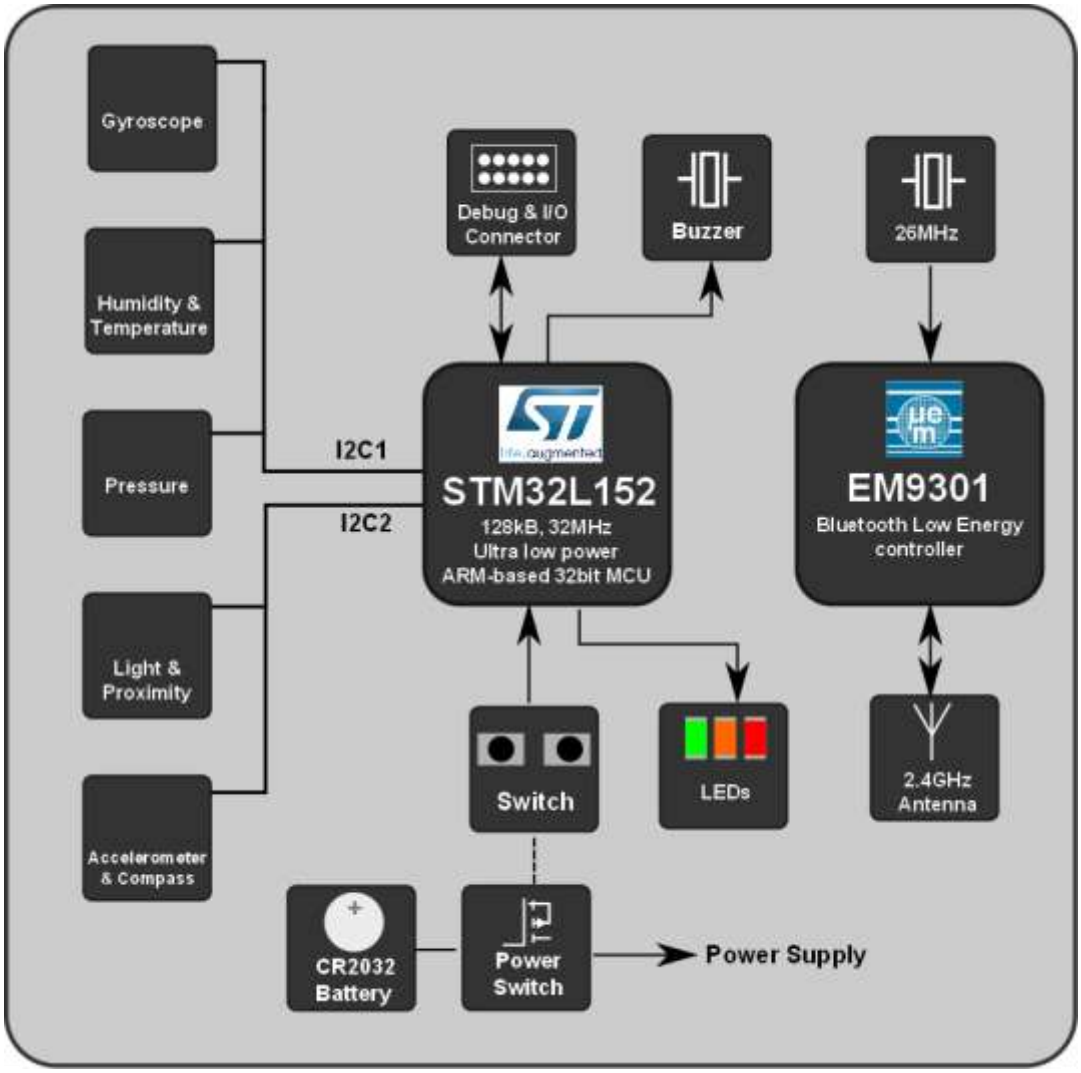


Figure2.: ALPW-BLETAG001 block diagram

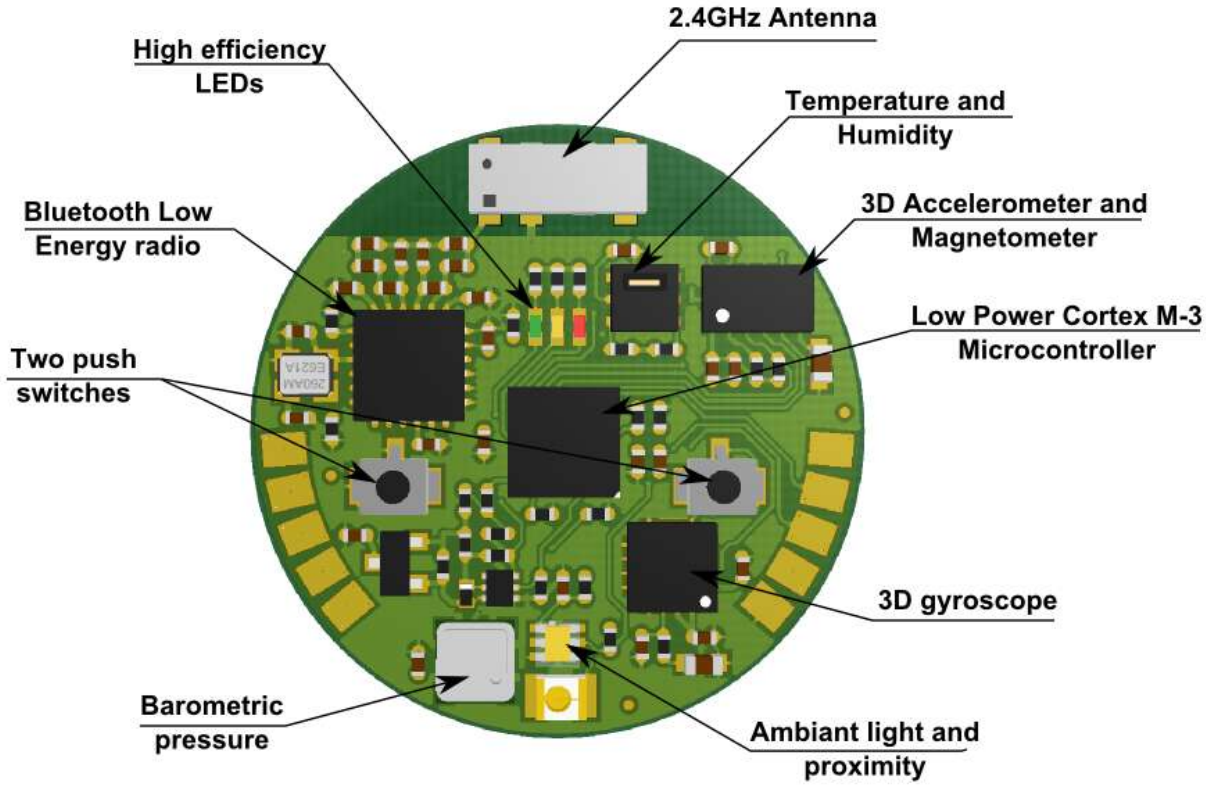


Figure3.: ALPW-BLETAG001 implantation

2 Detailed Description

2.1 Module Pin Description

Bottom-side 10-pins connector:

Figure4.: ALPW-BLETAG001 bottom-side connector

The ALPW-BLETAG001 embeds a 10-pins connector to allow programming and debugging as well as connection to user application.

	Signal Name	Type	Description
1	SWCLK	Digital	Serial Wire Debug Clock
2	VDD	Supply	Main power supply
3	SWDIO	Digital	Serial Wire Debug Data
4	PA12/USBDP	Digital	PA12 or USB data
5	NRST	Digital	MCU Reset
6	PA11/USBDM	Digital	PA11 or USB data
7	PB13	Digital	PB13
8	PB9/I2C SDA	Digital	PB9 or I2C Serial Data
9	PB8/I2C SCL	Digital	PB8 or I2C Serial Clock
10	GND	Supply	GND

Figure5.: Tag bottom-side connector pinout

Top Side pads :

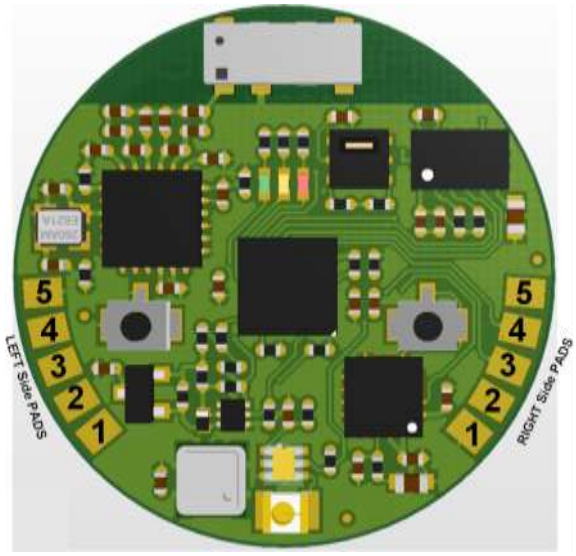


Figure6.: Tag top-side pads implantation

To allow an easy connection to another application, the ALPW-BLETAG001 has 10 pads on its top side, that export the following signals:

	Signal Name	Type	Description
LEFT Side pads			
1	VDD	Supply	Main Power supply
2	BOOT0	Digital	MCU BOOT Selection
3	PA9/USART1 TX	Digital	PA9 or USART1 Transmit data
4	PA10/USART1 RX	Digital	PA10 or USART1 Received data
5	GND	Supply	GND
RIGHT Side pads			
1	GND	Supply	GND
2	PB12	Digital	PB12 / ADC Input 18
3	PA2	Digital	PA2 / ADC Input 2
4	PA1	Digital	PA1 / ADC Input 1
5	VDD	Supply	Main power source

Figure7.: Tag top-side pads pinout

2.2 Embedded Sensors

2.2.1 Overview

	Sensor Type	Manufacturer	Part name	Description
U3	Gyroscope	ST Microelectronics	L3G4200D	MEMS motion sensor, three-axis gyroscope
U5	Barometric Pressure	Bosh Sensortec	BMP180	Digital, barometric pressure sensor
U7	Humidity and Temperature	Sensirion	SHT21	Humidity and Temperature sensor IC
U4	Light Proximity	Taos	TSL27713FN	Light to digital converter with proximity sensing
U6	Accelerometer and Magnetometer	ST Microelectronics	LSM303DLHC	High performance e-compass, 3D accelerometer and 3D magnetometer module

Figure8.: Sensors overview

2.2.2 Gyroscope

MCU Pin	Direction	Sensor	Description
PB8 / I2C1_SCL	→	SCL	
PB9 / I2C1_SDA	←→	SDA	
PC10	←	INT2	
PC11	←	INT1	

Figure9.: Gyroscope to MCU connection

The ST Microelectronics L3G4200D is a low-power three-axis angular rate sensor with digital output, integrating a MEMS mechanical sensing element along with a CMOS IC.

Symbol	Description	Note	Min	Typ.	Max	Unit
FS	Measurement range		±250	±500	±2000	°/sec (dps)
AXES	Number of sensing axes		-	3	-	-
NL	Non linearity		-	0.2	-	%FS
T	Working temperature range		-40	-	+85	°C
Sg	Shock Survivability	*Acceleration g for 0.1ms*	-	10000	-	*g*
ODR	Output data rate	*User Selectable*		100 200 400 800		Hz
So	Sensitivity	*FS=250 dps*		130		mdps/ digit
		FS=500 dps		*200*		
		FS=2000 dps		*70*		
ZRT	Zero Rate Level[1]	*FS=250 dps*		±10		Dps
		FS=500 dps		±15		
		FS=2000 dps		±75		

Idd	Supply current			6.1		mA
Idd_{slp}	Supply current in sleep mode			1.5		mA
Idd_{pd}	Supply current in power-down mode			5		µA

[1] : *Zero rate level when no velocity applied*

Figure10.: Gyroscope characteristics

2.2.3 Barometric Pressure

The BMP180 is a high performance, ultra low power barometric pressure sensor from Bosh Sensortec, based on a piezo-resistive stain gauge technology.

MCU Pin	Direction	Sensor	Description
PB8 / I2C1_SCL	→	SCL	
PB9 / I2C1_SDA	←→	SDA	

Figure11.: Barometric pressure sensor to MCU connection

Symbol	Description	Note	Min	Typ.	Max	Unit
FS	Measurement range		300	-	1100	hPa
ACC	Absolute accuracy pressure	*0°C to +65°C*	-4.0	-1.0	+2.0	hPa
		-20°C to 0°C	-6.0	-1.0	+4.5	
RES	Resolution of output data			0.01		hPa
Tconv	Conversion Time	Ultra low power mode		3	4.5	ms
		Standard mode		5	7.5	
		High Resolution mode		9	13.5	
		Ultra high resolution mode		17	25.5	
		Advanced resolution mode		51	76.5	
Idd	Current Consumption in various operational modes	Ultra low power mode	-	3	-	*µA*
		Standard Mode	-	5	-	
		High resolution mode	-	7	-	
		Ultra high resolution mode	-	12	-	
		Advanced resolution mode	-	32	-	
		Peak current during conversion	-	650	1000	
		Standby current @25°C	-	0.1	-	
NOISE	RMS Noise	Ultra low power mode	-	0.06	-	hPa
		Standard mode	-	0.05	-	
		High Resolution mode	-	0.04	-	
		Ultra high resolution mode	-	0.03	-	
		Advanced resolution mode	-	*0.02*	-	

Figure12.: Barometric pressure sensor characteristics

From the pressure measurement, the altitude can be calculated as follows:

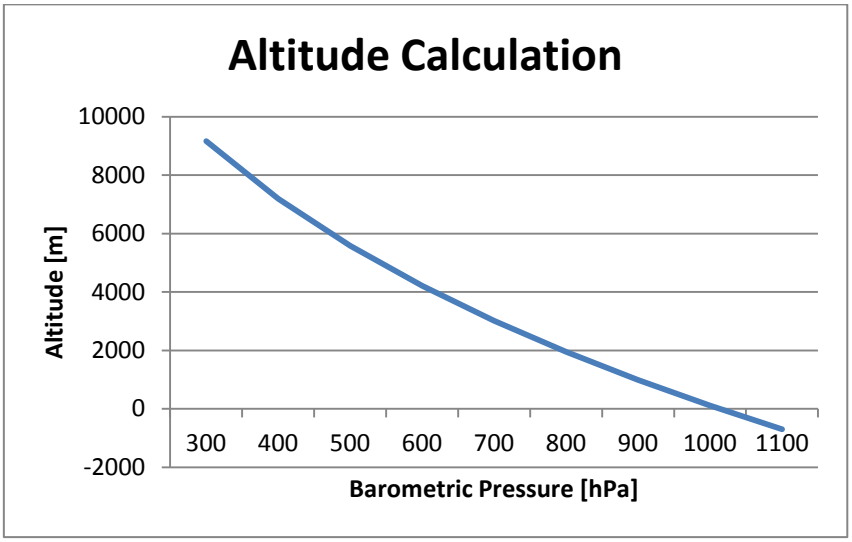


Figure13.: Altitude calculation formula

2.2.4 Humidity and Temperature

The Sensirion SHT21 is a temperature and humidity sensor with I2C interface.

MCU Pin	Direction	Sensor	Description
PB8 / I2C1_SCL	→	SCL	
PB9 / I2C1_SDA	←→	SDA	

Figure14.: Humidity and temperature sensor to MCU connection

Symbol	Description	Note	Min	Typ.	Max	Unit
FS	Measurement range	*Humidity*	0		100	%RH
		Temperature	-40		+125	°C
ACC	Accuracy	*Humidity*	-	±2.0	-	%RH
		Temperature	-	±0.3	-	°C
NL	Non Linearity	*Humidity*			0.1	%RH
DRIFT	Long Term Drift	*Humidity*			0.5	%RH/ yr
		Temperature			0.04	°C/yr
Idd	Current Consumption	*Sleep Mode*		0.15	0.4	µA
		Measuring	200	300	330	µA

Figure15.: Humidity and temperature sensor characteristics

2.2.5 Light proximity

The TSL2771 is light-to-digital converter with proximity sensing. The ambient-light sensing element converts the data of two photodiodes and integrates it to approximate the human eye response.

The proximity sensing element uses an external infrared LED as light source and measure the amount of reflected light.

MCU Pin	Direction	Sensor	Description
PB10 / I2C1_SCL	→	SCL	
PB11 / I2C1_SDA	←→	SDA	
PC1	←	INT	Active low

Figure16.: Ambient light sensor to MCU connection

Symbol	Description	Note	Min	Typ.	Max	Unit
D	Proximity detection operating distance[1]			45		cm
Idd	Current Consumption	*Active – LDR pulses off*	-	175	250	µA
		Wait mode	-	65	-	µA
		Sleep Mode (no I2C activity)	-	2.5	4	µA

[1]: Operating distance highly depends on the reflecting surface used.

Figure17.: Ambient light sensor characteristics

2.2.6 Accelerometer and magnetometer

The ST Microelectronics LSM303DLHC is a high performance 3D accelerometer and 3D magnetometer module.

MCU Pin	Direction	Sensor	Description
PB10 / I2C1_SCL	→	SCL	
PB11 / I2C1_SDA	←→	SDA	
PC2	←	DRDY	
PC3	←	INT1	
PC4	←	INT2	

Figure18.: Accelerometer/magnetometer sensor to MCU connection

Symbol	Description	Note	Min	Typ.	Max	Unit
FS_{acc}	Linear acceleration measurement range	*User Selectable*	-	±2 ±4 ±8 ±10	-	*g*
FS_{mag}	Magnetic measurement range	*User Selectable*	-	±1.3 ±1.9 ±2.5 ±4.0 ±4.7 ±5.6 ±8.1	-	gauss
S_{acc}	Linear acceleration sensitivity	±2g range	-	1	-	mg/ LSB
		±4g range	-	2	-	
		±8g range	-	4	-	
		±10g range	-	12	-	
$G_{magnetic}$	Magnetic Gain Setting	Depends on the magnetic measurement range	205	-	1100	LSB/ Gauss
Zg_{acc}	Zero-g offset level			±60		Mg
R_{mag}	Magnetic resolution			2		mgau ss
T	Operating temperature range		-40	-	+85	°C

Figure19.: Accelerometer/magnetometer sensor characteristics

2.3 User Interface

2.3.1 LEDs

MCU Pin	Direction	LED	Description
PC7	→	Green LED	Active low
PC8	→	Red LED	Active low
PC9	→	Yellow LED	Active low

Figure20.: LEDs to MCU connection

2.3.2 Buzzer

MCU Pin	Direction	Buzzer	Description
PB6	→	Buzzer pin 1	PWM output
PB7	→	Buzzer pin 2	PWM output

Figure21.: Buzzer to MCU connection

2.3.3 Switches

MCU Pin	Direction	Switch	Description
PA0	←	SW1	Active high
PC12	←	SW2	Active low or high

Figure22.: Switches to MCU connection

2.4 Bluetooth Low Energy Controller

MCU Pin	Direction	BLE Controller	Description
PA4/SPI1_NSS	→	SPI CS	Active low
PA5/SPI1_SCK	→	SPI SCK	
PA6/SPI1_MISO	←	SPI MISO	
PA7/SPI1_MOSI	→	SPI MOSI	
PA8	→	RST	Active high
PA3	←	IRQ	Active low

Figure23.: Bluetooth Low Energy controller to MCU connection

2.5 Power Supply

The ALPW-BLETAG001 is designed to operate from a single 3V CR2032 coin-cell battery.

2.5.1 Battery Characteristics

Symbol	Description	Note	Min	Typ.	Max	Unit
V_{batt}	Battery Nominal Voltage		-	3.0	-	V
C_{batt}	Battery typical capacity		-	225	-	mAh
$I_{discharge}$	Discharge current		-	0.2	3	mA
I_{peak}	Peak Discharge current		-	-	15	mA

Figure24.: Battery characteristics

The TAG consumption depends on the application itself (autonomy, current peaks …) and power management. Consequently, the type of battery results of current consumption and the necessary capacity to run the application.

For a common application the CR2032 battery will be used, otherwise external power supply can be possible.

Take care of the polarity of the battery: the minus side must be in contact with the board, the plus side is in contact with the battery holder.

2.6 Microcontroller

The ALPW-BLETAG001 embeds a low-power Cortex M3 microcontroller from ST Microelectronics

Symbol	Description	Note	Min	Typ.	Max	Unit
Sysclk	System Clock Frequency		0,032	-	32	MHz
M_{FLASH}	Flash Memory			128		kBytes
M_{RAM}	RAM Memory			16		kBytes
M_{EEPROM}	EEPROM Memory			4		kBytes
RES_{ADC}	ADC Resolution		-	12	-	Bits

Figure25.: Microcontroller characteristics

The microcontroller can be programmed through the Serial-Wire Debug (SWD) interface, accessible on the bottom-side connector.

Alpwise provides a tag programming board, which adapts the tag connector to a standard 20-pins SWD connector. Refer to chapter 9.3 for more information.

3 Device operating requirements

3.1 Absolute Maximum Ratings

The absolute maximum ratings listed below have not been tested, and correspond to the main components specifications. Stresses beyond those limits may cause permanent damage to the module.

Symbol	Description	Note	Min	Typ.	Max	Unit
Vdd-Vss	Main Supply Voltage		-0.2	-	3.6	V
Vin	Input Voltage on any pad		-0.2	-	4.0	V
|Vssx – Vss|	Voltage difference between all power or ground pins		-	50	-	mV
$V_{ESD(HBM)}$	Electrostatic discharge (Human Body Model)		-	2000	-	V
V_{RF_IN}	Input RMS voltage to RF pin		-0.5	-	2.1	V
$T_{storage}$	Storage temperature range		-50	-	+105	°C

Figure26.: Absolute maximum ratings

3.2 Recommended operating conditions

Symbol	Description	Note	Min	Typ.	Max	Unit
Vdd-Vss	Supply Voltage		2.0	3	3.5	V
Vin	Input voltage on any pad		0	-	3.6	V
T°	Operational Temperature Range		-10	-	+85	°C
		Other	-	530	-	mW

Figure27.: Recommended operating conditions

3.3 Power Consumption

Average current consumption	
Sleep mode	8.6µA
Average current in Advertising state (Tadv = 1,28s)	91.4µA
Average current in Connection state, TI = 500ms (without sending data)	915µA
Average current in Connection state, TI = 500ms (with sending data), multislot transfer	970µA
Static current consumption	
TX/RX pulse : connection state + data sending	12.6mA
TX/RX peak : connection state + data sending	14.6mA

Figure28.: Power consumptions

3.4 Electrical Characteristics

3.4.1 RF Electrical Characteristics

Symbol	Description	Note	Min	Typ.	Max	Unit
F_{RF}	Operational RF Frequency		2402		2480	MHz
B_{ch}	Channel Spacing		-	1	-	MHz
Z_{in}	Input Impedance		-	50	-	Ohms
S_{in}	Sensitivity		-80	-	-	dBm
P_{RF}	Ouput RF Power	Software Programmable	-18	-	+3	dBm
$P_{out-of-band}$	Out of band emissions	30kHZ to 1Ghz	-	-	-30	dBm
		1 to 12.75GHz	-	-	-30	dBm
		2^{nd} Harmonic	-	-	-30	dBm
		3^{rd} Harmonic	-	-	-30	dBm

Figure29.: RF Characteristics

4 Software

4.1 Embedded Firmware

Libraries and software modules are available to empower your product designs.

Alpwise provides API's for:

- User Interface capabilities
- Sensor drivers
- *Bluetooth* low energy core stack and profiles

Qualified *Bluetooth*® low energy protocol stack with GAP, SMP, ATT, L2CAP and GATT protocols.

Alpwise provides a continuously updated list of profiles :

- Alpwise Data Exchange Profile
- Health Thermometer Profile
- Find Me Profile,
- Proximity Profile
- Time Profile
- Phone Alert Status Profile
- Heart Rate Profile,
- Human Interface Device Profile
- Alert Notification Profile

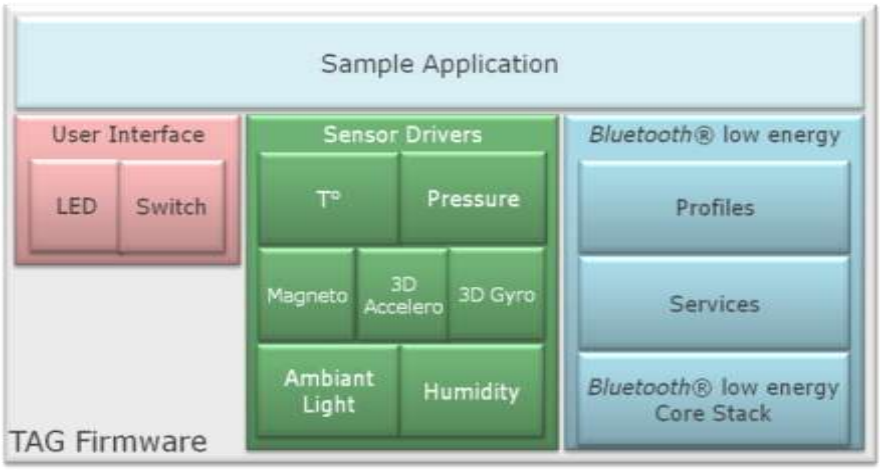


Figure30.: Software architecture

4.2 Smartphone Application

Alpwise provides OEM Firmware to handle remote sensor and control mechanism from iOS or Android Apps.

- Profiles and Services are plugged above IOS/Andoid Native BLE Core Stack
- Specific customer development can be done

The Alpwise BLE App is part of the Alpwise network of things approach, and complements all the existing Alpwise's Bluetooth® 4.0 products to offer a complete end-to-end product development solution.

It is compatible with all Bluetooth Smart accessories.

It supports Proximity profile, Find Me profile and Battery Profile, Health Thermometer, ALPW Weather Station, ALPW Free Fall Detection, ALPW Light and ALPW Light Switch. A "Featured" section offers the possibility to build a weather station and to control light with your device.

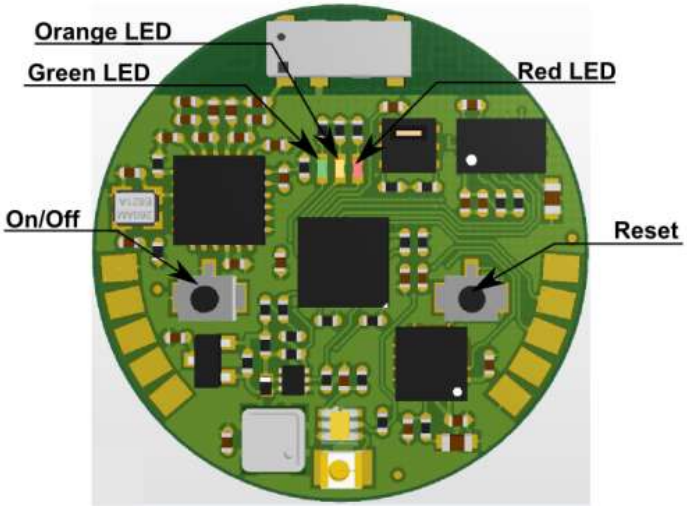
The Alpwise BLE App allows the development of Bluetooth Low Energy applications with Alpwise's BLE solutions like tags (ALPW-BLETAG) or development kits (ALPW-BLEDVK).

4.3 Quick Start Demonstration

Download the Alpwise BLE application and install it on your peripheral.

1. First, insert the battery into the battery holder. Respect the polarity.

2. Push the On/Off switch to switch on the ALPW-BLETAG001. This switch completely switches off the TAG (no power consumption).



3. When powered up, the green light starts blinking. If it doesn't, try replacing the battery and restart the device. It the orange LED lights up, replace the battery.

Green LED	This led blinks when the tag is discoverable and connectable This led is on when the tag is connected This led can be on or off or blinking during a demonstration
Orange LED	This led blinks in case of error, or proximity alert
Red LED	This led can be on or off or blinking during a demonstration

5 Product Dimensions

5.1 Mechanical Dimensions

The ALPW-BLETAG001 has a diameter of 28.0mm. The figure below shows the position of the LEDs, buttons and holes. The module has a thickness of about 6.5mm (4.2mm for the battery holder, 1.1mm for the PCB, and 1.2mm for the components) (6.9mm including the height of the buttons). The step model of the TAG is available upon request.

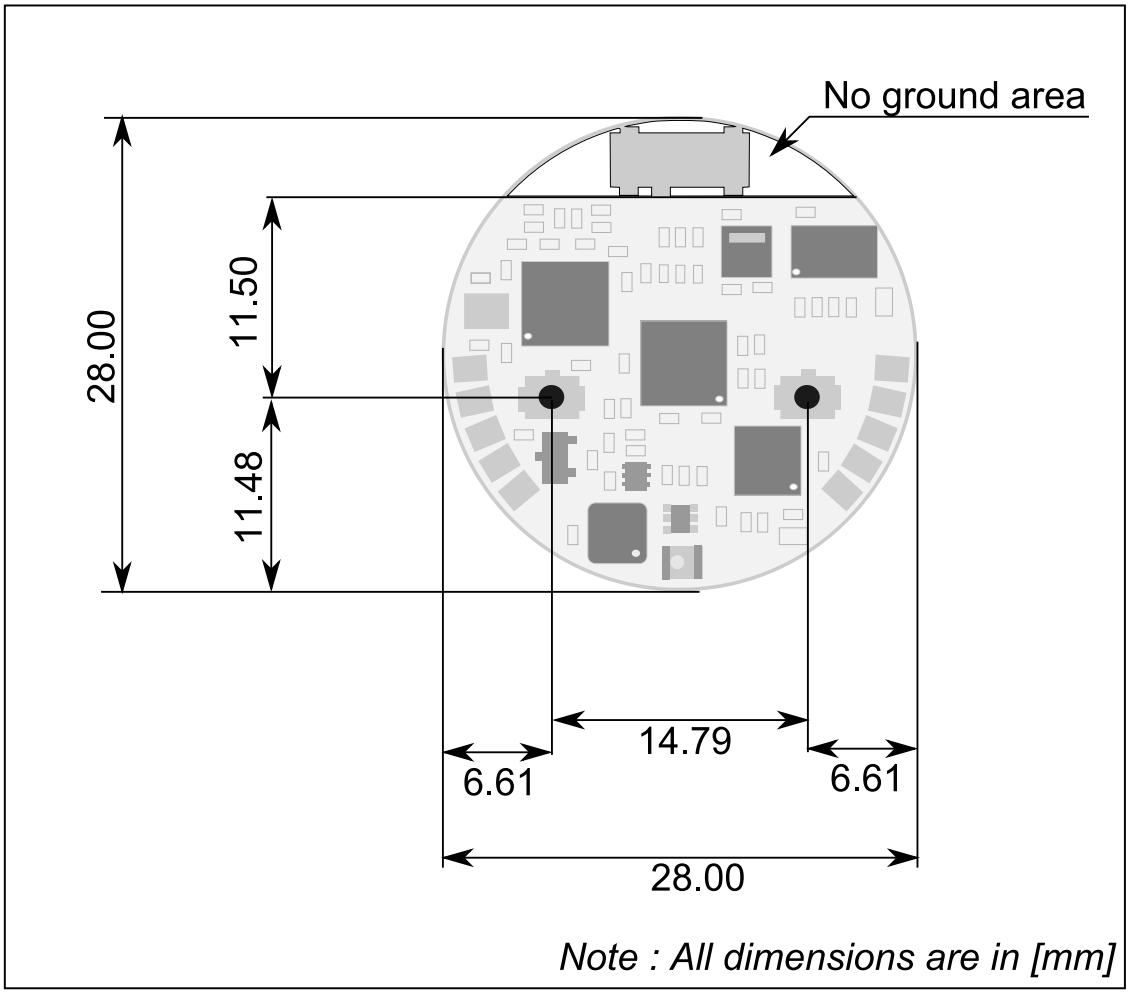


Figure31.: Tag mechanical dimensions

6 Cautions

6.1 Design notes

The user must deliver a low-noise power supply to the module, without AC ripple voltage. Noisy supply voltages must come with a decoupling circuit (serial ferrite bead connected to a shunt capacitor to ground).

The product should be mechanically stressed when installed.

6.2 Installation notes

Do not wash the product.

6.3 Usage conditions notes

This product has limited ESD protection. Take measures to protect the unit against static electricity, especially in dry atmosphere.

Follow the operating conditions regarding the power supply applied to the product.

This product is intended for general purpose and standard use in general electronic equipment. For applications in a particular environment, please contact the technical support.

Dispose the battery properly and keep out of reach of children. If swallowed, contact a physician immediately.

6.4 Storage notes

In order to preserve the performance characteristics of the module, do not store the product in the following conditions :

- Storage in an environment where the temperature may be outside the 5°C to 35°C range
- Storage in an environment where the humidity may be outside the 45% to 85% range
- Storage of the product for more than 1 year after the date of delivery

6.5 Other Cautions

The datasheet document is copyrighted.

Do not use this product for other purposes than those listed

7 Environmental Consideration

Alpwise is committed to respecting the environment and the regulations of the countries where we do business.

One important regulation is the European Union's Directive 2002/95/EC, Restriction on Use of Hazardous Substances (RoHS), which has strict rules regarding products put on the European market after July 1, 2006.

Alpwise will mark RoHS compliant products with this symbol on the package and/or barcode label:

8 Regulatory Information

CE / FCC / Canada / Japan certification pending.

Bluetooth SIG Statement pending.

9 Resources

9.1 Related Documents

- Alpwise Bluetooth Low Energy Software Development Kit
- Bluetooth SIG Specification
- ST Microelectronics STM32L152 Datasheet
- ST Microelectronics L3G4200D Datasheet
- ST Microelectronics LSM303DLHC Datasheet
- Bosh Sensortec BMP180 Datasheet
- Sensiron SHT21 Datasheet
- Taos TSL27713 Datasheet

9.2 Software Resource

SDK supporting Bluetooth Low Energy protocol stack exists. Pease contact our sales support to get the right information and find the best solution for your application

9.3 Hardware Resource

The ALPW-BLETAG001 can be delivered along with a programming board, to adapt a standard 20-pins debug connector to the tag connector.

For more information about our product line, please contact our sales support

9.4 Support

For any technical questions regarding usage of this tag, please consider the following email address:

alpwisesales@alpwise.com

9.5 Sales

For any commercial questions regarding access of this tag, please consider the following email address:

alpwisesales@alpwise.com

9.6 Contact information

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