



FEATURES

- Ready-to-use *Bluetooth®* low energy module
- Ultra Small form factor 12mm x 19mm
- Ultra Low Power consumption
- EM9301 2.4 Ghz *Bluetooth®* low energy controller
- Complete connectivity
- LGA footprint for easy integration
- Embedded ARM Cortex M0 micro-processor, to allow an easy user application development based on the *Bluetooth®* Low energy protocol stack.
- 64 kBytes Flash, 8 kBytes RAM
- 48 MHz max. CPU frequency

APPLICATIONS

- Medical Devices
- Mobile Accessories
- Sport and Fitness
- Entertainment Devices
- Wireless Sensors
- Consumer Electronics
- Monitoring and Control
- Industrial
- Building Automation



DESCRIPTION

The ALPW-BLEM003 module is a complete ready-to-use single-mode *Bluetooth®* low energy compliant solution.

The ALPW-BLEM003 module combines ultra low power hardware design and a complete *Bluetooth®* Low Energy protocol stack.

The ALPW-BLEM003 embedded module integrates a 64kBytes flash, 48 MHz Cortex M0 microcontrollers able to run the *Bluetooth®* Low Energy protocol stack, profiles and user application.



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1 Order codes

Below is an overview on the Alpwis module product line:

Product Order Code	Optional Shielding
ALPW-BLEM003-A REV B	Mounted
ALPW-BLEM003-B REV B	Not Mounted

2 Product Description

The ALPW-BLEM003 is designed around the EM Microelectronic Marin EM9301 *Bluetooth*[®] Low Energy controller. The EM9301 features a low power physical layer, a link layer with an embedded security engine, a Host Controller Interface (HCI), and a powerful power management.

A Cortex M-0 microcontroller is also embedded on the module, and is delivered with an integrated ALPWISE *Bluetooth*[®] Low Energy SDK. The ALPW-BLESDK for BLEM003 provides a complete environment to ease engineers to integrate the single mode *Bluetooth*[®] Low Energy stack and profiles into their products.

The microcontroller can operate at 48MHz, and embeds 64kBytes of flash memory.

The module is accessible through UART or I2C Interface. 4 Analog to digital converters are available for the user, as well as 16 GPIOs (depending on pins multiplexing).

2.1 Functional Block Diagram

Below is a functional block diagram:

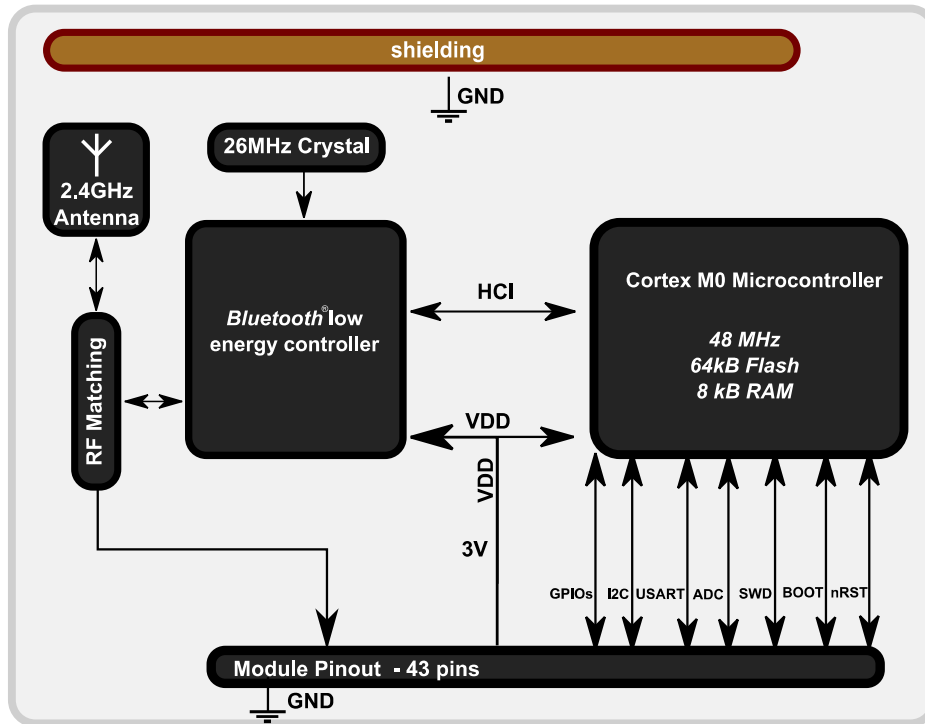
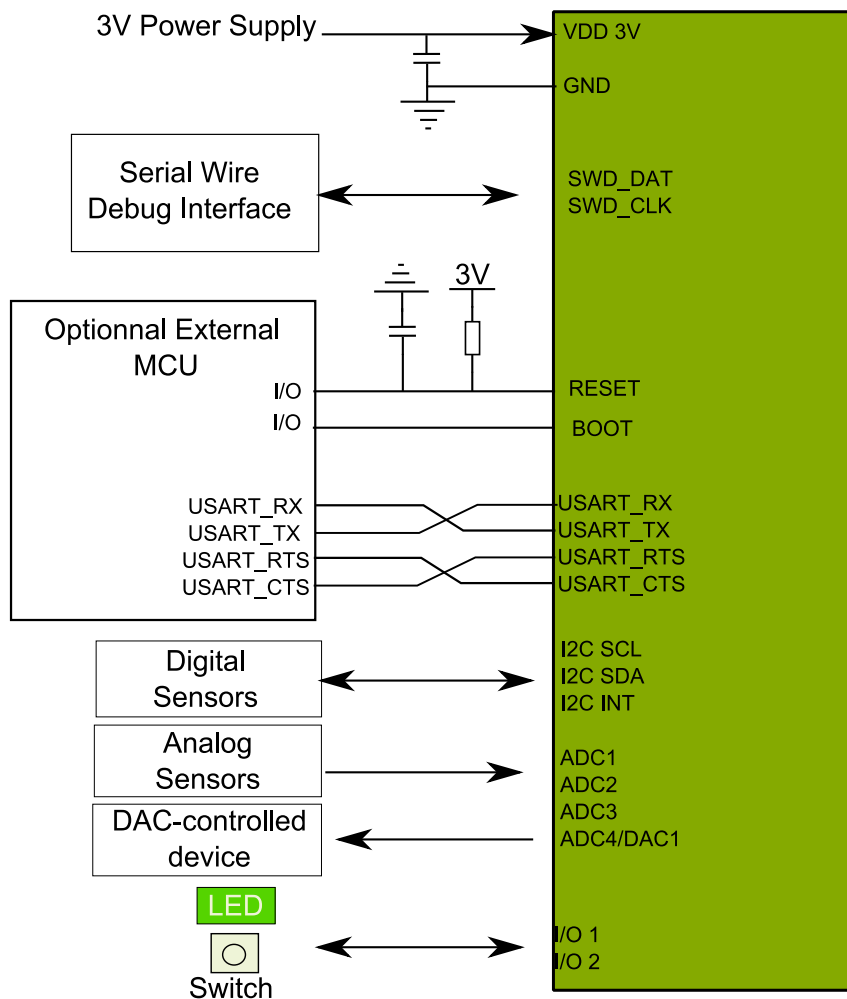


Figure1.: ALPW-BLEM003 block diagram

Below is a typical application diagram, showing how to easily design your own applications around the ALPW-BLEM003.



Optionnal User Peripheral

ALPW-BLEM003

Figure2.: ALPW-BLEM003 typical application

Although the module itself is fully autonomous, it can be easily connected to the user external peripherals: an optional MCU, sensors, LEDs or switches.

3 Detailed Description

3.1 Module Pin Description

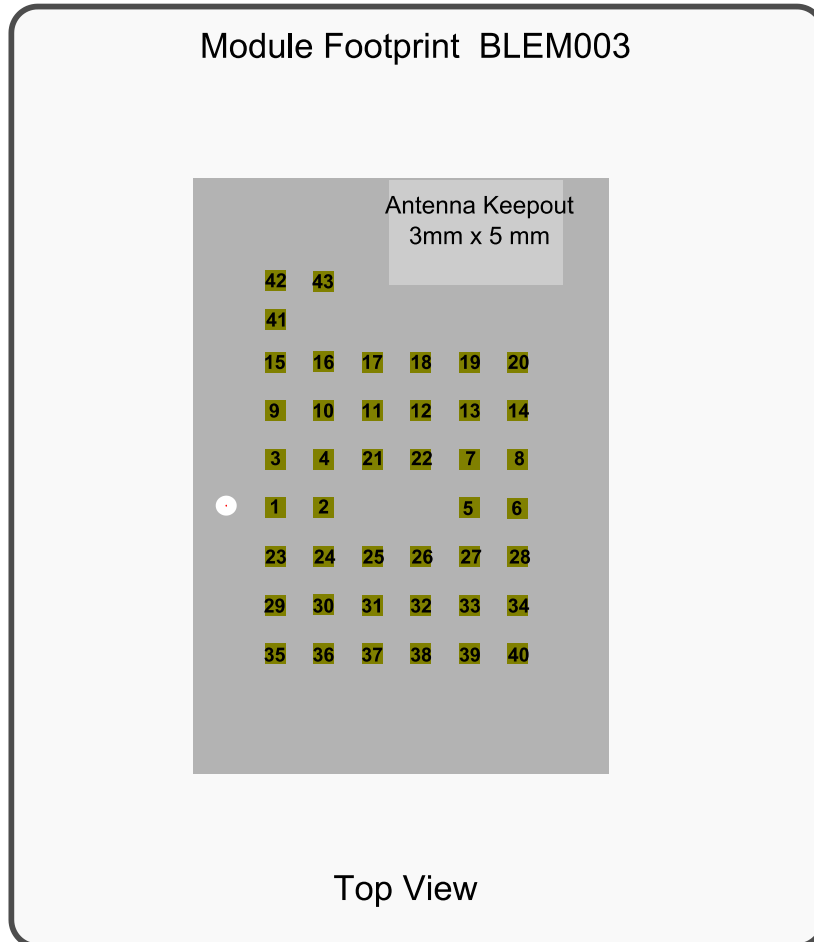


Figure3.: Module pin numbering (Top View)

LGA43 pin	Signal Name	Type	Description	Cortex-M0 Connection
1	GND	Supply	Ground	GND
2	NC	-	-	-
3	ADC4	Analogue	Analog-to-Digital Converter Input	PB1 (ADC Channel 9)
4	ADC3	Analogue	Analog-to-Digital Converter Input	PA2 (ADC Channel 2)
5	USART_RTS	Digital	USART bus Request to send	PA12 (USART 1)
6	USART_CLK	Digital	USART bus clock	PA8 (USART 1)
7	USART_CTS	Digital	USART bus Clear to send	PA11(USART 1)
8	VDD 3,3V	Supply	3.3V supply to the module.	VDD
9	GND	Supply	Ground	GND
10	NC	-	-	-
11	USART_TX	Digital	USART bus transmit	PA9 (USART 1)
12	NC	-	-	-
13	NC	-	-	-
14	GND	Supply	Ground	-
15	BOOT	Digital	BOOT mode selection pin Internally Pulled down	BOOT0
16	USART_RX	Digital	USART bus receive	PA10 (USART 1)
17	NC	-	-	-
18	NC	-	-	-
19	NC	-	-	-
20	NC	-	-	-
21	GND	Supply	Ground	GND
22	GND	Supply	Ground	GND
23	SWD_DAT	Digital	Serial Wire Debug Data	PA13
24	I2C_SMBA	Digital	I2C bus Alert	PB5 (I2C1)
25	GND	Supply	Ground	GND
26	GND	Supply	Ground	GND
27	VDDA	Supply	Analogue Supply to MCU	VDDA
28	ADC1	Analogue	Analog-to-Digital Converter Input	PB0 (ADC Channel 8)
29	SWD_CLK	Digital	Serial Wire Debug Clock	PA14
30	IO2	Digital	General purpose Input/output	PF1
31	NC	-	-	-
32	NC	-	-	-
33	I2C_SCL	Digital	I2C bus Serial Clock	PB6 (I2C1)
34	I2C_SDA	Digital	I2C bus Serial Data	PB7 (I2C1)
35	ADC2	Analogue	Analog-to-Digital Converter Input	PA1 (ADC Channel 1)
36	IO1	Digital	General purpose Input/output	PF0
37	MCU NRST	Digital	MCU Reset Signal	NRST
38	NC	-	-	-
39	NC	-	-	-
40	GND	Supply	Ground	GND
41	GND	Supply	Ground	GND
42	RF_OUT	RF	50 ohms RF output	-
43	GND	Supply	Ground	GND

3.2 Power Supply

The module is designed to operate within a 2.0V to 3.6V voltage range. User should ensure a proper filtering of its power supply: a ferrite bead, connected to a shunt capacitor to the ground (10uF typically) is a good practice.

3.3 Clocking

3.3.1 Module Clocking

The Cortex M0 microcontroller is clocked by its own High Speed Internal (HSI) RC oscillator. The HSI oscillator delivers a 8MHz clock reference. The microcontroller can run at 48MHz through the PLL.

Symbol	Description	Note	Min	Typ.	Max	Unit
Fc	Frequency		-	8	-	MHz
Ic	HSI current consumption		-	80	100	μA
Ts	Startup time		1	-	2	μs
Dacc	Accuracy	-10°C to 70°C	-2.9	-	2.9	%
		25°C	-1	-	1	%

3.4 Reset

3.4.1 Module Reset

The microcontroller reset signal is accessible on the pads of the module. Note that the signal is floating and not filtered on the module. The reset signal should be pulled up and filtered with a shunt capacitor (typically 100nF) to the ground.

To ensure a proper reset of the cortex-M0 microcontroller, the reset signal should remain low for at least 10ms.

4 Device operating requirements

4.1 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
V _{dd-Vss}	Main Supply Voltage		-0.2	-	3.8	V
V _{in}	Input Voltage on any pin		-0.2	-	4.0	V
V _{SSX} – V _{SS}	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

4.2 Recommended operating conditions

Symbol	Description	Note	Min	Typ.	Max	Unit
V _{dd-Vss}	Supply Voltage		2.0	3	3.5	V
V _{in}	Input voltage on any pin		0	-	3.6	V
T°	Operational Temperature Range		-10	-	+85	°C
		Other	-	530	-	mW

4.3 Power Consumption

4.3.1 Static current consumption

T = 25°C

Symbol	Description	Note	Min	Typ.	Max	Unit
I _{RX}	RX peak Current		-	-	25	mA
I _{TX}	TX peak Current		-	-	26	mA
I _{idle}	Idle Mode Current	MCU is in STOP mode Radio Controller in Idle mode	-	294	-	µA
I _{sleep}	Sleep Mode Current	MCU in Stop Mode Radio controller in Sleep mode	-	24	-	µA
I _{off mode}	OFF Mode Current	MCU in stop mode Radio controller in off-mode	-	14	-	µA

4.3.2 Bluetooth® Low Energy Application current consumption

$T = 25^{\circ}\text{C}$, $P_{RFout} = +3\text{dbm}$

Symbol	Description	Note	Min	Typ.	Max	Unit
I_{ADV}	Average Advertising current consumption	Advertising Interval set to 200ms	-	273	-	μA
I_{CON}	Average current in connected mode	500ms	-	240	-	μA
		1.28s	-	214	-	μA
		4.0s	-	194	-	μA
$I_{BLE\ Sleep}$	Current consumption in BLE Sleep Mode	MCU in Stop mode, Radio controller in BLE Sleep mode	-	62	-	μA

4.4 Electrical Characteristics

4.4.1 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		-80dBm	-	-	dBm
P_{RF}	Output 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

5 Soldering recommendations

To avoid damaging the module components, the following reflow profile should be observed.

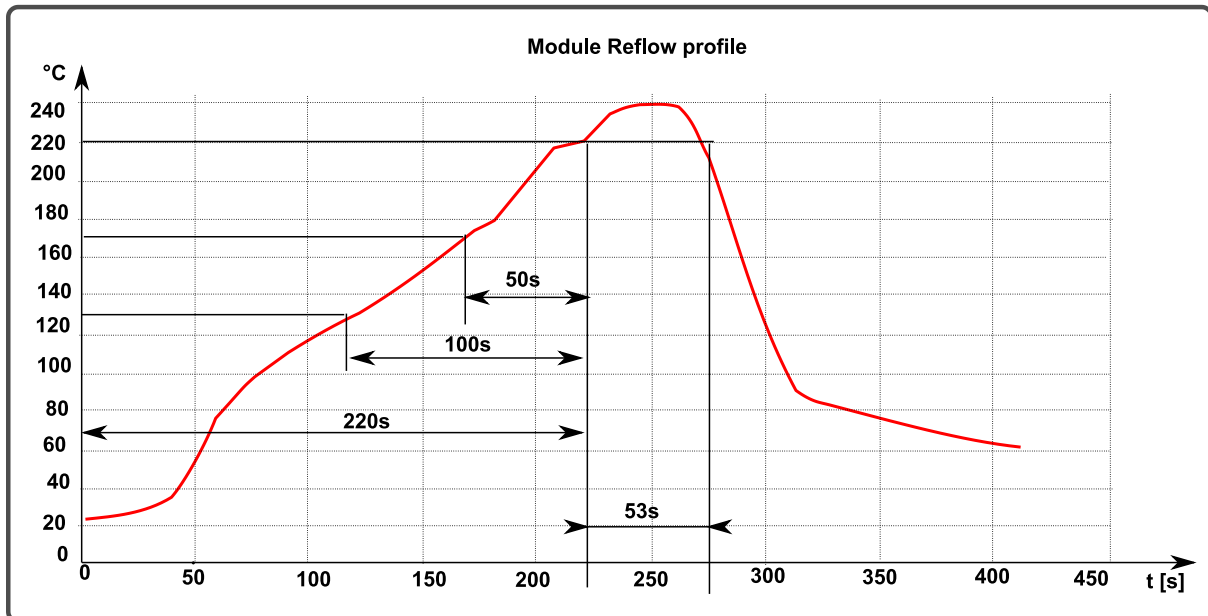


Figure4.: Recommended reflow profile

6 Product Dimensions

6.1 External Dimensions

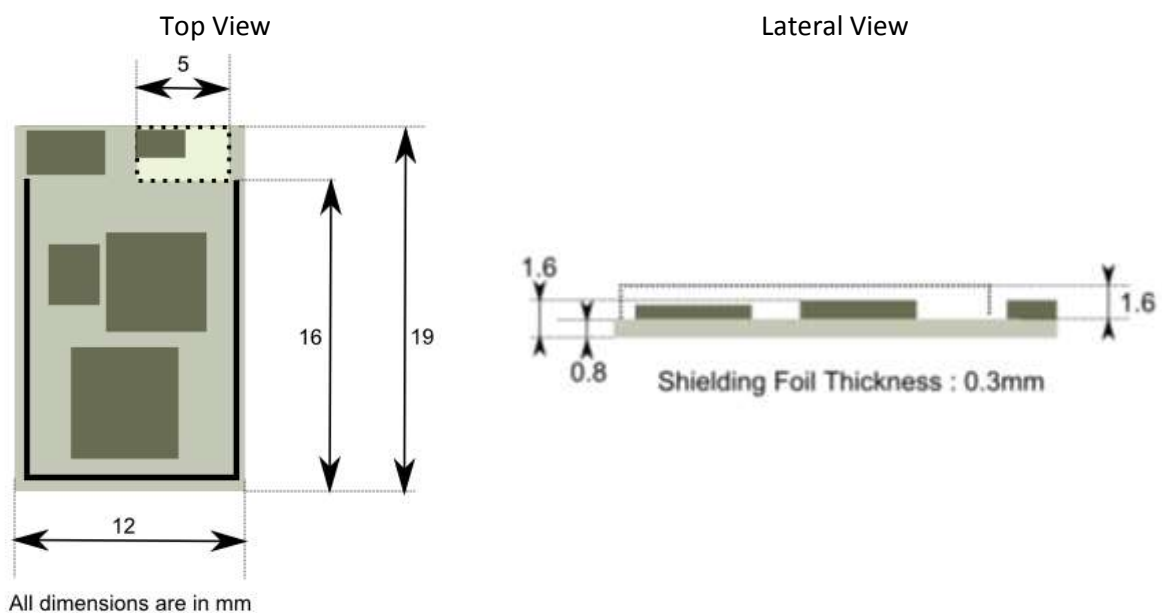


Figure5.: Product dimensions

6.2 Footprint

The LGA-43 footprint of the module is detailed below.

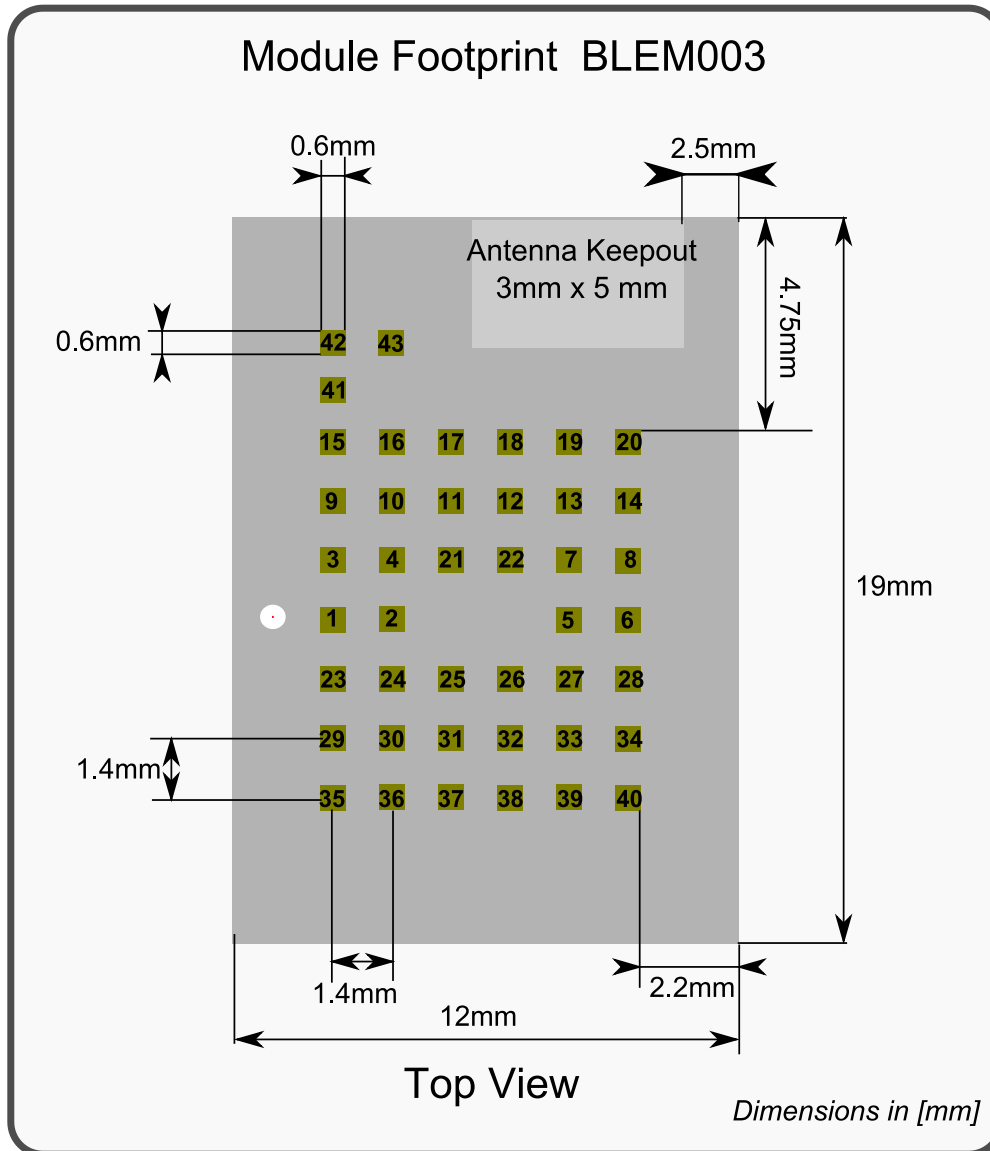


Figure6.: Module footprint (Top View)

6.3 Top Side marking

The picture below shows the typical product printed codes :



Figure7.: Product top-side marking

Code	Meaning
ALPWBLEM003BA	ALPW-BLEM003, Hardware REV B, option A
FCC ID	FCC mandatory identification

7 Recommended Layout

When implementing the module on a custom PCB, the antenna clearance zone must be respected by all means:

- No ground
- No copper tracks, via, on any layer of the pcb.

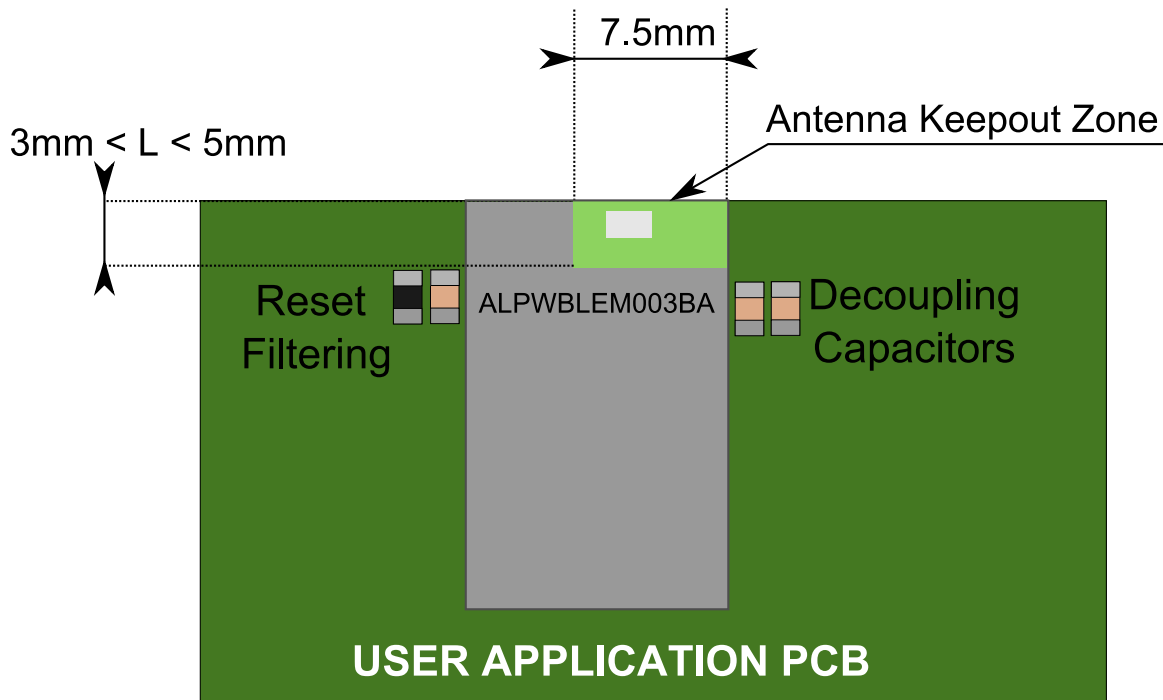


Figure8.: Recommended end-application PCB integration

8 Cautions

8.1 Design notes

The antenna keep out zone must be respected by all means. If the module cannot be implemented as recommended in chapter 7, then the antenna keep out zone must correspond to a no-copper region on every layer of the PCB.

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.

Refer to the recommended design when designing a board.

8.2 Installation notes

Reflow soldering is possible, according to the recommendations in chapter 5.

Do not wash the product.

8.3 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.

8.4 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

8.5 Other Cautions

The datasheet document is copyrighted.

Do not use this product for other purposes than those listed

9 Packaging

Individual modules come in anti-electrostatic plastic bag.

For more packaging possibilities, please contact our sales support.

10 ROHS Declaration

Upcoming subcontractor certificate.

11 Regulatory Information

CE / FCC / Canada / Japan certification pending.

Bluetooth[®] SIG Statement pending.

12 Resources

12.1 Related Documents

Alpwise *Bluetooth*® Low Energy Software Development Kit

Bluetooth® SIG Specification

12.2 Software Resource

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

12.3 Hardware Resource

The ALPW-BLEM003 is embedded on our ALPW-BLEASY kit, designed to ensure an easy evaluation of our product, and an easy development of your application.

The kit provides an adaptation for the ALPW-BLEM003 module, with USB power supply and a debug connector.



Furthermore, for sensor application, the ALPW-DVBBLE *Bluetooth*® Low Energy Development board can be connected to the kit. The board integrates an accelerometer, temperature sensor, LEDs and switches to ease sensor application development.

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

12.4 Support

For any technical questions regarding usage of this *Bluetooth*® module, please consider the following Email address:

alpwiseales@alpwise.com

12.5 Sales

For any commercial questions regarding access of this *Bluetooth*® module, please consider the following Email address:

alpwiseales@alpwise.com

12.6 Contact information

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