ALPW-BLEM003

Bluetooth® Smart Embedded Module

DESCRIPTION

The ALPW-BLEM003 is a ready-to-use single-mode *Bluetooth®* Low Energy compliant module targeting stand-alone and low-power applications.

The ALPW-BLEM003 module combines low power hardware design and a complete *Bluetooth®* Low Energy protocol stack to ease its integration. The ALPW-BLEM003 can be powered directly from a widely spread 3V coin cell.

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.

FEATURES

- Ready-to-use *Bluetooth®* v4.0 Low Energy Smart Embedded Module
- Low power consumption
- Complete connectivity
  - UART, I2C, GPIO, ADC, DAC
- LGA-43 footprint for easy integration
- Embedded ARM Cortex M0 microcontroller with 48MHz max. CPU frequency
- Radio characteristics
  - TX Power : 3dBm to -18dBm
  - RX Sensitivity : -80dBm
  - Typical free-space range : 20m
- RF Output for external antenna connection
- Dimensions : 12 x 19 x 2.2 mm
- *Bluetooth®* SIG, CE, FCC and IC qualified

APPLICATIONS

The ALPW-BLEM003 facilitates the integration of cost-effective and low power consumption wireless technologies for a wide range of application segments, thanks to a continuously updated and qualified list of services and profiles.

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

Table of Contents

Table of Figures

1 Product Description

The ALPW-BLEM003 is a *Bluetooth*® Low Energy compliant module that can be used in a stand-alone configuration. The embedded cortex-M0 microprocessor allows running the ALPWISE *Bluetooth*® Low Energy complete protocol stack as well as the user application.

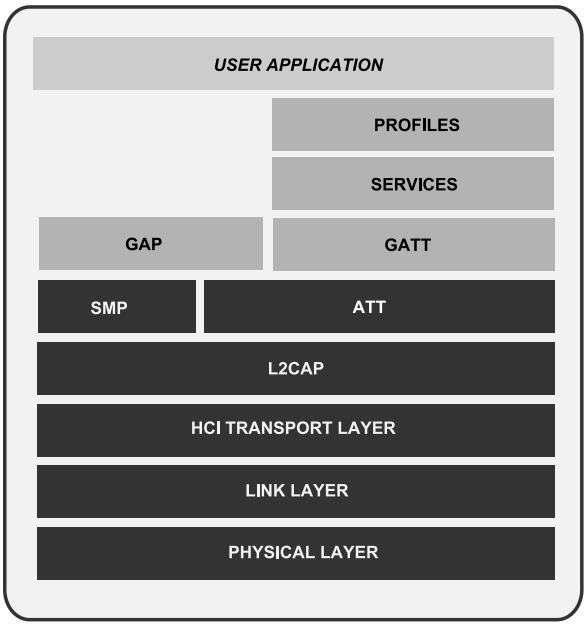

Figure1.: Simplified *Bluetooth*® Low Energy Stack – Stand-alone model

The module provides several host connections possibilities: UART, I2C, GPIO, ADC and DAC. This flexibility ensures an easy integration of the ALPW-BLEM003 with any microcontroller.

The ALPW-BLEM003 can also be used as a *Bluetooth*® Low Energy coprocessor.

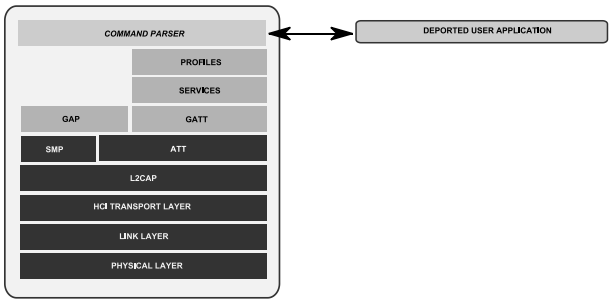

Figure2.: Simplified *Bluetooth*® Low Energy Stack – Coprocessor model

1.1 Functional Block Diagram

Below is a functional block diagram:

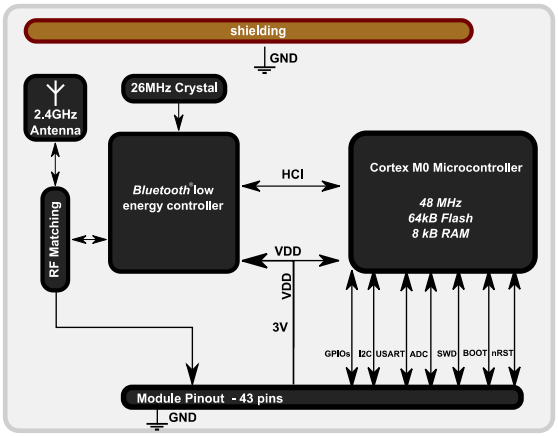

Figure3.: Block diagram

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

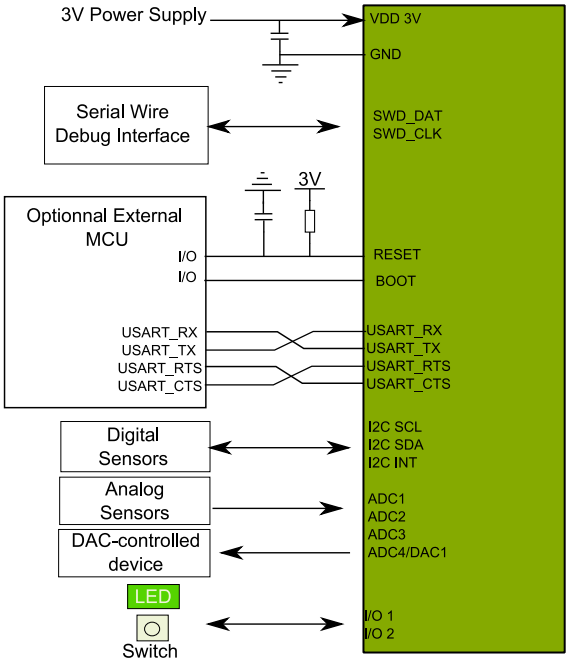

Figure4.: ALPW-BLEM003 typical application

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

2 Detailed Description

2.1 Module Pin Description

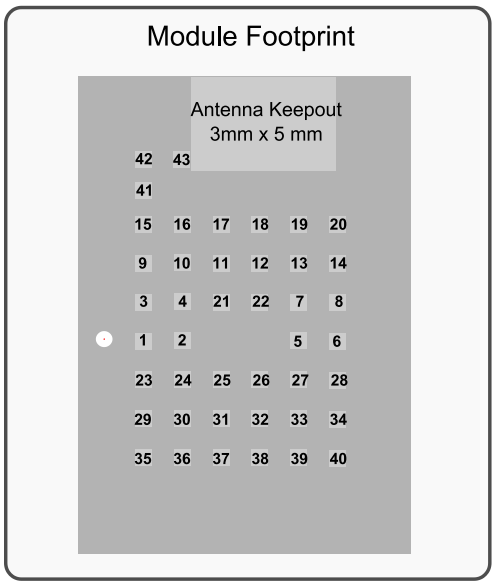

Figure5.: Module pin numbering (Top View)

Pin	Signal	Description	Cortex M0 pin
1	GND	Ground	GND
2	NC		-
3	ADC4	Analog-to-Digital Converter Input	PB1
4	ADC3	Analog-to-Digital Converter Input	PA2
5	USART_RTS	USART bus Request to send	PA12 (USART1)
6	USART_CLK	USART bus clock	PA8 (USART1)
7	USART_CTS	USART bus Clear to send	PA11 (USART1)
8	VDD 3,3V	3.3V supply to the module.	VDD
9	GND	Ground	GND
10	NC	-	-
11	USART_TX	USART bus transmit	PA9 (USART1)
12	NC	-	-
13	NC	-	-
14	GND	Ground	-
15	BOOT	BOOT mode selection pin Internally Pulled down	BOOT0
16	USART_RX	USART bus receive	PA10 (USART1)
17	NC	-	-
18	NC	-	-
19	NC	-	-
20	NC	-	-
21	GND	Ground	GND
22	GND	Ground	GND
23	SWD_DAT	Serial Wire Debug Data	PA13
24	I2C_SMBA	I2C bus Alert	PB5 (I2C1)
25	GND	Ground	GND
26	GND	Ground	GND
27	VDDA	Analogue Supply to MCU	VDDA
28	ADC1	Analog-to-Digital Converter Input	PB0
29	SWD_CLK	Serial Wire Debug Clock	PA14
30	IO2	General purpose Input/output	PF1
31	NC	-	-
32	NC	-	-
33	I2C_SCL	I2C bus Serial Clock	PB6 (I2C1)
34	I2C_SDA	I2C bus Serial Data	PB7 (I2C1)
35	ADC2	Analog-to-Digital Converter Input	PA1
36	IO1	General purpose Input/output	PF0
37	MCU NRST	MCU Reset Signal	NRST
38	NC	-	-
39	NC	-	-
40	GND	Ground	GND
41	GND	Ground	GND
42	RF_OUT	50 ohms RF output	-
43	GND	Ground	GND

2.2 Power Supply

The module is designed to operate within a 2.7V to 3.3V 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.

2.3 Reset

2.3.1 Module Reset

The microcontroller reset signal is accessible on the pad 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.

2.4 Clocking

2.4.1 Module Clocking

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

Sym	Description	Value	Unit
F_{SYS}	System operating frequency	32.768 to 48000	kHz
F_{HSI}	High-Speed Internal Frequency	8	MHz
F_{LSI}	Low-Speed Internal Frequency	30 to 50	kHz
Ts_{HSI}	High-Speed Oscillator Startup time	1 to 2	µs
Ts_{LSI}	Low-Speed Oscillator Startup time	Max 85	µs

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.

Sym	Description	Value	Unit
V_{DD}	Supply Voltage	-0.2 to 3.8	V
V_{IN}	Input Voltage on any pin	0.2 to 4.0	V
ΔV_{SS}	Voltage difference between ground pins	Max 10	mV
V_{RFIN}	Input RMS Voltage on RF pin	Max 2.1	V

3.2 Recommended operating conditions

Sym	Description	Value	Unit
V_{DD}	Supply Voltage	2.7 to 3.3	V
T_{OPNom}	Operational Temperature Range	-20 to +55°C	°C
I_{Max}	Maximum Input Current	20	mA

3.3 Power Consumption

3.3.1 Static System current consumption

T= 25°C

Sym	Description	Value	Unit
I_{PEAK}	Typical Peak Current	19	mA
I_{Idle}	Idle Mode Current	294	µA
I_{Sleep}	Sleep Mode Current	24	µA
$I_{Deep-Sleep}$	Deep Sleep Mode Current	13	µA

3.3.2 *Bluetooth*® Low Energy Application System current consumption

T= 25°C, P_{RFout} =+3dbm

Sym	Description	Value	Unit
I_{ADV_1}	Classic Advertising (200ms)	244	µA
I_{ADV_2}	Classic Advertising (5s)	67	µA
I_{ADV_3}	Smart Advertising (5s)[1]	34	µA
I_{CON_1}	Connected mode (1.28s Interval)	138	µA
I_{CON_2}	Connected mode (4.0s Interval)	85	µA

Figure6.: Average Consumption

3.4 Electrical Characteristics

3.4.1 Digital interface Characteristics

Sym	Description	Value	Unit
$UART_{BR}$	UART Baud Rate	Max 1843.2	kBd/s

3.4.2 Module Timing Characteristics

Sym	Description	Value	Unit
$T_{Start-up}$	Start Up time	15.5	ms
$T_{Sleep\ to\ idle}$	Sleep to Idle Mode time	2.6	ms
$T_{Deep-Sleep\ to\ Idle}$	Deep-Sleep to Idle Mode time	2.7	ms

3.4.3 RF General Characteristics

Sym	Description	Value	Unit
F	Operating RF band	2.4-2.483	GHz
DR	On-air data rate	1	Mb/s
Ch	Channel spacing	2	MHz
Receiver			
Z_{in}	Input Impedance	50	Ω
S_{in}	Sensitivity	-80	dBm
$P_{in\ max}$	Maximum input power	-5	dBm
Transmitter			
P_{RF}	Output RF Power	-18 to +3	dBm
D_m	Typical Range	20	m

[1] The Smart Advertising feature allows 10µA power consumption between advertising peaks.

The typical range highly depends on the module integration and the environment characteristics. In free-space conditions, use the following graph to determine the average path losses:

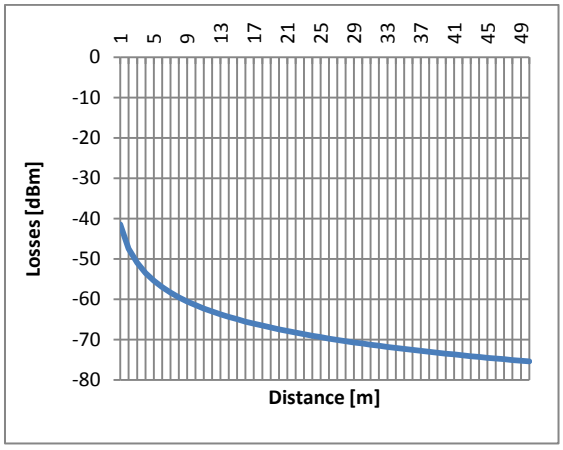

Figure7.: Free-Space Losses

4 Soldering recommendations

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

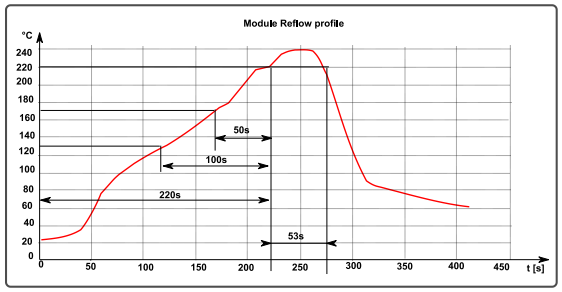

Figure8.: Recommended reflow profile

5 Product Dimensions

5.1 External Dimensions

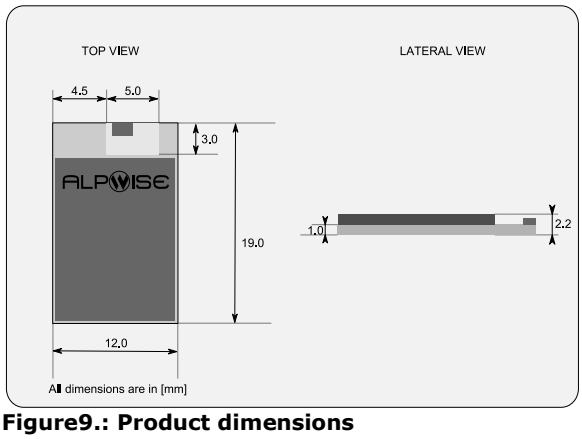

Figure9.: Product dimensions

5.2 Footprint

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

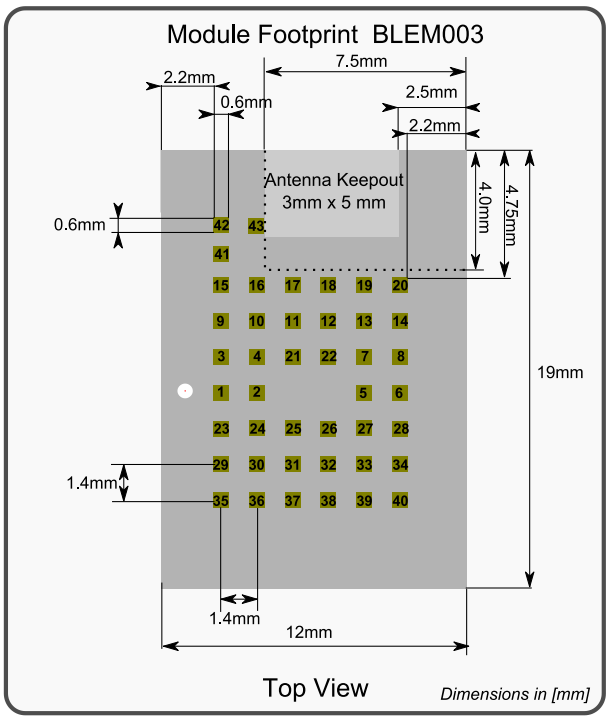

Figure10.: Module footprint (Top View)

The antenna keep-out zone above is the minimum acceptable. The best recommended practice is to place the module on the board corner and implement the dotted-line clearance zone. Avoid proximity with metallic objects.

6 Top Side marking

The picture below shows the typical product printed codes:

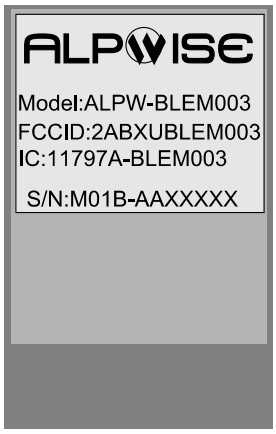

Figure11.: Product top-side marking

S/N	M01	B	-	AA	XXXXX
	Module Id	HW Rev.		Manufacturing Lot Id	Serial Number

7 Recommended Layout

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

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

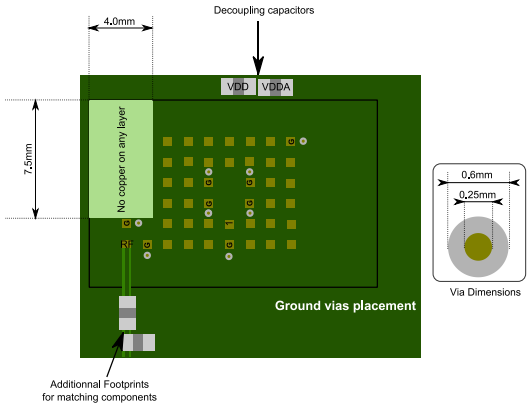

Figure12.: Recommended end-application PCB integration

The output RF power, achievable range, harmonic level directly depends on the integration of the module. The antenna clearance zone must be respected by all means, excluding copper on any layer of the pcb.

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

The placement of the ground vias is very important. Ground tracks length must be as short as possible to avoid parasitic inductance. A four-layer PCB is the insurance of a low-impedance ground plane: see the example layout above.

8 Resources

8.1 Software Resource

ALPWISE is providing a complete software solution to build complete Bluetooth Solution.

A complete SDK supporting *Bluetooth*® Low Energy protocol stack and a complete list of profiles allows writing APLW-BLEM003 embedded applications.

ALPWISE proprietary firmware allow to use the ALPW-BLEM003 in coprocessor mode, using the module as AT command based BLE modem or in Cable replacement mode.

Pease contact our sales support to get the right information and find the best solution for your application.

8.2 Hardware Resource

The ALPW-BLEM003 is embedded on our ALPW-BLEEASY 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.

9 Certifications

9.1 Bluetooth SIG

Certification pending.

9.2 FCC and IC

The ALPW-BLEM003 is certified compliant with the FCC CFR 47 Part 15, Subpart B and C, and RSS-210 Issue 8.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by ALPWISE could void the user's authority to operate the equipment.

FCC RF Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter meets both portable and mobile limits as demonstrated in the RF Exposure Analysis. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

IC Statements:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

OEM Responsibilities to comply with FCC and Industry Canada Regulations

The ALPW-BLEM003 module has been certified for integration into products by OEM integrators under the following condition:

- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

As long as the two condition above is met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE : In the event that these conditions can not be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID and IC Certification Number can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC and Industry Canada authorization.

End Product Labeling

The BLEM003 module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

"Contains FCC ID: 2ABXUBLEM003"
"Contains IC: 11797A-BLEM003"

The OEM integrator has to be aware not to provide information to the end user regarding

how to install or remove this RF module or change RF related parameters in the user manual of the end product.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If the equipment does cause harmful interference to radio or television reception which can be determined by turning the equipment off and on, the user is encourage to try to correct interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

9.2.1 FCC et IC

Déclaration d'IC:

Ce dispositif est conforme aux normes RSS exemptes de licence d'Industrie Canada. Son fonctionnement est assujetti aux deux conditions suivantes : (1) ce dispositif ne doit pas provoquer de perturbation et (2) ce dispositif doit accepter toute perturbation, y compris les perturbations qui peuvent entraîner un fonctionnement non désiré du dispositif. Selon les réglementations d'Industrie Canada, cet émetteur radio ne doit fonctionner qu'avec une antenne d'une typologie spécifique et d'un gain maximum (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Pour réduire les éventuelles perturbations radioélectriques nuisibles à d'autres utilisateurs, le type d'antenne et son gain doivent être choisis de manière à ce que la puissance isotrope rayonnée équivalente (P.I.R.E.) n'excède pas les valeurs nécessaires pour obtenir une communication convenable.

Responsabilités des OEM quant à la conformité avec les réglementations de FCC et d'Industrie Canada

Le module ALPW-BLEM003 a été certifié pour entrer dans la fabrication de produits exclusivement réalisés par des intégrateurs dans les conditions suivantes :

- Le module transmetteur ne doit pas être installé ou utilisé en concomitance avec une autre antenne ou un autre transmetteur.

Tant que ces deux conditions sont réunies, il n'est pas nécessaire de procéder à des tests supplémentaires sur le transmetteur. Cependant, l'intégrateur est responsable des tests effectués sur le produit final afin de se mettre en conformité avec d'éventuelles exigences complémentaires lorsque le module est installé (exemple : émissions provenant d'appareils numériques, exigences vis-à-vis de périphériques informatiques, etc.)

REMARQUE IMPORTANTE : En cas d'inobservance de ces conditions (en ce qui concerne certaines configurations ou l'emplacement du dispositif à proximité d'un autre émetteur), les autorisations de FCC et d'Industrie Canada ne seront plus considérées valables et l'identification de FCC et le numéro de certification d'IC ne pourront pas être utilisés sur le produit final. Dans ces cas, l'intégrateur OEM sera chargé d'évaluer à nouveau le produit final (y compris l'émetteur) et d'obtenir une autorisation indépendante de FCC et d'Industrie Canada.

Etiquetage du produit final :

« Contient identification FCC : 2ABXUBLEM003 »

« Contient IC : 11797A-BLEM003 »

Dans le guide d'utilisation du produit final, l'intégrateur OEM doit s'abstenir de fournir des informations à l'utilisateur final portant sur les procédures à suivre pour installer ou retirer ce module RF ou pour changer les paramètres RF.

9.3 CE

The ALPW-BLEM003 is certified compliant with the following standard:

SAFETY:

EN60950-1

EMF

EN 62311 (2008) : Limitation of human exposure to electromagnetic fields

RADIO

EN 300 328 v1.7.1 : Electromagnetic compatibility and Radio Spectrum Matters (ERM)

10 Cautions

10.1 Installation notes

The product should be mechanically stressed when installed.

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

10.2 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.

All external circuits connected to our device shall be of SELV type (*Safety Extra Low Voltage*), and shall be qualified as *Limited Power Souces,* as defined in chapters 2.2 and 2.5 of IEC60950-1:2005+/A1:2010 and EN60950-1:2006+/A11:2009+/A1:2010+/A12:2011.

All power sources provided to our device shall be of SELV type (*Safety Extra Low Voltage*), and shall be qualified as *Limited Power Souces,* as defined in chapters 2.2 and 2.5 of IEC60950-1:2005+/A1:2010 and EN60950-1:2006+/A11:2009+/A1:2010+/A12:2011.

The antennas and antenna cables connected to our device shall always remain indoor, and in the same building as our device.

Do not wash the product.

10.3 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

10.4 Other Cautions

The datasheet document is copyrighted.

Do not use this product for other purposes than those listed.

11 Packaging

Individual modules come in anti-electrostatic plastic bag.

For more packaging possibilities, please contact our sales support.

12 ROHS Declaration

This product is manufactured following the restrictions of the 2002/95/CE European directive, based upon the information from our subcontractor.

13 Support

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

alpwisesales@alpwise.com

14 Sales

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

alpwisesales@alpwise.com

15 Contact information

ALPWISE S.A.S
LE PULSAR
4 Avenue Doyen Louis Weil
38000 GRENOBLE
FRANCE
www.alpwise.com

Legal notices

Information furnished is believed to be accurate and reliable. However, ALPWISE assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of ALPWISE.

Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. ALPWISE products are not authorized for use as critical components in life support devices or systems without express written approval of ALPWISE.

The ALPWISE logo is a registered trademark of ALPWISE SAS.

The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Alpwise is under license.

All other names are the property of their respective owners.

www.alpwise.com