CASAMBI

CBM-003B/C PRELIMINARY DATASHEET

Features

Casambi Lighting Control System:

- Wirelessly controllable with a Bluetooth smart device
- No need for an external gateway device
- Forms automatically a wireless mesh network
- Device firmware can be updated over-the-air
- Casambi cloud service available
- Extremely easy set-up

2.8 mm

20.0 mm

12.7 mm

CBM-003B Features:

- Small form factor, 12.7 mm x 20.0 mm x 2.8 mm
- 12 pcs general-purpose input/output pins
- 4 GPIO can be configured as analog inputs
- SPI, TWI, UART, PWM (max. 8 ch)
- Integrated antenna
- Up to +8 dBm output power and -95 dBm RX sensitivity
- -103 dBm RX sensitivity in long-range mode
- Range up to 300 m in long-range mode (preliminary) *
- Can be mounted in horizontal or vertical position
- Delivered preloaded with Casambi firmware
- Contains an nRF52840 chip.
- DALI-2 (CMOS levels)
- 0-10V support

Applications

- LED drivers, single and multi-channel
- Different lighting control applications
- Light fixtures
- Single and multicolor LED bulbs
- Sensors

* Enabling long-range mode (currently in beta) requires all the devices in the network to support long-range mode.
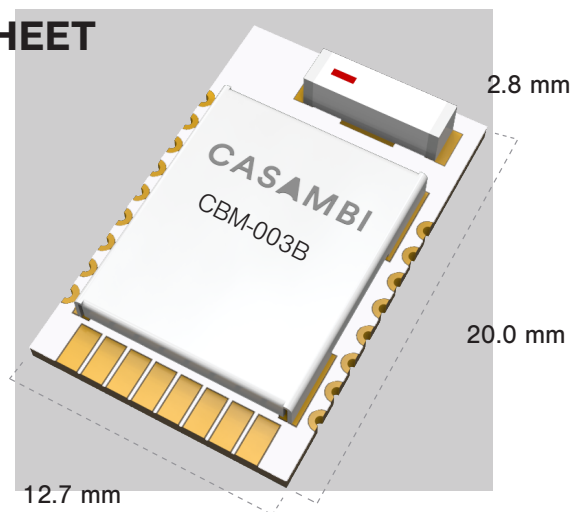
Description

CBM-003B/C is a Class 2 embedded Bluetooth module designed to be integrated into LED drivers, different lighting control applications, light fixtures, and LED bulbs. It is pre-programmed with Casambi's proprietary firmware making it completely compatible with other Casambi enabled devices.

CBM-003B/C is controlled wirelessly with Casambi smartphone and tablet ("smart device") applications using Bluetooth protocol. Devices form a self-healing and self-organizing wireless mesh network automatically so that a large number of luminaires can be controlled from any point. No external gateway module is needed.

CBM-003B/C contains a powerful 32-bit ARM® Cortex® -M4 CPU and a 2.4 GHz transceiver with an onboard antenna. Different external components, such as motion detectors, ambient light sensors, and PWM circuits can be interfaced with the module using its 12 general-purpose I/O pins.

CBM-003B/C can be mounted both in horizontal and vertical positions, making it very versatile for projects with different form factors.

CASAMBI

Table of Contents

CASAMBI

1. Operation

Casambi CBM-003B/C is an embedded wireless module with a powerful 32-bit ARM® Cortex® -M4 CPU and a 2.4 GHz transceiver with an onboard antenna. It can be integrated, for example, into an LED driver, a light fixture, LED bulb, or any sensor.

The CBM-003B/C has a total of 12 GPIO pins, which can be configured to perform various tasks, such as SPI, TWI (I2C compatible), UART, 8 PWM outputs, and 4 channel Analog-to-Digital Converter input. ADC input channels have fixed GPIO pins. Other functions can be configured to any free GPIO pin. **Note:** The CBM-003B/C is based on nRF52840 chip, which has some limitations compared to earlier models. Many of nRF52840 pins are recommended to be used only in standard-drive (2 mA) **and** low-frequency (≤10kHz) mode. CBM-003B/C has 6 standard and 6 High-drive GPIOs.

All >10KHz and High-drive IOs shall be connected to High-drive pins, otherwise radio performance may be compromised.

The CBM-003B/C has an integrated 2.4 GHz antenna, so this will have to be considered when the device is integrated into any environment. See chapter 7 for further instructions.

Many of the CBM-003B/C's different settings can be configured in the Casambi Admin webtool and taken into use without the need of re-programming the module. These settings include, for example, I/O pin mapping, PWM, and push-buttons.

The Casambi CBM-003B/C is based on the Nordic Semiconductor nRF52840 chip, and all technical data shall be referred to regarding the chip's datasheet.

2. Block Diagram
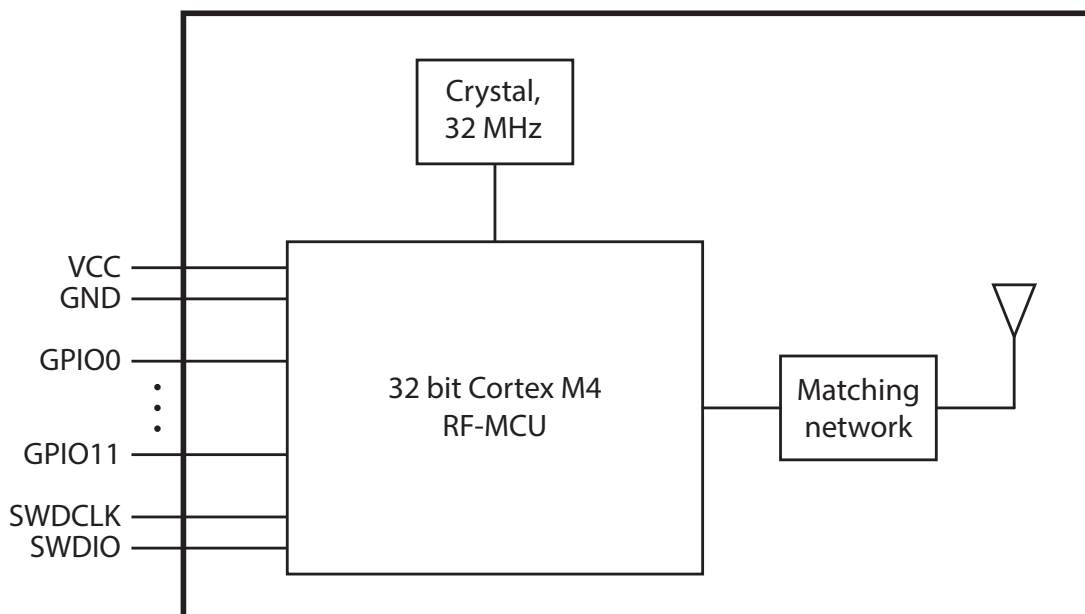
CBM-003B block diagram

CASAMBI

3. System blocks

3.1 General Purpose I/O (GPIO)

The CBM-003B/C has 12 General Purpose I/O pins. Some of them are High-drive (9 mA) while some are standard-drive (2 mA). Each GPIO can be accessed individually, and each has the following features:

- Input/output direction
- Configurable output drive strength, standard-drive (6 pcs) or High-drive (6 pcs)
- Configurable internal pull-up and pull-down resistors
- Buffered inputs
- Trigger interrupt on all pins (rising edge, falling edge, any change)
- Serial interface output can be freely configured to any of 6 High-drive pins
- >10 kHz PWM output can be freely configured to any of 6 High-drive pins
- ≤10 kHz PWM output can be freely configured to any of 12 GPIO pins

GPIO pins 0-3 also support analog input signals when an internal Analog-to-Digital Converter (ADC) is used.

3.2 Analog-to-Digital Converter (ADC)

The Casambi system can use an Analog-to-Digital Converter (ADC), for example, in light level sensing and battery voltage monitoring. The ADC resolution is selected automatically (8-bit or 12-bit) based on the application. The specific functionality available through the ADC inputs is determined by Casambi Firmware and how it is configured.

The Analog-to-Digital Voltage range for any ADC input is 0-3.6 V, but not above Vcc. This means that 0 V gives a zero reading from the ADC, and 3.6 V gives a maximum reading (255 for 8-bit and 4095 for 12-bit resolution).

No pin should be exposed to voltages higher than VCC. The operating voltage of the module, VCC, is the maximum limit to the analog input voltage. While the full range of ADC is 3.6V, if the supply voltage Vcc is only 3.3V or 3.0V, the full range cannot be used.

3.3 PWM Output

Any GPIO pin can be configured to output a PWM signal, and up to 8 PWM channels can be used simultaneously. A PWM frequency can be determined freely up to 40 kHz and is the same with all PWM channels. However, any PWM over 10 kHz requires the use of High-drive pin. The resolution can be selected between 100-5000 steps. The maximum resolution depends on the PWM frequency.

The PWM signal is logic level (max. VCC), and it has a driving capacity of 2 mA (standard) or 9 mA on a High-drive pin. See also the Nordic nRF52840 datasheet for limitations. An adjustable analog voltage (0 V - VCC) can be derived from the PWM signal by an external RC filter.
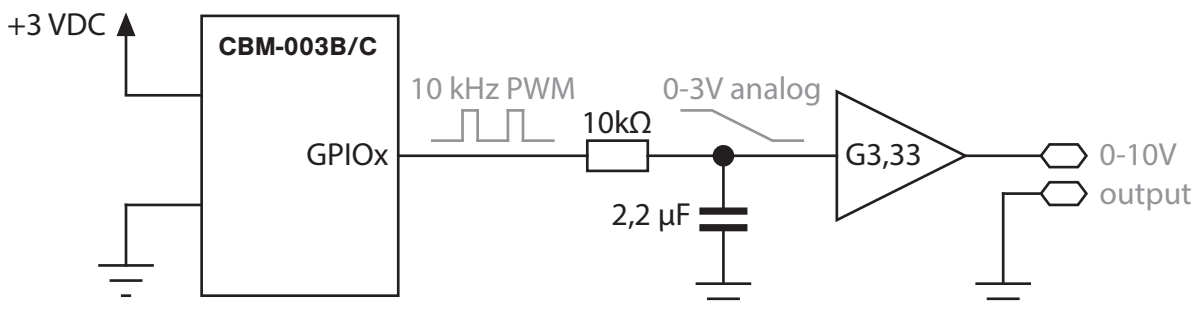
Picture 2 Adjustable 0–10V output from PWM signal

4. Serial Interfaces

The CBM-003B/C can be connected to an external MCU through its Casambi proprietary interface extension interface, which supports SPI, TWI, and UART. All extension interface signals shall be connected to High-drive pins if data rate exceeds 10 kHz. UART/SPI/TWI interfaces are dedicated for this purpose and are not available for generic use outside of Extension Interface Protocol without special arrangements from Casambi Technologies. Through this interface, it is possible to, for example, gather information from sensors within the Casambi network. For detailed serial info, refer to the nRF52840 datasheet. For detailed Casambi extension interface, refer to the Firmware Extension Interface datasheet.

4.1 Serial Peripheral Interface (SPI)

The CBM-003B/C supports a 4-wire (SCK, MISO, MOSI, SS) bidirectional SPI bus with fast data transfers to connected MCU ('client').

The SPI peripheral supports SPI modes 0 through 3.

4.2 Two-Wire Interface (TWI)

The Two-Wire Interface (I2C compatible) can interface a bidirectional wired-AND bus with two lines (SCL, SDA). The interface is capable of clock stretching, and data rates of 100 kbps and 400 kbps are supported. The TWI transmitter and receiver are single buffered.

4.3 Universal Asynchronous Receiver/Transmitter (UART)

The Universal Asynchronous Receiver/Transmitter offers fast, full-duplex, asynchronous serial communication with built-in flow control support in HW up to 1 Mbps. Parity checking and generation for the 9th data bit are supported.

5. Pin Assignment

CASAMBI
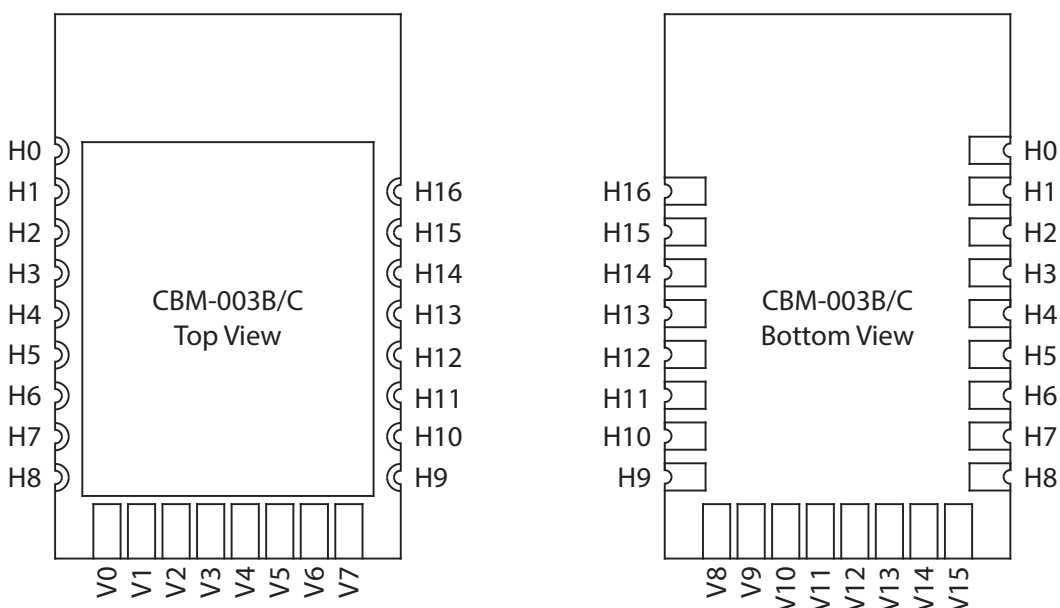
003 pin	Vert pin	MCU pin	Pin name	Pin Function	Description
H0	-	-	GND	Power	Ground
H1	V7	P0.02	GPIO0 AIN0	Digital I/O Analog input	Standard drive, low frequency I/O only ADC input0
H2	V6	P0.29	GPIO1 AIN1	Digital I/O Analog input	Standard drive, low frequency I/O only ADC input1
H3	V5	P0.31	GPIO2 AIN2	Digital I/O Analog input	Standard drive, low frequency I/O only ADC input2
H4	V4	P0.04	GPIO3 AIN3	Digital I/O Analog input	General-purpose I/O pin ADC input3
H5	V3	-	VCC	Power	Power Supply
H6	V2	SWDCLK	SWDCLK	Digital Input	HW debug and flashing
H7	V1	SWDIO	SWDIO	Digital I/O	HW debug and flashing
H8	V0	GND	GND	Power	Ground
H9	V8	P0.09	GPIO4	Digital I/O	Standard drive, low frequency I/O only NFC antenna (future option)*
H10	V9	P0.10	GPIO5	Digital I/O	Standard drive, low frequency I/O only NFC antenna (future option)*
H11	V10	P0.20	GPIO6	Digital I/O	General-purpose I/O pin
H12	V11	P0.01	GPIO7	Digital I/O	General-purpose I/O pin Connection for 32.768 kHz crystal (future option)
H13	V12	P0.00	GPIO8	Digital I/O	General-purpose I/O pin Connection for 32.768 kHz crystal (future option)
H14	V13	P0.22	GPIO9	Digital I/O	General-purpose I/O pin
H15	V14	P1.00	GPIO10	Digital I/O	General-purpose I/O pin
H16	V15	P1.04	GPIO11	Digital I/O	Standard drive, low frequency I/O only

*Leakage current between NFC pads when driven to different states 1 µA (typ) and 10 µA (max).

CASAMBI

6. Electrical Specifications

6.1 Absolute Maximum Ratings

Maximum ratings are the extreme limits to which CBM-003B/C can be exposed without permanently damaging it. Exceeding maximum ratings will permanently damage the product. Data extracted here is from nRF52840 datasheet revision 1.1.

Absolute Maximum Ratings	Min.	Max.	Units
Supply voltage, Vcc	-0.3	+3.9	V
GND		0	V
I/O pin voltage	-0.3	Vdd+0.3	V
Storage temperature	-40	+125	°C
Operation temperature, T_A	-40	+85	°C
Relative humidity, storage		90	%
Relative humidity, operating		90	%

6.2 Power Supply Specification

Power Supply Specification	Min.	Typ.	Max.	Units
Supply voltage, VCC	+2.5	+3.0	+3.6	V
Supply rise time (0 to 1.7 V)			60	ms
Supply current, Icc (@3.0V)		7	25 *	mA

*In TX mode.

CASAMBI

6.3 General Purpose I/O Specification

GPIO Specification	Min.	Typ.	Max.	Units
Input high voltage, VIH	0.7xVdd		Vdd	V
Input low voltage, VIL	GND		0.3xVdd	V
Output high voltage, VOH	Vdd-0.4		Vdd	V
Output low voltage, VOL	GND		GND+0.4	V
Current at VSS+0.4 V, output set low, standard drive	1	2	4	mA
Current at VSS+0.4 V, output set low, high drive, VDD ≥ 2.7 V	6	10	15	mA
Current at VDD-0.4 V, output set high, standard drive	1	2	4	mA
Current at VDD-0.4 V, output set high, high drive	6	9	14	mA
Pull-up resistance, RPU	11	13	16	kΩ
Pull-down resistance, RPD	11	13	16	kΩ

*VDD ≥ 2.7V. For details, see nRF52840 datasheet "GPIO Electrical Specification".

6.4 Communication interface characteristics, bit rates

Bit Rates	Min.	Typ.	Max.	Units
Bit rate for SPI, f_{SPI}	0.125		8	Mbps
Bit rates for TWI, f_{2W}	100		400	kbps
Baud rate for UART, f_{UART}			1000	kbps

CASAMBI

6.5 General Radio Characteristics

General Radio Characteristics	Min.	Typ.	Max.	Units
Operating frequencies, f_{OP}, 1 MHz chann. spacing	2402		2483	MHz
PLL programming resolution, PLLres		1		MHz
Frequency deviation, Δf_{BLE}	±225	±250	±275	kHz
On-air data rate, bps_{SFSK}	1000	+4	2000	kbps
Maximum output power, P_{RF}		+8		dBm
Sensitivity, P_{SENS}		-93		dBm

6.6 PWM specification

PWM Specification	Min.	Typ.	Max.	Units
PWM frequency, fPWM			40	kHz
PWM resolution	100		5000	steps
PWM resolution @ fPWM 10 kHz			1600	steps
PWM resolution @ fPWM 20 kHz			800	steps
PWM resolution @ fPWM 40 kHz			400	steps

CASAMBI

7. Mounting

CBM-003B/C has two sets of soldering pads, which allow it to be mounted both in horizontal and vertical position. Inn vertical position module can be installed either by to a 1,27 mm pitch 2-row pin header, or by soldering the module directly into a routed slot on the main PCB.

When mounted in horizontal position there will have to be two keep-out areas; one for the antenna area and one for the unused pads used for vertical assembly.

7.1 Horizontal mounting

When CBM-002B/C is mounted in a horizontal position it is soldered in by using the soldering pads on both long sides of the module. The soldering pads are designed so that the module can be both hand and reflow soldered.

When mounted in a horizontal position, there are two mandatory keep-out areas involved. One is for antenna and the other is for bottom side soldering pads at the narrow end of the module. These pads are used for vertical assembly.

For the CBM-003B, the antenna keep-out applies to all layers of the mother board. There shall not be any components, traces, pads or copper areas in any layer within the keep-out area. The same applies to other metals as well, such as the enclosure of the product, fixing screws, etc.

The keep-out area for the soldering pads applies only to the outer surface of the mother board.
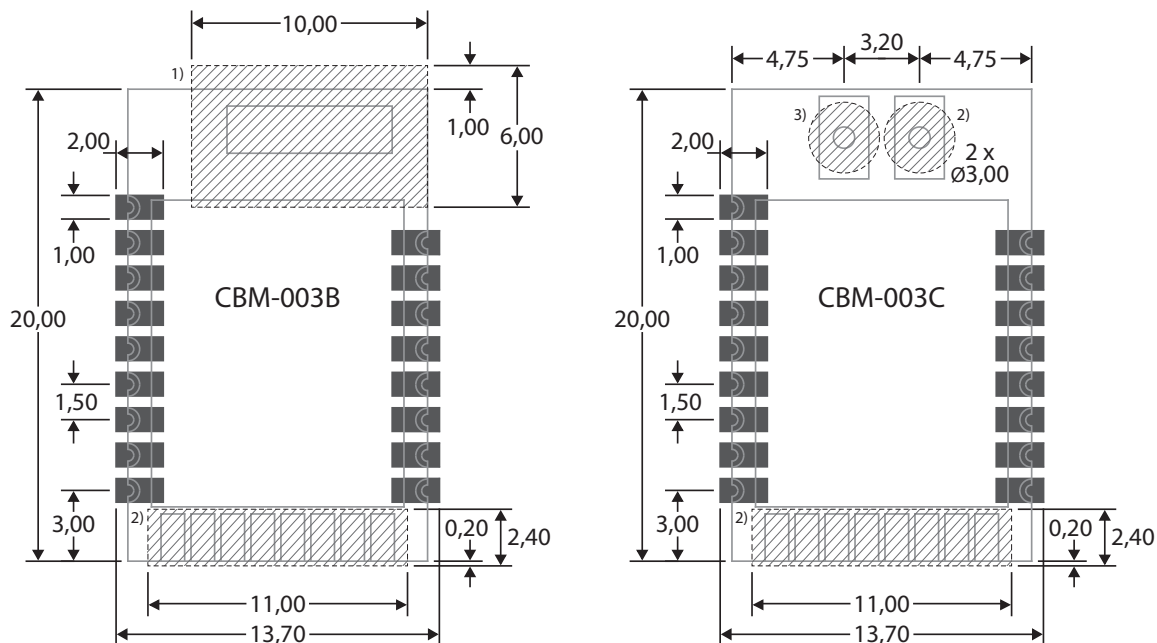
Recommended land pattern for horizontal assembly and required keep-out areas.

1) This keep-out area will have to be kept clear from any parts, traces and copper on all layers.
2) This keep-out area applies only to the layer closest to the module.
3) If CBM-003C antenna is soldered vertically, this keep-out area will have to be a hole. Otherwise keep-out area applies only to the layer closest to the module.

7.2 Vertical mounting

CBM-003B/C can be mounted in vertical position by using the soldering pads on the narrow end of the module. There are two methods of soldering the module in vertical position. It can be either soldered between pin rows of a 2-row 1,27 mm pin header (2 x 8P) or it can be soldered in a 0,9 mm slot routed on the main board with soldering pads at the edge of the slot. The thickness of the module printed circuit board is 0,85 mm (+/- 0,1mm).

Pad size: 1 x 2 mm

Routed slot

0,90

1,27

12,7
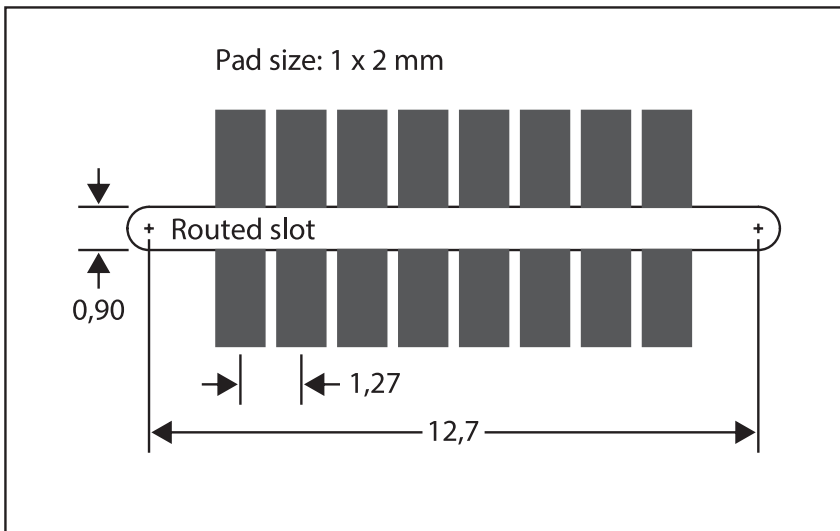
Suggested land pattern for vertical mounting in a slot

8. Mechanical Specifications
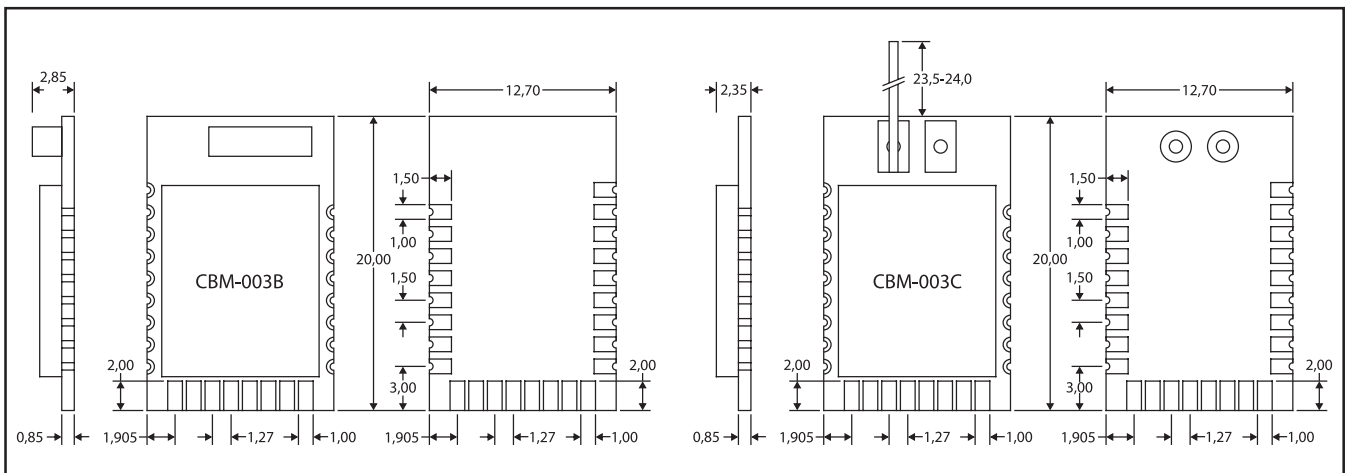
Mechanical dimensions.
Outline dimension tolerance typ ± 0,3mm, max ± 0,5mm. L 20±0.5mm W 12.7±0.3mm H 2.85±0.2mm

CASAMBI

9. Soldering

9.1 Leadfree Reflow Soldering

Temp. (˚C)

Max. 235˚C | 10s (±1s)

220˚C (±5˚C)

200˚C

70s (+20s/-10s)

150˚C (±10˚C)

90s (±30s)

Time (s)
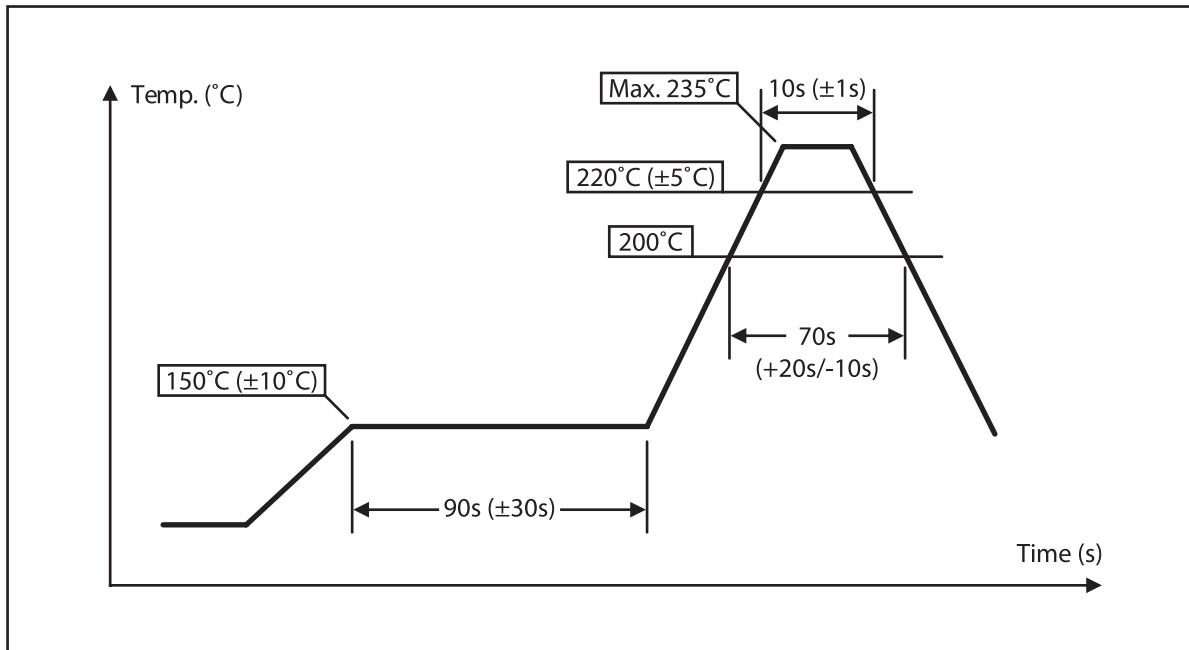
Recommended temperature profile for leadfree reflow soldering

Maximum number of reflow cycles: 2
Opposite side reflow is prohibited due to the module's weight. (i.e. you must not place the module on the bottom / underside of your PCB and reflow).

9.2 Hand Soldering

Hand soldering is possible. When using a soldering iron, follow IPC recommendations (reference document IPC-7711).

9.3 Rework

The module can be unsoldered from the host board. Use of a hot air rework tool should be programmable and the solder joint and module should not exceed the maximum peak reflow temperature of 250°C.

If temperature ramps exceed the reflow temperature profile, module and component damage may occur due to thermal shock. Avoid overheating. Never attempt a rework on the module itself, (e.g. replacing individual components).

9.4 Cleaning

In general, cleaning the populated modules is strongly discouraged. Residuals under the module cannot be easily removed with any cleaning process. Use of "No Clean" soldering paste is strongly recommended, as it does not require cleaning after the soldering process.

CASAMBI

13. Antenna versions

CBM-003B/C is available in two different antenna versions. CBM-003B is equipped with an on-board SMD ceramic chip antenna and CBM-003C is equipped with a 1/4 wavelength dipole antenna. Usually CBM-003C offers better range, but CBM-003B is more compact solution.

CBM-003C is delivered with the antenna detached, so the antenna will have to be soldered in place before taking the module into use. This is because the antenna can be soldered in vertical or horizontal position. The host device application determines which antenna orientation is more suitable.

CBM-003C is delivered with the antenna detached. The antenna is a 27 mm long single strand copper wire and it can be soldered in horizontal or vertical orientation, depending on the best suitability for the host application.

The antenna can be bent to fit the host application better. However, there are some guidelines that need to be taken into consideration.

1. Make sure that antenna is not in contact with any kind of metal.
2. The antenna should be places as far away from any metal structures as possible.
3. The tip of the antenna is especially sensitive for close by metals.
4. The less bending is done on the antenna, the smaller impact it haves on the range.
5. Do not use any other kind of antenna, or do not cut or otherwise modify the delivered antenna.

The antenna is soldered onto the left side solder pad (the pad closer to the antenna matching components). When soldering the antenna in horizontal position, for correct operation, place the antenna so that it fills the whole length of the soldering pad. This way the antenna extents over the edge of the module by 23,5-24,0 mm.

When the antenna is soldered in vertical position, solder it so that the antenna rises 23,5-24,0 mm over the PCB surface. Cut the antenna wire from the bottom side to the desired length. This cutting does not affect the performance or approvals.
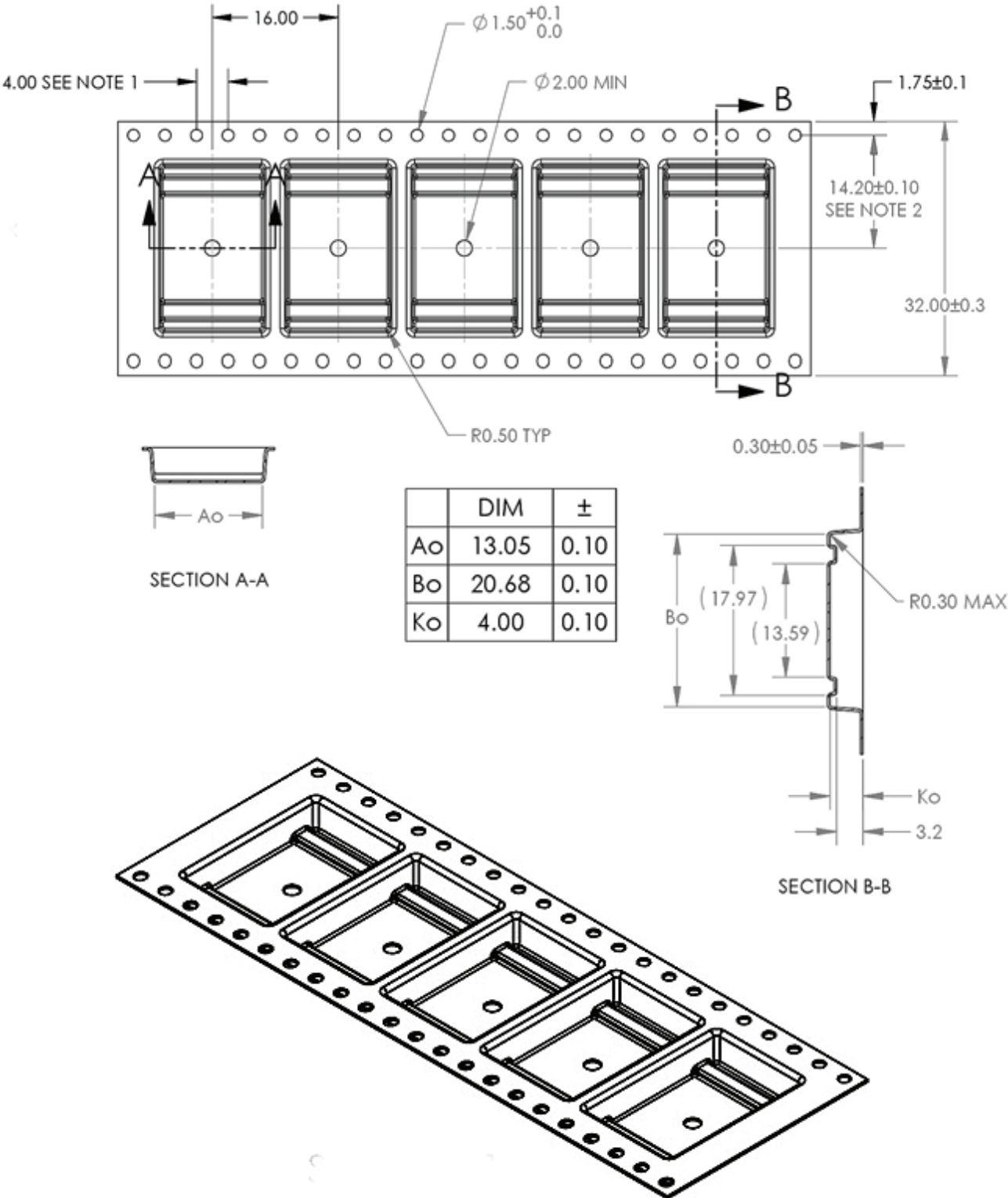
Important!
CBM-003C has been certified with the supplied antenna and modifying it beyond the instructions given in this datasheet will void the certification.
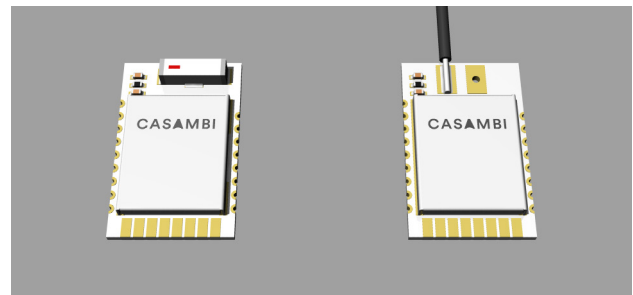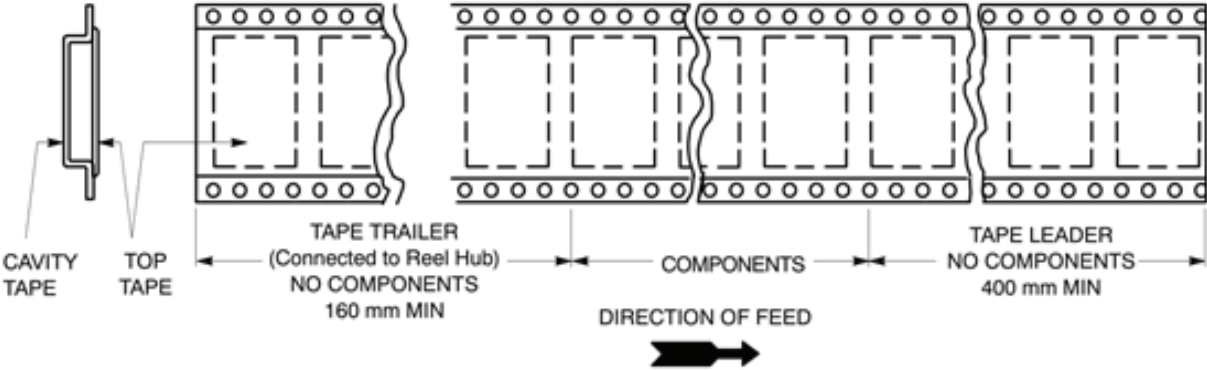

CBM-003B on left and CBM-003C on right

14. Packaging

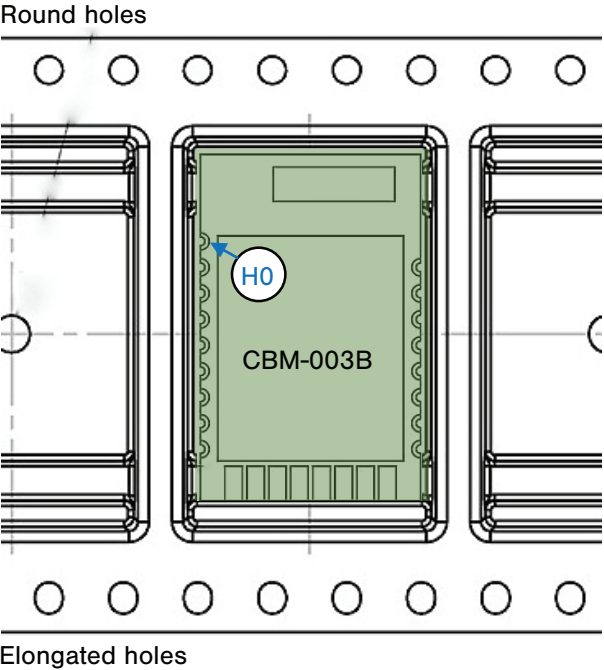## 14.1 Tape Dimensions
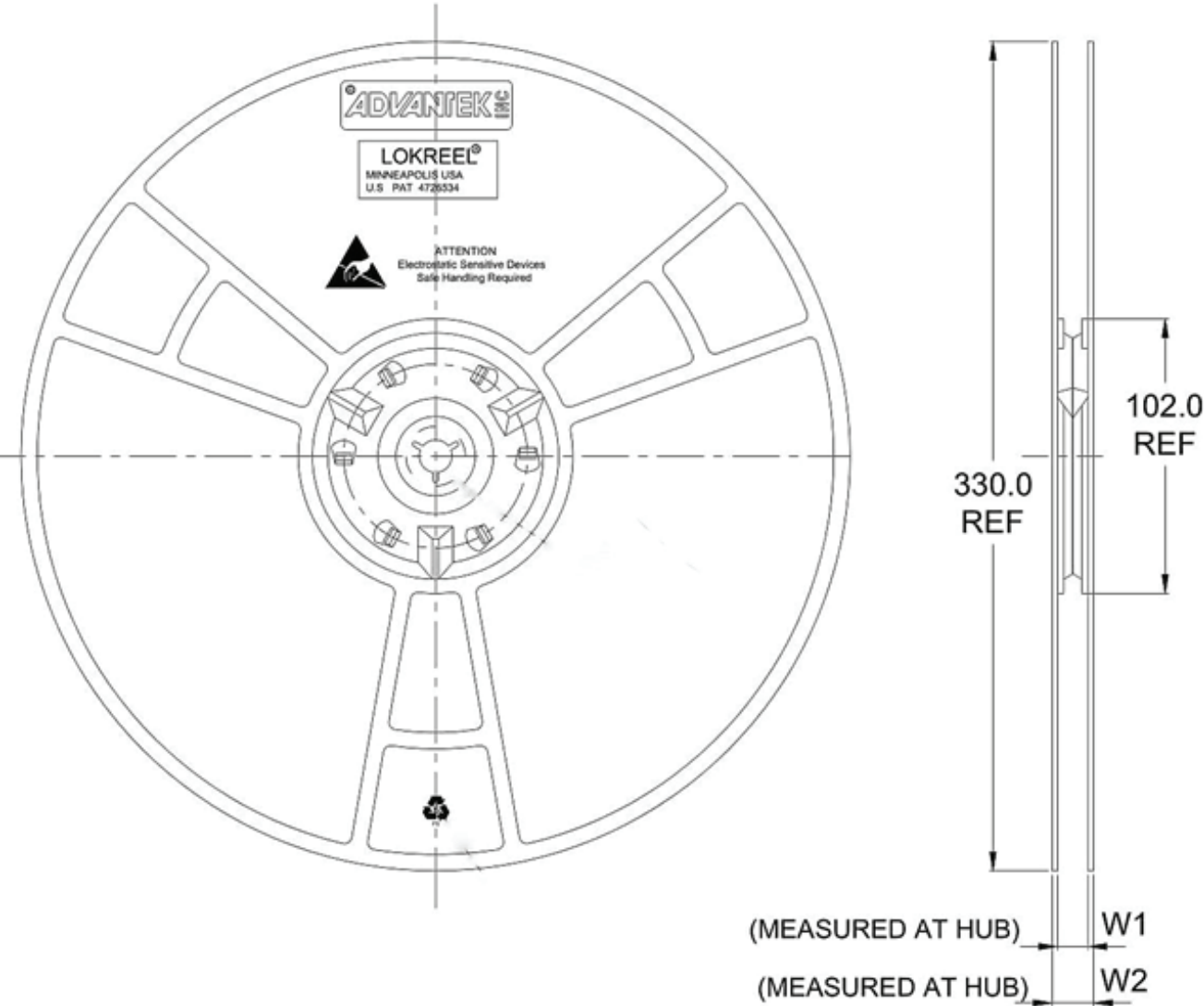

	DIM	±
Ao	13.05	0.10
Bo	20.68	0.10
Ko	4.00	0.10

SECTION A-A

SECTION B-B

14.2 Packing in Tape

14.3 Component Direction

Round holes

Elongated holes

14.4 Reel Dimensions

14.5 Reel Winding Direction

DIRECTION OF FEED

ELONGATED HOLES

ROUND HOLES

BARCODE LABEL
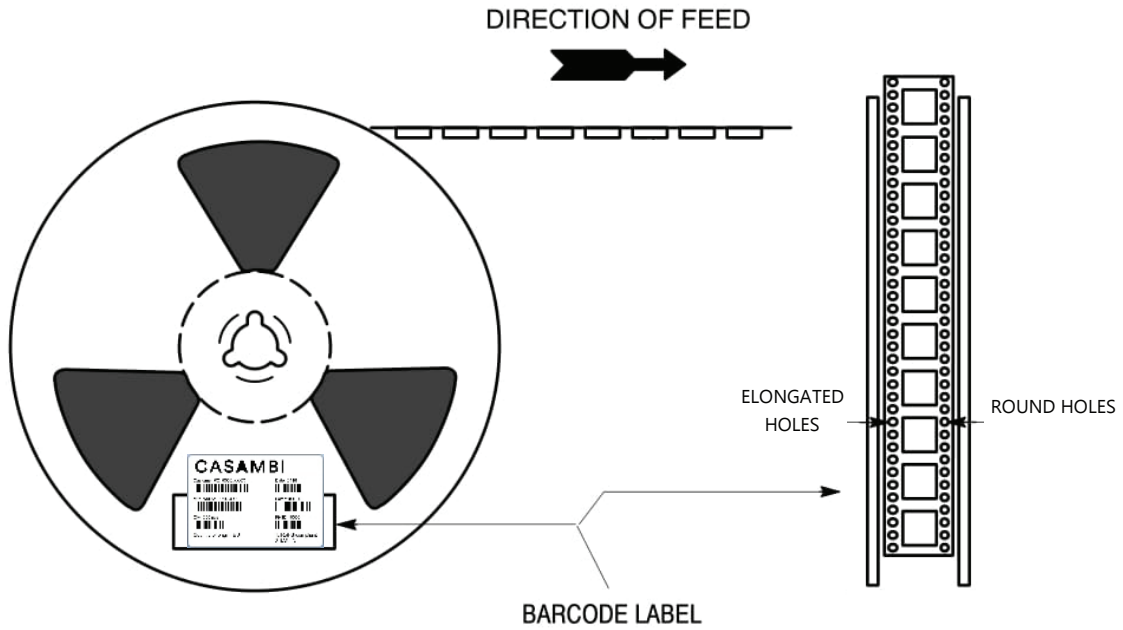
14.6 Label Information

CASAMBI

Casambi Technologies Oy
Alberga Business Park
Bertel Jungin Aukio 1 E
02600 Espoo Finland

Customer PO: 0000/XXXX

Date: WWYY

Mfr. part no: CBM-003B/C

Batch: #0000

Qty: 000 pcs

Fix ID: XXXX

Country of origin: XX

1. ROHS compliant
2. MSL 3

CASAMBI

15. Federal Communications Commission (FCC) Statement

Warning

Changes or modifications to this unit not expressly approved by Casambi Technologies Oy could void the user's authority to operate the equipment.

Compliance Statement

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.

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 instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

To maintain compliance with FCC's RF exposure guidelines, the distance must be at least 20cm between the radiator and your body, and fully supported by the operating and installation configurations of the transmitter and its antenna(s).

16. Innovation, Scientific and Economic Development Canada (ISED) Statement

Radiation Exposure Statement for Canada

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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The device has been evaluated to meet general RF exposure requirement. To maintain compliance with RSS-102 - Radio Frequency (RF) Exposure guidelines, this equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Le dispositif de a été évalué à répondre général rf exposition exigence. Pour maintenir la conformité avec les directives d'exposition du RSS-102-Radio Fréquence (RF). Ce matériel doit être installé et exploité à une distance minimale de 20 cm entre le radiateur et votre corps.

CASAMBI

17. End Product Labeling

CBM-003B/C has been labeled with its own FCC ID and IC Certification Number. The end product manufacturer must ensure that FCC and ISED labeling requirements are met. If the FCC ID of 2ALA3-CBM003B/2ALA3-CBM003C and IC Certification Number of 22496-CBM003B / 22496-CBM003C are not visible when the module is installed inside another device, then the device must have a clearly visible label containing the following information:

CBM-003B/C a été identifié avec son propre numéro d'identification de la FCC ainsi que son numéro de certification IC. Le fabricant du produit final doit assurer que les obligations d'identification de la FCC et des indicateurs du développement énergétique durable soient satisfaites. Si le numéro d'identifcation FCC de 2ALA3-CBM003B / 2ALA3-CBM003C et lenuméro de certifcation IC de 22496-CBM003B / 22496-CBM003C ne sont pas visibles lors de l'installation du module dans un autreappareil, une étiquette claire et visible avec les informations ci-après devra alors être apposée sur l'appareil:

> Contains FCC ID: 2ALA3-CBM003B
> Contains IC: 22496-CBM003B

> Contains FCC ID: 2ALA3-CBM003C
> Contains IC: 22496-CBM003C

18. Notes

Note 1: This module certified that complies with RF exposure requirementunder mobile or fixed condition, this module is to be installed only in mobile or fixed applications. A separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and difference antenna configurations. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Note 2: Any modifications made to the module will void the Grant of Certification, this module is limited to OEM installationonly and must not be sold to end-users, end-user has no manual instructions to remove or install the device, only software or operating procedure shall be placed in the end-user operating manual of final products.

Note 3: Additional testing and certification may be necessary when multiple modules are used.

Note 4: The module may be operated only with the antenna with which it is authorized. Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator.

This product must be professionally installed to ensure that no antenna other than that furnished by the responsible party shall be used with the device

Information in this document is subject to change.
CBM-003B preliminary datasheet ver 0.91

Casambi Technologies Oy
Bertel Jungin aukio 1 E, 02600 Espoo, Finland

Copyright Casambi Technologies Oy

casambi.com
19