

CBM-003 PRELIMINARY DATASHEET

Features

Casambi Lighting Control System:

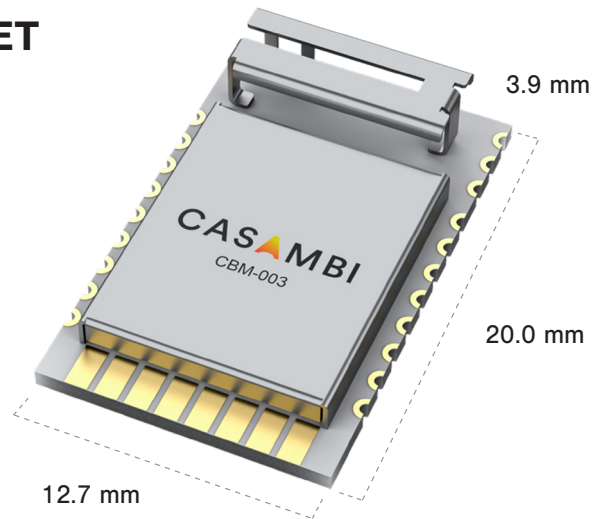
- Wirelessly controllable with a Bluetooth smart device
- No need for an external gateway device
- Forms automatically a wireless mesh network
- Device firmware can be updated over-the-air
- Casambi cloud service available
- Extremely easy set-up

CBM-003 Features:

- Small form factor, 12.7 mm x 20.0 mm x 3.9 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 700 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



Description

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

Table of Contents

1. Operation	3
2. Block Diagram	3
3. System blocks.....	4
4. Serial Interfaces.....	5
5. Pin Assignment.....	5
6. Electrical Specifications	7
7. Module installation placement.....	9
8. Radio Characteristics	10
9. Communication Interface Characteristics.....	11
10. PWM Specifications.....	11
11. Packaging.....	12
12. Federal Communications Commission (FCC) Statement	16
13. Innovation, Scientific and Economic Development Canada (ISED) Statement	16
14. End Product Labeling.....	17

1. Operation

Casambi CBM-003 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-003 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-003 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 ($\leq 10\text{kHz}$) mode. CBM-003 has 6 standard and 6 High-drive GPIOs.

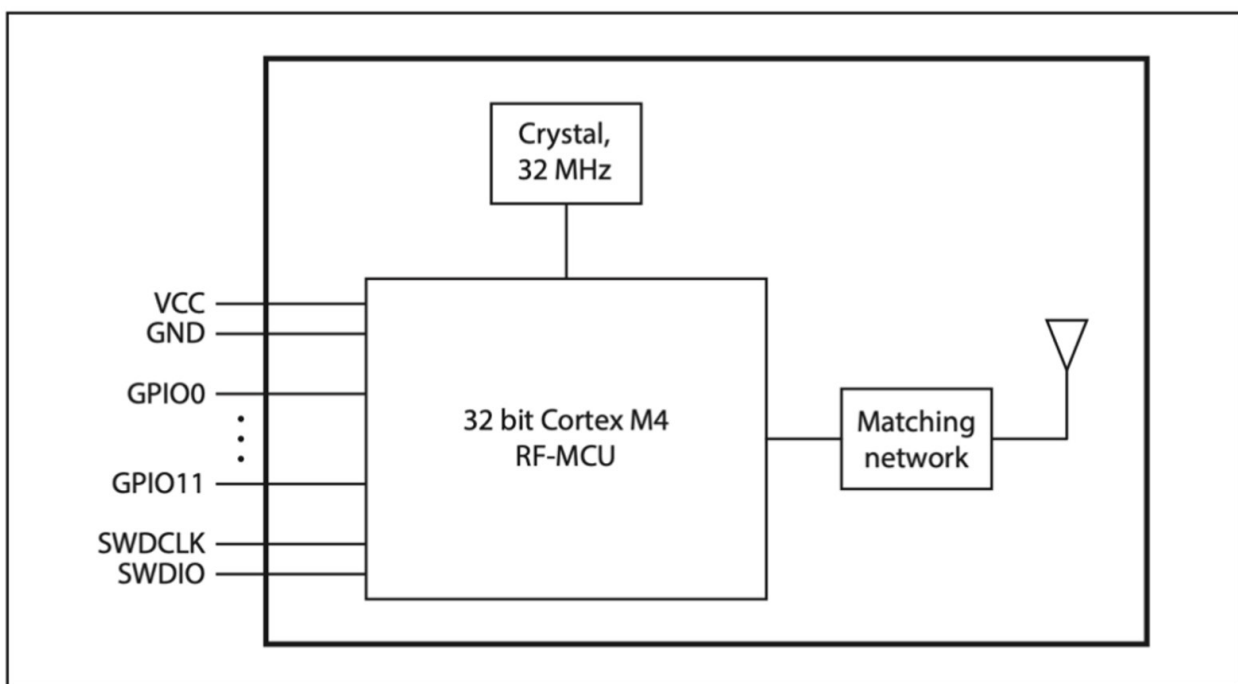
All $>10\text{kHz}$ and High-drive IOs shall be connected to High-drive pins, otherwise radio performance may be compromised.

The CBM-003 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-003'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-003 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-003 block diagram

3. System blocks

3.1 General Purpose I/O (GPIO)

The CBM-003 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.

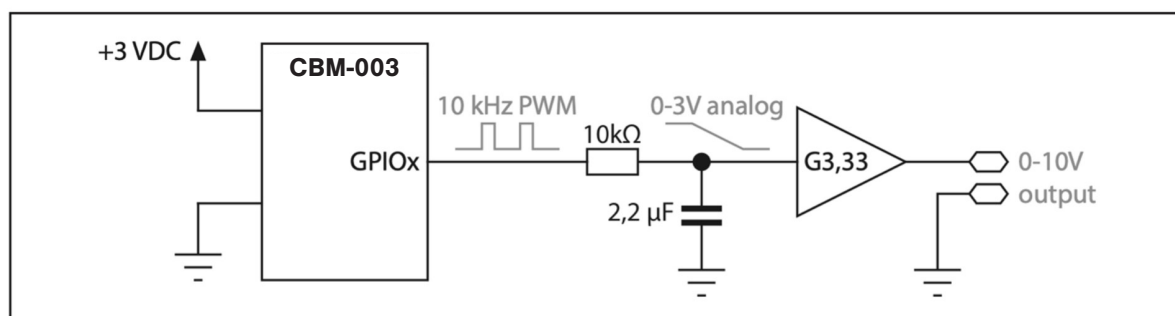
The Analog-to-Digital Voltage range for any ADC input is 0-3.6 V, but not above Vcc. This means that 0 V gives a zero reading from the ADC, and 3.6 V gives a maximum reading (255 for 8-bit and 4095 for 12-bit resolution).

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-003 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-003 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.

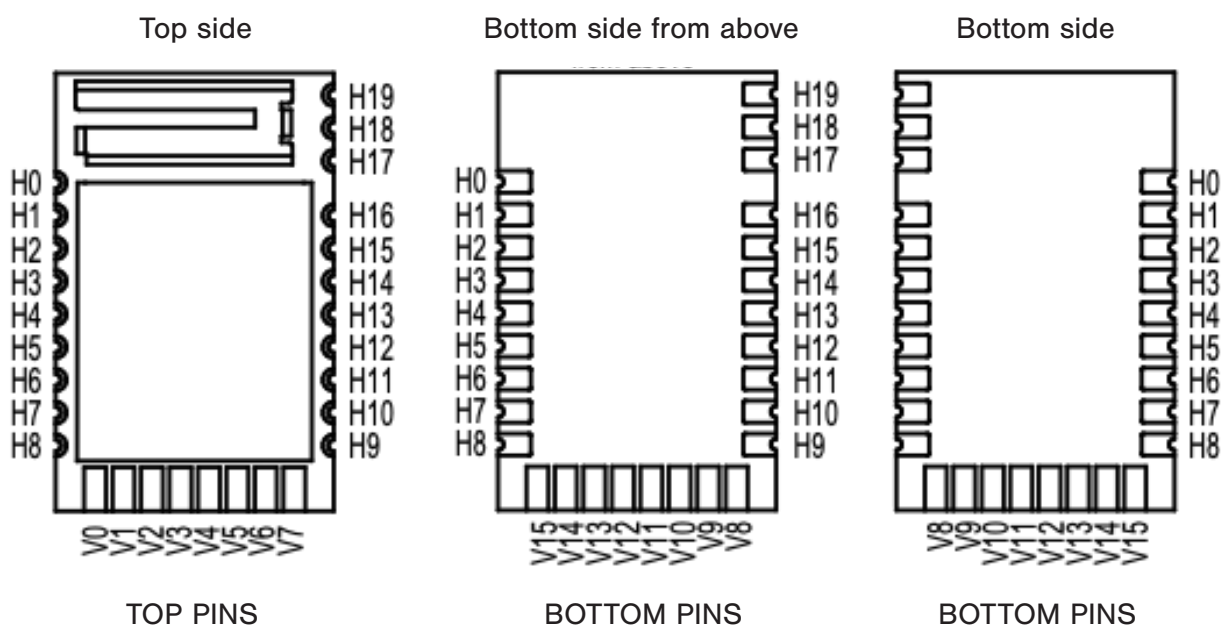
4.2 Two-Wire Interface (TWI)

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



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	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
			GND		Ground plane connection for antenna
			GND		Ground plane connection for antenna
			GND		Ground plane connection for antenna

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

6. Electrical Specifications

6.1 Absolute Maximum Ratings

Maximum ratings are the extreme limits to which CBM-003 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, I _{cc} (@3.0V)		7	17 *	mA

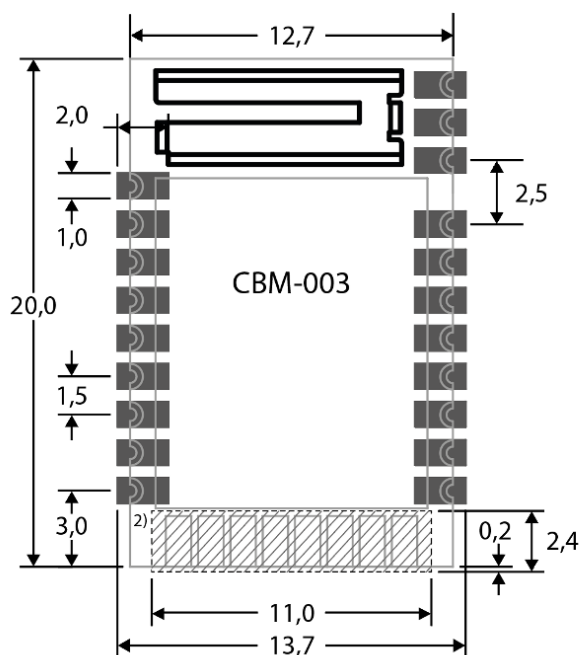
*In TX mode.

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".

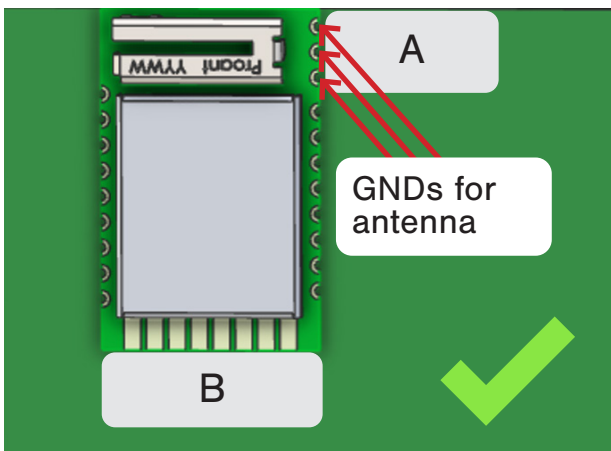
Suggested PCB footprint



7. Module installation placement

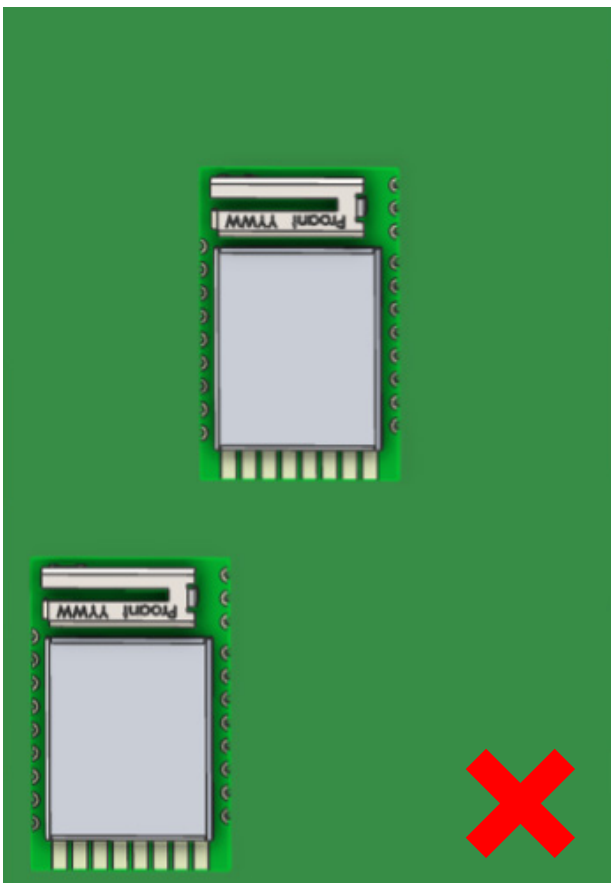
The CBM-003A uses an antenna that operates best when the CBM-003A module is properly grounded on the carrier PCB ground plane and has three extra grounding terminals for this purpose. However, the module can be used without connecting these terminals, but it may decrease antenna performance.

The antenna side ("A") is located at the edge of the carrier board. The CBM-003 antenna is not affected by surrounding materials. However, it's always good to avoid having nearby plastic or metal objects within its vicinity.



The optimal position for the CBM-003 on the carrier board

- Antenna aligned with PCB edge
- As much as possible ground around and below module
- Extra antenna grounding pads (marked by red arrows) grounded
- If GND plane is not available in area "A" it shall be available in area "B"



Bad design examples

- Bad module locations
- Antenna not at the edge of pcb board

Bad PCB design

- Module not provided with proper ground plane
- Routing is not allowed below antenna area
Routing below module on TOP

8. Radio Characteristics

8.1. General Radio Characteristics

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

Transmit power: +4 dBm max

9. Communication Interface Characteristics

9.1. Bit Rates

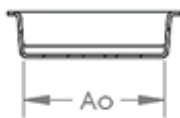
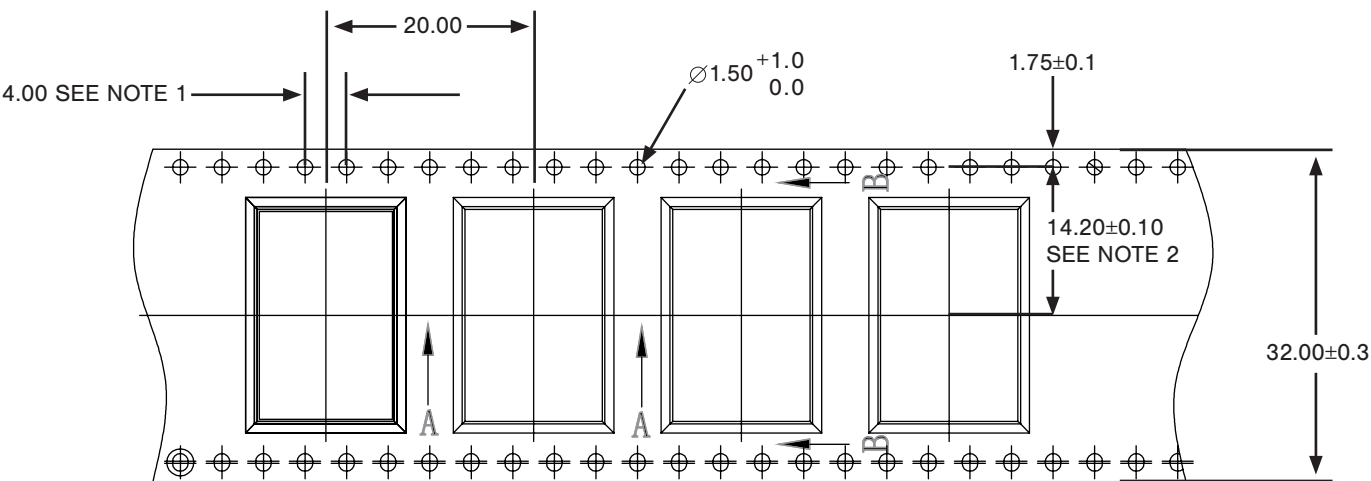
Bit Rates	Min.	Typ.	Max.	Units
Bit rate for SPI, f _{SPI}	0.125		8	Mbps
Bit rates for TWI, f _{2W}	100		400	kbps
Baud rate for UART, f _{UART}			1000	kbps

10. PWM Specifications

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

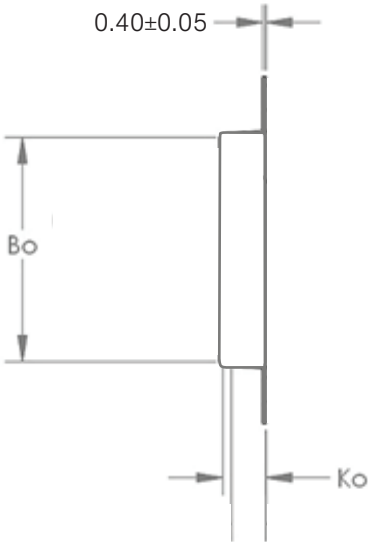
11. Packaging

11.1 Tape Dimensions



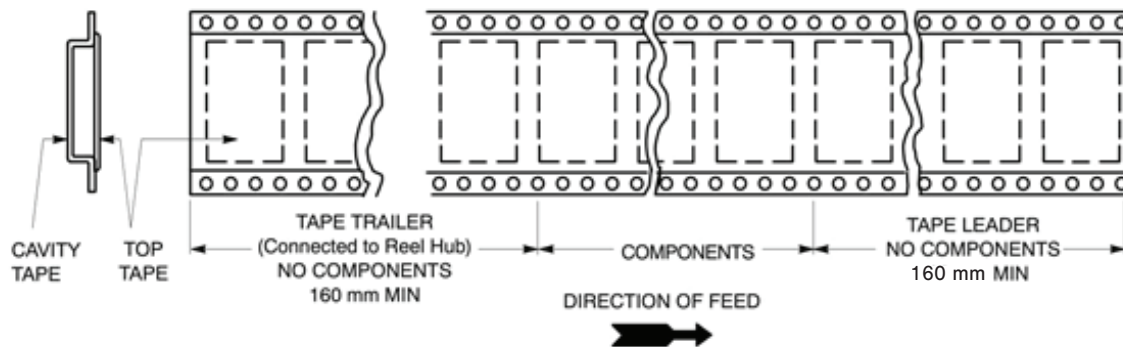
SECTION A-A

	DIM	$\pm$
Ao	13.20	0.10
Bo	20.40	0.10
Ko	4.50	0.10

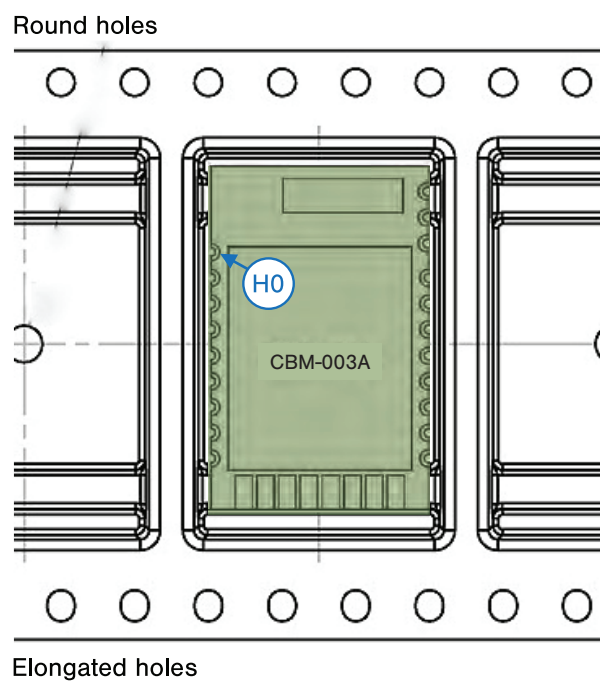


SECTION B-B

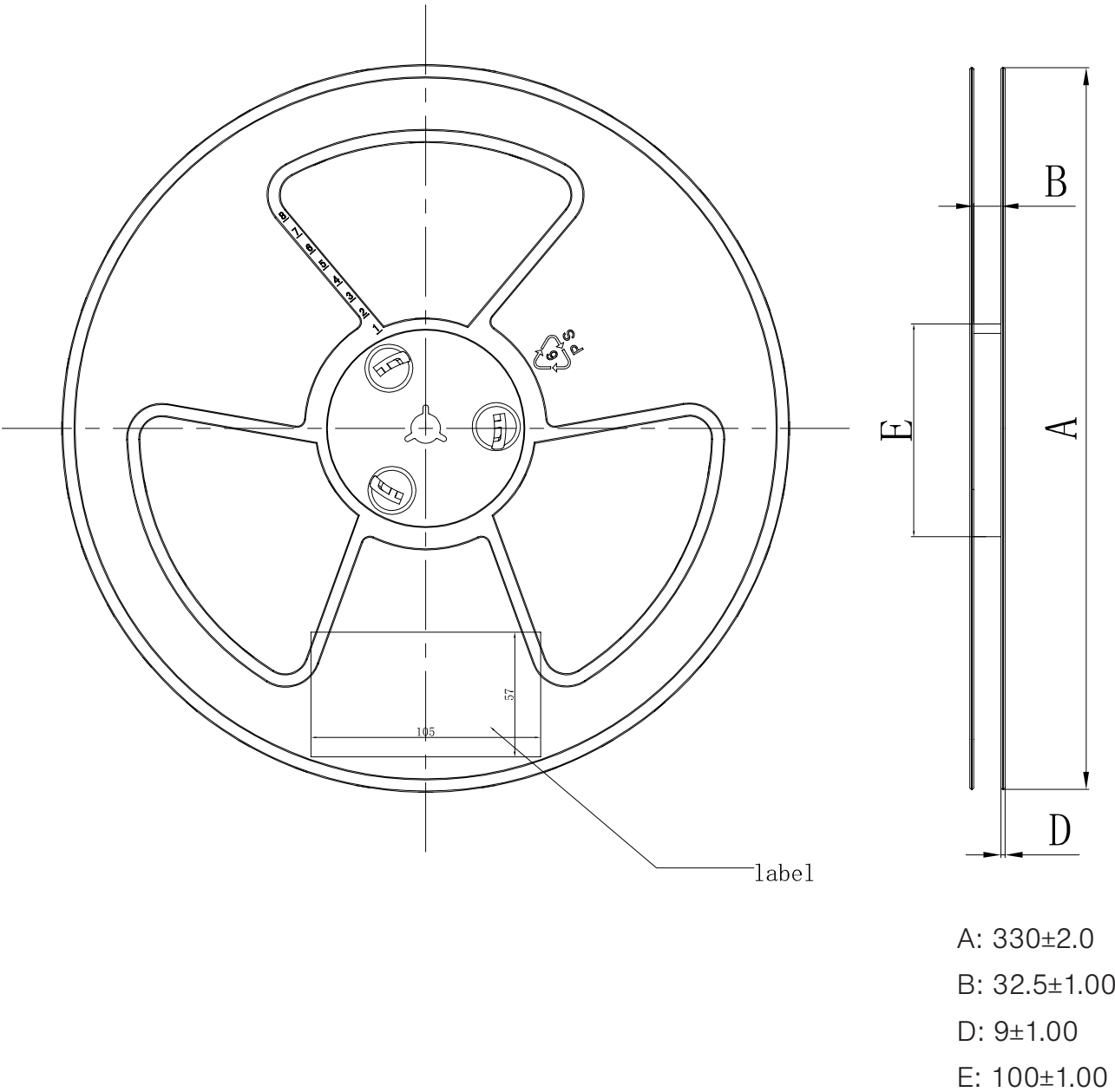
11.2 Packing in Tape



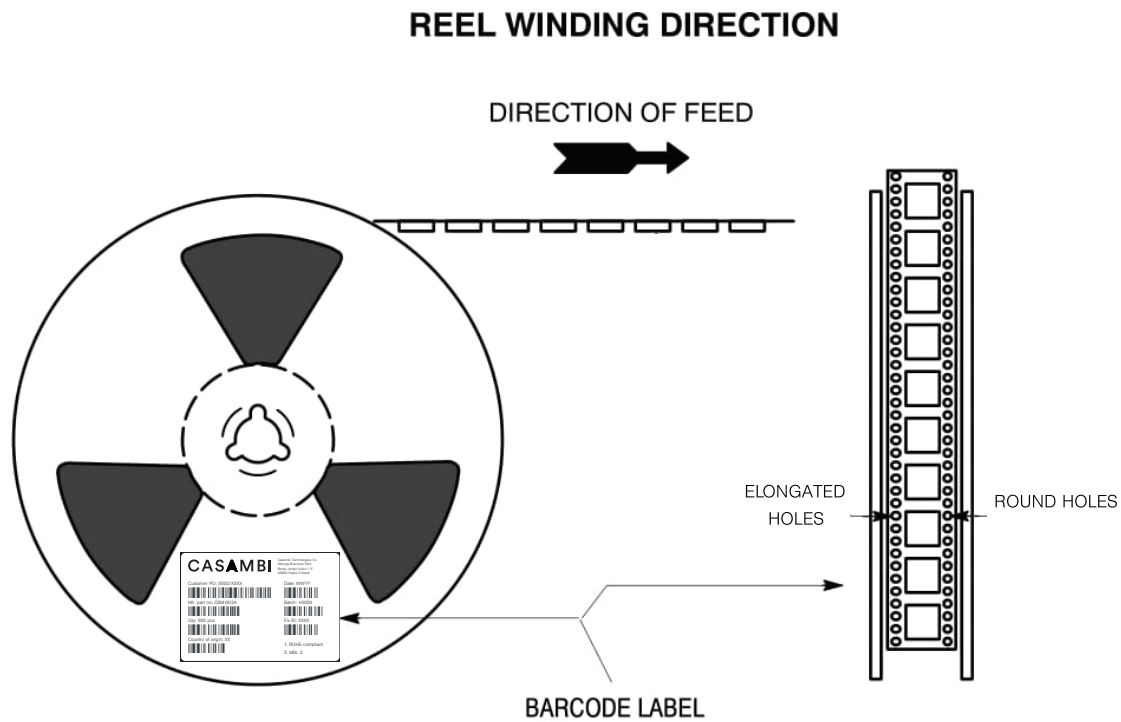
11.3 Component Direction



11.4 Reel Dimensions



11.5 Reel Winding Direction



11.6 Label Information

CASAMBI

Customer PO: 0000/XXXX

Mfr. part no: CBM-003A

Qty: 000 pcs

Country of origin: XX

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

Date: WWYY

Batch: #0000

Fix ID: XXXX

1. ROHS compliant
2. MSL 3

12. 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.

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).

- 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.

13. 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 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.

14. End Product Labeling

CBM-003A 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-CBM003A and IC Certification Number of 22496-CBM003A 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-003A 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'identification FCC de 2ALA3-CBM003A et le numéro de certification IC de 22496-CBM003A ne sont pas visibles lors de l'installation du module dans un autre appareil, une étiquette claire et visible avec les informations ci-après devra alors être apposée sur l'appareil:

Contains FCC ID: 2ALA3-CBM003A
Contains IC: 22496-CBM003A

Note 1: This module certified that complies with RF exposure requirement under 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 installation only 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