



Bluetooth® Low-Energy Proximity Beacon With Accelerometer



FEATURES

- | Supports all popular beacon formats such as iBeacon™, Eddystone™, AltBeacon™, and compatible with Quuppa Intelligent Locating System™
- | Unique iBeacon ID and scannable QR-code come standard
- | Accelerometer can be used to activate beaconing on actions such as movement, or gestures
- | Secure over-the-air updates possible with all major mobile platforms in the field
- | Multiple interleaved packet types with customizable parameters:
- | Packet types, including custom packet type
- | Device name, address, manufacturer name, model number, HW/SW revision
- | UUID, Major/Minor ID, UID or URL
- | Beacon interval, Transmitter power
- | Accelerometer function and sensitivity
- | Firmware can be customized and loaded at production for large quantity orders
- | Long battery lifetime
- | Over 4 year battery lifetime at 0dBm and 1sec intervals, when active 8 hours/day
- | Battery lifetime calculator available
- | Long range
- | Up to 200m line-of-sight (LOS) at maximum output power
- | Push button with LED feedback (red and green)
- | Weatherproof Enclosure (IP-64 Rating)
- | Key-fob or custom accessories available
- | Available with an optional connector for software development
- | Adding sensors
- | Alternate power source
- | Available as PCB module with CR2032 battery standard
- | Allows support of other Li coin cell batteries (i.e. CR2016, CR2450, and CR2477) and custom housing designs
- | Temperature range from -20C to +60C
- | Modular Bluetooth V5.0, FCC, IC, and CE certified, RoHS and REACH compliant
- | Made with Swatch Electronics Group technologies:
- | EM Microelectronic EM9304 Bluetooth V5.0 SOC
- | Renata CR2032 coin-cell battery
- | Micro Crystal 32.768kHz crystal

DESCRIPTION

The EMBC22 is a high-performance, customizable Bluetooth V5.0 low energy proximity beacon with an accelerometer for tracking objects that move. Similar to the EMBC02, the EMBC22 comes in simple, easy to use coin-shape housing, and is now powered by the EM9304, the world's lowest power Bluetooth IC.

New features include:

- Longer life from a CR2032 battery
- Longer range (up to 200m LOS)
- Over-the-air configurability
- Multiple interleaved packet types
- Modular RF certification
- Optional connector for sensors or power source

The EMBC22 is compatible with all major beacon formats including iBeacon™, Eddystone™, AltBeacon™ and compatible with Quuppa Intelligent Locating System™. The beacon is fully customizable over the air or in production. For example, the following parameters can be easily modified:

- Packet types, including custom packet type
- Device name, address, manufacturer name, model number, HW/SW revision
- UUID, Major/Minor ID, UID or URL
- Beacon interval, Transmitter power
- Accelerometer function and sensitivity

The EMBC22 can be shipped pre-programmed with custom firmware or custom parameters and can be securely updated in the field with over-the-air programming from a mobile device (all major iOS® and Android™ devices supported).

The EMBC22 accelerometer can be used to implement efficient and low-energy algorithms for various applications. The accelerometer can be used to activate beaconing on movement, or gestures, for example. When not active, the beacon dissipates minimal energy.

The EMBC22 can be stored in off mode without significantly degrading the battery lifetime. When active for 8 hours per day and configured for 0dBm output power and 1 second advertising intervals, the battery lifetime is more than 4 years.

The EMBC22 can be delivered in any quantity with guaranteed unique ID. A 2D unique serial number is printed on the beacon housing for optical scanning.

The EMBC22 is also available in PCB module format without housing. The module comes with the switch and battery holder. The beacon comes standard with a Renata CR2032/ 225mAh battery. Other Renata Lithium primary batteries such as CR2016/90mAh, CR2450/540mAh and CR2477/950mAh can also be accommodated.

The EMBC22 comes in a waterproof housing, and operates over a -20C to +60C temperature range. The EMBC22 is modular Bluetooth V5.0, FCC, IC, and CE certified, RoHS and REACH compliant.



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1. GENERAL DESCRIPTION

The EMBC22 is a 2.4 GHz RF electronic beacon with proximity capability, compatible with most common beacon standards with a low cost design for mass production, and includes a low-power accelerometer for activation features.

Over-the-air configurable:

- **Up to 10 advertisements running parallel and uniquely defined**
 - Industry Standard Packet Types
 - iBeacon™
 - altBeacon™
 - Eddystone™ UID, TLM, and URL
 - User defined
 - Advertisement interval
 - From 30ms to 18hrs
 - 17 Output Power Steps
 - From +6dBm to -34dBm
 - Conditional Advertising Options
 - Continuous Advertising
 - Advertising On Activity
 - Advertising On Inactivity
- **Simple state machine**
 - User defined events to enter Configuration Mode
 - Options for: Short button press, long button press or accelerometer flip
 - User defined events to toggle between Warehouse and Beacons Mode
 - Options for: Short button press, long button press or accelerometer flip
 - User configurable timeouts from the Configuration and Active Mode
 - From 100ms to 1.8hrs
 - User defined events to activate Activity Mode
 - Motion, tap, double tap, freefall, flip or short button press
 - Lockable
- **Flexible accelerometer settings**
 - Control of sensitivity, sampling rates, duration, etc. settings

Long Range:

- 100m LOS at 0dBm
- 200m LOS at max output power

Long Battery Life:

- Replaceable CR2032 Li 3V battery
- Up to 10 years storage life

Normal Operating Conditions:

- -20 to +60 C
- Weather proof (IP-64 rating)

Small and Lightweight:

- 30mm diameter x 10mm disk
- 7 grams

Certifications:

- Environmental: RoHS, REACH, Halogen Free
- RF: FCC, IC, CE

Compatible With:

- Bluetooth Smart Ready Devices
- Most Common Beacon Standards

EMBC Configuration Tool

- A free smart phone and tablet application for:
 - iOS
 - Android

Included Hardware:

- A white plastic enclosure
- A push button for mode changes
- A green and red LED for user feedback
- A permanent label with a unique serial number and QR Code

Multiple Delivery Formats:

- Finished product
- Custom Firmware
- Custom Housing
- PCB Only

Optional Mounting Accessories:

- Key-fob
- Other options possible (wall-mount, wrist-band are available upon demand)

Multiple Battery Sizes:

- Standard in EMBC22 housing is CR2032/225mAh battery
- CR2016/90mAh, CR2450/540mAh, CR2477/950mAh (housing available upon demand)

Fully Customizable:

- Development kit available
- Adjustable parameters
- Modifiable firmware

1. ENVIRONMENTAL AND STORAGE CONDITIONS

The operating and storage conditions are listed in Table 1.

Table 1: Environmental and storage conditions	
Module operating temperature and humidity range	-20°C to 60°C and 0 to 90% RH
Weatherproof	Module can be used in outdoor conditions. It is rated IP64 according to CEI 60529.
Module storage temperature and humidity range	Modules must be stored in original EM packing at Temp=25°C±5°C / RH 30-45%.

2. PRODUCT DESCRIPTION

3.0 INTRODUCTION

The EMBC22 is a single PCB BLE solution that can be used with many housing types or battery combinations. An example of the single modular transmitter module applied to a beacon application is shown below.

2.1. EMBC22 APPLICATION TO A FINISHED BEACON

The finished product outline dimensions are shown in Figure 1 for the CR2032 version only. Dimensions for housings for other battery sizes available upon request.

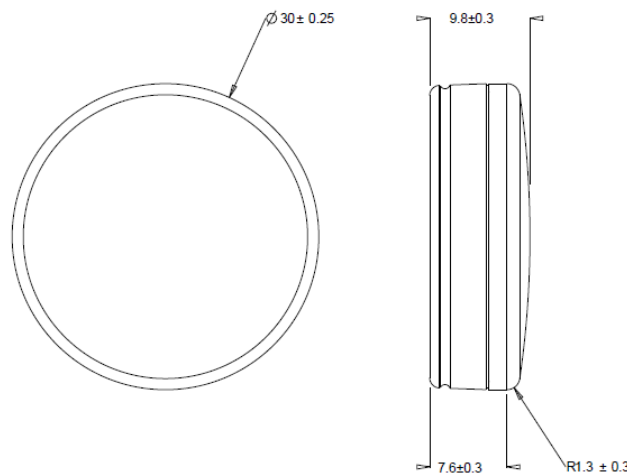


Figure 1: EMBC22 application to beacon

2.2. PCB

The EMBC22 accelerometer beacon module PCB is shown in Figure 2 with a 26mm diameter. An optional SlimStack™ connector (Molex PN 5037761610) can be used for software development (JTAG access), for connection to a daughter board with sensors for example, or to connect to a different power source such as a battery pack. The standard version comes with a CR2032 replaceable battery and battery holder. Other battery sizes such as CR2016, CR2450, or CR2477 batteries can also be accommodated.

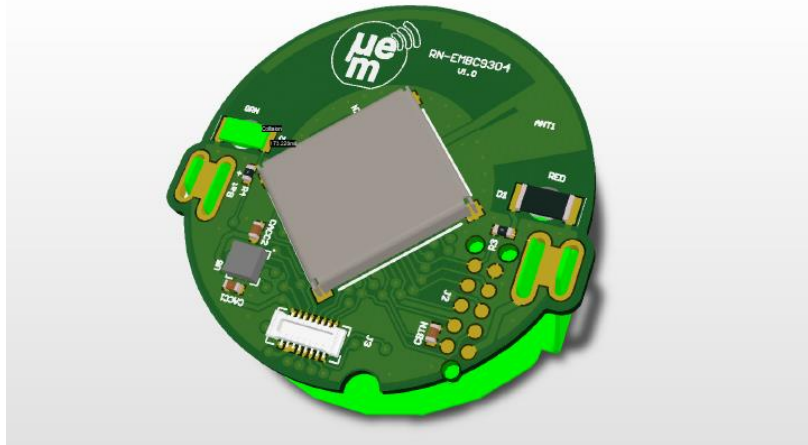


Figure 2: Accelerometer beacon module PCB with connector

3. MECHANICAL

3.1. PUSH BUTTON

The push button is activated with a firm press. It is designed so that it cannot be activated accidentally.

3.2. LED

The green and red LEDs are visible through the plastic enclosure under indoor lighting conditions. LEDs are used to indicate the operating mode of the beacon.

4. ELECTRICAL

CAUTION. RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.

Typical values are stated at room temperature (T=25°C) with a supply voltage of VCC=3.0V.

4.1. HANDLING PROCEDURES AND ABSOLUTE MAXIMUM RATINGS

The finished product is compliant with EN 61000-4-2 (Electrostatic Discharge) level 2: 4kV contact discharge and 4kV air discharge. This PCB module has built-in protection against high static voltages or electric fields; however, anti-static precautions must be taken when handling the PCB module, for example, when replacing the battery.

Unless otherwise specified, proper operation can only occur when all terminal voltages are kept within the specified voltage range. The absolute maximum ratings of are listed in Table 2.

Parameter	Min	Max	Unit
Supply Voltage VCC - VSS	-0.3	3.8	V

Stresses above these listed maximum ratings may cause permanent damage to the device. Exposure beyond specified operating conditions may affect device reliability or cause malfunction

4.2. GENERAL OPERATING CONDITIONS

The general operating conditions of are listed in Table 3.

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC)	2.0	3.0	3.6	V
Temperature Range	-20	25	+60	°C



4.3. ELECTRICAL CHARACTERISTICS

The electrical characteristics of are given in Table 4 for a typical use case.
Unless otherwise specified: VCC=3.0V, T=25°C

Table 4: Battery Life-Time and Range					
Operating Mode	Specification	Min	Typ	Max	Unit
Warehouse Mode	Storage Time		1		years
	Average Current		1.5		µA
Active Mode (10% activity)	Daily Activity		10		%
	Beacon Interval		1000		msec
	Output Power		0		dBm
	Average Current		3.8		µA
	Line-of-Site(LOS) Distance		100		m
Sleep Mode	Daily Sleep Time		90		%
Battery Lifetime	CR2032 Battery Above Use Case		5		years

Note 1: Battery Lifetime is calculated based on the average current using a Renata CR2032 battery with 225mAh of battery life under typical conditions.

Note 2: Beacon interval is the Bluetooth advertising interval (advInterval) as defined in the Bluetooth Specification V5.0, Volume 6, Part B, and Section 4.4.2.2.

Note 3: Range is measured outdoors, line-of-site, with an iPhone™.

4.4. REGULATORY

EMBC22 is modular certified and complies with the following regulatory requirements:

4.4.1. USA-FCC

- Single Modular Transmitter
- EMC
FCC CFR 47, Part 15, Subpart B (10-1-17 Edition), Secs. 15.109
- RF
FCC Part 15.247, 10-1-17 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.
FCC Part 15.209, 10-1-17 Edition: Radiated emission limits; general requirements

4.4.2. Canada-IC

- EMC
ICES-003 Issue 6 – Update April (2017)
- RF
RSS-247 Issue 2 (February 2017).
RSS-Gen Issue 4 (November 2014).

4.4.3. CE

EM Microelectronic, as the responsible party for regulatory compliance, declares under our sole responsibility that as delivered the described product is in conformity with the RED Radio Equipment Directive 2014/53/EU, following the provisions of ERP Directive 2009/125/EC, EU RoHS Directive 2011/65/EU, including the amendment 2015/863/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment, and carries the CE-marking. Refer to emmicroelectronic.com for the signed declaration.

- EMC
ETSI EN 301 489-1 V2.2.0
ETSI EN 301 489-17 V3.2.0
- RF
ETSI EN 300 328 v2.1.1 (2016-11):

4.4.3.1. SAFETY File

1. Information on all plastics (flame rating and UL listing) model numbers
2. Battery: Specification, UL listing, and reports from vendor (Standards are UL 1642 and IEC/EN 62133)
3. PCB Board (same info as plastics)
4. Label (same info as plastics)



5.4.4 REGULATORY INFORMATION USA

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

5.4.4.1 Class B device notice

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.

5.4.4.2 RF exposure safety

This device meets the SAR Test Exclusion threshold specified in KDB447498 and is authorized for portable and mobile operation. Installers and end-users must be provided with antenna installation instructions and transmitter operating conditions and instructions for satisfying RF exposure compliance.

5.4.4.3 Permitted Antenna

This radio transmitter model, FCC ID: 2ACQR-EMBC22 has been approved by FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Type	Max Gain
Integrated PCB IFA	1.5 dBi

5.4.4.4 Labelling Requirements for the Host Device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains FCC ID: 2ACQR-EMBC22

5.4.5 REGULATORY INFORMATION CANADA

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Les changements ou modifications non expressément approuvés par la partie responsable de la conformité pourraient annuler l'autorisation de l'utilisateur d'utiliser l'équipement.

This device complies with Industry Canada's license-exempt RSSs. 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.

5.4.5.1 RF Exposure Safety

According to "RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)", paragraph "2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation", the device operates below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance. The evaluation has been done at a distance of 5mm.

5.4.5.2 Permitted Antenna

This radio transmitter model, IC: 12155A-EMBC22 has been approved by the ISED to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Type	Max Gain
Integrated PCB IFA	1.5 dBi

Le présent émetteur radio modèle, IC: 12155A-EMBC22 a été approuvé par ISDE pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Type	Max Gain
Integrated PCB IFA	1.5 dBi

5.4.5.3 CAN ICES-3 (B)/NMB-3(B)

This Class B digital apparatus complies with Canadian ICES-003

Cet appareil numérique de classe B est conforme à la norme Canadienne ICES-003

5.4.5.4 Labelling Requirements for the Host Device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

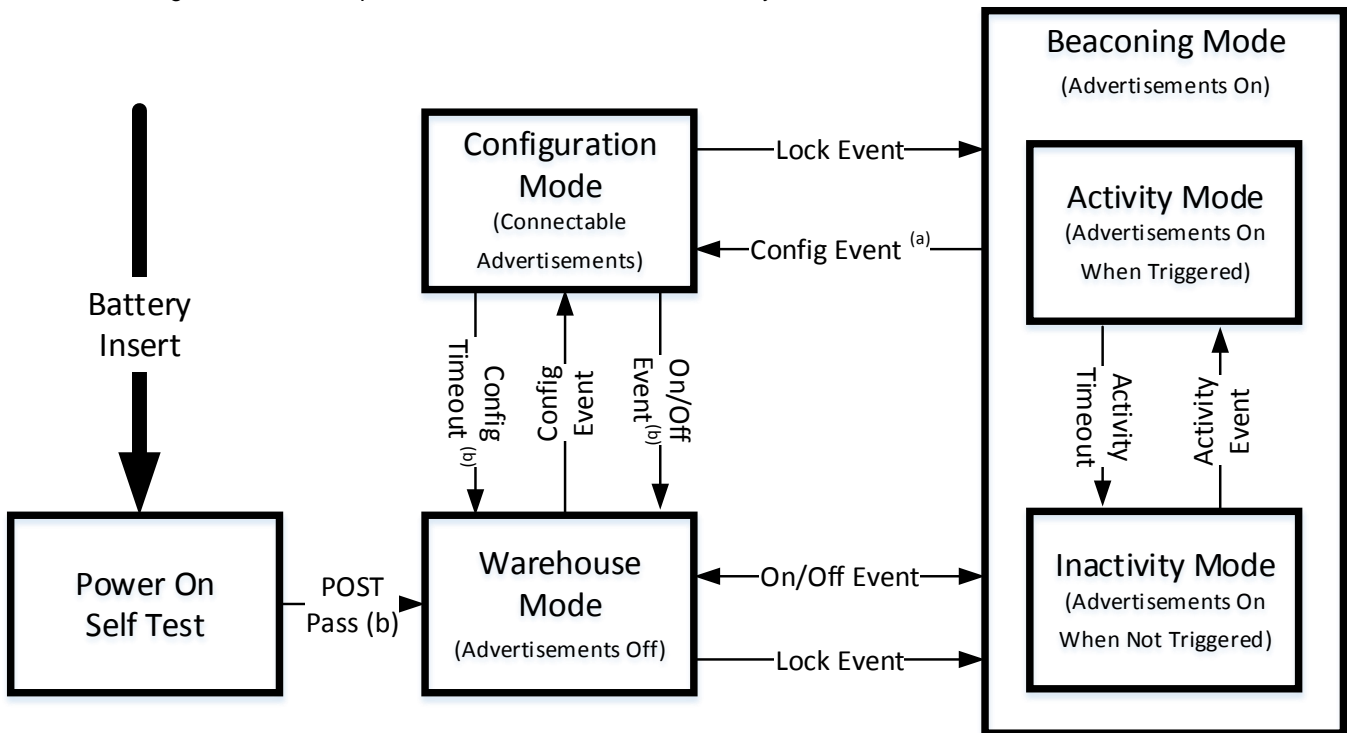
Contains IC: 12155A-EMBC22

L'équipement hôte doit être correctement étiqueté pour identifier les modules dans l'équipement. L'étiquette de certification du module doit être clairement visible en tout temps lorsqu'il est installé dans l'hôte, l'équipement hôte doit être étiqueté pour afficher l'IC du module, précédé des mots "Contient le module émetteur", ou le mot "Contient", ou un libellé similaire exprimant la même signification, comme suit:

Contains IC: 12155A-EMBC22

6 FIRMWARE

The following is a basic description of EMBC22 firmware functionality.



(a) Event disabled after Lock Event occurs

(b) Event can be configured transition to “Beaconing”, rather than “Warehouse” Mode

6.4 STATE MACHINE

The state-diagram for the EMBC22 standard firmware is shown in Figure 3.

Figure 3: Firmware State-Diagram

6.4.5 State Machine Configuration Options

Table 5: State Machine Configuration Options		
Parameter	Options	Default
Hardware Features	Button Red LED Green LED Accelerometer	All Enabled
Startup Mode	Warehouse Mode Beaconing Mode	Warehouse Mode
Activity Event Source	Disabled Short Button Press Movement Tap Double Tap Freefall Flip	Movement
On/Off Event Source	Disabled Short Button Press Long Button Press Flip	Short Button Press
Config Event Source	Disabled Short Button Press Long Button Press Flip	Long Button Press
Config Timeout	0.1 to 6553.5 seconds	60 sec
Activity Timeout	0.1 to 6553.5 seconds	60 sec



6.4.6 Hardware Features

The hardware features of the button, Red LED, Green LED and Accelerometer may be disabled in firmware. The option to disable these hardware features is unavailable in the standard release of the EM9304 Beacon Configuration Tool Suite. Options to control these features are made available on request in EM9304 Beacon Configuration Tool Suite.

6.4.7 Operating Modes

Operating Modes of the EMBC22 are indicated with boxes in the Figure 3: Firmware State-Diagram. The modes are fixed unless code patches are written and applied to redefine the states. Code patches may be developed using the EM9304 Beacon SDK on the EMBC22 DVK. Behaviors within specific states, such as advertisement profiles in the Beaconsing Mode, can be redefined using the EM9304 Beacon Configuration Tool Suite. No source code development is required when using the EM9304 Beacon Configuration Tool Suite.

6.4.7.1 Power-On-Self-Test (POST)

On battery insertion, a self-test feature is run to confirm functionality of the key electrical components for advertising. The test sequence follows the flow listed below:

1. Test the 32kHz crystal operation, red and green LEDs on
2. Test the 48MHz crystal operation, red LED on
3. Test the accelerometer, green LED on
4. LEDs off

If the test passes, both LEDs will turn off. If the test fails, one or more of the LEDs will remain on in the present state to indicate which step failed.

6.4.7.2 Startup Mode

The startup mode is the mode that will be entered after POST or on a Config Timeout Event. The default definition of Startup Mode and reassignment options are as defined in Table 5: State Machine Configuration Options.

6.4.7.3 Warehouse Mode

In Warehouse Mode, the EMBC22 is in its lowest consumption state to support long term storage. A Config Event, On/Off Event and Lock Event will all initiate exiting the Warehouse Mode. If a Config Event or On/Off Events are defined to use the flip option, the accelerometer will be sampling at the rate defined in the accelerometer configuration settings and the consumption will increase as defined in the Table 8: Accelerometer Configuration Options at the selected sampling rate. If the Config Event and On/Off Event are not defined to use the flip option, the accelerometer is in a power down state and the consumption of the device is as defined in Section 4.3.

6.4.7.4 Configuration Mode

In Configuration Mode, the EMBC22 advertises a connectable advertisement at the default interval and output power as defined in Table 6: Configuration Mode Advertisement Configuration Options. The advertisement rate and output power may be redefined by the user. The configuration timer is started on entry into the Configuration Mode. If no connections are made before the Config Timeout occurs, the EMBC22 returns to the startup state. Exit from Configuration Mode is initiated by an On/Off Event, Lock Event or Config Timeout. When a connection is made to the EMBC22, the part will stay in a connected state until the master breaks the connection or is out of range. On disconnect, the EMBC22 initiates a reset and returns to the POST state.

Description	Supported Type	Default
Packet Type	Connectable	Connectable
Advertisement Interval	30ms - 18hrs ⁽¹⁾	500 ms
TX Power Level Settings (dBm)	6.2 4.6 2.5 0.4 -1.4 -2.6 -4 -5.5 -6.9 -8.4 -9.9	0.4 dBm



	-11.4	
	-13.1	
	-14.6	
	-16.4	
	-17.9	
	-29	
	-33.5	

6.4.7.5 Beaconsing Mode

In Beaconsing Mode, the EMBC22 beaconsing engine is enabled. The beaconsing engine supports up to 10 advertisements running in parallel. Each advertisement may have a unique Packet Type, Advertisement Interval, and Transmit Power Level. In addition, each advertisement may be gated such that the advertisement is Always Enabled, Enabled Only When Active or Enabled Only When Inactive. Table 7: Beaconsing Mode Advertisement Configuration Options shows the configuration options available for each advertisement.

Description	Supported Type	Default
Packet Type	iBeacon™ Eddystone UID™ Eddystone URL™ Eddystone TLM™ altBeacon™ Connectable User Defined – Fixed Payload	Adv 1-10 Disabled
Advertisement Interval	30ms - 18hrs ⁽¹⁾	Adv 1-10 Disabled
Tx Power Level Settings (dBm)	6.2 4.6 2.5 0.4 -1.4 -2.6 -4 -5.5 -6.9 -8.4 -9.9 -11.4 -13.1 -14.6 -16.4 -17.9 -29 -33.5	Adv 1-10 Disabled
Advertisement Gating	Off Always Enabled Enabled when Active Enabled when Inactive	Off

The beacon engine combines the settings of the 10 defined advertisement to create an interleaved advertisement profile. Below is a diagram showing an example where three advertisements are enabled. Adv1 is an Eddystone™ URL packet type with an output power of 0dBm at a 1 second interval and a URL of www.Moving.com set to transmit when the module is moving. Adv2 is a Connectable advertisement with an output power of -14dBm at a 300ms interval and is always enabled. Adv3 is an

Eddystone™ URL packet type with an output power of -5dBm at a 1.5 second interval and a URL of www.NotMoving.com set to transmit only when the module is not moving.

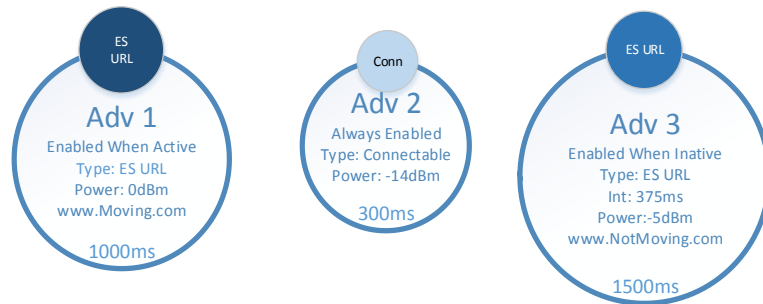


Figure 4: Example of three advertisements enabled

The beacon engine combines these three independent advertisement definitions to create appropriate interleaved advertisement profiles based on the Activity Events detected. The part is in an Inactivity Mode until an Activity Event is detected and the beacon engine manages interleaving the advertisement profiles is as shown in the figure below.

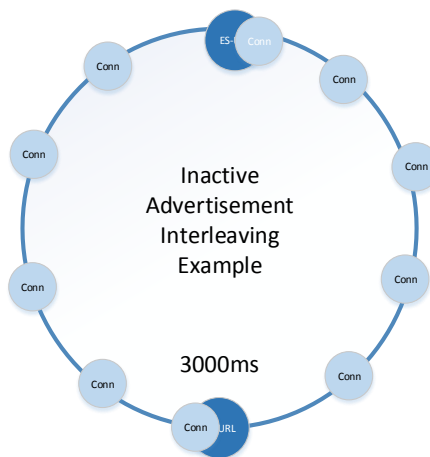


Figure 5: Example advertisement interleaving in Inactivity Mode

Once an Activity Event is detected, the beacon engine reengages to disable the On When Inactive advertisement and enable the On When Active advertisements. The resulting interleaved advertisement profile in this example is shown below.

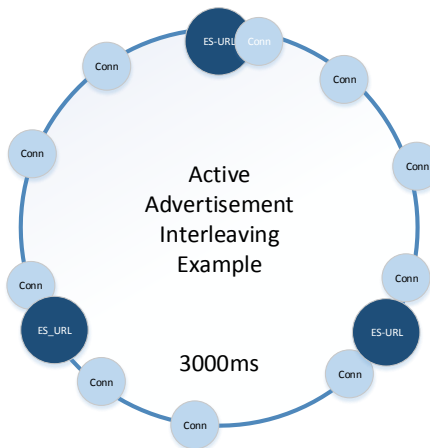


Figure 6: Example advertisement interleaving in Activity Mode

When multiple advertisements are running in parallel timing collisions may occur. The firmware will make priority decisions regarding which advertisement to send next. The advertising interval of one or more packets is extended by a minimum of 30ms when collisions occurs in order to prevent violation to BLE advertisement protocols.

6.4.7.5.1 Activity Mode

Activity Mode is a subset of Beaconsing Mode. When advertisements are assigned to this Advertisement Gating option, the advertisement will only occur after an Activity Event has been detected and for the duration of time defined by the Activity Timeout. Advertisements assigned to the Always Enabled advertisement gating option will continue to be transmitted while in the Activity Mode.

6.4.7.5.2 Inactivity Mode

Inactivity Mode is a subset of Beaconsing Mode. When advertisements are assigned to this advertisement gating option, the advertisement will only occur when not in the Activity Mode. Advertisements assigned to the Always Enabled advertisement gating option will continue to be transmitted while in the Inactivity Mode.

6.4.7.6 BLE Connection

A connection can be initiated from any mode where a connectable advertisement is sent. When a connection is made, all accelerometer interrupt sources are disabled. If the connection was made from Configuration or Activity Mode, the correlating timer continues to run while the connection is enabled. If the corresponding timer expires while the connection is enabled, the timeout event will occur on disconnect. Pressing the button during a connection will initiate a disconnect. If the corresponding timer does not expire while the connection is still enabled, the mode that the connection was initially made in will resume on disconnect. Specific services may initiate a Reset Event. A Reset Event will return the part to POST.

6.4.8 Mode Transitions

Mode transitions of the EMBC22 are indicated with arrows in the Figure 3: Firmware State-Diagram. The start and ending mode of transitions are fixed unless code patches are written and applied. Code patches may be written using the EM Beacon SDK and developed on the EM Beacon DVK. The duration of a Config Timeout or an Activity Timeout can be redefined using the EM Beacon Configuration Tools. Additionally, the source of the Config Event and On/Off Event can be redefined using the EM Beacon Configuration Tools. No source code development is required when using the EM Beacon Configuration Tools.

6.4.8.1 Config Event

A Config Event generates a transition from the Beaconsing Mode or Warehouse Mode into Configuration Mode. The Config Event may be assigned as defined in Table 6: Configuration Mode Advertisement Configuration Options using the EM Beacon Configuration Tools. No source code development is required when using the EM Beacon Configuration Tools.

The Green LED flashes twice when a Config Event occurs.

6.4.8.2 Config Timeout

On entry into the Configuration Mode, the configuration timer is started. A Config Timeout is generated when that timer expires and initiates a transition from Config Mode to the startup mode. The duration of the Config Timeout may be modified with the EM Beacon Configuration Tools as defined in Table 6: Configuration Mode Advertisement Configuration Options. No source code development is required when using the EM Beacon Configuration Tools.

The Red LED flashes twice when a Config Timeout occurs.

6.4.8.3 On/Off Event

An On/Off Event generates a transition from the Beaconsing Mode to Warehouse Mode, from Configuration Mode to Beaconsing Mode and from Beaconsing Mode to Warehouse Mode. The On/Off Event may be modified as defined in Table 6: Configuration Mode Advertisement Configuration Options using the EM Beacon Configuration Tools. No source code development is required when using the EM Beacon Configuration Tools.

When the On/Off Event initiates transitioning to Beaconsing Mode, the Green LED is enabled while the event is occurring. When the On/Off Event initiates transitioning to Warehouse Mode, the Red LED is enabled while the event is occurring.

6.4.8.4 Activity Event

An Activity Event generates a transition from the Inactivity Mode to Activity Mode. The Activity Event may be assigned as defined in Table 6: Configuration Mode Advertisement Configuration Options.

No LED indicators are used to communicate transitions between Activity and Inactivity Mode.



6.4.8.5 Activity Timeout

On entry into the Activity Mode, the activity timer is started. An Activity Timeout is generated when the activity timer expires and initiates a transition from Activity Mode to the startup mode. The duration of the Activity Timeout may be modified with the EM Beacon Configuration Tools as defined in Table 6: Configuration Mode Advertisement Configuration Options. No source code development is required when using the EM Beacon Configuration Tools.

No LED indicators are used to communicate transitions between Activity and Inactivity Mode.

6.4.8.6 Reset Event

A Reset Event is initiated by battery insertion, toggling the enable signal from the test bus or from select BLE services. A Reset Event clears data RAM and returns to the POST state to reinitialize the part.

After a Reset Event the LED indicators of POST running will be seen.

6.4.8.7 Lock Event

A Lock Event will disable the On/Off Event and initiate a transition to Beaconsing Mode. The only way to exit beaconsing mode after an On/Off Event has been initiated is to issue a Reset Event.

The Green LED flashes three times when a Lock Event has been initiated.

6.4.9 Accelerometer Configuration

Configuration of key control registers on the accelerometer may be modified from the EM Beacon Configuration Tools. The configurable options are listed in **Error! Reference source not found.** Description of the parameter are from the STM LIS2DWL datasheet DocID029682 Rev4. Additional details regarding the impact on the operating behavior, consumption and performance of the device can be found in the accelerometer datasheet.

Table 8: Accelerometer Configuration Options			
Description	Available Options	Default	Units
Output Data Rate	Power Down 1.6 12.5 25 50 100 200	12.5	Hz
Power Mode	Low Power High Performance	Low Power	-
Low Noise	Enable Disable	Disabled	-
Filter Bandwidth	Div 2 Div 4 Div 10 Div 20	Div 2	-
Full Scale Range	2 4 8 16	2	G
Filter Selection	Low Pass High Pass	Low Pass	-
Movement Threshold	0 to 63	4	-
Movement Duration (Sequential Samples)	0 1 2 3	0	-
Flip 4D/6D	4D Detection 6D Detection	6D	-
6D Threshold	50 60 70 80	60	Degrees
6D Low Pass Filter	Enable Disable	Disable	-
Tap Shock X Threshold	0 to 31	9	-
Tap Shock Y Threshold	0 to 31	9	-
Tap Shock Z Threshold	0 to 31	9	-
Tap Shock Time	4	16	Samples



	8 12 16		
Tap Quiet Time	2 4 6 8	8	Samples
Double Tap Latency	16 32 48 64 80 96 112 128 144 160 176 192 208 224 240 256	128	Samples
Tap Axii	X Axis Y Axis Z Axis	All Enabled	-
Freefall Duration	0-63 Samples	3	-
Freefall Threshold	156 219 250 312	312	mg

6.5 ADVERTISEMENTS

The Bluetooth advertising packets are non-connectable, undirected advertising events (ADV_NONCONN_IND) which follow the GAP specification according to the Bluetooth Specification V5.0, Volume 3, Part C, Section 11.

6.5.5 Device Address

Each EMBC22 has a unique factory-assigned address. The first 3 octets of the device address are the EM Microelectronic OUI assigned address from the IEEE 802 committee: 0x0CF3EE. The last 3 octets of the device address are uniquely assigned by EM Microelectronic. All advertisements enabled in the Beaconsing and Configuration Modes share the same Device Address.

The device address to be used may be modified with the EM Beacon Configuration Tools. If the address 00:00:00:00:00:00 is entered, then the factory-assigned address will be used.

6.5.6 Advertising Channels

Each EMBC22 has a unique factory-assigned address. The first 3 octets of the device address are the EM Microelectronic OUI assigned address from the IEEE 802 committee: 0x0CF3EE. The last 3 octets of the device address are uniquely assigned by EM Microelectronic. All advertisements enabled in the Beaconsing and Configuration Modes share the same Device Address.

7 LABEL

The label has the following contents:

- Model: EMBC22
- Unique Serial Number
- FCC-ID: 2ACQR-EMBC22
- IC ID: 12155A-EMBC22
- FCC and CE Marking
- EM Microelectronic company name
- QR Code containing the unique Serial Number

7.4 SERIAL NUMBER

The serial number is generated by reading the device address of EMBC22, reversing the byte order, and printing the number in decimal form.

For example:

- Device Address: 0x0CF3EE5A0001 corresponds to Serial Number: 001101037237004

8 PACKING AND LABELING

8.4 FINISHED PRODUCT

8.4.5 Inner Packing

EMBC22 beacons are packed in custom antistatic trays.

- Only one tray per box can have parts from 2 different product lots.
- Tray size is 300 x 261 x 38 mm.
- Number of parts per tray is 100pcs.
- There are 5 trays per stack, excluding cover tray.

A label is applied on each stack. The minimum information on the label is specified in Figure 7.

EM P/N:
Mfg date:
Module Lot Nr:
Qty:

Figure 7: Packing label information

8.4.6 External Packing

Tray stacks are packed in cardboard box.

- Quantity of parts per box is 1000 pcs (2 tray stacks).
- Box dimensions are 37 x 55 x 43 cm.

A label is applied on each box. The minimum information on the label is specified in Figure 8.

EM P/N:
Mfg date:
Module Lot Nr:
Qty:
Weight:

Figure 8: Panel packing label information

9 ACCESSORIES

Please reference the EMBC01 datasheet for description of available accessories.

10 ENVIRONMENTAL SAFETY

EMBC22 is:

- RoHS compliant according to EU Directive 2011/65/EU and its amendments including 2015/863/EU
- Halogen Free according to IEC 61249-2-21:2003.
- REACH compliant according to EU Regulation 1907/2006

11 ORDERING INFORMATION

The EMBC22 is available as a finished product in a plastic housing with full FCC, IC, and CE certification. It is also available in PCB form as a panel which requires country certification (ie FCC, CE, etc.) of final product performed by the customer. The EMBC01 key-fob, wall-mount, and wrist-band accessories are available separately. Pre-certification beacons are available for evaluation and development. The EMBC22 Beacon Development Kit is available with 5 pre-certification beacons, an interface board, and JTAG cable for custom program development. The EMBC22 ordering information is shown in Figure 9 and the order numbers are shown in Table 9.

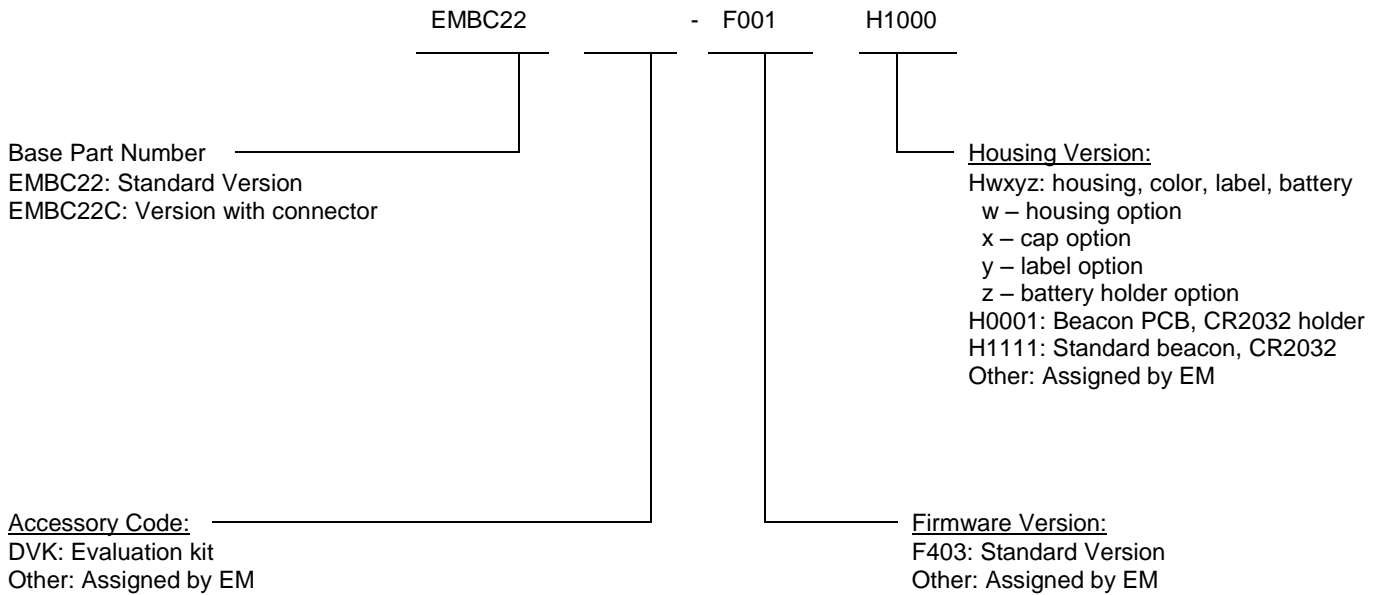


Figure 9: EMBC22 Ordering Information

Table 9: EMBC22 Related Order Numbers

ORDER NUMBER	DESCRIPTION	CONTAINER	UNITS PER CONTAINER	MINIMUM ORDER QUANTITY
EMBC22-F403-H1111	Standard Accelerometer beacon	Individual	1	1
EMBC22-F403-H1111	Standard Accelerometer beacon	Tray	100	100
EMBC22-F403-H0001	Accelerometer beacon PCB, CR2032 battery holder, switch, (no battery). Special conditions apply, please contact EM.	Tray	100	100
EMBC22C-F403-H0001	Accelerometer beacon PCB with connector, CR2032 battery holder, switch, (no battery)	Individual	1	1
EMBC22DVK	EMBC22 Development Kit – includes 5 beacons with connectors	Box	1	1

12 CONTACT INFORMATION

Inquiries for lead-times, quotes, orders:

EMDirect@emmicroelectronic.com

13 REFERENCE DOCUMENTS

- EMBC01 device specification
- EM9304 device specification
- LIS2DWL device Specification
- Bluetooth Specification V5.0
- Proximity Beacon Specification Release R1 Draft D



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