em microelectronic

A COMPANY OF THE SWATCH GROUP

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ENCAPSULATED SENSOR BEACON WITH BLUETOOTH LOW ENERGY AND RAIN RFID INTERFACES

General Description

The EMBQ24 is a high-performance, cost-effective, easy-to-use, customizable Bluetooth Low Energy v5.0 sensor beacon with RAIN RFID interface, accelerometer, and temperature sensor. The rugged, IP67-compliant EMBQ24 comes fully encapsulated for protection against dust and liquids, enabling reliable use in harsh environments.

The unique combination of Bluetooth LE and RAIN RFID facilitates upgrading an already deployed RAIN RFID infrastructure to support Bluetooth LE. It also enables bridging the gap between the industrial world and the final customer world.

The product is compatible with all major Bluetooth® beacon formats including iBeacon™ and Eddystone™. The beacon is fully customizable over-the-air (via Bluetooth® or RAIN RFID), either during manufacturing or after deployment. For example, the following parameters can be easily modified:

- UID (UUID, Major/Minor ID)
- URL and telemetry data
- Multiple interleaved packet types
- Bluetooth LE transmit power

The EPCTM Gen2 and ISO/IEC 18000-63 compliant RAIN RFID interface is compatible with industrial RFID infrastructures, enabling a multitude of RAIN RFID use cases, from device activation to data exchange with RAIN RFID readers to track-and-trace and supply chain management applications.

The accelerometer can be used to implement efficient, ultralow-energy algorithms for various applications, activating beaconing on movement or specific gestures. When not active, the beacon consumes minimal energy.

The integrated temperature sensor supports temperatures from -40°C to +60°C, with typical accuracy of ±1.0°C over the full range and ±0.6°C over the typical range for cold chain applications.

The EMBQ24 is manufactured with the highest Swiss quality standards. It leverages Swatch Group technologies, including the EM9304 Bluetooth® V5.0 System-on-Chip and EM4325 RAIN RFID IC from EM Microelectronic.

Each device has a guaranteed unique ID and a 2D unique serial number printed on the beacon for optical scanning.

The EMBQ24 operates over a -30°C to +70°C temperature range. It is FCC and CE certified, RoHS, REACH, and Halogen Free compliant.

Features

- Cost-effective and easy to use
- Small, rugged, encapsulated in polymer resin; IP67 rating
- Supports popular beaconing formats including iBeacon™ and Eddystone™
- Secure over-the-air updates in the field possible with all major mobile platforms
- Up to 5 years of battery life – Battery Lifetime Calculator available
- Extremely low power accelerometer can be used to monitor motion or activate beaconing on actions such as movement, taps, or gestures. Accelerometer measurement ranges are ±2g, ±4g, ±8g; sampling rates from 12.5Hz to 400Hz
- Bluetooth LE range up to 100 meters line-of-sight (LOS) at maximum output power
- Minimum RAIN RFID range 4 meters in an open space when using a reader with -80 dBm sensitivity
- Rich set of parameters configurable over-the-air allows for rapid development of an extensive range of applications without modifying source code
- Embedded temperature sensor with measurement range -40°C to +60°C, with typical accuracy of ±1.0°C
- Manufactured with Swiss quality and including the following Swatch Group technologies:
  - **EM9304** Bluetooth® Low Energy V5.0 System-on-Chip
  - **EM4325** Class-3 Gen2 RFID IC compliant with ISO/IEC 18000-63, ISO/IEC 18000-64, and EPC™ Class-1 Generation-2
- Unique ID and scannable QR-code
- Operating temperature range -30°C to +70°C
- FCC and CE certified
- Optional tamper loop for security systems

Product Dimensions

EMBQ24 finished product outline dimensions are shown in Figure 1.

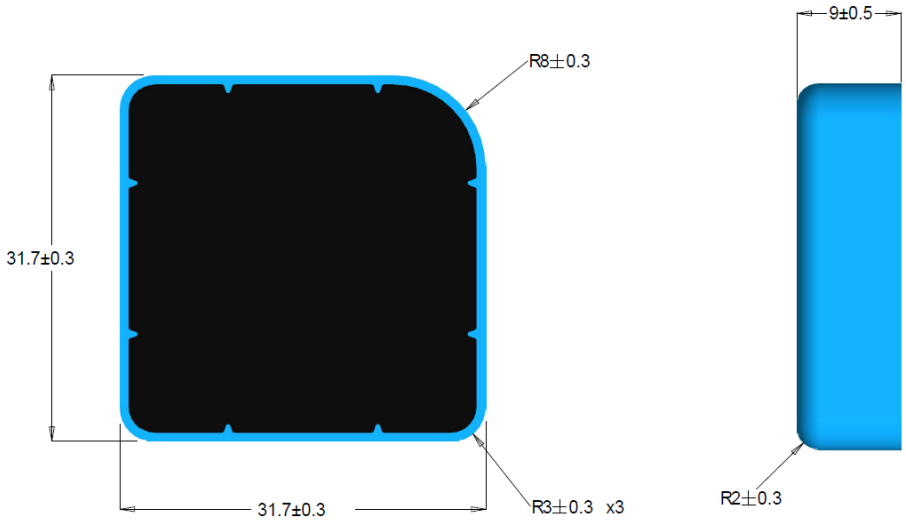

Figure 1: Finished Product Dimensions in mm.

Ordering Information

EMBQ24 is available as a finished product with full FCC and CE certification. The EMBQ24 ordering information is shown in Figure 2.

EMBQ24 - Fxxx Hxxxx

Base Part Number

EMBQ24

Housing Version:

Hwxyz: housing, color, label, battery
w – housing option
x – marking layout
y – not assigned → y = 0
z – not assigned → z = 0

Firmware Version:

F001: V001 Firmware
Other: Assigned by EM

Order Number	Description	Container	Units per Container
EMBQ24-Fxxx-Hxxxx	Standard Encapsulated Accelerometer Beacon in Blue Cup	Box	50

Figure 2: Ordering Information

Contact Information

Inquiries for lead times, quotes, and orders: modules@emmicroelectronic.com

EMBQ DEMONSTRATION SETUP

Concept

A demonstration setup is provided to demonstrate the interaction between Bluetooth LE and RFID systems enabled by the EMBQ device.

In this demonstration, the EM9304 Bluetooth LE SoC in the EMBQ is activated when a UHF field is detected by the EM4325. Once activated, the EMBQ advertises over Bluetooth LE for a period defined as *Adv Duration* in the RFID memory.

Bluetooth LE advertisement parameters can be modified using RFID. The Bluetooth MAC address is available in RFID memory.

Use

1. Activate EMBQ24 by placing it within RFID reader field.
2. Observe EMBQ24 advertising using default values.
3. Read EMBQ24 Bluetooth LE MAC address from EMBQ24 RFID memory.
4. Modify EMBQ24 Bluetooth LE advertising settings by writing to EMBQ24 RFID memory.

Bluetooth LE default settings

- Advertising interval: 1 second
- Advertising duration: 5 minutes
- TX power level: 0 dBm

Advertising content

The EMBQ Bluetooth LE advertising packet has a custom format and contains a manufacturer-specific data element described below:

Data type	Field	Description	Default value
U16	Manufacturer ID	EM manufacturer ID	0x005A
U8	Module ID	EMBQ module ID (EMBQ beacon: #471)	0x40 + 47
U8	Version	Application version	
U64	UID	A unique identifier assigned to the beacon	
U32	Counter	Advertising counter since activation	
I16 x3	ACC Values	ACC axis values (in 1/1024 g)	
I8	ACC Temp	ACC temperature (in °C)	
I8	RFID Temp	RFID temperature (in °C)	
U8	SVLD	Battery voltage (in 100 mV + 1.9 V)	

Version

Defined as a single octet containing major version in high nibble and minor version in low nibble.

Example: v2.3 is encoded as 0x23.

UID

The UID contains a header followed by the MAC address:

MAC = 0C:F3:EE:12:34:56

UID = 0x43250CF3EE123456

Counter

The counter increments at each advertising interval showing the number of advertisement packets sent since activation.

Accelerometer data

Reset to 0s when no accelerometer.

RFID temperature

Temperature obtained from the RFID chip.

SVLD

The SVLD value is the value of the SVLD comparator representing the battery voltage. The battery voltage in V could then be computed as:

VBat = SVLD * 0.1 V + 1.9 V

RFID memory structure

The EM4325 device contains an EEPROM memory organized in 64 pages of 4 words of 16 bits. The User Memory Bank contains 48 pages of 4 words, starting at physical word address 0x2C.

Address	Page	Size	Field	Description	Default value
0x2C	11	U16	Manufacturer ID	EM manufacturer ID	0x005A
0x2D [0]	11	U8	Module ID	EMBQ module ID (EMBQ beacon: #471)	0x40 + 47
0x2D [1]	11	U8	Version	Application version	
0x2E [0]	11	U8	SVLD	SVLD value	0x00-0x0D
0x2E [1]	11	U8	Vbat	Battery voltage, in 100 mV	
0x2F	11	U16	RFU	Reserved for future use	
0x30-0x33	12	U64	UID	Unique identifier assigned to the beacon	
0xE8	58	U16	Adv Interval	Bluetooth advertising interval, in ms	1000
0xE9	58	U16	Adv Duration	Advertising duration, in s	300
0xEA [0]	58	U8	TX Power Level	TX power level	14
0xEA [1]	58	U8	RFU	Reserved for future use	
0xEB	58	U16	RFU	Reserved for future use	

TX Power Level Mapping

TX Power Level	Typical TX Power value in dBm		TX Power Level	Typical TX Power value in dBm
7	-9.9		13	-1.4
8	-8.4		14	0.4
9	-6.9		15	2.5
10	-5.5		16	4.6
11	-4.0		17	6.2
12	-2.6			