

IQ2.0

IQ2.0

IQ223, IQ224

Antennas

Version	Date	Changes	Author
2.0	11/10/2022	First edition with BGM220. Previous edition saved in 9-Histórico	M.U.

Table of contents

1 IQ223..... 3

IEEE 802.15.4 antenna 3

Bluetooth LE antenna..... 4

2 IQ224..... 6

IEEE 802.15.4 antenna 6

Bluetooth LE antenna..... 7

Annex I 9

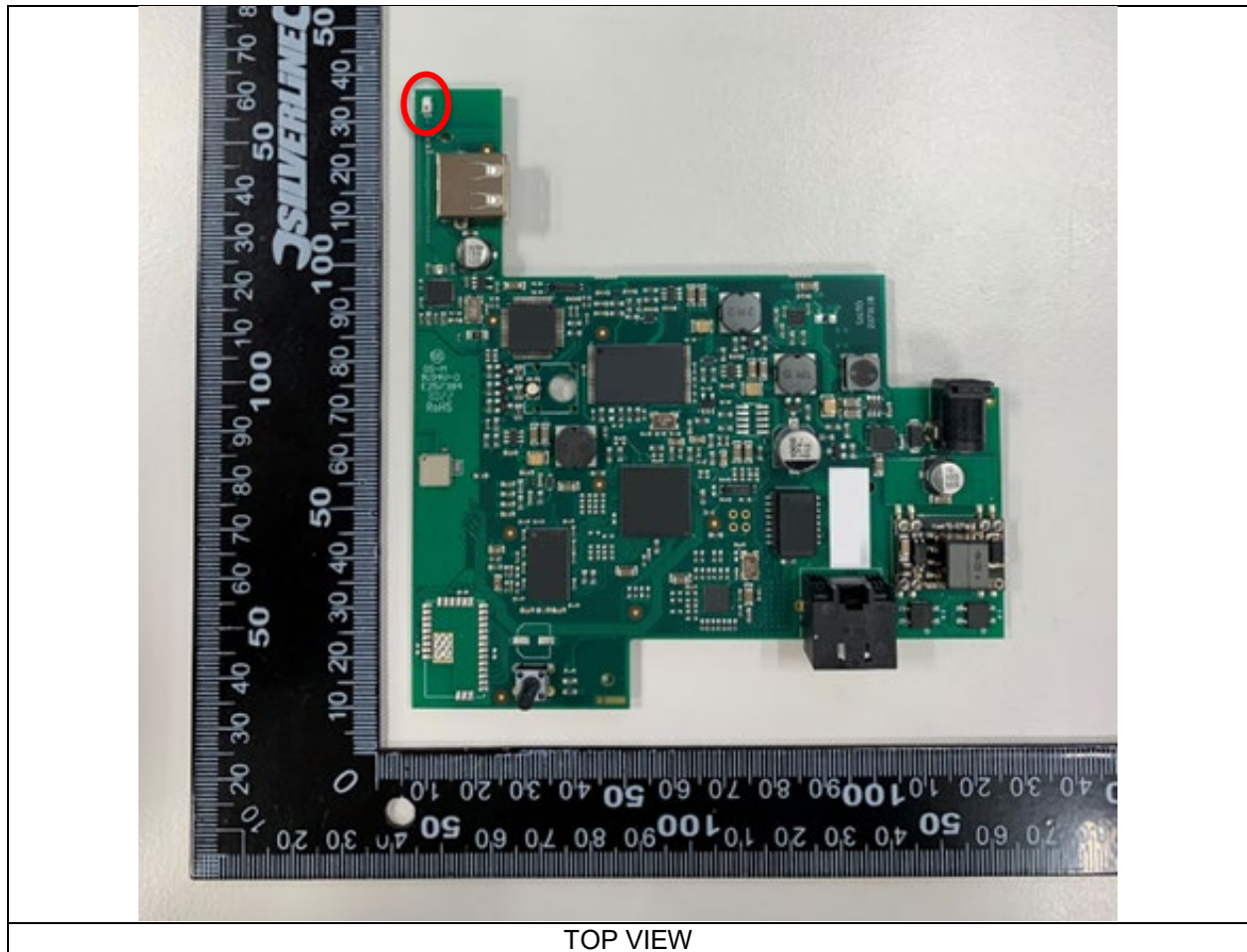
Annex II 14

1 IQ223

IQ2.0 IQ2.0		IQ223
		IEEE 802.15.4 (1) + BGM220 (2)
Antennas	Number of antennas	2
	Manufacturer	1- N\A 2- N\A
	Model number	1- N\A 2- N\A
	Type	1- Integral, Chip 2- Integral, Chip
	Gain	1- 0.5 dBi 2- 2.3 dBi
	Frequency of Operation	1- 2400 - 2483.5 MHz 2- 2400 - 2483.5 MHz
Channels	Number of channels	1- 16 2- 40
	Spacing	1- 5 MHz 2- 2 MHz
	Bandwidth	1- 2 MHz 2- 2 MHz
Type of Modulation		1- O-QPSK, DSSS 2- GFSK
Declared Nominal Output Power (Max.)		1- 5 dBm 2- 6 dBm
ITU Emission Designator		1- G1D 2- F1D
Equipment Configuration for frequency Stability: Data Rate		1- 250 Kbit/s 2- 1 Mbit/s
Equipment Configuration for Field Strenght Measurement: Data Rate		1- 250 Kbit/s 2- 1 Mbit/s

IEEE 802.15.4 antenna

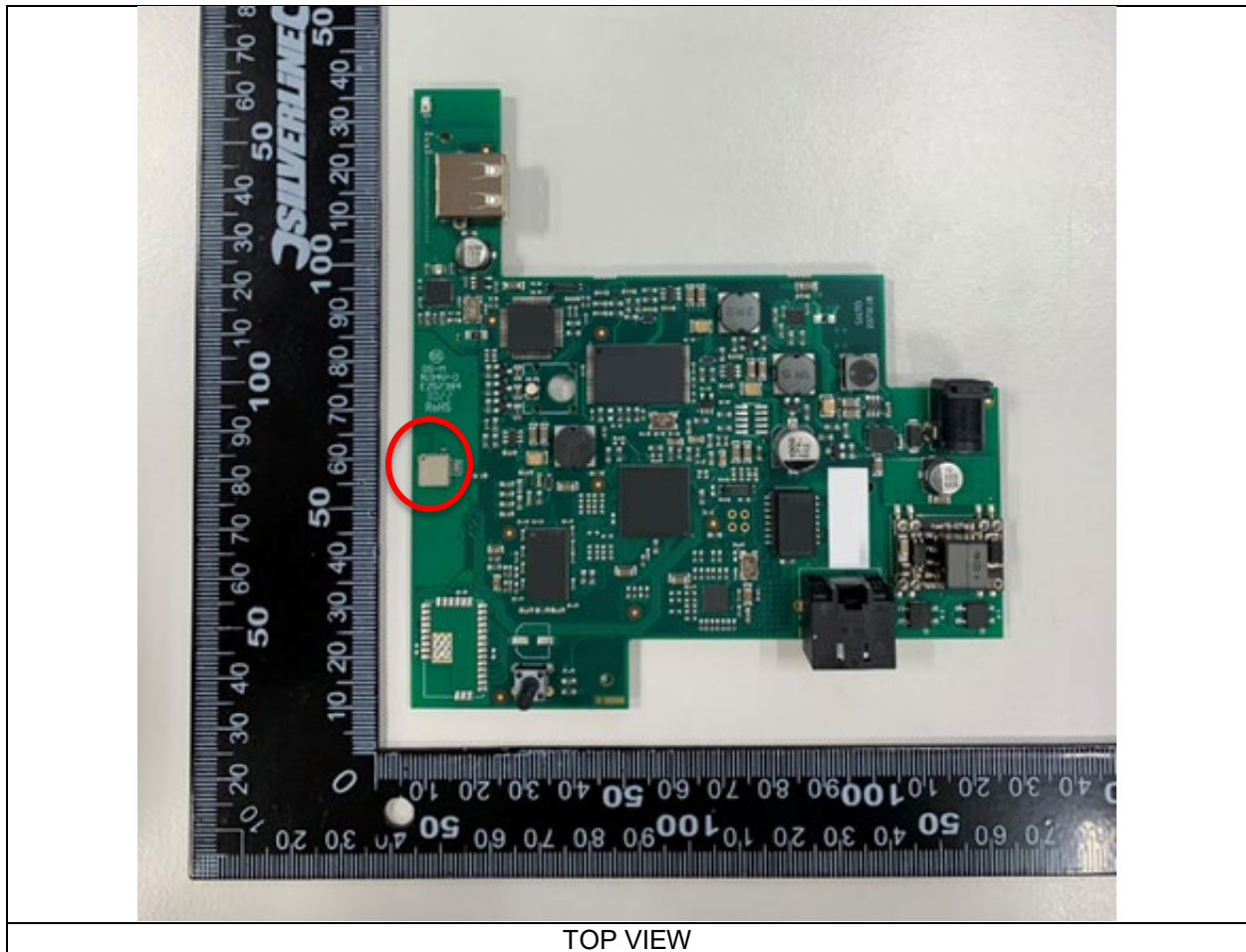
The IEEE 802.15.4 antenna is the 2450AT18B100 from Johanson Technology. The antenna is located on the upper left side of the circuit, 227313B. The following image shows the location of the antenna on the control circuit.



The remaining technical information of the antenna is described in the data sheet included in Annex I.

Bluetooth LE antenna

The antenna used for Bluetooth LE is a built-in antenna integrated in the BGM220 certified module from Silicon Labs. The BGM220 module is located on the middle left side of the circuit, 227313B. The following image shows the location and dimensions of the antenna on the circuit.



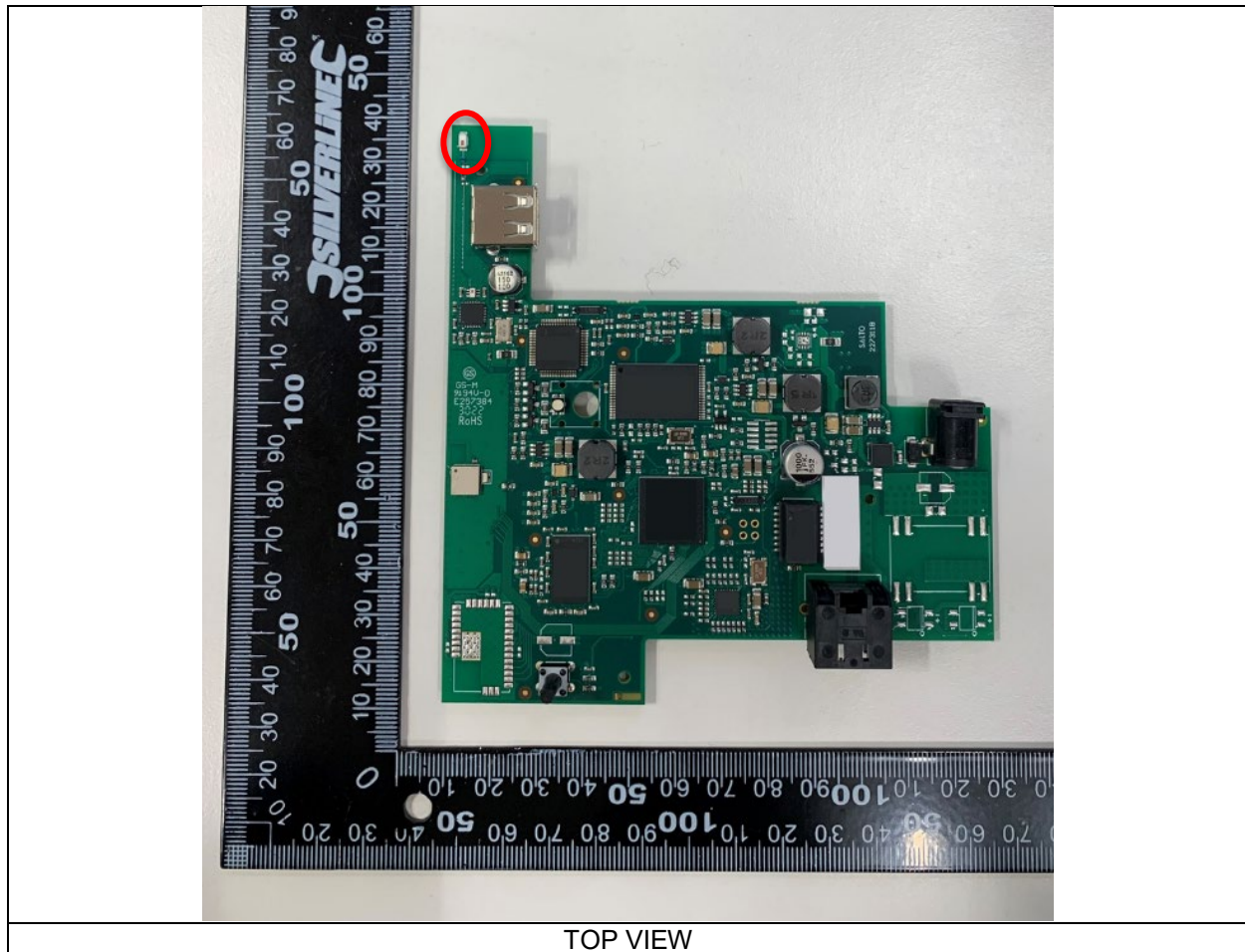
The remaining technical information of the antenna is described in the data sheet included in Annex II.

2 IQ224

IQ2.0 IQ2.0		IQ224
		IEEE 802.15.4 (1) + BGM220 (2)
Antennas	Number of antennas	2
	Manufacturer	1- N\A 2- N\A
	Model number	1- N\A 2- N\A
	Type	1- Integral, Chip 2- Integral, Chip
	Gain	1- 0.5 dBi 2- 2.3 dBi
	Frequency of Operation	1- 2400 - 2483.5 MHz 2- 2400 - 2483.5 MHz
Channels	Number of channels	1- 16 2- 40
	Spacing	1- 5 MHz 2- 2 MHz
	Bandwidth	1- 2 MHz 2- 2 MHz
Type of Modulation		1- O-QPSK, DSSS 2- GFSK
Declared Nominal Output Power (Max.)		1- 5 dBm 2- 6 dBm
ITU Emission Designator		1- G1D 2- F1D
Equipment Configuration for frequency Stability: Data Rate		1- 250 Kbit/s 2- 1 Mbit/s
Equipment Configuration for Field Strenght Measurement: Data Rate		1- 250 Kbit/s 2- 1 Mbit/s

IEEE 802.15.4 antenna

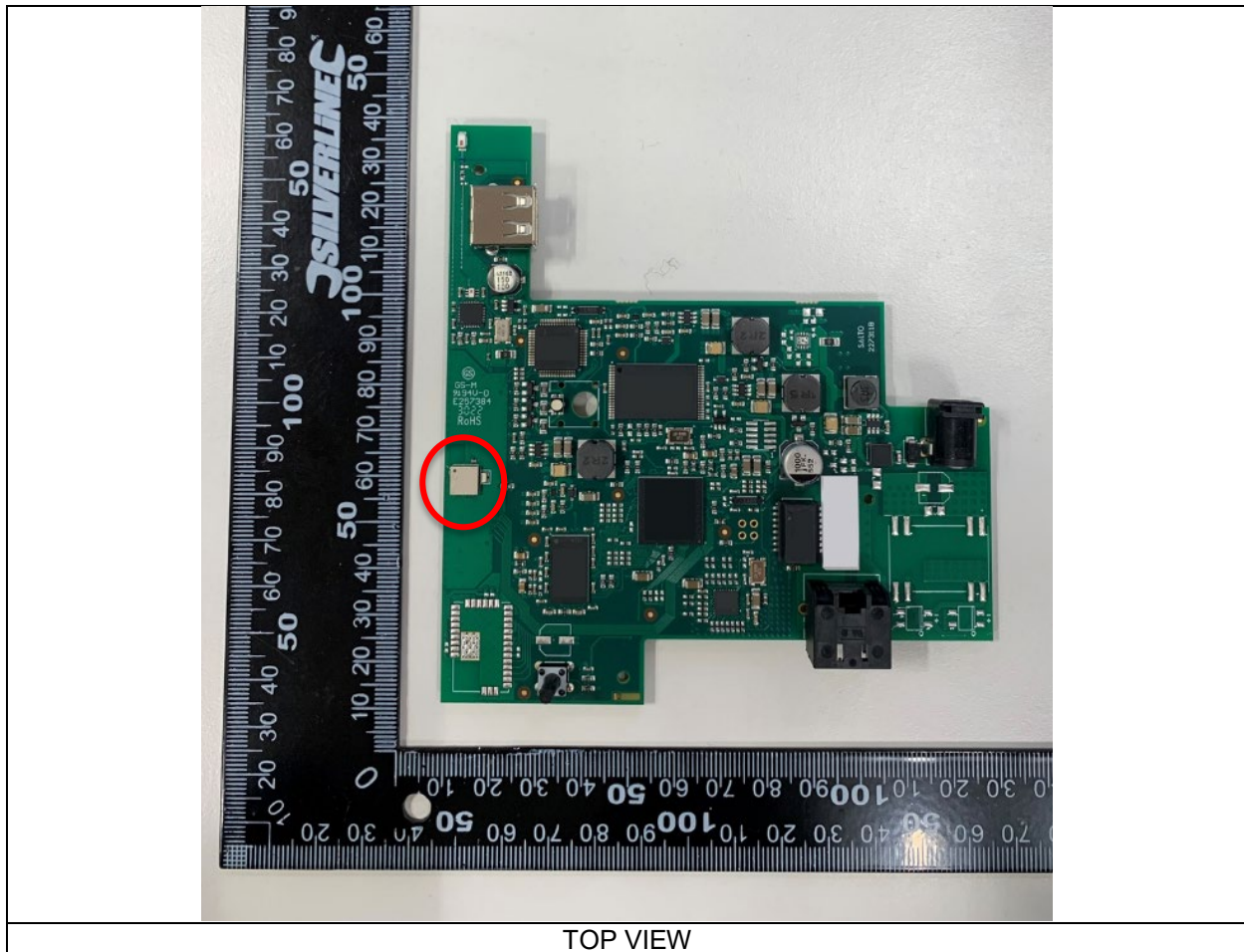
The IEEE 802.15.4 antenna is the 2450AT18B100 from Johanson Technology. The antenna is located on the upper left side of the circuit, 227314B. The following image shows the location of the antenna on the control circuit.



The remaining technical information of the antenna is described on the data sheet included in Annex I.

Bluetooth LE antenna

The antenna used for Bluetooth LE is a built-in antenna integrated in the BGM220 certified module from Silicon Labs. The BGM220 module is located on the middle left side of the circuit, 227314B. The following image shows the location and dimensions of the antenna on the circuit.



The remaining technical information of the antenna is described on the data sheet included in Annex II.

Annex I

High Frequency Ceramic Solutions

2.4GHz Mini Antenna, SMT

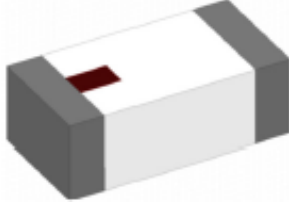
P/N 2450AT18B100

Detail Specification: 11/5/2018

Page 1 of 5

Let us help you with the antenna design, optimization, and tuning!

General Specifications

Part Number	2450AT18B100		
Frequency (MHz)	2400 - 2500		
Avg. Rad Efficiency*	76%		
Peak Gain (dBi typ.)	0.5		
Average Gain (dBi typ.)	-0.5		
Return Loss (dB)	9.5 min.	Storage Temperature	-45 to +125°C
Impedance	50 Ω	Operating Temperature	-45 to +125°C
Input Power	2 Watts max. (CW)	Recommended Storage Conditions of unused product on T&R and period.	+5 to +35°C Humidity 45~75%RH 18 months max.
		Reel Quantity	3000pcs

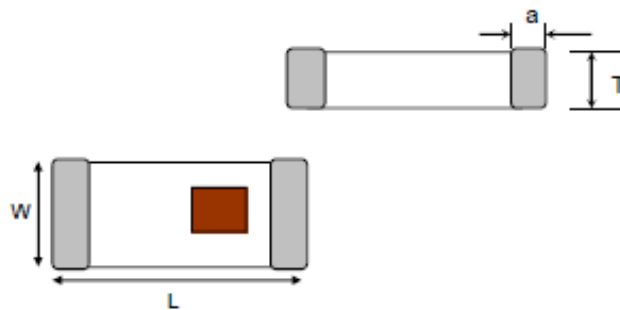
*Efficiency based on Johanson's standard evaluation board

Part Number Explanation

P/N Suffix	Packing Style	Bulk (loose)	Suffix = S	e.g. 2450AT18B100S
		T & R	Suffix = E	e.g. 2450AT18B100E
		100% Tin	Suffix = E or S	e.g. 2450AT18B100(E or S)
	Evaluation Board	2450AT18B100-EB1SMA (see page 2&3 for details)		

Mechanical Dimensions

	in	mm
L	0.126 ± 0.008	3.20 ± 0.2
W	0.063 ± 0.008	1.60 ± 0.2
T	0.051 +0.004/-0.008	1.30 +0.1/-0.2
a	0.020 ± 0.008	0.50 ± 0.2

Want the layout file? Request it at: <https://www.johansontechnology.com/ask-a-question>

Terminal Configuration

No.	Function
1	FEED
2	NC



Johanson Technology, Inc. reserves the right to make design changes without notice.
 All sales are subject to Johanson Technology, Inc. terms and conditions.


<https://www.johansontechnology.com>

4001 Calle Tecate • Camarillo, CA 93012 • TEL 805.389.1166 FAX 805.389.1821

Ver. 4.0

2018 Johanson Technology, Inc. All Rights Reserved

High Frequency Ceramic Solutions

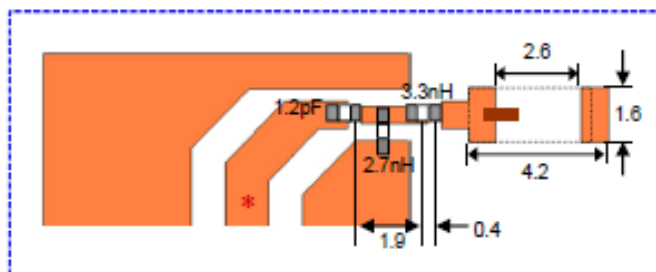
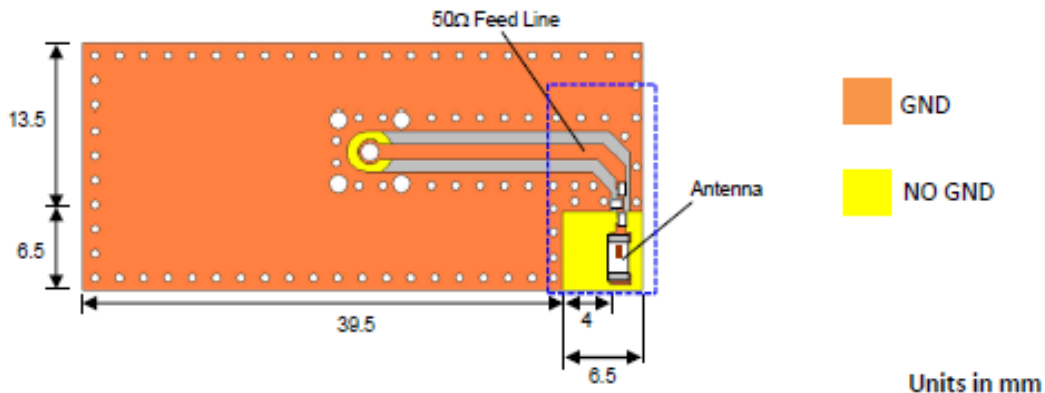
2.4GHz Mini Antenna, SMT

P/N 2450AT18B100

Detail Specification: 11/5/2018

Page 2 of 5

Mounting Considerations 1: Evaluation Board



JTI P/N for Matching Circuit:
 Capacitor (1.2pF): 500R07S1R2BV4T
 Inductor (2.7nH): L-07C2N7SV6T
 Inductor (3.3nH): L-07C3N3SV6T

*Line width should be designed to provide 50Ω impedance

To order a pre-tuned 50Ω EVB with a female SMA connector click here: <https://www.johansontechnology.com/request-a-sample>
 Reference p/n: 2450AT18B100-EB1SMA

Johanson Technology, Inc. reserves the right to make design changes without notice.
 All sales are subject to Johanson Technology, Inc. terms and conditions.



<https://www.johansontechnology.com>
 4001 Calle Tecate • Camarillo, CA 93012 • TEL 805.389.1166 FAX 805.389.1821
 Ver. 4.0 2018 Johanson Technology, Inc. All Rights Reserved

High Frequency Ceramic Solutions

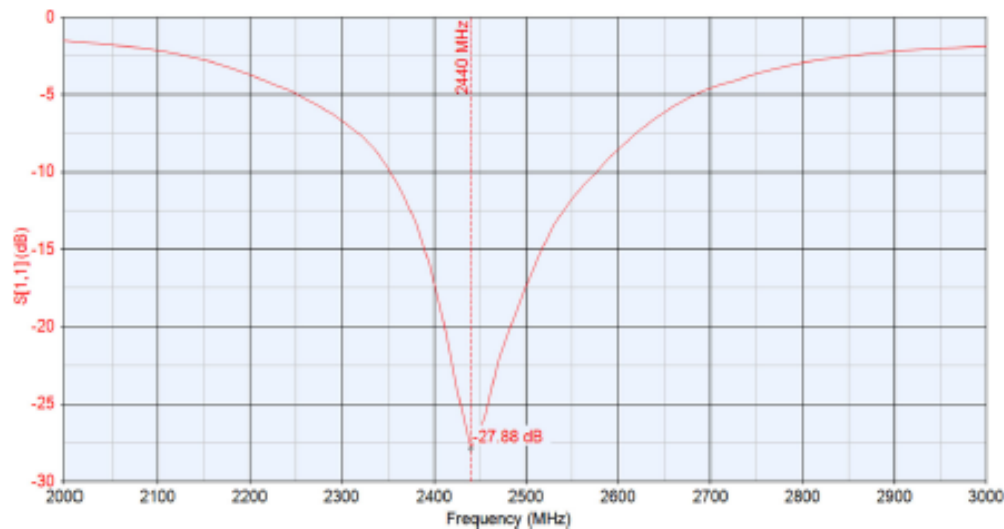
2.4GHz Mini Antenna, SMT

P/N 2450AT18B100

Detail Specification: 11/5/2018

Page 3 of 5

Mounting Considerations 1: Typical Electrical Performance (T=25°C)



Would you like the antenna layout? Have antenna tuning issues?

Please contact us if you have any questions regarding the implementation of this antenna in your PCB's layout. We'll be happy to guide you to maximize the antenna's performance.

Contact our applications engineers at:

<https://www.johansontechnology.com/ask-a-question>

Johanson Technology, Inc. reserves the right to make design changes without notice.
 All sales are subject to Johanson Technology, Inc. terms and conditions.



<https://www.johansontechnology.com>
 4001 Calle Tecate • Camarillo, CA 93012 • TEL 805.389.1166 FAX 805.389.1821
 Ver. 4.0 2018 Johanson Technology, Inc. All Rights Reserved

High Frequency Ceramic Solutions

2.4GHz Mini Antenna, SMT

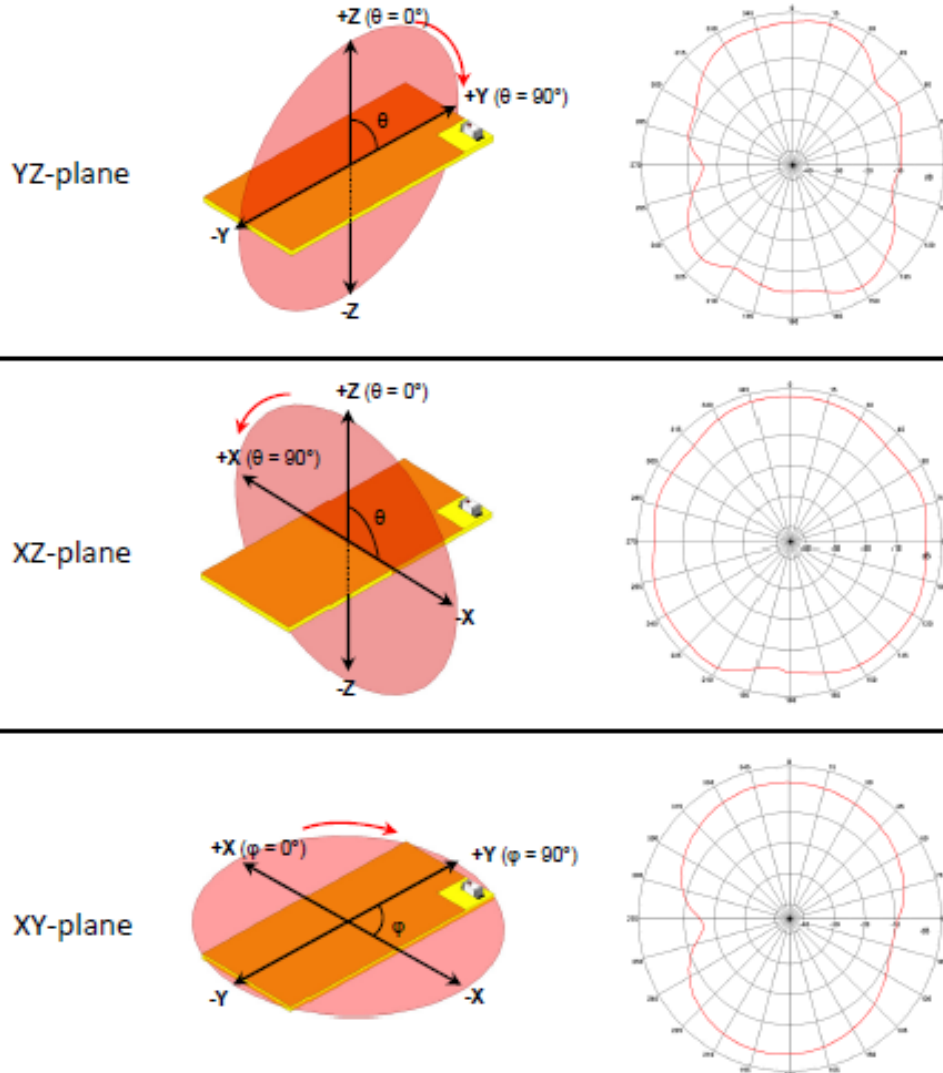
P/N 2450AT18B100

Detail Specification: 11/5/2018

Page 4 of 5

Mounting Considerations 1: Antenna Performance

Typical 2D radiation patterns @ 2.44GHz



Johanson Technology, Inc. reserves the right to make design changes without notice.
 All sales are subject to Johanson Technology, Inc. terms and conditions.

JOHANSON
TECHNOLOGY


<https://www.johansontechnology.com>
 4001 Calle Tecate • Camarillo, CA 93012 • TEL 805.389.1166 FAX 805.389.1821
 Ver. 4.0 2018 Johanson Technology, Inc. All Rights Reserved

High Frequency Ceramic Solutions

2.4GHz Mini Antenna, SMT	P/N 2450AT18B100
Detail Specification: 11/5/2018	Page 5 of 5

Antenna tuning, optimization, and validation services:

<https://www.johansontechnology.com/ipc-antenna-services>

For more antennas and to download measured S-parameters, go to:

<https://www.johansontechnology.com/antennas>

Soldering Information

<https://www.johansontechnology.com/ipsoldering-profile>

MSL Info

<https://www.johansontechnology.com/msl-rating>

Packaging information

<https://www.johansontechnology.com/tape-reel-packaging>

For layout review contact our Applications Team at:

<https://www.johansontechnology.com/ask-a-question>

RoHS Compliance

<https://www.johansontechnology.com/rohs-compliance>

Need help designing the antenna in? Use our antenna design services!

<https://www.johansontechnology.com/ipc-antenna-services>

We provide 2 free layout reviews and if you need us to tune and characterize the antenna on your product (inside our anechoic chamber) we can do that too. Small lab fee may apply.

Johanson Technology, Inc. reserves the right to make design changes without notice.

All sales are subject to Johanson Technology, Inc. terms and conditions.



<https://www.johansontechnology.com>

4001 Calle Tecate • Camarillo, CA 93012 • TEL 805.389.1166 FAX 805.389.1821

Ver. 4.0

2018 Johanson Technology, Inc. All Rights Reserved

Annex II



BGM220S Wireless Gecko Bluetooth® Module Data Sheet



The BGM220S is a module designed and built to meet the performance, security, and reliability requirements of battery-powered IoT products running on Bluetooth networks.

Based on the EFR32BG22 SoC, the BGM220S enables Bluetooth® Low Energy connectivity while delivering best-in-class RF range and performance, future-proof capability for feature and OTA firmware updates, enhanced security features, and low energy consumption.

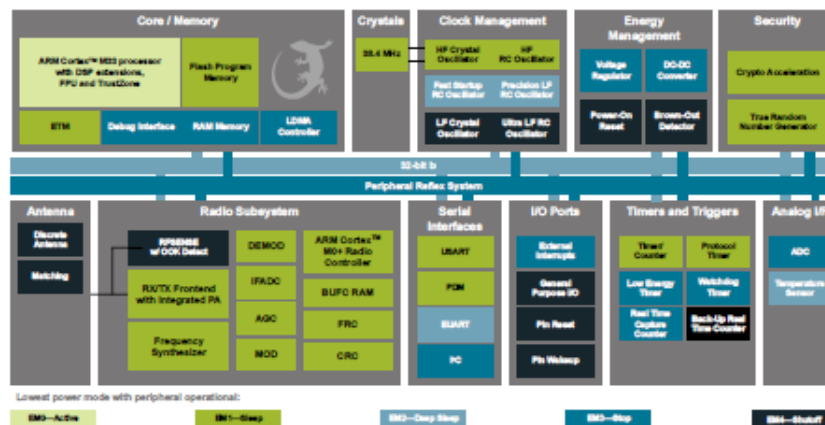
BGM220S modules are a full solution that comes with fully-upgradeable, robust software stacks, world-wide regulatory certifications, advanced development and debugging tools, and support that will minimize and simplify the engineering and development of your end-products helping to accelerate their time-to-market.

The BGM220S is intended for a broad range of applications, including:

- Asset Tags and Beacons
- Portable Medical
- Sports, Fitness, and Wellness devices
- Connected Home
- Industrial and Building Automation
- Bluetooth mesh Low Power Nodes

KEY FEATURES

- Bluetooth 5.2
- Built-in antenna or RF pin
- Up to 6 dBm TX power
- -98.6 dBm BLE RX sensitivity at 1 Mbps
- 32-bit ARM Cortex-M33 core at up to 76.8 MHz
- 512/32 kB of Flash/RAM memory
- Optimal selection of MCU peripherals
- 25 GPIO pins
- 6 mm × 6 mm × 1.1 mm



1. Feature List

- **Supported Protocols**
 - Bluetooth Low Energy (Bluetooth 5.2)
 - Direction finding
 - 1M, 2M, and LE Coded PHYs
 - Bluetooth Mesh Low Power Node
- **Wireless System-on-Chip**
 - 2.4 GHz radio
 - TX power up to 6 dBm
 - High-performance 32-bit ARM Cortex-M33® with DSP instruction and floating-point unit for efficient signal processing
 - Up to 512 kB flash program memory
 - 32 kB RAM data memory
 - Embedded Trace Macrocell (ETM) for advanced debugging
- **High Receiver Performance**
 - -106.4 dBm sensitivity (0.1% BER) at 125 kbps GFSK
 - -102.3 dBm sensitivity (0.1% BER) at 500 kbps GFSK
 - -98.6 dBm sensitivity (0.1% BER) at 1 Mbps GFSK
 - -95.9 dBm sensitivity (0.1% BER) at 2 Mbps GFSK
- **Low-Energy Consumption**
 - 4.2 mA RX current at 1 Mbps GFSK
 - 4.6 mA TX current at 0 dBm output power
 - 26 µA/MHz in Active Mode (EM0)
 - 1.40 µA EM2 DeepSleep current (RTCC running from LFXO, Full RAM retention)
- **Regulatory Certifications¹**
 - CE and UKCA - EU and UK
 - FCC - USA
 - ISED - Canada
 - MIC - Japan
 - KC - South Korea
- **Wide Operating Range**
 - 1.8 to 3.8 V
 - -40 to +105 °C and -40 to +85 °C Versions Available
- **Dimensions**
 - 6 mm × 6 mm × 1.1 mm
- **Security Features**
 - Secure Boot with Root of Trust and Secure Loader (RTSL)
 - Hardware Cryptographic Acceleration for AES128/256, SHA-1, SHA-2 (up to 256-bit), ECC (up to 256-bit), ECDSA, and ECDH
 - True Random Number Generator (TRNG) compliant with NIST SP800-90 and AIS-31
 - ARM® TrustZone®
 - Secure Debug with lock/unlock
- **Wide Selection of MCU Peripherals**
 - Analog to Digital Converter (ADC)
 - 12-bit @ 1 Msps
 - 16-bit @ 76.8 kpsps
 - 25 General Purpose I/O pins with output state retention and asynchronous interrupts
 - 8 Channel DMA Controller
 - 12 Channel Peripheral Reflex System (PRS)
 - 4 × 16-bit Timer/Counter with 3 Compare/Capture/PWM channels
 - 1 × 32-bit Timer/Counter with 3 Compare/Capture/PWM channels
 - 32-bit Real Time Counter
 - 24-bit Low Energy Timer for waveform generation
 - 1 × Watchdog Timer
 - 2 × Universal Synchronous/Asynchronous Receiver/Transmitter (UART/SPI/SmartCard (ISO 7816)/IrDA/I²S)
 - 1 × Enhanced Universal Asynchronous Receiver/Transmitter (EUSART)
 - 2 × I²C interface with SMBus support
 - Digital microphone interface (PDM)
 - RFSense with selective OOK mode

3.2 EFR32BG22 SoC

The EFR32BG22 SoC features a 32-bit ARM Cortex M33 core, a 2.4 GHz high-performance radio, 512 kB of flash memory, a rich set of MCU peripherals, and various clock management and serial interfacing options. Consult the [EFR32xG22 Wireless Gecko Reference Manual](#) and the [EFR32BG22 Data Sheet](#) for details.

3.3 Antenna

BGM220S modules include an integral antenna on board with the characteristics detailed in the tables below.

Table 3.1. Antenna Efficiency and Peak Gain (BGM220S12A)

Parameter	With optimal layout	Note
Efficiency	-1.4 to -2.6 dB	Antenna efficiency, gain and radiation pattern are highly dependent on the application PCB layout and mechanical design. Refer to 7. Design Guidelines for recommendations to achieve optimal antenna performance.
Peak gain	1.5 dBi	

Table 3.2. Antenna Efficiency and Peak Gain (BGM220S22A)

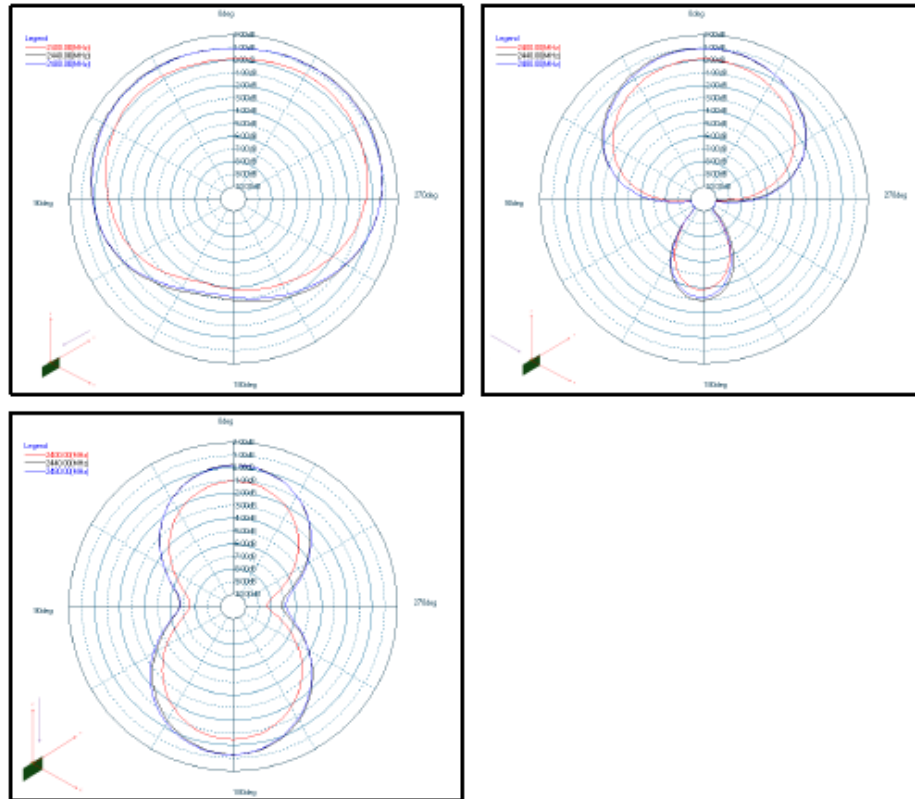
Parameter	With optimal layout	Note
Efficiency	-1 to -2 dB	Antenna efficiency, gain and radiation pattern are highly dependent on the application PCB layout and mechanical design. Refer to 7. Design Guidelines for recommendations to achieve optimal antenna performance.
Peak gain	2.3 dBi	

3.4 Power Supply

The BGM220S requires a single nominal supply level of 3.0 V to operate. All necessary decoupling and filtering components are included in the module, and the supply is fully regulated internally.

4.16.1 Antenna Typical Characteristics

Typical BGM220S radiation patterns for the on-board chip antenna under optimal operating conditions are plotted in the figures that follow. Antenna gain and radiation patterns have a strong dependence on the size and shape of the application PCB the module is mounted on, as well as on the proximity of any mechanical design to the antenna.



Top Left: $\Phi 0^\circ$, Top Right: $\Phi 90^\circ$, Bottom Left: $\Theta 90^\circ$

Figure 4.3. BGM220S12A Typical 2D Antenna Radiation Patterns on 50 mm x 30 mm board

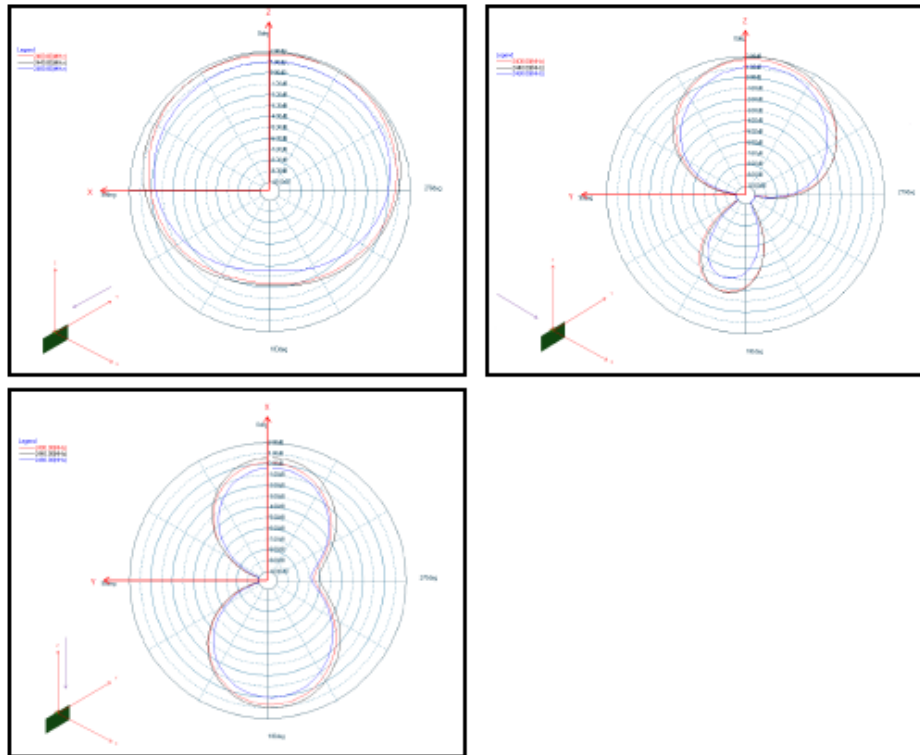

 Top Left: $\Phi 0^\circ$, Top Right: $\Phi 90^\circ$, Bottom Left: $\Theta 90^\circ$

Figure 4.4. BGM220S22A Typical 2D Antenna Radiation Patterns on 55 mm x 20 mm board