BGM241S22A
Integral Antenna Data Sheet

This document provides the specification of the integral antenna designed in the *Bluetooth Low Energy* (*LE*) wireless radio modules with model name of BGM241S22A and brand name of SILICON LABS.

Antenna type: Ground Loop realized by a PCB Trace Design.

Manufacturer: Silicon Laboratories Finland Oy

Address: Alberga Business Park, Bertel Jungin aukio 3,
02600 Espoo, Finland - Web: https://www.silabs.com/

Contents

1. Overview

The integral antenna of the BGM241S22A radio module is a partitioned ground loop type antenna realized by a PCB trace design.

The part which is internal to the module is the replacement to the typical embedded ceramic chip antenna: it acts as the 2.4GHz resonator, and it is comprised of traces, discrete chip components, and their distributed parasitic, within a controlled substrate.

This antenna relies on an external loop trace, acting as the reflector being designed in host board, and on the ground plane of such host board. See the user manual / datasheet of the modules (Chapter 7, “Design Guidelines”) for the detailed requirements of the host part.

A chip capacitor, in series with the antenna loop trace, connects to the GND plane of the host board.

The embedded antenna is not commercially available: it is only intended to be used as the self-contained part of the integral antenna for the radio modules mentioned above.

2. Antenna specification

Antenna Parameter	Symbol	Min	Typ	Max	Unit
Frequency range	F_{RANGE}	2400	-	2483.5	MHz
Gain (relative to isotropic)	G_{MAX}	-	-	1.48	dBi
Efficiency	Efficiency	-2.5	-	-1.36	dB
Reference impedance	Z	-	50	-	Ω
Dielectric constant of host board	DI_{CONST}	-	4.3	-	-
VSWR	VSWR	-	-	2:1	-
Trace thickness (of the embedded resonator)	$T_{THICKNESS}$	-	47	-	µm
Trace length (of the embedded resonator)	T_{LENGTH}	-	3.6	-	mm

Note: The integral antenna meets the specifications in the table above if the host board is designed so that it takes into account the design guidelines and integration constraints stipulated in the module’s user manual / datasheet.

3. Details of the antenna pins of the modules

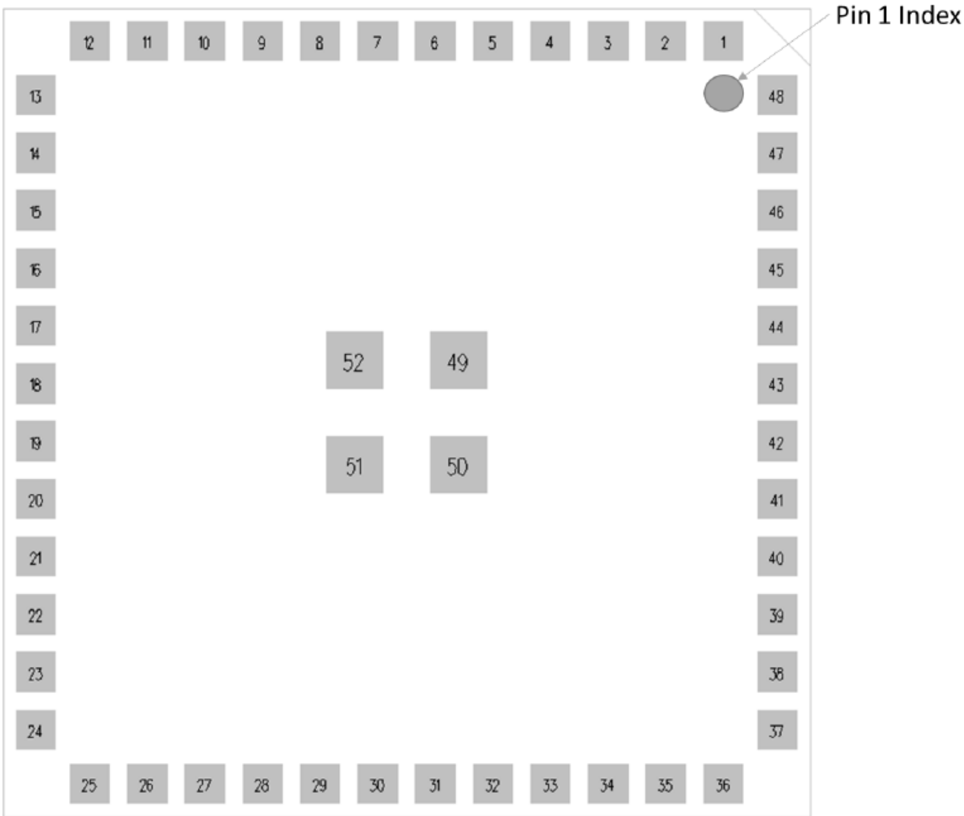


Figure 1: Pin numbering of the BGM241S22A

The table below denotes the names and descriptions given to the integral antenna-relevant pins:

Pin Name	No.	Description
DNC	1	Do Not connect
ANT OUT	2	Integral Ant Out
DNC	3	Do Not connect
DNC	4	Do Not connect
ANT IN	5	Integral Ant In
2G4IO	6	RF IN/OUT
GND	7,12,25,29,48,49,50,51,52	Ground

4. Gain, efficiency and radiation patterns

Peak Gain (dBi), max 1.48dBi

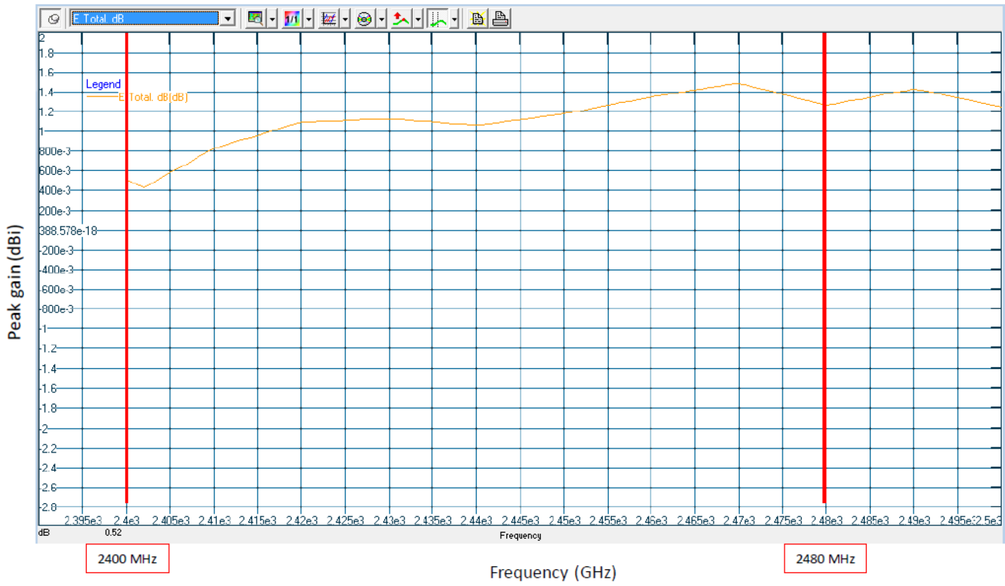


Figure 2: Integral Antenna Gain

Efficiency (dB), max -1.36dB

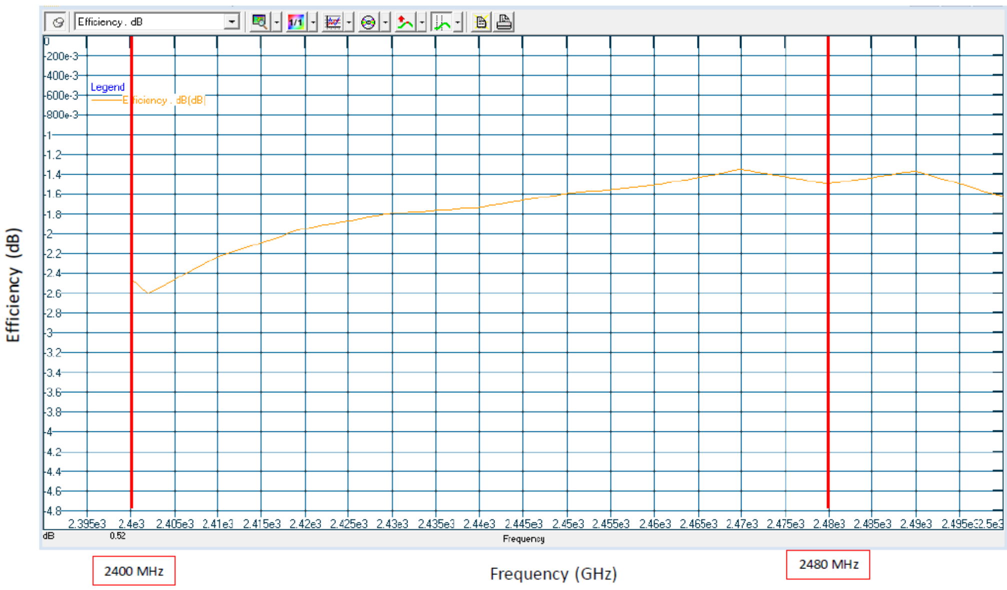


Figure 3: Integral Antenna Efficiency

Phi0 Gain cut (dBi)

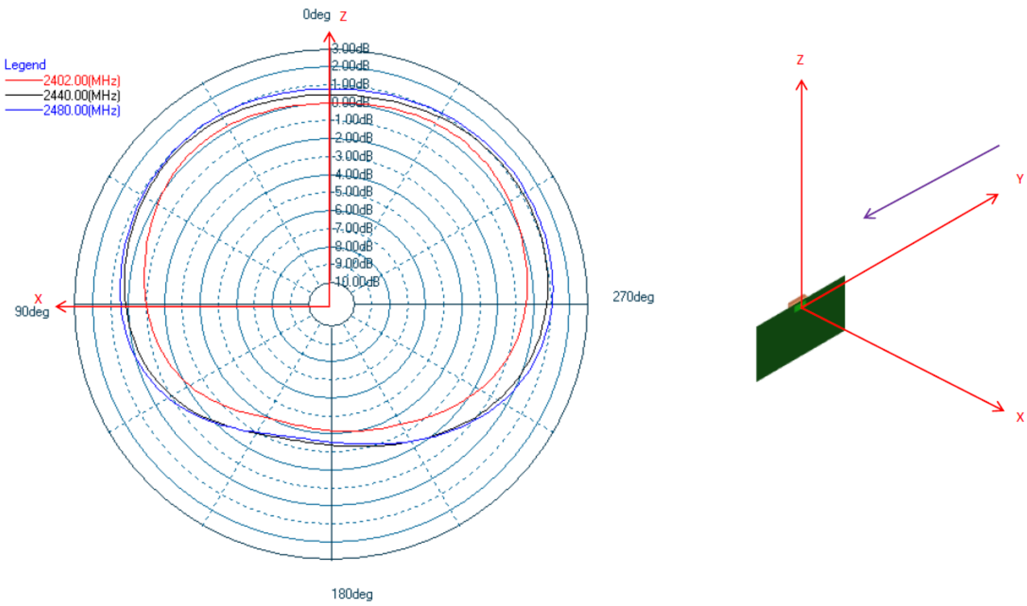


Figure 4: Integral Antenna Radiation Pattern Phi 0°

Phi90 Gain cut

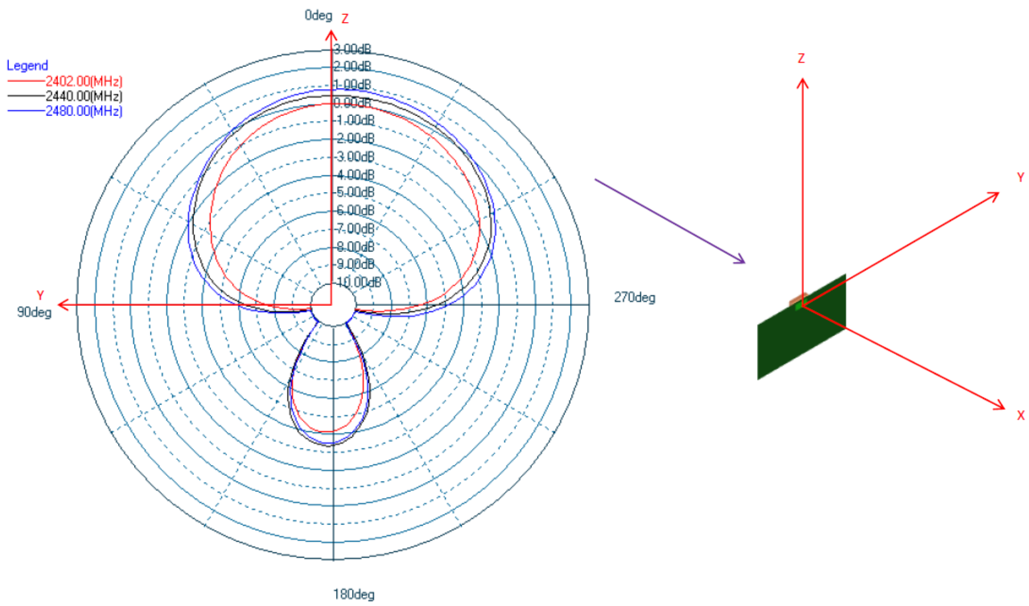


Figure 5: Integral Antenna Radiation Pattern Phi 90°

Theta90 Gain cut

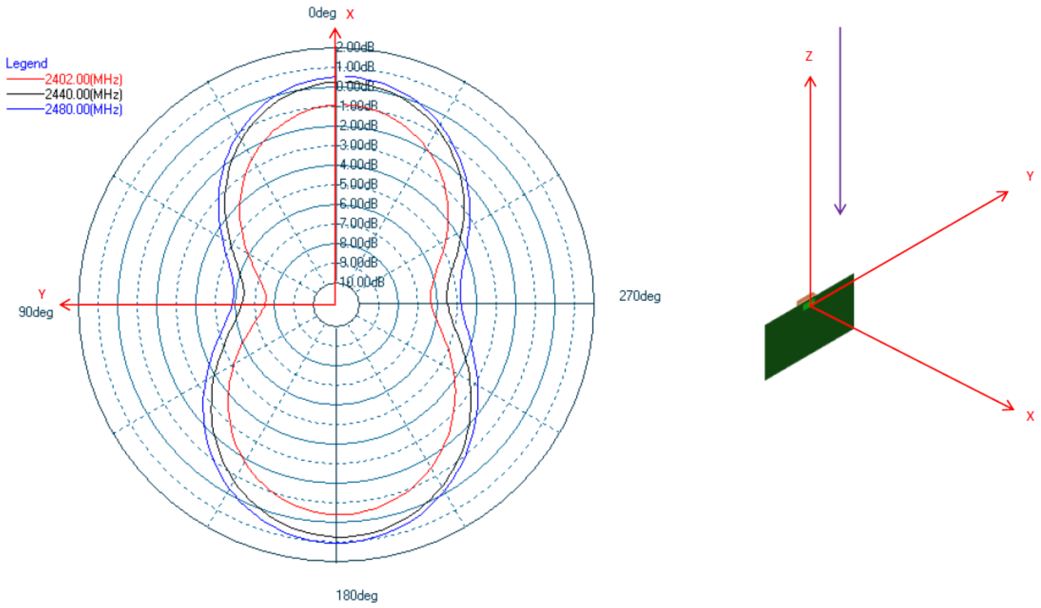


Figure 6: Integral Antenna Radiation Pattern Theta 90°

4.1 Note on the peak gain, efficiency, and radiation patterns (gain cuts)

Figures 2 to 6 depict measurements performed on manufacturer's behalf by a third-party independent lab, as follows:

Name: Sasken Finland Oy (part of Sasken Technologies Ltd.)
Address: Vissavedentie 1, FI-69600 Kaustinen, Finland (Web: https://www.sasken.com/fi/)

Test date: June 23, 2022
Test operator: Aki Myllymäki
Test setup photos and description of measurements: see Annex 1

Test equipment:

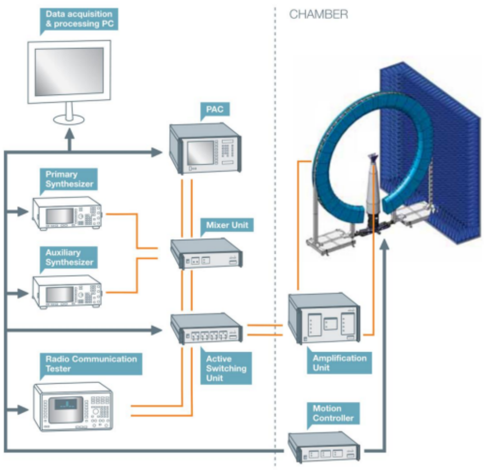
- Model name / description: Satimo SG64 / Multi-probe system for the most accurate solution in testing antennas and wireless devices, particularly developed to measure stand alone antennas or antennas integrated in subsystems
- Manufacturer: Satimo (part of Microwave Vision Group)
- Software name and version: SatEnv, v3.0.3.0
- Configuration: Probe Array Controller (PAC) for passive measurements
- Calibration date: September 11, 2020 (performed by test equipment manufacturer)
- Calibration info: Reference point: end of antenna feed cable on antenna mast
  Reference antenna: Dual-Ridge Horn antenna SH400/S#0040, 0.4-6GHz
  Validity: 2 years, up to September 10, 2022

Annex 1

Test setup photos and description of measurements

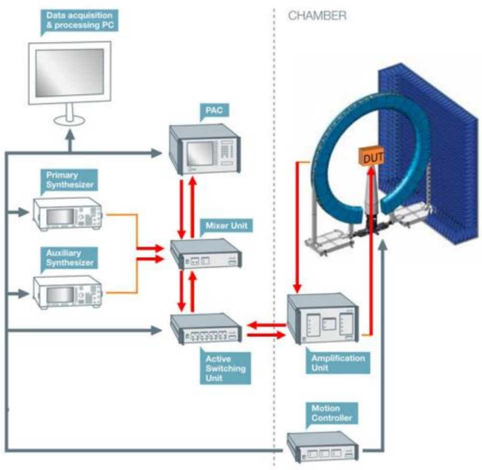
Satimo SG64 Setup

- SG64 has been developed to measure stand alone antennas or antennas integrated in subsystem. It is also ideal for CTIA certifiable measurement facilities.
- SG system can switch between the Probe Array Controller (PAC) for passive measurements and the Radio Communication Tester for active measurements.
  - For passive measurements it uses Analog RF Signal Generators for emitting from the probe array to the Antenna Under Test or from the Antenna Under Test to the probe array. The PAC is also a RF receiver for antenna measurements. The PAC controls as well the electronic scanning of the probe array. The Amplification Unit has RF amplifiers for both RX and TX channels.
  - For active measurements, the test is performed with a Multi-protocol Radio Communication Tester. It is used to communicate with the DUT and to measure the Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS).

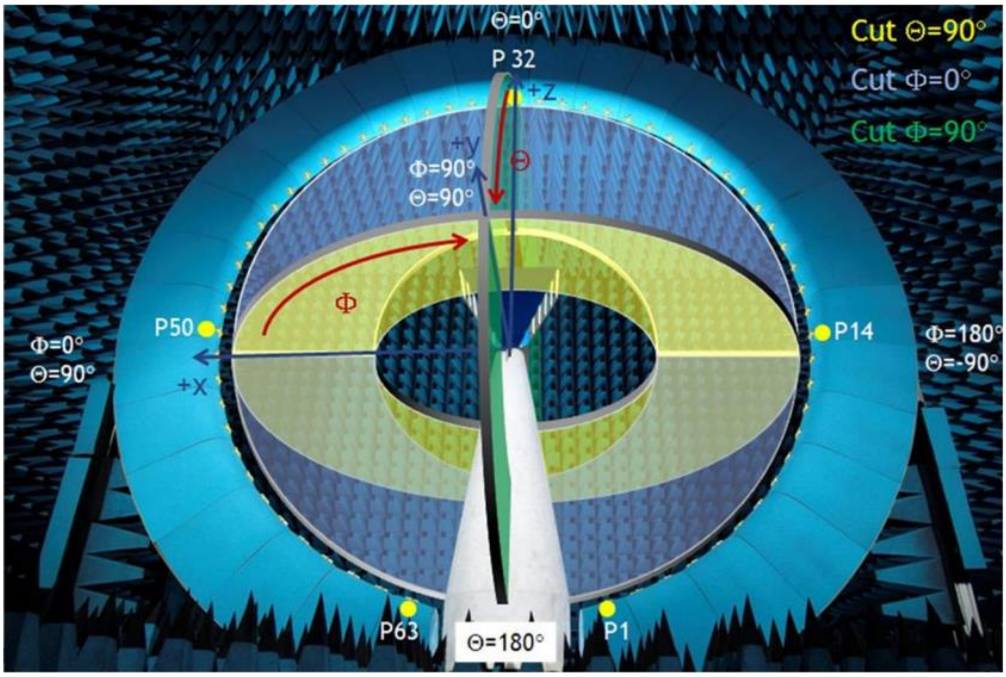


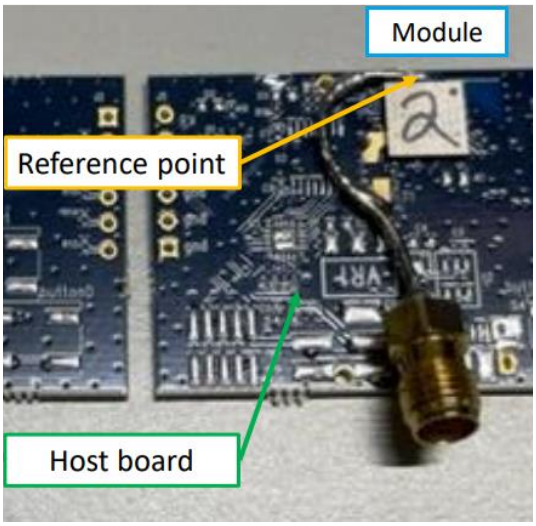
Passive Measurement Setup

- All antenna measurements were done using Satimo SG64 Passive Measurement Setup.
- Setup:
  - DUT is prepared with coaxial probe cable to be connected with antenna feed cable coming from the antenna mast on the turntable.
  - Satimo test system feeds the signal on specified frequencies through the antenna feed cable to DUT
  - The DUT is then rotated with turntable and the Satimo probe array will measure the signal from all directions for all rotation steps to get a 3D radiation pattern.
  - Near-field to far-field transformation will be then done to the measurement data.
- Calibration
  - System is calibrated to the reference point that is in the end of antenna feed cable on the antenna mast.
  - System calibration is done yearly by Satimo
    - last system calibration was done on week 37/2020
  - Measurement calibration is done with reference antennas.
    - Dual-Ridge Horn antenna SH400/S#0040 (0.4 - 6GHz)



Sasken coordinate system





Module is placed on this side of the printed circuit board