Movano Evie Wellness Ring – Antenna Description

V2.3, 12/11/23

Layout Details of Evie Ring Antenna.

The antenna is an 18.5mm trace that is on Layer 4 of the rigid-flex PCB. It is a classic F-Type antenna, which has Gnd at one end and is RF-fed toward the middle (closer to the Gnd point as shown below). *The PCB antenna described below has antenna gain of -7.49 dBi (dB gain in maximum direction compared to isotropic radiator).*

This PCB antenna trace is connected to a match and harmonic attenuation passive circuit which is connected to the single-ended output of the Bluetooth Low Energy (BLE) radio output of the 32-pin Silicon Labs EFR32GB22C224F512GN32-C microcontroller (MCU) IC, as shown in the below diagrams.

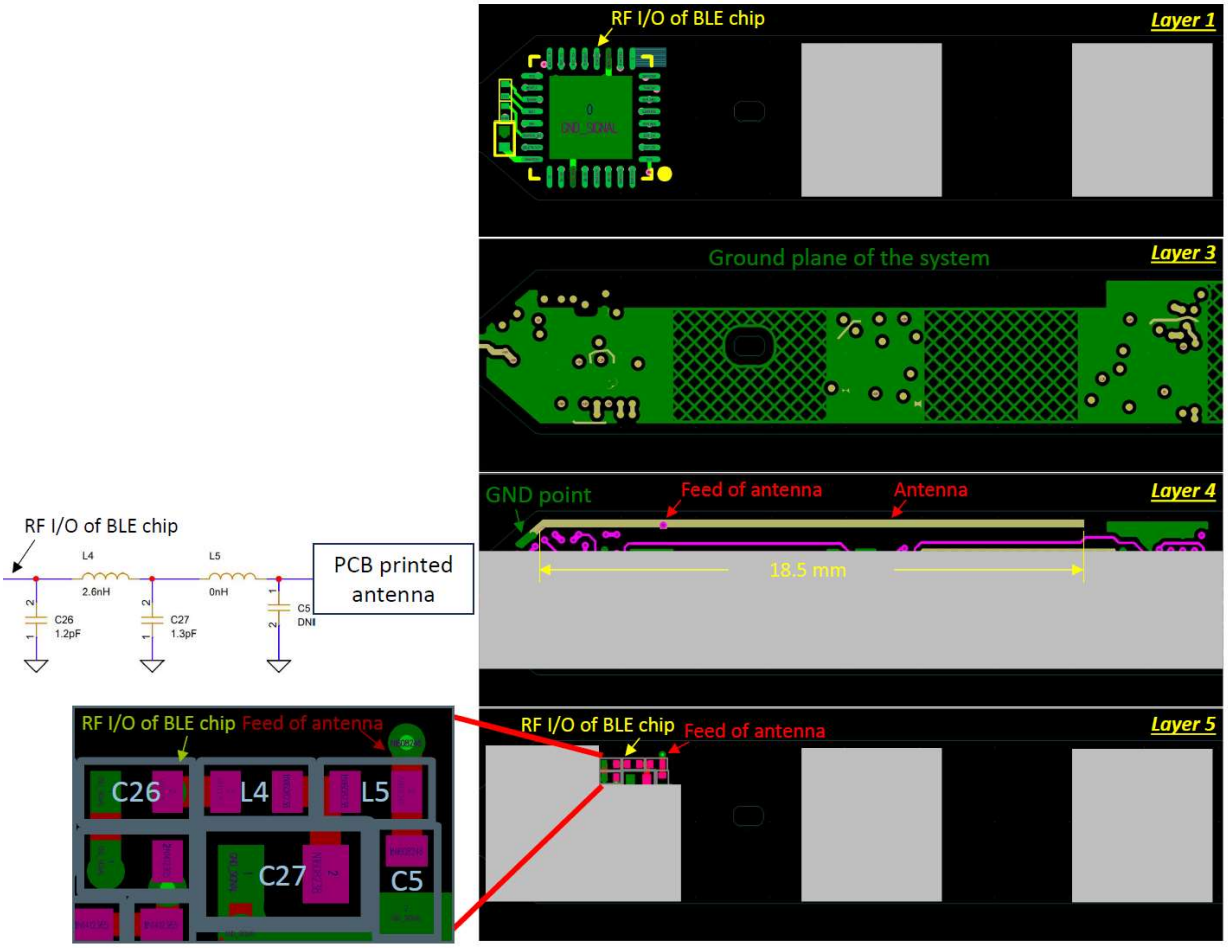

Figure 1

F-Type Antenna Example

Below is a technical example of a F-Type antenna, the type used in the Evie Ring

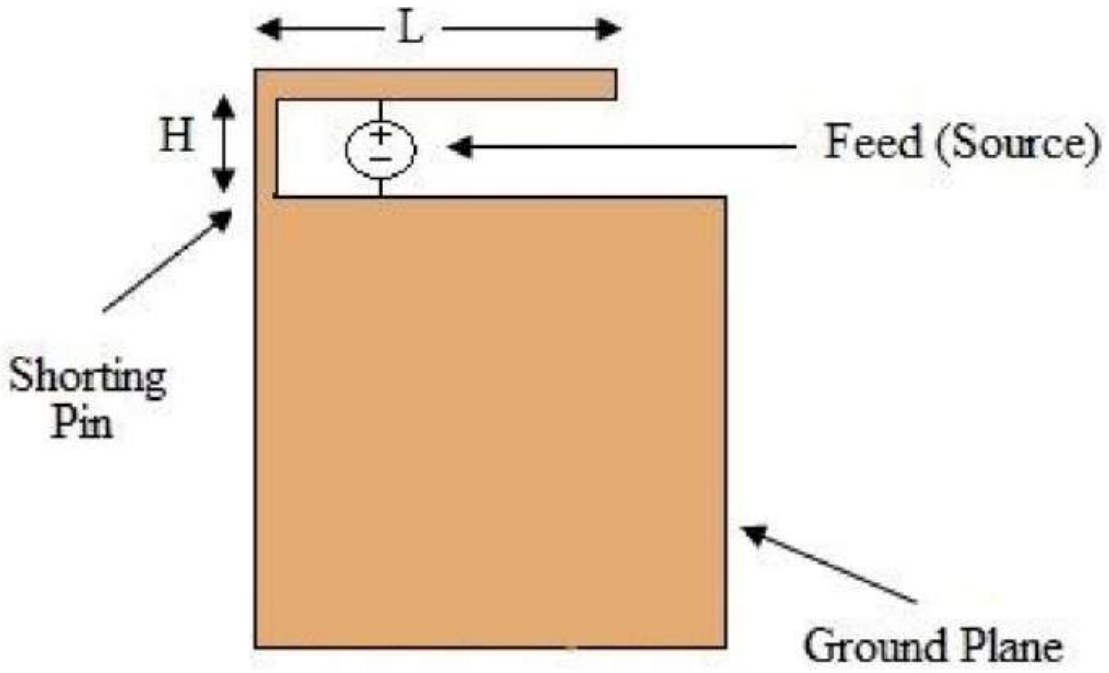

Figure 2

Bluetooth Low Energy Radio Output Power

The BLE radio in the Evie Ring (32-pin Silicon Labs EFR32GB22C224F512GN32-C microcontroller (MCU) IC) has Firmware-limited power output of 3dBm. This was the power used for all EMC testing reported in Intertek Reports 105658950MPK-001, 105658950MPK-002, and 105658950MPK-003.

Annotated Photo of the Evie Ring PCBA showing the location of the antenna (Orange line across top of the PCBA)

Figure 3

Discussion of Measured Test Results

There were several factors that led to the free-field measurements in Reports 105658950MPK-001, 105658950MPK-002, and 105658950MPK-003.

The Evie Ring antenna is extremely small and the radio feed to the match network and antenna is a single small pin on the Silicon Labs EFR32GB22C224F512GN32-C microcontroller (MCU) and BLE radio. Direct measurements of the radio output power on the Evie Ring PCBA would introduce parasitics that would invalidate such measurements.

Similarly, performing a reliable and antenna gain measurement, which is normally performed by instrumenting the antenna and measuring the power directly from the radio would be even more difficult and would not provide valid results, due to the PCB Layer 4 embedded and extremely small size of the PCB antenna.

Therefore, the EMC compliance team suggested that free-field measurements be conducted to determine the direction of maximum antenna gain. Their measurements confirmed the direction shown in attached simulation plots. Therefore, the measurements presented in Reports 105658950MPK-001, 105658950MPK-002, and 105658950MPK-003 are representative of the antenna gain described in the below simulations.

Antenna Simulations

As the Ring PCBA contains a trace that serves as the antenna, simulations were conducted to obtain the antenna gain. Note that the simulation presented below assumes an output from the Evie Ring MCU/BLE IC (Silicon Labs EFR32GB22C224F512GN32-C microcontroller (MCU) and BLE radio) and includes the effect of the BLE IC match network shown in Figure 1, from the MCU/BLE IC output to the PCB trace antenna.

Below is the finite element electromagnetic model of the Evie Ring in free-field, the condition that matches the EMC test conditions reported in Intertek Reports 105658950MPK-001, 105658950MPK-002, and 105658950MPK-003. Note that the EMC testing was performed by Intertek Menlo Park with an output power of 3dBm, that matches the production Ring output power, and free-field conditions.

Evie Ring Electromagnetic Simulation Result: -7.49 dBi Antenna Gain

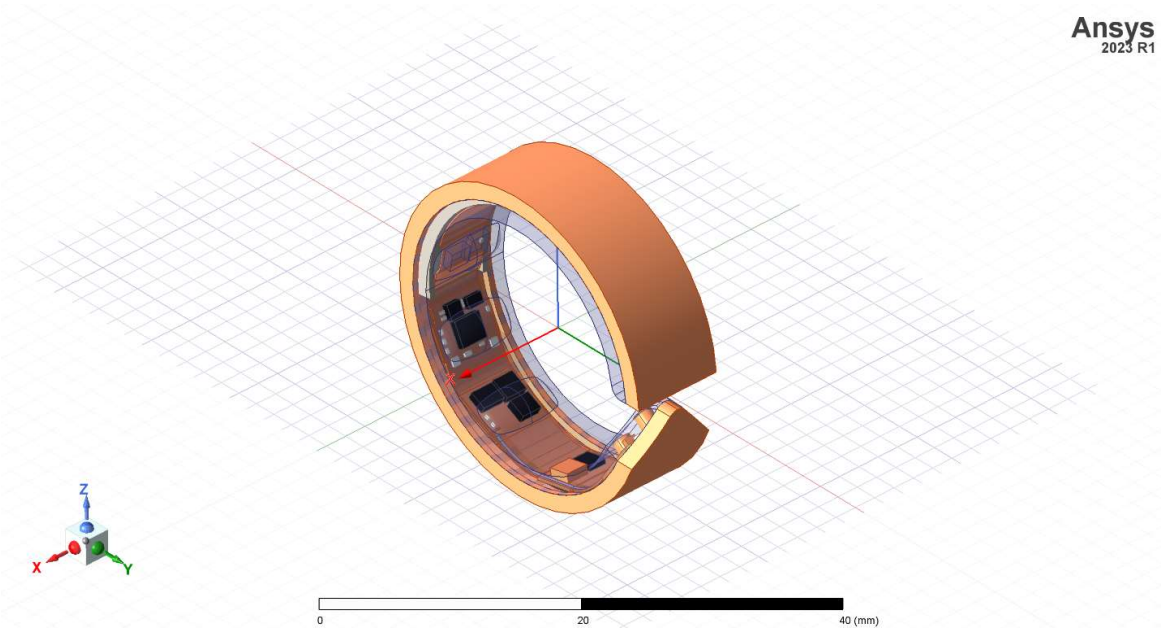

Figure 4

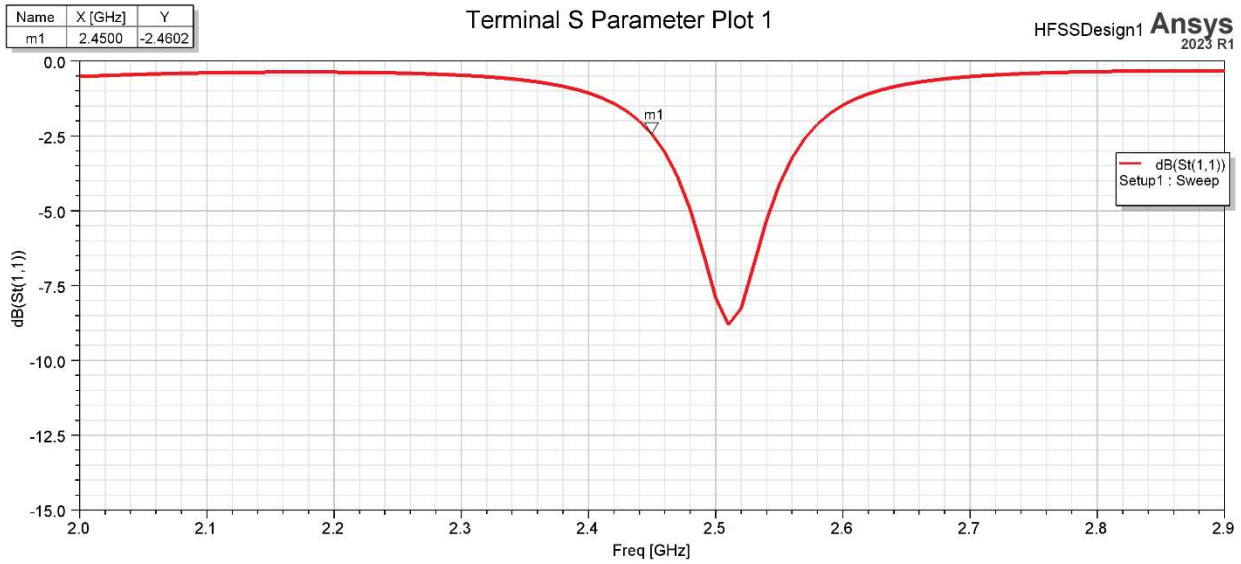

Figure 5

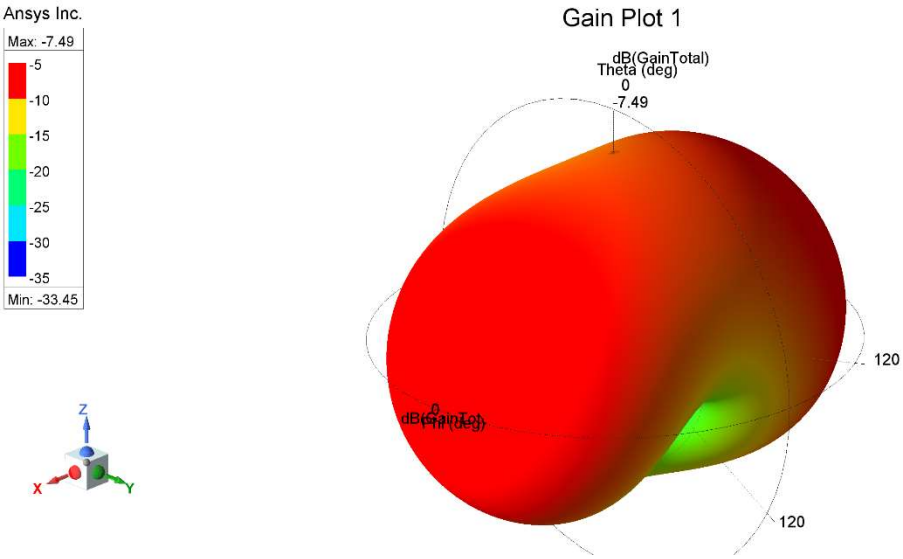

Figure 6