



FCC Part 15 Subpart C Antenna Test Exhibit

**ICL Exhibit # 2887B
Related FCC ID: 2A8T5-GENIUSIOT**

Test Specification: FCC Rule Part: 15.203 & 15.247

**Manufacturer: Genesis Energy Technology, LLC
EUT Description: Antenna for Genius IoT**

**Test Start Date: 9/26/2022
Test End Date: 10/17/2022**

Report Issue Date: 12/15/2022

Test Result: Meets Requirements

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1.0 Purpose

The purpose of this exhibit is to document antenna compliance with FCC CFR Title 47, Part 15, Subpart C.

The antenna testing covered in this exhibit was performed as a supplement to the certification process for FCC ID: 2A8T5-GENIUSIOT.

2.0 Summary of Testing

Test Description	Regulation	Result
Antenna Requirement	FCC CFR 47 Part 15.203 FCC CFR 47 Part 15.247(b)	MEETs Requirement

Table 2-1 – Summary of Testing

3.0 Reference Documents

US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: *Radio Frequency Devices, Intentional Radiators*

ANSI C63.10-2013: American National Standard for Methods of Measurement of Procedures for Compliance Testing of Unlicensed Wireless Devices

ICL Test Report #2887 Rev. 1

4.0 General Information

4.1 Related Device FCC-ID

2A8T5-GENIUSIOT

4.2 Antenna Connector

Soldered Directly to PCB.

4.3 Antenna Description

The EUT antenna as a customer fabricated whip antenna soldered directly to the PCB. The highest measured gain of the antenna is 6.38 dBi. Additional antenna information:

- Length: 81mm
- Diameter/Wire Gauge: 22 AWG

4.4 Selected Test Frequencies

Low Channel: 903.2 MHz, Middle Channel: 913 MHz, High Channel: 922.8 MHz

4.5 Test Conditions

Temperature: 18 – 24 °C, Relative Humidity: 26 – 51 %RH, Air Pressure: 97 – 100 kPa

5.0 Test Equipment List

Test Equipment List						
ICL No.	Manufacturer	Equipment Type	Model	Serial	Last Calibrated	Cal Interval
1029	ETS Rayproof	EMC Chamber	Series 81	n/a	n/a ^a	n/a
1162	Rohde & Schwarz	EMI Test Receiver	ESIB 26	100040	8/25/2022	1 year
1052	EMCO	Biconilog Antenna	3141	9706-1052	4/8/2020	3 year
1446	Pasternack	Attenuator	PE7087-3	n/a	n/a ^b	n/a
1447	Pasternack	Attenuator	PE7087-3	n/a	n/a ^b	n/a

^a Verified in a calibrated system by ICL during NSA process and checked by A2LA during ISO 17025 laboratory assessment. Refer to A2LA accreditation.

^b Correction factors charted and verified in a NIST traceable calibration system prior to use.

Table 5-1 – List of Test Equipment

6.0 Antenna Requirement

6.1 Regulation

FCC CFR 47 Part 15.203 and 15.247(b)

6.2 Requirement

An intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device. The use of permanently attached antennas or antennas with unique coupling to the intentional radiator shall be considered sufficient. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed.

Additionally, the antenna gain must be known as this determines the maximum allowed device transmit power.

6.3 Evaluation

Attachment of the antenna to the end device involves directly soldering the antenna to the PCB inside the EUT enclosure. This is considered to meet the “permanently attached” requirement of Part 15.203.

The antenna is a customer fabricated whip antenna and therefore has no data sheet or manufacturer specified gain. For this reason, measurements were performed to determine antenna gain. The procedure for determining antenna gain is described in the following sections.

6.4 Setup

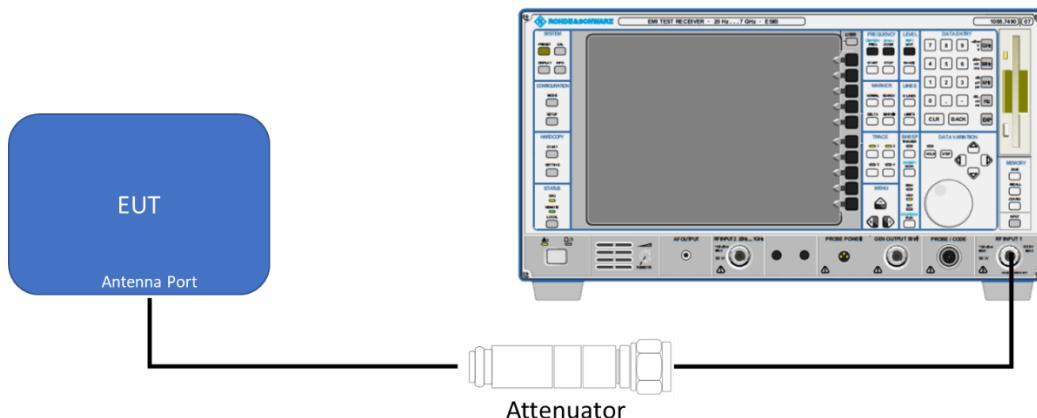


Figure 6-1 - Conducted Port Measurement Setup

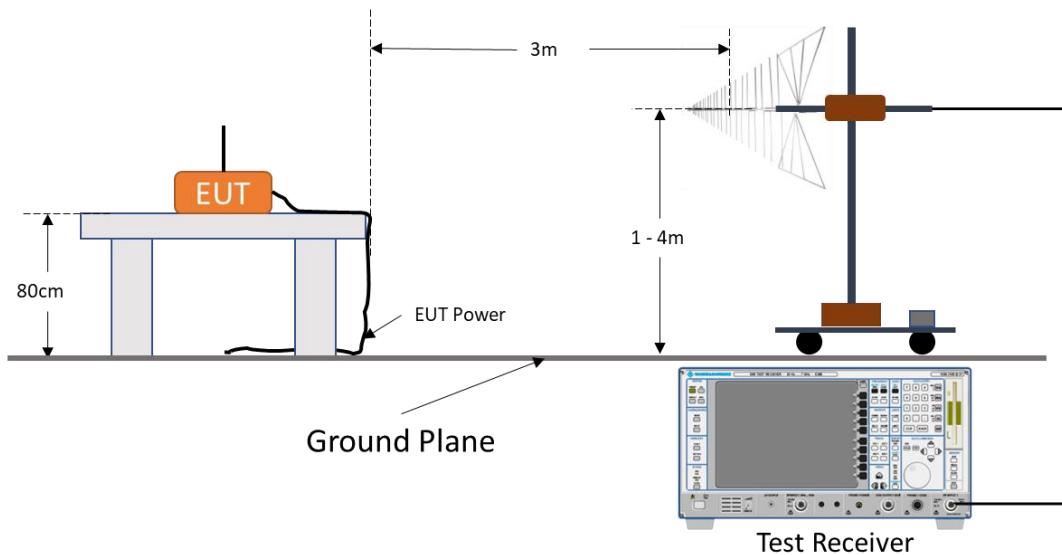


Figure 6-2 - Radiated Measurement Setup

6.5 Test Method

ANSI C63.10-2013, Clause 7.8.5 and Clause 6.5.

First, a conducted peak output measurement was performed. This testing was performed and documented under the Maximum Conducted Peak Output Power section of the device test report for FCC ID: 2A8T5-GENIUSIOT, ICL Report #2887. The conducted output measurements were used in the gain calculations covered later in this section

Radiated fundamental measurements were then performed with the antenna installed in an identical representative device used for conducted output power measurements. The measurements were performed at the same 3 transmit frequencies as in the conducted port measurements and at 3 orthogonal axes for each frequency. The analyzer resolution bandwidth, video bandwidth and detector settings were set to match the respective settings used during the conducted port measurements. The radiated measurements were maximized to find the greatest differential between the conducted power measurement and the respective field strength measurement.

During radiated measurements, automated software (Tile 7.5.7.6) was used to setup and control the measurement and positional instrumentation. The software was also loaded with the appropriate calibration factors (cable loss and antenna factors) and performed the corrections after gathering the raw uncorrected measurement instrument data. Sample calculations used in the software:

- Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor

Antenna gain was then calculated using the following formula:

$$\text{Gain (dBi)} = \text{Radiated Field Strength (dBuV)} - (\text{Conducted Output Power (dBm)} + 95.2)$$

6.6 Results

Frequency/ Channel (MHz)	Maximum Peak Conducted Output Power (dBm)	Maximum Peak Radiated Fundamental Field Strength (dBuV/m)	Antenna Gain (dBi)	Maximum Permitted Transmitter Peak Output Power (Adjusted) (dBm)	Result
903.2	16.32	117.9	6.38	29.62	Meets Requirement

Table 6-1 - Antenna Gain (highest gain)