Test Report 2025-006

Version B
Issued 08 Apr 2025

Project GCL-0710
Model Identifier: A04954
Primary Test Standard(s)
CFR 47, FCC Part 15, Subpart C
RSS-210 Issue 11

Garmin Compliance Lab
Garmin International
1200 E 151st Street
Olathe Kansas 66062 USA

Client-supplied Information

FCC ID: IPH-04954
IC ID: 1792A-04954

ACCREDITED
CERTIFICATE #6162.01

See section 6 of this report regarding the presence or absence of accreditation logos or marks on this cover page.

1. Summary

The equipment or product described in section 5 of this report was tested at the Garmin Compliance Lab according to standards listed in section 6. This report focuses on the ANT transceiver. Test records within this report may include data for the BLE transmitter, but BLE is addressed in separate report. The results are as follows.

Parameter	Description	Key Performance Values	Result	Data starts at page
Radio Modulation	Summary of the kinds of communication this radio can achieve, as stated by the client. [RSS-GEN at Annex A item 10b]	Digitally modulated spread spectrum at rates as high as 60 Kbps and 1 MHz channel separation.	Reported	NT
Adjacent Restricted Bands	The radio must not emit in certain designated restricted frequency bands to the transmission band above a set of limit values. This entry focuses on bands adjacent to the operating band. [15.205; RSS-210 at 7.1]	Emissions in the adjacent restricted bands were at least 7.8 dB below the applicable limits. Compliance for the remaining restricted bands is demonstrated by the spurious emission data.	PASS	15
Carrier, Harmonic, and Spurious Emissions	The field strength from the radio carrier and its harmonics must meet specific limits at a 3 m test distance. Other unwanted emissions also have to meet what is commonly called the Class B limit. [15.249(a); RSS-210 at B.10]	The limit is 50 mV/m (94 dBuV/m) in the carrier band, and 0.5 mV/m (54 dBuV/m) at all other frequencies. This sample demonstrated 7.0 dB of margin or greater. At other non-harmonic frequencies, unwanted emissions had at least 9.5 dB of margin.	PASS	21
Duty Cycle Effects	A summary of how ANT transmitter Duty Cycle alters the measured emission levels.	This is presented to the reader for background information on test methodology.	Reported	44
Other Bandwidths	Regulatory agencies also require the reporting of signal bandwidths using alternate processes. [2.202; RSS-GEN at 6.7]	These values are reported but have no actual performance requirements.	Reported	46
Frequency Stability	The radio tuning must be robust over a range of temperature and supply voltage conditions. [RSS-Gen at 6.11]	NT	NT	NT
Unwanted Emissions (Mains Conducted)	While transmitting, the emissions conducted into the power mains must not be too strong. [15.207, RSS-Gen at 8.8]	Emissions other than the fundamental and harmonics must meet the 'Class B' limits. The measured emissions had at least 6.5 dB of margin.	PASS	51

NT (Not Tested) means the requirement may or may not be applicable, but the relevant measurement or test was not performed as part of this test project.

N/A (Not Applicable) means the lab judged that the test sample is exempt from the requirement.

Table 1: Summary of results

Report Organization
For convenience of the reader, this report is organized as follows:

1. Summary
2. Test Background
3. Report History and Approval
4. Test Sample Modifications and Special Conditions
5. Description of Equipment Tested
6. Test Standards Applied
7. Measurement Instrumentation Uncertainty
8. Selected Examples of Calculations
9. Environmental Conditions During Test
10. Immunity Performance Criteria
11. 3m RF Chamber Block Diagrams

Annex: Test records are provided for each type of test, following the order and page numbering stated in the summary table. Concluding notes appear on the final page of this report.

Due to confidentiality, certain material (such as test setup photographs) has been removed from this report and placed in GCL Test Report 2025-10. That report is treated as a part of this document by way of this reference.

2. Test Background

2.1 The Test Lab

The testing reported here was performed at the Garmin Compliance Lab, an organization within Garmin International, located at 1200 E 151st St, Olathe Kansas, USA. The contact telephone number is +1.913.397.8200.

2.2 The Client

The testing was performed on behalf of the Garmin design group, a separate organization located at 1200 E 151st St, Olathe Kansas, USA. Witnesses from the business group included: None.

2.3 Other Information

Test Sample received: 03 Jan 2025
Test Start Date: 04 Jan 2025
Test End Date: 28 Mar 2025

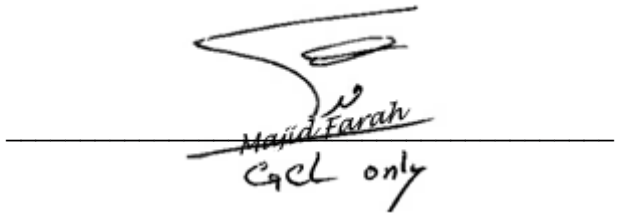
The data in this test report apply only to the specific samples tested.

Upon receipt all test samples were believed to be properly assembled and ready for testing.

3. Report History and Approval

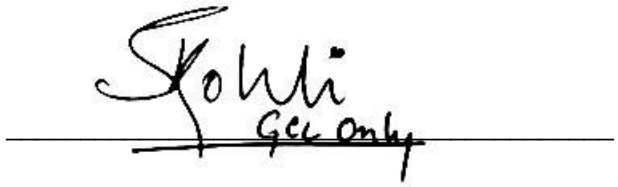
Version B of this report has an update in section 5.2. Version B was written by Majid Farah on 08 Apr 2025. This report was written by Majid Farah and initially issued on 31 Mar 2025 as Version A.

Report Technical Review:



Majid Farah
Senior EMC Engineer

Report Approval:



Shruti Kohli
Senior Manager Operations

4. Test Sample Modifications and Special Conditions

The following special conditions or usage attributes were judged during test to be necessary to achieve compliance with one or more of the standards listed in section 6 of this report:
None.

The following modifications to the test sample(s) were made, and are judged necessary to achieve compliance with one or more of the standards listed in section 6 of this report:

Modification 1
Detailed Description: Firmware upgrade from V2.24 to V3.05
Date applied: 27 Mar 2025
Reason for this modification: The Firmware V3.05 allows GCL staff to perform receiver blocking test for BLE radio while device is in test mode which is not related to FCC tests.

The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: Radiated emission, Conducted emission.

5. Description of the Equipment Tested

5.1 Unique Identification

Product Model	A04954
Serial Numbers Tested	3503267193, 3503267168, 3503267181

This product tested is a digital device with low power data transceiver(s) for data exchanging purposes and radiodetermination.

The client affirmed that the test samples will be representative of production in all relevant aspects.

5.2 Key Parameters

EUT Input Power:	5 Vdc
I/O Ports:	USB C
Radio Transceivers:	Bluetooth Low Energy, ANT
Radio Receivers:	GPS L1, GPS L5, Galileo E1, Galileo E5a/b, BeiDou, GLONASS
Primary Functions:	Low power transceiver
Typical use:	Portable device, multiple orientations
Highest internal frequency:	2.484 GHz
Highest digital frequency:	800 MHz
Firmware Revision	2.24 and 3.05

5.3 Operating modes

During test, the EUT was operated in one or more of the following modes.

Mode 3: M3 (Ble Tx). Bluetooth Low Energy radio transmitting consistently on a selected channel at 1 Mbps or 2 Mbps.

Mode 4: M4 (Ble lnk). Bluetooth Low Energy radio is paired to a companion device, transmitting and receiving data on various channels in accordance with the protocol, and maintaining the paired relationship.

Mode 5: M5 (ANT Tx). ANT radio transmitting consistently on a selected channel.

Mode 6: M6 (ANT lnk). ANT radio is paired to a companion device, transmitting and receiving data in accordance with the protocol, and maintaining the paired relationship.

Mode 9: M9 (RxBtBlA). The radio was set to receive 2.4 GHz signals but not transmit in Bluetooth, Bluetooth low energy or ANT. (mention which Rx used)

Mode 13: M13 (Gnss). The Global Navigation Satellite System receiver is monitoring the GNSS bands, attempting to detect a constellation and determine location. Unless otherwise noted, the EUT was provided simulated GNSS signals representing one of more constellation types. In addition, the EUT may have been reporting signal levels and satellite data to an attached computer to monitor link health.

Mode 19: M19 (ML1). BLE, ANT radios are linked to their companion devices simultaneously.

5.4 EUT Arrangement

During test, the EUT components and associated support equipment were selected including the following arrangement sets.

Arrangement 1: A1 (Solo) The test sample operates from its battery and no external physical connections. No block diagram is needed for this arrangement.

Arrangement 2: A2 (Upwr). The test sample is attached to USB adaptor which is connected to AC mains. The adaptor provides power to the sample over a cable but no user data. See the block diagram in Figure 1.

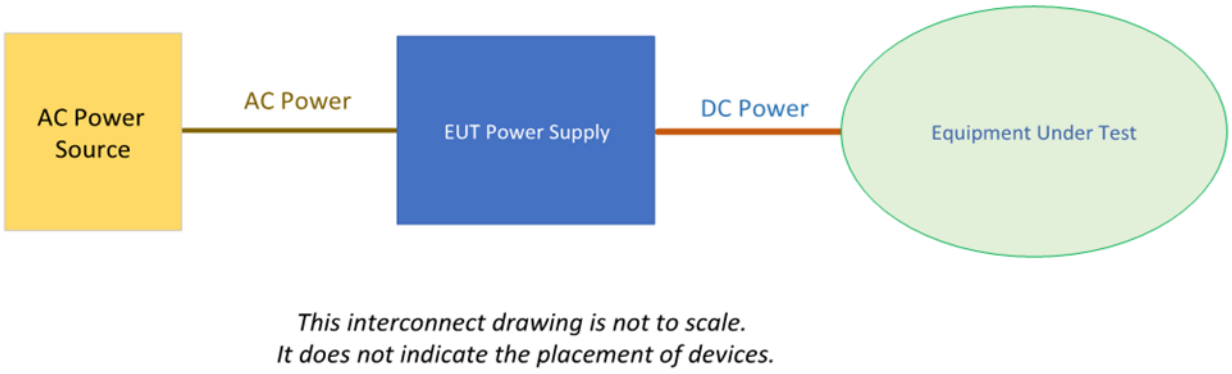


Figure 1: Block diagram of equipment arrangement A2

Arrangement 3: A3 (Udata). The test sample is connected to PC through its USB C port. The PC is providing the power to the device as well as data is being transferred between the test sample and the PC.

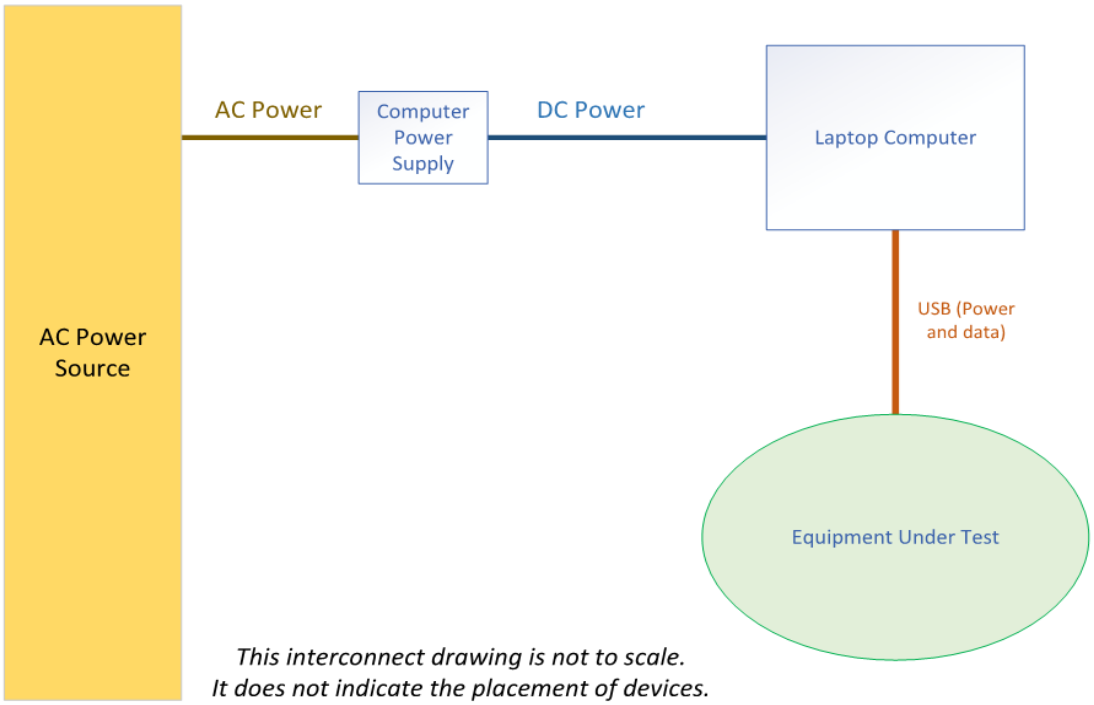


Figure 2: Block diagram of equipment arrangement A3

Arrangement 4: A4 (Udc). The test sample was in either arrangement 2 or arrangement 3, but for the test involved the different was not relevant.

5.5 Associated Equipment (AE) used

Description	Manufacturer	Model	Serial Number
Laptop	Dell	Precision 5540	3JYG33
Power Supply-Laptop	Dell	HA130PM130	CN-0V363H-CH200-78G-0DC1-A01
Power adaptor	Garmin/PHIHONG	AQ27A-59CFA	233730835A2

Table 2: List of associated equipment that may have been used during test

5.6 Cables used

Description	From	To	Length	EMC Treatment
USB C Cable	EUT	Power adapter/Laptop	0.5 m	None

Table 3: List of cables that may have been used during test

6. Test Standards Applied

6.1. Accredited Standards

The following test or measurement standards were applied and are within the scope of the lab's accreditation. All results in this report that cite these standards are presented as Accredited results consistent with ISO/IEC 17025.

CFR 47, FCC Part 15, Subpart C
ANSI C63.10: 2020 and ANSI C63.10: 2020 +Cor 1: 2023
RSS-GEN Issue 5 Amd 2
RSS-210 Issue 11

6.2 Non-accredited Standards

The following test or measurement standards were applied and are either outside the scope of the lab's accreditation, or were performed in such a way that results are not presented as being fully accredited.

FCC Part 2.202
TRC-43 Issue 3

6.3 Variances

The following variances were applied to standards cited in this section.

Where different test standards cover the same test parameter or phenomenon, and the standards have compatible differences, the stricter of the requirements is typically applied. For example, a consolidated limit may be applied to emission tests selecting the strictest of the limits at each frequency. Likewise, if one standard requires a vertical antenna sweep with bore sighting and another does not, swept motion with boresighting will typically be used as it is the more stringent requirement.

Some standards that apply an Average detector provide a variety of methods to handle time-averaging, especially where the transmission is not continuous and the Duty Cycle (DC) is below a value such as 98%. The basic GCL process is to begin by applying an Average detector to the emission with the receiver in Max-Hold data mode. This Max Average method is worst-case compared to any of the methods of time-averaging provided. If the Max Average result complies with the limit, that result is provided in the test record and the emission judged to be compliant without additional detail. If the Max Average result is near or above the limit at one or more emission frequencies, then one of the appropriate time-averaging methods is applied to determine final compliance. When time-averaging is used, the test record will indicate which method of time-averaging was used.

Some standards ask for measurements made with a 'Time Domain Power' function, but that function is not defined in the standards. GCL addresses this gap as follows. Staff capture a zero-span Average detector data record of emission power, with a timespan covering a transmission burst. When the maximum power in the data record is clearly below the limit, this value will be reported. When the maximum power in the data record is near or above the limit, then the average of the power (in linear units) during a transmission burst is calculated and reported.

6.4 Laboratory Accreditation

The Garmin Compliance Lab, an organization within Garmin International, is registered with the US Federal Communication Commission as US1311. The lab is recognized by the Canada Department of Innovation, Science, and Economic Development (ISED) under CAB identifier US0233.

The Garmin Compliance Lab, an organization within Garmin International, is accredited by A2LA, Certificate No. 6162.01. The presence of the A2LA logo on the cover of this report indicates this is an accredited ISO/IEC 17025 test report. If the logo is absent, this report is not issued as an accredited report. Other marks and symbols adjacent to the A2LA logo are accreditation co-operations of which A2LA is a member under a mutual recognition agreement, and to which the Garmin Compliance Lab has been sublicensed.

7. Measurement Instrumentation Uncertainty

The lab has analyzed the sources of measurement instrumentation uncertainty. The analysis concludes that the actual measurement values cited in this report are accurate within the U_{LAB} intervals shown below with approximately 95% statistical confidence. Where the report shows a judgment that a test sample passes a test against a published limit based on these measured values, that judgment has a statistical confidence of 97.5% or greater. Measurement Instrumentation Uncertainty is one component of over-all measurement uncertainty, and other uncertainty components are not considered as part of this analysis.

The primary benchmark for measurement instrumentation uncertainty (MIU) in an electromagnetic compatibility (EMC) test lab is the set of U_{CISPR} values published in CISPR 16-4-2. In all cases where a U_{CISPR} value is published by CISPR, the analysis shows that U_{LAB} – this lab's estimated MIU – is better than the U_{CISPR} benchmark.

The secondary benchmark for MIU in an EMC lab performing radio transceiver tests is a set of uncertainty limit values published in various ETSI standards. In this report, U_{ETSI} is the most restrictive of the values found in the ETSI EN standards listed in section 5 of this report. The analysis principles are described in the ETSI TR documents listed there. In most cases U_{LAB} is better than the U_{ETSI} benchmark. Where U_{LAB} exceeds the U_{ETSI} benchmark cited here, that entry is preceded by an asterisk. When required by the ETSI EN standards, excess uncertainty will be added to the measurand before comparison to a limit. In an individual test report, staff may re-evaluate that excess uncertainty based on the uncertainty of the method used and the uncertainty limits of the actual ETSI EN standard being applied, and the revised uncertainty values will be shown in the test report.

Some measurement uncertainties analyzed and reported here are not addressed in CISPR 16-4-2 or the ETSI standards, as indicated by the entry 'None.'

Test Type		**U_{LAB}**	**U_{CISPR}**	**U_{ETSI}**
Conducted DC voltage		0.09% + 2 x LSDPV	None	1%
Conducted AC voltage below 500 Hz		1.0% + 3 x LSDPV	None	2%
Conducted Emissions, Mains Voltage		0.10% + 10 mV	None	None
Conducted Emissions, Mains Current		0.10% + 3 mA	None	None
Conducted Emissions, Mains Power		0.15% + 100 mW	None	None
Conducted Emissions, Power Mains, 9 kHz to 150 kHz		1.70 dB	3.8 dB	None
Conducted Emissions, Power Mains, 150 kHz to 30 MHz		1.48 dB	3.4 dB	None
Conducted Emissions, Cat 6 LCL, 150 kHz to 30 MHz		1.57 dB	5 dB	None
Conducted Emissions, Cat 5 LCL, 150 kHz to 30 MHz		3.06 dB	5 dB	None
Conducted Emissions, Cat 3 LCL, 150 kHz to 30 MHz		4.27 dB	5 dB	None
Radiated Emissions, below 30 MHz		0.88 dB	None	6 dB
Radiated Emissions, 30 MHz to 1000 MHz		2.79 dB	6.3 dB	6 dB
Radiated Emissions, 1 GHz to 18 GHz		2.54 dB	5.2 & 5.5 dB	6 dB
Radiated Emissions, 18 GHz to 26.5 GHz		2.68 dB	None	6 dB
Radiated Emissions, 26.5 GHz to 40 GHz		3.17 dB	None	6 dB
*Radio Signal Frequency Accuracy		*1.55 x 10^-7	None	1.0 x 10^-7
Radio Signal Occupied Bandwidth		0.95%	None	5%
Radio Power or Power Spectral Density		0.98 dB	None	1 dB
Temperature		0.38 °C	None	1 °C
Barometric Pressure		0.38 kPA	None	None
Relative Humidity		2.85% RH	None	±5% RH
Signal Timing	The greater of these three...	0.63 usec 0.01% of value 0.5 x LSDPV	None	None

Note: *LSDPV stands for the Least Significant Digit Place Value reported. In the value 1470 msec, the least significant digit is the 7. It has a 10 msec place value. The LSDPV is thus 10 msec and the maximum error due to roundoff would be 5 msec. If the time value were reported as 147<u>0</u> msec, the underscore indicates that the 0 is a significant figure and the error due to roundoff would be 0.5 msec. All digits provided to the right of a decimal point radix are significant.*

8. Selected Example Calculations

Certain regulators require samples of the calculations that lead from the raw measurement to the final result for AC Mains conducted and unintended radiated emissions. The assumption is that the lab performs raw measurements, then adds, subtracts, multiplies, or divides based on transducer factors, amplifier gains, and losses in the signal transmission path. In this lab, our CISPR 16 Receiver does not work that way. The calibration factors and losses and gains are provided to the receiver as detailed data files. These factors are applied in the RF measurement path prior to the detector. But as a step in the lab measurement process, staff frequently verify that these factors are applied correctly. They make a measurement with the factors applied inside the receiver, then they disable the factors and remeasure the result manually adding in the various relevant factors.

The transmission loss is measured including the combined losses and gains of preamplifiers, cables, and any band-selective filters. In many cases above 1 GHz it is a negative value, indicating that the preamplifier gain is greater than these other losses.

Here are examples of these calculations. The data in these examples was not taken as part of this project:

8.1 AC Mains conducted emissions at 22 MHz

(Raw measurement) + (AMN factor) + (transmission loss) = Result

(7.145 dBµV) + (9.812 dB) + (0.216 dB) = 17.173 dBµV

8.2 Radiated Emissions at 630 MHz

(Raw measurement) + (Antenna factor) + (transmission loss) = Result

(2.25 dBµV) + (27.80 dB/m) + (2.89 dB) = 32.94 dBµV/m

8.3 Radiated Emissions at 2.7 GHz

(Raw measurement) + (Antenna factor) + (transmission loss) = Result

(43.72 dBµV) + (32.22 dB/m) + (-36.09 dB) = 39.85 dBµV/m

9. Environmental Conditions During Test

Environmental conditions in the test lab were monitored during the test period. Temperature and humidity are controlled by an air handling system. As information to the reader, the conditions were observed at the values or within the ranges noted below. For any tests where environmental conditions are critical to test results and require further constraints or details, the test records in the annex may provide more specific information.

Temperature:	19.5 to 22.1 °C
Relative Humidity:	41.5% to 51.8% (non-condensing)
Barometric Pressure	96.1 to 99.9 kPa

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Barometer	Traceable	6453	240300703	9-Apr-2024	9-Apr-2027

Table 4: Environmental monitoring device

10. Immunity Performance Criteria

If this report includes immunity tests then results have been categorized as Performance Criteria A, B, C, or D. The standards that the lab applied will define the details for A, B, and C, as well as which criterion is required for each type of test. They will also define the electrical stresses that were applied during each test. In a very general sense the observed criteria noted in this report are as follows:

Criterion A. The stress applied did not alter product operation. This criterion is generally used for 'continuous' stresses that can be present for a long time in the places the product will be used, or that can appear often, even though they may come and go over time.

Criterion B. The stress applied altered product operation, but the product self-recovered so that the user would not have to try to figure out how to restore it to full operation. This criterion is generally used for 'transient' stresses that appear briefly and occasionally, but are usually not present in the places the product will be used.

Criterion C. The stress applied altered product operation, but the user could restore it to full operation, for example by power cycling the product. This criterion is generally used for 'transient' stresses that appear briefly and only rarely in the places the product will be used.

Criterion D. This is not an official criterion in the standards, because it would be a failure of the requirements. This indication in a test record means the product was affected in a way that the user might not be able to correct. The effect could include some degree of hardware damage, or it could include loss of program files or data files necessary for operation.

Repeatability is an issue in all EMC immunity work. When the product operation changes unexpectedly during a test, and the change would fail the requirements of the standard, this is an anomaly. The test operator needs to determine whether the anomaly was a result of the applied electrical stress. The investigation is done by repeating the section of the test where the anomaly occurred three times. If the same or a similar anomaly occurs in any of the three repeat trials, it is confirmed as a response to the stress. If not, the anomaly is judged unreproducible and is not considered when judging the A, B, or C observed performance. Since there is usually no ability to confirm a Criterion D anomaly, these are usually treated as Criterion D upon a single occurrence.

Tests that require Criterion B performance will be judged to Pass if criteria A or B is observed. Similarly, tests that require Criterion C performance will be judged to Pass if criteria A, B, or C is observed.

11. 3m RF Chamber Block Diagrams

The 3m chamber has three basic configurations which are shown in the figures below. These figures are not to scale.

Figure 1 shows a semi anechoic setup which is typically used for frequencies below 1 GHz. In this example, the antenna is mounted on a mast capable of 1-4 m elevation changes. If a preamplifier or RF filter is used, they are located at or just below floor level. The receiver is outside the chamber, typically in an adjacent separate shielded room.

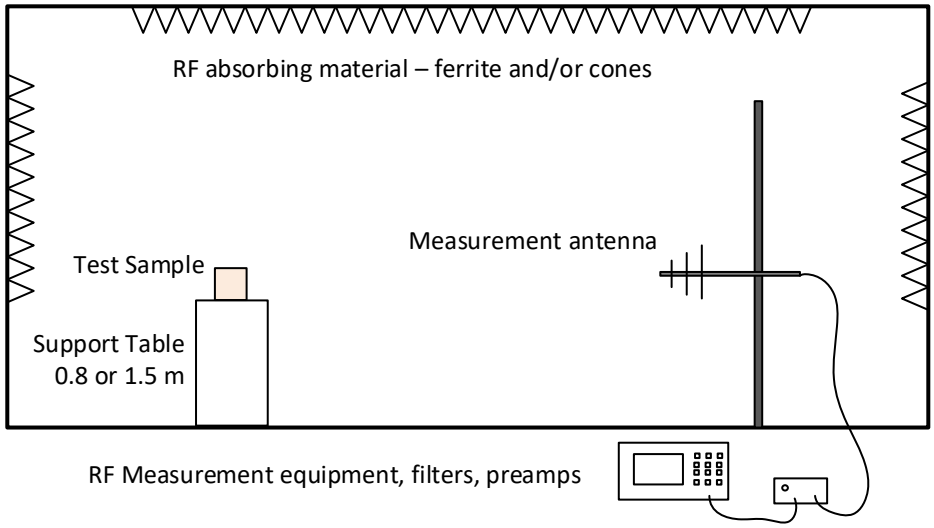


Figure 1: Typical configuration for measurements below 1 GHz

Figure 2 shows an FSOATS setup which is typically used for frequencies above 1 GHz but below an upper limit such as 14 or 18 GHz. In this example, the antenna is mounted on a mast capable of 1-4 m elevation changes and bore sighting. If a preamplifier or RF filter is used, they are located at or just below floor level. The receiver is outside the chamber, typically in an adjacent separate shielded room.

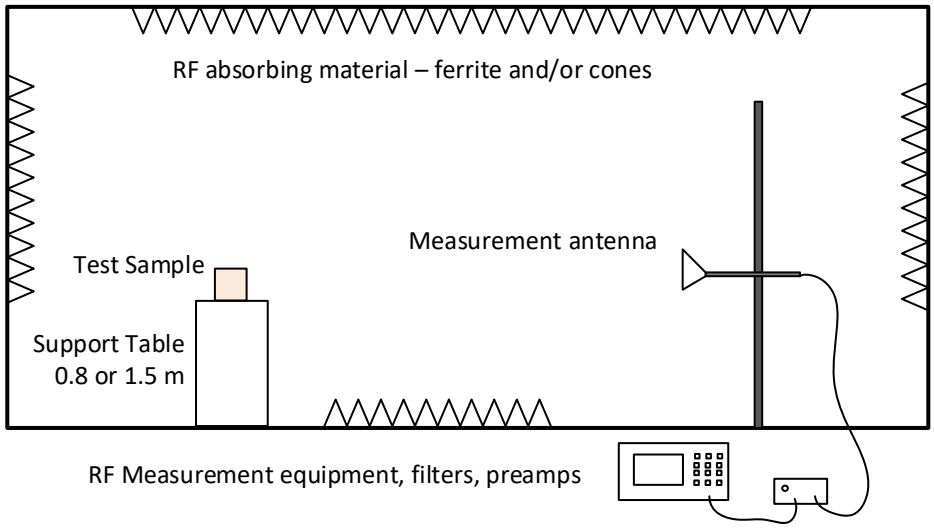


Figure 2: Typical configuration for measurements between 1 GHz and 14 GHz

Figure 3 shows an alternate FSOATS setup which is typically used for frequencies above 14 GHz. In this example, the antenna is mounted on a mast capable of 1-4 m elevation changes and bore sighting. A preamplifier is located on the mast just behind the antenna. The receiver is located in the chamber near floor level but outside the antenna beam. The receiver may be operated manually by an operator in the chamber and or remotely via an Ethernet connection.

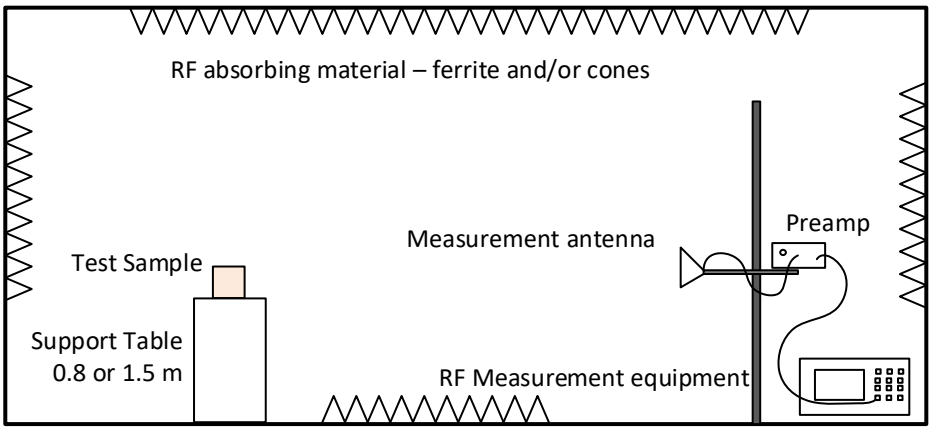


Figure 3: Typical configuration for measurements above 14 GHz

ANNEX

The remainder of this report is an Annex containing individual test data records. These records are the basis for the judgments summarized in section 1 of this report. The Annex ends with a set of concluding notes regarding use of the report.

Test Record
Radiated Emission Test RE04
Project GCL0710

Test Date(s)	08 Jan 2025
Test Personnel	David Kerr
Product Model	A04954
Serial Number tested	3503267193
Operating Mode	M5 (AntTx) (2402, 2480MHz)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	RSS-GEN; ANSI C63.10, FCC Part 15.249; RSS-210 (as noted in Section 6 of the report)
Frequency Range:	Restricted Bands (2200-2300 MHz, 2310-2390 MHz, 2483.5-2500 MHz)
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	13 Jan 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required

Table RE04.1: Test Equipment Used

Software Used
Keysight PXE receiver software A.32.06, RE Signal Maximization Tool v2021Feb25.xlsx, RE C63p10AvgMeasurementToolV2024Dec20.xlsx.

Test Data

This restricted band investigation began with a benchtop setup wherein the emissions in the restricted bands were observed from a modified test sample with an RF output cable replacing the onboard antenna. The actual emission levels within restricted bands in many of the test sample's available transmission modes are too low to be reliably measured in the radiated environment. By applying the required peak and average detectors and bandwidths to the signals direct from the transmitter, lab staff identified the worst-case operational modes. These were then measured using an unmodified unit in the required radiated environment.

The radiated emission test began with a preliminary scan in each restricted band at multiple turntable angles, antenna heights, and both antenna polarizations. For test standards that require reorienting the test sample, further preliminary scans were taken in those alternate orientations typically described as X, Y, and Z. Subsequent testing was done using on the orientation(s) producing the highest result relative to the test limit. Final field strength measurements were taken in that set of positions.

Restricted band measurements in the lower band were made while the transmitter was tuned to its lowest frequency of 2402 MHz. Measurements in the upper band were made while the transmitter was tuned to its highest frequency of 2480 MHz.

At azimuth angle 0° the 'front' reference mark of the turntable is pointed Southward. At 90° the reference mark points West. At -90° it points East. At -7° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The tables show the selected final measurement data between the FCC restricted bands. It includes a the strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC restricted band Class B Limit at 3m.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the ANT radio had a constant duty cycle less than 98% and so the trace-averaging method with duty cycle adjustment from clause 11.12.2.5.2.1 was applied. The measured Duty Cycle was 96.3%.

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2274.3	54	74	38.902	48.488	15.098	25.512	31	1118	VERT
2274.02	54	74	42.173	47.97	11.827	26.03	31	1118	VERT

Table RE04.2: FCC restricted bands from 2200 to 2390 MHz (ANT 2402 MHz)

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2488.8	54	74	34.167	46.592	19.833	27.408	112	1087	HORZ
2529.971	54	74	34.317	46.952	19.683	27.048	112	1087	HORZ

Table RE04.3: FCC restricted band from 2483.5 to 2500 MHz (ANT 2402 MHz)

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2351.8	54	74	42.436	51.341	11.564	22.659	109	1177	HORZ
2352.01	54	74	46.123	51.134	7.877	22.866	109	1177	HORZ

Table RE04.4: FCC restricted bands from 2200 to 2390 MHz (ANT 2480 MHz)

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2483.5	54	74	36.173	60.548	17.827	13.452	124	1037	HORZ
2488.063	54	74	41.586	52.278	12.414	21.722	124	1037	HORZ

Table RE04.5: FCC restricted band from 2483.5 to 2500 MHz (ANT 2480 MHz)

The graphs below show the background spectrum observed during pre-scan, as well as the final data points from the table above.

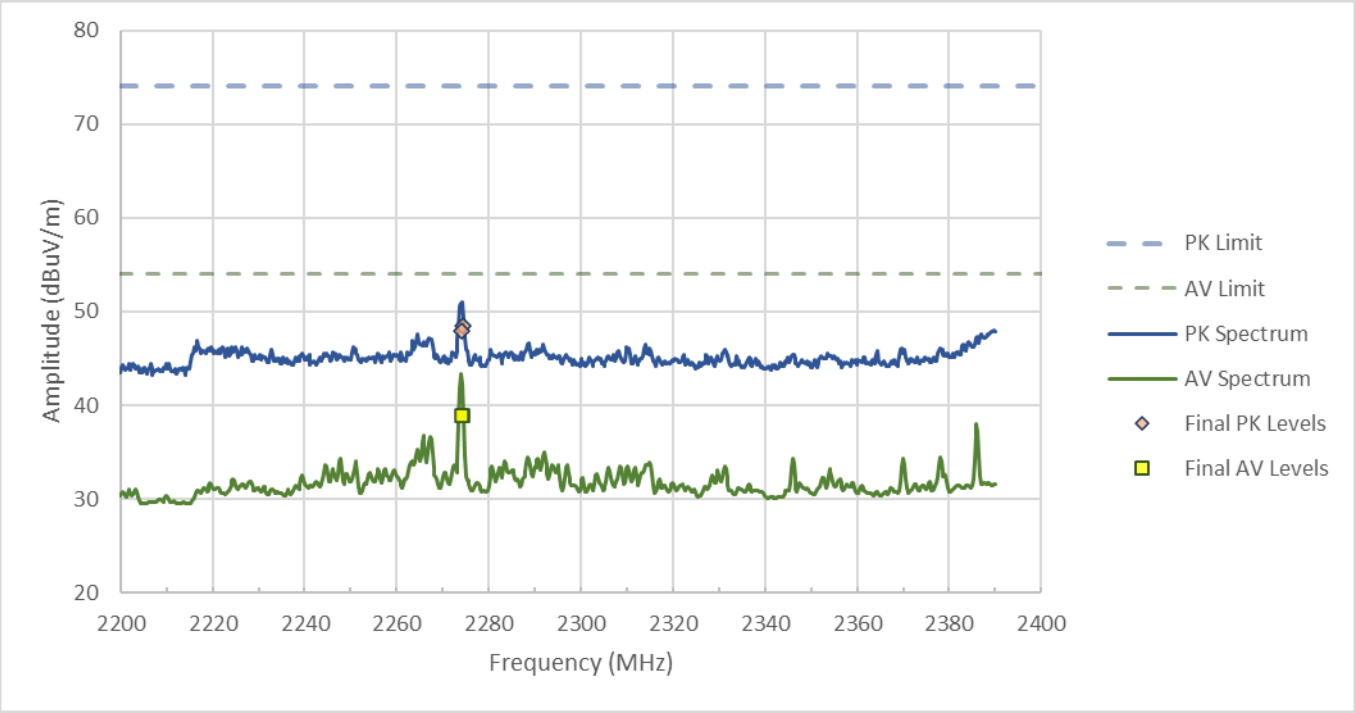


Figure RE04.1: FCC restricted band spectral data from 2200 to 2390 MHz (BLE 2402 MHz)

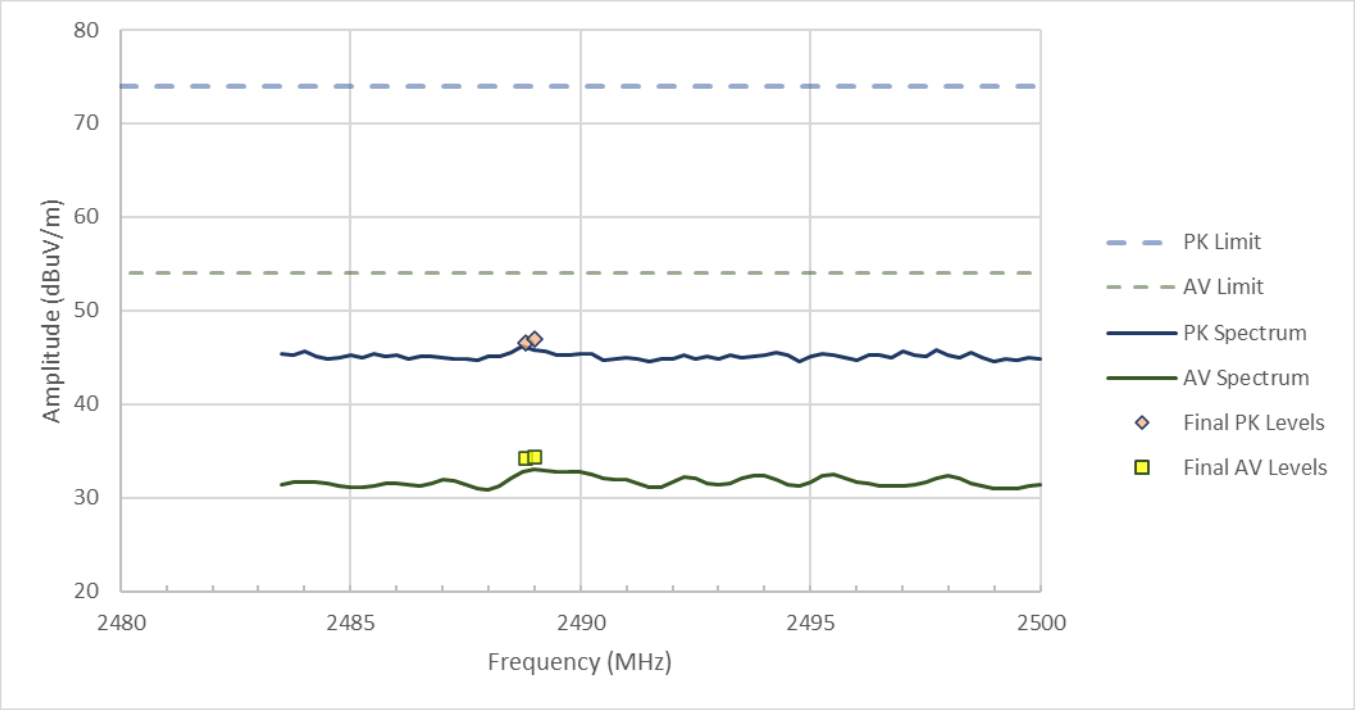


Figure RE04.2: FCC restricted band spectral data from 2483.5 to 2500 MHz (ANT 2402 MHz)

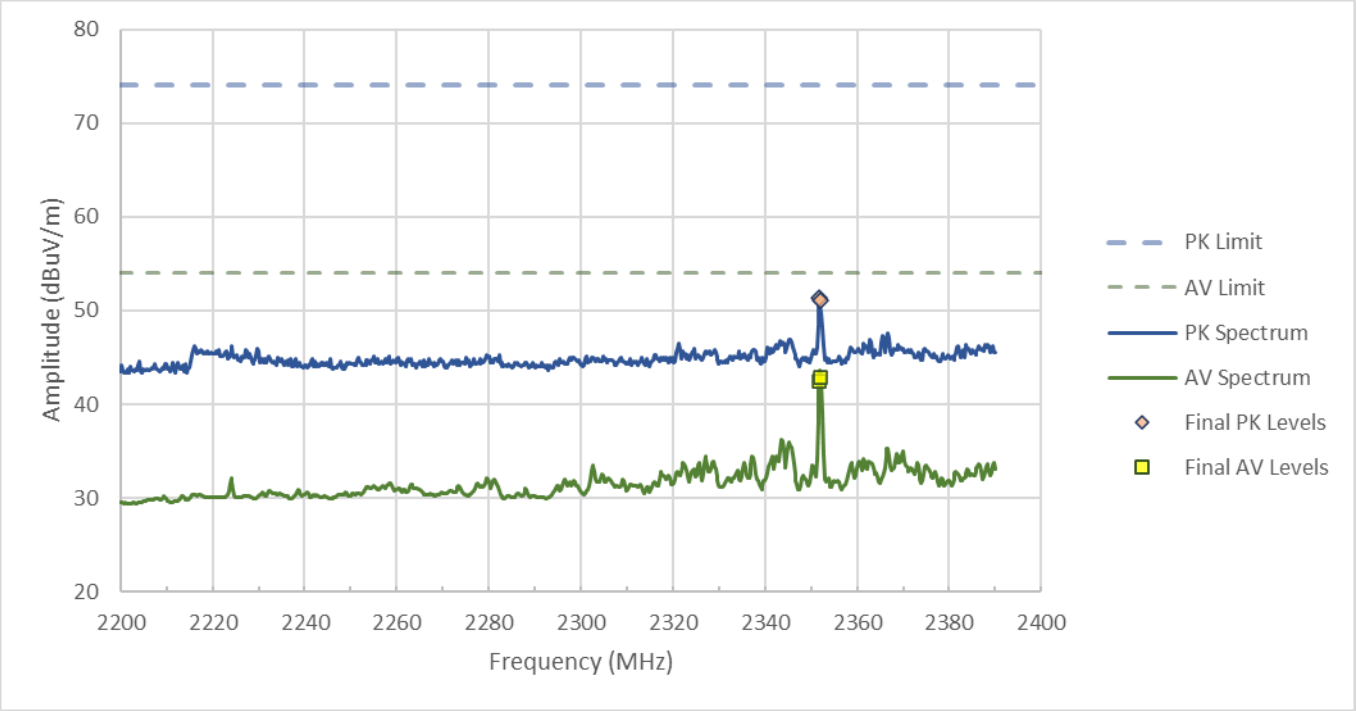


Figure RE04.3 FCC restricted band spectral data from 2200 to 2390 MHz (ANT 2480 MHz)

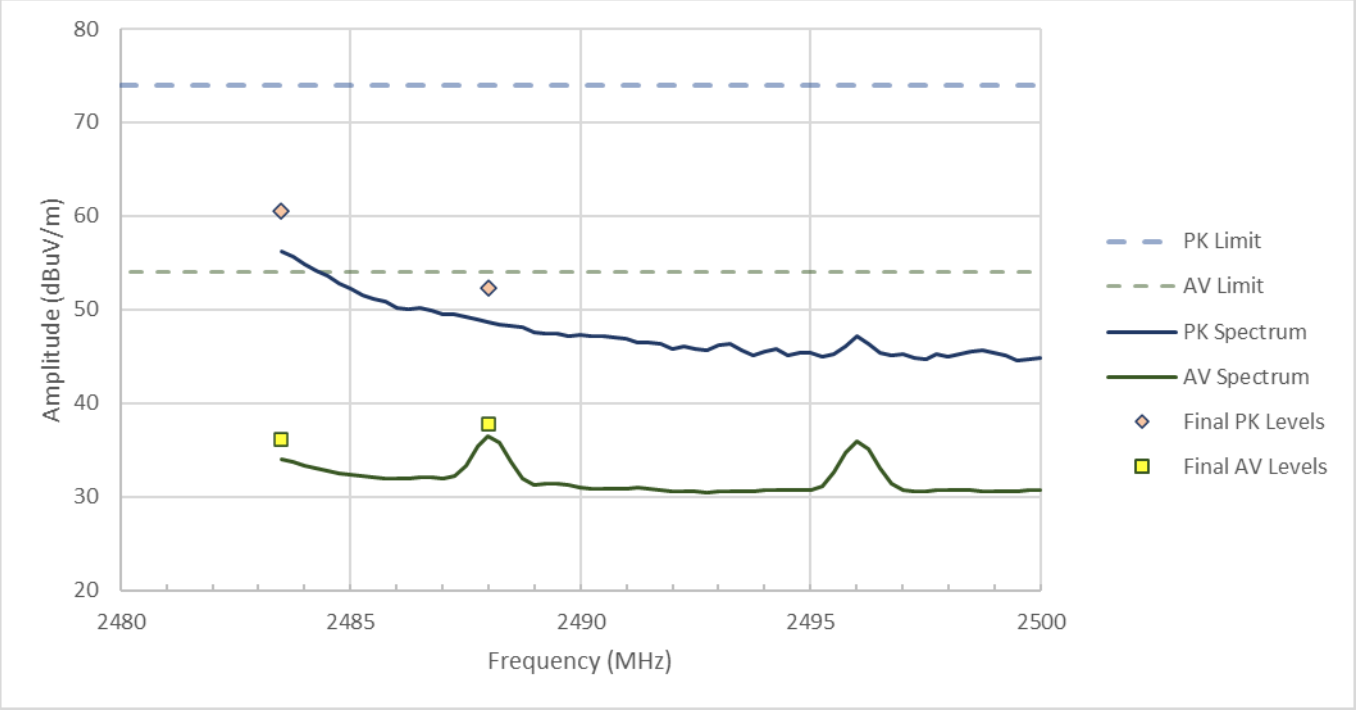


Figure RE04.4: FCC restricted band spectral data from 2483.5 to 2500 MHz (ANT 2480 MHz)

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

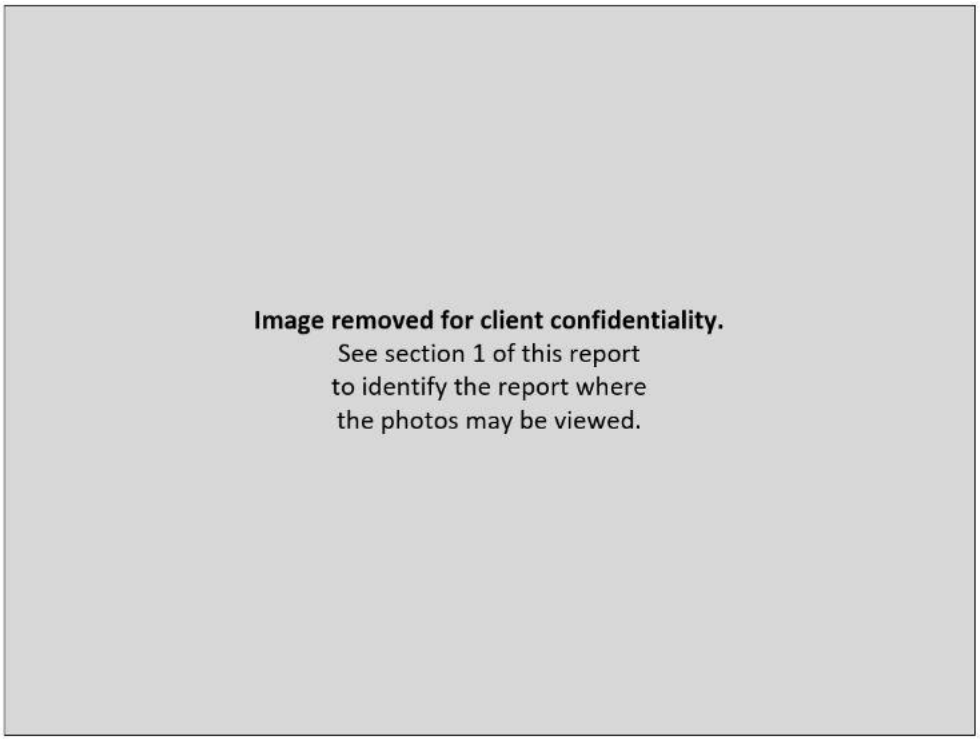


Figure RE04.5: EUT test setup, Y orientation

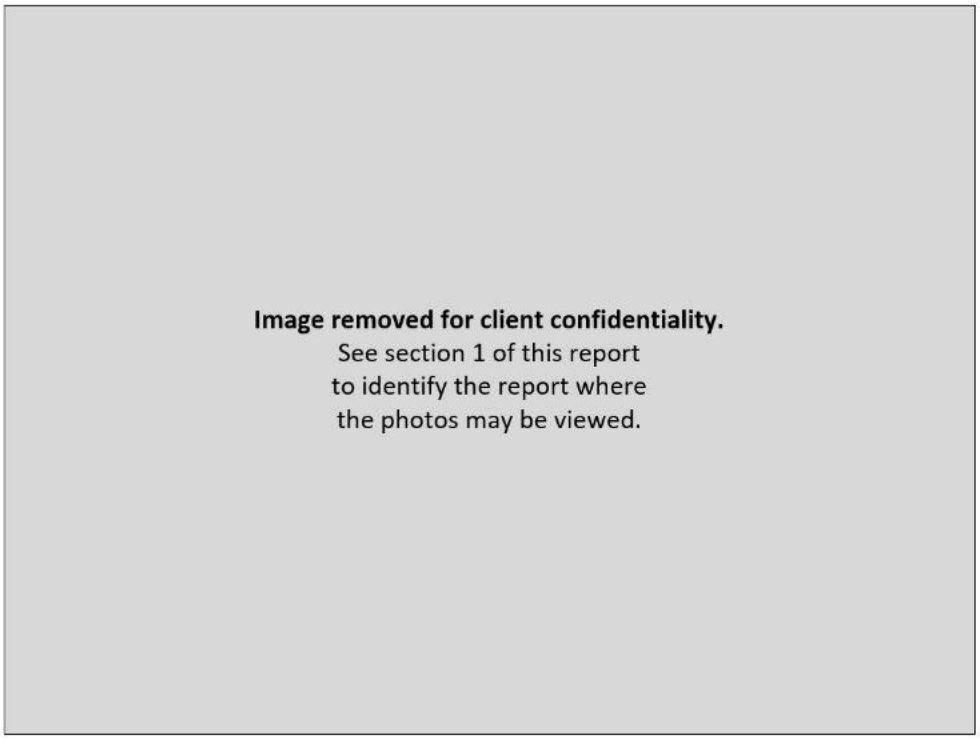


Figure RE04.6: EUT test setup, Front view

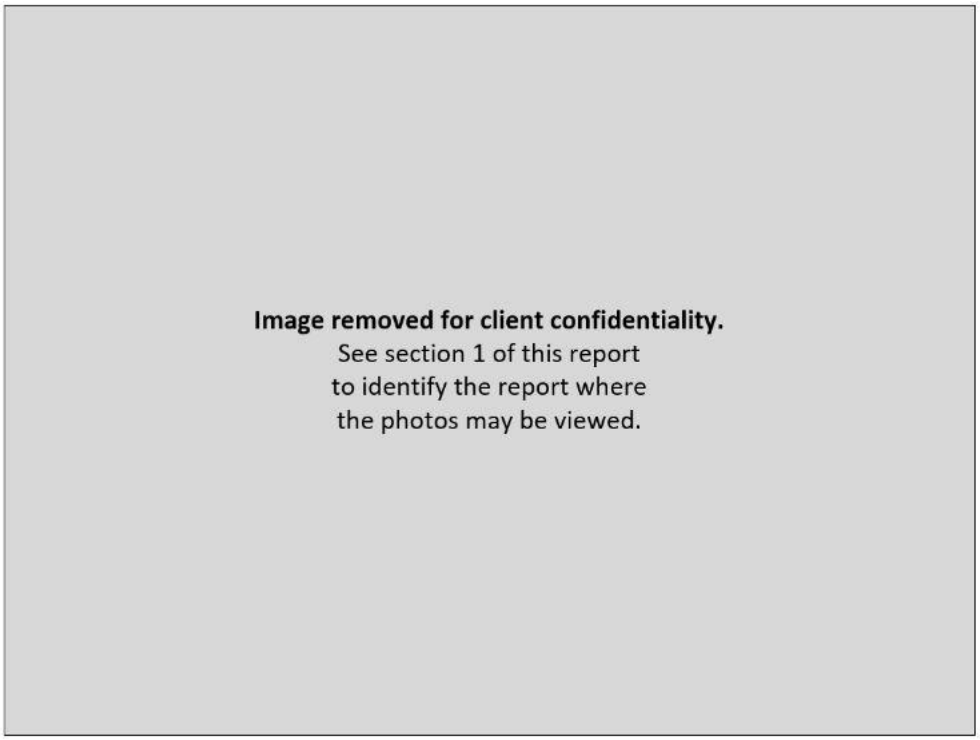


Figure RE04.7: EUT test setup, reverse view

This line is the end of the test record.

Test Record
Radiated Emission Test RE10
Project GCL0710

Test Date(s)	09 Jan 2025
Test Personnel	David Kerr, Jim Solum
Product Model	A04954
Serial Number tested	3503267193
Operating Mode	M5 (AntTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Frequency Range:	1 GHz to 14 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this record:	10 Jan 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013784	26-Jun-2024	26-Jun-2027
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required
3 GHz High Pass filter	Anatech Electronics	0K0R2	01	Calibration	Not Required

Table RE10.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, EPX test software Version 2023.01.001, RE C63p10AvgMeasurementToolV2024Dec20.xlsx

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

In the 1 GHz to 3.2 GHz frequency range, a Chebyshev 'Wifi' notch filter covering the 2.4 GHz ISM band was placed in series just before the preamplifier to ensure it operated in its linear range. This filter is accounted for in the system loss, so it appears in the prescan plots as high noise floor levels from 2400 – 2483 MHz. These are not failing emissions. A 3 GHz high pass filter was applied during testing between 3.2 GHz and 14 GHz to similarly protect the preamplifier.

In the 1 GHz to 14 GHz frequency range, pre-scan spectral data was taken at 1 meter and extrapolated to a 3 meter distance. Final measurements were made at 3 meters.

At azimuth angle 180° the 'front' reference mark of the turntable is pointed Southward. At 270° the reference mark points West. At 90° it points East. At 173° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 1 GHz and 14 GHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the ANT radios had a constant duty cycle less than 98% and so the trace-averaging method with duty cycle adjustment from clause 11.12.2.5.2.1 was applied.

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
2227.99	H	N/A	47.3	-4.0	31.41	43.3	54.0	74.0	22.58	30.7	246.6	265.0
2274.05	H	N/A	53.3	-3.5	41.89	49.8	54.0	74.0	12.10	24.2	100.0	306.0
2529.440	H	38.6	50.4	-2.6	36.0	47.8	54.0	74.0	18.0	26.2	118.4	306.0
4804.1	V	N/A	49.8	3.2	45.24	53.0	54.0	74.0	8.76	21.0	104.5	36.0
7206.26	V	40.0	48.7	7.0	47.0	55.7	54.0	74.0	7.0	18.3	115.3	132.0
11870.64	V	N/A	41.3	14.4	43.75	55.7	54.0	74.0	10.24	18.3	284.8	8.0

Table RE10.2: Emission summary ANT 2402 MHz

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
2216.25	H	N/A	47.6	-3.9	30.59	43.7	54.0	74.0	23.41	30.3	204.2	71.0
2312.045	H	N/A	53.7	-3.5	42.83	50.2	54.0	74.0	11.17	23.8	110.6	295.0
2526.800	H	34.9	47.3	-2.5	32.4	44.8	54.0	74.0	21.6	29.2	254.6	313.0
2567.720	H	41.6	50.8	-2.7	38.9	48.1	54.0	74.0	15.1	25.9	100.0	301.0
4880.06	V	N/A	48.4	2.8	43.35	51.2	54.0	74.0	10.65	22.8	100.0	64.0
7320.38	H	N/A	47.9	6.9	45.92	54.8	54.0	74.0	8.08	19.2	265.1	321.0

Table RE10.3: Emission summary ANT 2440 MHz

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(μV)		dB(1/m)	dB(μV/m)		dB(μV/m)		dB		cm	deg
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
2223.94	H	N/A	48.6	-3.9	31.42	44.7	54.0	74.0	22.58	29.3	313.6	278.0
2352.08	H	N/A	52.7	-3.5	42.42	49.2	54.0	74.0	11.58	24.8	130.8	310.0
2607.760	H	39.7	50.5	-2.6	37.1	47.9	54.0	74.0	16.9	26.1	100.0	295.0
2824.07	H	N/A	47.1	-2.6	31.76	44.5	54.0	74.0	22.23	29.5	124.3	189.0
4960.005	V	N/A	48.4	2.9	44.26	51.3	54.0	74.0	9.74	22.7	100.0	61.0
7439.875	V	N/A	47.1	7.1	44.22	54.2	54.0	74.0	9.78	19.8	379.5	117.0

Table RE10.4: Emission summary ANT 2480 MHz

The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

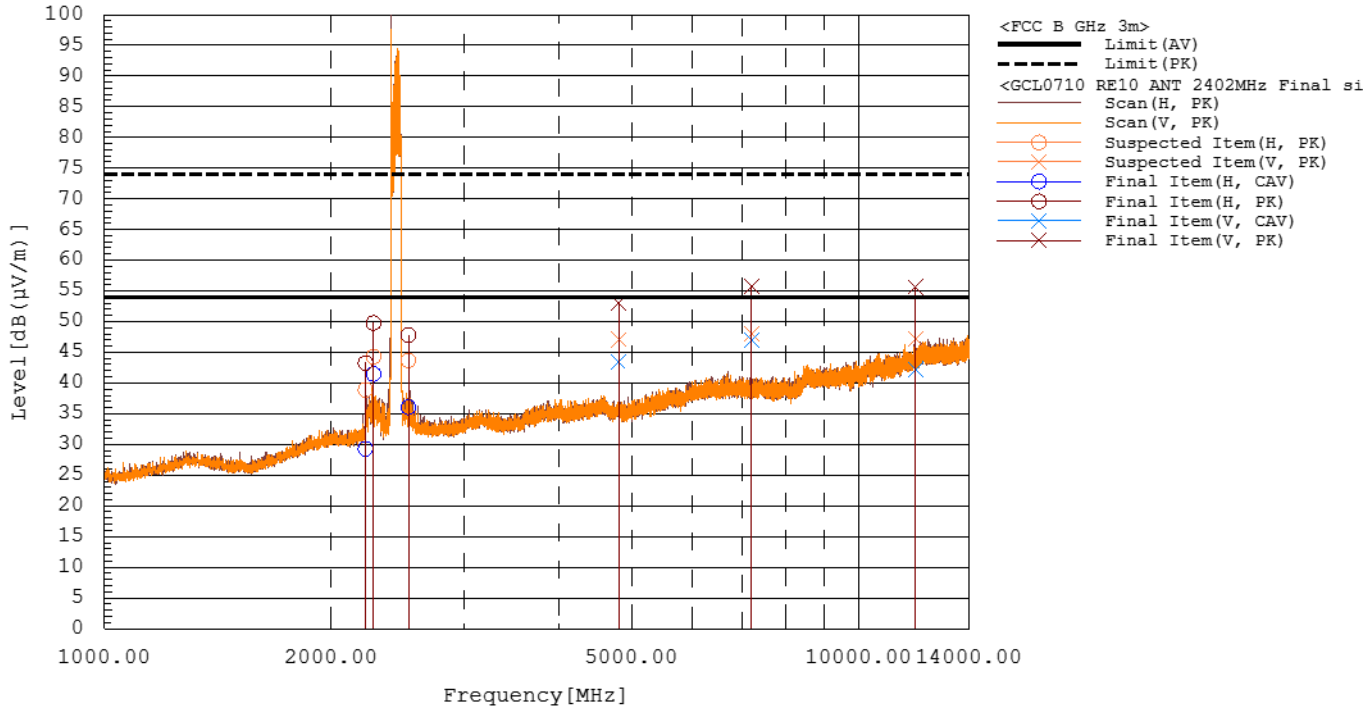


Figure RE10.1: Spectral data ANT 2402 MHz

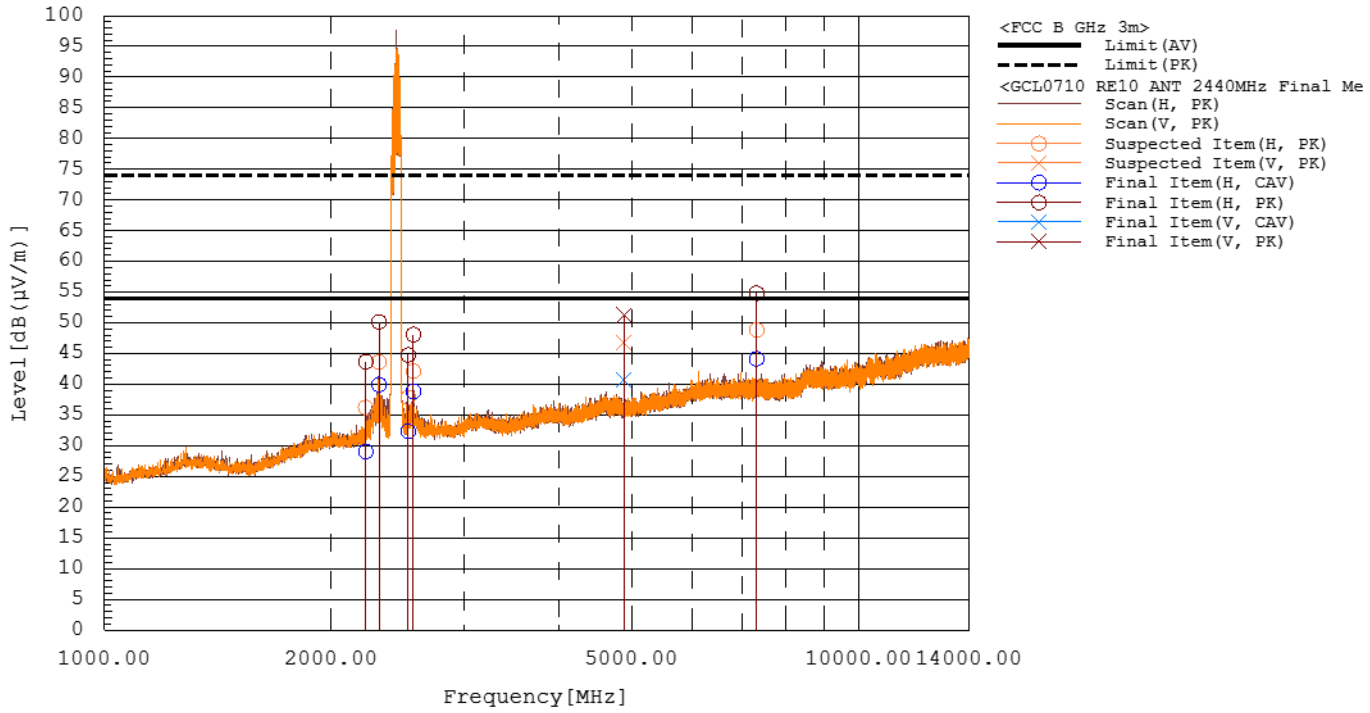


Figure RE10.2: Spectral data ANT 2440 MHz

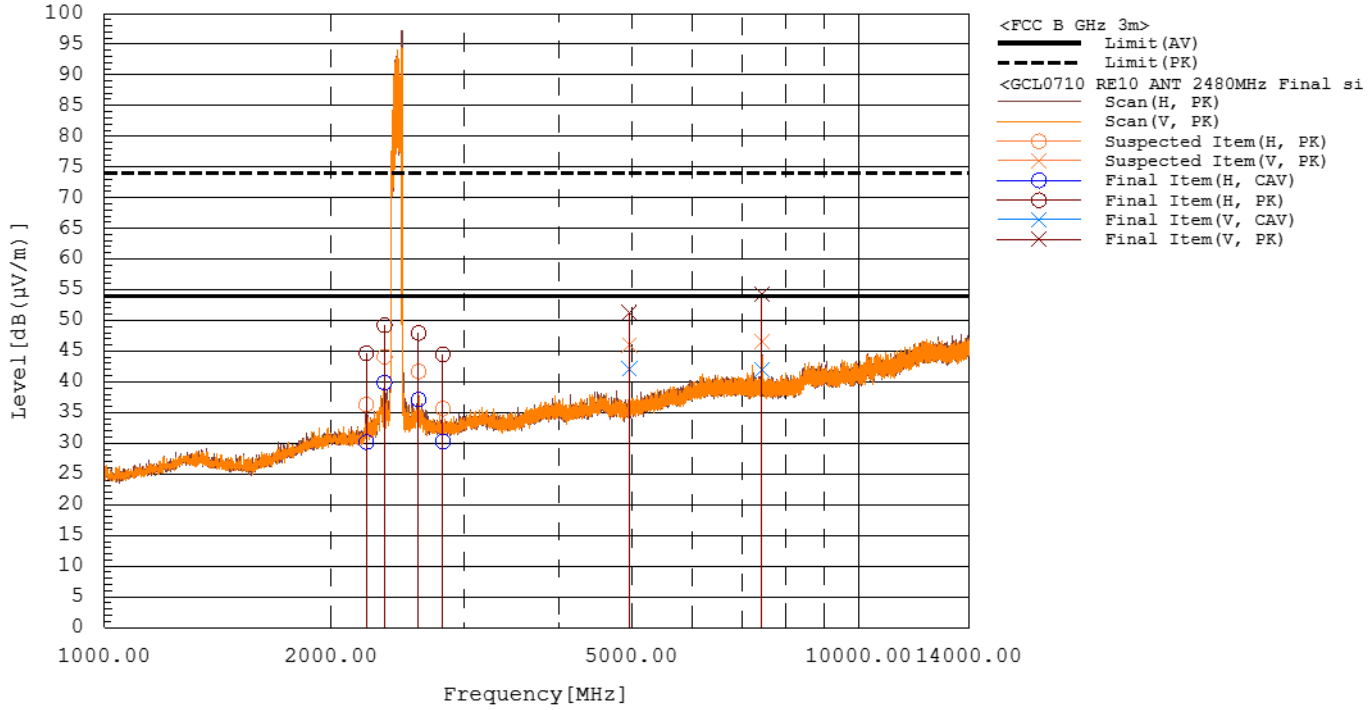


Figure RE10.3: Spectral data ANT 2480 MHz

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

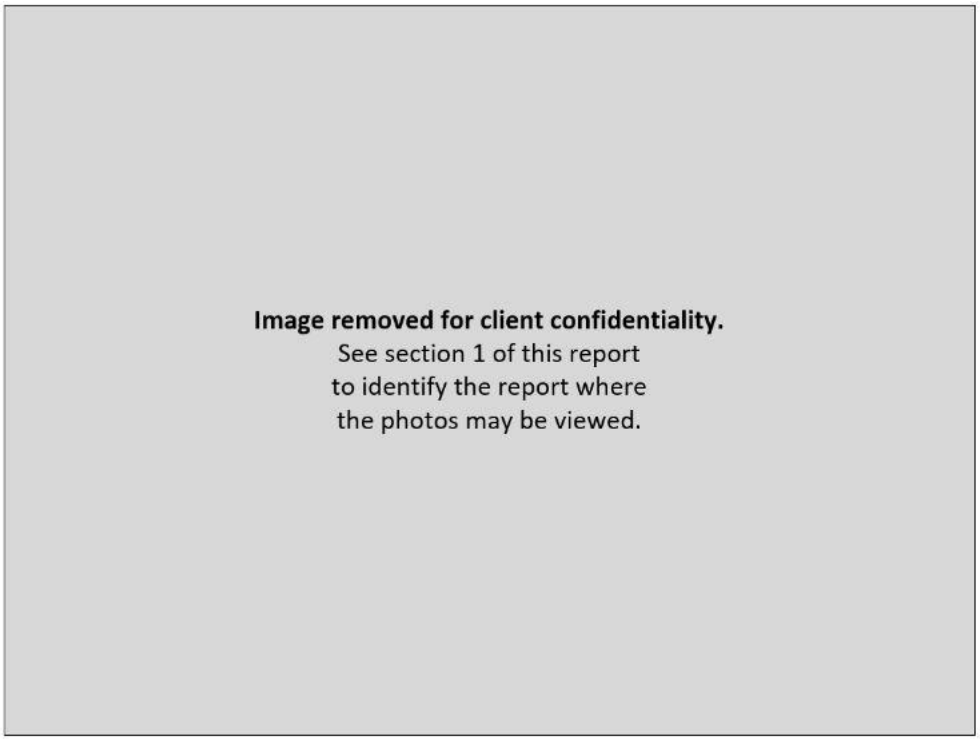


Figure RE10.4: EUT test setup, first view

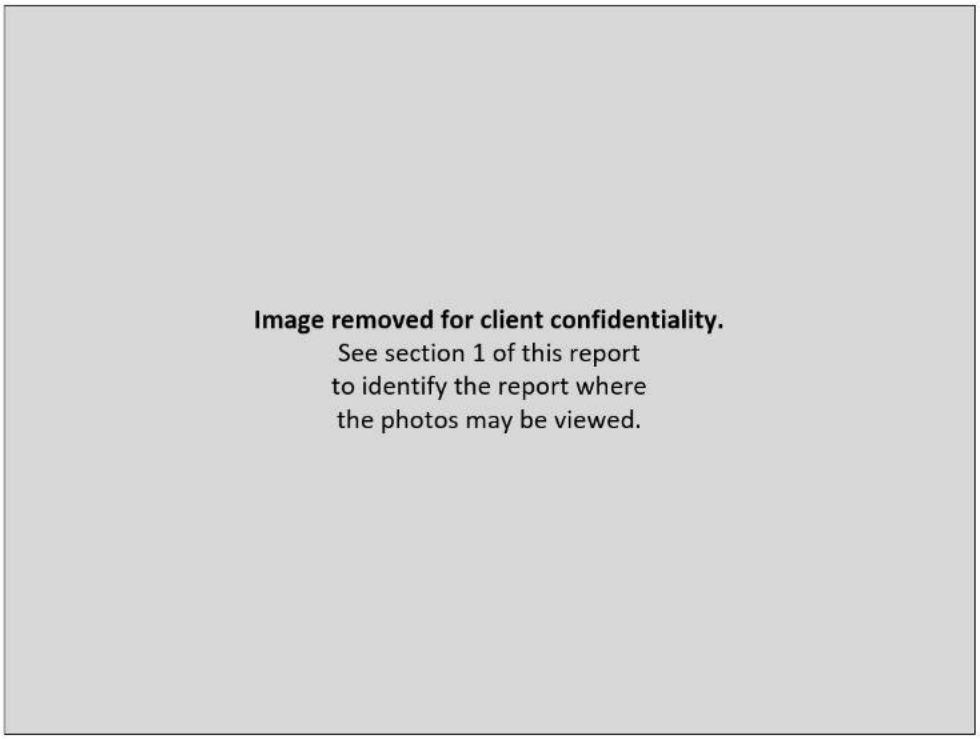


Figure RE10.5: EUT test setup, second view

This line is the end of the test record.

Test Record
Radiated Emission Test RE10a
Project GCL0710

Test Date(s)	28 Mar 2025
Test Personnel	Vladimir Tolstik supervised by Jim Solum
Product Model	GCL0710
Serial Number tested	3503267181
Operating Mode	M5 (AntTX)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Frequency Range:	2402 MHz, 2440 MHz, 2480 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this record:	28 Mar 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026

Table RE10a.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, RE Signal Maximization Tool v2024Jul31.xlsx

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

At azimuth angle 0° the ‘front’ reference mark of the turntable is pointed Southward. At 90° the reference mark points West. At -90° it points East. At -7° the turntable reference mark is pointed directly at the antenna mast for tests that involve changes in antenna elevation. At 0° the turntable reference mark is pointed directly at the loop

antenna location. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The test limit is the FCC Part 15.249 limit for a fundamental emission in the 2.4 GHz band: 50 mV/m or 94 dBuV/m for an Average detector, and 20 dB higher for a Peak detector.

The test sample was transmitting with a 96.3% duty cycle during this test. The duty cycle was measured using a fast diode detector RF power sensor and calculated according to ANSI C63.10. The client states that the maximum duty cycle for the ANT protocol is 14%. The CISPR Average detector has a square law response for signal pulses with these ANT timing parameters. In the data tables below, the Average detector values for the carrier frequencies have been adjusted downward by 16.75 dB, which comes from 20 * log (14% / 96.3%). The Peak detector values are not reduced for duty cycle, nor were the other emissions adjusted for duty cycle.

Frequency	Avg Limit	Pk Limit	Avg level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2402	94	114	79.794	97.599	14.206	16.401	120	1074	Horz
2440	94	114	78.741	96.938	15.259	17.062	120	1074	Horz
2480	94	114	77.893	95.835	16.107	18.165	120	1074	Horz

Table RE10a.2: Emission summary

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

Figure RE10a.1: EUT test setup, first view

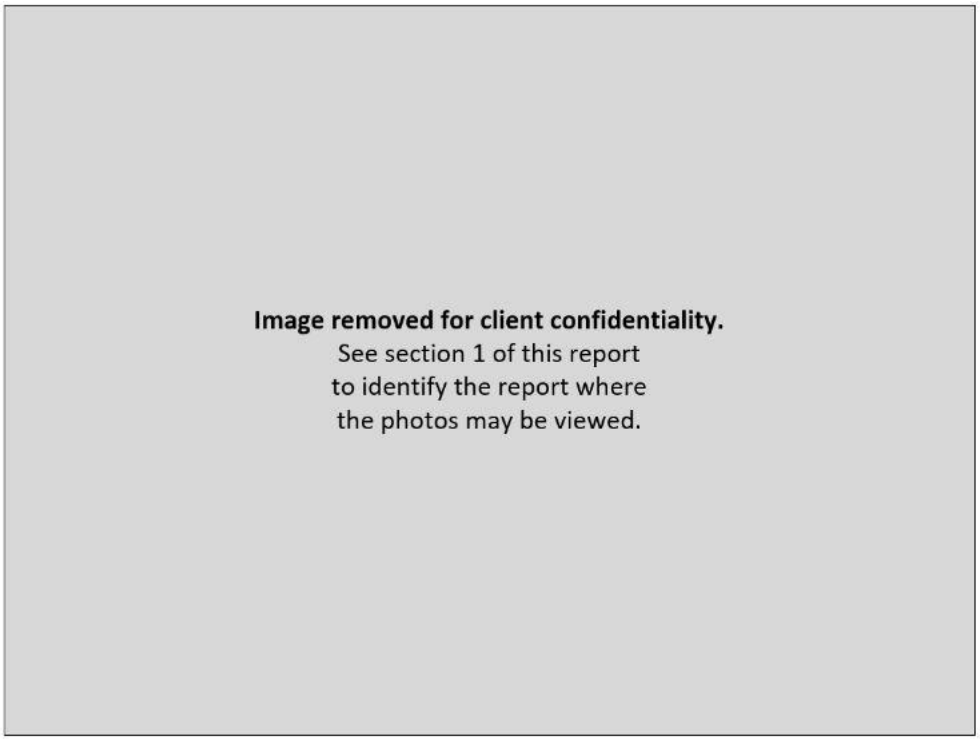


Figure RE10a.2: EUT test setup, second view

This line is the end of the test record.

Test Record
Radiated Emission Test RE16
Project GCL0710

Test Date(s)	14 Jan 2025
Test Personnel	David Kerr
Product Model	A04954
Serial Number tested	3503267193
Operating Mode	M5 (AntTx) (2402 MHz, 2440 MHz, 2480 MHz)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15.249; RSS-210; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).
Frequency Range:	14 GHz to 25 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	14 Jan 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025
Antenna, Horn, 10-40 GHz	ETS Lindgren	3116C	259186	29-Apr-2024	29-Apr-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013783	26-Jun-2024	26-Jun-2027
Preamplifier, 14 GHz to 40 GHz	Com-Power	PAM-840A	461364	Calibration	Not Required

Table RE16.1: Test Equipment Used

Software Used: Keysight PXE software A.33.03, EPX test software Version 2023.01.001

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

In the 14 GHz to 26.5 GHz frequency range, pre-scan spectral data was taken at 1 meter and extrapolated to a 3 meter distance. Final measurements were made at 3 meters.

At azimuth angle 180° the 'front' reference mark of the turntable is pointed Southward. At 270° the reference mark points West. At 90° it points East. At 173° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 14 GHz and 25 GHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

In this test, fewer than six emissions were observed within 20 dB of the limit. The relevant emissions were measured, including one or more noise floor signals as judged appropriate to the spectrum.

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(µV)		dB(1/m)	dB(µV/m)		dB(µV/m)		dB		cm	deg
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
20855.200	H	23.3	36.8	19.7	43.0	56.5	54.0	74.0	11.0	17.5	380.0	180.0

Table RE16.2: Emission summary (ANT 2402 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(µV)		dB(1/m)	dB(µV/m)		dB(µV/m)		dB		cm	deg
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
23521.600	H	22.1	36.0	20.6	42.7	56.6	54.0	74.0	11.3	17.4	285.7	345.0

Table RE16.3: Emission summary (ANT 2440 MHz)

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle
MHz		dB(µV)		dB(1/m)	dB(µV/m)		dB(µV/m)		dB		cm	deg
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
23261.450	H	22.0	36.0	20.4	42.4	56.4	54.0	74.0	11.6	17.6	292.1	325.0

Table RE16.4: Emission summary (ANT 2480 MHz)

The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

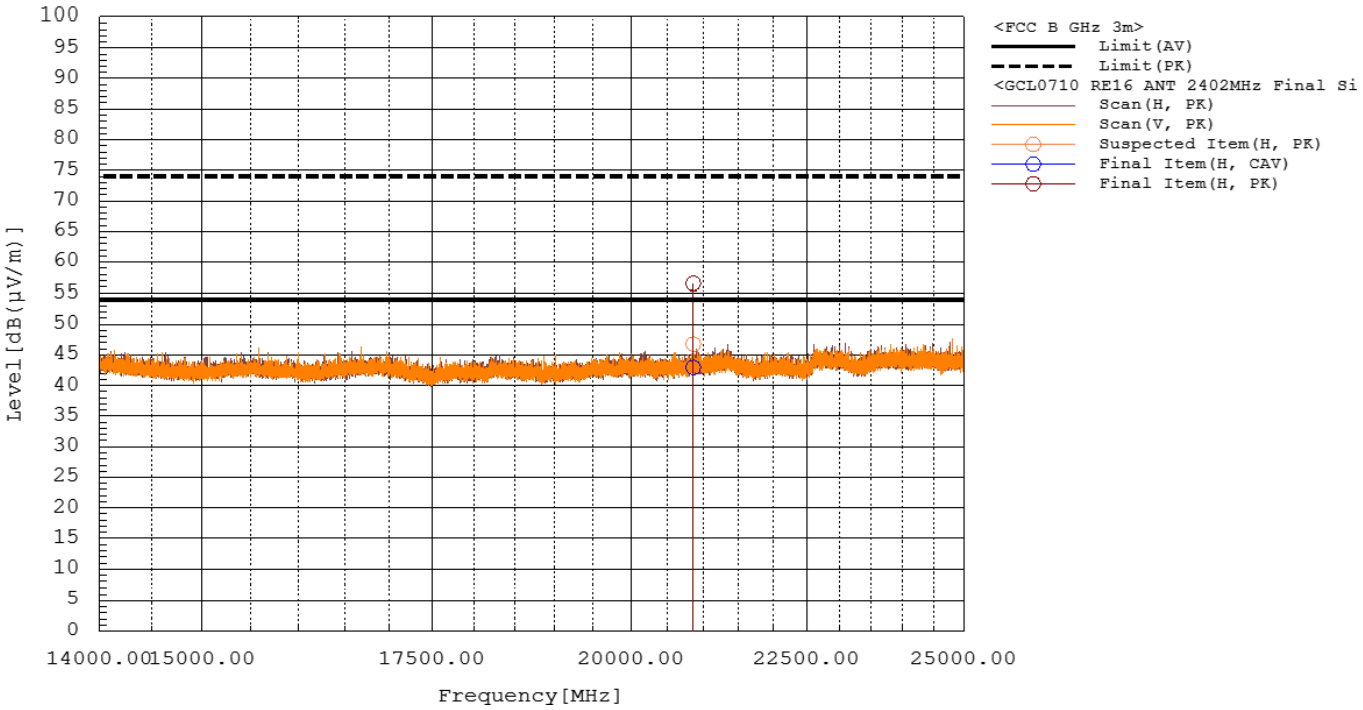


Figure RE16.1: Spectral data (ANT 2402 MHz)

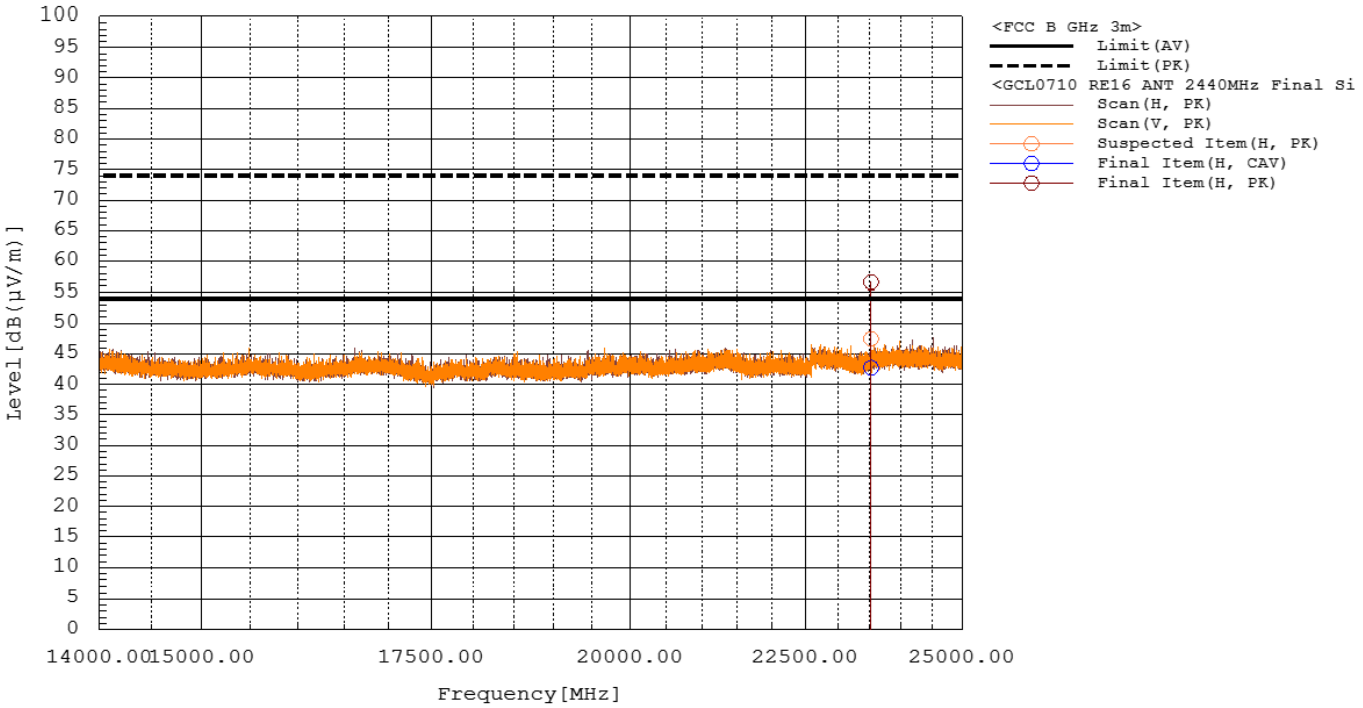


Figure RE16.2: Spectral data (ANT 2440 MHz)

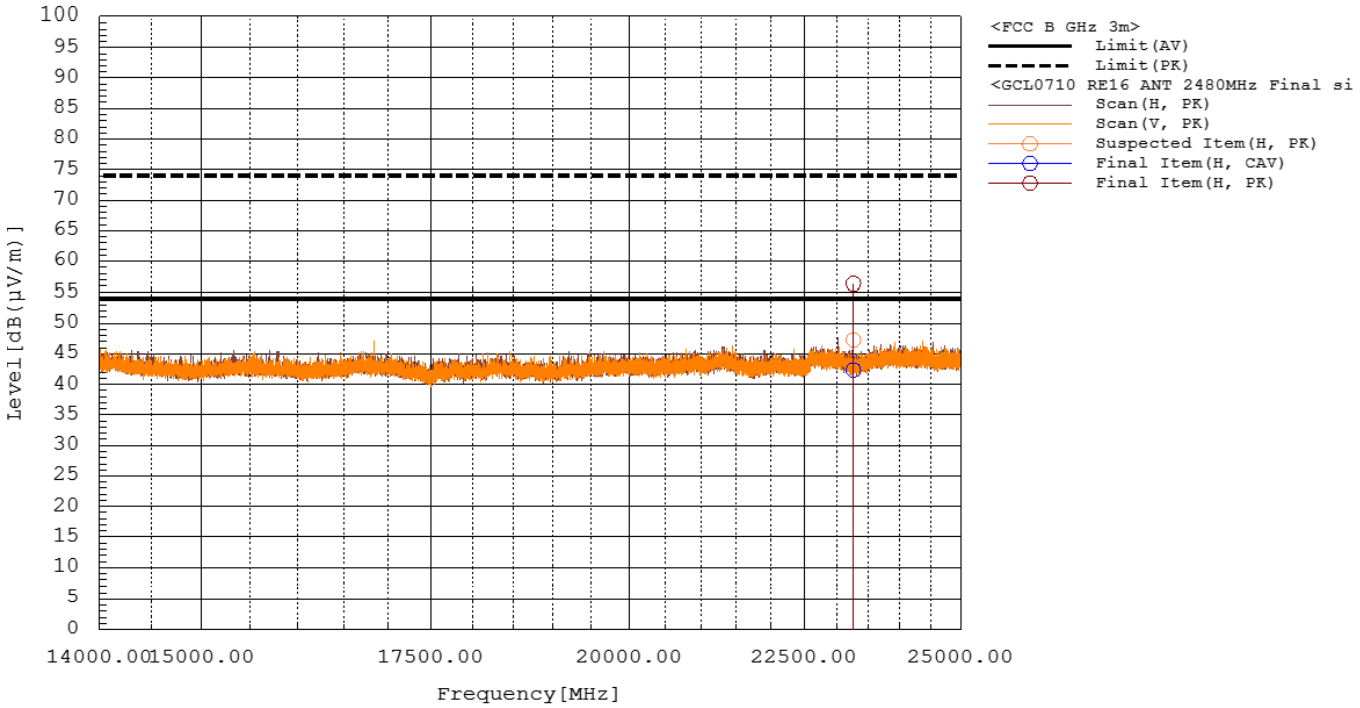


Figure RE16.3: Spectral data (ANT 2480 MHz)

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

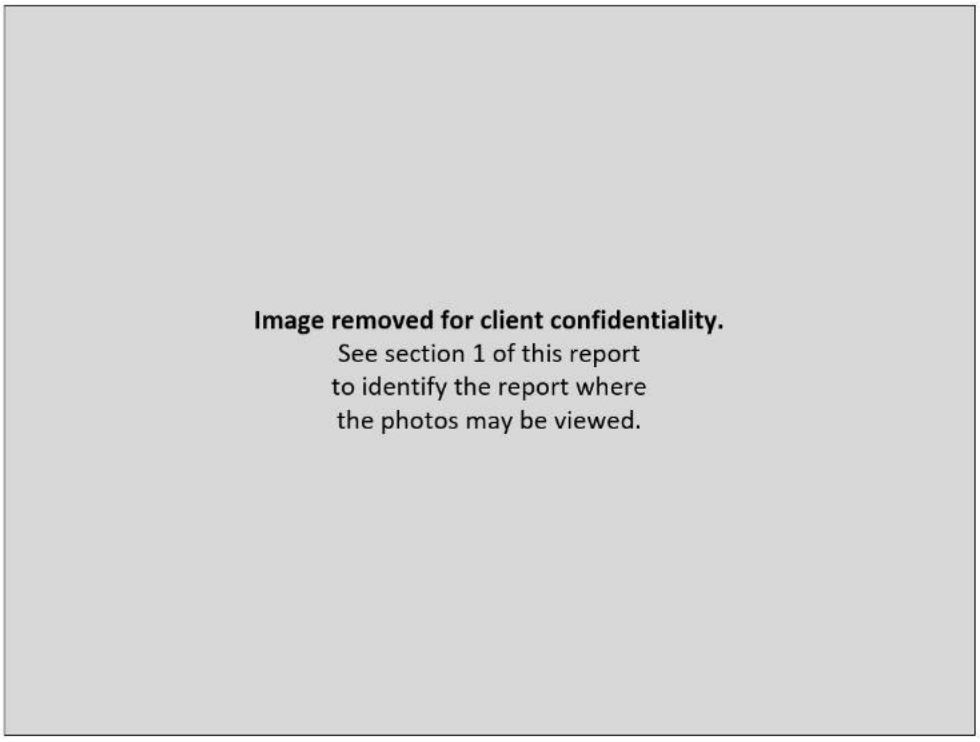


Figure RE16.4: EUT test setup, first view (EUT Y Orientation)

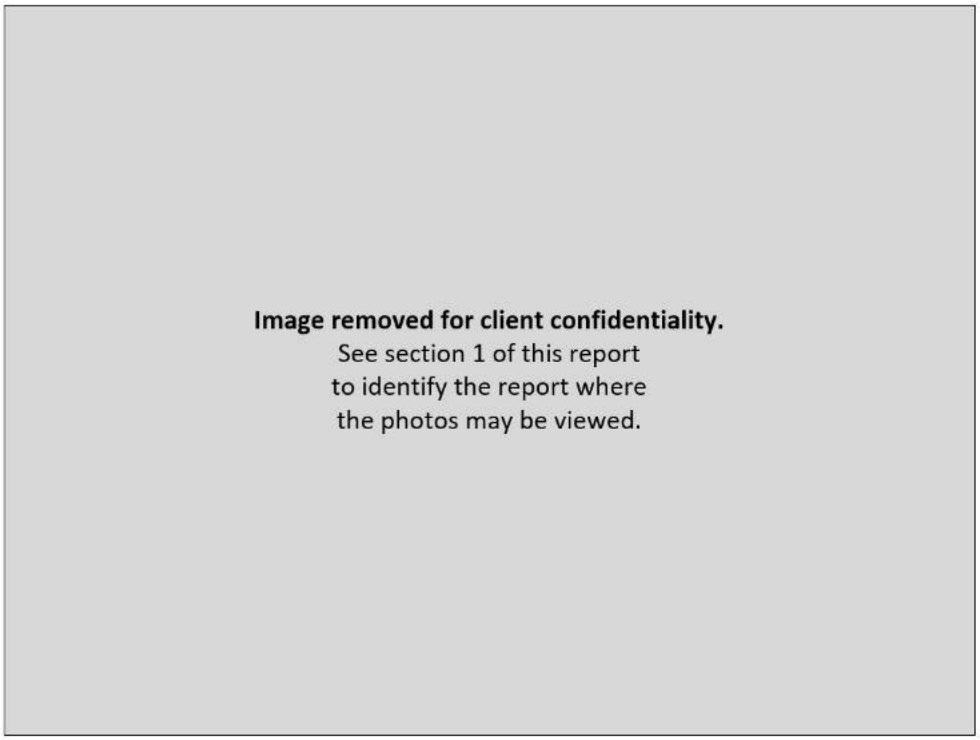


Figure RE16.5: EUT test setup, first view (EUT Y Orientation)

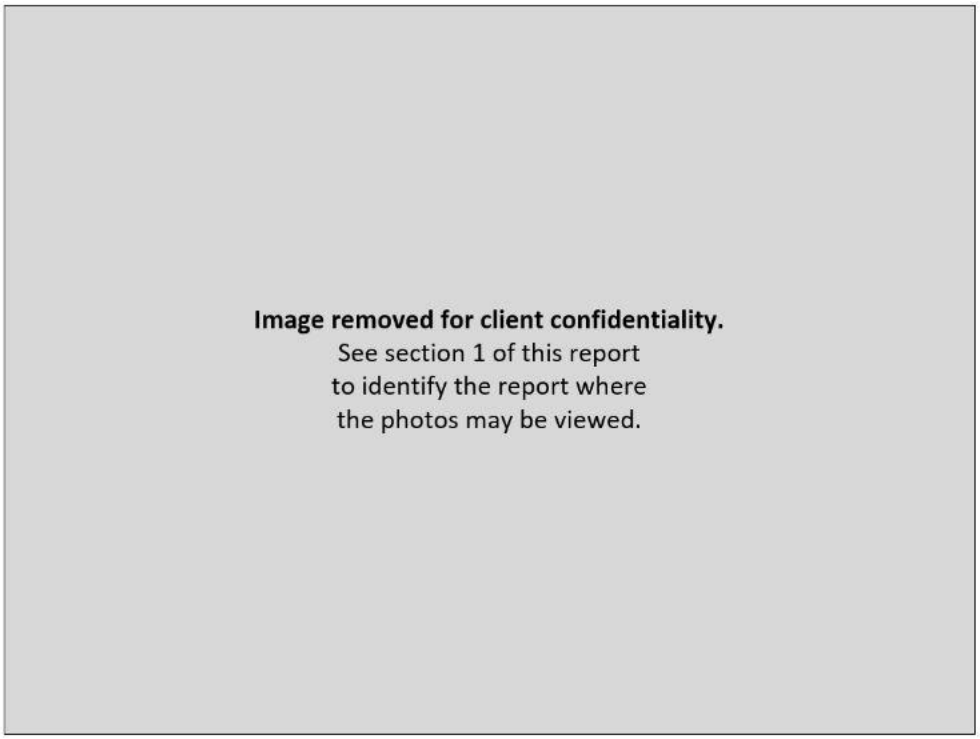


Figure RE16.6: EUT test setup, second view (EUT Y Orientation)

This line is the end of the test record.

Test Record
Radiated Emission Test RE19
Project GCL0710

Test Date(s)	21 Jan 2025
Test Personnel	David Kerr, Jim Solum
Product Model	A04954
Serial Number tested	3503267193
Operating Mode	M5 (AntTx)
Arrangement	A2 (Upwr)
Input Power	5 Vdc
Test Standards:	FCC Part 15, RSS-GEN, ANSI C63.10, RSS-210 (as noted in Section 6 of the report).
Frequency Range:	9 kHz to 30 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this record:	22 Jan 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Loop antenna, amplified	Schwarzbeck	FMZB 1519B	00174	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	25-Jan-2023	25-Jan-2026
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013784	26-Jun-2024	26-Jun-2027

Table RE19.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, RE 150k to 30M Signal Maximization Tool V1 2021Mar17.xlsx, RE FccCanada 9k30mAnalysis2.xlsx

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, and in the three loop antenna polarizations. The loop antenna was positioned at a 1.5 m height. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the loop was set to the worst case orientation for that frequency and the turntable angle was explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

At azimuth angle 0° the ‘front’ reference mark of the turntable is pointed Southward. At 90° the reference mark points West. At -90° it points East. At -7° the turntable reference mark is pointed directly at the antenna mast for tests that involve changes in antenna elevation. At 0° the turntable reference mark is pointed directly at the loop

antenna location. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 9 kHz and 30 MHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

Test limits for electric fields above 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m with a factor of 20 dB per decade of distance. Test limits for electric or magnetic fields below 30 MHz that are stated for a distance other than 3 m are adjusted to 3 m by one of two methods. For ETSI testing, the extrapolation uses the curve of ETSI EN 300 330 Annex H figure H.2. For FCC and ISED testing, the conservative method of ANSI C63.10 clause 6.4.4.1 is applied: 40 dB per decade for distances within the boundary (wavelength / 2 Pi), 20 dB per decade beyond that distance boundary.

In this test, fewer than six emissions were observed within 20 dB of the limit. The relevant emissions were measured, including one or more noise floor signals as judged appropriate to the spectrum.

Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
0.0483	36.47	Avg	113.93	77.46	45.18	133.93	88.75	Y	-147

Table RE19.2: Emission summary ANT 2402 MHz

Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
0.0483	33.51	Avg	113.92	80.41	43.70	133.92	90.22	X	-17

Table RE19.3: Emission summary ANT 2440 MHz

Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
0.0484	32.72	Avg	113.91	81.19	42.34	133.91	91.57	Z	53

Table RE19.4: Emission summary ANT 2480 MHz

The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

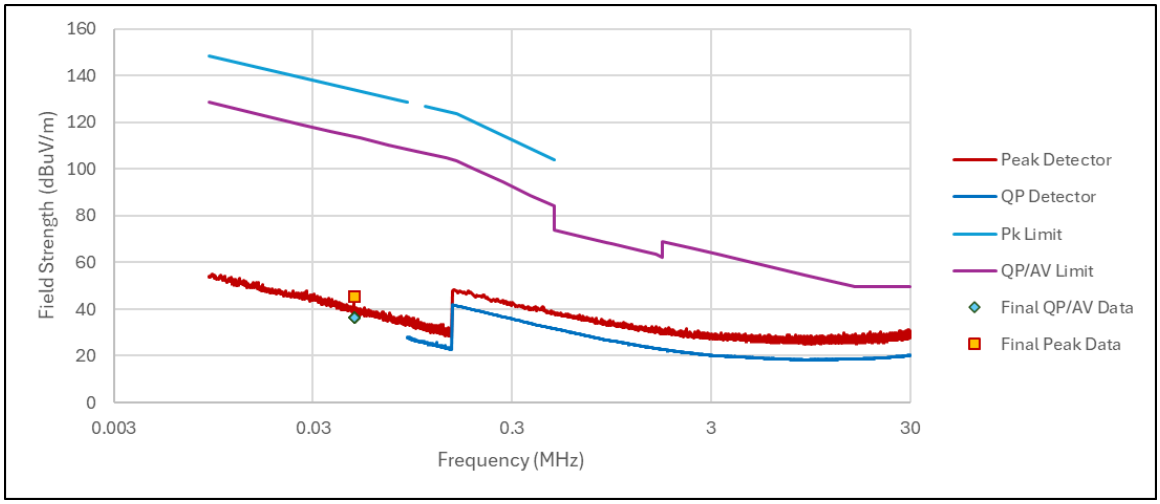


Figure RE19.1: Spectral data ANT 2402 MHz

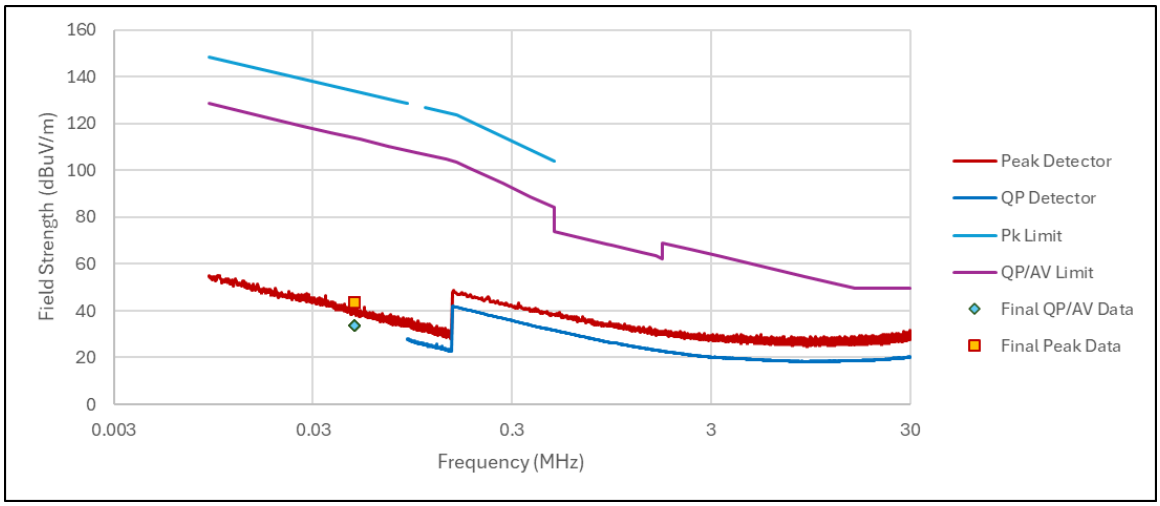


Figure RE19.2: Spectral data ANT 2440 MHz

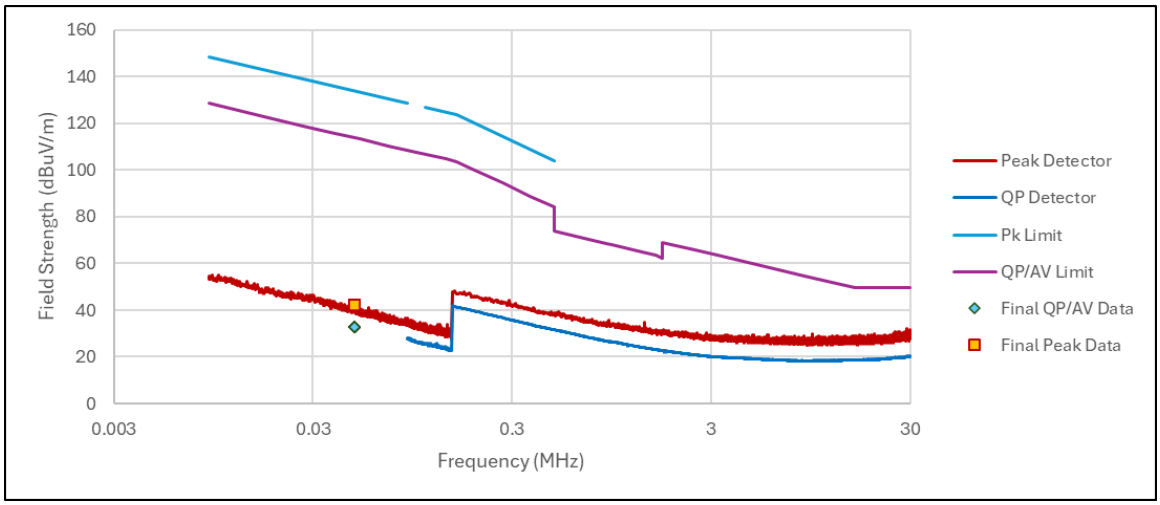


Figure RE19.3: Spectral data ANT 2480 MHz

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

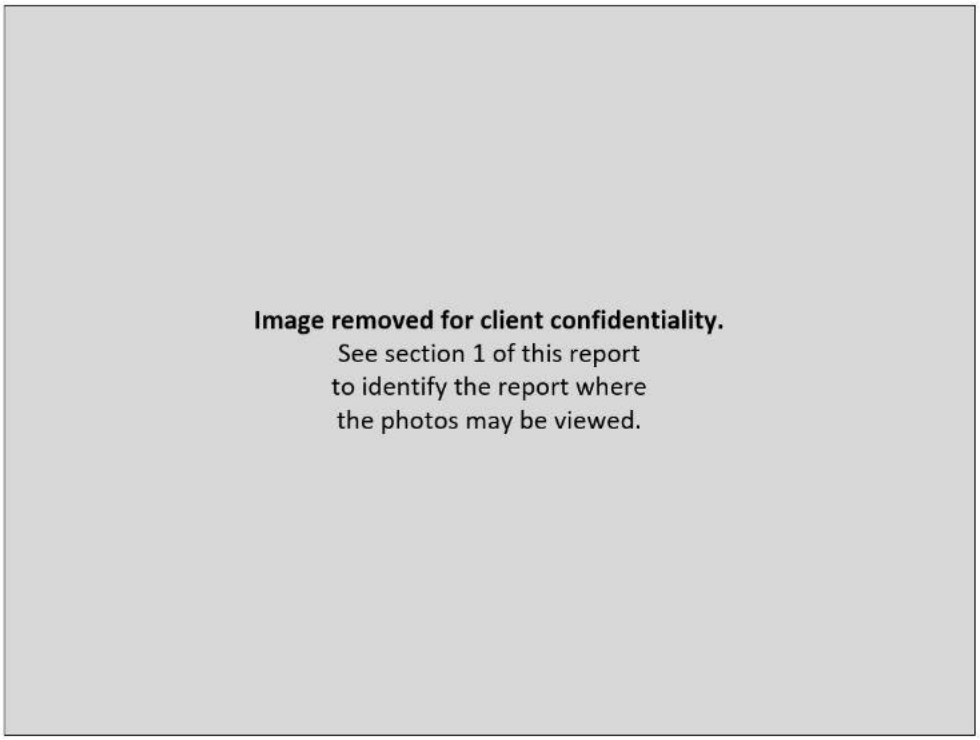


Figure RE19.2: EUT test setup, first view

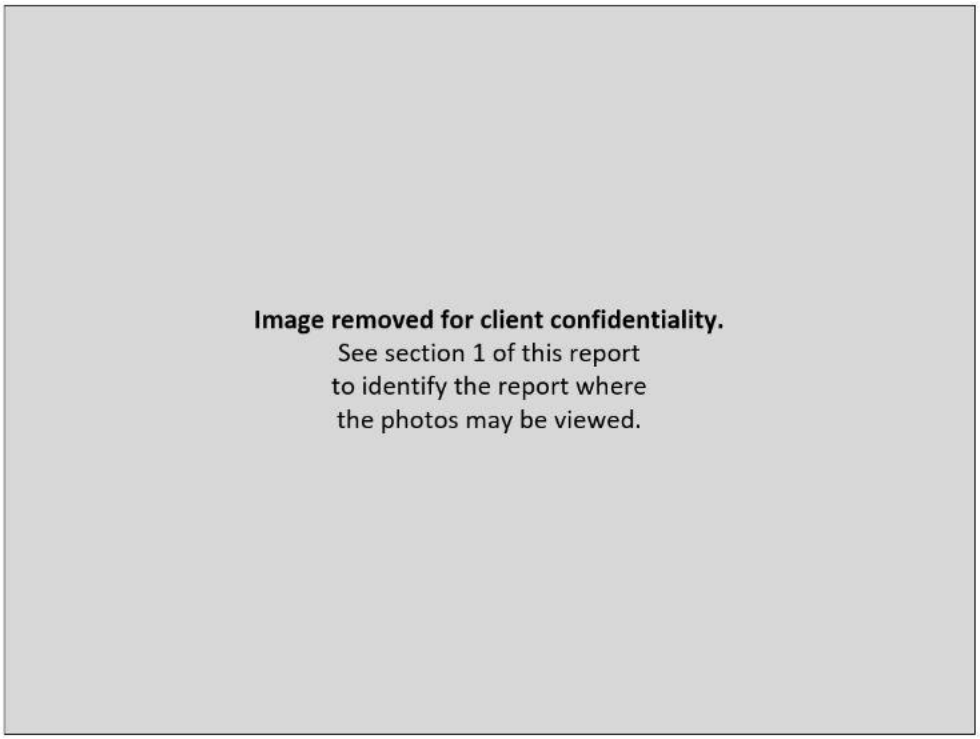


Figure RE19.3: EUT test setup, second view (Antenna X position)

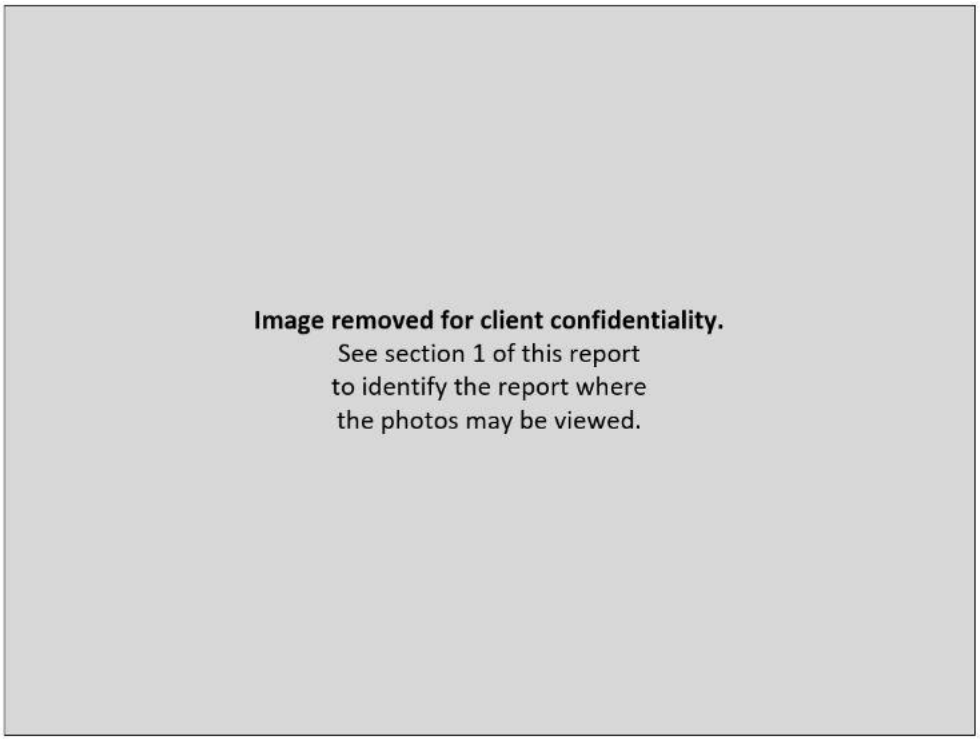


Figure RE19.4: EUT test setup, second view (Antenna Y position)

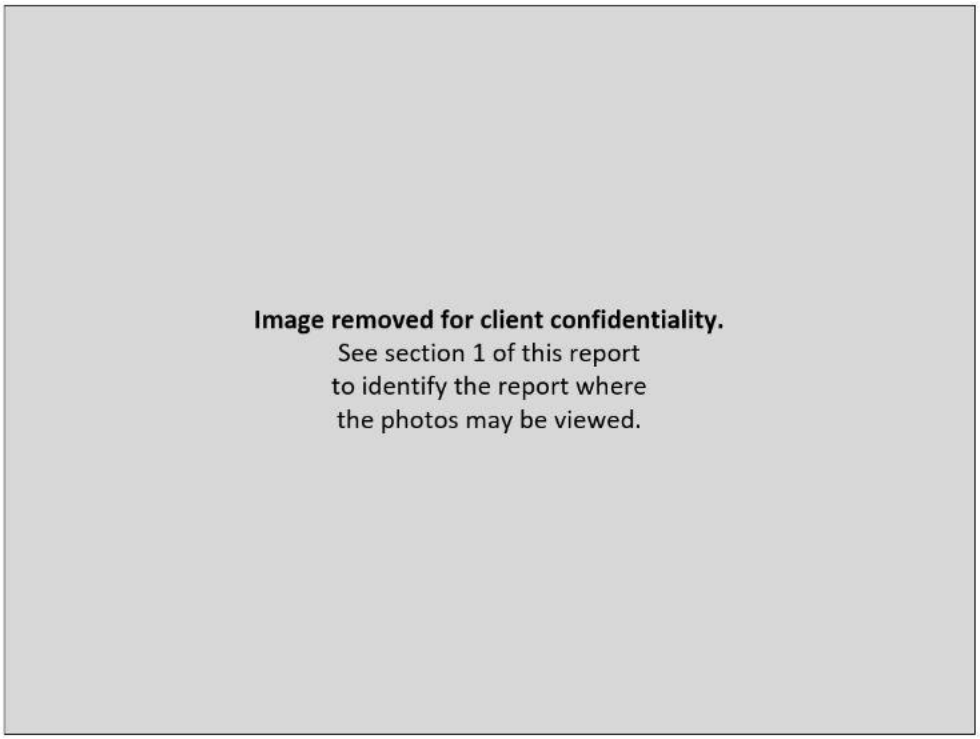


Figure RE19.5: EUT test setup, second view (Antenna Z position)

This line is the end of the test record.

Test Record
Radiated Emission Test RE39
Project GCL0710

Test Date(s)	17 Jan 2025
Test Personnel	Vladimir Tolstik supervised by Jim Solum
Product Model	A04954
Serial Number tested	3503267193
Operating Mode	M5 (AntTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15; RSS-210; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).
Frequency Range:	30 MHz to 1000 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Vladimir Tolstik
Date of this record:	17 Jan 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Biconilog, 30M-6 GHz	ETS Lindgren	3142E	00233201	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	25-Jan-2023	25-Jan-2026

Table RE39.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, EPX test software Version 2023.01.001

Test Data

For test standards that require reorienting the test sample, preliminary scans were taken in those alternate orientations to find the orientation that produced that largest field at the receive antenna. With intentional radiators, that highest field is usually found at the carrier frequency. The alternate orientations are typically described as X, Y, and Z and explained with a photograph. Subsequent testing was done using on the orientation identified in this way.

The radiated emission test process continued with a preliminary scan at multiple turntable angles, antenna heights, and both antenna polarizations. Where the test standard requires cable manipulation, this was done at one of more likely worst case frequencies selected by the test personnel while observing the receiver display. At each of the frequencies selected for final measurements, the turntable angle, antenna height, and antenna polarization were explored to find the worst-case settings. Final field strength measurements were taken in that set of positions. Full maximization was not performed at frequencies that are noise floor measurements included per the test standard requirements.

At azimuth angle 180° the ‘front’ reference mark of the turntable is pointed Southward. At 270° the reference mark points West. At 90° it points East. At 173° the turntable reference mark is pointed directly at the antenna. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 30 MHz and 1 GHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

In this test, fewer than six emissions were observed within 20 dB of the limit. The relevant emissions were measured, including one or more noise floor signals as judged appropriate to the spectrum.

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB(μV)	dB(1/m)	dB(μV/m)	dB(μV/m)	dB	cm	deg
		QP		QP	QP	QP		
148.500	V	5.4	16.4	21.8	43.5	21.7	112.1	7.0
144.540	H	7.1	15.7	22.8	43.5	20.7	139.2	269.0
152.670	H	4.3	17.6	21.9	43.5	21.6	199.6	82.0

Table RE39.2: Emission summary for ANT at low channel (2402 MHz)

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB(μV)	dB(1/m)	dB(μV/m)	dB(μV/m)	dB	cm	deg
		QP		QP	QP	QP		
148.500	V	6.5	16.4	22.9	43.5	20.6	110.2	7.0
45.450	V	15.9	14.6	30.5	40.0	9.5	100.0	166.0

Table RE39.3: Emission summary for ANT at mid channel (2440 MHz)

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB(μV)	dB(1/m)	dB(μV/m)	dB(μV/m)	dB	cm	deg
		QP		QP	QP	QP		
148.500	V	5.0	16.4	21.4	43.5	22.1	119.9	5.0
45.570	V	15.4	14.6	30.0	40.0	10.0	100.0	156.0

Table RE39.4: Emission summary for ANT at high channel (2480 MHz)

The graph below shows the background spectrum observed during pre-scan, as well as the final data points from the table above.

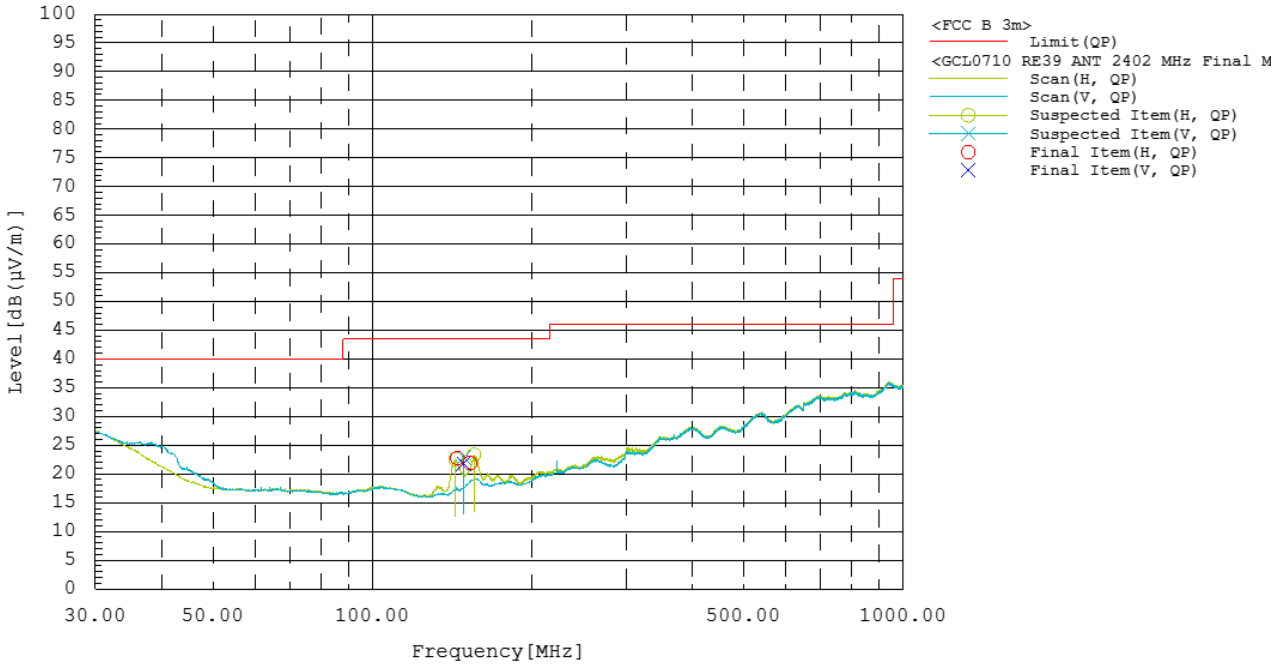


Figure RE39.1: Spectral data for ANT at low channel (2402 MHz)

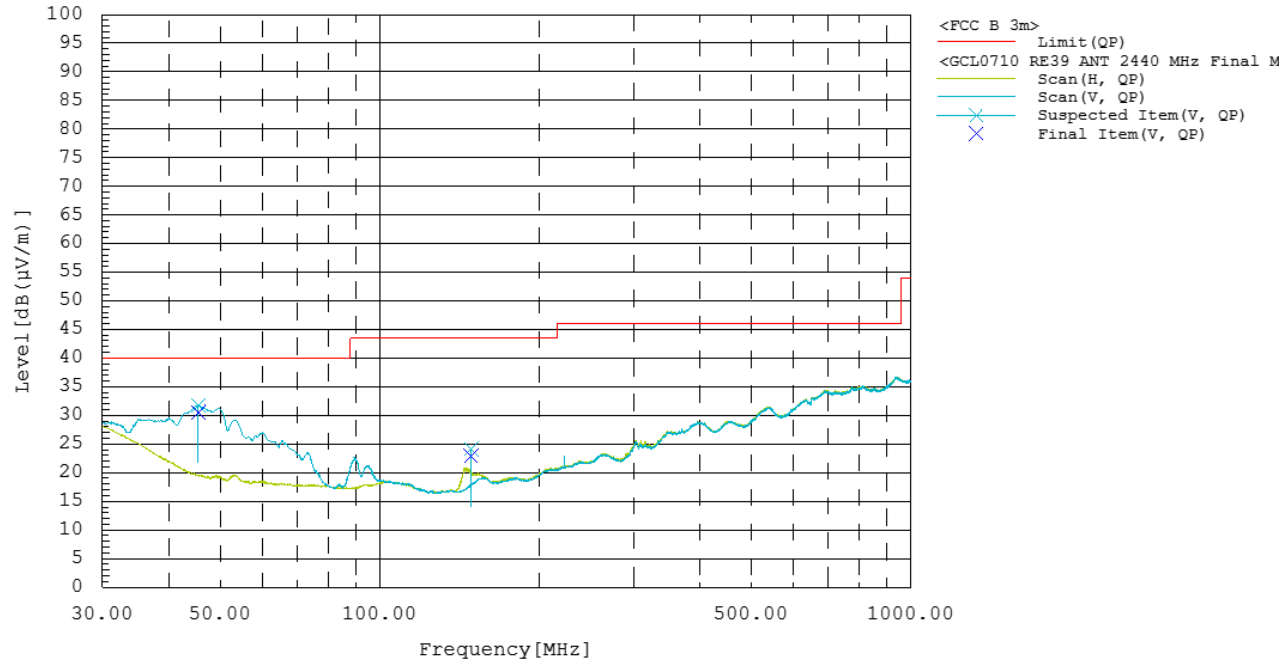


Figure RE39.2: Spectral data for ANT at mid channel (2440 MHz)

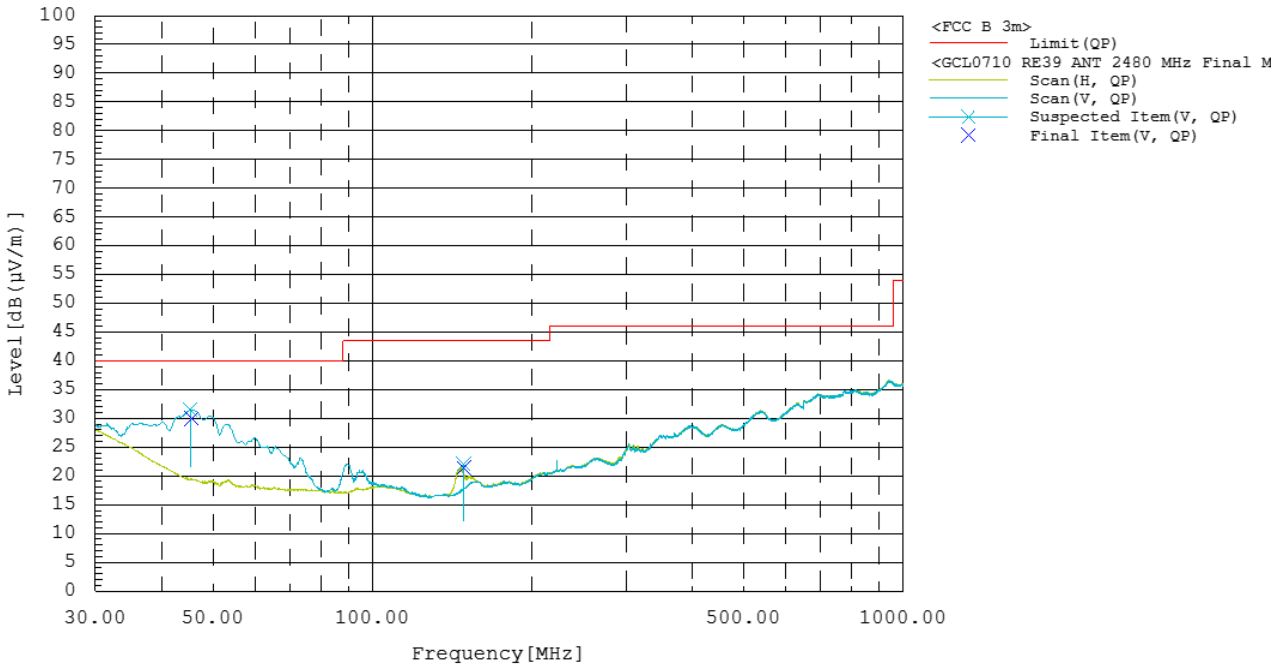


Figure RE39.3: Spectral data for ANT at high channel (2480 MHz)

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

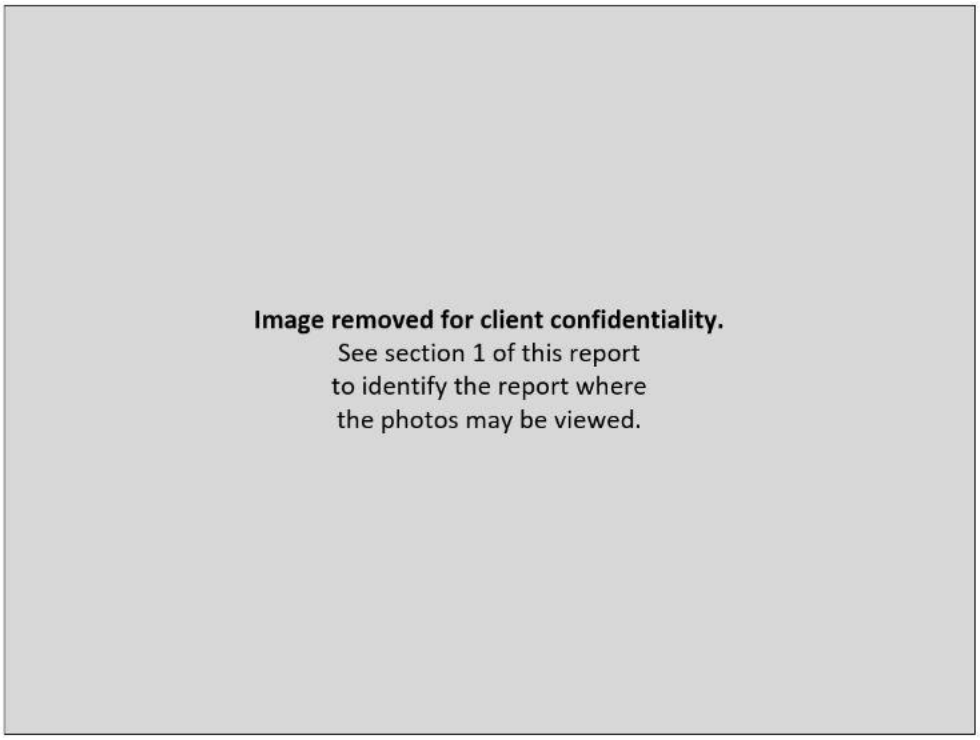


Figure RE39.4: EUT test setup, first view

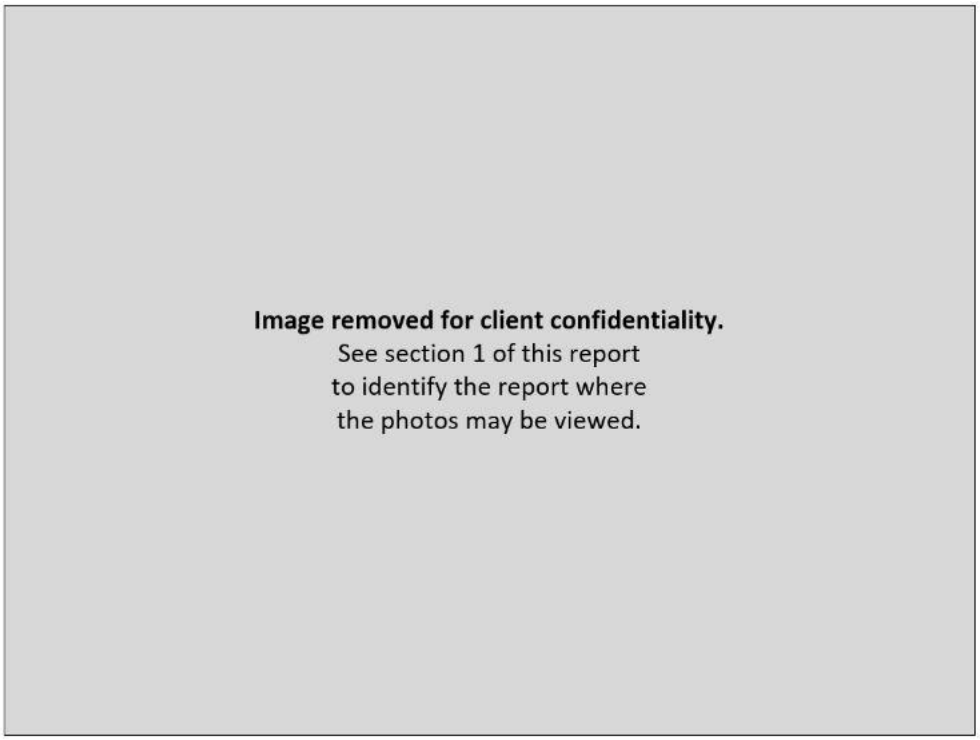


Figure RE39.5: EUT test setup, second view

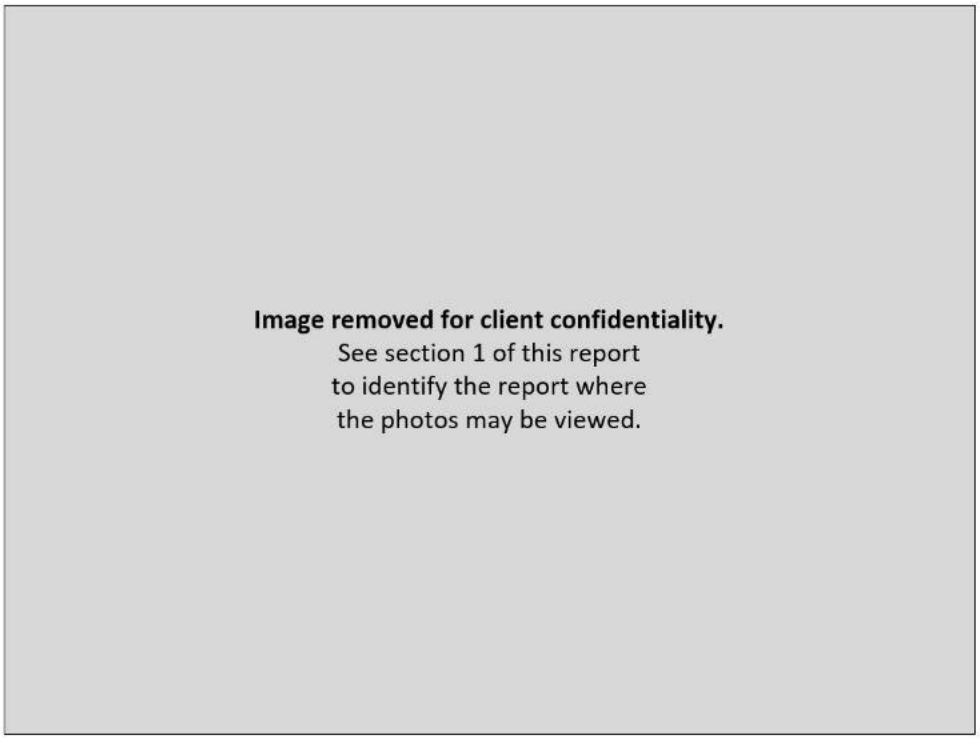


Figure RE39.6: EUT test setup, third view

This line is the end of the test record.

Test Record
Duty Cycle Effects SP01

Test Date	19 Jan 2023
Test Personnel	David Arnett
Product Model	A04600
Serial Number tested	3431708548
Operating Mode	Special: ANT Transmit per the sample studied
Arrangement	Special: USB Powered per the sample studied
Input Power	5V dc

Test record created by: **David Arnett**
Date of this test record: **27 Jan 2023**
Original record, Version A, created 27 Jan 2023.
Version B created 29 May 2024 for use in general test projects.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
RF Power Sensor	Rohde&Schwarz	NRP8S	109927	13-Jul-2022	15-Jul-2023
PXE 44GHz	Keysight	N9048B	MY59500016	2-Feb-2022	2-Feb-2023

Table SP01.1: Test equipment used

Test Software used: Keysight MXE System Code rev. A.33.03, R&S Power Viewer V11.3

Background
The question this test record addresses is how the radiated emission results above 1 GHz are affected by a change in transmission duty cycle. This is a general question related to the dynamics of the ANT transmission protocol and the CISPR detectors, not a specific product. As such this test record is relevant to many Garmin products other than the specific model used in the study.

ANSI C63.10 at various locations (such as 11.9.2.2.5.j) indicates that adjustment of measured average values using the measured duty cycle (D) is to be based on a linear law: 10 log(1/D). However, CISPR 16-1-1:2019 shows that a CISPR Average detector has square law pulse repetition response: 20 log(1/D). See, for example, figure 9 of CISPR 16-1-1, showing that a change in pulse repetition by a factor of 10 results in a 20 dB change in the instrument reading. The same figure shows that the reading of a CISPR peak detector should not be affected by the pulse repetition rate. This assumes the pulses are of sufficient duration to be detected.

The test application software in the test sample has two relevant modes for ANT radio transmissions. One is the regular ANT transmit test mode which produces near-continuous data. This is the operating mode used during radiated emission tests. The other is Packet mode which produces packets of a fixed length at a specified rate. That rate is expressed in units of packets-per-Hertz. These modes can be used to understand how the ANT duty cycle affects the Average Detector emission results, and whether it follows a linear or square law response.

Test Data
The client for the January 2023 project reported that the ANT radio protocol has a maximum duty cycle of 13.8%, which is much lower than the duty cycle used during radiated emission testing. The test modes discussed above allow a range of duty cycles to be evaluated above and below this protocol-limited value.

The duty cycles available in the various modes were first evaluated using the NRP8S, which is a fast diode RF power meter. This sample was one of the modified units providing a coaxial output from the transmitter rather than using the internal antenna. The packet length in Packet mode was measured at 156 usec, and duty cycles were measured for each available setting. The transmit power level from this sample was then evaluated in the same modes in a conducted manner by feeding the transmitter output through a coaxial cable to the input of the PXE Receiver. Data was recorded at the carrier frequency using peak and average detectors as they are usually set up

in a CISPR-compliant receiver during radiated emission tests above 1 GHz. All amplitude data in dBm units were then normalized to the Peak detector level as measured at the maximum duty cycle.

The resulting duty cycle and normalized amplitude data are presented in Table SP01.2.

Packet Rate (Hz)	Duty Cycle (%)	Peak (dB)	Avg (db)
Ant Tx Mode	96.300%	0	-1.2
255	3.978%	0	-27.98
128	1.997%	0	-33.89
64	0.998%	0.1	-39.69
32	0.499%	0	-45.4
16	0.250%	0.1	-50.62
8	0.125%	0	-55.42
4	0.062%	0.1	-58.95
2	0.031%	0	-61.33
1	0.016%	0.1	-61.99

Table SP01.2: Duty Cycle and Normalized Amplitude for ANT transmitter

Figure SP01.1 below plots this data along with the curves for the linear law response in ANSI C63.10 (green) and the square law response for a CISPR 16-1-1 Average detector (yellow). The average data is observed to follow the square law response for duty cycles above 0.5%, and the Peak detector data is unaffected by the duty cycle.

The orange triangles in the plot show the factors that were used in January 2023 for converting measured data in ANT Transmit test mode to the levels one would find when ANT has the maximum duty cycle permitted by the radio protocol. For comparison of data to a peak detector limit, that adjustment was 0 dB. For comparison of data to an average detector limit, that change was 20 * log(13.8% / 96.3%) or -16.83 dB.

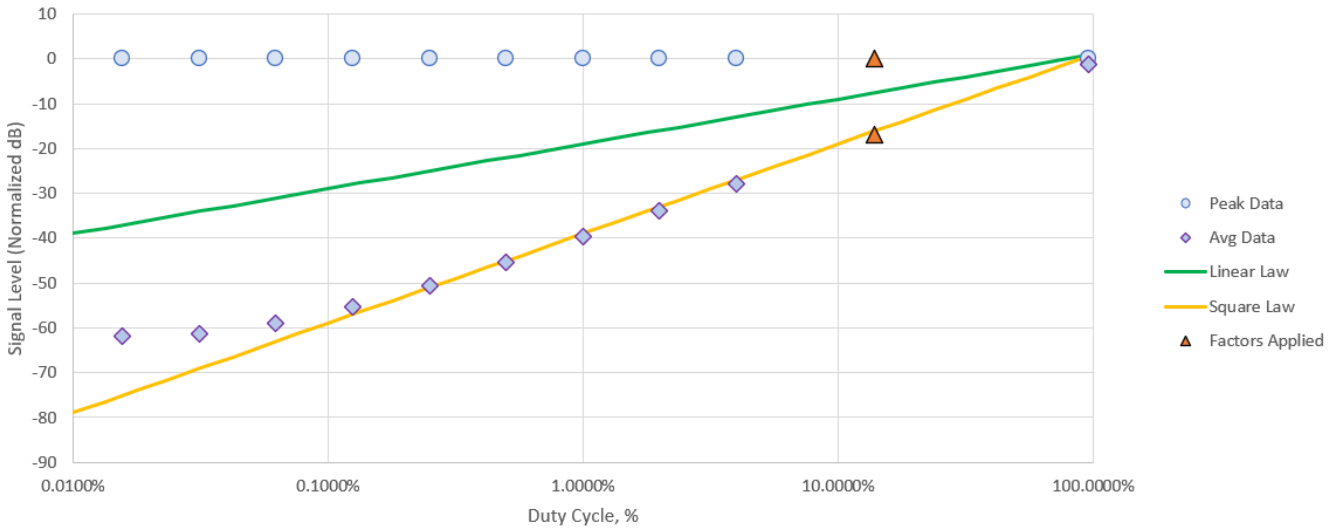


Figure SP01.1: Normalized Amplitude for ANT transmitter and linear or square law references

The Garmin Compliance lab uses this general result for projects involving ANT transmitter field measurements. The actual duty cycle, d_r, is measured for the test mode that will be used during radiated emission testing. The client reports the maximum duty cycle that the unit can produce in actual usage, d_u. Radiated emission data that has been measured using a CISPR Average detector can be reduced using $20*\log_{10}(d_u/d_r)$ before comparing against a limit. Radiated emission data measured using a Peak detector is not reduced but is reported as measured.

This line is the end of the test record.

Test Record
Transmitter Bandwidth Tests
Test IDs TR10 – TR11
Project GCL0710

Test Date(s)	08 Jan 2025
Test Personnel	Vladimir Tolstik supervised by Majid Farah
Product Model	A04954
Serial Number tested	3503267168
Operating Mode	M3 (BleTx), M5 (AntTx)
Arrangement	A4 (Udc)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 2.202, ANSI C63.10, TRC-43, RSS-GEN (as noted in Section 6 of the report).
Radio Protocol	Bluetooth Low Energy (BLE), ANT
Radio Band	2480 to 2483.5 MHz
Pass/Fail Judgment:	**Reported**
Test record created by:	Vladimir Tolstik
Date of this record:	09 Jan 2025

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025

Table TR10.1 Equipment Used

Software used: Keysight PXE software A.33.03

Background
There are regulatory requirements to present two additional types of bandwidth analyses: 99% Occupied Bandwidth and Necessary Bandwidth. There are no limits or functional requirements around these data, beyond a reporting requirement. The contents of this test record are for information, and do not affect compliance of the devices that are the subject of this report.

For BLE operating at 2 Mbps, the lowest operating frequency was 2404 MHz, and the highest operating frequency was 2478 MHz. For all other Bluetooth, BLE, and ANT radios reported here, the lowest operating frequency was 2402 MHz, and the highest operating frequency was 2480 MHz.

Test Setup

This block diagram shows the test equipment setup.

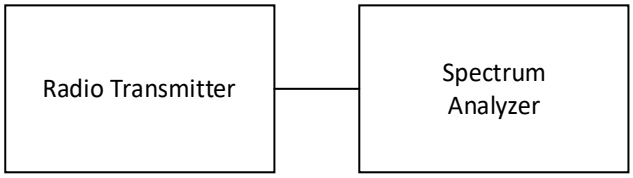


Figure TR10.1: Test setup

Occupied Bandwidth, 99% Test Method

During this test the transmitter output is fed directly, or through RF attenuators, to the spectrum analyzer. The analyzer has a built-in capability to identify the minimum bandwidth that contains a specified percentage of the total power observed. The spectrum is scanned hundreds of times so that the varied effects of modulation are appropriately assessed. Since the focus is on the relative distribution of energy across a range of frequencies, the absolute amplitudes recorded during this test are not relevant and may not include cable losses or attenuation factors.

Occupied Bandwidth, 99% Test Data

The data for each type of bandwidth is summarized below, followed by the spectral data for the cases highlighted in yellow. The analysis threshold for this test was the bandwidth containing 99% of the observed power using the ANSI C63.10 method. The standards require testing a frequency near the bottom, middle, and top of the band. The measured bandwidth data are in bold font and have MHz as their units of measure.

Frequency	(MHz)	2402	2404	2440	2478	2480
BT Low Energy	1 Mbps	**1.050**	**NT**	**1.051**	**NT**	**1.052**
BT Low Energy	2 Mbps	**NT**	**2.045**	**2.048**	**2.052**	**NT**
ANT	----------	**0.985**	**NT**	**0.987**	**NT**	**0.988**

Table TR10.2: Summary of 99% Occupied Bandwidth Data in MHz for ANT and BLE modes

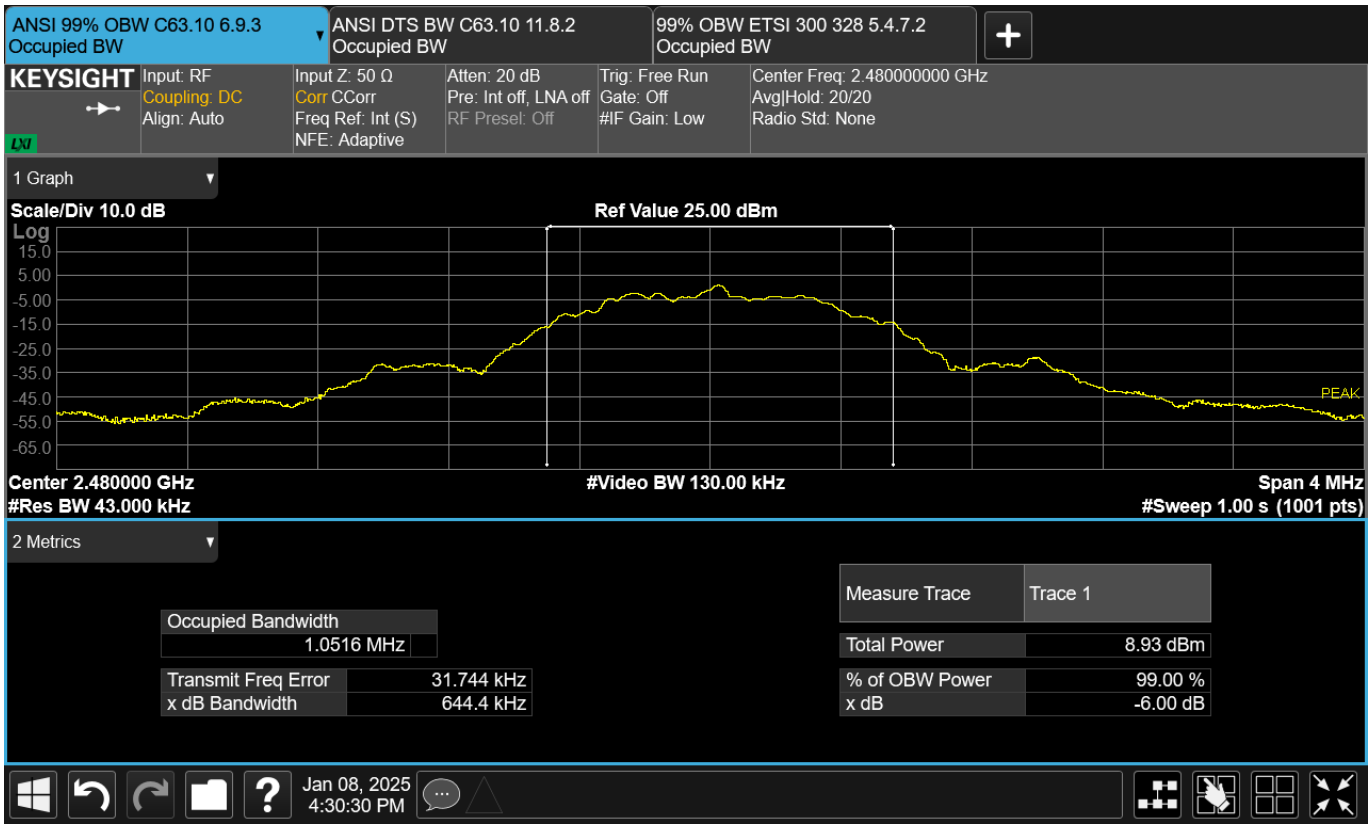


Figure TR10.2: Occupied bandwidth data for BLE 1 Mbps at high channel (2480 MHz)

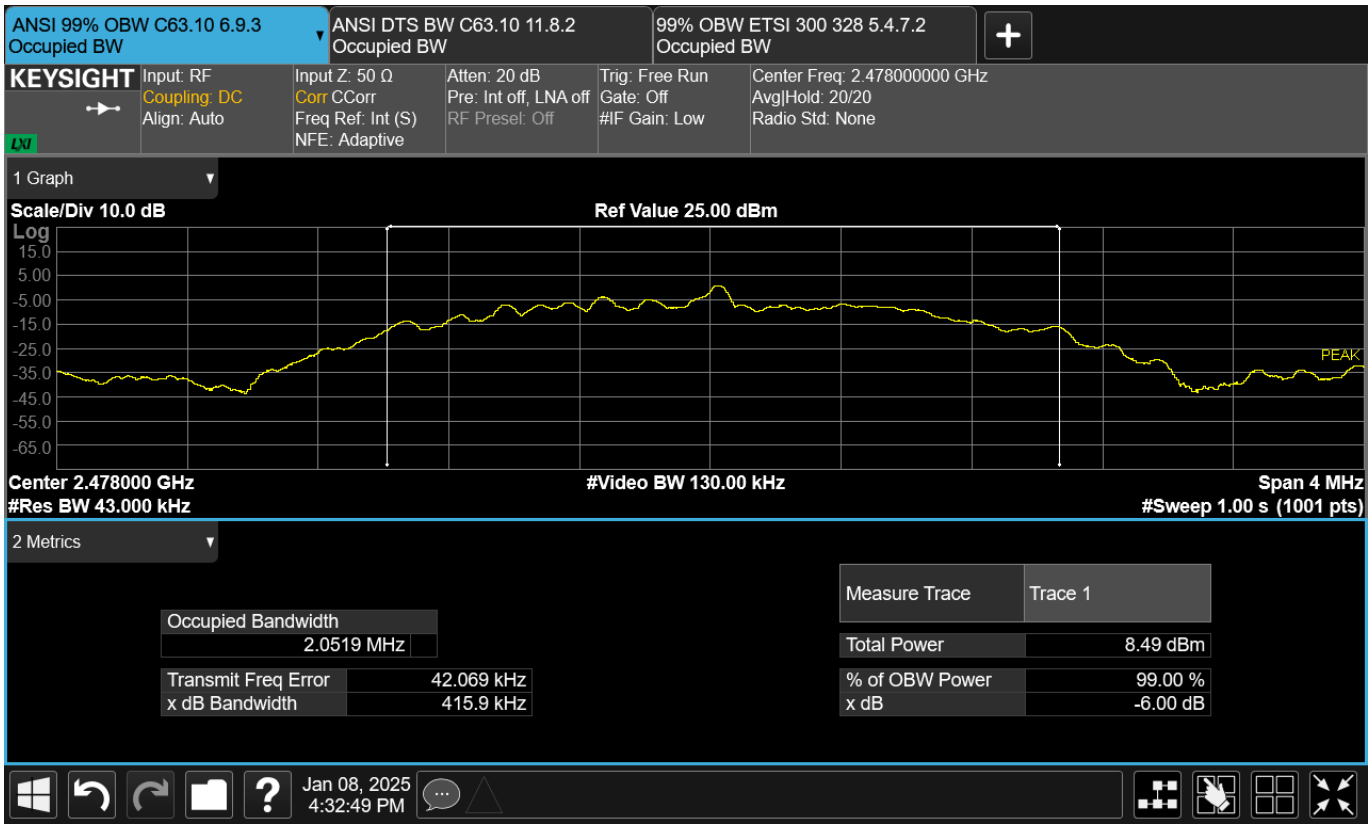


Figure TR10.3: Occupied bandwidth data for BLE 2 Mbps at high channel (2478 MHz)

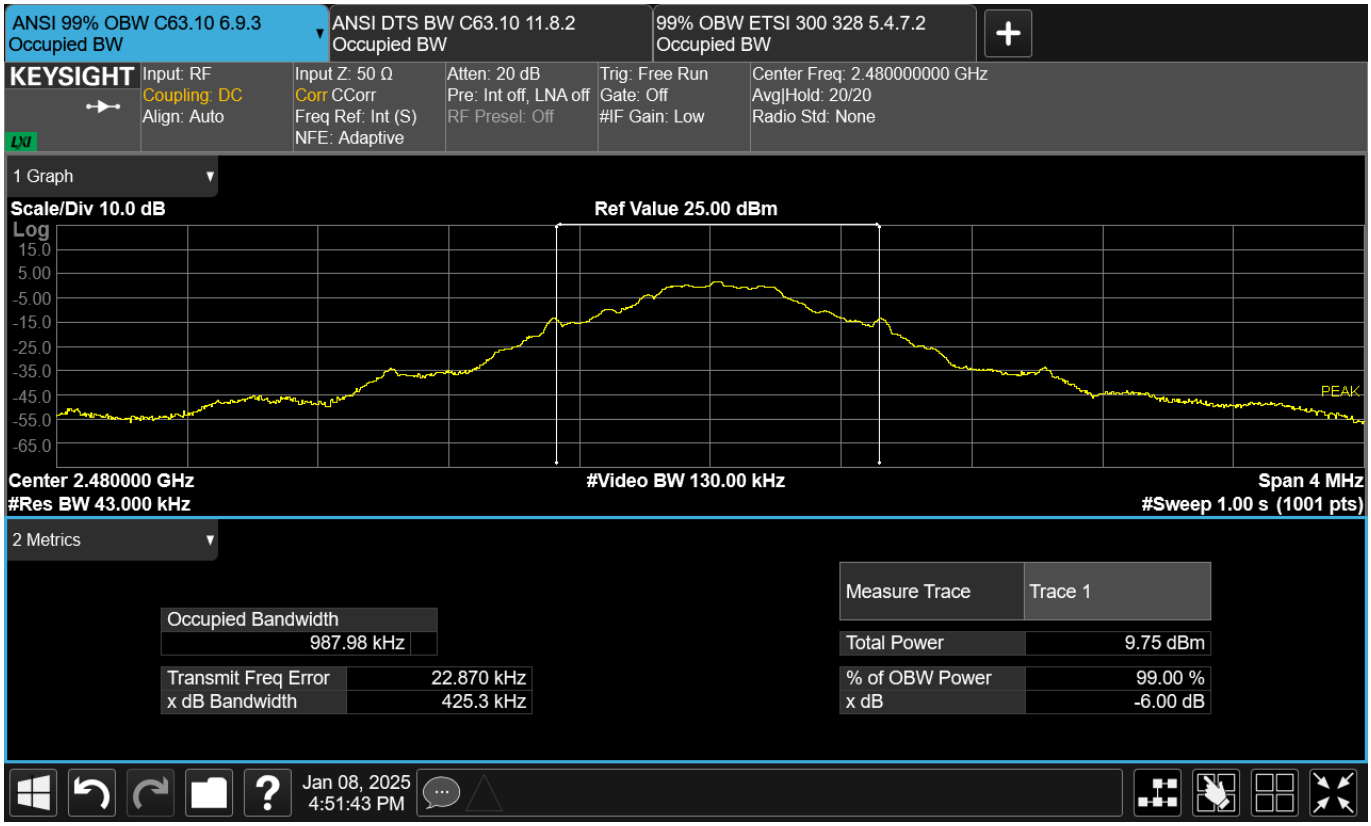


Figure TR10.4: Occupied bandwidth data for ANT at high channel (2480 MHz)

Necessary Bandwidth Calculations

The Necessary Bandwidth is a theoretical value based on the specifications for a communication protocol, rather than the hardware implementation and a subsequent lab measurement. The analysis methods in FCC Part 2.202 and TRC-43 are the same for NFC, Bluetooth, ANT, and IEEE 802.11b WiFi. However, they differ for IEEE 802.11g and 11n systems because the Canadian TRC-43 standard provides different analysis methods for Orthogonal Frequency Division Multiplexing systems (OFDM). The tables below will show the analysis for most of the radios signals as a combined approach, then separately analyze the results for IEEE 802.11g and n systems. The tables below may include radio protocols that are not part of the product being evaluated.

NFC (Near Field Communication) at 13.56 MHz uses continuous wave telegraphy without tone modulation. The bit rate 'B' in the FCC and TRC equations is split into two parts here. B is the baud rate. C is a coding factor. C=1 for Miller encoding where the transition speed is as high as the bit rate, or C=2 for Manchester encoding where the transition speed is as high as twice the bit rate). K is a factor set to 3 for non-fading circuits under the standards. The Necessary Bandwidth, B_N is then:

$B_N = BCK$

Radio Type	B (kbaud)	C	K	B_N (kHz)
NFC A	106	1	3	318.0
NFC B	212	2	3	1272.0
NFC B	424	2	3	2544.0

Table TRxx.100: Necessary Bandwidth for NFC

The radio modulation schemes for Ant, for the various Bluetooth protocols, and for IEEE 802.11 b WiFi are a mix of Phase Shift Key (PSK) and Quadrature Amplitude Modulation (QAM) techniques. The Necessary Bandwidth calculations use the equations from 47CFR Part 2.202(g) table section 6. We have set the variable K=1, which leaves the equation for both PSK and QAM as:

$B_N = 2R / Log_2(S)$

where B_N is the Necessary Bandwidth, R is the bit rate, and S is the number of signaling states.

Radio Type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
ANT / ANT+	1	1	2	1	2

Table TRxx.101: Necessary Bandwidth for ANT and ANT+ Radio Protocols (FCC and TRC-43)

Radio Type	Sub-type	Method	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
Bluetooth	BR	GFSK	1	1	2	1	2
	EDR2	Pi/4 DPSK	2	1	4	2	2
	EDR3	8DPSK	3	1	8	3	2
BLE	1Mbps	GFSK	1	1	2	1	2
	2Mbps	DQPSK	2	1	4	2	2

Table TRxx.102: Necessary Bandwidth for Bluetooth Radio Protocols (FCC and TRC-43)

Radio Type	Sub-type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
802.11 b	1	1	1	2	1	2
	2	2	1	4	2	2
	5.5	5.5	1	4	2	5.5
	11	11	1	4	2	11

Table TRxx.103: Necessary Bandwidth for IEEE 802.11 b Radio Protocol (FCC and TRC-43)

Radio Type	Sub-type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
802.11 a/g	6	6	1	2	1	12
	9	9	1	2	1	18
	12	12	1	4	2	12
	18	18	1	4	2	18
	24	24	1	16	4	12
	36	36	1	16	4	18
	48	48	1	64	6	16
	54	54	1	64	6	18
802.11 n/ac	MCS0	7.2	1	2	1	14.4
	MCS1	14.4	1	4	2	14.4
	MCS2	21.7	1	4	2	21.7
	MCS3	28.9	1	16	4	14.5
	MCS4	43.3	1	16	4	21.7
	MCS5	57.8	1	64	6	19.3
	MCS6	65	1	64	6	21.7
	MCS7	72.2	1	64	6	24.1
	MCS8	86.7	1	256	8	21.7

Table TRxx.104: Necessary Bandwidth for IEEE 802.11 a, g, n, and ac 20 MHz Radio Protocols (FCC)

Radio Type	Sub-type	R Mbps	K	S	LogBase2 of (S)	B_N (MHz)
802.11 n/ac	MCS0	15	1	2	1	30.0
	MCS1	30	1	4	2	30.0
	MCS2	45	1	4	2	45.0
	MCS3	60	1	16	4	30.0
	MCS4	90	1	16	4	45.0
	MCS5	120	1	64	6	40.0
	MCS6	135	1	64	6	45.0
	MCS7	150	1	64	6	50.0
	MCS8	180	1	256	8	45.0
	MCS9	200	1	256	8	50.0

Table TRxx.105: Necessary Bandwidth for IEEE 802.11 n and ac 40 MHz Radio Protocols (FCC)

As a note, the bit rate for IEEE 802.11 n or ac WiFi is calculated based on the IEEE standard's short guard interval of 400 nsec. If only the long guard interval of 800 nsec were implemented, the bit rates would decrease by a small amount.

The TRC-43 method for OFDM signals simply multiplies the number of subcarriers, K, and the subcarrier spacing, N_S. In both cases, Ns is 312.5 kHz. The count of subcarriers includes nulls. So for example, 802.11 n uses 4 pilot subcarriers, 52 data subcarriers, and one null suppressed subcarrier in the middle for 57 total subcarrier channels.

$B_N = N_S * K$

Radio Type	Mode	Ns (MHz)	K	B_N (MHz)
802.11a/g	20 MHz	0.3125	53	16.6
802.11n/ac	20 MHz	0.3125	57	17.8
802.11n/ac	40 MHz	0.3125	117	36.6

Table TRxx.106: Necessary Bandwidth for IEEE 802.11 a, g, n, and ac Radio Protocols (TRC-43)

This line is the end of the test record.

Test Record
Conducted Emissions Mains Test CE02
Project GCL0710

Test Date(s)	27 Jan 2025
Test Personnel	Jim Solum
Product Model	A04954
Serial Number tested	3503267193
Operating Mode	M5 (AntTx)
Arrangement	A2 (Upwr)
Input Power	120 Vac 60 Hz
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Frequency Range:	150 kHz to 30 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Jim Solum
Date of this record:	28 Jan 2025

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026
DMM Multimeter	Fluke	87V	63490051	2-Jan-2025	2-Jan-2028
Milliohm meter	Extech	380560	H.424648	15-May-2024	15-May-2026
LISN multiline; 20A 50uH	Com-Power	LIN-120C	20160005	3-Apr-2024	1-Apr-2027

Table CE02.1: Test Equipment Used

Software Used
Keysight PXE software A.32.06, CE Mains 150k to 30M Data Analysis V3a 2025Jan08.xlsx

Test Data

The conducted emission test process began with a set of preliminary scans on both power conductors using both Quasi-Peak and Average detectors across the frequency range. Where the test standard requires cable manipulation, one or more likely worst case frequencies selected by the test personnel. Cables were manipulated to find the maximal signal strength while observing the receiver levels at those selected frequencies. At each of the frequencies selected for final measurements, Quasi-peak and Average detector readings were taken on each conductor.

The table shows the selected final measurement data. It includes at least the six strongest emissions observed relative to the limit lines, along with other data points of interest. The yellow highlight indicate the data points with the least margin to the quasi-peak detector limit and the average detector limit. A positive margin value indicates that the emission was below the test limit. The test limit is the Composite FCC/CISPR Class B Limit.

Frequency	QP Limit	AV Limit	L1 QP	L2 QP	L1 AV	L2 AV	QP Margin	AV Margin
(kHz)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)
152	65.88	55.88	59.38	54.64	28.86	28.76	6.50	27.01
170	64.95	54.95	57.30	53.21	27.91	26.03	7.64	27.04
215	63.00	53.00	48.41	52.60	22.65	25.52	10.40	27.48
438	57.10	47.10	41.31	37.98	21.61	22.58	15.79	24.52
1671	56.00	46.00	27.55	27.94	19.91	21.07	28.06	24.93
8023	60.00	50.00	30.10	30.22	22.33	23.37	29.78	26.63

Table CE02.2: Emission summary

The graph below shows preliminary scan data as continuous curves. Superimposed are the final measurement data points reported in the table above.

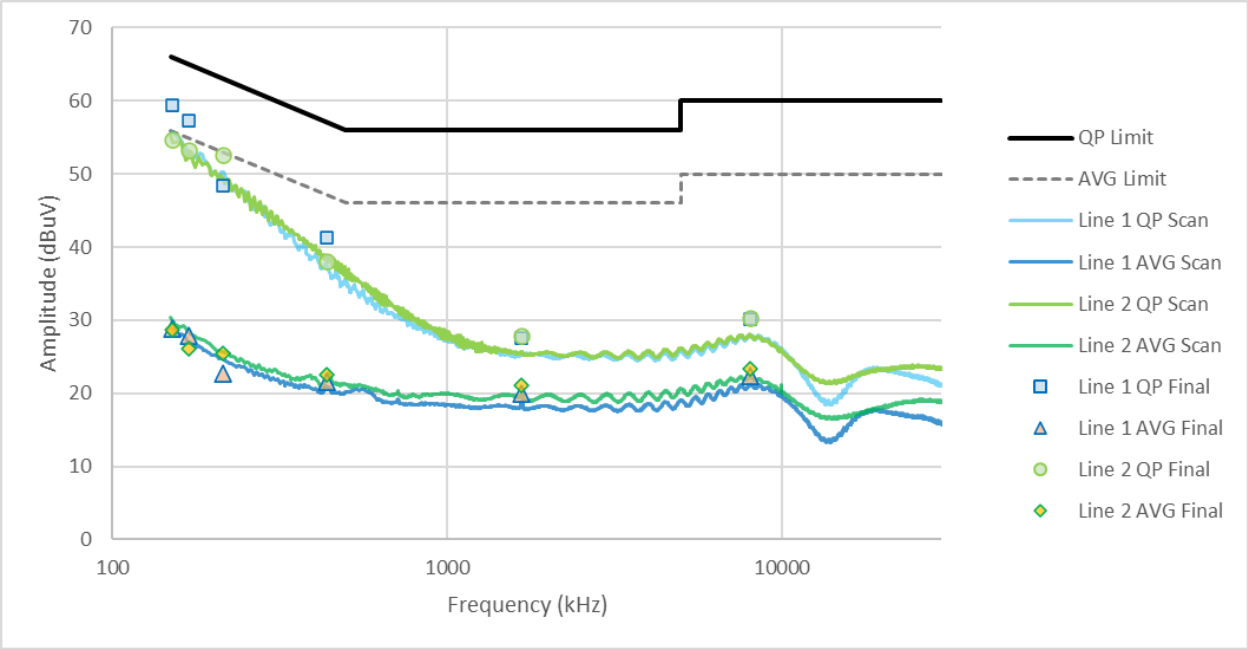


Figure CE02.1: Spectral data

Setup Photographs

The following photographs show the EUT configured and arranged in the manner in which it was measured.

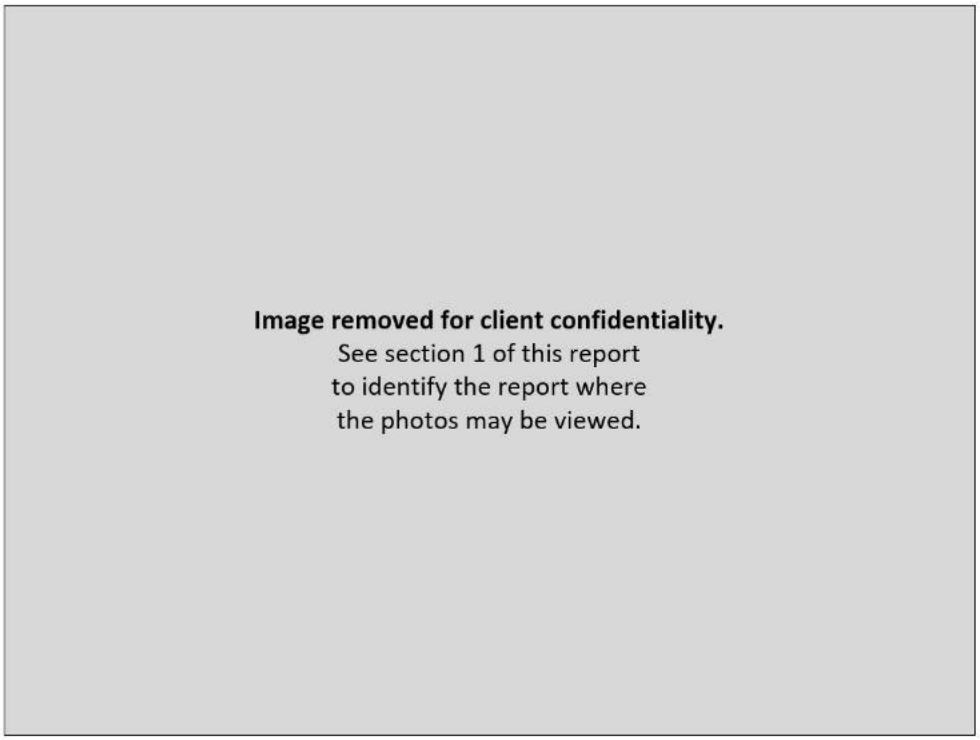


Figure CE02.2: Test setup, first view

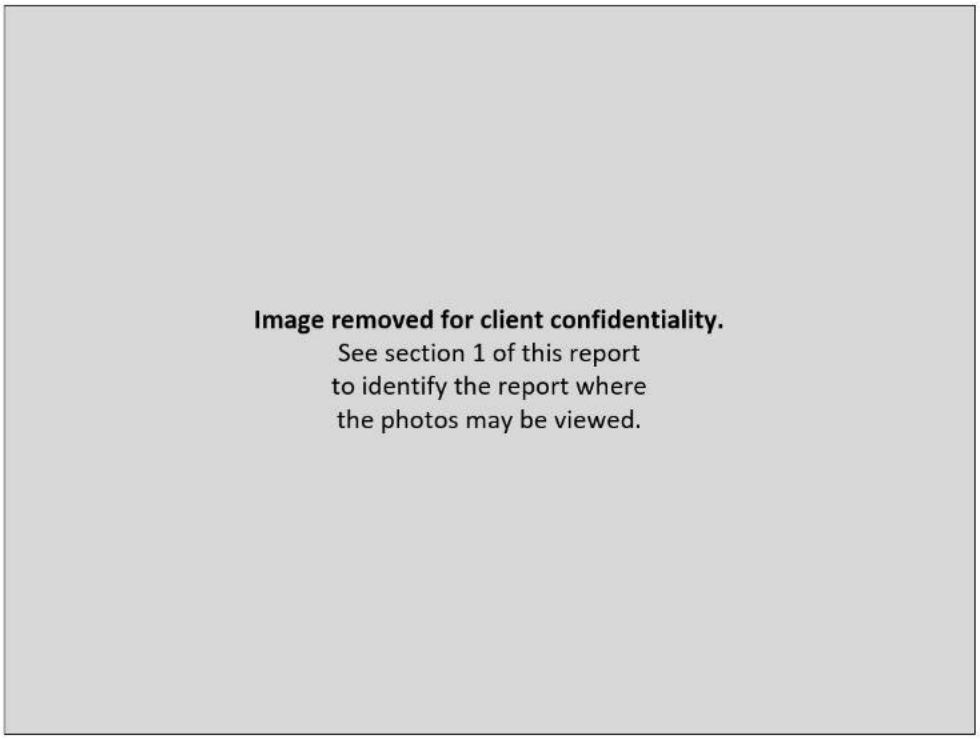


Figure CE02.3: Test setup, second view

This line is the end of the test record.

Concluding Notes

This report stands as an integrated record of the tests performed and must be copied or distributed in its complete form. The reproduction of selected pages or sections separate from the complete report would require specific approval from the manager of the Garmin Compliance Lab.

This is the final page of the report.