Test Report 2024-123

Version A
Issued 21 Aug 2024

Project GCL-0575
Model Identifier A04666
Primary Test Standards
FCC Part 15.247
RSS-247 Issue 3
ANSI C63.10: 2020

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

Client-supplied Information

FCC ID:	IPH-04666
IC ID:	1792A-04666

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 Bluetooth Low Energy (BLE) and IEEE 802.11 b/g/n (WiFi) radio transceiver(s). 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 72.2 Mbps.	Reported	N/A
Hopping Channels	The radio manages it use of channels appropriately. [15.247(a)(1); RSS-247 at 5.1]	N/A. The radios described in this report are not subjected to the Frequency Hopping rules.	N/A	N/A
DTS Bandwidth	The nature of the radio signal is broadband, being at least 500 kHz wide. [15.247(a)(2); RSS-247 at 5.2(a)]	The 6dB bandwidth is 728 kHz or greater.	PASS	12
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	16
Transmit Power	The peak transmit power presented to the antenna is no greater than 1 Watt or 30 dBm. The effective radiated power is limited to 4 Watts or 36 dBm EIRP. [15.247(b); RSS-247 at 5.4(d)]	The maximum transmit power is 14.46 dBm or 27.9 mW.	PASS	23
Antenna Gain	The radio should not focus too much energy in any direction. Unless additional rules are applied, the antenna gain is no greater than 6 dBi. [15.247(b)(4) and (c)]	NT. The client stated that the antenna gain was 0.2 dBi and will document antenna gain separately.	NT	NT
Unwanted Emissions (Conducted Spurious)	The radio should not provide too much radio energy to the antenna at frequencies beyond its intended frequency band. [15.247(d); RSS-247 at 5.5]	Emissions outside the band must be reduced at least 20 dB from in-band levels. The measured reduction was at least 38 dB.	PASS	26
Restricted Bands	The radio must not emit in certain designated restricted frequency bands above a set of limit values. [15.247(d) and 15.205; RSS-247 at 3.3]	Emissions in the restricted bands were at least 2.9 dB below the applicable limits.	PASS	34

Power Spectral Density	The radio must not focus too much radio energy in a narrow frequency band. [15.247(e); RSS-247 at 5.2(b)]	The limit is 8 dBm in a 3 kHz band. The strongest emission level was -2.17 dBm in a band of at least 3 kHz.	PASS	56
Hybrid Systems	A radio that is both frequency hopping and digitally modulated should satisfy a combination of system rules. [15.247(f); RSS-247 at 5.3]	N/A. The radios described in this report are not subjected to the Hybrid System rules.	N/A	N/A
Frequency Hopping Rules	Frequency hopping systems have additional functional requirements. [15.247(g) and (h); RSS-247 at 5.1]	N/A. The radios described in this report are not subjected to the Frequency Hopping rules.	N/A	N/A
Radio Safety	The radio emissions must meet public health & safety guidelines related to human exposure. [15.247(i) and 1.1307; RSS-Gen at 3.4]	NT. Client will report radio energy safety results separately.	NT	NT
Frequency Stability	The radio tuning must be robust over a range of temperature and supply voltage conditions. [RSS-Gen at 6.11]	Radio emissions remained within the allowed radio band under all environmental conditions tested.	PASS	61
Unwanted Emissions (Radiated Spurious)	While transmitting, the radiated emissions must not be too strong. [15.209, RSS-Gen at 8.9]	Emissions other than the fundamental and harmonics must meet the 'Class B' limits. The measured emissions had at least 4.1 dB of margin.	PASS	67
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 15.8 dB of margin.	PASS	109

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

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 2024-124. 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: 4 Jun 2024
Test Start Date: 19 Jun 2024
Test End Date: 15 Aug 2024

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

This report was written by Dave Arnett and initially issued on 21 Aug 2024 as Version A.

Report Technical Review:

David Arnett
Technical Lead EMC Engineer

Report Approval:

Shruti Kohli
Manager Test and Measurement (EMC, Reliability and Calibration)

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:
None

5. Description of the Equipment Tested

5.1 Unique Identification

Product Model	A04666
Serial Numbers Tested	3475366209,3475366056, 3475366137

The product tested is a portable transceiver with GFSK, GMSK, and IEEE 802.11b/g/n modulations that is used for collecting and sharing information with the user and nearby devices.

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
Radio Transceivers:	IEEE 802.11 b/g/n, Bluetooth Low Energy, ANT
Radio Receivers:	GNSS
Primary Functions:	Information collection, display, and telemetry
Typical use:	Portable in multiple orientations
Highest internal frequency:	2.484 GHz
FVIN/Firmware Revision	0.19

5.3 Operating modes

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

Mode 1: M3 (BleTx). The sample was continuously transmitting Bluetooth Low Energy (BLE) data signals modulated on a selected channel and signaling mode.

Mode 2: M5 (AntTx). The sample was continuously transmitting ANT data signals modulated on a selected channel and signaling mode.

Mode 3: M7 (WiFiTx). The sample was continuously transmitting IEEE 802.11 (WiFi) data signals modulated on a selected channel and signaling mode.

Mode 4: M13 (Gnss). The test sample was in a typical user operating mode, attempting to decode GNSS location signals.

5.4 EUT Arrangement

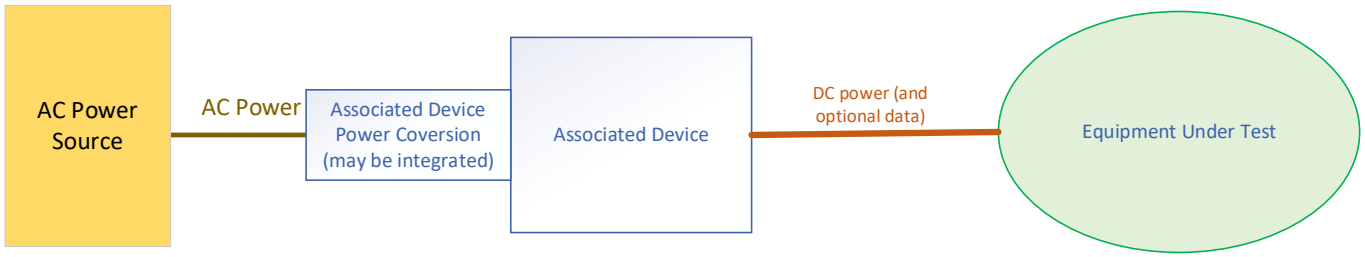
During test, the EUT components and associated support equipment were selected including the following arrangement sets.

Arrangement 1: A1 (Batt) The test sample operates on battery not connected to other devices. No setup diagram is provided for this arrangement.

Arrangement 2: A2 (Upwr) The test sample is connected over a cable to a USB-style power source capable fo converting AC Mains power to 5 Vdc. See Figure 1.

Arrangement 3: A3 (Udata) The test sample is connected over a cable to a USB data port capable of providing data interchange and also supplying the sample with 5 Vdc power. See Figure 1.

Arrangement 4: A4 (USB) The test sample is connected over a cable to a USB data port. This arrangement was designated for tests where it was not relevant to the test results whether data was present at the interface or not. See Figure 1.



This interconnect drawing is not to scale.
It does not indicate the placement of devices.

Figure 1: Generalized block diagram of equipment arrangements A2 through A4

5.5 Associated Equipment (AE) used

Description	Manufacturer	Model	Serial Number
Power adaper	Garmin	362-00118-00	N/A
Laptop	Dell	inspiron	7DCR5R3
Power Supply	Dell	DA65NM191	CN-0KPVMF-DES00-233-EE1V-A00
Laptop	Dell	Latitude 5410	5VSPFB3

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

5.6 Cables used

Description	From	To	Length	EMC Treatment
USB-style	Test Sample	Power or Computer	111 cm	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.

AS/NZS 4268: 2017
CFR 47, FCC Part 15, Subpart C (15.247)
ANSI C63.10: 2013, ANSI C63.10: 2020, and ANSI C63.10: 2020 +Cor 1: 2023
RSS-GEN Issue 5 Amd 2
RSS-247 Issue 3

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.

(None)

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 boresighting and another does not, swept motion with boresighting will typically be used as it is the more stringent requirement.

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		1.49 dB	3.8 dB	None
Conducted Emissions, Power Mains, 150 kHz to 30 MHz		1.40 dB	3.4 dB	None
Conducted Emissions, Cat 6 LCL, 150 kHz to 30 MHz		2.80dB	5 dB	None
Conducted Emissions, Cat 5 LCL, 150 kHz to 30 MHz		3.21 dB	5 dB	None
Conducted Emissions, Cat 3 LCL, 150 kHz to 30 MHz		4.24 dB	5 dB	None
Radiated Emissions, below 30 MHz		0.88 dB	None	6 dB
Radiated Emissions, 30 MHz to 1000 MHz		2.77 dB	6.3 dB	6 dB
Radiated Emissions, 1 GHz to 18 GHz		2.60 dB	5.2 & 5.5 dB	6 dB
Radiated Emissions, 18 GHz to 26.5 GHz		2.73 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 dBuV) + (9.812 dB) + (0.216 dB) = 17.173 dBuV

8.2 Radiated Emissions at 630 MHz

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

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

8.3 Radiated Emissions at 2.7 GHz

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

(43.72 dBuV) + (32.22 dB/m) + (-36.09 dB) = 39.85 dBuV/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:	19.8 to 22.5 °C
Relative Humidity:	42.3% to 60% (non-condensing)
Barometric Pressure	96.7 to 110.0 kPa

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Barometer	Traceable	6453	221702700	3-Aug-2022	1-Aug-2024
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.

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
Transmitter Bandwidth Tests
Test IDs TR6, TR7, TR8
Project GCL-0575

Test Date(s)	5 July 2024
Test Personnel	David Arnett assisted by Vladimir Tolstik
Product Model	A04666
Serial Number tested	3475366137
Operating Mode	M3 (BleTx), M5 (AntTx), M7(WiFiTx)
Arrangement	A4 (USB)
Input Power	5Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247 (as noted in Section 6 of the report).
Radio Protocol	Bluetooth Low Energy (BLE), ANT, IEEE 802.11b/g/n (WiFi)
Radio Band	2400 to 2483.5 MHz

Pass/Fail Judgment: **PASS**

Test record created by: **David Arnett**
Date of this record: **5 July 2024**
Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025

Table TR6.1: List of test equipment used

Test Software Used: Keysight PXE firmware A.37.02

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 portion of the total power observed, and also identify parameters such as the edge frequencies for that bandwidth and the center frequency error. The spectrum is scanned many 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.

For BLE operating at 2 Mbps, the lowest operating frequency was 2404 MHz, and the highest operating frequency was 2478 MHz. For all other non-WiFi 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.

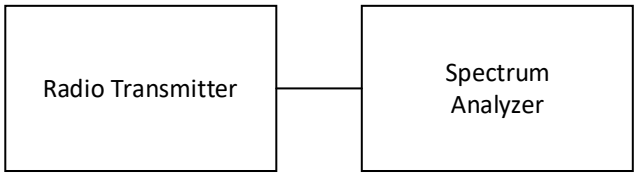


Figure TR6.1: Test setup

Test Data

The data for each test is summarized below, followed by the spectral data for each case highlighted in yellow.

The DTS Bandwidth is measured using a spectrum analyzer operating with a defined resolution bandwidth. The analysis finds the smallest continuous range of frequencies containing all emissions within 6 dB of the highest value. The requirement is that the DTS Bandwidth be greater than 500 kHz. As such the lowest measured bandwidth is worst case. All radios reported here are judged to have met this requirement.

	2402 (04)	2440	2480 (78)
ANT	**934**	**766**	**936**
BLE 1Mbps	**805**	**728**	**787**
BLE 2Mbps	**1442**	**1318**	**1458**

Table TR6.2: Summary of bandwidth data in kHz for ANT and BLE modes

Modulation	Mbps	Ch 1	Ch 6	Ch 11	Ch 13
B	1	**9141**	**10020**	**10040**	**9588**
B	11	**8336**	**8388**	**8396**	**8402**
G	6	**16090**	**15820**	**15880**	**15860**
G	54	**16480**	**16500**	**16490**	**16500**
N	6.5	**16350**	**16810**	**16570**	**16620**
N	72.2	**16890**	**17100**	**17120**	**17060**

Table TR6.3: Summary of bandwidth data in kHz for IEEE 802.11 WiFi modes

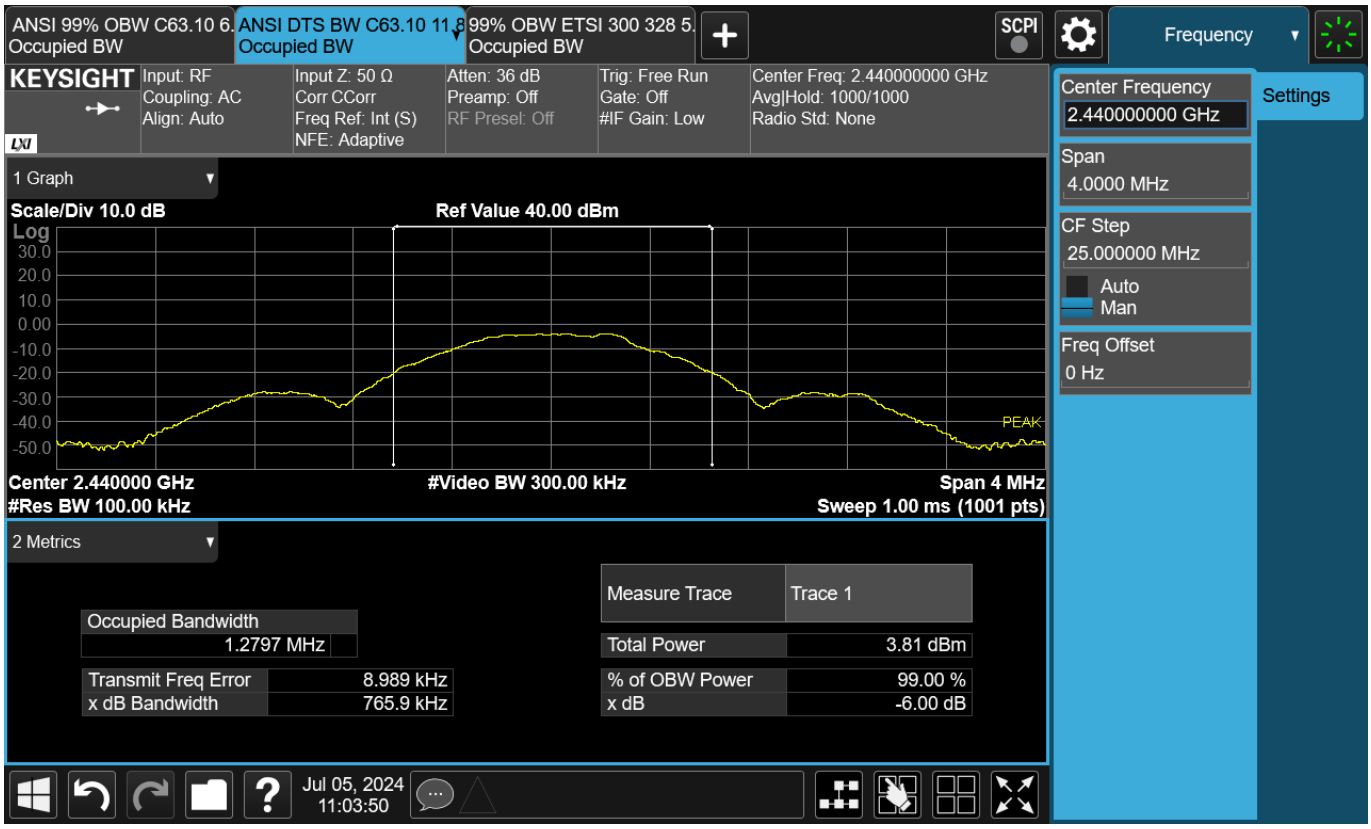


Figure TR6.2: Bandwidth data for ANT at mid channel (2440 MHz)

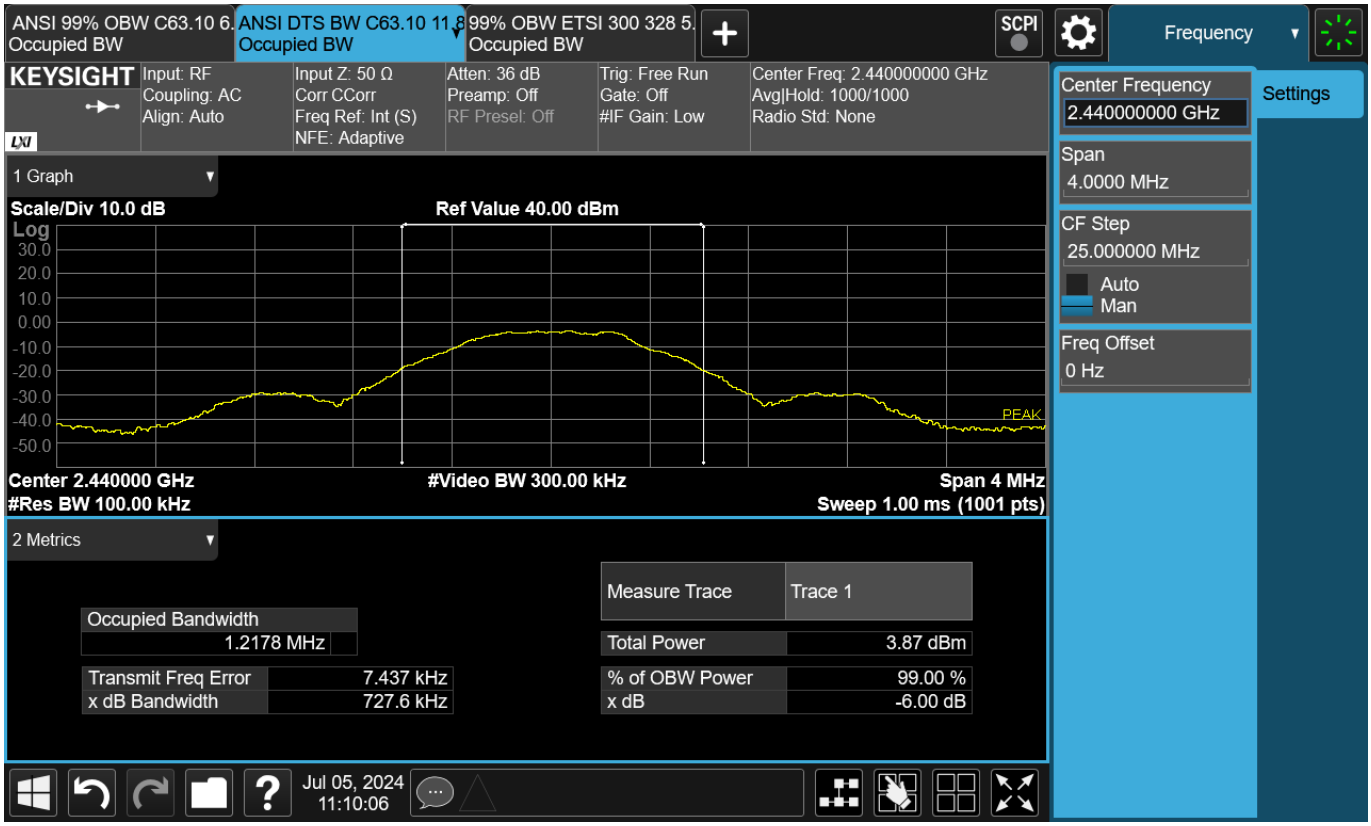


Figure TR6.3: Bandwidth data for BLE 1 Mbps at mid channel (2440 MHz)

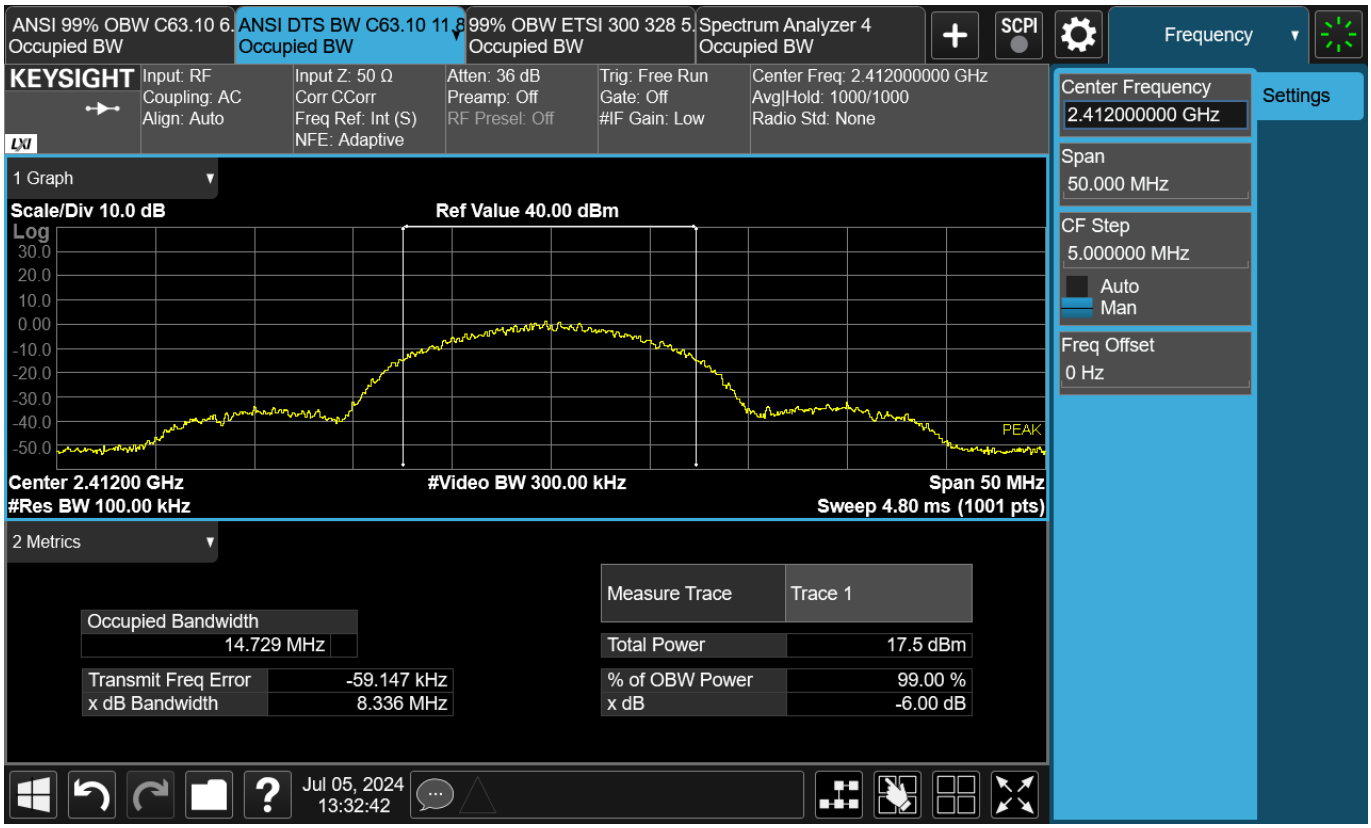


Figure TR6.4: Bandwidth data for 802.11b 11 Mbps at channel 1

This line is the end of the test record.

Test Record
Transmitter Bandwidth Tests
Test IDs TR10 – TR12
Project GCL0575

Test Date(s)	5 July 2024
Test Personnel	David Arnett assisted by Vladimir Tolstik
Product Model	A04666
Serial Number tested	3475366137
Operating Mode	M3 (BleTx), M5 (AntTx), M7(WiFiTx)
Arrangement	A4 (USB)
Input Power	5Vdc
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, IEEE 802.11b/g/n (WiFi)
Radio Band	2480 to 2483.5 MHz
Pass/Fail Judgment:	**Reported**
Test record created by:	**David Arnett**
Date of this record:	**5 July 2024**

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025

Table TR10.1 Equipment Used

Test Software used: Keysight MXE System Code rev. A.37.02

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 BLE and ANT radios reported here, the lowest operating frequency was 2402 MHz, and the highest operating frequency was 2480 MHz. For WiFi in North America, channels 1, 6, and 11 are typically treated as the low, mid, and high channels. Since channels 12 and 13 are also engaged in this product at reduced Tx power levels, channel 13 is also treated here as a high channel.

Test Setup

This block diagram shows the test equipment setup.

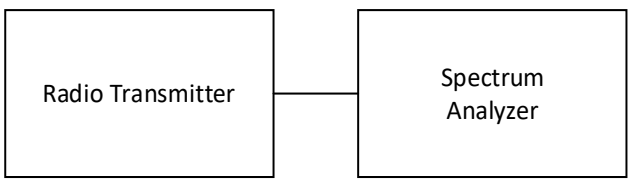


Figure TR10.1: Test setup

Occupied Bandwith, 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.

BLE, ANT, and IEEE 802.11b have few enough operating speeds that all speeds were measured for the low, mid, and high channels. For IEEE 802.11 g and n, mid-channel 6 was measured for all speeds. The lowest and highest channels were also measured at the lowest and highest speeds, plus at any other speeds where a higher bandwidth was observed in the channels 6 data. 'NT' indicates a channel/speed combination that was not tested.

Occupied Bandwith, 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.

	2402 (04)	2440	2480 (78)
ANT	**1.424**	**1.262**	**1.449**
BLE1	**1.312**	**1.232**	**1.268**
BLE2	**2.582**	**2.549**	**2.588**

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

Modulation	Mbps	Ch 1	Ch 6	Ch 11	Ch 13
B	1	**15.152**	**15.179**	**15.417**	**15.053**
	2	**15.153**	**15.181**	**15.391**	**14.978**
	5.5	**14.518**	**14.563**	**14.752**	**14.822**
	11	**14.715**	**14.76**	**14.88**	**14.727**
G	6	**17.024**	**17.059**	**17.006**	**17.031**
	9	NT	**16.978**	NT	NT
	12	NT	**16.979**	NT	NT
	18	NT	**16.787**	NT	NT
	24	NT	**16.794**	NT	NT
	36	NT	**16.909**	NT	NT
	48	NT	**16.637**	NT	NT
	54	**16.746**	**16.737**	**16.745**	**16.726**
N	6.5	**17.62**	**17.637**	**17.585**	**17.595**
	13	**17.738**	**17.888**	**17.609**	**17.595**
	19.5	NT	**17.735**	NT	NT
	26	NT	**17.667**	NT	NT
	39	NT	**17.644**	NT	NT
	52	NT	**17.519**	NT	NT
	58.5	NT	**17.631**	NT	NT
	65	NT	**17.485**	NT	NT
	72.2	**17.607**	**17.597**	**17.592**	**17.593**

Table TR10.3: Summary of 99% Occupied Bandwidth Data for IEEE 802.11 WiFi modes

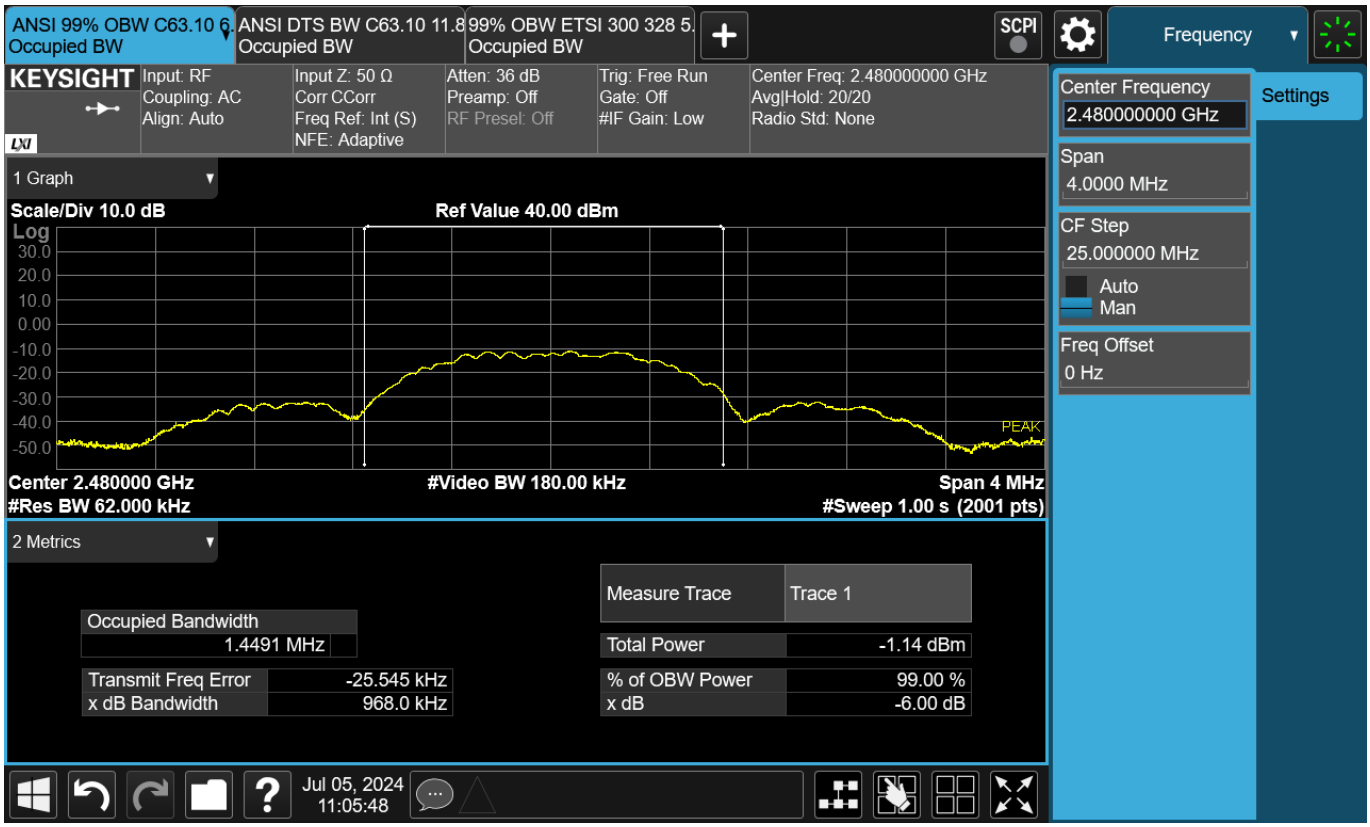


Figure TR10.1: Occupied bandwidth data for ANT at high channel (2480 MHz)

Figure TR10.2: Occupied bandwidth data for BLE, 1 Mbps at low channel (2402 MHz)

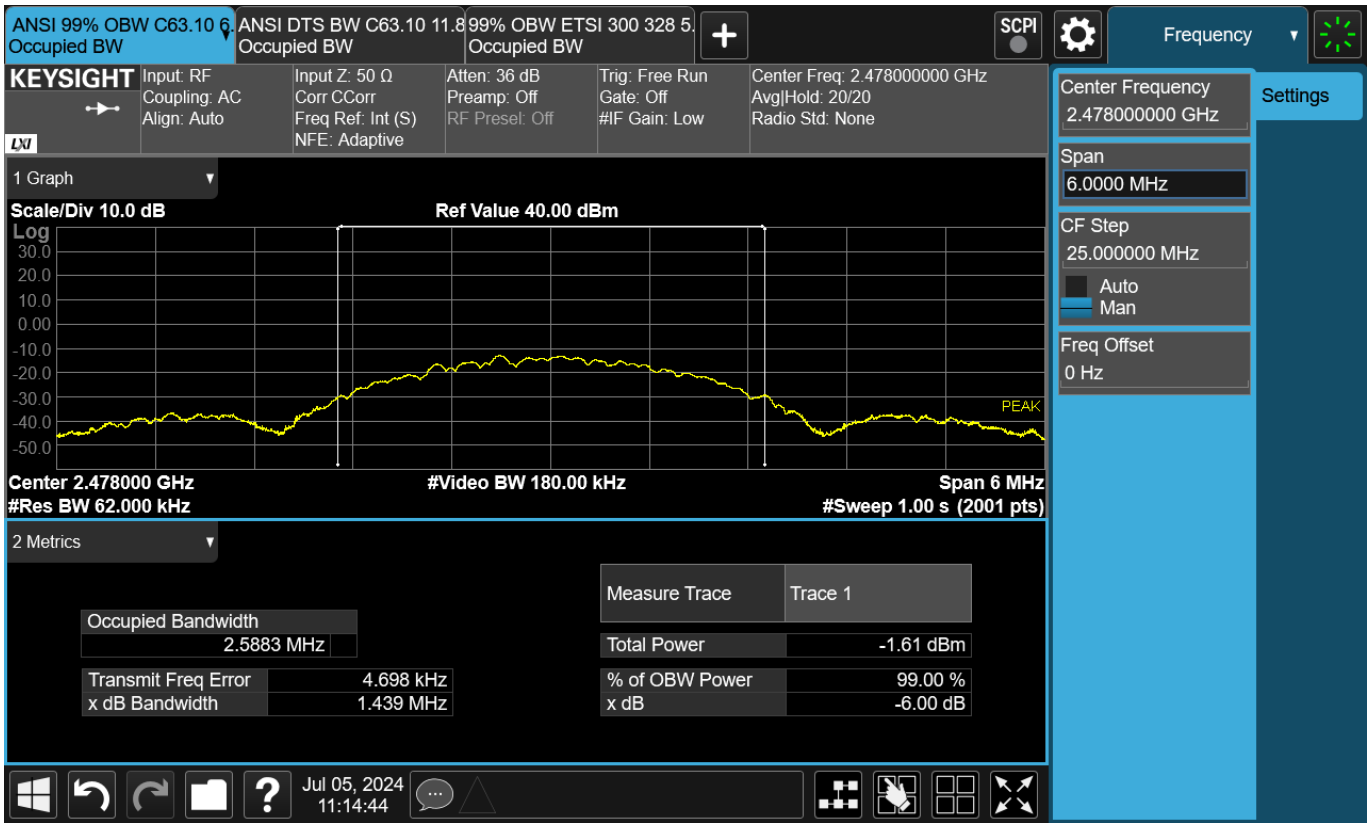


Figure TR10.3: Occupied bandwidth data for BLE, 2 Mbps at high channel (2478 MHz)

Figure TR10.4: Occupied bandwidth data for 802.11b, 1 Mbps at channel 11

Figure TR10.5: Occupied bandwidth data for 802.11g, 6 Mbps at channel 6

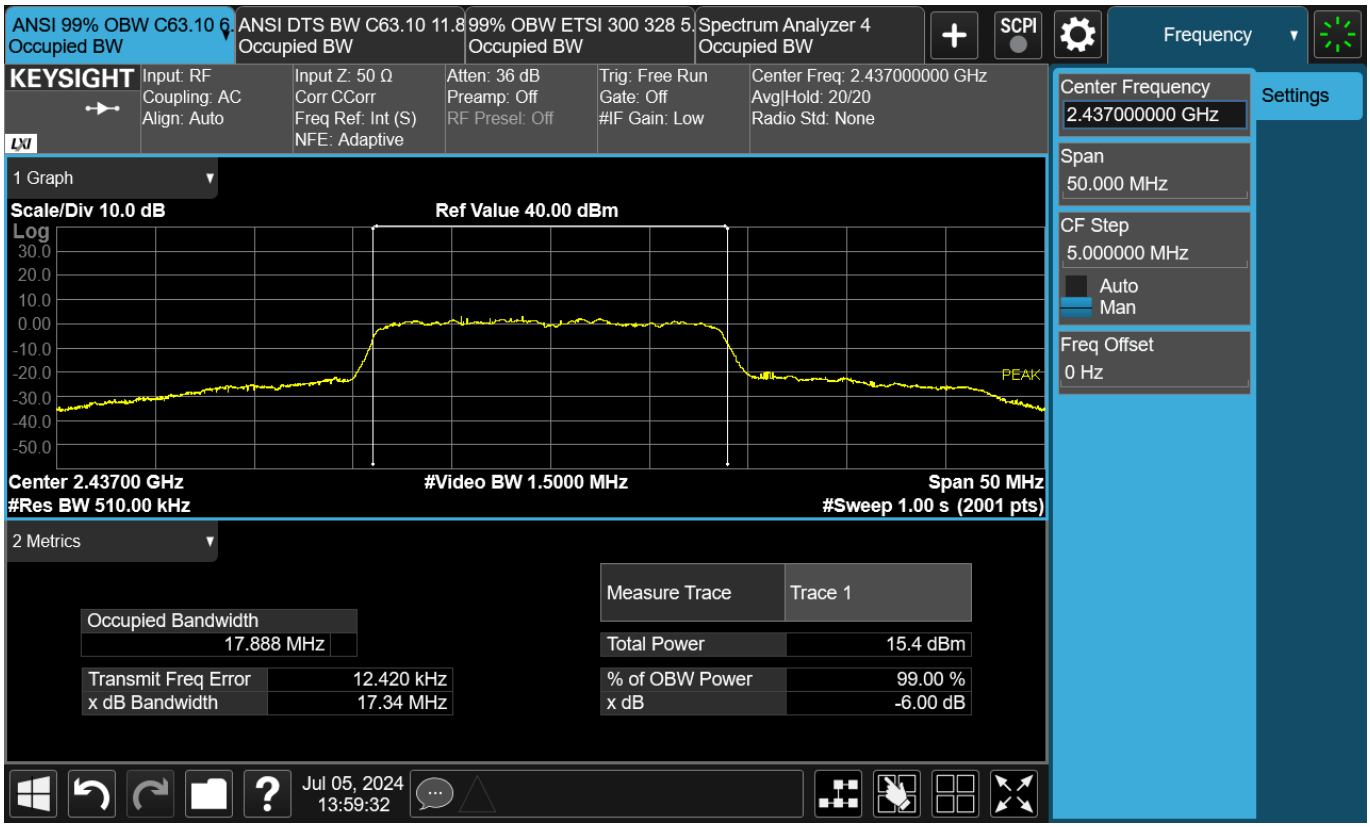


Figure TR10.6: Occupied bandwidth data for 802.11n, 13 Mbps at channel 6

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 TR10.100: 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 TR10.101: 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 TR10.102: 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 TR10.103: 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 TR10.104: 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 TR10.105: 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 TR10.106: 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
Transmitter Power, Duty Cycle and RF Exposure
Test IDs TR02, TR03, TR04
Project GCL0575

Test Date(s)	02 Jul 2024
Test Personnel	Matt Carroll under supervision of Majid Farah
Product Model	A04666
Serial Number tested	3475366137
Operating Mode	M3 (BleTx), M5 (AntTx), M7 (Wifi Tx)
Arrangement	A4 (USB)
Input Power	5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247, FCC Part 1.1310, FCC Part 2.1093, RSS-GEN, RSS-102, ANSI C95.3 (as noted in Section 6 of the report).
Antenna Gain	Maximum 0.2 dBi, as reported by the client
Radio Protocol	BLE (Bluetooth Low Energy), ANT, IEEE 802.11b/g/n
Pass/Fail Judgment:	**PASS**
Test record created by:	**Matt Carroll and Majid Farah**
Date of this record:	**8 Jul 2024**

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
RF Power Sensor	Rohde&Schwarz	NRP8S	109124	18-Jul-2023	15-Jul-2025

Table TR02.1: List of test equipment used

Software used: Rohde & Schwarz Power Viewer V11.3; TimePowerAnalysisSpreadsheetv11.xls

Test Method
The basic test standards provide options for the time evaluation test method. The following test methods were applied.

ANSI C63.10: 11.9.1.3

Transmit Power Data

Each measurement is made conducted from the antenna port with the transmitter on a specified channel and in a selected transmission protocol. Where standards cited here apply harmonized test methods and different limits, the more strict limit has been applied. In this case, the ANSI method finds the highest value (numerical peak) and applies the 30 dBm limit from the US and Canadian standards. All values met the respective limits with more than 10 dB of margin. The results are shown below.

Frequency	(MHz)	2402	2404	2440	2478	2480
BT Low Energy	1 Mbps	**-0.70**	**NT**	**1.76**	**NT**	**-3.75**
BT Low Energy	2 Mbps	**NT**	**2.70**	**1.74**	**-3.23**	**NT**
ANT	----	**-0.64**	**NT**	**1.83**	**NT**	**-3.22**

Table TR02.2: Transmit Power Summary in dBm for BLE and ANT with ANSI C63.10 analytical methods
NT: Not tested

For Wifi, yellow highlighted cells indicate the highest peak power measured value for each radio protocol.

Mode	Speed	1	2	3	4	5	6	7	8	9	10	11	12	13
B	1	**13.70**	**NT**	**NT**	**NT**	**NT**	**13.24**	**NT**	**NT**	**NT**	**NT**	**12.74**	**NT**	**-1.16**
B	2	**13.75**	**NT**	**NT**	**NT**	**NT**	**13.33**	**NT**	**NT**	**NT**	**NT**	**12.78**	**NT**	**-1.16**
B	5.5	**13.95**	**NT**	**NT**	**NT**	**NT**	**14.40**	**NT**	**NT**	**NT**	**NT**	**13.29**	**NT**	**-0.92**
B	11	**13.87**	**13.73**	**13.77**	**13.75**	**13.62**	**14.46**	**13.21**	**13.40**	**13.26**	**13.10**	**13.22**	**-0.83**	**-0.93**
G	6	**12.70**	**NT**	**NT**	**NT**	**NT**	**12.47**	**NT**	**NT**	**NT**	**NT**	**7.08**	**NT**	**0.32**
G	9	**12.67**	**NT**	**NT**	**NT**	**NT**	**12.49**	**NT**	**NT**	**NT**	**NT**	**7.05**	**NT**	**0.29**
G	12	**12.85**	**13.18**	**12.91**	**12.64**	**12.47**	**12.28**	**12.06**	**11.90**	**11.51**	**10.84**	**7.70**	**1.00**	**0.83**
G	18	**12.41**	**NT**	**NT**	**NT**	**NT**	**11.78**	**NT**	**NT**	**NT**	**NT**	**7.75**	**NT**	**0.96**
G	24	**11.21**	**NT**	**NT**	**NT**	**NT**	**10.58**	**NT**	**NT**	**NT**	**NT**	**7.60**	**NT**	**0.81**
G	36	**10.98**	**NT**	**NT**	**NT**	**NT**	**9.44**	**NT**	**NT**	**NT**	**NT**	**7.75**	**NT**	**0.82**
G	48	**9.09**	**NT**	**NT**	**NT**	**NT**	**8.39**	**NT**	**NT**	**NT**	**NT**	**6.83**	**NT**	**-0.01**
G	54	**8.72**	**NT**	**NT**	**NT**	**NT**	**7.91**	**NT**	**NT**	**NT**	**NT**	**6.40**	**NT**	**-0.25**
N	6.5	**11.98**	**NT**	**NT**	**NT**	**NT**	**12.26**	**NT**	**NT**	**NT**	**NT**	**6.91**	**NT**	**0.17**
N	13	**12.28**	**NT**	**NT**	**NT**	**NT**	**12.26**	**NT**	**NT**	**NT**	**NT**	**7.70**	**NT**	**0.76**
N	19.5	**12.20**	**12.99**	**12.83**	**12.57**	**12.44**	**12.63**	**12.13**	**11.96**	**11.22**	**11.00**	**11.00**	**1.03**	**0.87**
N	26	**12.24**	**NT**	**NT**	**NT**	**NT**	**11.72**	**NT**	**NT**	**NT**	**NT**	**7.72**	**NT**	**0.76**
N	39	**11.03**	**NT**	**NT**	**NT**	**NT**	**10.03**	**NT**	**NT**	**NT**	**NT**	**7.68**	**NT**	**0.79**
N	52	**9.03**	**NT**	**NT**	**NT**	**NT**	**8.33**	**NT**	**NT**	**NT**	**NT**	**6.90**	**NT**	**0.28**
N	58.5	**8.92**	**NT**	**NT**	**NT**	**NT**	**8.20**	**NT**	**NT**	**NT**	**NT**	**6.74**	**NT**	**-0.08**
N	65	**7.77**	**NT**	**NT**	**NT**	**NT**	**6.93**	**NT**	**NT**	**NT**	**NT**	**6.03**	**NT**	**-0.24**
N	72.2	**7.75**	**NT**	**NT**	**NT**	**NT**	**7.22**	**NT**	**NT**	**NT**	**NT**	**5.94**	**NT**	**-0.22**

Table TR02.3: Transmit power summary in dBm for IEEE 802.11b/g/n protocols using ANSI C63.10 analytical methods

RF Exposure Results

Each measurement is made conducted from the antenna port with the transmitter on a specified channel and in a selected transmission protocol. The data record length is 100 msec for the Bluetooth-like protocols and 1 second for WiFi.

The analytical method reports the power in linear units, such as milliwatt, where the level is averaged over the measurement record. In addition, short-time duty cycle is reported since this is a portion of the over-all 6-minute time averaging result but this factor is not double-counted in the final result for tuned time-averaged EIRP power.

Frequency	(MHz)	2402	2404	2440	2478	2480
BT Low Energy	1 Mbps	**0.85**	**NT**	**1.49**	**NT**	**0.42**
BT Low Energy	2 Mbps	**NT**	**1.84**	**1.48**	**0.47**	**NT**
ANT	----	**0.86**	**NT**	**1.51**	**NT**	**0.47**

Table TR02.4: Transmit Power Summary in mW for BLE and ANT protocols using RF Exposure analytical methods

For Wifi, yellow highlighted cells indicate the highest RF Exposure value for each radio protocol.

Mode	Speed	1	2	3	4	5	6	7	8	9	10	11	12	13
B	1	**22.64**	**NT**	**NT**	**NT**	**NT**	**20.42**	**NT**	**NT**	**NT**	**NT**	**18.21**	**NT**	**0.74**
B	2	**22.32**	**NT**	**NT**	**NT**	**NT**	**20.16**	**NT**	**NT**	**NT**	**NT**	**17.95**	**NT**	**0.73**
B	5.5	**21.57**	**NT**	**NT**	**NT**	**NT**	**24.08**	**NT**	**NT**	**NT**	**NT**	**18.74**	**NT**	**0.73**
B	11	**19.40**	**18.75**	**18.96**	**18.89**	**18.38**	**21.98**	**16.62**	**17.47**	**16.96**	**16.25**	**16.61**	**0.68**	**0.67**
G	6	**17.18**	**NT**	**NT**	**NT**	**NT**	**16.37**	**NT**	**NT**	**NT**	**NT**	**4.74**	**NT**	**1.00**
G	9	**16.62**	**NT**	**NT**	**NT**	**NT**	**15.97**	**NT**	**NT**	**NT**	**NT**	**4.58**	**NT**	**0.96**
G	12	**17.03**	**18.46**	**16.99**	**16.19**	**15.58**	**15.06**	**14.28**	**13.71**	**12.58**	**10.72**	**5.22**	**1.12**	**1.06**
G	18	**14.54**	**NT**	**NT**	**NT**	**NT**	**12.58**	**NT**	**NT**	**NT**	**NT**	**5.03**	**NT**	**1.02**
G	24	**10.63**	**NT**	**NT**	**NT**	**NT**	**9.21**	**NT**	**NT**	**NT**	**NT**	**4.63**	**NT**	**0.95**
G	36	**9.35**	**NT**	**NT**	**NT**	**NT**	**6.45**	**NT**	**NT**	**NT**	**NT**	**4.42**	**NT**	**0.85**
G	48	**6.81**	**NT**	**NT**	**NT**	**NT**	**5.83**	**NT**	**NT**	**NT**	**NT**	**4.03**	**NT**	**0.79**
G	54	**6.46**	**NT**	**NT**	**NT**	**NT**	**5.49**	**NT**	**NT**	**NT**	**NT**	**3.87**	**NT**	**0.75**
N	6.5	**14.51**	**NT**	**NT**	**NT**	**NT**	**15.46**	**NT**	**NT**	**NT**	**NT**	**4.53**	**NT**	**0.96**
N	13	**14.72**	**NT**	**NT**	**NT**	**NT**	**14.82**	**NT**	**NT**	**NT**	**NT**	**5.04**	**NT**	**1.04**
N	19.5	**13.55**	**16.41**	**15.92**	**15.02**	**14.52**	**15.12**	**13.69**	**13.00**	**11.07**	**10.49**	**10.49**	**1.06**	**0.99**
N	26	**12.81**	**NT**	**NT**	**NT**	**NT**	**11.58**	**NT**	**NT**	**NT**	**NT**	**4.69**	**NT**	**0.91**
N	39	**9.34**	**NT**	**NT**	**NT**	**NT**	**7.45**	**NT**	**NT**	**NT**	**NT**	**4.37**	**NT**	**0.87**
N	52	**6.74**	**NT**	**NT**	**NT**	**NT**	**5.84**	**NT**	**NT**	**NT**	**NT**	**4.18**	**NT**	**0.85**
N	58.5	**6.80**	**NT**	**NT**	**NT**	**NT**	**5.67**	**NT**	**NT**	**NT**	**NT**	**4.10**	**NT**	**0.79**
N	65	**5.14**	**NT**	**NT**	**NT**	**NT**	**4.27**	**NT**	**NT**	**NT**	**NT**	**3.45**	**NT**	**0.76**
N	72.2	**5.02**	**NT**	**NT**	**NT**	**NT**	**4.43**	**NT**	**NT**	**NT**	**NT**	**3.30**	**NT**	**0.72**

Table TR02.5: WiFi RF exposure power summary in mW for IEEE 802.11b/g/n protocols using RF Exposure analytical methods

The duty cycle embedded in power measurements was 100% for BLE, ANT and Wifi protocols, therefore the duty cycle results are not tabulated.

Setup Diagram
The following block diagrams show how the EUT and test equipment is arranged for test.

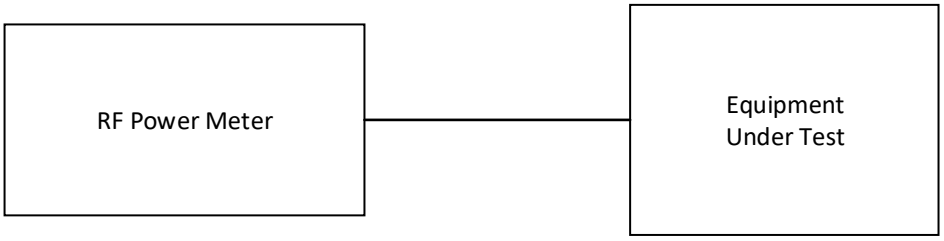


Figure TR02.1: Test equipment setup

This line is the end of the test record.

Test Record
Conducted Spurious Emissions
Test IDs TR27, TR28, TR29
Project GCL-0575

Test Date(s)	05 Jul 2024
Test Personnel	Majid Farah
Product Model	A04666
Serial Number tested	3475366137
Operating Mode	M3 (BleTx), M5 (AntTx), M7 (WifiTx)
Arrangement	A4 (USB)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	**Matt Carroll**
Date of this test record:	**09 Jul 2024**

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44GHz	Keysight	N9048B	MY62220139	13-Mar-2024	15-Mar-2025

Table TR27.1: Test equipment used

Software used: Keysight PXE software A.33.03.

Test Method

The basic test standards provide options for the test method. The following test methods were applied.
ANSI C63.10: 11.11.2 and 11.11.3

Test Setup

This block diagram shows the test equipment setup.

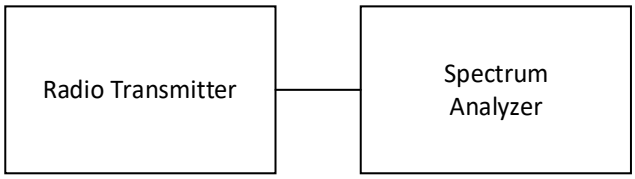


Figure TR27.1: Test setup

Test Data

The conducted spurious emission test measures the strength of intentional and unintentional radio signals conducted from the transmitter to the antenna across a wide range of frequencies. It does not evaluate whether intentional signals meet specific limits. Rather, it ensures that magnitudes unintentional signals are sufficiently reduced relative to the intentional signal to satisfy the requirements of the relevant standards.

This measurement requires that a coaxial feed line from the transmitter is available as a connector exterior to the test sample. This feed line and connector may be a part of the shipping product, or it may be a special modification

to the product for testing purposes. The connector is attached via laboratory cables to the measurement instrument. The results have been adjusted to account for the losses in the laboratory cables. Where feasible, the losses of any added feed lines are also included in that adjustment.

Data is collected using the required detector function(s) across the frequency range. The instrument uses a 100 kHz bandwidth detector.

The data table below shows the final measurement data which may be at harmonics of the carrier, or at frequencies that represent one of the highest data points measured.

For BLE operating at 2 Mbps, the lowest operating frequency was 2404 MHz, and the highest operating frequency was 2478 MHz. For BLE, operating at 1 Mbps, the lowest operating frequency was 2402 MHz, and the highest operating frequency was 2480 MHz.

The peak level of the fundamental is also identified. The harmonics or spurious emissions must be reduced from this fundamental level by 20 dBc. This harmonic limit is calculated and used to determine compliance. A reduction from the carrier that is greater than 20 is a passing result. The minimum margin from the peak level for each mode are highlighted in yellow.

Data plots are provided for the worst-case data sets. One plot shows the spectrum at the carrier, and another shows the spectrum across the band. On this second plot, a green reference line is at approximately the 20 dBc maximum spurious emission level.

		2402 (04)	2440	2480 (78)
BLE	1 Mb	**53.22**	**55.76**	**53.84**
	2 Mb	**56.70**	**57.32**	**52.68**
ANT		**54.57**	**53.26**	**48.67**

Table TR27.2: Results Summary for BLE and ANT in dBc

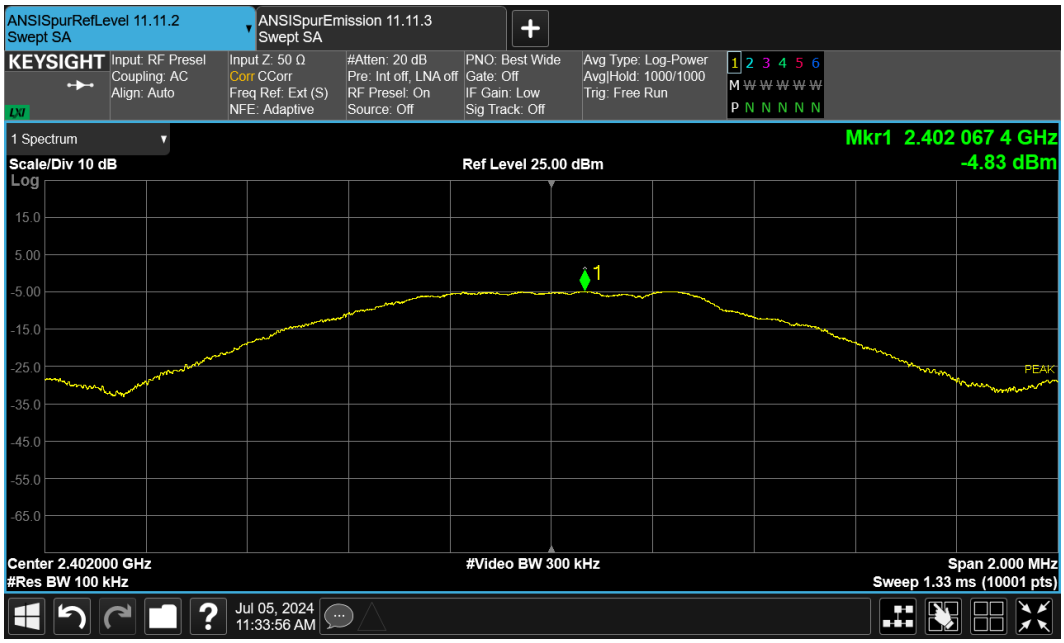


Figure TR27.2: Reference level measurement for BLE 1 at 2402 MHz

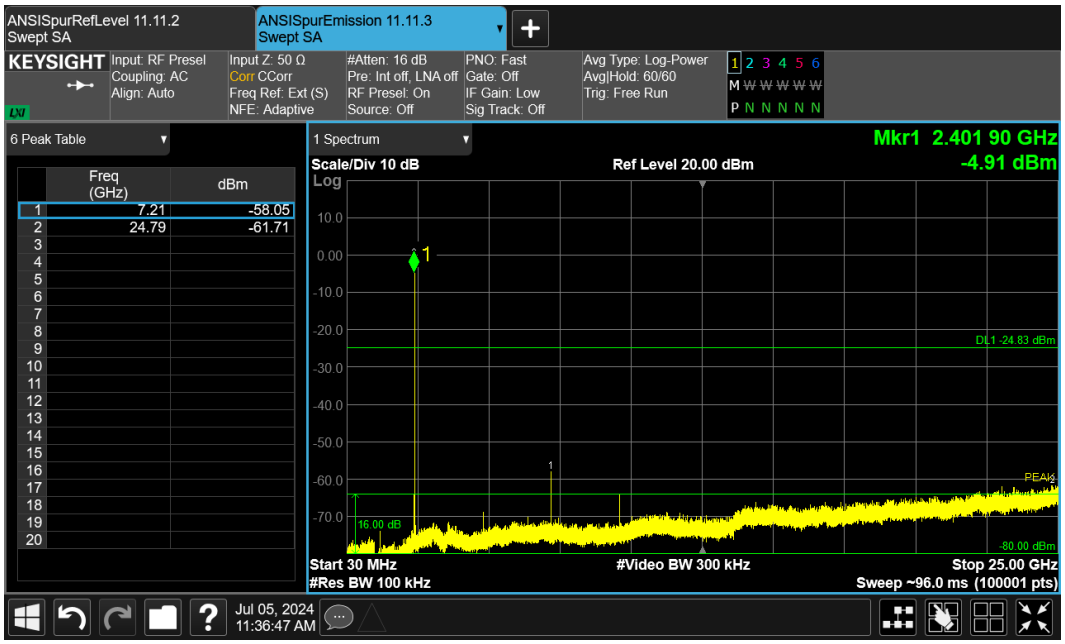


Figure TR27.3: Spectral data for BLE 1 at 2402 MHz

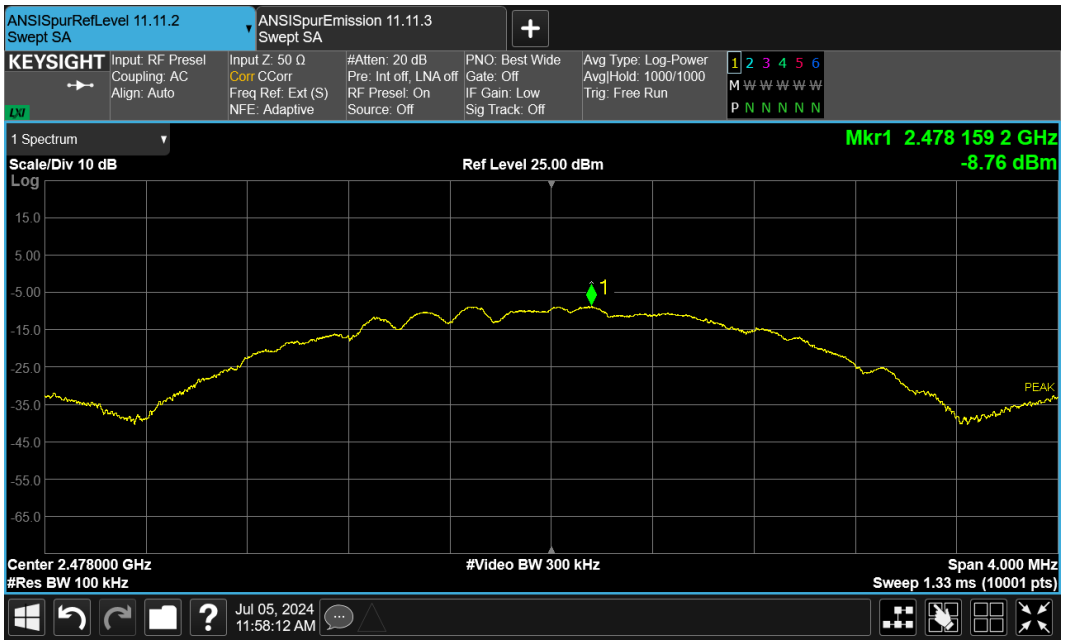


Figure TR27.4: Reference level measurement for BLE 2 Mbps at 2478 MHz

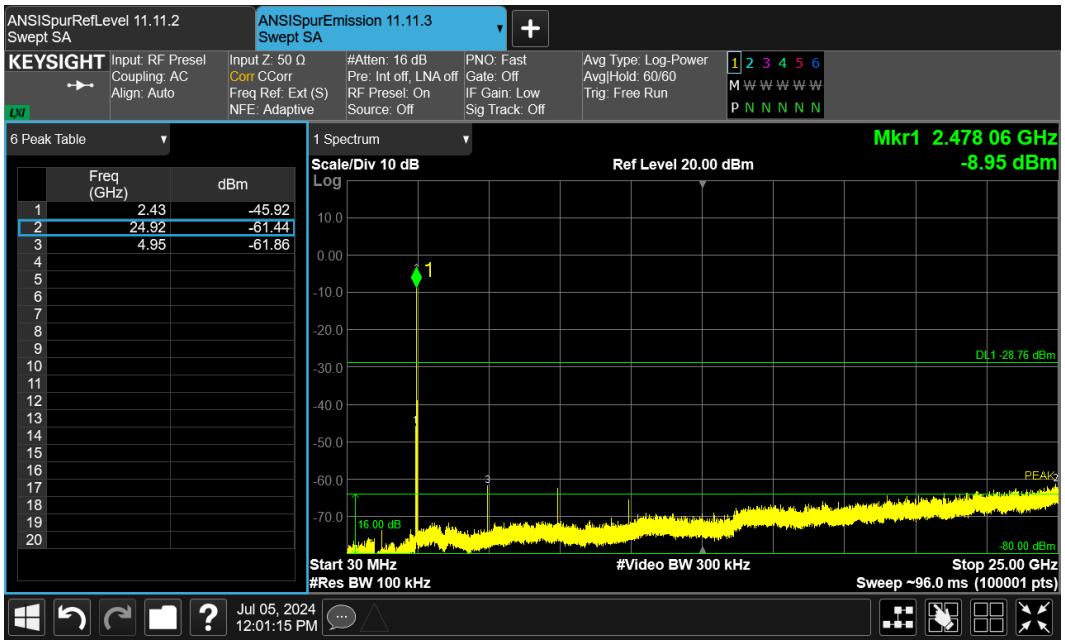


Figure TR27.5 Spectral data for BLE 2 Mbps at 2478 MHz

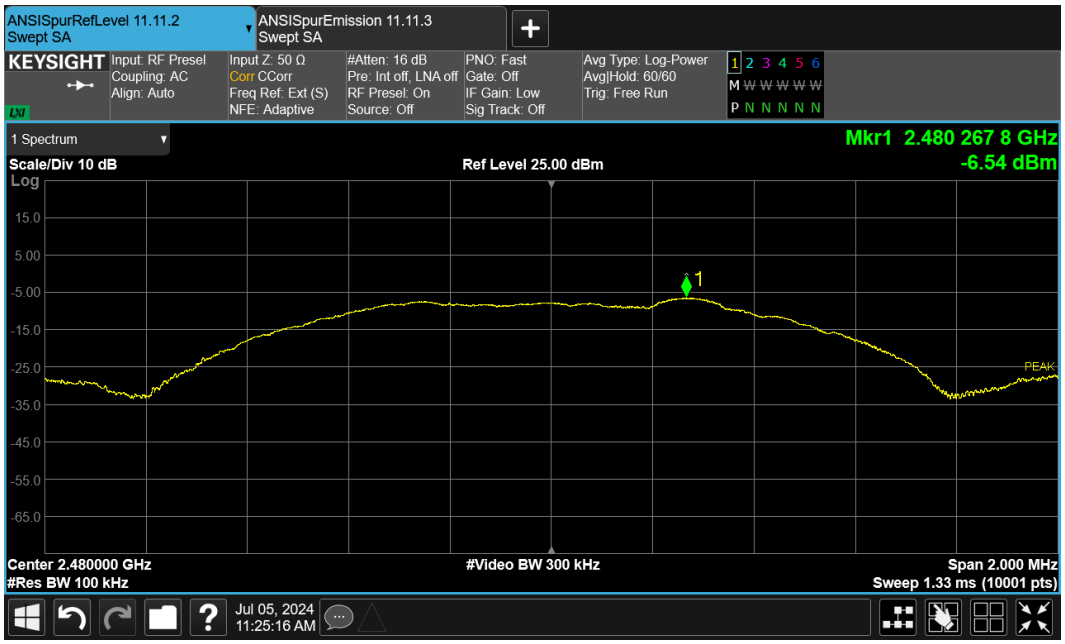


Figure TR27.6: Reference level measurement for ANT at 2480 MHz

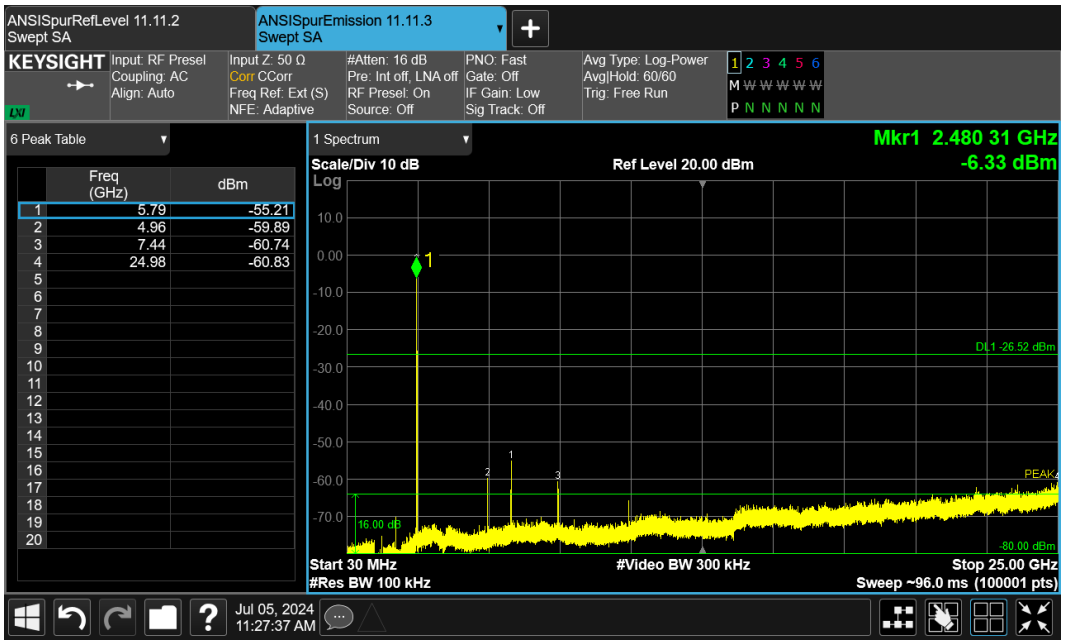


Figure TR27.7 Spectral data for ANT at 2480 MHz

	Speed (Mbps)	Channel 1	Channel 6	Channel 11	Channel 13
B	11	**54.83**	**50.29**	**55.08**	**40.45**
G	12	**49.68**	**52.41**	**45.21**	**38.67**
N	19.5	**48.09**	**52.08**	**43.73**	**39.00**

Table TR27.3: Results Summary for Wifi in dBc

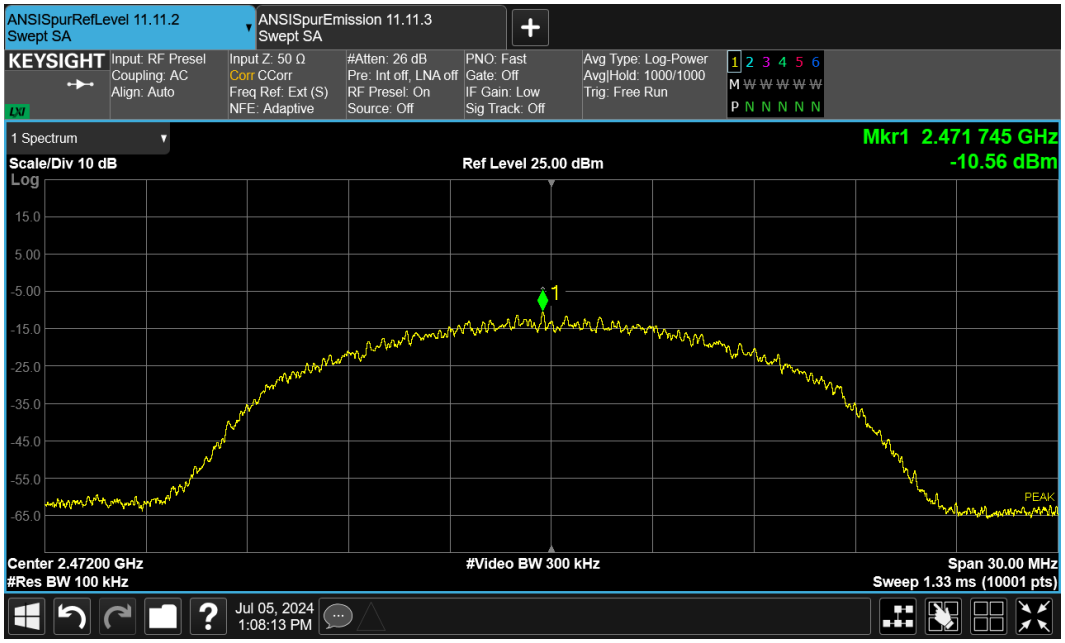


Figure TR27.8 Reference level measurement for IEEE 802.11b channel 13 at 11 Mbps

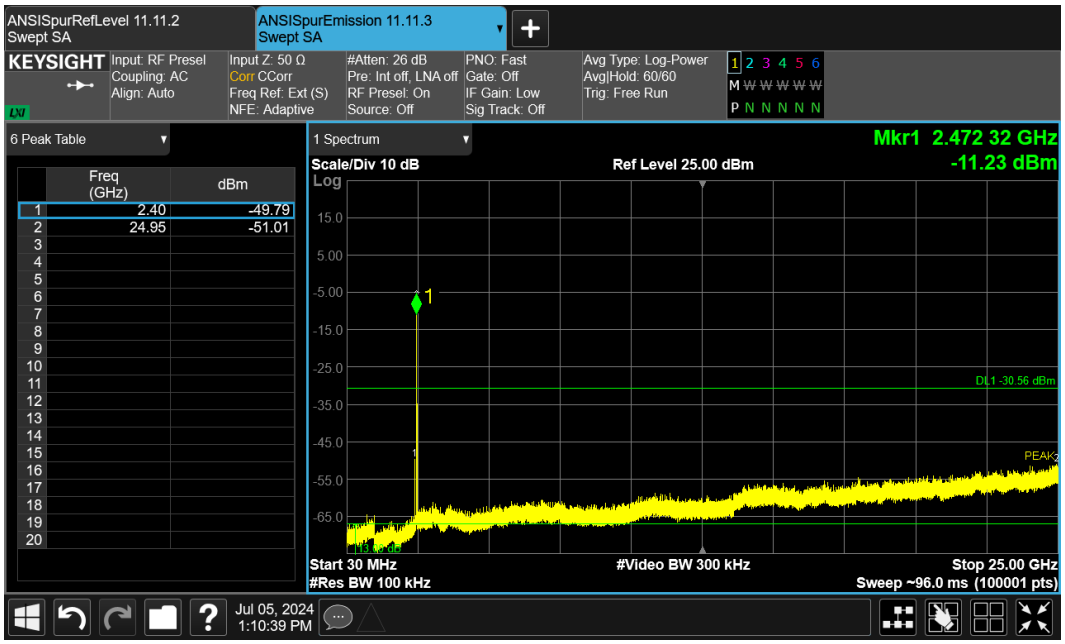


Figure TR27.9 Spectral data for IEEE 802.11b channel 13 at 11 Mbps

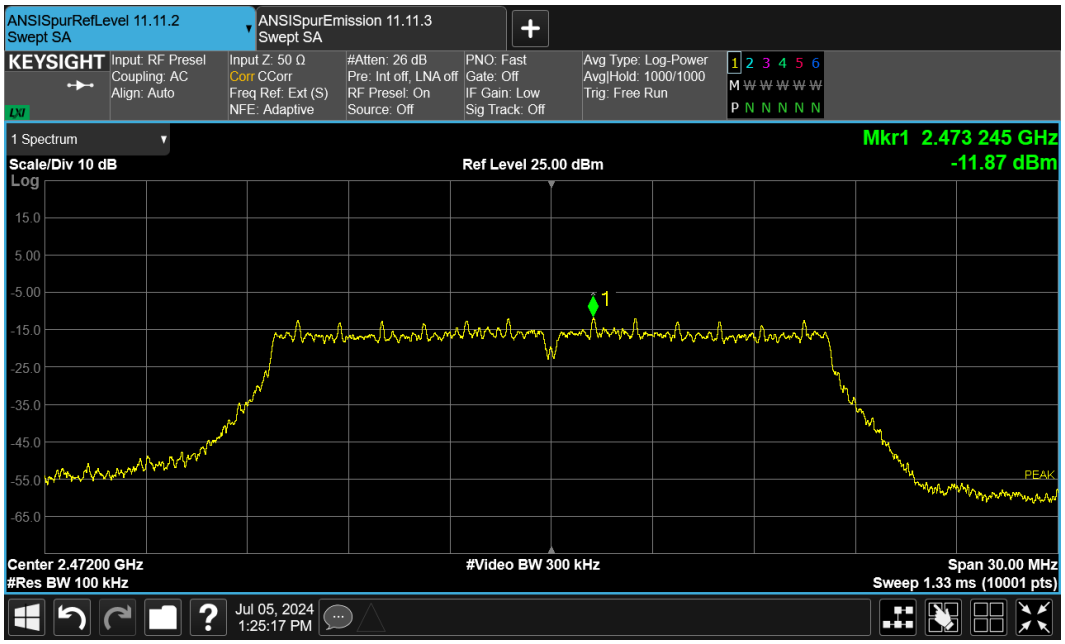


Figure TR27.10 Reference level measurement for IEEE 802.11g channel 13 at 12 Mbps

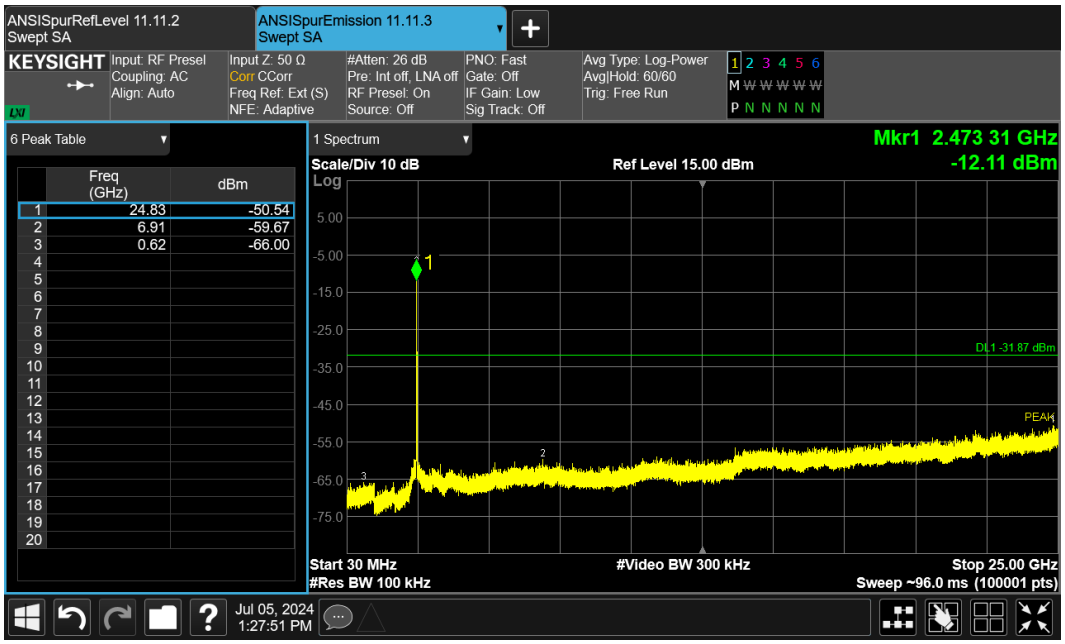


Figure TR27.11 Spectral data for IEEE 802.11g channel 13 at 12 Mbps

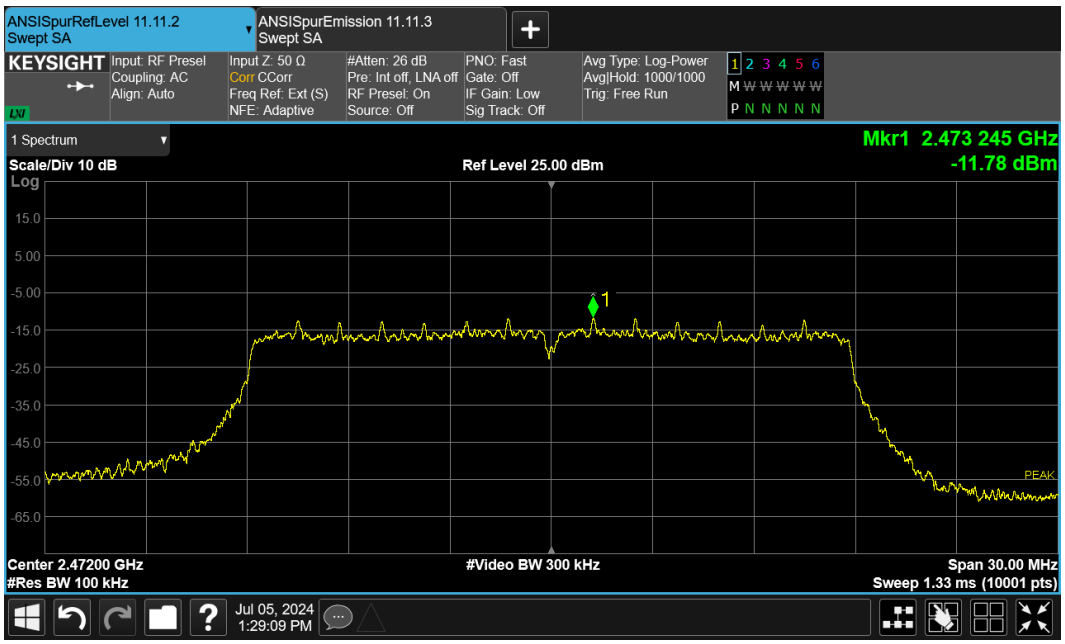


Figure TR27.12 Reference level measurement for IEEE 802.11n channel 13 at 19.5 Mbps

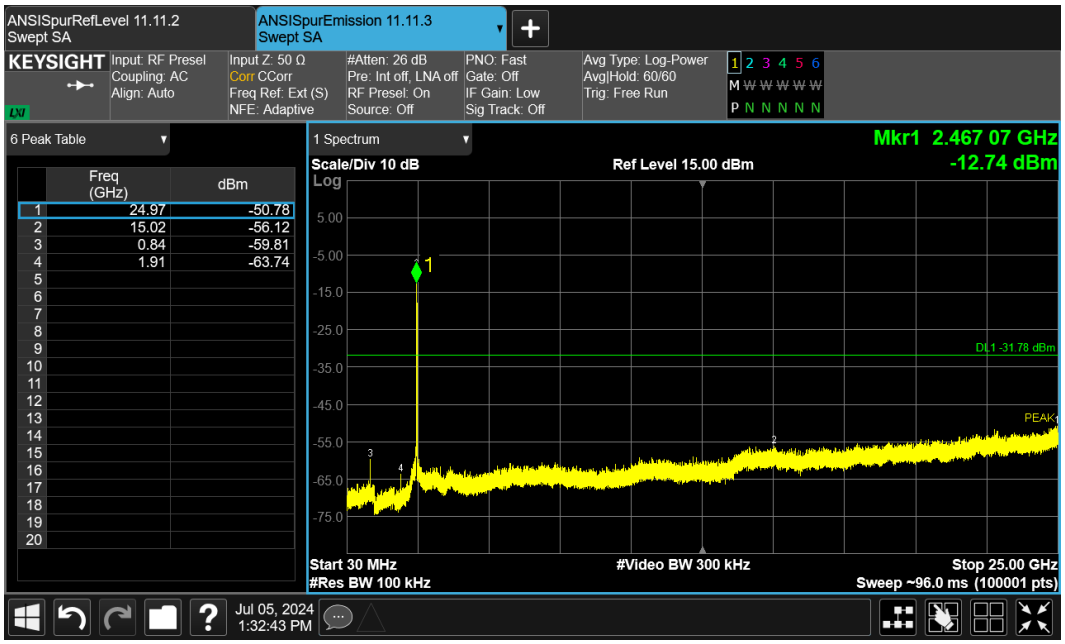


Figure TR27.13 Spectral data for IEEE 802.11n channel 13 at 19.5 Mbps

This line is the end of the test record.

Test Record
Radiated Emission Test RE01
Project GCL0575

Test Date(s)	01 Jul 2024
Test Personnel	David Kerr
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx)
Arrangement	A2 (Upwr)
Input Power	115 V/ 60 Hz
Test Standards:	FCC Part 15 (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:	01 Jul 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	227596	14-Sep-2023	14-Sep-2025
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Tape measure, 1" x 33'	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 RE01.1: Test Equipment Used

Software Used
Keysight PXE receiver software A.32.06, GCL 0575 RE Signal Maximization Tool v2023Jul14.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.

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 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.

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)	---
2387	54	74	42.562	55.504	11.438	18.496	-16	1161	HORZ
2385.8	54	74	42.674	55.836	11.326	18.164	-16	1161	HORZ

Table RE01.2: FCC restricted bands from 2200 to 2390 MHz (ch1 B 1Mbs, X orientation)

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)	---
2388.5	54	74	41.945	56.52	12.055	17.48	-16	1161	HORZ
2387.5	54	74	42.216	56.6675	11.784	17.3325	-16	1161	HORZ

Table RE01.3: FCC restricted band from 2483.5 to 2500 MHz (ch1 B 11Mbs, X orientation)

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)	---
2389.8	54	74	50.422	69.295	3.578	4.705	-16	1161	HORZ
2390	54	74	50.578	68.937	3.422	5.063	-16	1161	HORZ

Table RE01.4: FCC restricted band from 2483.5 to 2500 MHz (ch1 G12 11Mbs, X orientation)

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)	---
2390	54	74	47.795	65.505	6.205	8.495	-16	1161	HORZ
2390	54	74	47.763	65.255	6.237	8.745	-16	1161	HORZ

Table RE01.5: FCC restricted band from 2483.5 to 2500 MHz (ch1 G18 11Mbs, X orientation)

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)	---
2390	54	74	51.098	69.17	2.902	4.83	-16	1161	HORZ
2390	54	74	51.074	62.279	2.926	11.721	-16	1161	HORZ

Table RE01.6: FCC restricted band from 2483.5 to 2500 MHz (ch1 N 13Mbs, X orientation)

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)	---
2390	54	74	49.301	68.051	4.699	5.949	-16	1161	HORZ
2389.5	54	74	49.172	67.345	4.828	6.655	-16	1161	HORZ

Table RE01.7: FCC restricted band from 2483.5 to 2500 MHz (ch1 N 26Mbs, X orientation)

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)	---
2390	54	74	49.988	67.492	4.012	6.508	-16	1161	HORZ
2390	54	74	49.961	67.578	4.039	6.422	-16	1161	HORZ

Table RE01.8: FCC restricted band from 2483.5 to 2500 MHz (ch2 N 13Mbs, X orientation)

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)	---
2388.5	54	74	47.096	66.848	6.904	7.152	-16	1161	HORZ
2390	54	74	47.78	65.744	6.22	8.256	-16	1161	HORZ

Table RE01.9: FCC restricted band from 2483.5 to 2500 MHz (ch2 N 26Mbs, X orientation)

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	37.032	49.887	16.968	24.113	-76	3523	HORZ
2483.5	54	74	37.045	50.515	16.955	23.485	-76	3523	HORZ

Table RE01.10: FCC restricted band from 2483.5 to 2500 MHz (ch10 B 2Mbs, X orientation)

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	54	74	37.084	56.518	16.916	17.482	-76	3523	HORZ
2500	54	74	37.897	54.206	16.103	19.794	-76	3523	HORZ

Table RE01.11: FCC restricted band from 2483.5 to 2500 MHz (ch10 G 12Mbs, X orientation)

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)	---
2488.3	54	74	37.393	57.013	16.607	16.987	-76	3523	HORZ
2493.5	54	74	38.012	55.638	15.988	18.362	-76	3523	HORZ

Table RE01.12: FCC restricted band from 2483.5 to 2500 MHz (ch10 G 18Mbs, X orientation)

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	39.781	60.132	14.219	13.868	-76	3523	HORZ
2487.5	54	74	39.927	59.541	14.073	14.459	-76	3523	HORZ

Table RE01.13: FCC restricted band from 2483.5 to 2500 MHz (ch10 N 13Mbs, X orientation)

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	54	74	43.044	53.696	10.956	20.304	-76	3523	HORZ
2487.8	54	74	43.231	53.453	10.769	20.547	-76	3523	HORZ

Table RE01.14: FCC restricted band from 2483.5 to 2500 MHz (ch11 B 1Mbs, X orientation)

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)	---
2483.8	54	74	36.499	54.988	17.501	19.012	-76	3523	HORZ
2500	54	74	37.136	51.698	16.864	22.302	-76	3523	HORZ

Table RE01.15: FCC restricted band from 2483.5 to 2500 MHz (ch11 G 36Mbs, X orientation)

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	38.384	58.055	15.616	15.945	-76	3523	HORZ
2483.5	54	74	38.411	58.464	15.589	15.536	-76	3523	HORZ

Table RE01.16: FCC restricted band from 2483.5 to 2500 MHz (ch11 N 13Mbs, X orientation)

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)	---
2487.3	54	74	34.496	48.149	19.504	25.851	-76	3523	HORZ
2483.5	54	74	34.812	48.77	19.188	25.23	-76	3523	HORZ

Table RE01.17: FCC restricted band from 2483.5 to 2500 MHz (ch13 B 2Mbs, X orientation)

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)	---
2496.8	54	74	34.329	47.67	19.671	26.33	-76	3523	HORZ
2483.5	54	74	34.869	48.64	19.131	25.36	-76	3523	HORZ

Table RE01.18: FCC restricted band from 2483.5 to 2500 MHz (ch13 B 5.5Mbs, X orientation)

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)	---
2488.3	54	74	35.076	49.645	18.924	24.355	-76	3523	HORZ
2483.8	54	74	35.212	49.622	18.788	24.378	-76	3523	HORZ

Table RE01.19: FCC restricted band from 2483.5 to 2500 MHz (ch13 G 24Mbs, X orientation)

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)	---
2494.5	54	74	35.176	49.627	18.824	24.373	-76	3523	HORZ
2493.8	54	74	35.188	48.753	18.812	25.247	-76	3523	HORZ

Table RE01.20: FCC restricted band from 2483.5 to 2500 MHz (ch13 N 6.5Mbs, X orientation)

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)	---
2484.3	54	74	35.201	50.483	18.799	23.517	-76	3523	HORZ
2483.5	54	74	35.43	50.735	18.57	23.265	-76	3523	HORZ

Table RE01.21: FCC restricted band from 2483.5 to 2500 MHz (ch13 N 65Mbs, X orientation)

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

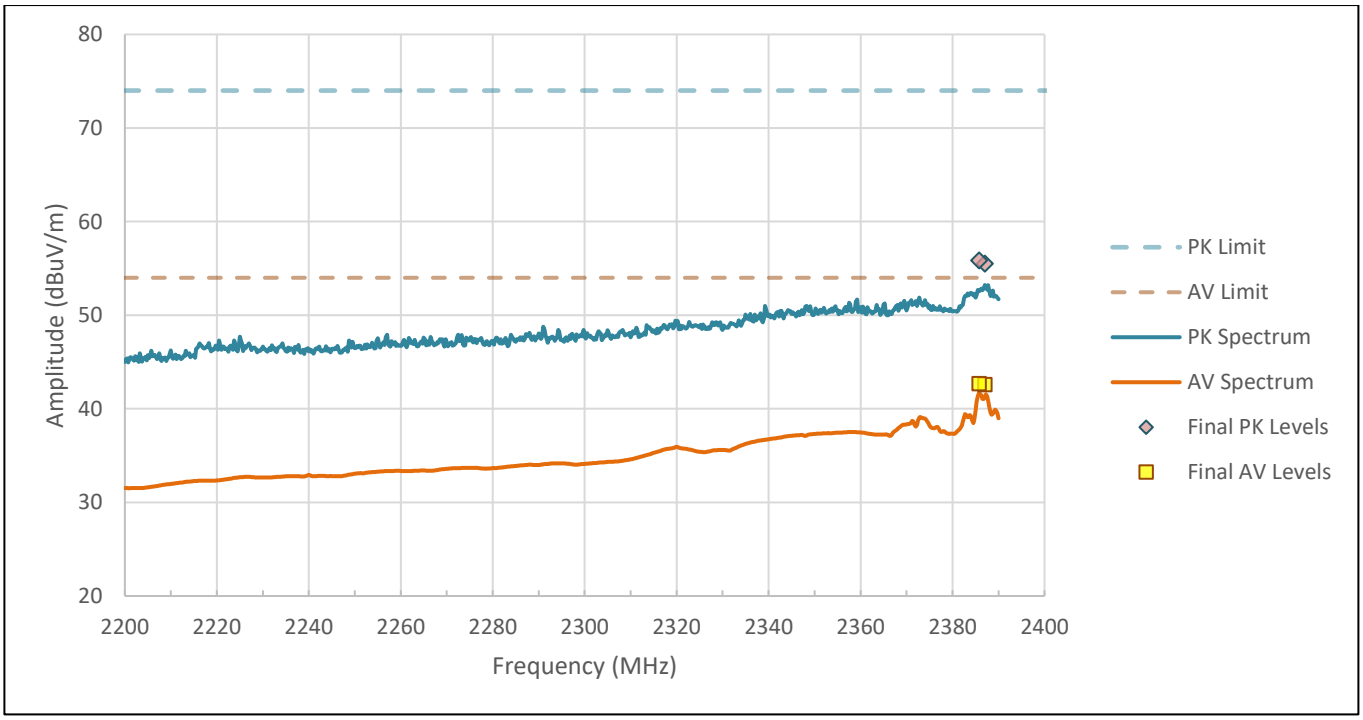


Figure RE01.1: FCC restricted band spectral data from 2200 to 2390 MHz (ch1 B 1Mbs, X orientation)

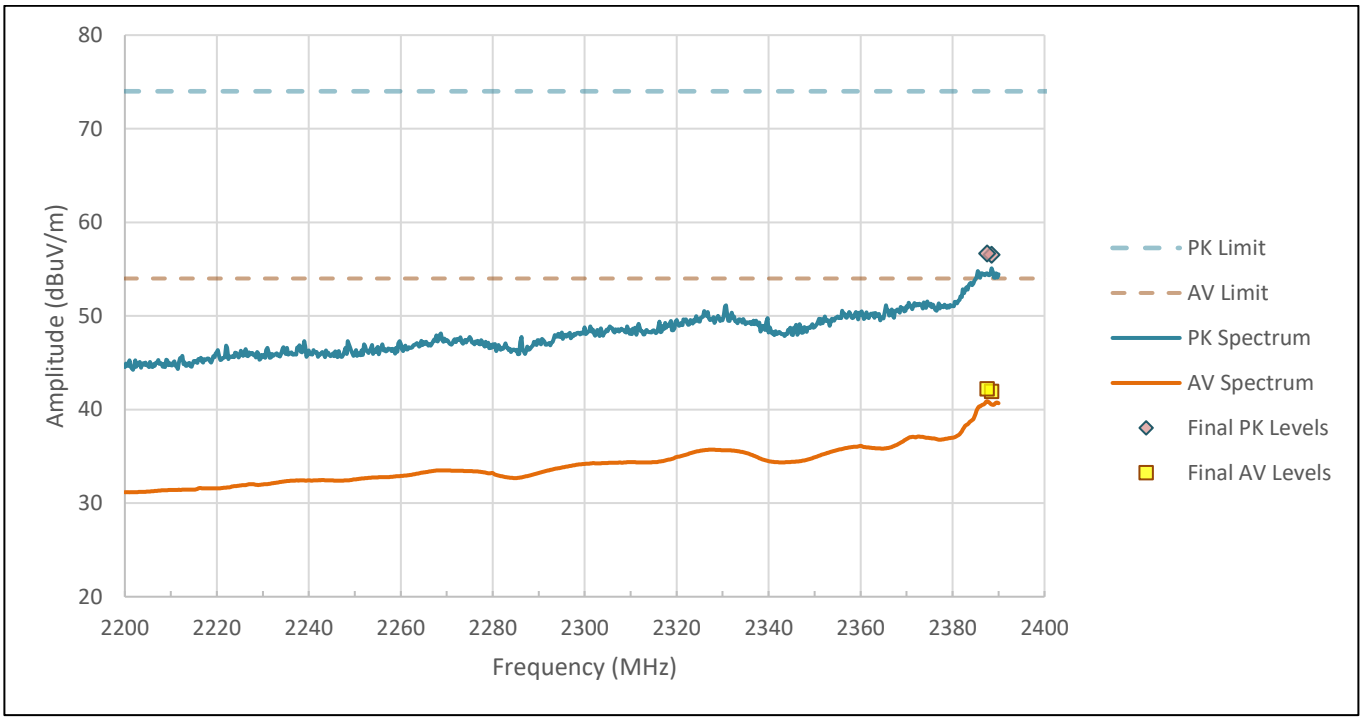


Figure RE01.2: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch1 B 11Mbs, X orientation)

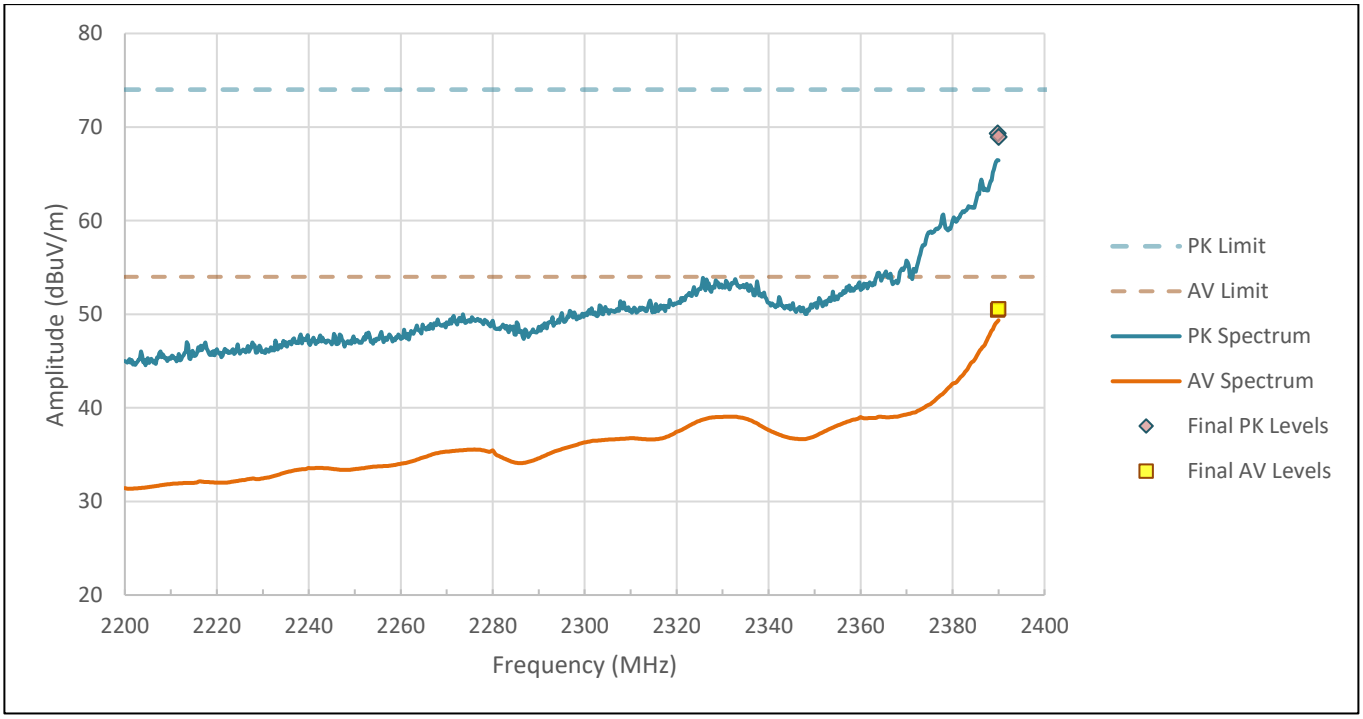


Figure RE01.3: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch1 G12 11Mbs, X orientation)

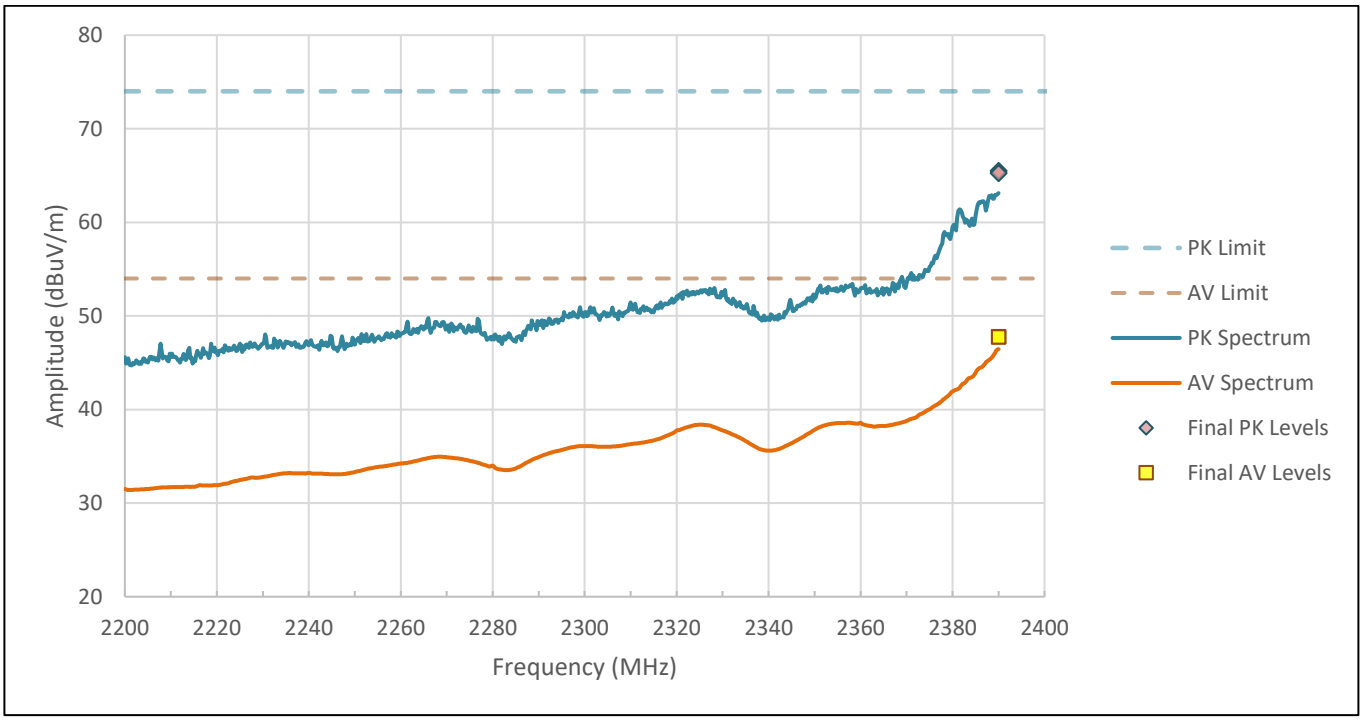


Figure RE01.4: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch1 G18 11Mbs, X orientation)

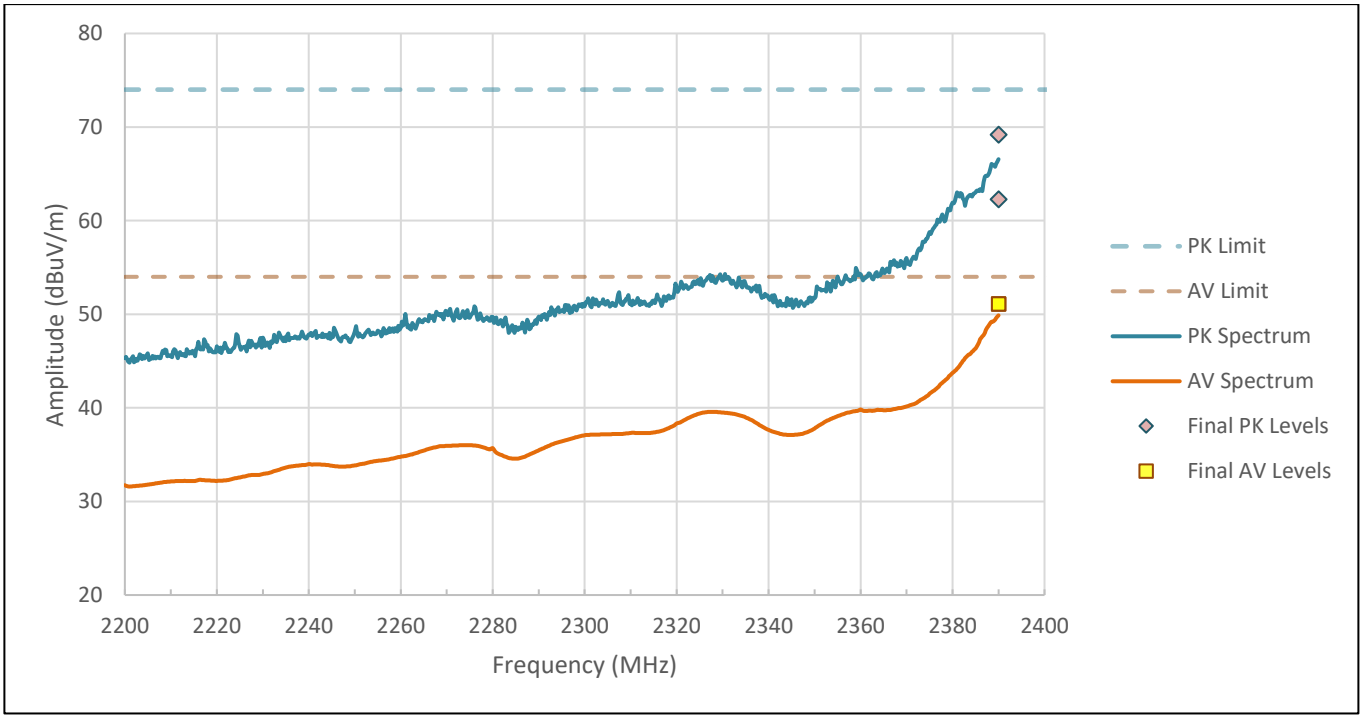


Figure RE01.5: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch1 N 13Mbs, X orientation)

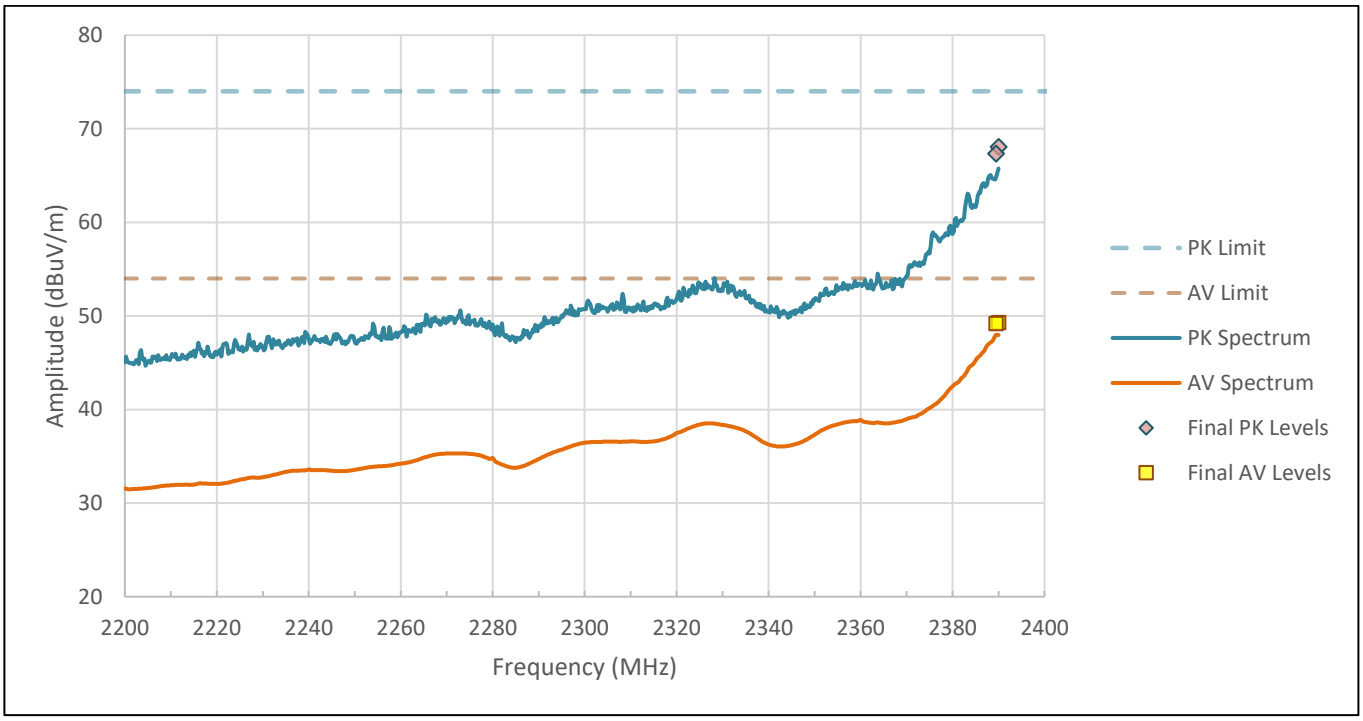


Figure RE01.6: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch1 N 26Mbs, X orientation)

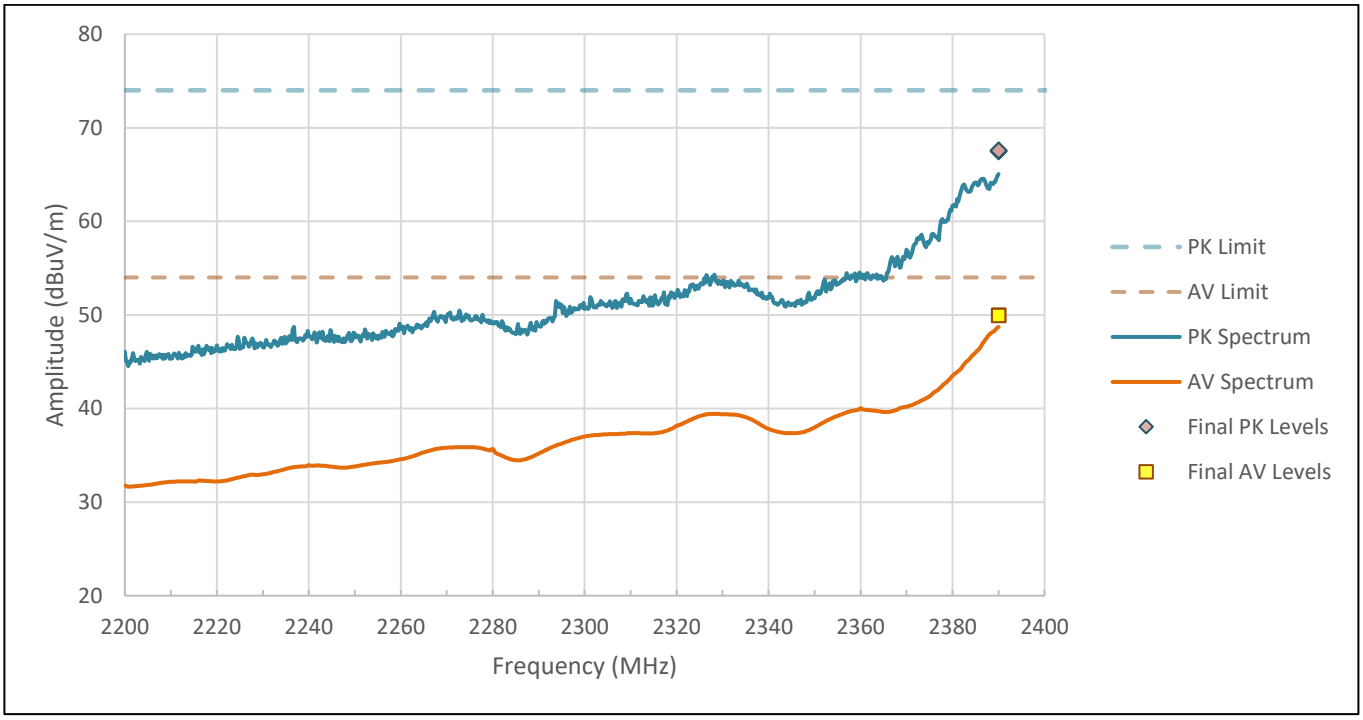


Figure RE01.7: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch2 N 13Mbs, X orientation)

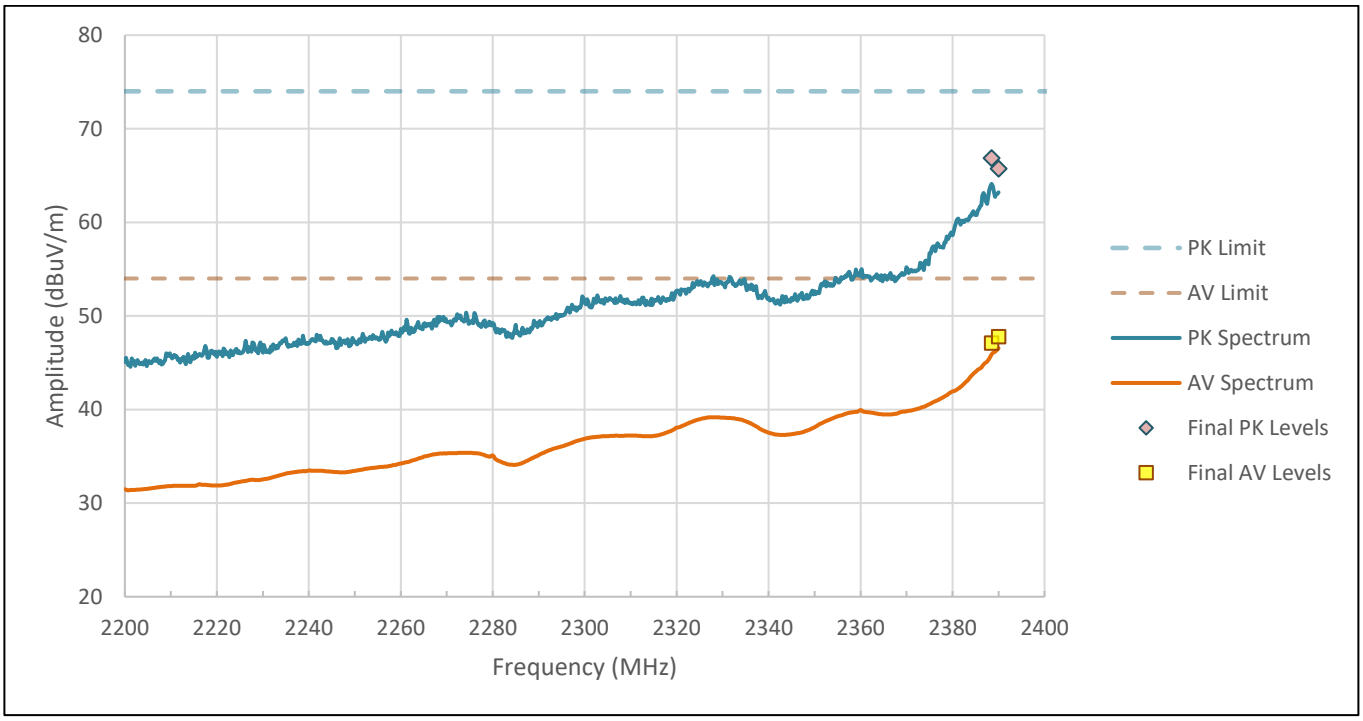


Figure RE01.8: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch2 N 26Mbs, X orientation)

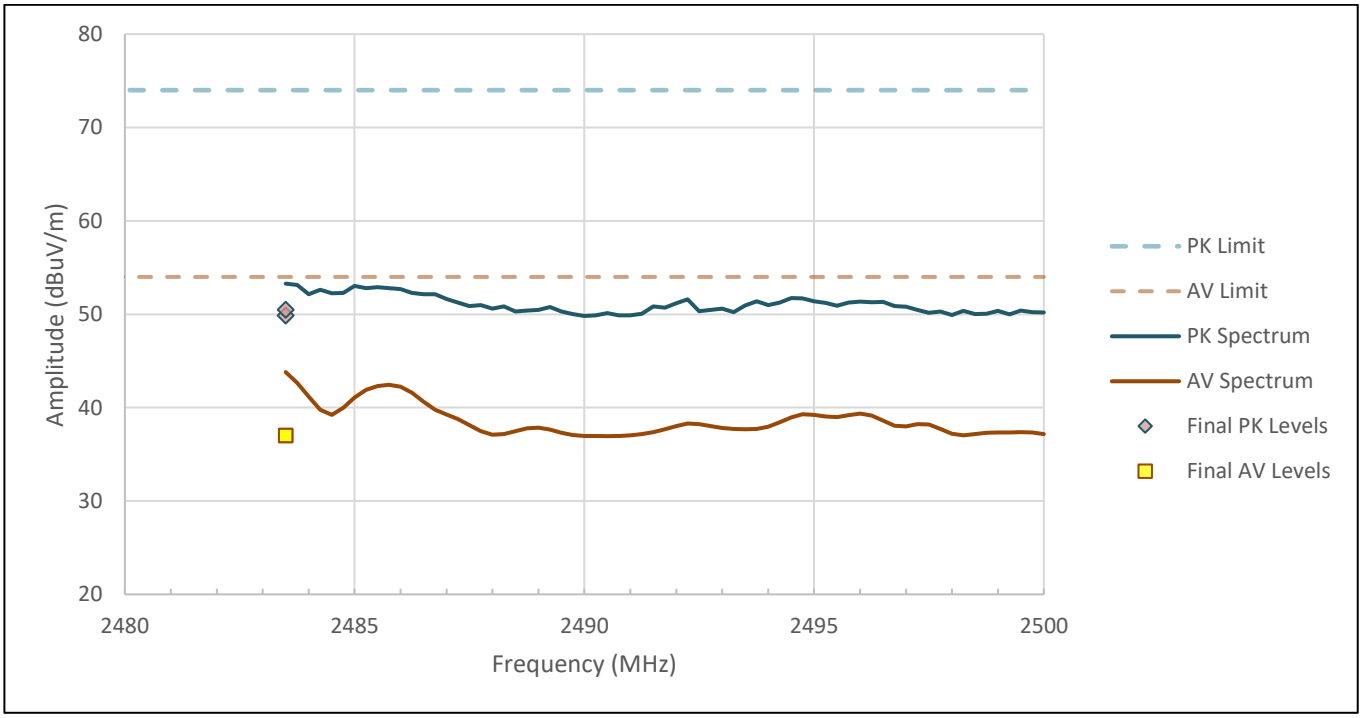


Figure RE01.9: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch10 B 2Mbs, X orientation)

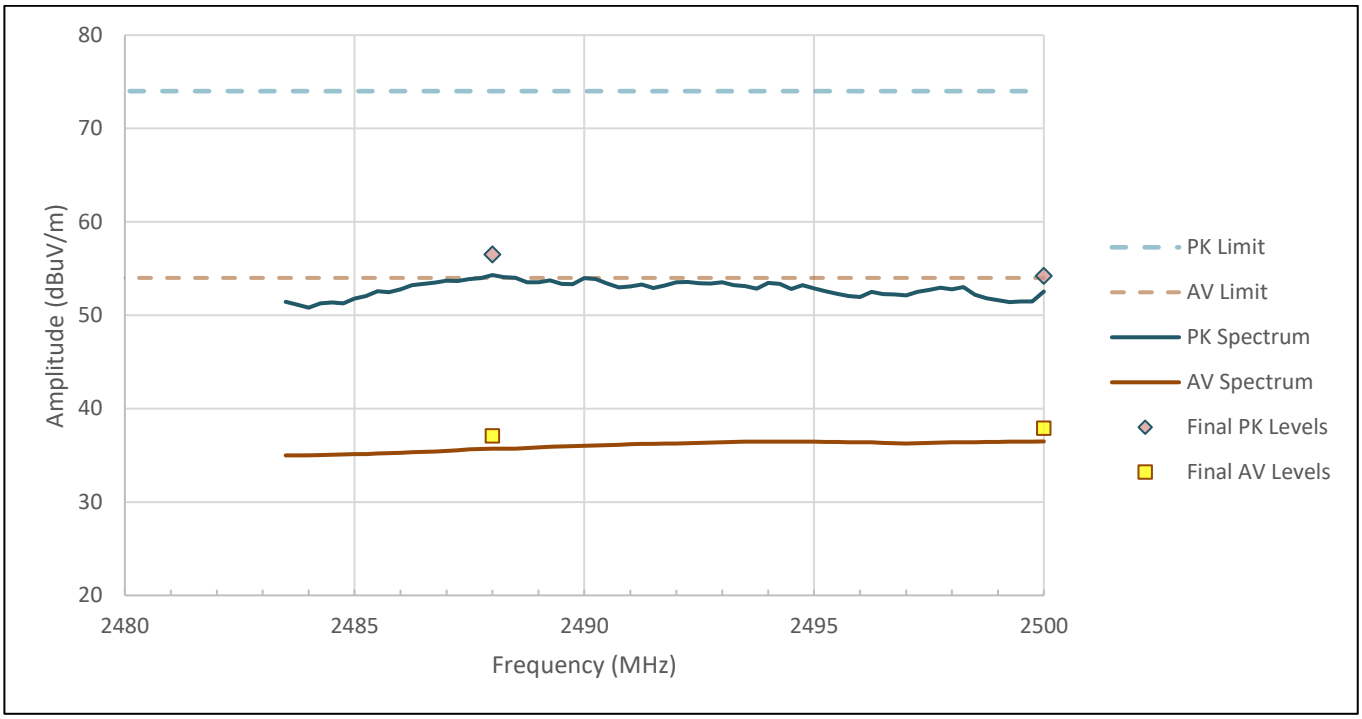


Figure RE01.10: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch10 G 12Mbs, X orientation)

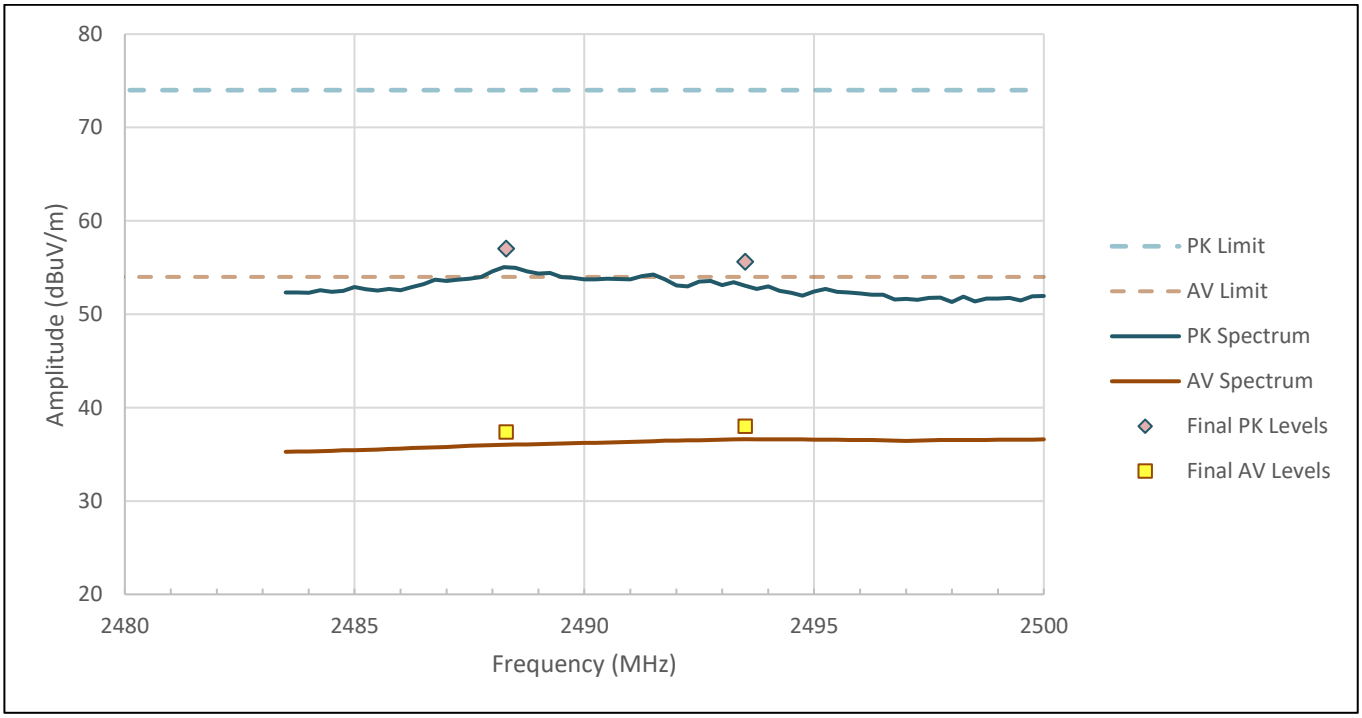


Figure RE01.11: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch10 G 18Mbs, X orientation)

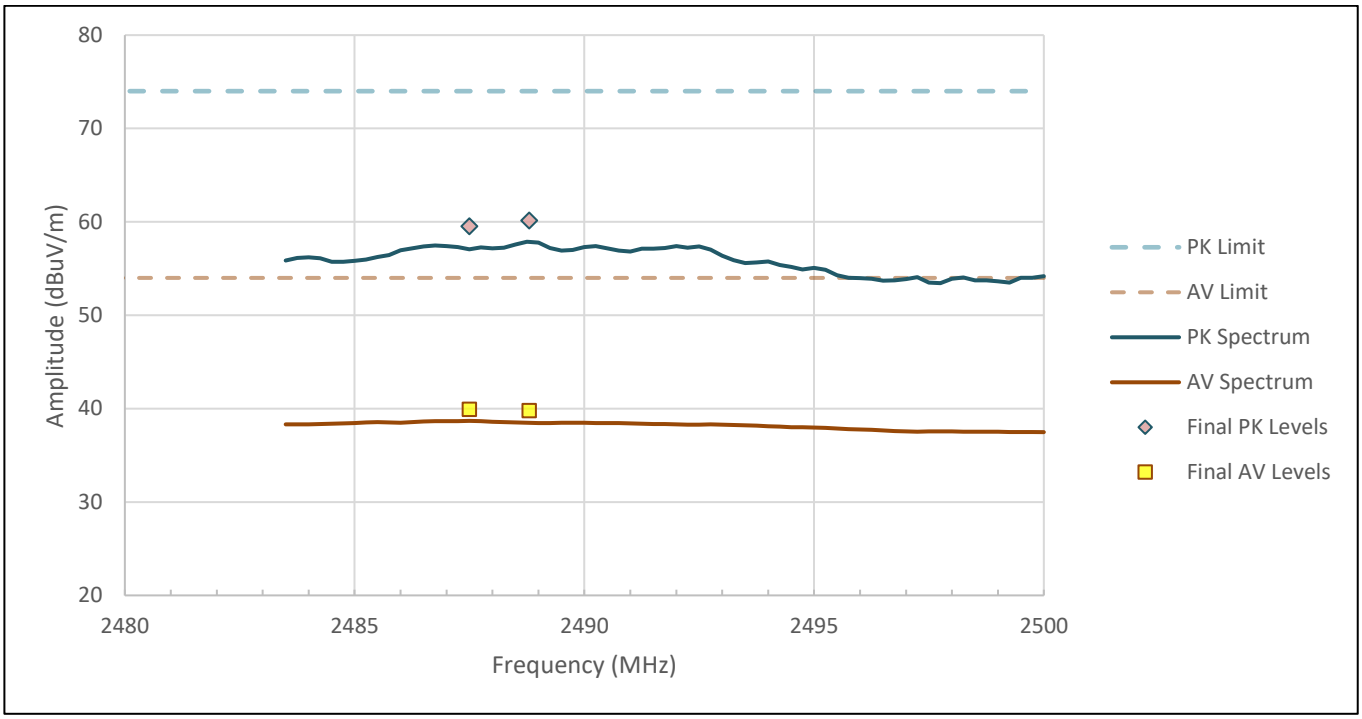


Figure RE01.12: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch10 N 13Mbs, X orientation)

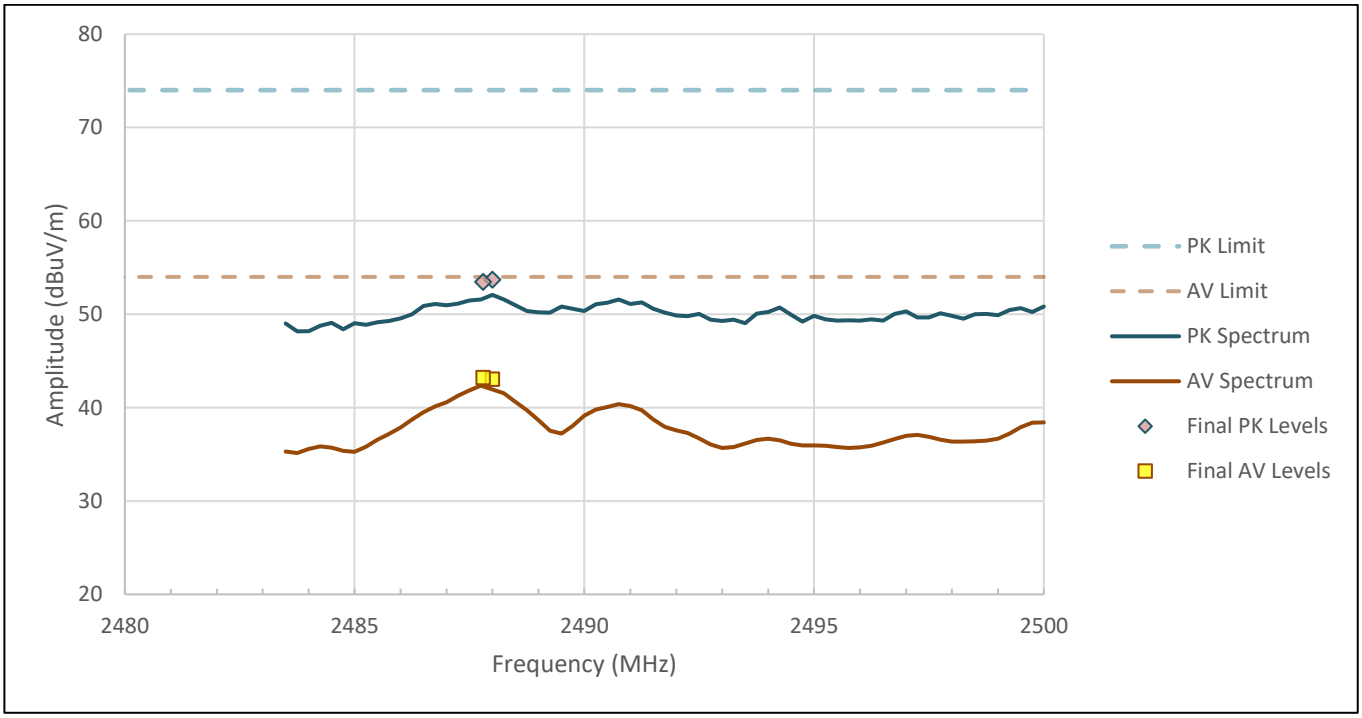


Figure RE01.13: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch11 B 1Mbs, X orientation)

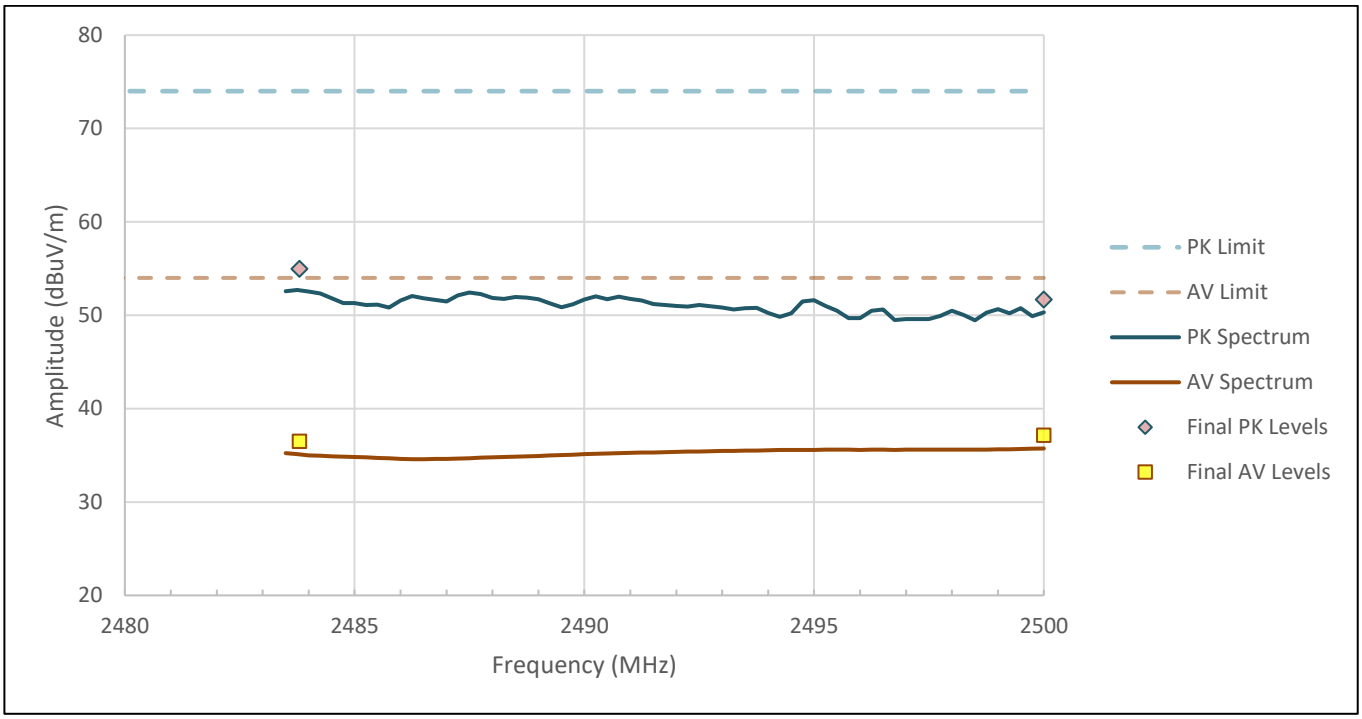


Figure RE01.14: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch11 G 36Mbs, X orientation)

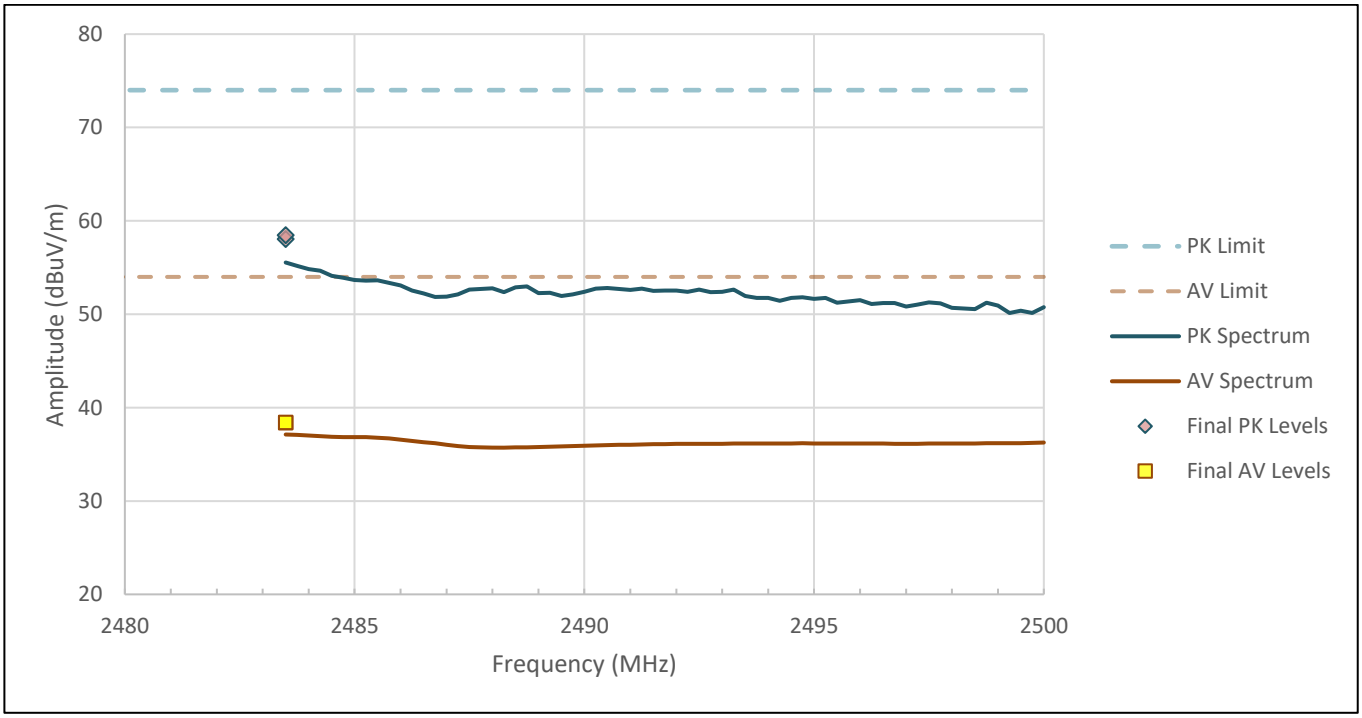


Figure RE01.15: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch11 N 13Mbs, X orientation)

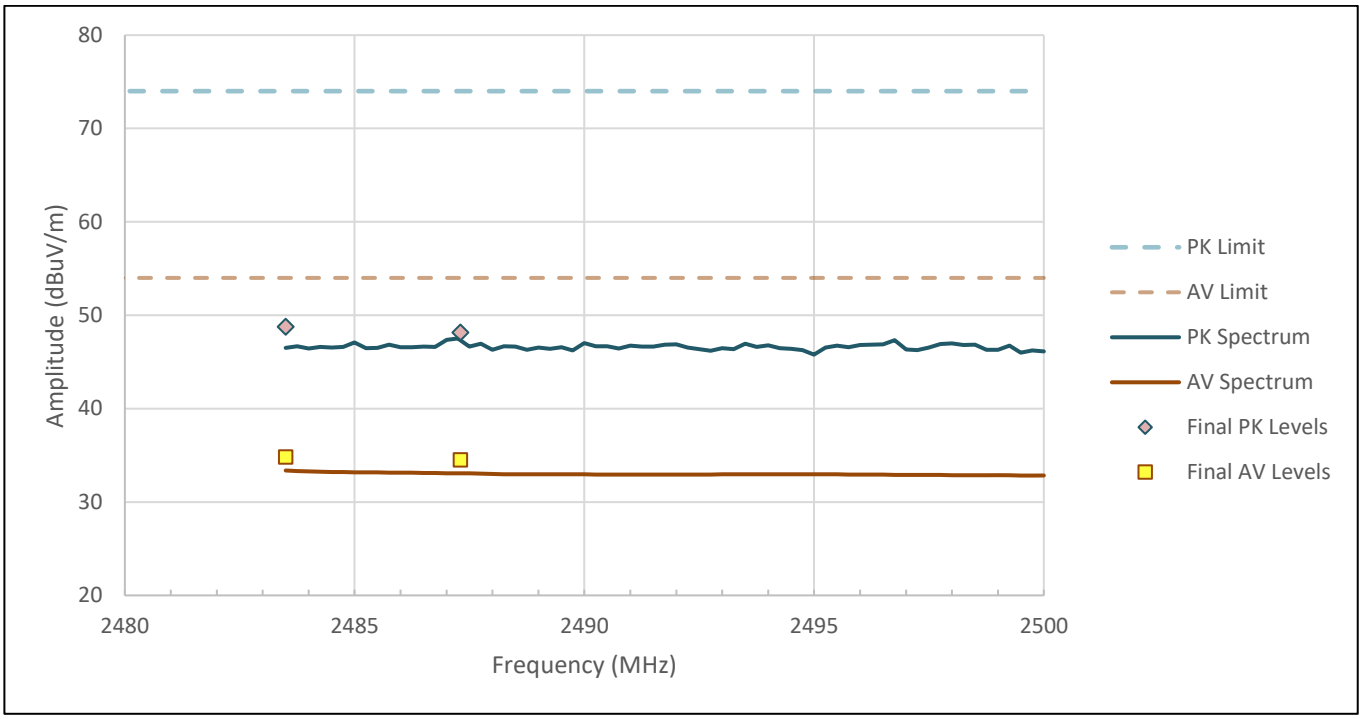


Figure RE01.16: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch13 B 2Mbs, X orientation)

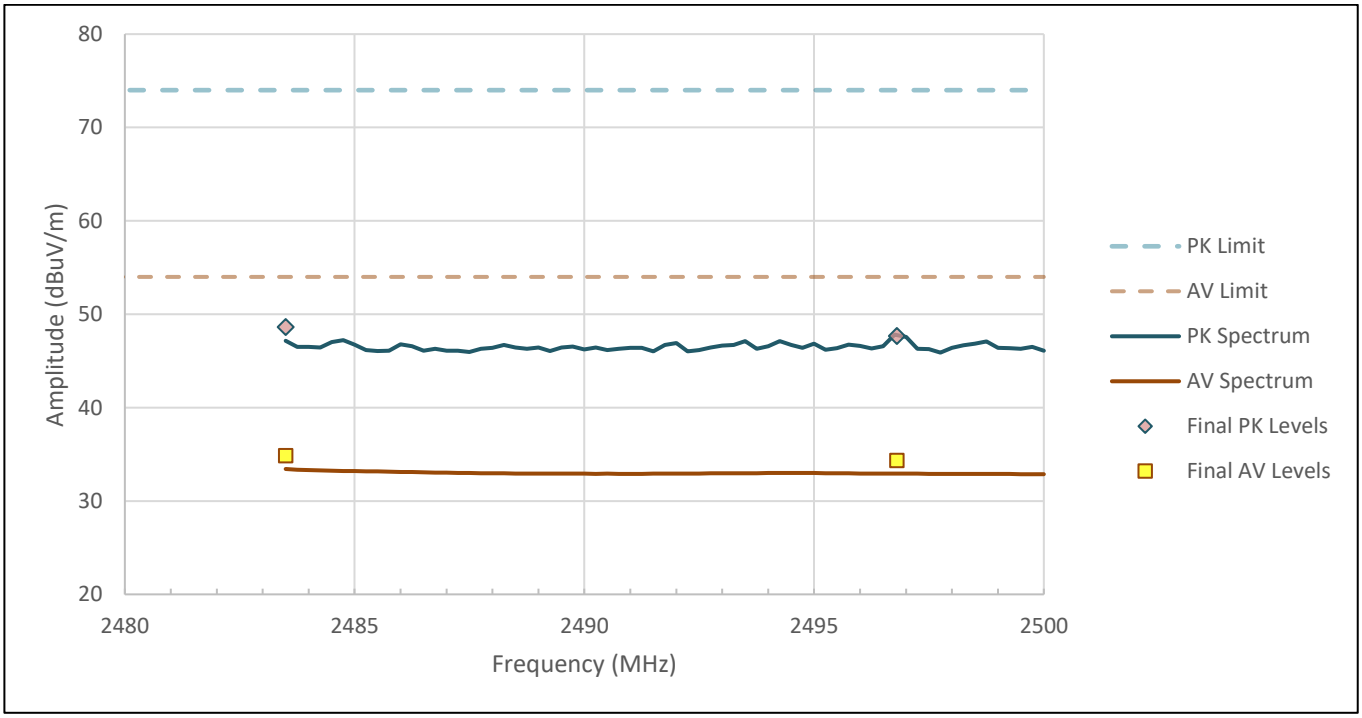


Figure RE01.17: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch13 B 5.5Mbs, X orientation)

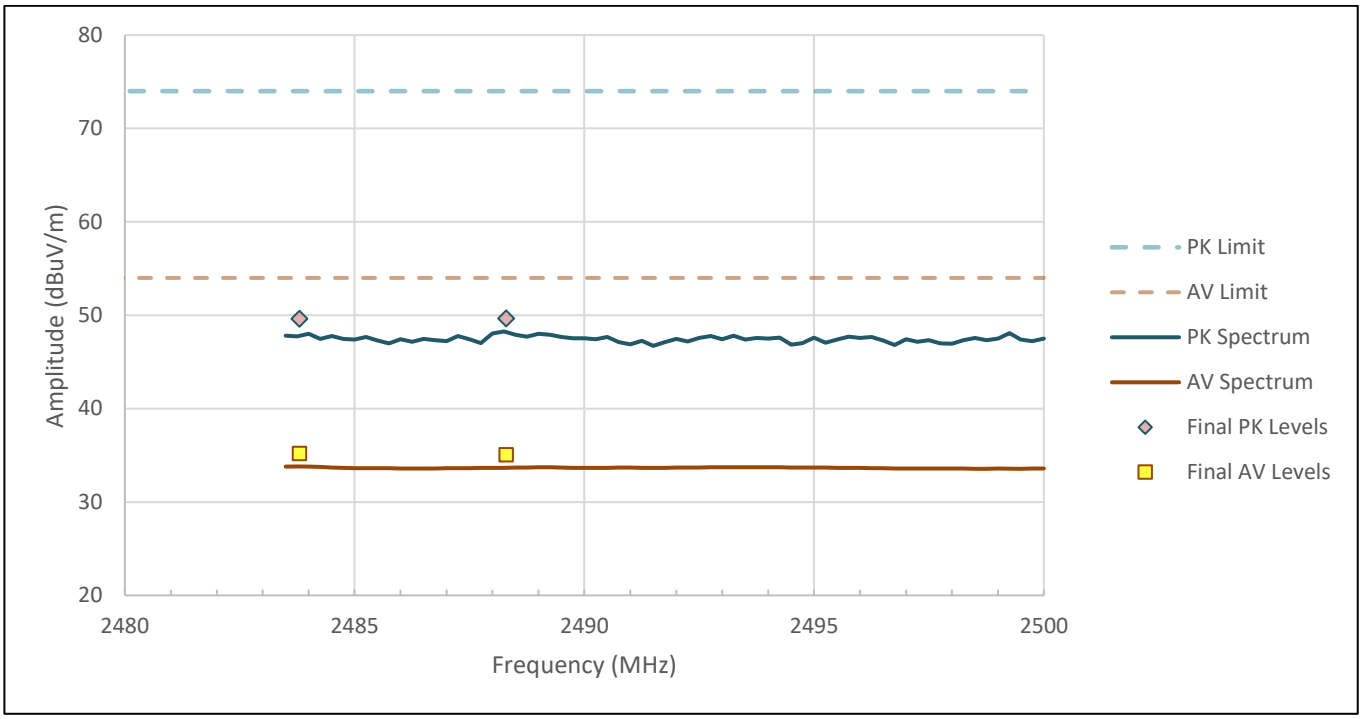


Figure RE01.18: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch13 G 24Mbs, X orientation)

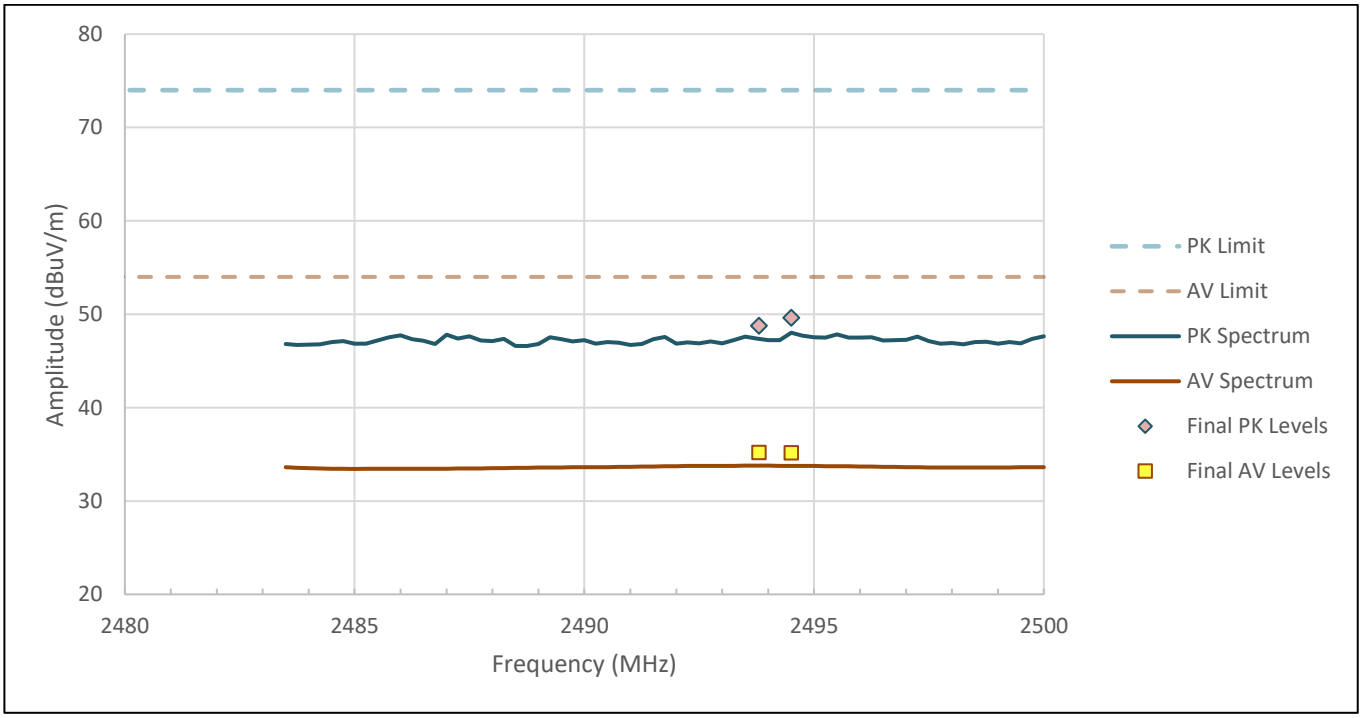


Figure RE01.19: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch13 N 6.5Mbs, X orientation)

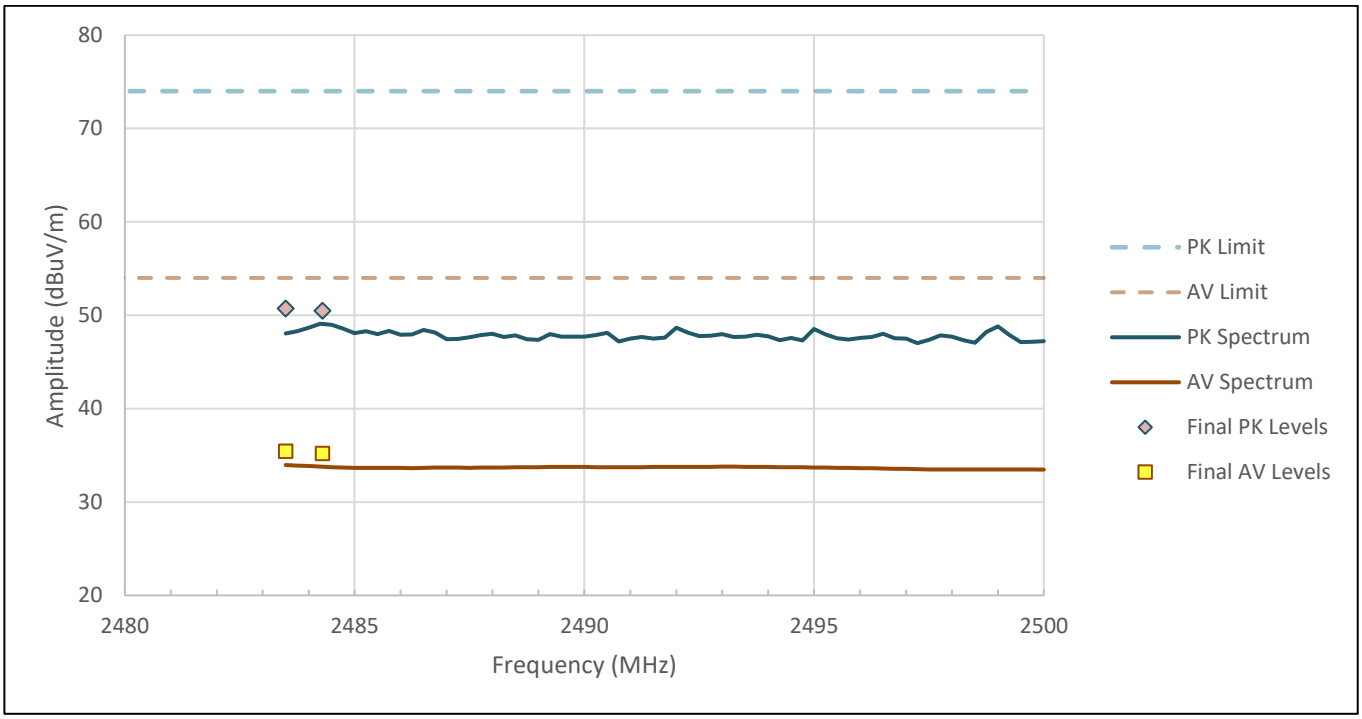


Figure RE01.20: FCC restricted band spectral data from 2483.5 to 2500 MHz (ch13 N 65Mbs, X orientation)

Setup Photographs

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

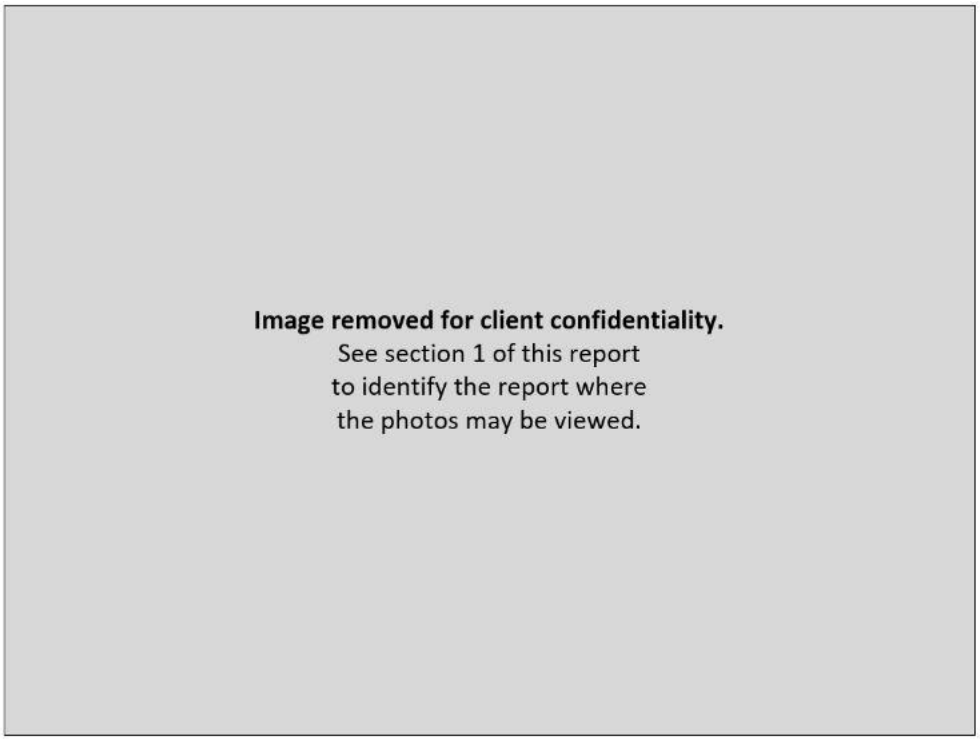


Figure RE01.21: EUT test setup, primary view

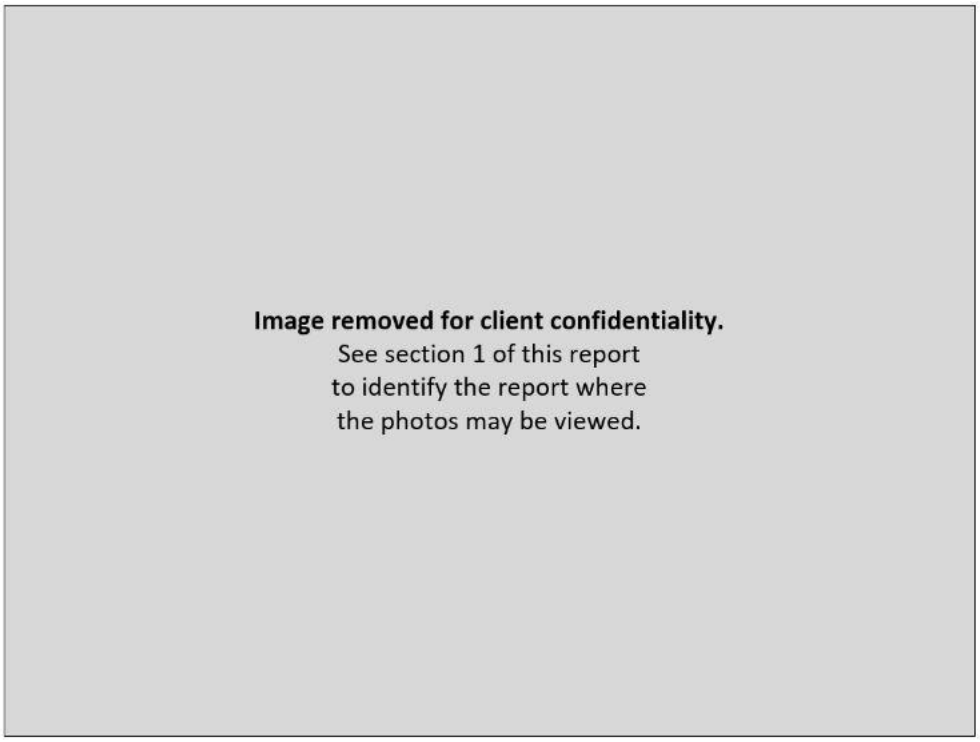


Figure RE01.22: EUT test setup, reverse view

This line is the end of the test record.

Test Record
Radiated Emission Tests RE03, RE04
Project GCL0575

Test Date(s)	01 Jul 2024
Test Personnel	Jim Solum
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M3 (BleTx), M5 (AntTx)
Arrangement	A2 (Upwr)
Input Power	USB 5Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247, RSS-GEN (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:	Jim Solum
Date of this record:	02 Jul 2024

Original record, Version A.

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	227596	14-Sep-2023	14-Sep-2025
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Tape measure, 1" x 33'	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 RE03.1: Test Equipment Used

Software Used
Keysight PXE receiver software A.32.06, RE Signal Maximization Tool v2023Jul14

Test Data

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 for ANT and the BLE 1 Mbps data rate, and 2404 MHz for the BLE 2 Mbps data rate. Measurements in the upper band were made while the transmitter was tuned to its highest frequency of 2480 MHz for ANT and the BLE 1 Mbps data rate, and 2478 MHz for the 2 Mbps data rate.

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 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.

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)	---
2385	54	74	34.053	47.954	19.947	26.046	-16	1161	HORZ
2389	54	74	34.259	48.336	19.741	25.664	-16	1161	HORZ

Table RE03.2: FCC restricted bands from 2200 to 2390 MHz (BLE 1 Mbps)

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)	---
2485	54	74	34.529	48.439	19.471	25.561	-76	3523	HORZ
2483.5	54	74	34.71	48.702	19.29	25.298	-76	3523	HORZ

Table RE03.3: FCC restricted band from 2483.5 to 2500 MHz (BLE 1 Mbps)

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)	---
2389.8	54	74	35.723	48.989	18.277	25.011	-16	1161	HORZ
2389.3	54	74	36.234	49.056	17.766	24.944	-16	1161	HORZ

Table RE03.2: FCC restricted bands from 2200 to 2390 MHz (BLE 2 Mbps)

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)	---
2489.5	54	74	34.19	48.091	19.81	25.909	-76	3523	HORZ
2483.5	54	74	34.706	48.604	19.294	25.396	-76	3523	HORZ

Table RE03.3: FCC restricted band from 2483.5 to 2500 MHz (BLE 2 Mbps)

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)	---
2386	54	74	34.234	48.033	19.766	25.967	-16	1161	HORZ
2390	54	74	34.398	48.019	19.602	25.981	-16	1161	HORZ

Table RE03.4: FCC restricted bands from 2200 to 2390 MHz (ANT)

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)	---
2486.3	54	74	34.608	48.943	19.392	25.057	-76	3523	HORZ
2483.8	54	74	35.006	48.789	18.994	25.211	-76	3523	HORZ

Table RE03.5: FCC restricted band from 2483.5 to 2500 MHz (ANT)

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

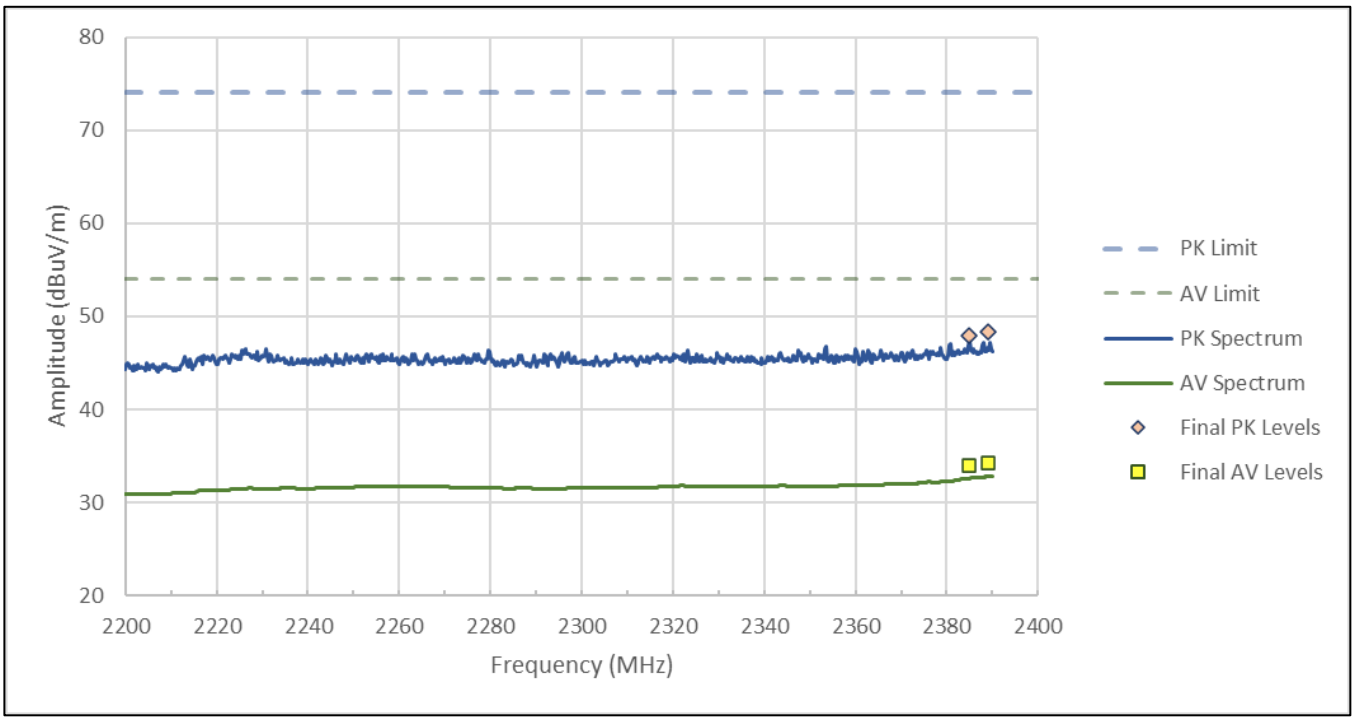


Figure RE03.1: FCC restricted band spectral data from 2200 to 2390 MHz (BLE 1Mbps)

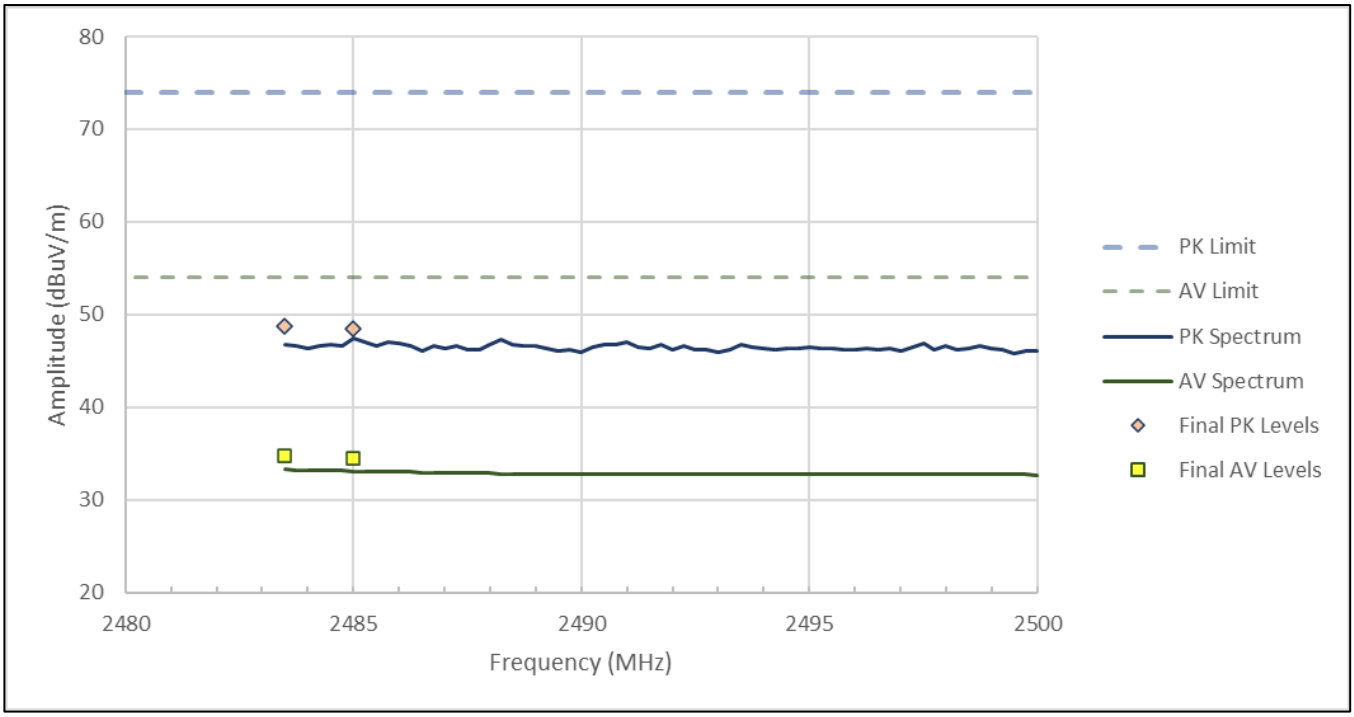


Figure RE03.2: FCC restricted band spectral data from 2483.5 to 2500 MHz (BLE 1Mbps)

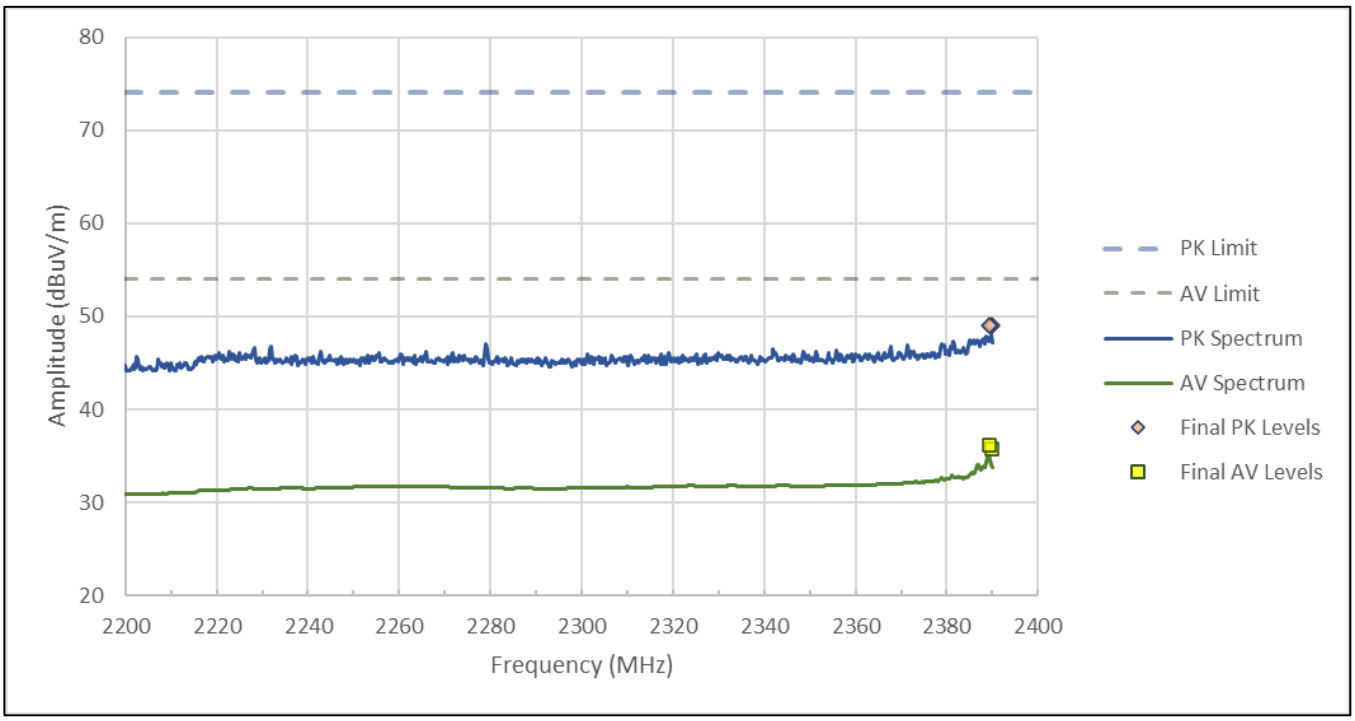


Figure RE03.3: FCC restricted band spectral data from 2200 to 2390 MHz (BLE 2 Mbps)

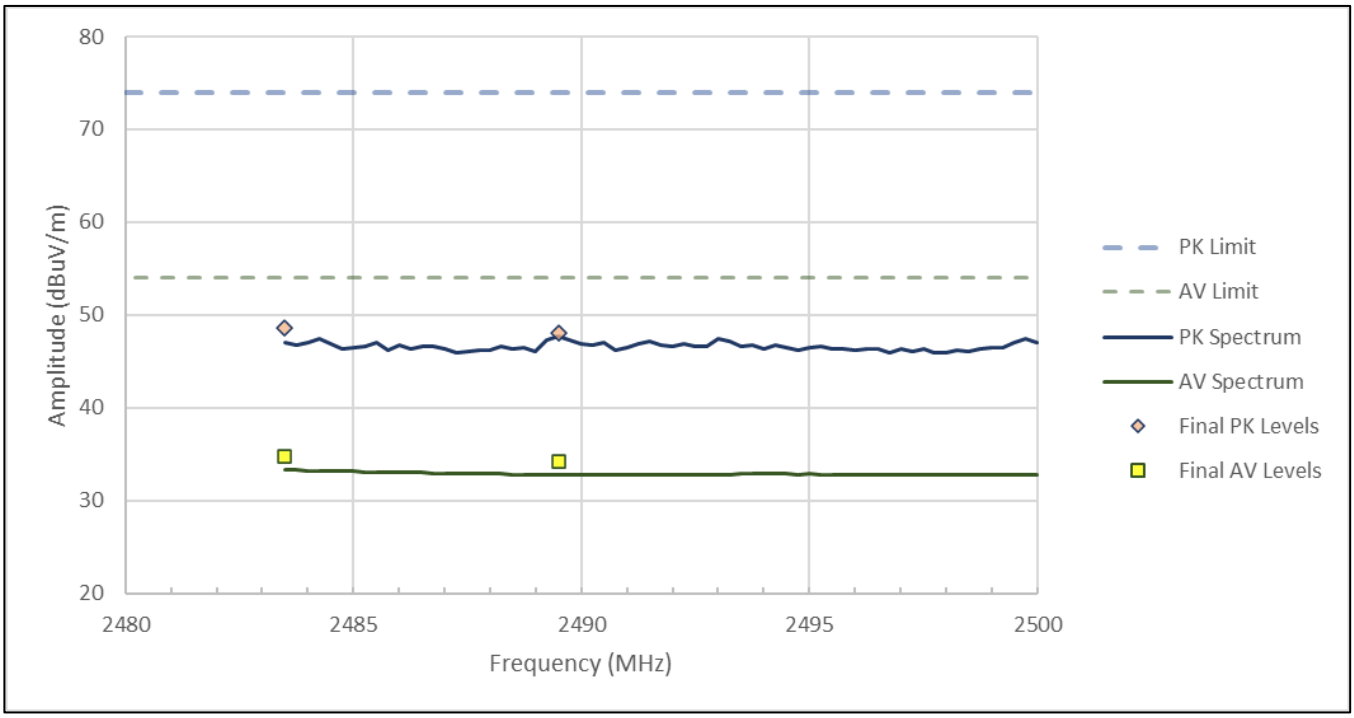


Figure RE03.4: FCC restricted band spectral data from 2483.5 to 2500 MHz (BLE 2 Mbps)

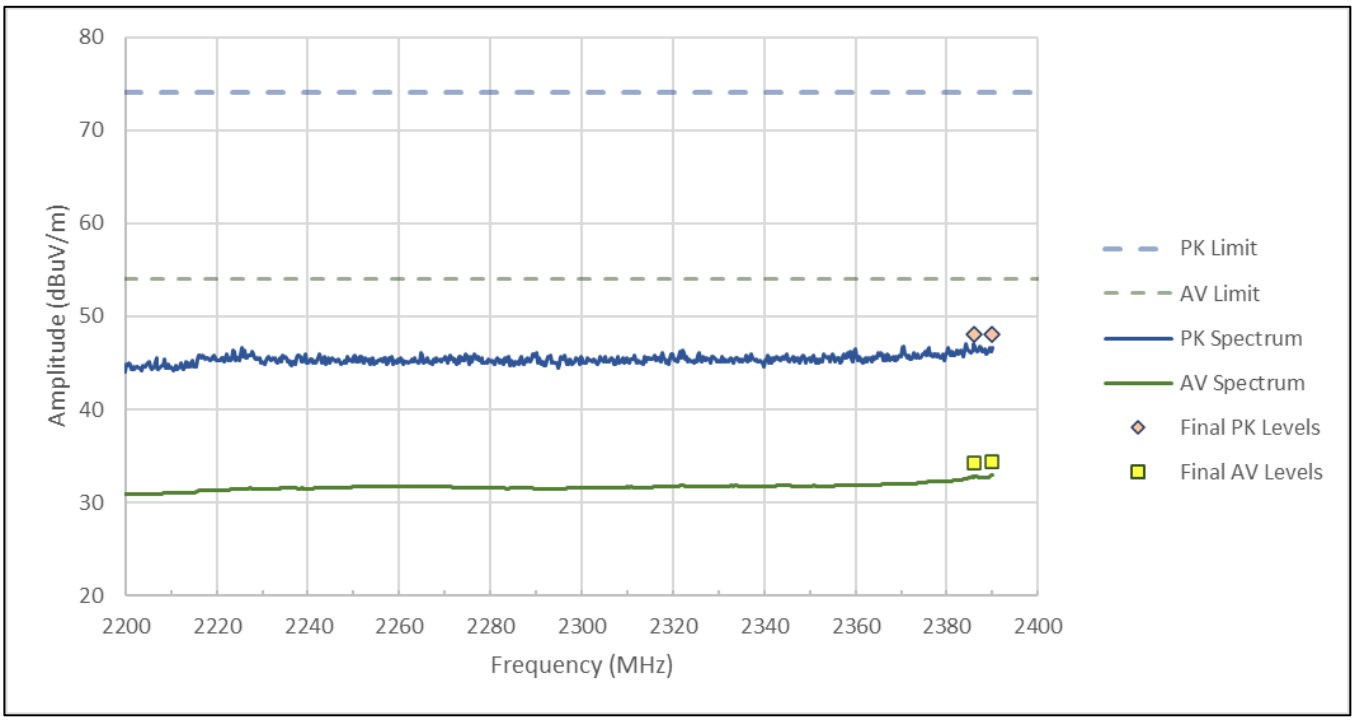


Figure RE03.5: FCC restricted band spectral data from 2200 to 2390 MHz (BLE 2 Mbps)

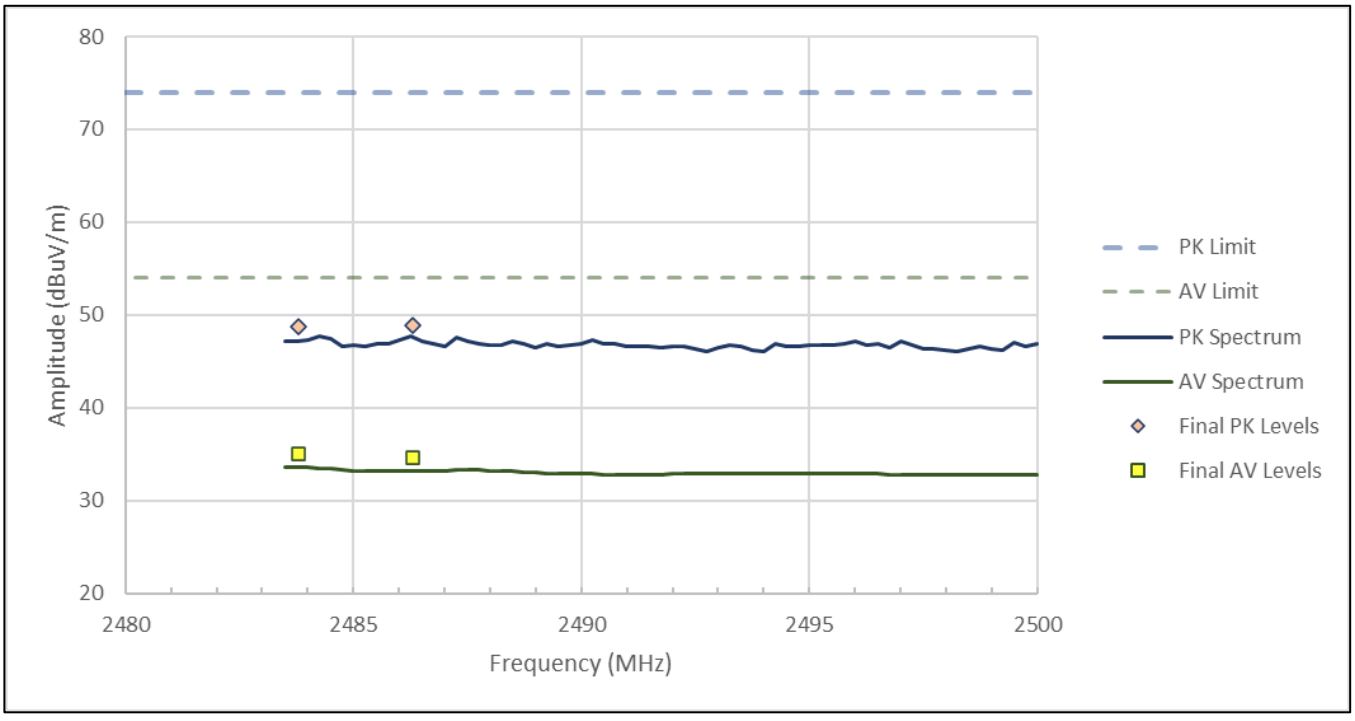


Figure RE03.6: FCC restricted band spectral data from 2483.5 to 2500 MHz (BLE 2 Mbps)

Setup Photographs

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

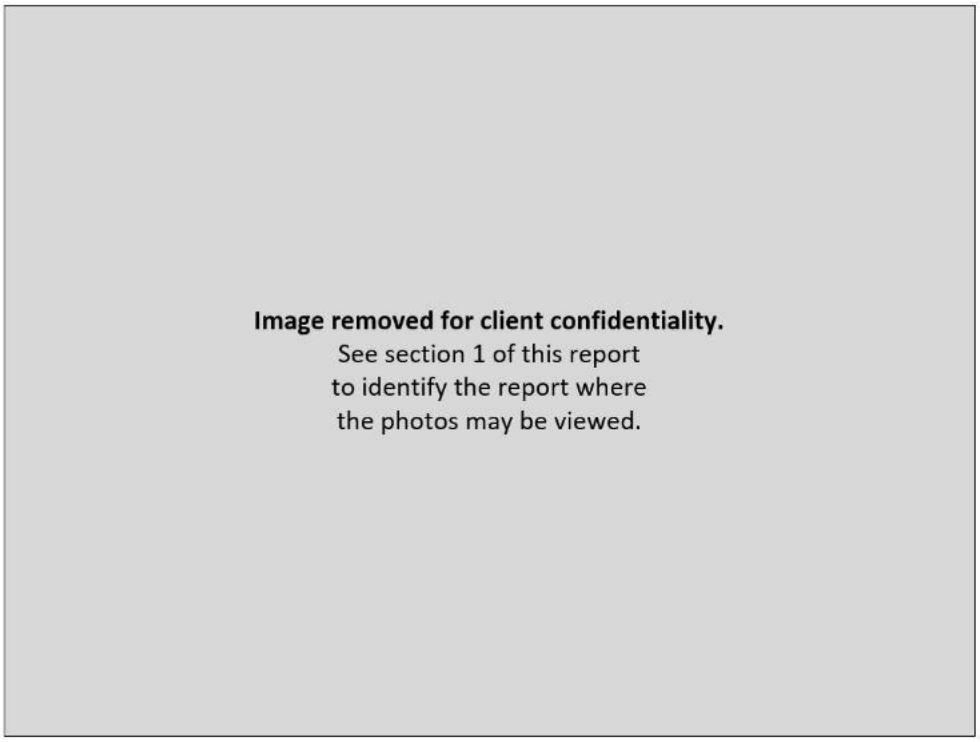


Figure RE03.7: EUT test setup, primary view

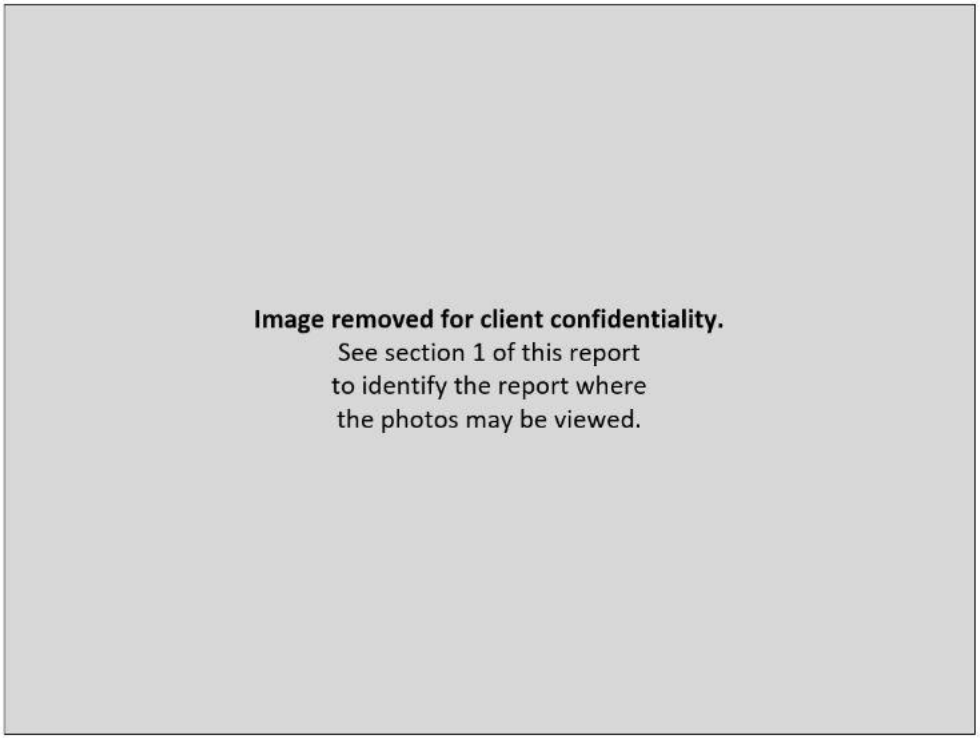


Figure RE03.8: EUT test setup, reverse view

This line is the end of the test record.

Test Record
Transmitter Power Spectral Density
Test IDs TR19
Project GCL-0575

Test Date(s)	6 July 2024
Test Personnel	David Arnett
Product Model	A04666
Serial Number tested	3475366137
Operating Mode	M3 (BleTx), M5 (AntTx), M7(WiFiTx)
Arrangement	A4 (USB)
Input Power	5Vdc
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Antenna Gain	Not Applicable
Radio Protocol	Bluetooth Low Energy (BLE), ANT, IEEE 802.11 b/g/n (WiFi)
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this record:	**8 July 2024**

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025

Table TR19.1: Test equipment used

Software Used: Keysight MXE software A.37.02

Test Method

The basic test standards provide options for the test method. The following test methods were applied.

ANSI C63.10: PKPSD (11.10.2)

Test Setup

This block diagram shows the test equipment setup.

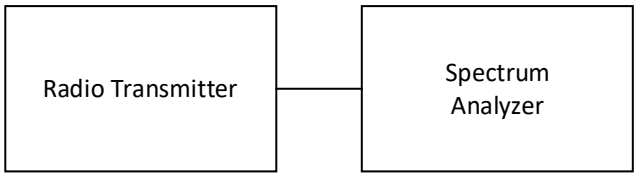


Figure TR19.1: Test setup

Test Data

Each measurement is made conducted from the antenna port with the transmitter on a specified channel and in a selected transmission protocol. The results include the effects of any measurement cable losses. Results reported are in units of dBm/Bandwidth and do not include the effect of antenna gain. The standard limit is 8 dBm / 3 kHz,

and meeting the limit with higher resolution bandwidths is permitted. All data met the limit using a 30 kHz resolution bandwidth.

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.

For WiFi radios, the various data speeds were compared on channel 6 to determine the modulation producing the highest PSD value. The indicated speed was then measured on channels 1, 6, 11, and 13 and is reported below.

The highest PSD levels for each mode are highlighted in yellow, and graphical results are provided for those cases.

Modulation	2402(04)	2440	2480(78)
ANT	-9.72	-6.44	-12.22
BLE1	-9.03	-6.55	-11.10
BLE2	-12.79	-10.57	-15.38

Table TR19.2: Summary of results, BLE and ANT radios

Modulation	Mbps	Ch 1	Ch 6	Ch 11	Ch 13
B	11	-2.17	-2.35	-3.15	-16.89
G	6	-4.51	-3.85	-10.32	-16.60
N	19.5	-5.68	-5.44	-10.93	-17.48

Table TR19.3: Summary of results, WiFi radio

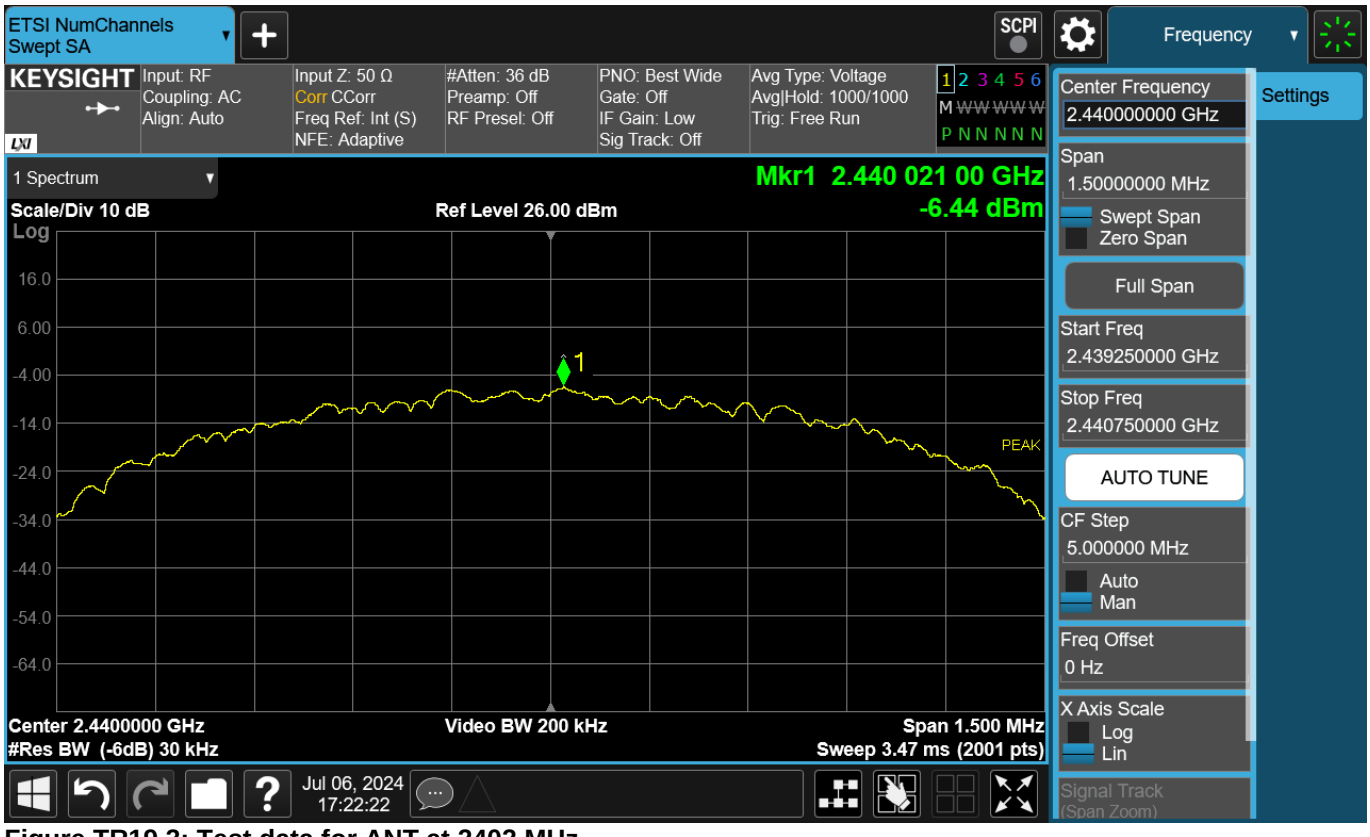


Figure TR19.3: Test data for ANT at 2402 MHz

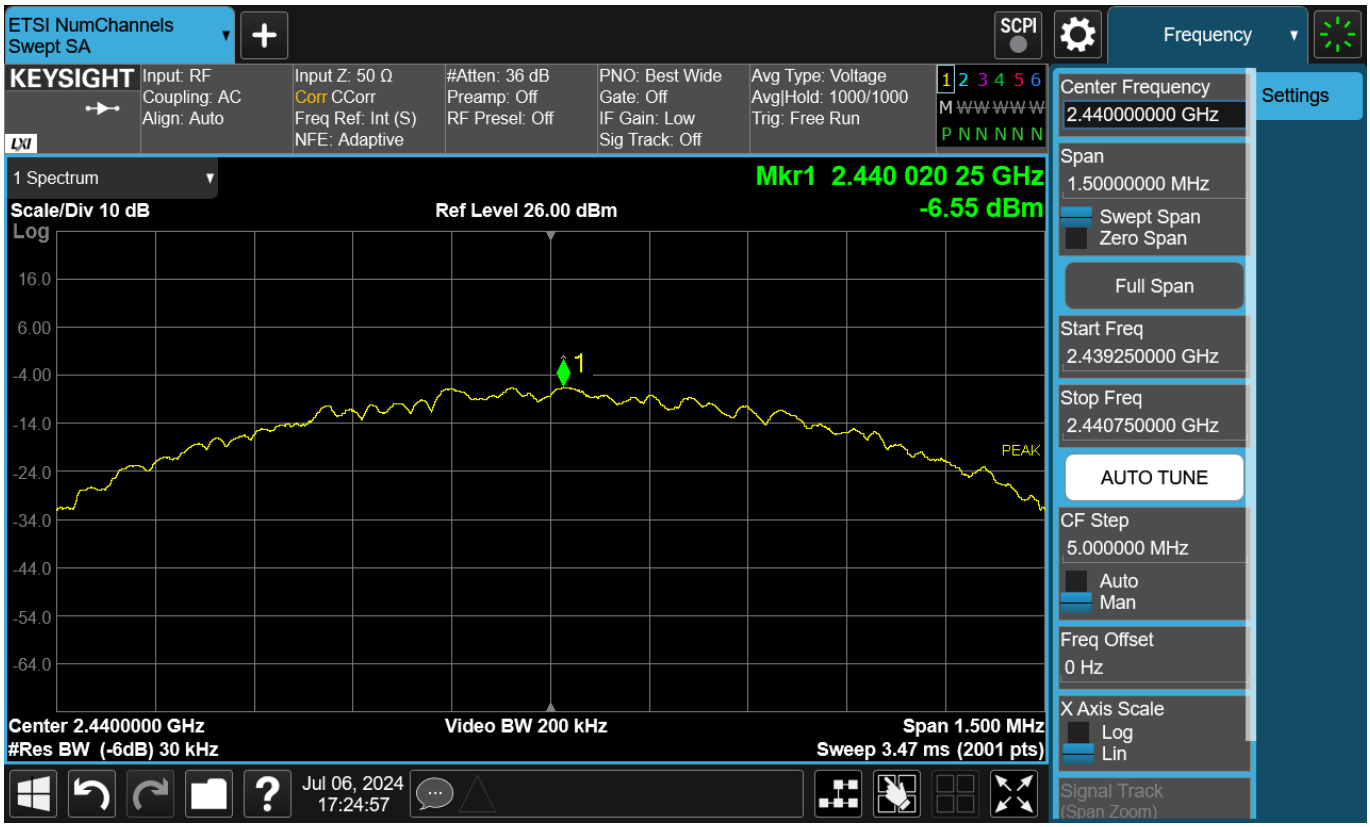


Figure TR19.4: Test data for BLE, 1 Mbps at 2440 MHz

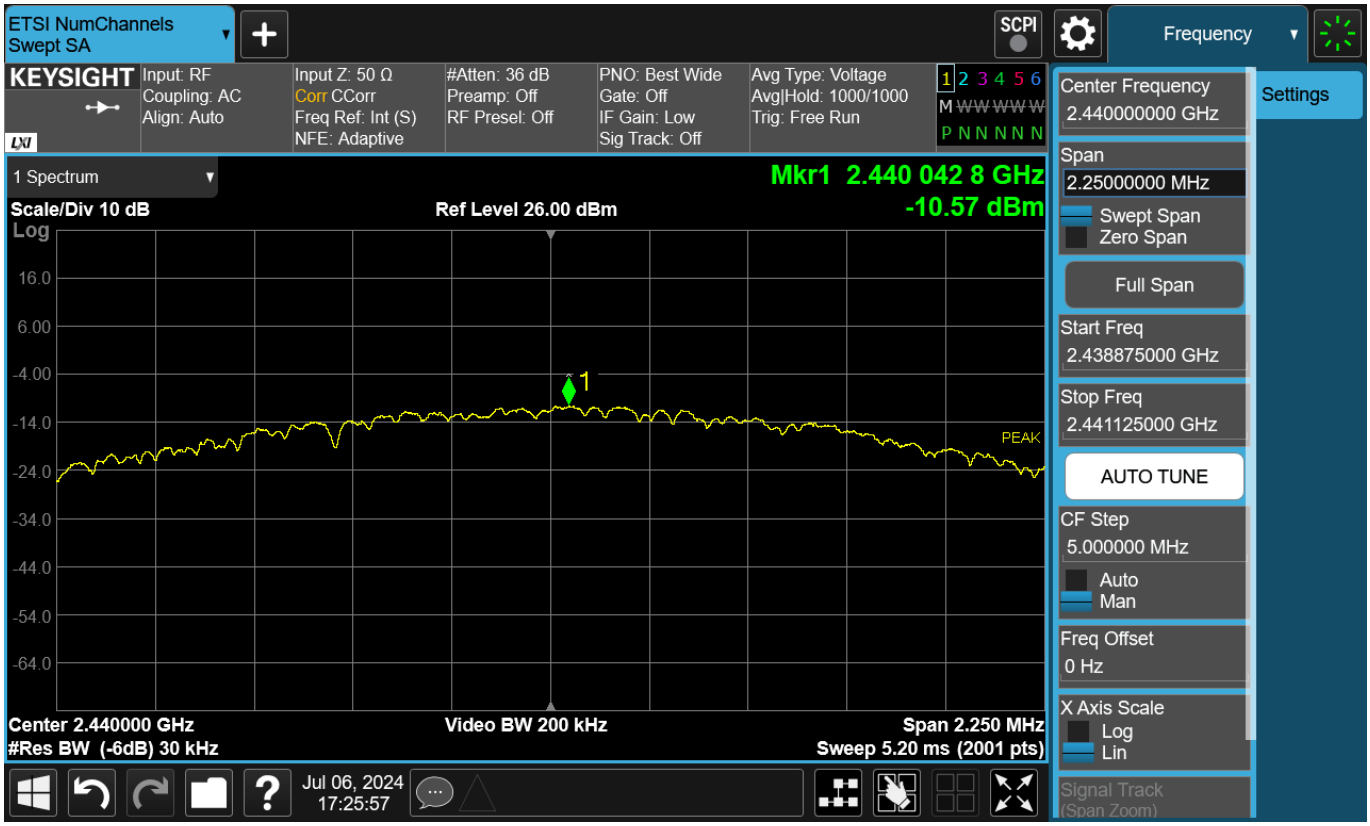


Figure TR19.5: Test data for BLE, 2 Mbps at 2440 MHz

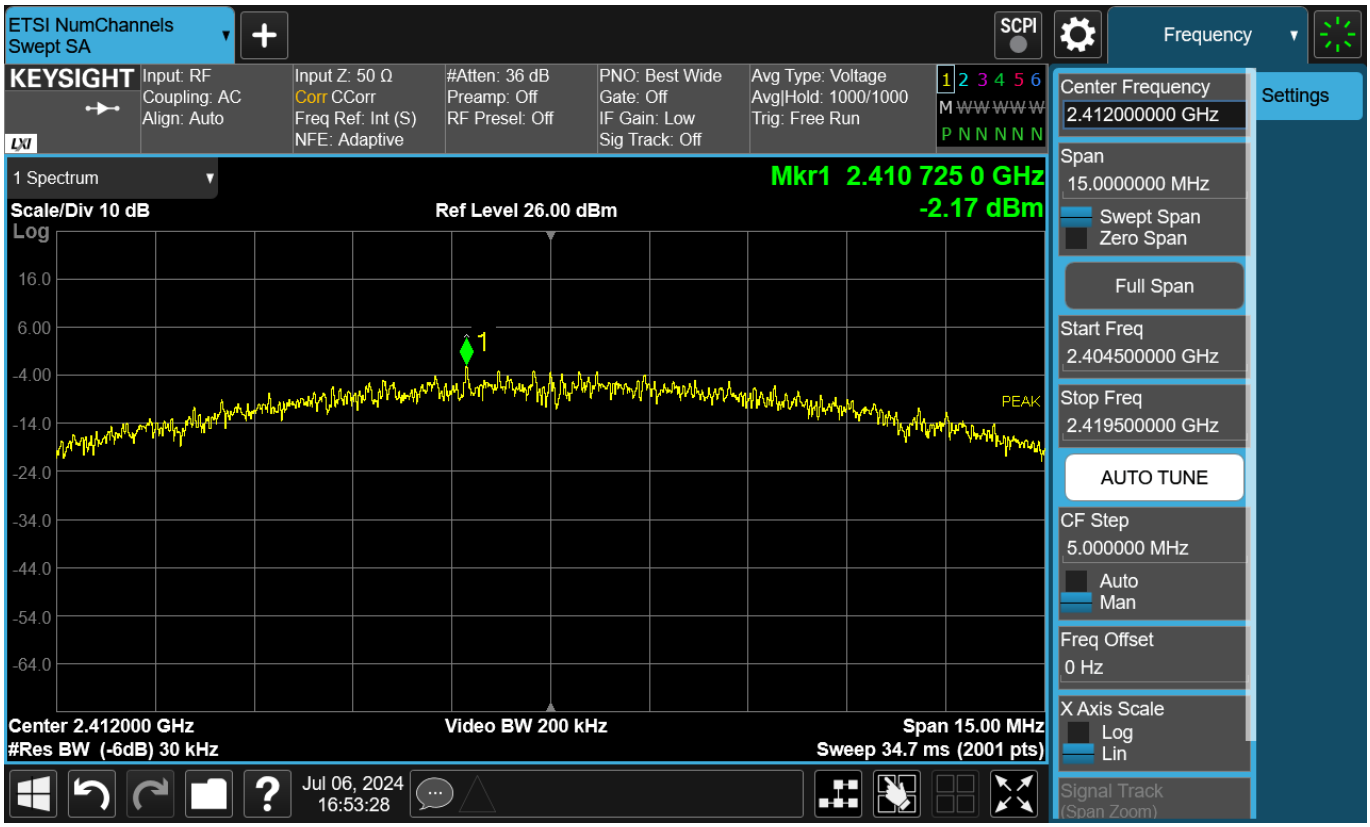


Figure TR19.6: Test data for IEEE 802.11b at 11 Mbps on channel 1, 2412 MHz

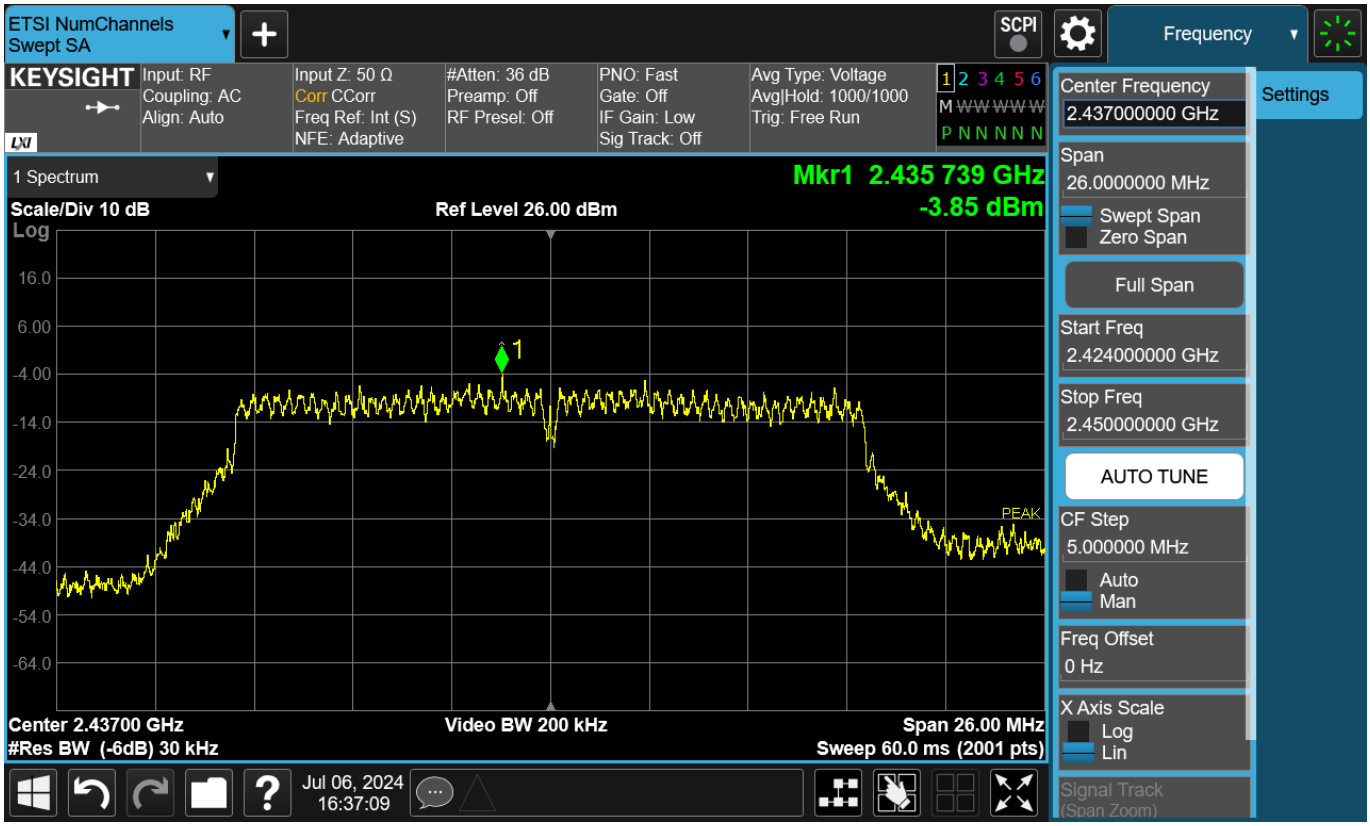


Figure TR19.7: Test data for IEEE 802.11g at 6 Mbps on channel 6, 2437 MHz

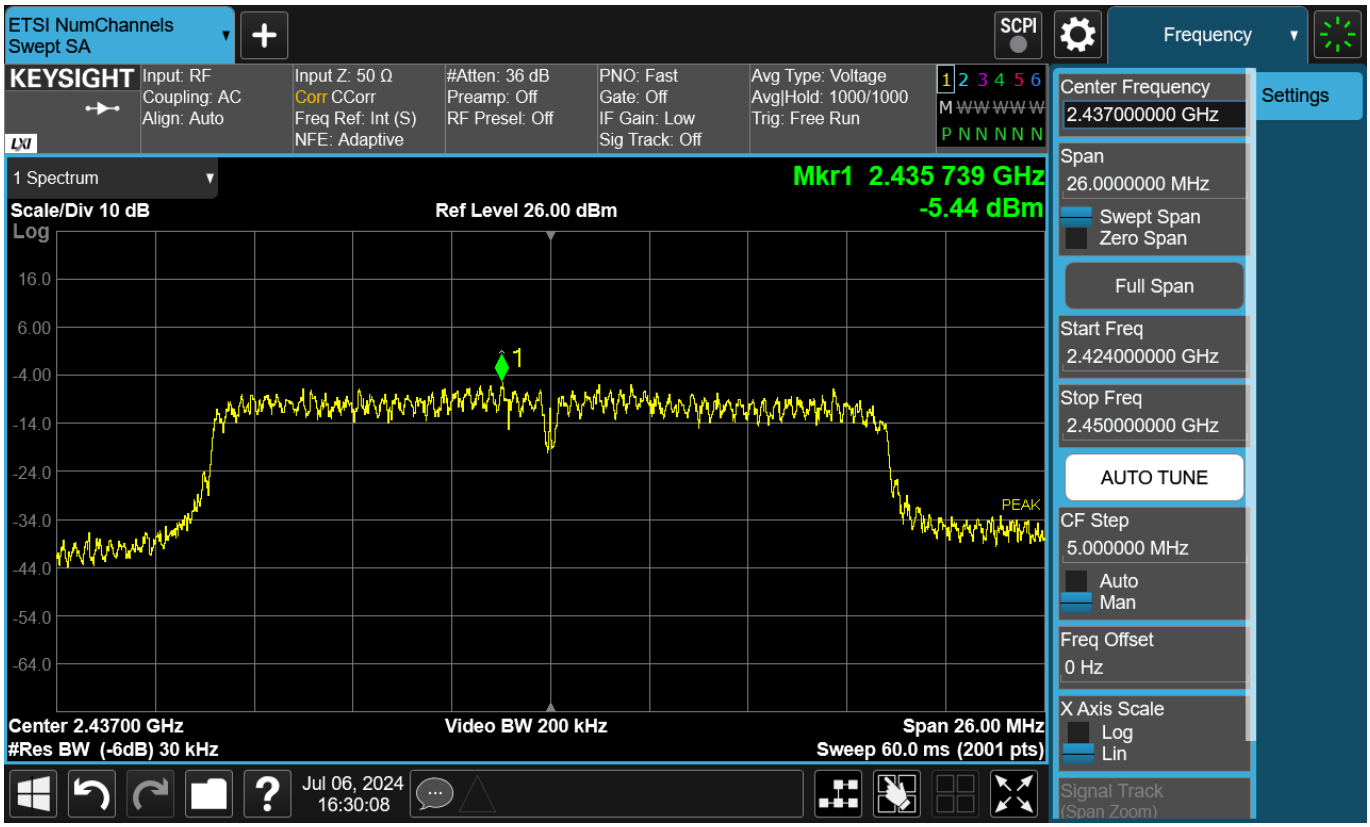


Figure TR19.8: Test data for IEEE 802.11n at 19.5 Mbps on channel 6, 2437 MHz

This line is the end of the test record.

Test Record
Transmitter Stability in Extreme Conditions
Test IDs TR43
Project GCL0575

Test Date(s)	08 Jul 2024
Test Personnel	Vladimir Tolstik supervised by Majid Farah
Product Model	A04666
Serial Number tested	3475366056
Operating Mode	M5 (AntTx)
Arrangement	A4 (USB)
Nominal Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN (as noted in Section 6 of the report)
Radio Protocol	ANT
Pass/Fail Judgment:	**PASS**
Test record created by:	**Vladimir Tolstik**
Date this record:	**10 Jul 2024**

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025
Thermometer	Thermco	ACCD370P	210607316	21-Sep-2023	15-Sep-2024
Thermal Chamber	Tenney	T2RC	32774-02	Calibration	Not Required
DMM Multimeter 87V	Fluke	87V	63490051	21-Jun-2024	21-Jun-2025

Table TR43.1: List of test equipment used

Software Used: MXE Software Revision A.37.02

Test Method

The standards cited require observation of the stability for transmission frequency and/or power at certain environmental extremes. The reference is performance on nominal input voltage and a temperature of 20 °C. Where the standards cited here impose different limits or conditions, the most stringent limits and conditions have been applied.

The acceptance criterion is that the 6 dBc Occupied Bandwidth of modulated signal should remain within the permitted radio band of 2400 – 2483.6 MHz.

The modes utilized include those that showed emissions closest to the band edge during prior bandwidth testing.

Test Data

The test sample(s) were subjected to extreme conditions and performed as shown below. Yellow highlights indicate the highest level for a protocol, for which an image of the spectrum is also provided. In the spectral plots, the data sets have been combined to present the low and high channel results side by side. Markers 1 and 3 indicate the spectral peak while markers 2 and 4 are at the 2400 MHz or 2483.5 MHz band edge. Markers 2 and 4 in the table below spectral data show differences to Markers 1 and 3.

Tx Mode	Temp	Volts	Low Ch.	High Ch.
	˚C	Vdc	dBc	dBc
ANT	60	5	-25.96	-32.79
ANT	50	5	-25.25	-32.63
ANT	40	5	-26.19	-32.45
ANT	30	5	-26.11	-32.43
ANT	20	5	-26.98	-33.01
ANT	10	5	-27.84	-33.35
ANT	0	5	-26.93	-34.07
ANT	-10	5	-26.98	-34.62
ANT	-20	5	-28.06	-34.17

Table TR43.2 Difference between peak and band edge levels for ANT transmissions during temperature variations

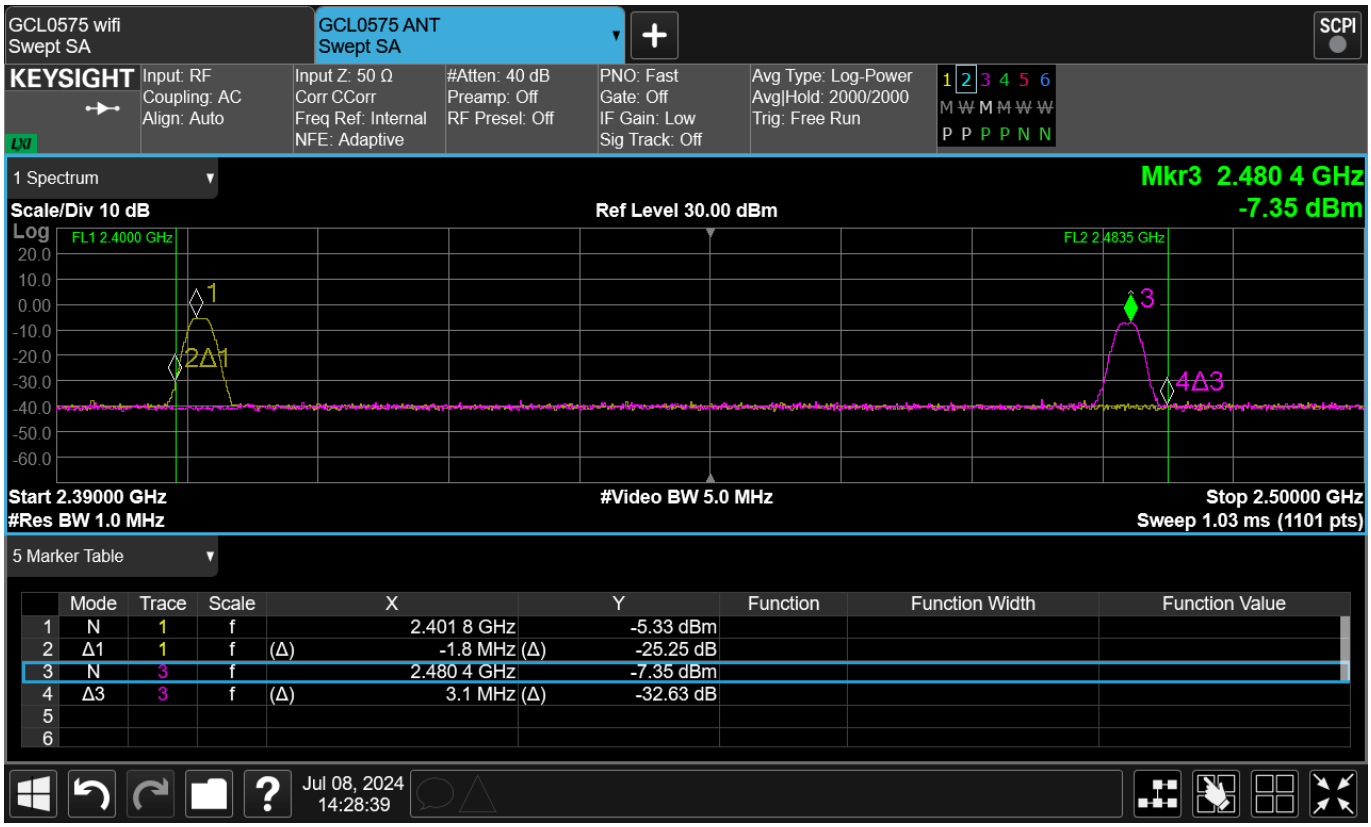


Figure TR43.1: Spectral data for ANT at 50 °C which represent low and high channel

Tx Mode	Temp	Volts	Low Ch.	High Ch.
	˚C	Vdc	dBc	dBc
ANT	20	4.25	-27.14	-33.95
ANT	20	5	-26.98	-33.01
ANT	20	5.75	-27.12	-33.18

Table TR43.3: Difference between peak and band edge levels for ANT transmissions at 20 °C during voltage variations

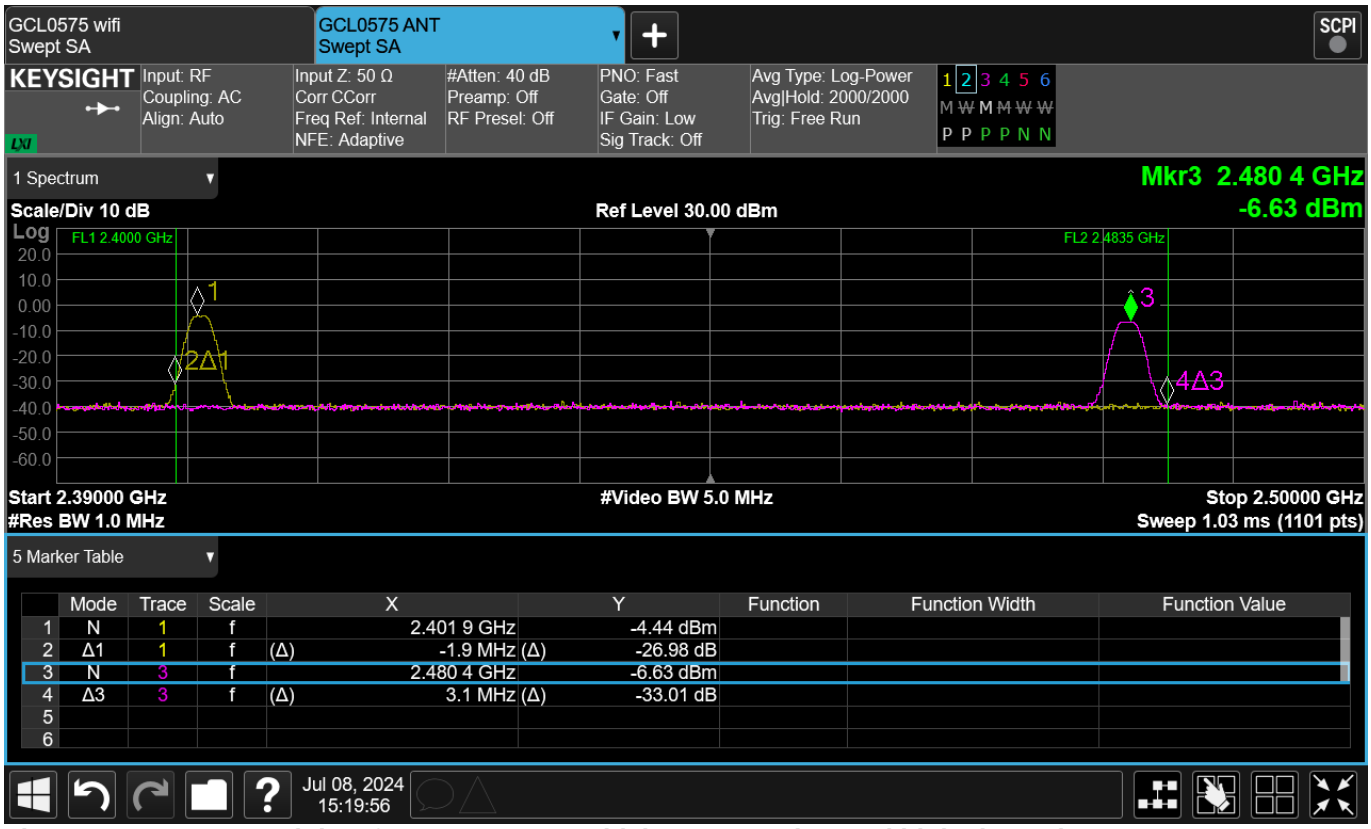


Figure TR43.2: Spectral data for ANT at 20 °C which represent low and high channel at 5.00 V.

Setup Block Diagram

The following block diagram shows the EUT configured and arranged in the manner in which it was measured.

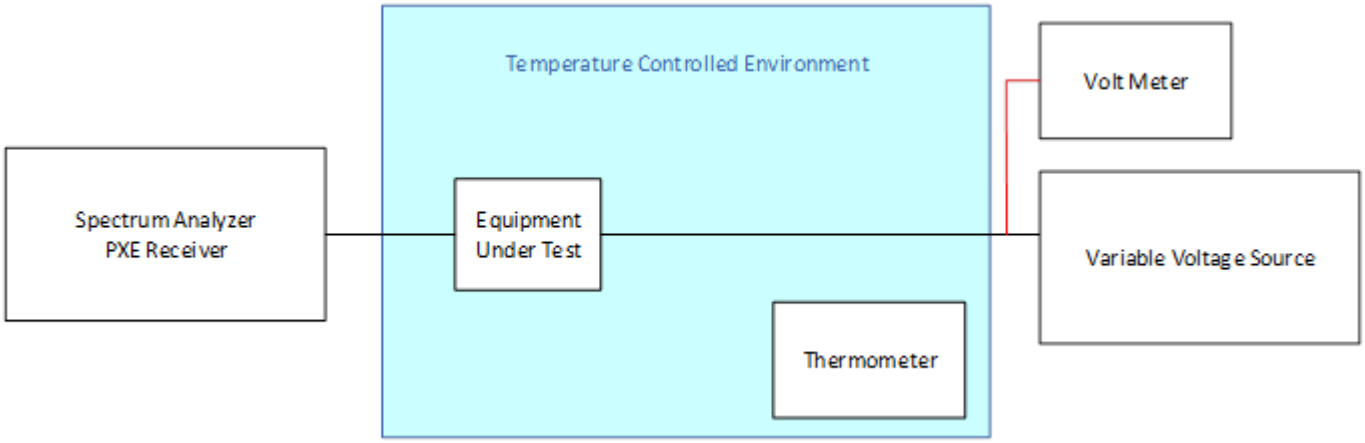


Figure TR43.3: Schematic drawing of the test equipment setup

This line is the end of the test record.

Test Record
Transmitter Stability in Extreme Conditions
Test IDs TR44
Project GCL0575

Test Date(s)	08 Jul 2024
Test Personnel	Vladimir Tolstik supervised by Majid Farah
Product Model	A04666
Serial Number tested	3475366056
Operating Mode	M7 (WiFiTx)
Arrangement	A4 (USB)
Nominal Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN (as noted in Section 6 of the report)
Radio Protocol	WiFi (IEEE 802.11b/g/n)
Pass/Fail Judgment:	**PASS**
Test record created by:	**Vladimir Tolstik**
Date this record:	**10 Jul 2024**

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025
Thermometer	Thermco	ACCD370P	210607316	21-Sep-2023	15-Sep-2024
Thermal Chamber	Tenney	T2RC	32774-02	Calibration	Not Required
DMM Multimeter 87V	Fluke	87V	63490051	21-Jun-2024	21-Jun-2025

Table TR44.1: List of test equipment used

Software Used: MXE Software Revision A.37.02

Test Method

The standards cited require observation of the stability for transmission frequency and/or power at certain environmental extremes. The reference is performance on nominal input voltage and a temperature of 20 °C. Where the standards cited here impose different limits or conditions, the most stringent limits and conditions have been applied.

The acceptance criterion is that the 6 dBc Occupied Bandwidth of the modulated signal should remain within permitted radio band 2400-2483.5 MHz.

The modes utilized include those that showed emissions closest to the band edge during prior bandwidth testing.

Test Data

The test sample(s) were subjected to extreme conditions and performed as shown below. Yellow highlights indicate the highest level for a protocol, for which an image of the spectrum is also provided. In the spectral plots, the data sets have been combined to present channel 1, channel 11 and channel 13 results side by side. Markers 1, 3 and 5 indicate the spectral peak while markers 2, 4 and 6 are at the 2400 MHz or 2483.5 MHz band edge. Markers 2, 4 and 6 in the table below spectral data show differences to Markers 1, 3 and 5.

Tx Mode	Temp	Volts	Ch. 1	Ch. 11	Ch. 13
WiFi	˚C	Vdc	dBc	dBc	dBc
N 13Mbps	60	5	-30.58	-39.31	-31.16
N 13Mbps	50	5	-28.66	-36.96	-31.65
N 13Mbps	40	5	-27.71	-36.66	-32.95
N 13Mbps	30	5	-25.75	-36.73	-33.97
N 13Mbps	20	5	-26.36	-35.80	-32.07
N 13Mbps	10	5	-24.57	-37.32	-33.27
N 13Mbps	0	5	-25.98	-37.89	-33.10
N 13Mbps	-10	5	-25.45	-37.66	-34.03
N 13Mbps	-20	5	-23.39	-37.70	-34.32

Table TR44.2 Difference between peak and band edge levels for WiFi transmissions during temperature variations

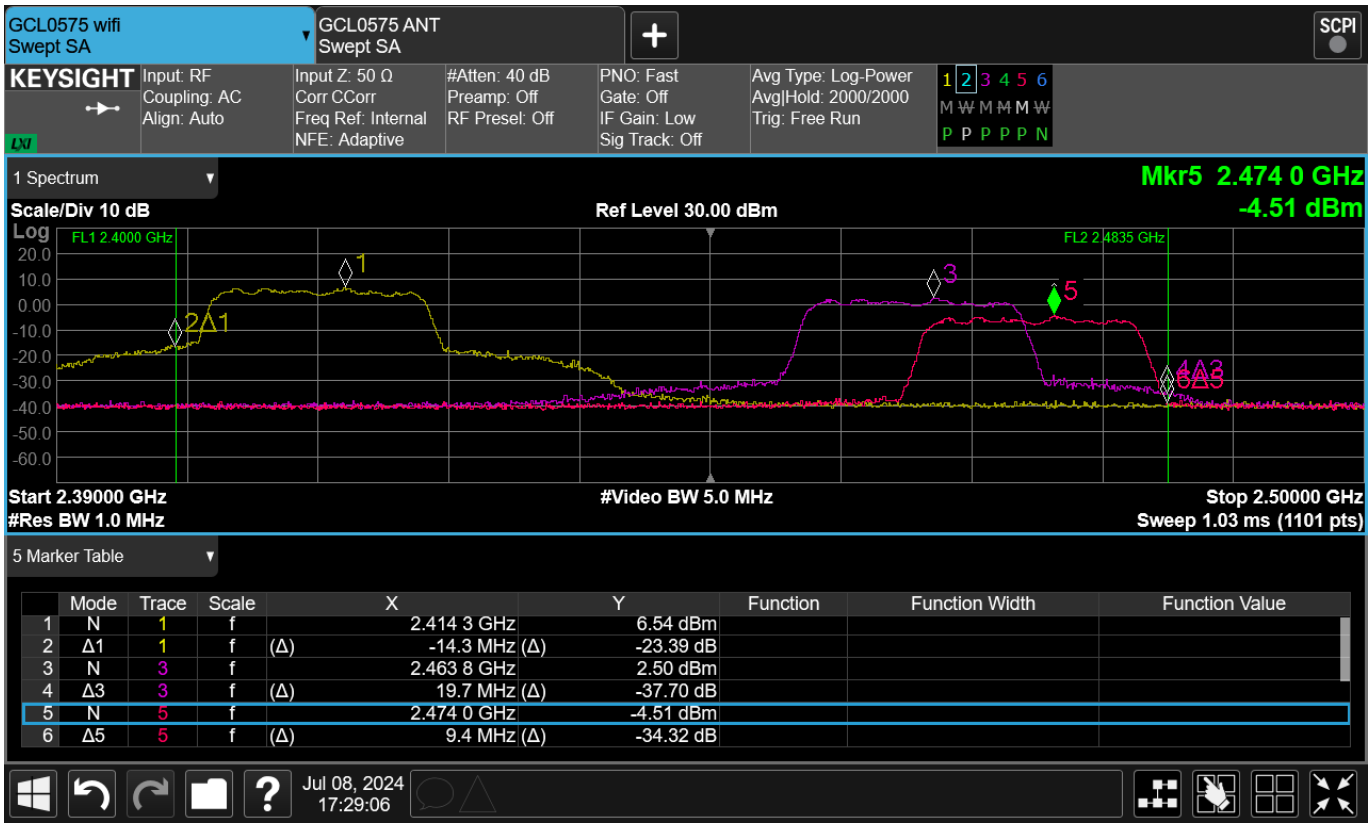


Figure TR44.1: Spectral data for WiFi at -20 °C which represent low and high channel

Tx Mode	Temp	Volts	Ch. 1	Ch. 11	Ch. 13
WiFi	˚C	Vdc	dBc	dBc	dBc
N 13Mbps	20	4.25	-26.96	-34.07	-33.90
N 13Mbps	20	5	-26.36	-35.80	-32.07
N 13Mbps	20	5.75	-26.03	-37.66	-32.23

Table TR44.3: Difference between peak and band edge levels for WiFi transmissions at 20 °C during voltage variations

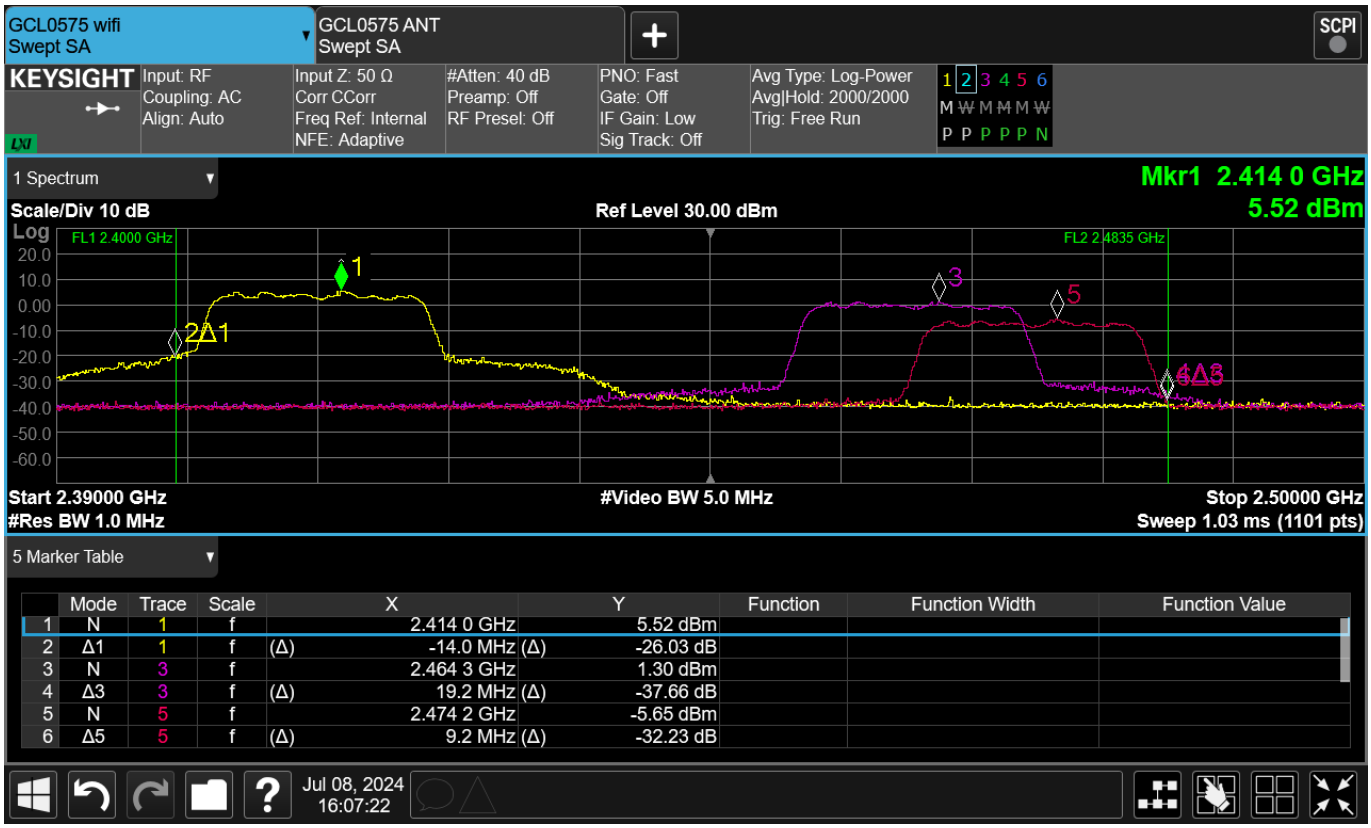


Figure TR44.2: Spectral data for WiFi at 20 °C which represent low and high channel at 5.75 V.

Setup Block Diagram

The following block diagram shows the EUT configured and arranged in the manner in which it was measured.

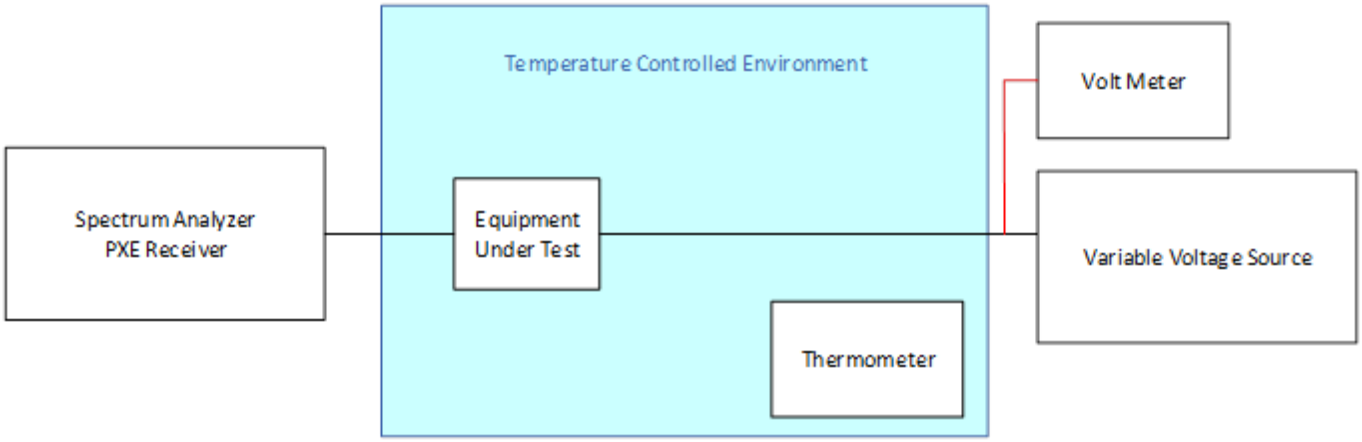


Figure TR44.3: Schematic drawing of the test equipment setup

This line is the end of the test record.

Test Record
Radiated Emission Test RE30
Project GCL0575

Test Date(s)	14 Aug 2024
Test Personnel	David Kerr
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M3 (BleTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247, RSS-GEN (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:	16 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Loop antenna, amplified	Schwarzbeck	FMZB 1519B	174	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	7-Nov-2022	7-Nov-2025
Tape measure, 1" x 33'	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026

Table RE30.1: Test Equipment Used

Software Used: Keysight PXE software A.32.06, RE 150k to 30M Signal Maximization Tool V1 2021Mar17.xlsx, RE 9k to 30M XYZ_orientations_TemplateV7.xlsm, 9k30mAnalysisDraft5.xlsx.

Test Data

The radiated emission test process began with a preliminary scan 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. 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. 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 adjusted based on 40 dB per decade of distance. Any unintentional radio emission limits are not applied to intentional radio signals.

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
0.0197	39.96	Avg	121.71	81.75	50.00	141.71	91.71	Z	180
0.02105	39.23	Avg	121.14	81.91	49.38	141.14	91.76	Z	118
0.04215	33.27	Avg	115.11	81.84	43.06	135.11	92.05	Z	167
0.0484	38.78	Avg	113.91	75.12	48.65	133.91	85.26	X	-144
0.1379	24.77	Avg	104.81	80.05	33.68	124.81	91.13	Z	-148
0.15	22.15	Avg	104.08	81.93	31.46	124.08	92.62	Z	-77

Table RE30.2: Emission summary (TX BLE 1Mbps, 2440 MHz)

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

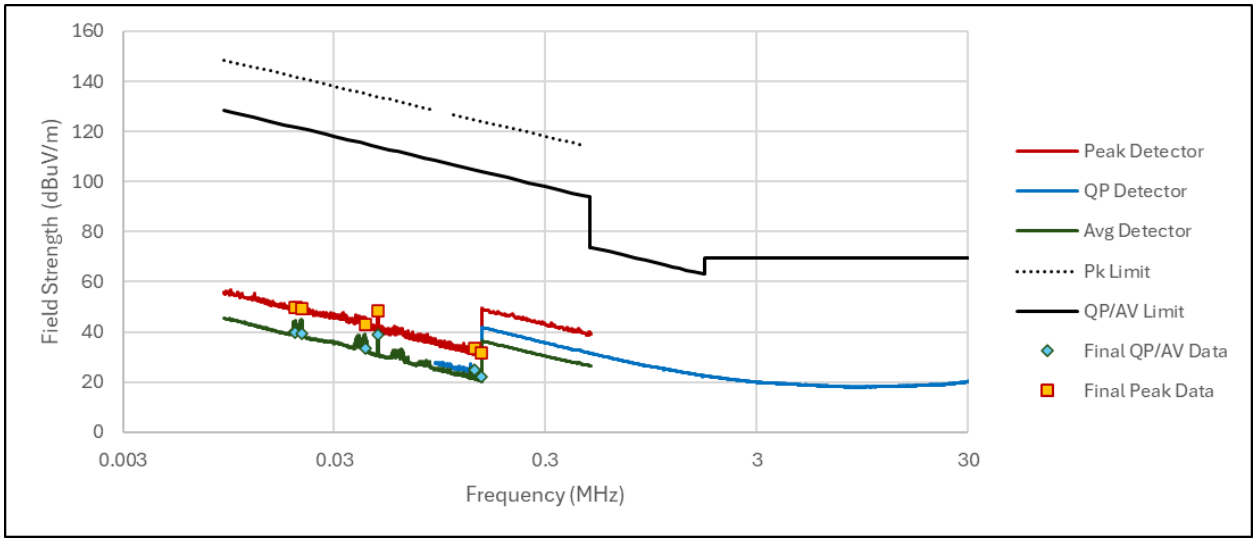


Figure RE30.1: Spectral data (TX BLE 1Mbps, 2440 MHz)

Setup Photographs

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

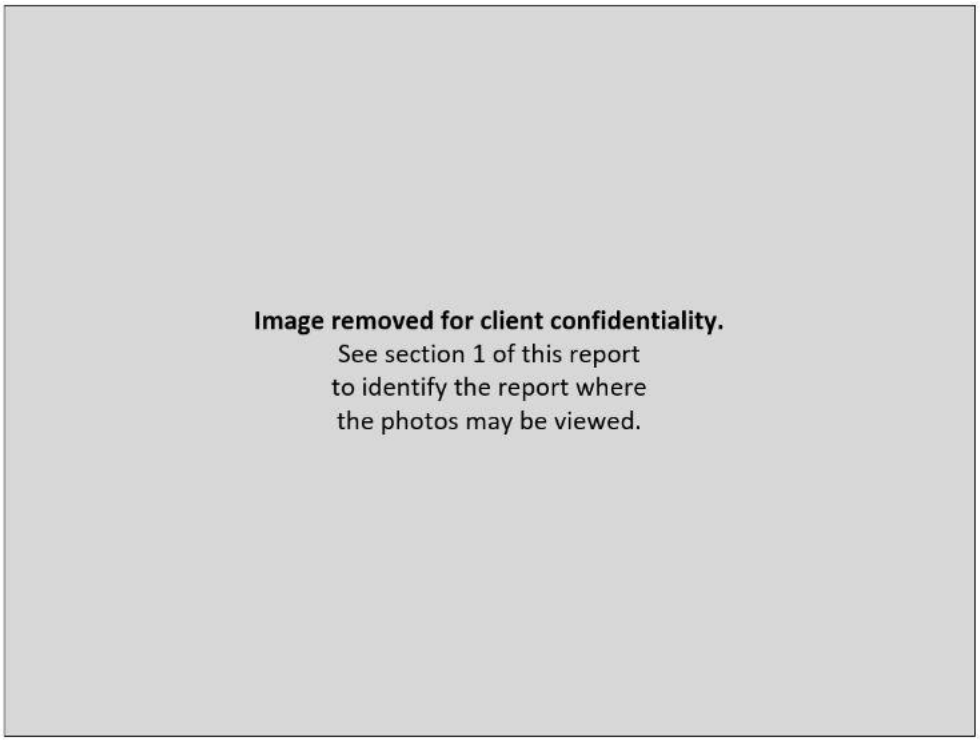


Figure RE30.2: EUT test setup, first view (Antenna X POL)

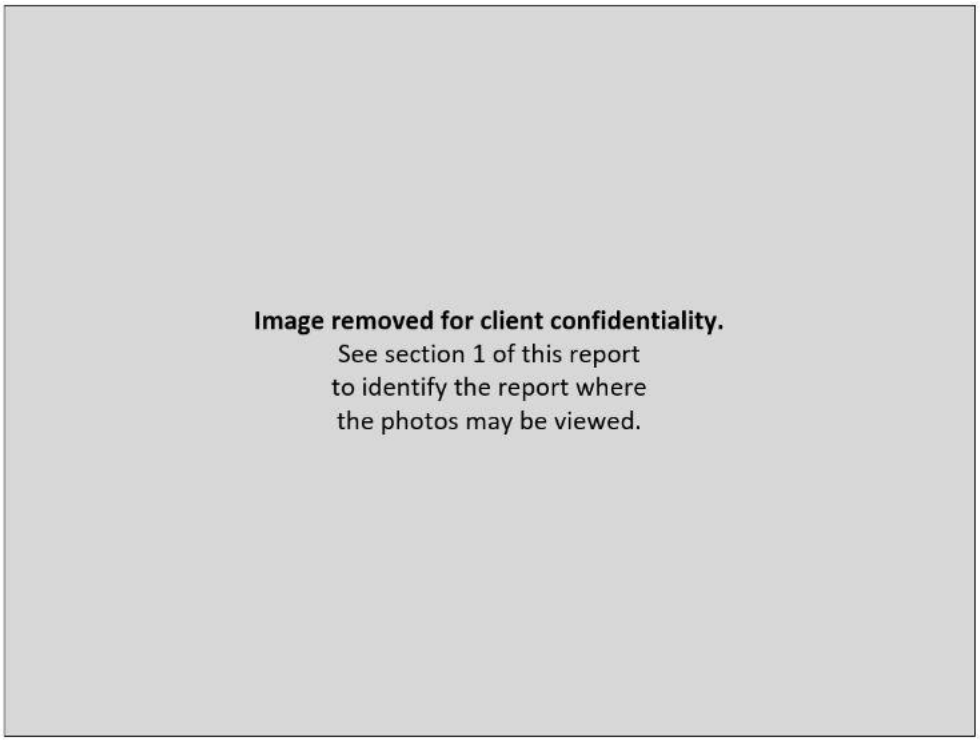


Figure RE30.3: EUT test setup, second view (Antenna X POL)

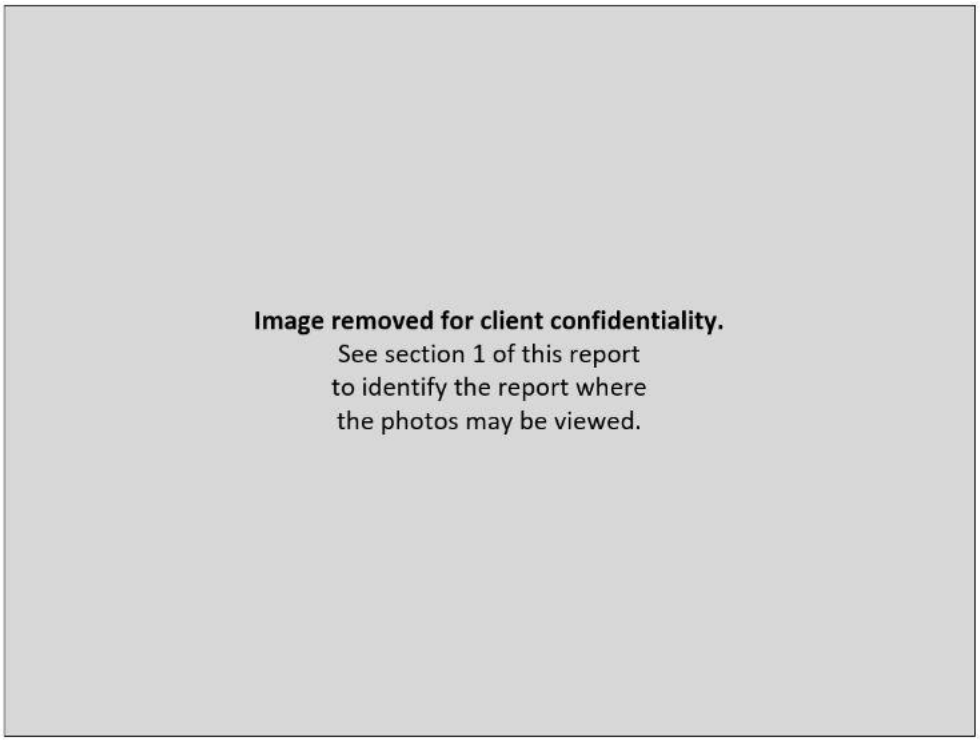


Figure RE30.4: EUT test setup, first view (Antenna Y POL)

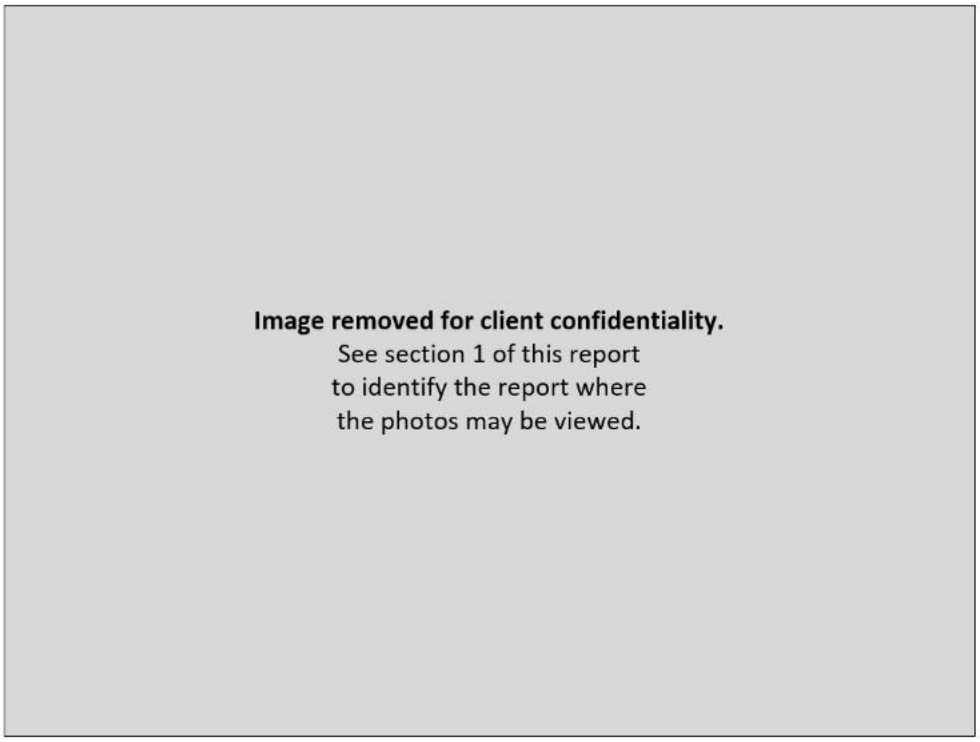


Figure RE30.5: EUT test setup, second view (Antenna Y POL)

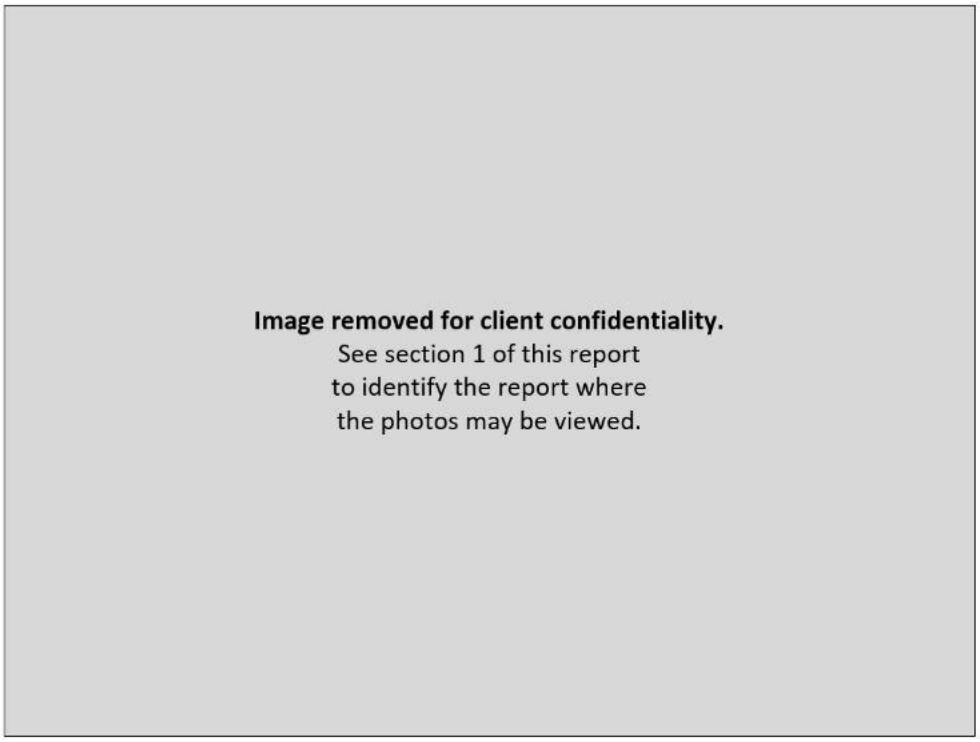


Figure RE30.6: EUT test setup, first view (Antenna Z POL)

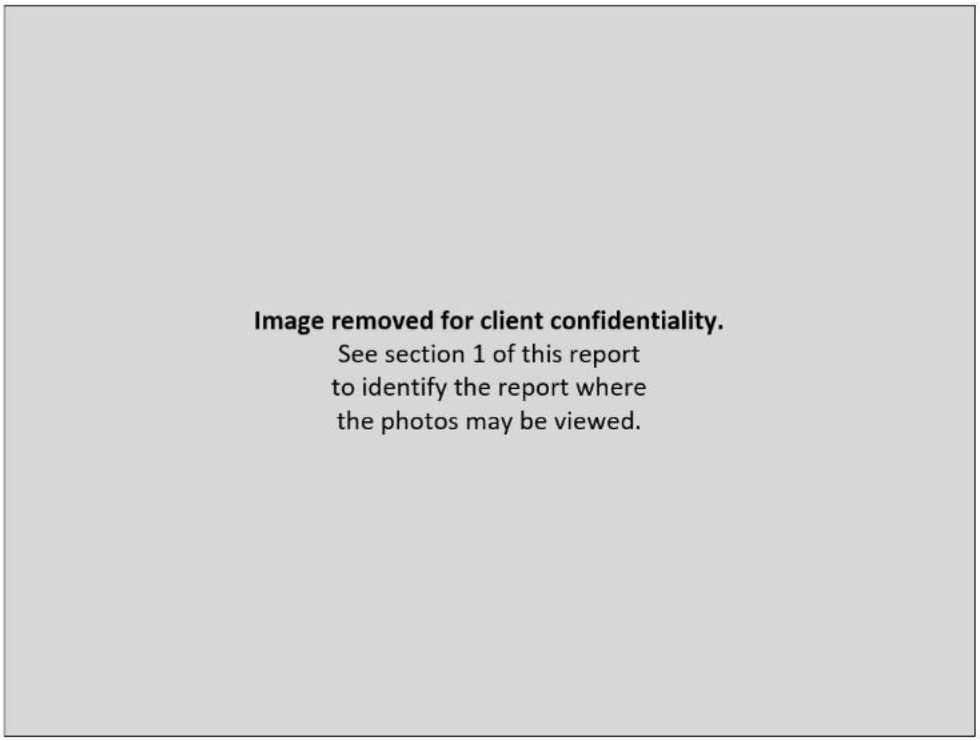


Figure RE30.7: EUT test setup, second view (Antenna Z POL)

This line is the end of the test record.

Test Record
Radiated Emission Test RE31
Project GCL0575

Test Date(s)	14 Aug 2024
Test Personnel	David Kerr
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247, RSS-GEN (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:	16 Aug 2024

Original record, Version A.

Test Equipment

See test record GCL0575 Radiated Emission Test RE30, Table 30.1 for a description of the test equipment used.

Software Used: Keysight PXE software A.32.06, RE 150k to 30M Signal Maximization Tool V1 2021Mar17.xlsx, RE 9k to 30M XYZ_orientations_TemplateV7.xlsm, 9k30mAnalysisDraft5.xlsx.

Test Data

The radiated emission test process began with a preliminary scan 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. 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. 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 adjusted based on 40 dB per decade of distance. Any unintentional radio emission limits are not applied to intentional radio signals.

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
0.04845	37.65	Avg	113.90	76.24	45.64	133.90	88.26	Y	156
0.0485	38.59	Avg	113.89	75.30	47.68	133.89	86.21	Y	-151
0.067	31.10	Avg	111.08	79.99	40.20	131.08	90.89	Z	-80
0.13335	25.85	Avg	105.10	79.26	33.71	125.10	91.40	X	-38
0.1379	24.66	Avg	104.81	80.16	32.85	124.81	91.97	Y	-78
0.15	21.72	Avg	104.08	82.36	31.12	124.08	92.97	Z	180

Table RE31.1: Emission summary (TX 802.11b 11Mbps Ch. 6)

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

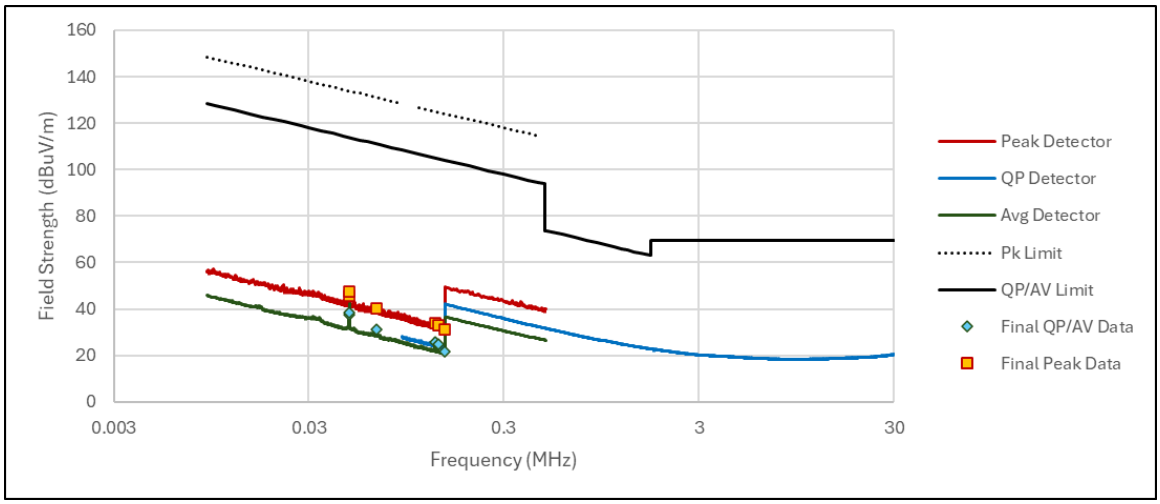


Figure RE31.1: Spectral data (TX 802.11b 11Mbps Ch. 6)

Setup Photographs

See test record GCL0575 Radiated Emission Test RE30, Figures RE30.2 through RE30.6, for photographs that show the EUT configured and arranged in the manner in which it was measured.

This line is the end of the test record.

Test Record
Radiated Emission Test RE32
Project GCL0575

Test Date(s)	15 Aug 2024
Test Personnel	David Kerr Jim Solum assisted by Vladimir Tolstik
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M3 (BleTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	30 MHz to 1000 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	15 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Biconilog, 30M-6 GHz	ETS Lindgren	3142E	233201	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	7-Nov-2022	7-Nov-2025
Tape measure, 1" x 33'	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026

Table RE32.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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.

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		
43.710	V	11.0	15.7	26.7	40.0	13.3	100.0	171.0
74.250	V	10.9	14.5	25.4	40.0	14.6	100.0	0.0
408.750	H	0.0	27.8	27.8	46.0	18.2	385.3	1.0
517.950	H	6.7	29.8	36.5	46.0	9.5	153.6	318.0
688.410	H	3.0	33.4	36.4	46.0	9.6	108.3	325.0
936.000	H	-0.4	36.7	36.3	46.0	9.7	300.1	158.0

Table RE32.2: Emission summary

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

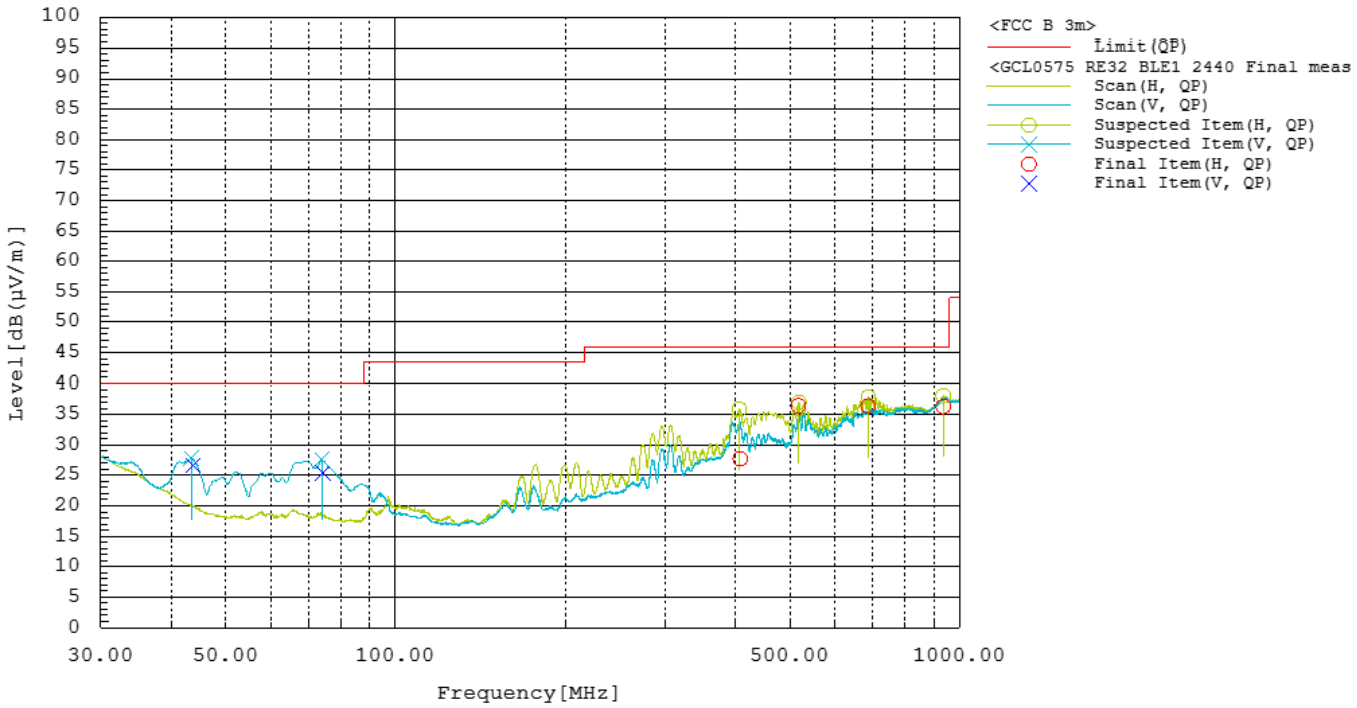


Figure RE32.1: Spectral data

Setup Photographs

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

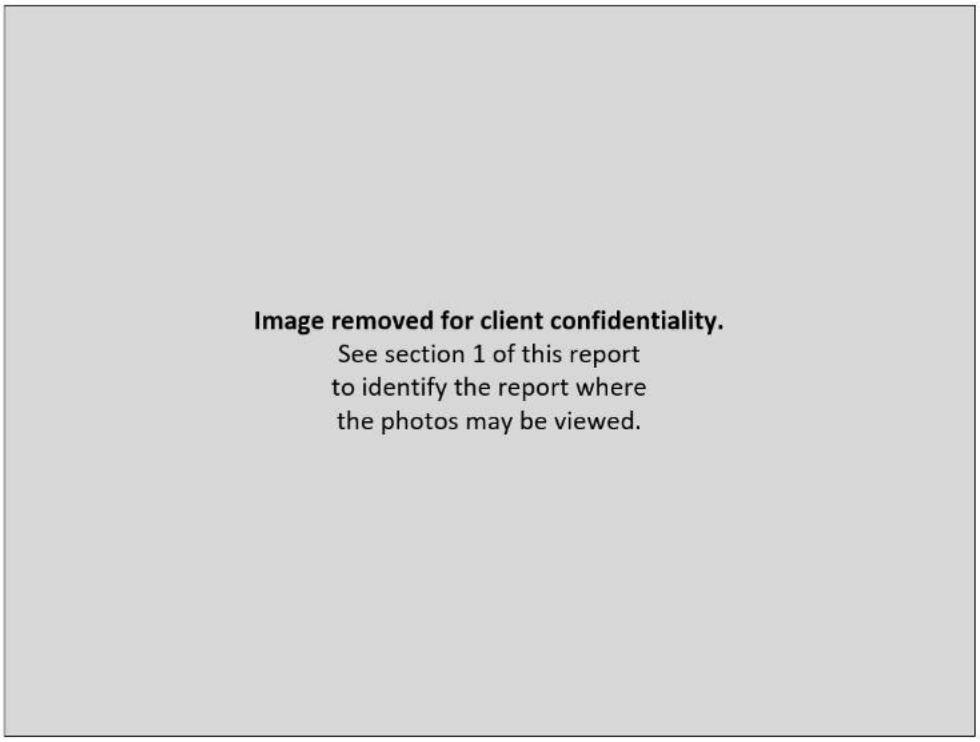


Figure RE32.2: EUT test setup, first view

Figure RE32.3: EUT test setup, second view

This line is the end of the test record.

Test Record
Radiated Emission Test RE08
Project GCL0575

Test Date(s)	07 Jul 2024
Test Personnel	David Kerr
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx)
Arrangement	A2 (Upwr)
Input Power	115 V/ 60 Hz
Test Standards:	FCC Part 15.247, RSS-247, ANSI C63.10, RSS-GEN (as noted in Section 6 of the report).
Frequency Range:	30 MHz to 1000 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	07 Jul 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Biconilog, 30M-6 GHz	ETS Lindgren	3142E	233204	2-Nov-2023	1-Nov-2025
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	7-Nov-2022	7-Nov-2025
Tape measure, 1" x 33'	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026

Table RE08.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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.

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		
43.350	V	10.0	15.9	25.9	40.0	14.1	100.0	160.0
97.320	V	4.8	15.9	20.7	43.5	22.8	100.0	257.0
228.180	H	14.9	20.0	34.9	46.0	11.1	139.4	339.0
404.820	H	8.9	27.5	36.4	46.0	9.6	208.8	283.0
531.960	H	4.6	30.6	35.2	46.0	10.8	150.8	234.0
689.700	H	4.5	33.3	37.8	46.0	8.2	116.1	166.0

Table RE08.2: Emission summary

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

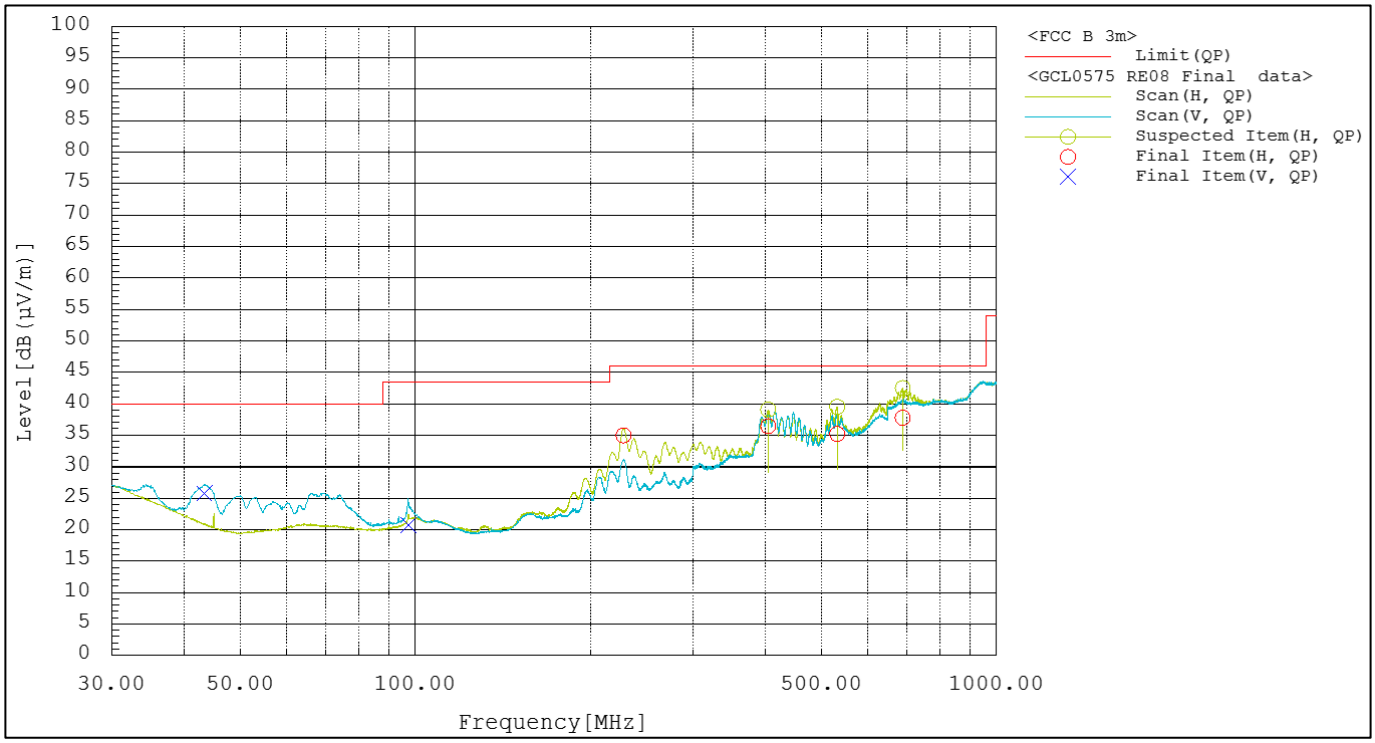


Figure RE08.1: Spectral data

Setup Photographs

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

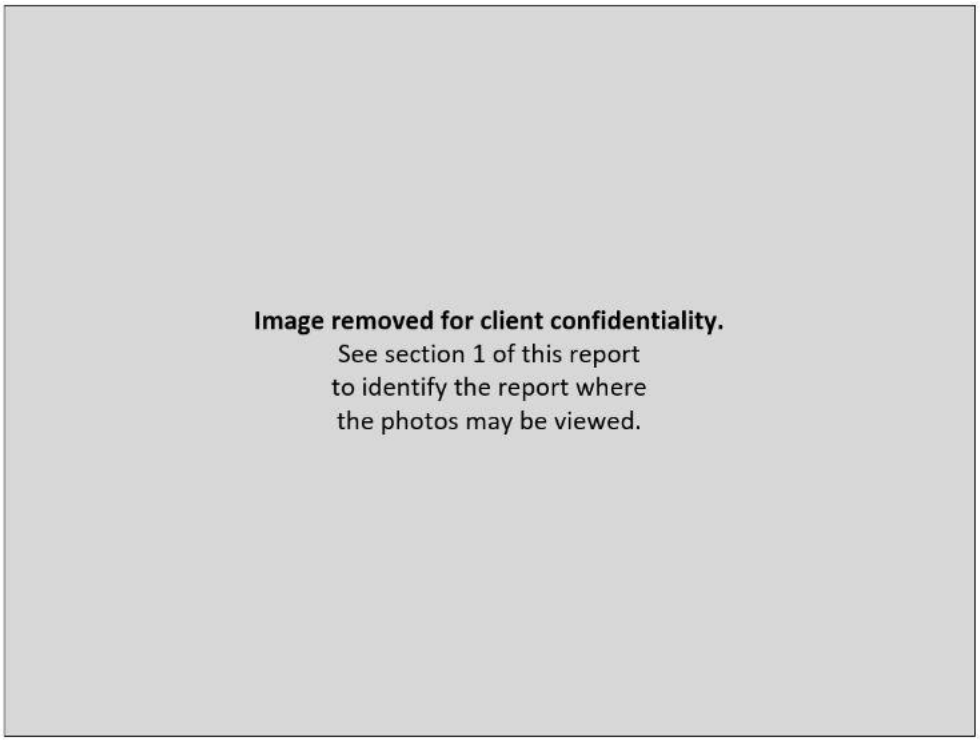


Figure RE08.2: EUT test setup, first view (X orientation)

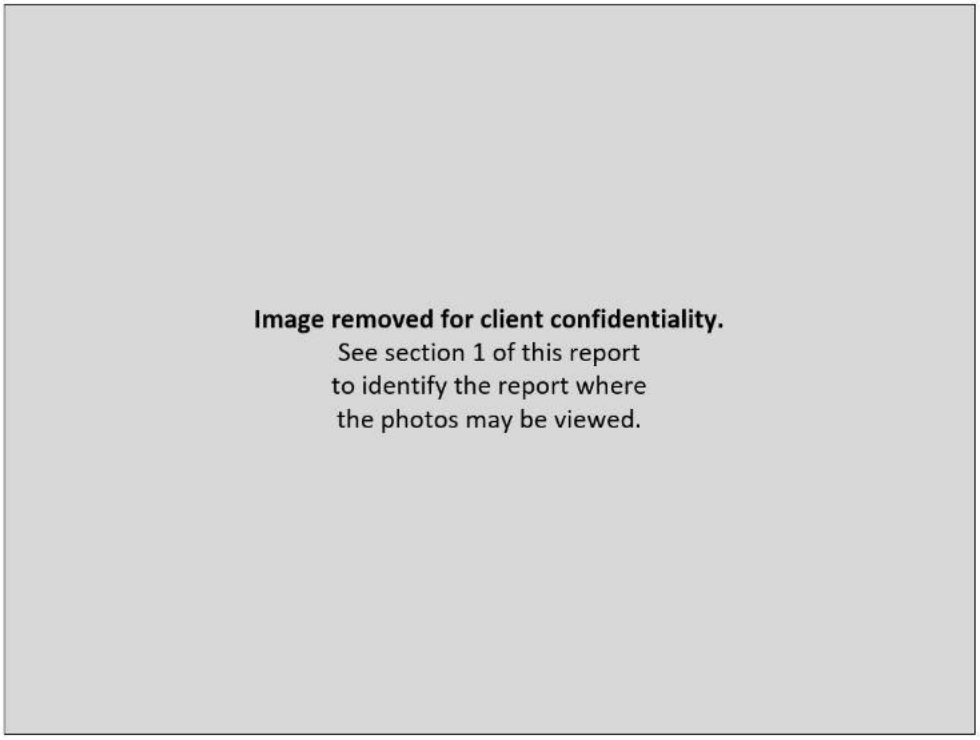


Figure RE08.3: EUT test setup, second view (X orientation)

This line is the end of the test record.

Test Record
Radiated Emission Test RE33
Project GCL0575

Test Date(s)	05, 06, 07 Aug 2024
Test Personnel	David Kerr Jim Solum assisted by Vladimir Tolstik
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M3 (BleTx)
Arrangement	A2 (Upwr)
Input Power	115 V/ 60 Hz
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	1 GHz to 18 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	09 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Tape measure, 1" x 33'	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
3 GHz High Pass filter	Anatech Electronics	0K0R2	1	Calibration	Not Required

Table RE33.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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, pre-scan spectral data and final measurements were taken at 3 meters. 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.

In the 3.2 GHz to 18 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 tables shows the selected final measurement data between 1 GHz and 18 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.

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		
2115.750	H	32.6	46.4	-1.4	31.2	45.0	54.0	74.0	22.8	29.0	211.0	59.0
3070.500	H	32.9	46.7	1.1	34.0	47.8	54.0	74.0	20.0	26.2	386.9	30.0

Table RE33.2: Emission summary (BLE 1Mb 2402MHz, 1 – 3.2GHz)

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		
1899.250	H	32.4	46.1	-1.7	30.7	44.4	54.0	74.0	23.3	29.6	375.1	70.0
3166.750	V	33.2	46.5	1.5	34.7	48.0	54.0	74.0	19.3	26.0	190.9	255.0

Table RE33.3: Emission summary (BLE 1Mb 2440MHz, 1 – 3.2GHz)

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		
1900.750	H	33.7	46.5	-1.7	32.0	44.8	54.0	74.0	22.0	29.2	151.9	341.0
3142.750	H	33.1	46.2	1.5	34.6	47.7	54.0	74.0	19.4	26.3	361.5	248.0

Table RE33.4: Emission summary (BLE 1Mb 2480MHz, 1 – 3.2GHz)

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		
4804.500	V	30.7	44.2	7.3	38.0	51.5	54.0	74.0	16.0	22.5	230.7	223.0
7206.750	H	31.2	45.4	11.5	42.7	56.9	54.0	74.0	11.3	17.1	221.2	342.0
9608.500	V	28.3	41.9	15.1	43.4	57.0	54.0	74.0	10.6	17.0	211.5	18.0
12009.500	V	27.2	40.9	18.5	45.7	59.4	54.0	74.0	8.3	14.6	104.6	0.0
14412.000	V	25.8	39.3	20.7	46.5	60.0	54.0	74.0	7.5	14.0	139.1	343.0
16814.250	V	25.4	38.9	24.0	49.4	62.9	54.0	74.0	4.6	11.1	278.8	86.0

Table RE33.5: Emission summary (BLE 1Mb 2402MHz, 3.2 - 18GHz)

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		
4880.250	V	29.9	43.8	6.7	36.6	50.5	54.0	74.0	17.4	23.5	243.3	328.0
7320.750	V	33.5	45.8	11.6	45.1	57.4	54.0	74.0	8.9	16.6	225.5	358.0
9760.500	V	29.0	43.2	14.9	43.9	58.1	54.0	74.0	10.1	15.9	205.7	341.0
12122.000	V	27.4	41.0	19.1	46.5	60.1	54.0	74.0	7.5	13.9	104.6	16.0
14640.000	V	26.2	39.6	21.0	47.2	60.6	54.0	74.0	6.8	13.4	269.6	0.0
17080.000	V	25.5	39.0	24.1	49.6	63.1	54.0	74.0	4.4	10.9	296.9	324.0

Table RE33.6: Emission summary (BLE 1Mb 2440MHz, 3.2 - 18GHz)

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		
4960.000	V	29.6	43.3	6.8	36.4	50.1	54.0	74.0	17.6	23.9	283.4	317.0
7440.000	V	30.9	44.1	11.7	42.6	55.8	54.0	74.0	11.4	18.2	238.0	76.0
9920.000	V	29.2	42.6	16.2	45.4	58.8	54.0	74.0	8.6	15.2	203.8	22.0
12400.000	V	27.4	41.2	18.9	46.3	60.1	54.0	74.0	7.7	13.9	400.0	64.0
14880.000	V	25.9	39.2	21.4	47.3	60.6	54.0	74.0	6.7	13.4	278.2	27.0
17360.000	V	25.5	39.1	23.5	49.0	62.6	54.0	74.0	5.0	11.4	162.6	187.0

Table RE33.7: Emission summary (BLE 1Mb 2480MHz, 3.2 - 18GHz)

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

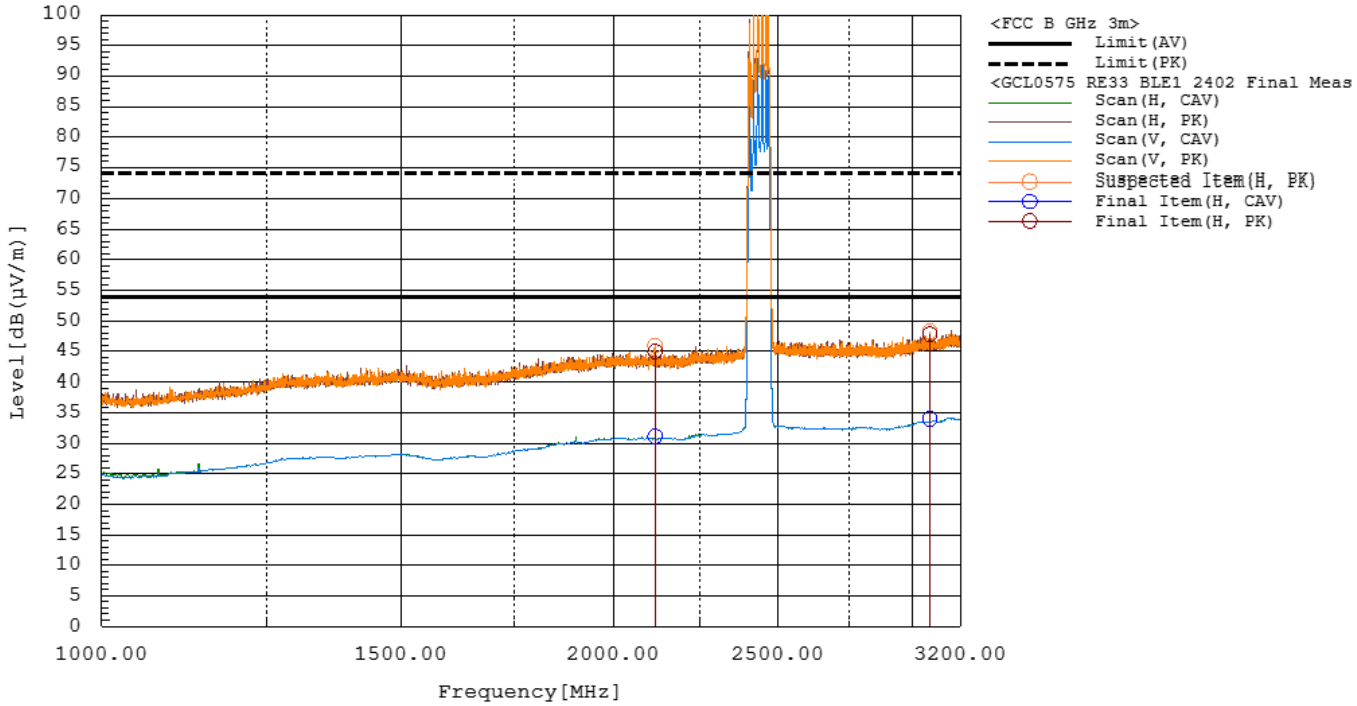


Figure RE33.1: Spectral data (BLE 1Mb 2402MHz, 1 - 3.2 GHz)

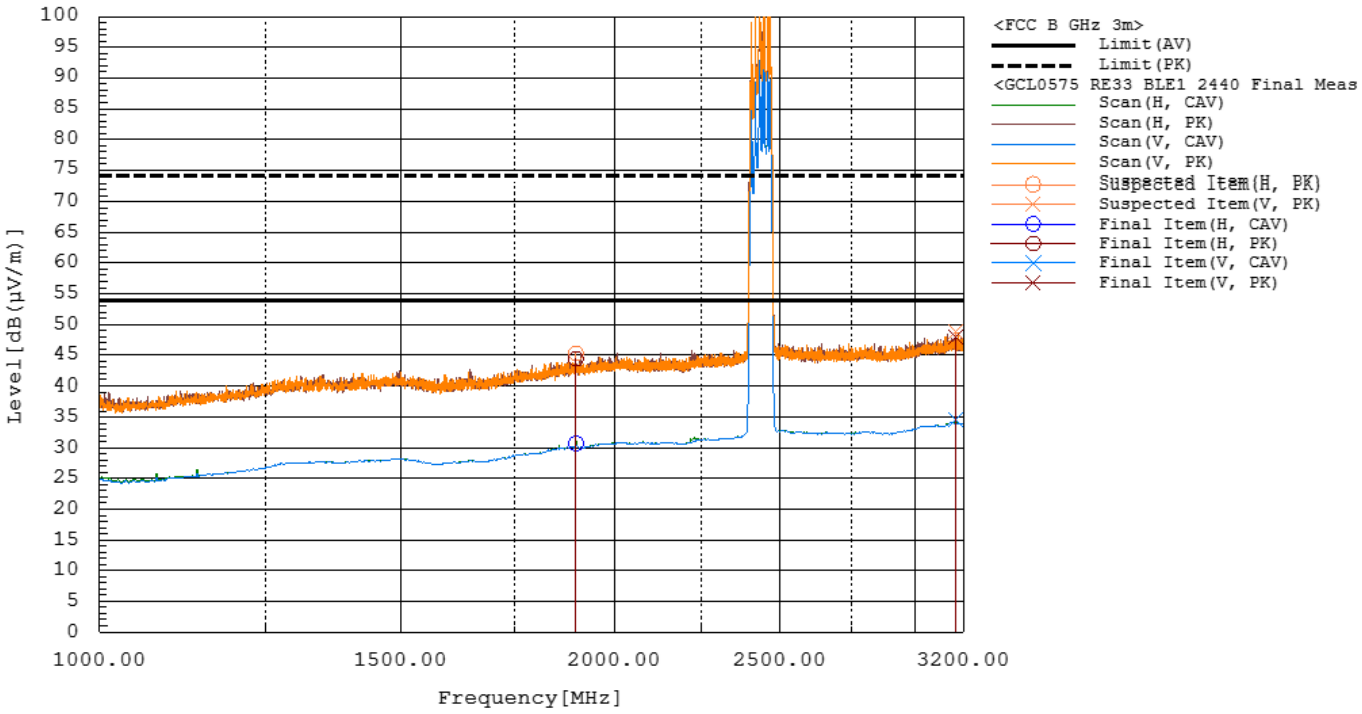


Figure RE33.2: Spectral data (BLE 1Mb 2440MHz, 1 - 3.2 GHz)

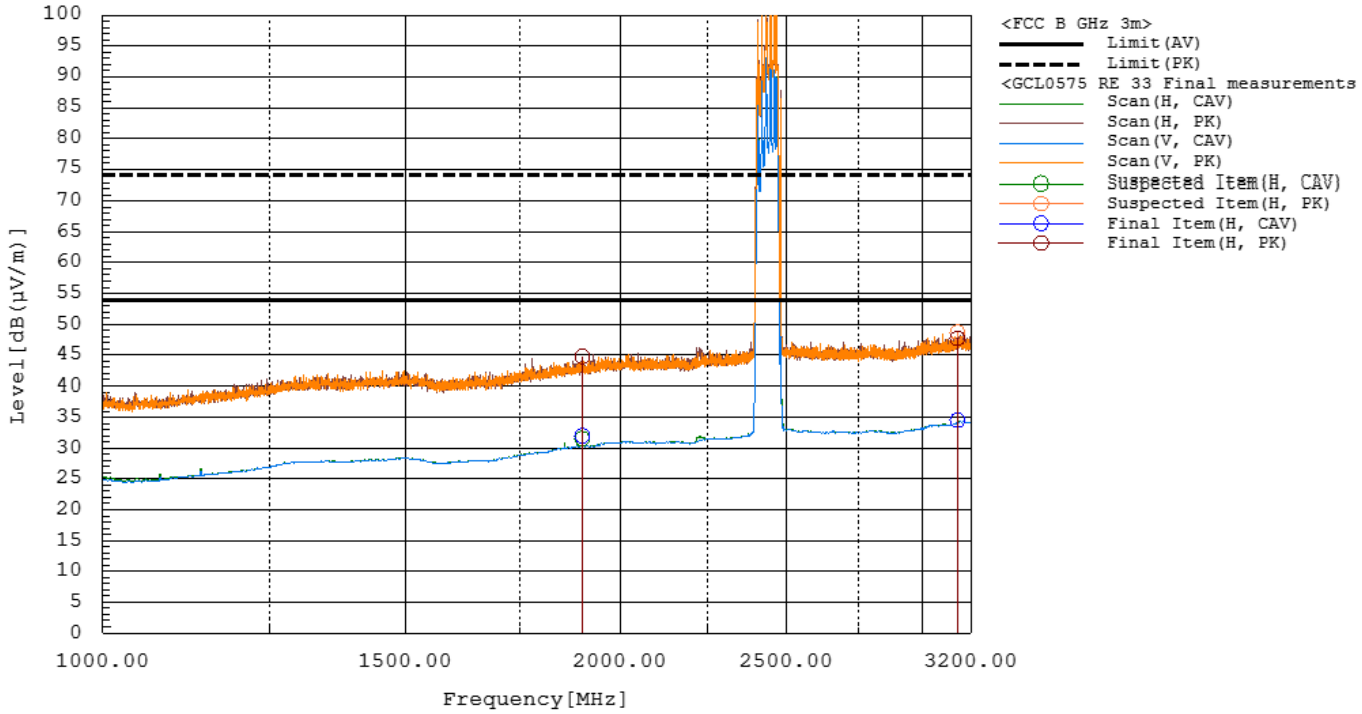


Figure RE33.3: Spectral data (BLE 1Mb 2480MHz, 1 - 3.2 GHz)

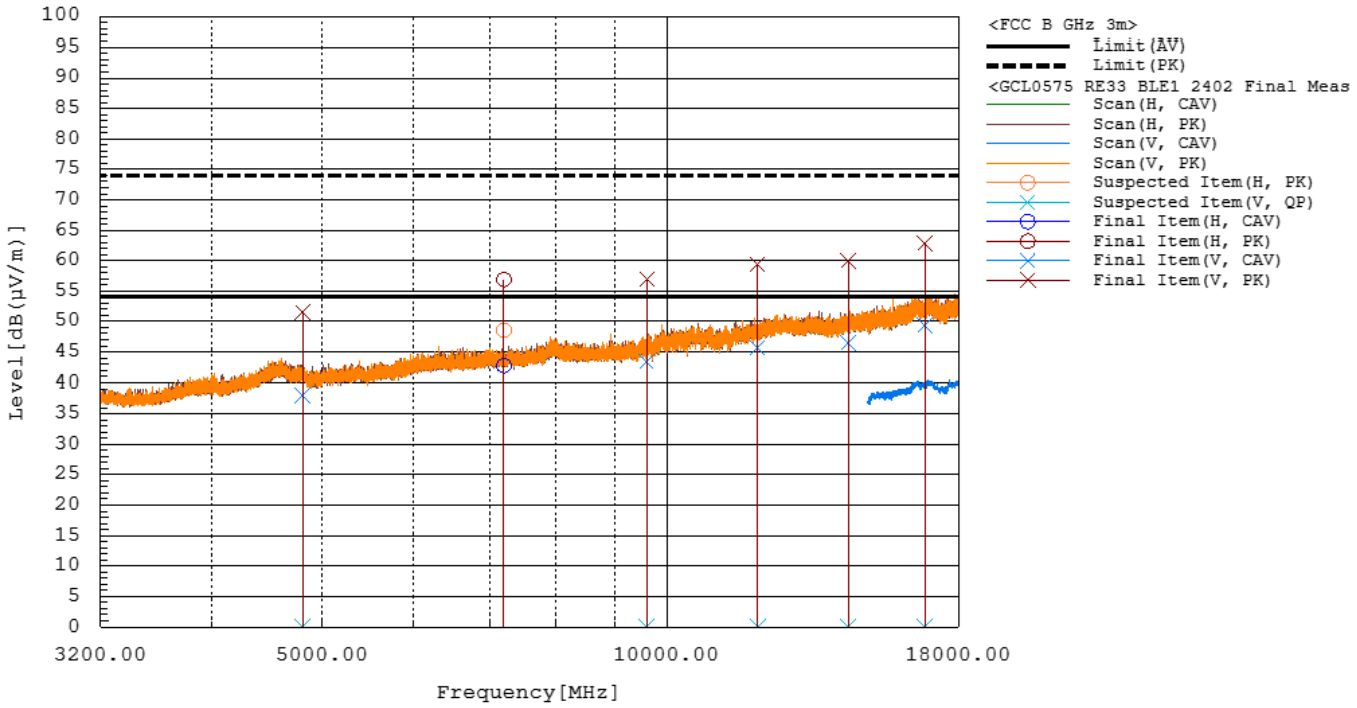


Figure RE33.4: Spectral data (BLE 1Mb 2402MHz, 3.2 - 18GHz)

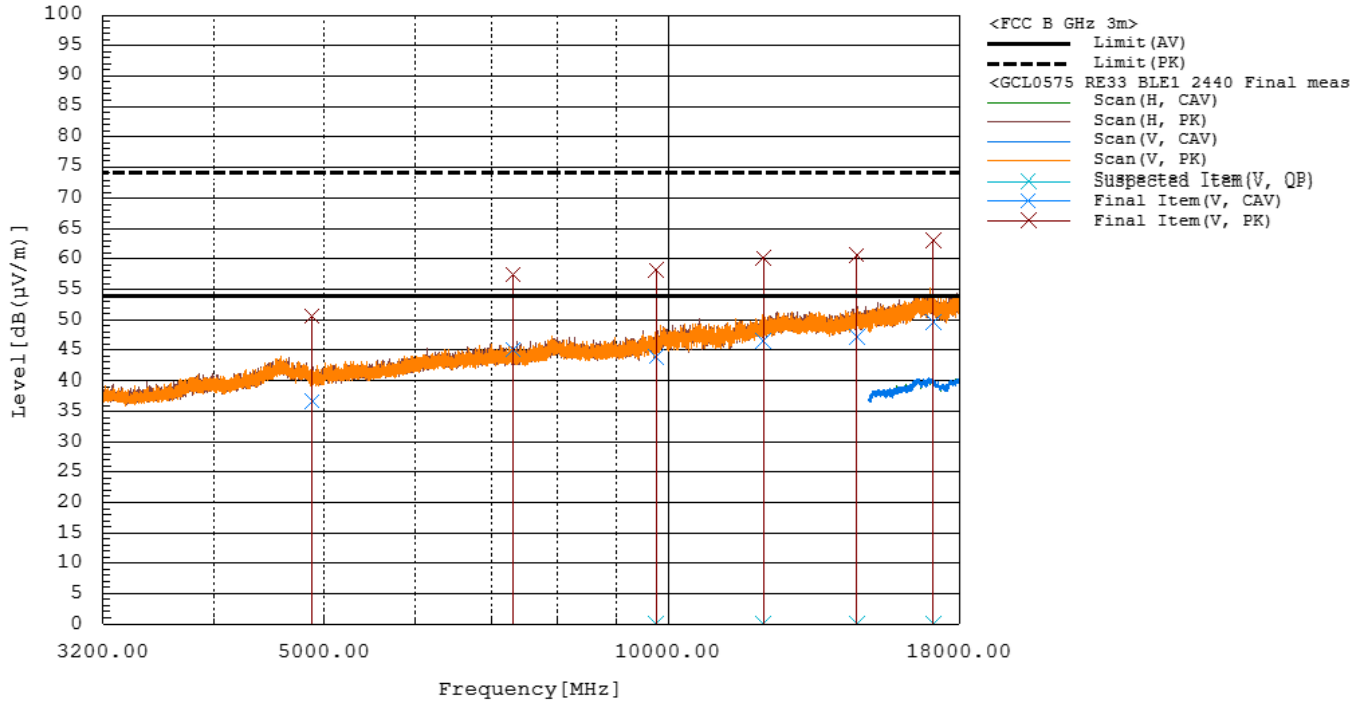


Figure RE33.5: Spectral data (BLE 1Mb 2440MHz, 3.2 - 18GHz)

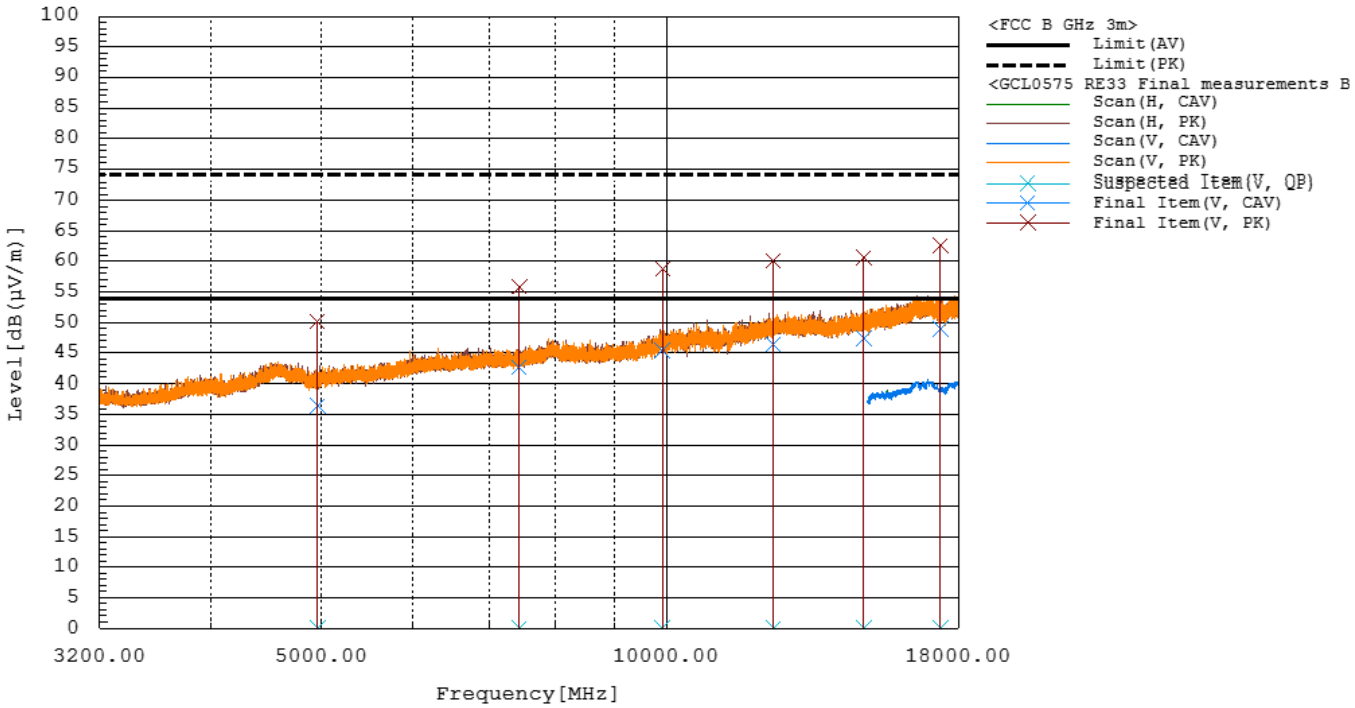


Figure RE33.6: Spectral data (BLE 1Mb 2480MHz, 3.2 - 18GHz)

Setup Photographs

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

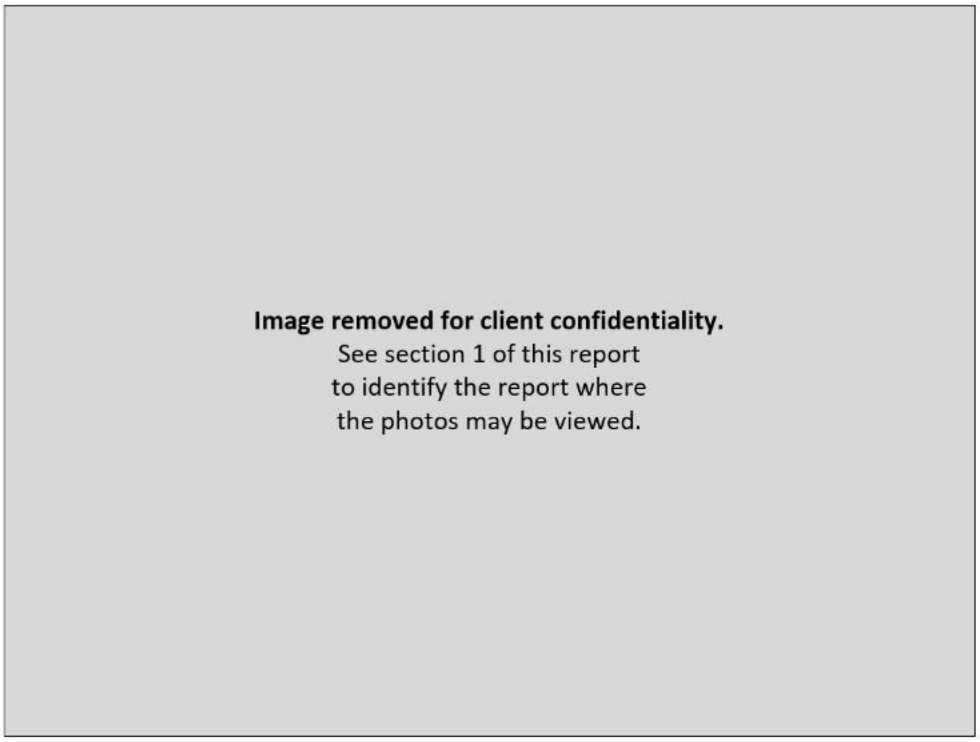


Figure RE33.7: EUT test setup, first view (X orientation)

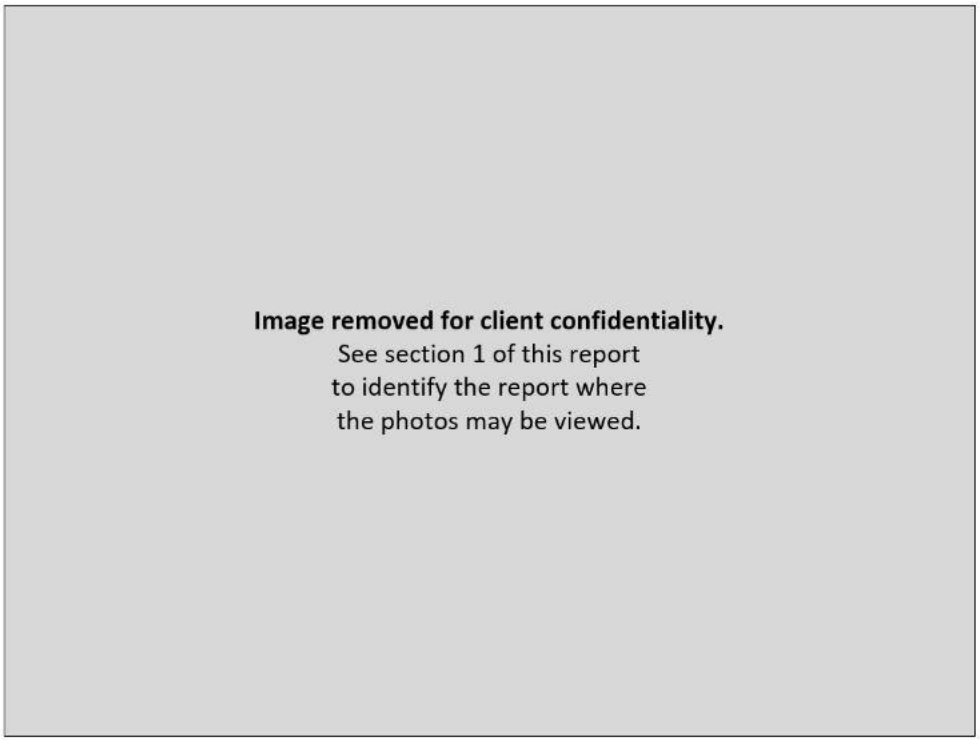


Figure RE33.8: EUT test setup, second view (X orientation)

This line is the end of the test record.

Test Record
Radiated Emission Test RE34
Project GCL0575

Test Date(s)	08 Aug 2024
Test Personnel	David Kerr Jim Solum assisted by Vladimir Tolstik
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx)
Arrangement	A2 (Upwr)
Input Power	115 V/ 60 Hz
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	1 GHz to 18 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	08 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Tape measure, 1" x 33'	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
3 GHz High Pass filter	Anatech Electronics	0K0R2	1	Calibration	Not Required

Table RE34.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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, pre-scan spectral data and final measurements were taken at 3 meters. 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 a high noise floor levels from 2400 – 2483 MHz. These are not failing emissions.

In the 3.2 GHz to 18 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 tables shows the selected final measurement data between 1 GHz and 18 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.

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		
1900.750	H	33.4	46.4	-1.7	31.7	44.7	54.0	74.0	22.3	29.3	114.2	338.0
3168.000	H	33.2	47.1	1.5	34.7	48.6	54.0	74.0	19.3	25.4	363.1	61.0

Table RE34.2: Emission summary (Wifi B11, ch 1, 1 – 3.2GHz)

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		
1900.750	H	33.3	46.4	-1.7	31.6	44.7	54.0	74.0	22.4	29.3	189.8	342.0
3135.750	H	32.9	46.6	1.4	34.3	48.0	54.0	74.0	19.7	26.0	355.5	358.0

Table RE34.3: Emission summary (Wifi B11, ch 6, 1 – 3.2GHz)

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		
1900.750	H	33.4	47.0	-1.7	31.7	45.3	54.0	74.0	22.3	28.7	189.8	342.0
2575.000	H	34.6	49.0	0.2	34.8	49.2	54.0	74.0	19.2	24.8	100.0	110.0
3163.750	H	33.1	46.6	1.5	34.6	48.1	54.0	74.0	19.4	25.9	400.0	0.0

Table RE34.4: Emission summary (Wifi B11, ch 11, 1 – 3.2GHz)

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		
1900.750	H	33.2	46.8	-1.7	31.5	45.1	54.0	74.0	22.5	28.9	192.9	342.0
3127.750	H	32.8	46.1	1.4	34.2	47.5	54.0	74.0	19.8	26.5	161.7	63.0

Table RE34.5: Emission summary (Wifi B11, ch 13, 1 – 3.2GHz)

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		
12060.000	V	26.6	40.4	18.8	45.4	59.2	54.0	74.0	8.6	14.8	199.7	304.0
14472.000	H	26.0	39.7	20.9	46.9	60.6	54.0	74.0	7.1	13.4	313.8	111.0
16884.000	V	25.9	39.3	24.0	49.9	63.3	54.0	74.0	4.1	10.7	219.9	292.0

Table RE34.6: Emission summary (Wifi B11, ch 1, 3.2 - 18GHz)

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		
12185.000	V	26.7	40.4	19.3	46.0	59.7	54.0	74.0	8.0	14.3	345.8	320.0
14622.000	H	25.9	40.0	21.0	46.9	61.0	54.0	74.0	7.1	13.0	106.8	0.0
17059.000	V	25.6	39.1	23.9	49.5	63.0	54.0	74.0	4.5	11.0	152.0	267.0

Table RE34.7: Emission summary (Wifi B11, ch 6, 3.2 - 18GHz)

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		
12310.000	V	27.3	41.3	19.0	46.3	60.3	54.0	74.0	7.7	13.7	365.1	315.0
14772.000	V	25.8	39.2	21.2	47.0	60.4	54.0	74.0	7.0	13.6	268.8	73.0
17234.000	V	25.6	38.9	23.7	49.3	62.6	54.0	74.0	4.7	11.4	295.1	353.0

Table RE34.8: Emission summary (Wifi B11, ch 11, 3.2 - 18GHz)

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		
12360.000	V	27.3	40.7	18.9	46.2	59.6	54.0	74.0	7.8	14.4	250.2	6.0
14832.000	V	25.8	39.6	21.3	47.1	60.9	54.0	74.0	6.9	13.1	366.8	358.0
17304.000	V	25.0	38.5	23.8	48.8	62.3	54.0	74.0	5.2	11.7	266.2	318.0

Table RE34.9: Emission summary (Wifi B11, ch 13, 3.2 - 18GHz)

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

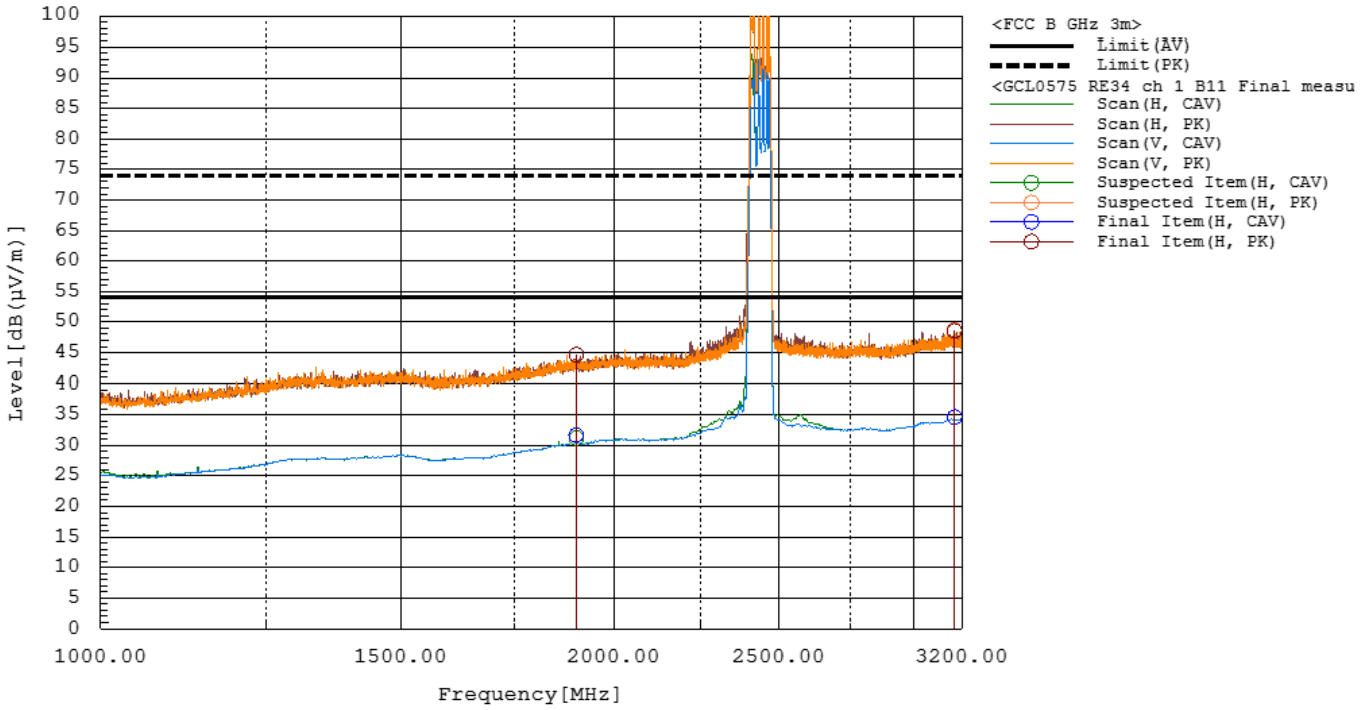


Figure RE34.1: Spectral data (Wifi B11, ch 1, 1 – 3.2GHz)

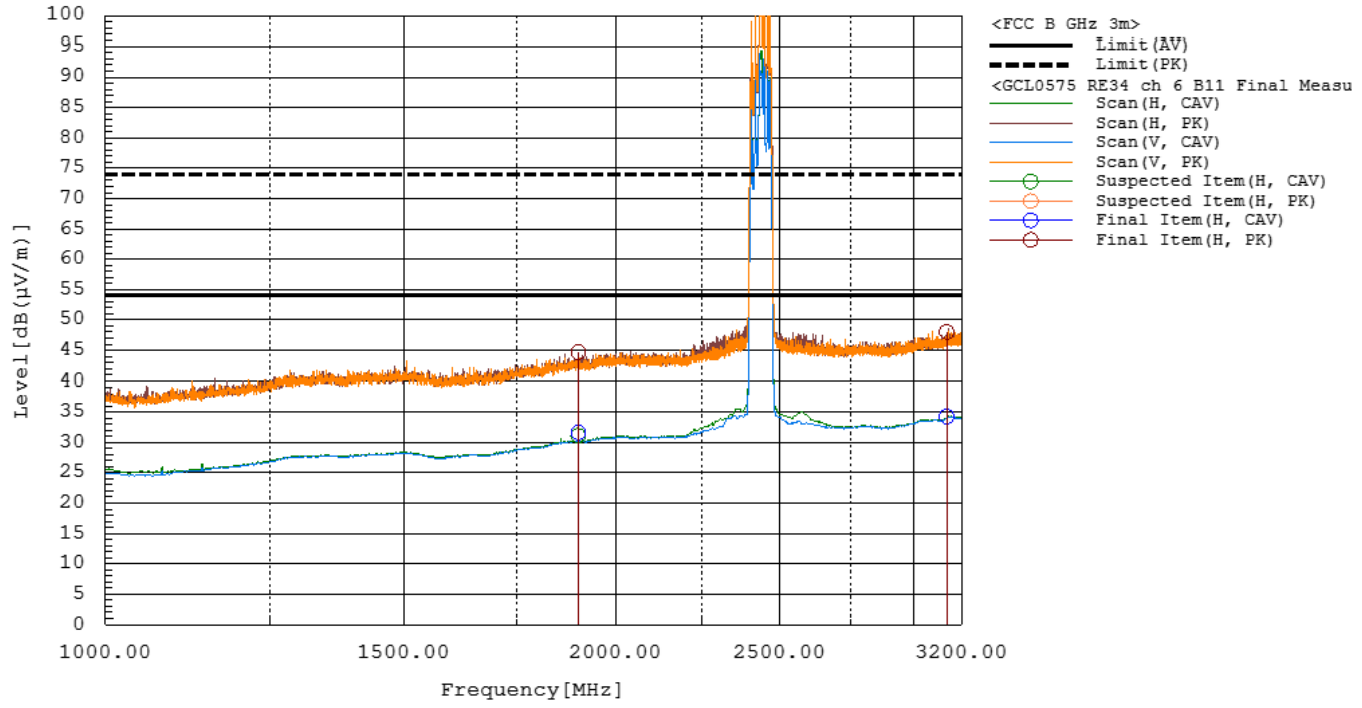


Figure RE34.2: Spectral data (Wifi B11, ch 6, 1 - 3.2 GHz)

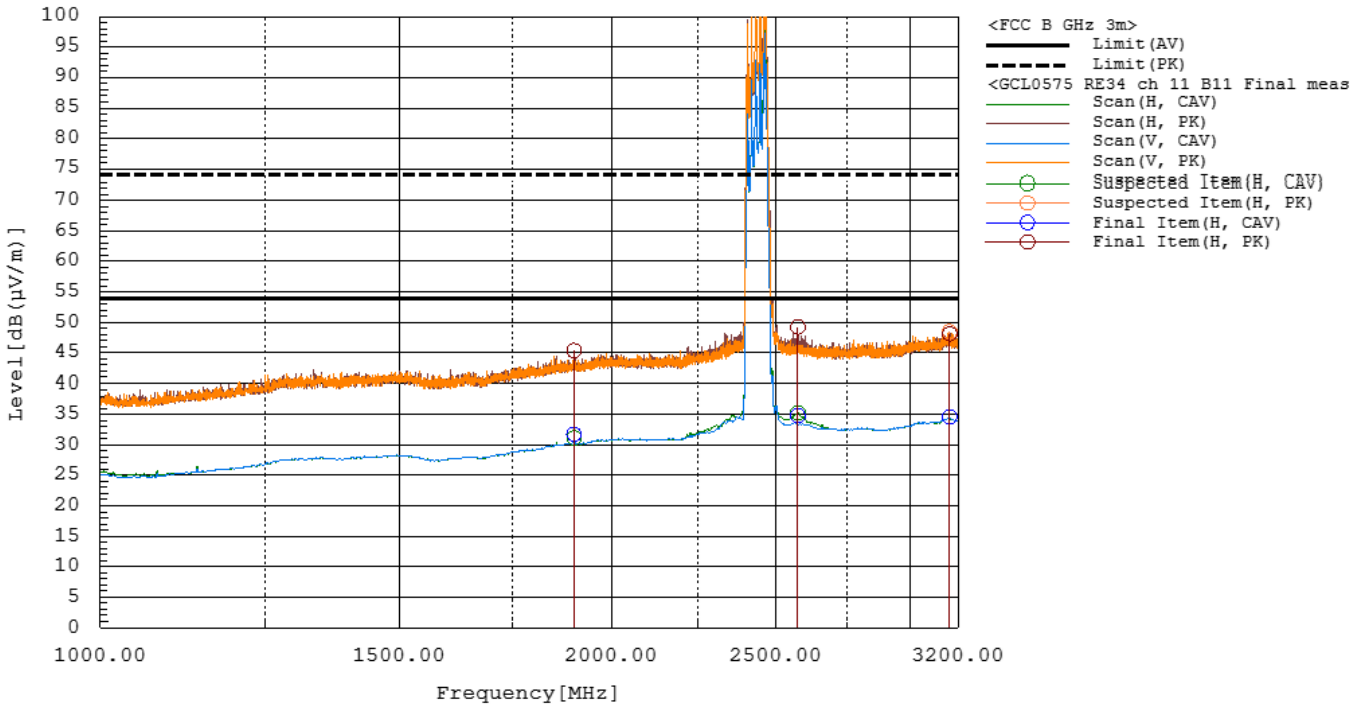


Figure RE34.3: Spectral data (Wifi B11, ch 11, 1 - 3.2 GHz)

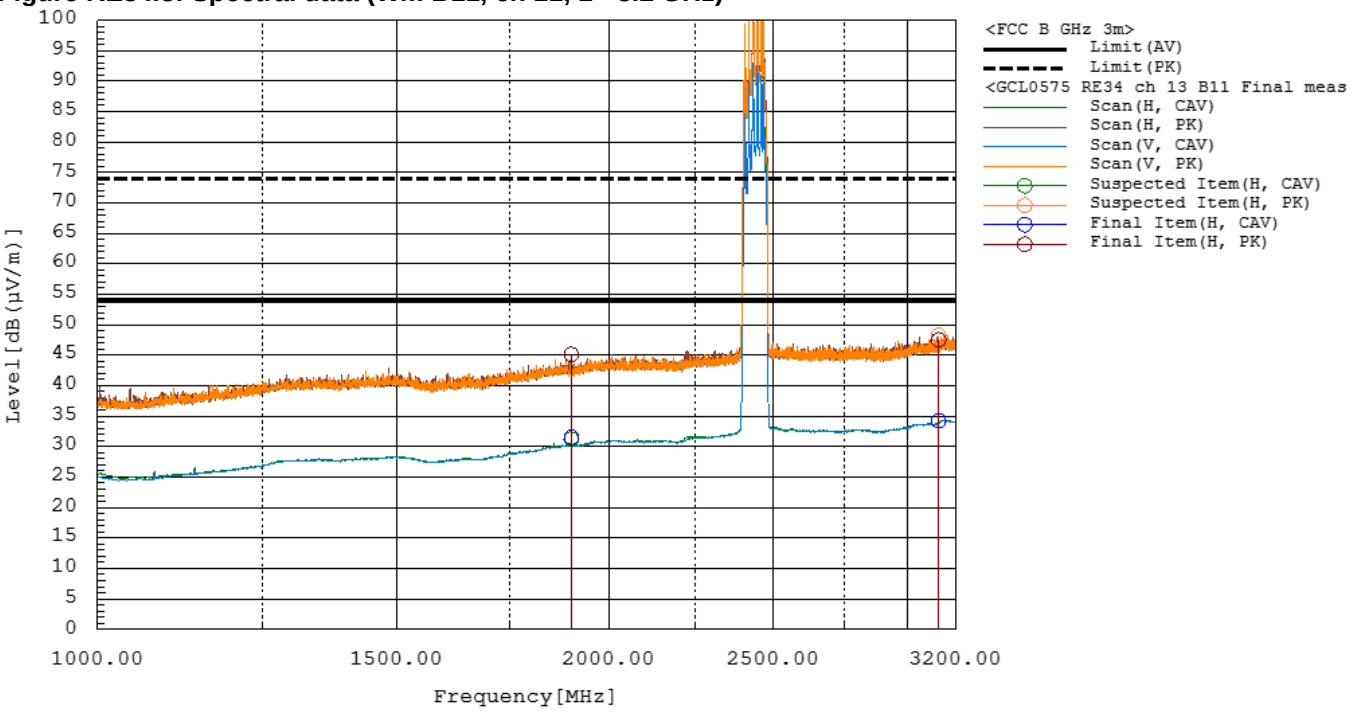


Figure RE34.4: Spectral data (Wifi B11, ch 13, 1 - 3.2 GHz)

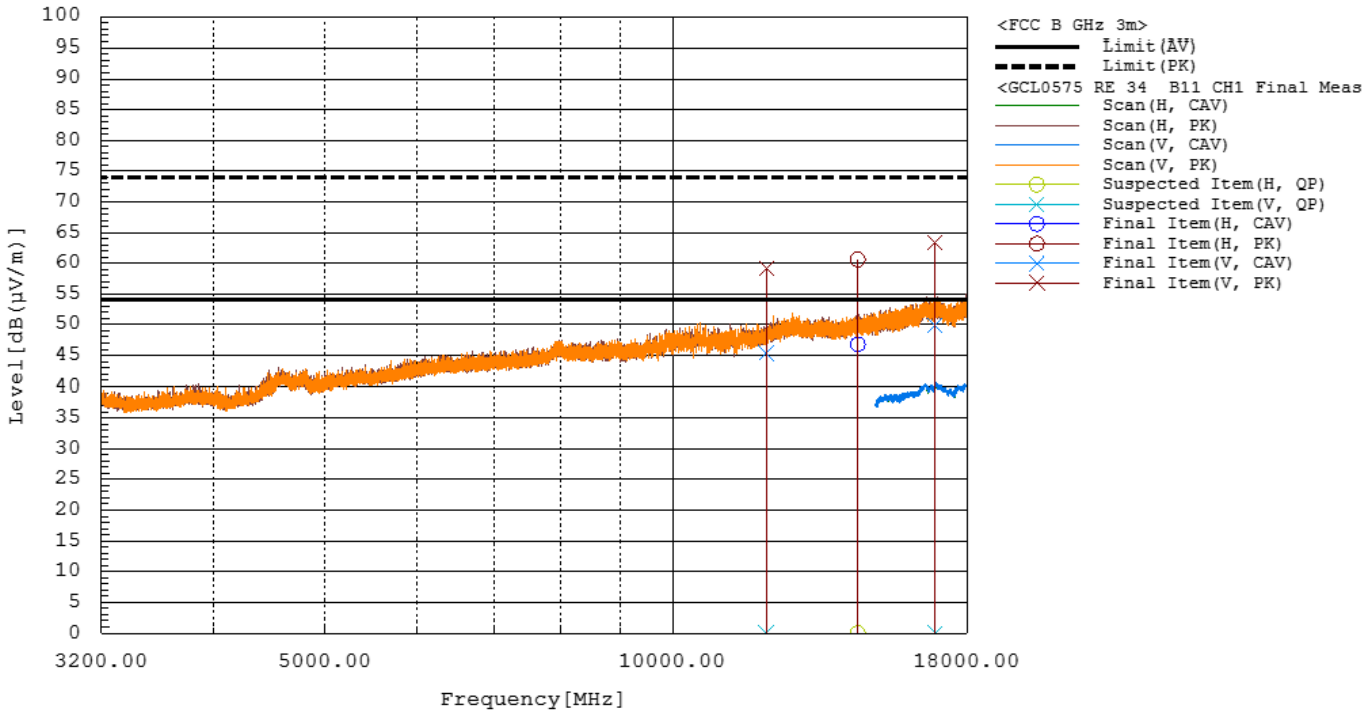


Figure RE34.5: Spectral data (Wifi B11, ch 1, 3.2 - 18GHz)

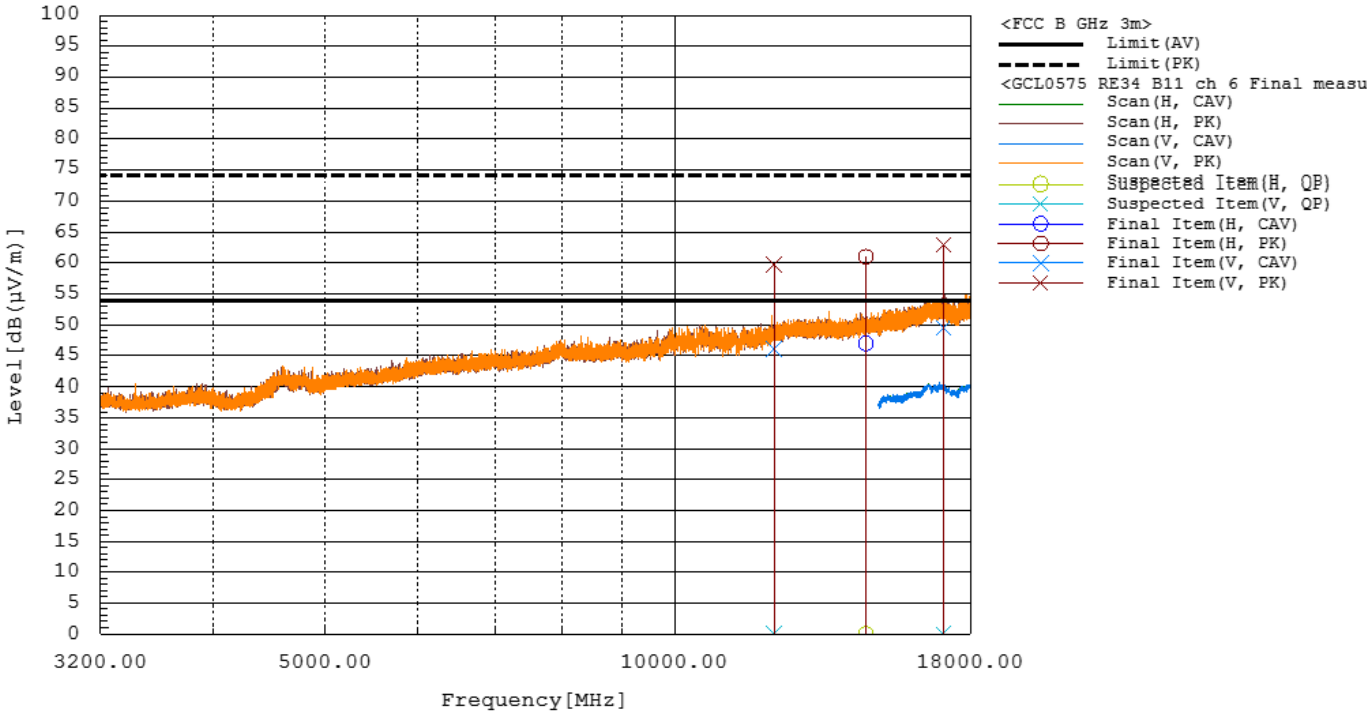


Figure RE34.6: Spectral data (Wifi B11, ch 6, 3.2 - 18GHz)

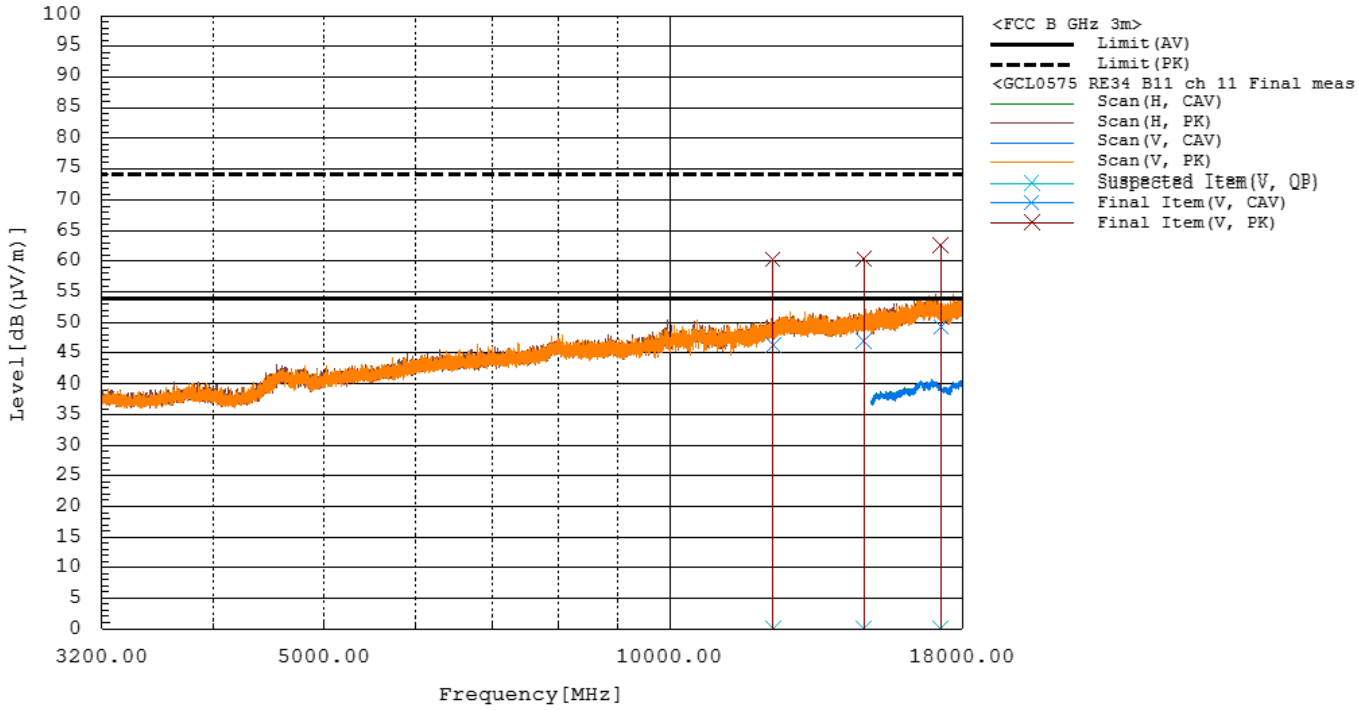


Figure RE34.7: Spectral data (Wifi B11, ch 11, 3.2 - 18GHz)

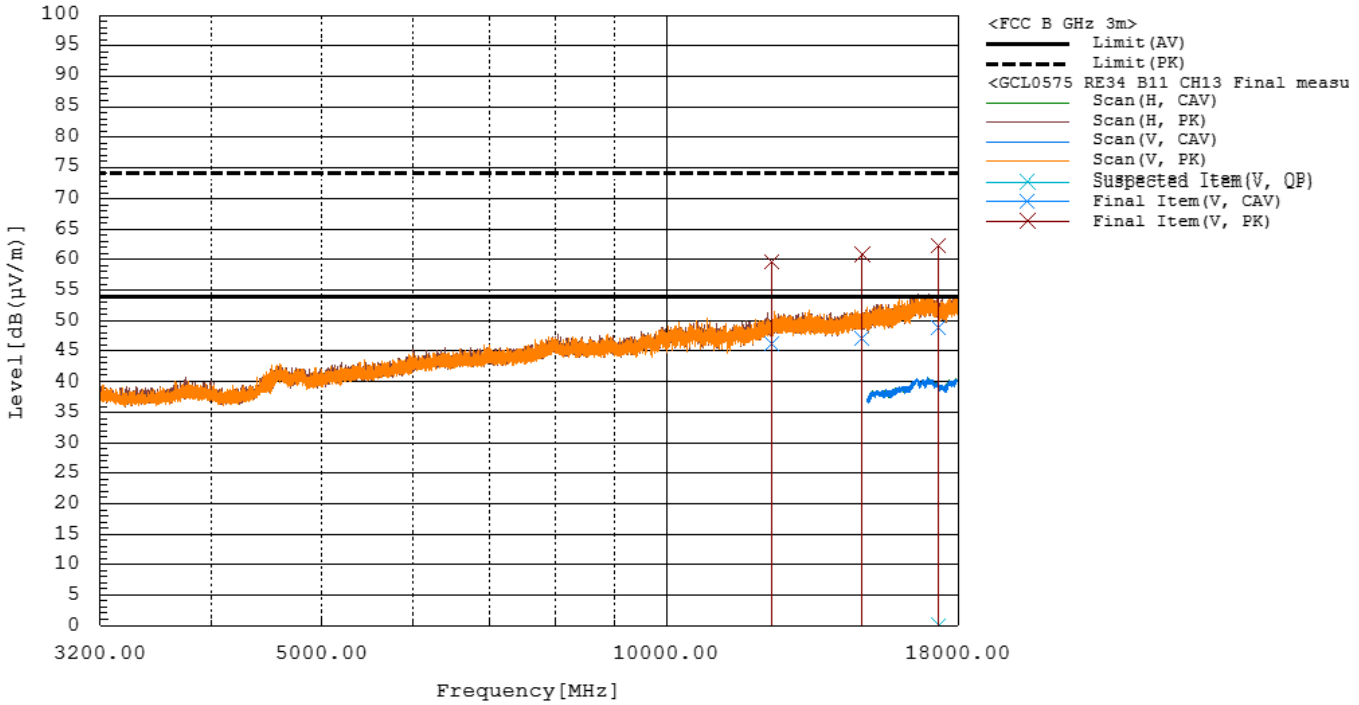


Figure RE34.8: Spectral data (Wifi B11, ch 13, 3.2 - 18GHz)

Setup Photographs

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

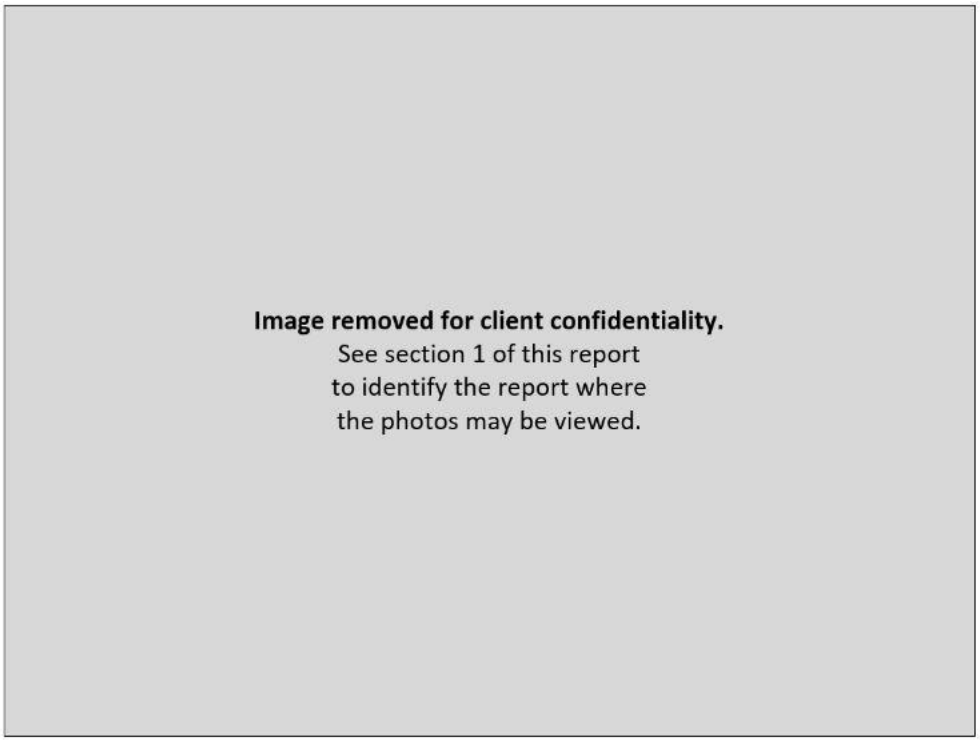


Figure RE34.9: EUT test setup, first view (X orientation)

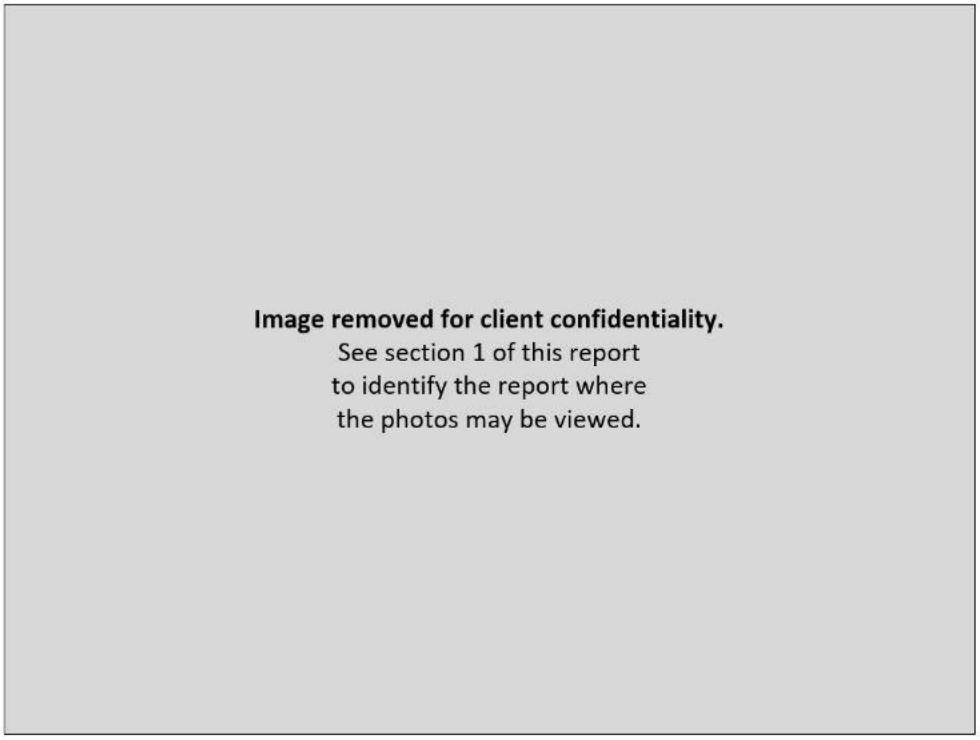


Figure RE34.10: EUT test setup, second view (X orientation)

This line is the end of the test record.

Test Record
Radiated Emission Test RE34
Project GCL0575

Test Date(s)	08 Aug 2024
Test Personnel	David Kerr Jim Solum assisted by Vladimir Tolstik
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx) (G6)
Arrangement	A2 (Upwr)
Input Power	115 V/ 60 Hz
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	1 GHz to 18 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	David A Kerr
Date of this record:	08 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	27-Sep-2023	1-Oct-2024
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Tape measure, 1" x 33'	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
3 GHz High Pass filter	Anatech Electronics	0K0R2	1	Calibration	Not Required

Table RE35.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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, pre-scan spectral data and final measurements were taken at 3 meters. 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 a high noise floor levels from 2400 – 2483 MHz. These are not failing emissions.

In the 3.2 GHz to 18 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 tables shows the selected final measurement data between 1 GHz and 18 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.

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		
2355.000	H	39.8	53.5	-0.6	39.2	52.9	54.0	74.0	14.8	21.1	134.2	89.0
3192.750	H	33.1	46.7	1.4	34.5	48.1	54.0	74.0	19.5	25.9	400.0	0.0

Table RE35.2: Emission summary (Wifi G6, ch 1, 1 – 3.2GHz)

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		
2367.750	H	39.8	53.5	-0.5	39.3	53.0	54.0	74.0	14.7	21.0	144.2	180.0
2572.000	H	35.8	50.0	0.2	36.0	50.2	54.0	74.0	18.0	23.8	154.2	105.0

Table RE35.3: Emission summary (Wifi G6, ch 6, 1 – 3.2GHz)

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		
2367.250	V	36.1	50.0	-0.5	35.6	49.5	54.0	74.0	18.4	24.5	255.2	319.0
2551.750	H	36.3	49.6	0.2	36.5	49.8	54.0	74.0	17.5	24.2	120.0	95.0

Table RE35.4: Emission summary (Wifi G6, ch 11, 1 – 3.2GHz)

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		
2379.000	H	32.6	46.0	-0.3	32.3	45.7	54.0	74.0	21.7	28.3	126.3	120.0
3166.250	H	33.0	46.4	1.5	34.5	47.9	54.0	74.0	19.5	26.1	296.0	180.0

Table RE35.5: Emission summary (Wifi G6, ch 13, 1 – 3.2GHz)

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		
12060.000	V	26.7	40.6	18.8	45.5	59.4	54.0	74.0	8.5	14.6	174.2	0.0
14472.000	V	26.0	39.7	20.9	46.9	60.6	54.0	74.0	7.1	13.4	159.7	343.0
16884.000	V	25.8	39.3	24.0	49.8	63.3	54.0	74.0	4.2	10.7	100.0	43.0

Table RE35.6: Emission summary (Wifi G6, ch 1, 3.2 - 18GHz)

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		
12185.000	V	26.7	40.8	19.3	46.0	60.1	54.0	74.0	8.0	13.9	112.6	179.0
14622.000	V	25.9	40.1	21.0	46.9	61.1	54.0	74.0	7.1	12.9	104.6	10.0
17059.000	V	25.6	39.1	23.9	49.5	63.0	54.0	74.0	4.5	11.0	400.0	0.0

Table RE35.7: Emission summary (Wifi G6, ch 6, 3.2 - 18GHz)

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		
12310.000	V	27.2	40.7	19.0	46.2	59.7	54.0	74.0	7.8	14.3	148.0	96.0
14772.000	V	25.7	39.1	21.2	46.9	60.3	54.0	74.0	7.1	13.7	171.7	237.0
17234.000	V	25.5	39.0	23.7	49.2	62.7	54.0	74.0	4.8	11.3	191.4	0.0

Table RE35.8: Emission summary (Wifi G6, ch 11, 3.2 - 18GHz)

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		
12360.000	V	27.2	41.2	18.9	46.1	60.1	54.0	74.0	7.9	13.9	349.3	132.0
14832.000	V	25.8	39.5	21.3	47.1	60.8	54.0	74.0	6.9	13.2	231.6	167.0
17304.000	V	25.0	38.7	23.8	48.8	62.5	54.0	74.0	5.2	11.5	400.0	358.0

Table RE35.9: Emission summary (Wifi G6, ch 13, 3.2 - 18GHz)

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

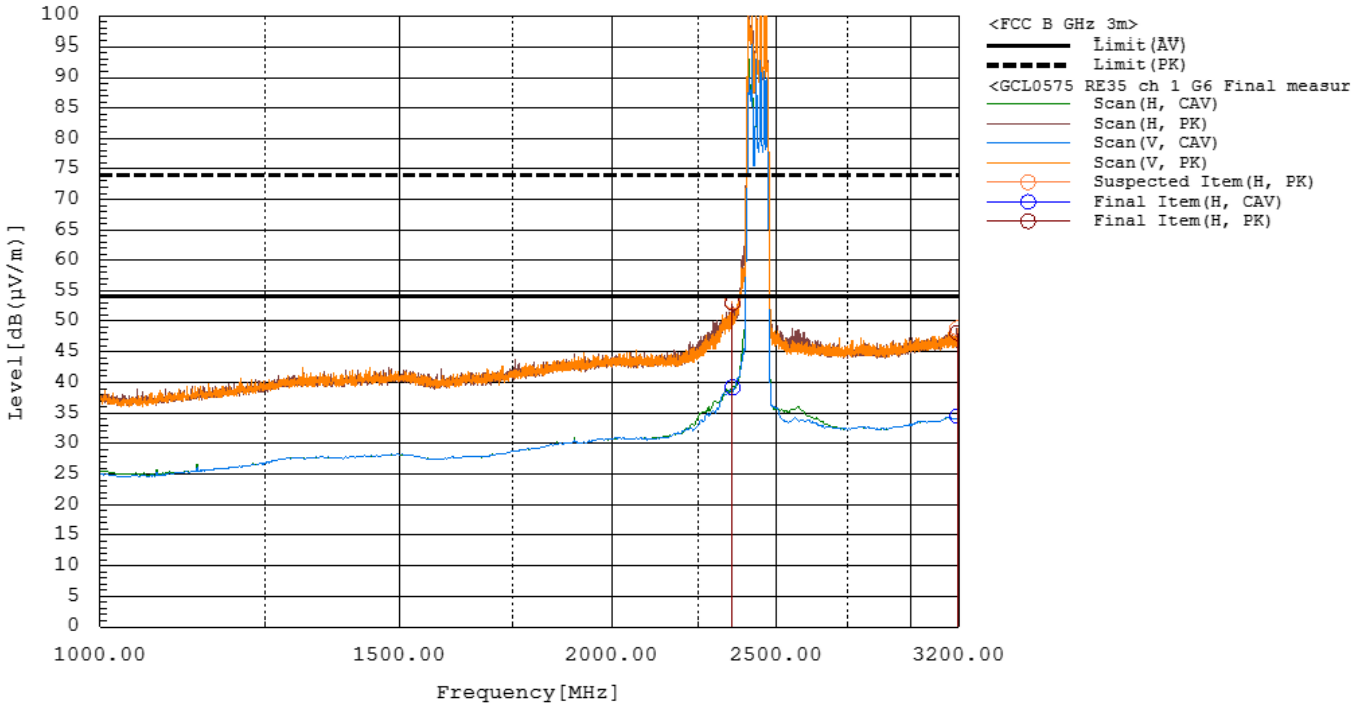


Figure RE35.1: Spectral data (Wifi G6, ch 1, 1 – 3.2GHz)

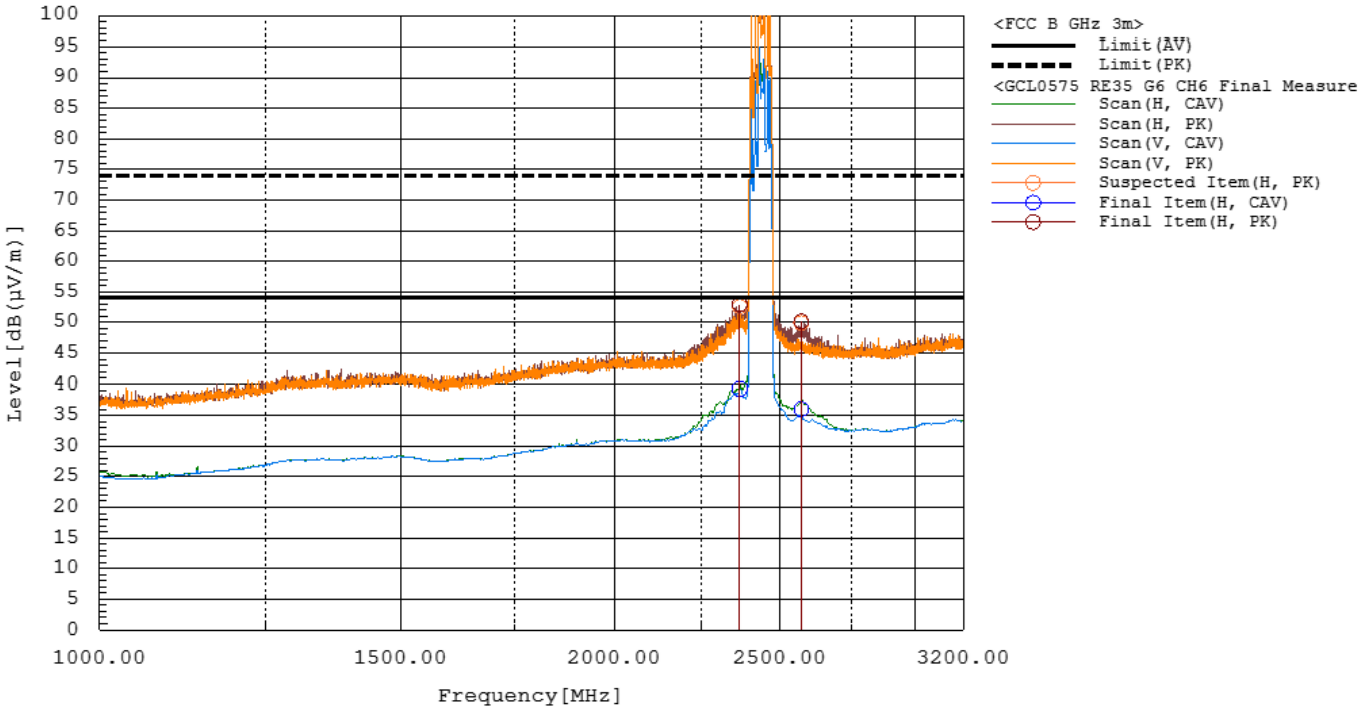


Figure RE35.2: Spectral data (Wifi G6, ch 6, 1 - 3.2 GHz)

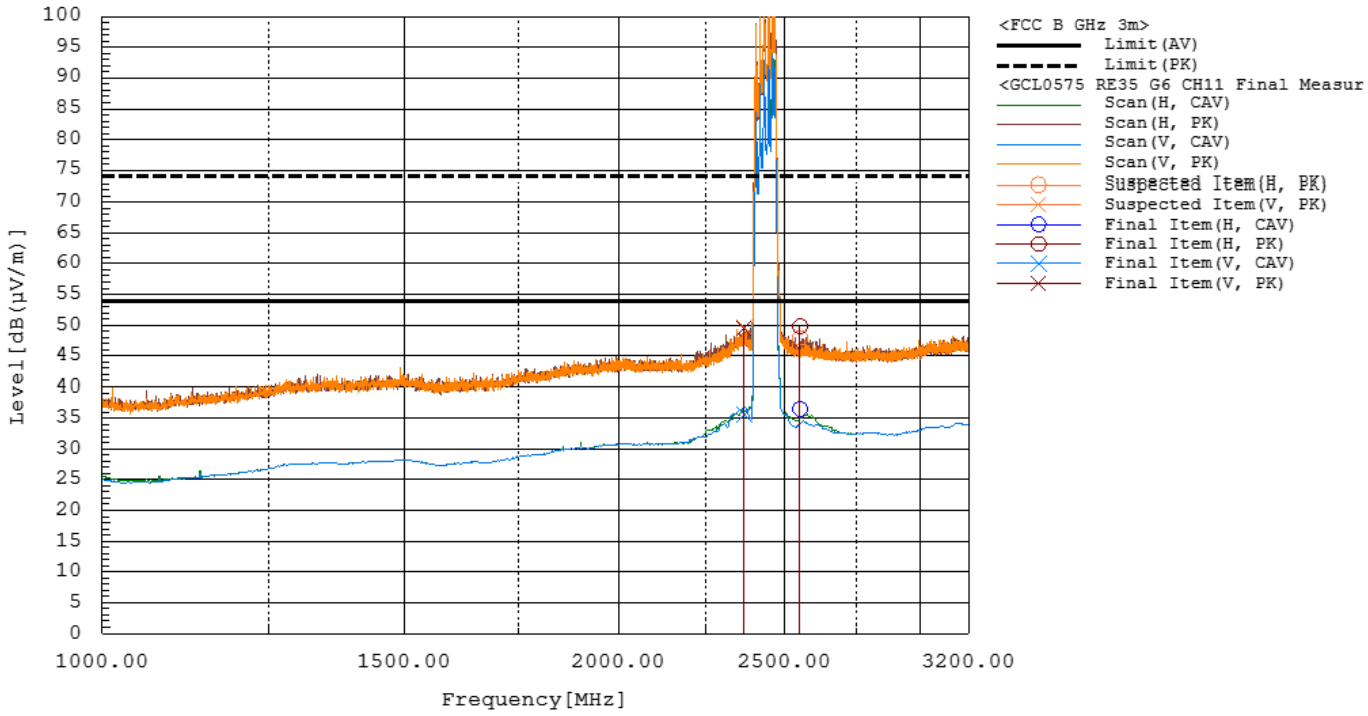


Figure RE35.3: Spectral data (Wifi G6, ch 11, 1 - 3.2 GHz)

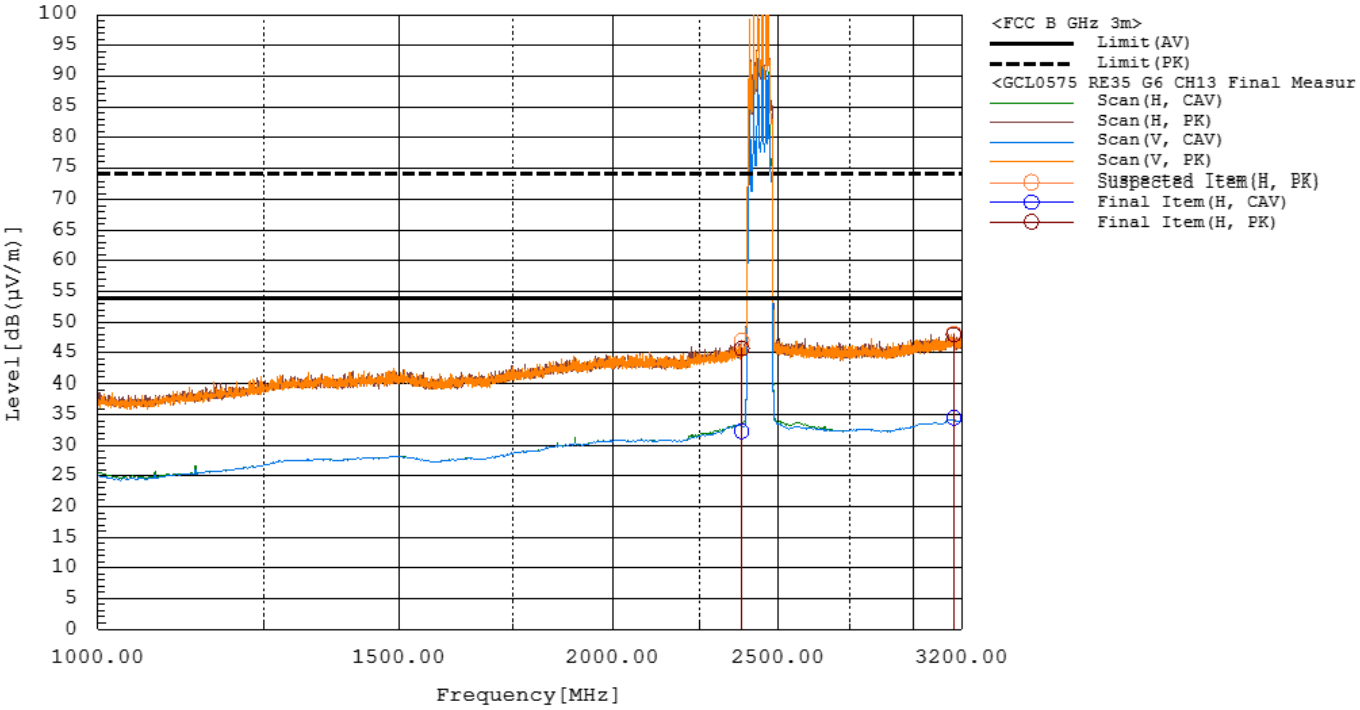


Figure RE35.4: Spectral data (Wifi G6, ch 13, 1 - 3.2 GHz)

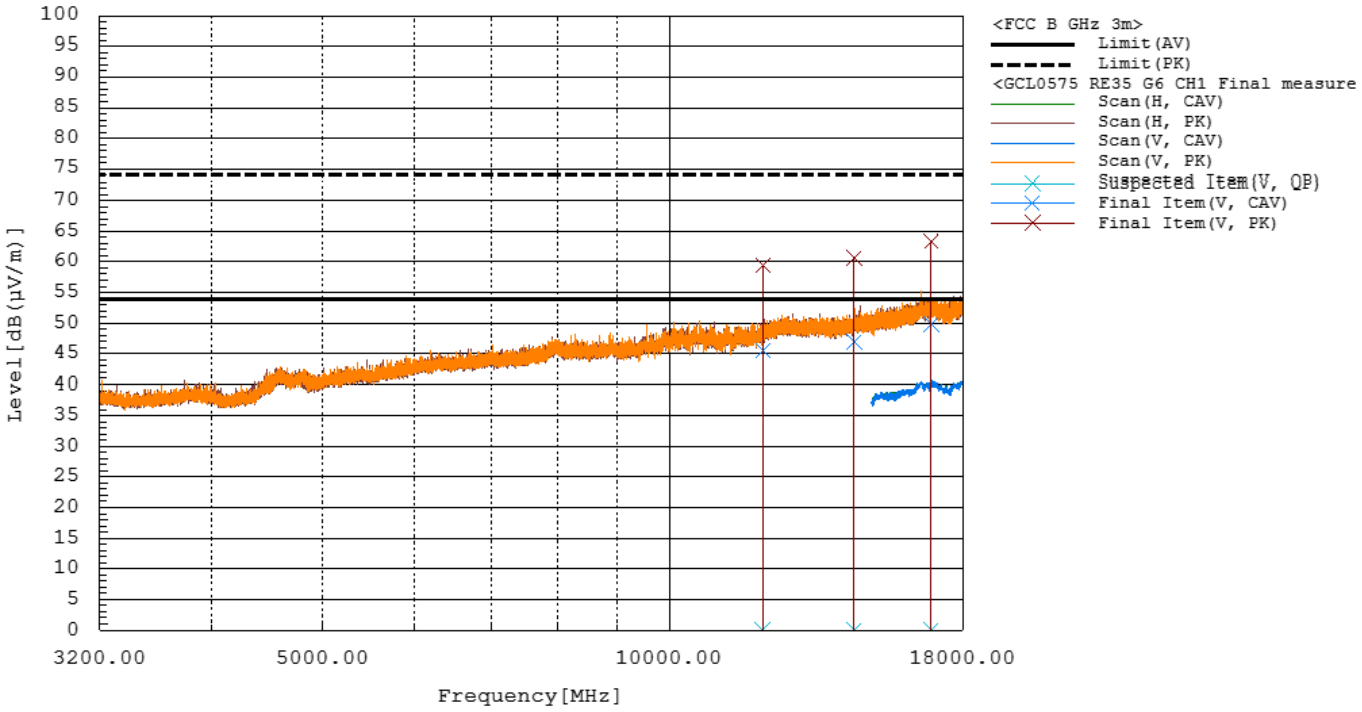


Figure RE35.5: Spectral data (Wifi G6, ch 1, 3.2 - 18GHz)

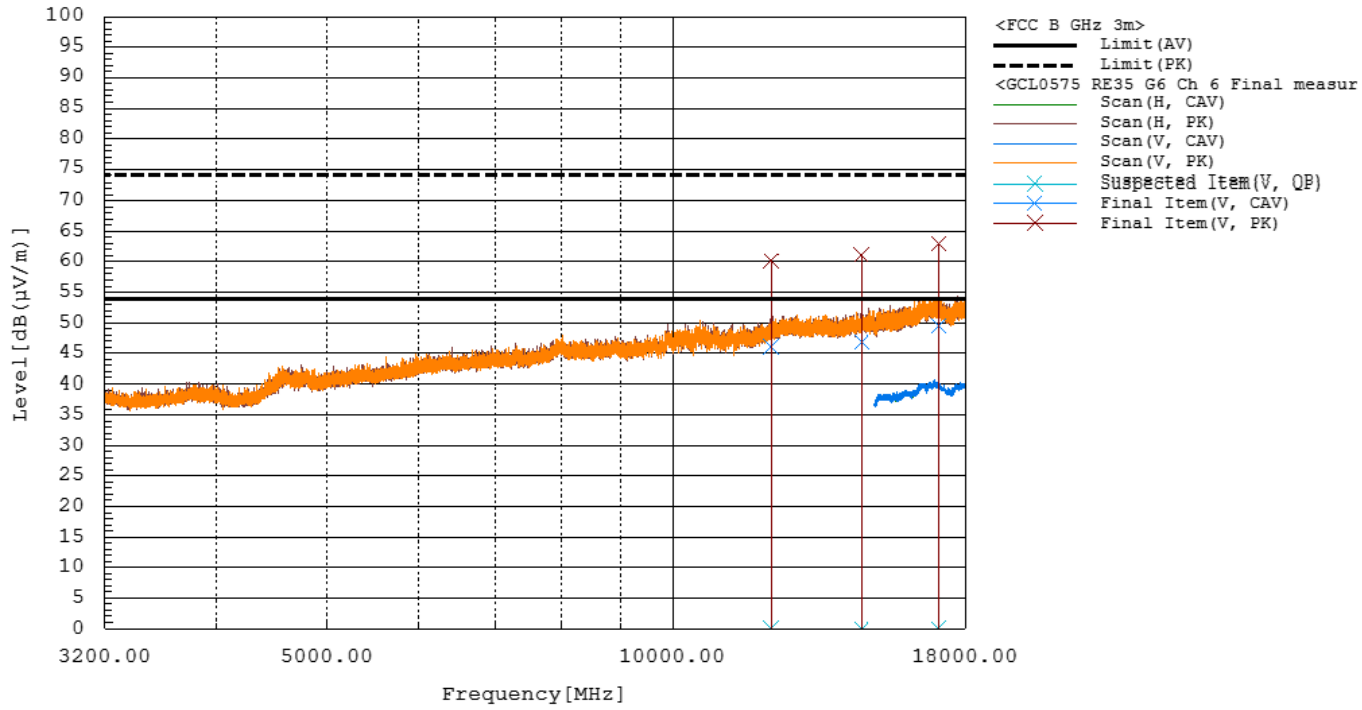


Figure RE35.6: Spectral data (Wifi G6, ch 6, 3.2 - 18GHz)

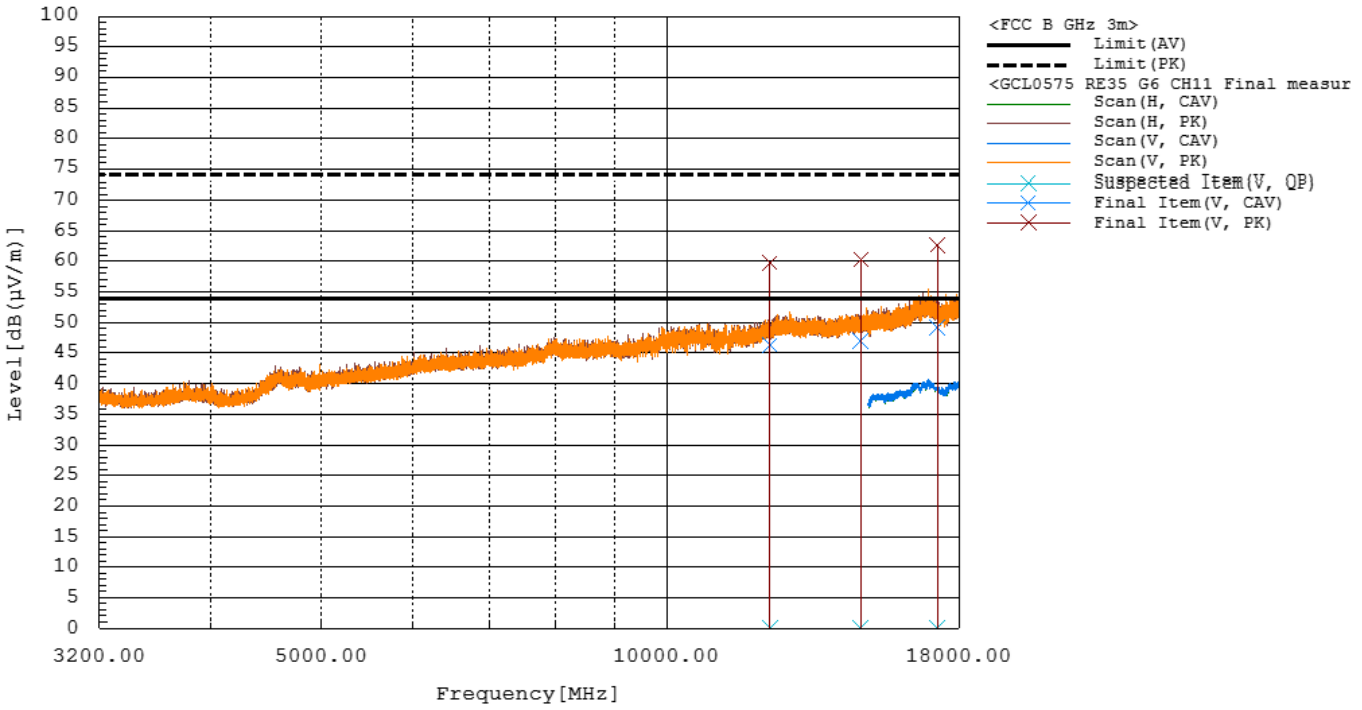


Figure RE35.7: Spectral data (Wifi G6, ch 11, 3.2 - 18GHz)

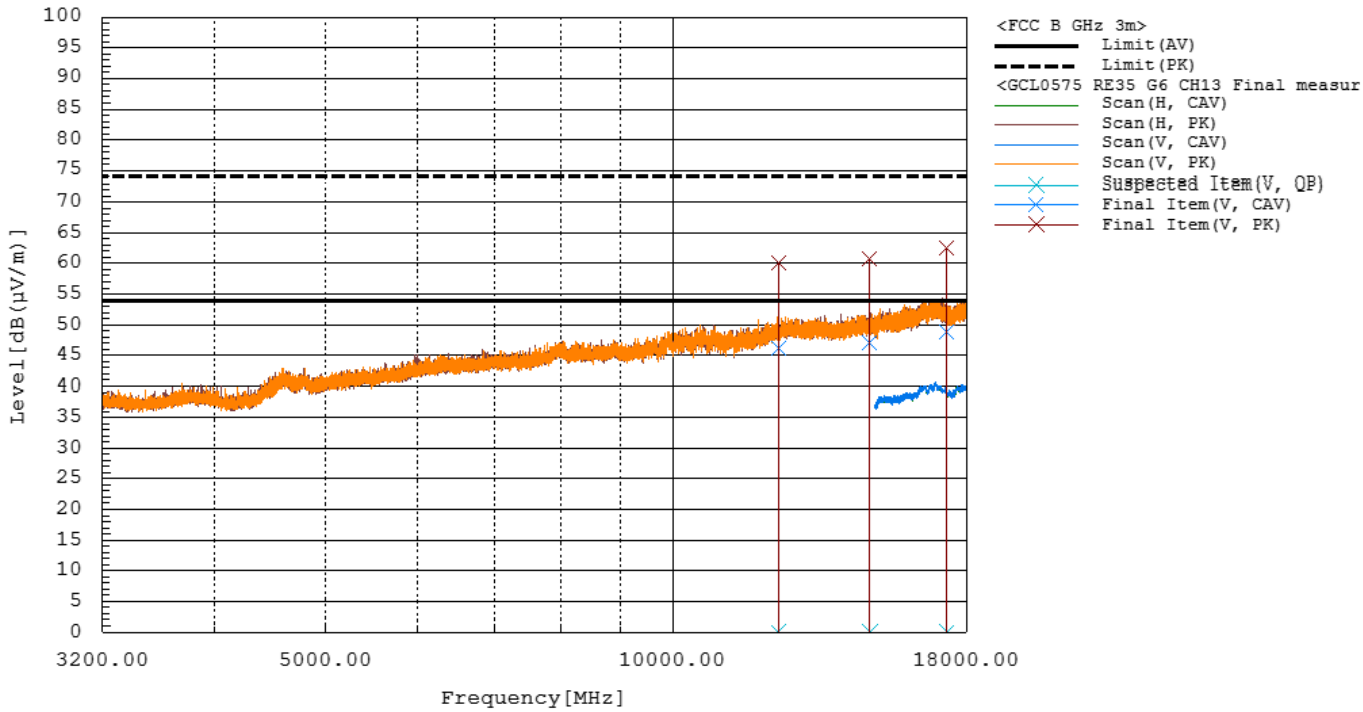


Figure RE35.8: Spectral data (Wifi G6, ch 13, 3.2 - 18GHz)

Setup Photographs

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

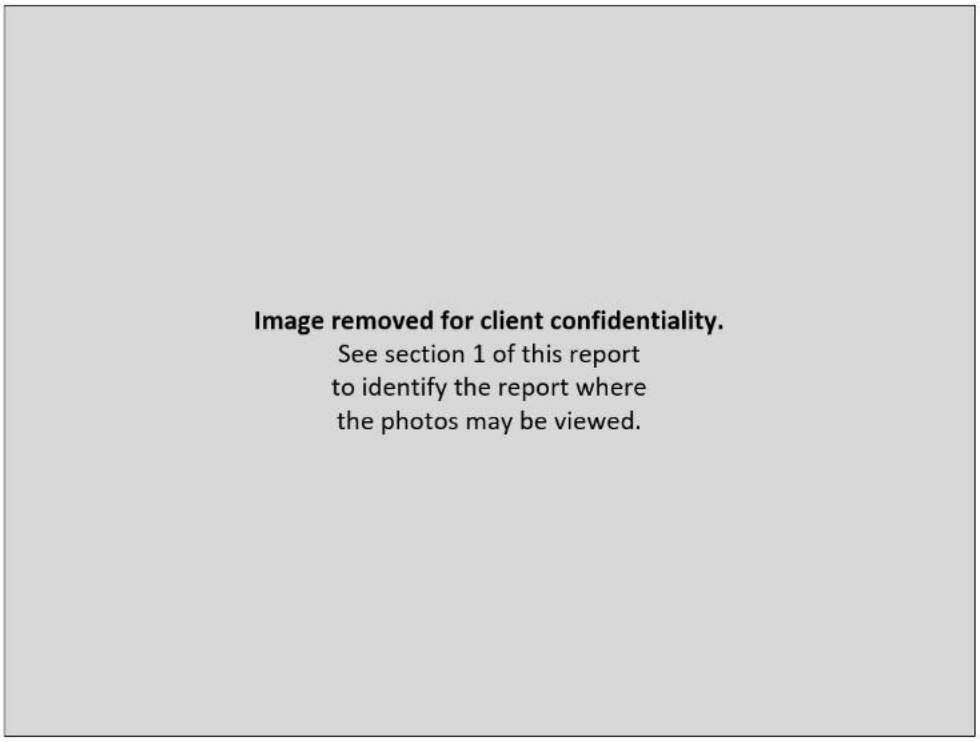


Figure RE35.9: EUT test setup, first view (X orientation)

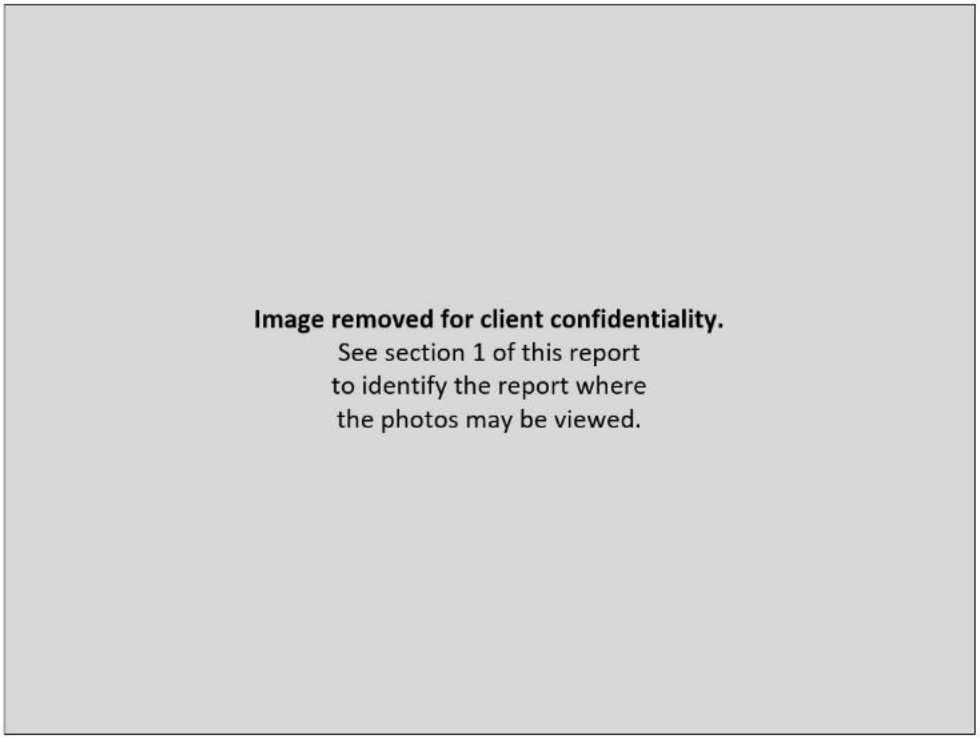


Figure RE35.10: EUT test setup, second view (X orientation)

This line is the end of the test record.

Test Record
Radiated Emission Test RE36
Project GCL0575

Test Date(s)	15 Aug 2024
Test Personnel	Vladimir Tolstik supervised by Jim Solum
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M3 (BleTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, RSS-247, ANSI C63.10, RSS-GEN (as noted in Section 6 of the report).
Frequency Range:	18 GHz to 25 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Vladimir Tolstik
Date of this record:	16 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44GHz	Keysight	N9048B	MY62220139	13-Mar-2024	15-Mar-2025
Antenna, Horn, 10-40 GHz	ETS Lindgren	3116C	00227673	14-Sep-2023	15-Sep-2025
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Shockforce G1 Tape Measure	Crecent Lufkin	L1135CME-02	GMN0013784	26-Jun-2024	26-Jun-2027
Preamplifier, 18 Ghz to 40 Ghz	Com-Power	PAM-840A	461364	Calibration	Not Required

Table RE36.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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 18 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 18 GHz and 25 GHz. 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.

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		
20993.750	V	23.7	37.5	19.9	43.6	57.4	54.0	74.0	10.4	16.6	400.0	227.0
24400.000	H	22.3	36.5	21.5	43.8	58.0	54.0	74.0	10.2	16.0	325.2	346.0

Table RE36.2: Emission summary

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

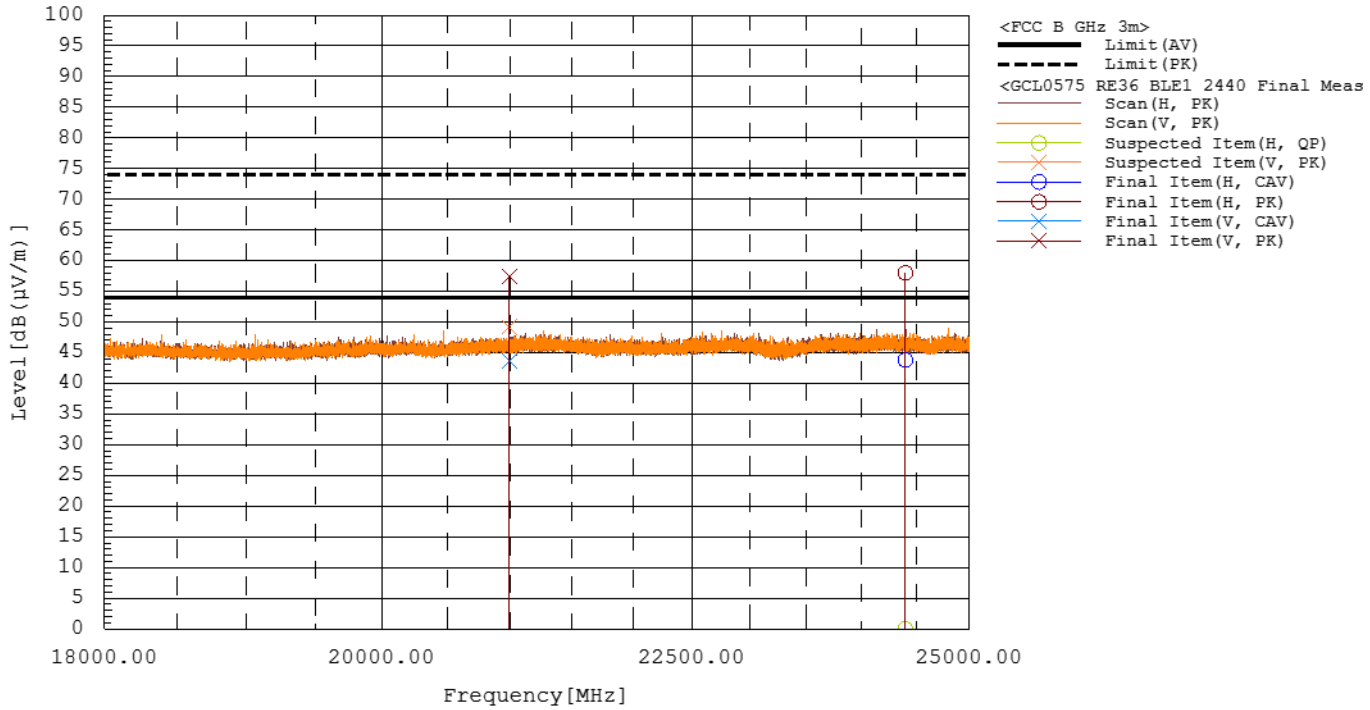


Figure RE36.1: Spectral data graph

Setup Photographs

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

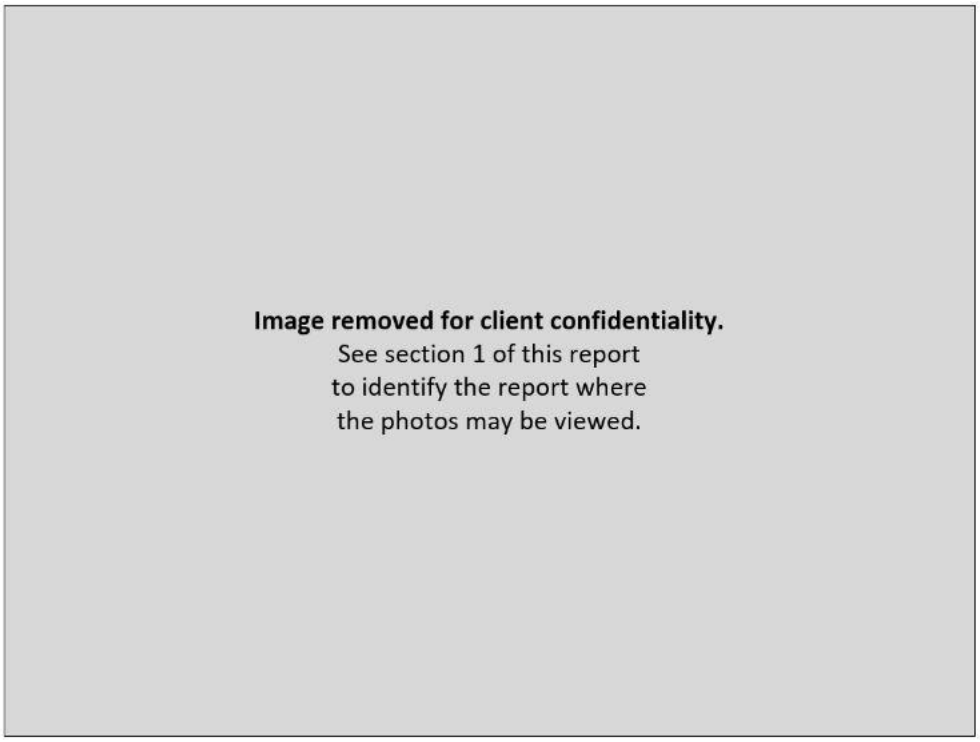


Figure RE36.2: EUT test setup, first view

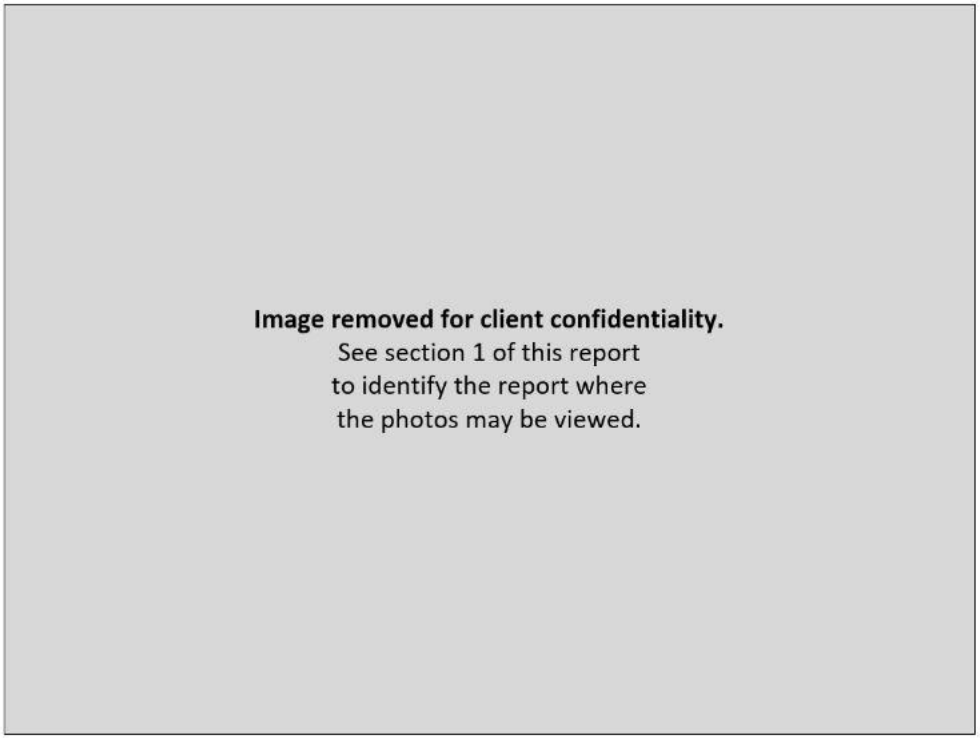


Figure RE36.3: EUT test setup, second view

This line is the end of the test record.

Test Record
Radiated Emission Test RE37
Project GCL0575

Test Date(s)	15 Aug 2024
Test Personnel	David Kerr, Vladimir Tolstik supervised by Jim Solum
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx)
Arrangement	A2 (Upwr)
Input Power	USB 5 Vdc
Test Standards:	FCC Part 15, RSS-247, ANSI C63.10, RSS-GEN (as noted in Section 6 of the report).
Frequency Range:	18 GHz to 25 GHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Vladimir Tolstik
Date of this record:	16 Aug 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44GHz	Keysight	N9048B	MY62220139	13-Mar-2024	15-Mar-2025
Antenna, Horn, 10-40 GHz	ETS Lindgren	3116C	00227673	14-Sep-2023	15-Sep-2025
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	16-Nov-2022	16-Nov-2025
Shockforce G1 Tape Measure	Crecent Lufkin	L1135CME-02	GMN0013784	26-Jun-2024	26-Jun-2027
Preamplifier, 18 Ghz to 40 Ghz	Com-Power	PAM-840A	461364	Calibration	Not Required

Table RE37.1: Test Equipment Used

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

Test Data

The radiated emission test process began with a preliminary scan 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. 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 18 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 18 GHz and 25 GHz. 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.

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		
21708.000	V	23.0	36.7	20.0	43.0	56.7	54.0	74.0	11.0	17.3	310.2	213.0
22630.250	H	22.8	36.4	20.8	43.6	57.2	54.0	74.0	10.4	16.8	291.3	341.0

Table RE37.2: Emission summary

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

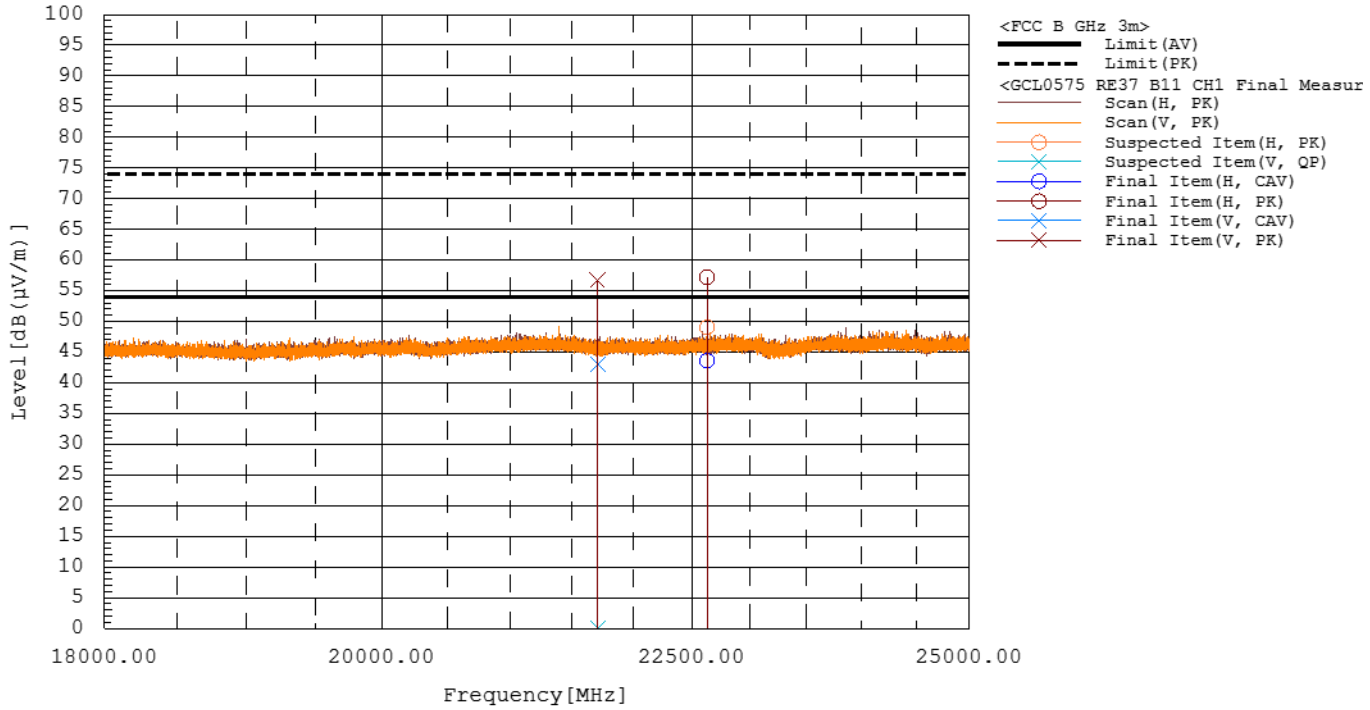


Figure RE37.1: Spectral data graph

Setup Photographs

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

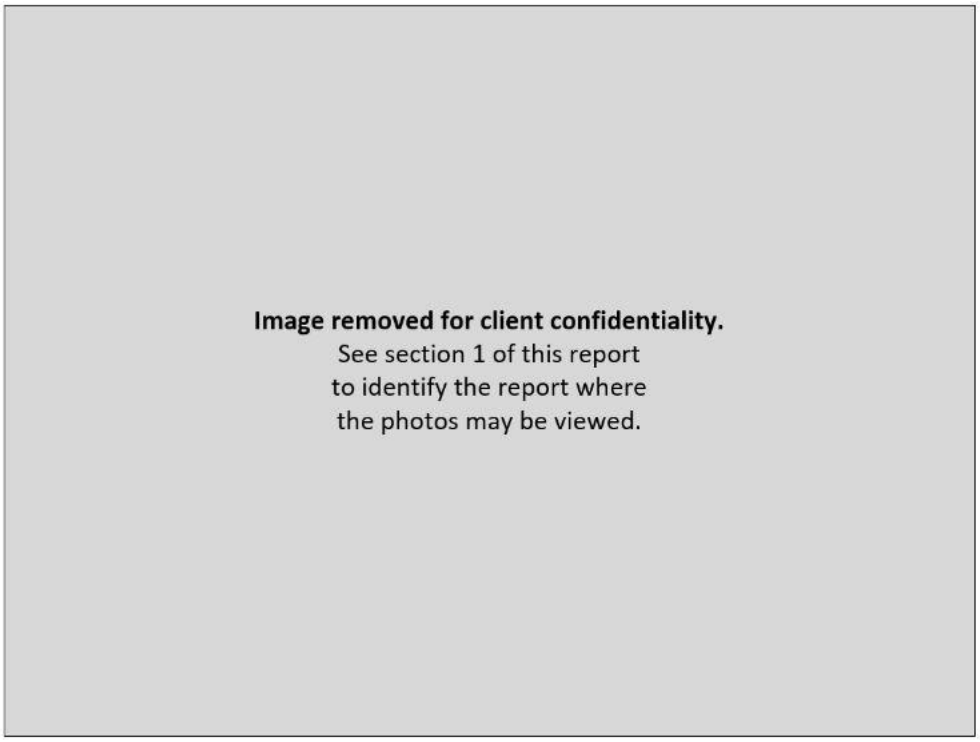


Figure RE37.2: EUT test setup, first view

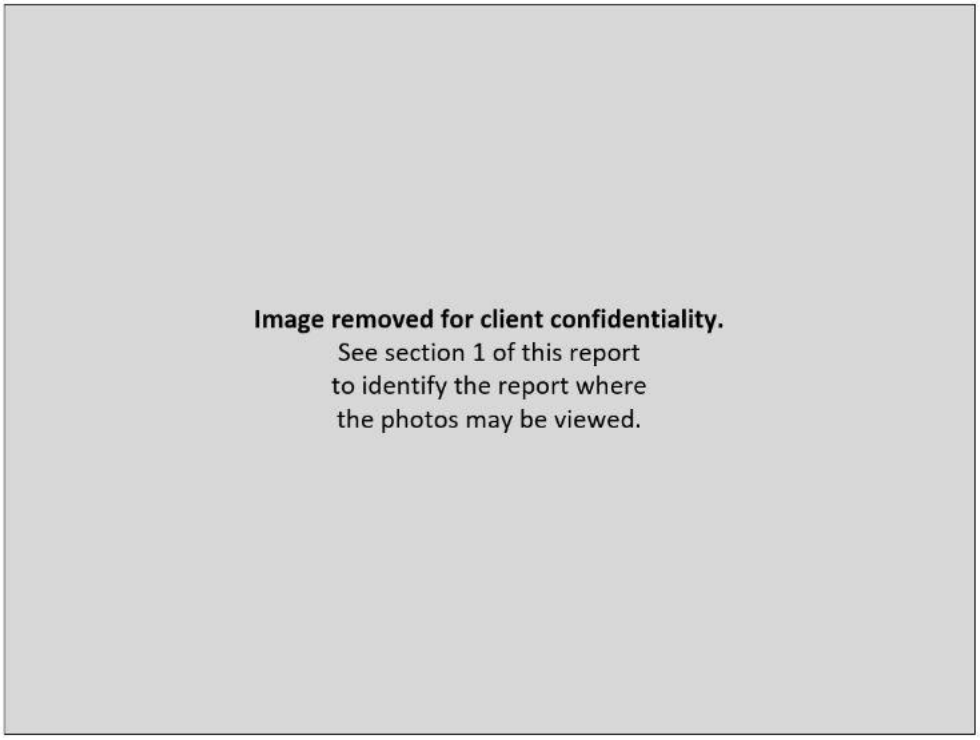


Figure RE37.3: EUT test setup, second view

This line is the end of the test record.

Test Record
Conducted Emissions Mains Test CE01
Project GCL0575

Test Date(s)	03 July 2024
Test Personnel	Andy Heier supervised by Dave Arnett
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M3 (BleTx)
Arrangement	A2 (Upwr)
Input Power	120 Vac 60 Hz
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	150 kHz to 30 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Andy Heier
Date of this record:	08 July 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025
Tape measure, 1" x 33'	Lufkin	PHV1410CMEN	10721	30-Aug-2023	1-Sep-2026
LISN multiline; 20A 50uH	Com-Power	LIN-120C	20160005	3-Apr-2024	1-Apr-2027

Table CE01.1: Test Equipment Used

Software Used
Keysight MXE software A.37.02; CE Mains 150k to 30M Data Analysis V3 2024May23.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 (kHz)	QP Limit (dBuV)	AV Limit (dBuV)	L1 QP (dBuV)	L2 QP (dBuV)	L1 AV (dBuV)	L2 AV (dBuV)	QP Margin (dB)	AV Margin (dB)
150	66.00	56.00	36.76	37.08	32.70	32.81	28.92	23.19
258	61.50	51.50	39.32	38.77	35.44	35.29	22.17	16.05
2969	56.00	46.00	26.07	26.04	22.08	21.97	29.93	23.92
5003	60.00	50.00	25.65	25.37	21.07	20.87	34.35	28.93
11002	60.00	50.00	24.09	24.53	19.38	19.78	35.47	30.22
17016	60.00	50.00	25.95	26.40	21.11	21.98	33.60	28.02

Table CE01.2: Emission summary

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

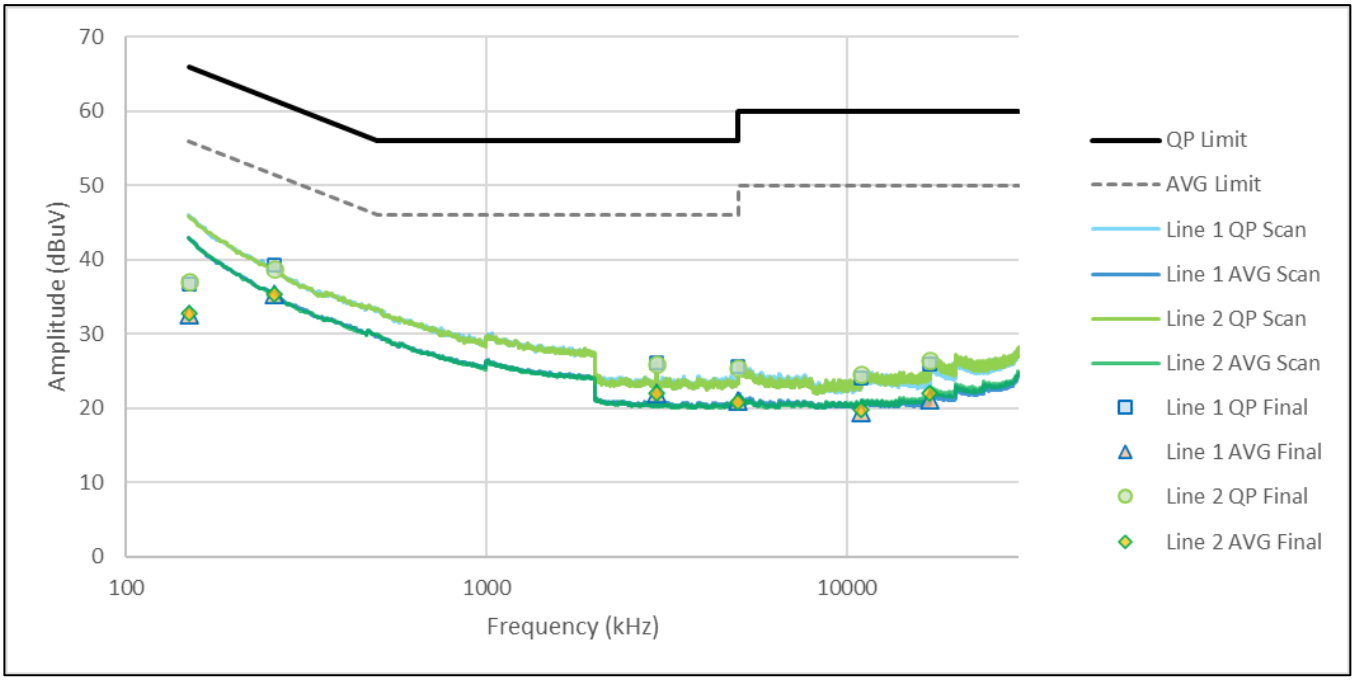


Figure CE01.1: Spectral data

Setup Photographs

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

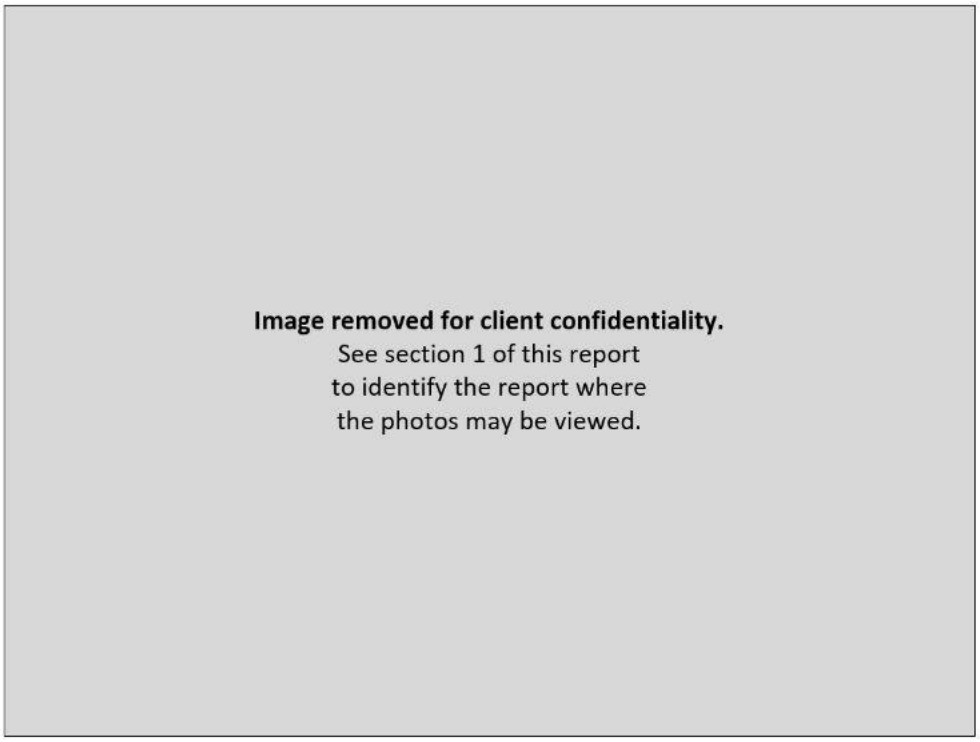


Figure CE01.2: Test setup, first view

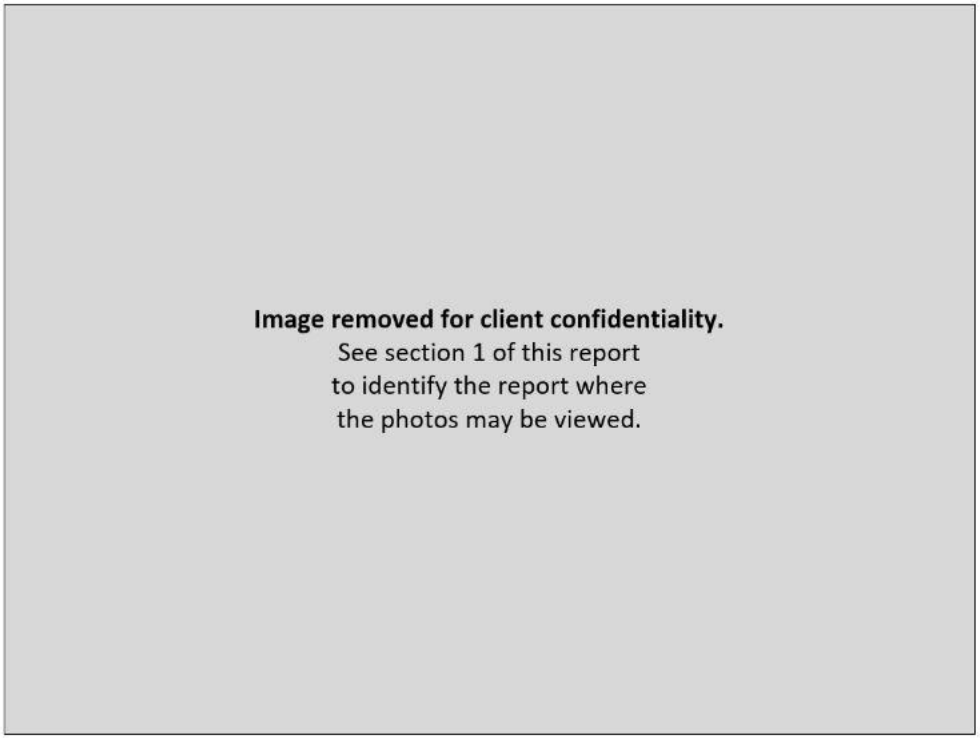


Figure CE01.3: Test setup, second view

This line is the end of the test record.

Test Record
Conducted Emissions Mains Test CE03
Project GCL0575

Test Date(s)	03 July 2024
Test Personnel	Andy Heier supervised by Dave Arnett
Product Model	A04666
Serial Number tested	3475366209
Operating Mode	M7 (WiFiTx)
Arrangement	A2 (Upwr)
Input Power	120 Vac 60 Hz
Test Standards:	FCC Part 15, ANSI C63.10, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	150 kHz to 30 MHz
Pass/Fail Judgment:	**PASS**
Test record created by:	Andy Heier
Date of this record:	08 July 2024

Original record, Version A.

Test Equipment

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	28-Feb-2024	1-Mar-2025
Tape measure, 1" x 33'	Lufkin	PHV1410CMEN	10721	30-Aug-2023	1-Sep-2026
LISN multiline; 20A 50uH	Com-Power	LIN-120C	20160005	3-Apr-2024	1-Apr-2027

Table CE03.1: Test Equipment Used

Software Used
Keysight MXE software A.37.02; CE Mains 150k to 30M Data Analysis V3 2024May23.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 (kHz)	QP Limit (dBuV)	AV Limit (dBuV)	L1 QP (dBuV)	L2 QP (dBuV)	L1 AV (dBuV)	L2 AV (dBuV)	QP Margin (dB)	AV Margin (dB)
150	66.00	56.00	37.62	37.25	33.16	32.98	28.38	22.84
258	61.50	51.50	38.98	38.97	35.68	35.43	22.52	15.81
312	59.92	49.92	37.04	36.89	33.05	33.20	22.87	16.72
364	58.64	48.64	35.55	35.48	31.89	31.73	23.09	16.75
1010	56.00	46.00	29.83	30.03	25.85	25.68	25.97	20.15
5019	60.00	50.00	25.55	25.21	21.07	20.83	34.45	28.93
17018	60.00	50.00	26.24	26.67	21.78	21.93	33.33	28.07
20002	60.00	50.00	26.50	26.99	22.19	22.38	33.01	27.62

Table CE03.2: Emission summary

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

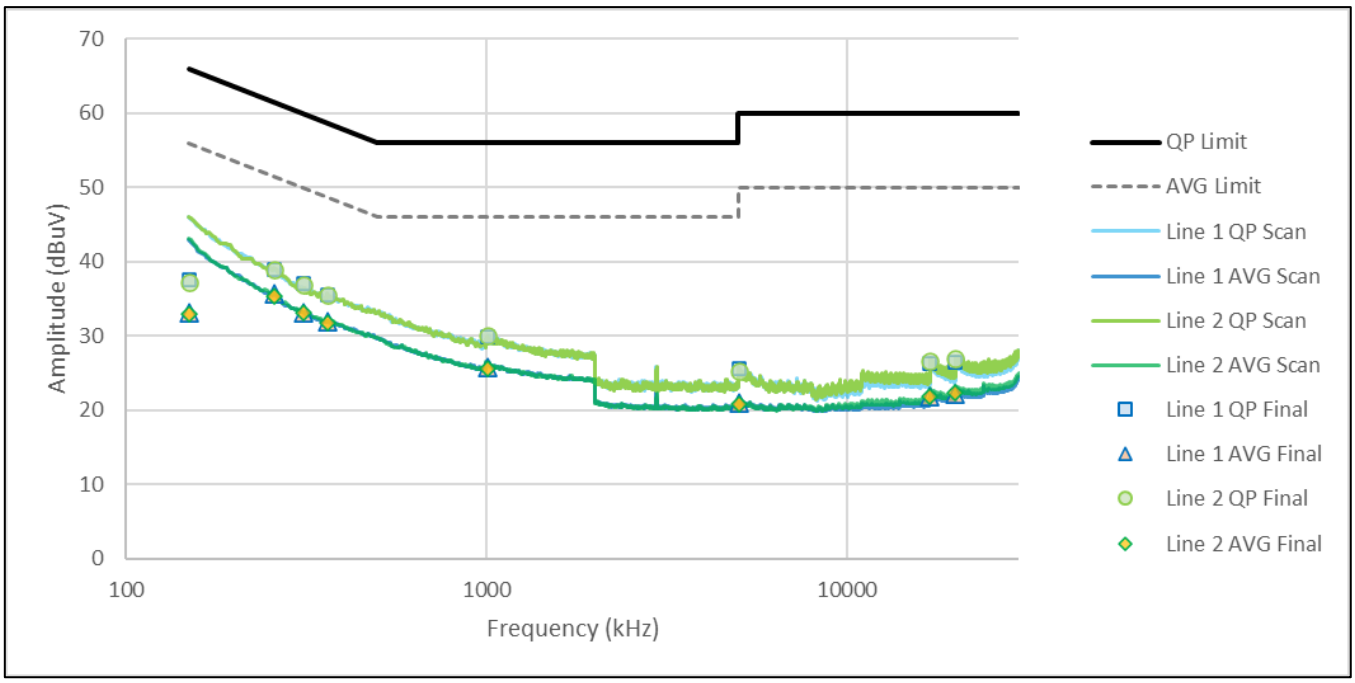


Figure CE03.1: Spectral data

Setup Photographs

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

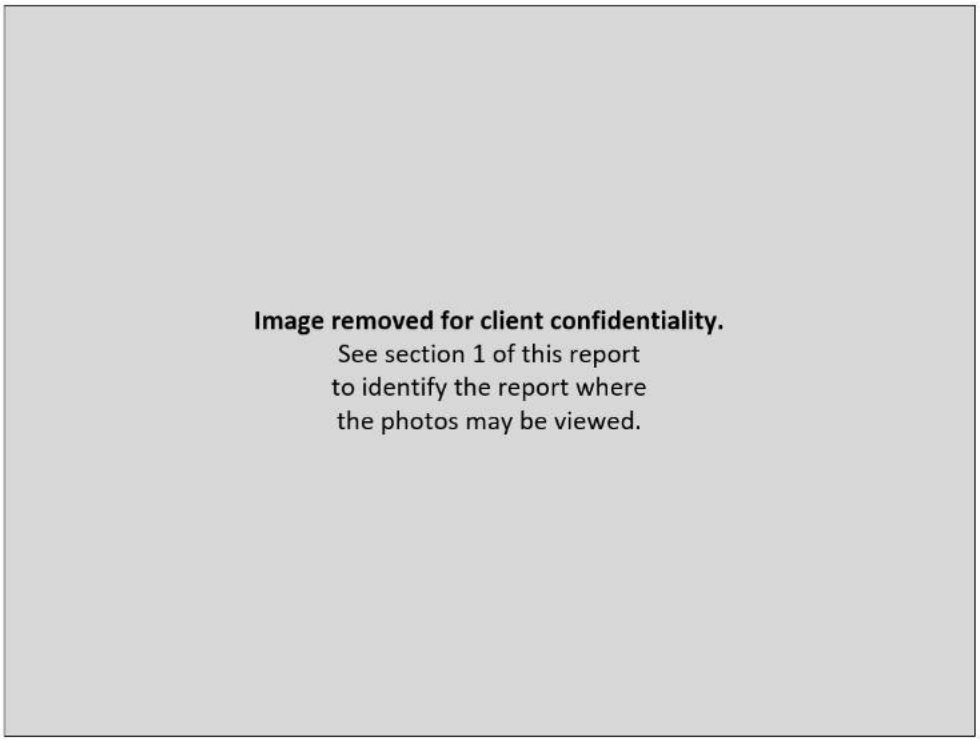


Figure CE03.2: Test setup, first view

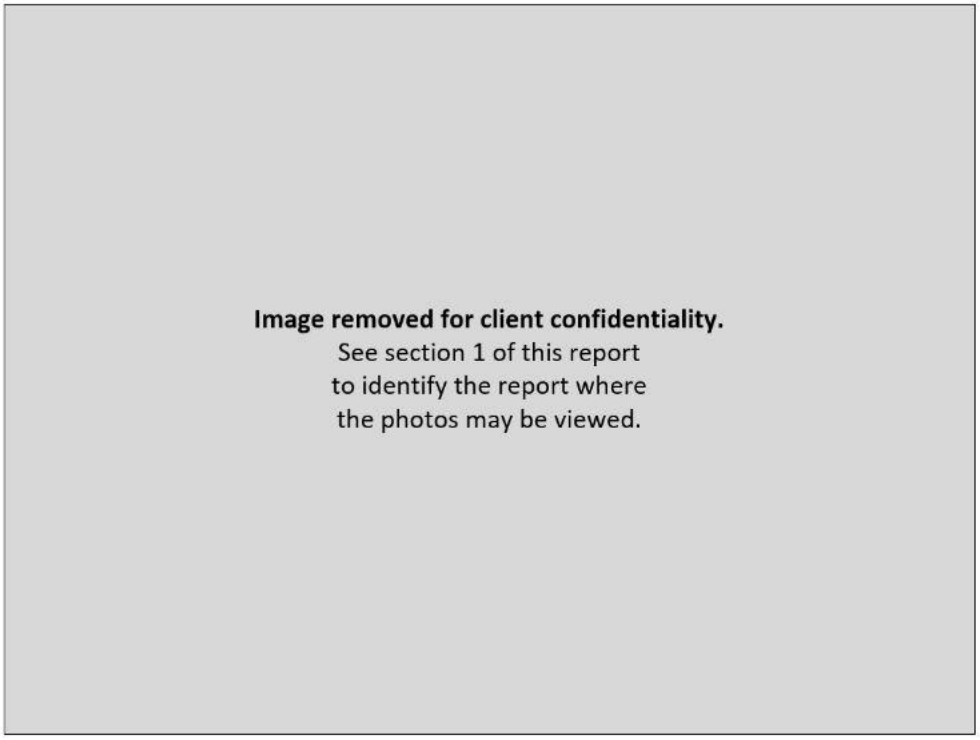


Figure CE03.3: Test setup, second view

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.