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16-Feb-26

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U.S.A.  
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**Contact Email:** [matias.rodriguez@garmin.com](mailto:matias.rodriguez@garmin.com)  
**Subject:** SUBTEL, Chile (Resolution 737) Certification Compliance 2026  
**Commercial Name:** Xero L60i

	Información (Information)
<b>Tipo de equipo (Equipment type)</b>	Portable Digital Transceiver
<b>Marca (Brand)</b>	Garmin 
<b>Modelo (Model)</b>	A04378
<b>Tecnología o modulación (Technology or modulation)</b>	GFSK for BLE / DSSS for 802.11b / OFDM for 802.11g/n
<b>Frecuencias (Frequencies)</b>	2402-2480 MHz / 2412-2462 MHz
<b>Ganancia de antena (dBi) (Antenna gain (dBi))</b>	BLE 2.71 dBi, / 802.11b/g/n 2.71 dBi
<b>P.i.r.e. (E.I R P.)</b>	-1.32 dBm, 0.735 mW / 17.33 dBm 54.01 mW
<b>Módulos (Modules)</b>	BLE, WiFi

Declaration of Conformity Statement: the equipment previously identified complies with the provisions established in the Technical Standard for Small Range Equipment, approved by Exempt Resolution No.1,985 of 2017, of the Undersecretary of Telecommunications.

Declaración de conformidad: El equipo anteriormente identificado cumple con las disposiciones establecidas en la Norma Técnica para Equipos de Corto Alcance, aprobada mediante la Resolución Exenta N° 1.985 de 2017, de la Subsecretaría de Telecomunicaciones.

# Test Report 2025-022

**Version B**

**Issued 11 Jun 2025**

**Project: GCL-0835**

**Model Identifier: A04378**

**Primary Test Standard(s):**

CFR 47, FCC Part 15.247

RSS-247 Issue 3

## Garmin Compliance Lab

Garmin International

1200 E 151<sup>st</sup> Street

Olathe Kansas 66062 USA

### Client-supplied Information

FCC ID:           IPH- 04378  
IC ID:             1792A- 04378



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 2.4 GHz 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 its 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 6 dB bandwidth is 11.32 MHz or greater.	PASS	15
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	19
Transmit Power	The 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 17 dBm or 54 mW.	PASS	25
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 2.71 dBi and will document antenna gain separately.	NT	NT
Unwanted (Spurious) Emissions	The radio should not provide too much radio energy to the antenna at frequencies beyond its intended frequency band. [15.247(d); 15.209, RSS-247 at 5.5, RSS-Gen at 8.9]	Emissions outside the band must meet the 'Class B' limits of 15.209 or be reduced at least 20 dB from in-band levels. The margin to the 'Class B' limit was 1 dB or greater.	PASS	29

Adjacent Restricted Bands	The radio must not emit in certain designated restricted frequency bands to the transmission band above a set of limit values. This entry focuses on bands adjacent to the operating band. [15.247(d) and 15.205; RSS-247 at 3.3]	Emissions in the adjacent restricted bands were at least 6.5 dB below the applicable limits.  Compliance for the remaining restricted bands is demonstrated by the spurious emission data.	PASS	54
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 -7 dBm in a band of at least 3 kHz.	PASS	61
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.	NT	NT
Unwanted Emissions (Mains Conducted)	While transmitting, the emissions conducted into the power mains must not be too strong. [15.207, RSS-Gen at 8.8]	Emissions other than the fundamental and harmonics must meet the 'Class B' limits. The measured emissions had at least 5.5 dB of margin.	PASS	64

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

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

**Table 1: Summary of results**

Report Organization

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

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

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

Due to confidentiality, certain material (such as test setup photographs) has been removed from this report and placed in GCL Test Report 2025-023. 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 151<sup>st</sup> 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 151<sup>st</sup> St, Olathe Kansas, USA. Witnesses from the business group included: None.

### 2.3 Other Information

Test Sample received: 17 Mar 2025  
Test Start Date: 18 Mar 2025  
Test End Date: 30 Apr 2025

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

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

## 3. Report History and Approval

This report was written by Andy Heier and initially issued on 6 May 2025 as Version A. Version B, issued on 11 June 2025; corrected the FCC ID and IC ID number on page 1. Removed ANT references from test ID TR12 on pages 19, 22, and 23.

### Report Technical Review:

David Arnett  
Technical Lead EMC Engineer



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### Report Approval:

Shruti Kohli  
Senior Manager Operations



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#### 4. Test Sample Modifications and Special Conditions

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

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

##### Modification 1

Detailed Description: Samples E1 (s/n 7MK001302) and E2's (s/n 7MK001303) firmware was updated from version 1.55 v3 to 1.55 v4

Date applied: 1-Apr-2025

Reason for this modification: The ETSI WiFi power table values were reduced to comply with ETSI Power Spectral Density requirements.

The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: ANSI Power Spectral Density. This change was for ETSI only and no impact on testing for North America.

##### Modification 2

Detailed Description: Samples E1 (s/n 7MK001302) and E2's (s/n 7MK001303) firmware was updated from version 1.55 v4 to 1.55 v5

Date applied: 7-Apr-2025

Reason for this modification: The ETSI WiFi power table Ch1-5 values were further reduced to comply with ETSI Power Spectral Density requirements.

The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: ANSI Tx Power, DTS Bandwidth, ANSI Occupied Bandwidth, and ANSI Power Spectral Density. This change was for ETSI only and no impact on testing for North America.

##### Modification 3

Detailed Description: Samples E1 (s/n 7MK001302) and E2's (s/n 7MK001303) firmware was updated from version 1.55 v5 to 1.55 v6

Date applied: 10-Apr-2025

Reason for this modification: The FCC WiFi G & N Ch11 power table values were reduced to comply with FCC Restricted Bands radiated emissions requirements.

The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: ANSI Tx Power (WiFi mode B, G & N Ch's 1 & 6), DTS Bandwidth, ANSI Occupied Bandwidth, ANSI Power Spectral Density, and A/C Mains Conducted Emissions.

##### Modification 4

Detailed Description: Sample E1's (s/n 7MK001302) firmware was updated from version 1.55 v6 to 1.55 v7

Date applied: 11-Apr-2025

Reason for this modification: The FCC WiFi G & N Ch11 power table values were further reduced to comply with FCC Restricted Bands radiated emissions requirements. The ETSI WiFi mode B power table values were further reduced to comply with ETSI power at temperature requirements.

The following tests were performed without this modification being present, and the presence or absence of the modification is judged by the lab and client to have no significant effect on these specific tests: ANSI Tx Power (WiFi B mode, G & N Ch's 1 & 6), DTS Bandwidth, ANSI Occupied Bandwidth, ANSI Power Spectral Density, and A/C Mains Conducted Emissions.

## 5. Description of the Equipment Tested

### 5.1 Unique Identification

Product Model A04378  
Serial Numbers Tested 7MK001302, 7MK001303

This product tested is a portable transceiver.

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  
Radio Receivers: GPS L1, Galileo E1, BeiDou, GLONASS  
Primary Functions: Text  
Typical use: Portable in multiple orientations  
Highest internal frequency: 2.484 GHz  
Highest digital frequency: 200 MHz  
Firmware Revision 1.55 v7 (see section 4)

### 5.3 Operating modes

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

Mode 1: M7 (WiFi Tx). The IEEE 802.11 b/g/n radio was transmitting consistently on a selected channel, with a specified modulation type, and data rate.

Mode 2: M8 (WiFi Link). The IEEE 802.11 b/g/n radio is paired to a companion device, transmitting and receiving data on a selected channel in accordance with the protocol, and maintaining the paired relationship

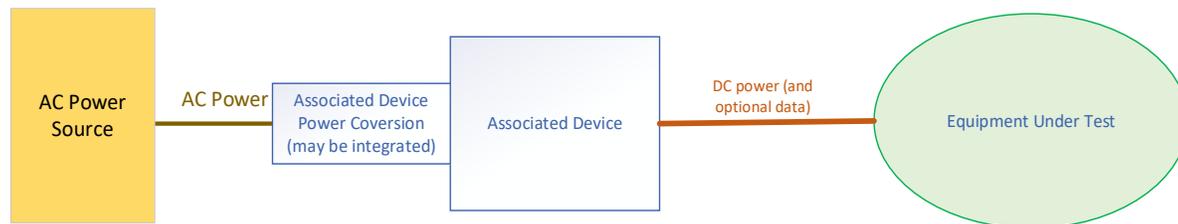
### 5.4 EUT Arrangement

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

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

Arrangement 2: A2 (Upwr). The test sample is attached to a Mains-powered device connected that provides dc power to the sample over a cable but no user data. See the block diagram in Figure 1.

Arrangement 3: A3 (Udata). The test sample is attached to a Mains-powered device connected that provides dc power to the sample and user data over a cable. See the block diagram in Figure 1.



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

**Figure 1: Block diagram of equipment arrangements A2 and A3**

### 5.5 Associated Equipment (AE) used

Description	Manufacturer	Model	Serial/Part Number
USB C power adaptor	Phihong (Garmin)	AQ27A-59CFA	362-00118-00

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

### 5.6 Cables used

Description	From	To	Length	EMC Treatment
USB-C Cable	laptop	test sample	0.5m	none

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

## 6. Test Standards Applied

### 6.1. Accredited Standards

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

CFR 47, FCC Part 15, Subpart C  
ANSI C63.10: 2020 and ANSI C63.10: 2020 +Cor 1: 2023  
AS/NZS 4268: 2017  
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.

FCC Part 2.202  
TRC-43 Issue 3

### 6.3 Variances

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

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

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

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

### 6.4 Laboratory Accreditation

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

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

## 7. Measurement Instrumentation Uncertainty

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

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

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

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

Test Type	$U_{LAB}$	$U_{CISPR}$	$U_{ETSI}$
Conducted DC voltage	0.09% + 2 x LSDPV	None	1%
Conducted AC voltage below 500 Hz	1.0% + 3 x LSDPV	None	2%
Conducted Emissions, Mains Voltage	0.10% + 10 mV	None	None
Conducted Emissions, Mains Current	0.10% + 3 mA	None	None
Conducted Emissions, Mains Power	0.15% + 100 mW	None	None
Conducted Emissions, Power Mains, 9 kHz to 150 kHz	1.70 dB	3.8 dB	None
Conducted Emissions, Power Mains, 150 kHz to 30 MHz	1.48 dB	3.4 dB	None
Conducted Emissions, Cat 6 LCL, 150 kHz to 30 MHz	1.57 dB	5 dB	None
Conducted Emissions, Cat 5 LCL, 150 kHz to 30 MHz	3.06 dB	5 dB	None
Conducted Emissions, Cat 3 LCL, 150 kHz to 30 MHz	4.27 dB	5 dB	None
Radiated Emissions, below 30 MHz	0.88 dB	None	6 dB
Radiated Emissions, 30 MHz to 1000 MHz	2.79 dB	6.3 dB	6 dB
Radiated Emissions, 1 GHz to 18 GHz	2.54 dB	5.2 & 5.5 dB	6 dB
Radiated Emissions, 18 GHz to 26.5 GHz	2.68 dB	None	6 dB
Radiated Emissions, 26.5 GHz to 40 GHz	3.17 dB	None	6 dB
*Radio Signal Frequency Accuracy	$1.55 \times 10^{-7}$	None	$1.0 \times 10^{-7}$
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... 0.01% 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 1470 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

$$(7.145 \text{ dB}\mu\text{V}) + (9.812 \text{ dB}) + (0.216 \text{ dB}) = 17.173 \text{ dB}\mu\text{V}$$

### 8.2 Radiated Emissions at 630 MHz

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

$$(2.25 \text{ dB}\mu\text{V}) + (27.80 \text{ dB/m}) + (2.89 \text{ dB}) = 32.94 \text{ dB}\mu\text{V/m}$$

### 8.3 Radiated Emissions at 2.7 GHz

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

$$(43.72 \text{ dB}\mu\text{V}) + (32.22 \text{ dB/m}) + (-36.09 \text{ dB}) = 39.85 \text{ dB}\mu\text{V/m}$$

## 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:	21 to 24 °C
Relative Humidity:	40% to 55% (non-condensing)
Barometric Pressure	95.0 to 98.7 kPa

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

**Table 4: Environmental monitoring device**

## 10. Immunity Performance Criteria

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

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

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

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

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

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

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

### 11. 3m RF Chamber Block Diagrams

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

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

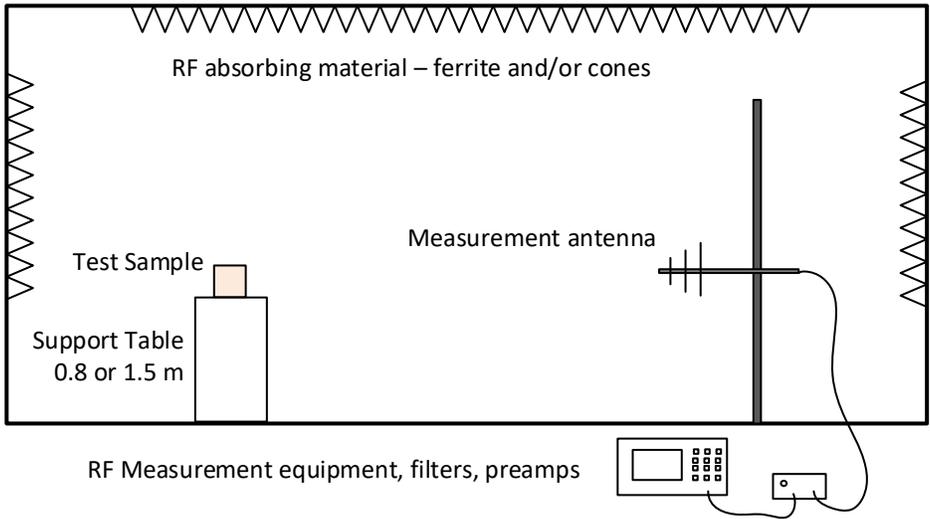


Figure 1: Typical configuration for measurements below 1 GHz

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

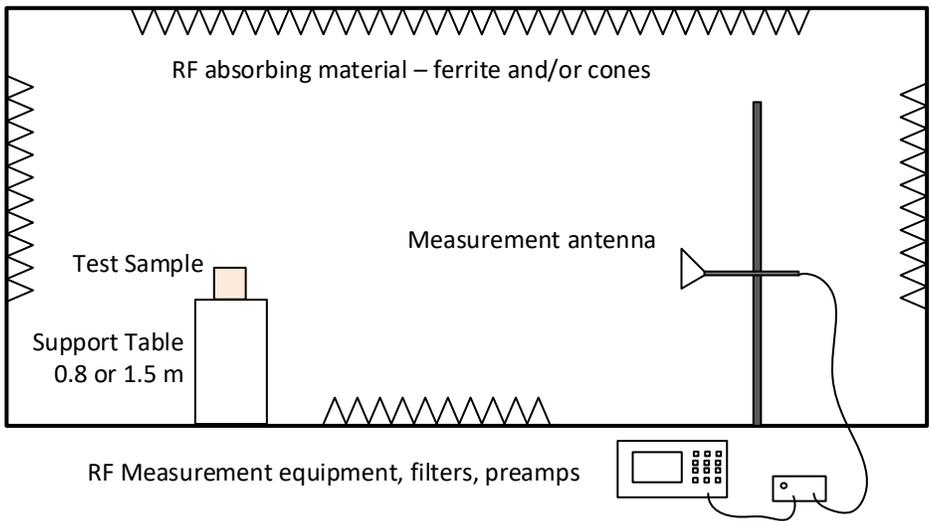


Figure 2: Typical configuration for measurements between 1 GHz and 14 GHz

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

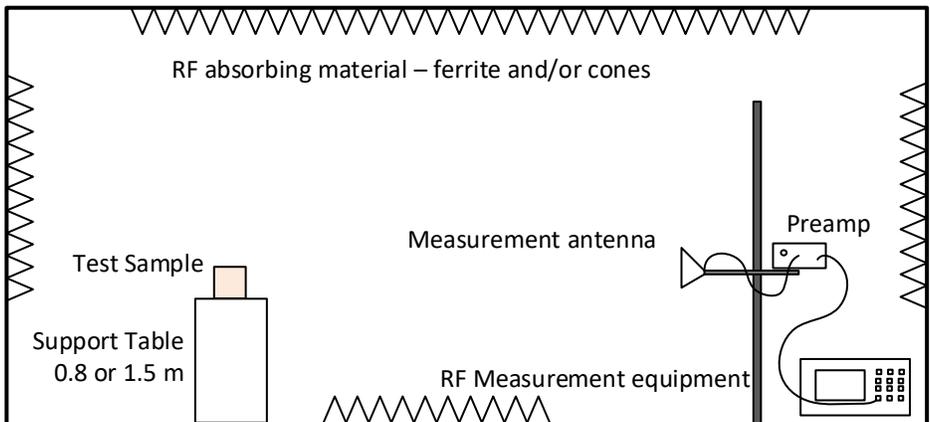


Figure 3: Typical configuration for measurements above 14 GHz

**ANNEX**

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

**Test Record**  
**Transmitter Bandwidth Tests**  
**Test IDs TR08**  
**Project GCL-0835**

Test Date(s) 03, 04 April 2025  
 Test Personnel Jim Solum

Product Model A04378  
 Serial Number tested 7MK001303

Operating Mode M7 (WiFiTx)  
 Arrangement A2 (Upwr)  
 Input Power 5Vdc

Test Standards: FCC Part 15, ANSI C63.10, RSS-GEN (as noted in Section 6 of the report).

Radio Protocol IEEE 802.11b/g/n  
 Radio Band 2400 to 2483.5 MHz

**Pass/Fail Judgment: PASS**

**Test record created by:** Jim Solum  
**Date of this record:** 07 April 2025

Original record, Version A.

**Test Equipment Used**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	17-Mar-2025	17-Mar-2026

**Table TR08.1: List of test equipment used**

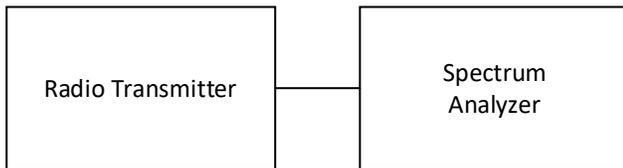
**Test Software Used:** Keysight PXE firmware A.37.02

**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.

**Test Setup**

This block diagram shows the test equipment setup.



**Figure TR08.1: 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.

	Ch1	Ch6	Ch11
B1	11.32	12.23	11.33
B2	11.63	12.44	11.62
B5.5	11.96	12.10	11.96
B11	12.02	12.27	12.01
G6	16.41	16.47	16.36
G9	16.39	16.41	16.43
G12	16.37	16.57	16.53
G18	16.45	16.50	16.56
G24	16.50	16.42	16.46
G36	16.58	16.57	16.51
G48	16.58	16.51	16.54
G54	16.53	16.42	16.48
NMCS0	17.69	17.80	17.73
NMCS1	17.71	17.70	17.72
NMCS2	17.61	17.74	17.67
NMCS3	17.78	17.84	17.75
NMCS4	17.70	17.70	17.74
NMCS5	17.68	17.68	17.72
NMCS6	17.59	17.66	17.62
NMCS7	17.60	17.67	17.65

Table TR08.3: Summary of bandwidth data in MHz for IEEE 802.11 WiFi modes



Figure TR08.2: Bandwidth data for 802.11b 1 Mbps at channel 1

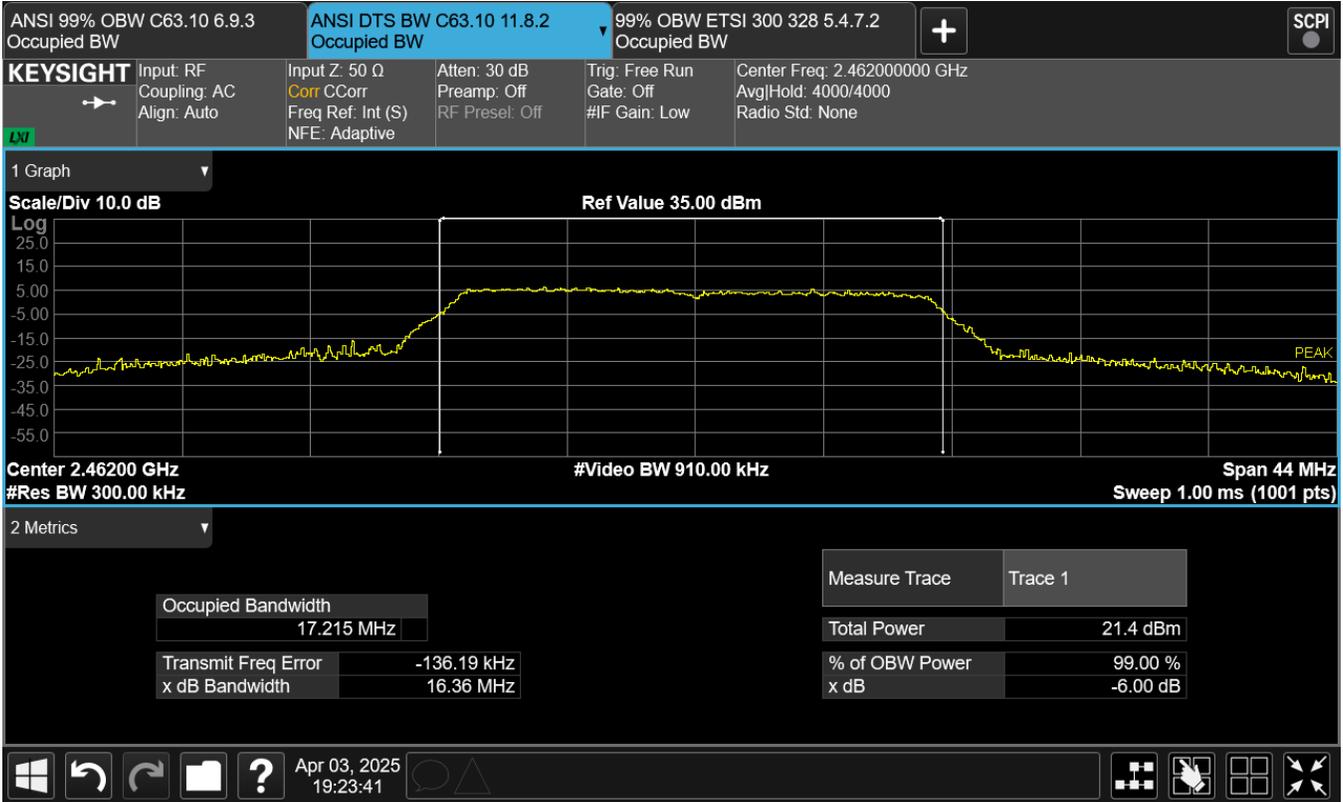


Figure TR08.3: Bandwidth data for 802.11g 6 Mbps at channel 11

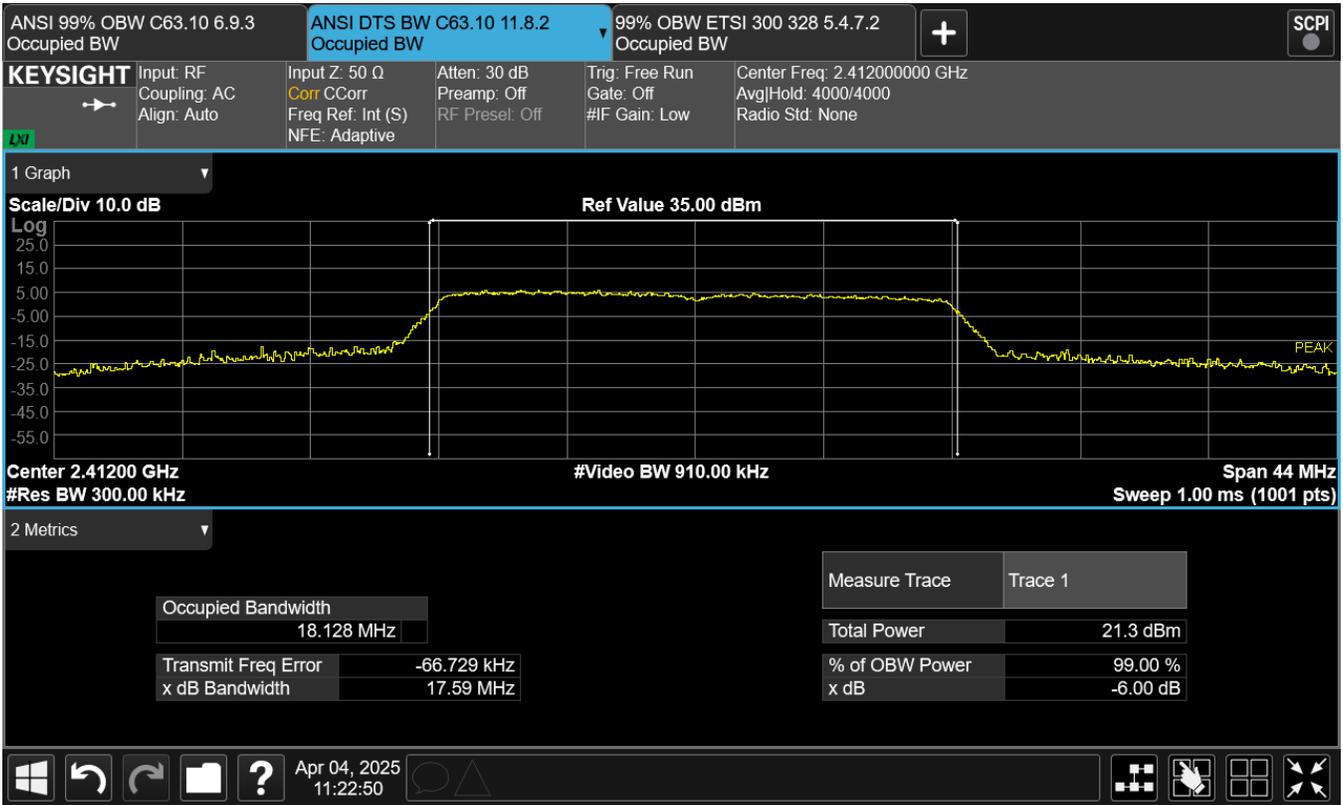


Figure TR08.4: Bandwidth data for 802.11n MCS6 at channel 1

This line is the end of the test record.

**Test Record**  
**Transmitter Bandwidth Tests**  
**Test IDs TR12**  
**Project GCL00835**

Test Date(s) 03, 04 April 2025  
 Test Personnel Jim Solum

Product Model A04378  
 Serial Number tested 7MK001303

Operating Mode M7 (WiFITx)  
 Arrangement A2 (Upwr)  
 Input Power 5 Vdc

Test Standards: FCC Part 2.202, ANSI C63.10, TRC-43, RSS-GEN (as noted in Section 6 of the report).

Radio Protocol IEEE 802.11 b/g/n (WiFi)  
 Radio Band 2480 to 2483.5 MHz

**Pass/Fail Judgment: Reported**

Test record created by: Jim Solum  
 Date of this record: 11 Jun 2025

Version B. Corrected date and removed ANT radio references. Original record, Version A, issued on 07 April 2025

**Test Equipment Used**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	17-Mar-2025	17-Mar-2026

**Table TR12.1 Equipment Used**

**Software used:** Keysight PXE software A.37.02

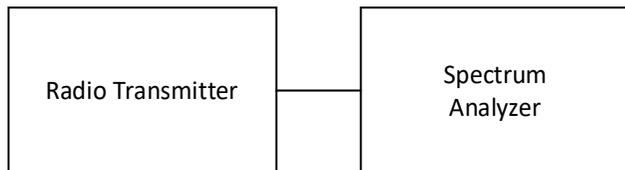
**Background**

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 Bluetooth and BLE 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 TR12.1: Test setup**

### Occupied Bandwidth, 99% Test Method

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

### Occupied Bandwidth, 99% Test Data

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

	Ch1	Ch6	Ch11
B1	<b>14.257</b>	<b>14.115</b>	<b>14.079</b>
B2	<b>14.214</b>	<b>14.129</b>	<b>14.079</b>
B5.5	<b>13.900</b>	<b>13.829</b>	<b>13.860</b>
B11	<b>13.952</b>	<b>13.887</b>	<b>13.887</b>
G6	<b>17.437</b>	<b>17.222</b>	<b>17.237</b>
G9	<b>17.348</b>	<b>17.180</b>	<b>17.275</b>
G12	<b>17.089</b>	<b>16.943</b>	<b>17.025</b>
G18	<b>17.072</b>	<b>16.940</b>	<b>17.012</b>
G24	<b>16.994</b>	<b>16.894</b>	<b>16.941</b>
G36	<b>17.013</b>	<b>16.889</b>	<b>16.952</b>
G48	<b>16.987</b>	<b>16.867</b>	<b>16.924</b>
G54	<b>16.987</b>	<b>16.863</b>	<b>16.913</b>
NMCS0	<b>17.950</b>	<b>17.896</b>	<b>17.905</b>
NMCS1	<b>17.949</b>	<b>17.873</b>	<b>17.905</b>
NMCS2	<b>17.971</b>	<b>17.909</b>	<b>17.949</b>
NMCS3	<b>17.951</b>	<b>17.883</b>	<b>17.906</b>
NMCS4	<b>17.958</b>	<b>17.892</b>	<b>17.928</b>
NMCS5	<b>17.933</b>	<b>17.898</b>	<b>17.904</b>
NMCS6	<b>18.122</b>	<b>18.053</b>	<b>18.047</b>
NMCS7	<b>17.927</b>	<b>17.874</b>	<b>17.893</b>

**Table TR12.2: Summary of 99% Occupied Bandwidth Data for IEEE 802.11 WiFi modes**

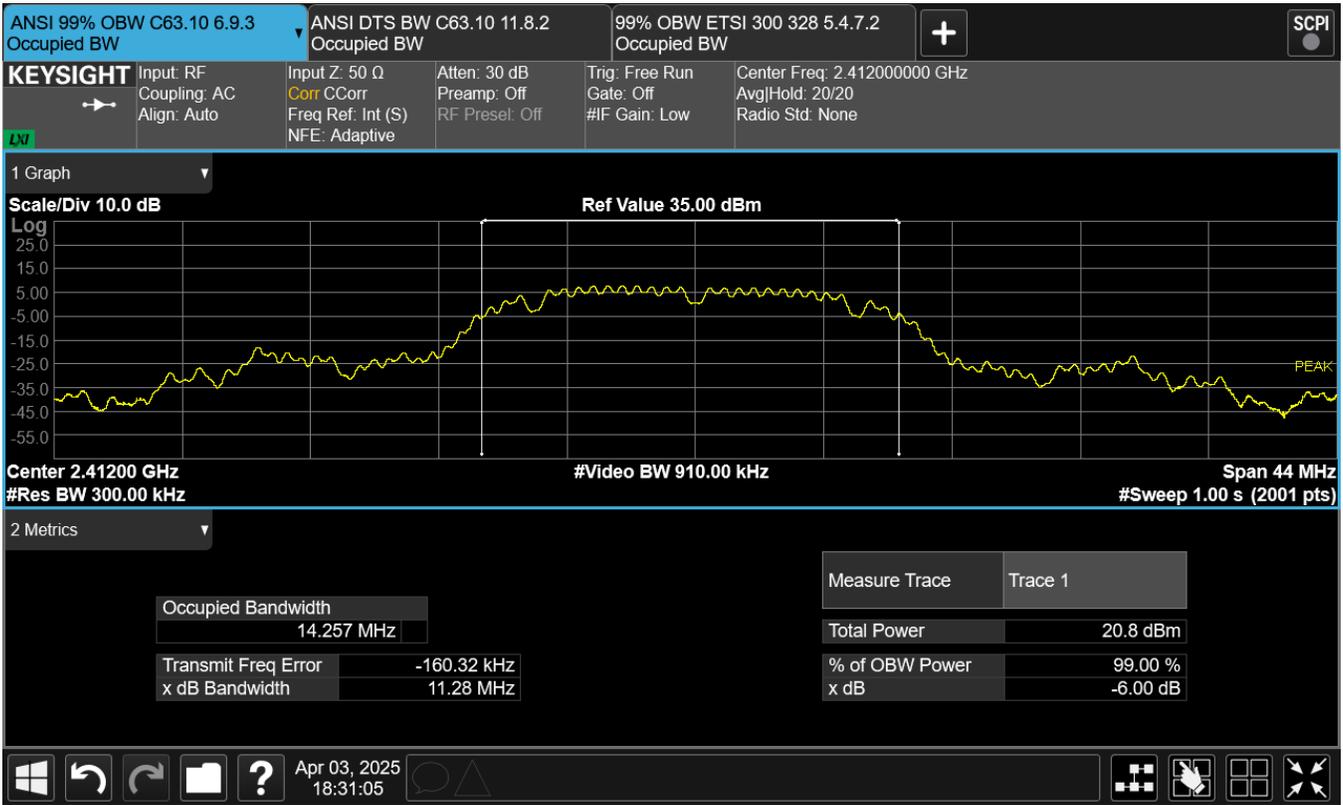


Figure TR12.2: Occupied bandwidth data for 802.11b 1 Mbps at channel 1

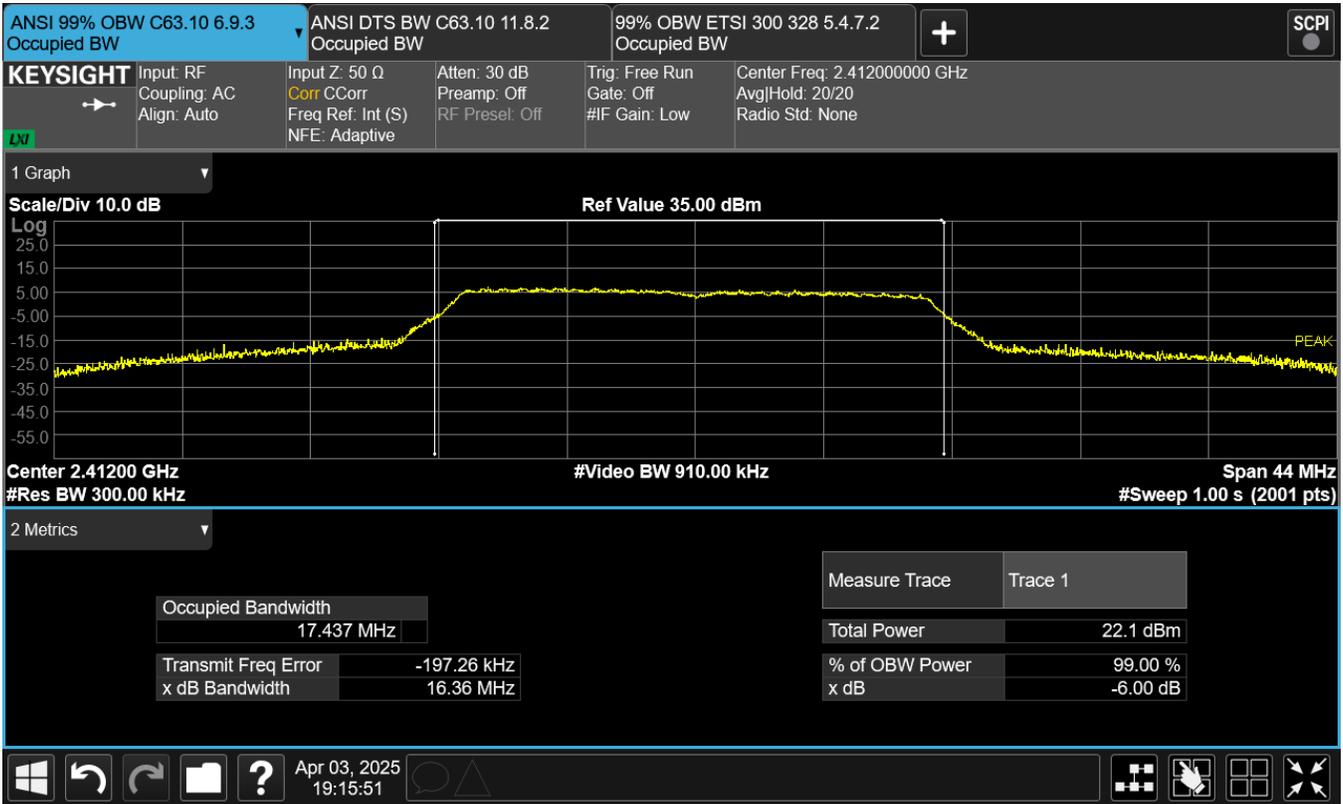


Figure TR12.3: Occupied bandwidth data for 802.11g 6 Mbps at channel 1

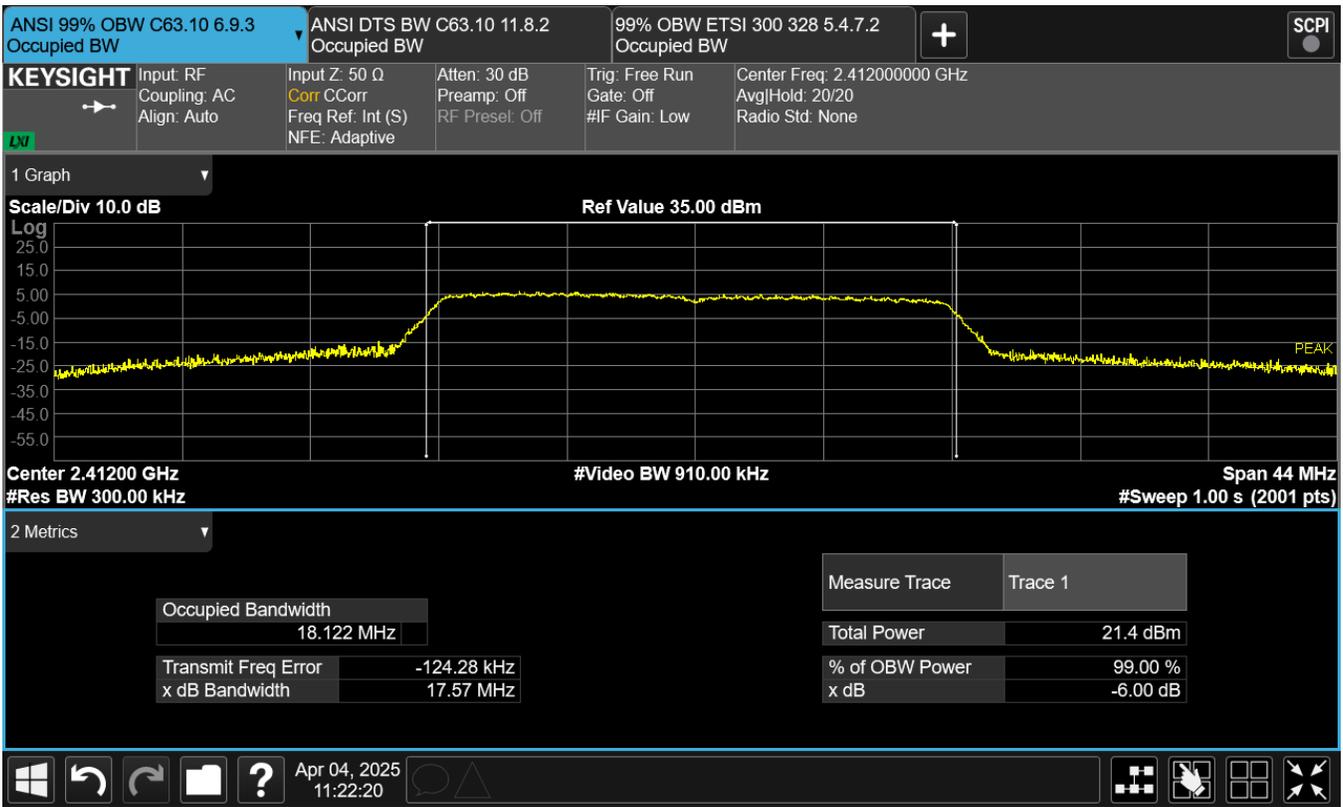


Figure TR12.4: Occupied bandwidth data for 802.11n MCS6 at channel 1

**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, 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<sub>N</sub> is then:

$$B_N = BCK$$

Radio Type	B (kbaud)	C	K	B <sub>N</sub> (kHz)
NFC A	106	1	3	318.0
NFC B	212	2	3	1272.0
NFC B	424	2	3	2544.0

Table TR12.100: Necessary Bandwidth for NFC

The radio modulation schemes 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:

$$B_N = 2R / \text{Log}_2(S)$$

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

Radio Type	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 TR12.101: 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 TR12.102: 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
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 TR12.103: 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 <sub>N</sub> (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 TR12.104: 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<sub>s</sub>. In both cases, N<sub>s</sub> 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	N <sub>s</sub> (MHz)	K	B <sub>N</sub> (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 TR12.105: 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**  
**Test ID TR05**  
**Project GCL0835**

Test Date(s) 02 April 2025  
 14 April 2025 (G,N Ch11)  
 Test Personnel Jim Solum  
 Product Model A04378  
 Serial Number 7MK001303  
 Operating Mode M7 (WiFITx)  
 Arrangement A2 (Upwr)  
 Input Power 5Vdc  
 Test Standards: FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247, (as noted in Section 6 of the report).  
 Antenna Gain 2.71 dBi, as reported by the client  
 Radio Protocol IEEE 802.11b/g/n  
 Hopping Frequencies N/A

**Pass/Fail Judgment: PASS**

Test record created by: Jim Solum  
 Date of this record: 14 April 2025

Original record, Version A.

**Test Equipment Used**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
RF Power Sensor	Rohde&Schwarz	NRP8S	109927	18-Jul-2024	18-Jul-2026

Table TR05.1: List of test equipment used

Software used: Rohde & Schwarz Power Viewer V11.3; TimePowerAnalysisSpreadsheetv12d.xls

**Test Method**

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

ANSI C63.10: 11.9.2.3.2 (Gated average power with broadband power meter)

Under the ETSI standard, the parameters of duty cycle, transmitter timing, or medium utilization are typically not required for adaptive transceivers or transceivers emitting at 10 dBm EIRP or less, so those results will typically be omitted from the data set. Duty Cycle data will be included if it is relevant to test methods used for other standards such as Average Detector methods in the ANSI standards that apply duty cycle correction or certain kinds of analysis under the RF exposure standards.

### Transmit Power and Timing 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 applied.

This test record will show results based on one or more of the following methods of analyzing the same set of raw power data vs. time. The ANSI peak power method looks for the highest power in the data record, with results in dBm units. The ANSI gated average power method determines the average power in the data record but only during times when the transmitter is keyed on, with results in dBm units. Under the US and Canadian rules a limit of 30 dBm is applied independent of which ANSI method is used. The ETSI 300 328 method looks at the individual transmission bursts within the data record and reports the power level from the burst with the for the highest average power. The ETSI result is presented in dBm EIRP units, and a 20 dBm EIRP limit is applied. The RF exposure analysis asks for the average power observed over the entire data record time, with results in linear power units such as milliwatts. RF exposure limits are not addressed in this test record. Many of these standards also care about duty cycle, the portion of the time when the transmitter was actually transmitting. That is presented as a percentage, and no limit applies. All of these results are drawn from the same trace of Tx power data. The results are shown below.

#### ANSI Power

Mode	Speed	1	6	11
B	1	16.91	17.29	16.67
B	2	16.89	17.30	16.73
B	5.5	17.02	17.33	16.58
B	11	16.75	17.12	16.41
G	6	14.29	14.58	13.43
G	9	14.31	14.63	13.44
G	12	14.28	14.88	13.30
G	18	14.50	14.66	13.17
G	24	14.23	14.67	13.09
G	36	14.32	14.52	13.04
G	48	14.44	14.69	13.37
G	54	14.36	14.68	13.18
N	MCS0	14.49	14.66	11.96
N	MCS1	14.20	14.56	11.93
N	MCS2	14.13	14.47	11.91
N	MCS3	14.09	14.43	11.91
N	MCS4	14.05	14.42	11.86
N	MCS5	14.06	14.38	11.81
N	MCS6	14.02	14.41	11.81
N	MCS7	13.94	14.35	11.75

Table TR05.2: Transmit Power, ANSI method, in dBm

Other Power Analyses

Mode	Speed	1	6	11
B	1	49.11	53.57	46.42
B	2	48.91	53.71	47.12
B	5.5	50.37	54.08	45.47
B	11	47.33	51.57	43.71
G	6	26.83	28.69	22.03
G	9	26.97	29.01	22.10
G	12	26.77	30.78	21.36
G	18	28.20	29.24	20.76
G	24	26.49	29.32	20.36
G	36	27.01	28.33	20.15
G	48	27.78	29.47	21.75
G	54	27.27	29.39	20.78
N	MCS0	28.14	29.21	15.70
N	MCS1	26.28	28.56	15.59
N	MCS2	25.88	28.02	15.54
N	MCS3	25.66	27.71	15.51
N	MCS4	25.42	27.65	15.34
N	MCS5	25.46	27.43	15.18
N	MCS6	25.23	27.58	15.18
N	MCS7	24.79	27.24	14.95

Table TR05.5: Transmit Power, RF exposure method, in mW

Mode	Speed	1	6	11
B	1	100.0%	100.0%	100.0%
B	2	100.0%	100.0%	100.0%
B	5.5	100.0%	100.0%	100.0%
B	11	100.0%	100.0%	100.0%
G	6	100.0%	100.0%	100.0%
G	9	100.0%	100.0%	100.0%
G	12	100.0%	100.0%	100.0%
G	18	100.0%	100.0%	100.0%
G	24	100.0%	100.0%	100.0%
G	36	100.0%	100.0%	100.0%
G	48	100.0%	100.0%	100.0%
G	54	100.0%	100.0%	100.0%
N	MCS0	100.0%	100.0%	100.0%
N	MCS1	100.0%	100.0%	100.0%
N	MCS2	100.0%	100.0%	100.0%
N	MCS3	100.0%	100.0%	100.0%
N	MCS4	100.0%	100.0%	100.0%
N	MCS5	100.0%	100.0%	100.0%
N	MCS6	100.0%	100.0%	100.0%
N	MCS7	100.0%	100.0%	100.0%

Table TR05.6: Duty cycle for each radio mode

**Setup Diagram**

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

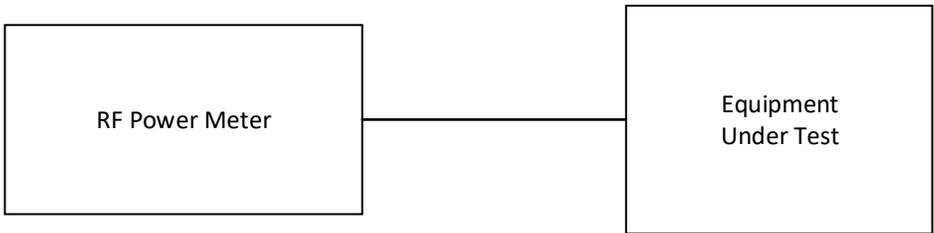


Figure TR05.51: Test equipment setup

**This line is the end of the test record.**

**Test Record**  
**Radiated Emission Test RE21**  
**Project GCL0835**

Test Date(s) 22 Apr 2025  
 Test Personnel David Kerr

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFiTx)  
 Arrangement A2 (Upwr)  
 Input Power USB 5 Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).

Frequency Range: 9 kHz to 30 MHz  
**Pass/Fail Judgment: PASS**

**Test record created by:** David A Kerr  
**Date of this record:** 22 Apr 2025

Original record, Version A.

**Test Equipment**

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

**Table RE21.1: Test Equipment Used**

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

**Test Data**

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

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

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

At 0° the turntable reference mark is pointed directly at the loop antenna location. The designation of the X, Y, and Z orientations of the test sample are sample dependent, so these are reported by use of photographs.

The table shows the selected final measurement data between 9 kHz and 30 MHz. It includes at least the six strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted in 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.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the WIFI radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

In this test, fewer than six emissions were observed within 10 dB of the limit. The relevant emissions were measured, including one or more noise floor signals as judged appropriate to the spectrum.

Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
24.545	20.91	QP	49.54	28.63	27.85	None	None	Z	0

**Table RE21.2: Emission summary (802.11B 2Mbs, Ch 1)**

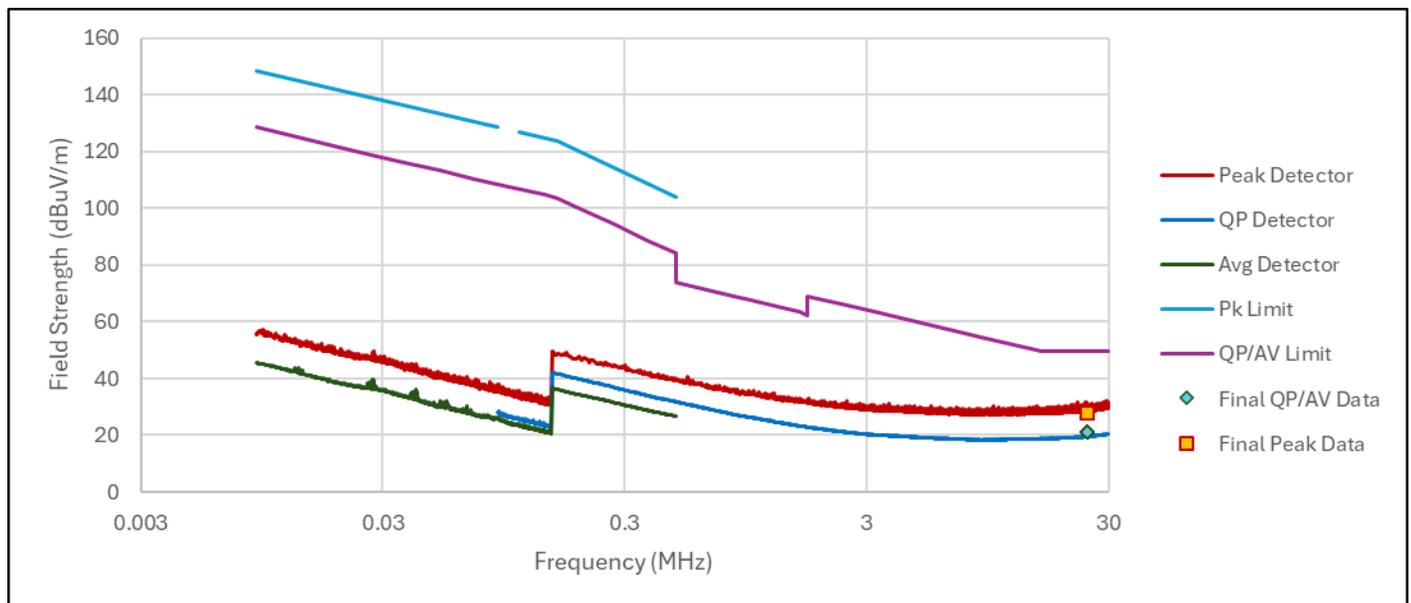
Freq.	Level	Detector	Limit	Margin	Peak Level	Pk Limit	Pk Margin	Antenna	Table
MHz	dBuV/m	Type	dBuV/m	dB	dBuV/m	dBuV/m	dB	Orientation	Azimuth, deg
18.708	20.18	QP	49.54	29.36	28.73	None	None	X	0

**Table RE21.3: Emission summary (802.11B 2Mbs, Ch 6)**

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
12.086	19.85	QP	51.94	32.09	27.29	None	None	Z	0

**Table RE21.4: Emission summary (802.11B 2Mbs, Ch 11)**

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



**Figure RE21.1: Spectral data (802.11B 2Mbs, Ch 1)**

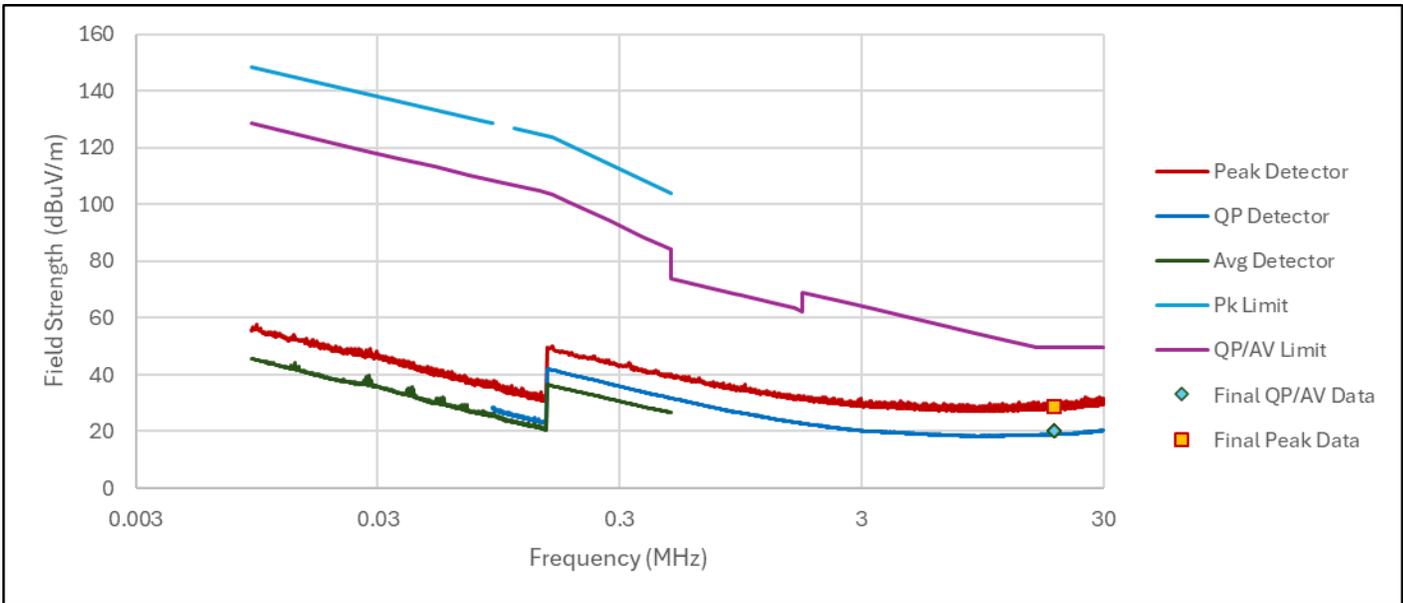


Figure RE21.2: Spectral data (802.11B 2Mbps, Ch 6)

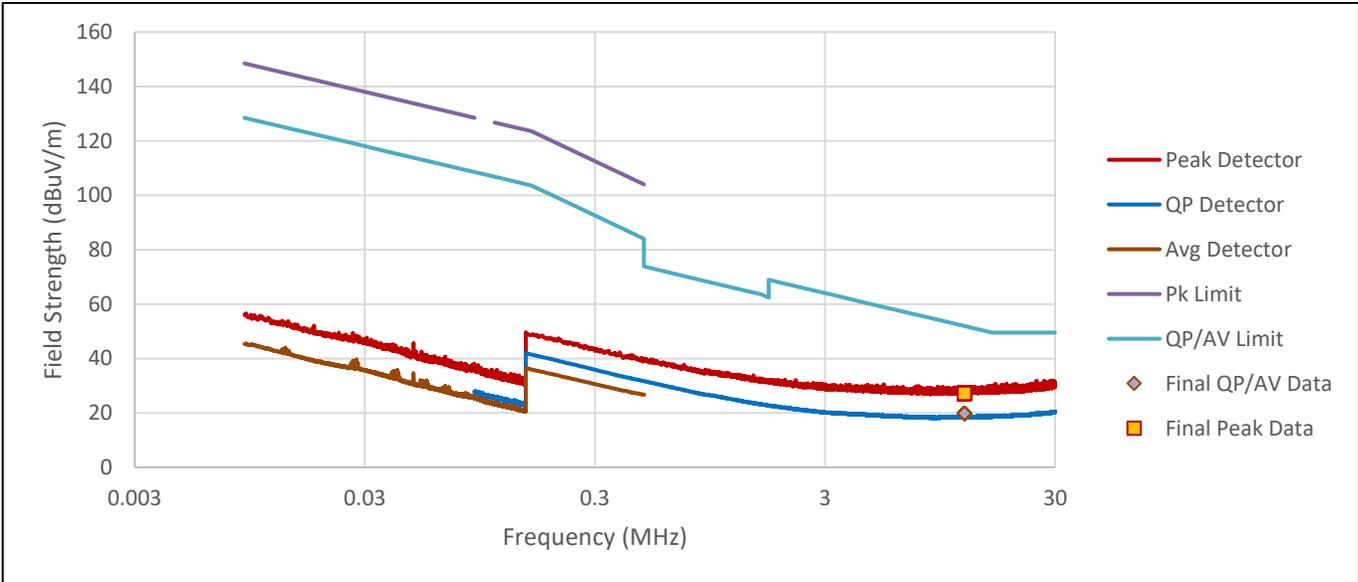


Figure RE21.3: Spectral data (802.11B 2Mbps, Ch 11)

## Setup Photographs

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



**Figure RE21.4: EUT test setup, first view**



**Figure RE21.5: EUT test setup, second view (Antenna X orientation)**

**Image removed for client confidentiality.**  
See section 1 of this report  
to identify the report where  
the photos may be viewed.

**Figure RE21.6: EUT test setup, second view (Antenna Z orientation)**

**This line is the end of the test record.**

**Test Record**  
**Radiated Emission Test RE42**  
**Project GCL0835**

Test Date(s) 17 Apr 2025  
 Test Personnel David Kerr

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFiTx)  
 Arrangement A2 (Upwr)  
 Input Power USB 5 Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).

Frequency Range: 30 MHz to 1000 MHz

**Pass/Fail Judgment: PASS**

**Test record created by:** David A Kerr  
**Date of this record:** 17 Apr 2025

Original record, Version A.

**Test Equipment**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Biconilog, 30M-6 GHz	ETS Lindgren	3142E	00233201	18-Jul-2024	18-Jul-2026
SAC 3m, below 1 GHz	Frankonia	SAC3	F199004	25-Jan-2023	25-Jan-2026
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013783	26-Jun-2024	26-Jun-2027

**Table RE42.1: Test Equipment Used**

**Software Used:** Keysight PXE software A.32.06, EPX test software Version 2025.01.000, RE C63p10AvgMeasurementToolV2024Dec20.xlsx

**Test Data**

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

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

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 in yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC Class B Limit at 3m. Any unintentional radio emission limits are not applied to intentional radio signals.

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

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report. The duty cycle for the WIFI radio had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB( $\mu$ V)	dB(1/m)	dB( $\mu$ V/m)	dB( $\mu$ V/m)	dB	cm	deg
		QP		QP	QP	QP		
71.820	V	10.8	13.8	24.6	40.0	15.4	104.6	0.0
330.000	H	23.85	21.5	23.85	46.0	22.15	100.0	299.0
350.010	V	5.3	23.4	28.7	46.0	17.3	137.6	81.0
360.000	V	5.2	23.6	28.8	46.0	17.2	116.1	98.0
369.990	V	6.4	24.0	30.4	46.0	15.6	120.1	331.0
380.010	V	7.0	24.5	31.5	46.0	14.5	121.8	329.0

**Table RE42.2: Emission summary (802.11B 2 Mbs, Ch 1)**

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB( $\mu$ V)	dB(1/m)	dB( $\mu$ V/m)	dB( $\mu$ V/m)	dB	cm	deg
		QP		QP	QP	QP		
43.470	V	11.2	15.2	26.4	40.0	13.6	100.0	110.0
350.010	H	7.1	23.4	30.5	46.0	15.5	100.0	307.0
360.000	H	8.1	23.6	31.7	46.0	14.3	100.0	32.0
369.990	V	5.0	24.0	29.0	46.0	17.0	135.6	85.0
380.010	V	5.6	24.5	30.1	46.0	15.9	100.0	340.0
730.020	H	5.7	30.8	36.5	46.0	9.5	100.0	40.0

**Table RE42.3: Emission summary (802.11B 2 Mbs, Ch 6)**

Frequency	Pol.	Reading	Factor	Level	Limit	Margin	Height	Angle
MHz		dB( $\mu$ V)	dB(1/m)	dB( $\mu$ V/m)	dB( $\mu$ V/m)	dB	cm	deg
		QP		QP	QP	QP		
44.700	V	12.3	14.7	27.0	40.0	13.0	100.0	200.0
330.000	H	6.1	21.5	27.6	46.0	18.4	327.0	109.0
350.010	H	7.1	23.4	30.5	46.0	15.5	100.0	300.0
369.990	V	5.9	24.0	29.9	46.0	16.1	122.0	326.0
380.010	V	6.8	24.5	31.3	46.0	14.7	116.3	325.0
729.990	H	6.1	30.8	36.9	46.0	9.1	100.0	52.0

**Table RE42.4: Emission summary (802.11B 2 Mbs, Ch 11)**

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

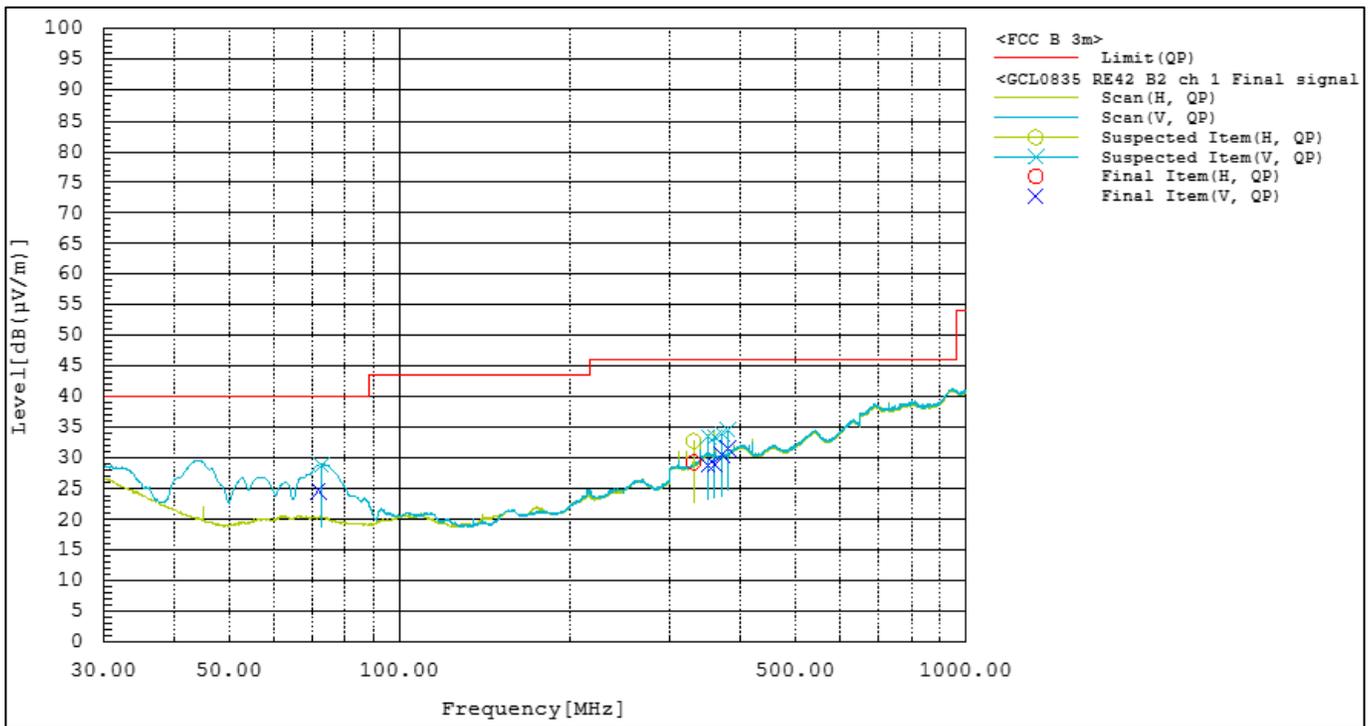


Figure RE42.1: Spectral data (802.11B 2 Mbs, Ch 1)

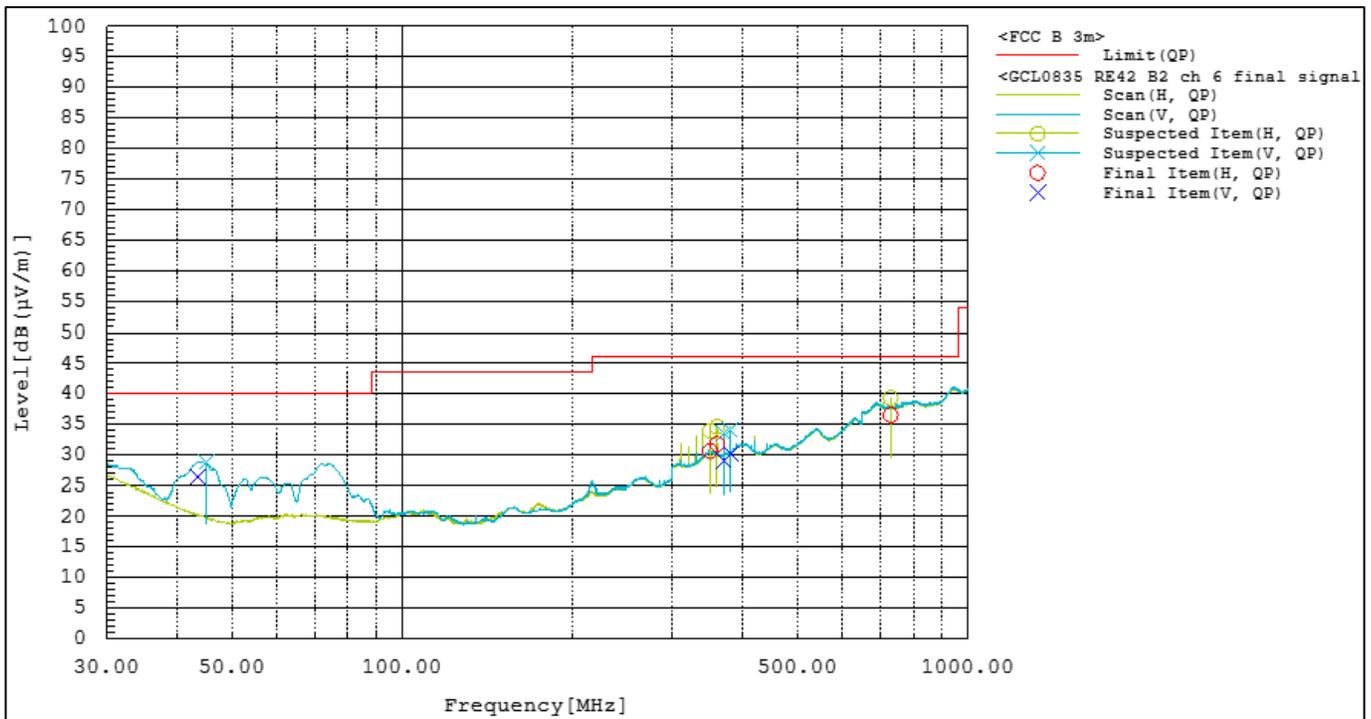


Figure RE42.2: Spectral data (802.11B 2 Mbs, Ch 6)

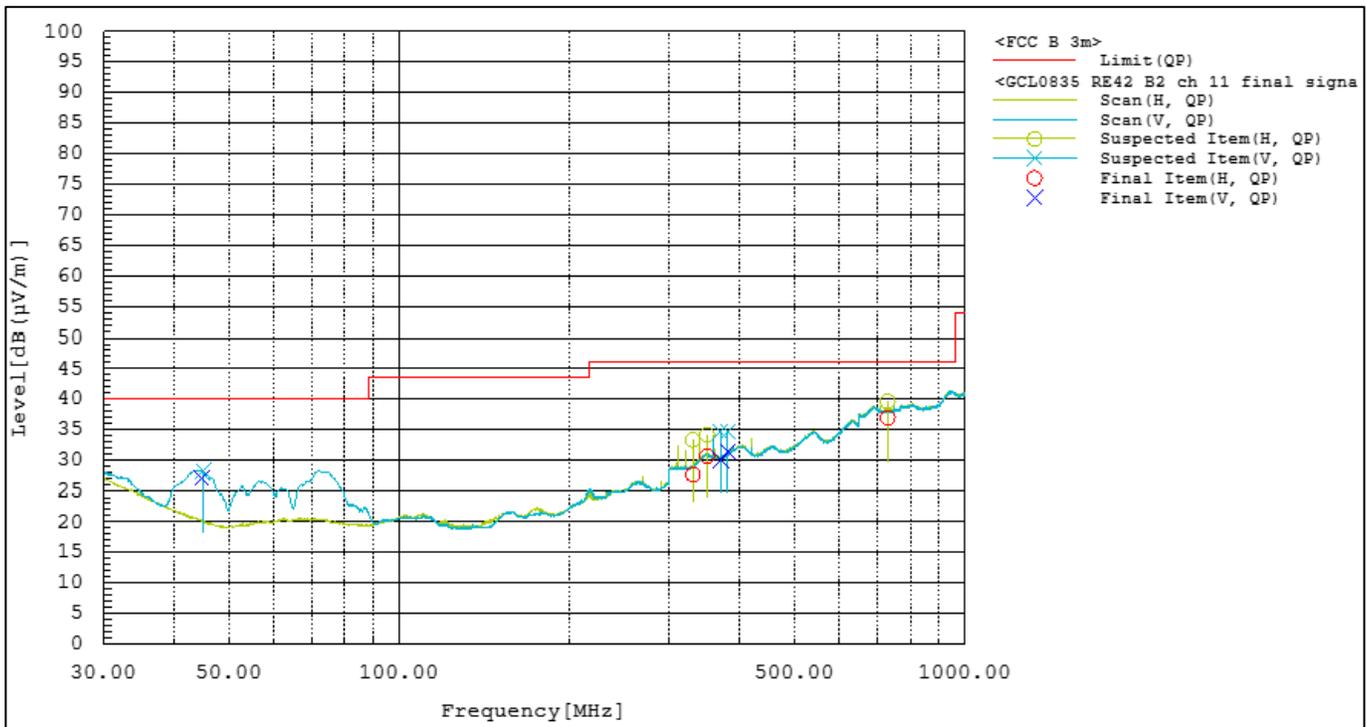


Figure RE42.3: Spectral data (802.11B 2 Mbs, Ch 11)

### Setup Photographs

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



Figure RE42.4: EUT test setup, first view (Z Orientation)

**Image removed for client confidentiality.**  
See section 1 of this report  
to identify the report where  
the photos may be viewed.

**Figure RE42.5: EUT test setup, second view (Z Orientation)**

**This line is the end of the test record.**

**Test Record**  
**Radiated Emission Test RE12**  
**Project GCL0835**

Test Date(s) 14 Apr 2025  
 Test Personnel David Kerr

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFiTx)Arrangement (802.11B 2Mbps)  
 A2 (Upwr)  
 Input Power USB 5 Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).

Frequency Range: 1 GHz to 14 GHz  
**Pass/Fail Judgment: PASS**

**Test record created by:** David A Kerr  
**Date of this record:** 14 Apr 2025

Original record, Version A.

**Test Equipment**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013783	26-Jun-2024	26-Jun-2027
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required
3 GHz High Pass filter	Anatech Electronics	0KOR2	01	Calibration	Not Required

**Table RE12.1: Test Equipment Used**

**Software Used:** Keysight PXE software A.32.06, EPX test software Version 2025 01.000, RE C63p10AvgMeasurementToolV2024Dec20.xlsx

**Test Data**

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

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

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

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

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

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

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

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the WIFI radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

Frequency MHz	Pol.	Reading		Factor dB(1/m)	Level		Limit		Margin		Height cm	Angle deg
		dB(μV)			dB(μV/m)		dB(μV/m)		dB			
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
1056.405	V	23.74	50.2	-9.2	*23.74	41.0	54.0	74.0	*30.26	33.0	106.8	260.0
1247.720	V	31.7	46.8	-7.6	24.1	39.2	54.0	74.0	29.9	34.8	167.6	214.0
2227.61	H	29.55	46.4	-4.6	*29.55	41.8	54.0	74.0	*24.45	32.2	286.2	291.0
4823.99	V	53.03	57.5	0.1	*53.03	57.6	54.0	74.0	*0.97	16.4	212.8	284.0
7232.180	V	39.9	48.2	4.4	44.3	52.6	54.0	74.0	9.7	21.4	187.9	303.0
9647.600	V	42.0	47.8	8.2	50.2	56.0	54.0	74.0	3.8	18.0	376.9	285.0

**Table RE12.2: Emission summary (802.11 B 2Mbs, Ch 1 Wifi)** \* = RMS Average, Restricted Band

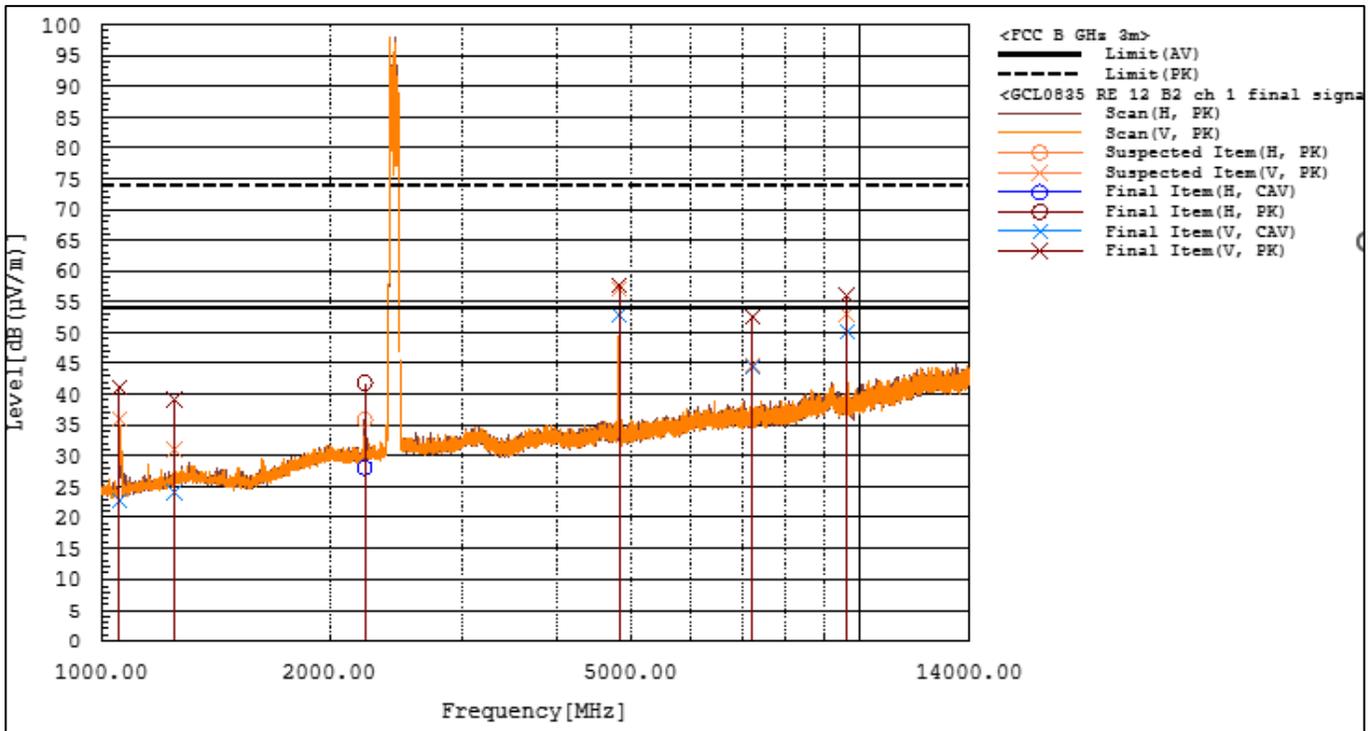
Frequency MHz	Pol.	Reading		Factor dB(1/m)	Level		Limit		Margin		Height cm	Angle deg
		dB(μV)			dB(μV/m)		dB(μV/m)		dB			
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
1056.66	V	23.80	48.7	-9.2	*23.80	39.5	54.0	74.0	*30.2	34.5	110.1	12.0
2226.93	H	30.41	48.4	-4.7	*30.41	43.7	54.0	74.0	*23.59	30.3	329.3	310.0
4873.98	V	49.41	55.5	-0.1	*49.41	55.4	54.0	74.0	*4.59	18.6	316.8	284.0
7314.25	V	41.64	45.8	4.4	*41.64	50.2	54.0	74.0	*12.36	23.8	203.4	304.0
9748.040	V	41.8	47.4	8.2	50.0	55.6	54.0	74.0	4.0	18.4	375.0	305.0
12185.06	V	43.57	42.1	12.3	*43.57	54.4	54.0	74.0	*10.43	19.6	248.7	215.0

**Table RE12.3: Emission summary (802.11 B 2Mbs, Ch 6 Wifi)** \* = RMS Average, Restricted Band

Frequency MHz	Pol.	Reading		Factor dB(1/m)	Level		Limit		Margin		Height cm	Angle deg
		dB( $\mu$ V)			dB( $\mu$ V/m)		dB( $\mu$ V/m)		dB			
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
1056.55	V	23.8	49.6	-9.2	*23.8	40.4	54.0	74.0	*30.2	33.6	110.6	252.0
2227.225	H	30.64	48.7	-4.7	*30.64	44.0	54.0	74.0	*23.36	30.0	373.4	0.0
4923.915	V	49.2	53.9	-0.1	*49.2	53.8	54.0	74.0	*4.8	20.2	296.2	283.0
7383.05	V	40.85	46.1	4.8	*40.85	50.9	54.0	74.0	*23.15	23.1	203.1	302.0
9847.940	V	43.0	48.4	8.0	51.0	56.4	54.0	74.0	3.0	17.6	392.7	293.0
12309.98	V	44.36	43.1	11.7	*44.36	54.8	54.0	74.0	*9.64	19.2	274.6	273.0

**Table RE12.4: Emission summary (802.11 B 2Mbs, Ch 11 Wifi)** \* = RMS Average, Restricted Band

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



**Figure RE12.1: Spectral data (802.11 B 2Mbs, Ch 1 Wifi)**

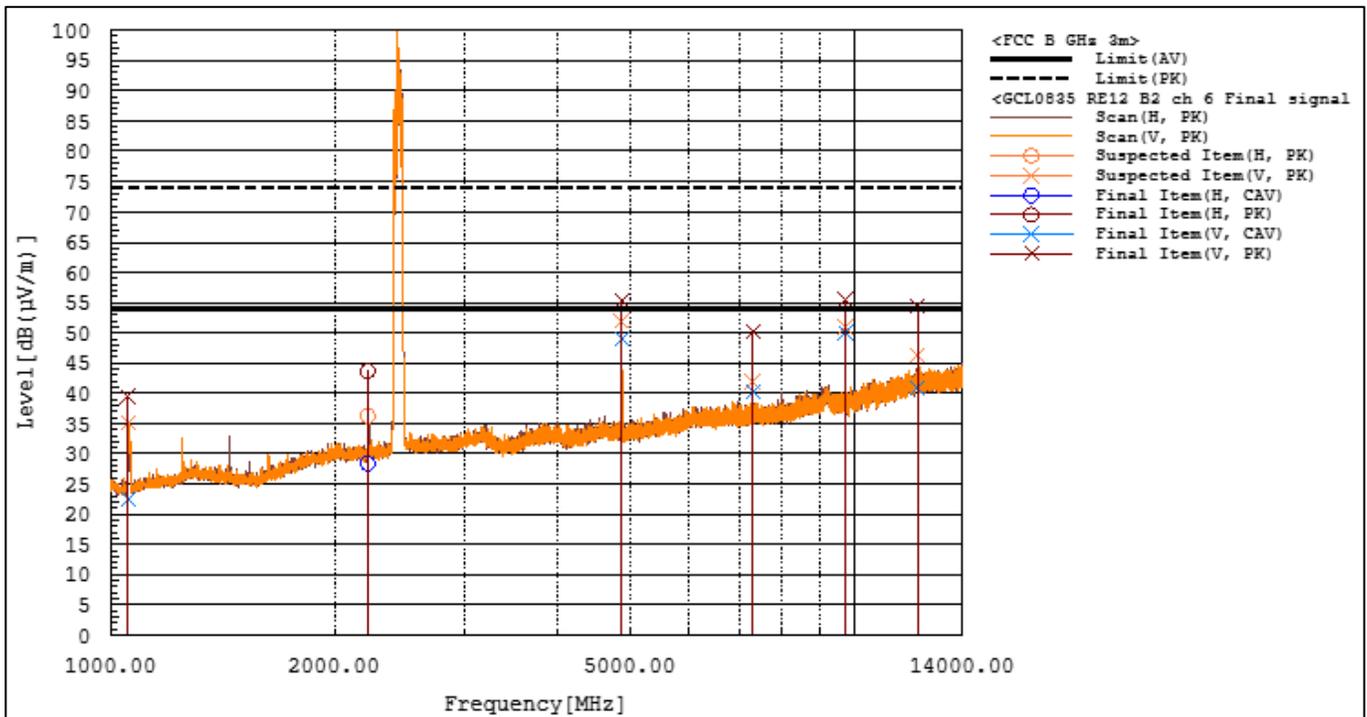


Figure RE12.2: Spectral data (802.11 B 2Mbs, Ch 6 Wifi)

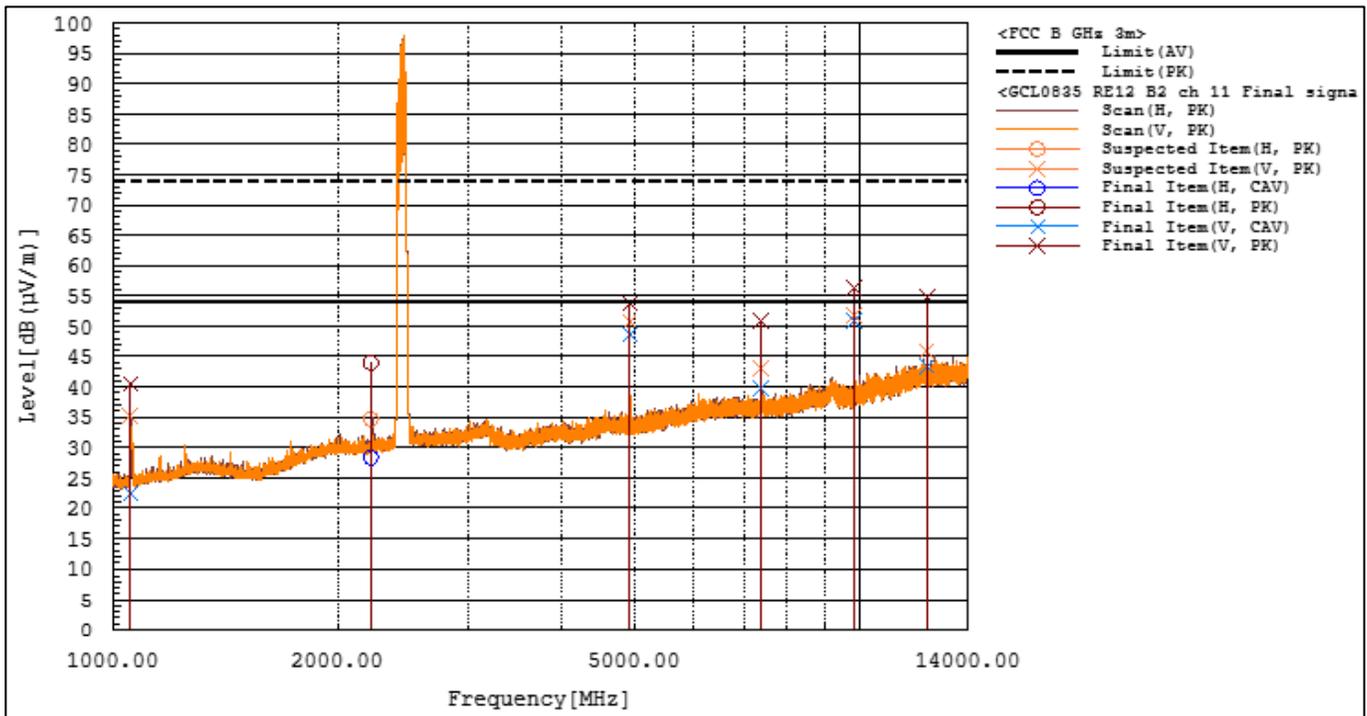


Figure RE12.3: Spectral data (802.11 B 2Mbs, Ch 11 Wifi)

## Setup Photographs

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



**Figure RE12.4: EUT test setup, first view**



**Figure RE12.5: EUT test setup, second view**

This line is the end of the test record.

**Test Record**  
**Radiated Emission Test RE13**  
**Project GCL0835**

Test Date(s) 15 Apr 2025  
 Test Personnel David Kerr

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFiTx)  
 Arrangement A2 (Upwr)  
 Input Power USB 5 Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).

Frequency Range: 1 GHz to 14 GHz  
**Pass/Fail Judgment: PASS**

**Test record created by:** David A Kerr  
**Date of this record:** 15 Apr 2025

Original record, Version A.

**Test Equipment**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape Measure, 1-3/16 in x 33 ft	Crecent Lufkin	L1135CME-02	GMN0013783	26-Jun-2024	26-Jun-2027
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required
3 GHz High Pass filter	Anatech Electronics	0KOR2	01	Calibration	Not Required

**Table RE13.1: Test Equipment Used**

**Software Used:** Keysight PXE software A.32.06, EPX test software Version 2025 01.000, RE C63p10AvgMeasurementToolV2024Dec20.xlsx

**Test Data**

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

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

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

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

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

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

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

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the WIFI radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

Frequency MHz	Pol.	Reading		Factor dB(1/m)	Level		Limit		Margin		Height cm	Angle deg
		dB(μV)			dB(μV/m)		dB(μV/m)		dB			
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
1002.5	H	23.71	45.4	-9.1	*23.71	36.3	54.0	74.0	*30.29	37.7	219.3	308.0
1055.925	V	23.7	48.8	-9.2	*23.7	39.6	54.0	74.0	*30.3	34.4	100.0	214.0
2216.125	H	29.78	48.7	-4.7	*29.78	44.0	54.0	74.0	*24.22	30.0	363.5	177.0
4814.15	V	43.82	55.7	0.1	*43.82	55.8	54.0	74.0	*13.1	18.2	210.9	279.0
7228.400	V	35.0	49.8	4.3	39.3	54.1	54.0	74.0	14.7	19.9	181.6	310.0
9648.140	V	42.3	49.4	8.2	50.5	57.6	54.0	74.0	3.5	16.4	175.9	298.0

**Table RE13.2: Emission summary (WIFI N0, Ch 1)** \* = RMS Average, Restricted Band

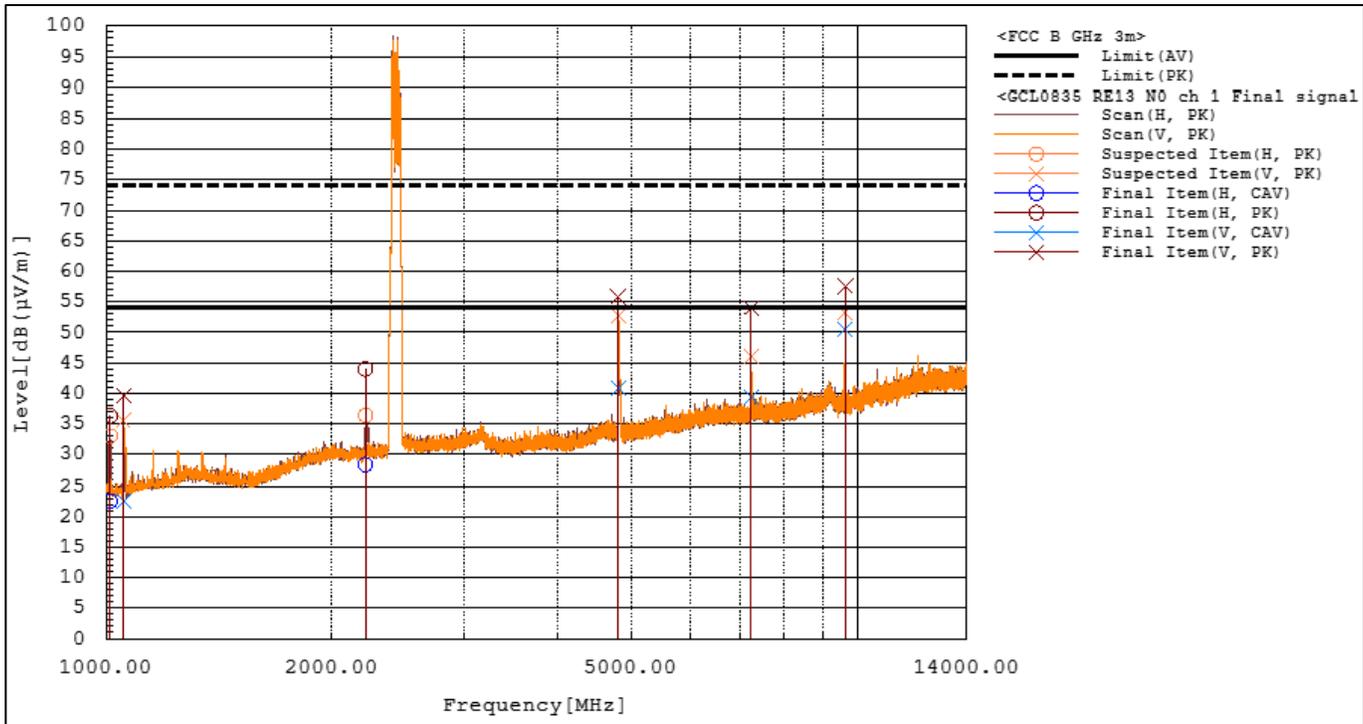
Frequency MHz	Pol.	Reading		Factor dB(1/m)	Level		Limit		Margin		Height cm	Angle deg
		dB(μV)			dB(μV/m)		dB(μV/m)		dB			
		CAV	PK		CAV	PK	AV	PK	CAV	PK		
1056.1	V	23.79	49.7	-9.2	*23.79	40.5	54.0	74.0	*30.21	33.5	119.7	270.0
2226.925	H	30.22	48.2	-4.6	*30.22	43.6	54.0	74.0	*23.78	30.4	329.6	31.0
4874.04	V	40.39	52.6	-0.1	*40.39	52.5	54.0	74.0	*13.61	21.5	217.4	285.0
7315.455	H	39.43	49.6	4.5	*39.43	54.1	54.0	74.0	*14.57	19.9	168.0	233.0
9748.040	V	42.4	47.9	8.2	50.6	56.1	54.0	74.0	3.4	17.9	323.9	307.0
12184.92	V	45.55	43.0	12.3	*45.55	55.3	54.0	74.0	*8.45	18.7	338.6	276.0

**Table RE13.3: Emission summary (WIFI N0, Ch 6)** \* = RMS Average, Restricted Band

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle	
MHz		dB( $\mu$ V)			dB(1/m)	dB( $\mu$ V/m)		dB( $\mu$ V/m)		dB			
		CAV	PK			CAV	PK	AV	PK	CAV			PK
1055.925	V	23.77	49.6	-9.2	*23.77	40.4	54.0	74.0	*30.23	33.6	106.8	282.0	
2227.775	H	29.74	47.0	-4.7	*29.74	42.3	54.0	74.0	*24.26	31.7	325.7	46.0	
4923.935	V	36.02	49.2	-0.1	*36.02	49.1	54.0	74.0	*17.98	24.9	203.7	279.0	
9847.940	V	44.3	48.9	8.0	52.3	56.9	54.0	74.0	1.7	17.1	312.3	283.0	
12309.95	V	45.78	43.5	11.7	45.78	55.2	54.0	74.0	8.22	18.8	330.6	274.0	

**Table RE13.4: Emission summary (WIFI N0, Ch 11)** \* = RMS Average, Restricted Band

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



**Figure RE13.1: Spectral data (WIFI N0, Ch 1)**

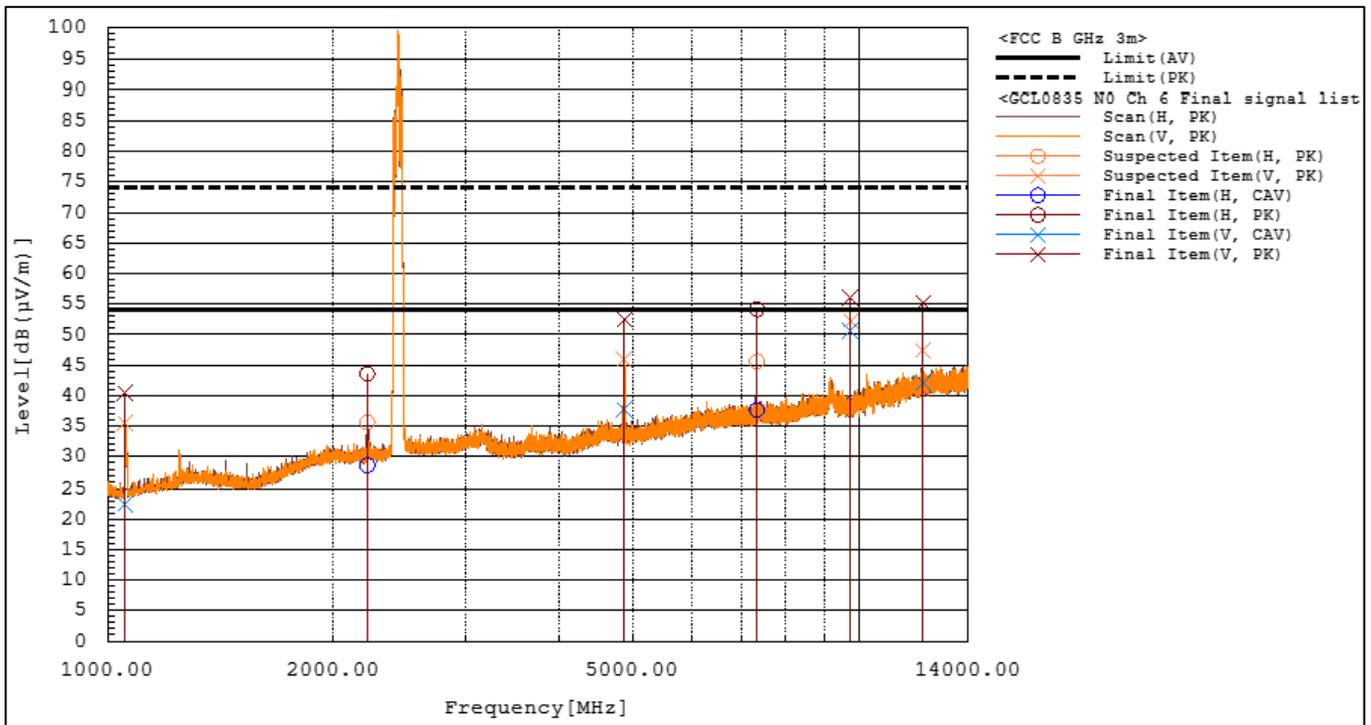


Figure RE13.2: Spectral data (WIFI N0, Ch 6)

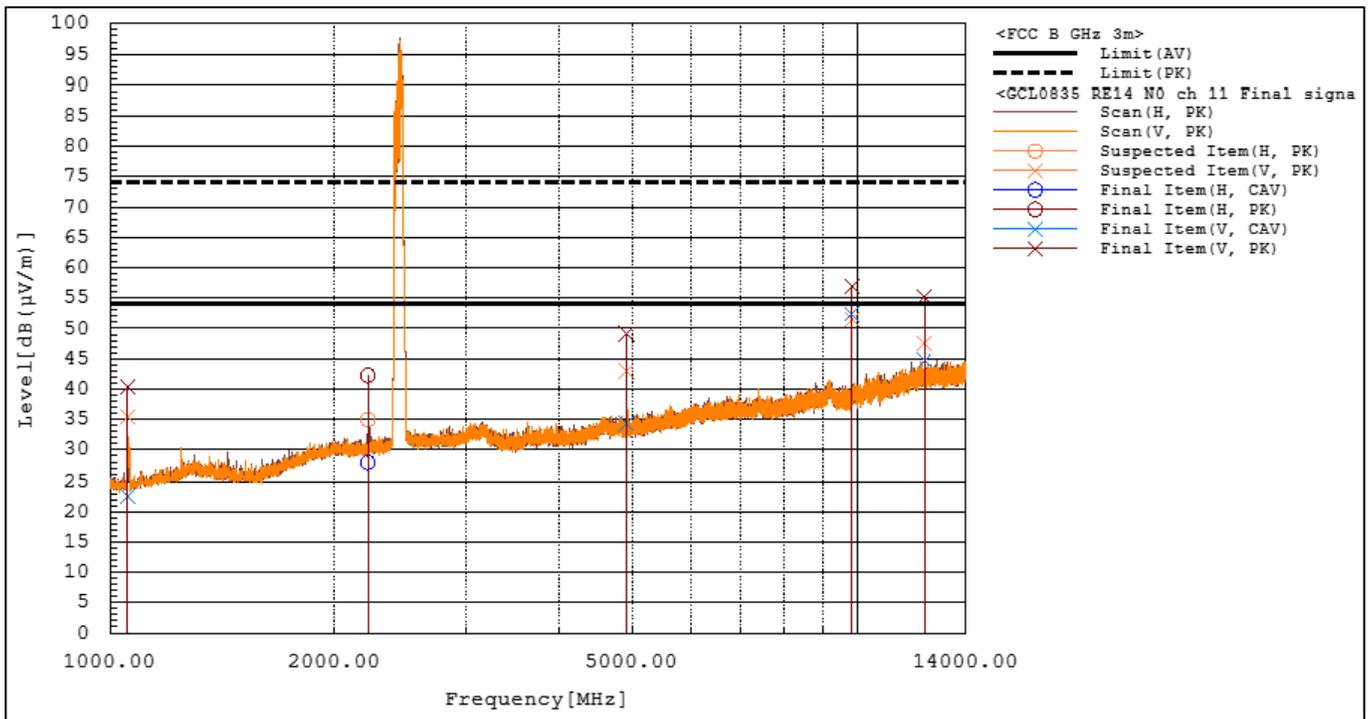


Figure RE13.3: Spectral data (WIFI N0, Ch 11)

## Setup Photographs

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



**Figure RE13.4: EUT test setup, first view**



**Figure RE13.5: EUT test setup, second view**

This line is the end of the test record.

**Test Record**  
**Radiated Emission Test RE15**  
**Project GCL0835**

Test Date(s) 29, 30 Apr 2025  
 Test Personnel Jim Solum

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFITx) (802.11B 2Mbps, ch 1, ch 6, ch 11)  
 Arrangement A2 (Upwr)  
 Input Power USB 5 Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).

Frequency Range: 14 GHz to 25 GHz  
**Pass/Fail Judgment: PASS**

**Test record created by:** Jim Solum  
**Date of this record:** 30 Apr 2025

Original record, Version A.

**Test Equipment**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025
Antenna, Horn, 10-40 GHz	ETS Lindgren	3116C	00227673	14-Sep-2023	15-Sep-2025
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Preamplifier, 14 GHz to 40 GHz	Com-Power	PAM-840A	461364	Calibration	Not Required

**Table RE15.1: Test Equipment Used**

**Software Used:** Keysight PXE software A.33.03, EPX test software Version 2025.01.000

**Test Data**

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

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

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

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

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

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

Emissions were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report.) The duty cycle for the WIFI radios had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

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

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle	
MHz		dB(μV)			dB(1/m)	dB(μV/m)		dB(μV/m)		dB			
		RMS	PK			RMS	PK	AV	PK	RMS			PK
19295.931	V	29.6	37.4	19.7	49.3	57.1	54.0	74.0	4.7	16.9	327.2	0.0	
22157.762	V	25.8	37.6	21.0	46.8	58.6	54.0	74.0	7.2	15.4	353.6	314.0	
14471.991	H	20.2	31.2	27.0	47.2	58.2	54.0	74.0	6.8	15.8	381.8	86.0	

**Table RE15.2: Emission summary (802.11B 2Mbs, Ch 1)**

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle	
MHz		dB(μV)			dB(1/m)	dB(μV/m)		dB(μV/m)		dB			
		RMS	PK			RMS	PK	AV	PK	RMS			PK
16904.010	V	24.1	31.7	21.5	45.6	53.2	54.0	74.0	8.4	20.8	400.0	0.0	
17233.617	H	24.9	36.7	20.9	45.8	57.6	54.0	74.0	8.2	16.4	400.0	344.0	
19495.917	V	30.1	39.2	19.7	49.8	58.9	54.0	74.0	4.2	15.1	293.6	180.0	
23255.508	H	27.8	36.9	21.9	49.7	58.8	54.0	74.0	4.3	15.2	400.0	0.0	

**Table RE15.3: Emission summary (802.11B 2Mbs, Ch 6)**

Frequency	Pol.	Reading		Factor	Level		Limit		Margin		Height	Angle	
MHz		dB(μV)			dB(1/m)	dB(μV/m)		dB(μV/m)		dB			
		RMS	PK			RMS	PK	AV	PK	RMS			PK
14218.596	V	19.9	28.0	27.9	47.8	55.9	54.0	74.0	6.2	18.1	100.0	0.0	
16799.786	V	23.9	35.4	21.7	45.6	57.1	54.0	74.0	8.4	16.9	377.1	238.0	
19405.291	V	26.4	38.2	19.7	46.1	57.9	54.0	74.0	7.9	16.1	349.9	51.0	
19616.675	V	29.5	36.5	19.8	49.3	56.3	54.0	74.0	4.7	17.7	304.6	0.0	
24221.970	H	25.6	35.3	22.6	48.2	57.9	54.0	74.0	5.8	16.1	400.0	0.0	

**Table RE15.4: Emission summary (802.11B 2Mbs, Ch 11)**

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

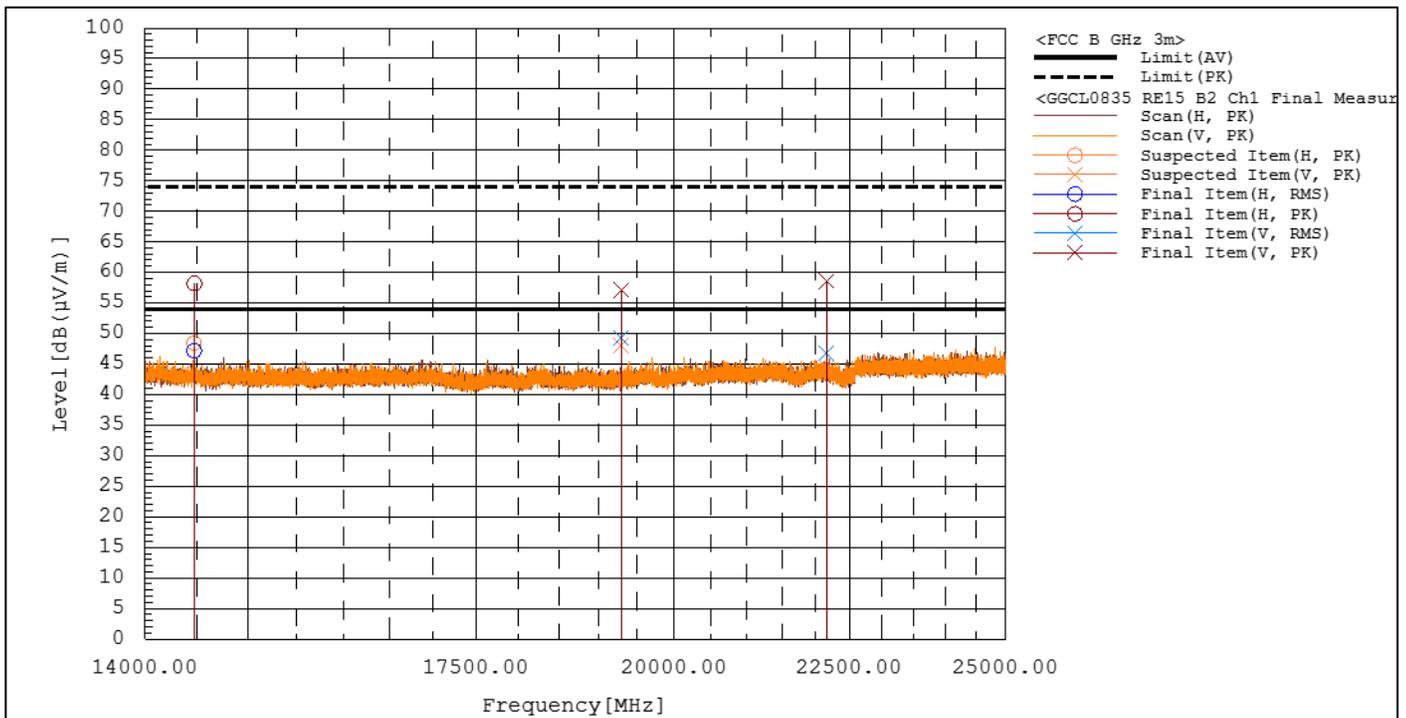


Figure RE15.1: Spectral data (802.11B 2Mbs, Ch 1)

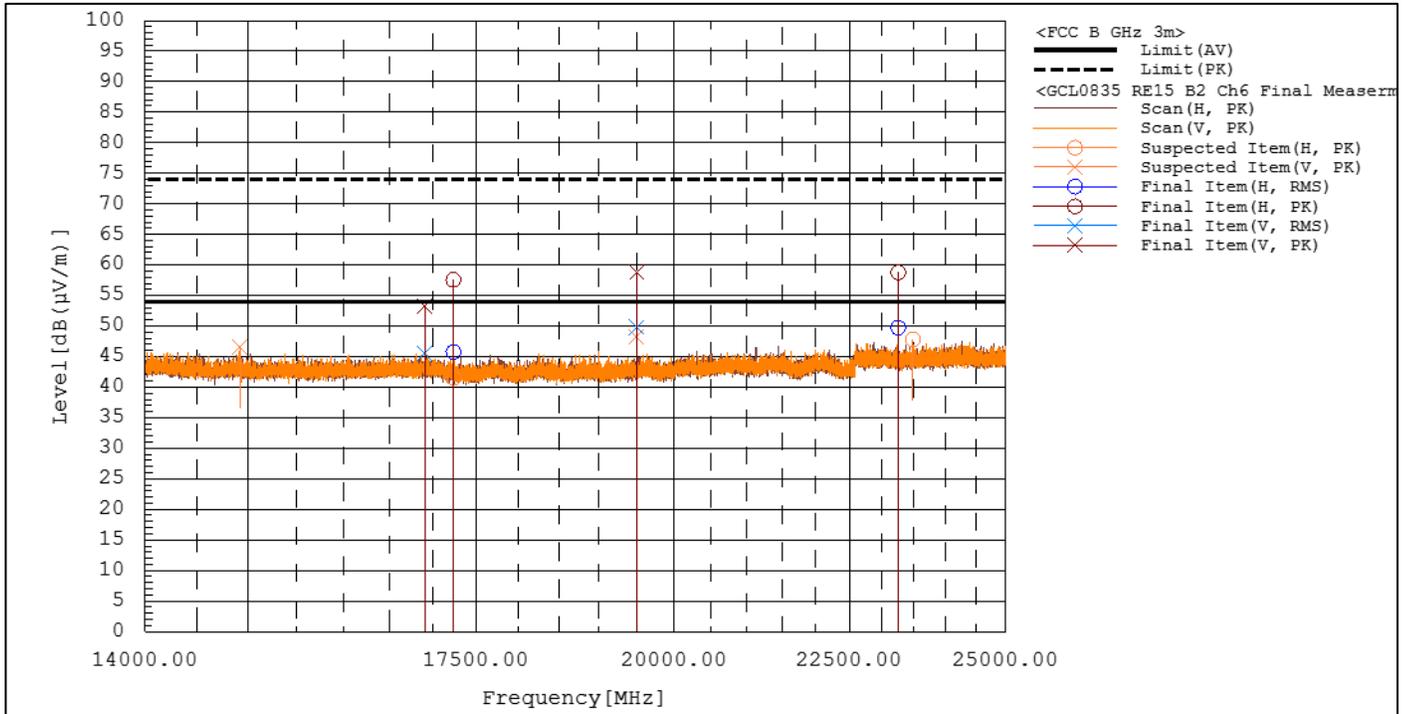


Figure RE15.2: Spectral data (802.11B 2Mbs, Ch 6)

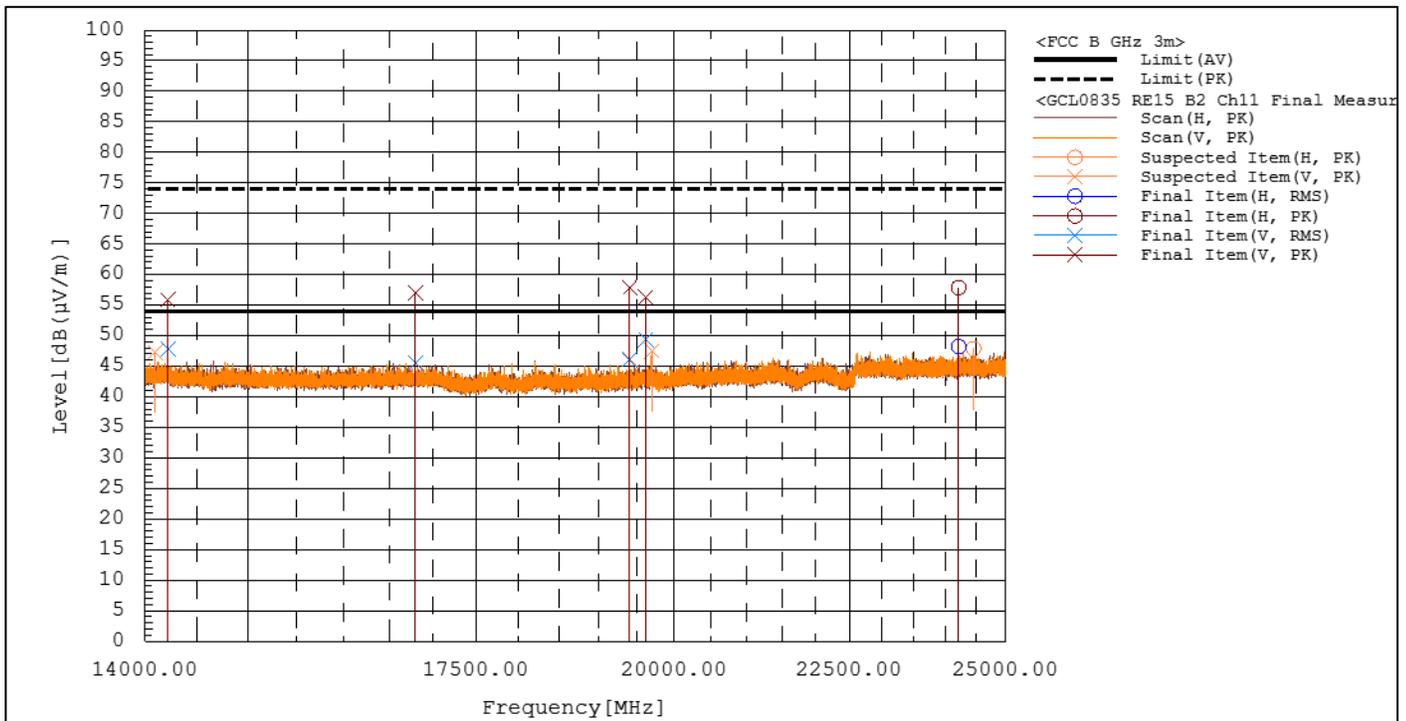


Figure RE15.3: Spectral data (802.11B 2Mbps, Ch 11)

### Setup Photographs

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



Figure RE15.4: EUT test setup, first view (Z orientation)

**Image removed for client confidentiality.**  
See section 1 of this report  
to identify the report where  
the photos may be viewed.

**Figure RE15.5: EUT test setup, second view (Z orientation)**

**This line is the end of the test record.**

**Test Record**  
**Radiated Emission Test RE01**  
**Project GCL0835**

Test Date(s) 10, 11, 14 Apr 2025  
 Test Personnel David Kerr

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFiTx) (B1 ch1,ch9,ch11 G6 ch1,ch11 N4 ch1 N6 ch11)  
 Arrangement A2 (Upwr)  
 Input Power USB 5 Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (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:** 10 Apr 2025

Original record, Version A.

**Test Equipment**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 26 GHz	Keysight	N9048B	MY59290135	24-Oct-2024	24-Oct-2025
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00259208	30-May-2024	30-May-2026
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	7-Mar-2023	7-Mar-2026
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Calibration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required

**Table RE01.1: Test Equipment Used**

**Software Used**

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

## Test Data

US and Canadian laws contain dozens of bands where radio operation is restricted. Compliance with most of those band restrictions is typically demonstrated by a series of spurious emission tests covering a very wide span of frequencies from kilohertz to Gigahertz. This test record focuses on restricted bands that are immediately adjacent to the authorized band in which the test sample radio operate. It shows whether the modulation products are sufficiently suppressed to meet the restricted band requirements.

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 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 channels 1 and Measurements in the upper band were made while the transmitter was tuned to channels 9 and 11.

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

The tables show the selected final measurement data between the FCC restricted bands. It includes a the strongest emissions observed relative to the test limit, along with other data points of interest. Where a data point is highlighted is yellow, this is an aid to indicate the data point(s) with the least margin to the test limit. A positive margin value indicates that the emission was below the test limit. The test limit is the FCC restricted band 'Class B' Limit at 3 m listed at 15.209 and RSS-Gen clause 8.9.

Emissions within the restricted bands were measured with an averaging process described in the ANSI C63.10 methods noted in this paragraph. (See also section 6.3 of this test report. The duty cycle for the WIFI radio had a duty cycle of 98% or greater and so the trace-averaging method of clause 11.12.2.5.1 was applied.

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2390	54	74	40.50	50.81	13.50	23.19	131	2563	HORZ	2390	40.489
2389.3	54	74	41.43	49.68	12.57	24.32	131	2563	HORZ	2389.3	41.435

**Table RE01.2: FCC restricted bands from 2200 to 2390 MHz (11B 1Mbs, Ch 1)**

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2390	54	74	46.65	67.96	7.36	6.04	131	2563	HORZ	2390	46.641

**Table RE01.3: FCC restricted bands from 2200 to 2390 MHz (11G 6Mbs, Ch 1)**

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2390	54	74	48.81	68.69	5.19	5.31	131	2563	HORZ	2390	48.798

**Table RE01.4: FCC restricted bands from 2200 to 2390 MHz (11N 4Mbs, Ch 1)**

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2484.5	54	74	39.64	49.33	14.36	24.67	131	2563	HORZ	2484.5	39.65
2484.3	54	74	39.81	48.98	14.19	25.02	131	2563	HORZ	2484.3	39.81

**Table RE01.5: FCC restricted band from 2483.5 to 2500 MHz (11B 1Mbps, Ch 9)**

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2488	54	74	40.14	49.77	13.86	24.23	-150	3650	VERT	2488	40.145
2487.8	54	74	40.61	50.08	13.39	23.92	-150	3650	VERT	2487.8	40.574

**Table RE01.6: FCC restricted band from 2483.5 to 2500 MHz (11B 1Mbps, Ch 11)**

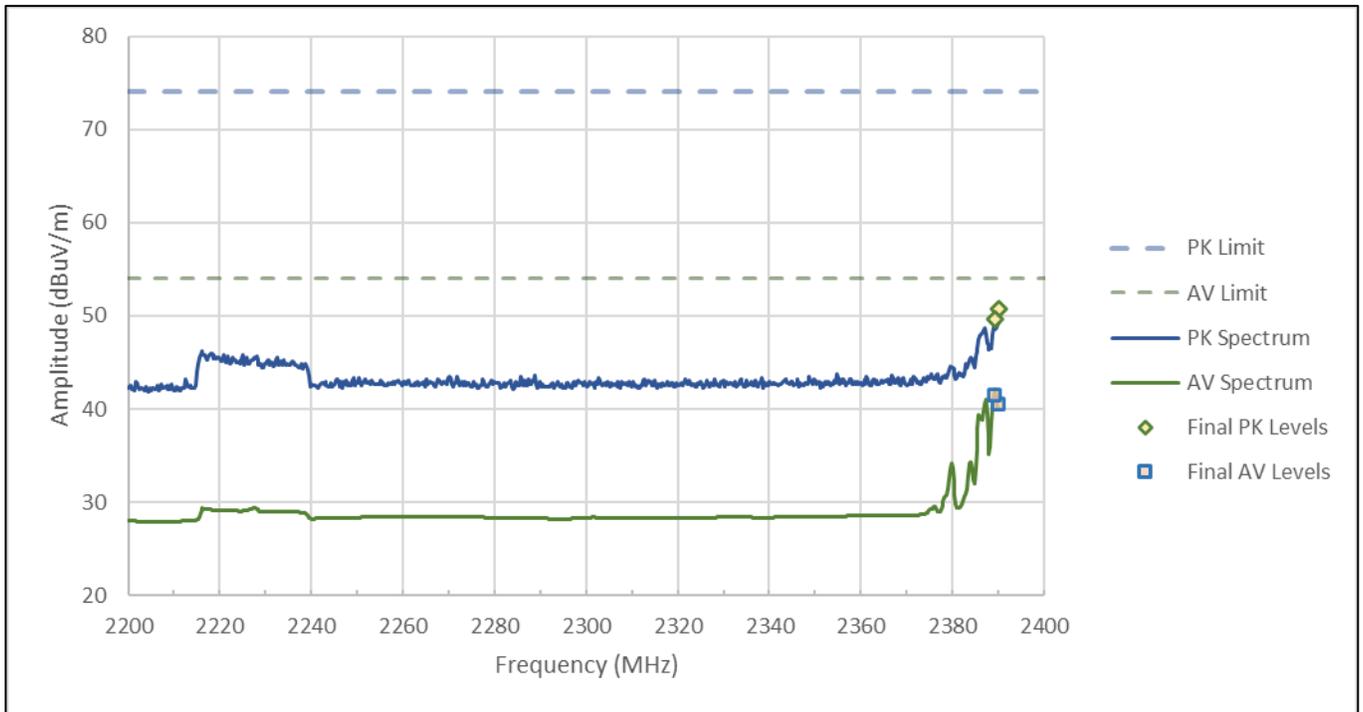
Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2483.5	54	74	41.58	67.55	12.42	6.45	135	2688	HORZ	2483.5	41.579

**Table RE01.7: FCC restricted band from 2483.5 to 2500 MHz (11G 6Mbps, Ch 11)**

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity	Avg Type	DC Adjust
(MHz)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)	(dB)	(degree)	(mm)	---	---	(dB)
2483.5	54	74	42.88	68.43	11.12	5.57	135	2688	HORZ	2483.5	42.855

**Table RE01.8: FCC restricted band from 2483.5 to 2500 MHz (11N 6Mbps, Ch 11)**

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



**Figure RE01.1: FCC restricted band spectral data from 2200 to 2390 MHz (11B 1Mbps, Ch 1)**

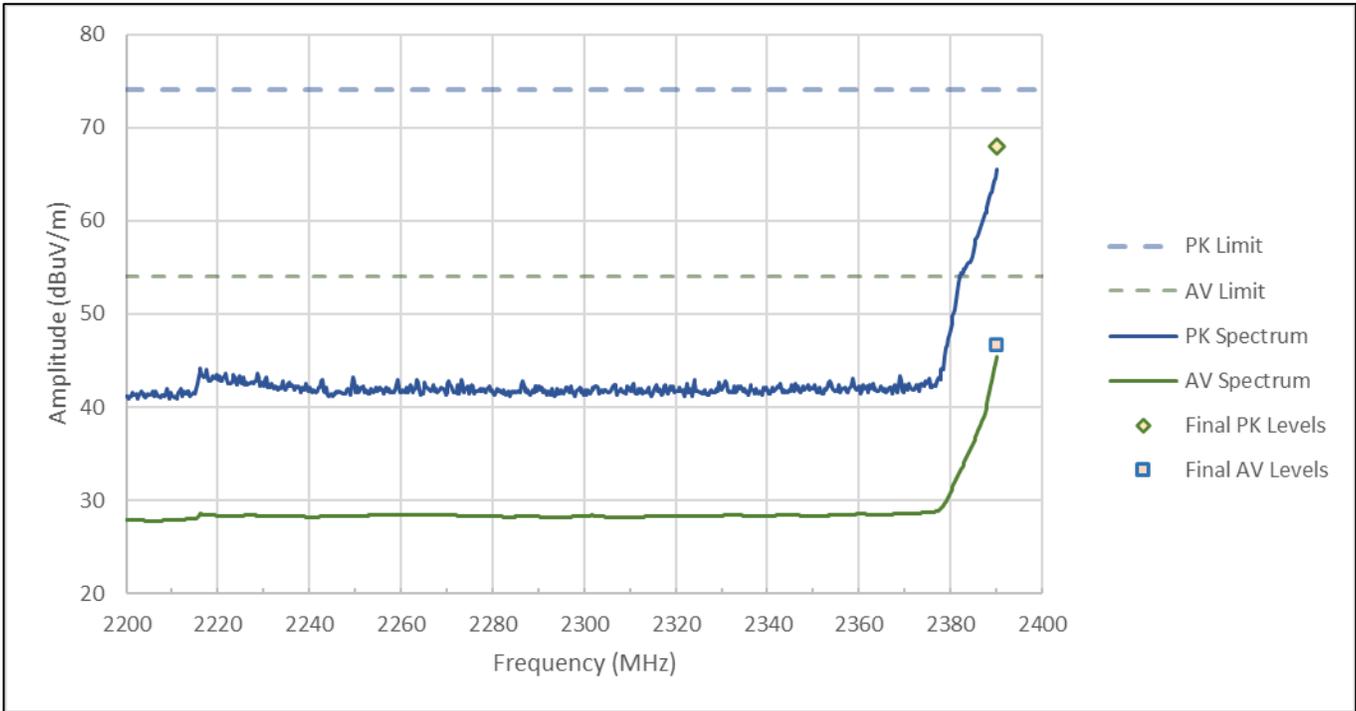


Figure RE01.2: FCC restricted band spectral data from 2200 to 2390 MHz (11G 6Mbps, Ch 1)

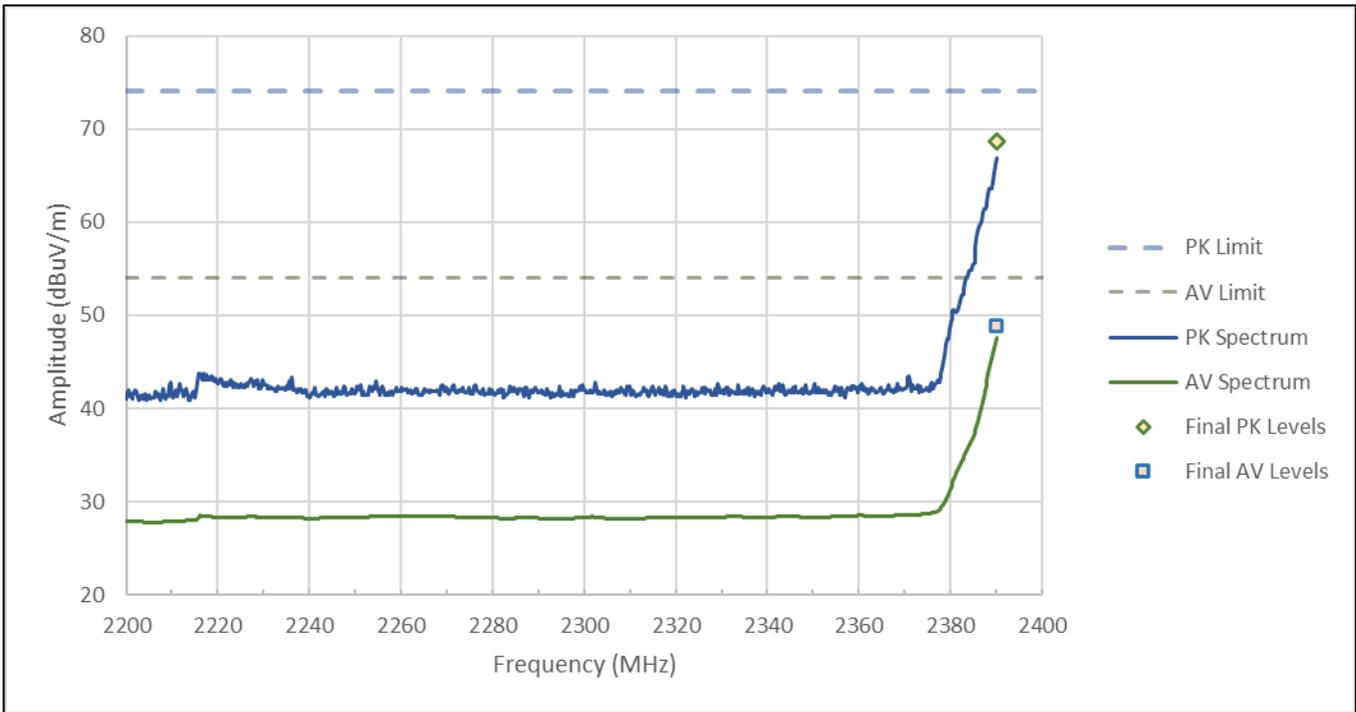


Figure RE01.3: FCC restricted band spectral data from 2200 to 2390 MHz (11N 4Mbps, Ch 1)

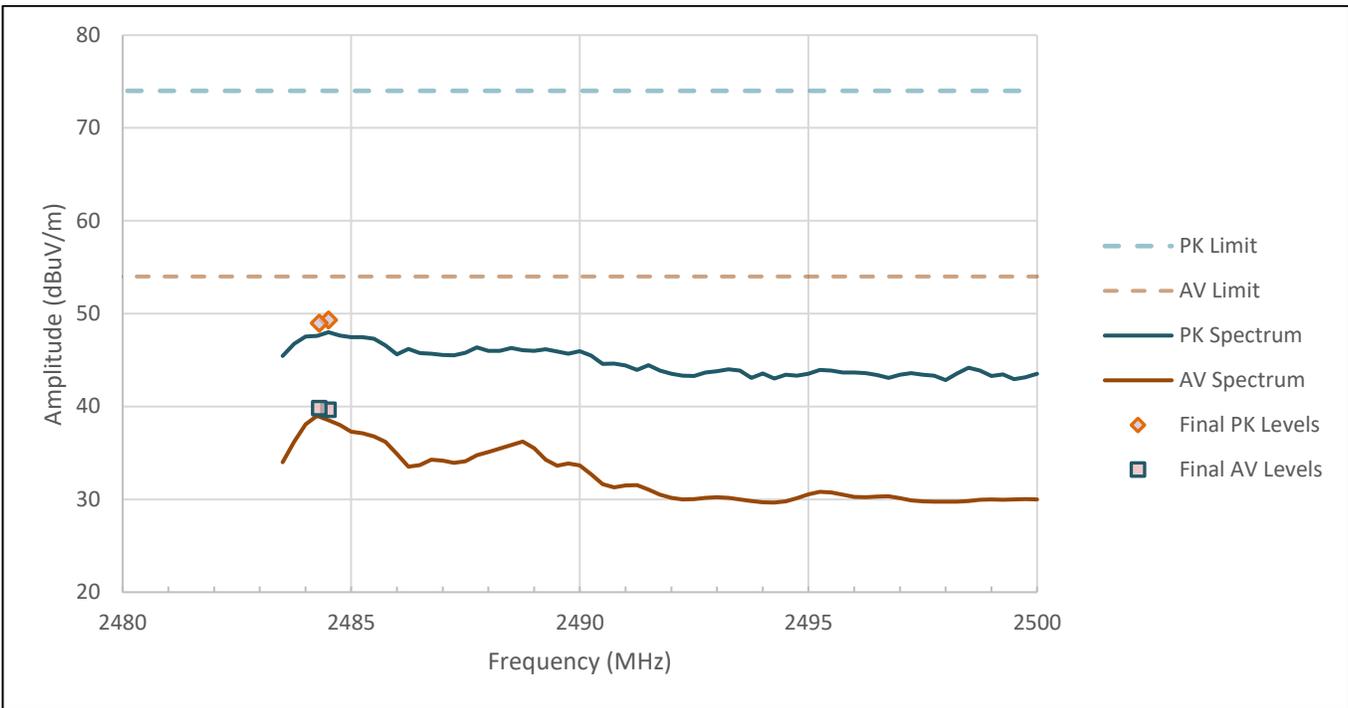


Figure RE01.4: FCC restricted band spectral data from 2483.5 to 2500 MHz (11B 1Mbs, Ch 9)

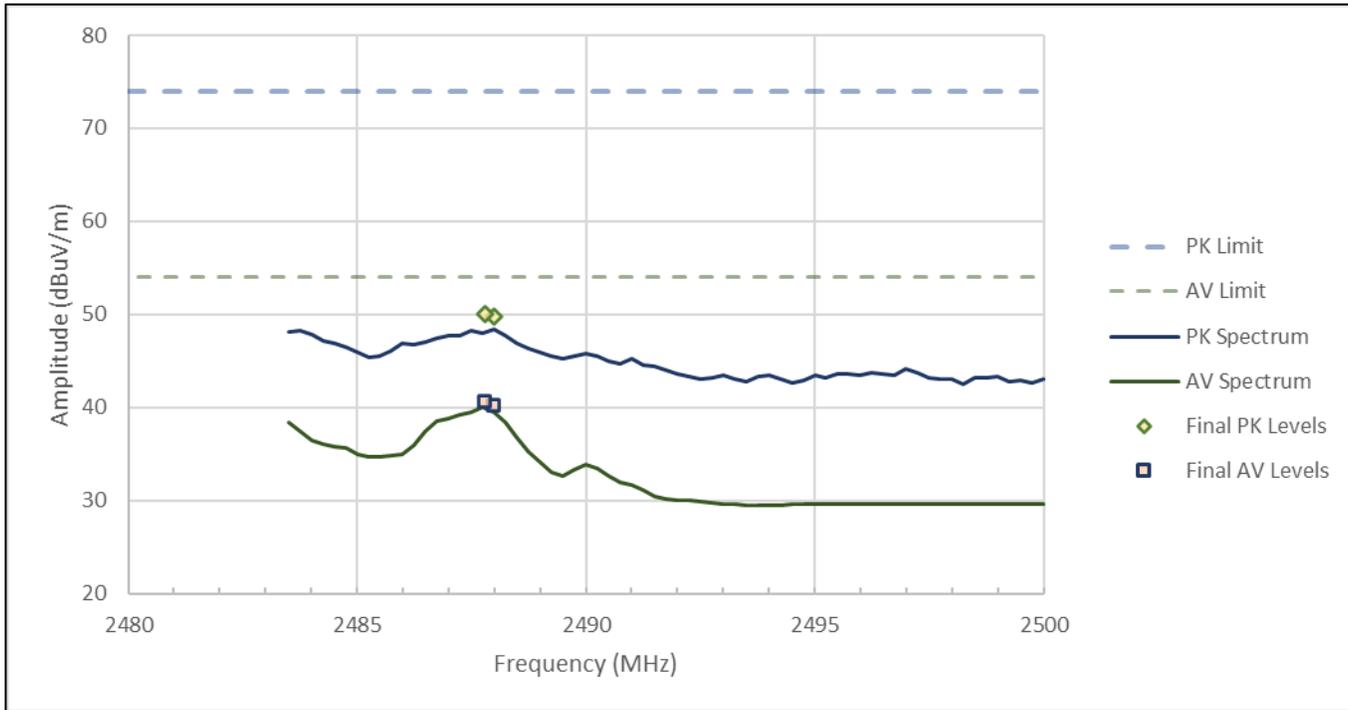


Figure RE01.5: FCC restricted band spectral data from 2483.5 to 2500 MHz (11B 1Mbs, Ch 11)

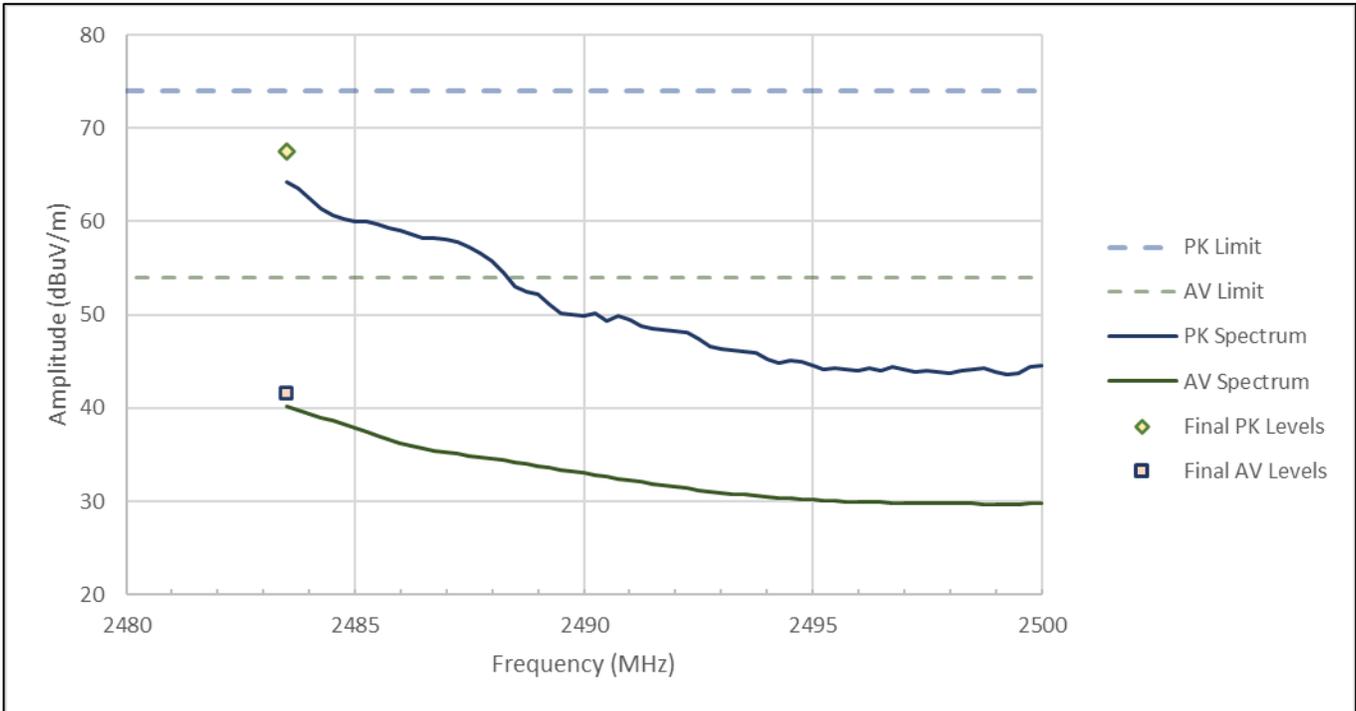


Figure RE01.6: FCC restricted band spectral data from 2483.5 to 2500 MHz (11G 6Mbps, Ch 11)

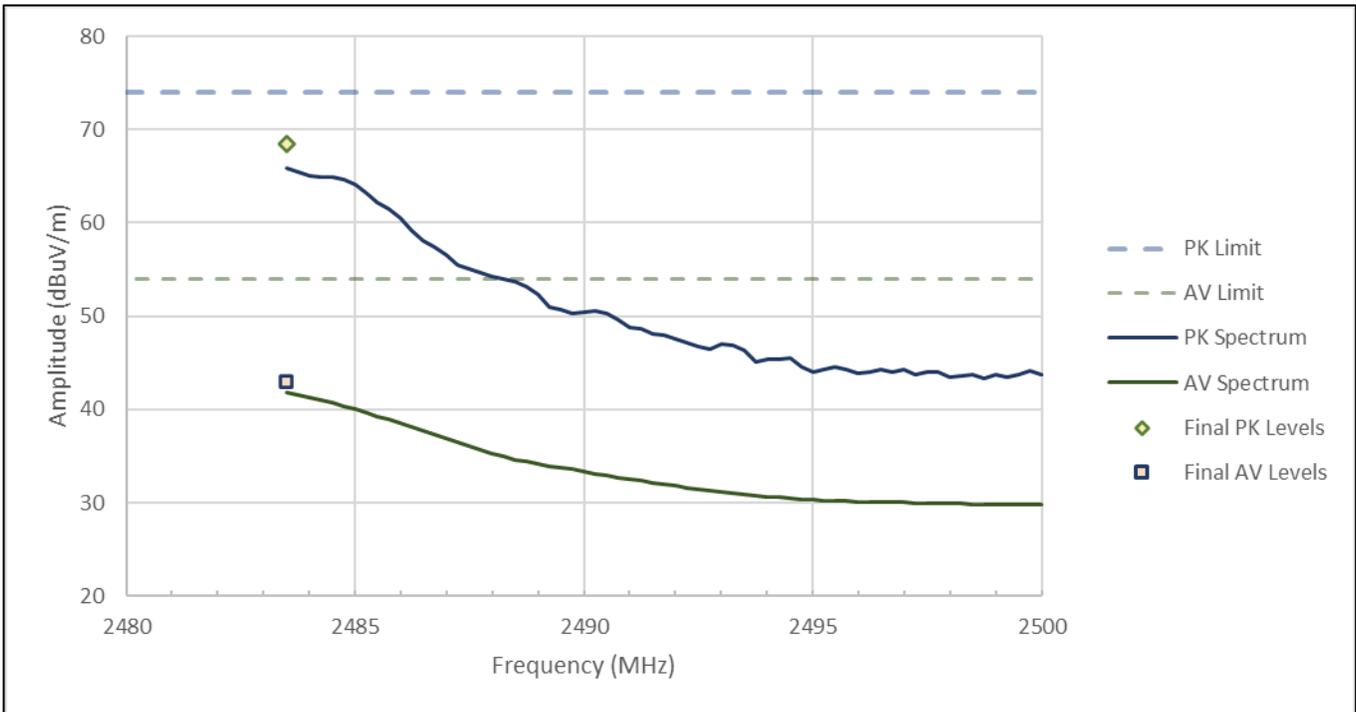


Figure RE01.7: FCC restricted band spectral data from 2483.5 to 2500 MHz (11N 6Mbps, Ch 11)

## Setup Photographs

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



**Figure RE01.8: EUT test setup, primary view (EUT Z orientation)**



**Figure RE01.9: EUT test setup, reverse view (EUT Z orientation)**

This line is the end of the test record.

**Test Record**  
**Transmitter Power Spectral Density**  
**Test IDs TR21**  
**Project GCL-0835**

Test Date(s) 26, 27 Mar 2025  
 Test Personnel Vladimir Tolstik supervised by Jim Solum

Product Model A04378  
 Serial Number tested 7MK001303

Operating Mode M7 (WiFiTx)  
 Arrangement A2 (Upwr)  
 Input Power USB 5Vdc

Test Standards: FCC Part 15.247; RSS-247; RSS-GEN; ANSI C63.10 (as noted in Section 6 of the report).

Antenna Gain 2.71 dBi, as reported by the client  
 Radio Protocol IEEE 802.11 b/g/n (WiFi)

**Pass/Fail Judgment: PASS**

**Test record created by:** Vladimir Tolstik  
**Date of this record:** 27 Mar 2025  
 Original record, Version A.

**Test Equipment Used**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
MXE Receiver 8.4 GHz	Keysight	N9038B	MY63460112	17-Mar-2025	17-Mar-2026

**Table TR21.1: Test equipment used**

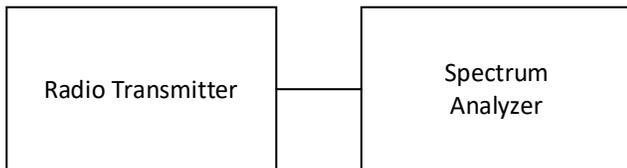
**Software Used:** Keysight PXE software A.37.02

**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 TR21.1: 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 a wider resolution bandwidths is permitted. All data met the limit using a 3 kHz resolution bandwidth.

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

	Ch1	Ch6	Ch11
B2	-7.60	-6.97	-7.66
NMCS0	-10.99	-9.50	-9.50

Table TR21.2: Summary of results for WiFi radio in dBm / 3 kHz



Figure TR21.2: Test data for IEEE 802.11 B2 modulation, Channel 6

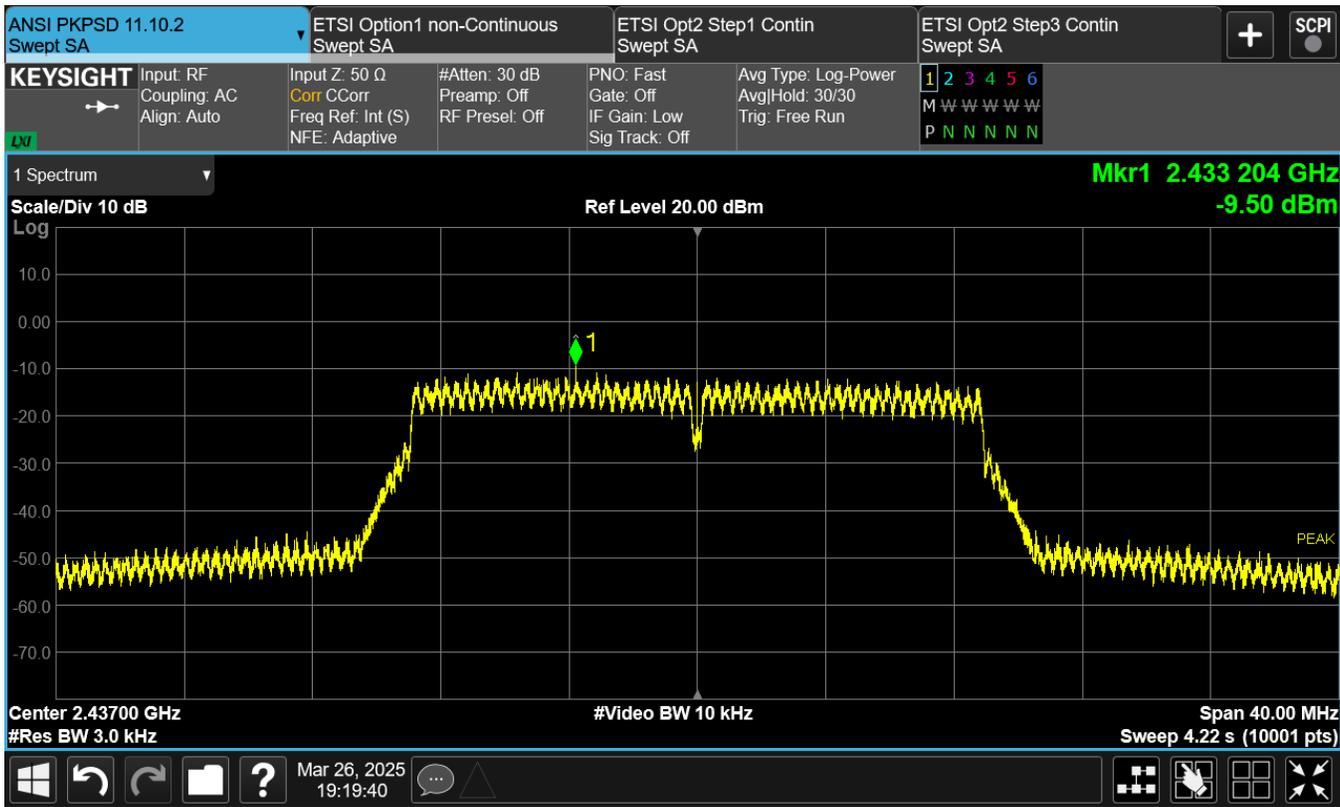


Figure TR21.3: Test data for IEEE 802.11 NMCS0 modulation, channel 6

This line is the end of the test record.

**Test Record**  
**Conducted Emissions Mains Test CE03**  
**Project GCL0835**

Test Date(s) 09 April 2025  
 Test Personnel David Kerr, Jim Solum

Product Model A04378  
 Serial Number tested 7MK001302

Operating Mode M7 (WiFiTx)  
 Arrangement A2 (Upwr)

Input Power 120 Vac 60 Hz

Test Standards: FCC Part 15, ANSI C63.10, RSS-GEN, 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:** Jim Solum  
**Date of this record:** 10 April 2025

Original record, Version A.

**Test Equipment**

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE Receiver 44 GHz	Keysight	N9048B	MY62220139	21-Oct-2024	21-Oct-2025
Tape measure, 1 in x 33 ft	Lufkin	PHV1410CMEN	10720	16-Jan-2023	15-Jan-2026
DMM Multimeter	Fluke	87V	63490051	2-Jan-2025	2-Jan-2028
LISN multiline; 20A 50uH	Com-Power	LIN-120C	20160005	3-Apr-2024	1-Apr-2027
Coaxial Power Cable	Com-Power	RG214/U	20230124-01	3-Apr-2024	1-Apr-2027

**Table CE03.1: Test Equipment Used**

**Software Used**

Keysight PXE software A.33.03; CE Mains 150k to 30M Data Analysis V3a 2025Jan08.xlsx

**Test Data**

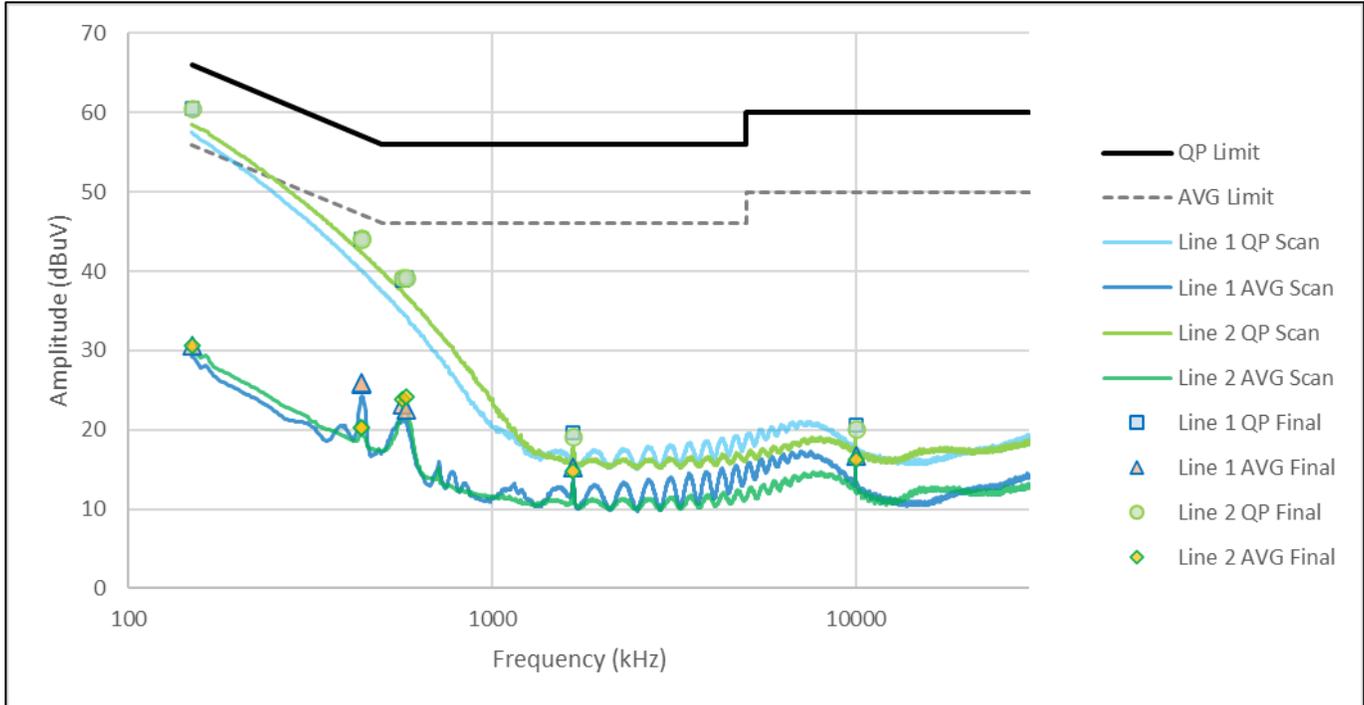
The conducted emission test process began with a set of preliminary scans on both power conductors using both Quasi-Peak and Average detectors across the frequency range. Where the test standard requires cable manipulation, one or more likely worst case frequencies selected by the test personnel. Cables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

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

Frequency (kHz)	QP Limit (dB $\mu$ V)	AV Limit (dB $\mu$ V)	L1 QP (dBuV)	L2 QP (dBuV)	L1 AV (dBuV)	L2 AV (dBuV)	QP Margin (dB)	AV Margin (dB)
150	66.00	56.00	60.51	60.46	30.67	30.61	5.49	25.33
438	57.10	47.10	43.96	44.26	25.70	20.28	12.84	21.40
440	57.06	47.06	44.01	44.04	25.87	20.24	13.02	21.19
569	56.00	46.00	38.90	39.20	23.14	23.91	16.80	22.09
582	56.00	46.00	39.17	39.19	22.51	24.14	16.81	21.86
1676	56.00	46.00	19.60	19.15	15.22	14.79	36.40	30.78
10001	60.00	50.00	20.68	20.13	16.74	16.22	39.32	33.26

**Table CE03.2: Emission summary**

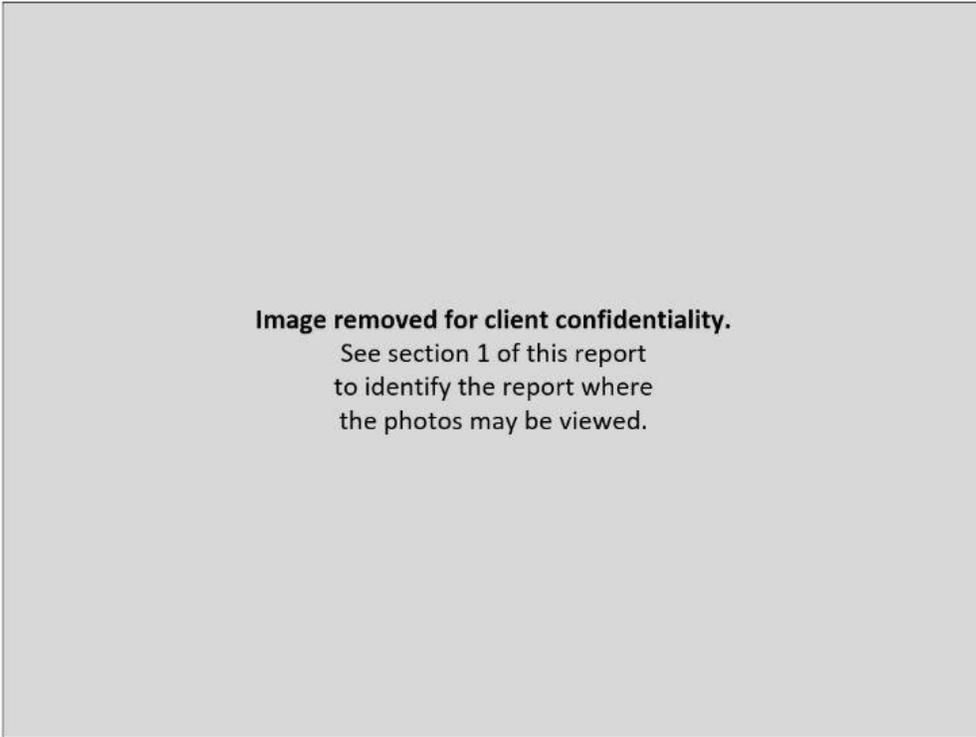
The graph below shows preliminary scan data as continuous curves. Superimposed are the final measurement data points reported in the table above.



**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.**

## FCC/ISED Test Report

**Prepared for:**           **Garmin International, Inc.**

**Address:**               **1200 E. 151<sup>st</sup> Street**  
                                  **Olathe, Kansas, 66062, USA**

**Product:**               **A04378**

**Test Report No:**       **R230504-20-E2A**

**Approved by:**



**Fox Lane,**  
**EMC Test Engineer**

**DATE:**                   **August 30, 2024**

**Total Pages:**         **49**

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Prepared for:	Garmin International, Inc.		

**REVISION PAGE**

<b>Rev. No.</b>	<b>Date</b>	<b>Description</b>
0	7 August 2024	Issued by FLane Reviewed by KVepuri Prepared by FLane, ESchmidt
A	30 August 2024	Added statement regarding Band edges – FL



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## 1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section:

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15
- (2) ISED RSS-Gen, Issue 5
- (3) ISED RSS-247, Issue 3

APPLIED STANDARDS AND REGULATIONS		
Standard Section	Test Type	Result
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(b)(3) RSS-247 Issue 3 Section 5.4(d)	Peak output power	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 3 Section 5.2 (a)	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 3 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(e) RSS-247 Issue 3 Section 5.2 (b)	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 3 Section 5.5	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	Pass



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## 2.0 EUT DESCRIPTION

### 2.1 EQUIPMENT UNDER TEST

#### Summary and Operating Condition:

<b>EUT</b>	A04378
<b>FCC ID</b>	IPH-04378
<b>IC</b>	1792A-04378
<b>EUT Received</b>	23 October 2023
<b>EUT Tested</b>	23 October 2023- 3 July 2024
<b>Serial No.</b>	3442231329 (Radiated Measurements) 3442134065 (Conducted Measurements)
<b>Operating Band</b>	2400 – 2483.5 MHz
<b>Device Type</b>	<input checked="" type="checkbox"/> GMSK <input type="checkbox"/> GFSK <input type="checkbox"/> BT BR <input type="checkbox"/> BT EDR 2MB <input type="checkbox"/> BT EDR 3MB <input type="checkbox"/> 802.11x
<b>Power Supply / Voltage</b>	Internal Battery / 5VDC Charger: Garmin (Phi Hong) Model: AQ27A-59CFA GPN: 362-00118-00 (Representative Power Supply)

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

GMSK 1MB Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

GMSK 2MB Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequencies and designations.

### 2.3 DESCRIPTION OF SUPPORT UNITS

None

### 3.0 LABORATORY AND GENERAL TEST DESCRIPTION

#### 3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)  
 4740 Discovery Drive  
 Lincoln, NE 68521  
 A2LA Certificate Number: 1953.01  
 FCC Accredited Test Site Designation No: US1060  
 Industry Canada Test Site Registration No: 4294A  
 NCC CAB Identification No: US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of 35 ± 4%  
 Temperature of 22 ± 3° Celsius



#### 3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Fox Lane	Test Engineer	Testing and Report
2	Blake Winter	Test Engineer	Testing
3	Ethan Schmidt	Test Engineer	Testing and Report
4	Karthik Vepuri	Technical Manager	Review

**Notes:** All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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### 3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 17, 2023	July 17, 2025
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 18, 2023	July 17, 2025
SunAR RF Motion	JB1	A091418	July 27, 2023	July 26, 2024
ETS-Lindgren Red Horn Antenna	3115	218576	July 31, 2023	July 30, 2024
Com-Power LISN, Single Phase	LI-220C	20070017	July 17, 2023	July 17, 2025
Agilent Preamp*	87405A	3207A01475	May 2, 2024	May 2, 2026
ETS Red Preamplifier (Orange)*	3115-PA	00218576	January 22, 2024	January 22, 2026
Trilithic High Pass Filter*	6HC330	23042	June 5, 2023	June 5, 2025
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2024
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 22, 2024	May 22, 2026
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)*	PE9128	NCEE BH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)*	PE9128	NCEE BH2	June 5, 2023	June 5, 2025
TDK Emissions Lab Software	V11.25	700307	NA	NA

\*Internal Characterization

**Notes:**

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

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### 3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

Measurement type presented in this report (Please see the checked box below):

#### Conducted

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

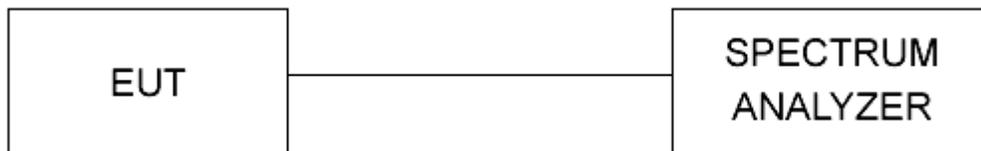


Figure 1 - Bandwidth Measurements Test Setup

#### Radiated

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

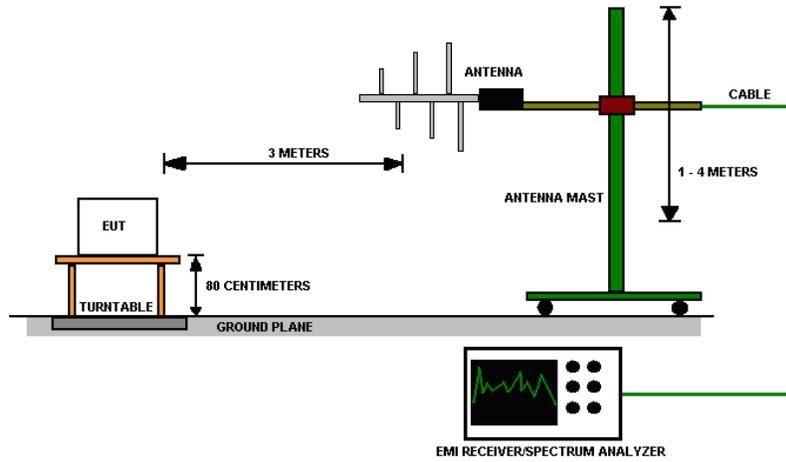


Figure 2 - Radiated Emissions Test Setup

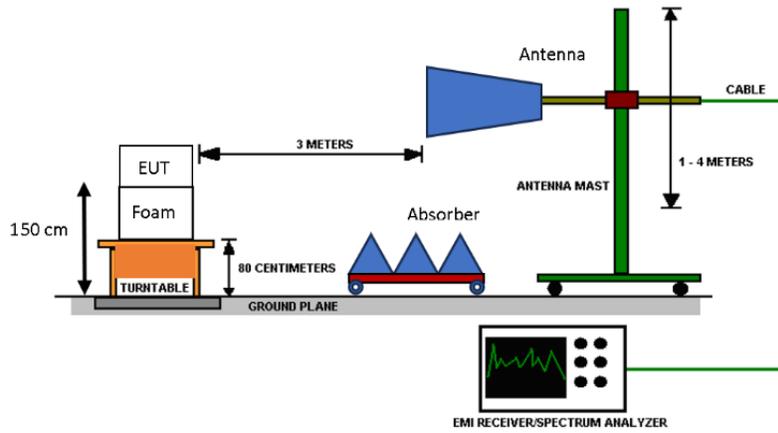


Figure 3 - Radiated Emissions Test Setup, >1GHz



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#### 4.0 RESULTS

DTS Radio Measurements					
CHANNEL	Transmitter	Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)	Peak PSD (dBm)	RESULT
Low	GMSK 1MB	1051.5	707.2	-19.001	PASS
Mid	GMSK 1MB	1050.1	710.6	-16.049	PASS
High	GMSK 1MB	1050.3	712.3	-16.245	PASS
Low	GMSK 2MB	2064.6	1189.0	-21.274	PASS
Mid	GMSK 2MB	2066.8	1187.0	-18.494	PASS
High	GMSK 2MB	2068.6	1188.0	-18.992	PASS
Occupied Bandwidth = N/A; 6 dB Bandwidth Limit >500kHz				PSD Limit = 8dBm	

DTS Power Measurements						
CHANNEL	Transmitter	Raw Avg Output Power (dBm)	DCCF (dB) (for Power)**	Corrected Avg Output Power(dBm)	Corrected Avg Output Power(mW)	RESULT
Low	GMSK 1MB	-4.29	1.03	-3.260	0.472	PASS
Mid	GMSK 1MB	-2.37	1.03	-1.340	0.735	PASS
High	GMSK 1MB	-2.78	1.03	-1.750	0.668	PASS
Low	GMSK 2MB	-5.35	0.97	-4.380	0.365	PASS
Mid	GMSK 2MB	-2.36	0.97	-1.390	0.726	PASS
High	GMSK 2MB	-2.73	0.97	-1.760	0.667	PASS
**See Section 4.3 for more information regarding DCCF						



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Peak Restricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Detector	Limit (dBuV/m @ 3m)	Margin	Result
Low	GMSK 1MB	2390.00	54.346	Peak	73.98	19.634	PASS
Low	GMSK 2MB	2390.00	49.691	Peak	73.98	24.289	PASS
High	GMSK 1MB	2483.50	55.913	Peak	73.98	18.067	PASS
High	GMSK 2MB	2483.50	54.577	Peak	73.98	19.403	PASS

\*Limit shown is the average limit taken from FCC Part 15.209

Average Restricted Band-Edge									
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Average Out of Band Level (dBuV/m @ 3m)	DCCF for Emissions (dB)**	Corrected Out of band level (dBuV/m @ 3m)	Meas. Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	GMSK 1MB	2390.00	42.736	2.07	44.806	Average	53.98	9.174	PASS
Low	GMSK 2MB	2390.00	38.195	1.94	40.135	Average	53.98	13.845	PASS
High	GMSK 1MB	2483.50	42.115	2.07	44.185	Average	53.98	9.795	PASS
High	GMSK 2MB	2483.50	39.688	1.94	41.628	Average	53.98	12.352	PASS

Corrected Out of band level = Average out of band level + DCCF for emissions

\*Limit shown is the average limit taken from FCC Part 15.209

\*\*See Section 4.3 for more information regarding DCCF

Entirety of restricted bands were investigated and found to be compliant, worst-case emissions were reported.

Unrestricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBm)	Relative Fundamental (dBm)	Delta (dB)	Min Delta (dB)	Result
Low	GMSK 1MB	2400.00	55.607	103.458	47.852	30.00	PASS
Low	GMSK 2MB	2400.00	71.616	103.616	32.00	30.00	PASS
High	GMSK 1MB	2483.50	53.751	106.160	52.409	30.00	PASS
High	GMSK 2MB	2483.50	53.628	106.155	52.527	30.00	PASS



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#### 4.1 OUTPUT POWER

**Test Method:**

All measurements were performed using section 11.9.2.2.4 from ANSI C63.10.

**Limits of power measurements:**

**For FCC Part 15.247 Device:**

The maximum allowed output power is 30 dBm.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

1. All the output power plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.



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## 4.2 BANDWIDTH

### Test Method:

All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

### Limits of bandwidth measurements:

#### For FCC Part 15.247 Device:

The 99% occupied bandwidth is for informational/documentary purposes only. The 6dB bandwidth of the signal must be greater than 500 kHz.

### Test procedures:

Details can be found in section 3.4 of this report.

### Deviations from test standard:

No deviation.

### Test setup:

Test setup details can be found in section 3.4 of this report.

### EUT operating conditions:

Details can be found in section 2.1 of this report.

### Test results:

## Pass

#### Comments:

1. All the bandwidth plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.

### 4.3 DUTY CYCLE

#### Test Method:

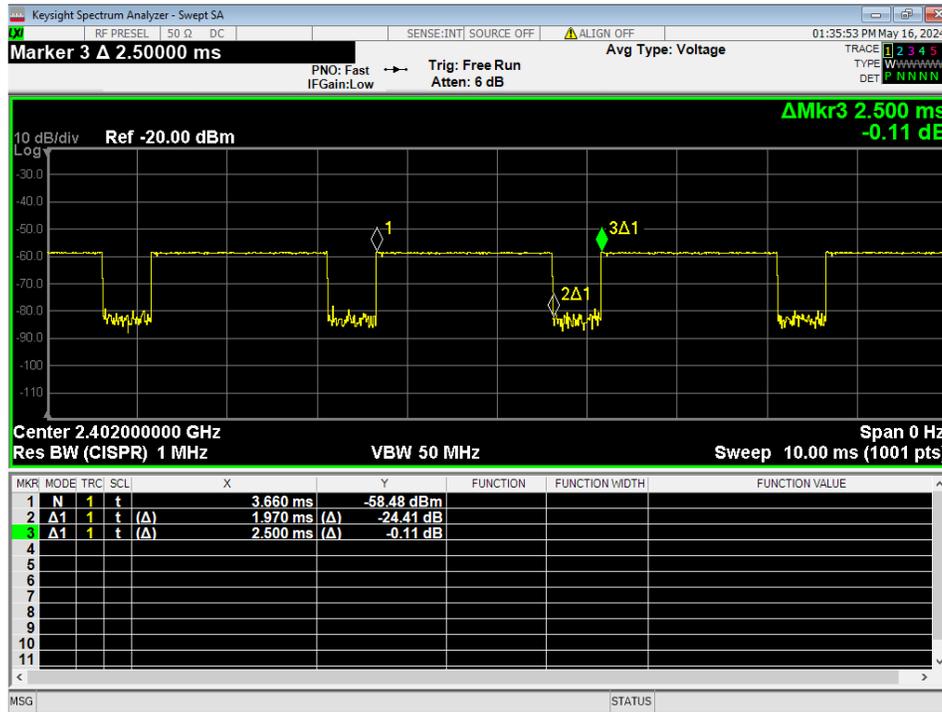


Figure 4 – Duty Cycle, GMSK 1MB

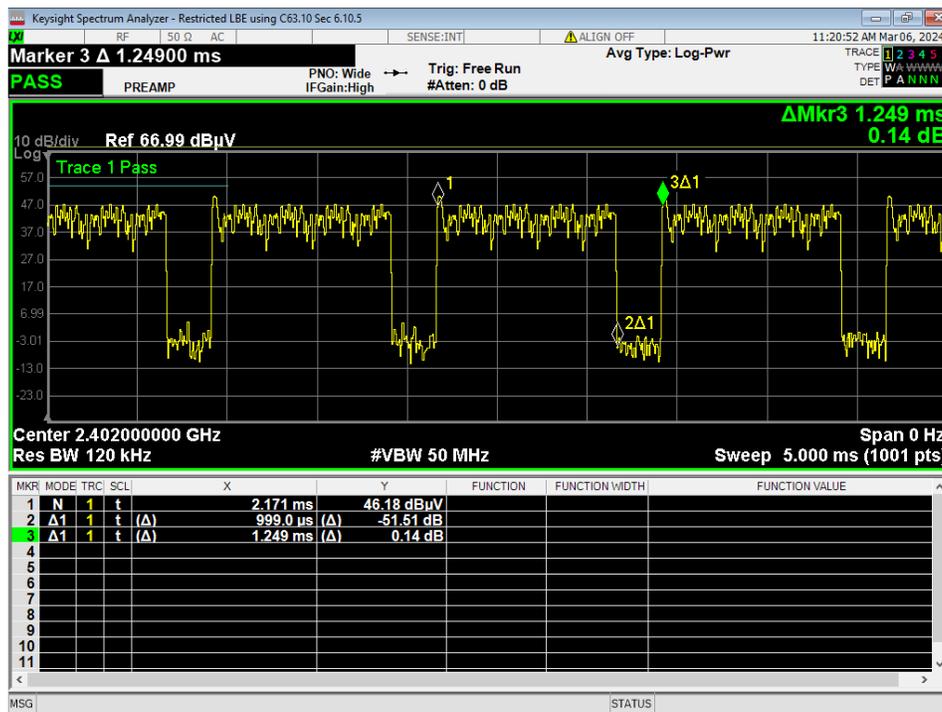


Figure 5 – Duty Cycle, GMSK 2MB



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Transmitter	DC	DCCF For Emissions	DCCF For Power
GMSK 1MB	0.788	2.07	1.03
GMSK 2MB	0.800	1.94	0.97

DC = ON Time / Period

DCCF For Emissions =  $20 \cdot \log(1/DC)$

DCCF For Power =  $10 \cdot \log(1/DC)$

**GMSK 1MB:**

DC =  $1.970/2.500 = 0.788$

DCCF For Emissions =  $20 \cdot \log(1/0.788) = 2.07\text{dB}$

DCCF For Power =  $10 \cdot \log(1/0.788) = 1.03\text{dB}$

**GMSK 2MB:**

DC =  $0.999/1.249 = 0.80$

DCCF For Emissions =  $20 \cdot \log(1/0.80) = 1.94\text{dB}$

DCCF For Power =  $10 \cdot \log(1/0.230) = 0.97\text{dB}$

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#### 4.4 RADIATED EMISSIONS

**Test Method:**

ANSI C63.10-2020, Section 6.5, 6.6

**Limits for radiated emissions measurements:**

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (µV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**NOTE:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 \* log \* Emission level (µV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worst-case emissions were produced while running off of USB power, so results from this mode are presented.



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**Test procedures:**

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.
- d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.
- e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

**NOTE:**

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.
- 2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

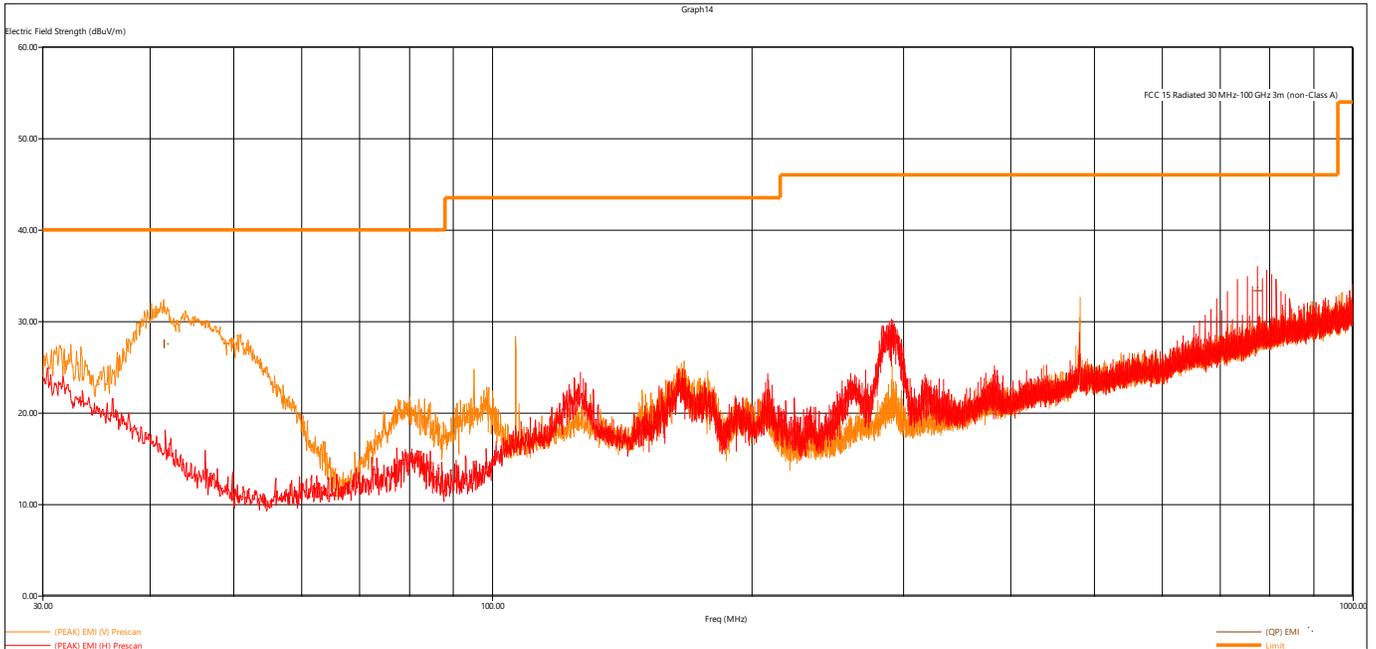
**Deviations from test standard:**

No deviation.

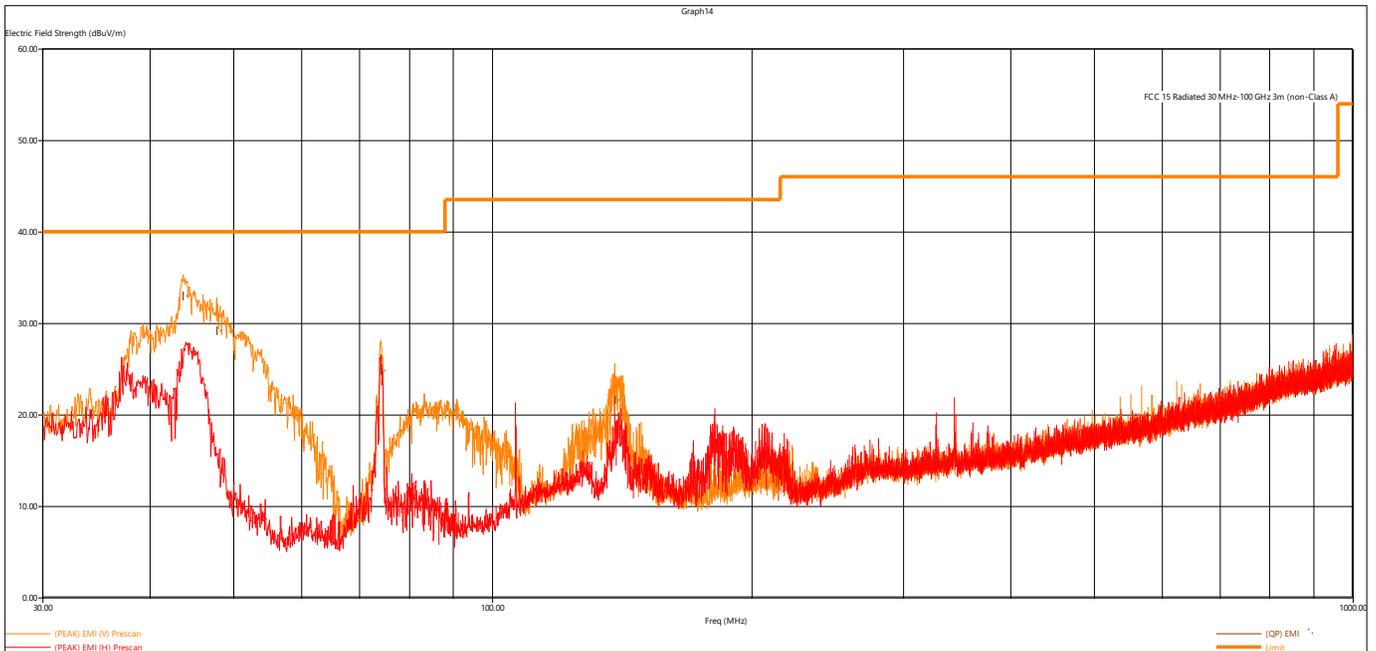
**EUT operating conditions**

Details can be found in section 2.1 of this report.

**Test results:**



**Figure 6 - Radiated Emissions Plot, Receive**



**Figure 7 - Radiated Emissions Plot, GMSK 1MB**

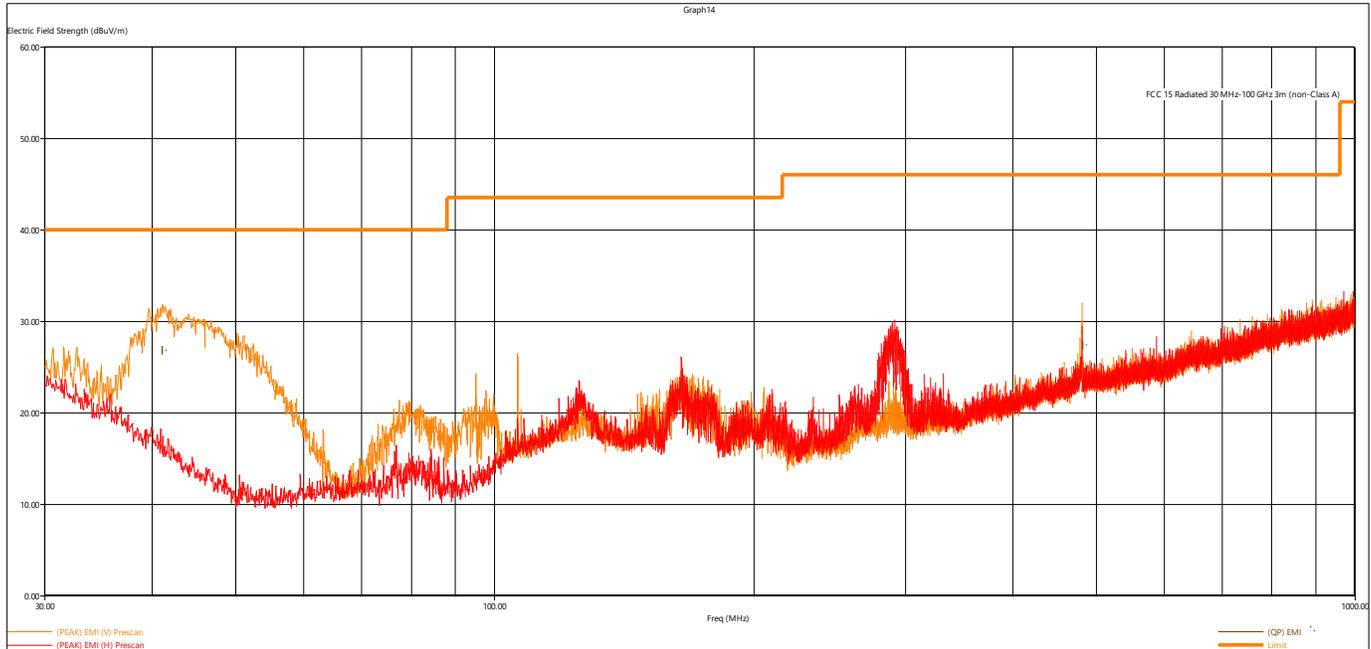


Figure 8 - Radiated Emissions Plot, GMSK 2MB

**REMARKS:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level

Quasi-Peak Measurements								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
43.870080	32.92	40.00	7.08	109.02	276.75	V	Mid	BLE 1MB
47.901840	29.16	40.00	10.84	111.17	358.25	V	Mid	BLE 1MB
73.999200	24.79	40.00	15.21	171.35	290.00	V	Mid	BLE 1MB
138.645120	21.55	43.52	21.97	108.97	54.50	V	Mid	BLE 1MB
40.973760	26.80	40.00	13.20	112.23	106.50	V	Mid	BLE 2MB
481.218000	27.32	46.02	18.70	107.82	9.00	V	Mid	BLE 2MB
773.878320	33.26	46.02	12.76	113.01	228.50	H		Rx
41.514480	27.48	40.00	12.52	104.29	117.00	V		Rx

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above. All other measurements were found to be at least 6 dB below the limit.



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Peak Measurements, BLE								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB $\mu$ V/m	dB $\mu$ V/m	dB	cm.	deg.			
4881.292000	39.71	73.98	34.27	330.76	238.25	H	Mid	BLE 1MB
7319.880000	56.25	73.98	17.73	245.02	54.25	V	Mid	BLE 1MB
4959.646000	44.40	73.98	29.58	322.64	237.00	H	High	BLE 1MB
7440.148000	53.63	73.98	20.35	131.47	52.75	V	High	BLE 1MB
7318.486000	57.80	73.98	16.18	238.08	38.25	V	Mid	BLE 2MB
7321.354000	57.21	73.98	16.77	181.37	38.25	V	Mid	BLE 2MB
7438.484000	54.22	73.98	19.76	128.65	26.50	V	High	BLE 2MB

Average Measurements, BLE										
Frequency	Level	DCCF	Corrected Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB $\mu$ V/m	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	cm.	deg.			
4881.292000	26.28	2.07	28.35	53.98	27.70	330.76	238.25	H	Mid	BLE 1MB
7319.880000	45.01	2.07	47.08	53.98	8.97	245.02	54.25	V	Mid	BLE 1MB
4959.646000	33.93	2.07	36.00	53.98	20.05	322.64	237.00	H	High	BLE 1MB
7440.148000	42.36	2.07	44.43	53.98	11.62	131.47	52.75	V	High	BLE 1MB
7318.486000	46.23	1.94	48.17	53.98	7.75	238.08	38.25	V	Mid	BLE 2MB
<b>7321.354000</b>	<b>46.83</b>	<b>1.94</b>	<b>48.77</b>	<b>53.98</b>	<b>7.15</b>	<b>181.37</b>	<b>38.25</b>	<b>V</b>	<b>Mid</b>	<b>BLE 2MB</b>
7438.484000	42.14	1.94	44.08	53.98	11.84	128.65	26.50	V	High	BLE 2MB



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#### 4.5 CONDUCTED SPURIOUS EMISSIONS

**Test Method:**

ANSI C63.10-2020, Section 6.7

**Limits of spurious emissions:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

**Test procedures:**

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 30dB below the fundamental. More details can be found in section 3.4 of this report.

**Deviations from test standard:**

None.

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

Note that the line shown on the plot(s) is not a limit line. It is a line for reference.

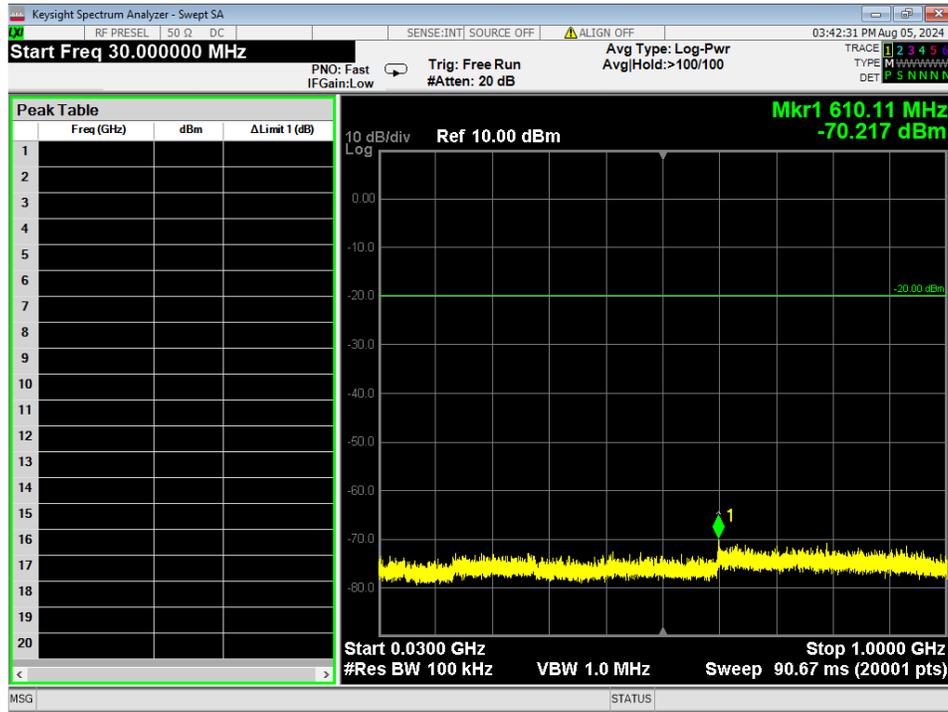


Figure 9 - Conducted Spurious emissions, GMSK 1MB, 30MHz – 1GHz, Mid

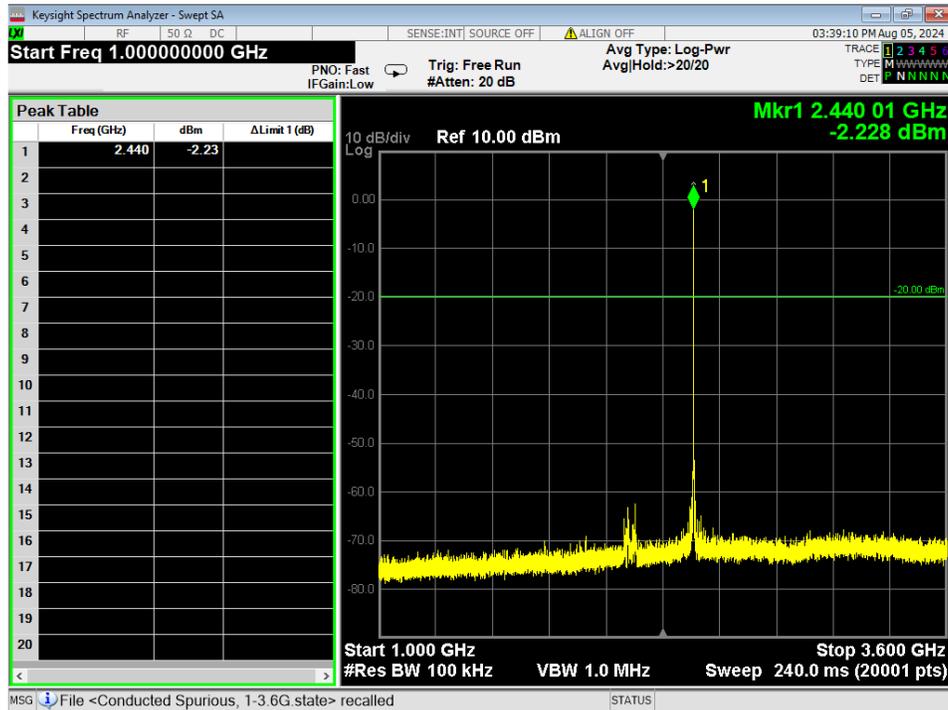


Figure 10 - Conducted Spurious emissions, GMSK 1MB, 1GHz – 3.6GHz, Mid

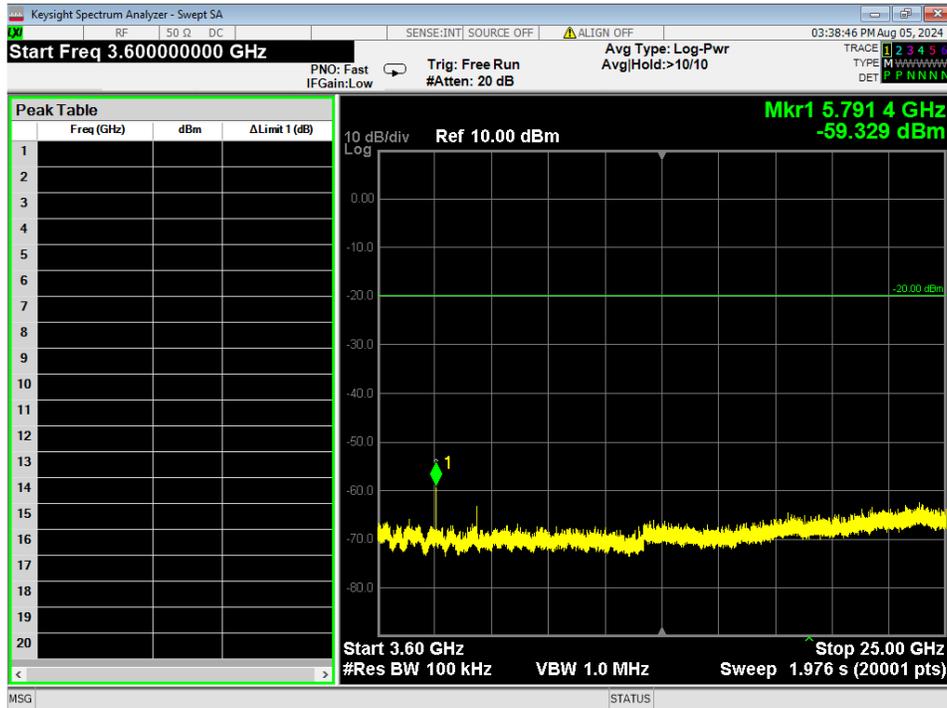


Figure 11 - Conducted Spurious emissions, GMSK 1MB, 3.6GHz – 25GHz, Mid

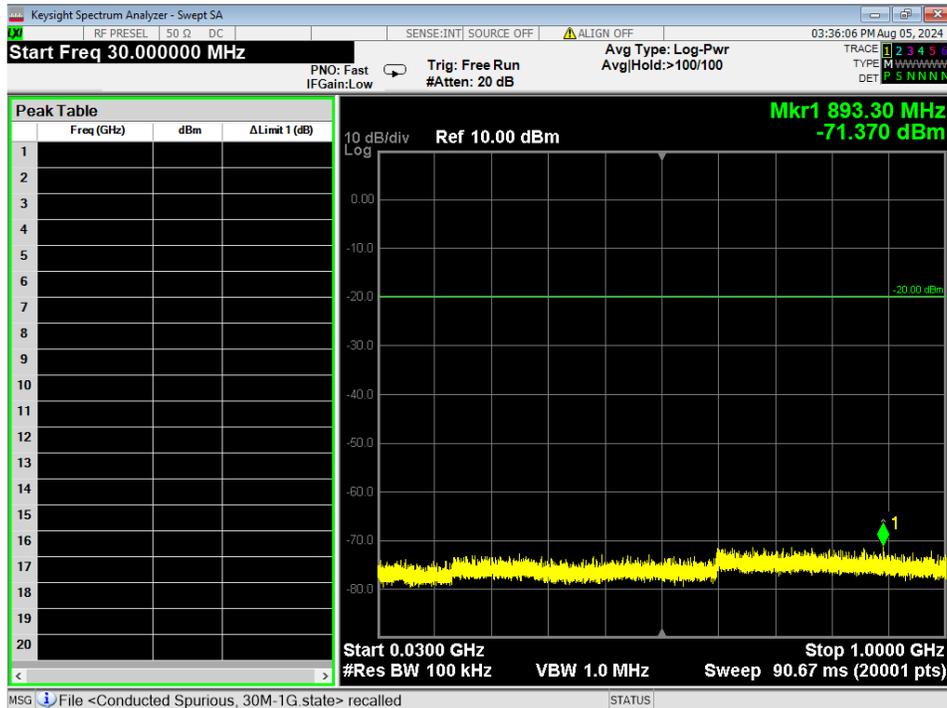


Figure 12 - Conducted Spurious emissions, GMSK 2MB, 30MHz – 1GHz, Mid

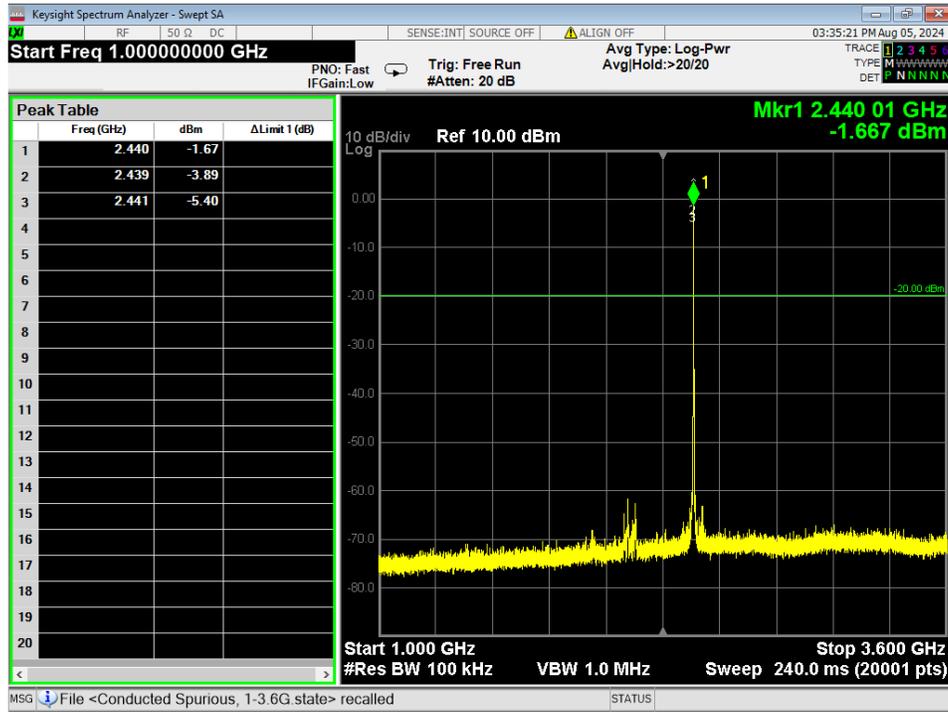


Figure 13 – Conducted Spurious emissions, GMSK 2MB, 1GHz – 3.6GHz, Mid

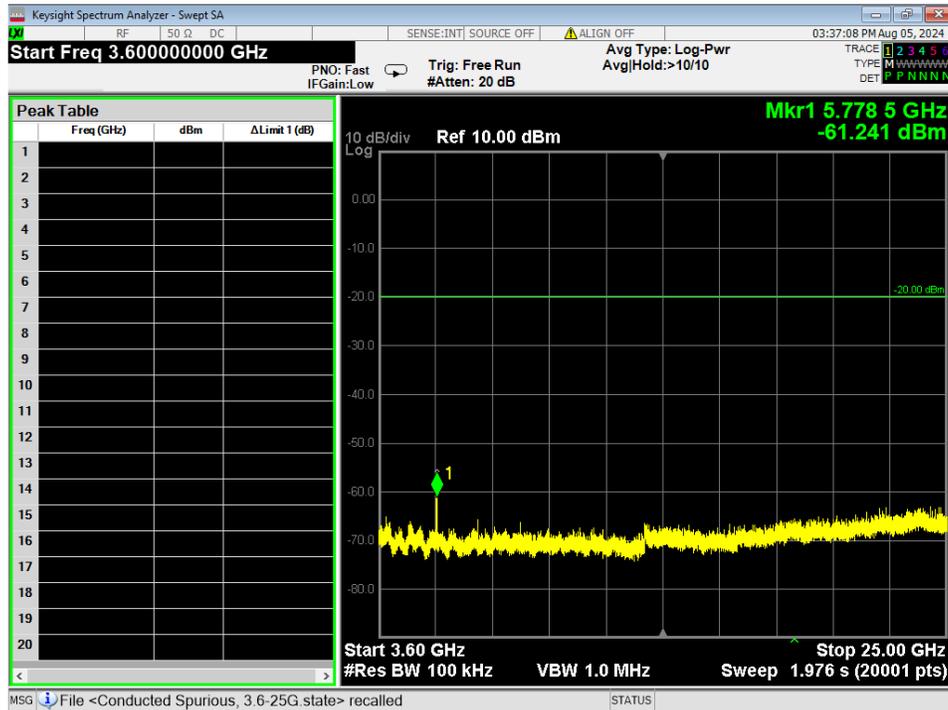


Figure 14 - Conducted Spurious emissions, GMSK 2MB, 3.6GHz – 25GHz, Mid

#### 4.6 BAND EDGES



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**Test Method:**

All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of band-edge measurements:**

**For FCC Part 15.247 Device:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

**Test procedures:**

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.



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**Test results:**

**Pass**

Comments:

1. All the band edge plots can be found in Appendix C.
2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 30 dB between peak and the band edge.
3. The restricted band edge compliance is shown by comparing it to the general limit defined in Part 15.209.
4. Tabulated data is listed in section 4.0.



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## 4.7 POWER SPECTRAL DENSITY

### Test Method:

All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

### Limits of power measurements:

#### For FCC Part 15.247 Device:

The maximum PSD allowed is 8 dBm.

### Test procedures:

Details can be found in section 3.4 of this report.

### Deviations from test standard:

No deviation.

### Test setup:

Details can be found in section 3.4 of this report.

### EUT operating conditions:

Details can be found in section 2.1 of this report.

### Test results:

## Pass

#### Comments:

1. All the Power Spectral Density (PSD) plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.



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## 4.8 CONDUCTED AC MAINS EMISSIONS

### Test Method:

ANSI C63.10-2020, Section(s) 6.2

### Limits for conducted emissions measurements:

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

### Notes:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

### Test Procedures:

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

### Deviation from the test standard:

No deviation

### EUT operating conditions:

Details can be found in section 2.1 of this report.

Test Results:

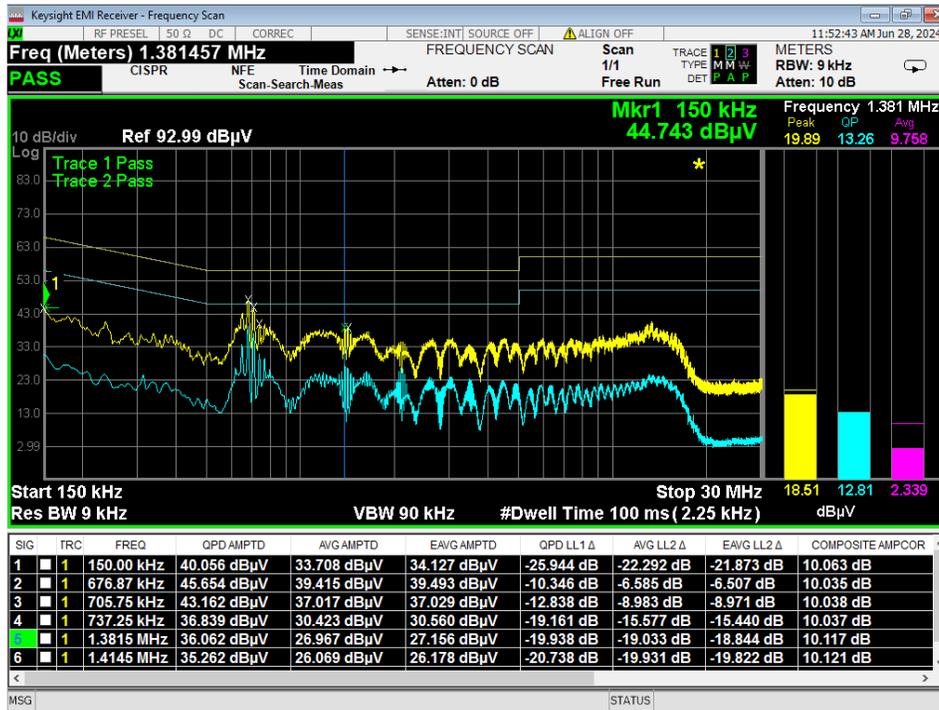


Figure 15 - Conducted Emissions Plot, Line, TX

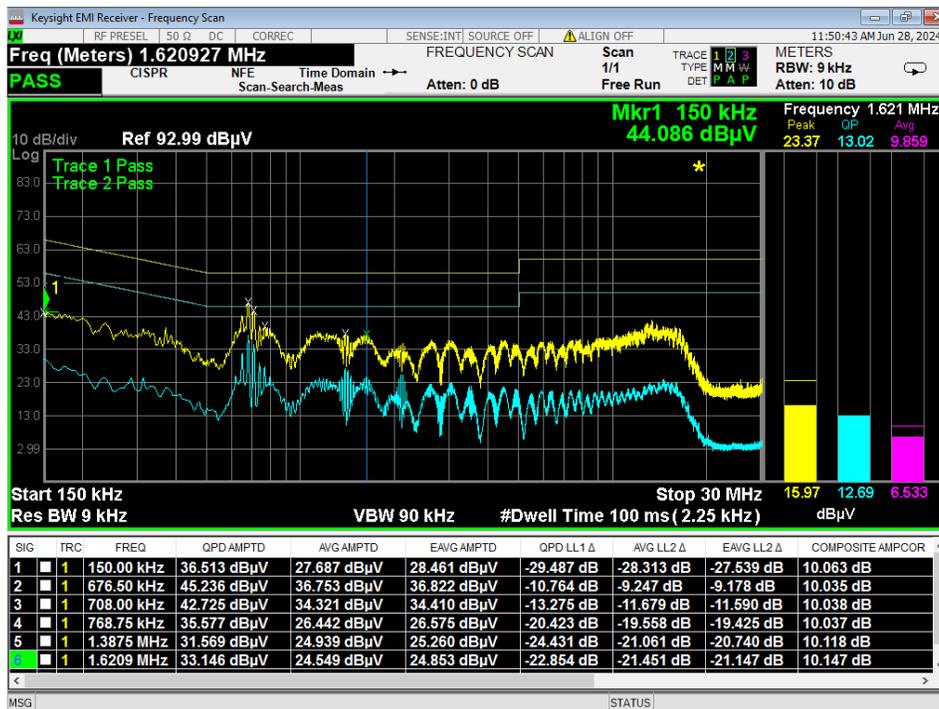


Figure 16 - Conducted Emissions Plot, Neutral, TX



Figure 17 - Conducted Emissions Plot, Line, IDLE

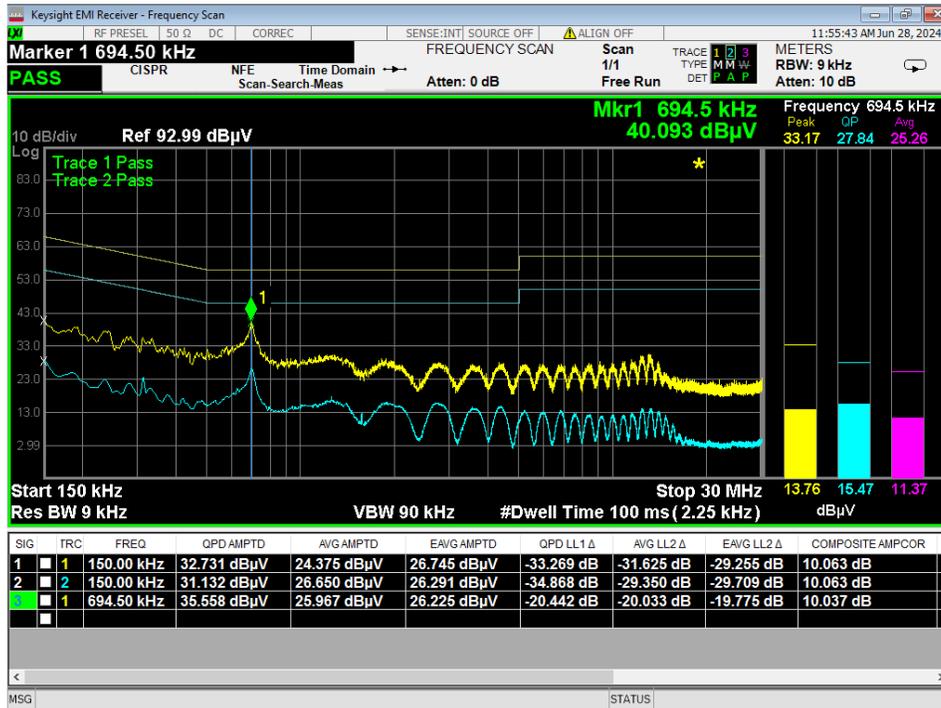


Figure 18 - Conducted Emissions Plot, Neutral, IDLE



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**APPENDIX A: SAMPLE CALCULATION**

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor, Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF - (-CF + AG) + AV$$

- where FS = Field Strength
- RA = Receiver Amplitude
- AF = Antenna Factor
- CF = Cable Attenuation Factor
- AG = Amplifier Gain
- AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB $\mu$ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB $\mu$ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.  
Level in  $\mu$ V/m = Common Antilogarithm [(48.1 dB $\mu$ V/m)/20]= 254.1  $\mu$ V/m  
AV is calculated by taking the 20\*log(T<sub>on</sub>/100) where T<sub>on</sub> is the maximum transmission time in any 100ms window.

**EIRP Calculations**

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

*EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]<sup>2</sup> / 30*  
*Power (watts) = 10<sup>[Power (dBm)/10]</sup> / 1000*  
*Voltage (dB $\mu$ V) = Power (dBm) + 107 (for 50 $\Omega$  measurement systems)*  
*Field Strength (V/m) = 10<sup>[Field Strength (dB $\mu$ V/m) / 20]</sup> / 10<sup>6</sup>*  
*Gain = 1 (numeric gain for isotropic radiator)*  
*Conversion from 3m field strength to EIRP (d=3):*

*EIRP = [FS(V/m) x d<sup>2</sup>]/30 = FS [0.3] for d = 3*  
*EIRP(dBm) = FS(dB $\mu$ V/m) - 10(log 10<sup>9</sup>) + 10log[0.3] = FS(dB $\mu$ V/m) - 95.23*  
*10log( 10<sup>9</sup>) is the conversion from micro to milli*



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APPENDIX B – MEASUREMENT UNCERTAINTY

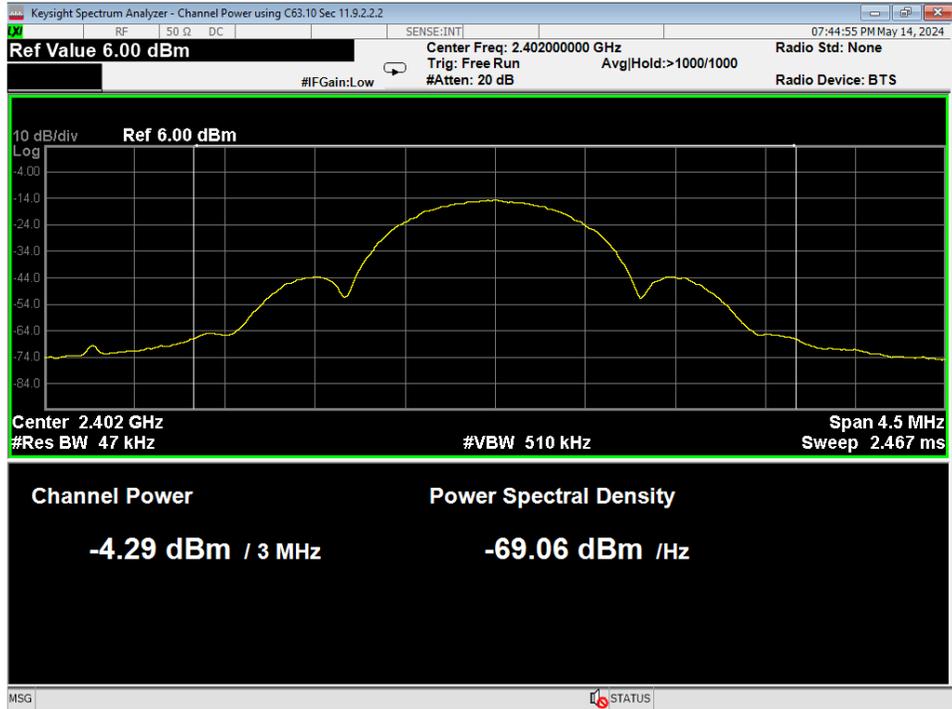
NCEE Labs does not add uncertainty values to levels/measurements.

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

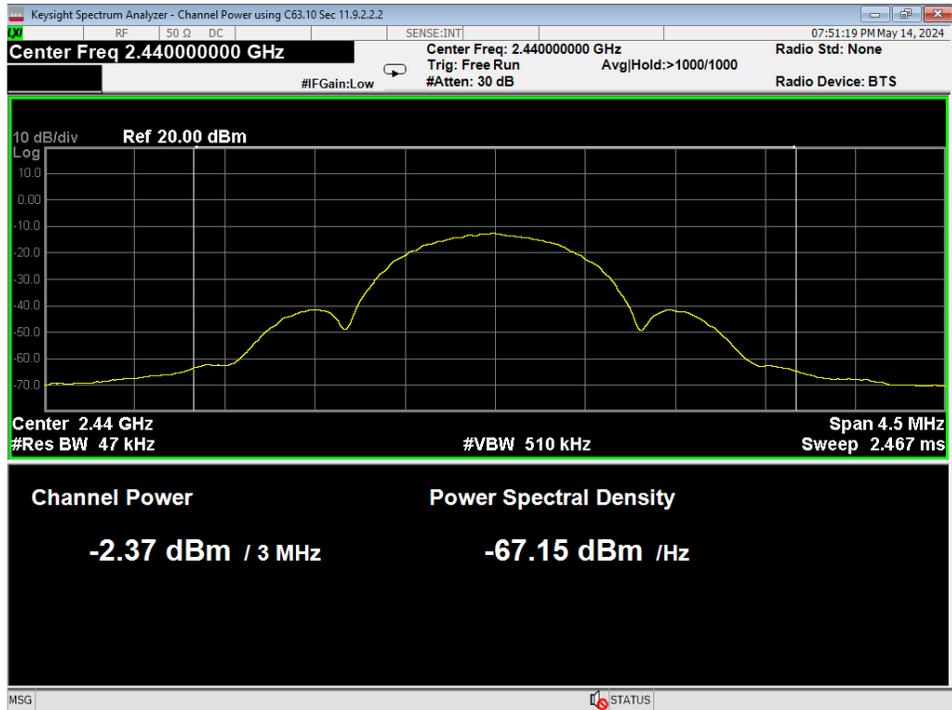
Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	±4.31
Radiated Emissions, 3m	1GHz - 18GHz	±5.08
Emissions limits, conducted	30MHz – 18GHz	±3.03

Expanded uncertainty values are calculated to a confidence level of 95%.

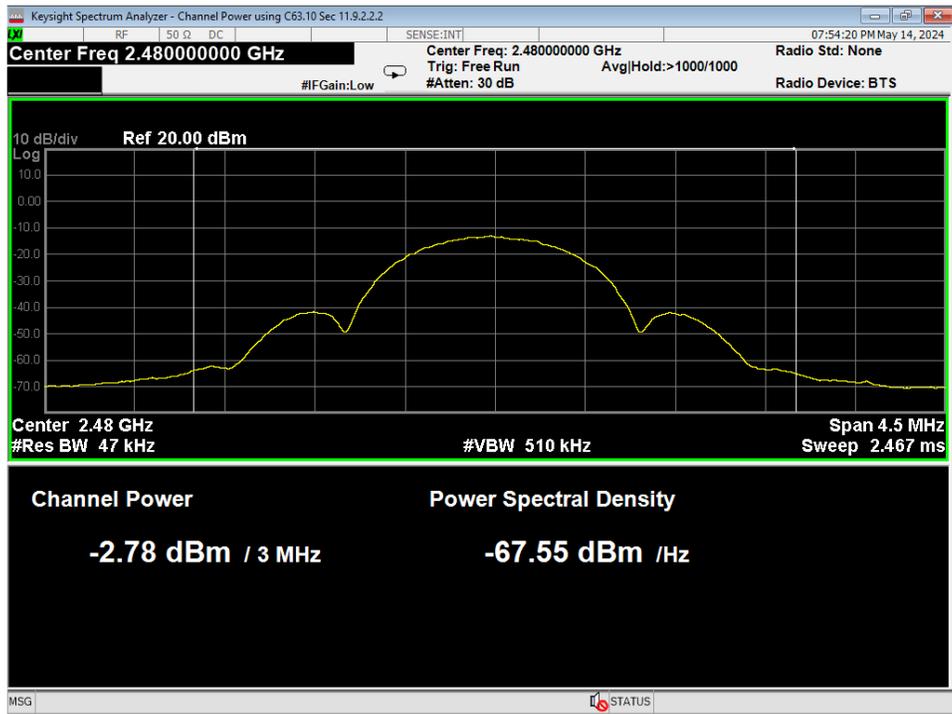
### APPENDIX C – GRAPHS AND TABLES



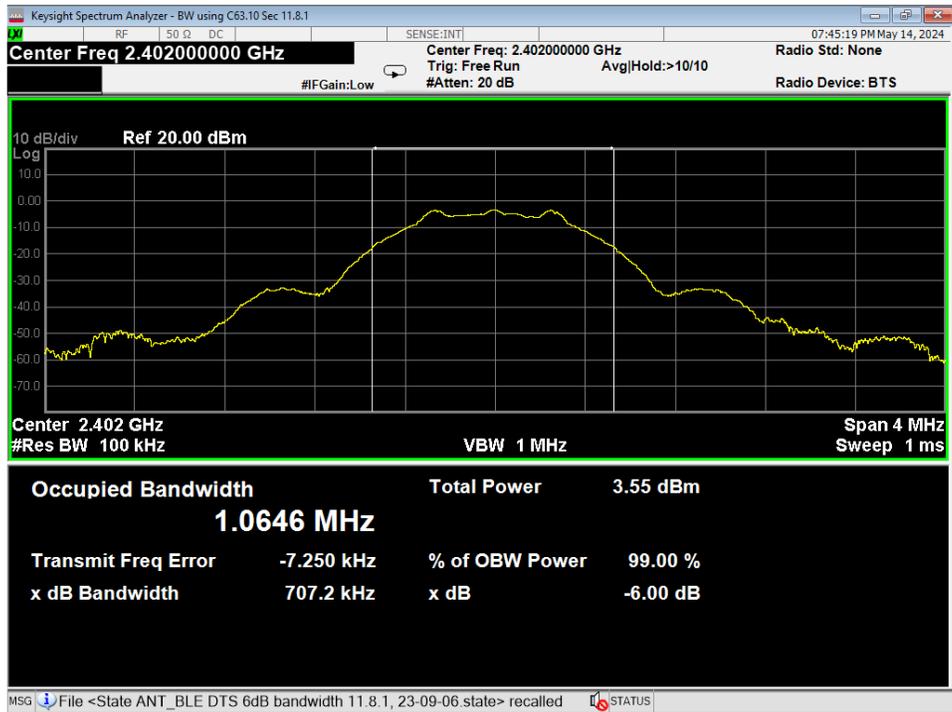
**01 Average Power, Low Channel, GMSK 1MB**



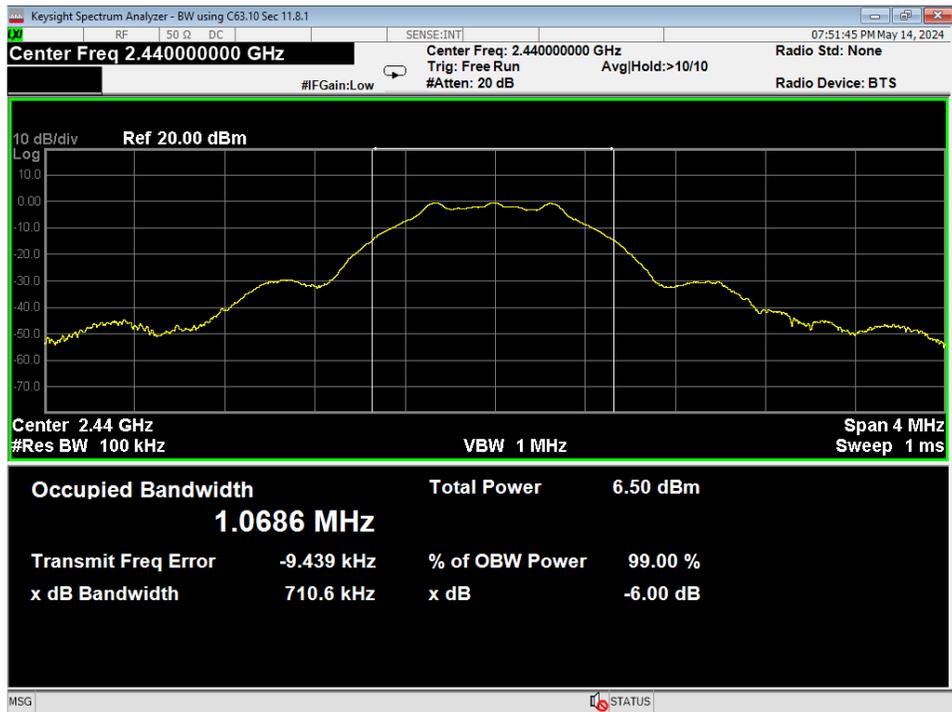
**02 Average Power, Mid Channel, GMSK 1MB**



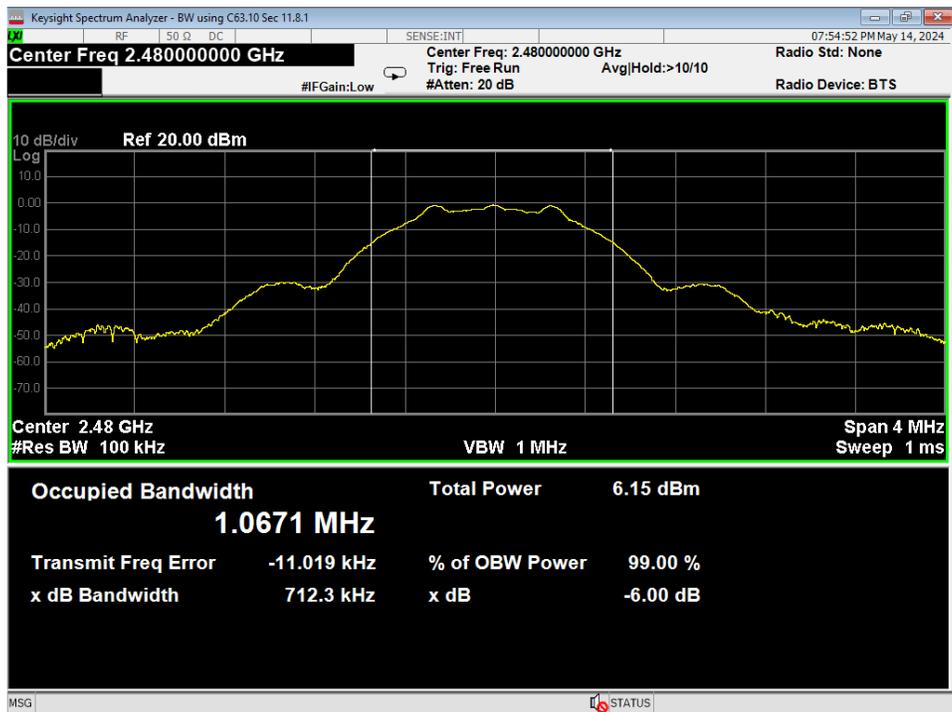
03 Average Power, High Channel, GMSK 1MB



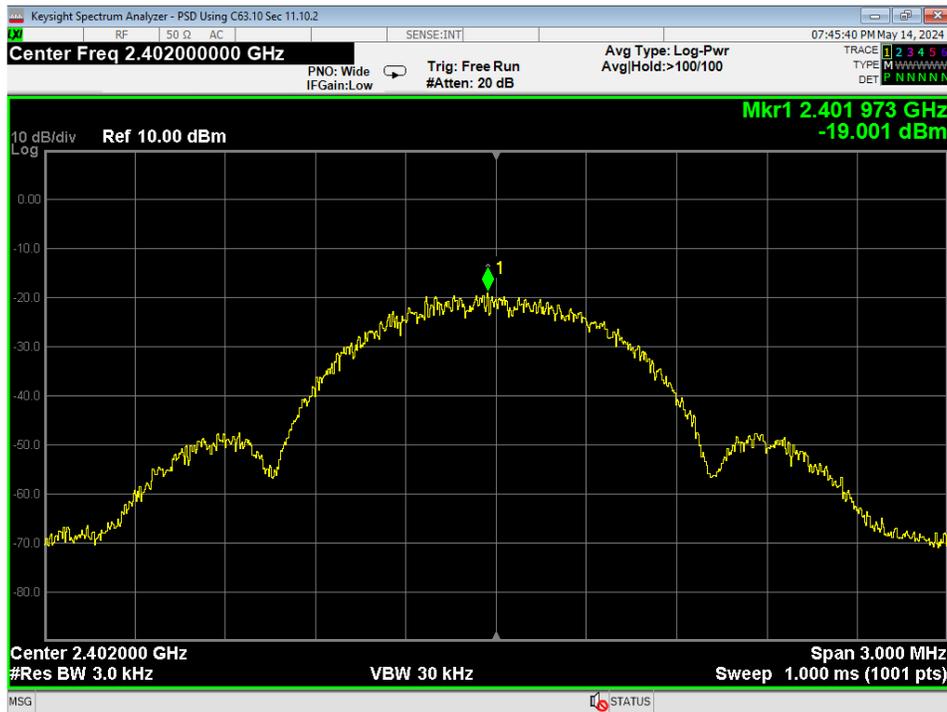
04 6dB Bandwidth, Low Channel, GMSK 1MB



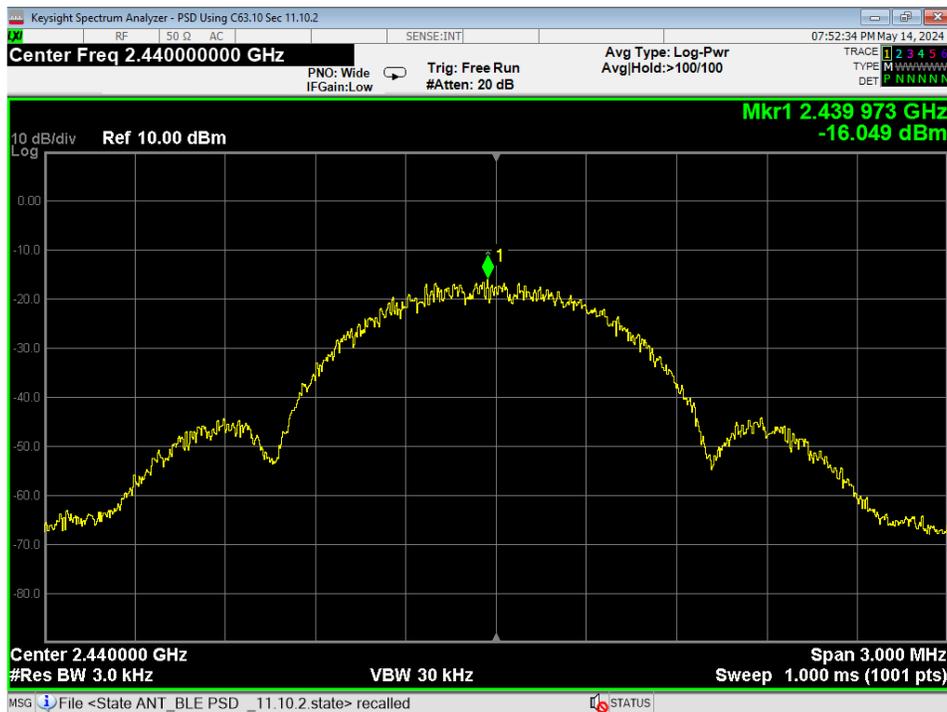
05 6dB Bandwidth, Mid Channel, GMSK 1MB



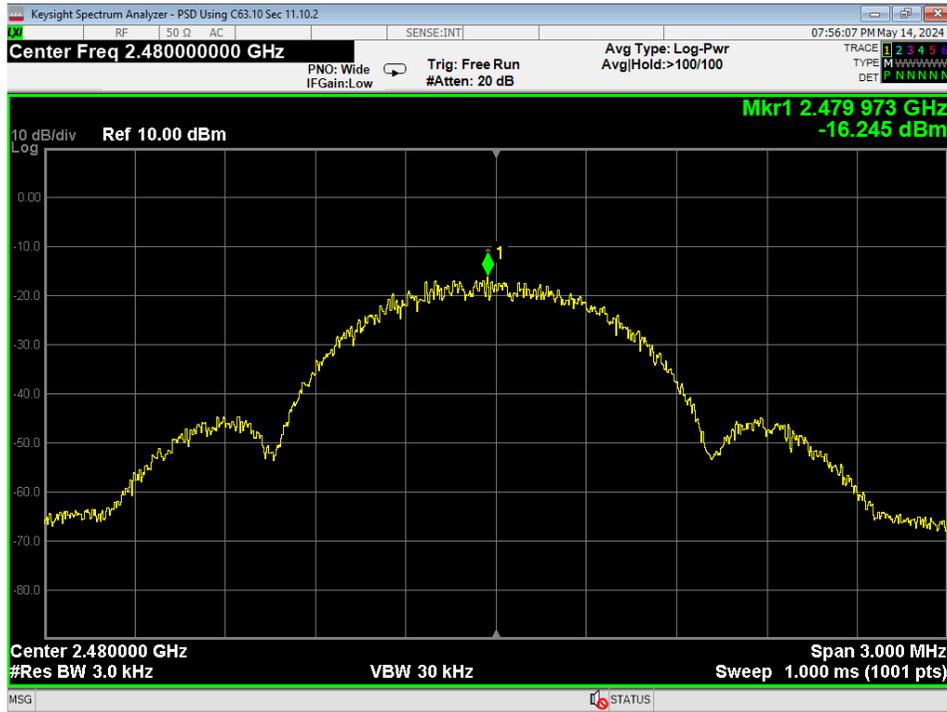
06 6dB Bandwidth, High Channel, GMSK 1MB



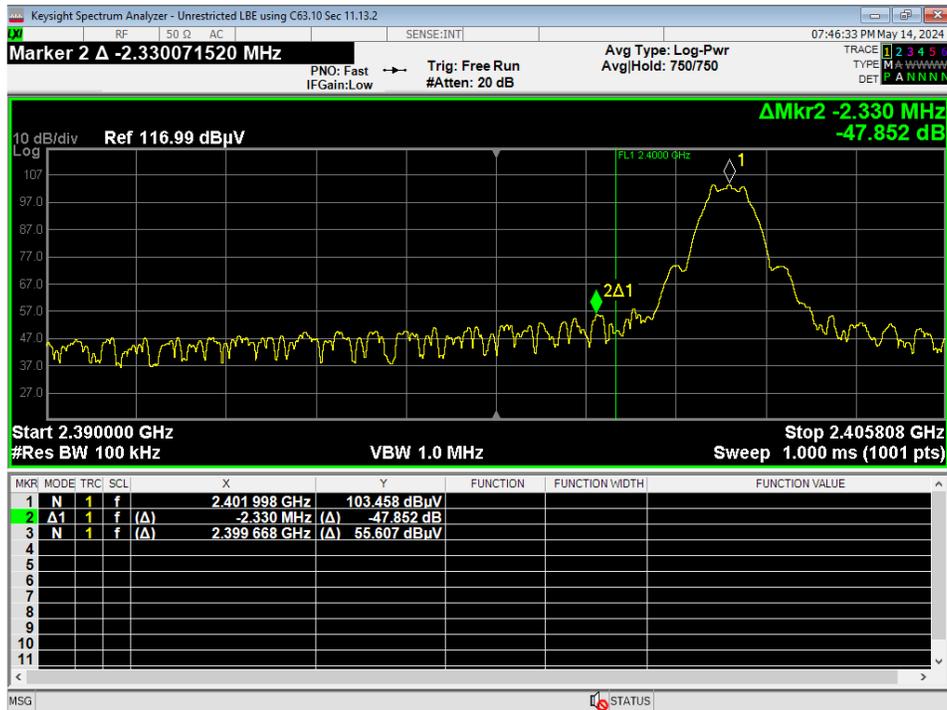
07 PSD, Low Channel, GMSK 1MB



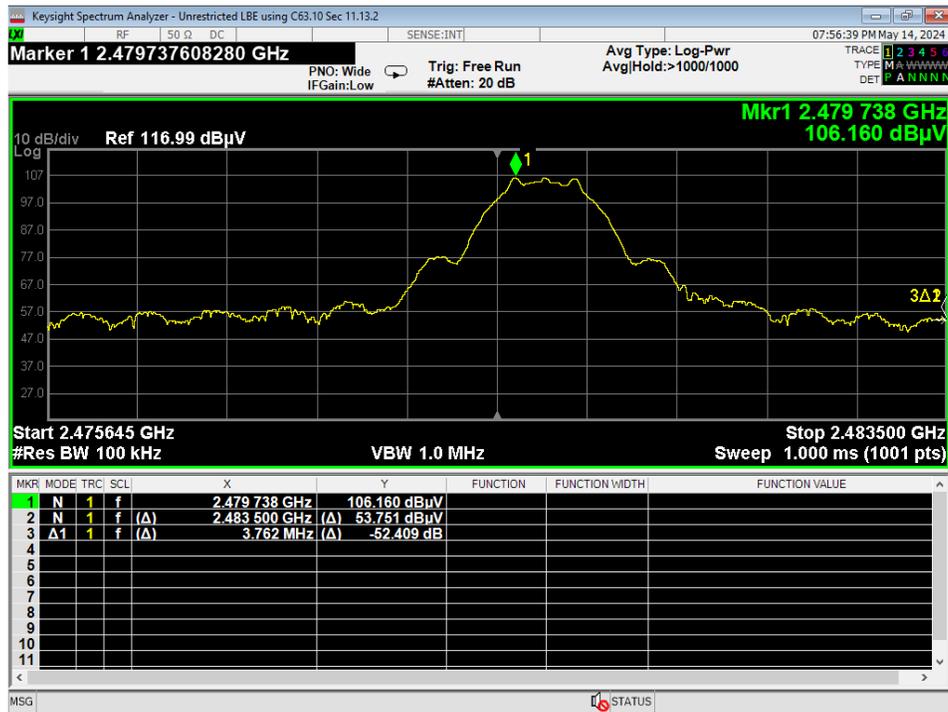
08 PSD, Mid Channel, GMSK 1MB



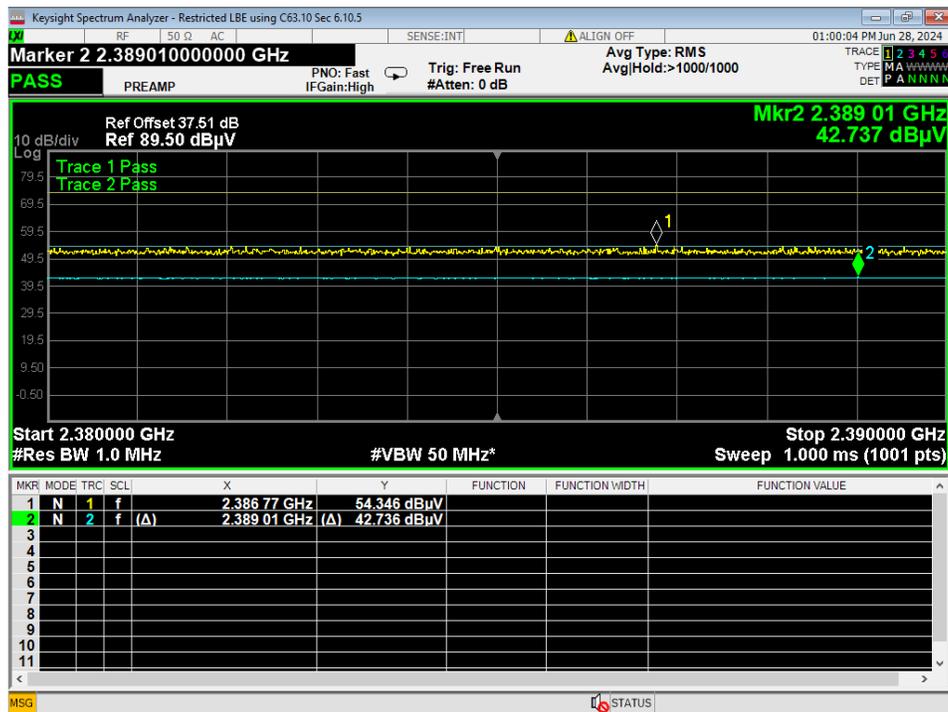
09 PSD, High Channel, GMSK 1MB



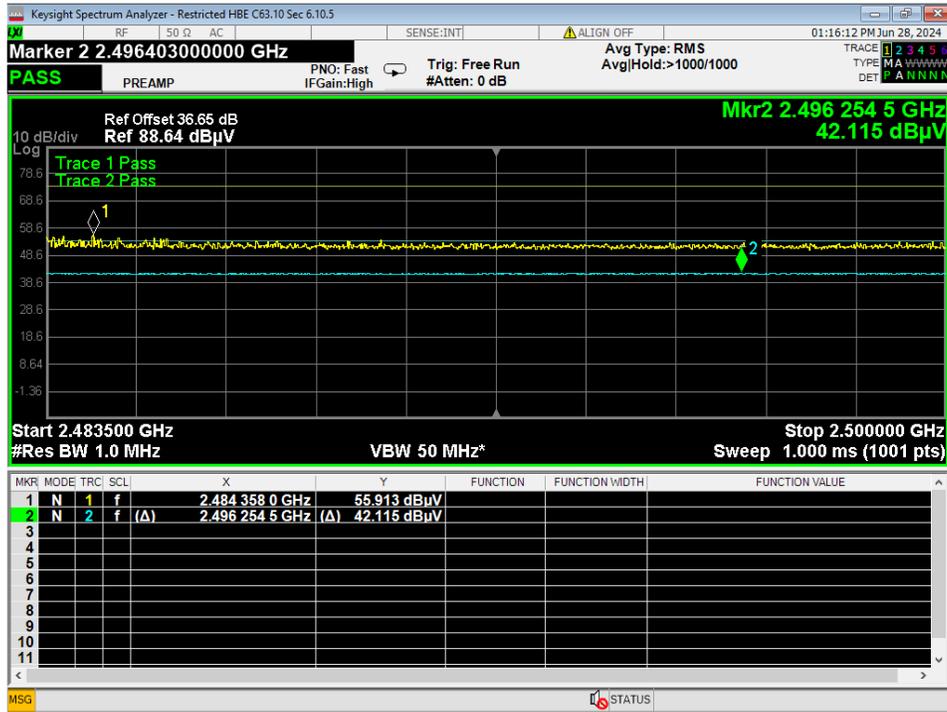
10 Lower Bandedge, Unrestricted, GMSK 1MB



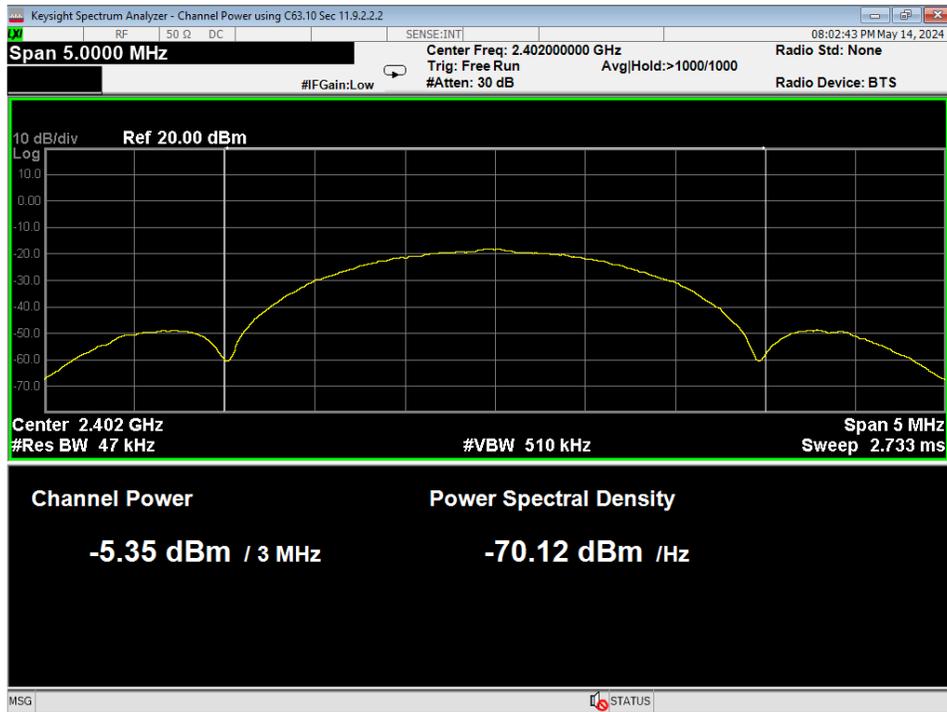
11 Higher Bandedge, Unrestricted, GMSK 1MB



12 Lower Bandedge, Restricted, GMSK 1MB



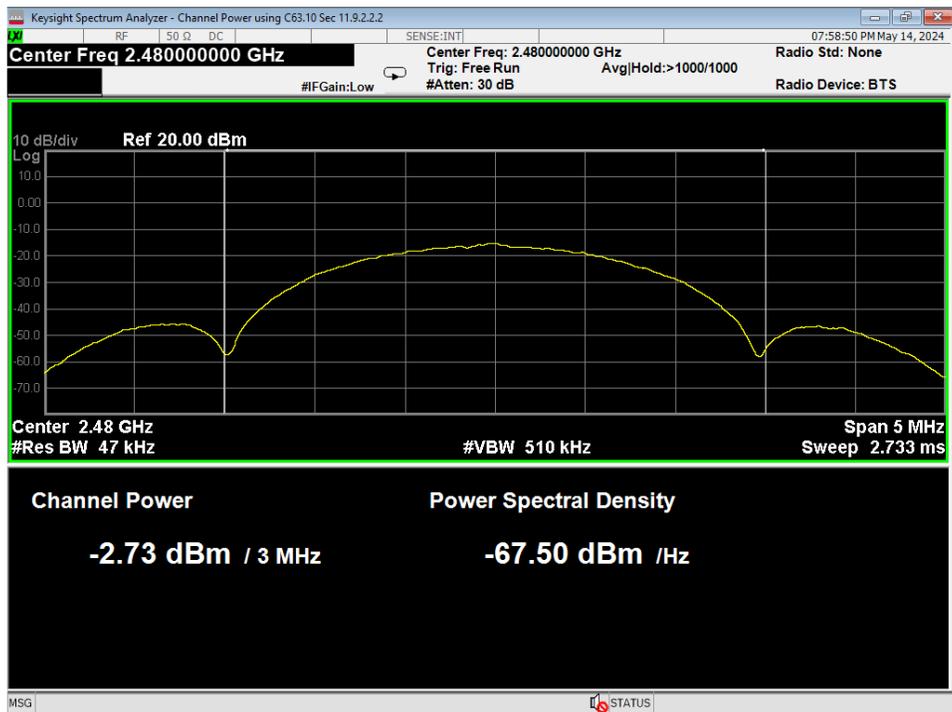
13 Higher Bandedge, Restricted, GMSK 1MB



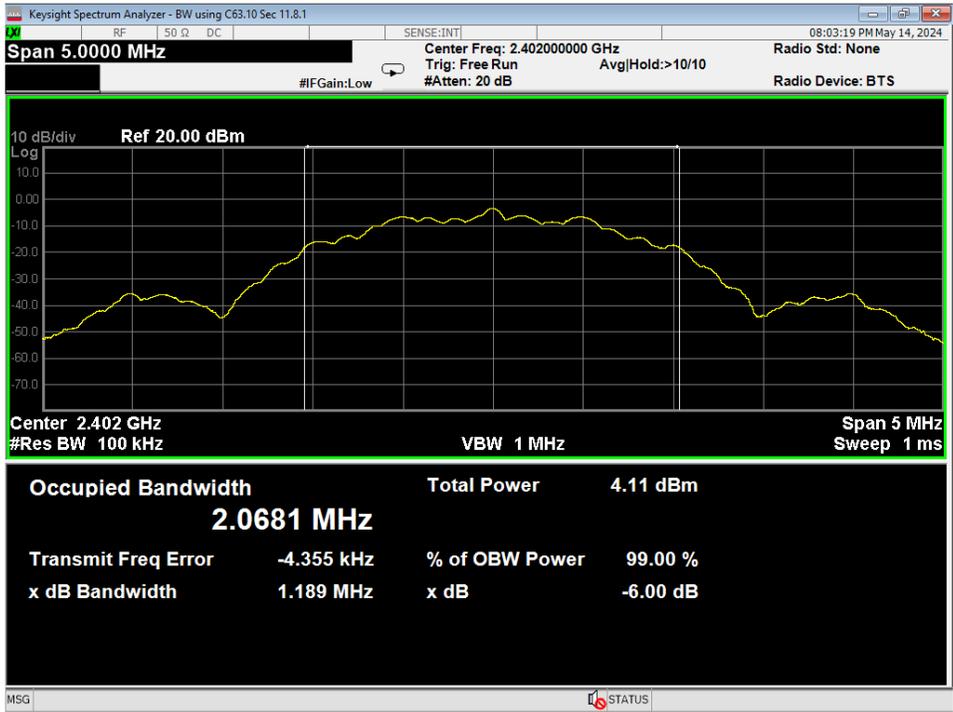
14 Average Power, Low Channel, GMSK 2MB



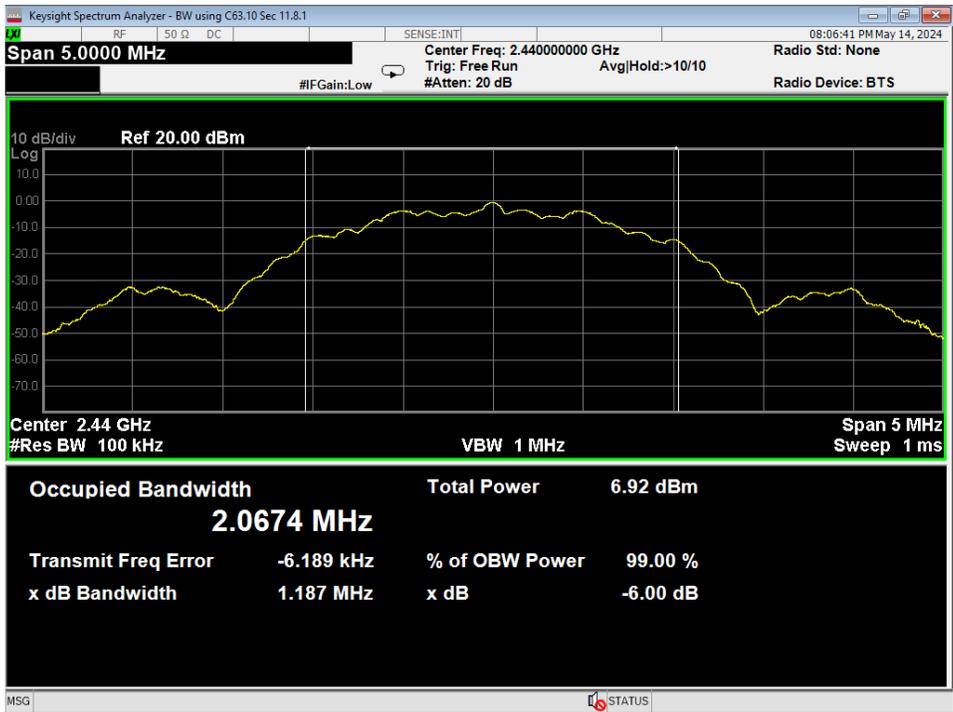
15 Average Power, Mid Channel, GMSK 2MB



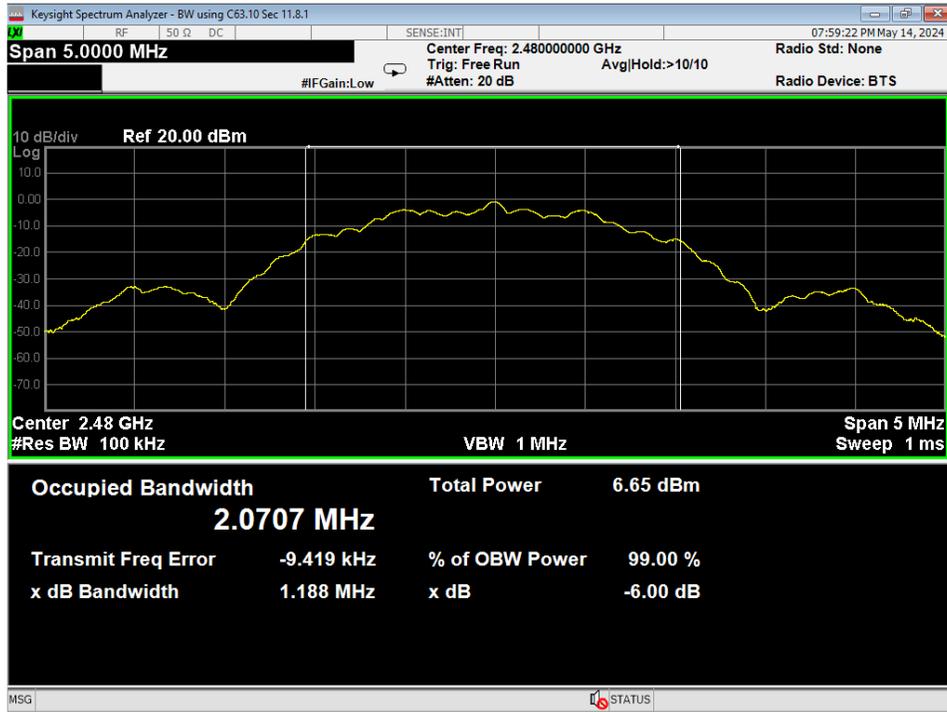
16 Average Power, High Channel, GMSK 2MB



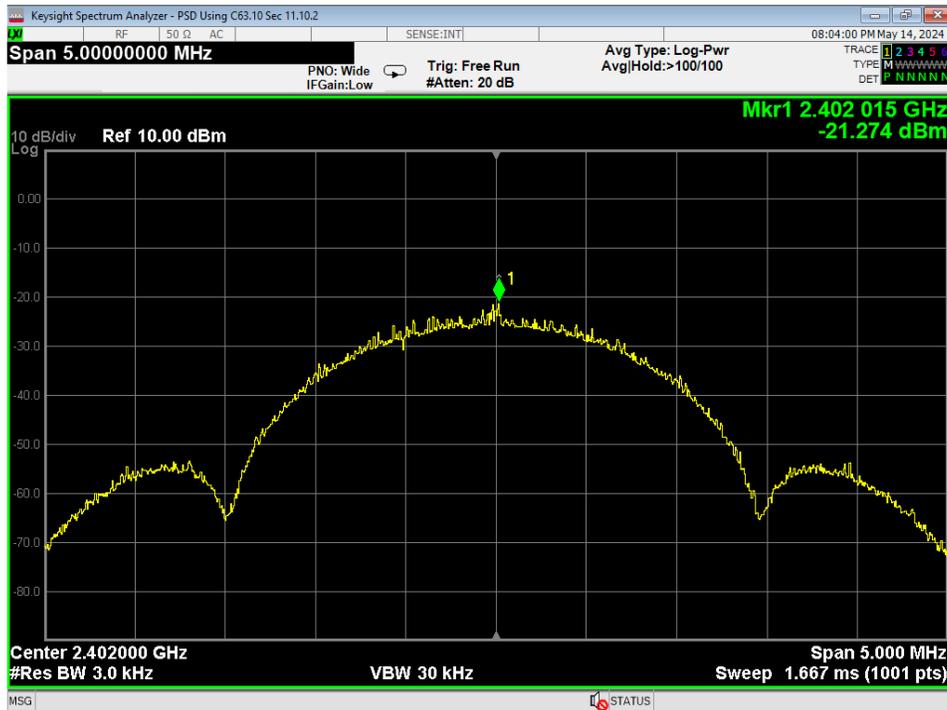
17 6dB Bandwidth, Low Channel, GMSK 2MB



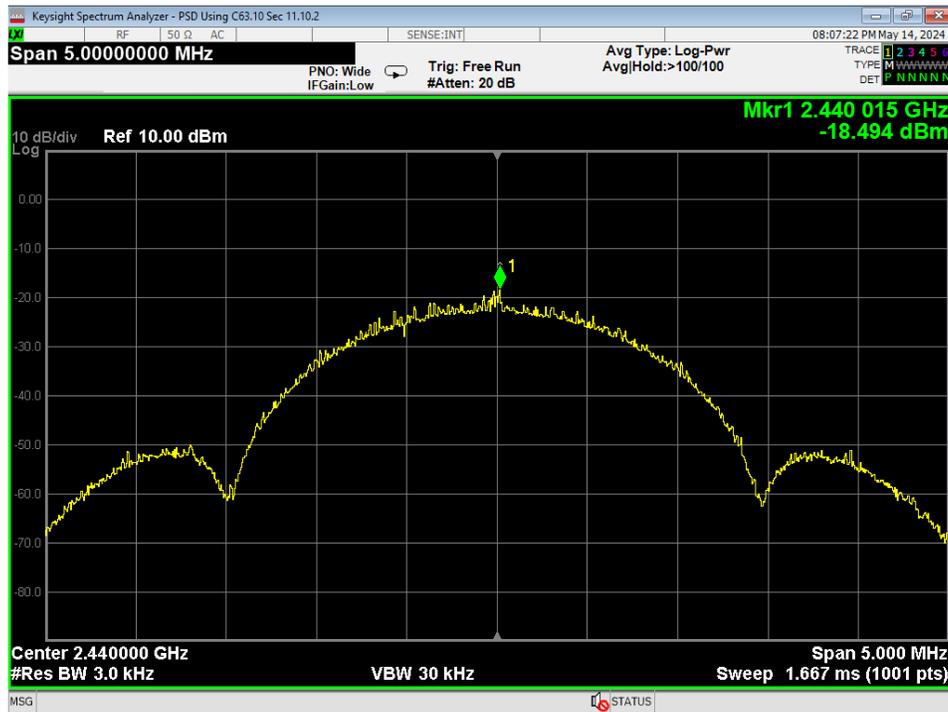
18 6dB Bandwidth, Mid Channel, GMSK 2MB



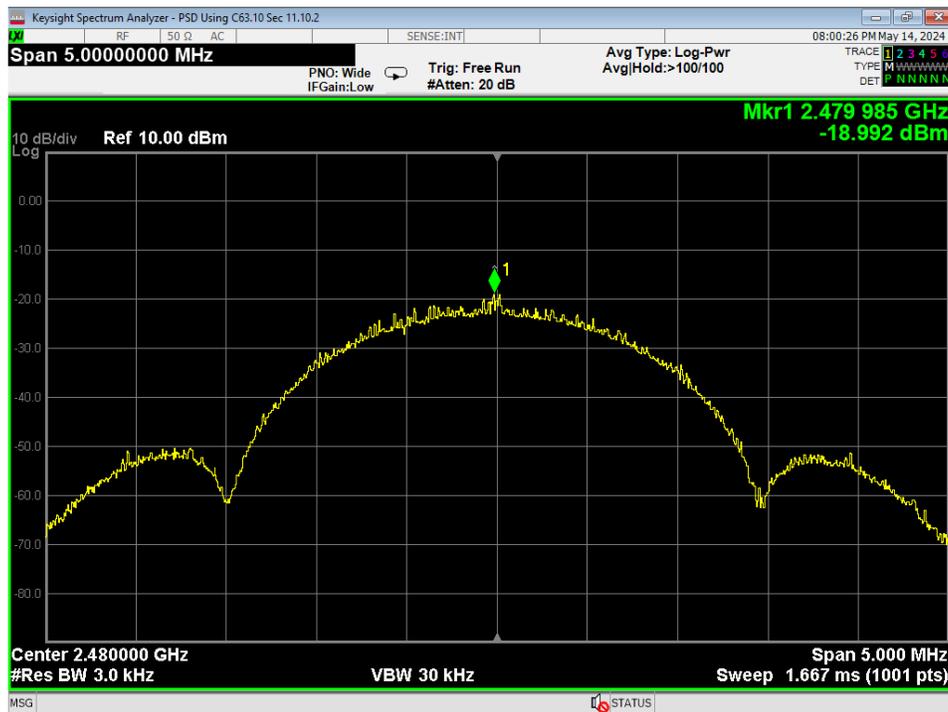
19 6dB Bandwidth, High Channel, GMSK 2MB



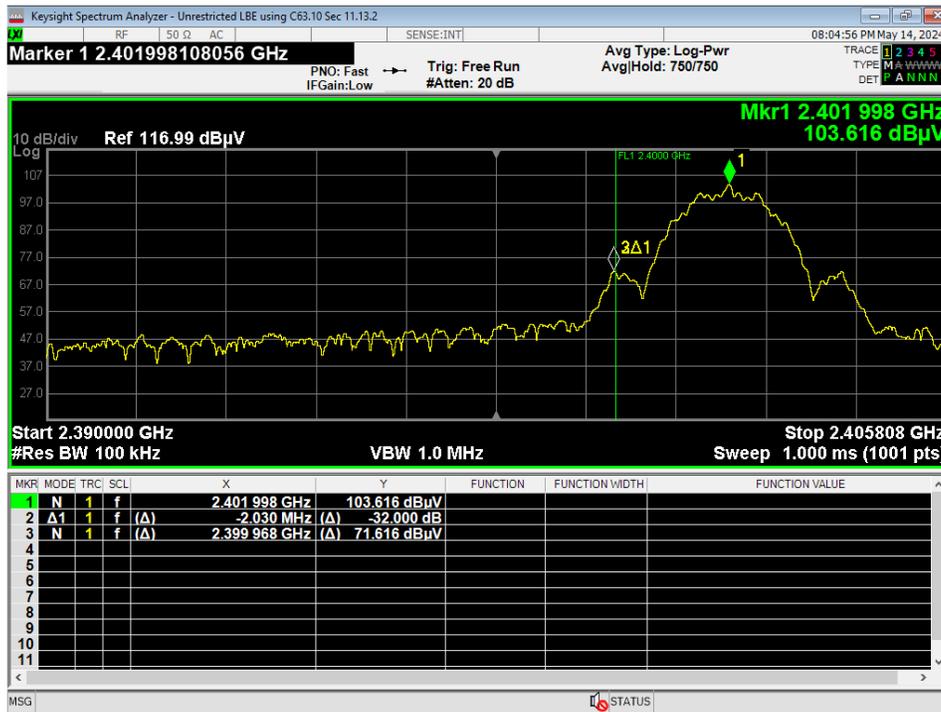
20 PSD, Low Channel, GMSK 2MB



21 PSD, Mid Channel, GMSK 2MB



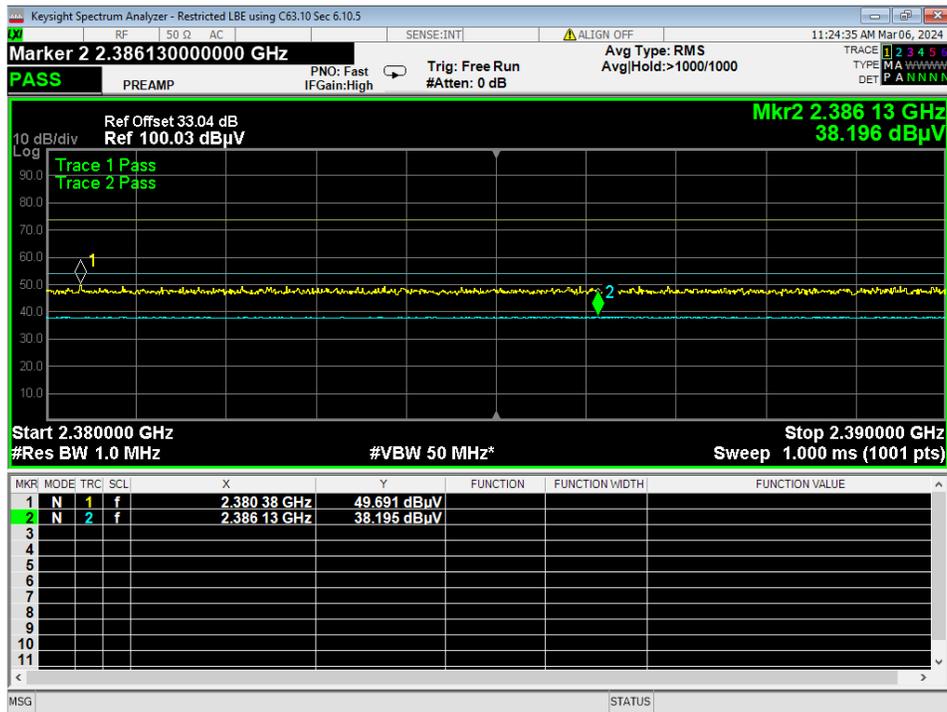
22 PSD, High Channel, GMSK 2MB



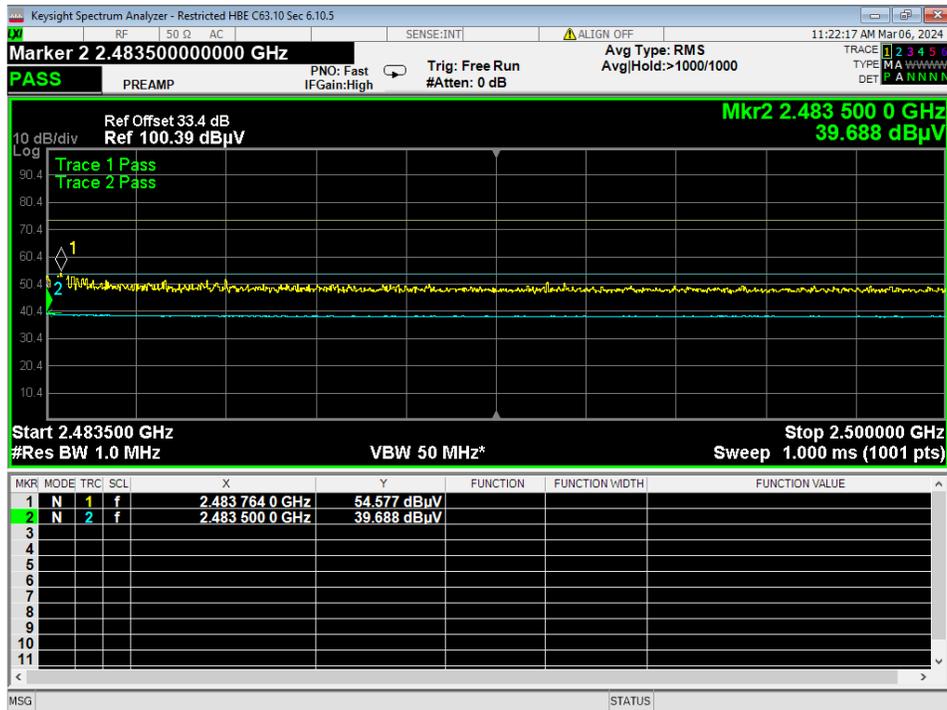
23 Lower Bandedge, Unrestricted, GMSK 2MB



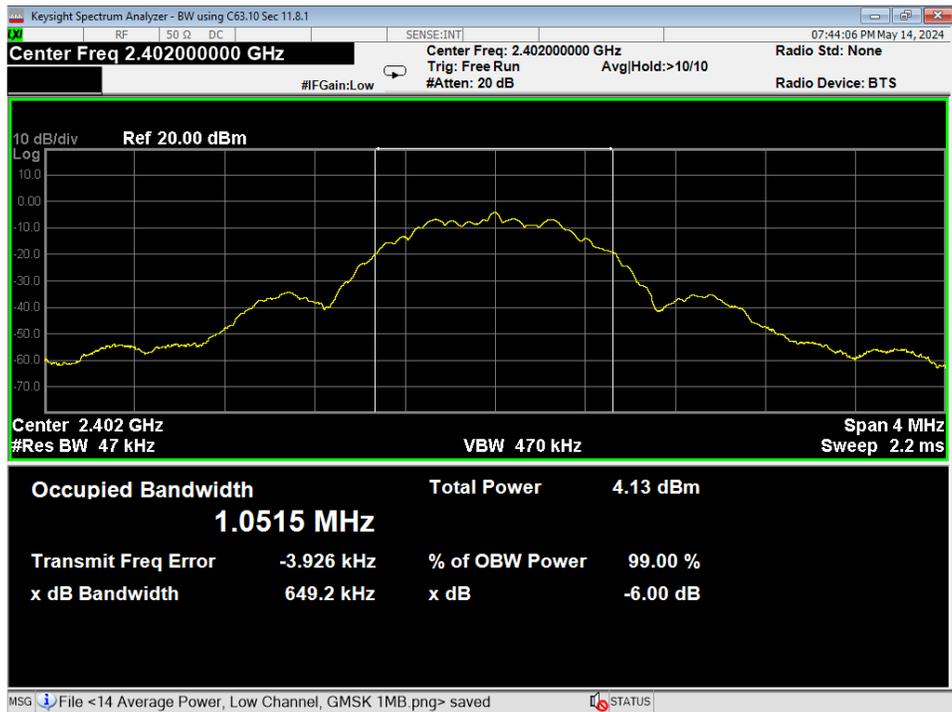
24 Higher Bandedge, Unrestricted, GMSK 2MB



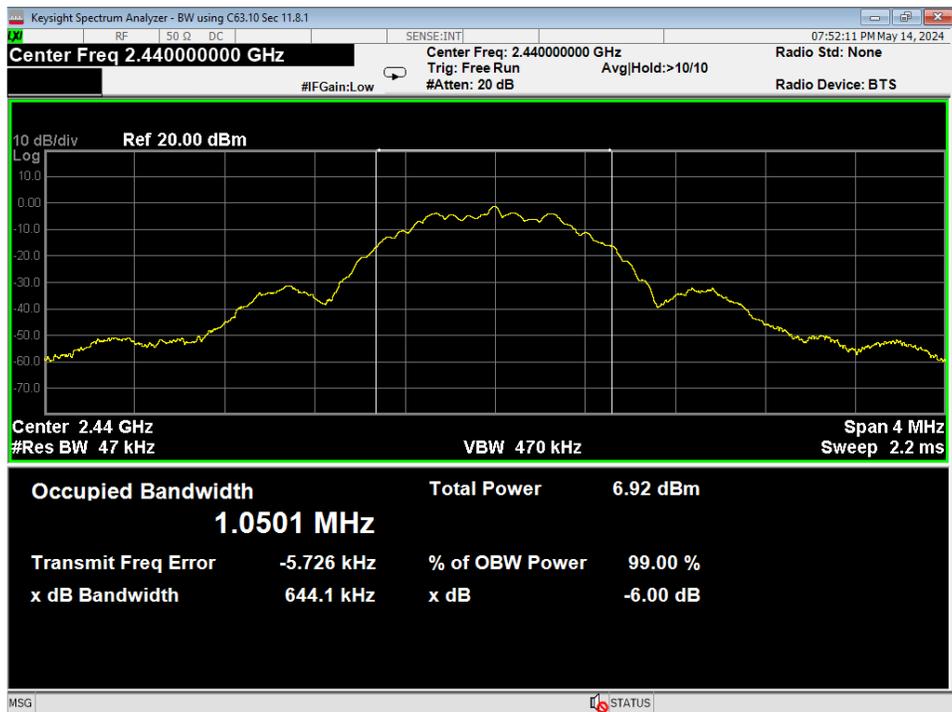
25 Lower Bandedge, Restricted, GMSK 2MB



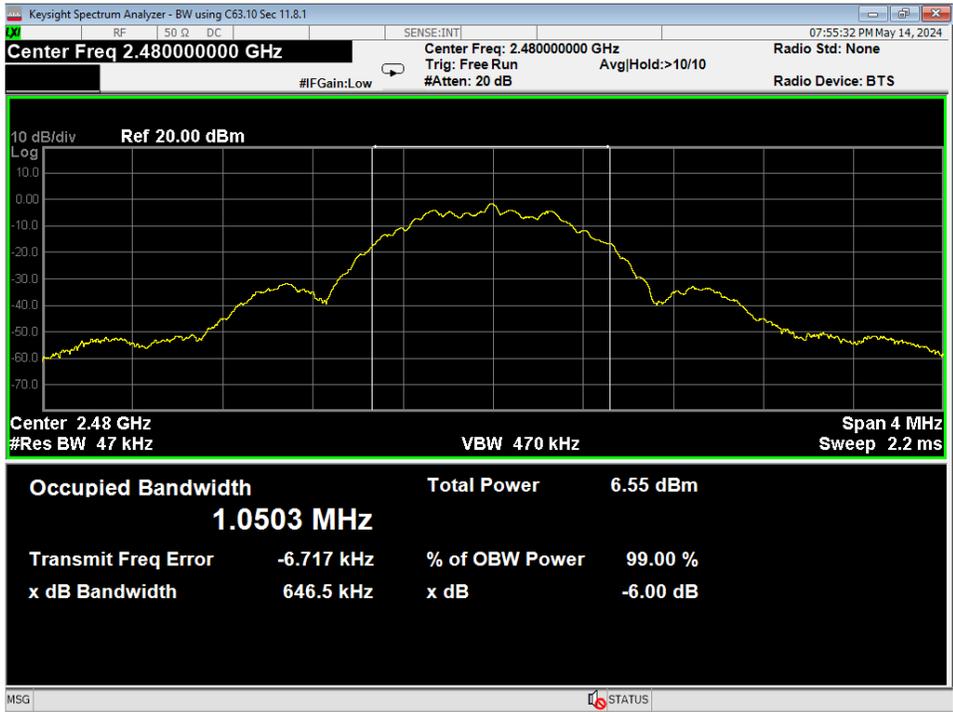
26 Higher Bandedge, Restricted, GMSK 2MB



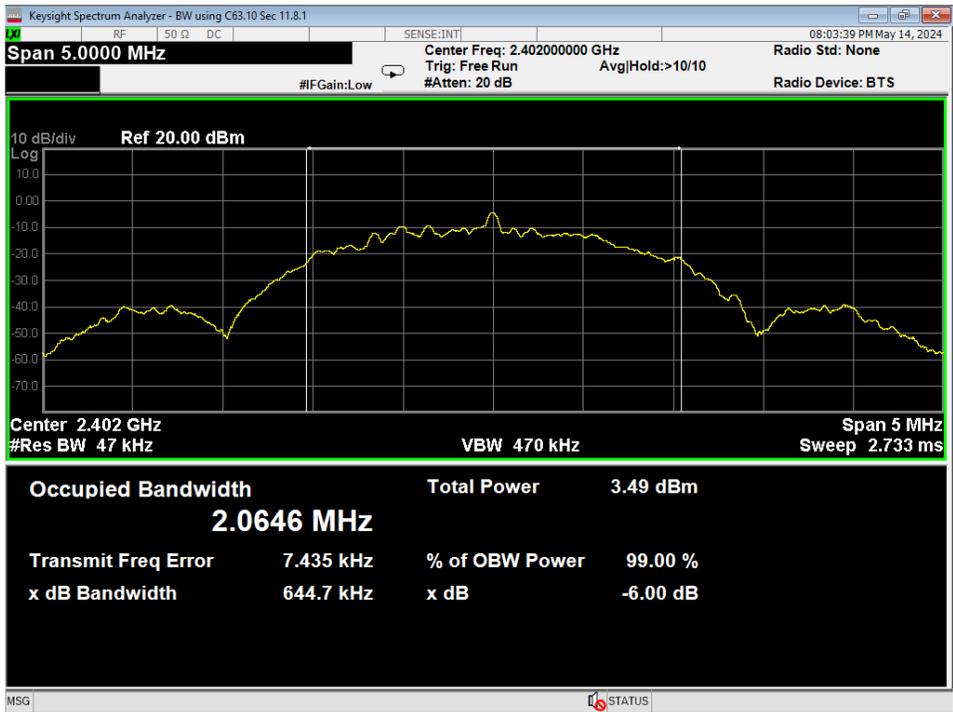
**27 Occupied Bandwidth, Low Channel, GMSK 1MB**



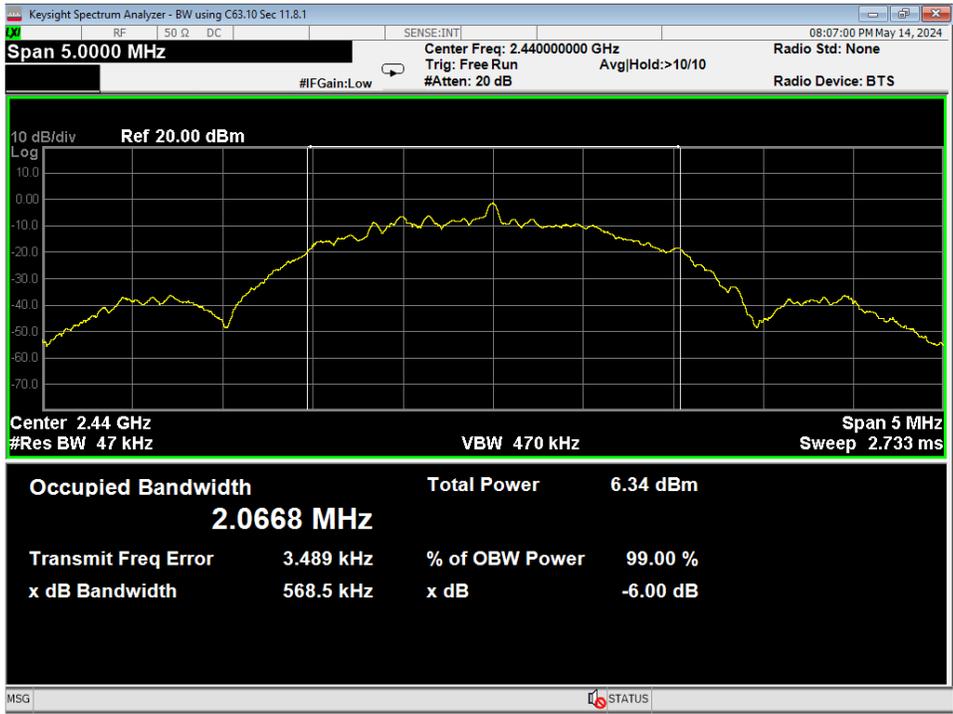
**28 Occupied Bandwidth, Mid Channel, GMSK 1MB**



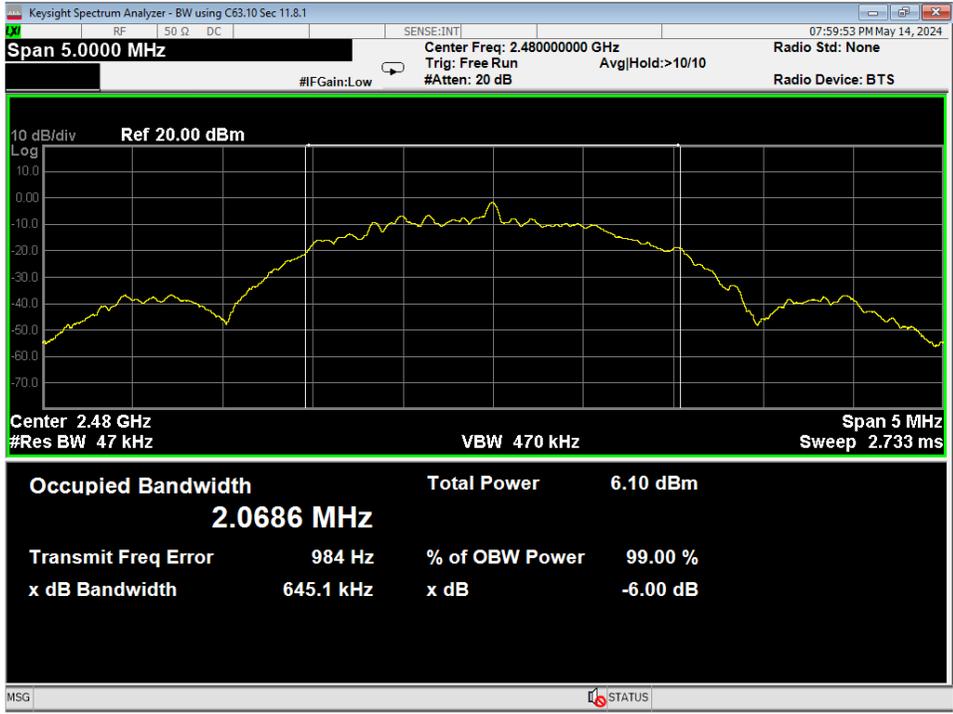
29 Occupied Bandwidth, High Channel, GMSK 1MB



30 Occupied Bandwidth, Low Channel, GMSK 2MB



31 Occupied Bandwidth, Mid Channel, GMSK 2MB



32 Occupied Bandwidth, High Channel, GMSK 2MB



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Prepared for:

Garmin International, Inc.

REPORT END

## SAR EVALUATION REPORT

<b>FCC ID:</b>	IPH-04378
<b>IC:</b>	1792A-04378
HVIN/Model(s):	A04378
Device Type:	Portable Digital Transceiver
Report Issue Date:	June 10, 2025

<b>Garmin International, Inc.</b> 1200 E. 151 <sup>st</sup> Street, Olathe, KS 66062, United States
<b>Certification</b>

Band / Mode	Face SAR [W/kg]	Body SAR [W/kg]	Extremity SAR [W/Kg]
2.4 GHz WLAN	< 0.10	0.58	0.27
2.4 GHz Bluetooth LE	N/A	N/A	N/A
FCC/ISED Limit	<b>1.6</b>	<b>1.6</b>	<b>4.0</b>

The measurement evaluations presented in this report are based on the maximum performance of the tested device(s), which has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general population exposure federal limits in 47CFR § 1.1310 and Health Canada Safety Code 6 and has been tested in accordance with the measurement procedures specified within this report.

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This document has been revised and replaces all previously issued versions of this document with the same Test Report S/N.



**Steve Liu**  
President

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# 1. DUT Specifics

## 1.1. Device under Test

The device under test is a wireless short-range device, incorporating the technologies listed in Table 1-1 below. The manufacturer has confirmed that the device is within operational tolerances expected for production units and has the same physical, mechanical, and thermal characteristics expected for production units. The serial number of the device used for each test is indicated alongside the results.

## 1.2. Device Overview

Table 1-1 Supported Technologies

Band/Mode	Frequency (MHz)
2.4 GHz WIFI	2412 - 2462 MHz
2.4 GHz Bluetooth LE	2402 - 2480 MHz

## 1.3. Maximum Time-Averaged Power From Manufacturer

The manufacturer has confirmed that this device follows the below target output power specifications and tolerances. SAR values were scaled to the maximum allowed power (including tolerance) to determine compliance per KDB Publication 447498 D04v01.

Table 1-2 2.4 GHz WIFI Target RF Output Power

2.4 GHz WIFI Target Power [dBm]					
Power Level	Channel Bandwidth [MHz]	Mode	802.11b	802.11g	802.11n
		Channel	2.4 GHz Antenna	2.4 GHz Antenna	2.4 GHz Antenna
Max	22 (802.11b) / 20 (802.11g/n)	1-10	16.5	14	14
		11	16.5	13	11
Tolerance: +/- 2 dB					

Table 1-3 2.4 GHz Bluetooth LE Target RF Output Power

2.4 GHz Bluetooth LE Target Power [dBm]			
Power Level	Mode	Data Rate	2.4 GHz Antenna
Max	BLE	1 Mbps	-2.0
	BLE	2 Mbps	-2.5
Tolerance: +/- 2 dB			

#### 1.4. Surfaces Required for Testing

Antenna	Back	Front	Top	Bottom	Right	Left
2.4 GHz Antenna	No	Yes	Yes	No	Yes	Yes

Note: Particular DUT edges were not required to be evaluated if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02r01 Section III. The distances between the transmit antennas and the edges of the device are included in the filing. Additional DUT edges were evaluated per manufacturer's request.

#### 1.5. Test Guidance Applied

- IEEE 1528-2013 (FCC)
- IEC/IEEE 62209-1528:2020 (ISED)
- RSS-102 Issue 6 (ISED)
- RSS-102.SAR.MEAS (ISED)
- Health Canada Safety Code 6 (ISED)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices) (FCC/ISED)
- FCC KDB Publication 447498 D04v01 (General SAR Guidance) (FCC/ISED)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz) (FCC)

## 2. Bluetooth LE SAR Test Exemption Assessment

### 2.1. FCC SAR Test Exemption

Per FCC KDB 447498 D01 v06 Section 4.3.1, For 100 MHz to 6 GHz “1-g and 10-g SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when... *test separation distances*  $\leq 50$  mm, the **1-g and 10-g SAR test exclusion “numeric thresholds”**:

$$\frac{MaxPower}{Distance} \cdot \sqrt{f_{GHz}} \leq 3.0 \quad (\text{for 1-g SAR})$$

$$\frac{MaxPower}{Distance} \cdot \sqrt{f_{GHz}} \leq 7.5 \quad (\text{for 10-g SAR})$$

Where:  $f_{GHz}$  = RF Channel frequency in GHz  
 $MaxPower$  = Power of channel, including tune-up tolerance, rounded to the nearest mW before calculation  
 $Distance$  = Min. Test Separation Distance in mm, rounded to the nearest mm before calculation

Per FCC KDB 447498 D01 v06 Section 4.3.1, “Power and distance are rounded to the nearest mW and mm before calculation.” The result is rounded to one decimal place for comparison.

For Bluetooth LE,  $-2$  dBm +  $2$  dB =  $1$  mW

For distances  $\leq 5$ mm, per FCC policy the value of 5 shall be used for the distance component of the equation.

$$\begin{aligned} \frac{MaxPower}{Distance} \cdot \sqrt{f_{GHz}} &= \frac{1}{5} \cdot \sqrt{2.48} \\ &= 0.31 \end{aligned}$$

$$0.31 \leq 3.0 \quad (\text{for 1-g SAR})$$

$$0.31 \leq 7.5 \quad (\text{for 10-g SAR})$$

**1-g and 10-g Bluetooth LE SAR is Exempt** per FCC KDB 447498 D01 v06.

### 2.2. ISED SAR Test Exemption

Per RSS-102 Section 6.3, SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when... *test separation distances*  $\leq 20$  cm, the **1-g SAR test exclusion “numeric thresholds”**:

Frequency (MHz)	$\leq 5$ mm (mW)
2450	3

Note: For 10-g SAR, the exemption limits above are multiplied by a factor of 2.5

For Bluetooth LE,  $-2 \text{ dBm} + 2 \text{ dB} = 1 \text{ mW}$

$1.0 \leq 3.0$  (for 1-g SAR)

$1.0 \leq 7.5$  (for 10-g SAR)

**1-g and 10-g Bluetooth LE SAR is Exempt per RSS-102.**

### 3. DUT Conducted Powers

#### 3.1. WIFI Conducted Powers

Table 3-1

2.4 GHz WIFI Measured Conducted Power [dBm]						
Power Level	Channel Bandwidth [MHz]	Mode		802.11b	802.11g	802.11n
		Ch.	Freq. [MHz]	2.4 GHz Antenna	2.4 GHz Antenna	2.4 GHz Antenna
Max	22 (802.11b) / 20 (802.11g/n)	1	2412	17.39	15.18	15.08
		6	2437	17.43	15.16	15.43
		11	2462	17.14	12.11	11.58



Figure 3-1 Power Measurement Setup

## 4. DUT SAR Test Results

### 4.1. WIFI SAR Data

Table 4-1

Exposure Condition	Band/Mode	Antenna	DUT SN	Power Drift [dB]	Maximum Duty Cycle [%]	Measured Duty Cycle [%]	Frequency [MHz]	Channel	Modulation/Configuration	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Measured Conducted Power [dBm]	Separation Distance [mm]	Position	Measured 1g SAR [W/kg]	Reported 1g SAR [W/kg]	Test Plot
Face	2.4 GHz WIFI	2.4 GHz Antenna	00338	-0.02	100.0%	100.0%	2412	1	IEEE 802.11b - 22 MHz	1	18.5	17.39	0	Front	0.004	0.005	-
Face	2.4 GHz WIFI	2.4 GHz Antenna	00338	-0.06	100.0%	100.0%	2437	6	IEEE 802.11b - 22 MHz	1	18.5	17.43	0	Front	0.005	0.006	1
Face	2.4 GHz WIFI	2.4 GHz Antenna	00338	0.00	100.0%	100.0%	2462	11	IEEE 802.11b - 22 MHz	1	18.5	17.14	0	Front	0.000	0.000	-

Table 4-2

Exposure Condition	Band/Mode	Antenna	DUT SN	Power Drift [dB]	Maximum Duty Cycle [%]	Measured Duty Cycle [%]	Frequency [MHz]	Channel	Modulation/Configuration	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Measured Conducted Power [dBm]	Separation Distance [mm]	Position	Measured 1g SAR [W/kg]	Reported 1g SAR [W/kg]	Measured 10g SAR [W/kg]	Reported 10g SAR [W/kg]	Test Plot
Body/Extremity	2.4 GHz WIFI	2.4 GHz Antenna	00338	-0.07	100.0%	100.0%	2412	1	IEEE 802.11b - 22 MHz	1	18.5	17.39	0	Top	0.249	0.322	0.116	0.150	-
Body/Extremity	2.4 GHz WIFI	2.4 GHz Antenna	00338	-0.18	100.0%	100.0%	2437	6	IEEE 802.11b - 22 MHz	1	18.5	17.43	0	Top	0.119	0.152	0.054	0.069	-
Body/Extremity	2.4 GHz WIFI	2.4 GHz Antenna	00338	0.08	100.0%	100.0%	2462	11	IEEE 802.11b - 22 MHz	1	18.5	17.14	0	Top	0.425	0.581	0.195	0.267	2
Body/Extremity	2.4 GHz WIFI	2.4 GHz Antenna	00338	-0.10	100.0%	100.0%	2437	6	IEEE 802.11b - 22 MHz	1	18.5	17.43	0	Right	0.003	0.004	0.000	0.000	-
Body/Extremity	2.4 GHz WIFI	2.4 GHz Antenna	00338	-0.10	100.0%	100.0%	2437	6	IEEE 802.11b - 22 MHz	1	18.5	17.43	0	Left	0.079	0.101	0.041	0.052	-

### 4.2. General SAR Testing Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, IEC/IEEE 62209-1528, RSS-102.SAR.MEAS and FCC KDB Publication 447498 D04v01.
2. Per IEC/IEEE 62209-1528, SAR testing was performed using probes calibrated for the modulation specific signal.
3. SAR evaluations were made in accordance with the latest version of RSS-102 Issue 6 and RSS-102.SAR.MEAS, then IEC/IEEE 62209-1528. FCC KDB Publications listed in RSS-102 can be used as supplementary procedures due to limitation of technology specific testing protocols in the international standards.
4. Liquid tissue depth was at least 15.0 cm for all frequencies.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D04v01.
6. Batteries are fully charged at the beginning of the SAR measurements.
7. Per IEC/IEEE 62209-1528, the worst case configuration was additionally evaluated for all channels.
8. Face SAR is measured with the front surface of the device positioned against a flat phantom, representative of the normal operating conditions expected by users.
9. Since top/right/left edge of the device are intended for use on user's hand, extremity SAR is evaluated for these surfaces.
10. Since top/right/left edge of the device is in close proximity to the user's body, body SAR is also measured with these surfaces positioned against a flat phantom, representative of the operating conditions expected by users.
11. This device has no simultaneous transmission capabilities.

### 4.3. WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI operations, the initial test configuration was selected according to the 802.11 transmission modes with the highest maximum allowed powers. SAR for other 802.11 modes was not required due to the maximum allowed powers and the highest reported SAR.
2. When the maximum reported 1g averaged SAR is  $\leq 0.8$  W/kg (2.0 W/kg for 10g evaluations), SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was  $\leq 1.20$  W/kg for 1g evaluations (3 W/kg for 10g evaluations) or all test channels were measured.
3. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. Procedures used to measure the duty factor are identical to that in the associated Part 15 test reports.

## 5. DUT SAR Measurement Variability Requirement

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was not required since the measured SAR results for a frequency band were less than 0.8 W/kg for 1g SAR and 2.0 W/kg for 10g SAR.

## 6. General Introduction

Title 47 of the Code of Federal Regulations (CFR) pertains to United States Federal regulation for Telecommunications. The **Federal Communications Commission (FCC)** is the agency responsible for implementing and enforcing these regulations. The rules define a **radiofrequency device** as any device which in its operation is capable of emitting radiofrequency energy by radiation, conduction, or other means.

47CFR §2.1093(b) states, “A **portable device** is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) **is/are within 20 centimeters of the body of the user.**”

Also, 47CFR §2.1093(d)(6) states, that General population/uncontrolled exposure limits defined in §1.1310 “apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure.”

47CFR §2.1093(d)(2) states that evaluation of compliance within FCC’s SAR limits can be demonstrated by laboratory measurements. This test report serves this purpose.

## 7. Background on Radiofrequency (RF) Exposure Limits

### 7.1. Controlled Environment

**Controlled environments** are defined as locations where the RF field intensities have been adequately characterized by means of measurement or calculation and exposure is incurred by persons who are: aware of the potential for RF field exposure, cognizant of the intensity of the RF fields in their environment, aware of the potential health risks associated with RF field exposure and able to control their risk using mitigation strategies. In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

### 7.2. Uncontrolled Environment

**Uncontrolled environments** are defined as locations where either insufficient assessment of RF fields have been conducted or where persons who are allowed access to these areas have not received proper RF field awareness/safety training and have no means to assess or, if required, to mitigate their exposure to RF fields. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed, or in which persons who may not be made fully aware of the potential for exposure, or cannot exercise control over their exposure. Members of the general public would fall under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### 7.3. RF Exposure Limits for 100kHz – 6 GHz

Per FCC 47 CFR §1.1310 and Health Canada Safety Code 6, the SAR limits are applied for frequencies 100kHz ~ 6 GHz as shown below.

Table 7-1 Human Exposure to RF Radiation Limits in 47 CFR §1.1310 and Health Canada Safety Code 6- SAR Basic Restrictions

Environment	Condition	SAR	Averaging volume
Uncontrolled / General Population	Head, Neck Trunk	<b>1.6 W/kg</b>	1g cube
	Extremity	<b>4.0 W/kg</b>	10g cube
Controlled	Head/Trunk	<b>8 W/kg</b>	1g cube
	Extremity / Limbs	<b>20 W/kg</b>	10g cube

## 8. RF Safety Laboratory SAR Measurement System

### 8.1. SAR Measurement Hardware and Software

Peak spatially averaged SAR (psSAR) measurements are performed using a DASY8 robot system with cDASY8 module SAR software. The DASY8 is made by SPEAG in Switzerland and consists of a 6-axis robot, robot controller, computer, dosimetric probe, probe alignment light beam unit, and various SAR phantoms.

### 8.2. E-Field Probe

Manufacturer	Schmid & Partner Engineering AG
Model	EX3DV4
Description	Smallest isotropic electric (E-) field probe for high precision specific absorption rate (SAR) measurements
Frequency Range	10 MHz - 10.0 GHz
Dynamic Range	10 $\mu$ W/g – >100 mW/g
Overall Length (mm)	337
Body Diameter (mm)	12
Tip Length (mm)	337
Tip Diameter (mm)	2.5
Probe Tip to Sensor X Calibration Point (mm)	1
Probe Tip to Sensor Y Calibration Point (mm)	1
Applications	High precision dosimetric measurements in any exposure scenario (e.g. very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better than 30%
Compatibility	DASY8 robot + cDASY8 module SAR software

### 8.3. Peak Spatially Averaged SAR (psSAR) Measurements

SAR Evaluations are performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface, and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528.

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASy manual online for more details):
  - a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than the area scan and zoomscan resolutions specified in FCC KDB Publication 865664 D01v01r04 section 2.7.1, IEEE 1528:2013 table 6, and IEC/IEEE 62209-1528 table 3 & table 4. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
  - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
  - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
  - d. The zoom scan is confirmed to meet both of the following parameters if the result is > 0.1 W/kg. If the result does not meet the below parameters, it is re-measured with a finer resolution scan until the below parameters are met.
    - (1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x- and y-directions.
    - (2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum SAR value shall be at least 30%
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

## 8.4. Test Positions

### 8.4.1. Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon = 3$  and loss tangent  $\delta = 0.02$ .

### 8.4.2. Body SAR Test

Since top/right/left edge of the device are in close proximity to the user’s body, body SAR is also measured with these edges positioned against a flat phantom, representative of the operating conditions expected by users.

### 8.4.3. Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1g body and 10g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D04v01 should be applied to determine SAR test requirements.

### 8.5. RF Safety Laboratory SAR System Measurement Uncertainty

SAR Uncertainty for DUTs According to 62209-1528 (Frequencies: 300 MHz - 3 GHz)										
Symbol	Input Quantity (Xi) (Source of Uncertainty)	62209-1528 Ref	Unc. (xi)	Prob. Dist. PDFI	Div(qj)	ci (1g)	ci (10g)	Std Unc (1g)	Std. Unc (10g)	vi
<b>Measurement System Errors</b>										
CF	Probe Calibration	8.4.1.1	11.0%	N (k=2)	2	1	1	5.50%	5.5%	∞
CFdrift	Probe Calibration Drift	8.4.1.2	1.7%	R	√3	1	1	1.0%	1.0%	∞
LIN	Probe Linearity and Detection Limit	8.4.1.3	4.7%	R	√3	1	1	2.7%	2.7%	∞
BBS	Broadband Signal	8.4.1.4	2.8%	R	√3	1	1	1.6%	1.6%	∞
ISO	Probe Isotropy	8.4.1.5	7.6%	R	√3	1	1	4.4%	4.4%	∞
DAE	Other probe and data acquisition errors	8.4.1.6	0.8%	N	1	1	1	0.8%	0.8%	∞
AMB	RF Ambient and Noise	8.4.1.7	1.8%	N	1	1	1	1.8%	1.8%	∞
Δxyz	Probe Positioning Errors	8.4.1.8	0.006 mm	N	1	0.14	0.14	0.1%	0.1%	
DAT	Data Processing Errors	8.4.1.9	1.2%	N	1	1	1	1.2%	1.2%	∞
<b>Phantom and Device Errors</b>										
LIQ(σ)	Measurement of Phantom Conductivity	8.4.2.1	2.5%	N	1	0.78	0.71	2.0%	1.8%	∞
LIQ(Tc)	Temperature Effects (Medium)	8.4.2.2	3.3%	R	√3	0.78	0.71	1.5%	1.4%	∞
EPS	Shell Permittivity	8.4.2.3	14.0%	R	√3	0	0	0.0%	0.0%	∞
DIS	Distance between the radiating element of the DUT and the phantom medium	8.4.2.4	2.0%	N	1	2	2	4.0%	4.0%	∞
Dxyz	Repeatability of Positioning the DUT or source against the phantom	8.4.2.5	1.0%	N	1	1	1	1.0%	1.0%	5
H	Device Holder Effects	8.4.2.6	3.6%	N	1	1	1	3.6%	3.6%	8
MOD	Effect of Operating mode on probe sensitivity	8.4.2.7	2.4%	R	√3	1	1	1.4%	1.4%	∞
RFdrift	Variation in SAR due to Drift in output of DUT	8.4.2.9	2.5%	N	1	1	1	2.5%	2.5%	∞
VAL	Validation Antenna Uncertainty (Validation measurement only)	8.4.2.10	0.0%	N	1	1	1	0.0%	0.0%	∞
Pin	Uncertainty in Accepted Power (Validation Measurement only)	8.4.2.11	0.0%	N	1	1	1	0.0%	0.0%	∞
<b>Correction to the SAR Results</b>										
C(ε',σ)	Phantom Deviation from Target (ε',σ)	8.4.3.1	1.9%	N	1	1	0.84	1.9%	1.6%	∞
C(R)	SAR Scaling	8.4.3.2	0.0%	R	√3	1	1	0.0%	0.0%	∞
u(ΔSAR)	Combined Uncertainty							10.7%	10.6%	∞
U	Expanded Uncertainty and Effective Degrees of Freedom (k=2)							21.3%	21.1%	

## 9. Technology Specific Test Setup Requirements

### 9.1. Measured and Reported SAR

Per FCC KDB Publication 447498 D04v01, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

### 9.2. Procedures Used to Establish RF Signal for SAR

Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation.

### 9.3. SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

#### 9.3.1. General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% duty factor to determine compliance at the maximum tune-up tolerance limit.

### 9.3.2. Initial Test Position Procedure

The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is  $\leq 0.4$  W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is  $\leq 0.8$  W/kg or all test positions are measured. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

### 9.3.3. 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- 1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2) When the reported SAR is  $> 0.8$  W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is  $> 1.2$  W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

## 10. Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT
Amplifier Research	5S1G4	RF Broadband Amplifier (800 MHz - 4.2 GHz)	331258			✓
Anritsu	MA24118A	Microwave USB Power Sensor (10MHz - 18 GHz)	2123431	1/13/2025	1/13/2026	
Anritsu	MA24118A	Microwave USB Power Sensor (10MHz - 18 GHz)	2123500	1/13/2025	1/13/2026	
Anritsu	S820E	Vector Network Analyzer	2348026	11/30/2023	11/30/2025	
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025	
Control Company	4352	Long Stem Liquid Thermometer	230662223	9/28/2023	9/28/2025	
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	BW-S3W2+	3dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	BW-S3W2+	3dB RF Fixed Attenuator (DC - 18 GHz)	-			✓
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3318			✓
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓
Mini-Circuits	VLF-3000+	Coaxial Low Pass Filter (DC - 3 GHz)	-			✓
Mitutoyo	CD-4"AX	Digital Caliper	B23243217	9/28/2023	9/28/2025	
Narda	4226-20 (26733)	20 dB SMA Directional Coupler (0.5 - 18 GHz)	0201			✓
Rohde & Schwarz	SMCV100B	R&S SMCV100B Vector Signal Generator (VSG)	103882	12/21/2023	12/19/2025	
SPEAG	D2450V2	2450 MHz System Validation Dipole	1112	11/15/2024	11/15/2025	
SPEAG	DAE4ip	Data Acquisition Electronics with Integ. Power	1839	9/4/2024	9/4/2025	
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	9/2/2024	9/2/2025	
SPEAG	EX3DV4	SAR Measurement Probe	7836	9/12/2024	9/12/2025	
SPEAG	SE UMS 171 EA	MAIA Modulation and Interference Analyzer	1820			
SPEAG	SE UMS 176 C	ANT Wideband Communication Antenna	1601			

✓ Note: Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

## 11. Conclusion

The SAR evaluation indicates that the DUT is capable of compliance with the RF radiation exposure limits of the FCC and ISED, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.