Test Report 2022-015

Version C
Issued 21 Nov 2022

Project GCL-0200
Primary Test Standard: FCC Part 15.247; RSS-247 Iss. 2

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

Client-supplied Information
FCC: IPH-04396; IC: 1792A-04396

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. The results are as follows.

Parameter	Description	Key Performance Values	Result	Data starts at page
Hopping Channels	The radio manages it use of channels appropriately. [15.247(a)(1); RSS-247 at 5.1]	N/A. The radios described in this report are not subject to the Frequency Hopping rules.	N/A	N/A
Occupied Bandwidth	The nature of the radio signal is broadband, being at least 500 kHz wide. [15.247(a)(2); RSS-247 at 5.2(a)]	The 6dB bandwidth is 552 kHz or greater.	PASS	10
Transmit Power	The peak transmit power presented to the antenna is no greater that 1 Watt or 30 dBm. The effective radiated power is limited to 4 Watts or 36 dBm EIRP. [15.247(b); RSS-247 at 5.4(d)]	The maximum transmit power is 14.27 dBm (0.027 W) or 18.71 dBm EIRP (0.074 W EIRP).	PASS	14
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	NT	NT
Unwanted Emissions (Conducted Spurious)	The radio should not provide too much radio energy to the antenna at frequencies beyond its intended frequency band. [15.247(d); RSS-247 at 5.5]	Emissions outside the band must be reduced at least 20 dB from in-band levels. The measured reduction was at least 26.5 dB.	PASS	16
Restricted Bands	The radio must not emit in certain designated restricted frequency bands above a set of limit values. [15.247(d) and 15.209; RSS-247 at 3.3]	Emissions in the restricted bands were at least 14.9 dB below the applicable limits.	PASS	29
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 -4.25 dBm in a band of at least 3 kHz.	PASS	47
Hybrid Systems	A radio that is both frequency hopping and digitally modulated should a combination of system rules. [15.247(f); RSS-247 at 5.3]	N/A. The radios described in this report are not subject to the Hybrid System rules.	N/A	N/A
Frequency Hopping Rules	Frequency hopping systems have additional functional requirements.	N/A. The radios described in this report are not	N/A	N/A

	[15.247(g) and (h); RSS-247 at 5.1]	subject to the Frequency Hopping rules.		
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	NT	NT
Frequency Stability	The radio tuning must be robust over a range of temperature and supply voltage conditions. [RSS-Gen at 6.11]	Radio emissions remained within the allowed radio band under all environmental conditions tested.	PASS	51

Table 1: Summary of Results

NT (Not Tested) means the requirement is or may be applicable, but the relevant measurement or test was not performed as part of this test project. The client may address these topics separately.
N/A (Not Applicable) means the lab judged that the test sample is exempt from the requirement.

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

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 2022-016. That report is treated as a part of this document by way of this reference.

2. Test Background

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

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

Test Sample received: 15 Aug 2022
Test Start Date: 17 Aug 2022
Test End Date: 14 Oct 2022

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.

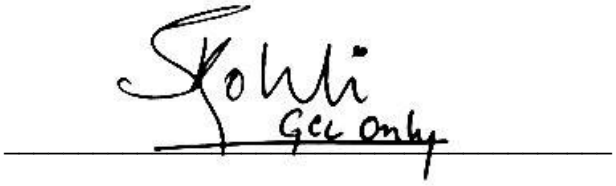
3. Report History and Approval

This report was initially issued on 24 Oct 2022 as Version A.
Version B corrected the description of the data network port and was released on 17 Nov 2022.
Version C included an update to test record TR30, near page 16, regarding photographs.
It was written by David Arnett.

Report Technical Review:

David Arnett
Technical Lead EMC Engineer

Report Approval:



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

4. Test Sample Modifications and Special Conditions

The following special conditions or usage attributes were found 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) made and are necessary to achieve compliance with one or more of the standards listed in section 6 of this report:
None

5. Description of the Equipment Tested

5.1 Unique Identification

Product Model	A04396
Serial Numbers Tested	3425814561 (with cradle 87933), 3425814565 (with cradle 87967)
Development Stage	Factory Prototype
Regulatory Identifiers	FCC: IPH-04396; IC: 1792A-04396

This product tested is a navigation and communication device for use on watercraft. It consists of a main unit with a single connector interface to a cradle. The cradle provides a fixed mechanical mounting point within the vehicle and connection to multiple cables. The sample ending in 565 has been modified to provide an RF cable connection instead of its normal internal 2.4 GHz antenna for conducted RF signal testing.

5.2 Key Parameters

EUT Input Power:	12 Vdc (13.8V)
I/O Ports:	Sonar transducer port, data networking, NMEA 2000
Primary Functions:	Geolocation, sonar imaging and ranging, data mapping, information exchange
Typical use location:	Vehicle mounted
Highest internal frequency:	2.484 GHz
Antenna gain	4.44 dBi, as reported by client
Firmware Revision	1.0.AB; Factory Test App version 8.31
Approximate dimensions	30 cm x 17 cm x 15 cm
Approximate mass category	☐ 100 g or less ☐ 300 g ☑ 1 kg ☐ 3 kg ☐ 10 kg ☐ 30 kg ☐ 100 kg or more

5.3 Operating modes

During test, the EUT was operated in one or more of the following modes. Some modes listed may not have been used in this test.

Mode M1: Sonar & Wifi. Display, sonar imaging, IEEE 802.11 WiFi, and GNSS tracking active

Mode M2: Sonar only. Display, sonar imaging active, with radio services idle.

Mode M3: WiFi. IEEE 802.11 WiFi is actively transmitting in a test mode. Display, and GNSS tracking are active. GNSS signals may or may not be sufficient for location lock.

Mode M4: BLE. The Bluetooth Low Energy is actively transmitting in a test mode that is typically on a fixed frequency. Display, and GNSS tracking are active. GNSS signals may or may not be sufficient for location lock.

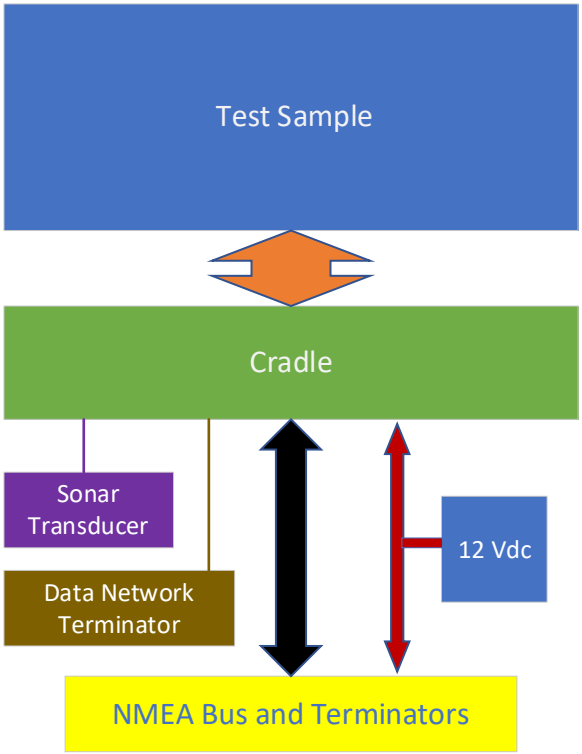
Mode M5: ANT. ANT is actively transmitting in a test mode. Display, and GNSS tracking are active. GNSS signals may or may not be sufficient for location lock. In this report, ANT includes ANT+ operation.

Mode M6: Rx Only. The 2.4 GHz transmission subsystem that provides WiFi, BLE and ANT services is not transmitting but is in a Receive mode. The display is active, and GNSS tracking is not active.

Mode M7: GNSS. Display, and GNSS tracking are active. GNSS signals may or may not be provided with enough space vehicles for location lock.

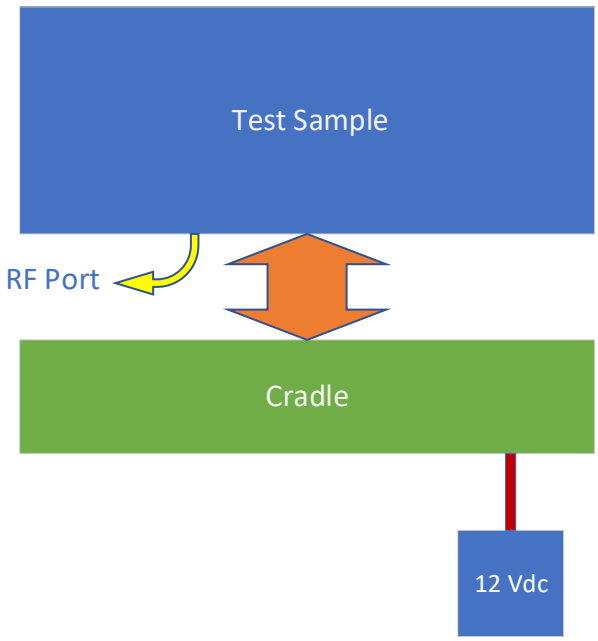
5.4 EUT Arrangement

During test, the EUT components and associated support equipment were selected including the following arrangement sets. Some arrangements listed may not have been used in this test.



Schematic drawing, not to scale

Figure 1: Arrangement A1, Full. The sample is provided with appropriate power, data, and loads on each port.



Schematic drawing, not to scale

Figure 2: Arrangement A2, Radio. The sample is provided with DC power and has an RF test port added.

5.5 Associated Equipment (AE) used

Description	Manufacturer	Model	Serial Number
Sonar Transducer	Garmin	GT56UHD-TM	6QR003615
DC power supply	Samlex	SEC 1212	03051-7F03-00426
NMEA2000 Bus Tees and Terminators (passive)	Unmarked	Unmarked	None

Table 2: List of devices used to load or exercise the test sample

5.6 Cables used

Description	From	To	Length	EMC Treatment
Power	DC supply	EUT or NEMA2000 Bus	180 cm	None
NMEA2000	NEMA2000 Bus	EUT	212 cm	None
Data Network cable	EUT	Built-in passive termination	30 cm	None

Table 3: List of cables used to interconnect the ports of the EUT and AE

6 Test Standards Applied

6.1. Accredited Standards

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

AS/NZS 4268: 2017
CFR 47, FCC Part 15, Subpart C
RSS-GEN Issue 5 Amd 2
RSS-247 Issue 2
ANSI C63.10: 2013

6.2. Non-accredited Standards

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

(None)

6.3 Variances

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

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

6.4 Laboratory Accreditation

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

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

7 Measurement Instrumentation Uncertainty

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

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

The secondary benchmark for MIU in an EMC lab performing radio transceiver tests is a set of uncertainty limit values published in various ETSI standards. In this report, U_{ETSI} is the most restrictive of the values found in the ETSI EN standards including those listed in section 6 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 applied 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 below or in the relevant test records.

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		1.54 dB	3.8 dB	None
Conducted Emissions, Power Mains, 150 kHz to 30 MHz		1.42 dB	3.4 dB	None
Conducted Emissions, Cat 5 LCL, 150 kHz to 30 MHz		3.77 dB	5 dB	None
Conducted Emissions, Cat 3 LCL, 150 kHz to 30 MHz		2.77 dB	5 dB	None
Radiated Emissions, below 30 MHz		1.15 dB	None	6 dB
Radiated Emissions, 30 MHz to 1000 MHz	3.07 dB	6.3 dB	6 dB	
Radiated Emissions, 1 GHz to 18 GHz		3.00 dB	5.2 & 5.5 dB	6 dB
Radiated Emissions, 18 GHz to 26.5 GHz	3.13 dB	None	6 dB	
*Radio Signal Frequency Accuracy		*1.55 x 10^-7	None	1.0 x 10^-7
Radio Signal Occupied Bandwidth		0.95%	None	5%
Radio Power or Power Spectral Density	0.98 dB	None	1 dB	
Temperature		0.95 °C	None	1 °C
Relative Humidity		0.048 x Reading	None	0.05 x Reading
Signal Timing	The greater of these three...	0.63 usec 0.01% of value 0.5 x LSDPV	None	None

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

8 Selected Example Calculations

Certain regulators require samples of the calculations that lead from the raw measurement to the final result for AC Mains conducted and unintended radiated emissions. The assumption is that the lab performs raw measurements, then adds, subtracts, multiplies, or divides based on transducer factors, amplifier gains, and losses in the signal

transmission path. In this lab, our CISPR 16 Receiver does not work that way. The calibration factors and losses and gains are provided to the receiver as detailed data files. These factors are applied in the RF measurement path prior to the detector. But as a step in the lab measurement process, staff frequently verify that these factors are applied correctly. They make a measurement with the factors applied inside the receiver, then they disable the factors and remeasure the result manually adding in the various relevant factors.

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

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

8.1 AC Mains conducted emissions at 22 MHz
(Raw measurement) + (AMN factor) + (transmission loss) = Result

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

8.2 Radiated Emissions at 630 MHz
(Raw measurement) + (Antenna factor) + (transmission loss) = Result

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

8.3 Radiated Emissions at 2.7 GHz
(Raw measurement) + (Antenna factor) + (transmission loss) = Result

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

9 Environmental Conditions During Test

Environmental conditions in the test lab were monitored during the test period. Temperature and humidity are controlled by an air handling system. As information to the reader, the conditions were observed as 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:	22.8 to 27.1 °C (73.0 to 80.8 °F)
Relative Humidity:	33.2% to 53.9% (non-condensing)
Barometric Pressure	97.2 to 98.4 kPa

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
DTS Bandwidth Tests
Test IDs TR46 – TR50
Project GCL0200

Test Date(s)	13 Oct 2022
Test Personnel	David Arnett
Product Model	A04396
Serial Number tested	3425814565
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Radio Protocol	Bluetooth Low Energy (BLE), ANT, IEEE 802.11 b/g/n (WiFi)
Radio Band	2480 to 2483.5 MHz
Arrangement	A2 (Radio)
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this record:	**14 Oct 2022**

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE 44GHz	Keysight	N9048B	MY59500016	2-Feb-2022	2-Feb-2023

Table TR46.1

Test Software used: Keysight PXE System Code rev. A.32.06.

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, and also identify the center frequency error. 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.

Test Data
The analysis threshold for this test was the -6 dB bandwidth using the method of ANSI C63.10 clause 11.8.2. The standards cited require the DTS Bandwidth to be at least 500 kHz.

In the tables below, the measured bandwidth is shown in bold text. The channel for each modulation type with the lowest DTS bandwidth is highlighted in yellow. Data plots are provided for those highlighted test cases.

All data met the 500 kHz threshold limit.

DTS bw in kHz	Channel/Frequency		
	2402	2442	2480
ANT	**552.5**	**553.4**	**552.4**
BLE	**722.1**	**720.3**	**721.3**

Table TR46.2: Summary of DTS Bandwidth Data for ANT and BLE, in kHz

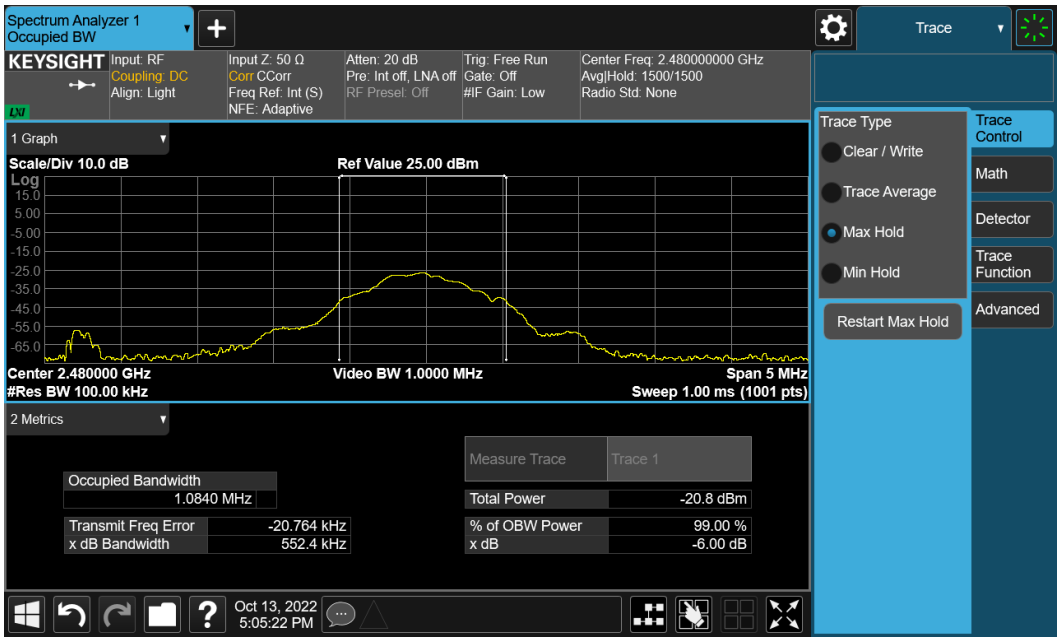


Figure TR46.1: DTS bandwidth data for ANT at high channel (2480 MHz)

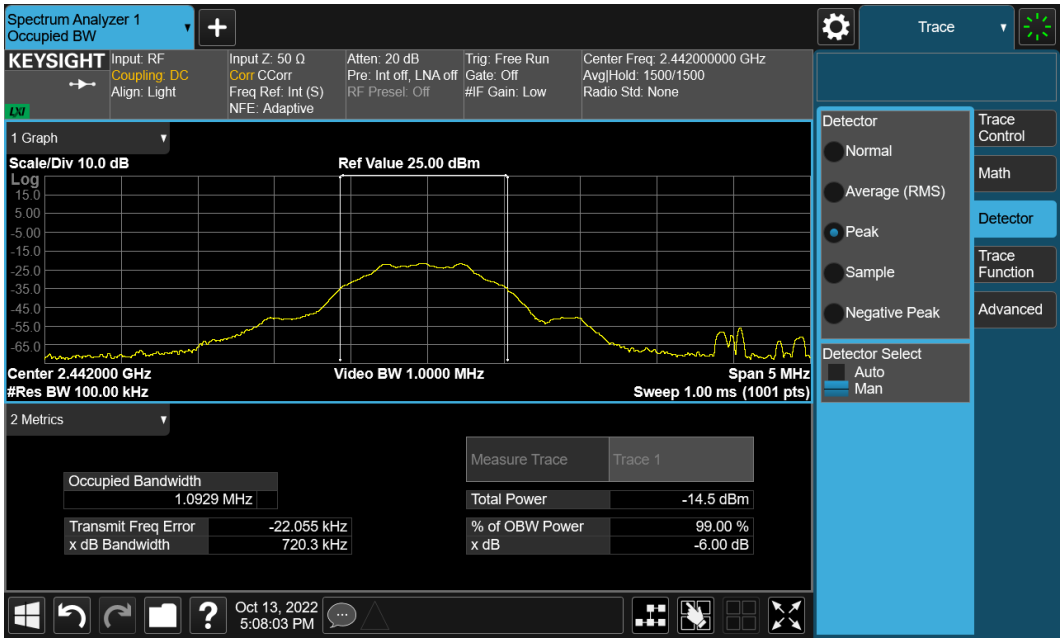


Figure TR46.2: DTS bandwidth data for BLE at mid channel (2442 MHz)

DTS bw in MHz	Channel/Frequency		
	1	6	11
IEEE 802.11 b 11Mbps	**8.481**	**8.635**	**8.328**
IEEE 802.11 g 54Mbps	**15.170**	**15.180**	**15.450**
IEEE 802.11 n MCS7	**17.270**	**16.300**	**16.380**

Table TR46.3: Summary of DTS Bandwidth Data for IEEE 802.11 modulations, in MHz

Figure TR46.3: DTS bandwidth data for 802.11b 11 Mbps at channel 11

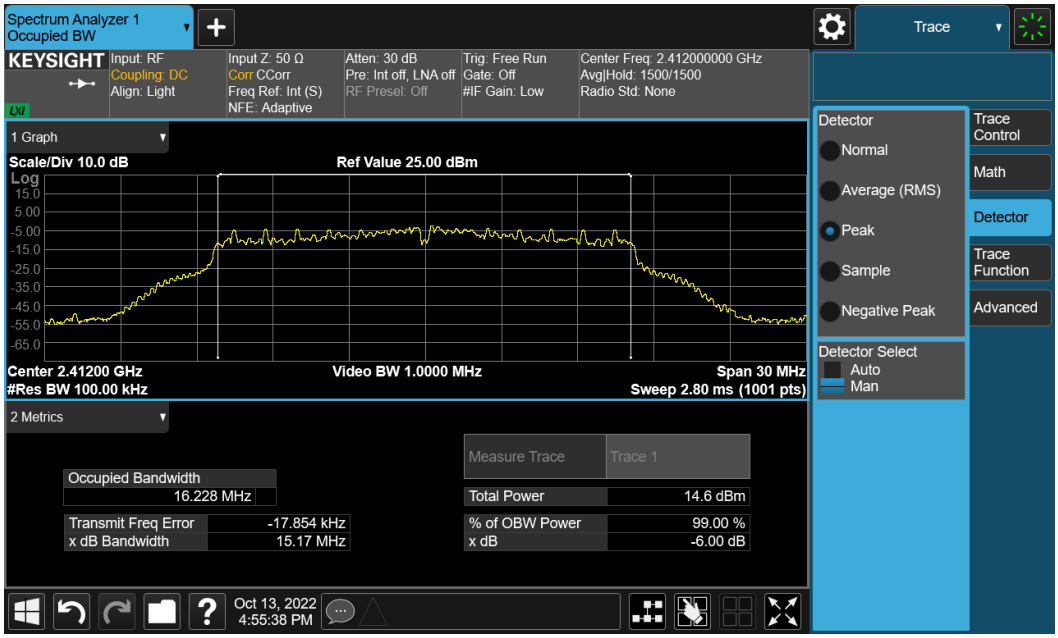


Figure TR46.4: DTS bandwidth data for 802.11g 54 Mbps at channel 1

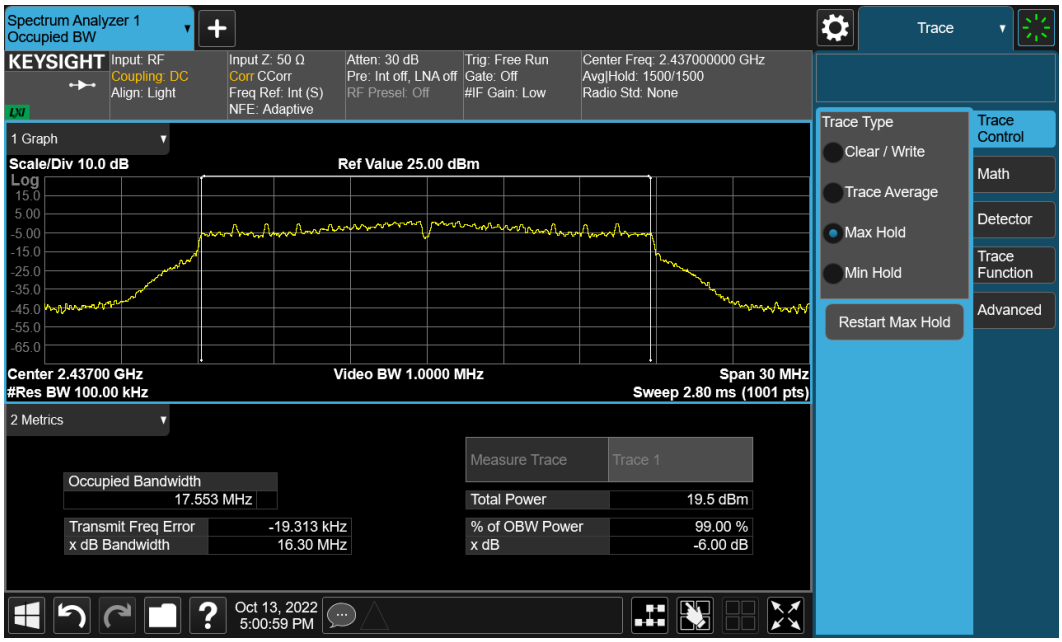


Figure TR46.5: DTS bandwidth data for 802.11n MCS7 at channel 6

This line is the end of the test record.

Test Record
Transmitter Power
Test IDs TR01 – TR05
Project GCL0200

Test Date(s)	17 Aug 2022, 14 Sep 2022
Test Personnel	David Arnett assisted by Christian Shepherd and Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	Modes M3 (WiFi), M4 (BLE) and M5 (ANT)
Arrangement	A2 (Radio)
Input Power	12 Vdc (13.8V)
Test Standards:	FCC Part 15, ANSI C63.10, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Antenna Gain	4.44 dBi, as reported by the client
Cable loss	The test sample has a cable added to provide external radio signals for conducted measurements. The client provided a table of cable losses at various frequencies. In the 2.5 GHz band the loss is 2.85 dB.
Radio Protocol	Bluetooth Low Energy (BLE), ANT, IEEE 802.11 b/g/n (WiFi)
Hopping Frequencies	Treated as a non-hopping system
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this record:	**19 Sep 2022**

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Thermohygrometer	Mannix	CMM880	10319186	26-May-2021	1-Jun-2024
RF Power Sensor	Rohde&Schwarz	NRP8S	109927	13-Jul-2022	15-Jul-2023

Table TR01.1 Equipment used

Test or Analysis Software used: R&S Power Viewer V11.3. 3.2.2020.

Test Method
The basic test standards provide options for the test method. The measurements here are the peak of the power measured with an Average detector. The following test methods were applied.

ANSI C63.10	11.9.2.3.1

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 been applied.

IEEE 802.11 transmission power was tested on all available channels, 1 (2412 MHz) through 11 (2462 MHz). The IEEE 802.11b data rates tested were 1, 2, 5.5, and 11 Mbps. The IEEE 802.11g data rates tested were 6, 9, 12, 18, 24, 36, 48, and 54 Mbps. The IEEE 802.11n modulations tested were N0 through N7.

BLE and ANT operate on channels every 2 MHz apart from 2402 to 2480 MHz. The channels tested were 2402, 2404, 2406, 2408, 2436. 2438, 2440, 2442, 2444, 2468, 2472, 2478, and 2480 MHz.

The transmitter was in continuous transmit mode for these measurements, >99% duty cycle. The highest power values for each type of radio signal are shown below.

Transmit Mode	Max Power dBm, EIRP	Limit dBm, EIRP	Margin dB	Max Power dBm	Limit dBm	Margin dB
ANT	4.55	36.00	31.45	0.11	30.00	29.89
BLE	15.60	36.00	20.40	11.16	30.00	18.84
802.11 b	16.92	36.00	19.08	12.48	30.00	17.52
802.11 g	18.68	36.00	17.32	14.24	30.00	15.76
803.11 n	18.71	36.00	17.29	14.27	30.00	15.73

Table TR01.2 Summary of direct connected (dBm) and effective radiated (dBm EIRP) power levels

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

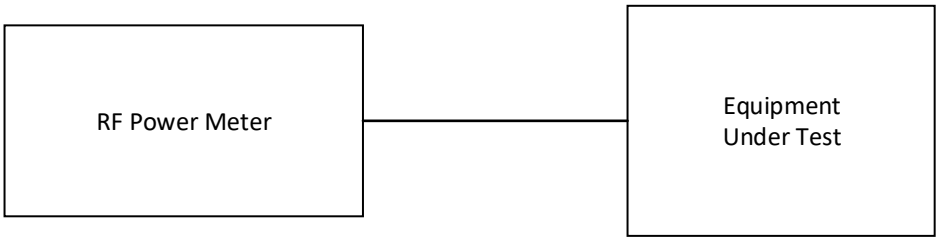


Figure TR01.2

Test Record
Conducted Spurious Emissions Test TR30
Project GCL2022

Test Date(s)	14 Oct 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	M3 (WiFi): IEEE 802.11 b
Arrangement	A2 (Radio)
Input Power	12Vdc (13.8V)
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this test record:	**21 Nov 2022**

Version B adds a photograph of the test setup as requested by the client.
Original record, Version A, created 17 Oct 2022..

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
PXE 44GHz	Keysight	N9048B	MY59500016	2-Feb-2022	2-Feb-2023

Table TR30.1: Test equipment used

Test software used: Keysight PXE System Code rev. A32.06; ConductedSpurAnalysis V1.xlsx

Test Method
The conducted spurious emission test measures the strength of intentional and unintentional radio signals conducted from the transmitter to the antenna across a wide range of frequencies. It does not evaluate whether intentional signals meet specific limits. Rather, it ensures that magnitudes unintentional signals are sufficiently reduced relative to the intentional signal to satisfy the requirements of the relevant standards. The test method is found in ANSI C63.10 clause 11.11.

This measurement requires that a coaxial feed line from the transmitter is available as a connector exterior to the test sample. This feed line and connector may be a part of the shipping product, or it may be a special modification to the product for testing purposes. The connector is attached via laboratory cables to the measurement instrument. The results have been adjusted to account for the losses in the laboratory cables. Where feasible, the losses of any added feed lines are also included in that adjustment.

Data is collected using the required detector function(s) across the frequency range 30 MHz to 25 GHz. The instrument uses a 100 kHz bandwidth detector at half-bandwidth intervals to ensure overlapping measurements. For very wide spectra, this may be done by subranges. The data sets are saved for later analysis.

Test Data
The data tables below shows the final measurement data at harmonics of the carrier. This is identified for each harmonic number n by identifying the nth multiple of the lower radio band edge, and the nth multiple of the upper radio band edge, The data record is searched to identify the frequency in this harmonic range with the largest amplitude. That frequency is selected and reported. Particularly for higher order harmonics, this frequency will often be the measurement instrumentation noise floor.

The peak spectral density of the fundamental is also identified. For many standards, the harmonics must be reduced from this fundamental level by a certain decibel ratio. This harmonic limit is calculated and used to determine compliance. Positive margin indicates that the result is compliant.

The sample is tested at low, middle, and high frequencies within the band. For some radio protocols, the data may be measured at more than one modulation data rate. A table will compare the signal level reductions at the harmonics to the signal levels at the carrier in dBc units. Also noted is the frequency at which each signal level was found. Green highlights indicate the data point with the lowest dBc ratio for each harmonic number. A yellow highlight indicates the test case for which a data plot and detailed data chart are also provided.

Harmonic	1 Mbps	Ch 01	1 Mbps	Ch 06	1 Mbps	Ch 11	11 Mbps	Ch 01	11 Mbps	Ch 06	11 Mbps	Ch 11	Min Value
#	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	dBc
Fund.	2411.95	0	2436.95	0	2461.95	0	2411.35	0	2436.45	0	2461.00	0	0
2	4823.90	67.06	4873.90	68.29	4923.90	66.93	4802.25	57.10	4940.70	57.53	4807.25	57.09	57.09
3	7235.90	58.41	7310.90	58.55	7385.90	57.59	7277.70	56.23	7271.95	56.78	7207.75	56.10	56.10
4	9647.90	71.71	9931.80	73.43	9888.35	72.21	9647.85	53.16	9747.90	53.87	9847.90	52.98	52.98
5	12169.05	71.17	12157.25	71.23	12310.70	70.50	12177.60	53.78	12302.00	55.21	12346.20	54.73	53.78
6	14476.05	68.33	14470.85	67.97	14601.70	67.75	14615.00	49.97	14566.40	51.15	14453.45	50.32	49.97
7	17265.90	66.19	17201.15	65.94	17330.95	65.97	17128.70	49.25	17160.40	49.67	17156.75	49.76	49.25
8	19782.40	65.53	19765.20	65.35	19326.95	64.27	19543.30	47.17	19306.60	47.99	19795.80	48.31	47.17
9	22067.85	63.81	22069.75	63.24	21783.60	62.99	22142.90	45.84	22337.45	45.80	22110.55	47.06	45.80
10	24807.70	61.93	24778.35	61.48	24351.90	61.38	24208.35	43.14	24802.15	44.92	24783.50	44.62	43.14

Table TR30.2: Over-all results summary

Harmonic	Frequency	Level	Limit	Margin
#	MHz	dBm	dBm	dB
Fund.	2411.35	2.23	None	None
2	4802.25	-54.87	-17.77	37.10
3	7277.70	-54.00	-17.77	36.23
4	9647.85	-50.93	-17.77	33.16
5	12177.60	-51.55	-17.77	33.78
6	14615.00	-47.73	-17.77	29.97
7	17128.70	-47.02	-17.77	29.25
8	19543.30	-44.94	-17.77	27.17
9	22142.90	-43.61	-17.77	25.84
10	24208.35	-40.91	-17.77	23.14

Table TR30.3: Detailed results for the selected test case

The graphs below show the spectral data as continuous curves. Superimposed are the harmonic data points reported in the table above. The harmonic limit line is included as a reference.

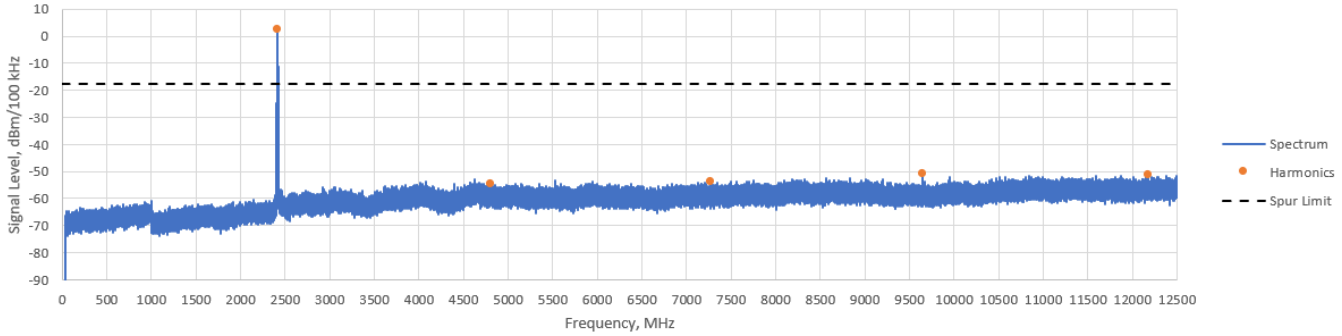


Figure TR30.1: Spectral data, 30 MHz to 12.5 GHz

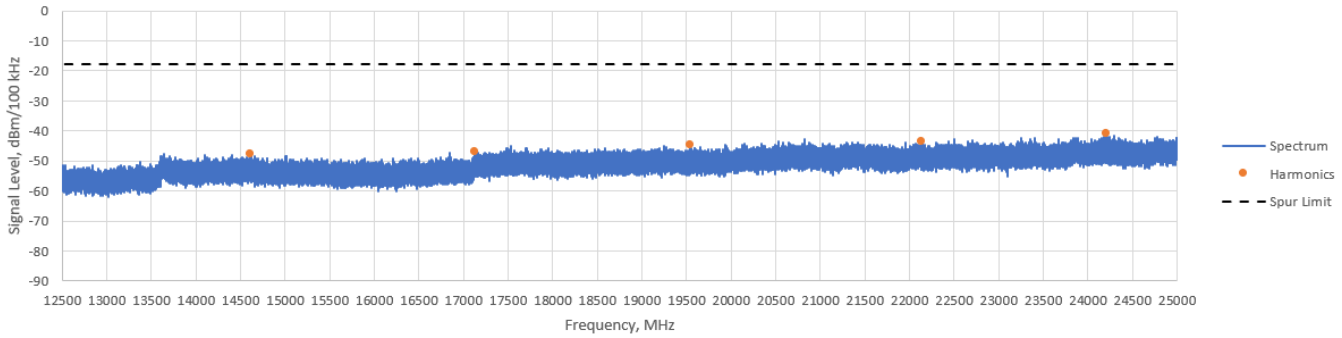


Figure TR30.2: Spectral data, 12.5 GHz to 25 GHz

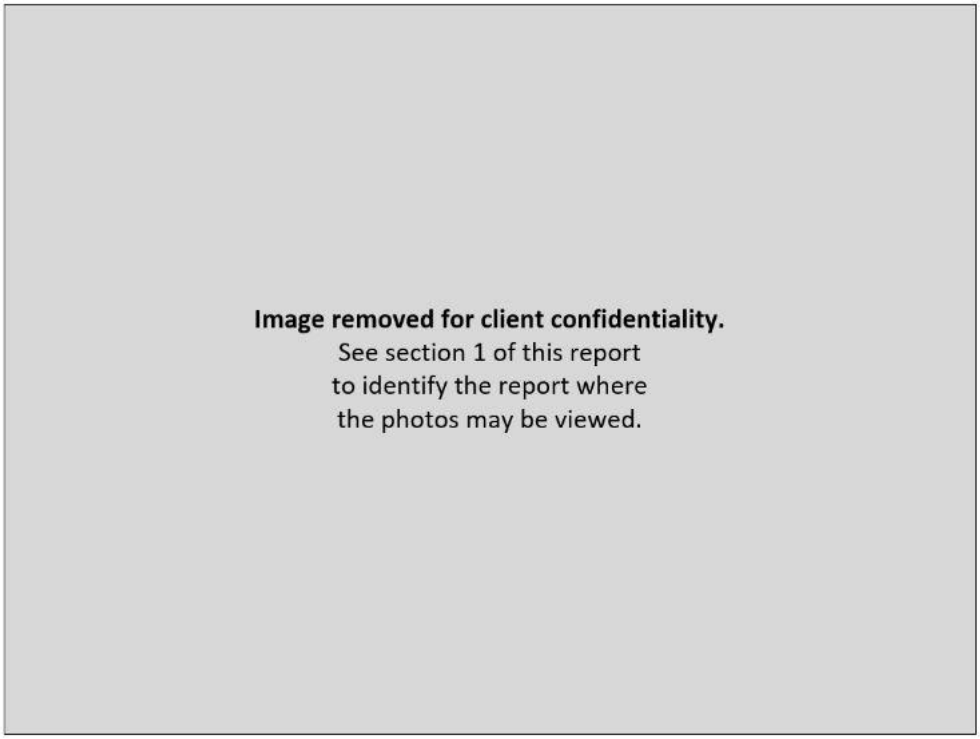


Figure TR30.3: Test setup

This line is the end of the test record.

Test Record
Conducted Spurious Emissions Test TR31
Project GCL2022

Test Date(s)	14 Oct 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	M3 (WiFi): IEEE 802.11 g
Arrangement	A2 (Radio)
Input Power	12Vdc (13.8V)
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this test record:	**17 Oct 2022**

Original record, Version A.

Test Method and Test Equipment Used
Refer to test record TR30 in this report for the list of test equipment, the statement of software used, and the explanation of the test method.

Test Data
The data tables below shows the final measurement data at harmonics of the carrier. This is identified for each harmonic number n by identifying the nth multiple of the lower radio band edge, and the nth multiple of the upper radio band edge, The data record is searched to identify the frequency in this harmonic range with the largest amplitude. That frequency is selected and reported. Particularly for higher order harmonics, this frequency will often be the measurement instrumentation noise floor.

The peak spectral density of the fundamental is also identified. For many standards, the harmonics must be reduced from this fundamental level by a certain decibel ratio. This harmonic limit is calculated and used to determine compliance. Positive margin indicates that the result is compliant.

The sample is tested at low, middle, and high frequencies within the band. For some radio protocols, the data may be measured at more than one modulation data rate. A table will compare the signal level reductions at the harmonics to the signal levels at the carrier in dBc units. Also noted is the frequency at which each signal level was found. Green highlights indicate the data point with the lowest dBc ratio for each harmonic number. A yellow highlight indicates the test case for which a data plot and detailed data chart are also provided.

Harmonic	6 Mbps	Ch 01	6 Mbps	Ch 06	6 Mbps	Ch 11	54 Mbps	Ch 01	54 Mbps	Ch 06	54 Mbps	Ch 11	Min Value
#	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	dBc
Fund.	2412.95	0	2436.35	0	2458.20	0	2411.35	0	2437.25	0	2461.60	0	0
2	4887.85	53.47	4944.35	57.58	4912.70	52.97	4895.60	52.86	4892.80	59.31	4883.90	53.58	52.86
3	7272.65	52.25	7318.65	56.07	7303.55	51.59	7373.90	53.14	7252.70	58.15	7223.00	52.62	51.59
4	9647.90	50.87	9747.85	52.22	9847.90	47.97	9921.15	50.91	9747.85	55.84	9847.90	48.99	47.97
5	12242.50	50.75	12388.35	53.80	12202.10	49.06	12343.35	50.20	12395.55	55.85	12333.00	49.76	49.06
6	14504.30	46.98	14550.80	50.28	14647.55	46.05	14712.10	47.40	14488.25	51.95	14449.40	46.41	46.05
7	17345.05	45.06	17321.70	48.50	17180.20	43.73	17162.60	45.33	17312.50	50.61	17240.10	44.22	43.73
8	19323.15	43.99	19231.20	47.51	19332.35	42.64	19364.60	43.44	19832.70	49.35	19383.10	43.16	42.64
9	22167.90	42.37	22202.85	46.01	22065.20	40.47	21654.65	42.56	22090.15	47.07	22113.95	42.72	40.47
10	24780.60	39.88	24772.85	44.20	24315.20	38.53	24461.60	41.25	24181.20	44.80	24264.55	39.40	38.53

Table TR31.1: Over-all results summary

Harmonic	Frequency	Level	Limit	Margin
#	MHz	dBm	dBm	dB
Fund.	2458.20	-2.29	None	None
2	4912.70	-55.27	-22.29	32.97
3	7303.55	-53.88	-22.29	31.59
4	9847.90	-50.26	-22.29	27.97
5	12202.10	-51.35	-22.29	29.06
6	14647.55	-48.34	-22.29	26.05
7	17180.20	-46.02	-22.29	23.73
8	19332.35	-44.93	-22.29	22.64
9	22065.20	-42.76	-22.29	20.47
10	24315.20	-40.83	-22.29	18.53

Table TR31.2: Detailed results for the selected test case

The graphs below show the spectral data as continuous curves. Superimposed are the harmonic data points reported in the table above. The harmonic limit line is included as a reference.

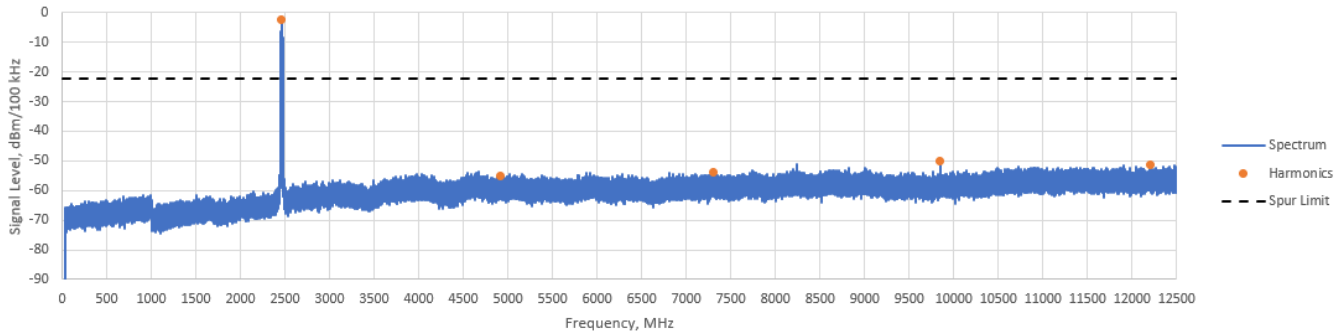


Figure TR31.1: Spectral data, 30 MHz to 12.5 GHz

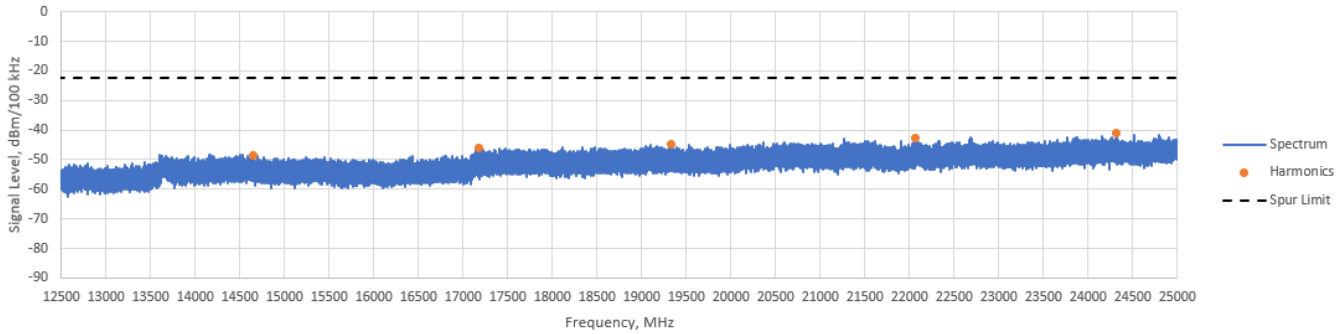


Figure TR31.2: Spectral data, 12.5 GHz to 25 GHz

This line is the end of the test record.

Test Record
Conducted Spurious Emissions Test TR32
Project GCL2022

Test Date(s)	14 Oct 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	M3 (WiFi): IEEE 802.11 n
Arrangement	A2 (Radio)
Input Power	12Vdc (13.8V)
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this test record:	**17 Oct 2022**

Original record, Version A.

Test Method and Test Equipment Used
Refer to test record TR30 in this report for the list of test equipment, the statement of software used, and the explanation of the test method.

Test Data
The data tables below shows the final measurement data at harmonics of the carrier. This is identified for each harmonic number n by identifying the nth multiple of the lower radio band edge, and the nth multiple of the upper radio band edge, The data record is searched to identify the frequency in this harmonic range with the largest amplitude. That frequency is selected and reported. Particularly for higher order harmonics, this frequency will often be the measurement instrumentation noise floor.

The peak spectral density of the fundamental is also identified. For many standards, the harmonics must be reduced from this fundamental level by a certain decibel ratio. This harmonic limit is calculated and used to determine compliance. Positive margin indicates that the result is compliant.

The sample is tested at low, middle, and high frequencies within the band. For some radio protocols, the data may be measured at more than one modulation data rate. A table will compare the signal level reductions at the harmonics to the signal levels at the carrier in dBc units. Also noted is the frequency at which each signal level was found. Green highlights indicate the data point with the lowest dBc ratio for each harmonic number. A yellow highlight indicates the test case for which a data plot and detailed data chart are also provided.

Harmonic	MSC0	Ch 01	MSC0	Ch 06	MSC0	Ch 11	MCS7	Ch 01	MCS7	Ch 06	MCS7	Ch 11	Min Value
#	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	dBc
Fund.	2409.45	0	2438.25	0	2462.60	0	2410.70	0	2437.60	0	2455.70	0	0
2	4959.85	52.29	4814.90	57.09	4893.15	51.37	4963.70	53.22	4868.05	58.17	4883.65	52.06	51.37
3	7355.35	52.01	7251.65	56.07	7273.15	49.60	7327.10	52.63	7317.80	56.59	7364.50	52.24	49.60
4	9905.65	50.15	9747.90	54.41	9847.85	46.29	9647.85	50.76	9747.85	55.49	9847.90	47.49	46.29
5	12200.45	48.62	12114.00	53.10	12028.85	48.13	12386.65	50.48	12326.15	55.45	12395.90	49.92	48.13
6	14418.35	45.68	14411.45	50.82	14485.05	44.46	14473.20	46.36	14509.80	52.50	14459.45	46.85	44.46
7	17167.45	43.55	17221.95	48.61	17180.45	42.76	17281.00	44.71	17311.95	49.56	17332.70	44.52	42.76
8	19276.85	41.96	19850.45	46.24	19650.25	41.12	19202.60	43.88	19376.05	48.81	19539.20	43.12	41.12
9	22053.40	41.36	22305.90	45.81	22110.15	39.78	22082.60	41.78	22097.70	47.13	22073.80	41.97	39.78
10	24808.35	39.26	24135.55	43.77	24756.80	36.90	24210.65	40.45	24791.10	44.30	24758.25	40.26	36.90

Table TR32.1: Over-all results summary

Harmonic	Frequency	Level	Limit	Margin
#	MHz	dBm	dBm	dB
Fund.	2462.60	-3.76	None	None
2	4893.15	-55.12	-23.76	31.37
3	7273.15	-53.36	-23.76	29.60
4	9847.85	-50.05	-23.76	26.29
5	12028.85	-51.88	-23.76	28.13
6	14485.05	-48.22	-23.76	24.46
7	17180.45	-46.52	-23.76	22.76
8	19650.25	-44.88	-23.76	21.12
9	22110.15	-43.54	-23.76	19.78
10	24756.80	-40.66	-23.76	16.90

Table TR32.2: Detailed results for the selected test case

The graphs below show the spectral data as continuous curves. Superimposed are the harmonic data points reported in the table above. The harmonic limit line is included as a reference.

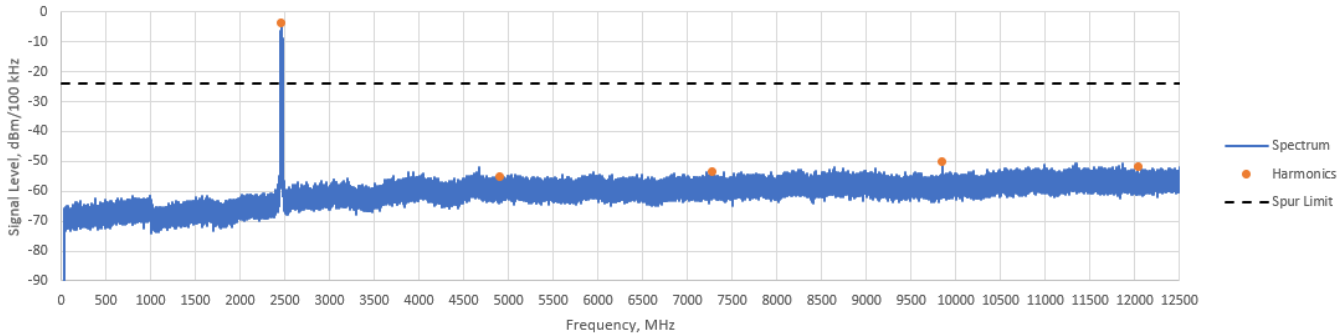


Figure TR32.1: Spectral data, 30 MHz to 12.5 GHz

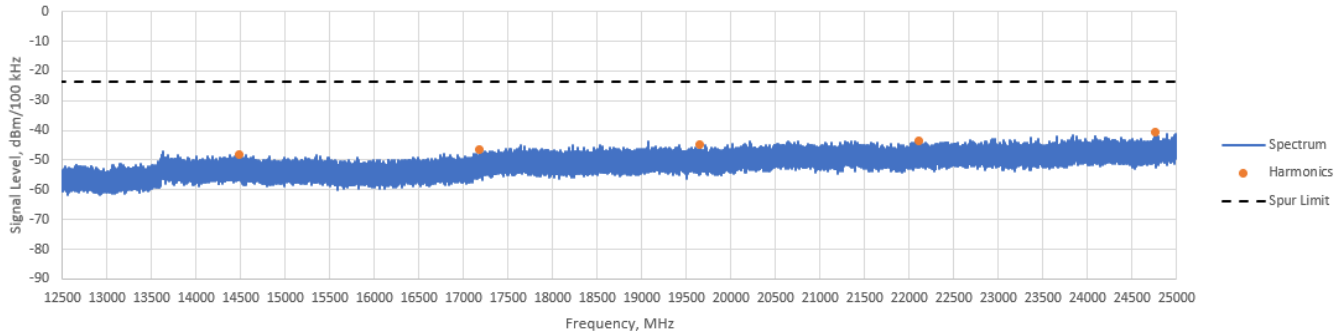


Figure TR32.2: Spectral data, 12.5 GHz to 25 GHz

This line is the end of the test record.

Test Record
Conducted Spurious Emissions Test TR33
Project GCL2022

Test Date(s)	14 Oct 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	M4 (BLE)
Arrangement	A2 (Radio)
Input Power	12Vdc (13.8V)
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this test record:	**17 Oct 2022**

Original record, Version A.

Test Method and Test Equipment Used
Refer to test record TR30 in this report for the list of test equipment, the statement of software used, and the explanation of the test method.

Test Data
The data tables below shows the final measurement data at harmonics of the carrier. This is identified for each harmonic number n by identifying the nth multiple of the lower radio band edge, and the nth multiple of the upper radio band edge, The data record is searched to identify the frequency in this harmonic range with the largest amplitude. That frequency is selected and reported. Particularly for higher order harmonics, this frequency will often be the measurement instrumentation noise floor.

The peak spectral density of the fundamental is also identified. For many standards, the harmonics must be reduced from this fundamental level by a certain decibel ratio. This harmonic limit is calculated and used to determine compliance. Positive margin indicates that the result is compliant.

The sample is tested at low, middle, and high frequencies within the band. For some radio protocols, the data may be measured at more than one modulation data rate. A table will compare the signal level reductions at the harmonics to the signal levels at the carrier in dBc units. Also noted is the frequency at which each signal level was found. Green highlights indicate the data point with the lowest dBc ratio for each harmonic number. A yellow highlight indicates the test case for which a data plot and detailed data chart are also provided.

Harmonic	1 Mbps	2402 MHz	1 Mbps	2442 MHz	1 Mbps	2480 MHz	Min Value
#	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	dB
Fund.	2401.95	0	2401.95	0	2479.95	0	0
2	4966.15	44.35	4966.15	44.35	4961.35	45.05	44.35
3	7259.70	43.92	7259.70	43.92	7320.75	43.61	43.61
4	9837.40	43.85	9837.40	43.85	9920.90	39.13	39.13
5	12263.10	42.02	12263.10	42.02	12210.60	41.52	41.52
6	14575.05	38.39	14575.05	38.39	14401.65	37.80	37.80
7	17344.65	36.55	17344.65	36.55	17294.15	36.16	36.16
8	19571.55	35.15	19571.55	35.15	19758.50	33.78	33.78
9	22103.90	33.60	22103.90	33.60	21601.80	33.87	33.60
10	24777.25	32.24	24777.25	32.24	24486.95	31.45	31.45

Table TR33.1: Over-all results summary

Harmonic	Frequency	Level	Limit	Margin
#	MHz	dBm	dBm	dB
Fund.	2479.95	-20.12	None	None
2	4961.35	-65.17	-40.12	25.05
3	7320.75	-63.73	-40.12	23.61
4	9920.90	-59.25	-40.12	19.13
5	12210.60	-61.64	-40.12	21.52
6	14401.65	-57.92	-40.12	17.80
7	17294.15	-56.28	-40.12	16.16
8	19758.50	-53.90	-40.12	13.78
9	21601.80	-53.99	-40.12	13.87
10	24486.95	-51.57	-40.12	11.45

Table TR33.2: Detailed results for the selected test case

The graphs below show the spectral data as continuous curves. Superimposed are the harmonic data points reported in the table above. The harmonic limit line is included as a reference.

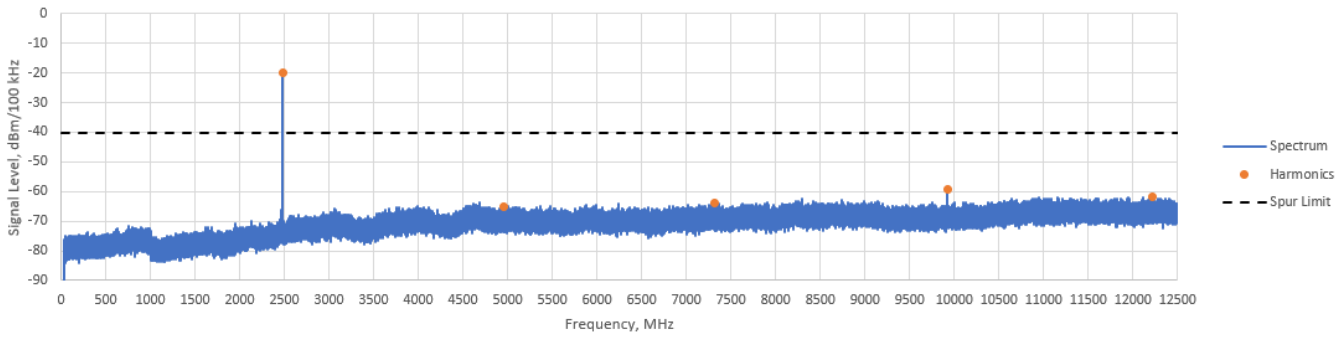


Figure TR33.1: Spectral data, 30 MHz to 12.5 GHz

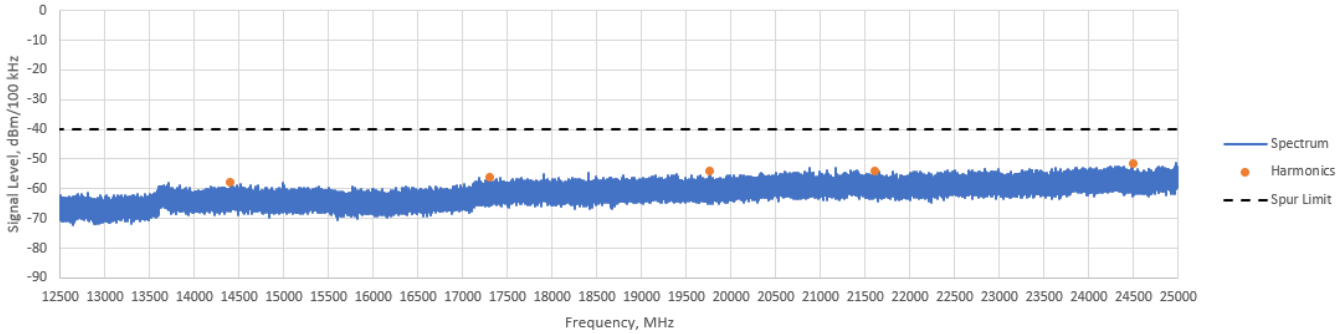


Figure TR33.2: Spectral data, 12.5 GHz to 25 GHz

This line is the end of the test record.

Test Record
Conducted Spurious Emissions Test TR34
Project GCL2022

Test Date(s)	14 Oct 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	M5 (ANT)
Arrangement	A2 (Radio)
Input Power	12Vdc (13.8V)
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-210 (as noted in Section 6 of the report).
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this test record:	**17 Oct 2022**

Original record, Version A.

Test Method and Test Equipment Used
Refer to test record TR30 in this report for the list of test equipment, the statement of software used, and the explanation of the test method.

Test Data
The data tables below shows the final measurement data at harmonics of the carrier. This is identified for each harmonic number n by identifying the nth multiple of the lower radio band edge, and the nth multiple of the upper radio band edge, The data record is searched to identify the frequency in this harmonic range with the largest amplitude. That frequency is selected and reported. Particularly for higher order harmonics, this frequency will often be the measurement instrumentation noise floor.

The peak spectral density of the fundamental is also identified. For many standards, the harmonics must be reduced from this fundamental level by a certain decibel ratio. This harmonic limit is calculated and used to determine compliance. Positive margin indicates that the result is compliant.

The sample is tested at low, middle, and high frequencies within the band. For some radio protocols, the data may be measured at more than one modulation data rate. A table will compare the signal level reductions at the harmonics to the signal levels at the carrier in dBc units. Also noted is the frequency at which each signal level was found. Green highlights indicate the data point with the lowest dBc ratio for each harmonic number. A yellow highlight indicates the test case for which a data plot and detailed data chart are also provided.

Harmonic	ANT	2402 MHz	ANT	2442 MHz	ANT	2480 MHz	Min Value
#	Frq, MHz	dBc	Frq, MHz	dBc	Frq, MHz	dBc	dB
Fund.	2401.90	0	2441.95	0	2479.95	0	0
2	4932.85	40.77	4913.00	42.30	4946.70	41.19	40.77
3	7433.50	39.22	7227.40	41.17	7264.75	40.83	39.22
4	9888.80	38.50	9768.60	41.32	9632.70	39.71	38.50
5	12405.65	37.23	12213.30	39.87	12123.30	37.53	37.23
6	14635.25	33.84	14507.90	36.33	14404.10	35.33	33.84
7	17260.30	32.16	17305.95	34.44	17284.00	33.00	32.16
8	19419.95	30.70	19424.25	33.13	19424.55	30.83	30.70
9	21756.15	28.90	22252.80	31.53	22074.35	27.77	27.77
10	24322.95	26.56	24783.50	29.75	24725.20	27.84	26.56

Table TR34.1: Over-all results summary

Harmonic	Frequency	Level	Limit	Margin
#	MHz	dBm	dBm	dB
Fund.	2401.90	-24.57	None	None
2	4932.85	-65.33	-44.57	20.77
3	7433.50	-63.79	-44.57	19.22
4	9888.80	-63.07	-44.57	18.50
5	12405.65	-61.80	-44.57	17.23
6	14635.25	-58.41	-44.57	13.84
7	17260.30	-56.73	-44.57	12.16
8	19419.95	-55.27	-44.57	10.70
9	21756.15	-53.47	-44.57	8.90
10	24322.95	-51.13	-44.57	6.56

Table TR34.2: Detailed results for the selected test case

The graphs below show the spectral data as continuous curves. Superimposed are the harmonic data points reported in the table above. The harmonic limit line is included as a reference.

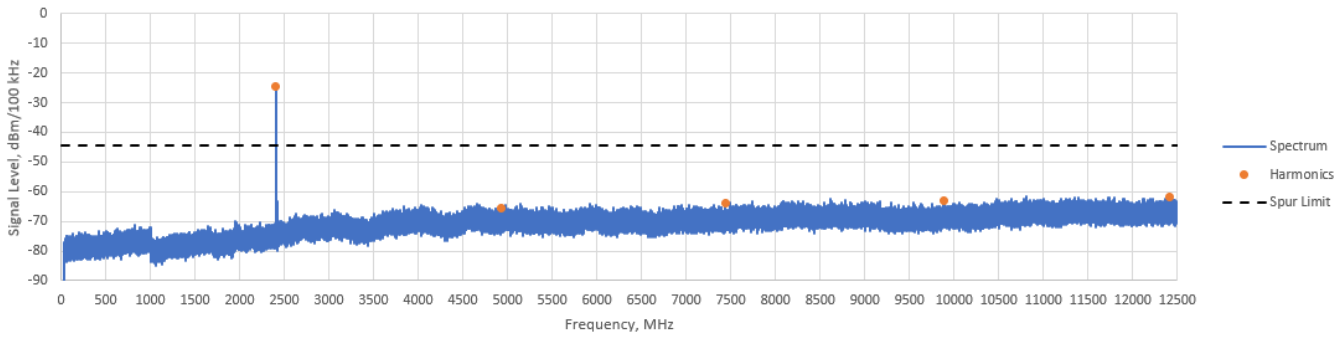


Figure TR34.1: Spectral data, 30 MHz to 12.5 GHz

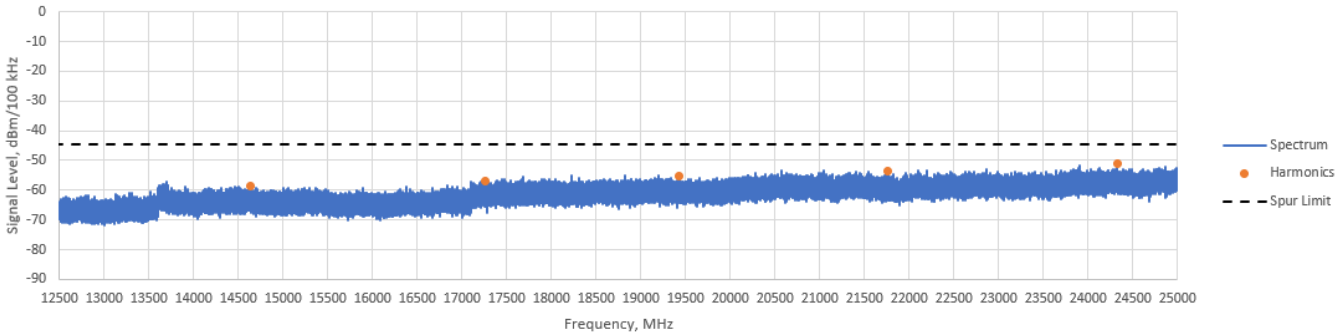


Figure TR34.2: Spectral data, 12.5 GHz to 25 GHz

This line is the end of the test record.

Test Record
Radiated Emission Test RE5-RE9
Project GCL0200

Test Date(s)	18 Aug 2022
Test Personnel	David Kerr
Product Model	A04396
Serial Number tested	3425814561
Operating Mode	M3 (WiFi), M4 (BLE), M5 (ANT)
Arrangement	A1 (Full)
Input Power	13.8 Vdc
Test Standards:	FCC Part 15C, ANSI C63.10, RSS-210, RSS-247 (as noted in Section 6 of the report).
Frequency Range:	FCC Restricted Bands
Pass/Fail Judgment:	**PASS**

Test record created by: Majid Farah
Date of this record: 12 Sep 2022

Original record, Version A.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Tape measure, 1" x 33'	Lufkin	PHV1410CMEN	10720	3-Jan-2020	7-Jan-2023
Thermohygrometer	Mannix	CMM880	10319186	26-May-2021	1-Jun-2024
FSOATS 3m, above 1 GHz	Frankonia	SAC3	F199004	4-Nov-2021	4-Nov-2024
Antenna, Horn, 1-18 GHz	ETS Lindgren	3117	00227596	27-Aug-2021	1-Sep-2023
Preamplifier, 500 MHz 18 GHz	Com-Power	PAM-118A	18040133	Cal bration	Not Required
Wifi Filter	K&L	8NSL26-2437/E82.2-0/0	1	Calibration	Not Required
DMM Multimeter	FLUKE	79 III	71740743	18-Apr-2022	15-Apr-2023
MXE Receiver 44GHz	Keysight	N9038A	MY56400055	18-Oct-2021	18-Oct-2022

Table RE5.1 Test equipment used

Test Software Used: Keysight MXE System Code rev. A.30.11, RE Signal Maximization tool v2021Feb25.xls

Test Data

The radiated emission test process began 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 frequency bands required for restricted band 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.

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 support table height was 1.5 m and the antenna was boresighted to this height.

The table shows the selected final measurement data across the pair of restricted bands covered by 2400 – 2390 MHz, as well as the restricted bands from 2483.5 – 2500 MHz. It includes at least the strongest emissions observed for Peak and Average detectors, and may include other data points of interest. The test limit is the FCC & Industry Canada Class B Limit at 3m.

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2387.5	54	74	N/A	47.594	N/A	26.406	116	1934	VERT
2398.8	54	74	34.067	N/A	19.933	N/A	116	1934	VERT

Table RE5.2 IEEE 802.11 B 5.5 Mbps Ch 1

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2385	54	74	N/A	45.077	N/A	28.923	110	1853	VERT
2387.3	54	74	33.101	N/A	20.899	N/A	110	1853	VERT

Table RE5.3 IEEE 802.11 B 5.5 Mbps Ch 2

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2494.8	54	74	N/A	45.231	N/A	28.769	147	2381	VERT
2483.8	54	74	33.491	N/A	20.509	N/A	147	2381	VERT

Table RE5.4 IEEE 802.11 B 5.5 Mbps Ch 10

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2491.3	54	74	N/A	45.674	N/A	28.326	160	2683	VERT
2483.5	54	74	33.614	N/A	20.386	N/A	160	2683	VERT

Table RE5.5 IEEE 802.11 B 5.5 Mbps Ch 11

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

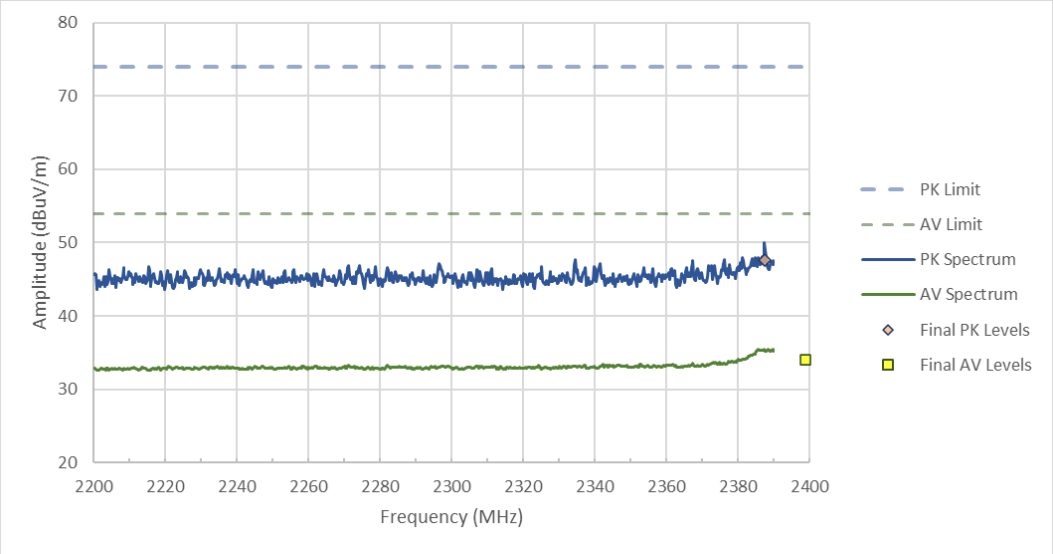


Figure RE5.1 IEEE 802.11 B 5.5 Mbps Ch 1

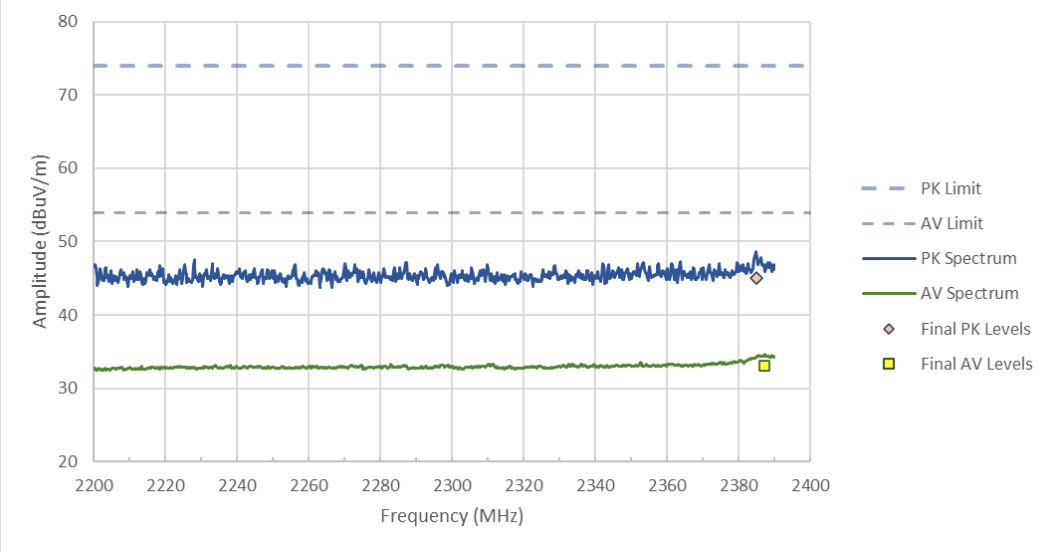


Figure RE5.2 IEEE 802.11 B 5.5 Mbps Ch 2

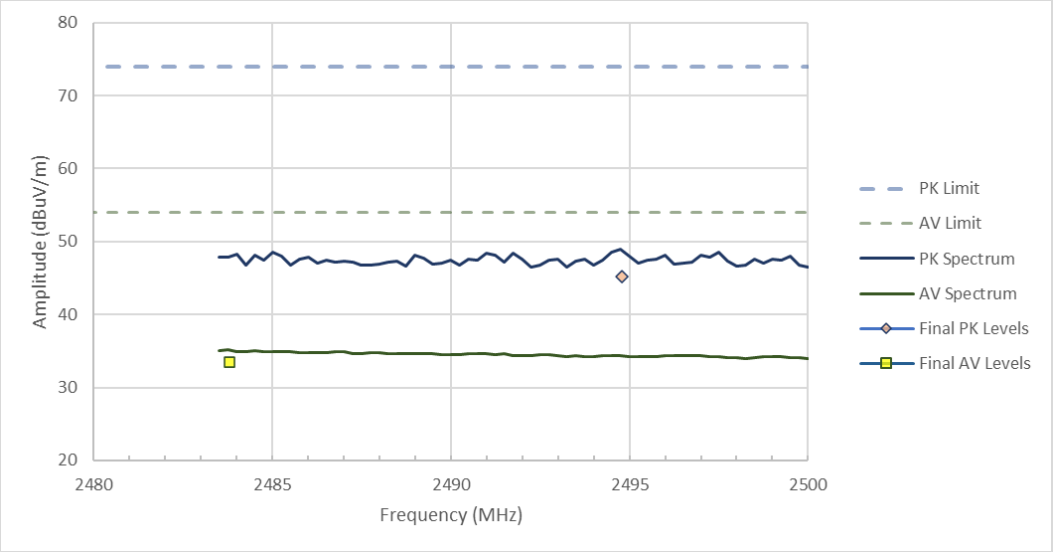


Figure RE5.3 IEEE 802.11 B 5.5 Mbps Ch 10

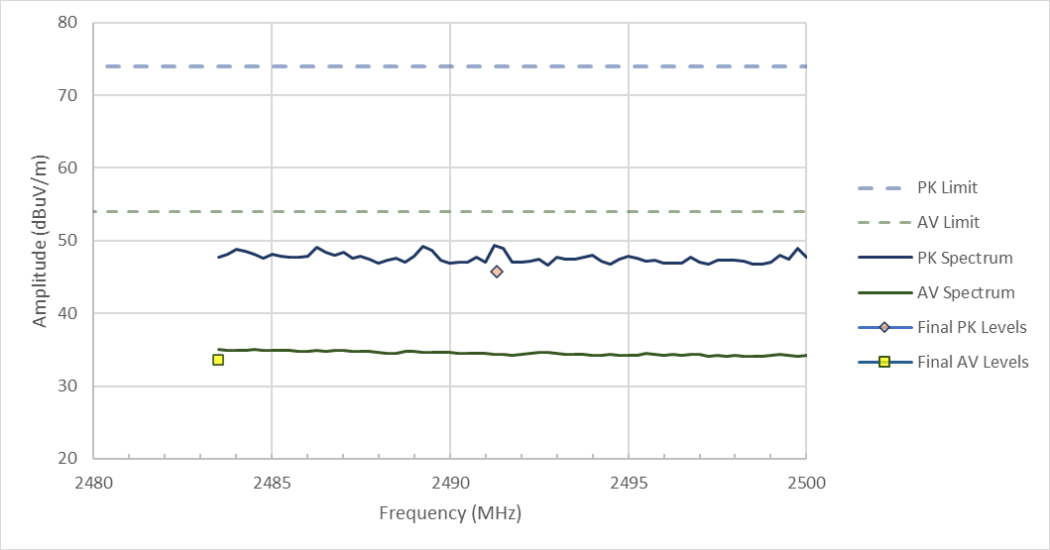


Figure RE5.4 IEEE 802.11 B 5.5 Mbps Ch 11

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2387.3	54	74	N/A	48.43	N/A	25.57	116	1934	VERT
2386.5	54	74	34.051	N/A	19.949	N/A	116	1934	VERT

Table RE5.6 IEEE 802.11 B 11 Mbps Ch 1

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2249.8	54	74	N/A	45.579	N/A	28.421	110	1853	VERT
2387.3	54	74	33.049	N/A	20.951	N/A	110	1853	VERT

Table RE5.7 IEEE 802.11 B 11 Mbps Ch 2

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2484.3	54	74	N/A	45.595	N/A	28.405	147	2381	VERT
2483.5	54	74	33.564	N/A	20.436	N/A	147	2381	VERT

Table RE5.8 IEEE 802.11 B 11 Mbps Ch 10

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2486.3	54	74	N/A	46.217	N/A	27.783	160	2683	VERT
2487	54	74	33.202	N/A	20.798	N/A	160	2683	VERT

Table RE5.9 IEEE 802.11 B 11 Mbps Ch 11

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

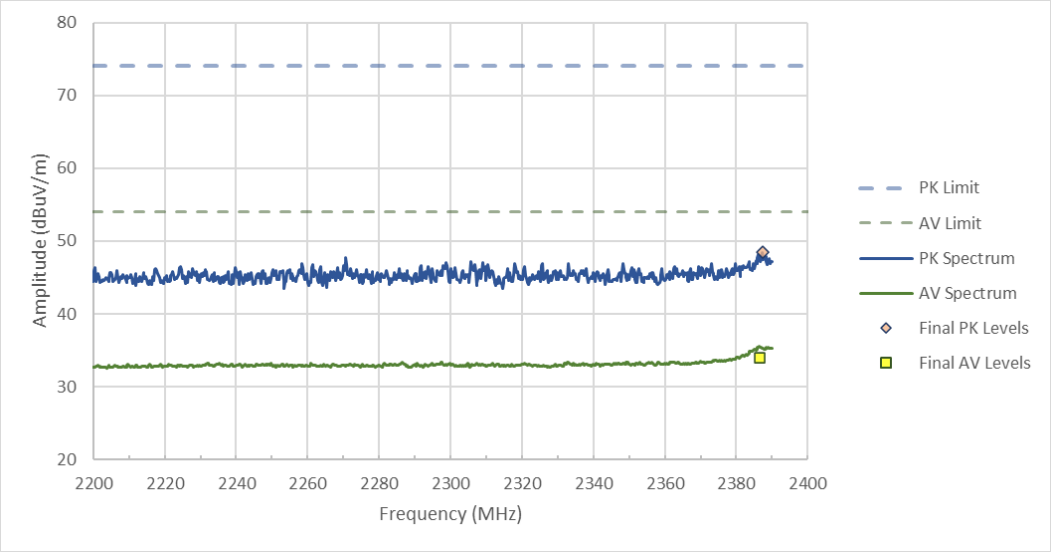


Figure RE5.5 IEEE 802.11 B 11 Mbps Ch 1

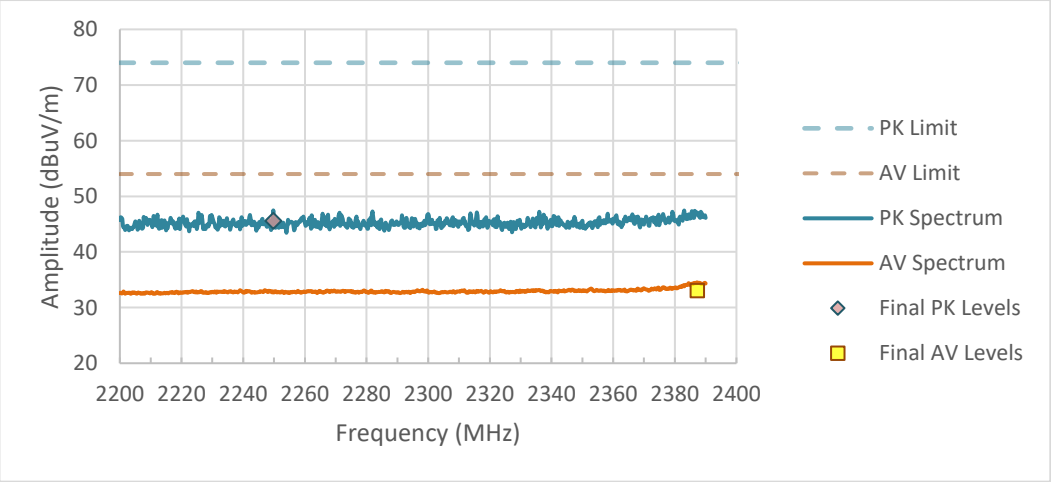


Figure RE5.6 IEEE 802.11 B 11 Mbps Ch 2

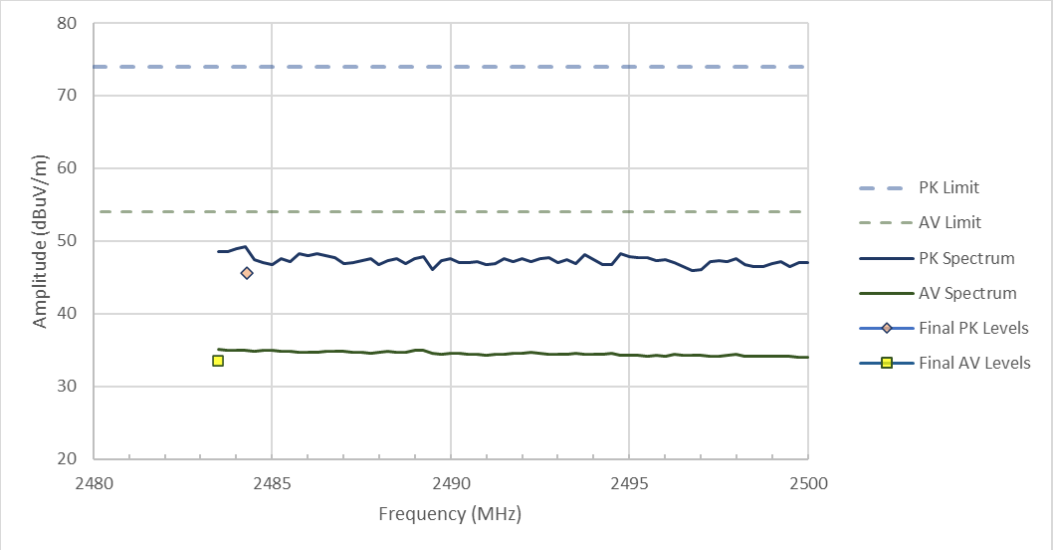


Figure RE5.7 IEEE 802.11 B 11 Mbps Ch 10

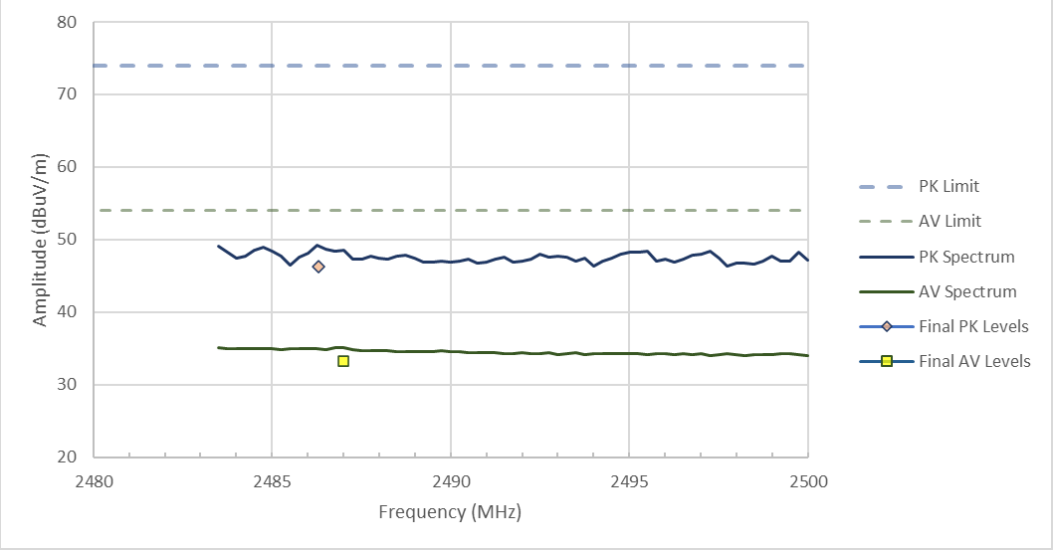


Figure RE5.8 IEEE 802.11 B 11 Mbps Ch 11

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2388.8	54	74	N/A	52.48	N/A	21.52	116	1934	VERT
2387	54	74	39.058	N/A	14.942	N/A	116	1934	VERT

Table RE5.10 IEEE 802.11 G 6 Mbps Ch 1

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2386.5	54	74	N/A	49.608	N/A	24.392	110	1853	VERT
2388.3	54	74	36.72	N/A	17.28	N/A	110	1853	VERT

Table RE5.11 IEEE 802.11 G 6 Mbps Ch 2

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2484.5	54	74	N/A	49.012	N/A	24.988	147	2381	VERT
2484.8	54	74	35.695	N/A	18.305	N/A	147	2381	VERT

Table RE5.12 IEEE 802.11 G 6 Mbps Ch 10

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2483.8	54	74	N/A	47.504	N/A	26.496	160	2683	VERT
2483.5	54	74	35.069	N/A	18.931	N/A	160	2683	VERT

Table RE5.13 IEEE 802.11 G 6 Mbps Ch 11

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

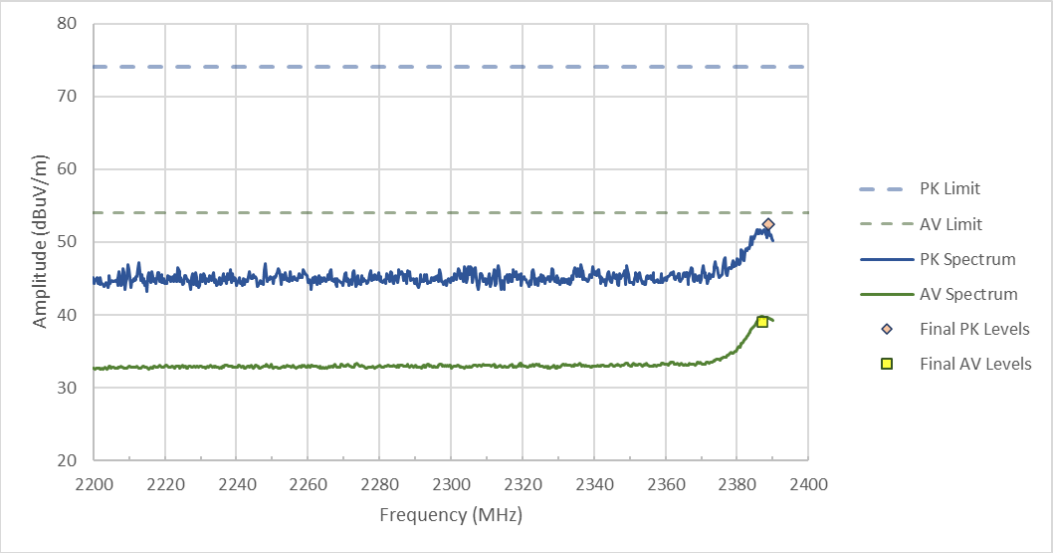


Figure RE5.9 IEEE 802.11 G 6 Mbps Ch 1

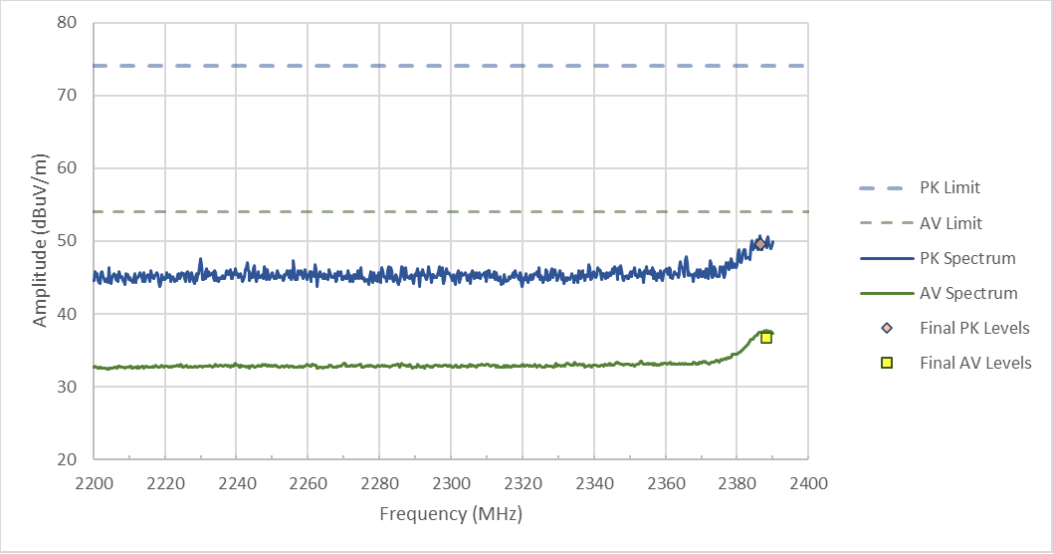


Figure RE5.10 IEEE 802.11 G 6 Mbps Ch 2

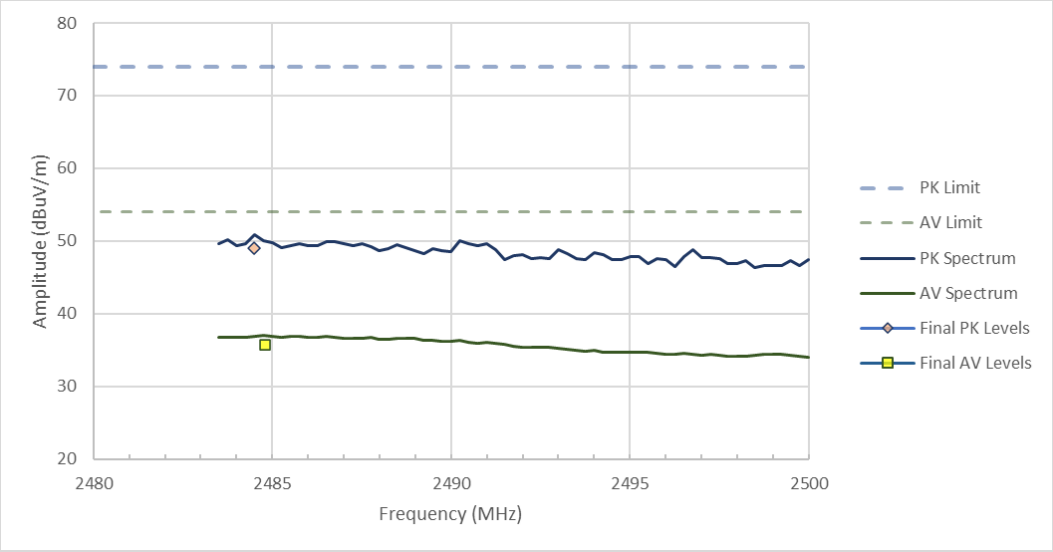


Figure RE5.12 IEEE 802.11 G 6 Mbps Ch 10

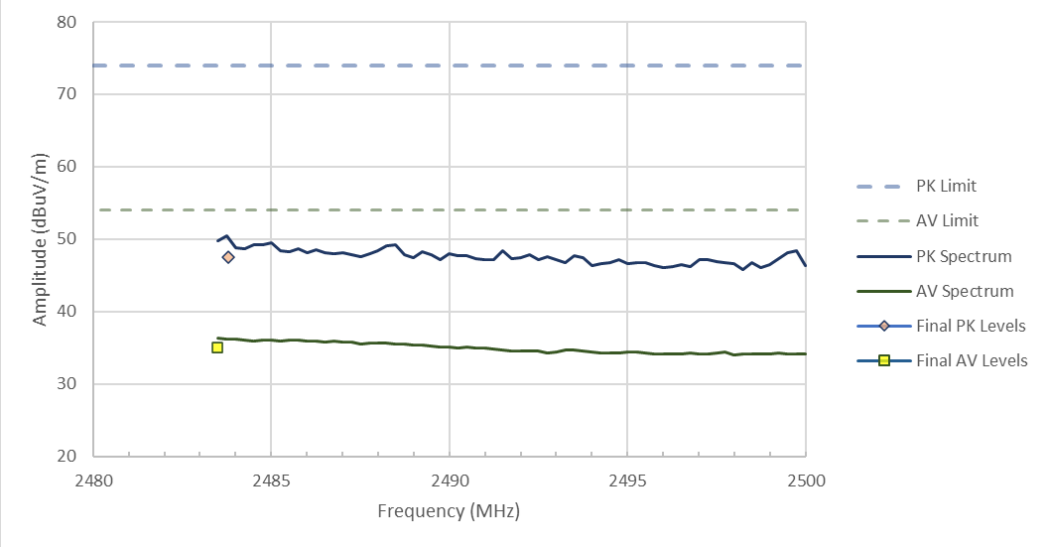


Figure RE5.12 IEEE 802.11 G 6 Mbps Ch 11

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2388.3	54	74	N/A	53.041	N/A	20.959	116	1934	VERT
23867.8	54	74	38.443	N/A	15.557	N/A	116	1934	VERT

Table RE5.14 IEEE 802.11 G 54 Mbps Ch 1

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2385.8	54	74	N/A	49.784	N/A	24.216	110	1853	VERT
23875	54	74	36.426	N/A	17.574	N/A	110	1853	VERT

Table RE5.15 IEEE 802.11 G 54 Mbps Ch 2

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2487.3	54	74	N/A	47.91	N/A	26.09	147	2381	VERT
2483.8	54	74	35.523	N/A	18.477	N/A	147	2381	VERT

Table RE5.16 IEEE 802.11 G 54 Mbps Ch 10

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2483.5	54	74	N/A	47.783	N/A	26.217	160	2683	VERT
2483.5	54	74	35.013	N/A	18.987	N/A	160	2683	VERT

Table RE5.17 IEEE 802.11 G 54 Mbps Ch 11

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

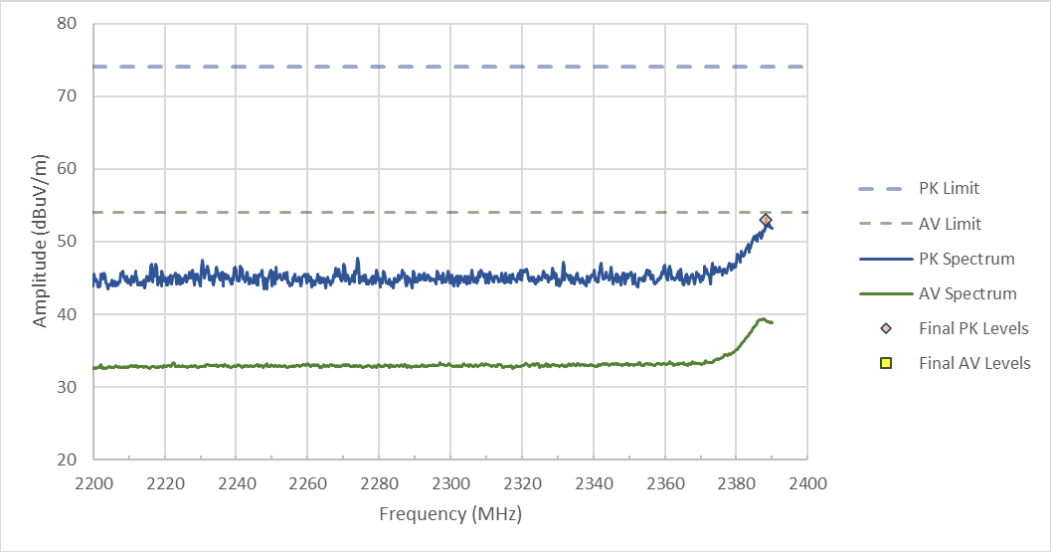


Figure RE5.13 IEEE 802.11 G 54 Mbps Ch 1

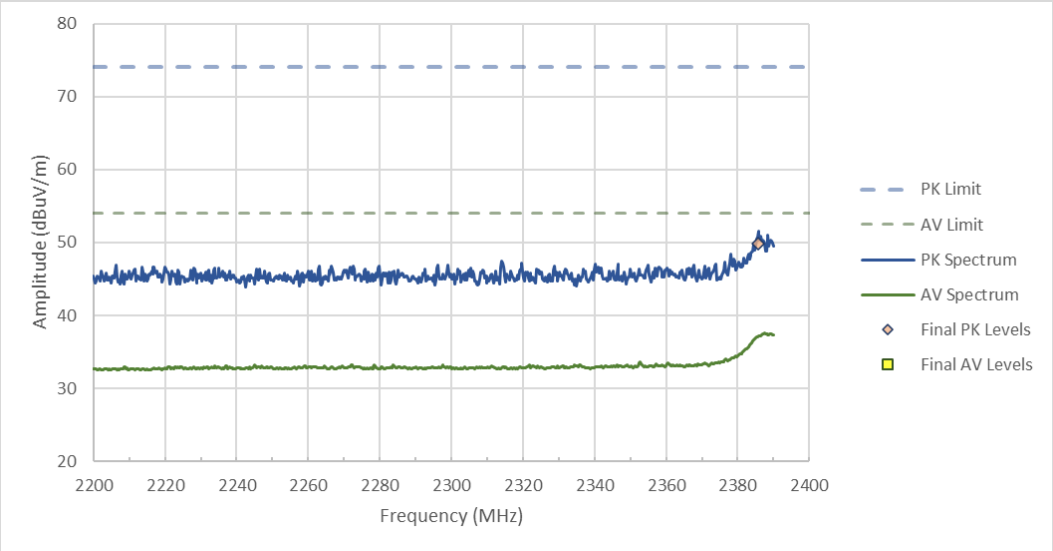


Figure RE5.14 IEEE 802.11 G 54 Mbps Ch 2

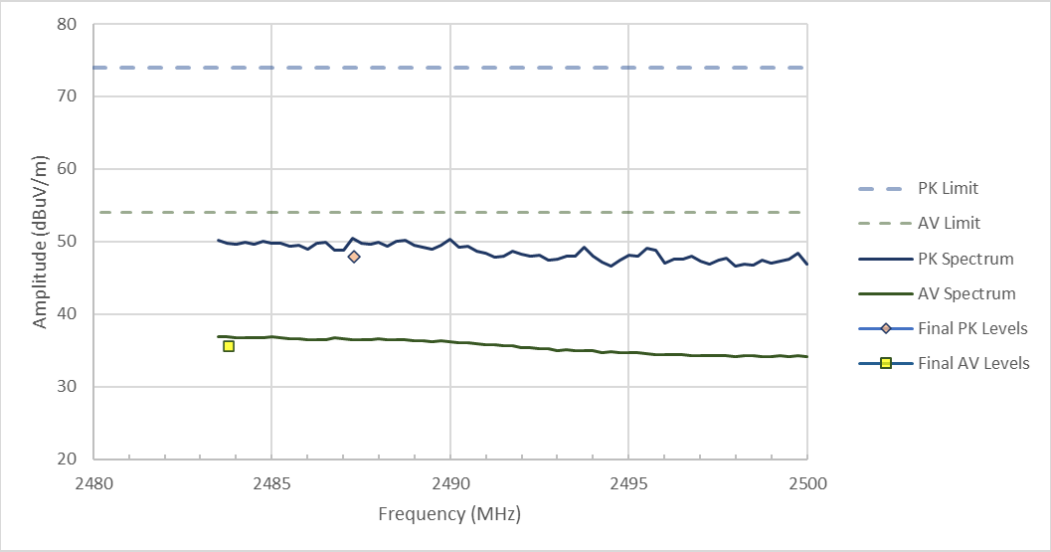


Figure RE5.15 IEEE 802.11 G 54 Mbps Ch 10

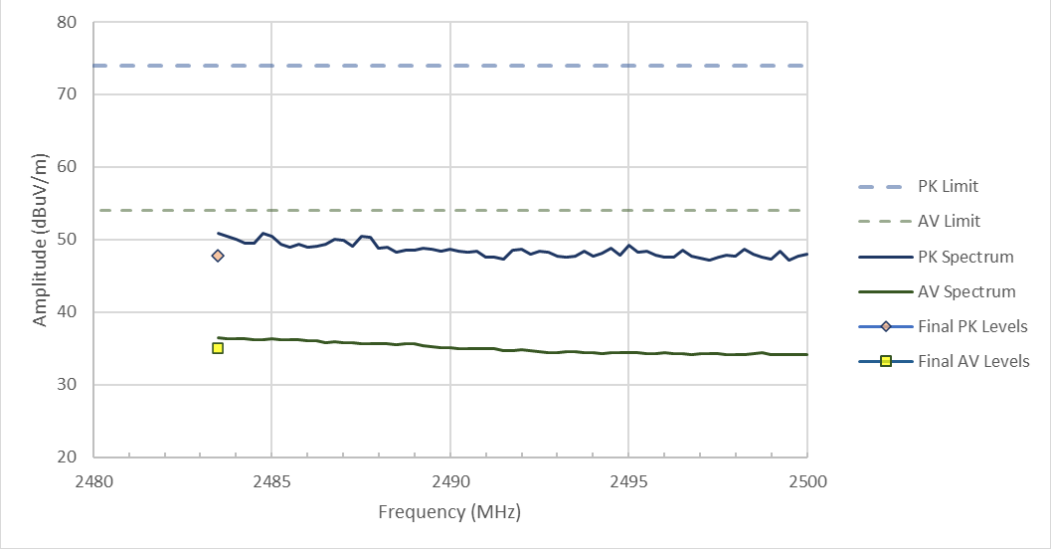


Figure RE5.16 IEEE 802.11 G 54 Mbps Ch 11

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2388.5	54	74	N/A	51.886	N/A	22.114	116	1934	VERT
2387.3	54	74	38.386	N/A	15.614	N/A	116	1934	VERT

Table RE5.18 IEEE 802.11 N MCS0 Ch 1

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
23855	54	74	N/A	50.098	N/A	23.902	110	1853	VERT
2388	54	74	36.336	N/A	17.664	N/A	110	1853	VERT

Table RE5.19 IEEE 802.11 N MCS0 Ch 2

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2487.8	54	74	N/A	48.11	N/A	25.89	147	2381	VERT
2483.5	54	74	35.939	N/A	18.061	N/A	147	2381	VERT

Table RE5.20 IEEE 802.11 N MCS0 Ch 10

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2488.5	54	74	N/A	47.885	N/A	26.115	160	2683	VERT
24835	54	74	35.025	N/A	18.975	N/A	160	2683	VERT

Table RE5.21 IEEE 802.11 N MCS0 Ch 11

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

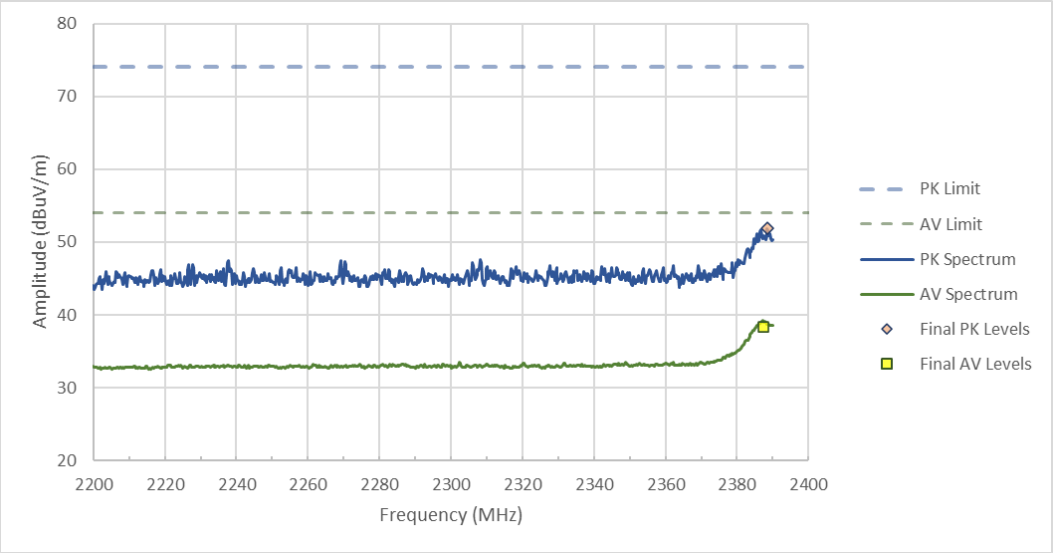


Figure RE5.17 IEEE 802.11 N MCS0 Ch 1

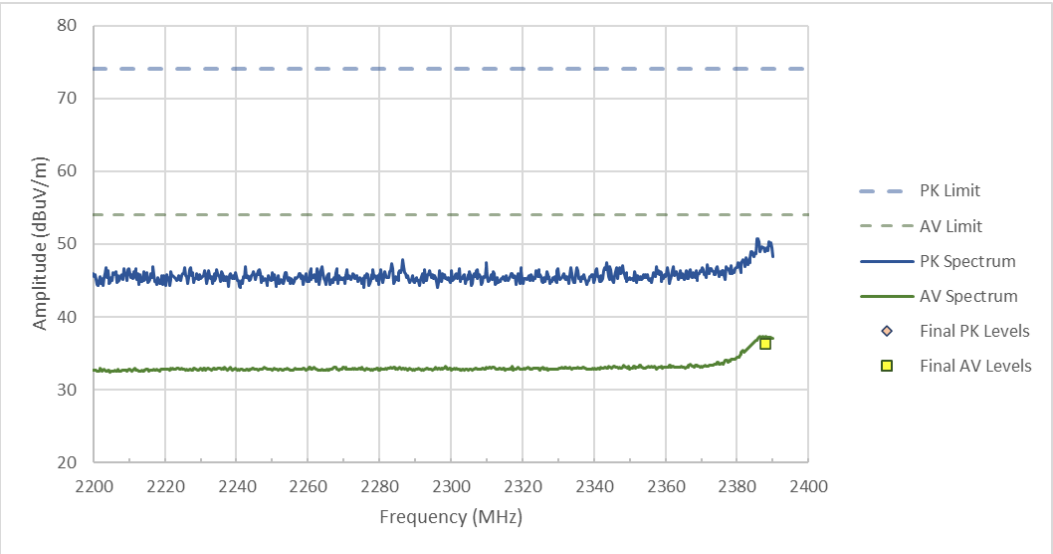


Figure RE5.18 IEEE 802.11 N MCS0 Ch 2

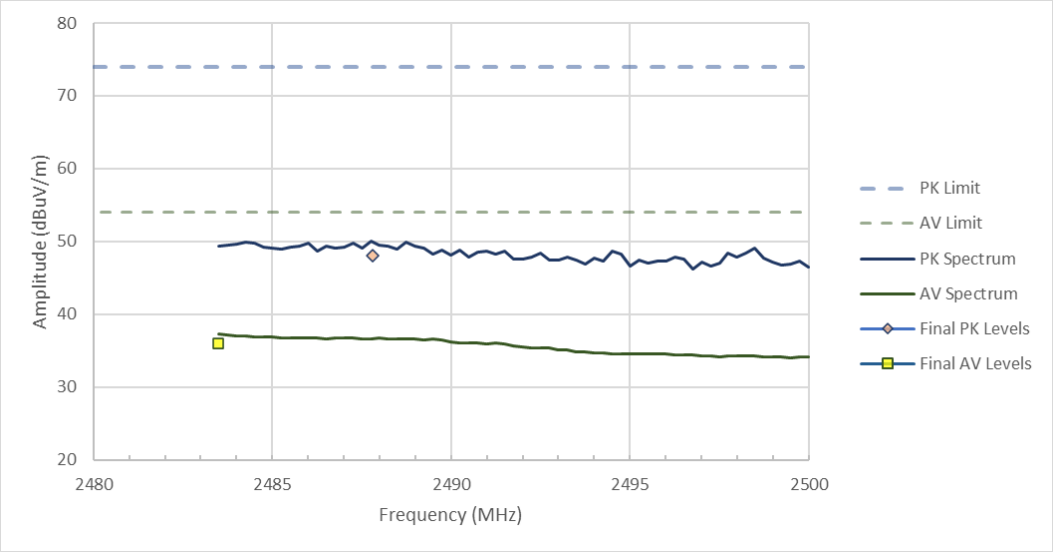


Figure RE5.19 IEEE 802.11 N MCS0 Ch 10

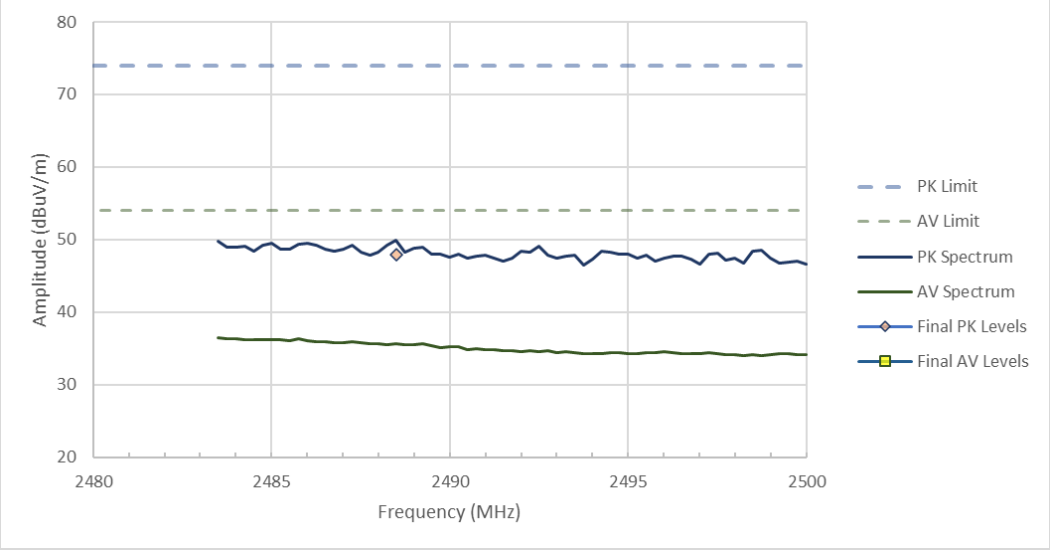


Figure RE5.20 IEEE 802.11 N MCS0 Ch 11

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2386	54	74	N/A	50.778	N/A	23.222	116	1934	VERT
2387.3	54	74	37.745	N/A	16.255	N/A	116	1934	VERT

Table RE5.22 IEEE 802.11 N MCS7 Ch 1

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2389	54	74	N/A	50.106	N/A	23.894	110	1853	VERT
2387.3	54	74	35.934	N/A	18.066	N/A	110	1853	VERT

Table RE5.23 IEEE 802.11 N MCS7 Ch 2

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2483.8	54	74	N/A	49.37	N/A	24.63	147	2381	VERT
2483.8	54	74	35.601	N/A	18.399	N/A	147	2381	VERT

Table RE5.24 IEEE 802.11 N MCS7 Ch 10

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2483.8	54	74	N/A	48.17	N/A	25.83	160	2683	VERT
2483.8	54	74	34.789	N/A	19.211	N/A	160	2683	VERT

Table RE5.25 IEEE 802.11 N MCS7 Ch 11

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

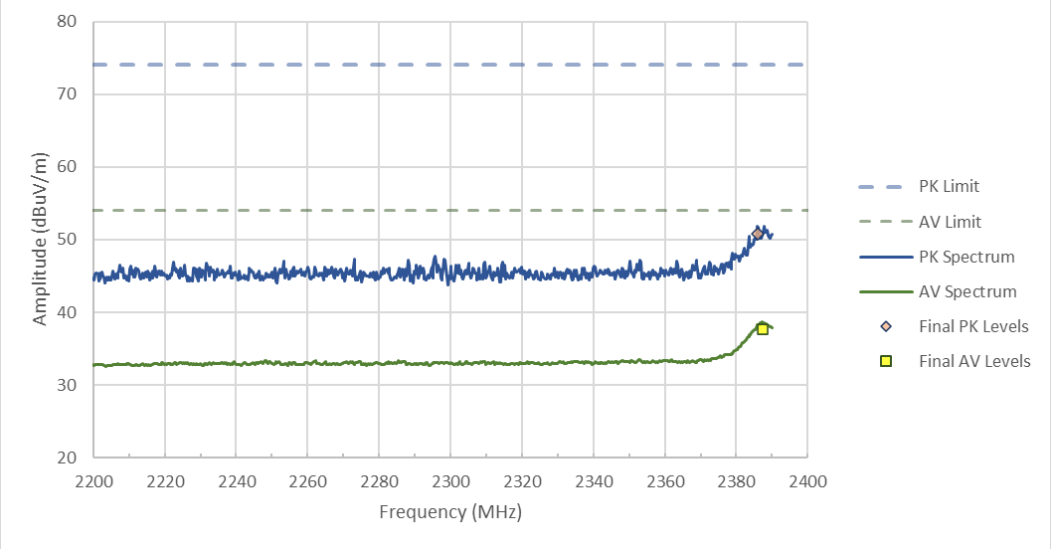


Figure RE5.21 IEEE 802.11 N MCS7 Ch 1

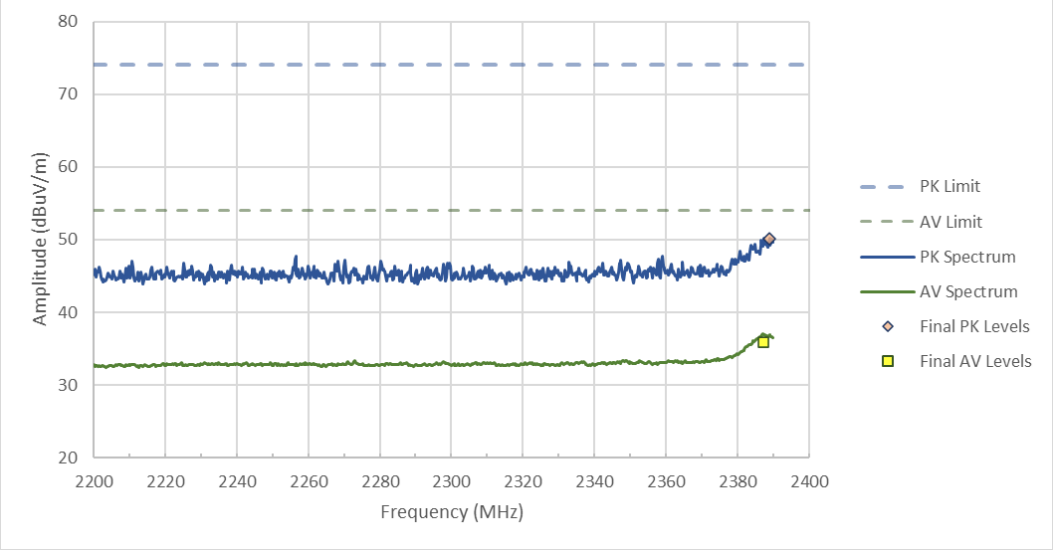


Figure RE5.22 IEEE 802.11 N MCS7 Ch 2

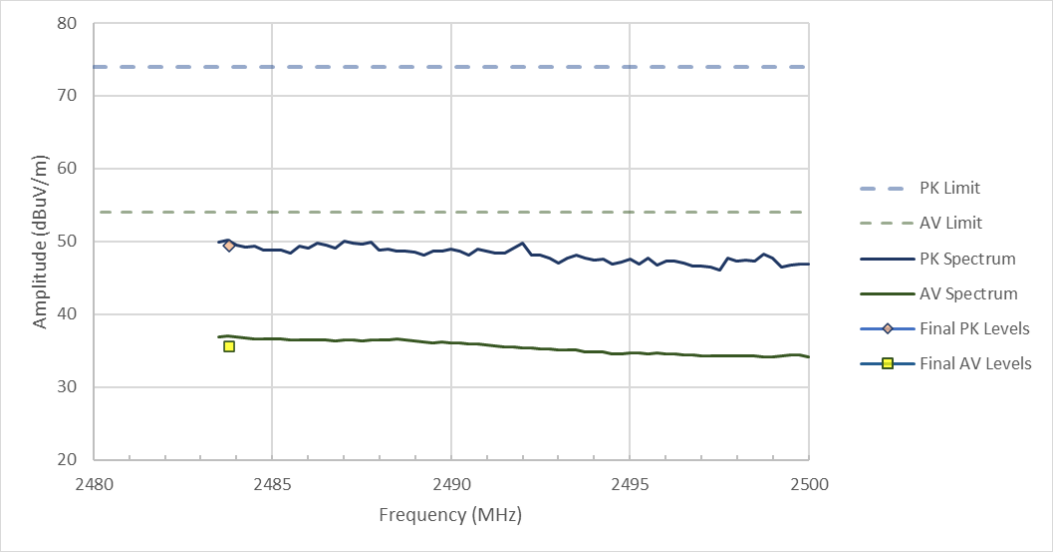


Figure RE5.23 IEEE 802.11 N MCS7 Ch 10

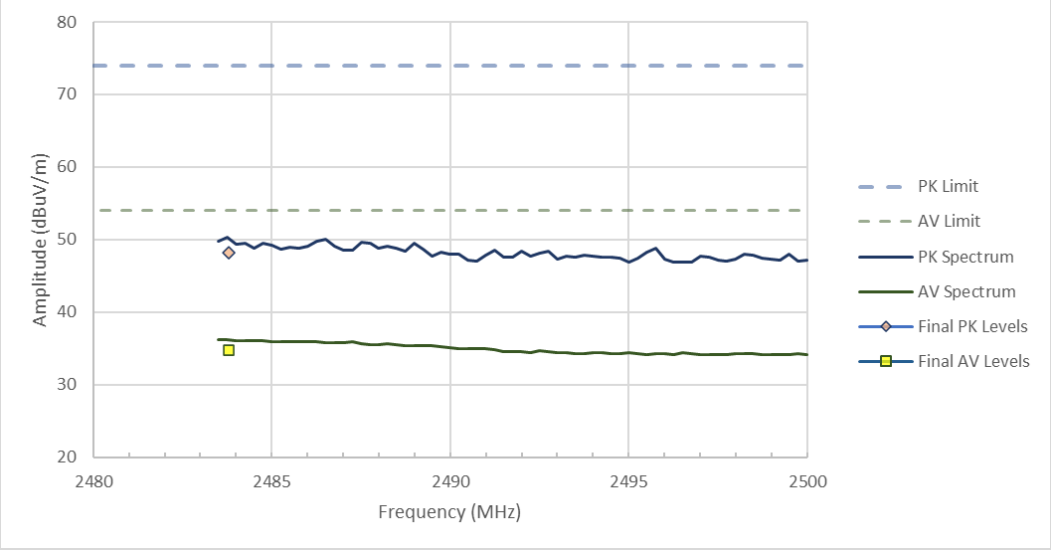


Figure RE5.24 IEEE 802.11 N MCS7 Ch 11

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2350.8	54	74	N/A	44.291	N/A	29.709	116	1934	VERT
2390	54	74	32.391	N/A	21.609	N/A	116	1934	VERT

Table RE5.26 BLE Low Ch 2402

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2485.3	54	74	N/A	46.123	N/A	27.877	160	2683	VERT
2483.5	54	74	33.17	N/A	20.83	N/A	160	2683	VERT

Table RE5.27 BLE Hi Ch 2480

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

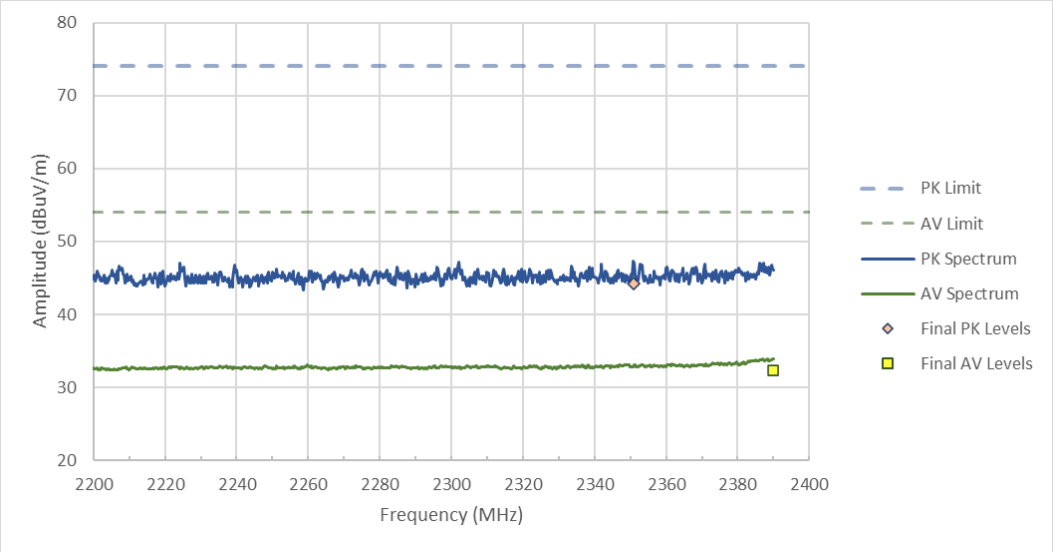


Figure RE5.25 BLE Low Ch 2402

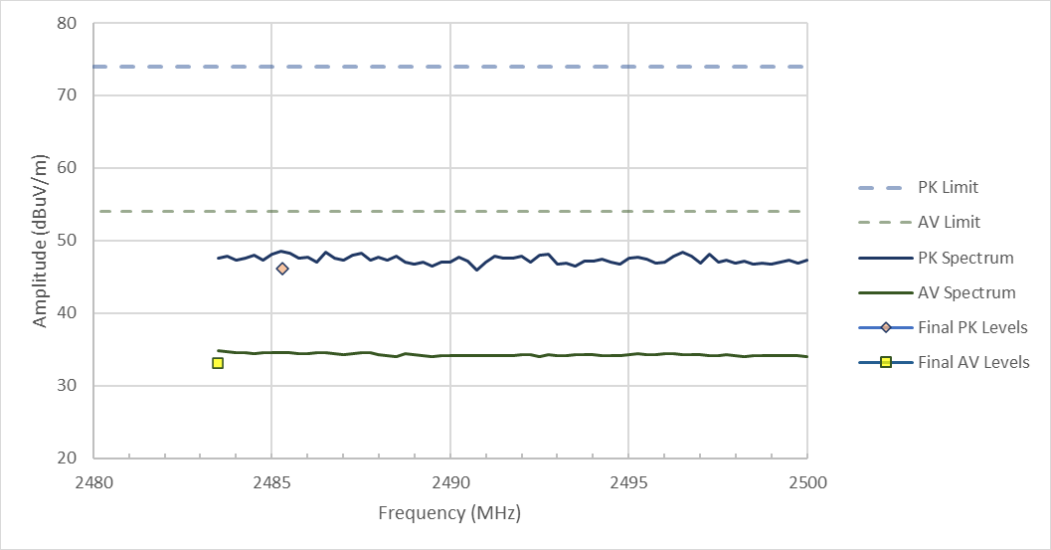


Figure RE5.26 BLE Hi Ch 2480

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2381.5	54	74	N/A	45.468	N/A	28.532	116	1934	VERT
2387	54	74	32.117	N/A	21.883	N/A	116	1934	VERT

Table RE5.28 ANT Low Ch 2402

Frequency	Avg Limit	Pk Limit	Avg Level	Pk Level	Av Margin	Pk Margin	Azimuth	Height	Polarity
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(degree)	(mm)	---
2487.3	54	74	N/A	44.794	N/A	29.206	160	2683	VERT
2483.5	54	74	33.112	N/A	20.888	N/A	160	2683	VERT

Table RE5.29 ANT Hi Ch 2480

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

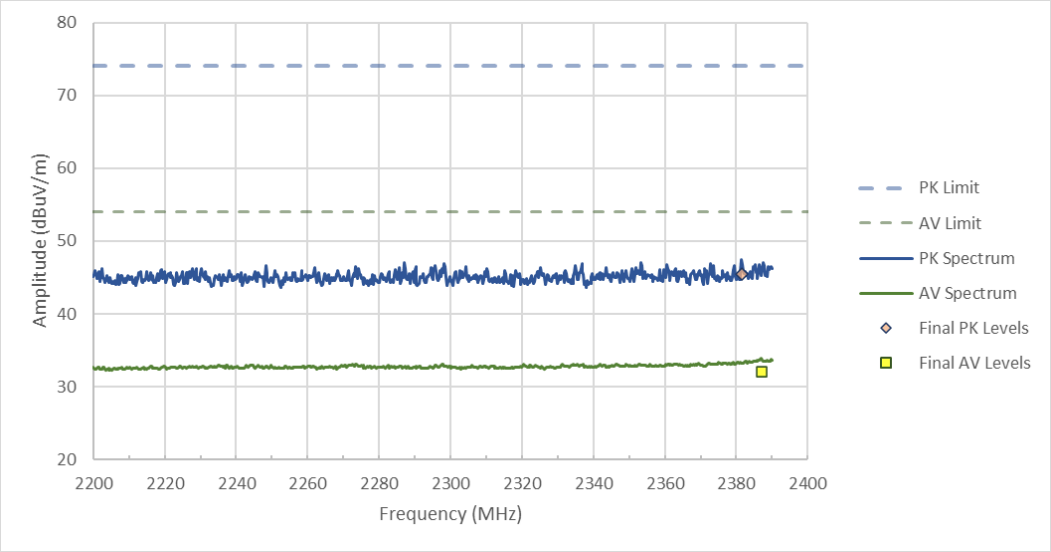


Figure RE5.27 ANT Low Ch 2402

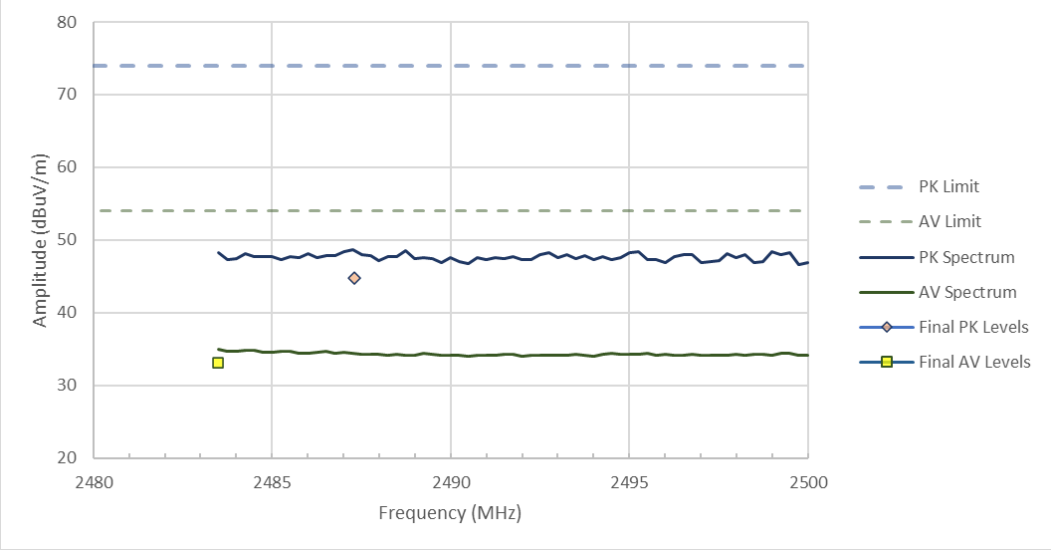
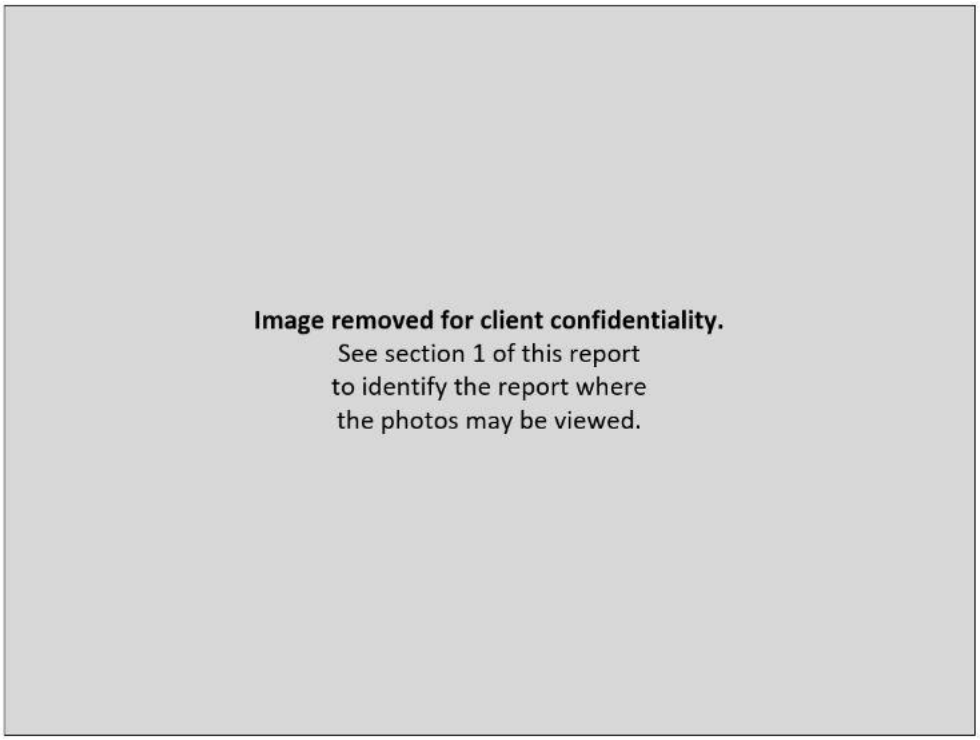


Figure RE5.28 ANT Hi Ch 2480



Setup Photographs

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

Figure RE5.29 EUT Back side view

Figure RE5.30 EUT Front view

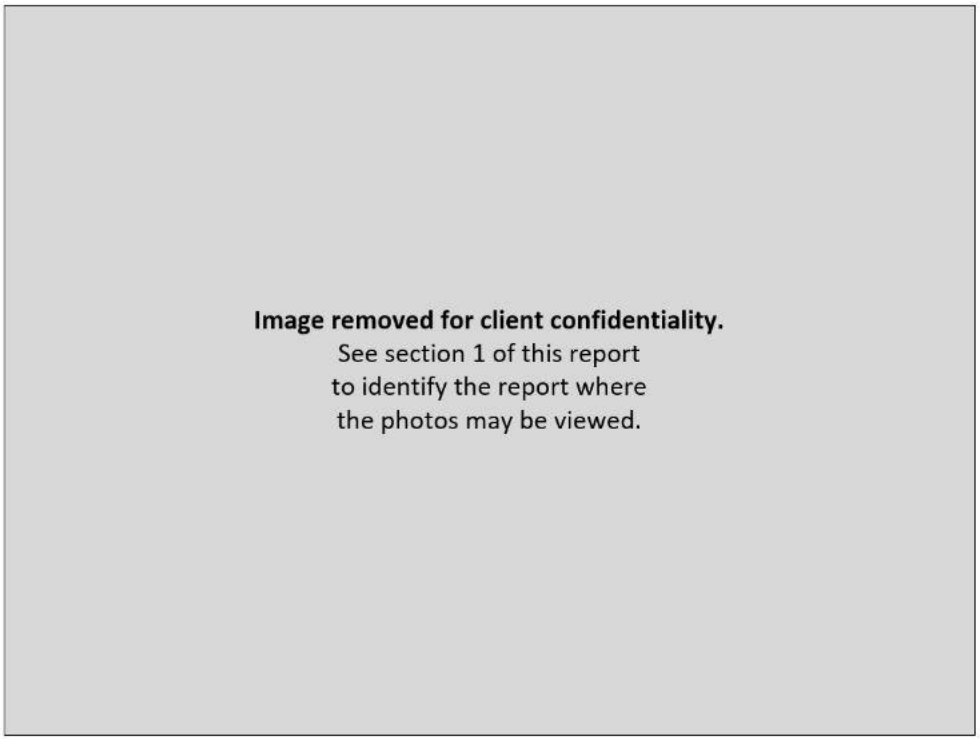


Figure RE5.31 EUT Side view

This line is the end of the test record.

Test Record
Transmitter Power Spectral Density
Test IDs TR17 – TR21
Project GCL-0200

Test Date(s)	20 Aug 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814565
Operating Mode	M3 (WiFi), M4 (BLE), M5 (ANT)
Arrangement	A2 (Radio)
Input Power	12 V (13.8V) dc
Test Standards:	FCC Part 15, ANSI C63.10, AS/NZS 4268, RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Radio Protocol	IEEE 802.11b/g/n, Bluetooth Low Energy (BLE), ANT

Pass/Fail Judgment: **PASS**

Test record created by: **David Arnett**
Date of this record: **12 Oct 2022**
Version 1 was created 30 Sep 2022.
Version 2 corrects a misstatement of the date when testing was performed.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Thermohygrometer	Mannix	CMM880	10319186	26-May-2021	1-Jun-2024
Rental MXE Receiver 26 GHz	Keysight	N9038A	MY51210204	10-Sep-2020	10-Sep-2022

Table TR17.1: Equipment used

Software Used: MXE Receiver A26.10

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 Data
Each measurement is made conducted from the antenna port with the transmitter on a specified channel and in a selected transmission protocol. The transmissions were continuous, with a duty cycle exceeding 99%. The results include the effects of both the estimated loss in the feed cable emerging from the test sample the measured loss of the cable leading to the MXE analyzer.

Yellow highlight indicates the highest level for a protocol, for which an image of the spectrum is also provided. In the spectral plots, the WiFi modes have been fully analyzed to include both types of cable loss. The plots for BLE and ANT are raw data and do not include the feed cable loss.

	Channel			Maximum	Limit	Margin
	1	5	11	dBm/100kHz	dBm/3kHz	dB
B 1 Mbps	-5.79	-5.64	-5.73	-5.64	8.00	13.64
B 5.5 Mbps	-6.39	-6.14	-6.24	-6.14	8.00	14.14
B 11 Mbps	-6.29	-5.94	-6.49	-5.94	8.00	13.94
G 6Mbps	-7.25	-4.38	-8.21	-4.38	8.00	12.38
G 54 Mbps	-7.15	-4.25	-8.11	-4.25	8.00	12.25
N MCS0	-8.73	-4.61	-8.99	-4.61	8.00	12.61
N MCS7	-9.24	-4.90	-9.73	-4.90	8.00	12.90

Table TR17.2 Power spectral density data for IEEE 802.11 WiFi modes

	Frequency (MHz)			Maximum	Limit	Margin
	2402	2442	2480	dBm/100kHz	dBm/3kHz	dB
BLE	-13.85	-12.36	-13.05	-12.36	8.00	20.36
ANT	-29.42	-23.80	-24.82	-23.80	8.00	31.80

Table TR17.3 Power spectral density data for BLE and ANT modes

Spectral Plots

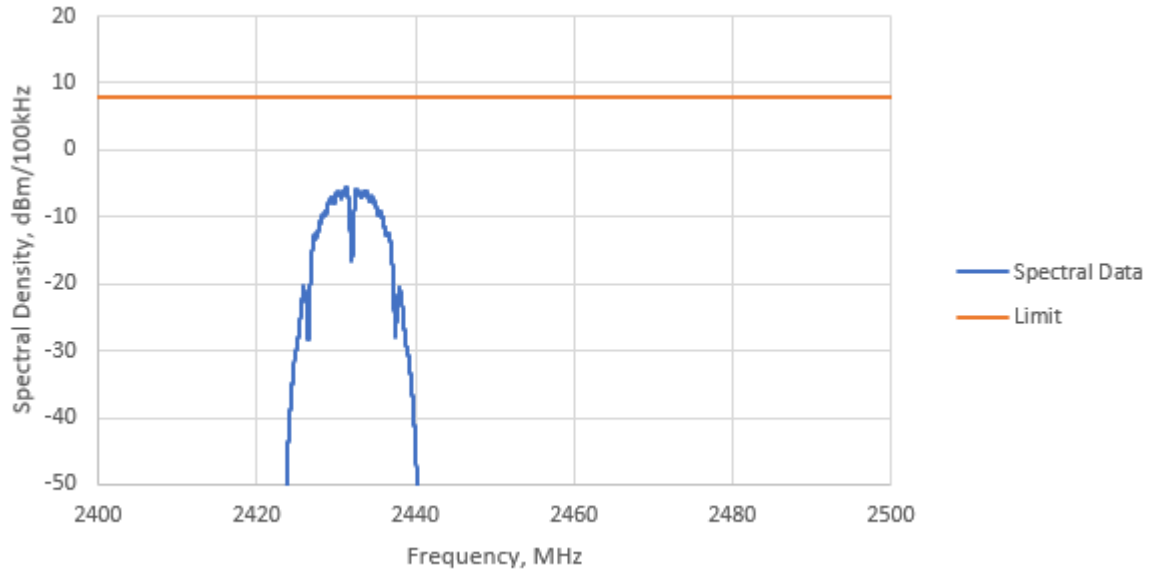


Figure Tr17.1: Power spectral density data for IEEE 802.11 b, 1 Mbps, Channel 5

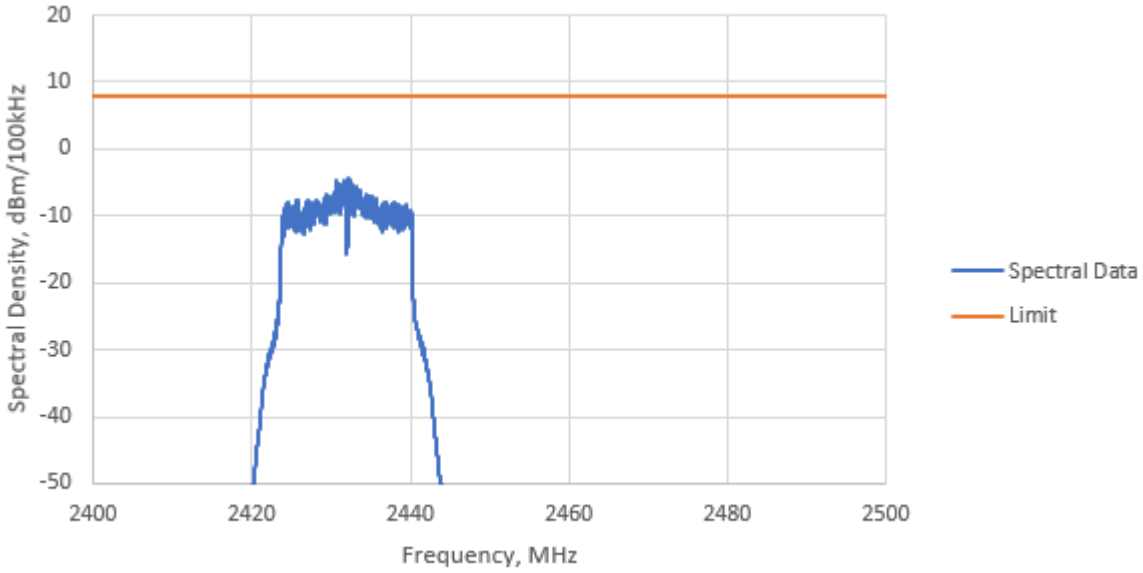


Figure Tr17.2: Power spectral density data for IEEE 802.11 g, 54 Mbps, Channel 5

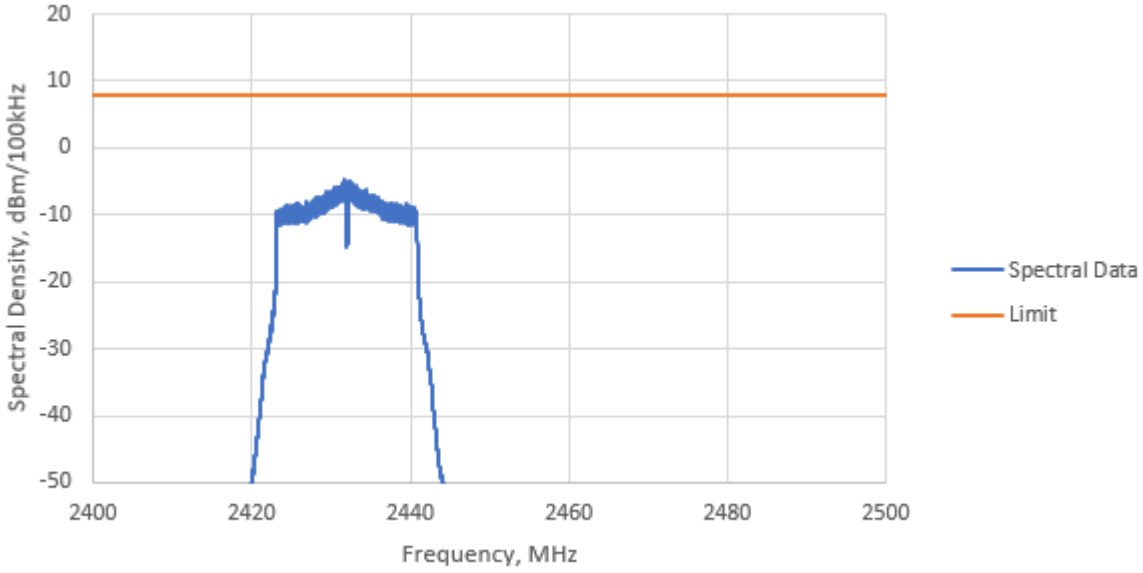


Figure Tr17.3: Power spectral density data for IEEE 802.11 n, MCS0, Channel 5

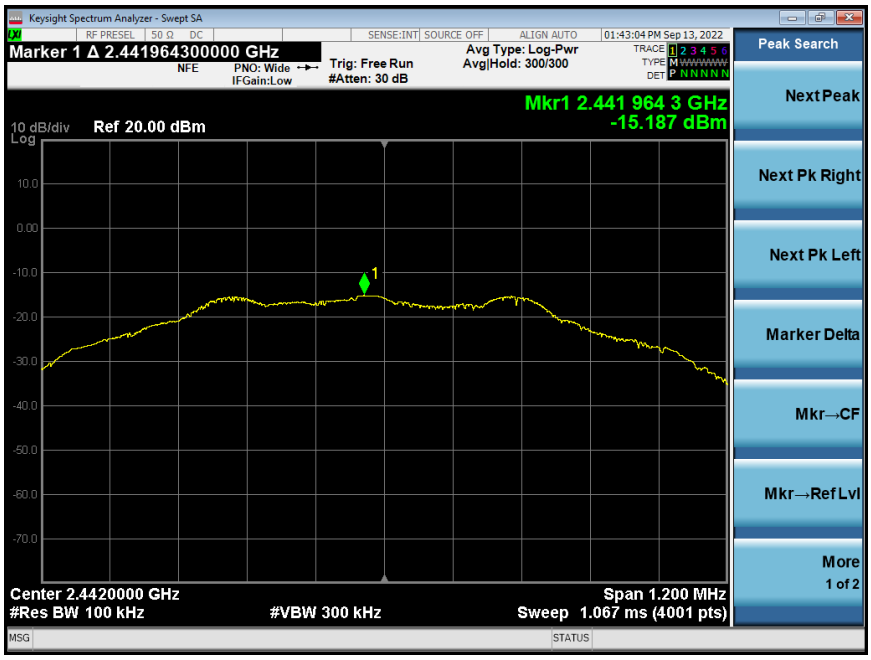


Figure Tr17.4: Partially corrected power spectral density data for Bluetooth Low Energy, 2442 MHz

Figure Tr17.5: Partially corrected power spectral density data for ANT, 2442 MHz

This line is the end of the test record.

Test Record
Transmitter Frequency Stability
Test IDs TR26 – TR28
Project GCL-0200

Test Date(s)	15 Sep 2022, 22 Sep 2022
Test Personnel	David Arnett assisted by Majid Farah
Product Model	A04396
Serial Number tested	3425814561
Operating Mode	M3 (WiFi), M4 (BLE)
Arrangement	A2 (Radio)
Input Power	12 V (13.8V) dc
Test Standards:	RSS-GEN, RSS-247 (as noted in Section 6 of the report).
Radio Protocol	IEEE 802.11n, Bluetooth Low Energy (BLE)
Pass/Fail Judgment:	**PASS**
Test record created by:	**David Arnett**
Date of this record:	**1 Oct 2022**

Original record, Version 1.

Test Equipment Used

Description	Make	Model #	Serial #	Last Cal/Ver	Next Due
Thermohygrometer	Mannix	CMM880	10319186	26-May-2021	1-Jun-2024
Near Field Probe Kit	Com-Power	PS400	151679	Calibration	Not Required
PXE Receiver 44GHz	Keysight	N9048B	MY59500016	2-Feb-2022	2-Feb-2023
Thermometer	Thermco	ACCD370P	210607316	11-Aug-2021	15-Aug-2023
Programmable DC power source	Keithley	2260B-30-72 720 W	14911917	6-Nov-2021	15-Feb-2023

Table TR26.1: Equipment used

Software Used: Keysight MXE System Code rev. A.30.11

Test Method
The RSS-GEN standard requires a frequency stability test with variations in temperature and supply voltage, but RSS-247 does not provide further guidance on this test. RSS-GEN suggests one possible criterion for unlicensed transmitters could be that the carrier remains in the central 80% of the frequency band. However, the Bluetooth and ANT protocols have carriers that are intentionally closer to the band edge. The basic concept applied here is that the 6 dBc Occupied Bandwidth of the modulated signal should remain within the 2400-2483.5 MHz radio band. To evaluate this, the peak carrier level and the level at the band edge are compared to ensure that signal at the band edge is reduced at least 6 dB across the specified range of voltages and temperatures. The data is reported in terms of dBc as a positive value, meaning we report the ratio between the peak carrier signal level and the level at the band edge to demonstrate that the resulting intentional signals remained within the allowed band.

The temperature stability of these transmissions was observed for both the channel plans used. IEEE 802.11 has a minimum transmission center frequency at 2412 MHz (channel 1) and a maximum at 2462 MHz (channel 11). MCS7 modulation was selected as the worst case to investigate due to its high occupied bandwidth. BLE and ANT use the same channel plan with a minimum transmission center frequency at 2402 MHz and a maximum at 2480 MHz. BLE was selected as the worst case to investigate, due to its higher occupied bandwidth.

The test sample was placed in a thermal chamber and connected to an appropriate dc power source. A near-field probe was placed near the sample and connected by cable to the PXE analyzer. The analyzer was set up to detect radio signals from the test sample.

The test temperatures are -20 °C, +20 °C, and +50 °C, all at rated voltage. However, the rated voltage has two possible values. The test sample is intended for vehicle use, and vehicles are usually said to operate on "12 V" systems. That phrase has a historical background from the 20th century, but actual vehicle power today tends to be 13.8 Vdc. For the temperature variation test series, the supply voltage was set to 13.8 V. For the voltage variation test at +20 °C, the voltage is to be varied 15% above and below the rated voltage. Data was taken at 12 Vdc and 15% lower at 10.2 Vdc. Data was also taken at 13.8 Vdc and 15% higher at 15.9 Vdc.

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 transmissions were continuous, with a duty cycle exceeding 99%. The amplitude results are unscaled and may not include the effects such as near field probe coupling or cable losses. Such effects are minimal when comparing two nearby data points in a single spectral scan. Probe coupling may vary between scans due to test sample movement which adjusting the operating modes.

Yellow highlight indicates the highest level for a protocol, for which an image of the spectrum is also provided. In the spectral plots, the data sets have been combined to present the low and high channel results side by side. Orange diamond markers indicate the spectral peak, which the black square markers are at the 2400 MHz or 2483.5 MHz band edge.

Temp	Volts	Low Ch.	High Ch.
°C	Vdc	dBc	dBc
-20	13.8	37.6	35.9
20	13.8	36.3	42.1
50	13.8	33.7	36.4

Table TR26.2 Difference between peak and band edge levels for IEEE 802.11 n MCS7 transmissions during temperature variations

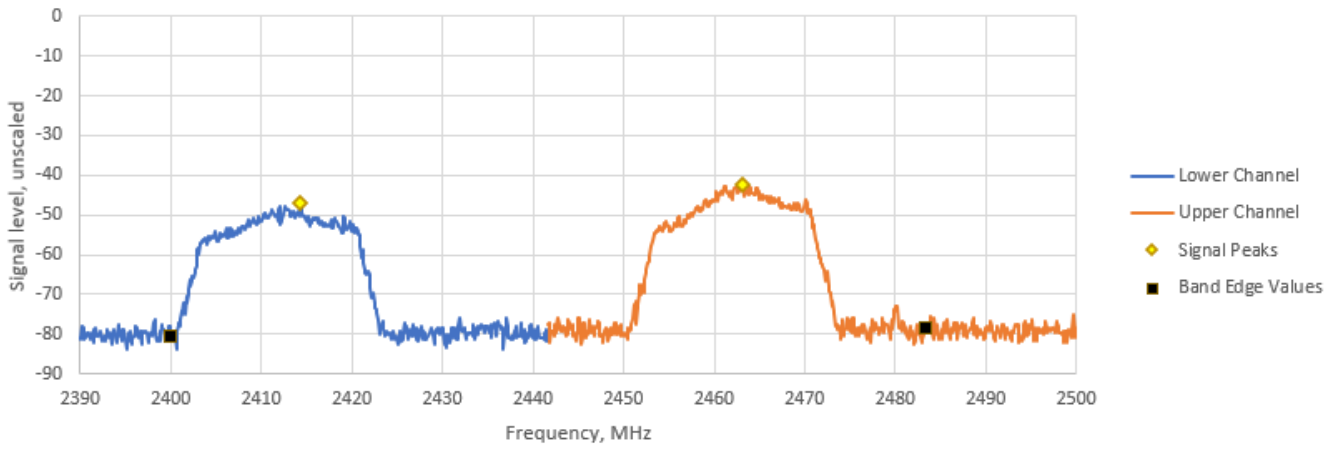


Figure TR26.1: Measured data for MCS7 at 50 °C

Temp	Volts	Low Ch.	High Ch.
°C	Vdc	dBc	dBc
20	10.2	35.2	28.8
20	12	38.3	29.1
20	13.8	35.3	34.6

20	15.9	39.3	30.2

Table TR26.3 Difference between peak and band edge levels for IEEE 802.11 n MCS7 transmissions during voltage variations

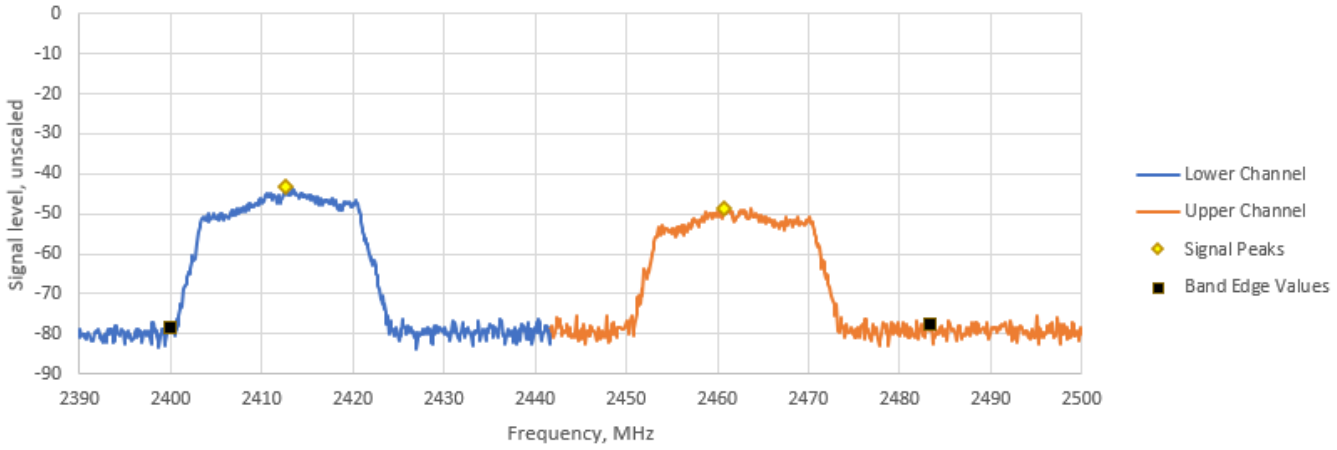


Figure TR26.2: Measured data for MCS7 at 10.2 Vdc

Temp	Volts	Low Ch.	High Ch.
°C	Vdc	dBc	dBc
-20	13.8	40	46.7
20	13.8	43.1	12.5
50	13.8	13.1	23.2

Table TR26.4 Difference between peak and band edge levels for BLE transmissions during temperature variations

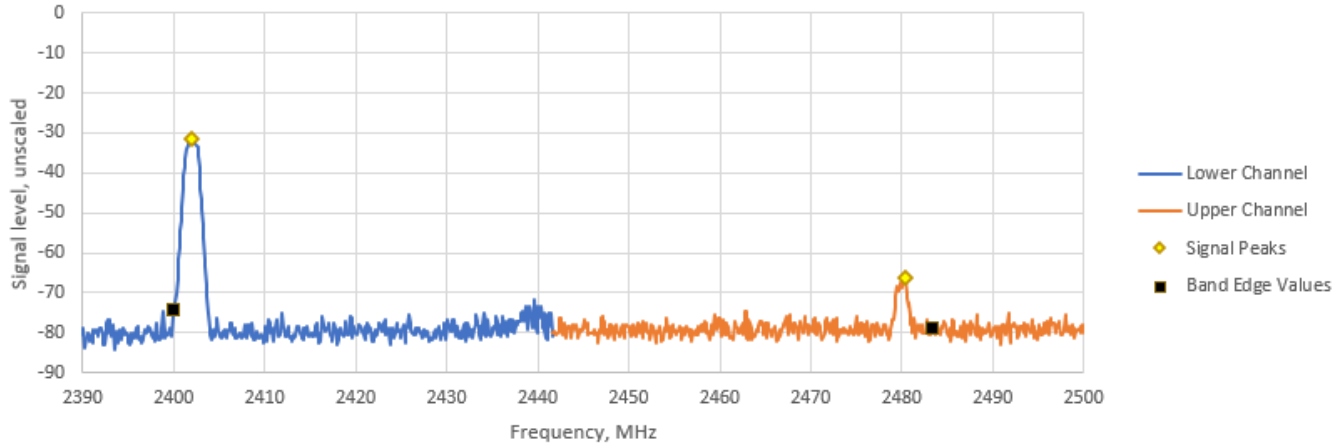


Figure TR26.3: Measured data for BLE at 20 °C

Temp	Volts	Low Ch.	High Ch.
°C	Vdc	dBc	dBc
20	10.2	19.8	10.6
20	12	19	11.9
20	13.8	23.6	19.4
20	15.9	25.2	18.8

Table TR26.5 Difference between peak and band edge levels for BLE transmissions during voltage variations

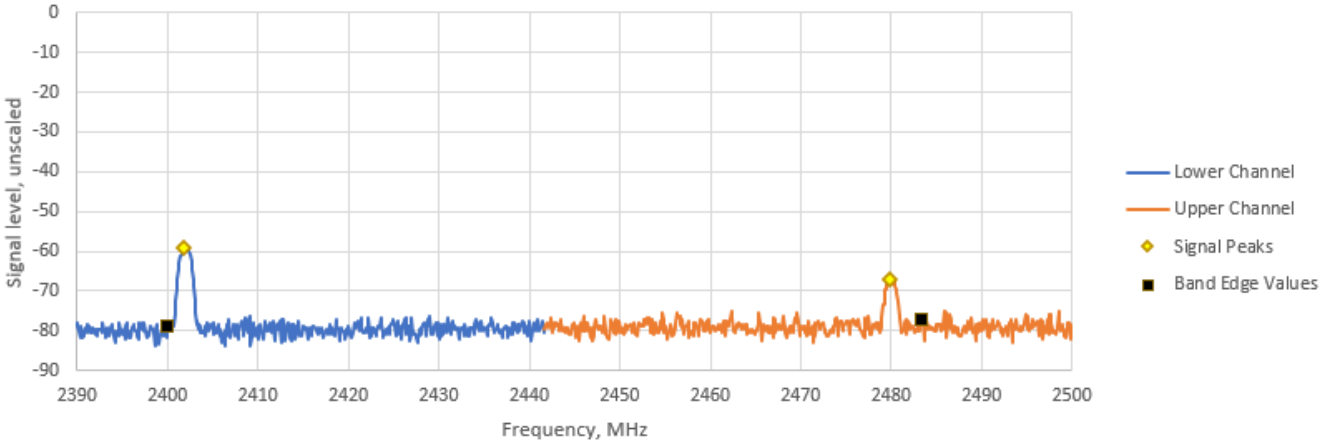


Figure TR26.4: Measured data for BLE at 10.2 Vdc

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.

As an editorial note, reviewers noted some places where test records include an incomplete serial number for the 44 GHz MXE receiver. As this typo does not affect the accuracy of measurements or the validity of judgements and statements of compliance, they were allowed to stand. The correct and complete serial number is MY56400055.

This is the final page of the report.