



FCC / ISSED Test Report

FOR:

Garmin International, Inc.

Model Name:

A04281

Product Description:

Mobile mounted digital recording device

FCC ID: IPH-04281

ISED ID: 1792A-04281

Applied Rules and Standards:

47 CFR Part 15.407 (NII) & 5 GHz (UNII)

RSS-247 Issue 2 (DTSS) & (LE-LAN), and RSS-Gen Issue 5

REPORT #: EMC_GARMI-107-22001_15.407_UNII_Rev1

DATE: 12-05-2022



A2LA Accredited

IC recognized #
3462B-1

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.407 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Model #
Garmin International, Inc.	Mobile mounted digital recording device	A04281

Responsible for Testing Laboratory:

12-05-2022	Compliance	Arndt Stoecker (Director of Regulatory Services)	
Date	Section	Name	Signature

Responsible for the Report:

12-05-2022	Compliance	Kris Lazarov (EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Director of Regulatory Services:	Arndt Stoecker
Responsible Project Leader:	Sangeetha Sivaraman

2.2 Identification of the Client

Client's Name:	Garmin International, Inc.
Street Address:	1200 East 151st Street
City/Zip Code	Olathe, KS / 66062
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	A04281	
HW Version :	0	
SW Version :	0.42	
FCC-ID :	IPH-04281	
IC-ID:	1792A-04281	
FWIN:	A04281	
HVIN:	A04281	
PMN:	A04281	
Product Description:	Mobile mounted digital recording device	
Frequency Range / number of channels:	Frequency Range (MHz)	Channel Number
	5150-5250	36-48 [4]
	5725-5850	149-165 [5]
Modes of Operation / Channel Bandwidths:	IEEE Std. 802.11(xxxx)	Data Rate / MCS
	a	6-54 Mbps
	n/ac: HT20 / HT40 / HT80	MCS 0-7; MCS 8-15
Transmit Chains(N_{TX})	1	
Antenna Information as declared:	Frequency (MHz)	Peak Gain (dBi)
	5150-5250	1.98
	5725-5850	-1.39
Max. Output Power:	18 dBm	
Power Supply/ Rated Operating Voltage Range:	5Vdc, 2A	
Operating Temperature Range	-20°C to + 70°C	
Other Radios included in the device:	Bluetooth (LE) WiFi 802.11b/g/n (2.4GHz) Cellular LTE Bands 2, 4, 5, 12, 66	
Sample Revision	☐ Prototype Unit; ☐ Production Unit; ☒ Pre-Production	

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	3408476455	0	0.42	Conducted
2	3418387316	0	0.42	Radiated

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Vehicle Power Cable	320-00845-04	Garmin	N/A

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#2 + AE#1	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software that is not available to the end user. The internal antenna was connected.

3.5 Justification for Worst Case Mode of Operation

For Frequency Stability testing at extreme conditions the 802.11n mode was used as a representative of the combination of high PSD, and emissions bandwidth.

For Spurious Emissions testing the 802.11a mode was used because of the highest PSD. During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and highest possible duty cycle. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

For Band Edge the higher emissions bandwidth 802.11ac modes were evaluated in addition to 802.11a mode.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.407 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

This test report is to support a request for new equipment authorization under the FCC ID: IPH-04281 and ISED ID: 1792A-04281.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.407(e) RSS-247 6.2.4.1	Emission Bandwidth	Nominal	802.11a/n/ac	■	□	□	Complies
§15.407(a) RSS-247 6	Power Spectral Density	Nominal	802.11a/n/ac	■	□	□	Complies
§15.407(a) RSS-247 6	Maximum Output Power	Nominal	802.11a/n/ac	■	□	□	Complies
§15.407(g)	Frequency stability	Extreme temperature	802.11n	■	□	□	Complies
§15.407; 15.205 RSS-247 6; RSS-Gen 8.10	Band Edge Compliance	Nominal	802.11a/ac	■	□	□	Complies
§15.407(b); §15.209; 15.205 RSS-247 6; RSS-Gen 8.9; 8.10	Radiated TX Spurious Emissions	Nominal	802.11a	■	□	□	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	N/A	□	■	□	Complies

Note: NA= Not Applicable; NP= Not Performed.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=2.

Measurement System	EMC 1	EMC 2
Conducted emissions (mains port)	1.12 dB	0.46 dB
Radiated emissions		
(< 30 MHz)	3.66 dB	3.88 dB
(30 MHz – 1GHz)	3.17 dB	3.34 dB
(1 GHz – 3 GHz)	5.01 dB	4.45 dB
(>3 GHz)	4.0 dB	4.79 dB

6.1 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

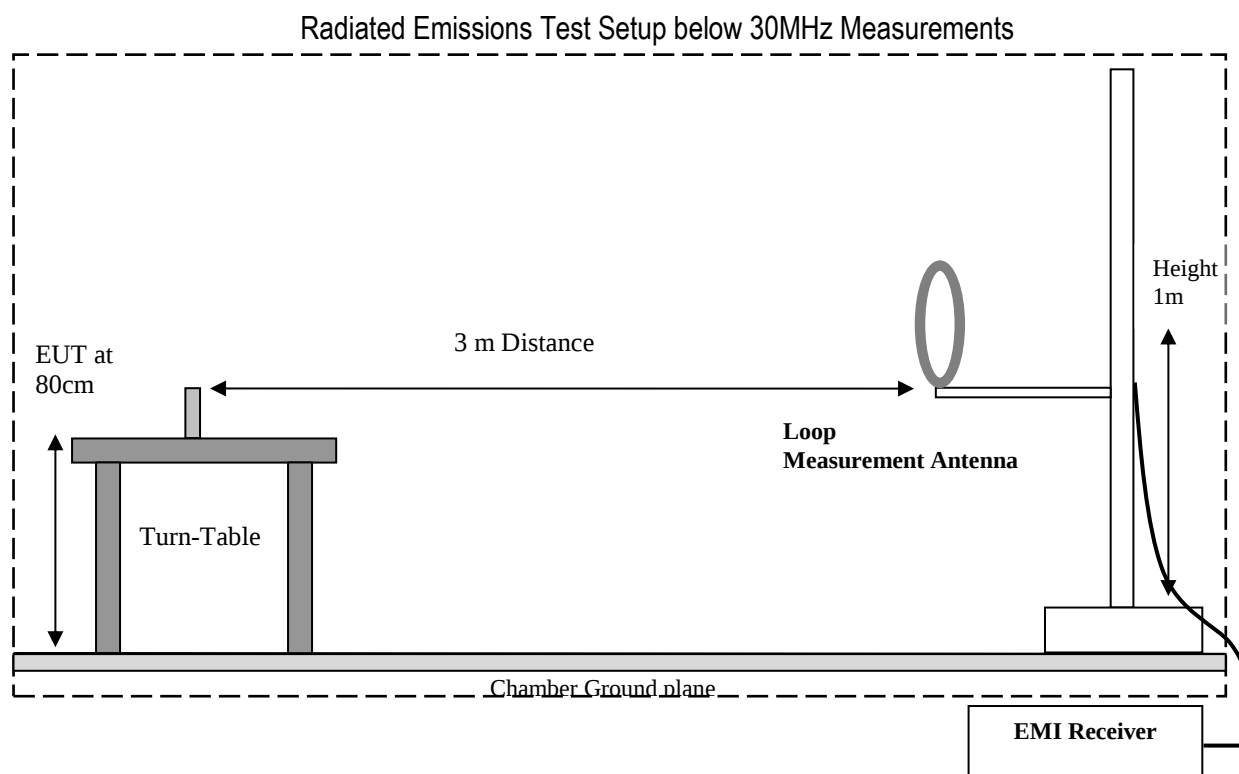
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7 Measurement Procedures

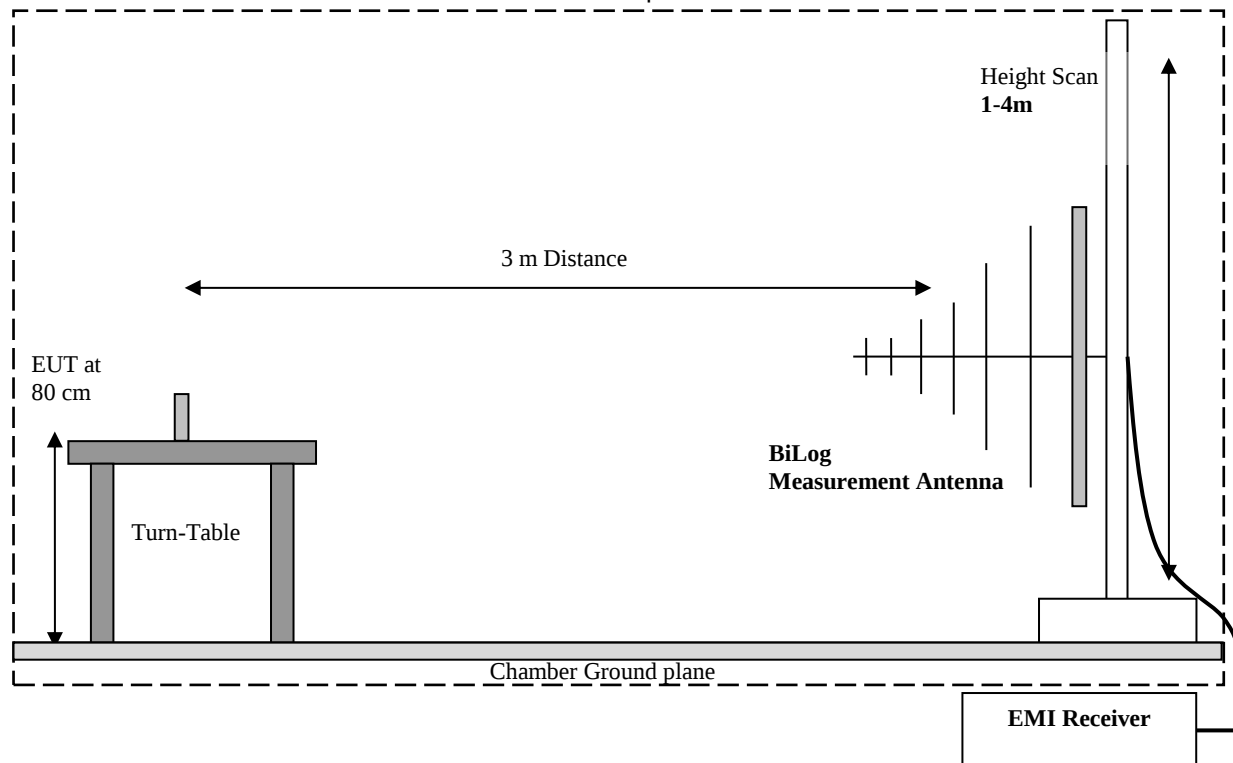
7.1 Radiated Measurement

The radiated measurement is performed according to ANSI C63.10 (2013)

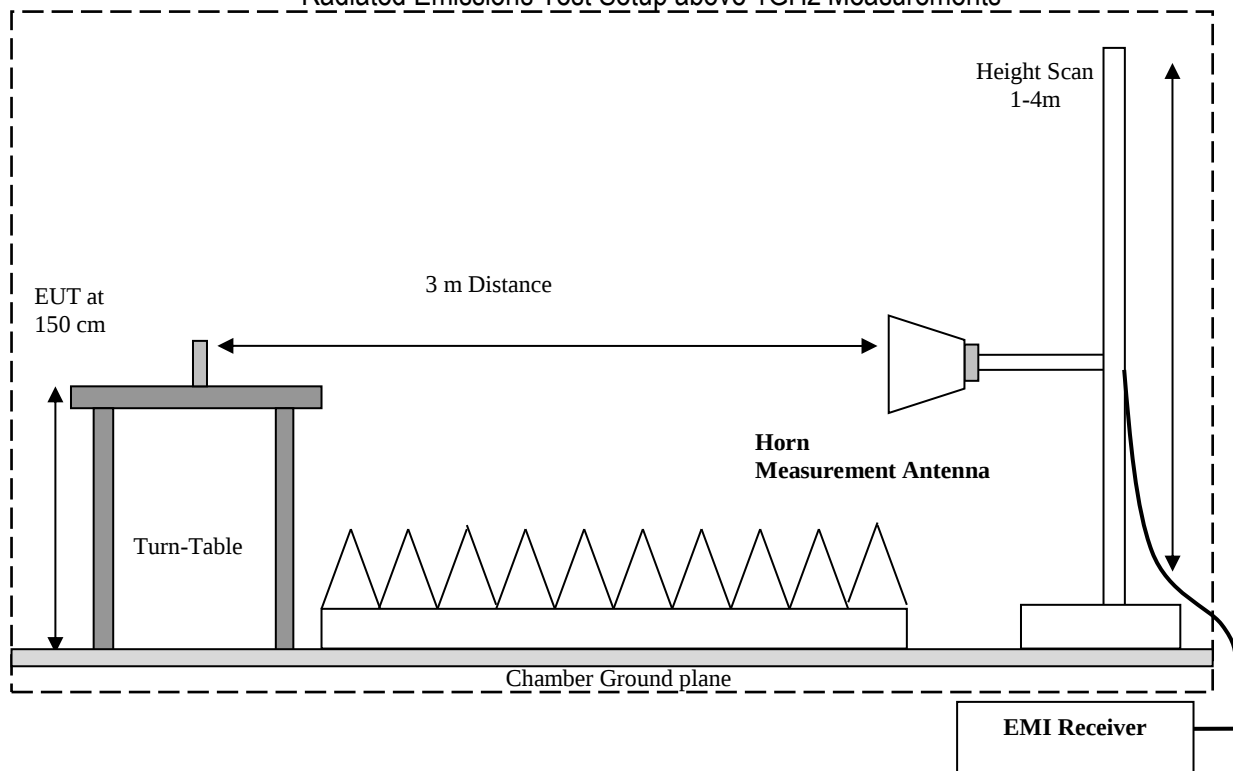
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dB μ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/m)
1000	80.5	3.5	14	98.0

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – “GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES” - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

8 Test Result Data

8.1 Maximum Output Power

8.1.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Spectrum Analyzer settings for method SA-1:

- Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- Set RBW = 1 MHz
- Set the VBW $\geq$ 3 MHz
- Detector = RMS
- Number of points in sweep $\geq$ 2 Span / RBW. (This ensures that bin-to-bin spacing is $\leq$ RBW/2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = Auto Couple
- Trace mode = Trace average at least 100 traces in power averaging (i.e., RMS mode).
- If transmit duty cycle $<$ 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle $\geq$ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."
- Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

8.1.2 Limits:

FCC§15.407

Sub-band 5150-5250 MHz

- For AP the maximum conducted output power over the frequency band of operation shall not exceed 1 W
- For Client Devices the maximum conducted output power over the frequency band of operation shall not exceed 250 mW

Sub-band 5725-5850 MHz

- The maximum conducted output power over the frequency band of operation shall not exceed 1 W

RSS-247

Sub-band 5150-5250 MHz

- For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
- For other devices, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz.

Sub-band 5725-5850 MHz

- The maximum conducted output power shall not exceed 1 W.

Note: All limits are conducted. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.1.3 Test conditions and setup:

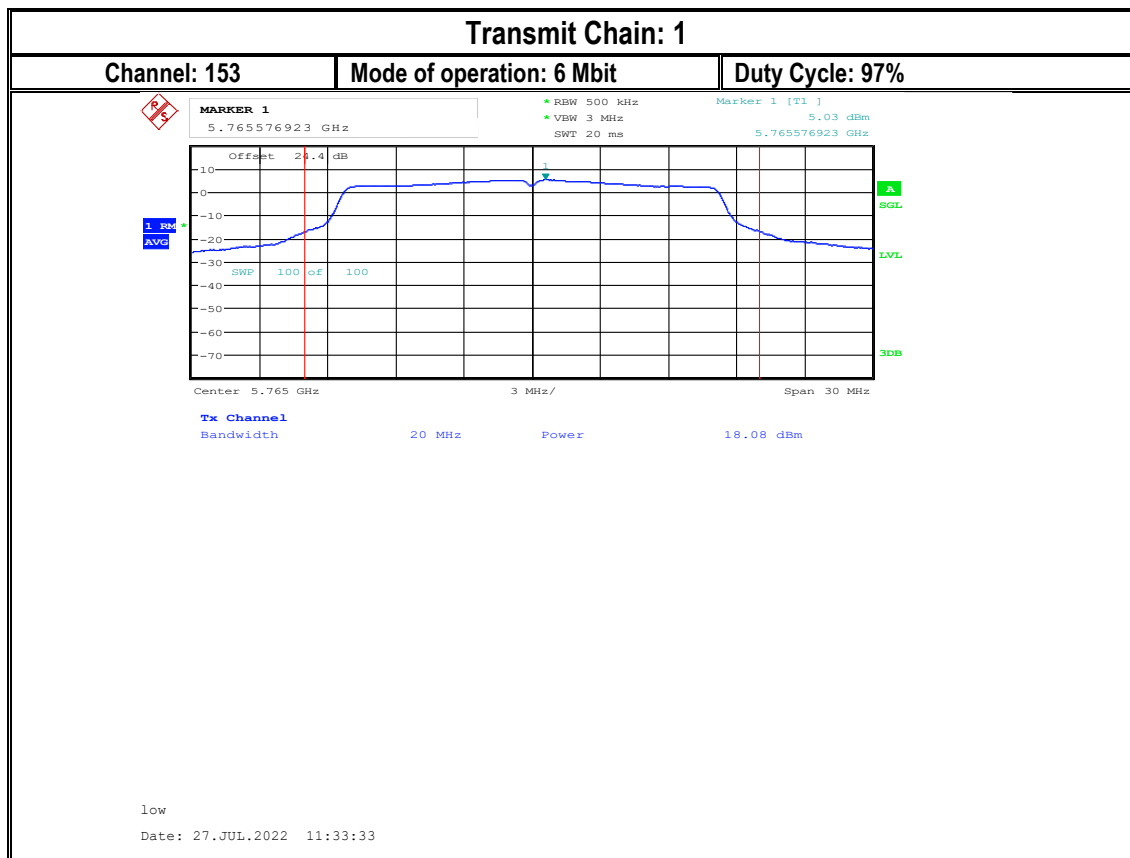
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
22° C	1	Continuous fixed channel TX	12 VDC	UNII-1 1.98dBi UNII-3 -1.39dBi

8.1.4 Measurement result:

UNII-1								
Mode	CH36 Conducted Power (dBm)	CH36 EIRP (dBm)	CH40 Conducted Power (dBm)	CH40 EIRP (dBm)	CH48 Conducted Power (dBm)	CH48 EIRP (dBm)	Limit (dBm)	Result
6 Mbit	17.37	19.35	17.00	18.98	16.71	18.69	23	Pass
MCS0 HT20	16.97	18.95	16.56	18.54	16.45	18.43	23	Pass
Mode	CH38 Conducted Power (dBm)	CH38 EIRP (dBm)	CH42 Conducted Power (dBm)	CH42 EIRP (dBm)	CH46 Conducted Power (dBm)	CH46 EIRP (dBm)	Limit (dBm)	Result
MCS0 HT40	14.89	16.87	-	-	15.07	17.05	23	Pass
MCS0 HT80	-	-	14.47	16.45	-	-	23	Pass

UNII-3								
Mode	CH149 Conducted Power (dBm)	CH149 EIRP (dBm)	CH153 Conducted Power (dBm)	CH153 EIRP (dBm)	CH165 Conducted Power (dBm)	CH165 EIRP (dBm)	Limit (dBm)	Result
6 Mbit	17.99	16.6	18	16.61	17.55	16.16	30	Pass
MCS0 HT20	17.75	16.36	17.64	16.25	17.24	15.85	30	Pass
Mode	CH151 Conducted Power (dBm)	CH151 EIRP (dBm)	CH155 Conducted Power (dBm)	CH155 EIRP (dBm)	CH159 Conducted Power (dBm)	CH159 EIRP (dBm)	Limit (dBm)	Result
MCS0 HT40	14.49	13.10	-	-	15.03	13.64	30	Pass
MCS0 HT80	-	-	14.49	13.10	-	-	30	Pass

8.1.5 Highest Power Measurement Plot:



8.2 Power Spectral Density

8.2.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Spectrum Analyzer Settings for Peak PSD in 1 MHz Band with Method SA-1:

- Use the settings in section 8.1.1
- Use the peak marker function to determine the maximum amplitude level within the RBW. The result is the Maximum PSD over 1 MHz reference bandwidth

Spectrum Analyzer Settings for Peak PSD in 500 kHz Band with Method SA-1:

- Set RBW 500 kHz
- Set VBW $\geq$ 3 RBW.
- Measure the Maximum PSD in 500 kHz reference bandwidth for sub-band 5725-5850 MHz

8.2.2 Limits:

FCC§15.407

Sub-band 5150-5250 MHz

- For AP the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band
- For Client Devices the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band

Sub-band 5725-5850 MHz

- The maximum power spectral density shall not exceed 30 dBm in any 500 kHz band

RSS-247

Sub-band 5150-5250 MHz

- PSD shall be less than 10 dBm in any 1 MHz band- EIRP

Sub-band 5725-5850 MHz

- PSD shall be less than 30 dBm in any 500 kHz band

Note: All limits are conducted. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.2.3 Test conditions and setup:

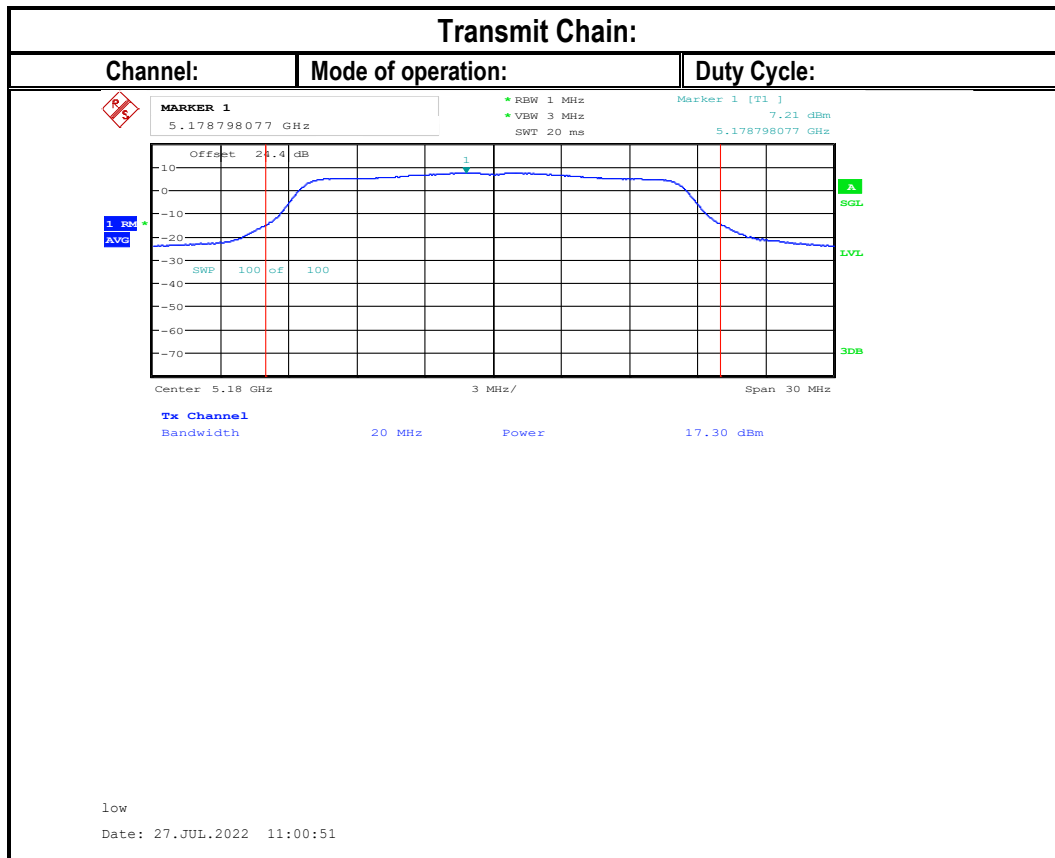
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
22° C	1	Continuous fixed channel TX	12 VDC	UNII-1 1.98dBi UNII-3 -1.39dBi

8.2.4 Measurement result:

UNII-1								
Mode	Measured PSD CH 36 (dBm/1MHz)	Antenna Gain Corrected PSD CH 36 (dBm/1MHz)	Measured PSD CH 40 (dBm/1MHz)	Antenna Gain Corrected PSD CH 40 (dBm/1MHz)	Measured PSD CH 48 (dBm/1MHz)	Antenna Gain Corrected PSD CH 48 (dBm/1MHz)	Limit (dBm/1MHz)	Result
6 Mbit	7.21	9.19	6.77	8.75	6.7	8.68	10	Pass
MCS0 HT20	6.72	8.7	6.15	8.13	6.18	8.16	10	Pass
Mode	Measured PSD CH 38 (dBm/1MHz)	Antenna Gain Corrected PSD CH 38 (dBm/1MHz)	Measured PSD CH 42 (dBm/1MHz)	Antenna Gain Corrected PSD CH 42 (dBm/1MHz)	Measured PSD CH 46 (dBm/1MHz)	Antenna Gain Corrected PSD CH 46 (dBm/1MHz)	Limit (dBm/1MHz)	Result
MCS0 HT40	1.75	3.73	-	-	1.95	3.93	10	Pass
MCS0 HT80	-	-	-1.55	0.43	-	-	10	Pass

UNII-3								
Mode	Measured PSD CH 149 (dBm/0.5MHz)	Antenna Gain Corrected PSD CH 149 (dBm/0.5MHz)	Measured PSD CH 157 (dBm/0.5MHz)	Antenna Gain Corrected PSD CH 157 (dBm/0.5MHz)	Measured PSD CH 165 (dBm/0.5MHz)	Antenna Gain Corrected PSD CH 165 (dBm/0.5MHz)	Limit (dBm/0.5MHz)	Result
6 Mbit	5.14	3.75	5.03	3.64	4.87	3.48	30	Pass
MCS0 HT20	4.61	3.22	4.62	3.23	4.21	2.82	30	Pass
Mode	Measured PSD CH 151 (dBm/0.5MHz)	Antenna Gain Corrected PSD CH 151 (dBm/0.5MHz)	Measured PSD CH 155 (dBm/0.5MHz)	Antenna Gain Corrected PSD CH 155 (dBm/0.5MHz)	Measured PSD CH 159 (dBm/0.5MHz)	Antenna Gain Corrected PSD CH 159 (dBm/0.5MHz)	Limit (dBm/0.5MHz)	Result
MCS0 HT40	-1.67	-3.06	-	-	-1.03	-2.42	30	Pass
MCS0 HT80	-	-	-4.27	-5.66	-	-	30	Pass

8.2.5 Highest PSD Measurement Plots:



8.3 Emission Bandwidth 6 dB, 26 dB, and 99%

8.3.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

- For the band 5.150-5.250 GHz the 26 dB and 99% EBW is measured
- For the band 5.725-5.850 GHz the 6 dB and 99% EBW is measured

Spectrum Analyzer Settings for 6 dB EBW in band 5.725 – 5.850 GHz:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Spectrum Analyzer Settings for 99% Occupied Bandwidth

- Set center frequency to the nominal EUT channel center frequency
- Set span = 1.5 times to 5.0 times the OBW
- Set RBW = 1% to 5% of the OBW
- Set VBW $\geq 3 \times$ RBW
- Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used
- Use the 99% power bandwidth function of the instrument (if available)
- If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies

8.3.2 Limits:

FCC §15.247(e) and RSS-407 6.2.4.1

- For equipment operating in the band 5725-5850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz.

8.3.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	Continuous fixed channel TX	12 VDC

8.3.4 Measurement result:

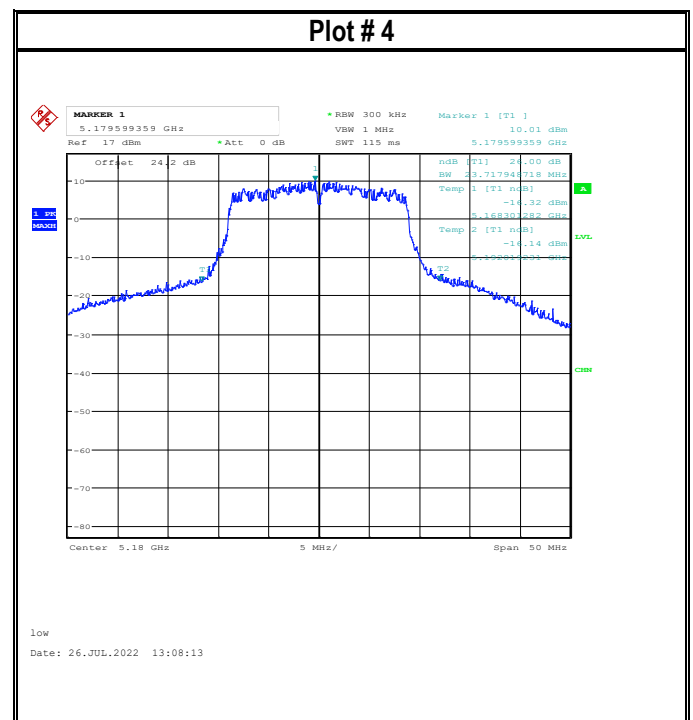
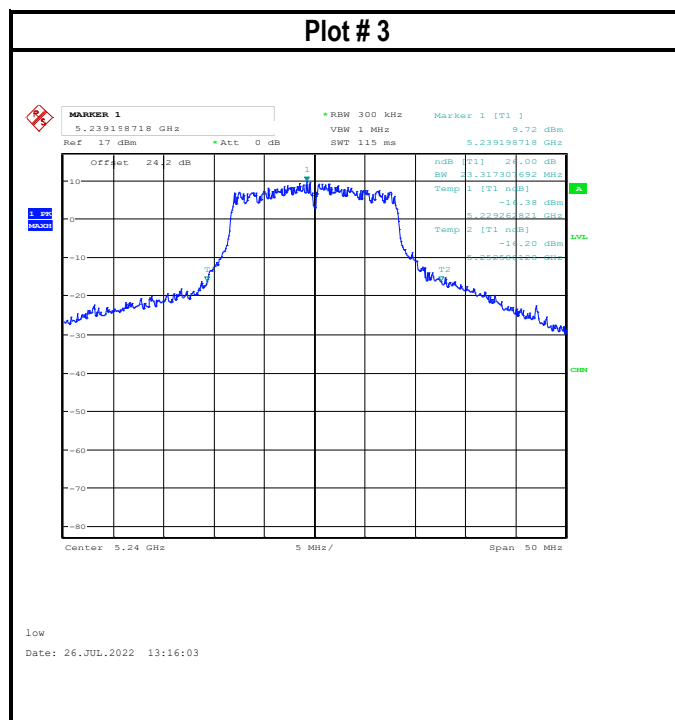
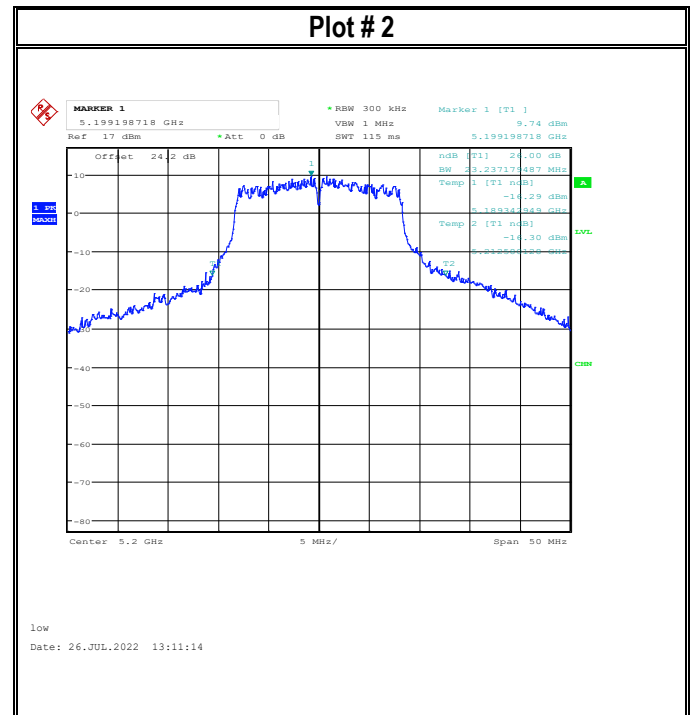
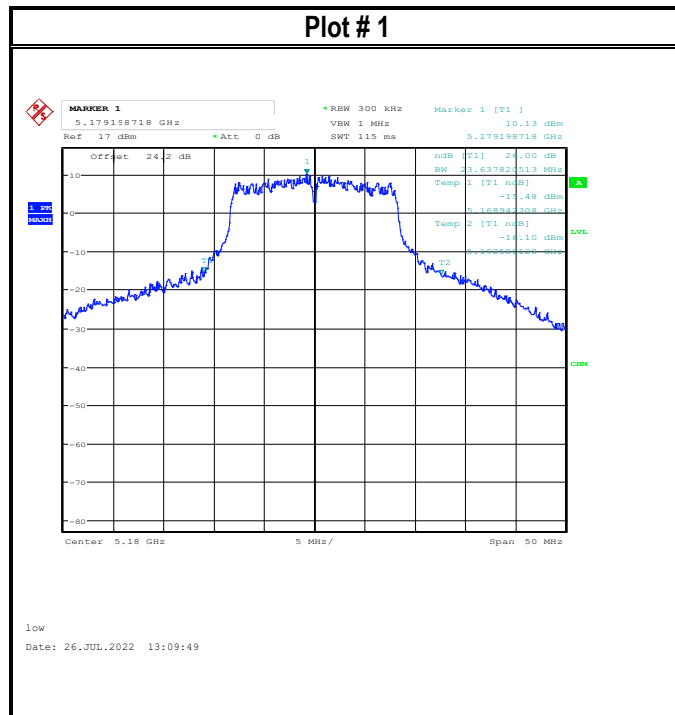
Plot #	Mode of Operation	Channel	26dB Emissions Bandwidth (MHz)
1	6 Mbit	36	23.6
2	6 Mbit	40	23.2
3	6 Mbit	48	23.5
4	MCS0 20MHz	36	23.7
5	MCS0 20MHz	40	23.3
6	MCS0 20MHz	48	23.6
7	MCS0 40MHz	38	40.7
8	MCS0 40MHz	46	40.9
9	MCS0 80MHz	42	83.6

Plot #	Mode of Operation	Channel	99% Emissions Bandwidth (MHz)
10	6 Mbit	36	17.5
11	6 Mbit	40	17.5
12	6 Mbit	48	18.5
13	MCS0 20MHz	36	18.4
14	MCS0 20MHz	40	17.6
15	MCS0 20MHz	48	18.5
16	MCS0 40MHz	38	36.6
17	MCS0 40MHz	46	36.5
18	MCS0 80MHz	42	75.9

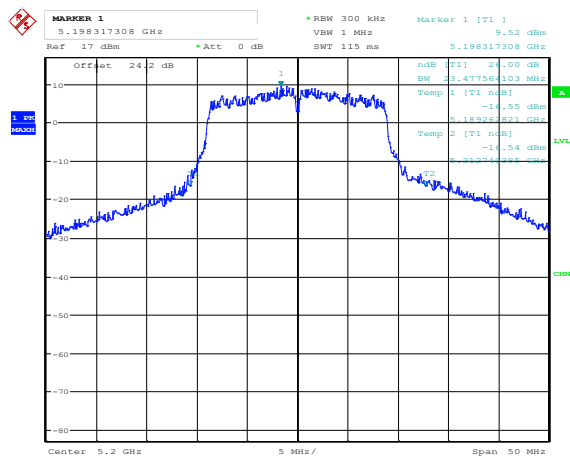
Plot #	Mode of Operation	Channel	6dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
19	6 Mbit	149	16.4	> 0.5	Pass
20	6 Mbit	157	16.4	> 0.5	Pass
21	6 Mbit	165	16.4	> 0.5	Pass
22	MCS0 20MHz	149	17.6	> 0.5	Pass
23	MCS0 20MHz	157	17.6	> 0.5	Pass
24	MCS0 20MHz	165	17.6	> 0.5	Pass
25	MCS0 40MHz	151	36.2	> 0.5	Pass
26	MCS0 40MHz	159	35.9	> 0.5	Pass
27	MCS0 80MHz	155	75.8	> 0.5	Pass

Plot #	Mode of Operation	Channel	99% Emissions Bandwidth (MHz)	Limit (MHz)	Result
28	6 Mbit	149	17.6	> 0.5	Pass
29	6 Mbit	157	17.7	> 0.5	Pass
30	6 Mbit	165	17.7	> 0.5	Pass
31	MCS0 20MHz	149	18.6	> 0.5	Pass
32	MCS0 20MHz	157	18.6	> 0.5	Pass
33	MCS0 20MHz	165	18.6	> 0.5	Pass
34	MCS0 40MHz	151	36.6	> 0.5	Pass
35	MCS0 40MHz	159	36.5	> 0.5	Pass
36	MCS0 80MHz	155	75.8	> 0.5	Pass

8.3.5 Measurement Plots:



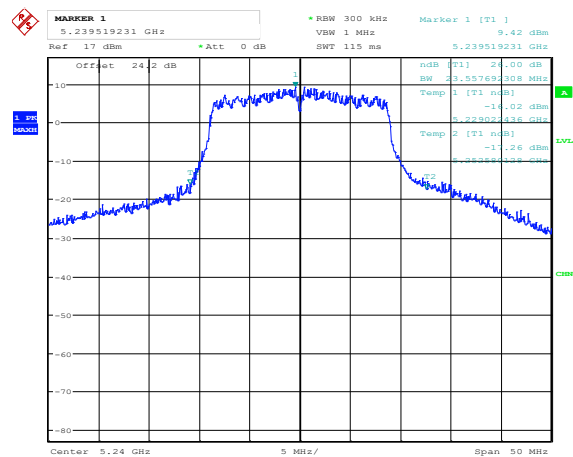
Plot # 5



low

Date: 26.JUL.2022 13:13:27

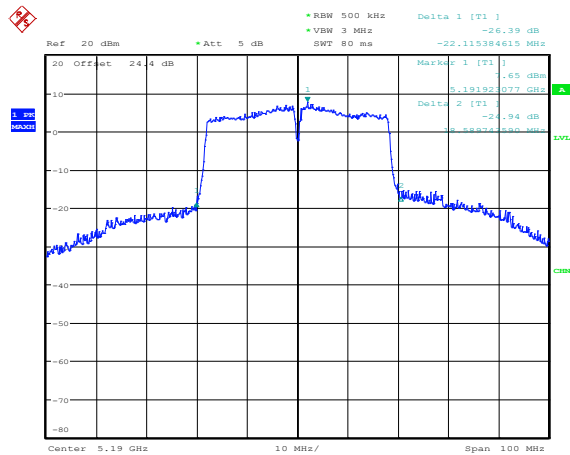
Plot # 6



low

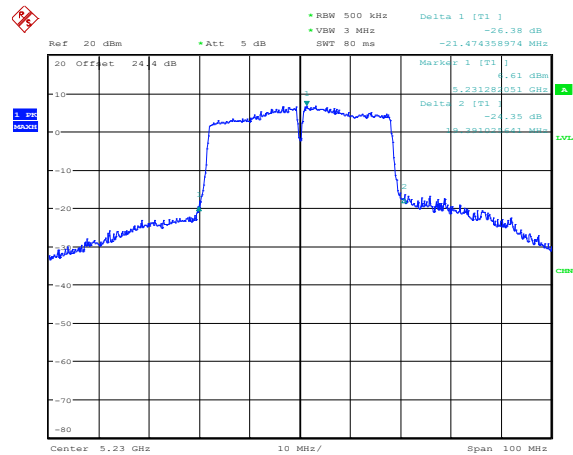
Date: 26.JUL.2022 13:14:45

Plot # 7

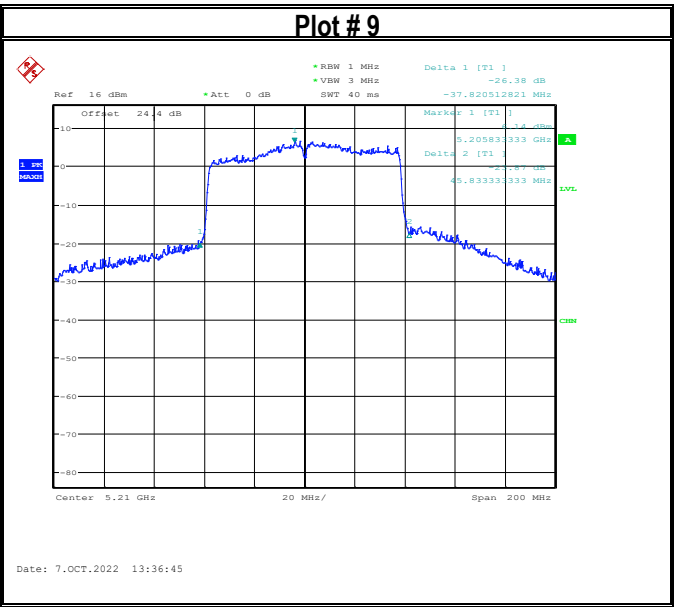


Date: 7.OCT.2022 13:41:55

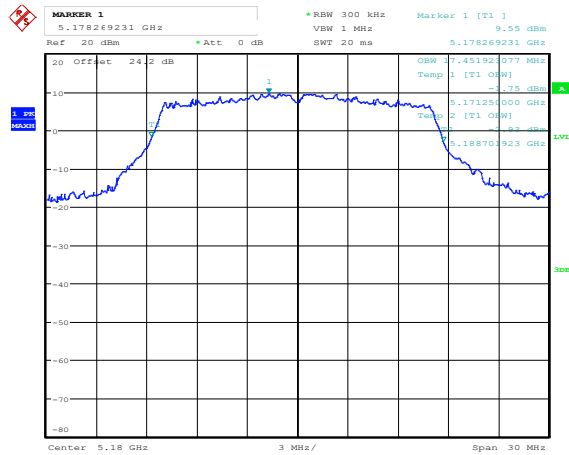
Plot # 8



Date: 7.OCT.2022 13:44:06



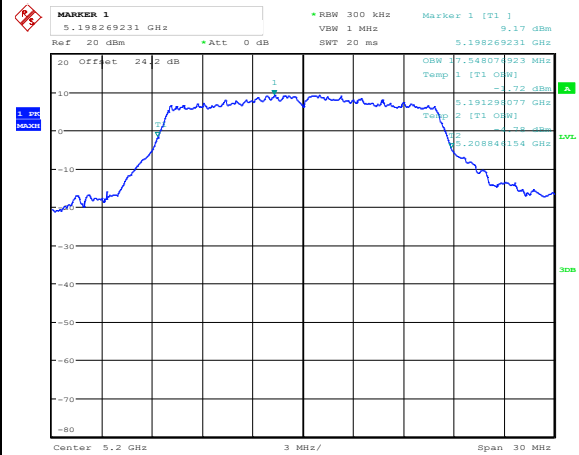
Plot # 10



low

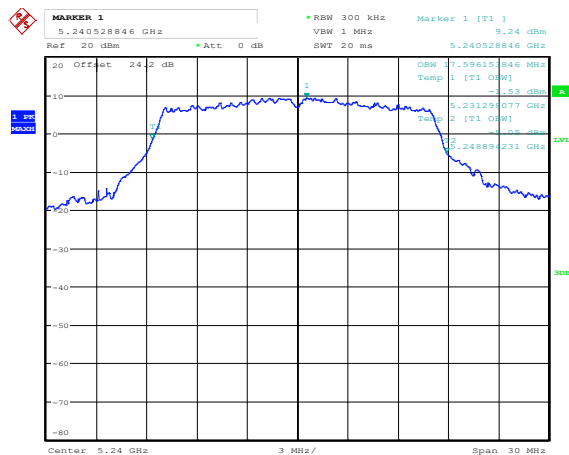
Date: 26.JUL.2022 13:22:11

Plot # 11



low
Date: 26.JUL.2022 13:21:11

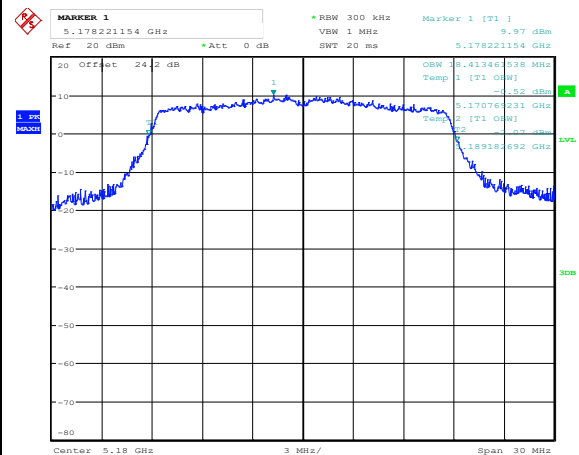
Plot # 12



low

Date: 26.JUL.2022 13:18:18

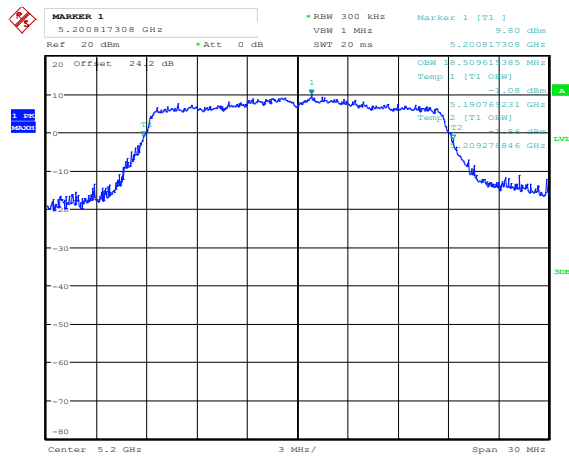
Plot # 13



low

Date: 26.JUL.2022 13:23:12

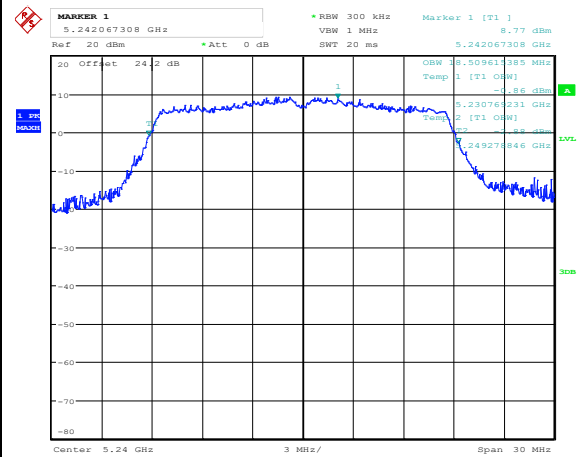
Plot # 14



low

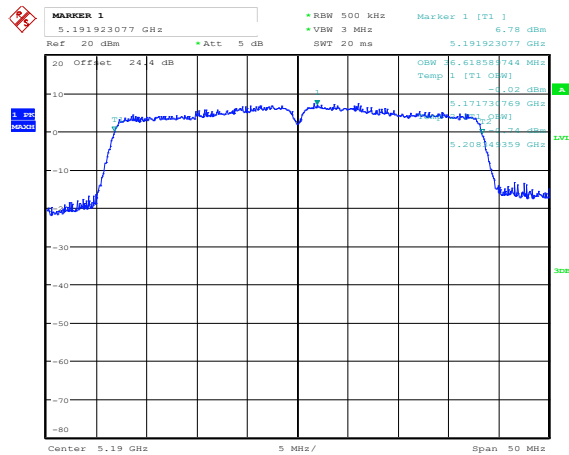
Date: 26.JUL.2022 13:20:26

Plot # 15



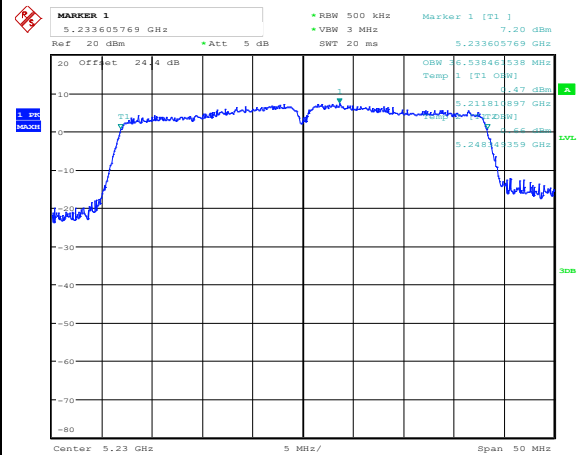
low
Date: 26.JUL.2022 13:19:16

Plot # 16

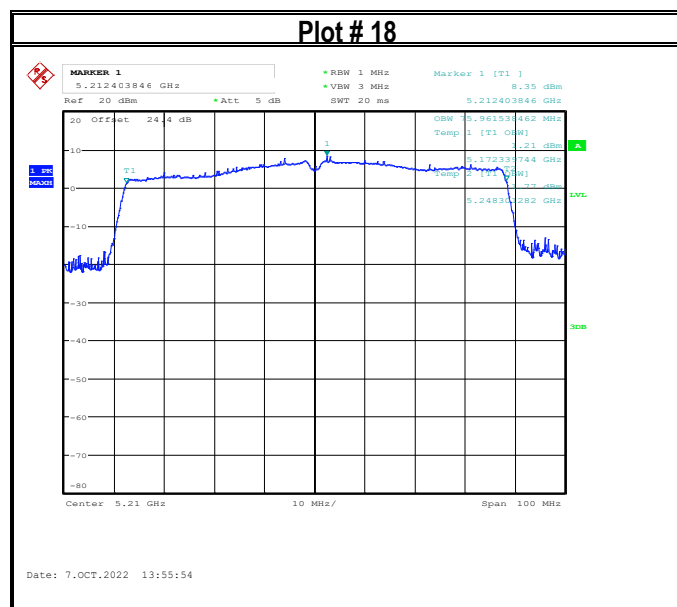


Date: 7.OCT.2022 13:48:38

Plot # 17

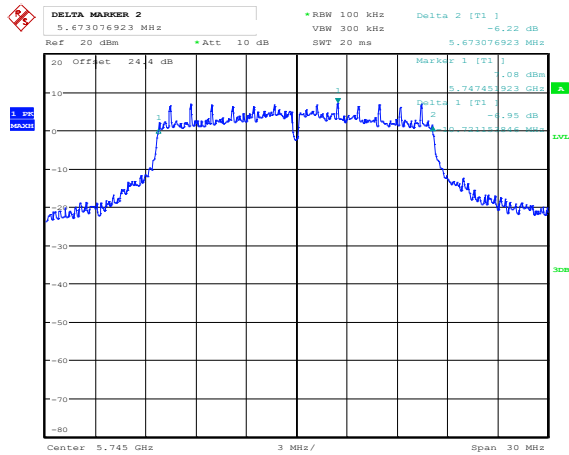


Date: 7.OCT.2022 13:46:53



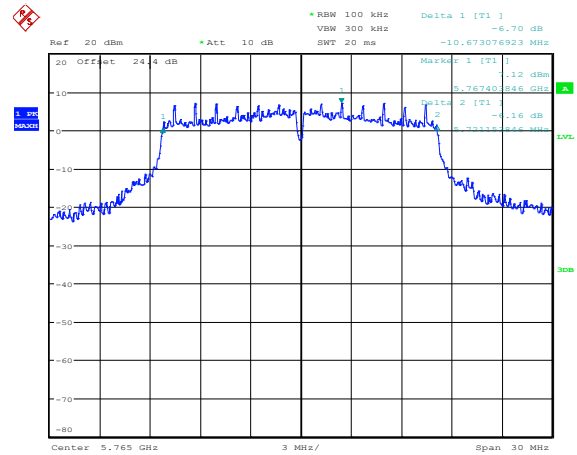


Plot # 19



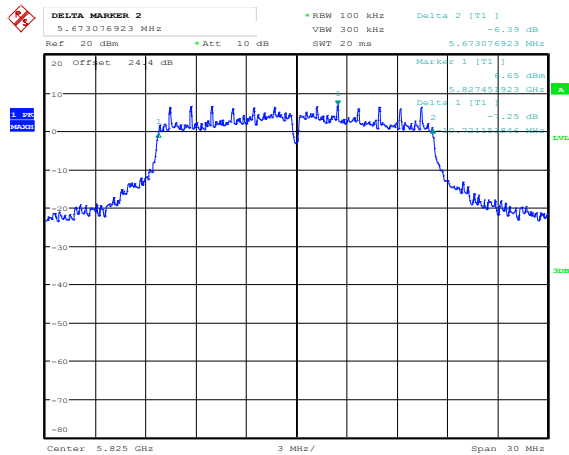
low
Date: 22.JUL.2022 14:17:35

Plot # 20



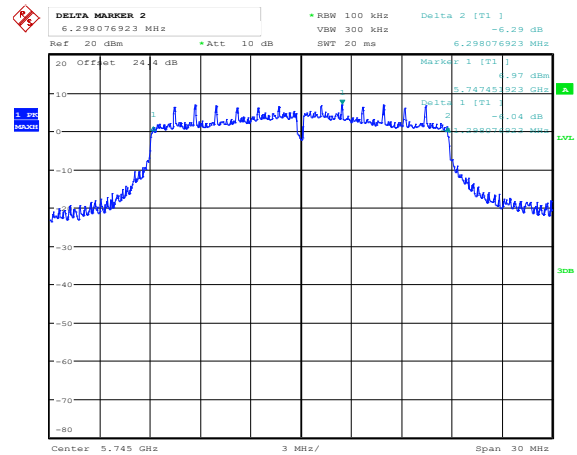
low
Date: 22.JUL.2022 13:56:34

Plot # 21



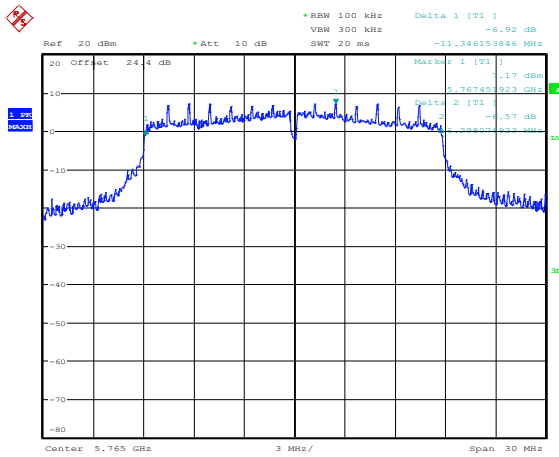
low
Date: 22.JUL.2022 14:09:17

Plot # 22



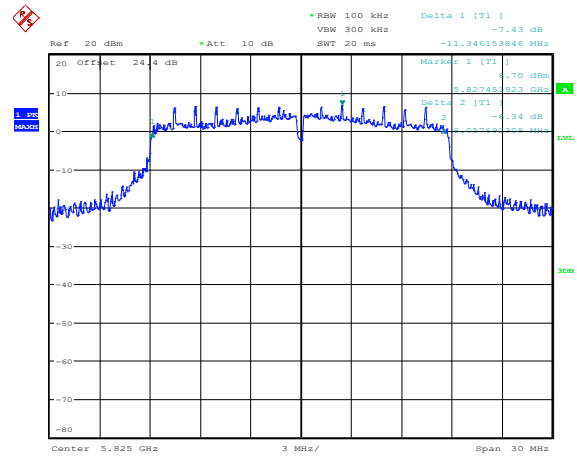
low
Date: 22.JUL.2022 14:20:02

Plot # 23



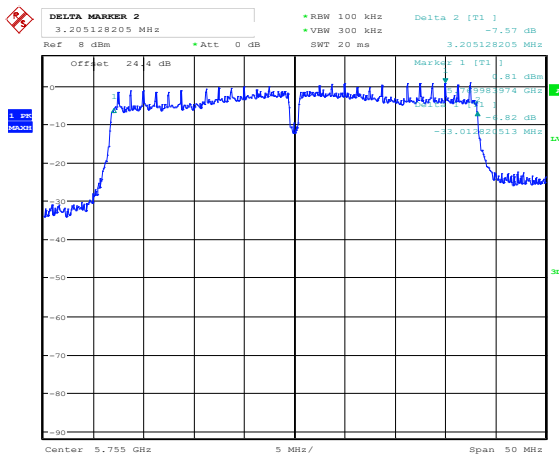
low
Date: 22.JUL.2022 14:01:25

Plot # 24



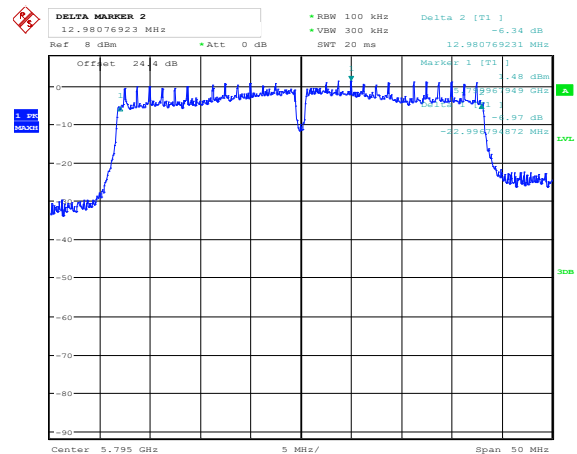
low
Date: 22.JUL.2022 14:07:36

Plot # 25



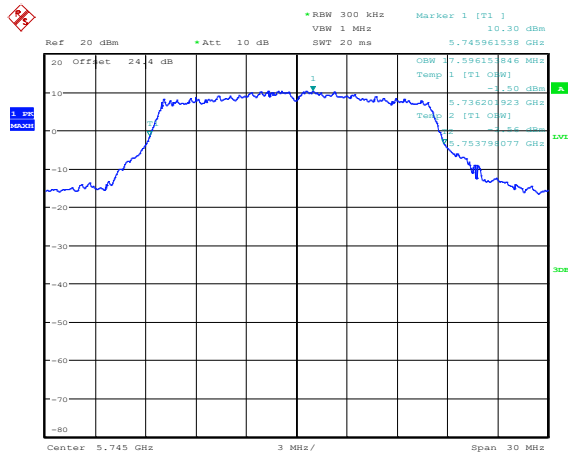
Date: 7.OCT.2022 13:18:23

Plot # 26

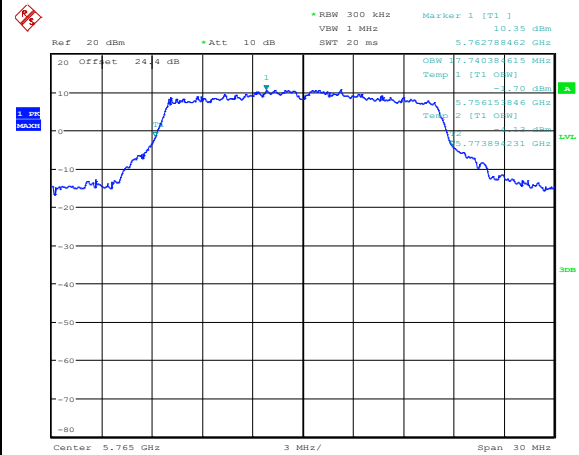


Date: 7.OCT.2022 13:20:29

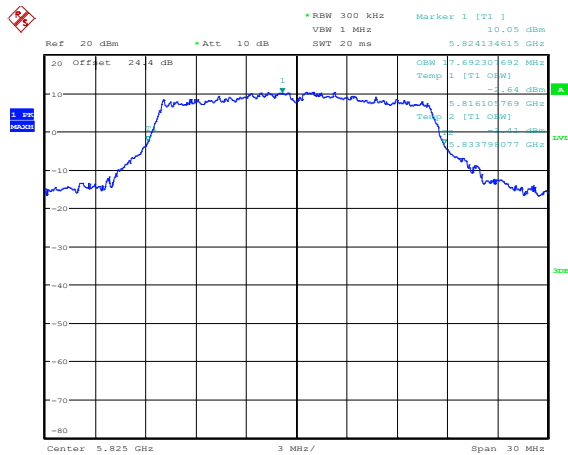
Plot # 28



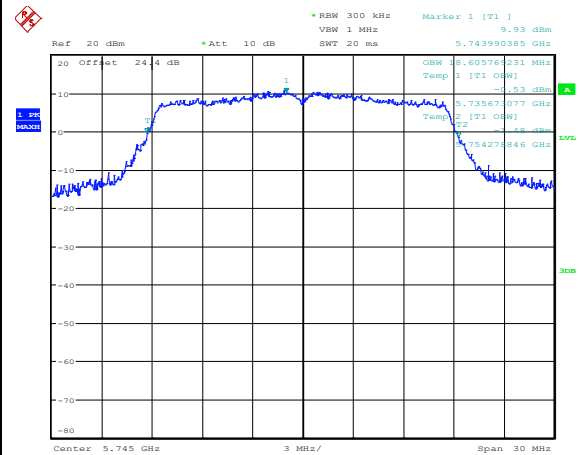
Plot # 29



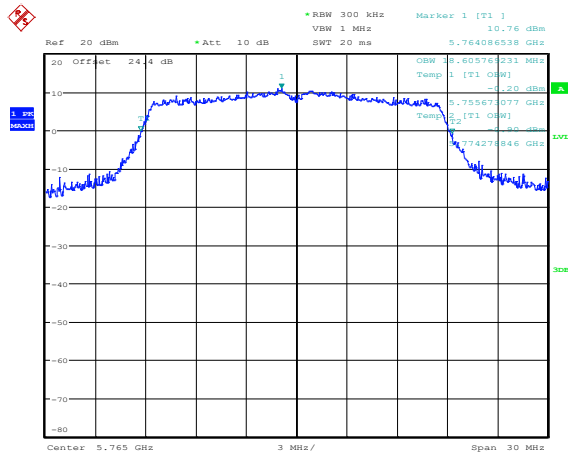
Plot # 30



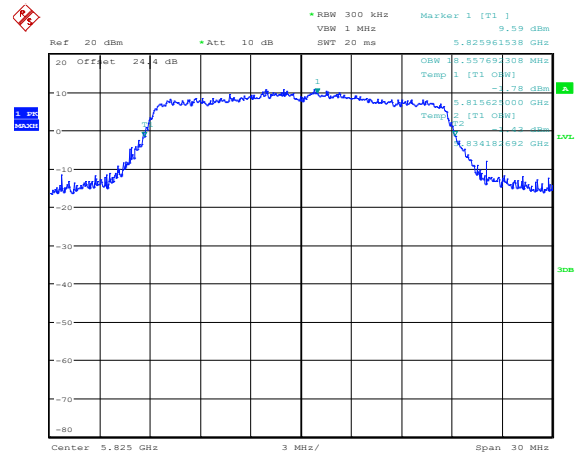
Plot # 31



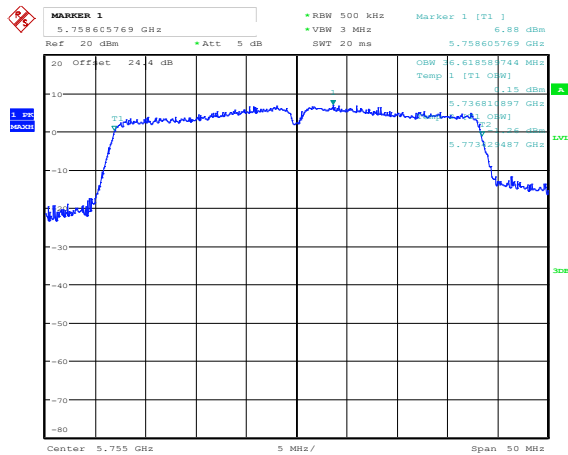
Plot # 32



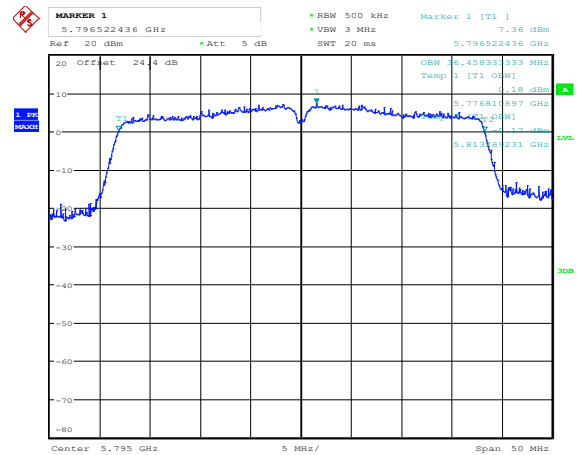
Plot # 33

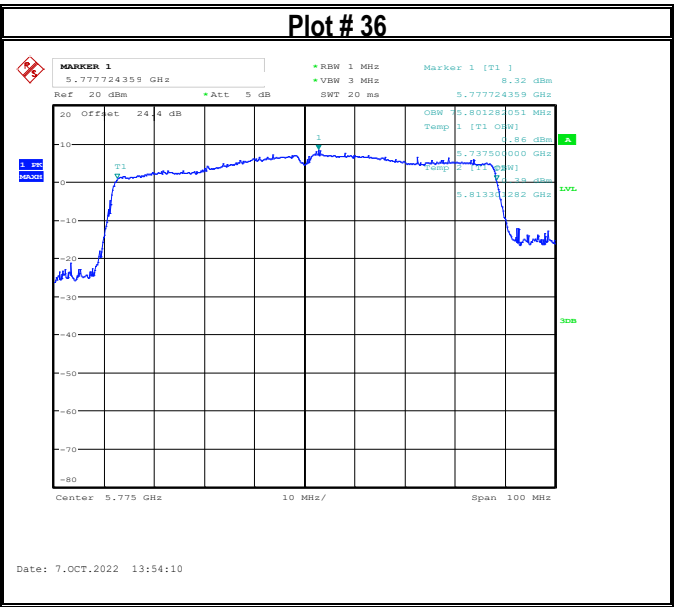


Plot # 34



Plot # 35





8.4 Frequency stability

8.4.1 Measurement Procedure

- The EUT was placed inside temperature chamber
- Set the EUT to the operation mode needed
- Set the chamber to the highest temperature specified
- Allow sufficient time for the temperature of the chamber to stabilize, measure the operating frequency
- Repeat step with the temperature chamber set to lowest temperature

8.4.2 Limits:

FCC §15.407(g)

- Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual

8.4.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22	1	Continuous fixed channel TX	12 VDC

8.4.4 Measurement result:

Temp	802.11n_HT20	Measured CF GHz	ACF GHz	Frequency Stability (ppm)
25°C	36	5.180	5.180	-9.65
	40	5.200	5.200	9.62
	48	5.240	5.240	-14.31
	149	5.745	5.745	0.00
	153	5.765	5.765	8.67
	165	5.825	5.825	-8.58
-20°C	36	5.180	5.180	9.65
	40	5.200	5.200	14.42
	48	5.240	5.240	0.00
	149	5.745	5.745	13.05
	153	5.765	5.765	13.01
	165	5.825	5.825	8.58
70°C	36	5.180	5.180	9.65
	40	5.200	5.200	33.65
	48	5.240	5.240	14.31
	149	5.745	5.745	17.41
	153	5.765	5.765	39.03
	165	5.825	5.825	8.58

8.5 Radiated Transmitter Spurious Emissions and Band Edge Compliance

8.5.1 Measurement according to ANSI C63.10 (2013)

- Band edge was tested on the modes with the highest PSD, and widest bandwidth.

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak
- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)
- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz
- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

8.5.2 Limits:

FCC§15.407 (b); RSS-247 6

- For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
- Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.
- The provisions of §15.205 apply to intentional radiators operating under this section.

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (μV/m)	Measurement Distance (m)	Field strength @ 3m (dBμV/m)
0.009–0.490	2400/F(kHz) / -----	300	-
0.490–1.705	24000/F(kHz) / -----	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBμV/m
88–216	150	3	43.5 dBμV/m
216–960	200	3	46 dBμV/m
Above 960	500	3	54 dBμV/m

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- 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)).

*PEAK LIMIT= 74 dBμV/m

*AVG. LIMIT= 54 dBμV/m

8.5.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	2	GFSK continuous fixed channel	12 VDC

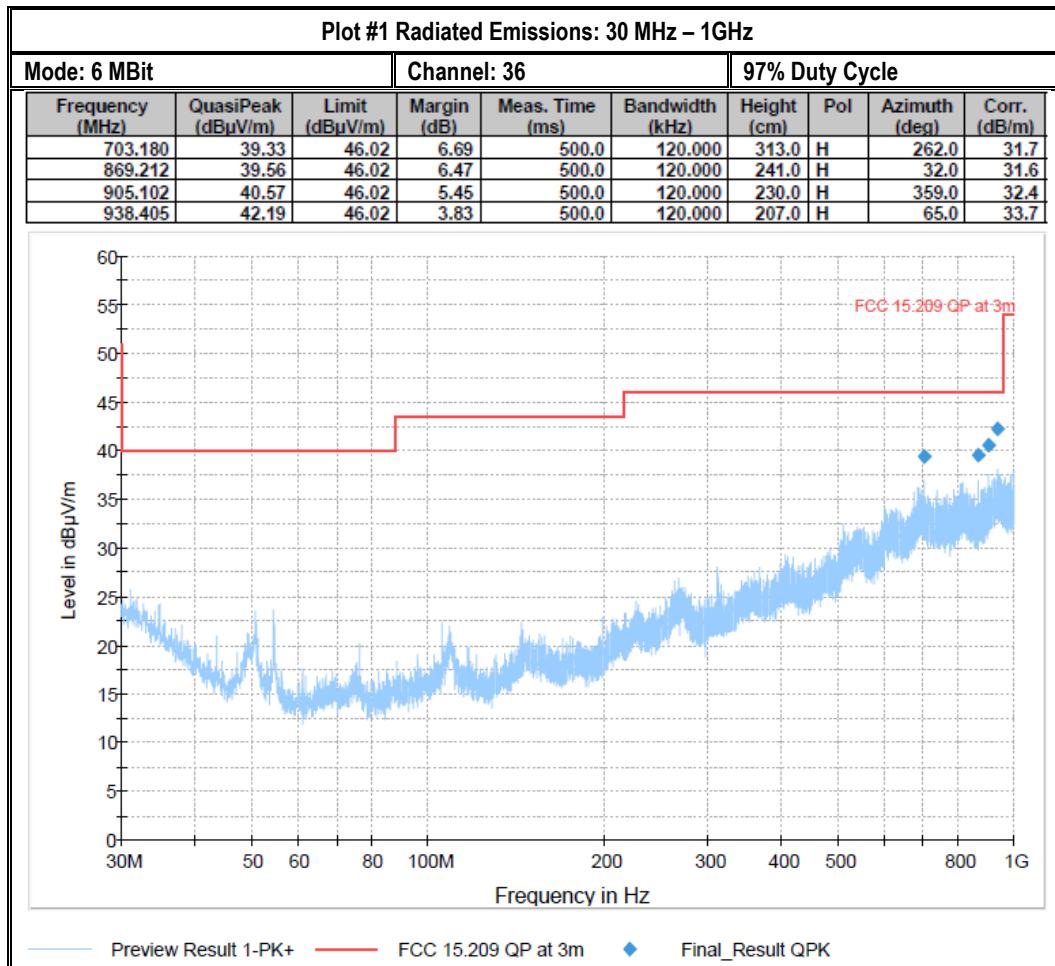
8.5.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	36	30 MHz – 18 GHz	See section 8.5.2	Pass
4-8	40	9 kHz – 26 GHz	See section 8.5.2	Pass
9-11	48	30 MHz – 18 GHz	See section 8.5.2	Pass
12-14	149	30 MHz – 18 GHz	See section 8.5.2	Pass
15-19	153	9 kHz – 26 GHz	See section 8.5.2	Pass
20-22	165	30 MHz – 18 GHz	See section 8.5.2	Pass

Restricted Band Edge @ 5.15GHz

Plot #	EUT operating mode	Band Edge	Band Edge Max (dB μ V/m)	Limit (dB μ V/m)	Result
23	6 Mbit 20MHz	Restricted Peak	70	74	Pass
24	6 Mbit 40MHz	Restricted AVG	52	54	Pass
25	MCS0 40MHz	Restricted Peak	68	74	Pass
26	MCS0 40MHz	Restricted AVG	51	54	Pass
27	MCS0 80MHz	Restricted Peak	67	74	Pass
28	MCS0 80MHz	Restricted AVG	51	54	Pass

8.5.5 Measurement Plots:



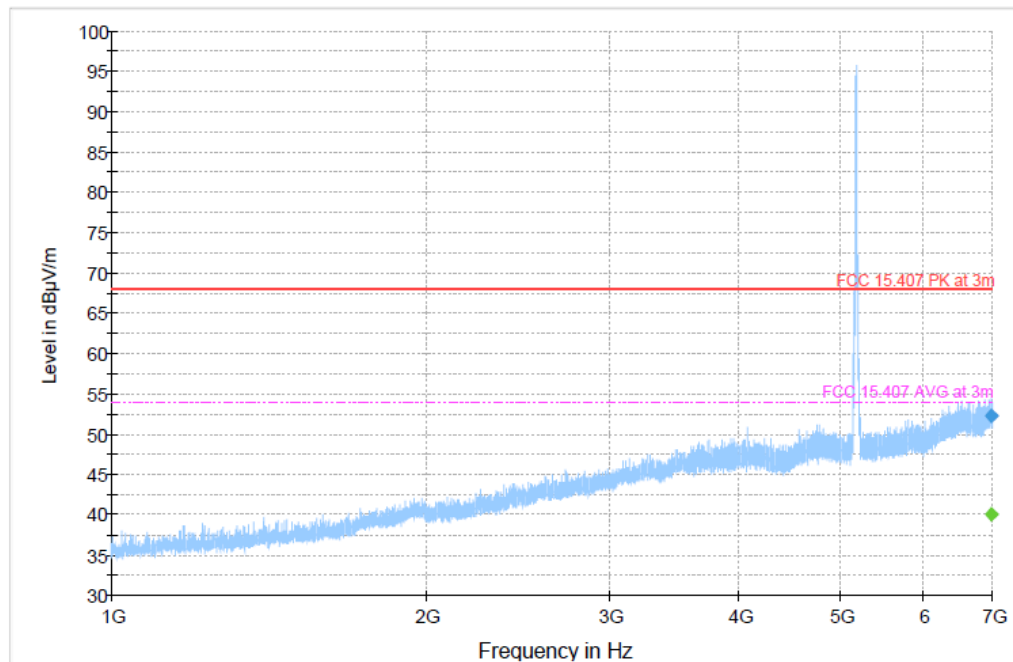
Plot # 2 Radiated Emissions: 1-7 GHz

Mode: 6 MBit

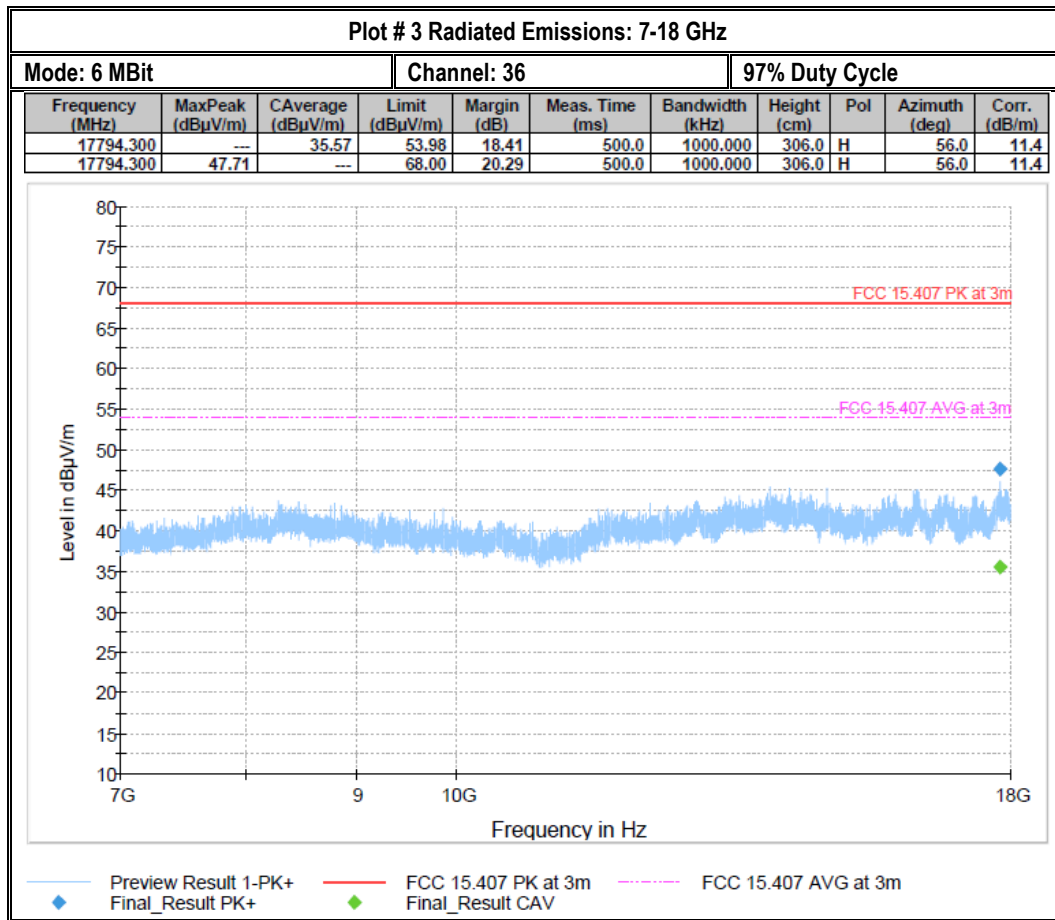
Channel: 36

97% Duty Cycle

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
6976.100	---	40.06	53.98	13.91	500.0	1000.000	265.0	H	-45.0	19.9
6976.100	52.32	---	68.00	15.68	500.0	1000.000	265.0	H	-45.0	19.9



Preview Result 1-PK+ Final_Result PK+ FCC 15.407 PK at 3m Final_Result CAV FCC 15.407 AVG at 3m



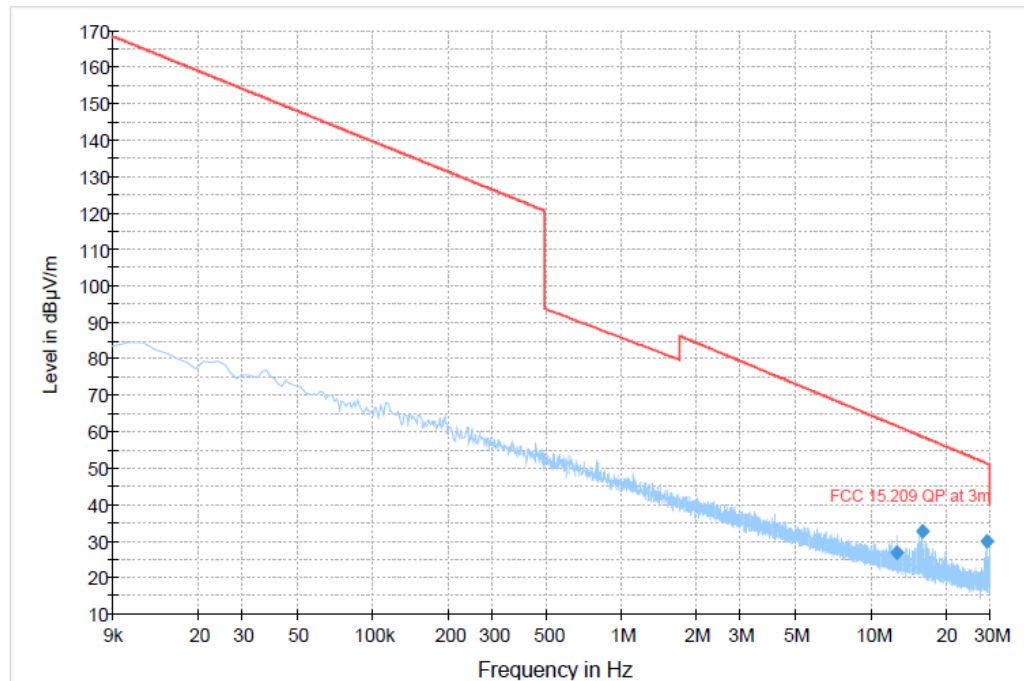
Plot # 4 Radiated Emissions: 9 KHz – 30 MHz

Mode: MBit

Channel: 40

97% Duty Cycle

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
12.808	26.91	61.52	34.61	500.0	9.000	231.0	V	222.0	17.1
16.168	32.80	58.65	25.85	500.0	9.000	242.0	V	148.0	16.9
29.237	29.74	51.36	21.61	500.0	9.000	150.0	V	-37.0	16.1



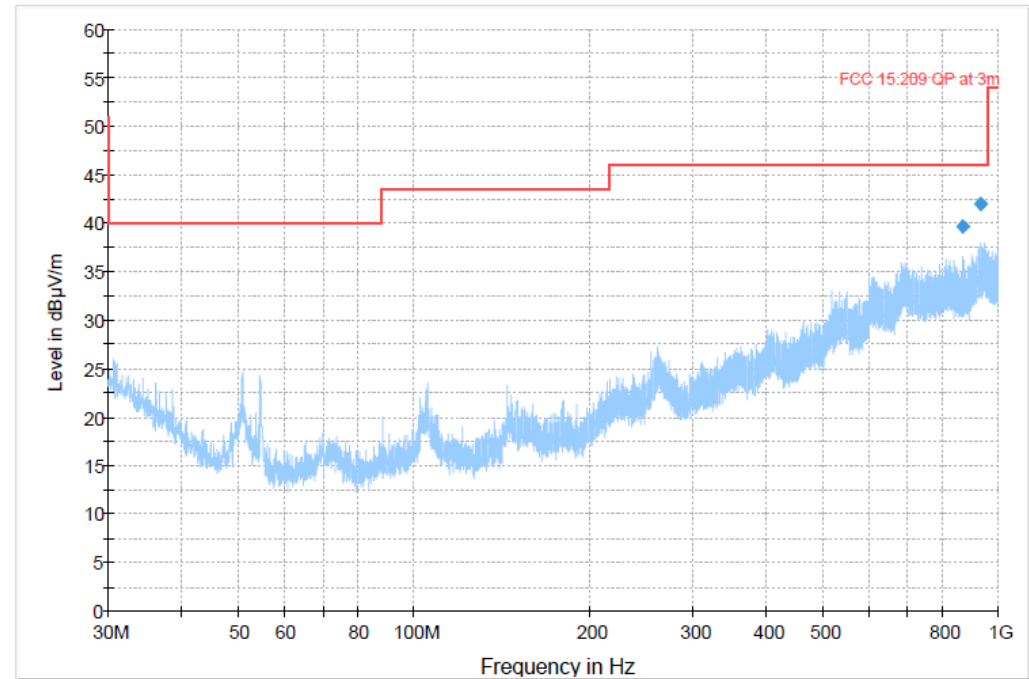
Plot # 5 Radiated Emissions: 30 MHz – 1GHz

Mode: 6 MBit

Channel: 40

97% Duty Cycle

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
869.697	39.62	46.02	6.40	500.0	120.000	150.0	H	154.0	31.6
932.908	41.98	46.02	4.04	500.0	120.000	211.0	H	277.0	33.6



Preview Result 1-PK+ FCC 15.209 QP at 3m Final_Result QPK

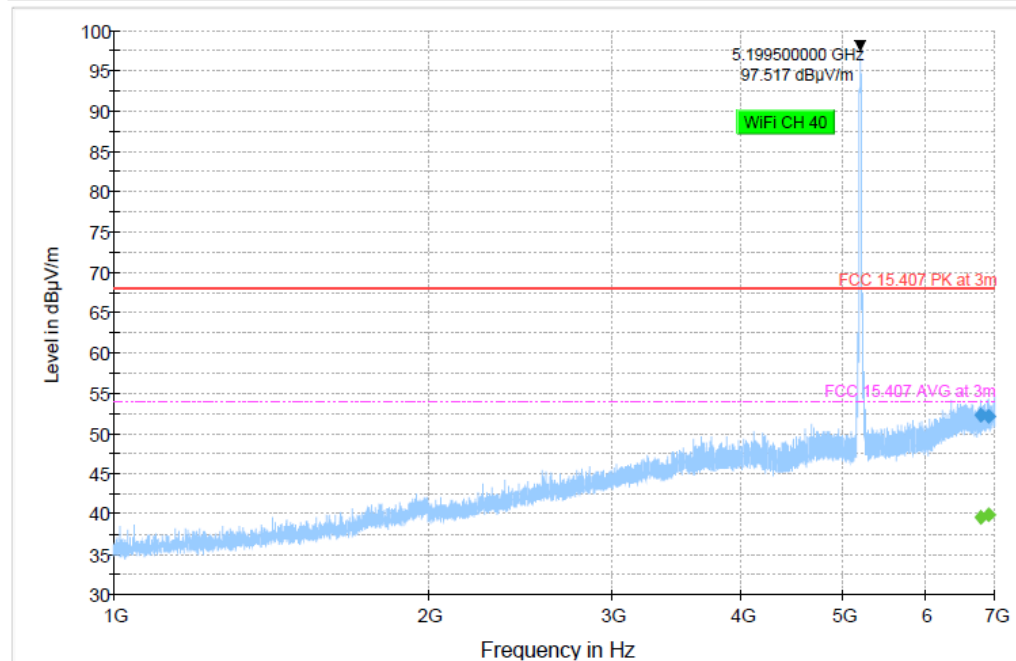
Plot # 6 Radiated Emissions: 1-7 GHz

Mode: 6 MBit

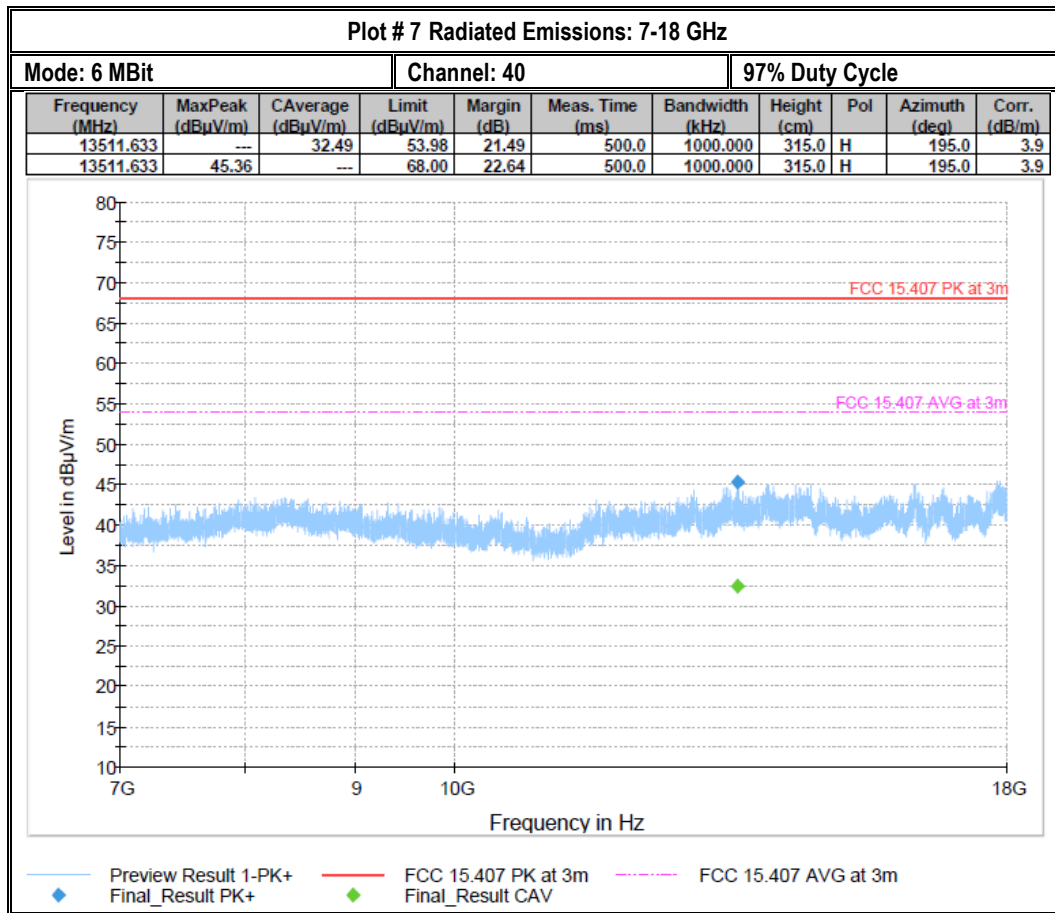
Channel: 40

97% Duty Cycle

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
6778.200	---	39.57	53.98	14.41	500.0	1000.000	299.0	H	133.0	19.4
6778.200	52.35	---	68.00	15.65	500.0	1000.000	299.0	H	133.0	19.4
6908.350	---	39.90	53.98	14.08	500.0	1000.000	175.0	H	268.0	19.8
6908.350	52.16	---	68.00	15.84	500.0	1000.000	175.0	H	268.0	19.8

Preview Result 1-PK+
Final_Result PK+FCC 15.407 PK at 3m
Final_Result CAV

FCC 15.407 AVG at 3m



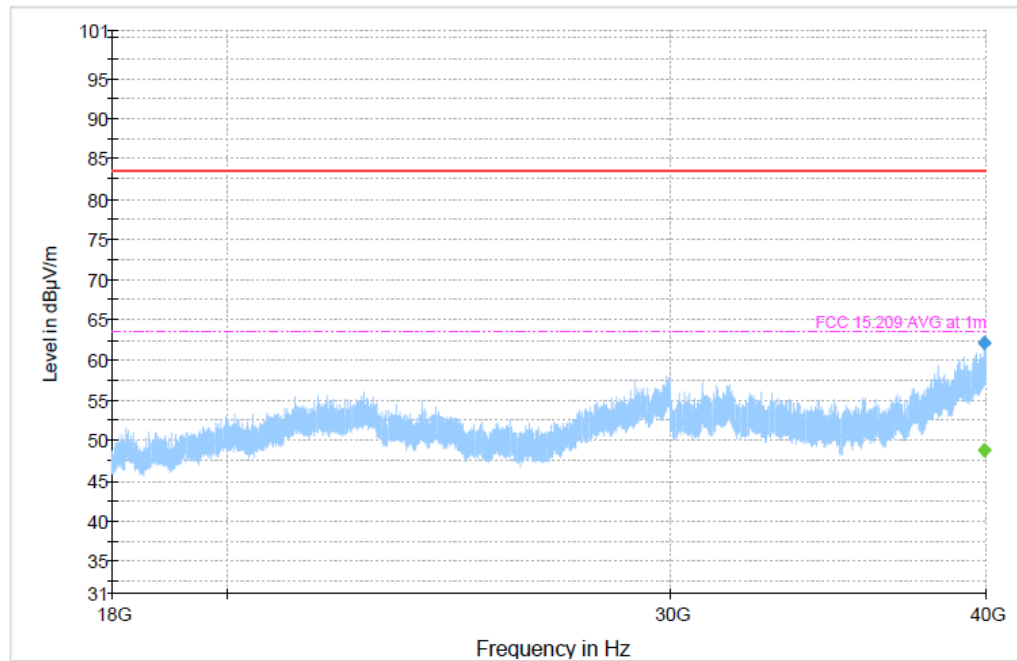
Plot # 8 Radiated Emissions: 18-40 GHz

Mode: 6 MBit

Channel: 40

97% Duty Cycle

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39974.063	---	48.84	63.50	14.66	500.0	1000.000	150.0	H	219.0	24.9
39974.063	62.20	---	83.50	21.30	500.0	1000.000	150.0	H	219.0	24.9



Preview Result 1-PK+ FCC 15.209 PK at 1m FCC 15.209 AVG at 1m
Final_Result PK+ Final_Result CAV

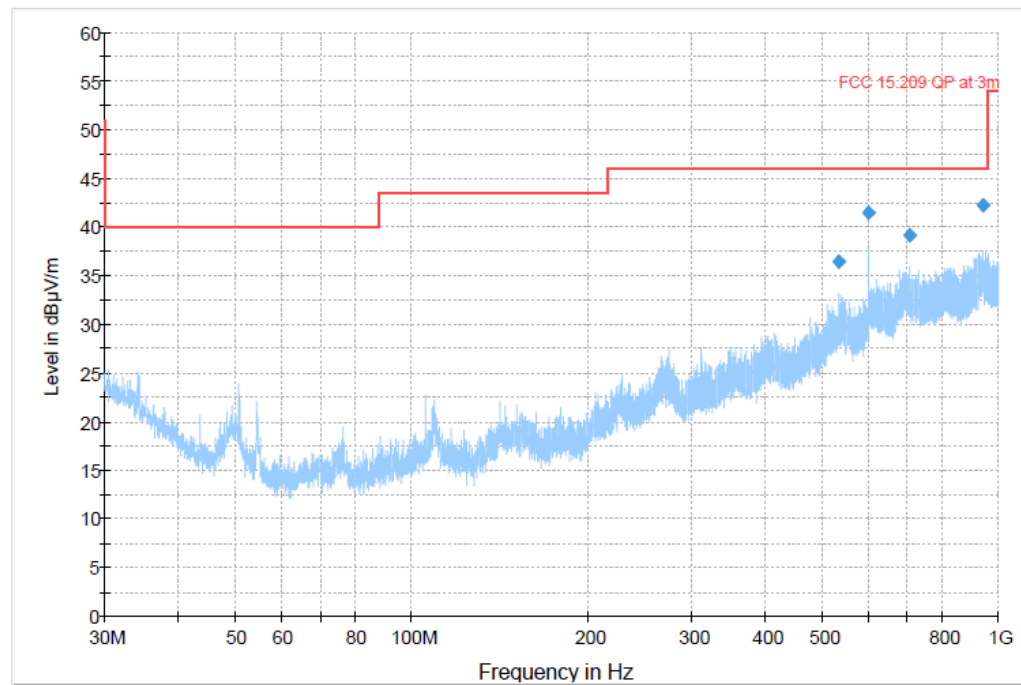
Plot # 9 Radiated Emissions: 30 MHz – 1GHz

Mode: 6 MBit

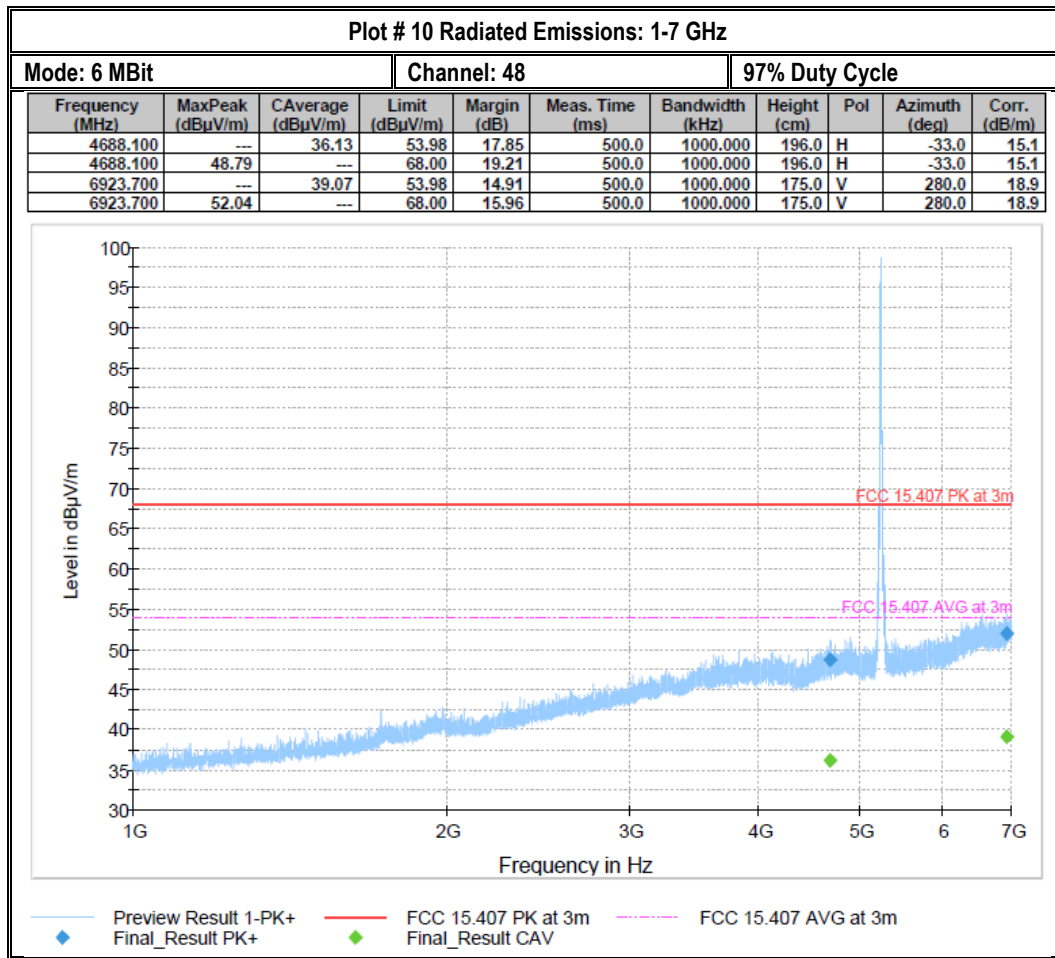
Channel: 48

97% Duty Cycle

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
535.305	36.49	46.02	9.53	500.0	120.000	315.0	H	-5.0	29.3
600.004	41.44	46.02	4.58	500.0	120.000	163.0	H	163.0	29.7
705.476	39.16	46.02	6.86	500.0	120.000	231.0	H	265.0	31.6
939.472	42.18	46.02	3.84	500.0	120.000	164.0	H	-25.0	33.8



Preview Result 1-PK+ FCC 15.209 QP at 3m Final_Result QPK



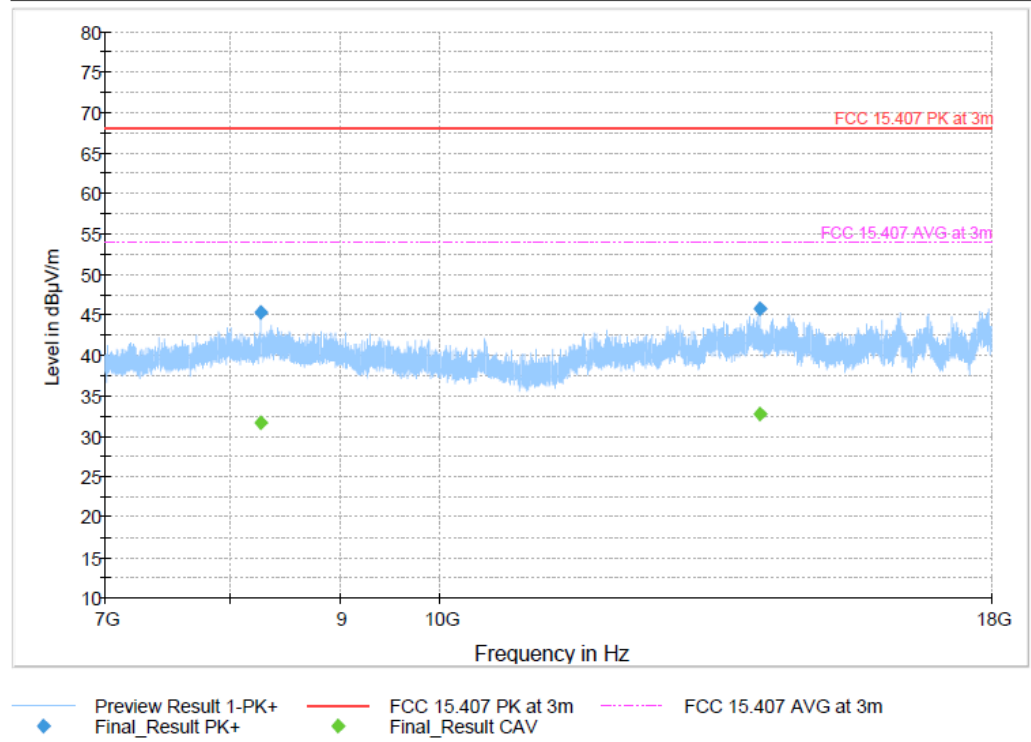
Plot # 11 Radiated Emissions: 7-18 GHz

Mode: 6 MBit

Channel: 48

97% Duty Cycle

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8258.400	45.26	---	68.00	22.74	500.0	1000.000	269.0	V	285.0	1.9
8258.400	---	31.61	53.98	22.37	500.0	1000.000	269.0	V	285.0	1.9
14073.000	45.73	---	68.00	22.27	500.0	1000.000	196.0	V	112.0	4.5
14073.000	---	32.81	53.98	21.16	500.0	1000.000	196.0	V	112.0	4.5



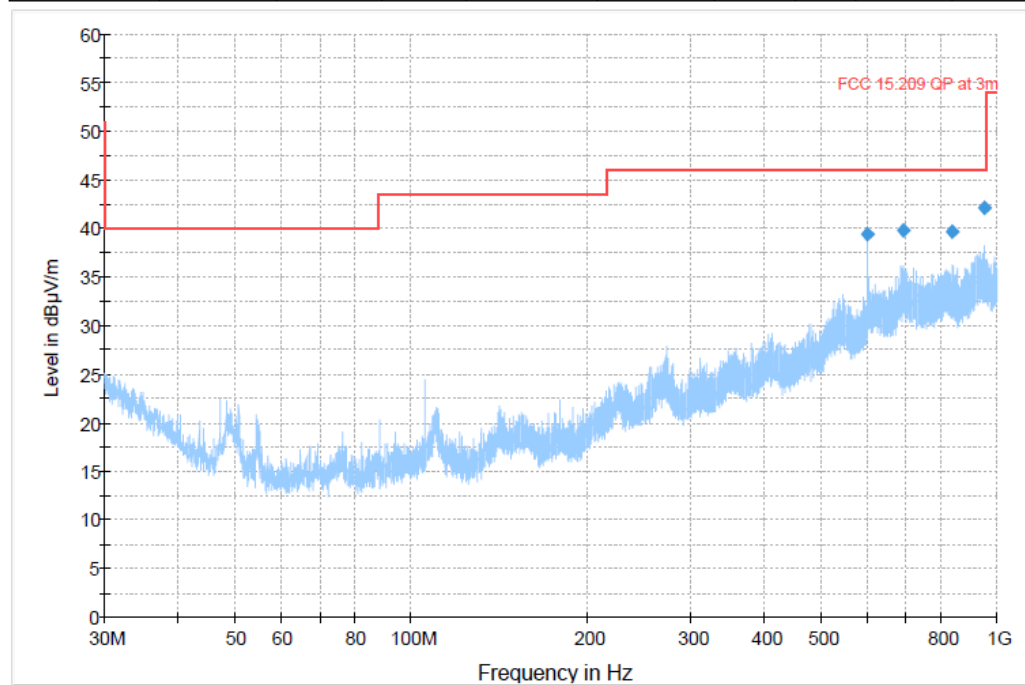
Plot # 12 Radiated Emissions: 30 MHz – 1GHz

Mode: 6 MBit

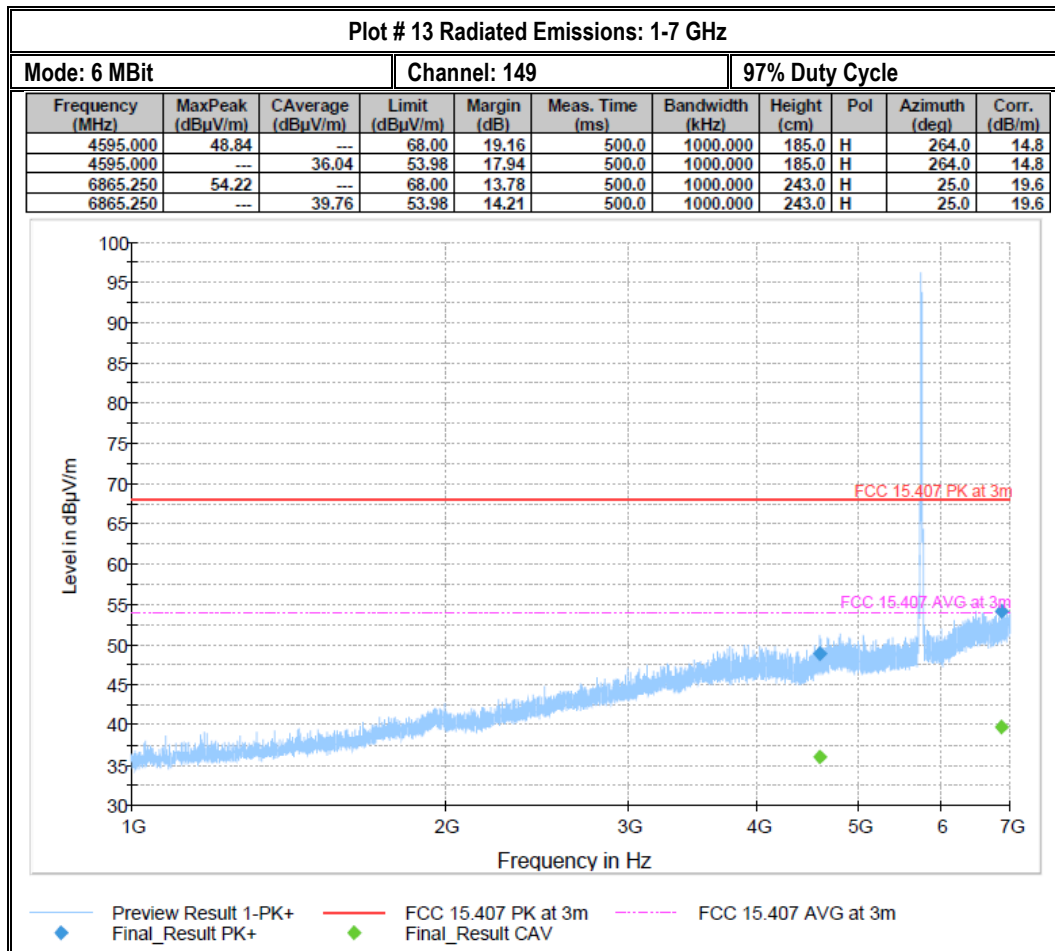
Channel: 149

97% Duty Cycle

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
600.004	39.44	46.02	6.58	500.0	120.000	165.0	H	149.0	29.7
689.891	39.73	46.02	6.29	500.0	120.000	273.0	H	-45.0	32.1
840.015	39.64	46.02	6.38	500.0	120.000	274.0	H	197.0	31.7
948.687	42.11	46.02	3.91	500.0	120.000	315.0	H	159.0	33.7



Preview Result 1-PK+ FCC 15.209 QP at 3m Final_Result QPK



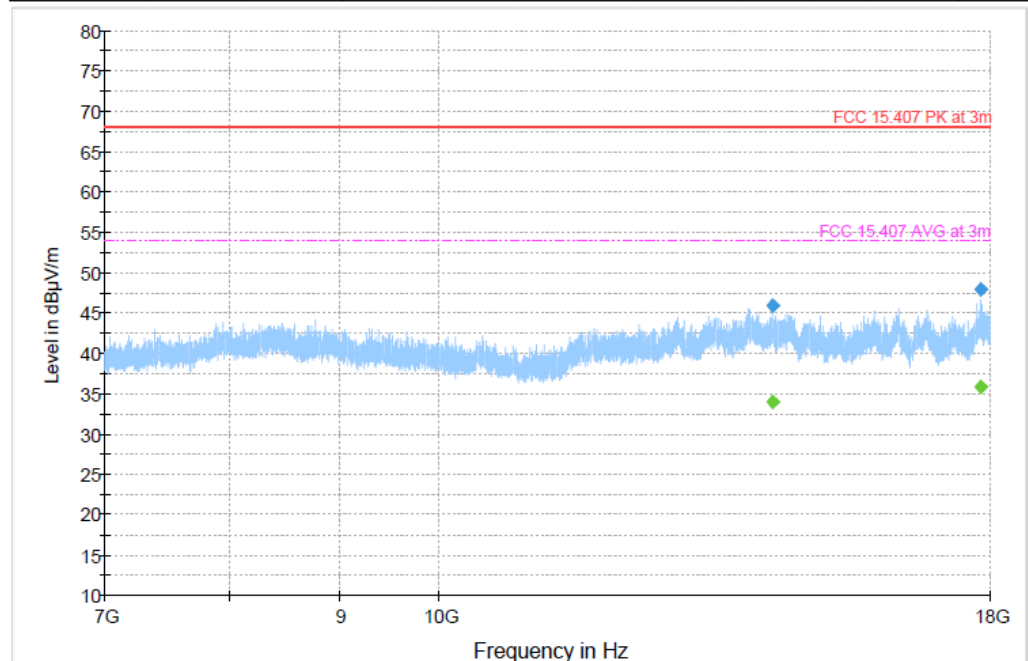
Plot # 14 Radiated Emissions: 7-18 GHz

Mode: 6 MBit

Channel: 149

97% Duty Cycle

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
14274.667	---	33.96	53.98	20.02	500.0	1000.000	150.0	V	134.0	5.4
14274.667	45.99	---	68.00	22.01	500.0	1000.000	150.0	V	134.0	5.4
17827.667	---	35.87	53.98	18.11	500.0	1000.000	315.0	V	220.0	11.6
17827.667	48.01	---	68.00	19.99	500.0	1000.000	315.0	V	220.0	11.6



Preview Result 1-PK+ Final_Result PK+ FCC 15.407 PK at 3m Final_Result CAV FCC 15.407 AVG at 3m

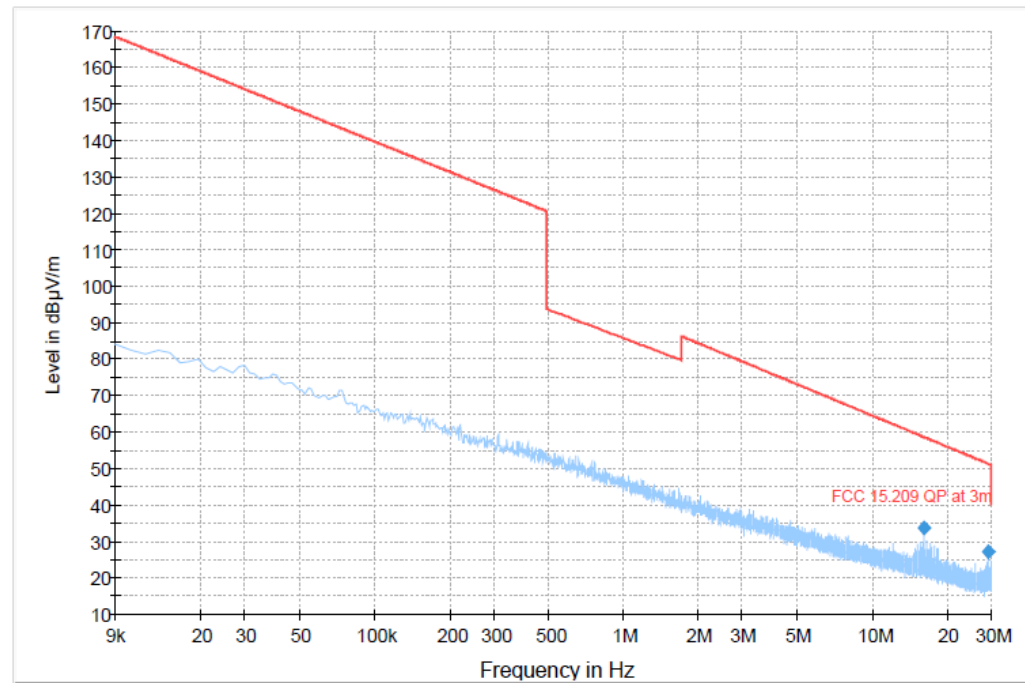
Plot # 15 Radiated Emissions: 9 KHz – 30 MHz

Mode: 6 MBit

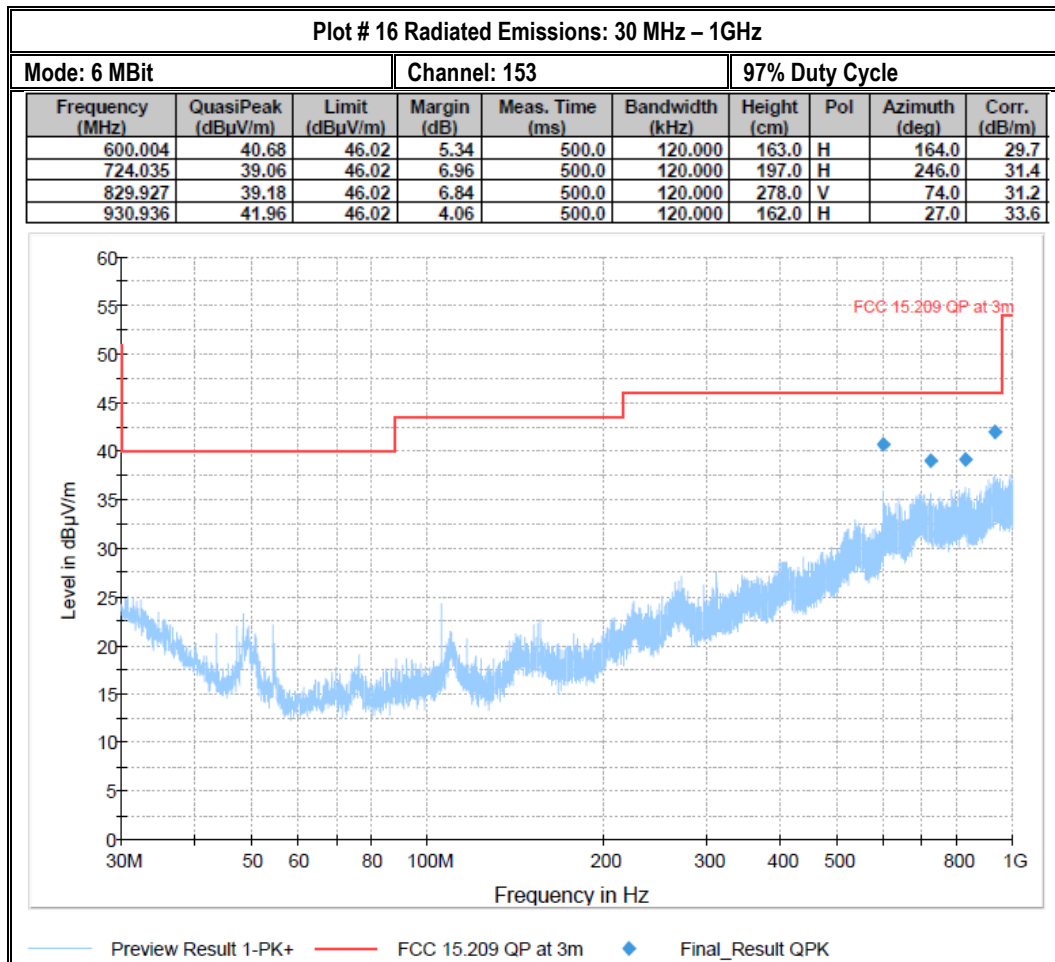
Channel: 153

97% Duty Cycle

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
16.228	33.60	58.60	25.00	500.0	9.000	196.0	V	249.0	16.9
29.237	27.10	51.36	24.26	500.0	9.000	306.0	V	194.0	16.1



Preview Result 1-PK+ FCC 15.209 QP at 3m Final_Result QPK



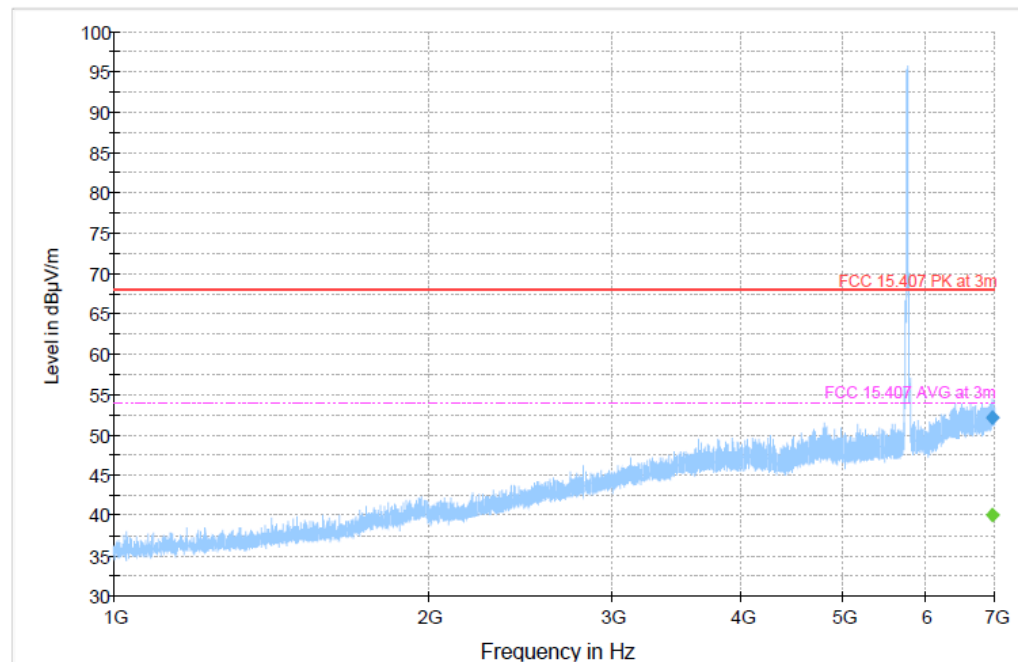
Plot # 17 Radiated Emissions: 1-7 GHz

Mode: 6 MBit

Channel: 153

97% Duty Cycle

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
6967.100	---	40.04	53.98	13.94	500.0	1000.000	149.0	H	286.0	19.9
6967.100	52.10	---	68.00	15.90	500.0	1000.000	149.0	H	286.0	19.9



Preview Result 1-PK+ Final_Result PK+ FCC 15.407 PK at 3m Final_Result CAV FCC 15.407 AVG at 3m

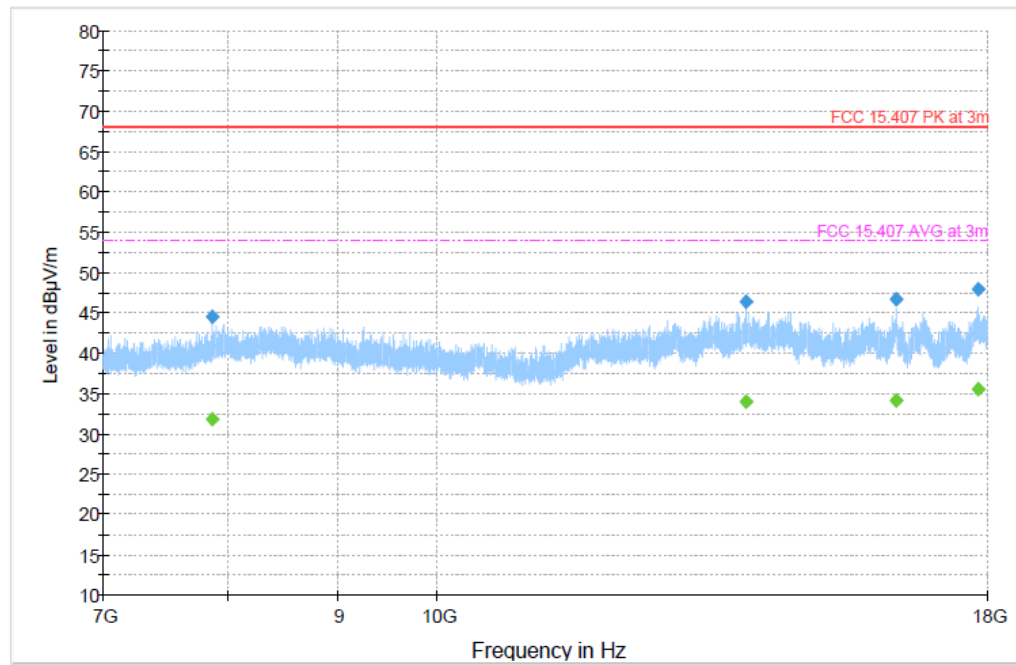
Plot # 18 Radiated Emissions: 7-18 GHz

Mode: 6 MBit

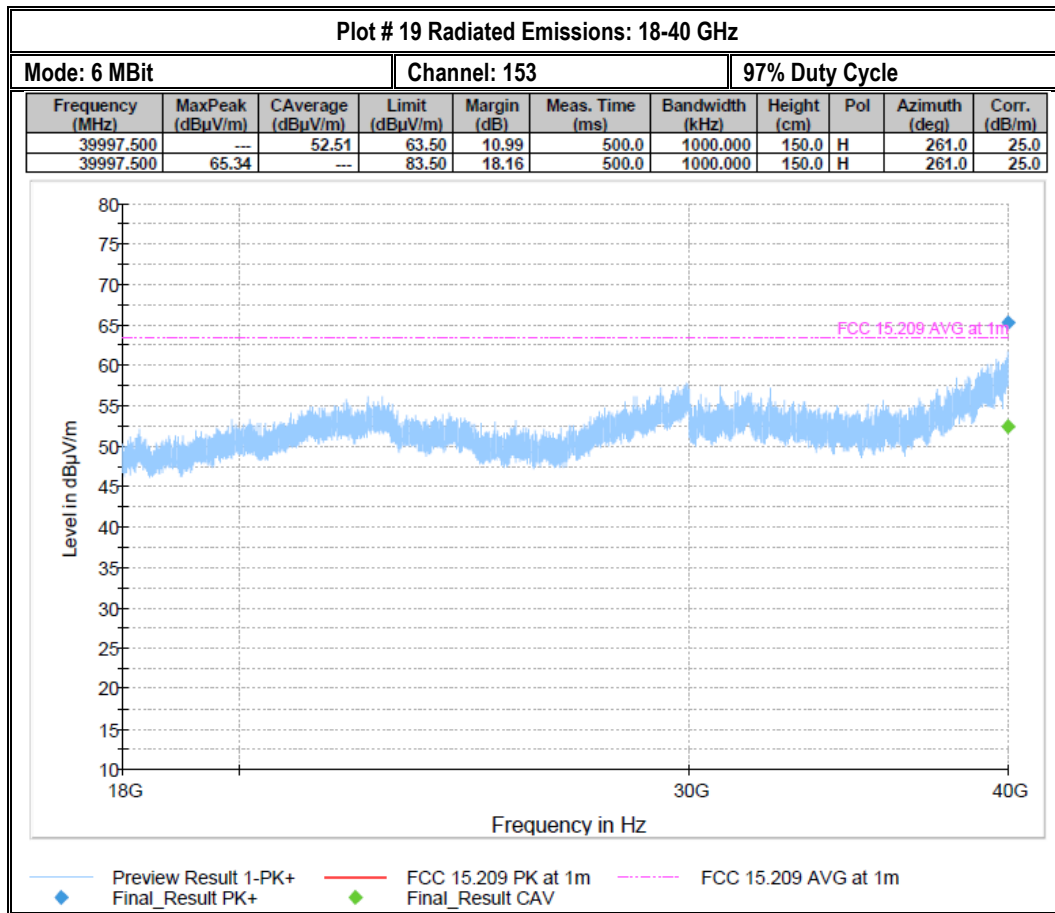
Channel: 153

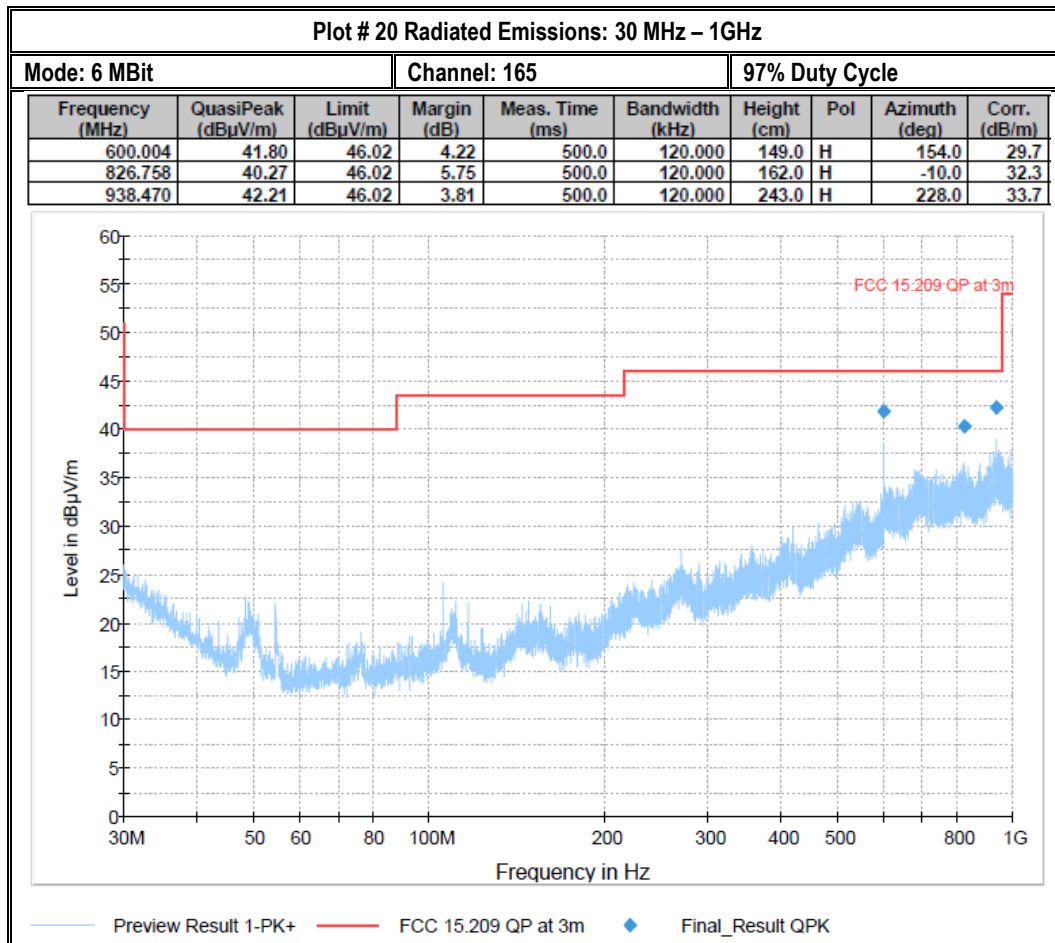
97% Duty Cycle

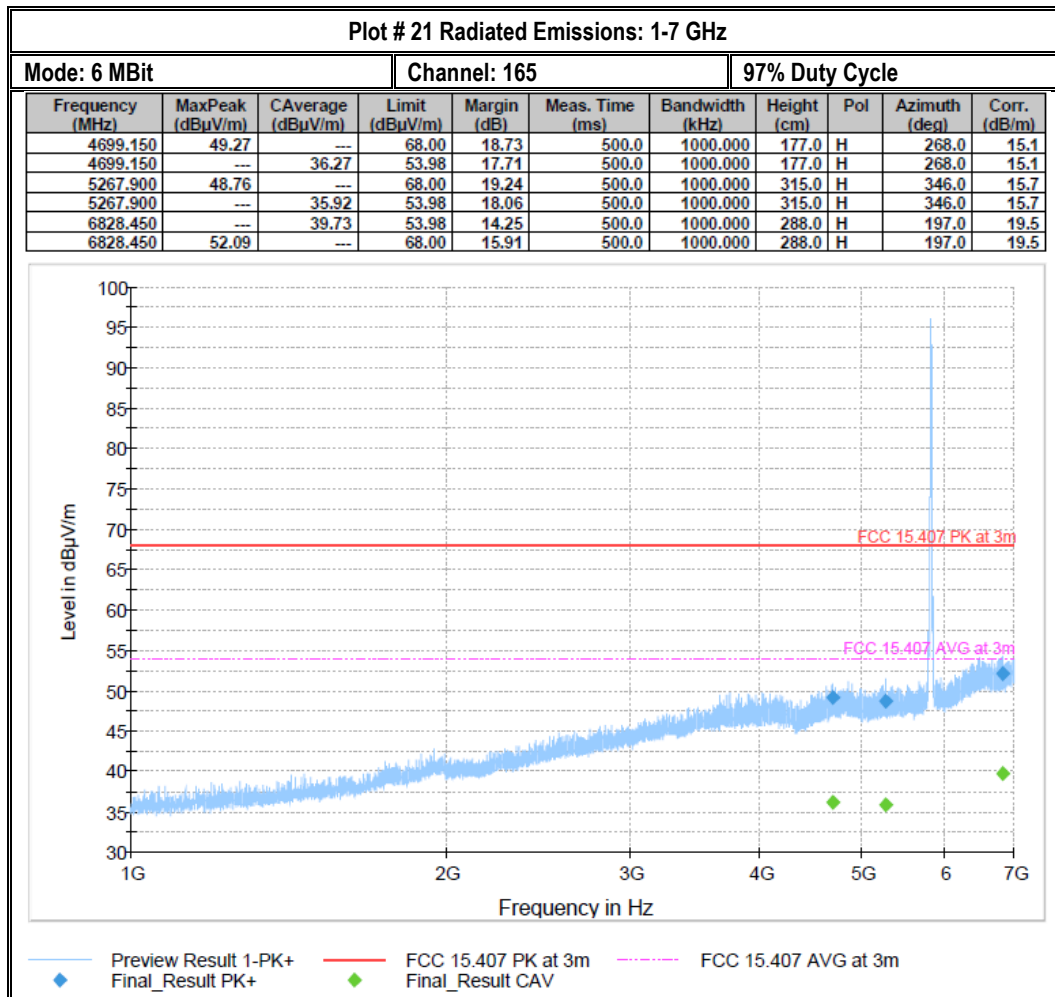
Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7869.000	44.47	---	68.00	23.53	500.0	1000.000	229.0	V	293.0	1.7
7869.000	---	31.80	53.98	22.18	500.0	1000.000	229.0	V	293.0	1.7
13916.433	---	33.99	53.98	19.99	500.0	1000.000	177.0	H	286.0	5.1
13916.433	46.39	---	68.00	21.61	500.0	1000.000	177.0	H	286.0	5.1
16325.067	---	34.09	53.98	19.89	500.0	1000.000	315.0	H	195.0	7.3
16325.067	46.77	---	68.00	21.23	500.0	1000.000	315.0	H	195.0	7.3
17838.667	47.95	---	68.00	20.05	500.0	1000.000	175.0	V	286.0	11.7
17838.667	---	35.56	53.98	18.42	500.0	1000.000	175.0	V	286.0	11.7

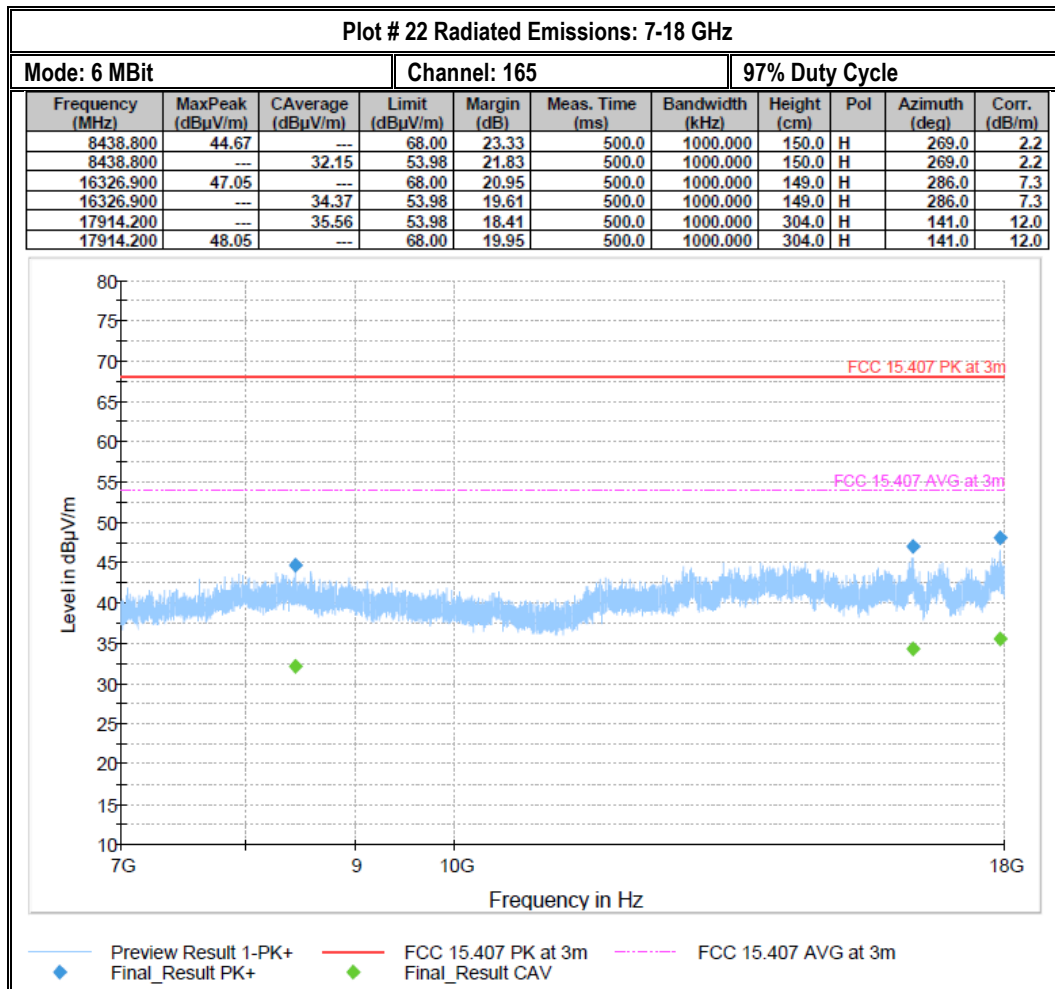


Preview Result 1-PK+ Final_Result PK+ FCC 15.407 PK at 3m Final_Result CAV FCC 15.407 AVG at 3m







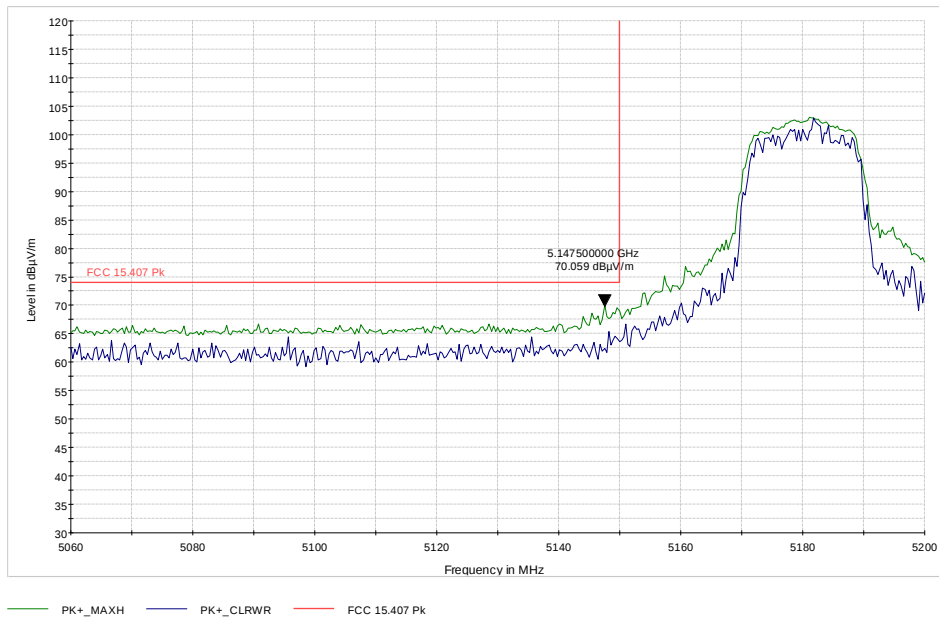


Plot # 23 Peak Restricted Band Edge @ 5.15GHz

Mode: 6 MBit

Channel: 36

97% Duty Cycle

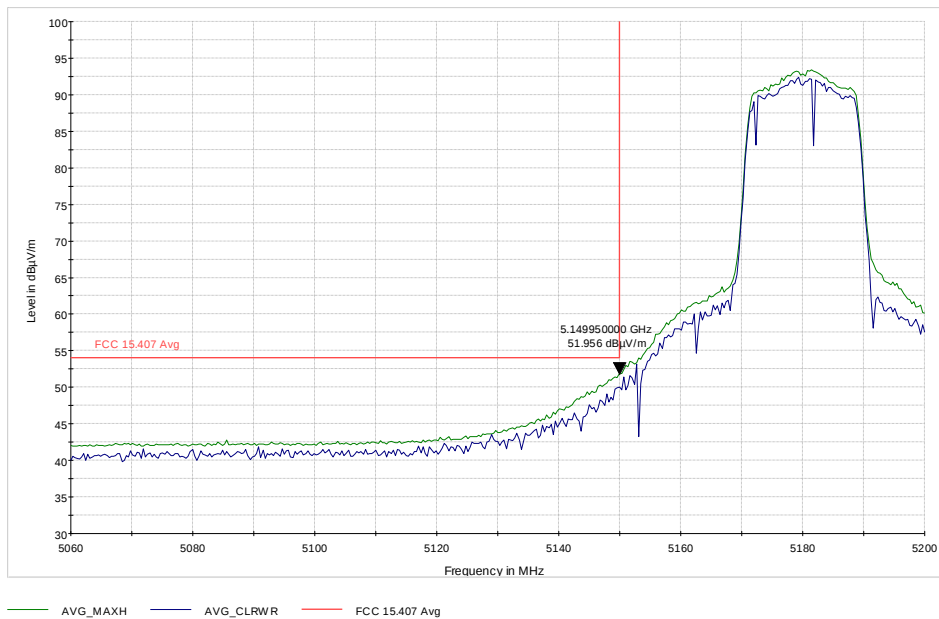


Plot # 24 AVG Restricted Band Edge @ 5.15GHz

Mode: 6 MBit

Channel: 36

97% Duty Cycle

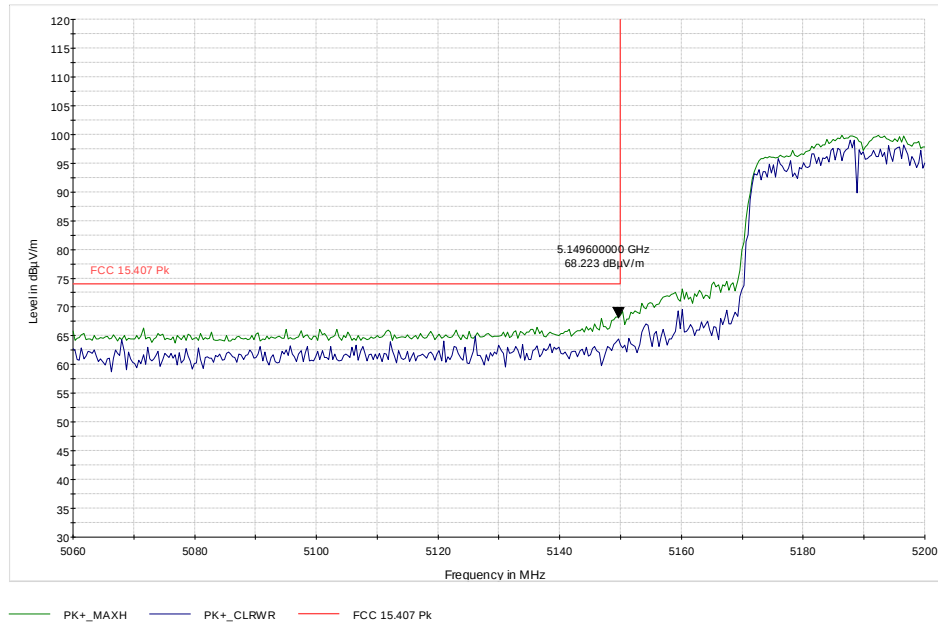


Plot # 25 Peak Restricted Band Edge @ 5.15GHz

Mode: MCS0 40MHz

Channel: 38

97% Duty Cycle

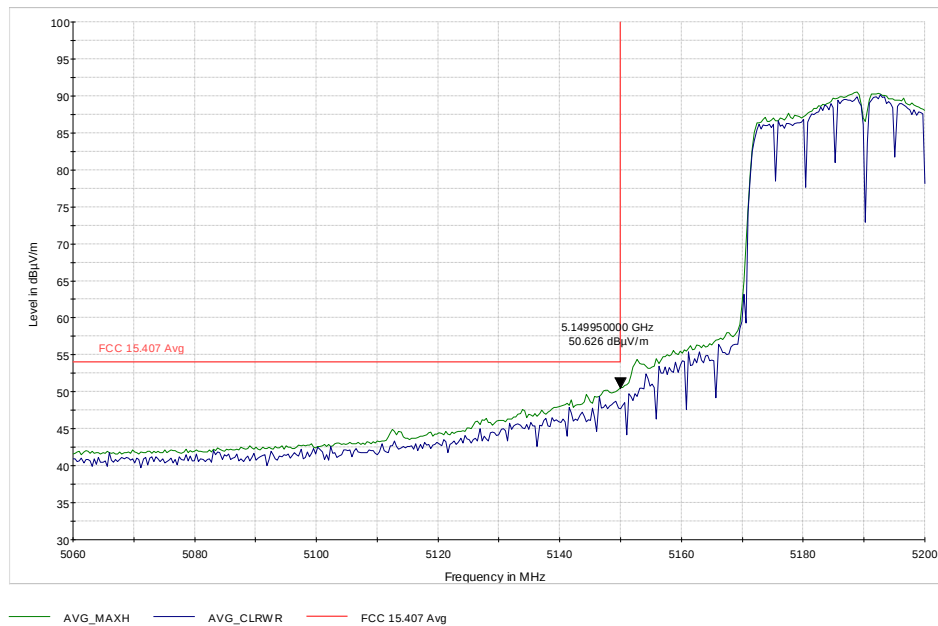


Plot # 26 AVG Restricted Band Edge @ 5.15GHz

Mode: MCS0 40MHz

Channel: 38

97% Duty Cycle

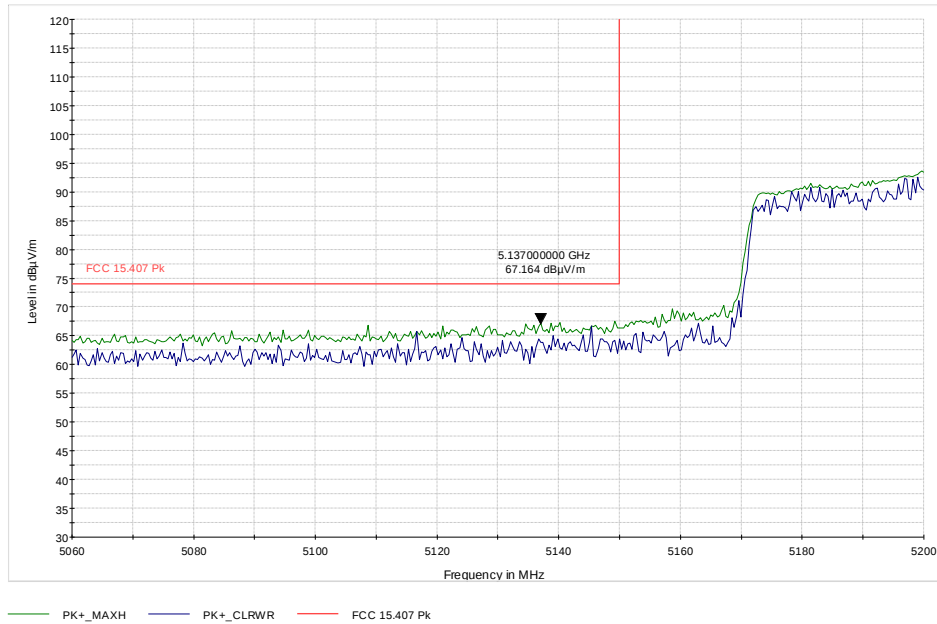


Plot # 27 Peak Restricted Band Edge @ 5.15GHz

Mode: MCS0 80MHz

Channel: 42

97% Duty Cycle

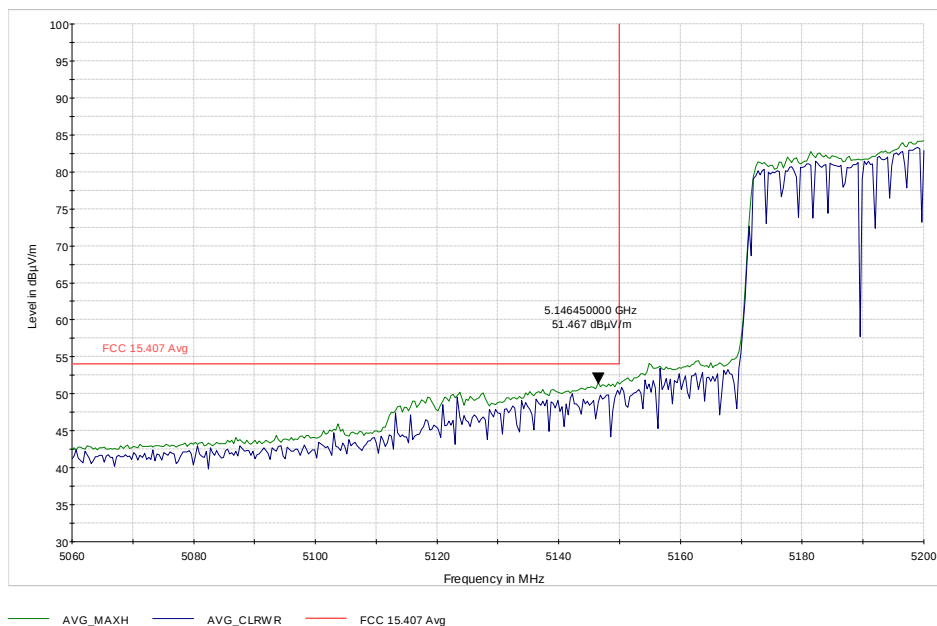


Plot # 28 AVG Restricted Band Edge @ 5.15GHz

Mode: MCS0 80MHz

Channel: 42

97% Duty Cycle



9 Test setup photos

Setup photos are included in supporting file name: "EMC_GARMI-107-22001_RSE_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Name/Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
EMI Receiver	Rohde & Schwarz	ESW44	101715	3 Years	9/13/2021
Signal Analyzer	Rohde & Schwarz	FSV40	101022	3 Years	9/14/2021
Active Loop antenna	ETS Lindgren	6507	161344	3 Years	10/30/2020
Biconlog Antenna	AH systems	BiLA2G	569	3 years	12/1/2020
Horn Antenna	EMCO	3115	35111	3 years	9/30/2021
Horn Antenna	ETS Lindgren	3117-PA	169547	3 years	9/1/2020
Horn Antenna	ETS Lindgren	3116C-PA	169535	3 years	9/30/2020
Digital Thermometer	Control Company	36934-164	191872028	3 Years	10/20/2021
Digital Barometer	VWR	10510-922	200236891	3 Years	4/13/2020

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

11 History

Date	Template Revision	Changes to report	Prepared by	Approved by
9-14-2022	EMC_GARMI-107-22001_15.407_UNII	Initial Version	Kris Lazarov	
12-05-2022	EMC_GARMI-107-22001_15.407_UNII_Rev1	Added testing notes to sections 3.5, and 8.5.1	Kris Lazarov	

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