

FCC RF Test Report

Test Report Number	HME-20080441-LC-FCC-UNII
FCC ID	BYM7002
Applicant	HM Electronics Inc
Applicant Address	2848 Whiptail Loop, Carlsbad, CA 92010 USA
Product Name	Nexeo AIO headset
Model (s)	7002
Date of Receipt	09/01/2020
Date of Test	09/01/2020 – 10/26/2020
Report Issue Date	10/27/2020
Test Standards	47CFR Part 15.407
Test Result	PASS
	<p>Issued by:</p> <p>Vista Compliance Laboratories 1261 Puerta Del Sol, San Clemente, CA 92673 USA www.vista-compliance.com</p>
 <hr style="width: 80%; margin: 0 auto;"/> <p>Daniel Bruno (Test Technician)</p>	 <hr style="width: 80%; margin: 0 auto;"/> <p>David Zhang (Technical Manager)</p>
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REVISION HISTORY

Report Number	Version	Description	Issued Date
HME-20080441-LC-FCC-UNII	Original	Initial report	10/27/2020

TABLE OF CONTENTS

1 TEST SUMMARY4

2 GENERAL INFORMATION.....5

2.1 Applicant.....5

2.2 Product information.....5

2.3 Test standard and method.....5

3 TEST SITE INFORMATION.....6

4 MODIFICATION OF EUT / DEVIATIONS FROM STANDARDS.....6

5 TEST CONFIGURATION AND OPERATION.....6

5.1 EUT Test Configuration6

5.2 Supporting Equipment.....6

6 UNCERTAINTY OF MEASUREMENT7

7 TEST RESULTS8

7.1 Antenna Requirement.....8

7.2 6 dB Bandwidth.....9

7.3 26 dB Bandwidth12

7.4 Maximum Output Power16

7.5 Power Spectral Density23

7.6 Automatically Discontinue Transmission27

7.7 Radiated Spurious Emissions into Restricted Frequency Bands.....28

8 EUT AND TEST SETUP PHOTOS.....50

9 TEST INSTRUMENT LIST.....51

1 Test Summary

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	47 CFR Part 15.203	N/A	Pass
6 dB Bandwidth	47 CFR Part 15.407	ANSI C63.10 (2013)	Pass
26 dB Bandwidth	47 CFR Part 15.407	ANSI C63.10 (2013)	Pass
Maximum Conducted Output Power	47 CFR Part 15.407	ANSI C63.10 (2013)	Pass
Power Spectral Density	47 CFR Part 15.407	ANSI C63.10 (2013)	Pass
Automatically Discontinue Transmission	47 CFR Part 15.407	ANSI C63.10 (2013)	Pass
Radiated Spurious Emission	47 CFR Part 15.407	ANSI C63.10 (2013)	Pass
Radiated Band-Edge into Restricted Frequency Bands	47 CFR Part 15.205	ANSI C63.10 (2013)	Pass
AC Power Line Conducted Emissions	47 CFR Part 15.207	ANSI C63.10 (2013)	N/A(1)

Note: EUT is battery operated and does not connect to AC power line directly or indirectly.

2 General Information

2.1 Applicant

Applicant	HM Electronics Inc
Applicant address	2848 Whiptail Loop, Carlsbad, CA 92010 USA
Manufacturer	HM Electronics Inc
Manufacturer Address	2848 Whiptail Loop, Carlsbad, CA 92010 USA

2.2 Product information

Product Name	Nexeo AIO headset
Model Number	7002
Family Models	N/A
Serial Number	N/A
Frequency Band	BLE: 2402-2480MHz NFC: 13.56MHz (Passive Tag) 5Ghz-20Mhz: 5180-5240Mhz, 5260-5320Mhz, 5500-5720Mhz, 5745-5825Mhz
Type of modulation	BLE: GFSK 5GHz: OFDM NFC: ASK
Equipment Class	DTS, U-NII
Antenna Information	BLE: Internal chip antenna, 0 dBi gain 5GHz: Internal antenna, 1.3 dBi gain NFC: Internal coil antenna
Clock Frequencies	N/A
Input Power	Lithium battery: DC 3.7V
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BLE and 5GHz can transmit simultaneously.
Additional Info	N/A

2.3 Test standard and method

Test standard	47CFR Part 15.407, Subpart E
Test method	ANSI C63.10 (2013) 789033 D02 General UNII Test Procedures New Rules v02r01

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.5°C	58.2%	996 mbar
Radiated Emission Testing	23.5°C	58.2%	996 mbar

4 Modification of EUT / Deviations from Standards

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

5 Test Configuration and Operation

5.1 EUT Test Configuration

The EUT is powered by removable battery. EUT was set to continuous transmission mode during TX testing.

The following software was used for testing.

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing
cmd.exe	To set EUT into continuous TX and RX mode under different modulation, data rate and channel, etc.
RTX EAI Port Server	Establish communication between test laptop and EUT

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
Laptop	Dell	Latitude E6440	FFF4JC2

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

7 Test Results

7.1 Antenna Requirement

7.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

7.1.2 Result

Analysis:

- EUT uses internal PCB antenna. No standard RF connector is used.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

7.2 6 dB Bandwidth

7.2.1 Requirement

§ 15.407 (e)

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

7.2.2 Test setup



7.2.3 Test Procedure

According to 789033 D02 General U-NII Test Procedures New Rules v02r01, Section C) Emission bandwidth.

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

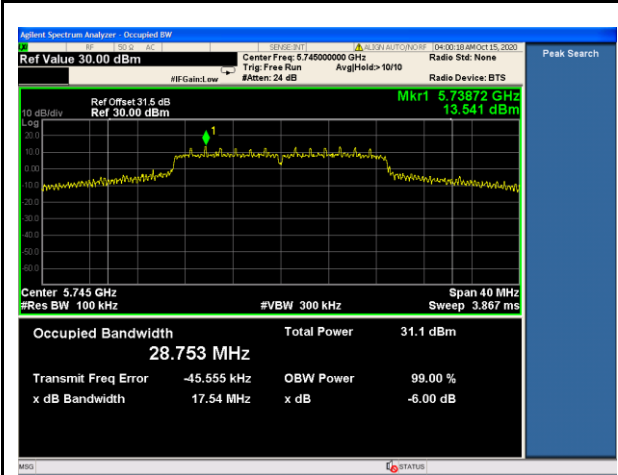
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

7.2.4 Test Result

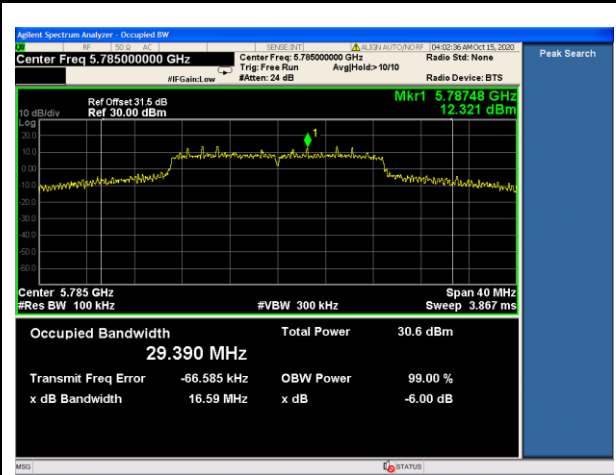
For U-NII-3 band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
5GHz	149	5745	MSC0	17540	500	Pass
5GHz	157	5785	MSC0	16590	500	Pass
5GHz	165	5825	MSC0	16010	500	Pass

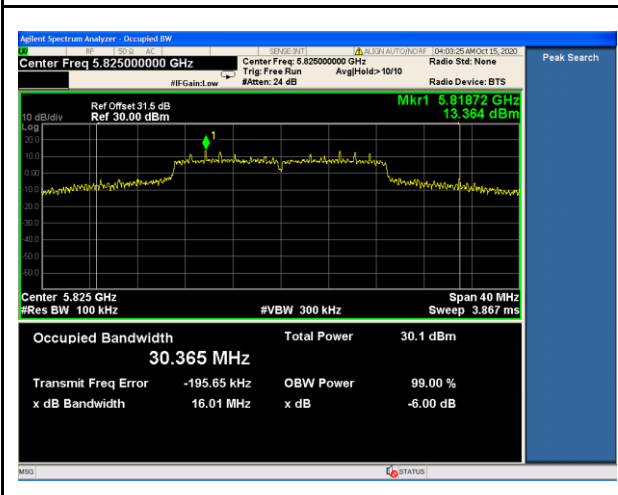
7.2.5 Test Plots



6dB BW - 5745MHz



6dB BW - 5785MHz



6dB BW - 5825MHz



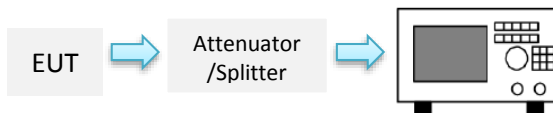
7.3 26 dB Bandwidth

7.3.1 Requirement

§ 15.407 (a)

This section is for reporting purpose only. There are no restriction limits for bandwidth.

7.3.2 Test setup



7.3.3 Test Procedure

According to 789033 D02 General U-NII Test Procedures New Rules v02r01, Section C) Emission bandwidth.

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 26 dB, if the functionality described above (i.e., RBW , VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function.

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

7.3.4 Test Result

For U-NII-1 band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 26 dB Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
5GHz	36	5180	MSC0	21380	N/A	N/A
5GHz	44	5220	MSC0	21870	N/A	N/A
5GHz	48	5240	MSC0	21790	N/A	N/A

For U-NII-2A band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
5GHz	52	5260	MSC0	23710	N/A	N/A
5GHz	60	5300	MSC0	26020	N/A	N/A
5GHz	64	5320	MSC0	21790	N/A	N/A

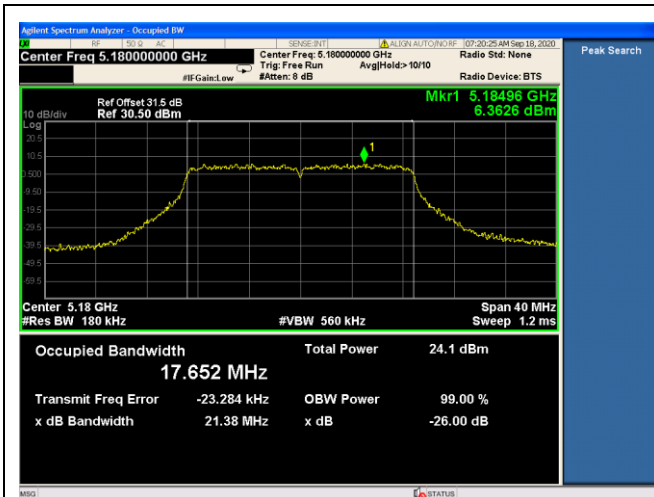
For U-NII-2C band

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 26 dB Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
5GHz	100	5500	MSC0	21860	N/A	N/A
5GHz	116	5580	MSC0	23660	N/A	N/A
5GHz	140	5700	MSC0	21140	N/A	N/A

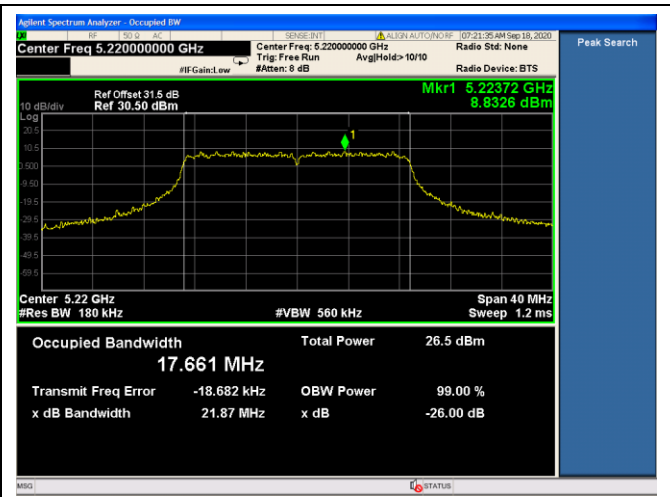
For U-NII-2C band Cross-band channel

Mode/ Bandwidth	Channel	Frequency (MHz)	Data rate	Measured 26 dB Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
5GHz	144	5720	MSC0	24530	N/A	N/A

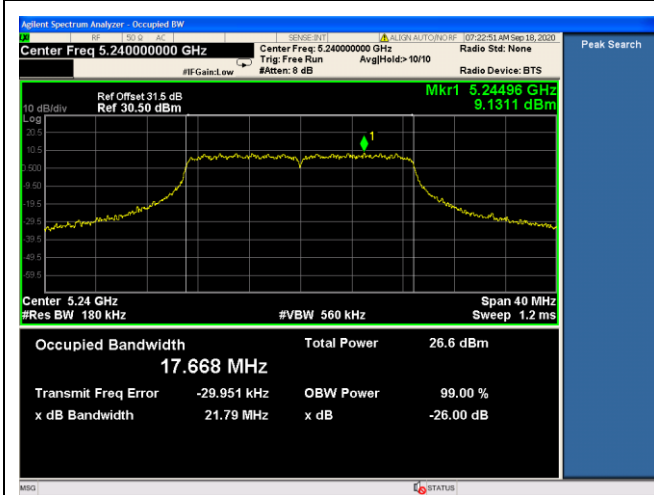
7.3.5 Test Plots



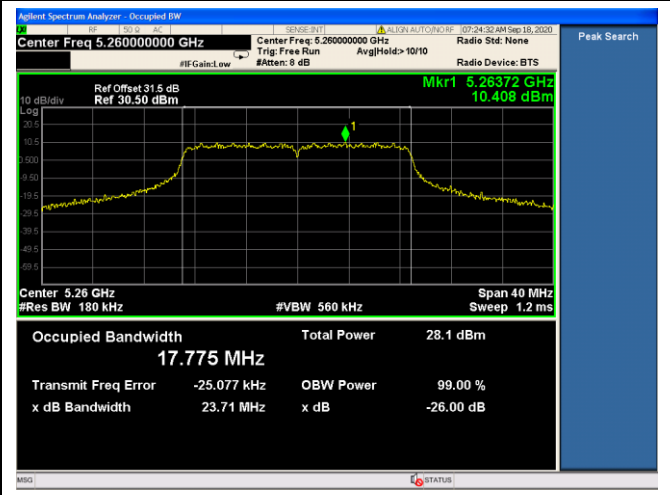
26dB BW - 5180MHz



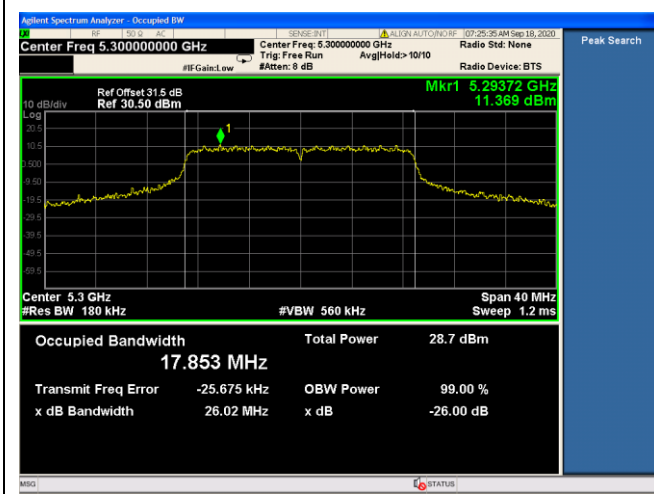
26dB BW - 5220MHz



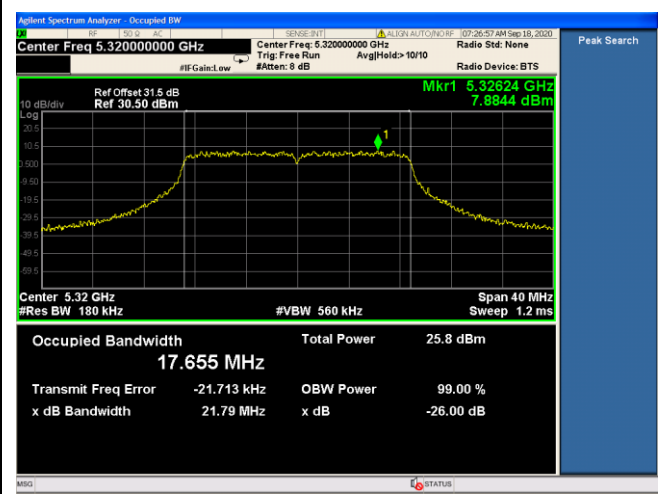
26dB BW - 5240MHz



26dB BW - 5260MHz



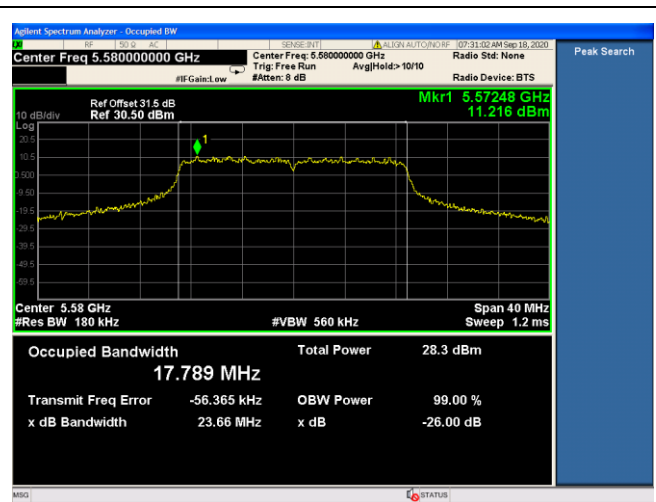
26dB BW - 5300MHz



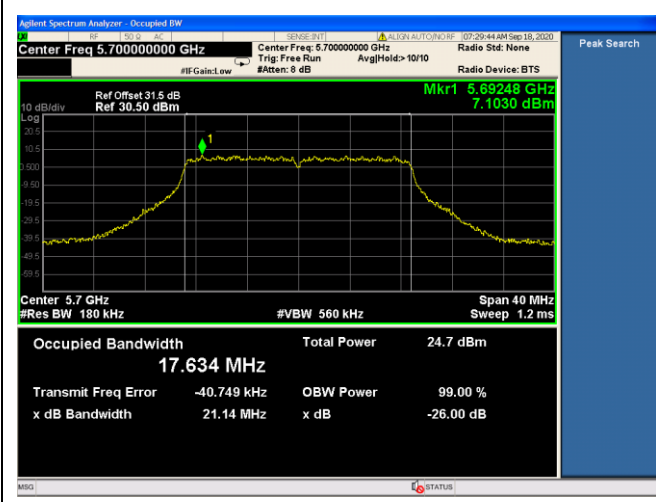
26dB BW - 5320MHz



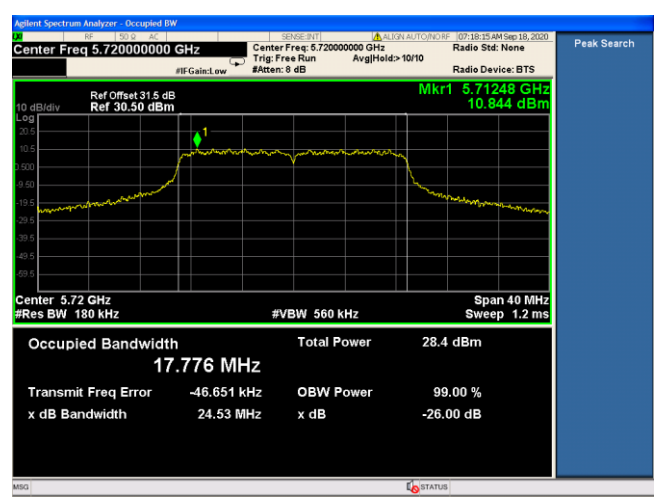
26dB BW – 5500MHz



26dB BW - 5580MHz



26dB BW - 5700MHz



26dB BW - 5720MHz

7.4 Maximum Output Power

7.4.1 Requirement

Per § 15.407 (a),

For the 5.15–5.25 GHz bands:

For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. 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.

For the 5.25–5.725 GHz bands:

The maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

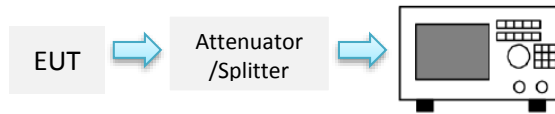
For Straddle Channel, according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, if the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

For the band 5.725-5.85 GHz:

The maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. 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.

7.4.2 Test setup



7.4.3 Test Procedure

According to 789033 D02 General U-NII Test Procedures New Rules v02r01, Section E) Maximum conducted output power, 2, b), method SA-1

1. Set span to encompass the entire emission bandwidth (EBW)(or, alternatively, the entire 99% occupied bandwidth)of the signal.
2. Set RBW=1MHz
3. Set VBW $\geq 3 \times$ RBW
4. Number of points in sweep $\geq 2 \times$ span/ RBW. (This ensures that bin-to-bin spacing is \leq RBW/2, so that narrowband signals are not lost between frequency bins.)
5. Sweep time = auto couple.
6. Detector = Power averaging (RMS)
7. Trace average at least 100 traces in power averaging(rms)mode.
8. 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.

7.4.4 Test Result

For U-NII-1 band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX power (dBm)	Highest or Total power (dBm)	Max Output Power Limit (dBm)	Result
5GHz	5180	MCS0	16.53	16.53	24.00	Pass
5GHz	5220	MCS0	22.93	22.93	24.00	Pass
5GHz	5240	MCS0	22.84	22.84	24.00	Pass

For U-NII-2A band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
5GHz	5260	MCS0	20.53	20.53	24.00	Pass
5GHz	5300	MCS0	21.13	21.13	24.00	Pass
5GHz	5320	MCS0	18.19	18.19	24.00	Pass

For U-NII-2C band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
5GHz	5500	MCS0	16.23	16.23	24.00	Pass
5GHz	5580	MCS0	20.80	20.80	24.00	Pass
5GHz	5700	MCS0	16.91	16.91	24.00	Pass

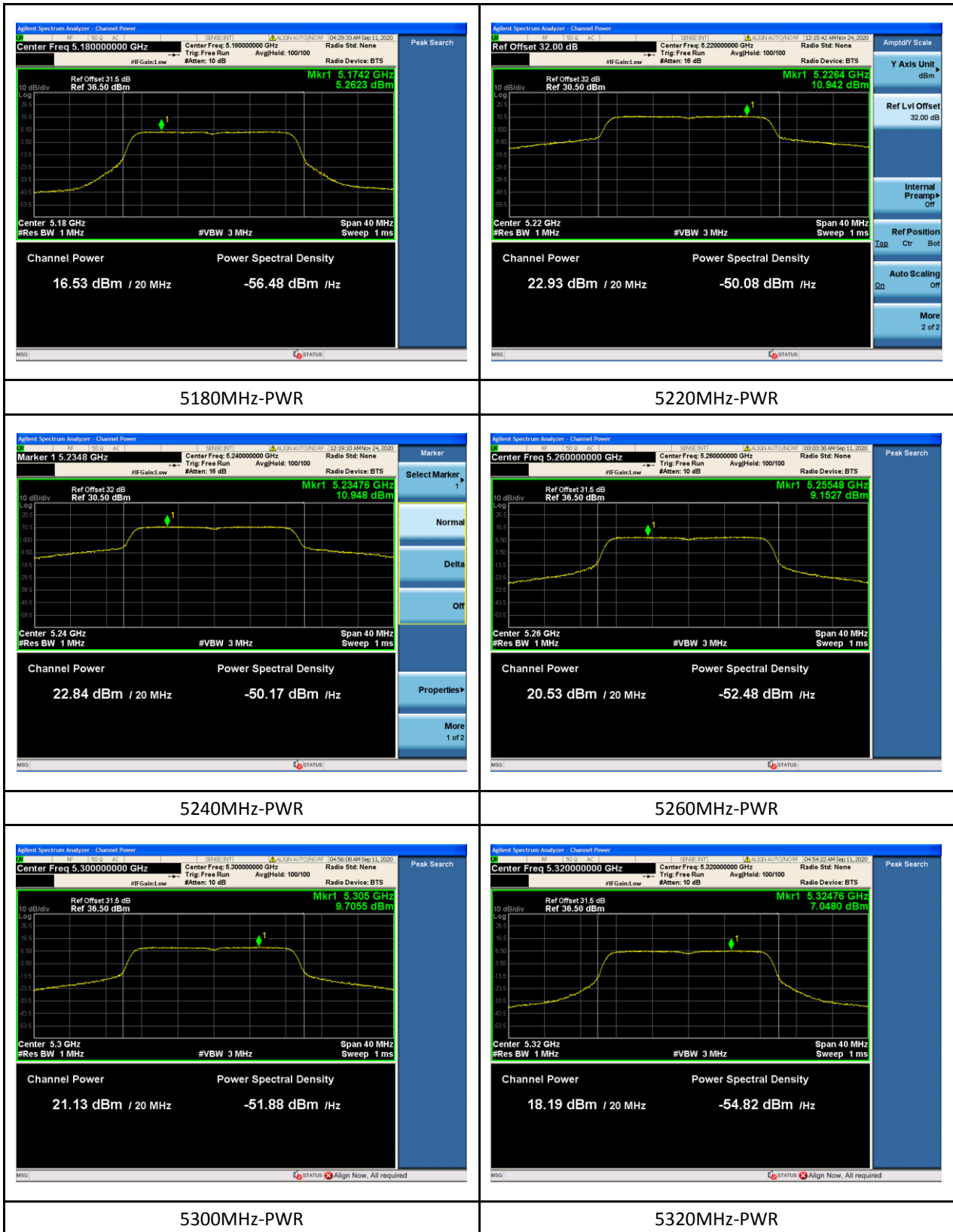
For U-NII-3 band

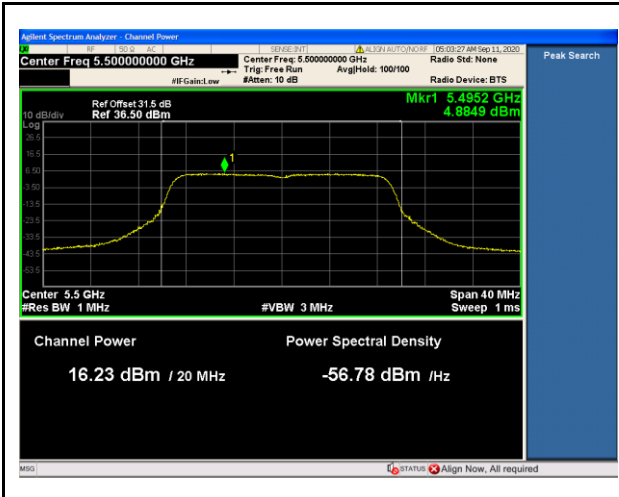
Mode/ Bandwidth	Frequency (MHz)	Data rate	TX power (dBm)	Highest or Total power (dBm)	Max Output Power Limit (dBm)	Result
5GHz	5745	MCS0	22.13	22.13	30.00	Pass
5GHz	5785	MCS0	22.05	22.05	30.00	Pass
5GHz	5825	MCS0	21.76	21.76	30.00	Pass

For U-NII-2C band Cross-band channel

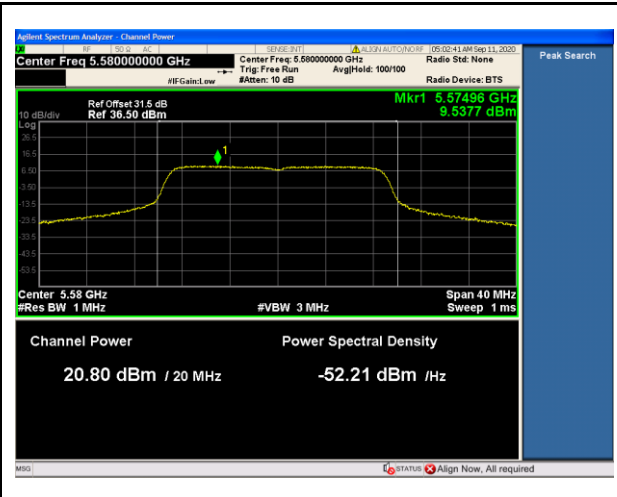
Mode/ Bandwidth	Frequency (MHz)	Data rate	TX power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
5GHz	5720	MCS0	19.84	19.84	24.00	Pass

7.4.5 Test Plots

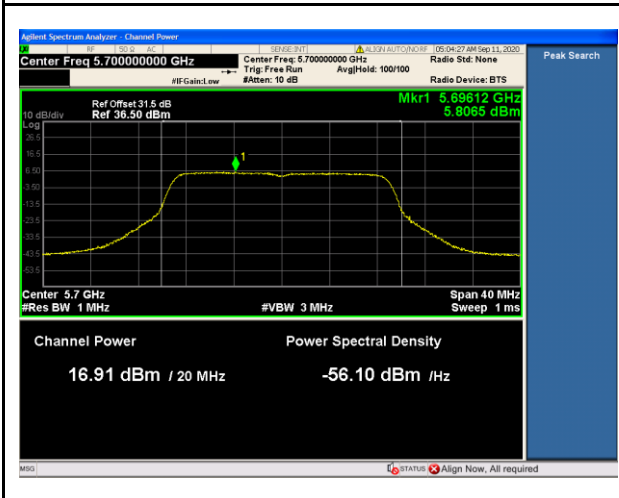




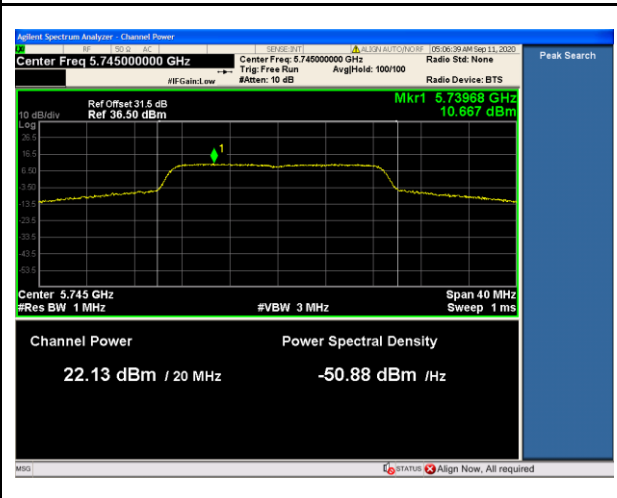
5500MHz-PWR



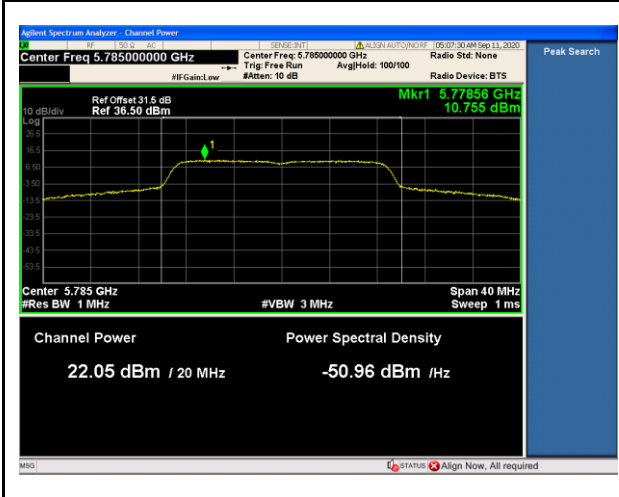
5580MHz-PWR



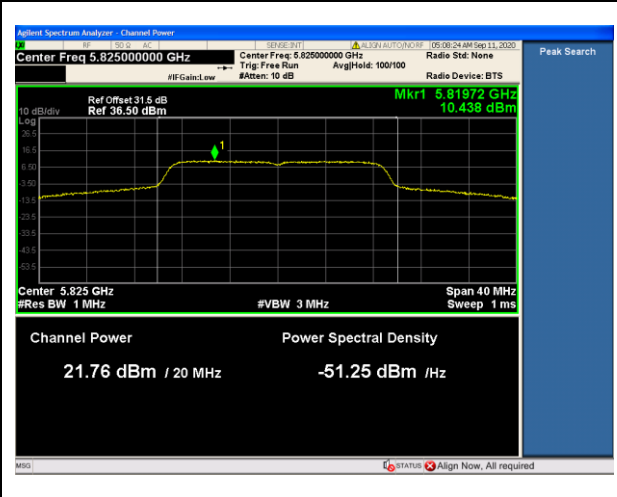
5700MHz-PWR



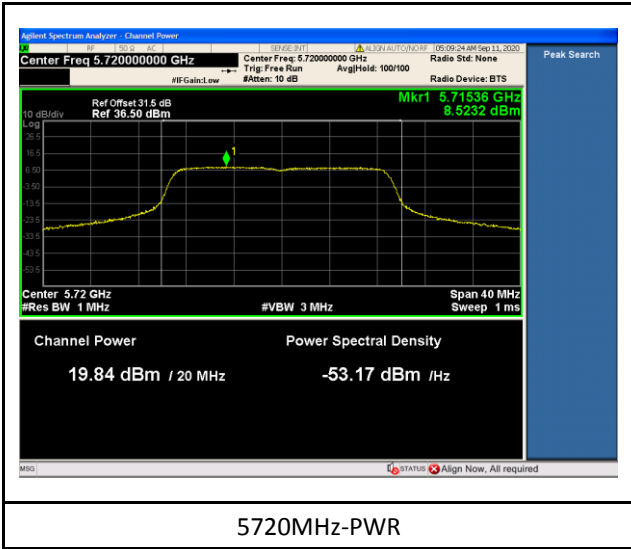
5745MHz-PWR



5785MHz-PWR



5825MHz-PWR



7.5 Power Spectral Density

7.5.1 Requirement

§ 15.407 (a)

For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.5.2 Test setup



7.5.3 Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, section F) Maximum power spectral density. Method SA-1

1. Set span to encompass the entire emission bandwidth (EBW)(or, alternatively, the entire 99% occupied bandwidth)of the signal.
2. Set RBW=1MHz
3. Set VBW $\geq 3 \times$ RBW
4. Number of points in sweep $\geq 2 \times$ span/ RBW. (This ensures that bin-to-bin spacing is \leq RBW/2, so that narrowband signals are not lost between frequency bins.)
5. Sweep time = auto couple.
6. Detector = Power averaging (RMS)
7. Trace average at least 100 traces in power averaging(rms)mode.
8. Use the peak marker function to determine the maximum amplitude level within the RBW.

7.5.4 Test Result

For U-NII-1 band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Max PSD (dBm/MHz)	Result
5GHz	5180	MCS0	5.262	5.262	11	Pass
5GHz	5220	MCS0	11.574	10.942	11	Pass
5GHz	5240	MCS0	11.510	10.948	11	Pass

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Max PSD (dBm/MHz)	Result
5GHz	5260	MCS0	9.153	9.153	11	Pass
5GHz	5300	MCS0	9.706	9.706	11	Pass
5GHz	5320	MCS0	7.048	7.048	11	Pass

For U-NII-2C band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Max PSD (dBm/MHz)	Result
5GHz	5500	MCS0	4.885	4.885	11	Pass
5GHz	5580	MCS0	9.538	9.538	11	Pass
5GHz	5700	MCS0	5.807	5.807	11	Pass

For U-NII-3 band

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Corrected PSD (dBm/500KHz)	Max PSD (dBm/500KHz)	Result
5GHz	5745	MCS0	10.667	10.667	7.657	30	Pass
5GHz	5785	MCS0	10.755	10.755	7.745	30	Pass
5GHz	5825	MCS0	10.438	10.438	7.428	30	Pass

For U-NII-2C band Cross-band channel

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX PSD (dBm/MHz)	Highest or Total PSD (dBm/MHz)	Max PSD (dBm/MHz)	Result
5GHz	5720	MCS0	8.523	8.523	11	Pass

Note:

- 1) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10 \log(1\text{MHz}/\text{RBW})$ to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

7.5.5 Test Plots

Refer to test plots in conducted peak output power

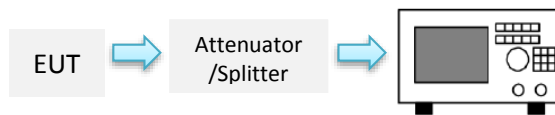
7.6 Automatically Discontinue Transmission

7.6.1 Requirement

§ 15.407 (c)

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signalling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

7.6.2 Test setup



7.6.3 Test Result

The transmission on this device is based on a single type, unique frame structure which only allows it to transmit a 143 uS duration within every 10000 uS period. In case of absence of information, the EUT will continue to transmit using repetitive codes to complete frame or burst intervals.

This frame structure makes the maximum TX duty cycle and channel loading to be:

$$\text{Channel loading} = 143 \text{ us} / 10000 \text{ us} * 100\% = 1.43 \%$$

7.7 Radiated Spurious Emissions into Restricted Frequency Bands

7.7.1 Requirement

§ 15.205, 15.209, 15.407(b)

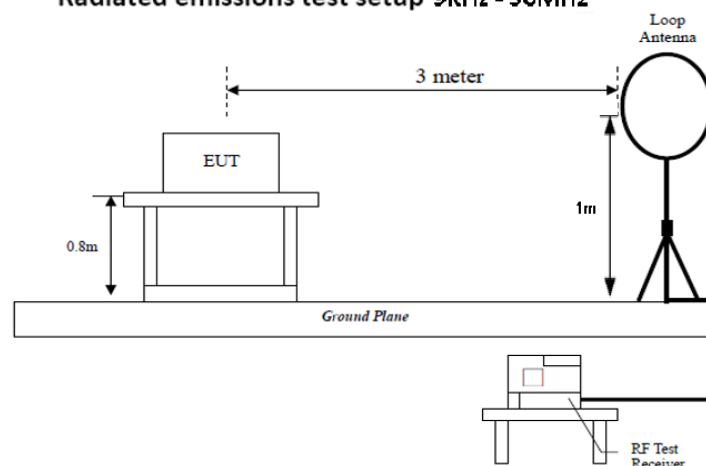
- (1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.
- (3) For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz.
- (5) Restricted band, emission must also comply with the radiated emission limits specified in 15.209

Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

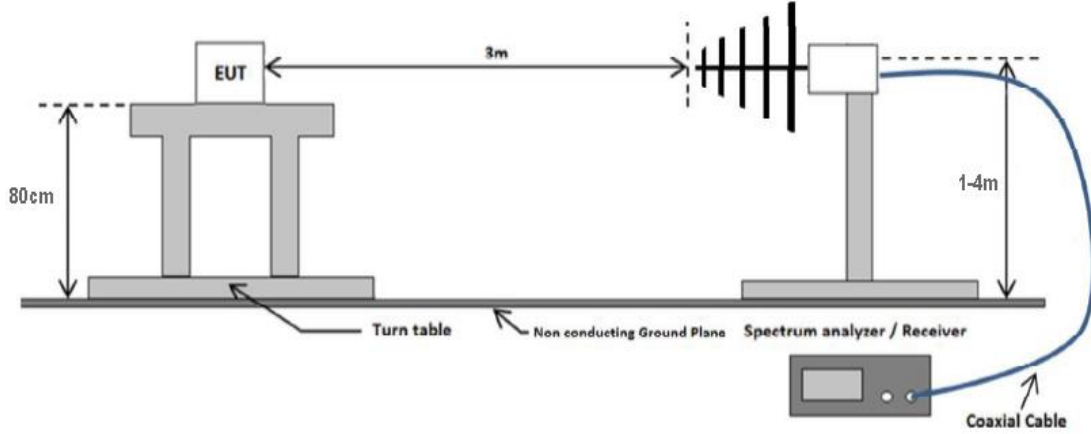
Frequency range (MHz)	Field Strength ($\mu\text{V}/\text{m}$)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 - 88	100
88 - 216	150
216 960	200
Above 960	500

7.7.2 Test setup

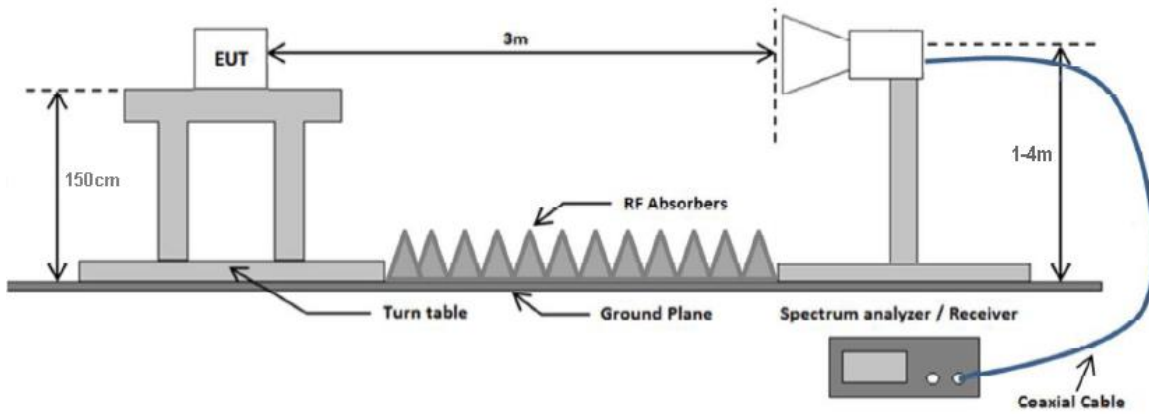
Radiated emissions test setup 9KHz - 30MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.7.3 Test Procedure

According to FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement. And subclause 12.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

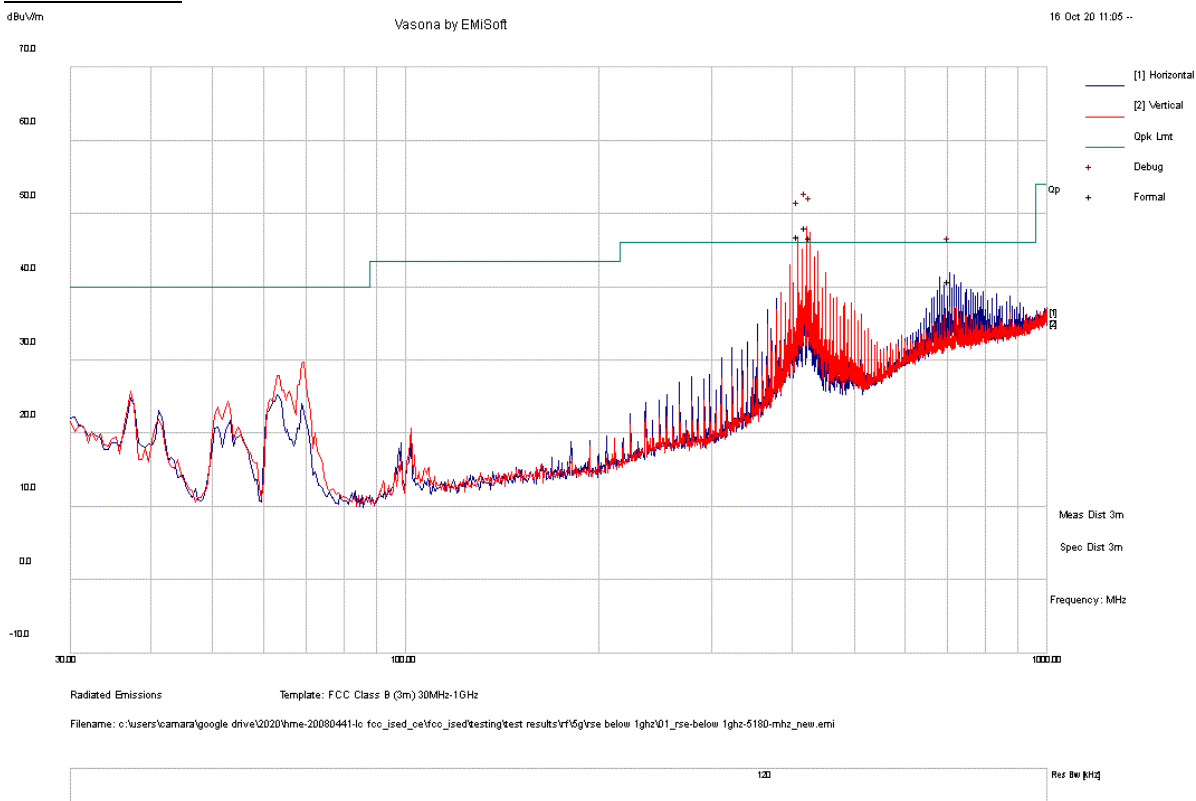
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

7.7.4 Test Result

RADIATED EMISSIONS < 1 GHZ

Test Standard:	15.209, 15.407	Mode:	5180 MHz
Frequency Range:	30 - 1000 MHz	Test Date:	10/16/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5180 MHz

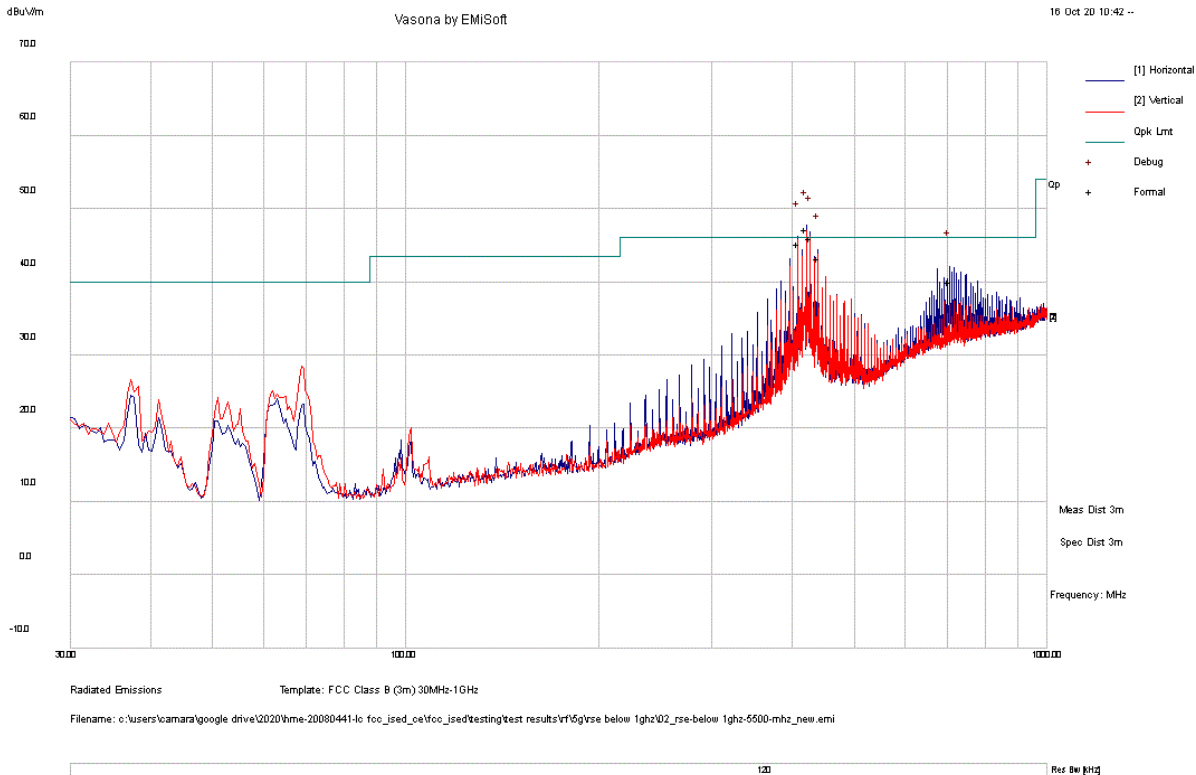


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
420.85	55.30	6.30	-13.40	48.20	Quasi Max	V	100	322	46	N/A	N/A
426.98	54.00	6.30	-13.50	46.70	Quasi Max	V	108	1	46	N/A	N/A
408.55	53.80	6.30	-13.20	46.90	Quasi Max	V	120	350	46	N/A	N/A
703.45	41.80	7.30	-8.30	40.80	Quasi Max	H	100	20	46	-5.2	Pass

Note: The emission at around 400MHz are from digital circuit, not from RF transmitter, and shall be compared to the Class A digital limit declared by manufacturer, instead of 15.209 limit. See the data under ITE mode for comparison

Test Standard:	15.209, 15.407	Mode:	5500 MHz
Frequency Range:	30 - 1000 MHz	Test Date:	10/16/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5500MHz

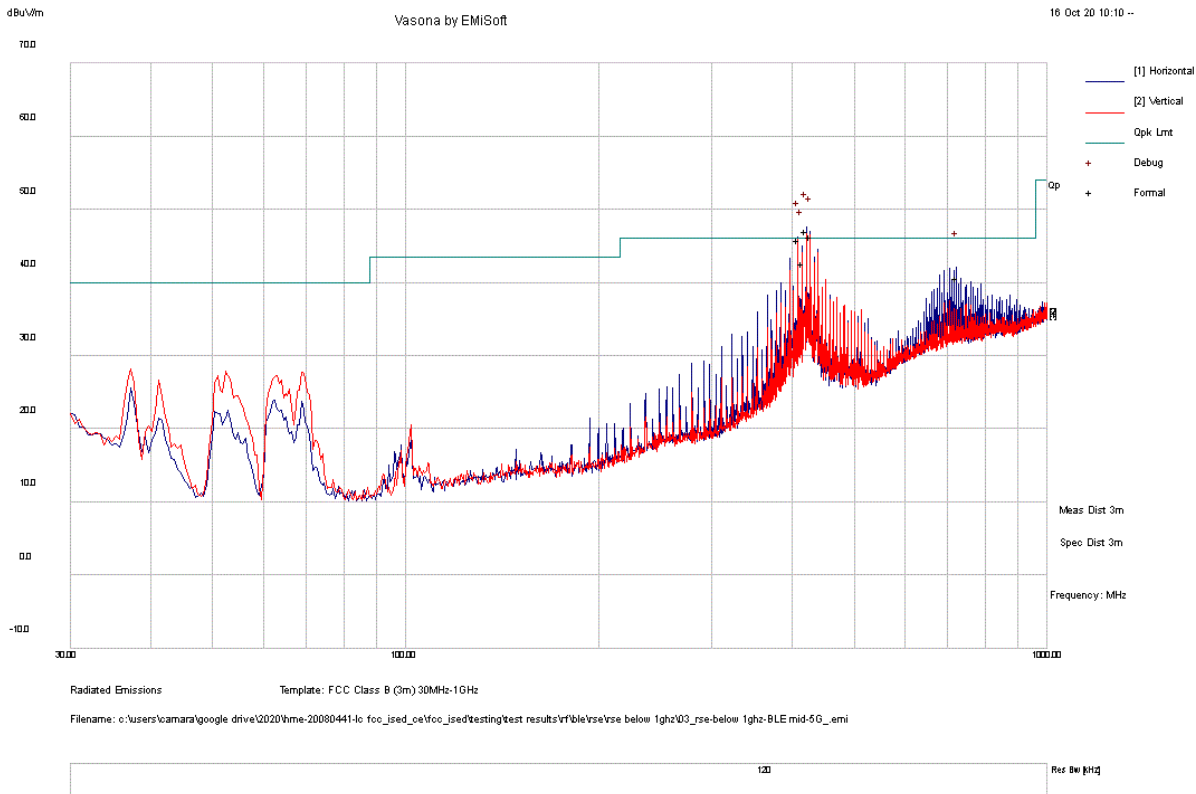


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
420.87	54.40	6.30	-13.40	47.20	Quasi Max	H	200	339	46	N/A	N/A
426.98	53.20	6.30	-13.50	46.00	Quasi Max	H	179	325	46	N/A	N/A
408.55	52.10	6.30	-13.20	45.30	Quasi Max	H	195	348	46	N/A	N/A
439.29	50.70	6.20	-13.70	43.20	Quasi Max	H	180	0	46	-2.8	Pass
703.44	41.10	7.30	-8.30	40.10	Quasi Max	H	100	4	46	-5.9	Pass

Note: The emission at around 400MHz are from digital circuit, not from RF transmitter, and shall be compared to the Class A digital limit declared by manufacturer, instead of 15.209 limit. See the data under ITE mode for comparison

Test Standard:	RSS-Gen, RSS-247	Mode:	BLE + 5GHz co-located
Frequency Range:	30 - 1000 MHz	Test Date:	10/16/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

BLE + 5GHz co-located

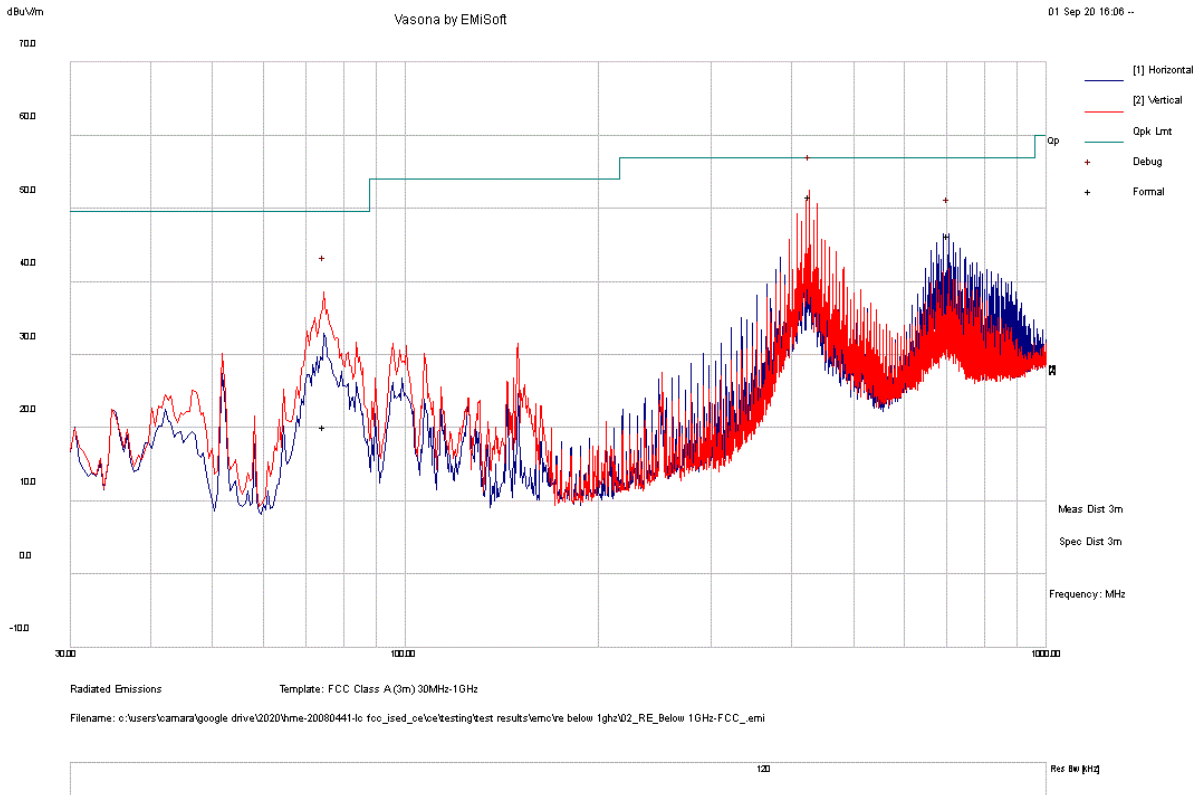


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
420.86	54.30	6.30	-13.40	47.10	Quasi Max	H	206	337	46	N/A	N/A
426.98	53.50	6.30	-13.50	46.30	Quasi Max	H	178	328	46	N/A	N/A
408.55	52.70	6.30	-13.20	45.80	Quasi Max	H	196	335	46	N/A	N/A
414.70	49.70	6.30	-13.30	42.70	Quasi Max	H	100	353	46	-3.3	Pass
721.91	41.50	7.30	-8.00	40.70	Quasi Max	H	103	11	46	-5.3	Pass

Note: The emission at around 400MHz are from digital circuit, not from RF transmitter, and shall be compared to the Class A digital limit declared by manufacturer, instead of 15.209 limit. See the data under ITE mode for comparison

Test Standard:	FCC Part 15B, ICES-003	Mode:	ITE mode (TX off)
Frequency Range:	30 - 1000 MHz	Test Date:	09/01/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	Class A	Test Result:	Pass

ITE mode (Transmitter off)



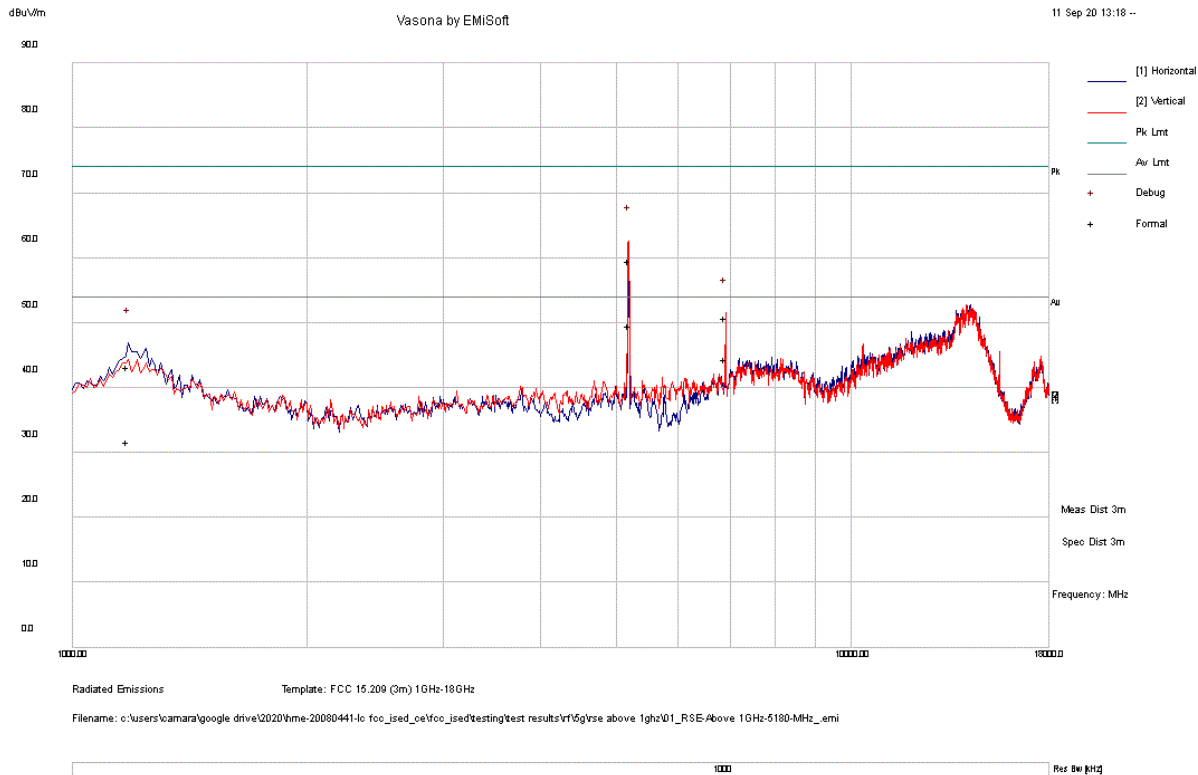
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
426.98	59.00	6.30	-13.50	51.70	Quasi Max	V	122	343	56.90	-5.20	Pass
703.50	47.40	7.30	-8.30	46.40	Quasi Max	H	100	13	56.90	-10.50	Pass
74.75	41.50	3.20	-24.50	20.30	Quasi Max	V	288	38	49.60	-29.30	Pass

Note: These data are for comparison purpose only. The emissions at around 400 MHz exist when transmitters are off. Limit here is Class A limit.

RADIATED EMISSIONS > 1 GHZ

Test Standard:	15.209, 15.407	Mode:	5180MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/11/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5180MHz

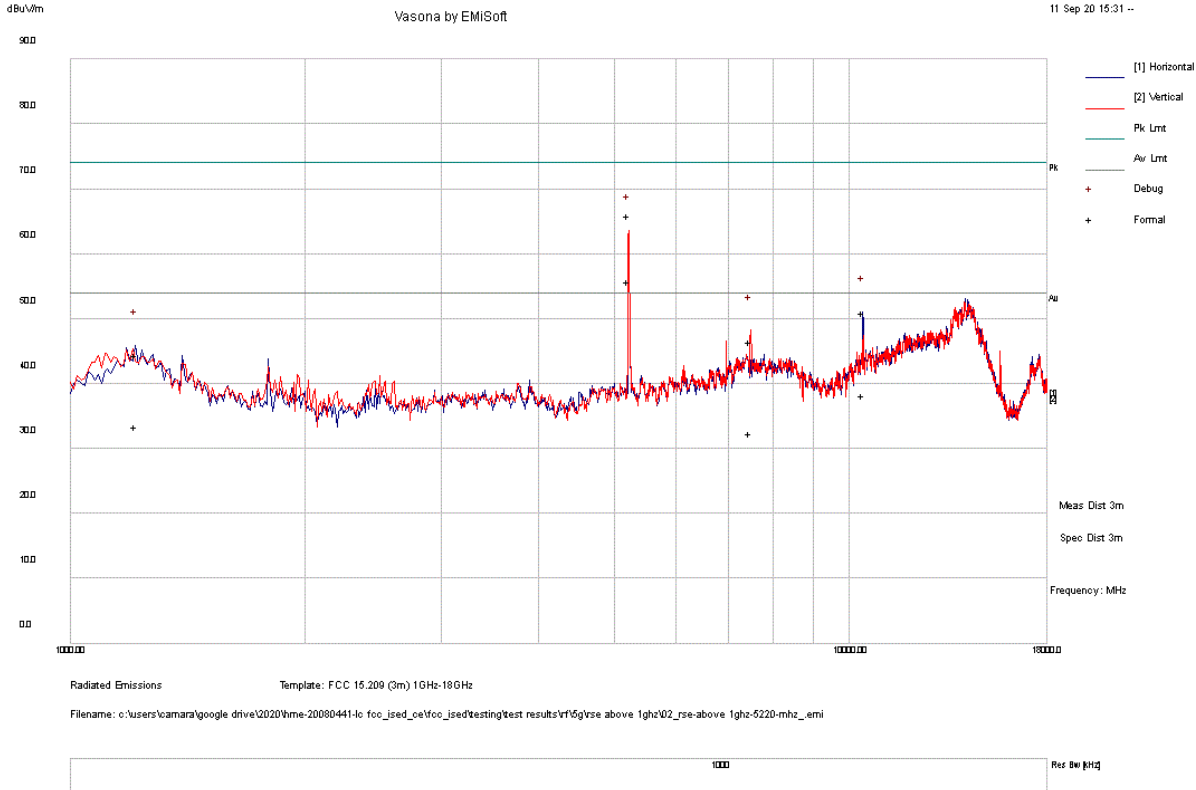


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
6906.74	30.1	19.9	0.8	50.8	Peak Max	V	215	284	74	-23.2	Pass
1178.903	34.2	14.3	-5.2	43.2	Peak Max	H	172	244	74	-30.8	Pass
6906.74	23.7	19.9	0.8	44.4	Average Max	V	215	284	54	-9.6	Pass
1178.903	22.6	14.3	-5.2	31.7	Average Max	H	172	244	54	-22.3	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5220MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/11/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5220 MHz

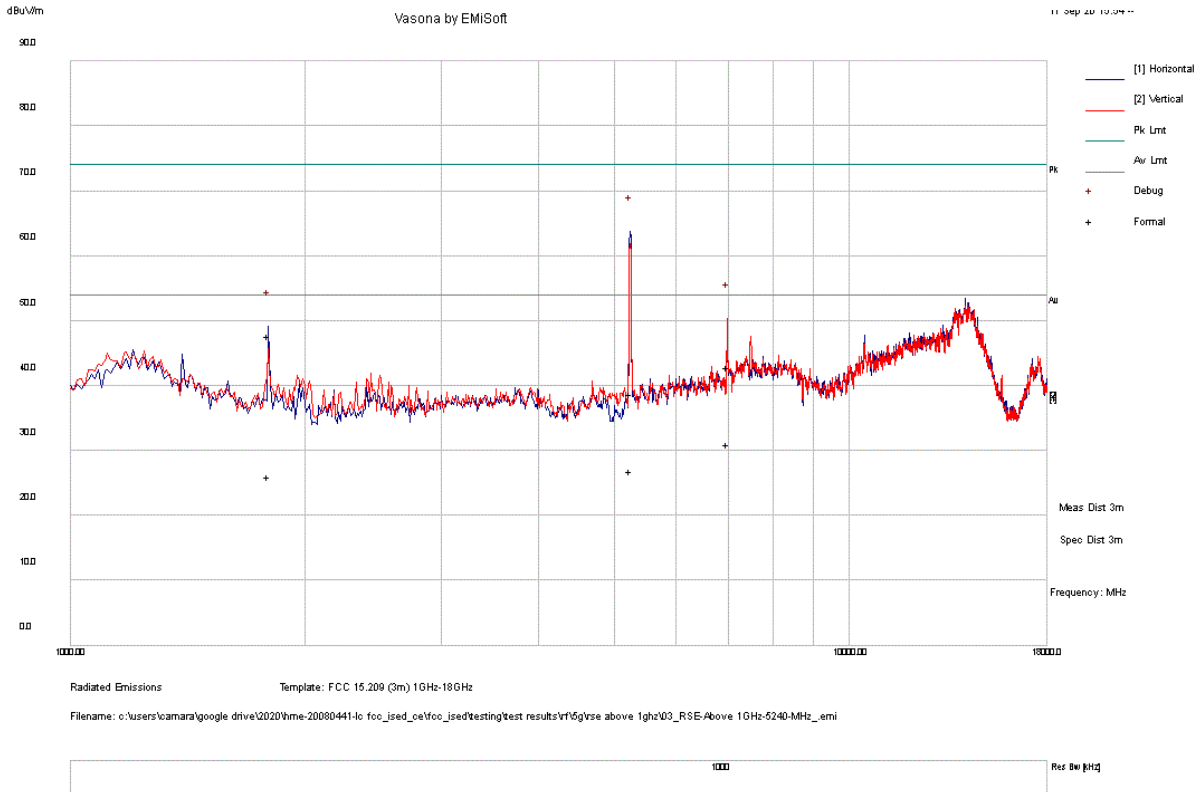


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10433.15	25.9	23	2	50.9	Peak Max	H	182	41	74	-23.1	Pass
7480.69	24.7	21	0.9	46.6	Peak Max	V	165	173	74	-27.4	Pass
1213.273	35.5	14.3	-5.4	44.4	Peak Max	H	100	176	74	-29.6	Pass
10433.15	13.3	23	2	38.3	Average Max	H	182	41	54	-15.7	Pass
7480.69	10.5	21	0.9	32.4	Average Max	V	165	173	54	-21.6	Pass
1213.273	24.5	14.3	-5.4	33.5	Average Max	H	100	176	54	-20.5	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5240MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/11/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5240 MHz

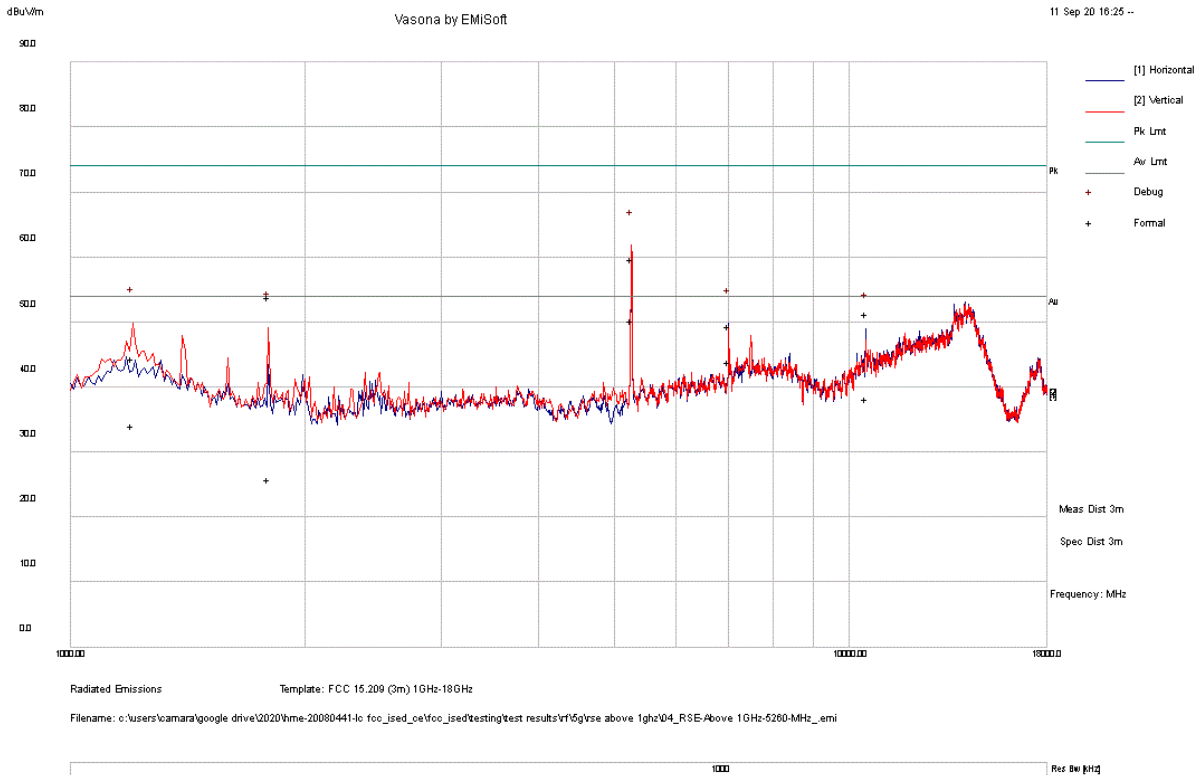


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
6982.895	22.2	20	0.8	43	Peak Max	V	215	18	74	-31	Pass
1798.788	42.4	14.5	-9.1	47.8	Peak Max	H	100	106	74	-26.2	Pass
6982.895	10.2	20	0.8	31	Average Max	V	215	18	54	-23	Pass
1798.788	20.5	14.5	-9.1	26	Average Max	H	100	106	54	-28	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5260MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/11/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5260 MHz

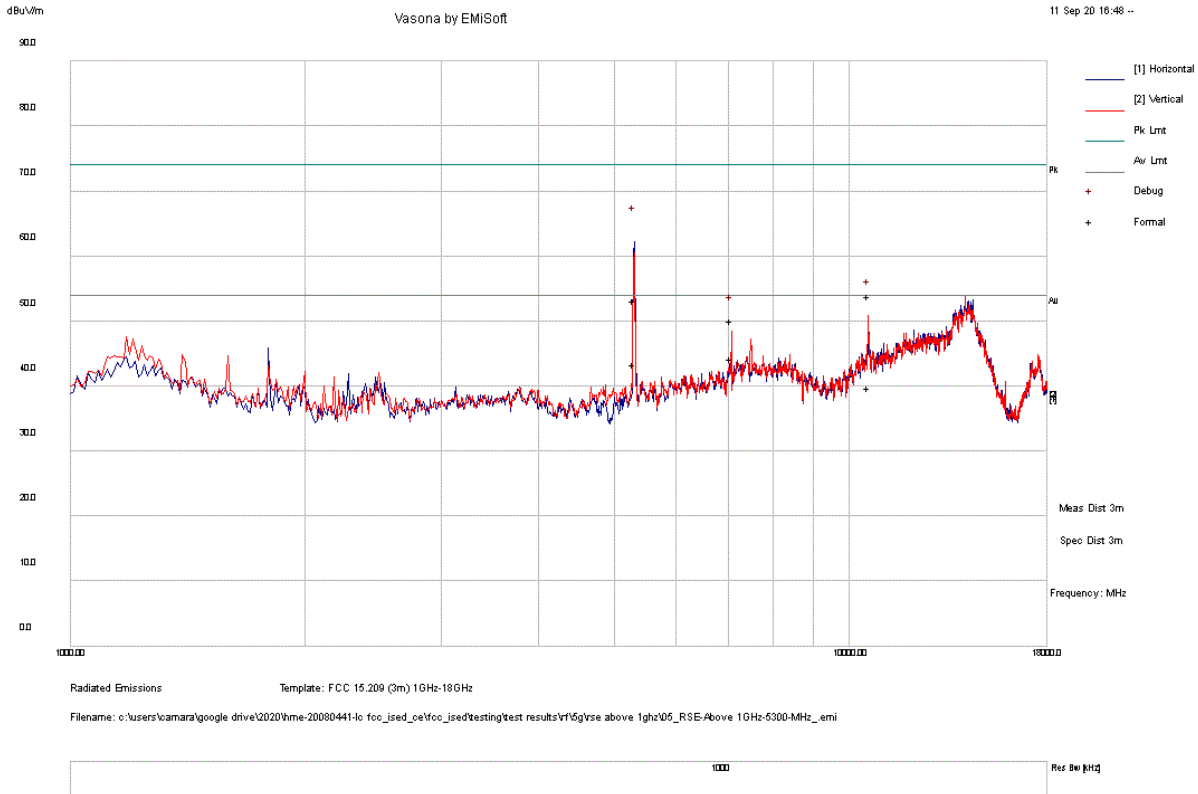


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1201.12	35.3	14.3	-5.2	44.4	Peak Max	V	316	0	74	-29.6	Pass
7013.30	28.6	20.1	0.8	49.5	Peak Max	H	245	360	74	-24.5	Pass
1798.45	48.5	14.5	-9.1	53.9	Peak Max	V	305	314	74	-20.1	Pass
10519.42	26.1	23.2	2.1	51.4	Peak Max	H	188	292	74	-22.6	Pass
1201.12	25	14.3	-5.2	34.1	Average Max	V	316	0	54	-19.9	Pass
7013.30	23	20.1	0.8	43.9	Average Max	H	245	360	54	-10.1	Pass
1798.45	20.4	14.5	-9.1	25.9	Average Max	V	305	314	54	-28.1	Pass
10519.42	13	23.2	2.1	38.3	Average Max	H	188	292	54	-15.7	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5300MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/11/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5300 MHz

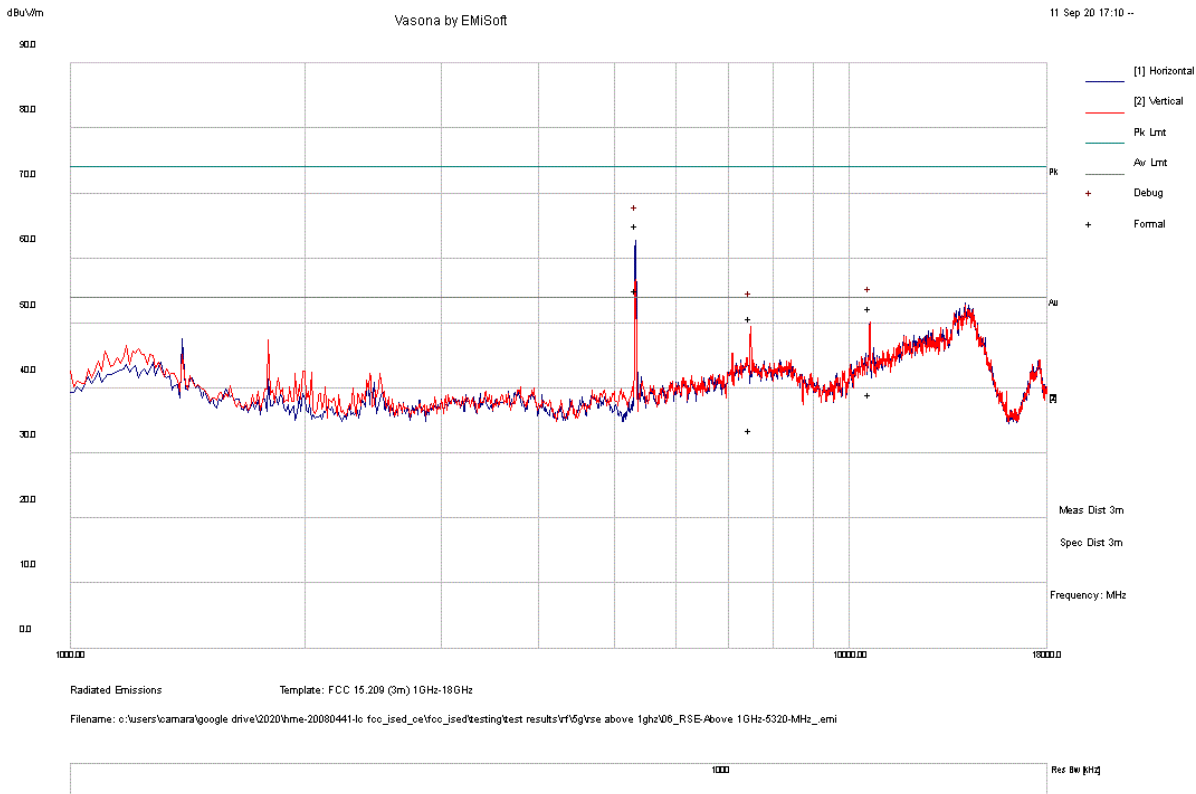


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10595.44	28.6	23.3	2	54	Peak Max	V	207	56	74	-20	Pass
7066.54	29	20.2	1	50.1	Peak Max	V	106	73	74	-23.9	Pass
10595.44	14.5	23.3	2	39.9	Average Max	V	207	56	54	-14.1	Pass
7066.54	23.2	20.2	1	44.3	Average Max	V	106	73	54	-9.7	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5320MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/11/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5320 MHz

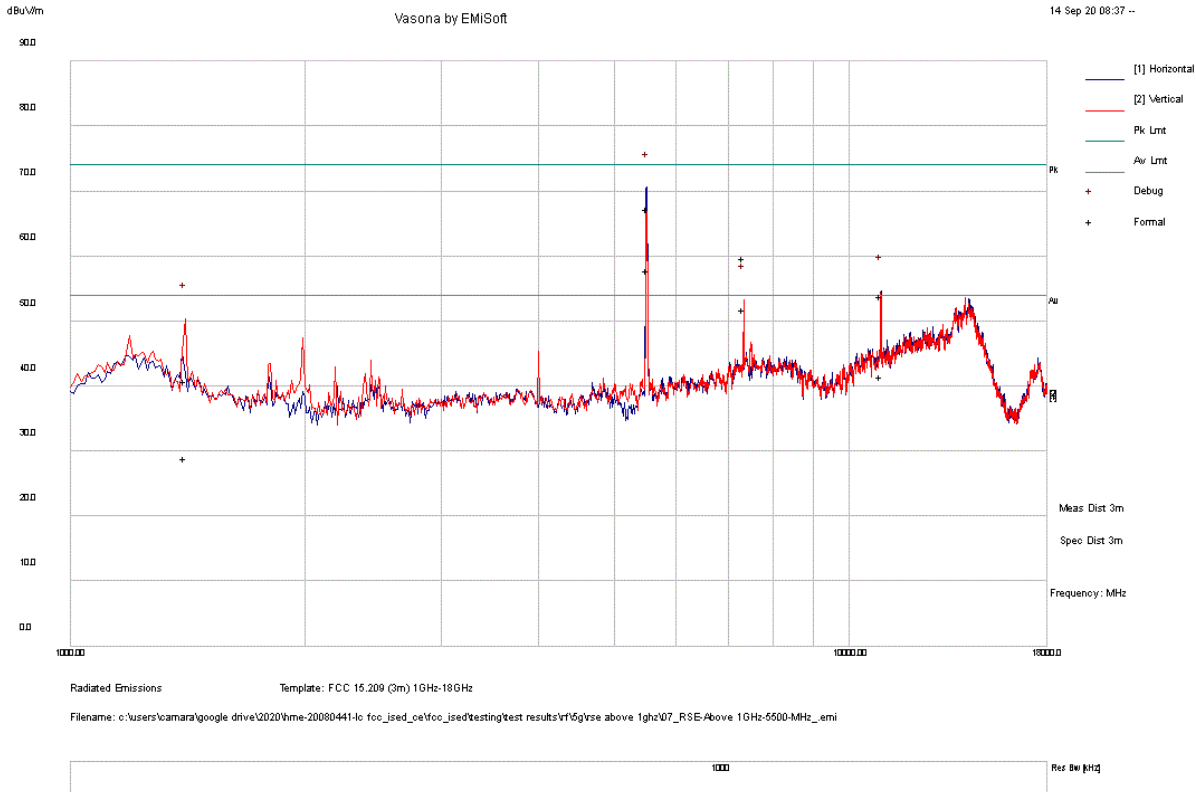


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
10649.258	27	23.4	2.1	52.4	Peak Max	V	221	64	74	-21.6	Pass
7480.76	28.9	21	0.9	50.7	Peak Max	V	102	177	74	-23.3	Pass
10649.26	13.8	23.4	2.1	39.2	Average Max	V	221	64	54	-14.8	Pass
7480.76	11.8	21	0.9	33.6	Average Max	V	102	177	54	-20.4	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5500MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/14/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5500 MHz

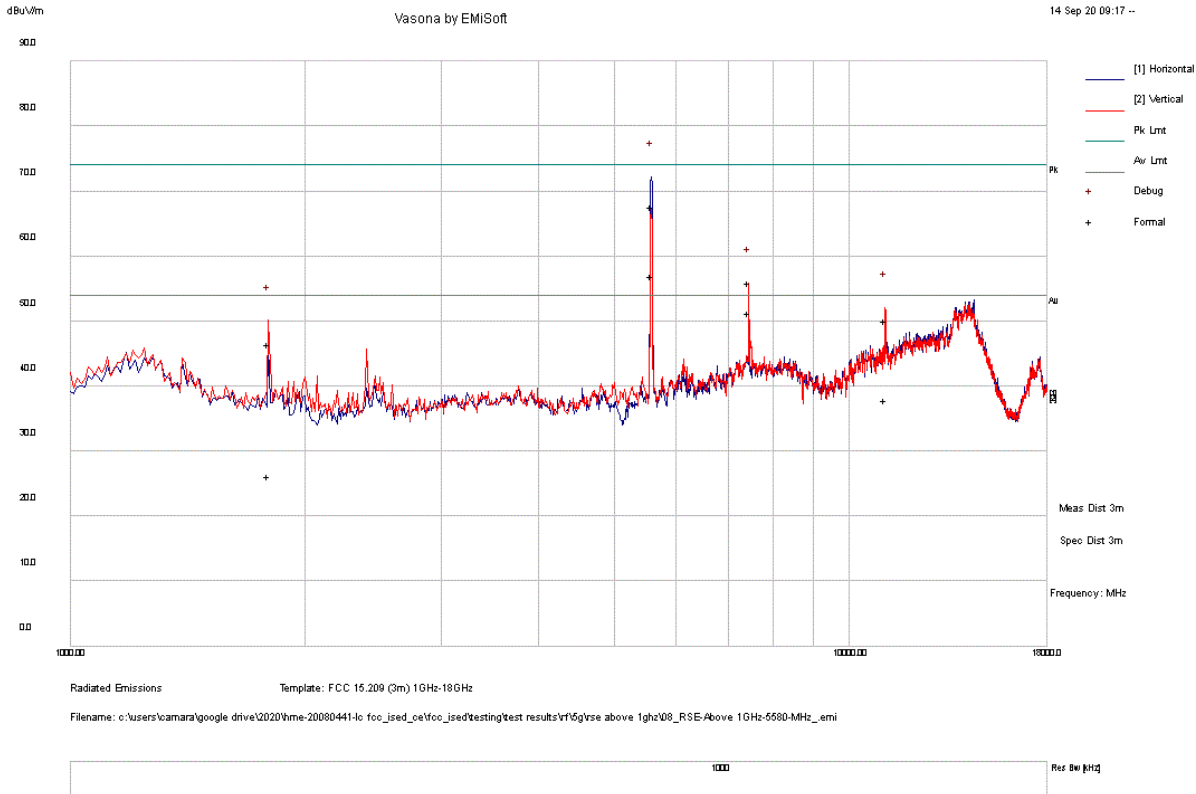


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
11007.553	27	23.9	3	53.8	Peak Max	H	258	15	74	-20.2	Pass
7333.46	37.8	20.7	1.2	59.7	Peak Max	V	104	206	74	-14.3	Pass
1402.36	33.3	14.7	-7.2	40.8	Peak Max	V	198	188	74	-33.2	Pass
11007.55	14.6	23.9	3	41.5	Average Max	H	258	15	54	-12.5	Pass
7333.46	30	20.7	1.2	51.9	Average Max	V	104	206	54	-2.1	Pass
1402.36	21.5	14.7	-7.2	29	Average Max	V	198	188	54	-25	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5580MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/14/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5580 MHz

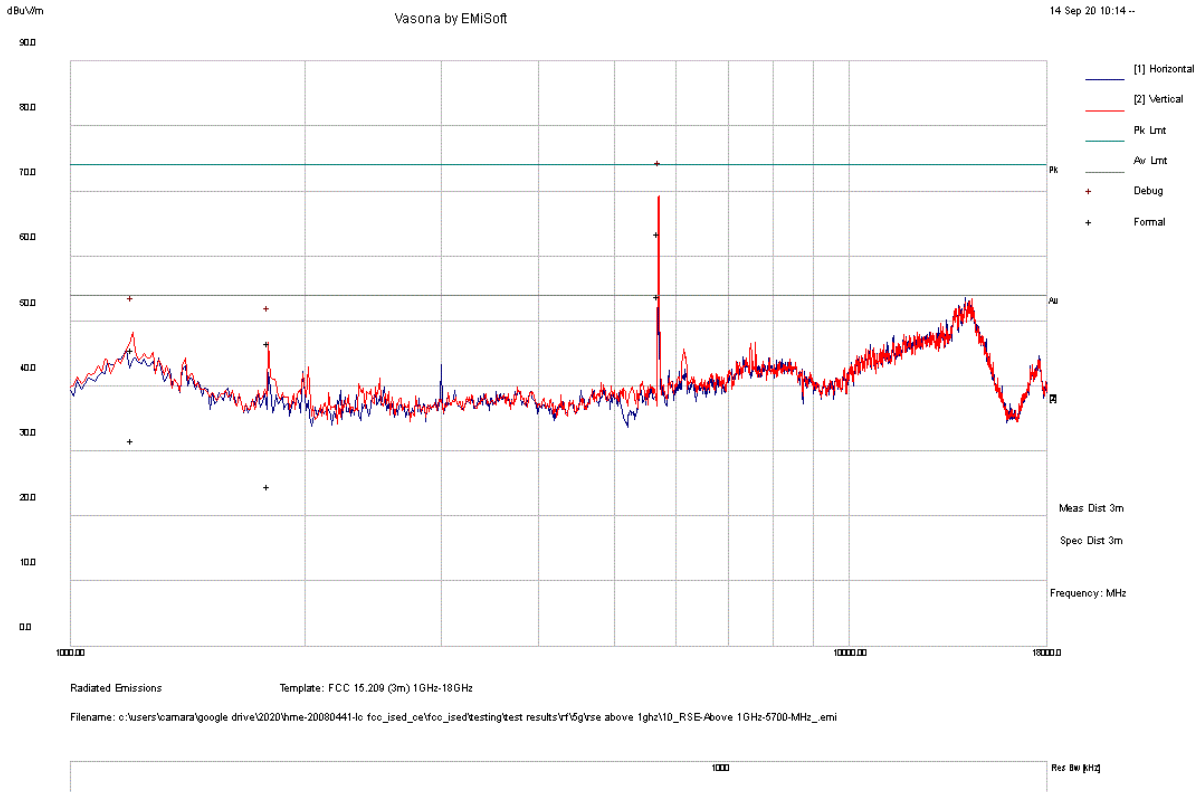


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7439.963	34.1	20.9	1	56	Peak Max	V	113	212	74	-18	Pass
11148.49	22.9	24.1	3.1	50.2	Peak Max	V	141	357	74	-23.8	Pass
1798.09	41.1	14.5	-9.1	46.5	Peak Max	V	277	118	74	-27.5	Pass
7439.96	29.4	20.9	1	51.3	Average Max	V	113	212	54	-2.7	Pass
11148.49	10.6	24.1	3.1	37.9	Average Max	V	141	357	54	-16.1	Pass
1798.09	20.9	14.5	-9.1	26.3	Average Max	V	277	118	54	-27.7	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5700MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/14/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5700 MHz

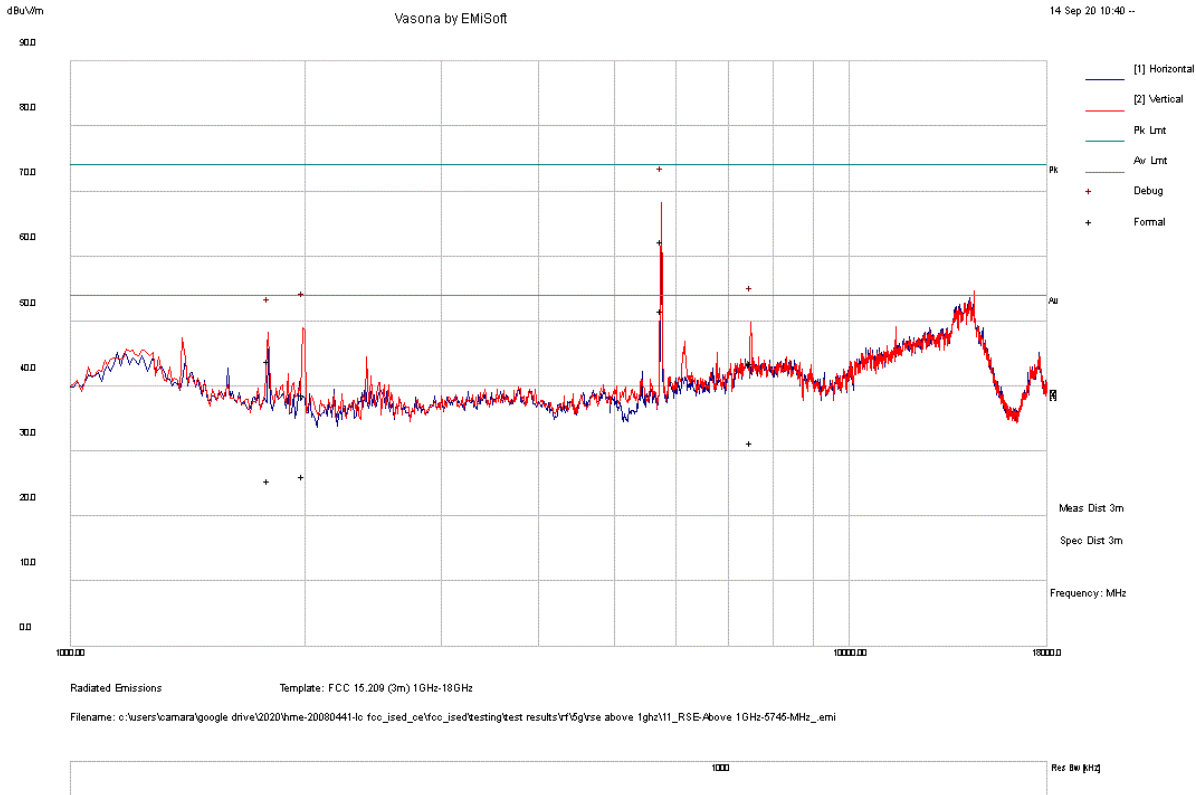


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1200.57	36.6	14.3	-5.2	45.7	Peak Max	V	152	1	74	-28.3	Pass
1797.13	41.3	14.5	-9.1	46.7	Peak Max	V	234	0	74	-27.3	Pass
1200.57	22.7	14.3	-5.2	31.8	Average Max	V	152	1	54	-22.2	Pass
1797.13	19.2	14.5	-9.1	24.6	Average Max	V	234	0	54	-29.4	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5745MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/14/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5745 MHz

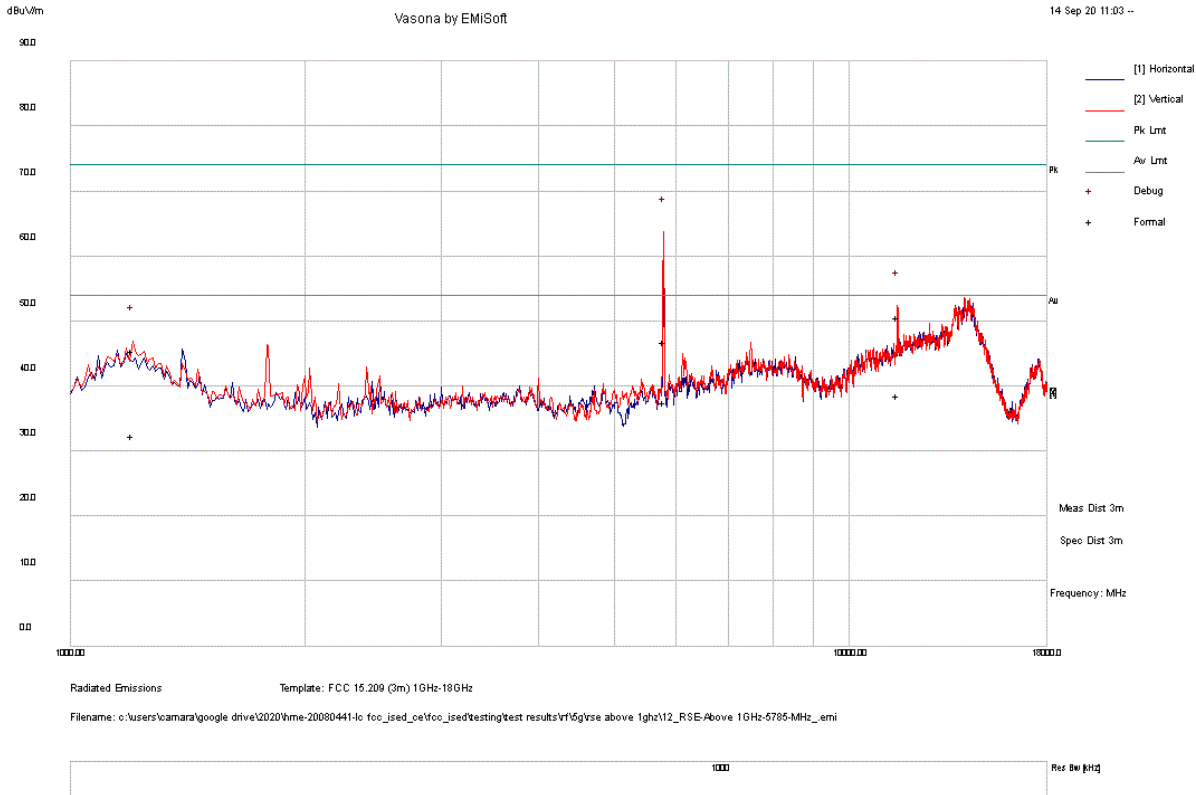


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7493.325	21.7	21	0.9	43.5	Peak Max	V	260	0	74	-30.5	Pass
1990.03	34	14.3	-9.5	38.8	Peak Max	V	264	222	74	-35.2	Pass
1798.36	38.6	14.5	-9.1	44	Peak Max	V	277	238	74	-30	Pass
7493.33	9.6	21	0.9	31.5	Average Max	V	260	0	54	-22.5	Pass
1990.03	21.5	14.3	-9.5	26.2	Average Max	V	264	222	54	-27.8	Pass
1798.36	20.1	14.5	-9.1	25.5	Average Max	V	277	238	54	-28.5	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5785MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/14/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5785 MHz

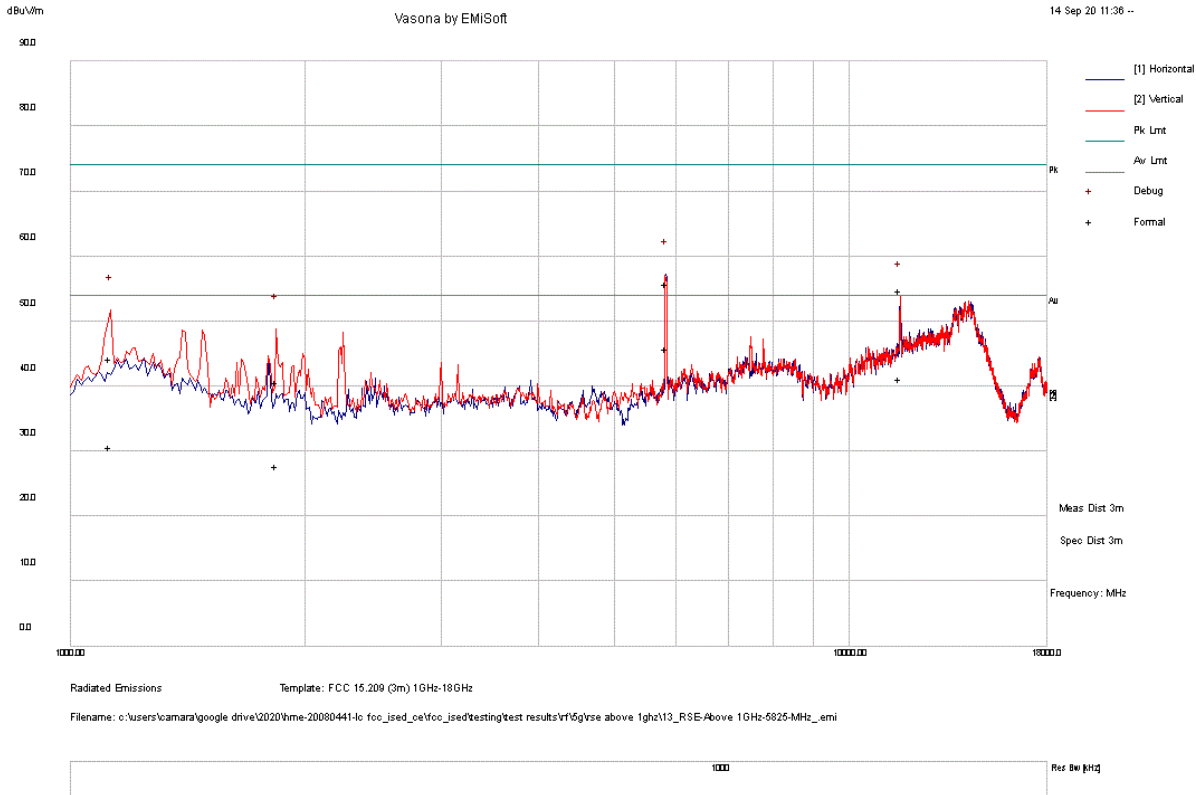


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
11562.08	22.2	24.9	3.5	50.6	Peak Max	V	149	315	74	-23.4	Pass
1200.36	36.4	14.3	-5.2	45.4	Peak Max	V	202	44	74	-28.6	Pass
11562.08	10.3	24.9	3.5	38.7	Average Max	V	149	315	54	-15.3	Pass
1200.36	23.3	14.3	-5.2	32.4	Average Max	V	202	44	54	-21.6	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	5825MHz
Frequency Range:	1 - 18 GHz	Test Date:	09/14/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

5825 MHz

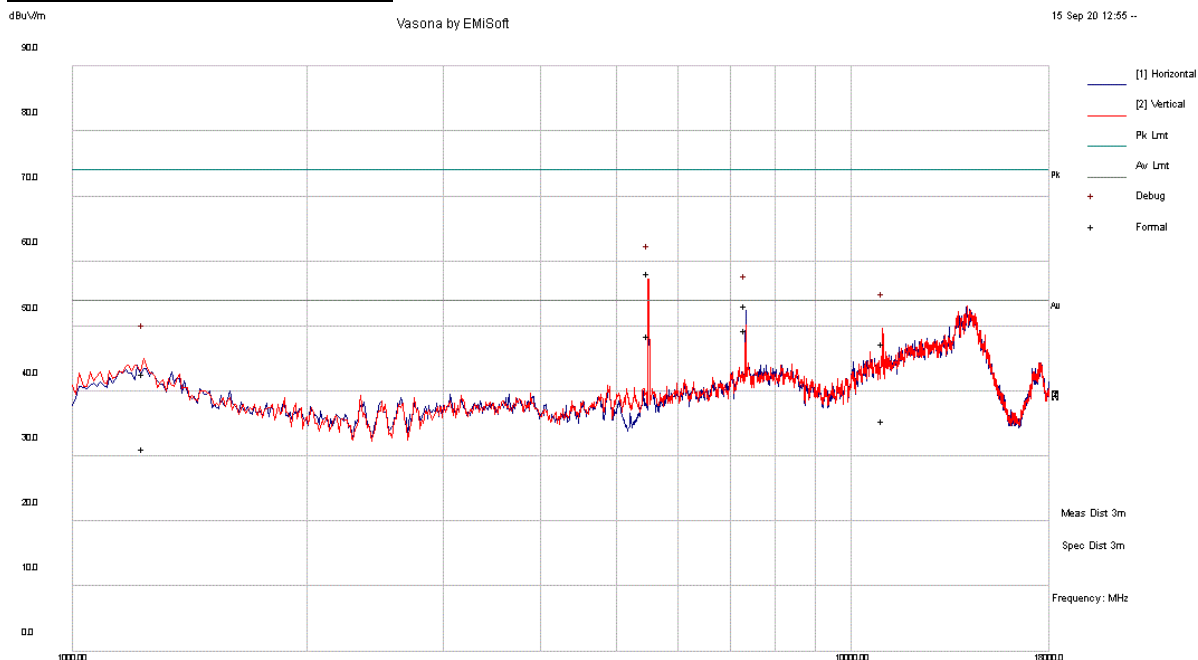


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
11644.47	25.9	25	3.8	54.7	Peak Max	H	193	123	74	-19.3	Pass
1125.63	34.7	14.1	-4.6	44.2	Peak Max	V	209	308	74	-29.8	Pass
1838.39	34.9	14.4	-8.7	40.7	Peak Max	V	163	113	74	-33.3	Pass
11644.47	12.4	25	3.8	41.2	Average Max	H	193	123	54	-12.8	Pass
1125.63	21.2	14.1	-4.6	30.7	Average Max	V	209	308	54	-23.3	Pass
1838.39	22	14.4	-8.7	27.7	Average Max	V	163	113	54	-26.3	Pass

Note: the highest emission is fundamental emission.

Test Standard:	15.209, 15.407	Mode:	BLE+5GHz co-located
Frequency Range:	1 - 18 GHz	Test Date:	09/15/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

BLE+5GHz co-located



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz

Filename: c:\users\camara\google drive\2020\hme-20080441-lc_fcc_used_ce\used\testing\test results\vt\5g\use above 1ghz\14_RSE-Above 1GHz-5500+BLEMHz.emi

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7333.193	31.4	20.7	1.2	53.3	Peak Max	H	100	31	74	-20.7	Pass
10997.39	20.5	23.9	3	47.3	Peak Max	V	197	86	74	-26.7	Pass
1234.99	33.9	14.4	-5.6	42.7	Peak Max	V	269	110	74	-31.3	Pass
7333.19	27.5	20.7	1.2	49.4	Average Max	H	100	31	54	-4.6	Pass
10997.39	8.8	23.9	3	35.6	Average Max	V	197	86	54	-18.4	Pass
1234.99	22.4	14.4	-5.6	31.2	Average Max	V	269	110	54	-22.8	Pass

Note: the highest emission is fundamental emission.

18GHz - 40GHz test result

Note: no substantial emission is found other than the noise floor.

Radiated Band Edge measurement result



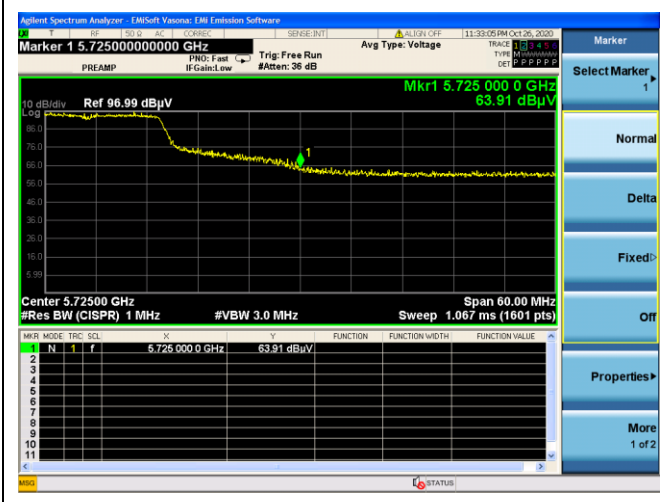
5180MHz- Edge 5150MHz



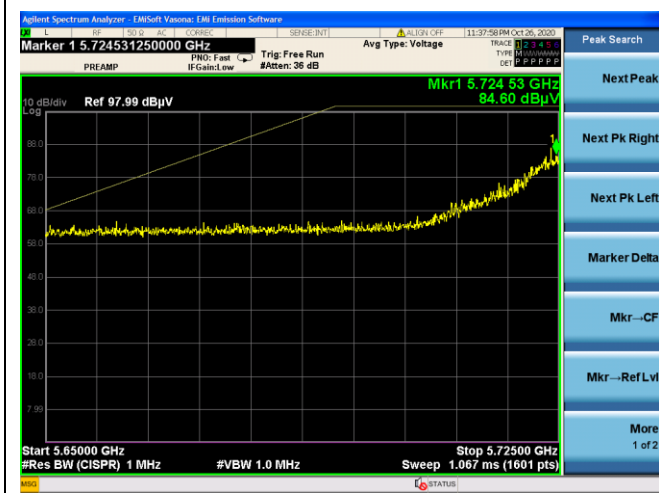
5320MHz- Edge 5350MHz



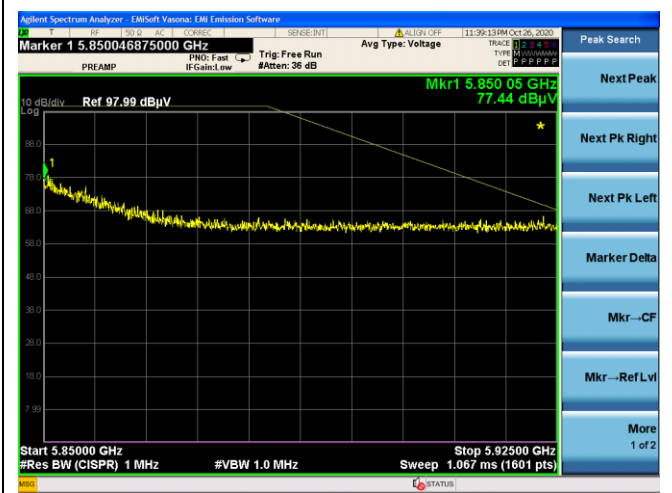
5500MHz- Edge 5470MHz



5700MHz- Edge 5725MHz



5745MHz- Edge 5725MHz



5825MHz- Edge 5850MHz

8 EUT and Test Setup Photos

See FCC filing exhibits

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/19	10/18/20
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	6/17/20	6/17/21
EMC Test Receiver	R&S	ESL6	100230	6/14/20	6/14/21
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	5/4/20	5/4/21
LISN (9KHz – 30MHz)	Com-Power	LI-550C	20140050	01/29/2020	01/29/2021
LISN (9KHz – 30MHz)	Com-Power	LI-550C	20140051	01/29/2020	01/29/2021
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2019	11/15/2020
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	5/14/2020	5/14/2021
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	6/24/20	6/24/21
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	7/16/2020	7/16/2021
True RMS Multi-meter	UNI-T	UT181A	C173014829	5/5/2020	5/5/2021
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	5/15/2020	5/15/2021
RF Attenuator	Pasternack	PE7005-3	VL061	7/16/2020	7/16/2021
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	7/16/2020	7/16/2021
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	5/16/20	5/16/21
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	7/16/2020	7/16/2021
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	7/16/2020	7/16/2021
RE test cable (>18GHz)	Sucoflex	104	344903/4	7/16/2020	7/16/2021
Pulse limiter	Com-Power	LIT-930A	531727	7/16/2020	7/16/2021
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	7/16/2020	7/16/2021
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	7/16/2020	7/16/2021
Vector Signal Generator	Keysight	N5182A	US47080548	6/17/20	6/17/21
RF Power Amplifier (80-1000MHz)	Ophir	5226FE	1013/1815	N/A	N/A
RF Power Amplifier (700-6000MHz)	Ophir	5293FE	1063/1815	N/A	N/A
Horn Antenna (1-18GHz)	FT-RF	HA-07M18G-NF	180010HA	N/A	N/A