STARRY, INC.

TEST REPORT

SCOPE OF WORK
Emissions Testing on COMET 24 – 5GHz Radio

REPORT NUMBER
104749253BOX-008

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DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. December 2017

EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 104749253BOX-008
Project Number: G104749253

Report Issue Date: 10/29/2021
Report Last Revision Date: 1/06/2022

Model(s) Tested: COMET 24 – 5GHz Radio

Standards: CFR47 FCC Part 15.407 Subpart E: 07/2021,
CFR47 FCC Part 15 Subpart B: 07/2021,
CFR47 FCC Part 1.1310: 07/2021

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Starry, Inc.
38 Chauncy St, Suite 200
Boston, MA 02111
USA

Report prepared by

Vathana Ven / EMC Engineering Supervisor

Report reviewed by

Kouma Sinn / EMC Engineering Supervisor

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Maximum Peak Output Power and Human RF exposure CFR47 FCC Part 15.407 Subpart E:07/2021, Section 15.407 (a)(3) CFR47 FCC Part 1.1310:2021	Pass
7	6 dB Bandwidth, 26 dB Bandwidth and Occupied Bandwidth CFR47 FCC Part 15.407 Subpart E: 07/2021, Section 15.407(a)(12) and 15.407(e)	Pass
8	Power Spectral Density CFR47 FCC Part 15.407 Subpart E: 07/2021, Section 15.407 (a)(3)	Pass
9	Transmitter Radiated Spurious Emissions (CFR47 FCC Part 15.407 Subpart C, 15.407(b)(4)(9),15.209:07/2021, 15.205:07/2021,	Pass
10	Digital Device Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 07/2021,	Pass
11	AC Mains Conducted Emissions FCC 47CFR Part 15.107: 07/2021	Pass
12	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Starry, Inc.
38 Chauncy St, Suite 200
Boston, MA 02111
USA

Contact: Robert White
Telephone: (617) 297-9559
Fax: None
Email: rwhite@starry.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Starry, Inc.
38 Chauncy St, Suite 200
Boston, MA 02111
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Multipoint Radio operating with 5 GHz radio module	Starry, Inc.	S01311	2123000009

Receive Date:	06/14/2021
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
Multipoint Radio operating with 5 GHz radio module

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
54 VDC	1.1A	N/A	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	The EUT was set to transmit at Low, Mid, and High channel continuous with modulation at 100 % duty cycle.
2	Radio in receive or normal mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Proprietary Software that controls the operation of the radio.

Radio/Receiver Characteristics	
Frequency Band(s)	5.725-5.895 GHz
Modulation Type(s)	OFDM, MCS0-9 per 802.11ac
Maximum Output Power	Channel 157 20 MHz BW (5.785 GHz): 13.97 dBm Channel 159 40 MHz BW (5.795 GHz): 16.19 dBm Channel 155 80 MHz BW (5.775 GHz): 8.17 dBm
Test Channels	Channel 157 20 MHz BW (5.785 GHz) Channel 159 40 MHz BW (5.795 GHz) Channel 155 80 MHz BW (5.775 GHz)
Occupied Bandwidth	Channel 157 20 MHz BW (5.785 GHz): 19.30 MHz Channel 159 40 MHz BW (5.795 GHz): 37.60 MHz Channel 155 80 MHz BW (5.775 GHz): 76.19 MHz
6 dB Bandwidth	Channel 157 20 MHz BW (5.785 GHz): 17.74 MHz Channel 159 40 MHz BW (5.795 GHz): 36.51 MHz Channel 155 80 MHz BW (5.775 GHz): 76.62 MHz
26 dB Bandwidth	Channel 157 20 MHz BW (5.785 GHz): 20.85 MHz Channel 159 40 MHz BW (5.795 GHz): 41.76 MHz Channel 155 80 MHz BW (5.775 GHz): 82.07 MHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
Antenna Type and Gain	Integrated, 5.5 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	None	--	--	--	--

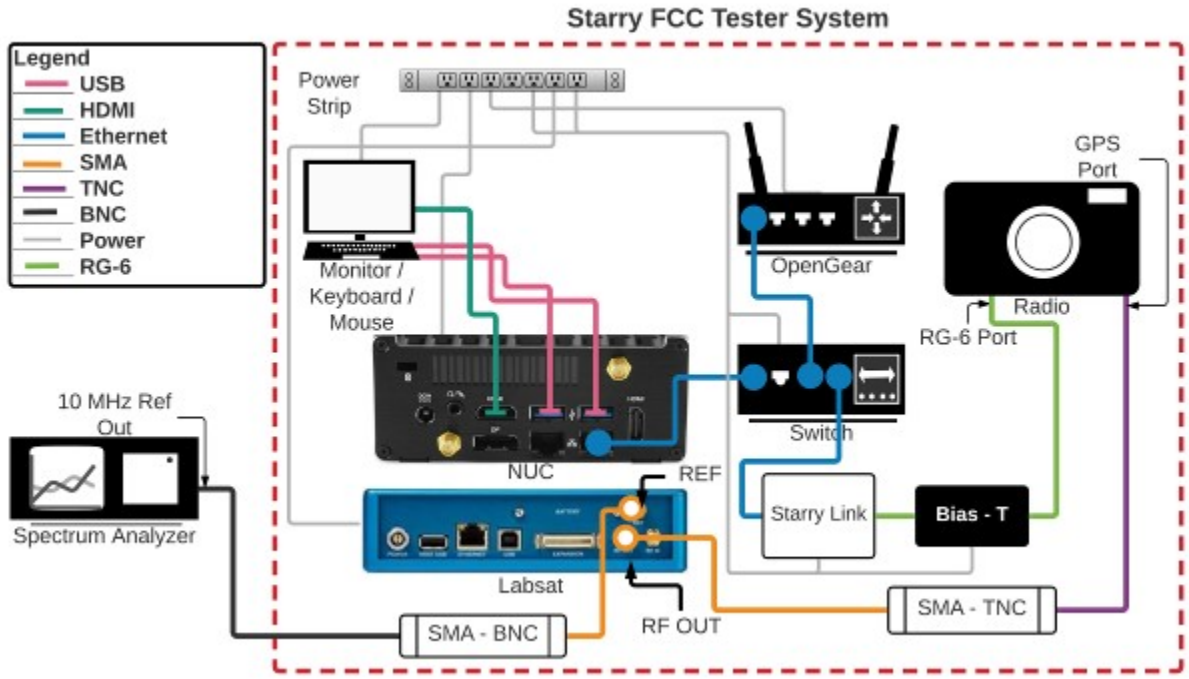
Support Equipment			
Description	Manufacturer	Model Number	Serial Number
USB Power Supply	Travel Charger	ES-KC15	Not Labelled

5.1 Method:

Configuration as required by Configuration as required by CFR47 FCC Part 15.407 Subpart E: 07/2021, CFR47 FCC Part 15 Subpart B: 07/2021, CFR47 FCC Part 1.1310:07/2021, ANSI C 63.10: 2013, and ANSI C 63.4: 2014.

5.2 EUT Block Diagram:

Comet 24



6 Maximum Peak Output Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.407, CFR47 FCC Part 1.1310, and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m Absorber-lined Shielded Enclosures (ALSE) is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/20/2021	03/20/2022
CBLSHF204'	Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5)	Huber + Suhner	Sucoflex 102EA	234714001	02/03/2021	02/03/2022
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021

Software Utilized:

Name	Manufacturer	Version
None		

6.3 Results:

The sample tested was found to Comply.

§15.407 (a) (3) *For the band 5.725-5.895 GHz:* (i) For the band 5.725-5.850 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations

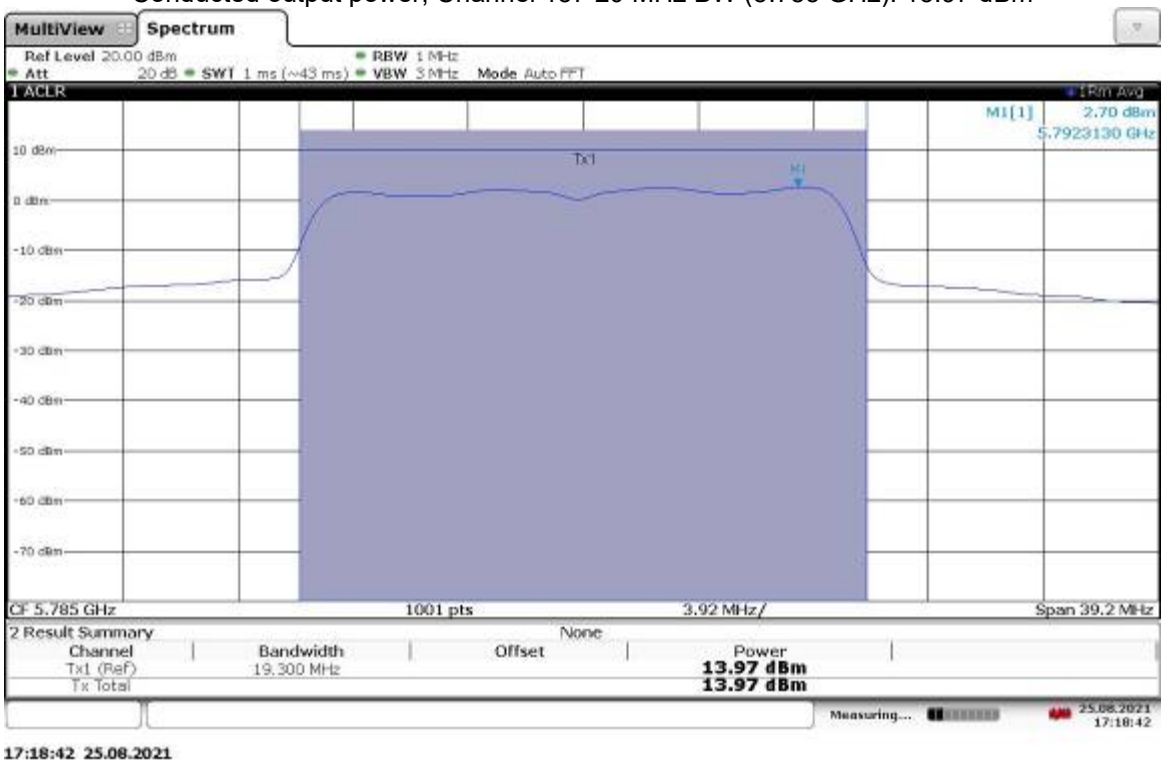
Frequency (MHz)	Power Settings	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
Channel 157 20 MHz BW (5.785 GHz)	19	13.97	30	-16.03
Channel 159 40 MHz BW (5.795 GHz)	19	16.19	30	-13.81
Channel 155 80 MHz BW (5.775 GHz)	9	8.17	30	-21.83

6.4 Setup Photograph:

Confidential – Photo not included in this report

6.5 Test Data:

Conducted output power, Channel 157 20 MHz BW (5.785 GHz): 13.97 dBm



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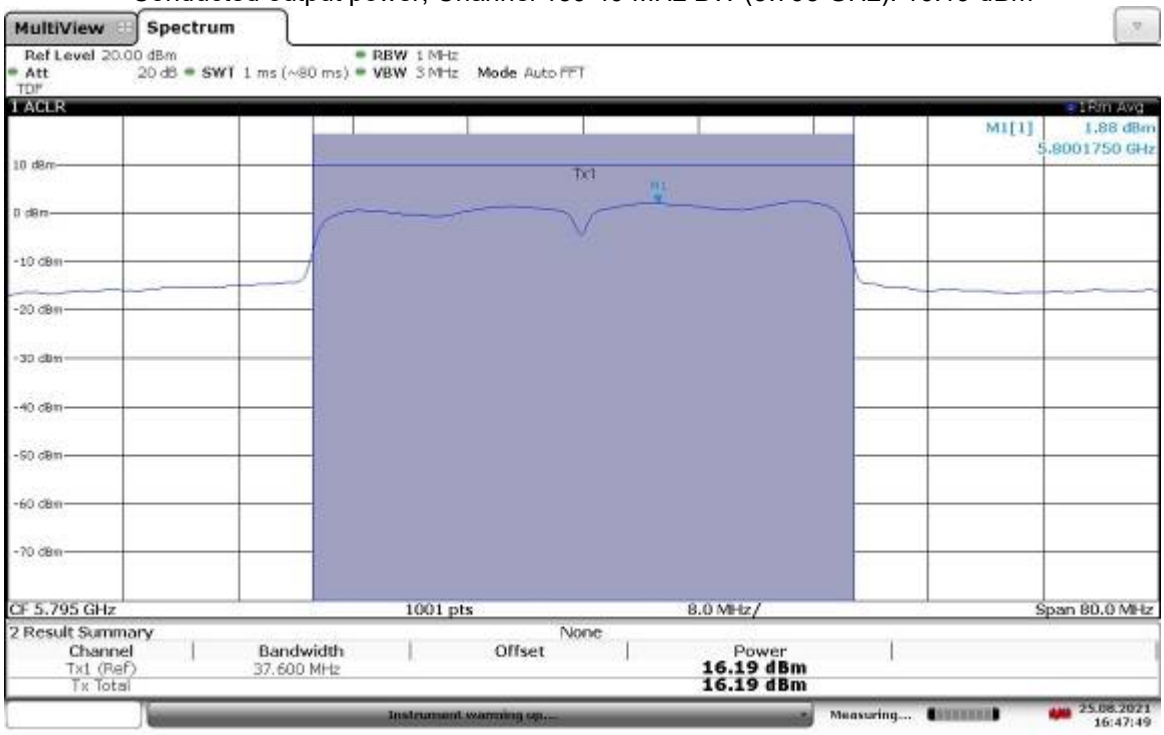
Conducted output power, Channel 159 40 MHz BW (5.795 GHz): 16.19 dBm



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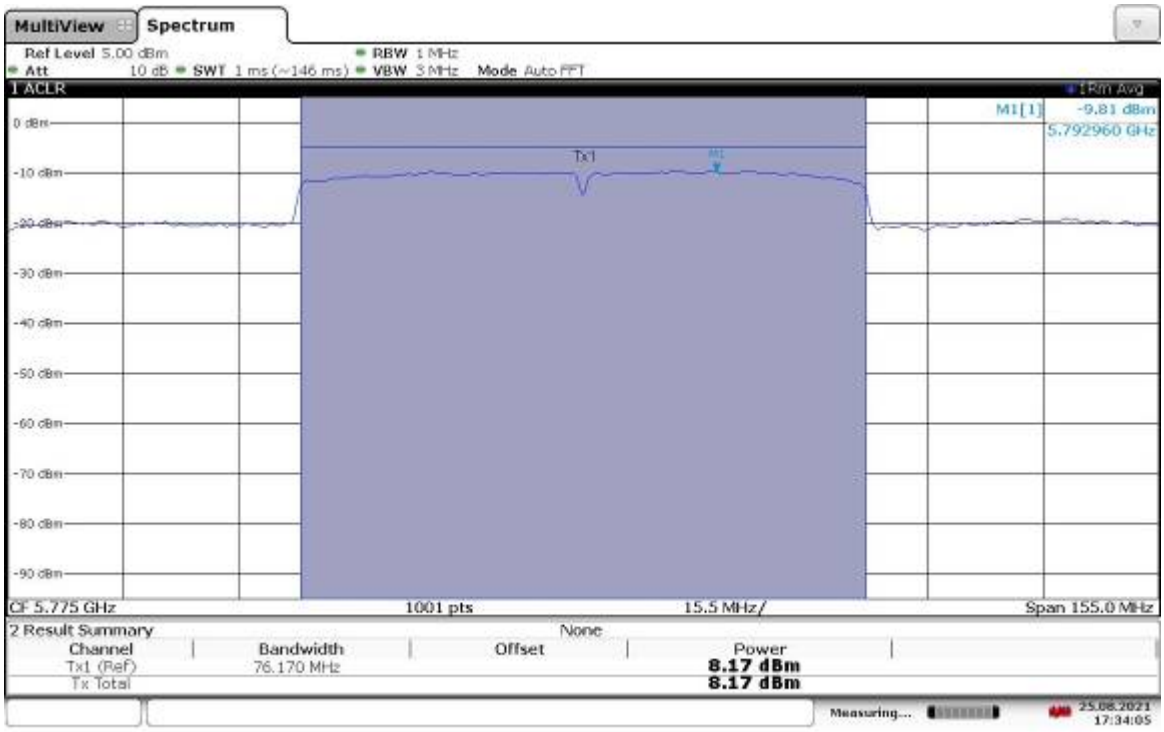
Conducted output power, Channel 155 80 MHz BW (5.775 GHz): 8.17 dBm



17:34:05 25.08.2021

MPE Calculation

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

RSS-102 Issue 5 Exposure Limits:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.1 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedPower(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

1.2 Results:

Maximum conducted output power = 16.19 dBm

Maximum output power, EIRP = +16.19 dBm + 5.5 dBi = 21.69 dBm or 147.571 mW

Power Density = 147.571/5025.6

Power Density = 0.02936 mW/cm^2

Limit at 5.795 GHz = $1mW/cm^2$

The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

Test Personnel:	Vathana Ven VSV	Test Date:	08/25/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.407	Limit Applied:	See report section 6.3
Input Voltage:	48 VDC Via External P/S	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	30 %
		Atmospheric Pressure:	1008 mbars

Deviations, Additions, or Exclusions: None

7 6 dB Bandwidth, 26 dB Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.407, RSS-247, and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/20/2021	03/20/2022
CBLSHF204'	Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5)	Huber + Suhner	Sucoflex 102EA	234714001	02/03/2021	02/03/2022
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021

Software Utilized:

Name	Manufacturer	Version
None	--	--

7.3 Results:

The sample tested was found to Comply.

§15.407 (e) Within the 5.725-5.850 GHz and 5.850-5.895 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

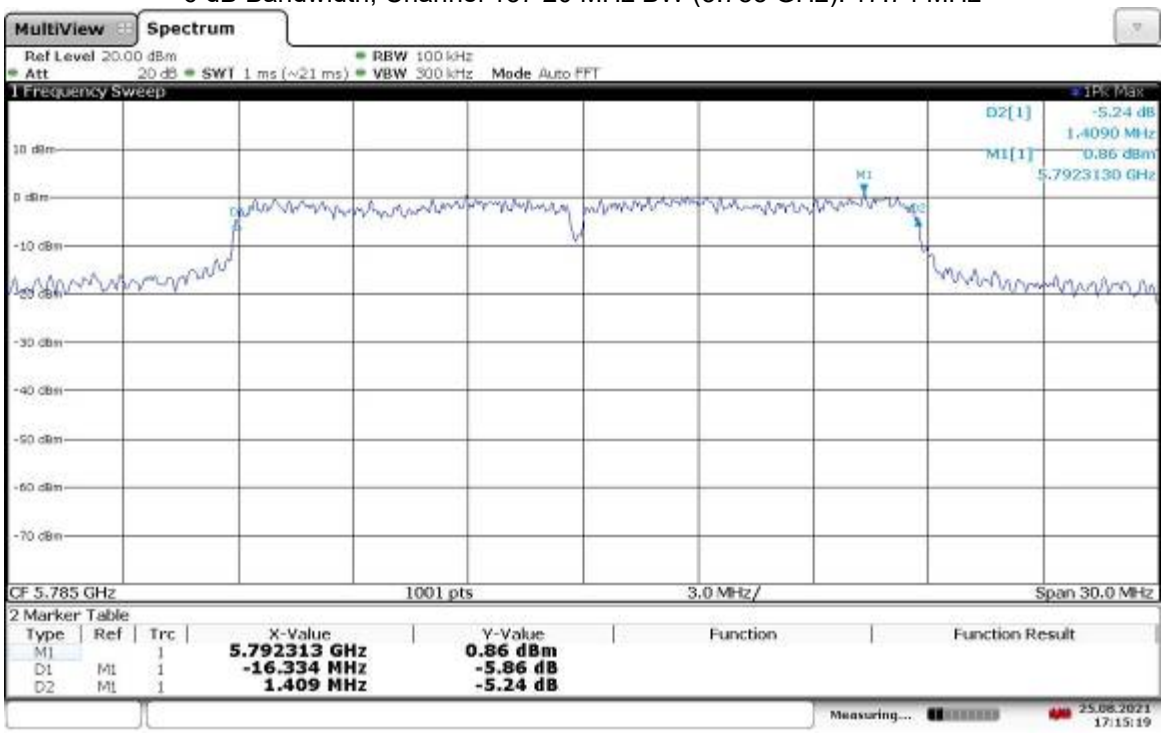
Frequency (MHz)	DTS Bandwidth (6 dB Bandwidth) (MHz)	Bandwidth (26 dB Bandwidth) (MHz)	Occupied Bandwidth (MHz)
Channel 157 20 MHz BW (5.785 GHz)	17.74	20.85	19.30
Channel 159 40 MHz BW (5.795 GHz)	36.51	41.76	37.60
Channel 155 80 MHz BW (5.775 GHz)	76.62	82.07	76.19

7.4 Setup Photograph:

Confidential – Photo not included in this report

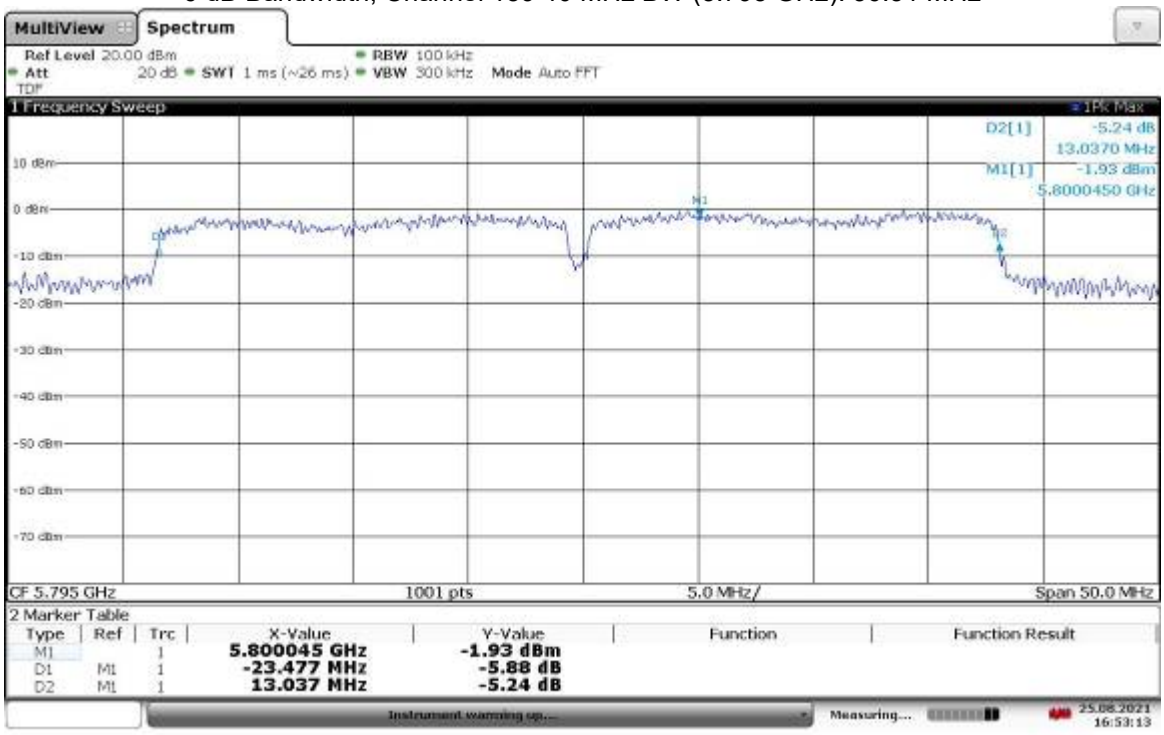
7.5 Plots/Data:

6 dB Bandwidth, Channel 157 20 MHz BW (5.785 GHz): 17.74 MHz



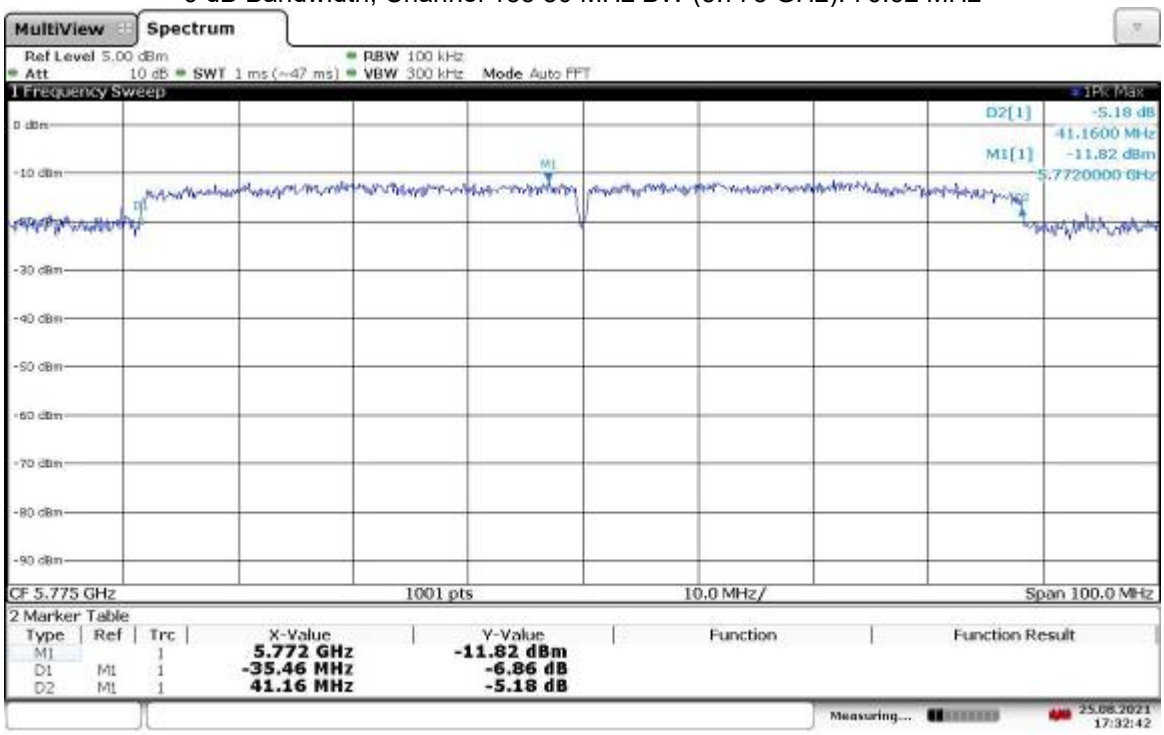
17:15:20 25.08.2021

6 dB Bandwidth, Channel 159 40 MHz BW (5.795 GHz): 36.51 MHz



16:53:13 25.08.2021

6 dB Bandwidth, Channel 155 80 MHz BW (5.775 GHz): 76.62 MHz



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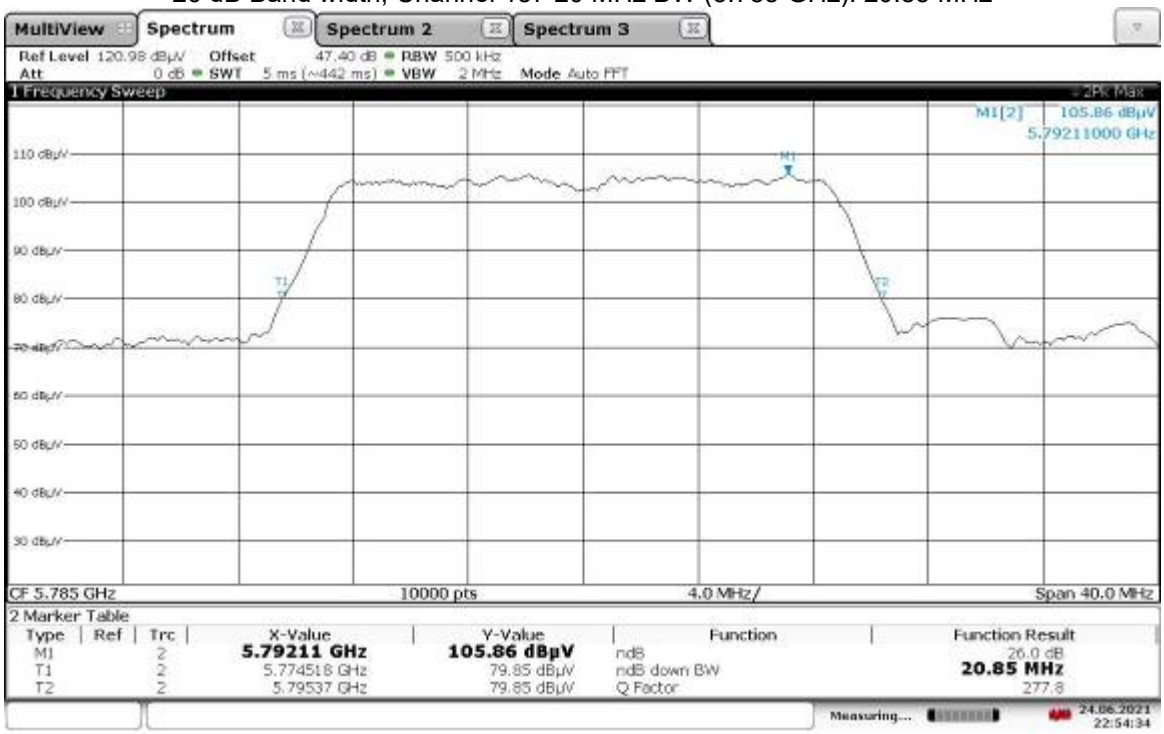
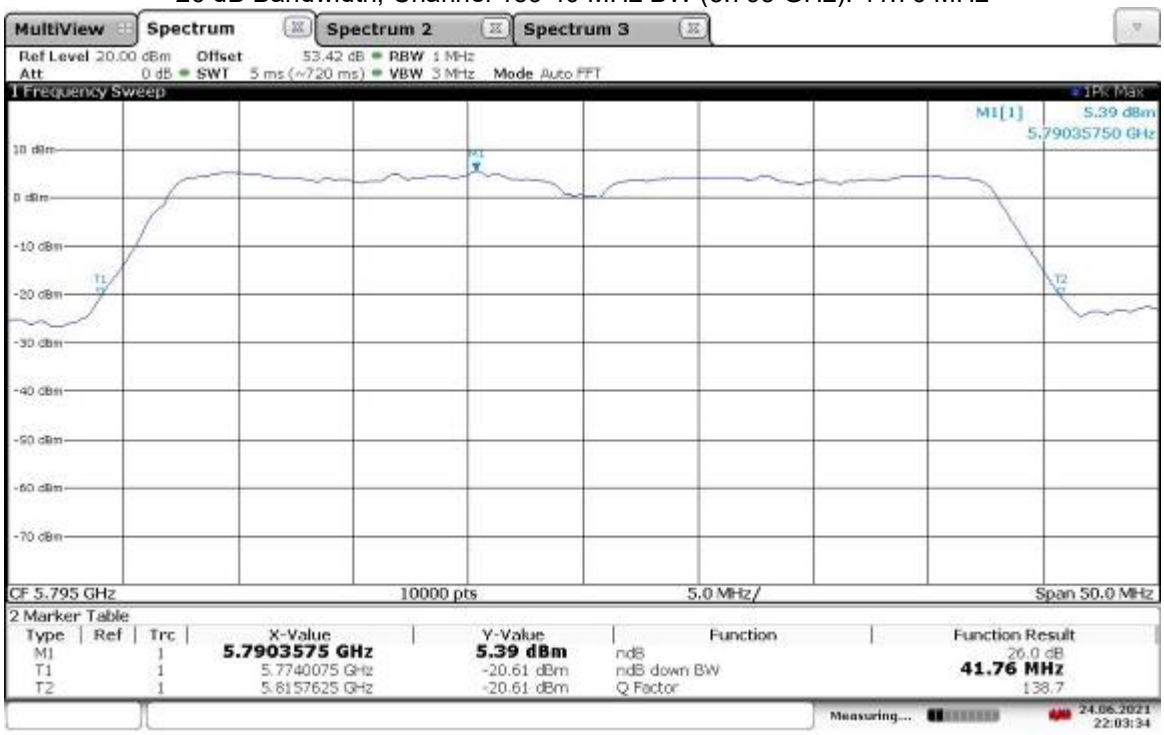
26 dB Band width, Channel 157 20 MHz BW (5.785 GHz): 20.85 MHz



22:54:35 24.06.2021

26 dB Bandwidth, Channel 159 40 MHz BW (5.795 GHz): 41.76 MHz



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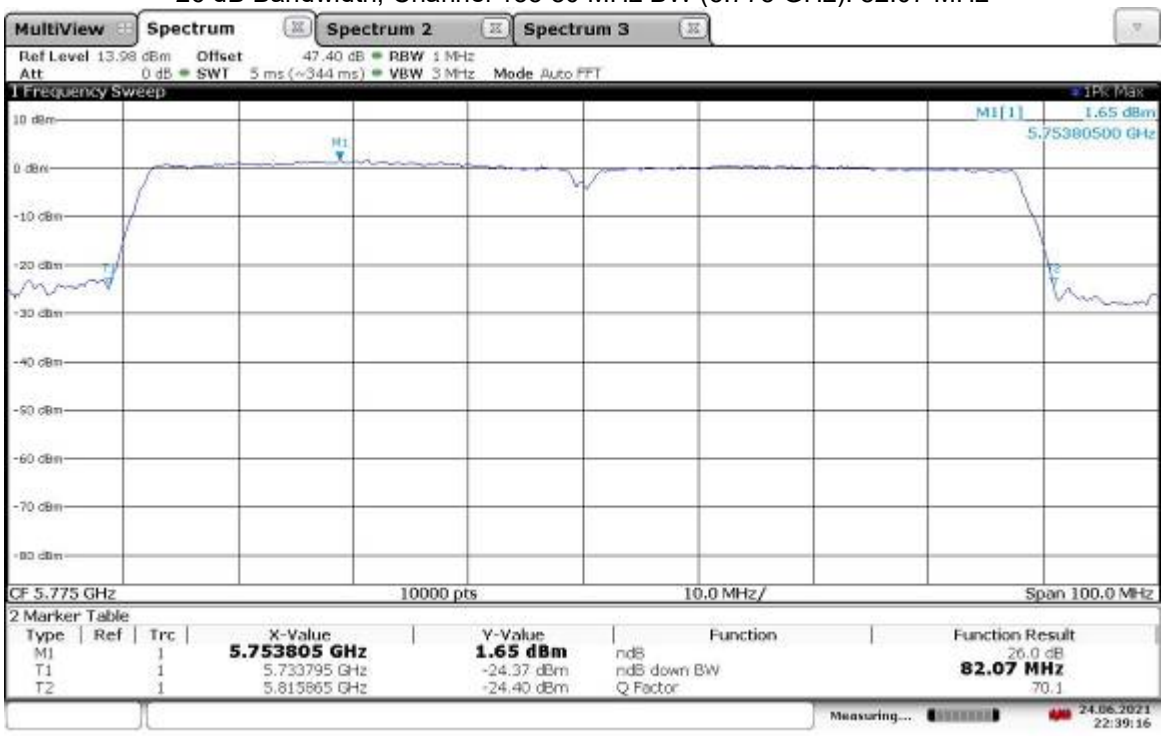
26 dB Bandwidth, Channel 155 80 MHz BW (5.775 GHz): 82.07 MHz



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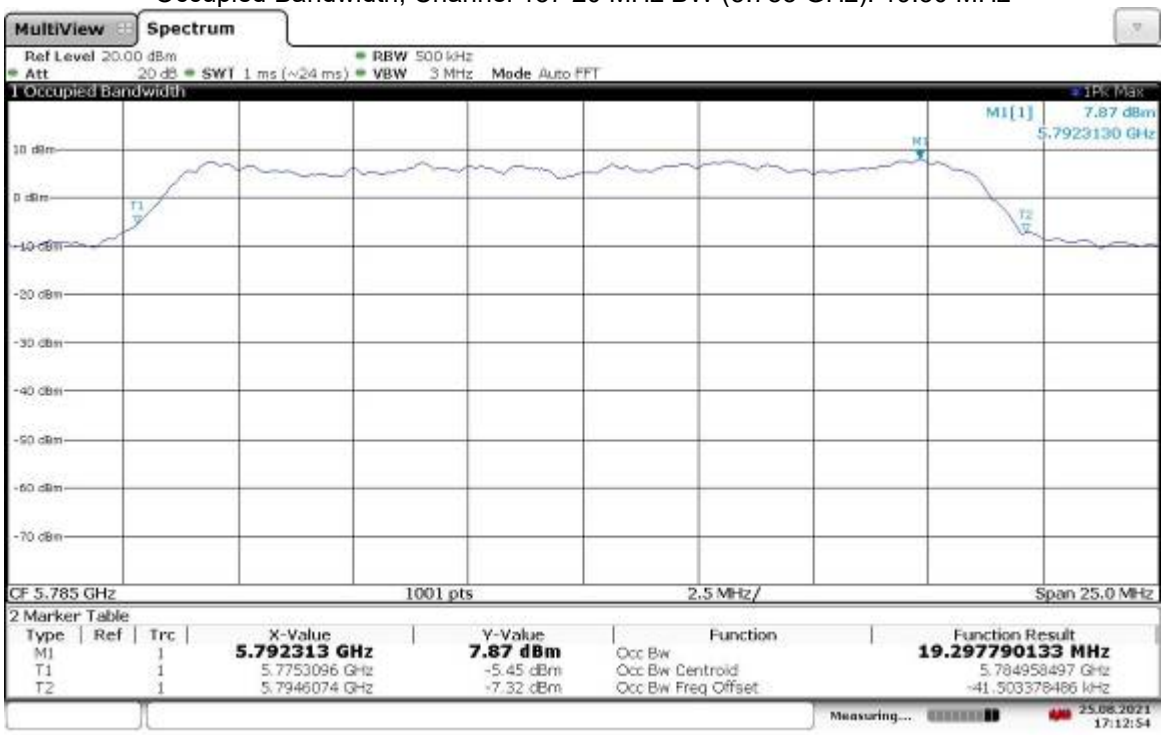
Occupied Bandwidth, Channel 157 20 MHz BW (5.785 GHz): 19.30 MHz



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Occupied bandwidth, Channel 159 40 MHz BW (5.795 GHz): 37.60 MHz

16:43:59 25.08.2021

Channel 155 80 MHz BW (5.775 GHz): 76.19 MHz

17:30:33 25.08.2021

Test Personnel:	Vathana Ven VJV	Test Date:	06/24/2021, 08/25/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.407	Limit Applied:	See report section 7.3
Input Voltage:	48 VDC Via External P/S	Ambient Temperature:	22, 22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	12, 30 %
		Atmospheric Pressure:	1017, 1008 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.407 and ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/20/2021	03/20/2022
CBLSHF204'	Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5)	Huber + Suhner	Sucoflex 102EA	234714001	02/03/2021	02/03/2022
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021

Software Utilized:

Name	Manufacturer	Version
None		

8.3 Results:

The sample tested was found to Comply.

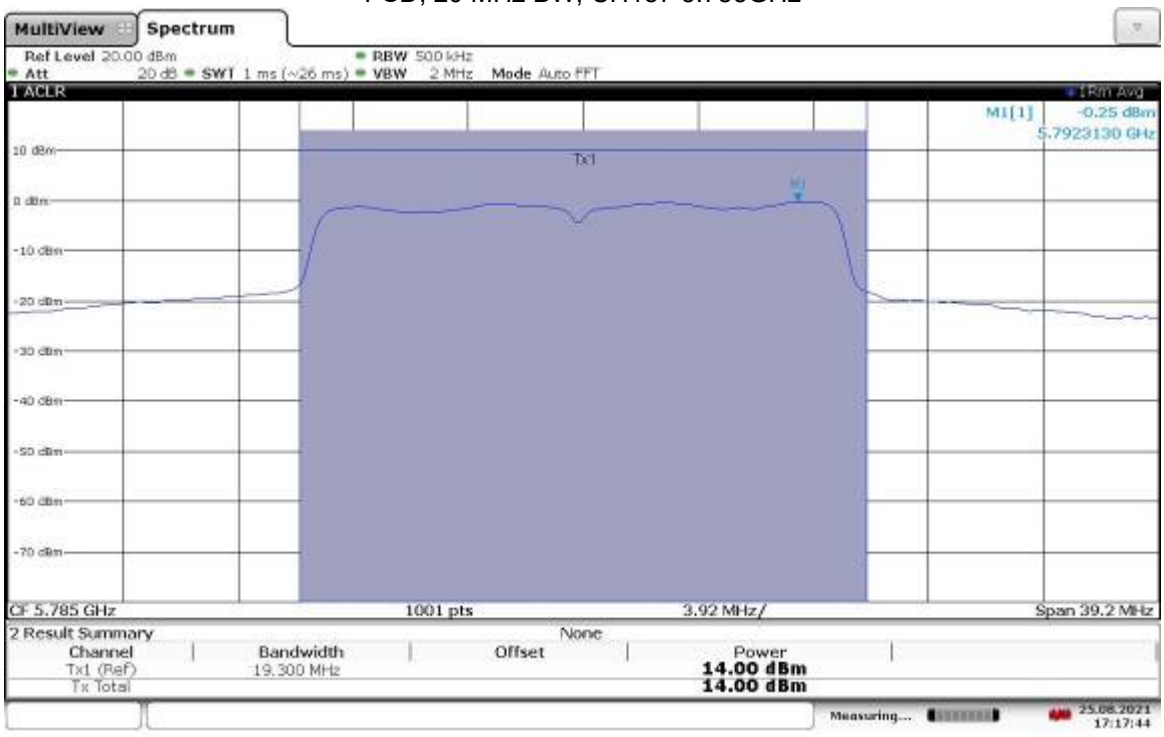
§15.407 (a) (3) *For the band 5.725-5.895 GHz:* (i) For the band 5.725-5.850 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations

8.4 Setup Photograph:

Confidential – Photo not included in this report

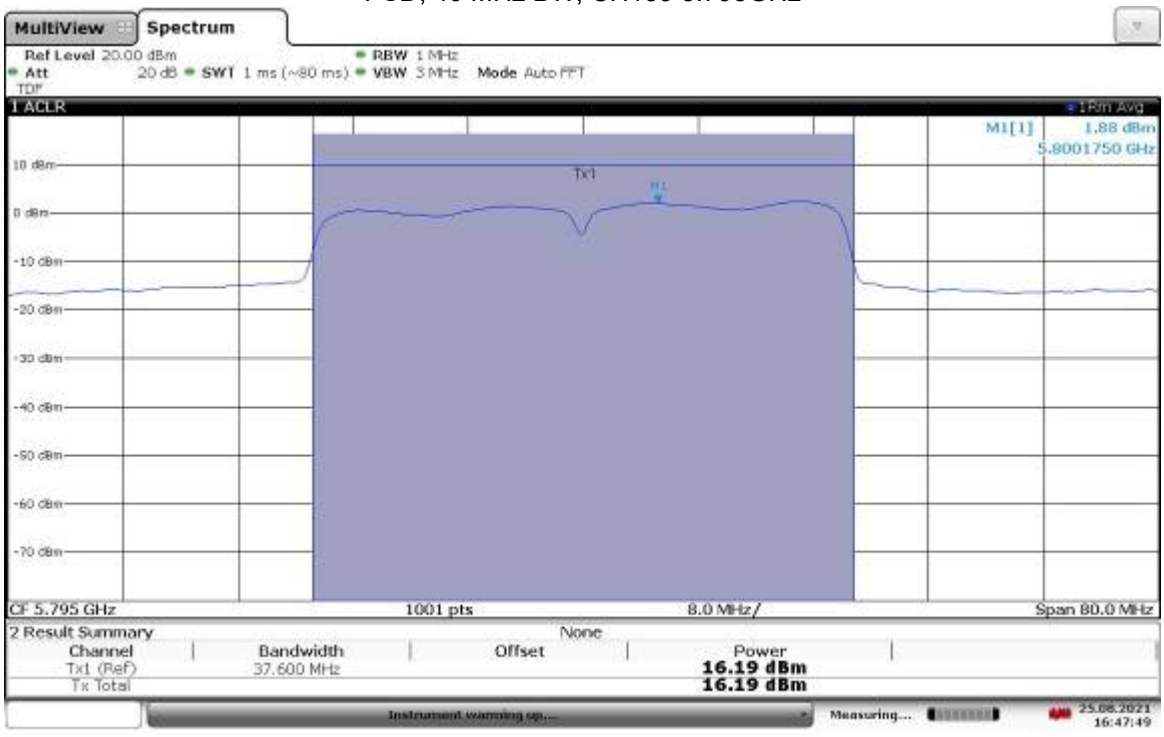
8.5 Test Data:

PSD, 20 MHz BW, CH157 5.785GHz



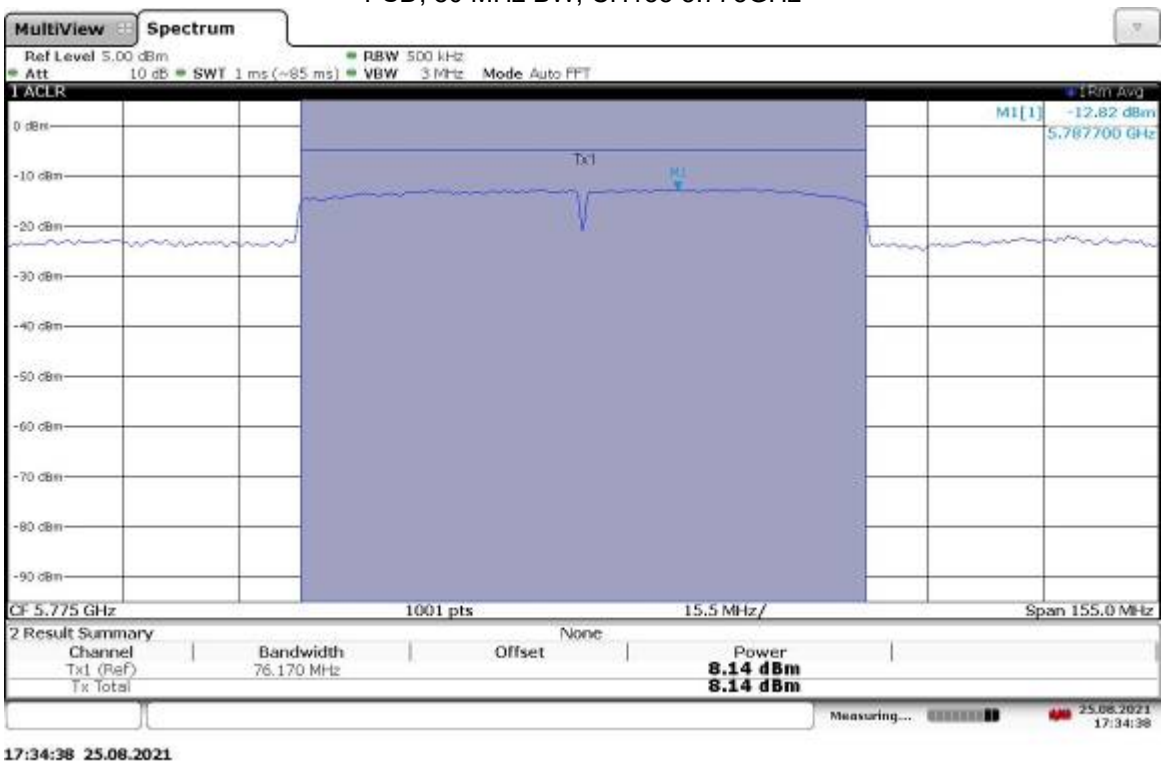
17:17:44 25.08.2021

PSD, 40 MHz BW, CH159 5.795GHz



16:47:50 25.08.2021

PSD, 80 MHz BW, CH155 5.775GHz



Test Personnel:	Vathana Ven VSV	Test Date:	08/25/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.407	Limit Applied:	See report section 8.3
Input Voltage:	48 VDC Via External P/S	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	30 %
		Atmospheric Pressure:	1008 mbars

Deviations, Additions, or Exclusions: None

9 Transmitter spurious emissions

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.407 and ANSI C 63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

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

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/20/2021	03/20/2022
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/09/2021	06/09/2022
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/21/2020	09/21/2021
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/22/2021	06/22/2022
HS003'	10m under floor cable	Huber-Schuner	10m-1	HS003	02/17/2021	02/17/2022
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	07/13/2020	07/13/2021
IW001'	Receiver to floor cable	Insulated Wire	2801-NPS	001	10/07/2020	10/07/2021
IW006'	Pre-amp to antenna cable	Insulated Wire	2800-NPS	IW006	11/25/2020	11/25/2021
IW003'	8.4 meter cable	Insulated Wire	2800-NPS	003	10/08/2020	10/08/2021
PRE12'	Pre-amp, 1-18GHz	Com-Power	PAM-118A	18040117	12/07/2020	12/07/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/03/2020	08/03/2021
HS003'	10m under floor cable	Huber + Suhner	10m-1	HS003	02/17/2021	02/17/2022
IW002'	2 meter Armored cable	Insulated Wire	2800-NPS	002	09/23/2020	09/23/2021
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/19/2021	02/19/2022
REA008'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/22/2020	07/22/2021
PRE8'	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	11/25/2020	11/25/2021
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021
REA009'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/22/2020	07/22/2021
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	01/28/2021	01/28/2022

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16

9.3 Results:

The sample tested was found to Comply.

15.407 (b)(4)(i) For transmitters operating solely in the 5.725-5.850 GHz band:

(i) 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.

15.407 (b)(9) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.

9.4 Setup Photographs:

Confidential – Photo not included in this report

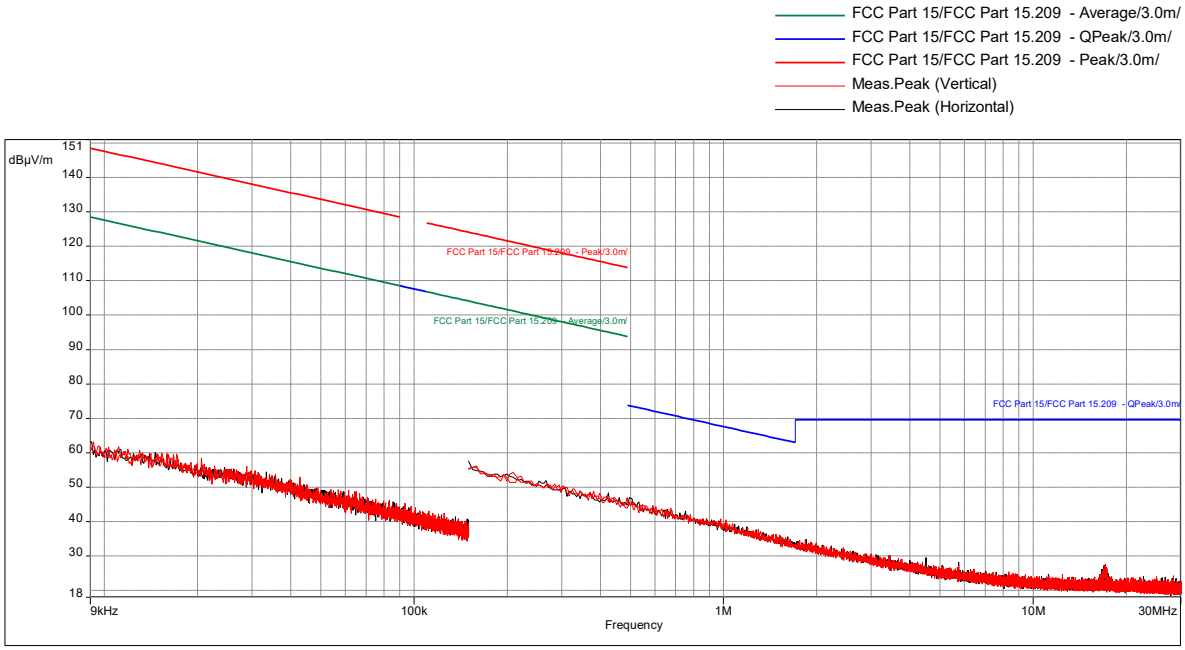
9.5 Plots/Data:

Transmit at Low Channel, 9kHz-30 MHz

Test Information:

Date and Time	6/25/2021 10:04:13 PM
Client and Project Number	Starry
Engineer	Kouma Sinn
Temperature	24C
Humidity	41%
Atmospheric Pressure	1018mbar
Comments	RE 9kHz-30MHz _Comet 24, Lower Band: Low Channel 24.34 GHz, 160 MHz Bandwidth, MCSO Modulation, att0.25-mixer27, BT Tx High CH, 5G Tx 157

Graph:



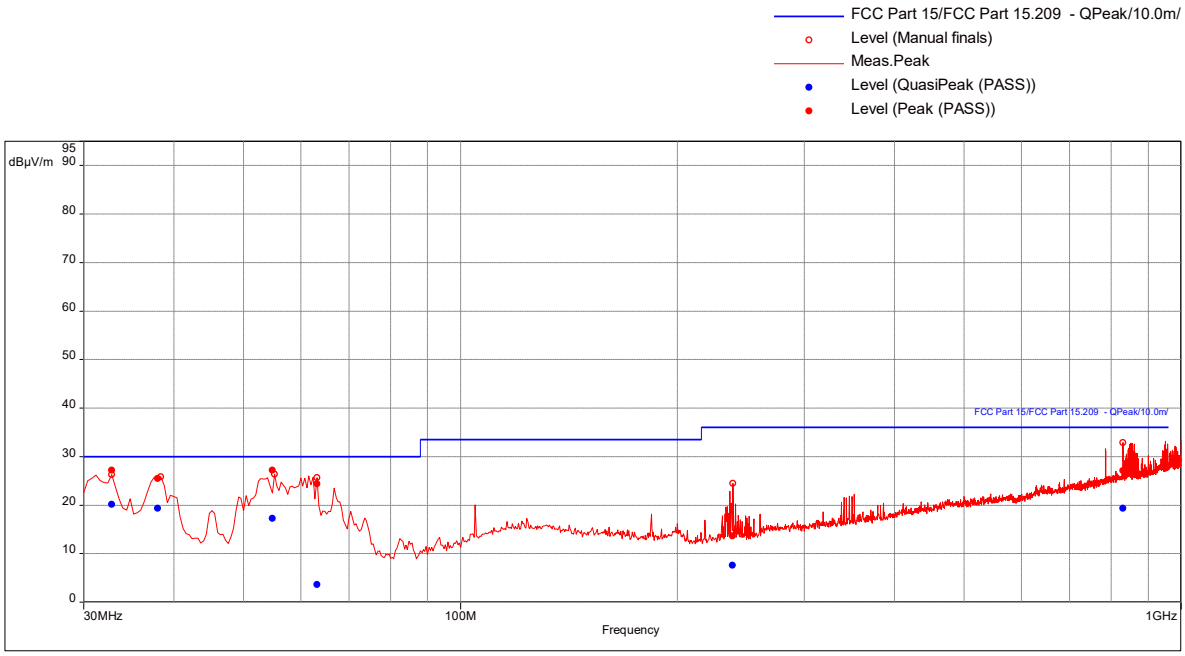
Results: No emissions were detected.

Transmit at Low Channel, 30-1000 MHz

Test Information:

Date and Time	6/29/2021 5:26:07 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Low Channel 24.34 GHz, 160 MHz BW, MCSO, att0.25-mixer27, BT Tx Low CH_5GHz Tx CH157 80 MHz BW_30-1000MHz

Graph:



Results:

QuasiPeak (PASS) (6)

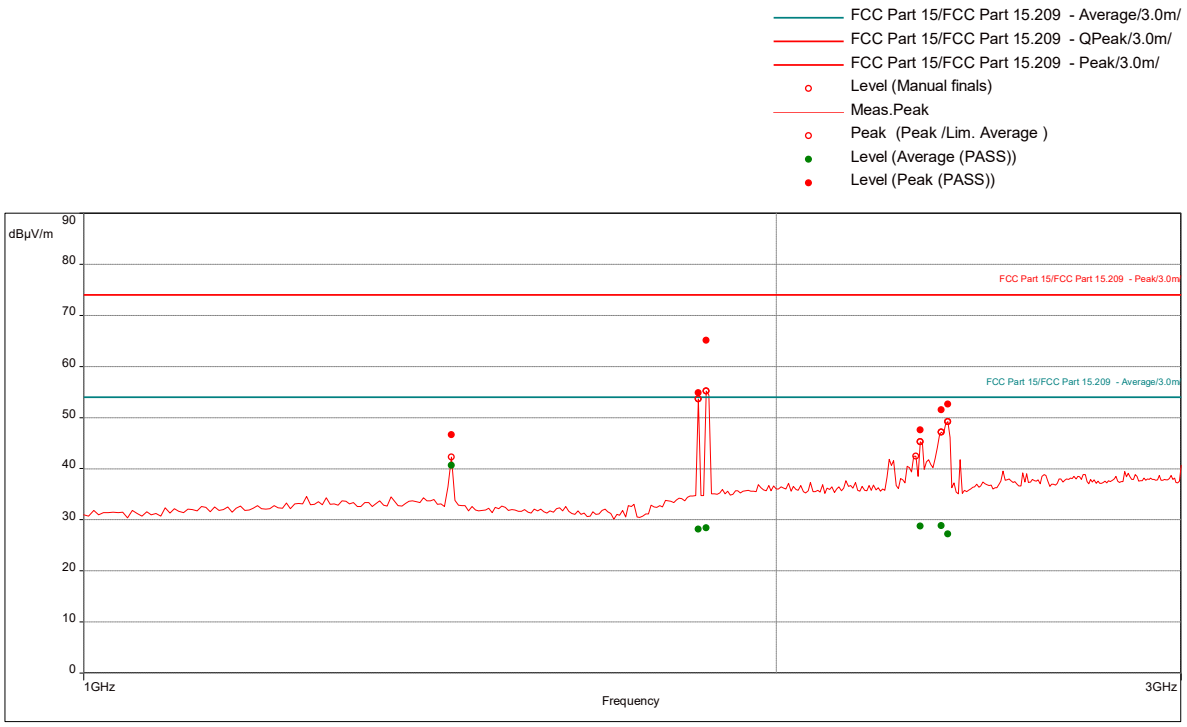
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
32.70526316	20.15	30.00	-9.85	230.00	2.47	Vertical	120000.00	-14.34
37.92631579	19.35	30.00	-10.65	99.00	1.14	Vertical	120000.00	-18.19
54.66315789	17.25	30.00	-12.75	105.00	2.64	Vertical	120000.00	-25.93
63.38947368	3.66	30.00	-26.34	327.00	1.14	Horizontal	120000.00	-25.39
238.2947368	7.61	36.00	-28.39	99.00	1.99	Horizontal	120000.00	-20.57
830.1789474	19.35	36.00	-16.65	120.00	1.08	Vertical	120000.00	-7.43

Transmit at Low Channel, 1-3 GHz

Test Information:

Date and Time	7/2/2021 6:30:29 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Upper Band: High Channel 25.16 GHz, 160 MHz BW, MCSO, att0.5mixer24, BT Tx Low CH_5GHz Tx CH157 80 MHz BW_1-3GHz 15.209

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	46.61	74.00	-27.39	0.00	1.60	Horizontal	1000000.00	-7.57
1851.052632	54.87	74.00	-19.13	312.00	1.06	Vertical	1000000.00	-4.73
1866.578947	65.15	74.00	-8.85	135.00	1.00	Horizontal	1000000.00	-4.72
2311.842105	47.56	74.00	-26.44	32.00	2.05	Horizontal	1000000.00	-4.00
2361.052632	51.50	74.00	-22.50	24.00	1.95	Horizontal	1000000.00	-3.82
2373.684211	52.64	74.00	-21.36	32.00	1.55	Horizontal	1000000.00	-3.76

Average (PASS) (6)

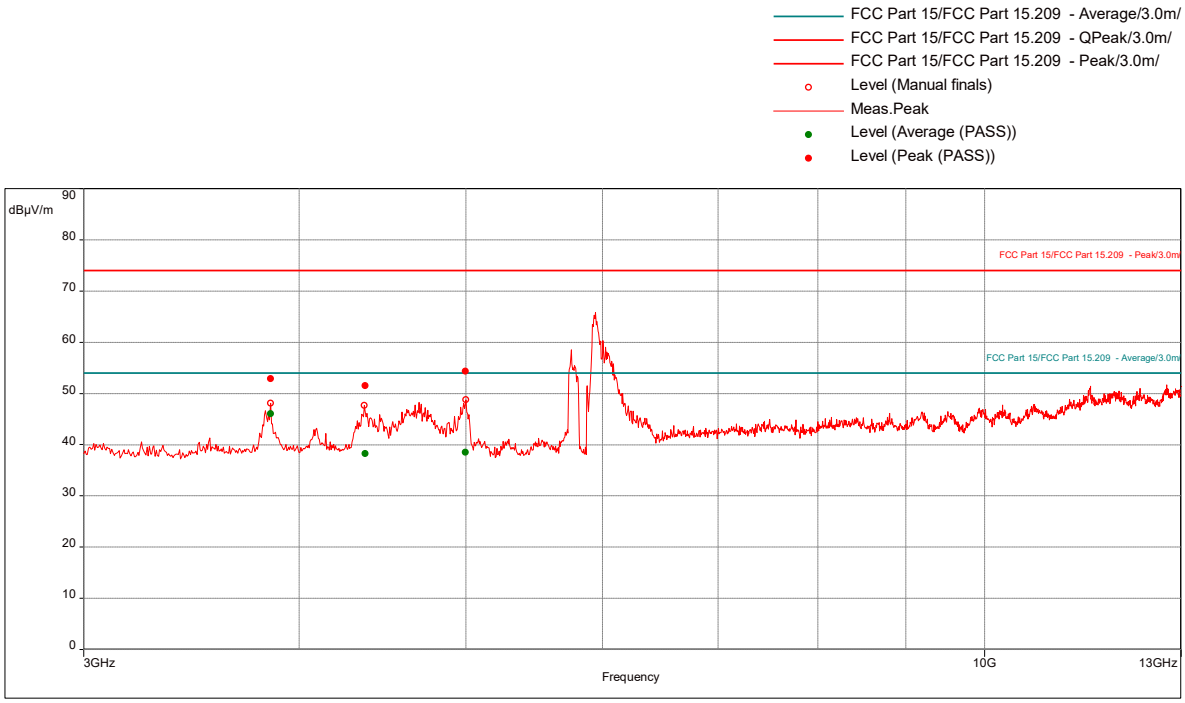
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	40.68	54.00	-13.32	0.00	1.60	Horizontal	1000000.00	-7.57
1851.052632	28.13	54.00	-25.87	312.00	1.06	Vertical	1000000.00	-4.73
1866.578947	28.44	54.00	-25.56	135.00	1.00	Horizontal	1000000.00	-4.72
2311.842105	28.74	54.00	-25.26	32.00	2.05	Horizontal	1000000.00	-4.00
2361.052632	28.81	54.00	-25.19	24.00	1.95	Horizontal	1000000.00	-3.82
2373.684211	27.25	54.00	-26.75	32.00	1.55	Horizontal	1000000.00	-3.76

Transmit at Low Channel, 3-26 GHz

Test Information:

Date and Time	7/2/2021 10:37:07 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Low Channel 24.34 GHz, 160 MHz BW, MCSO, att0.25mixer27, BT Tx Low CH_5GHz Tx CH157 80 MHz BW_3-13GHz Part 15.209

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3850	52.84	74.00	-21.16	359.00	2.30	Horizontal	1000000.00	-1.06
4368.947368	51.48	74.00	-22.52	314.00	1.25	Horizontal	1000000.00	-0.22
4996.842105	54.33	74.00	-19.67	343.00	1.85	Horizontal	1000000.00	1.14

Average (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3850	45.99	54.00	-8.01	359.00	2.30	Horizontal	1000000.00	-1.06
4368.947368	38.24	54.00	-15.76	314.00	1.25	Horizontal	1000000.00	-0.22
4996.842105	38.50	54.00	-15.50	343.00	1.85	Horizontal	1000000.00	1.14

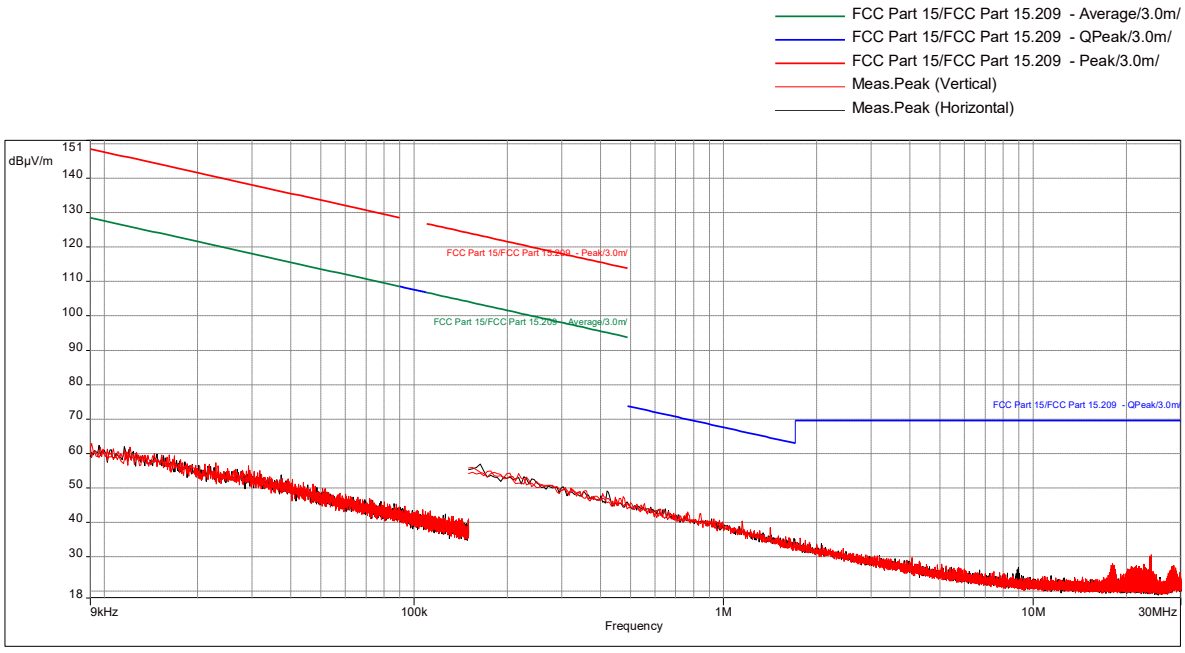
Big peaks were from the fundamental frequency. Manual scan was performed from 13-26 GHz, no emissions were detected above the measuring equipment noise floor.

Transmit at Mid Channel, 9kHz-30 MHz

Test Information:

Date and Time	7/1/2021 7:50:01 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Low Channel 24.35 GHz, 160 MHz BW, MCSO, att0.75mixer27, BT Tx Mid CH_5GHz Tx CH157 80 MHz BW_9kH-30MHz 15.209

Graph:



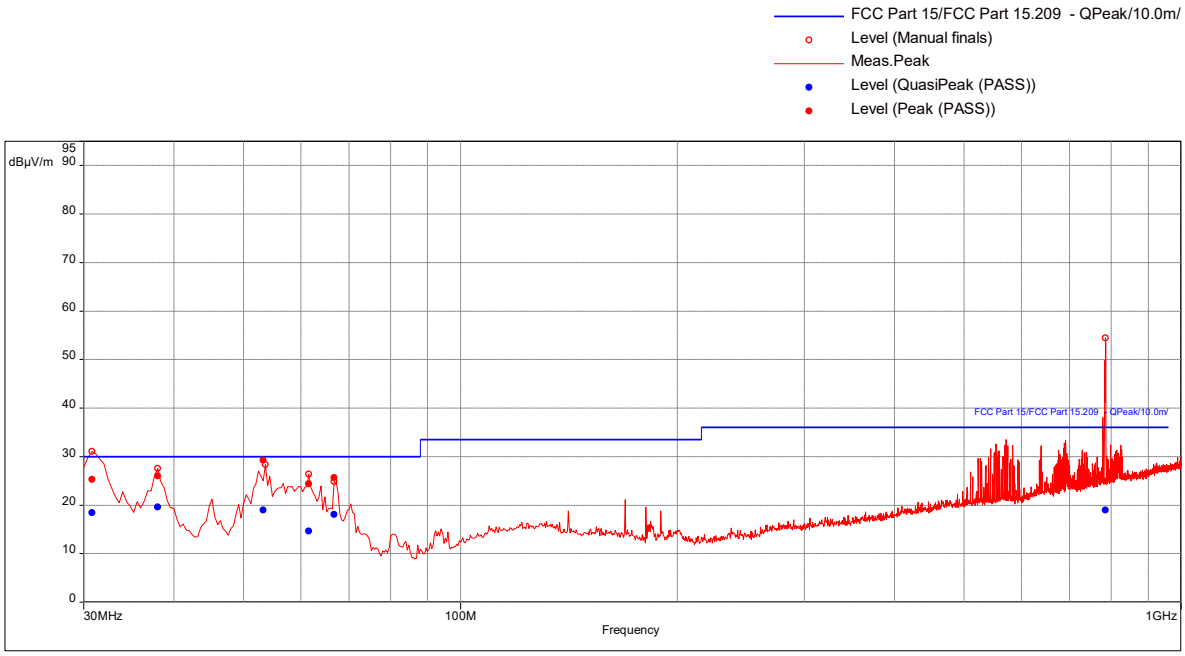
Results: No emissions were detected.

Transmit at Mid Channel, 30-1000 MHz

Test Information:

Date and Time	6/29/2021 6:26:24 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Mid Channel 24.35 GHz, 160 MHz BW, MCSO, att0.75-mixer27, BT Tx Mid CH_5GHz Tx CH157 80 MHz BW_30-1000MHz_FCC 15.209

Graph:



Results:

QuasiPeak (PASS) (6)

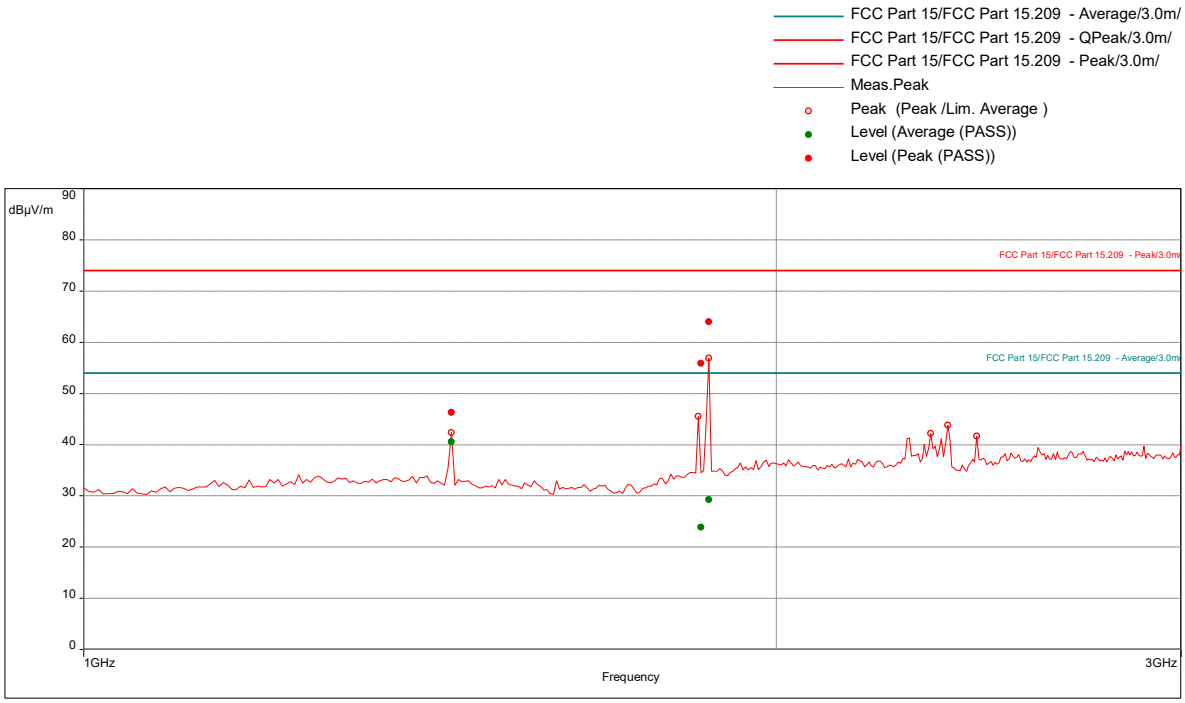
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.86315789	18.42	30.00	-11.58	359.00	1.69	Vertical	120000.00	-14.01
37.87368421	19.63	30.00	-10.37	314.00	2.61	Vertical	120000.00	-18.16
53.31578947	19.00	30.00	-11.00	10.00	2.53	Vertical	120000.00	-25.88
61.47368421	14.64	30.00	-15.36	306.00	2.82	Vertical	120000.00	-25.55
66.8	18.03	30.00	-11.97	0.00	1.00	Vertical	120000.00	-25.11
785.6	18.95	36.00	-17.05	54.00	2.35	Vertical	120000.00	-8.28

Transmit at Mid Channel, 1-3 GHz

Test Information:

Date and Time	7/2/2021 9:54:06 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Mid Channel 24.35 GHz, 160 MHz BW, MCSO, att0.75mixer27, BT Tx Mid CH_5GHz Tx CH157 80 MHz BW_1-3GHz 15.209

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	46.33	74.00	-27.67	0.00	2.70	Horizontal	1000000.00	-7.57
1852.631579	55.87	74.00	-18.13	239.00	3.79	Horizontal	1000000.00	-4.73
1867.894737	64.01	74.00	-9.99	98.00	3.10	Vertical	1000000.00	-4.72

Average (PASS) (3)

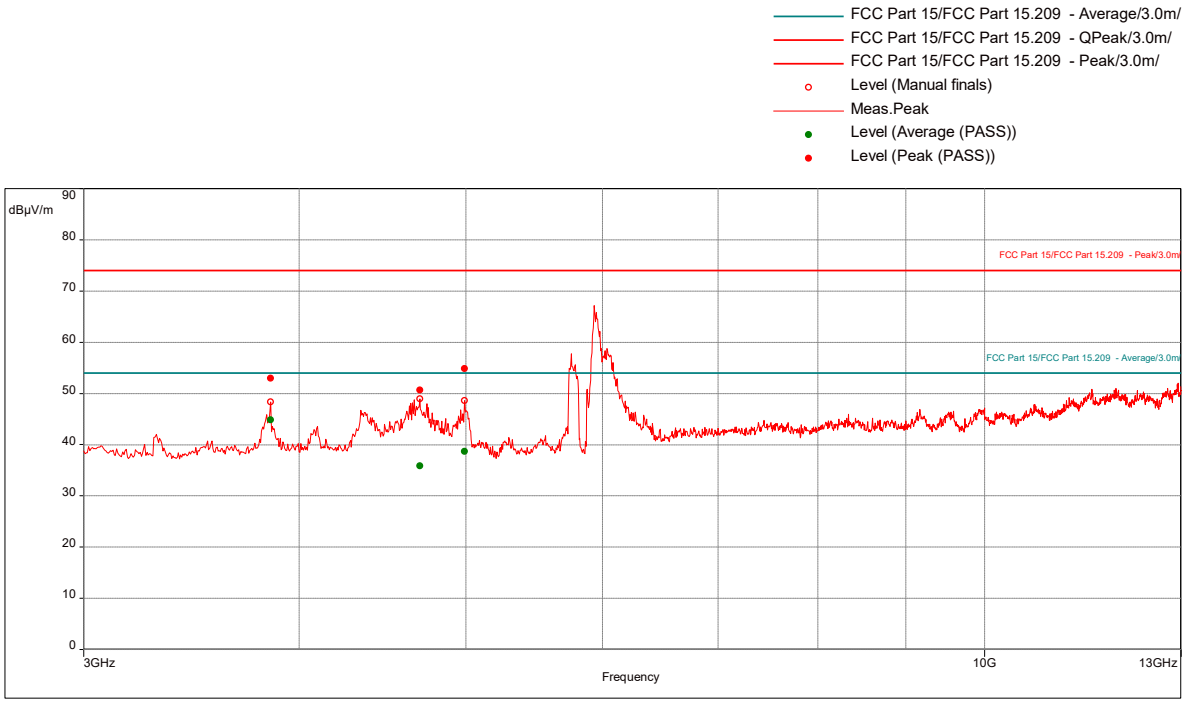
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	40.57	54.00	-13.43	0.00	2.70	Horizontal	1000000.00	-7.57
1852.631579	23.89	54.00	-30.11	239.00	3.79	Horizontal	1000000.00	-4.73
1867.894737	29.29	54.00	-24.71	98.00	3.10	Vertical	1000000.00	-4.72

Transmit at Mid Channel, 3-26 GHz

Test Information:

Date and Time	7/2/2021 10:13:29 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Mid Channel 24.35 GHz, 160 MHz BW, MCSO, att0.75mixer27, BT Tx Mid CH_5GHz Tx CH157 80 MHz BW_3-13GHz Part 15.209

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3849.736842	52.98	74.00	-21.02	0.00	2.30	Horizontal	1000000.00	-1.06
4699.736842	50.61	74.00	-23.39	311.00	1.35	Horizontal	1000000.00	0.37
4990	54.86	74.00	-19.14	341.00	1.90	Horizontal	1000000.00	1.10

Average (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3849.736842	44.81	54.00	-9.19	0.00	2.30	Horizontal	1000000.00	-1.06
4699.736842	35.88	54.00	-18.12	311.00	1.35	Horizontal	1000000.00	0.37
4990	38.64	54.00	-15.36	341.00	1.90	Horizontal	1000000.00	1.10

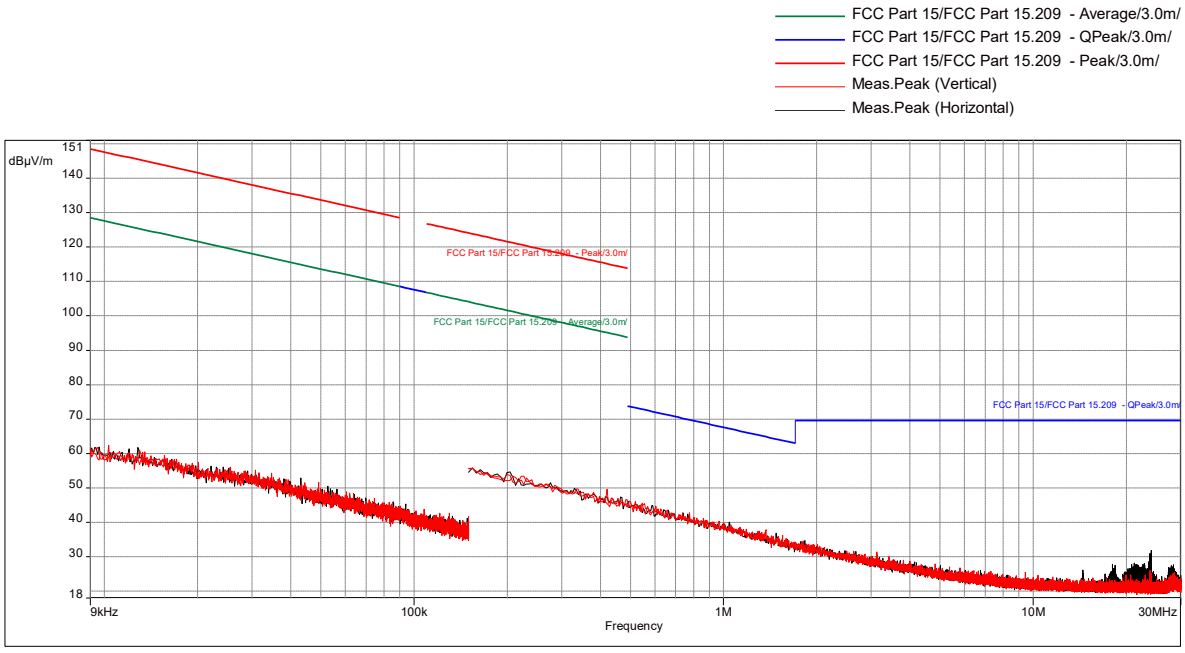
Big peaks were from the fundamental frequency. Manual scan was performed from 13-26 GHz, no emissions were detected above the measuring equipment noise floor.

Transmit at High Channel, 9kHz-30 MHz

Test Information:

Date and Time	7/1/2021 6:22:12 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: Low Channel 24.34 GHz, 160 MHz BW, MCSO, att0.25mixer27, BT Tx High CH_5GHz Tx CH157 80 MHz BW_9kH-30MHz 15.209

Graph:



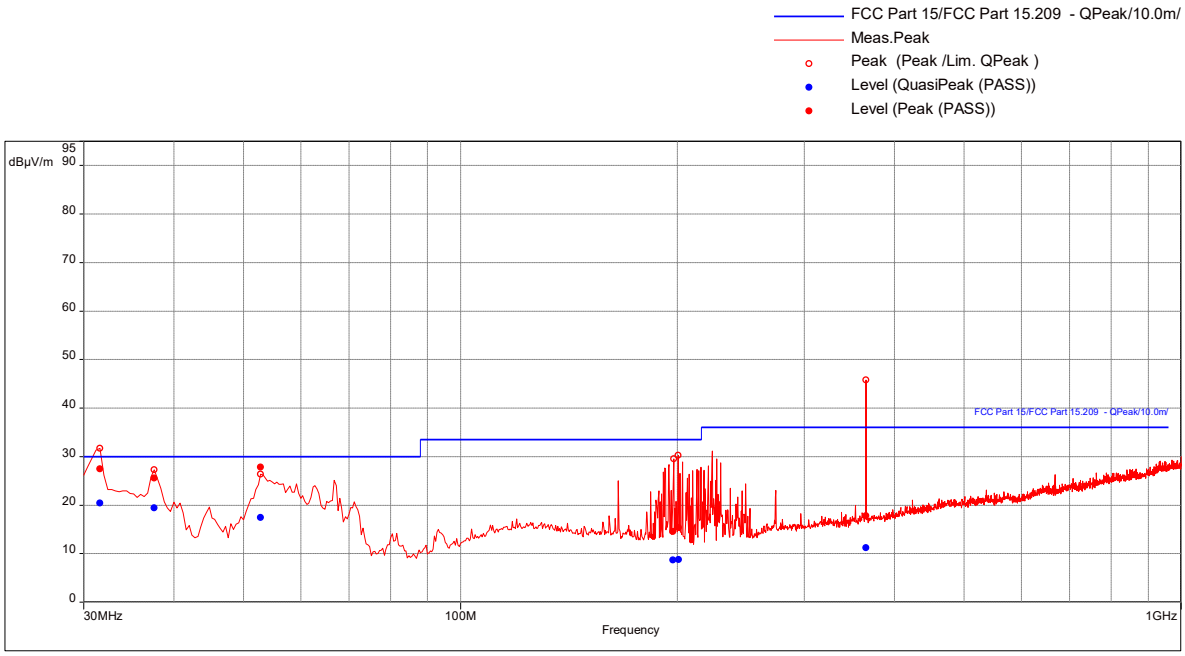
Results: No emissions were detected.

Transmit at High Channel, 30-1000 MHz

Test Information:

Date and Time	6/29/2021 8:04:33 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Upper Band: Low Channel 24.84 GHz, 160 MHz BW, MCSO, att0.75-mixer25, BT Tx High CH_5GHz Tx CH157 80 MHz BW_30-1000MHz_FCC 15.209

Graph:



Results:

QuasiPeak (PASS) (6)

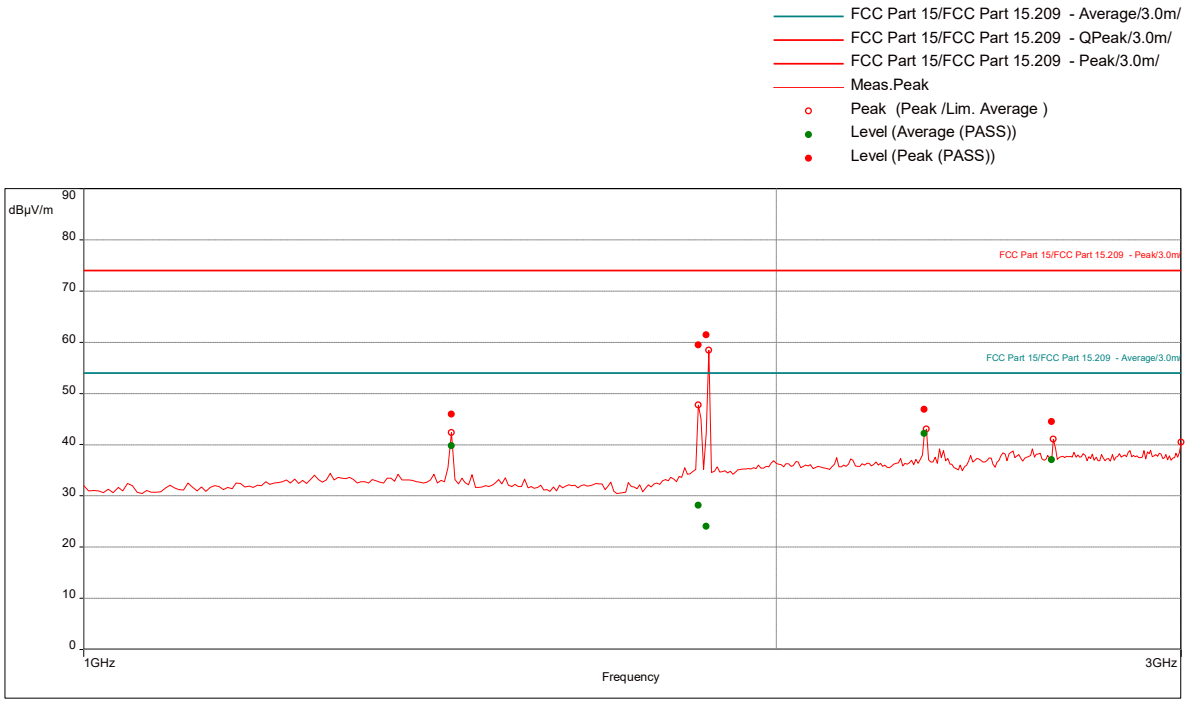
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
31.41052632	20.42	30.00	-9.58	306.00	1.45	Vertical	120000.00	-14.35
37.63157895	19.39	30.00	-10.61	0.00	2.72	Vertical	120000.00	-18.01
52.83157895	17.47	30.00	-12.53	289.00	2.80	Vertical	120000.00	-25.84
197.2842105	8.63	33.50	-24.87	1.00	1.99	Vertical	120000.00	-19.89
200.9052632	8.80	33.50	-24.70	217.00	1.95	Vertical	120000.00	-19.71
365.2947368	11.24	36.00	-24.76	78.00	3.19	Horizontal	120000.00	-16.71

Transmit at High Channel, 1-3 GHz

Test Information:

Date and Time	7/2/2021 9:50:13 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: High Channel 24.36 GHz, 160 MHz BW, MCSO, att0.5mixer27, BT Tx High CH_5GHz Tx CH157 80 MHz BW_1-3GHz 15.209

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	45.91	74.00	-28.09	357.00	1.55	Horizontal	1000000.00	-7.57
1851.052632	59.45	74.00	-14.55	298.00	1.85	Horizontal	1000000.00	-4.73
1867.368421	61.47	74.00	-12.53	261.00	3.45	Vertical	1000000.00	-4.72
2322.368421	46.87	74.00	-27.13	25.00	1.55	Horizontal	1000000.00	-3.96
2637.368421	44.49	74.00	-29.51	333.00	1.85	Horizontal	1000000.00	-3.05

Average (PASS) (5)

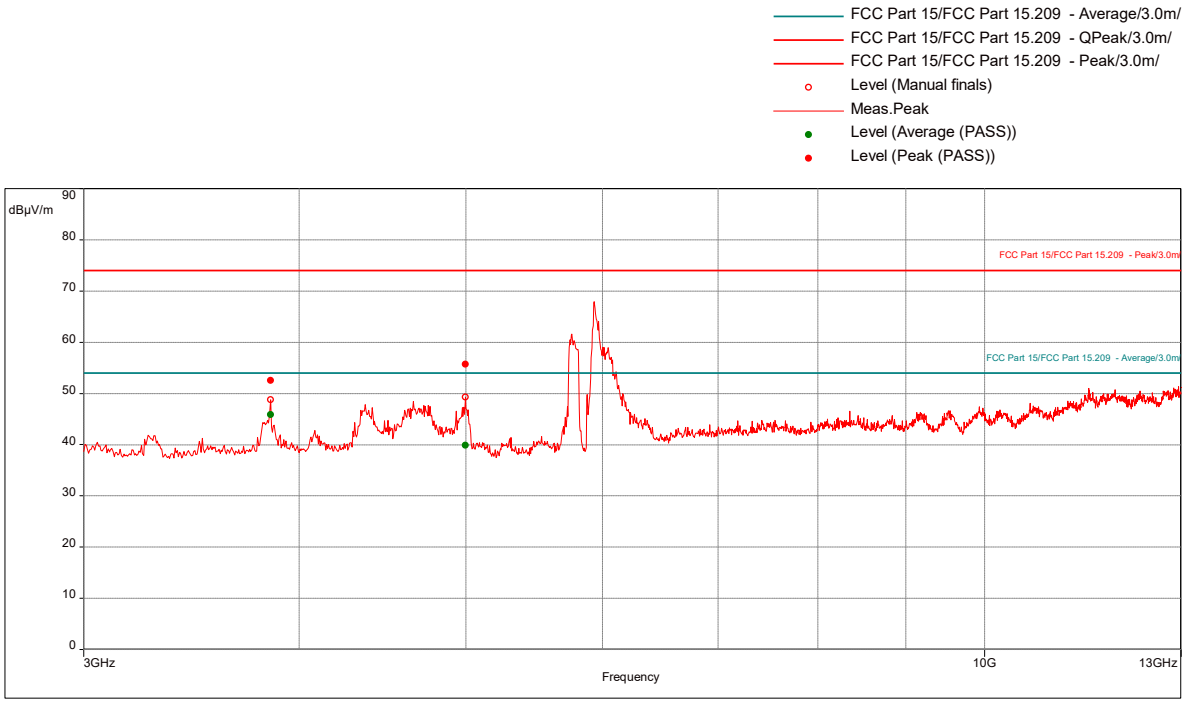
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	39.81	54.00	-14.19	357.00	1.55	Horizontal	1000000.00	-7.57
1851.052632	28.17	54.00	-25.83	298.00	1.85	Horizontal	1000000.00	-4.73
1867.368421	24.07	54.00	-29.93	261.00	3.45	Vertical	1000000.00	-4.72
2322.368421	42.20	54.00	-11.80	25.00	1.55	Horizontal	1000000.00	-3.96
2637.368421	37.05	54.00	-16.95	333.00	1.85	Horizontal	1000000.00	-3.05

Transmit at High Channel, 3-26 GHz

Test Information:

Date and Time	7/2/2021 9:10:25 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	29 deg C
Humidity	41%
Atmospheric Pressure	1009mbar
Comments	Comet 24, Lower Band: High Channel 24.36 GHz, 160 MHz BW, MCSO, att0.5mixer27, BT Tx High CH_5GHz Tx CH157 80 MHz BW_3-13GHz 15.209

Graph:



Results:

Peak (PASS) (2)

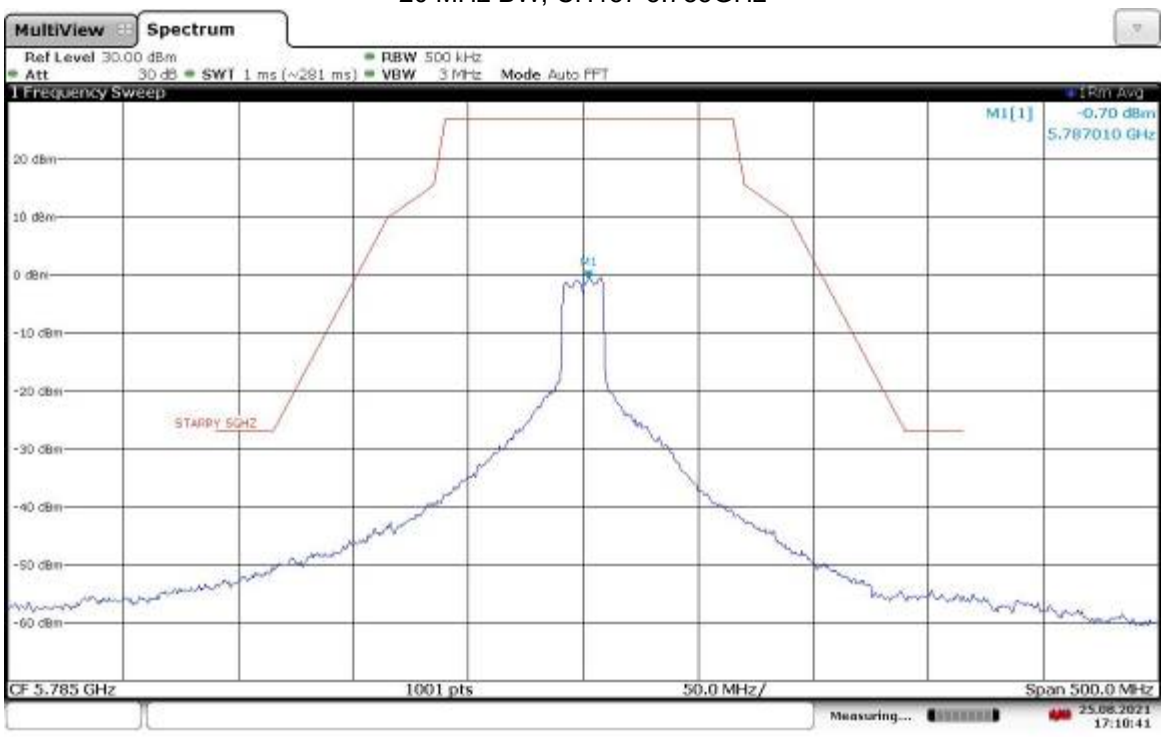
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3850	52.56	74.00	-21.44	0.00	1.75	Horizontal	1000000.00	-1.06
4995.526316	55.74	74.00	-18.26	341.00	1.95	Horizontal	1000000.00	1.13

Average (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3850	45.86	54.00	-8.14	0.00	1.75	Horizontal	1000000.00	-1.06
4995.526316	39.85	54.00	-14.15	341.00	1.95	Horizontal	1000000.00	1.13

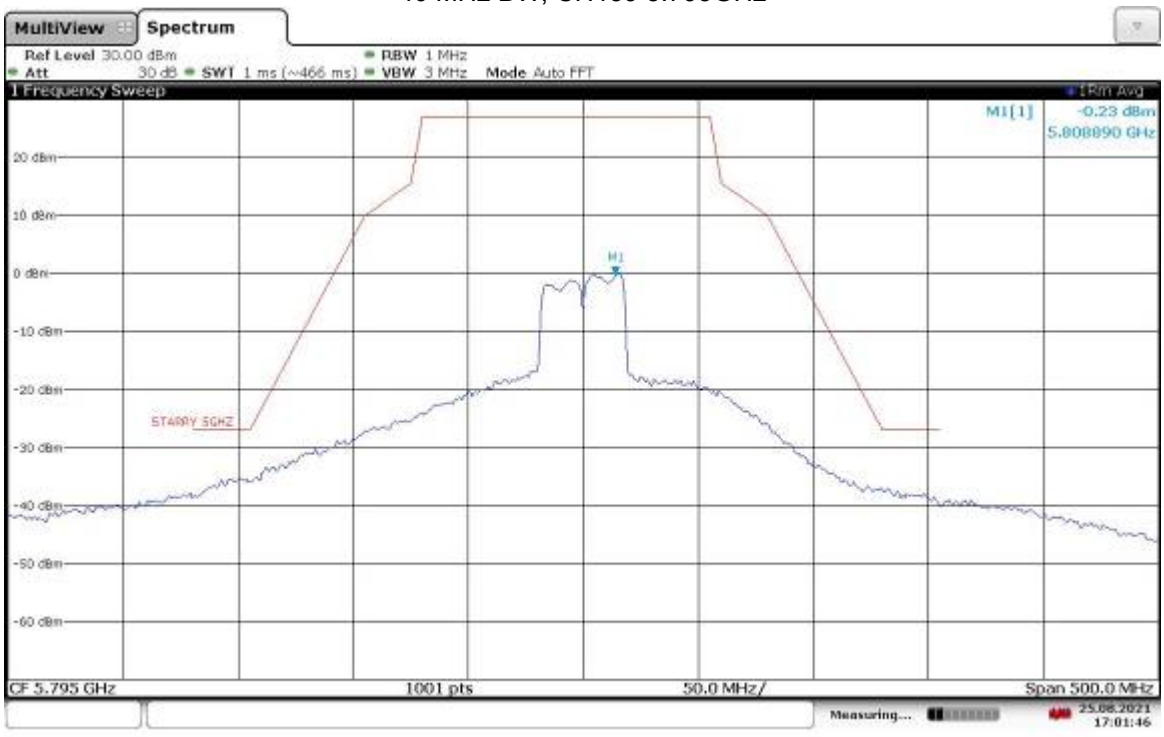
Big peaks were from the fundamental frequency. Manual scan was performed from 13-26GHz, no emissions were detected above the measuring equipment noise floor.

Band edge compliance
20 MHz BW, CH157 5.785GHz



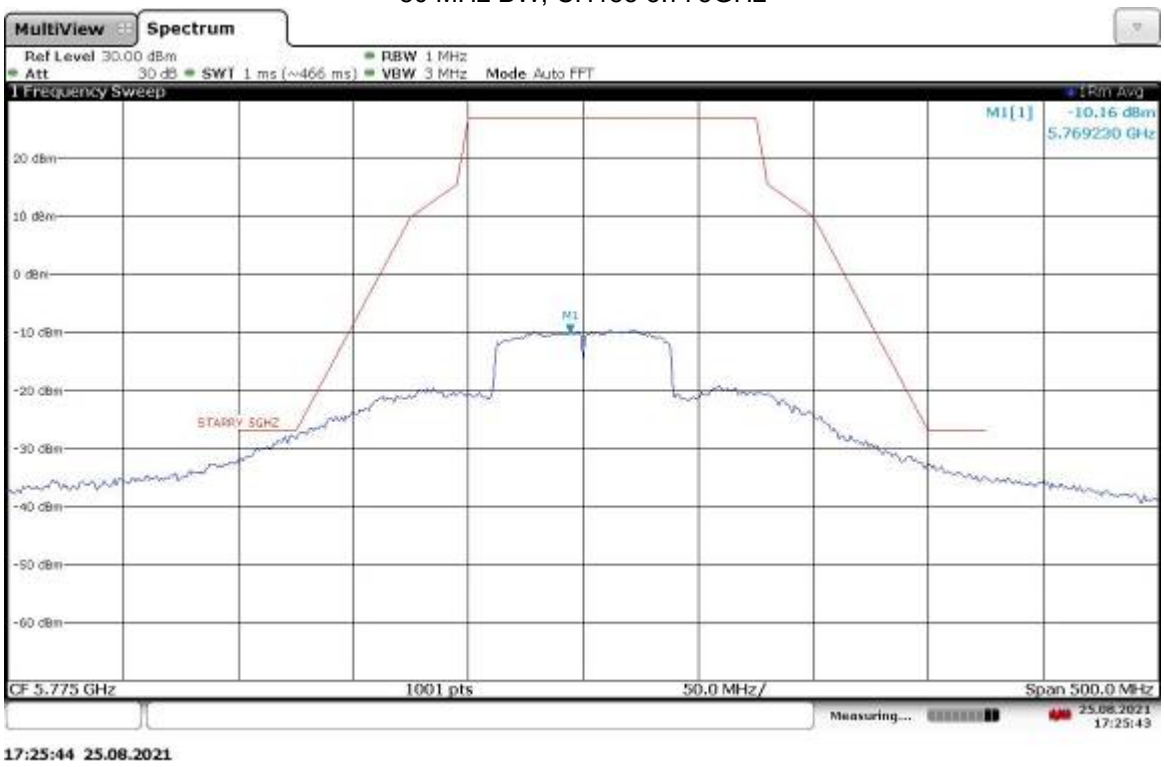
17:10:41 25.08.2021

40 MHz BW, CH159 5.795GHz



17:01:46 25.08.2021

80 MHz BW, CH155 5.775GHz



Test Personnel:	Vathana Ven VSV	Test Date:	06/25/2021, 06/29/2021, 07/01/2021, 07/02/2021, 08/25/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.407	Limit Applied:	See report section 9.3
Input Voltage:	48 VDC Via External P/S	Ambient Temperature:	24, 29, 29, 29 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	41, 41, 41, 41 %
		Atmospheric Pressure:	1009, 1009, 1009, 1009 mbars

Deviations, Additions, or Exclusions: None

10 Digital Device and Receiver Radiated Spurious Emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart Band ANSI C 63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

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

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/20/2021	03/20/2022
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/09/2021	06/09/2022
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/21/2020	09/21/2021
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/22/2021	06/22/2022
HS003'	10m under floor cable	Huber-Schuner	10m-1	HS003	02/17/2021	02/17/2022
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	07/13/2020	07/13/2021
IW001'	Receiver to floor cable	Insulated Wire	2801-NPS	001	10/07/2020	10/07/2021
IW006'	Pre-amp to antenna cable	Insulated Wire	2800-NPS	IW006	11/25/2020	11/25/2021
IW003'	8.4 meter cable	Insulated Wire	2800-NPS	003	10/08/2020	10/08/2021
PRE12'	Pre-amp, 1-18GHz	Com-Power	PAM-118A	18040117	12/07/2020	12/07/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/03/2020	08/03/2021
HS003'	10m under floor cable	Huber + Suhner	10m-1	HS003	02/17/2021	02/17/2022
IW002'	2 meter Armored cable	Insulated Wire	2800-NPS	002	09/23/2020	09/23/2021
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/19/2021	02/19/2022
REA008'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/22/2020	07/22/2021
PRE8'	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	11/25/2020	11/25/2021
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021
REA009'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/22/2020	07/22/2021
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	01/28/2021	01/28/2022

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16

10.3 Results:

The sample tested was found to Comply.

§15.109 Radiated emission limits.

The field strength of radiated emissions form unintentional radiators at a distance of 3 meters shall not exceed the following values.

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBµV/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

10.4 Setup Photographs:

Confidential – Photo not included in this report

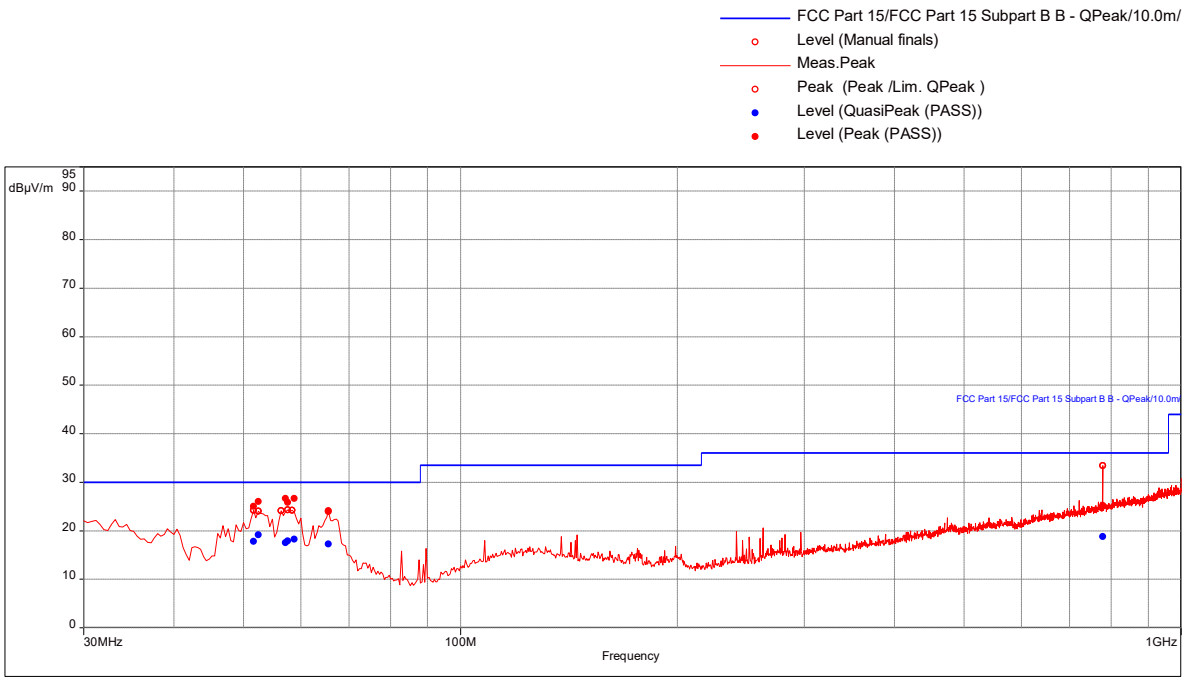
10.5 Plots/Data:

30-1000 MHz

Test Information:

Date and Time	7/13/2021 9:10:45 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	43%
Atmospheric Pressure	1016mbar
Comments	RE 30-1000MHz_Radio in normal operating mode

Graph:



Results:

Peak (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
51.72631579	25.05	30.00	-4.95	164.00	2.29	Vertical	120000.00	-25.72
52.58947368	26.04	30.00	-3.96	261.00	1.57	Vertical	120000.00	-25.82
57	26.61	30.00	-3.39	201.00	2.58	Vertical	120000.00	-25.90
57.53684211	25.86	30.00	-4.14	98.00	3.12	Vertical	120000.00	-25.84
58.68421053	26.67	30.00	-3.33	359.00	2.69	Vertical	120000.00	-25.78
65.6	24.11	30.00	-5.89	84.00	1.91	Vertical	120000.00	-25.20
777.8736842	25.18	36.00	-10.82	158.00	1.59	Vertical	120000.00	-8.42

QuasiPeak (PASS) (7)

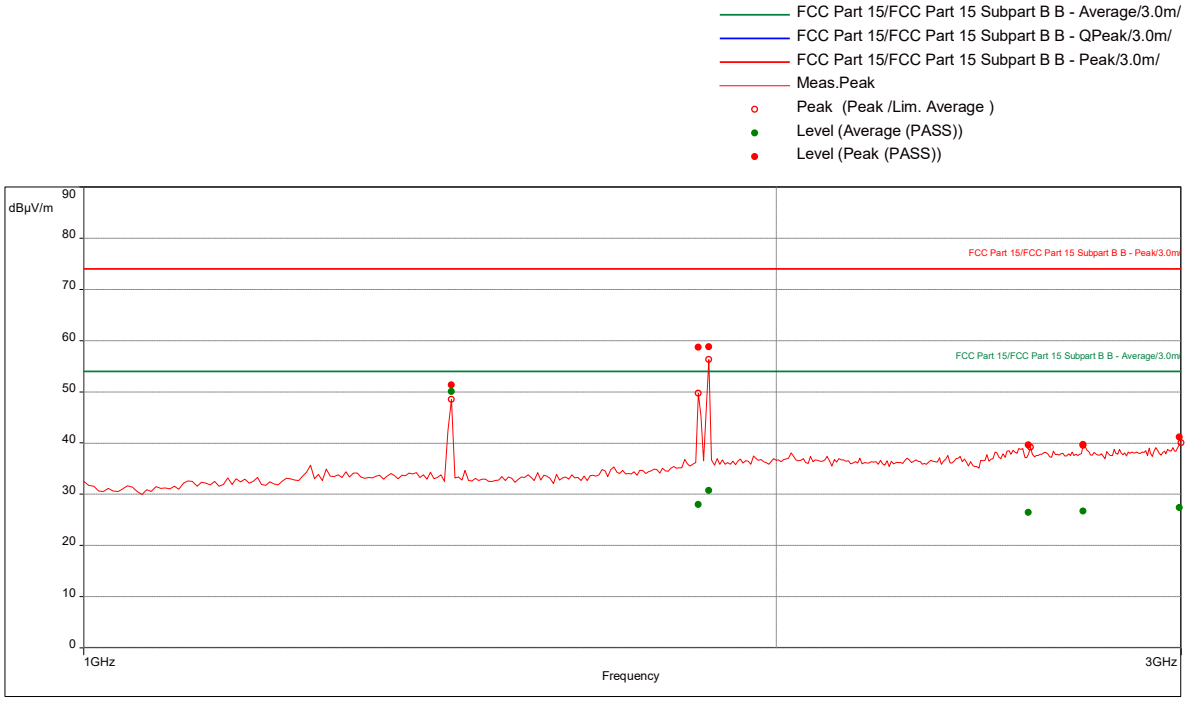
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
51.72631579	17.80	30.00	-12.20	164.00	2.29	Vertical	120000.00	-25.72
52.58947368	19.19	30.00	-10.81	261.00	1.57	Vertical	120000.00	-25.82
57	17.49	30.00	-12.51	201.00	2.58	Vertical	120000.00	-25.90
57.53684211	17.89	30.00	-12.11	98.00	3.12	Vertical	120000.00	-25.84
58.68421053	18.22	30.00	-11.78	359.00	2.69	Vertical	120000.00	-25.78
65.6	17.23	30.00	-12.77	84.00	1.91	Vertical	120000.00	-25.20
777.8736842	18.82	36.00	-17.18	158.00	1.59	Vertical	120000.00	-8.42

1-3 GHz

Test Information:

Date and Time	7/13/2021 8:29:15 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	43%
Atmospheric Pressure	1016mbar
Comments	RE 1 to 3 GHz_Radio in normal operating mode

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	51.37	74.00	-22.63	0.00	1.85	Horizontal	1000000.00	-7.57
1851.052632	58.67	74.00	-15.33	239.00	2.75	Vertical	1000000.00	-4.73
1868.157895	58.81	74.00	-15.19	83.00	2.75	Horizontal	1000000.00	-4.72
2576.578947	39.65	74.00	-34.35	61.00	2.75	Vertical	1000000.00	-3.21
2717.631579	39.71	74.00	-34.29	142.00	1.20	Horizontal	1000000.00	-3.02
2995.526316	41.14	74.00	-32.86	165.00	3.20	Horizontal	1000000.00	-2.27

Average (PASS) (6)

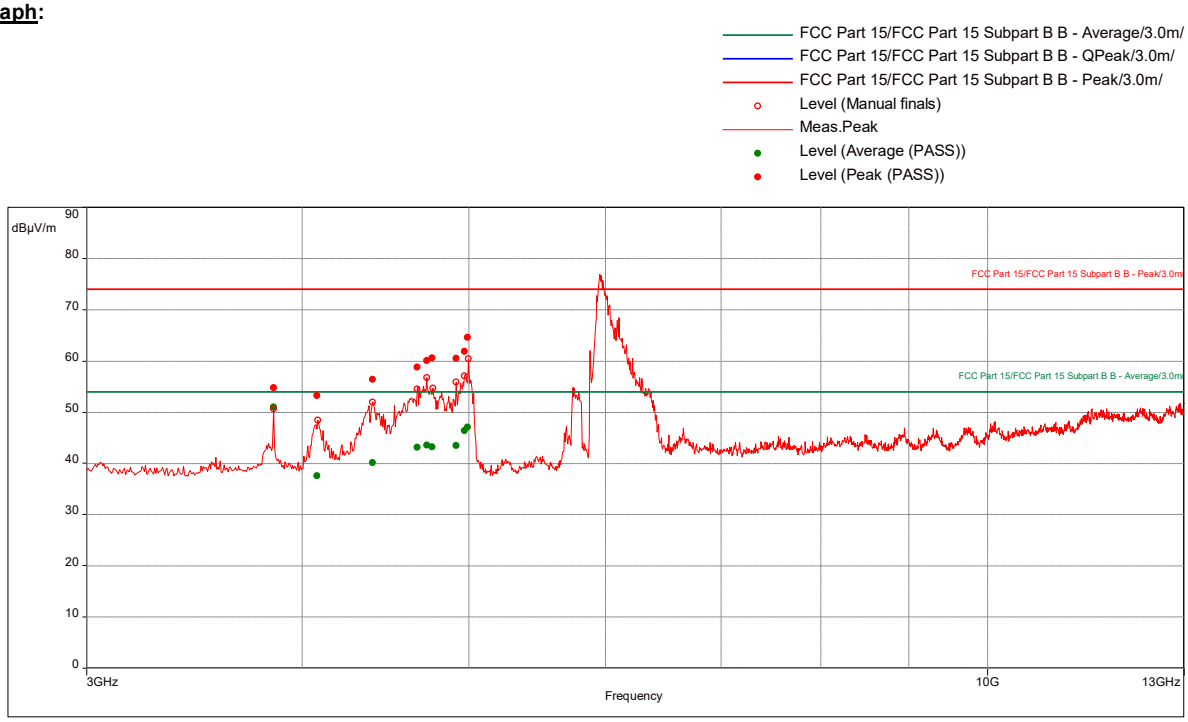
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1443.684211	50.04	54.00	-3.96	0.00	1.85	Horizontal	1000000.00	-7.57
1851.052632	27.97	54.00	-26.03	239.00	2.75	Vertical	1000000.00	-4.73
1868.157895	30.70	54.00	-23.30	83.00	2.75	Horizontal	1000000.00	-4.72
2576.578947	26.42	54.00	-27.58	61.00	2.75	Vertical	1000000.00	-3.21
2717.631579	26.66	54.00	-27.34	142.00	1.20	Horizontal	1000000.00	-3.02
2995.526316	27.37	54.00	-26.63	165.00	3.20	Horizontal	1000000.00	-2.27

3-13 GHz

Test Information:

Date and Time	7/13/2021 7:33:57 PM
Client and Project Number	Starry
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	43%
Atmospheric Pressure	1016mbar
Comments	RE 3 to 13 GHz_Radio in normal operating mode

Graph:



Results:

Peak (PASS) (9)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3850	54.80	74.00	-19.20	0.00	1.95	Horizontal	1000000.00	-1.06
4080.263158	53.23	74.00	-20.77	1.00	1.60	Horizontal	1000000.00	-0.95
4395	56.38	74.00	-17.62	320.00	1.00	Horizontal	1000000.00	-0.16
4665.526316	58.81	74.00	-15.19	319.00	1.50	Horizontal	1000000.00	0.48
4723.684211	60.02	74.00	-13.98	321.00	1.30	Horizontal	1000000.00	0.42
4761.842105	60.60	74.00	-13.40	342.00	1.80	Horizontal	1000000.00	0.54
4913.421053	60.46	74.00	-13.54	342.00	1.40	Horizontal	1000000.00	0.76
4971.315789	61.90	74.00	-12.10	342.00	1.85	Horizontal	1000000.00	1.02
4990.526316	64.64	74.00	-9.36	342.00	1.65	Horizontal	1000000.00	1.11

Average (PASS) (9)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
3850	50.97	54.00	-3.03	0.00	1.95	Horizontal	1000000.00	-1.06
4080.263158	37.59	54.00	-16.41	1.00	1.60	Horizontal	1000000.00	-0.95
4395	40.11	54.00	-13.89	320.00	1.00	Horizontal	1000000.00	-0.16
4665.526316	43.13	54.00	-10.87	319.00	1.50	Horizontal	1000000.00	0.48
4723.684211	43.55	54.00	-10.45	321.00	1.30	Horizontal	1000000.00	0.42
4761.842105	43.19	54.00	-10.81	342.00	1.80	Horizontal	1000000.00	0.54
4913.421053	43.48	54.00	-10.52	342.00	1.40	Horizontal	1000000.00	0.76
4971.315789	46.34	54.00	-7.66	342.00	1.85	Horizontal	1000000.00	1.02
4990.526316	47.05	54.00	-6.95	342.00	1.65	Horizontal	1000000.00	1.11

Note: Big peak was from the 5G radio.

Test Personnel: Vathana F. Ven VFV Test Date: 07/13/2021

Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B,	Limit Applied:	See report section 10.3
Input Voltage:	48 VDC Via External P/S	Ambient Temperature:	24 ºC
Pretest Verification w/ Ambient Signals or BB Source:	BB Source	Relative Humidity:	43 %
		Atmospheric Pressure:	1016 mbars

Deviations, Additions, or Exclusions: None

11 AC Mains Conducted Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B and ANSI C 63.4.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	1.2 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.8 dB	5.0dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “TF” is the LISN or ISN Correction Factor; “PA+CL” are Attenuator and Cable Loss. These are already accounted for in the “Level” column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
LISN32'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191955	05/01/2021	05/01/2022
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	06/24/2021	06/24/2022
MIN001'	10dB Attenuator	Mini-Circuits	CAT-10	MIN001	10/30/2020	10/30/2021
CBL2014-1'	RG58C/U, BNC (M)	Pomona	2249-C-180	CBL2014-1	02/04/2021	02/04/2022
147275'	Signal Generator	Rohde & Schwarz	SML01	100931	07/20/2020	07/20/2021
147239'	Digital Multimeter (Full Color)	Fluke	187	89300561	02/06/2021	02/06/2022

Software Utilized:

Name	Manufacturer	Version
Compliance 5	Teseq	5.26.46.46

11.3 Results:

The sample tested was found to Comply.

§15.207 Conducted limits.

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

11.4 Setup Photographs:

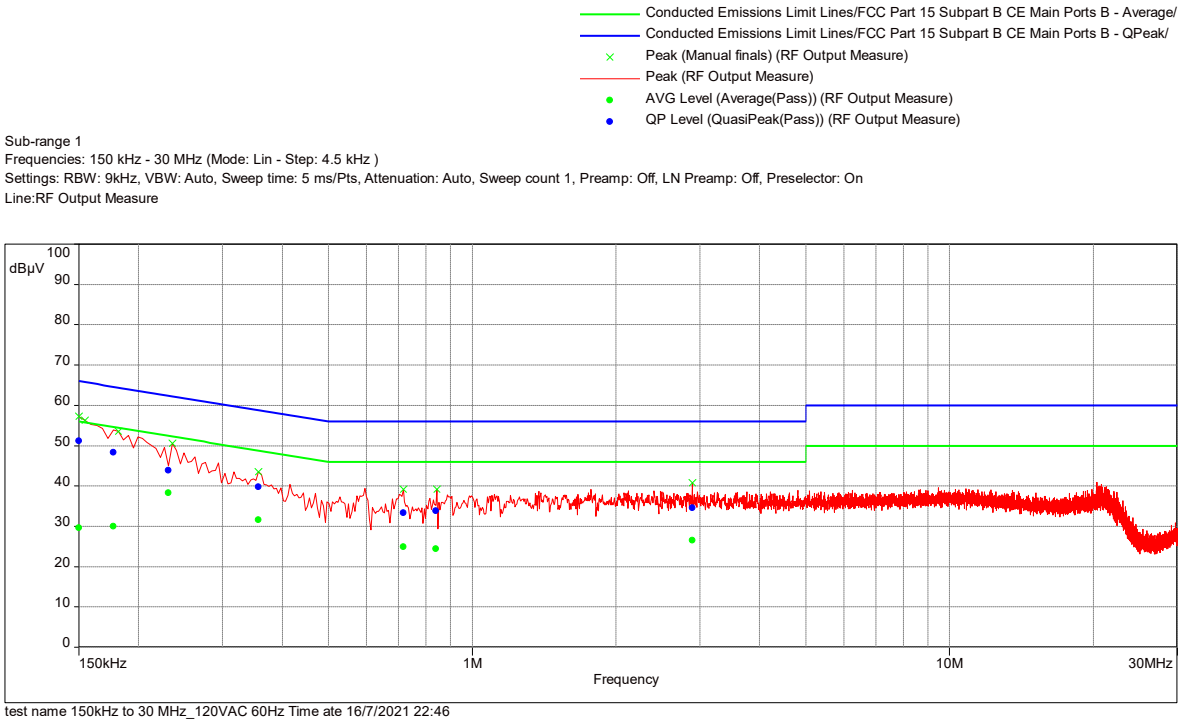
Confidential – Photo not included in this report

11.5 Plots/Data:

Test Information:

Date and Time	7/16/2021 10:37:15 PM
Client and Project Number	Starry_G104723800_G104749253
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	59%
Atmospheric Pressure	1005mbars
Comments	150kHz to 30 MHz_120VAC 60Hz

Graph:



Results:

QuasiPeak(Pass) (7)

Frequency (MHz)	SR	QP Level (dBµV)	QP Limit (dBuV)	QP Margin (dB)	Line	RBW	Meas.Time	Correction (dB)
0.1515	1	51.19	66.00	-14.81	Neutral	9k	0.01	20.28
0.1785	1	48.33	64.63	-16.29	Phase 1	9k	0.01	20.19
0.232	1	43.90	62.41	-18.51	Phase 1	9k	0.01	20.18
0.3565	1	39.84	58.80	-18.96	Neutral	9k	0.01	20.21
0.7165	1	33.37	56.00	-22.63	Neutral	9k	0.01	20.20
0.838	1	33.88	56.00	-22.12	Neutral	9k	0.01	20.21
2.8885	1	34.56	56.00	-21.44	Neutral	9k	0.01	20.30

Average(Pass) (7)

Frequency (MHz)	SR	AVG Level (dBµV)	AVG Limit (dBuV)	AVG Margin (dB)	Line	RBW	Meas.Time	Correction (dB)
0.1515	1	29.57	56.00	-26.43	Neutral	9k	0.01	20.28
0.1785	1	29.96	54.63	-24.67	Phase 1	9k	0.01	20.19
0.232	1	38.30	52.41	-14.12	Phase 1	9k	0.01	20.18
0.3565	1	31.59	48.80	-17.21	Neutral	9k	0.01	20.21
0.7165	1	24.89	46.00	-21.11	Neutral	9k	0.01	20.20
0.838	1	24.36	46.00	-21.64	Neutral	9k	0.01	20.21
2.8885	1	26.52	46.00	-19.48	Neutral	9k	0.01	20.30

Test Personnel:	Vathana Ven VSV	Test Date:	07/16/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15 Subpart B,	Limit Applied:	Class B
Input Voltage:	48 VDC Via External P/S		
Pretest Verification w/ Ambient Signals or BB Source:	BB Source	Ambient Temperature:	21 ºC
		Relative Humidity:	59 %
		Atmospheric Pressure:	1005 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	10/29/2021	104749253BOX-001	VFV	KPS	Original Issue
1	11/08/2021	104749253BOX-001	VFV	KPS	Removed test setup photos
2	11/10/2021	104749253BOX-001	VFV	KPS	Fixed model number on page 5 and modulation type on page 6
3	1/06/2022	104749253BOX-001	VFV	KPS	Removed photos in §10.4 and made editorial changes