

STARRY, INC.

TEST REPORT

SCOPE OF WORK

Emissions Testing on S01311 (2.4 GHz Bluetooth Low Energy)

REPORT NUMBER

104749253BOX-001

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EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 104749253BOX-001

Project Number: G104749253

Report Issue Date: 01/25/2022

Model(s) Tested: S01311 (2.4 GHz Bluetooth Low Energy)

Model(s) Partially Tested: None

Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15.247 Subpart C: 07/2021,
CFR47 FCC Part 15 Subpart B: 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

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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 Subpart C:07/2021, Section 15.247 (b)(3)	Pass
7	6 dB (DTS) Bandwidth and Occupied Bandwidth CFR47 FCC Part 15 Subpart C: 07/2021, Section 15.247 (a)(2)	Pass
8	Maximum Power Spectral Density CFR47 FCC Part 15 Subpart C: 07/2021, Section 15.247 (e)	Pass
9	Band Edge Compliance CFR47 FCC Part 15 Subpart C: 07/2021, Section 15.247 (d)	Pass
10	Transmitter spurious emissions CFR47 FCC Part 15 Subpart C: 07/2021, Section 15.247 (d)	Pass
11	Digital Device and Receiver Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 07/2021,	Pass
12	AC Mains Conducted Emissions FCC 47CFR Part 15.107: 07/2021	Pass
13	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
Point to Point Radio with BLE module	Starry, Inc.	S01311	2123000009

Receive Date:	07/01/2021, 01/11/2022
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)	
Multipoint Radio operating with BLE module	

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

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	The EUT was set to transmit continuously at Low, Mid, and High channels 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)	2402-2480 MHz
Modulation Type(s)	GFSK
Maximum Output Power	Low Channel (2402 MHz): 9.02 dBm (Conducted) Mid Channel (2440 MHz): 8.85 dBm (Conducted) High Channel (2480 MHz): 8.65 dBm (Conducted)
Test Channels	Low Channel (2402 MHz) Mid Channel (2440 MHz) High Channel (2480 MHz)
Occupied Bandwidth	Low Channel (2402 MHz): 1.03 MHz Mid Channel (2440 MHz): 1.03 MHz High Channel (2480 MHz): 1.03 MHz
6 dB (DTS) Bandwidth	Low Channel (2402 MHz): 699.30 kHz Mid Channel (2440 MHz): 739.30 kHz High Channel (2480 MHz): 689.30 kHz
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
Antenna Type and Gain	Integrated, 1.1 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

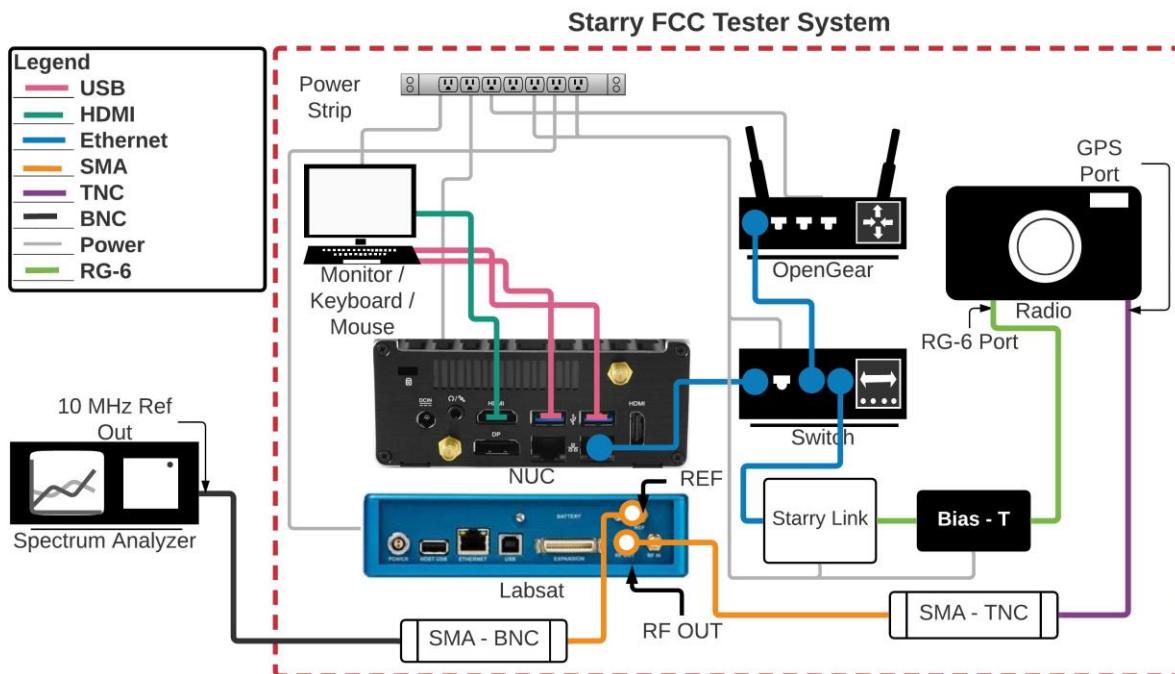
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	None	--	--	--	--

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 FCC Part 15 Subpart C 15.247: 09/2021, FCC Part 15 Subpart B: 09/2021, ANSI C 63.10: 2013, ANSI C 63.4: 2014, and KDB 558074 D01 15.247 Meas Guidance v05r02.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, ANSI C63.10 Section 11.9.1.1, and KDB 558074 D01.

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 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.

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 $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

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 $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V}/20)} = 39.8 \mu\text{V}/\text{m}$$

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
CEN001	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
CBLSHF204'	Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5)	Huber + Suhner	Sucoflex 102EA	234714001	02/03/2021	02/03/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwartz	FSW43	100646	11/02/2021	11/02/2022

Software Utilized:

Name	Manufacturer	Version
None	--	--

6.3 Results:

The sample tested was found to Comply.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm.

Frequency (MHz)	Ant. Gain (dBi)	Conducted Output Power (dBm)	EIRP Output Power (dBm)	Conducted Output Power Limit (dBm)	Conducted Output Power Margin (dB)
2402	1.1	7.92	9.02	30	-20.98
2440	1.1	7.75	8.85	30	-21.15
2480	1.1	7.55	8.65	30	-21.35

6.4 Setup Photographs:

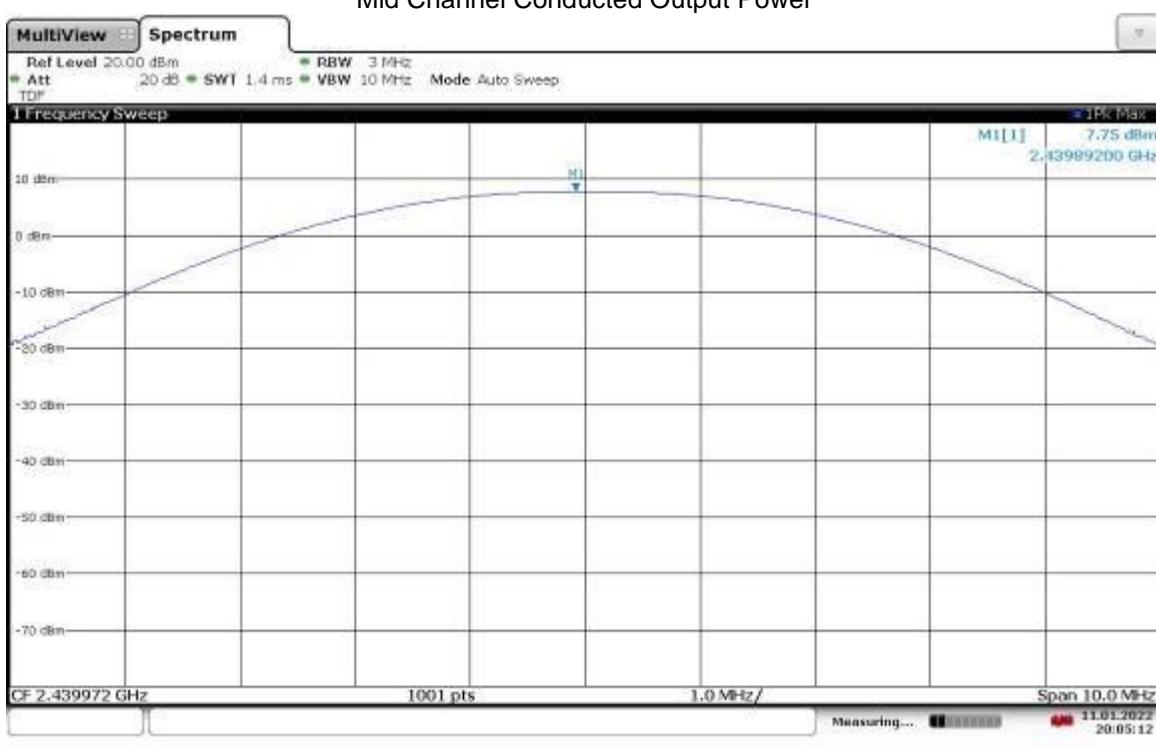
Confidential – Photo not included in this report

6.5 Test Data:

Low Channel Conducted Output Power



Mid Channel Conducted Output Power



Notes: The cable loss and attenuator were compensated internally as transducer factor.

High Channel Conducted Output Power



Notes: The cable loss and attenuator were compensated internally as transducer factor.

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	81.4	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.

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

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

$$\text{Conducted Power}_{\text{mW}} = 10^{\text{Conducted Power (dBm)/10}}$$

$$\text{Power Density} = (\text{Conducted Power}_{\text{mW}} \times \text{C} \times \text{Ant. Gain}) / (4\pi \times (20_{\text{cm}})^2)$$

Results:

$$\text{Maximum EIRP} = 9.02 \text{ dBm or } 7.98 \text{ mW}$$

$$\text{Power Density} = 7.98/5025.6$$

$$\text{Power Density} = 0.001588 \text{ mW/cm}^2$$

$$\text{Limit at } 2.403 \text{ GHz} = 1 \text{ mW/cm}^2$$

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

Test Personnel: Vathana Ven
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: CFR47 FCC Part 15.247
Input Voltage: 48 VDC Via External P/S
Pretest Verification w/
Ambient Signals or
BB Source: N/A

Test Date: 01/11/2022
Limit Applied: See report section 6.3
Ambient Temperature: 24 °C
Relative Humidity: 8 %
Atmospheric Pressure: 1022 mbars

Deviations, Additions, or Exclusions: None

7 6 dB (DTS) Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, ANSI C63.10 Section 11.8.1, and KDB 558074 D01.

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
CEN001	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
CBLSHF204'	Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5)	Huber + Suhner	Sucoflex 102EA	234714001	02/03/2021	02/03/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwartz	FSW43	100646	11/02/2021	11/02/2022

Software Utilized:

Name	Manufacturer	Version
None	--	--

7.3 Results:

The sample tested was found to Comply.

§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6 dB (DTS) Bandwidth and Occupied Bandwidth

Frequency (MHz)	6 dB (DTS) Bandwidth (kHz)	Occupied Bandwidth (MHz)
2402	699.30	1.03
2440	739.30	1.03
2480	689.30	1.03

7.4 Setup Photographs:

Confidential – Photo not included in this report

7.5 Plots/Data:

Low Channel 6 dB (DTS) Bandwidth



19:51:22 11.01.2022

Mid Channel 6 dB (DTS) Bandwidth



20:03:32 11.01.2022

Notes: The cable loss and attenuator were compensated internally as transducer factor.

High Channel 6 dB (DTS) Bandwidth



20:09:03 11.01.2022

Low Channel Occupied Bandwidth



19:52:47 11.01.2022

Notes: The cable loss and attenuator were compensated internally as transducer factor.

Mid Channel Occupied Bandwidth



20:02:55 11.01.2022

High Channel Occupied Bandwidth



20:10:08 11.01.2022

Notes: The cable loss and attenuator were compensated internally as transducer factor.

Test Personnel: Vathana Ven
Supervising/Reviewing
Engineer:
(Where Applicable) Kouma Sinn
Product Standard: CFR47 FCC Part 15.247
Input Voltage: 48 VDC Via External P/S
Pretest Verification w/
Ambient Signals or
BB Source: N/A

Test Date: 01/11/2022
Limit Applied: See report section 7.3
Ambient Temperature: 24 °C
Relative Humidity: 8 %
Atmospheric Pressure: 1022 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, and ANSI C63.10 Section 11.10.2, and KDB 558074 D01.

TEST SITE: 10m Chamber Building

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
CEN001	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
CBLSHF204'	Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5)	Huber + Suhner	Sucoflex 102EA	234714001	02/03/2021	02/03/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/02/2021	11/02/2022

Software Utilized:

Name	Manufacturer	Version
None	--	--

8.3 Results:

The sample tested was found to Comply.

§15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Power Spectral Density

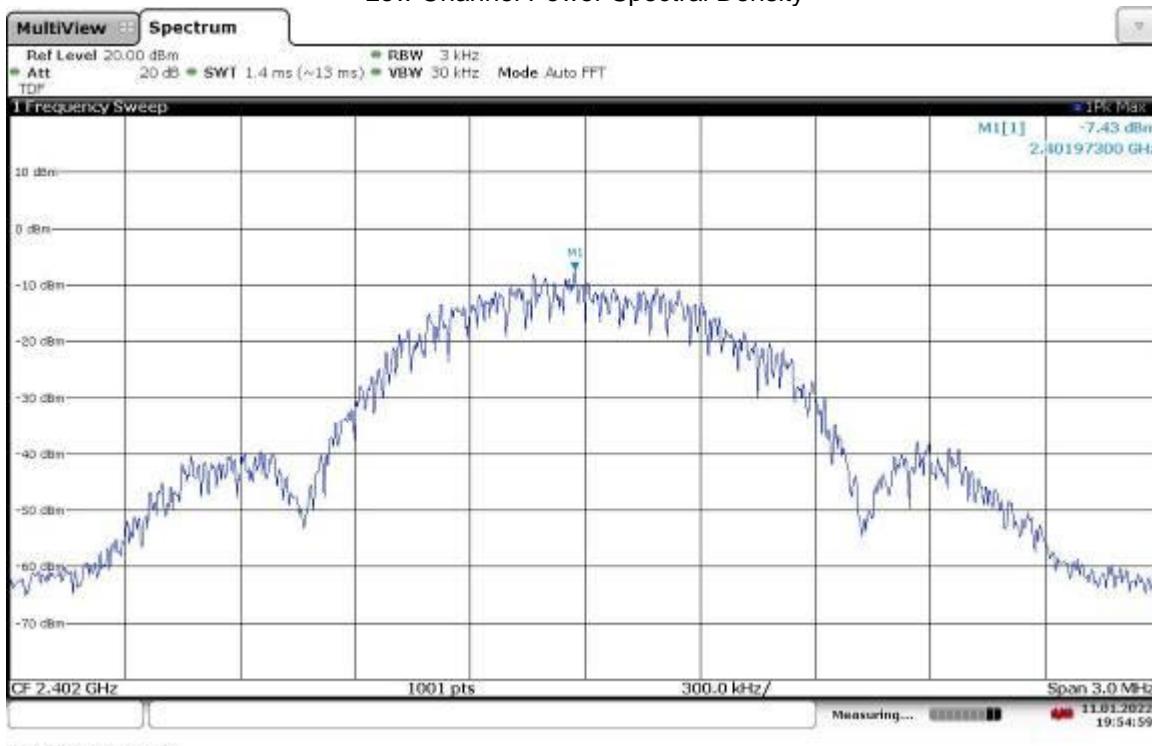
Frequency (MHz)	Conducted Power Spectral Density (dBm)	Limit (dBm)	Margin (dB)
2402	-7.43	8	-15.43
2440	-7.74	8	-15.74
2480	-7.99	8	-15.99

8.4 Test Setup Photographs:

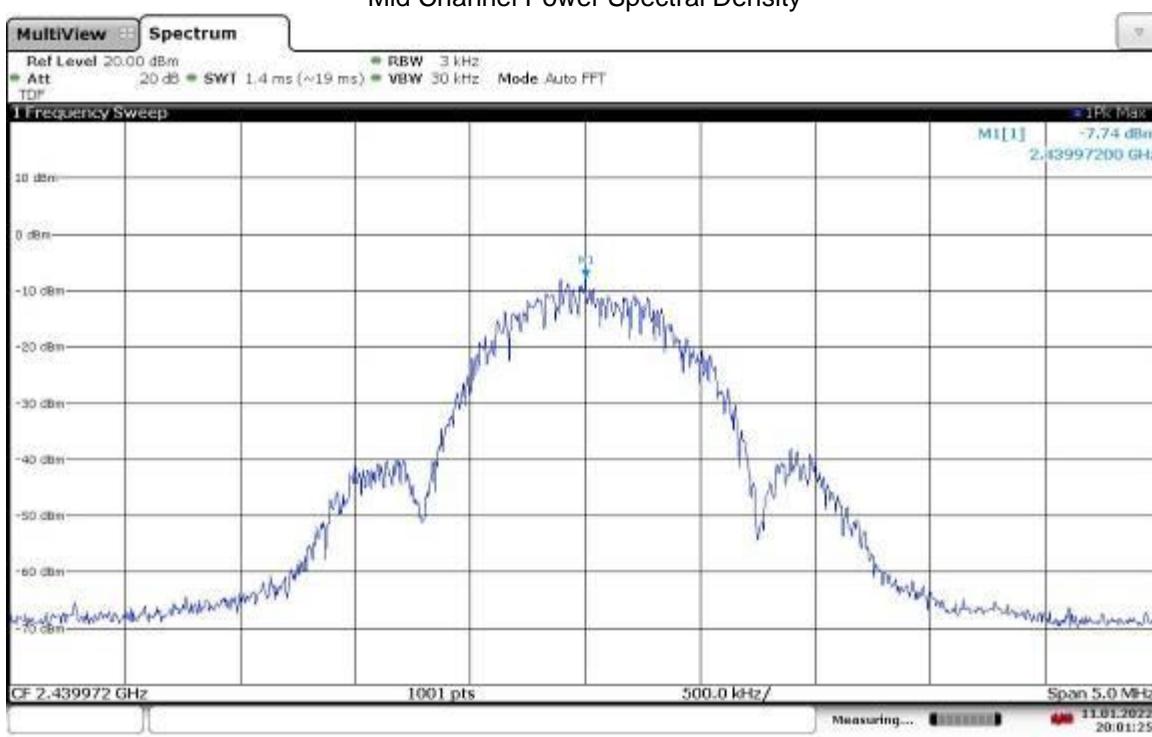
Confidential – Photo not included in this report

8.5 Test Data:

Low Channel Power Spectral Density

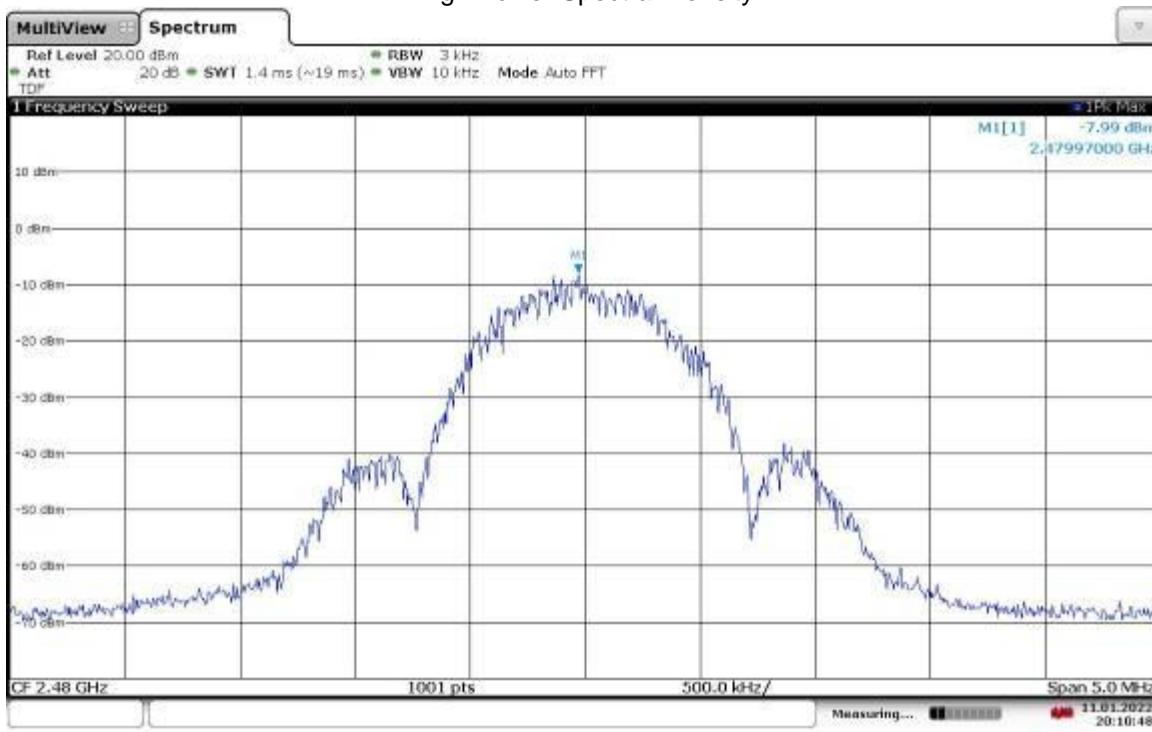


Mid Channel Power Spectral Density



Notes: The cable loss and attenuator were compensated internally as transducer factor.

High Power Spectral Density



Notes: The cable loss and attenuator were compensated internally as transducer factor.

Test Personnel: Vathana Ven *VJV*
 Supervising/Reviewing
 Engineer:
 (Where Applicable) Kouma Sinn *KPS*
 Product Standard: CFR47 FCC Part 15.247
 Input Voltage: 48 VDC Via External P/S
 Pretest Verification w/
 Ambient Signals or
 BB Source: N/A

Test Date: 01/11/2022
 Limit Applied: See report section 8.3
 Ambient Temperature: 24 °C
 Relative Humidity: 8 %
 Atmospheric Pressure: 1022 mbars

Deviations, Additions, or Exclusions: None

9 Band Edge Compliance

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, ANSI C 63.10 Section 13, and KDB 558074 D01.

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.

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
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/24/2021	08/24/2022
145-414'	Cables 145-400 145-403 145-405 145-409	Huber + Suhner	3m Track A cables	multiple	07/09/2021	07/09/2022
145-420'	Receiver to floor cable	Utiflex	UFB311A-2-0591-70070	145-420	02/17/2021	02/17/2022
145-422'	10Amp Pre-amp to under floor	Utiflex	UFB311A-0-2756-70070	145-422	02/17/2021	02/17/2022
IV003'	8.4 meter cable	Insulated Wire	2800-NPS	.003	10/15/2021	10/15/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/02/2021	11/02/2022

Software Utilized:

Name	Manufacturer	Version
None	--	--

9.3 Results:

The sample tested was found to Comply.

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

9.4 Setup Photographs:

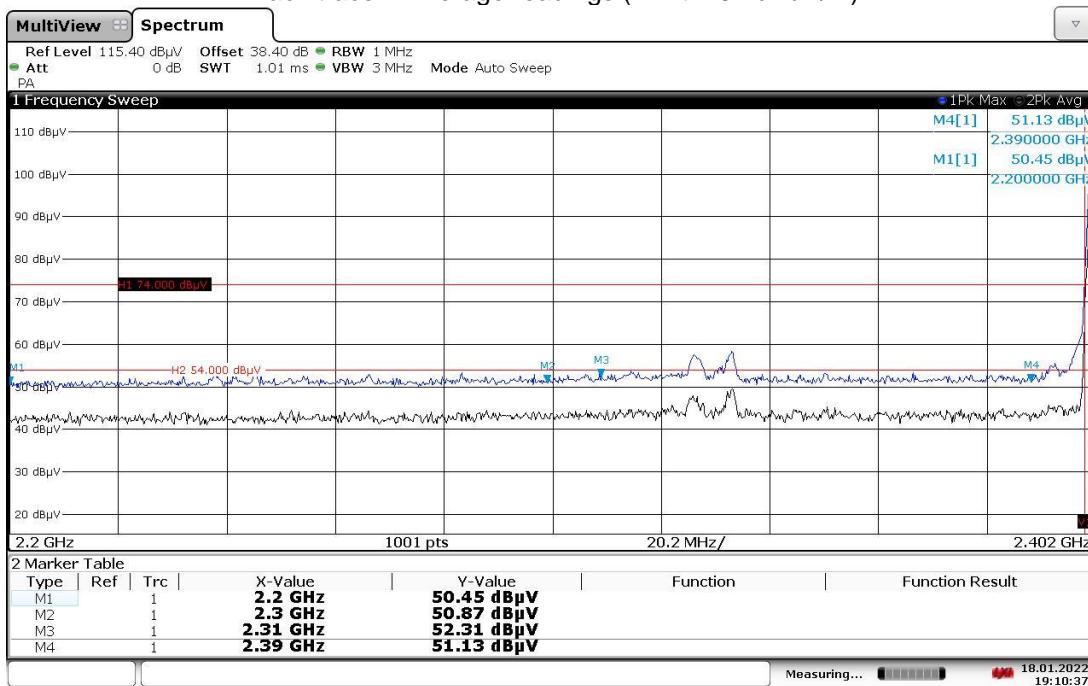
Confidential – Photo not included in this report

9.5 Test Data:

Lower Band Edge With Restricted Band Edge Limit (1 MHz RBW)

Blue trace = Peak readings (Limit = 74 dBuV/m)

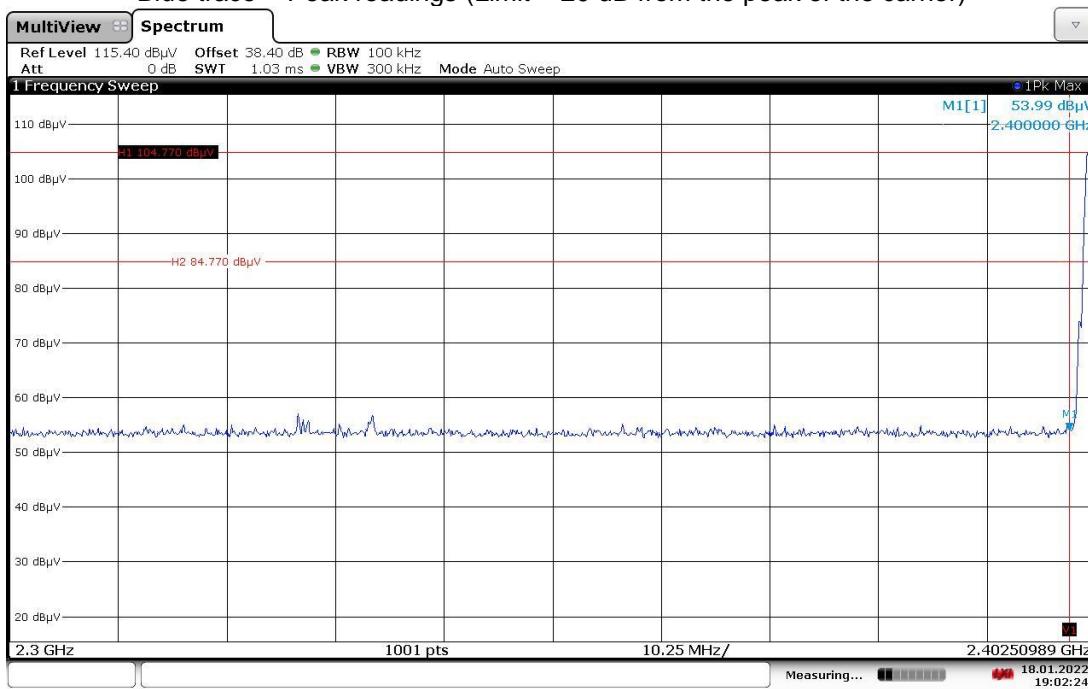
Black trace = Average readings (Limit = 54 dBuV/m)



19:10:38 18.01.2022

Lower Band Edge With 20 dB From the Carrier Limit (100 kHz RBW)

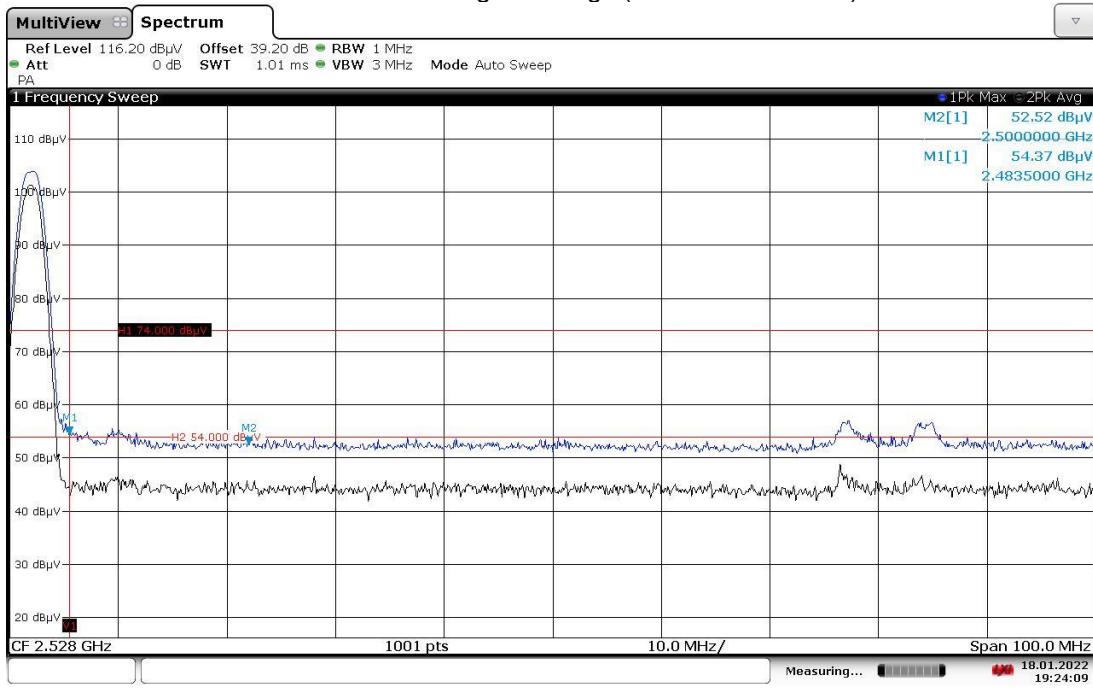
Blue trace = Peak readings (Limit = 20 dB from the peak of the carrier)



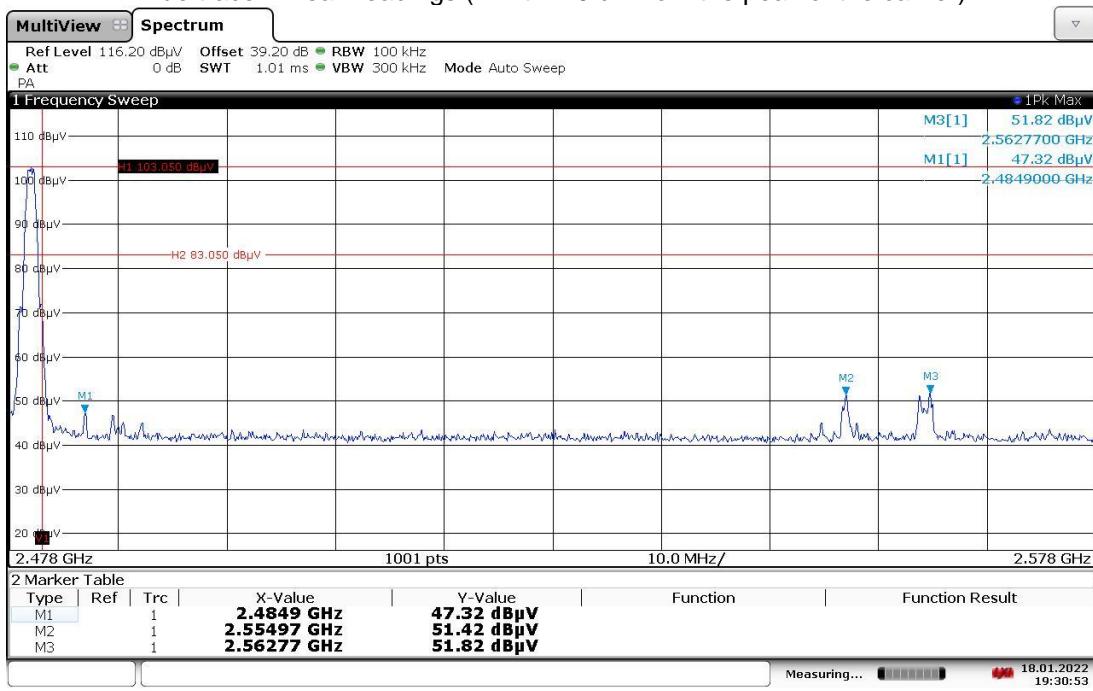
19:02:25 18.01.2022

Notes: The cable loss, antenna factor, and attenuator were compensated internally as dB offset (EMI Receive Antenna in Horizontal Polarity – Worst-case)

Lower Band Edge With Restricted Band Edge Limit (1 MHz RBW)
 Blue trace = Peak readings (Limit = 74 dBuV/m)
 Black trace = Average readings (Limit = 54 dBuV/m)



Upper Band Edge With 20 dB From the Carrier Limit (100 kHz RBW)
 Blue trace = Peak readings (Limit = 20 dB from the peak of the carrier)



Notes: The cable loss, antenna factor, and attenuator were compensated internally as dB offset (EMI Receive Antenna in Horizontal Polarity – Worst-case)

Test Personnel: Kouma Sinn *KPS*
Supervising/Reviewing
Engineer:
(Where Applicable) Vathana Ven *VVV*
Product Standard: CFR47 FCC Part 15.247
Input Voltage: 48 VDC Via External P/S
Pretest Verification w/
Ambient Signals or
BB Source: N/A

Test Date: 01/18/2022
Limit Applied: See report section 9.3
Ambient Temperature: 24 °C
Relative Humidity: 12 %
Atmospheric Pressure: 1002 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter spurious emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, FCC Part 15 Subpart B, ANSI C 63.10, ANSI C 63.4, and KDB 558074 D01.

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 $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

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 $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

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		09/02/2021	09/02/2022
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/22/2021	06/22/2022
HS003'	10m under floor cable	Huber+Schuhner	10m-1	HS003	02/17/2021	02/17/2022
PRE12'	Pre-amplifier	Com Power	PAM-118A	18040117	12/06/2021	12/06/2022
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/24/2021	08/24/2022
HS003'	10m under floor cable	Huber+Schuhner	10m-1	HS003	02/17/2021	02/17/2022
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	07/28/2021	07/28/2022
PRE8'	PREAMPLIFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	12/27/2021	12/27/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Schwart	FSW43	100646	11/02/2021	11/02/2022
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	01/28/2021	01/28/2022
HS003'	10m under floor cable	Huber+Schuhner	10m-1	HS003	02/17/2021	02/17/2022
145-420'	Receiver to floor cable	Utiflex	UFB311A-2-0591-70070	145-420	02/17/2021	02/17/2022
145-422'	10Amp Pre-amp to under floor	Utiflex	UFB311A-0-2756-70070	145-422	02/17/2021	02/17/2022
CBLSHF101'	Cable, SMA - SMA, 9kHz-40GHz, (Cable Kit 6)	Sucoflex (Huber Suhne	104PE	CBLSHF101	02/03/2021	02/03/2022
MEG02'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber+Schuhner	SF102	252676002	02/19/2021	02/19/2022
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber+Schuhner	SF102	252675002	02/10/2021	02/10/2022
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber+Schuhner	SF102	252676002	02/19/2021	02/19/2022
PRE9'	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	09/23/2021	09/23/2022
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	01/28/2021	01/28/2022
REA006'	18GHz High Pass Filter	Reactel, Inc	7HS-18G/40G K11	(06)1	04/23/2021	04/23/2022

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16

10.3 Results:

The sample tested was found to Comply.

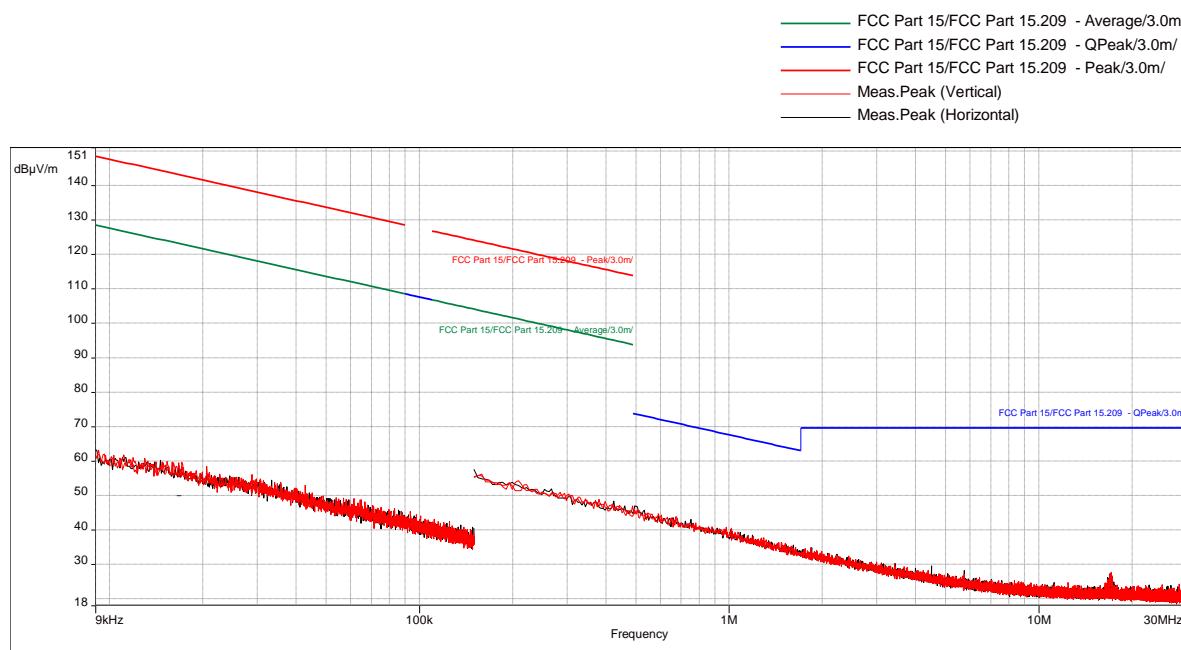
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that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

10.4 Setup Photographs:

Confidential – Photo not included in this report

10.5 Plots/Data:**Transmit at Low Channel, 9 kHz-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 _S01311, Lower Band: Low Channel 24.34 GHz, 160 MHz Bandwidth, MCS0 Modulation, att0.25-mixer27, BT Tx High CH, 5G Tx 157

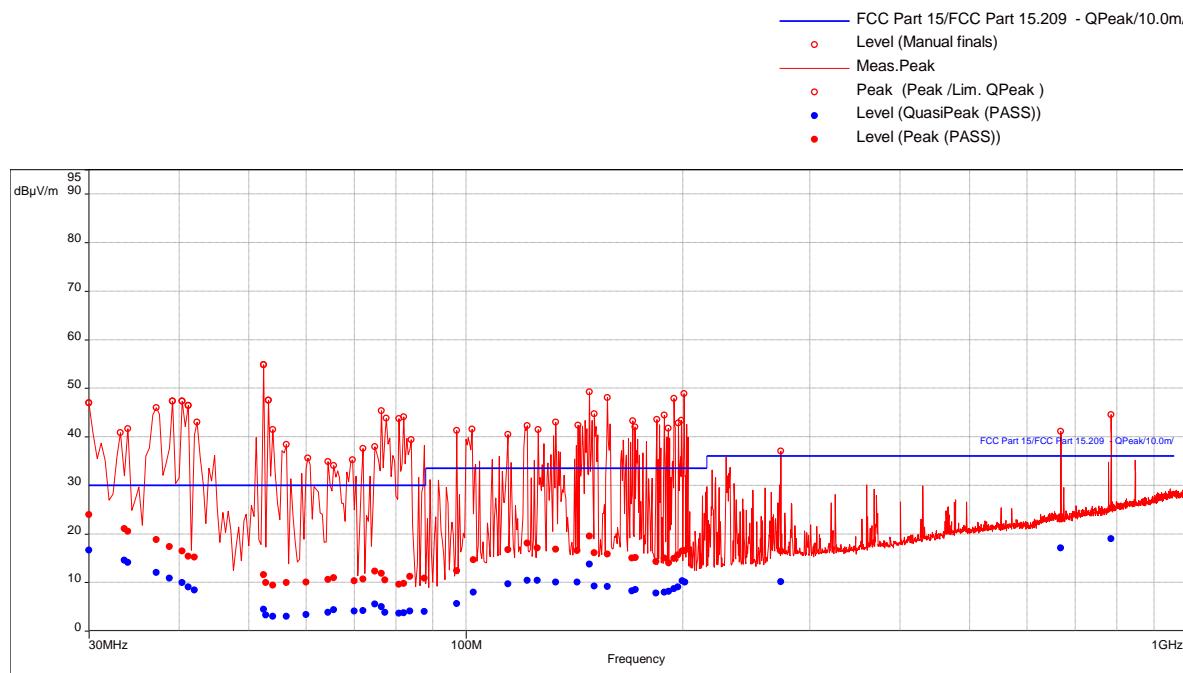
Graph:

Results: No emissions were detected.

Transmit at Low Channel, 30-1000 MHz

Test Information:

Date and Time	1/12/2022 8:13:29 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	12%
Atmospheric Pressure	1007 mB
Comments	RE 30-1000MHz_BLE Tx Low CH 2402MHz

Graph:

Results:

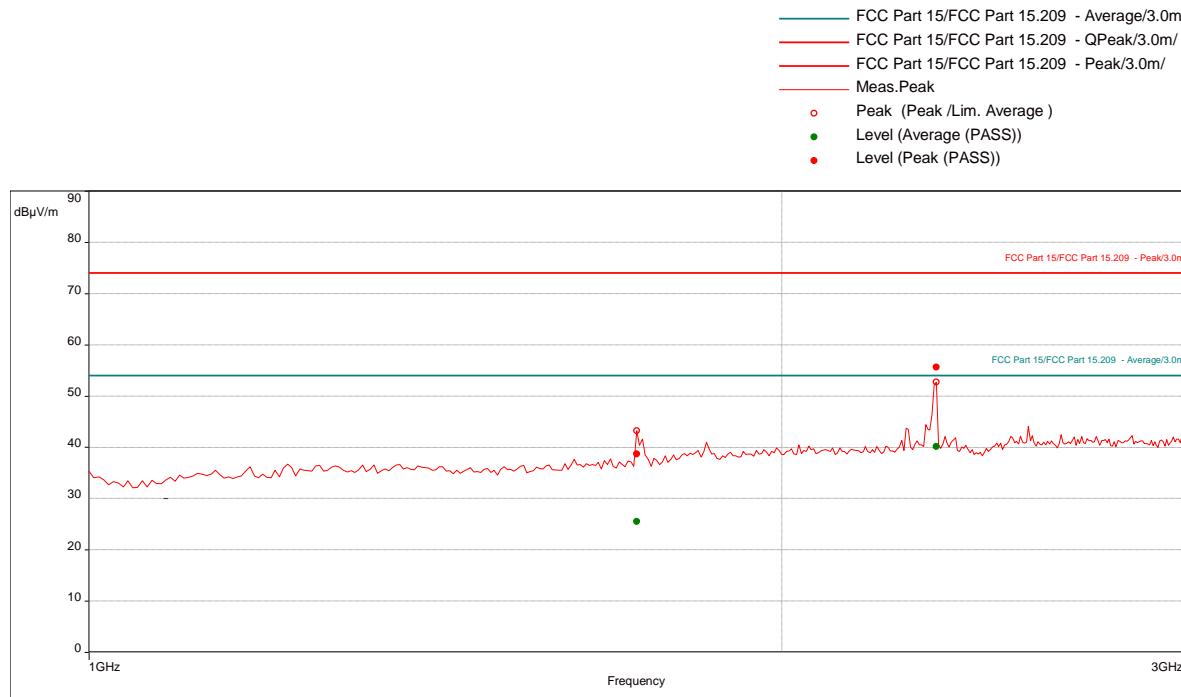
QuasiPeak (PASS) (46)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.15789474	16.61	30.00	-13.39	243.00	2.07	Vertical	120000.00	-12.63
33.57894737	14.52	30.00	-15.48	249.00	3.17	Vertical	120000.00	-14.78
34.12631579	14.05	30.00	-15.95	249.00	3.30	Vertical	120000.00	-15.14
37.10526316	12.03	30.00	-17.97	250.00	3.87	Vertical	120000.00	-17.16
38.97894737	10.82	30.00	-19.18	249.00	3.61	Vertical	120000.00	-18.38
40.21052632	9.90	30.00	-20.10	251.00	1.68	Vertical	120000.00	-19.30
41.23157895	9.05	30.00	-20.95	250.00	3.44	Vertical	120000.00	-20.00
42.14736842	8.41	30.00	-21.59	249.00	2.17	Vertical	120000.00	-20.63
52.36842105	4.44	30.00	-25.56	248.00	3.46	Vertical	120000.00	-25.84
52.82105263	3.28	30.00	-26.72	243.00	3.47	Vertical	120000.00	-25.92
53.93684211	2.95	30.00	-27.05	248.00	1.77	Horizontal	120000.00	-26.04
56.49473684	2.98	30.00	-27.02	248.00	1.00	Horizontal	120000.00	-25.96
60.17894737	3.33	30.00	-26.67	249.00	2.63	Horizontal	120000.00	-25.56
64.33684211	3.83	30.00	-26.17	248.00	2.67	Horizontal	120000.00	-25.11
65.6	4.36	30.00	-25.64	249.00	3.24	Vertical	120000.00	-25.03
69.82105263	4.07	30.00	-25.93	191.00	2.73	Horizontal	120000.00	-24.82
71.93684211	4.15	30.00	-25.85	248.00	1.94	Horizontal	120000.00	-24.79
74.98947368	5.54	30.00	-24.46	250.00	1.92	Vertical	120000.00	-24.96
76.55789474	4.94	30.00	-25.06	250.00	1.00	Vertical	120000.00	-25.02
77.37894737	3.77	30.00	-26.23	249.00	3.41	Horizontal	120000.00	-25.07
80.61052632	3.61	30.00	-26.39	243.00	1.36	Vertical	120000.00	-25.28
81.93684211	3.68	30.00	-26.32	249.00	2.51	Vertical	120000.00	-25.37
83.65263158	4.06	30.00	-25.94	191.00	1.41	Vertical	120000.00	-25.33
87.50526316	3.95	30.00	-26.05	249.00	1.66	Vertical	120000.00	-25.14
97.10526316	5.63	33.50	-27.87	243.00	3.51	Vertical	120000.00	-23.04
102.4105263	7.99	33.50	-25.51	249.00	3.23	Vertical	120000.00	-21.55
114.4631579	9.68	33.50	-23.82	250.00	3.52	Vertical	120000.00	-19.10
121.6315789	10.35	33.50	-23.15	242.00	1.52	Vertical	120000.00	-18.38
125.7789474	10.35	33.50	-23.15	250.00	4.00	Vertical	120000.00	-18.32
133.1052632	10.01	33.50	-23.49	248.00	1.29	Vertical	120000.00	-18.40
142.9157895	10.00	33.50	-23.50	243.00	2.30	Vertical	120000.00	-19.05
148.4631579	13.72	33.50	-19.78	46.00	1.30	Vertical	120000.00	-19.41
150.8631579	9.26	33.50	-24.24	249.00	1.52	Vertical	120000.00	-19.58
157.2631579	9.09	33.50	-24.41	243.00	2.08	Vertical	120000.00	-19.74
170.1157895	8.27	33.50	-25.23	249.00	1.30	Vertical	120000.00	-20.25
172.0736842	8.46	33.50	-25.04	242.00	3.68	Vertical	120000.00	-20.33
183.7473684	7.79	33.50	-25.71	249.00	2.39	Vertical	120000.00	-20.73
188.4947368	7.99	33.50	-25.51	242.00	2.40	Vertical	120000.00	-20.53
191.1157895	8.11	33.50	-25.39	249.00	2.40	Vertical	120000.00	-20.24
194.2421053	8.69	33.50	-24.81	242.00	1.52	Vertical	120000.00	-19.88
196.8842105	9.07	33.50	-24.43	243.00	2.13	Vertical	120000.00	-19.45
199.7052632	10.33	33.50	-23.17	250.00	1.51	Vertical	120000.00	-19.02
201.1789474	10.07	33.50	-23.43	249.00	1.47	Vertical	120000.00	-19.07
273.4421053	10.10	36.00	-25.90	243.00	1.06	Vertical	120000.00	-18.03
668.2315789	17.04	36.00	-18.96	1.00	1.78	Vertical	120000.00	-10.07
785.0421053	18.99	36.00	-17.01	111.00	1.00	Vertical	120000.00	-8.05

Transmit at Low Channel, 1-3 GHz

Test Information:

Date and Time	1/11/2022 9:17:02 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	8%
Atmospheric Pressure	1022 mB
Comments	RE 1 to 3 GHz_Tx Low CH 2402 MHz

Graph:Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1730.526316	38.66	74.00	-35.34	3.00	3.98	Vertical	1000000.00	-5.62
2334.210526	55.62	74.00	-18.38	27.00	1.50	Horizontal	1000000.00	-2.79

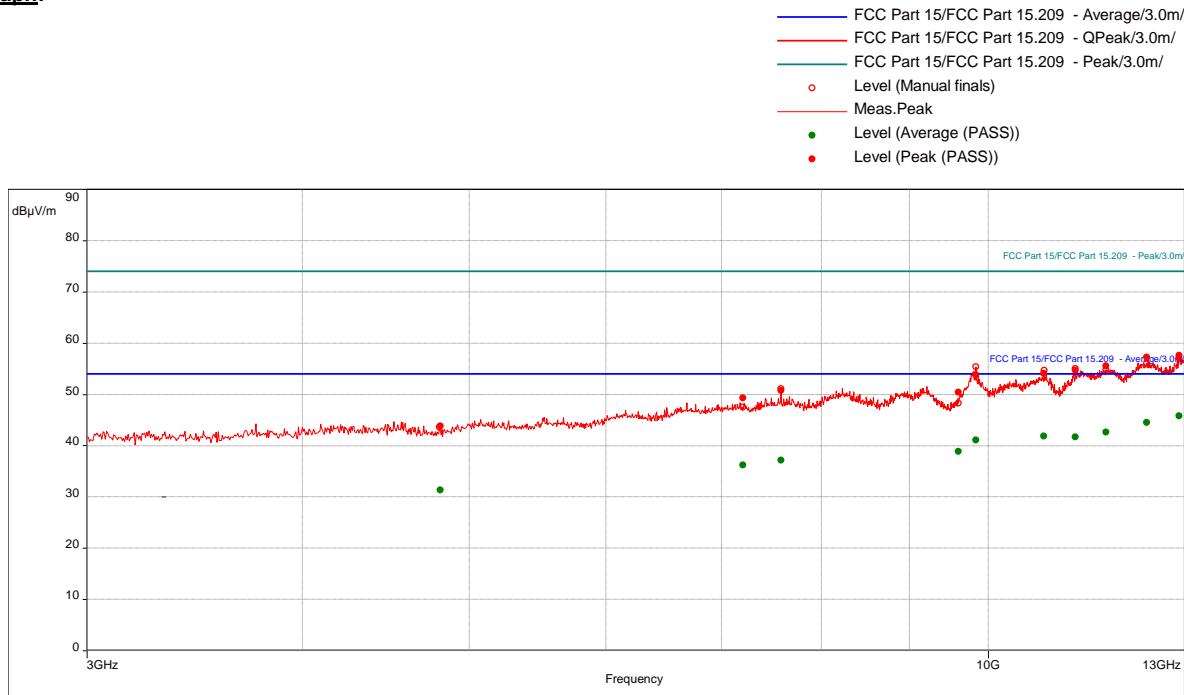
Average (PASS) (2)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1730.526316	25.51	54.00	-28.49	3.00	3.98	Vertical	1000000.00	-5.62
2334.210526	40.15	54.00	-13.85	27.00	1.50	Horizontal	1000000.00	-2.79

Transmit at Low Channel, 3-26 GHz

Test Information:

Date and Time	1/18/2022 6:09:27 PM
Client and Project Number	Starry
Engineer	Kouma Sinn
Temperature	24 C
Humidity	12 %
Atmospheric Pressure	1002 mbar
Comments	Scan 2: Tx @ Low 2402 MHz, REA004 Filter, RE 3 to 13 GHz SA mode

Graph:

Results:

Peak (PASS) (10)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4807.631579	43.81	74.00	-30.19	66.00	1.00	Horizontal	1000000.00	2.43
7202.631579	49.33	74.00	-24.67	285.00	1.00	Vertical	1000000.00	7.28
7582.368421	50.73	74.00	-23.27	276.00	2.40	Vertical	1000000.00	7.96
9609.736842	50.44	74.00	-23.56	24.00	1.70	Horizontal	1000000.00	10.21
9835.526316	53.81	74.00	-20.19	334.00	2.70	Horizontal	1000000.00	11.89
10772.36842	54.09	74.00	-19.91	39.00	2.15	Vertical	1000000.00	13.11
11232.36842	54.67	74.00	-19.33	24.00	1.90	Vertical	1000000.00	14.05
11698.94737	55.50	74.00	-18.50	0.00	2.30	Horizontal	1000000.00	14.77
12353.68421	57.22	74.00	-16.78	334.00	1.01	Horizontal	1000000.00	15.83
12905	57.58	74.00	-16.42	25.00	2.56	Horizontal	1000000.00	17.57

Average (PASS) (10)

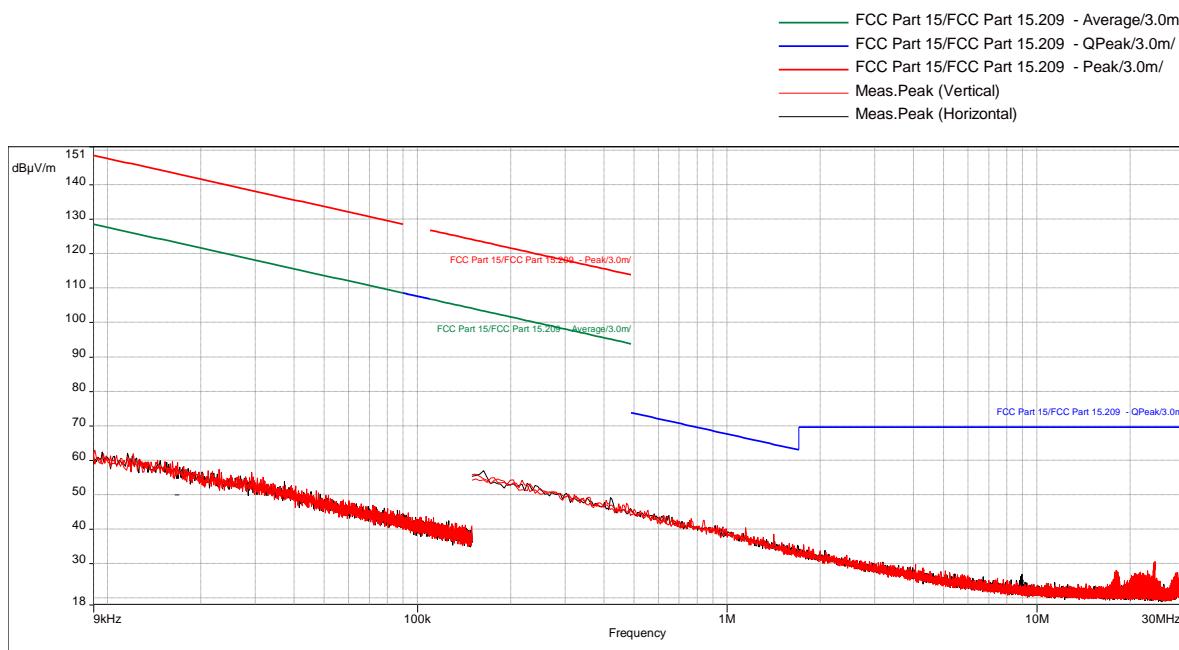
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4807.631579	31.32	54.00	-22.68	66.00	1.00	Horizontal	1000000.00	2.43
7202.631579	36.22	54.00	-17.78	285.00	1.00	Vertical	1000000.00	7.28
7582.368421	37.11	54.00	-16.89	276.00	2.40	Vertical	1000000.00	7.96
9609.736842	38.84	54.00	-15.16	24.00	1.70	Horizontal	1000000.00	10.21
9835.526316	41.04	54.00	-12.96	334.00	2.70	Horizontal	1000000.00	11.89
10772.36842	41.84	54.00	-12.16	39.00	2.15	Vertical	1000000.00	13.11
11232.36842	41.66	54.00	-12.34	24.00	1.90	Vertical	1000000.00	14.05
11698.94737	42.61	54.00	-11.39	0.00	2.30	Horizontal	1000000.00	14.77
12353.68421	44.51	54.00	-9.49	334.00	1.01	Horizontal	1000000.00	15.83
12905	45.75	54.00	-8.25	25.00	2.56	Horizontal	1000000.00	17.57

Note: Manual scan was performed from 13-26 GHz at 10 cm from EUT. No emissions were detected above the measuring equipment noise floor.

Transmit at Mid Channel, 9 kHz-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	S01311, Lower Band: Low Channel 24.35 GHz, 160 MHz BW, MCS0, att0.75mixer27, BT Tx Mid CH_5GHz Tx CH157 80 MHz BW_9kHz-30MHz 15.209

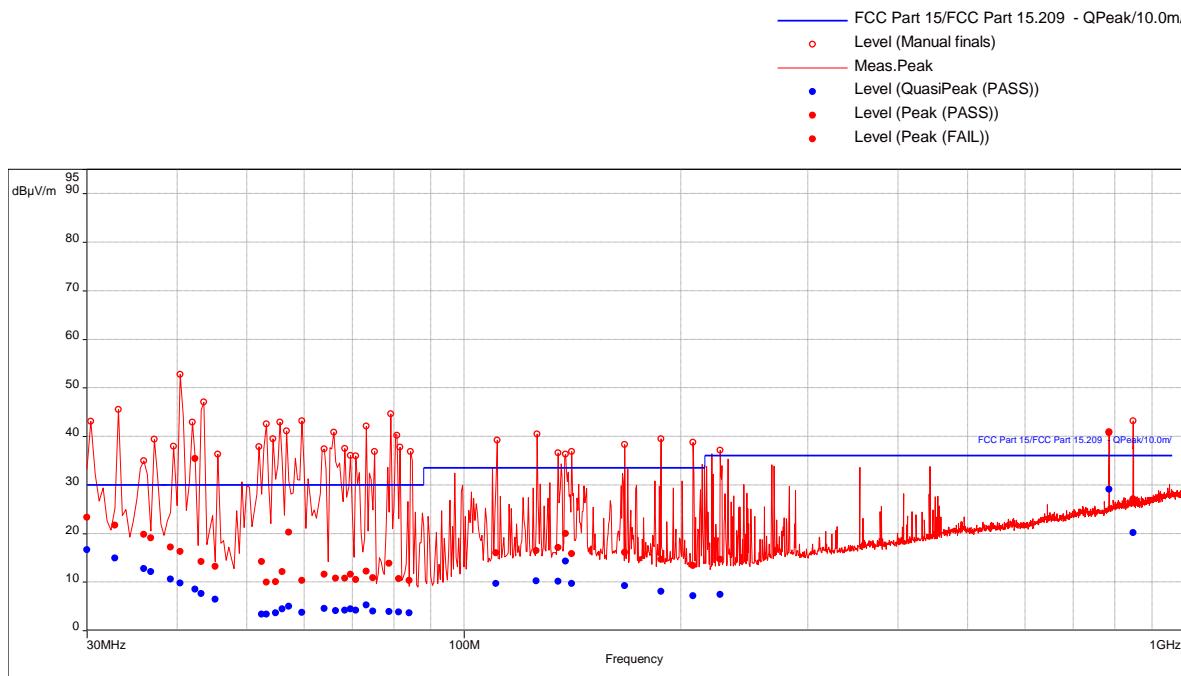
Graph:

Results: No emissions were detected.

Transmit at Mid Channel, 30-1000 MHz

Test Information:

Date and Time	1/12/2022 8:20:37 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	12%
Atmospheric Pressure	1007 mB
Comments	RE 30-1000MHz_BLE Tx Mid CH 2440MHz

Graph:

Results:

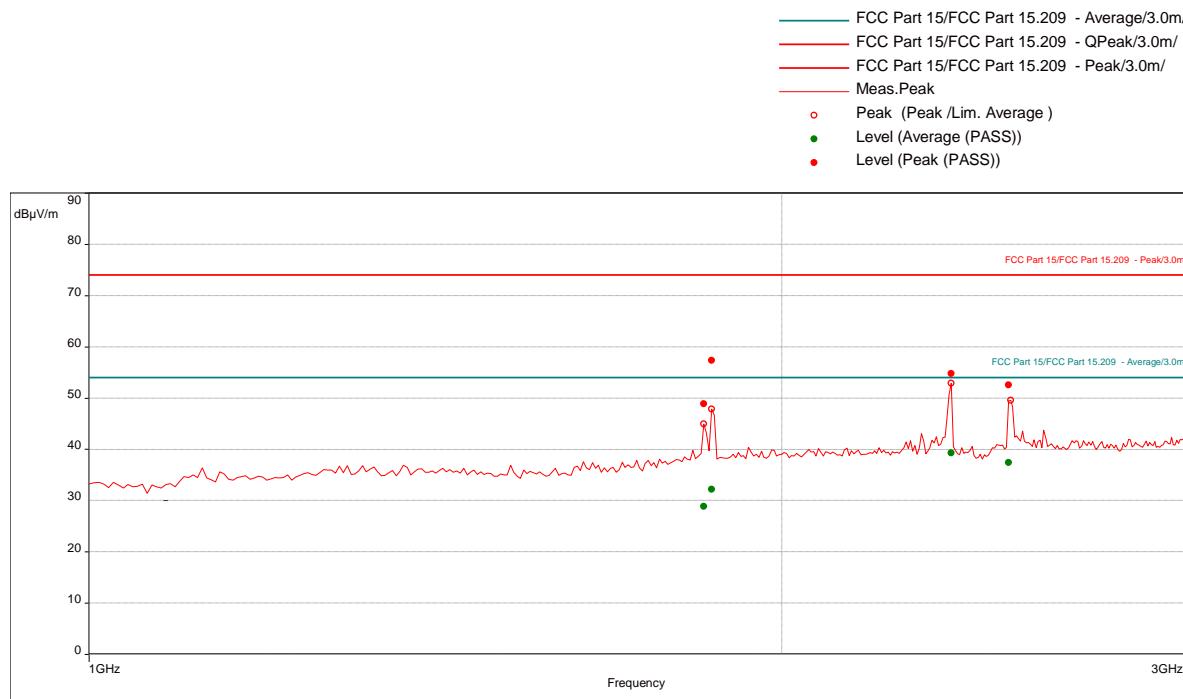
QuasiPeak (PASS) (36)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.09473684	16.60	30.00	-13.40	250.00	3.22	Vertical	120000.00	-12.60
32.82105263	14.91	30.00	-15.09	98.00	3.00	Vertical	120000.00	-14.28
35.87368421	12.75	30.00	-17.25	250.00	3.98	Vertical	120000.00	-16.34
36.85263158	12.14	30.00	-17.86	191.00	2.35	Vertical	120000.00	-17.00
39.22105263	10.59	30.00	-19.41	250.00	2.51	Vertical	120000.00	-18.56
40.27368421	9.80	30.00	-20.20	90.00	1.85	Vertical	120000.00	-19.34
42.25263158	8.54	30.00	-21.46	183.00	3.91	Vertical	120000.00	-20.71
43.34736842	7.56	30.00	-22.44	186.00	2.26	Vertical	120000.00	-21.48
45.22105263	6.42	30.00	-23.58	183.00	2.41	Vertical	120000.00	-22.73
52.22105263	3.38	30.00	-26.62	183.00	1.92	Vertical	120000.00	-25.82
53.07368421	3.34	30.00	-26.66	184.00	1.58	Vertical	120000.00	-25.95
54.71578947	3.65	30.00	-26.35	183.00	1.35	Vertical	120000.00	-26.04
55.82105263	4.39	30.00	-25.61	191.00	3.57	Vertical	120000.00	-26.02
57.08421053	4.93	30.00	-25.07	185.00	2.28	Vertical	120000.00	-25.90
59.44210526	3.75	30.00	-26.25	148.00	3.67	Vertical	120000.00	-25.64
64	4.56	30.00	-25.44	250.00	1.57	Vertical	120000.00	-25.12
66.28421053	4.11	30.00	-25.89	184.00	1.41	Vertical	120000.00	-24.99
68.55789474	4.20	30.00	-25.80	191.00	3.99	Vertical	120000.00	-24.85
69.6	4.47	30.00	-25.53	250.00	3.23	Vertical	120000.00	-24.82
70.61052632	4.18	30.00	-25.82	191.00	1.40	Vertical	120000.00	-24.81
73.38947368	5.27	30.00	-24.73	168.00	1.30	Vertical	120000.00	-24.87
74.91578947	3.99	30.00	-26.01	248.00	3.82	Vertical	120000.00	-24.95
78.97894737	3.85	30.00	-26.15	248.00	1.99	Vertical	120000.00	-25.20
81.30526316	3.84	30.00	-26.16	246.00	1.14	Vertical	120000.00	-25.30
83.98947368	3.66	30.00	-26.34	254.00	3.46	Vertical	120000.00	-25.33
110.8842105	9.66	33.50	-23.84	321.00	3.47	Vertical	120000.00	-19.64
126.0842105	10.19	33.50	-23.31	248.00	3.27	Vertical	120000.00	-18.32
135.3894737	10.15	33.50	-23.35	328.00	4.00	Vertical	120000.00	-18.58
138.2736842	14.30	33.50	-19.20	0.00	1.47	Vertical	120000.00	-18.80
141.3263158	9.69	33.50	-23.81	191.00	2.50	Vertical	120000.00	-18.99
167.1368421	9.26	33.50	-24.24	248.00	3.37	Vertical	120000.00	-20.08
187.6315789	8.09	33.50	-25.41	248.00	1.52	Vertical	120000.00	-20.59
208.1894737	7.14	33.50	-26.36	191.00	1.90	Vertical	120000.00	-21.22
226.8	7.37	36.00	-28.63	241.00	1.77	Vertical	120000.00	-20.70
785.0736842	29.07	36.00	-6.93	75.00	1.73	Vertical	120000.00	-8.05
847.5684211	20.13	36.00	-15.87	113.00	1.68	Vertical	120000.00	-6.65

Transmit at Mid Channel, 1-3 GHz

Test Information:

Date and Time	1/11/2022 9:32:59 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	8%
Atmospheric Pressure	1022 mB
Comments	RE 1 to 3 GHz_Tx Mid CH 2440 MHz

Graph:Results:

Peak (PASS) (4)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1851.315789	48.86	74.00	-25.14	59.00	1.55	Vertical	1000000.00	-4.14
1867.368421	57.36	74.00	-16.64	109.00	2.60	Horizontal	1000000.00	-3.98
2368.421053	54.78	74.00	-19.22	31.00	1.75	Horizontal	1000000.00	-2.66
2511.052632	52.53	74.00	-21.47	30.00	1.30	Horizontal	1000000.00	-1.88

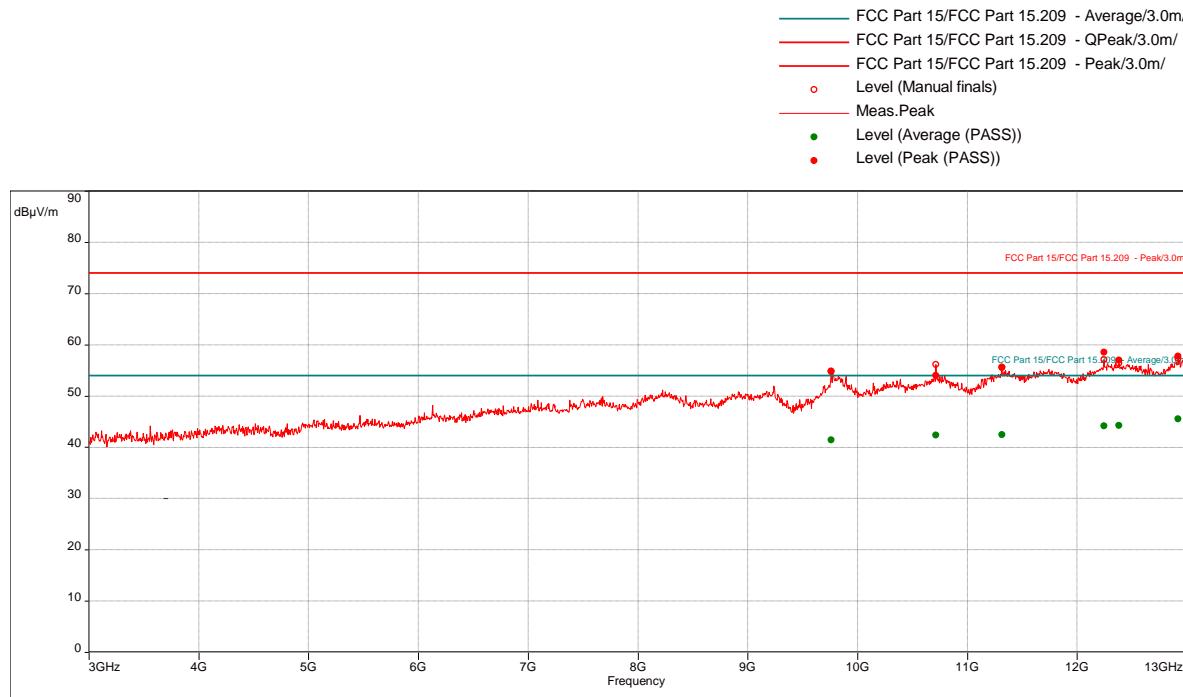
Average (PASS) (4)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1851.315789	28.82	54.00	-25.18	59.00	1.55	Vertical	1000000.00	-4.14
1867.368421	32.14	54.00	-21.86	109.00	2.60	Horizontal	1000000.00	-3.98
2368.421053	39.25	54.00	-14.75	31.00	1.75	Horizontal	1000000.00	-2.66
2511.052632	37.41	54.00	-16.59	30.00	1.30	Horizontal	1000000.00	-1.88

Transmit at Mid Channel, 3-26 GHz

Test Information:

Date and Time	1/11/2022 11:02:54 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	8%
Atmospheric Pressure	1022 mB
Comments	RE 3 to 13 GHz_Tx Mid CH 2440 MHz

Graph:Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
9760	54.85	74.00	-19.15	219.00	1.40	Horizontal	1000000.00	11.66
10713.94737	54.00	74.00	-20.00	313.00	1.90	Vertical	1000000.00	12.99
11314.73684	55.55	74.00	-18.45	205.00	2.20	Vertical	1000000.00	14.00
12243.94737	58.54	74.00	-15.46	149.00	2.90	Horizontal	1000000.00	15.75
12378.68421	56.99	74.00	-17.01	119.00	2.05	Vertical	1000000.00	15.86
12918.68421	57.75	74.00	-16.25	320.00	3.74	Vertical	1000000.00	17.59

Average (PASS) (6)

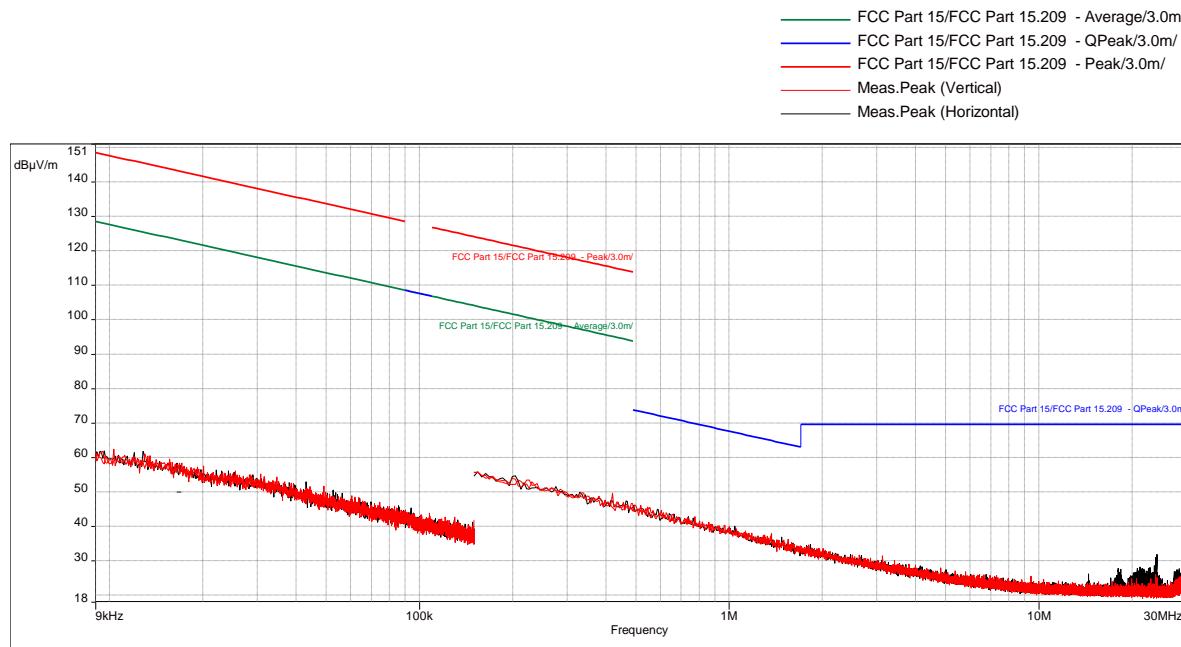
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
9760	41.44	54.00	-12.56	219.00	1.40	Horizontal	1000000.00	11.66
10713.94737	42.33	54.00	-11.67	313.00	1.90	Vertical	1000000.00	12.99
11314.73684	42.46	54.00	-11.54	205.00	2.20	Vertical	1000000.00	14.00
12243.94737	44.16	54.00	-9.84	149.00	2.90	Horizontal	1000000.00	15.75
12378.68421	44.27	54.00	-9.73	119.00	2.05	Vertical	1000000.00	15.86
12918.68421	45.55	54.00	-8.45	320.00	3.74	Vertical	1000000.00	17.59

Note: Manual scan was performed from 13-26 GHz at 10 cm from EUT. No emissions were detected above the measuring equipment noise floor.

Transmit at High Channel, 9 kHz-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	S01311, Lower Band: Low Channel 24.34 GHz, 160 MHz BW, MCS0, att0.25mixer27, BT Tx High CH_5GHz Tx CH157 80 MHz BW_9kHz-30MHz 15.209

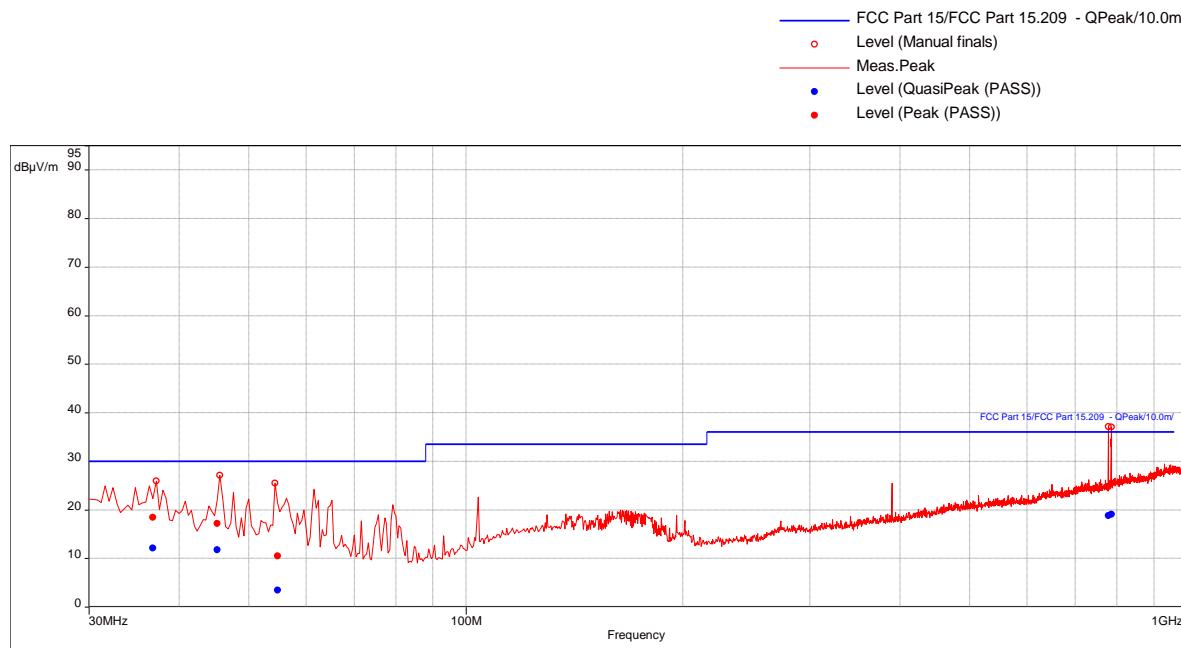
Graph:

Results: No emissions were detected.

Transmit at High Channel, 30-1000 MHz

Test Information:

Date and Time	1/18/2022 4:47:53 PM
Client and Project Number	Starry
Engineer	Kouma Sinn
Temperature	24 C
Humidity	12 %
Atmospheric Pressure	1002 mbar
Comments	Scan 1: Tx at high channel, 2480 MHz, RE 30-1000MHz SA mode

Graph:Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
36.88421053	18.47	30.00	-11.53	184.00	2.40	Vertical	120000.00	-17.02
45.31578947	17.18	30.00	-12.82	184.00	3.41	Vertical	120000.00	-22.79
54.62105263	10.52	30.00	-19.48	255.00	3.58	Vertical	120000.00	-26.04
778.0315789	24.76	36.00	-11.24	131.00	1.63	Horizontal	120000.00	-8.33
786.3157895	25.46	36.00	-10.54	322.00	1.40	Vertical	120000.00	-8.04

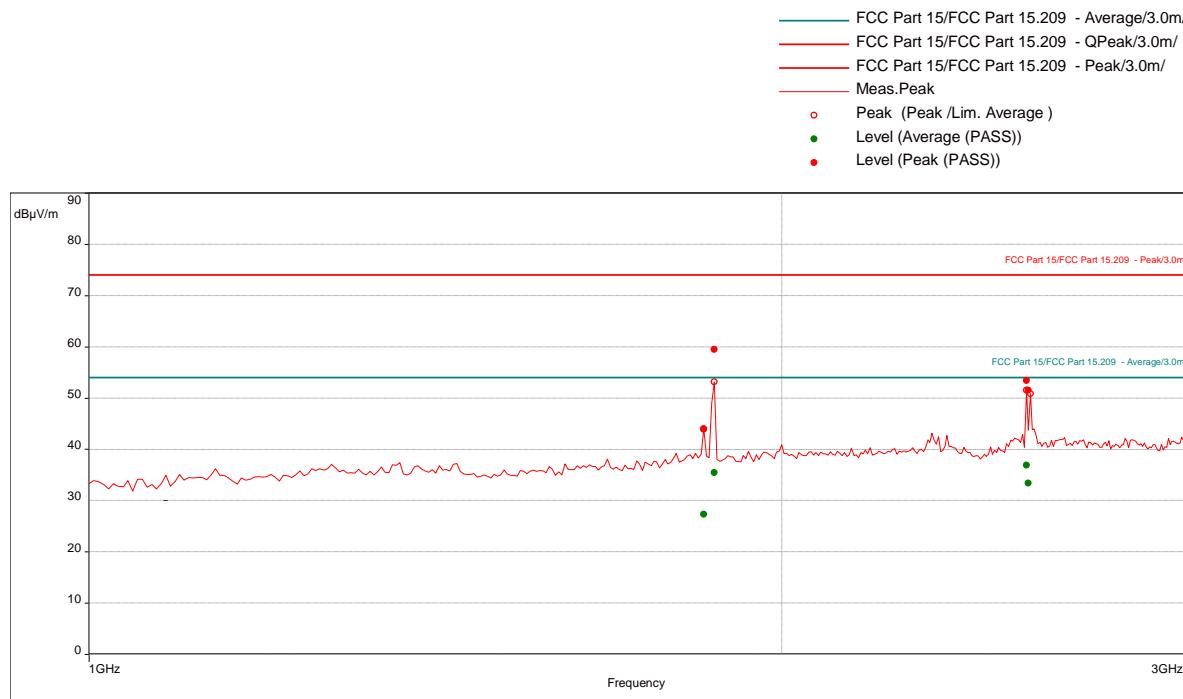
QuasiPeak (PASS) (5)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
36.88421053	12.07	30.00	-17.93	184.00	2.40	Vertical	120000.00	-17.02
45.31578947	11.72	30.00	-18.28	184.00	3.41	Vertical	120000.00	-22.79
54.62105263	3.40	30.00	-26.60	255.00	3.58	Vertical	120000.00	-26.04
778.0315789	18.77	36.00	-17.23	131.00	1.63	Horizontal	120000.00	-8.33
786.3157895	19.06	36.00	-16.94	322.00	1.40	Vertical	120000.00	-8.04

Transmit at High Channel, 1-3 GHz

Test Information:

Date and Time	1/11/2022 10:15:27 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	8%
Atmospheric Pressure	1022 mB
Comments	RE 1 to 3 GHz_Tx High CH 2480 MHz

Graph:Results:

Peak (PASS) (4)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1851.578947	43.93	74.00	-30.07	124.00	3.98	Vertical	1000000.00	-4.14
1867.894737	59.47	74.00	-14.53	284.00	3.64	Vertical	1000000.00	-3.98
2554.736842	53.39	74.00	-20.61	30.00	1.80	Horizontal	1000000.00	-2.15
2561.842105	51.55	74.00	-22.45	46.00	1.00	Horizontal	1000000.00	-2.15

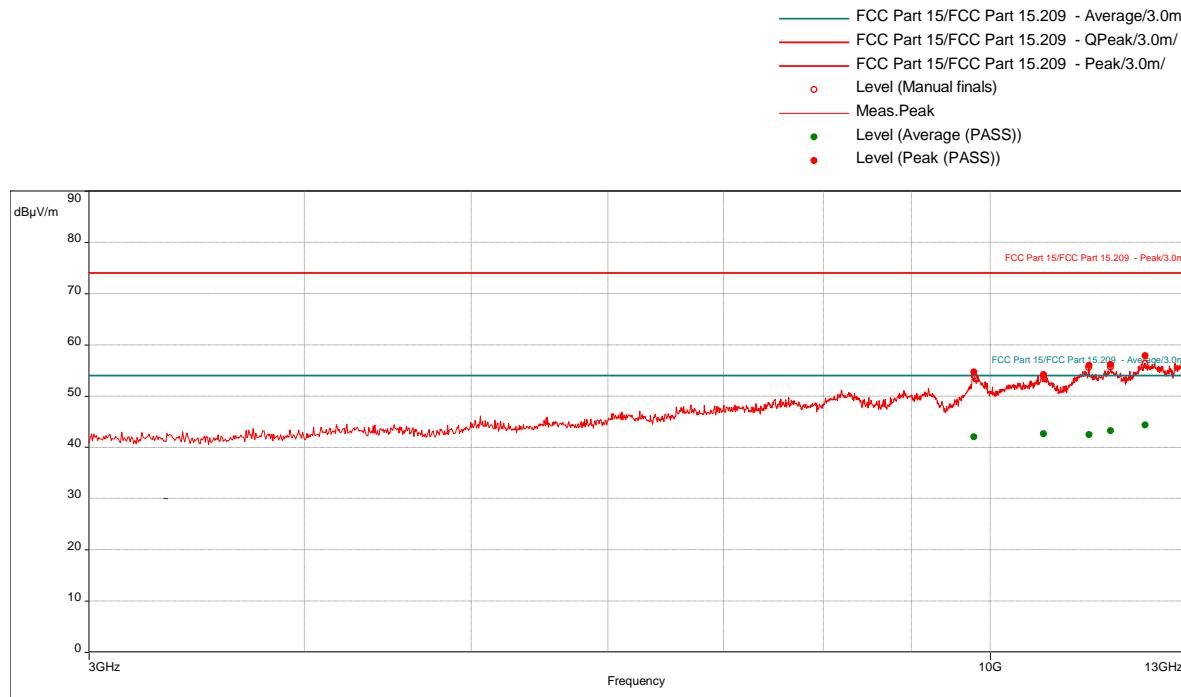
Average (PASS) (4)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1851.578947	27.34	54.00	-26.66	124.00	3.98	Vertical	1000000.00	-4.14
1867.894737	35.44	54.00	-18.56	284.00	3.64	Vertical	1000000.00	-3.98
2554.736842	36.84	54.00	-17.16	30.00	1.80	Horizontal	1000000.00	-2.15
2561.842105	33.36	54.00	-20.64	46.00	1.00	Horizontal	1000000.00	-2.15

Transmit at High Channel, 3-26 GHz

Test Information:

Date and Time	1/11/2022 10:35:15 PM
Client and Project Number	Starry_G104749253
Engineer	Vathana Ven
Temperature	24 deg C
Humidity	8%
Atmospheric Pressure	1022 mB
Comments	RE 3 to 13 GHz_Tx High CH 2480 MHz

Graph:Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
9786.052632	54.67	74.00	-19.33	97.00	3.74	Horizontal	1000000.00	11.89
10737.36842	54.17	74.00	-19.83	17.00	3.20	Vertical	1000000.00	13.04
11407.63158	55.95	74.00	-18.05	232.00	2.05	Horizontal	1000000.00	14.00
11743.94737	56.11	74.00	-17.89	211.00	2.55	Horizontal	1000000.00	14.83
12298.94737	57.86	74.00	-16.14	53.00	3.79	Horizontal	1000000.00	15.77
12975	58.44	74.00	-15.56	47.00	3.54	Horizontal	1000000.00	17.68

Average (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
9786.052632	41.99	54.00	-12.01	97.00	3.74	Horizontal	1000000.00	11.89
10737.36842	42.58	54.00	-11.42	17.00	3.20	Vertical	1000000.00	13.04
11407.63158	42.46	54.00	-11.54	232.00	2.05	Horizontal	1000000.00	14.00
11743.94737	43.24	54.00	-10.76	211.00	2.55	Horizontal	1000000.00	14.83
12298.94737	44.34	54.00	-9.66	53.00	3.79	Horizontal	1000000.00	15.77
12975	45.86	54.00	-8.14	47.00	3.54	Horizontal	1000000.00	17.68

Note: Manual scan was performed from 13-26 GHz at 10 cm from EUT. No emissions were detected above the measuring equipment noise floor.

Test Personnel:	Vathana Ven Kouma Sinn	Test Date:	07/01/2021 01/11/2022
Supervising/Reviewing Engineer: (Where Applicable)	N/A		01/18/2022
Product Standard:	CFR47 FCC Part 15.247, CFR47 FCC Part 15	Limit Applied:	See report section 10.3
Input Voltage:	48 VDC Via External P/S	Ambient Temperature:	29, 24, 24 °C
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Relative Humidity:	41, 8, 12 %
		Atmospheric Pressure:	1009, 1022, 1002 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device and Receiver Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B and 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 $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

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 $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}/\text{m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V}/\text{m}$$

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in } \text{dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V}/\text{m}$$

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.

11.2 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		09/02/2021	09/02/2022
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/22/2021	06/22/2022
HS003'	10m under floor cable	Huber-Schuhner	10m-1	HS003	02/17/2021	02/17/2022
PRE12'	Pre-amplifier	Com Power	PAM-118A	18040117	12/06/2021	12/06/2022
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/24/2021	08/24/2022
HS003'	10m under floor cable	Huber + Suhner	10m-1	HS003	02/17/2021	02/17/2022
HS003'	10m under floor cable	Huber-Schuhner	10m-1	HS003	02/17/2021	02/17/2022
145-420'	Receiver to floor cable	Utiflex	UFB311A-2-0591-70070	145-420	02/17/2021	02/17/2022
145-422'	10Amp Pre-amp to under floor	Utiflex	UFB311A-0-2756-70070	145-422	02/17/2021	02/17/2022

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16

11.3 Results:

The sample tested was found to Comply.

§15.109 Radiated emission limits.

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

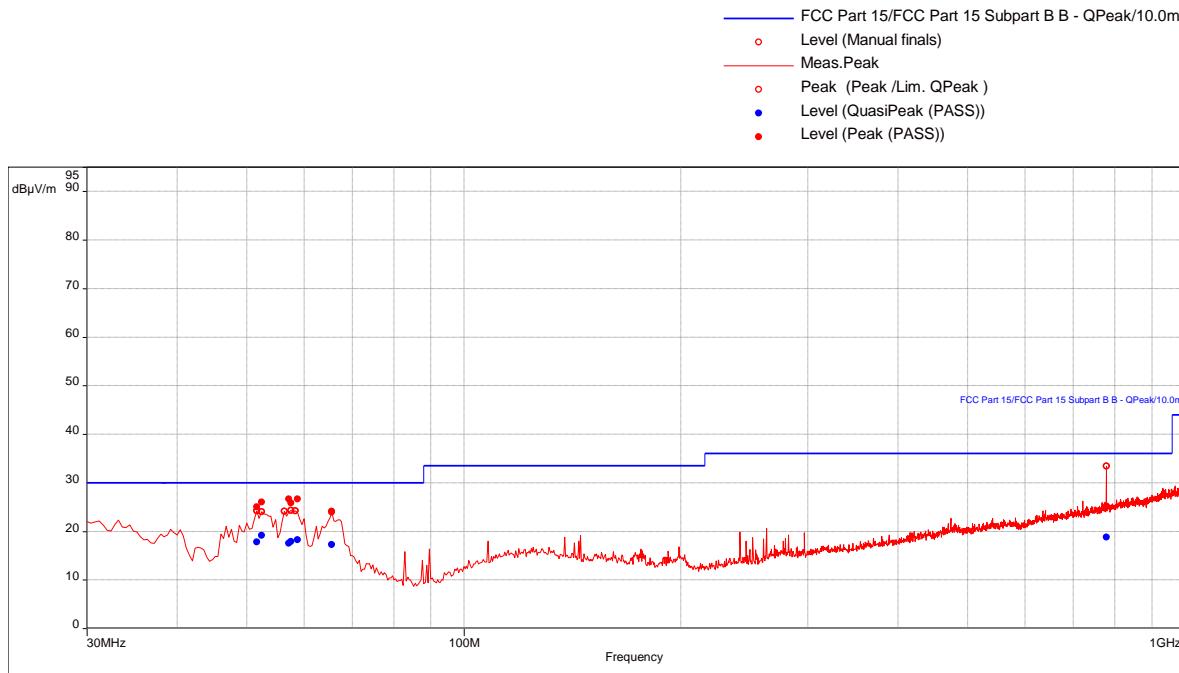
Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dB μ V/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

11.4 Setup Photographs:

Confidential – Photo not included in this report

11.5 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 (dB μ V/m)	Limit (dB μ V/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

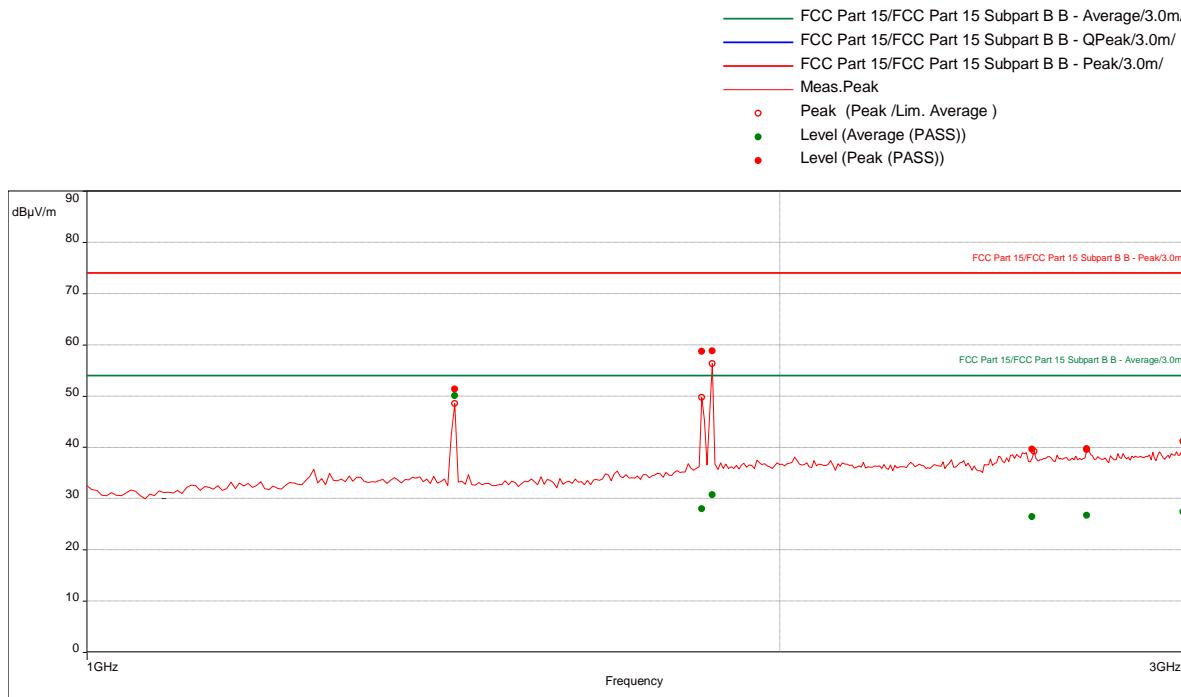
QuasiPeak (PASS) (7)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/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 (dB μ V/m)	Limit (dB μ V/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

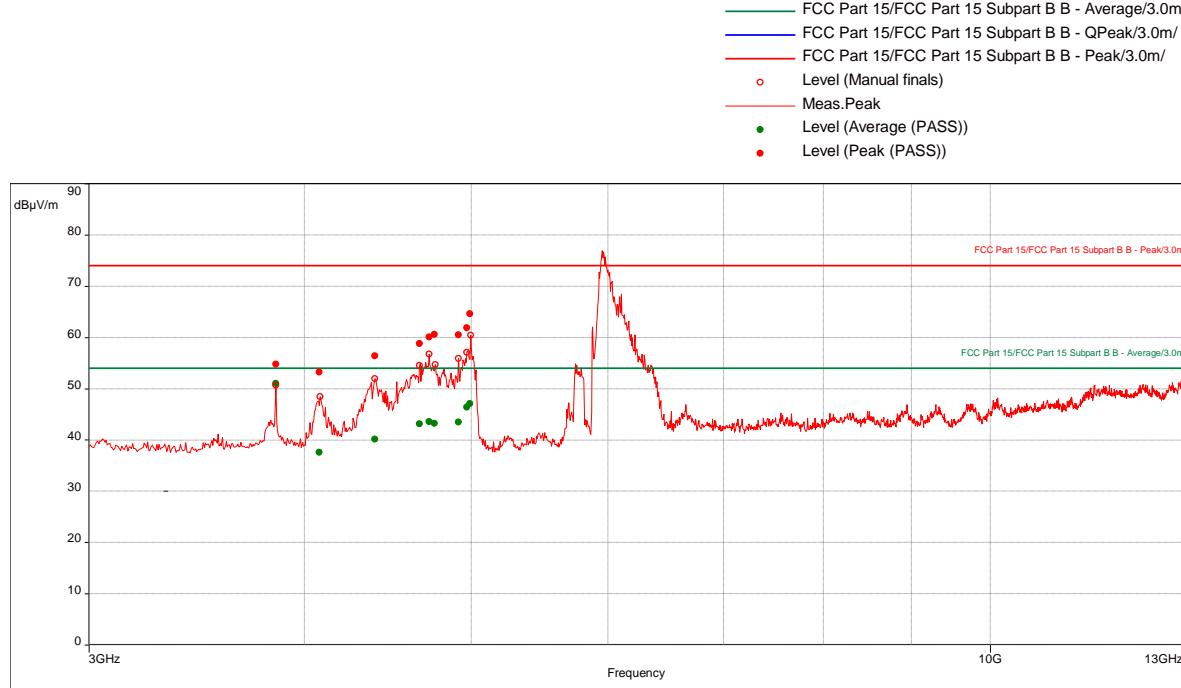
Average (PASS) (6)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/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 (dB μ V/m)	Limit (dB μ V/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 (dB μ V/m)	Limit (dB μ V/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: The high peak is from the 5 GHz radio.

Test Personnel: Vathana F. Ven *VFV*
Supervising/Reviewing
Engineer:
(Where Applicable) Kouma Sinn *KPS*
Product Standard: FCC Part 15 Subpart B
Input Voltage: 48 VDC Via External P/S
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 07/13/2021
Limit Applied: See report section 11.3
Ambient Temperature: 24 °C
Relative Humidity: 43 %
Atmospheric Pressure: 1016 mbars

Deviations, Additions, or Exclusions: None

12 AC Mains Conducted Emissions

12.1 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)	U _{CISPR}
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 dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

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.

12.2 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

12.3 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 (dB μ V)	
	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.

12.4 Setup Photographs:

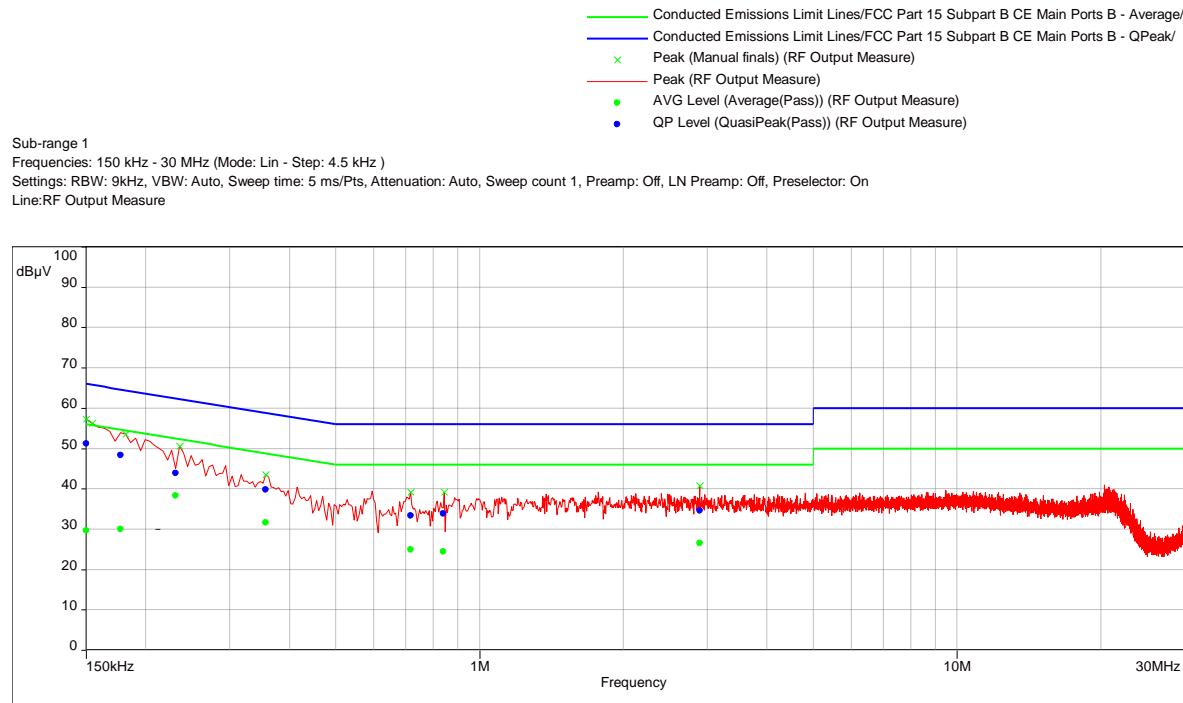
Confidential – Photo not included in this report

12.5 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 (dBuV)	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
Supervising/Reviewing
Engineer:
(Where Applicable) Kouma Sinn
Product Standard: FCC 15 Subpart B
Input Voltage: 48 VDC Via External P/S
Pretest Verification w/
Ambient Signals or
BB Source: Signal Generator

Test Date: 07/16/2021
Limit Applied: Class B
Ambient Temperature: 21 °C
Relative Humidity: 59 %
Atmospheric Pressure: 1005 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	01/25/2022	104749253BOX-001	VFV/VJW	KPS/KPS	Original Issue