CERTIFICATION TEST REPORT

Report Number. : R12790693-E5

Applicant	:	Husqvarna AB EM-FHR Huskvarna, SE-561 82 Sweden
Model	:	HQ-HH-002
FCC ID	:	ZAS-HQ-HH-002
IC	:	23307-HQHH002
EUT Description	:	BLE Module
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2020-05-01

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 USA
Tel: (919) 549-1400

NVLAP TESTING

NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
--	--	Initial Issue	
2	2020-05-01	Revised model name	Lariah Ijames

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Husqvarna AB
EM-FHR
Huskvarna, SE-561 82 Sweden

EUT DESCRIPTION: BLE Module

MODEL: HQ-HH-002

SERIAL NUMBER: Non-Serialized (Sample #3)

DATE TESTED: 2019-05-08 to 2019-07-05

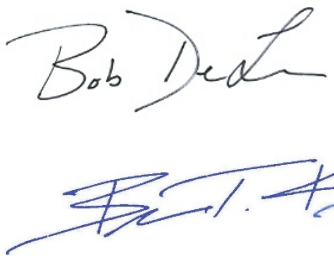
APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Compliant
ISED RSS-247 Issue 2	Compliant
ISED RSS-GEN Issue 5	Compliant

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

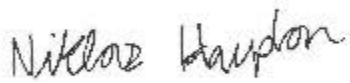
This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. government.

Approved & Released For
UL LLC



Bob DeLisi and Brian Kiewra
Principal Engineer and Project Engineer
Consumer Technology Division
UL LLC

Prepared By:



Niklas Haydon
Engineer
Consumer Technology Division
UL LLC

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, North Carolina, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, North Carolina, USA. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

12 Laboratory Dr.	2800 Perimeter Park Dr., Suite B
ISED Site Code: 2180C	
☐ Chamber A RTP	☒ North Chamber
☐ Chamber C RTP	☒ South Chamber

The above test sites and facilities are covered under FCC Test Firm Registration # 703469. Chambers above are covered under Industry Canada company address and respective code.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	2.00%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	2.50 dB
All emissions, radiated	4.88 dB
Temperature	2.26°C
Humidity	6.79%
DC Supply voltages	1.70%
Time	3.39%

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a BLE radio module.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE	0.72	1.18

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 2450AT18E0100 Johanson Technology antenna, with a maximum gain of 1 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was DTM (Direct Test Mode) nRF5 SDK v15.3.0 (The DTM application enables the DTM test functions described in Bluetooth Specification Version 5.0, Vol. 6, Part F).

5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

The worst-case data rate for each mode is determined to be as follows, based on input from the manufacturer of the radio.

All final tests in the BLE mode were made at 1 Mb/s.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
CMW500	R&S	CMW500	1201.0002K50-132911-tU	NA

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB to TTL	1	USB to TTL	USB to TTL	<3m	Connects to CBT for test purposes only
2	Power	1	Soldered/banana plug	Mains	<3m	Provides DC mains

TEST SETUP

The EUT is connected to a communications tester during test. The communications tester exercised the radio.

SETUP DIAGRAMS

Please refer to R12790693-EP5 for setup diagrams

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6. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 Section 11.6

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter

Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Out-of-band emissions in non-restricted bands: ANSI C63.10-2013 Section 11.11 & 6.10.4

Out-of-band emissions in restricted bands: ANSI C63.10-2013 Section 11.12.1 & 6.10.5

General Radiated Emissions: ANSI C63.10:2013 Sections 6.3 – 6.6

Power-Line Conducted Emissions: ANSI C63.10:2013 Sections 6.2

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
	Conducted Room 1				
T177 (PRE0079253)	Spectrum Analyzer	Agilent Technologies	E4446A	2019-04-22	2020-04-22
PWM004 (PRE0137346)	RF Power Meter	Keysight Technologies	N1911A	2018-07-30	2019-07-30
PWS004 (PRE0126443)	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2018-07-30	2019-07-30
SN 181474341	Environmental Meter	Fisherbrand	15-077-963	2018-07-27	2020-07-27
76021	DC Regulated Power Supply	CircuitSpecialists.Com	CSI3005X5	N/A	N/A
	Additional Equipment used				
80579 (T374)	Wideband Radio Communications Tester	Rohde and Schwartz	CMW500 (SN 132911)	2018-07-05	2019-07-05

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2018-06-19	2019-06-19
s/n 181562858	Environmental Meter	Fisher Scientific	14-650-118	2018-09-04	2020-09-04
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2018-08-21	2019-08-21
75141 (PRE0101521)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2018-08-22	2019-08-22
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2018-06-13	2019-06-13
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Miscellaneous (if needed)				
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2018-07-16	2019-07-16
LISN008	LISN, 50-ohm/50-uH, 2-conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	2018-09-03	2019-09-03
76021	DC Regulated Power Supply	CircuitSpecialists.Com	CSI3005X5	N/A	N/A
T374 80579	Wideband Communication Tested	Rohde & Schwarz	CMW500 (SN 132911)	2018-07-05	2019-07-05

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SN 181474341	Environmental Meter	Fisherbrand	15-077-963	2018-07-27	2020-07-27

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2019-01-24	2020-01-31
	30-1000 MHz				
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-07-24	2019-07-24
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
	Gain-Loss Chains				
S-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
S-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-13	2020-03-13
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-09-30	2019-09-30
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-02-28	2020-02-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474409	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27
80579 (T374)	Wideband Radio Communications Tester	Rohde and Schwartz	CMW500 (SN 132911)	2018-07-05	2019-07-05
76021	DC Power Supply	Circuit Specialists.com	CS13005X5	NA	NA
76022	DC Power Supply	Circuit Specialists.com	CS13005X5	NA	NA

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

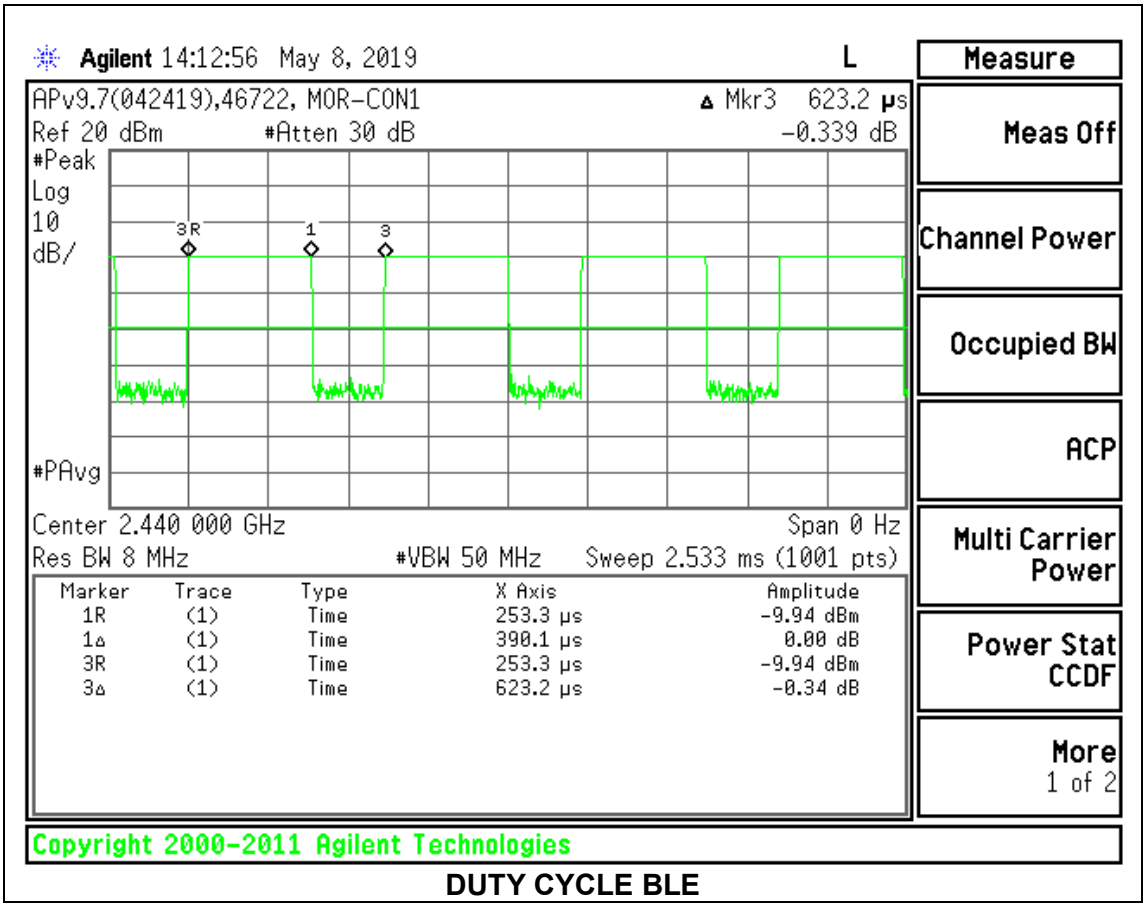
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
BLE	0.390	0.623	0.626	62.60%	2.03	2.563

DUTY CYCLE PLOTS



DUTY CYCLE BLE

8.2. 99% BANDWIDTH

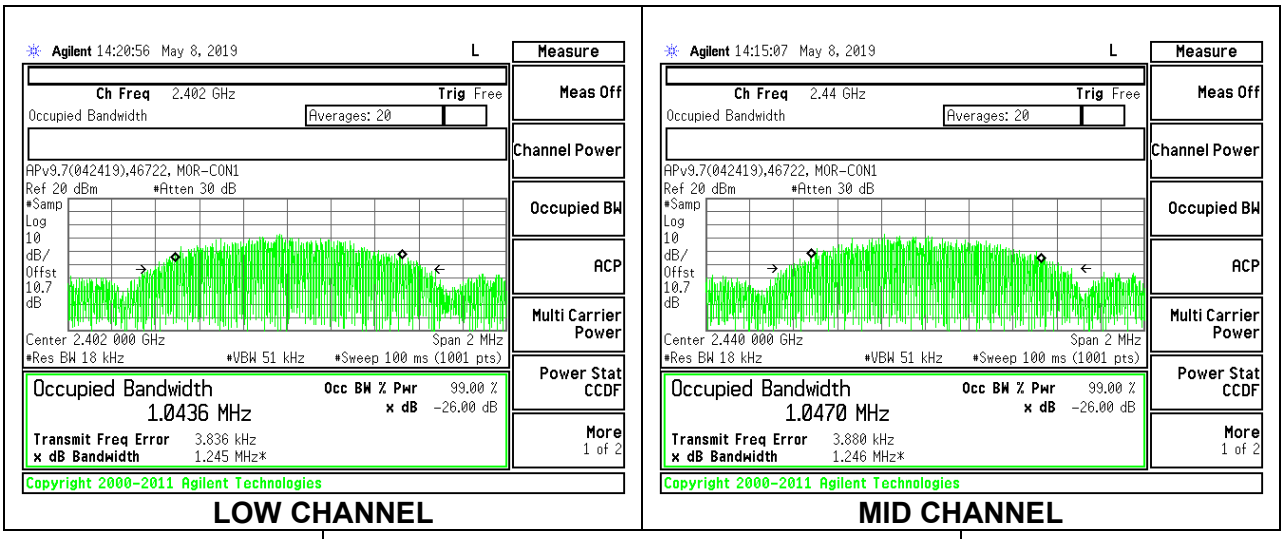
LIMITS

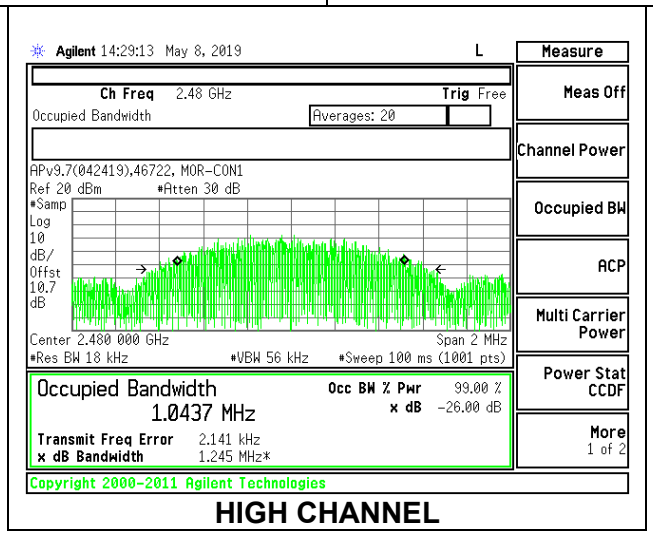
None; for reporting purposes only.

RESULTS

8.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.044
Middle	2440	1.047
High	2480	1.044





8.3. 6 dB BANDWIDTH

LIMITS

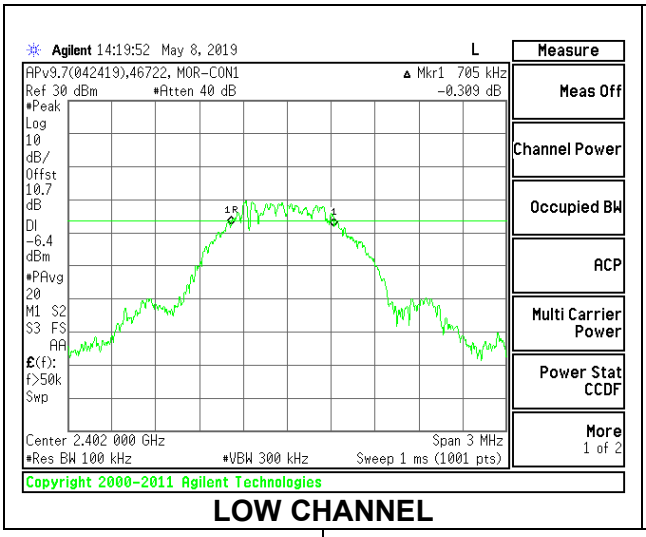
FCC §15.247 (a) (2)
RSS-247 5.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

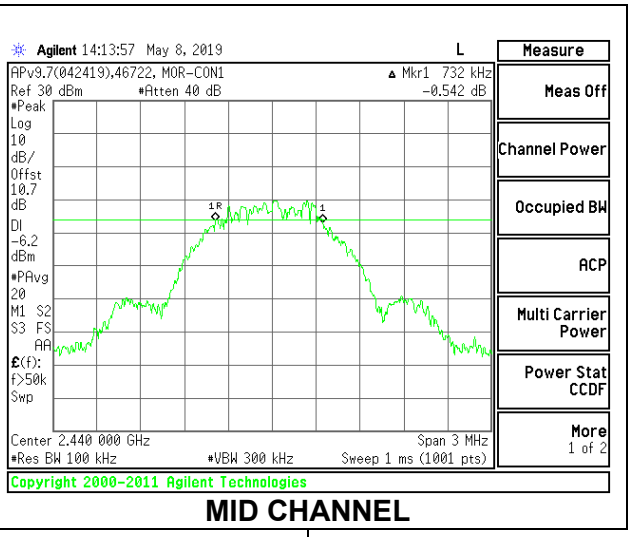
RESULTS

8.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.7050	0.5
Middle	2440	0.7320	0.5
High	2480	0.7170	0.5



LOW CHANNEL



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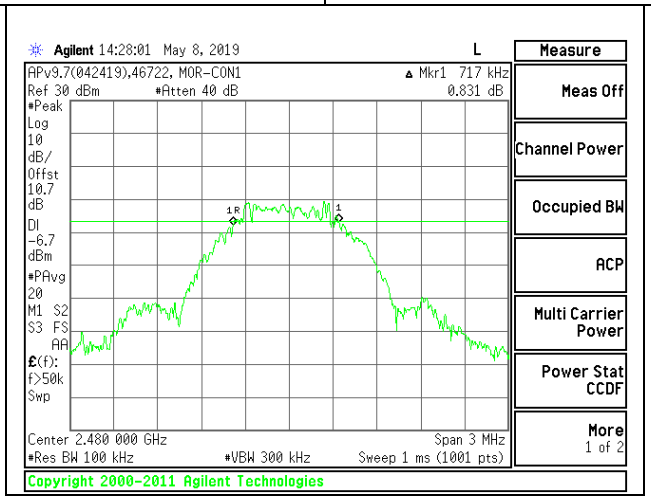

HIGH CHANNEL

8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)
RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.66 dB (including 10 dB pad and 0.66 dB cable) was entered as an offset in the power meter to allow for a peak reading of power.

RESULTS

8.4.1. BLE (1Mbps)

Tested By:	46722
Date:	2019-05-08

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.72	30	-29.280
Middle	2440	0.60	30	-29.400
High	2480	0.23	30	-29.770

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8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.66 dB (including 10 dB pad and 0.66 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

8.5.1. BLE (1Mbps)

Tested By:	46722
Date:	2019-05-08

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	0.63
Middle	2440	0.49
High	2480	0.11

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8.6. POWER SPECTRAL DENSITY

LIMITS

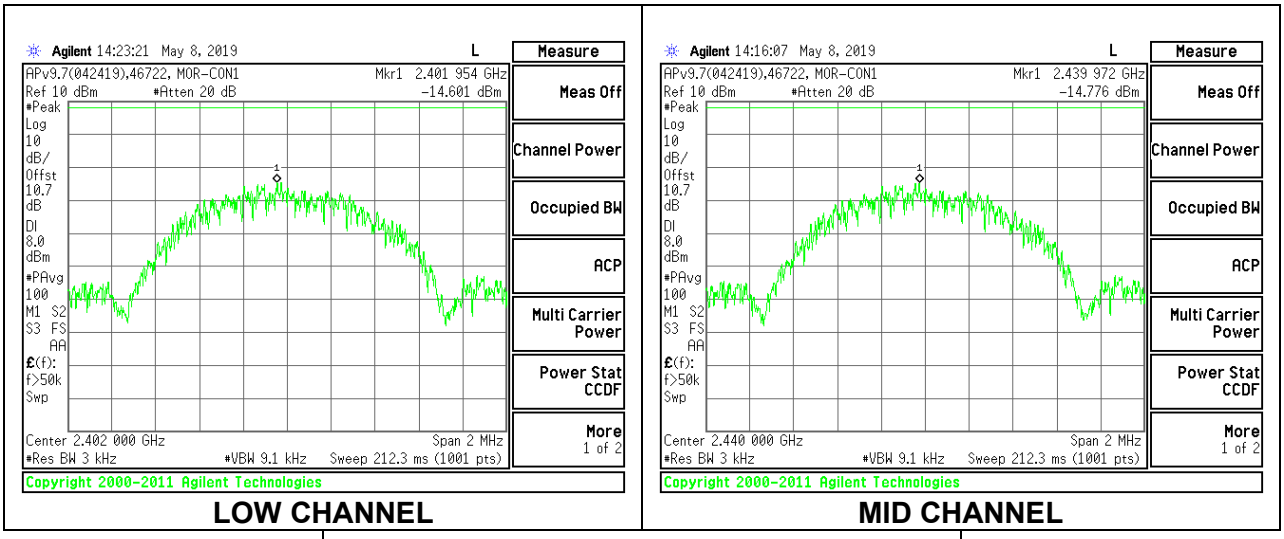
FCC §15.247 (e)
RSS-247 (5.2) (b)

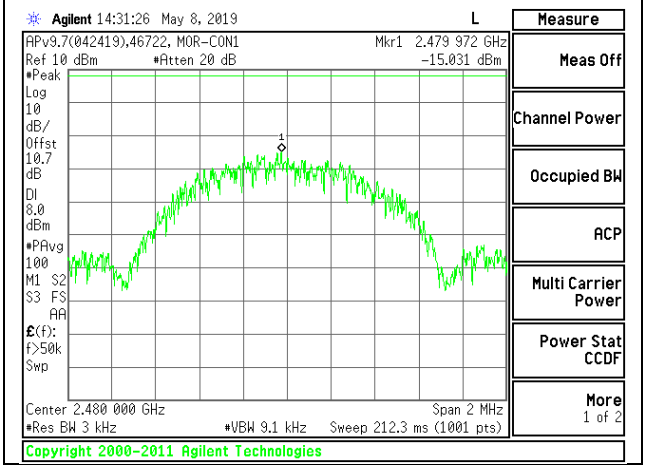
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

8.6.1. BLE (1Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-14.60	8	-22.60
Middle	2440	-14.78	8	-22.78
High	2480	-15.03	8	-23.03





HIGH CHANNEL

8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS

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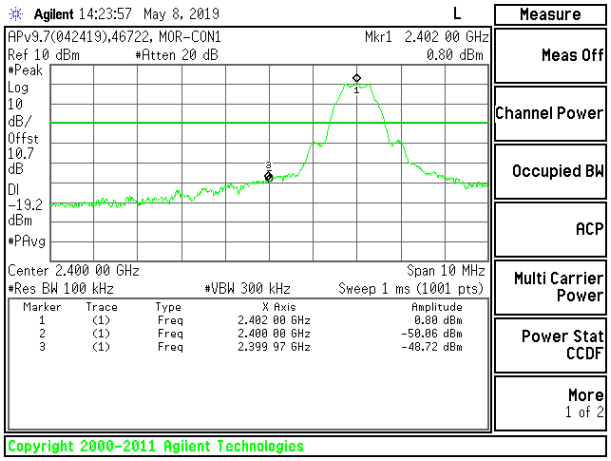
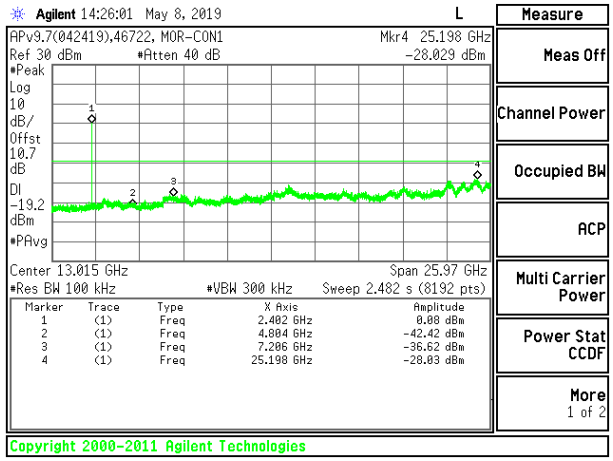
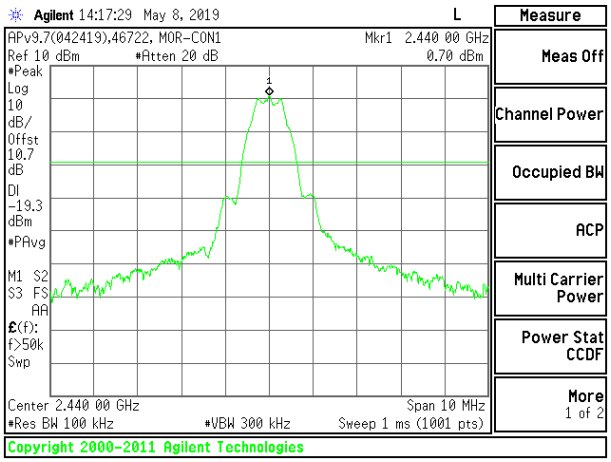
8.7.1. BLE (1Mbps)



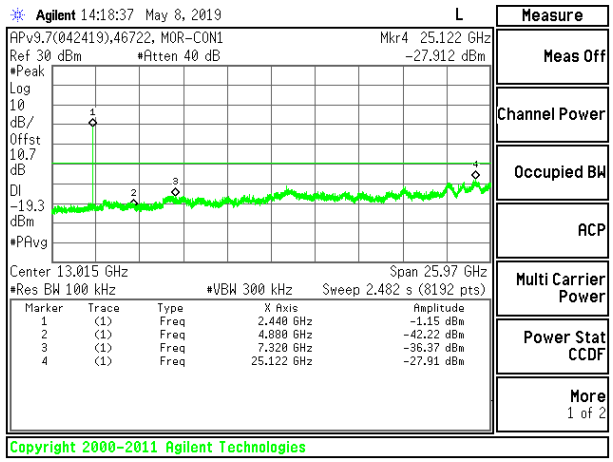
LOW CHANNEL BANDEDGE



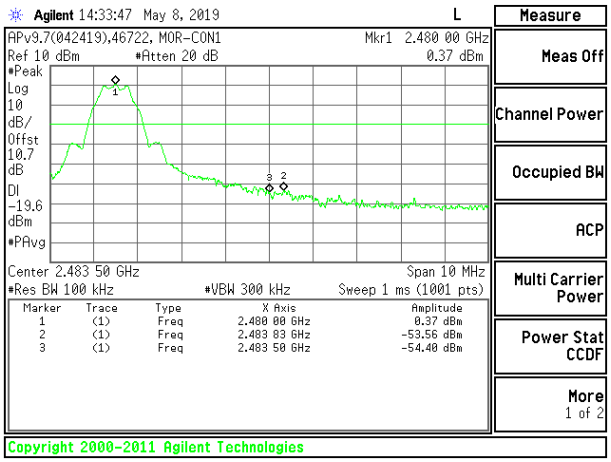
OUT-OF-BAND LOW CHANNEL



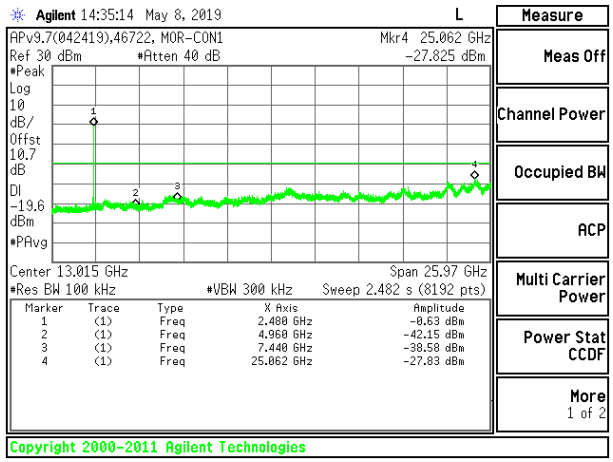
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements for the 30-1000 MHz range, 9 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements for the 0.15-30 MHz range and 200 Hz for peak detection measurements or 200 Hz for quasi-peak detection measurements for the 9 to 150 kHz range. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 kHz for peak measurements.

For final peak measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for average measurements above 1GHz, the resolution bandwidth and video bandwidth are set as described in ANSI C63.10:2013 for the applicable measurement. The particular averaging method used for this test program was RMS averaging.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

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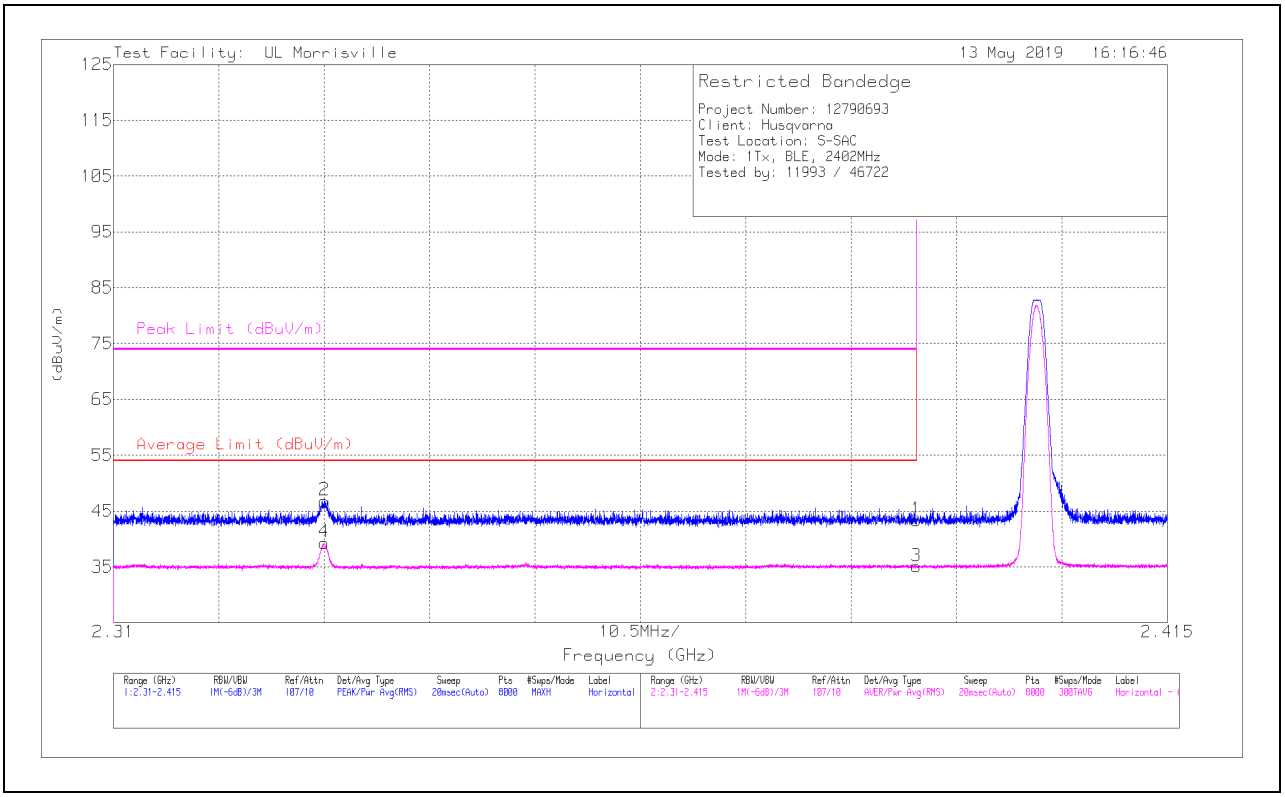
9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BLE (1Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.5	Pk	31.9	-24	0	43.4	-	-	74	-30.6	205	223	H
2	* ** 2.331	38.84	Pk	31.7	-23.7	0	46.84	-	-	74	-27.16	205	223	H
3	* ** 2.39	25.2	RMS	31.9	-24	2.03	35.13	54	-18.87	-	-	205	223	H
4	* ** 2.331	29.31	RMS	31.7	-23.7	2.03	39.34	54	-14.66	-	-	205	223	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
RMS - RMS detection

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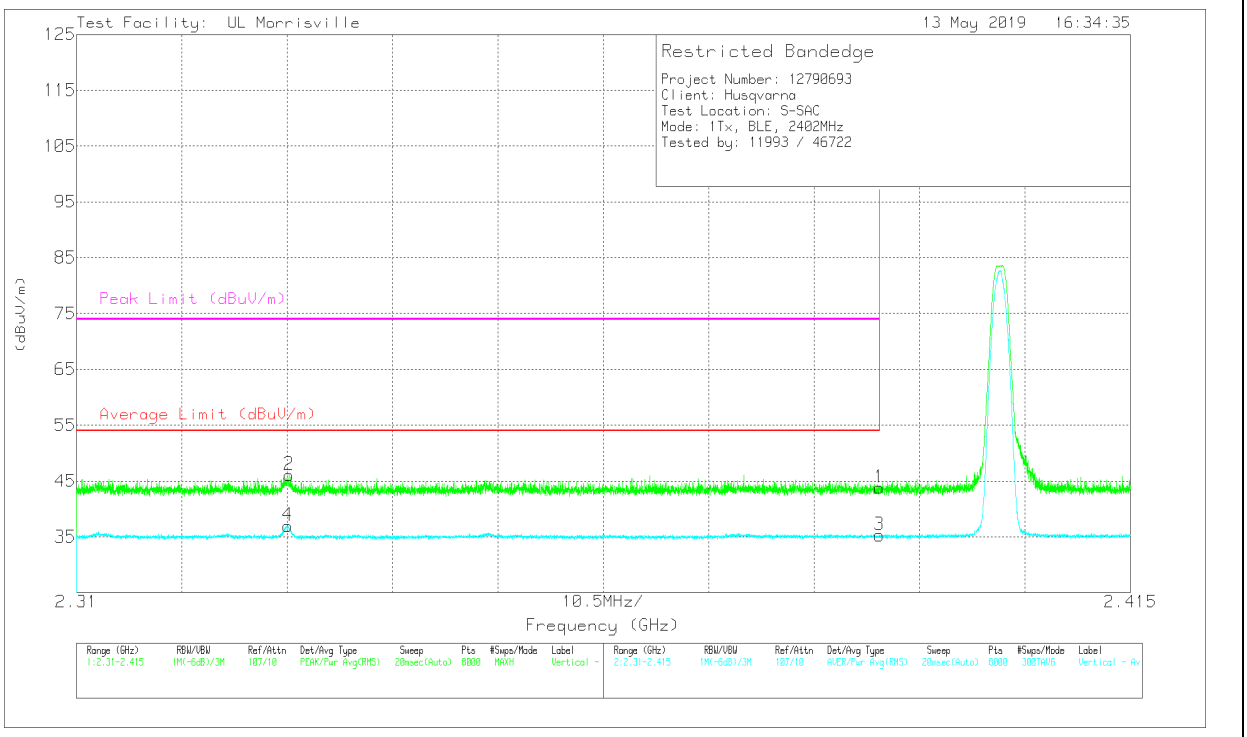
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.93	Pk	31.9	-24	0	43.83	-	-	74	-30.17	275	286	V
2	* ** 2.331	38.08	Pk	31.7	-23.7	0	46.08	-	-	74	-27.92	275	286	V
3	* ** 2.39	25.37	RMS	31.9	-24	2.03	35.3	54	-18.7	-	-	275	286	V
4	* ** 2.331	26.97	RMS	31.7	-23.7	2.03	37	54	-17	-	-	275	286	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
RMS - RMS detection

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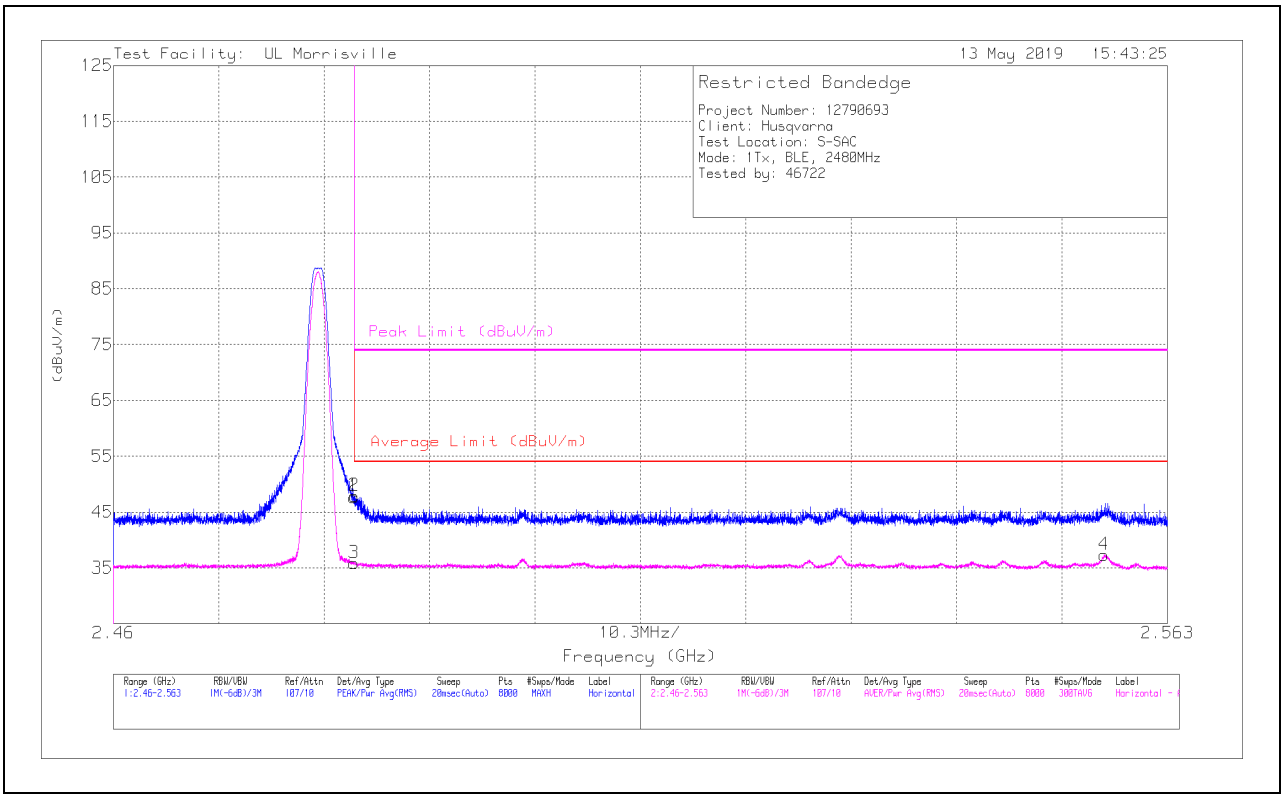
BANDEDGE (HIGH CHANNEL)

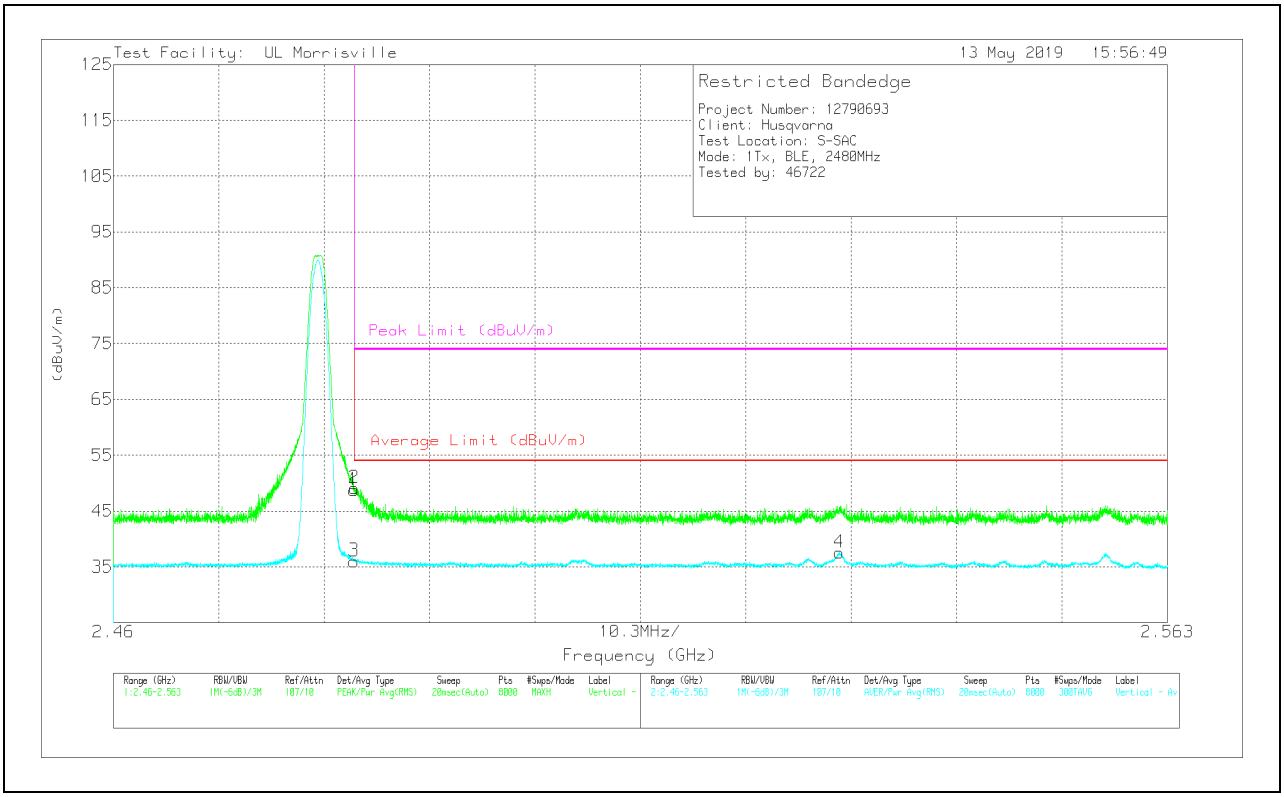
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.484	39.9	Pk	32.3	-24.5	0	47.7	-	-	74	-26.3	50	113	H
2	* ** 2.484	40.08	Pk	32.3	-24.5	0	47.88	-	-	74	-26.12	50	113	H
3	* ** 2.484	26.03	RMS	32.3	-24.5	2.03	35.86	54	-18.14	-	-	50	113	H
4	2.557	27.97	RMS	32.3	-25	2.03	37.3	54	-16.7	-	-	50	113	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.484	40.97	Pk	32.3	-24.5	0	48.77	-	-	74	-25.23	261	201	V
2	* ** 2.484	41.3	Pk	32.3	-24.5	0	49.1	-	-	74	-24.9	261	201	V
3	* ** 2.484	26.18	RMS	32.3	-24.5	2.03	36.01	54	-17.99	-	-	261	201	V
4	2.531	27.94	RMS	32.4	-24.8	2.03	37.57	54	-16.43	-	-	261	201	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
RMS - RMS detection

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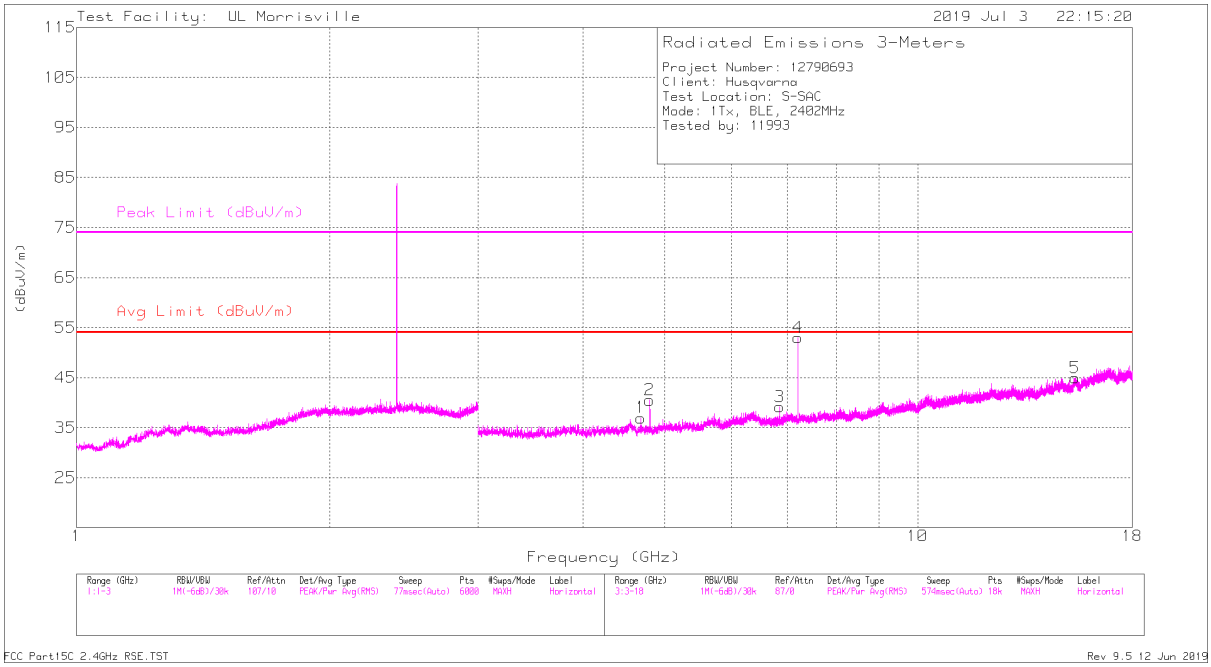
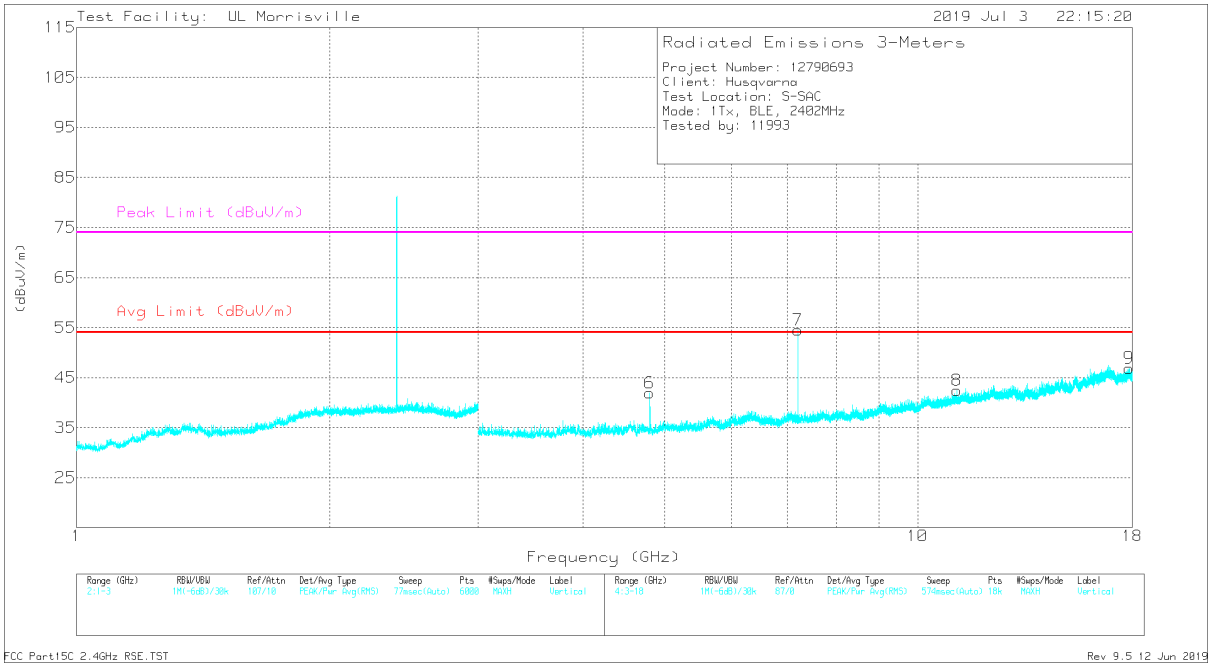
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 4.68794	39.35	PK2	34	-31.6	0	41.75	-	-	74	-32.25	271	400	H
	* ** 4.68785	27.67	MAv1	34	-31.6	2.03	32.1	54	-21.9	-	-	271	400	H
2	* ** 4.80362	42.66	PK2	34.2	-31	0	45.86	-	-	74	-28.14	329	102	H
	* ** 4.80399	33.79	MAv1	34.2	-31	2.03	39.02	54	-14.98	-	-	329	102	H
5	* ** 15.38426	33.51	PK2	39.9	-21.5	0	51.91	-	-	74	-22.09	320	134	H
	* ** 15.3845	21.63	MAv1	39.9	-21.5	2.03	42.06	54	-11.94	-	-	320	134	H
6	* ** 4.80408	43.25	PK2	34.2	-31	0	46.45	-	-	74	-27.55	54	215	V
	* ** 4.80363	33.67	MAv1	34.2	-31	2.03	38.9	54	-15.1	-	-	54	215	V
8	* ** 11.13509	34.16	PK2	37.9	-24	0	48.06	-	-	74	-25.94	45	249	V
	* ** 11.13512	22.06	MAv1	37.9	-24	2.03	37.99	54	-16.01	-	-	45	249	V
9	* ** 17.82922	32.71	PK2	41.2	-20.8	0	53.11	-	-	74	-20.89	338	217	V
	* ** 17.8278	21.44	MAv1	41.2	-20.8	2.03	43.87	54	-10.13	-	-	338	217	V
7	7.20524	46.79	Pk	35.7	-28	0	54.49	-	-	-	-	0-360	101	V
4	7.2069	45.31	Pk	35.7	-28	0	53.01	-	-	-	-	0-360	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

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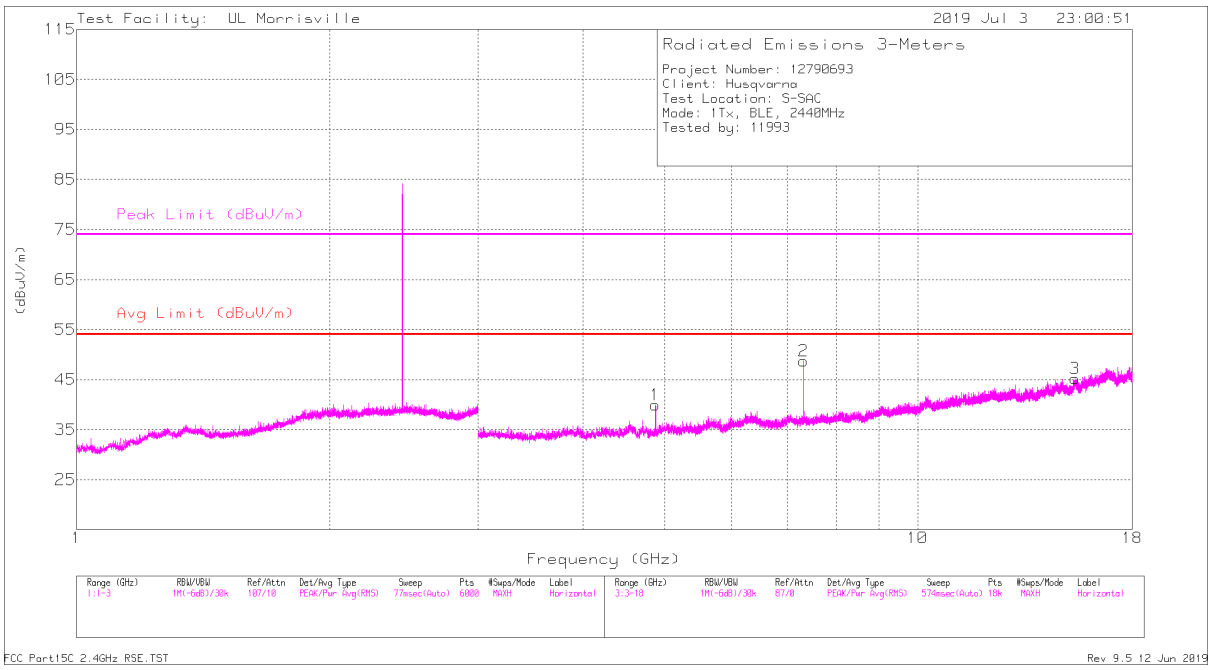
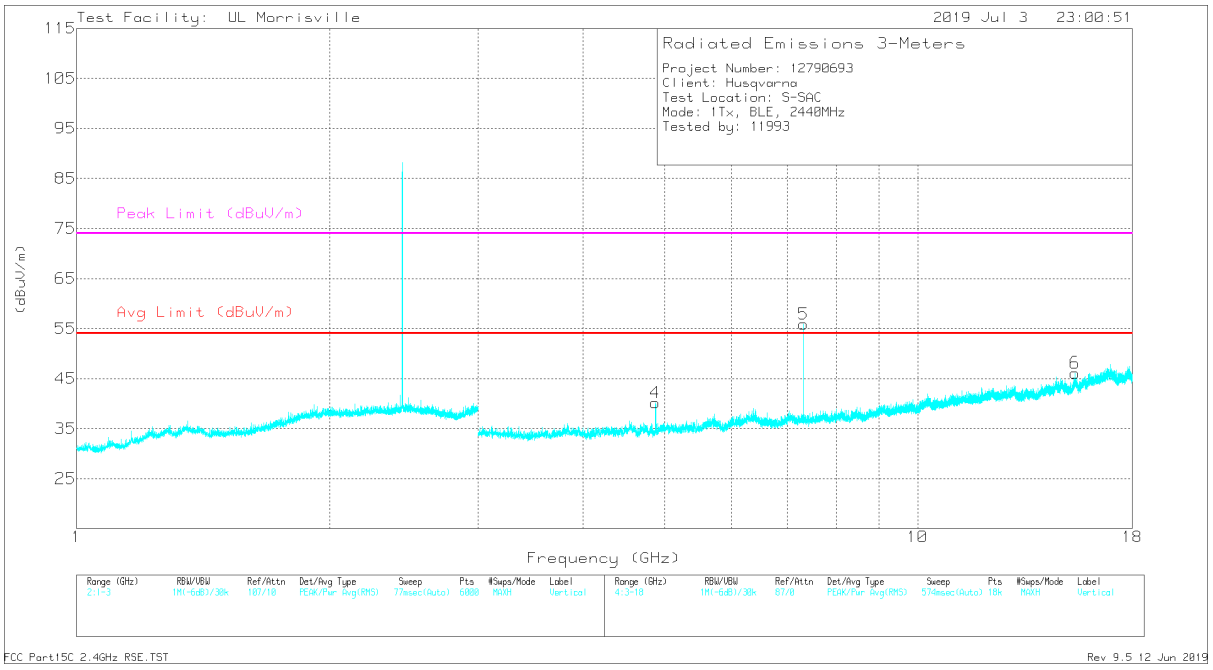
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 4.87955	42.4	PK2	34	-30.6	0	45.8	-	-	74	-28.2	273	102	H
	* ** 4.8797	33.04	MAv1	34	-30.6	2.03	38.47	54	-15.53	-	-	273	102	H
2	* ** 7.31924	45.05	PK2	35.7	-27.5	0	53.25	-	-	74	-20.75	166	101	H
	* ** 7.31933	37.11	MAv1	35.7	-27.5	2.03	47.34	54	-6.66	-	-	166	101	H
3	* ** 15.39217	34.32	PK2	39.9	-21.4	0	52.82	-	-	74	-21.18	244	164	H
	* ** 15.39196	21.65	MAv1	39.9	-21.4	2.03	42.18	54	-11.82	-	-	244	164	H
4	* ** 4.87955	42.71	PK2	34	-30.6	0	46.11	-	-	74	-27.89	190	210	V
	* ** 4.87968	32.97	MAv1	34	-30.6	2.03	38.4	54	-15.6	-	-	190	210	V
5	* ** 7.31918	50.44	PK2	35.7	-27.5	0	58.64	-	-	74	-15.36	205	175	V
	* ** 7.31933	43.67	MAv1	35.7	-27.5	2.03	53.9	54	-.1	-	-	205	175	V
6	* ** 15.39423	33.71	PK2	39.9	-21.3	0	52.31	-	-	74	-21.69	225	214	V
	* ** 15.3947	21.45	MAv1	39.9	-21.3	2.03	42.08	54	-11.92	-	-	225	214	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average
Pk - Peak detector

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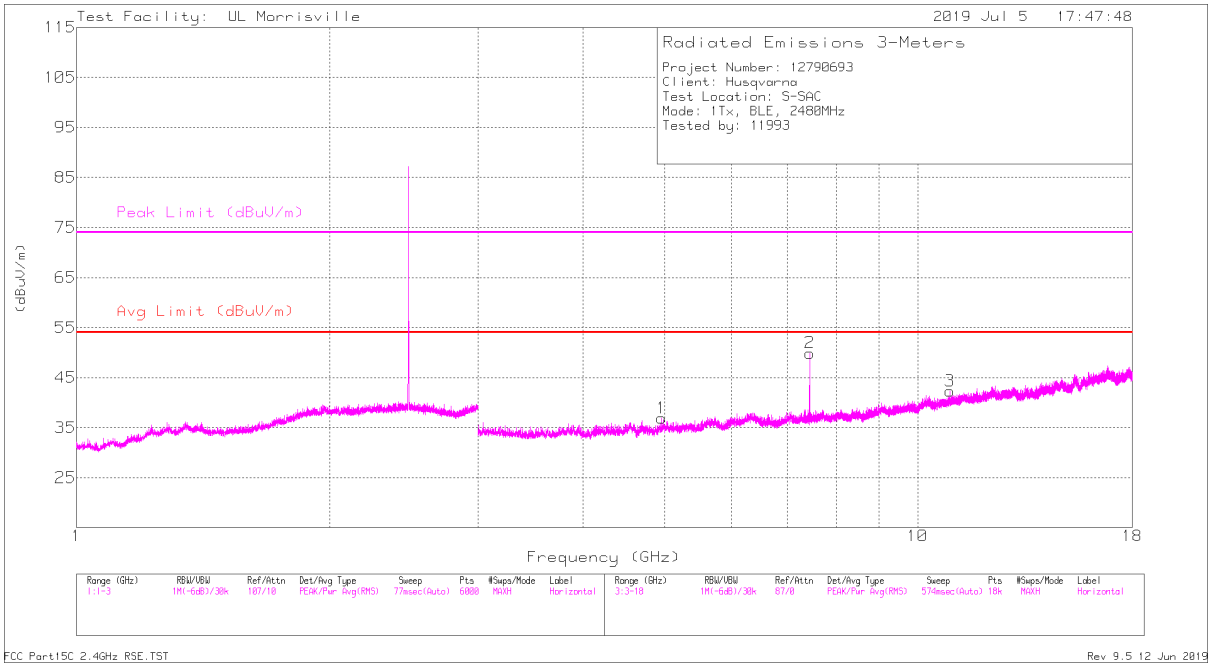
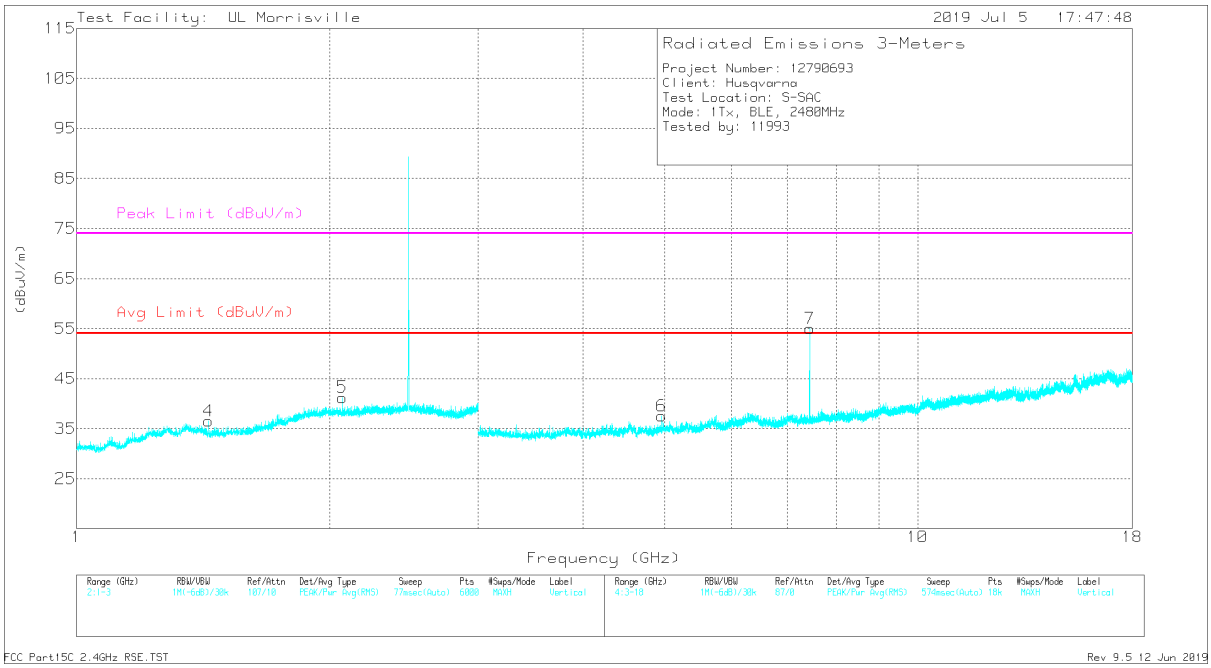
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* ** 1.43542	35.4	PK2	28.2	-22.7	0	40.9	-	-	74	-33.1	128	217	V
	* ** 1.43539	23.36	MAv1	28.2	-22.7	2.03	30.89	54	-23.11	-	-	128	217	V
1	* ** 4.95956	41.42	PK2	34.1	-31	0	44.52	-	-	74	-29.48	267	163	H
	* ** 4.95978	30.5	MAv1	34.1	-31	2.03	35.63	54	-18.37	-	-	267	163	H
2	* ** 7.44061	45.19	PK2	35.8	-27.8	0	53.19	-	-	74	-20.81	268	311	H
	* ** 7.43937	37.7	MAv1	35.8	-27.8	2.03	47.73	54	-6.27	-	-	268	311	H
3	* ** 10.9191	35.14	PK2	37.9	-24.3	0	48.74	-	-	74	-25.26	238	314	H
	* ** 10.919	22.36	MAv1	37.9	-24.3	2.03	37.99	54	-16.01	-	-	238	314	H
6	* ** 4.9602	39.99	PK2	34.1	-31.1	0	42.99	-	-	74	-31.01	164	174	V
	* ** 4.9601	29.34	MAv1	34.1	-31.1	2.03	34.37	54	-19.63	-	-	164	174	V
7	* ** 7.44068	49.59	PK2	35.8	-27.8	0	57.59	-	-	74	-16.41	222	142	V
	* ** 7.43933	42.78	MAv1	35.8	-27.8	2.03	52.81	54	-1.19	-	-	222	142	V
5	2.07051	32.74	Pk	31.2	-22.7	0	41.24	-	-	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK2 - Maximum Peak
MAv1 - Maximum RMS Average

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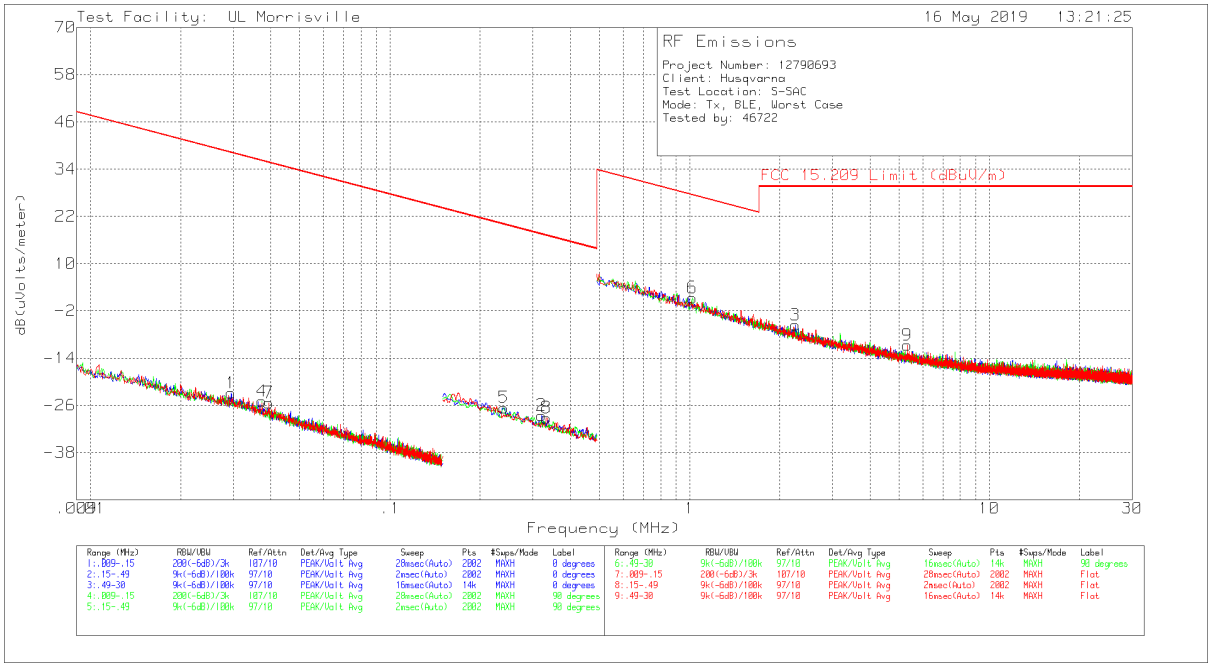
9.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).



ANTENNA- THREE ORIENTATIONS

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP FCC 15.209 Limit (dBuV/m)	Avg FCC 15.209 Limit (dBuV/m)	Pk FCC 15.209 Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)
1	.02951	43.53	Pk	13.5	.1	-80	-22.87	-	38.21	58.21	-61.08	0-360
4	.03735	42.29	Pk	12.7	.1	-80	-24.91	-	36.16	56.16	-61.07	0-360
7	.03938	42.03	Pk	12.5	.1	-80	-25.37	-	35.7	55.7	-61.07	0-360
5	.23951	42.58	Pk	10.7	.1	-80	-26.62	-	20.02	40.02	-46.64	0-360
2	.32034	40.73	Pk	10.6	.1	-80	-28.57	-	17.49	37.49	-46.06	0-360
8	.33335	40.11	Pk	10.6	.1	-80	-29.19	-	17.15	37.15	-46.34	0-360
6	1.02122	30.12	Pk	11	.2	-40	1.32	27.42	-	-	-26.1	0-360
3	2.2544	23.05	Pk	11.1	.2	-40	-5.65	29.54	-	-	-35.19	0-360
9	5.31943	17.87	Pk	11	.4	-40	-10.73	29.54	-	-	-40.27	0-360

Pk - Peak detector

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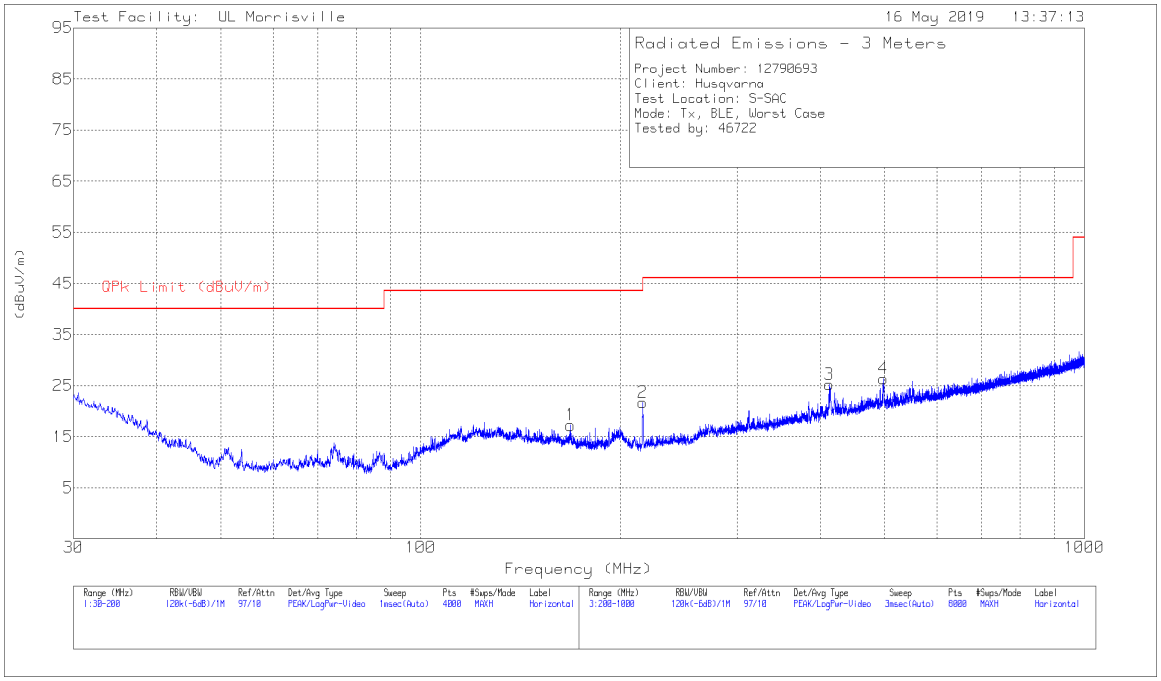
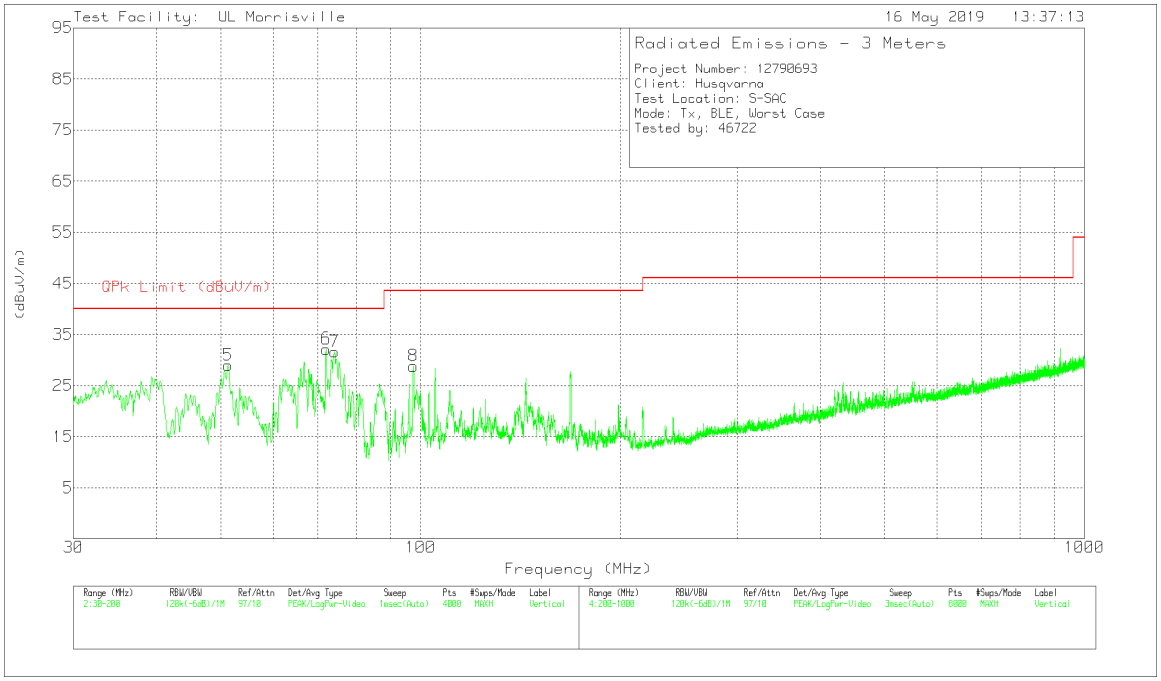
9.4. WORST CASE BELOW 1 GHZ

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

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Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 AF (dB/m)	Cbl/Amp	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	51.2555	48.04	Pk	12.4	-31.5	28.94	40	-11.06	0-360	101	V
6	72.0434	50.87	Pk	12.5	-31.2	32.17	40	-7.83	0-360	101	V
7	74.2114	50.44	Pk	12.4	-31.2	31.64	40	-8.36	0-360	101	V
8	97.55	46.1	Pk	13.7	-31	28.8	43.52	-14.72	0-360	101	V
1	168.0757	31.14	Pk	16.5	-30.4	17.24	43.52	-26.28	0-360	198	H
2	216.1021	36.32	Pk	15.5	-30.1	21.72	46.02	-24.3	0-360	198	H
3	412.9277	33.62	Pk	20.8	-29.2	25.22	46.02	-20.8	0-360	102	H
4	498.1388	32.85	Pk	22.2	-28.7	26.35	46.02	-19.67	0-360	198	H

Pk - Peak detector

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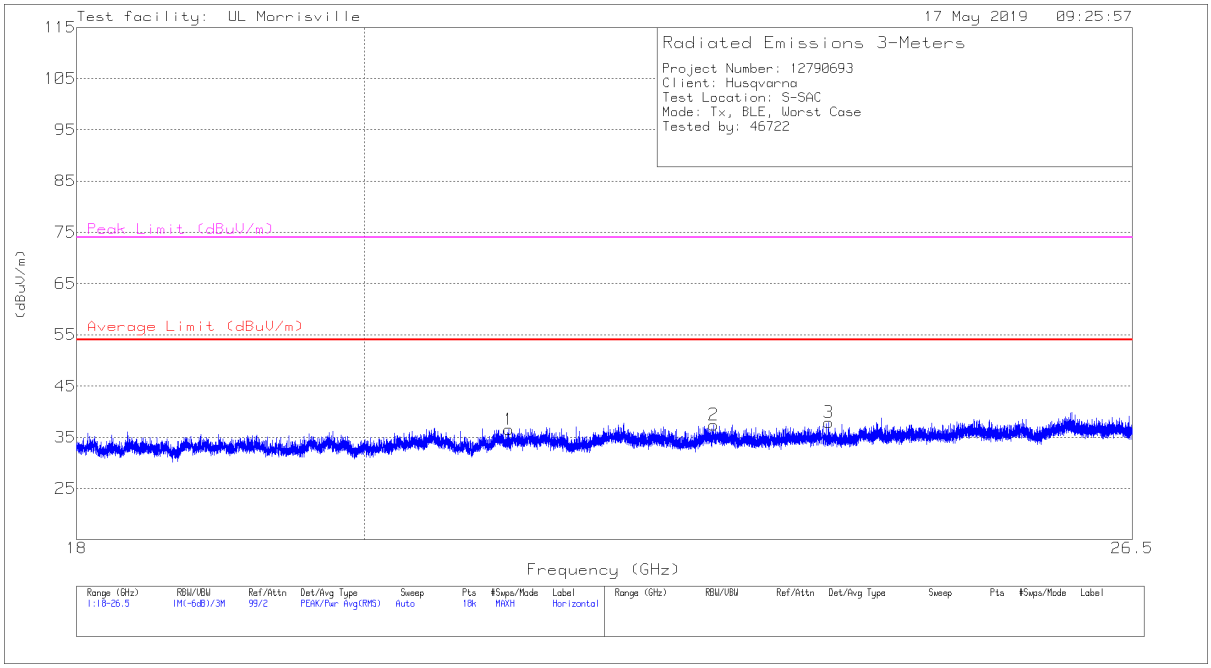
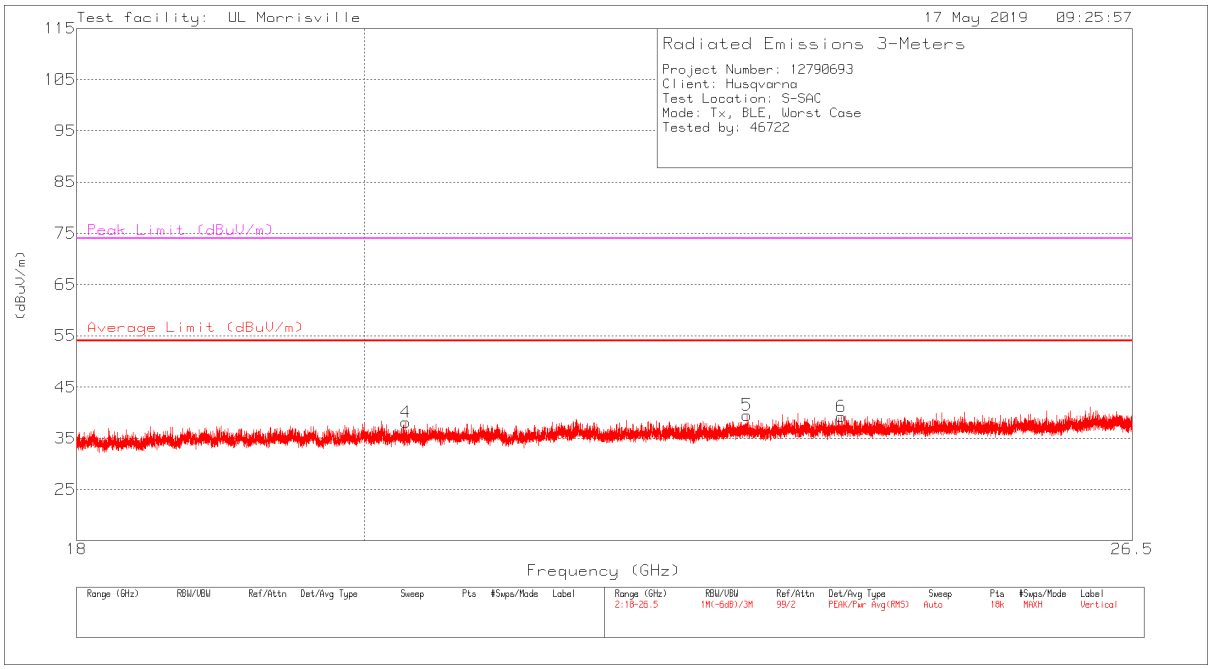
9.5. WORST CASE 18-26 GHZ

SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Cbl/Amp (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 21.09	42.03	Pk	33	-38.5	0	36.53	54	-17.47	74	-37.47	0-360	299	H
2	* ** 22.731	41.74	Pk	33.5	-37.8	0	37.44	54	-16.56	74	-36.56	0-360	199	H
3	* ** 23.711	41.32	Pk	34	-37.4	0	37.92	54	-16.08	74	-36.08	0-360	299	H
4	* ** 20.306	43.61	Pk	33	-38.5	0	38.11	54	-15.89	74	-35.89	0-360	151	V
5	* ** 23.011	43.53	Pk	33.7	-37.7	0	39.53	54	-14.47	74	-34.47	0-360	201	V
6	* ** 23.82	42.56	Pk	34	-37.3	0	39.26	54	-14.74	74	-34.74	0-360	151	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector

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10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

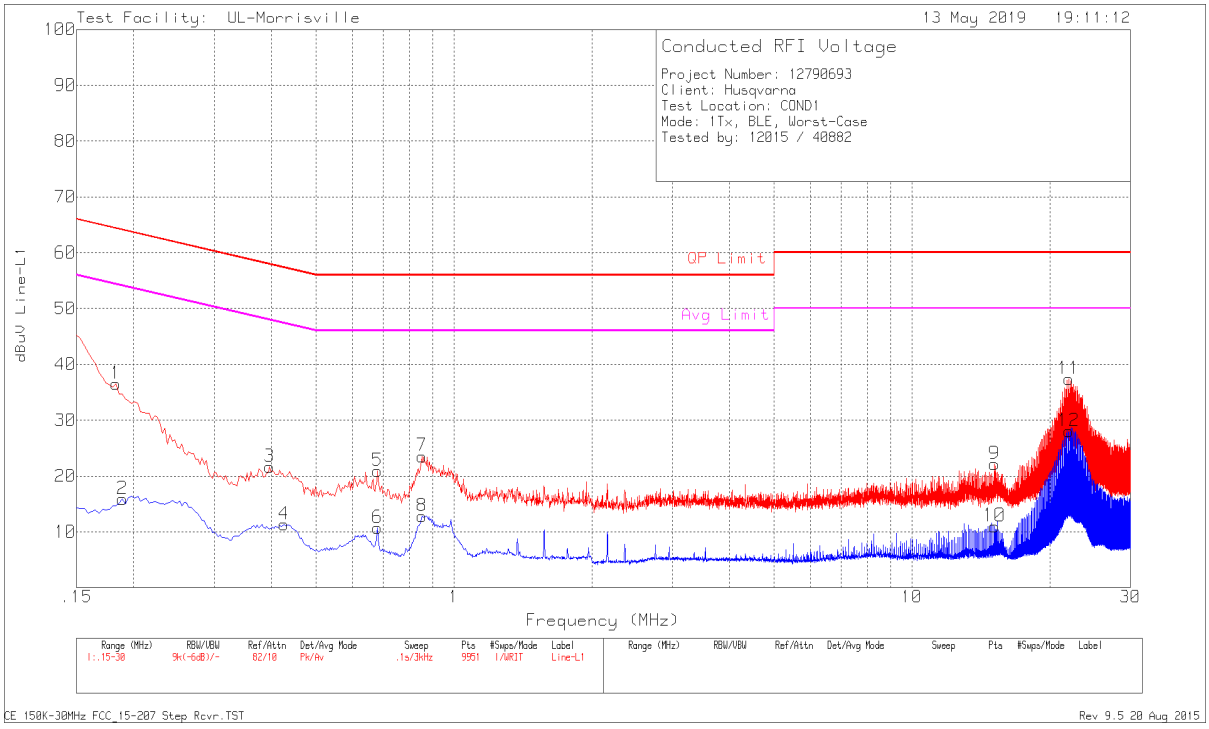
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

RESULTS

10.1.1. AC Power Line Normal

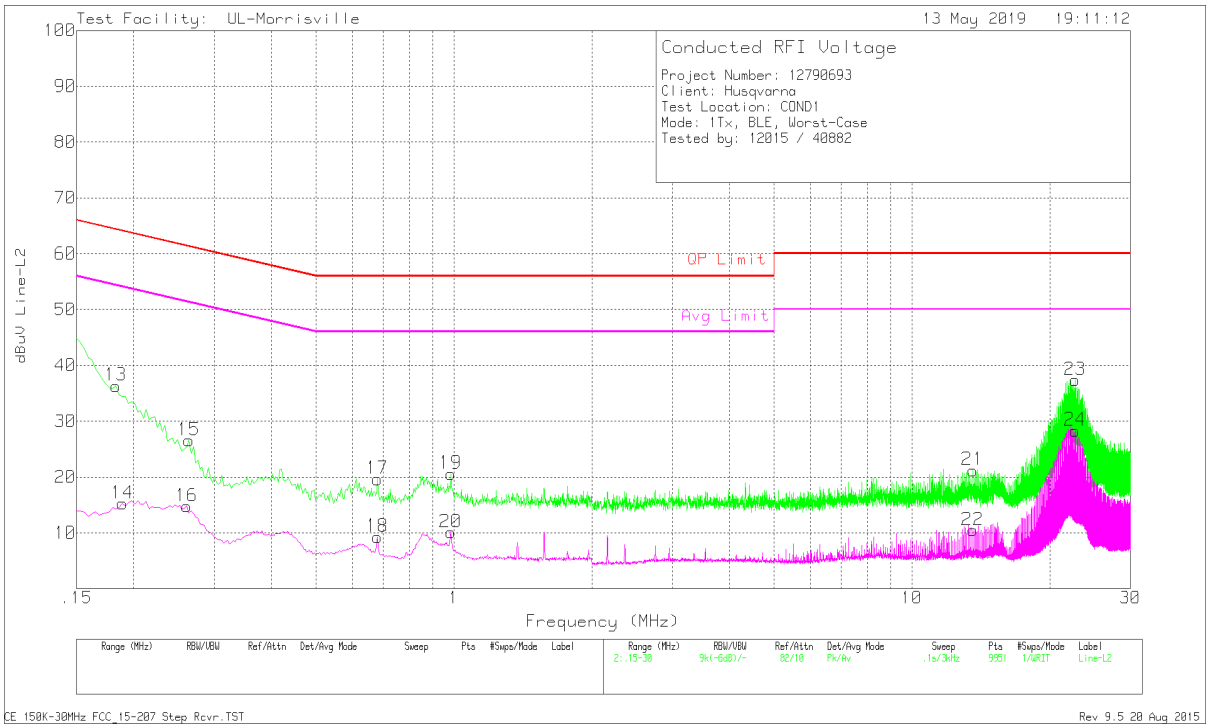
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	**Frequency (MHz)**	**Meter Reading (dBuV)**	**Det**	**LISN VCF (dB)**	**Cbl/Limiter (dB)**	**Corrected Reading dBuV**	**QP Limit**	**Margin (dB)**	**Avg Limit**	**Margin (dB)**
1	.183	26.32	Pk	.2	10	36.52	64.35	-27.83	-	-
2	.189	5.65	Av	.2	10	15.85	-	-	54.08	-38.23
3	.396	11.53	Pk	.1	10	21.63	57.94	-36.31	-	-
4	.426	1.22	Av	.1	10	11.32	-	-	47.33	-36.01
5	.681	10.9	Pk	0	10	20.9	56	-35.1	-	-
6	.681	.73	Av	0	10	10.73	-	-	46	-35.27
7	.852	13.56	Pk	0	10	23.56	56	-32.44	-	-
8	.852	2.82	Av	0	10	12.82	-	-	46	-33.18
9	15.147	11.65	Pk	.1	10.4	22.15	60	-37.85	-	-
10	15.147	.5	Av	.1	10.4	11	-	-	50	-39
11	22.032	26.6	Pk	.2	10.6	37.4	60	-22.6	-	-
12	22.032	17.23	Av	.2	10.6	28.03	-	-	50	-21.97

Pk - Peak detector
Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit	Margin (dB)	Avg Limit	Margin (dB)
13	.183	26.14	Pk	.2	10	36.34	64.35	-28.01	-	-
14	.189	5.09	Av	.2	10	15.29	-	-	54.08	-38.79
15	.264	16.49	Pk	.1	10	26.59	61.3	-34.71	-	-
16	.261	4.67	Av	.1	10	14.77	-	-	51.4	-36.63
17	.681	9.64	Pk	0	10	19.64	56	-36.36	-	-
18	.681	-.72	Av	0	10	9.28	-	-	46	-36.72
19	.984	10.6	Pk	0	10	20.6	56	-35.4	-	-
20	.984	.12	Av	0	10	10.12	-	-	46	-35.88
21	13.572	10.73	Pk	.1	10.4	21.23	60	-38.77	-	-
22	13.572	-.05	Av	.1	10.4	10.45	-	-	50	-39.55
23	22.719	26.57	Pk	.2	10.6	37.37	60	-22.63	-	-
24	22.719	17.53	Av	.2	10.6	28.33	-	-	50	-21.67

Pk - Peak detector
Av - Average detection

11. SETUP PHOTOS

Please refer to R12790693-EP5 for setup photos

END OF TEST REPORT

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