



CERTIFICATION TEST REPORT

Report Number. : R13158070-E3

Applicant : Braun GMBH
T-QTA Frankfurter Strasses 145
Kronberg TS, D-61476
Germany

Model : 3783

FCC ID : 2AG9A51910

EUT Description : Wireless Toothbrush Charging Base

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C

Date Of Issue:

March 20, 2020

Prepared by:

UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
TEL: (919) 549-1400

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
--	--	Initial Issue	

TABLE OF CONTENTS

REPORT REVISION HISTORY	2
TABLE OF CONTENTS	3
1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	7
4.1. MEASURING INSTRUMENT CALIBRATION	7
4.2. SAMPLE CALCULATION	7
4.3. MEASUREMENT UNCERTAINTY	7
5. EQUIPMENT UNDER TEST	8
5.1. EUT DESCRIPTION	8
5.2. MAXIMUM OUTPUT POWER	8
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	8
5.4. SOFTWARE AND FIRMWARE	8
5.5. WORST-CASE CONFIGURATION AND MODE	8
5.6. DESCRIPTION OF TEST SETUP	9
6. MEASUREMENT METHOD	10
7. TEST AND MEASUREMENT EQUIPMENT	11
8. ANTENNA PORT TEST RESULTS	14
8.1. ON TIME AND DUTY CYCLE	14
8.2. 99% BANDWIDTH	15
8.2.1. BLE (1Mbps)	15
8.3. 6 dB BANDWIDTH	16
8.3.1. BLE (1Mbps)	16
8.4. OUTPUT POWER	17
8.4.1. BLE (1Mbps)	17
8.5. AVERAGE POWER	18
8.5.1. BLE (1Mbps)	18
8.6. POWER SPECTRAL DENSITY	19
8.6.1. BLE (1Mbps)	19
8.7. CONDUCTED SPURIOUS EMISSIONS	20
8.7.1. BLE (1Mbps)	21

9. RADIATED TEST RESULTS.....	22
9.1. LIMITS AND PROCEDURE	22
9.2. TRANSMITTER ABOVE 1 GHz	24
9.2.1. BLE (1Mbps).....	24
9.3. WORST CASE BELOW 30MHZ	34
9.4. WORST CASE BELOW 1 GHZ.....	35
9.5. WORST CASE 18-26 GHZ	37
10. AC POWER LINE CONDUCTED EMISSIONS	39
10.1.1. AC Power Line Norm.....	40
11. SETUP PHOTOS	42

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Braun GMBH
T-QTA Frankfurter Strasses 145
Kronberg TS, D-61476
Germany

EUT DESCRIPTION: Wireless Toothbrush Charging Base

MODEL: 3783

SERIAL NUMBER: Charging base: BW012969000010

DATE RECEIVED: 2019-12-19

DATE TESTED: 2020-01-02 to 2020-01-06

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies

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.

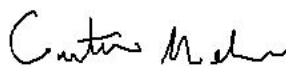
This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim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

Approved & Released For
UL LLC By:



Brian Kiewra
Project Engineer
Consumer Technology Division
UL LLC

Prepared By:



Cristian Melara
Engineer
Consumer Technology Division
UL LLC

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.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, NC 27709, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, 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.
☐ Chamber A RTP	☒ North Chamber
☐ Chamber C RTP	☒ South Chamber

The above test sites and facilities are covered under FCC Test Firm Registration # 703469.

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)
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

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.
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

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
Conducted Emissions (0.150-30MHz) - LISN	3.07 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%.

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a wireless toothbrush charging base with a BT/BLE/2.4/5GHz WLAN radio and a WPT radio that operates from 30-47 kHz. This reports covers the BLE function of the device.

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	3.07	2.03

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPC antenna, with a maximum gain of 2.12 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was Type 3782 firmware version:V12, Type 3783 firmware version: V20.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions in the range of 1-18GHz were tested with the EUT continuously transmitting on low, mid, and high channels.

AC Mains Line Conducted and radiated emissions in the ranges of 0.009-30MHz, 30-1000MHz, and 18-26GHz were are tested at worst-case channel based on power and PSD.

EUT only intended to operate in one orientation. Therefore all testing performed with EUT in its intended orientation.

All testing performed as 1Mbps as worst-case data rate declared by manufacturer

Though these tests were performed in other than open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788 D01.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Toothbrush	Braun	3765	BC811081911	USQ3765
Toothbrush	Braun	3765	BC811081913	USQ3765
Power supply	Braun	3780	Non-serialized	N/A

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	1	1	Proprietary 2 prong	2 conductor wire	<3	None

TEST SETUP

The EUT is powered by a power supply. The EUT begins charging as soon as powered up.

SETUP DIAGRAMS

Please refer to R13158070-EP2 for setup diagrams

6. MEASUREMENT METHOD

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

6 dB BW: ANSI C63.10 Subclause -11.8.1

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 –
For Reference only)

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

AC Line Conducted Emissions: ANSI C63.10:2013 Sections 6.2

7. TEST AND MEASUREMENT EQUIPMENT

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

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
30-1000 MHz					
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2019-008-08	2020-08-08
1-18 GHz					
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-03-22	2020-03-22
Gain-Loss Chains					
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-15	2020-03-15
Receiver & Software					
SA0026	Spectrum Analyzer	Agilent	N9030A	2019-03-19	2020-03-19
SOFTEMI	EMI Software	UL	Version 9.5 June 15, 2019	NA	NA
Additional Equipment used					
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz (Loop Ant.)					
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2019-08-08	2020-08-08
30-1000 MHz					
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2019-07-16	2020-07-16
18-40 GHz					
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2019-11-07	2020-11-07
AT0077	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2019-11-07	2020-11-07
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
S62/AMP017/CBL2 69426-001 (Effective 09/20/2019)	Gain-loss string:18-40GHz	Huber+Suhner Miteq MegaPhase	SUCOFLEX 102EA TTA1840-35-HG NC12-K1K1-216	2019-03-21	2020-03-21
Receiver & Software					
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-02-28	2020-02-28
SA0027 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2019-05-15	2020-05-15
SOFTEMI	EMI Software	UL	Version 9.5 June 15, 2019	NA	NA

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	2019-05-29	2020-05-29
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2019-07-10	2020-07-10
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	2019-08-19	2020-08-19
75141 (PRE0101521)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2019-08-20	2020-08-20
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2019-05-29	2020-05-29
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 June 15, 2019	NA	NA

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 2					
T177 (PRE0079253)	Spectrum Analyzer	Agilent Technologies	E4446A	2019-04-22	2020-04-22
PWM005 (PRE0136341)	RF Power Meter	Keysight Technologies	N1912A	2019-07-08	2020-07-08
PWS005	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	N1921A	2019-05-06	2020-05-06
SN 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27
SOFTEMI	EMC Software	UL	Version 2019-11-13	NA	NA

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

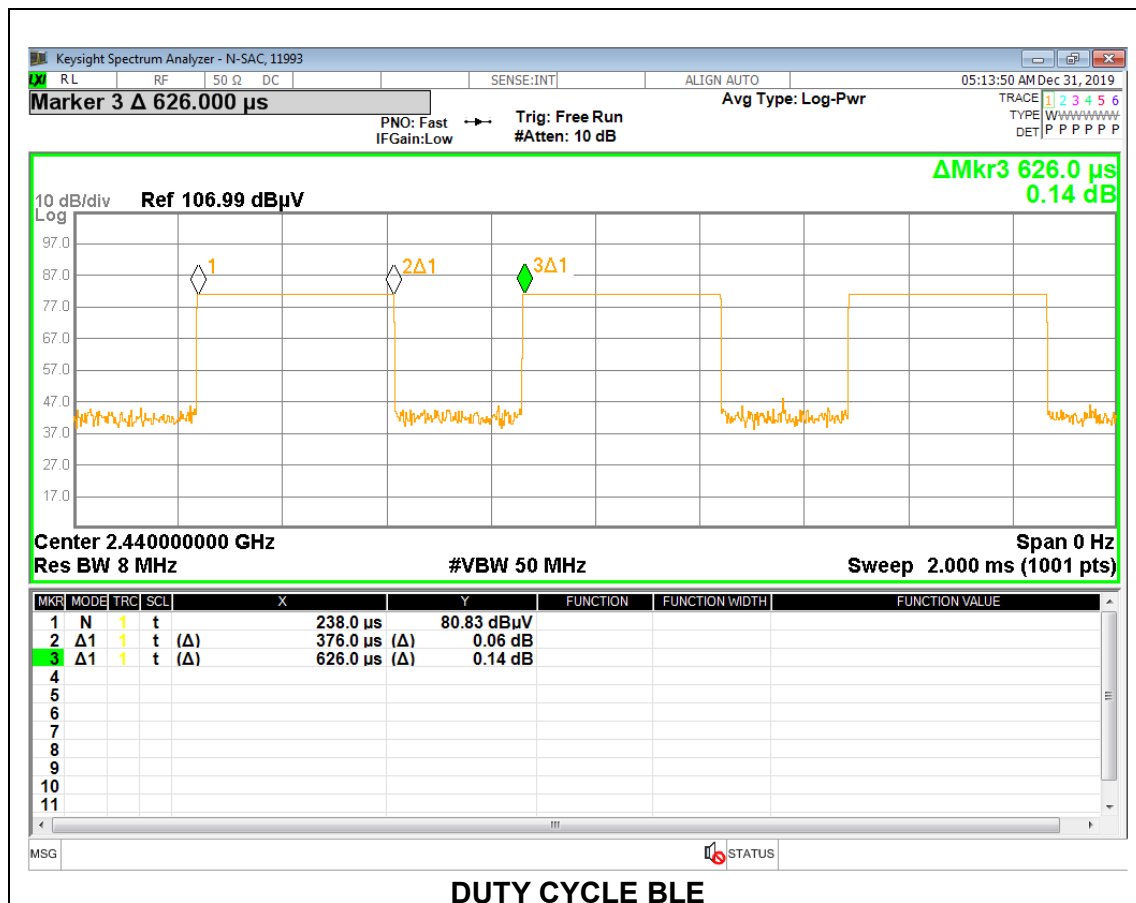
PROCEDURE

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	0.376	0.626	0.601	60.06%	4.43	2.660

DUTY CYCLE PLOTS



8.2. 99% BANDWIDTH

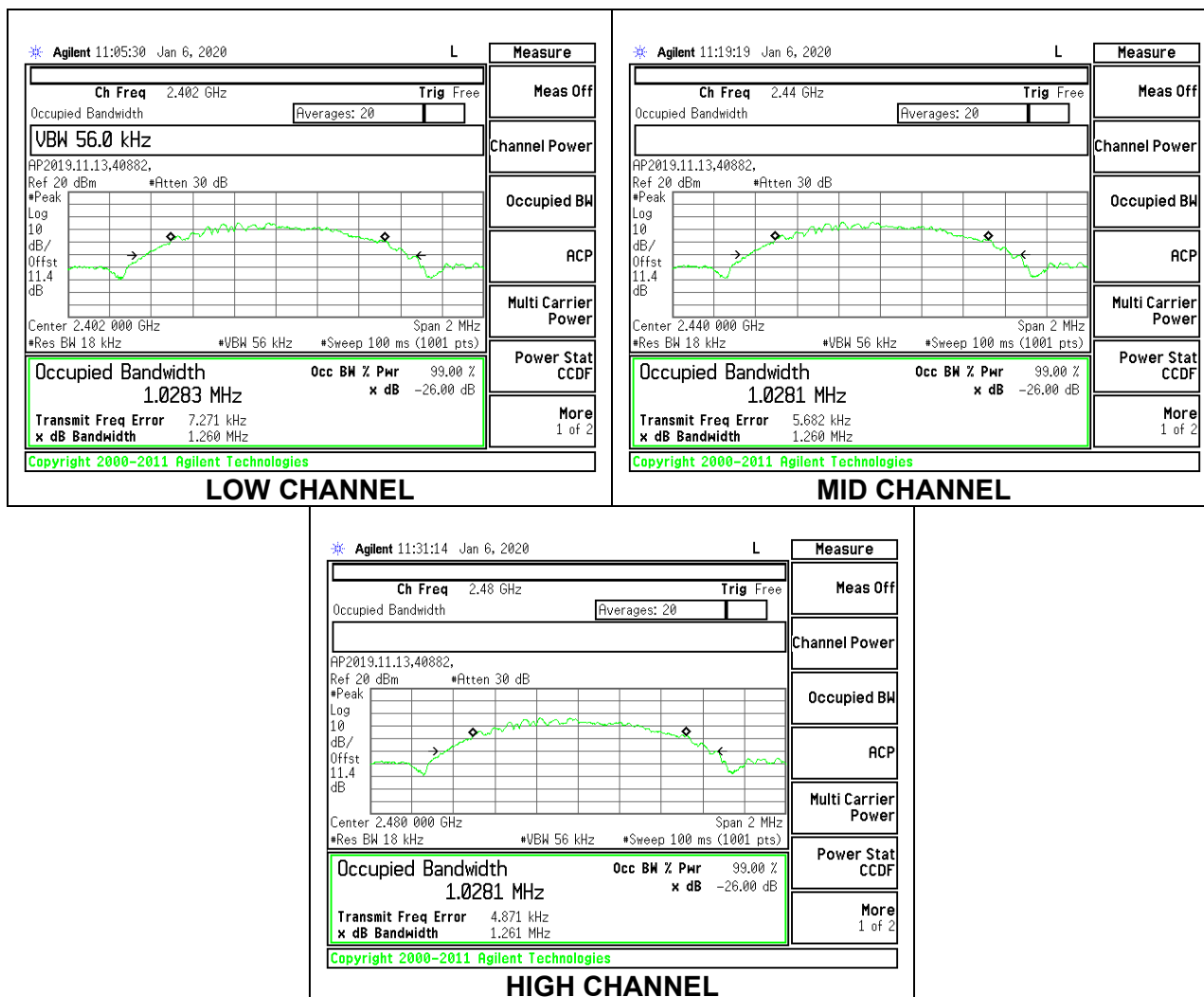
LIMITS

None; for reporting purposes only.

RESULTS

8.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0283
Middle	2440	1.0281
High	2480	1.0281



8.3. 6 dB BANDWIDTH

LIMITS

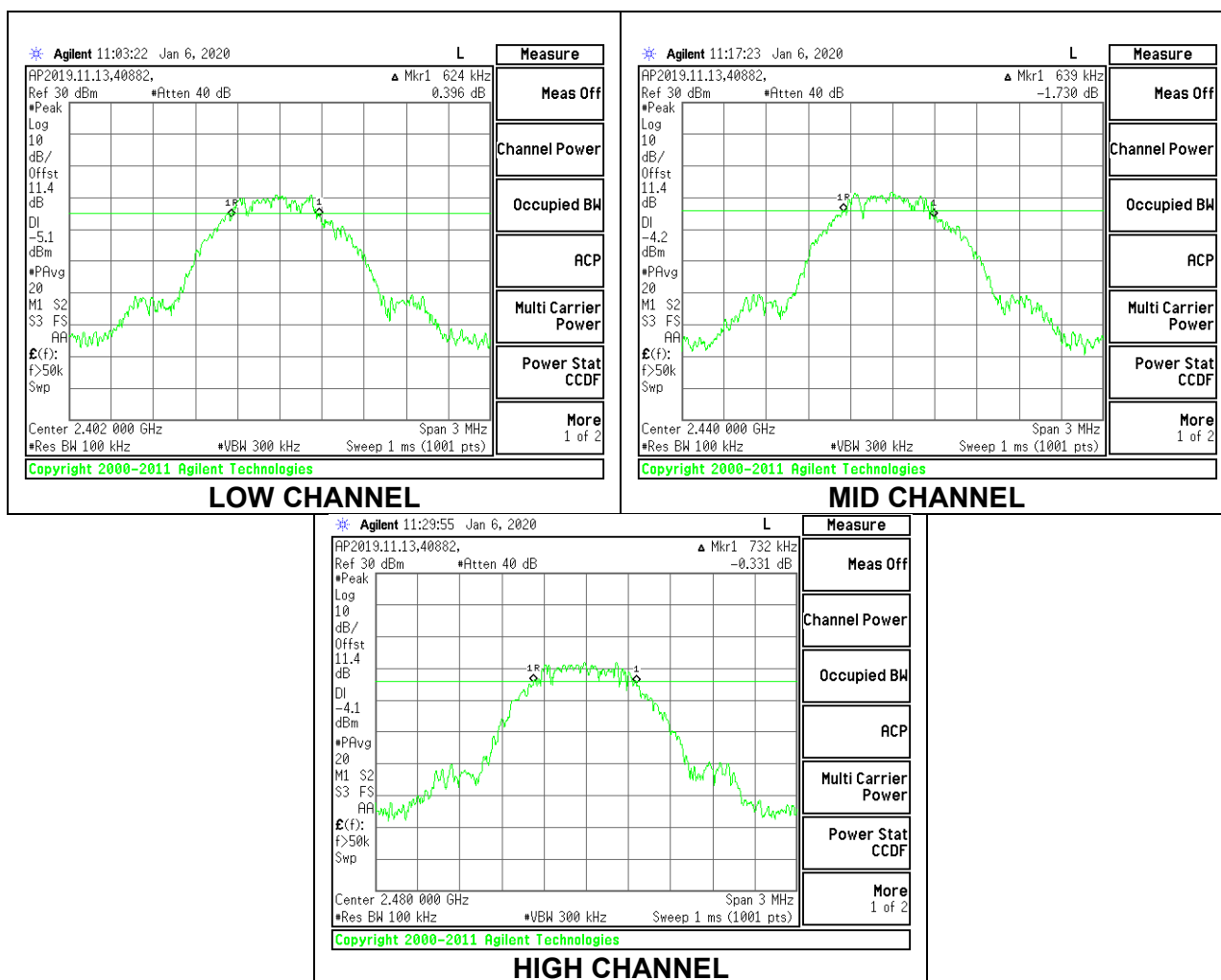
FCC §15.247 (a) (2)

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	0.624	0.5
Middle	2440	0.639	0.5
High	2480	0.732	0.5



8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

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 10.8 dB (including 10 dB pad and 0.8 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:	11993 / 44389
Date:	12/30/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.700	30	-28.300
Middle	2440	2.370	30	-27.630
High	2480	3.070	30	-26.930

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 10.8 dB (including 10 dB pad and 0.8 dB cable) was entered as an offset in the power meter to allow for a gated reading of power.

RESULTS

8.5.1. BLE (1Mbps)

Tested By:	11993/44389
Date:	2019-12-30

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	1.42
Middle	2440	2.03
High	2480	2.77

8.6. POWER SPECTRAL DENSITY

LIMITS

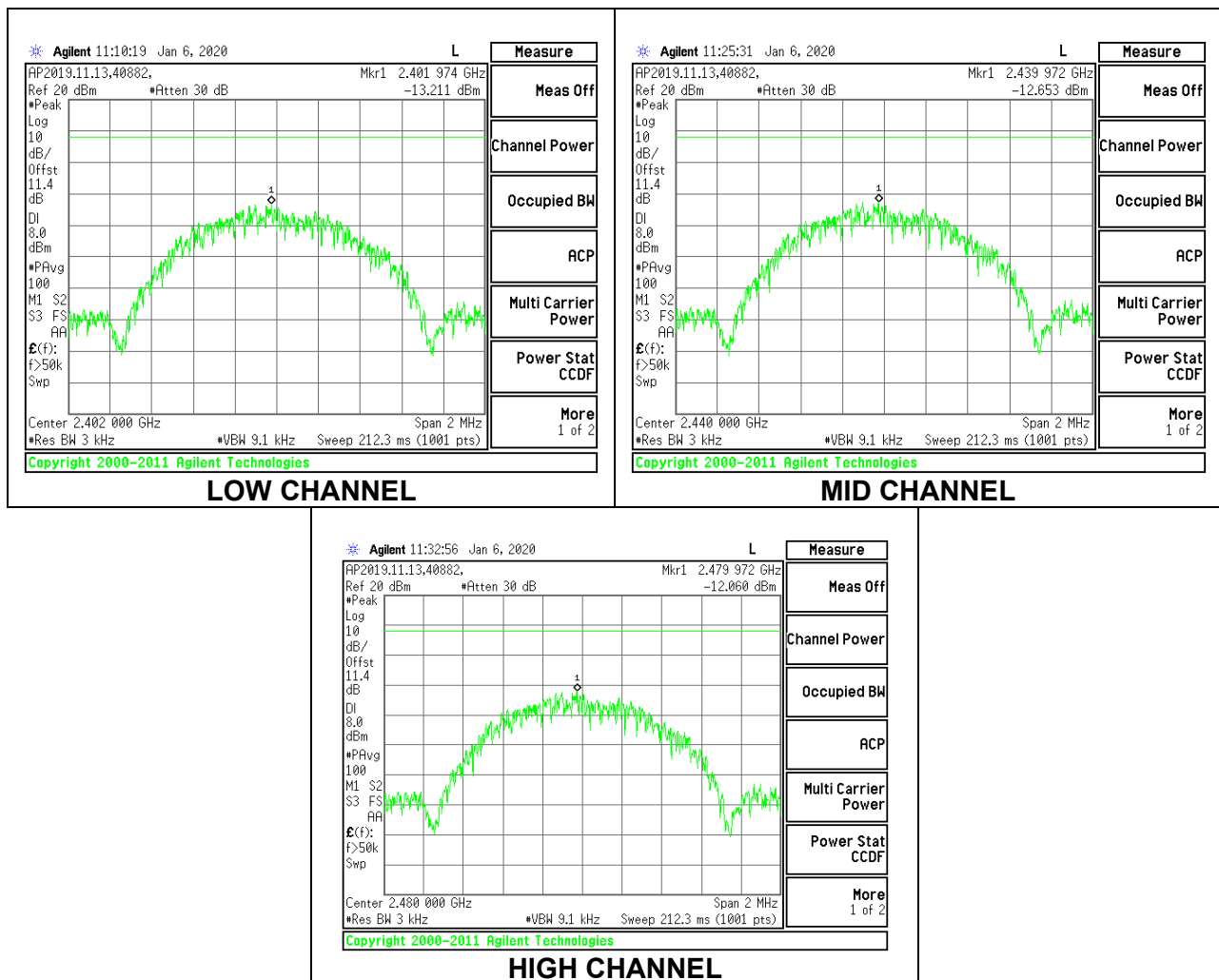
FCC §15.247 (e)

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	-13.21	8	-21.21
Middle	2440	-12.65	8	-20.65
High	2480	-12.06	8	-20.06



8.7. CONDUCTED SPURIOUS EMISSIONS

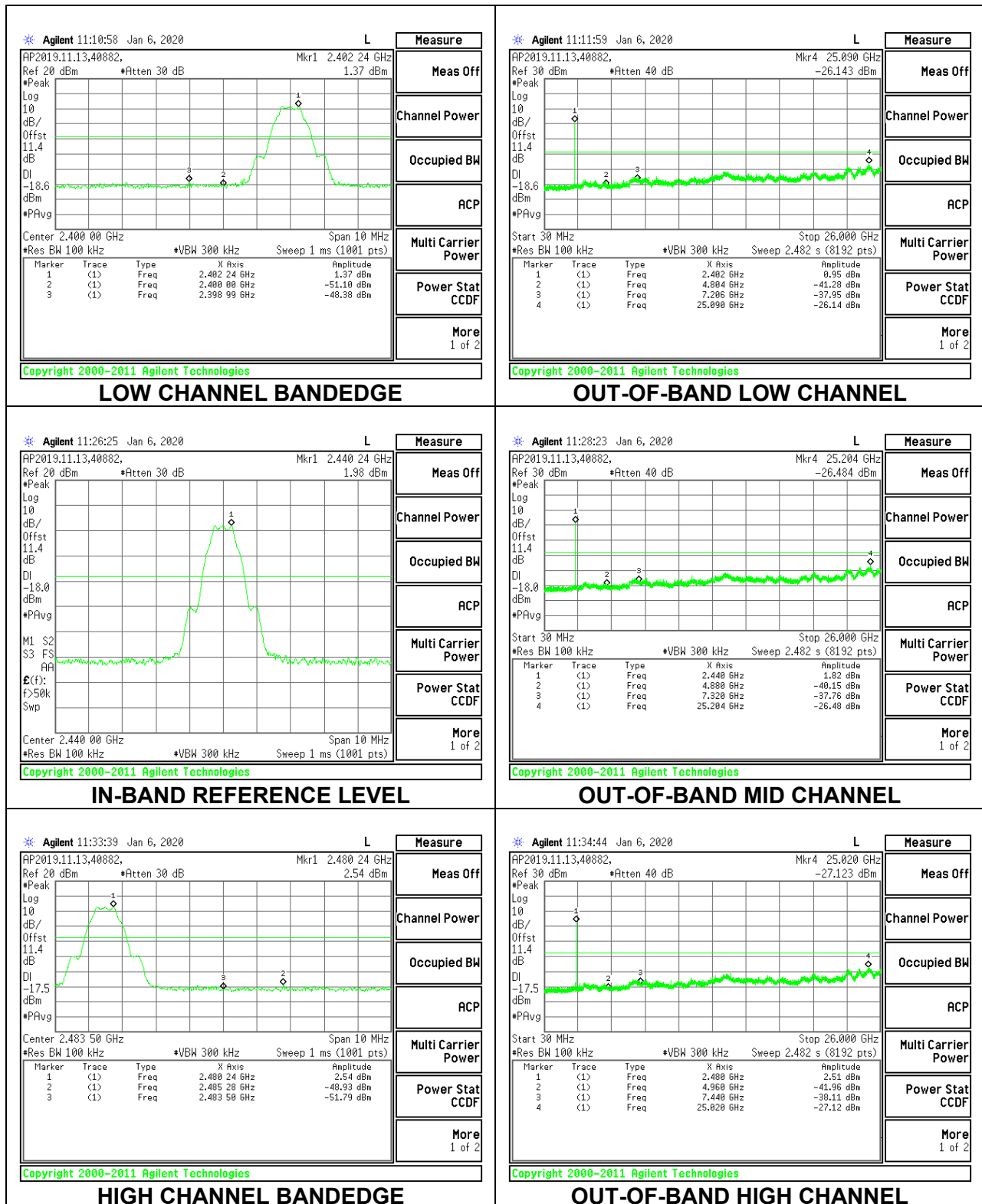
LIMITS

FCC §15.247 (d)

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

RESULTS

8.7.1. BLE (1Mbps)



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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 and/or quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz 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 measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements. The averaging method for this test program is voltage 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.

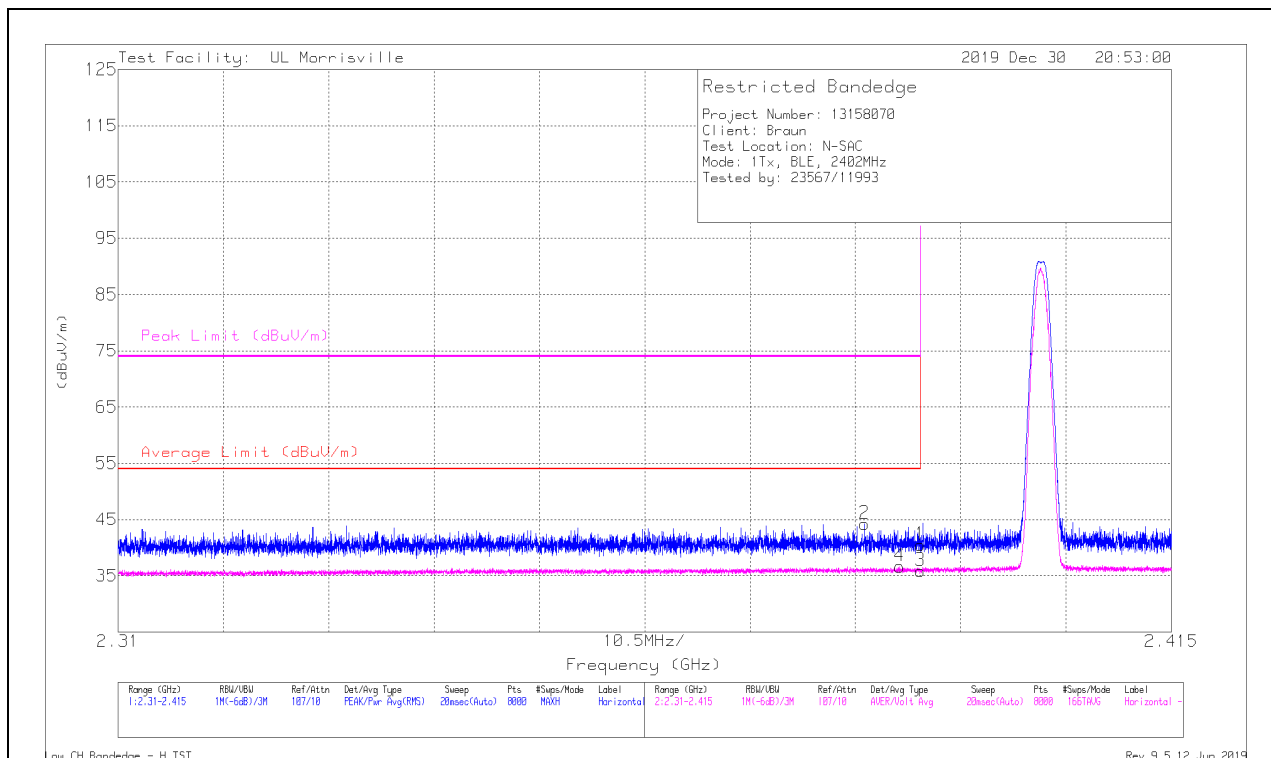
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BLE (1Mbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	32.9	Pk	32	-24.4	0	40.5	-	-	74	-33.5	310	103	H
2	* ** 2.3844	36.65	Pk	32	-24.4	0	44.25	-	-	74	-29.75	310	103	H
3	* ** 2.39	23.87	ADV	32	-24.4	4.43	35.90	54	-18.10	-	-	310	103	H
4	* ** 2.38794	24.65	ADV	32	-24.4	4.43	36.68	54	-17.32	-	-	310	103	H

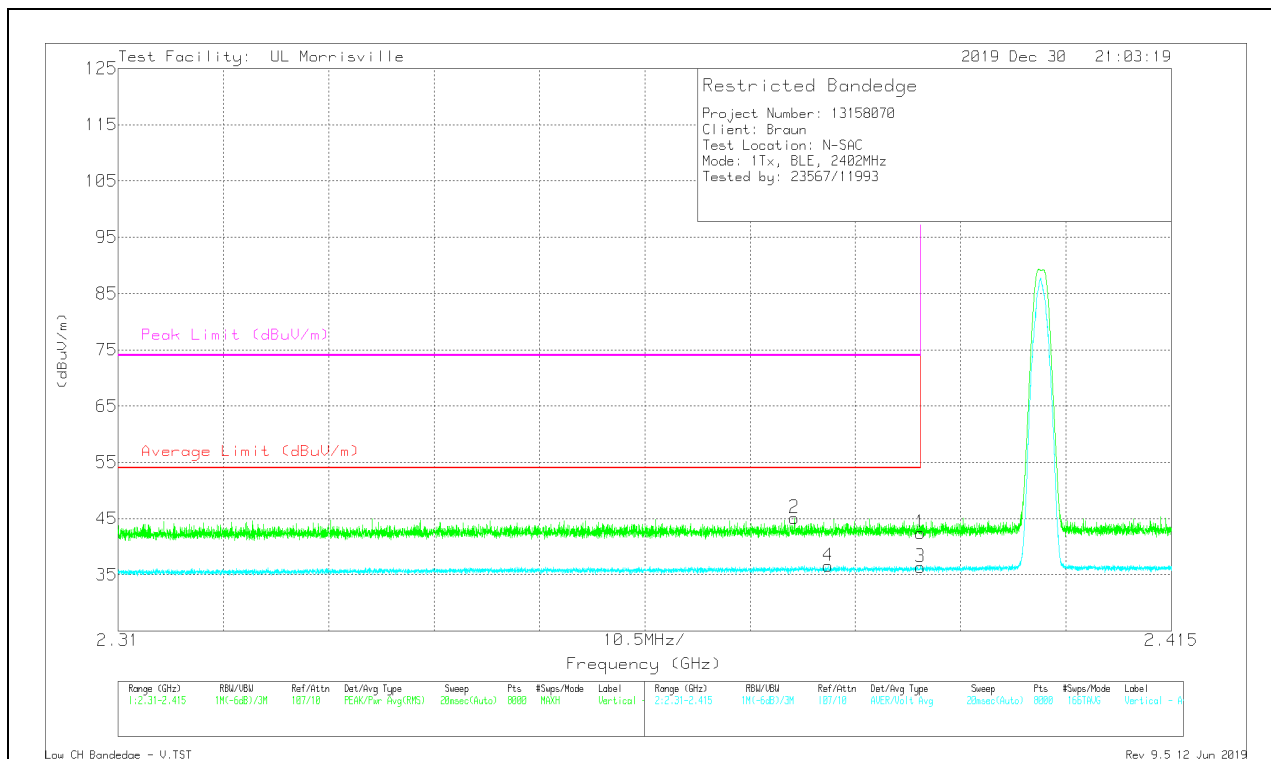
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	34.86	Pk	32	-24.4	0	42.46	-	-	74	-31.54	4	108	V
2	* ** 2.37741	37.58	Pk	31.9	-24.4	0	45.08	-	-	74	-28.92	4	108	V
3	*** 2.39	24.35	ADV	32	-24.4	4.43	36.38	54	-17.62	-	-	4	108	V
4	* ** 2.38079	24.56	ADV	32	-24.4	4.43	36.59	54	-17.41	-	-	4	108	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

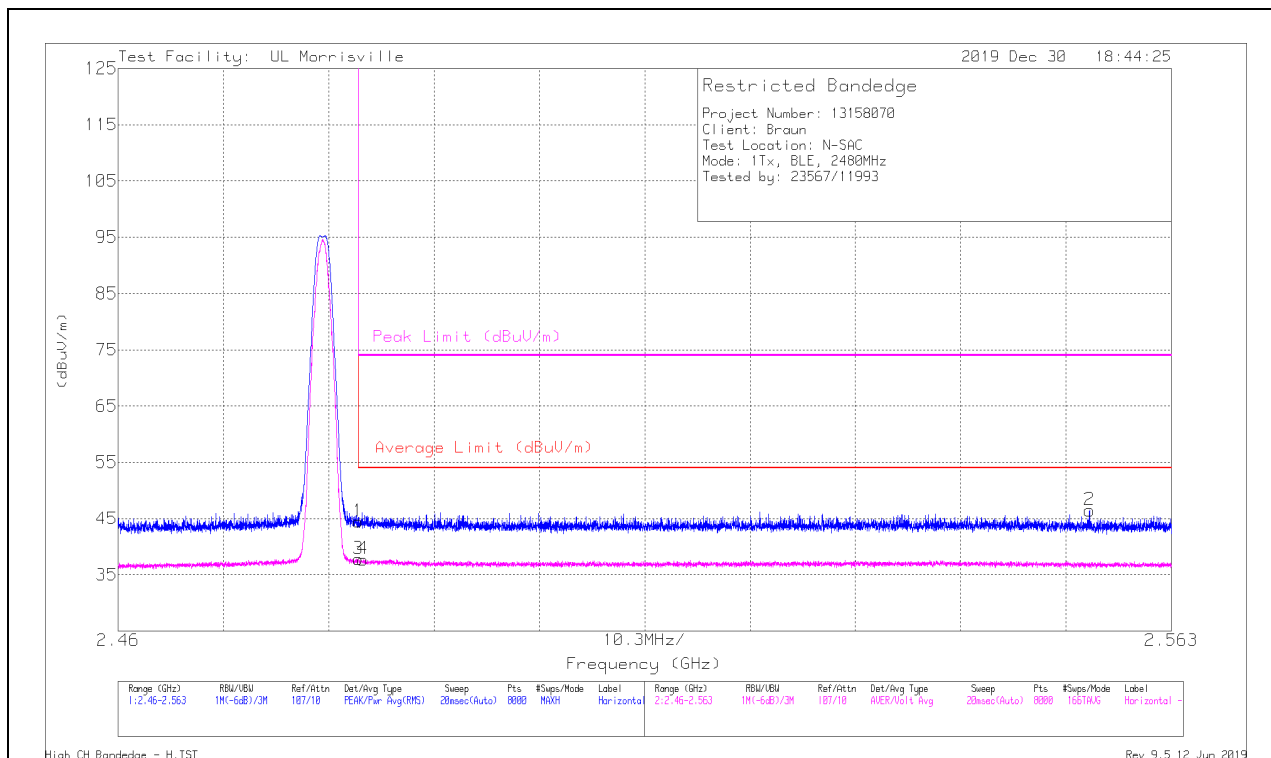
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	* ** 2.4835	36.35	Pk	32.4	-24.3	0	44.45	-	-	74	-29.55	62	154	H
2	** 2.55499	38.38	Pk	32.4	-24.3	0	46.48	-	-	74	-27.52	62	154	H
3	* ** 2.4835	25.27	ADV	32.4	-24.3	4.43	37.80	54	-16.20	-	-	62	154	H
4	* ** 2.48395	25.23	ADV	32.4	-24.3	4.43	37.76	54	-16.24	-	-	62	154	H

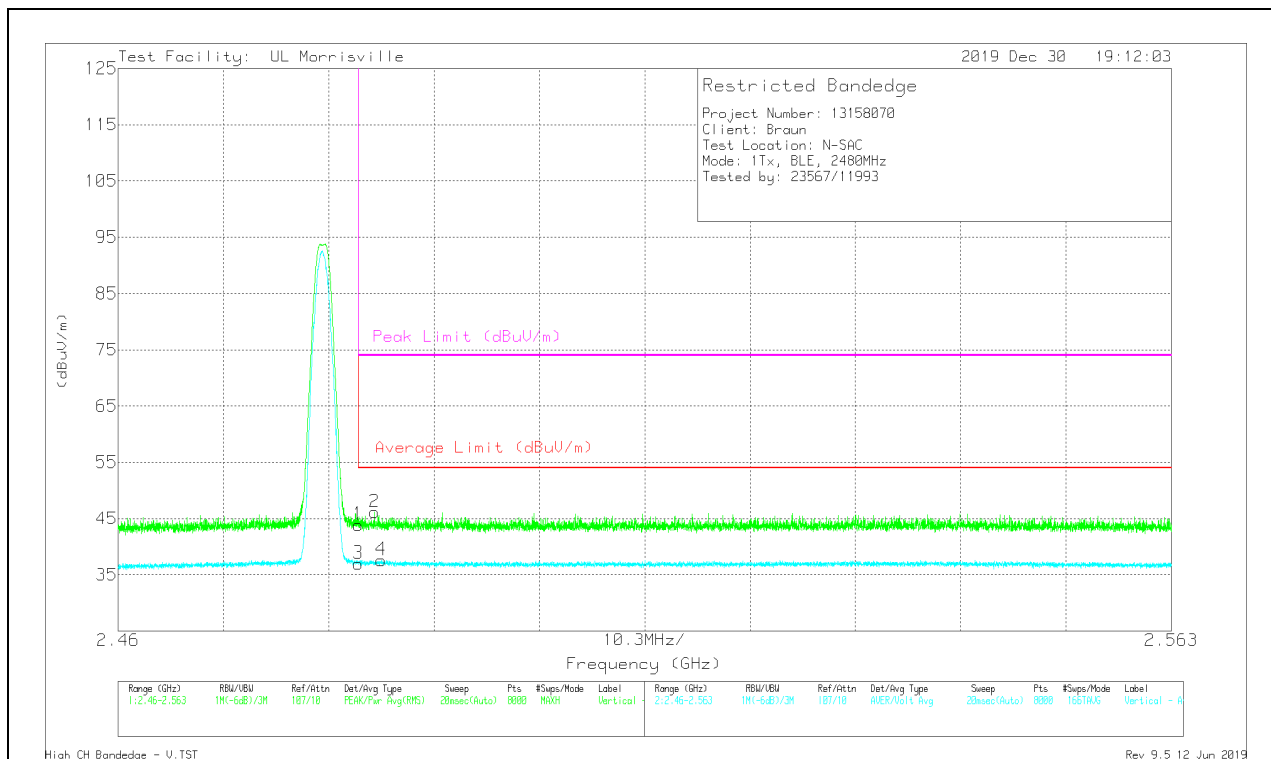
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	* ** 2.4835	35.78	Pk	32.4	-24.3	0	43.88	-	-	74	-30.12	337	157	V
2	* ** 2.48506	38.05	Pk	32.4	-24.3	0	46.15	-	-	74	-27.85	337	157	V
3	* ** 2.4835	24.47	ADV	32.4	-24.3	4.43	37.00	54	-17.00	-	-	337	157	V
4	* ** 2.48573	25.09	ADV	32.4	-24.3	4.43	37.62	54	-16.38	-	-	337	157	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

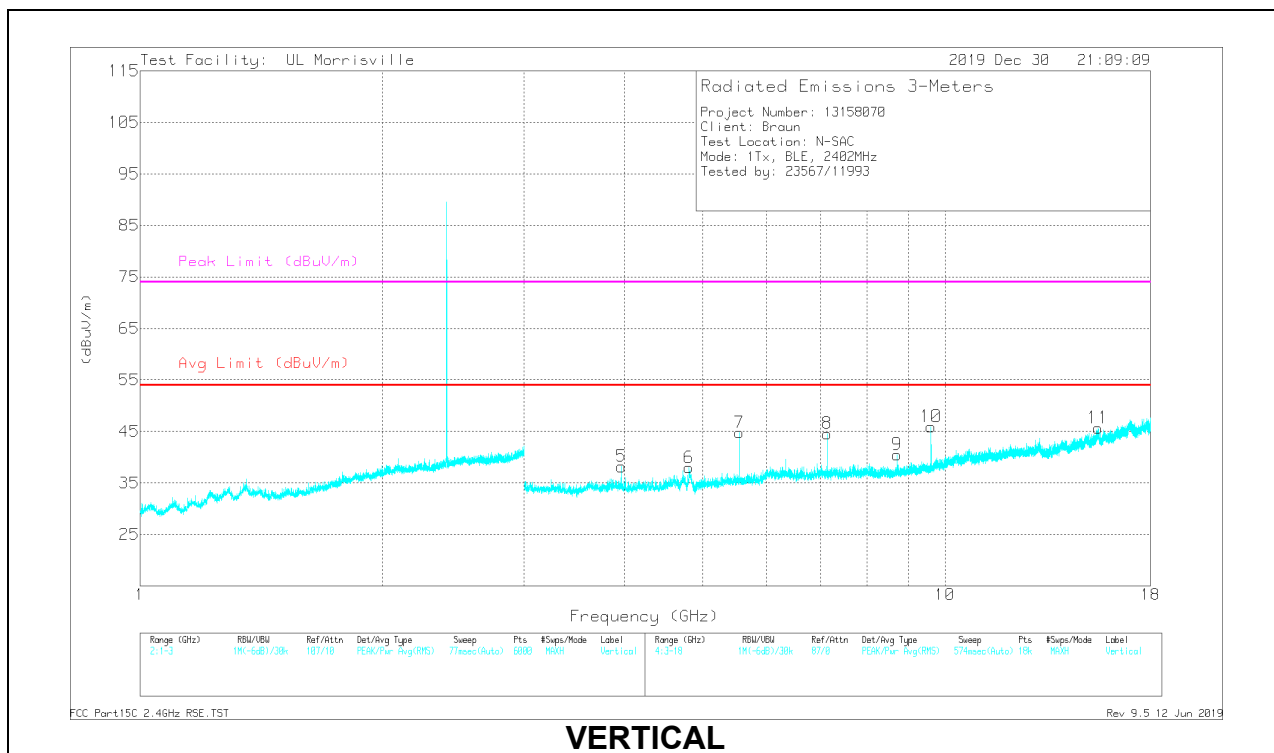
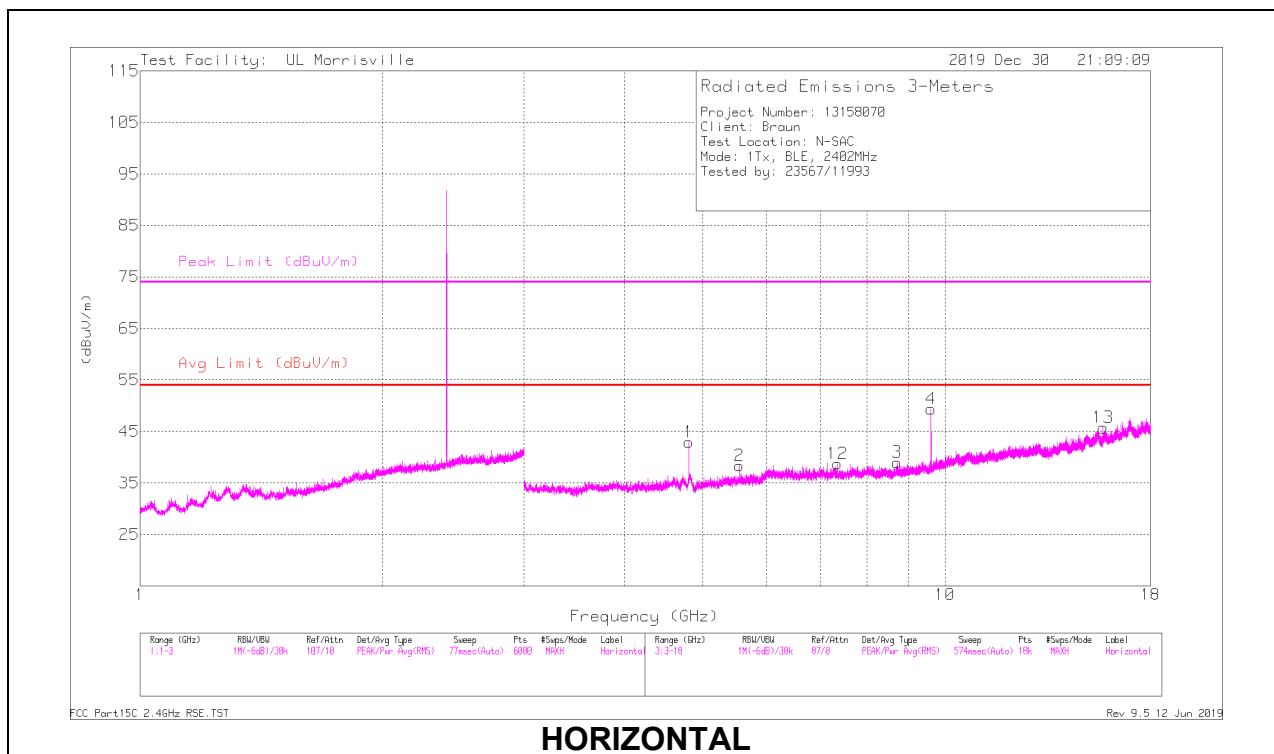
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	* ** 4.8041	47.76	PK2	34.1	-31.6	0	50.26	-	-	74	-23.74	7	102	H
	* ** 4.80383	28.44	ADV	34.1	-31.6	4.43	35.37	54	-18.63	-	-	7	102	H
12	* ** 7.35085	37.98	PK2	35.6	-29.1	0	44.48	-	-	74	-29.52	203	102	H
	* ** 7.34998	24.81	ADV	35.6	-29.1	4.43	35.74	54	-18.26	-	-	203	102	H
13	* ** 15.71789	35.88	PK2	40.1	-24.4	0	51.58	-	-	74	-22.42	98	369	H
	* ** 15.71881	22.56	ADV	40.1	-24.4	4.43	42.69	54	-11.31	-	-	98	369	H
5	* ** 3.96514	46.96	PK2	33.4	-31.7	0	48.66	-	-	74	-25.34	122	149	V
	* ** 3.965	32.48	ADV	33.4	-31.7	4.43	38.61	54	-15.39	-	-	122	149	V
6	* ** 4.80256	41.03	PK2	34.1	-31.6	0	43.53	-	-	74	-30.47	7	350	V
	* ** 4.80339	27.85	ADV	34.1	-31.6	4.43	34.78	54	-19.22	-	-	7	350	V
11	* ** 15.48531	35.54	PK2	40.1	-23.6	0	52.04	-	-	74	-21.96	50	216	V
	* ** 15.48516	22.18	ADV	40.1	-23.6	4.43	43.11	54	-10.89	-	-	50	216	V
2	5.55098	36.14	Pk	34.5	-32.3	0	38.34	-	-	-	-	0-360	102	H
7	5.55098	42.58	Pk	34.5	-32.3	0	44.78	-	-	-	-	0-360	102	V
8	7.1369	38.89	Pk	35.7	-30	0	44.59	-	-	-	-	0-360	102	V
3	8.72282	31.4	Pk	35.9	-28.3	0	39	-	-	-	-	0-360	198	H
9	8.72282	32.9	Pk	35.9	-28.3	0	40.5	-	-	-	-	0-360	198	V
4	9.60787	40.76	Pk	36.6	-28	0	49.36	-	-	-	-	0-360	102	H
10	9.60787	37.32	Pk	36.6	-28	0	45.92	-	-	-	-	0-360	102	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

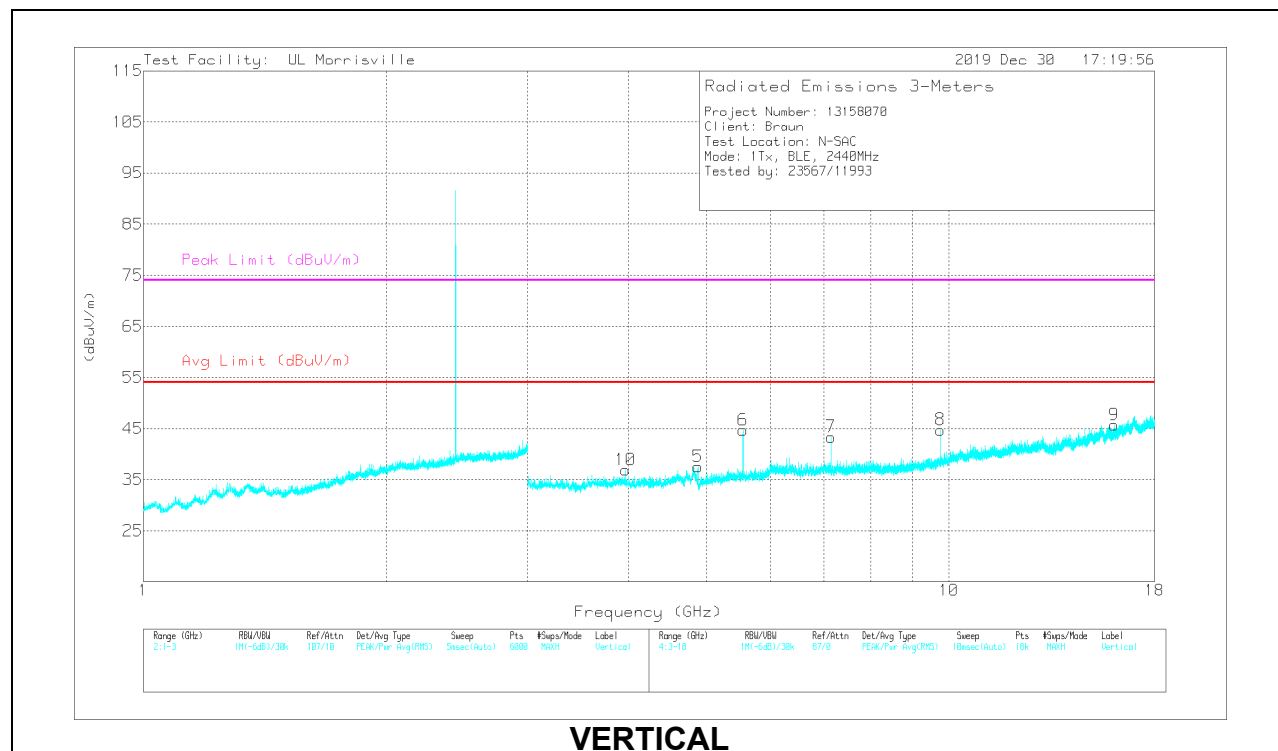
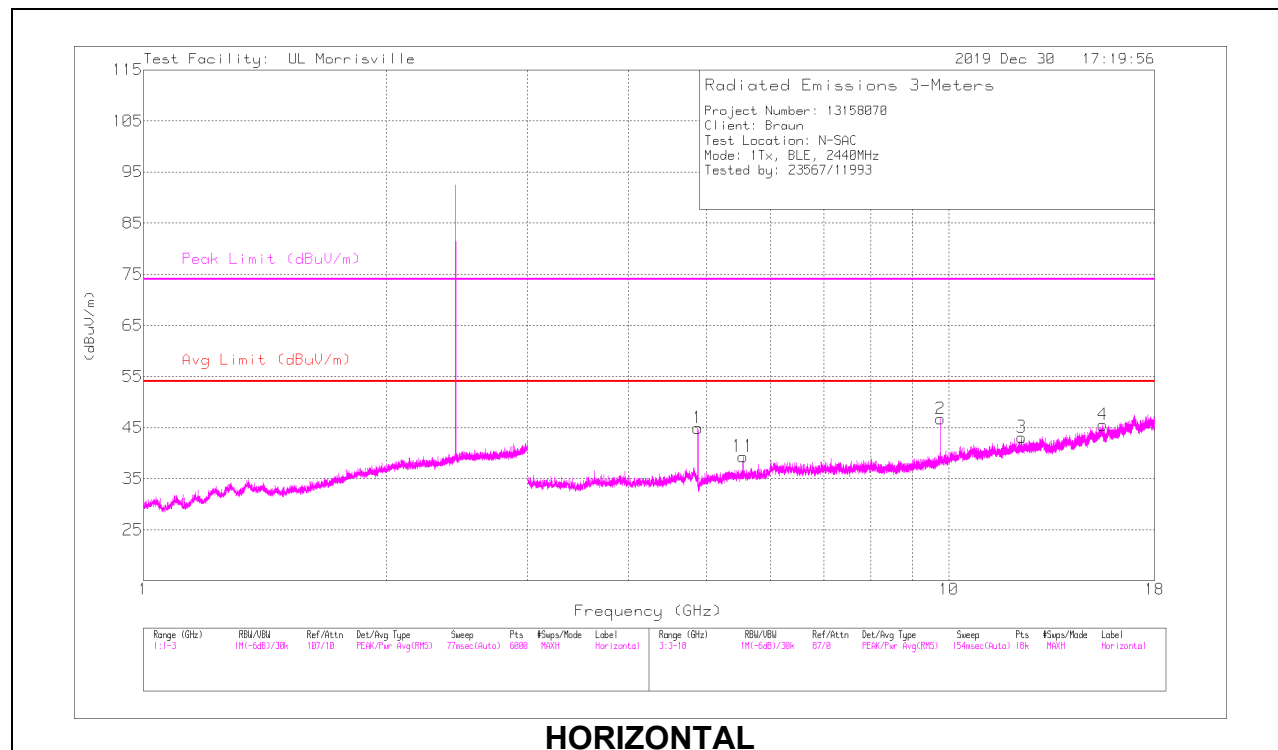
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

ADV - Linear Voltage Average

Pk - Peak detector

MID CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	*** 4.87997	47.86	PK2	33.9	-31.3	0	50.46	-	-	74	-23.54	4	104	H
	*** 4.87992	36.52	ADV	33.9	-31.3	4.43	43.55	54	-10.45	-	-	4	104	H
3	*** 12.31837	34.94	PK2	38.8	-25.7	0	48.04	-	-	74	-25.96	3	289	H
	*** 12.31826	22.07	ADV	38.8	-25.7	4.43	39.6	54	-14.4	-	-	3	289	H
4	*** 15.52435	35.08	PK2	40.2	-24	0	51.28	-	-	74	-22.72	265	167	H
	*** 15.52356	22.01	ADV	40.2	-24	4.43	42.64	54	-11.36	-	-	265	167	H
5	*** 4.88012	41.86	PK2	33.9	-31.3	0	44.46	-	-	74	-29.54	285	104	V
	*** 4.87985	29.24	ADV	33.9	-31.3	4.43	36.27	54	-17.73	-	-	285	104	V
9	*** 16.04598	36.7	PK2	40.5	-25.6	0	51.6	-	-	74	-22.4	199	163	V
	*** 16.04529	23.24	ADV	40.5	-25.6	4.43	42.57	54	-11.43	-	-	199	163	V
10	*** 3.96505	47.57	PK2	33.4	-31.7	0	49.27	-	-	74	-24.73	162	148	V
	*** 3.96501	33.38	ADV	33.4	-31.7	4.43	39.51	54	-14.49	-	-	162	148	V
11	5.55098	37.14	Pk	34.5	-32.3	0	39.34	-	-	-	-	0-360	102	H
6	5.55098	42.52	Pk	34.5	-32.3	0	44.72	-	-	-	-	0-360	102	V
7	7.1369	37.68	Pk	35.7	-30	0	43.38	-	-	-	-	0-360	102	V
2	9.75955	37.11	Pk	36.8	-27.2	0	46.71	-	-	-	-	0-360	102	H
8	9.75955	35.15	Pk	36.8	-27.2	0	44.75	-	-	-	-	0-360	198	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

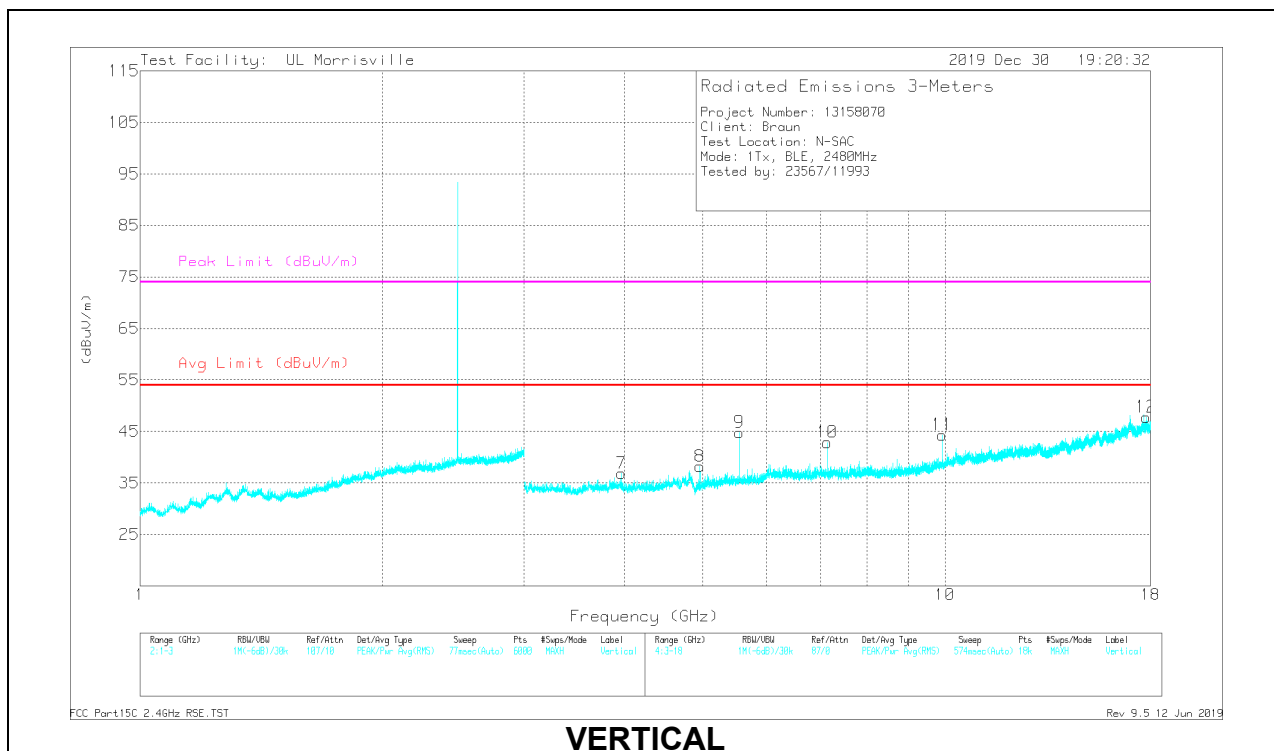
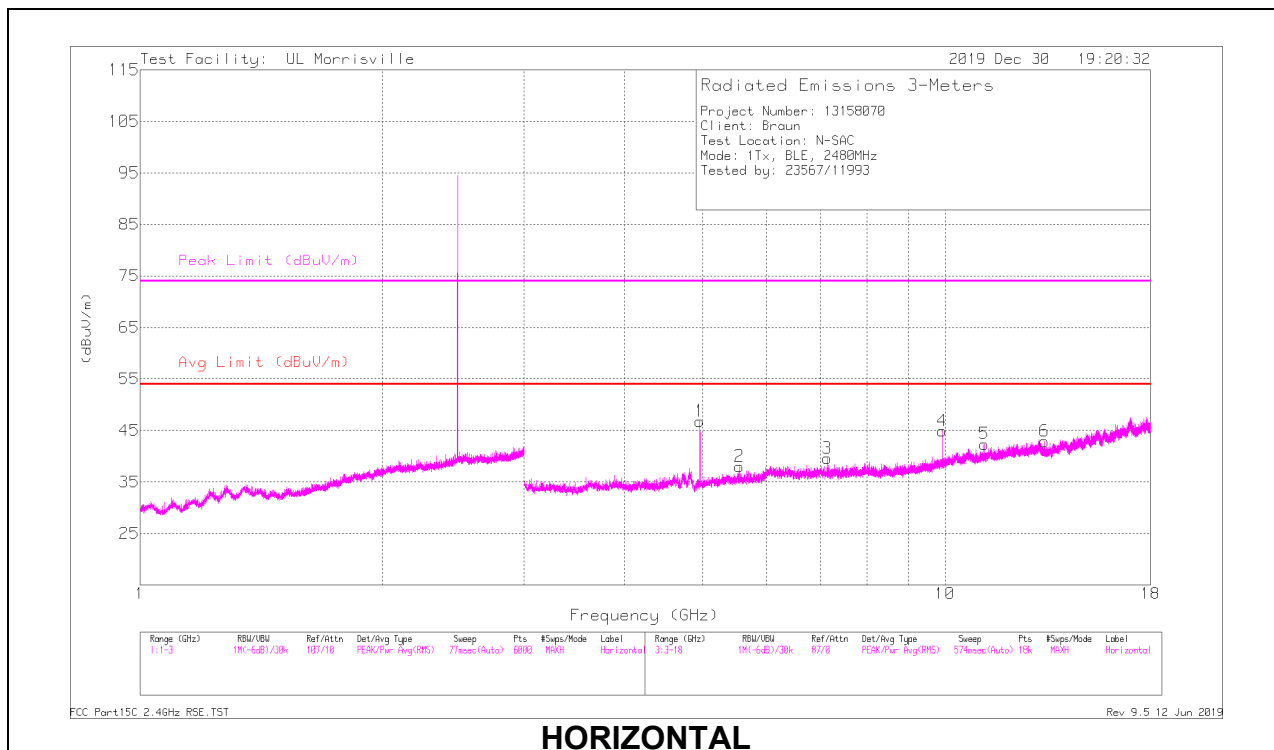
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

ADV - Linear Voltage Average

Pk - Peak detector

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 AF (dBuV/m)	Amp/Cbl/Filtr/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	*** 4.95867	39.91	PK2	33.9	-32.3	0	41.51	-	-	74	-32.49	172	329	H
	*** 4.95879	26.76	ADV	33.9	-32.3	4.43	32.79	54	-21.21	-	-	172	329	H
5	*** 11.19168	35.67	PK2	37.8	-26.1	0	47.37	-	-	74	-26.63	266	365	H
	*** 11.19094	22.59	ADV	37.8	-26.1	4.43	38.72	54	-15.28	-	-	266	365	H
6	*** 13.29451	37.38	PK2	38.9	-27.9	0	48.38	-	-	74	-25.62	266	104	H
	*** 13.29442	24.75	ADV	38.9	-27.9	4.43	40.18	54	-13.82	-	-	266	104	H
7	*** 3.96501	44.57	PK2	33.4	-31.7	0	46.27	-	-	74	-27.73	145	345	V
	*** 3.96494	30.46	ADV	33.4	-31.7	4.43	36.59	54	-17.41	-	-	145	345	V
8	*** 4.95838	39.82	PK2	33.9	-32.3	0	41.42	-	-	74	-32.58	136	356	V
	*** 4.95829	26.38	ADV	33.9	-32.3	4.43	32.41	54	-21.59	-	-	136	356	V
12	*** 17.78094	34.88	PK2	41.1	-22.4	0	53.58	-	-	74	-20.42	40	149	V
	*** 17.78069	21.66	ADV	41.1	-22.4	4.43	44.79	54	-9.21	-	-	40	149	V
2	5.55098	35.81	Pk	34.5	-32.3	0	38.01	-	-	-	-	0-360	198	H
9	5.55098	42.6	Pk	34.5	-32.3	0	44.8	-	-	-	-	0-360	102	V
3	7.1369	33.88	Pk	35.7	-30	0	39.58	-	-	-	-	0-360	198	H
10	7.1369	37.18	Pk	35.7	-30	0	42.88	-	-	-	-	0-360	102	V
4	9.91955	35.58	Pk	37	-27.7	0	44.88	-	-	-	-	0-360	102	H
11	9.91955	35.03	Pk	37	-27.7	0	44.33	-	-	-	-	0-360	102	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

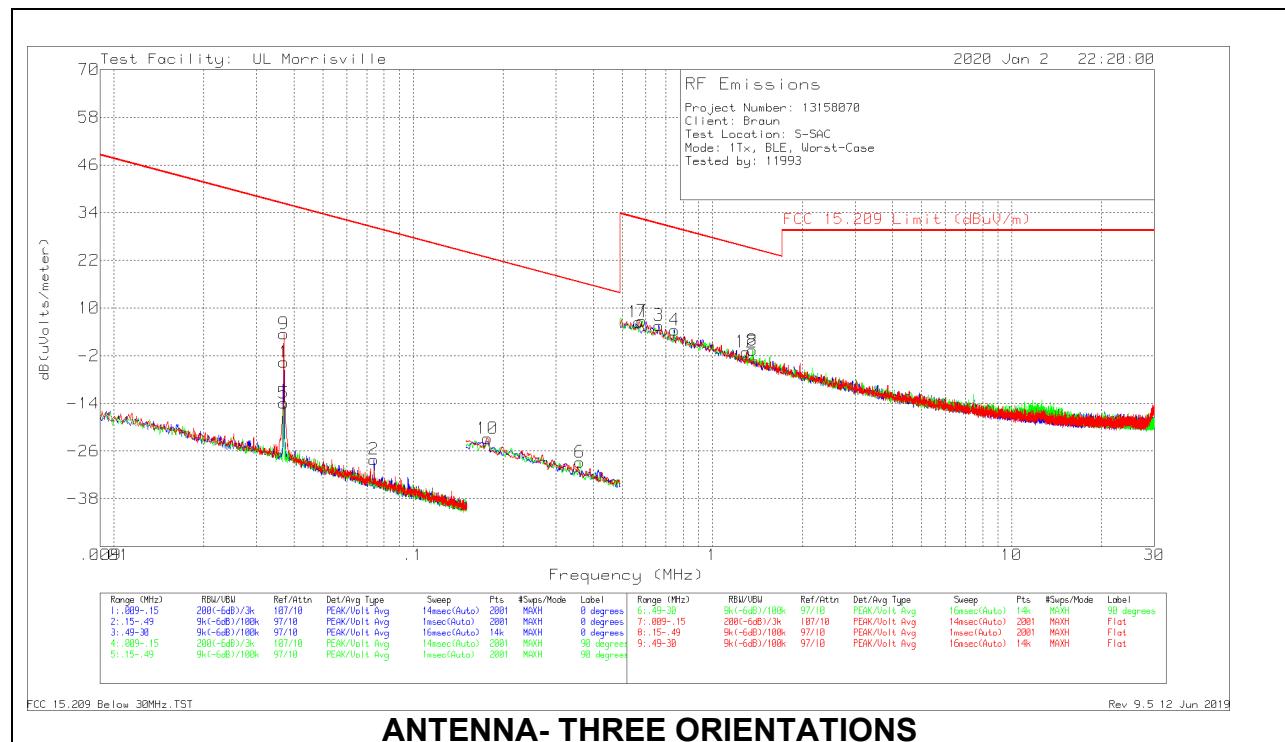
ADV - Linear Voltage Average

Pk - Peak detector

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 $40 \cdot \log(\text{test distance} / \text{specification distance})$.



ANTENNA- THREE ORIENTATIONS

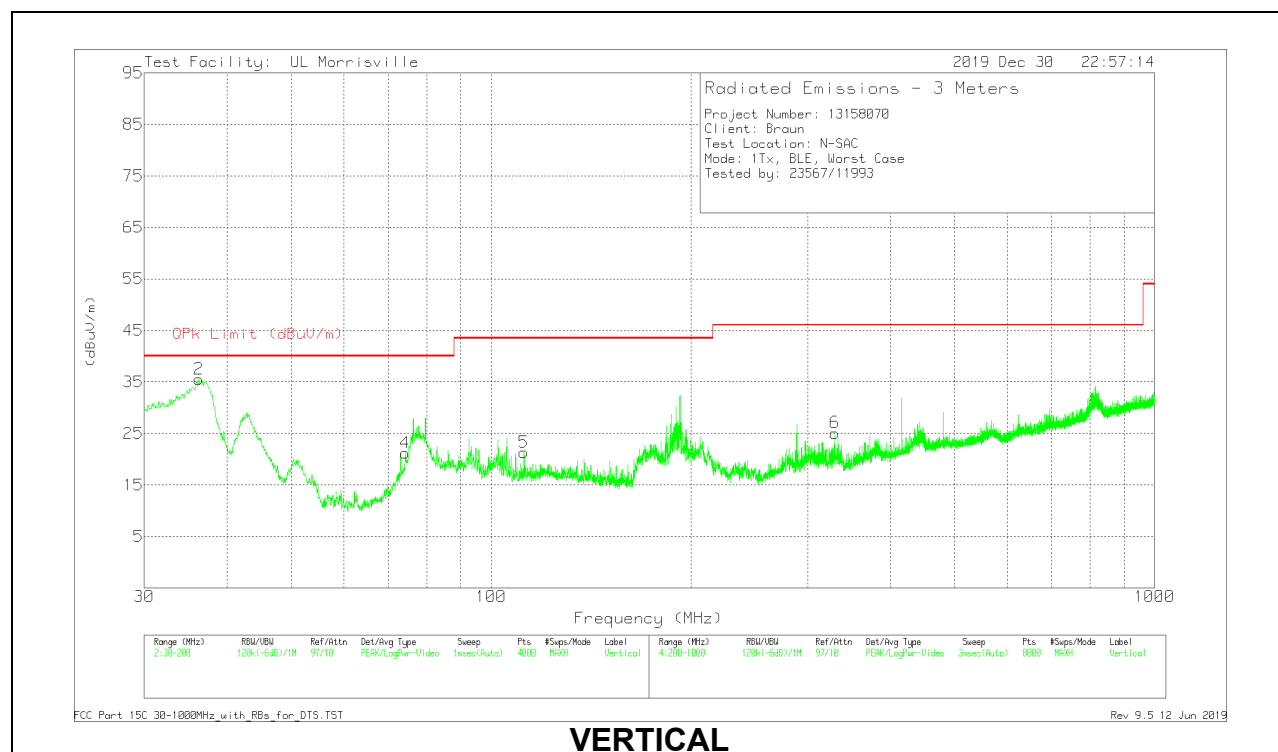
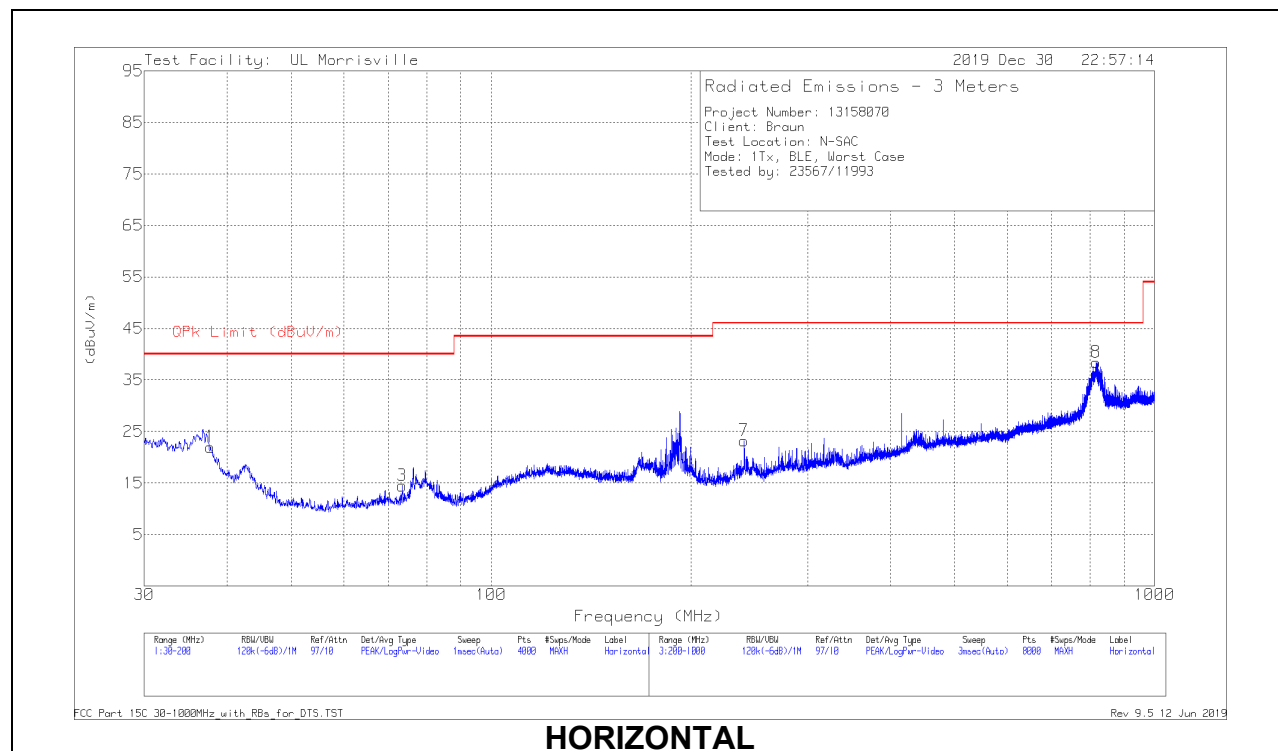
Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 QP/Avg Limit (dBuV/m)	FCC 15.209 Pk Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)	Antenna Face
1	.03697	63.68	Pk	12.6	.1	-80	-3.62	36.25	56.25	-39.87	0-360	On
5	.03697	53.37	Pk	12.6	.1	-80	-13.93	36.25	56.25	-50.18	0-360	Off
9	.03697	70.81	Pk	12.6	.1	-80	3.51	36.25	56.25	-32.74	0-360	Flat
2	.07404	40.63	Pk	11.2	.1	-80	-28.07	30.22	50.22	-58.29	0-360	On
10	.17737	46.12	Pk	11	.1	-80	-22.78	22.63	42.63	-45.41	0-360	Flat
6	.36097	40.12	Pk	11	.1	-80	-28.78	16.45	36.45	-45.23	0-360	Off
11	.568	35.36	Pk	11	.1	-40	6.46	32.52	-	-26.06	0-360	Flat
7	.58275	35.68	Pk	11	.1	-40	6.78	32.29	-	-25.51	0-360	Off
3	.66286	34.52	Pk	11	.1	-40	5.62	31.18	-	-25.56	0-360	On

Pk - Peak detector

9.4. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 37.737	32.16	Pk	21.5	-31.7	21.96	40	-18.04	0-360	199	H
3	* 73.4888	31.58	Pk	14	-31.1	14.48	40	-25.52	0-360	299	H
4	** 74.254	38.3	Pk	14	-31.1	21.2	40	-18.8	0-360	102	V
5	* ** 112.0887	33	Pk	19.1	-30.8	21.3	43.52	-22.22	0-360	102	V
7	* ** 240.7053	35.39	Pk	17.7	-29.9	23.19	46.02	-22.83	0-360	102	H
6	* ** 329.9169	34.3	Pk	20	-29.2	25.1	46.02	-20.92	0-360	102	V
2	36.2491	44.62	Pk	22.6	-31.7	35.52	-	-	0-360	102	V
8	816.6802	37.82	Pk	27.7	-27.1	38.42	-	-	0-360	102	H

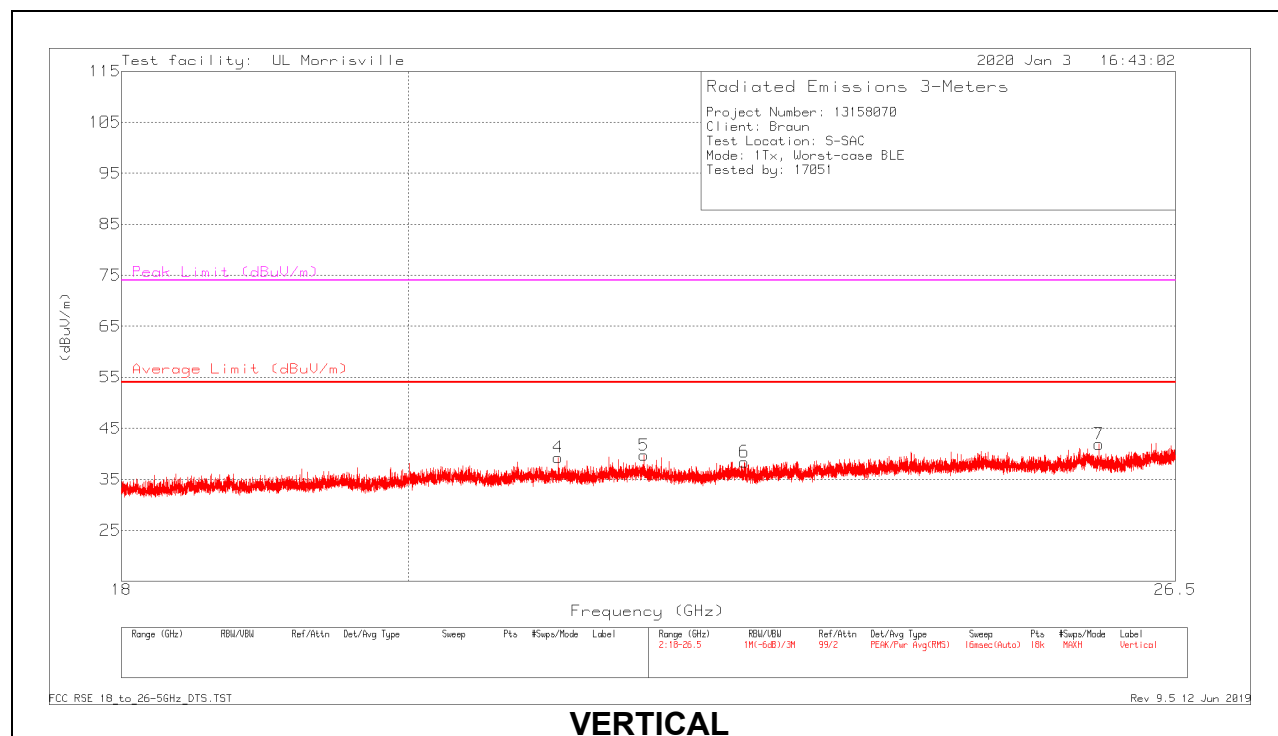
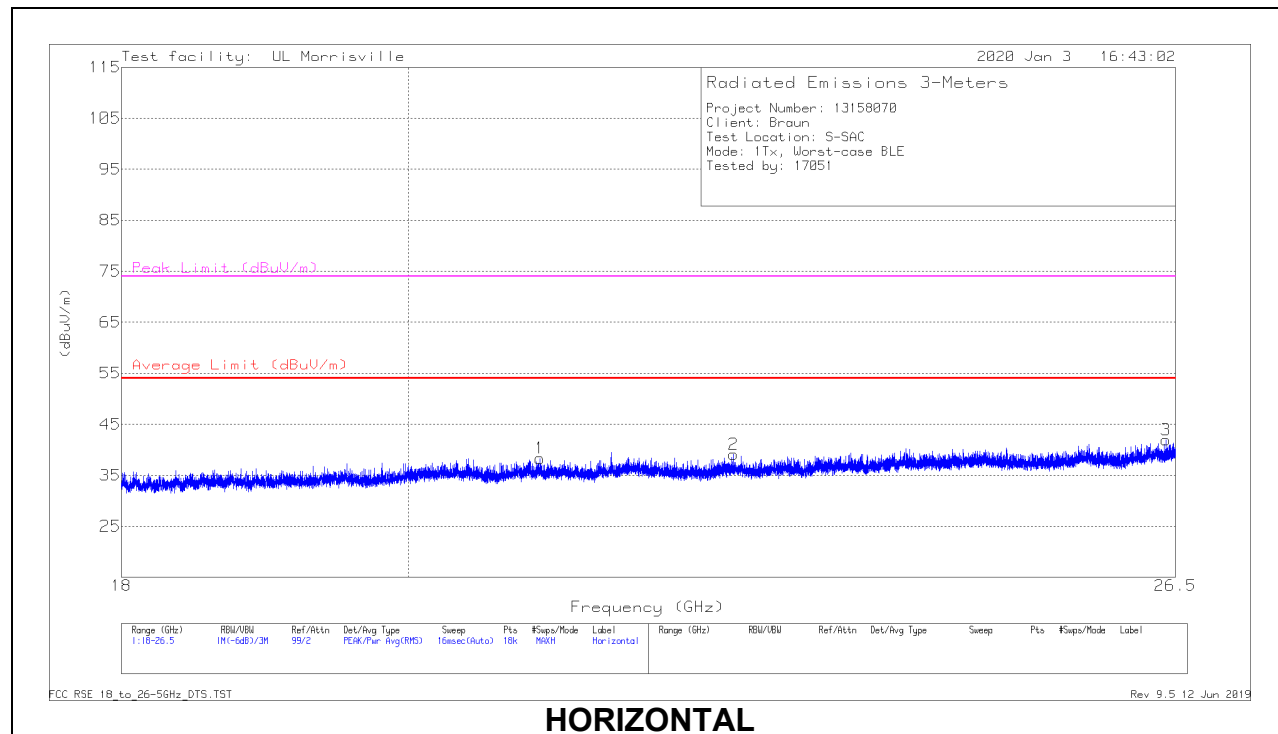
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

9.5 WORST CASE 18-26 GHZ

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



18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 20.9898	39.72	Pk	33.3	-34.7	38.32	54	-15.68	74	-35.68	0-360	148	H
2	* ** 22.535	39.94	Pk	33.6	-34.4	39.14	54	-14.86	74	-34.86	0-360	148	H
4	* ** 21.12817	40.8	Pk	33.1	-34.6	39.3	54	-14.7	74	-34.7	0-360	202	V
6	* ** 22.62095	39.23	Pk	33.5	-34.3	38.43	54	-15.57	74	-35.57	0-360	102	V
5	21.80396	40.51	Pk	33.5	-34.3	39.71	54	-14.29	74	-34.29	0-360	202	V
7	25.76659	40.39	Pk	34.5	-33	41.89	54	-12.11	74	-32.11	0-360	152	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

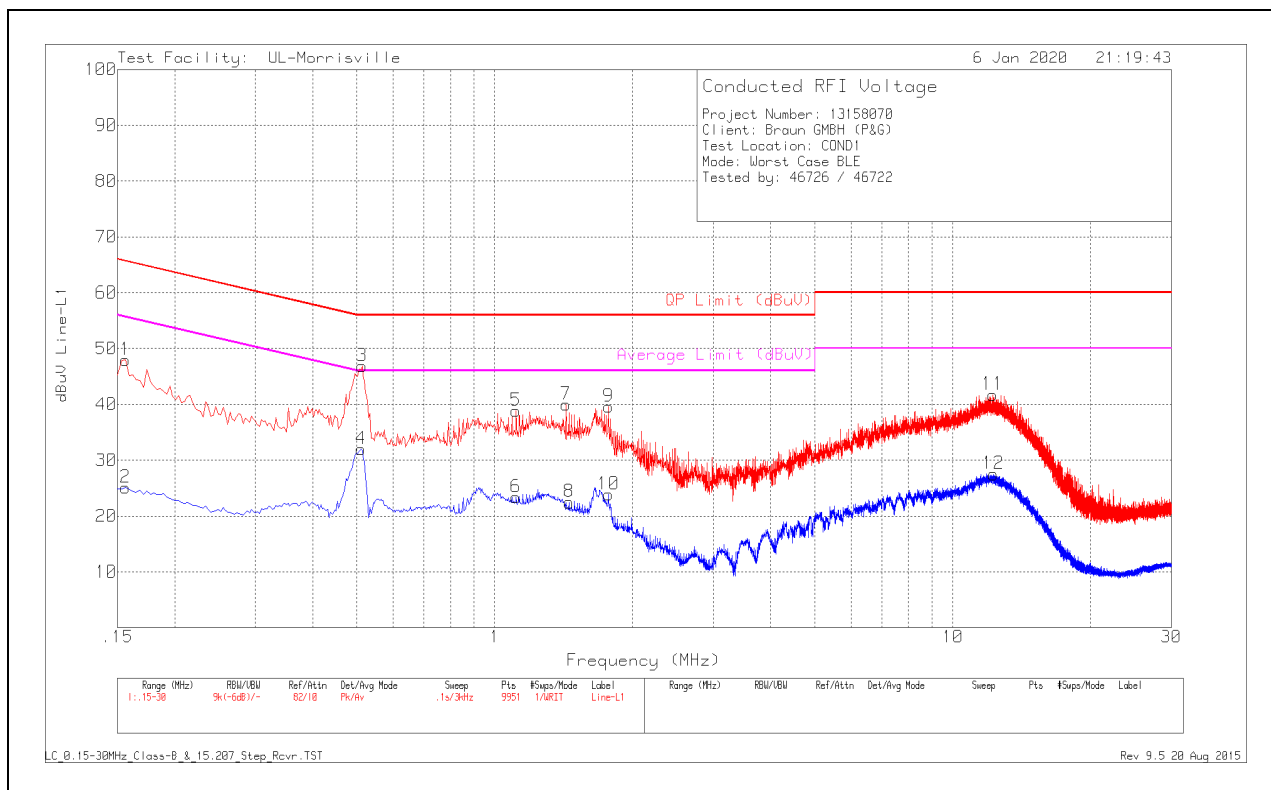
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 [*]	56 to 46 [*]
0.5-5	56	46
5-30	60	50

^{*} Decreases with the logarithm of the frequency.

RESULTS

10.1.1. AC Power Line Norm

LINE 1 RESULTS

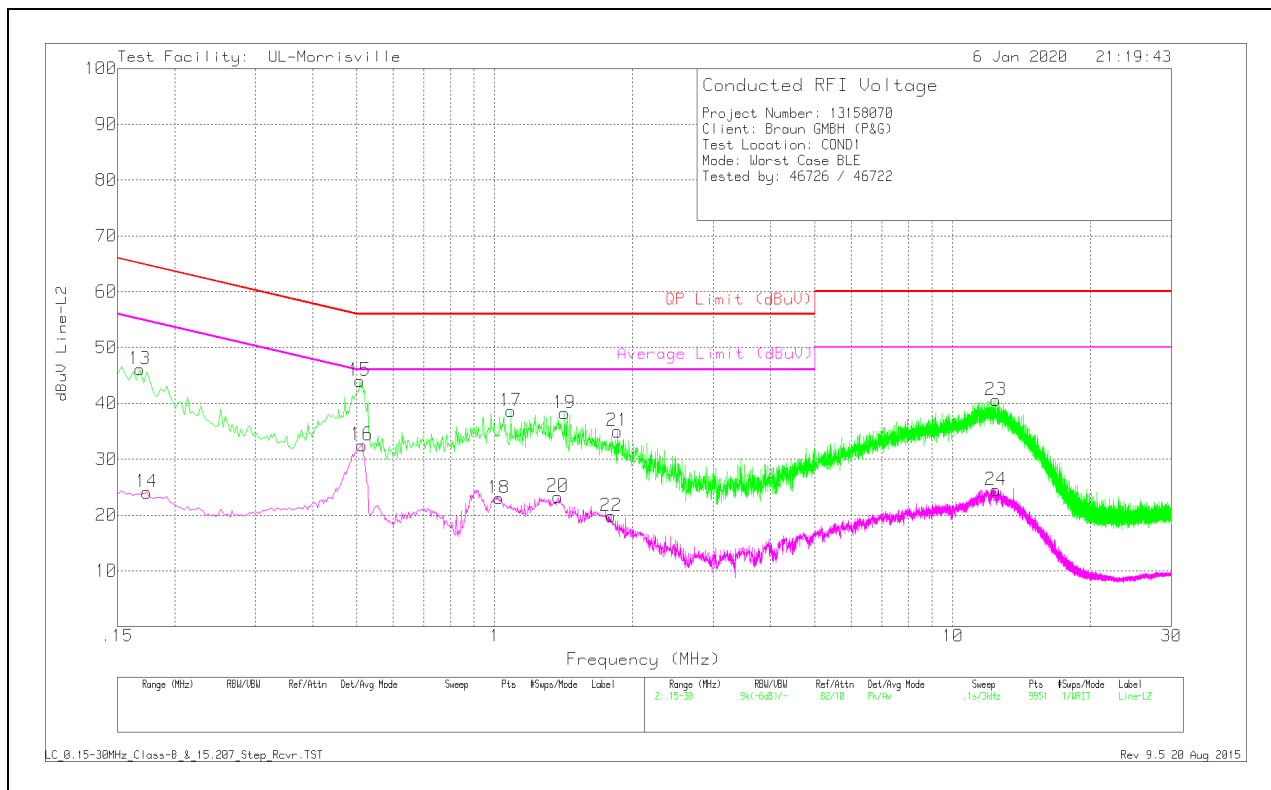


Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.156	37.78	Pk	.2	10	47.98	65.67	-17.69	-	-
2	.156	14.86	Av	.2	10	25.06	-	-	55.67	-30.61
3	.513	36.75	Pk	.1	10	46.85	56	-9.15	-	-
4	.51	21.89	Av	.1	10	31.99	-	-	46	-14.01
5	1.113	28.87	Pk	0	10	38.87	56	-17.13	-	-
6	1.113	13.37	Av	0	10	23.37	-	-	46	-22.63
7	1.431	29.87	Pk	0	10.1	39.97	56	-16.03	-	-
8	1.452	12.36	Av	0	10.1	22.46	-	-	46	-23.54
9	1.77	29.47	Pk	0	10.1	39.57	56	-16.43	-	-
10	1.77	13.75	Av	0	10.1	23.85	-	-	46	-22.15
11	12.222	31.24	Pk	.1	10.4	41.74	60	-18.26	-	-
12	12.264	17	Av	.1	10.4	27.5	-	-	50	-22.5

Pk - Peak Detector

Av - Average Detector

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 (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
13	.168	35.89	Pk	.2	10	46.09	65.06	-18.97	-	-
14	.174	13.86	Av	.2	10	24.06	-	-	54.77	-30.71
15	.507	34.06	Pk	0	10	44.06	56	-11.94	-	-
16	.513	22.52	Av	0	10	32.52	-	-	46	-13.48
17	1.083	28.59	Pk	0	10	38.59	56	-17.41	-	-
18	1.02	12.99	Av	0	10	22.99	-	-	46	-23.01
19	1.419	28.16	Pk	0	10.1	38.26	56	-17.74	-	-
20	1.374	13.19	Av	0	10.1	23.29	-	-	46	-22.71
21	1.854	24.9	Pk	0	10.1	35	56	-21	-	-
22	1.794	9.71	Av	0	10.1	19.81	-	-	46	-26.19
23	12.408	30.08	Pk	.1	10.4	40.58	60	-19.42	-	-
24	12.423	14.01	Av	.1	10.4	24.51	-	-	50	-25.49

Pk - Peak Detector
Av - Average Detector

11. SETUP PHOTOS

Please refer to R13158070-EP2 for setup diagrams

END OF TEST REPORT