



TEST REPORT

Report Number: R13571139-E1

Applicant : Chiaro Technology Ltd
63-66 Hatton Garden
London, EC1N 8LE
United Kingdom

Model : LIMA EV

Brand : LIMA BREAST PUMP

FCC ID : 2AEHI-EB01

EUT Description : Battery Operated Breast Pump

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5

Date Of Issue:
2021-02-04

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2021-02-04	Initial Issue	Noah Bennett

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Chiaro Technology Ltd
EUT DESCRIPTION: Battery powered Breast Pump
MODEL: LIMA EV
BRAND: LIMA BREAST PUMP
SERIAL NUMBER: EV52
SAMPLE RECEIPT DATE: 2020-12-28
DATE TESTED: 2021-01-14 to 2021-01-29.

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

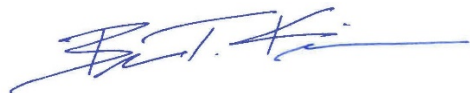
UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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
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2. TEST RESULTS SUMMARY

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW	Compliant	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power	Compliant	None.
See Comment		Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	RSS-247 5.2 (b)	PSD	Compliant	None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Compliant	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Compliant	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Compliant	None.

3. 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.

4. 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 Suite 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), CABID: US00067, is accredited by NVLAP, Laboratory Code 200246-0

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. 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	1.22%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
RF output power, radiated (SAC) < 180 MHz	6.18 dB
RF output power, radiated (SAC) >= 180 MHz	3.23 dB
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	1.94 dB
All emissions, radiated	6.01 dB
Conducted Emissions (0.150-30MHz) - LISN	3.40 dB
Temperature	0.57°C
Humidity	3.39%
DC Supply voltages	1.70%
Time	3.39%

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

5.4. 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

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a battery-operated Breast Pump with a BLE radio.

6.2. 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: 1Mbps	3.77	2.38
2403 - 2480	BLE: 2Mbps	3.75	2.37

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an chip antenna, with a maximum gain of -2.23 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was lima-puck-fw-v1.0.0-auto-dtm

The test utility software used during testing was CoolTerm v3.0.264.0.

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz and above 18GHz were performed with the EUT set to transmit at the channel and data rate with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels, at 1Mbps and 2Mbps.

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

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	T450s	PC0BHFNX	PD97265NGU

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB-A	2	USB-A	USB	<3m	Connects to laptop for configuration

TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

SETUP DIAGRAMS

Please refer to R13571139-EP1 for setup diagrams

7. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10-2013 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)

Emissions in non-restricted frequency bands: ANSI C63.10 Subclause -11.11 and 6.10.4

Emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.1 and 6.10.5

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

8. 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)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	(Loop Ant.)			
AT0059	Active Loop Antenna	EMCO	6502	2020-08-06	2021-08-06
	30-1000 MHz				
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2020-07-27	2021-07-27
	18-40 GHz				
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2020-10-30	2021-10-30
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2020-07-29	2021-07-29
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2020-07-29	2021-07-29
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2020-07-31	2021-07-31
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2020-07-16	2021-07-16
SOFTEMI	EMI Software	UL	Version 9.5 (2020-08-18)	NA	NA
	Additional Equipment used				
s/n 200037610	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

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

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-04-28	2021-04-28
	Gain-Loss Chains				
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2020-07-06	2021-07-06
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2020-03-17	2021-03-17
SOFTEMI	EMI Software	UL	Version 9.5 (2020-08-18)		
	Additional Equipment used				
s/n 200037635	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

Test Equipment Used - Radiated Disturbance Emissions (E-field) – Chamber C

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0062	HORN Antenna	ETS-Lindgren	3117	2020-01-30	2021-01-30
	Gain-Loss Chains				
C-SAC02	Gain-loss string: 1-18GHz	Various	Various	2020-03-03	2021-03-03
	Receiver & Software				
SA0018	Spectrum Analyzer	Agilent	PXA (N9030A)	2020-03-18	2021-03-18
SOFTEMI	EMI Software	UL	Version 9.5 (2020-08-18)	NA	NA
	Additional Equipment used				
HI0085	Temp/Humid/Pressure Meter	EXTECH	SD700	2020-04-20	2021-04-30

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 1				

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
PWM005 (PRE0136341)	RF Power Meter	Keysight Technologies	N1912A	2020-07-14	2021-07-14
PWS005 (s/n MY55090030)	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2020-05-26	2021-05-26
HI0091	Environmental Meter	Fisher Scientific	15-077-963	2020-06-26	2021-06-26
Conducted Room 2					
SA007 (PRE0126407)	Spectrum Analyzer	Keysight Technologies	N9030A	2020-06-10	2021-06-10
HI0090 (PRE0191271)	Environmental Meter	Fisher Scientific	15-077-963	2020-06-26	2021-06-26
SOFTEMI	Antenna Port Software	UL	Version 2020.12.3	NA	NA

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

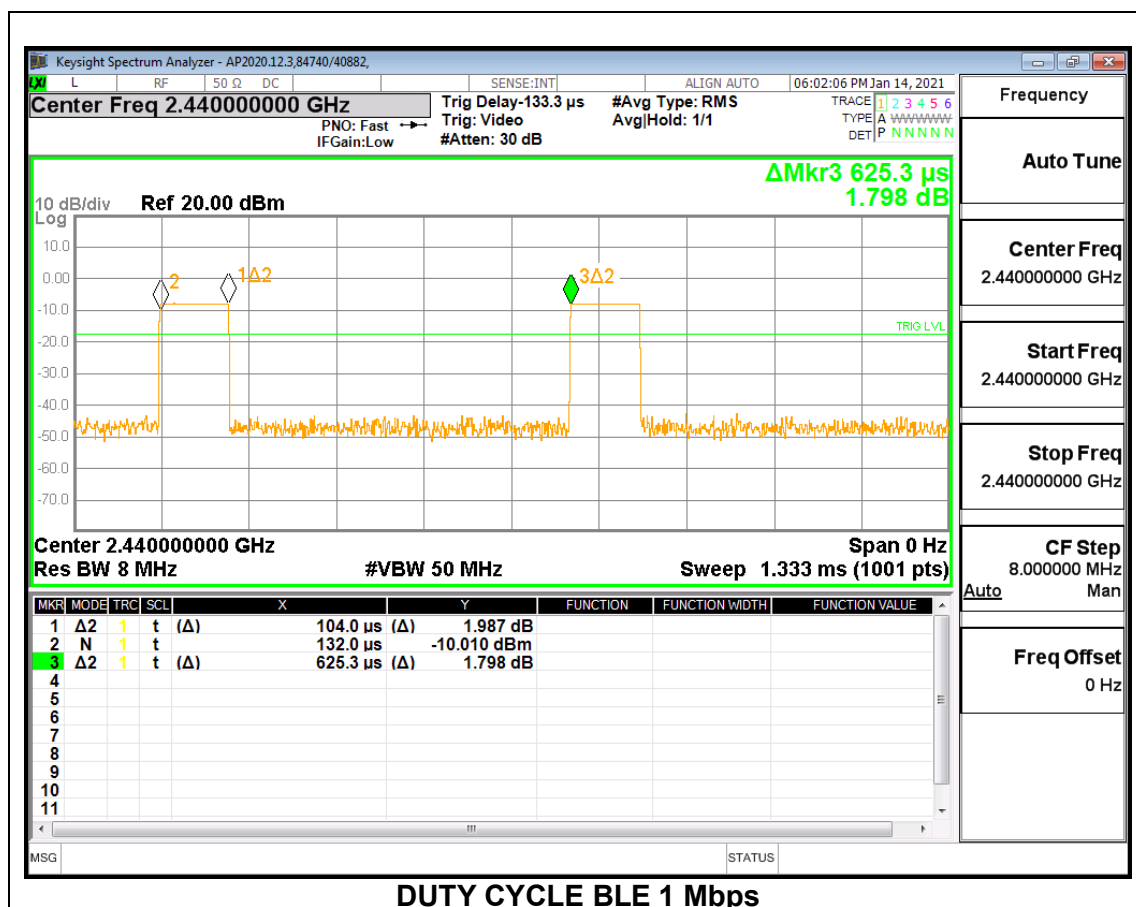
PROCEDURE

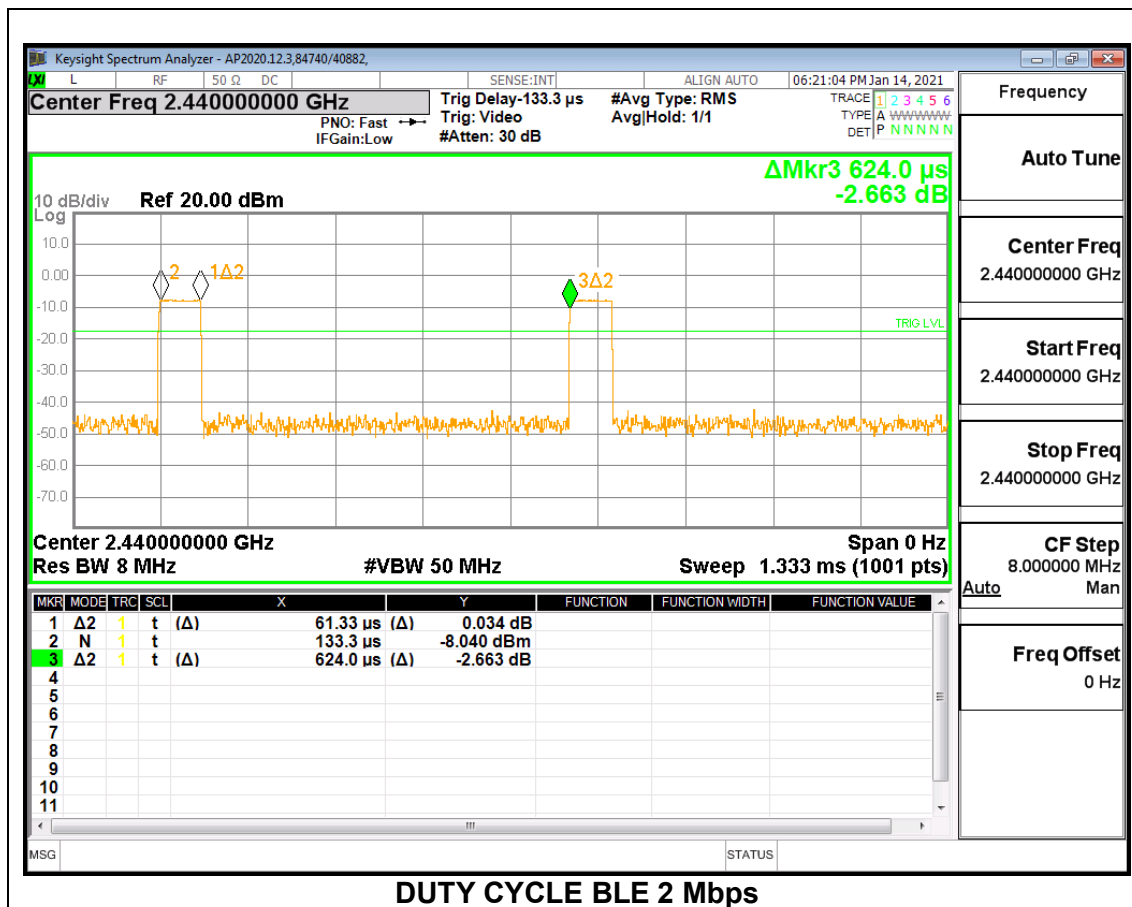
ANSI C63.10 Zero-Span Spectrum Analyzer Method

ON TIME AND DUTY CYCLE RESULTS

	B (msec)	(msec)	x (linear)	Cycle (%)	Correction Factor (dB)	Minimum VBW (kHz)
2.4GHz Band						
BLE 1 Mbps	0.104	0.625	0.166	16.64%	15.58	9.615
BLE 2 Mbps	0.061	0.624	0.098	9.78%	20.20	16.393

DUTY CYCLE PLOTS





9.2. 99% BANDWIDTH

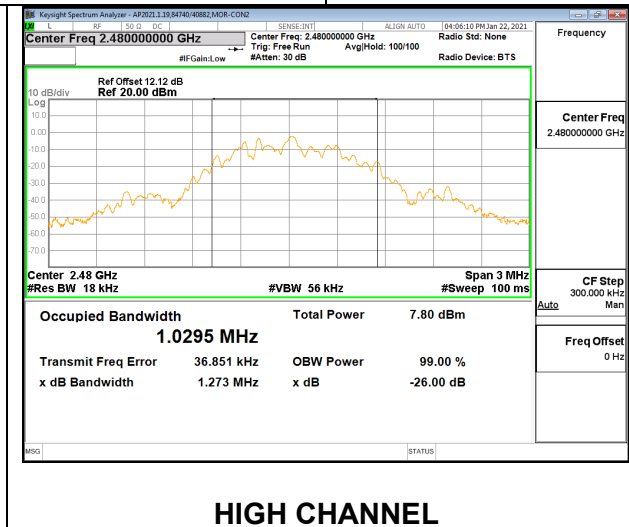
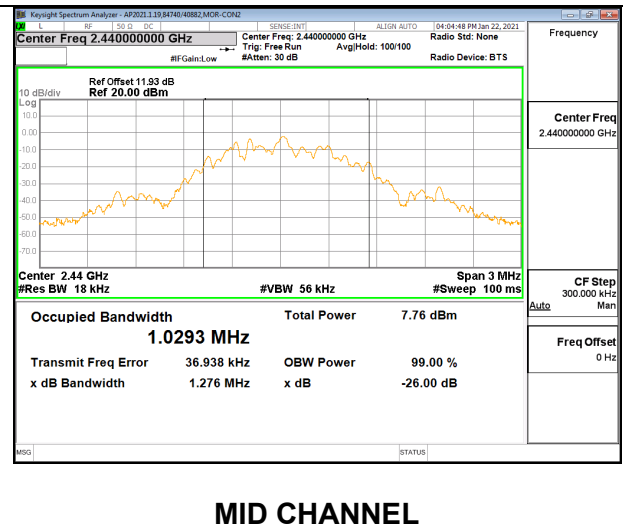
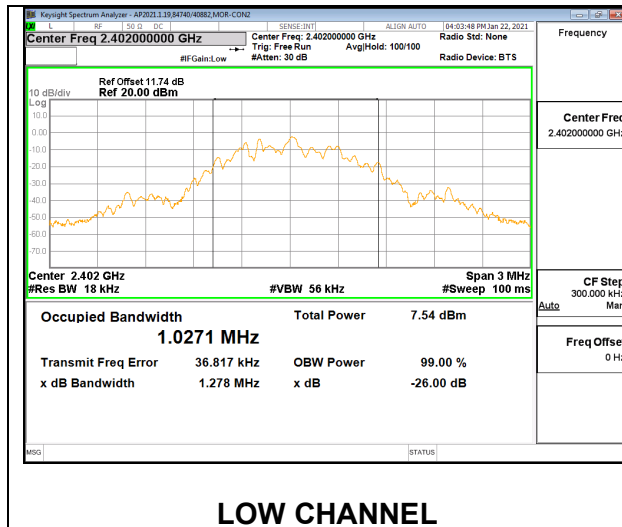
LIMITS

None; for reporting purposes only.

RESULTS

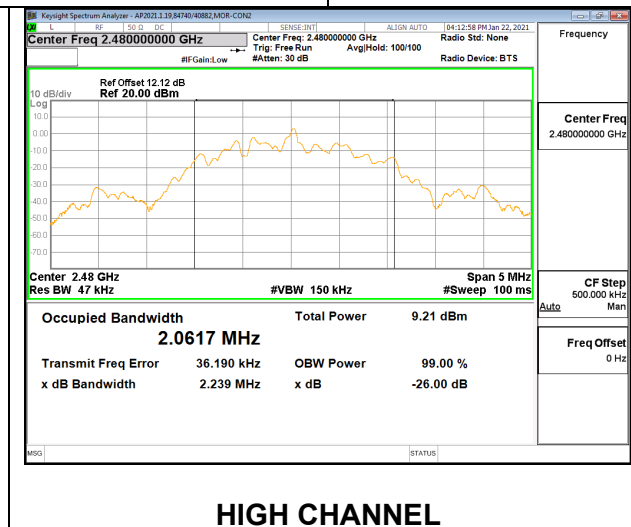
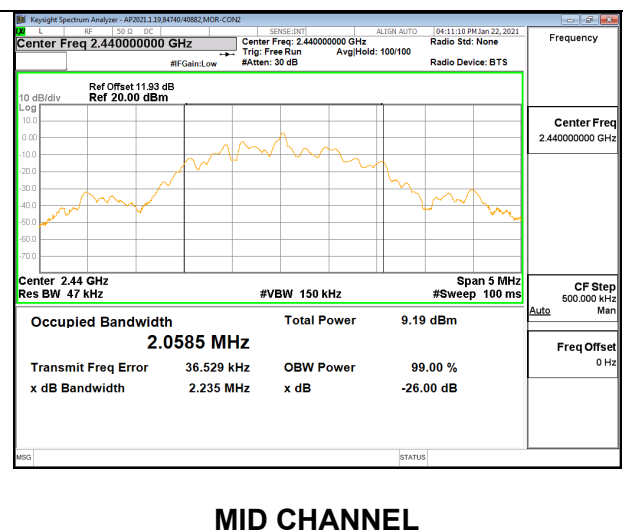
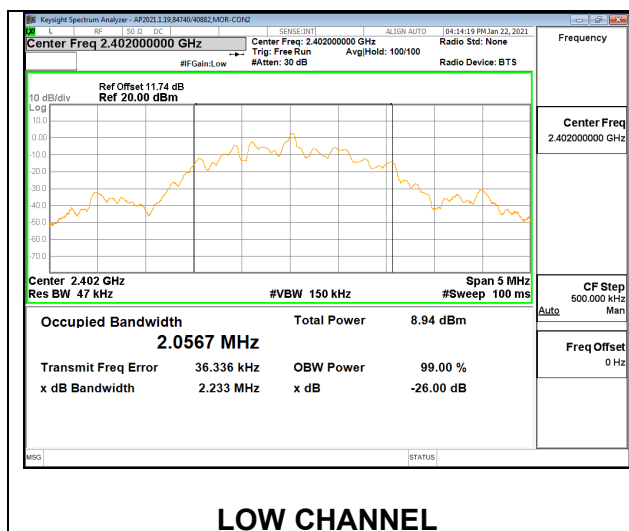
9.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0271
Middle	2440	1.0293
High	2480	1.0295



9.2.2. BLE (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.0567
Middle	2440	2.0585
High	2480	2.0617



9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

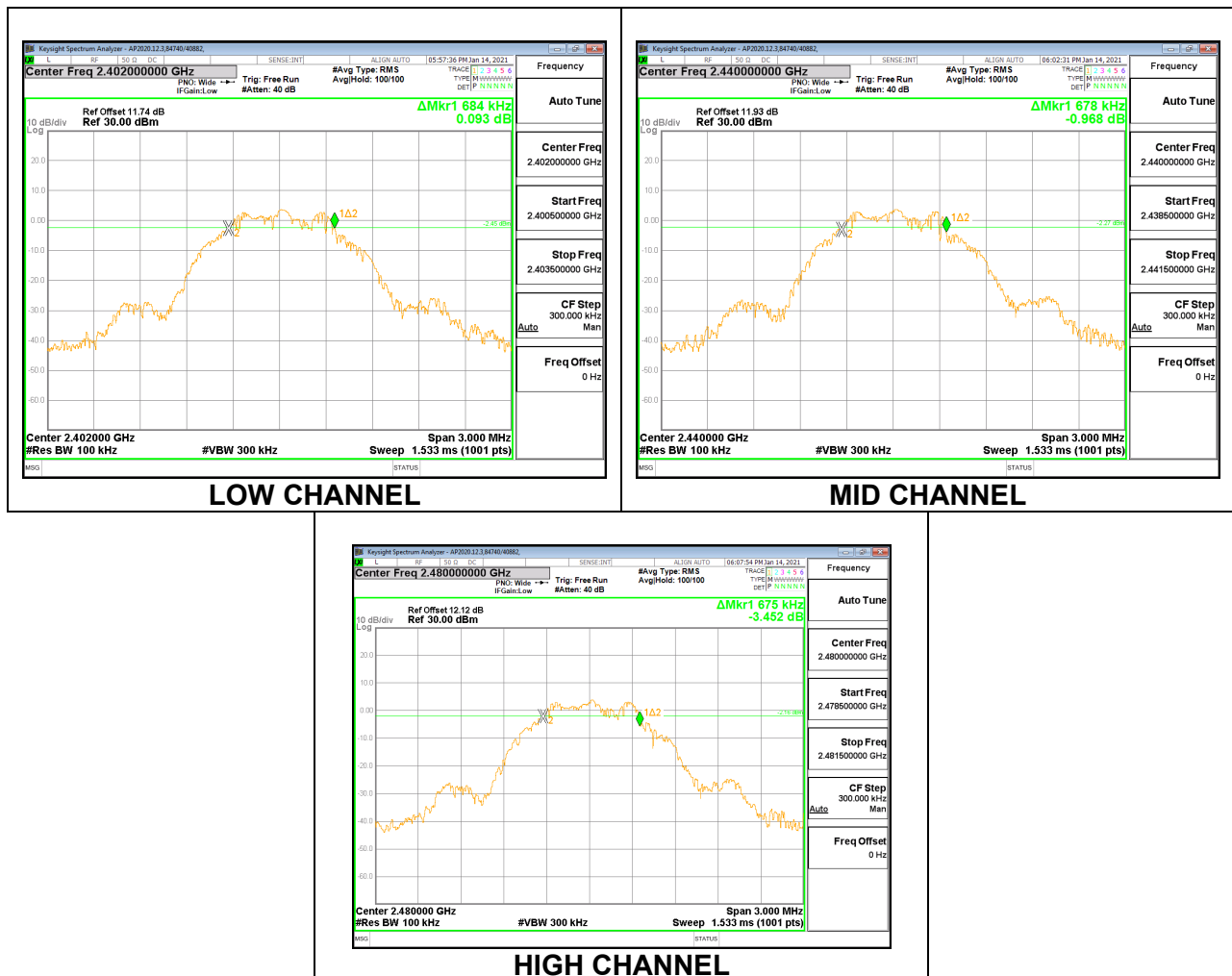
RSS-247 5.2 (a)

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

RESULTS

9.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6840	0.5
Middle	2440	0.6780	0.5
High	2480	0.6750	0.5



9.3.2. BLE (2Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.1700	0.5
Middle	2440	1.2120	0.5
High	2480	1.1820	0.5



9.4. 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 11.73 dB (including 10.28 dB pad and 1.45 dB cable) was entered as an offset in the power meter.

RESULTS

9.4.1. BLE (1Mbps)

Tested By:	84740/40882
Date:	2021-01-14

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	3.77	30	-26.230
Middle	2440	3.69	30	-26.310
High	2480	3.68	30	-26.320

9.4.2. BLE (2Mbps)

Tested By:	84740/40882
Date:	2021-01-14

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	3.75	30	-26.250
Middle	2440	3.70	30	-26.300
High	2480	3.71	30	-26.290

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a gated average power meter.

The cable assembly insertion loss of 11.73 dB (including 10.28 dB pad and 1.45 dB cable) was entered as an offset in the power meter.

RESULTS

9.5.1. BLE (1Mbps)

Tested By:	84740/40882
Date:	2021-01-14

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	3.6
Middle	2440	3.54
High	2480	3.52

9.5.2. BLE (2Mbps)

Tested By:	84740/40882
Date:	2021-01-14

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	3.58
Middle	2440	3.53
High	2480	3.51

9.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

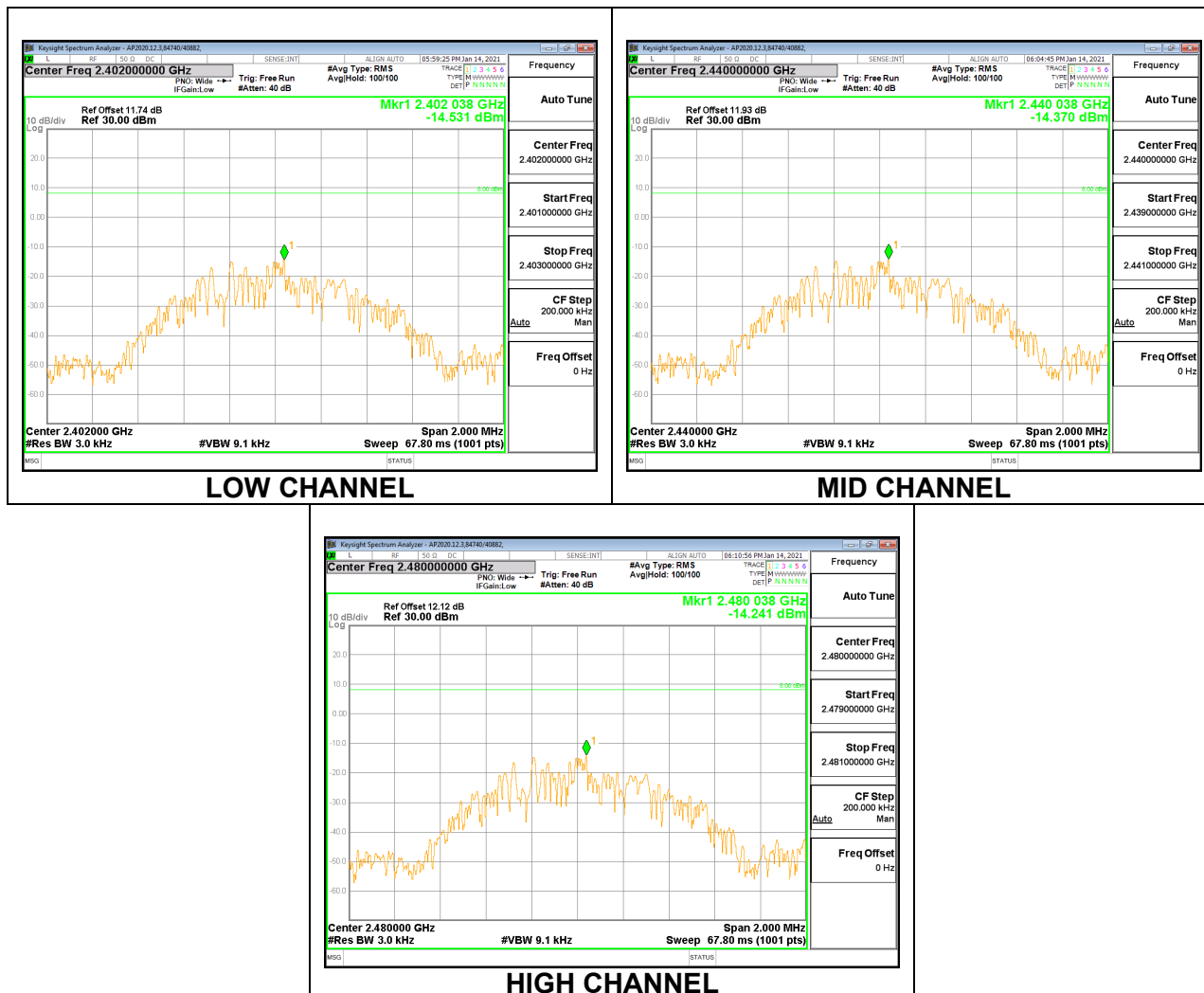
RSS-247 (5.2) (b)

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

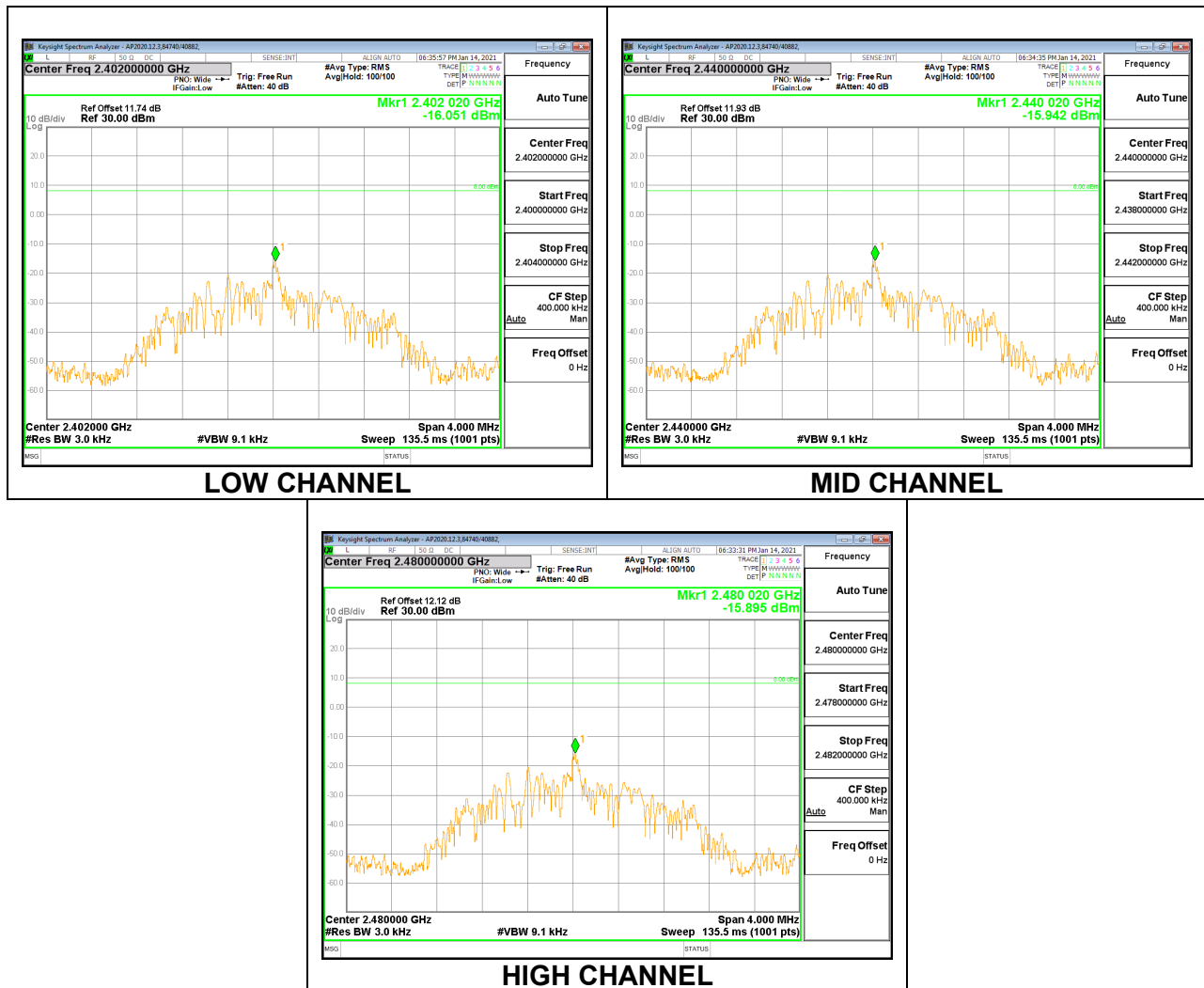
9.6.1. BLE (1Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-14.53	8	-22.53
Middle	2440	-14.37	8	-22.37
High	2480	-14.24	8	-22.24



9.6.2. BLE (2Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-16.05	8	-24.05
Middle	2440	-15.94	8	-23.94
High	2480	-15.90	8	-23.90



9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

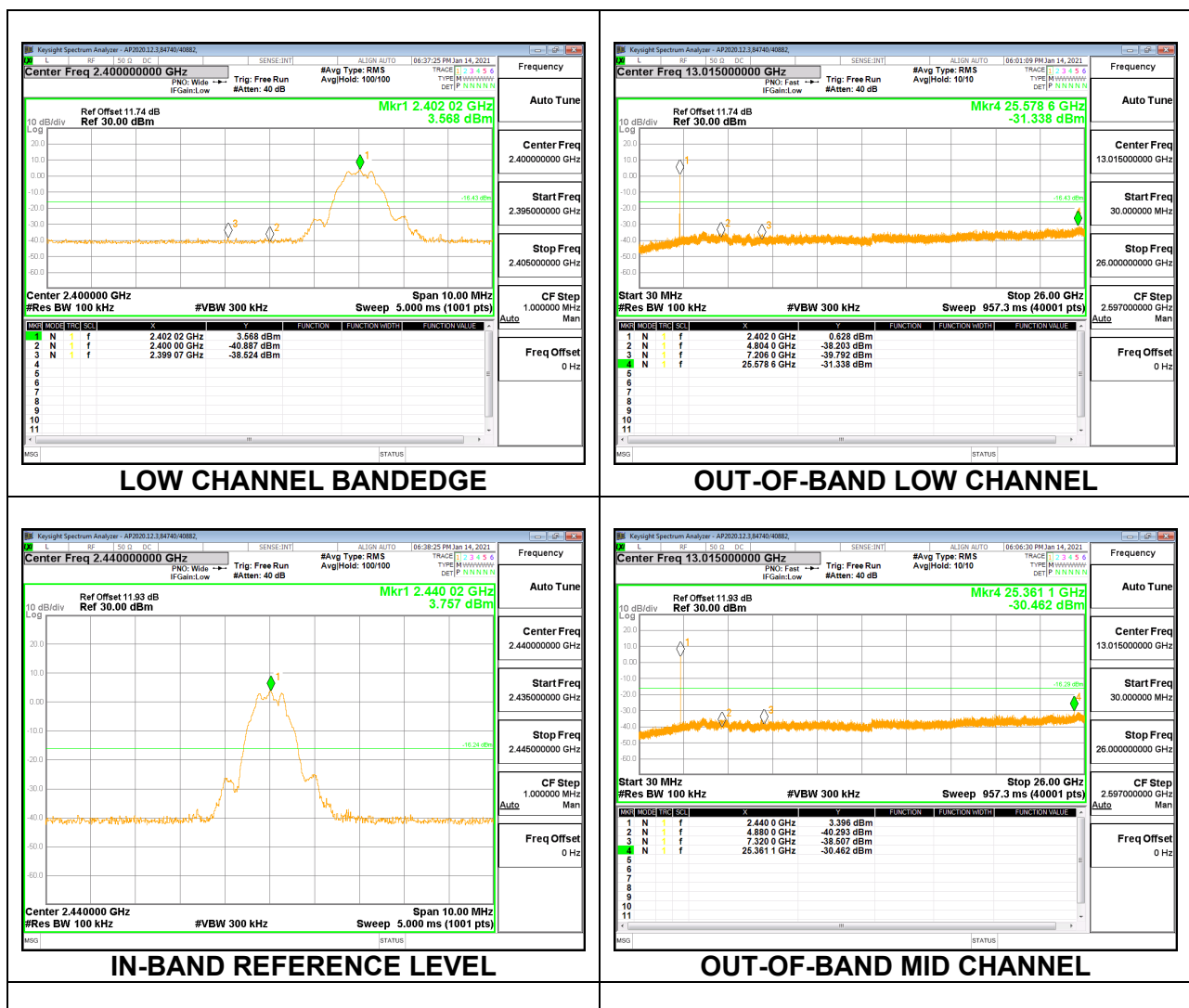
FCC §15.247 (d)

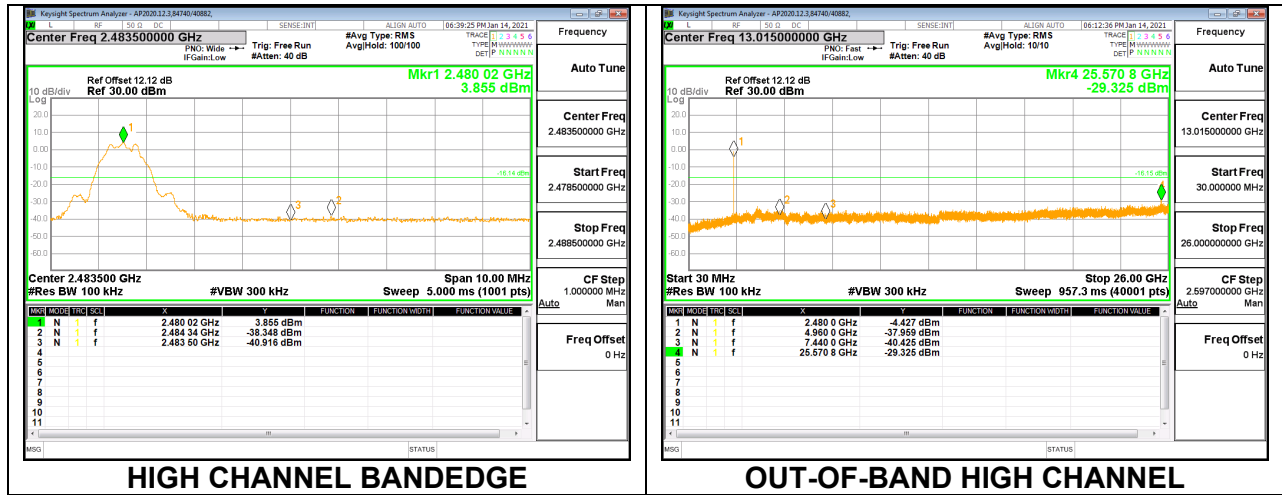
RSS-247 5.5

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

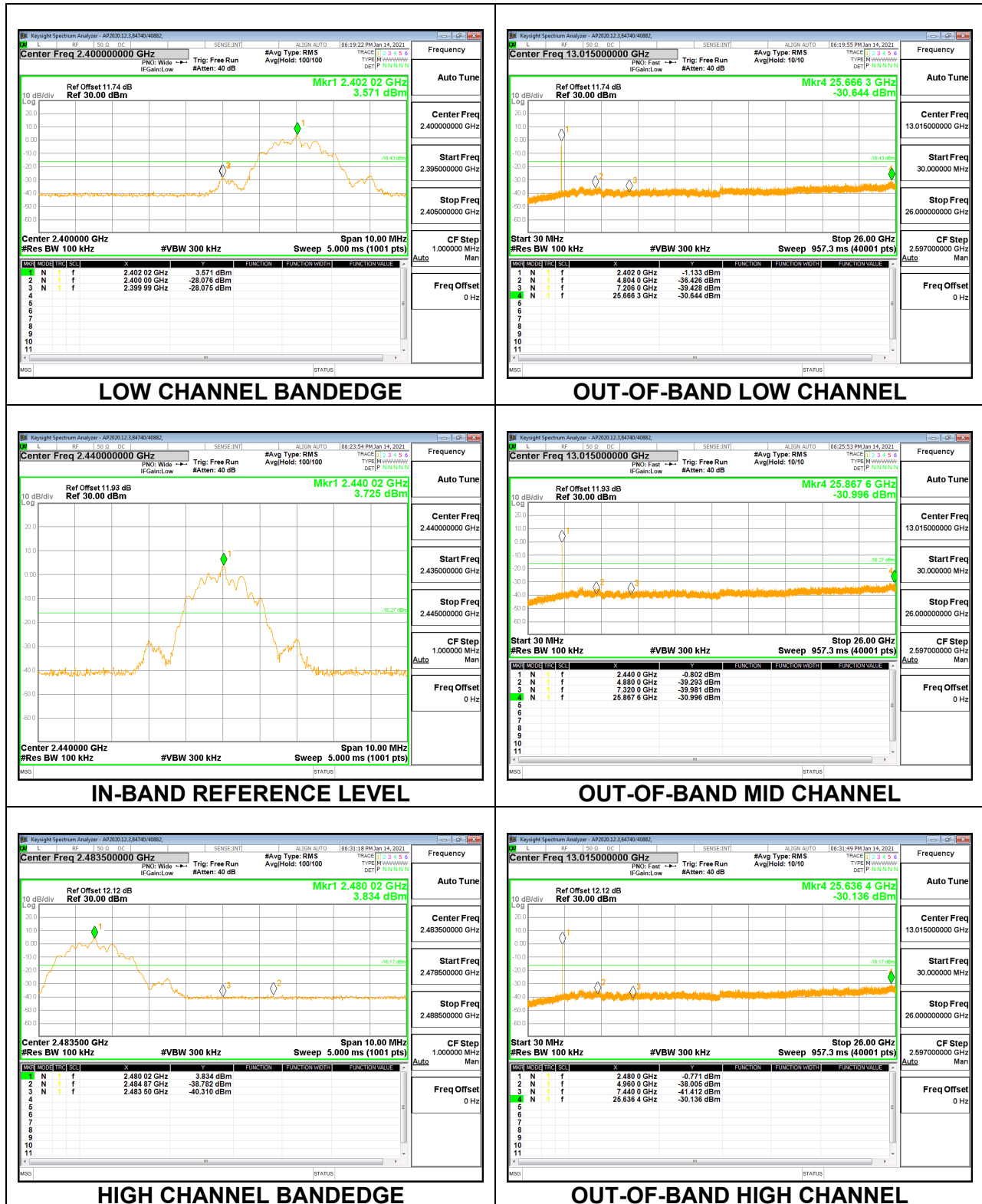
RESULTS

9.7.1. BLE (1Mbps)





9.7.2. BLE (2Mbps)



10. RADIATED TEST RESULTS

10.1. 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 100 kHz for peak detection measurements or 120 kHz for 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 or average (9-90kHz and 110-490kHz).

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 linear voltage average measurements.

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).

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.

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

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

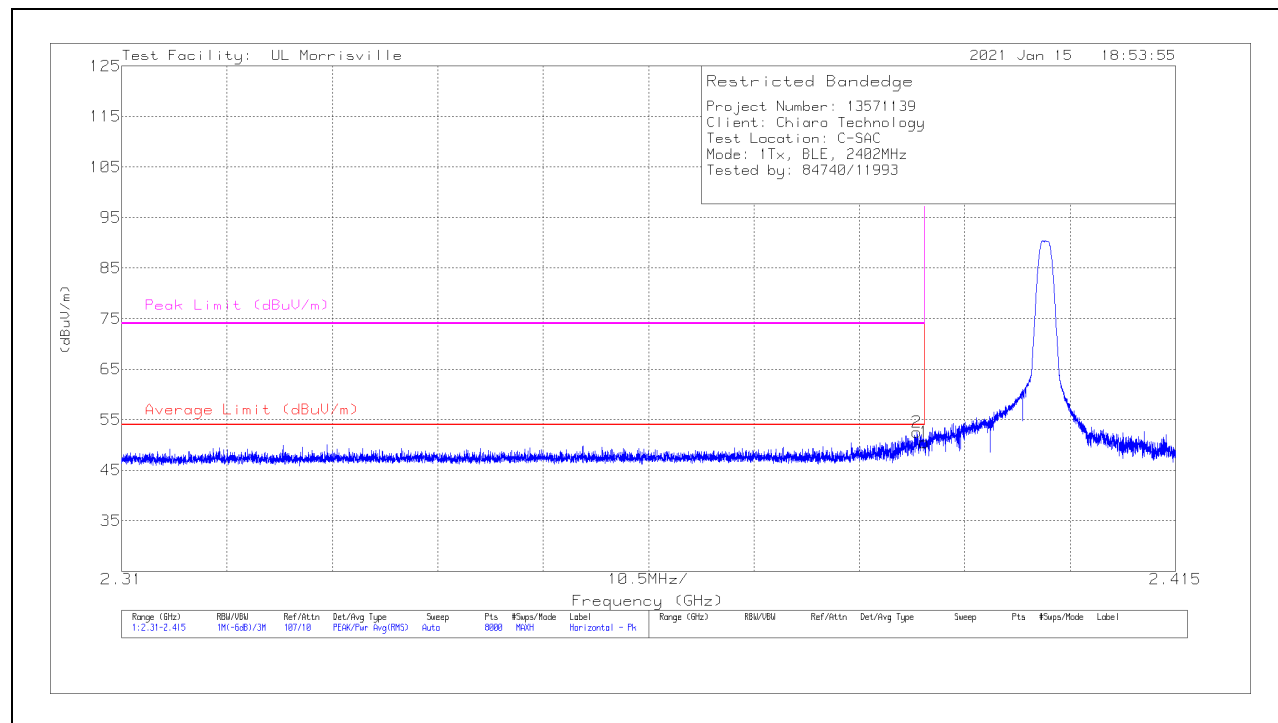
10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BLE (1Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



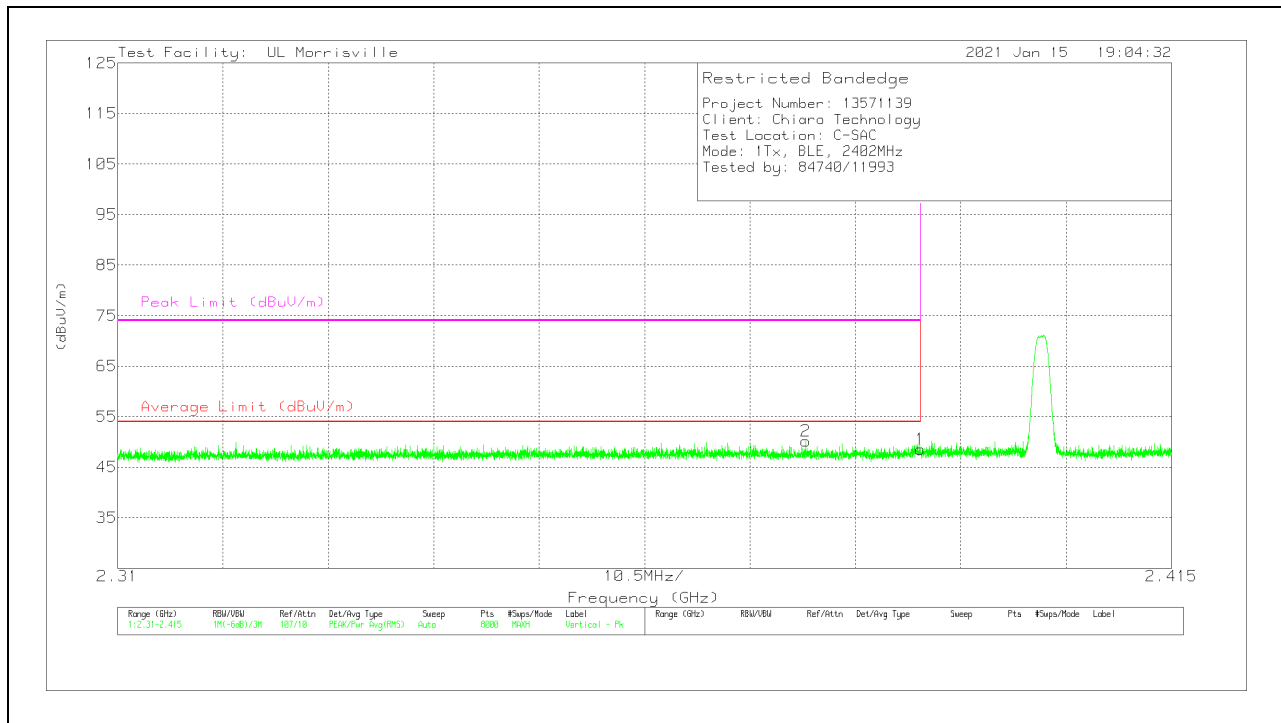
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	36.58	Pk	32.1	-18.2	50.48	54	-3.52	74	-23.52	283	132	H
2	* ** 2.38922	38.78	Pk	32	-18.2	52.58	54	-1.42	74	-21.42	283	132	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	AT0062 (dB/m)	Amp/Cbl (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	34.71	Pk	32.1	-18.2	48.61	54	-5.39	74	-25.39	270	290	V
2	* ** 2.37855	36.52	Pk	32	-18.4	50.12	54	-3.88	74	-23.88	270	290	V

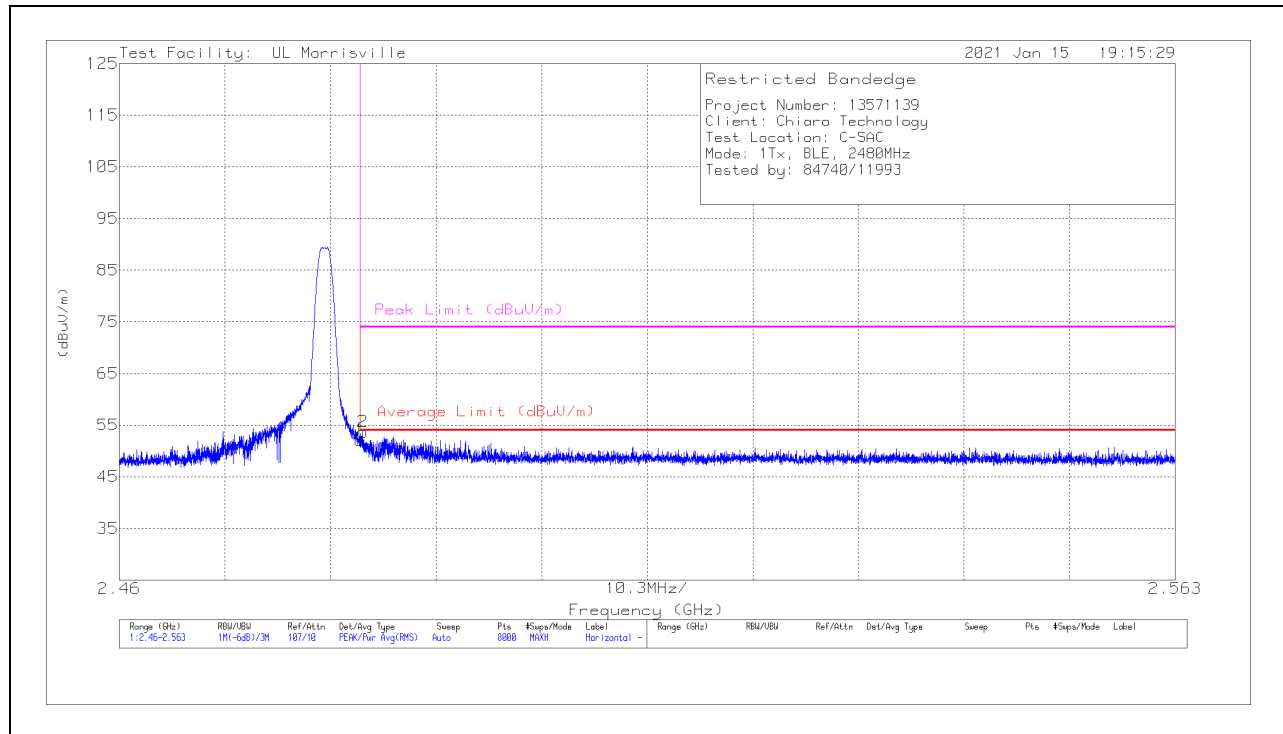
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



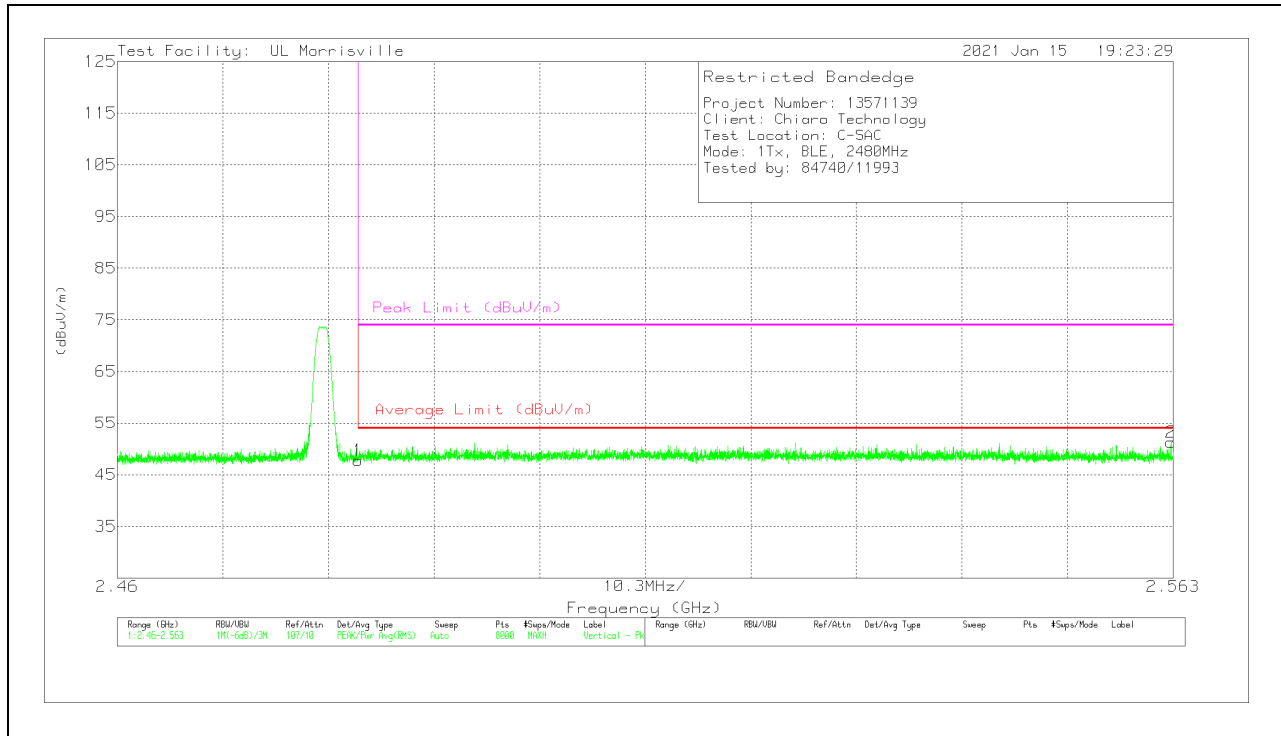
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	37.42	Pk	32.6	-18	52.02	54	-1.98	74	-21.98	259	211	H
2	* ** 2.48376	39.08	Pk	32.6	-18	53.68	54	-0.32	74	-20.32	259	211	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl (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	33.17	Pk	32.6	-18	47.77	54	-6.23	74	-26.23	164	240	V
2	** 2.56278	36.47	Pk	32.4	-17.6	51.27	54	-2.73	74	-22.73	164	240	V

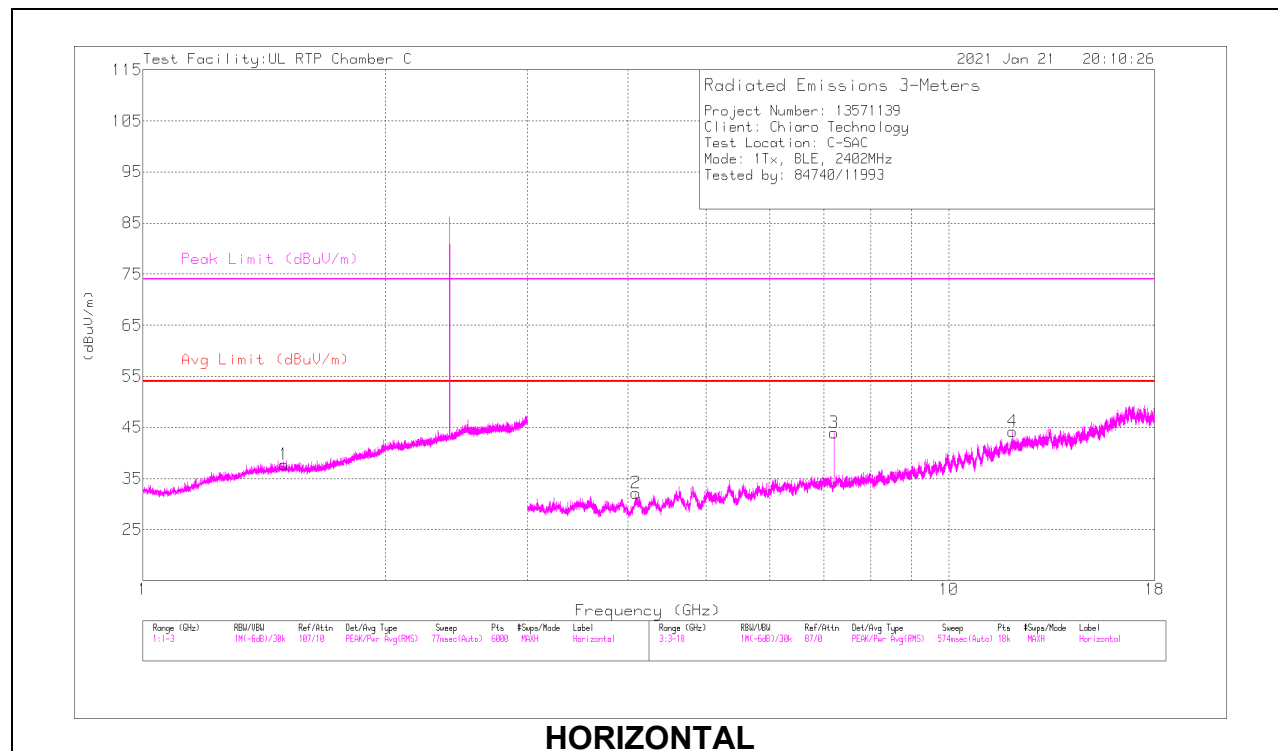
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

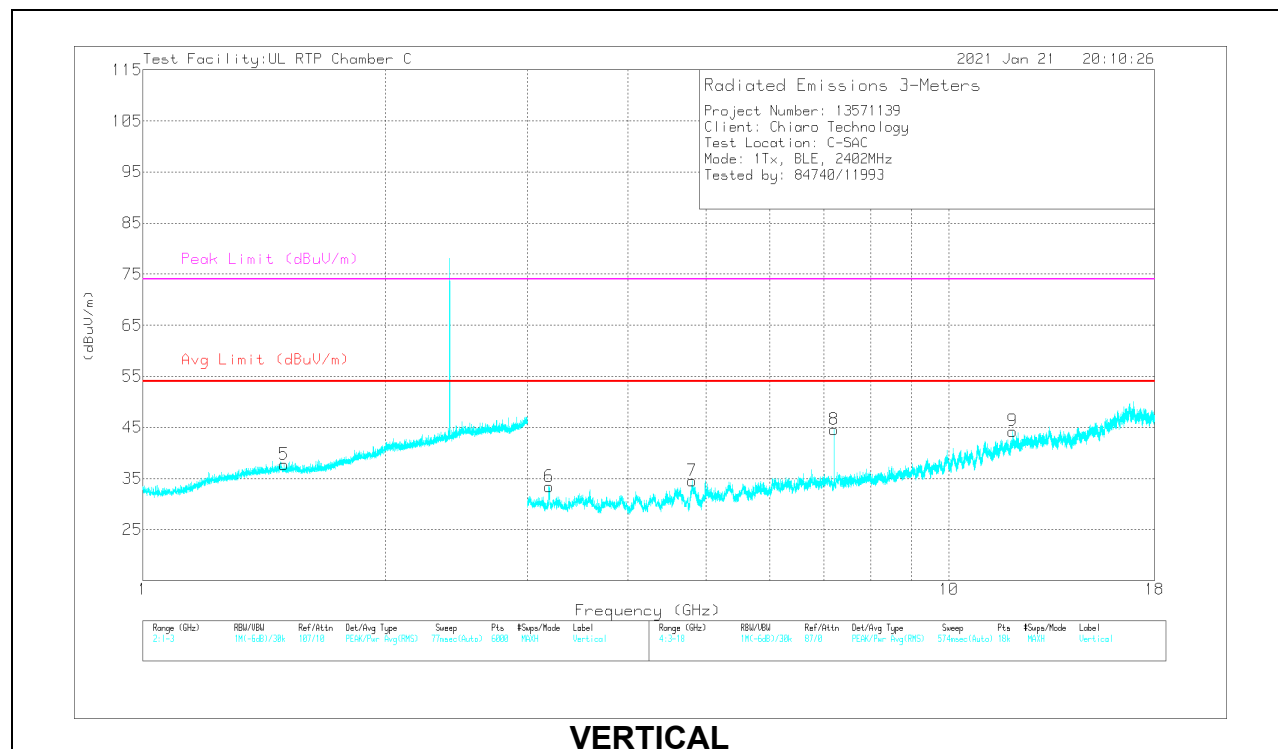
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 1.49602	34.42	PK2	27.8	-17.8	44.42	54	-9.58	74	-29.58	229	147	H
4	* ** 12.01009	48.53	PK2	38.8	-37.3	50.03	54	-3.97	74	-23.97	213	308	H
2	* ** 4.09292	51.61	PK2	33.5	-48.1	37.01	54	-16.99	74	-36.99	333	101	H
5	* ** 1.49831	34.02	PK2	27.8	-17.9	43.92	54	-10.08	74	-30.08	90	239	V
9	* ** 12.00861	49.52	PK2	38.8	-37.3	51.02	54	-2.98	74	-22.98	28	192	V
7	* ** 4.80434	52.39	PK2	34.1	-47.8	38.69	54	-15.31	74	-35.31	4	184	V
3	7.20607	53.54	Pk	35.7	-45.3	43.94	-	-	-	-	0-360	101	H
6	3.19001	50.34	Pk	32.9	-49.8	33.44	-	-	-	-	0-360	200	V
8	7.20607	54.2	Pk	35.7	-45.3	44.6	-	-	-	-	0-360	101	V

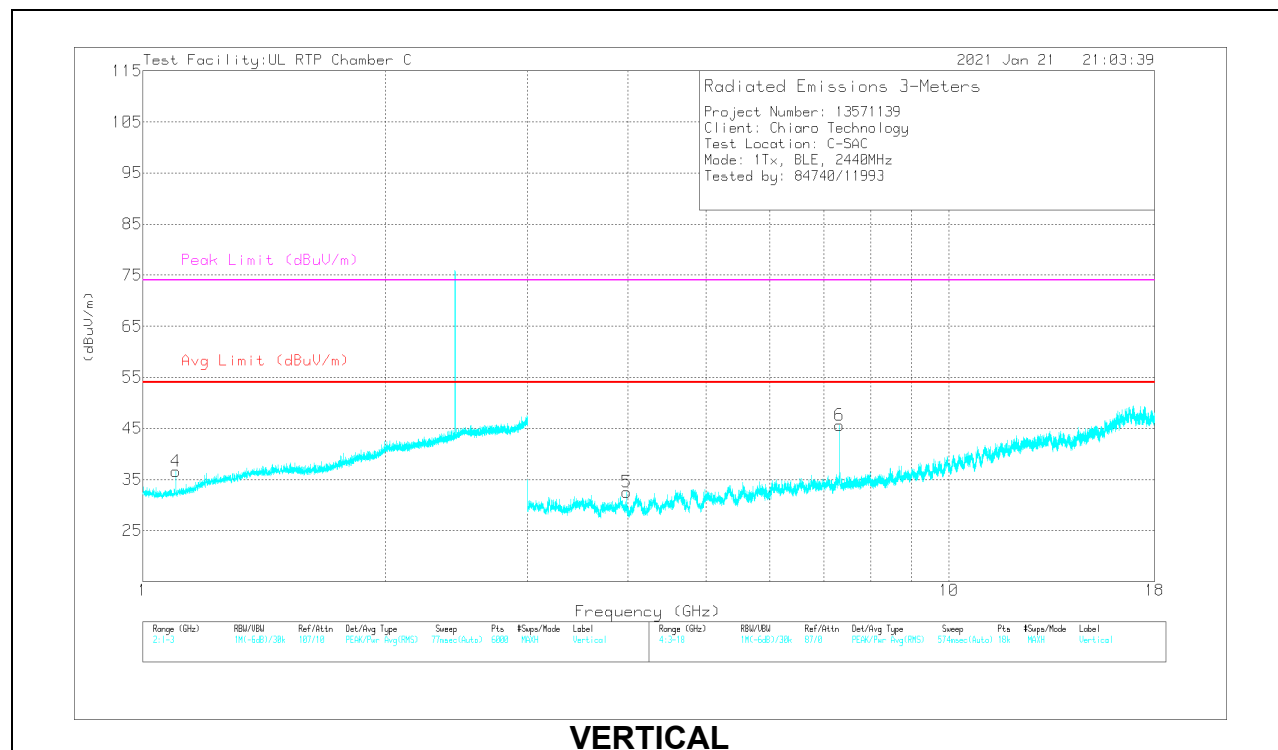
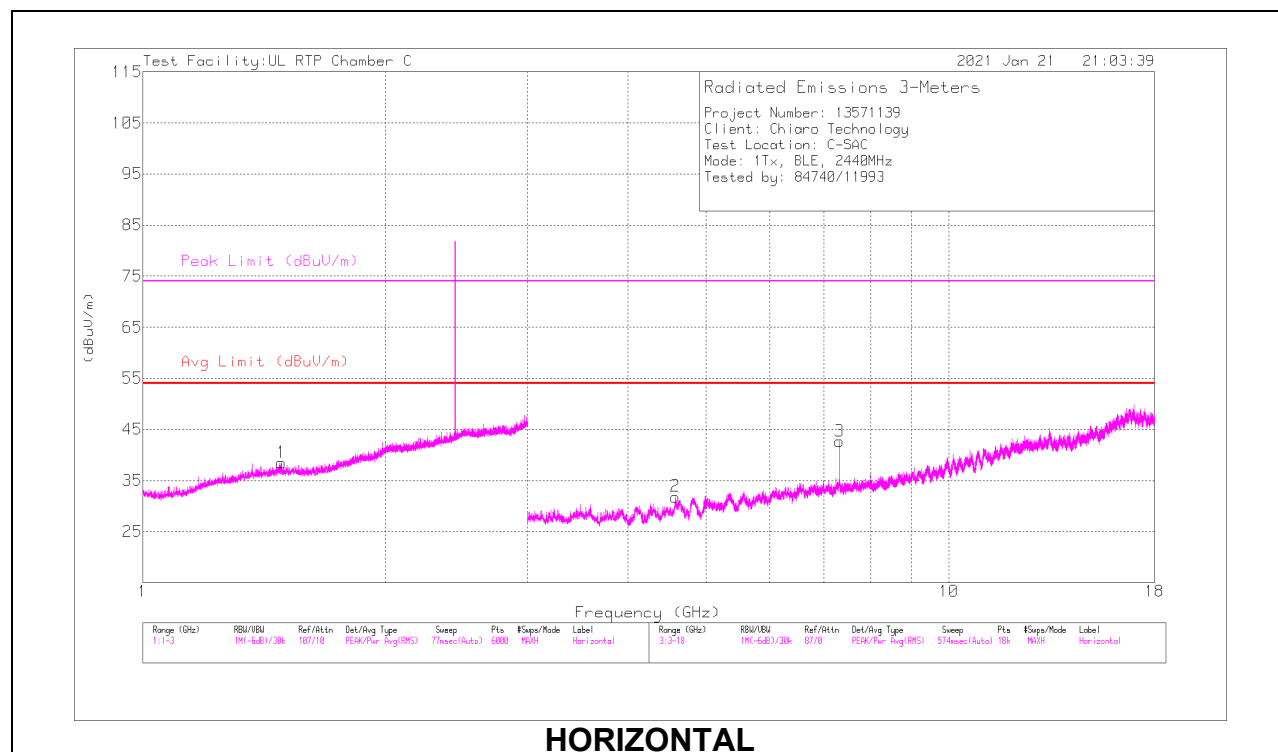
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

MID CHANNEL RESULTS



RADIATED EMISSIONS

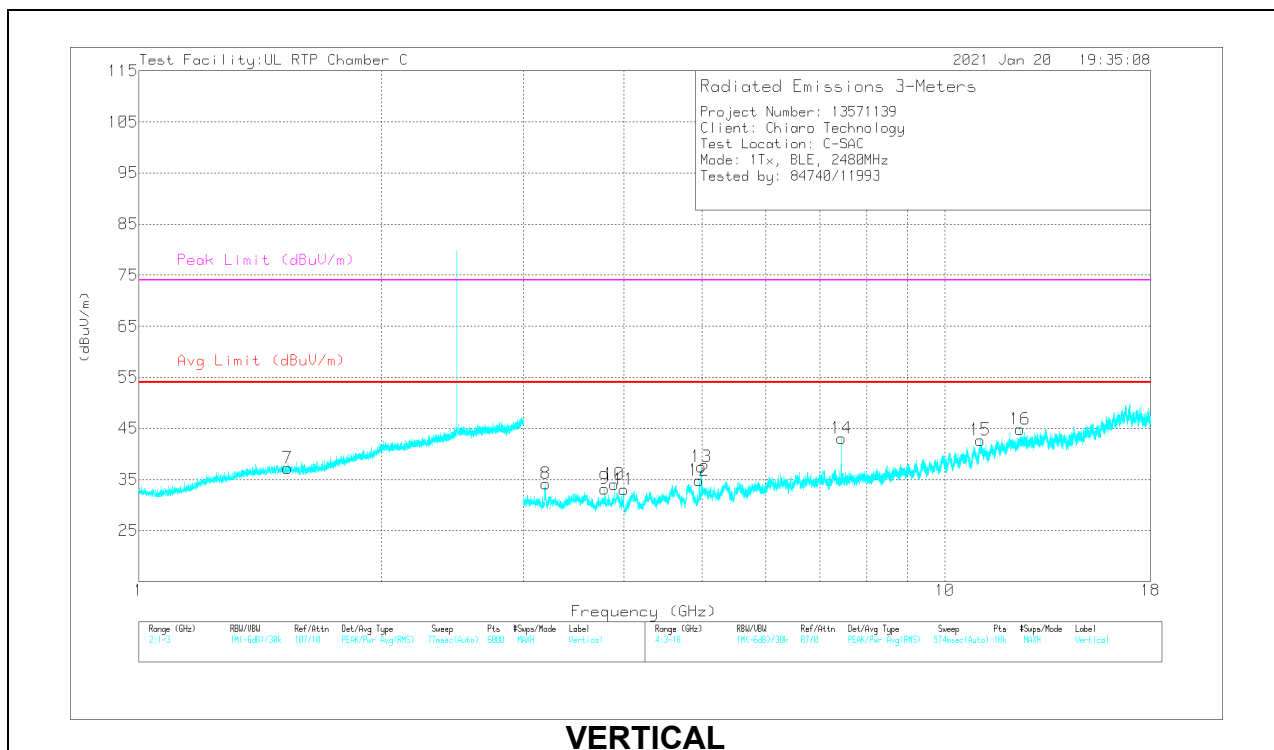
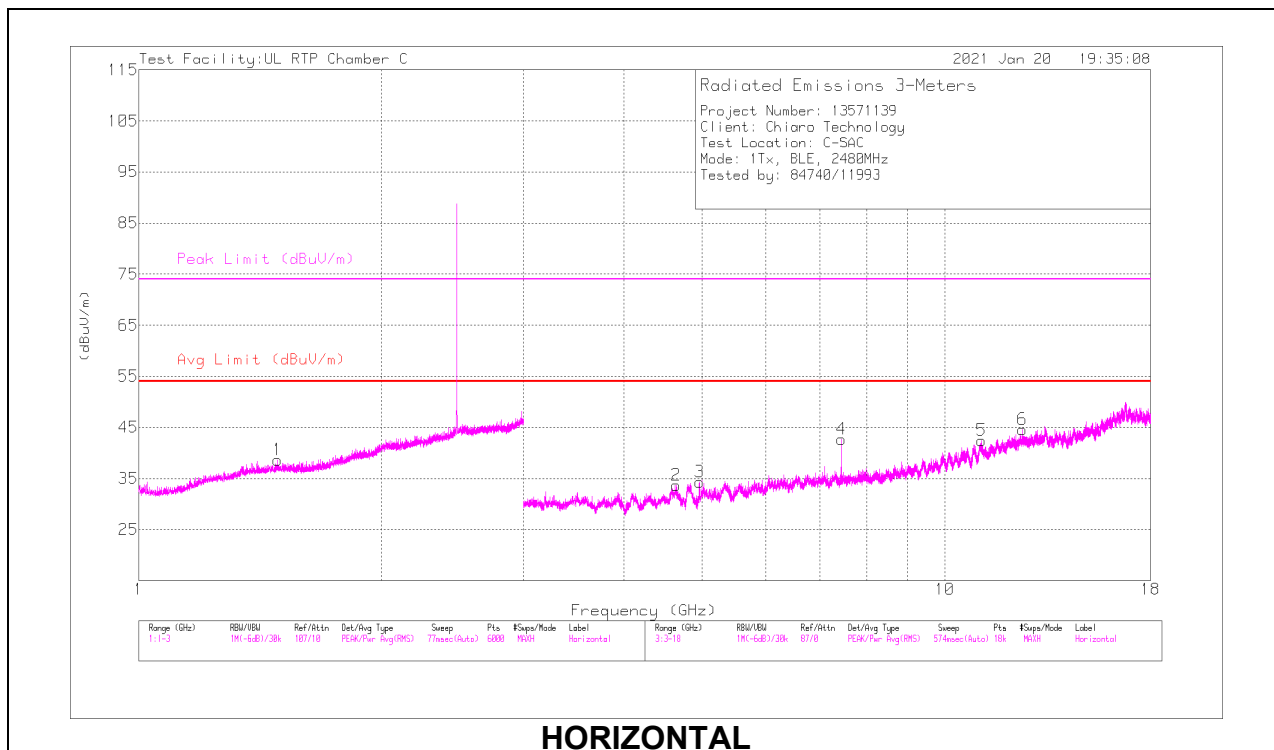
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 1.48462	34.22	PK2	27.8	-17.6	44.42	54	-9.58	74	-29.58	4	214	H
2	* ** 4.58121	50.58	PK2	34.1	-47.8	36.88	54	-17.12	74	-37.12	254	101	H
3	* ** 7.31928	56.1	PK2	35.7	-44.6	47.2	54	-6.8	74	-26.8	340	101	H
4	* ** 1.09931	41.89	PK2	27.3	-21	48.19	54	-5.81	74	-25.81	92	261	V
5	* ** 3.98243	53.64	PK2	33.4	-48.2	38.84	54	-15.16	74	-35.16	103	204	V
6	* ** 7.31921	58.25	PK2	35.7	-44.6	49.35	54	-4.65	74	-24.65	214	117	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Fitr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 1.48551	34.1	PK2	27.8	-17.8	44.1	54	-9.9	74	-29.9	346	392	H
5	** 11.11084	48.82	PK2	37.8	-38.7	47.92	54	-6.08	74	-26.08	351	193	H
6	*** 12.48942	49.07	PK2	39.1	-37.9	50.27	54	-3.73	74	-23.73	140	304	H
2	*** 4.64431	55	PK2	34.1	-46.9	42.2	54	-11.8	74	-31.8	103	393	H
3	*** 4.95974	54.66	PK2	34	-47.4	41.26	54	-12.74	74	-32.74	130	101	H
4	*** 7.44014	56.6	PK2	35.7	-45.3	47	54	-7	74	-27	158	101	H
7	*** 1.52819	34.09	PK2	28	-18.2	43.89	54	-10.11	74	-30.11	232	129	V
15	*** 11.06058	49.68	PK2	37.8	-38.9	48.58	54	-5.42	74	-25.42	190	320	V
16	*** 12.39884	49.69	PK2	39	-37.4	51.29	54	-2.71	74	-22.71	193	190	V
9	*** 3.78483	51.14	PK2	33.5	-48.2	36.44	54	-17.56	74	-37.56	33	197	V
10	*** 3.88959	52.69	PK2	33.5	-49.3	36.89	54	-17.11	74	-37.11	347	197	V
11	*** 3.99671	59.29	PK2	33.4	-48.6	44.09	54	-9.91	74	-29.91	97	206	V
12	*** 4.96055	52.93	PK2	34	-47.5	39.43	54	-14.57	74	-34.57	190	202	V
13	*** 4.99204	57.07	PK2	34	-47.3	43.77	54	-10.23	74	-30.23	248	214	V
14	*** 7.43929	56.71	PK2	35.7	-45.3	47.11	54	-6.89	74	-26.89	355	192	V
8	3.19751	51.13	Pk	32.9	-49.9	34.13	-	-	-	-	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

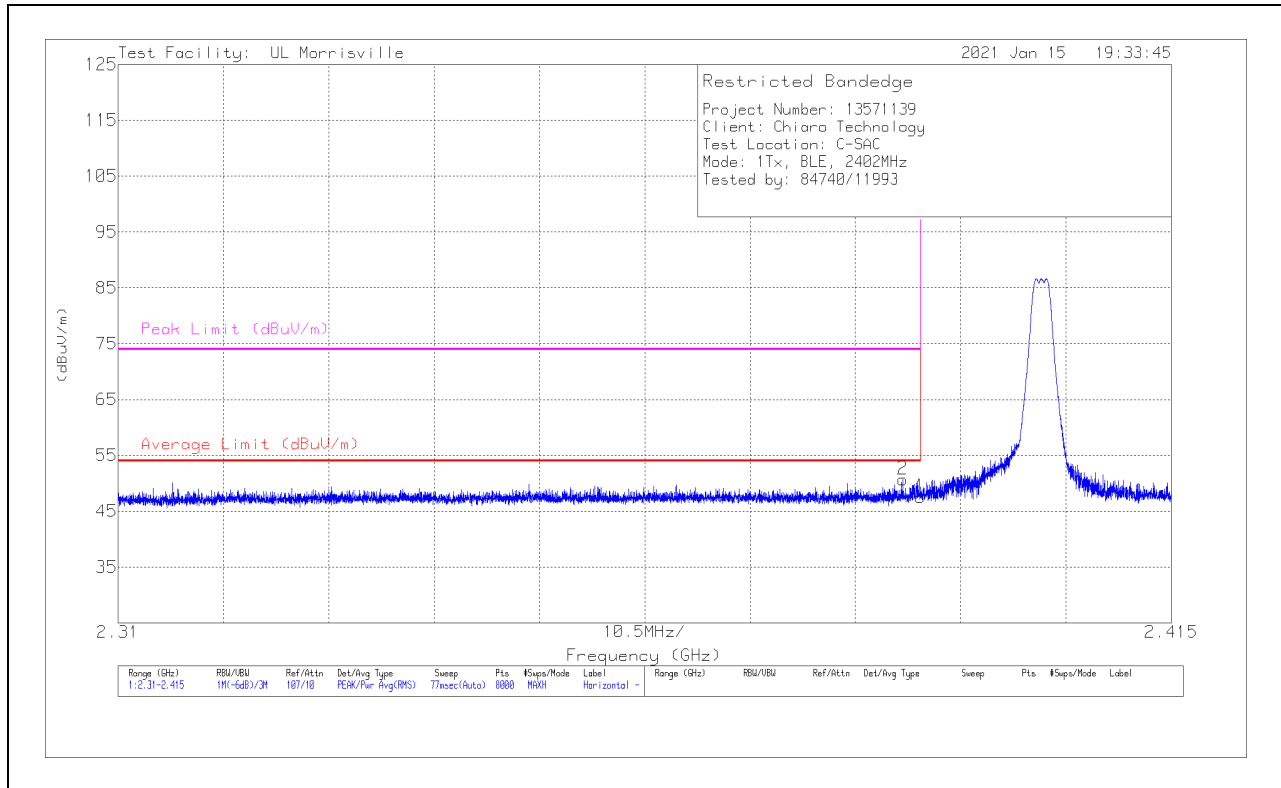
Pk - Peak detector

10.2.2. BLE (2Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



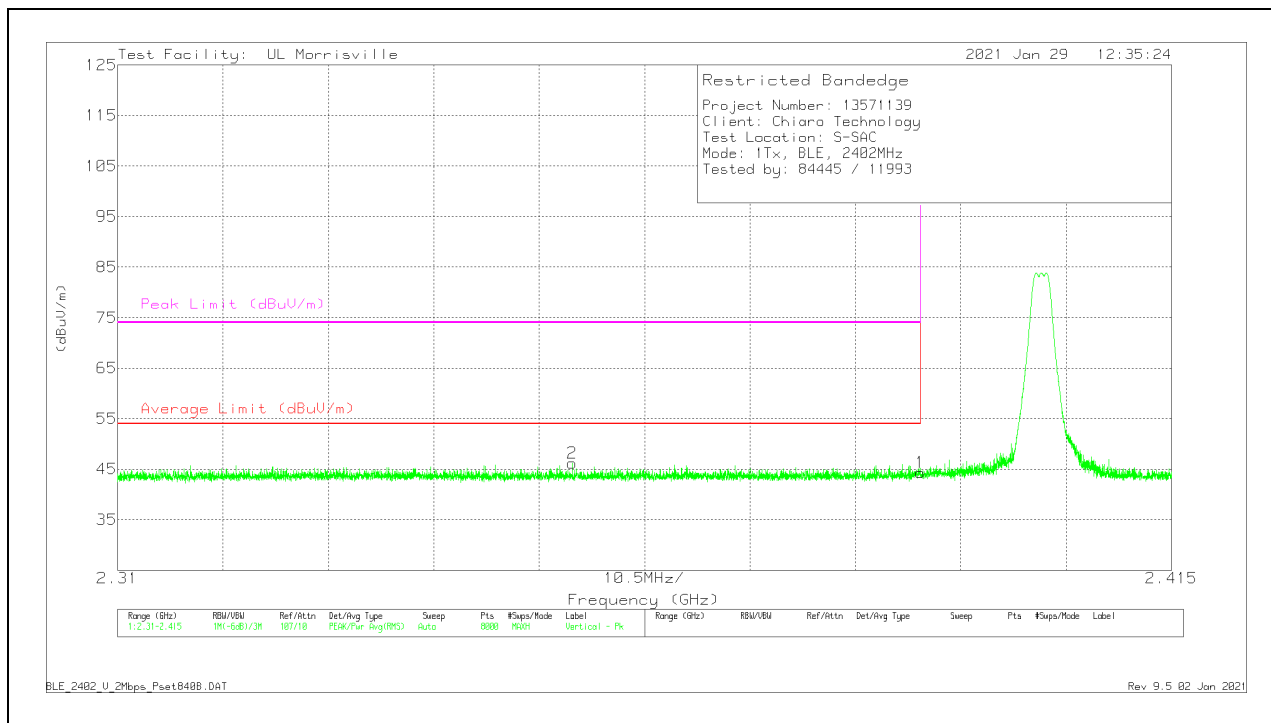
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	33.68	Pk	32.1	-18.2	47.58	54	-6.42	74	-26.42	30	276	H
2	* ** 2.38822	37.02	Pk	32	-18.3	50.72	54	-3.28	74	-23.28	30	276	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr/Pad (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	36.21	Pk	32.1	-24	44.31	54	-9.69	74	-29.69	111	367	V
2	* ** 2.35528	37.83	Pk	32.2	-23.8	46.23	54	-7.77	74	-27.77	111	367	V

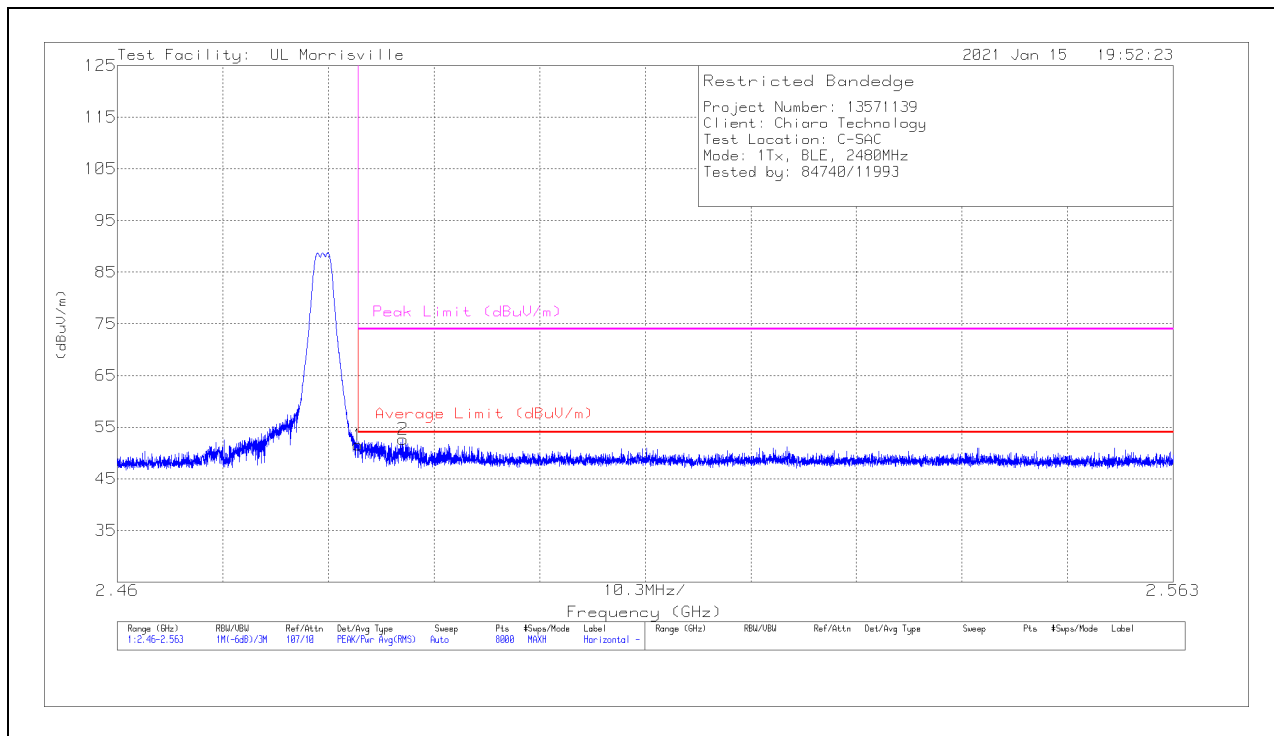
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



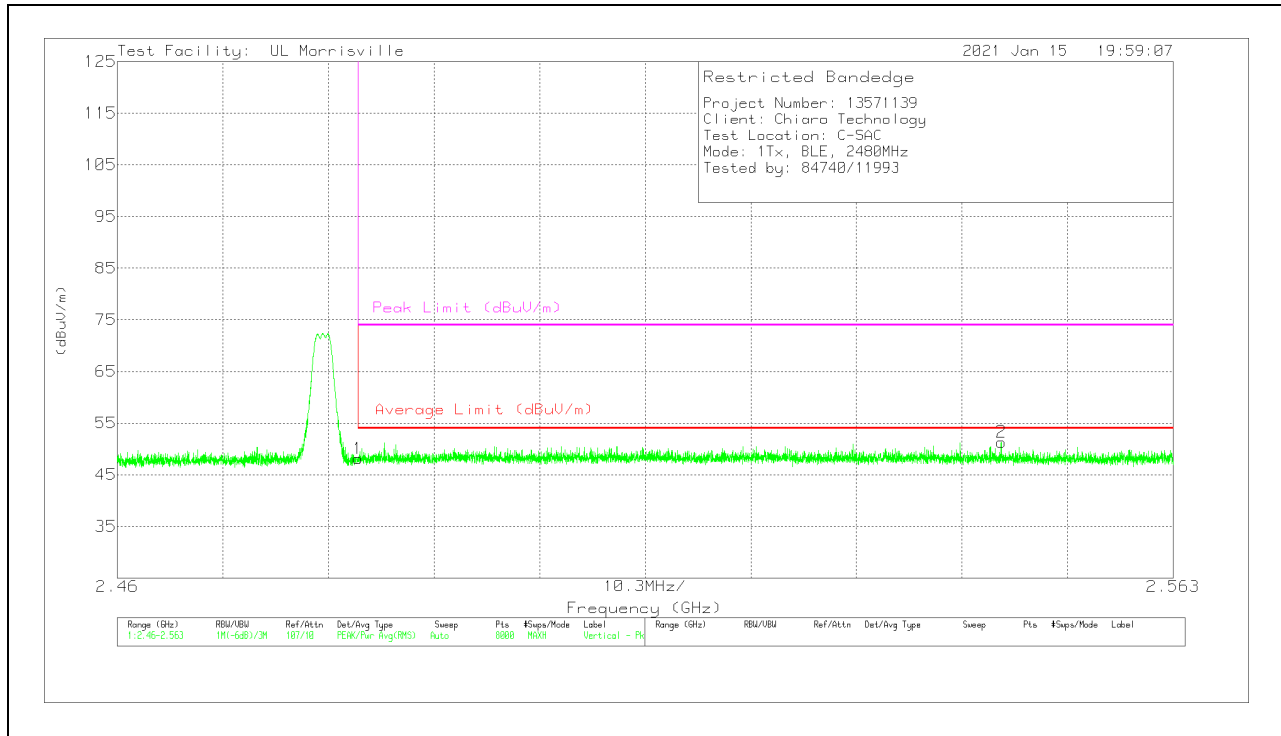
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	36.92	Pk	32.6	-18	51.52	54	-2.48	74	-22.48	256	152	H
2	* ** 2.48787	38.05	Pk	32.6	-18	52.65	54	-1.35	74	-21.35	256	152	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl (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	33.53	Pk	32.6	-18	48.13	54	-5.87	74	-25.87	181	264	V
2	** 2.54622	36.52	Pk	32.5	-17.7	51.32	54	-2.68	74	-22.68	181	264	V

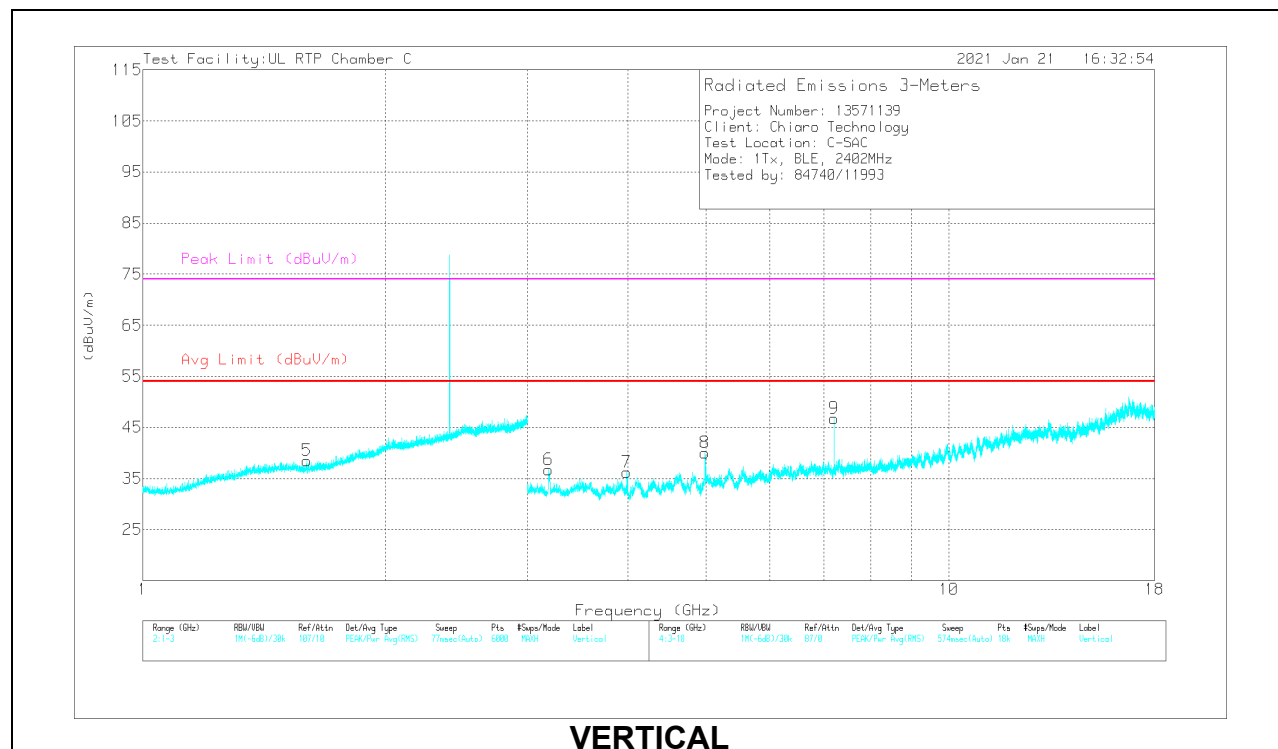
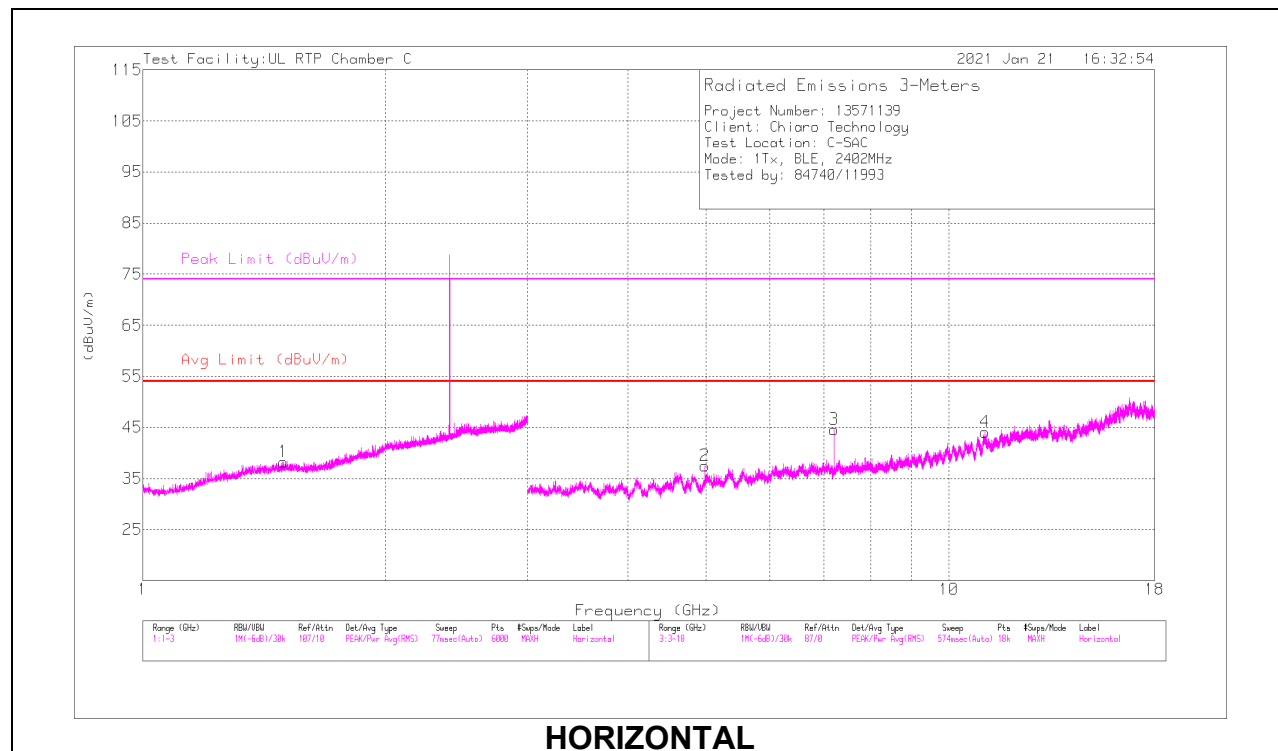
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 1.49281	34.58	PK2	27.8	-18	44.38	54	-9.62	74	-29.62	137	218	H
4	* ** 11.08399	48.33	PK2	37.7	-38.3	47.73	54	-6.27	74	-26.27	196	185	H
2	* ** 4.98072	58.09	PK2	34	-47.1	44.99	54	-9.01	74	-29.01	87	249	H
5	* ** 1.59975	34.3	PK2	28.2	-18.9	43.6	54	-10.4	74	-30.4	289	221	V
7	* ** 3.98654	59.42	PK2	33.4	-48.5	44.32	54	-9.68	74	-29.68	116	221	V
8	* ** 4.98012	60.86	PK2	34	-47.1	47.76	54	-6.24	74	-26.24	82	101	V
6	3.18584	53.66	Pk	32.9	-49.8	36.76	-	-	-	-	0-360	101	V
9	7.2044	56.37	Pk	35.7	-45.3	46.77	-	-	-	-	0-360	199	V

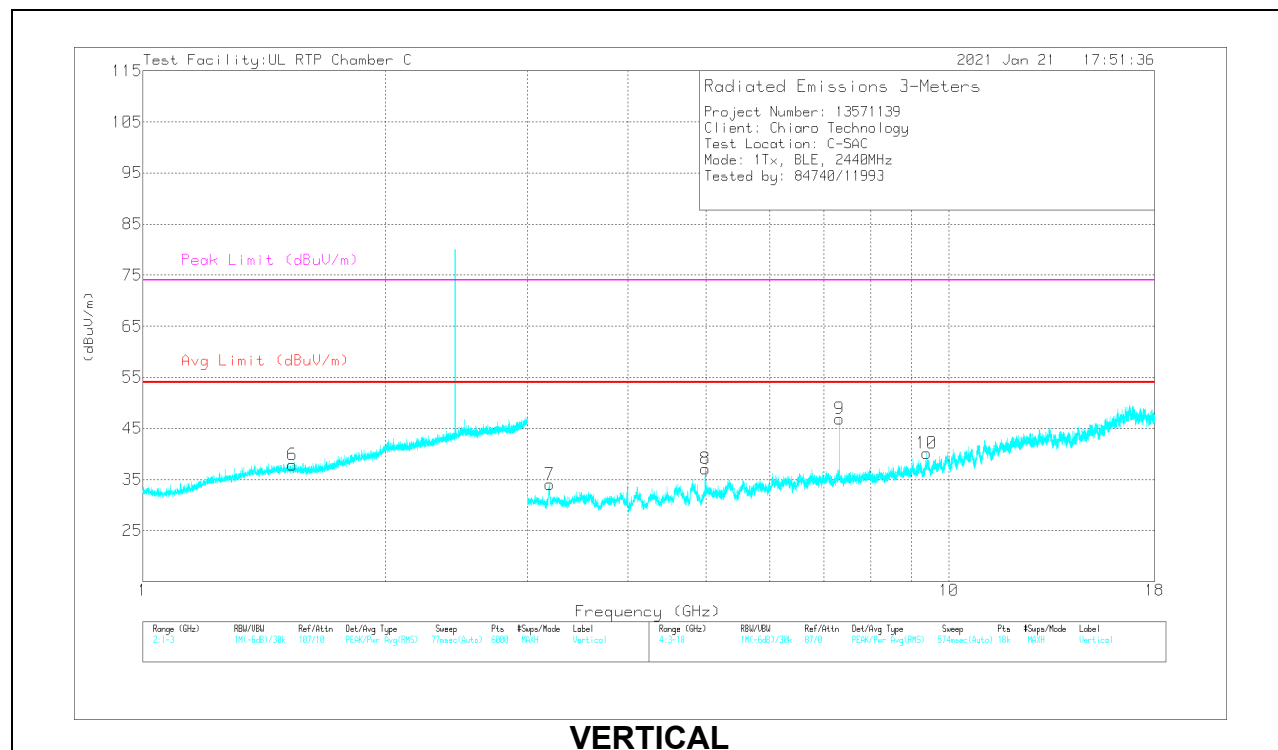
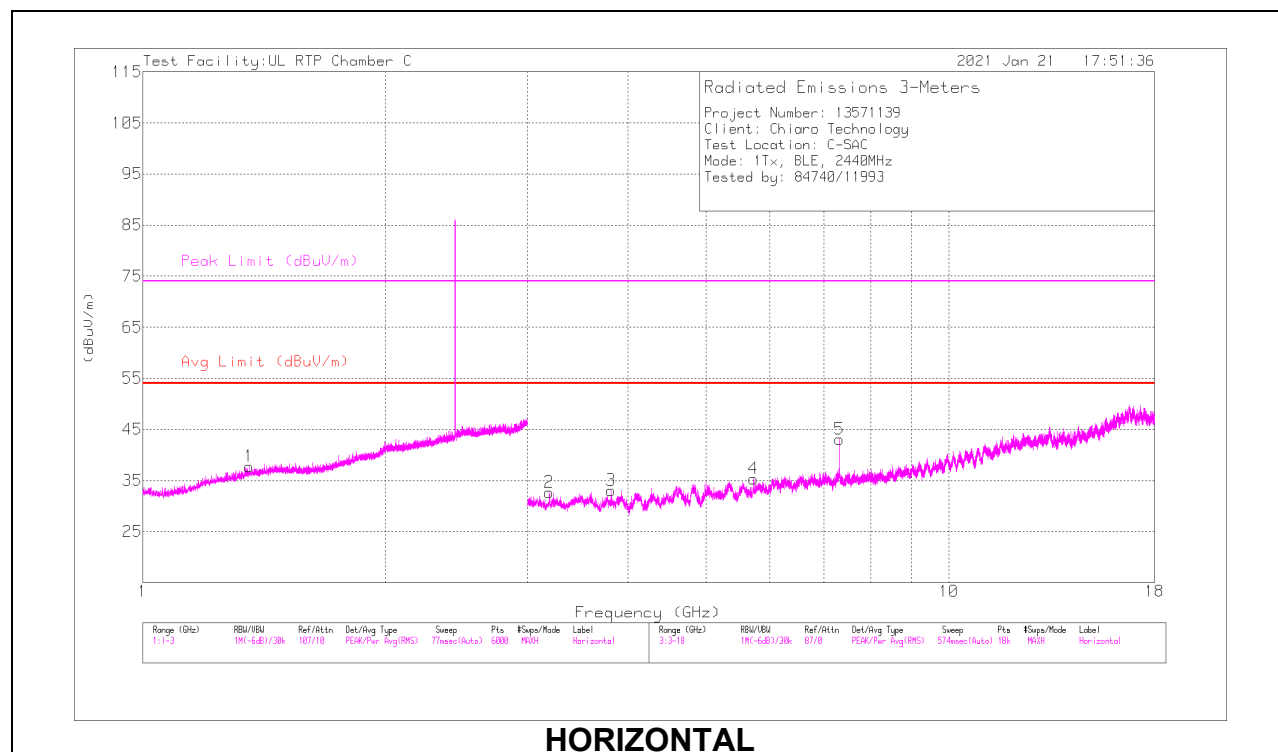
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

Pk - Peak detector

MID CHANNEL RESULTS



RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 1.35602	33.79	PK2	28.8	-19.5	43.09	54	-10.91	74	-30.91	210	245	H
3	* ** 3.81201	54.55	PK2	33.6	-48.5	39.65	54	-14.35	74	-34.35	171	399	H
5	* ** 7.31855	57.08	PK2	35.7	-44.6	48.18	54	-5.82	74	-25.82	347	102	H
6	* ** 1.53076	34.21	PK2	28	-18.1	44.11	54	-9.89	74	-29.89	254	380	V
8	* ** 4.98883	56.23	PK2	34	-47.2	43.03	54	-10.97	74	-30.97	65	212	V
9	* ** 7.32001	57.75	PK2	35.7	-44.5	48.95	54	-5.05	74	-25.05	39	223	V
10	* ** 9.39061	52.41	PK2	36.4	-42.5	46.31	54	-7.69	74	-27.69	209	360	V
2	3.19501	49.51	Pk	32.9	-49.8	32.61	-	-	-	-	0-360	101	H
4	5.72182	47.63	Pk	34.6	-46.9	35.33	-	-	-	-	0-360	101	H
7	3.19918	51.02	Pk	32.9	-49.9	34.02	-	-	-	-	0-360	199	V

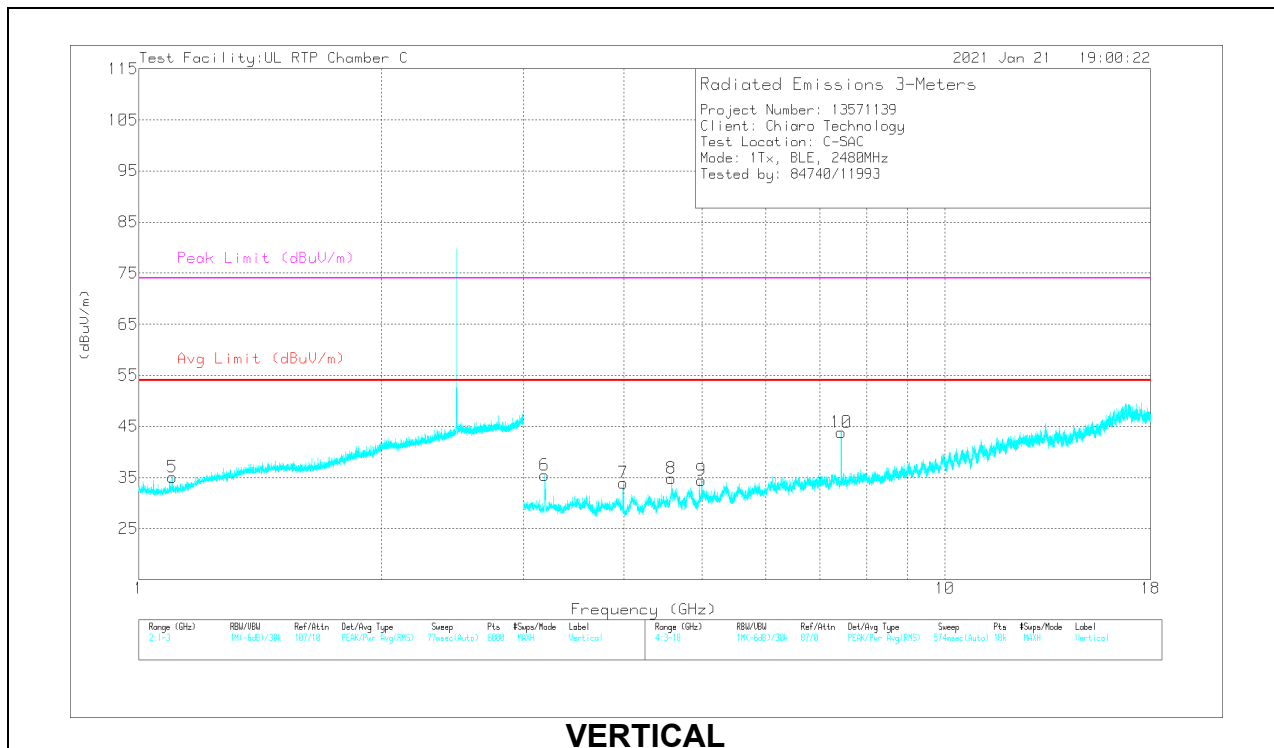
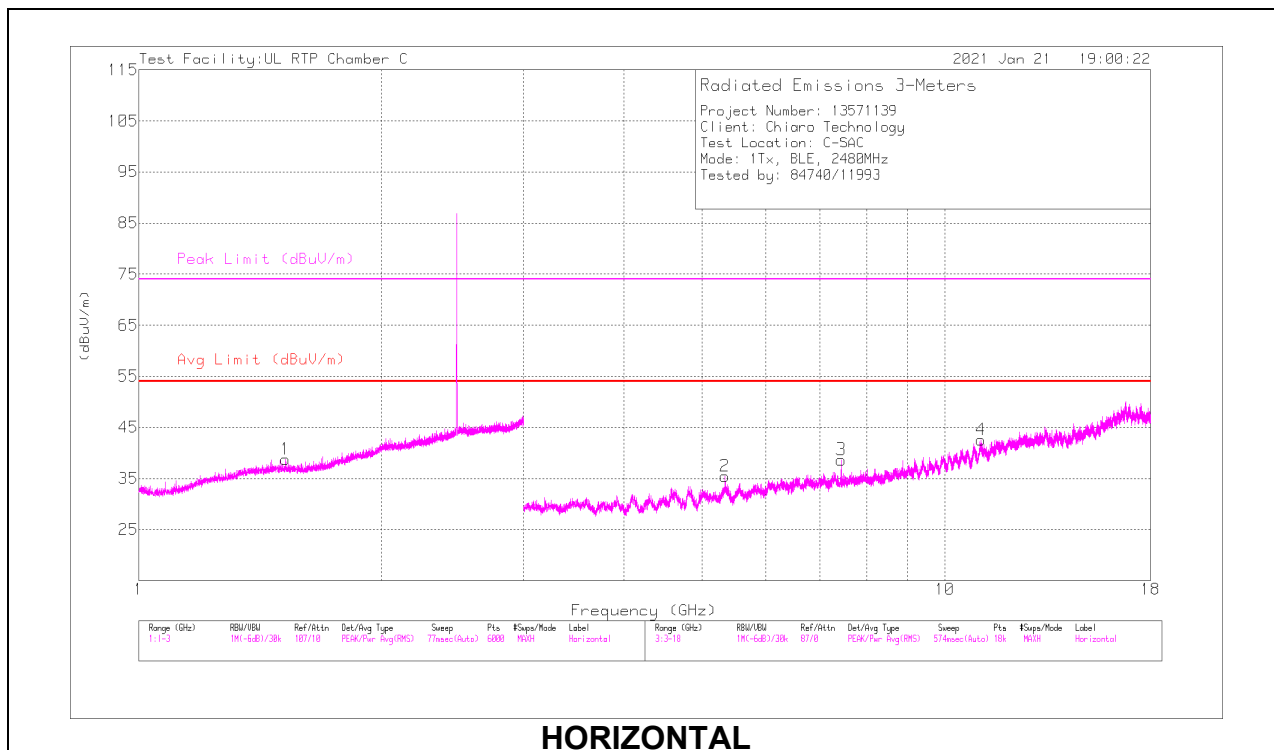
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

PK2 - Maximum Peak

Pk - Peak detector

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 1.51952	34.18	PK2	27.9	-18.1	43.98	54	-10.02	74	-30.02	58	368	H
4	* ** 11.09099	48.88	PK2	37.7	-38.3	48.28	54	-5.72	74	-25.72	1	101	H
3	* ** 7.44014	56.3	PK2	35.7	-45.3	46.7	54	-7.3	74	-27.3	161	101	H
5	* ** 1.0987	42.36	PK2	27.3	-21	48.66	54	-5.34	74	-25.34	111	354	V
7	* ** 3.99573	57.68	PK2	33.4	-48.6	42.48	54	-11.52	74	-31.52	283	372	V
8	* ** 4.58007	54.86	PK2	34.1	-47.8	41.16	54	-12.84	74	-32.84	113	381	V
9	* ** 4.9866	58.08	PK2	34	-47.4	44.68	54	-9.32	74	-29.32	38	224	V
10	* ** 7.43848	58.06	PK2	35.7	-45.3	48.46	54	-5.54	74	-25.54	203	101	V
2	5.33763	47.83	Pk	34.6	-47	35.43	-	-	-	-	0-360	101	H
6	3.18584	52.39	Pk	32.9	-49.8	35.49	-	-	-	-	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

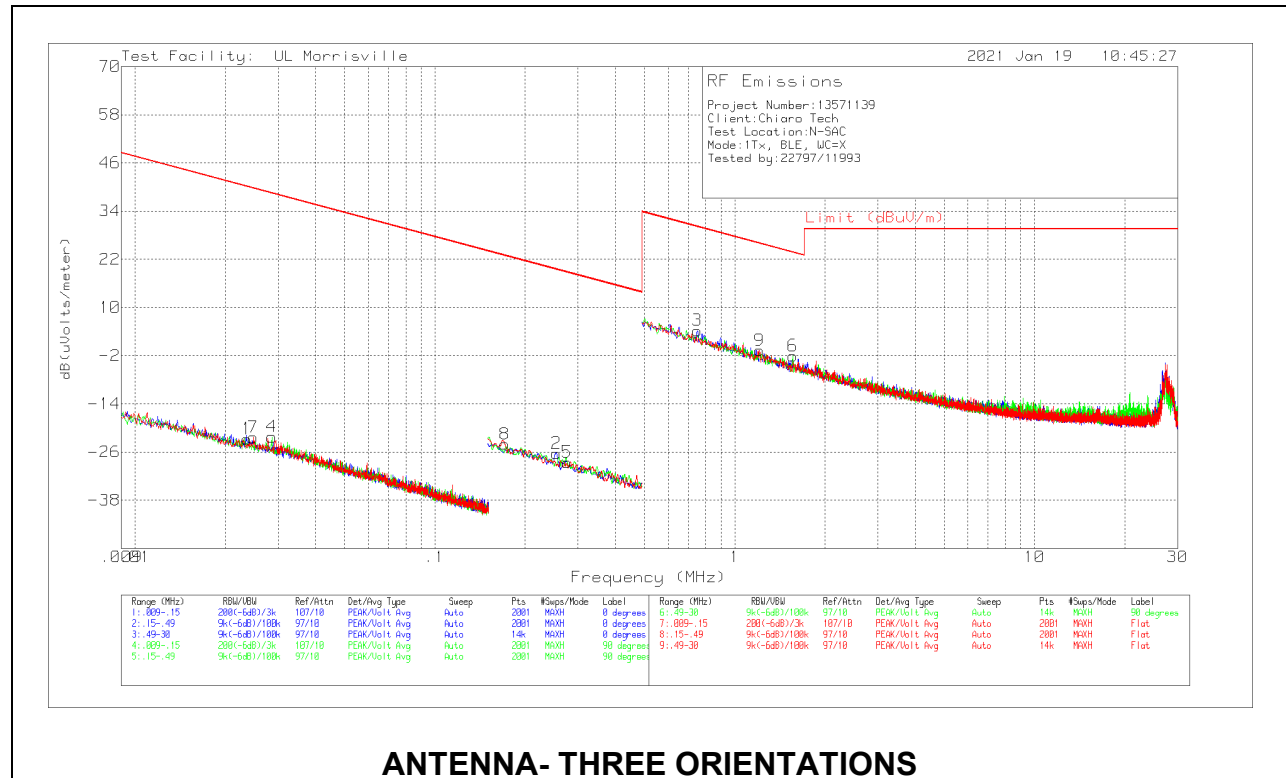
PK2 - Maximum Peak

Pk - Peak detector

10.3. WORST CASE BELOW 30MHZ

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).

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



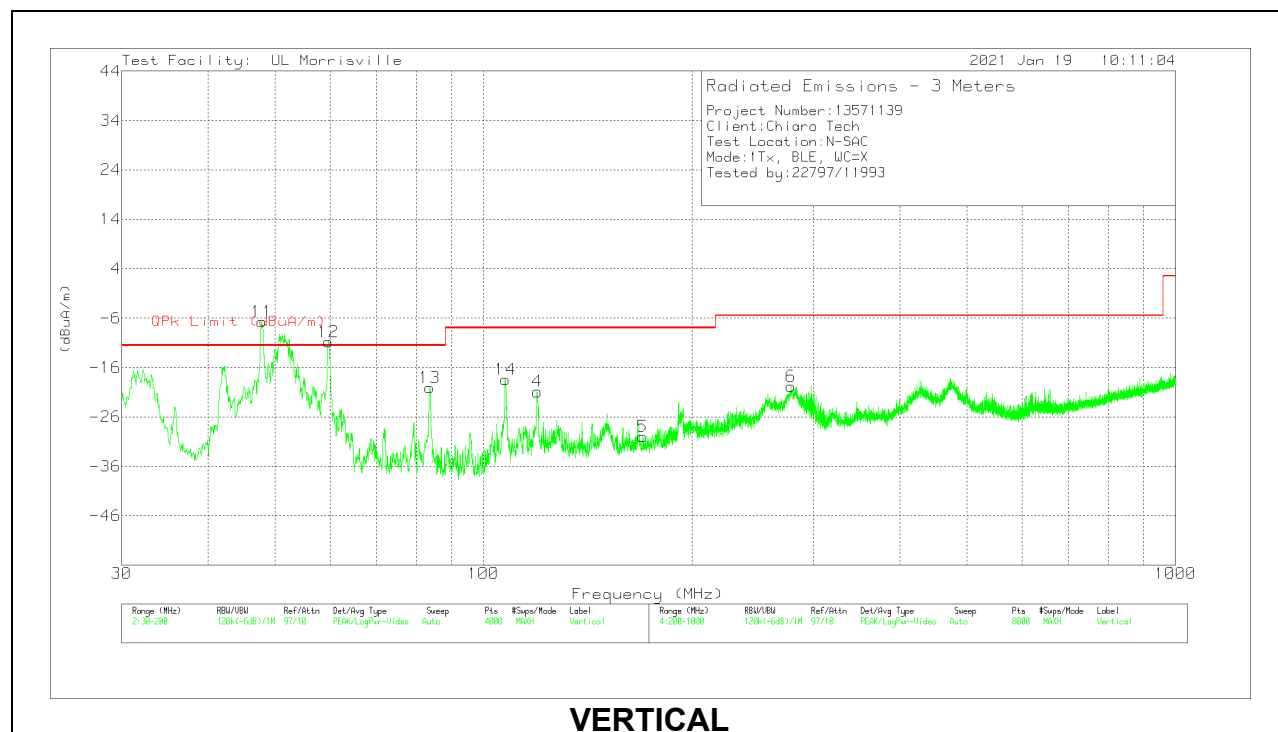
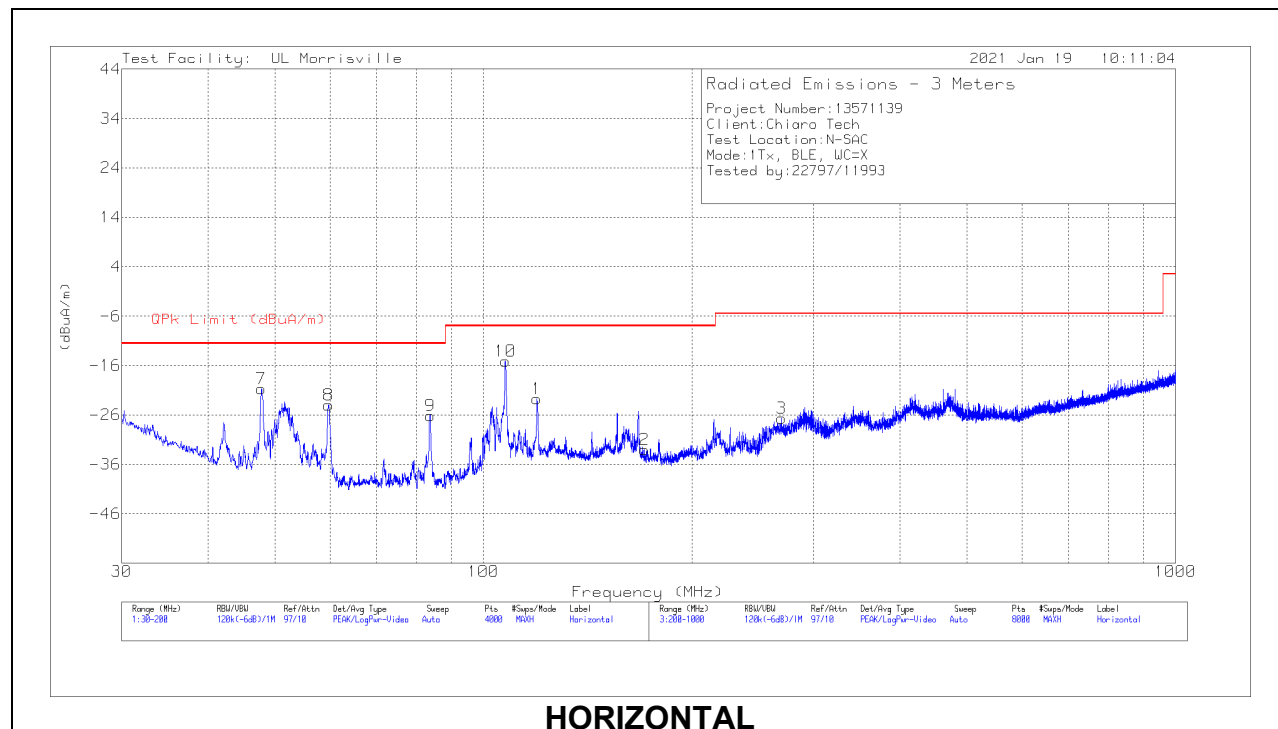
Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/Avg Limit (dBuV/m)	Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Face
1	.02363	43.56	Pk	13.6	.1	-80	-22.74	40.14	60.14	-62.88	0-360	0
7	.02483	44.03	Pk	13.5	.1	-80	-22.37	39.7	59.7	-62.07	0-360	0
4	.0286	44.28	Pk	13.4	.1	-80	-22.22	38.48	58.48	-60.7	0-360	0
8	.17108	45.03	Pk	10.8	.1	-80	-24.07	22.94	42.94	-47.01	0-360	90
2	.25438	42.84	Pk	10.7	.1	-80	-26.36	19.49	39.49	-45.85	0-360	90
5	.27614	40.64	Pk	10.7	.1	-80	-28.56	18.78	38.78	-47.34	0-360	90
3	.75139	33.24	Pk	10.8	.2	-40	4.24	30.09	-	-25.85	0-360	Flat
9	1.21094	28.11	Pk	11	.2	-40	-.69	25.94	-	-26.63	0-360	Flat
6	1.56297	26.63	Pk	11.1	.2	-40	-2.07	23.73	-	-25.8	0-360	Flat

Pk - Peak detector

10.4. WORST CASE BELOW 1 GHZ

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



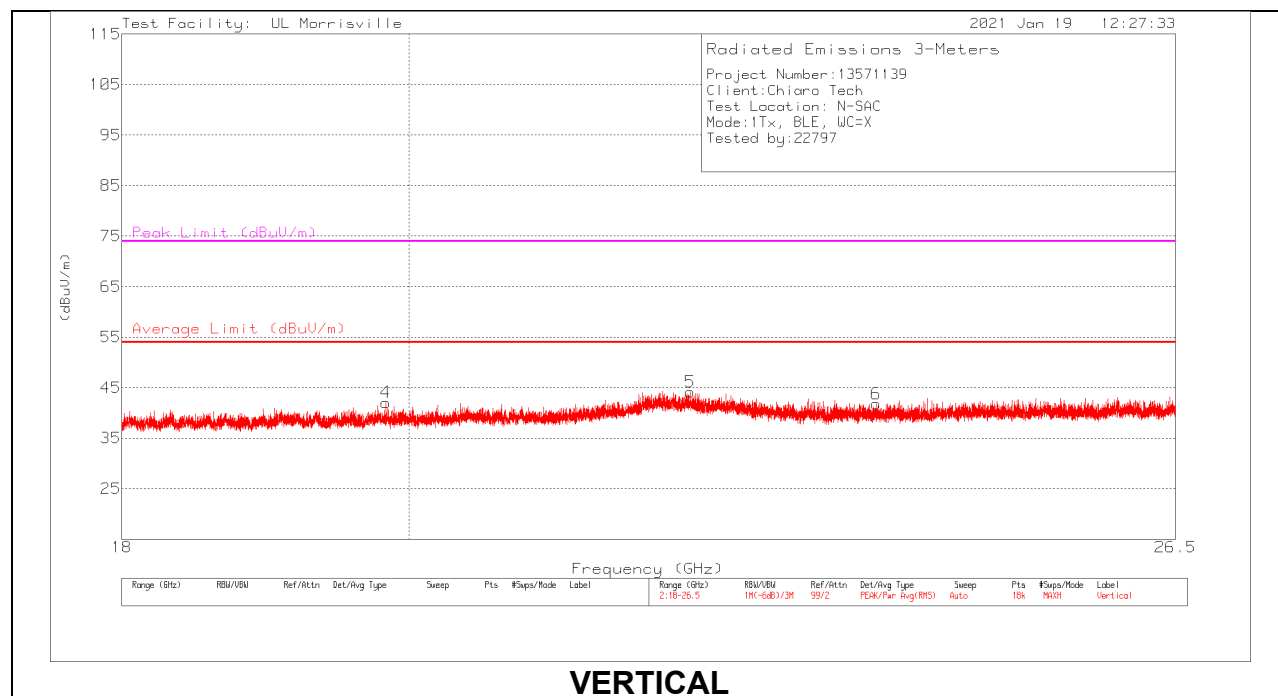
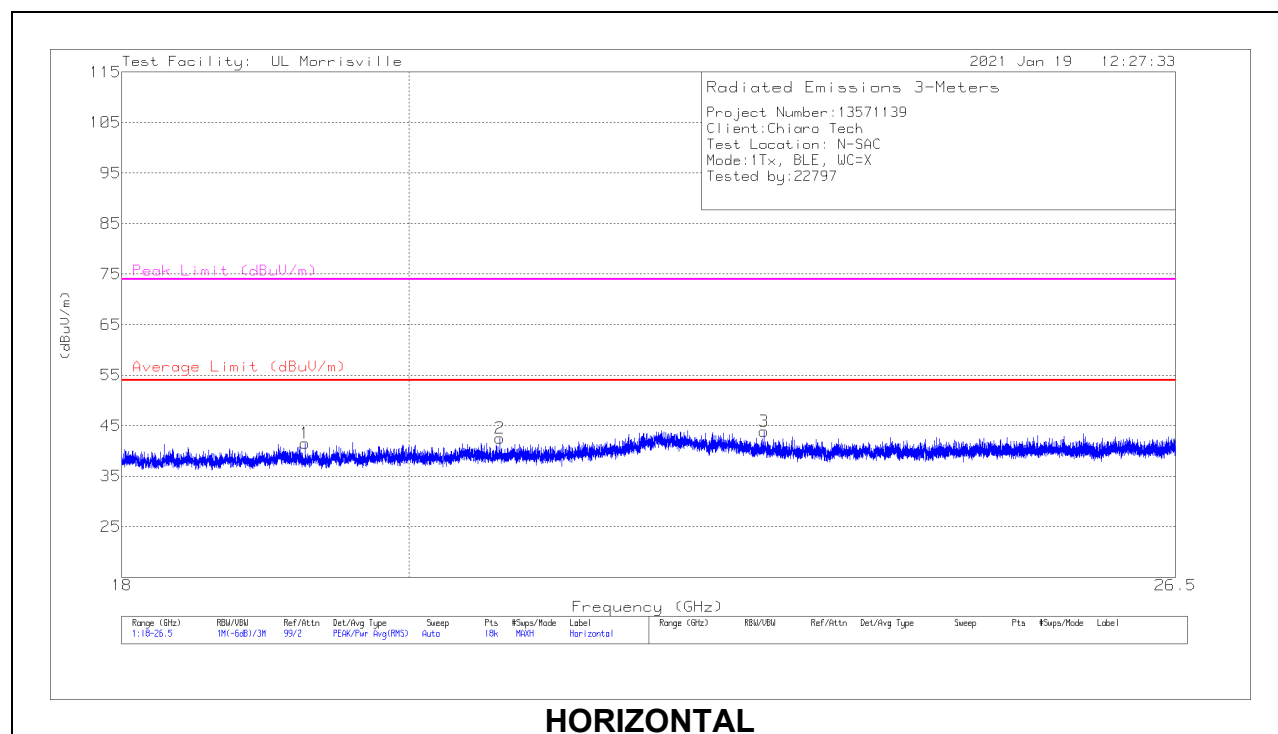
Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 119.4431	39.05	Pk	19.9	-30.2	28.75	43.52	-14.77	0-360	200	H
2	*** 170.7964	30.27	Pk	17.9	-29.7	18.47	43.52	-25.05	0-360	100	H
4	*** 119.5282	40.91	Pk	19.9	-30.2	30.61	43.52	-12.91	0-360	100	V
5	*** 169.9462	33.27	Pk	18	-29.7	21.57	43.52	-21.95	0-360	100	V
3	*** 269.8091	34.39	Pk	19.3	-28.9	24.79	46.02	-21.23	0-360	100	H
6	*** 278.3102	41.03	Pk	19.4	-28.8	31.63	46.02	-14.39	0-360	98	V
7	47.7696	47.04	Pk	14.8	-31.1	30.74	-	-	0-360	400	H
11	47.8121	61.04	Pk	14.8	-31.1	44.74	-	-	0-360	100	V
12	59.6727	58.18	Pk	13.5	-31	40.68	-	-	0-360	100	V
8	59.7152	45.04	Pk	13.5	-31	27.54	-	-	0-360	300	H
13	83.6489	48.78	Pk	13.3	-30.7	31.38	-	-	0-360	100	V
9	83.7339	42.68	Pk	13.3	-30.6	25.38	-	-	0-360	400	H
10	107.5401	48.58	Pk	18.2	-30.4	36.38	-	-	0-360	300	H
14	107.5401	45.34	Pk	18.2	-30.4	33.14	-	-	0-360	100	V

Pk - Peak detector

10.5. WORST CASE 18-26 GHZ

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



18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0063 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	* ** 19.25335	48.59	Pk	33.5	-40.6	41.49	54	-12.51	74	-32.51	0-360	250	H
2	* ** 20.67906	49.41	Pk	34	-40.9	42.51	54	-11.49	74	-31.49	0-360	250	H
3	* ** 22.78671	49.24	Pk	35.5	-40.9	43.84	54	-10.16	74	-30.16	0-360	250	H
4	* ** 19.83421	49.09	Pk	33.6	-40.6	42.09	54	-11.91	74	-31.91	0-360	200	V
5	* ** 22.17656	48.49	Pk	36.7	-41.1	44.09	54	-9.91	74	-29.91	0-360	200	V
6	* ** 23.74301	47.67	Pk	34.8	-40.7	41.77	54	-12.23	74	-32.23	0-360	150	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

11. SETUP PHOTOS

Please refer to R13571139-EP1 for setup photos.

END OF TEST REPORT