



TEST REPORT

Report Number. : 14008772-E3V3

Applicant : ENERGOUS CORPORATION
3590 NORTH FIRST STREET,
SUITE 210,
SAN JOSE, CA 95134, U.S.A.

Model : VN25

Brand : ENERGOUS

FCC ID : 2ADNG-VN25

EUT Description : WIRELESS CHARGER

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

Date Of Issue:
November 24, 2021

Prepared by:
UL VERIFICATION SERVICES
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888



REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	11/22/2021	Initial Issue	--
V2	11/23/2021	Updated Section 6.5, page 32, 6.6, 11, 12 to address TCB's additional questions	Tina Chu
V3	11/24/2021	Updated Section 6.5 to address TCB's question	Tina Chu

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ENERGOUS CORPORATION
3590 NORTH FIRST STREET,
SUITE 210,
SAN JOSE, CA 95134, U.S.A.

EUT DESCRIPTION: WIRELESS CHARGER

MODEL: VN25

BRAND: ENERGOUS

SERIAL NUMBER: 2012 and 205B (CONDUCTED); 2060 (RADIATED)

SAMPLE RECEIPT DATE: SEPTEMBER 23, 2021

DATE TESTED: OCTOBER 01, 2021 TO NOVEMBER 12, 2021

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

UL Verification Services Inc. 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.

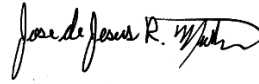
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



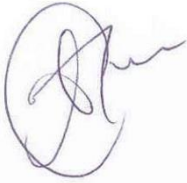
DAN CORONIA
OPERATIONS LEADER
UL Verification Services Inc.

Prepared By:



JOSE MARTINEZ
TEST ENGINEER
UL Verification Services Inc.

Reviewed By:



TINA CHU
SENIOR PROJECT ENGINEER
UL Verification Services Inc.

2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

FCC Clause	Requirement	Result	Comment
See Comment	Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	6dB BW	Complies	None.
15.247 (b) (3)	Output Power	Complies	None.
See Comment	Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	PSD	Complies	None.
15.247 (d)	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	Radiated Emissions	Complies	None.
15.207	AC Mains Conducted Emissions	Complies	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, KDB 414788 D01 Radiated Test Site v01r01.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, certification #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☒	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	208313
☐	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA	US0104	22541	208313
☒	Building 4: 47658 Kato Rd, Fremont, CA 94538, USA	US0104	2324B	208313

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	U _{Lab}
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.84 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB

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

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

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a stand-alone wireless charger with BLE and MSK tag mode that is mounted on a ceiling or a wall. The wireless charger transmits power via a frequency hopping signal between 917.2MHz to 918.8MHz and a DTS MSK signal between 2402MHz and 2480MHz, and charges multiple receivers at a time.

This report documents test results of the MSK tag mode radio portion (MSK tag mode only supports 500 Mbps) of the wireless charger.

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	MSK tag mode	19.80	95.50

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

The radio utilizes two internal PCB cross-polarized dipole antennas, with a maximum gain of 2.5 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 5.0.255.255_2059

The test utility software used during testing was 5.0.255.255_2059

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated band edge were performed with the EUT was set to transmit at the Low /2475MHz/High channels measured power.

Radiated harmonics, and spurious emissions from 1 GHz to 18GHz were performed with the EUT was set to transmit at the Low/Mid/High channels with highest output power as worst-case scenario.

Radiated emission below 30MHz, below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT was set to transmit at the channel with highest output power as worst-case scenario.

The EUT is a wall or ceiling mounted device and it has one USB type C port for power only. The fundamental of the EUT was investigated in four orthogonal orientations X,Y,Z1, Z2, it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation. Due to applicant is only able to exercise the commands via a USB cable that connected to a laptop, therefore all final radiated testing were performed with the EUT in Y orientation powered by laptop via USB cable.

AC powerline was performed in two configurations:

Configuration 1: powered by laptop via USB cable where the MSK tag mode Tx continuously

Configuration 2: powered by AC/DC adapter via USB cable where BLE (beaconing mode), MSK tag mode and WPT bands transmit simultaneously as worst case.

Worst-case data rate as provided by the client was:

MSK tag mode: 500 Mbps.

The EUT only supports MSK tag mode 2 Tx (MIMO) at the same time, it does not support 1 Tx (SISO). All radiated tests are performed on 2 Tx (MIMO) only.

WPT band and 2.4G MSK tag mode transmit simultaneously, simultaneous operation result of the radiated emissions is documented in UL document 14008772-E1 WPT report.

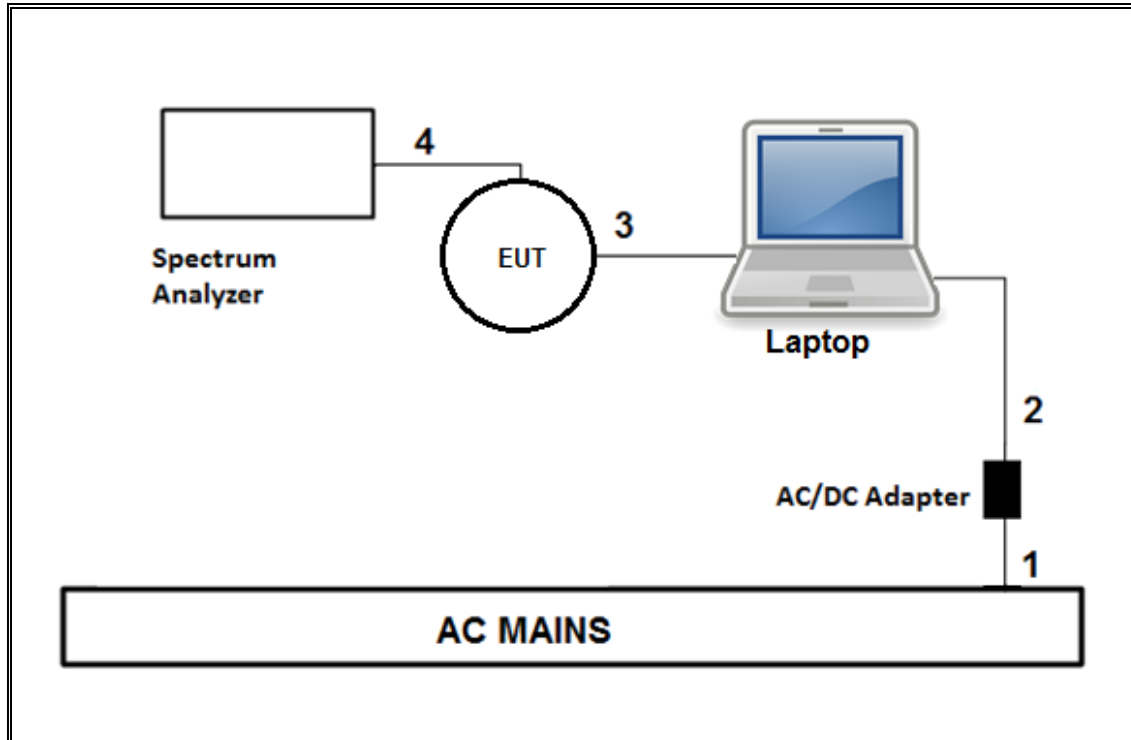
6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description		Manufacturer	Model	Serial Number		FCC ID/ DoC
Laptop		Dell	Latitude E7470	3F94RC2		DoC
Laptop AC/DC adapter		Dell	LA65NM130	CN-03NKWD-72438-38D-0F54-A00		DoC
Faraday Cage		ETS-LINDGREN	Not available (Custom built)	ECSB-001		DoC
I/O CABLES (RF CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	1	AC Mains to AC/DC Adapter
2	DC	1	DC	Un-shielded	1.5	AC/DC Adapter to Laptop
3	USB	1	UART	Shielded	1.5	EUT to Laptop
4	Antenna	1	SMA	Un-shielded	0.15	To spectrum analyzer
I/O CABLES (RF RADIATED TEST/AC LINE CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	1	AC/DC Adapter to Laptop
2	DC	1	DC	Un-shielded	1.5	
3	USB	1	USB Type C	Shielded	1	

TEST SETUP

The EUT was connected to the test laptop via USB cable. Test software exercised the EUT.

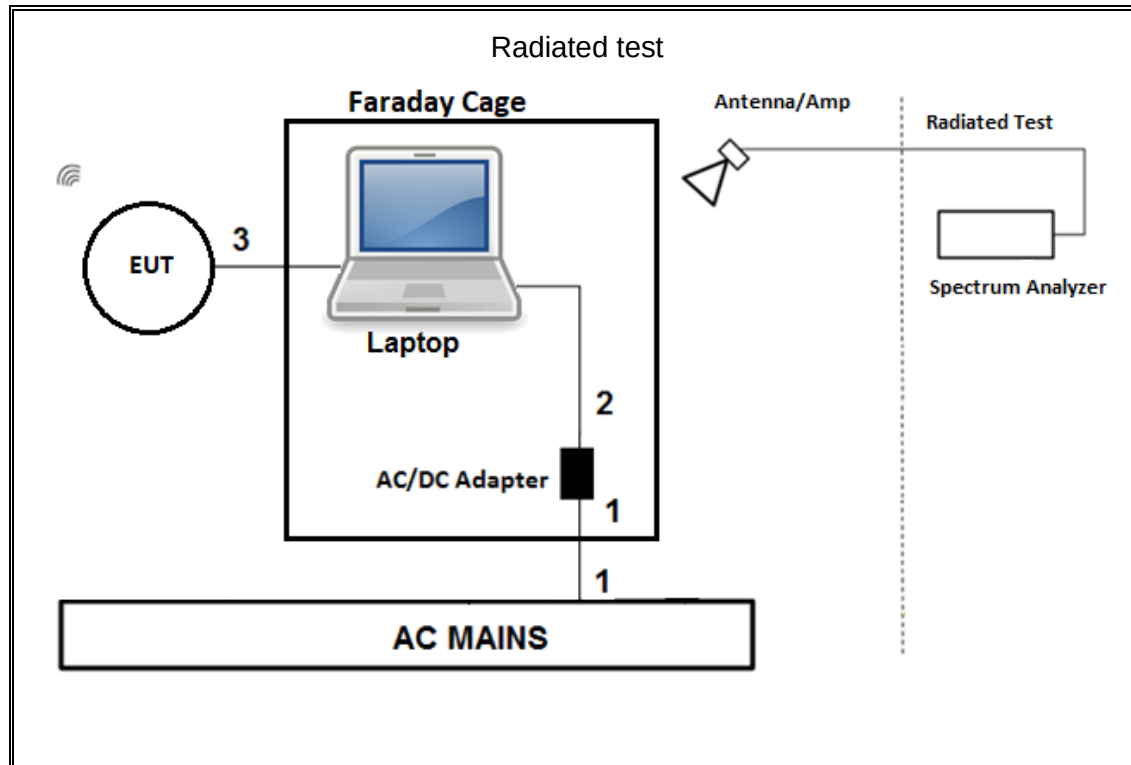
SETUP DIAGRAMS

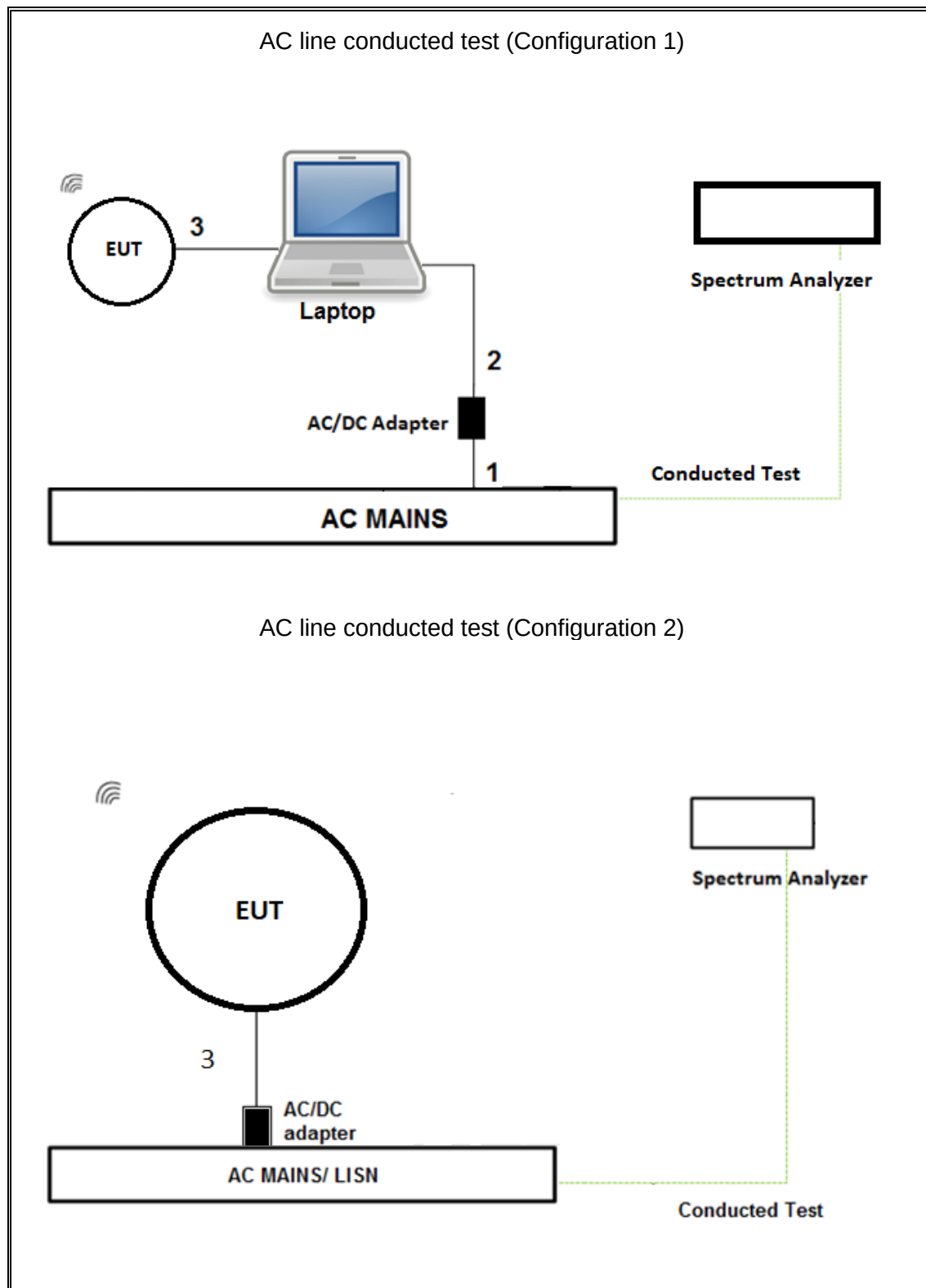


TEST SETUP- RADIATED TEST / AC LINE CONDUCTED TEST

The EUT was powered by laptop via USB cable. For radiated test, laptop was put inside a Faraday cage. Test software exercised the EUT.

SETUP DIAGRAM





7. MEASUREMENT METHOD

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW $\geq$ DTS BW

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)

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.4 Integration method -Trace averaging across ON and OFF times DC correction

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

8. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	SC-8015	05/24/2022	05/24/2021
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	SC-8014	05/24/2022	05/24/2021
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	80404	08/04/2022	08/04/2021
Amplifier, 100MHz-18GHz	AMPLICAL	AMP0.1G18-47-20	PRE0197319	04/08/2022	04/08/2021
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	82258	10/01/2022	10/01/2021
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	175953	01/21/2022	01/21/2021
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179367	02/21/2022	02/21/2021
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	81139	05/25/2022	05/25/2021
Rf Amplifier, 18-26.5GHz, 60dB gain	AMPLICAL	AMP18G26.5-60	171590	05/21/2022	05/21/2021
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Keysight Technologies Inc	E4440A	T198	05/13/2022	05/13/2021
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1272	01/21/2022	01/21/2021
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	T1223	06/17/2022	06/17/2021
AC Line Conducted					
LISN	Fischer Custom Communications, Inc	FCC-LISN-50/250- 25-2-01-480V	PRE0186446	01/20/2022	01/20/2021
EMI TEST RECEIVER	Rohde & Schwarz	ESR	T1436	02/19/2022	02/19/2021
Transient Limiter	TE	TBFL1	207996	06/01/2022	06/01/2021
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Rev 9.5, Jan 03, 2020		
Antenna Port Software	UL	UL RF	Ver 2021.08.27		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, 07 Jul 2020		

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

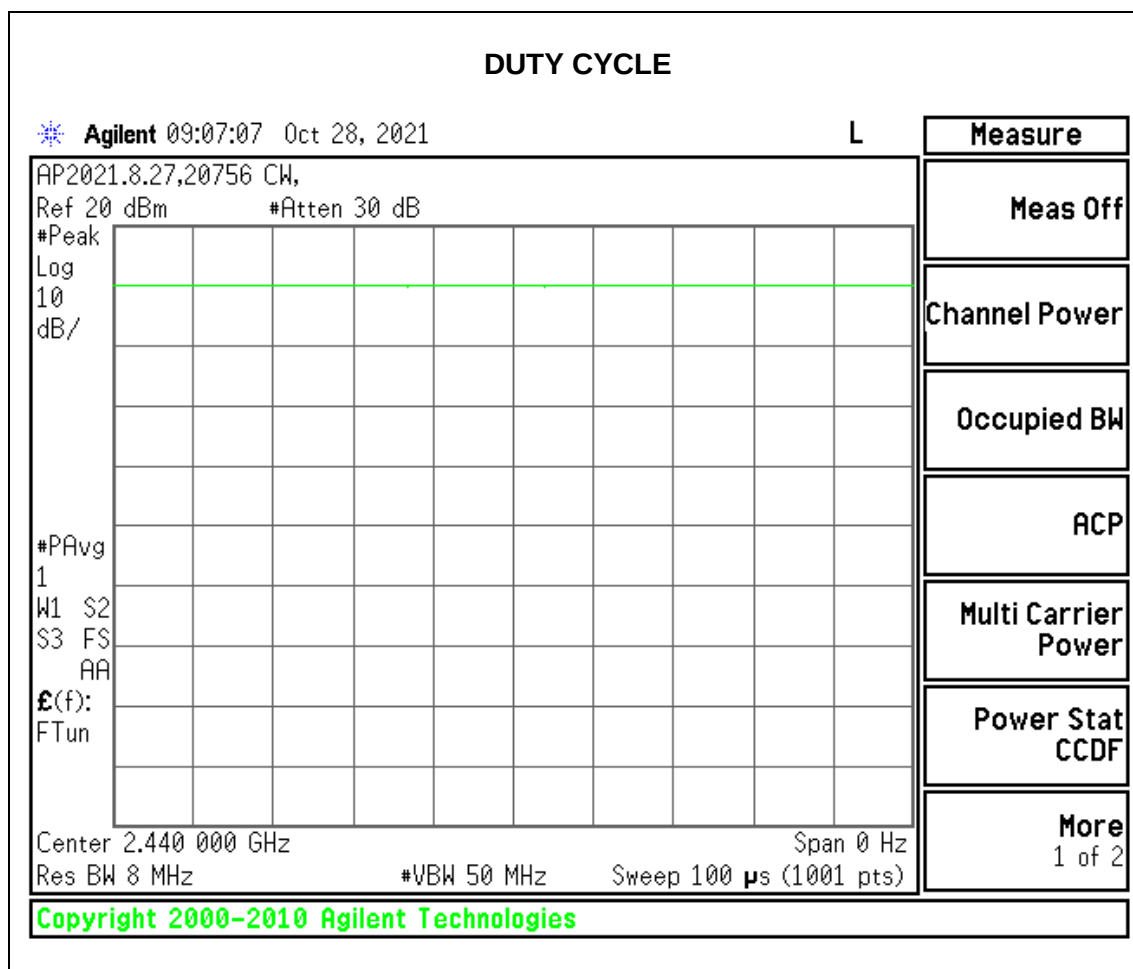
None; for reporting purposes only.

PROCEDURE

ANSI C63.10 Section 11.6 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						
MSK tag mode	1.000	1.000	1.000	100.00	0.00	0.010
Test Engineer	20756 CW					



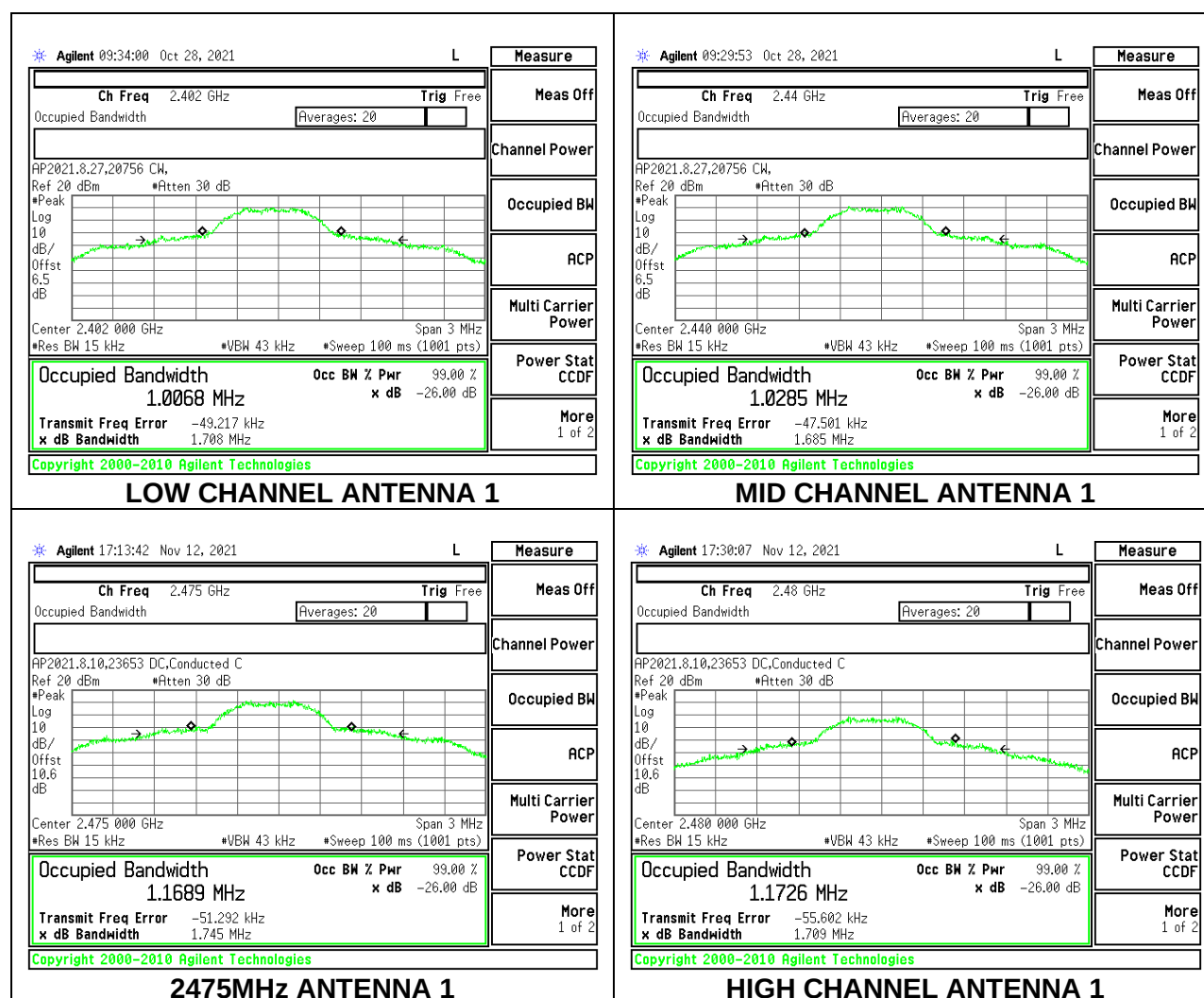
9.2. 99% BANDWIDTH

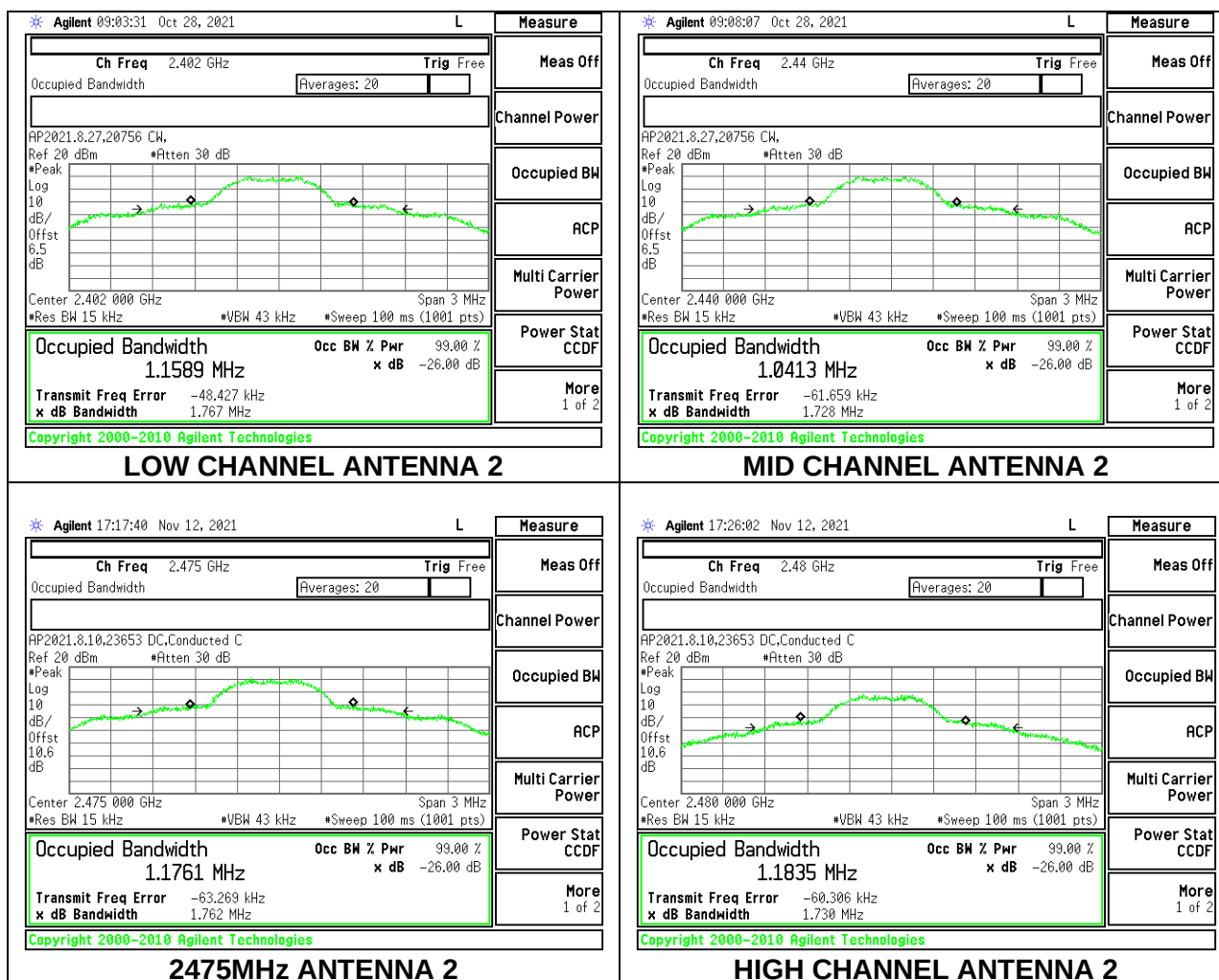
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz) Antenna 1	99% Bandwidth (MHz) Antenna 2
Low	2402	1.0068	1.1589
Middle	2440	1.0285	1.0413
Inner	2475	1.1689	1.1761
High	2480	1.1726	1.1835





9.3. 6 dB BANDWIDTH

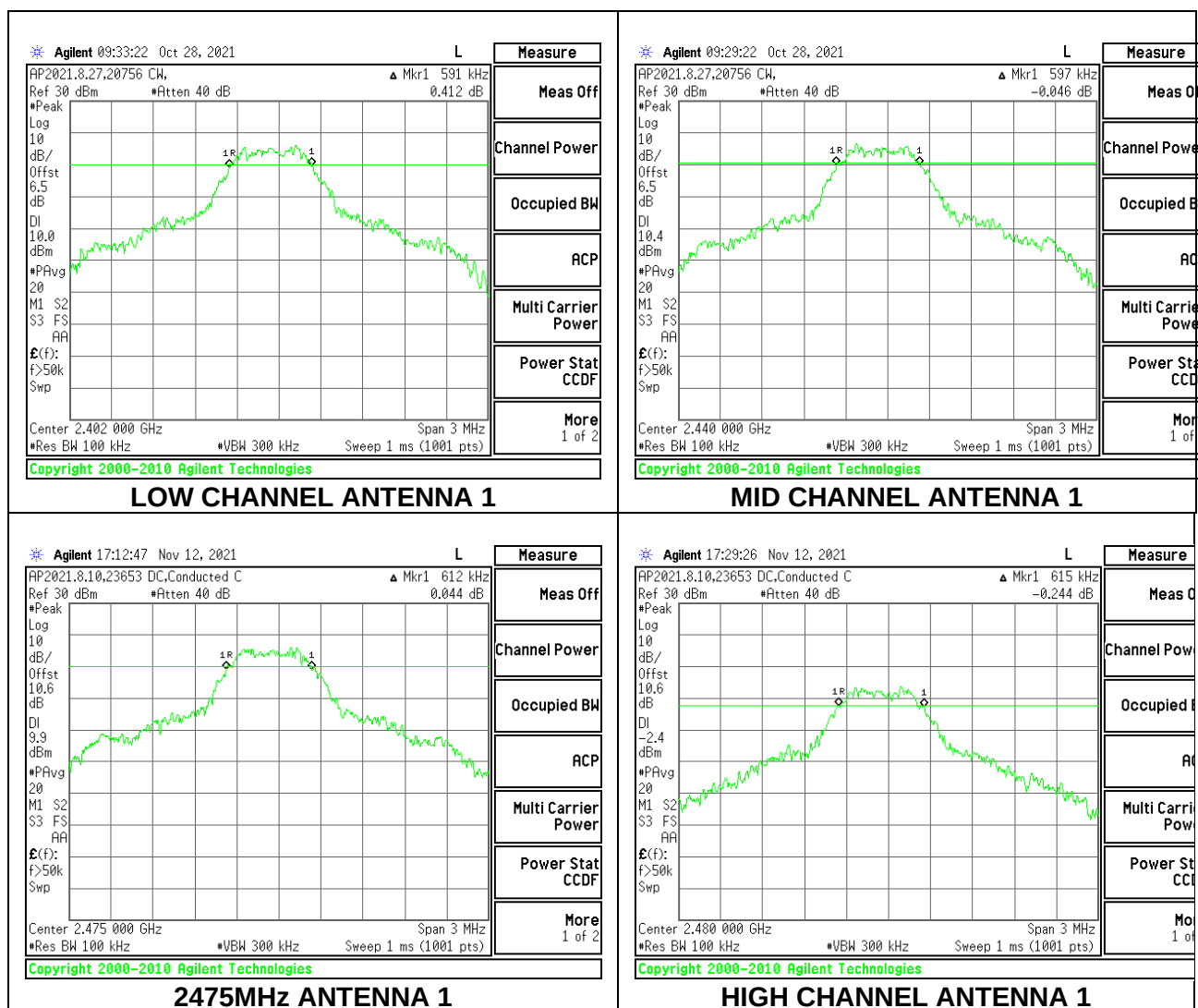
LIMITS

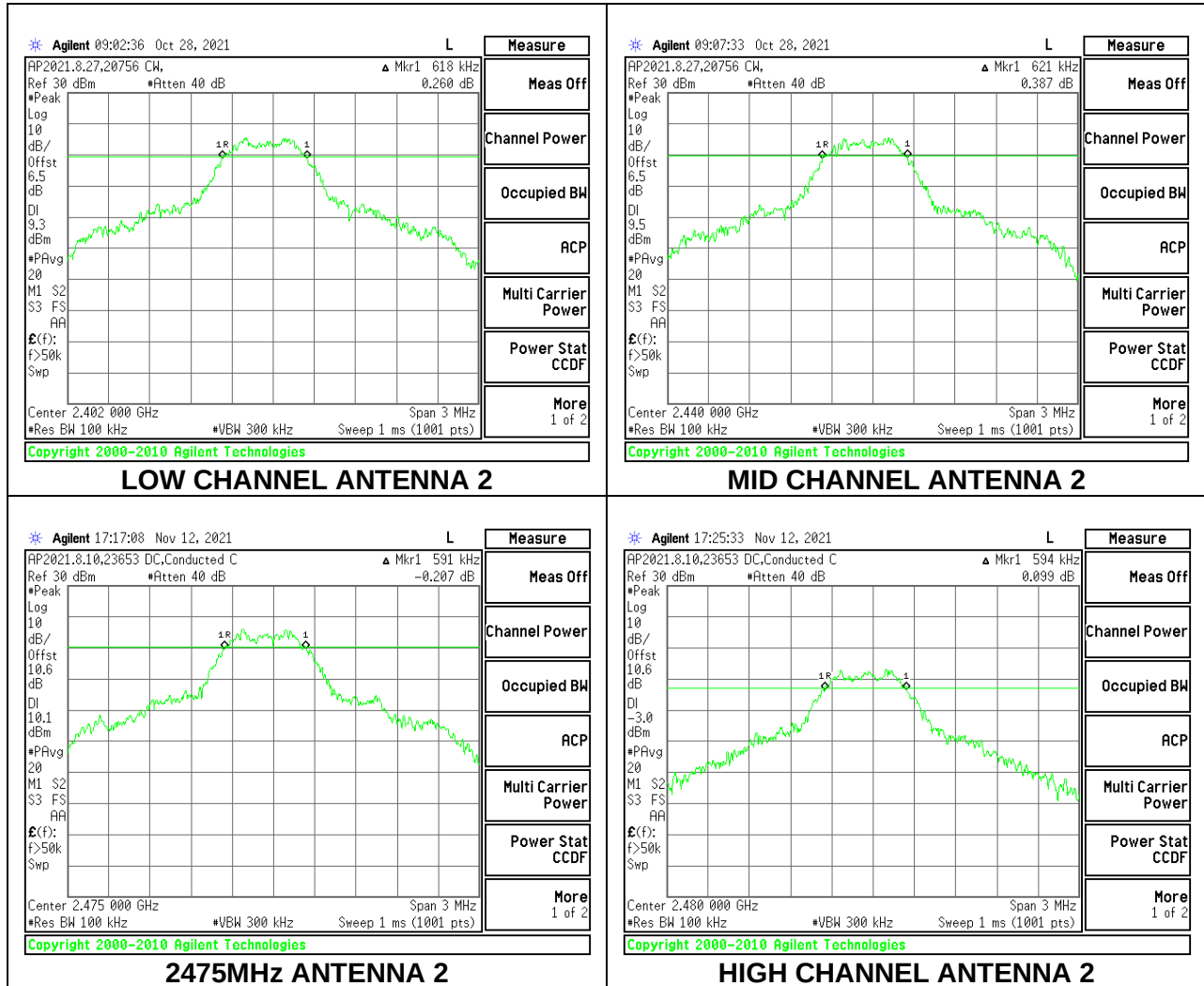
FCC §15.247 (a) (2)

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

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz) Antenna 1	6 dB Bandwidth (MHz) Antenna 2	Minimum Limit (MHz)
Low	2402	0.591	0.618	0.5
Middle	2440	0.597	0.621	0.5
Inner	2475	0.612	0.591	0.5
High	2480	0.615	0.594	0.5





9.4. 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 power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband peak power sensor. Peak output power was read directly from power meter.

RESULTS

Tested By:	20756 CW & 23653 DC
Date:	10/28/2021 & 11/12/2021

Channel	Frequency (MHz)	Output Power Antenna 1 (dBm)	Output Power Antenna 2 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	16.66	16.29	19.49	30	-10.51
Middle	2440	16.85	16.42	19.65	30	-10.35
Inner	2475	17.07	16.48	19.80	30	-10.20
High	2480	4.70	4.37	7.55	30	-22.45

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

RESULTS

Tested By:	20756 CW & 23653 DC
Date:	10/28/2021 & 11/12/2021

Channel	Frequency (MHz)	Average Power Antenna 1 (dBm)	Average Power Antenna 2 (dBm)	Total Power (dBm)
Low	2402	16.57	16.18	19.39
Middle	2440	16.75	16.30	19.54
Inner	2475	16.76	16.31	19.55
High	2480	4.20	3.77	7.00

9.6. POWER SPECTRAL DENSITY

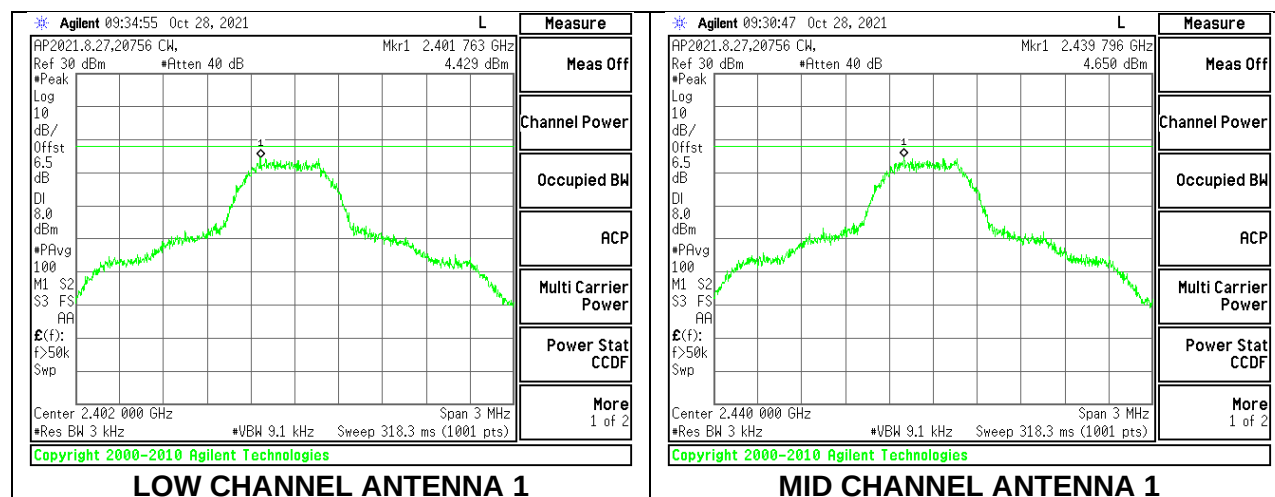
LIMITS

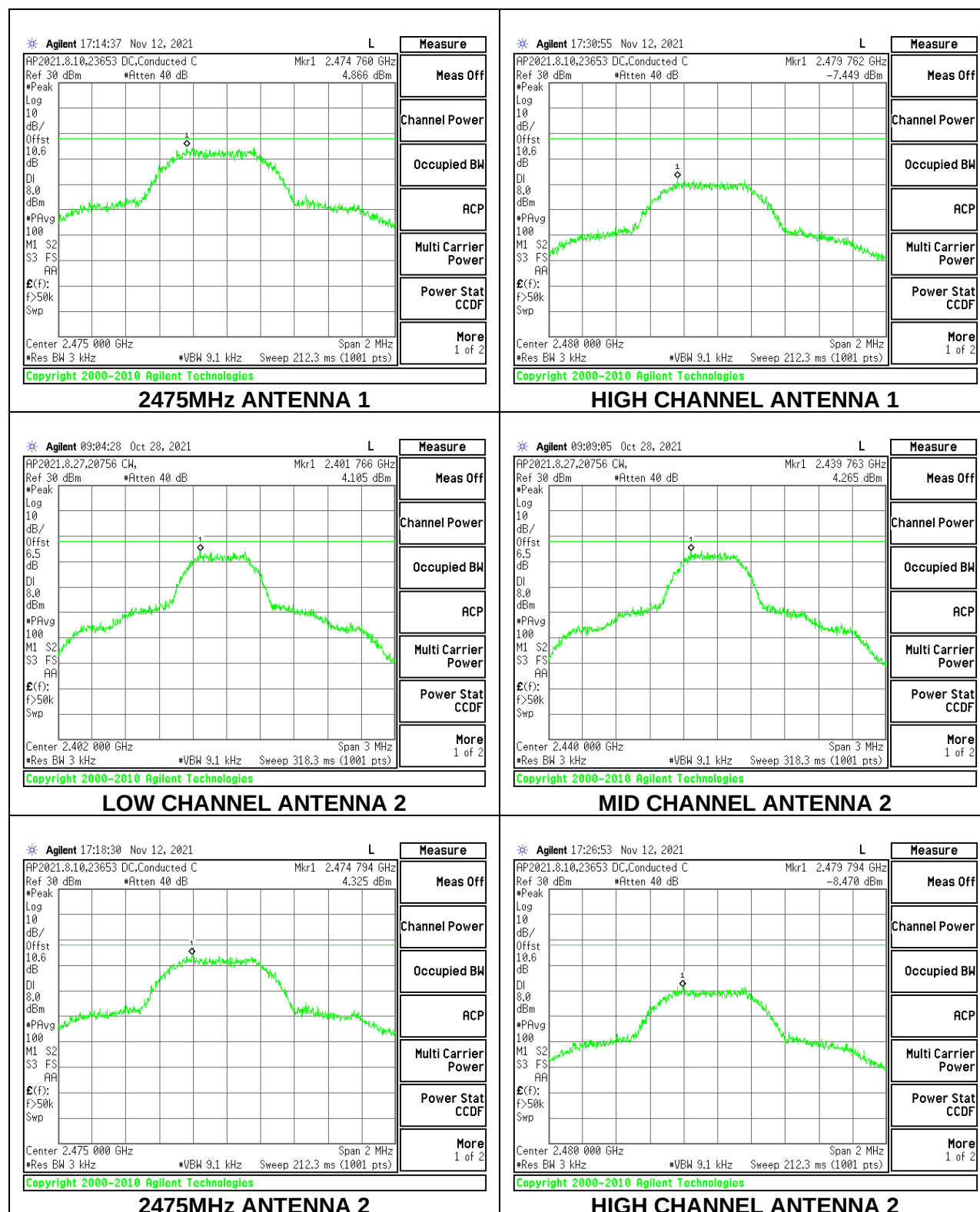
FCC §15.247 (e)

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

Channel	Frequency (MHz)	Antenna 1 Meas (dBm/ 3kHz)	Antenna 2 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low	2402	4.429	4.105	7.28	8.0	-0.7
Mid	2440	4.650	4.265	7.47	8.0	-0.5
Inner	2475	4.866	4.325	7.61	8.0	-0.4
High	2480	-7.449	-8.470	-4.92	8.0	-12.9





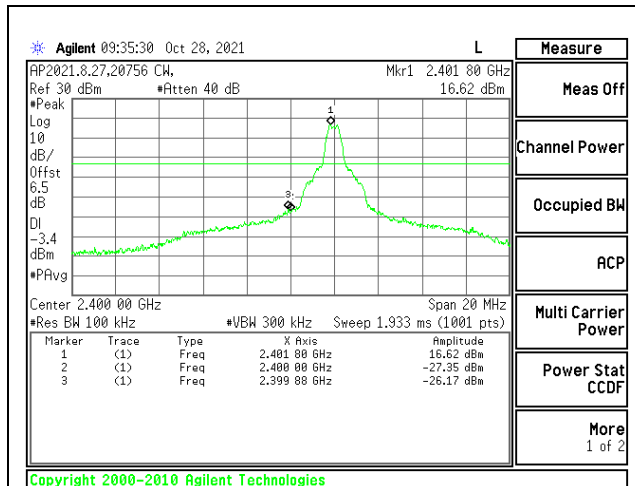
9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

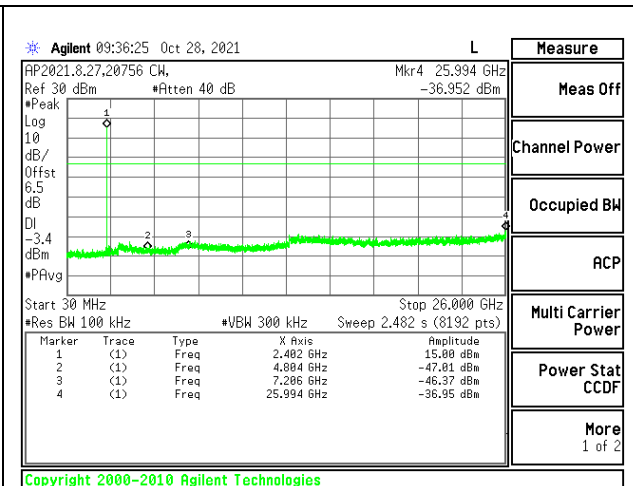
FCC §15.247 (d)

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

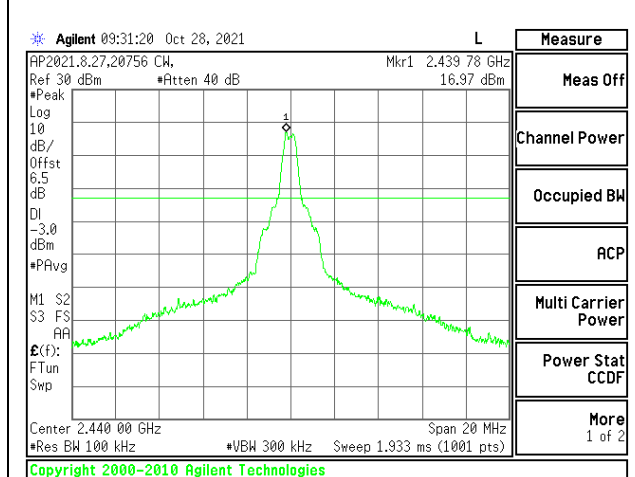
RESULTS



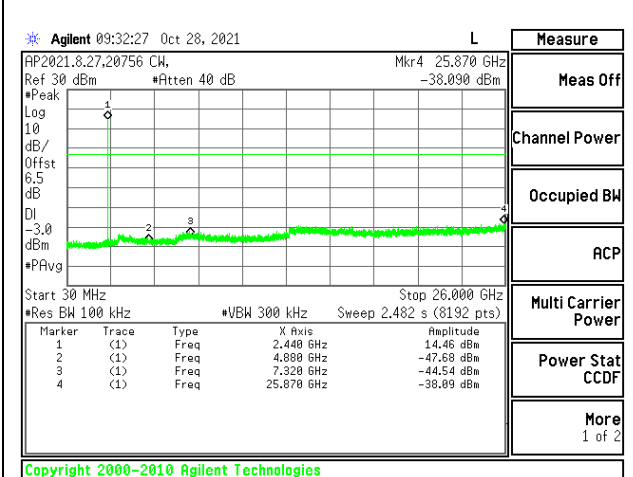
LOW CHANNEL BANDEDGE ANTENNA 1



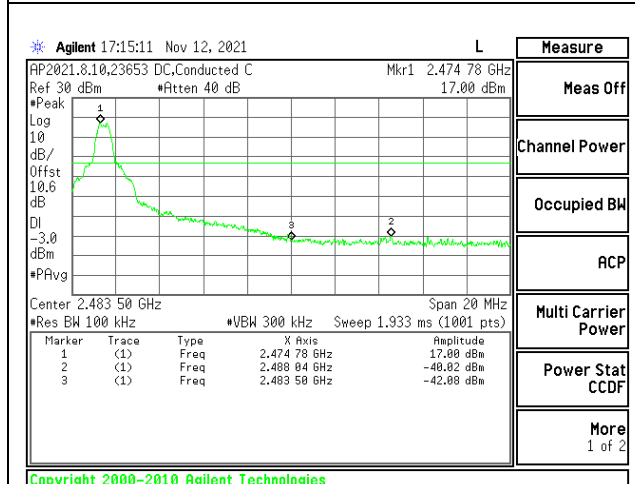
OUT-OF-BAND LOW CHANNEL ANTENNA 1



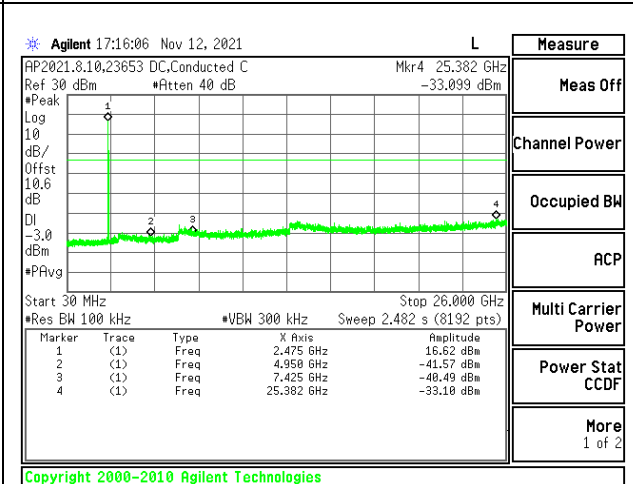
IN-BAND REFERENCE LEVEL ANTENNA 1



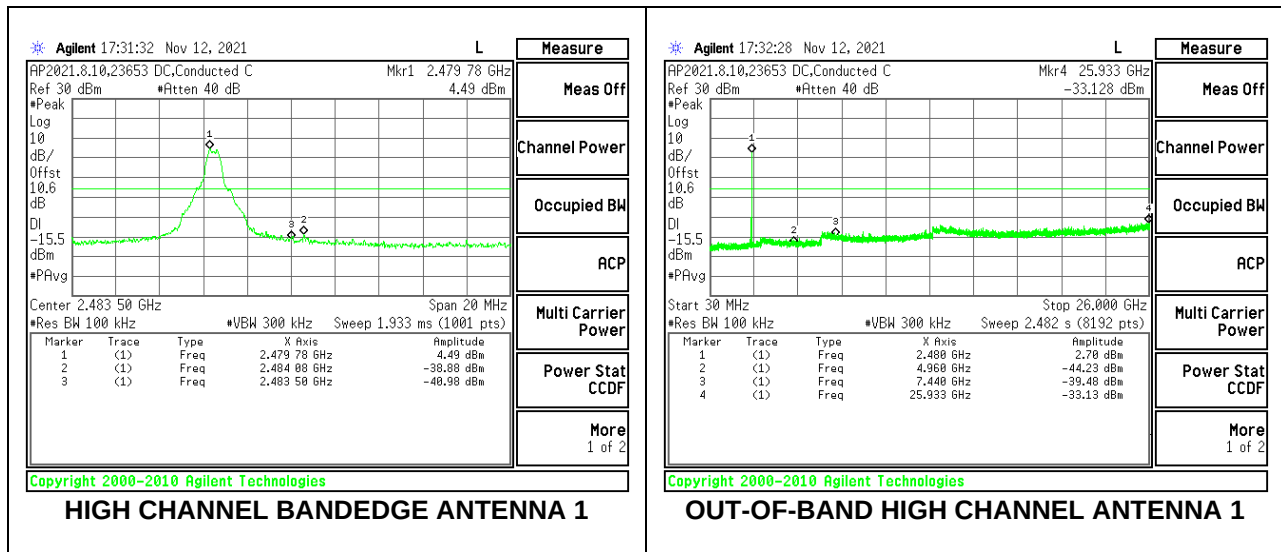
OUT-OF-BAND MID CHANNEL ANTENNA 1

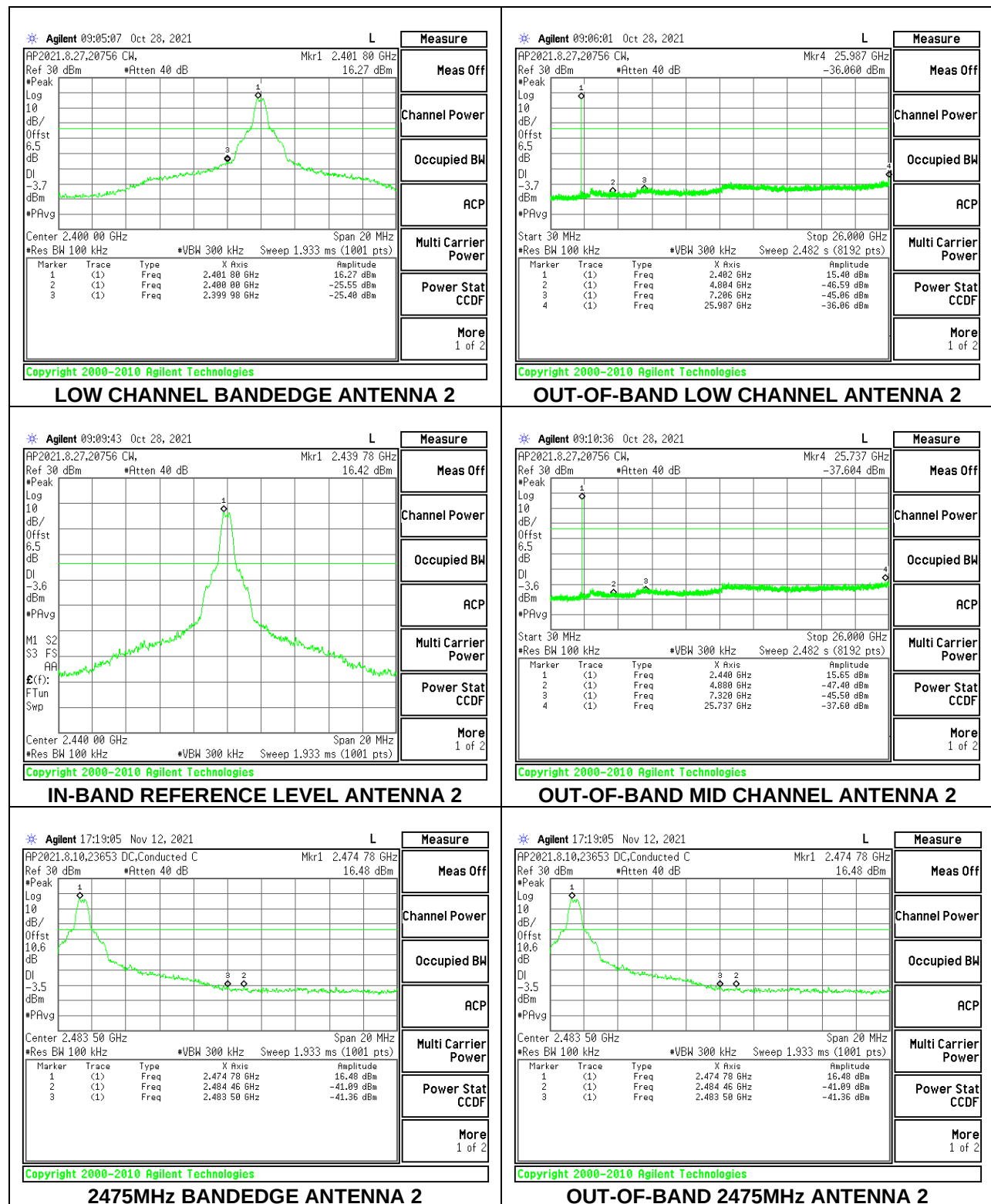


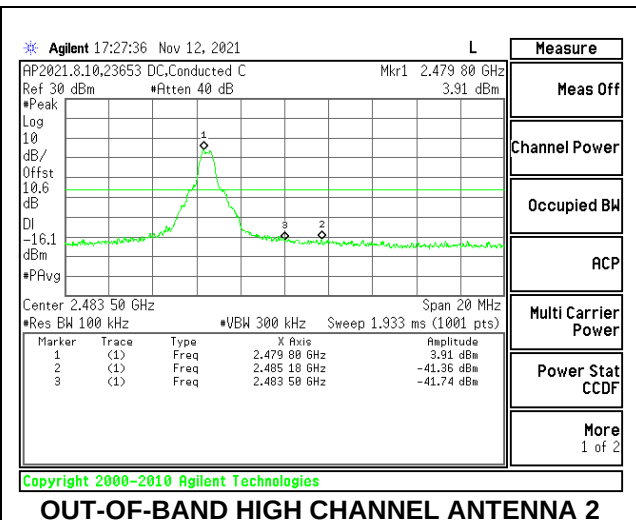
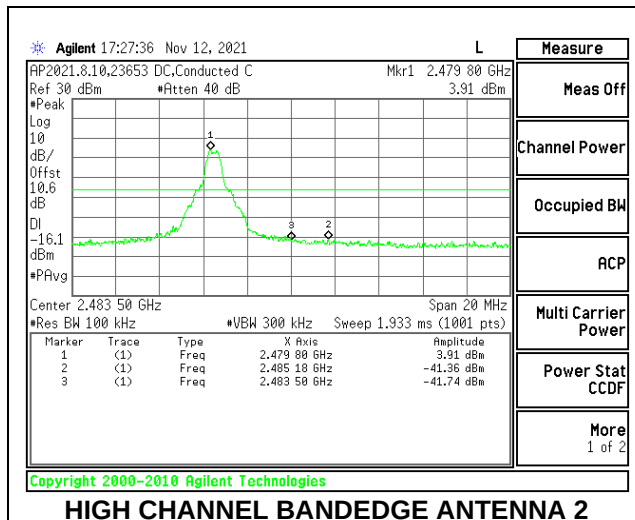
2475MHz BANDEDGE ANTENNA 1



OUT-OF-BAND 2475MHz ANTENNA 1







10. RADIATED TEST RESULTS

10.1. 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 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 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.

For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only. Blue color trace on plots: Parallel orientation. Green color trace on plots: Perpendicular orientation.

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.

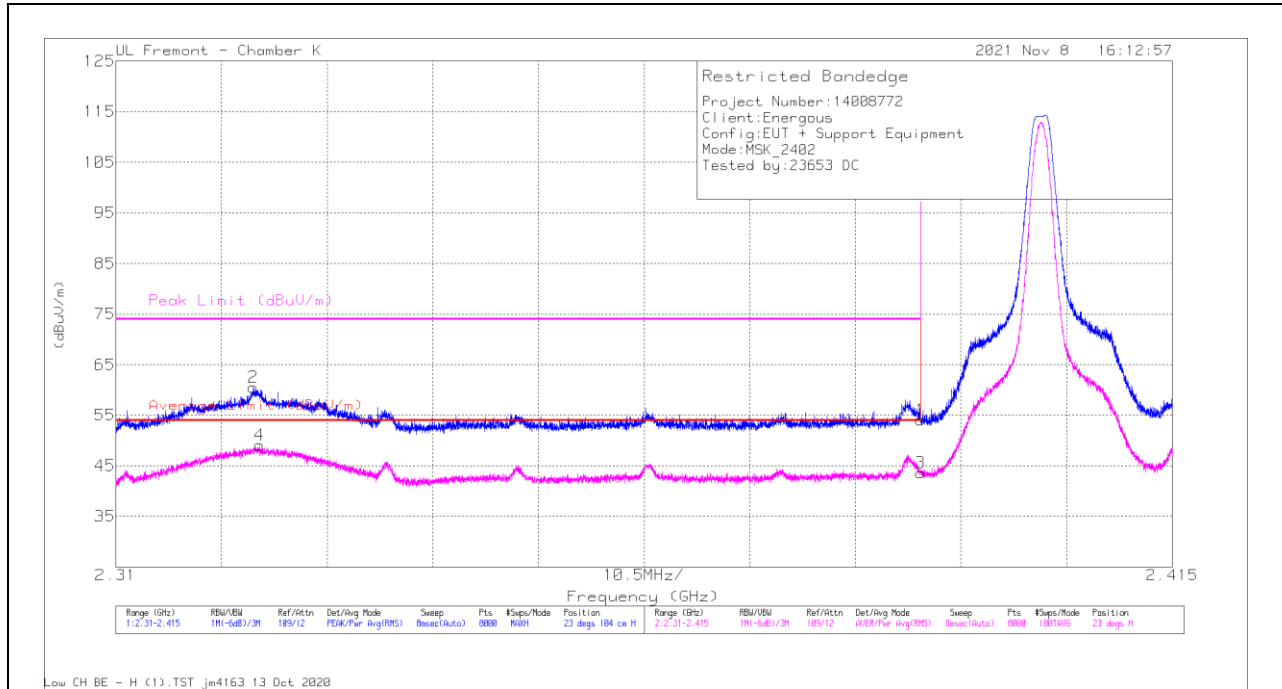
KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

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

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



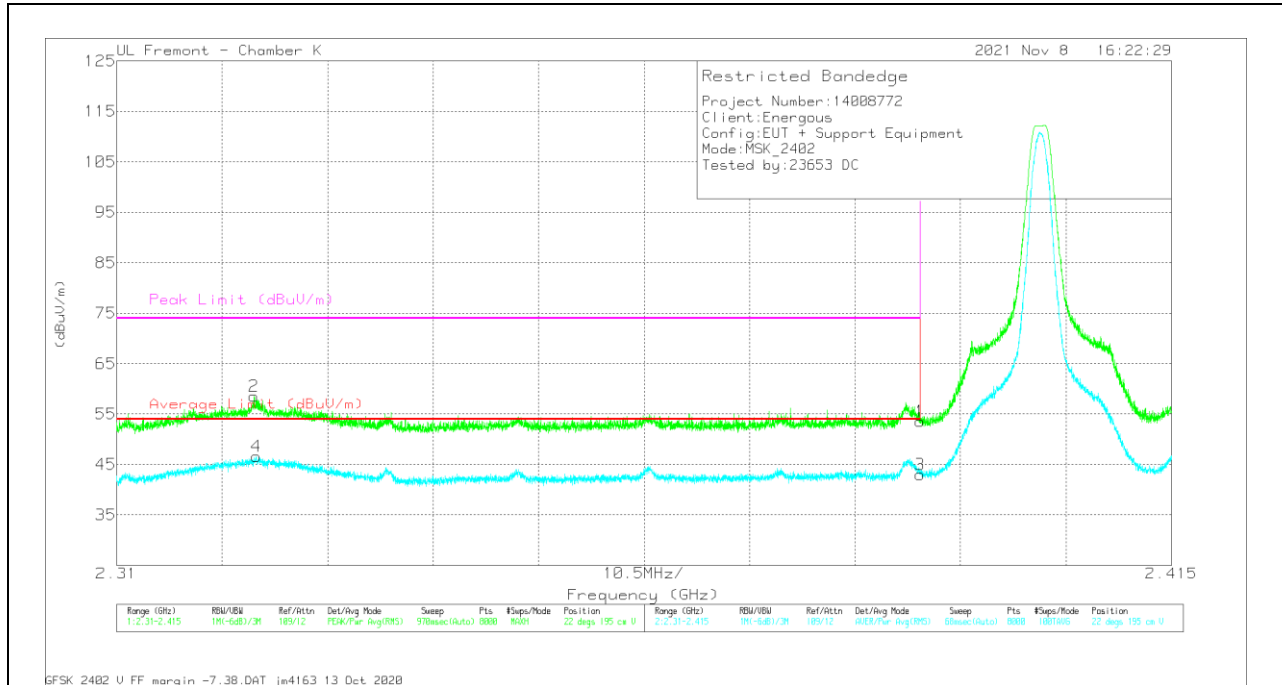
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cb/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	33.12	Pk	32.1	-11.2	54.02	-	-	74	-19.98	23	104	H
2	* 2.32369	39.96	Pk	31.9	-11.3	60.56	-	-	74	-13.44	23	104	H
3	* 2.39	22.75	RMS	32.1	-11.2	43.65	54	-10.35	-	-	23	104	H
4	* 2.32428	28.5	RMS	31.9	-11.3	49.1	54	-4.9	-	-	23	104	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/CbI/Ftr/Pa d (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	32.61	Pk	32.1	-11.2	53.51	-	-	74	-20.49	22	195	V
2	* 2.32369	37.96	Pk	31.9	-11.3	58.56	-	-	74	-15.44	22	195	V
3	* 2.39	22.07	RMS	32.1	-11.2	42.97	54	-11.03	-	-	22	195	V
4	* 2.32391	26.02	RMS	31.9	-11.3	46.62	54	-7.38	-	-	22	195	V

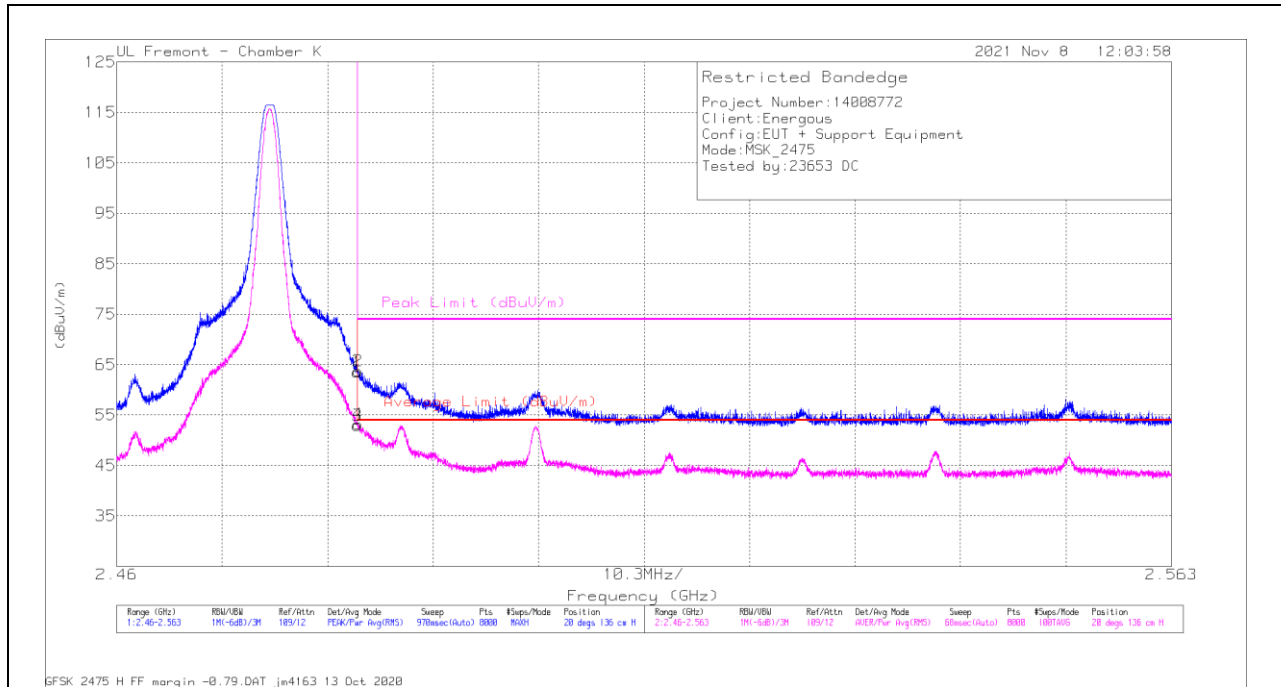
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

BANDEDGE (2475 MHz)

HORIZONTAL RESULT



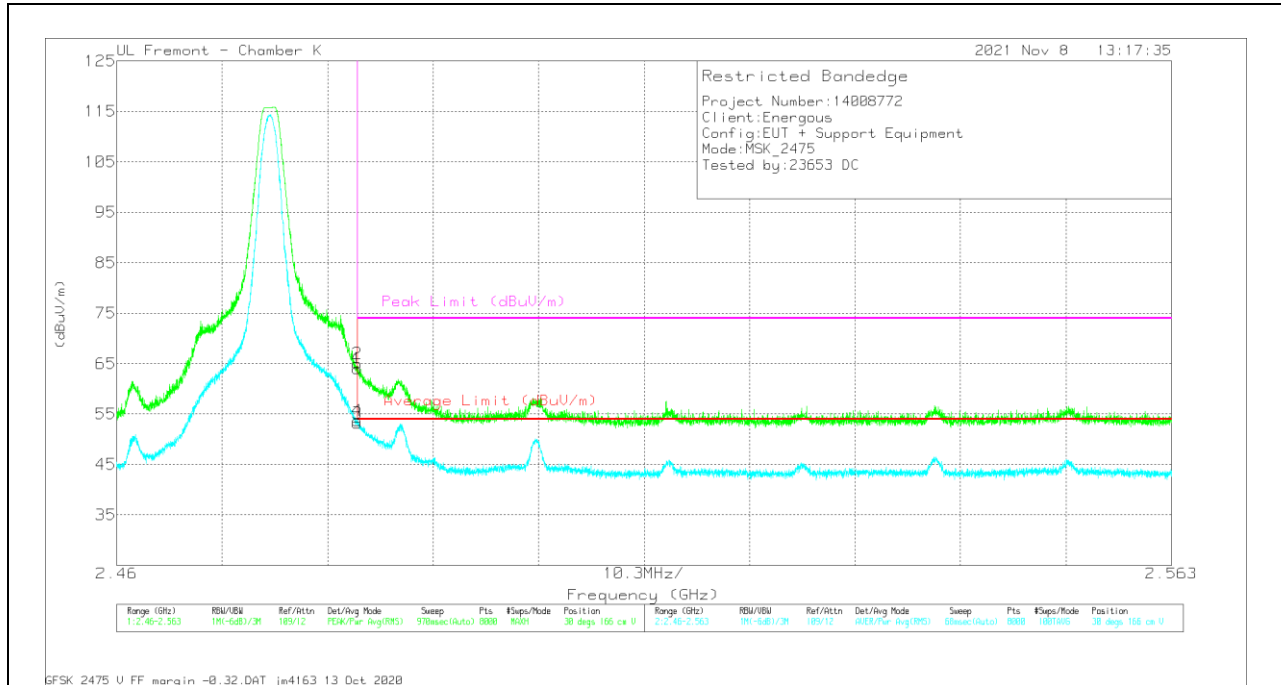
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dBm)	Amp/ICbl/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.72	Pk	32.7	-10.9	63.52	-	-	74	-10.48	20	136	H
2	* 2.48356	41.94	Pk	32.7	-10.9	63.74	-	-	74	-10.26	20	136	H
3	* 2.4835	31.16	RMS	32.7	-10.9	52.96	54	-1.04	-	-	20	136	H
4	* 2.48354	31.41	RMS	32.7	-10.9	53.21	54	-1.79	-	-	20	136	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/CbI/Ftr/Pa d (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	42.26	Pk	32.7	-10.9	64.06	-	-	74	-9.94	30	166	V
2	* 2.48351	43.17	Pk	32.7	-10.9	64.97	-	-	74	-9.03	30	166	V
3	* 2.4835	31.42	RMS	32.7	-10.9	53.22	54	-78	-	-	30	166	V
4	* 2.48351	31.88	RMS	32.7	-10.9	53.68	54	-32	-	-	30	166	V

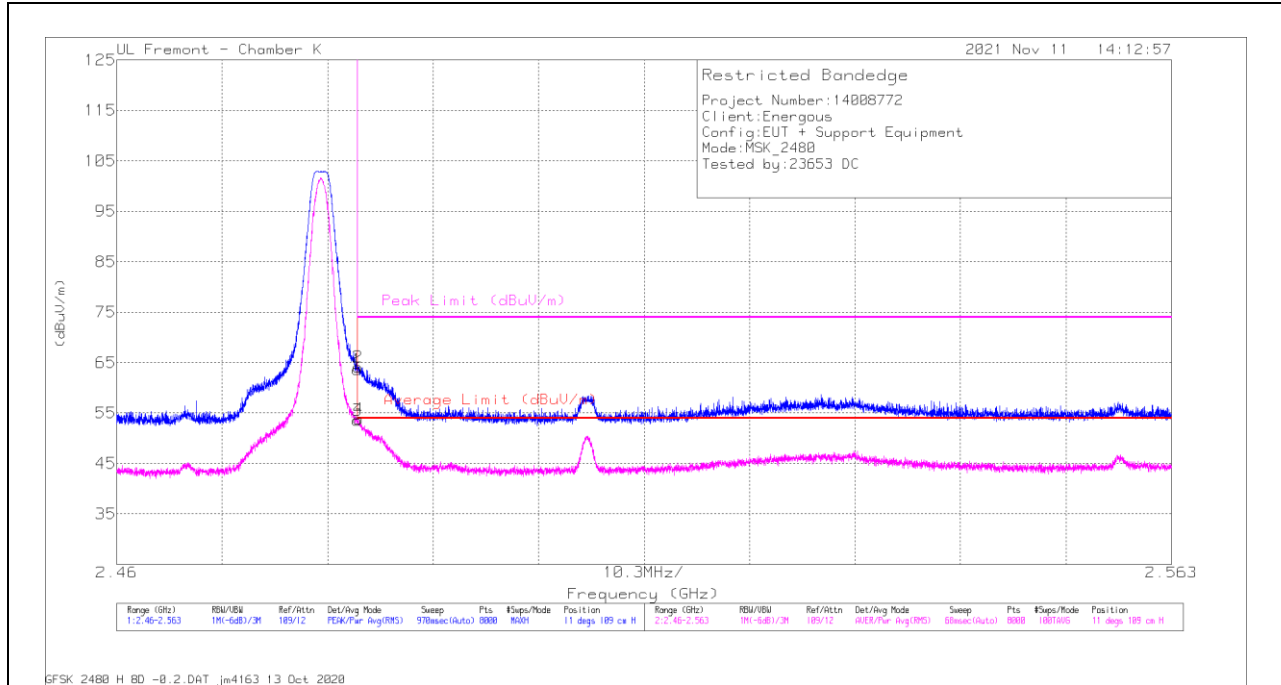
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Trace Markers

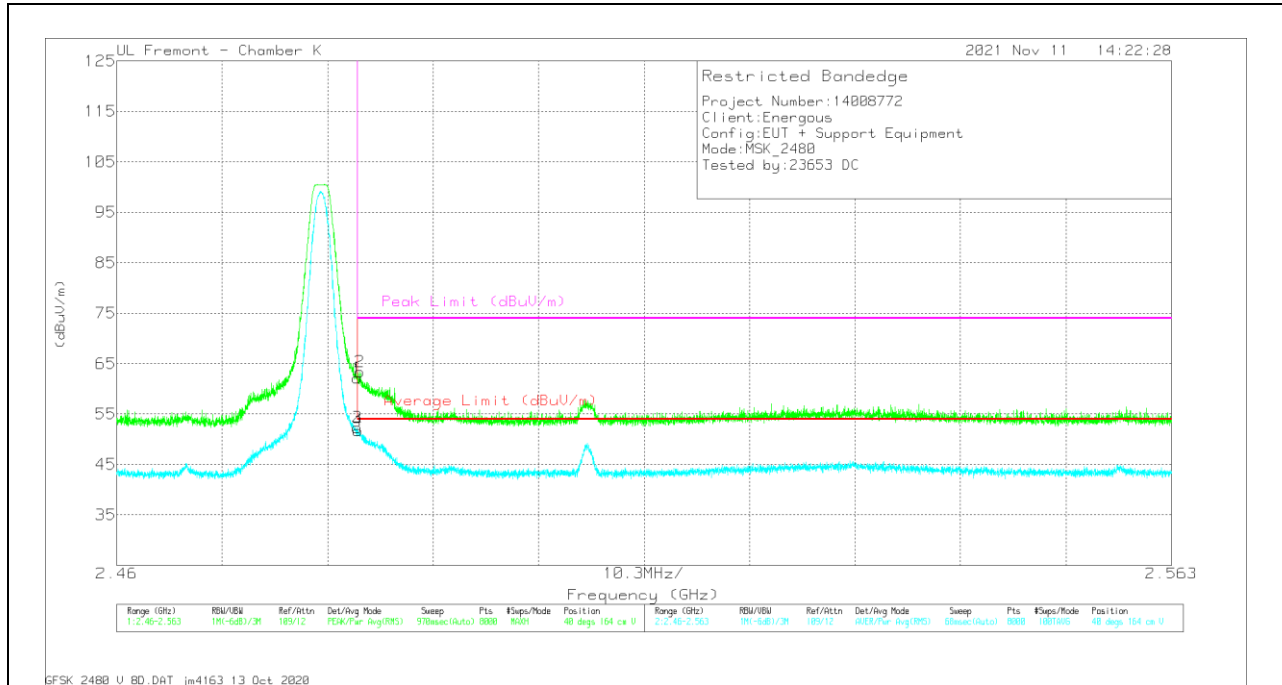
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dBm)	Amp/ICB/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.81	Pk	32.7	-10.9	63.61	-	-	74	-10.39	11	109	H
2	* 2.48354	42.39	Pk	32.7	-10.9	64.19	-	-	74	-9.81	11	109	H
3	* 2.4835	31.81	RMS	32.7	-10.9	53.61	54	-39	-	-	11	109	H
4	* 2.48362	32	RMS	32.7	-10.9	53.8	54	-2	-	-	11	109	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/ICBl/Ftr/Pa d (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	40.3	Pk	32.7	-10.9	62.1	-	-	74	-11.9	40	164	V
2	* 2.48376	41.59	Pk	32.7	-10.9	63.39	-	-	74	-10.61	40	164	V
3	* 2.4835	30.55	RMS	32.7	-10.9	52.35	54	-1.65	-	-	40	164	V
4	* 2.48358	29.89	RMS	32.7	-10.9	51.69	54	-2.31	-	-	40	164	V

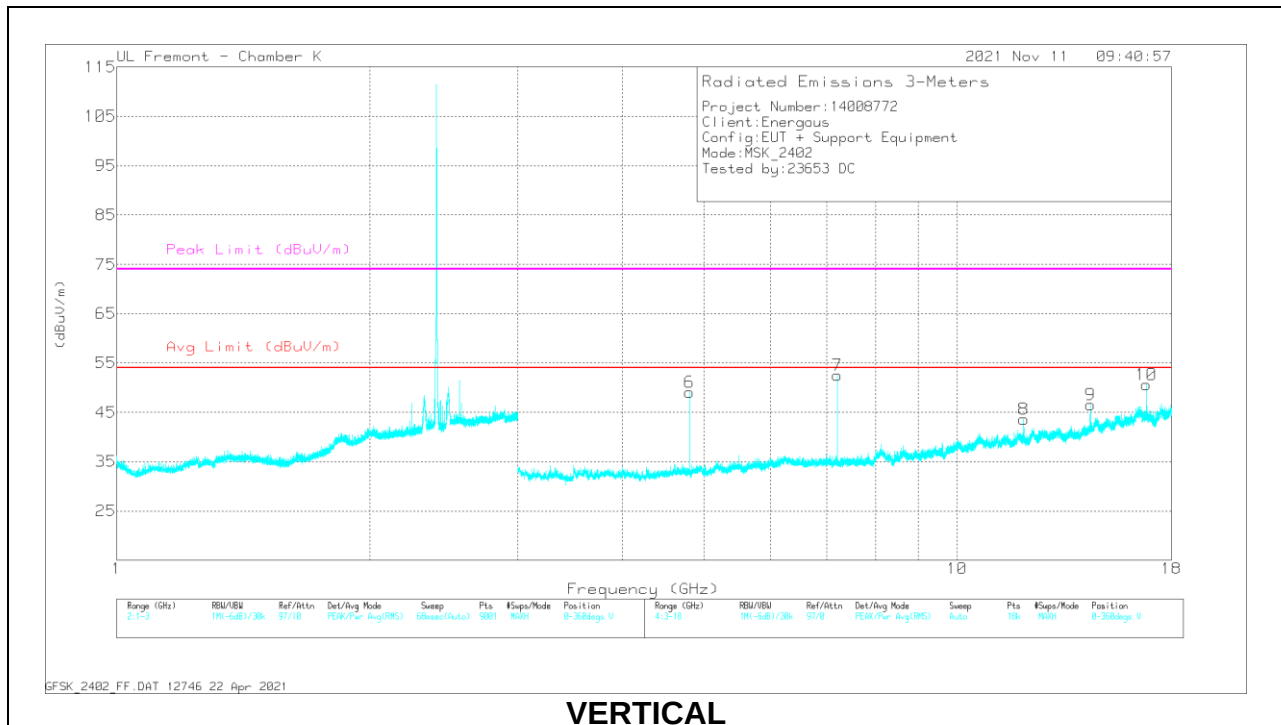
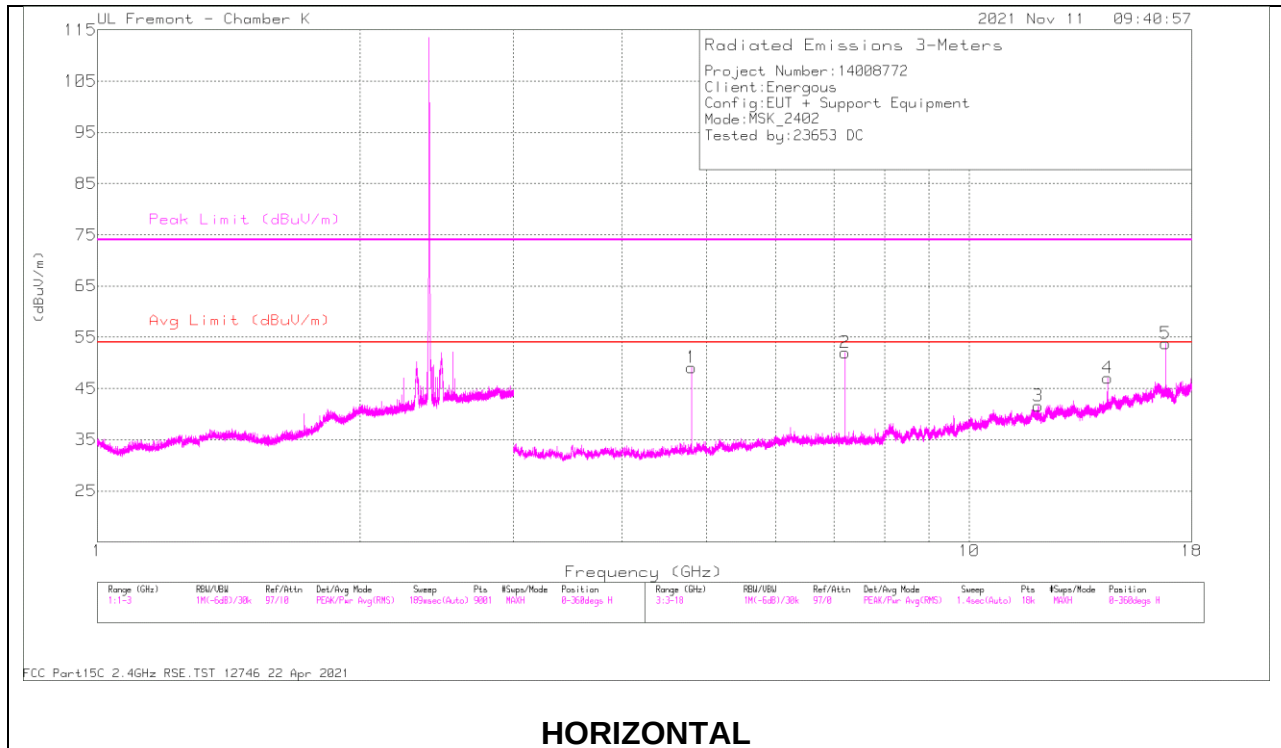
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl/Fitr/P ad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.80337	59.8	PK2	34.2	-40	54	-	-	74	-20	28	111	H
	* 4.80378	54.57	MAv1	34.2	-40	48.77	54	-5.23	-	-	28	111	H
2	7.20742	58.74	PK2	35.9	-37.8	56.84	-	-	-	-	308	117	H
	7.20589	52.35	MAv1	35.9	-37.8	50.45	-	-	-	-	308	117	H
4	14.41397	41.03	Pk	39.4	-33.4	47.03	-	-	-	-	0-360	199	H
5	16.81661	44.03	Pk	41.6	-31.8	53.83	-	-	-	-	0-360	199	H
3	* 12.01017	47.15	PK2	38.8	-33.8	52.15	-	-	74	-21.85	48	205	H
	* 12.00986	35.71	MAv1	38.8	-33.8	40.71	54	-13.29	-	-	48	205	H
6	* 4.80307	59.53	PK2	34.2	-40	53.73	-	-	74	-20.27	72	204	V
	* 4.80394	54.02	MAv1	34.2	-40	48.22	54	-5.78	-	-	72	204	V
7	7.20477	60.93	PK2	35.9	-37.8	59.03	-	-	-	-	53	108	V
	7.20584	54.74	MAv1	35.9	-37.8	52.84	-	-	-	-	53	108	V
8	* 12.00786	47.88	PK2	38.8	-33.8	52.88	-	-	74	-21.12	63	133	V
	* 12.01162	37.07	MAv1	38.8	-33.7	42.17	54	-11.83	-	-	63	133	V
9	14.41231	40.49	Pk	39.4	-33.4	46.49	-	-	-	-	0-360	100	V
10	16.81244	40.67	Pk	41.7	-31.8	50.57	-	-	-	-	0-360	199	V

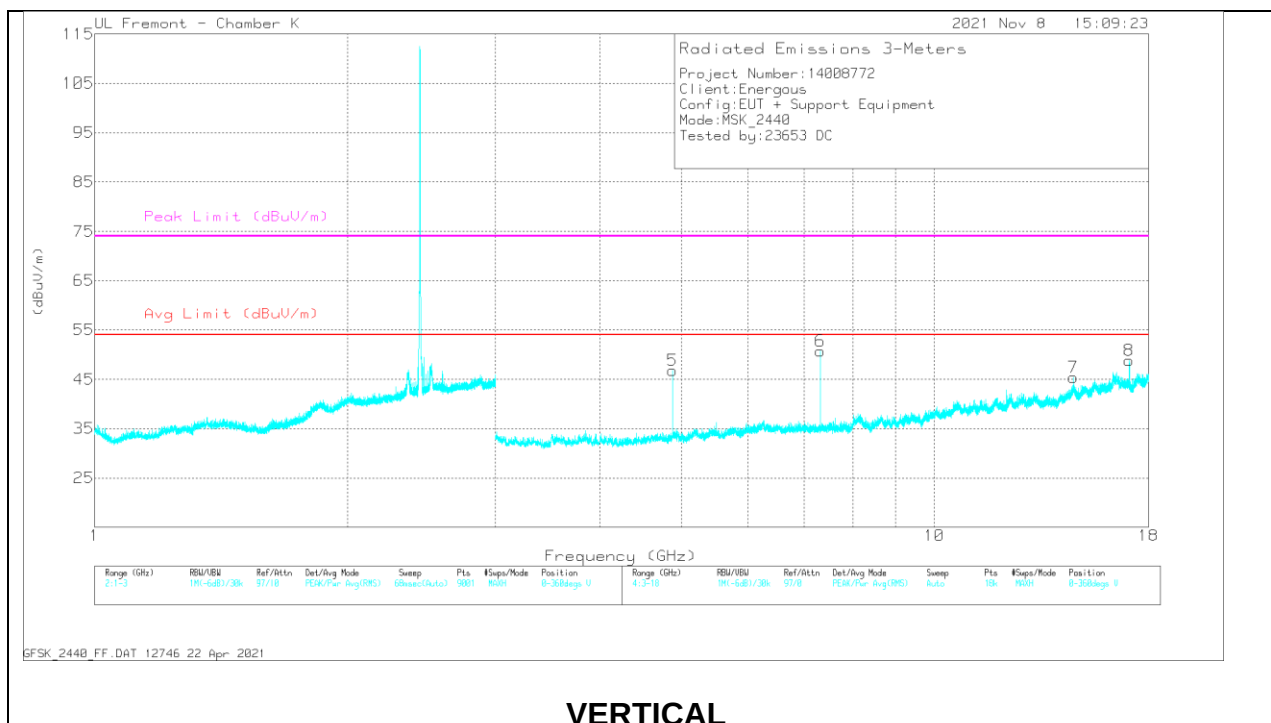
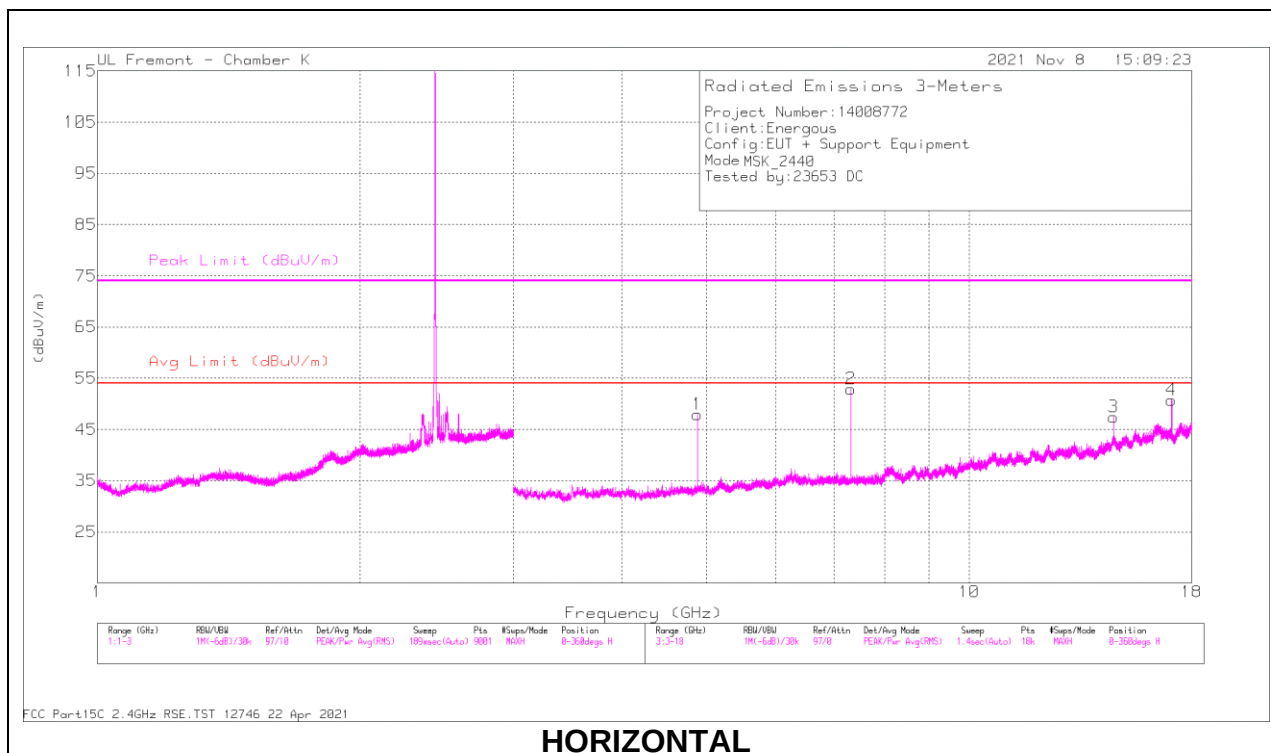
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

NOTE: Worst highest 6 markers frequencies are maximized.

MID CHANNEL RESULTS



RADIATED EMISSIONS

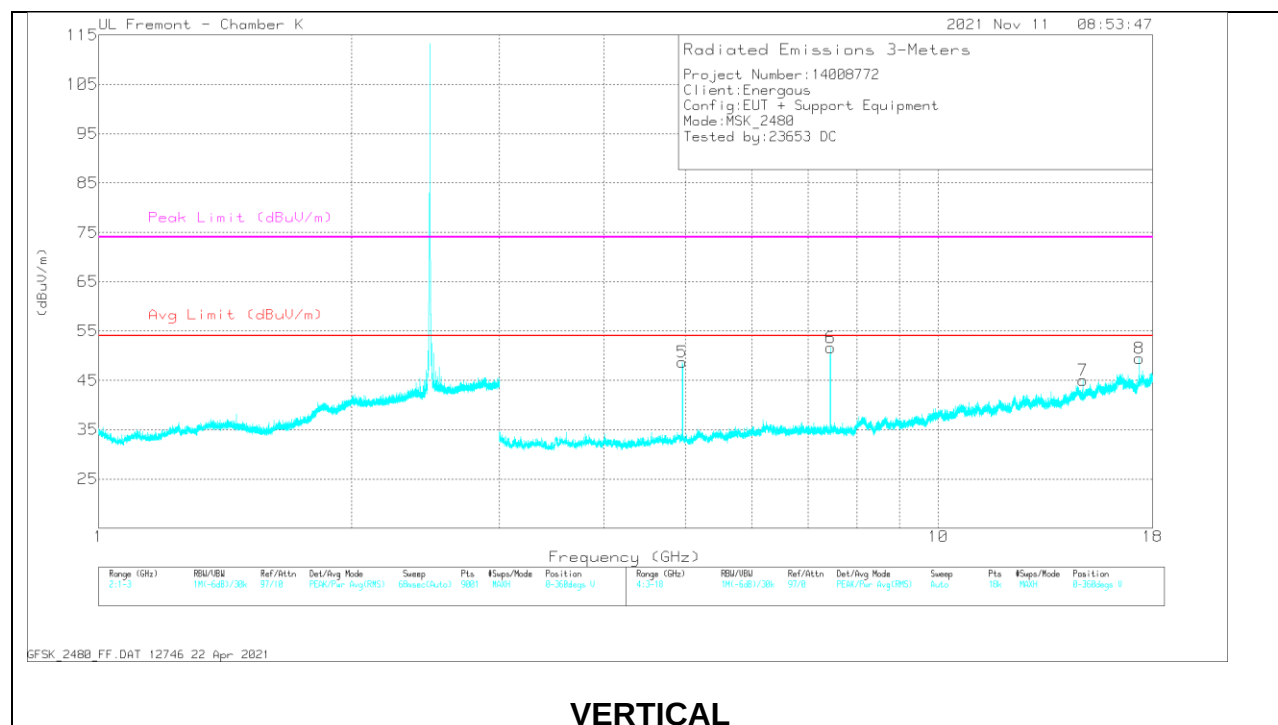
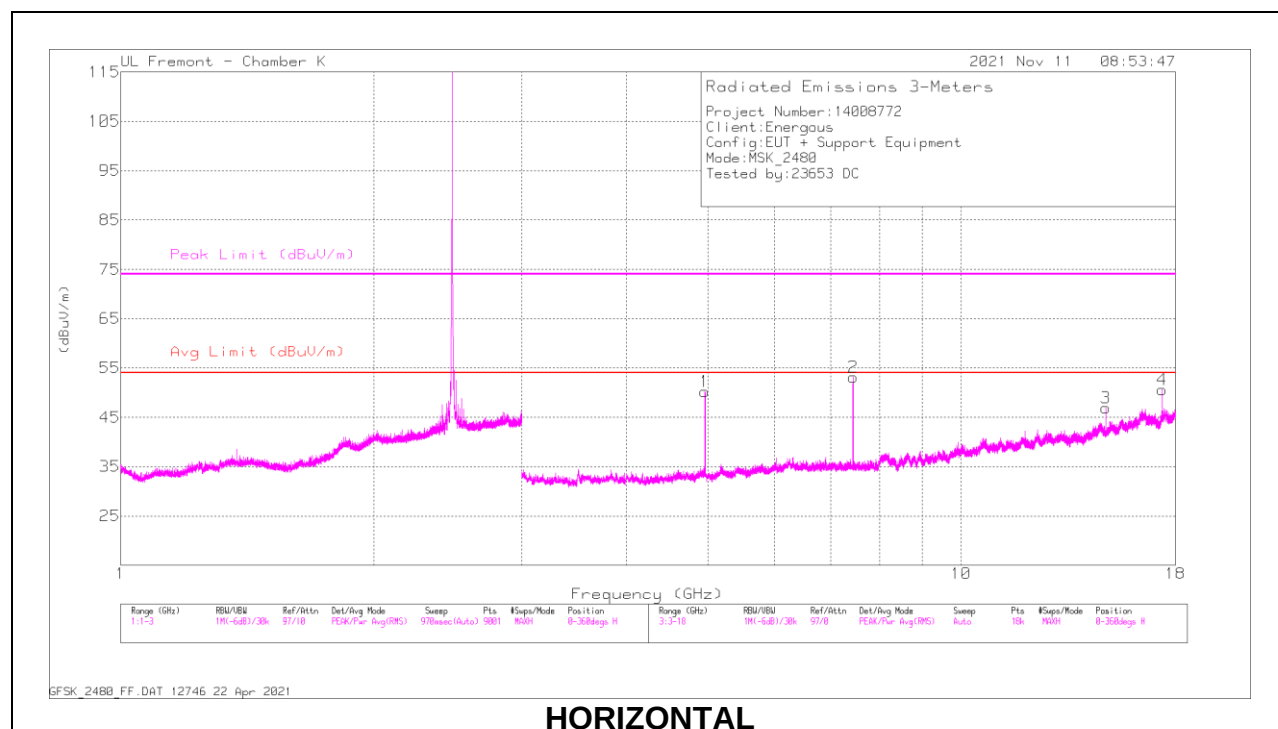
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.88068	58.93	PK2	34.1	-39.8	53.23	-	-	74	-20.77	32	99	H
	* 4.87993	53.61	MAv1	34.1	-39.8	47.91	54	-6.09	-	-	32	99	H
2	* 7.31875	61.31	PK2	35.8	-37.4	59.71	-	-	74	-14.29	322	113	H
	* 7.31991	55.16	MAv1	35.8	-37.4	53.56	54	-44	-	-	322	113	H
3	14.63804	49.16	PK2	39.9	-32.3	56.76	-	-	-	-	8	199	H
	14.63938	38.85	MAv1	39.9	-32.3	46.45	-	-	-	-	8	199	H
4	17.07646	51.74	PK2	41.3	-31.9	61.14	-	-	-	-	90	204	H
	17.07741	41.91	MAv1	41.3	-31.8	51.41	-	-	-	-	90	204	H
5	* 4.87913	57	PK2	34.1	-39.8	51.3	-	-	74	-22.7	50	318	V
	* 4.8797	50.41	MAv1	34.1	-39.8	44.71	54	-9.29	-	-	50	318	V
6	* 7.32115	59.38	PK2	35.8	-37.4	57.78	-	-	74	-16.22	16	118	V
	* 7.31993	53.19	MAv1	35.8	-37.4	51.59	54	-2.41	-	-	16	118	V
7	14.63756	52.06	PK2	39.9	-32.3	59.66	-	-	-	-	21	190	V
	14.6378	41.66	MAv1	39.9	-32.3	49.26	-	-	-	-	21	190	V
8	17.07771	50.59	PK2	41.3	-31.8	60.09	-	-	-	-	65	112	V
	17.07912	40.63	MAv1	41.2	-31.8	50.03	-	-	-	-	65	112	V

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

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.95919	61.89	PK2	34.1	-39.9	56.09	-	-	74	-17.91	31	98	H
	* 4.95985	56.82	MAv1	34.1	-39.9	51.02	54	-2.98	-	-	31	98	H
2	* 7.44077	59.96	PK2	35.8	-37.2	58.56	-	-	74	-15.44	69	200	H
	* 7.4408	54.06	MAv1	35.8	-37.2	52.66	54	-1.34	-	-	69	200	H
3	14.88067	40.37	Pk	39.8	-33.3	46.87	-	-	-	-	0-360	100	H
4	17.35771	52.22	PK2	41.4	-30.8	62.82	-	-	-	-	359	191	H
	17.35984	42.44	MAv1	41.5	-30.8	53.14	-	-	-	-	359	191	H
5	* 4.95996	60.76	PK2	34.1	-39.9	54.96	-	-	74	-19.04	68	170	V
	* 4.96005	55.51	MAv1	34.1	-39.9	49.71	54	-4.29	-	-	68	170	V
6	* 7.43848	60.62	PK2	35.8	-37.2	59.22	-	-	74	-14.78	44	260	V
	* 7.43986	54.78	MAv1	35.8	-37.2	53.38	54	-6.2	-	-	44	260	V
7	14.87983	38.57	Pk	39.8	-33.3	45.07	-	-	-	-	0-360	100	V
8	17.35691	48.98	PK2	41.4	-30.8	59.58	-	-	-	-	49	165	V

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

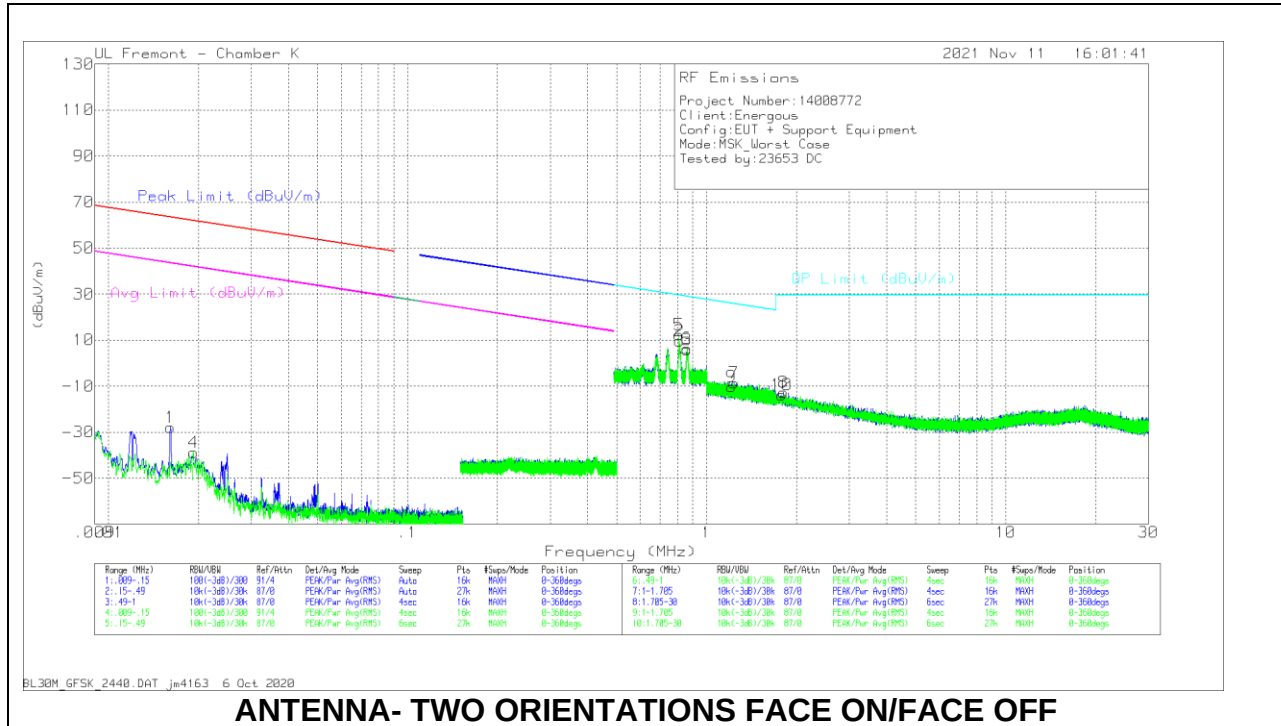
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

NOTE: Worst highest 6 markers frequencies are maximized.

10.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



Below 30MHz Data

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBUV/m)	Peak Limit (dBUV/m)	Margin (dB)	Avg Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)
1	.01615	24.1	Pk	59.5	-31.5	-80	-27.9	63.42	-91.32	43.42	-71.32	0-360
4	.01923	13.85	Pk	59.1	-31.8	-80	-38.85	61.9	-100.75	41.9	-80.75	0-360

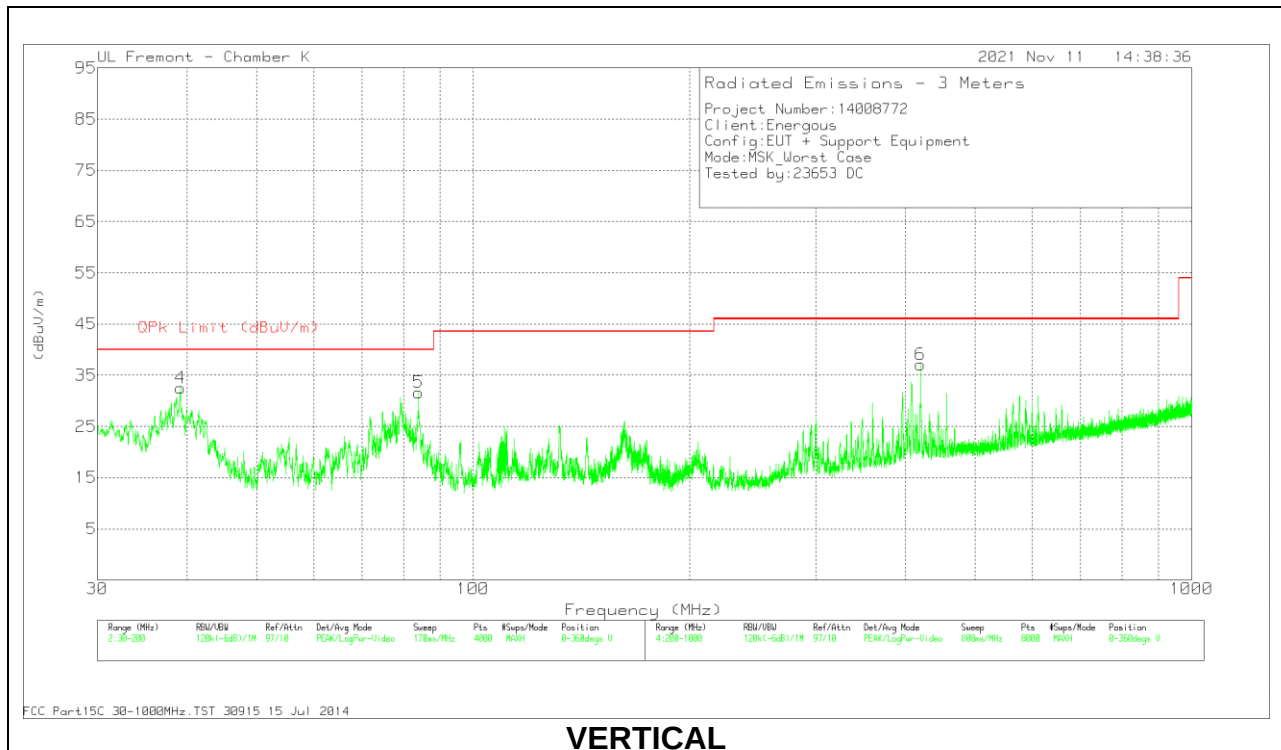
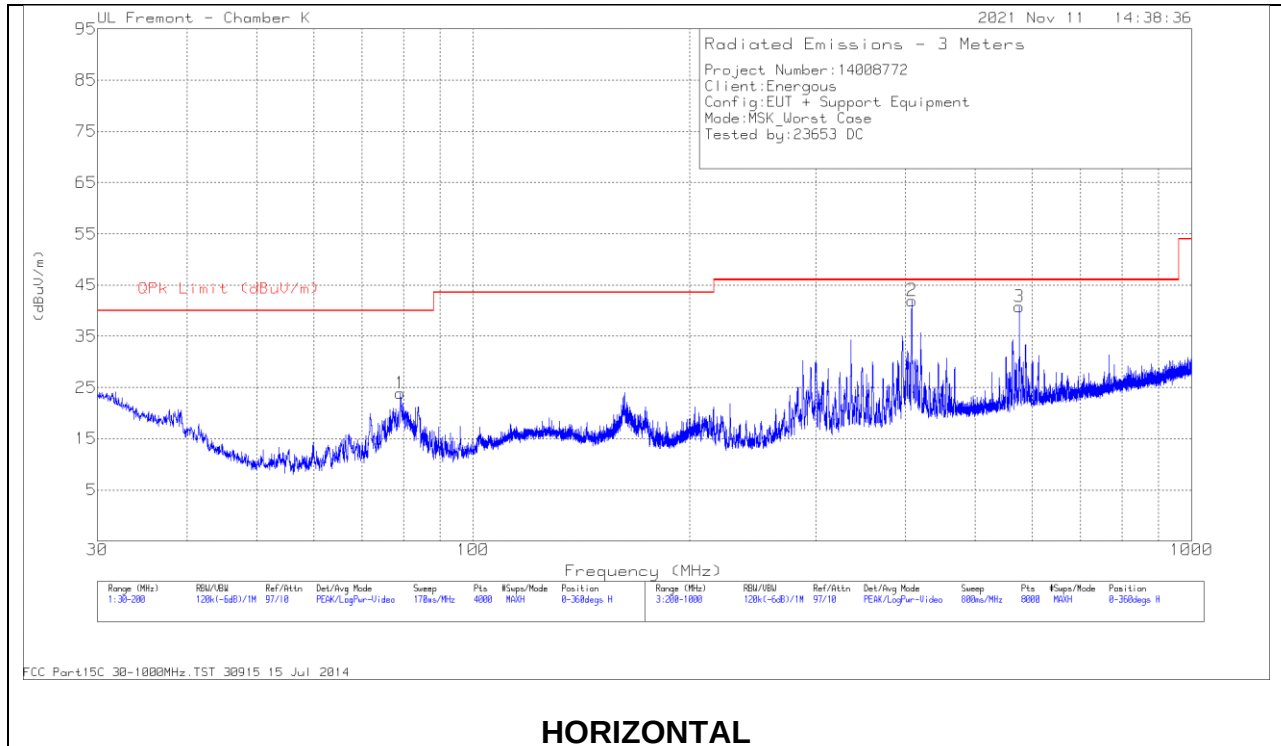
Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB)	Corrected Reading (dBUV/m)	QP Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)
2	.81173	25.43	Pk	56.2	-32.1	-40	9.53	29.43	-19.9	0-360
3	.86126	21.7	Pk	56.2	-32.1	-40	5.8	28.92	-23.12	0-360
5	.80584	28.31	Pk	56.2	-32.1	-40	12.41	29.49	-17.08	0-360
6	.86005	22.24	Pk	56.2	-32.1	-40	6.34	28.93	-22.59	0-360
7	1.23426	17.84	Pk	45.7	-32.1	-40	-8.56	25.8	-34.36	0-360
8	1.80666	16.8	Pk	42.6	-32.1	-40	-12.7	29.5	-42.2	0-360
9	1.20896	16.11	Pk	45.8	-32.1	-40	-10.19	25.98	-36.17	0-360
10	1.78046	15.54	Pk	42.8	-32.1	-40	-13.76	29.5	-43.26	0-360

Pk - Peak detector

10.4. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

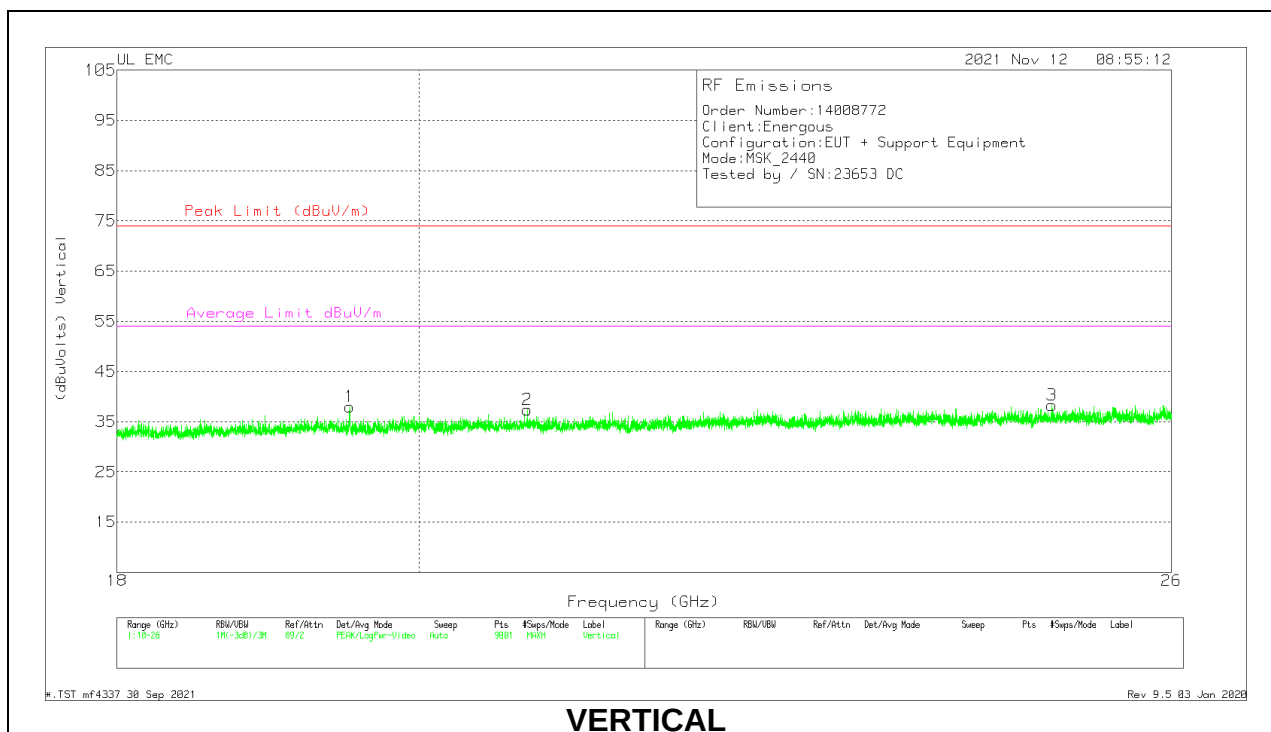
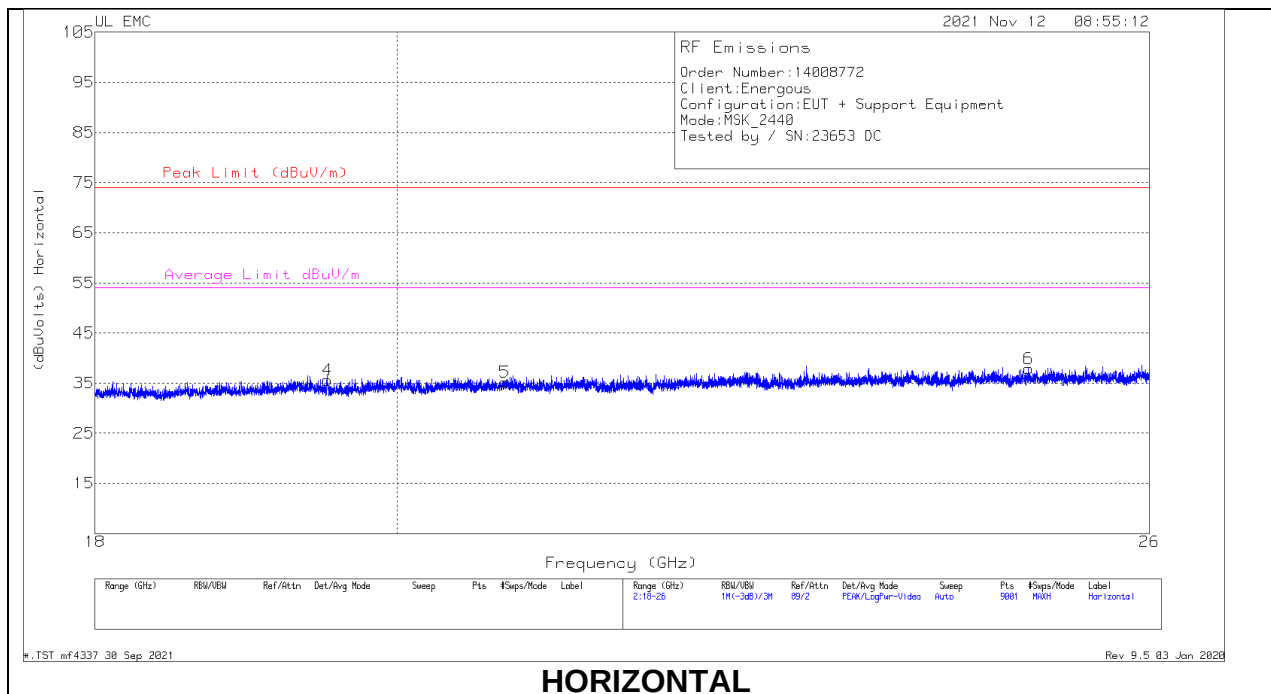
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	82258 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	79.2702	41.01	Pk	13.8	-30.9	23.91	40	-16.09	0-360	197	H
4	39.1399	43.08	Pk	20.8	-31.4	32.48	40	-7.52	0-360	100	V
5	83.9465	49.25	Pk	13.4	-31	31.65	40	-8.35	0-360	100	V
2	* 407.77281	50.85	Pk	22.4	-29.3	43.95	46.02	-2.07	302	151	H
	* 407.7728	35.59	Qp	22.4	-29.3	28.69	46.02	-17.33	302	151	H
3	575.624	46.27	Pk	25.2	-28.5	42.97	46.02	-3.05	124	110	H
	575.624	31.63	Qp	25.2	-28.5	28.33	46.02	-17.69	124	110	H
6	419.5285	43.81	Pk	22.6	-29.3	37.11	46.02	-8.91	0-360	199	V

Pk - Peak detector

Qp - Quasi-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	AF 81139 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	PK Margin (dB)	Average Limit dBuV/m	Margin (dB)
1	19.52178	71.39	Pk	33.3	-57.2	-9.5	37.99	74	-36.01	54	-16.01
2	20.76978	69.86	Pk	33.8	-56.8	-9.5	37.36	74	-36.64	54	-16.64
3	24.93778	68.4	Pk	34.9	-55.5	-9.5	38.3	74	-35.7	54	-15.7
4	19.52	68.98	Pk	33.3	-57.2	-9.5	35.58	74	-38.42	54	-18.42
5	20.76533	67.69	Pk	33.8	-56.8	-9.5	35.19	74	-38.81	54	-18.81
6	24.92622	68.1	Pk	34.9	-55.6	-9.5	37.9	74	-36.1	54	-16.1

Pk - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

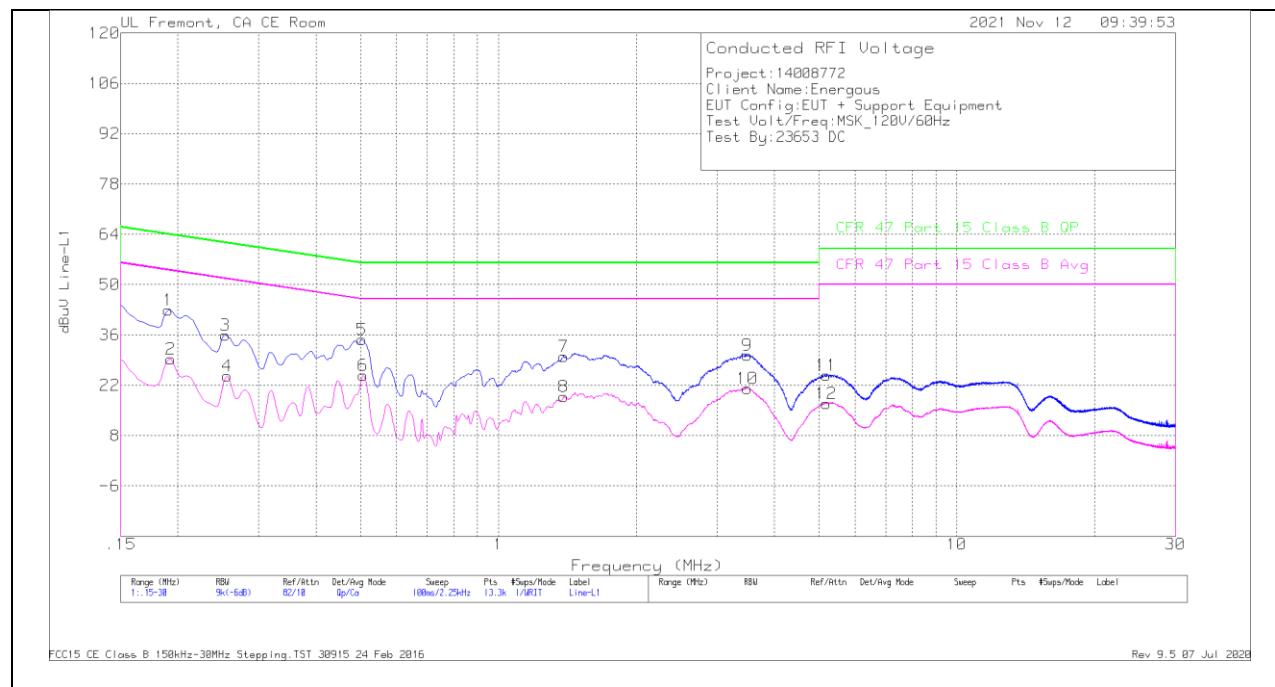
FCC §15.207 (a)

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

*Decreases with the logarithm of the frequency.

RESULTS

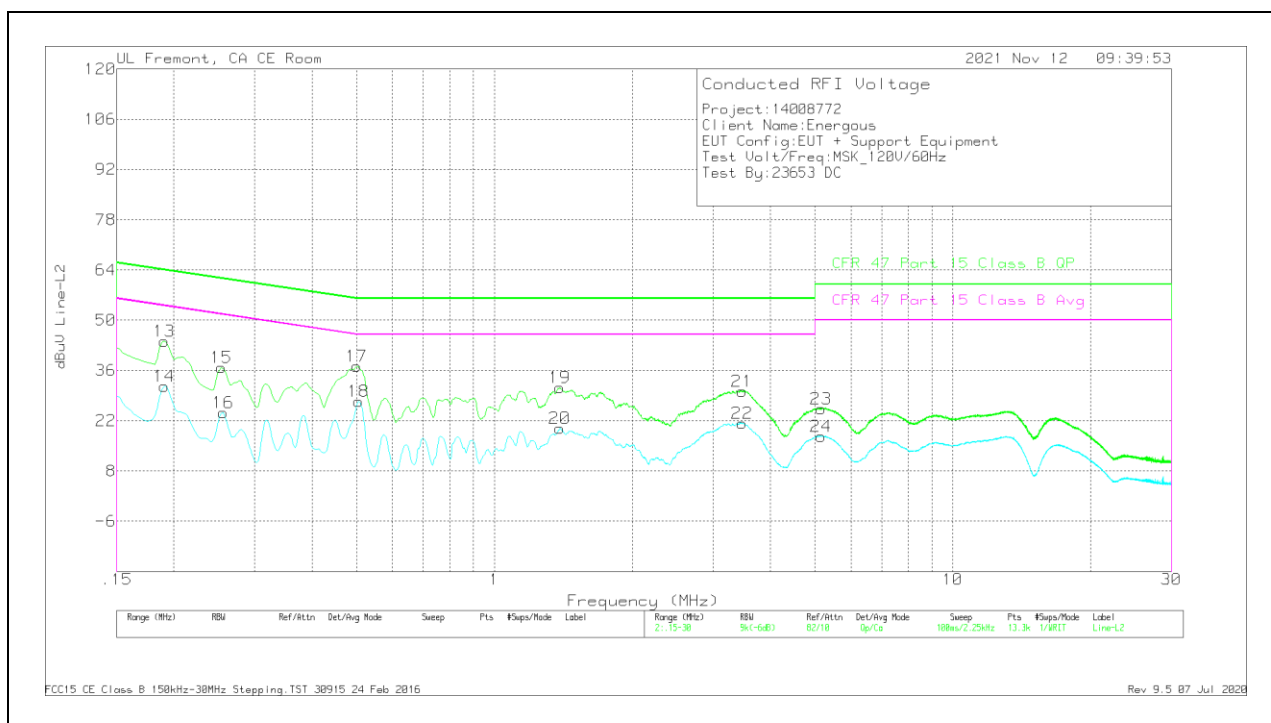
11.1. CONFIGURATION 1 LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L1	C1&C3 cable calibration factor	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)M argin (dB)
2	.19275	20.02	Ca	0	0	9.3	29.32	-	-	53.92	-24.6
4	.25575	15.29	Ca	0	0	9.3	24.59	-	-	51.57	-26.98
6	.50775	15.46	Ca	0	0	9.3	24.76	-	-	46	-21.24
8	1.38975	9.39	Ca	0	.1	9.3	18.79	-	-	46	-27.21
10	3.489	11.75	Ca	0	.1	9.3	21.15	-	-	46	-24.85
12	5.19338	7.53	Ca	0	.1	9.3	16.93	-	-	50	-33.07
1	.1905	33.55	Qp	0	0	9.3	42.85	64.01	-21.16	-	-
3	.2535	26.62	Qp	0	0	9.3	35.92	61.64	-25.72	-	-
5	.50325	25.41	Qp	0	0	9.3	34.71	56	-21.29	-	-
7	1.38975	20.68	Qp	0	.1	9.3	30.08	56	-25.92	-	-
9	3.49125	20.89	Qp	0	.1	9.3	30.29	56	-25.71	-	-
11	5.199	15.35	Qp	0	.1	9.3	24.75	60	-35.25	-	-

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS

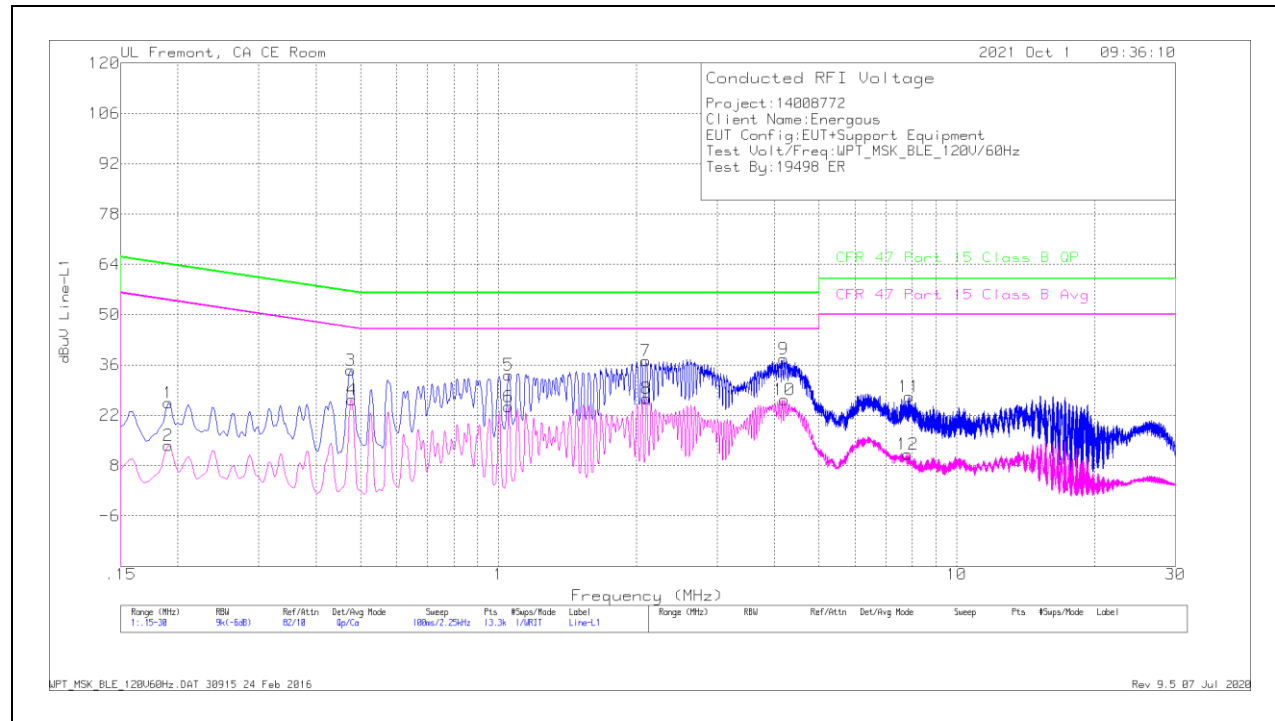


Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L2	C2&C3 cable	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
14	.1905	22.3	Ca	0	0	9.3	31.6	-	-	54.01	-22.41
16	.25575	14.94	Ca	0	0	9.3	24.24	-	-	51.57	-27.33
18	.5055	18.05	Ca	0	0	9.3	27.35	-	-	46	-18.65
20	1.38975	10.46	Ca	0	.1	9.3	19.86	-	-	46	-26.14
22	3.4755	11.85	Ca	0	.1	9.3	21.25	-	-	46	-24.75
24	5.16075	8.21	Ca	0	.1	9.3	17.61	-	-	50	-32.39
13	.1905	34.79	Qp	0	0	9.3	44.09	64.01	-19.92	-	-
15	.2535	27.44	Qp	0	0	9.3	36.74	61.64	-24.9	-	-
17	.501	27.86	Qp	0	0	9.3	37.16	56	-18.84	-	-
19	1.3875	21.8	Qp	0	.1	9.3	31.2	56	-24.8	-	-
21	3.4665	20.73	Qp	0	.1	9.3	30.13	56	-25.87	-	-
23	5.16525	15.86	Qp	0	.1	9.3	25.26	60	-34.74	-	-

Qp - Quasi-Peak detector

Ca - CISPR average detection

11.2. CONFIGURATION 2 LINE 1 RESULTS

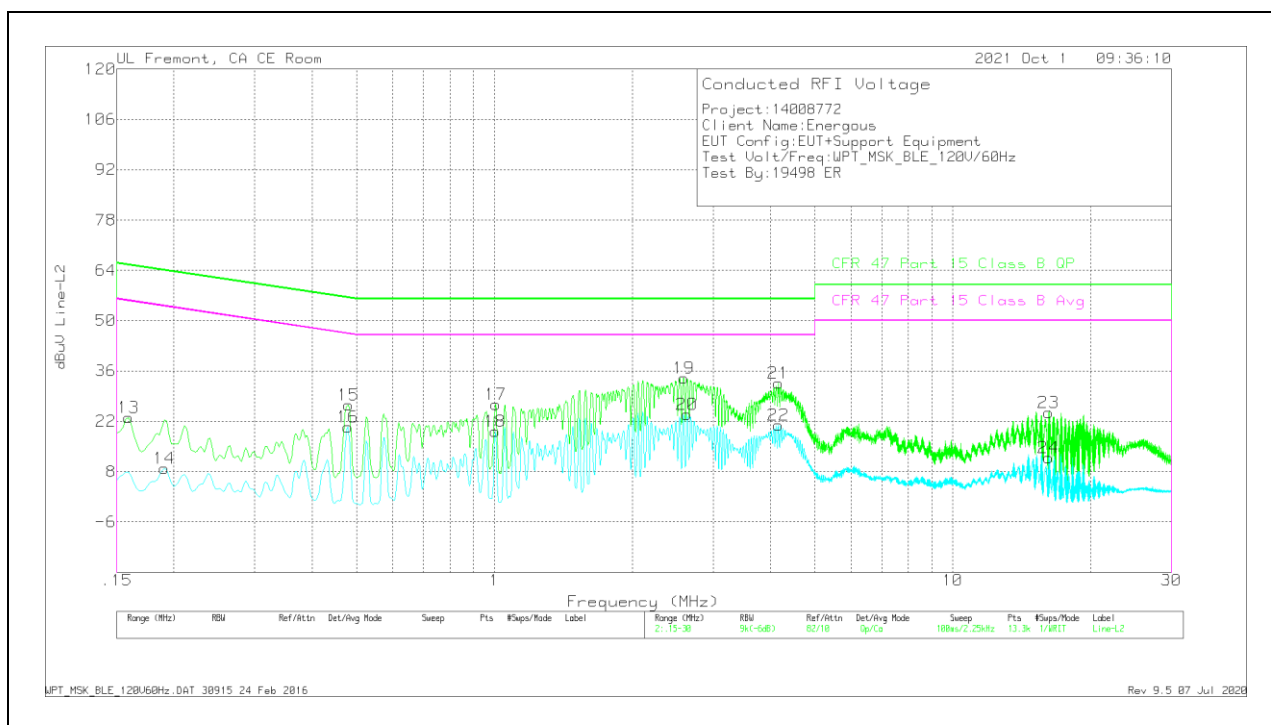


Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L1	LC Cables C1&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)M argin (dB)
2	.1905	4.3	Ca	0	0	9.3	13.6	-	-	54.01	-40.41
4	.4785	17.07	Ca	0	0	9.3	26.37	-	-	46.37	-20
6	1.05225	14.98	Ca	0	.1	9.3	24.38	-	-	46	-21.62
8	2.10525	17.31	Ca	0	.1	9.3	26.71	-	-	46	-19.29
10	4.209	16.91	Ca	0	.1	9.3	26.31	-	-	46	-19.69
12	7.8135	1.72	Ca	0	.1	9.3	11.12	-	-	50	-38.88
1	.1905	16.14	Qp	0	0	9.3	25.44	64.01	-38.57	-	-
3	.47625	25.23	Qp	0	0	9.3	34.53	56.4	-21.87	-	-
5	1.05225	23.84	Qp	0	.1	9.3	33.24	56	-22.76	-	-
7	2.0985	27.73	Qp	0	.1	9.3	37.13	56	-18.87	-	-
9	4.1955	28.3	Qp	0	.1	9.3	37.7	56	-18.3	-	-
11	7.8675	17.85	Qp	0	.1	9.3	27.25	60	-32.75	-	-

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L2	LC Cables C2&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)M argin (dB)
14	.1905	-.34	Ca	0	0	9.3	8.96	-	-	54.01	-45.05
16	.4785	11.19	Ca	0	0	9.3	20.49	-	-	46.37	-25.88
18	1.005	9.87	Ca	0	.1	9.3	19.27	-	-	46	-26.73
20	2.63175	14.53	Ca	0	.1	9.3	23.93	-	-	46	-22.07
22	4.16625	11.58	Ca	0	.1	9.3	20.98	-	-	46	-25.02
24	16.20038	2.39	Ca	0	.2	9.3	11.89	-	-	50	-38.11
13	.159	13.66	Qp	0	0	9.4	23.06	65.52	-42.46	-	-
15	.48075	17.15	Qp	0	0	9.3	26.45	56.33	-29.88	-	-
17	1.00725	17.34	Qp	0	.1	9.3	26.74	56	-29.26	-	-
19	2.58675	24.66	Qp	0	.1	9.3	34.06	56	-21.94	-	-
21	4.1685	23.21	Qp	0	.1	9.3	32.61	56	-23.39	-	-
23	16.19925	14.97	Qp	0	.2	9.3	24.47	60	-35.53	-	-

Qp - Quasi-Peak detector

Ca - CISPR average detection