FCC 47 CFR PART SUBPART C §15.249

CERTIFICATION TEST REPORT

FOR

24 GHz GROUND BASED SURVEILLANCE RADAR

MODEL SERIES: CK

MODELS:
CK20, CK20B-CE, CK10B-CE, CK2B-CE AND CK5B-CE

FCC ID: C06-CK-CLS-B

REPORT NUMBER: 12542067-E1V3

ISSUE DATE: SEPTEMBER 10 , 2019

Prepared for

SPOTTERRF
720 TIMPANOGOS PARKWAY
OREM, UTAH, 84097, USA

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	7/18/2019	Initial Issue	M. Heckrotte
V2	8/12/2019	Revised Model Numbers	S. Aguilar
V3	9/10/2019	Specified Employee Numbers of Test Conductors on the Plots in Section 6 and Section 7. Added KDB 414788 Statement in Section 9.1.	GP Chin

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SPOTTER RF
720 TIMPANOGOS PARKWAY
OREM, UTAH, 84097, USA

EUT DESCRIPTION: 24 GHz GROUND BASED SURVEILLANCE RADAR

MODELS: CK20, CK20B-CE, CK10B-CE, CK2B-CE AND CK5B-CE

MODEL TESTED: **CK20**
SERIAL NUMBER TESTED: CK20 - SP0101B

DATE TESTED: MAY 15TH – JUNE 18, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15.249	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. 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 NVLAP, NIST, or any agency of the Federal Government.

Approved & Released For
UL Verification Services Inc. By:

MICHAEL HECKROTTE
PRINCIPAL ENGINEER
UL Verification Services Inc.

Tested By:

STEVE AGUILAR
TEST ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.249.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. 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.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
☐ Chamber A	☐ Chamber D	☒ Chamber I
☐ Chamber B	☐ Chamber E	☒ Chamber J
☐ Chamber C	☐ Chamber F	☐ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	☒ Chamber M

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

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

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	±3.52 dB
Radiated Disturbance, 30 to 1000 MHz	±4.94 dB
Radiated Disturbance, 1 to 6 GHz	±3.86 dB
Radiated Disturbance, 6 to 18 GHz	±4.23 dB
Radiated Disturbance, 18 to 26 GHz	±5.30 dB
Radiated Disturbance, 26 to 40 GHz	±3.23 dB
Radiated Disturbance, 40 GHz above	±3.50dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The CK Series products are 24 GHz Ground and Over Water Based Surveillance Radar.

The model CK20 is tested and represents models CK20B-CE, CK10B-CE,CK2B-CE and CK5B-CE which are electrically equivalent using the same PCB and circuitry. Models differentiated by the distance and angle and is activated by software settings and a reduction of power.

CK20 – 250m x 175m Coverage Area (9 acres)

Related Models not tested :
CK20B-CE – 250m x 175m Coverage Area (9 acres)
CK10B-CE – 150m x 150m Coverage Area (4 acres)
CK5B-CE - 100m x 125m Coverage Area (2.5 acres)
CK2B-CE – 125m x 40m Coverage Area (1 acre)

5.2. FUNDAMENTAL FIELD STRENGTH AND OUTPUT POWER

The transmitter has a maximum field strength of 86.05 dBuV/m at 3 m distance and a maximum radiated output power of -9.11 dBm/MHz EIRP.

Frequency Range (GHz)	Mode	Field Strength (dBuV/m at 3 m)	Output Power (dBm/MHz EIRP)
24.005-24.08	K1	85.84	-9.32
24.085-24.16	K2	85.80	-9.46
24.165 – 24.24	K3	86.05	-9.11

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Integral PCB patch antenna with an antenna gain of 12 dBi.

5.4. MODULATION

The CK Series porducts uses a Frequency Modulated Continuous Wave (FMCW).

5.5. SOFTWARE AND FIRMWARE

Software version : Spotter_v4.3.x

5.6. WORST-CASE CONFIGURATION

The EUT was placed in a test mode for Radiated Emissions testing. Both Horizontal and Vertical polarization was used to find the worst case emissions detected.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model #**	**Serial # if applicable**
Laptop	Toshiba	Portege R835-P88	2C165037H
AC to DC Adapter Laptop	Toshiba	PA3822U-1ACA	G71C000AR410
24VDC Power Supply	Phoenix Contact	TRIO-PS/1AC/24DC/5	3016100782
POE Single port	L-Com	BTD-CAT5-P1	--

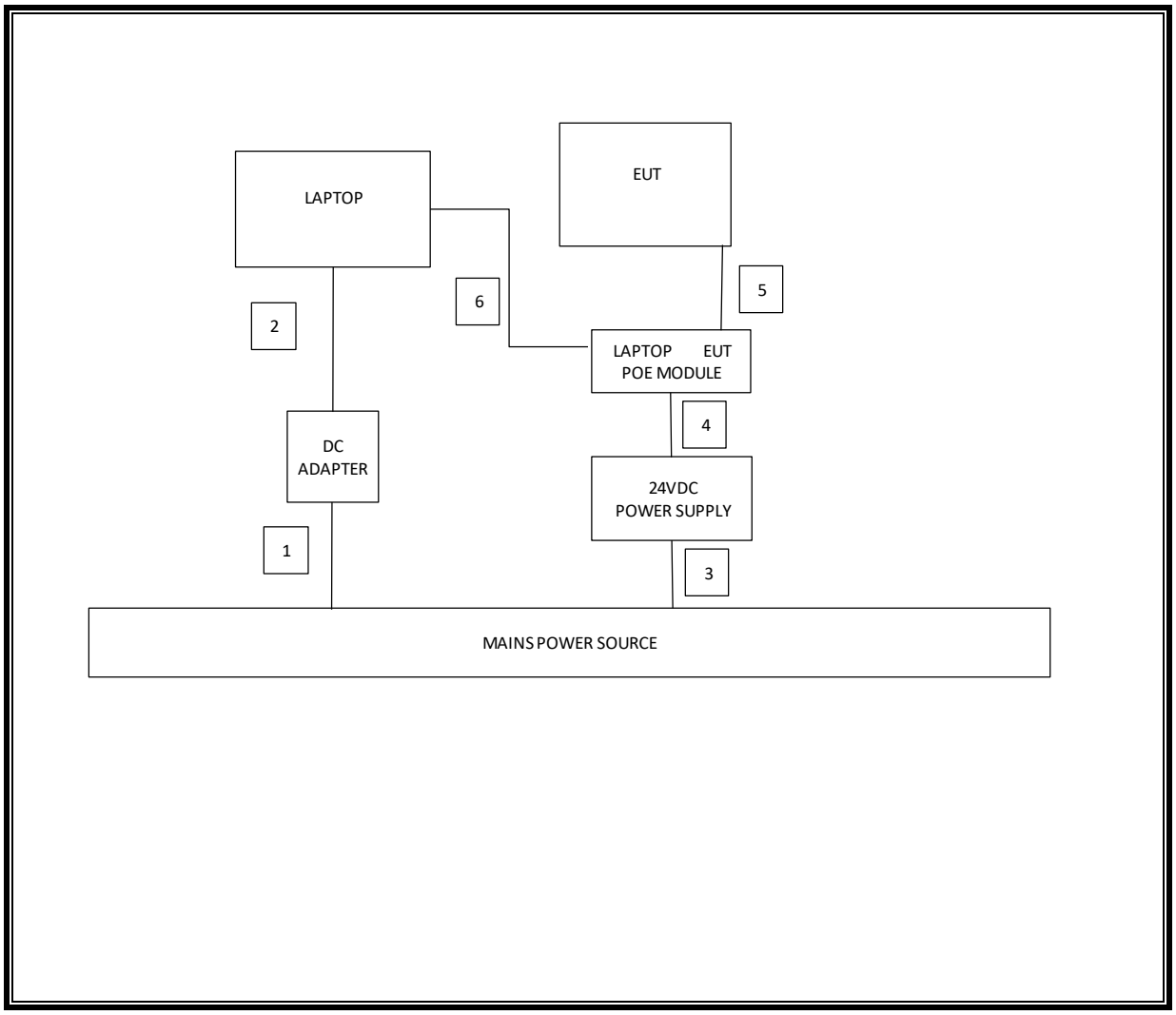
I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	1	2-Prong	Unshielded	1.6	--
2	DC	1	barrel	Shielded	1.8	--
3	AC	1	3-Prong	Unshielded	0.6	--
4	DC	1	Barrel	Unshielded	0.6	--
5	Ethernet	1	RJ45	Unshielded	1.5	--
6	Ethernet	1	RJ45	Unshielded	8.0	--

TEST SETUP

The EUT was placed in a test mode which transmits the 24 GHz sensor signal continuously.

SETUP DIAGRAM FOR TESTS



5.8. 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**	**S/N or Local ID**	**Cal Due**
PXA Signal Analyzer	Agilent	N9030A	T313	1/25/2020
PSG Analog Signal Generator, 250KHz to 50GHz	Keysight	E8257D	PRE0160761	8/13/2019
0.010-33 GHZ Diode Det.	Agilent	8474C	T109	CNR
Digital Signal Analyzer, 8 GHz	Agilent	DSA90804A	PRE0079430	8/10/2019
Low Pass Filter, 10 MHz	Solar Electric Co.	6623-10	T417	9/25/2018
Voltage Amplifier, 200 MHz	FEMTO	HVA-200M-40-B	PRE0184145	CNR
18-26 GHz Horn	ARA		T39	CNR
Horn antenna, 33-50 GHz	CMI	HO22R	--	CNR
LNA, 40-50 GHz	Spacek Labs	SL4510-33-4W	14J05	9/24/2019
Filter Low Pass	Spacek Labs	LPF5-50-8-22	T1099	CNR
50-75 GHz Horn	C M i	HO15R	H15-1	9/20/2019
LNA, 50-75 GHz	Vivatech	VTLNA-15-6018-FB	2013051	CNR
50-75 GHz Downconverter	OML	C15H1DC01	PRE0180075	CNR
75-110 GHz Horn	C M i	HO10R	H10-1	9/20/2019
LNA, 75-110 GHz	Spacek	SLW-22-5	15J04	CNR
75-110 GHz Downconverter	OML	C10H1DC01	PRE0180076	CNR
ESW EMI Test Receiver 44 GHz	Rohde & Schwartz	ESW44	PRE0179376	2/14/2020
Hybrid Antenna, 30MHz to 3GHz	SunAR	JB3	PRE0184971	11/13/2019
Amplifier, 9kHz to 1GHz, 32dB	Sonoma Instruments	310	PRE0180175	7/09/2019*
Antenna, Horn 1-18GHz	A.H. SYSTEMS, INC.	SAS-571	PRE0190810	7/10/2019*
1-18 GHz Amplifier	MITEQ	AFS42-00101800-25-S-42	PRE0181078	8/01/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	PRE0078297	1/23/2020
Amplifier, 9KHz to 1GHz, 32dB	Sonoma Instruments	310	PRE0180174	6/01/2020
Antenna, Broadband Hybrid, 30MHz to 3GHz	SunAR rf motion	JB3	PRE0181575	8/01/2020
30Hz-1MHz Loop Ant.	Electro-Metrics	EM-6871	PRE0179465	5/31/2020
100KHz-30MHz Loop Ant	Electro-Metrics	EM-6872	PRE0179467	5/31/2020
ESW EMI Test Receiver 44 GHz	Rohde & Schwarz	ESW44	PRE0179375	2/08/2020
Amplifier 1-18GHz	AMPLICAL	AMP0.1G18-47-20	PRE0181909	3/11/2020
RF switch filter & amp box 1-40GHz	UL	--	PRE0190418	3/11/2020
Horn 1-12 GHz	Narda ATM	PNR 1-12-440EM-NF	PRE0181261	7/23/2019
Horn 6.5-18 GHz	Narda ATM	PNR 650-442EM-NF	PRE0181533	7/27/2019
ESW EMI Test Receiver 44 GHz	Rohde & Schwartz	ESW44	PRE0179376	2/14/2020
HF Switch Box & Preamps 18-40 GHz	UL	---	PRE0183142	7/3/2019
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	PRE0182188	8/29/2019
Antenna, Horn 26.5 to 40GHz	ARA	MWH-2640/B	PRE0182201	9/04/2019
Test Receiver 10Hz-7GHz	Rohde & Schwarz	ESR	T1436	2/14/2020
10 dB Attenuator	Com-Power	LIT-930	531588	1/24/2020
LISN	Fischer Custom Comm.	FCC-LISN-50/250-25-2-01	T1310	1/24/2020
LISN	Fischer Custom Comm.	FCC-LISN-50/250-25-2-01	114	1/24/2020
Digital Multimeter	Fluke	87V	PRE0073921	1/23/2020
UL EMC Radiated Software	Version	Rev. 9.5.11 9.5.30 9.5.22		

*used before calibarion due date.

All horn antennas at and above the 33-50 GHz band are standard gain horns. In accordance with ANSI C63.10 clause 4.4.3 (a) Standard gain horns need not be periodically recalibrated, unless damage or deterioration is suspected or known to have occurred. If a standard gain horn is not periodically recalibrated, then its critical dimensions (see IEEE Std 1309-2005) shall be verified and documented on an annual basis.

UL measures the critical dimensions on an annual basis and checks for damage and deterioration before each test.

6. DUTY CYCLE

LIMIT

None, for reporting purposes only.

TEST PROCEDURE

The fundamental is measured using a Standard Gain Horn Antenna, feeding a Diode Detector connected to an Oscilloscope. Pulse widths, burst lengths, and periods are measured, then the duty cycle is calculated.

The total Duty Cycle is calculated as the duty cycle across bursts multiplied by the duty cycle within each burst.

The duty cycle factor is calculated as:

Duty Cycle Factor (dB) = 10 * Log (1 / x)
Where X = Duty Cycle (linear)

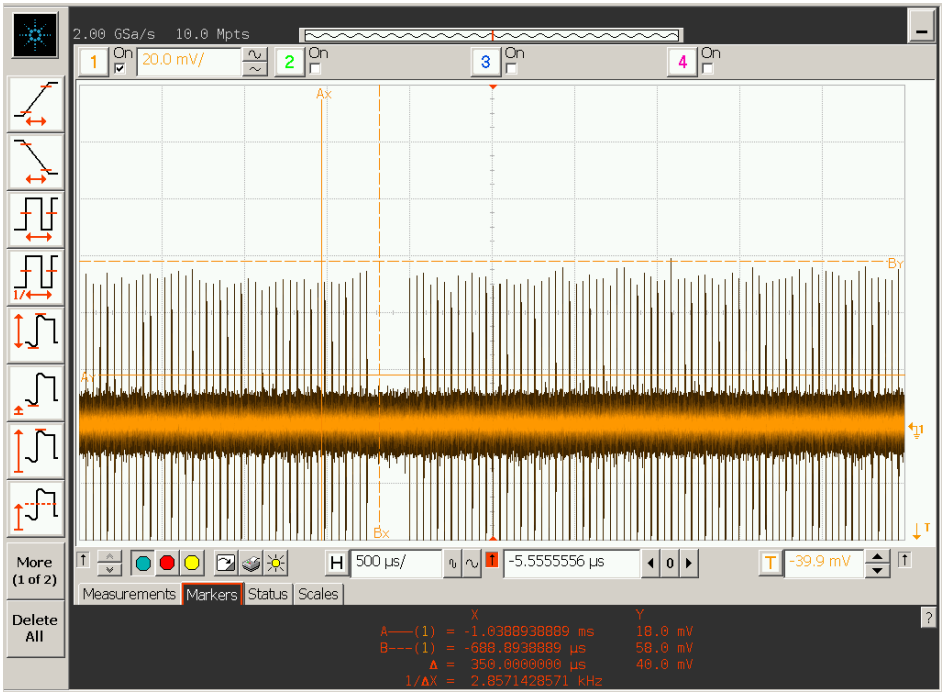
RESULTS

The signal is continuously present in all modes therefore the duty cycle is 100%.
Information on the chirp is given for informational purposes.

CHIRP TIME

MODE	Period (ms)	Chirp Up Time (us)	Chirp Down Time (us)
K1	1	650	350
K2	1	350	650
K3	1	350	650

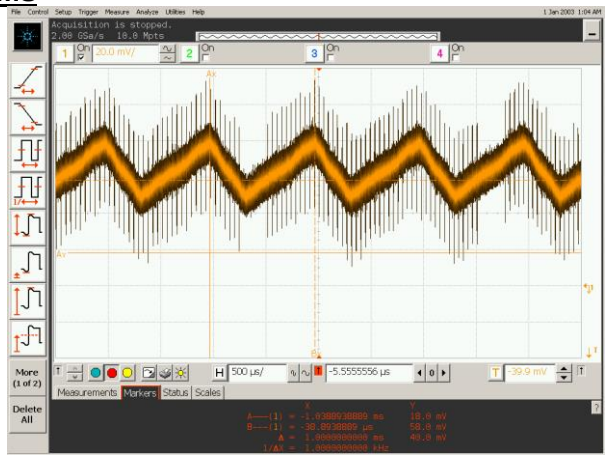
Noise Floor



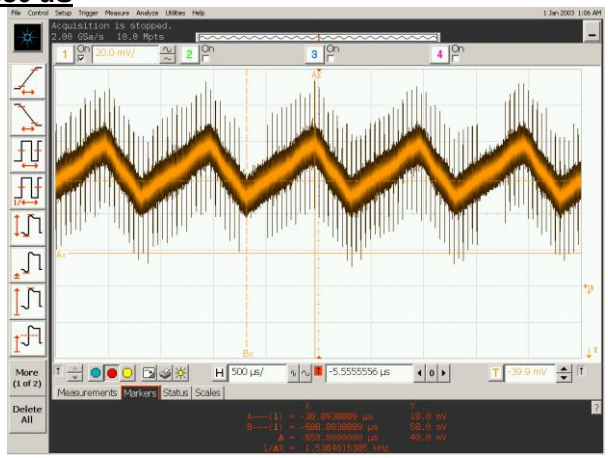
Tested By: 31016

MODE K1– CHIRP TIME

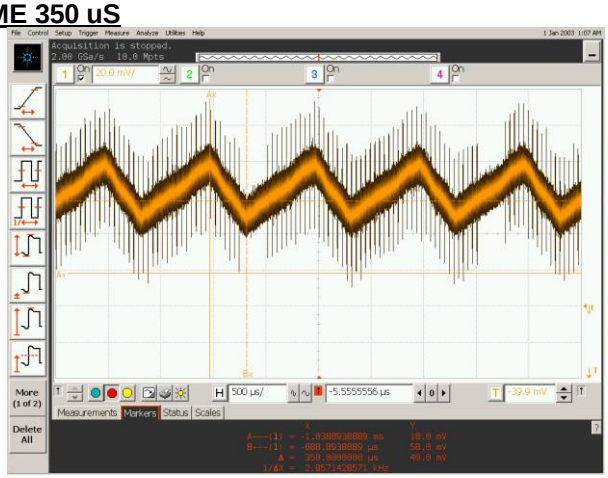
PERIOD 1mS



UP TIME 650 uS



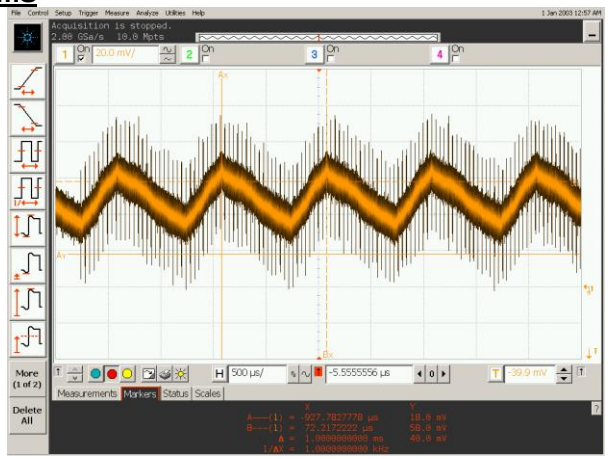
DOWN TIME 350 uS



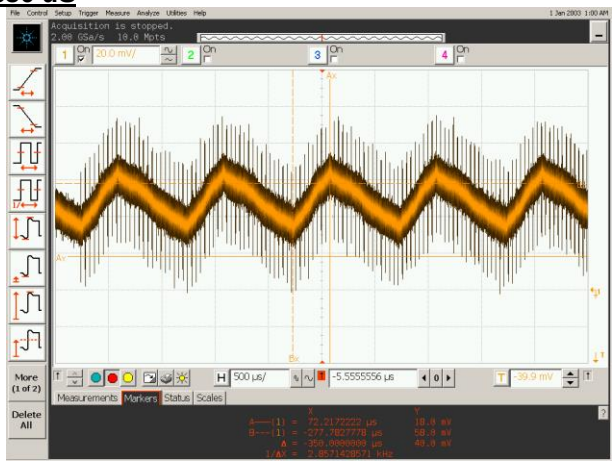
Tested By: 31016

MODE K2– CHIRP TIME

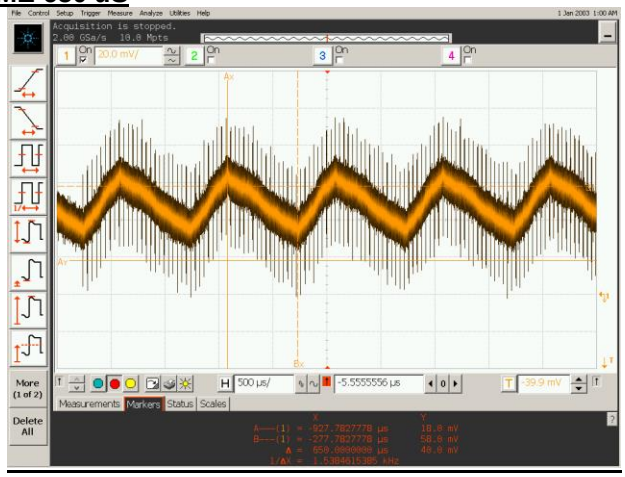
PERIOD 1mS



UP TIME 350 uS



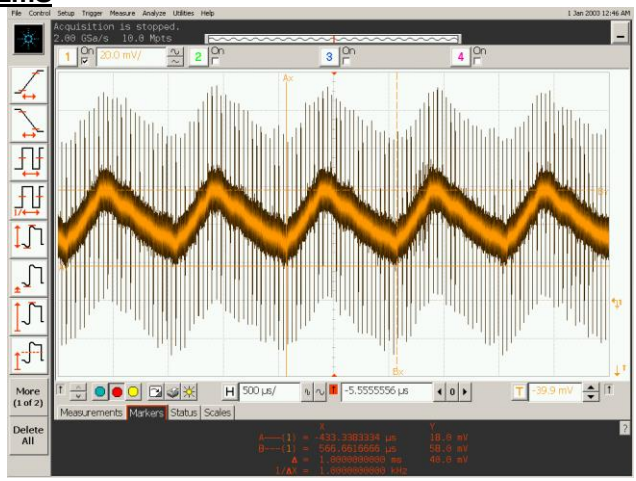
DOWN TIME 650 uS



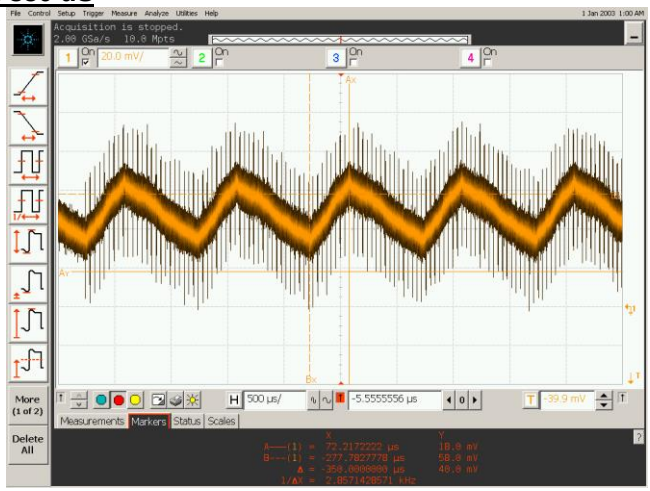
Tested By: 31016

MODE K3 – CHIRP TIME

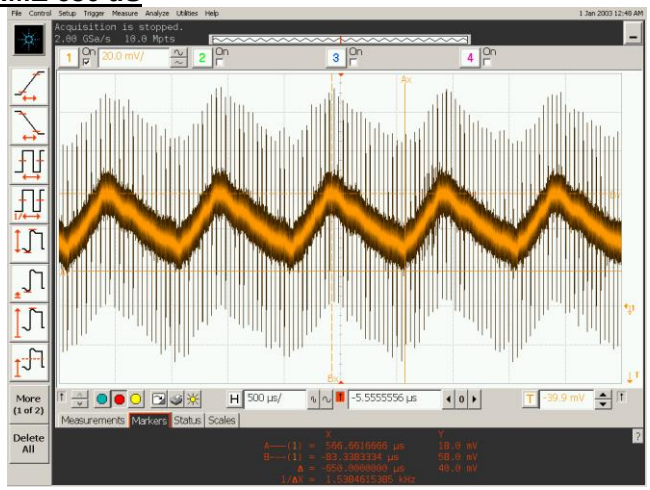
PERIOD 1mS



UP TIME 350 uS



DOWN TIME 650 uS



Tested By: 31016

7. BANDWIDTH

LIMIT

99% Bandwidth Limit - None, for reporting purposes only.

20 dB Bandwidth Limit

§15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

TEST PROCEDURE

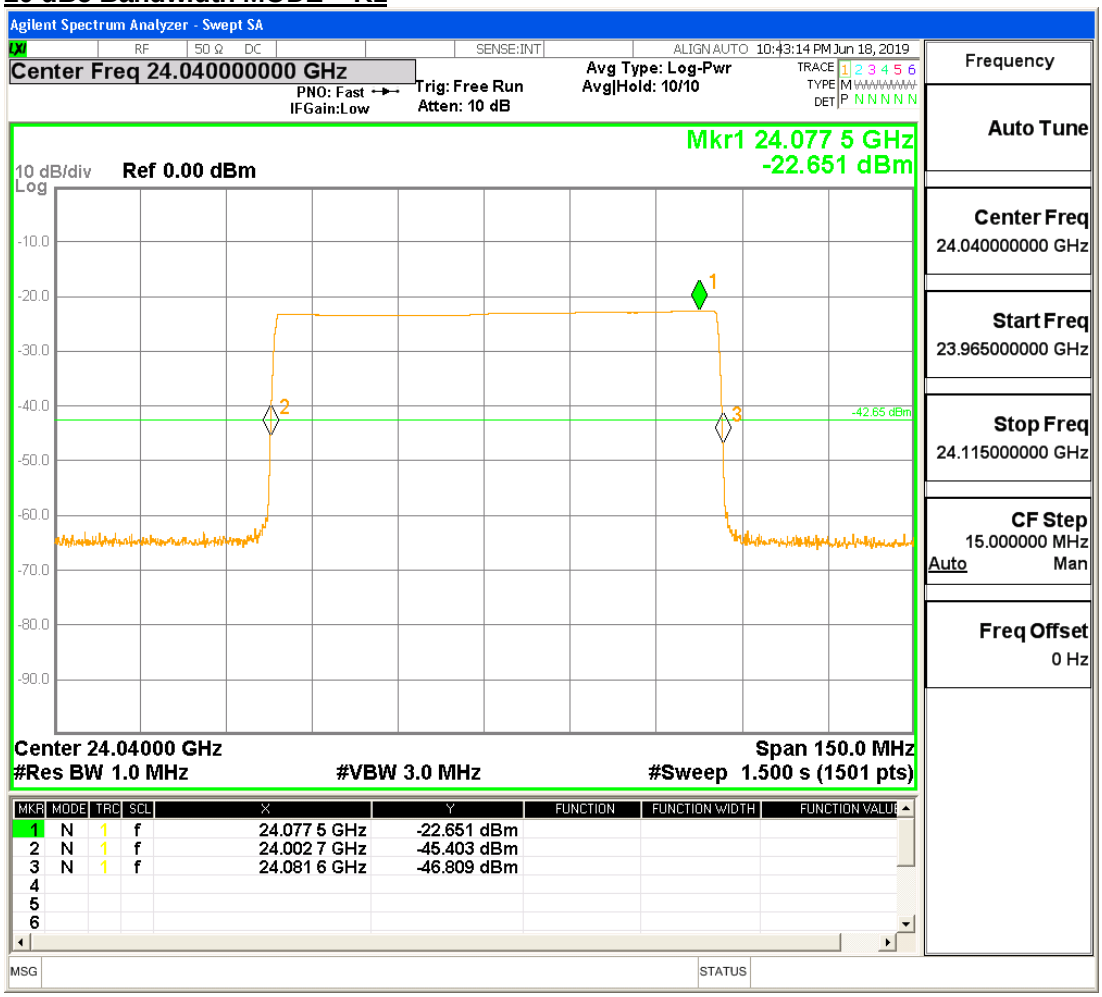
ANSI C63.10:2013

RESULTS

MODE	99% Bandwidth (MHz)
K1	76.626
K2	76.539
K3	76.671

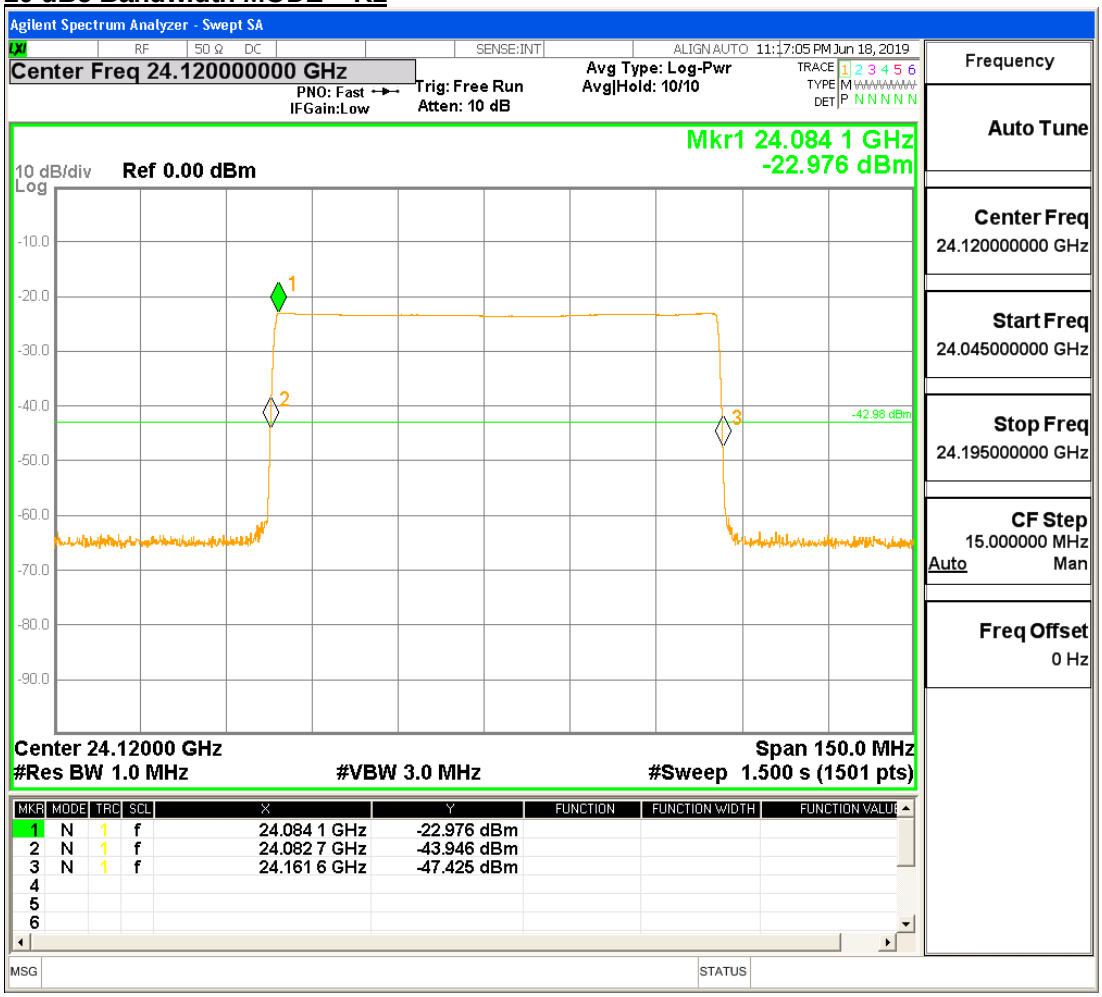
MODE	20 dB Bandwidth (MHz)	Meas FL (GHz)	FL Limit (GHz)	FL (Pass/Fail)	Meas FH (GHz)	FH Limit (GHz)	FH (Pass/Fail)
K1	78.9	24.0027	≥24.00	Pass	24.0816	≤24.25	Pass
K2	78.9	24.0827	≥24.00	Pass	24.1616	≤24.25	Pass
K3	79	24.1626	≥24.00	Pass	24.2416	≤24.25	Pass

20 dBc Bandwidth MODE = K1



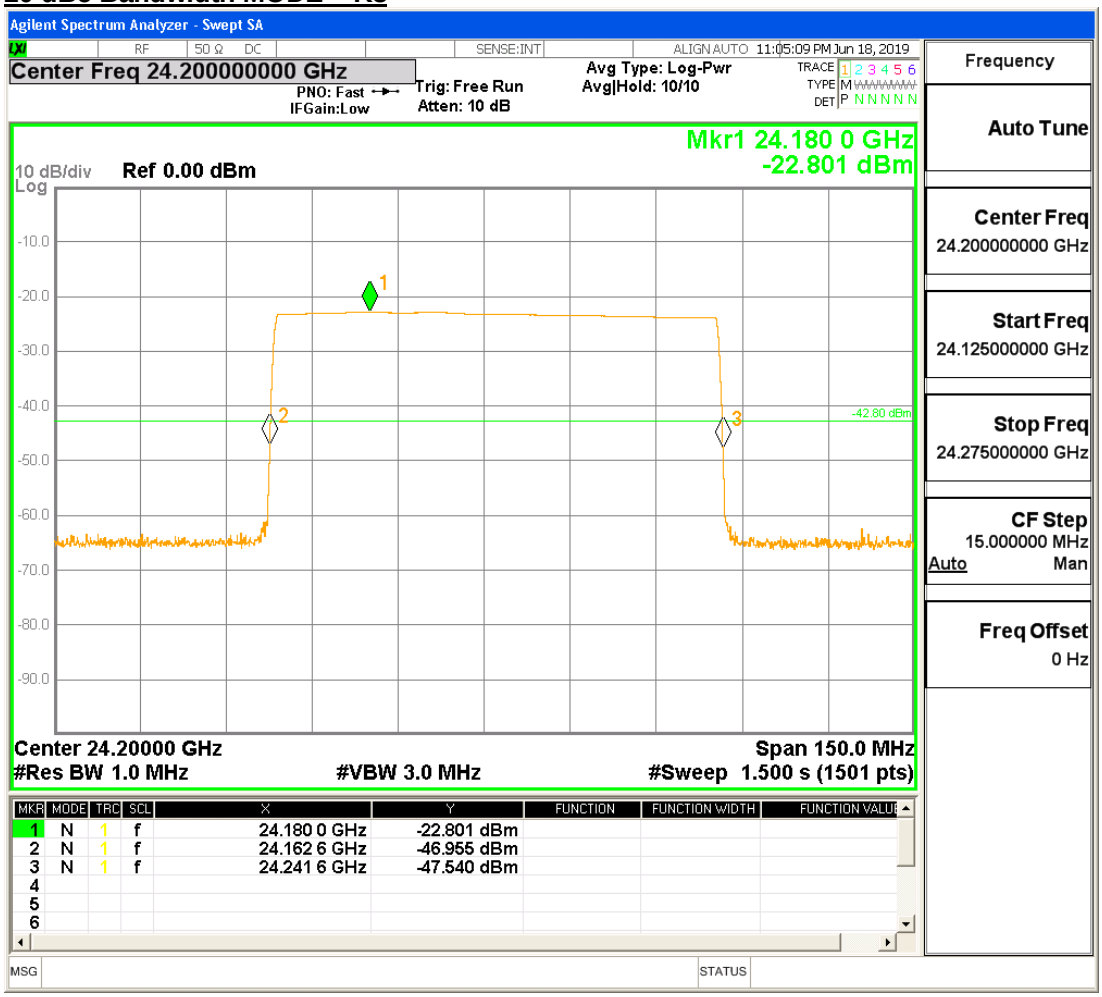
Tested By: 31016

20 dBc Bandwidth MODE = K2



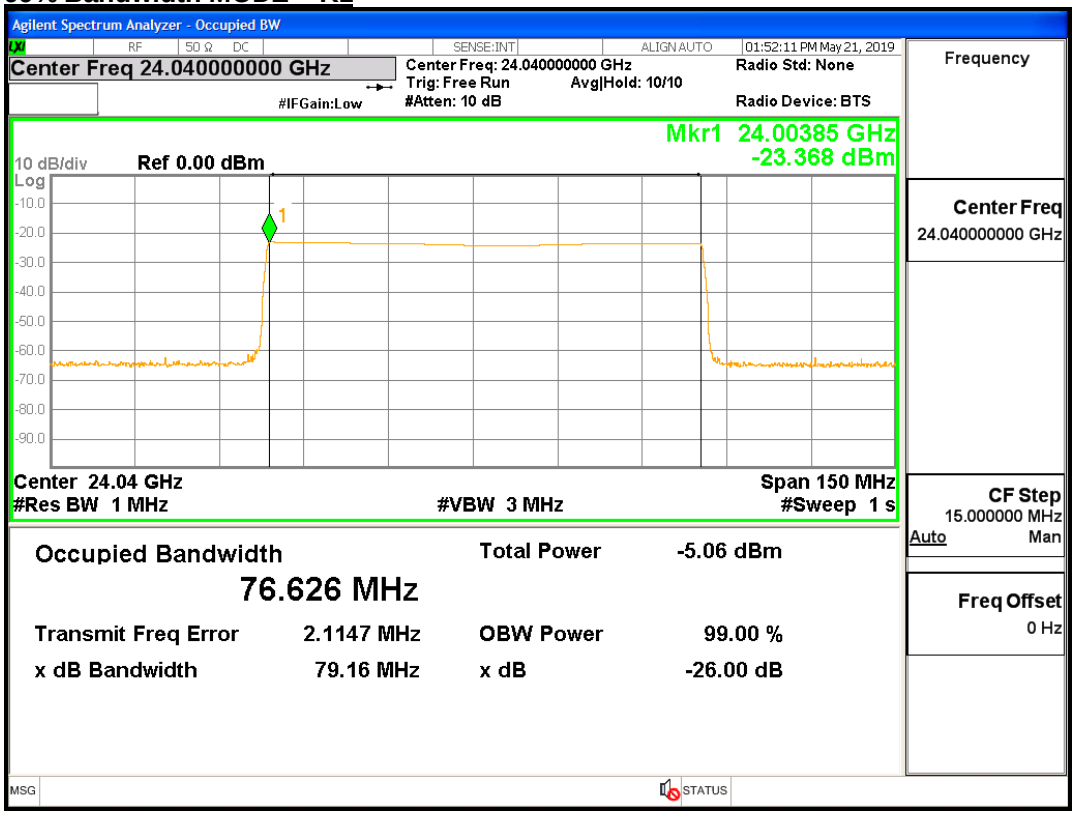
Tested By: 31016

20 dBc Bandwidth MODE = K3



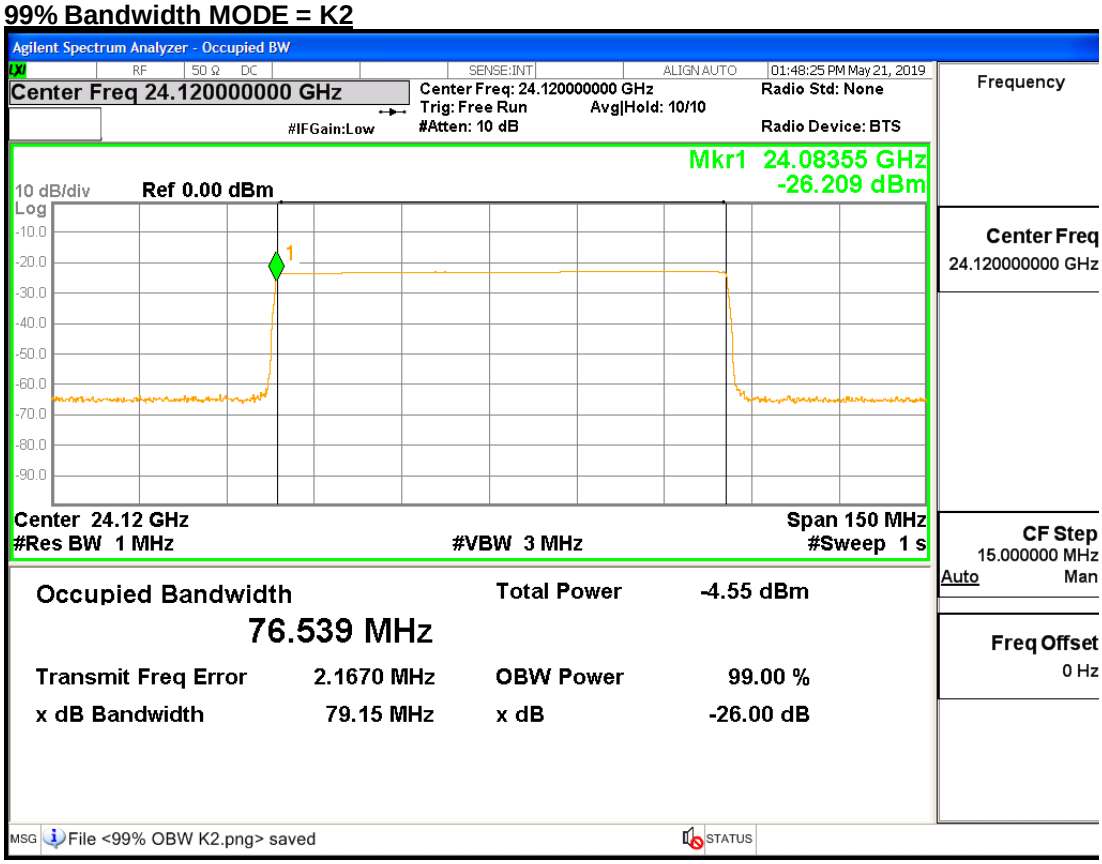
Tested By: 31016

99% Bandwidth MODE = K1



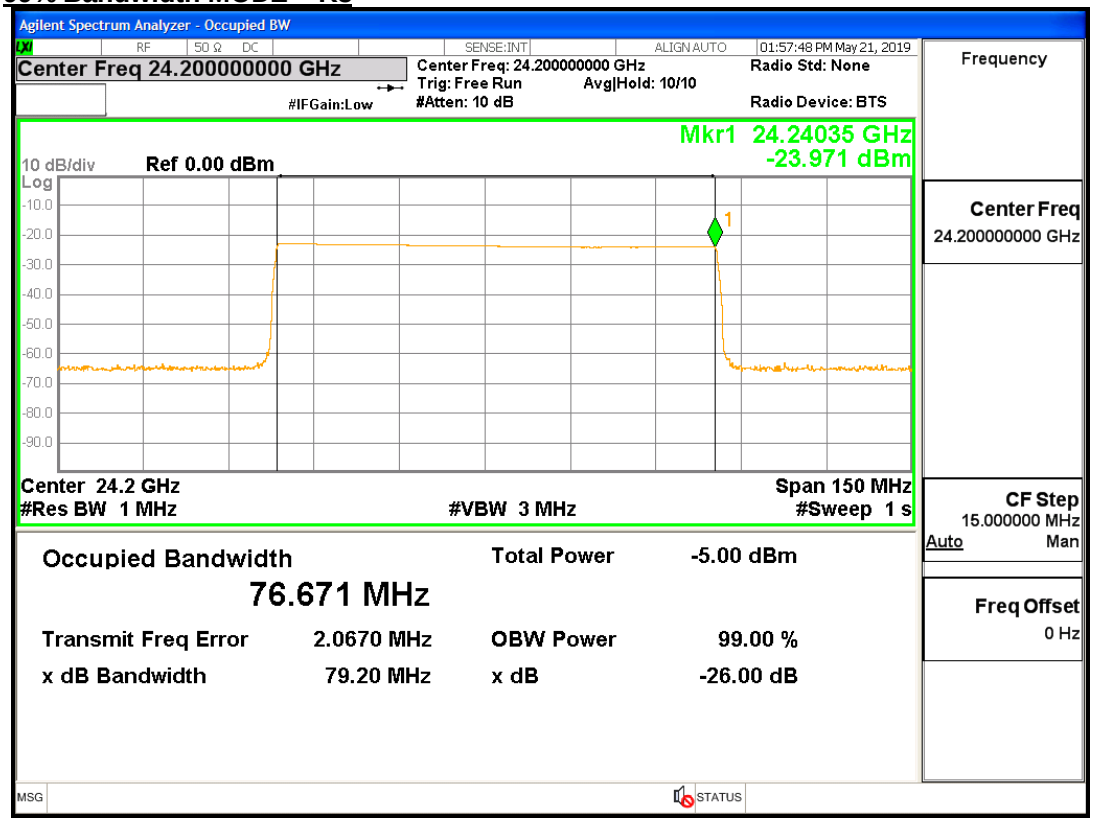
Tested By: 02970

99% Bandwidth MODE = K2



Tested By: 02970

99% Bandwidth MODE = K3



Tested By: 02970

8. FIELD SRENGTH OF FUNDAMENTAL

LIMITS

§15.249 (a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)
24.0-24.25 GHz	250 (108 dBuV/m)

Peak Limit = 128 dBuV/m
Average Limit = 108 dBuV/m

TEST PROCEDURE

ANSI C63.10:2013

FMCW DESENSITIZATION FACTORS

The measured bandwidth of the used to calculate the FMCW desensitization factor which is added to the measured values of peak detection measurements. The shortest ramp time is used to calculate the Desensitization Factor, to yield the worst-case desensitization.

Keysight Technologies Application Note 5952-1039 “Spectrum and Signal Analysis Pulsed RF” provides the derivation of the FMCW Desensitization Factor for Gaussian-shaped Resolution Bandwidth Filters in Appendix B “IF Amplifier Response and Distortion”.

Equation B-10 is excerpted:

$$\alpha = \frac{1}{\sqrt[4]{1+\left(\frac{2\ln(2)}{\pi}\right)^2\left(\frac{F_s}{T_s B^2}\right)^2}} \qquad \text{(B-10)}$$

Where

α is the reduction in amplitude
F_s= Sweep Width
T_s = Sweep Time
B= 3 dB IF Bandwidth = RBW

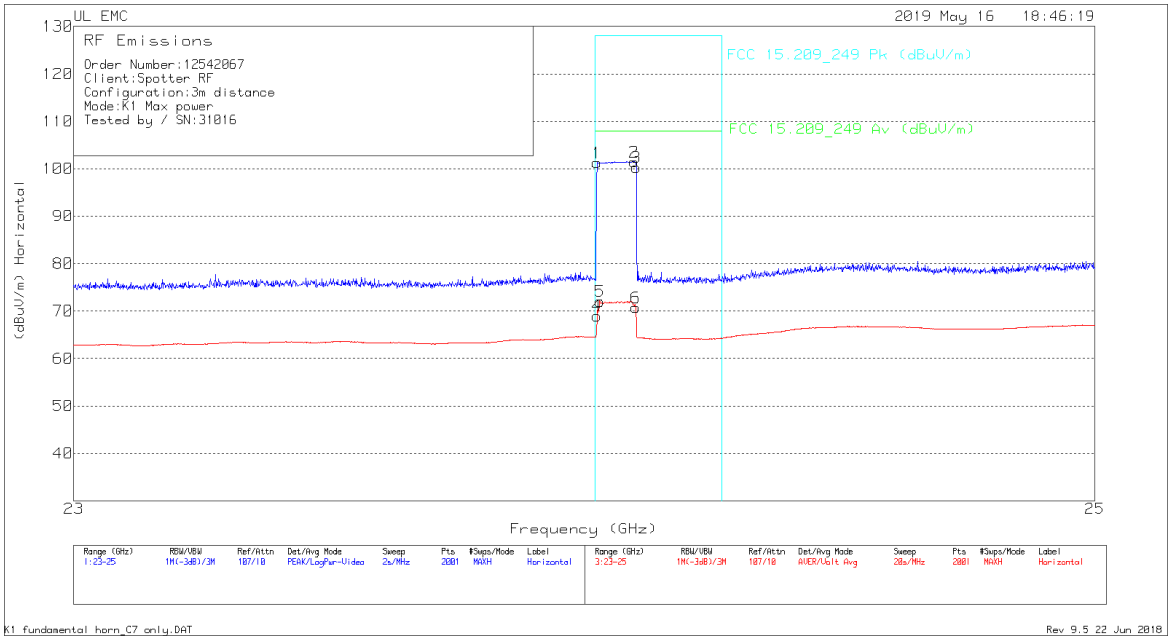
Fundamental

Mode	Start Freq	Stop Freq	Cntr Freq	FMCW Width	Ramp Time*	Sweep Rate	Sweep Rate	RBW	RBW	Normalized Sweep Rate	Amplitude Loss	Amplitude Loss
	(GHz)	(GHz)	(GHz)	(MHz)	(ms)	(MHz/ms)	(Hz/s)	(MHz)	(Hz)	(lin)	(lin)	(dB)
K1	24.003	24.08	24.0415	77	0.35	220.00	2.20E+11	1.00	1.00E+06	0.22	0.9977	-0.020
K2	24.083	24.16	24.1215	77	0.35	220.00	2.20E+11	1.00	1.00E+06	0.22	0.9977	-0.020
K3	24.164	24.24	24.202	76	0.35	217.14	2.17E+11	1.00	1.00E+06	0.22	0.9977	-0.020

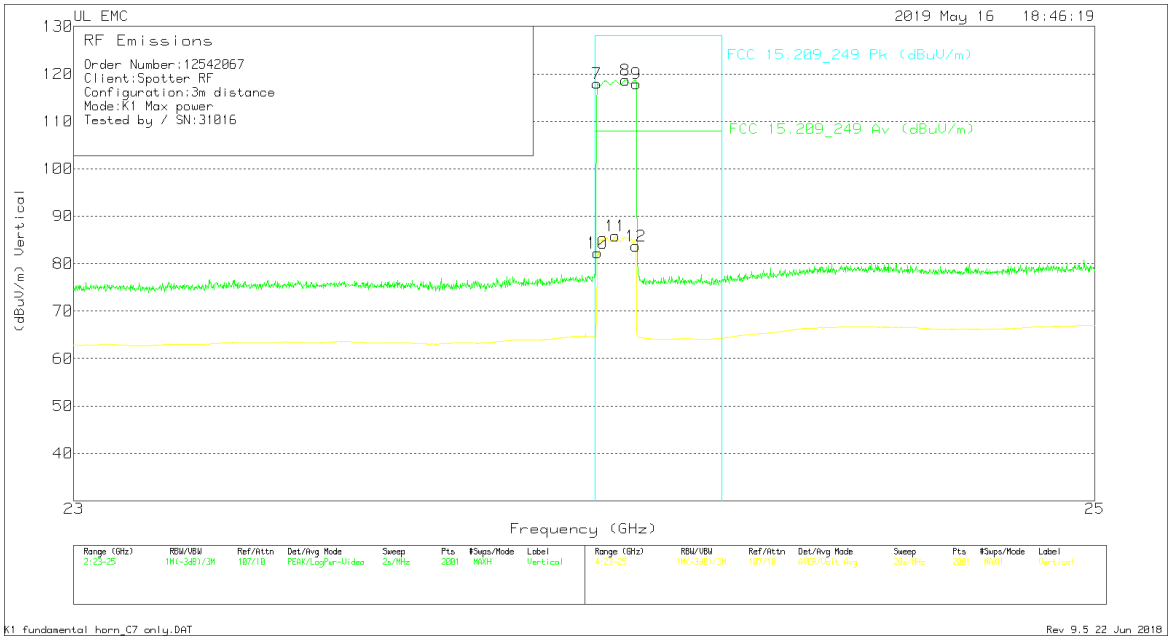
RESULTS

MODE = K1

HORIZONTAL



VERTICAL



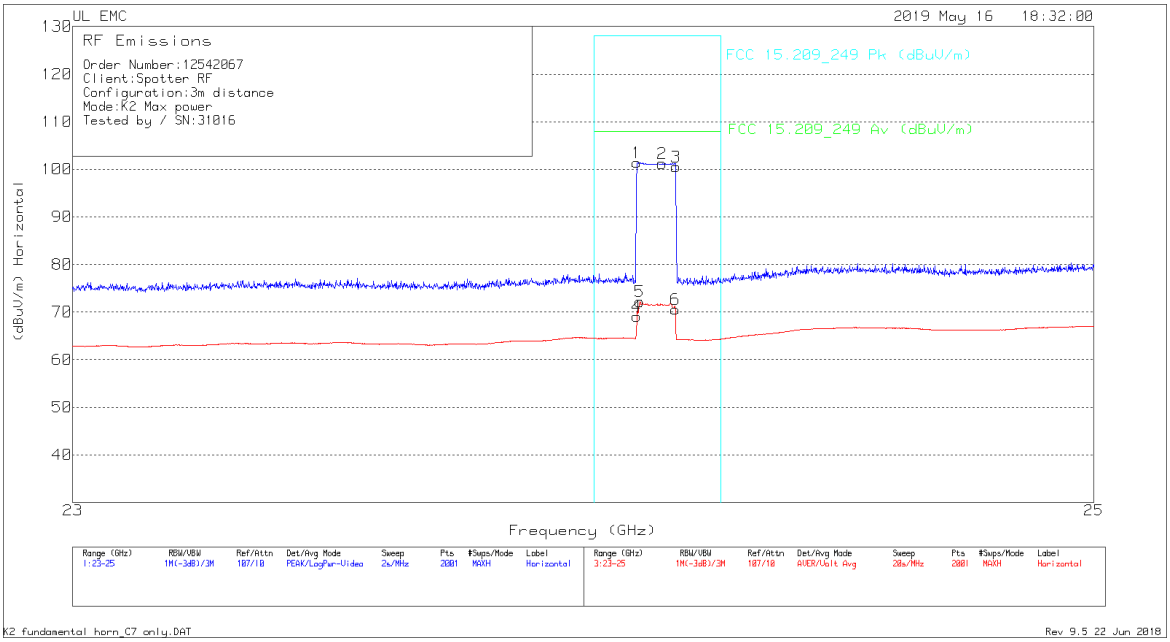
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	18-40 C7 Cable Factors	FMCW Factor	Corrected Reading (dBuV/m)	FCC 15.249 Av (dBuV/m)	Avg Margin (dB)	FCC 15.249 Pk (dBuV/m)	PK Margin (dB)	Polarity
4	24.004	31.29	Av	34.4	3.3	-	68.99	108	-39.01	-	-	H
5	24.01	34.47	Av	34.3	3.3	-	72.07	108	-35.93	-	-	H
6	24.08	32.87	Av	34.6	3.3	-	70.77	108	-37.23	-	-	H
10	24.005	44.59	Av	34.4	3.3	-	82.29	108	-25.71	-	-	V
11	24.04	48.04	Av	34.5	3.3	-	85.84	108	-22.16	-	-	V
12	24.08	45.79	Av	34.6	3.3	-	83.69	108	-24.31	-	-	V
1	24.004	63.58	Pk	34.4	3.3	0.02	101.3	-	-	128	-26.7	H
2	24.077	63.56	Pk	34.6	3.3	0.02	101.48	-	-	128	-26.52	H
3	24.081	62.41	Pk	34.6	3.3	0.02	100.33	-	-	128	-27.67	H
7	24.004	80.27	Pk	34.4	3.3	0.02	117.99	-	-	128	-10.01	V
8	24.06	80.78	Pk	34.6	3.3	0.02	118.7	-	-	128	-9.3	V
9	24.081	80	Pk	34.6	3.3	0.02	117.92	-	-	128	-10.08	V

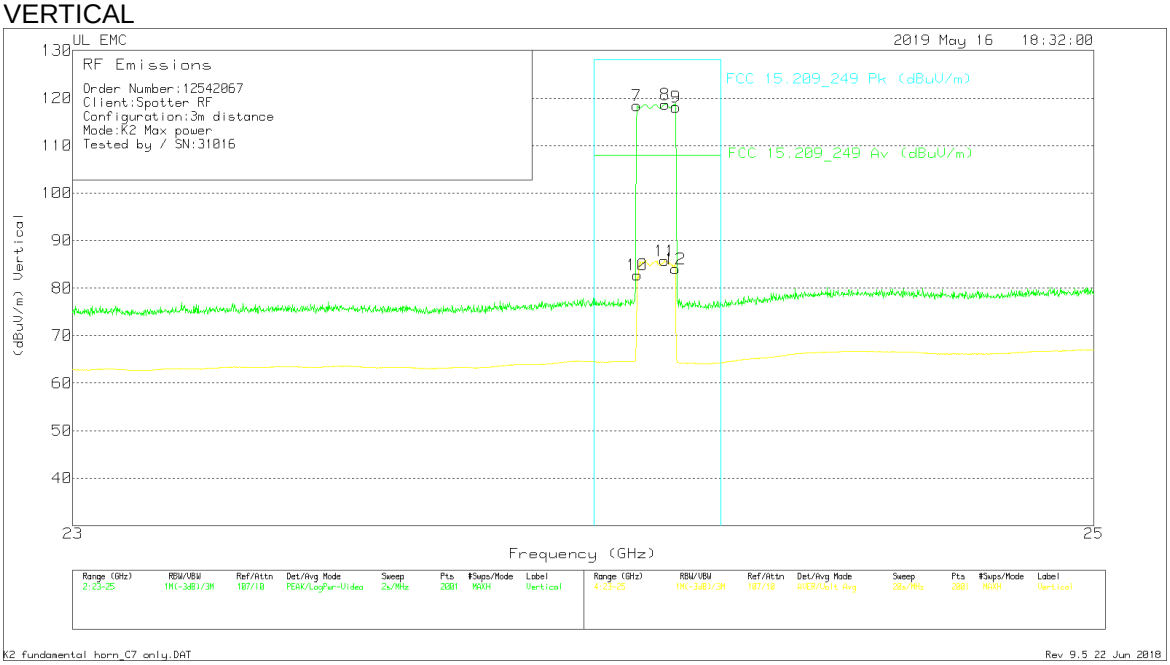
Pk - Peak detector
Av - Average detection
K1 fundamental horn_C7 only.DAT
Rev 9.5 22 Jun 2018

MODE = K2

HORIZONTAL



VERTICAL



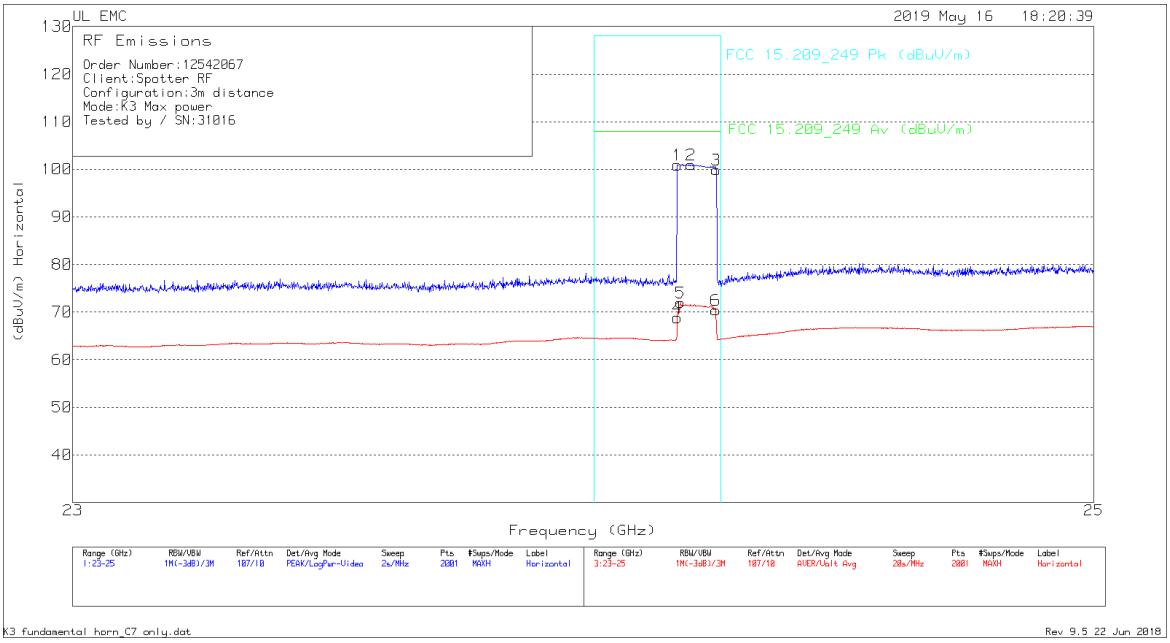
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	18-40 C7 Cable Factors	FMCW Factor	Corrected Reading (dBuV/m)	FCC 15.249 Av (dBuV/m)	Avg Margin (dB)	FCC 15.249 Pk (dBuV/m)	PK Margin (dB)	Polarity
4	24.084	31.27	Av	34.5	3.3	-	69.07	108	-38.93	-	-	H
5	24.09	34.39	Av	34.5	3.3	-	72.19	108	-35.81	-	-	H
6	24.16	32.78	Av	34.5	3.3	-	70.58	108	-37.42	-	-	H
10	24.085	44.96	Av	34.5	3.3	-	82.76	108	-25.24	-	-	V
11	24.139	48.1	Av	34.4	3.3	-	85.8	108	-22.2	-	-	V
12	24.16	46.26	Av	34.5	3.3	-	84.06	108	-23.94	-	-	V
1	24.084	63.62	Pk	34.5	3.3	0.02	101.44	-	-	128	-26.56	H
2	24.134	63.48	Pk	34.4	3.3	0.02	101.20	-	-	128	-26.80	H
3	24.161	62.62	Pk	34.6	3.3	0.02	100.54	-	-	128	-27.46	H
7	24.084	80.62	Pk	34.5	3.3	0.02	118.44	-	-	128	-9.56	V
8	24.14	80.96	Pk	34.4	3.3	0.02	118.68	-	-	128	-9.32	V
9	24.161	80.21	Pk	34.6	3.3	0.02	118.13	-	-	128	-9.87	V

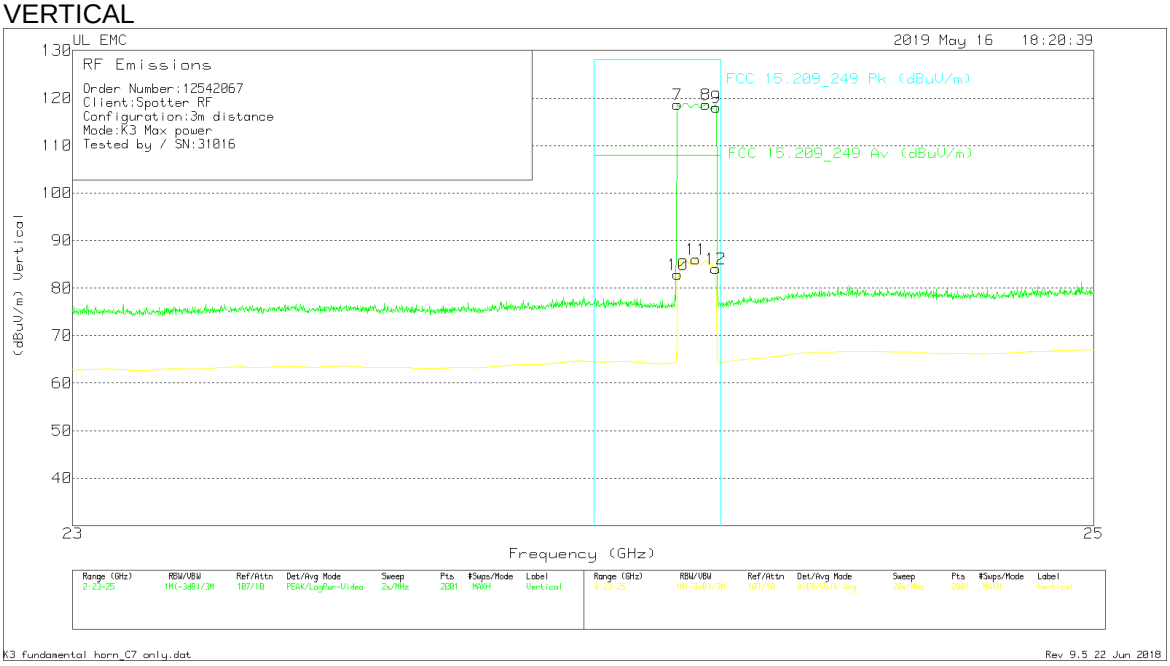
Pk - Peak detector
Av - Average detection
K2 fundamental horn_C7 only.DAT
Rev 9.5 22 Jun 2018

MODE = K3

HORIZONTAL



VERTICAL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	18-40 C7 Cable Factors	FMCW Factor	Corrected Reading (dBuV/m)	FCC 15.249 Av (dBuV/m)	Avg Margin (dB)	FCC 15.249 Pk (dBuV/m)	PK Margin (dB)	Polarity
4	24.164	30.9	Av	34.6	3.3	-	68.8	108	-39.2	-	-	H
5	24.17	34.1	Av	34.6	3.3	-	72	108	-36	-	-	H
6	24.24	32.59	Av	34.4	3.4	-	70.39	108	-37.61	-	-	H
10	24.165	44.99	Av	34.6	3.3	-	82.89	108	-25.11	-	-	V
11	24.201	48.15	Av	34.6	3.3	-	86.05	108	-21.95	-	-	V
12	24.24	46.28	Av	34.4	3.4	-	84.08	108	-23.92	-	-	V
1	24.164	62.99	Pk	34.6	3.3	0.02	100.91	-	-	128	-27.09	H
2	24.191	63.05	Pk	34.6	3.3	0.02	100.97	-	-	128	-27.03	H
3	24.241	62.06	Pk	34.4	3.4	0.02	99.88	-	-	128	-28.12	H
7	24.164	80.74	Pk	34.6	3.3	0.02	118.66	-	-	128	-9.34	V
8	24.22	80.85	Pk	34.5	3.3	0.02	118.67	-	-	128	-9.33	V
9	24.241	80.24	Pk	34.4	3.4	0.02	118.06	-	-	128	-9.94	V

Pk - Peak detector
Av - Average detection
K3 fundamental horn_C7 only.dat
Rev 9.5 22 Jun 2018

9. UNWANTED RADIATED EMISSIONS

9.1. LIMITS AND PROCEDURES

LIMITS

§15.249 (a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
24.0-24.25 GHz	250 (108 dBuV/m)	2500 (68 dBuV/m)

§15.249 (d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

The §15.209 average limit above 960 MHz is 500 uV/m at 3 meters, equivalent to 54 dBuV/m at 3 meters.

The field strength of the fundamental is 118.67 dBuV/m at 3 meters, peak.
An attenuation of 50 dB yields 68.67 dBuV/m at 3 meters.

The §15.209 peak limit above 960 MHz is 5000 uV/m at 3 meters, equivalent to 74 dBuV/m at 3 meters.

The §15.209 limits correspond to the lesser attenuation, for both peak and average emissions.

§15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

PROCEDURE

ANSI C63.10: 2013

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

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

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

FMCW DESENSITIZATION FACTORS

The measured bandwidth of each harmonic is used to calculate the FMCW desensitization factor which is added to the measured values to the peak measurements.

Mode	Start Freq	Stop Freq	Cntr Freq	FMCW Width	Ramp Time*	Sweep Rate	Sweep Rate	RBW	RBW	Normalized Sweep Rate	Amplitude Loss	Amplitude Loss
	(GHz)	(GHz)	(GHz)	(MHz)	(ms)	(MHz/ms)	(Hz/s)	(MHz)	(Hz)	(lin)	(lin)	(dB)
K1	48.007	48.16	48.0835	153	0.35	437.14	4.37E+11	1.00	1.00E+06	0.44	0.9909	-0.079
K2	48.167	48.32	48.2435	153	0.35	437.14	4.37E+11	1.00	1.00E+06	0.44	0.9909	-0.079
K3	48.3277	48.4805	48.4041	152.8	0.35	436.57	4.37E+11	1.00	1.00E+06	0.44	0.9909	-0.079

3rd Harm.

Mode	Start Freq	Stop Freq	Cntr Freq	FMCW Width	Ramp Time*	Sweep Rate	Sweep Rate	RBW	RBW	Normalized Sweep Rate	Amplitude Loss	Amplitude Loss
	(GHz)	(GHz)	(GHz)	(MHz)	(ms)	(MHz/ms)	(Hz/s)	(MHz)	(Hz)	(lin)	(lin)	(dB)
K1	72.012	72.24	72.126	228	0.35	651.43	6.51E+11	1.00	1.00E+06	0.65	0.9803	-0.173
K2	72.252	72.48	72.366	228	0.35	651.43	6.51E+11	1.00	1.00E+06	0.65	0.9803	-0.173
K3	72.491	72.72	72.6055	229	0.35	654.29	6.54E+11	1.00	1.00E+06	0.65	0.9802	-0.174

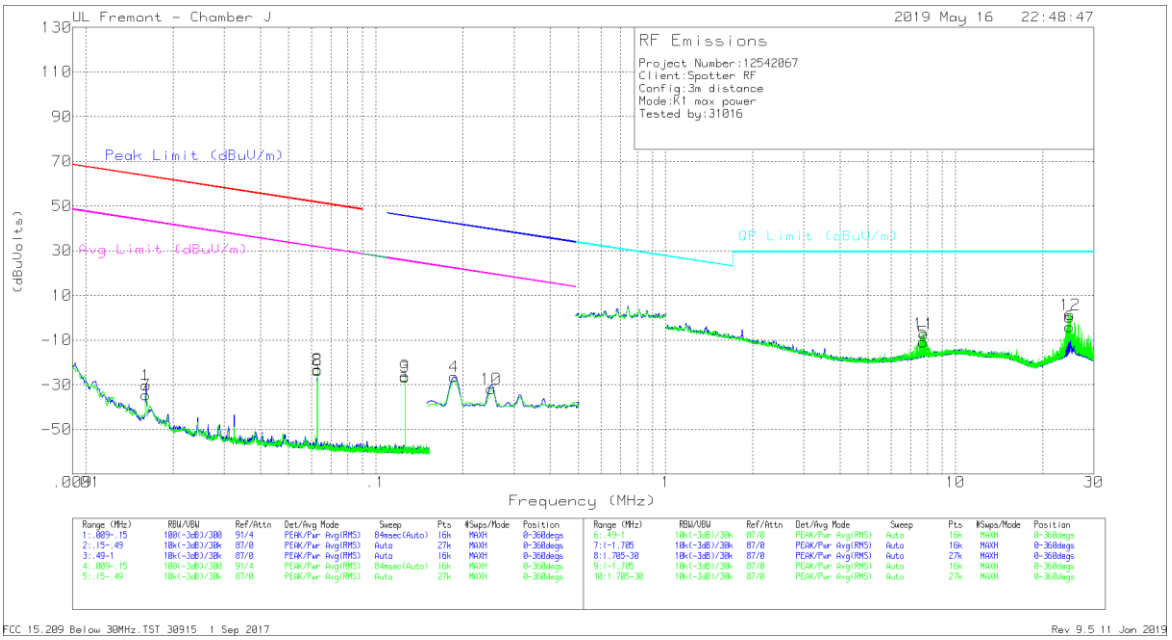
4th Harm.

Mode	Start Freq	Stop Freq	Cntr Freq	FMCW Width	Ramp Time*	Sweep Rate	Sweep Rate	RBW	RBW	Normalized Sweep Rate	Amplitude Loss	Amplitude Loss
	(GHz)	(GHz)	(GHz)	(MHz)	(ms)	(MHz/ms)	(Hz/s)	(MHz)	(Hz)	(lin)	(lin)	(dB)
K1	96.016	96.32	96.168	304	0.35	868.57	8.69E+11	1.00	1.00E+06	0.87	0.9663	-0.298
K2	96.336	96.641	96.4885	305	0.35	871.43	8.71E+11	1.00	1.00E+06	0.87	0.9661	-0.300
K3	96.655	96.96	96.8075	305	0.35	871.43	8.71E+11	1.00	1.00E+06	0.87	0.9661	-0.300

9.2. RESULTS

9.2.1. EMISSIONS 9 kHz – 30 MHz

MODE = K1



Trace Markers

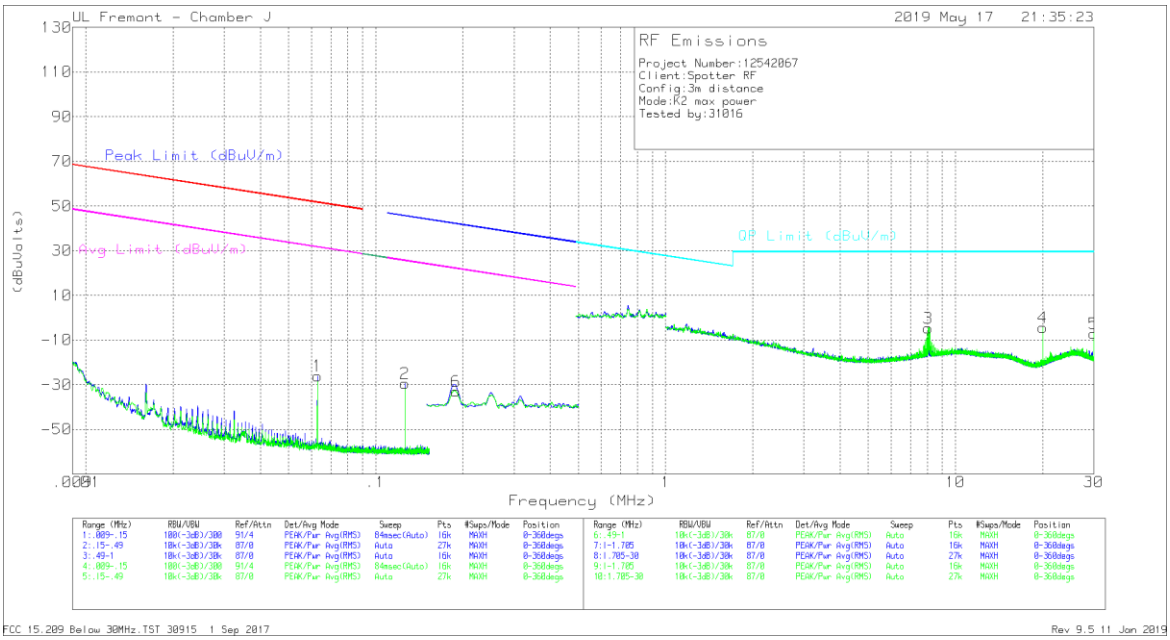
Marker	Freq. (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.01616	18.9	Pk	59.5	-28.5	-80	-30.1	63.42	-93.52	43.42	-73.52	-	-	-	-	0-360
2	.06301	29.27	Pk	56.1	-28.6	-80	-23.23	51.6	-74.83	31.6	-54.83	-	-	-	-	0-360
3	.12617	26.65	Pk	55.8	-28.6	-80	-26.15	-	-	-	-	45.61	-71.76	25.61	-51.76	0-360
4	.18686	25.78	Pk	56.2	-28.5	-80	-26.52	-	-	-	-	42.19	-68.71	22.19	-48.71	0-360
7	.01615	14.42	Pk	59.5	-28.5	-80	-34.58	63.42	-98	43.42	-78	-	-	-	-	0-360
8	.06296	28.96	Pk	56.1	-28.6	-80	-23.54	51.6	-75.14	31.6	-55.14	-	-	-	-	0-360
9	.12611	26.06	Pk	55.8	-28.6	-80	-26.74	-	-	-	-	45.61	-72.35	25.61	-52.35	0-360
10	.25013	20.5	Pk	56.3	-28.6	-80	-31.8	-	-	-	-	39.65	-71.45	19.65	-51.45	0-360

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/ Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
5	7.72995	22.37	Pk	34.9	-28.1	-40	-10.83	29.5	-40.33	0-360
6	24.71594	29.47	Pk	34.2	-27.7	-40	-4.03	29.5	-33.53	0-360
11	7.79283	26.16	Pk	34.8	-28	-40	-7.04	29.5	-36.54	0-360
12	24.89934	34.88	Pk	34.2	-27.7	-40	1.38	29.5	-28.12	0-360

Pk - Peak detector

FCC 15.209 Below 30MHz.TST 30915 1 Sep 2017
Rev 9.5 11 Jan 2019

MODE = K2



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/ Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.063	26.5	Pk	56.1	-28.6	-80	-26	51.6	-77.6	31.6	-57.6	-	-	-	-	0-360
2	.1262	23.52	Pk	55.8	-28.6	-80	-29.28	-	-	-	-	45.6	-74.88	25.6	-54.88	0-360
6	.18919	19.27	Pk	56.2	-28.5	-80	-33.03	-	-	-	-	42.08	-75.11	22.08	-55.11	0-360

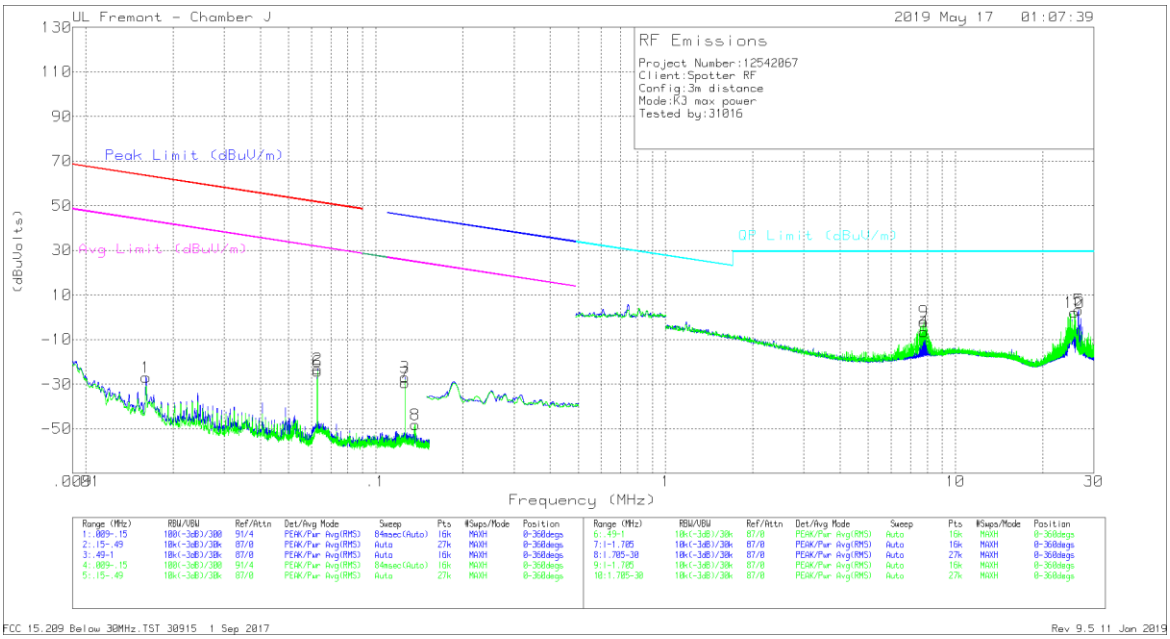
Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	8.04226	28.64	Pk	34.8	-28	-40	-4.56	29.5	-34.06	0-360
4	19.99994	29.96	Pk	33.5	-27.8	-40	-4.34	29.5	-33.84	0-360
5	29.9989	28.09	Pk	32.4	-27.6	-40	-7.11	29.5	-36.61	0-360

Pk - Peak detector

FCC 15.209 Below 30MHz.TST 30915 1 Sep 2017
Rev 9.5 11 Jan 2019

MODE = K3



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/ Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/ m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/ m)	Margin (dB)	Azimuth (Degs)
1	.01616	21.94	Pk	59.5	-28.5	-80	-27.06	63.42	-90.48	43.42	-70.48	-	-	-	-	0-360
2	.06296	29.44	Pk	56.1	-28.6	-80	-23.06	51.6	-74.66	31.6	-54.66	-	-	-	-	0-360
3	.12611	25.93	Pk	55.8	-28.6	-80	-26.87	-	-	-	-	45.61	-72.48	25.61	-52.48	0-360
6	.06296	28.15	Pk	56.1	-28.6	-80	-24.35	51.6	-75.95	31.6	-55.95	-	-	-	-	0-360
7	.12606	23.3	Pk	55.8	-28.6	-80	-29.5	-	-	-	-	45.61	-75.11	25.61	-55.11	0-360
8	.13672	4.35	Pk	55.9	-28.5	-80	-48.25	-	-	-	-	44.91	-93.16	24.91	-73.16	0-360

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/ Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
4	7.79283	26.68	Pk	34.8	-28	-40	-6.52	29.5	-36.02	0-360
5	26.60967	37.45	Pk	33.6	-27.7	-40	3.35	29.5	-26.15	0-360
9	7.79178	31.16	Pk	34.8	-28	-40	-2.04	29.5	-31.54	0-360
10	25.69372	35.93	Pk	34	-27.7	-40	2.23	29.5	-27.27	0-360

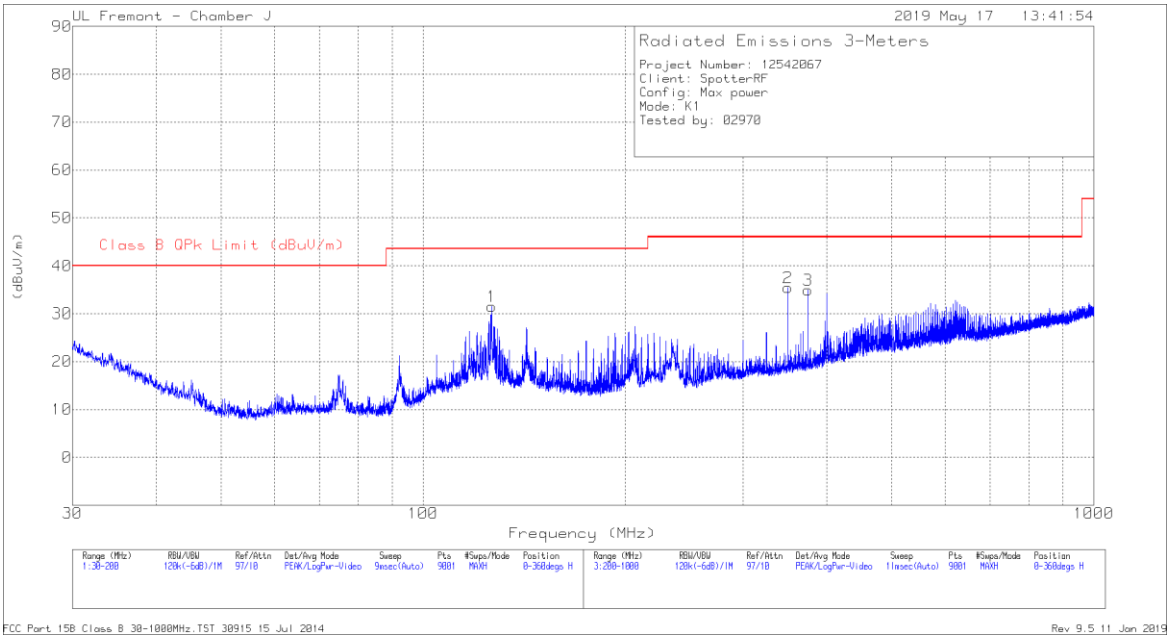
Pk - Peak detector

FCC 15.209 Below 30MHz.TST 30915 1 Sep 2017
Rev 9.5 11 Jan 2019

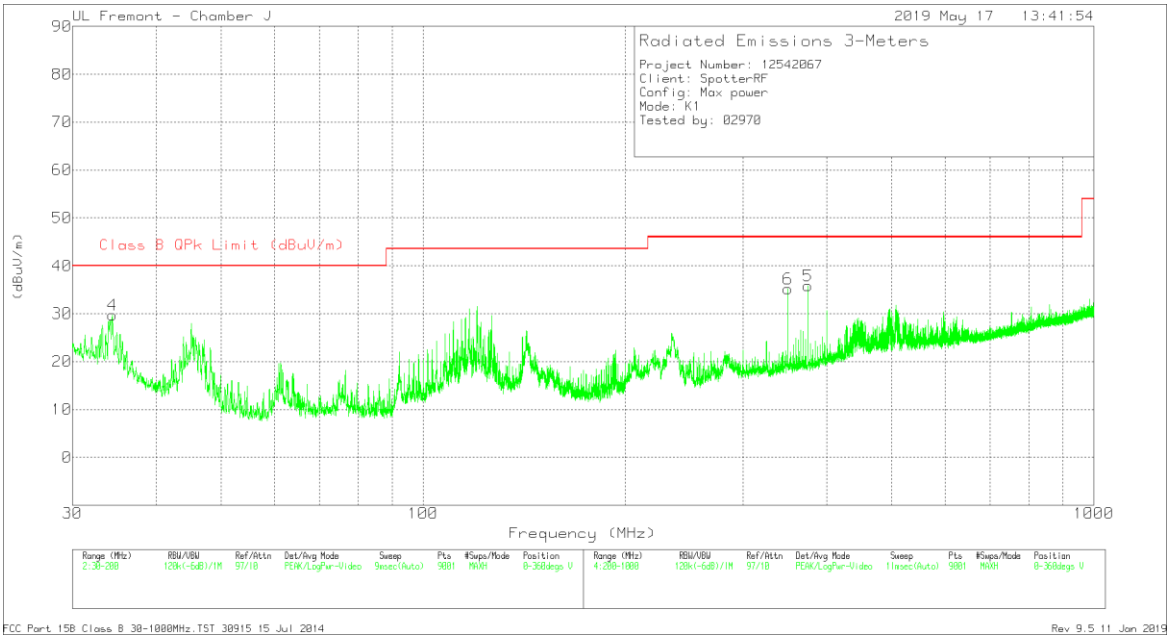
9.2.2. EMISSIONS 30MHz – 1GHz

MODE = K1

HORIZONTAL



VERTICAL



Trace Markers

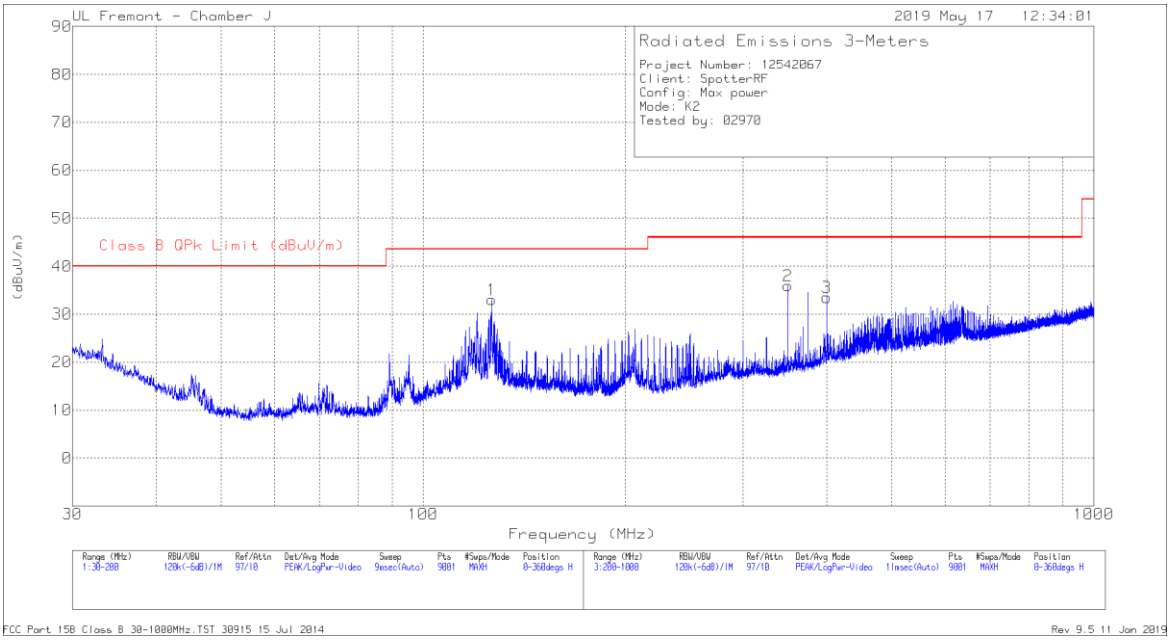
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	QP Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	126.55	44.9	Pk	19.8	-30.8	33.9	-	-	105	232	H
1	126.55	42.45	Qp	19.8	-30.8	31.45	43.52	-12.07	105	232	H
4	34.4	42.32	Pk	23.5	-31.4	34.42	-	-	314	130	V
4	34.4	34.68	Qp	23.5	-31.4	26.78	40	-13.22	314	130	V
2	350	46.58	Pk	20.1	-29.8	36.88	-	-	239	101	H
2	350	45.19	Qp	20.1	-29.8	35.49	46.02	-10.53	239	101	H
3	374.994	44.53	Pk	20.9	-29.7	35.73	-	-	265	240	H
3	374.994	43	Qp	20.9	-29.7	34.2	46.02	-11.82	265	240	H
5	350	46.63	Pk	20.1	-29.8	36.93	-	-	354	130	V
5	350	45.42	Qp	20.1	-29.8	35.72	46.02	-10.3	354	130	V
6	374.9988	45.84	Pk	20.9	-29.7	37.04	-	-	326	111	V
6	374.9988	44.44	Qp	20.9	-29.7	35.64	46.02	-10.38	326	111	V

Pk - Peak detector
Qp - Quasi-Peak detector

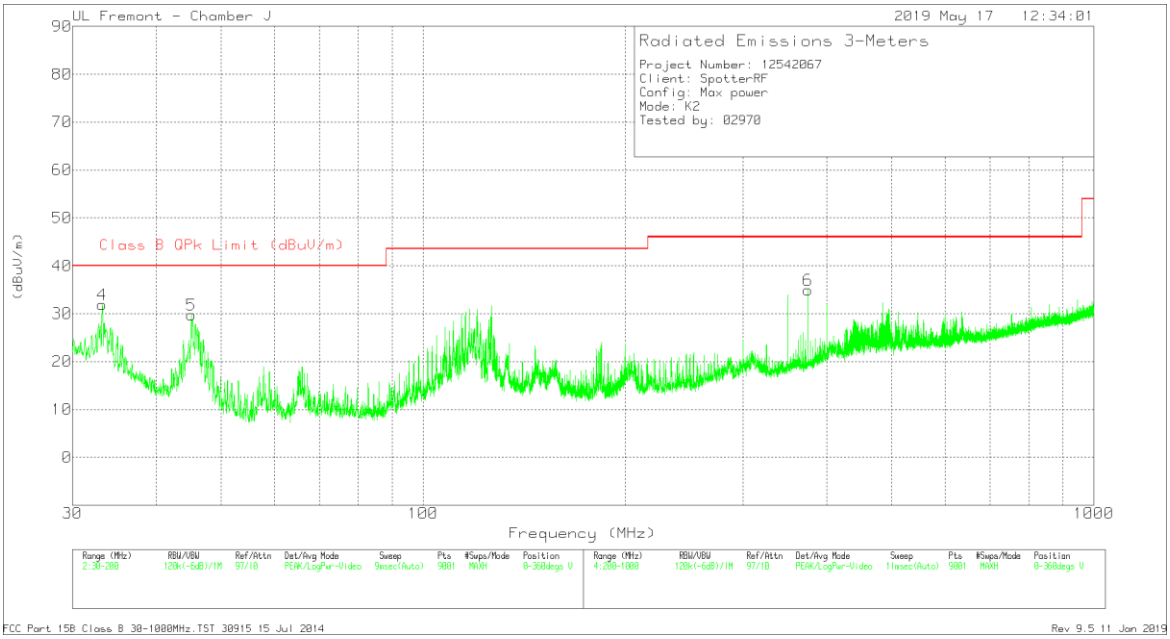
FCC Part 15B Class B 30-1000MHz.TST 30915 15 Jul 2014
Rev 9.5 11 Jan 2019

MODE = K2

HORIZONTAL



VERTICAL



Trace Markers

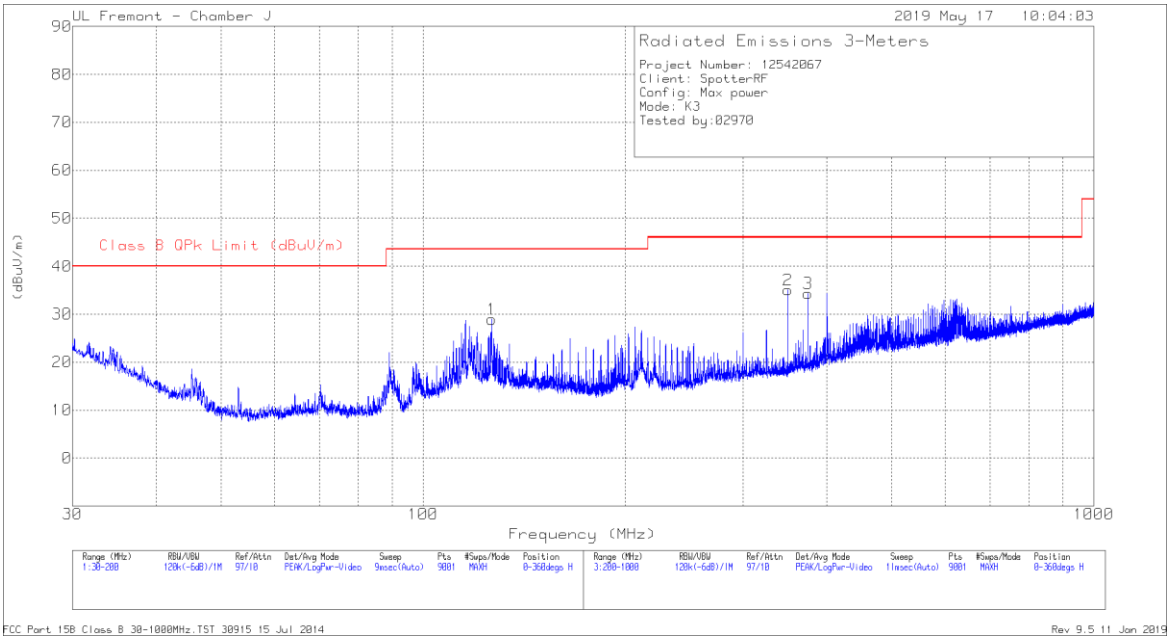
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	QP Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	126.55	45.5	Pk	19.8	-30.8	34.5	43.52	-	-	230	H
1	126.55	43.27	Qp	19.8	-30.8	32.27	43.52	-11.25	114	230	H
4	33.246	41.35	Pk	24.4	-31.5	34.25	40	-	-	103	V
4	33.246	37.25	Qp	24.4	-31.5	30.15	40	-9.85	112	103	V
5	45.12	48.48	Pk	15.9	-31.4	32.98	40	-	-	170	V
5	45.12	42.09	Qp	15.9	-31.4	26.59	40	-13.41	229	170	V
2	349.99	46.65	Pk	20.1	-29.8	36.95	46.02	-	-	101	H
2	349.99	45.39	Qp	20.1	-29.8	35.69	46.02	-10.33	236	101	H
3	400	46.15	Pk	21.5	-29.7	37.95	46.02	-	-	188	H
3	400	39.21	Qp	21.5	-29.7	31.01	46.02	-15.01	132	188	H
6	375	44.95	Pk	20.9	-29.7	36.15	46.02	-	-	114	V
6	375	43.57	Qp	20.9	-29.7	34.77	46.02	-11.25	327	114	V

Pk - Peak detector
Qp - Quasi-Peak detector

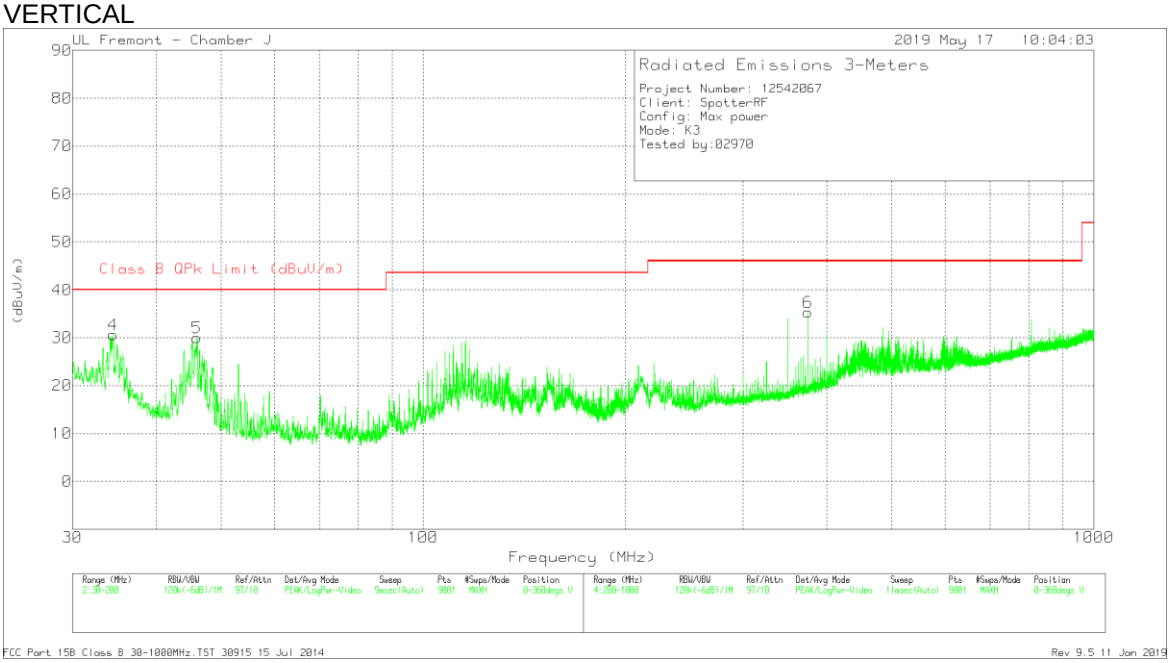
FCC Part 15B Class B 30-1000MHz.TST 30915 15 Jul 2014
Rev 9.5 11 Jan 2019

MODE = K3

HORIZONTAL



VERTICAL



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	QP Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	126.5628	41.38	Pk	19.8	-30.8	30.38	-	-	296	222	H
1	126.5628	38.45	Qp	19.8	-30.8	27.45	43.52	-16.07	296	222	H
4	33.966	35.02	Pk	23.9	-31.4	27.52	-	-	315	113	V
4	33.966	36.07	Qp	23.5	-31.4	28.17	40	-11.83	315	113	V
5	45.7913	47.84	Pk	15.6	-31.4	32.04	-	-	180	131	V
5	45.7913	41.04	Qp	15.6	-31.4	25.24	40	-14.76	180	131	V
2	349.996	45.29	Pk	20.1	-29.8	35.59	-	-	259	102	H
2	349.996	43.62	Qp	20.1	-29.8	33.92	46.02	-12.1	259	102	H
3	375	43.43	Pk	20.9	-29.7	34.63	-	-	106	248	H
3	375.00001	41.98	Qp	20.9	-29.7	33.18	46.02	-12.84	106	248	H
6	375	45.7	Pk	20.9	-29.7	36.9	-	-	143	116	V
6	375	44.16	Qp	20.9	-29.7	35.36	46.02	-10.66	143	116	V

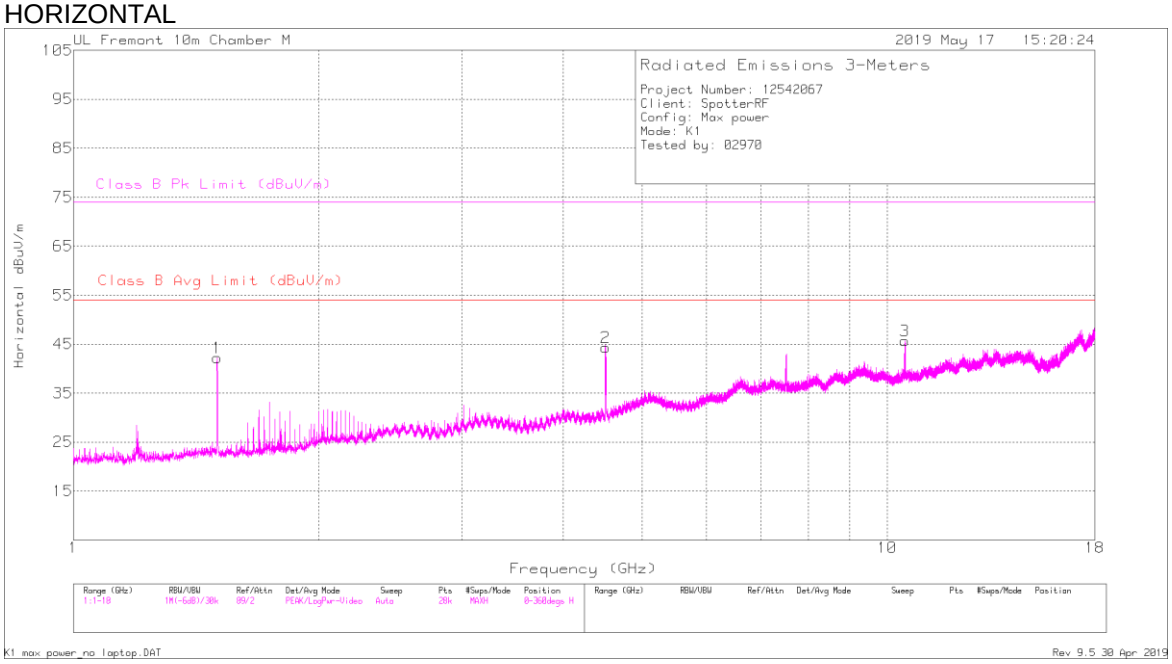
Pk - Peak detector
Qp - Quasi-Peak detector

FCC Part 15B Class B 30-1000MHz.TST 30915 15 Jul 2014
Rev 9.5 11 Jan 2019

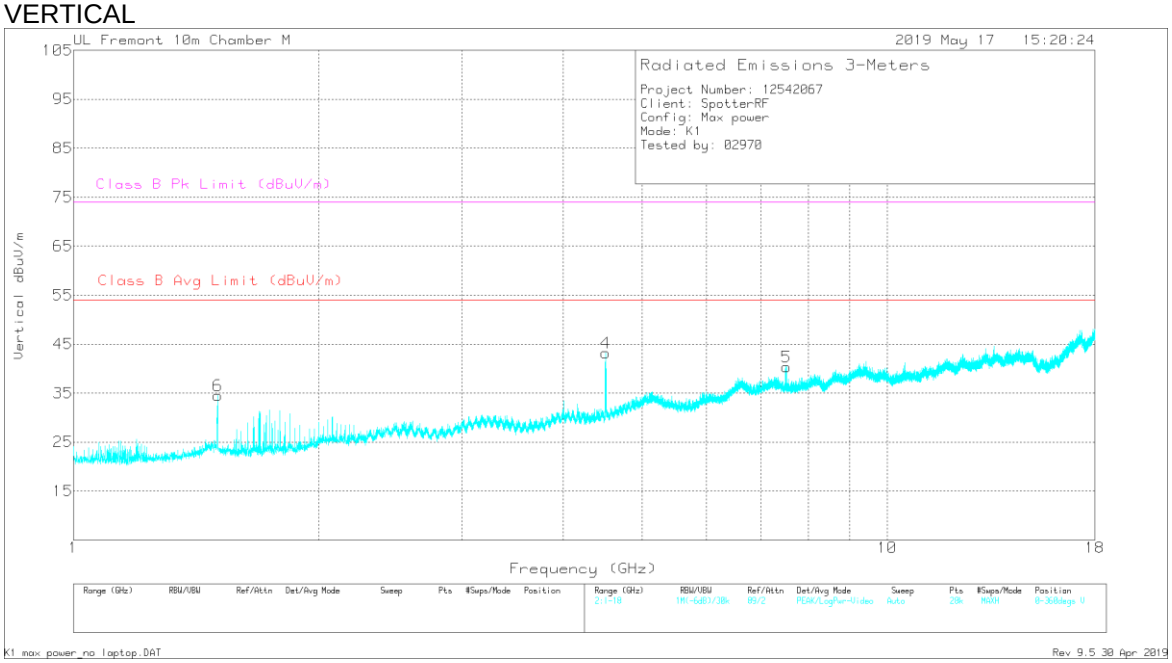
9.2.3. EMISSIONS 1-18 GHz

MODE = K1

HORIZONTAL



VERTICAL



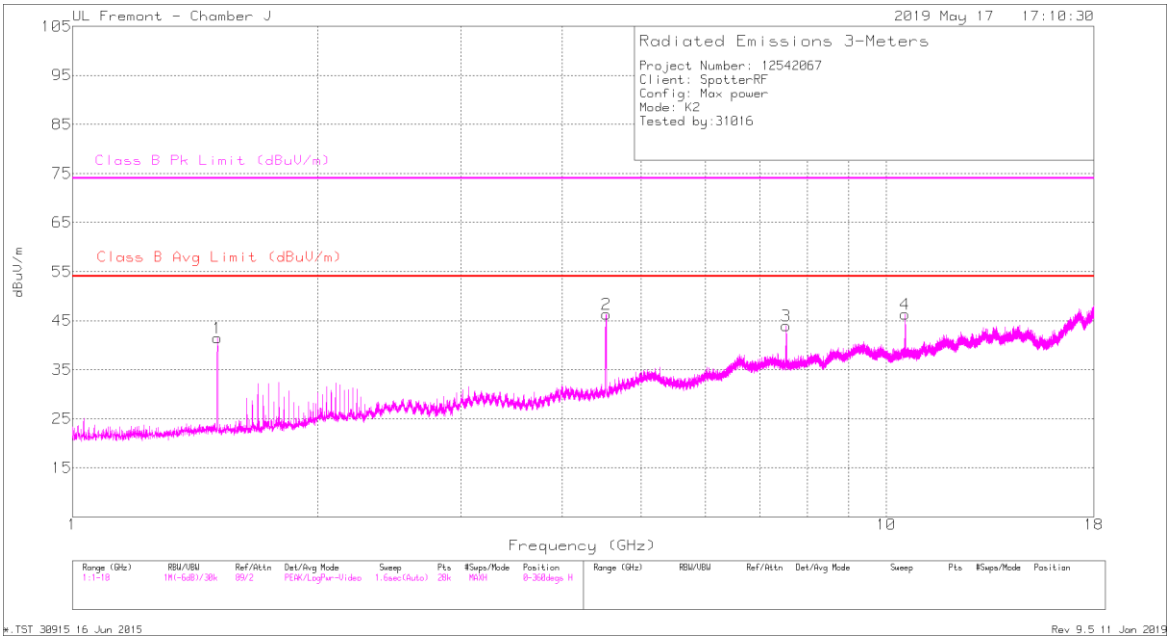
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Avg. Margin (dB)	Class B Pk Limit (dBuV/m)	Peak Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.50026	54.3	Pk	25	-36.2	43.1	-	-	74	-30.9	225	178	H
1	1.50026	35.91	Av	25	-36.2	24.71	54	-29.29	-	-	225	178	H
2	4.51501	48.11	Pk	32.5	-32	48.61	-	-	74	-25.39	95	107	H
2	4.51501	30.11	Av	32.5	-32	30.61	54	-23.39	-	-	95	107	H
3	10.53504	37.69	Pk	38.4	-25.9	50.19	-	-	74	-23.81	356	191	H
3	10.53504	23.99	Av	38.4	-25.9	36.49	54	-17.51	-	-	356	191	H
4	4.508	43.3	Pk	32.4	-31.9	43.8	-	-	74	-30.2	106	105	V
4	4.508	29.29	Av	32.4	-31.9	29.79	54	-24.21	-	-	106	105	V
5	7.51244	37.31	Pk	37.5	-28.3	46.51	-	-	74	-27.49	310	190	V
5	7.51244	24.37	Av	37.5	-28.3	33.57	54	-20.43	-	-	310	190	V
6	1.5007	44.98	Pk	25	-36.2	33.78	-	-	74	-40.22	233	196	V
6	1.5007	35	Av	25	-36.2	23.8	54	-30.2	-	-	233	196	V

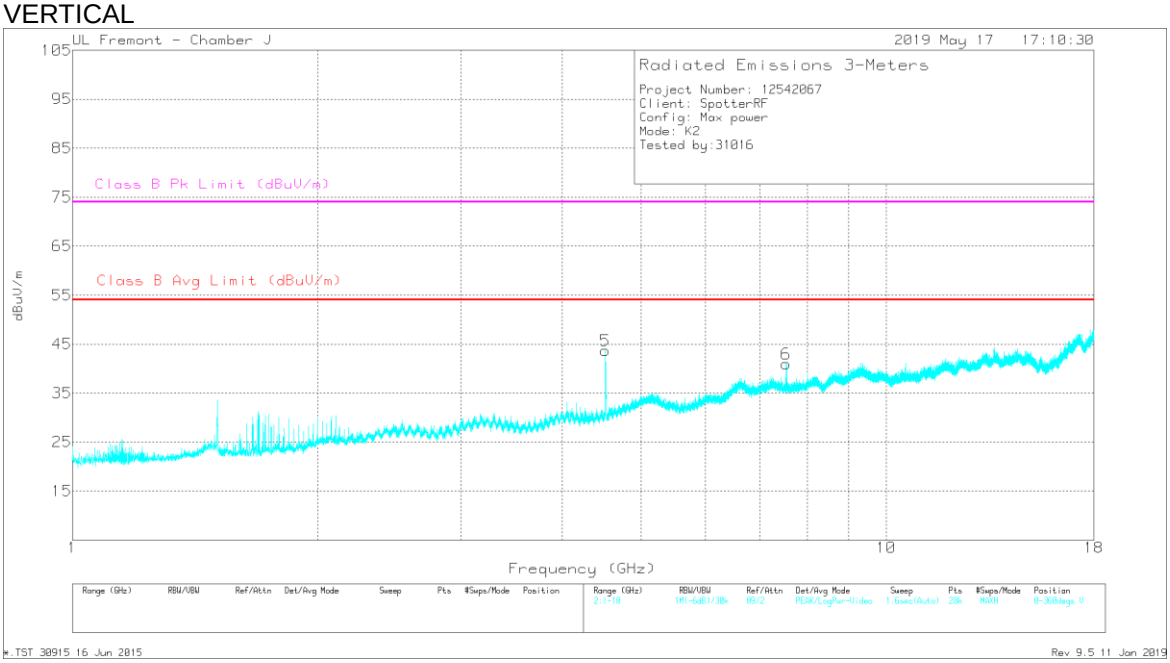
Pk - Peak detector
Av - Average detection
Rev 9.5 30 Apr 2019

MODE = K2

HORIZONTAL



VERTICAL



Trace Markers

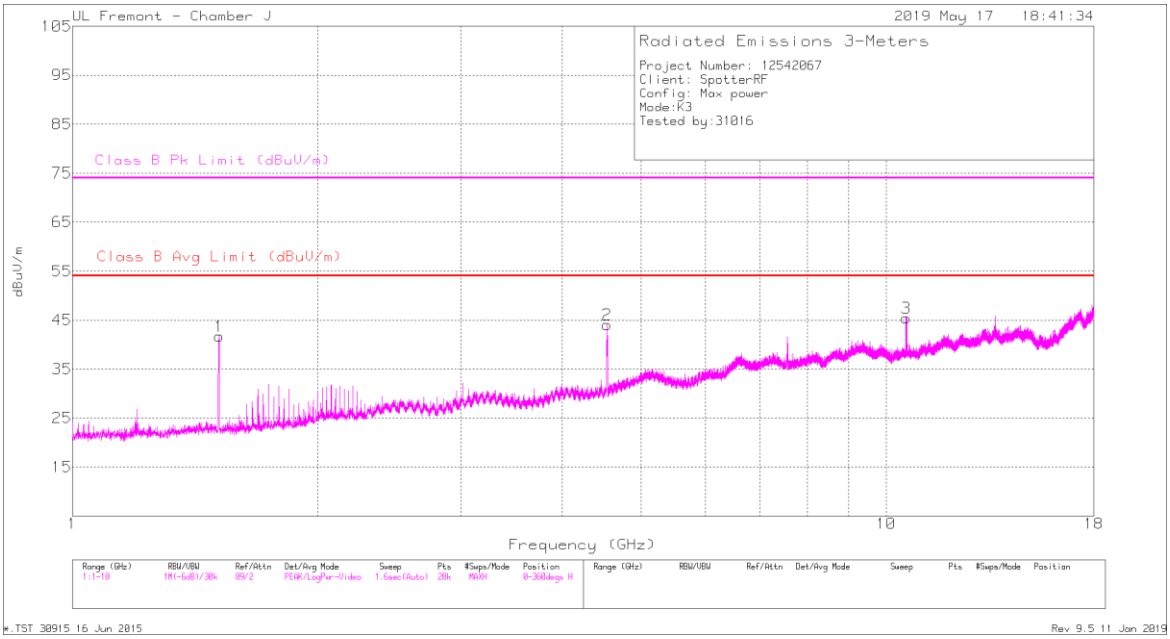
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Avg. Margin (dB)	Class B Pk Limit (dBuV/m)	Peak Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.507	55.87	Pk	25.1	-36.1	44.87	-	-	74	-29.13	231	213	H
1	1.507	44.31	Av	25.1	-36.1	33.31	54	-20.69	-	-	231	213	H
2	4.529	49.27	Pk	32.5	-32.1	49.67	-	-	74	-24.33	16	162	H
2	4.529	32.49	Av	32.5	-32.1	32.89	54	-21.11	-	-	16	162	H
3	7.538	42.24	Pk	37.5	-28.3	51.44	-	-	74	-22.56	146	112	H
3	7.538	26.33	Av	37.5	-28.3	35.53	54	-18.47	-	-	146	112	H
4	10.561	39.14	Pk	38.5	-25.7	51.94	-	-	74	-22.06	348	143	H
4	10.561	24.33	Av	38.5	-25.7	37.13	54	-16.87	-	-	348	143	H
5	4.517	48.92	Pk	32.5	-32	49.42	-	-	74	-24.58	61	186	V
5	4.517	31.86	Av	32.5	-32	32.36	54	-21.64	-	-	61	186	V
6	7.533	41.89	Pk	37.5	-28.3	51.09	-	-	74	-22.91	304	212	V
6	7.533	26.03	Av	37.5	-28.3	35.23	54	-18.77	-	-	304	212	V

Pk - Peak detector
Av - Average detection

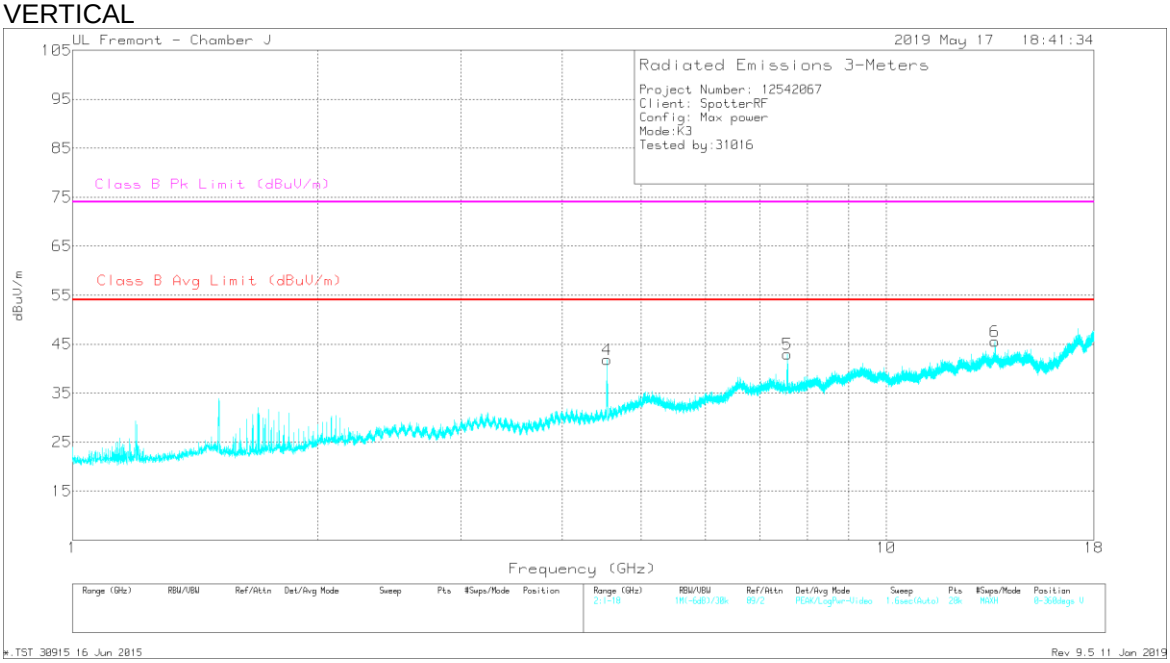
*.TST 30915 16 Jun 2015
Rev 9.5 11 Jan 2019

MODE = K3

HORIZONTAL



VERTICAL



Trace Markers

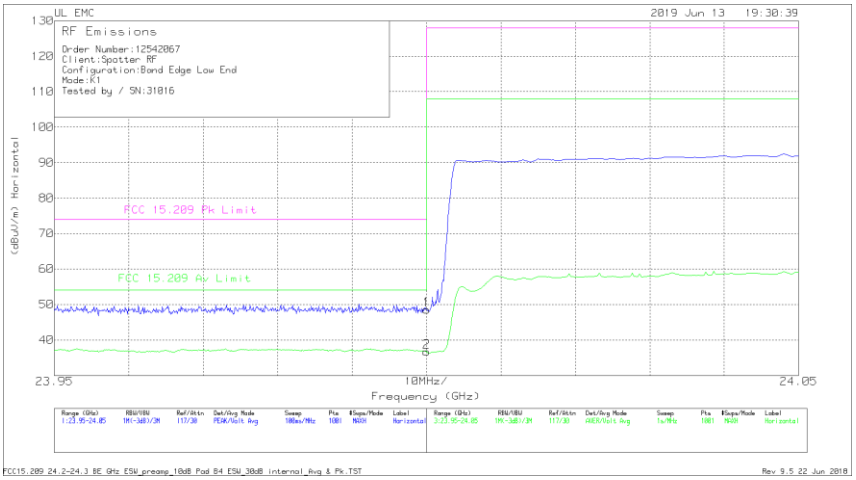
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Avg. Margin (dB)	Class B Pk Limit (dBuV/m)	Peak Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.513	55.6	Pk	25.1	-36.2	44.5	-	-	74	-29.5	229	236	H
1	1.513	44.02	Av	25.1	-36.2	32.92	54	-21.08	-	-	229	236	H
2	4.537	49.61	Pk	32.6	-32.1	50.11	-	-	74	-23.89	94	119	H
2	4.537	32.92	Av	32.6	-32.1	33.42	54	-20.58	-	-	94	119	H
3	10.588	40.28	Pk	38.5	-25.6	53.18	-	-	74	-20.82	7	195	H
3	10.588	24.74	Av	38.5	-25.6	37.64	54	-16.36	-	-	7	195	H
4	4.537	48.16	Pk	32.6	-32.1	48.66	-	-	74	-25.34	61	198	V
4	4.537	31.78	Av	32.6	-32.1	32.28	54	-21.72	-	-	61	198	V
5	7.567	42.22	Pk	37.4	-28.2	51.42	-	-	74	-22.58	308	200	V
5	7.567	26.19	Av	37.4	-28.2	35.39	54	-18.61	-	-	308	200	V
6	13.6	36.72	Pk	40.6	-22.6	54.72	-	-	74	-19.28	340	196	V
6	13.6	22.29	Av	40.6	-22.6	40.29	54	-13.71	-	-	340	196	V

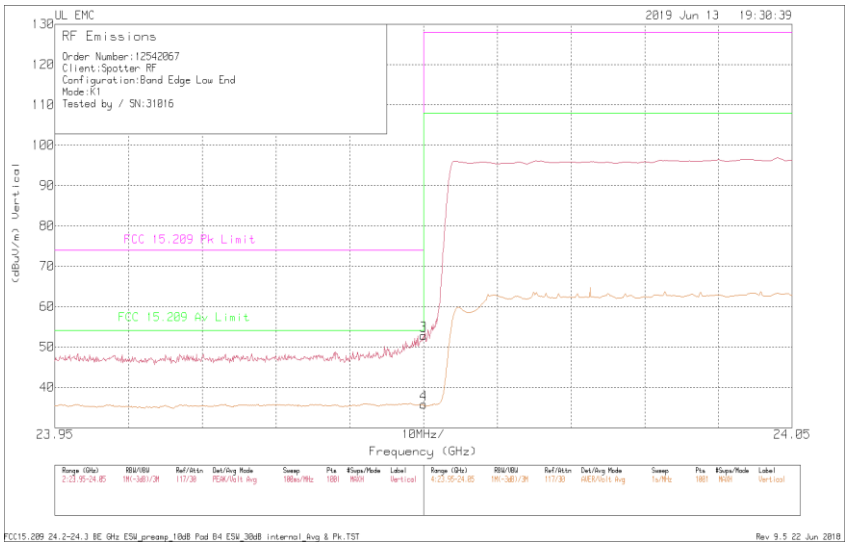
Pk - Peak detector
Av - Average detection

*.TST 30915 16 Jun 2015
Rev 9.5 11 Jan 2019

9.2.4. EMISSIONS 18-26 GHz AND BAND-EDGE

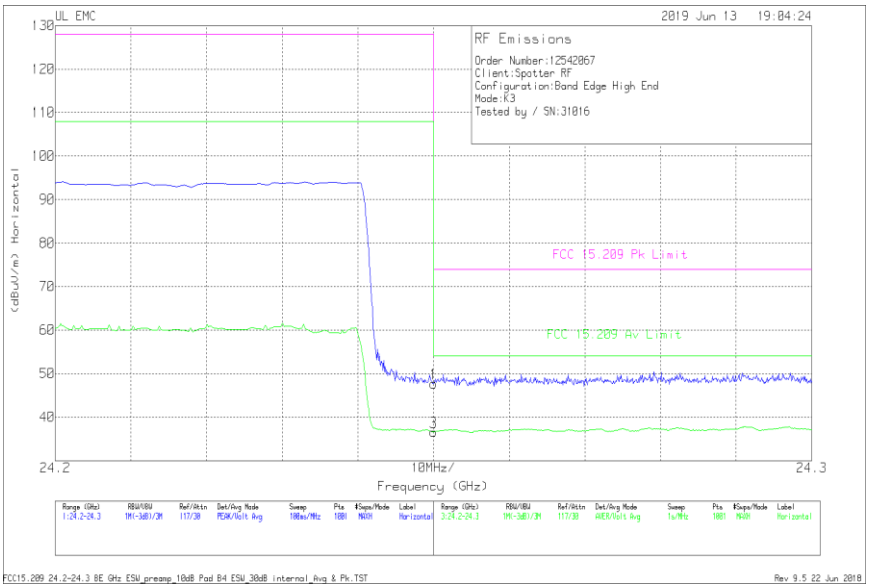
LOW BAND-EDGE USING K1 BANDWIDTH MODE

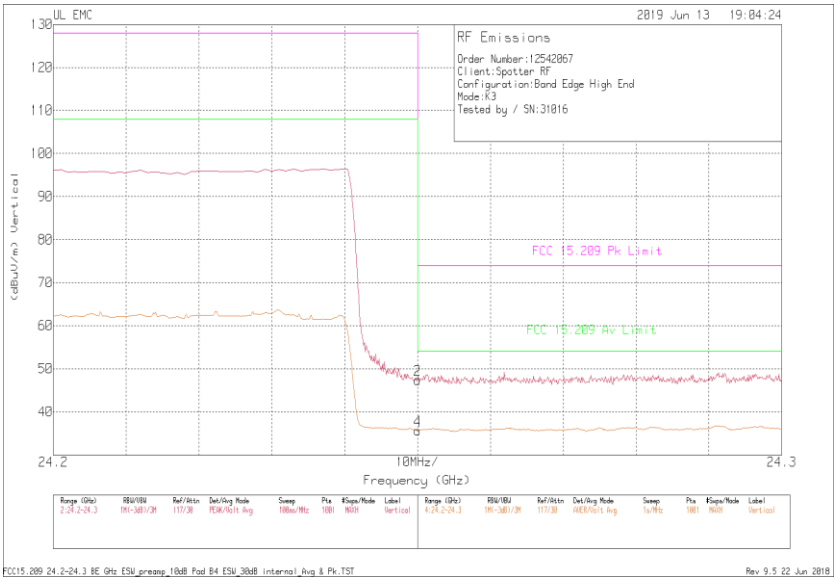




Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	18-26GHz Port Factors (dB)	10dB PAD (dB)	Corrected Reading (dBuV/m)	FCC 15.209 Pk Limit (dBuV/m)	PK Margin (dB)	FCC 15.209 Av Limit (dBuV/m)	Av Margin (dB)	Polarity
2	24	49.28	Av	34.4	-57	10	36.68	-	-	54	-17.32	H
4	24	48.35	Av	34.4	-57	10	35.75	-	-	54	-18.25	V
1	24	61.12	Pk	34.4	-57	10	48.52	74	-25.48	-	-	H
3	24	65.38	Pk	34.4	-57	10	52.78	74	-21.22	-	-	V

HIGH BAND-EDGE USING K3 BANDWIDTH MODE

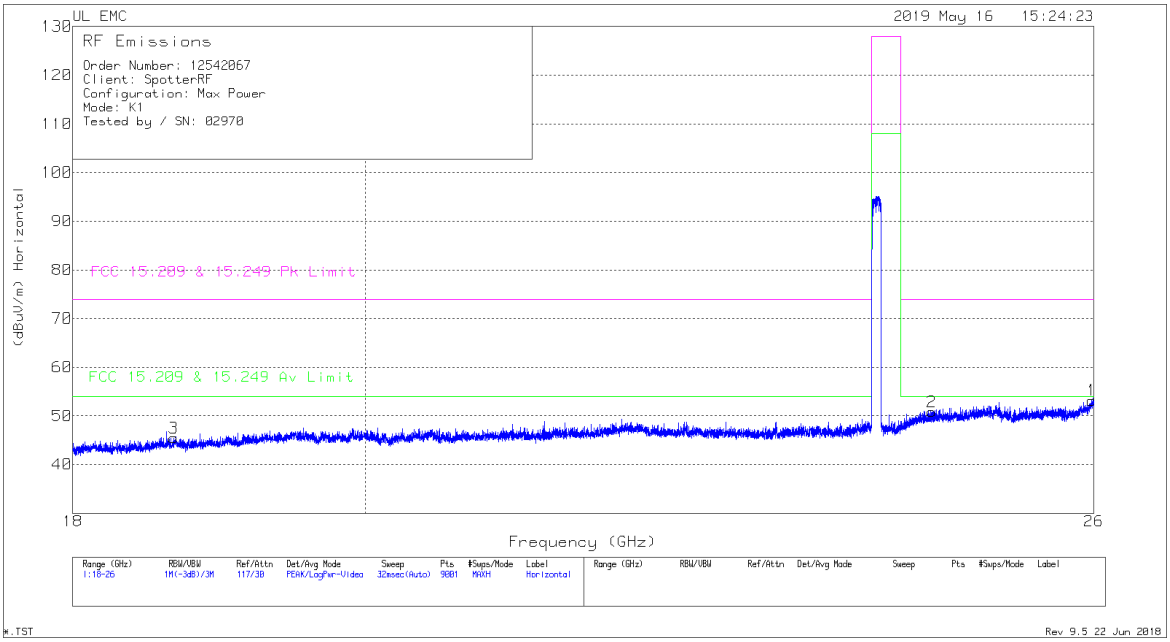




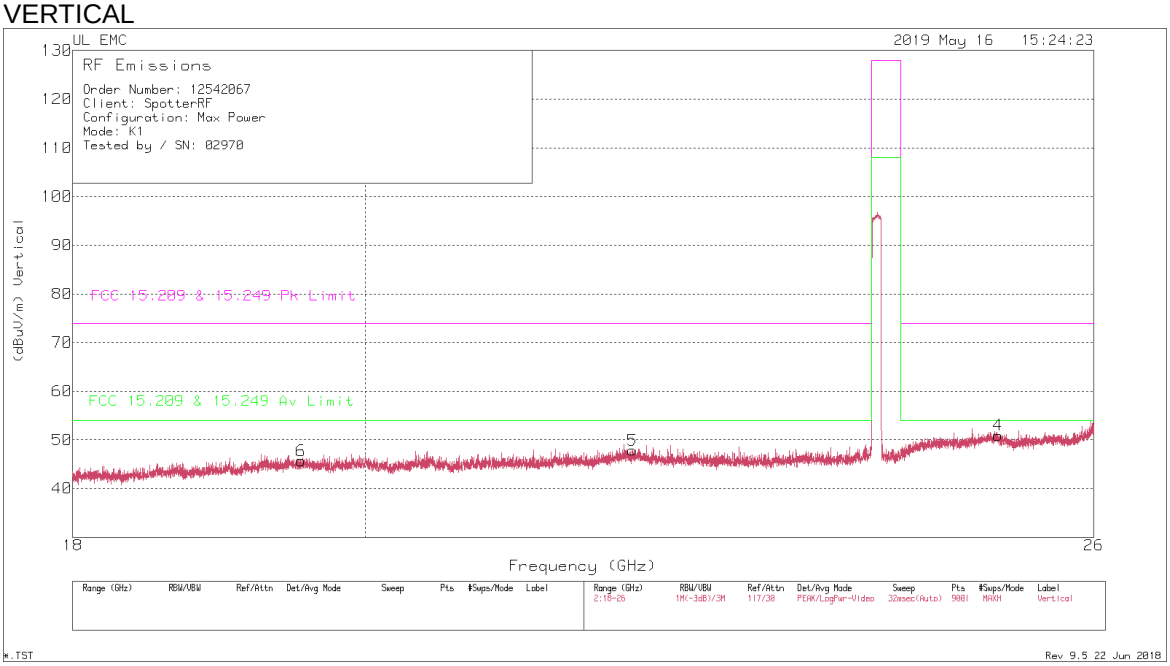
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	18-26GHz Port Factors (dB)	10dB PAD (dB)	Corrected Reading (dBuV/m)	FCC 15.209 Pk Limit (dBuV/m)	PK Margin (dB)	FCC 15.209 Av Limit (dBuV/m)	Av Margin (dB)	Polarity
3	24.25	48.96	Av	34.5	-56.9	10	36.56	-	-	54	-17.44	H
4	24.25	48.03	Av	34.5	-56.9	10	35.63	-	-	54	-18.37	V
1	24.25	60.1	Pk	34.5	-56.9	10	47.7	74	-26.3	-	-	H
2	24.25	59.81	Pk	34.5	-56.9	10	47.41	74	-26.59	-	-	V

MODE = K1

HORIZONTAL



VERTICAL



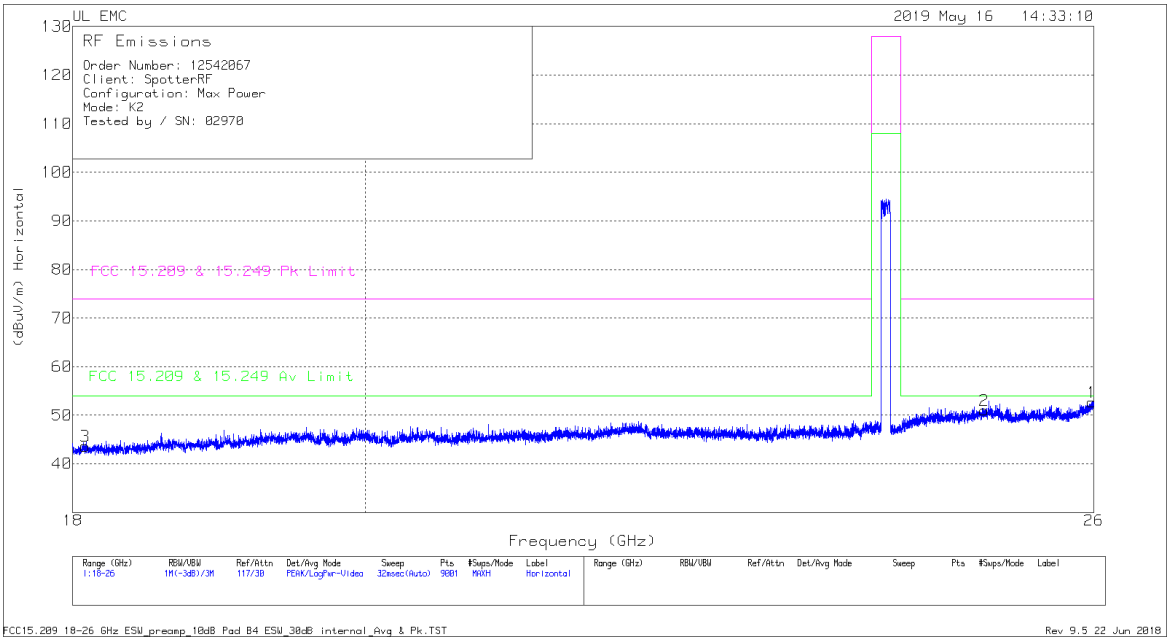
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE01 82188 (dB/m)	18-26GHz Port Factors	10dB PAD	Corrected Reading (dBuV/m)	FCC 15.209 Pk Limit	PK Margin (dB)	FCC 15.209 Av Limit	Avg. Margin (dB)	Polarity
1	25.98	63.82	Pk	35.3	-54.9	10	54.22	74	-19.78	-	-	H
1	25.98	50.13	Av	35.3	-54.9	10	40.53	-	-	54	-13.47	H
5	22.02	61.48	Pk	33.9	-57.4	10	47.98	74	-26.02	-	-	V
5	22.02	48.13	Av	33.9	-57.4	10	34.63	-	-	54	-19.37	V
3	18.667	59.3	Pk	33	-58.4	10	43.9	74	-30.1	-	-	H
3	18.667	46.1	Av	33	-58.4	10	30.7	-	-	54	-23.3	H
4	25.116	62.73	Pk	34.9	-55.3	10	52.33	74	-21.67	-	-	V
4	25.116	48.75	Av	34.9	-55.3	10	38.35	-	-	54	-15.65	V
2	24.525	62.18	Pk	34.7	-56	10	50.88	74	-23.12	-	-	H
2	24.525	48.91	Av	34.7	-56	10	37.61	-	-	54	-16.39	H
6	19.544	60.18	Pk	33.1	-57	10	46.28	74	-27.72	-	-	V
6	19.544	46.64	Av	33.1	-57	10	32.74	-	-	54	-21.26	V

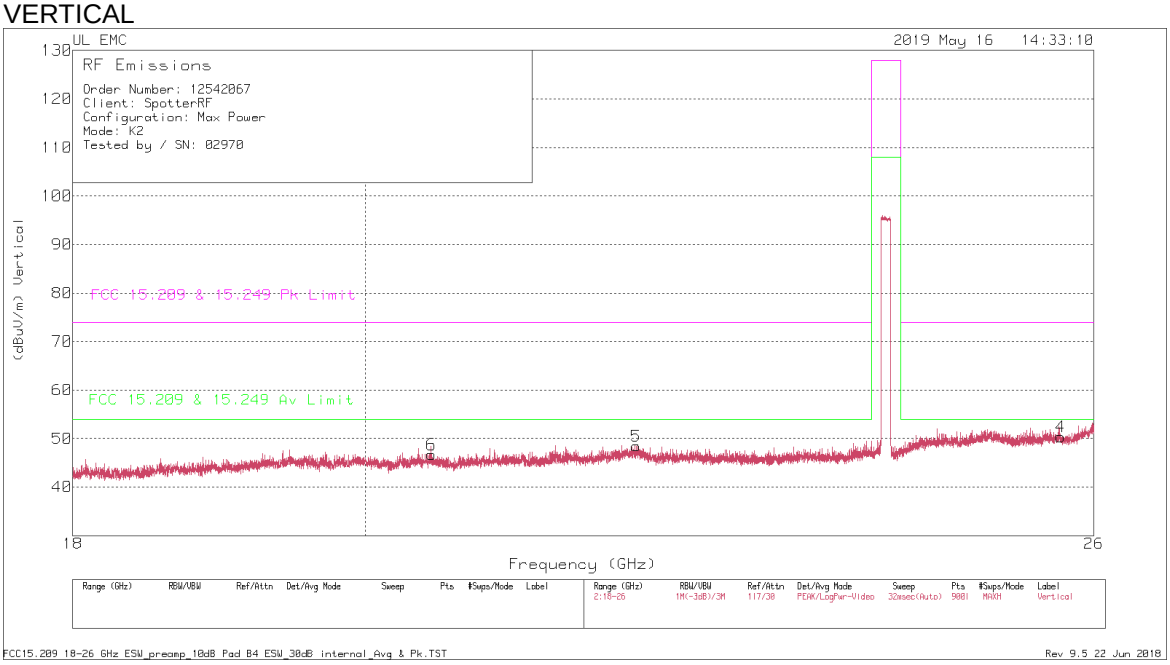
Pk - Peak detector
Av - Average detection
Rev 9.5 22 Jun 2018

MODE = K2

HORIZONTAL



VERTICAL



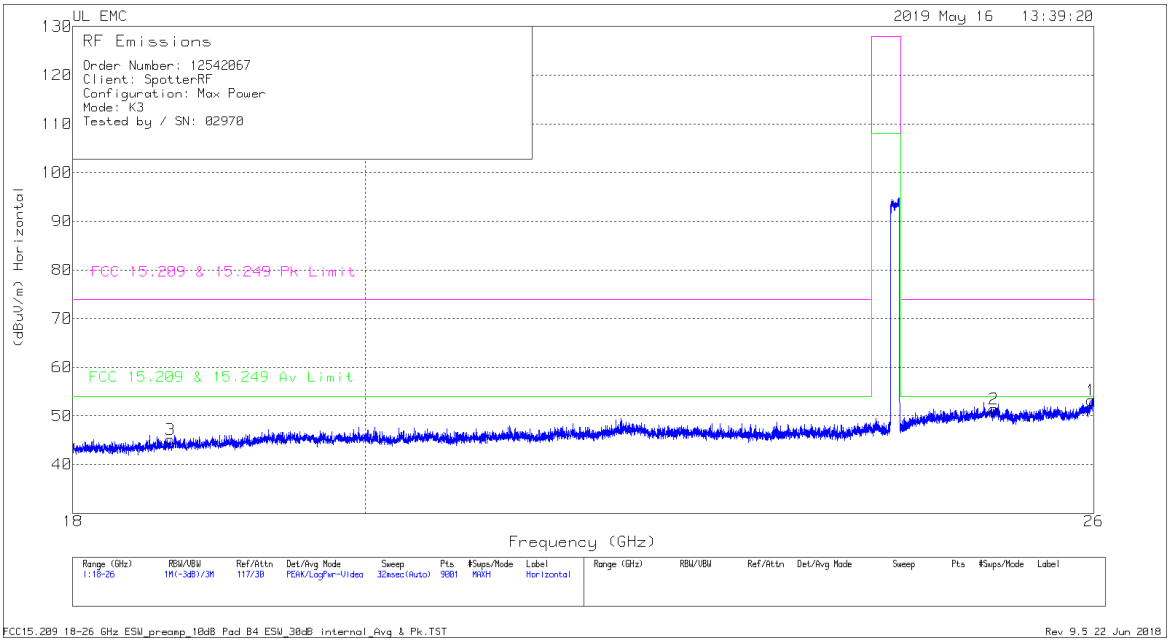
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE01 82188 (dB/m)	18-26GHz Port Factors	10dB PAD	Corrected Reading (dBuV/m)	FCC 15.209 Pk Limit	PK Margin (dB)	FCC 15.209 Av Limit	Avg. Margin (dB)	Polarity
1	25.981	63.58	Pk	35.3	-55.3	10	53.58	74	-20.42	-	-	H
1	25.981	50.16	Av	35.3	-55.3	10	40.16	-	-	54	-13.84	H
2	24.993	62.12	Pk	35	-54.9	10	52.22	74	-21.78	-	-	H
2	24.993	48.83	Av	35	-54.9	10	38.93	-	-	54	-15.07	H
3	18.08	59.88	Pk	32.9	-60	10	42.78	74	-31.22	-	-	H
3	18.08	46.68	Av	32.9	-60	10	29.58	-	-	54	-24.42	H
4	25.689	61.58	Pk	35.1	-55.3	10	51.38	74	-22.62	-	-	V
4	25.689	48.47	Av	35.1	-55.3	10	38.27	-	-	54	-15.73	V
5	22.049	61.65	Pk	33.9	-57.4	10	48.15	74	-25.85	-	-	V
5	22.049	48.17	Av	33.9	-57.4	10	34.67	-	-	54	-19.33	V
6	20.483	60.08	Pk	33.7	-56.8	10	46.98	74	-27.02	-	-	V
6	20.483	46.32	Av	33.7	-56.8	10	33.22	-	-	54	-20.78	V

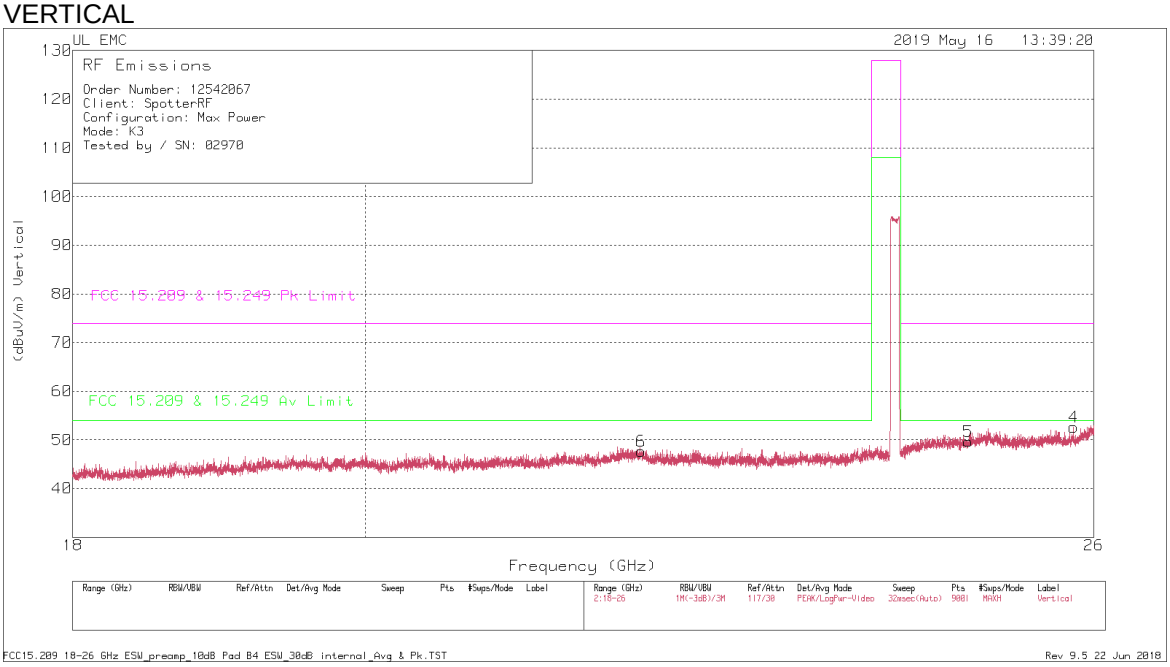
Pk - Peak detector
Av - Average detection
Rev 9.5 22 Jun 2018

MODE = K3

HORIZONTAL



VERTICAL



Trace Markers

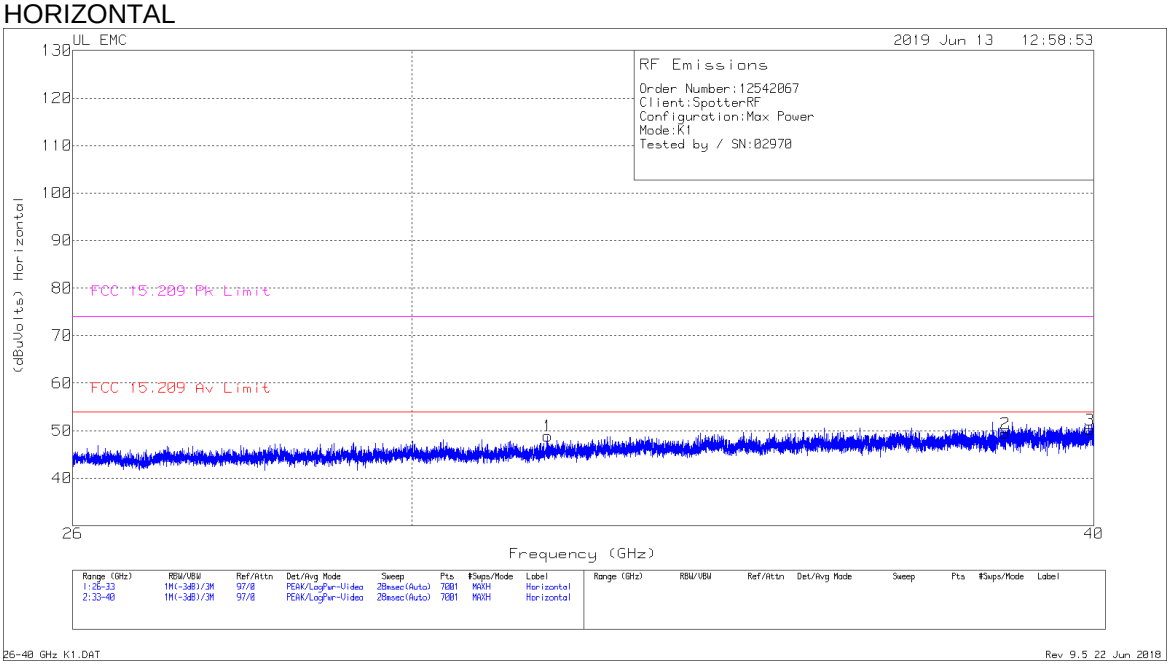
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE01 82188 (dB/m)	18-26GHz Port Factors	10dB PAD	Corrected Reading (dBuV/m)	FCC 15.209 Pk Limit	PK Margin (dB)	FCC 15.209 Av Limit	Avg. Margin (dB)	Polarity
1	25.972	63.51	Pk	35.2	-55.4	10	53.31	74	-20.69	-	-	H
1	25.977	49.95	Av	35.2	-55.3	10	39.85	-	-	54	-44.15	H
2	25.081	62.19	Pk	35	-55.2	10	51.99	74	-22.01	-	-	H
2	25.081	48.78	Av	35	-55.2	10	38.58	-	-	54	-5.42	H
3	18.644	59.89	Pk	33	-58.7	10	44.19	74	-29.81	-	-	H
3	18.644	46.12	Av	33	-58.7	10	30.42	-	-	54	-23.58	H
4	25.811	61.72	Pk	35.1	-55.6	10	51.22	74	-22.78	-	-	V
4	25.811	48.36	Av	35.1	-55.6	10	37.86	-	-	54	-26.14	V
5	24.852	61.67	Pk	35	-55.7	10	50.97	74	-23.03	-	-	V
5	24.852	48.3	Av	35	-55.7	10	37.6	-	-	54	-26.4	V
6	22.089	61.6	Pk	34.1	-57.8	10	47.9	74	-26.1	-	-	V
6	22.089	47.81	Av	34.1	-57.8	10	34.11	-	-	54	-19.88	V

Pk - Peak detector
Av - Average detection
Rev 9.5 22 Jun 2018

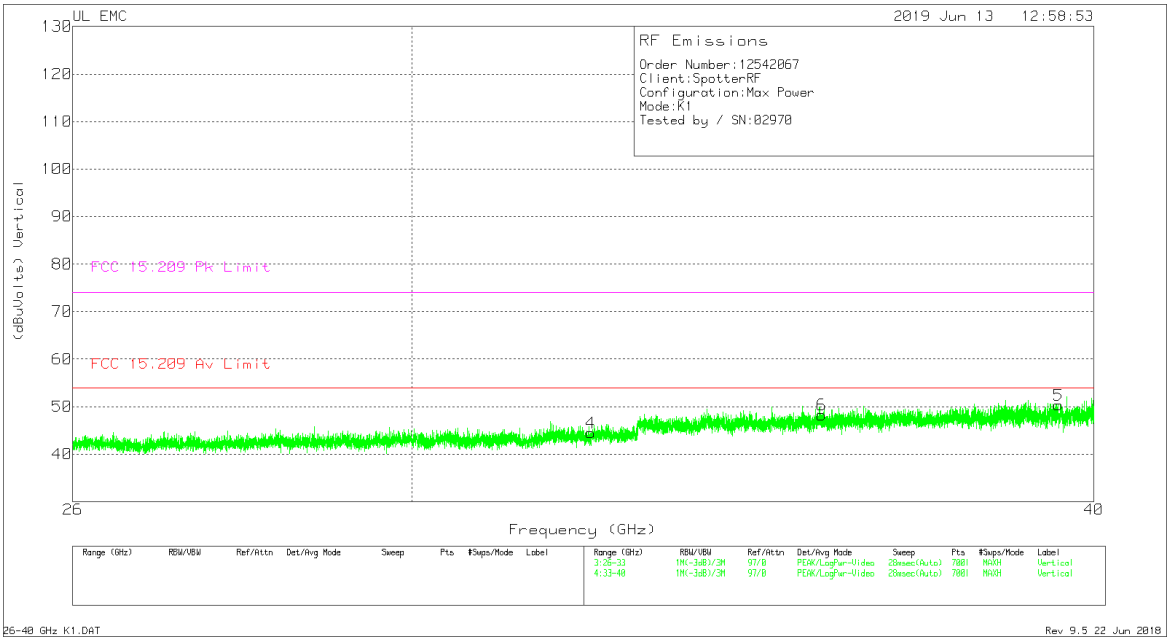
9.2.5. EMISSIONS 26-40 GHz

MODE = K1

HORIZONTAL



VERTICAL

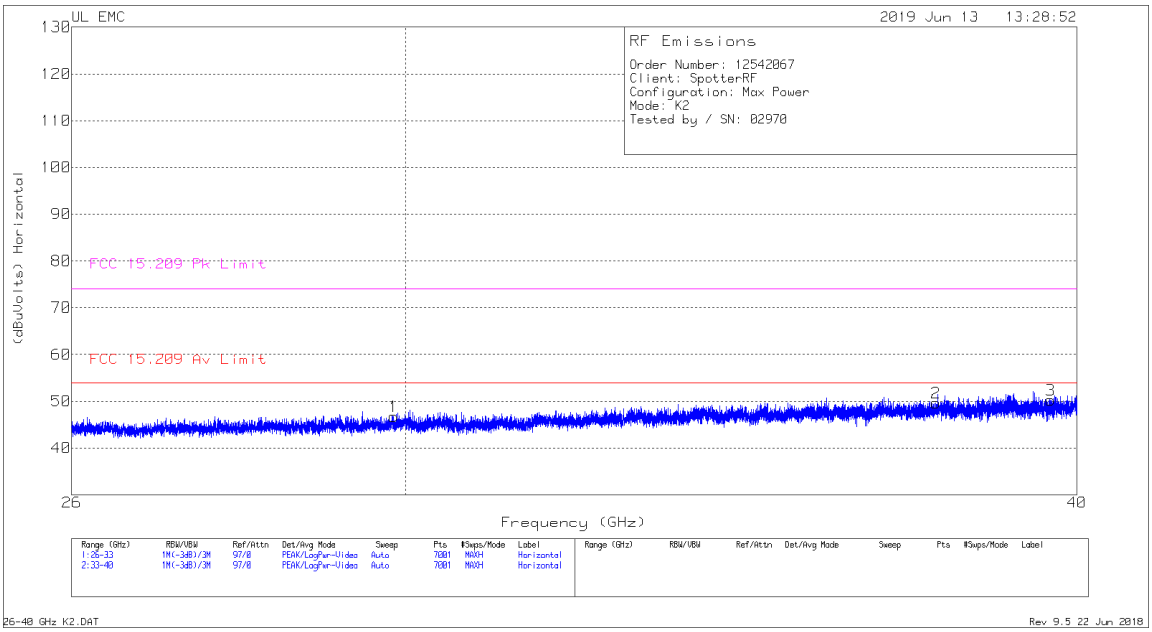


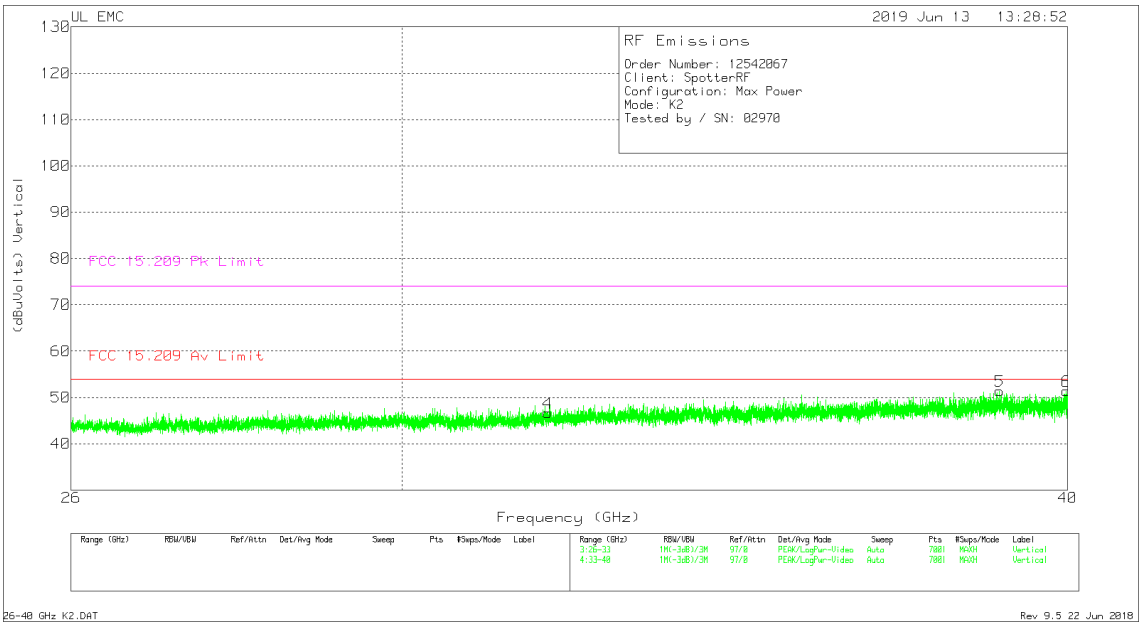
Trace Markers

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	26-40GHz Horn T445	26-40GHz Port Factors	Corrected Reading (dBuVolts)	FCC 15.209 Av Limit (dBuVolts)	Av Margin (dB)	FCC 15.209 Pk Limit (dBuVolts)	PK Margin (dB)	Polarity
1	31.768	63.91	Pk	36.8	-54.3	46.41	-	-	74	-27.59	H
1	31.768	50.15	Av	36.8	-54.3	32.65	54	-22.35	-	-	H
2	38.53	66.74	Pk	38.2	-54.9	50.04	-	-	74	-23.96	H
2	38.53	53.05	Av	38.2	-54.9	36.35	54	-17.65	-	-	H
3	39.973	65.22	Pk	38.4	-53.6	50.02	-	-	74	-23.98	H
3	39.973	51.61	Av	38.4	-53.6	36.41	54	-17.59	-	-	H
4	32.348	64.14	Pk	36.6	-54.8	45.94	-	-	74	-28.06	V
4	32.348	50.44	Av	36.6	-54.8	32.24	54	-21.76	-	-	V
5	39.403	66.08	Pk	38.3	-54.1	50.28	-	-	74	-23.72	V
5	39.403	52.13	Av	38.3	-54.1	36.33	54	-17.67	-	-	V
6	35.659	67.18	Pk	37.6	-56	48.78	-	-	74	-25.22	V
6	35.659	53.03	Av	37.6	-56	34.63	54	-19.37	-	-	V

Pk - Peak detector
Av - Average detection
26-40 GHz K1.DAT
Rev 9.5 22 Jun 2018

MODE = K2





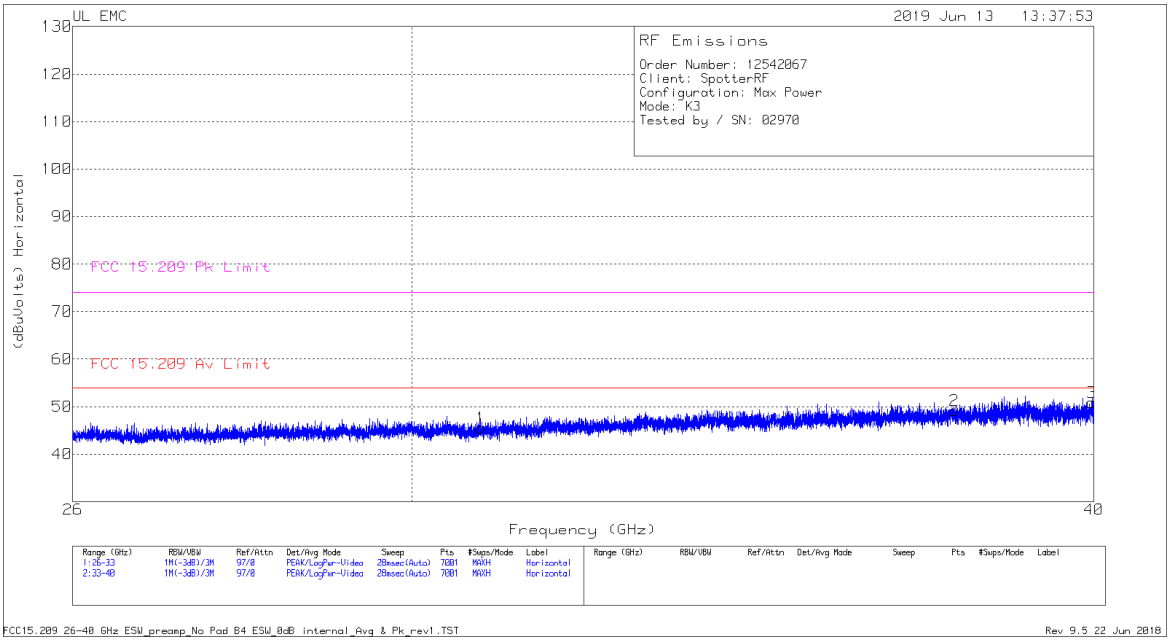
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	26-40GHz Horn T445	26-40GHz Port Factors	Corrected Reading (dBuVolts)	FCC 15.209 Av Limit	Margin (dB)	FCC 15.209 Pk Limit	PK Margin (dB)	Polarity
1	29.846	62.99	Pk	36.4	-54	45.39	54	-8.61	74	-28.61	H
1	29.846	49.5	Av	36.4	-54	31.9	-	-	-	-	H
2	37.652	66.3	Pk	38	-56.2	48.1	54	-5.9	74	-25.9	H
2	37.652	52.85	Av	38	-56.2	34.65	-	-	-	-	H
3	39.551	65.26	Pk	38.3	-53	50.56	54	-3.44	74	-23.44	H
3	39.551	51.92	Av	38.3	-53	37.22	-	-	-	-	H
4	31.951	63.83	Pk	36.7	-54.7	45.83	54	-8.17	74	-28.17	V
4	31.951	50.08	Av	36.7	-54.7	32.08	-	-	-	-	V
5	38.849	66.94	Pk	38.3	-54.7	50.54	54	-3.46	74	-23.46	V
5	38.849	52.97	Av	38.3	-54.7	36.57	-	-	-	-	V
6	39.976	65.66	Pk	38.4	-53.9	50.16	54	-3.84	74	-23.84	V
7	39.976	51.62	Av	38.4	-53.9	36.12	-	-	-	-	V

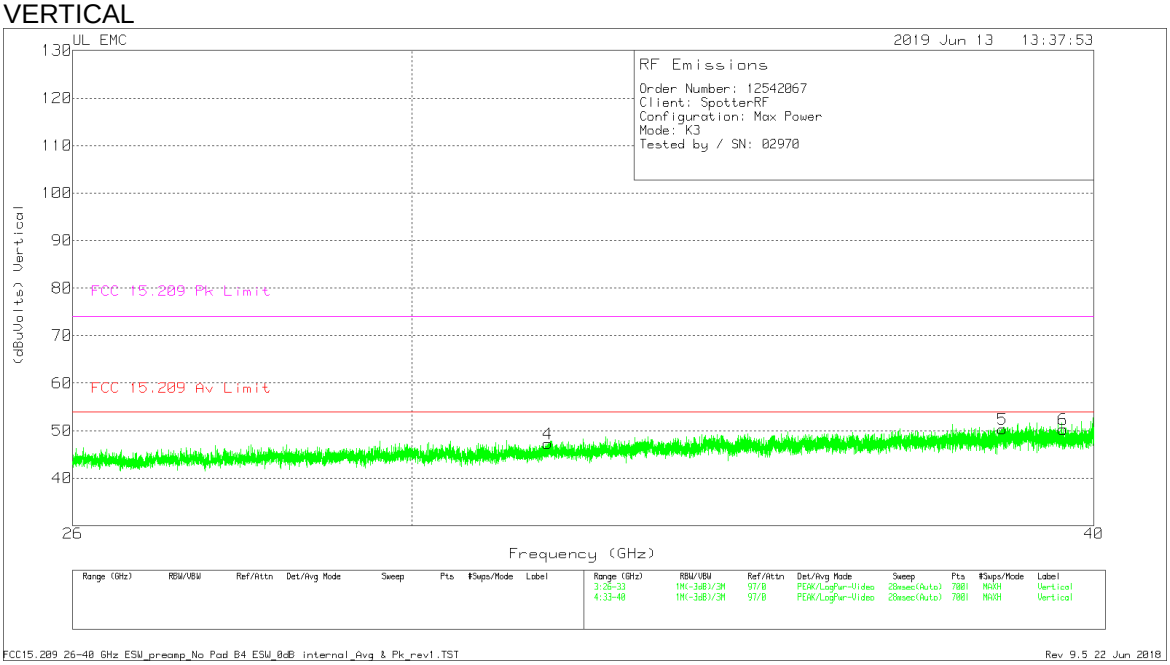
Pk - Peak detector
Av - Average detection
26-40 GHz K2.DAT
Rev 9.5 22 Jun 2018

MODE = K3

HORIZONTAL



VERTICAL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	26-40GHz Horn T445	26-40GHz Port Factors	Corrected Reading (dBuVolts)	FCC 15.209 Av Limit (dBuVolts)	Av Margin (dB)	FCC 15.209 Pk Limit (dBuVolts)	PK Margin (dB)	Polarity
1	30.884	64.31	Pk	36.4	-55.2	45.51	-	-	74	-28.49	H
1	30.884	50.66	Av	36.4	-55.2	31.86	54	-22.14	-	-	H
3	39.966	65.47	Pk	38.3	-53.2	50.57	-	-	74	-23.43	H
3	39.966	51.7	Av	38.3	-53.2	36.8	54	-17.2	-	-	H
2	37.713	66.39	Pk	38	-55.7	48.69	-	-	74	-25.31	H
2	37.713	53.06	Av	38	-55.7	35.36	54	-18.64	-	-	H
4	31.769	64.44	Pk	36.8	-54.6	46.64	-	-	74	-27.36	V
4	31.769	50.28	Av	36.8	-54.6	32.48	54	-21.52	-	-	V
5	38.488	66.11	Pk	38.2	-55.3	49.01	-	-	74	-24.99	V
5	38.488	52.79	Av	38.2	-55.3	35.69	54	-18.31	-	-	V
6	39.483	65.3	Pk	38.3	-54.2	49.4	-	-	74	-24.6	V
6	39.483	51.5	Av	38.3	-54.2	35.6	54	-18.4	-	-	V

Pk - Peak detector
Av - Average detection
Rev 9.5 22 Jun 2018

9.2.6. EMISSIONS 40-50 GHz

Bandwidth Mode K1

PEAK			
Frequency (GHz)	**Measurement Distance (m)**	**Peak Power (dBm)**	**Total Receiving Gain (dB)**
48.1279	1.500	-42.24	47.80
FMCW Desens. Factor	**EIRP (dBm)**		**Specification Distance (m)**
0.079	-20.35		3.0

Field Strength (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
74.85	88.00	**-13.154**

Average			
Frequency (GHz)	**Measurement Distance (m)**	**Average Power (dBm)**	**Total Receiving Gain (dB)**
48.143	1.500	-66.09	47.80
Duty Cycle Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0	-44.28		3.0

Field Strength (dBuV/m)	Avg. Limit (dBuV/m)	Margin (dB)
50.92	68.00	**-17.080**

2nd Harmonic at 48 GHz

Bandwidth Mode K2

PEAK

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
48.2	1.500	-42.64	47.80
FMCW Desens. Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0.079	-20.74		3.0

Field Strength (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
74.46	88.00	**-13.537**

Average

Frequency (GHz)	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
48.179	1.500	-66.16	47.80
Duty Cycle Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0	-44.35		3.0

Field Strength (dBuV/m)	Avg. Limit (dBuV/m)	Margin (dB)
50.85	68.00	**-17.146**

Bandwidth Mode K3

PEAK

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
48.465	1.500	-43.65	47.80
FMCW Desens. Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0.08	-21.70		3.0

Field Strength (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
73.50	88.00	**-14.502**

Average

Frequency (GHz)	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
48.479	1.500	-67.19	47.80
Duty Cycle Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0	-45.32		3.0

Field Strength (dBuV/m)	Avg. Limit (dBuV/m)	Margin (dB)
49.88	68.00	**-18.120**

2nd Harmonic at 48 GHz

9.2.7. EMISSIONS FROM 50-75 GHz

Bandwidth Mode K1

PEAK

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
72.037	1.500	-63.21	29.34
FMCW Desens. Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0.173	-19.26		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
75.94	88.00	**-12.062**

Average

Frequency (GHz)	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
72.239	1.500	-84.11	29.34
Duty Cycle Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0	-40.32		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
54.88	68.00	**-13.115**

.

3rd Harmonic at 72 GHz

Bandwidth Mode K2

PEAK			
Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
72.267	1.500	-64.28	29.34
FMCW Desens. Factor (dB)	EIRP (dBm)		Specification Distance (m)
0.173	-20.31		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.89	88.00	**-13.106**

Average			
Frequency (GHz)	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
72.479	1.500	-83.87	29.34
Duty Cycle Factor (dB)	EIRP (dBm)		Specification Distance (m)
0	-40.05		3.0

Field Strength (dBuv/m)	Limit (dBuV/m)	Margin (dB)
55.15	68.00	**-12.846**

Bandwidth Mode K3

PEAK			
Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
72.267	1.500	-64.28	29.34
FMCW Desens. Factor (dB)	EIRP (dBm)		Specification Distance (m)
0.174	-20.30		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.90	88.00	**-13.105**

Average			
Frequency	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
72.649	1.500	-83.86	29.34
Duty Cycle Factor (dB)	EIRP (dBm)		Specification Distance (m)
0	-40.02		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
55.18	68.00	**-12.816**

3rd Harmonic at 72 GHz

9.2.8. EMISSIONS FROM 75-100 GHz

Bandwidth Mode K1

PEAK			
Frequency (GHz)	**Measurement Distance (m)**	**Peak Power (dBm)**	**Total Receiving Gain (dB)**
96.124	1.500	-59.96	36.34
FMCW Desens. Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0.298	-20.39		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
74.81	88.00	**-13.186**

Average			
Frequency (GHz)	**Measurement Distance (m)**	**Average Power (dBm)**	**Total Receiving Gain (dB)**
96.32	1.500	-83.63	36.34
Duty Cycle Factor (dB)	**EIRP (dBm)**		**Specification Distance (m)**
0	-44.34		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
50.86	68.00	**-17.139**

4th Harmonic at 96 GHz

Bandwidth Mode K2

PEAK			
Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
96.336	1.500	-61.52	36.34
FMCW Desens. Factor (dB)	EIRP (dBm)		Specification Distance (m)
0.3	-21.92		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
73.28	88.00	**-14.725**

Average			
Frequency (GHz)	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
96.64	1.500	-83.26	36.34
Duty Cycle Factor (dB)	EIRP (dBm)		Specification Distance (m)
0	-43.93		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
51.27	68.00	**-16.732**

Bandwidth Mode K3

PEAK			
Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Total Receiving Gain (dB)
96.943	1.500	-62.77	36.34
FMCW Desens. Factor (dB)	EIRP (dBm)		Specification Distance (m)
0.300	-23.12		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
72.08	88.00	**-15.920**

Average			
Frequency (GHz)	Measurement Distance (m)	Average Power (dBm)	Total Receiving Gain (dB)
96.96	1.500	-82.86	36.34
Duty Cycle Factor (dB)	EIRP (dBm)		Specification Distance (m)
0	-43.51		3.0

Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
51.69	68.00	**-16.309**

4th Harmonic at 96 GHz

9.3. AC LINE CONDUCTED LIMITS

LIMIT

§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.

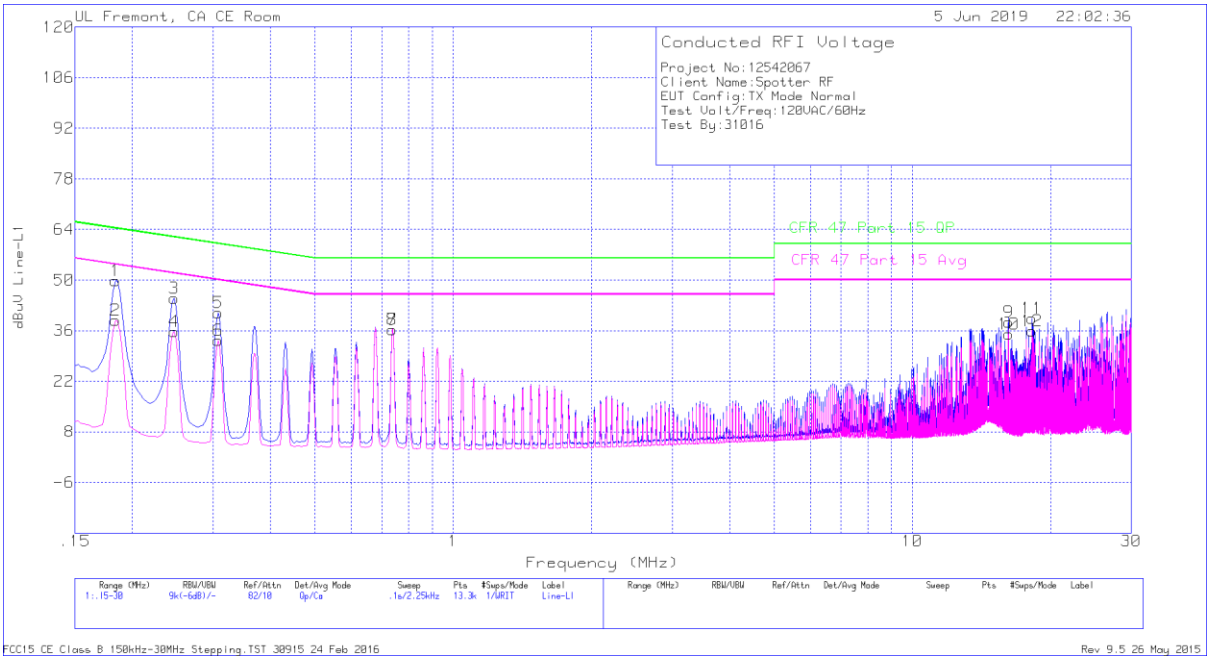
TEST PROCEDURE

ANSI C63.10

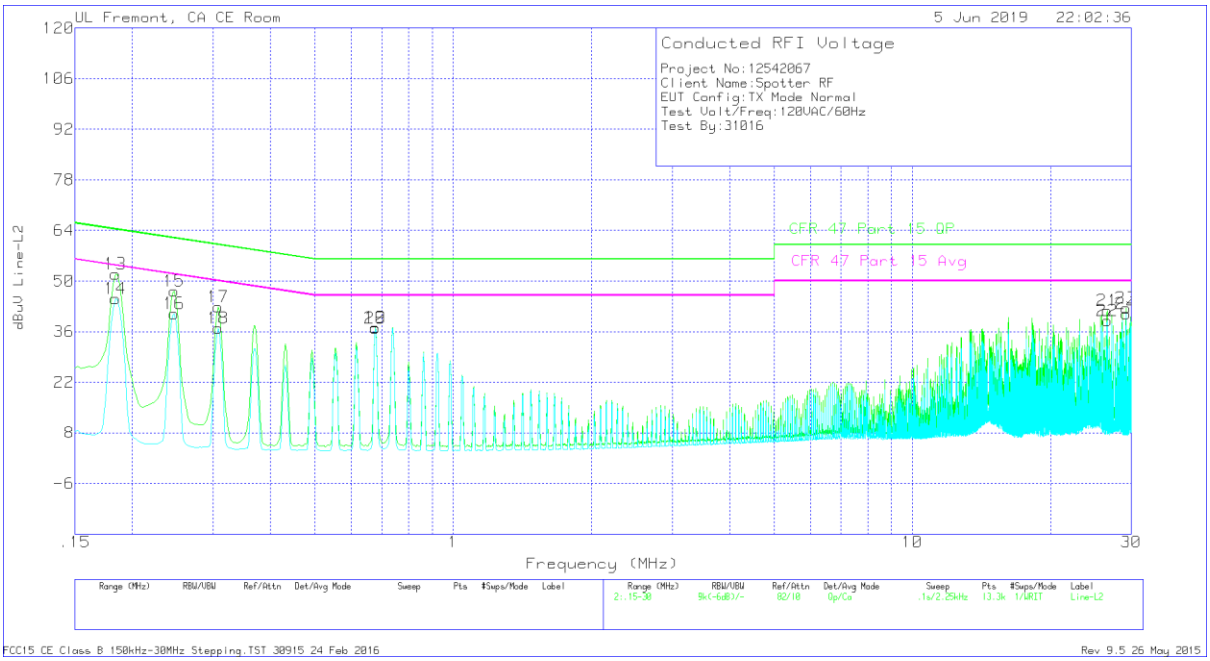
Worst case mode (highest power) tested.

RESULTS

L1 – PLOT



L2 – PLOT



Trace Markers

Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 QP	QP Margin (dB)	CFR 47 Part 15 Avg	Av(CISPR) Margin (dB)
1	.18375	39.77	Qp	0	0	10.1	49.87	64.31	-14.44	-	-
2	.18375	28.75	Ca	0	0	10.1	38.85	-	-	54.31	-15.46
3	.24675	34.8	Qp	0	0	10.1	44.9	61.87	-16.97	-	-
4	.24675	25.69	Ca	0	0	10.1	35.79	-	-	51.87	-16.08
5	.3075	30.93	Qp	0	0	10.1	41.03	60.04	-19.01	-	-
6	.3075	23.15	Ca	0	0	10.1	33.25	-	-	50.04	-16.79
7	.73725	26.2	Qp	0	0	10.1	36.3	56	-19.7	-	-
8	.73725	26.17	Ca	0	0	10.1	36.27	-	-	46	-9.73
9	16.22625	27.69	Qp	.1	.3	10.3	38.39	60	-21.61	-	-
10	16.22625	24.36	Ca	.1	.3	10.3	35.06	-	-	50	-14.94
11	18.24225	28.7	Qp	.1	.3	10.3	39.4	60	-20.6	-	-
12	18.24225	25.24	Ca	.1	.3	10.3	35.94	-	-	50	-14.06

Qp - Quasi-Peak detector
Ca - CISPR average detection

Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 QP	QP Margin (dB)	CFR 47 Part 15 Avg	Av(CISPR) Margin (dB)
13	.18375	41.89	Qp	0	0	10.1	51.99	64.31	-12.32	-	-
14	.18375	35.03	Ca	0	0	10.1	45.13	-	-	54.31	-9.18
15	.24675	37.19	Qp	0	0	10.1	47.29	61.87	-14.58	-	-
16	.24675	30.94	Ca	0	0	10.1	41.04	-	-	51.87	-10.83
17	.3075	32.85	Qp	0	0	10.1	42.95	60.04	-17.09	-	-
18	.3075	26.86	Ca	0	0	10.1	36.96	-	-	50.04	-13.08
19	.6765	27.08	Qp	0	0	10.1	37.18	56	-18.82	-	-
20	.6765	26.91	Ca	0	0	10.1	37.01	-	-	46	-8.99
21	26.61	30.89	Qp	.1	.3	10.5	41.79	60	-18.21	-	-
22	26.61	28.12	Ca	.1	.3	10.5	39.02	-	-	50	-10.98
23	29.23575	31.54	Qp	.1	.4	10.5	42.54	60	-17.46	-	-
24	29.23575	29.94	Ca	.1	.4	10.5	40.94	-	-	50	-9.06

Qp - Quasi-Peak detector
Ca - CISPR average detection
FCC15 CE Class B 150kHz-30MHz Stepping.TST 30915 24 Feb 2016
Rev 9.5 26 May 2015