



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

WIRELESS TRANSMITTER

MODEL NUMBER: RFMD

FCC ID: QZC-RFMD-01

REPORT NUMBER: 10583303B

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Prepared for
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Revision History

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--	May 10, 2016	Initial Issue	Joseph McWilliams
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Elster American Meter Co LLC
2221 Industrial Rd
Nebraska City, NE, 68410-6886, USA

EUT DESCRIPTION: 902-928MHz wireless transever

MODEL: RFMD

SERIAL NUMBER: None

DATE TESTED: September 10, 2015 to November 2, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
47 CFR Part 15 Subpart C	Pass
47 CFR Part 15, Subpart B	Pass

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

Approved & Released For
UL LLC By:

Tested By:



Bart Mucha
Staff Engineer
UL LLC

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Project Engineer
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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, ANSI C63.4:2014, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC Public Notice DA 00-705

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 333 Pfingsten Road, Northbrook, IL 60062 USA.

UL NBK is accredited by NVLAP, Laboratory Code 100414-0. The full scope of accreditation can be viewed at <http://ts.nist.gov>

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

Sample Calculations

Radiated Field Strength and Conducted Emissions data contained within this report is calculated on the following basis:

Field Strength (dBuV/m) = Meter Reading (dBuV) + AF (dB/m) - Gain (dB) + Cable Loss (dB)

Conducted Voltage (dBuV) = Meter Reading (dBuV) + Cable Loss (dB) + LISN IL (dB)

Conducted Current (dBuA) = Meter Reading (dBuV) + Cable Loss (dB) - Transducer Factor (dBohms)

4.3. MEASUREMENT UNCERTAINTY

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

Test	Range	Equipment	Uncertainty k=2
Radiated Emissions	30-200MHz	Bicon 10m Horz	4.27dB
Radiated Emissions	30-200MHz	Bicon 10m Vert	4.28dB
Radiated Emissions	200-1000MHz	LogP 10m Horz	3.33dB
Radiated Emissions	200-1000MHz	LogP 10m Vert	3.39dB
Radiated Emissions	30-200MHz	Bicon 3m Horz	3.30dB
Radiated Emissions	30-130MHz	Bicon 3m Vert	4.84dB
Radiated Emissions	130-200MHz	Bicon 3m Vert	4.94dB
Radiated Emissions	200-1000MHz	LogP 3m Horz	3.46dB
Radiated Emissions	200-1000MHz	LogP 3m Vert	4.98dB
Radiated Emissions	1-6GHz	Horn	5.02dB
Radiated Emissions	6-18GHz	Horn	5.34dB
Radiated Emissions	18-26GHz	Horn	6.60dB
Conducted Ant Port	30MHz-26GHz	Spectrum Analyzer	2.94

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a 902-928MHz transceiver model RFMD.

The radio is manufactured by Elster American Meter Co LLC.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
902 - 928	2GFSK	1.35	1.36

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an intergraded chip antenna, with a maximum gain of +0.5 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was RFM2_EMC, rev. 0.08.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the low, middle and high channels.

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

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop Computer	acer	ICONA TAB	LERK6020472190112D96500	Unknown
Laptop Power Supply	Delta Electronics	ADP-40TH A	ADT AP0400100221009402P105	None

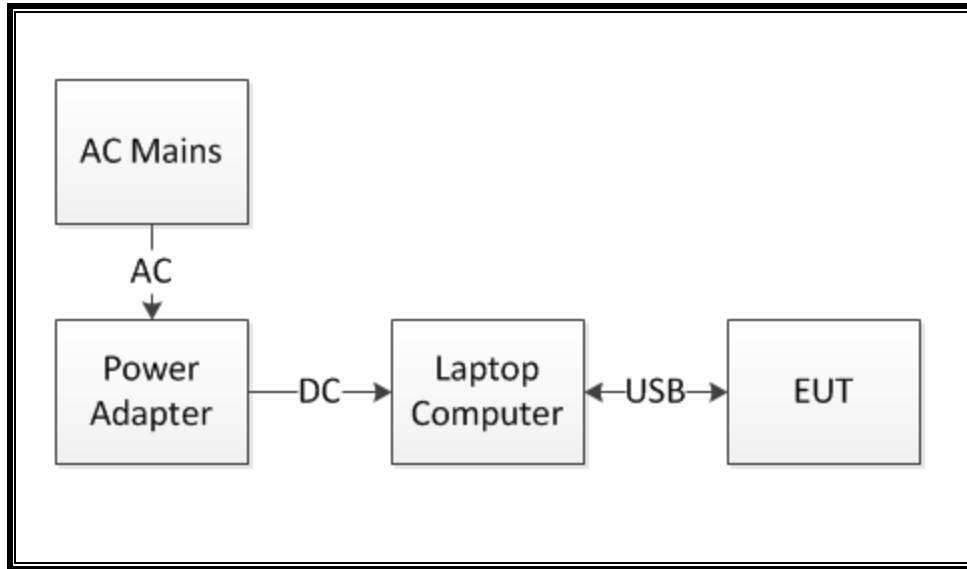
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	0	USB	USB	1.8m	None

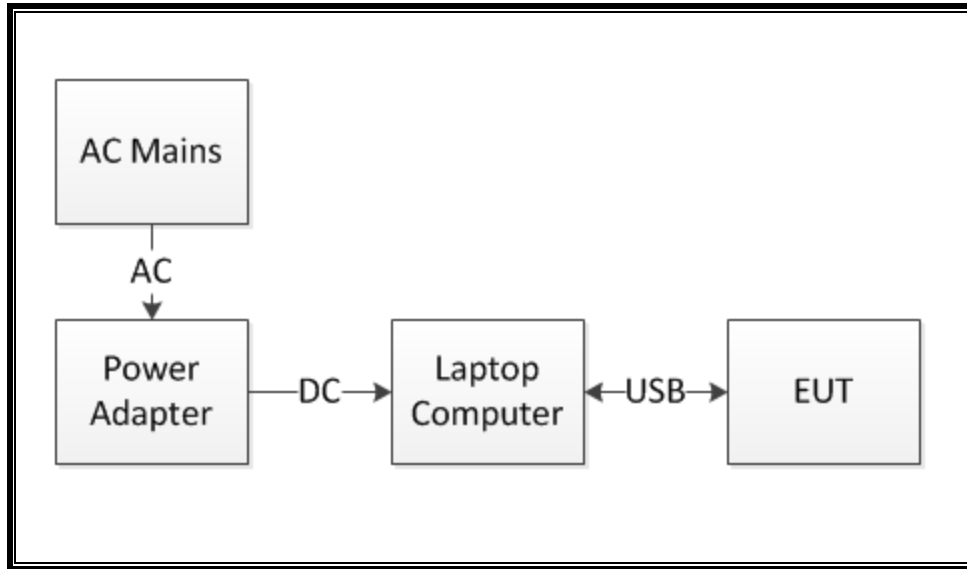
TEST SETUP

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

SETUP DIAGRAM FOR TESTS



SETUP DIAGRAM FOR DIGITAL DEVICE TESTS



6. 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	Cal Date	Cal Due
Radiated Software	UL	UL EMC	Ver 9.5, Oct 09 , 2015		
Conducted Software	UL	UL EMC	Ver 9.5, May 17 2012		
Spectrum Analyzer	Agilent	N9030A (PXA)	EMC4360	1/8/2016	1/31/2017
Near Field Probe	EMCO	7405	1270	N/A	N/A
Test Receiver	Rhode & Schwarz	ESCI	EMC4328	12/18/2014	12/30/2015
Loop Antenna	ETS - Lindgren	6502	201021	7/31/2015	7/31/2016
Log-P Antenna	Chase	UPA6109	EMC4258	4/27/2015	4/27/2016
Bicon Antenna	Electro-Metrics	VBA6106A	EMC4323	12/18/2014	12/31/2015
Antenna Array	UL	BOMS	EMC4276	11/15/2015	11/30/2016
EMI Test Receiver	Rohde & Schwarz	ESU	EMC4323	1/2/2016	1/31/2017

7. ANTENNA PORT TEST RESULTS

7.1. NORMAL OPERATING MODE

7.1.1. 20 dB BANDWIDTH

LIMIT

15.247(a)(1)(i)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

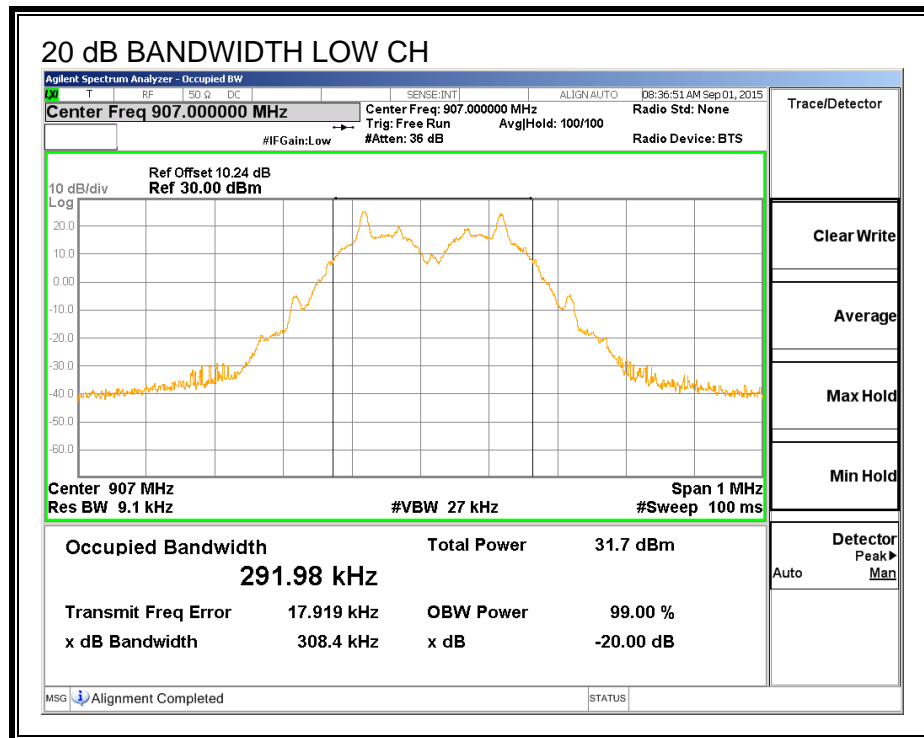
TEST PROCEDURE

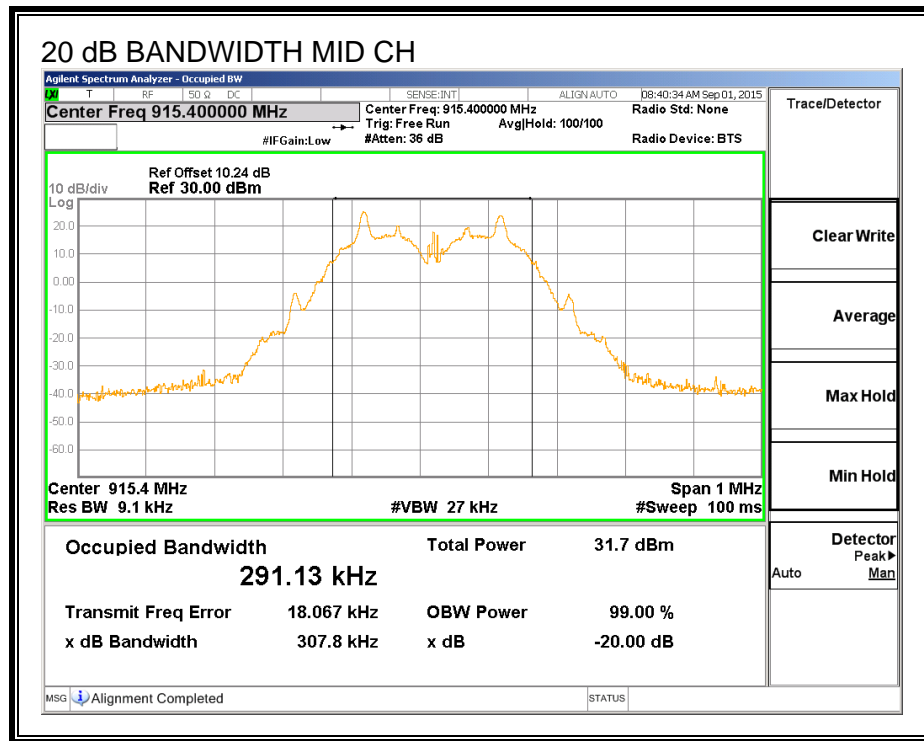
Testing of 20dB Bandwidth was conducted in accordance to C63.10:2013 section 6.9.2

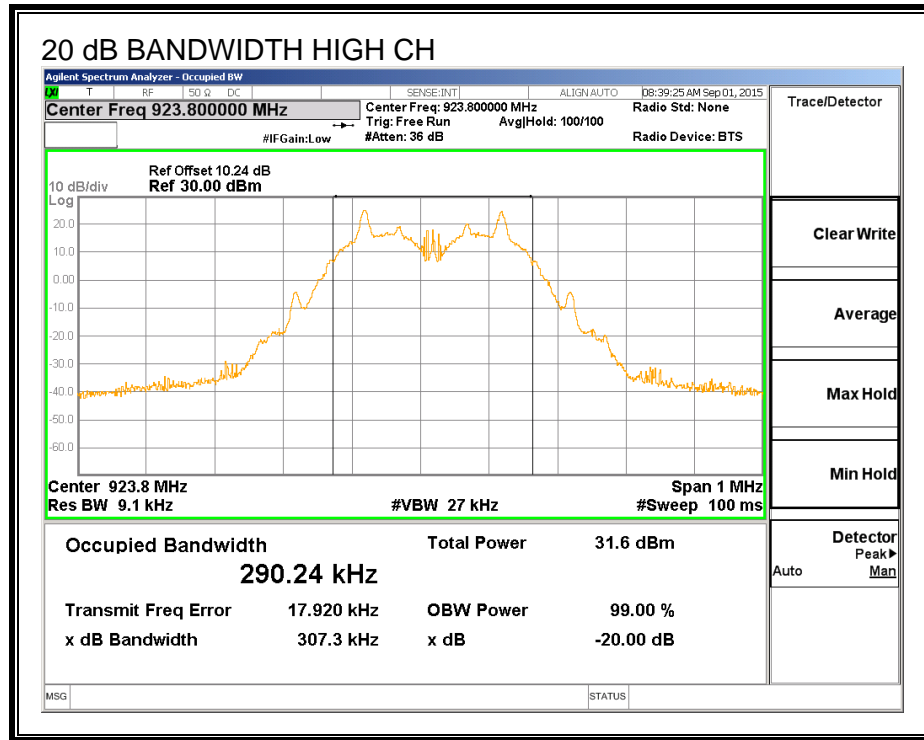
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	907	308.4
Middle	915.4	307.8
High	923.8	307.3

20 dB BANDWIDTH







7.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

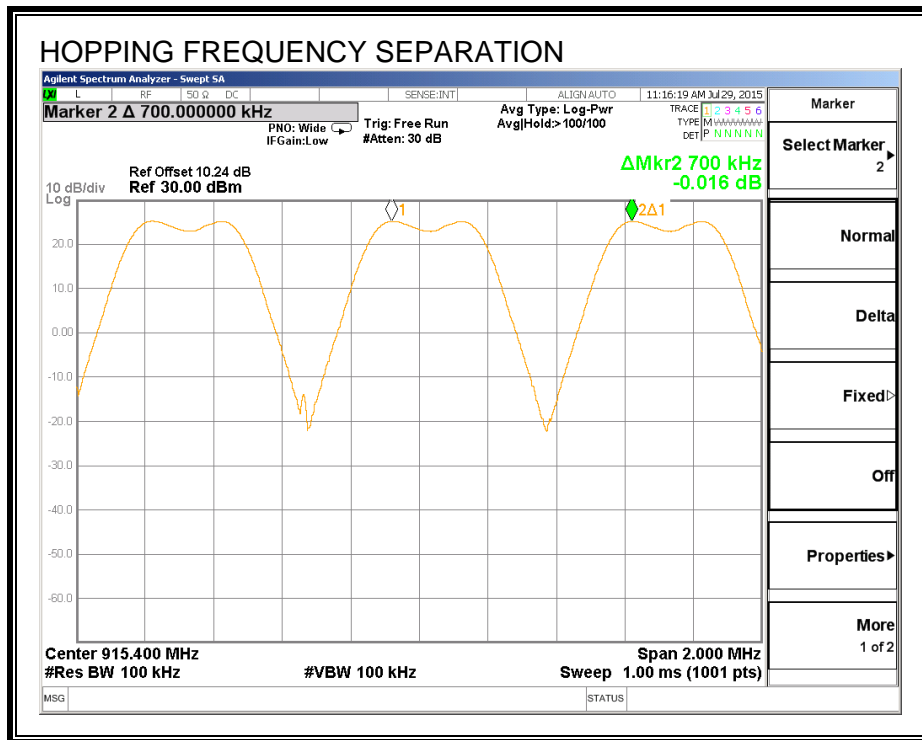
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (i)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

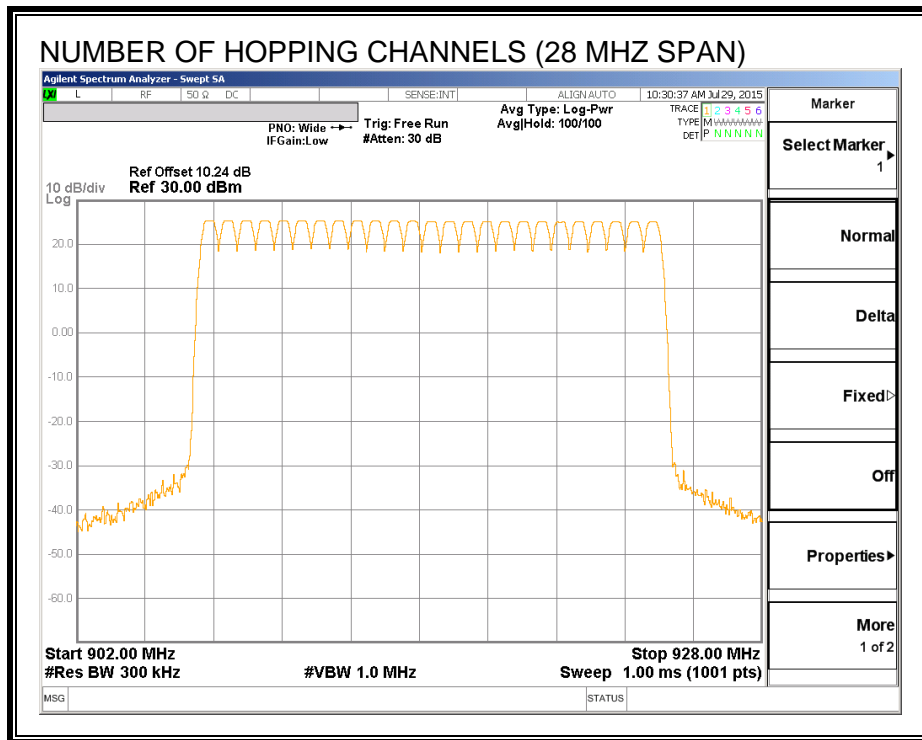
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 25 Channels observed.

NUMBER OF HOPPING CHANNELS



7.1.4. ON TIME AND DUTY CYCLE

LIMIT

FCC §15.247 (a) (1) (i)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

Manufacturer provided data to show the worst case possible duty cycle and maximum on time.

In addition to data provided by manufacturer a normal operating sample of the EUT was used to measure the on time. When the transmission is activated on the EUT, the transmission either stops after it initiates communication with the meter or times out after device cannot communicate with meter. To observe the maximum on time, testing was performed with no meter within the range of the EUT

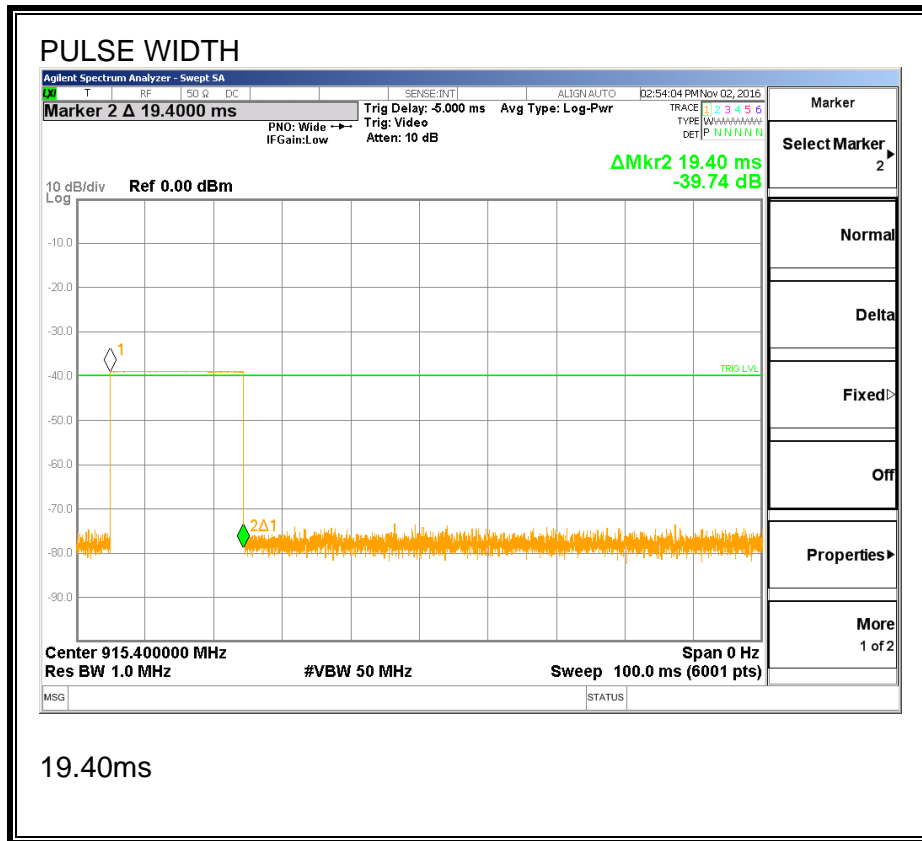
RESULTS

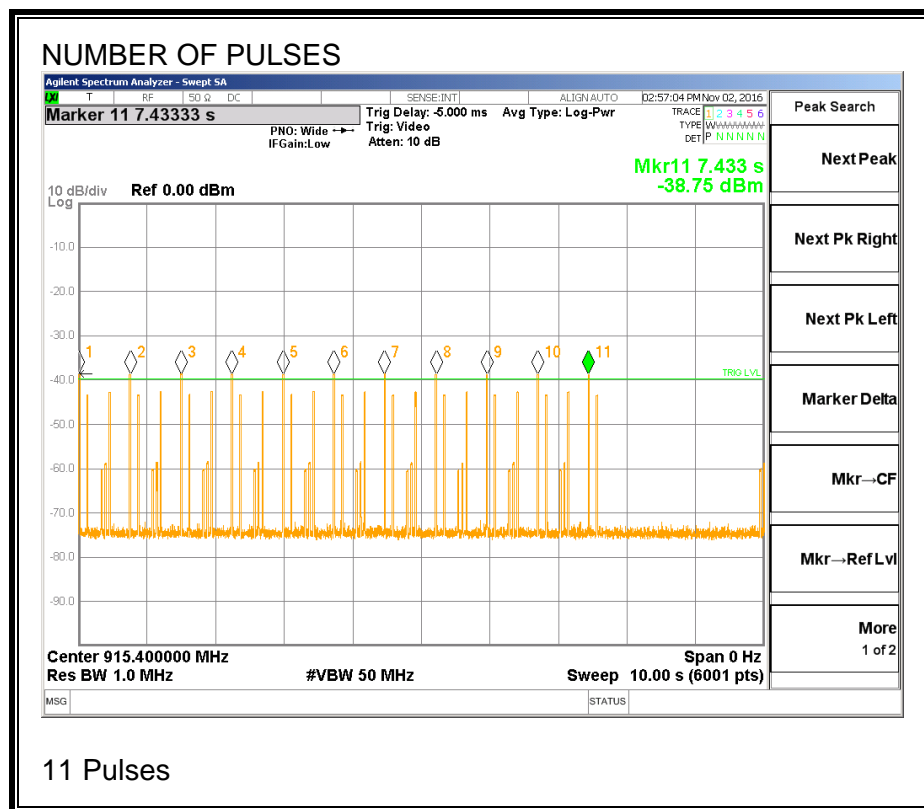
Manufactuer specifies that the maximum TX time per channel withing 10 seconds is 271.6mS. Maximum TX time per channel in 100mS is 38.8mS. Per DA 00-0705 this will result in duty cycle factor of -8.2dB.

The on time and duty cycle is explained in the theory of operationi document:
QZC-Rxxx_TheoryOfOperation_002.pdf

Packet Mode	Pulse Width (msec)	Number of Pulses in 10 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
1	19.4	11	0.213	0.4	-0.187

PULSE WIDTH





7.1.5. OUTPUT POWER

LIMIT

§15.247 (b) (2)

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted.

TEST PROCEDURE

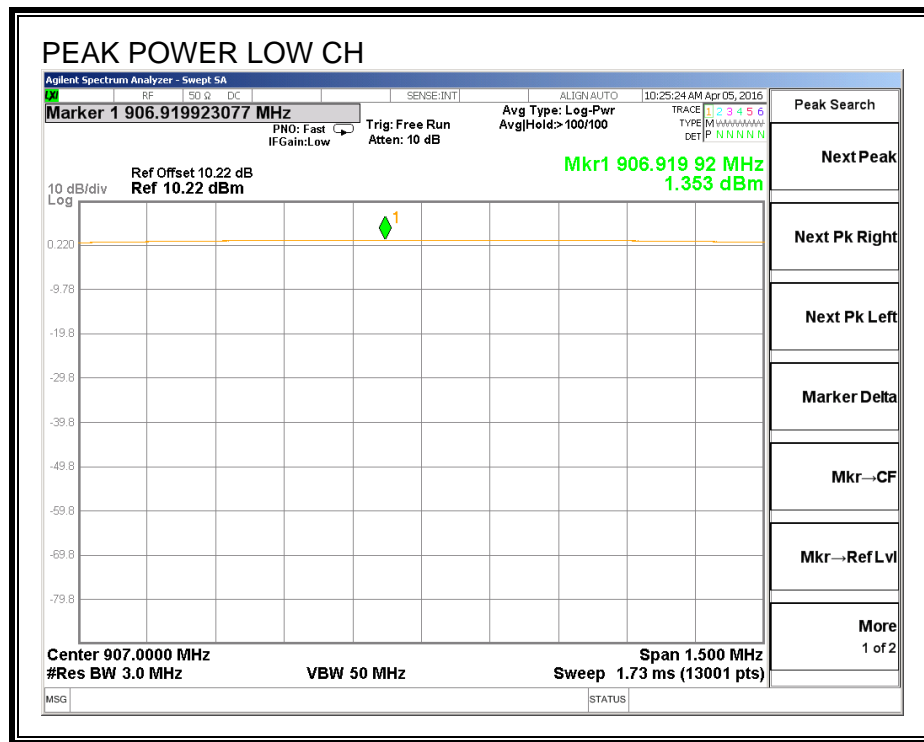
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

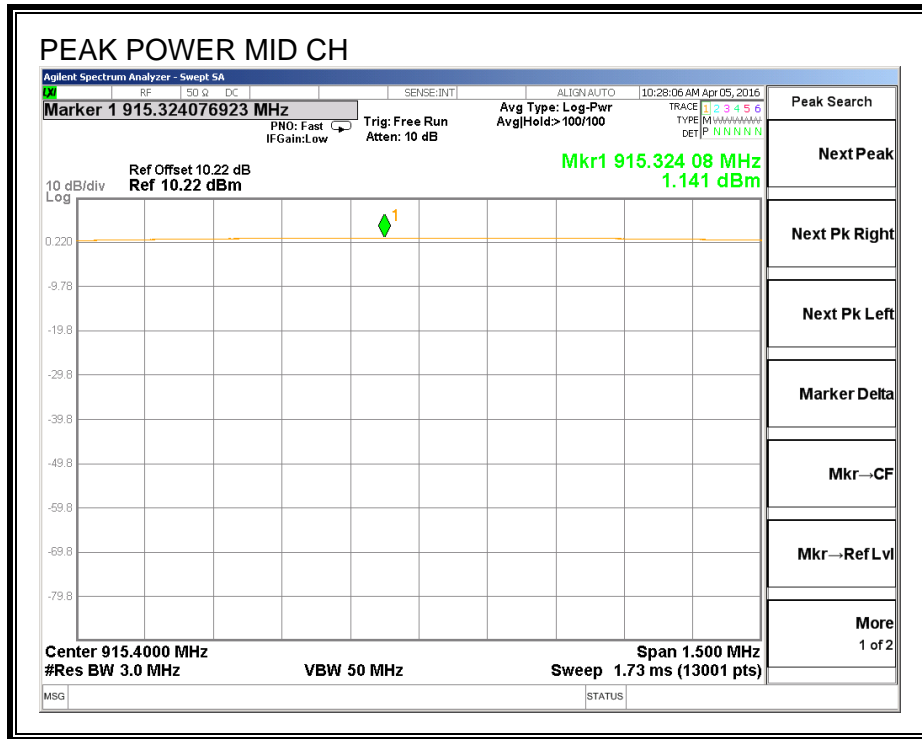
RESULTS

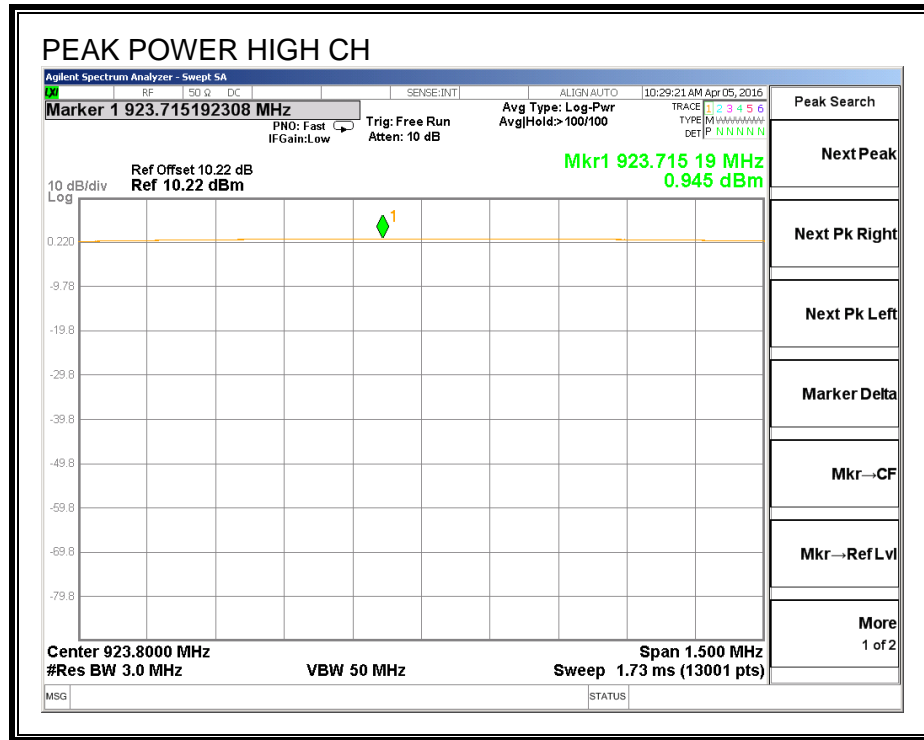
For 25 hopping channels

Channel	Frequency (MHz)	Output Power (dBm)	Antenna Gain (dBi)	Limit (dBm)	Margin (dB)
Low	907	1.35	0.50	24	-22.65
Middle	915.4	1.14	0.50	24	-22.86
High	923.8	0.95	0.50	24	-23.06

OUTPUT POWER







7.1.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.24 dB (including 10 dB pad and 0.24 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	1.16
Middle	2441	0.98
High	2480	0.75

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

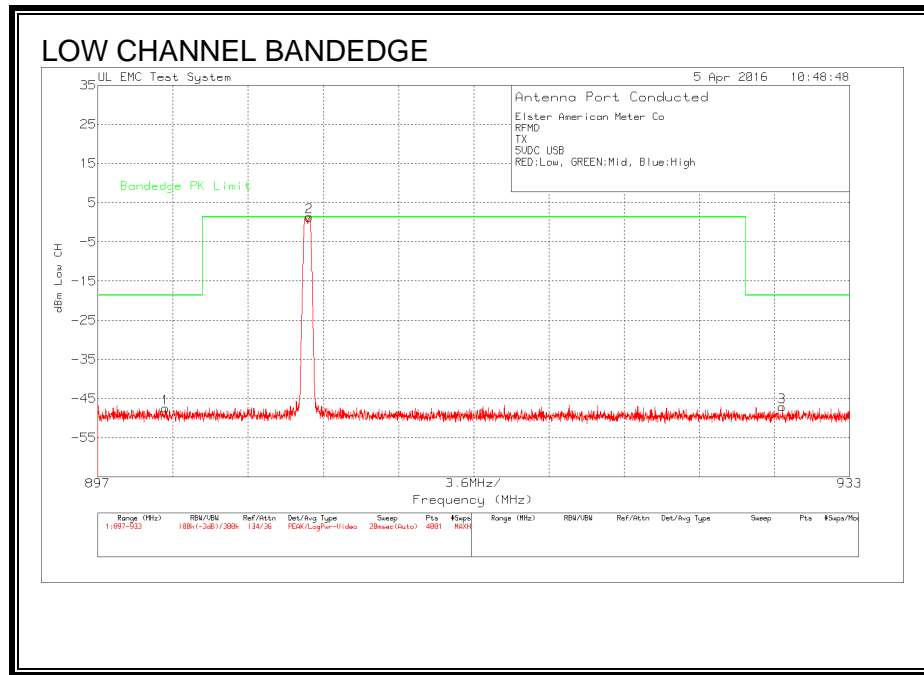
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

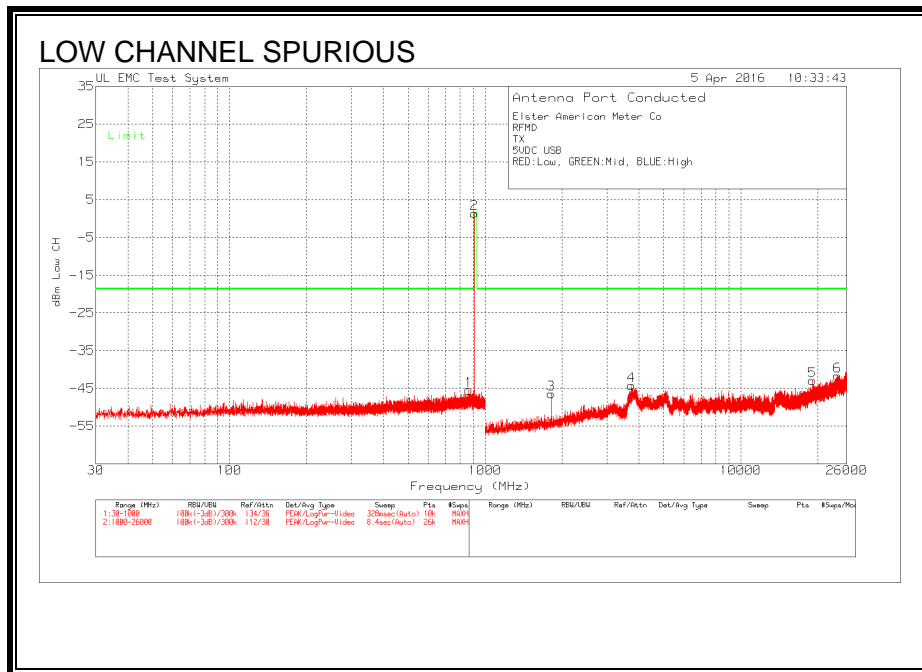
The spectrum from 30 MHz to 26 GHz is investigated (only up to 10GHz required) with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 902 and 928 MHz are investigated with the transmitter set to the normal hopping mode.

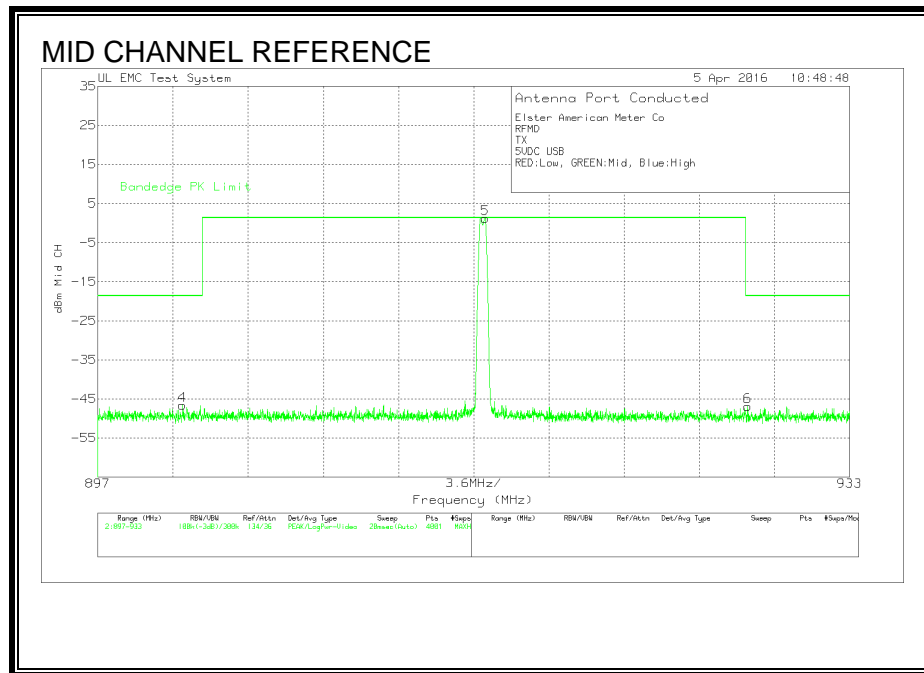
RESULTS

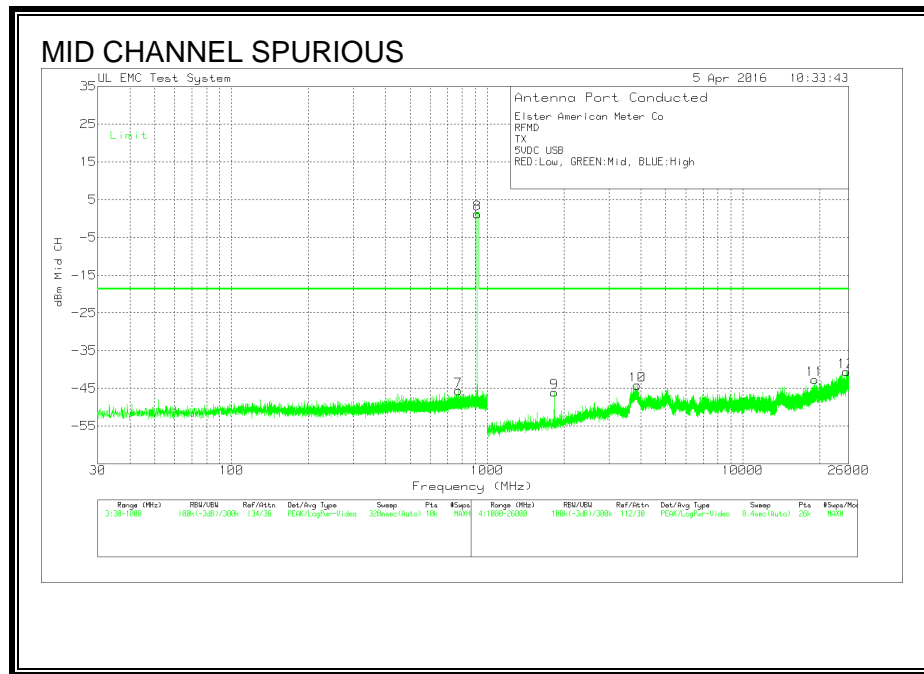
SPURIOUS EMISSIONS, LOW CHANNEL



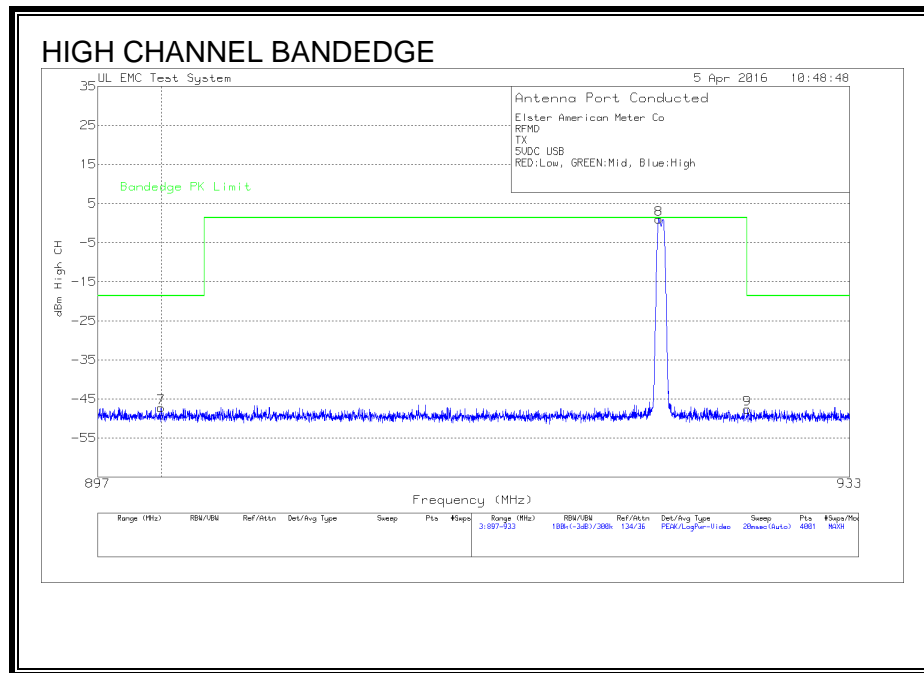


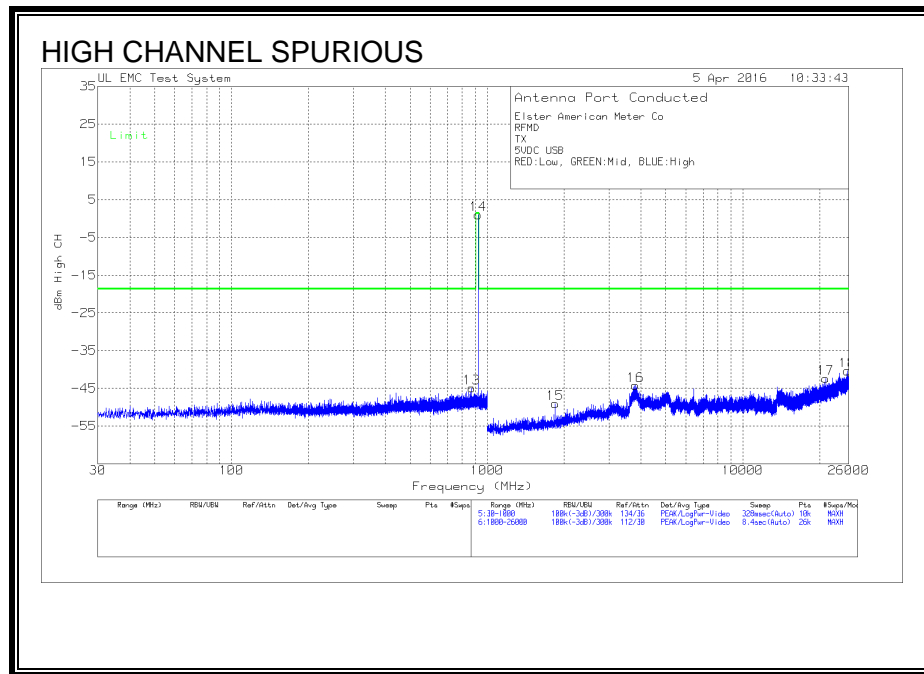
SPURIOUS EMISSIONS, MID CHANNEL



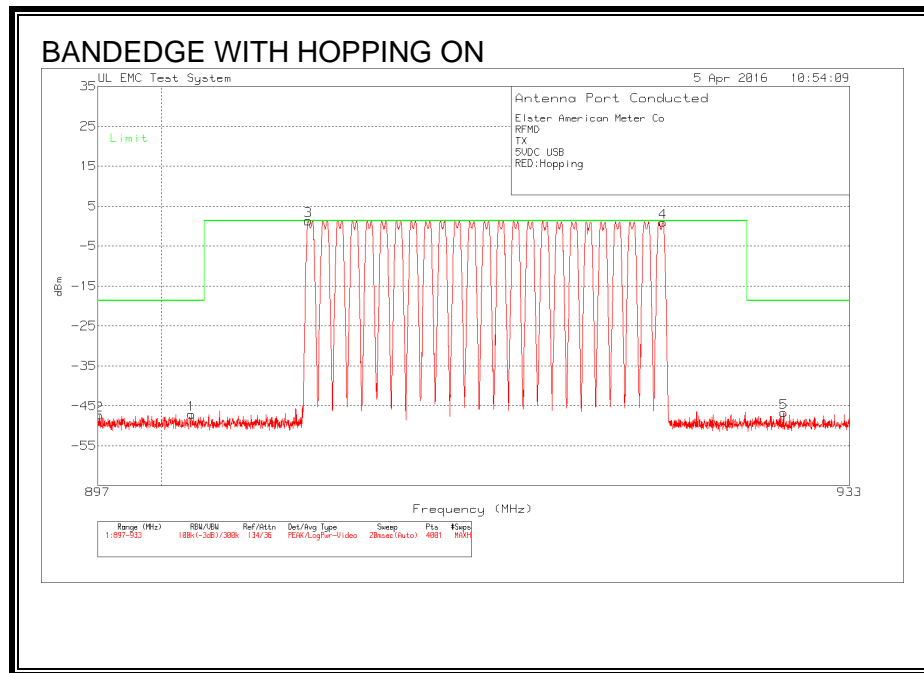


SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

FCC §15.109

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m	Field Strength Limit (dBuV/m) at 10 m
0.009 – 0.490	2400/F (kHz)	128.5 – 93.8	–
0.490 – 1.705	24000/F (kHz)	73.8 – 63.0	–
1.705 – 30.0	30	69.5 – 69.5	–
30 – 88	100	40	29.54
88 – 216	150	43.5	33.06
216 – 960	200	46	35.56
Above 960	500	54	43.52

Procedure

EUT on 80cm table above groundplane transmitting continuously on single selected channel. If any emissions related to the transceiver are observed then all three channels shall be measured. Between 9kHz-150kHz the RBW was 200Hz and VBW at least 3 times the resolution bandwidth. Between 150kHz-30MHz the RBW was 9kHz and VBW was at least 3 times the resolution bandwidth. Correlation measurements between the chamber and outside were conducted and data can be provided upon request.

Radiated Spurious Emissions measurements 30MHz – 1000MHz

EUT on 80cm table above groundplane transmitting continuously on either low, middle or high channel. The RBW used was 120kHz and VBW was at least 3 times the RBW.

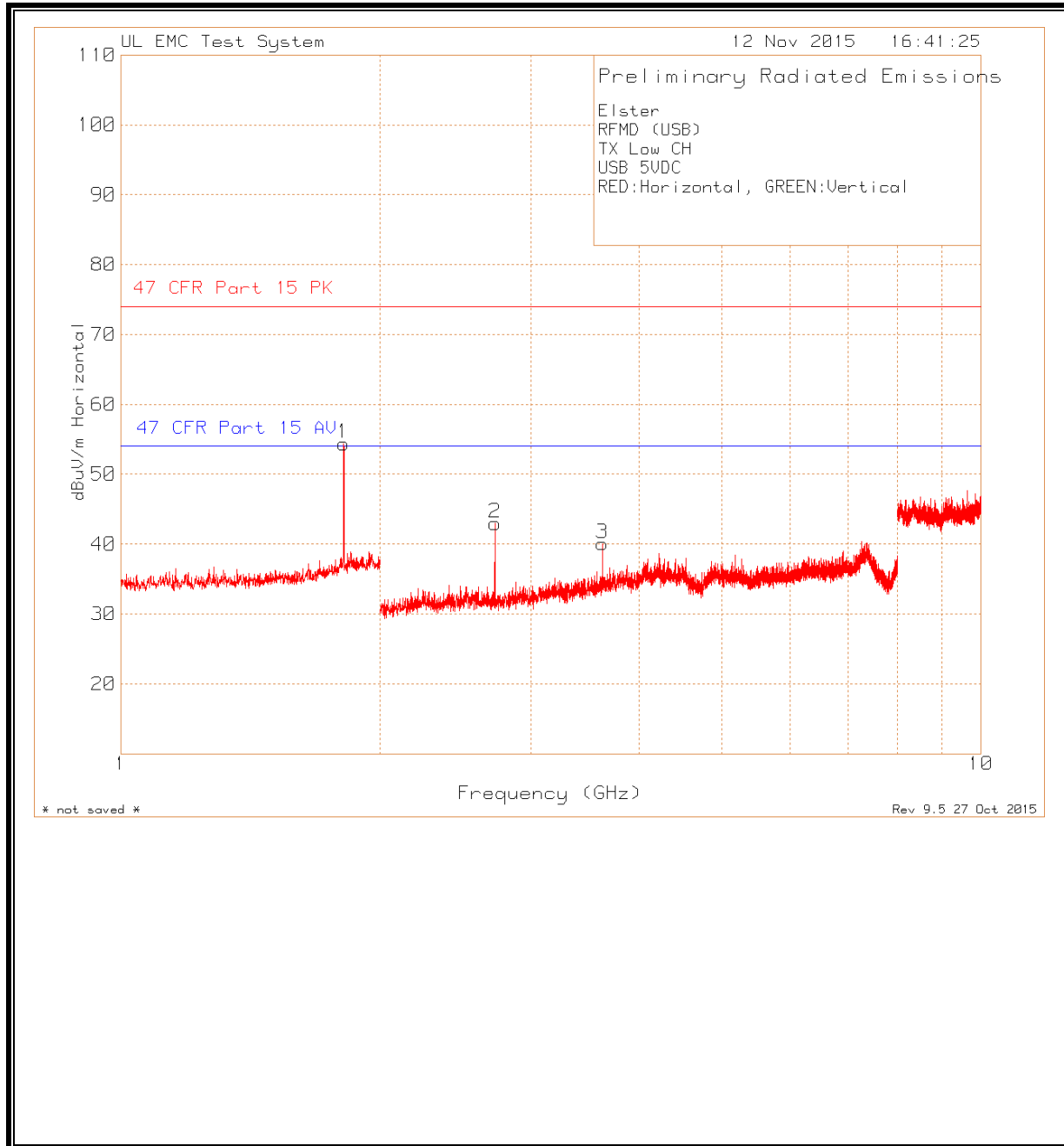
Radiated Spurious Emissions measurements above 1GHz

EUT on 150cm table above groundplane transmitting continuously on either low, middle or high channels. RBW was set to 1MHz and VBW was at least three times RBW.

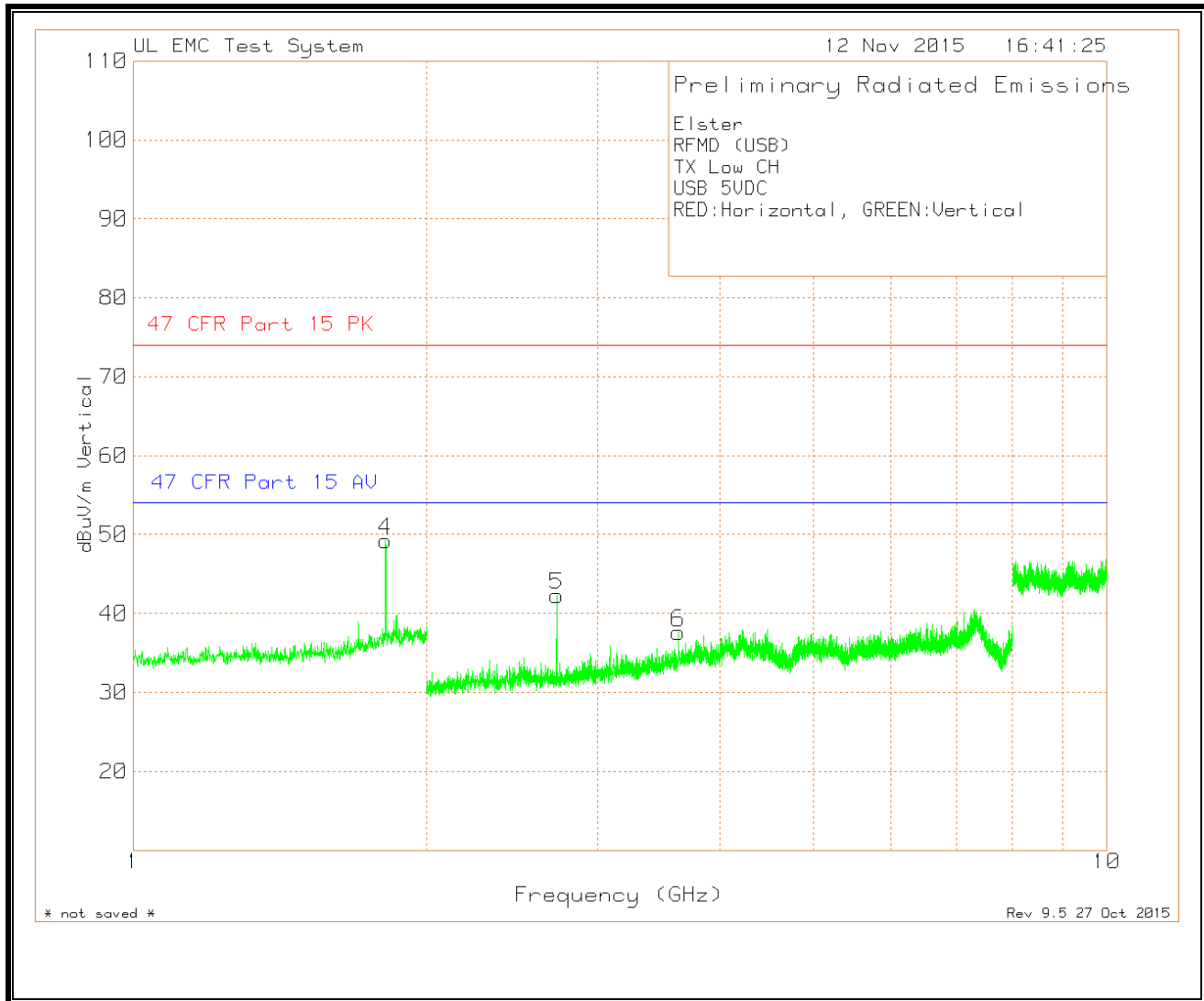
8.2. TRANSMITTER ABOVE 1 GHz

SPURIOUS EMISSIONS 1GHz TO 10 GHz (WORST-CASE CONFIGURATION)

Horizontal Plot



Vertical Plot



DATA

Trace Markers 1 - 2MHz

Marker No.	Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	BRF 200-4000MHz	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
**1	1.815	81.68	Pk	27.1	0.4	-54.81	54.37	-	-	-	-	0-360	99	H
**4	1.815	76.52	Pk	27.1	0.4	-54.81	49.21	-	-	-	-	0-360	99	V

** Not in restricted band. Limit does not apply

Trace Markers 2 - 4MHz

Marker No.	Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2	2.722	71.85	Pk	22.1	-50.96	42.99	74	-31.01	54	-11.01	0-360	99	H
3	3.629	66.71	Pk	23.3	-49.95	40.06	74	-33.94	54	-13.94	0-360	99	H
5	2.722	71.17	Pk	22.1	-50.96	42.31	74	-31.69	54	-11.69	0-360	150	V
6	3.628	64.27	Pk	23.3	-49.97	37.6	74	-36.4	54	-16.4	0-360	99	V

Pk - Peak detector

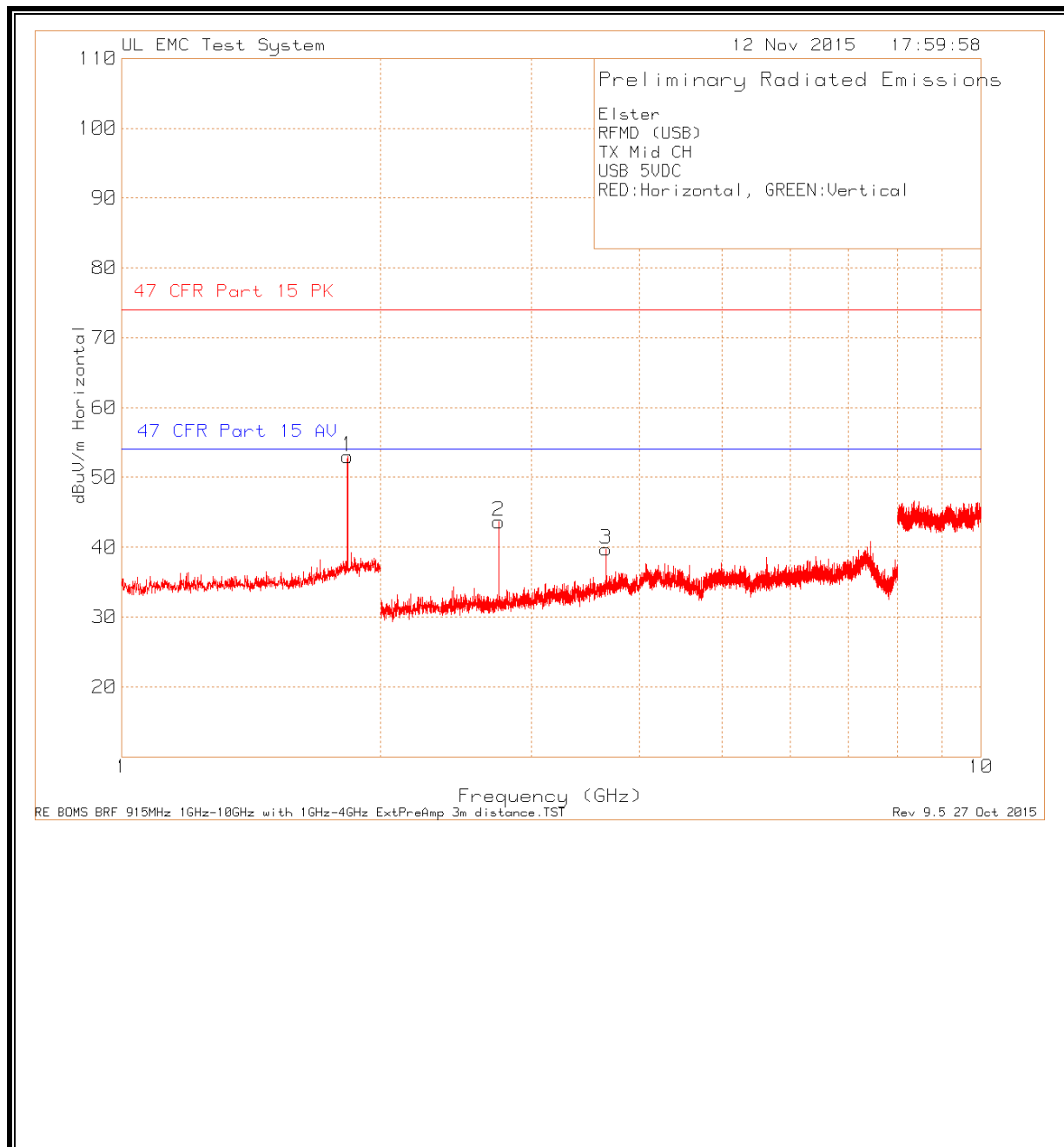
Radiated Emission Data

Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	BRF 200-4000MHz	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1.8138	82.25	Pk	27.1	0.4	-54.82	54.93	74	-19.07	-	-	351	100	H
Peak Level with Duty Cycle Correction (-8.2dB)						46.73	-	-	54	-7.27	351	100	H
1.8142	79.13	Pk	27.1	0.4	-54.82	51.81	74	-22.19	-	-	360	207	V
Peak Level with Duty Cycle Correction (-8.2dB)						43.61	-	-	54	-10.39	360	207	V

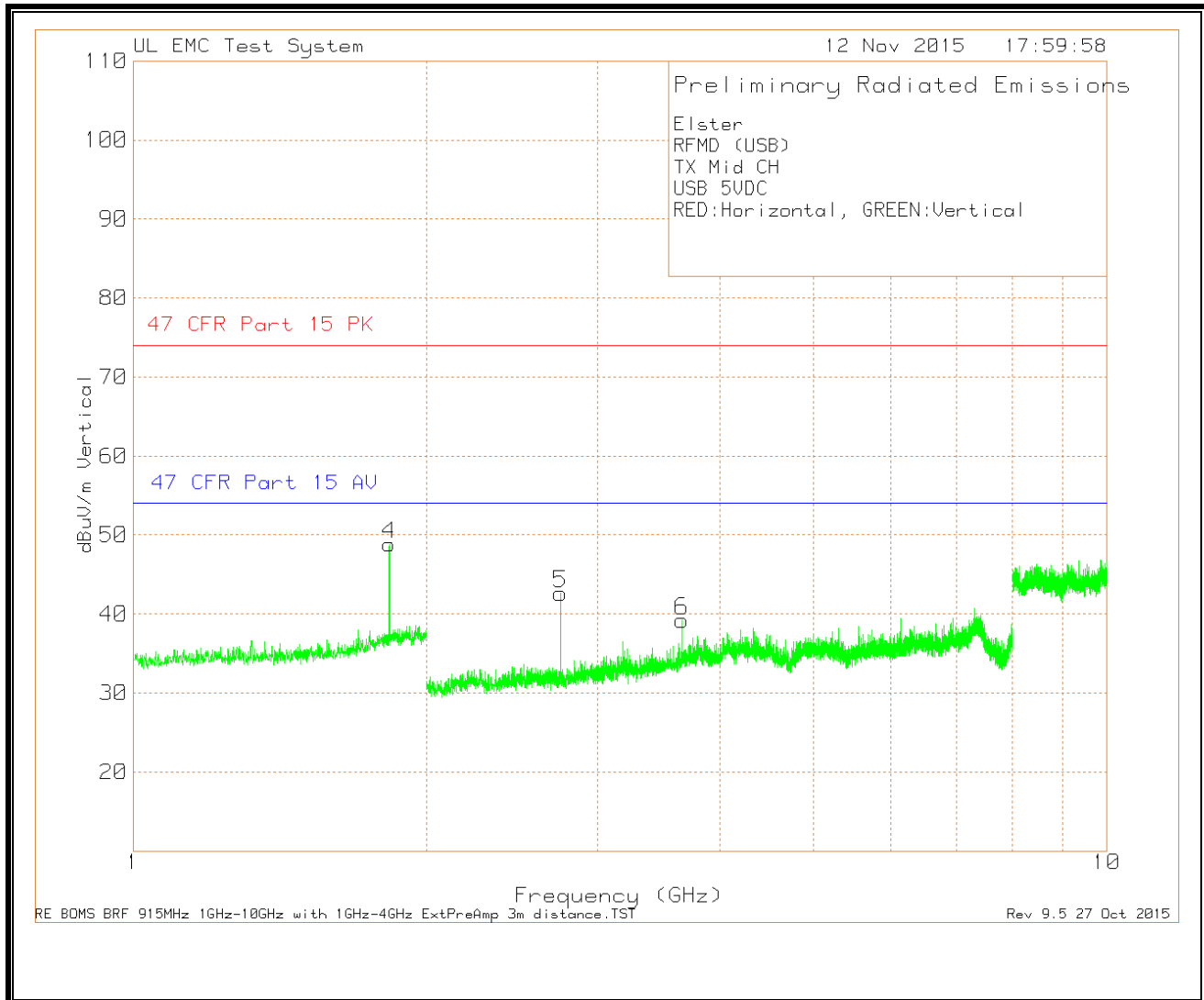
*Peak level with duty cycle satisfies the requirement therefore average measurements are not needed.

Pk - Peak detector

Horizontal Plot



Vertical Plot



DATA

Trace Markers 1 - 2MHz

Marker No.	Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	BRF 200-4000MHz	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
**1	1.832	80.13	Pk	27.1	0.4	-54.66	52.97	-	-	-	-	0-360	99	H
**4	1.832	76	Pk	27.1	0.4	-54.66	48.84	-	-	-	-	0-360	150	V

** Not in restricted band. Limit does not apply.

Trace Markers 2 - 4MHz

Marker No.	Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2	2.747	72.45	Pk	22.1	-50.87	43.68	74	-30.32	54	-10.32	0-360	99	H
3	3.662	65.66	Pk	23.4	-49.34	39.72	74	-34.28	54	-14.28	0-360	99	H
5	2.747	71.4	Pk	22.1	-50.87	42.63	74	-31.37	54	-11.37	0-360	150	V
6	3.662	65.15	Pk	23.4	-49.34	39.21	74	-34.79	54	-14.79	0-360	99	V

Pk - Peak detector

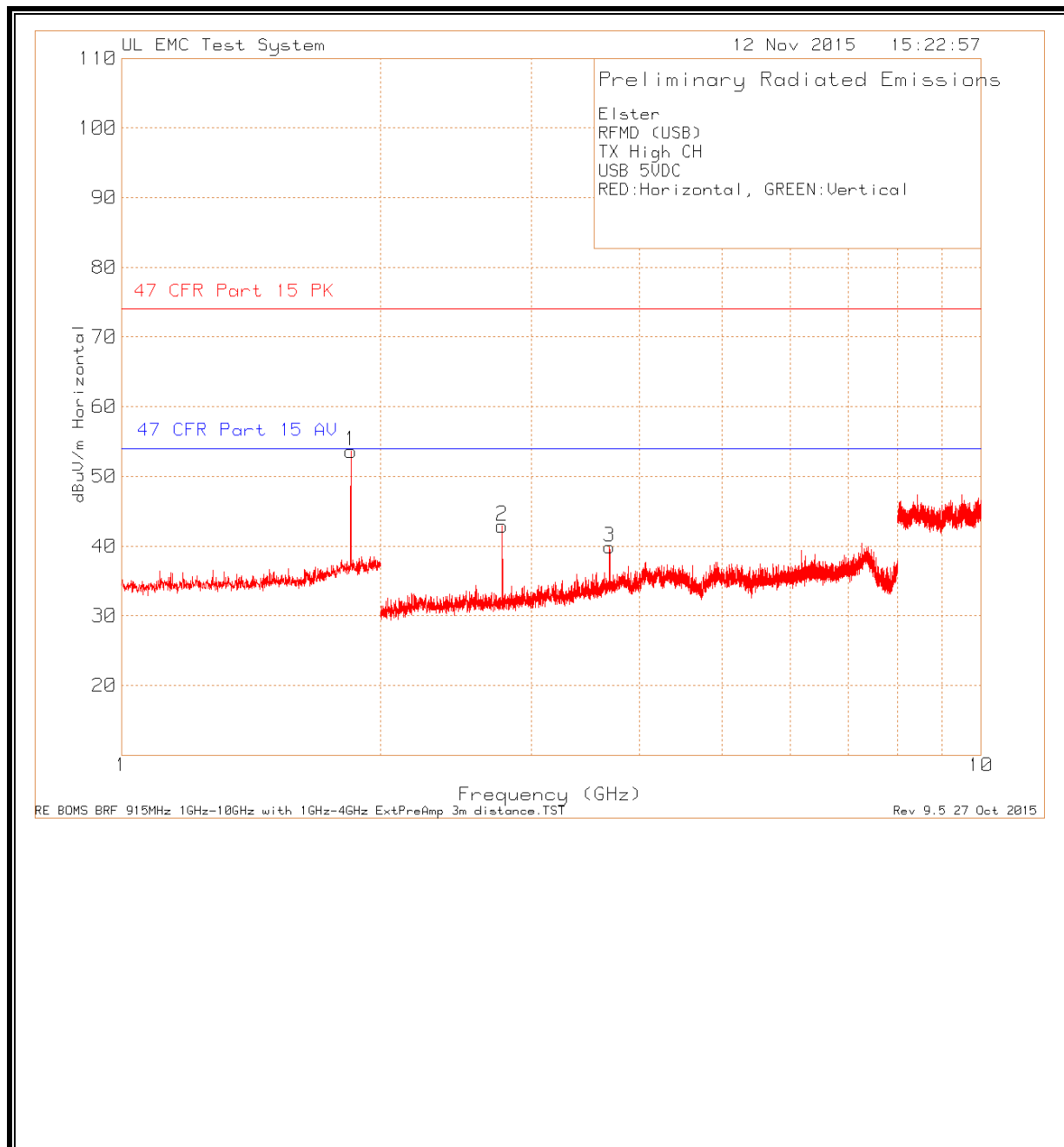
Radiated Emission Data

Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	BRF 200-4000MHz	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1.8306	81.09	Pk	27.1	0.4	-54.66	53.93	74	-20.07	-	-	336	105	H
Peak Level with Duty Cycle Correction (-8.2dB)						45.73	-	-	54	-8.27	336	105	H
1.8307	77.49	Pk	27.1	0.4	-54.66	50.33	74	-23.67	-	-	2	201	V
Peak Level with Duty Cycle Correction (-8.2dB)						42.13	-	-	54	-11.87	2	201	V

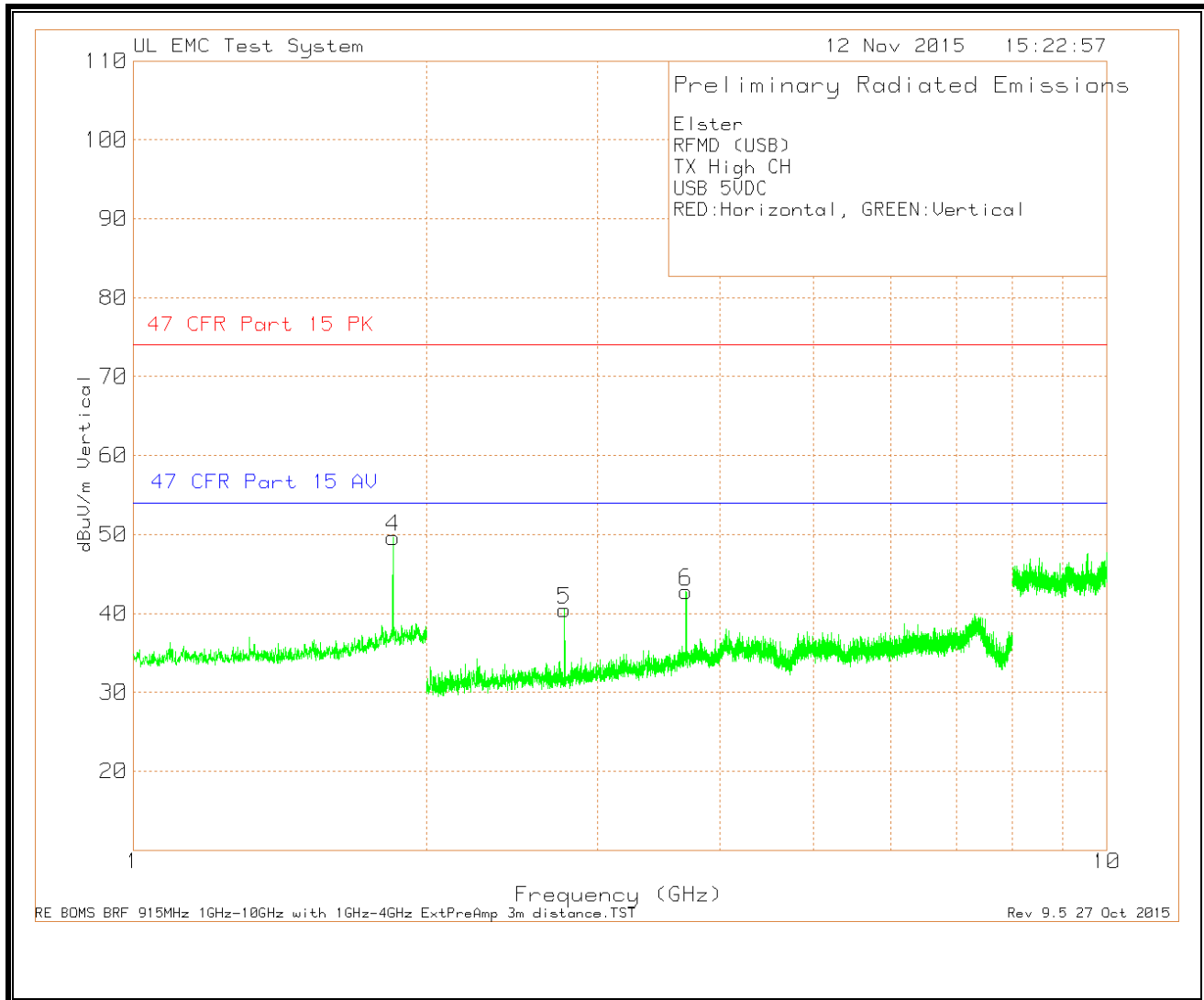
*Peak level with duty cycle satisfies the requirement therefore average measurements are not needed.

Pk - Peak detector

Horizontal Plot



Vertical Plot



DATA

Trace Markers 1 - 2GHz														
Marker No.	Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	BRF 200-4000MHz	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
**1	1.849	80.54	Pk	27.2	0.5	-54.62	53.62	-	-	-	-	0-360	99	H
**4	1.849	76.55	Pk	27.2	0.5	-54.62	49.63	-	-	-	-	0-360	99	V

** Not in restricted band. Limit does not apply.

Trace Markers 2 - 4GHz													
Marker No.	Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2	2.772	71.46	Pk	22.2	-50.76	42.9	74	-31.1	54	-11.1	0-360	150	H
3	3.696	65.75	Pk	23.5	-49.37	39.88	74	-34.12	54	-14.12	0-360	150	H
5	2.772	69.03	Pk	22.2	-50.76	40.47	74	-33.53	54	-13.53	0-360	150	V
6	3.696	68.63	Pk	23.5	-49.37	42.76	74	-31.24	54	-11.24	0-360	99	V

Pk - Peak detector

Radiated Emission Data													
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor	BRF 200-4000MHz	Gain/Loss (dB)	Corrected Reading dBuV/m	47 CFR Part 15 PK	Margin (dB)	47 CFR Part 15 AV	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1.8475	81.39	Pk	27.2	0.5	-54.61	54.48	74	-19.52	-	-	349	148	H
Peak Level with Duty Cycle Correction (-8.2dB)						46.28	-	-	54	-7.72	349	148	H
1.8479	78.39	Pk	27.2	0.5	-54.61	51.48	74	-22.52	-	-	2	234	V
Peak Level with Duty Cycle Correction (-8.2dB)						43.28	-	-	54	-10.72	2	234	V

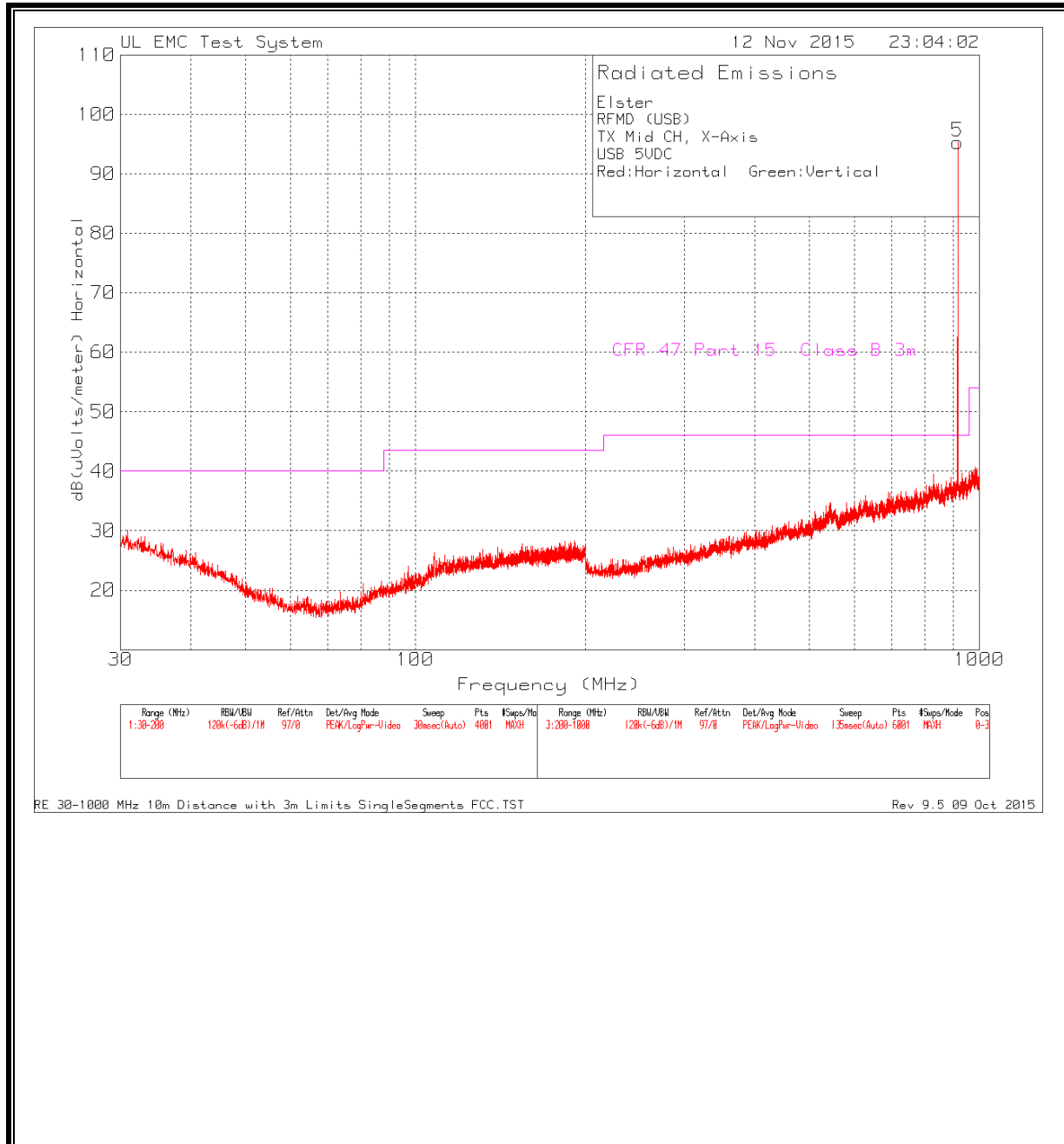
*Peak level with duty cycle satisfies the requirement therefore average measurements are not needed.

Pk - Peak detector

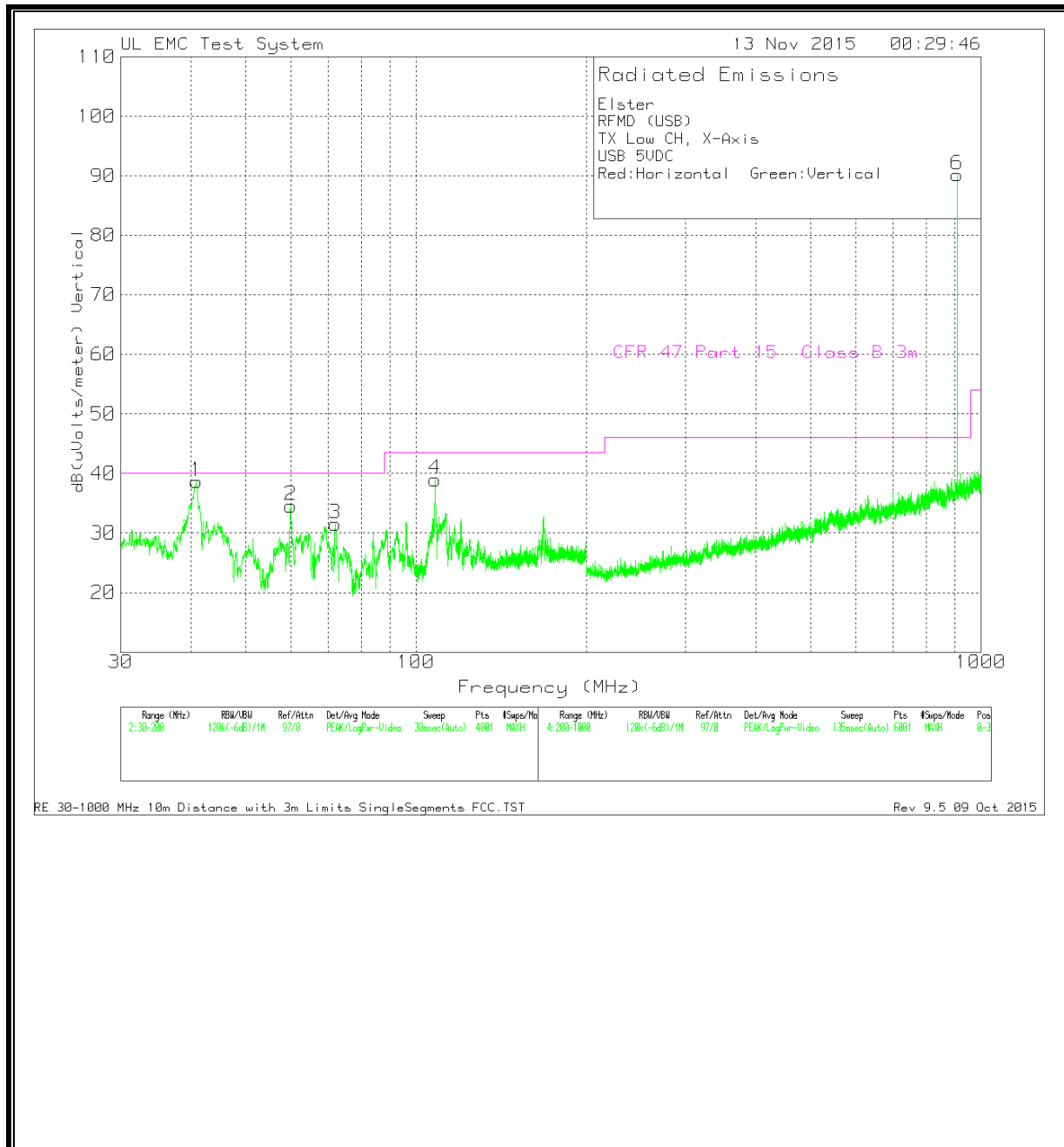
8.3. WORST-CASE BELOW 1 GHz

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

Horizontal Plot



Vertical Plot



DATA

* Not in restricted bands

Trace Markers

Marker No.	Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Cable Factor	10m to 3m	Corrected Reading dB(uVolts /meter)	CFR 47 Part 15 Class B 3m	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1	40.88	44.65	Pk	13.7	-30.2	10.5	38.65	40	-1.35	0-360	101	V
2	60.005	47.67	Pk	6.5	-30.1	10.5	34.57	40	-5.43	0-360	251	V
3	71.9475	44.62	Pk	6.4	-30	10.5	31.52	40	-8.48	0-360	399	V
4	108.03	46.3	Pk	12.1	-29.9	10.5	39	43.52	-4.52	0-360	101	V
5	907.1982	87.05	Pk	23.1	-26.8	10.5	93.85	-	-	0-360	103	H
6	907.0649	83.36	Pk	23.1	-26.8	10.5	90.16	-	-	0-360	399	V

Pk - Peak detector

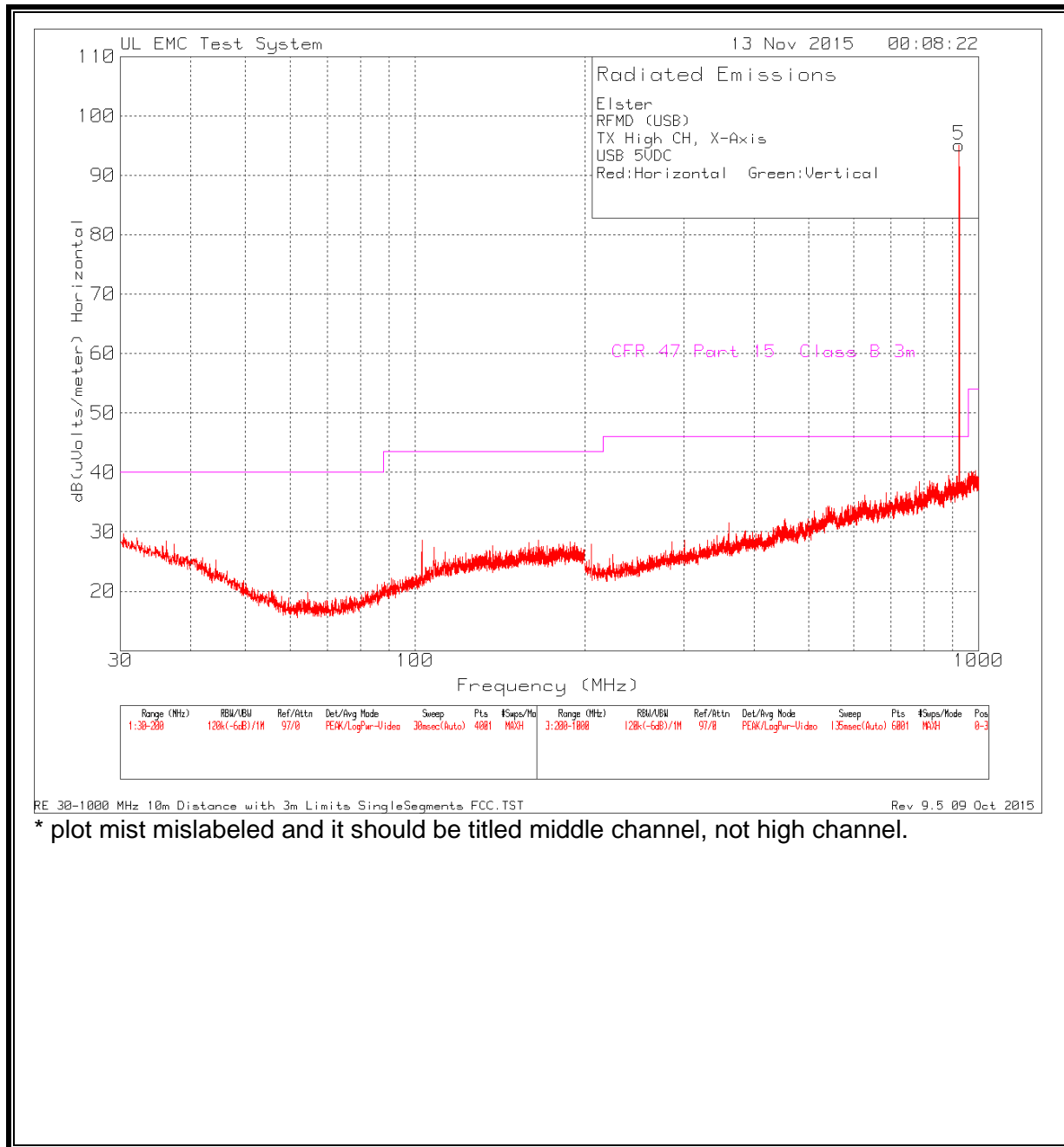
Radiated Emission Data

Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Cable Factor	10m to 3m	Corrected Reading dB(uVolts /meter)	CFR 47 Part 15 Class B 3m	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
40.8882	40.87	Qp	13.7	-30.2	10.5	34.87	40	-5.13	278	104	V
59.9913	45.04	Qp	6.5	-30.1	10.5	31.94	40	-8.06	326	265	V
108.0646	40.49	Qp	12.1	-29.9	10.5	33.19	43.52	-10.33	147	110	V

Qp - Quasi-Peak detector

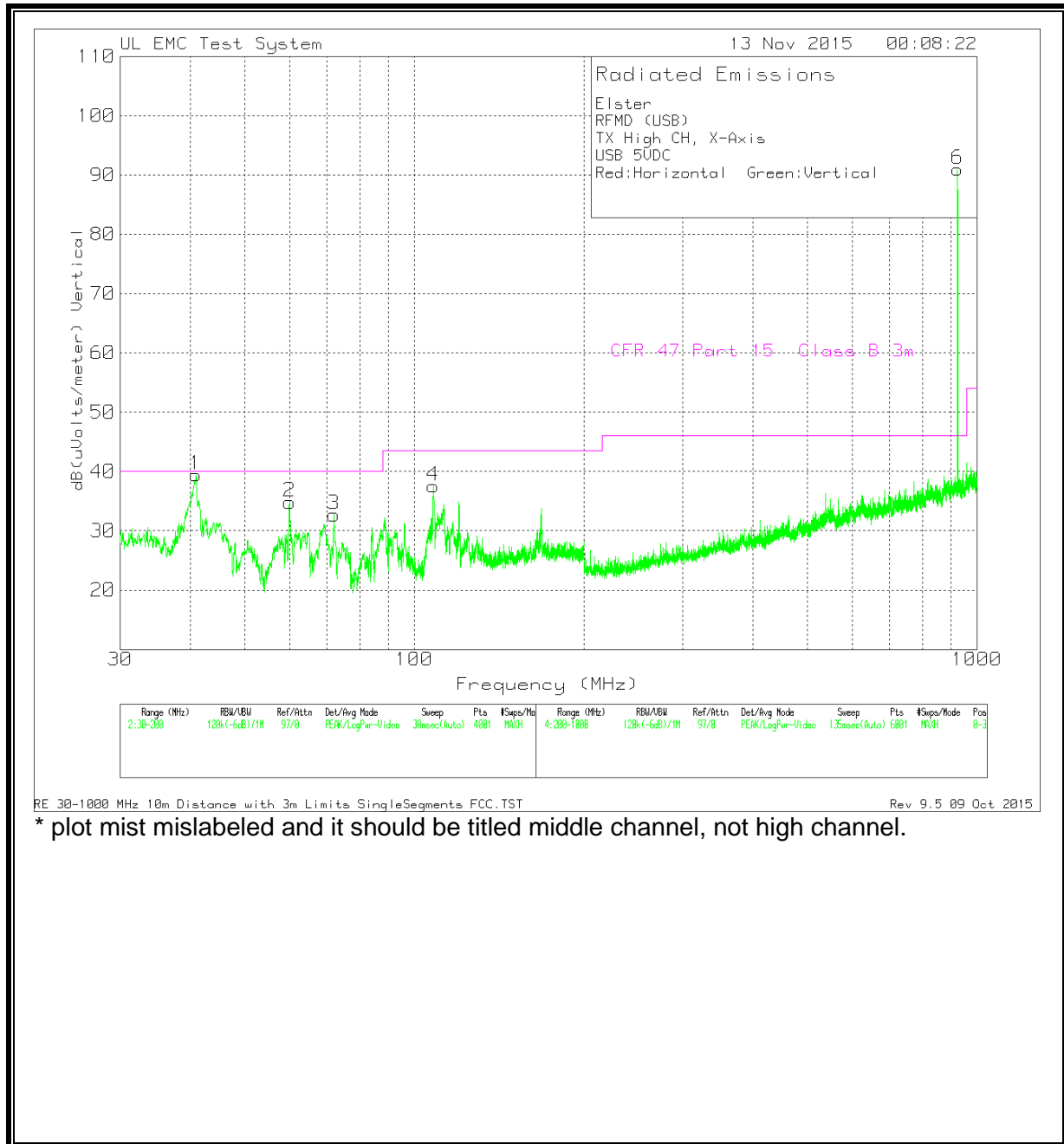
Rev 9.5 09 Oct 2015

Horizontal Plot



* plot mist mislabeled and it should be titled middle channel, not high channel.

Vertical Plot



DATA

* Not in restricted bands

Trace Markers

Marker No.	Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Cable Factor	10m to 3m	Corrected Reading dB(uVolts /meter)	CFR 47 Part 15 Class B 3m	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1	40.9225	45.02	Pk	13.6	-30.2	10.5	38.92	40	-1.08	0-360	101	V
2	63.405	48.3	Pk	6.2	-30.1	10.5	34.9	40	-5.1	0-360	251	V
3	71.99	47.51	Pk	6.4	-30	10.5	34.41	40	-5.59	0-360	251	V
4	108.03	44.06	Pk	12.1	-29.9	10.5	36.76	43.52	-6.76	0-360	101	V
5	915.3315	87.93	Pk	23	-26.1	10.5	95.33	-	-	0-360	102	H
6	915.3315	83.37	Pk	23	-26.1	10.5	90.77	-	-	0-360	399	V

Pk - Peak detector

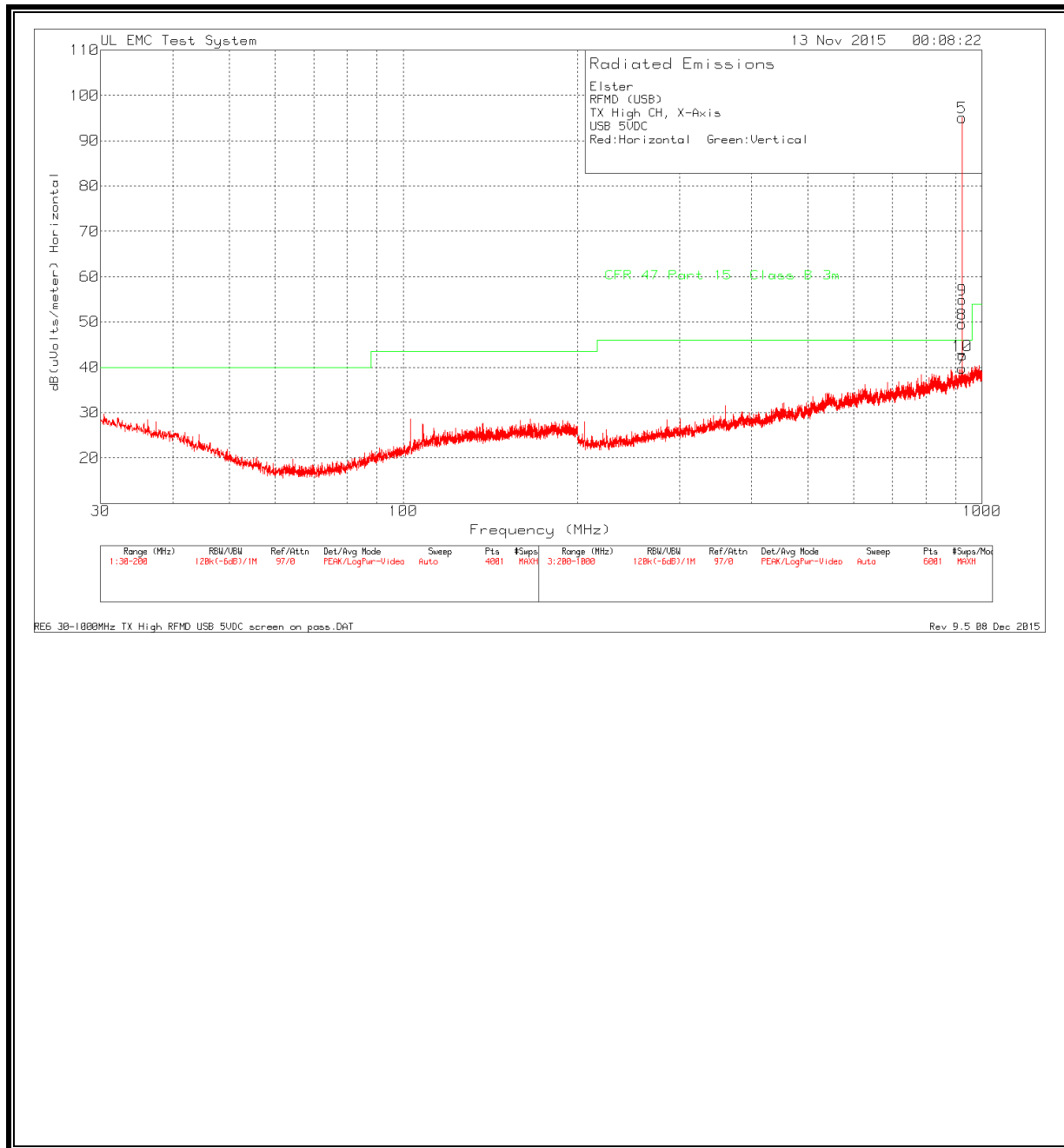
Radiated Emission Data

Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Cable Factor	10m to 3m	Corrected Reading dB(uVolts /meter)	CFR 47 Part 15 Class B 3m	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
40.8899	41.52	Qp	13.7	-30.2	10.5	35.52	40	-4.48	237	104	V
63.4239	43.18	Qp	6.2	-30.1	10.5	29.78	40	-10.22	84	245	V
71.9943	42.99	Qp	6.4	-30	10.5	29.89	40	-10.11	0	346	V

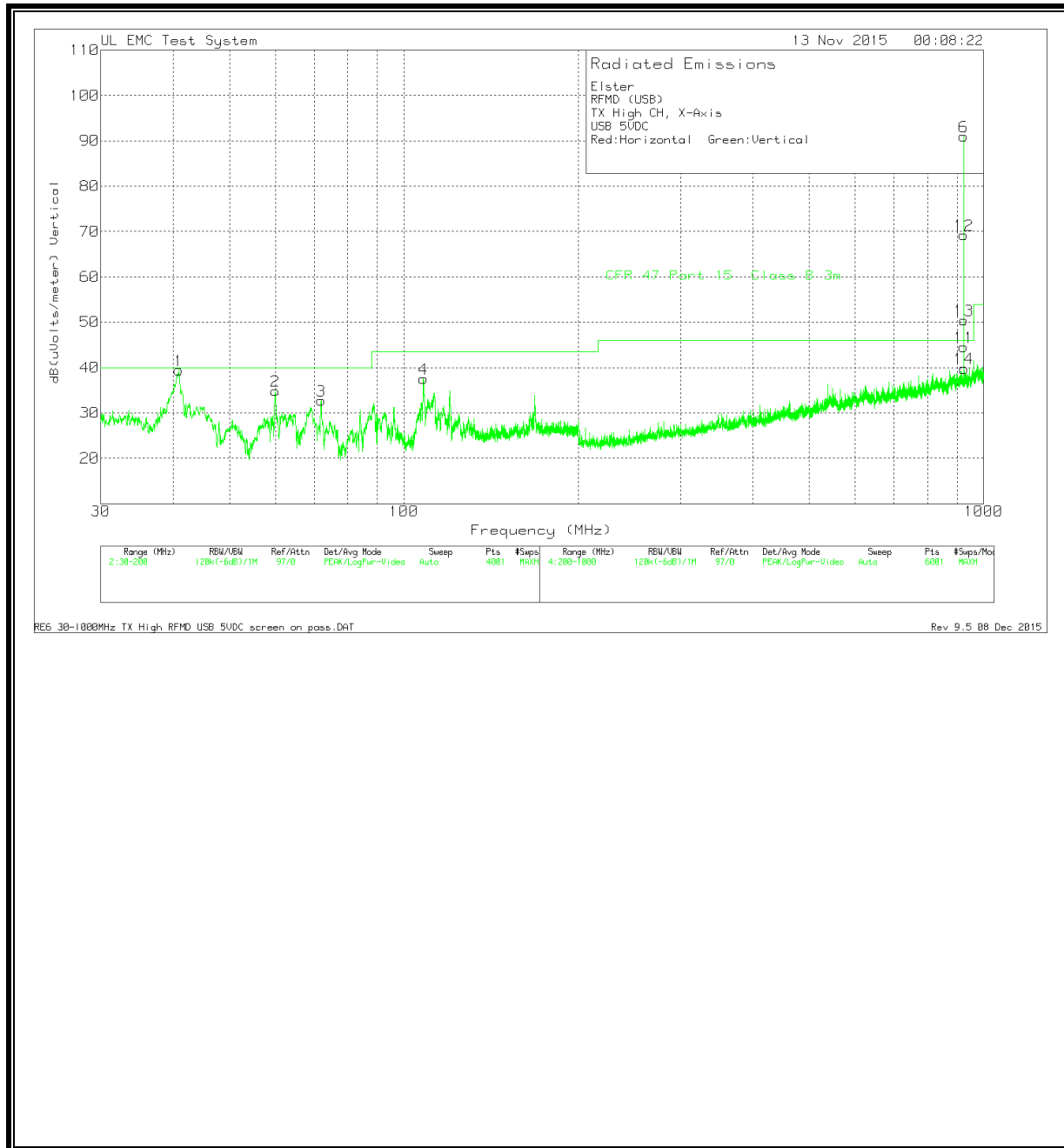
Qp - Quasi-Peak detector

Rev 9.5 09 Oct 2015

Horizontal Plot



Vertical Plot



DATA

Trace Markers

Marker No.	Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Cable Factor	10m to 3m	Corrected Reading dB(uVolts /meter)	CFR 47 Part 15 Class B 3m	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1	40.9225	45.54	Pk	13.6	-30.2	10.5	39.44	40	-0.56	0-360	102	V
2	60.005	47.94	Pk	6.5	-30.1	10.5	34.84	40	-5.16	0-360	251	V
3	71.99	45.81	Pk	6.4	-30	10.5	32.71	40	-7.29	0-360	398	V
4	108.03	44.87	Pk	12.1	-29.9	10.5	37.57	43.52	-5.95	0-360	251	V
5	923.7315	88.48	Pk	22.8	-26.7	10.5	95.08	-	-	0-360	103	H
7	923.3315	33.14	Pk	22.8	-26.7	10.5	39.74	46.02	-6.28	0-360	299	H
8	923.4649	42.95	Pk	22.8	-26.7	10.5	49.55	-	-	0-360	103	H
9	924.2649	48.19	Pk	22.8	-26.6	10.5	54.89	-	-	0-360	299	H
10	924.3982	35.8	Pk	22.8	-26.5	10.5	42.6	46.02	-3.42	0-360	103	H
6	923.7315	84.37	Pk	22.8	-26.7	10.5	90.97	-	-	0-360	399	V
11	923.4649	37.94	Pk	22.8	-26.7	10.5	44.54	46.02	-1.48	0-360	399	V
12	923.5982	62.63	Pk	22.8	-26.7	10.5	69.23	-	-	0-360	299	V
13	924.2649	43.73	Pk	22.8	-26.6	10.5	50.43	-	-	0-360	399	V
14	924.3982	32.99	Pk	22.8	-26.5	10.5	39.79	46.02	-6.23	0-360	399	V

Pk - Peak detector

Radiated Emission Data

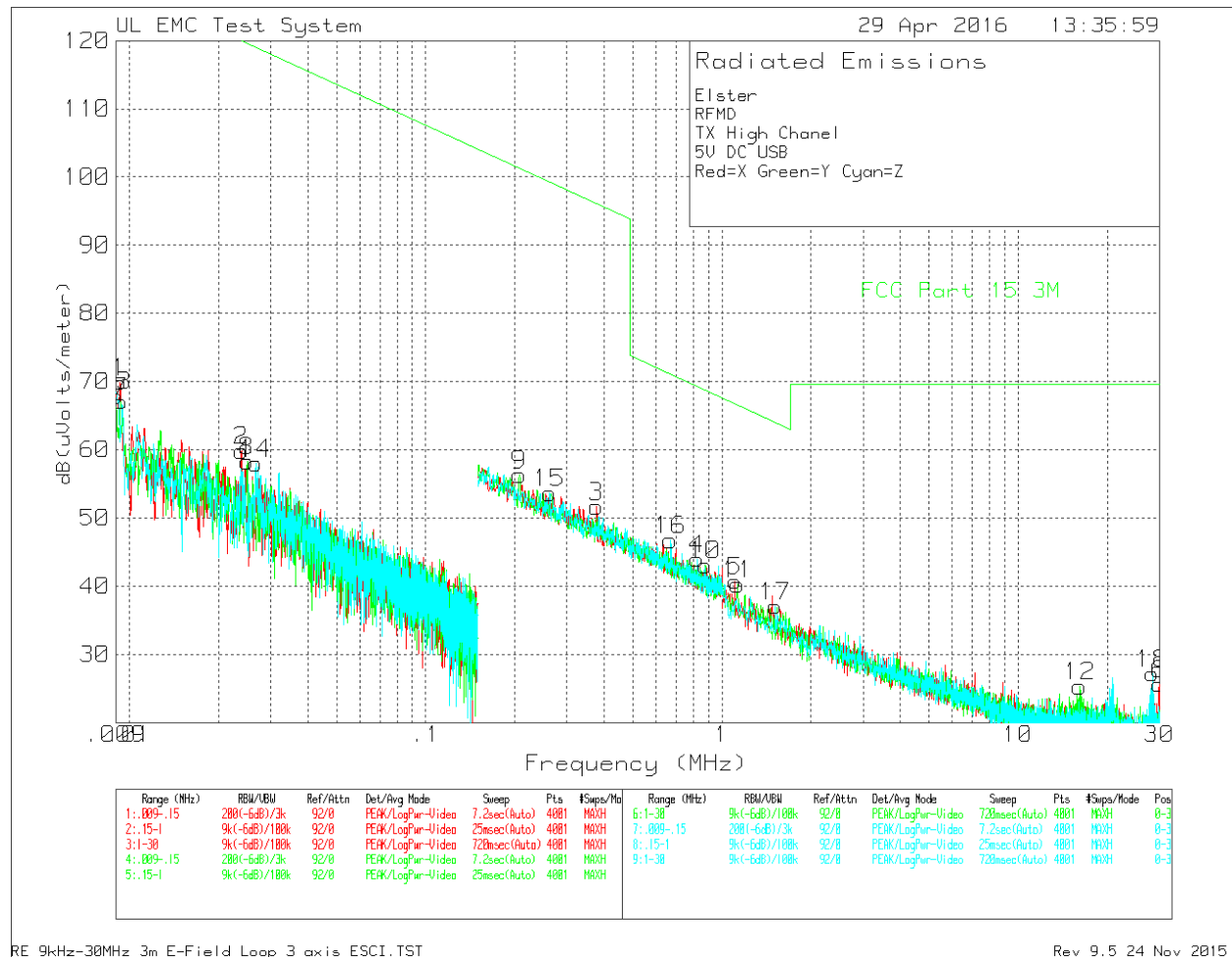
Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor	Cable Factor	10m to 3m	Corrected Reading dB(uVolts /meter)	CFR 47 Part 15 Class B 3m	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
108.0887	41.59	Qp	12.1	-29.9	10.5	34.29	43.52	-9.23	158	103	V
40.8875	42.72	Qp	13.7	-30.2	10.5	36.72	40	-3.28	278	101	V
59.9885	44.77	Qp	6.5	-30.1	10.5	31.67	40	-8.33	319	268	V
71.97	41.88	Qp	6.4	-30	10.5	28.78	40	-11.22	157	208	V

Qp - Quasi-Peak detector

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* Not in restricted bands

SPURIOUS EMISSIONS 9kHz TO 30 MHz (WORST-CASE CONFIGURATION)



* No emissions recorded. Only single channel was measured.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones off tests made in an open field based on KDB 937606.

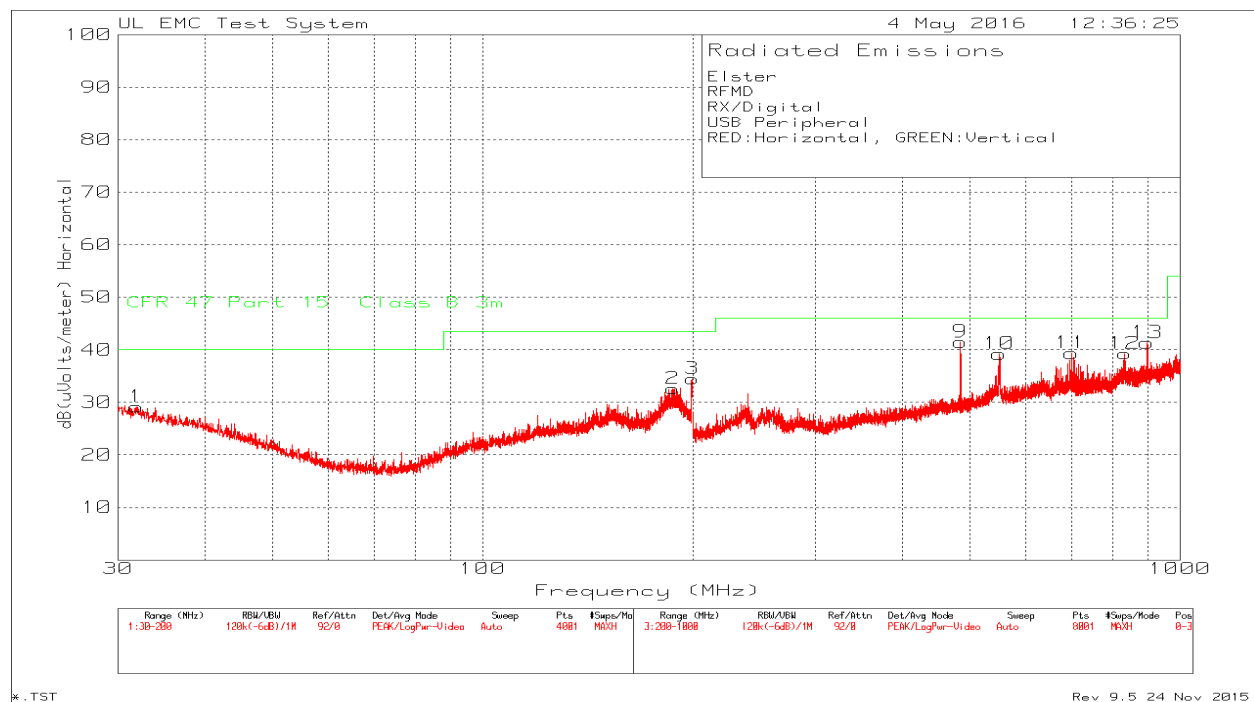
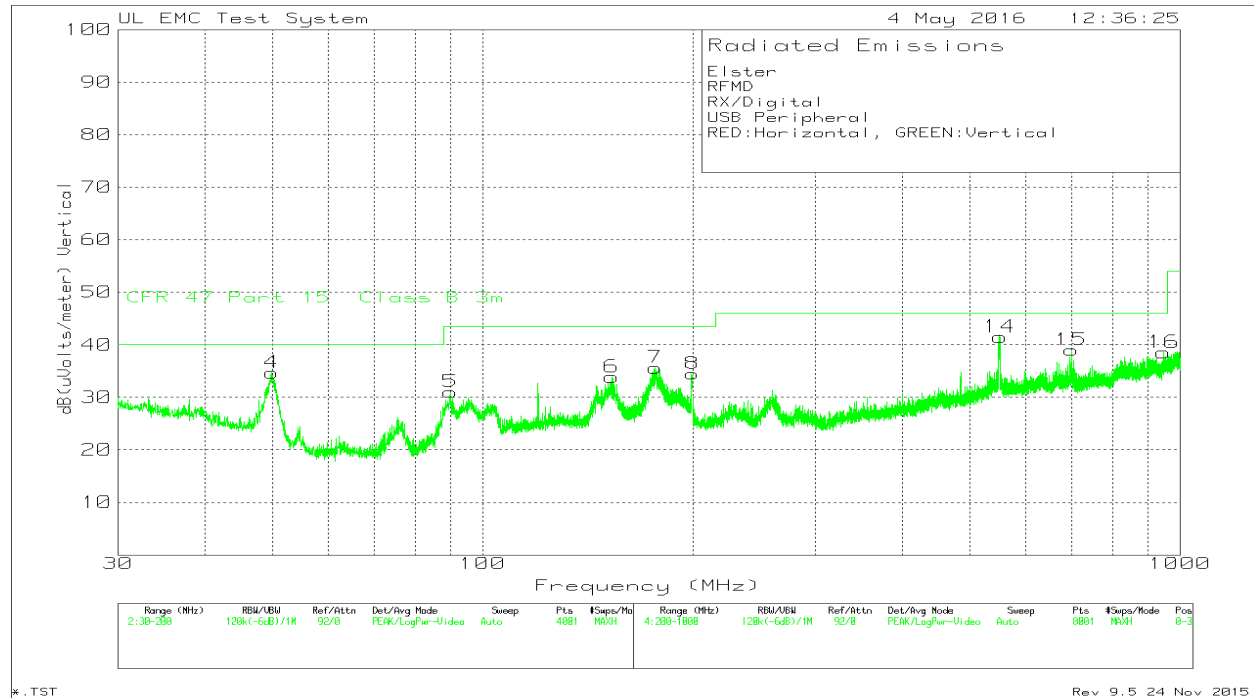
Elster
RFMD
TX High Chanel
5V DC USB
Red=X Green=Y Cyan=Z

Trace Markers	Test	Meter	Transducer	Gain/Loss	Corrected	Limit:1	2	3	4	5	6
No.	Frequency (MHz)	Reading	Factor (dB)	Factor (dB)	Reading dB(uVolts/meter)						
=====											
Receive Antenna X-Axis											
1	.00928	47.94dBuV Pk	22	0	69.94	128.23	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-58.29	-	-	-	-	-
2	.02388	43.48dBuV Pk	16.4	0	59.88	120.03	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-60.15	-	-	-	-	-
3	.37748	39.73dBuV Pk	11.9	0	51.63	96.06	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-44.43	-	-	-	-	-
4	.82585	31.87dBuV Pk	12	.1	43.97	69.27	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-25.3	-	-	-	-	-
5	1.10875	28.04dBuV Pk	12.6	.1	40.74	66.71	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-25.97	-	-	-	-	-
6	29.8985	16.22dBuV Pk	9.1	.3	25.62	69.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-43.92	-	-	-	-	-
Receive Antenna Y-Axis											
7	.00935	45.18dBuV Pk	21.9	0	67.08	128.17	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-61.09	-	-	-	-	-
8	.02496	41.89dBuV Pk	16.4	0	58.29	119.64	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-61.35	-	-	-	-	-
9	.2073	44.29dBuV Pk	12	0	56.29	101.27	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-44.98	-	-	-	-	-
10	.87974	30.86dBuV Pk	12.1	.1	43.06	68.72	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-25.66	-	-	-	-	-
11	1.1305	27.55dBuV Pk	12.6	.1	40.25	66.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-26.29	-	-	-	-	-
12	16.15975	14.1dBuV Pk	11	.2	25.3	69.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-44.24	-	-	-	-	-
Receive Antenna Z-Axis											
13	.00904	45.49dBuV Pk	22.4	0	67.89	128.47	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-60.58	-	-	-	-	-
14	.02671	41.78dBuV Pk	16.2	0	57.98	119.06	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-61.08	-	-	-	-	-
15	.26225	41.73dBuV Pk	11.9	0	53.63	99.23	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-45.6	-	-	-	-	-
16	.67057	34.75dBuV Pk	12	0	46.75	71.08	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-24.33	-	-	-	-	-
17	1.51475	24.57dBuV Pk	12.4	.1	37.07	64	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-26.93	-	-	-	-	-
18	28.405	17.58dBuV Pk	9.3	.3	27.18	69.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-42.36	-	-	-	-	-

LIMIT 1: FCC Part 15 3M
Pk - Peak detector

8.4. DIGITAL DEVICE (Data to be used for reference only)

EMISSIONS 30 TO 1000 MHz



Elster
RFMD
RX/Digital
USB Peripheral
RED:Horizontal, GREEN:Vertical

Trace Markers											
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1	2	3	4	5	6
dB (uVolts/meter)											
1	31.87	31.25dBuV Pk	17.4	-19.5	29.15	40	-	-	-	-	-
		Azimuth:0-360	Height:249	Horz	Margin (dB)	-10.85	-	-	-	-	-
2	187.3775	35.32dBuV Pk	15.9	-18.6	32.62	43.52	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-10.9	-	-	-	-	-
3	199.915	36.6dBuV Pk	16	-18.1	34.5	43.52	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-9.02	-	-	-	-	-
4	49.8475	43.66dBuV Pk	10.5	-19.5	34.66	40	-	-	-	-	-
		Azimuth:0-360	Height:101	Vert	Margin (dB)	-5.34	-	-	-	-	-
5	89.9675	41.12dBuV Pk	9.3	-19.4	31.02	43.52	-	-	-	-	-
		Azimuth:0-360	Height:101	Vert	Margin (dB)	-12.5	-	-	-	-	-
6	153.2075	38.58dBuV Pk	14.3	-19	33.88	43.52	-	-	-	-	-
		Azimuth:0-360	Height:101	Vert	Margin (dB)	-9.64	-	-	-	-	-
7	176.8375	39.23dBuV Pk	15.2	-18.8	35.63	43.52	-	-	-	-	-
		Azimuth:0-360	Height:101	Vert	Margin (dB)	-7.89	-	-	-	-	-
8	200	36.58dBuV Pk	16	-18.1	34.48	43.52	-	-	-	-	-
		Azimuth:0-360	Height:243	Vert	Margin (dB)	-9.04	-	-	-	-	-
9	484.4	41.65dBuV Pk	17.3	-17.5	41.45	46.02	-	-	-	-	-
		Azimuth:0-360	Height:199	Horz	Margin (dB)	-4.57	-	-	-	-	-
10	550.4	36.45dBuV Pk	19.9	-17.1	39.25	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-6.77	-	-	-	-	-
11	698.4	35.27dBuV Pk	20.8	-16.7	39.37	46.02	-	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-6.65	-	-	-	-	-
12	833.3	34.1dBuV Pk	22.4	-17.2	39.3	46.02	-	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-6.72	-	-	-	-	-
13	896.4	35.94dBuV Pk	22.5	-17.1	41.34	46.02	-	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-4.68	-	-	-	-	-
14	551.6	38.86dBuV Pk	19.7	-17.1	41.46	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Vert	Margin (dB)	-4.56	-	-	-	-	-
15	698.4	34.92dBuV Pk	20.8	-16.7	39.02	46.02	-	-	-	-	-
		Azimuth:0-360	Height:199	Vert	Margin (dB)	-7	-	-	-	-	-
16	947.1	32.24dBuV Pk	23.4	-17.1	38.54	46.02	-	-	-	-	-
		Azimuth:0-360	Height:103	Vert	Margin (dB)	-7.48	-	-	-	-	-

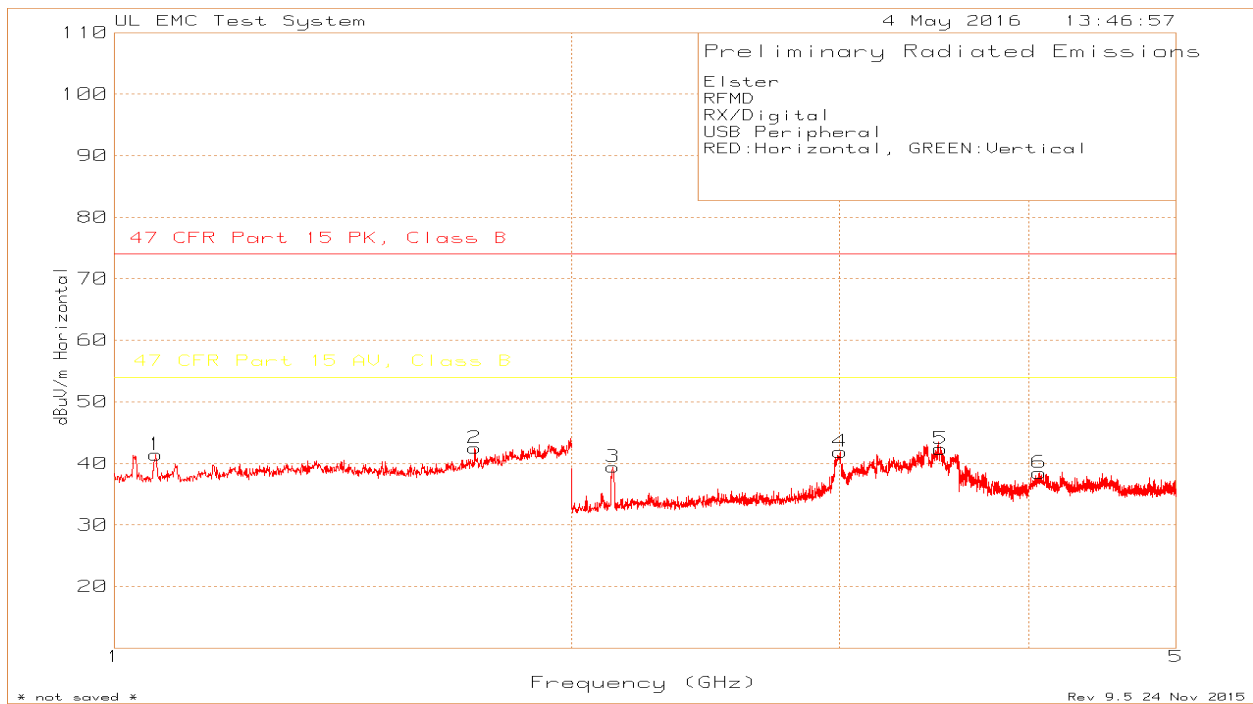
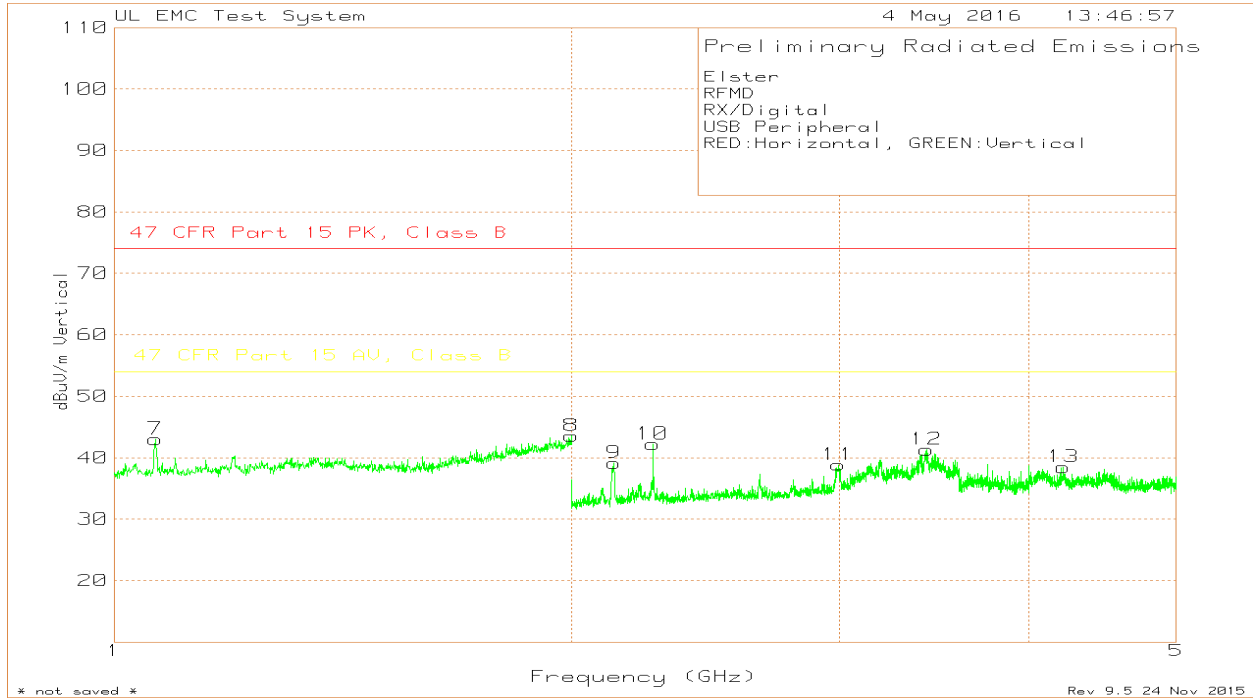
LIMIT 1: CFR 47 Part 15 Class B 3m
Pk - Peak detector

Radiated Emission Data

	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1	2	3	4	5	6
	484.3381	36.81dBuV Qp	17.3	-17.5	36.61	46.02	-	-	-	-	-
		Azimuth: 6	Height:197	Horz	Margin (dB):	-9.41	-	-	-	-	-
	896.2875	34.37dBuV Qp	22.5	-17.1	39.77	46.02	-	-	-	-	-
		Azimuth: 348	Height:100	Horz	Margin (dB):	-6.25	-	-	-	-	-
	551.57938	37.54dBuV Qp	19.7	-17.1	40.14	46.02	-	-	-	-	-
		Azimuth: 210	Height:334	Vert	Margin (dB):	-5.88	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m
Qp - Quasi-Peak detector

EMISSIONS 1000 TO 5000 MHz



Elster
RFMD
RX/Digital
USB Peripheral
RED:Horizontal, GREEN:Vertical

Trace Markers

No.	Test Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1 dBuV/m	2	3	4	5	6
1	1.065	71.5dBuV Pk	27.6	-57.7	41.4	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Horz	Margin (dB)	-32.6	-12.6	-	-	-	-
2	1.727	68.45dBuV Pk	29.5	-55.44	42.51	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Horz	Margin (dB)	-31.49	-11.49	-	-	-	-
3	2.13	70.03dBuV Pk	21.5	-52.1	39.43	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Horz	Margin (dB)	-34.57	-14.57	-	-	-	-
4	3.006	69.86dBuV Pk	22.5	-50.48	41.88	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Horz	Margin (dB)	-32.12	-12.12	-	-	-	-
5	3.499	69.06dBuV Pk	23.5	-50.2	42.36	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Horz	Margin (dB)	-31.64	-11.64	-	-	-	-
6	4.063	61.78dBuV Pk	28.4	-51.69	38.49	74	54	-	-	-	-
		Azimuth:0-360	Height:101	Horz	Margin (dB)	-35.51	-15.51	-	-	-	-
7	1.064	73.08dBuV Pk	27.6	-57.69	42.99	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-31.01	-11.01	-	-	-	-
8	1.999	65.76dBuV Pk	31.8	-54.01	43.55	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-30.45	-10.45	-	-	-	-
9	2.133	69.77dBuV Pk	21.5	-52.13	39.14	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-34.86	-14.86	-	-	-	-
10	2.262	71.72dBuV Pk	21.7	-51.21	42.21	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Vert	Margin (dB)	-31.79	-11.79	-	-	-	-
11	2.996	66.85dBuV Pk	22.5	-50.5	38.85	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-35.15	-15.15	-	-	-	-
12	3.426	68.33dBuV Pk	23.5	-50.51	41.32	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Vert	Margin (dB)	-32.68	-12.68	-	-	-	-
13	4.214	61.74dBuV Pk	28.3	-51.55	38.49	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Vert	Margin (dB)	-35.51	-15.51	-	-	-	-

LIMIT 1: 47 CFR Part 15 PK, Class B
LIMIT 2: 47 CFR Part 15 AV, Class B

Pk - Peak detector

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

FCC §15.107 (to be used for reference only)

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

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

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

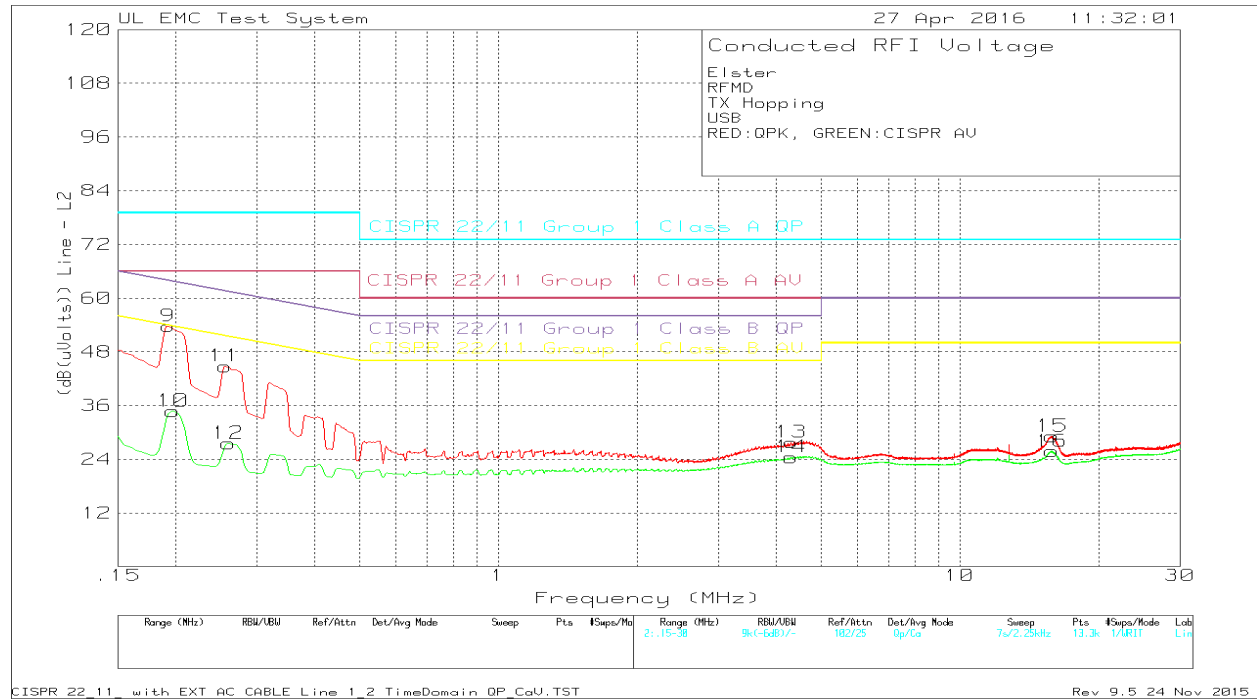
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

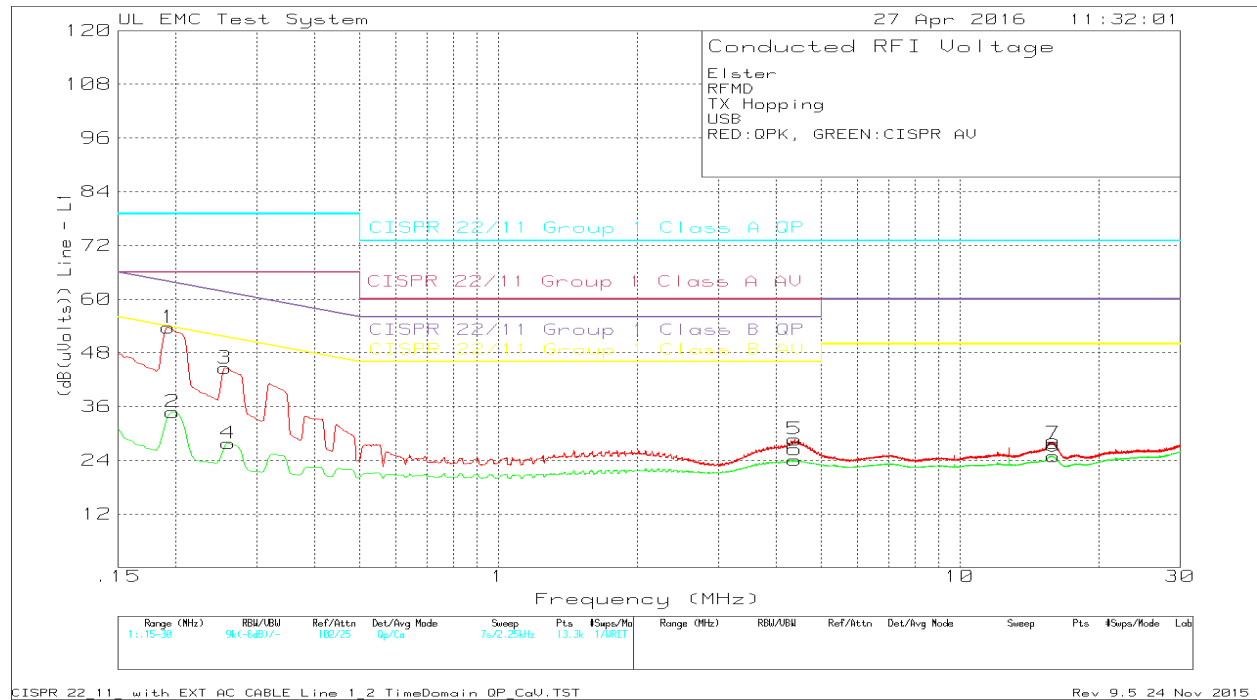
RESULTS

Below results are for when device is connected to laptop via usb and it is in tx mode. Because of how the device is configured this data is also representative of digital mode (FCC part 15, subpart B).

Neutral



Line



Elster
RFMD
TX Hopping
USB
RED:QPK, GREEN:CISPR AV

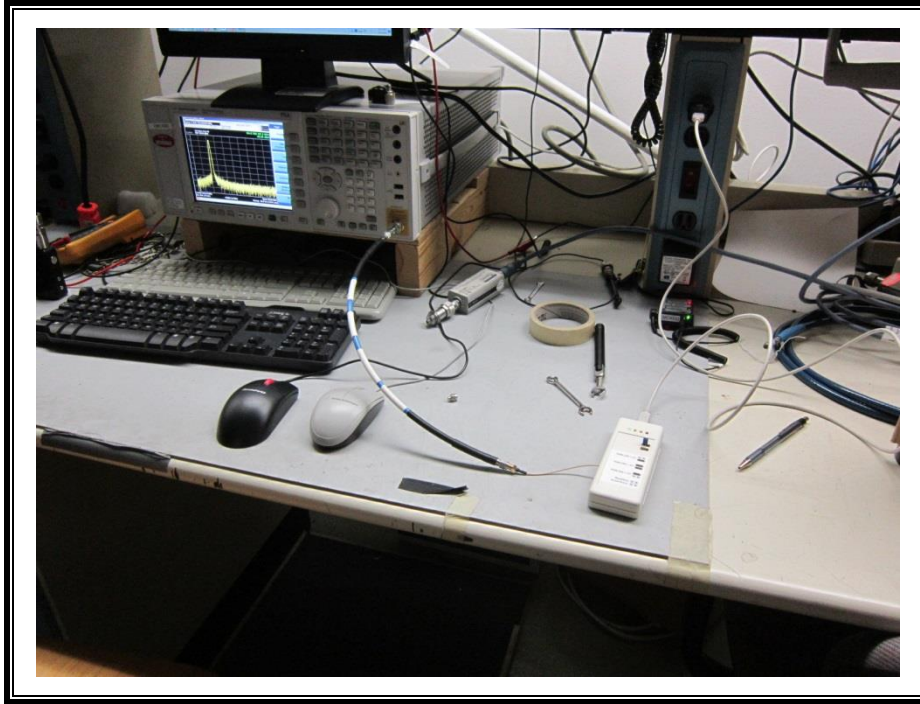
Trace Markers		Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading (dB(uVolts))	Limit:1	2	3	4	5	6
No.	Test Frequency (MHz)										
=====											
Line											
1	.19275	42.05dBuV Qp	.1	11.5	53.65	79	-	63.92	-	-	-
					Margin (dB)	-25.35	-	-10.27	-	-	-
2	.19725	23.15dBuV Ca	.1	11.5	34.75	-	66	-	53.73	-	-
					Margin (dB)	-	-31.25	-	-18.98	-	-
3	.25575	33.38dBuV Qp	0	11.2	44.58	79	-	61.57	-	-	-
					Margin (dB)	-34.42	-	-16.99	-	-	-
4	.26025	16.7dBuV Ca	0	11.1	27.8	-	66	-	51.42	-	-
					Margin (dB)	-	-38.2	-	-23.62	-	-
5	4.38225	17.86dBuV Qp	0	10.8	28.66	73	-	56	-	-	-
					Margin (dB)	-44.34	-	-27.34	-	-	-
6	4.38225	13.26dBuV Ca	0	10.8	24.06	-	60	-	46	-	-
					Margin (dB)	-	-35.94	-	-21.94	-	-
7	15.945	15.97dBuV Qp	0	11.8	27.77	73	-	60	-	-	-
					Margin (dB)	-45.23	-	-32.23	-	-	-
8	15.945	13.07dBuV Ca	0	11.8	24.87	-	60	-	50	-	-
					Margin (dB)	-	-35.13	-	-25.13	-	-
Neutral											
9	.19275	41.65dBuV Qp	.1	12	53.75	79	-	63.92	-	-	-
					Margin (dB)	-25.25	-	-10.17	-	-	-
10	.19725	22.63dBuV Ca	.1	12	34.73	-	66	-	53.73	-	-
					Margin (dB)	-	-31.27	-	-19	-	-
11	.25575	33dBuV Qp	.1	11.7	44.8	79	-	61.57	-	-	-
					Margin (dB)	-34.2	-	-16.77	-	-	-
12	.26025	15.73dBuV Ca	.1	11.7	27.53	-	66	-	51.42	-	-
					Margin (dB)	-	-38.47	-	-23.89	-	-
13	4.31025	16.5dBuV Qp	0	11.3	27.8	73	-	56	-	-	-
					Margin (dB)	-45.2	-	-28.2	-	-	-
14	4.308	13.15dBuV Ca	0	11.3	24.45	-	60	-	46	-	-
					Margin (dB)	-	-35.55	-	-21.55	-	-
15	15.846	16.89dBuV Qp	0	12.2	29.09	73	-	60	-	-	-
					Margin (dB)	-43.91	-	-30.91	-	-	-
16	15.83588	13.6dBuV Ca	0	12.2	25.8	-	60	-	50	-	-
					Margin (dB)	-	-34.2	-	-24.2	-	-

LIMIT 1: CISPR 22/11 Group 1 Class A QP
LIMIT 2: CISPR 22/11 Group 1 Class A AV
LIMIT 3: CISPR 22/11 Group 1 Class B QP
LIMIT 4: CISPR 22/11 Group 1 Class B AV

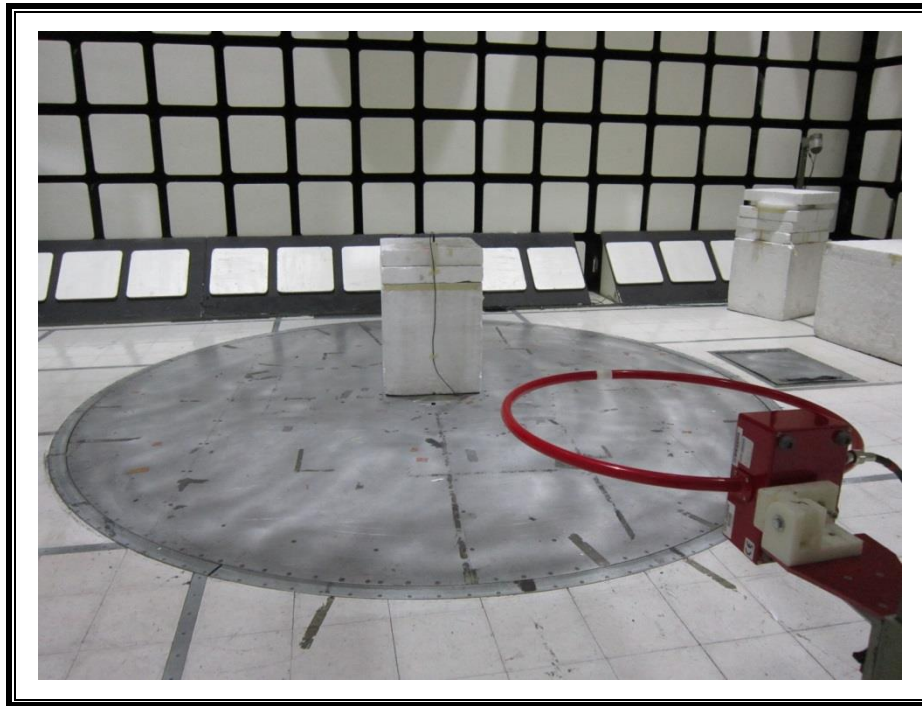
Qp - Quasi-Peak detector
Ca - CISPR Average detection

10. SETUP PHOTOS

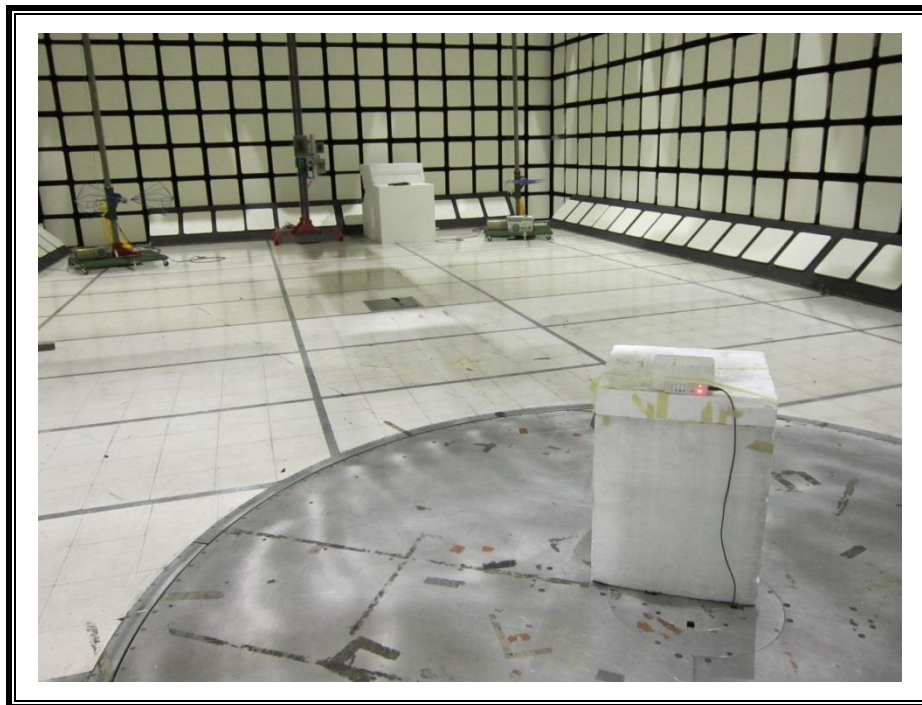
ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



RADIATED RF MEASUREMENT SETUP (BELOW 1 GHz)

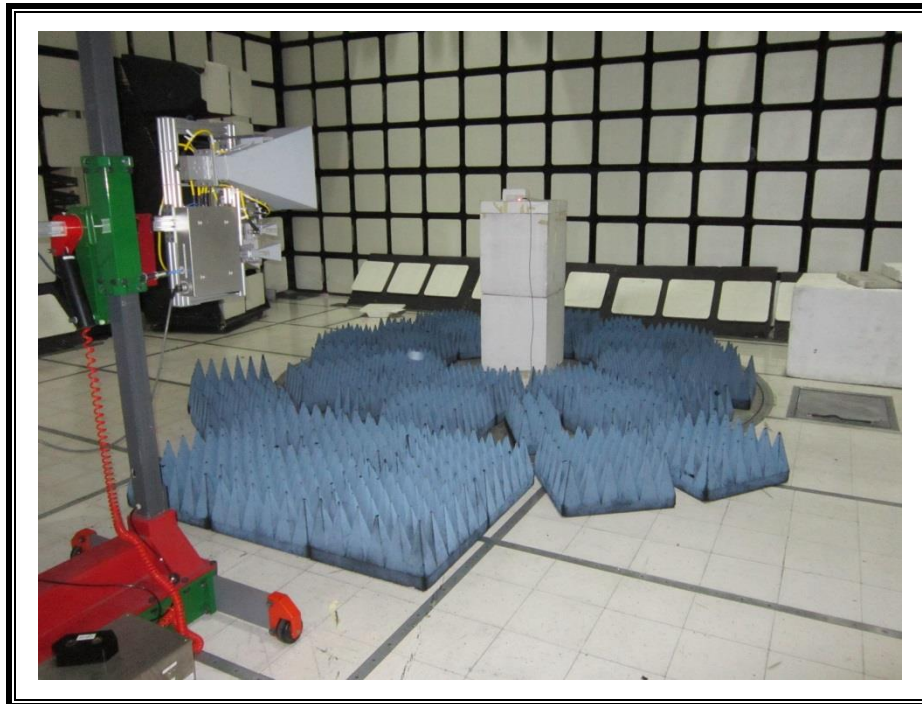


* Emissions 9kHz-30MHz

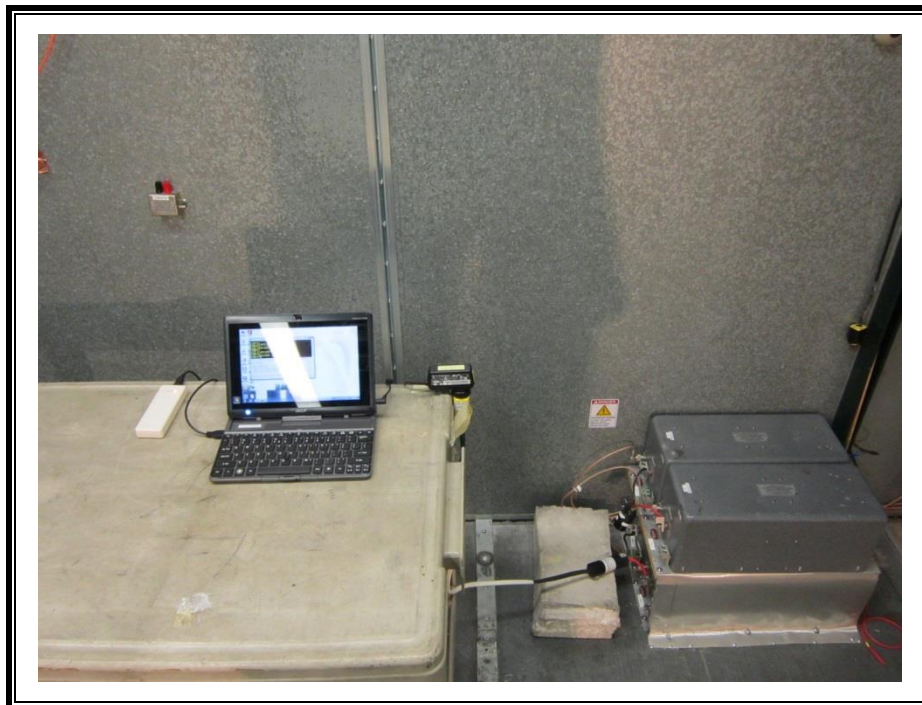


* Emissions 30MHz – 1GHz

RADIATED RF MEASUREMENT SETUP (ABOVE 1 GHz)

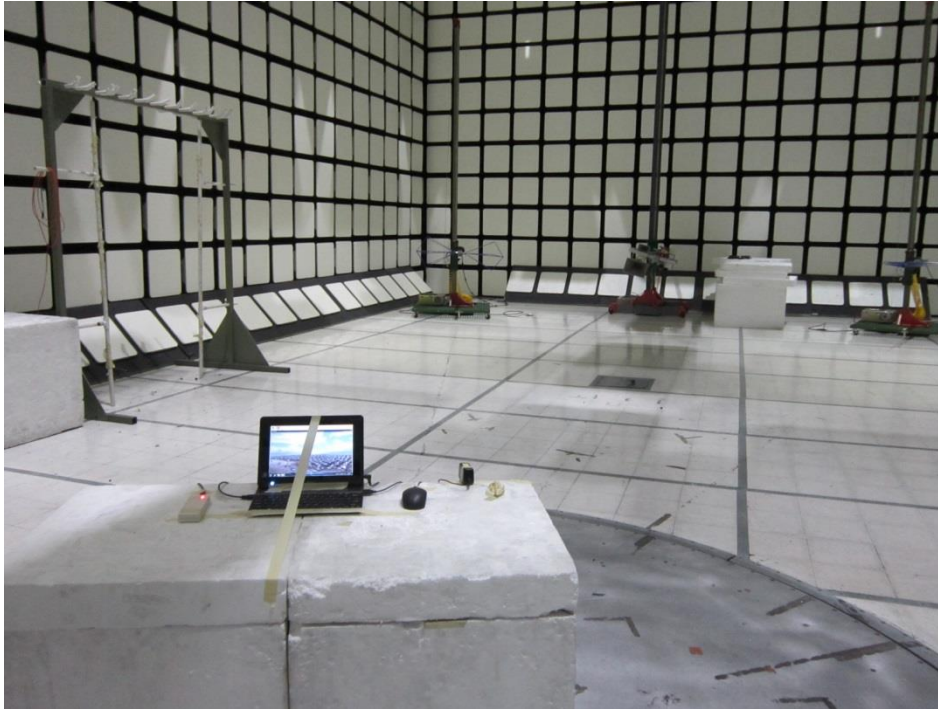


LINE CONDUCTED EMISSIONS (THRU HOST DEVICE)

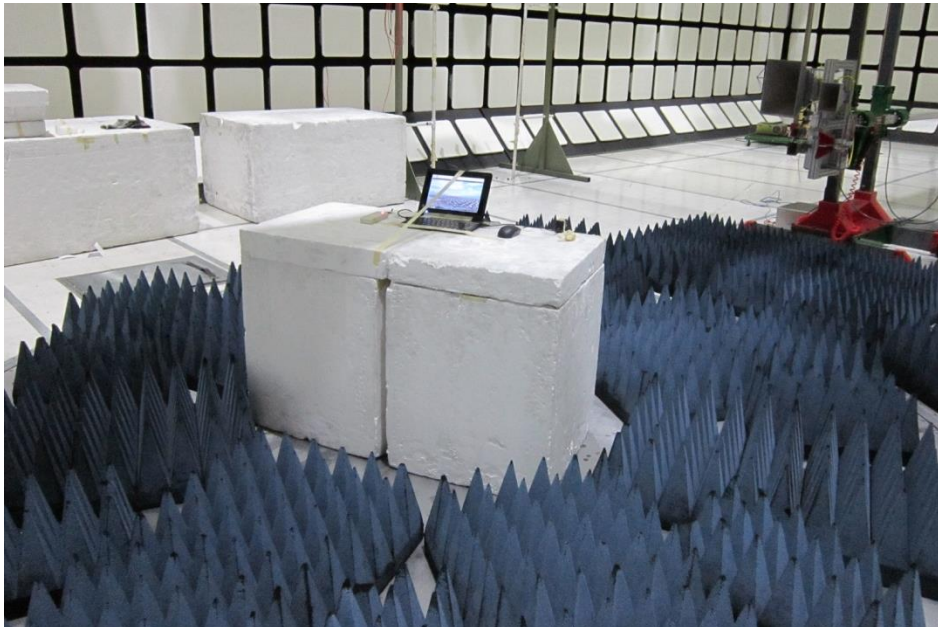


RADIATED RF MEASUREMENT SETUP for Digital Device

30MHz-1GHz



1GHz-5GHz



END OF REPORT