



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

WIRELESS TRANSMITTER

MODEL NUMBER: RFMM

FCC ID: QZC-RMD-01

REPORT NUMBER: 10583303A

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Prepared for
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	May 10, 2016	Initial Issue	Joseph McWilliams
REV1	December 20, 2016	Revised data	Vincent Sabalvaro
REV2	January 17, 2017	Editorial Changes	Vincent Sabalvaro

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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: Wireless Transmitter

MODEL: RFMM

SERIAL NUMBER: None

DATE TESTED: September 10, 2015 to December 9, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	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
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Tested By:



Bart Mucha
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UL LLC



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UL LLC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, 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)
907.0 - 923.8	2GFSK	23.29	213.30

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

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 one orientations X (normal installation), it was determined that X orientation was the only orientation the EUT would be used; 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

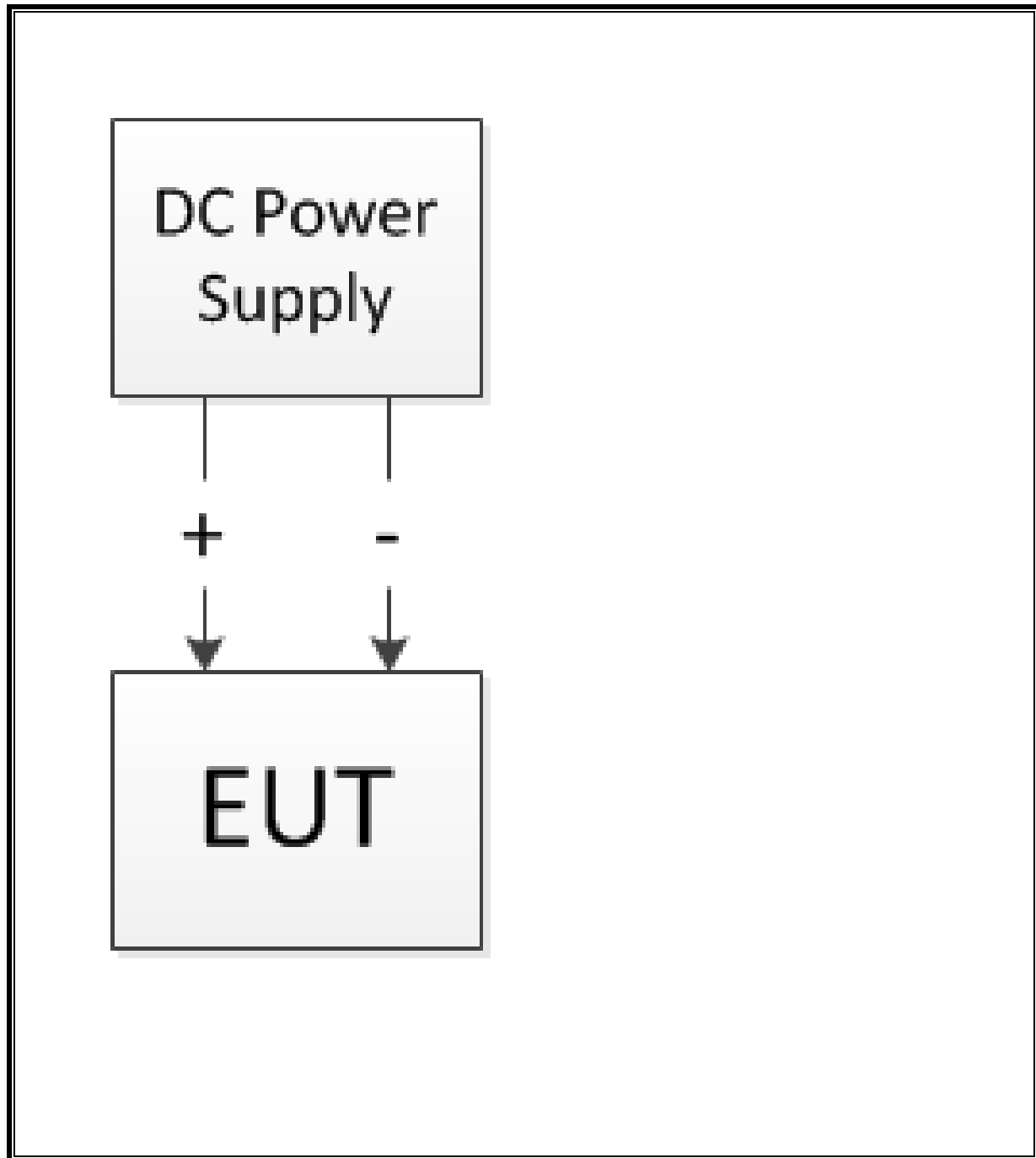
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1*	Power	0	None	Unshielded	1m	DC Power
2	I/O	0	Pin Plug	Unshielded	1m	I/O for programming
*EUT is normally powered by internal 3.7V battery.						

TEST SETUP

The EUT is installed on a meter during the tests. The EUT was connected to the laptop for EUT programming prior to testing however the EUT was only connected to DC power during testing.

SETUP DIAGRAM FOR 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.

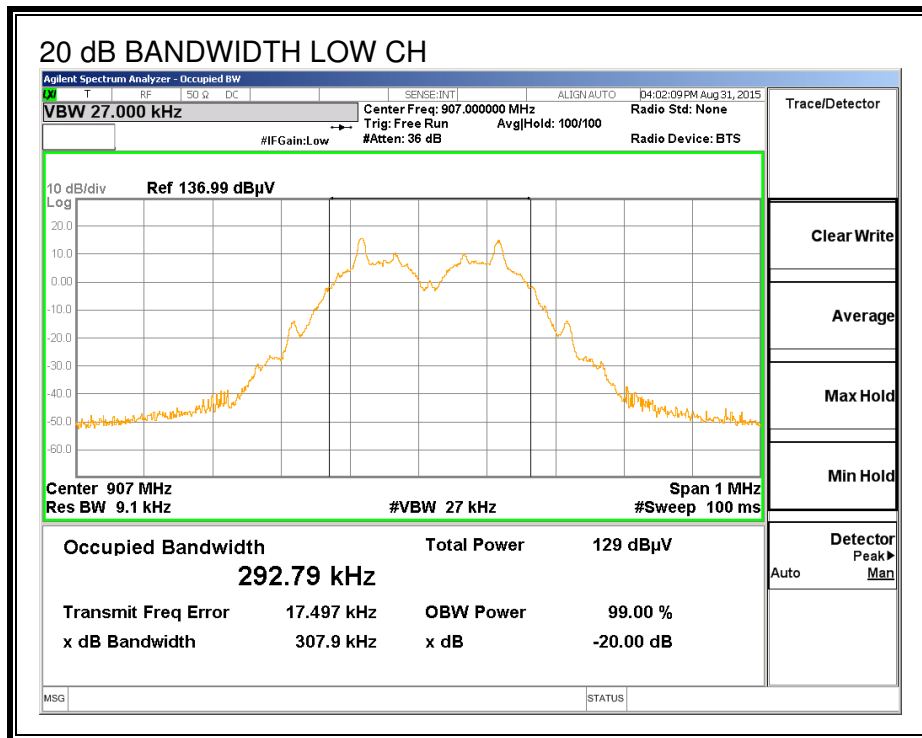
TEST PROCEDURE

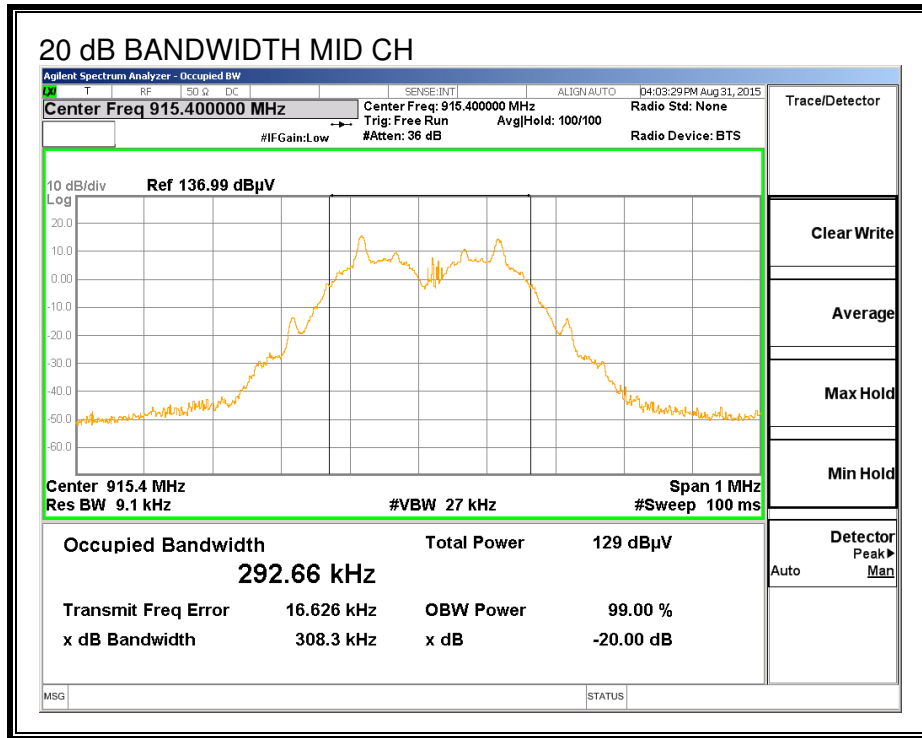
Testing of 20dB Bandwidth was conducted in accordance to C63.10:2013 section 6.9.2

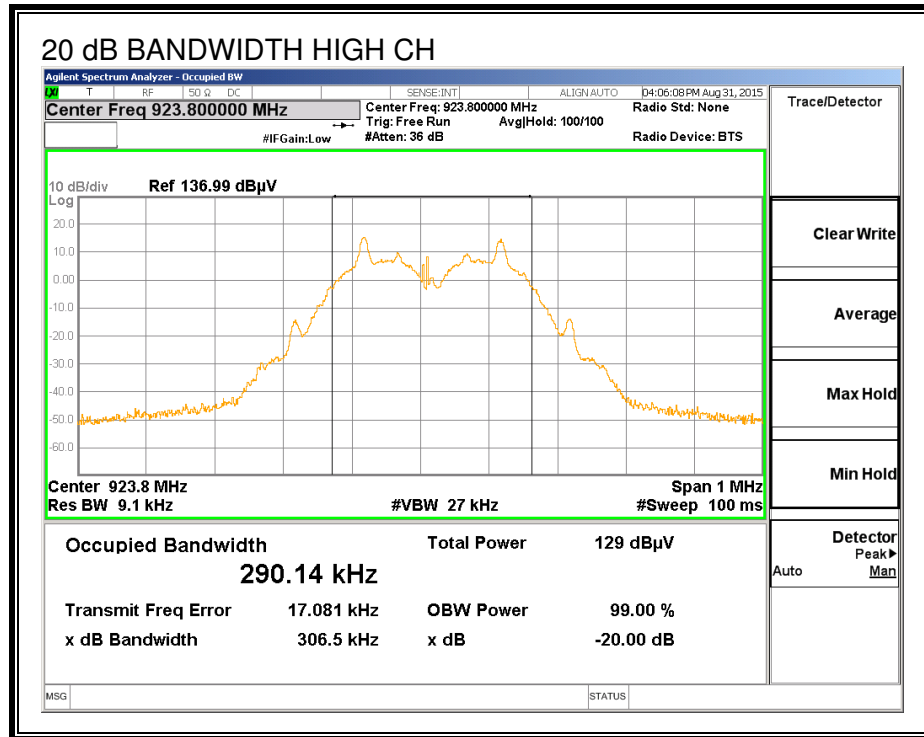
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	907	307.9
Middle	915.4	308.3
High	923.8	306.5

20 dB BANDWIDTH







7.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

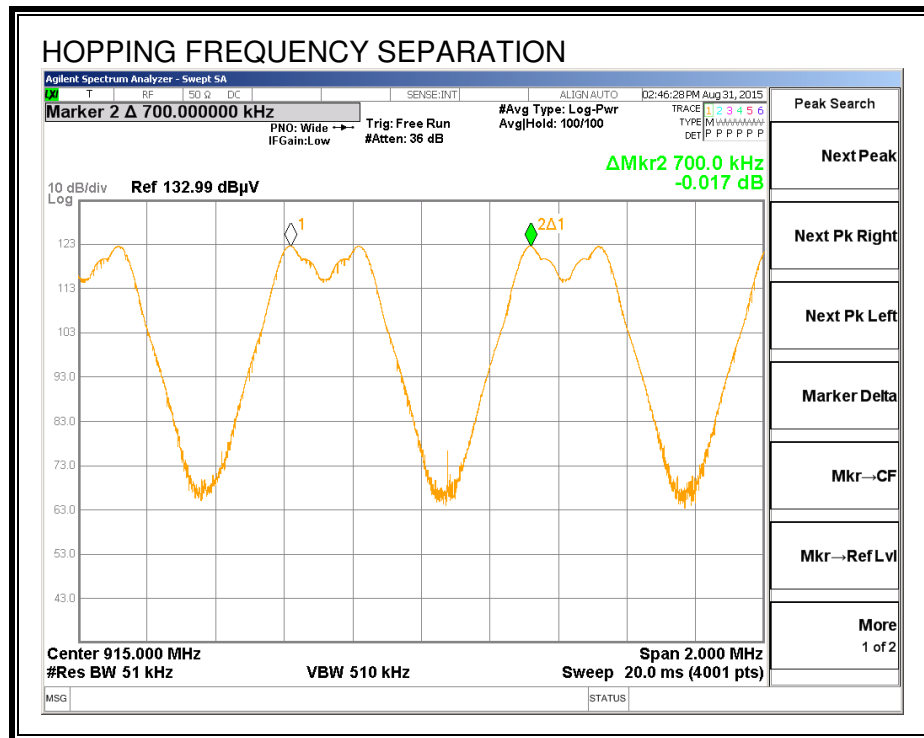
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

Selected RBW and VBW were used to clearly show the envelope of the emission and accurately measure the frequency separation

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

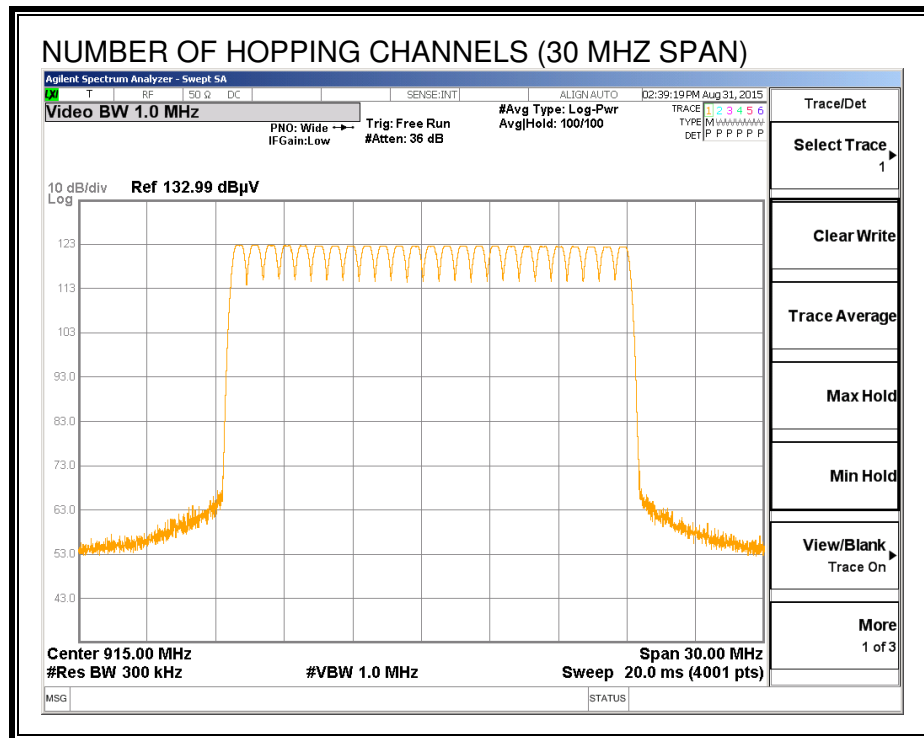
TEST PROCEDURE

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

LIMITS

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 possible worst-case duty cycle and maximum on time.

A normal operating sample of the EUT was used to measure the on time.

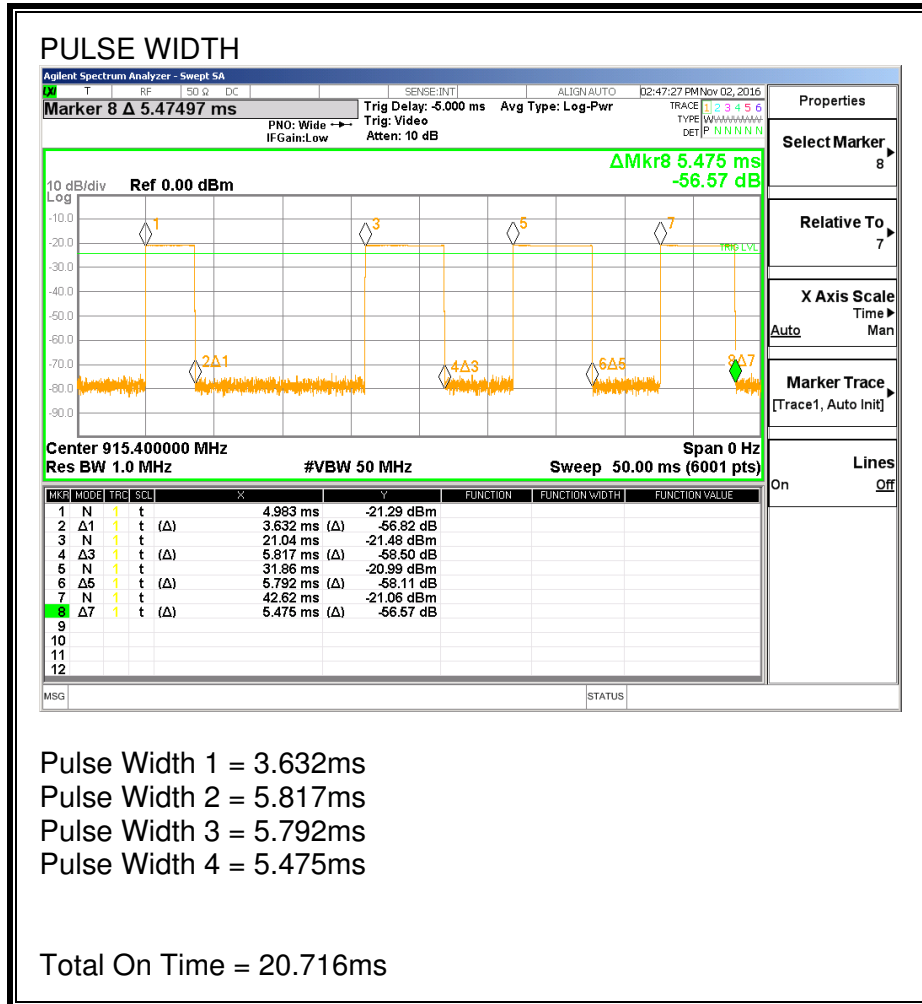
RESULTS

Manufacturer specifies that the maximum TX time per channel within 10 seconds is 105.84mS. Maximum TX time per channel in 100mS is 77.7mS. Per DA 00-0705 this will result in duty cycle factor of -2.19dB.

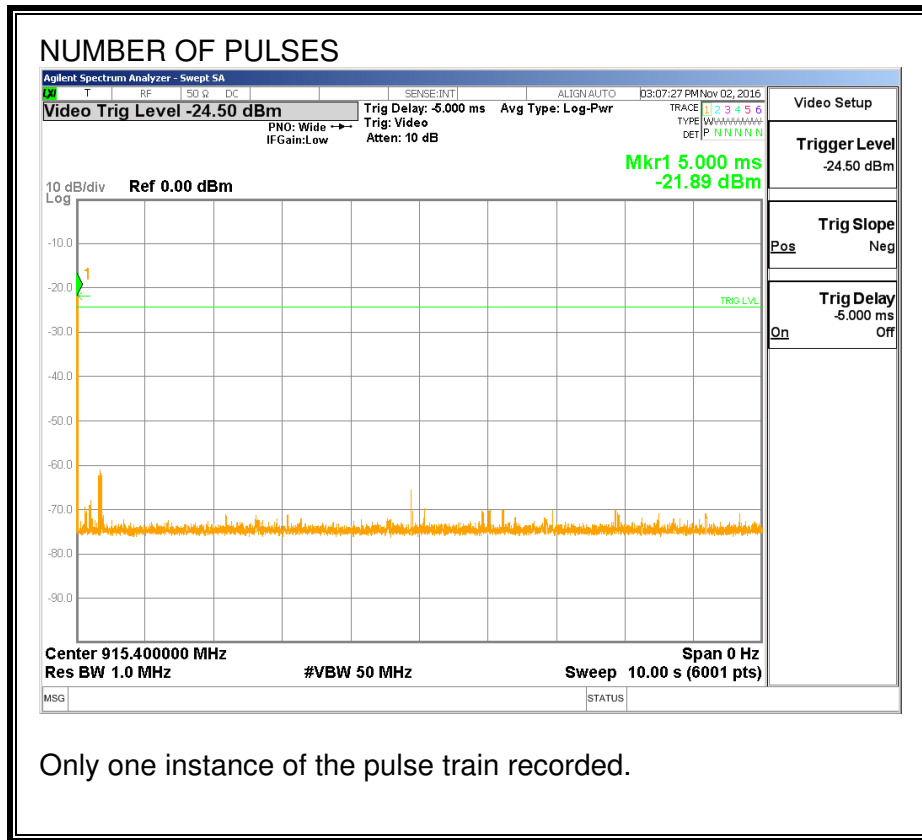
The on time and duty cycle is explained in the theory of operationi document:
QZC-Rxxx_TheoryOfOperation_002.pdf

Packet Number	Pulse Width (msec)	Number of Pulses in 10 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
1	20.716	1	0.021	0.4	-0.379

PULSE WIDTH



NUMBER OF PULSES IN 10 SECOND OBSERVATION PERIOD



Only one instance of the pulse train recorded.

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 under paragraph (a)(1)(i) of this section

TEST PROCEDURE

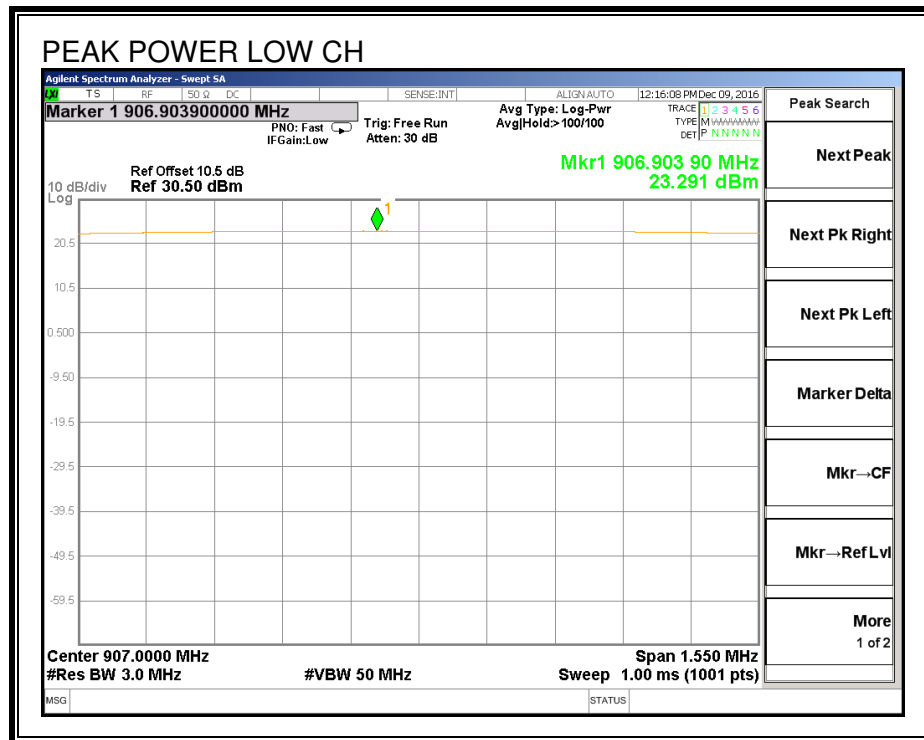
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT. Span was set to a value smaller then the aproximatly 5 times the emissions bandwidth, however it was ensured that the highest peak within the modulation envelope was captured.

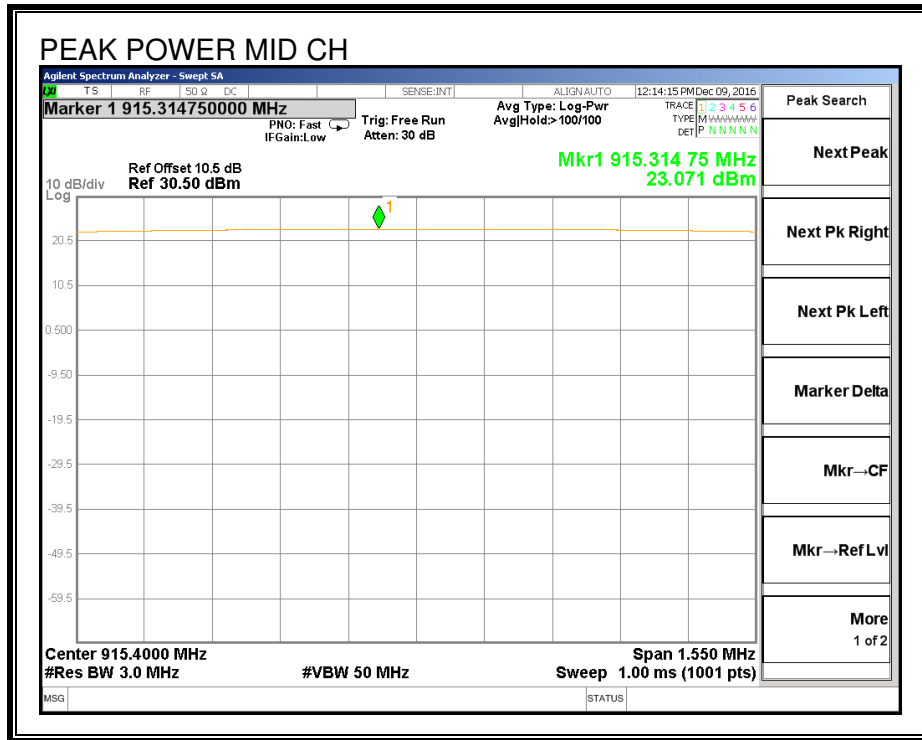
RESULTS

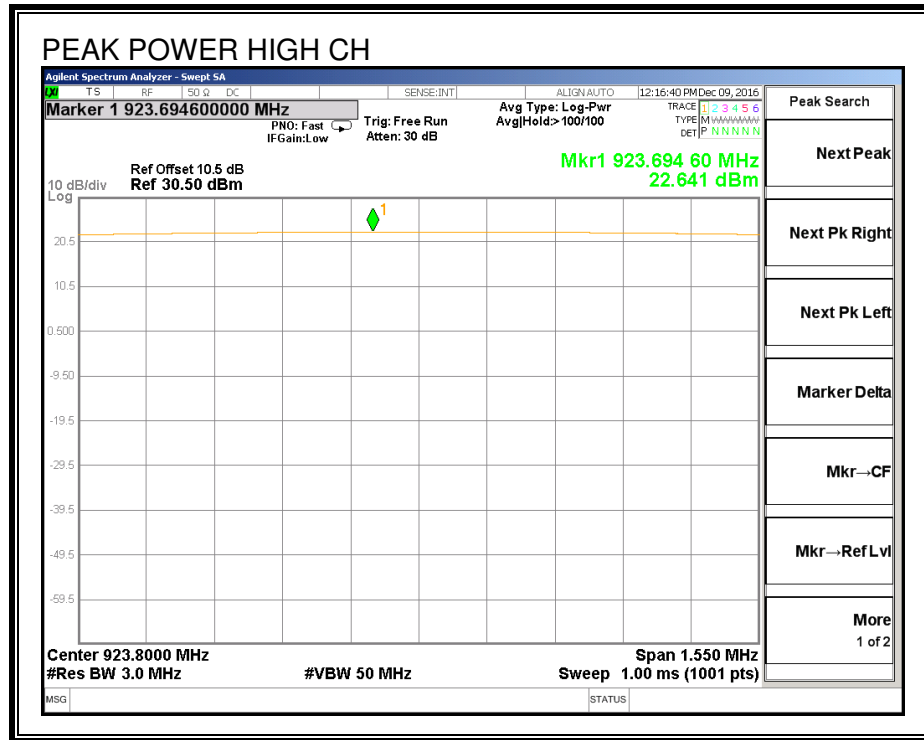
For 25 hopping channels

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	907	23.29	0.50	23.979	-0.69
Middle	915.4	23.07	0.50	23.979	-0.91
High	923.8	22.64	0.50	23.979	-1.34

OUTPUT POWER







7.1.6. 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

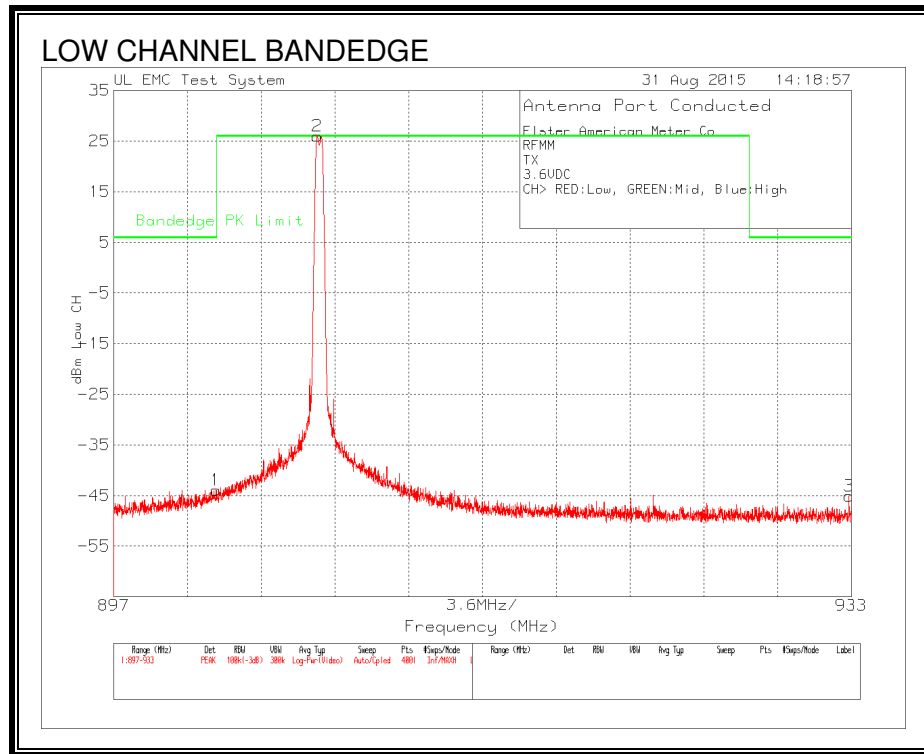
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

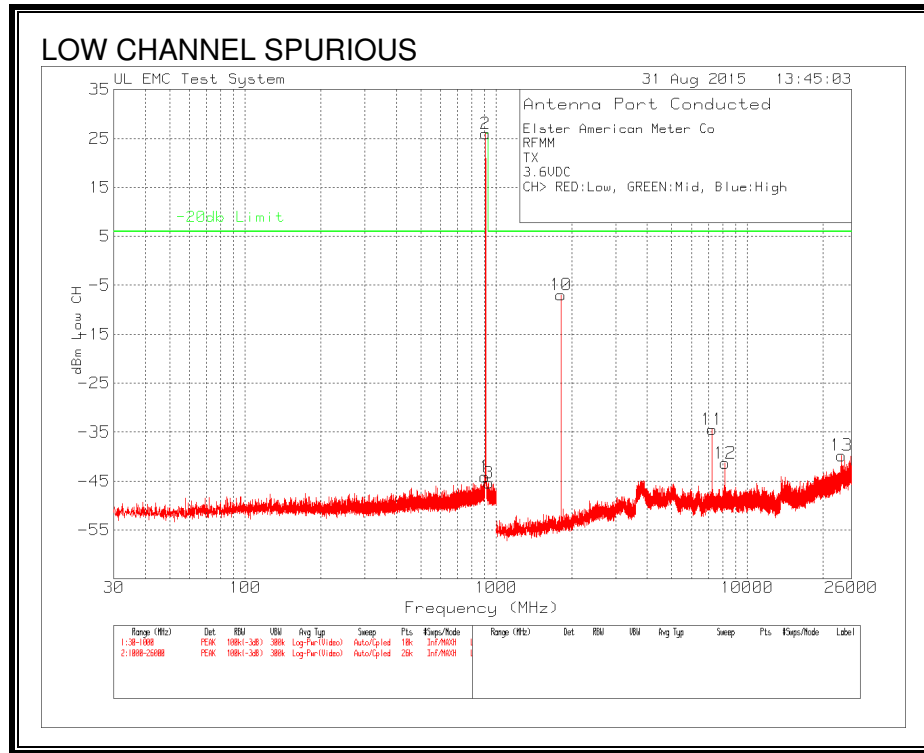
The spectrum from 30 MHz to 26 GHz is investigated (only up to 10GHz required) with the transmitter set to the lowest, middle, and highest channels.

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

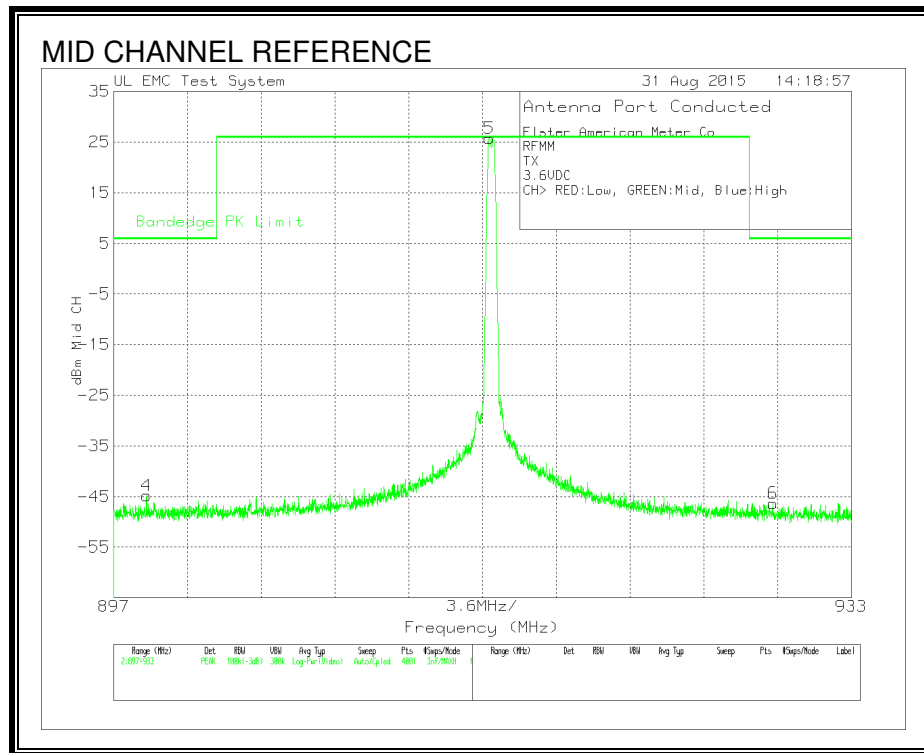
RESULTS

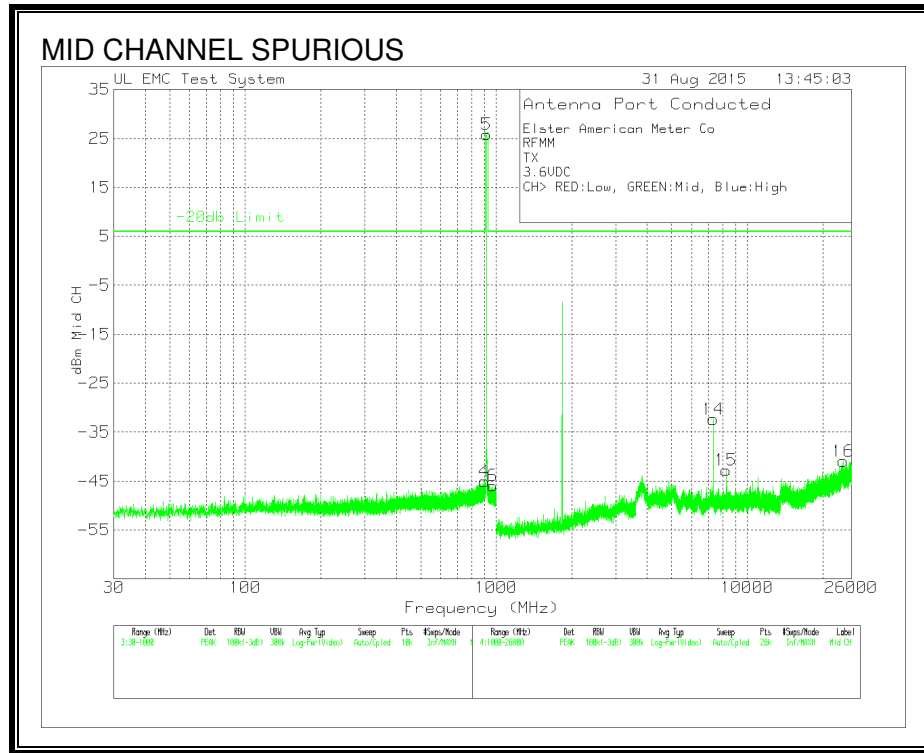
SPURIOUS EMISSIONS, LOW CHANNEL



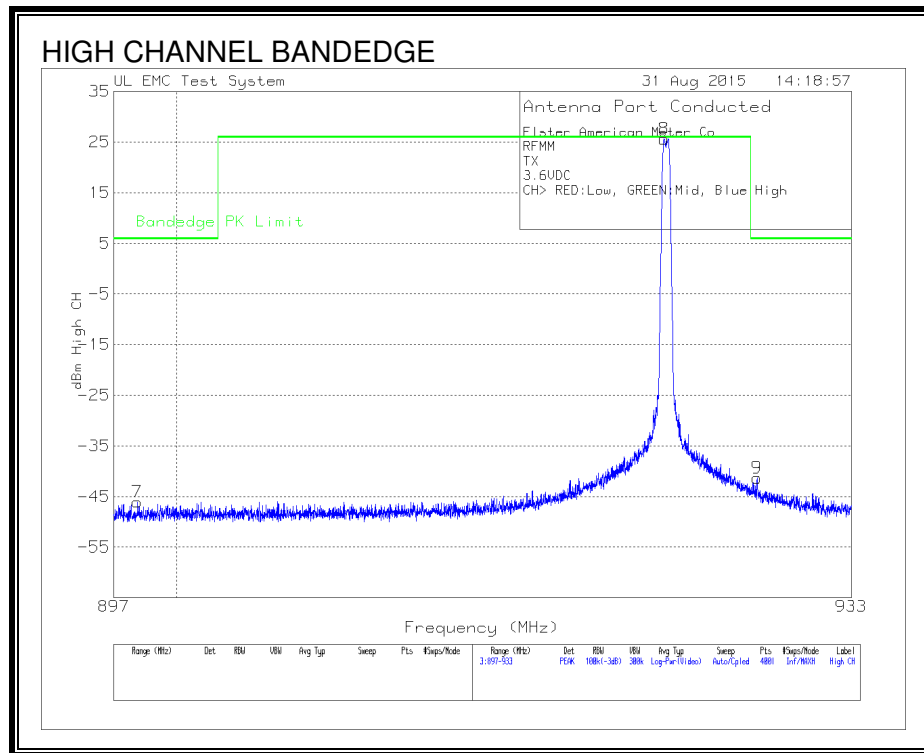


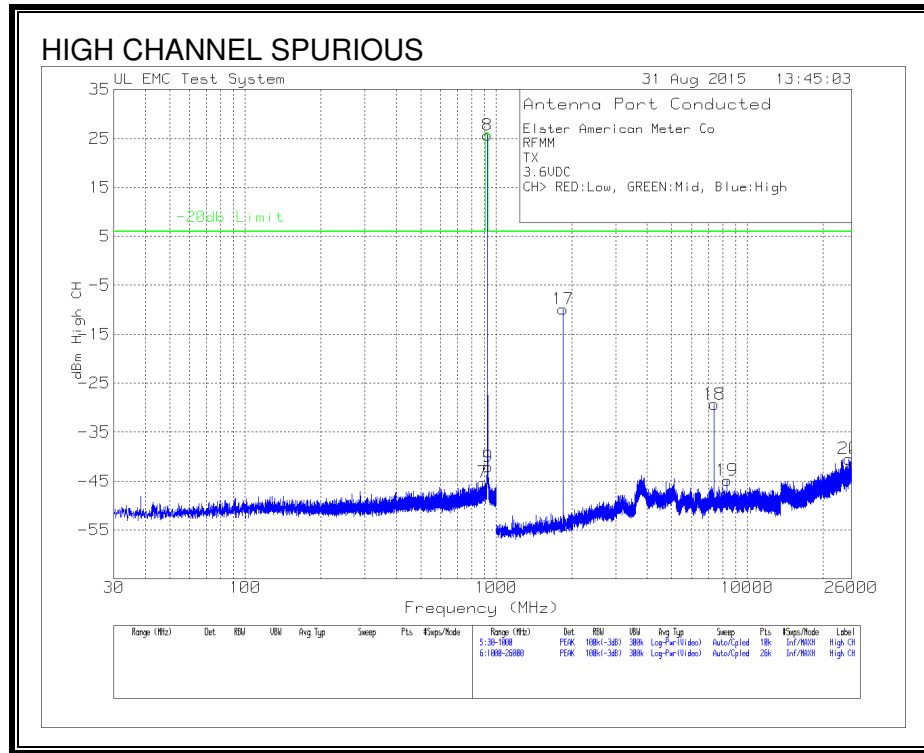
SPURIOUS EMISSIONS, MID CHANNEL



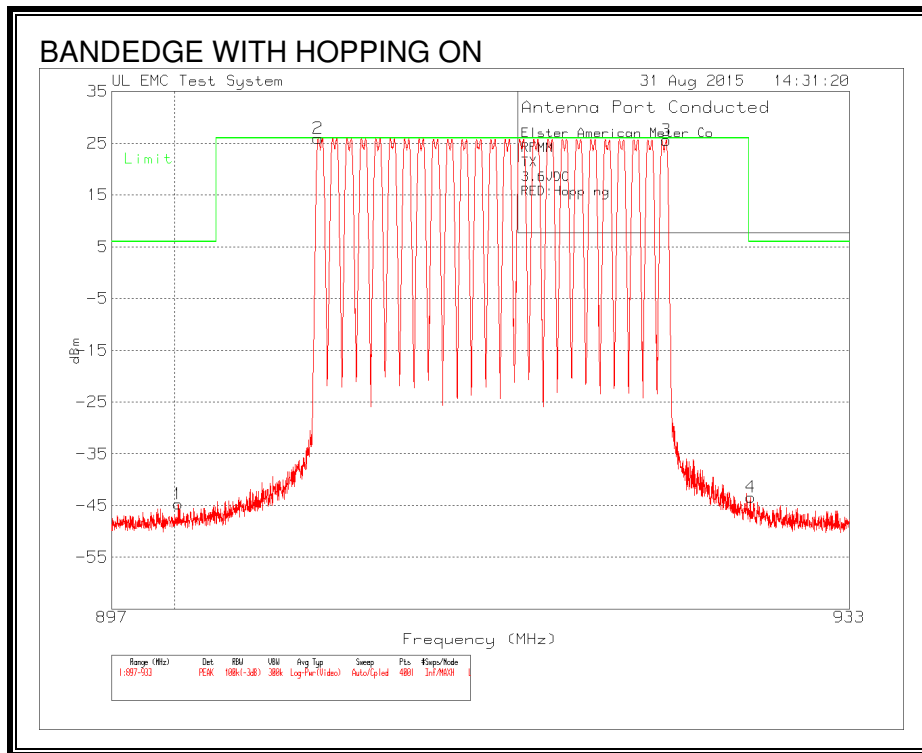


SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

FCC Public Notice DA 00-705

ANSI C63.10:2013

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

Radiated Spurious Emissions measurements 9kHz – 30MHz

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.

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.

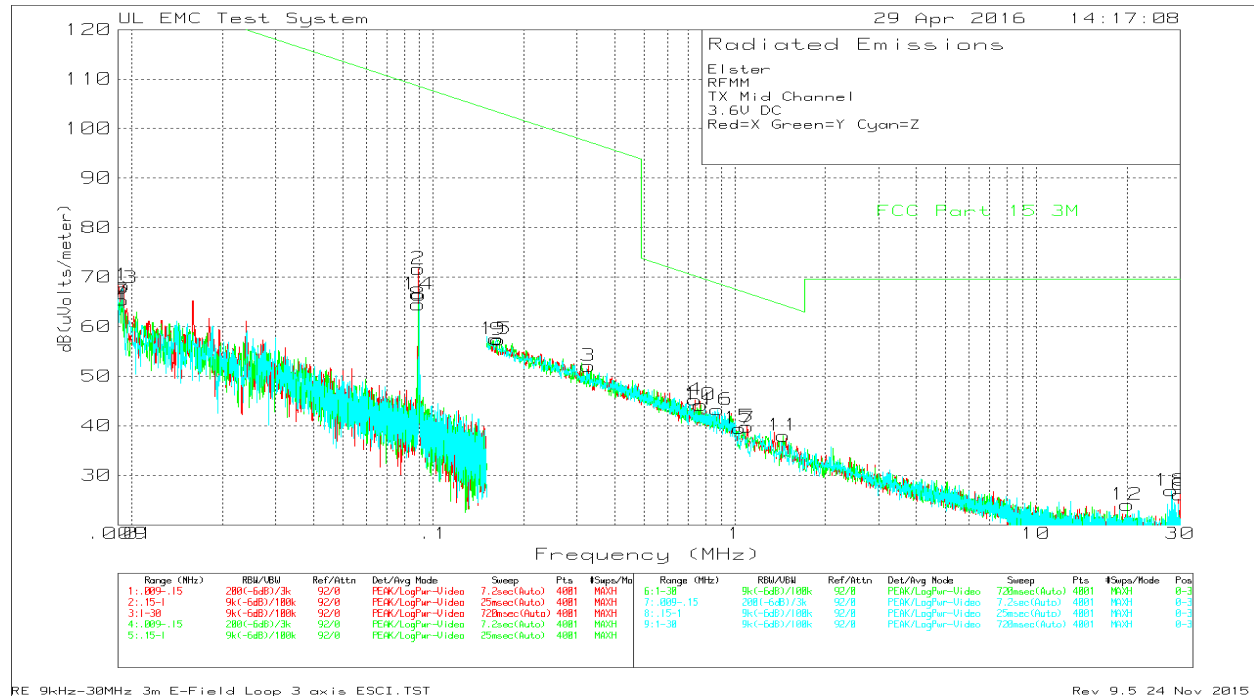
Radiated Spurious Emissions measurements above 1GHz

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.

8.1. WORST-CASE BELOW 1 GHz

HARMONICS, SPURIOUS EMISSIONS & RESTRICTED BANDEDGE

9kHz – 30MHz Data



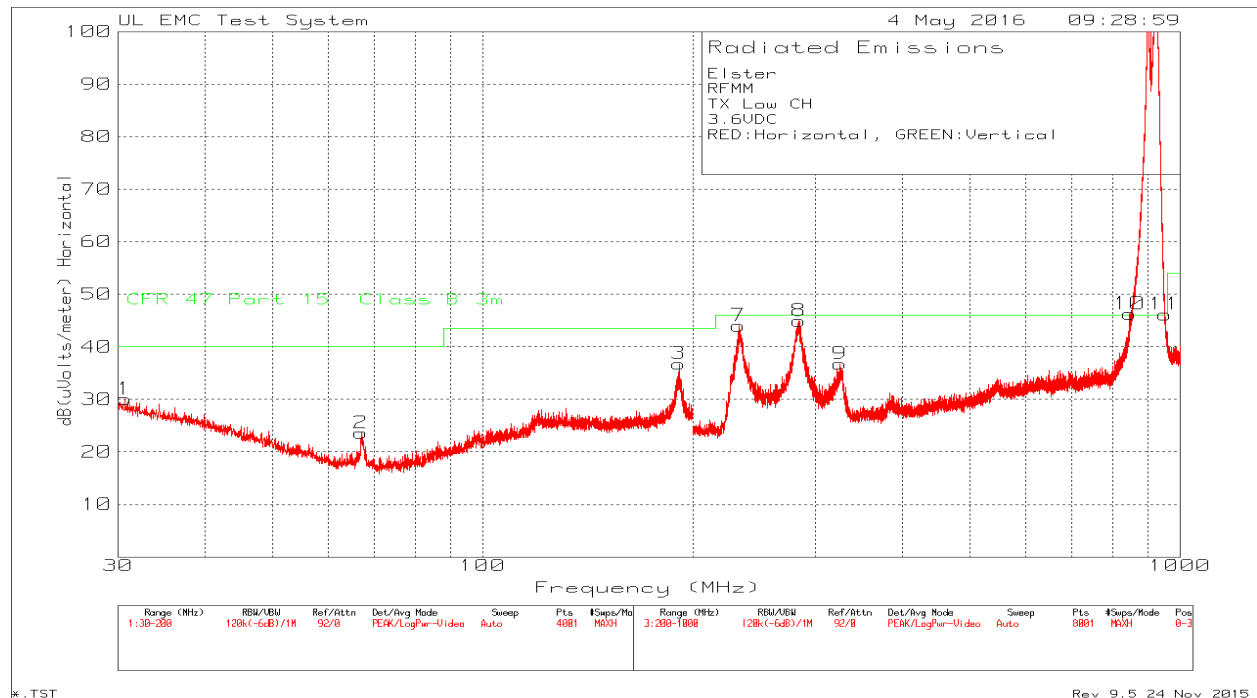
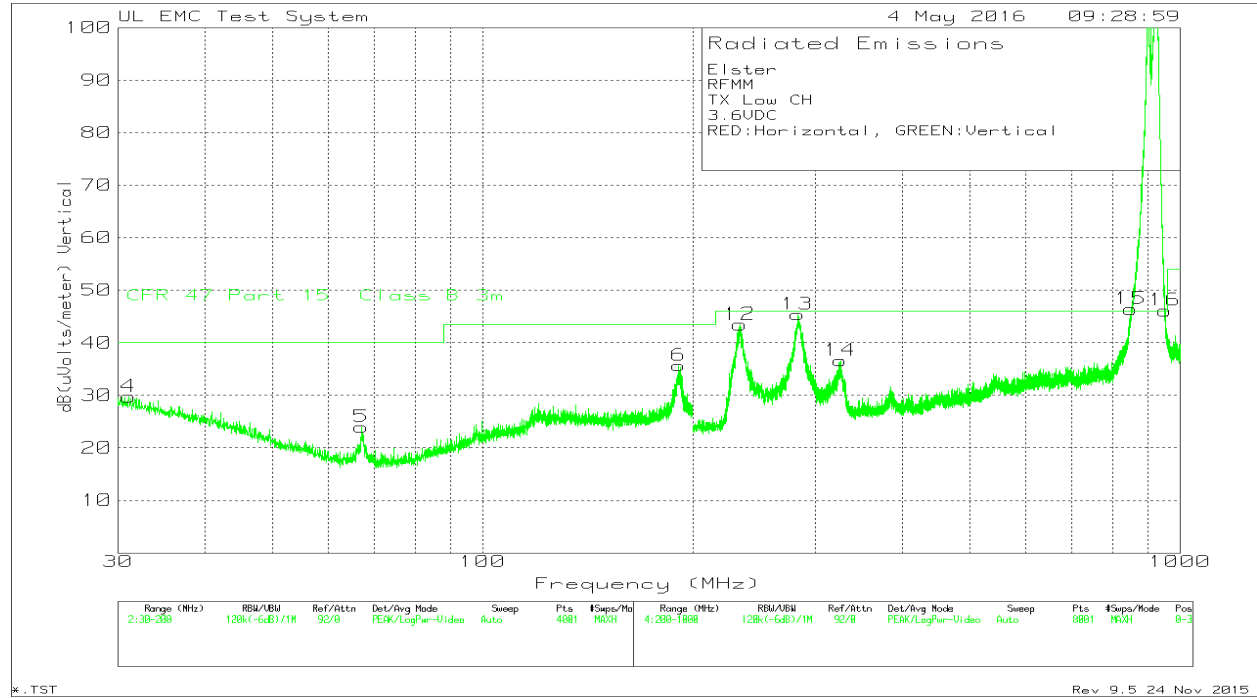
Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones off tests made in an open field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

Elster
RFMM
TX Mid Channel
3.6V DC
Red=X Green=Y Cyan=Z

Trace Markers

Test No.	Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1	2	3	4	5	6
=====											
Range 1: Parallel to EUT											
1	.00935	46.44dBuV Pk	21.9	0	68.34	128.17	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-59.83	-	-	-	-	-
2	.08929	58.68dBuV Pk	13	0	71.68	108.58	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-36.9	-	-	-	-	-
3	.32658	40.18dBuV Pk	11.9	0	52.08	97.32	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-45.24	-	-	-	-	-
4	.73767	33.24dBuV Pk	12	0	45.24	70.25	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-25.01	-	-	-	-	-
5	1.09425	27.09dBuV Pk	12.6	.1	39.79	66.82	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-27.03	-	-	-	-	-
6	29.90575	16.68dBuV Pk	9.1	.3	26.08	69.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-43.46	-	-	-	-	-
Range 4: Perpend to EUT											
7	.00928	43.39dBuV Pk	22	0	65.39	128.23	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-62.84	-	-	-	-	-
8	.08908	51.49dBuV Pk	13	0	64.49	108.6	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-44.11	-	-	-	-	-
9	.16427	45.17dBuV Pk	12.2	0	57.37	103.29	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-45.92	-	-	-	-	-
10	.77153	32.18dBuV Pk	12	0	44.18	69.86	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-25.68	-	-	-	-	-
11	1.4495	25.39dBuV Pk	12.5	.1	37.99	64.38	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-26.39	-	-	-	-	-
12	20.024	13.04dBuV Pk	10.7	.3	24.04	69.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-45.5	-	-	-	-	-
Range 7: Parallel to GND											
13	.00928	45.82dBuV Pk	22	0	67.82	128.23	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-60.41	-	-	-	-	-
14	.08971	53.47dBuV Pk	13	0	66.47	108.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-42.07	-	-	-	-	-
15	.16193	45.33dBuV Pk	12.2	0	57.53	103.41	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-45.88	-	-	-	-	-
16	.87676	31.06dBuV Pk	12.1	.1	43.26	68.75	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-25.49	-	-	-	-	-
17	1.03625	26.77dBuV Pk	12.6	.1	39.47	67.29	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-27.82	-	-	-	-	-
18	27.999	17.3dBuV Pk	9.3	.3	26.9	69.54	-	-	-	-	-
		Azimuth:0-360			Margin (dB)	-42.64	-	-	-	-	-
LIMIT 1: FCC Part 15 3M											
Pk - Peak detector											

Low Channel 30MHz-1GHz



Elster
RFMM
TX Low CH
3.6VDC
RED:Horizontal, GREEN:Vertical

Trace Markers

No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading (dB)	Limit:1 (uVolts/meter)	2	3	4	5	6
1	30.68	31.61dBuV Pk	17.9	-19.5	30.01	40	-	-	-	-	-
		Azimuth:0-360	Height:398	Horz	Margin (dB)	-9.99	-	-	-	-	-
2	66.9325	36.6dBuV Pk	6.5	-19.5	23.6	40	-	-	-	-	-
		Azimuth:0-360	Height:398	Horz	Margin (dB)	-16.4	-	-	-	-	-
3	191.16	39.16dBuV Pk	16	-18.4	36.76	43.52	-	-	-	-	-
		Azimuth:0-360	Height:398	Horz	Margin (dB)	-6.76	-	-	-	-	-
4	31.0625	31.44dBuV Pk	17.8	-19.5	29.74	40	-	-	-	-	-
		Azimuth:0-360	Height:251	Vert	Margin (dB)	-10.26	-	-	-	-	-
5	67.0175	36.97dBuV Pk	6.5	-19.5	23.97	40	-	-	-	-	-
		Azimuth:0-360	Height:398	Vert	Margin (dB)	-16.03	-	-	-	-	-
6	191.0325	38.09dBuV Pk	16	-18.4	35.69	43.52	-	-	-	-	-
		Azimuth:0-360	Height:398	Vert	Margin (dB)	-7.83	-	-	-	-	-
7	232.8	51.5dBuV Pk	11.2	-18.7	44	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-2.02	-	-	-	-	-
8	284.2	49.93dBuV Pk	13.3	-18.3	44.93	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Horz	Margin (dB)	-1.09	-	-	-	-	-
9	325.3	40.66dBuV Pk	14.1	-18	36.76	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-9.26	-	-	-	-	-
*10	846.4	32.25dBuV Pk	22.7	-8.7	46.25	46.02	-	-	-	-	-
		Azimuth:0-360	Height:199	Horz	Margin (dB)	.23	-	-	-	-	-
*11	950.8	29.78dBuV Pk	23.5	-7.1	46.18	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	.16	-	-	-	-	-
12	233.9	50.95dBuV Pk	11.2	-18.7	43.45	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-2.57	-	-	-	-	-
13	282.7	50.5dBuV Pk	13.2	-18.3	45.4	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Vert	Margin (dB)	-.62	-	-	-	-	-
14	325.8	40.51dBuV Pk	14.1	-18	36.61	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-9.41	-	-	-	-	-
*15	850.1	30.31dBuV Pk	22.8	-6.7	46.41	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	.39	-	-	-	-	-
*16	951.6	30.56dBuV Pk	23.5	-7.9	46.16	46.02	-	-	-	-	-
		Azimuth:0-360	Height:199	Vert	Margin (dB)	.14	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

*Not in restricted band, no radiated emissions limits.

Pk - Peak detector

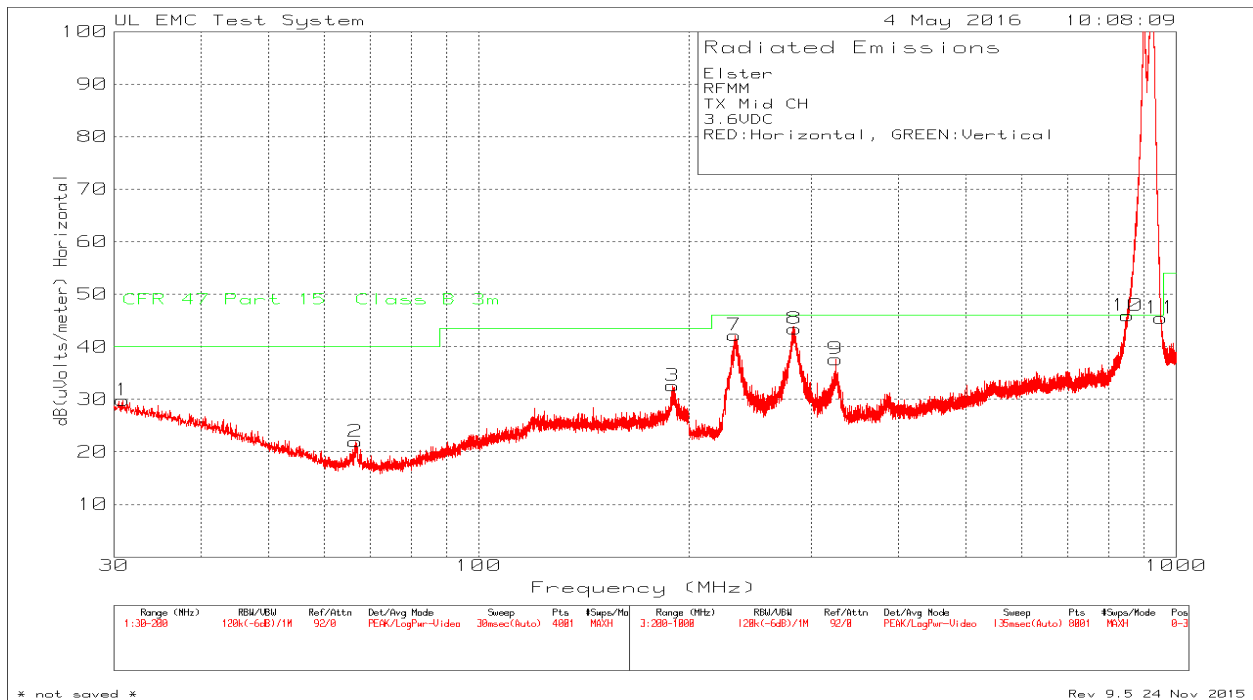
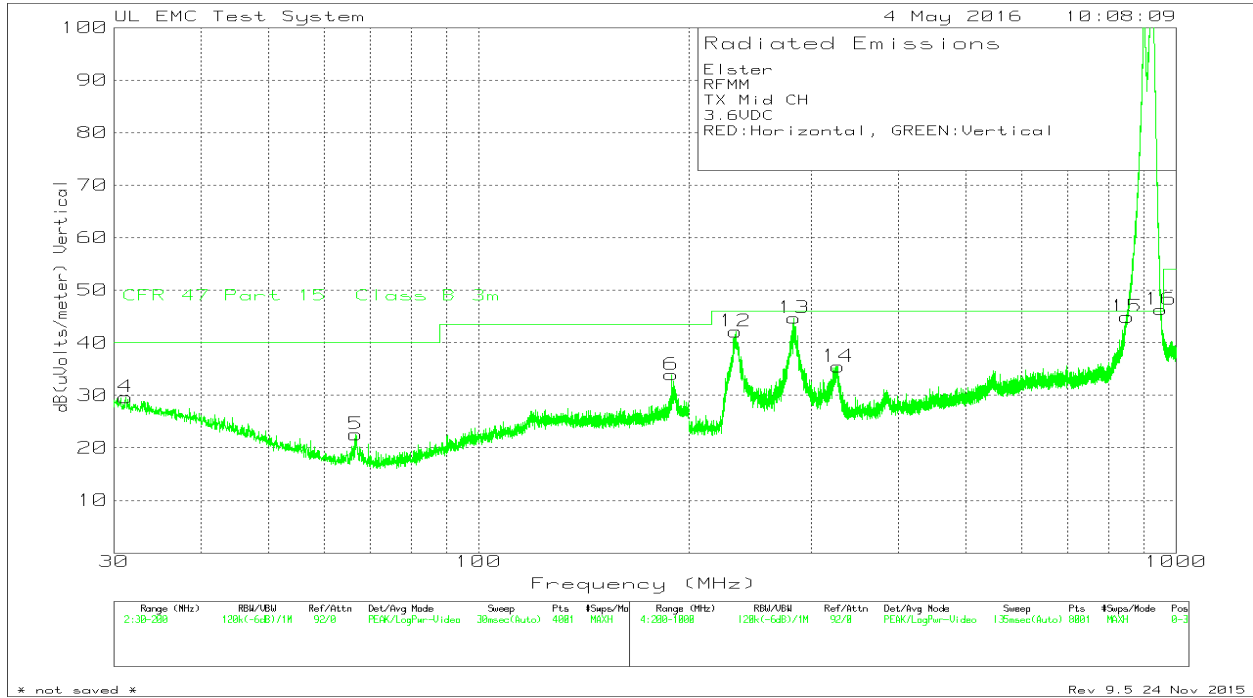
Radiated Emission Data

No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading (dB)	Limit:1 (uVolts/meter)	2	3	4	5	6
283.29		46.94dBuV Qp	13.2	-18.3	41.84	46.02	-	-	-	-	-
	Azimuth: 3	Height:282	Horz		Margin (dB):	-4.18	-	-	-	-	-
233.5975		46.87dBuV Qp	11.2	-18.7	39.37	46.02	-	-	-	-	-
	Azimuth: 71	Height:395	Horz		Margin (dB):	-6.65	-	-	-	-	-
282.96875		46.69dBuV Qp	13.2	-18.3	41.59	46.02	-	-	-	-	-
	Azimuth: 4	Height:280	Vert		Margin (dB):	-4.43	-	-	-	-	-
233.70625		46.97dBuV Qp	11.2	-18.7	39.47	46.02	-	-	-	-	-
	Azimuth: 74	Height:395	Vert		Margin (dB):	-6.55	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Qp - Quasi-Peak detector

Middle Channel 30MHz-1GHz



Elster
RFMM
TX Mid CH
3.6VDC
RED:Horizontal, GREEN:Vertical

Trace Markers

Test No. Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1	2	3	4	5	6
1 30.85	31.44dBuV Pk	17.9	-19.5	29.84	40	-	-	-	-	-
	Azimuth:0-360	Height:100	Horz	Margin (dB)	-10.16	-	-	-	-	-
2 66.55	34.95dBuV Pk	6.5	-19.5	21.95	40	-	-	-	-	-
	Azimuth:0-360	Height:398	Horz	Margin (dB)	-18.05	-	-	-	-	-
3 189.715	35.1dBuV Pk	16	-18.5	32.6	43.52	-	-	-	-	-
	Azimuth:0-360	Height:398	Horz	Margin (dB)	-10.92	-	-	-	-	-
4 31.19	31.46dBuV Pk	17.7	-19.5	29.66	40	-	-	-	-	-
	Azimuth:0-360	Height:251	Vert	Margin (dB)	-10.34	-	-	-	-	-
5 66.635	35.57dBuV Pk	6.5	-19.5	22.57	40	-	-	-	-	-
	Azimuth:0-360	Height:398	Vert	Margin (dB)	-17.43	-	-	-	-	-
6 188.9925	36.46dBuV Pk	16	-18.5	33.96	43.52	-	-	-	-	-
	Azimuth:0-360	Height:398	Vert	Margin (dB)	-9.56	-	-	-	-	-
7 232.8	49.69dBuV Pk	11.2	-18.7	42.19	46.02	-	-	-	-	-
	Azimuth:0-360	Height:399	Horz	Margin (dB)	-3.83	-	-	-	-	-
8 283.8	48.51dBuV Pk	13.2	-18.3	43.41	46.02	-	-	-	-	-
	Azimuth:0-360	Height:299	Horz	Margin (dB)	-2.61	-	-	-	-	-
9 325	41.53dBuV Pk	14.1	-18	37.63	46.02	-	-	-	-	-
	Azimuth:0-360	Height:299	Horz	Margin (dB)	-8.39	-	-	-	-	-
*10 851.7	28.93dBuV Pk	22.7	-5.7	45.93	46.02	-	-	-	-	-
	Azimuth:0-360	Height:399	Horz	Margin (dB)	-.09	-	-	-	-	-
*11 951.1	29.26dBuV Pk	23.5	-7.3	45.46	46.02	-	-	-	-	-
	Azimuth:0-360	Height:199	Horz	Margin (dB)	-.56	-	-	-	-	-
12 233.6	49.66dBuV Pk	11.2	-18.7	42.16	46.02	-	-	-	-	-
	Azimuth:0-360	Height:399	Vert	Margin (dB)	-3.86	-	-	-	-	-
13 283.2	49.82dBuV Pk	13.2	-18.3	44.72	46.02	-	-	-	-	-
	Azimuth:0-360	Height:299	Vert	Margin (dB)	-1.3	-	-	-	-	-
14 327.55	39.17dBuV Pk	14.2	-17.9	35.47	46.02	-	-	-	-	-
	Azimuth:0-360	Height:399	Vert	Margin (dB)	-10.55	-	-	-	-	-
*15 851.1	28.28dBuV Pk	22.7	-6	44.98	46.02	-	-	-	-	-
	Azimuth:0-360	Height:399	Vert	Margin (dB)	-1.04	-	-	-	-	-
*16 951	30.15dBuV Pk	23.5	-7.3	46.35	46.02	-	-	-	-	-
	Azimuth:0-360	Height:399	Vert	Margin (dB)	.33	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

*Not in restricted band, no radiated emissions limits.

Pk - Peak detector

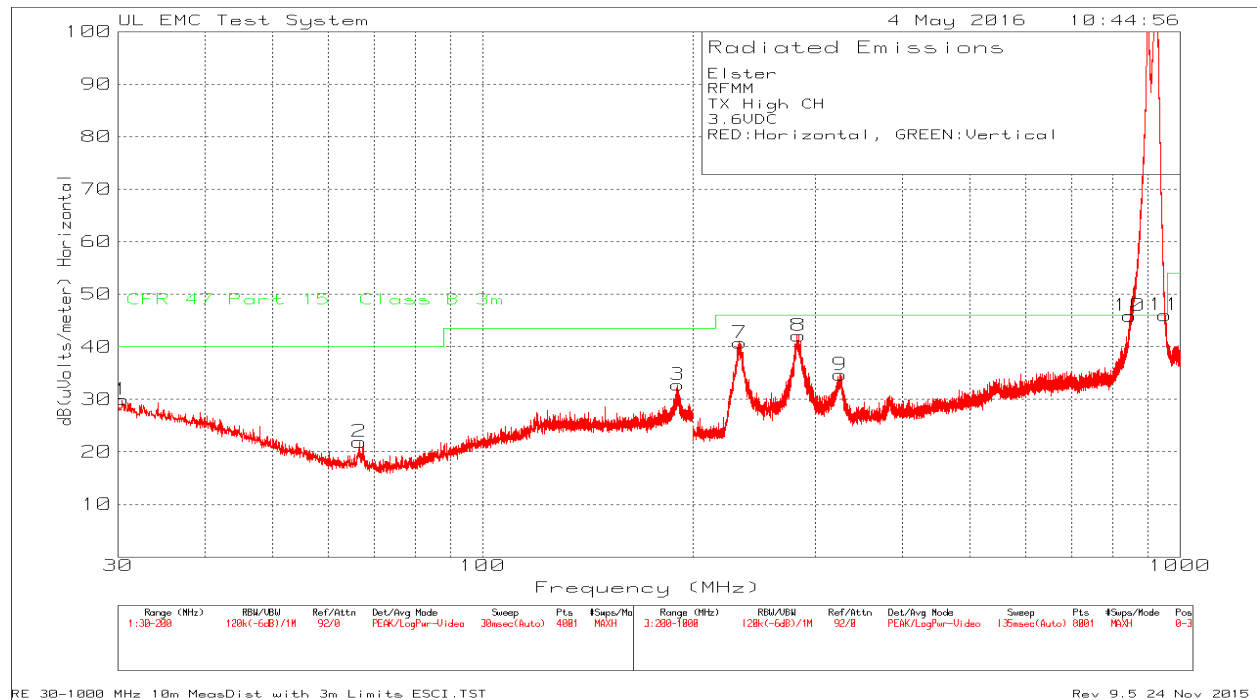
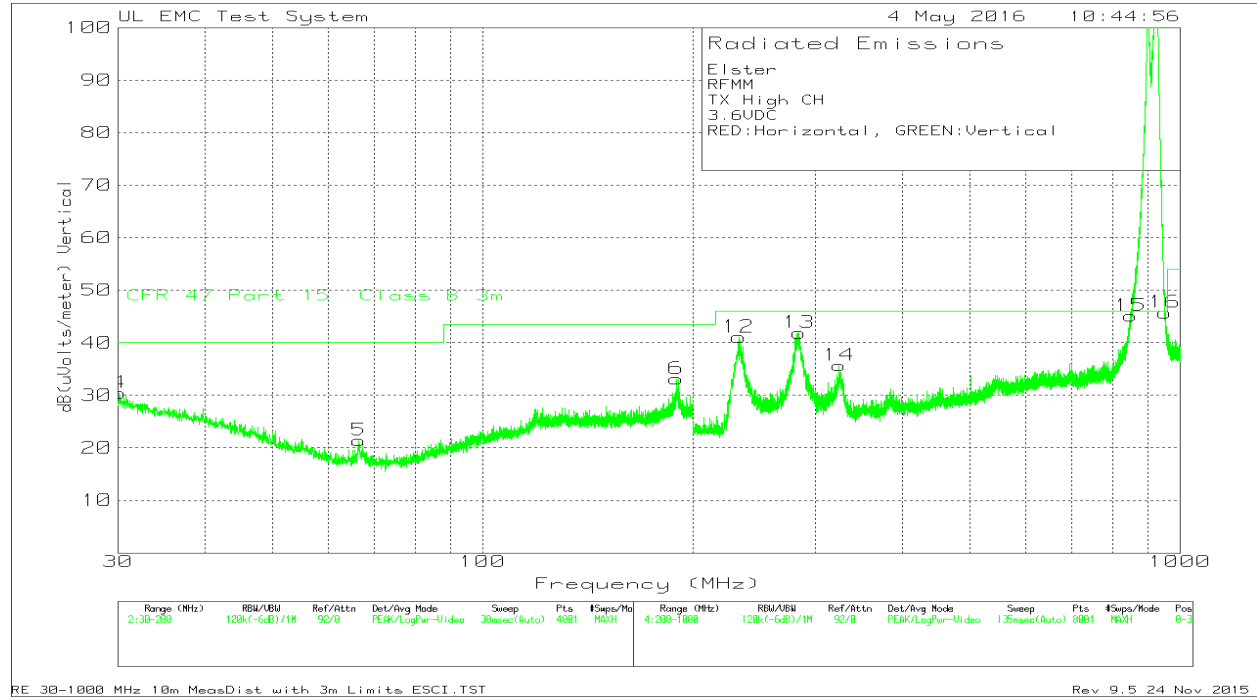
Radiated Emission Data

Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1	2	3	4	5	6
283.0575	46.04dBuV Qp	13.2	-18.3	40.94	46.02	-	-	-	-	-
	Azimuth: 14	Height:279	Horz	Margin (dB):	-5.08	-	-	-	-	-
233.71375	45.92dBuV Qp	11.2	-18.7	38.42	46.02	-	-	-	-	-
	Azimuth: 73	Height:395	Horz	Margin (dB):	-7.6	-	-	-	-	-
283.12	46.12dBuV Qp	13.2	-18.3	41.02	46.02	-	-	-	-	-
	Azimuth: 3	Height:282	Vert	Margin (dB):	-5	-	-	-	-	-
233.635	45.85dBuV Qp	11.2	-18.7	38.35	46.02	-	-	-	-	-
	Azimuth: 79	Height:393	Vert	Margin (dB):	-7.67	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Qp - Quasi-Peak detector

High Channel 30MHz-1GHz



Elster
RFMM
TX High CH
3.6VDC
RED:Horizontal, GREEN:Vertical

Trace Markers

No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1	2	3	4	5	6
1	30.425	31.47dBuV Pk	18	-19.5	29.97	40	-	-	-	-	-
		Azimuth:0-360	Height:241	Horz	Margin (dB)	-10.03	-	-	-	-	-
2	66.5925	34.92dBuV Pk	6.5	-19.5	21.92	40	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-18.08	-	-	-	-	-
3	190.4375	35.26dBuV Pk	16	-18.5	32.76	43.52	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-10.76	-	-	-	-	-
4	30.1275	31.83dBuV Pk	18.1	-19.5	30.43	40	-	-	-	-	-
		Azimuth:0-360	Height:251	Vert	Margin (dB)	-9.57	-	-	-	-	-
5	66.465	34.42dBuV Pk	6.5	-19.5	21.42	40	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-18.58	-	-	-	-	-
6	189.63	35.67dBuV Pk	16	-18.5	33.17	43.52	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-10.35	-	-	-	-	-
7	233.8	48.24dBuV Pk	11.2	-18.7	40.74	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Horz	Margin (dB)	-5.28	-	-	-	-	-
8	283.9	47.2dBuV Pk	13.2	-18.3	42.1	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Horz	Margin (dB)	-3.92	-	-	-	-	-
9	325.4	38.58dBuV Pk	14.1	-18	34.68	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Horz	Margin (dB)	-11.34	-	-	-	-	-
*10	847.2	31.51dBuV Pk	22.7	-8.3	45.91	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Horz	Margin (dB)	-.11	-	-	-	-	-
*11	951.35	30.14dBuV Pk	23.5	-7.6	46.04	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Horz	Margin (dB)	.02	-	-	-	-	-
12	232.9	48.55dBuV Pk	11.2	-18.7	41.05	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-4.97	-	-	-	-	-
13	284.2	46.91dBuV Pk	13.3	-18.3	41.91	46.02	-	-	-	-	-
		Azimuth:0-360	Height:299	Vert	Margin (dB)	-4.11	-	-	-	-	-
14	324.5	39.6dBuV Pk	14.1	-18	35.7	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-10.32	-	-	-	-	-
*15	849.7	29.23dBuV Pk	22.8	-6.9	45.13	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-.89	-	-	-	-	-
*16	951.3	29.87dBuV Pk	23.5	-7.6	45.77	46.02	-	-	-	-	-
		Azimuth:0-360	Height:399	Vert	Margin (dB)	-.25	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

*Not in restricted band, no radiated emissions limits.

Pk - Peak detector

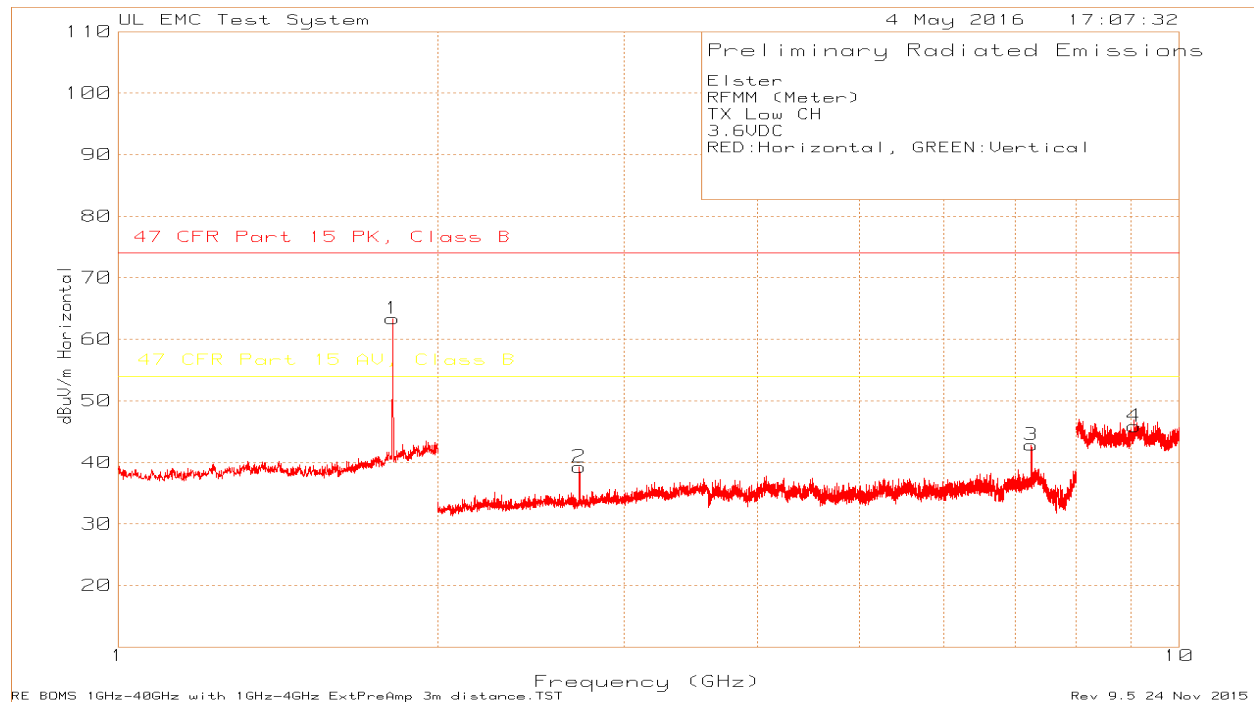
Radiated Emission Data											
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1	2	3	4	5	6
283.1125	44.45dBuV Qp	13.2	-18.3	39.35	46.02	-	-	-	-	-	-
	Azimuth: 15	Height:278	Horz	Margin (dB):	-6.67	-	-	-	-	-	-
232.99875	44.43dBuV Qp	11.2	-18.7	36.93	46.02	-	-	-	-	-	-
	Azimuth: 80	Height:395	Horz	Margin (dB):	-9.09	-	-	-	-	-	-
283.16	44.51dBuV Qp	13.2	-18.3	39.41	46.02	-	-	-	-	-	-
	Azimuth: 13	Height:278	Vert	Margin (dB):	-6.61	-	-	-	-	-	-
233.91625	44.44dBuV Qp	11.2	-18.7	36.94	46.02	-	-	-	-	-	-
	Azimuth: 78	Height:394	Vert	Margin (dB):	-9.08	-	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Qp - Quasi-Peak detector

8.2. TRANSMITTER ABOVE 1 GHz

Low Channel 1GHz – 10GHz



Elster
RFMM (Meter)
TX Low CH
3.6VDC
RED:Horizontal, GREEN:Vertical

Trace Markers

Test No.	Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1 dBuV/m	2	3	4	5	6
*1	1.814	87.49dBuV Pk	30.3	-54.42	63.37	-	-	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-	-	-	-	-	-
2	2.721	68.09dBuV Pk	22.1	-50.96	39.23	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-34.77	-14.77	-	-	-	-
3	7.256	58.86dBuV Pk	30.1	-46.13	42.83	74	54	-	-	-	-
		Azimuth:0-360	Height:149	Horz	Margin (dB)	-31.17	-11.17	-	-	-	-
4	9.07	58.71dBuV Pk	36.2	-49.06	45.85	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-28.15	-8.15	-	-	-	-
*5	1.814	94.04dBuV Pk	30.3	-54.42	69.92	-	-	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-	-	-	-	-	-
6	2.721	69.58dBuV Pk	22.1	-50.96	40.72	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-33.28	-13.28	-	-	-	-
7	7.256	68.42dBuV Pk	30.1	-46.13	52.39	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-21.61	-1.61	-	-	-	-
8	9.071	61dBuV Pk	36.2	-49.04	48.16	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-25.84	-5.84	-	-	-	-

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

Pk - Peak detector

*Not in restricted band, no radiated emissions limits.

Radiated Emission Data

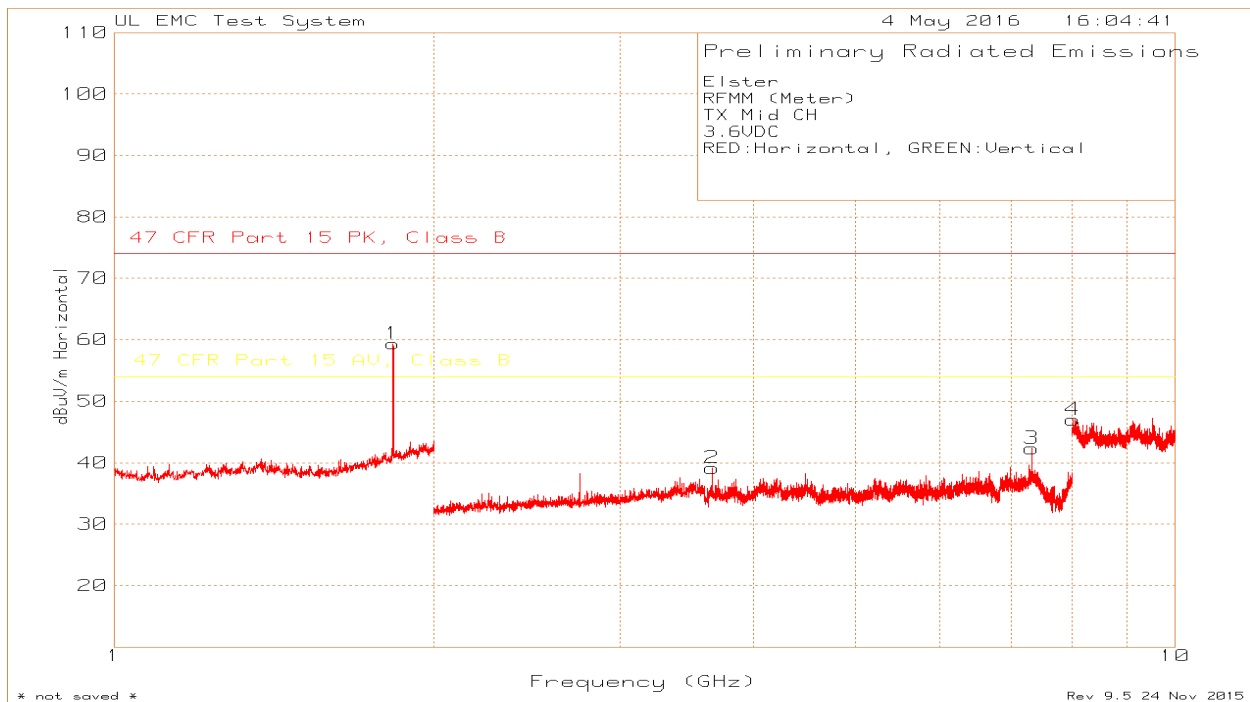
Test No.	Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1 dBuV/m	2	3	4	5	6
7.2554		71.35dBuV Pk	30.1	-46.14	55.31	74	-	-	-	-	-
	Azimuth: 64	Height:189	Vert		Margin (dB):	-18.69	-	-	-	-	-
7.2554		65.03dBuV LnAv	30.1	-46.14	48.99	74	-	-	-	-	-
	Azimuth: 64	Height:189	Vert		Margin (dB):	-25.01	-5.01	-	-	-	-
9.0693		64.57dBuV Pk	36.2	-49.07	51.7	74	-	-	-	-	-
	Azimuth: 263	Height:160	Vert		Margin (dB):	-22.3	-	-	-	-	-
9.0693		52.17dBuV LnAv	36.2	-49.07	39.3	74	54	-	-	-	-
	Azimuth: 263	Height:160	Vert		Margin (dB):	-34.7	-14.7	-	-	-	-

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

Pk - Peak detector

LnAv - Average detection

Middle Channel 1GHz – 10GHz



Elster
RFMM (Meter)
TX Mid CH
3.6VDC
RED:Horizontal, GREEN:Vertical

Trace Markers

Test No.	Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1 dBuV/m	2	3	4	5	6
*1	1.831	83.14dBuV Pk	30.5	-54.26	59.38	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-14.62	5.38	-	-	-	-
2	3.662	65.08dBuV Pk	23.4	-49.34	39.14	74	54	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-34.86	-14.86	-	-	-	-
3	7.325	57.75dBuV Pk	30.6	-46.02	42.33	74	54	-	-	-	-
		Azimuth:0-360	Height:149	Horz	Margin (dB)	-31.67	-11.67	-	-	-	-
4	8.008	57.9dBuV Pk	36.1	-47.02	46.98	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-27.02	-7.02	-	-	-	-
*5	1.831	89.74dBuV Pk	30.5	-54.26	65.98	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-8.02	11.98	-	-	-	-
6	3.663	64.54dBuV Pk	23.4	-49.32	38.62	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-35.38	-15.38	-	-	-	-
7	7.325	67.17dBuV Pk	30.6	-46.02	51.75	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-22.25	-2.25	-	-	-	-
8	8.007	57.5dBuV Pk	36.1	-47.03	46.57	74	54	-	-	-	-
		Azimuth:0-360	Height:100	Vert	Margin (dB)	-27.43	-7.43	-	-	-	-

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

Pk - Peak detector
*Not in restricted band, no radiated emissions limits.

Elster
RFMM (Meter)
TX Mid CH
3.6VDC
RED:Horizontal, GREEN:Vertical

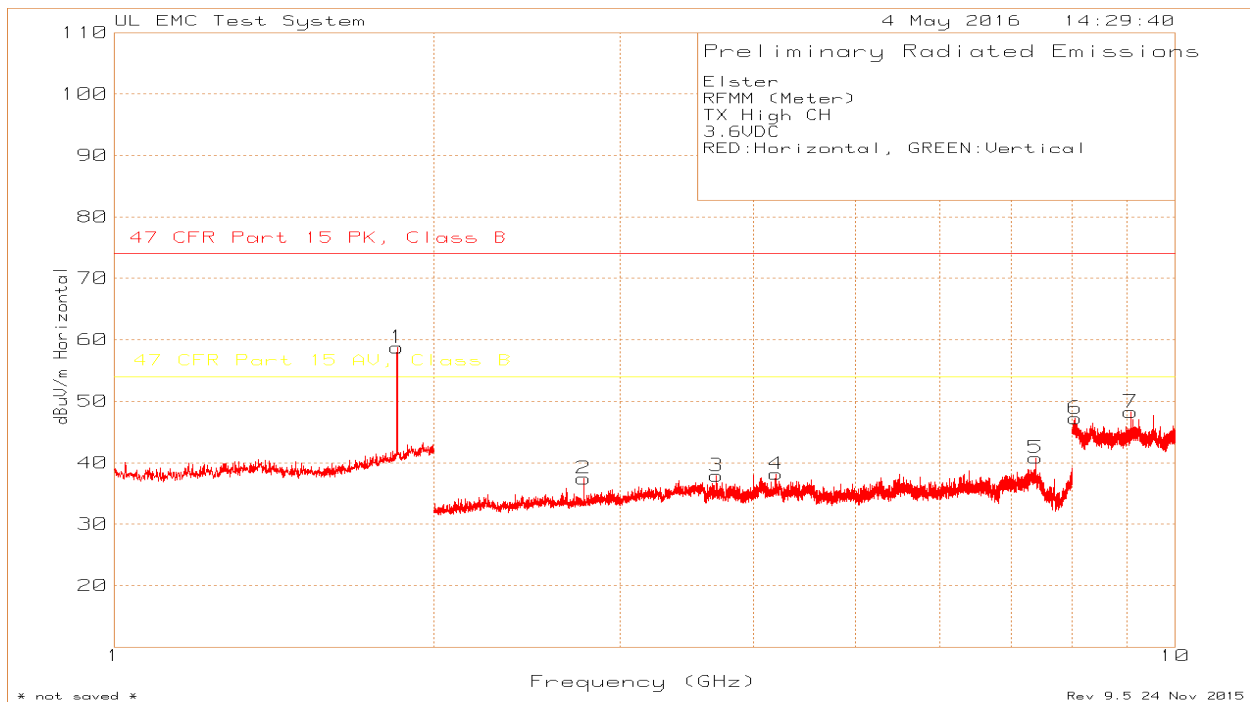
Radiated Emission Data

Test No.	Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1 dBuV/m	2	3	4	5	6
7.3226	66	69.63dBuV Pk	30.6	-46.01	54.22	74	-	-	-	-	-
		Azimuth: 66	Height:177	Vert	Margin (dB):	-19.78	-	-	-	-	-
7.3227	66	63.38dBuV Av	30.6	-46.01	47.97	74	54	-	-	-	-
		Azimuth: 66	Height:177	Vert	Margin (dB):	-26.03	-6.03	-	-	-	-

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

Pk - Peak detector
Av - Average detection

High Channel 1GHz – 10GHz



Elster
RFMM (Meter)
TX High CH
3.6VDC
RED:Horizontal, GREEN:Vertical

Trace Markers

Test No.	Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1	2	3	4	5	6
*1	1.848	82.16dBuV Pk	30.7	-54.11	58.75	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-15.25	4.75	-	-	-	-
2	2.771	66.01dBuV Pk	22.2	-50.77	37.44	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-36.56	-16.56	-	-	-	-
3	3.696	63.73dBuV Pk	23.5	-49.37	37.86	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-36.14	-16.14	-	-	-	-
4	4.206	61.36dBuV Pk	28.3	-51.48	38.18	74	54	-	-	-	-
		Azimuth:0-360	Height:149	Horz	Margin (dB)	-35.82	-15.82	-	-	-	-
5	7.391	56.65dBuV Pk	31.1	-46.95	40.8	74	54	-	-	-	-
		Azimuth:0-360	Height:149	Horz	Margin (dB)	-33.2	-13.2	-	-	-	-
6	8.052	57.51dBuV Pk	36.2	-46.49	47.22	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Horz	Margin (dB)	-26.78	-6.78	-	-	-	-
7	9.083	60.79dBuV Pk	36.2	-48.75	48.24	74	54	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-25.76	-5.76	-	-	-	-
*8	1.848	88.91dBuV Pk	30.7	-54.11	65.5	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-8.5	11.5	-	-	-	-
9	2.771	65.07dBuV Pk	22.2	-50.77	36.5	74	54	-	-	-	-
		Azimuth:0-360	Height:100	Vert	Margin (dB)	-37.5	-17.5	-	-	-	-
10	3.696	62.96dBuV Pk	23.5	-49.37	37.09	74	54	-	-	-	-
		Azimuth:0-360	Height:100	Vert	Margin (dB)	-36.91	-16.91	-	-	-	-
11	4.62	62.91dBuV Pk	27.7	-51.73	38.88	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-35.12	-15.12	-	-	-	-
12	5.516	60.51dBuV Pk	28.2	-49.73	38.98	74	54	-	-	-	-
		Azimuth:0-360	Height:99	Vert	Margin (dB)	-35.02	-15.02	-	-	-	-
13	7.392	64.43dBuV Pk	31.1	-46.98	48.55	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-25.45	-5.45	-	-	-	-
14	8.06	57.5dBuV Pk	36.2	-46.5	47.2	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-26.8	-6.8	-	-	-	-
15	9.246	58.14dBuV Pk	36.4	-48.04	46.5	74	54	-	-	-	-
		Azimuth:0-360	Height:150	Vert	Margin (dB)	-27.5	-7.5	-	-	-	-

LIMIT 1: 47 CFR Part 15 PK, Class B

LIMIT 2: 47 CFR Part 15 AV, Class B

*Not in restricted band, no radiated emissions limits.

Pk - Peak detector

Radiated Emission Data

Test Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading	Limit:1	2	3	4	5	6
9.0822	62.16dBuV Pk	36.2	-48.77	49.59	74	-	-	-	-	-
	Azimuth: 119	Height:150	Horz	Margin (dB):	-24.41	-	-	-	-	-
9.0838	49.63dBuV Av	36.2	-48.72	37.11	74	54	-	-	-	-
	Azimuth: 119	Height:150	Horz	Margin (dB):	-36.89	-16.89	-	-	-	-
7.3899	68.03dBuV Pk	31.1	-46.91	52.22	74	-	-	-	-	-
	Azimuth: 66	Height:185	Vert	Margin (dB):	-21.78	-	-	-	-	-
7.3898	60.57dBuV Av	31.1	-46.91	44.76	74	54	-	-	-	-
	Azimuth: 66	Height:185	Vert	Margin (dB):	-29.24	-9.24	-	-	-	-

LIMIT 1: 47 CFR Part 15 PK, Class B

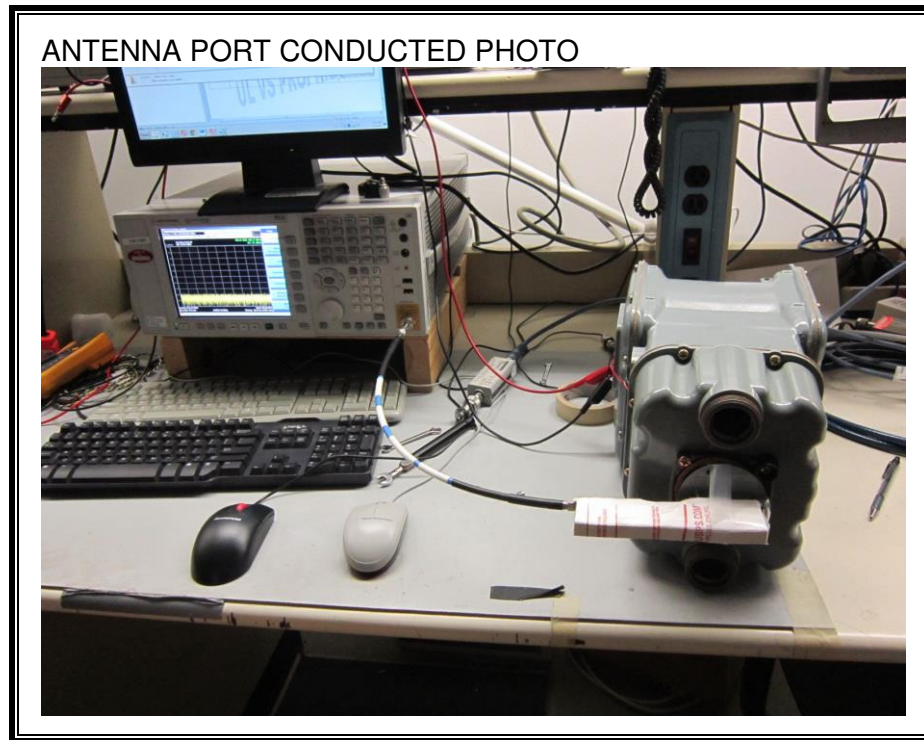
LIMIT 2: 47 CFR Part 15 AV, Class B

Pk - Peak detector

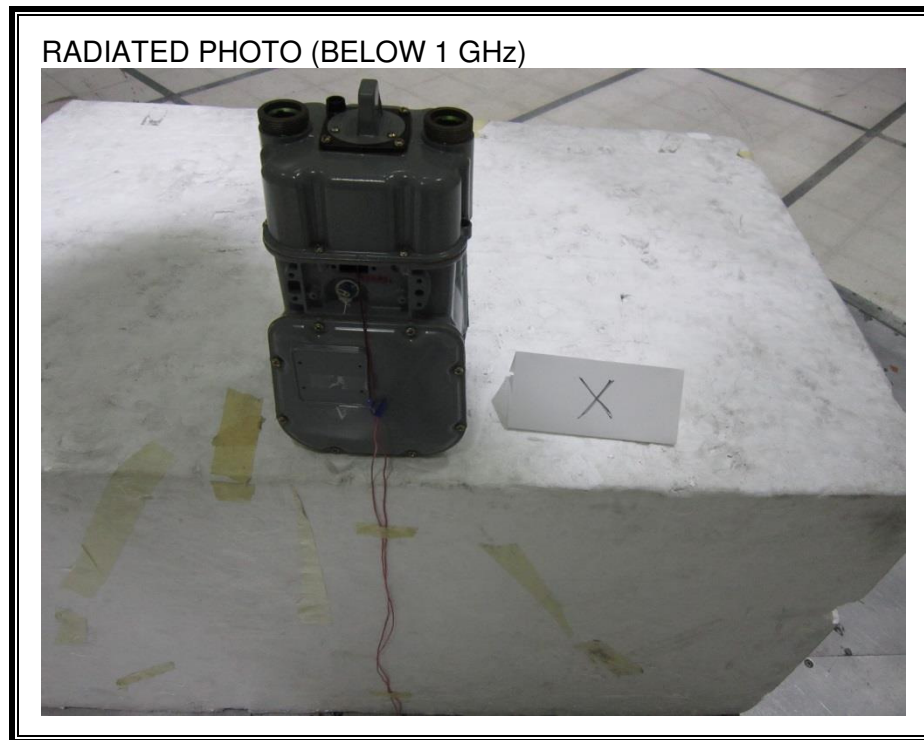
Av - Average detection

9. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



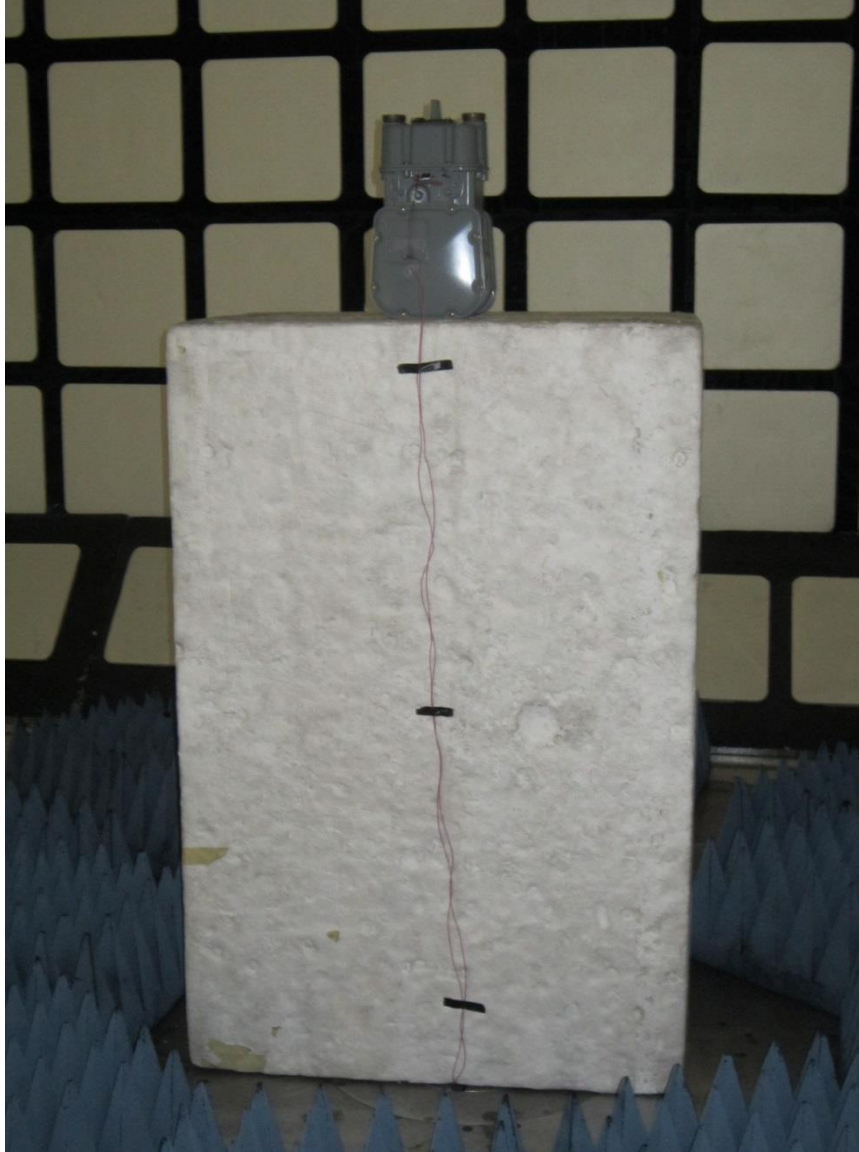
RADIATED RF MEASUREMENT SETUP (BELOW 1 GHz)

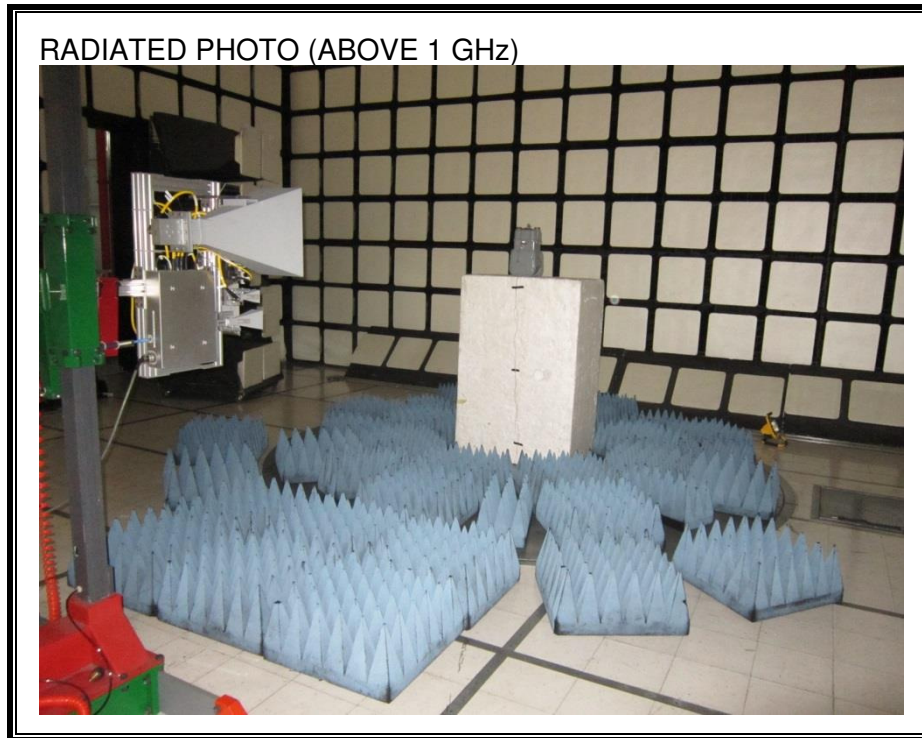




RADIATED RF MEASUREMENT SETUP (ABOVE 1 GHz)

RADIATED PHOTO (ABOVE 1 GHz)





END OF REPORT