EMISSIONS TEST REPORT

Report Number: 101831609BOX-003
Project Number: G101831609

Report Issue Date: 10/20/2014

Product Designation: Motion/Temperature/Light Sensor

Standards: RSS-210 Issue 8 December 2010 Annex 7,
ICES-003 Issue 5 August 2012,
RSS-Gen Issue 2 June 2007,
FCC 47CFR Part 15 Subpart C 15.245,
FCC 47CFR Part 15 Subpart C 15.209,
FCC 47CFR Part 15 Subpart C 15.207,
FCC 47CFR Part 15 Subpart B 15.109

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Express Controls
74A Averill Road
Brookline, NH 03033
USA

Report prepared by Reviewer

Vathana Ven / Senior Project Engineer

Report reviewed by

Michael Murphy / Sr. Staff Engineer, EMC

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test	--
5	System Setup and Method	--
6	Transmitter Radiated Fundamental Field Strength RSS-210 Issue 8 December 2010 Annex 7, FCC 47CFR Part 15 Subpart 15.245	Pass
7	Transmitter Radiated Spurious Emissions RSS-210 Issue 8 December 2010 Annex 7, ICES-003 Issue 5 August 2012, FCC 47CFR Part 15 Subpart C 15.245, FCC 47CFR Part 15 Subpart C 15.209 FCC 47CFR Part 15 Subpart B 15.109	Pass
8	Receiver Radiated Spurious Emissions ICES-003 Issue 5 August 2012, RSS-Gen Issue 2 June 2007, FCC 47CFR Part 15 Subpart B 15.109	Pass
9	Transmitter Bandwidth RSS-Gen Issue 2 June 2007	Pass
10	Transmitter Duty Cycle RSS-210 Issue 8 December 2010 Annex 7, FCC 47CFR Part 15 Subpart 15.245	Pass
11	AC Mains Conducted Emissions ICES-003 Issue 5 August 2012, RSS-Gen Issue 2 June 2007, FCC 47CFR Part 15 Subpart C 15.207, FCC 47CFR Part 15 Subpart B 15.109	Pass
12	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Express Controls
74A Averill Road
Brookline, NH 03033
USA
Contact: Mr. Eric Ryherd
Telephone: (603) 930-8822
Email: eric@expresscontrols.com

4 Description of Equipment Under Test

Manufacturer: Express Controls
74A Averill Road
Brookline, NH 03033
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Motion/Temp/Light Sensor	Express Controls	EZMultiPli	DUT # 1
Motion/Temp/Light Sensor	Express Controls	EZMultiPli	DUT # 2

Receive Date:	10/09/2014
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The equipment under test is motion, temperature, and light sensor operates at 908 MHz and 916 MHz

Equipment Under Test Power Configuration			
Rated Voltage	Rated Power	Rated Frequency	Number of Phases
120 VAC/60Hz	1 W	60 Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	DUT # 1 has the normal operating firmware. It has been configured to send RF data at the maximum rate of once every 120 seconds. It will attempt to send 3 times and then backoff to the back-up channel and try a couple of more times. These are very short packets of less than 64 bytes. The receiver is on all the time.
2	DUT # 2 has special firmware to make testing easier. This unit will turn the RF transmitter on constantly. This mode has to be enabled: a. When plugging the DUT into 120VAC, press and hold the pushbutton on the side of the unit. b. The LED behind the lens will blink either GREEN or RED i. RED means the transmitter is using 916 MHz ii. GREEN means the transmitter is using 908 MHz c. To switch between 916/908, press and hold the pushbutton until the LED change color

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Pre-programmed

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	AC Mains*	2.65	None	None	AC Mains

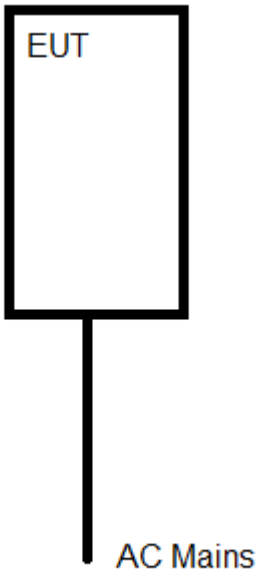
*The AC Mains cable was used for testing only. The EUT normally connects directly to the AC Mains outlet with no cable.

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None			

5.1 Method:

Configuration as required by RSS-210 Issue 8 December 2010 Annex 7, ICES-003 Issue 5 August 2012, RSS-Gen Issue 2 June 2007, FCC 47CFR Part 15 Subpart C 15.245, FCC 47CFR Part 15 Subpart C 15.209, FCC 47CFR Part 15 Subpart C 15.207, FCC 47CFR Part 15 Subpart B 15.109, and ANSI C63.10:2009.

5.2 EUT Block Diagram:



6 Transmitter Fundamental Field Strength

6.1 Method

Tests are performed in accordance with RSS-210, FCC 47CFR Part 15 Subpart C 15.245, and ANSI C63:2009.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	08/20/2013	08/20/2015
145145'	Receiving Antenna	Sunol Sciences	JB3	A122313	01/07/2014	01/07/2015
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/17/2014	03/17/2015
145033'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett-Packard	8447D	2944A08408	10/28/2013	10/28/2014

Software Utilized:

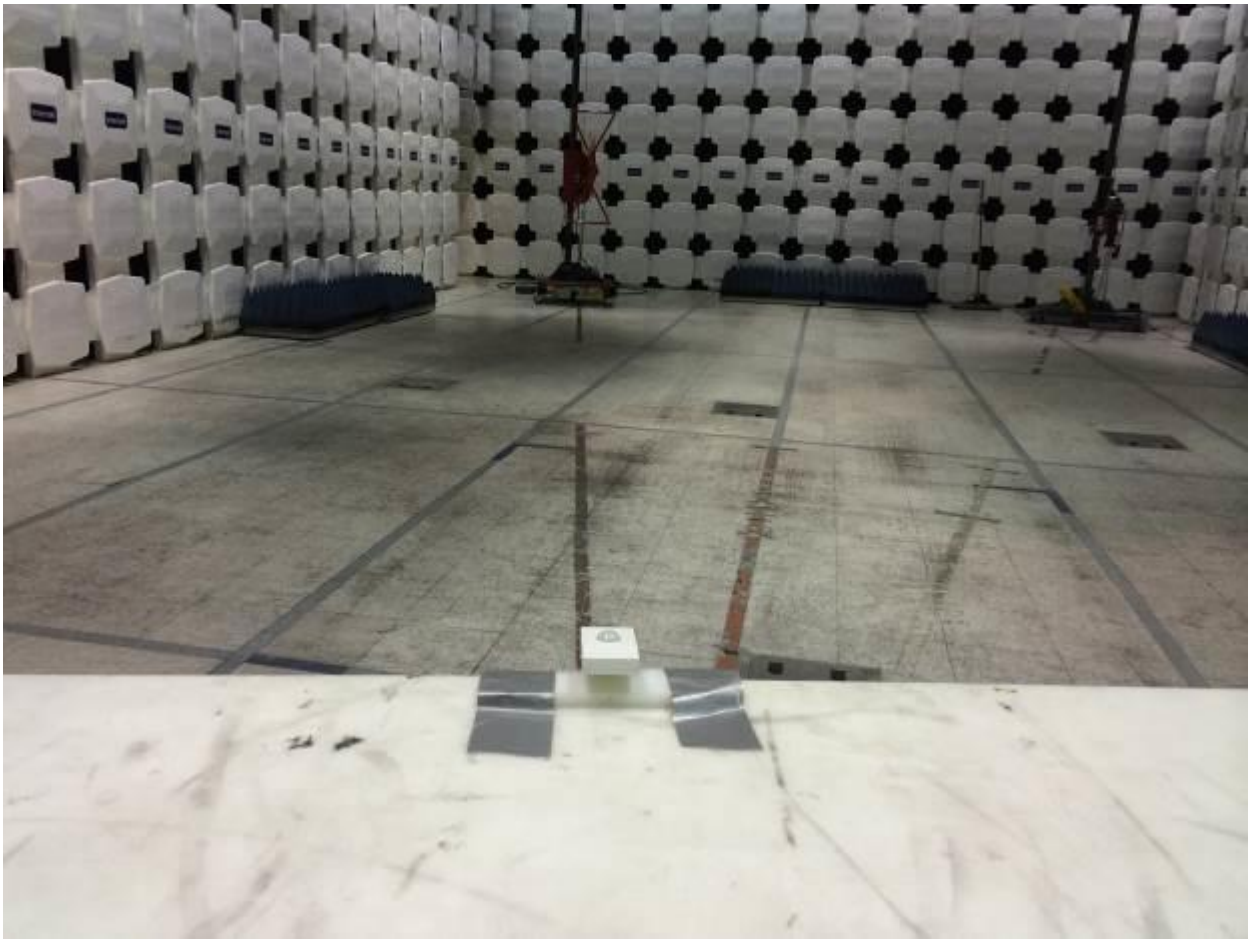
Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

6.3 Results:

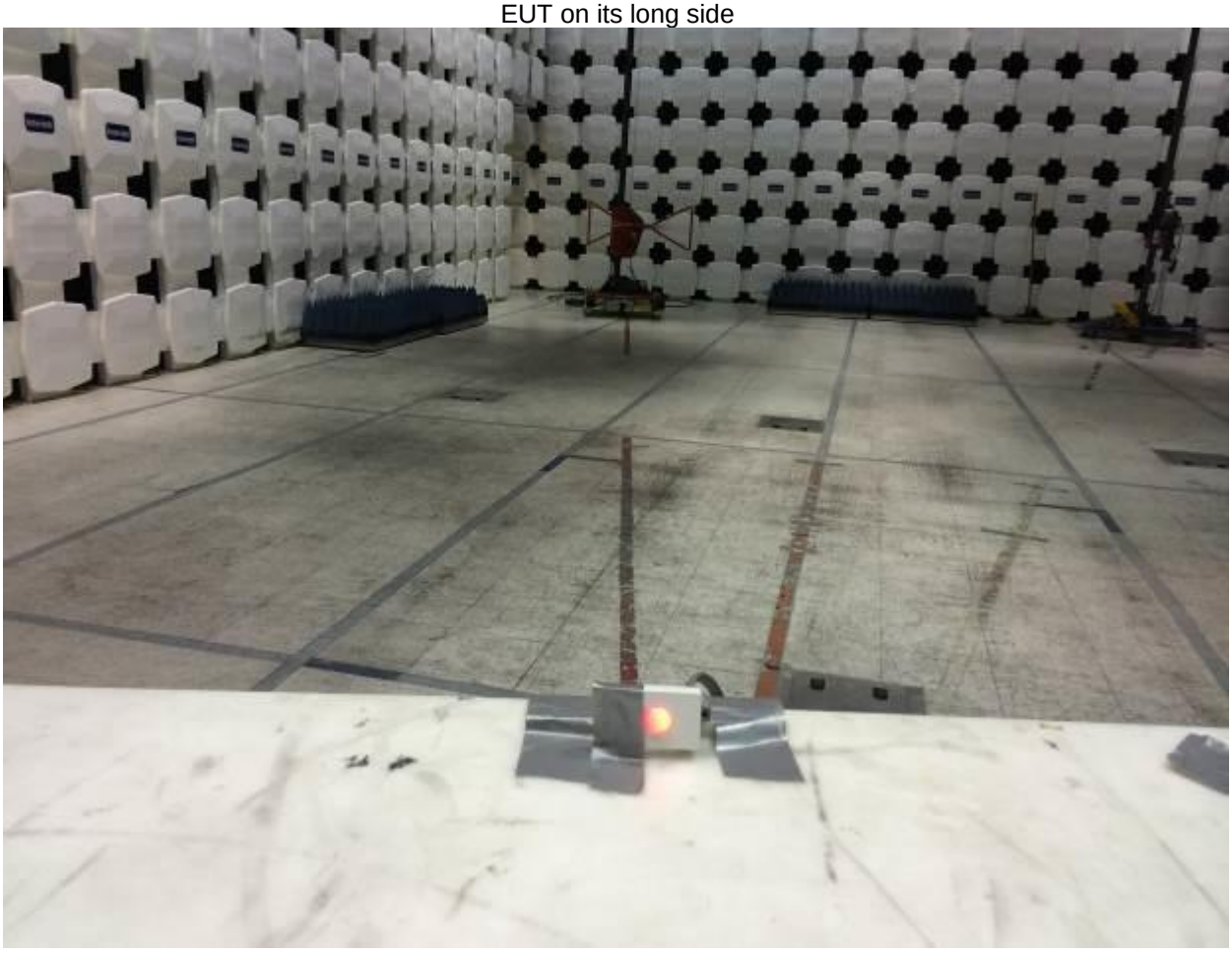
The sample tested was found to Comply.

6.4 Setup Photographs:

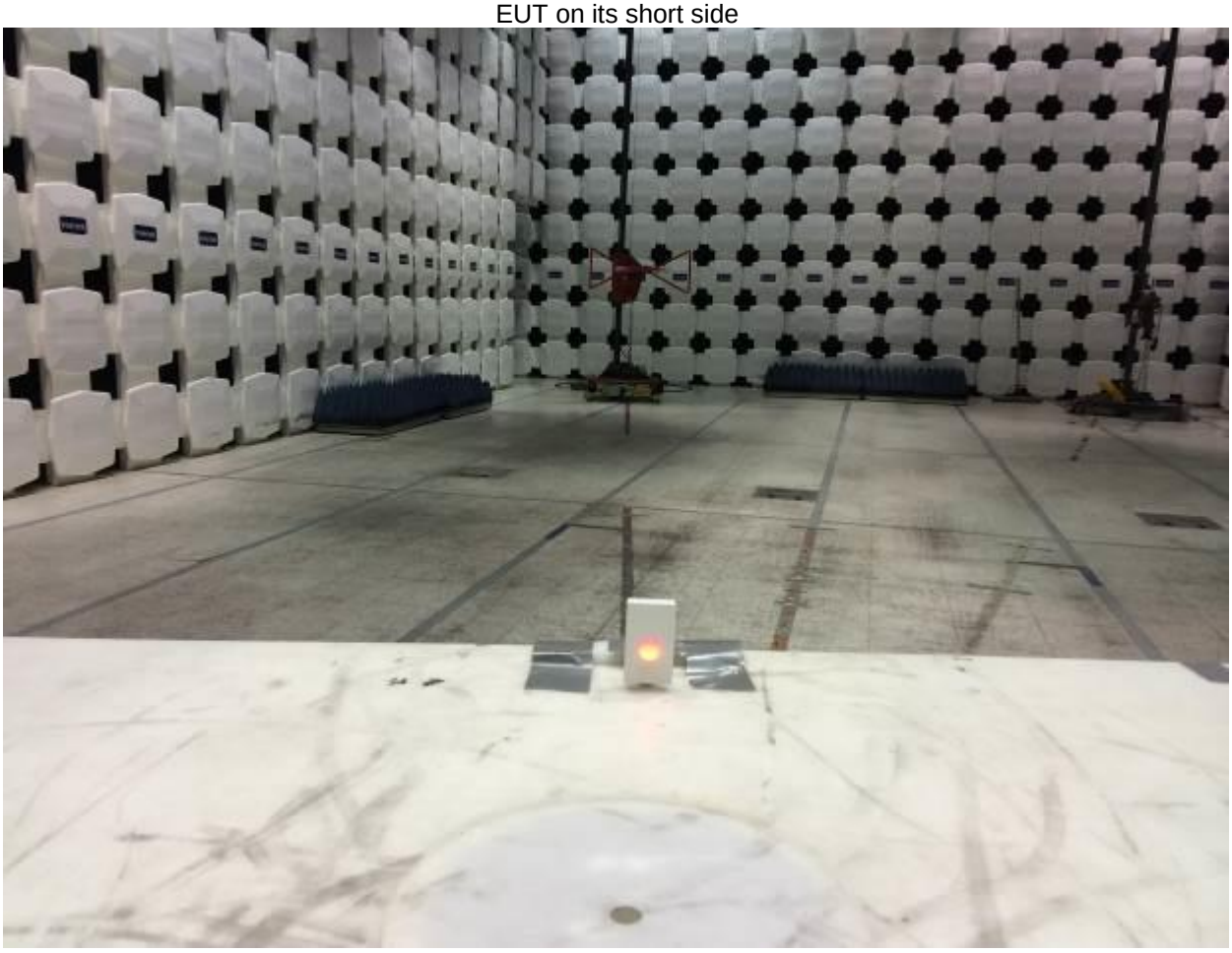
EUT on its back



EUT on its long side



EUT on its short side



6.5 Test Data:

Fundamental Radiated Field Strength Emissions

Company: Express Control
Model #: EZMULTIPLI
Serial #: DUT # 1
Engineers: Kouma Sinn
Project #: G101831609
Date(s): 10/09/14
Standard: FCC Part 15 Subpart C Section 15.245 (902-928 MHz)
Receiver: 145-128
PreAmp: NONE.
Location: 10M Chamber
Antenna & Cables: N
Bands: N, LF, HF, SHF
Antenna: 145-145 10M-H 01-07-15.txt 145-145 10M-H 01-07-15.txt
Cable(s): 145-410 10M Track A 10-04-15.txt NONE.
Barometer: DAV002
Filter: NONE
Temp/Humidity/Pressure: 21C 39% 1005mbar
Limit Distance (m): 3
Test Distance (m): 10
PreAmp Used? (Y or N): N
Voltage/Frequency: 120VAC/60Hz
Frequency Range: Fundamental

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Fundamental Power at 916 MHz at 3 meters. No pre-amp used. The EUT sit on its short side											
PK	V	915.956	66.25	21.86	4.93	0.00	-10.46	103.50	114.00	-10.50	120/300 kHz
PK	H	915.956	61.71	21.86	4.93	0.00	-10.46	98.96	114.00	-15.04	120/300 kHz
The EUT sits on its long side											
PK	V	915.956	62.40	21.86	4.93	0.00	-10.46	99.65	114.00	-14.35	120/300 kHz
PK	H	915.956	61.80	21.86	4.93	0.00	-10.46	99.05	114.00	-14.95	120/300 kHz
The EUT sits on its back											
PK	V	915.956	58.62	21.86	4.93	0.00	-10.46	95.87	114.00	-18.13	120/300 kHz
PK	H	915.956	63.37	21.86	4.93	0.00	-10.46	100.62	114.00	-13.38	120/300 kHz
Fundamental Power at 908 MHz at 3 meters. No pre-amp used. The EUT sits its back											
PK	V	908.360	58.70	22.07	4.86	0.00	-10.46	96.09	114.00	-17.91	120/300 kHz
PK	H	908.360	63.35	22.07	4.86	0.00	-10.46	100.74	114.00	-13.26	120/300 kHz
The EUT sits on its long side											
PK	V	908.360	63.77	22.07	4.86	0.00	-10.46	101.16	114.00	-12.84	120/300 kHz
PK	H	908.360	62.40	22.07	4.86	0.00	-10.46	99.79	114.00	-14.21	120/300 kHz
The EUT sits on its short side											
PK	V	908.360	66.36	22.07	4.86	0.00	-10.46	103.75	114.00	-10.25	120/300 kHz
PK	H	908.360	63.20	22.07	4.86	0.00	-10.46	100.59	114.00	-13.41	120/300 kHz

Test Personnel: Kouma Sinn KPS
Supervising/Reviewing Engineer: (Where Applicable) N/A
Test Date: 10/09/2014

Product Standard: FCC Part 15 Subpart C
Input Voltage: 120VAC/60Hz
Pretest Verification w/ Ambient Signals or BB Source: **BB Source**
Limit Applied: 15.245
Ambient Temperature: 21 ºC
Relative Humidity: 39 %
Atmospheric Pressure: 1005 mbars

Deviations, Additions, or Exclusions: None

7 Transmitter Spurious Emissions

7.1 Method

Tests are performed in accordance with ICES-003, RSS-210, RSS-Gen, FCC 47CFR Part 15 Subpart C 15.245, FCC 47CFR Part 15 Subpart C 15.209, and ANSI C63:2009.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

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Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
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Example:

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7.2 Test Equipment Used:

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145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/17/2014	03/17/2015
145033'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett-Packard	8447D	2944A08408	10/28/2013	10/28/2014
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/19/2013	12/19/2014
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2014	10/04/2015
REA003	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	12/30/2013	12/30/2015

Software Utilized:

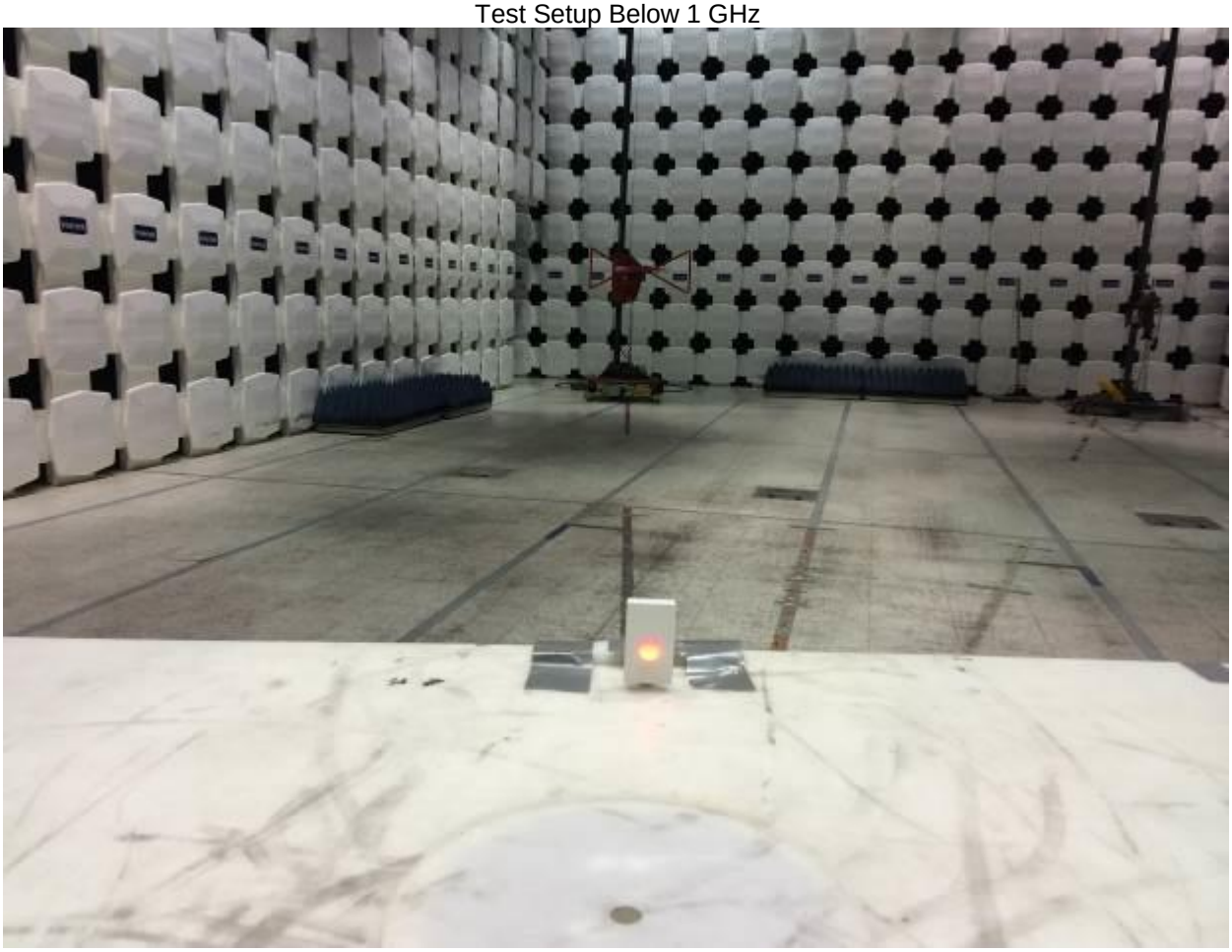
Name	Manufacturer	Version
C5	Teseq	5.26.46.46

7.3 Results:

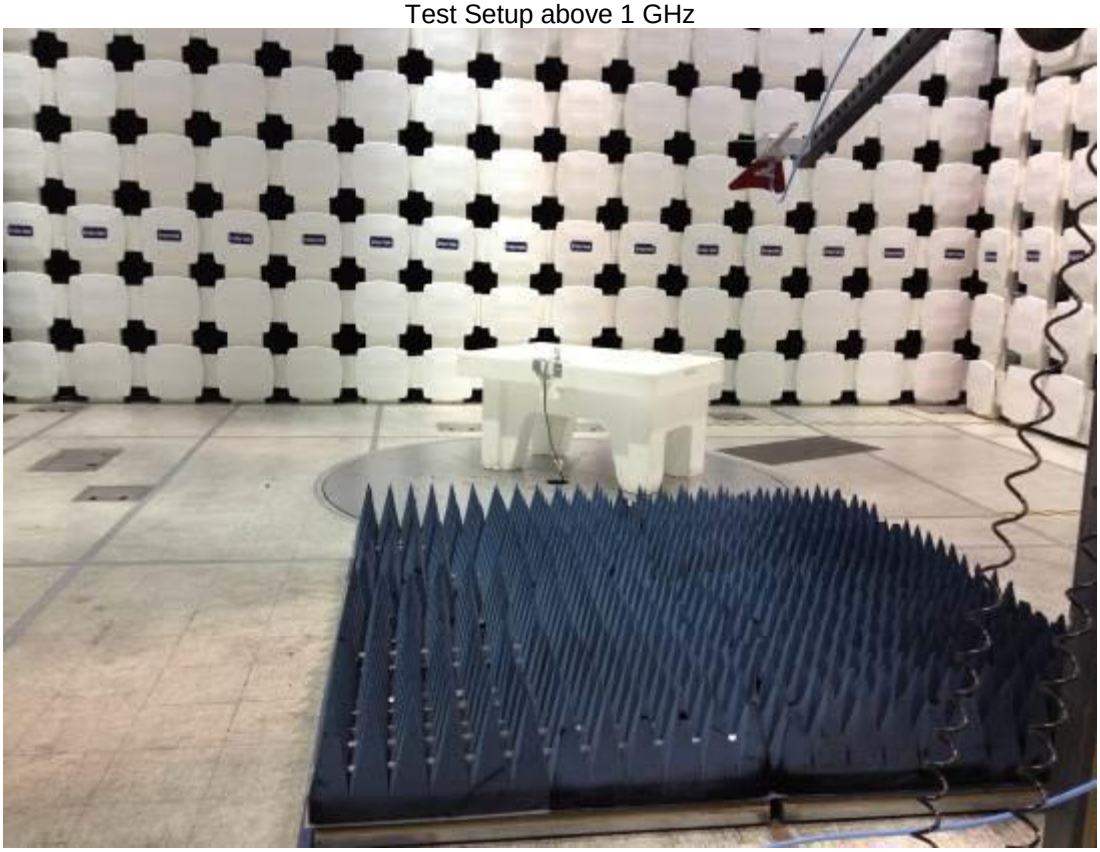
The sample tested was found to Comply.

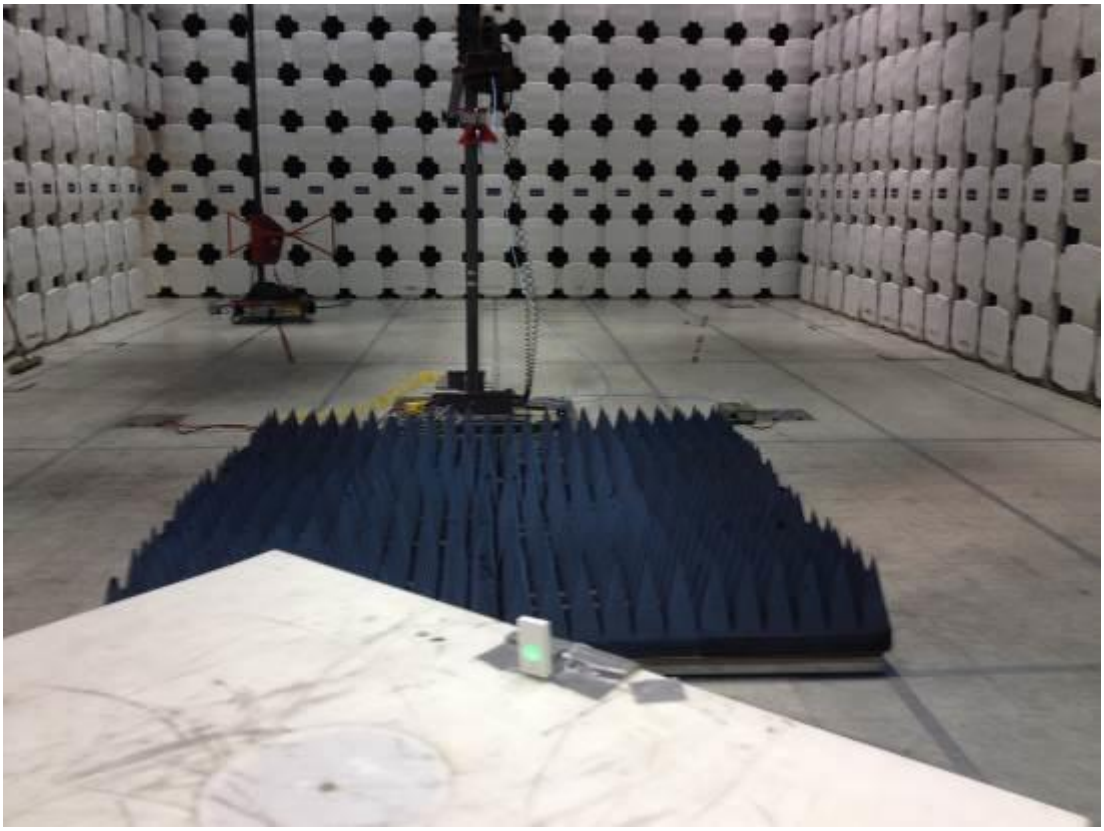
7.4 Setup Photographs:

Test Setup Below 1 GHz



Test Setup above 1 GHz





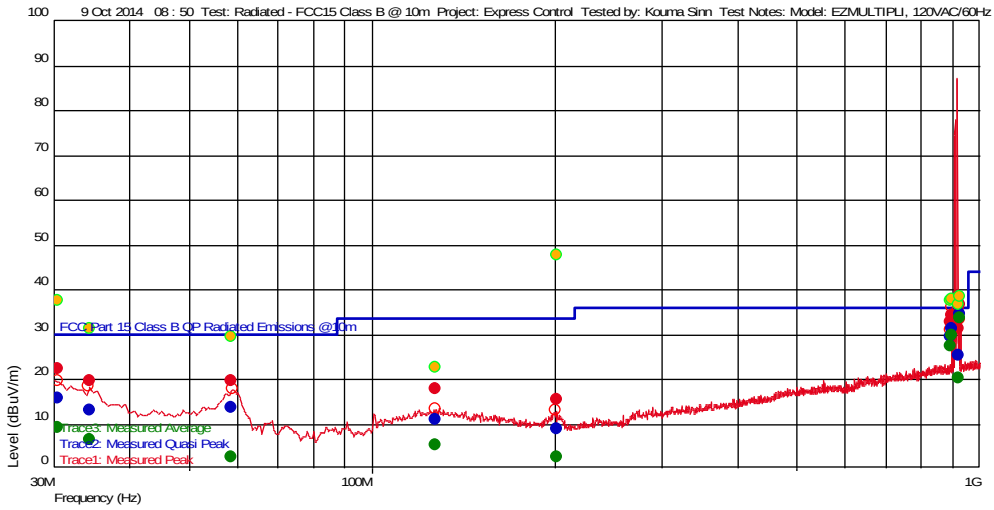
7.5 Plots/Data:

Transmit at 916 MHz – Radiated Emissions: 30-1000 MHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Express Control	
Test Notes:	Model: EZMULTIPLI, 120VAC/60Hz	
Temperature:	21C	
Humidity:	39%, 1005mbar	
Tested by:	Kouma Sinn	
Test Started:	9 Oct 2014 08 : 50	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

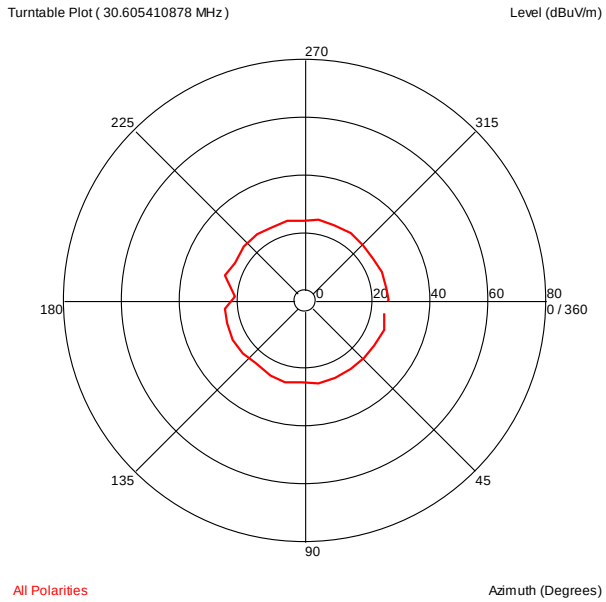
Trace1: Measured Peak

Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
201.622645098 M	15.37	12.116	-25.475	--	--	|	272	1.04	120 k	
127.719639557 M	17.83	14.428	-26.237	--	--	|	95	3.36	120 k	
34.509217942 M	19.58	18.144	-27.396	--	--	|	176	1.48	120 k	
58.852104575 M	19.62	7.300	-27.045	--	--	|	0	1.70	120 k	
30.605410878 M	22.13	20.876	-27.422	--	--	--	185	2.25	120 k	
923.619238723 M	31.17	22.300	-23.028	--	--	|	269	1.95	120 k	
895.932264521 M	32.74	22.000	-23.178	--	--	|	256	1.94	120 k	
903.276552996 M	34.20	22.066	-23.226	--	--	|	234	3.79	120 k	
927.999999695 M	36.66	22.300	-23.040	--	--	|	265	1.94	120 k	

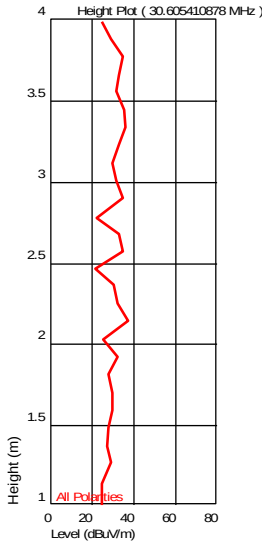
Trace2: Measured Quasi Peak

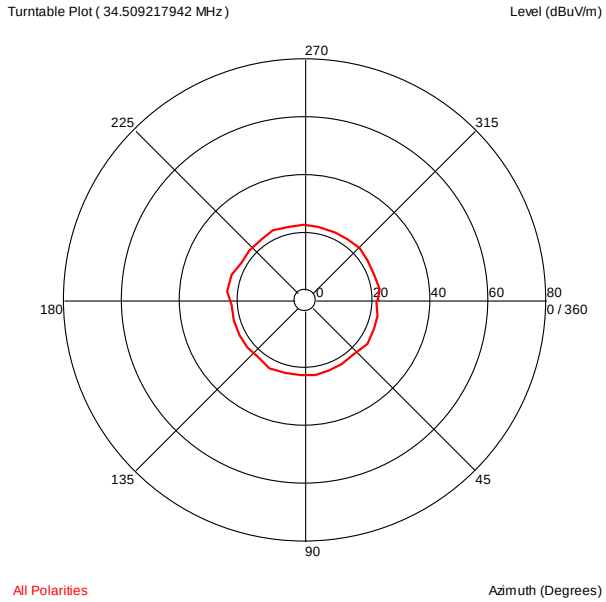
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
201.622645098 M	8.69	12.116	-25.475	33.520	-24.83	|	272	1.04	120 k	
127.719639557 M	10.80	14.428	-26.237	33.520	-22.72	|	95	3.36	120 k	
34.509217942 M	13.02	18.144	-27.396	30.000	-16.98	|	176	1.48	120 k	
58.852104575 M	13.73	7.300	-27.045	30.000	-16.27	|	0	1.70	120 k	
30.605410878 M	15.62	20.876	-27.422	30.000	-14.38	--	185	2.25	120 k	
923.619238723 M	25.22	22.300	-23.028	36.020	-10.80	|	269	1.95	120 k	
895.932264521 M	29.36	22.000	-23.178	36.020	-6.66	|	256	1.94	120 k	
903.276552996 M	31.20	22.066	-23.226	36.020	-4.82	|	234	3.79	120 k	
927.999999695 M	34.45	22.300	-23.040	36.020	-1.57	|	265	1.94	120 k	

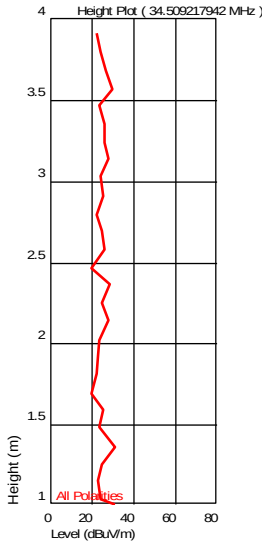
Azimuth Plots

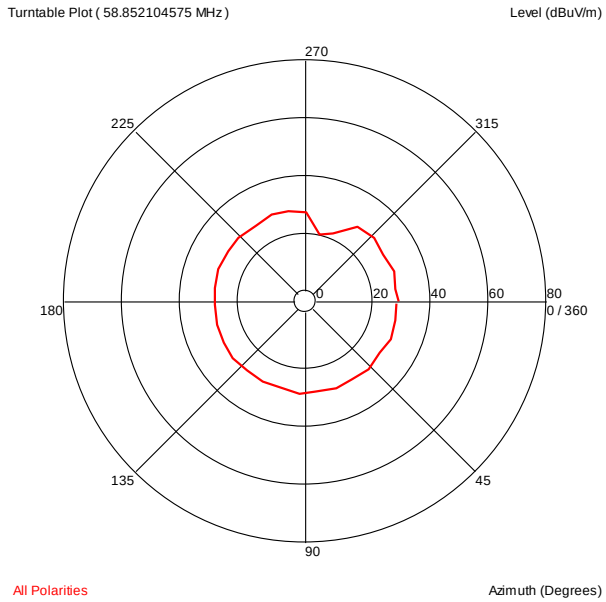


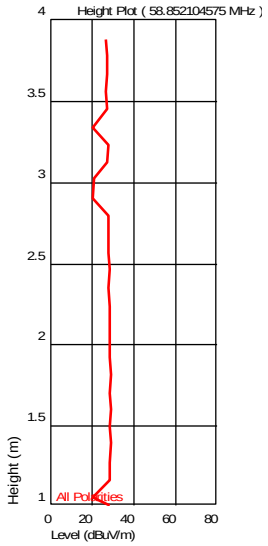
Turntable Plots

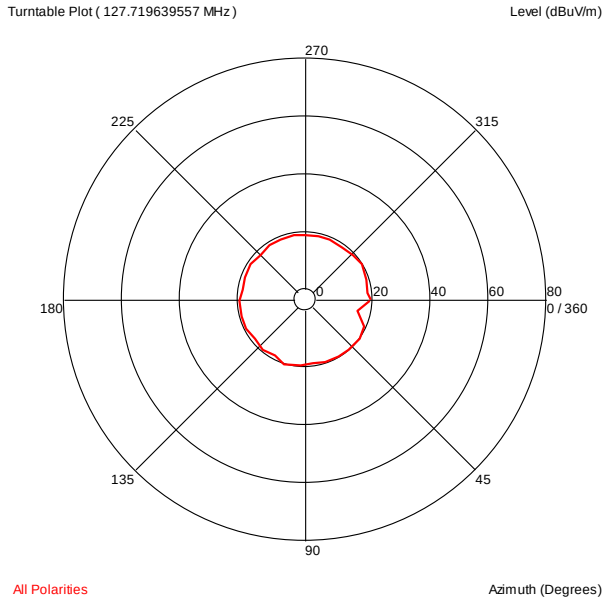


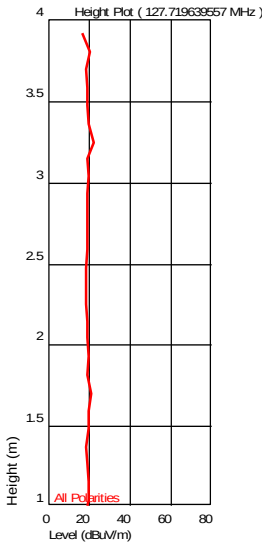


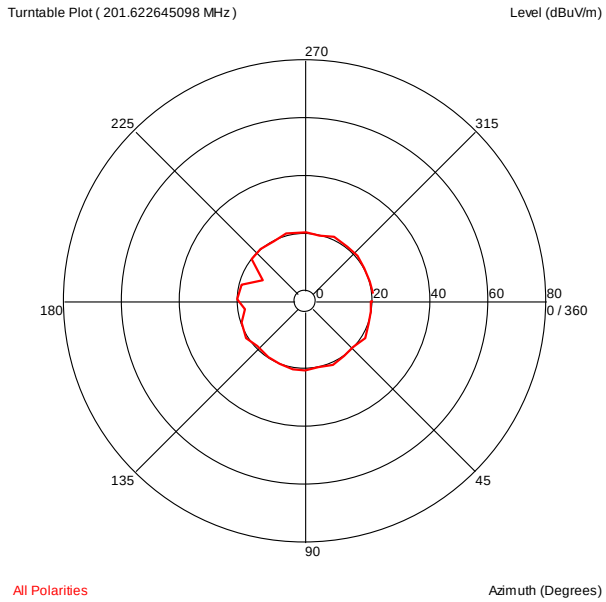


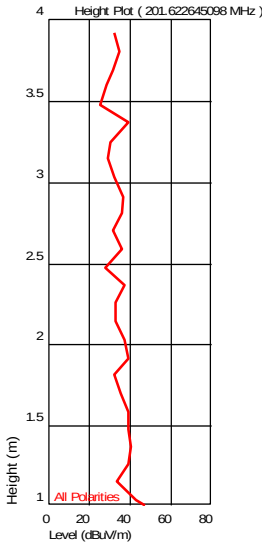

Turntable Plot (58.852104575 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

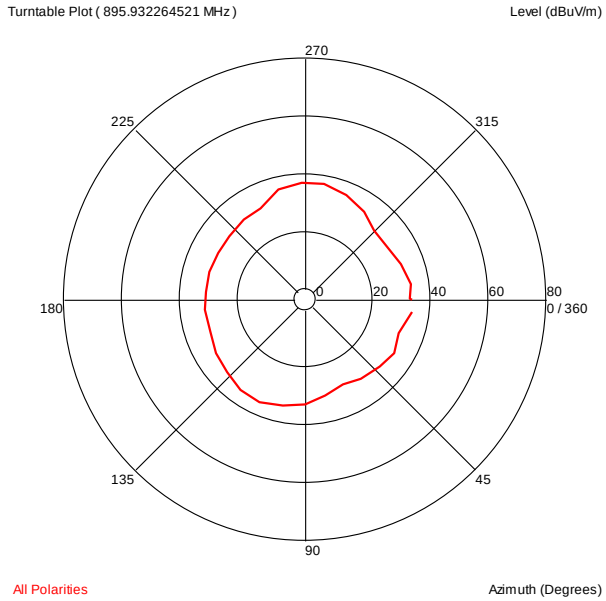

Height Plot (58.852104575 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

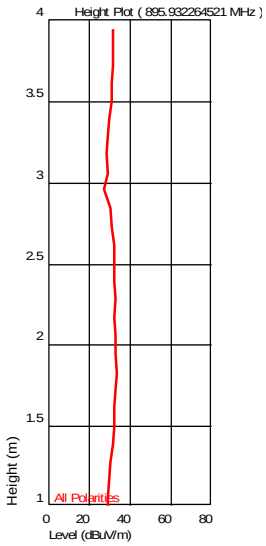

Turntable Plot (127.719639557 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

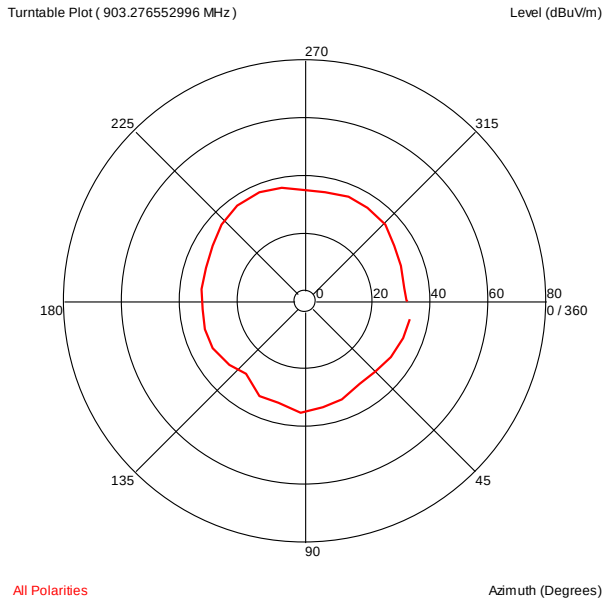

Height Plot (127.719639557 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

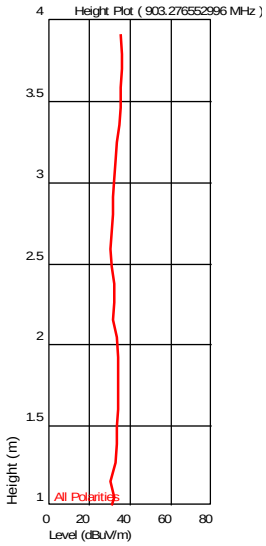

Turntable Plot (201.622645098 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

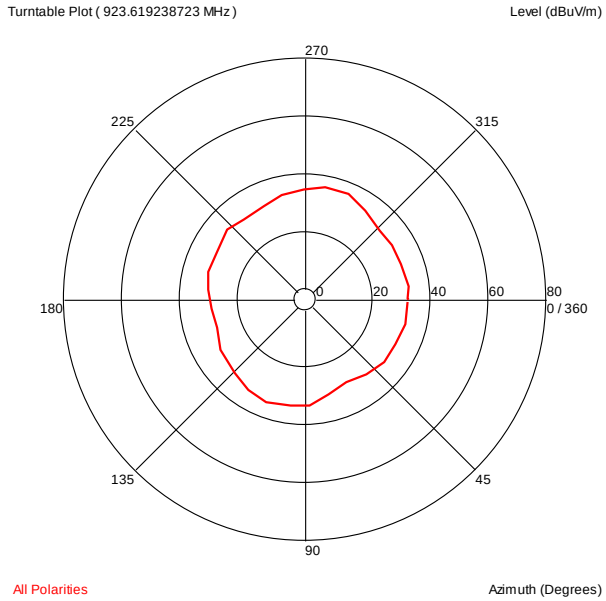

Height Plot (201.622645098 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

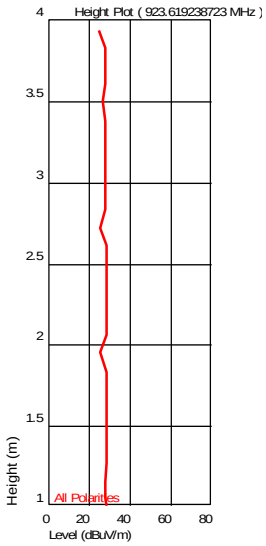

Turntable Plot (895.932264521 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

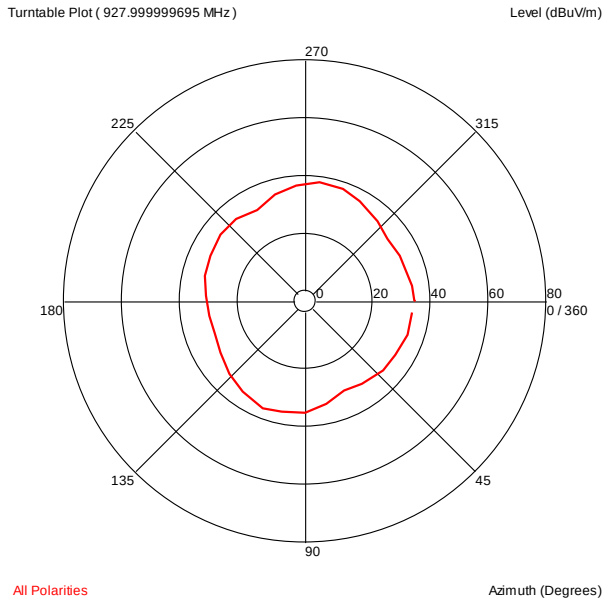

Height Plot (895.932264521 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

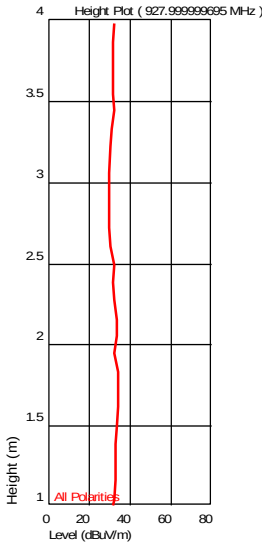

Turntable Plot (903.276552996 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (903.276552996 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (923.619238723 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (923.619238723 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (927.999999695 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (927.999999695 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Radiated Emissions

Company: Express Control
Model #: EZMULTIPLI
Serial #: DUT#2
Engineers: Vathana Ven
Project #: G101831609
Standard: FCC Part 15 Subpart C 15.245
Receiver: R&S ESI (145-128) 03-17-2015
PreAmp: PRE145014 04-29-2015.txt

Date(s): 10/09/14
Location: 10M
Limit Distance (m): 3
Test Distance (m): 3

Antenna & Cables: N
Antenna: ETS001 01-06-15.txt
Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt
Barometer: DAV002
Temp/Humidity/Pressure: 21C

Bands: N, LF, HF, SHF
ETS001 01-06-15.txt
NONE.
Filter: REA003
39%
1005mbar

PreAmp Used? (Y or N): Y
Voltage/Frequency: 120VAC/60Hz
Frequency Range: 1-10 GHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
F = 915.956 MHz													
PK	V	1831.912	43.92	30.48	5.22	30.33	0.00	49.30	84.08	-34.78	1/3 MHz		
AVG	V	1831.912	23.02	30.48	5.22	30.33	0.00	28.40	64.08	-35.68	1/3 MHz		
PK	V	2747.868	54.97	32.46	6.51	31.00	0.00	62.93	74.00	-11.07	1/3 MHz	RB	RB
AVG	V	2747.868	34.07	32.46	6.51	31.00	0.00	42.03	54.00	-11.97	1/3 MHz	RB	RB
PK	V	3663.824	43.27	33.28	7.73	31.55	0.00	52.73	74.00	-21.27	1/3 MHz	RB	RB
AVG	V	3663.824	22.37	33.28	7.73	31.55	0.00	31.83	54.00	-22.17	1/3 MHz	RB	RB
PK	V	4579.780	47.39	34.29	8.28	31.68	0.00	58.29	74.00	-15.71	1/3 MHz	RB	RB
AVG	V	4579.780	26.49	34.29	8.28	31.68	0.00	37.39	54.00	-16.61	1/3 MHz	RB	RB
PK	V	5495.736	36.17	34.55	9.44	31.70	0.00	48.46	74.00	-25.54	1/3 MHz		
AVG	V	5495.736	15.27	34.55	9.44	31.70	0.00	27.56	54.00	-26.44	1/3 MHz		
PK	V	6411.692	36.59	35.65	10.79	31.91	0.00	51.12	84.08	-32.96	1/3 MHz		
AVG	V	6411.692	15.69	35.65	10.79	31.91	0.00	30.22	64.08	-33.86	1/3 MHz		
PK	V	7327.648	40.79	35.75	10.74	32.21	0.00	55.07	84.08	-29.01	1/3 MHz		
AVG	V	7327.648	19.89	35.75	10.74	32.21	0.00	34.17	64.08	-29.91	1/3 MHz		
PK	V	8243.604	46.97	35.96	11.46	32.20	0.00	62.19	84.08	-21.89	1/3 MHz		
AVG	V	8243.604	26.07	35.96	11.46	32.20	0.00	41.29	64.08	-22.79	1/3 MHz		
PK	V	9159.560	34.98	36.43	11.93	31.88	0.00	51.46	84.08	-32.62	1/3 MHz		
AVG	V	9159.560	14.08	36.43	11.93	31.88	0.00	30.56	64.08	-33.52	1/3 MHz		

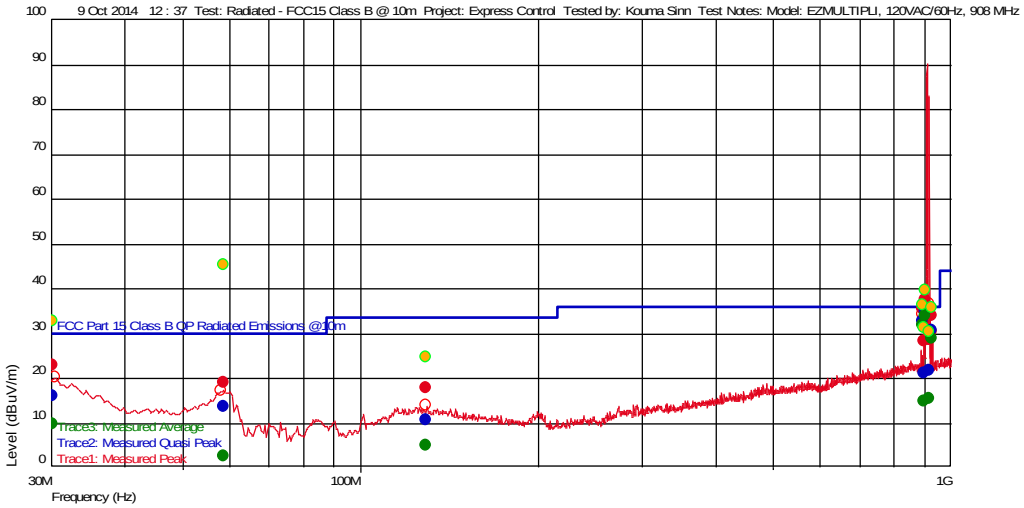
Average Factor = 20*LOG(9.018/100) = 20.9 dB
Average factors were subtracted from Peak readings to get Average readings

Transmit at 908 MHz – Radiated Emissions: 30-1000 MHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Express Control	
Test Notes:	Model: EZMULTIPLI, 120VAC/60Hz, 908 MHz	
Temperature:	21C	
Humidity:	39%, 1005mbar	
Tested by:	Kouma Sinn	
Test Started:	9 Oct 2014 12 : 37	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace1: Measured Peak

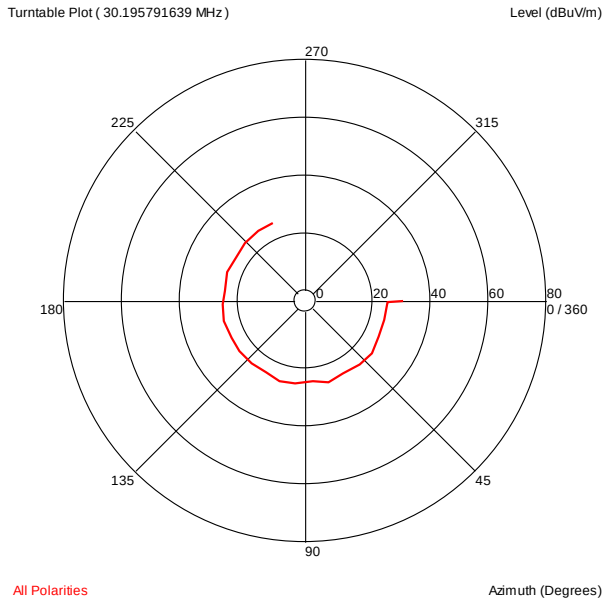
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
129.420640786 M	17.69	14.216	-26.208	--	--	--	354	3.71	120 k	
58.772344944 M	18.92	7.300	-27.055	--	--	|	0	1.15	120 k	
902.027454519 M	28.30	22.041	-23.186	--	--	|	180	1.15	120 k	
920.150901657 M	28.64	22.300	-23.105	--	--	|	251	1.40	120 k	
30.195791639 M	22.94	21.163	-27.367	--	--	|	1	3.52	120 k	
927.987174044 M	33.91	22.300	-23.038	--	--	|	258	1.60	120 k	
895.991583158 M	35.48	22.000	-23.185	--	--	|	240	1.61	120 k	
903.888777389 M	37.35	22.078	-23.176	--	--	|	257	1.93	120 k	

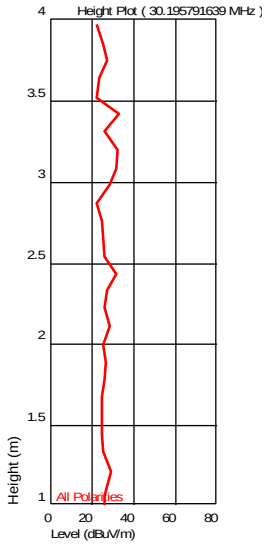
Trace2: Measured Quasi Peak

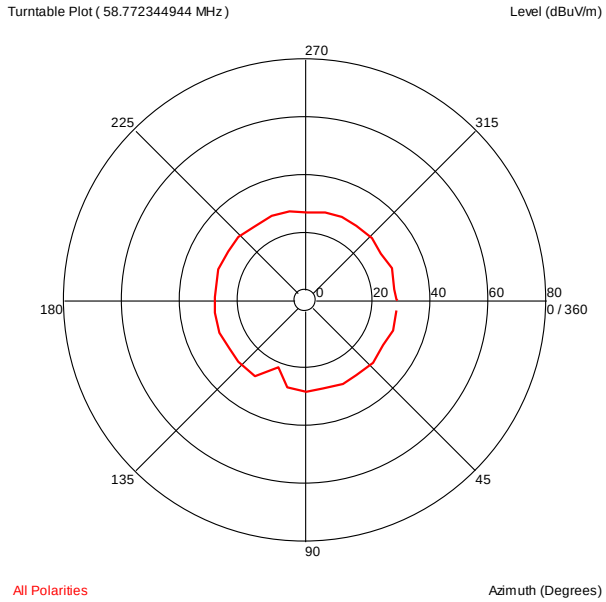
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
129.420640786 M	10.72	14.216	-26.208	33.520	-22.80	--	354	3.71	120 k	
58.772344944 M	13.69	7.300	-27.055	30.000	-16.31	|	0	1.15	120 k	
902.027454519 M	20.91	22.041	-23.186	36.020	-15.11	|	180	1.15	120 k	
920.150901657 M	21.58	22.300	-23.105	36.020	-14.44	|	251	1.40	120 k	
30.195791639 M	15.96	21.163	-27.367	30.000	-14.04	|	1	3.52	120 k	
927.987174044 M	30.70	22.300	-23.038	36.020	-5.32	|	258	1.60	120 k	
895.991583158 M	32.79	22.000	-23.185	36.020	-3.23	|	240	1.61	120 k	
903.888777389 M	34.79	22.078	-23.176	36.020	-1.23	|	257	1.93	120 k	

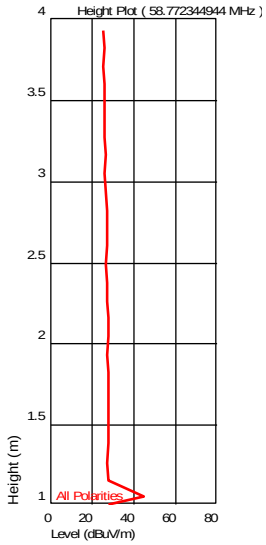
Azimuth Plots

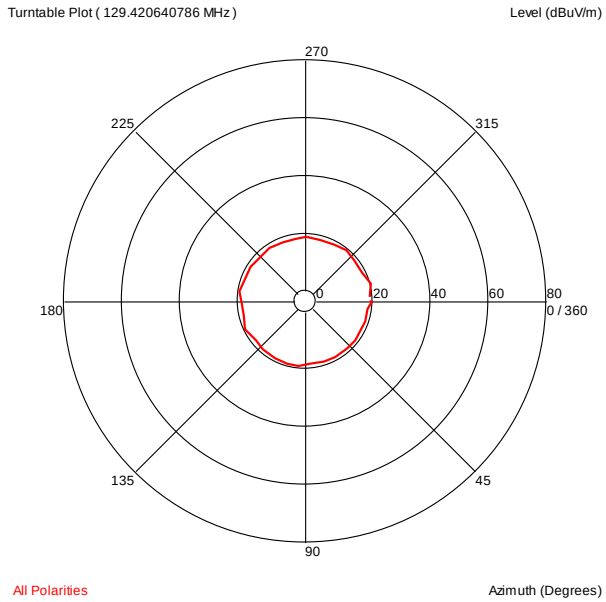
Turntable Plots

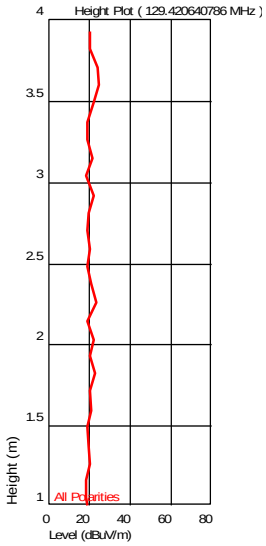


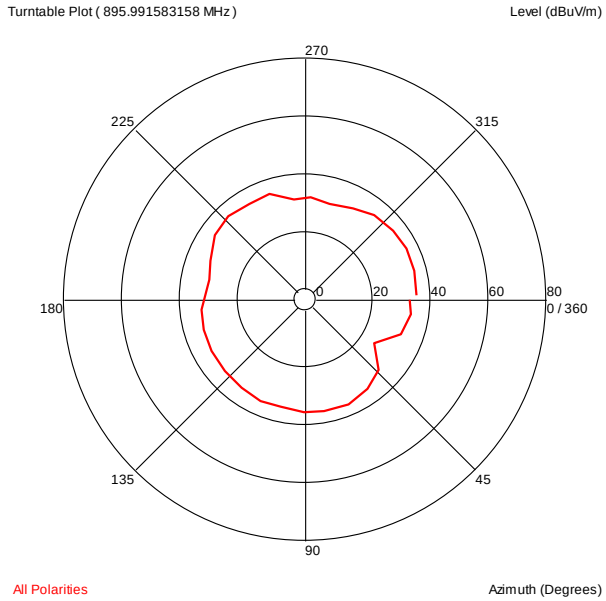


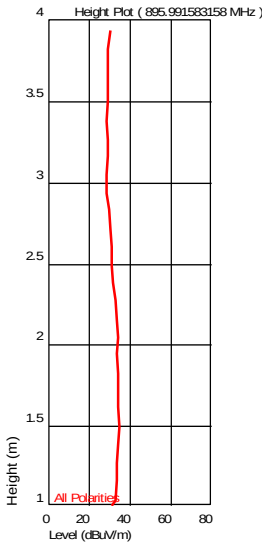


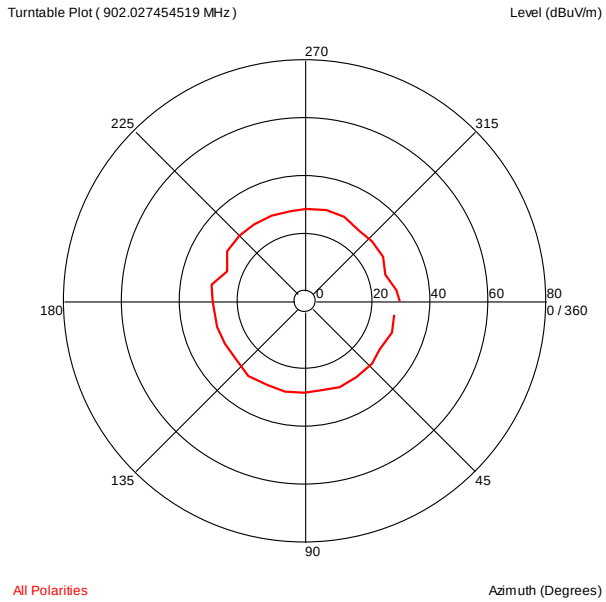


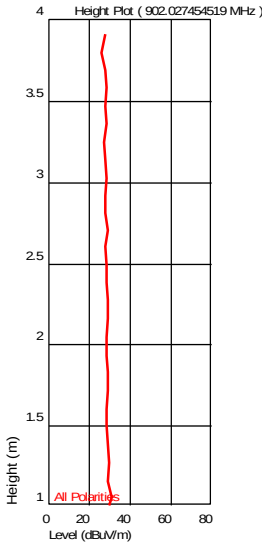

Turntable Plot (129.420640786 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

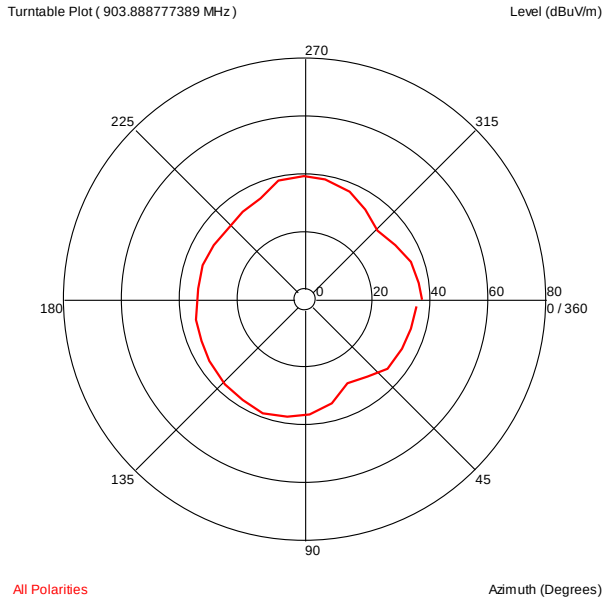

Height Plot (129.420640786 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

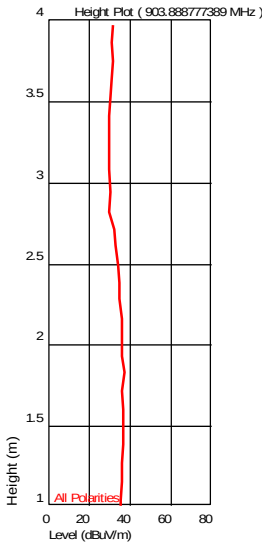

Turntable Plot (895.991583158 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

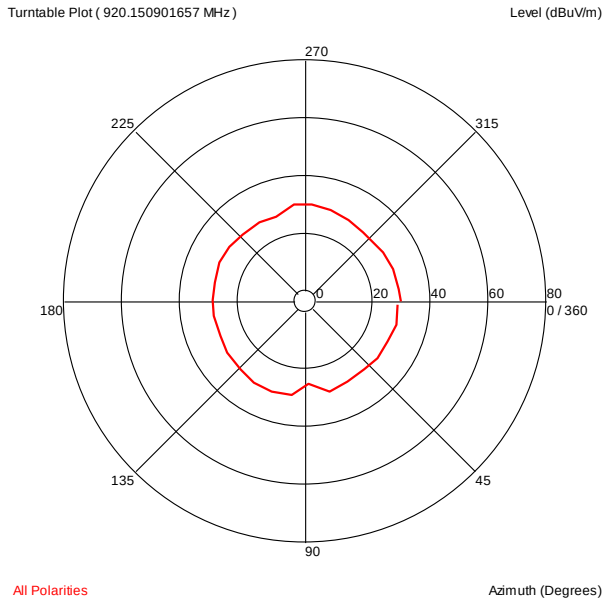

Height Plot (895.991583158 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

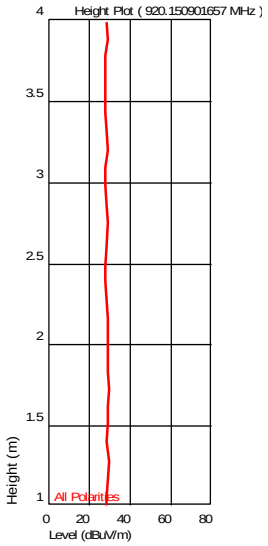

Turntable Plot (902.027454519 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

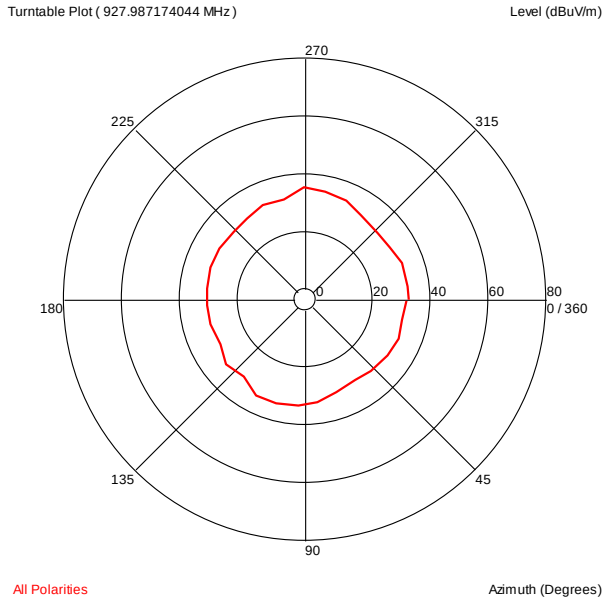

Height Plot (902.027454519 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

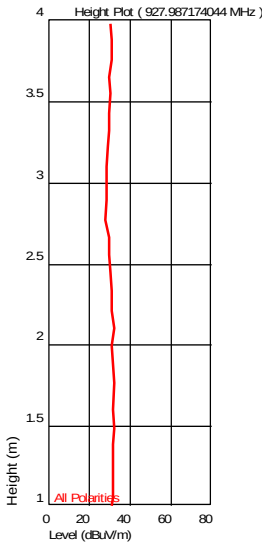

Turntable Plot (903.888777389 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (903.888777389 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (920.150901657 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (920.150901657 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (927.987174044 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (927.987174044 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Radiated Emissions

Company: Express Control
Model #: EZMULTIPLI
Serial #: DUT#2
Engineers: Vathana Ven Location: 10M
Project #: G101831609 Date(s): 10/09/14
Standard: FCC Part 15 Subpart C 15.245
Receiver: R&S ESI (145-128) 03-17-2015 Limit Distance (m): 3
PreAmp: PRE145014 04-29-2015.txt Test Distance (m): 3

Antenna & Cables: N Bands: N, LF, HF, SHF
Antenna: ETS001 01-06-15.txt ETS001 01-06-15.txt
Cable(s): 145-416 3m Track B 1-15GHz Cable 10-04-15.txt NONE.
Barometer: DAV002 Filter: REA003
Temp/Humidity/Pressure: 21C 39% 1005mbar

PreAmp Used? (Y or N): Y Voltage/Frequency: 120VAC/60Hz Frequency Range: 1-10 GHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Average Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC	Harmonic?
F = 908.3604 MHz														
PK	V	1816.721	41.86	30.29	5.19	30.34	0.00	46.99	84.08	-37.09	1/3 MHz			
AVG	V	1816.721	20.96	30.29	5.19	30.34	0.00	26.09	64.08	-37.99	1/3 MHz			
PK	V	2725.081	46.90	32.46	6.46	30.96	0.00	54.86	74.00	-19.14	1/3 MHz	RB	RB	
AVG	V	2725.081	26.00	32.46	6.46	30.96	0.00	33.96	54.00	-20.04	1/3 MHz	RB	RB	
PK	V	3633.442	46.71	33.21	7.66	31.55	0.00	56.03	74.00	-17.97	1/3 MHz	RB	RB	
AVG	V	3633.442	25.81	33.21	7.66	31.55	0.00	35.13	54.00	-18.87	1/3 MHz	RB	RB	
PK	V	4541.802	45.49	34.26	8.25	31.62	0.00	56.38	74.00	-17.62	1/3 MHz	RB	RB	
AVG	V	4541.802	24.59	34.26	8.25	31.62	0.00	35.48	54.00	-18.52	1/3 MHz	RB	RB	
PK	V	5450.162	36.93	34.54	9.40	31.70	0.00	49.17	74.00	-24.83	1/3 MHz	RB	RB	
AVG	V	5450.162	16.03	34.54	9.40	31.70	0.00	28.27	54.00	-25.73	1/3 MHz	RB	RB	
PK	V	6358.523	42.53	35.62	10.46	31.86	0.00	56.75	84.08	-27.33	1/3 MHz			
AVG	V	6358.523	21.63	35.62	10.46	31.86	0.00	35.85	64.08	-28.23	1/3 MHz			
PK	V	7266.883	42.74	35.75	10.69	32.17	0.00	57.01	84.08	-27.07	1/3 MHz			
AVG	V	7266.883	21.84	35.75	10.69	32.17	0.00	36.11	64.08	-27.97	1/3 MHz			
PK	V	8175.244	46.06	35.97	11.45	32.28	0.00	61.20	84.08	-22.88	1/3 MHz			
AVG	V	8175.244	25.16	35.97	11.45	32.28	0.00	40.30	64.08	-23.78	1/3 MHz			
PK	V	9083.604	36.53	36.38	12.17	31.86	0.00	53.21	84.08	-30.87	1/3 MHz			
AVG	V	9083.604	15.63	36.38	12.17	31.86	0.00	32.31	64.08	-31.77	1/3 MHz			

Average Factor = 20*LOG(9.018/100) = 20.9 dB
Average factors were subtracted from Peak readings to get Average readings

Test Personnel: Kouma Sinn KPS; Vathana Ven VJV
Supervising/Reviewing Engineer: (Where Applicable) N/A

Test Date: 10/09/2014

Product Standard: FCC Part 15 Subpart C
Input Voltage: 120VAC/60Hz
Pretest Verification w/ Ambient Signals or BB Source: **BB Source**

Limit Applied: 15.245 & 15.209
Ambient Temperature: 21 ºC
Relative Humidity: 39 %
Atmospheric Pressure: 1005 mbars

Deviations, Additions, or Exclusions: None

8 Receiver Spurious Emissions

8.1 Method

Tests are performed in accordance with ICES-003, RSS-Gen, FCC 47CFR Part 15 Subpart B 15.109, and ANSI C63:2009.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	08/20/2013	08/20/2015
145145'	Receiving Antenna	Sunol Sciences	JB3	A122313	01/07/2014	01/07/2015
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/17/2014	03/17/2015
145033'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett-Packard	8447D	2944A08408	10/28/2013	10/28/2014
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/19/2013	12/19/2014
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2014	10/04/2015

Software Utilized:

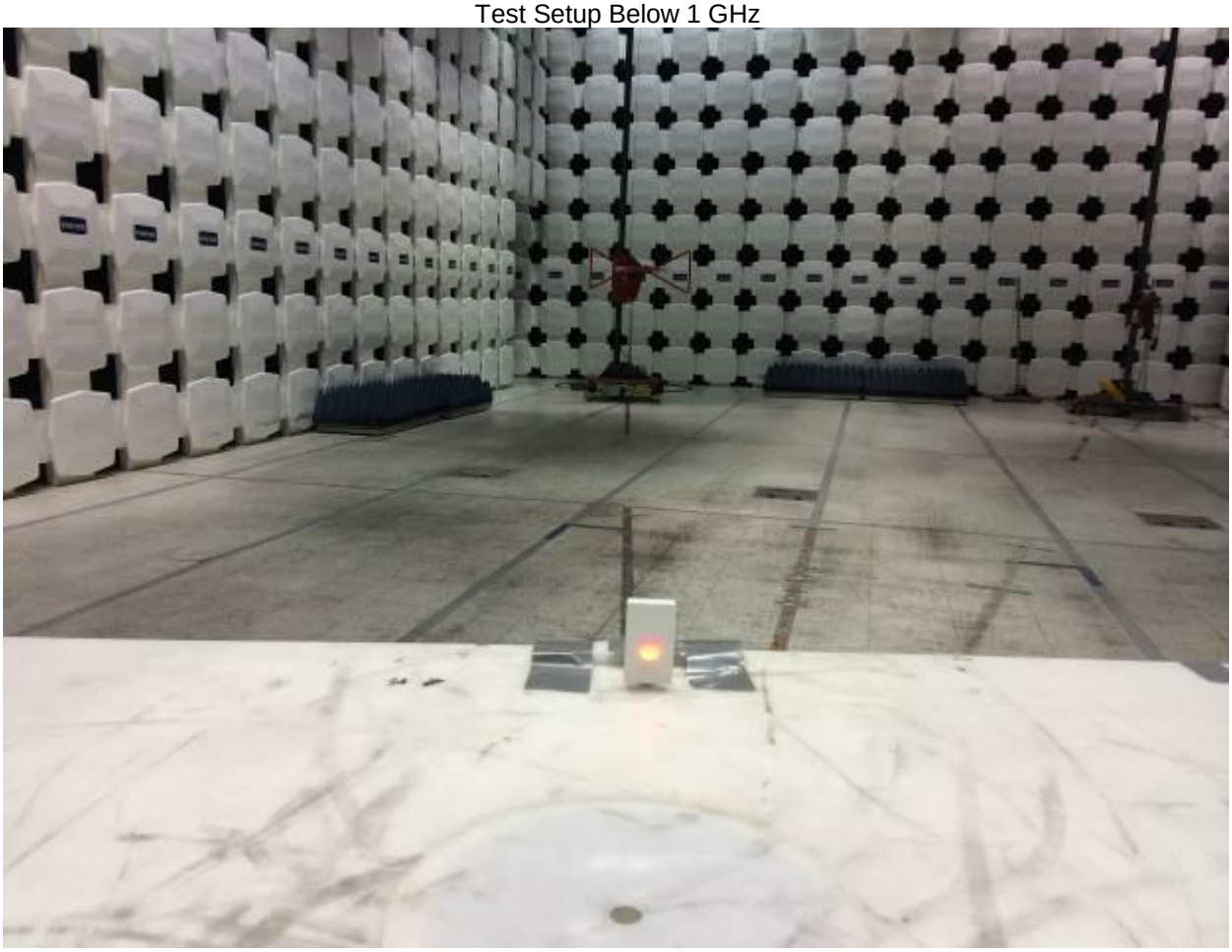
Name	Manufacturer	Version
C5	Teseq	5.26.46.46

8.3 Results:

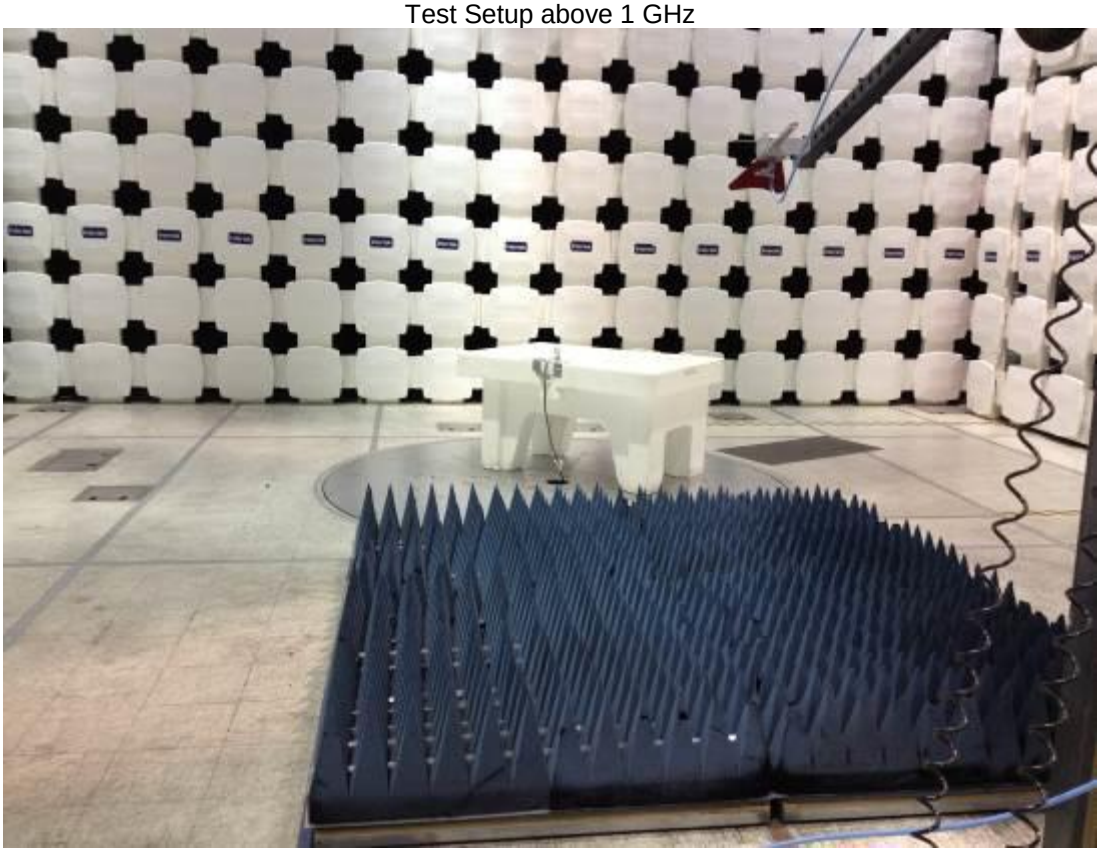
The sample tested was found to Comply.

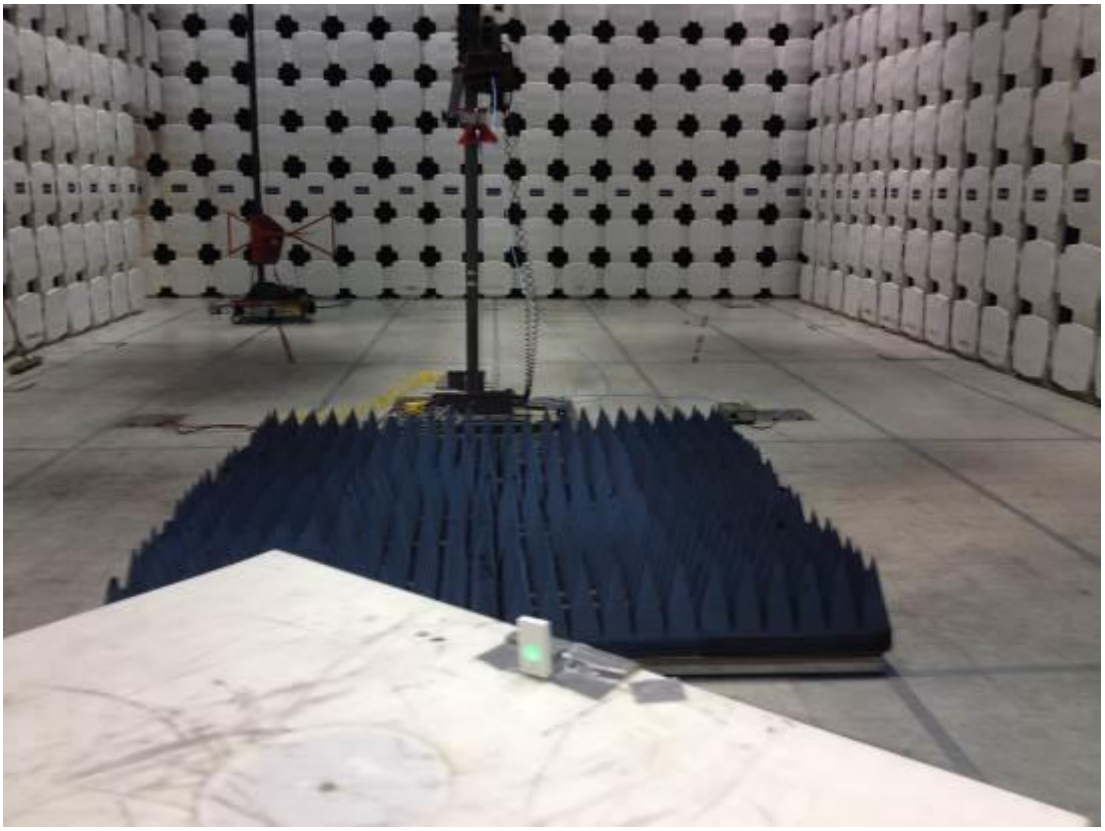
8.4 Setup Photographs:

Test Setup Below 1 GHz



Test Setup above 1 GHz





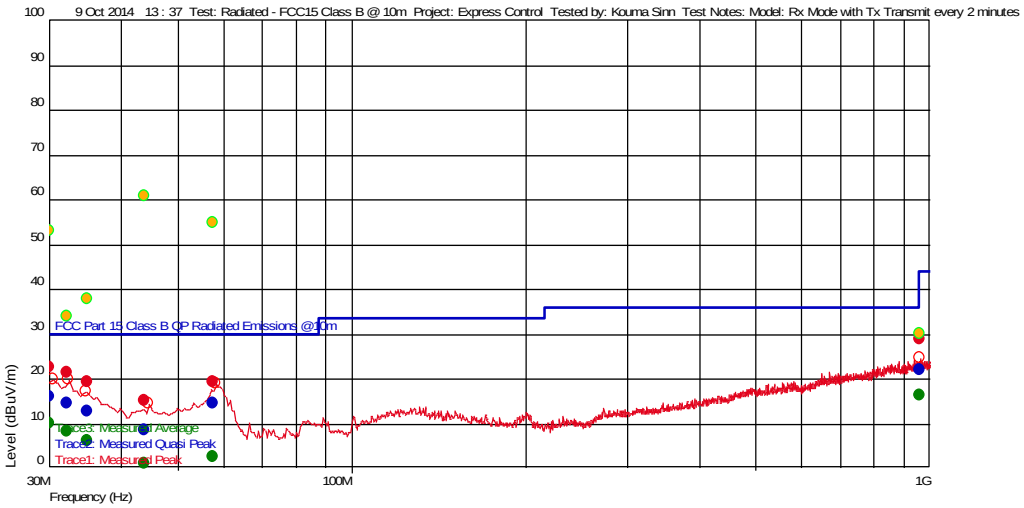
8.5 Plots/Data:

Receive Mode: 30-1000 MHz

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	Express Control	
Test Notes:	Model: Rx Mode with Tx Transmit every 2 minutes	
Temperature:	21C	
Humidity:	39%, 1005mbar	
Tested by:	Kouma Sinn	
Test Started:	9 Oct 2014 13 : 37	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

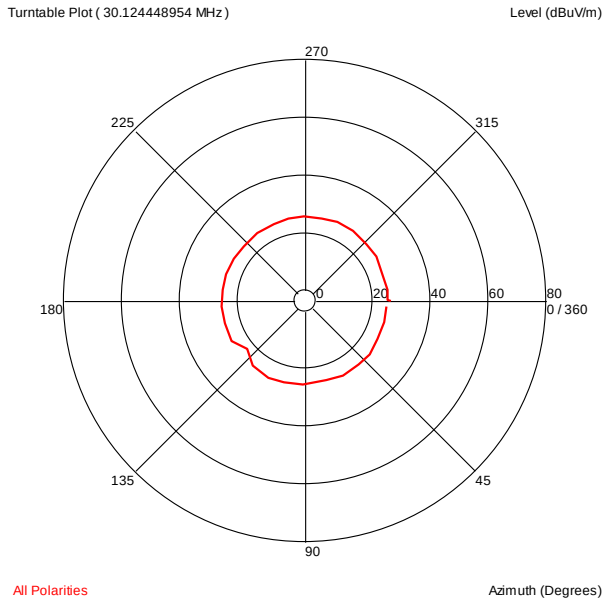
Trace1: Measured Peak

Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
961.7723442 M	28.84	22.700	-22.854	--	--	--	360	2.94	120 k	
44.036472629 M	15.07	11.278	-27.256	--	--	|	8	4.00	120 k	
35.012825212 M	19.26	17.791	-27.370	--	--	--	338	3.93	120 k	
57.854509273 M	19.40	7.285	-27.037	--	--	|	329	1.50	120 k	
32.358517315 M	21.25	19.685	-27.379	--	--	|	359	3.21	120 k	
30.124448954 M	22.65	21.213	-27.395	--	--	|	105	1.51	120 k	

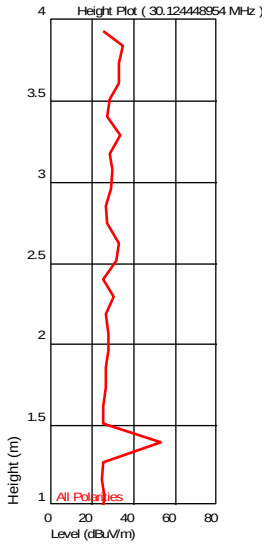
Trace2: Measured Quasi Peak

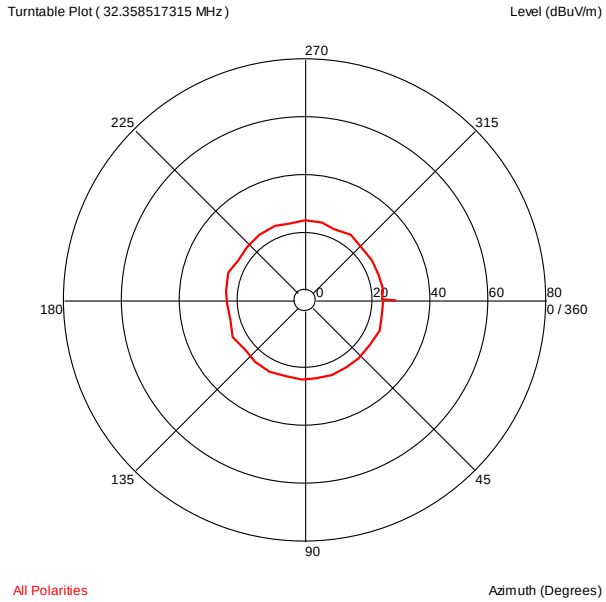
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
961.7723442 M	22.01	22.700	-22.854	43.980	-21.97	--	360	2.94	120 k	
44.036472629 M	8.46	11.278	-27.256	30.000	-21.54	|	8	4.00	120 k	
35.012825212 M	12.70	17.791	-27.370	30.000	-17.30	--	338	3.93	120 k	
57.854509273 M	14.45	7.285	-27.037	30.000	-15.55	|	329	1.50	120 k	
32.358517315 M	14.47	19.685	-27.379	30.000	-15.53	|	359	3.21	120 k	
30.124448954 M	15.98	21.213	-27.395	30.000	-14.02	|	105	1.51	120 k	

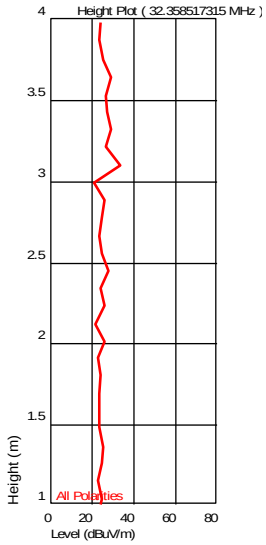
Azimuth Plots

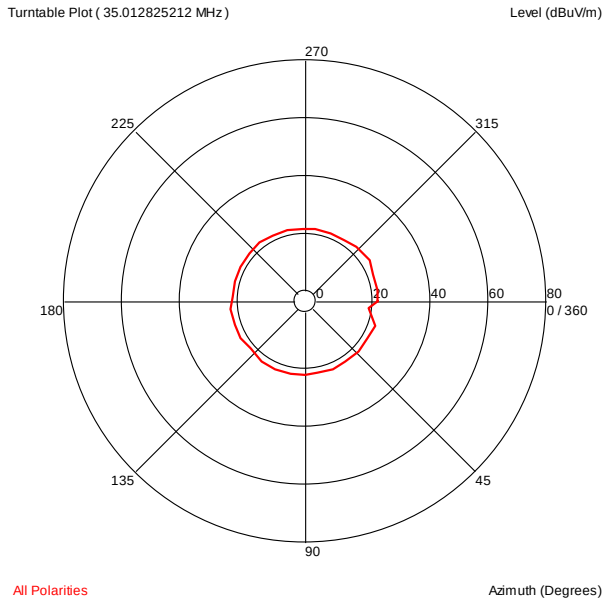


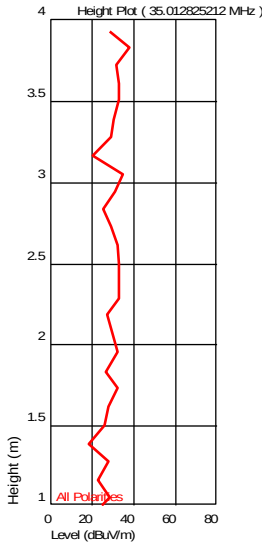
Turntable Plots

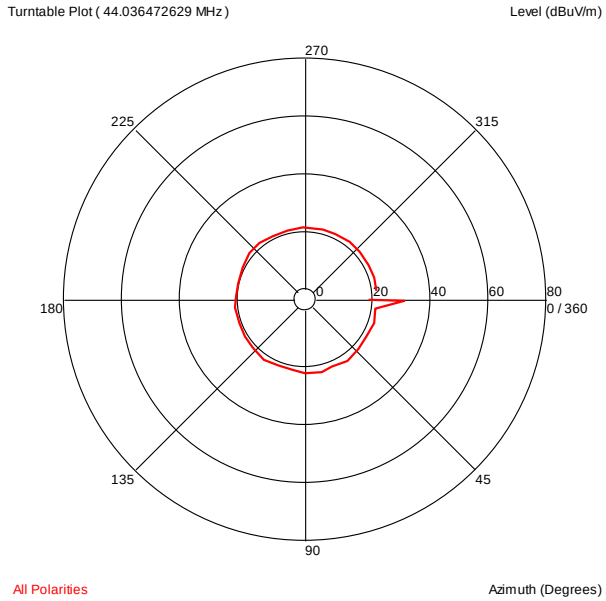


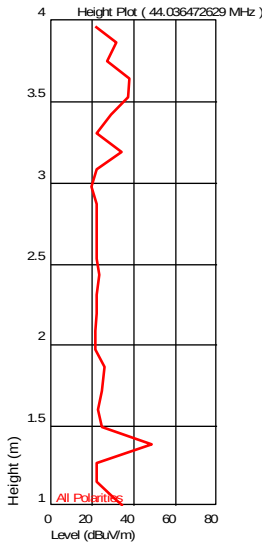


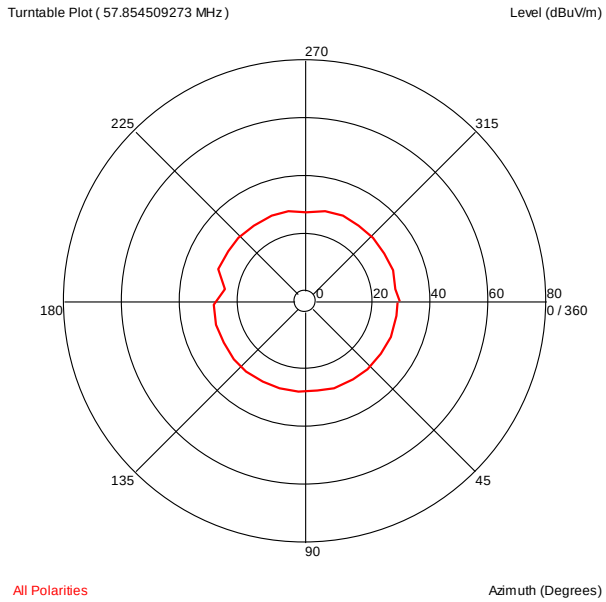


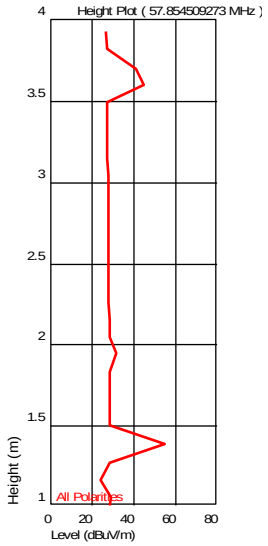

Turntable Plot (35.012825212 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

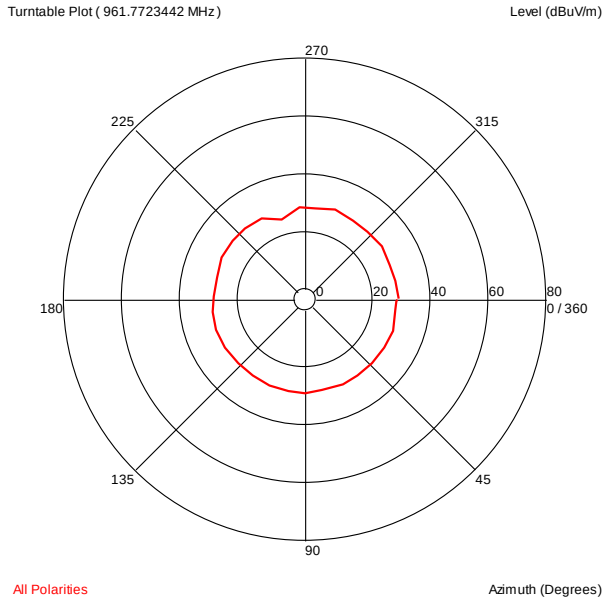

Height Plot (35.012825212 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

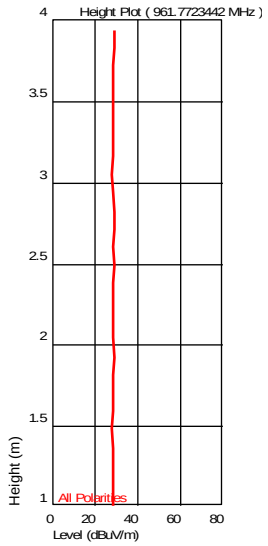

Turntable Plot (44.036472629 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (44.036472629 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (57.854509273 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (57.854509273 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

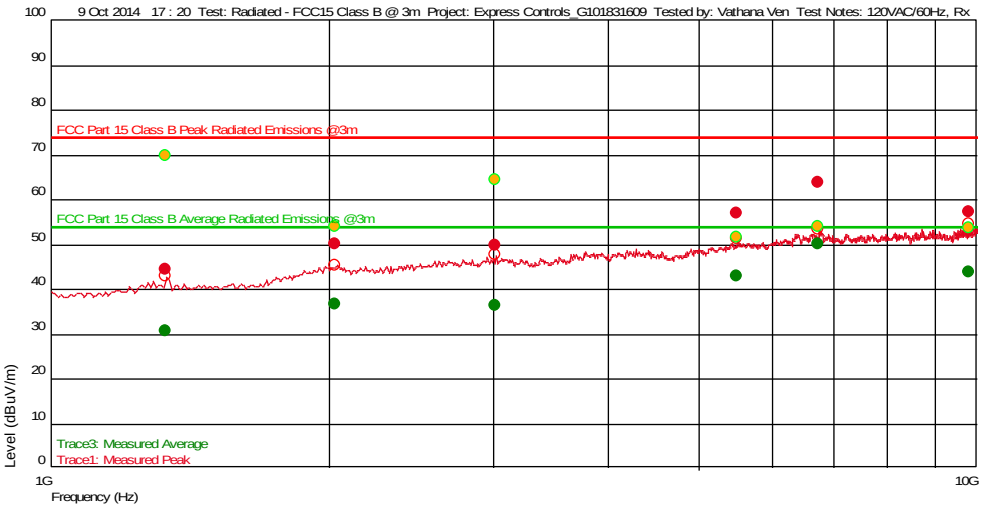

Turntable Plot (961.7723442 MHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (961.7723442 MHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 3m	
Project:	Express Controls_G101831609	
Test Notes:	120VAC/60Hz, Rx	
Temperature:	21 deg C	
Humidity:	34%, 1003 mB	
Tested by:	Vathana Ven	
Test Started:	9 Oct 2014 17 : 20	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace1: Measured Peak

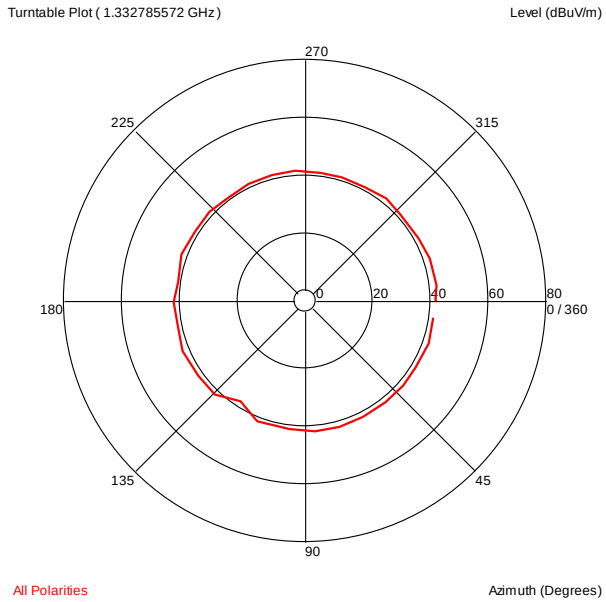
Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.332785572 G	44.24	28.896	-27.486	74.000	-29.76	|	341	1.32	1 M	
3.024716099 G	49.75	32.924	-25.103	74.000	-24.25	|	204	1.70	1 M	
2.02744823 G	50.12	31.727	-25.902	74.000	-23.88	--	244	1.68	1 M	
5.512017368 G	56.75	34.564	-21.318	74.000	-17.25	|	63	2.28	1 M	
9.806753507 G	57.29	37.005	-21.077	74.000	-16.71	|	56	2.17	1 M	
6.750701403 G	63.62	35.676	-20.793	74.000	-10.38	--	8	2.62	1 M	

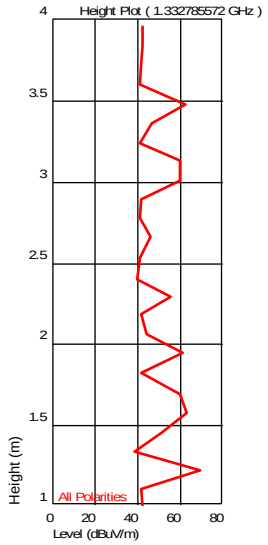
Trace3: Measured Average

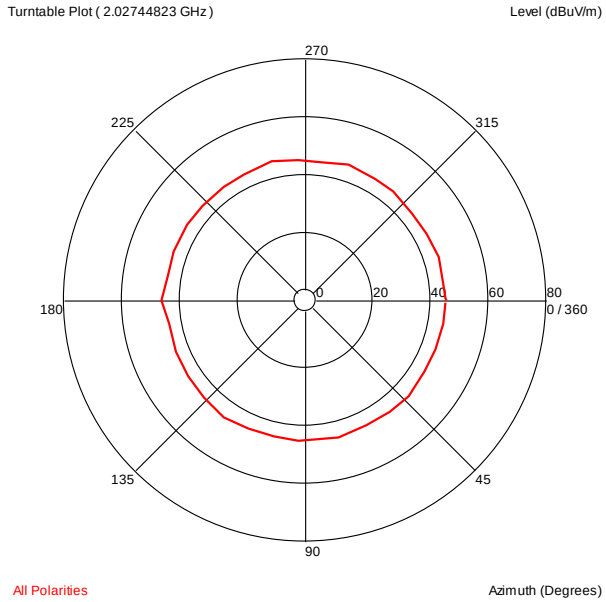
Frequency (Hz)	Level (dBuV/m)	AF	PA+CL	Limit (dBuV/m)	Margin (dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.332785572 G	30.49	28.896	-27.486	54.000	-23.51	|	341	1.32	1 M	
3.024716099 G	36.24	32.924	-25.103	54.000	-17.76	|	204	1.70	1 M	
2.02744823 G	36.52	31.727	-25.902	54.000	-17.48	--	244	1.68	1 M	
5.512017368 G	42.95	34.564	-21.318	54.000	-11.05	|	63	2.28	1 M	
9.806753507 G	43.80	37.005	-21.077	54.000	-10.20	|	56	2.17	1 M	
6.750701403 G	49.91	35.676	-20.793	54.000	-4.09	--	8	2.62	1 M	

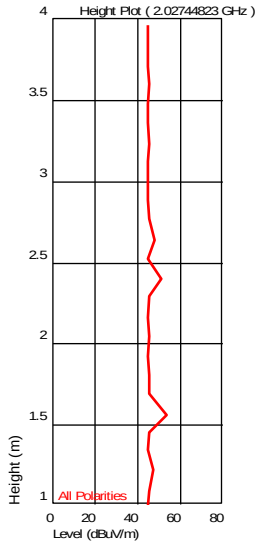
Azimuth Plots

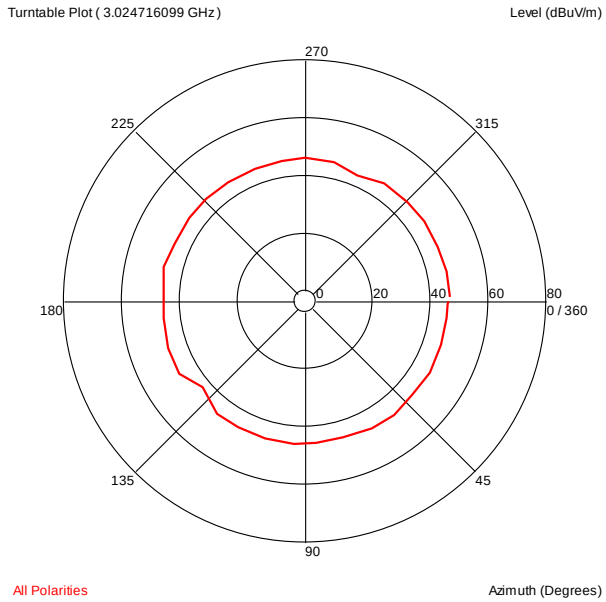
Turntable Plots

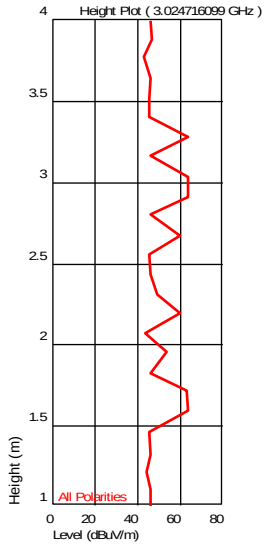


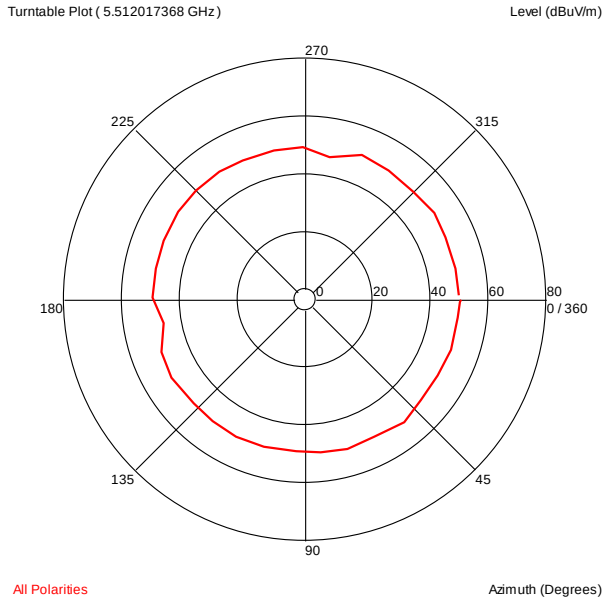


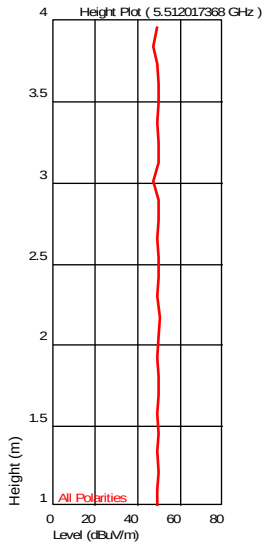


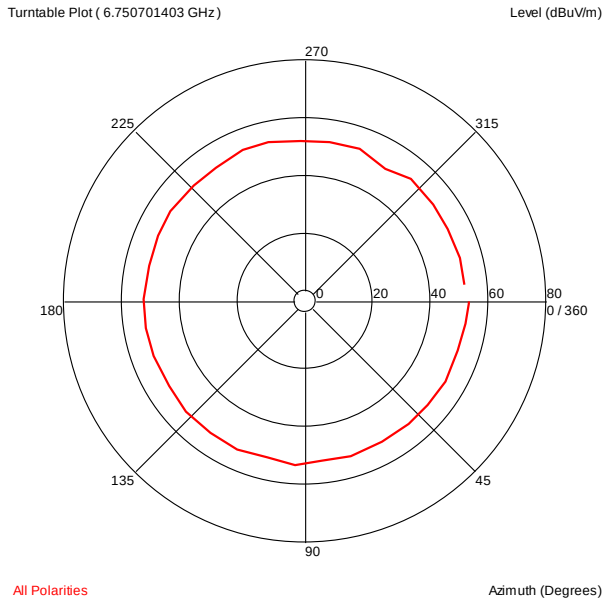


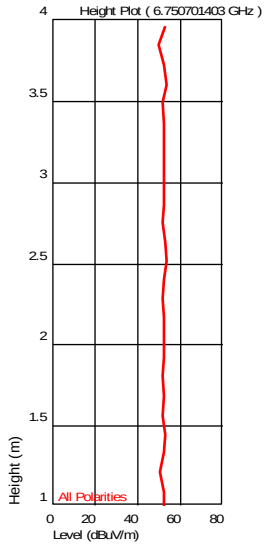

Turntable Plot (3.024716099 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)

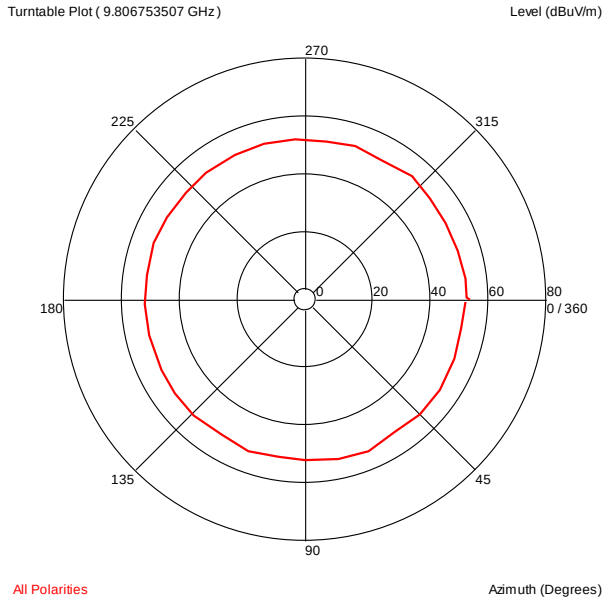

Height Plot (3.024716099 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

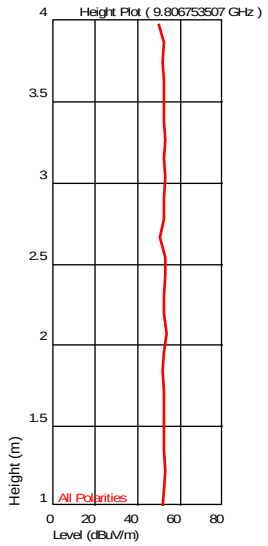

Turntable Plot (5.512017368 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (5.512017368 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (6.750701403 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (6.750701403 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)


Turntable Plot (9.806753507 GHz)
Level (dBuV/m)
270
225
315
180
0
20
40
60
80
0 / 360
135
45
90
All Polarities
Azimuth (Degrees)


Height Plot (9.806753507 GHz)
4
3.5
3
2.5
2
1.5
1
Height (m)
All Polarities
0
20
40
60
80
Level (dBuV/m)

Test Personnel:	Kouma Sinn KPS Vathana Ven VJV	Test Date:	10/09/2014
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B ICES-003	Limit Applied:	Class B
Input Voltage:	120VAC/60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**BB Source**	Relative Humidity:	39 %
		Atmospheric Pressure:	1005 mbars

Deviations, Additions, or Exclusions: None

9 Transmitter Bandwidth

9.1 Method

Tests are performed in accordance with RSS-Gen Issue 2 June 2007.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	08/20/2013	08/20/2015
145145'	Receiving Antenna	Sunol Sciences	JB3	A122313	01/07/2014	01/07/2015
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/17/2014	03/17/2015
145033'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett-Packard	8447D	2944A08408	10/28/2013	10/28/2014
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/19/2013	12/19/2014

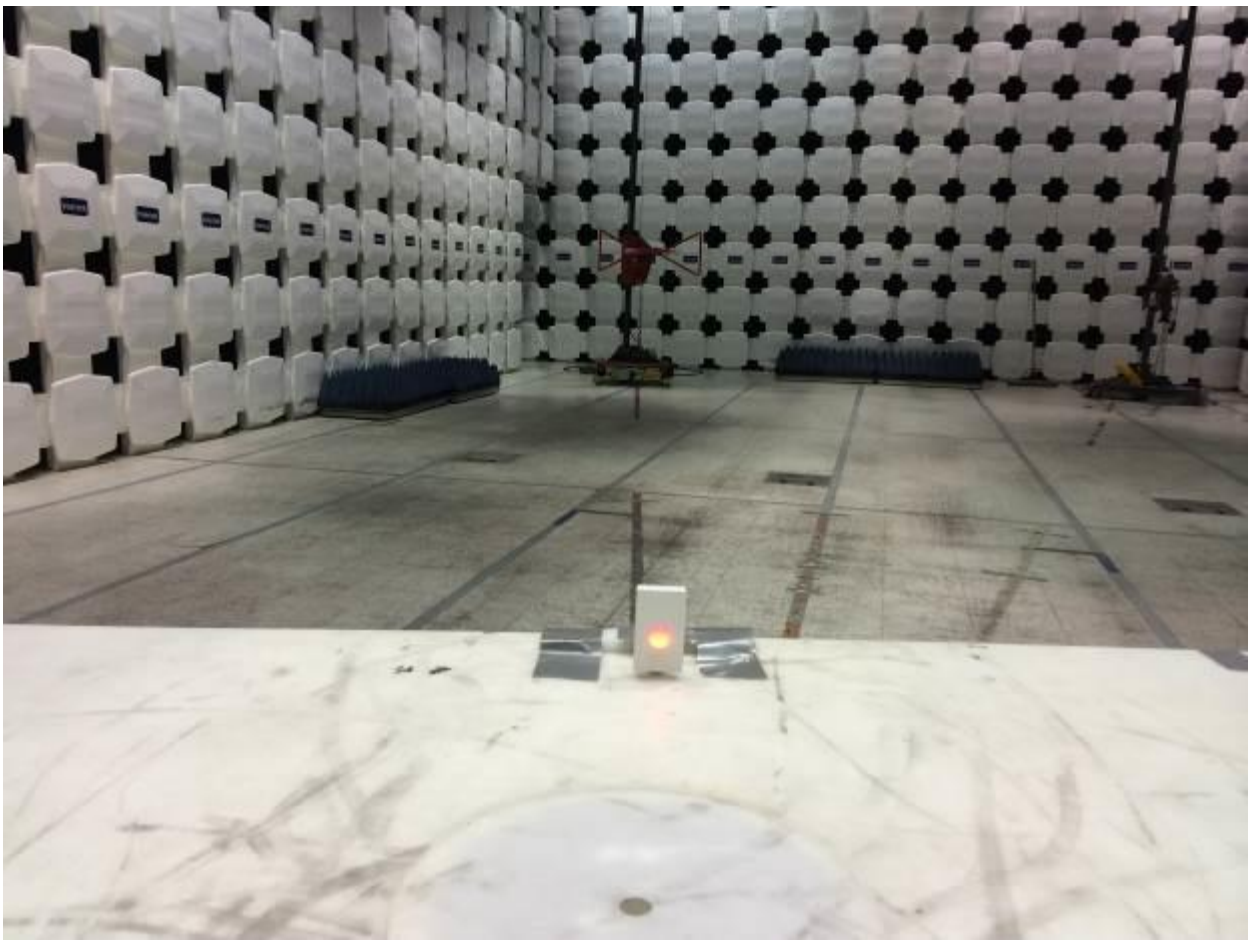
Software Utilized:

Name	Manufacturer	Version
None		

9.3 Results:

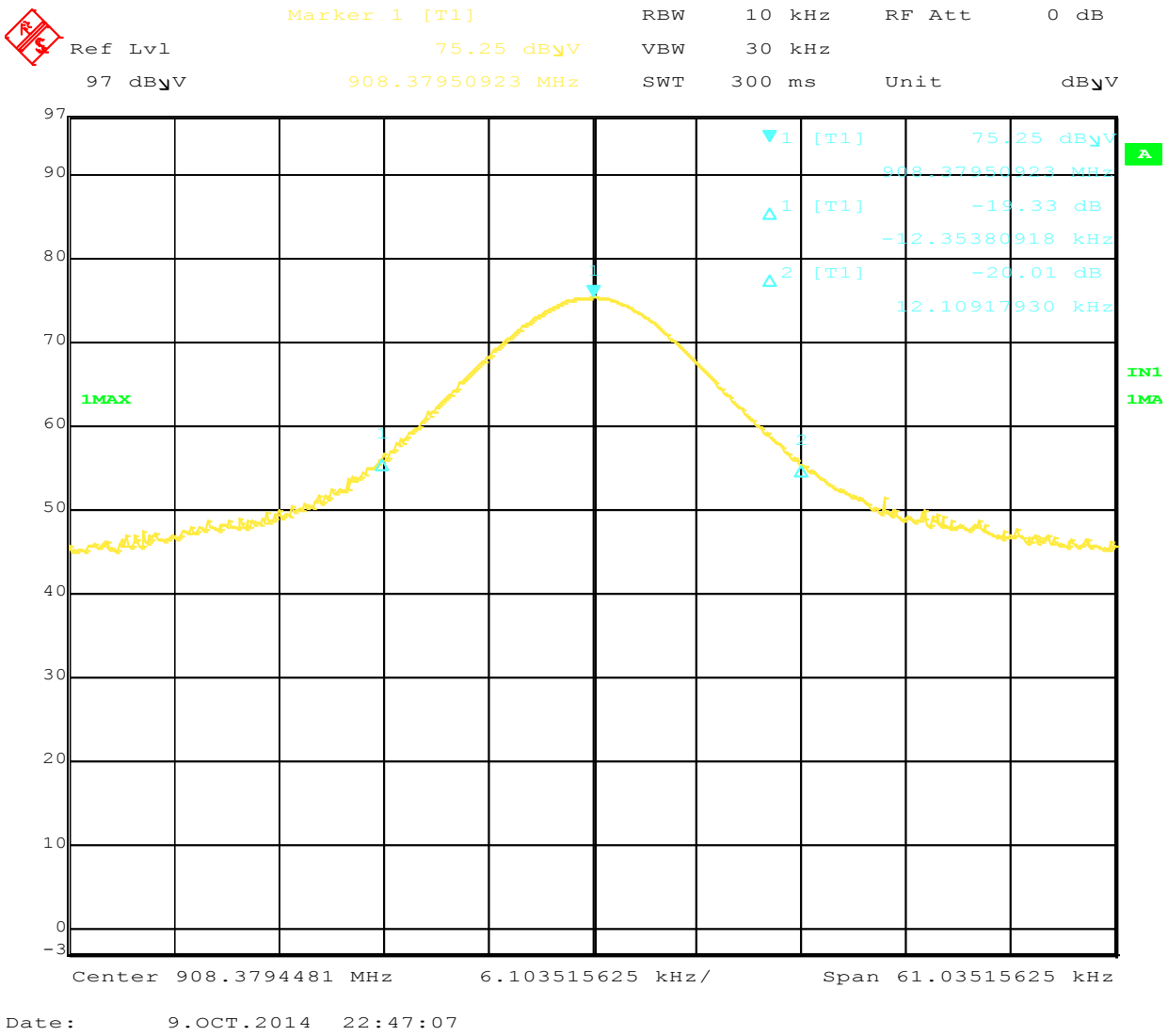
The sample tested was found to Comply.

9.4 Setup Photographs:



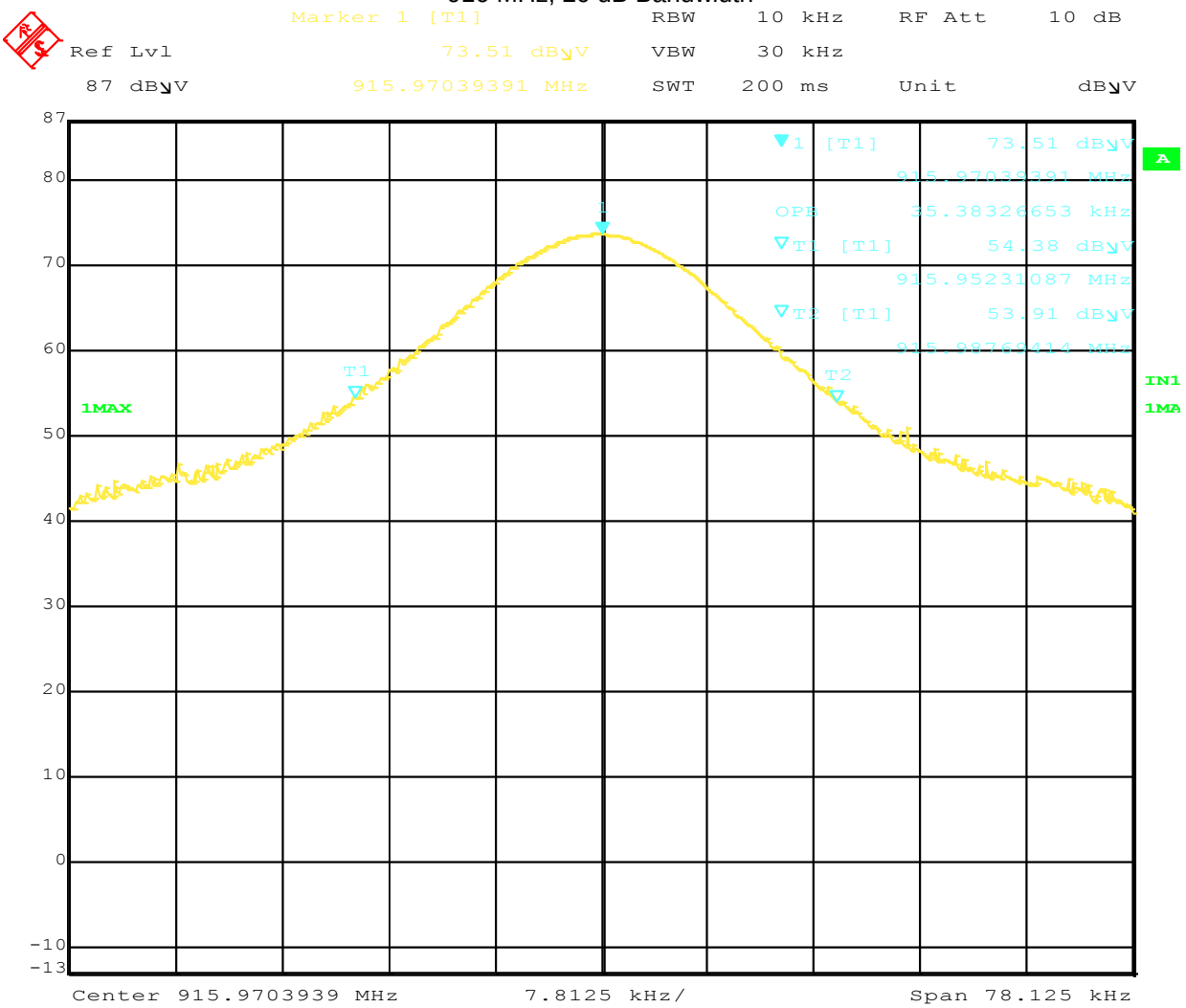
9.5 Plots/Data:

908 MHz, 20 dB Bandwidth



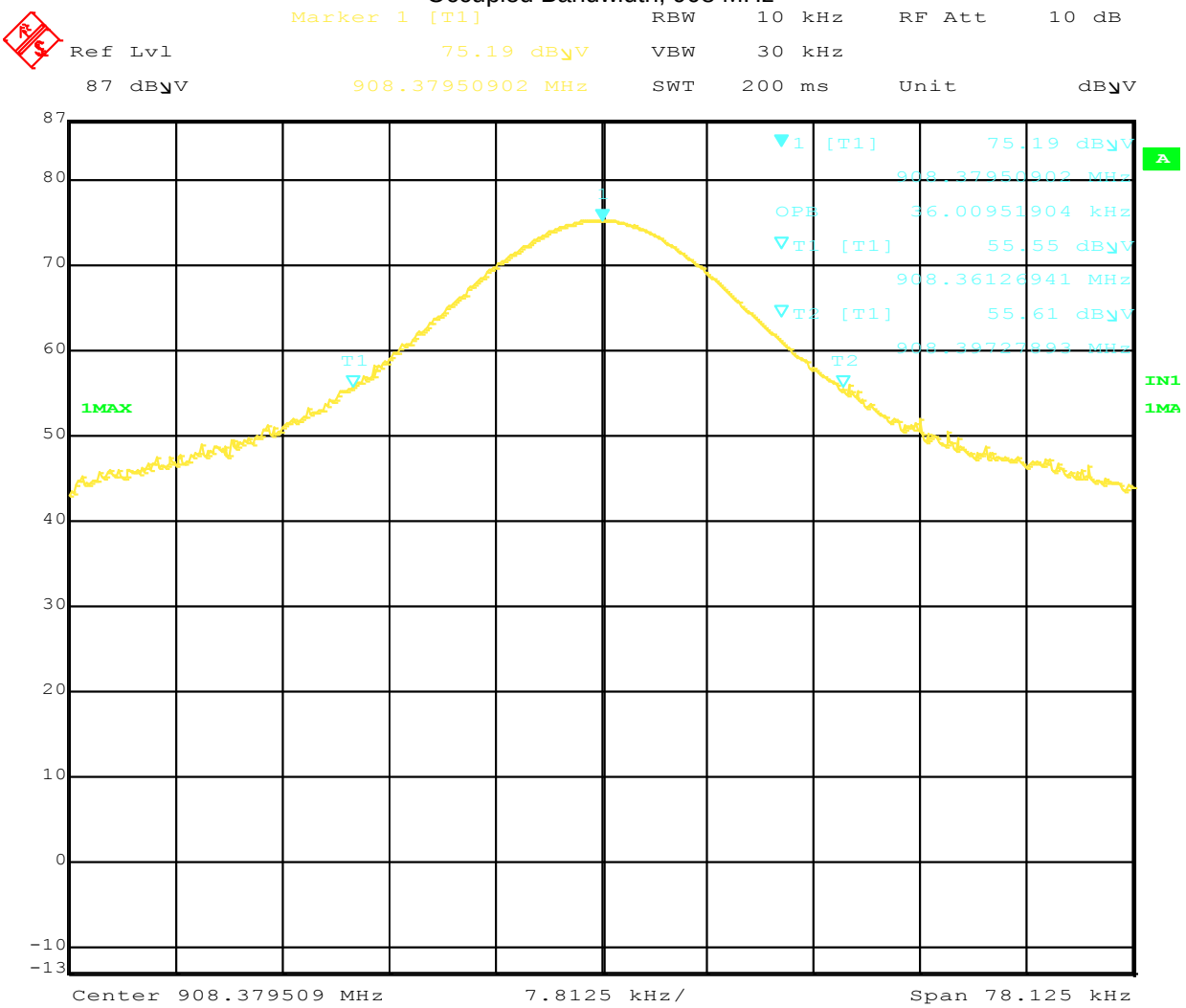
Date: 9.OCT.2014 22:47:07

916 MHz, 20 dB Bandwidth



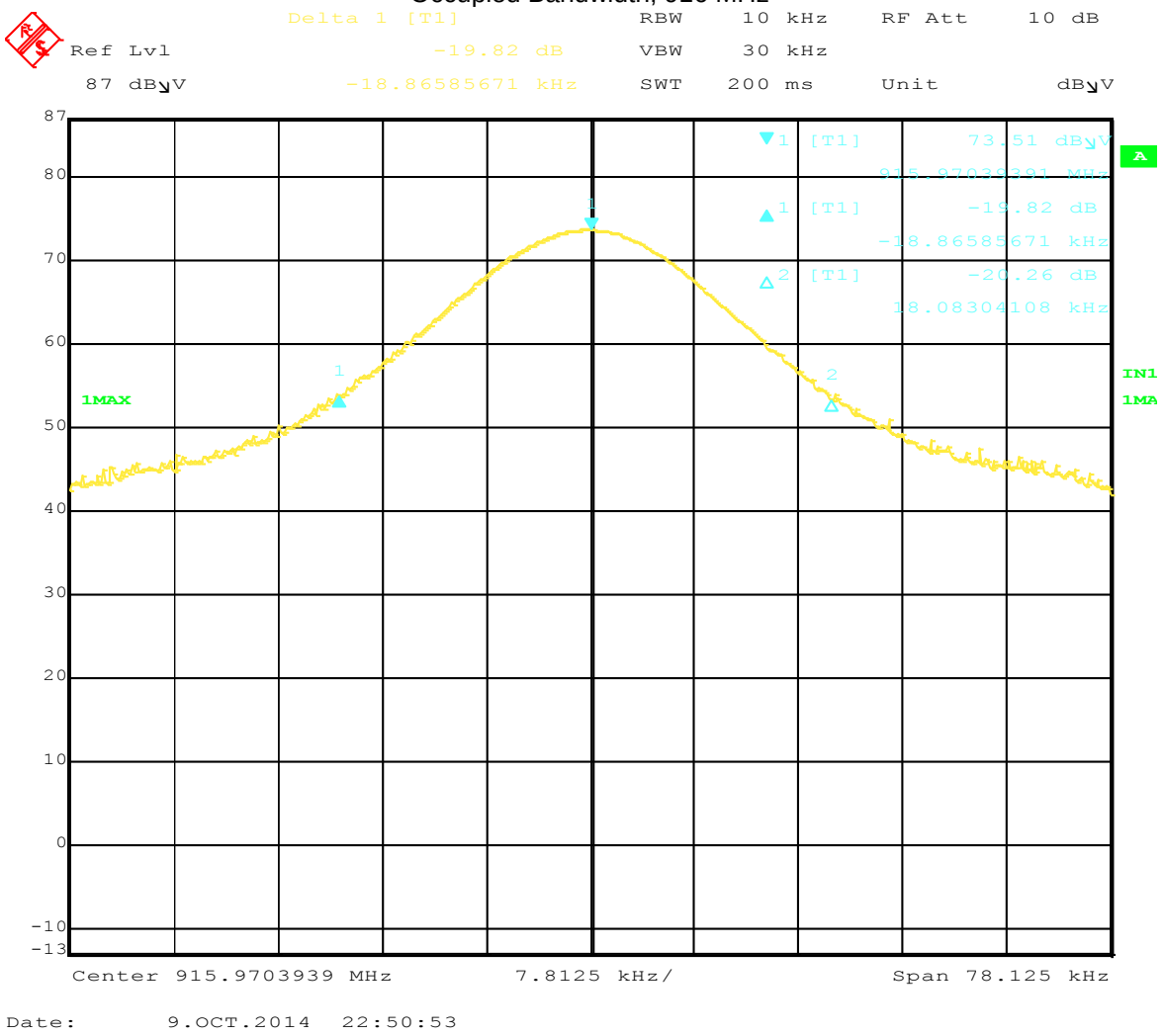
Date: 9.OCT.2014 22:49:53

Occupied Bandwidth, 908 MHz



Date: 9.OCT.2014 22:53:35

Occupied Bandwidth, 916 MHz



Test Personnel:	Vathana Ven VJV	Test Date:	10/09/2014
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	RSS-Gen	Limit Applied:	Bandwidth
Input Voltage:	120VAC/60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**BB Source**	Relative Humidity:	39 %
		Atmospheric Pressure:	1005 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter Duty Cycle

10.1 Method

Tests are performed in accordance with RSS-210 Issue 8 December 2010 Annex 7, FCC 47CFR Part 15 Subpart 15.245.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6	6.3
Radiated Emissions, 3m	30-1000 MHz	5.3	6.3
Radiated Emissions, 3m	1-6 GHz	4.5	5.2
Radiated Emissions, 3m	6-15 GHz	5.2	5.5
Radiated Emissions, 3m	15-18 GHz	5.0	5.5
Radiated Emissions, 3m	18-40 GHz	5.0	5.5

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “AF” is the Antenna Factor; “PA+CL” are Preamp and Cable Loss. These are already accounted for in the “Level” column.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	08/20/2013	08/20/2015
145145'	Receiving Antenna	Sunol Sciences	JB3	A122313	01/07/2014	01/07/2015
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2014	10/04/2015
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/17/2014	03/17/2015
145033'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett-Packard	8447D	2944A08408	10/28/2013	10/28/2014
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/19/2013	12/19/2014

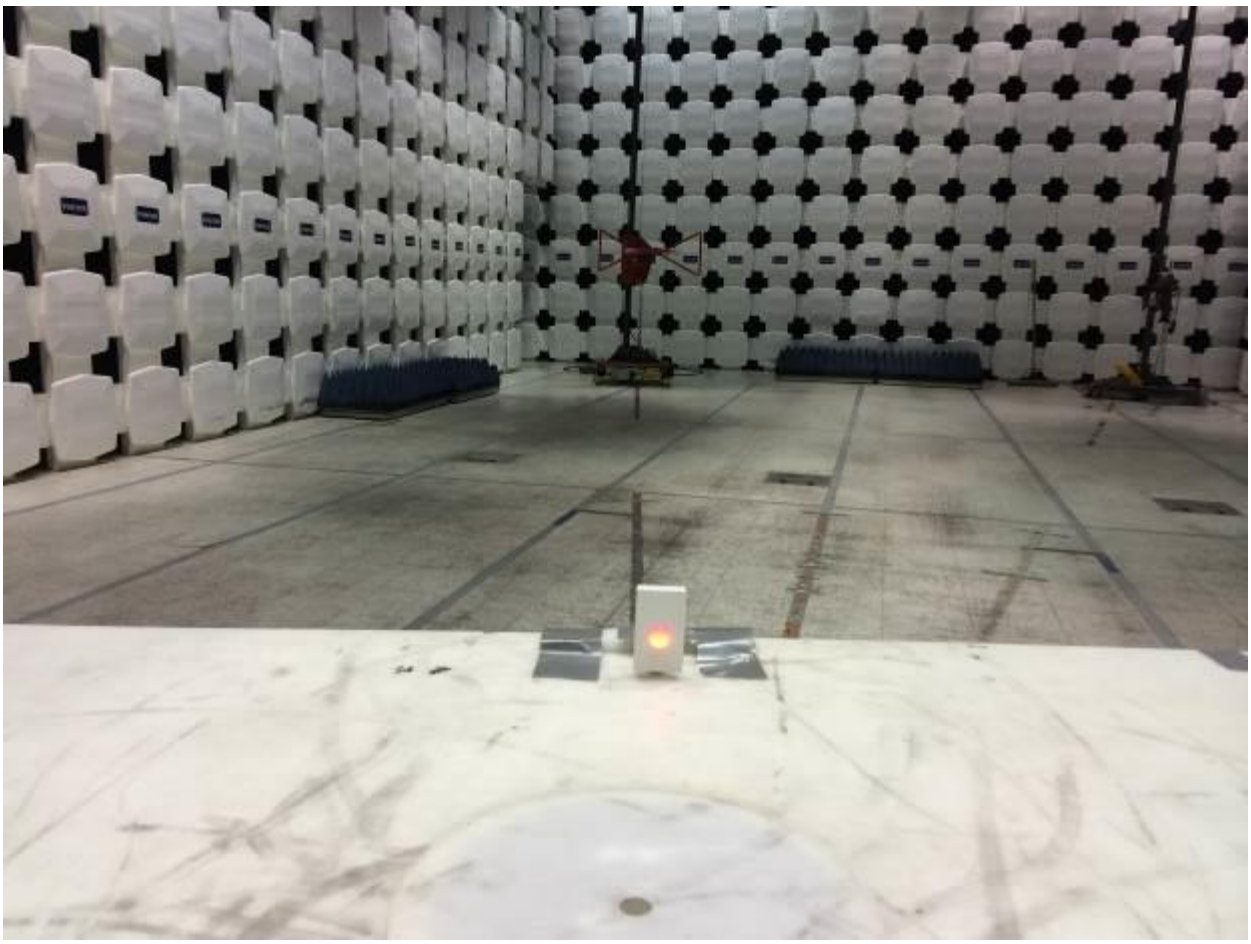
Software Utilized:

Name	Manufacturer	Version
None		

10.3 Results:

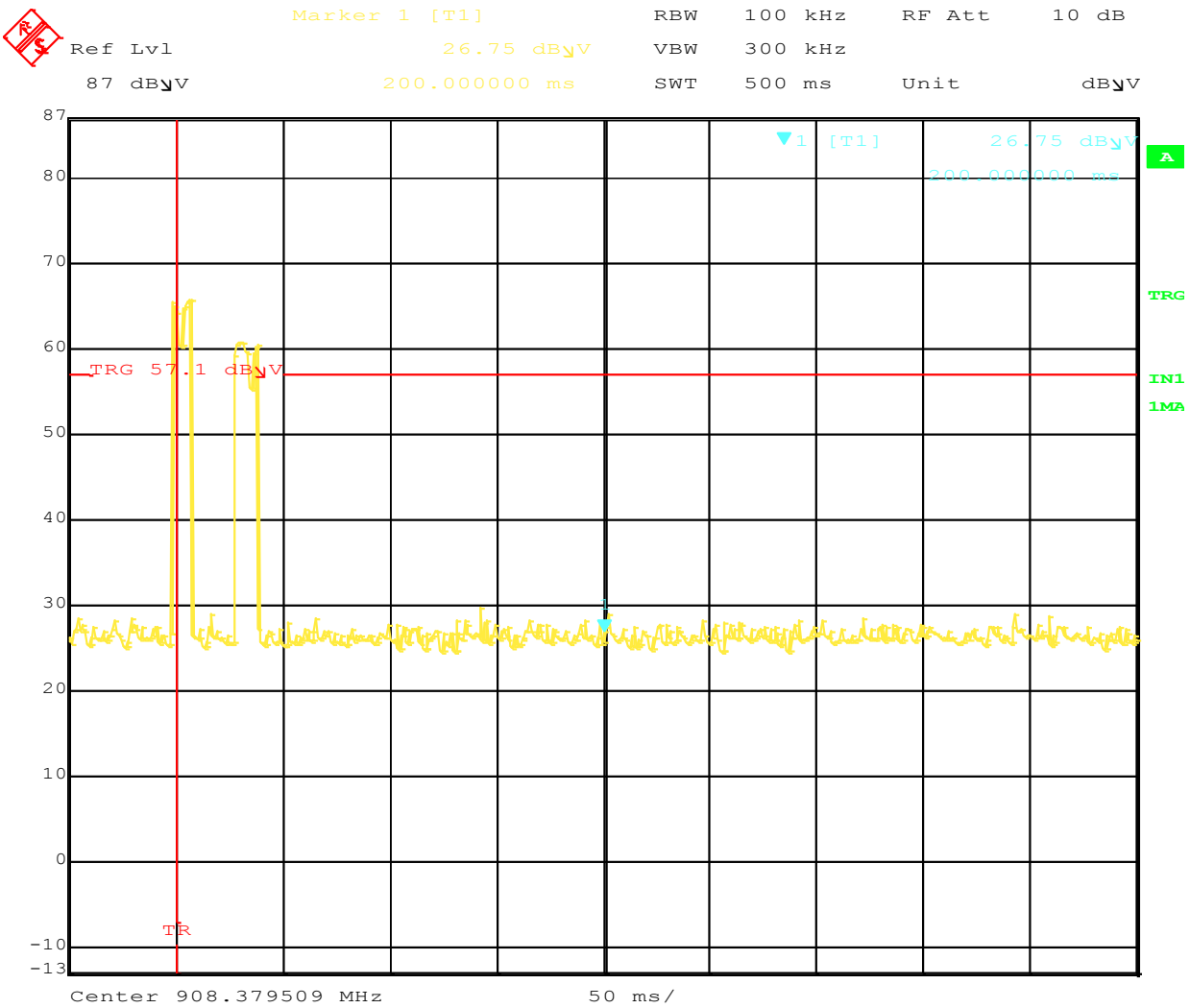
The sample tested was found to Comply.

10.4 Setup Photographs:



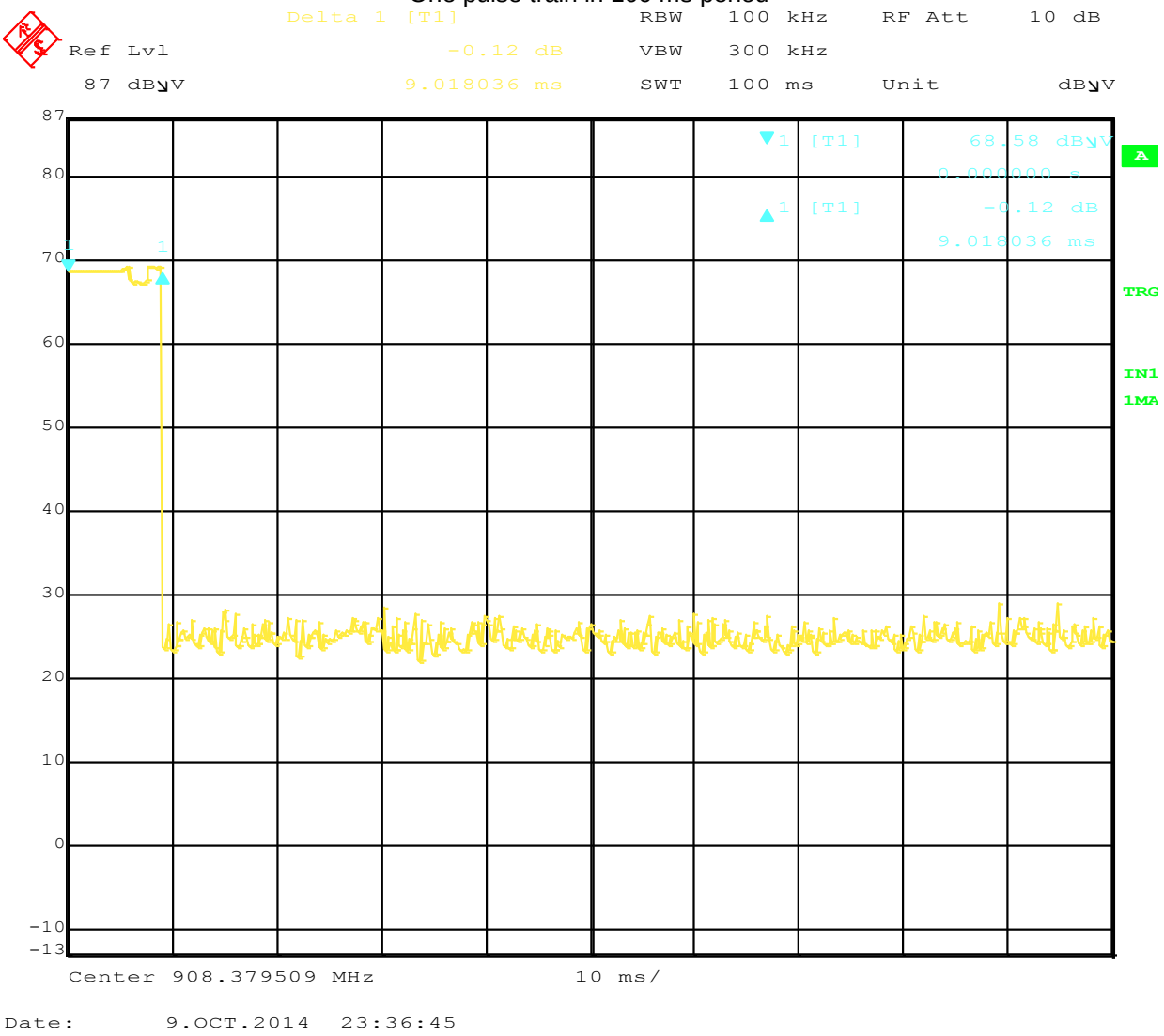
10.5 Plots/Data:

Pulse trains in 500 ms



Date: 9.OCT.2014 23:25:30

One pulse train in 100 ms period



Average Factor = 20*LOG(9.018/100) = 20.9 dB

Test Personnel:	Vathana Ven VJV	Test Date:	10/09/2014
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	RSS-210, FCC Part 15 Subpart C	Limit Applied:	Duty Cycle
Input Voltage:	120VAC/60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**BB Source**	Relative Humidity:	39 %
		Atmospheric Pressure:	1005 mbars

Deviations, Additions, or Exclusions: None

11 AC Mains Conducted Emissions

11.1 Method

Tests are performed in accordance with ICES-003 Issue 5 August 2012, RSS-Gen Issue 2 June 2007, FCC 47CFR Part 15 Subpart C 15.107, FCC 47CFR Part 15 Subpart C 15.207, and ANSI C63.4:2009

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	2.8	3.4
Telco Port Emissions	150 kHz - 30 MHz	3.2	5

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)} = 285.1\ \mu V/m$

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “TF” is the Transducer Factor; in this case LISN or ISN loss.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	08/20/2013	08/20/2015
LISN32'	CISPR 16 LISN	Com-Power	LI-215A	191955	02/26/2014	02/26/2015
DS22'	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS22	07/31/2014	07/31/2015
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2013	10/04/2014
CBLBNC10'	50 Ohm Coaxial Cable	Pomona	RG58C/U	CBLBNC10	11/13/2013	11/13/2014

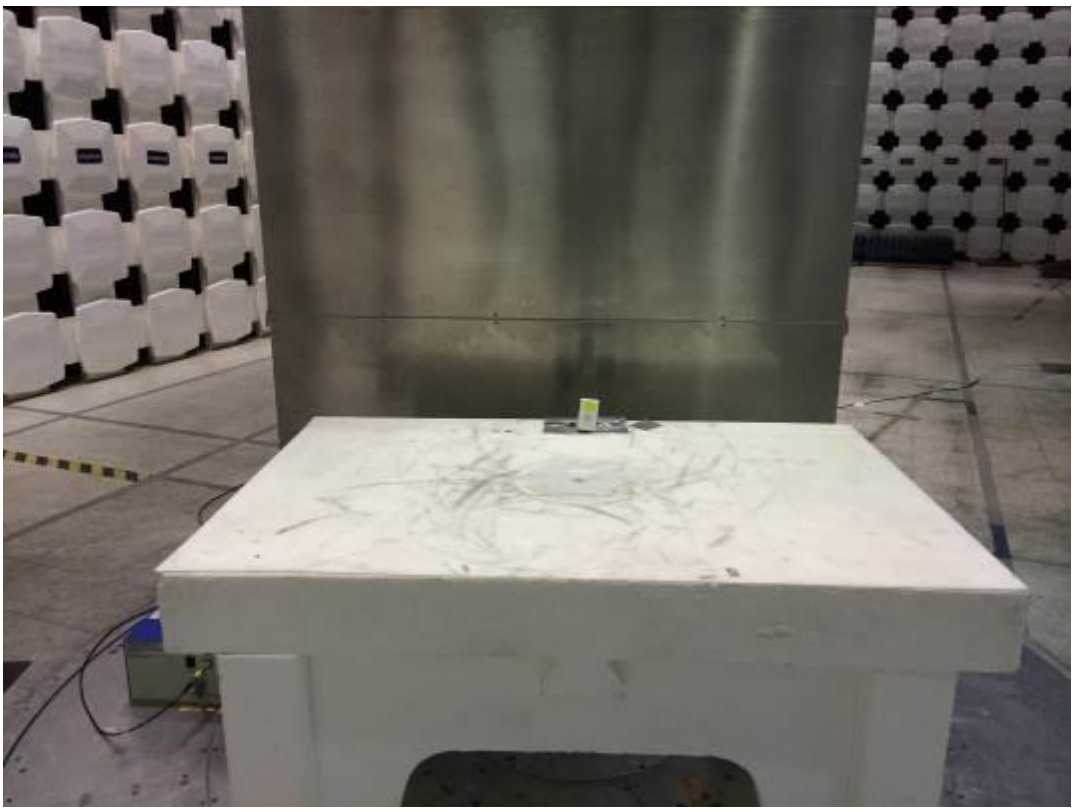
Software Utilized:

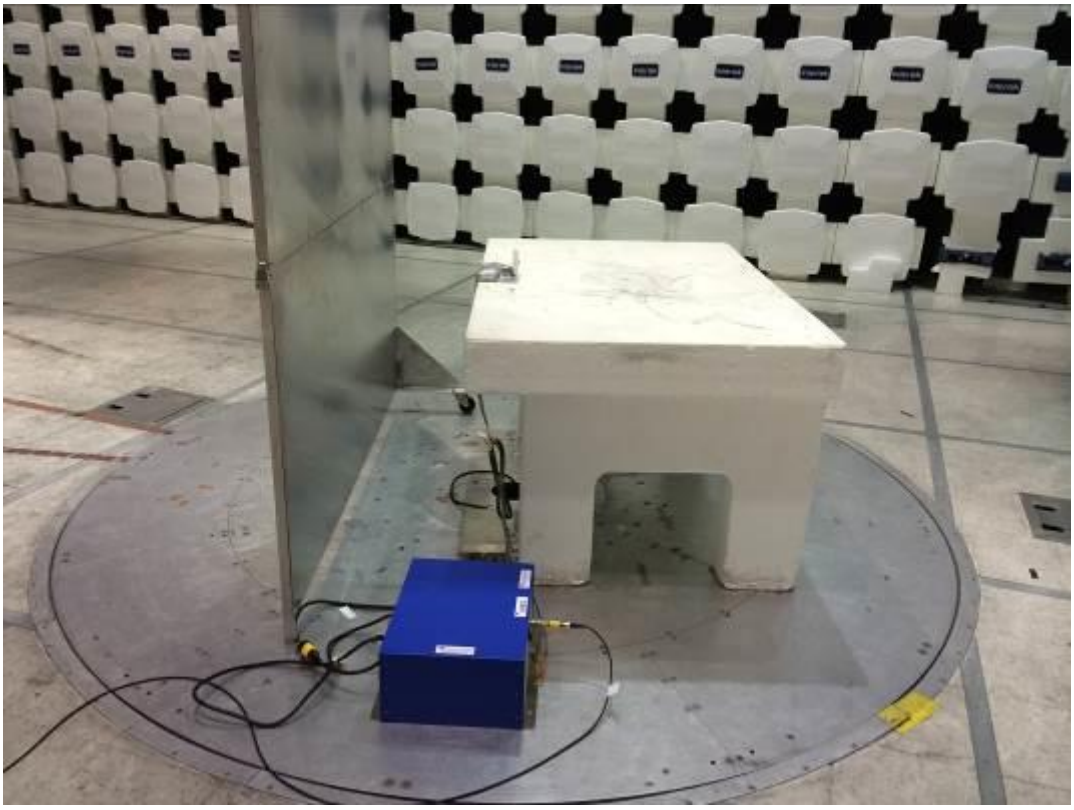
Name	Manufacturer	Version
C5	Teseq	5.26.46.46

11.3 Results:

The sample tested was found to Comply.

11.4 Setup Photographs:





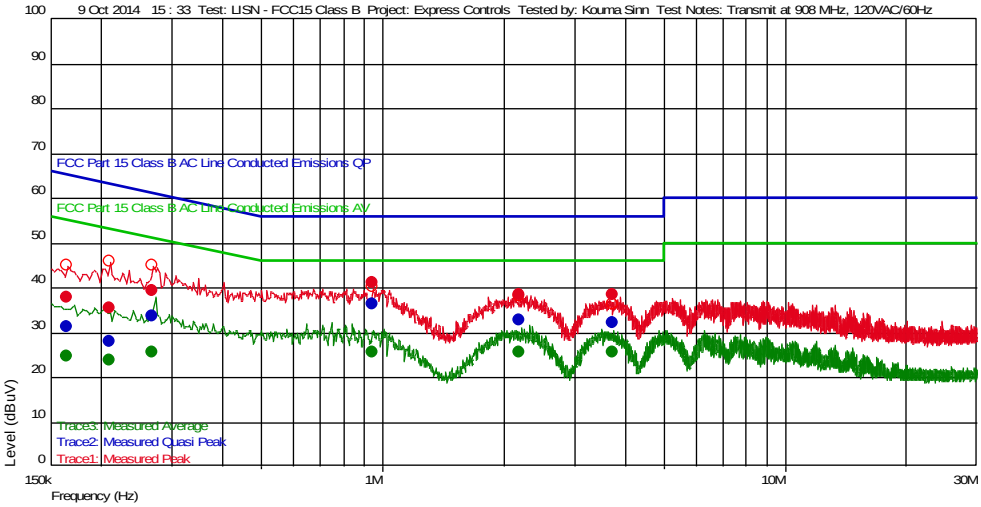
11.5 Plots/Data:

Transmit at 908 MHz, 120VAC/60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Express Controls	
Test Notes:	Transmit at 908 MHz, 120VAC/60Hz	
Temperature:	22C	
Humidity:	33%, 1003mbar	
Tested by:	Kouma Sinn	
Test Started:	9 Oct 2014 15 : 33	

Prescan Emission Graph



Measured Peak Value
Measured Quasi Peak Value
Measured Average Value
Maximum Value of Mast and Turntable

Swept Peak Data
Swept Quasi Peak Data
Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
210.0 k	27.88	0.080	20.302	63.205	-35.32	9 k		L1
165.0 k	31.28	0.077	20.244	65.208	-33.93	9 k		L1
270.0 k	33.45	0.080	20.350	61.118	-27.66	9 k		L1
3.735 M	32.02	0.100	20.464	56.000	-23.98	9 k		L1
2.19 M	32.67	0.090	20.415	56.000	-23.33	9 k		L1
945.0 k	36.22	0.091	20.401	56.000	-19.78	9 k		L1

Trace3: Measured Average

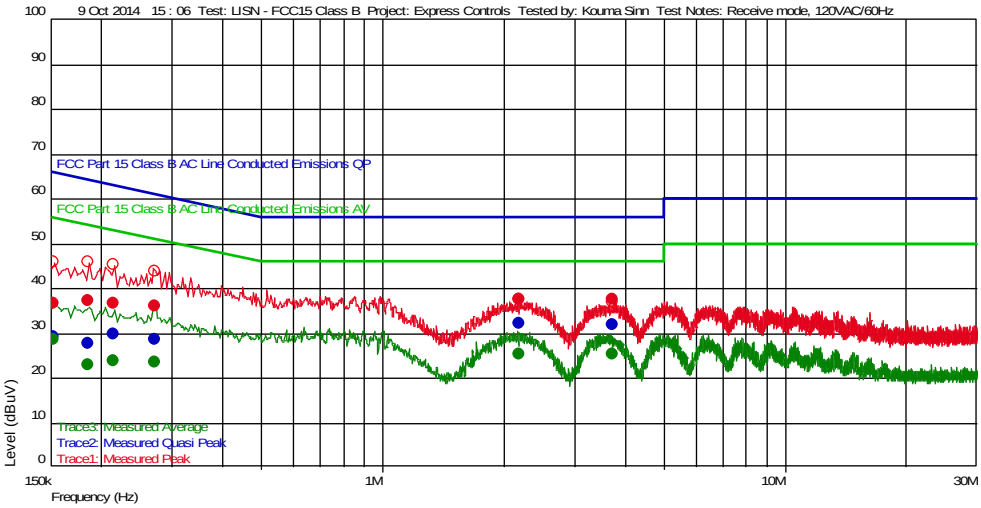
Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
165.0 k	24.58	0.077	20.244	55.208	-30.63	9 k		L1
210.0 k	23.76	0.080	20.302	53.205	-29.45	9 k		L1
270.0 k	25.49	0.080	20.350	51.118	-25.62	9 k		L1
945.0 k	25.56	0.091	20.401	46.000	-20.44	9 k		L1
2.19 M	25.57	0.090	20.415	46.000	-20.43	9 k		L1
3.735 M	25.63	0.100	20.464	46.000	-20.37	9 k		L1

Receive Mode, 120VAC/60Hz

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Express Controls	
Test Notes:	Receive mode, 120VAC/60Hz	
Temperature:	22C	
Humidity:	33%, 1003mbar	
Tested by:	Kouma Sinn	
Test Started:	9 Oct 2014 15 : 06	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
153.0 k	29.23	0.075	20.230	65.836	-36.61	9 k		L1
186.0 k	27.65	0.079	20.272	64.213	-36.56	9 k		L1
216.0 k	29.64	0.080	20.314	62.971	-33.34	9 k		L1
273.0 k	28.49	0.080	20.350	61.026	-32.54	9 k		L1
3.756 M	31.77	0.100	20.456	56.000	-24.23	9 k		L1
2.193 M	31.97	0.090	20.421	56.000	-24.03	9 k		L1

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
186.0 k	22.74	0.079	20.272	54.213	-31.47	9 k		L1
216.0 k	23.77	0.080	20.314	52.971	-29.20	9 k		L1
273.0 k	23.49	0.080	20.350	51.026	-27.53	9 k		L1
153.0 k	28.37	0.075	20.230	55.836	-27.47	9 k		L1
3.756 M	25.09	0.100	20.456	46.000	-20.91	9 k		L1
2.193 M	25.32	0.090	20.421	46.000	-20.68	9 k		L1

Test Personnel:	Kouma Sinn KPS	Test Date:	10/09/2014
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B ICES-003	Limit Applied:	Class B
Input Voltage:	120VAC/60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ Ambient Signals or BB Source:	Ambient Signals	Relative Humidity:	39 %
		Atmospheric Pressure:	1005 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	10/17/2014	101831609BOX-003	VFV	MFM	Original Issue