EMISSIONS TEST REPORT

Report Number: 100991931BOX-002
Project Number: G100991931

Report Issue Date: December 28, 2012

Product Designation: Replacement VIM

Standards: CFR47 FCC Part 15 Subpart C:2012 15.249,
IC RSS-210 Issue 8 December 2010 Annex 2.9
CFR47 FCC Part 15 Subpart B:2012
ICES-003 Issue 5 August 2012,
RSS-Gen Issue 3 December 2010+Notice DRS 2012-DRS0126

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

Client:
LoJack Corporation
40 Pequot Way
Canton, MA 02021

Report prepared by Reviewer

Nicholas Abbondante / Transmitter Staff Engineer

Report reviewed by

Michael F. Murphy / Sr. Staff Engineer, EMC

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	Fundamental Field Strength and Duty Cycle CFR47 FCC Part 15 Subpart C 15.249(a, c-e); IC RSS-210 Issue 8 December 2010 A2.9	Pass
7	Occupied Bandwidth CFR47 FCC Part 15 Subpart C 15.215(c); IC RSS-Gen Issue 3 December 2010 Section 4.6.1	Pass
8	Transmitter Spurious Radiated Emissions CFR47 FCC Part 15 Subpart C 15.209 & 15.249(a; c-e); IC RSS-210 December 2010 Annex 2.9; IC RSS-Gen Issue 3 December 2010 Sections 4.9 & 7.2.5 (Table 5)	Pass
9	Receiver Spurious Emissions FCC Part 15:2012 Subpart B Section 15.109 (a) RSS-Gen 3 December 2010, Section 6	Exempt, Below 30 MHz
10	Digital Device Spurious Emissions CFR47 FCC Part 15 Subpart B:2012 IC ICES-003 Issue 5 August 2012	Pass
11	AC Line-Conducted Emissions CFR47 FCC Part 15 Subpart B:2012, FCC Part 15:2011 Section 15.207 (a) RSS-Gen Issue 3 December 2010, 7.2.2 (Table 2) IC ICES-003 Issue 5 August 2012	Exempt, DC Power from Car Battery
12	Revision History	

3 Client Information

This EUT was tested at the request of:

Company: LoJack Corporation
40 Pequot Way
Canton, MA 02021
Contact: Mr. Vincent Ricci
Telephone: (781) 302-4332
Fax: (781) 302-2801
Email: vricci@lojack.com

4 Description of Equipment Under Test

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Replacement VIM	LoJack Corporation	VIM	Test Sample A
Replacement VIM	LoJack Corporation	VIM	Test Sample B

Receive Date:	12/12/2012
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)

The EUT is a Vehicle Interface Module. It is powered from the car battery and the enclosed 2.4 GHz radio utilizes an integral PCB antenna.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
12VDC	Not Rated	None, DC	None, DC

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	During transmitter testing, the VIM was powered from 12VDC and was transmitting repetitively
2	During idle mode testing, the VIM was powered from 12VDC and was idle

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Battery (+) Lead	0.39	None	None	Battery
2	Battery (-) Leads	0.39	None	None	Battery

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
2.4 GHz Transceiver	LoJack Corporation	V7A-VP	0C866F9

5.1 Method:

Configuration as required by ANSI C63.4:2009 and ANSI C63.10:2009.

5.2 EUT Block Diagram:

6 Fundamental Field Strength and Duty Cycle

6.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C, IC RSS-210, and ANSI C63.10:2009.

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 wooden table 80 cm high is used for table-top equipment.

Measurement Uncertainty

For radiated emissions, U_{lab} (3.5 dB at 3m and 3.5 dB at 10m below 1 GHz, and 4.2 dB at 3m above 1 GHz) < U_{CISPR} (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

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

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61 A	09/25/2012	09/25/2014
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	09/28/2012	09/28/2013
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2012	10/04/2013
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	04/16/2012	04/16/2013

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010
C5 Emissions	TESEQ	5.26.46.46

6.3 Results:

The sample tested was found to Comply.

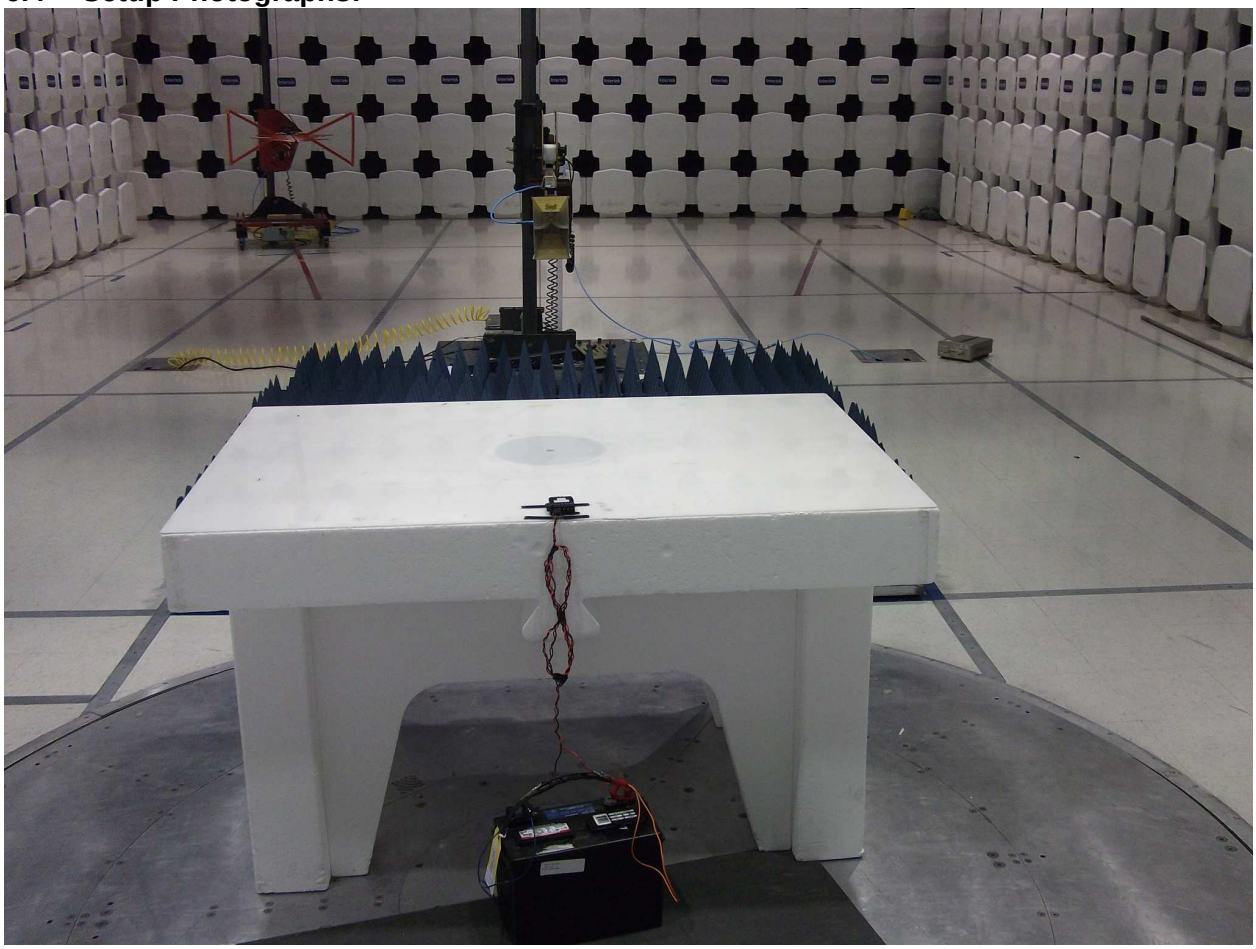
FCC 47CFR Part 15.249 and RSS-210 Annex 2.9

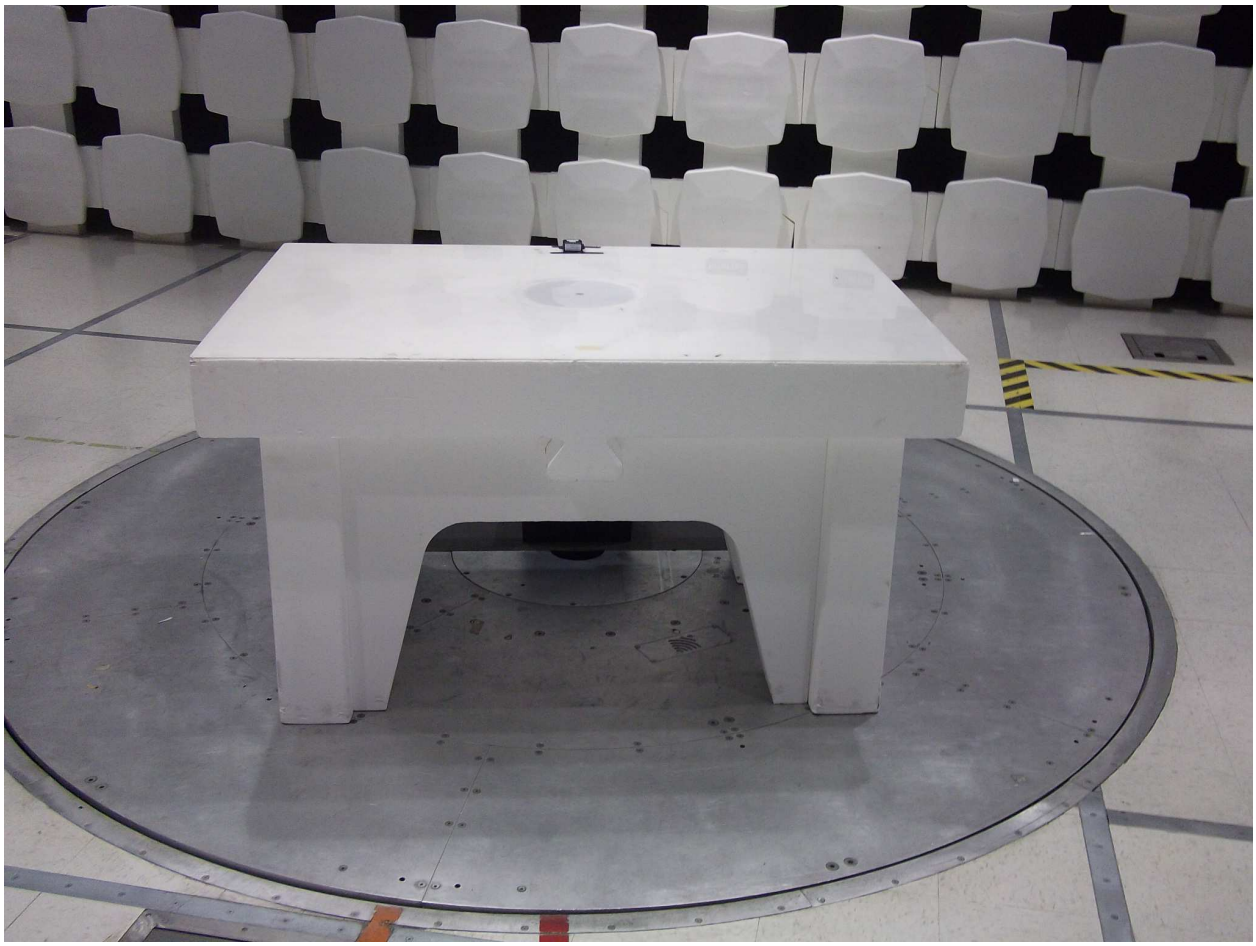
The field strength of emissions from intentional radiators operated within this frequency band shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)
2400-2483.5	50

Notes: Field strength limits are specified at a distance of 3 meters.

6.4 Setup Photographs:





6.5 Plots/Data:

Intertek

Radiated Emissions

Company: LoJack Corporation
Model #: Replacement VIM
Serial #: 0
Engineers: Nicholas Abbondante
Project #: G100991931
Standard: FCC Part 15 Subpart C 15.249
Receiver: R&S ESI (145128) 09-28-2013
PreAmp: NONE.
PreAmp Used? (Y or N): N
Date(s): 12/26/12
Location: 10m Chamber
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: 12VDC
Antenna & Cables: HF
Antenna: HORN3 H3m 04-16-2013.txt
Cable(s): 145-416 3mTrkB 10-04-2013.txt
Barometer: DAV004
Temp/Humidity/Pressure: 22c 16% 1010mB
Bands: N, LF, HF, SHF
HORN3 H3m 04-16-2013.txt
NONE.
Filter: NONE
Frequency Range: Frequencies Shown

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
Note: Average obtained using 1% duty cycle											
PK	H	2402.200	60.36	28.56	5.85	0.00	0.00	94.77	114.00	-19.23	3/5 MHz
AVG	H	2402.200	20.36	28.56	5.85	0.00	0.00	54.77	94.00	-39.23	3/5 MHz
PK	H	2442.200	59.69	28.71	5.91	0.00	0.00	94.31	114.00	-19.69	3/5 MHz
AVG	H	2442.200	19.69	28.71	5.91	0.00	0.00	54.31	94.00	-39.69	3/5 MHz
PK	H	2481.200	59.40	28.85	5.97	0.00	0.00	94.22	114.00	-19.78	3/5 MHz
AVG	H	2481.200	19.40	28.85	5.97	0.00	0.00	54.22	94.00	-39.78	3/5 MHz

Test Personnel: Nicholas Abbondante
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC Part 15 Subpart C & IC RSS-210
Input Voltage: 12VDC Fresh Battery
Pretest Verification w/ Ambient Signals or BB Source: **Ambient**

Test Date: 12/26/2012
Test Levels: See tables
Ambient Temperature: 22 ºC
Relative Humidity: 16 %
Atmospheric Pressure: 1010 mbars

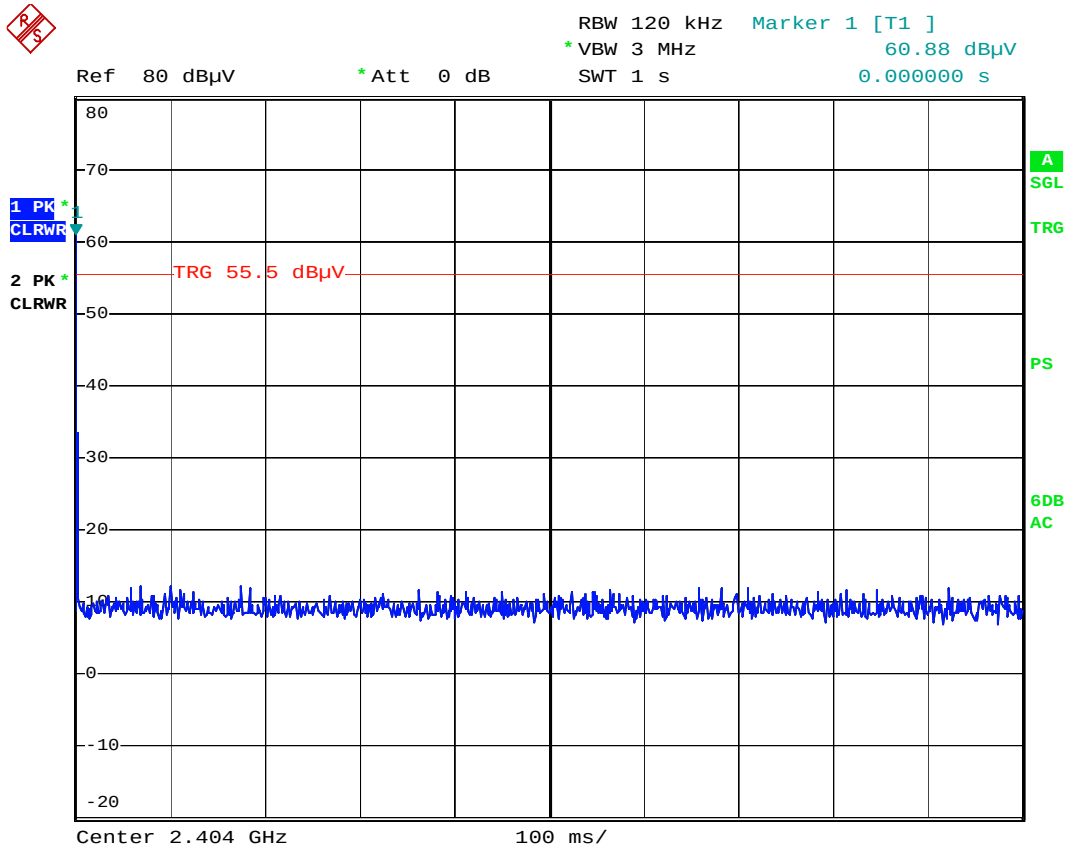
Deviations, Additions, or Exclusions: None

The Duty Cycle was measured using a V7A-VP as support equipment to create a typical RF link

Duty Cycle = $900x10^{-6}/100x10^{-3}$
= 0.009 or 0.9%

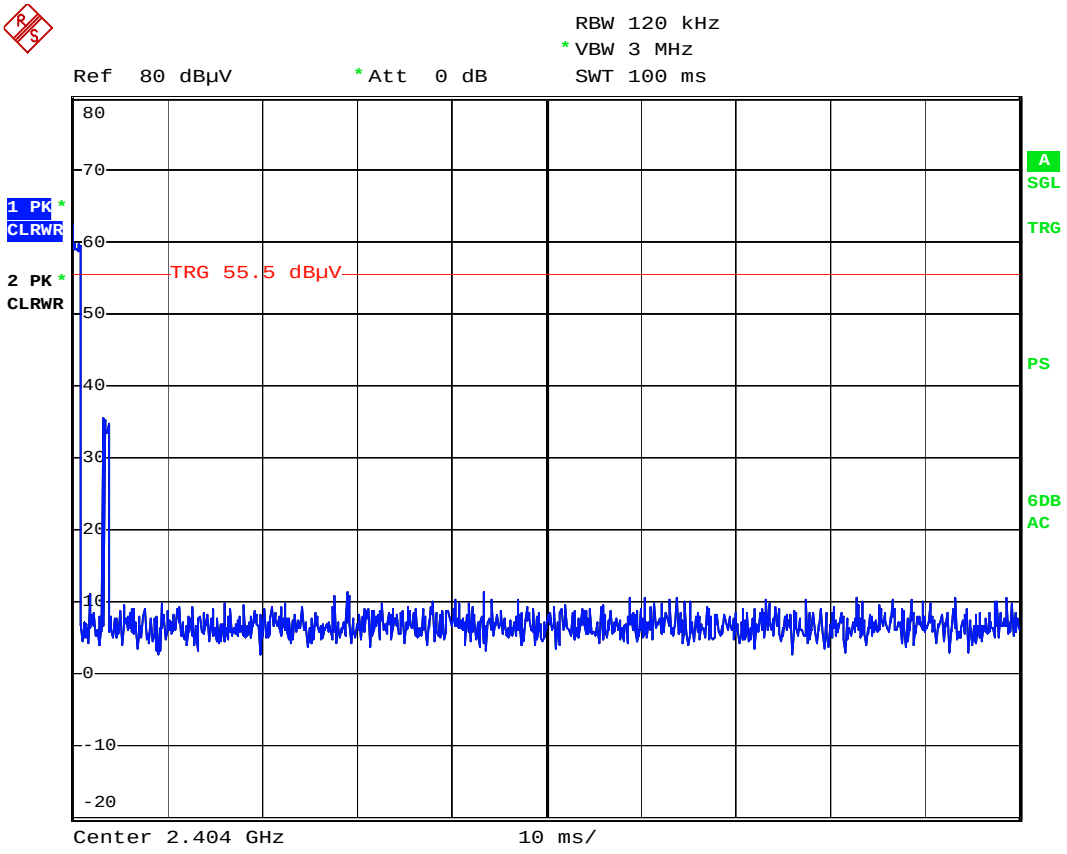
Average Factor = 20*log(0.009)
= 41 dB

A conservative estimate of 1% can be used, which would yield a 40 dB average factor.



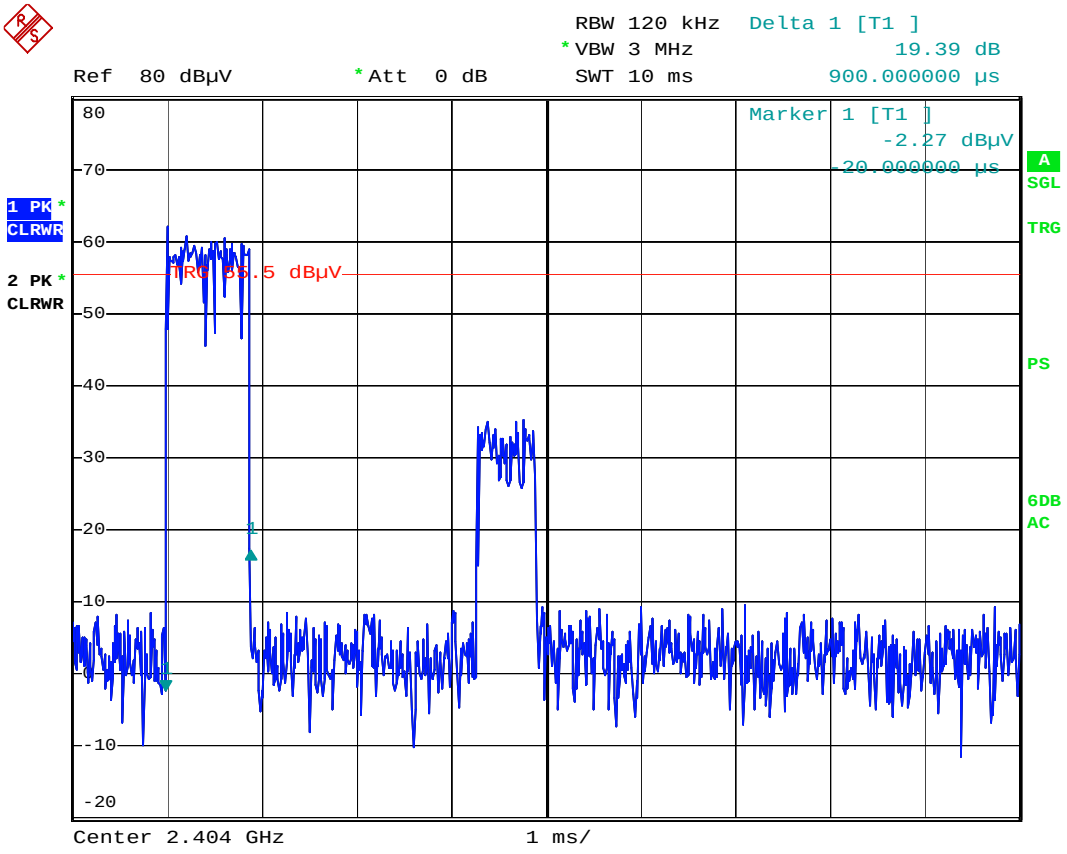
Date: 18.DEC.2012 18:42:58

Burst interval >1 second



Date: 18.DEC.2012 18:42:12

100ms averaging time



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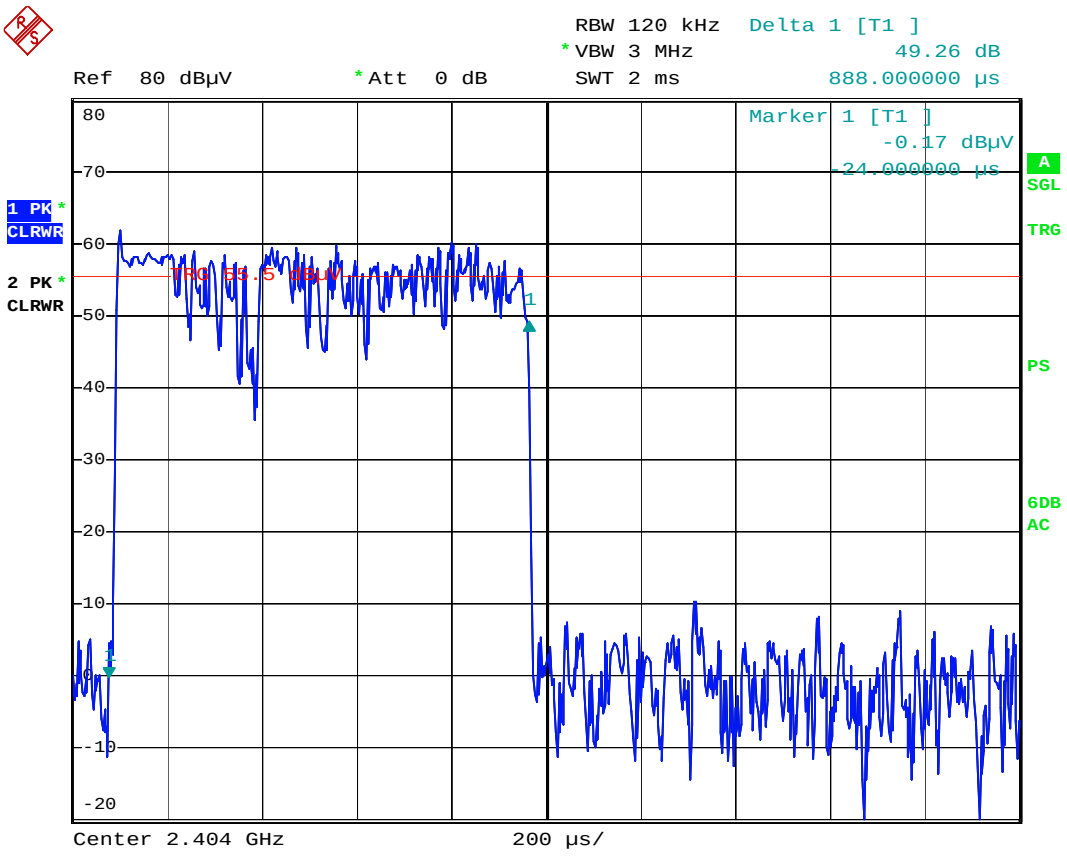
900 us Long Burst Length (lower amplitude burst is a reply from the support device)



Date: 18.DEC.2012 18:37:58

888 us Long Burst Length

Test Personnel:	Kouma Sinn KPS	Test Date:	12/18/2012
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart C & IC RSS-210	Test Levels:	N/A
Input Voltage:	12 V Car Battery	Ambient Temperature:	22 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**Ambient Signals**	Relative Humidity:	24%
		Atmospheric Pressure:	1002 mbars

Deviations, Additions, or Exclusions: None

7 Occupied Bandwidth

7.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C, IC RSS-210, and ANSI C63.10:2009.

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 wooden table 80 cm high is used for table-top equipment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61 A	09/25/2012	09/25/2014
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	09/28/2012	09/28/2013
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2012	10/04/2013
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	04/16/2012	04/16/2013

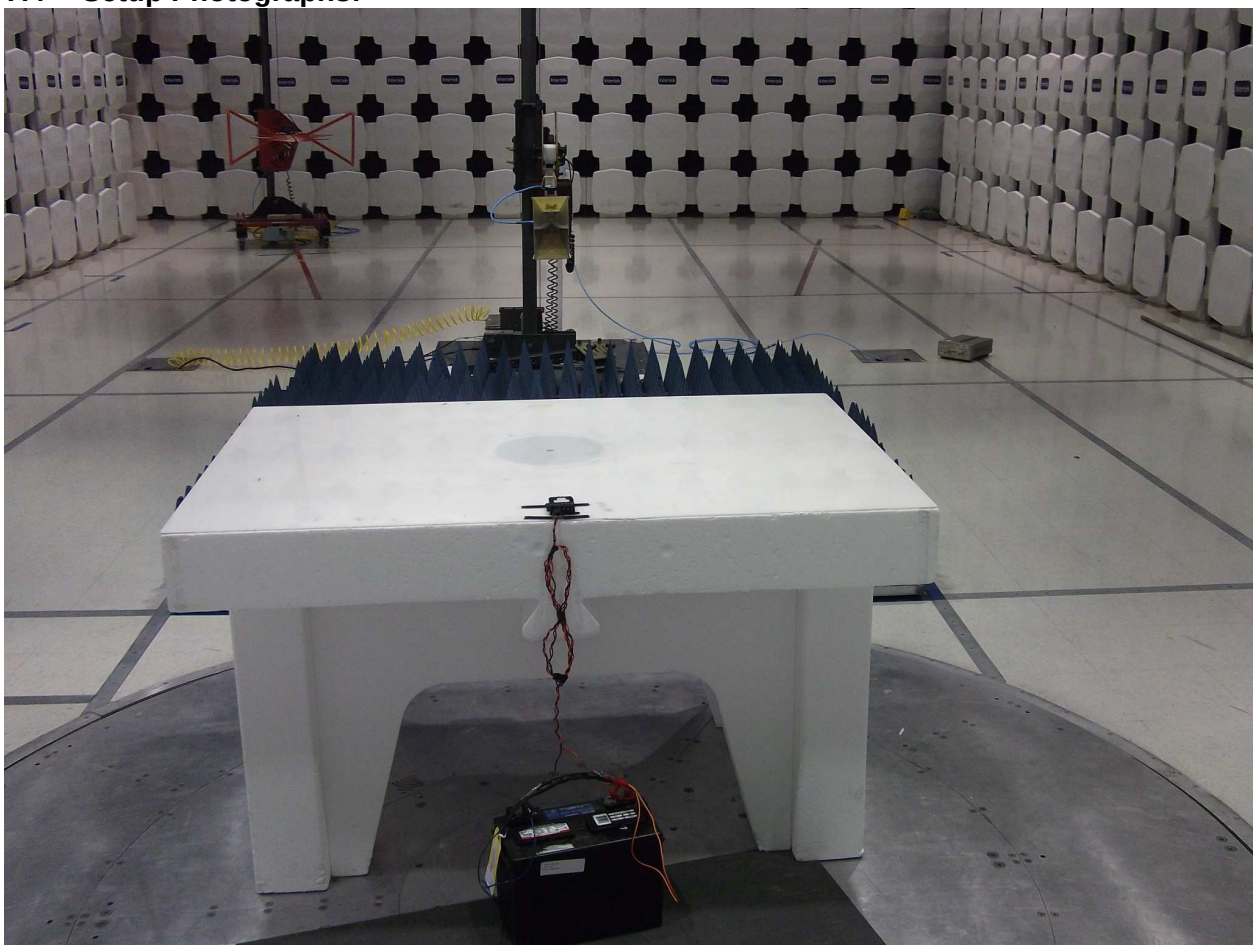
Software Utilized:

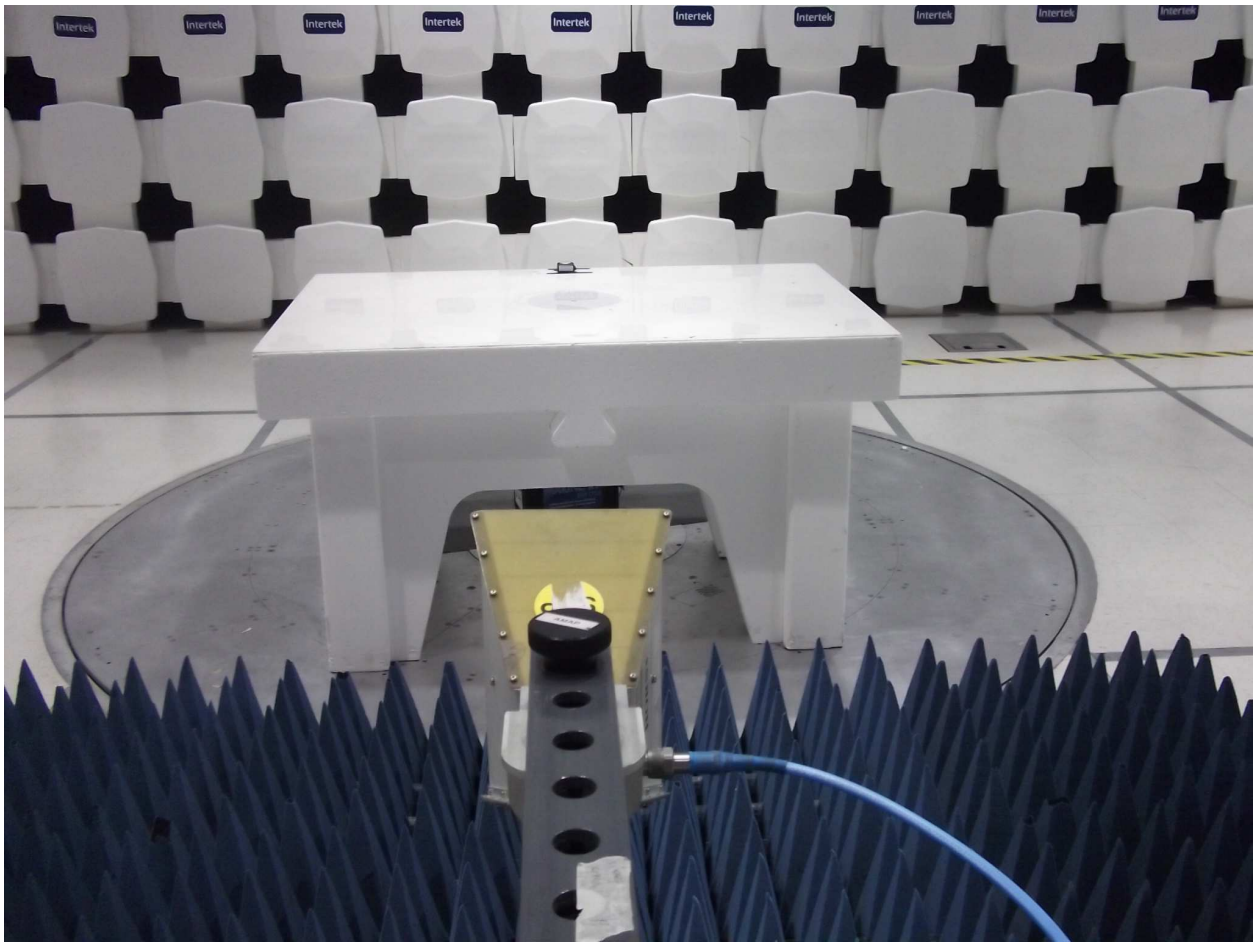
Name	Manufacturer	Version
None		

7.3 Results:

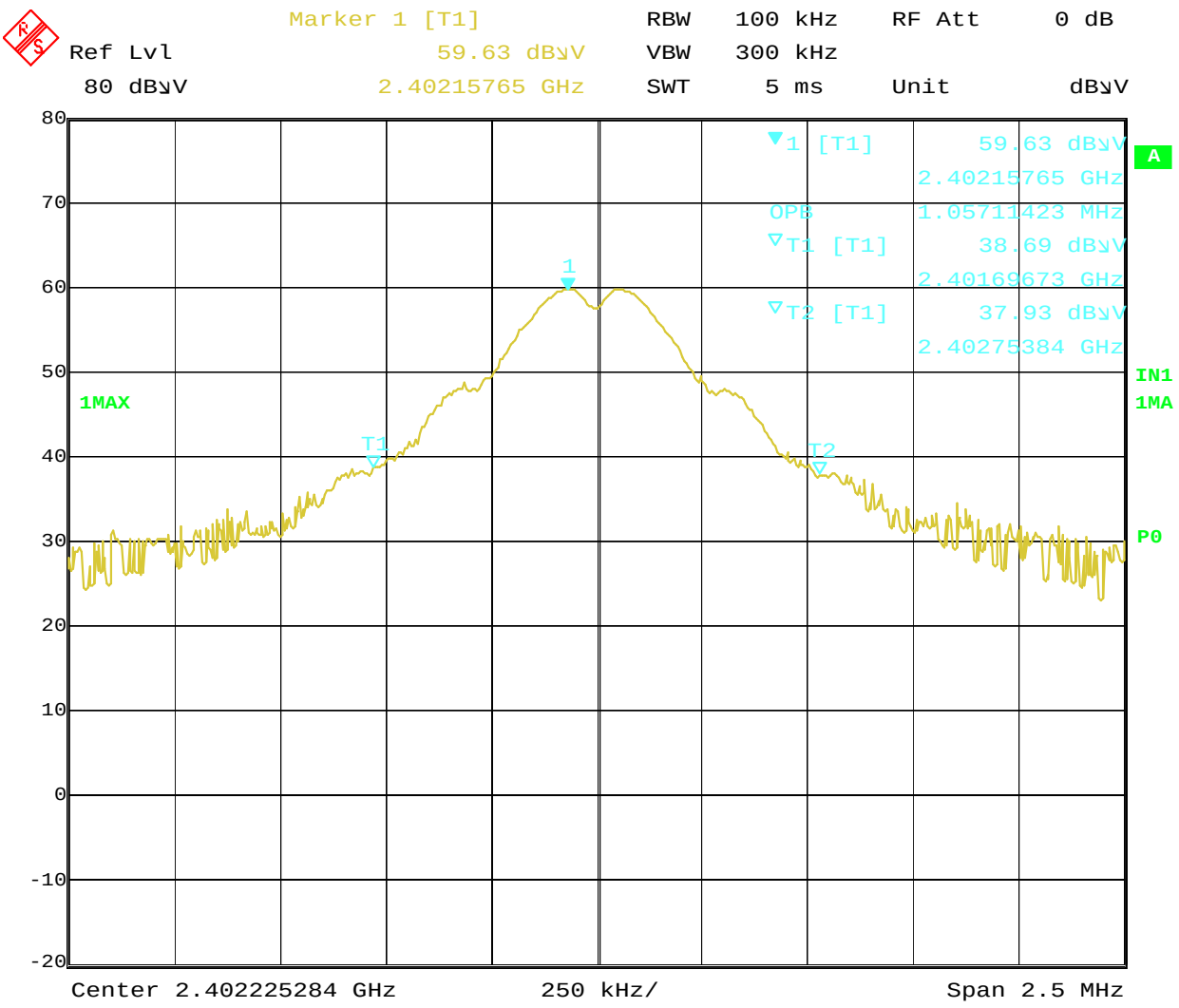
The sample tested was found to Comply. The occupied bandwidth (20 dB/99% power) must remain within the assigned band.

7.4 Setup Photographs:

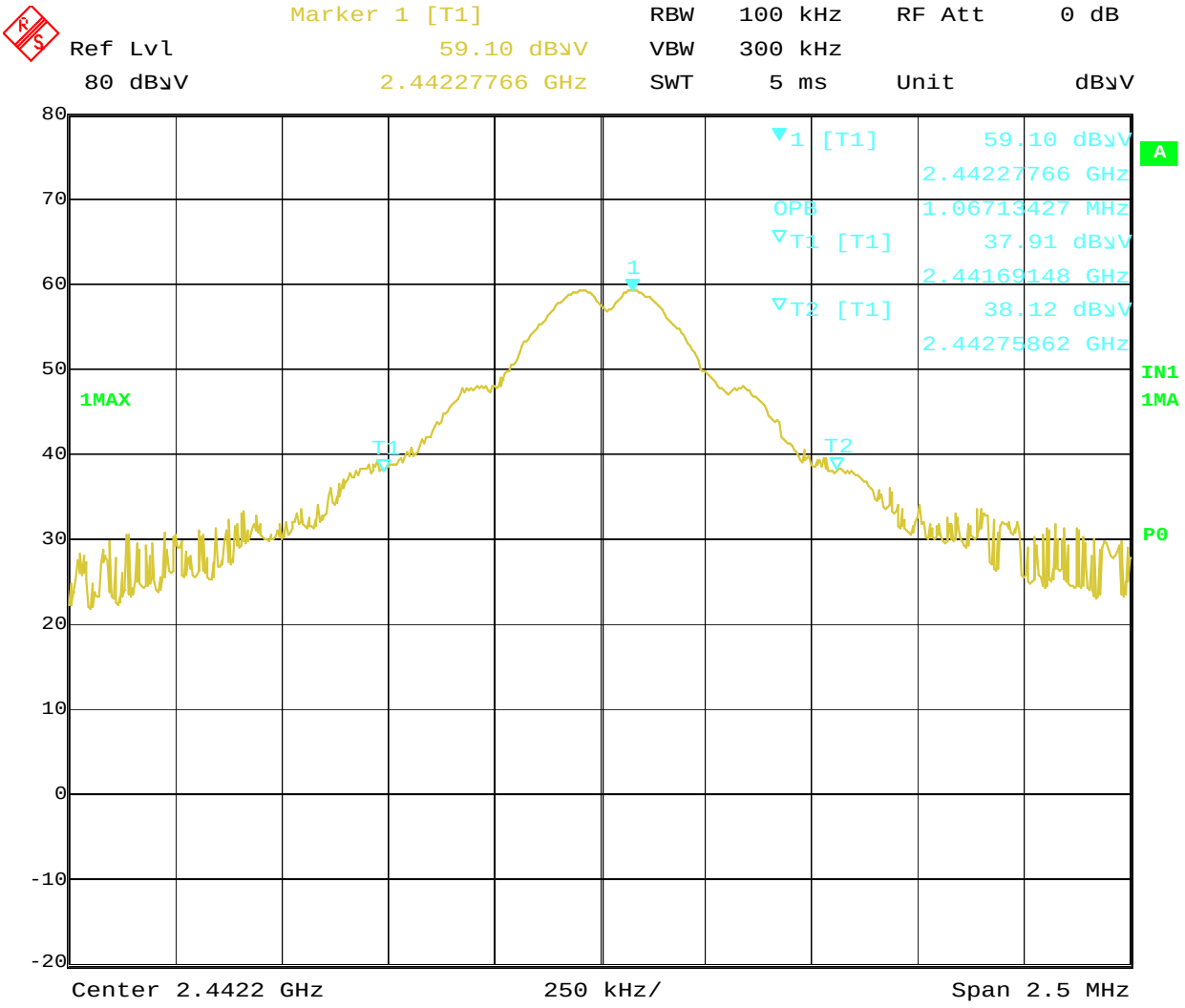



Intertek

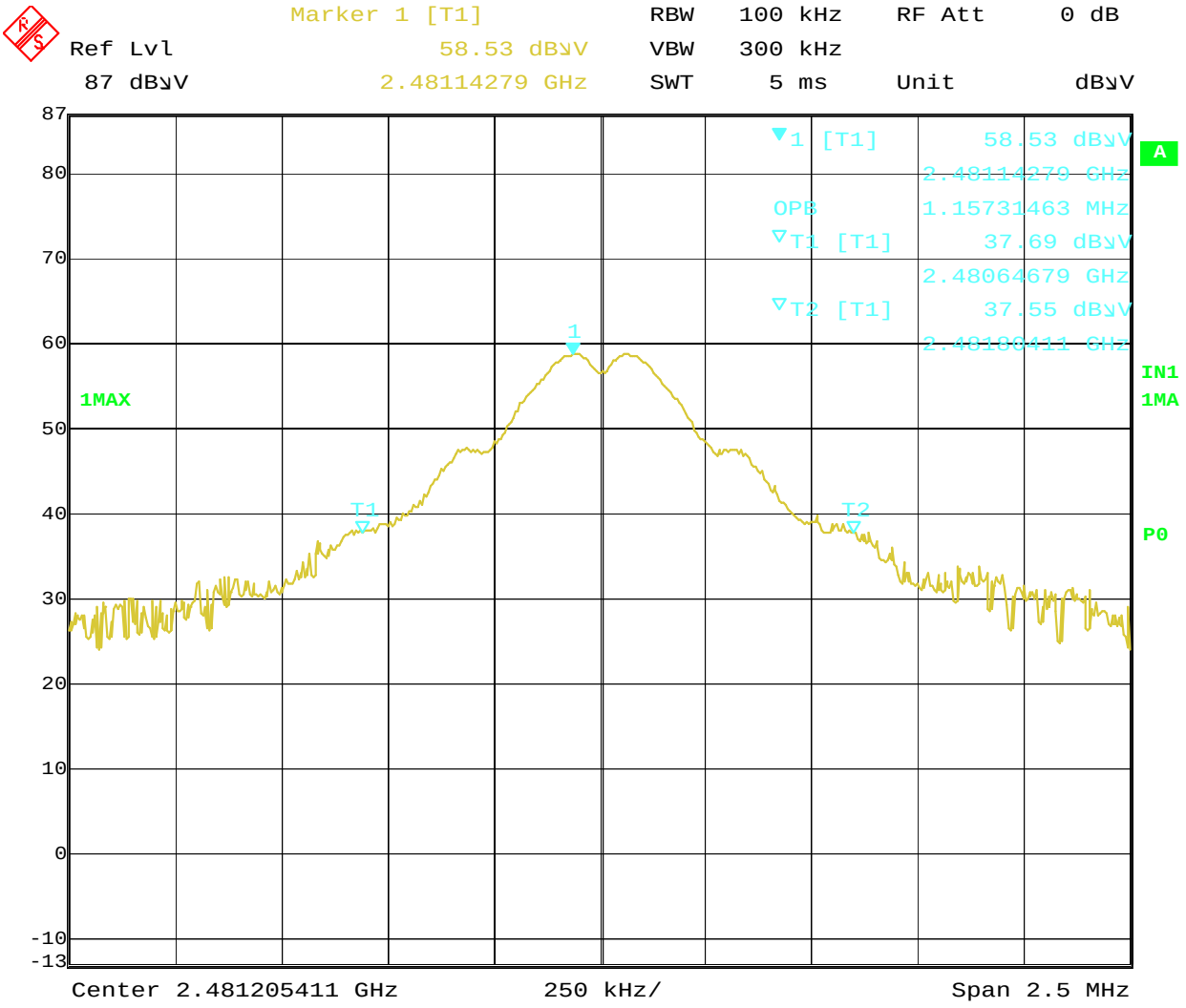
7.5 Plots/Data:



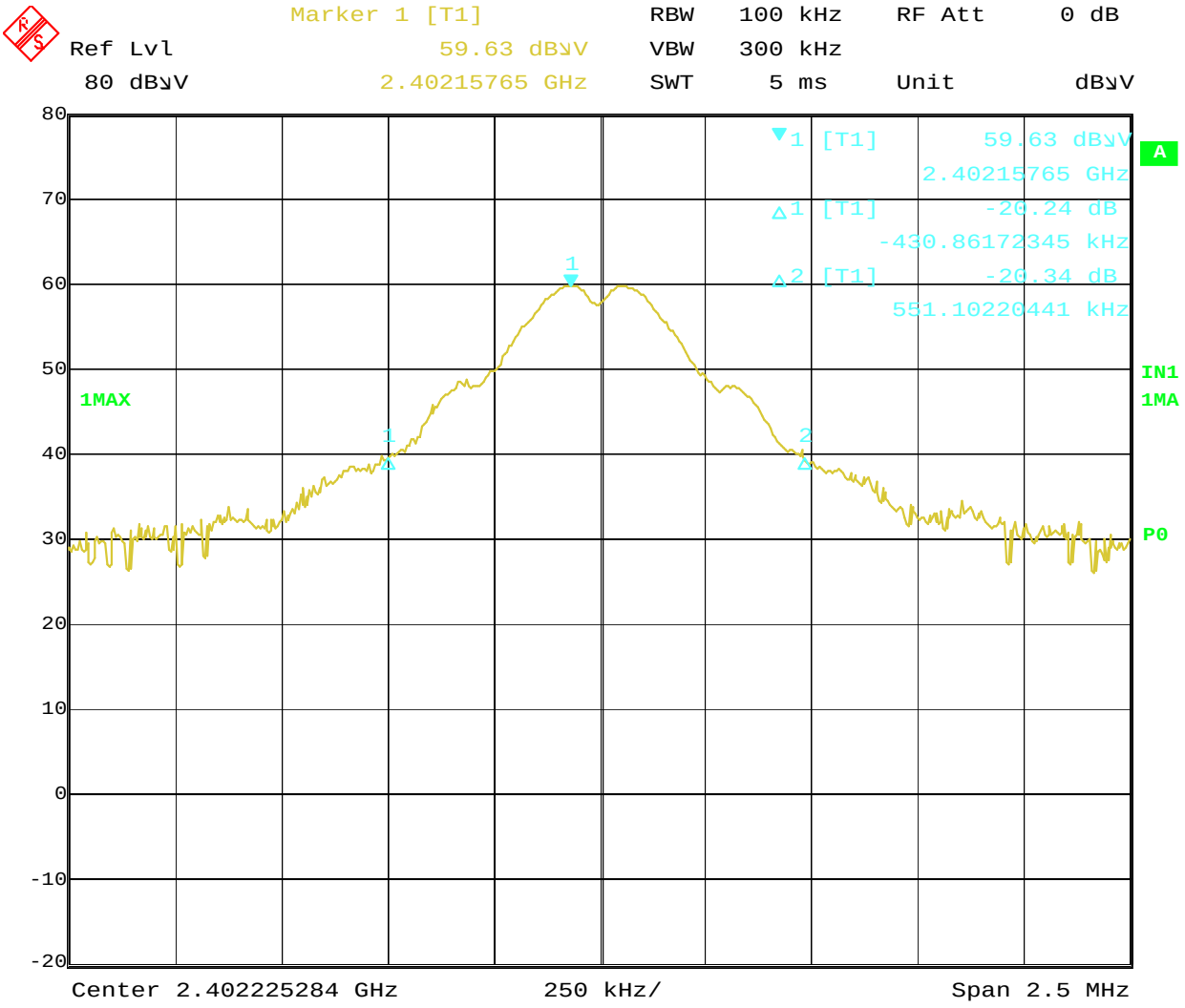
Low Channel 99% Power Bandwidth



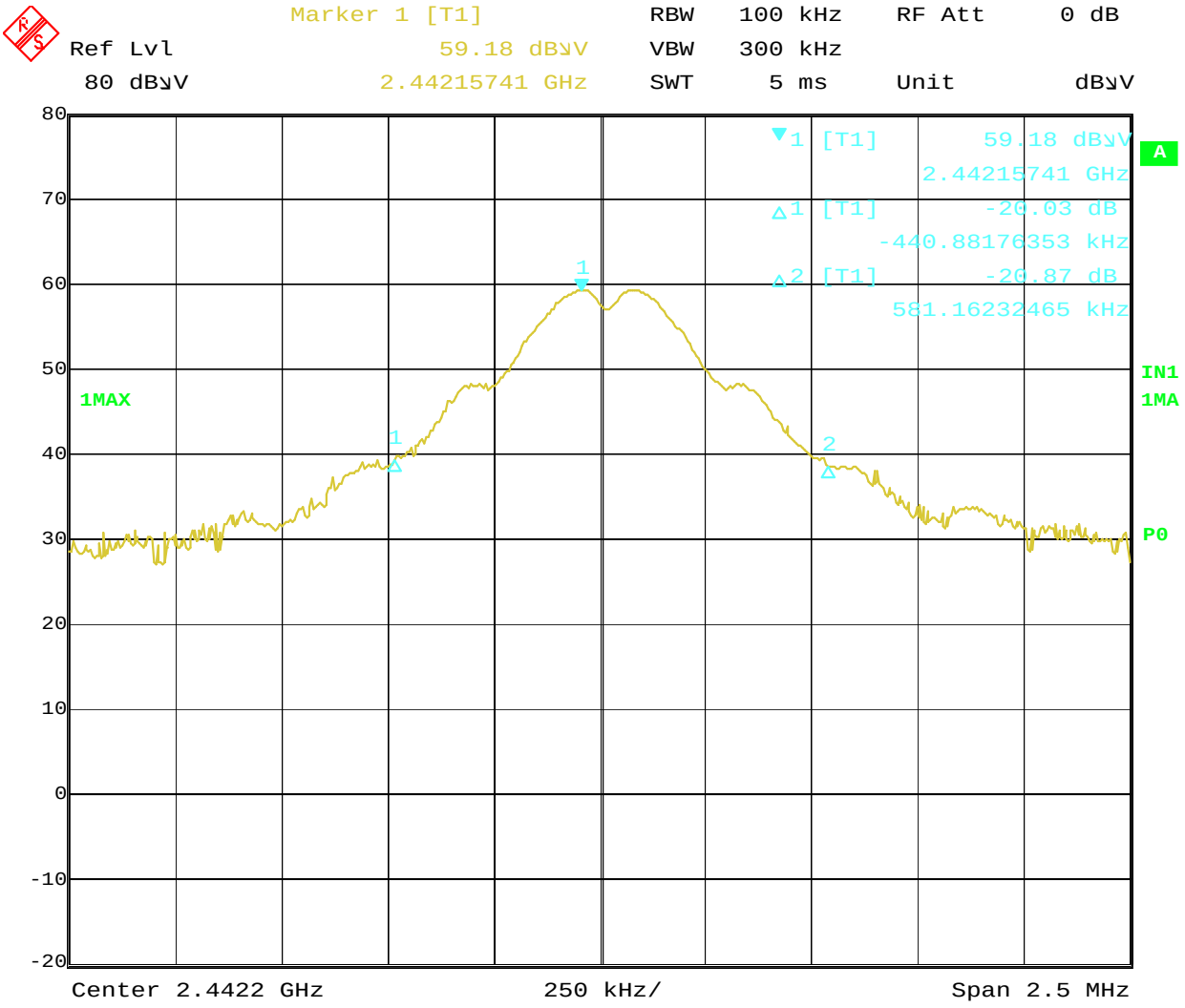
Mid Channel 99% Power Bandwidth



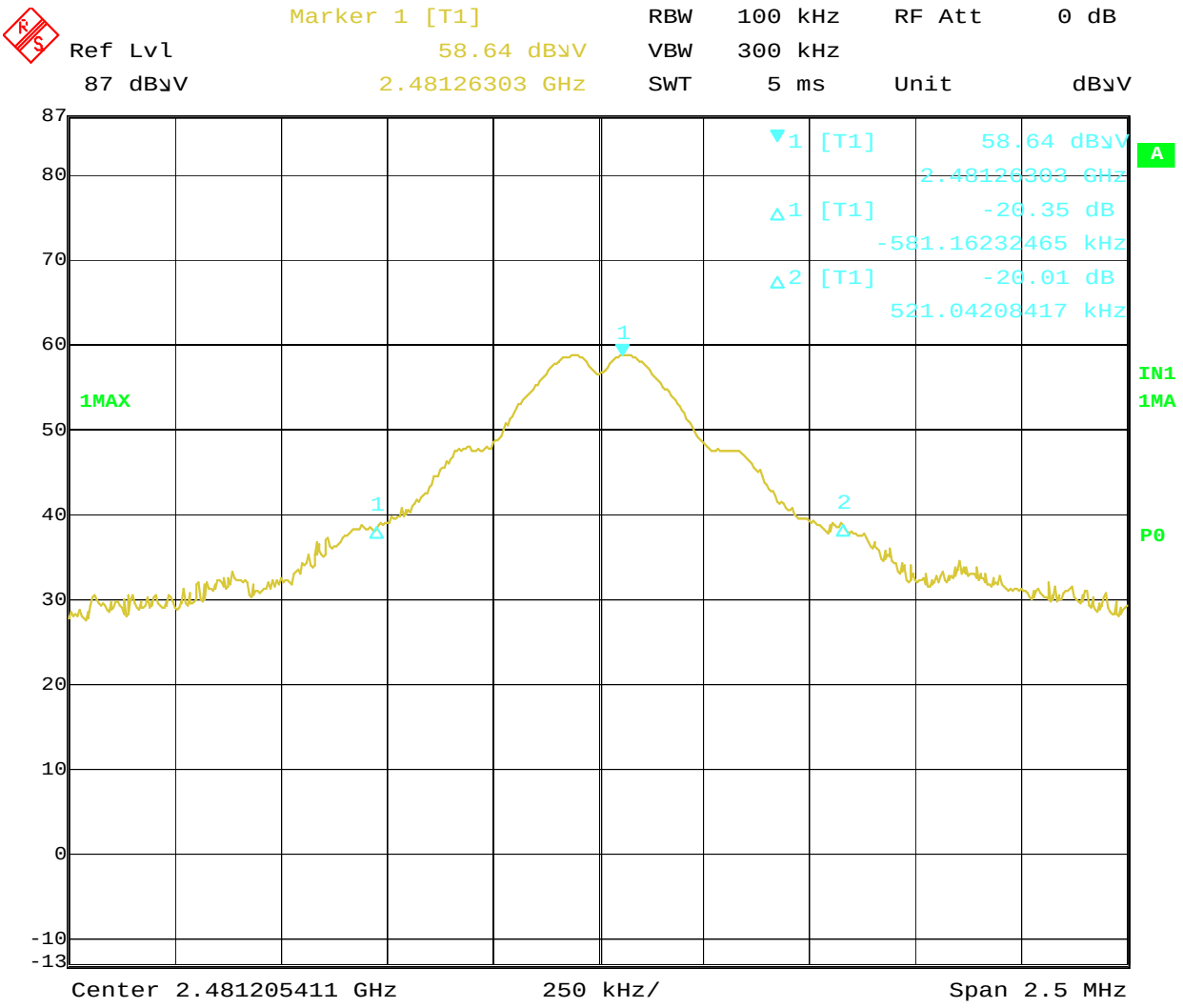
High Channel 99% Power Bandwidth



Low Channel 20 dB Bandwidth



Mid Channel 20 dB Bandwidth



High Channel 20 dB Bandwidth

Channel	99% Power Bandwidth	20 dB Bandwidth
Low	1.057 MHz	0.982 MHz
Mid	1.067 MHz	1.021 MHz
High	1.157 MHz	1.102 MHz

Test Personnel:	Nicholas Abbondante	Test Date:	12/26/2012
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart C & IC RSS-210	Test Levels:	Emissions must remain within the assigned band.
Input Voltage:	12VDC Fresh Battery		
Pretest Verification w/ Ambient Signals or BB Source:	**Ambient**	Ambient Temperature:	22 ºC
		Relative Humidity:	16 %
		Atmospheric Pressure:	1010 mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Spurious Radiated Emissions

8.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C, IC RSS-210, and ANSI C63.10:2009.

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 wooden table 80 cm high is used for table-top equipment.

Measurement Uncertainty

For radiated emissions, U_{lab} (3.5 dB at 3m and 3.5 dB at 10m below 1 GHz, and 4.2 dB at 3m above 1 GHz) < U_{CISPR} (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

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

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61 A	09/25/2012	09/25/2014
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/04/2012	09/04/2013
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	10/04/2012	10/04/2013
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2012	10/04/2013
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	10/04/2012	10/04/2013
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	09/28/2012	09/28/2013
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/13/2012	12/13/2013
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	04/16/2012	04/16/2013

Software Utilized:

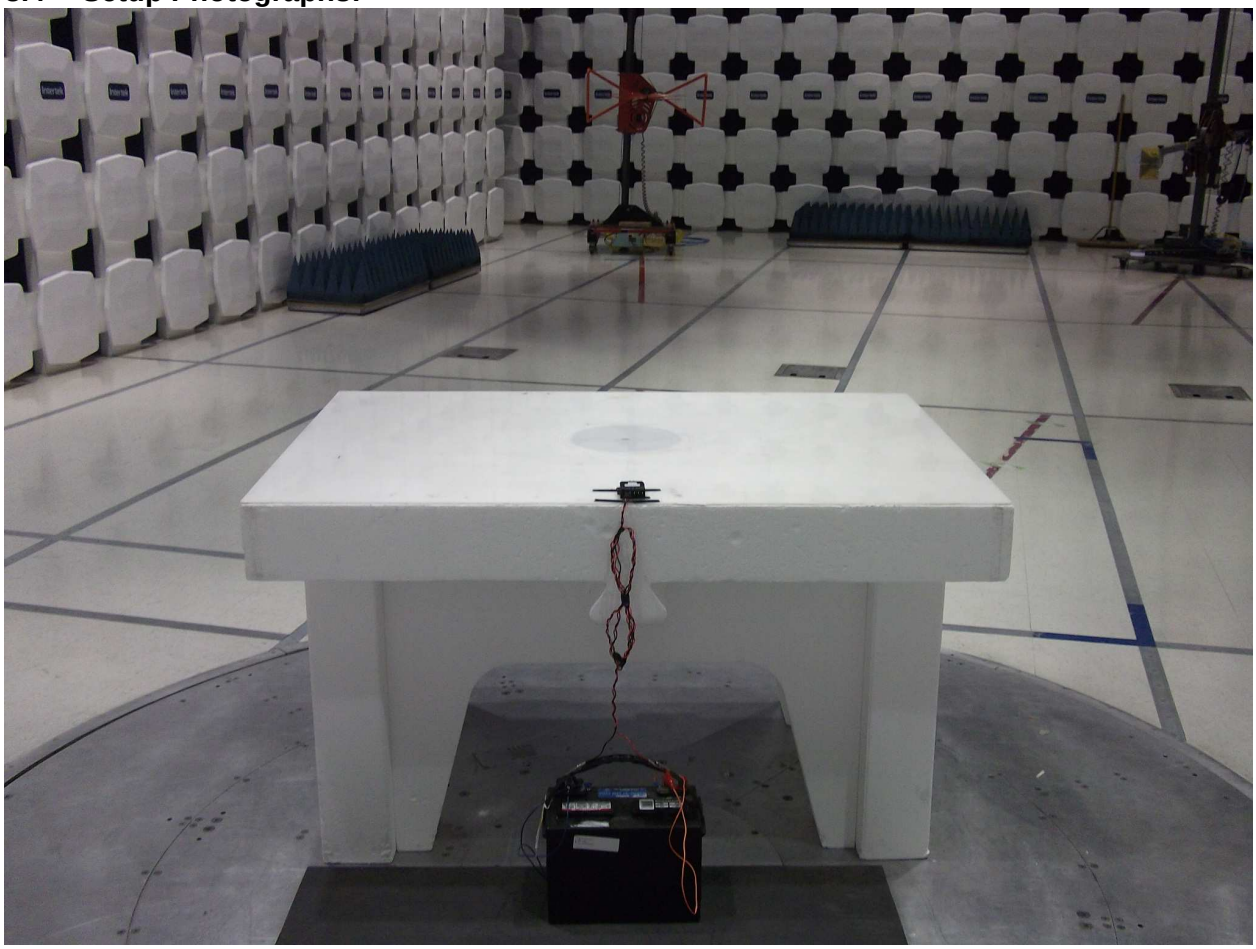
Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010
C5 Emissions	TESEQ	5.26.46.46

8.3 Results:

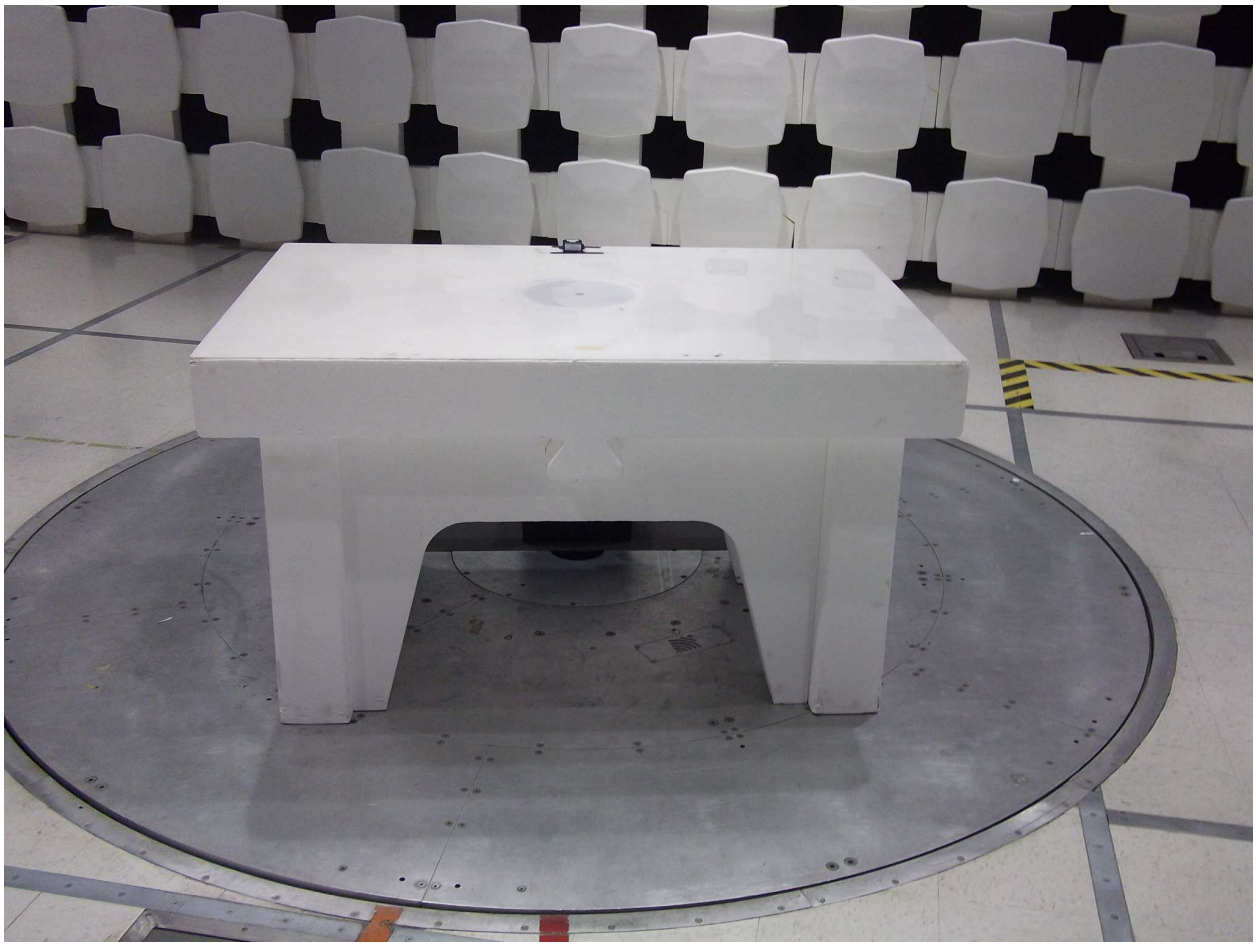
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in IC RSS-Gen and FCC 15.209, whichever is less stringent.

The sample tested was found to Comply. Note that the average values shown were obtained using an average detector, on a sample operating in the test mode. If instead the average were to be obtained by applying the duty cycle correction factor of 40 dB for a 1% duty cycle to the peak value, the results would also comply.

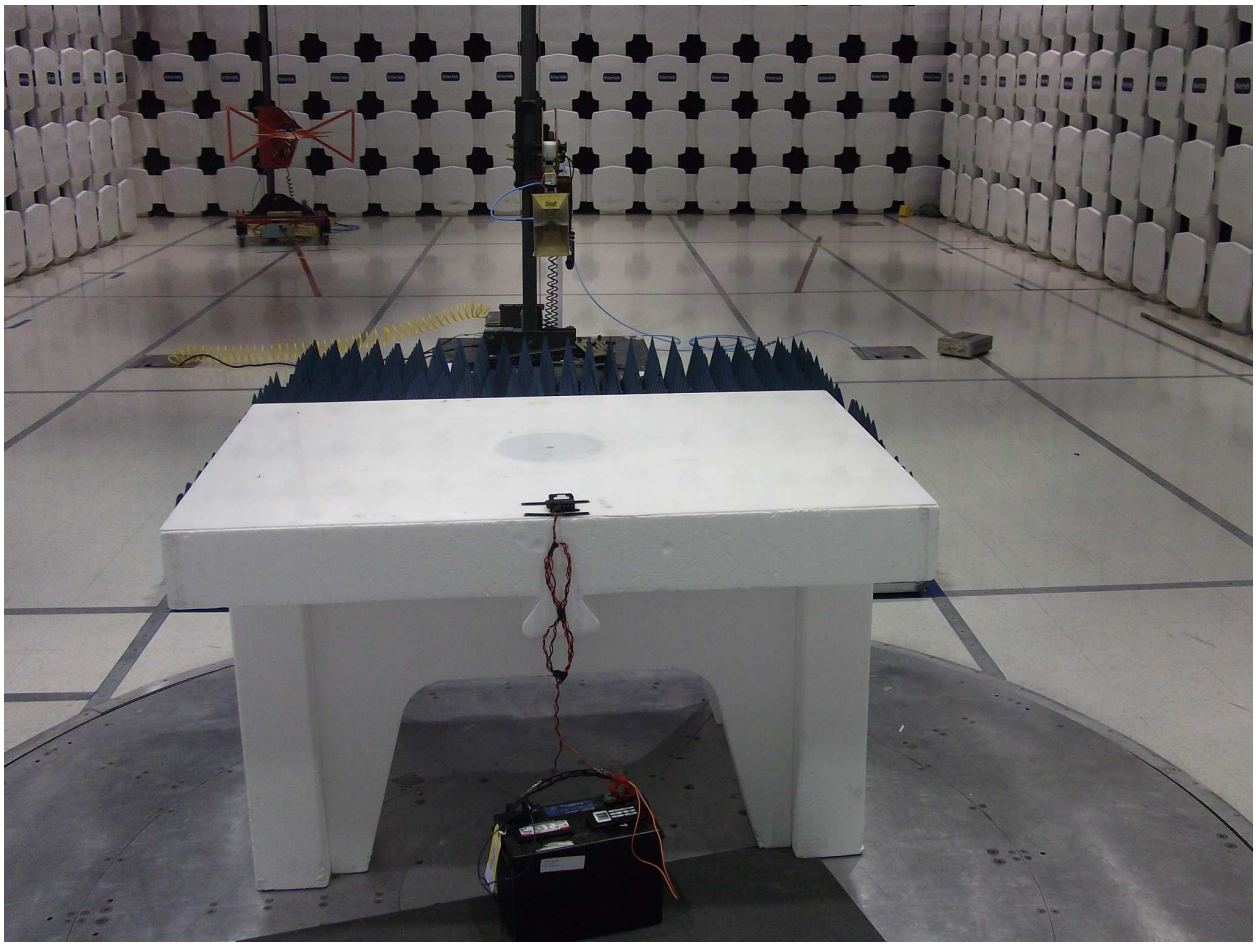
8.4 Setup Photographs:



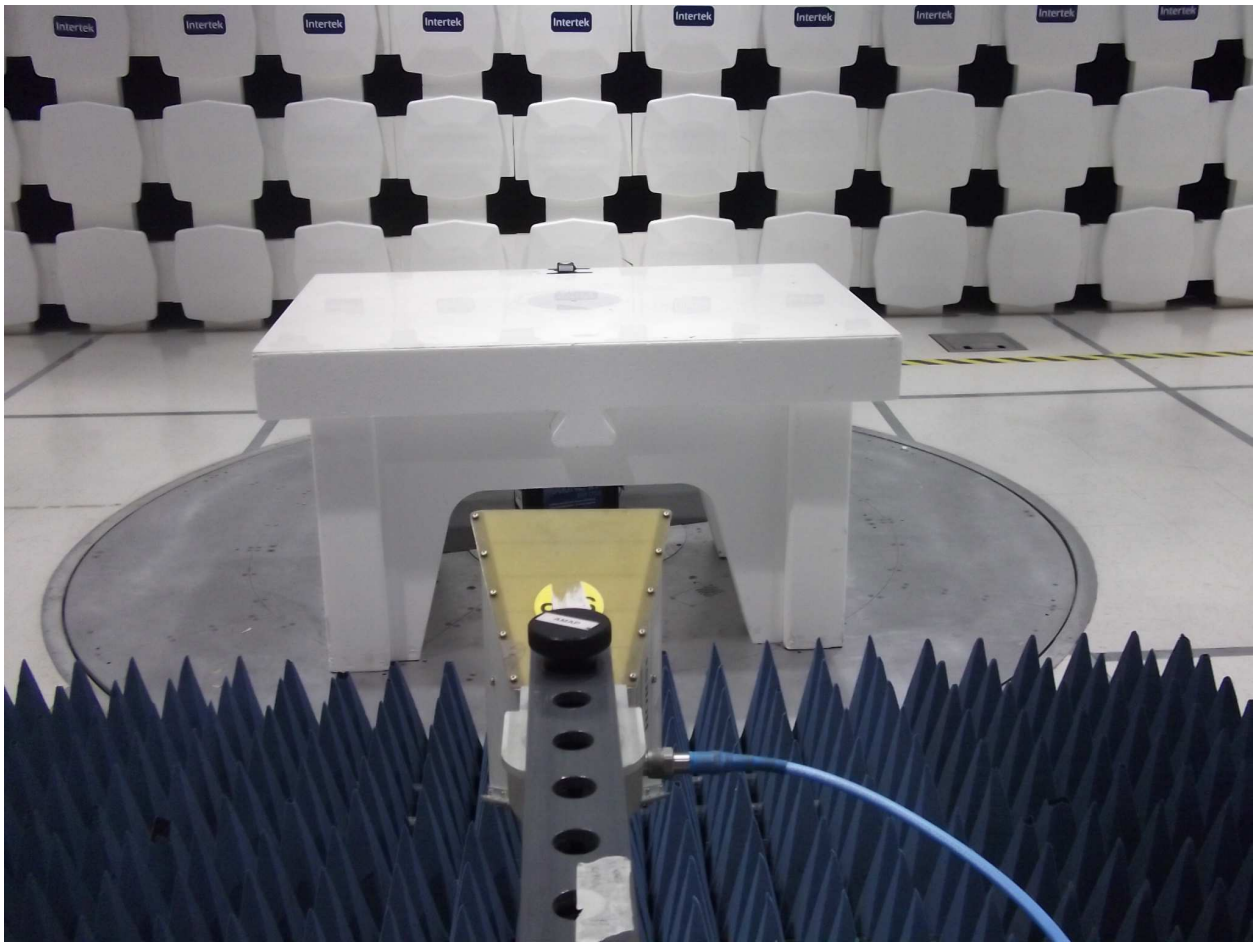
30-1000 MHz



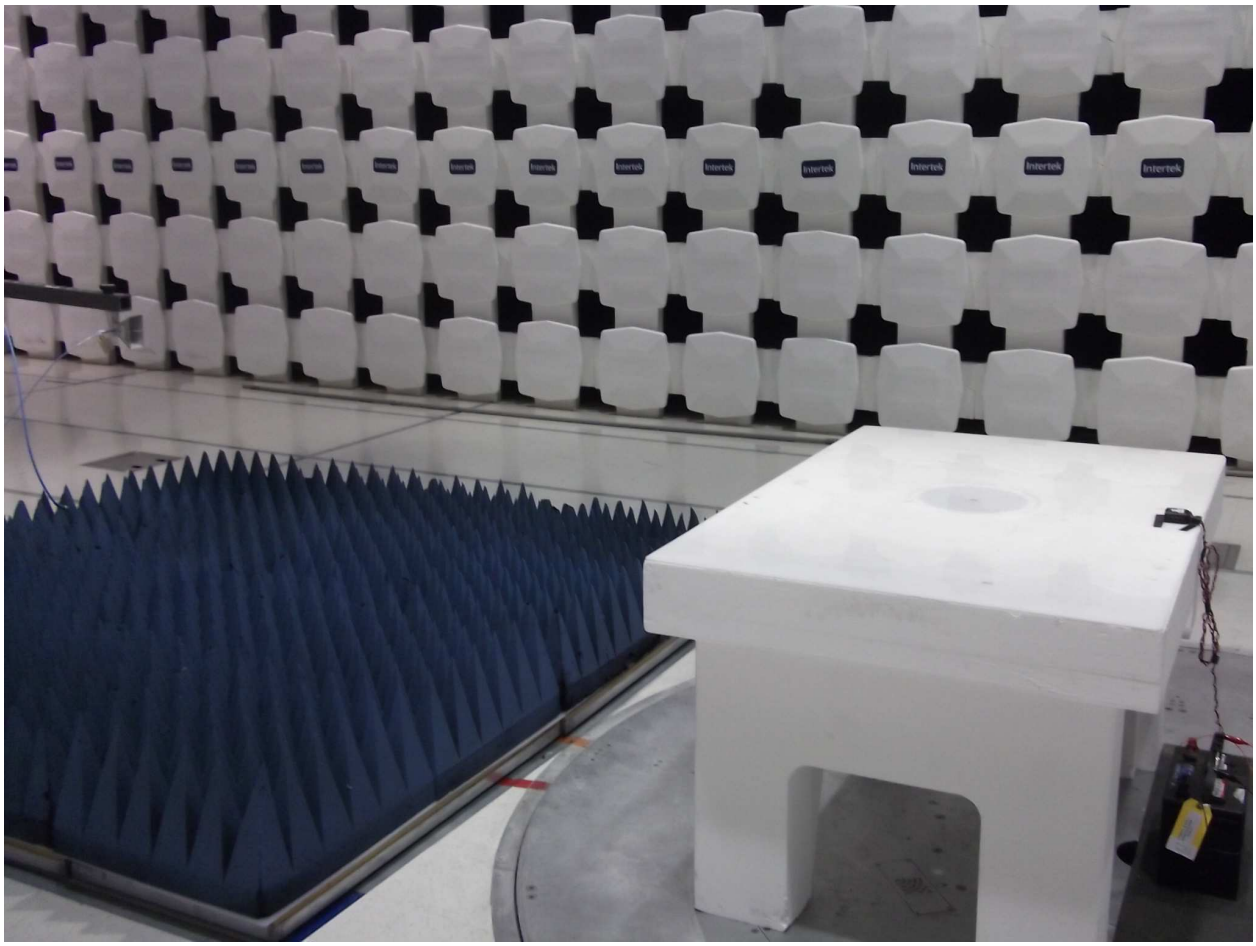
30-1000 MHz



1-18 GHz



1-18 GHz



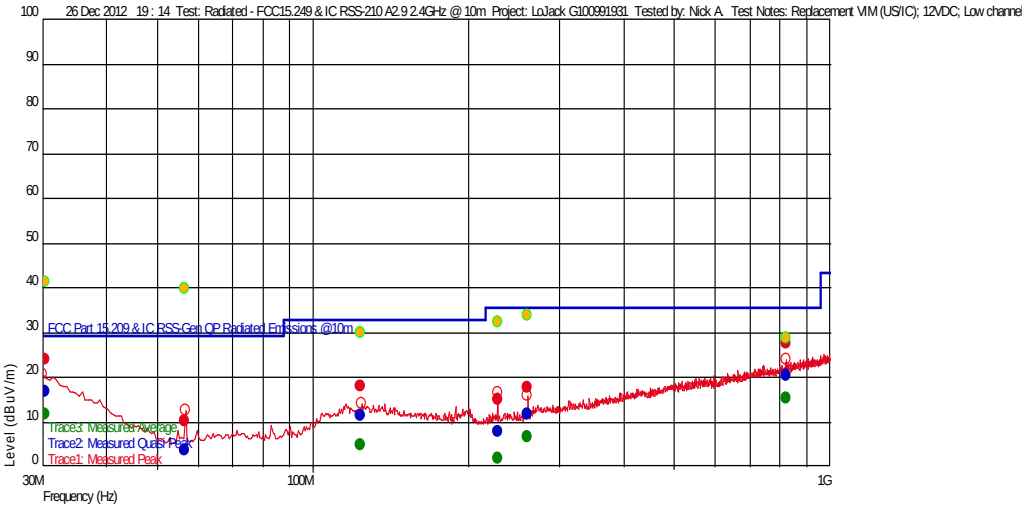
18-25 GHz

8.5 Plots/Data:

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15.249 & IC RSS-210 A2.9 2.4GHz @ 10m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC; Low channel	
Temperature:	22c	
Humidity:	16%,1010mB	
Tested by:	Nick A.	
Test Started:	26 Dec 2012 19 : 14	

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

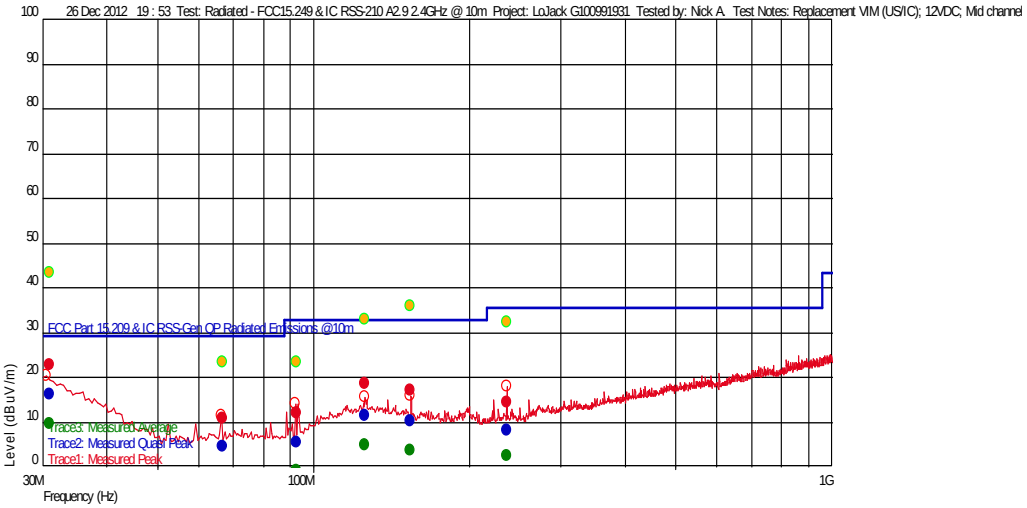
Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
228.156913665 M	7.81	11.226	-24.247	35.540	-27.73	|	211	1.65	120 k	
56.47595199 M	3.69	7.095	-26.117	29.540	-25.85	|	169	1.04	120 k	
260.046893385 M	11.73	12.107	-24.088	35.540	-23.81	|	168	1.05	120 k	
123.680561008 M	11.48	13.932	-25.267	33.040	-21.56	|	167	3.48	120 k	
821.658116695 M	20.53	21.700	-23.451	35.540	-15.01	|	245	2.36	120 k	
30.315831663 M	16.84	21.016	-26.455	29.540	-12.70	|	94	3.95	120 k	

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15.249 & IC RSS-210 A2.9 2.4GHz @ 10m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC; Mid channel	
Temperature:	22c	
Humidity:	16%,1010mB	
Tested by:	Nick A.	
Test Started:	26 Dec 2012 19 : 53	

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

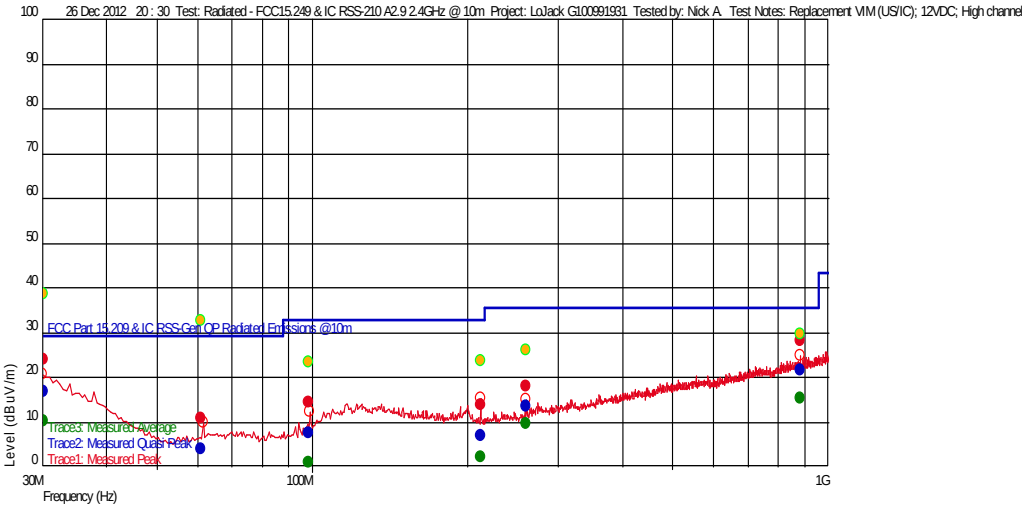
Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
236.137875543 M	8.06	11.568	-24.200	35.540	-27.48	|	281	2.20	120 k	
92.583567317 M	5.57	8.317	-25.559	33.040	-27.47	|	138	4.00	120 k	
66.858316842 M	4.54	7.914	-25.978	29.540	-25.00	|	195	1.05	120 k	
153.529258826 M	10.43	12.600	-24.986	33.040	-22.61	|	126	1.05	120 k	
125.718036126 M	11.63	13.956	-25.249	33.040	-21.41	|	110	1.66	120 k	
30.92845697 M	16.30	20.464	-26.445	29.540	-13.24	|	145	1.25	120 k	

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15.249 & IC RSS-210 A2.9 2.4GHz @ 10m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC; High channel	
Temperature:	22c	
Humidity:	16%,1010mB	
Tested by:	Nick A.	
Test Started:	26 Dec 2012 20 : 30	

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

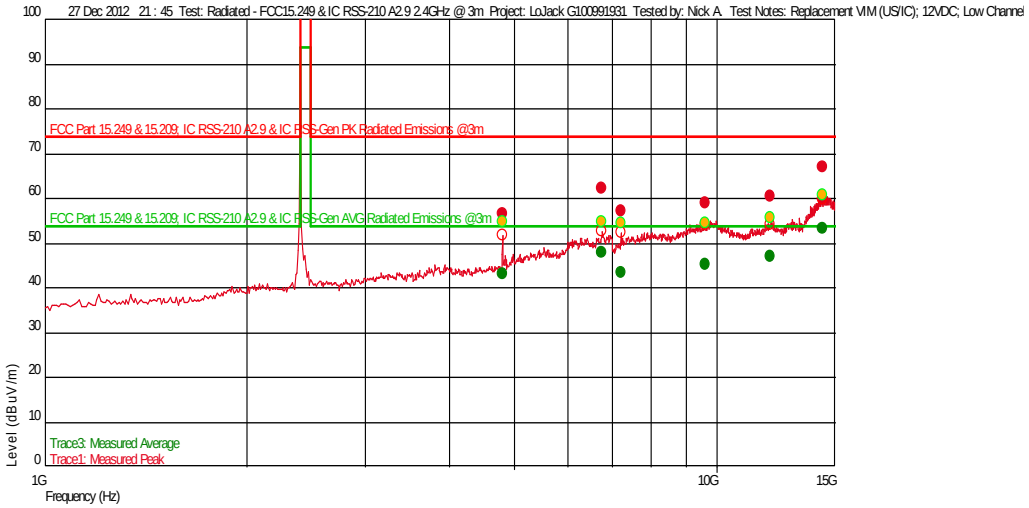
Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
212.674749541 M	7.11	10.753	-24.336	33.040	-25.93	|	222	1.96	120 k	
98.801202373 M	7.49	9.960	-25.493	33.040	-25.55	--	172	3.24	120 k	
61.140079808 M	4.05	7.528	-26.084	29.540	-25.49	|	221	1.05	120 k	
259.998797192 M	13.66	12.100	-24.088	35.540	-21.88	|	189	1.05	120 k	
882.262525471 M	21.54	22.100	-22.945	35.540	-14.00	--	154	1.04	120 k	
30.156312625 M	16.98	21.159	-26.457	29.540	-12.56	|	359	3.94	120 k	

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15.249 & IC RSS-210 A2.9 2.4GHz @ 3m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC; Low Channel	
Temperature:	22c	
Humidity:	26%, 989mB	
Tested by:	Nick A.	
Test Started:	27 Dec 2012 21 : 45	

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
4.804328657 G	56.44	33.302	-26.100	74.000	-17.56	--	331	1.21	1 M	
7.206680027 G	57.14	36.105	-23.691	74.000	-16.86	|	331	2.03	1 M	
9.629004676 G	58.93	38.998	-22.561	74.000	-15.07	--	289	3.91	1 M	
12.013961256 G	60.46	39.570	-21.218	74.000	-13.54	|	117	1.09	1 M	
6.761422846 G	62.13	35.253	-23.732	74.000	-11.87	--	137	3.20	1 M	
14.419939879 G	66.94	43.382	-19.309	74.000	-7.06	--	61	2.63	1 M	

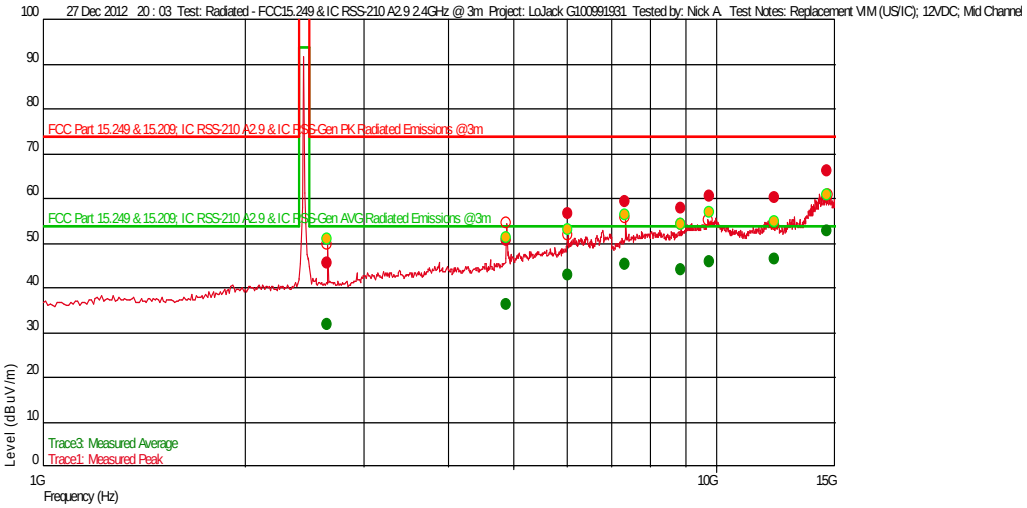
Trace3: Measured Average

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
4.804328657 G	43.15	33.302	-26.100	54.000	-10.85	--	331	1.21	1 M	
7.206680027 G	43.37	36.105	-23.691	54.000	-10.63	|	331	2.03	1 M	
9.629004676 G	45.19	38.998	-22.561	54.000	-8.81	--	289	3.91	1 M	
12.013961256 G	46.94	39.570	-21.218	54.000	-7.06	|	117	1.09	1 M	
6.761422846 G	47.96	35.253	-23.732	54.000	-6.04	--	137	3.20	1 M	
14.419939879 G	53.16	43.382	-19.309	54.000	-0.84	--	61	2.63	1 M	

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15.249 & IC RSS-210 A2.9 2.4GHz @ 3m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC; Mid Channel	
Temperature:	22c	
Humidity:	26%, 989mB	
Tested by:	Nick A.	
Test Started:	27 Dec 2012 20 : 03	

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
2.651202405 G	45.41	29.173	-27.413	74.000	-28.59	--	207	1.57	1 M	
4.887087508 G	50.71	33.449	-25.995	74.000	-23.29	--	155	2.15	1 M	
6.022839011 G	56.68	35.004	-24.419	74.000	-17.32	|	360	1.56	1 M	
8.864482298 G	57.70	38.320	-22.443	74.000	-16.30	--	70	3.68	1 M	
7.326619907 G	59.22	36.723	-23.466	74.000	-14.78	|	332	3.79	1 M	
12.227034068 G	60.25	39.300	-21.649	74.000	-13.75	|	41	2.13	1 M	
9.768643954 G	60.38	39.484	-22.606	74.000	-13.62	--	296	2.03	1 M	
14.651235805 G	66.19	43.572	-19.351	74.000	-7.81	|	116	2.39	1 M	

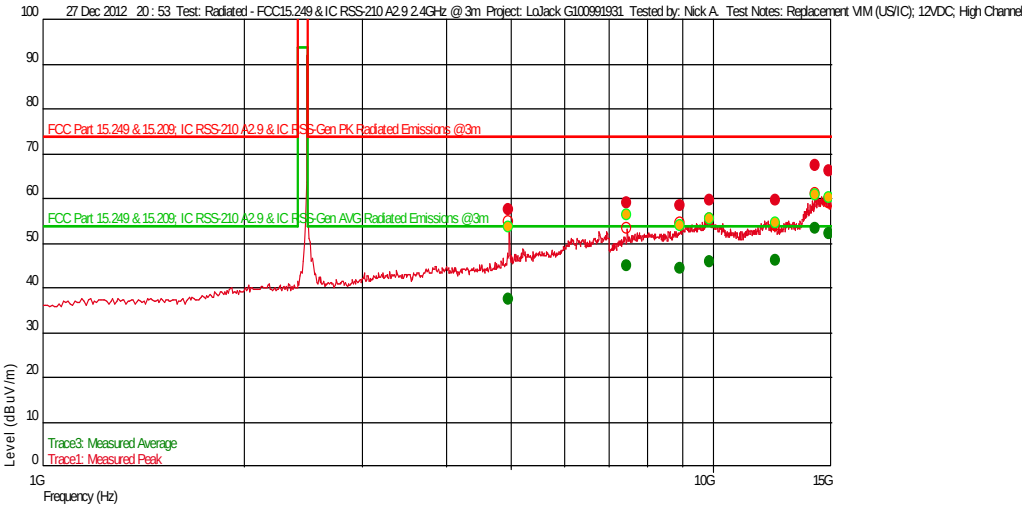
Trace3: Measured Average

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
2.651202405 G	31.76	29.173	-27.413	54.000	-22.24	--	207	1.57	1 M	
4.887087508 G	36.37	33.449	-25.995	54.000	-17.63	--	155	2.15	1 M	
6.022839011 G	42.97	35.004	-24.419	54.000	-11.03	|	360	1.56	1 M	
8.864482298 G	44.11	38.320	-22.443	54.000	-9.89	--	70	3.68	1 M	
7.326619907 G	45.19	36.723	-23.466	54.000	-8.81	|	332	3.79	1 M	
9.768643954 G	45.96	39.484	-22.606	54.000	-8.04	--	296	2.03	1 M	
12.227034068 G	46.41	39.300	-21.649	54.000	-7.59	|	41	2.13	1 M	
14.651235805 G	52.81	43.572	-19.351	54.000	-1.19	|	116	2.39	1 M	

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15.249 & IC RSS-210 A2.9 2.4GHz @ 3m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC; High Channel	
Temperature:	22c	
Humidity:	26%, 989mB	
Tested by:	Nick A.	
Test Started:	27 Dec 2012 20 : 53	

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
4.965237141 G	57.34	33.672	-25.894	74.000	-16.66	--	123	2.15	1 M	
8.933400134 G	58.38	38.381	-22.355	74.000	-15.62	|	219	4.01	1 M	
7.443633935 G	58.84	36.916	-23.246	74.000	-15.16	|	169	2.37	1 M	
9.916873747 G	59.51	39.946	-22.653	74.000	-14.49	--	250	1.46	1 M	
12.408443554 G	59.58	39.093	-22.015	74.000	-14.42	--	67	2.29	1 M	
14.892798931 G	66.21	42.692	-19.080	74.000	-7.79	--	1	3.55	1 M	
14.222905812 G	67.27	42.802	-18.788	74.000	-6.73	|	360	2.48	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
4.965237141 G	37.48	33.672	-25.894	54.000	-16.52	--	123	2.15	1 M	
8.933400134 G	44.44	38.381	-22.355	54.000	-9.56	|	219	4.01	1 M	
7.443633935 G	45.01	36.916	-23.246	54.000	-8.99	|	169	2.37	1 M	
9.916873747 G	45.88	39.946	-22.653	54.000	-8.12	--	250	1.46	1 M	
12.408443554 G	46.16	39.093	-22.015	54.000	-7.84	--	67	2.29	1 M	
14.892798931 G	52.03	42.692	-19.080	54.000	-1.97	--	1	3.55	1 M	
14.222905812 G	53.26	42.802	-18.788	54.000	-0.74	|	360	2.48	1 M	

Intertek

Special Radiated Emissions

Company: LoJack Corporation
Model #: Replacement VIM
Serial #: Test Unit A
Engineers: Nicholas Abbondante
Project #: G100991931 Date(s): 12/27/12
Standard: FCC Part 15 Subpart C 15.249
Receiver: R&S ESI (145128) 09-28-2013
PreAmp: PRE9 06-28-2013.txt
PreAmp Used? (Y or N): Y
Antenna & Cables: N Bands: N, LF, HF, SHF
Antenna: HORN3 H3m 04-16-2013.txt HORN3 H3m 04-16-2013.txt
Cable(s): CBLHF2012-2M-1 12-18-2013.txt CBLHF2012-5M-1 12-18-2013.txt
Location: 10m Chamber Barometer: DAV004 Filter: NONE
Temp/Humidity/Pressure: 22c 26% 989mB
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: Fresh 12V Battery Frequency Range: 15-18 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
Note: Only noise floor was detected. A hand scan at a much closer distance was also performed.													
PK	V	15000.000	33.16	42.12	10.45	26.23	0.00	59.50	74.00	-14.50	1/3 MHz		
AVG	V	15000.000	21.80	42.12	10.45	26.23	0.00	48.14	54.00	-5.86	1/3 MHz		
PK	V	18000.000	32.57	46.72	11.72	28.60	0.00	62.41	74.00	-11.59	1/3 MHz	RB	RB
AVG	V	18000.000	21.80	46.72	11.72	28.60	0.00	51.64	54.00	-2.36	1/3 MHz	RB	RB

Intertek

Special Radiated Emissions

Company: LoJack Corporation
Model #: Replacement VIM
Serial #: Test Unit A
Engineers: Nicholas Abbondante
Project #: G100991931 Date(s): 12/27/12
Standard: FCC Part 15 Subpart C 15.249
Receiver: R&S ESI (145128) 09-28-2013
PreAmp: PRE9 06-28-2013.txt
PreAmp Used? (Y or N): Y
Antenna & Cables: SHF Bands: N, LF, HF, SHF
Antenna: EMC04 H3m 02-08-2013.txt EMC04 H3m 02-08-2013.txt
Cable(s): CBLHF2012-2M-1 12-18-2013.txt CBLHF2012-5M-1 12-18-2013.txt
Location: 10m Chamber Barometer: DAV004 Filter: NONE
Temp/Humidity/Pressure: 22c 26% 989mB
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: Fresh 12V Battery Frequency Range: 18-25 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
Note: Only noise floor was detected. A hand scan at a much closer distance was also performed.													
PK	V	18000.000	33.51	44.47	11.72	28.60	0.00	61.10	74.00	-12.90	1/3 MHz	RB	RB
AVG	V	18000.000	21.54	44.47	11.72	28.60	0.00	49.13	54.00	-4.87	1/3 MHz	RB	RB
PK	V	25000.000	31.69	46.13	14.37	29.71	0.00	62.48	74.00	-11.52	1/3 MHz		
AVG	V	25000.000	20.38	46.13	14.37	29.71	0.00	51.17	54.00	-2.83	1/3 MHz		

Test Personnel: Nicholas Abbondante
Test Date: 12/26-27/2012
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC Part 15 Subpart C & IC RSS-210
Test Levels: See tables
Input Voltage: 12VDC Fresh Battery
Pretest Verification w/ Ambient Signals or BB Source: **Ambient**
Ambient Temperature: 22, 22 ºC
Relative Humidity: 16, 26 %
Atmospheric Pressure: 1010, 989 mbars

Deviations, Additions, or Exclusions: None

9 Digital Devices Spurious Radiated Emissions

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, IC ICES-003, 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. 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 wooden table 80 cm high is used for table-top equipment.

Measurement Uncertainty

For radiated emissions, U_{lab} (3.5 dB at 3m and 3.5 dB at 10m below 1 GHz, and 4.2 dB at 3m above 1 GHz) < U_{CISPR} (5.2 dB), which is the reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

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

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61 A	09/25/2012	09/25/2014
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/04/2012	09/04/2013
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	10/04/2012	10/04/2013
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	10/04/2012	10/04/2013
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	09/28/2012	09/28/2013

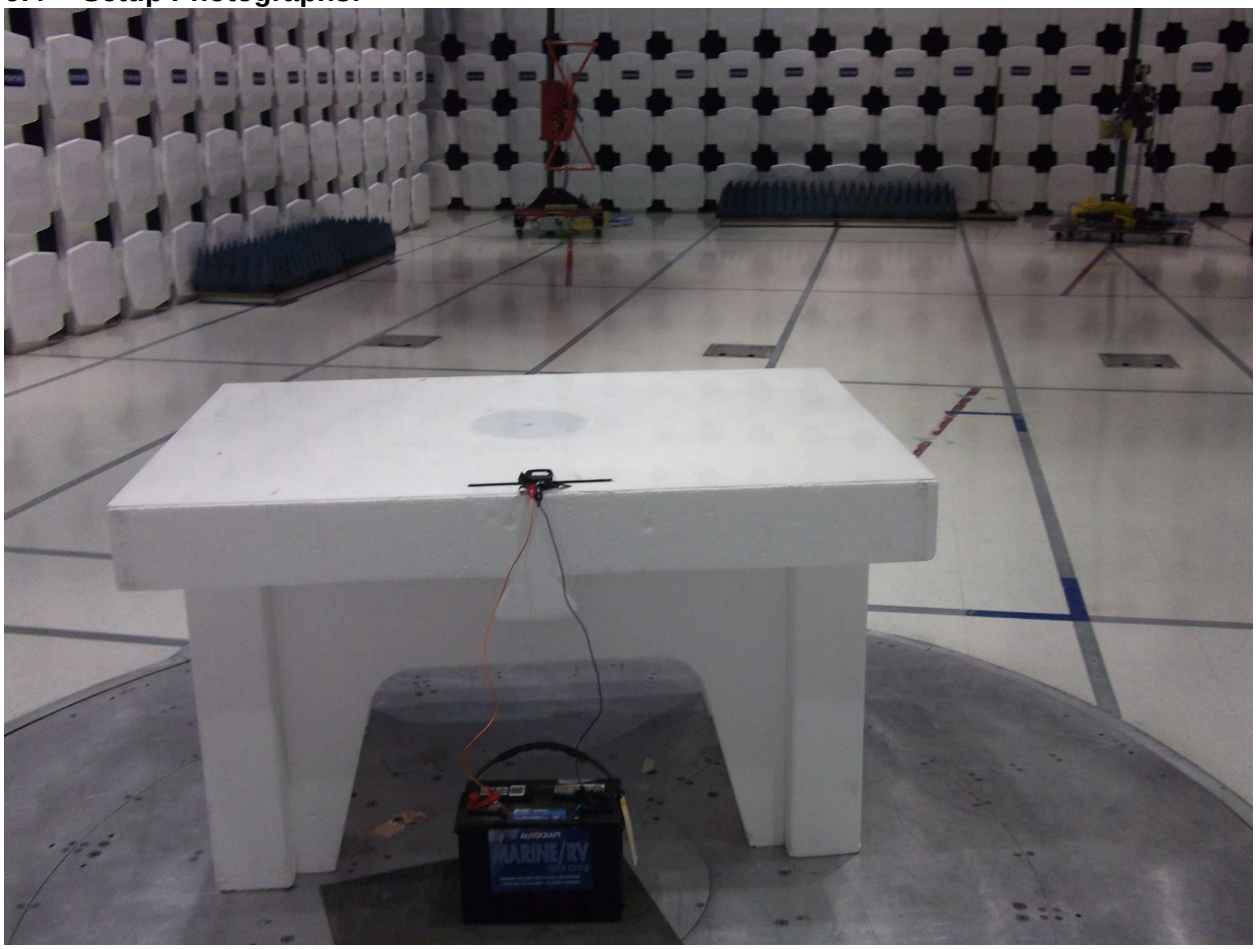
Software Utilized:

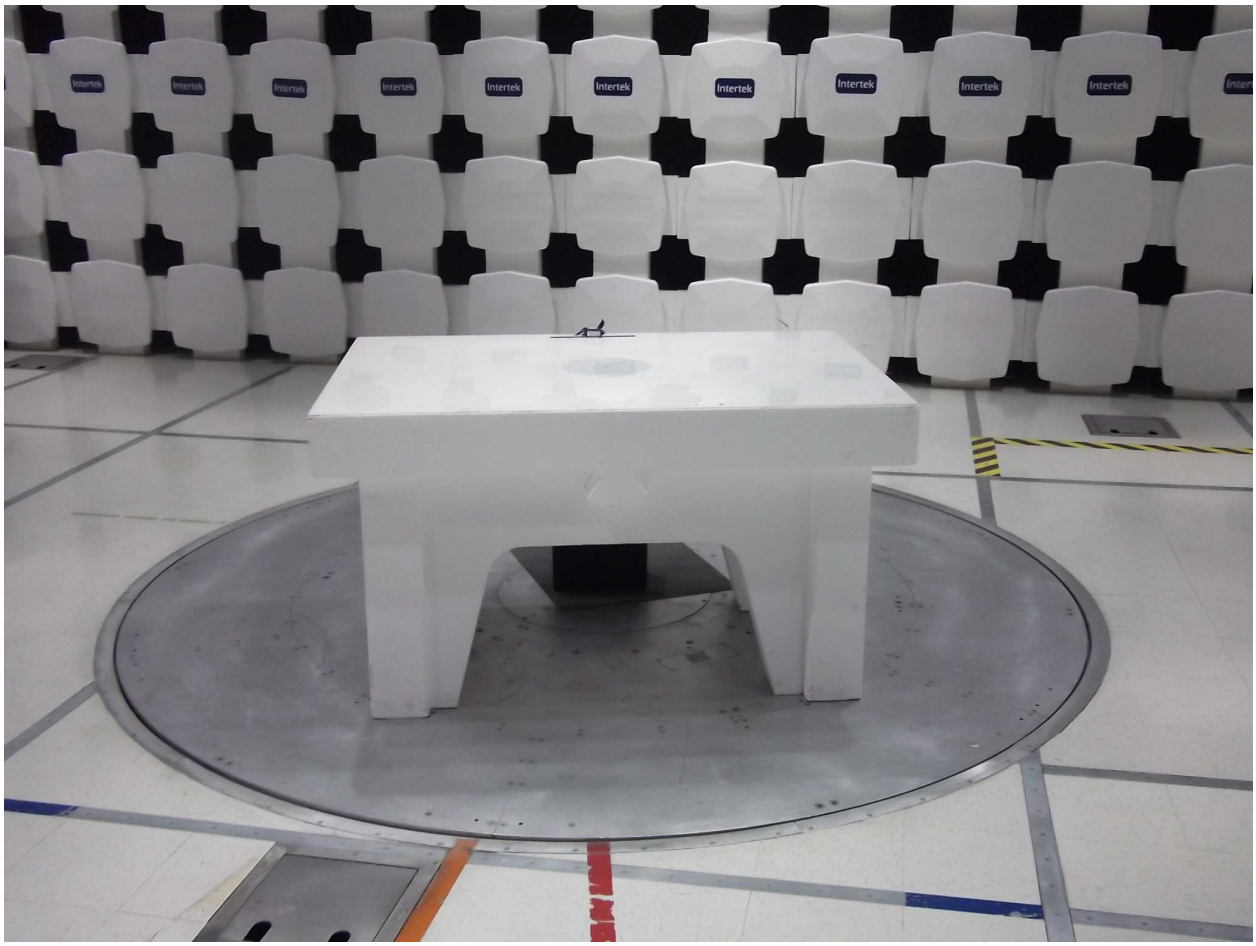
Name	Manufacturer	Version
C5 Emissions	TESEQ	5.26.46.46

9.3 Results:

The sample tested was found to Comply.

9.4 Setup Photographs:



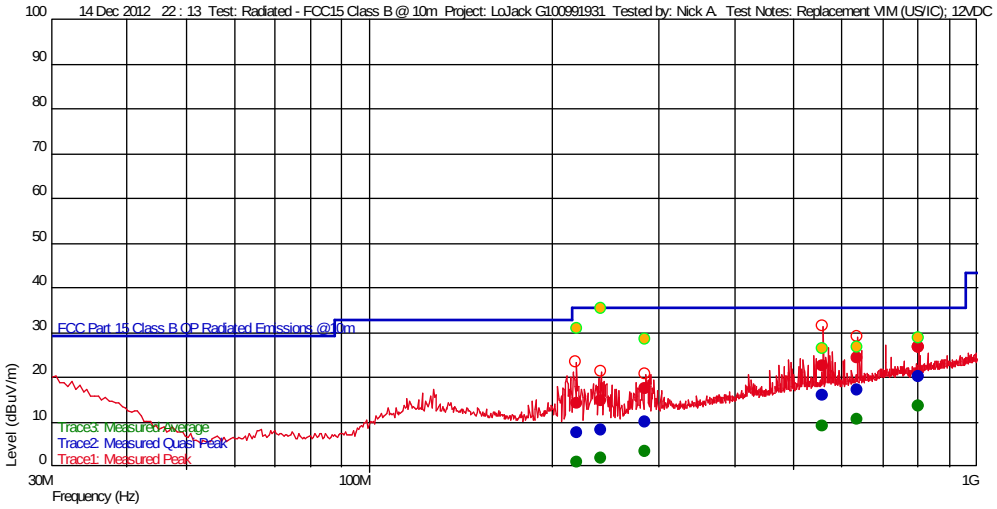

Intertek

9.5 Plots/Data:

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	LoJack G100991931	
Test Notes:	Replacement VIM (US/IC); 12VDC	
Temperature:	22c	
Humidity:	19%, 1010mB	
Tested by:	Nick A.	
Test Started:	14 Dec 2012 22 : 13	

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/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
220.046893671 M	7.53	11.001	-24.294	35.540	-28.01	--	0	1.56	120 k	
240.6368741 M	8.32	11.800	-24.174	35.540	-27.22	|	360	3.44	120 k	
284.711222904 M	9.87	13.600	-24.009	35.540	-25.67	|	360	1.05	120 k	
558.805611273 M	15.87	18.600	-24.427	35.540	-19.67	|	0	2.38	120 k	
635.526052076 M	17.24	19.711	-24.289	35.540	-18.30	|	113	4.00	120 k	
801.182965982 M	20.17	21.424	-23.639	35.540	-15.37	|	360	2.98	120 k	

Test Personnel:	Nicholas Abbondante	Test Date:	12/14/2012
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B IC ICES-003	Test Levels:	See tables
Input Voltage:	12VDC		
Pretest Verification w/ Ambient Signals or BB Source:	**Ambient**	Ambient Temperature:	22 ºC
		Relative Humidity:	19 %
		Atmospheric Pressure:	1010 mbars

Deviations, Additions, or Exclusions: None

10 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	12/28/2012	100991931BOX-002	[illegible]	MFM	Original Issue