EMISSIONS TEST REPORT

Report Number: 100991532BOX-002
Project Number: G100991532

Report Issue Date: December 30, 2012

Product Designation: V7A-SP

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

Kouma Sinn / Sr. Project Engineer, EMC

Report reviewed by

Nicholas Abbondante / Transmitter Staff Engineer

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
--	Receiver Spurious Emissions FCC Part 15:2012 Subpart B Section 15.109 (a) RSS-Gen 3 December 2010, Section 6	Exempt, Below 30 MHz
9	Digital Device Spurious Emissions CFR47 FCC Part 15 Subpart B:2012 IC ICES-003 Issue 5 August 2012	Pass
--	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 Battery
10	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
2.4 GHz Transceiver	LoJack Corporation	V7A-SP	0C03000
2.4 GHz Transceiver	LoJack Corporation	V7A-SP	0A900F2

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

Description of Equipment Under Test (provided by client)
The equipment under test is a 2.4 GHz Transceiver that operates between 2400 MHz and 2483.5 MHz. It utilizes an integral PCB antenna.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
7.2 V (Lithium Battery Pack)	N/A	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Programmed to run on 3 channel, Low (2402 MHz), Mid (2442 MHz), and High (2481 MHz). Used power cycle to step between the three programmed channels. During transmitter testing, the V7A-SP was powered from 7.2VDC and was transmitting repetitively During idle mode testing, the V7A-SP was powered from 7.2VDC and was idle

5 System Setup and Method

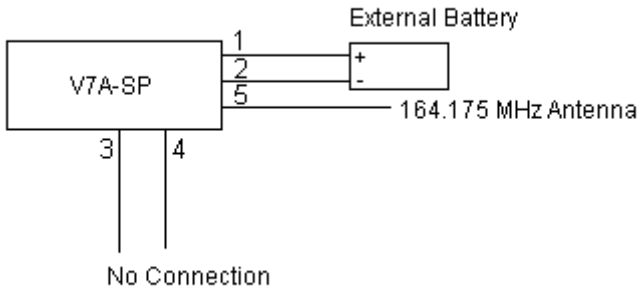
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	External Battery Lead (+)	0.3	None	None	Battery Pack
2	External Battery Lead (-)	0.3	None	None	Battery Pack
3	Ground Lead	0.38	None	None	None
4	Ground Lead	0.38	None	None	None
5	164.175 MHz Antenna	1.03	None	None	None

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None			

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	PE80529A61A	09/25/2012	09/25/2014
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	04/16/2012	04/16/2013
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
ROS002	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	06/13/2012	06/13/2013
CBLBNC2012-2	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-2	09/14/2012	09/14/2013

Software Utilized:

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

6.3 Results:

The sample tested was found to Comply.

FCC 47CFR Part 15.249 and RSS-210 Annex 2.9

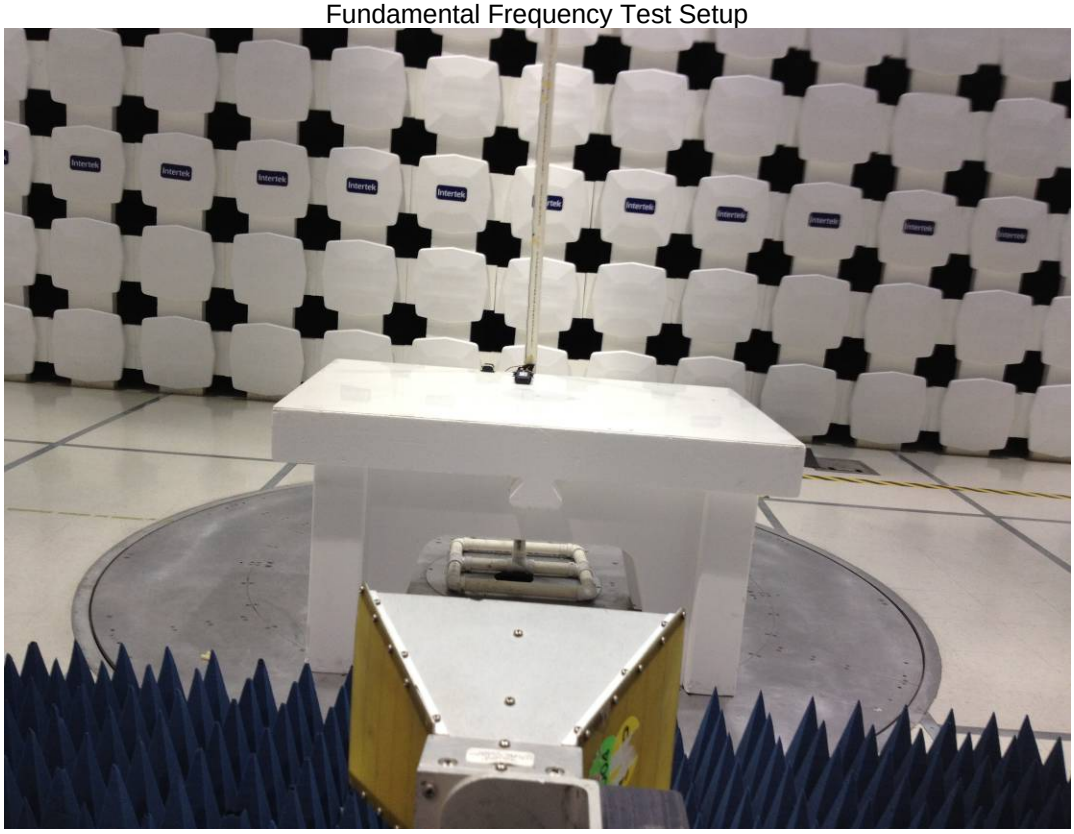
The field strength of emissions from intentional radiators operated within this frequency band shall comply with the following:

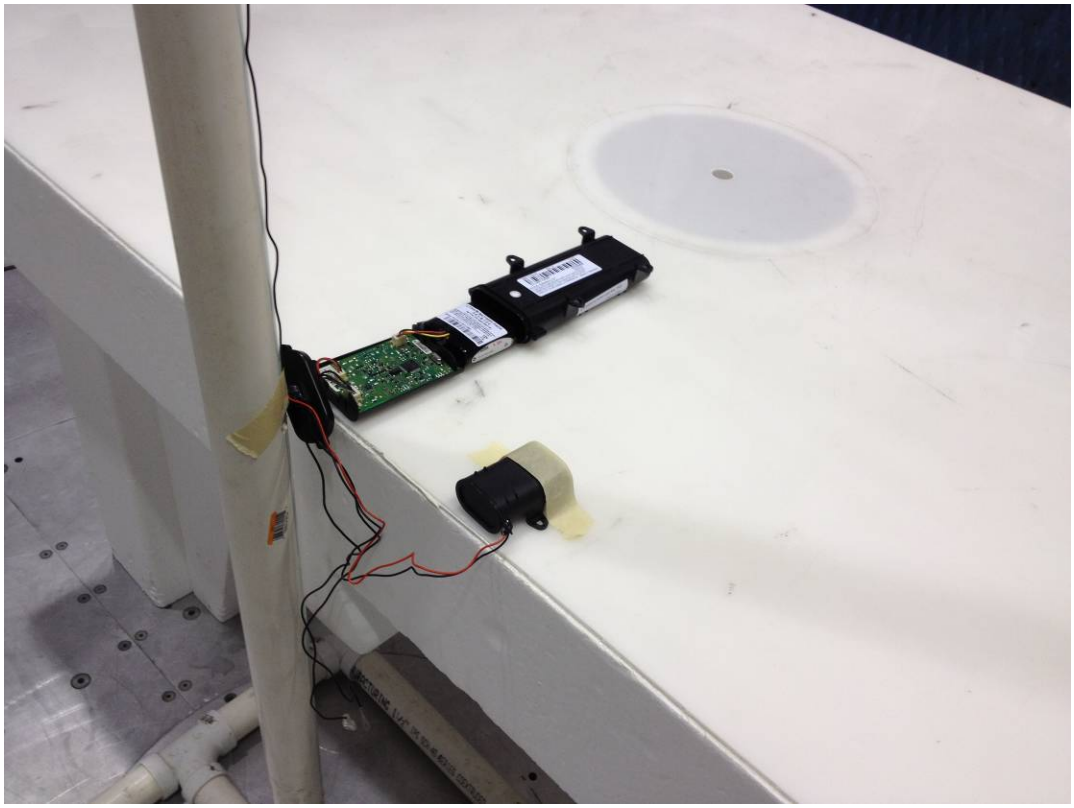
Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)
2400-2483.5	50

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

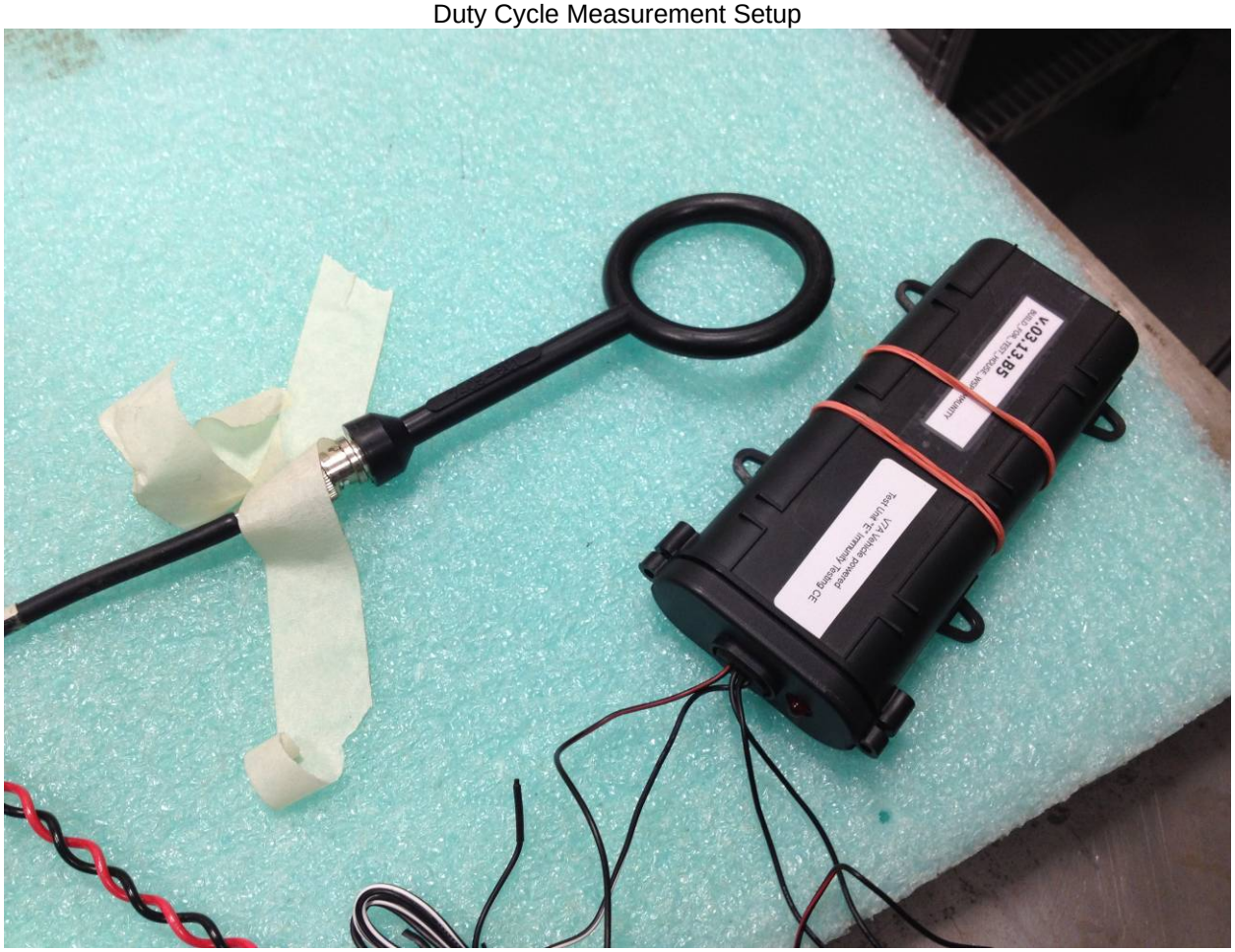
6.4 Setup Photographs:

Fundamental Frequency Test Setup





Duty Cycle Measurement Setup



6.5 Test Data:

Radiated Emissions

Company: LoJack | Antenna & Cables: N | Bands: N, LF, HF, SHF
Model #: V7A-SP | Antenna: HORN3 V3m 04-16-2013.txt | HORN3 H3m 04-16-2013.txt
Serial #: 0C03000 | Cable(s): 145-416 3mTrkB 10-04-2013.txt | NONE.
Engineers: Kouma Sinn | Location: 10m Chamber | Barometer: DAV003 | Filter:
Project #: G100991532 | Date(s): 12/17/12
Standard: FCC Part 15 Subpart C, Section 15.249, RSS-210 Annex 2.9 | Temp/Humidity/Pressure: 21C | 17% | 1015mbar
Receiver: 145-128 09-28-2013 | Limit Distance (m): 3
PreAmp: PRE145014 12-13-2013.txt | Test Distance (m): 3
PreAmp Used? (Y or N): N | Voltage/Frequency: Battery powered | Frequency Range: See below
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

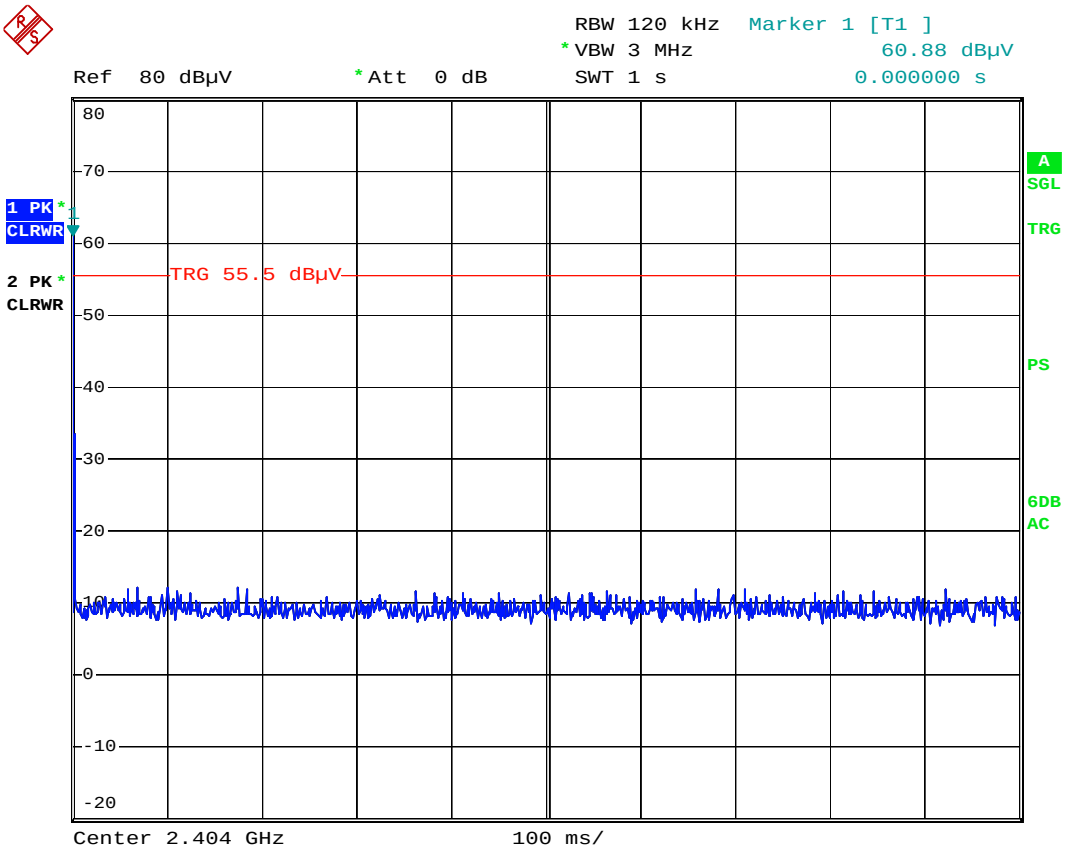
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
Low channel, 2402 MHz, at 3 meters with no pre-amp													
MaxH PK	H	2402.000	63.96	28.56	5.85	0.00	0.00	98.37	114.00	-15.63	1/3MHz		
AVG	H	2402.000	22.96	28.56	5.85	0.00	0.00	57.37	94.00	-36.63	1/3MHz		
MaxH PK	V	2402.000	56.79	28.72	5.85	0.00	0.00	91.36	114.00	-22.64	1/3MHz		
AVG	V	2402.000	15.79	28.72	5.85	0.00	0.00	50.36	94.00	-43.64	1/3MHz		
Mid channel, 2442 MHz, at 3 meters with no pre-amp													
MaxH PK	H	2442.000	62.30	28.71	5.91	0.00	0.00	96.92	114.00	-17.08	1/3MHz		
AVG	H	2442.000	21.30	28.71	5.91	0.00	0.00	55.92	94.00	-38.08	1/3MHz		
MaxH PK	V	2442.000	50.98	28.83	5.91	0.00	0.00	85.72	114.00	-28.28	1/3MHz		
AVG	V	2442.000	9.98	28.83	5.91	0.00	0.00	44.72	94.00	-49.28	1/3MHz		
High channel, 2481 MHz, at 3 meters with no pre-amp													
MaxH PK	H	2481.000	69.54	28.85	5.97	0.00	0.00	104.36	114.00	-9.64	1/3MHz		
AVG	H	2481.000	28.54	28.85	5.97	0.00	0.00	63.36	94.00	-30.64	1/3MHz		
MaxH PK	V	2481.000	46.96	28.94	5.97	0.00	0.00	81.87	114.00	-32.13	1/3MHz		
AVG	V	2481.000	5.96	28.94	5.97	0.00	0.00	40.87	94.00	-53.13	1/3MHz		
AVG = MaxH PK - 41 dB (average factor)													

Test Personnel: Kouma Sinn KPS | Test Date: 12/17/2012
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC 15.249, RSS-210 Annex 2.9 | Test Levels: Per standard
Input Voltage: 7.2V Battery powered
Pretest Verification w/ Ambient Signals or BB Source: Ambient Signals | Ambient Temperature: 21 ºC | Relative Humidity: 17% | Atmospheric Pressure: 1015 mbars

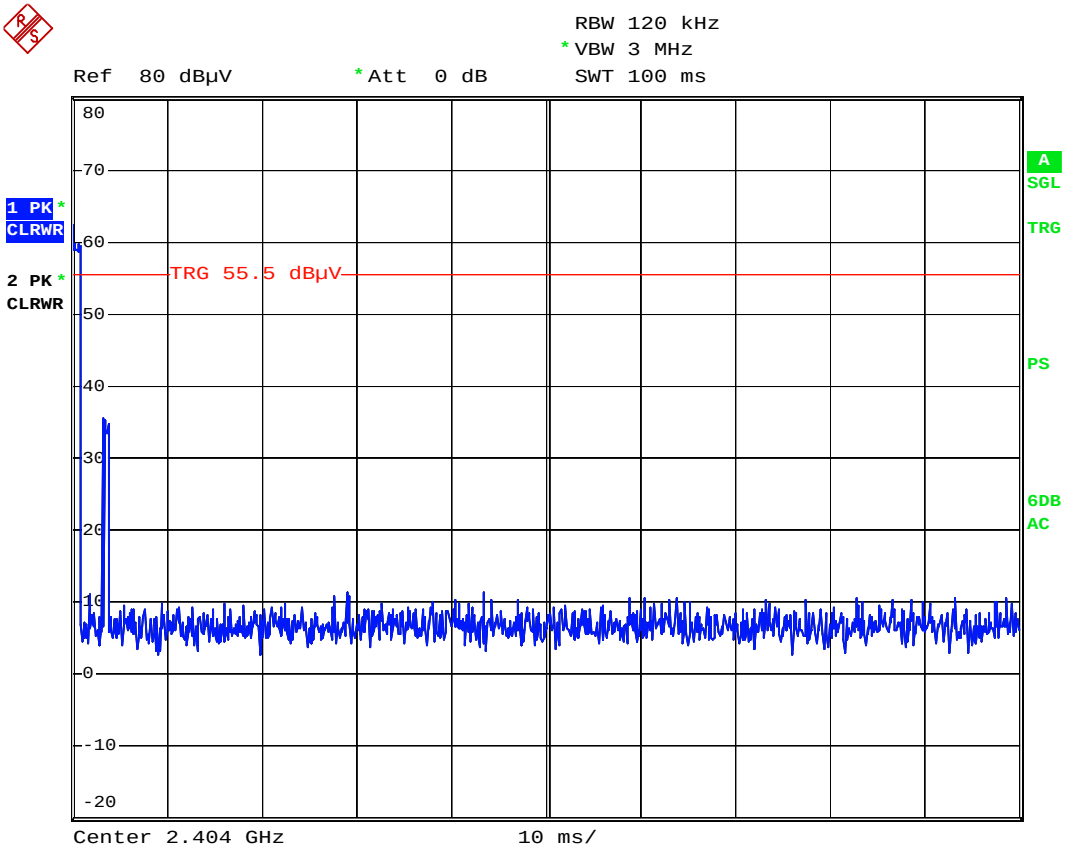
Deviations, Additions, or Exclusions: None

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

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

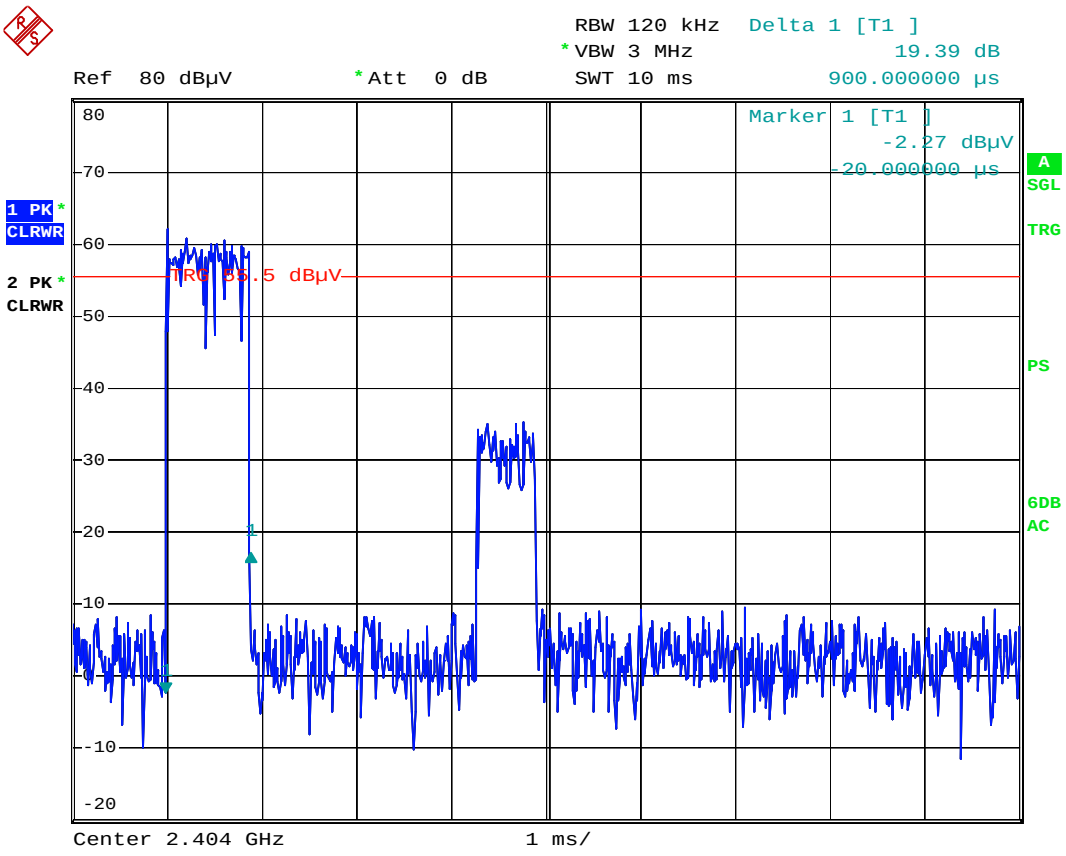


Date: 18.DEC.2012 18:42:58



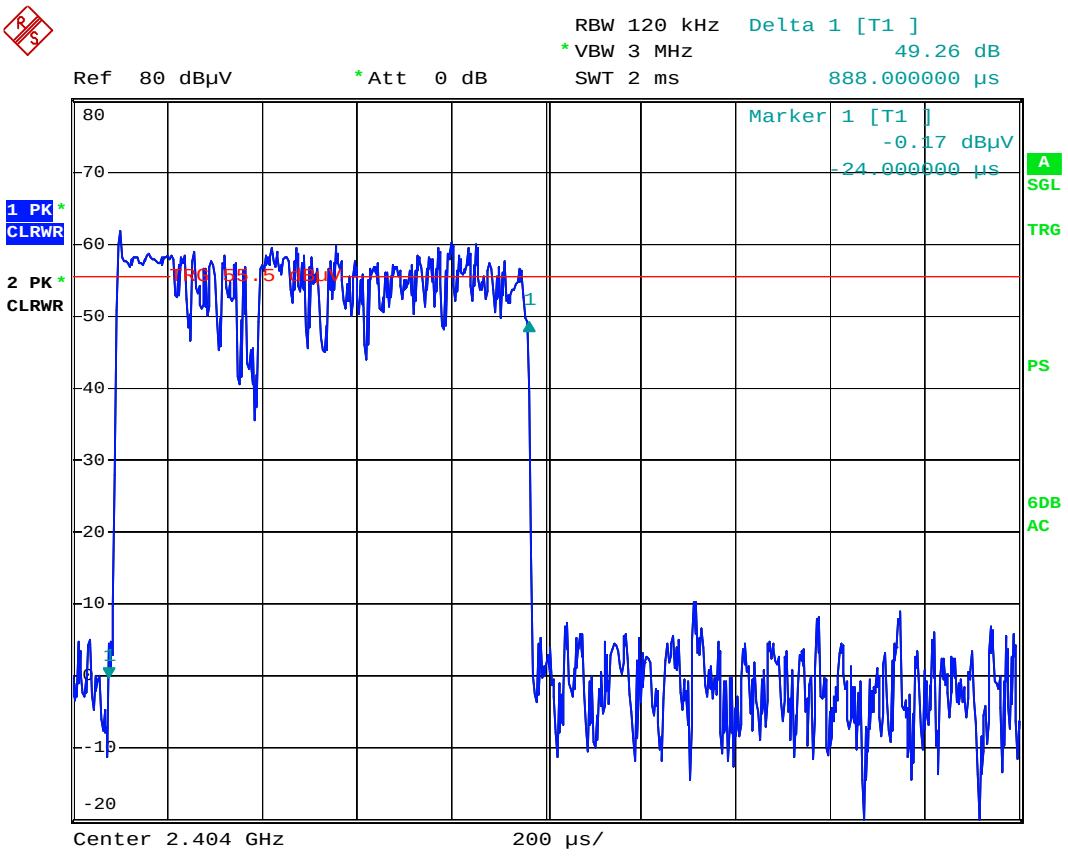
Date: 18.DEC.2012 18:42:12

The lower amplitude signal is a reply from a support unit.



Date: 18.DEC.2012 18:35:06

The lower amplitude signal is a reply from a support unit.



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

Test Personnel:	Kouma Sinn KPS	Test Date:	12/17/2012
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.249, RSS-210 Annex 2.9	Test Levels:	N/A
Input Voltage:	7.2 V Battery Powered	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
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	08/28/2012	08/28/2014
MEG005'	High Frequency Cable	Megaphase	TM40-K1K1-197	8148601-001	02/07/2012	02/07/2013
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	02/10/2012	02/10/2013
148012'	Temp/Humidity Chamber	Envirotronics	SH27C	08015563S11263	10/18/2012	10/18/2013

Software Utilized:

Name	Manufacturer	Version
None		

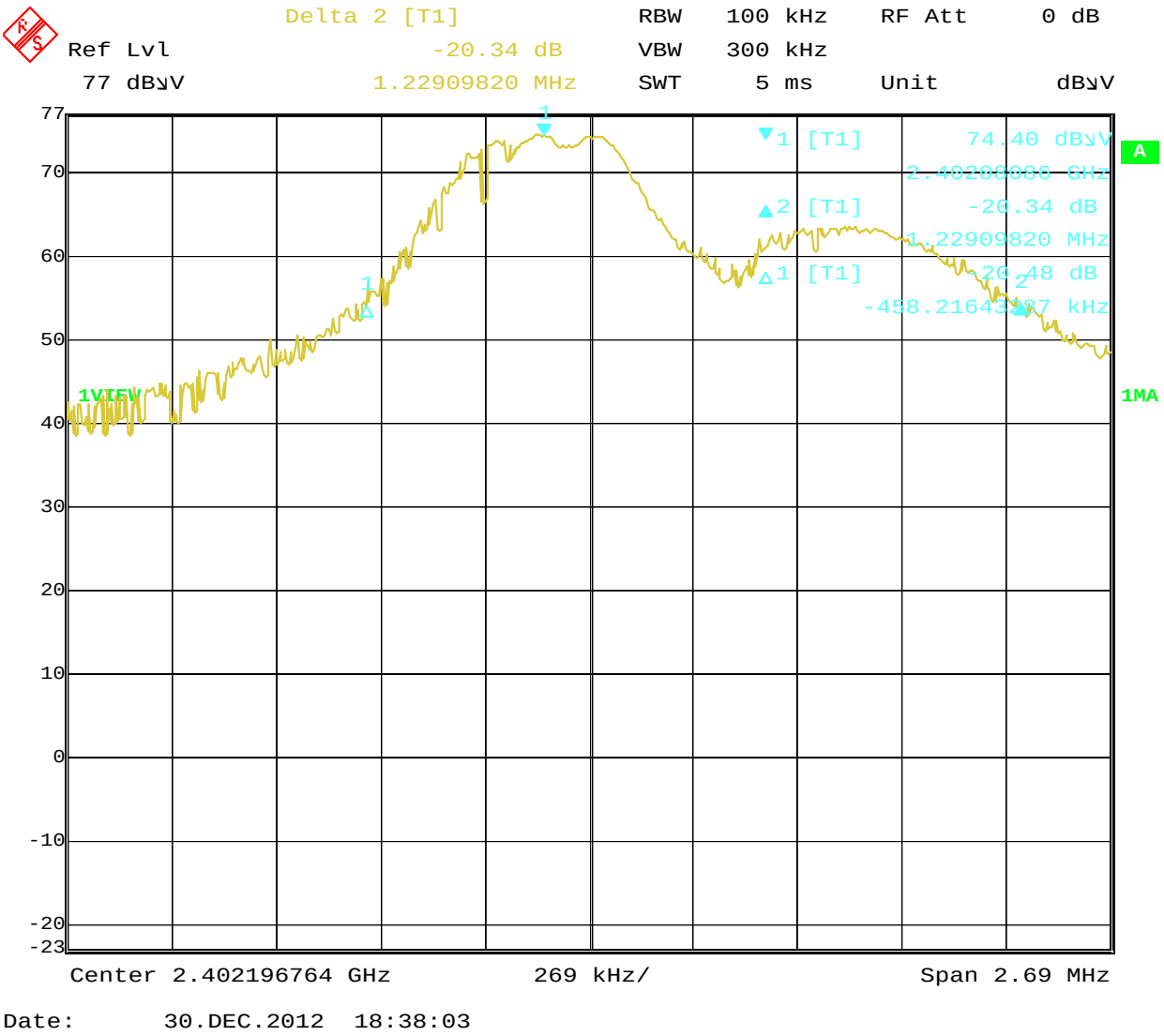
7.3 Results:

The sample tested was found to Comply.

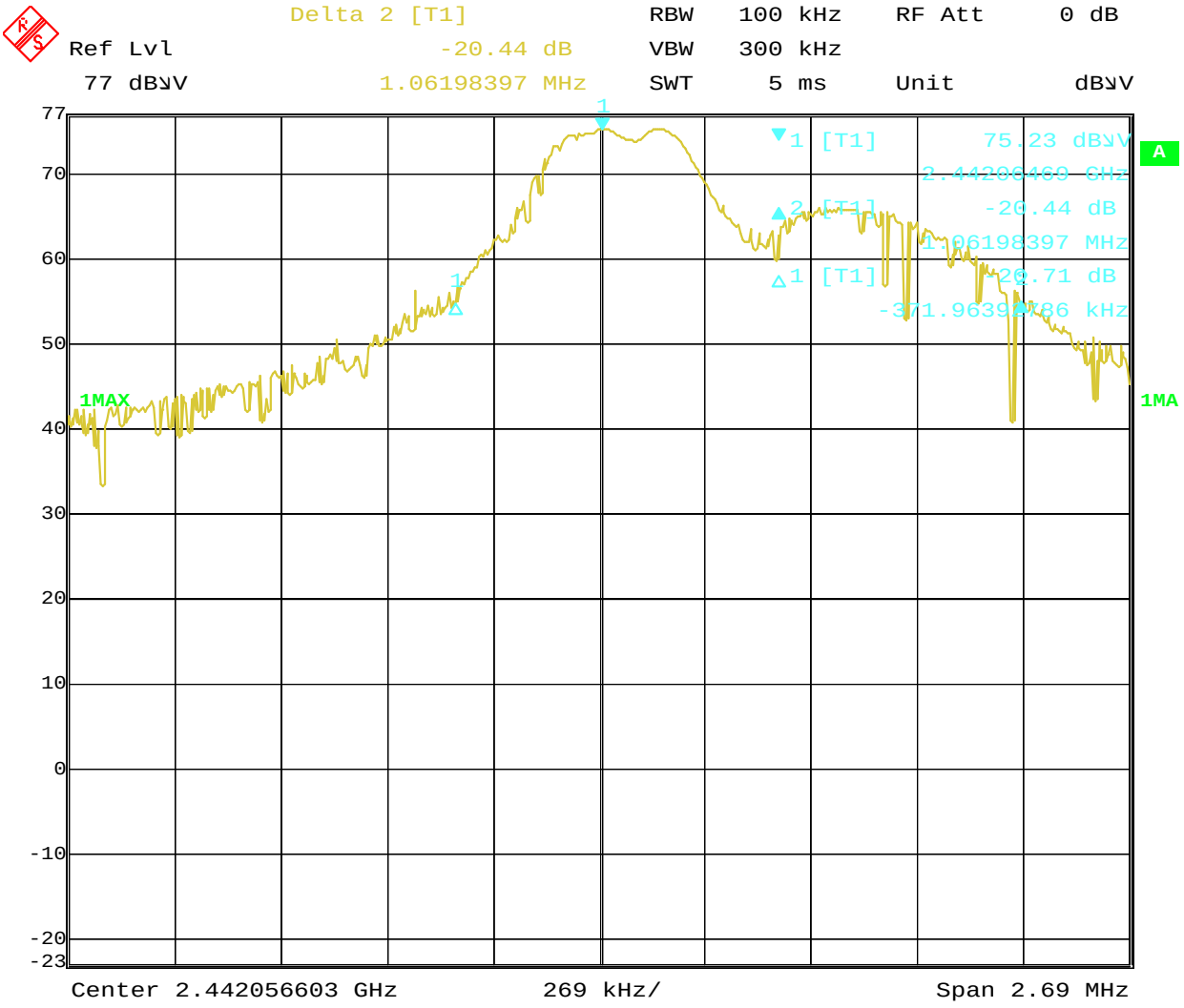
7.4 Setup Photograph:

7.5 Plots/Data:

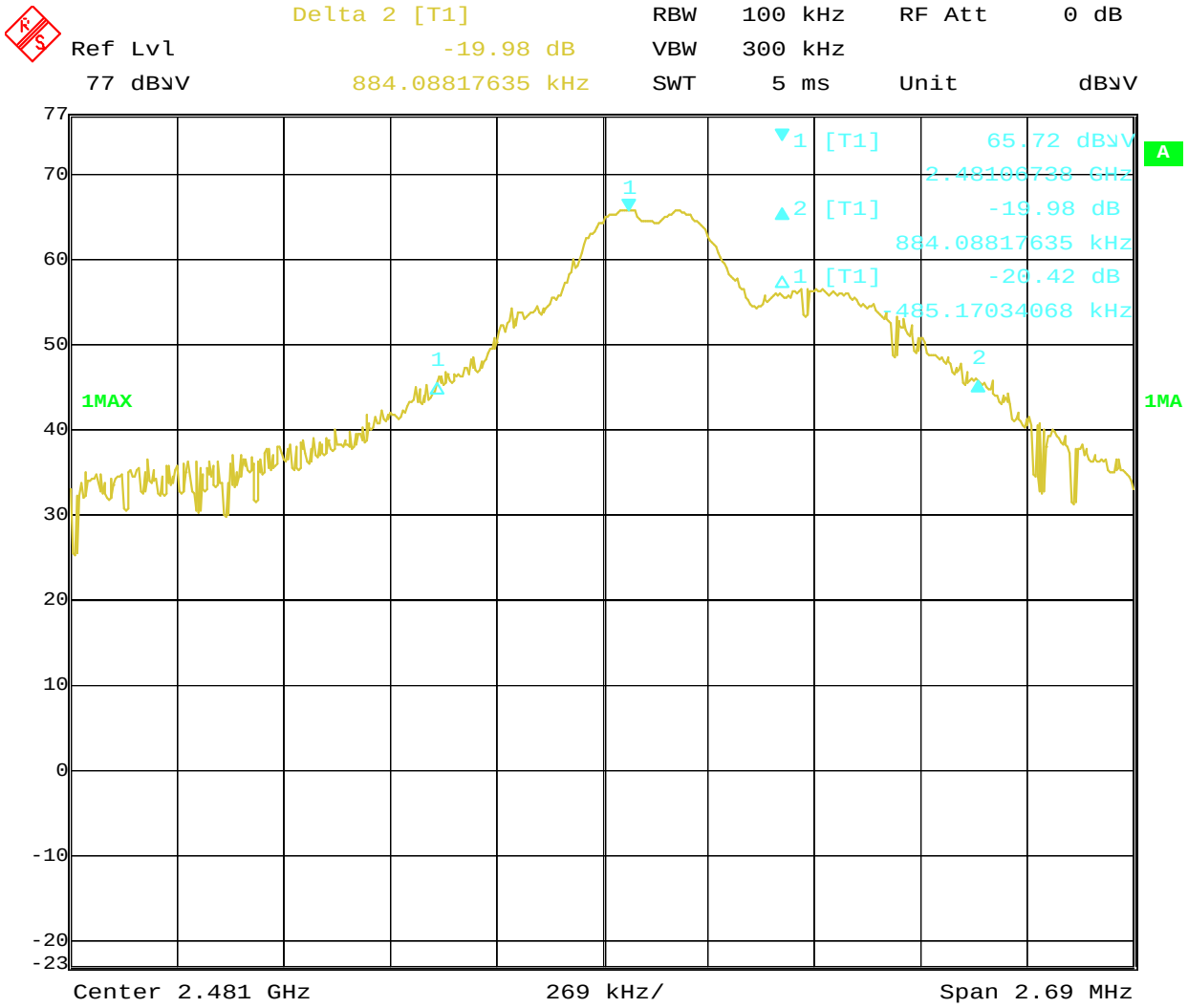
Channel 11, 2402 MHz,



Channel 18, 2442 MHz



Channel 26, 2481 MHz,



Test Personnel:	Kouma Sinn KPS	Test Date:	12/30/2012
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:	7.2V Battery Powered	Ambient Temperature:	21 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**Ambient**	Relative Humidity:	10 %
		Atmospheric Pressure:	996 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
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	02/08/2012	02/08/2013
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	02/08/2012	02/08/2013
MEG005'	High Frequency Cable	Megaphase	TM40-K1K1-197	8148601-001	02/07/2012	02/07/2013
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	09/25/2012	09/25/2014
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	02/10/2012	02/10/2013
PRE9'	100MHz-40GHz Preamp	MITEQ	NSP4000-NFG	1260417	06/28/2012	06/28/2013
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	04/16/2012	04/16/2013
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/04/2012	09/04/2013
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	09/28/2012	09/28/2013
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
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	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
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/13/2012	12/13/2013

Software Utilized:

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

8.3 Results:

The sample tested was found to Comply.

FCC 47CFR Part 15.249 and RSS-210 Annex 2.9

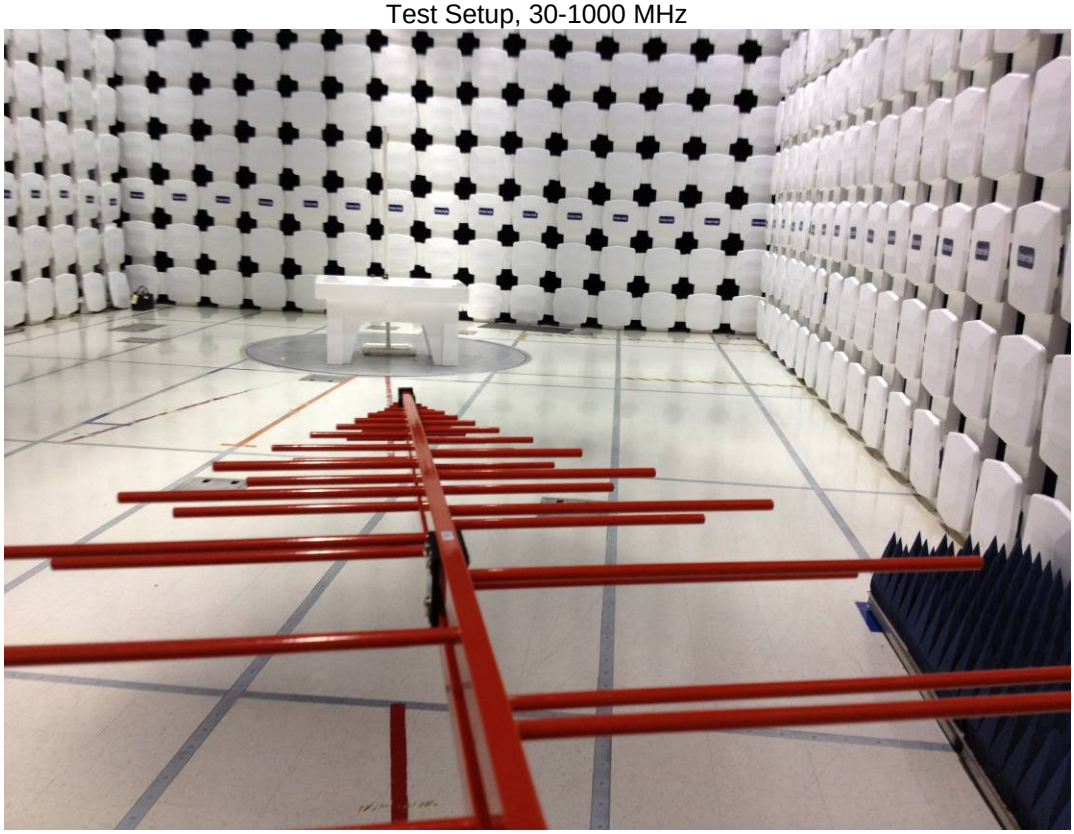
The emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to general radiated emission limits specified in 15.209 and RSS-Gen, whichever is lesser attenuation.

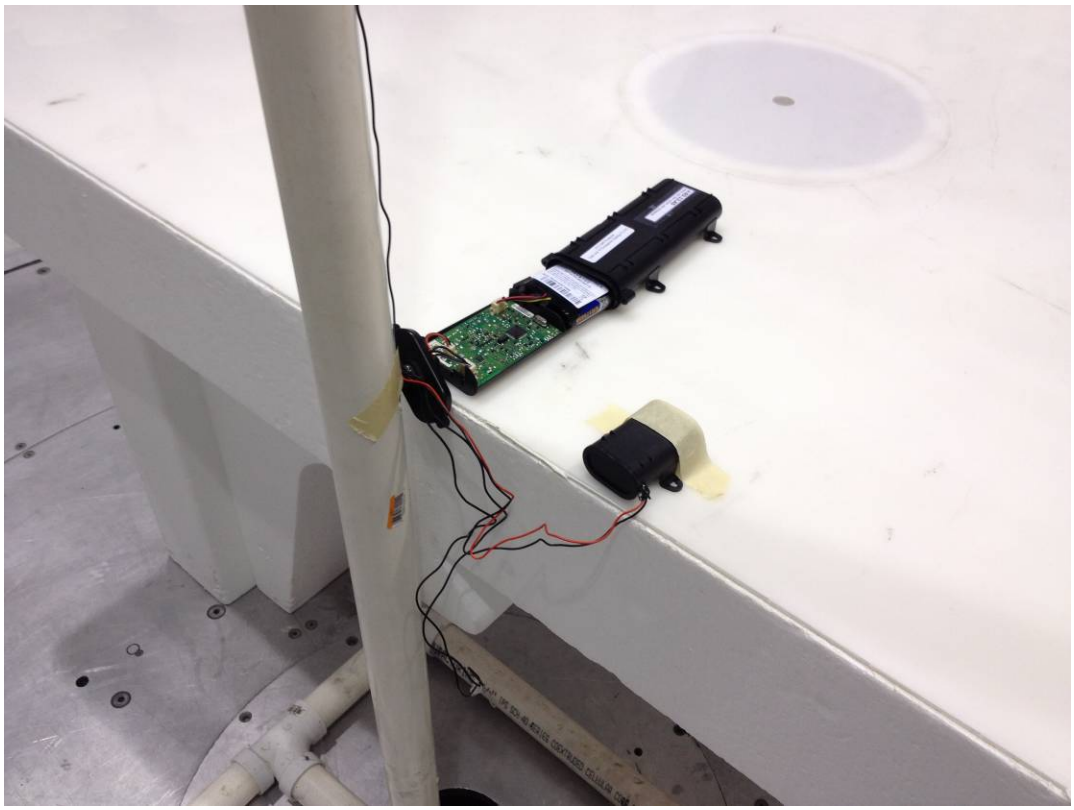
Fundamental frequency (MHz)	Field strength of harmonics (microvolts/meter)
2400-2483.5	500

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

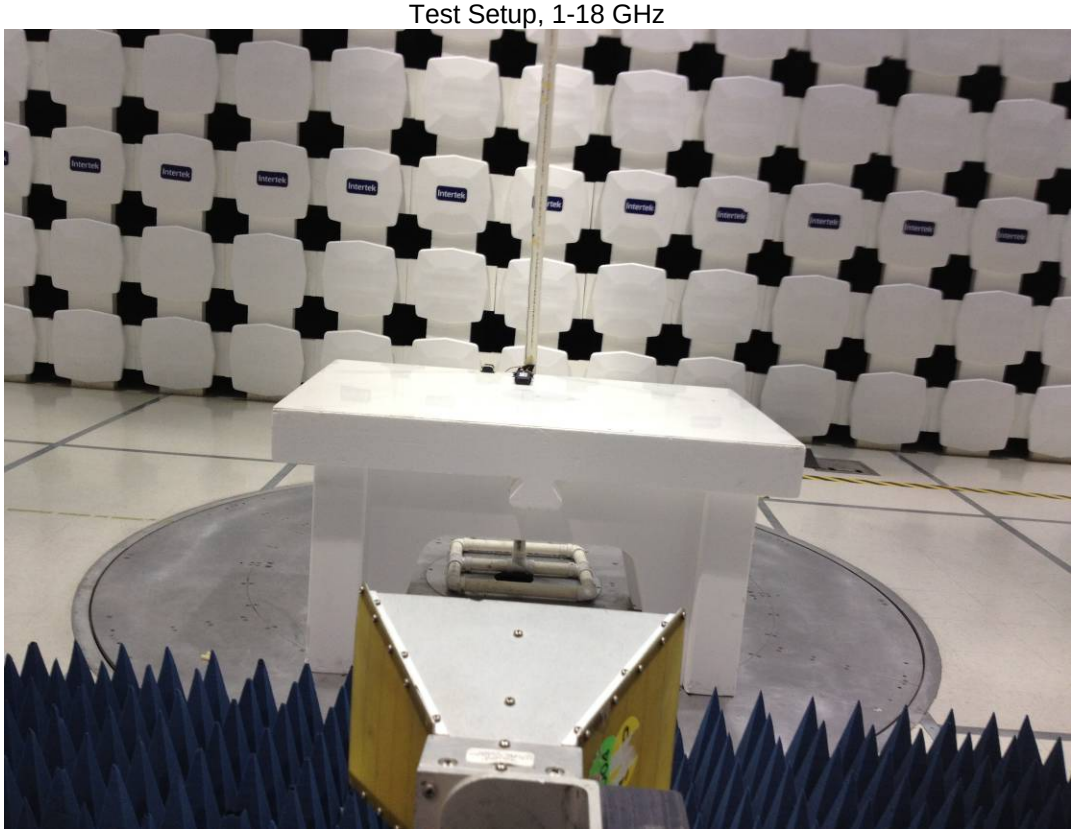
8.4 Setup Photographs:

Test Setup, 30-1000 MHz

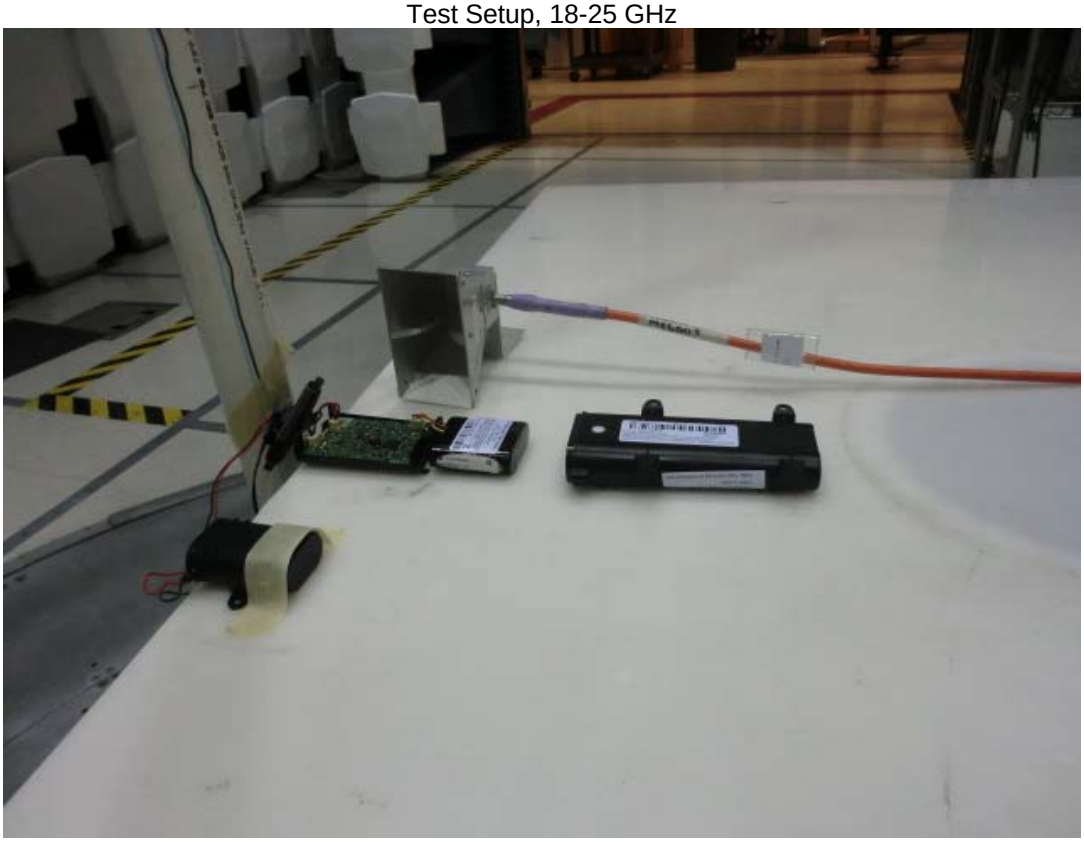




Test Setup, 1-18 GHz



Test Setup, 18-25 GHz



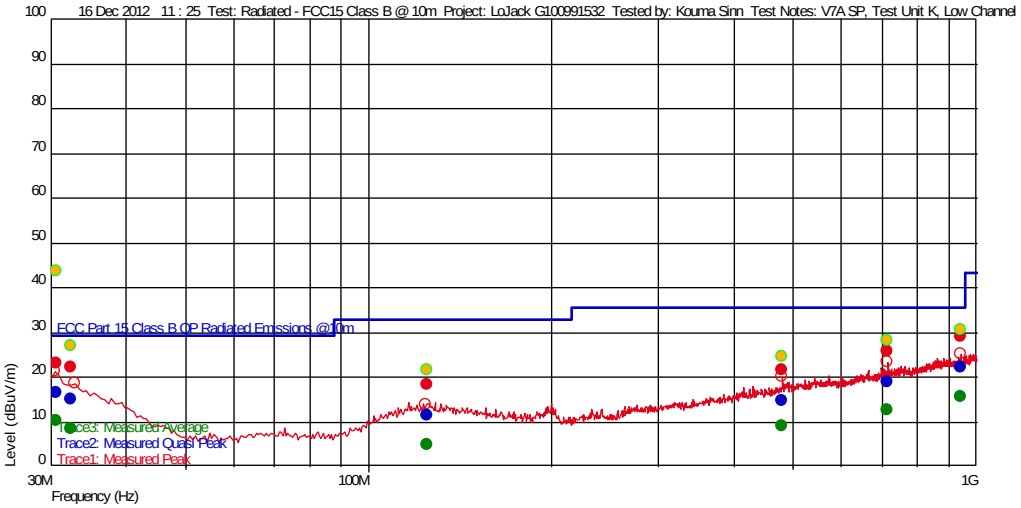
8.5 Plots/Data:

30-1000 MHz (Low Channel, 2402 MHz)

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	LoJack G100991532	
Test Notes:	V7A SP, Test Unit K, Low Channel	
Temperature:	21C	
Humidity:	17%, 1015mbar	
Tested by:	Kouma Sinn	
Test Started:	16 Dec 2012 11 : 25	

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

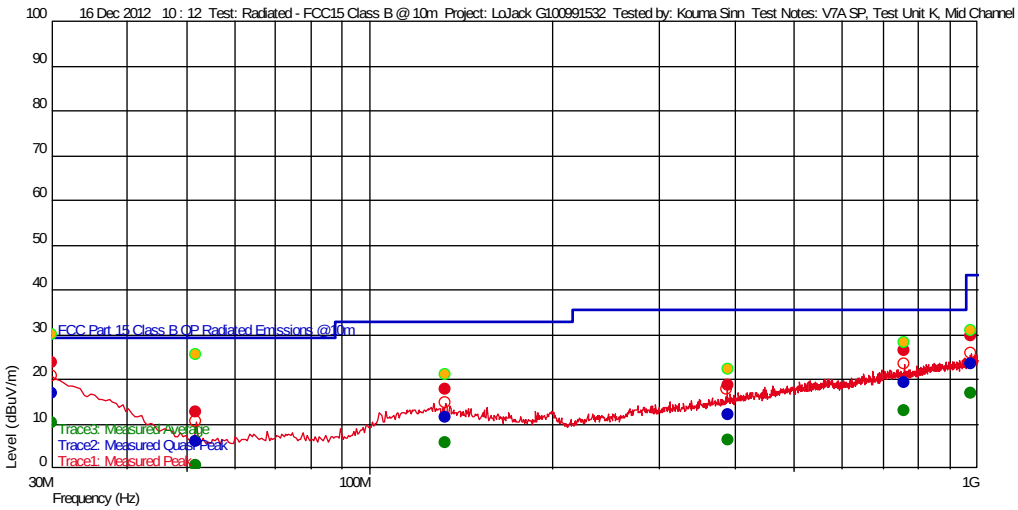
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
124.757915717 M	11.61	14.052	-25.257	33.040	-21.43	--	206	3.78	120 k	
479.677154212 M	14.66	17.887	-24.443	35.540	-20.88	|	218	1.75	120 k	
715.56032076 M	19.10	20.611	-23.789	35.540	-16.44	--	113	3.28	120 k	
32.436473283 M	15.12	19.494	-26.421	29.540	-14.42	--	335	1.15	120 k	
941.757314952 M	22.30	22.700	-22.785	35.540	-13.24	|	149	3.86	120 k	
30.748897852 M	16.45	20.626	-26.448	29.540	-13.09	|	228	3.86	120 k	

30-1000 MHz (Mid Channel, 2442 MHz)

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	LoJack G100991532	
Test Notes:	V7A SP, Test Unit K, Mid Channel	
Temperature:	21C	
Humidity:	17%, 1015mbar	
Tested by:	Kouma Sinn	
Test Started:	16 Dec 2012 10 : 12	

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

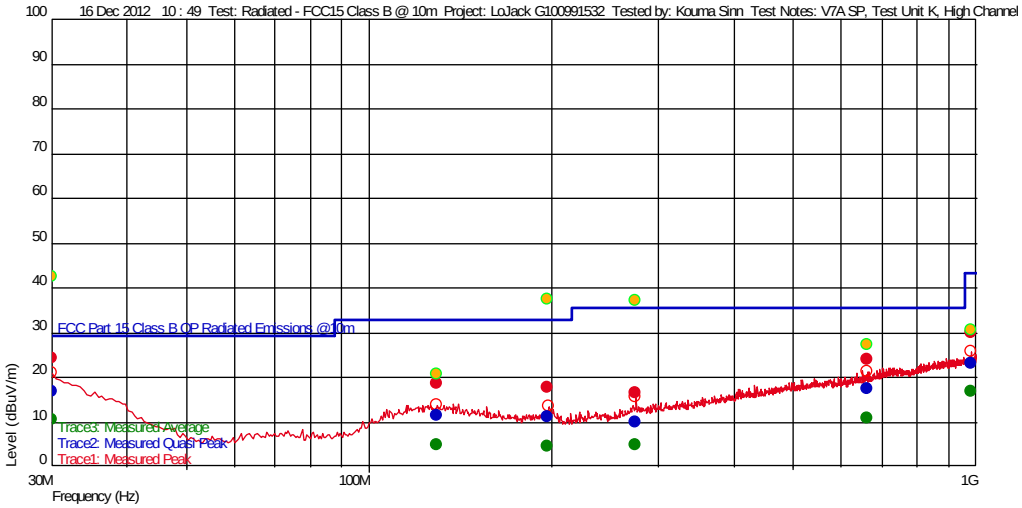
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver (|)	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
51.949698924 M	6.10	7.215	-26.133	29.540	-23.44	|	190	3.81	120 k	
388.861924202 M	12.17	15.277	-24.059	35.540	-23.37	--	320	2.49	120 k	
133.615430814 M	11.42	13.777	-25.177	33.040	-21.62	|	31	2.46	120 k	
977.805611641 M	23.31	22.944	-22.558	43.540	-20.23	|	268	1.45	120 k	
757.661122244 M	19.33	20.900	-23.616	35.540	-16.21	--	276	2.52	120 k	
30.0 M	17.00	21.300	-26.460	29.540	-12.54	|	262	3.73	120 k	

30-1000 MHz (High Channel, 2481 MHz)

Test Information

Test Details	User Entry	Additional Information
Test:	Radiated - FCC15 Class B @ 10m	
Project:	LoJack G100991532	
Test Notes:	V7A SP, Test Unit K, High Channel	
Temperature:	21C	
Humidity:	17%, 1015mbar	
Tested by:	Kouma Sinn	
Test Started:	16 Dec 2012 10 : 49	

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
275.27074182 M	9.89	13.505	-24.039	35.540	-25.65	|	325	1.05	120 k	
197.223447253 M	11.12	12.545	-24.444	33.040	-21.92	|	8	2.27	120 k	
129.422243992 M	11.45	13.958	-25.215	33.040	-21.59	|	98	1.25	120 k	
980.004809375 M	23.28	22.900	-22.540	43.540	-20.26	--	125	3.68	120 k	
663.97996009 M	17.52	19.820	-24.122	35.540	-18.02	|	90	1.45	120 k	
30.14749499 M	16.87	21.167	-26.458	29.540	-12.67	--	226	4.00	120 k	

1-25 GHz (Low Channel, 2402 MHz)

Radiated Emissions

Company: LoJack
Model #: V7A-SP
Serial #: 0C03000
Engineers: Kouma Sinn
Project #: G100991532
Date(s): 12/17/12
Standard: FCC Part 15 Subpart C, Section 15.249, RSS-210 Annex 2.9
Receiver: 145-128 09-28-2013
PreAmp: PRE145014 12-13-2013.txt
Location: 10m Chamber
Limit Distance (m): 3
Test Distance (m): 3
PreAmp Used? (Y or N): Y
Voltage/Frequency: Battery powered
Antenna & Cables: N
Antenna: HORN3 V3m 04-16-2013.txt
Cable(s): 145-416 3mTrkB 10-04-2013.txt
Barometer: DAV003
Temp/Humidity/Pressure: 21C 17%
Bands: N, LF, HF, SHF
HORN3 H3m 04-16-2013.txt
NONE.
Filter: REA004
PRE9 CBL030 REA006
EMC04 MEG05 ROS001
Frequency Range: See below

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
Low channel, 2402 MHz, at 3 meters with pre-amp (145014) and filter (REA004), 1-18 GHz.													
MaxH PK	H	4804.000	49.52	33.30	8.58	34.68	0.00	56.72	74.00	-17.28	1/3MHz	RB	RB
AVG	H	4804.000	8.52	33.30	8.58	34.68	0.00	15.72	54.00	-38.28	1/3MHz	RB	RB
MaxH PK	H	7206.000	43.26	36.10	10.91	34.60	0.00	55.67	74.00	-18.33	1/3MHz		
AVG	H	7206.000	2.26	36.10	10.91	34.60	0.00	14.67	54.00	-39.33	1/3MHz		
MaxH PK	V	9608.000	36.41	39.04	12.67	35.22	0.00	52.89	74.00	-21.11	1/3MHz	NF	
AVG	V	9608.000	26.69	39.04	12.67	35.22	0.00	43.17	74.00	-30.83	1/3MHz	NF	
MaxH PK	V	12010.000	35.34	39.64	15.02	36.23	0.00	53.77	74.00	-20.23	1/3MHz	RB, NF	RB
AVG	V	12010.000	25.29	39.64	15.02	36.23	0.00	43.72	54.00	-10.28	1/3MHz	RB, NF	RB
MaxH PK	V	14412.000	34.29	43.46	15.16	34.45	0.00	58.46	74.00	-15.54	1/3MHz	NF	
AVG	V	14412.000	24.47	43.46	15.16	34.45	0.00	48.64	54.00	-5.36	1/3MHz	NF	
MaxH PK	V	16814.000	34.56	40.06	17.58	34.64	0.00	57.56	74.00	-16.44	1/3MHz	NF	
AVG	V	16814.000	23.69	40.06	17.58	34.64	0.00	46.69	54.00	-7.31	1/3MHz	NF	
AVG = MaxH PK - 41 dB (average factor), no average factor was applied for noise floor readings													
Hand scans were performed from 18-25 GHz at a distance of less than 10cm, no emissions were detected above the measuring equipment noise floor.													

1-25 GHz (Mid Channel, 2442 MHz)

Radiated Emissions

Company: LoJack
Model #: V7A-SP
Serial #: 0C03000
Engineers: Kouma Sinn
Project #: G100991532
Date(s): 12/17/12
Standard: FCC Part 15 Subpart C, Section 15.249, RSS-210 Annex 2.9
Receiver: 145-128 09-28-2013
PreAmp: PRE145014 12-13-2013.txt
Location: 10m Chamber
Limit Distance (m): 3
Test Distance (m): 3
Antenna & Cables: N
Antenna: HORN3 V3m 04-16-2013.txt
Cable(s): 145-416 3mTrkB 10-04-2013.txt
Barometer: DAV003
Temp/Humidity/Pressure: 21C
Bands: N, LF, HF, SHF
HORN3 H3m 04-16-2013.txt
NONE.
Filter: REA004
PRE9
CBL030
REA006
EMC04
MEG05
ROS001

PreAmp Used? (Y or N): Y
Voltage/Frequency: Battery powered
Frequency Range: See below

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
Mid channel, 2442 MHz, at 3 meters with pre-amp (145014) and filter (REA004), 1-18 GHz.													
MaxH PK	H	4884.000	48.74	33.44	8.67	34.67	0.00	56.18	74.00	-17.82	1/3MHz	RB	RB
AVG	H	4884.000	7.74	33.44	8.67	34.67	0.00	15.18	54.00	-38.82	1/3MHz	RB	RB
MaxH PK	H	7326.000	43.68	36.72	11.07	34.53	0.00	56.94	74.00	-17.06	1/3MHz	RB	RB
AVG	H	7326.000	2.68	36.72	11.07	34.53	0.00	15.94	54.00	-38.06	1/3MHz	RB	RB
MaxH PK	V	9768.000	37.06	39.52	13.05	35.66	0.00	53.97	74.00	-20.03	1/3MHz	NF	
AVG	V	9768.000	26.70	39.52	13.05	35.66	0.00	43.61	54.00	-10.39	1/3MHz	NF	
MaxH PK	V	12210.000	36.01	39.35	14.82	36.44	0.00	53.75	74.00	-20.25	1/3MHz	RB, NF	RB
AVG	V	12210.000	25.60	39.35	14.82	36.44	0.00	43.34	74.00	-30.66	1/3MHz	RB, NF	RB
MaxH PK	V	14652.000	35.04	43.62	15.26	34.61	0.00	59.31	74.00	-14.69	1/3MHz	NF	
AVG	V	14652.000	24.98	43.62	15.26	34.61	0.00	49.25	54.00	-4.75	1/3MHz	NF	
MaxH PK	V	17094.000	34.15	41.57	18.79	34.39	0.00	60.13	74.00	-13.87	1/3MHz	NF	
AVG	V	17094.000	23.70	41.57	18.79	34.39	0.00	49.68	54.00	-4.32	1/3MHz	NF	
AVG = MaxH PK - 41 dB (average factor), no average factor was applied for noise floor readings													
Hand scans were performed from 18-25 GHz at a distance of less than 10cm, no emissions were detected above the measuring													
equipment noise floor.													

1-25 GHz (High Channel, 2481 MHz)

Radiated Emissions

Company: LoJack | Antenna & Cables: N | Bands: N, LF, HF, SHF
Model #: V7A-SP | Antenna: HORN3 V3m 04-16-2013.txt | HORN3 H3m 04-16-2013.txt | PRE9 | EMC04
Serial #: 0C03000 | Cable(s): 145-416 3mTrkB 10-04-2013.txt | NONE. | CBL030 | MEG05
Engineers: Kouma Sinn | Location: 10m Chamber | Barometer: DAV003 | Filter: REA004 | REA006 | ROS001
Project #: G100991532 | Date(s): 12/17/12
Standard: FCC Part 15 Subpart C, Section 15.249, RSS-210 Annex 2.9 | Temp/Humidity/Pressure: 21C | 17% | 1015mbar
Receiver: 145-128 09-28-2013 | Limit Distance (m): 3
PreAmp: PRE145014 12-13-2013.txt | Test Distance (m): 3
PreAmp Used? (Y or N): Y | Voltage/Frequency: Battery powered | Frequency Range: See below
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
High channel, 2481 MHz, at 3 meters with pre-amp (145014) and filter (REA004), 1-18 GHz.													
MaxH PK	H	4962.000	51.75	33.66	8.76	34.66	0.00	59.51	74.00	-14.49	1/3MHz	RB	RB
AVG	H	4962.000	10.75	33.66	8.76	34.66	0.00	18.51	54.00	-35.49	1/3MHz	RB	RB
MaxH PK	H	7443.000	44.50	36.92	11.22	34.47	0.00	58.17	74.00	-15.83	1/3MHz	RB	RB
AVG	H	7443.000	3.50	36.92	11.22	34.47	0.00	17.17	54.00	-36.83	1/3MHz	RB	RB
MaxH PK	V	9924.000	37.12	39.97	13.43	36.08	0.00	54.43	74.00	-19.57	1/3MHz	NF	
AVG	V	9924.000	27.00	39.97	13.43	36.08	0.00	44.31	54.00	-9.69	1/3MHz	NF	
MaxH PK	V	12405.000	35.06	39.13	14.63	36.64	0.00	52.18	74.00	-21.82	1/3MHz	RB, NF	RB
AVG	V	12405.000	26.61	39.13	14.63	36.64	0.00	43.73	54.00	-10.27	1/3MHz	RB, NF	RB
MaxH PK	V	14886.000	34.44	42.75	15.68	34.76	0.00	58.10	74.00	-15.90	1/3MHz	NF	
AVG	V	14886.000	25.71	42.75	15.68	34.76	0.00	49.37	54.00	-4.63	1/3MHz	NF	
MaxH PK	V	17367.000	35.31	43.54	20.04	34.12	0.00	64.76	74.00	-9.24	1/3MHz	NF	
AVG	V	17367.000	25.63	43.54	20.04	34.12	0.00	55.08	54.00	+1.08	1/3MHz	NF	
AVG = MaxH PK - 41 dB (average factor), no average factor was applied for noise floor readings													
Hand scans were performed from 18-25 GHz at a distance of less than 10cm, no emissions were detected above the measuring equipment noise floor.													

Test Personnel: Kouma Sinn KPS
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC 15.249, RSS-210 Annex 2.9
Input Voltage: 7.2 Battery powered
Pretest Verification w/ Ambient Signals or BB Source: Ambient Signals

Test Date: 12/16/2012, 12/17/2012
Test Levels: Per standard
Ambient Temperature: 21 ºC
Relative Humidity: 17 %
Atmospheric Pressure: 1015 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
DAV003'	Weather Station	Davis Instruments	7400	PE80529A39A	09/25/2012	09/25/2014
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/04/2012	09/04/2013
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	09/28/2012	09/28/2013
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
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	10/04/2012	10/04/2013

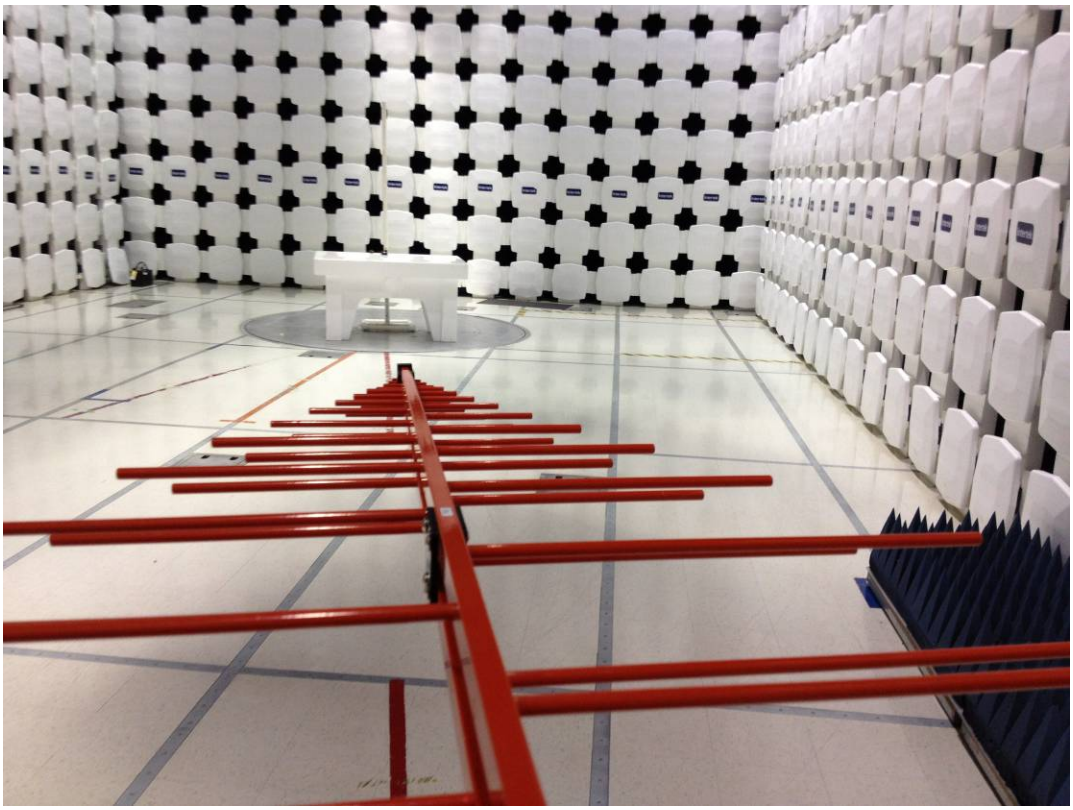
Software Utilized:

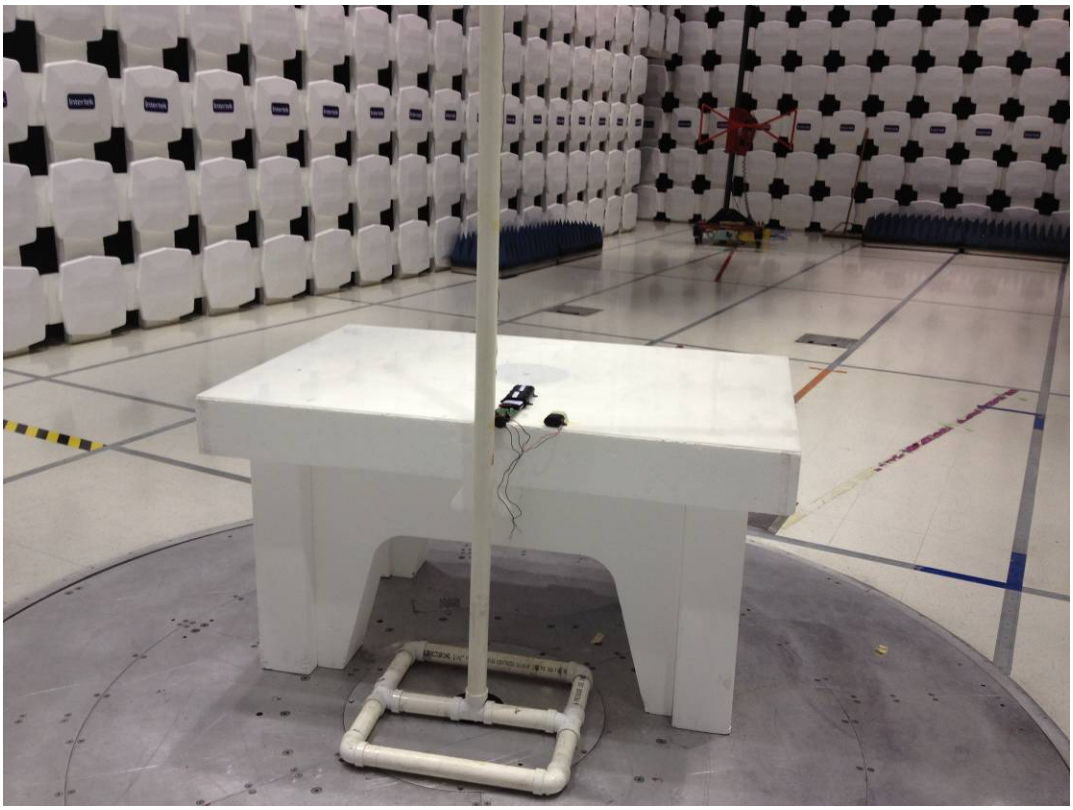
Name	Manufacturer	Version
C5 Emissions	TESEQ	5.26.46.46
EMI Boxborough.xls	Intertek	08/27/2010

9.3 Results:

The sample tested was found to Comply.

9.4 Setup Photographs:





9.5 Test Data:

Radiated Emissions

Company: LoJack | Antenna & Cables: N | Bands: N, LF, HF, SHF
Model #: V7A-SP | Antenna: 145106 V10m 09-04-2013.txt 145106 H10m 09-04-2013.txt
Serial #: 0A900F2 | Cable(s): 145-410 10mTrkA 10-04-2013.txt NONE.
Engineers: Vathana F. Ven | Location: 10m | Barometer: DAV004 | Filter: NONE
Project #: 100991532 | Date(s): 12/20/12
Standard: FCC Part 15 Subpart B Class B | Temp/Humidity/Pressure: 22C 23% 1009mbar
Receiver: 145-128 | Limit Distance (m): 3
PreAmp: PRE145003 10-04-2013.txt | Test Distance (m): 10
PreAmp Used? (Y or N): Y | Voltage/Frequency: 7.2V Battery Powered | Frequency Range: 30-1000MHz

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
PK	V	30.228	28.98	20.64	0.91	27.37	-10.46	33.62	40.00	-6.38	120/300 kHz
PK	V	84.841	29.08	7.70	1.51	27.22	-10.46	21.53	40.00	-18.47	120/300 kHz
PK	V	93.642	29.03	8.86	1.62	27.17	-10.46	22.80	43.50	-20.70	120/300 kHz
PK	V	154.601	29.22	12.42	2.02	27.00	-10.46	27.12	43.50	-16.38	120/300 kHz
PK	V	303.721	27.05	13.77	2.79	26.75	-10.46	27.33	46.00	-18.67	120/300 kHz

Test Personnel: Vathana F. Ven VFV
Test Date: 12/20/2012
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC Part 15 Subpart B IC ICES-003
Test Levels: See tables
Input Voltage: 7.2V Battery Powered
Ambient Temperature: 22 ºC
Pretest Verification w/ Ambient Signals or BB Source: **Ambient**
Relative Humidity: 23 %
Atmospheric Pressure: 1009 mbars

Deviations, Additions, or Exclusions: None

10 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	12/30/2012	100991532BOX-002	KPS	NNA	Original Issue