



EMISSIONS TEST REPORT

Report Number: 101011364BOX-002a

Project Number: G101011364

Report Issue Date: 02/19/2013

Product Designation: ITU7

Standards: Industry Canada RSS-119 Issue 11 June 2011, "Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41-960 MHz"

Industry Canada RSS-Gen Issue 3 December 2010 "General Requirements and Information for the Certification of Radio Apparatus"

CFR47 FCC Part 90:2013, "Private Land Mobile Radio Services"

CFR47 FCC Part 15 Subpart B:2013 "Unintentional Radiators"

IC ICES-003 Issue 5 August 2012

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

Client:
LoJack Corporation
780 Dedham Street
Canton, MA 02021

Report prepared by

Kouma Sinn
Senior Project Engineer, EMC

Report reviewed by

Nicholas Abbondante
Transmitter 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 3.0. 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 Comply 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 Output Power (IC RSS-119 Sections 4.1, 5.4; FCC 2.1046, 90.20(e)(6))	Pass
7	Transmitter Occupied Bandwidth (IC RSS-119 Section 5.5; FCC 2.1049, 90.20(e)(6))	Pass
8	Transmitter Frequency Stability (IC RSS-119 Sections 4.7, 5.3; FCC 2.1055, 90.213)	Pass
9	Transient Frequency Behavior (IC RSS-119 Section 5.9; FCC 2.1055, 90.214)	Pass
10	Transmitter Emissions Mask (IC RSS-119 Sections 5.5, 5.8; IC RSS-Gen Section 4.9; FCC 90.210(d))	Pass
11	Transmitter Out-of-Band Unwanted Emissions, Radiated (IC RSS-119 Sections 4.2, 5.8; IC RSS-Gen Section 4.9; FCC 2.1053, 90.210(d))	Pass
12	Receiver Radiated Spurious Emissions (IC RSS-119 Section 5.11, IC RSS-Gen Sections 4.10, 6.0; IC ICES-003 Issue 5 August 2012, CFR47 FCC Part 15 Subpart B:2013)	Pass
13	Revision History	--

3 Client Information

This EUT was tested at the request of:

Company: LoJack Corporation
780 Dedham Street
Canton, MA 02021

Contact: Vincent Ricci
Telephone: (781) 302-7148
Fax: Not provided
Email: vricci@lojack.com

4 Description of Equipment Under Test

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
ITU7 (MSK Transmit Mode)	LoJack Corporation	ITU7	0D31482
ITU7 (Receive Mode)	LoJack Corporation	ITU7	0D31B8C
ITU7 (Constant Carrier)	LoJack Corporation	ITU7	0D31487

Receive Date:	01/10/2013
Received Condition:	Good
Type:	Prototype

Description of Equipment Under Test (provided by client)

The EUT is an Installation Test Unit. It is used in mobile applications (>20cm from the body) for testing of installed transponders.

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

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	During testing, the EUT was powered from external 12VDC battery and was transmitting an MSK modulated signal repetitively

5 System Setup and Method

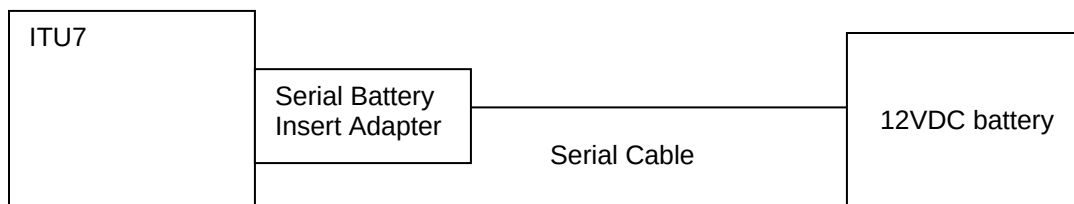
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Battery cables	2.4	Braid	None	External battery

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
12VDC battery	Autocraft	27DC-2	Not labeled

5.1 Method:

Configuration as required by RSS-Gen Issue 3 December 2010 and TIA-603C:2004.

5.2 EUT Block Diagram:



6 Transmitter Output Power

6.1 Method

Tests are performed in accordance with IC RSS-119 Sections 4.1, 5.4; FCC 2.1046, 90.20(e)(6).

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.

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
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/04/2012	09/04/2013
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
ANT5A'	BROADBAND ANTENNA	Compliance Design	B100	1670	08/15/2012	08/15/2013
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	02/08/2012	02/08/2013
HEW62'	Synthesized Sweep Generator	Hewlett Packard	83620A	3213A01244	04/16/2012	04/16/2014

Software Utilized:

Name	Manufacturer	Version
Excel 2003	Microsoft	(11.8231.8221) SP3
EMI Boxborough.xls	Intertek	08/27/10

6.3 Results:

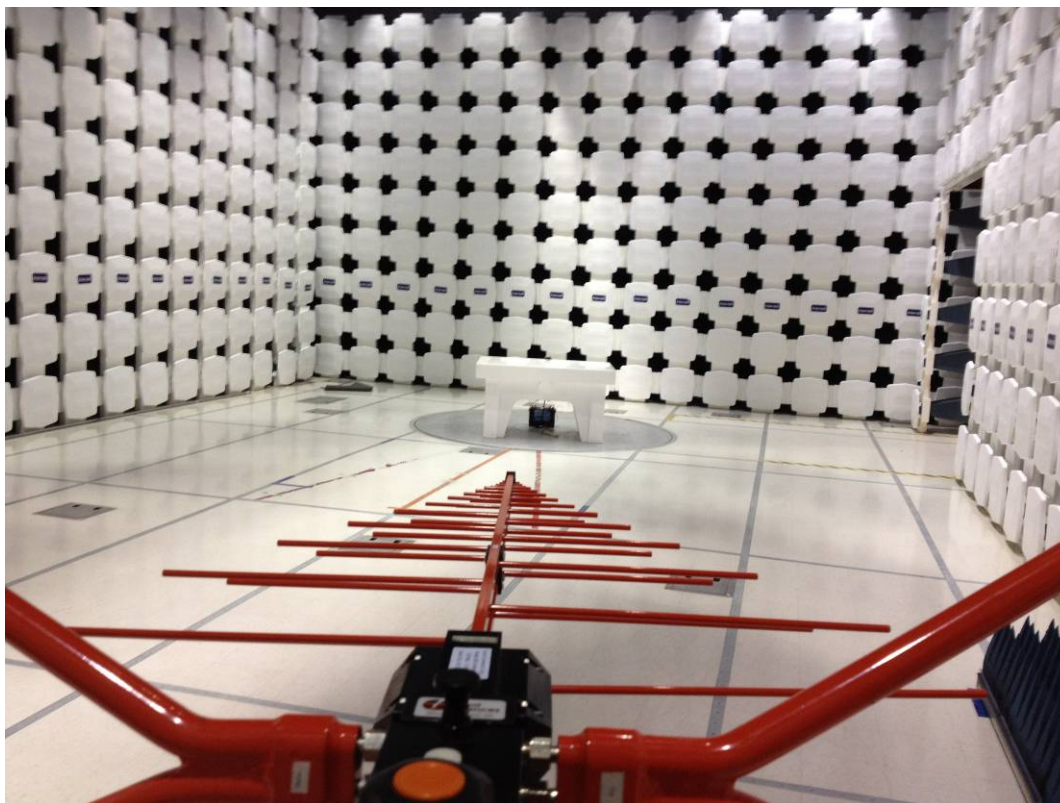
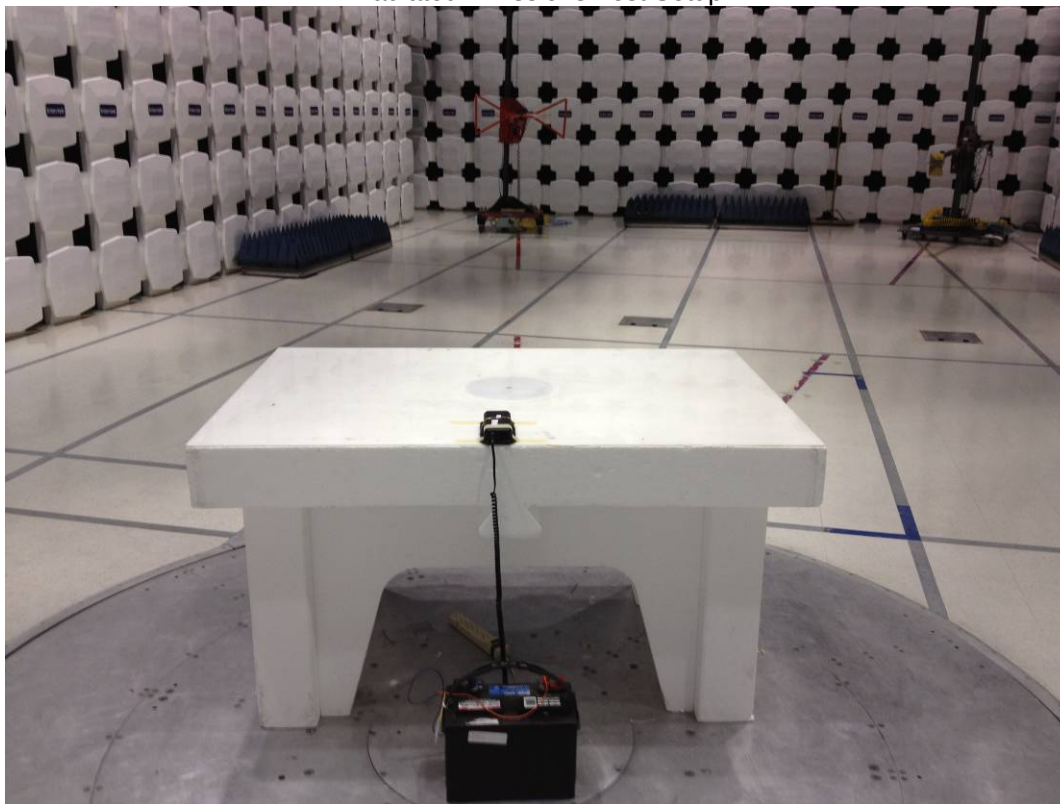
The output power shall not exceed 2.5W (34.0 dBm)

Transmitter output power shall be within ± 1.0 dB of the manufacturer's rated power.

The sample tested was found to comply.

6.4 Setup Photographs:

Radiated Emissions Test Setup



6.5 Test Data:**Fundamental Radiated Emissions, Substitution**

Company: LoJack Corporation
 Model #: ITU7
 Serial #: 0D31482
 Engineer(s): Kouma Sinn
 Project #: G101011364
 Standard: IC RSS-119 & FCC Part 90
 Barometer: DAV004 Temp/Humidity/Pressure: 20C 12% 1016mbar
 Test Distance (m): 10 Voltage/Frequency: Car Battery
 Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain (dBi or dBd)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor RB = Restricted Band; Bandwidth denoted as RBW/VBW

Rx Antenna: 145106
 Rx Cable(s): 145410
 Rx Preamp: None Receiver: 145-128
 Tx Antenna: ANT5A
 Tx Cable(s): CBL030
 Tx Signal Generator: HEW62
 ERP or EIRP?: ERP

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Notes: MSK Modulation, at 10 meters, 173.075 MHz. No pre-amp											
PK	V	173.075	63.13	51.26	0.37	-3.10	-20.00	-13.75	34.00	-47.75	120/300kHz

Test Personnel: Kouma Sinn *KPS*
 Product Standard: IC RSS-119, FCC Part 90
 Input Voltage: 12V Car Battery
 Pretest Verification w/
 BB Source: N/A

Test Date: 01/18/2013
 Test Levels: See section 6.3
 Ambient Temperature: 20 °C
 Relative Humidity: 12 %
 Atmospheric Pressure: 1016 mbars

Deviations, Additions, or Exclusions: None

7 Transmitter Occupied Bandwidth

7.1 Method

Tests are performed in accordance with IC RSS-119 Section 5.5; FCC 2.1049, 90.20(e)(6).

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	PE80529A61A	09/25/2012	09/25/2014
E1484'	Near field probe	ETS	7405	0001-4472	Cal not required	Cal not required
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	02/10/2012	02/10/2013
CBLBNC2012-2'	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-2	09/14/2012	09/14/2013

Software Utilized:

Name	Manufacturer	Version
None (Receiver Firmware)		

7.3 Results:

The transmitter occupied bandwidth shall not exceed the transmitter authorized bandwidth from IC RSS-119 Table 3 for the equipment's frequency band.

Frequency Band (MHz)	Related SRSP for Channelling Plan and e.r.p.	Channel Spacing (kHz)	Authorized Bandwidth (kHz)	Spectrum Masks with Audio Filter	Spectrum Masks Without Audio Filter
27.41-28.0 and 29.7-50.0	N/A	20	20	B	C
72-76	N/A	20	20	B	C
138-144; 148-149.9 and 150.05-174	SRSP-500	30	20	B	C
		15	11.25	D	D
		7.5	6	E	E
217-218 and 219-220	N/A	12.5	11.25	D or I	D or J
220-222	SRSP-512	5	4	F	F
406.1-430 and 450-470	SRSP-501	25	20	B	C (G, Note 1)
		12.5	11.25	D	D
		6.25	6	E	E
764-776 and 794-806	SRSP-511	6.25	Note 2	Section 5.8.9	Section 5.8.9
806-821-/851-866 and 821-824/866-869	SRSP-502	25	20	B	G
		12.5	11.25	D	D
896-901/ 935-940	SRSP-506	12.5	13.6	I	J (G, Note 3)
929-930 and 931-932	SRSP-504 (for Paging)	25	20	B	G
928-929/ 952-953 and 932-932.5/941-941.5	SRSP-505	25	20	B	G
		12.5	11.25	D	D
932.5-935/941.5-944	SRSP-507	25	20	B	G
		12.5	11.25	D	D

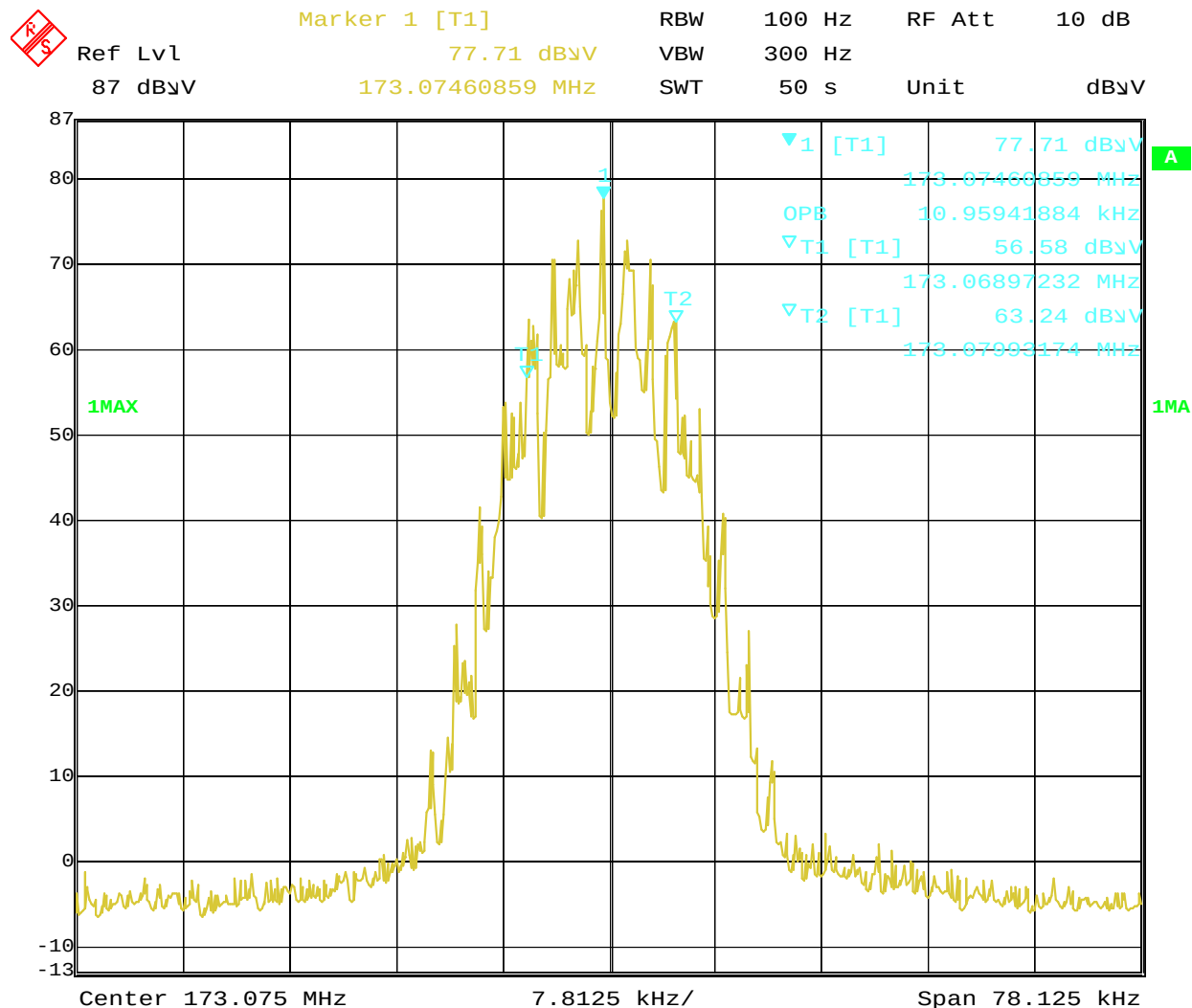
The sample tested was found to comply.

7.4 Setup Photographs:

Radiated Emissions Test Setup



7.5 Test Data:



Date: 10 . JAN . 2013 21:37:40

MSK Modulation 10.959 kHz

Test Personnel: Vathana Ven *VSV*

Product Standard: IC RSS-119, FCC Part 90

Input Voltage: 12V Car Battery

Pretest Verification w/
BB Source: No

Test Date: 01/10/2013

Test Levels: See Section 7.3

Ambient Temperature: 20 °C

Relative Humidity: 20 %

Atmospheric Pressure: 1023 mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Frequency Stability

8.1 Method

Tests are performed in accordance with IC RSS-119 Sections 4.7, 5.3; FCC 2.1055, 90.213.

TEST SITE: AMAP Lab

8.2 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
MET2'	Digital Multimeter	Meterman	15XP	050407779	12/27/2012	12/27/2013
RQS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	02/10/2012	02/10/2013
CBLBNC7'	30 ft 50 ohm coax, BNC - BNC	ITT Pomona	RG 58 C/U	CBLBNC7	01/14/2013	01/14/2014
148012'	Temp/Humidity Chamber	Envirotronics	SH27C	08015563S11263	10/18/2012	10/18/2013
146029'	DC Power Supply (0-30 volts 3 amps)	Electro Industries	DIGI 35A	M12/EM 1127-01	VBV	Verified

Software Utilized:

Name	Manufacturer	Version
Excel 2003	Microsoft	(11.8231.8221) SP3
EMI Boxborough.xls	Intertek	08/27/10

8.3 Results:

The transmitter carrier frequency shall not depart from the reference frequency in excess of the values given in IC RSS-119 Table 1.

Frequency Band (MHz)	Authorized Bandwidth (kHz)	Frequency Stability (ppm)		
		Base/Fixed	Mobile Station	
			>2 watts	≤ 2 watts
27.41-28 and 29.7-50	20	20	20	50
72-76	20	5	20	50
138-174	20	5	5	5
	11.25	2.5	5	5
	6.25	1	2	5
217-218 and 219-220	11.25	1	5	5
220-222 (Note 1)	4	0.1	1.5	1.5
406.1-430 and 450-470 (Note 5)	20	2.5	5	5
	11.25	1.5	2.5	2.5
	6.25	0.5	1	1
764-776 and 794-806 (Note 2)	for all authorized bandwidths	0.1 for narrowband	0.4 for narrowband (Note 3)	0.4 for narrowband (Note 3)
		1 for wideband	1.25 for wideband (Note 4)	1.25 for wideband (Note 4)
806-821/851-866 and 821-824/866-869 (Note 5)	20	1.5	2.5	2.5
	11.25	1	1.5	1.5
896-901/935-940 (Note 5)	13.6	0.1	1.5	1.5
929-930/931-932	20	1.5	N/A	N/A
928-929/952-953 and 932-932.5/941-941.5	20	1.5	N/A	N/A
	11.25	1	3 for remote station	N/A
896-901/935-940	13.6	0.1	1.5	1.5
932.5-935/941.5-944	20	2.5	N/A	N/A
	11.25	2.5	N/A	N/A

The sample tested was found to comply.

8.4 Setup Photograph:

Frequency Stability Test Setup Photo



8.5 Test Data:**Frequency Stability**

Company: LoJack

Model #: ITU7

Serial #: 0D31487

Engineer(s): Kouma Sinn

Project #: G101011364

Standard: IC RSS-119, FCC Part 90

Limit:

5 PPM

Nominal f: 173.075 MHz

Test Equipment Used:

MET2 ROS001

CBLBNC7 148012

146029

Location: Safety

Voltage: 13.8 VDC

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-30	173.075007	0.185	0.87
-20	173.074940	0.118	0.87
-10	173.074902	0.08	0.87
0	173.074855	0.033	0.87
10	173.074826	0.004	0.87
20	173.074822	0	0.87
30	173.074960	0.138	0.87
40	173.074857	0.035	0.87
50	173.074800	-0.022	0.87

Test Personnel: Kouma Sinn *KPS*Product Standard: IC RSS-119, IC RSS-GenInput Voltage: External DC Power Supply

Pretest Verification w/

BB Source: N/ATest Date: 01/25/2013Test Levels: See section 8.3Ambient Temperature: N/ARelative Humidity: N/AAtmospheric Pressure: N/A

Deviations, Additions, or Exclusions: None

9 Transient Frequency Behavior

9.1 Method

Tests are performed in accordance with IC RSS-119 Section 5.9; FCC 2.1055, 90.214.

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.

9.2 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
AGL002'	1GHz 4CH O'Scope	Agilent Technologies	DSO6104A	MY44008115	08/01/2012	08/01/2013
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	02/10/2012	02/10/2013
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
MIN002'	Splitter/Combiner 3-Way 650-1050 MHz	Mini-Circuits	ZN3PD	00337	12/02/2003	Verified
MIN004'	Splitter/Combiner	Mini Circuits	ZFRSC-2050	none	12/02/2003	Verified

Software Utilized:

Name	Manufacturer	Version
None		

9.3 Results:

When the transmitter is turned on, during the initial period in which the transmit frequency stabilizes, the frequency error or frequency difference between the instantaneous and steady state frequencies must not exceed the limits in IC RSS-119 Table 16.

Channel Spacing (kHz)	Time Intervals ^{1, 2}	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138-174 MHz	406.1-512 MHz
25	t ₁	±25	5	10
	t ₂	±12.5	20	25
	t ₃	±25	5	10
12.5	t ₁	±12.5	5	10
	t ₂	±6.25	20	25
	t ₃	±12.5	5	10
6.25	t ₁	±6.25	5	10
	t ₂	±3.125	20	25
	t ₃	±6.25	5	10

¹ t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t₁: the time period immediately following t_{on}.

t₂: the time period immediately following t₁.

t₃: the time period from the instant when the transmitter is turned off until t_{off}.

t_{off}: the instant when the 1 kHz test signal starts to rise.

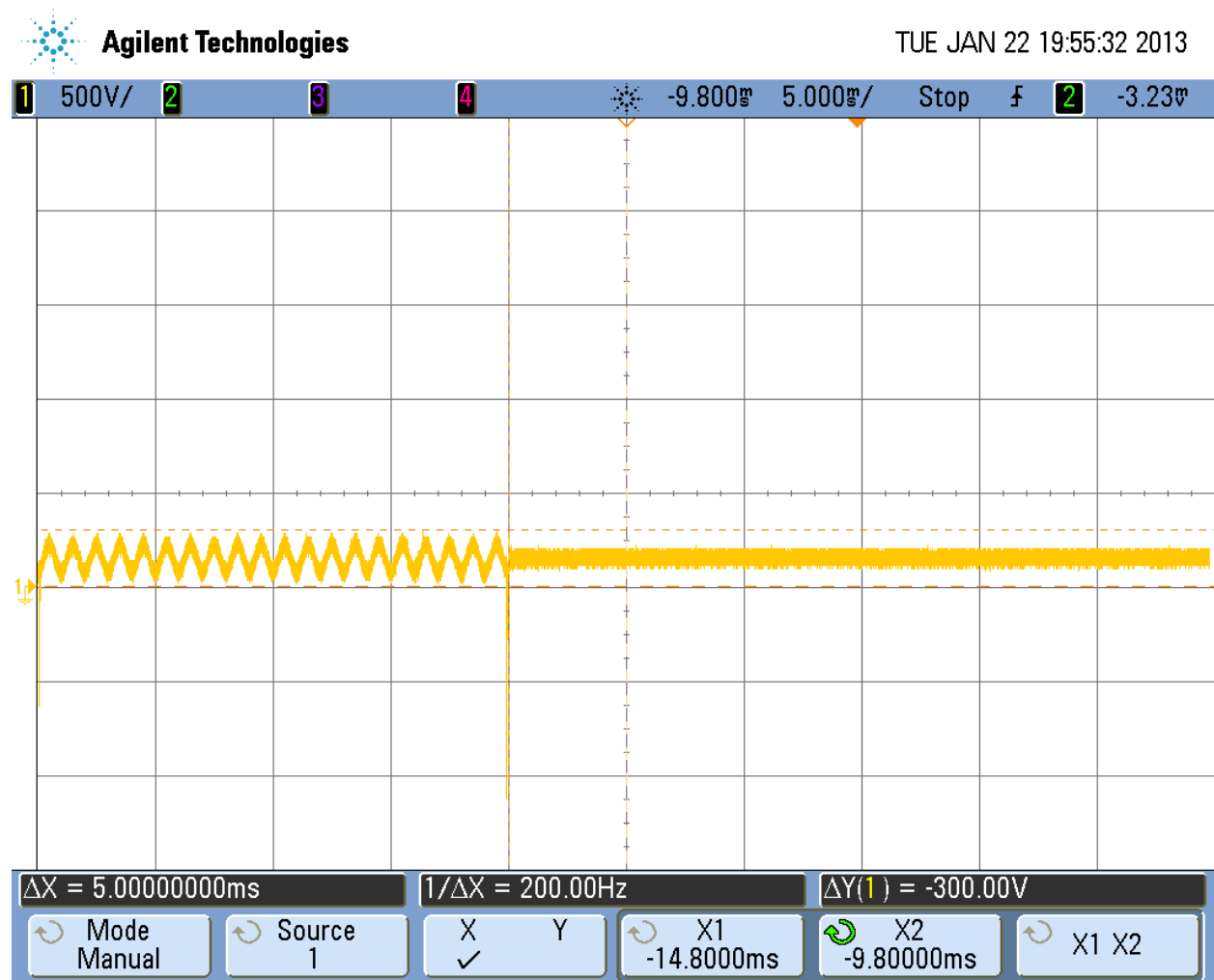
² If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t₁ and t₃ may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t₁ and t₃ shall be recorded in the test report.

The sample tested was found to comply.

9.4 Setup Photograph:



9.5 Test Data:

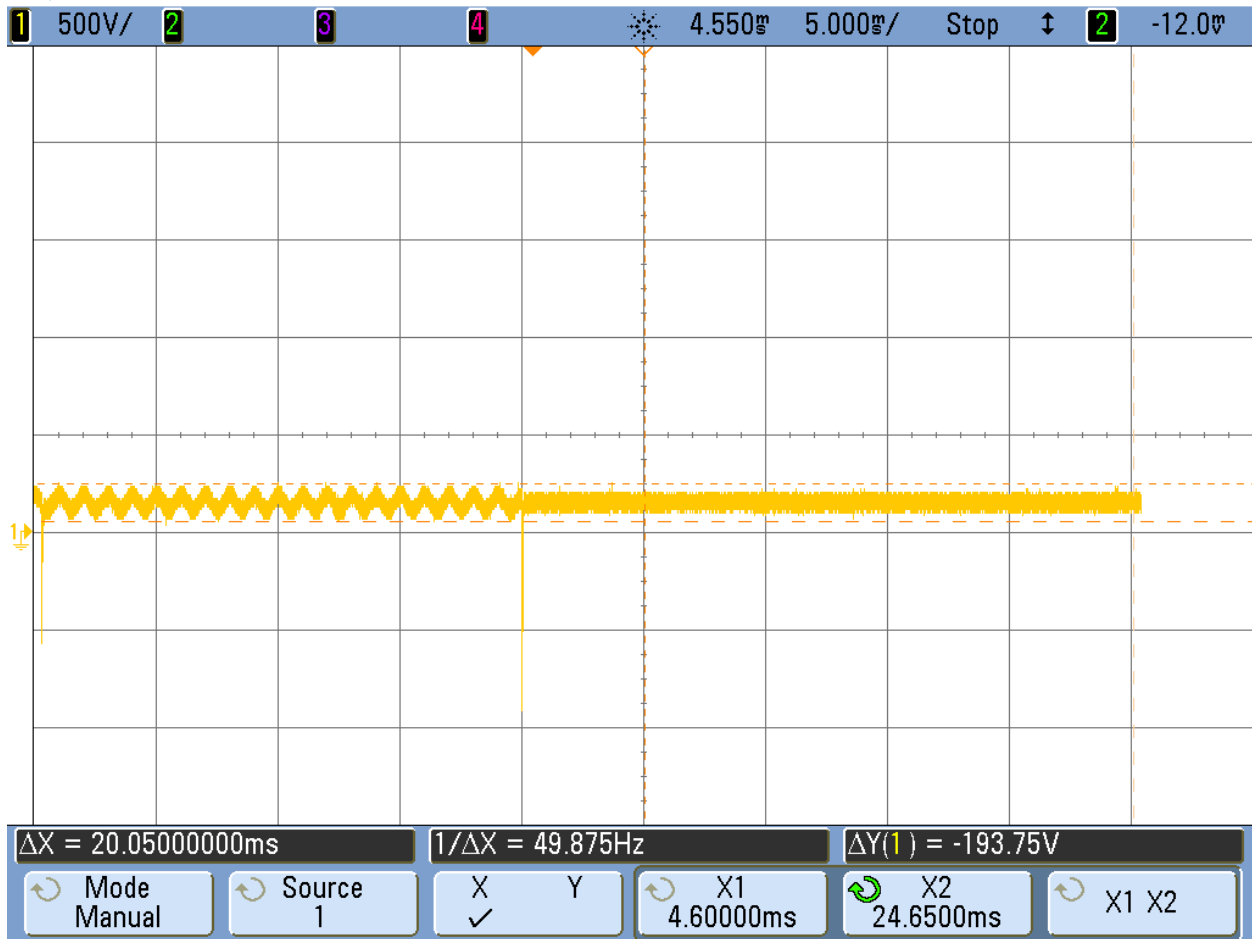


T1



Agilent Technologies

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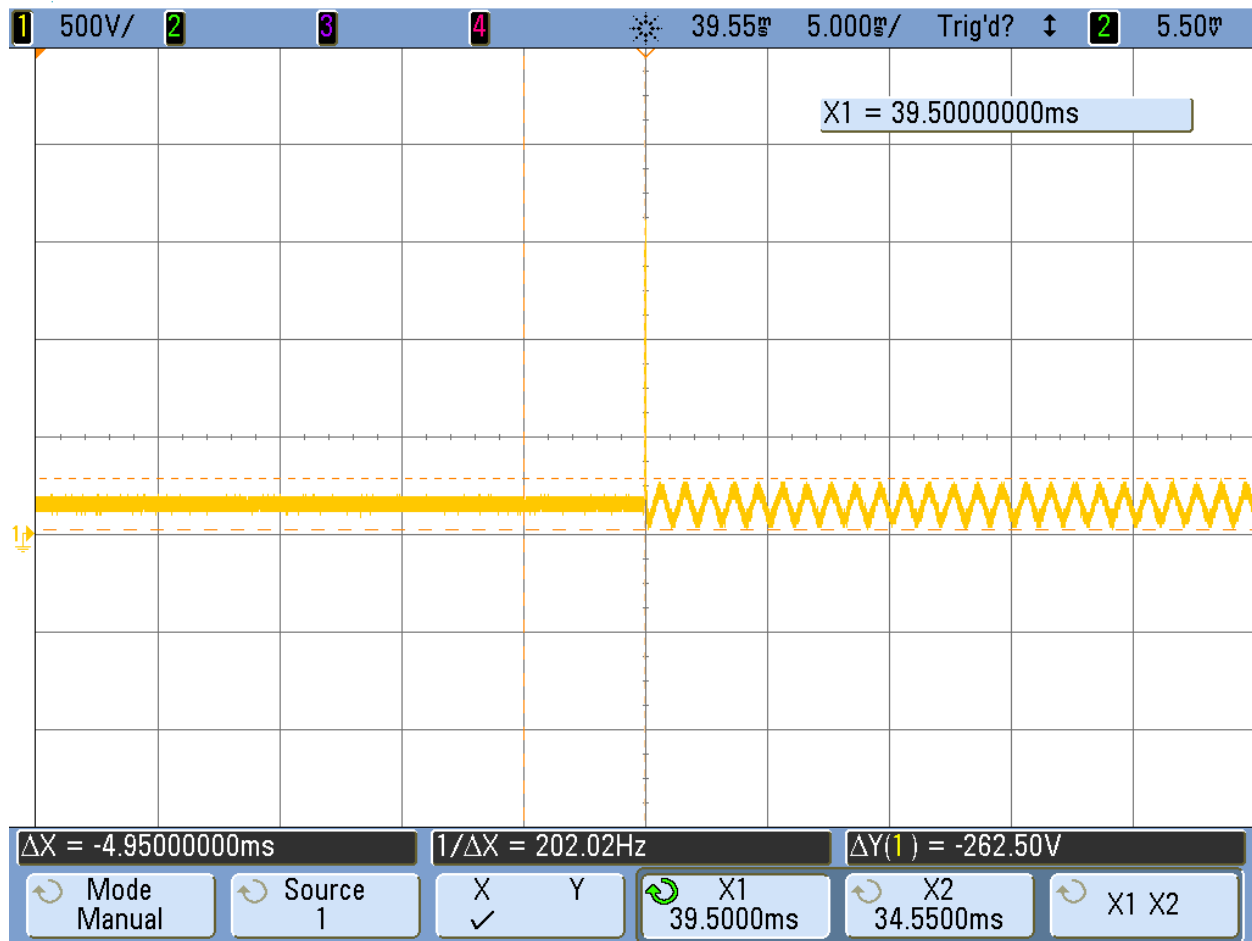


T2



Agilent Technologies

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T3

Test Personnel: Kouma Sinn *KPS*
Product Standard: IC RSS-119, FCC Part 90
Input Voltage: 12VDC
Pretest Verification w/
BB Source: No

Test Date: 01/22/2013
Test Levels: See section 9.3
Ambient Temperature: 21°C
Relative Humidity: 8 %
Atmospheric Pressure: 1006 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter Emissions Mask

10.1 Method

Tests are performed in accordance with IC RSS-119 Sections 5.5, 5.8; IC RSS-Gen Section 4.9; FCC 90.210(d).

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.

10.2 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)	Sundt Sciences	JB5	A111003	09/04/2012	09/04/2013
145128'	EMI Receiver 40 GHz (20 Hz - 40 GHz)	Rohde & Schwarz	ESL	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

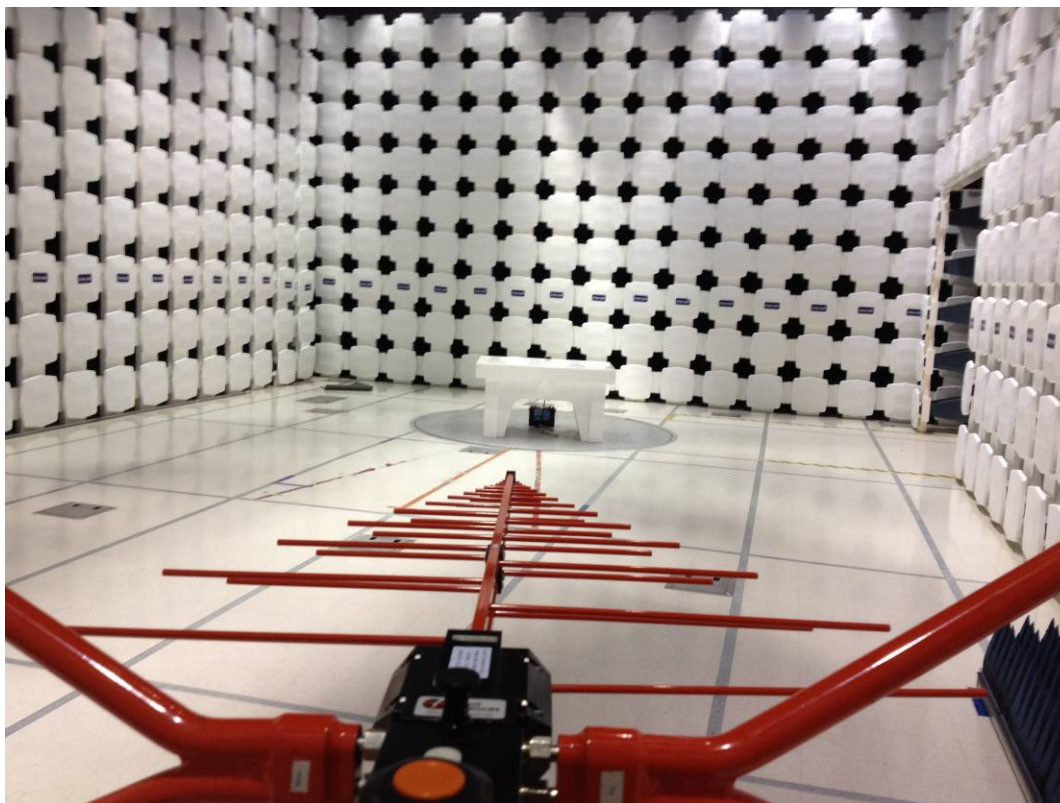
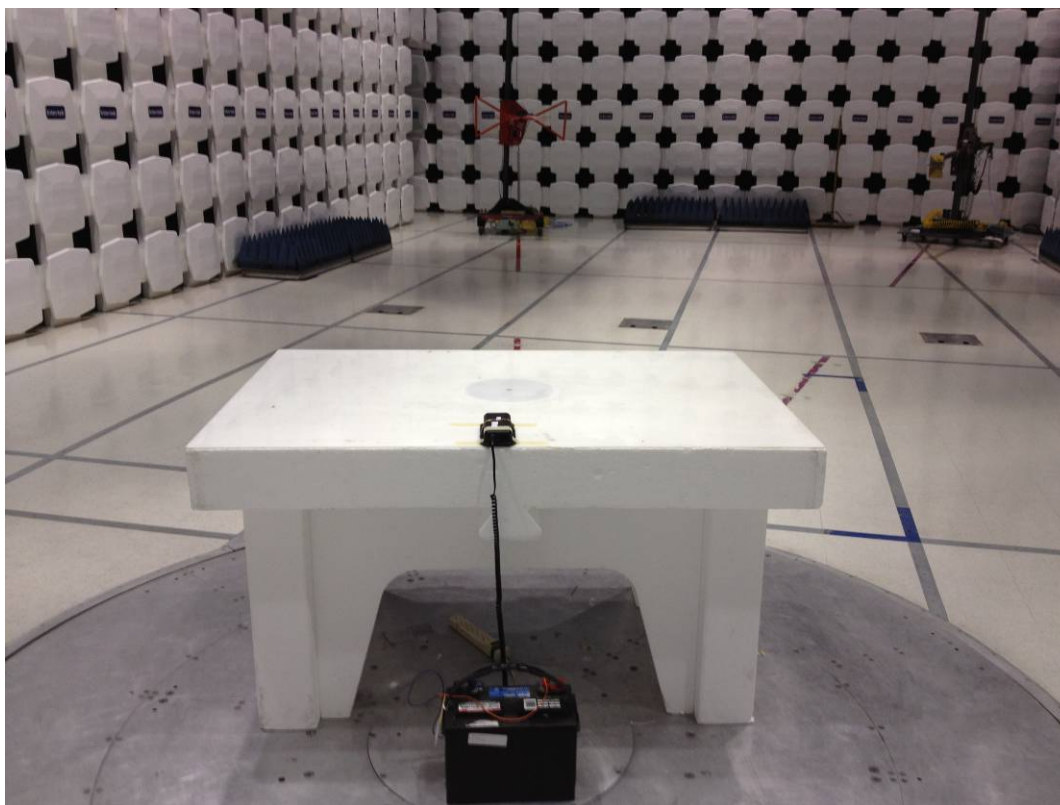
Software Utilized:

Name	Manufacturer	Version
None (Receiver Firmware)		

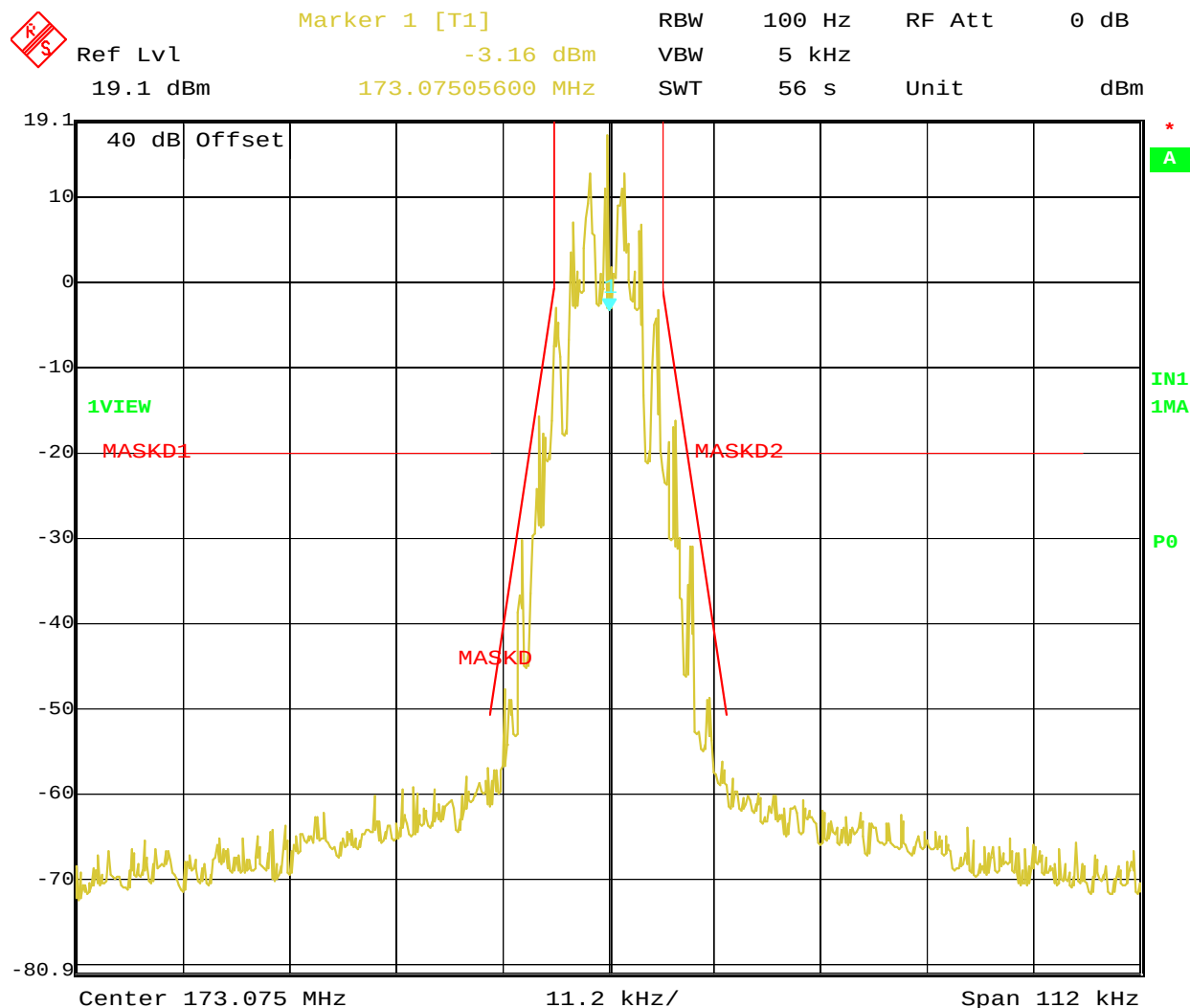
10.3 Results:

The transmitter waveform envelope must meet the applicable emissions masks as specified in IC RSS-119 Section 5.8 and 90.210.

The sample tested was found to Comply.

10.4 Setup Photograph:

10.5 Test Data:



Date: 16.FEB.2013 14:56:02

MSK Modulation

Test Personnel: Kouma Sinn *KPS*
 Product Standard: IC RSS-119, FCC Part 90
 Input Voltage: 12VDC Car Battery
 Pretest Verification w/
 BB Source: **No**

Test Date: 02/16/2013
 Test Levels: See section 10.3
 Ambient Temperature: 21 °C
 Relative Humidity: 22%
 Atmospheric Pressure: 1000 mbars

Deviations, Additions, or Exclusions: None

11 Transmitter Unwanted Out-of-Band Emissions, Radiated

11.1 Method

Tests are performed in accordance with IC RSS-119 Sections 4.2, 5.8; IC RSS-Gen Section 4.9; FCC 2.1053, 90.210(d).

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.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/04/2012	09/04/2013
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
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	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
ANT5A'	BROADBAND ANTENNA	Compliance Design	B100	1670	08/15/2012	08/15/2013
ANT5B'	BROADBAND ANTENNA	Compliance Design	B200	1671	08/15/2012	08/15/2013
ANT5C'	BROADBAND ANTENNA	Compliance Design	B300	1672	08/15/2012	08/15/2013
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	02/08/2012	02/08/2013
HEW62'	Synthesized Sweep Generator	Hewlett Packard	83620A	3213A01244	04/16/2012	04/16/2014
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	04/16/2012	04/16/2013
REA003'	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	11/30/2012	11/30/2013
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
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	01/18/2012	01/18/2013
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	09/25/2012	09/25/2014

Software Utilized:

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

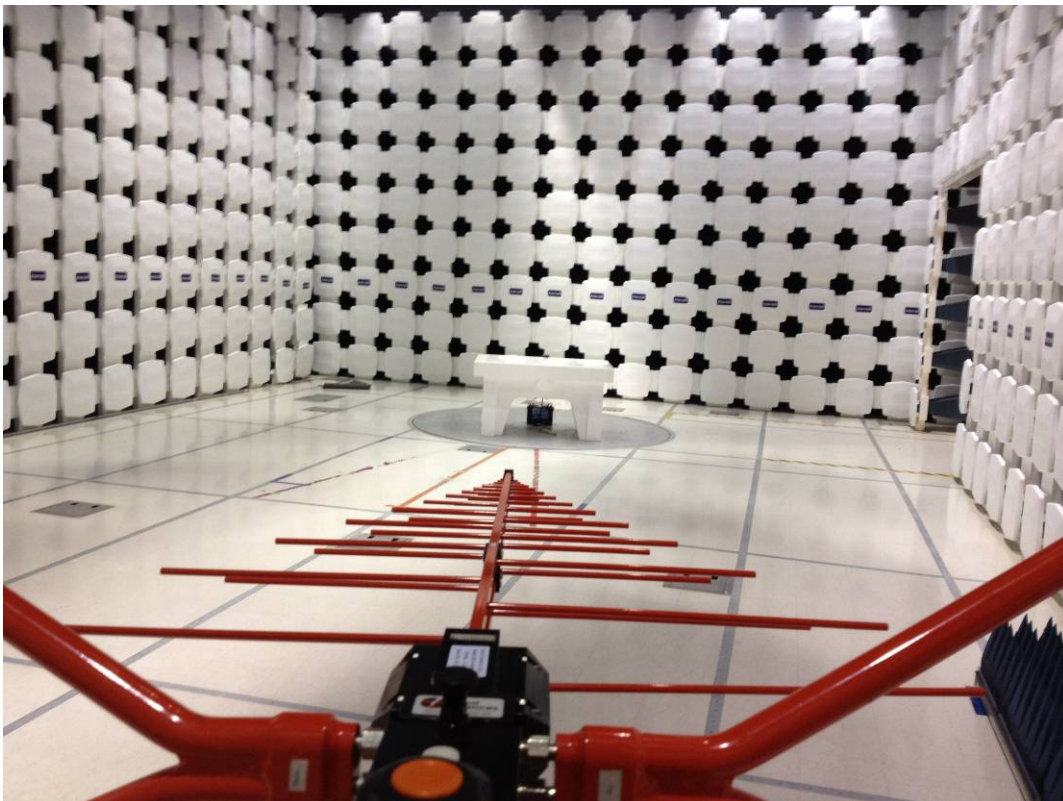
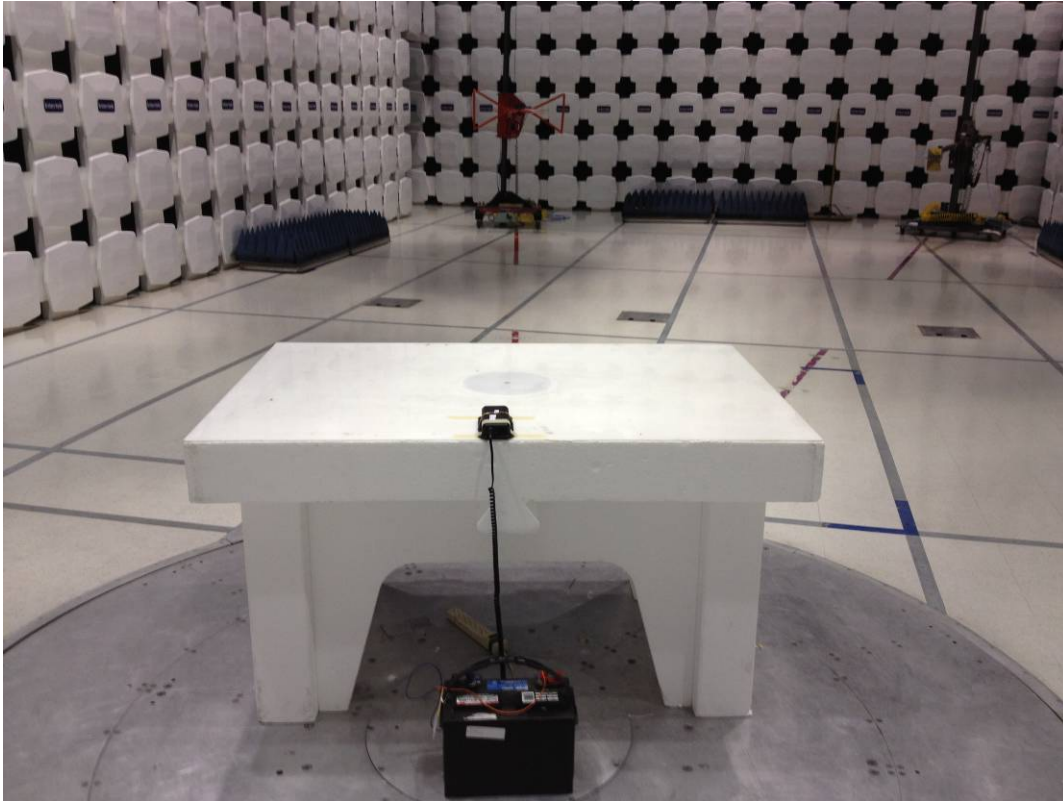
11.3 Results:

Transmitter unwanted out-of-band emissions must meet the limits of IC RSS-119 Section 5.8.

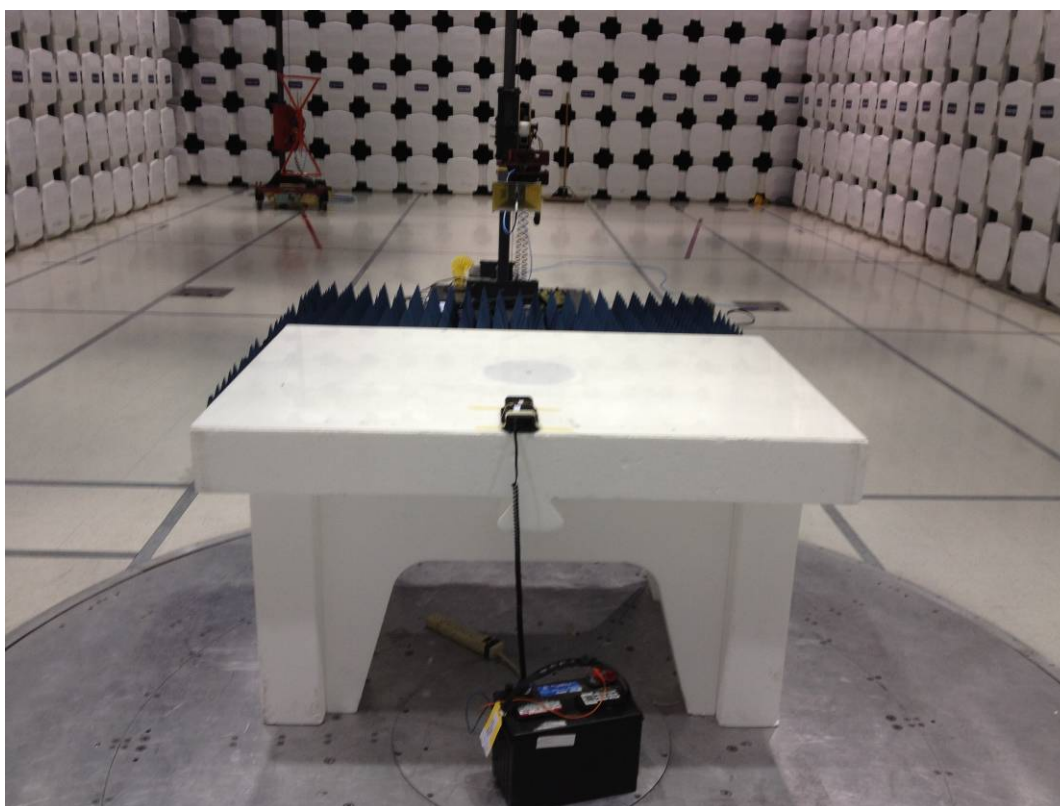
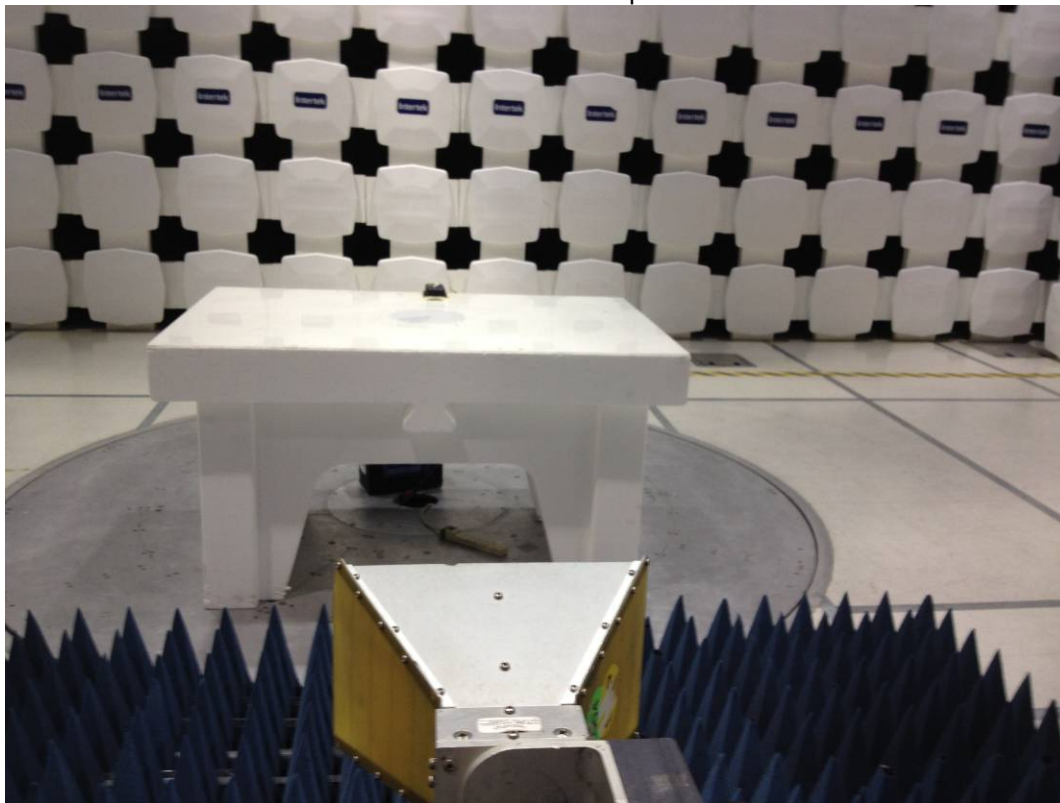
The sample tested was found to comply.

11.4 Setup Photographs:

Radiated Emissions Test Setup Below 1GHz



Radiated Emissions Test Setup Above 1GHz



11.5 Test Data:

30-1000MHz Spurious Radiated Emissions, Substitution

Company: LoJack Corporation
 Model #: ITU7
 Serial #: 0D31482
 Engineer(s): Kouma Sinn
 Project #: G101011364
 Standard: IC RSS-119 & FCC Part 90
 Barometer: DAV004 Temp/Humidity/Pressure: 20C 12% 1016mbar
 Test Distance (m): 10 Voltage/Frequency: Car Battery
 Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain (dBi or dBd)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor RB = Restricted Band; Bandwidth denoted as RBW/VBW

Rx Antenna: 145106
 Rx Cable(s): 145410
 Rx Preamp: 145003 Receiver: 145-128
 Tx Antenna: ANT5A ANT5B ANT5C
 Tx Cable(s): CBL030
 Tx Signal Generator: HEW62
 ERP or EIRP?: ERP

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Notes: MSK Modulation, at 10 meters, 30-1000 MHz. With pre-amp											
PK	V	346.150	43.09	76.85	0.50	-1.18	-20.00	-57.59	-20.00	-37.59	120/300kHz
PK	V	519.225	30.25	66.72	0.60	2.17	-20.00	-57.05	-20.00	-37.05	120/300kHz
PK	V	692.300	28.75	58.60	0.69	1.69	-20.00	-51.00	-20.00	-31.00	120/300kHz
PK	V	865.375	26.35	65.30	0.77	0.72	-20.00	-61.15	-20.00	-41.15	120/300kHz

1-2GHz Spurious Radiated Emissions, Substitution

Company: LoJack Corporation
 Model #: ITU7
 Serial #: 0D31482
 Engineer(s): Kouma Sinn
 Project #: G101011364
 Standard: FCC Part 90
 Barometer: DAV004 Temp/Humidity/Pressure: 22C 20% 1017mbar
 Test Distance (m): 3 Voltage/Frequency: Car Battery
 Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain (dBi or dBd)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor RB = Restricted Band; Bandwidth denoted as RBW/VBW

Rx Antenna: HORN3 Rx Filter REA003
 Rx Cable(s): 145-416
 Rx Preamp: 145014 Receiver: 145-128
 Tx Antenna: EMC02
 Tx Cable(s): CBL030
 Tx Signal Generator: HEW62
 ERP or EIRP?: ERP

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Notes: MSK Modulation, at 3 meters, 1-2 GHz											
PK	H	1038.450	39.40	88.56	0.82	6.50	-20.00	-65.63	-20.00	-45.63	1/3MHz NF
PK	H	1211.553	39.22	85.90	0.88	6.72	-20.00	-62.99	-20.00	-42.99	1/3MHz
PK	H	1384.653	47.34	86.09	0.95	7.96	-20.00	-53.89	-20.00	-33.89	1/3MHz
PK	H	1557.675	39.10	87.00	1.02	8.87	-20.00	-62.20	-20.00	-42.20	1/3MHz NF
PK	H	1730.750	38.24	84.60	1.09	8.65	-20.00	-60.95	-20.00	-40.95	1/3MHz NF

Test Personnel: Kouma Sinn *KPS*
 Product Standard: IC RSS-119
 Input Voltage: 12V Car Battery

Pretest Verification w/
 BB Source: **No**

Test Date: 01/18/2013
 Test Levels: See section 11.3

Ambient Temperature: 20 °C
 Relative Humidity: 12 %
 Atmospheric Pressure: 1016 mbars

Deviations, Additions, or Exclusions: None

12 Receiver Radiated Spurious Emissions

12.1 Method

Tests are performed in accordance with IC RSS-119 Section 5.11, IC RSS-Gen Sections 4.10, 6.0; IC ICES-003, FCC Part 15 Subpart B 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 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 dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- 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 dB μ V 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 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

12.2 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

12.3 Results:

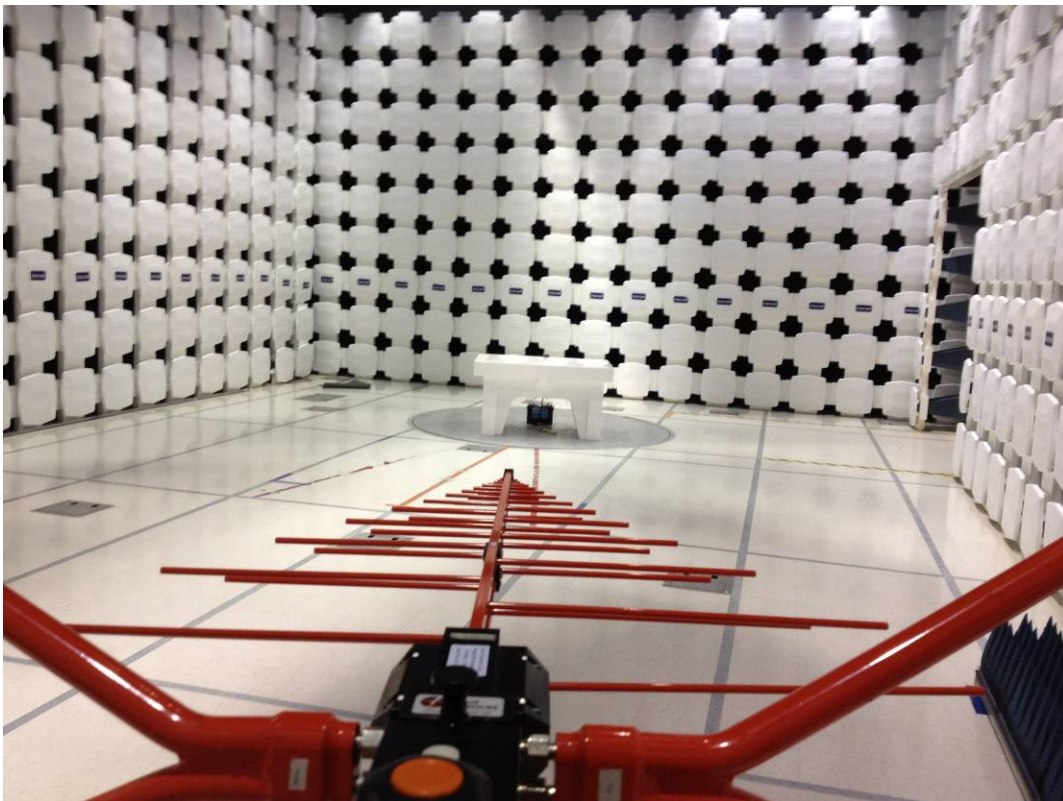
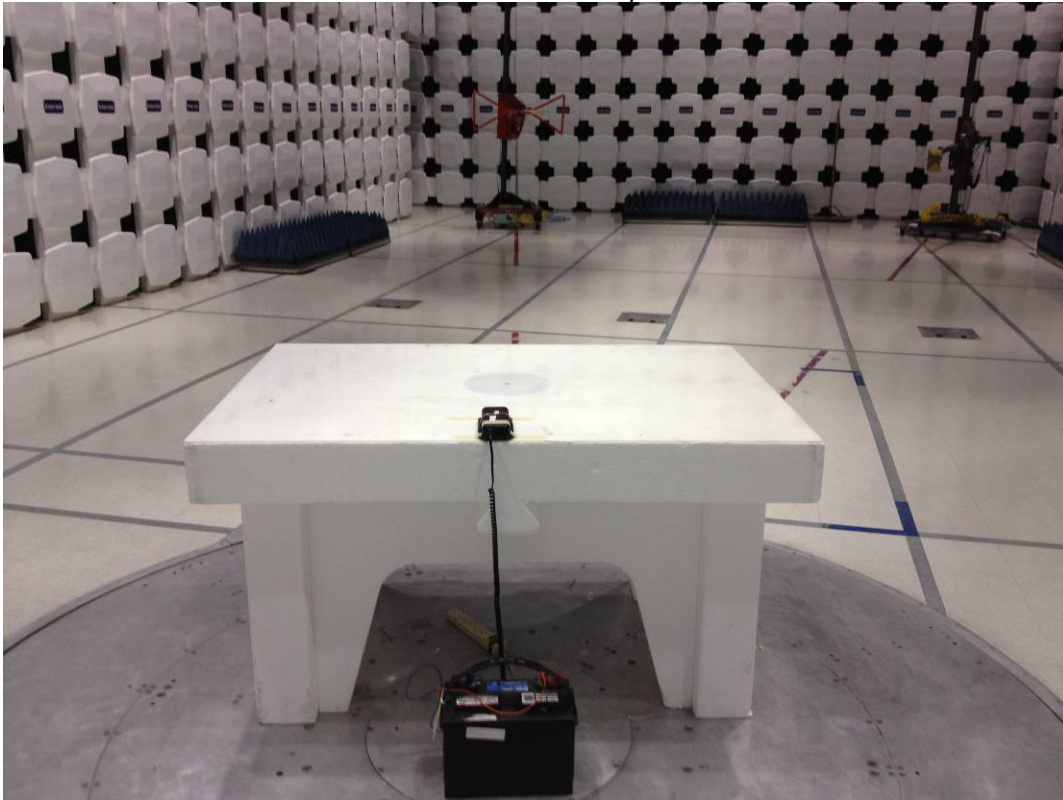
Receiver radiated emissions must not exceed the limits in IC RSS-Gen Table 2.

Frequency (MHz)	Field Strength (microvolts/m at 3 metres) *
30-88	100
88-216	150
216-960	200
Above 960	500

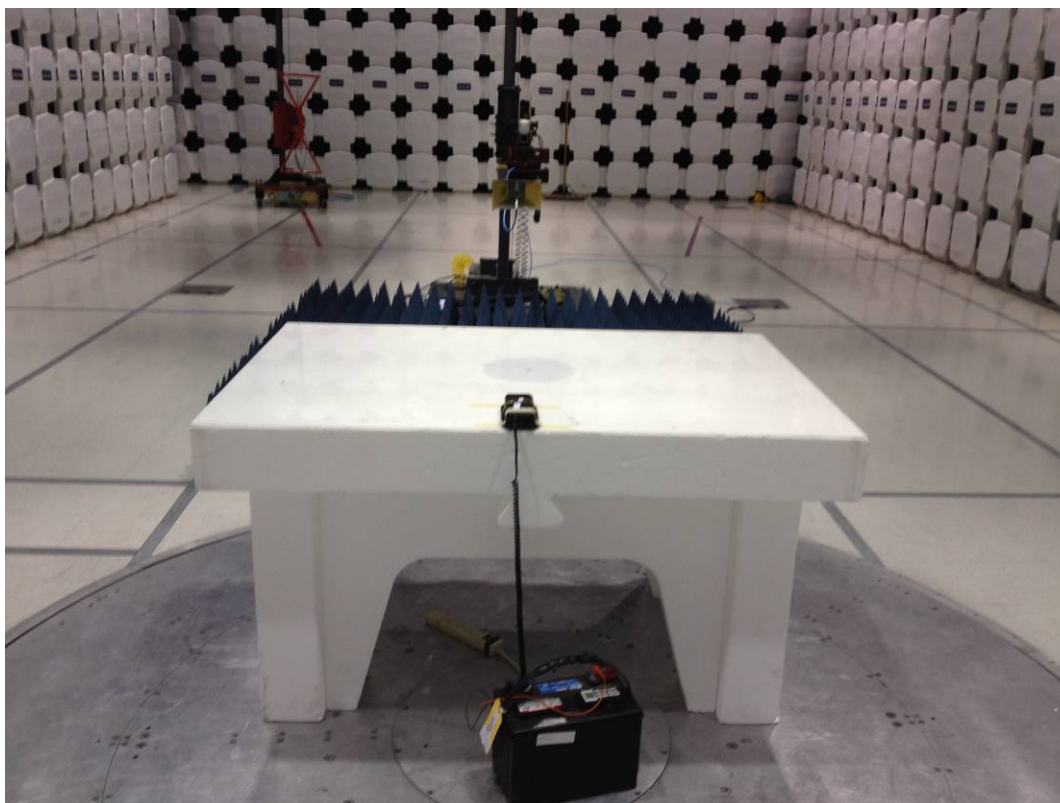
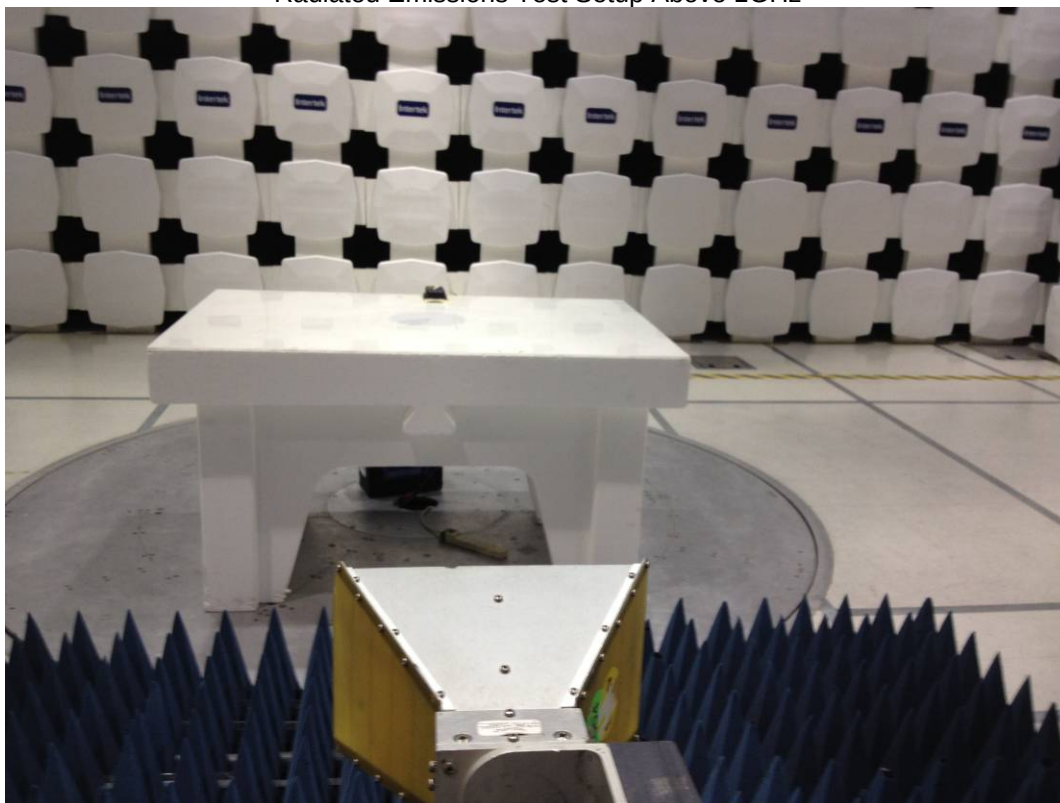
The sample tested was found to Comply.

12.4 Setup Photographs:

Radiated Emissions Test Setup Below 1GHz



Radiated Emissions Test Setup Above 1GHz



12.5 Plots/Data:

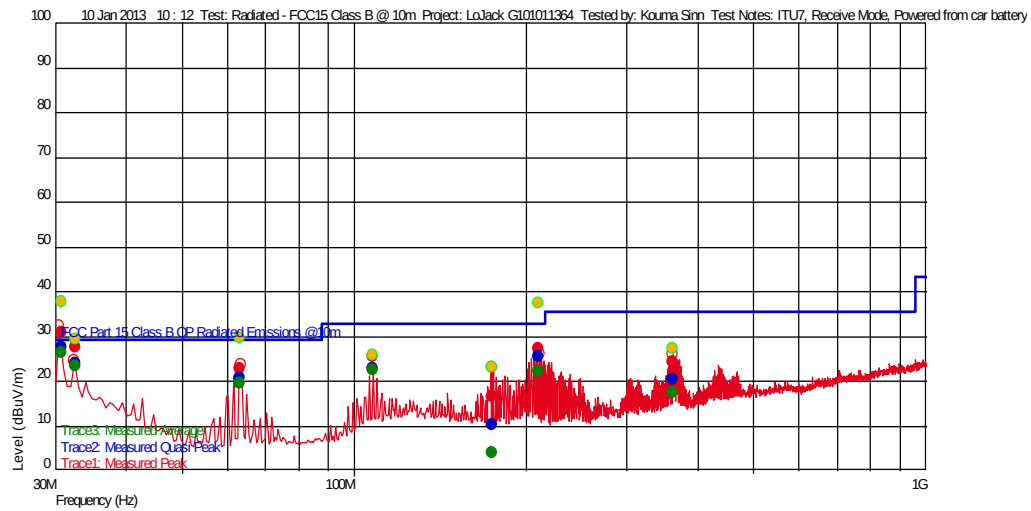
30-1000MHz

Test Information

Test Details
 Test: Radiated - FCC15 Class B @ 10m
 Project: LoJack G101011364
 Test Notes: ITU7, Receive Mode, Powered from car battery
 Temperature: 21C
 Humidity: 20%, 1017mbar
 Tested by: Kouma Sinn
 Test Started: 10 Jan 2013 10 : 12

Additional Information

Prescan Emission Graph



Emissions Test Data

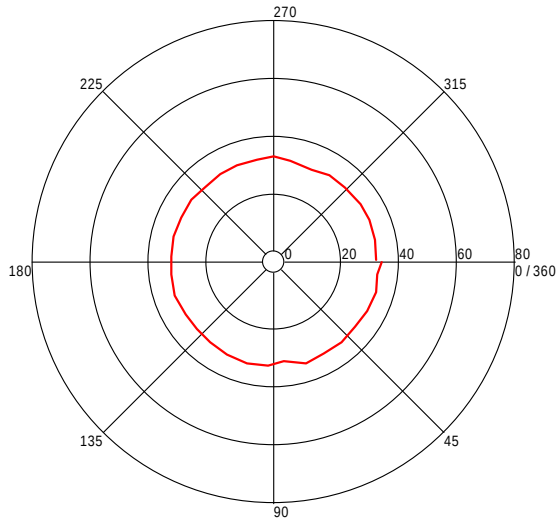
Trace2: Measured Quasi Peak

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
174.470140002 M	10.20	11.600	-24.727	33.040	-22.84		277	1.15	120 k	
361.515631587 M	20.59	15.030	-23.982	35.540	-14.95		261	1.05	120 k	
107.88637278 M	22.71	12.277	-25.409	33.040	-10.33		190	2.80	120 k	
63.330059992 M	20.77	7.766	-26.043	29.540	-8.77		50	3.34	120 k	
210.63747488 M	25.50	10.713	-24.348	33.040	-7.54		221	1.05	120 k	
32.542886052 M	24.12	19.420	-26.419	29.540	-5.42		50	1.75	120 k	
30.879559174 M	27.62	20.508	-26.446	29.540	-1.92		7	3.68	120 k	

Azimuth Plots

Turntable Plot (30.879559174 MHz)

Level (dBuV/m)

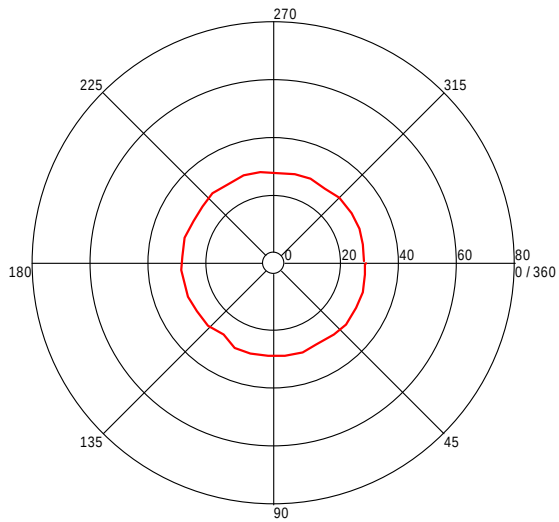


All Polarities

Azimuth (Degrees)

Turntable Plot (32.542886052 MHz)

Level (dBuV/m)

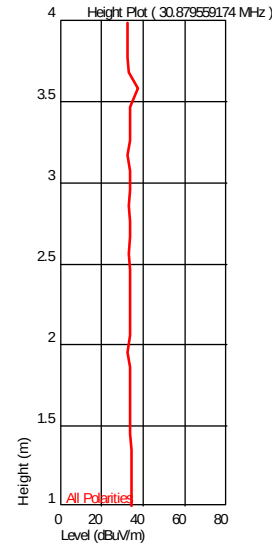


All Polarities

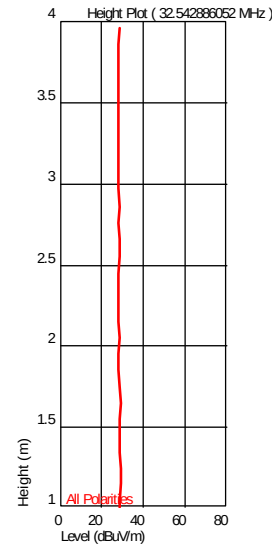
Azimuth (Degrees)

Turntable Plots

Height Plot (30.879559174 MHz)

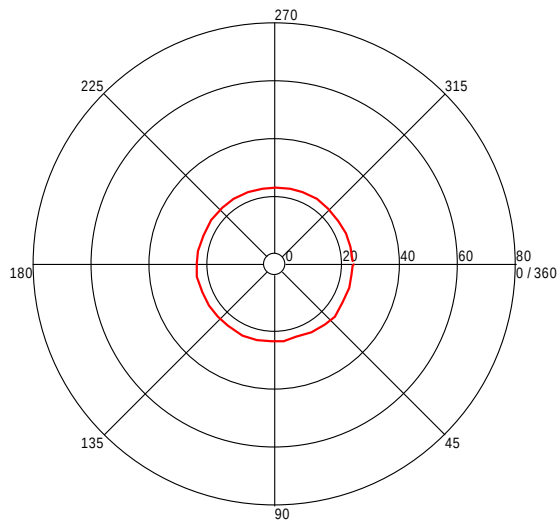


Height Plot (32.542886052 MHz)



Turntable Plot (63.33005992 MHz)

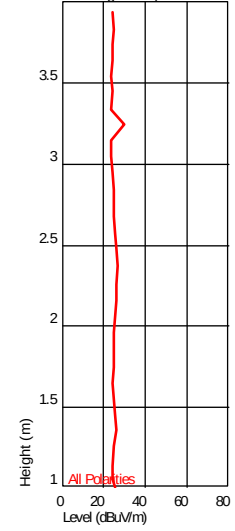
Level (dBuV/m)



All Polarities

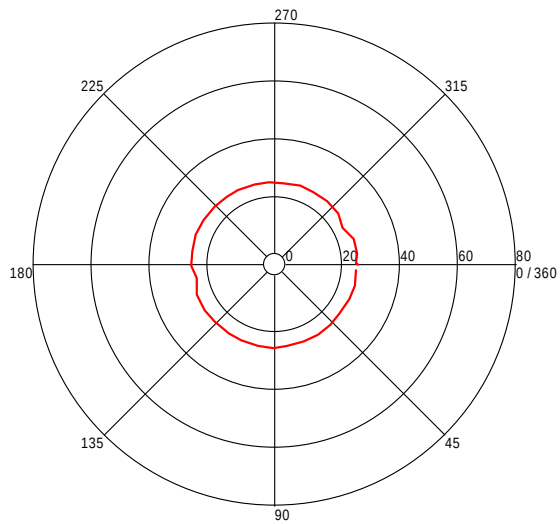
Azimuth (Degrees)

Height Plot (63.33005992 MHz)



Turntable Plot (107.88637278 MHz)

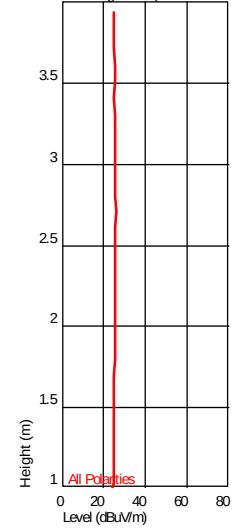
Level (dBuV/m)



All Polarities

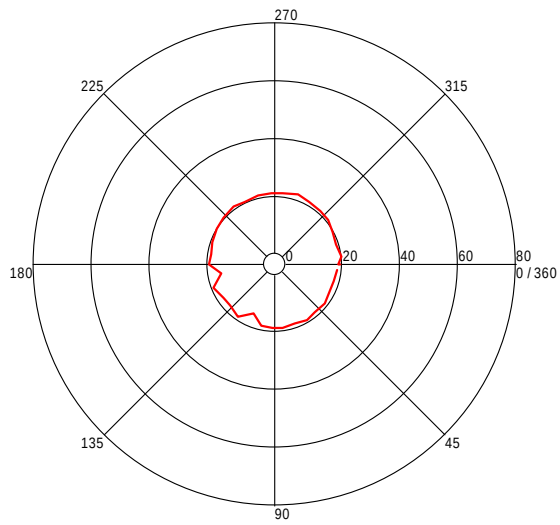
Azimuth (Degrees)

Height Plot (107.88637278 MHz)



Turntable Plot (174.470140002 MHz)

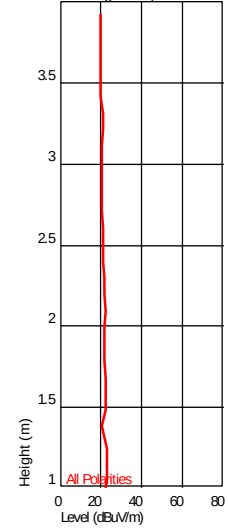
Level (dBuV/m)



All Polarities

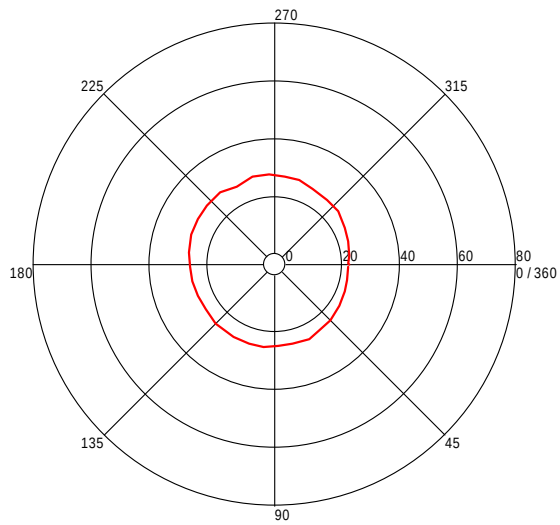
Azimuth (Degrees)

Height Plot (174.470140002 MHz)



Turntable Plot (210.63747488 MHz)

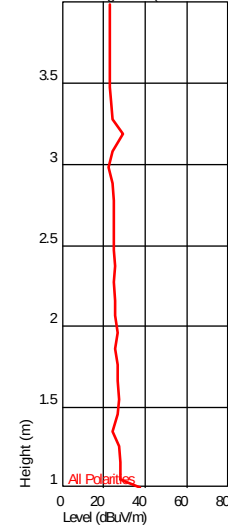
Level (dBuV/m)



All Polarities

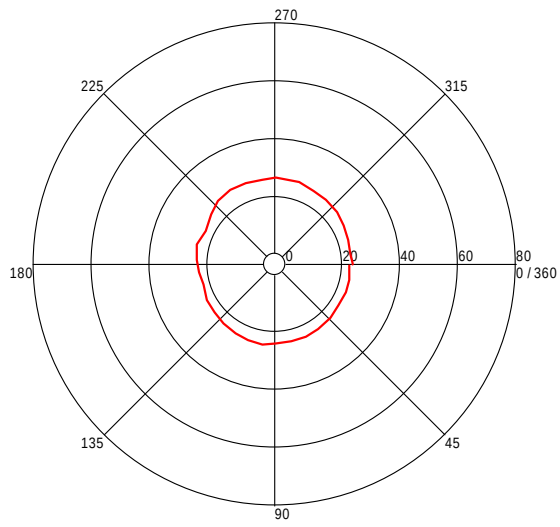
Azimuth (Degrees)

Height Plot (210.63747488 MHz)



Turntable Plot (361.515631587 MHz)

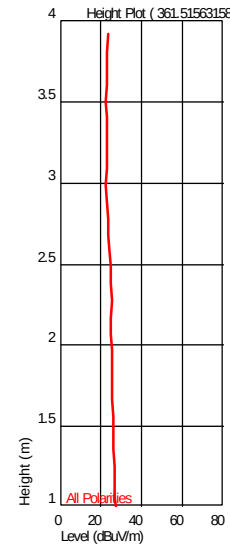
Level (dBuV/m)



All Polarities

Azimuth (Degrees)

Height Plot (361.515631587 MHz)



Height (m)

Level (dBuV/m)

1-2GHz

Test Information

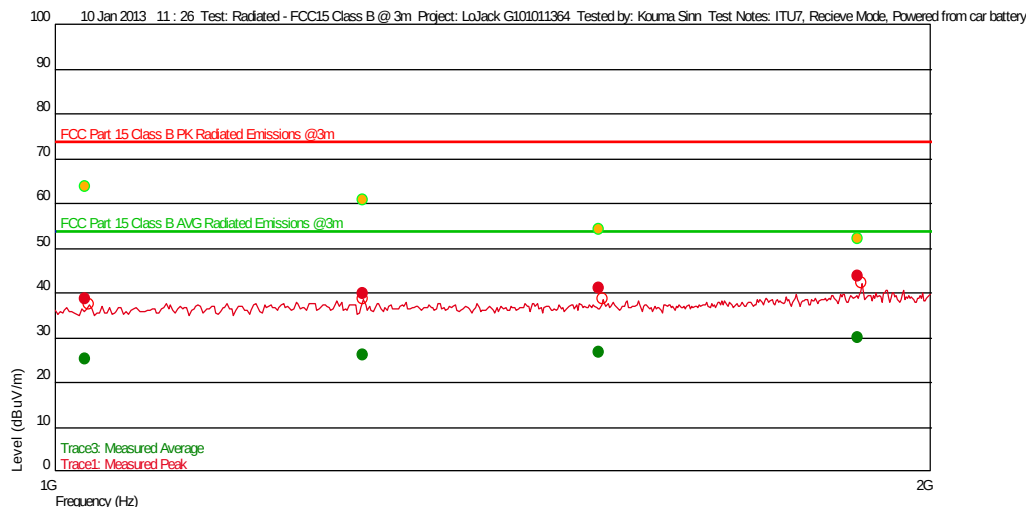
Test Details

Test: Radiated - FCC15 Class B @ 3m
 Project: LoJack G101011364
 Test Notes: ITU7, Recieve Mode, Powered from car battery
 Temperature: 21C
 Humidity: 20%, 1017mbar
 Tested by: Kouma Sinn
 Test Started: 10 Jan 2013 11 : 26

User Entry

Additional Information

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

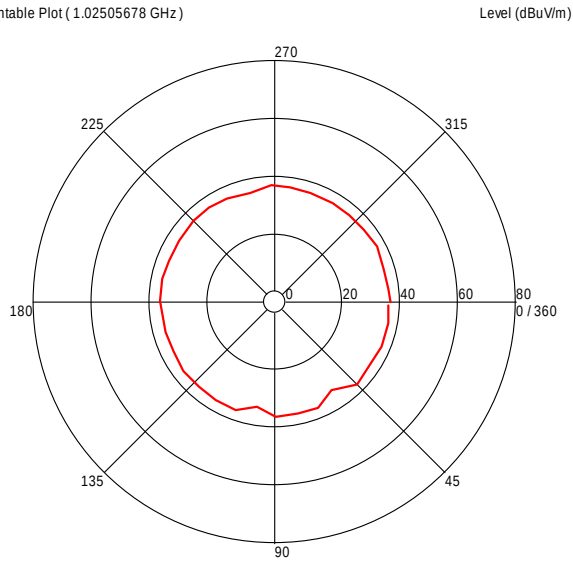
Frequency(Hz)	Level (dBuV/m)	AF	PA+CL	Limit(dBuV/m)	Margin(dBuV/m)	Hor (--), Ver ()	Azimuth (deg)(Deg)	Mast Height(m)	RBW(Hz)	Comment
1.02505678 G	38.68	24.275	-29.452	74.000	-35.32		321	1.57	1 M	
1.276793587 G	39.76	25.673	-28.873	74.000	-34.24	--	158	1.44	1 M	
1.538657314 G	41.05	25.519	-28.325	74.000	-32.95	--	304	2.16	1 M	
1.889111556 G	43.76	27.508	-28.010	74.000	-30.24	--	127	1.69	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
1.02505678 G	25.11	24.275	-29.452	54.000	-28.89		321	1.57	1 M	
1.276793587 G	26.20	25.673	-28.873	54.000	-27.80	--	158	1.44	1 M	
1.538657314 G	26.75	25.519	-28.325	54.000	-27.25	--	304	2.16	1 M	
1.889111556 G	30.06	27.508	-28.010	54.000	-23.94	--	127	1.69	1 M	

Azimuth Plots

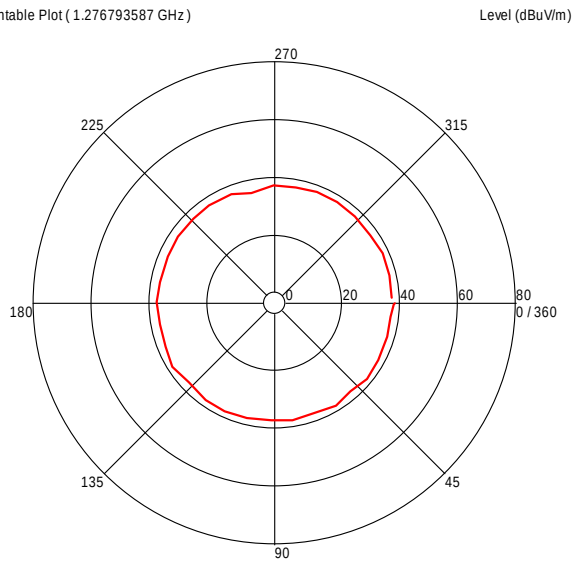
Turntable Plot (1.02505678 GHz)



All Polarities

Azimuth (Degrees)

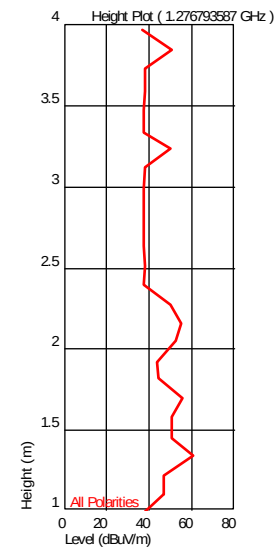
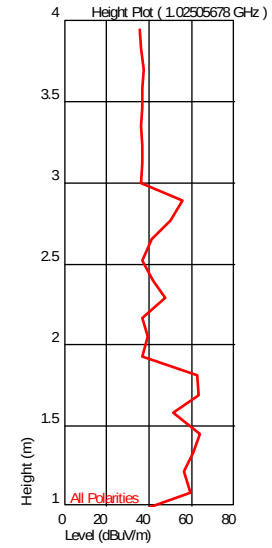
Turntable Plot (1.276793587 GHz)



All Polarities

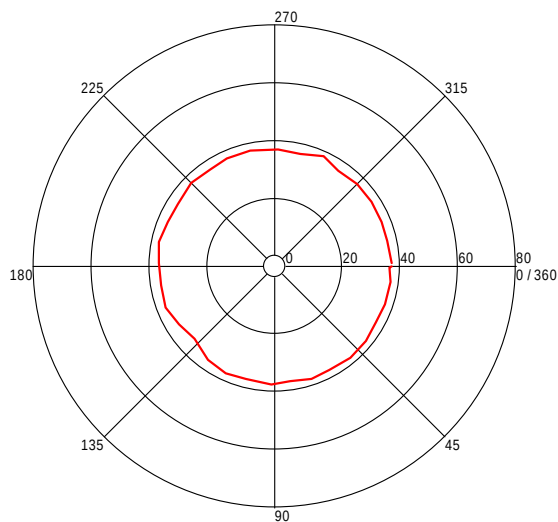
Azimuth (Degrees)

Turntable Plots



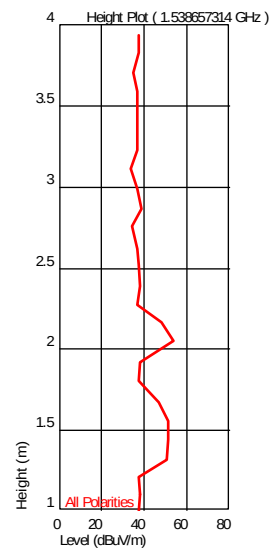
Turntable Plot (1.538657314 GHz)

Level (dBuV/m)



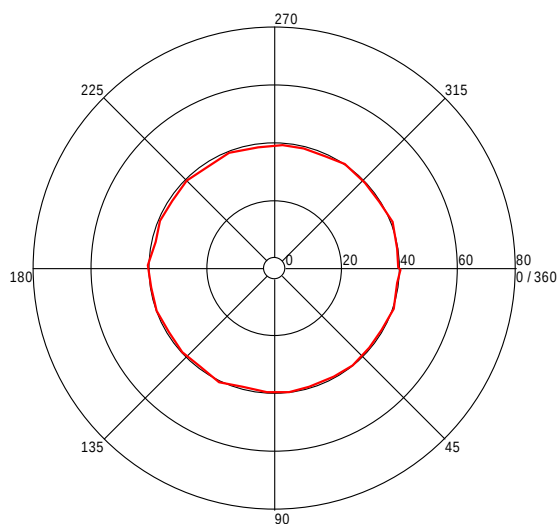
All Polarities

Azimuth (Degrees)



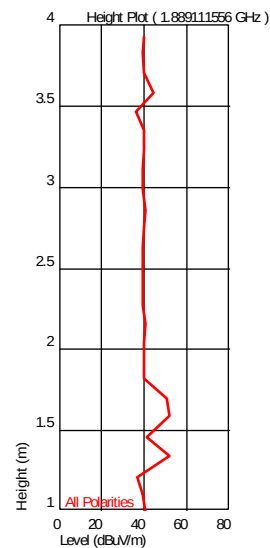
Turntable Plot (1.889111556 GHz)

Level (dBuV/m)



All Polarities

Azimuth (Degrees)



Test Personnel: Kouma Sinn *KPS*
Supervising Engineer: N/A
(Where Applicable)
Product Standard: FCC Part 15 Subpart B,
IC ICES-003, IC RSS-Gen
Input Voltage: 12V Car Battery
Pretest Verification w/
Ambient Signals or
BB Source: Ambient

Test Date: 01/10/2013Test Levels: See resultsAmbient Temperature: 21°CRelative Humidity: 20 %Atmospheric Pressure: 1017 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Notes
0	02/19/2013	101011364BOX-002a	Original Issue