

## EMISSIONS TEST REPORT

Report Number: 100480944BOX-003a

Project Number: G100480944

Report Issue Date: 09/13/2011

Product Designation: NRU

Standards: Industry Canada RSS-119 Issue 10 April 2010, "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"

FCC Part 90:2010, " Private Land Mobile Radio Services"

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

Report reviewed by



Michael F. Murphy / 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 **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

## 2 Test Summary

section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test	--
5	System Setup and Method	--
6	Transmitter 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 and Receiver Out-of-Band Unwanted Emissions, Conducted (IC RSS-119 Sections 4.2, 5.8, 5.11; IC RSS-Gen Section 4.9, 4.10, 6.0; FCC 2.1051, 90.210(d))	Pass
12	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
13	Receiver Radiated Emissions (IC RSS-119 Section 5.11, IC RSS-Gen Sections 4.10, 6.0; FCC 2.1053, 90.210(d))	Pass
14	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
Network Repeater Unit	LoJack Corporation	NRU	OB01712
Network Repeater Unit	LoJack Corporation	NRU	OB014DF <sup>(1)</sup>

<sup>(1)</sup> The GPS electronics in this unit was removed. Only radiated emission test was performed on this unit.

Receive Date:	08/22/2011
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The equipment under test is a Network Repeater Unit.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
12VDC	1A	N/A	N/A

Operating modes of the EUT:	
No.	Descriptions of EUT Exercising
1	The EUT was powered from 12VDC car battery and was programmed to transmit continuously during testing. During the frequency stability and the transient frequency behavior testing, the transmitter was unmodulated.

## 5 System Setup and Method

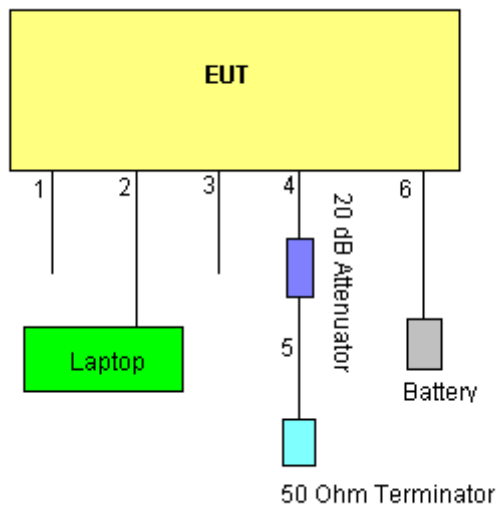
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	RJ45	0.82	Foil	None	None
2	RJ45	2.20	Foil	Yes	Laptop
3	RJ45	0.82	Foil	None	None
4	SMA	0.28	Braid	None	Attenuator
5	SMA	0.28	Braid	None	50 Ohm
6	Battery Leads	1.57	None	None	Battery

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
GPS Antenna	Trimble	PN: 5623	0950002
Laptop	Dell	LATTITUDE D610	C01007899029301310
Laptop Power Supply	Dell	PA-1900-02D	09T215-71615
Marine Battery	None	27DC-2	83996 14169

### 5.1 Method:

Configuration as required by RSS-Gen Issue 3 December 2010 and ANSI C63.4:2003.

### 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:** EMC Lab

**The EMC Lab** has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

**The AMAP Building and Lab** includes general lab space that can be used for testing where a shielded/enclosed environment is not required.

### 6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
BAR1'	Digital 4 Line Barometer	Mannix	0ABA116	BAR1	08/11/2010	08/11/2012
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	01/13/2011	01/13/2012
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/06/2011	01/06/2012
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	06/16/2011	06/16/2012
WEI18'	20 dB, Attenuator DC-18GHz	Weinschel Corp	47-20-34	BP0570	06/16/2011	06/16/2012

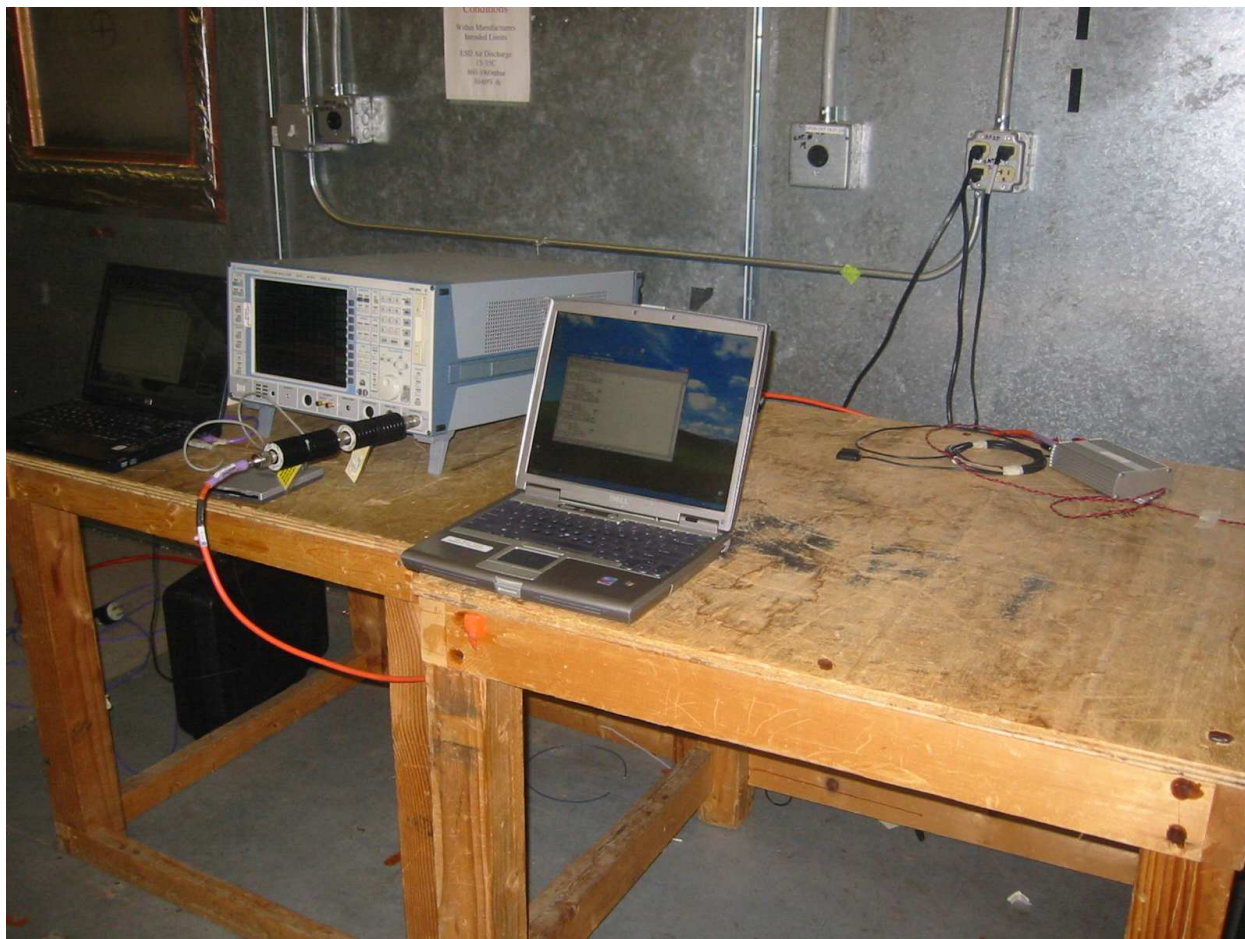
#### Software Utilized:

Name	Manufacturer	Version
None		

### 6.3 Results:

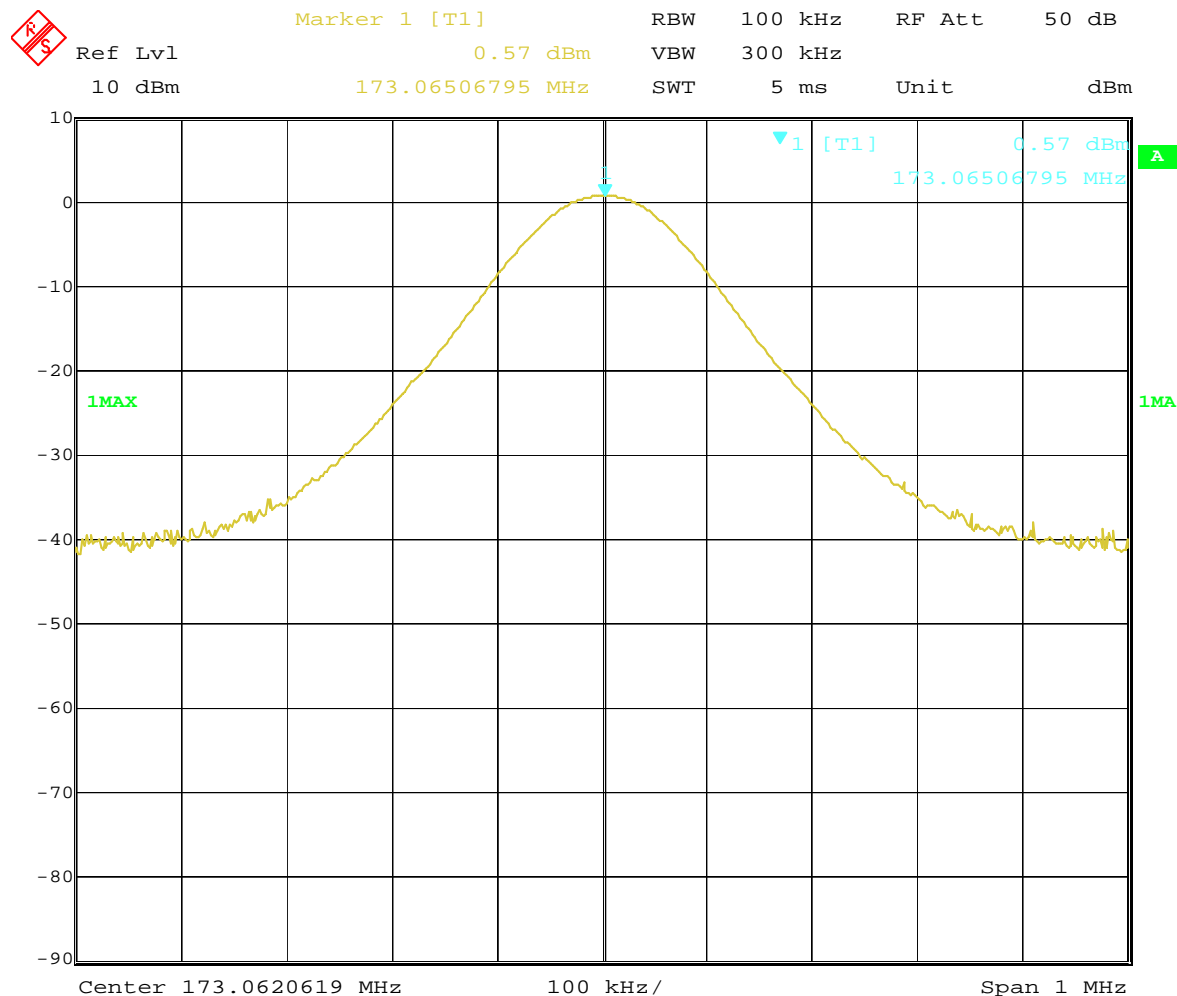
Transmitter output power shall be within  $\pm 1.0$  dB of the manufacturer's rated power.

The sample tested was found to comply.

**6.4 Setup Photograph:**

## 6.5 Test Data:

## Fundamental Frequency Power with MSK Modulation



Date: 25.AUG.2011 11:04:02

## Conducted Power Calculation From Plot Above

Company: LoJack

Model #: NRU

Serial #: OB01712

Engineers: Kouma Sinn

Project #: G100480944

Standard: FCC Part 90 &amp; RSS-119

Receiver: ROS001

PreAmp: NONE.

PreAmp Used? (Y or N): N

Limit Distance (m): N/A

Test Distance (m): N/A

Voltage/Frequency: Car battery

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

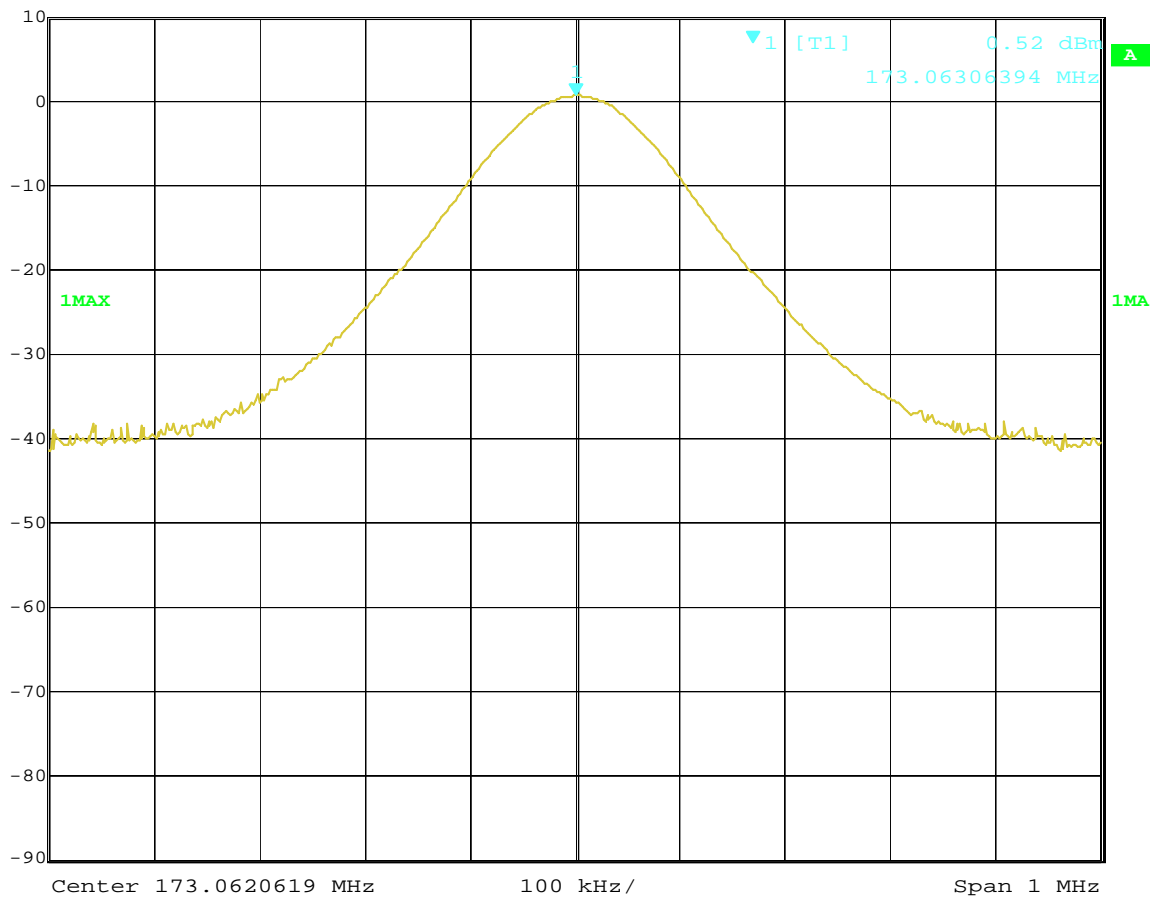
Detector Type	Ant. Pol.	Frequency MHz	Reading dBm	Attenuator Factor dB	Cable Loss dB	Pre-amp Factor N/A	Distance Factor N/A	Net dBm	Rated Power dBm	Margin dB	Bandwidth
MSK modulation = 173.065MHz, raw reading 0.57dBm											
PK	V	173.065	0.57	29.65	0.25	0.00	0.00	30.47	30.00	+0.47	100/300 kHz

Test Equipment Used: WEI 06-16-2012, WEI18 06-16-2012, CBL030 01-06-2012, BAR1, ROS001

## Fundamental Frequency Power with FSK Modulation



Marker 1 [T1] RBW 100 kHz RF Att 50 dB  
 Ref Lvl 0.52 dBm VBW 300 kHz  
 10 dBm 173.06306394 MHz SWT 5 ms Unit dBm



Date: 25.AUG.2011 10:58:14

## Conducted Power Calculation From Plots Above

Company: LoJack  
 Model #: NRU  
 Serial #: OB01712  
 Engineers: Kouma Sinn  
 Project #: G100480944  
 Standard: FCC Part 90 & RSS-119  
 Receiver: ROS001  
 PreAmp: NONE.

Date(s): 08/25/11  
 Location: EMC Lab  
 Barometer: BAR1  
 Temp/Humidity/Pressure: 21C 73% 1004mbar

Attenuator & Cables: N Bands: N, LF, HF, SHF  
 Attenuator: WEI8 06-16-2012.txt WEI18 06-16-2012.txt  
 Cable(s): CBL030 01-06-2012.txt NONE.  
 Filter: NONE

Limit Distance (m): N/A  
 Test Distance (m): N/A

PreAmp Used? (Y or N): N Voltage/Frequency: Car battery 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.	Frequency MHz	Reading dBm	Attenuator Factor dB	Cable Loss dB	Pre-amp Factor N/A	Distance Factor N/A	Net dBm	Rated Power dBm	Margin dB	Bandwidth
FSK modulation = 173.063MHz, raw reading 0.52dBm											
PK	V	173.063	0.52	29.65	0.25	0.00	0.00	30.42	30.00	+0.42	100/300 kHz

Test Equipment Used: WEI 06-16-2012, WEI18 06-16-2012, CBL030 01-06-2012, BAR1, ROS001



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

Test Date: 08/24/2011  
Test Levels: See Section 6.3  
Ambient Temperature: 21 °C  
Relative Humidity: 73 %  
Atmospheric Pressure: 1004 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
SAF768'	Weatherstation	Davis Instruments	Perception II	PE00729A03	01/14/2011	01/14/2012
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	01/13/2011	01/13/2012
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/06/2011	01/06/2012
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	06/16/2011	06/16/2012
WEI18'	20 dB, Attenuator DC-18GHz	Weinschel Corp	47-20-34	BP0570	06/16/2011	06/16/2012

#### Software Utilized:

Name	Manufacturer	Version
None		

### 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

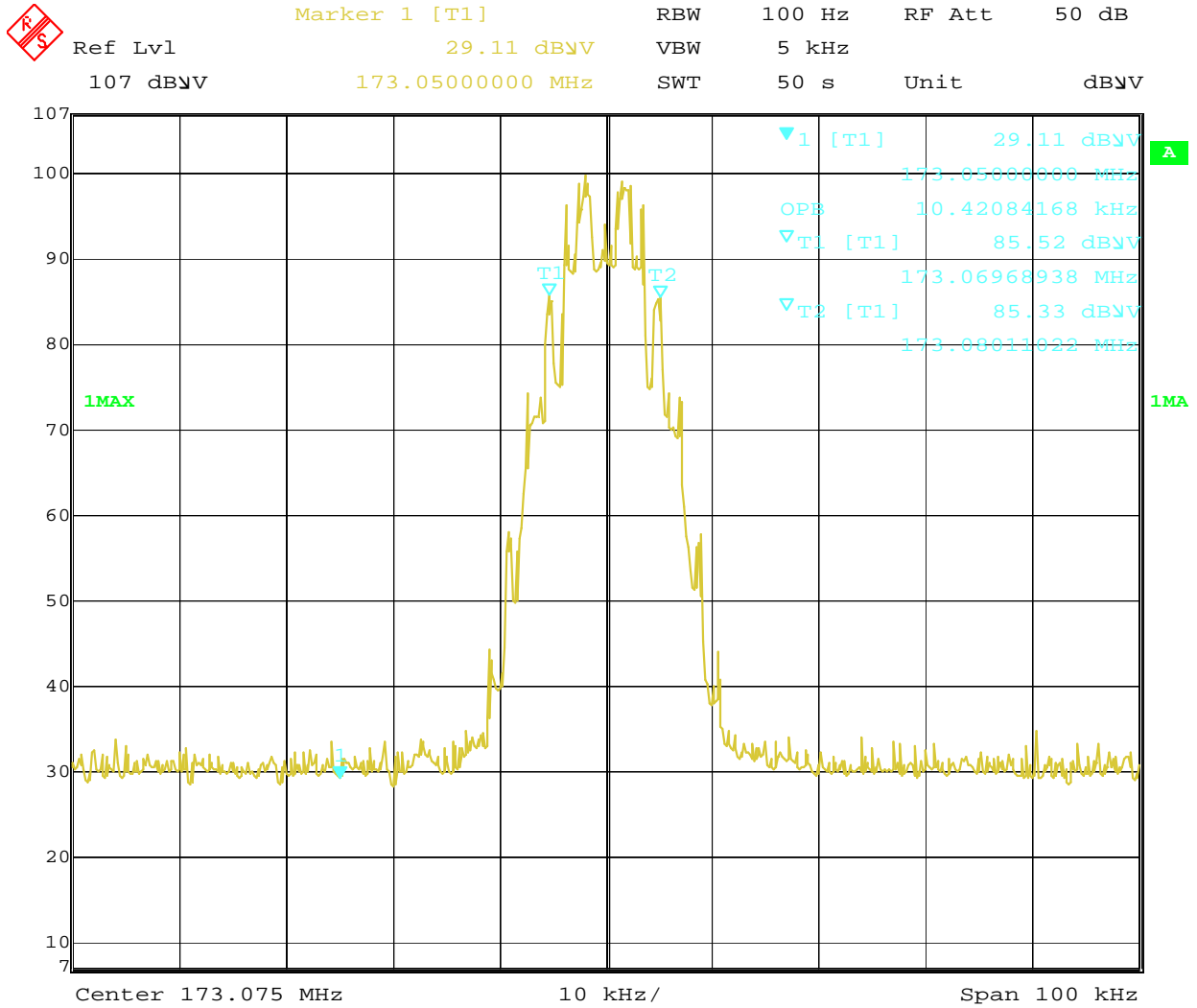
The sample tested was found to comply.

#### 7.4 Setup Photograph:



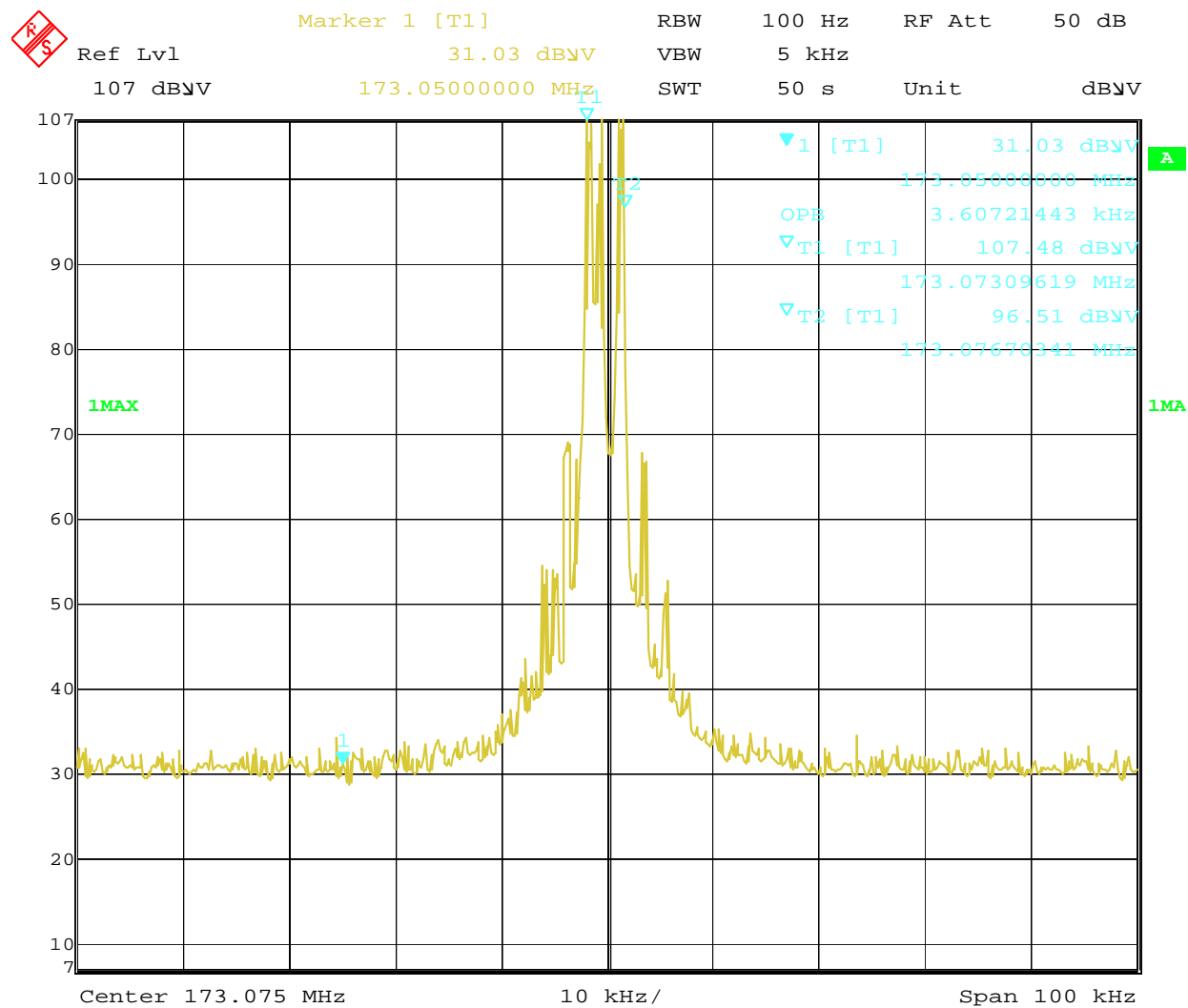
## 7.5 Test Data:

### Occupied Bandwidth with MSK Modulation



Date: 30.AUG.2011 16:17:29

## Occupied Bandwidth with FSK Modulation



Date: 30.AUG.2011 16:28:04

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

Test Date: 08/30/2011  
Test Levels: See Section 7.3  
Ambient Temperature: 22 °C  
Relative Humidity: 48 %  
Atmospheric Pressure: 1008 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

**The AMAP Building and Lab** includes general lab space that can be used for testing where a shielded/enclosed environment is not required.

### 8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	01/13/2011	01/13/2012
WEI18'	20 dB, Attenuator DC-18GHz	Weinschel Corp	47-20-34	BP0570	06/16/2011	06/16/2012
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	06/16/2011	06/16/2012
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/06/2011	01/06/2012
148071'	Digital Multimeter	Fluke	187	89970008	12/20/2010	12/20/2011
146029'	DC Power Supply (0-30 volts 3 amps)	Electro Industries	DIGI 35A	M12/EM 1127-01	VBU	Verified
148012'	Temp/Humidity Chamber	Envirotronics	SH27C	08015563S11263	08/30/2010	08/30/2011

#### Software Utilized:

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

### 8.3 Results:

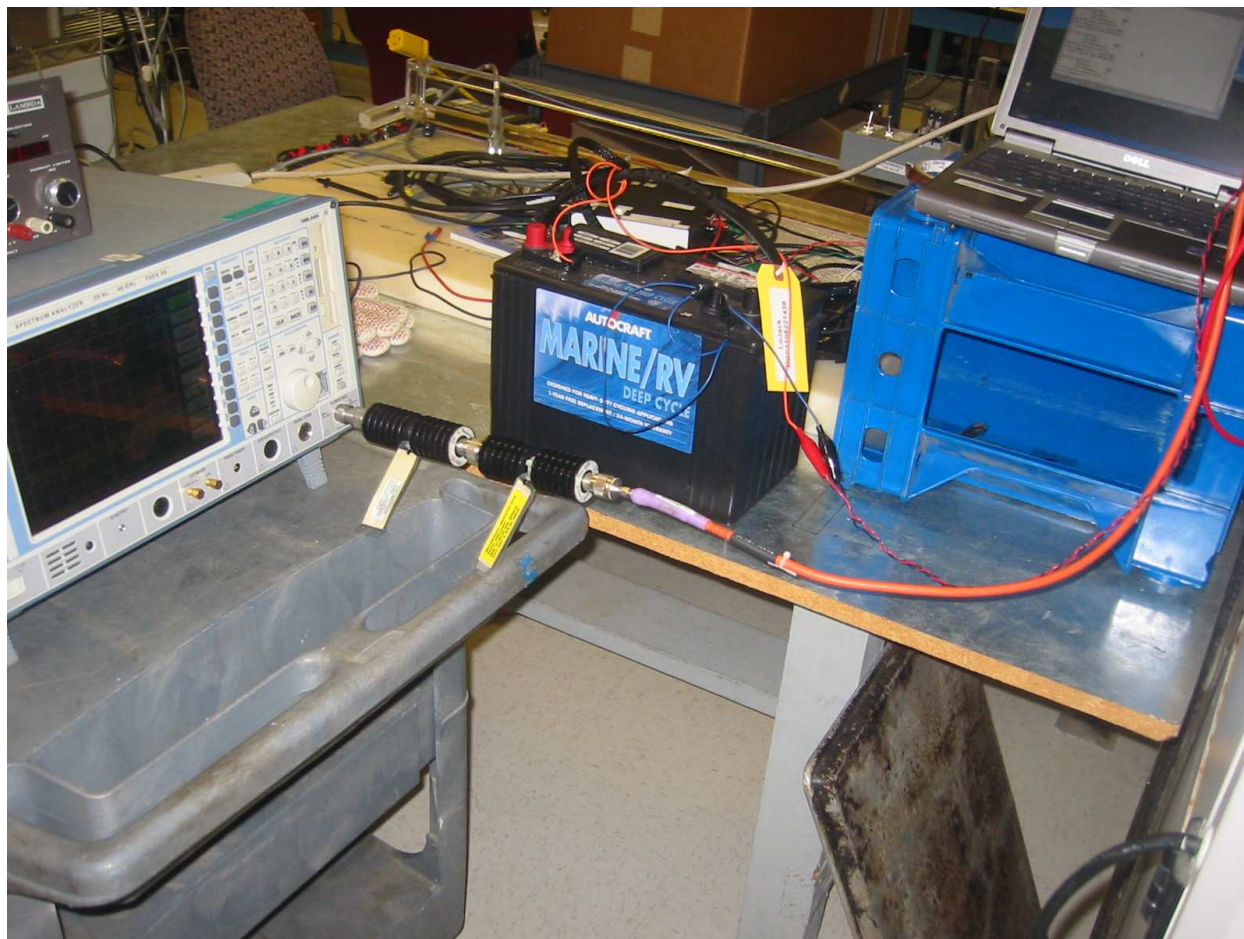
The transmitter carrier frequency shall not depart from the reference frequency in excess of the values given in IC RSS-119 Table 1.

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:



**8.5 Test Data:****Frequency Stability**

Company: LoJack

Model #: NRU

Serial #: OB01712

Engineer(s): Kouma Sinn

Project #: G100480944

Standard: FCC Part 90 &amp; RSS-119

Limit:

5 PPM

Date(s): 08/25/11

Location: AMAP Lab

8/26/2011

Test Equipment Used:

ROS001 WEI18

WEI8 CBL030

148-012 148-071

146-029

Nominal f: 173.07515 MHz

Voltage: 12 VDC

8/26/2011

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	10.2	173.057150	0	0.87
+0%	12	173.057150	0	0.87
+15%	13.8	173.057150	0	0.87

8/25/2011

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-30	173.074649	-0.501	0.87
-20	173.074900	-0.2505	0.87
-10	173.075515	0.36473	0.87
0	173.075150	0	0.87
10	173.075150	0	0.87
20	173.075150	0	0.87
30	173.075150	0	0.87
40	173.074649	-0.501	0.87
50	173.075401	0.2505	0.87

Test Personnel: Kouma Sinn *KPS*  
 Product Standard: IC RSS-119, FCC Part 90  
 Input Voltage: Car battery

Pretest Verification w/

BB Source: No

Test Date: 08/25/2011, 08/26/2011  
 Test Levels: See Section 8.3  
 Ambient Temperature: 21, 25 °C  
 Relative Humidity: 73, 45 %  
 Atmospheric Pressure: 1004, 1007 mbars

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
HEW63'	Generator, Signal	Hewlett Packard	8648C	3847A05291	01/17/2011	01/17/2012
MIN005'	Splitter/Combiner 2-Way 10-2000 MHz	Mini Circuits	ZESC-2-11	none	12/02/2003	Verified
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	06/16/2011	06/16/2012
WEI18'	20 dB, Attenuator DC-18GHz	Weinschel Corp	47-20-34	BP0570	06/16/2011	06/16/2012
HEW65'	Measuring Receiver	Hewlett Packard	8902A	3749A04397	06/27/2011	06/27/2012
AGL002'	1GHz 4CH O'Scope	Agilent Technologies	DSO6104A	MY44008115	07/12/2011	07/12/2012
WER4'	COUPLER, BI-DIRECTIONAL	Werlatone inc.	C3910	5284	04/18/2011	04/18/2012
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	01/13/2011	01/13/2012

#### 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 <sup>1, 2</sup>	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138-174 MHz	406.1-512 MHz
25	t <sub>1</sub>	±25	5	10
	t <sub>2</sub>	±12.5	20	25
	t <sub>3</sub>	±25	5	10
12.5	t <sub>1</sub>	±12.5	5	10
	t <sub>2</sub>	±6.25	20	25
	t <sub>3</sub>	±12.5	5	10
6.25	t <sub>1</sub>	±6.25	5	10
	t <sub>2</sub>	±3.125	20	25
	t <sub>3</sub>	±6.25	5	10

<sup>1</sup> t<sub>on</sub>: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t<sub>1</sub>: the time period immediately following t<sub>on</sub>.

t<sub>2</sub>: the time period immediately following t<sub>1</sub>.

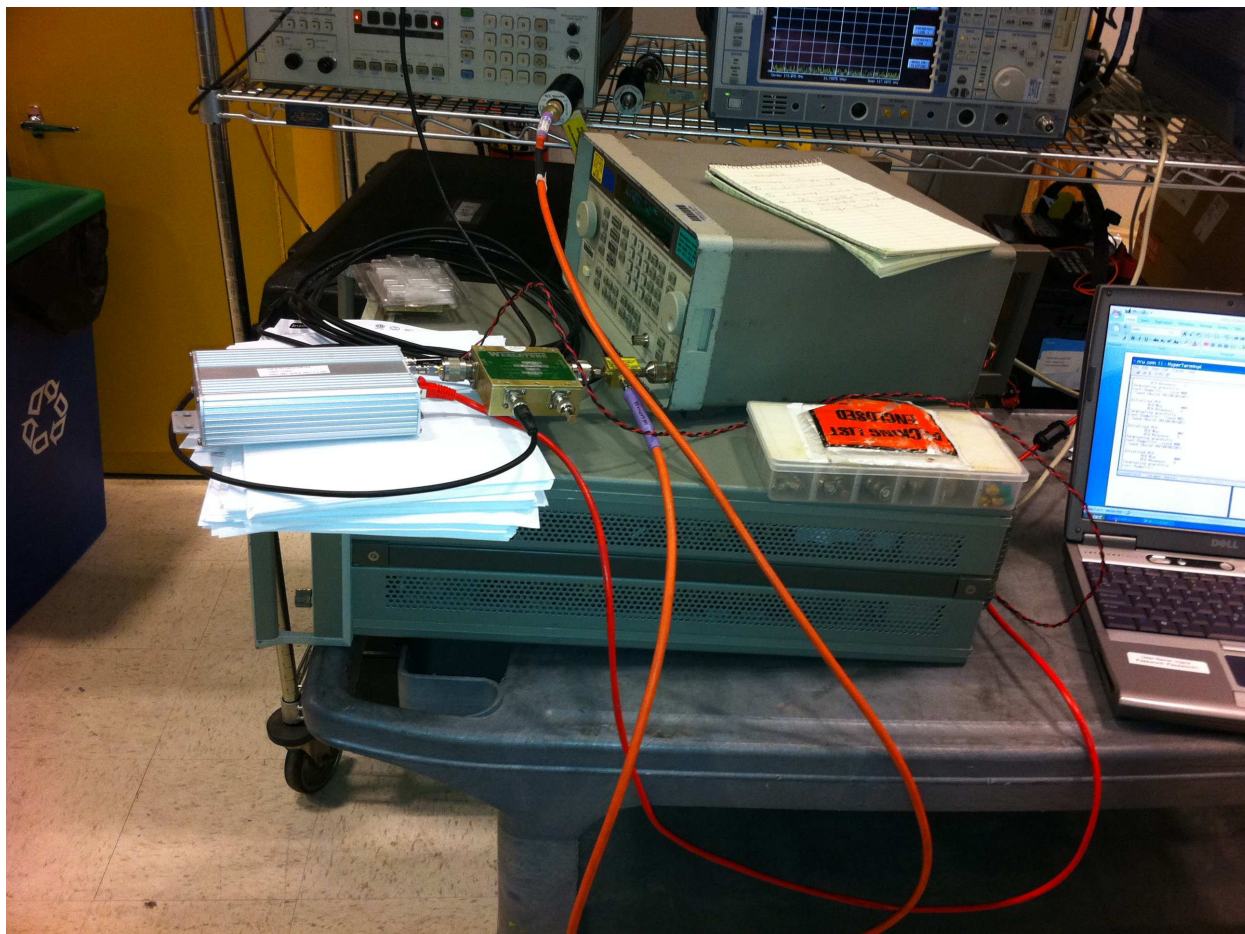
t<sub>3</sub>: the time period from the instant when the transmitter is turned off until t<sub>off</sub>.

t<sub>off</sub>: the instant when the 1 kHz test signal starts to rise.

<sup>2</sup> If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t<sub>1</sub> and t<sub>3</sub> may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t<sub>1</sub> and t<sub>3</sub> shall be recorded in the test report.

The sample tested was found to comply.

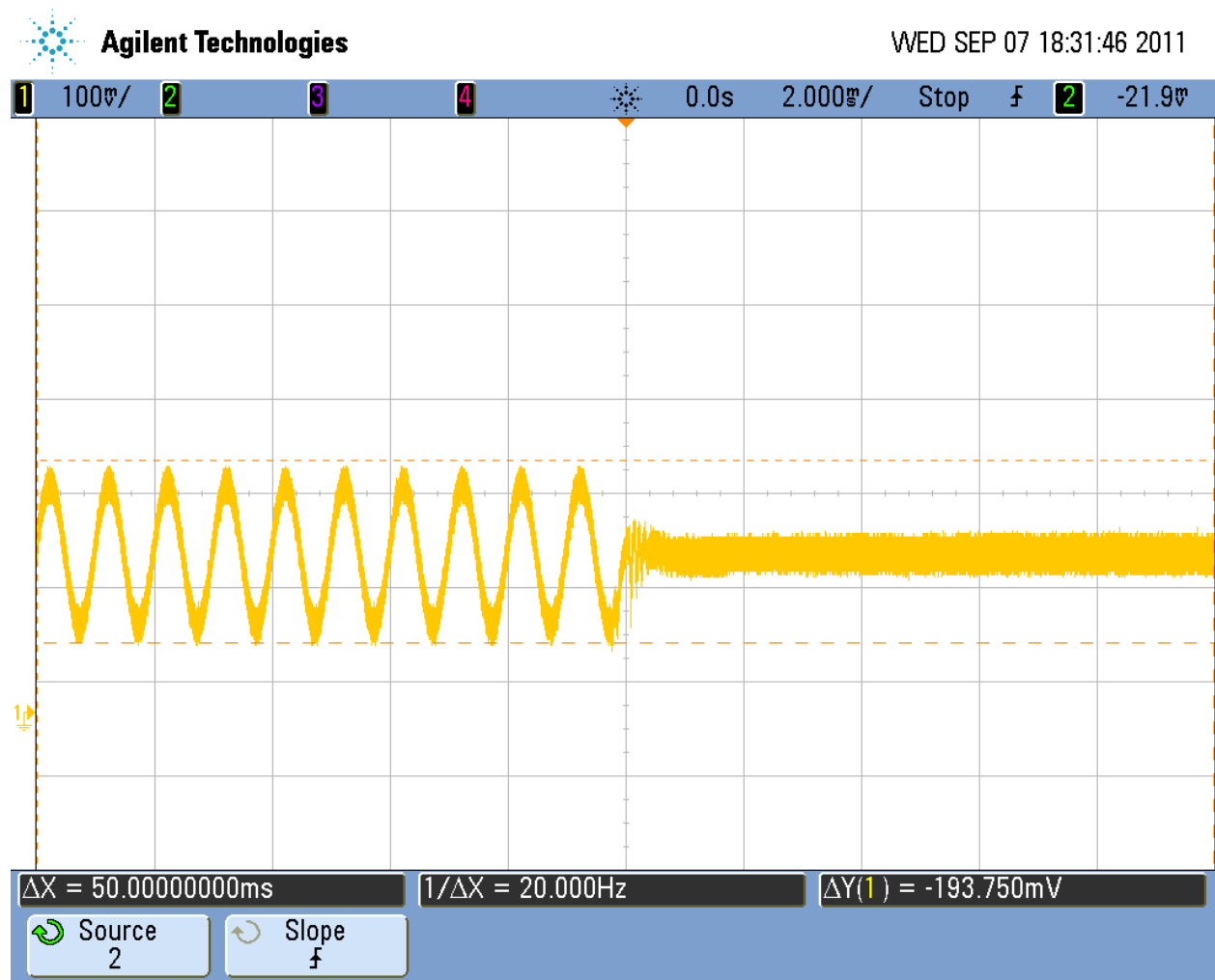
#### 9.4 Setup Photograph:





## 9.5 Test Data:

T<sub>1</sub>

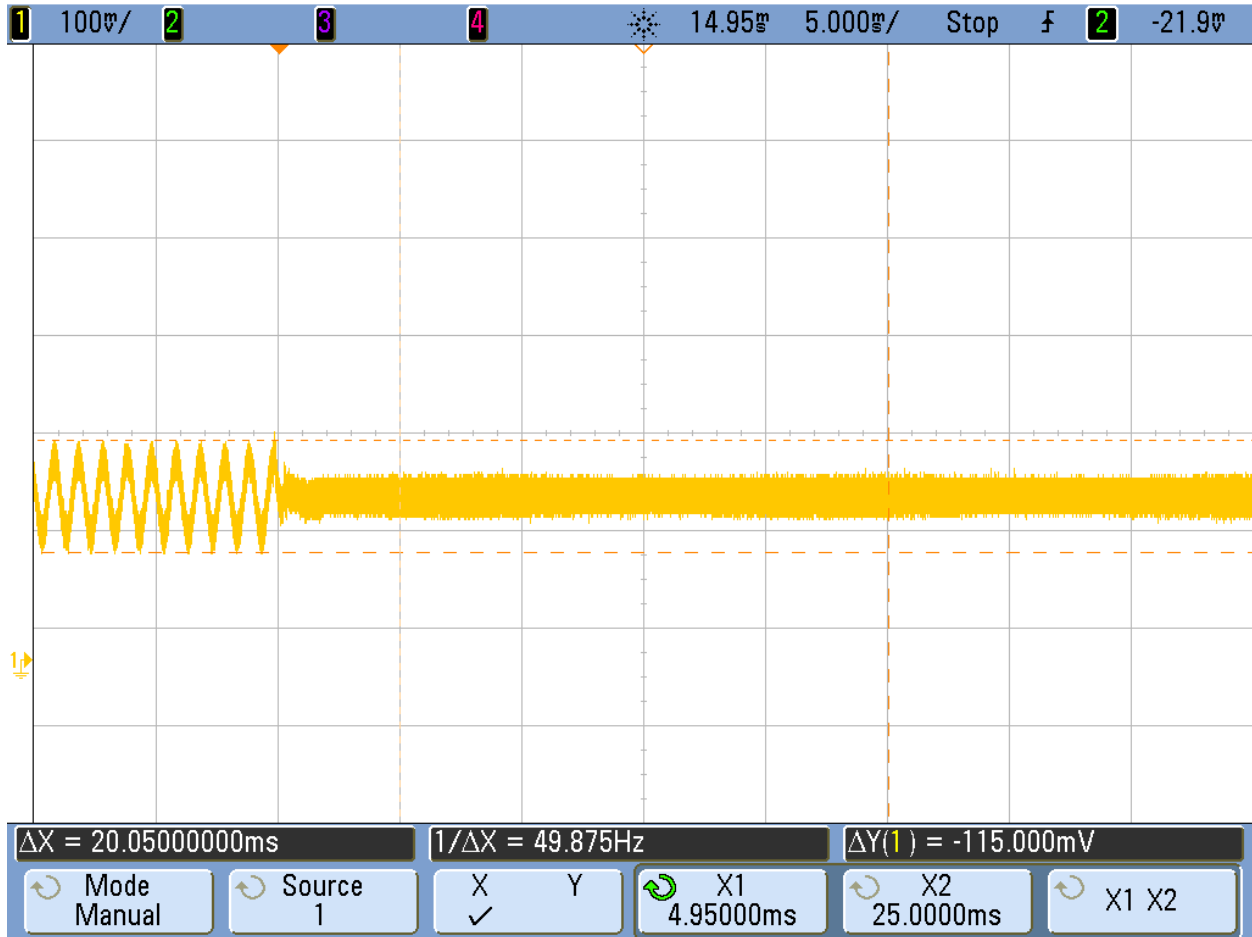


T<sub>2</sub>



Agilent Technologies

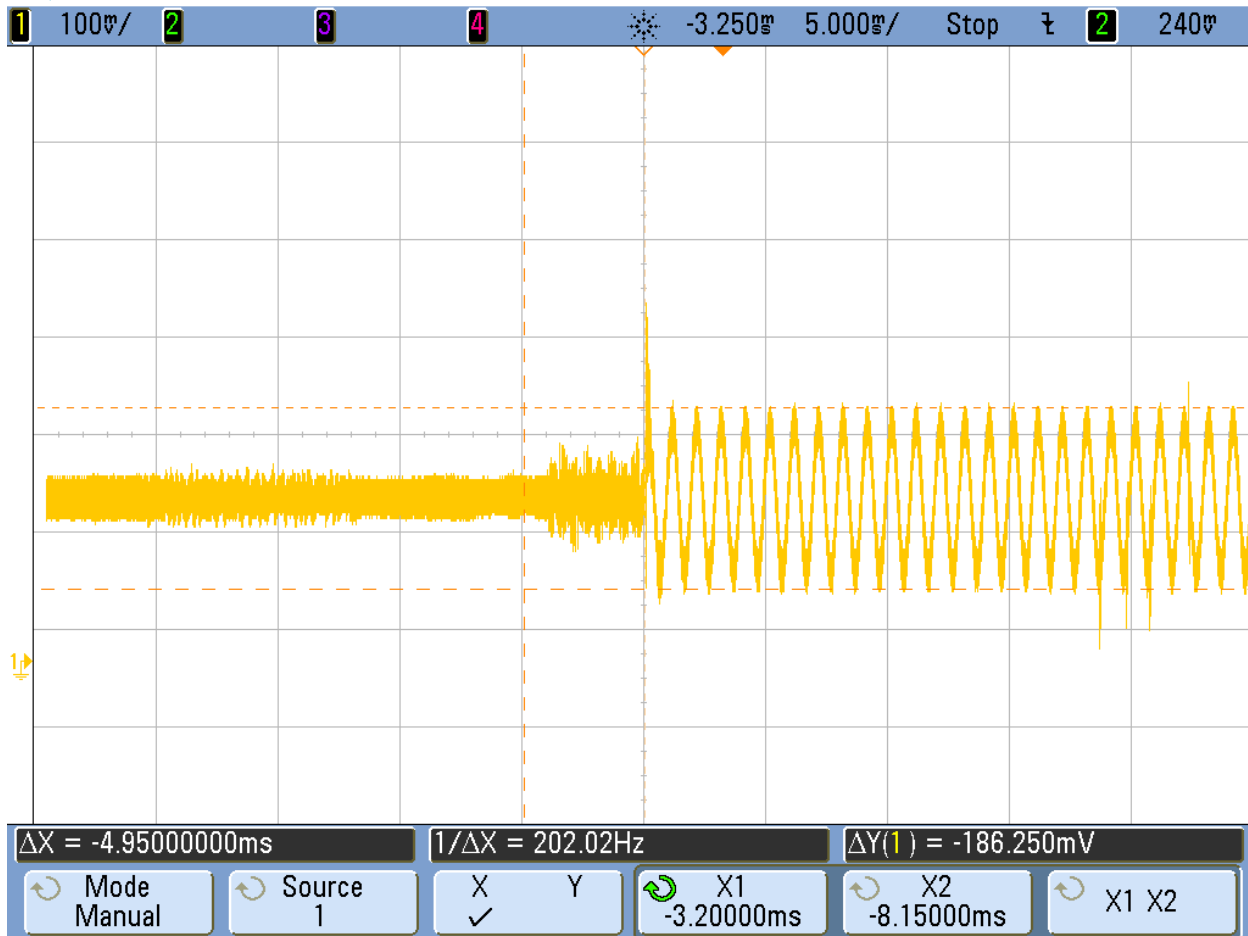
WED SEP 07 18:36:40 2011



T<sub>3</sub>

Agilent Technologies

WED SEP 07 19:47:36 2011



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

Test Date: 09/07/2011  
Test Levels: See Section 9.3  
Ambient Temperature: 20 °C  
Relative Humidity: 74 %  
Atmospheric Pressure: 1012 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
SAF768	Weatherstation	Davis Instruments	Perception II	PE00729A03	01/14/2011	01/14/2012
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	01/13/2011	01/13/2012
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/06/2011	01/06/2012
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	06/16/2011	06/16/2012
WEI18'	20 dB, Attenuator DC-18GHz	Weinschel Corp	47-20-34	BP0570	06/16/2011	06/16/2012

#### Software Utilized:

Name	Manufacturer	Version
None		

### 10.3 Results:

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

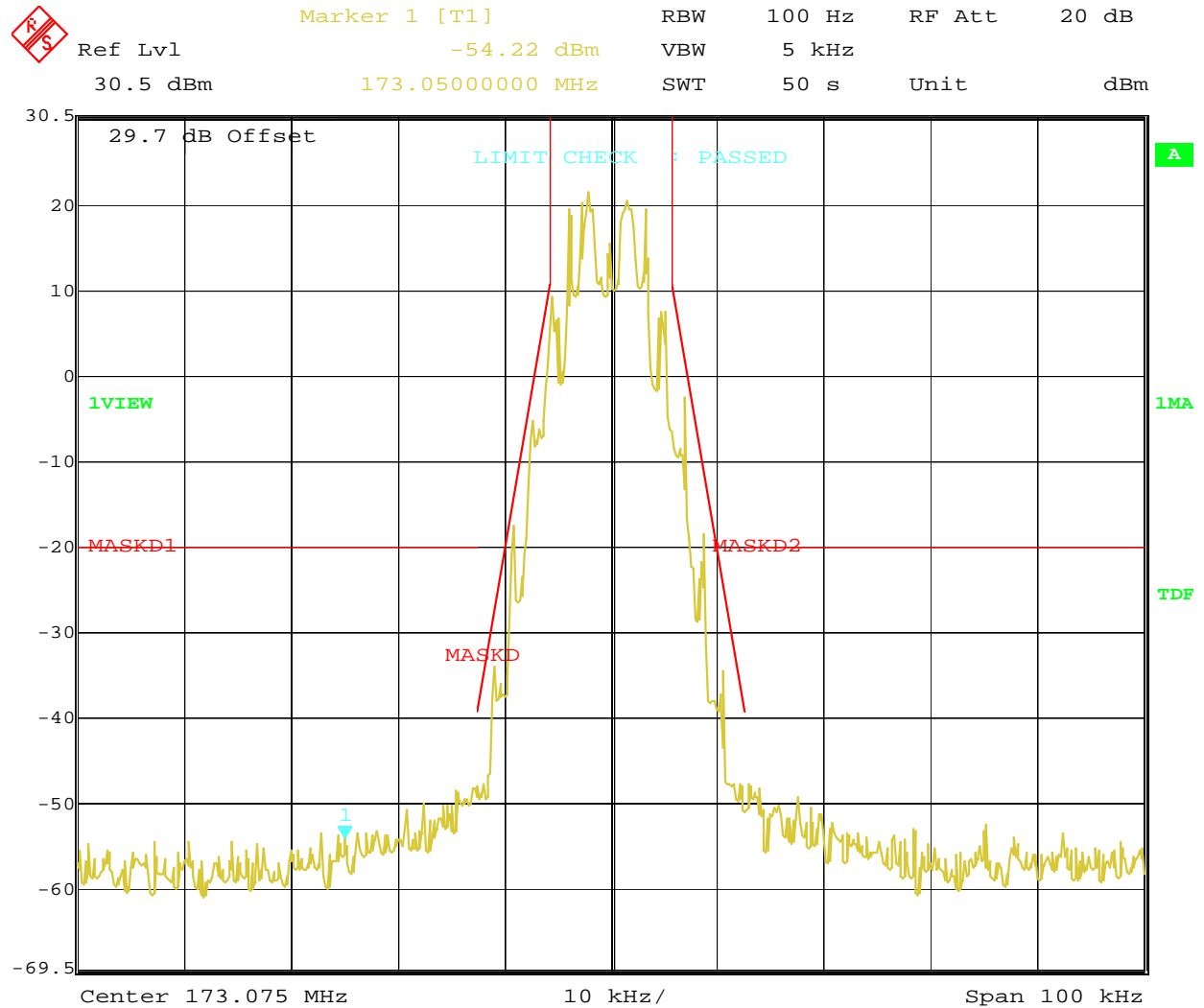
The sample tested was found to comply.

#### 10.4 Setup Photograph:



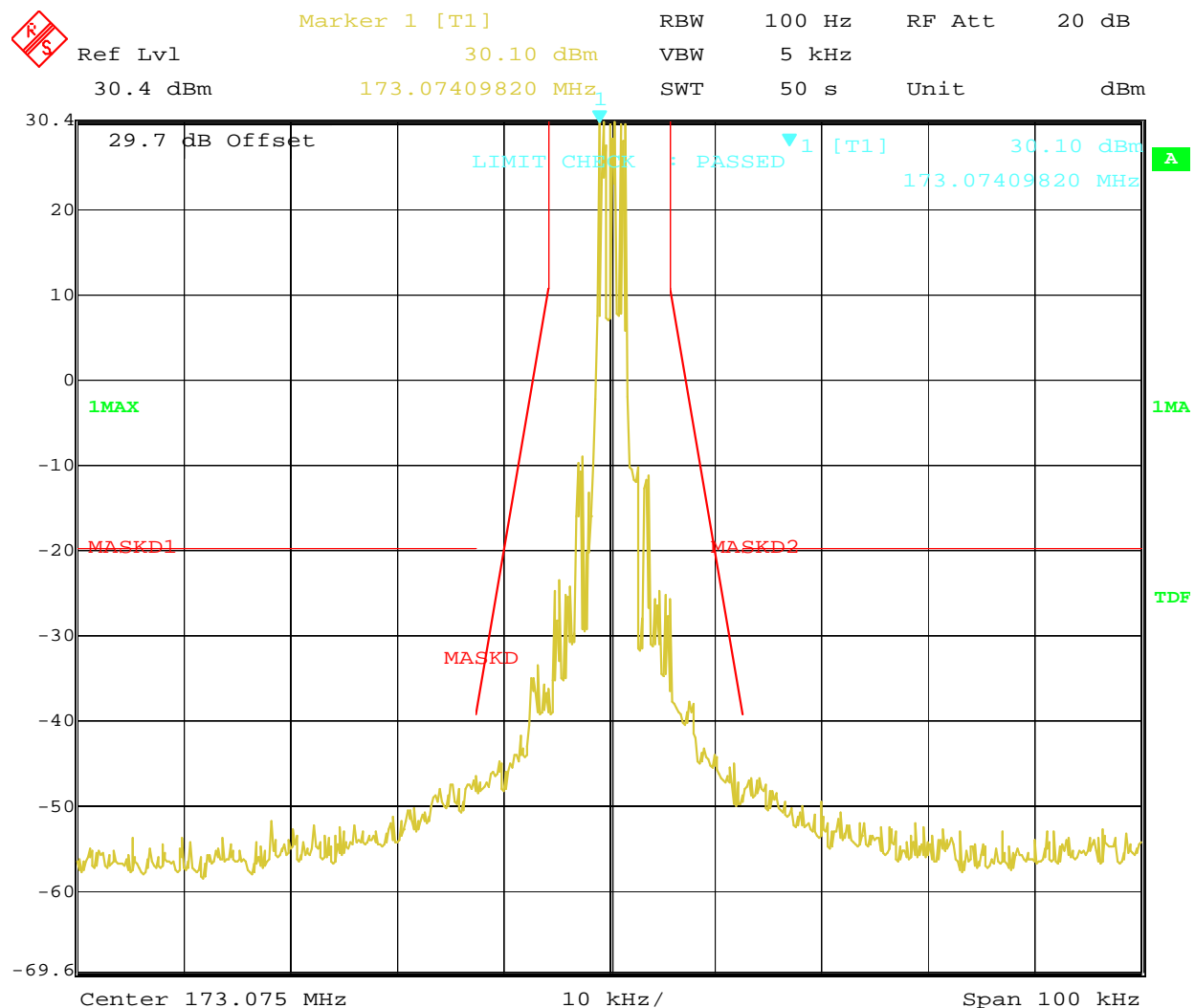
# 10.5 Test Data:

## Emission Mask D with MSK Modulation



Date: 30.AUG.2011 15:48:18

## Emission Mask D with FSK Modulation



Date: 30.AUG.2011 16:39:00

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

Test Date: 08/30/2011  
Test Levels: See Section 7.3  
Ambient Temperature: 22 °C  
Relative Humidity: 48 %  
Atmospheric Pressure: 1008 mbars

Deviations, Additions, or Exclusions: None

## 11 Transmitter and Receiver Unwanted Out-of-Band Emissions, Conducted

### 11.1 Method

Tests are performed in accordance with (IC RSS-119 Sections 4.2, 5.8, 5.11; IC RSS-Gen Section 4.9, 4.10, 6.0 and FCC 2.1051, 90.210(d)

**TEST SITE:** EMC Lab

**The EMC Lab** has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

**The AMAP Building and Lab** includes general lab space that can be used for testing where a shielded/enclosed environment is not required.

### 11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
BAR1'	Digital 4 Line Barometer	Mannix	0ABA116	BAR1	08/11/2010	08/11/2012
ROS001'	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	01/13/2011	01/13/2012
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/06/2011	01/06/2012
WEI8'	Attenuator	Weinschel Corp	47-10-34	BD8309	06/16/2011	06/16/2012
WEI18'	20 dB, Attenuator DC-18GHz	Weinschel Corp	47-20-34	BP0570	06/16/2011	06/16/2012

#### Software Utilized:

Name	Manufacturer	Version
None		

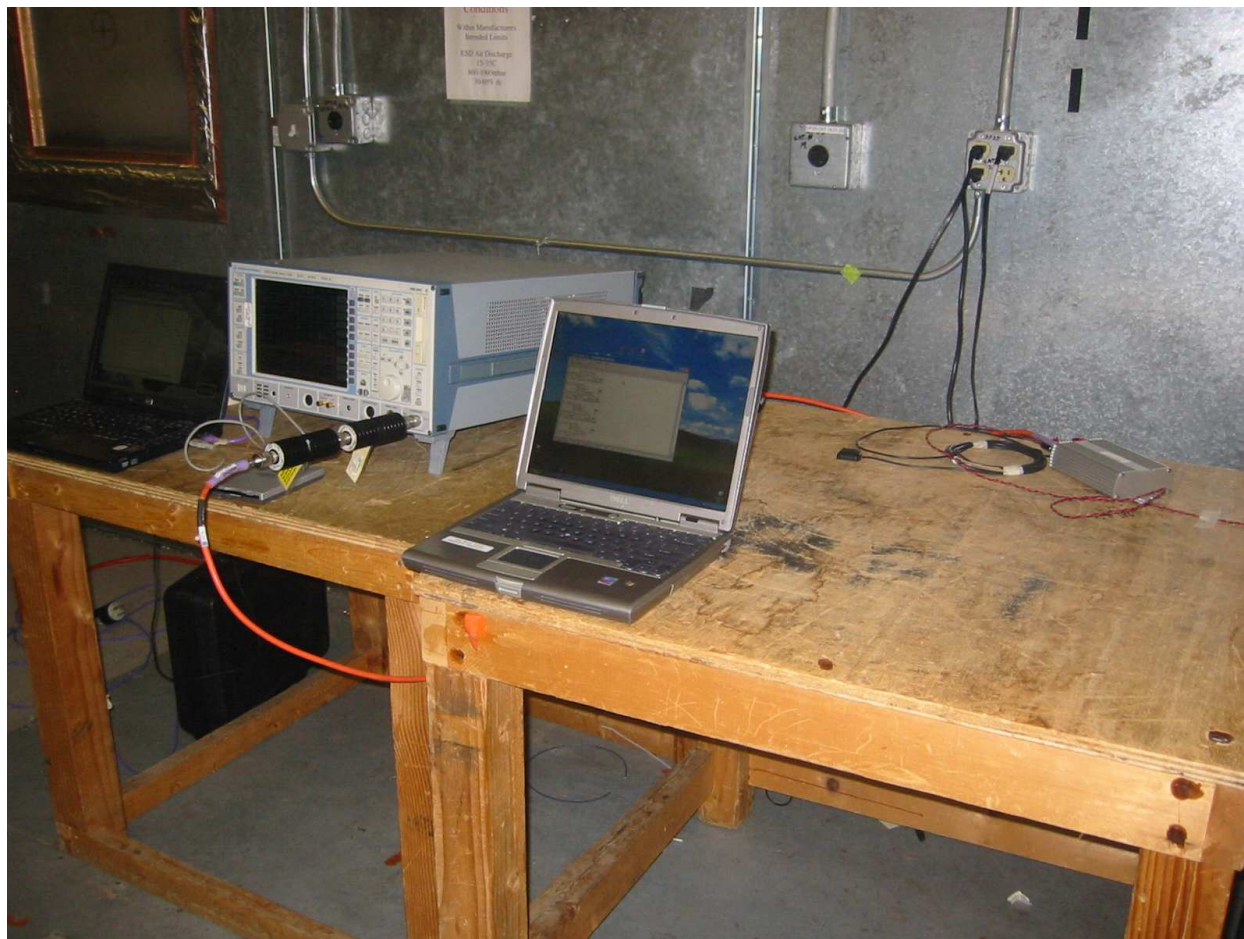
### 11.3 Results:

Transmitter unwanted out-of-band emissions must meet the limits of IC RSS-119 Section 5.8. Emissions must be below -20 dBm.

Receiver unwanted out-of-band emissions must meet the limits of IC RSS-Gen Section 6.2. Emissions must be below -57 dBm in the range from 30-1000 MHz and must be below -53 dBm in the range from 1-2 GHz.

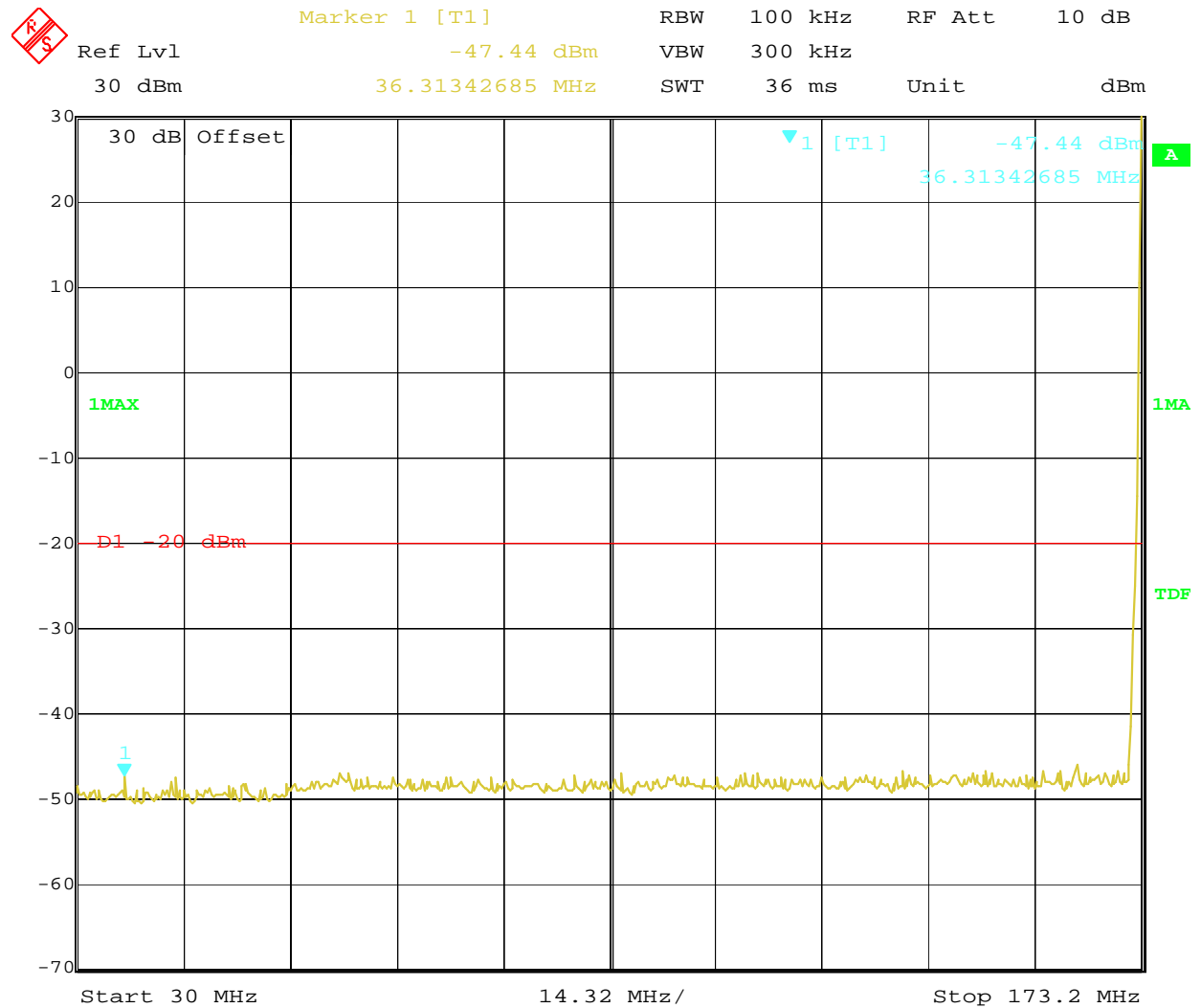
The sample tested was found to comply.

#### 11.4 Setup Photograph:



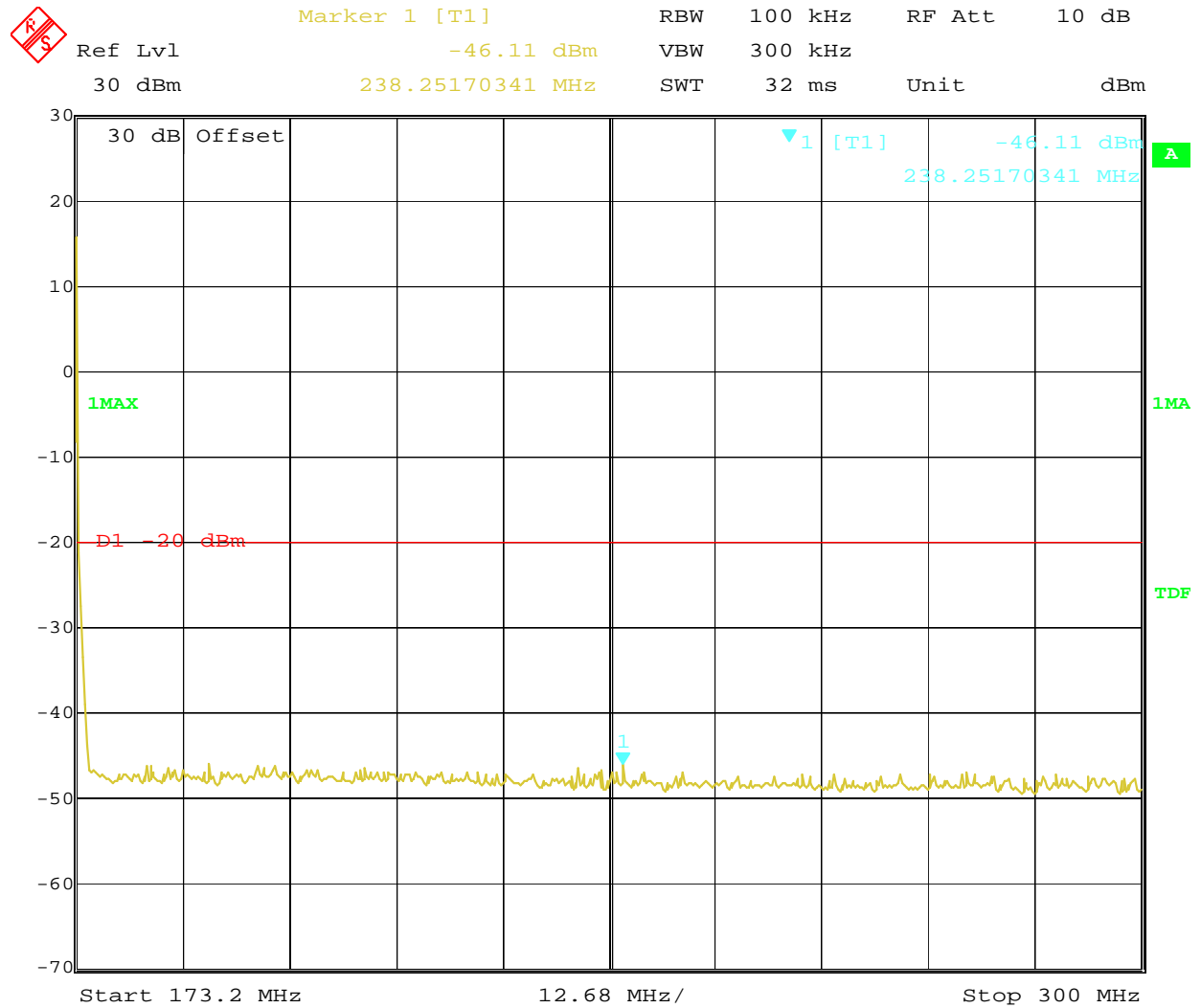
### 11.5 Test Data:

Transmit Mode (MSK Modulation) 30-173.2 MHz



Date: 26.AUG.2011 11:53:11

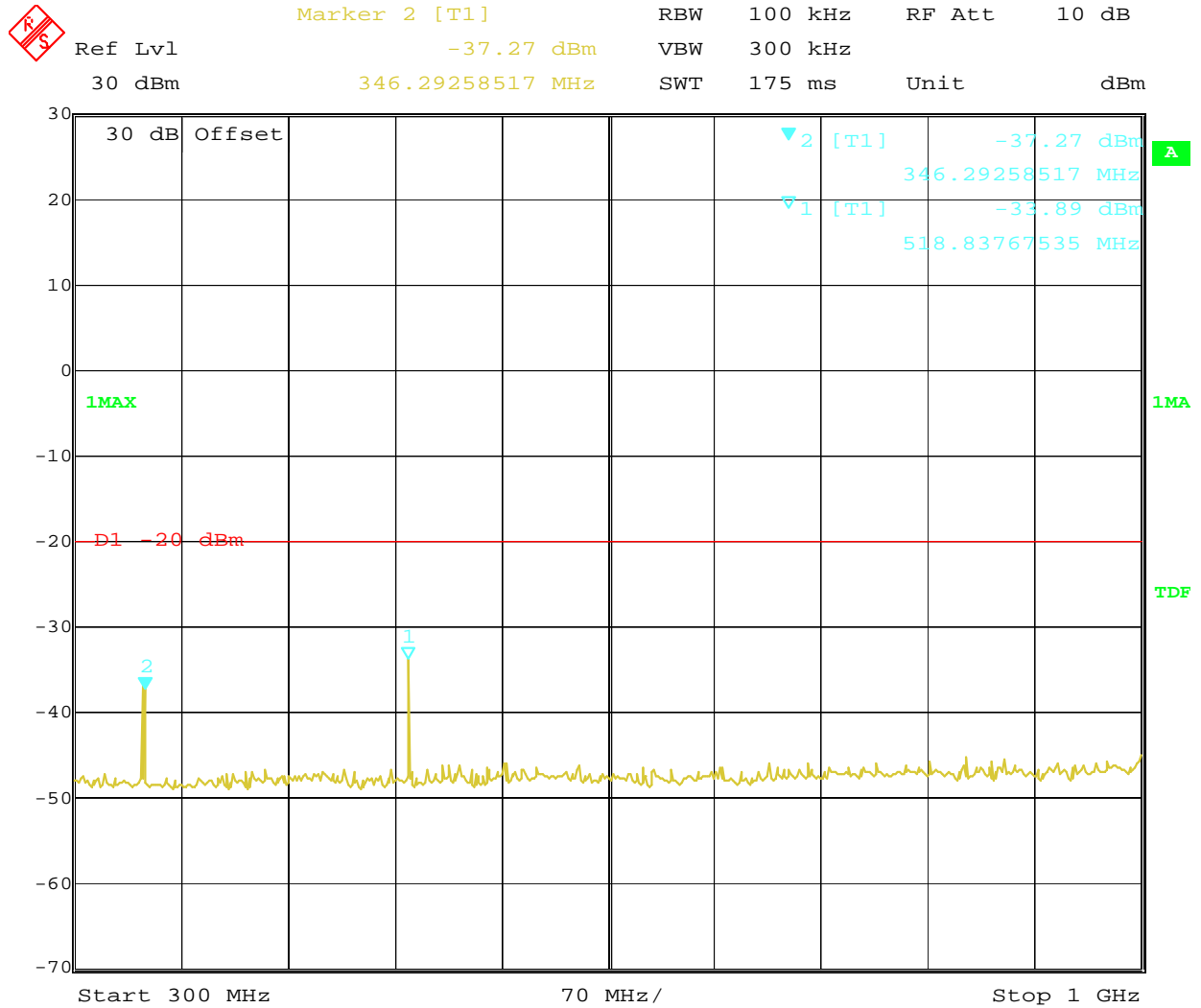
Transmit Mode (MSK Modulation) 173.2-300 MHz



Date: 26.AUG.2011 11:55:00

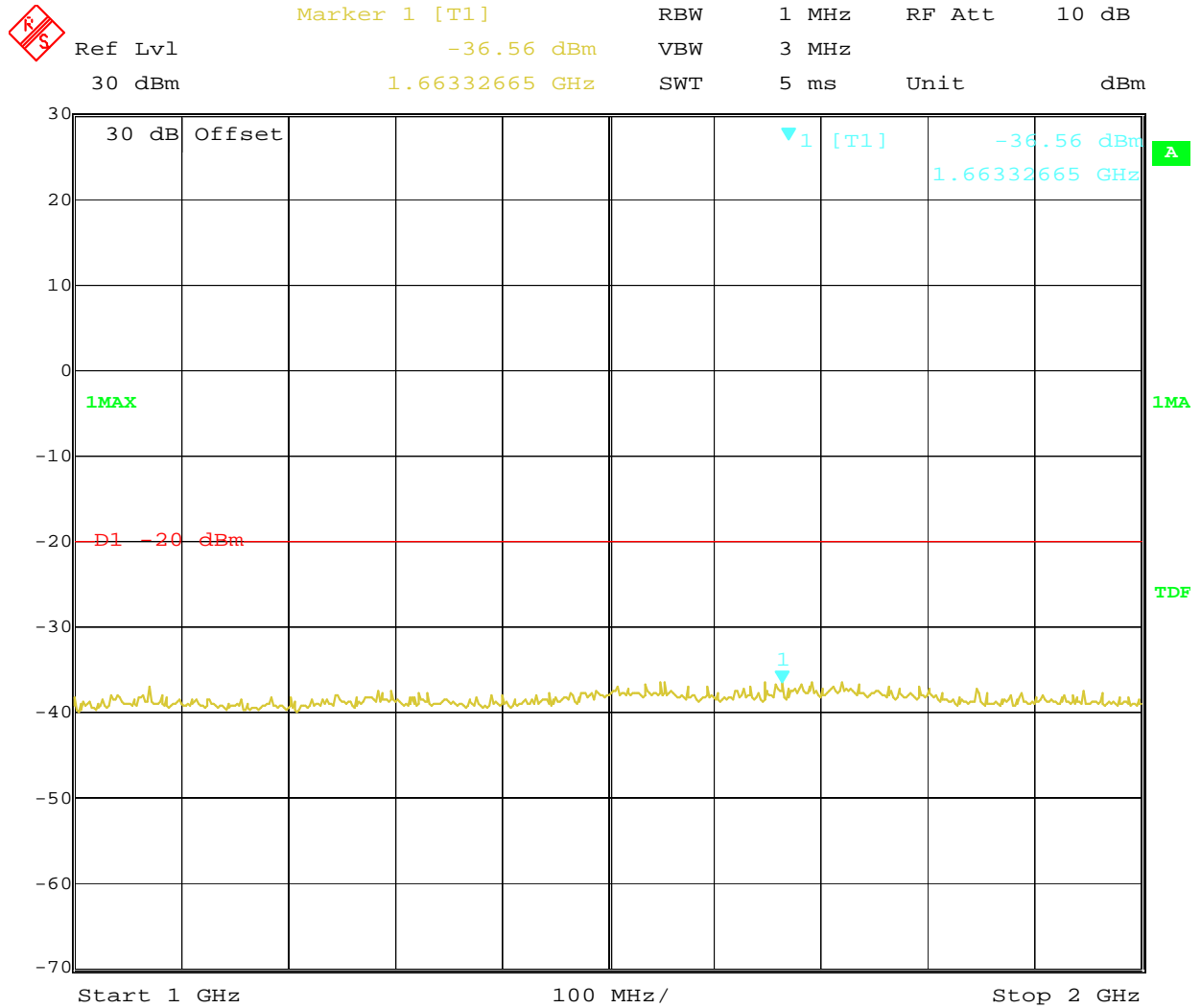


**Transmit Mode (MSK Modulation) 300-1000 MHz**



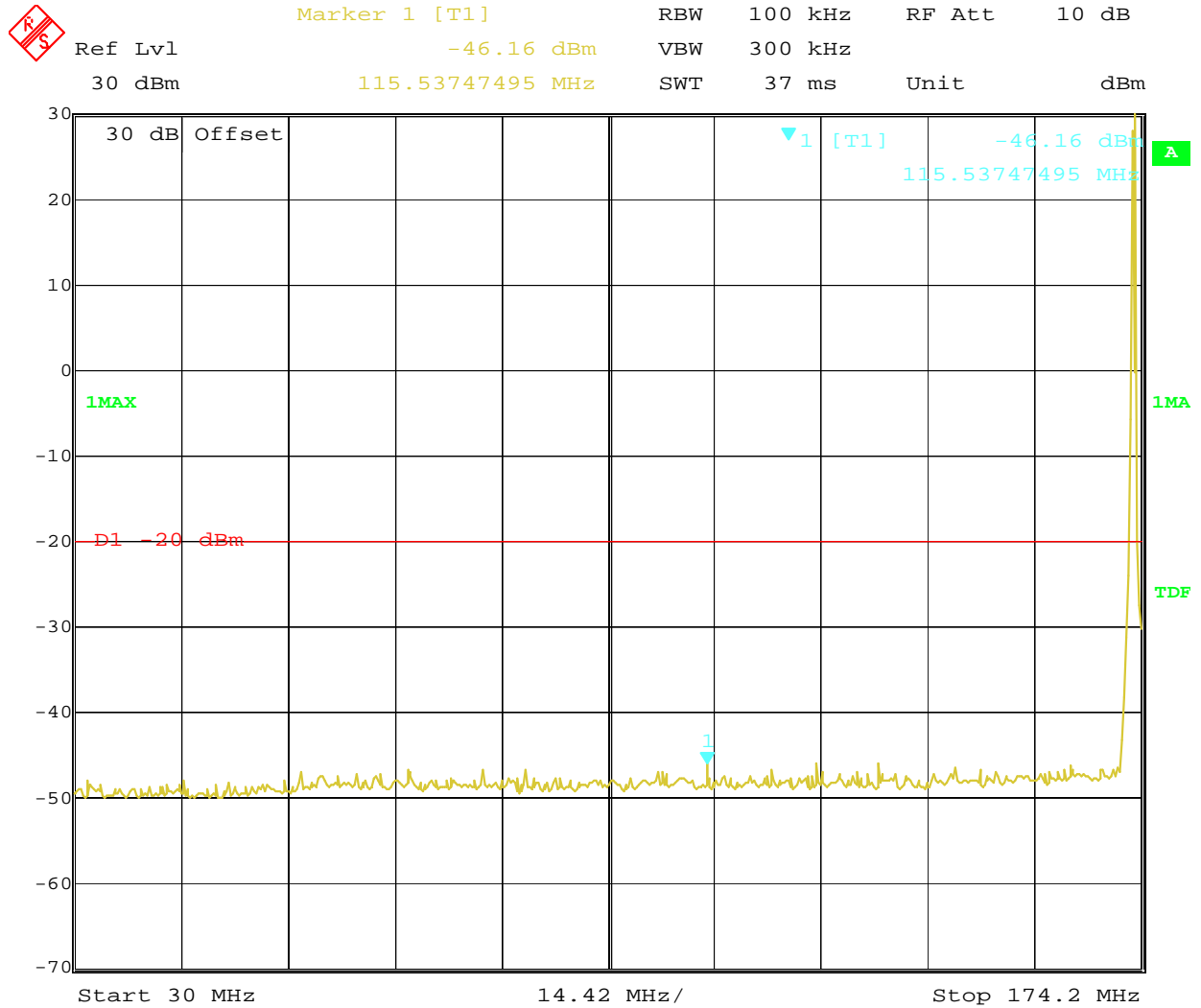
Date: 26.AUG.2011 11:56:48

**Transmit Mode (MSK Modulation) 1-2 GHz**



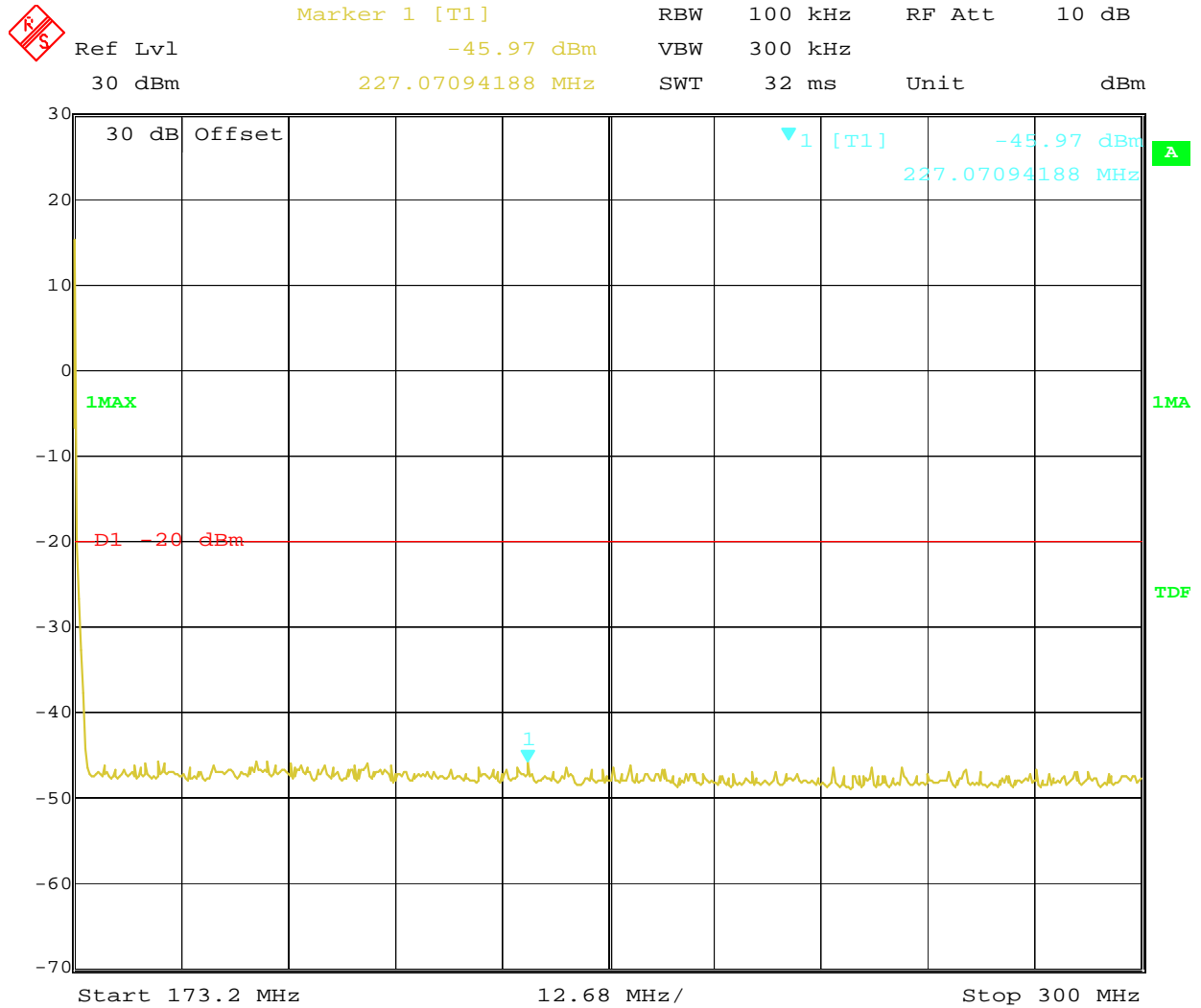
Date: 26.AUG.2011 11:50:47

Transmit Mode (FSK Modulation) 30-173.2 MHz



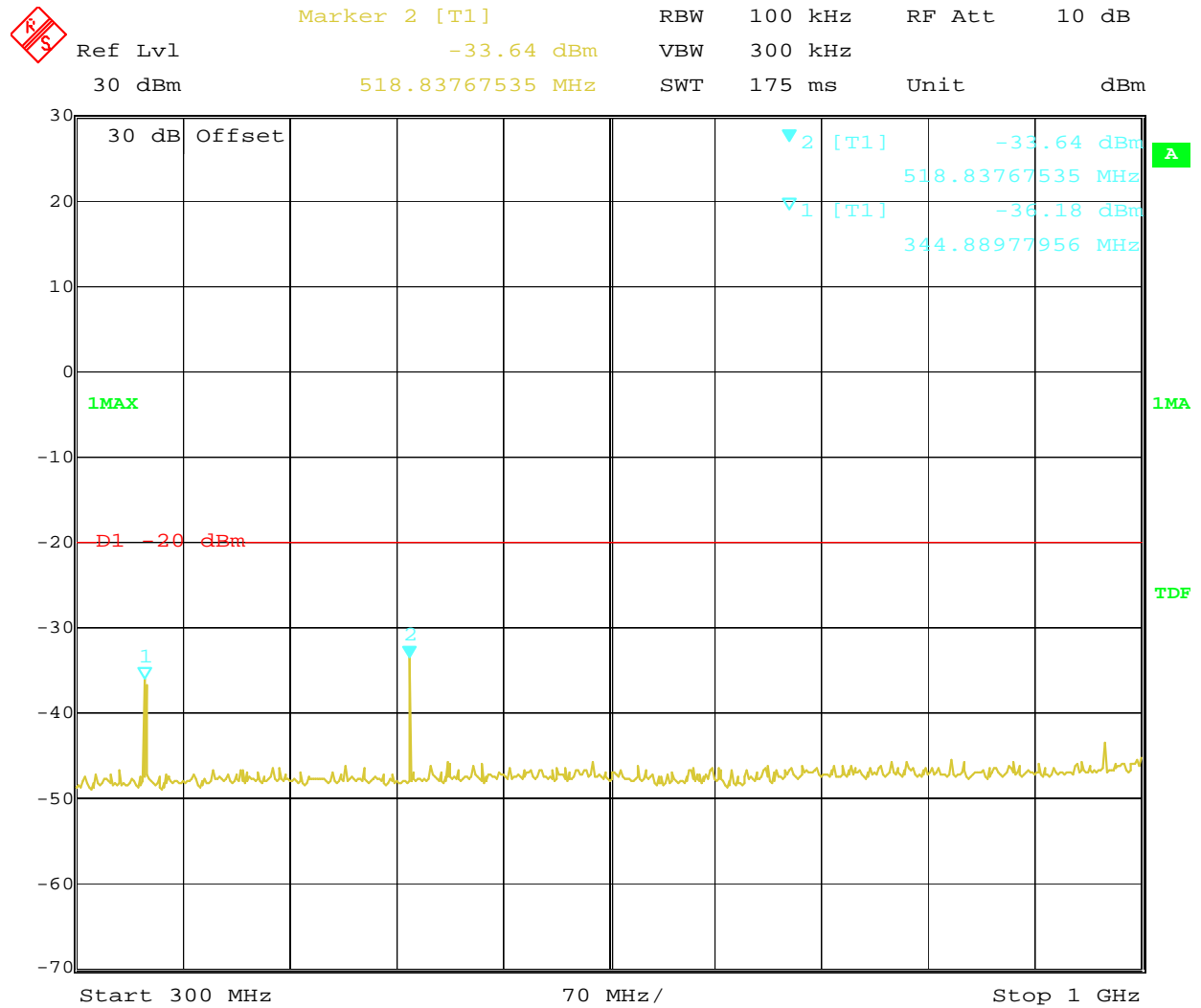
Date: 26.AUG.2011 11:39:21

Transmit Mode (FSK Modulation) 173.2-300 MHz



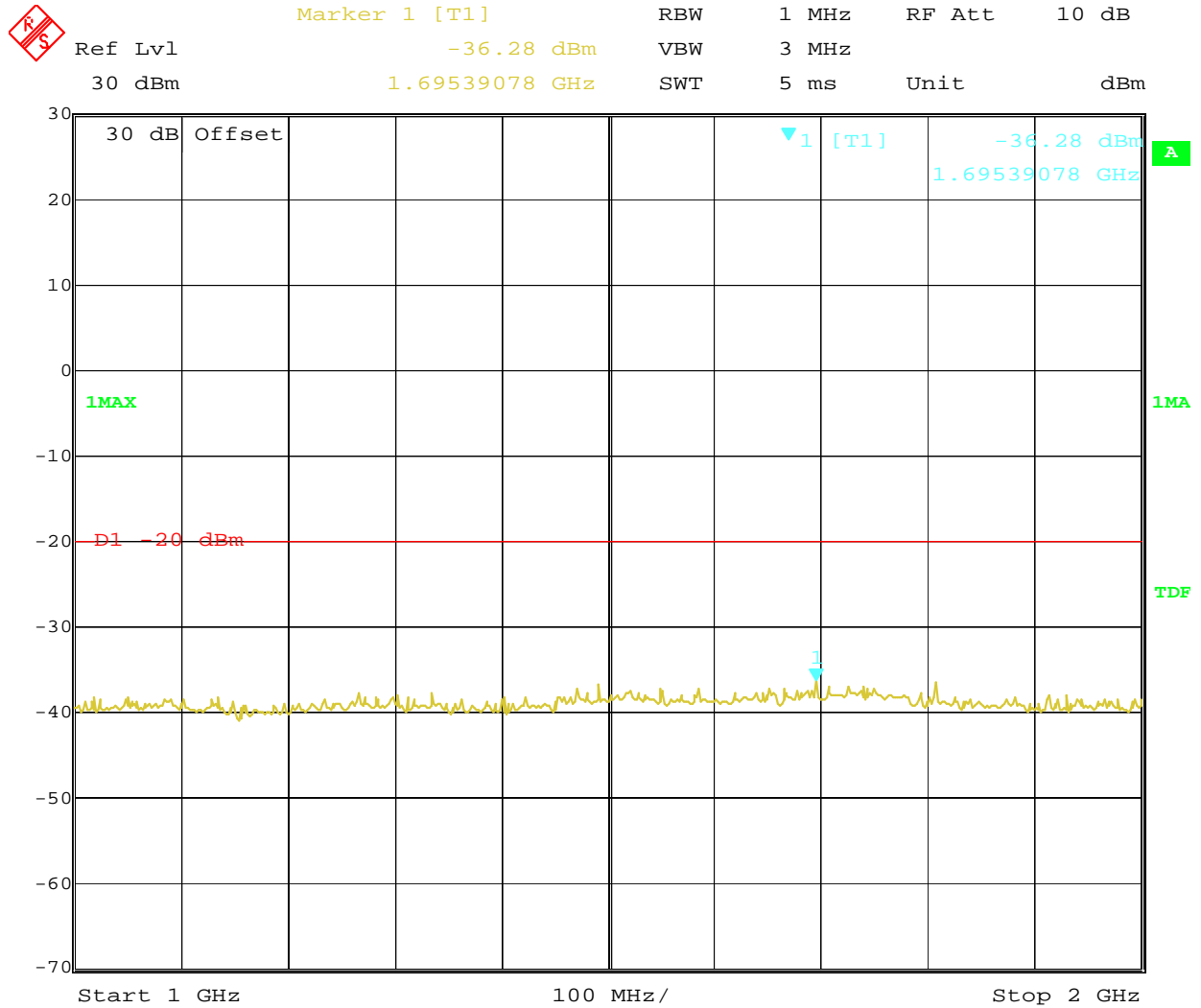
Date: 26.AUG.2011 11:42:21

Transmit Mode (FSK Modulation) 300-1000 MHz



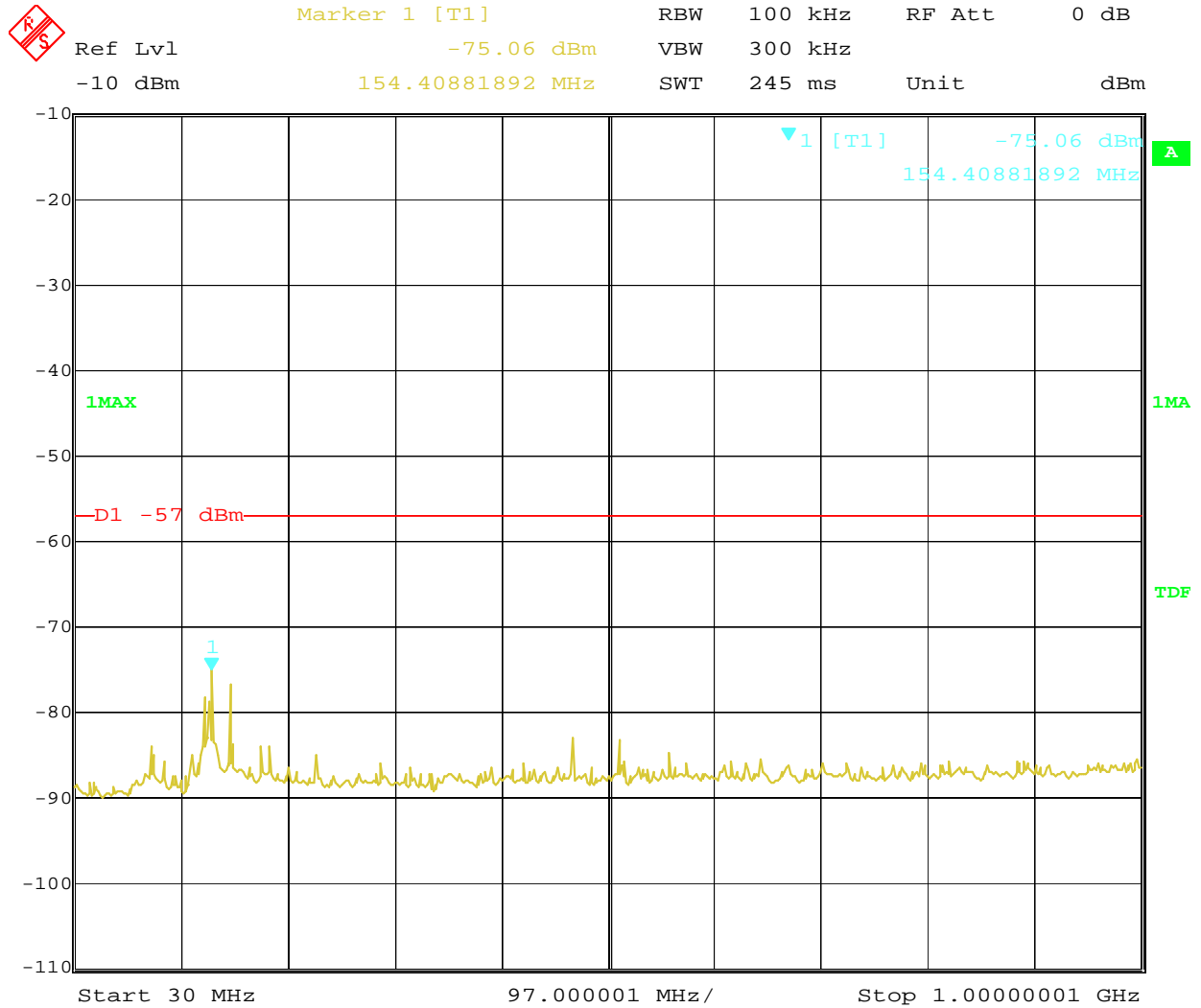
Date: 26.AUG.2011 11:44:50

**Transmit Mode (FSK Modulation) 1-2 GHz**



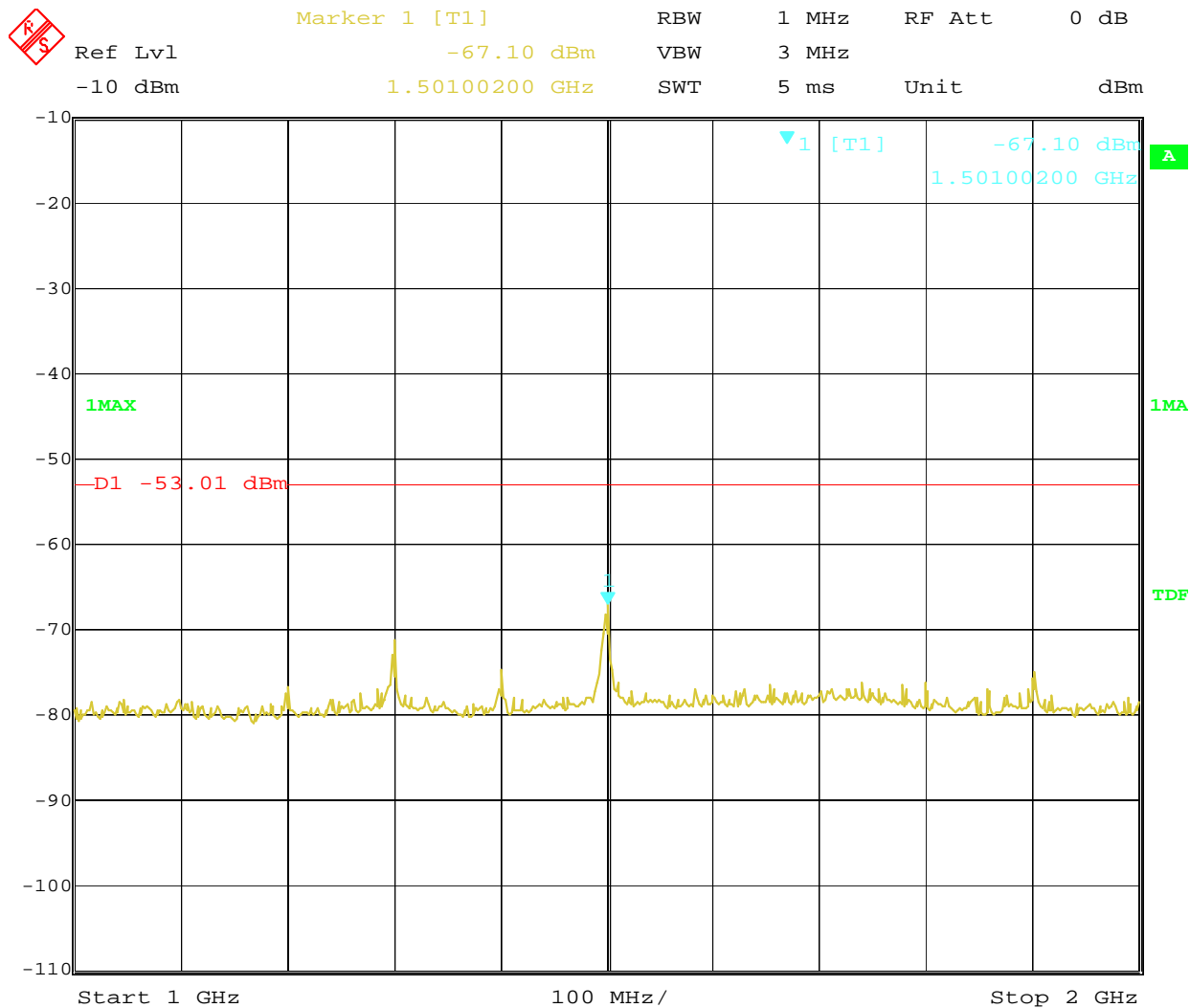
Date: 26.AUG.2011 11:46:56

Receive Mode 30-1000 MHz



Date: 26.AUG.2011 12:14:52

## Receive Mode 1-2 GHz



Date: 26.AUG.2011 12:19:55

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

Test Date: 08/26/2011  
Test Levels: See Section 11.3  
Ambient Temperature: 25 °C  
Relative Humidity: 45 %  
Atmospheric Pressure: 1007 mbars

Deviations, Additions, or Exclusions: None



## 12 Transmitter Unwanted Out-of-Band Emissions, Radiated

### 12.1 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.

#### **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 $\mu$ V/m
- RA = Receiver Amplitude (including preamplifier) in dB $\mu$ 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 $\mu$ 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 $\mu$ V/m. This value in dB $\mu$ V/m was converted to its corresponding level in  $\mu$ V/m.

RA = 52.0 dB $\mu$ V  
AF = 7.4 dB/m  
CF = 1.6 dB  
AG = 29.0 dB  
FS = 32 dB $\mu$ V/m

To convert from dB $\mu$ V to  $\mu$ V or mV the following was used:

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

NF = Net Reading in dB $\mu$ 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
SAF768'	Weatherstation	Davis Instruments	Perception II	PE00729A03	01/14/2011	01/14/2012
REA003'	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	12/06/2010	12/06/2011
145034'	BiLog Antenna (30 MHz to 1GHz)	Schaffner Chase EMC	CBL6111C	none	01/07/2011	01/07/2012
HORN2'	HORN ANTENNA	EMCO	3115	9602-4675	10/08/2010	10/08/2011
145-416'	Cables 145-400 145-408 145-402 145-404	Huber + Suhner	3m Track B cables	multiple	08/31/2010	09/15/2011
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	09/24/2010	09/24/2011
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/28/2010	12/28/2011
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESJ	8392831001	08/23/2011	08/23/2012
ANT3A'	BROADBAND ANTENNA	Compliance Design	B100	00523	05/31/2011	05/31/2012
ANT3C'	BROADBAND ANTENNA	Compliance Design	B300 (Switched with	1651	05/31/2011	05/31/2012
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	03/28/2011	03/28/2012
Cbl030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/06/2011	01/06/2012
HEW62'	Synthesized Sweep Generator	Hewlett Packard	83620A	3213A01244	04/08/2011	04/08/2012
145-410'	Cables 145-400 145-406 145-407 145-405 145-403	Huber + Suhner	10m Track A Cables	multiple	08/31/2010	09/15/2011

Test Date: 09/09/2011

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	08/12/2010	08/12/2012
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	08/15/2011	08/15/2012
145-410'	Cables 145-400 145-403 145-405 145-406 145-407	Huber + Suhner	10m Track A Cables	multiple	09/04/2011	09/04/2012
HORN2'	HORN ANTENNA	EMCO	3115	9602-4675	10/08/2010	10/08/2011
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	09/24/2010	09/24/2011
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESJ	8392831001	08/23/2011	08/23/2012
145-416'	Cables 145-400 145-402 145-404 145-408	Huber + Suhner	3m Track B cables	multiple	09/04/2011	09/04/2012
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	12/28/2010	12/28/2011

**Software Utilized:**

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

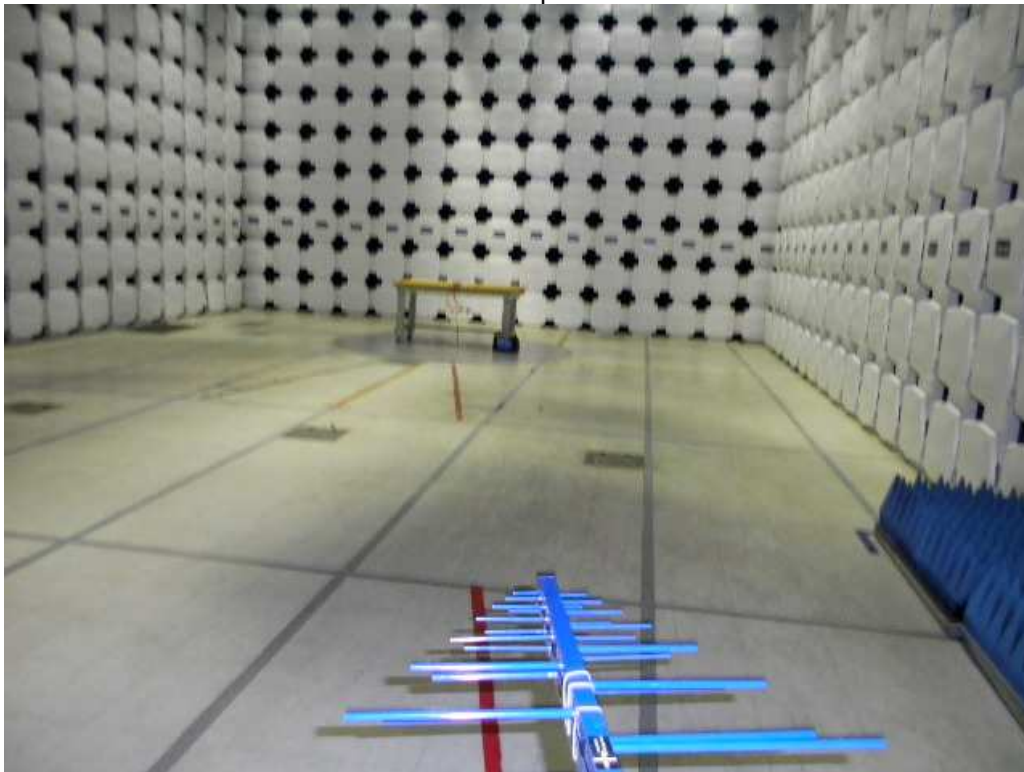
**12.3 Results:**

Transmitter unwanted out-of-band emissions must meet the limits of IC RSS-119 Section 5.8 & FCC Part 90.210(d).

The sample tested was found to comply.

## 12.4 Setup Photographs:

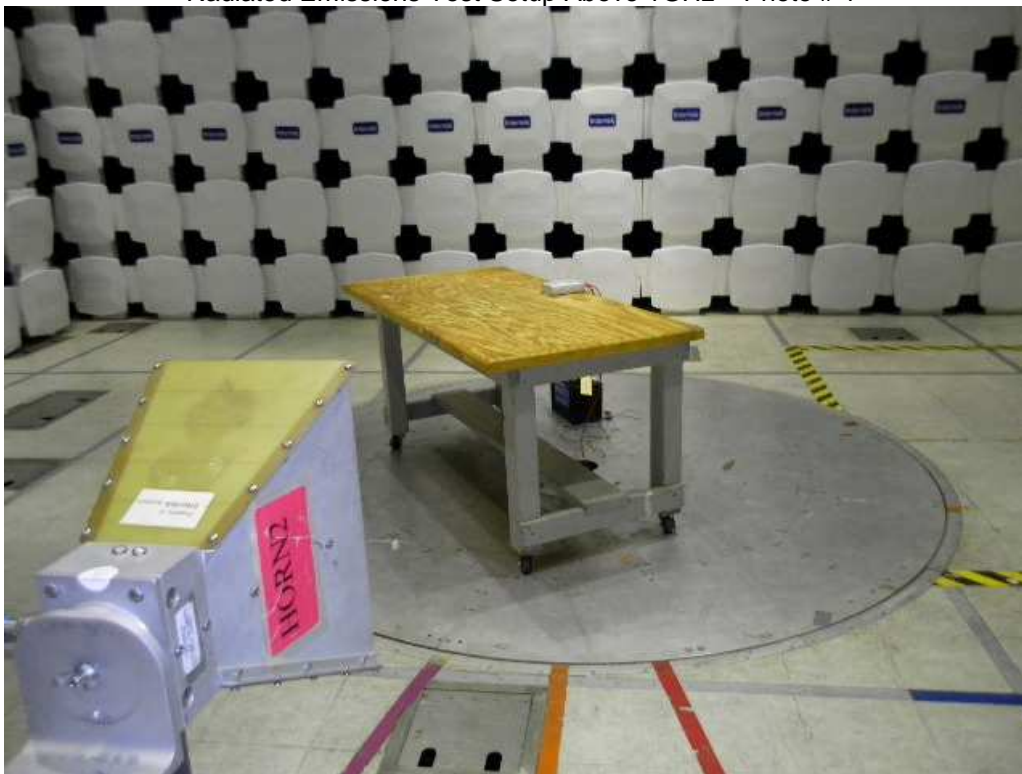
Radiated Emissions Test Setup Below 1GHz – Photo # 1



Radiated Emissions Test Setup Below 1GHz – Photo # 2



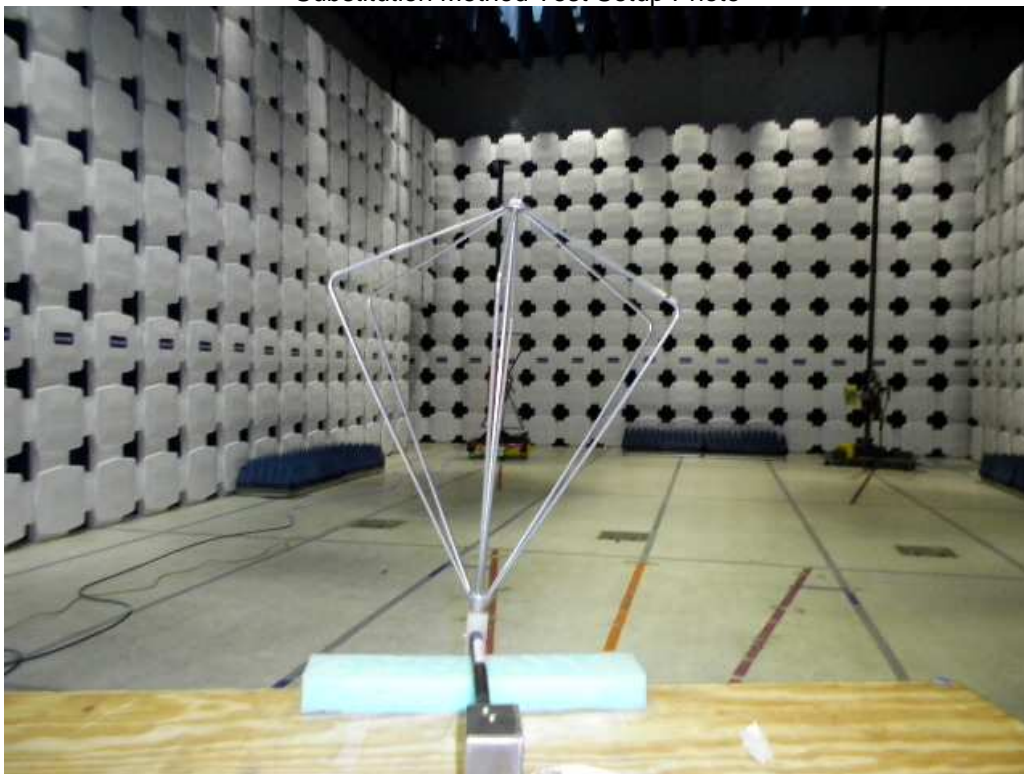
Radiated Emissions Test Setup Above 1GHz – Photo # 1



Radiated Emissions Test Setup Above 1GHz – Photo # 2



Substitution Method Test Setup Photo





## 12.5 Test Data:

### Radiated Emissions From the NRU With GPS Electronics Removed (30-1000MHz)

Company: LoJack Corporation  
 Model #: NRU  
 Serial #: OB014DF  
 Engineers: Vathana Ven  
 Project #: G 100480944  
 Standard: FCC Part 90 & RSS-119  
 Receiver: 145-128  
 PreAmp: PRE145003 9-24-11.txt  
 PreAmp Used? (Y or N): Y  
 Date(s): 09/09/11  
 Location: 10M  
 Barometer: DAV002  
 Temp/Humidity/Pressure: 23C 51% 998mbar  
 Antenna & Cables: N Bands: N, LF, HF, SHF  
 Antenna: 145106 V10m 08-15-2012.txt 145106 H10m 08-15-2012.txt  
 Cable(s): 145-410 10mTrkA 09-04-2012.txt NONE  
 Filter: NONE  
 Limit Distance (m): 3  
 Test Distance (m): 10  
 Voltage/Frequency: Car battery  
 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	FCC	IC	Harmonic?
Tx - MSK modulation, 30-1000MHz at 10 meters														
PK	V	58.186	40.52	7.43	1.53	27.52	-10.46	32.42	--	--	120/300 kHz			
PK	V	346.150	36.43	14.45	3.40	27.61	-10.46	37.12	--	--	120/300 kHz			
PK	V	519.225	24.00	18.02	4.01	28.28	-10.46	28.20	--	--	120/300 kHz			
PK	V	692.300	26.70	20.19	4.50	28.42	-10.46	33.44	--	--	120/300 kHz			
PK	V	865.375	24.00	22.21	5.04	28.10	-10.46	33.60	--	--	120/300 kHz			
Tx - FSK modulation, 30-1000MHz at 10 meters														
PK	V	58.186	40.00	7.43	1.53	27.52	-10.46	31.90	--	--	120/300 kHz			
PK	V	346.150	36.00	14.45	3.40	27.61	-10.46	36.69	--	--	120/300 kHz			
PK	V	519.225	24.50	18.02	4.01	28.28	-10.46	28.70	--	--	120/300 kHz			
PK	H	692.300	27.90	19.95	4.50	28.42	-10.46	34.39	--	--	120/300 kHz			
PK	V	865.375	23.80	22.21	5.04	28.10	-10.46	33.40	--	--	120/300 kHz			

### Radiated Emissions From the NRU With GPS Electronics Removed (1-2GHz)

Company: LoJack Corporation  
 Model #: NRU  
 Serial #: OB014DF  
 Engineers: Vathana Ven  
 Project #: G 100480944  
 Standard: FCC Part 90 & RSS-119  
 Receiver: 145-128  
 PreAmp: PRE\_145014\_12-28-2011.txt  
 PreAmp Used? (Y or N): Y  
 Date(s): 09/09/11  
 Location: 10M  
 Barometer: DAV002  
 Temp/Humidity/Pressure: 23C 51% 998mbar  
 Antenna & Cables: HF Bands: N, LF, HF, SHF  
 Antenna: HORN2 V3m 10-08-2011.txt HORN2 H3m 10-08-2011.txt  
 Cable(s): 145-416 3mTrkB 09-04-2012.txt NONE  
 Filter: NONE  
 Limit Distance (m): 3  
 Test Distance (m): 3  
 Voltage/Frequency: Car battery  
 Frequency Range: 1-2GHz  
 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
Tx - MSK modulation, 1-2GHz at 3 meters, No emissions were detected. Readings below are noise floor signals													
PK	V	1038.450	44.35	24.39	3.91	34.06	0.00	38.60	--	--	1/3 MHz	RB	RB
PK	V	1211.525	43.26	25.39	4.33	33.90	0.00	39.08	--	--	1/3 MHz	RB	RB
PK	V	1384.600	40.05	25.63	4.74	33.74	0.00	36.68	--	--	1/3 MHz	RB	RB
PK	V	1557.676	41.07	25.80	5.06	33.66	0.00	38.28	--	--	1/3 MHz	RB	RB
PK	V	1730.750	41.13	26.71	5.19	33.70	0.00	39.32	--	--	1/3 MHz		
Tx - FSK modulation, 1-2GHz at 3 meters, No emissions were detected. Readings below are noise floor signals													
PK	V	1038.450	40.55	24.39	3.91	34.06	0.00	34.80	--	--	1/3 MHz	RB	RB
PK	V	1211.525	41.90	25.39	4.33	33.90	0.00	37.72	--	--	1/3 MHz	RB	RB
PK	V	1384.600	40.69	25.63	4.74	33.74	0.00	37.32	--	--	1/3 MHz	RB	RB
PK	V	1557.676	41.00	25.80	5.06	33.66	0.00	38.21	--	--	1/3 MHz	RB	RB
PK	V	1730.750	40.55	26.71	5.19	33.70	0.00	38.74	--	--	1/3 MHz		

Notes: Base on the field strength measured above compared to the field strength measured from the unit with GPS electronics, the unit would meet the transmitter unwanted out-of-band emissions limits of IC RSS-119 Section 5.8 & FCC Part 90.210(d).

**Radiated Emissions (Substitution) From the NRU With GPS Electronics (30MHz-2GHz)**

Company: LoJack Corporation  
 Model #: NRU  
 Serial #: 0B01712  
 Engineer(s): Kouma Sinn  
 Project #: G 100480944  
 Standard: FCC Part 90 & RSS-119  
 Barometer: SAF768  
 Temp/Humidity/Pressure: 22C  
 Test Distance (m): 3 & 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

Filter: REA003 (used 1-2GHz)  
 Rx Antenna: 145034 HORN2  
 Rx Cable(s): 145-410 145-416  
 Rx Preamp: 145-003 145-014 Receiver: 145-128  
 Tx Antenna: ANT3A ANT3C HORN3  
 Tx Cable(s): CBL030  
 Tx Signal Generator: HEW62  
 ERP or EIRP?: ERP  
 Frequency Range: 30MHz-2GHz

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
Tx - MSK modulation, 30-1000MHz at 10 meters											
PK	V	58.186	51.63	89.89	0.13	-4.13	-20.00	-64.67	-20.00	-44.67	120/300 kHz
PK	V	346.150	37.00	76.51	0.35	-1.62	-20.00	-63.63	-20.00	-43.63	120/300 kHz
PK	V	519.225	23.90	74.02	0.43	1.87	-20.00	-70.83	-20.00	-50.83	120/300 kHz
PK	V	692.300	30.50	74.23	0.46	2.33	-20.00	-64.01	-20.00	-44.01	120/300 kHz
PK	V	865.375	22.28	71.65	0.48	-0.08	-20.00	-72.08	-20.00	-52.08	120/300 kHz
Tx - FSK modulation, 30-1000MHz at 10 meters											
PK	V	58.186	51.60	89.89	0.13	-4.13	-20.00	-64.70	-20.00	-44.70	120/300 kHz
PK	V	346.150	38.00	76.51	0.35	-1.62	-20.00	-62.63	-20.00	-42.63	120/300 kHz
PK	V	519.225	25.00	74.02	0.43	1.87	-20.00	-69.73	-20.00	-49.73	120/300 kHz
PK	H	692.300	34.00	73.40	0.46	2.54	-20.00	-59.48	-20.00	-39.48	120/300 kHz
PK	V	865.375	22.28	71.65	0.48	-0.08	-20.00	-72.08	-20.00	-52.08	120/300 kHz
Tx - MSK modulation, 1-2GHz at 3 meters. No emissions were detected. Readings below are noise floor signals											
PK	V	1038.450	41.61	89.10	0.85	6.08	-20.00	-64.41	-20.00	-44.41	1/3MHz
PK	V	1211.525	40.88	89.10	1.00	6.42	-20.00	-64.95	-20.00	-44.95	1/3MHz
PK	V	1384.600	41.90	88.43	0.96	7.18	-20.00	-62.46	-20.00	-42.46	1/3MHz
PK	V	1557.675	41.00	88.82	0.97	8.22	-20.00	-62.72	-20.00	-42.72	1/3MHz
PK	V	1730.750	41.27	83.65	0.78	8.54	-20.00	-56.77	-20.00	-36.77	1/3MHz
Tx - FSK modulation, 1-2GHz at 3 meters. No emissions were detected. Readings below are noise floor signals											
PK	V	1038.450	42.00	89.10	0.85	6.08	-20.00	-64.02	-20.00	-44.02	1/3MHz
PK	V	1211.525	41.00	89.10	1.00	6.42	-20.00	-64.83	-20.00	-44.83	1/3MHz
PK	V	1384.600	41.70	88.43	0.96	7.18	-20.00	-62.66	-20.00	-42.66	1/3MHz
PK	V	1557.675	41.00	88.82	0.97	8.22	-20.00	-62.72	-20.00	-42.72	1/3MHz
PK	V	1730.750	41.00	83.65	0.78	8.54	-20.00	-57.04	-20.00	-37.04	1/3MHz

Notes: The "EUT Reading" in the table above is the field strength measured at 10 meters.

Test Personnel(s):	<u>Kouma Sinn <i>KPS</i></u>	Test Date(s):	<u>08/29/2011</u>
	<u>Vathana Ven <i>VSV</i></u>		<u>09/09/2011</u>
Product Standard:	<u>IC RSS-119, FCC Part 90</u>	Test Levels:	<u>Per limits specified section 12.3</u>
Input Voltage:	<u>Car Battery (12VDC)</u>	Ambient Temperature:	<u>22, 23 °C</u>
Pretest Verification w/ Ambient Signals or BB Source:	<u>Ambient Signals</u>	Relative Humidity:	<u>59, 51 %</u>
		Atmospheric Pressure:	<u>1001, 998 mbars</u>

Deviations, Additions, or Exclusions: None



## 13 Receiver Radiated Emissions

### 13.1 Method

Tests are performed in accordance with (IC RSS-119 Section 5.11, IC RSS-Gen Sections 4.10, 6.0 & 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.

#### **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 $\mu$ V/m
- RA = Receiver Amplitude (including preamplifier) in dB $\mu$ 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 $\mu$ 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 $\mu$ V/m. This value in dB $\mu$ V/m was converted to its corresponding level in  $\mu$ V/m.

RA = 52.0 dB $\mu$ V  
AF = 7.4 dB/m  
CF = 1.6 dB  
AG = 29.0 dB  
FS = 32 dB $\mu$ V/m

To convert from dB $\mu$ V to  $\mu$ V or mV the following was used:

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

NF = Net Reading in dB $\mu$ V

**Example:**

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

**13.2 Test Equipment Used:**

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
145-410'	Cables 145-400 145-406 145-407 145-405 145-403	Huber + Suhner	10m Track A Cables	multiple	08/31/2010	08/31/2011
145034'	BiLog Antenna (30 MHz to 1GHz)	Schaffner Chase EMC	CBL6111C	none	01/07/2011	01/07/2012
145003'	Preamplifier (150 KHz to 1.3 GHz)	Hewlett Packard	8447D	2443A04077	09/24/2010	09/24/2011
SAF768'	Weatherstation	Davis Instruments	Perception II	PE00729A03	01/14/2011	01/14/2012
145128'	EMI Receiver 40 GHz (20 Hz - 40 Ghz)	Rohde & Schwarz	ESI	8392831001	08/23/2011	08/23/2012

**Software Utilized:**

Name	Manufacturer	Version

**13.3 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.

### 13.4 Setup Photograph:

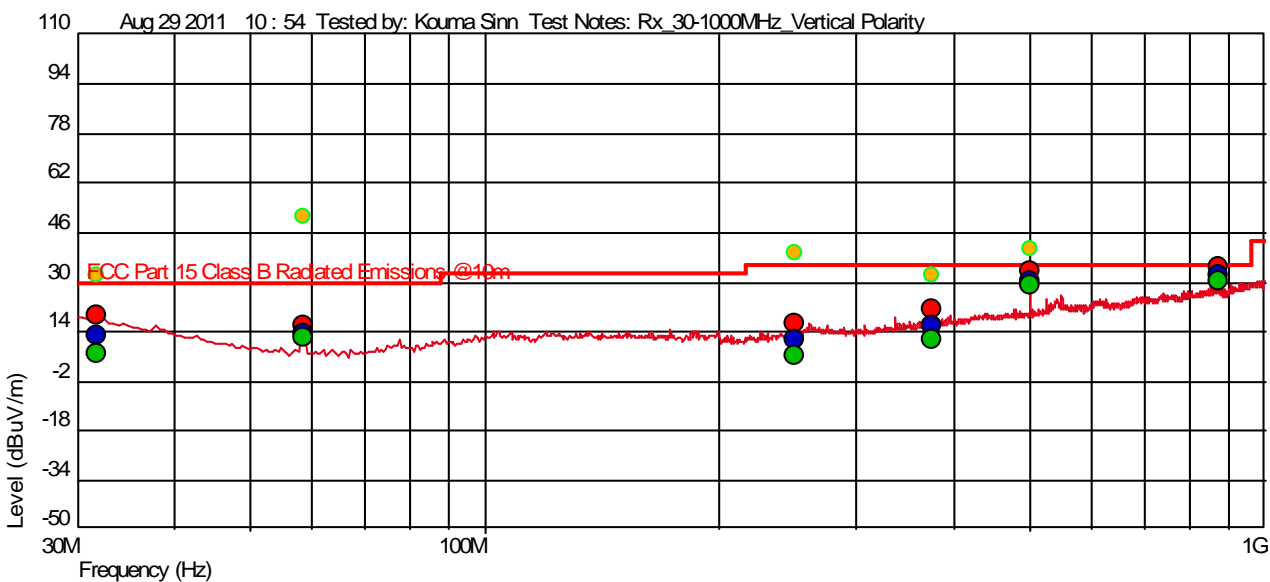
Receiver Radiated Emissions Setup Photo



## 13.5 Test Data:

## Vertical Polarity (Receive Mode)

## 30-1000MHz Radiated Emissions @ 10m



## "PORTRAIT"

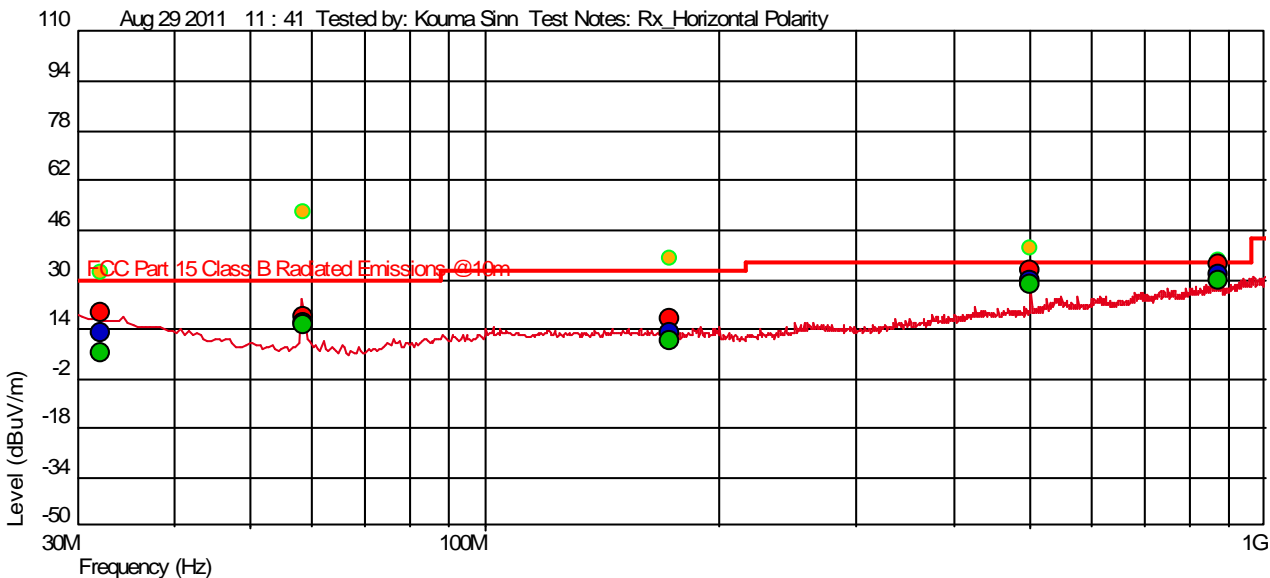
- Measured Peak Value
  - Measured Quasi Peak Value
  - Measured Average Value
  - Maximum Value of Mast and Turntable
- Level (dBuV/m) = AF + CL + PA + Raw
- AF = Antenna Factor
- CL = Cable Losses
- PA = Pre-Amplifier
- Raw = Raw Instrument Reading (Not listed on Spot Tables)

## Measured: Quasi-Peak

Frequency (Hz)	Level (dBuV/m)	Ant. Fact. (dB)	Other Fact. (dB)	Limit (dBuV/m)	Margin (dB)	Vert (°)	Angle (Deg)	Mast Height (m)	RBW (Hz)
31.680M	12.77	16.928	-26.547	29.54	-16.77		135	3.27	120 k
58.459M	13.54	5.862	-26.127	29.54	-16.00		101	1.59	120 k
250.084M	11.21	12.612	-24.825	35.54	-24.33		220	1.56	120 k
374.963M	15.82	15.398	-24.432	35.54	-19.72		140	1.52	120 k
500.031M	30.22	17.899	-24.540	35.54	-5.32		340	1.28	120 k
875.064M	32.18	22.896	-23.076	35.54	-3.36		315	2.66	120 k

Horizontal Polarity (Receive Mode)

30-1000MHz Radiated Emissions @ 10m



"PORTRAIT"

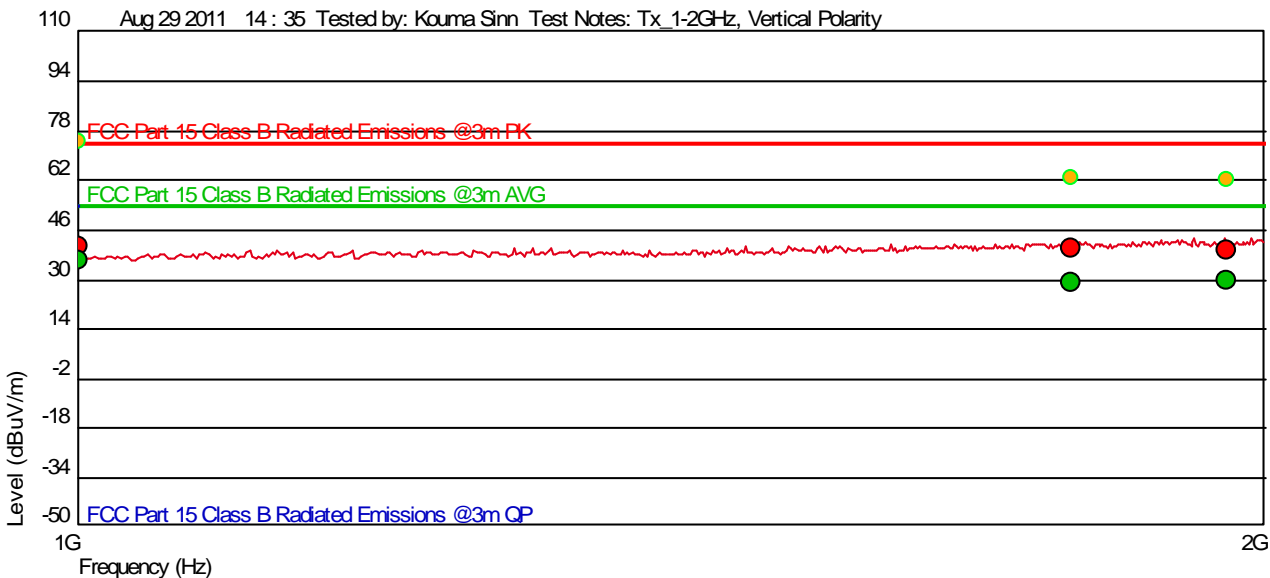
- Measured Peak Value
  - Measured Quasi Peak Value
  - Measured Average Value
  - Maximum Value of Mast and Turntable
- Level (dBuV/m) = AF + CL + PA + Raw
- AF = Antenna Factor
- CL = Cable Losses
- PA = Pre-Amplifier
- Raw = Raw Instrument Reading (Not listed on Spot Tables)

Measured: Quasi-Peak

Frequency (Hz)	Level (dBuV/m)	Ant. Fact. (dB)	Other Fact. (dB)	Limit (dBuV/m)	Margin (dB)	Hor (°)	Angle (Deg)	Mast Height (m)	RBW (Hz)
32.120M	12.55	16.704	-26.545	29.54	-16.99	--	171	1.18	120 k
58.505M	16.11	5.849	-26.126	29.54	-13.43	--	91	1.85	120 k
172.666M	12.84	9.967	-25.138	33.04	-20.20	--	99	1.70	120 k
500.013M	29.66	17.900	-24.540	35.54	-5.88	--	344	1.30	120 k
875.081M	31.60	22.895	-23.076	35.54	-3.94	--	316	2.43	120 k

Vertical Polarity (Receive Mode)

1-2GHz Radiated Emissions @ 3m



"PORTRAIT"

- Measured Peak Value
  - Measured Quasi Peak Value
  - Measured Average Value
  - Maximum Value of Mast and Turntable
- Level (dBuV/m) = AF + CL + PA + Raw
- AF = Antenna Factor
- CL = Cable Losses
- PA = Pre-Amplifier
- Raw = Raw Instrument Reading (Not listed on Spot Tables)

Measured: Peak

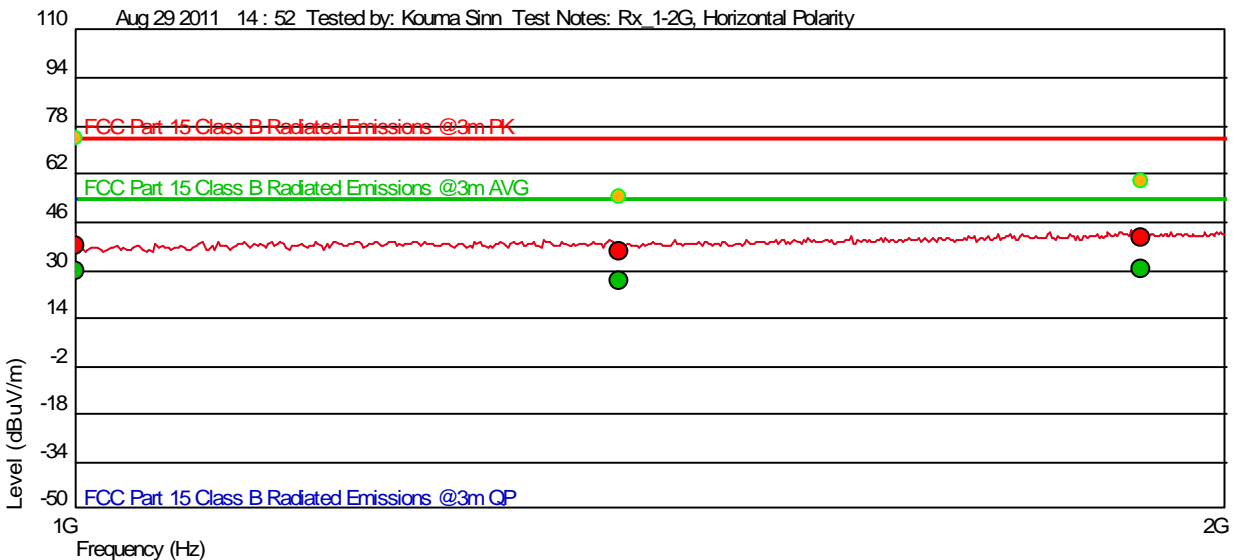
Frequency (Hz)	Level (dBuV/m)	Ant. Fact. (dB)	Other Fact. (dB)	Limit (dBuV/m)	Margin (dB)	Vert (I)	Angle (Deg)	Mast Height (m)	RBW (Hz)
1.000G	41.01	24.200	-30.490	74.00	-32.99		331	3.20	1M
1.787G	40.09	27.092	-28.825	74.00	-33.91		321	3.10	1M
1.955G	39.74	27.408	-28.669	74.00	-34.26		333	1.44	1M

Measured: Average

Frequency (Hz)	Level (dBuV/m)	Ant. Fact. (dB)	Other Fact. (dB)	Limit (dBuV/m)	Margin (dB)	Vert (I)	Angle (Deg)	Mast Height (m)	RBW (Hz)
1.000G	35.86	24.200	-30.490	54.00	-18.14		331	3.20	1M
1.787G	28.96	27.092	-28.825	54.00	-25.04		321	3.10	1M
1.955G	29.70	27.408	-28.669	54.00	-24.30		333	1.44	1M

Horizontal Polarity (Receive Mode)

1-2GHz Radiated Emissions @ 3m



"PORTRAIT"

- Measured Peak Value
  - Measured Quasi Peak Value
  - Measured Average Value
  - Maximum Value of Mast and Turntable
- Level (dBuV/m) = AF + CL + PA + Raw  
 AF = Antenna Factor  
 CL = Cable Losses  
 PA = Pre-Amplifier  
 Raw = Raw Instrument Reading (Not listed on Spot Tables)

Measured: Peak

Frequency (Hz)	Level (dBuV/m)	Ant. Fact. (dB)	Other Fact. (dB)	Limit (dBuV/m)	Margin (dB)	Hor (°)	Angle (Deg)	Mast Height (m)	RBW (Hz)
1.000G	38.01	24.040	-30.489	74.00	-35.99	--	320	3.02	1M
1.387G	36.47	25.598	-29.451	74.00	-37.53	--	120	1.43	1M
1.901G	40.74	27.424	-28.655	74.00	-33.26	--	252	1.29	1M

Measured: Average

Frequency (Hz)	Level (dBuV/m)	Ant. Fact. (dB)	Other Fact. (dB)	Limit (dBuV/m)	Margin (dB)	Hor (°)	Angle (Deg)	Mast Height (m)	RBW (Hz)
1.000G	29.92	24.040	-30.489	54.00	-24.08	--	320	3.02	1M
1.387G	26.43	25.598	-29.451	54.00	-27.57	--	120	1.43	1M
1.901G	30.11	27.424	-28.655	54.00	-23.89	--	252	1.29	1M

Test Personnel: Kouma Sinn *KPS*  
 Product Standard: IC RSS-119, FCC Part 90  
 Input Voltage: Car Battery (12VDC)  
 Pretest Verification w/  
 Ambient Signals or BB  
 Source: **Ambient Signals**

Test Date: 08/29/2011  
 Test Levels: Per limits specified section 13.3  
 Ambient Temperature: 22 °C  
 Relative Humidity: 59 %  
 Atmospheric Pressure: 1001 mbars

Deviations, Additions, or Exclusions: None



**14 Revision History**

Revision Level	Date	Report Number	Notes
0	09/13/2011	100480944BOX-003	Original Issue