



## EMISSIONS TEST REPORT

**Report Number: 100537026BOX-004**

**Project Number: G100537026**

**Report Issue Date: 11/17/2011**

**Product Designation: RLU7**

**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"**

**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  
40 Pequot Way  
Canton, MA 02021

Report prepared by Reviewer

Nicholas Abbondante, Staff Engineer

Report reviewed by

Michael F. Murphy, Staff Engineer

*This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.*

## 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 and Human RF Exposure (IC RSS-119 Sections 4.1, 5.4; FCC 2.1046, 90.20(e)(6))                             | Pass   |
| 7       | Transmitter Emissions Mask (IC RSS-119 Sections 5.5, 5.8; IC RSS-Gen Section 4.9; FCC 90.210(d))                                   | Pass   |
| 8       | 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   |
| 9       | Receiver Radiated Spurious Emissions (IC RSS-119 Section 5.11, IC RSS-Gen Sections 4.10, 6.0; FCC 2.1053, 90.210(d))               | Pass   |
| 10      | Revision History                                                                                                                   | --     |

Note that this report is a limited set of tests in support of an FCC permissive change filing and an Industry Canada 'family to previous model' certification.

### 3 Client Information

This EUT was tested at the request of:

**Company:** LoJack Corporation  
40 Pequot Way  
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 |
| Vehicle Location Unit<br>(Rx Mode) | LoJack Corporation | RLU7         | C6EDE58       |
| Vehicle Location Unit<br>(Tx Mode) | LoJack Corporation | RLU7         | 15BF47D       |

|                     |            |
|---------------------|------------|
| Receive Date:       | 11/04/2011 |
| Received Condition: | Good       |
| Type:               | Production |

#### Description of Equipment Under Test (provided by client)

The equipment under test is a vehicle location unit. It uses an integral antenna, which consists of a wire of length detailed in the cables section of this report. Note that this report is a limited set of tests in support of an FCC permissive change filing and an Industry Canada 'family to previous model' certification.

| Equipment Under Test Power Configuration |                         |                 |                  |
|------------------------------------------|-------------------------|-----------------|------------------|
| Rated Voltage                            | Rated Current           | Rated Frequency | Number of Phases |
| 3.6 & 7.2 VDC                            | Not label on the device | N/A             | N/A              |

#### Operating modes of the EUT:

| No. | Descriptions of EUT Exercising                                                                                                                                                      |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | The Vehicle Location Unit was powered from internal 3.6V & 7.2V Lithium battery pack and was programmed to transmit repetitively during testing except during receive mode testing. |

## 5 System Setup and Method

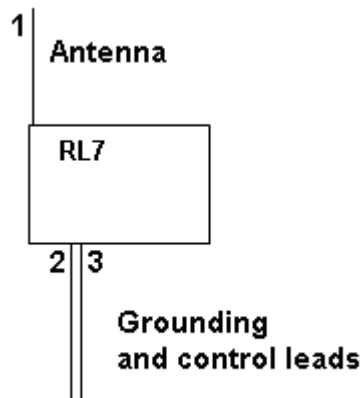
| Cables |             |            |           |          |             |
|--------|-------------|------------|-----------|----------|-------------|
| ID     | Description | Length (m) | Shielding | Ferrites | Termination |
| 1      | Antenna     | 0.53       | None      | None     | Antenna     |
| 2      | DC Ground   | 0.17       | None      | None     | None        |
| 3      | Control     | 0.17       | None      | None     | None        |

| Support Equipment |              |              |               |
|-------------------|--------------|--------------|---------------|
| Description       | Manufacturer | Model Number | Serial Number |
| None              |              |              |               |

### 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 and Human RF Exposure

### 6.1 Method

Tests are performed in accordance with IC RSS-119 Sections 4.1, 5.4.

**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.

**6.2 Test Equipment Used:**

| Asset    | Description                                    | Manufacturer      | Model              | Serial      | Cal Date   | Cal Due    |
|----------|------------------------------------------------|-------------------|--------------------|-------------|------------|------------|
| DAV003'  | Weather Station                                | Davis Instruments | 7400               | PE80529A39A | 08/02/2011 | 08/02/2012 |
| ~ANT2A   | BROADBAND ANTENNA                              | Compliance Design | B100               | 1852        | 11/18/2010 | 11/18/2011 |
| ~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 |
| 145128'  | EMI Receiver 40 GHz (20 Hz - 40 Ghz)           | Rohde & Schwarz   | ESL                | 8392831001  | 08/23/2011 | 08/23/2012 |
| 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 |

**Software Utilized:**

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

**6.3 Results:**

RSS-119 Section 5.4: Transmitter output power shall be within  $\pm 1.0$  dB of the manufacturer's rated power. Section 5.4.1: Typical transmitter output powers are 110 watts for base and/or fixed stations (paging transmitters excepted), and 30 watts for mobile stations. Higher powers may be certified, but it should be noted that mobile stations are normally only licensed up to 30 watts. See the SRSP relevant to the operating frequency for equipment power limits.

SRSP-500 6.3.1: Normally, the maximum power for base stations shall be 125 watts Effective Radiated Power (ERP) and 30 watts ERP for mobile stations.

90.20(e)(6)(iii) Mobile transmitters operating on this frequency with emissions authorized in a maximum bandwidth of 12.5 kHz are limited to 5.0 watts (37.0 dBm) power output.

The sample tested was found to comply.

Note that the device is a mobile device and the maximum output power measured was 30.52 dBm ERP (1.13 Watts ERP), or 32.66 dBm EIRP (1.845 Watts EIRP). Since it operates at 173.075 MHz with power not exceeding 2.5 Watts, it is exempt from RF exposure evaluation.

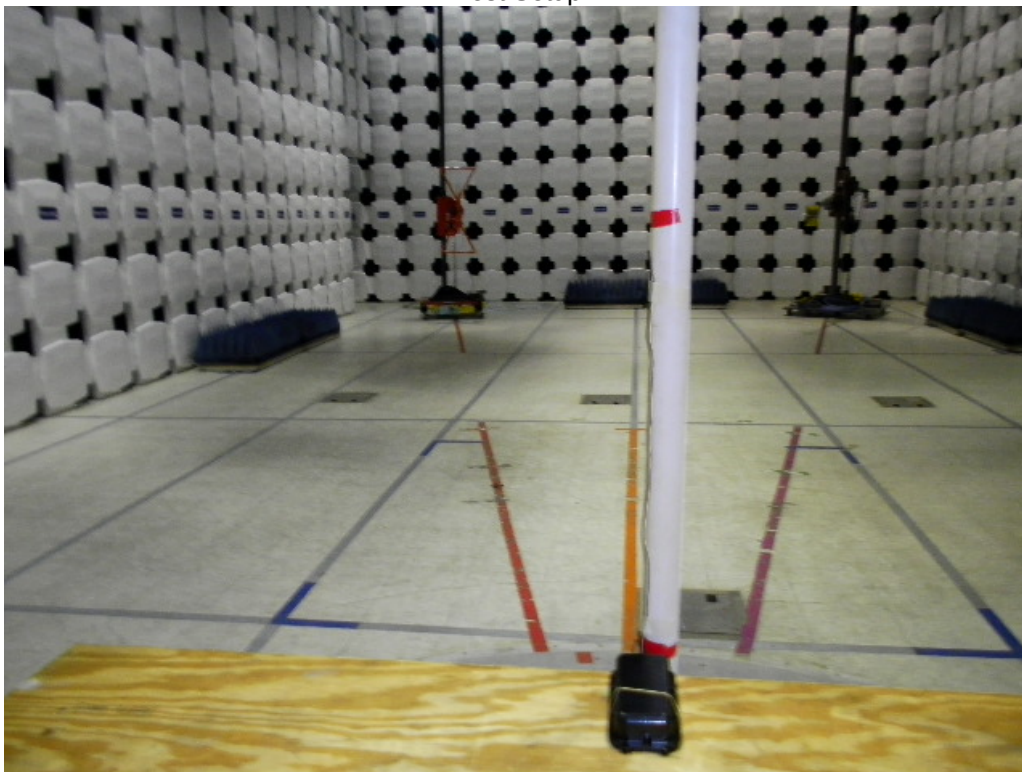
The EIRP is related to the RF exposure limit by the following relationship:

$$S = \text{EIRP} / (4\pi r^2)$$

Where S is the power density in mW/cm<sup>2</sup>, EIRP is the radiated isotropic power in milliWatts, and r is the Distance in centimeters. By using the limit of 1 mW/cm<sup>2</sup> (10 W/m<sup>2</sup>) for S and 1845 mW EIRP, the distance at which the RF exposure limit is met is 12.1 cm.

**6.4 Setup Photographs:**

Test Setup



## 6.5 Test Data:

## Intertek

## Radiated Emissions, Substitution

Company: LoJack Corporation  
 Model #: RL7  
 Serial #: 15BF47D  
 Engineer(s): Nicholas Abbondante  
 Project #: G100537026  
 Standard: IC RSS-119 and FCC CFR47 Part 90  
 Barometer: DAV003 Temp/Humidity/Pressure: 19, 19c 27, 23% 1010, 1007mB  
 Location: 10m Chamber  
 Date(s): 11/04/11 11/7/2011  
 Rx Antenna: 145106  
 Rx Cable(s): 145-410  
 Rx Preamp: None  
 Tx Antenna: ANT2A  
 Tx Cable(s): CBL030  
 Tx Signal Generator: HEW62  
 Filter: None  
 Receiver: 145128  
 ERP or EIRP?: ERP  
 Test Distance (m): See notes Voltage/Frequency: Fresh Batteries Frequency Range: 30 MHz - 2 GHz  
 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

| 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   |
|-------------------------------------------|-----------------|---------------|--------------------|--------------------------|------------------------|----------------------|---------------------|---------|-----------|-----------|-------------|
| Note: MSK Modulation @ 10m with no preamp |                 |               |                    |                          |                        |                      |                     |         |           |           |             |
| PK                                        | V               | 173.075       | 110.21             | 55.85                    | 0.25                   | -1.52                | -20.00              | 30.45   | 37.00     | -6.55     | 120/300 kHz |
| Note: FSK Modulation @ 10m with no preamp |                 |               |                    |                          |                        |                      |                     |         |           |           |             |
| PK                                        | V               | 173.075       | 110.28             | 55.85                    | 0.25                   | -1.52                | -20.00              | 30.52   | 37.00     | -6.48     | 120/300 kHz |

Test Personnel: Nicholas Abbondante   
 Supervising Engineer: N/A  
 Product Standard: IC RSS-119, FCC Part 90  
 Input Voltage: 3.6 & 7.2 VDC (Battery Pack)  
 Pretest Verification w/ Ambient Signals or BB Source: Ambient

Test Date: 11/07/2011  
 Test Levels: See Tables  
 Ambient Temperature: 19 °C  
 Relative Humidity: 23 %  
 Atmospheric Pressure: 1007 mbars

Deviations, Additions, or Exclusions: None

## 7 Transmitter Emissions Mask

### 7.1 Method

Tests are performed in accordance with IC RSS-119 Sections 5.5, 5.8; IC RSS-Gen Section 4.9.

**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    |
|----------|------------------------------------------------|-------------------|--------------------|-------------|------------|------------|
| DAV003'  | Weather Station                                | Davis Instruments | 7400               | PE80529A39A | 08/02/2011 | 08/02/2012 |
| ~ANT2A   | BROADBAND ANTENNA                              | Compliance Design | B100               | 1852        | 11/18/2010 | 11/18/2011 |
| ~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 |
| 145128'  | EMI Receiver 40 GHz (20 Hz - 40 Ghz)           | Rohde & Schwarz   | ESL                | 8392831001  | 08/23/2011 | 08/23/2012 |
| 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 |

#### Software Utilized:

| Name                     | Manufacturer | Version |
|--------------------------|--------------|---------|
| None (Receiver Firmware) |              |         |

### 7.3 Results:

The transmitter waveform envelope must meet the applicable emissions masks as specified in IC RSS-119 Section 5.8. The mask is shown referenced to the full power of the emission when measured using the same radiated emissions test setup. The MaskD1 and D2 limit lines are shown as a worst case, and actually should be higher.

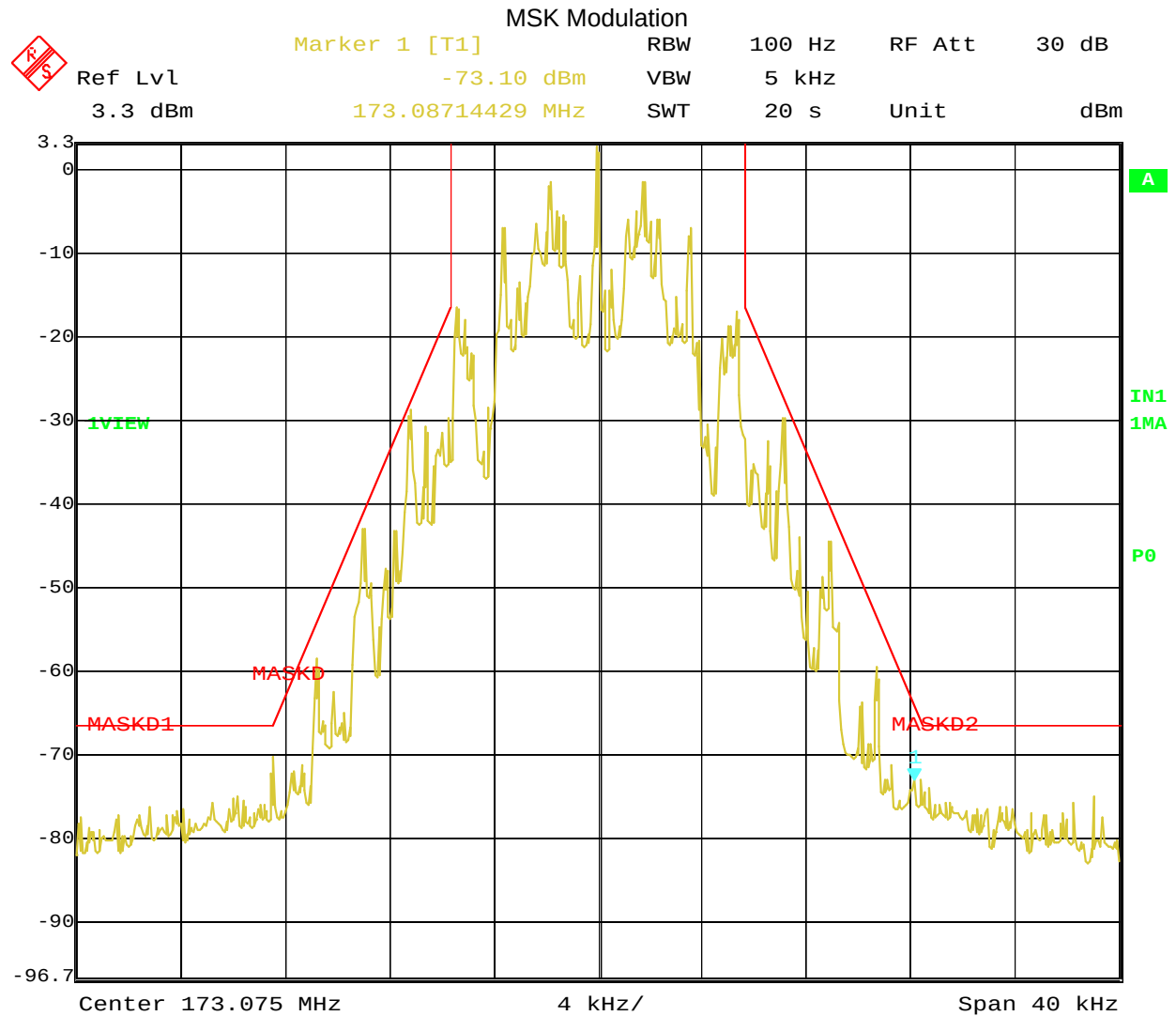
The sample tested was found to comply using a 3.0 kHz deviation setting.

**7.4 Setup Photograph:**

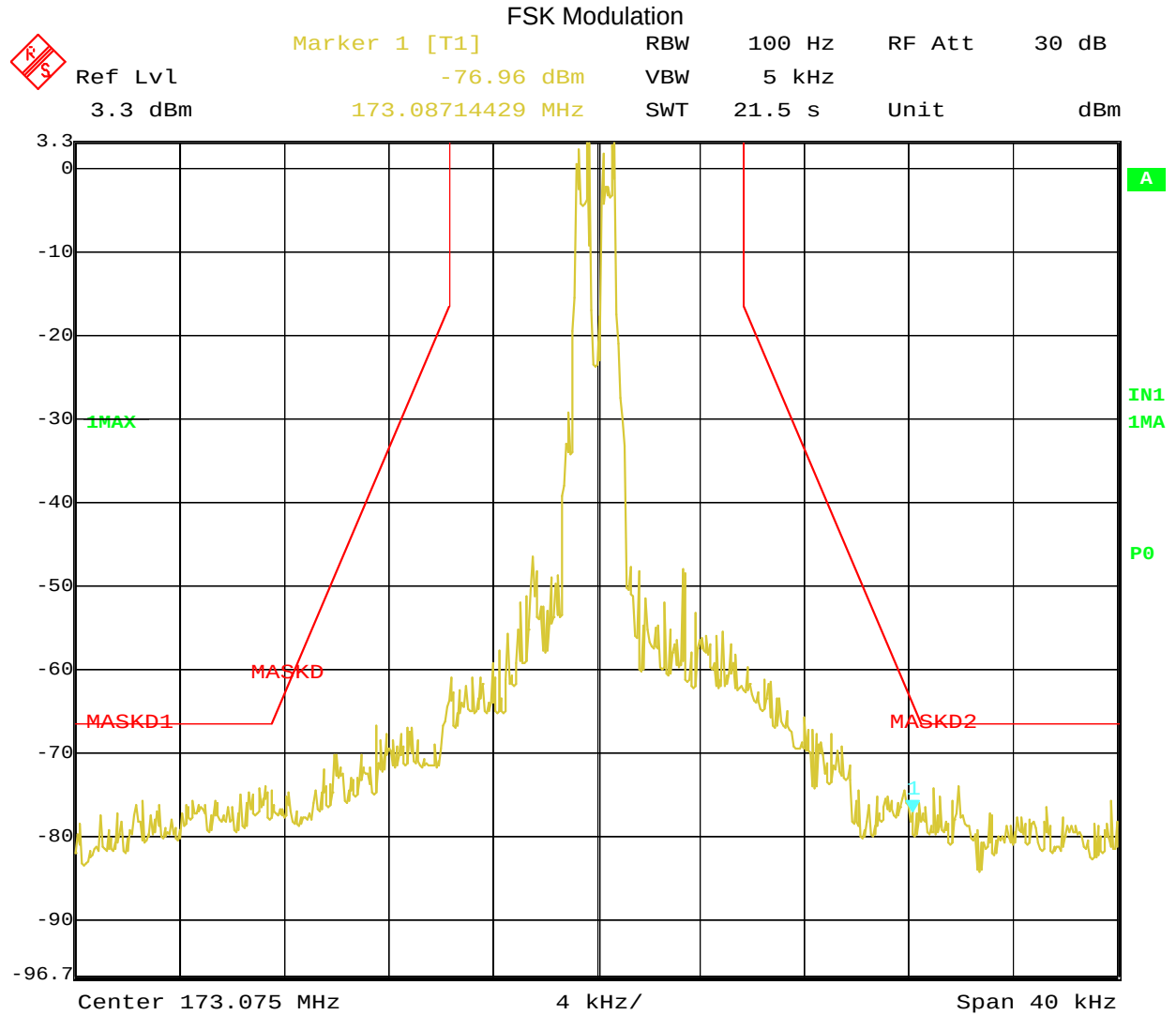
Test Setup



## 7.5 Test Data:



Date: 7.NOV.2011 21:38:35



Date: 7.NOV.2011 21:47:43

|                                                       |                              |
|-------------------------------------------------------|------------------------------|
| Test Personnel:                                       | Nicholas Abbondante          |
| Supervising Engineer:                                 | N/A                          |
| Product Standard:                                     | IC RSS-119, FCC Part 90      |
| Input Voltage:                                        | 3.6 & 7.2 VDC (Battery Pack) |
| Pretest Verification w/ Ambient Signals or BB Source: | <b>Ambient</b>               |

|                       |            |
|-----------------------|------------|
| Test Date:            | 11/07/2011 |
| Test Levels:          |            |
| Ambient Temperature:  | 19 °C      |
| Relative Humidity:    | 23 %       |
| Atmospheric Pressure: | 1007 mbars |

Deviations, Additions, or Exclusions: None

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

### 8.1 Method

Tests are performed in accordance with IC RSS-119 Sections 4.2, 5.8; IC RSS-Gen Section 4.9.

**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.

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

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

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

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

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

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

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

**Example:**

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

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

## 8.2 Test Equipment Used:

| Asset                            | Description                                    | Manufacturer      | Model              | Serial      | Cal Date   | Cal Due    |
|----------------------------------|------------------------------------------------|-------------------|--------------------|-------------|------------|------------|
| Test equipment used at 10 meters |                                                |                   |                    |             |            |            |
| DAV003'                          | Weather Station                                | Davis Instruments | 7400               | PE80529A39A | 08/02/2011 | 08/02/2012 |
| 145128'                          | EMI Receiver 40 GHz (20 Hz - 40 GHz)           | Rohde & Schwarz   | ESI                | 8392831001  | 08/23/2011 | 08/23/2012 |
| 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 |
| ~ANT2A                           | BROADBAND ANTENNA                              | Compliance Design | B100               | 1852        | 11/18/2010 | 11/18/2011 |
| ~ANT2B                           | BROADBAND ANTENNA                              | Compliance Design | B200               | 1850        | 11/18/2010 | 11/18/2011 |
| ~ANT2C                           | BROADBAND ANTENNA                              | Compliance Design | B300               | 00674       | 11/18/2010 | 11/18/2011 |
| ~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 |
| PRE7'                            | PREAMPLIFIER                                   | Hewlett Packard   | 8447D              | 2944A08718  | 07/01/2011 | 07/01/2012 |
| Test equipment used at 3 meters  |                                                |                   |                    |             |            |            |
| DAV003'                          | Weather Station                                | Davis Instruments | 7400               | PE80529A39A | 08/02/2011 | 08/02/2012 |
| ~REA003                          | 1GHz High Pass Filter                          | Reactel, Inc      | 7HS-1G/10G-S11     | 06-1        | 12/06/2010 | 12/06/2011 |
| ~HEW62                           | Synthesized Sweep Generator                    | Hewlett Packard   | 83620A             | 3213A01244  | 04/08/2011 | 04/08/2012 |
| ~HORN2                           | HORN ANTENNA                                   | EMCO              | 3115               | 9602-4675   | 10/24/2011 | 10/24/2012 |
| ~CBL030                          | High Frequency Cable 40GHz                     | Megaphase         | TM40 K1K1 80       | CBL030      | 01/06/2011 | 01/06/2012 |
| 145-416'                         | Cables 145-400 145-402 145-404 145-408         | Huber + Suhner    | 3m Track B cables  | multiple    | 09/04/2011 | 09/04/2012 |
| 145128'                          | EMI Receiver 40 GHz (20 Hz - 40 GHz)           | Rohde & Schwarz   | ESI                | 8392831001  | 08/23/2011 | 08/23/2012 |
| 145014'                          | Preamplifier (1 GHz to 26.5 GHz)               | Hewlett Packard   | 8449B              | 3008A00232  | 12/28/2010 | 12/28/2011 |
| HORN3'                           | HORN ANTENNA                                   | EMCO              | 3115               | 9610-4980   | 03/28/2011 | 03/28/2012 |

### Software Utilized:

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

## 8.3 Results:

Transmitter unwanted out-of-band emissions must meet the limits of IC RSS-119 Section 5.8 and CFR47 Part 90.210. Emissions must be attenuated below the carrier power by at least 50 + 10 log (P) dB (-20 dBm) or 70 dB, whichever is the lesser attenuation.

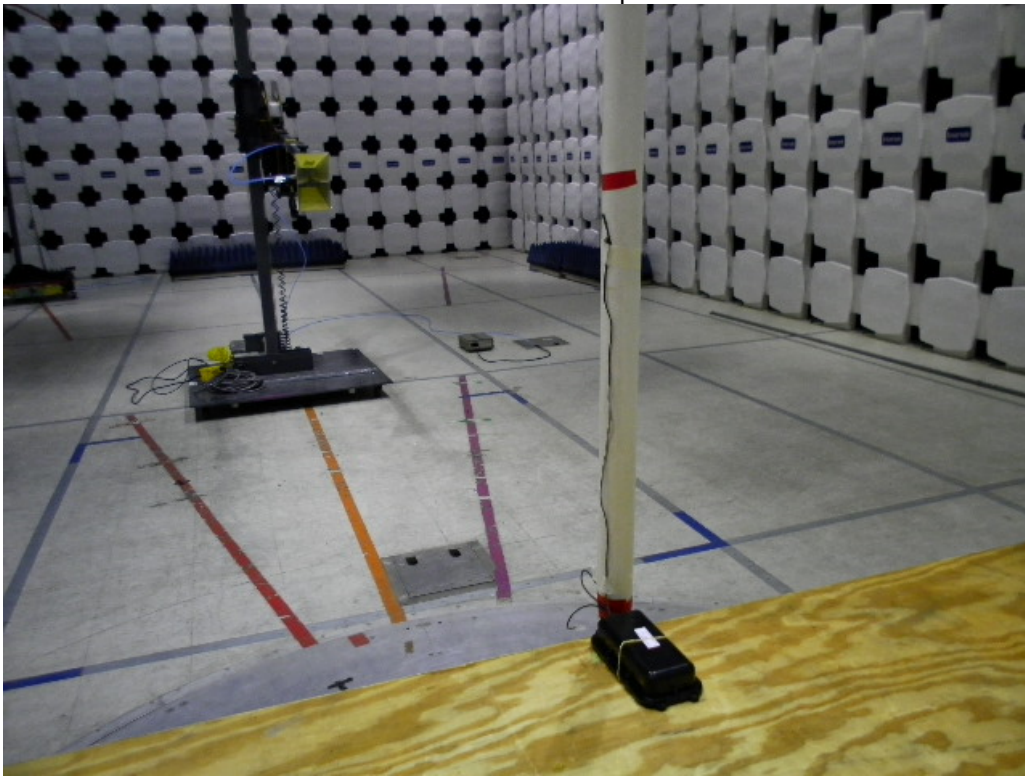
The sample tested was found to comply.

**8.4 Setup Photographs:**

30-1000 MHz Test Setup



1-2 GHz Test Setup



## 8.5 Test Data:

## Intertek

## Radiated Emissions, Substitution

Company: LoJack Corporation  
 Model #: RL7  
 Serial #: 15BF47D  
 Engineer(s): Nicholas Abbondante  
 Project #: G100537026  
 Standard: IC RSS-119 and FCC CFR47 Part 90  
 Barometer: DAV003  
 Temp/Humidity/Pressure: 19, 19c 27, 23% 1010, 1007mB  
 Location: 10m Chamber  
 Date(s): 11/04/11 11/7/2011  
 Rx Antenna: 145106 HORN3  
 Rx Cable(s): 145-410 145-416  
 Rx Preamp: 145014 Receiver: 145128  
 Tx Antenna: ANT2 HORN2  
 Tx Cable(s): CBL030  
 Tx Signal Generator: HEW62 Filter: REA003  
 ERP or EIRP?: ERP

Test Distance (m): See notes Voltage/Frequency: Fresh Batteries Frequency Range: 30 MHz - 2 GHz

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

| 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   |
|---------------------------------------------------------|-----------------|---------------|--------------------|--------------------------|------------------------|----------------------|---------------------|---------|-----------|-----------|-------------|
| Note: MSK Modulation @ 10m with no preamp               |                 |               |                    |                          |                        |                      |                     |         |           |           |             |
| PK                                                      | V               | 346.150       | 26.63              | 50.57                    | 0.35                   | -1.62                | -20.00              | -48.06  | -20.00    | -28.06    | 120/300 kHz |
| PK                                                      | V               | 519.225       | 26.84              | 48.68                    | 0.43                   | 1.87                 | -20.00              | -42.55  | -20.00    | -22.55    | 120/300 kHz |
| PK                                                      | V               | 692.300       | 27.02              | 48.33                    | 0.46                   | 2.33                 | -20.00              | -41.59  | -20.00    | -21.59    | 120/300 kHz |
| PK                                                      | V               | 865.375       | 29.05              | 45.09                    | 0.48                   | -0.08                | -20.00              | -38.75  | -20.00    | -18.75    | 120/300 kHz |
| Note: MSK Modulation @ 3m with preamp and filter REA003 |                 |               |                    |                          |                        |                      |                     |         |           |           |             |
| PK                                                      | V               | 1038.450      | 61.30              | 89.46                    | 0.85                   | 5.94                 | -20.00              | -45.22  | -20.00    | -25.22    | 1/3 MHz     |
| PK                                                      | V               | 1211.525      | 56.08              | 87.87                    | 1.00                   | 6.22                 | -20.00              | -48.72  | -20.00    | -28.72    | 1/3 MHz     |
| PK                                                      | V               | 1384.600      | 57.52              | 88.05                    | 0.96                   | 7.11                 | -20.00              | -46.53  | -20.00    | -26.53    | 1/3 MHz     |
| PK                                                      | V               | 1557.675      | 55.63              | 88.95                    | 0.97                   | 8.00                 | -20.00              | -48.44  | -20.00    | -28.44    | 1/3 MHz     |
| PK                                                      | V               | 1730.750      | 53.61              | 86.44                    | 0.78                   | 7.84                 | -20.00              | -47.92  | -20.00    | -27.92    | 1/3 MHz     |
| Note: FSK Modulation @ 10m with no preamp               |                 |               |                    |                          |                        |                      |                     |         |           |           |             |
| PK                                                      | V               | 346.150       | 26.07              | 50.57                    | 0.35                   | -1.62                | -20.00              | -48.62  | -20.00    | -28.62    | 120/300 kHz |
| PK                                                      | V               | 519.225       | 26.24              | 48.68                    | 0.43                   | 1.87                 | -20.00              | -43.15  | -20.00    | -23.15    | 120/300 kHz |
| PK                                                      | V               | 692.300       | 27.40              | 48.33                    | 0.46                   | 2.33                 | -20.00              | -41.21  | -20.00    | -21.21    | 120/300 kHz |
| PK                                                      | V               | 865.375       | 28.24              | 45.09                    | 0.48                   | -0.08                | -20.00              | -39.56  | -20.00    | -19.56    | 120/300 kHz |
| Note: FSK Modulation @ 3m with preamp and filter REA003 |                 |               |                    |                          |                        |                      |                     |         |           |           |             |
| PK                                                      | V               | 1038.450      | 46.36              | 89.46                    | 0.85                   | 5.94                 | -20.00              | -60.16  | -20.00    | -40.16    | 1/3 MHz     |
| PK                                                      | V               | 1211.525      | 43.04              | 87.87                    | 1.00                   | 6.22                 | -20.00              | -61.76  | -20.00    | -41.76    | 1/3 MHz     |
| PK                                                      | V               | 1384.600      | 45.38              | 88.05                    | 0.96                   | 7.11                 | -20.00              | -58.67  | -20.00    | -38.67    | 1/3 MHz     |
| PK                                                      | V               | 1557.675      | 44.13              | 88.95                    | 0.97                   | 8.00                 | -20.00              | -59.94  | -20.00    | -39.94    | 1/3 MHz     |
| PK                                                      | V               | 1730.750      | 42.85              | 86.44                    | 0.78                   | 7.84                 | -20.00              | -58.68  | -20.00    | -38.68    | 1/3 MHz     |

Test Personnel: Nicholas Abbondante   
 Supervising Engineer: N/A  
 Product Standard: IC RSS-119, FCC Part 90  
 Input Voltage: 3.6 & 7.2 VDC (Battery Pack)

Pretest Verification w/ Ambient  
 Signals or BB Source:

**Ambient**

Test Date: 11/04/2011, 11/07/2011  
 Test Levels: See Tables  
 Ambient Temperature: 19, 19 °C  
 Relative Humidity: 27, 23 %  
 Atmospheric Pressure: 1010, 1007 mbars

Deviations, Additions, or Exclusions: None

## 9 Receiver Radiated Spurious Emissions

### 9.1 Method

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

**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.

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

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

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

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

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

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

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

**Example:**

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

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

**9.2 Test Equipment Used:**

| Asset                            | Description                                    | Manufacturer      | Model              | Serial      | Cal Date   | Cal Due    |
|----------------------------------|------------------------------------------------|-------------------|--------------------|-------------|------------|------------|
| Test equipment used at 10 meters |                                                |                   |                    |             |            |            |
| DAV003'                          | Weather Station                                | Davis Instruments | 7400               | PE80529A39A | 08/02/2011 | 08/02/2012 |
| 145128'                          | EMI Receiver 40 GHz (20 Hz - 40 Ghz)           | Rohde & Schwarz   | ESI                | 8392831001  | 08/23/2011 | 08/23/2012 |
| 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 |
| PRE7'                            | PREAMPLIFIER                                   | Hewlett Packard   | 8447D              | 2944A08718  | 07/01/2011 | 07/01/2012 |
| Test equipment used at 3 meters  |                                                |                   |                    |             |            |            |
| DAV003'                          | Weather Station                                | Davis Instruments | 7400               | PE80529A39A | 08/02/2011 | 08/02/2012 |
| 145-416'                         | Cables 145-400 145-402 145-404 145-408         | Huber + Suhner    | 3m Track B cables  | multiple    | 09/04/2011 | 09/04/2012 |
| 145128'                          | EMI Receiver 40 GHz (20 Hz - 40 Ghz)           | Rohde & Schwarz   | ESI                | 8392831001  | 08/23/2011 | 08/23/2012 |
| 145014'                          | Preamplifier (1 GHz to 26.5 GHz)               | Hewlett Packard   | 8449B              | 3008A00232  | 12/28/2010 | 12/28/2011 |
| HORN3'                           | HORN ANTENNA                                   | EMCO              | 3115               | 9610-4980   | 03/28/2011 | 03/28/2012 |

**Software Utilized:**

| Name | Manufacturer | Version         |
|------|--------------|-----------------|
| C5   | Teseq        | Build 5.26.00.3 |

**9.3 Results:**

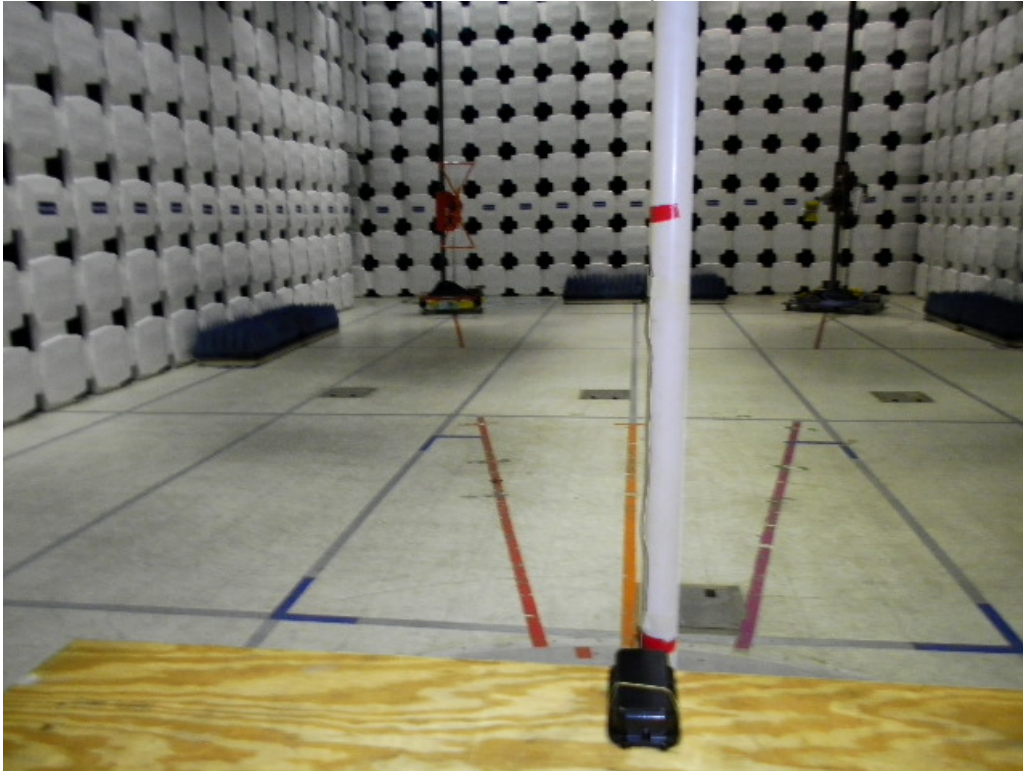
Receiver radiated emissions must not exceed the limits in IC RSS-Gen Table 2.

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

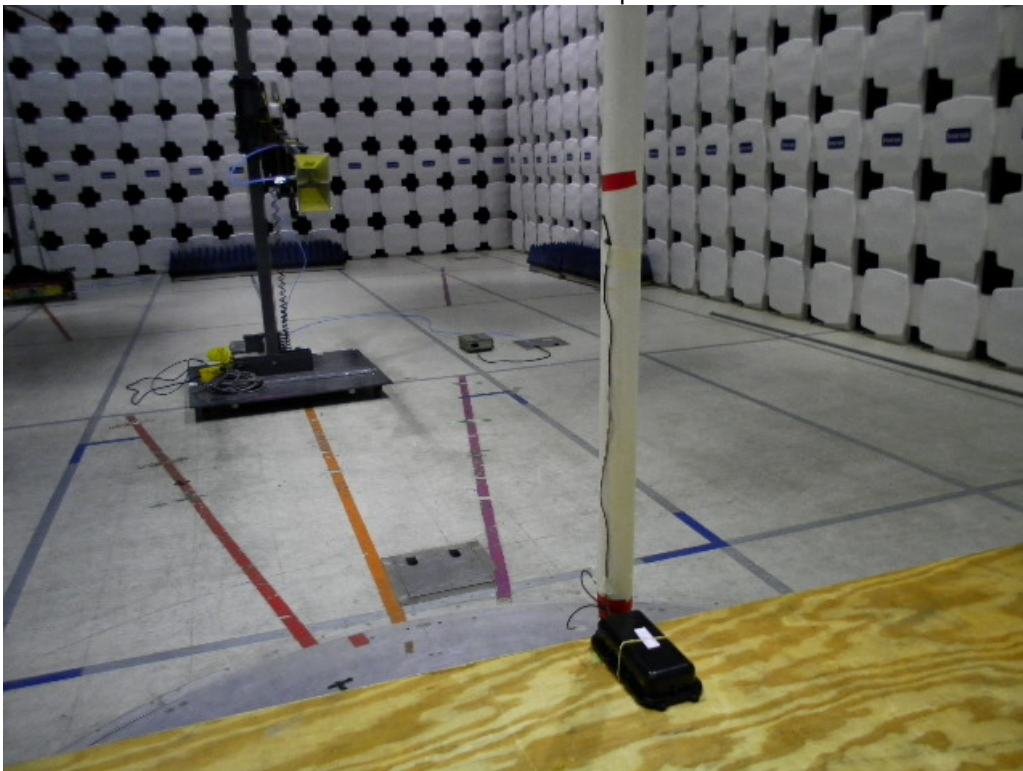
The sample tested was found to comply.

#### 9.4 Setup Photographs:

30-1000 MHz Test Setup



1-2 GHz Test Setup

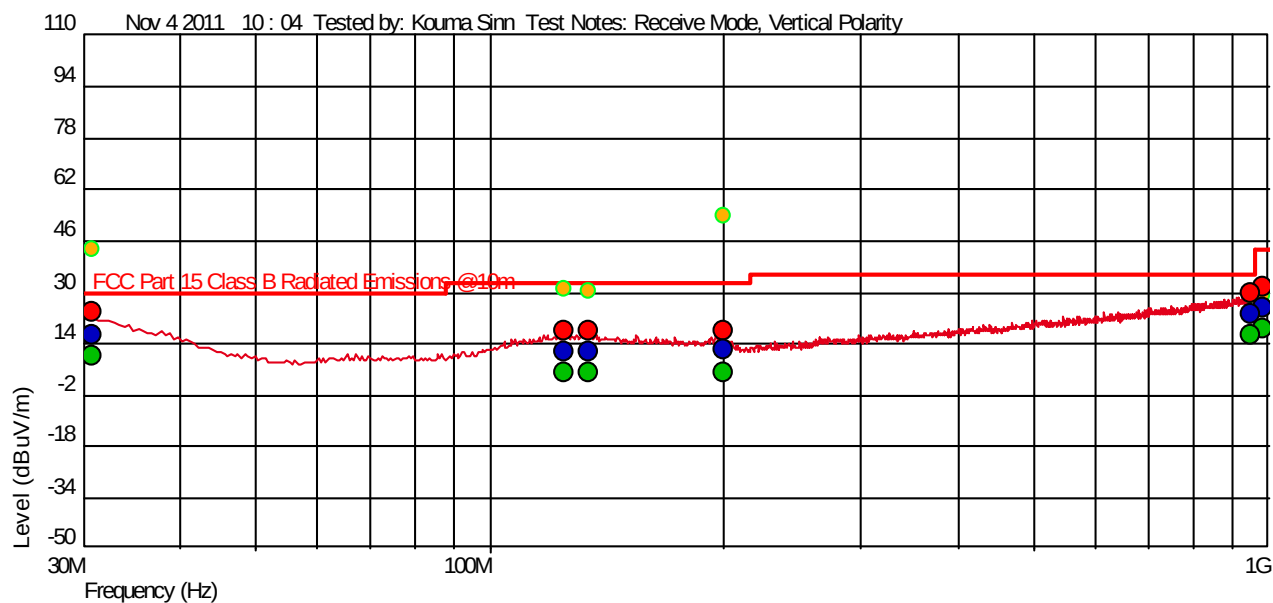


## 9.5 Test Data:

### Radiated Emissions 30-1000MHz Vertical Polarity @ 10m

#### Test Information

Test Details: Serial # C6EDE58  
 Test Notes: Receive Mode, Vertical Polarity  
 Temperature: 20C  
 Humidity: 29%, 1006mbar  
 Tested by: Kouma Sinn  
 Test Started: Nov 4 2011 10 : 04



#### "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 (I) | Angle (deg) | Mast Height (m) | RBW (Hz) |
|----------------|----------------|-----------------|------------------|----------------|-------------|----------|-------------|-----------------|----------|
| 30.832 M       | 16.66          | 20.134          | -25.525          | 29.54          | -12.88      |          | 52          | 3.91            | 120k     |
| 124.907 M      | 11.52          | 13.991          | -25.183          | 33.04          | -21.52      |          | 4           | 3.76            | 120k     |
| 133.760 M      | 11.49          | 13.748          | -25.074          | 33.04          | -21.55      |          | 254         | 3.22            | 120k     |
| 200.020 M      | 11.81          | 13.094          | -24.410          | 33.04          | -21.23      |          | 249         | 2.22            | 120k     |
| 948.268 M      | 23.23          | 23.200          | -22.361          | 35.54          | -12.31      |          | 155         | 3.64            | 120k     |
| 986.037 M      | 24.87          | 23.600          | -21.755          | 43.54          | -18.67      |          | 237         | 3.03            | 120k     |

## Radiated Emissions 30-1000MHz Horizontal Polarity @ 10m

## Test Information

## Test Details

## Test Notes:

## Temperature:

## Humidity:

## Tested by:

## Test Started:

Serial # C6EDE58

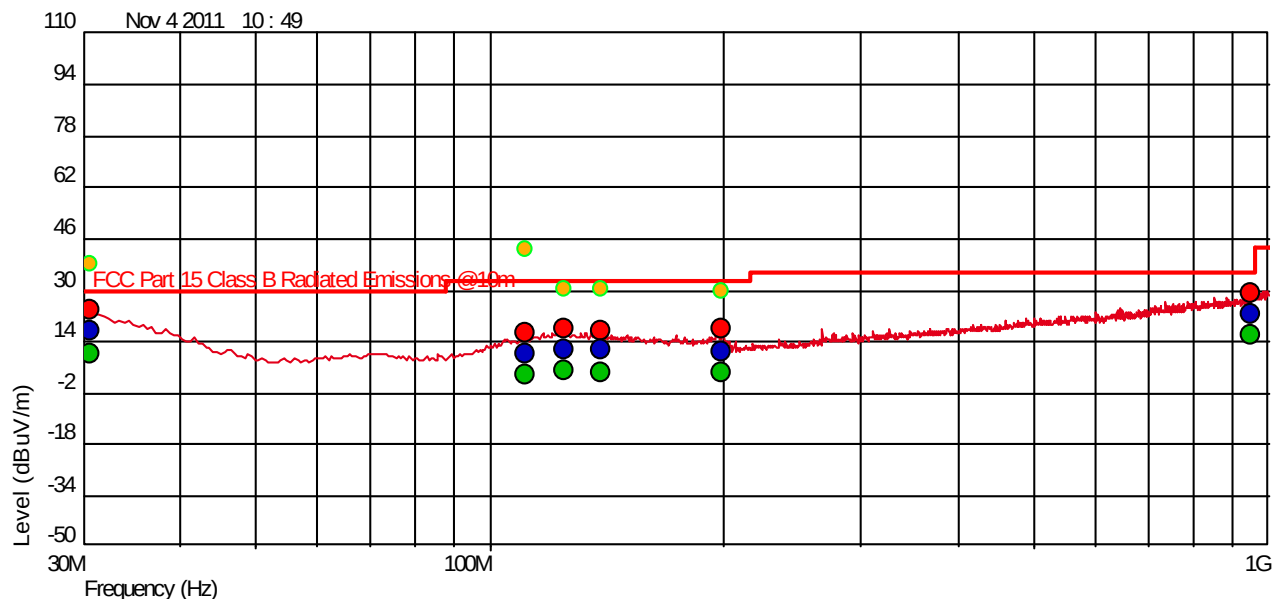
Receive Mode, Horizontal Polarity

20C

29%, 1006mbar

Kouma Sinn

Nov 4 2011 10 : 49



## "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)

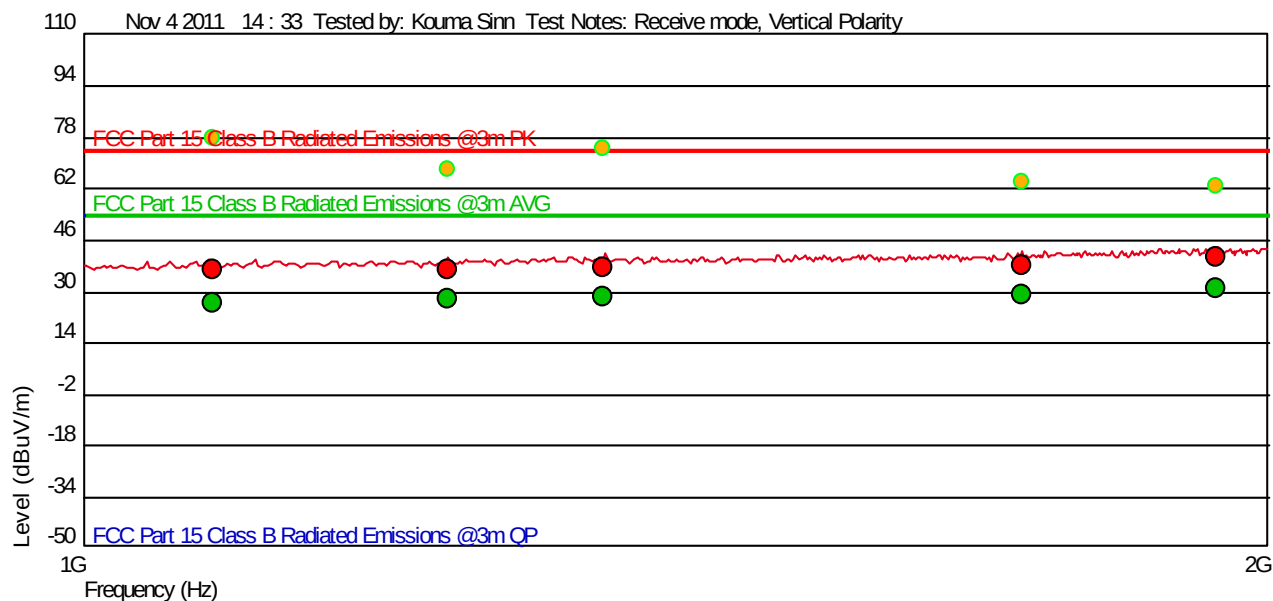
## Measured: Quasi-Peak

| Frequency (Hz) | Level (dBuV/m) | Ant. Fact. (dB) | Other Fact. (dB) | Limit (dBuV/m) | Margin (dB) | Hor (°) | Angle (deg) | Mast Height (m) | RBW (Hz) |
|----------------|----------------|-----------------|------------------|----------------|-------------|---------|-------------|-----------------|----------|
| 30.729 M       | 17.15          | 20.617          | -25.521          | 29.54          | -12.39      | --      | 77          | 3.76            | 120k     |
| 111.116 M      | 10.26          | 12.923          | -25.371          | 33.04          | -22.78      | --      | 292         | 3.60            | 120k     |
| 124.384 M      | 11.56          | 14.038          | -25.190          | 33.04          | -21.48      | --      | 33          | 3.39            | 120k     |
| 139.299 M      | 11.14          | 13.440          | -25.009          | 33.04          | -21.90      | --      | 99          | 3.58            | 120k     |
| 198.023 M      | 11.10          | 12.502          | -24.427          | 33.04          | -21.94      | --      | 297         | 3.84            | 120k     |
| 951.362 M      | 22.79          | 22.727          | -22.327          | 35.54          | -12.75      | --      | 165         | 2.45            | 120k     |

# Radiated Emissions 1-2GHz Vertical Polarity @ 3m

## Test Information

Test Details: Serial # C6EDE58  
 Test Notes: Receive mode, Vertical Polarity  
 Temperature: 21C  
 Humidity: 30%, 1006mbar  
 Tested by: Kouma Sinn  
 Test Started: Nov 4 2011 14 : 33



## "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) |
|----------------|----------------|-----------------|------------------|----------------|-------------|----------|-------------|-----------------|----------|
| 1.078 G        | 36.94          | 24.584          | -29.963          | 74.00          | -37.06      |          | 157         | 1.49            | 1M       |
| 1.237 G        | 36.78          | 25.637          | -29.403          | 74.00          | -37.22      |          | 168         | 1.05            | 1M       |
| 1.356 G        | 37.74          | 25.937          | -29.032          | 74.00          | -36.26      |          | 277         | 1.06            | 1M       |
| 1.73 G         | 38.33          | 26.432          | -28.510          | 74.00          | -35.67      |          | 221         | 1.50            | 1M       |
| 1.941 G        | 40.45          | 27.669          | -28.423          | 74.00          | -33.55      |          | 196         | 1.51            | 1M       |

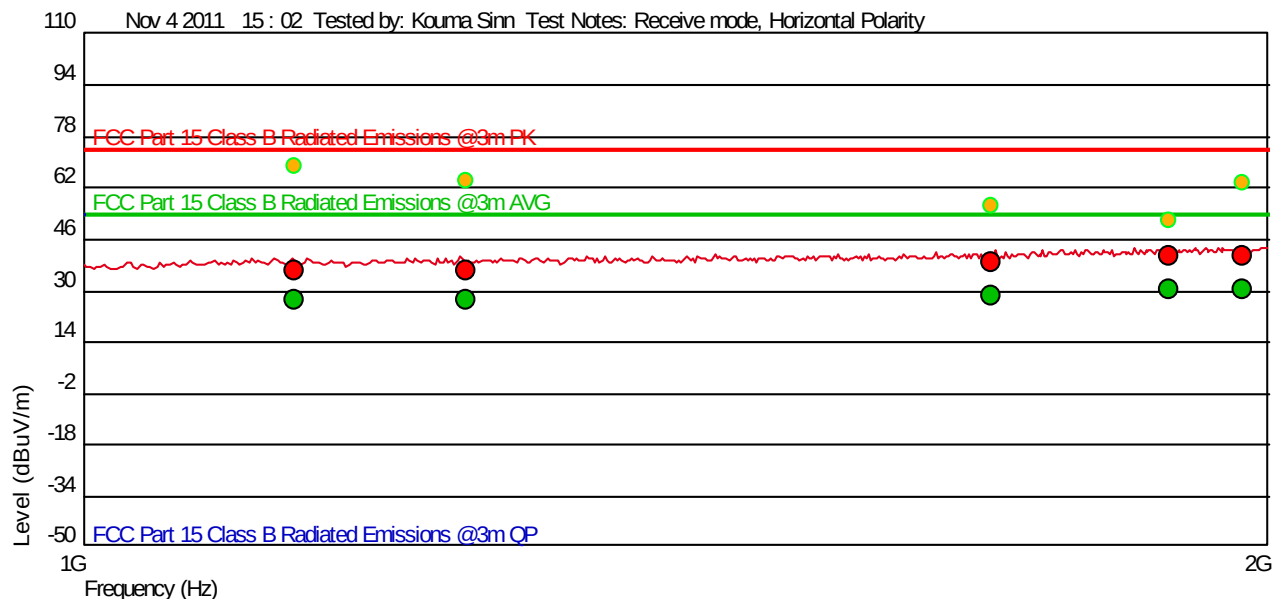
## Measured: Average

| 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) |
|----------------|----------------|-----------------|------------------|----------------|-------------|----------|-------------|-----------------|----------|
| 1.078 G        | 26.67          | 24.584          | -29.963          | 54.00          | -27.33      |          | 157         | 1.49            | 1M       |
| 1.237 G        | 27.45          | 25.637          | -29.403          | 54.00          | -26.55      |          | 168         | 1.05            | 1M       |
| 1.356 G        | 28.24          | 25.937          | -29.032          | 54.00          | -25.76      |          | 277         | 1.06            | 1M       |
| 1.732 G        | 29.13          | 26.432          | -28.510          | 54.00          | -24.87      |          | 221         | 1.50            | 1M       |
| 1.941 G        | 30.71          | 27.669          | -28.423          | 54.00          | -23.29      |          | 196         | 1.51            | 1M       |

Radiated Emissions 1-2GHz Horizontal Polarity @ 3m

Test Information

Test Details: Serial # C6EDE58  
 Test Notes: Receive mode, Horizontal Polarity  
 Temperature: 21C  
 Humidity: 29%, 1006mbar  
 Tested by: Kouma Sinn  
 Test Started: Nov 4 2011 15 : 02



"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) |
|----------------|----------------|-----------------|------------------|----------------|-------------|---------|-------------|-----------------|----------|
| 1.132 G        | 36.31          | 25.235          | -29.767          | 74.00          | -37.69      | --      | 177         | 2.42            | 1M       |
| 1.251 G        | 36.46          | 25.760          | -29.359          | 74.00          | -37.54      | --      | 168         | 1.57            | 1M       |
| 1.701 G        | 39.09          | 26.139          | -28.524          | 74.00          | -34.91      | --      | 52          | 2.09            | 1M       |
| 1.887 G        | 40.92          | 27.469          | -28.445          | 74.00          | -33.08      | --      | 297         | 1.59            | 1M       |
| 1.970 G        | 40.45          | 27.654          | -28.412          | 74.00          | -33.55      | --      | 53          | 1.69            | 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) |
|----------------|----------------|-----------------|------------------|----------------|-------------|---------|-------------|-----------------|----------|
| 1.132 G        | 27.17          | 25.235          | -29.767          | 54.00          | -26.83      | --      | 177         | 2.42            | 1M       |
| 1.251 G        | 27.09          | 25.760          | -29.359          | 54.00          | -26.91      | --      | 168         | 1.57            | 1M       |
| 1.701 G        | 28.44          | 26.139          | -28.524          | 54.00          | -25.56      | --      | 52          | 2.09            | 1M       |
| 1.887 G        | 30.24          | 27.469          | -28.445          | 54.00          | -23.76      | --      | 297         | 1.59            | 1M       |
| 1.970 G        | 30.58          | 27.654          | -28.412          | 54.00          | -23.42      | --      | 53          | 1.69            | 1M       |



|                                                          |                              |                       |                 |
|----------------------------------------------------------|------------------------------|-----------------------|-----------------|
| Test Personnel:                                          | Kouma Sinn <i>KPS</i>        | Test Date:            | 11/04/2011      |
| Supervising Engineer:                                    | N/A                          | Test Levels:          | See section 9.3 |
| Product Standard:                                        | IC RSS-119, FCC Part 90      | Ambient Temperature:  | 20 °C           |
| Input Voltage:                                           | 3.6 & 7.2 VDC (Battery Pack) | Relative Humidity:    | 29 %            |
| Pretest Verification w/ Ambient<br>Signals or BB Source: | <b>Ambient Signals</b>       | Atmospheric Pressure: | 1006 mbars      |

Deviations, Additions, or Exclusions: None

**10 Revision History**

| Revision Level | Date       | Report Number    | Notes                  |
|----------------|------------|------------------|------------------------|
| 0              | 11/17/2011 | 100537026BOX-004 | Original Issue         |
| 1              | 01/12/2012 | 100537026BOX-004 | Updated client address |
|                |            |                  |                        |
|                |            |                  |                        |
|                |            |                  |                        |
|                |            |                  |                        |