

## EMISSIONS TEST REPORT

Report Number: 3178496BOX-002  
Project Number: 3178496

Testing performed on the  
Vehicle Location Unit  
Models: V7E-SP

To

CFR47 "Telecommunications" FCC Part 90 "Private Land Mobile Radio Services"

For

LoJack Corporation

Test Performed by:  
Intertek – ETL SEMKO  
70 Codman Hill Road  
Boxborough, MA 01719

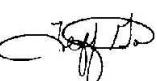
Test Authorized by:  
LoJack Corporation  
780 Dedham Street  
Canton, MA 02021

Prepared by:

  
Nicholas Abbondante

Date: 08/03/2009

Reviewed by:

  
Jeff Goulet

Date: 08/03/09

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## 1.0 Job Description

### 1.1 Client Information

This EUT has been tested at the request of:

**Company:** LoJack Corporation  
780 Dedham Street  
Canton, MA 02021

**Contact:** Mr. Bob White

**Telephone:** 781-302-7128

**Fax:** 781-302-7299

**Email:** [rwhite@lojack.com](mailto:rwhite@lojack.com)

### 1.2 Equipment Under Test

**Equipment Type:** Vehicle Location Unit

**Model Number(s):** V7E-SP

**Serial number(s):** 01120902900092, 01120902900024 (V7E-SP), 8 (VLU7-SP)

**Manufacturer:** LoJack Corporation

**EUT receive date:** 11-03-2008 (VLU7-SP)  
06-18-2009 (V7E-SP)

**EUT received condition:** Prototype in Good Condition

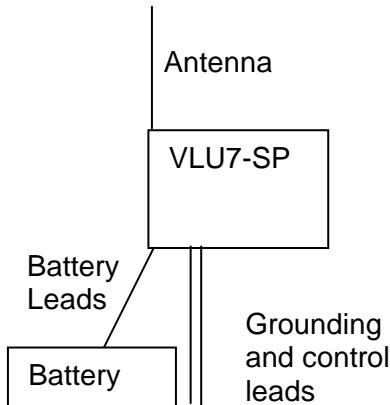
**Test start date:** 11-05-2008 (VLU7-SP)  
06-18-2009 (V7E-SP)

**Test end date:** 07-08-2009

**1.3 Test Plan Reference:** Tested according to the standards listed and with the guidance of ANSI/TIA-603-C-2004. Please note that the V7E-SP is a modified version of the VLU7-SP, and only the tests which would be expected to have been affected by the modifications were performed. Test data for tests which were not expected to change due to the modifications are included for reference from the VLU7-SP testing.

## 1.4 Test Configuration

### 1.4.1 Block Diagram



**1.4.2. Cables:**

Cable	Shielding	Connector	Length (m)	Qty.
Antenna	None	Wire	1.067	1
DC Ground	None	Wire	0.4	1
Control	None	Wire	0.4	1
Backup Battery Power And Return	None	Wire	0.31	2

**1.4.3. Support Equipment:**

Name: GW DC Power Supply  
Model No.: GPS-1830D  
Serial No.: E00233

**1.5 Mode(s) of Operation:**

The EUT was activated from a fresh battery throughout testing, except for frequency stability testing where a DC power supply was used to supply 6.1 and 3.3 VDC to the VLU7-SP. During frequency stability testing, samples were configured to transmit continuously in unmodulated (CW) mode. All other testing was performed using both the FSK and MSK modulation schemes, set to normal burst lengths but configured to transmit the burst repetitively to aid in testing. Conducted emissions and output power testing was performed through a Mini Circuits 50 Ohm transformer used as a temporary 50 Ohm antenna port.

**1.6 Floor Standing Equipment:** Applicable:\_\_\_\_\_ Not Applicable: X

## 2.0 Test Summary

TEST STANDARD	RESULTS	
CFR47 FCC Part 90		
SUB-TEST	TEST PARAMETER	COMMENT
RF Output Power and Spurious Emissions FCC 2.1046, 2.1053, 90.20(e)(6), 90.210(c)	RF Output Power must not exceed 2.5 Watts (34 dBm).	Pass
Conducted Spurious Emissions	Spurious emissions must not exceed -13 dBm.	Pass
Radiated Spurious Emissions	Spurious emissions must not exceed -13 dBm.	Pass
Occupied Bandwidth FCC 2.1049, 90.20(e)(6)	Occupied bandwidth must not exceed 20 kHz.	Pass
Emissions Mask FCC 90.210(c)	The transmit waveform must meet the Requirements of Emissions Mask C.	Pass
On-Time FCC 90.20(e)(6)	On time must not exceed 200 ms over the period of 1 second when the transmitter is in active mode. On time must not exceed 200 ms over the period of 10 seconds when the transmitter is not in active mode.	Pass
Transient Frequency Behavior FCC 90.214	The transmit frequency must stay within 12.5 kHz of the nominal frequency for the 20 ms after the first 5 ms that follow the transmitter being keyed on.	Pass
Frequency Stability FCC 2.1055, 90.213	Frequency drift must not exceed 50 PPM	Pass

### REVISION SUMMARY – The following changes have been made to this Report:

<u>Date</u>	<u>Project No.</u>	<u>Project Handler</u>	<u>Page(s)</u>	<u>Item</u>	<u>Description of Change</u>
08/03/09	3178496	N. Abbondante	24-25	Transient plot	Updated test results for the transient frequency behavior test

### 3.0 Sample Calculations

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  $\text{dB}\mu\text{V}/\text{m}$

$RA$  = Receiver Amplitude (including preamplifier) in  $\text{dB}\mu\text{V}$

$CF$  = 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  $\text{dB}\mu\text{V}$  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  $\text{dB}\mu\text{V}/\text{m}$ . This value in  $\text{dB}\mu\text{V}/\text{m}$  was converted to its corresponding level in  $\mu\text{V}/\text{m}$ .

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

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

$CF = 1.6 \text{ dB}$

$AG = 29.0 \text{ dB}$

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

$$\text{Level in } \mu\text{V}/\text{m} = [10(32 \text{ dB}\mu\text{V}/\text{m})/20] = 39.8 \mu\text{V}/\text{m}$$

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

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

$RF$  = Reading from receiver in  $\text{dB}\mu\text{V}$

$LF$  = LISN Correction Factor in dB

$CF$  = Cable Correction Factor in dB

$AF$  = Attenuator Loss Factor in dB

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

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

#### Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V}/20)} = 254 \mu\text{V}/\text{m}$$

### 3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.

The expanded uncertainty ( $k = 2$ ) for radiated emissions from 30 to 1000 MHz has been determined to be:

$\pm 3.5$  dB at 10m,  $\pm 3.8$  dB at 3m

The expanded uncertainty ( $k = 2$ ) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

$\pm 2.6$  dB

The expanded uncertainty ( $k = 2$ ) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

$\pm 3.2$  for ISN and voltage probe measurements

$\pm 3.1$  for current probe measurements

### 3.2 Site Description

#### Test Site(s): 2

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

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 groundplanes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** RF Output Power

**Performance Criterion:** RF Output Power must not exceed 2.5 Watts (34 dBm).

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	20	Humidity (%):	51	Pressure (hPa):	1008
Pretest Verification Performed		Yes		Equipment under Test:		V7E-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		01120902900024 (V7E-SP)	
Engineer's Initials:	NNA	Date Test Performed:	06-18-2009	Reviewer's Initials:	JC	Date Reviewed:	06/24/09

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80519A93	06/10/2010
2	Universal Power meter	Gigatronics	8651A	8651298	02/05/2010
3	Power Sensor	Gigatronics	80334A	1835789	02/05/2010

**Test Details:**

Notes: Output power of the V7E-SP was measured to be 31.54 dBm for FSK modulation and 31.51 dBm for MSK modulation at the temporary 50 Ohm antenna port.

**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** Conducted Spurious Emissions

**Performance Criterion:** Spurious emissions must not exceed -13 dBm.

**Test Environment:**

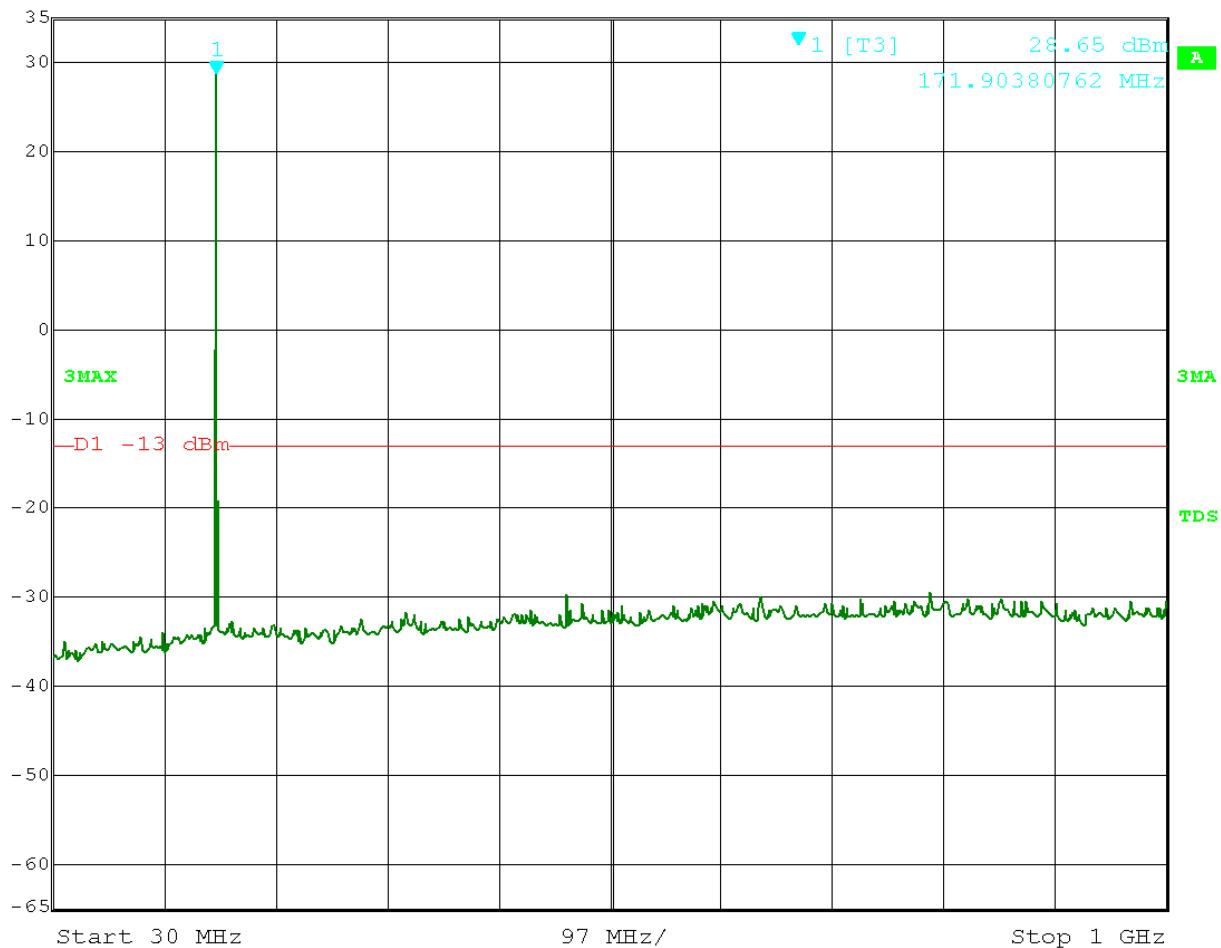
Environmental Conditions During Testing:		Ambient (°C):	24	Humidity (%):	59	Pressure (hPa):	998
Pretest Verification Performed		Yes		Equipment under Test:		V7E-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		01120902900092 (V7E-SP)	
Engineer's Initials:	NNA	Date Test Performed:	06/23/2009	Reviewer's Initials:	JC	Date Reviewed:	06/24/09

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80529A39A	06/10/2010
2	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009
3	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	12/10/2009
4	10W, 30dB Attenuator	Weinschel Corp	47-30-34	BD43291	10/15/2009

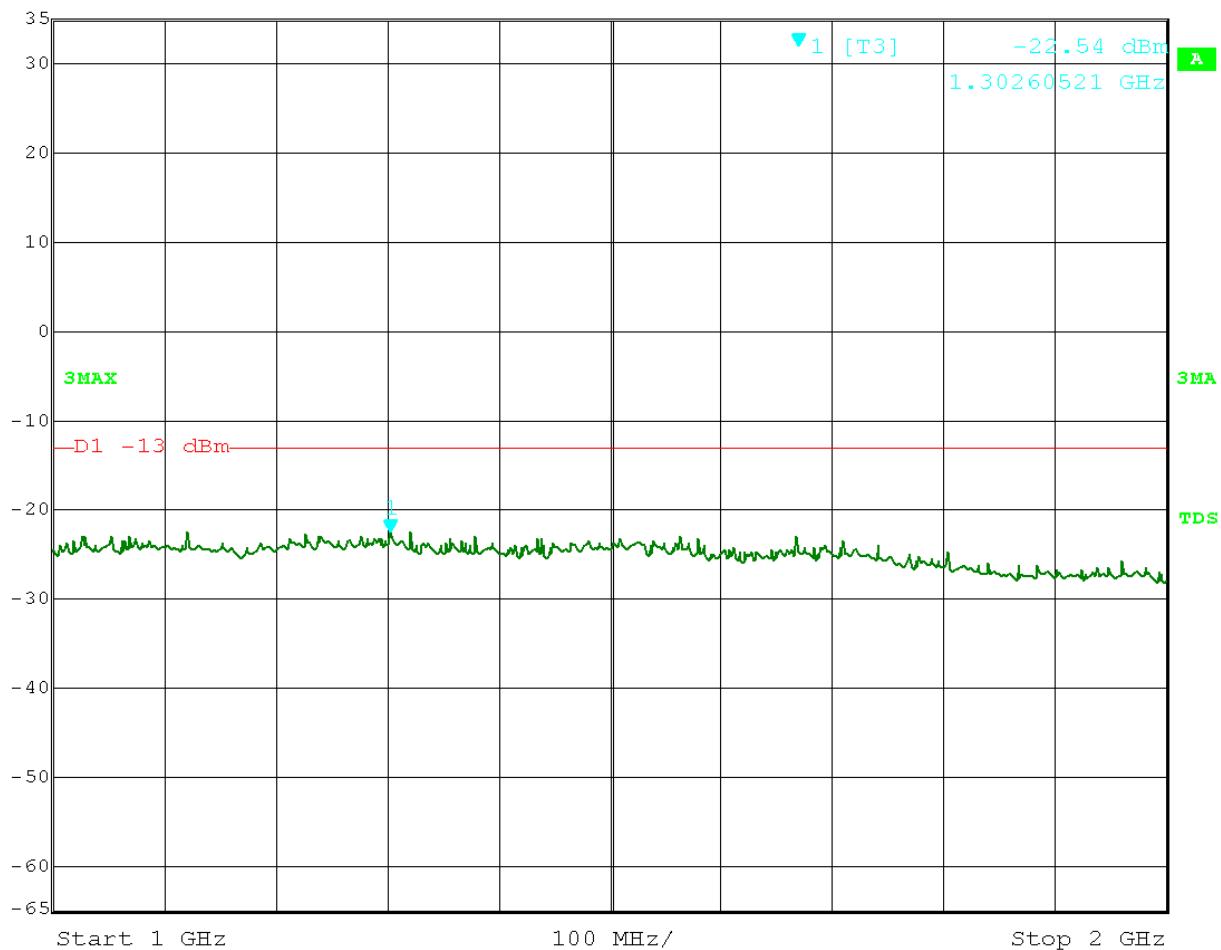
**Test Details:**

Max/Ref Lvl	Marker 1 [T3]	RBW	100 kHz	RF Att	10 dB
35 dBm	28.65 dBm	VBW	300 kHz		
0 dBm	171.90380762 MHz	SWT	245 ms	Unit	dBm



Date: 23.JUN.2009 17:41:43  
Spurious Emissions, 30-1000 MHz, FSK Modulation, VLU7-SP

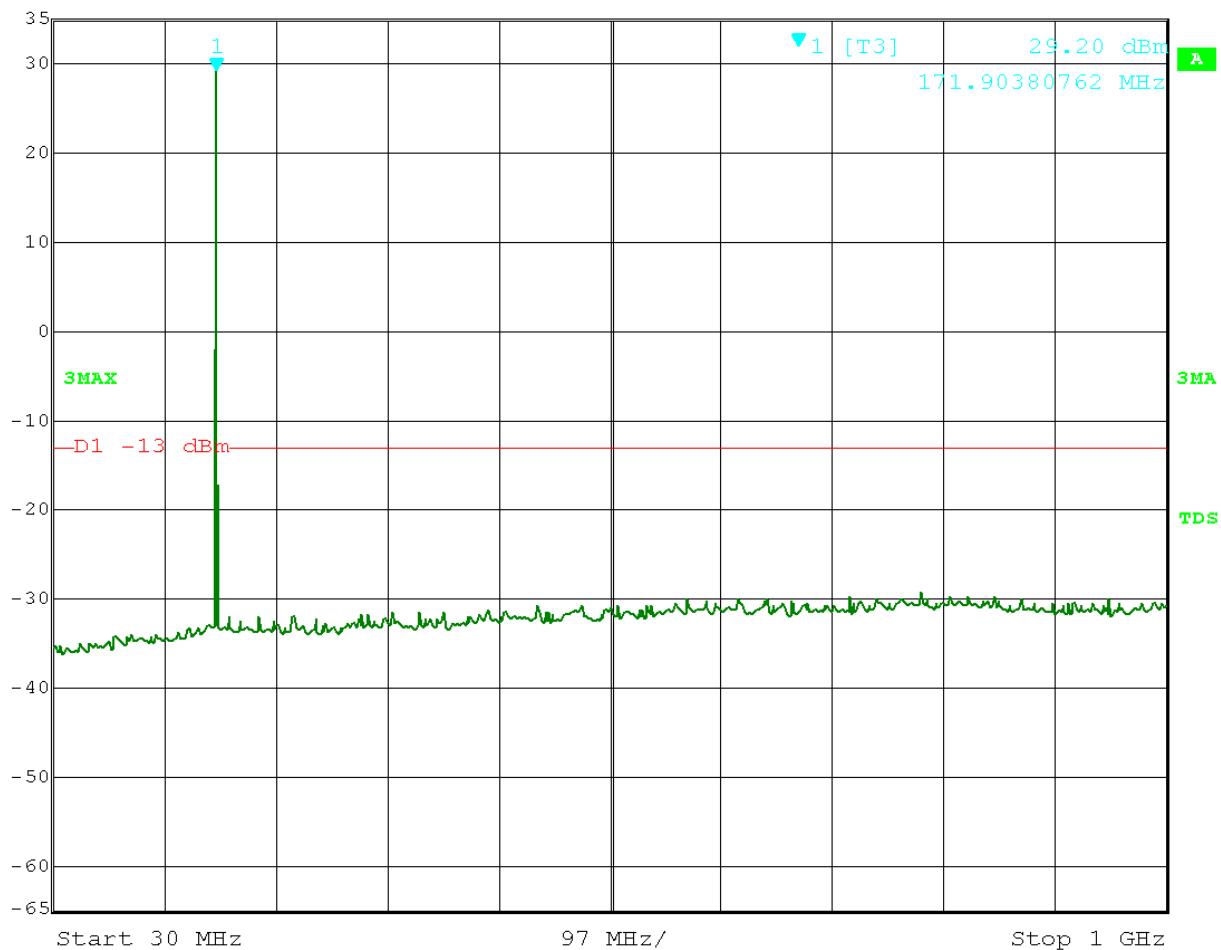
Max/Ref Lvl	Marker 1 [T3]	RBW	1 MHz	RF Att	10 dB
35 dBm	-22.54 dBm	VBW	3 MHz		
0 dBm	1.30260521 GHz	SWT	5 ms	Unit	dBm



Date: 23.JUN.2009 17:42:46

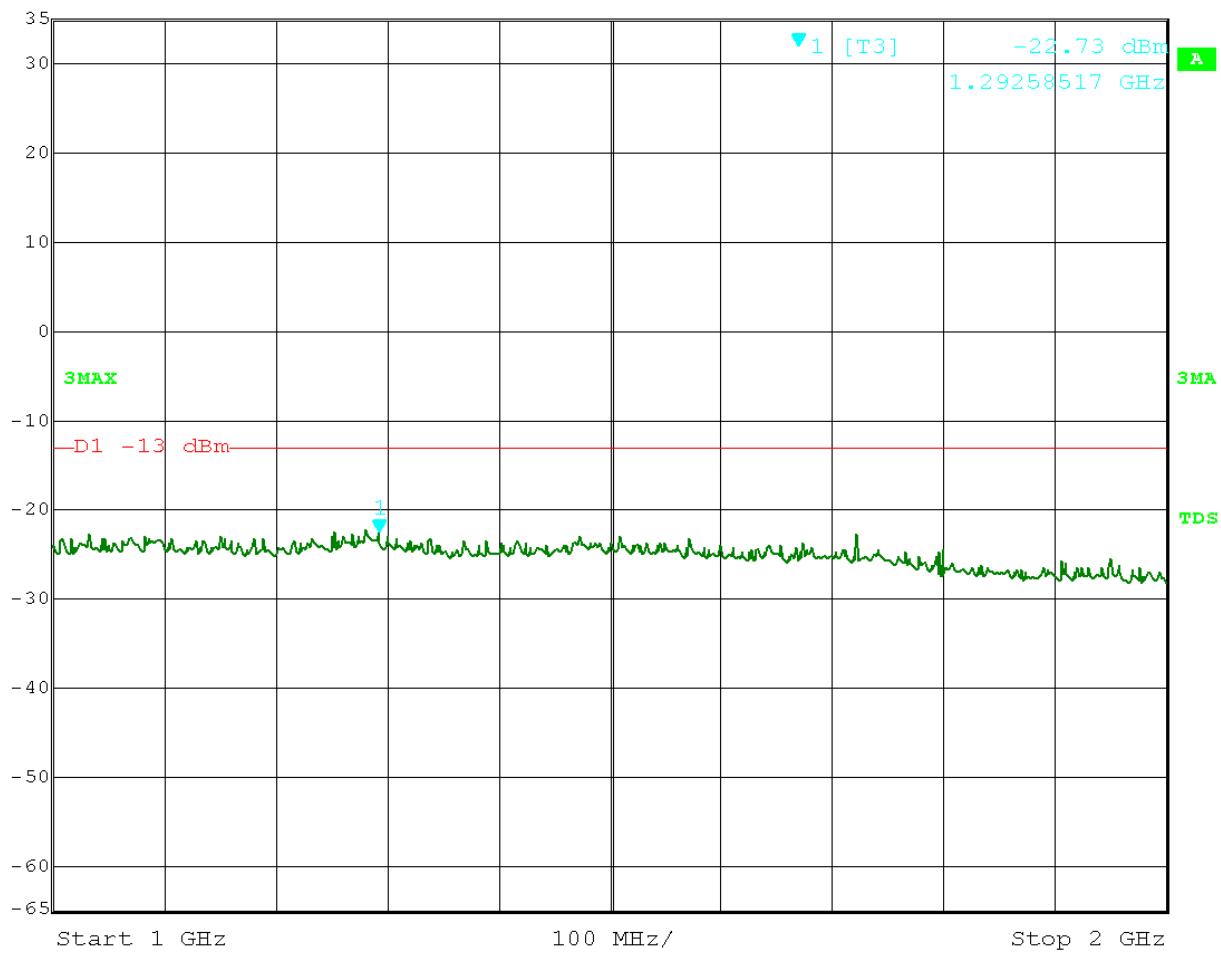
Spurious Emissions, 1-2 GHz, FSK Modulation, VLU7-SP

Max/Ref Lvl	Marker 1 [T3]	RBW	100 kHz	RF Att	10 dB
35 dBm	29.20 dBm	VBW	300 kHz		
0 dBm	171.90380762 MHz	SWT	245 ms	Unit	dBm



Date: 23.JUN.2009 17:36:45  
Spurious Emissions, 30-1000 MHz, MSK Modulation, VLU7-SP

Max/Ref Lvl	Marker 1 [T3]	RBW	1 MHz	RF Att	10 dB
35 dBm	-22.73 dBm	VBW	3 MHz		
0 dBm	1.29258517 GHz	SWT	5 ms	Unit	dBm



Date: 23.JUN.2009 17:37:49  
Spurious Emissions, 1-2 GHz, MSK Modulation, VLU7-SP

**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** Occupied Bandwidth

**Performance Criterion:** The occupied bandwidth must not exceed 20 kHz.

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	21	Humidity (%):	70	Pressure (hPa):	998
Pretest Verification Performed		Yes		Equipment under Test:		V7E-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		01120902900024 (V7E-SP)	
Engineer's Initials:	NNA	Date Test Performed:	06/19/2009	Reviewer's Initials:	JC	Date Reviewed:	06/24/09

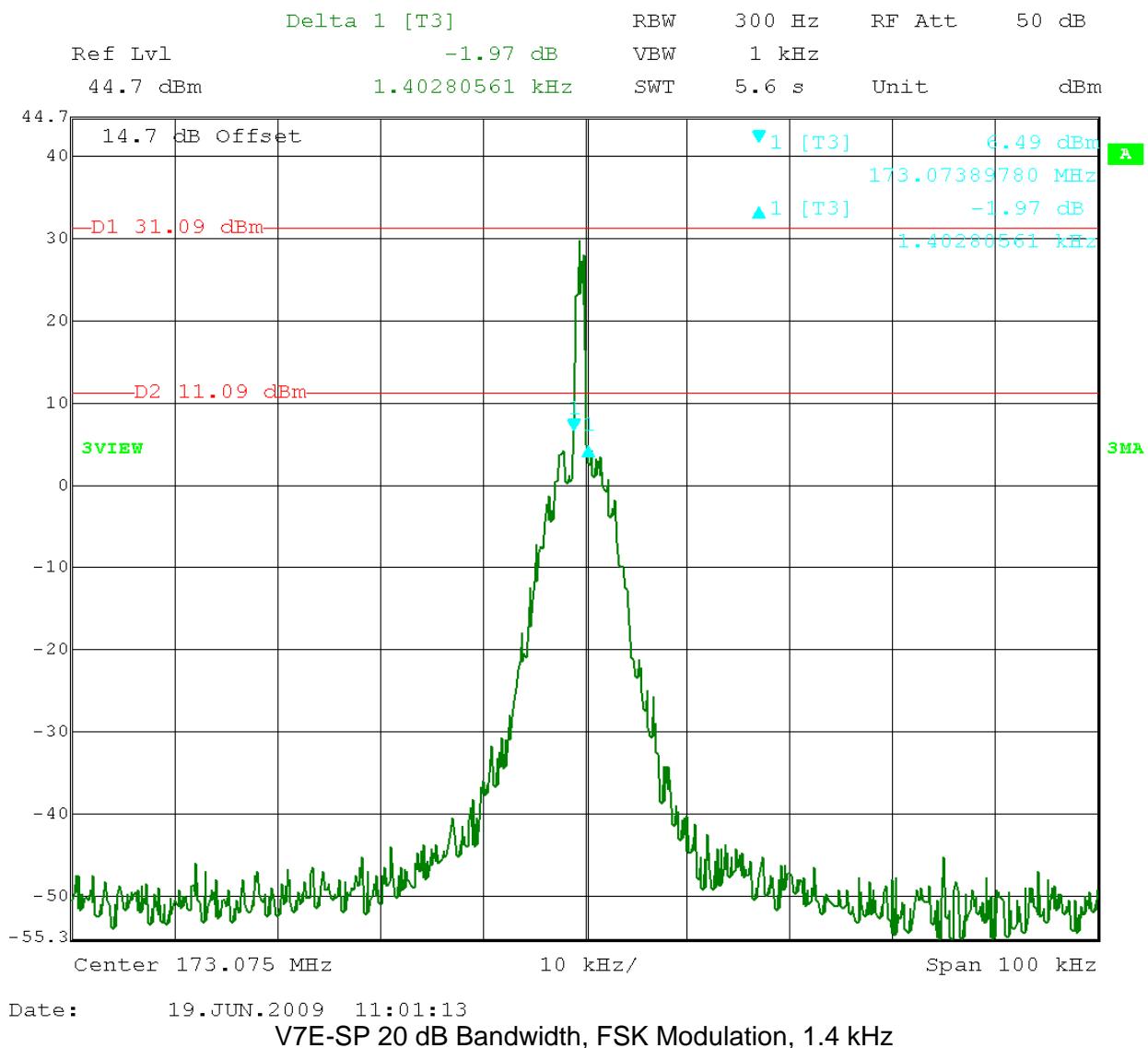
**Test Equipment Used:**

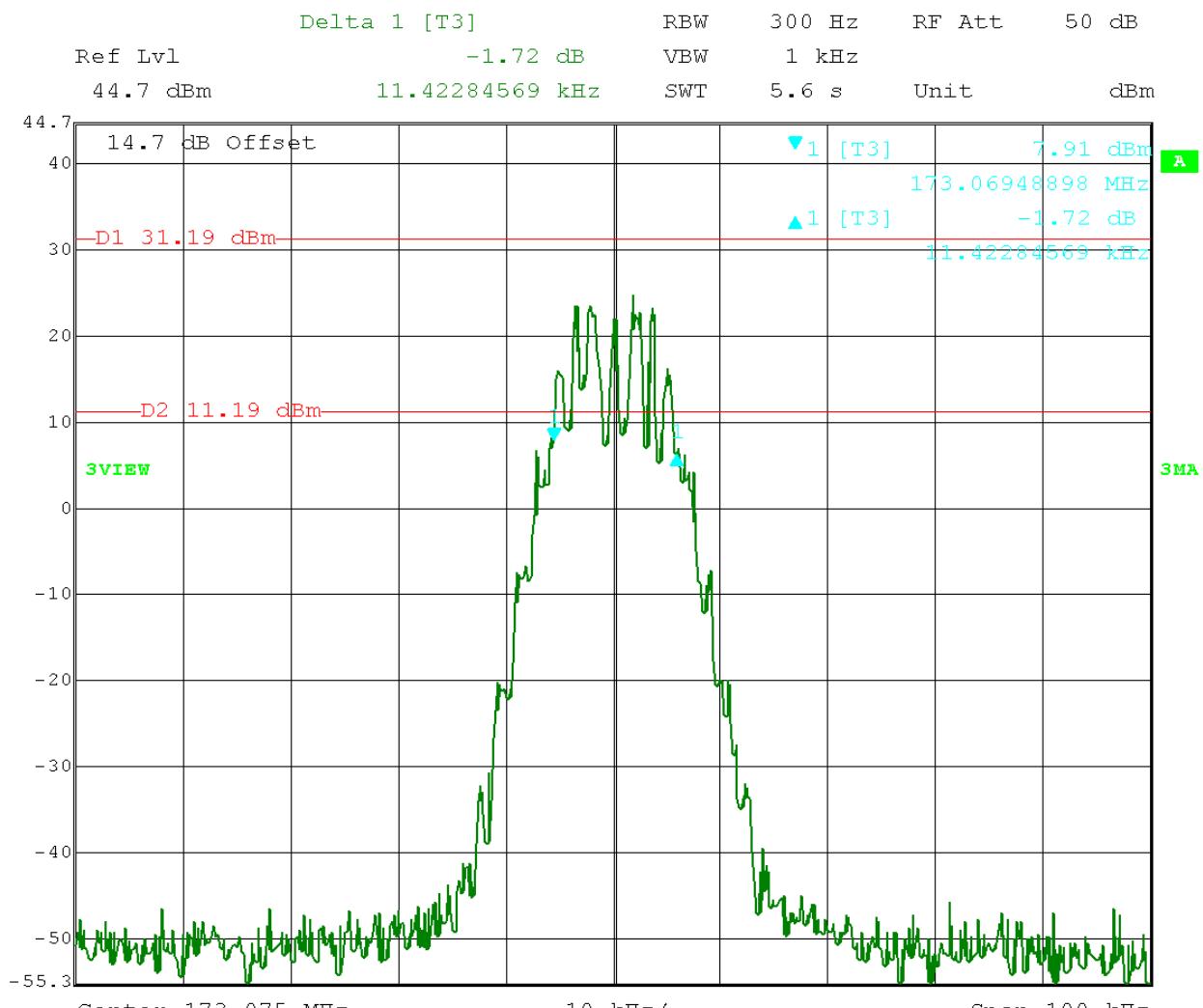
TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80519A93	06/10/2010
2	40 GHz Cable	Megaphase	TM40-K1K1-80	58013901001	05/26/2010
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009

**Test Details:**

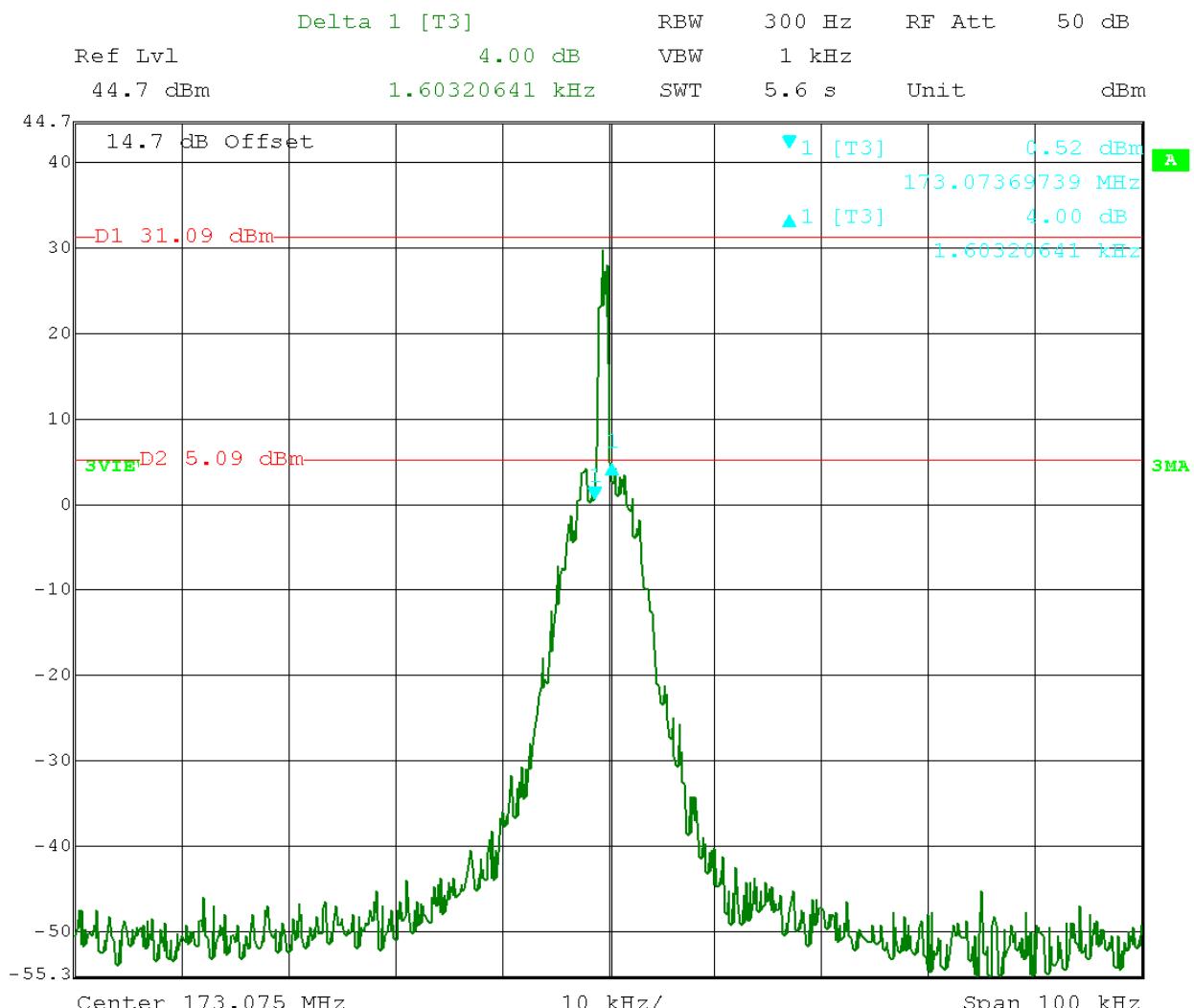
Notes: The V7E-SP 20 dB bandwidth is 1.4 kHz for FSK modulation and 11.4 kHz for MSK modulation. The V7E-SP 26 dB bandwidth is 1.6 kHz for FSK modulation and 15.0 kHz for MSK modulation. The V7E-SP 99% power bandwidth is 2.8 kHz for FSK modulation and 12.0 kHz for MSK modulation.

The 20 dB and 26 dB bandwidth measurements are relative measurements and are referenced to the signal strength when viewed with a 100 kHz bandwidth in the same configuration.

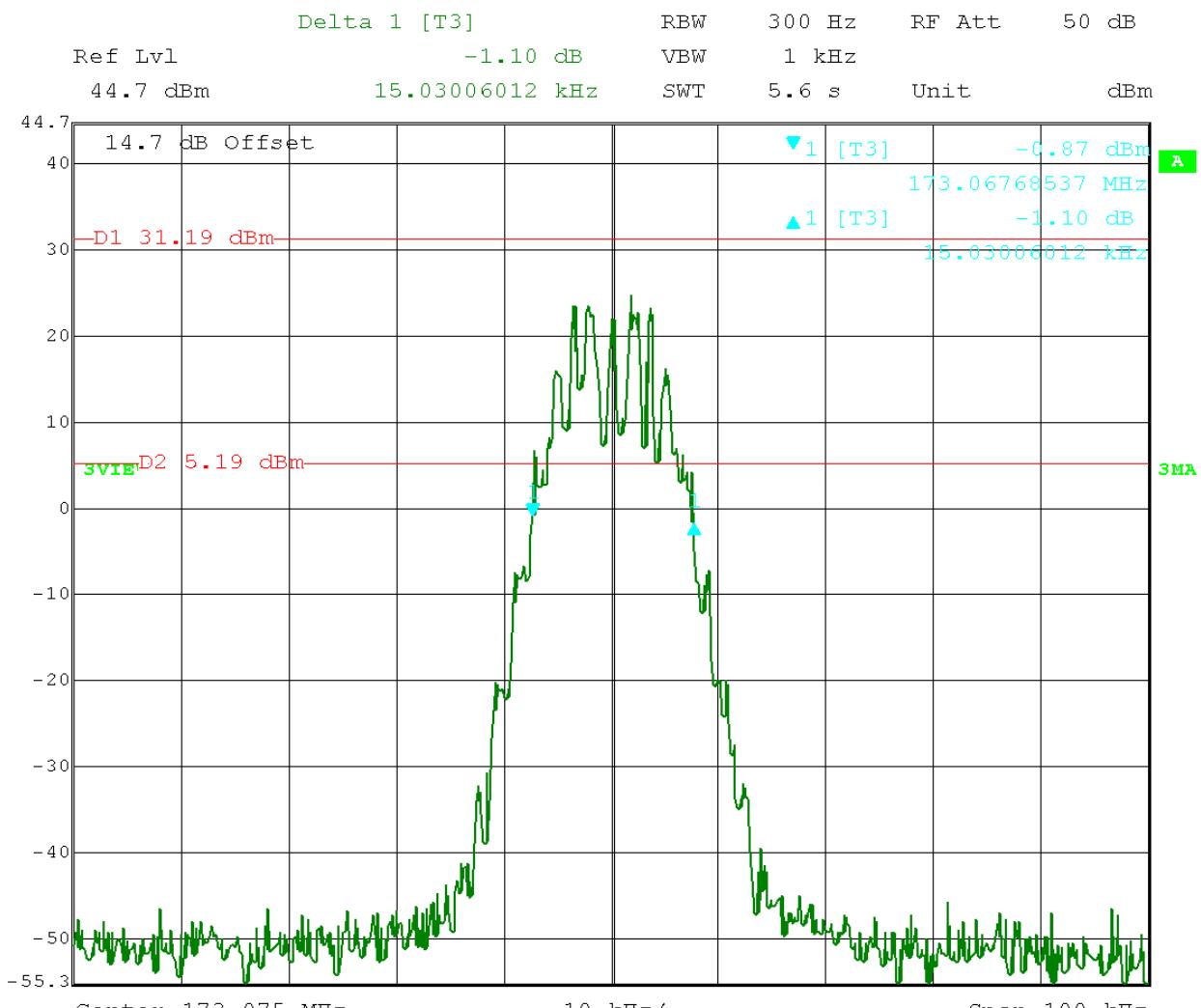




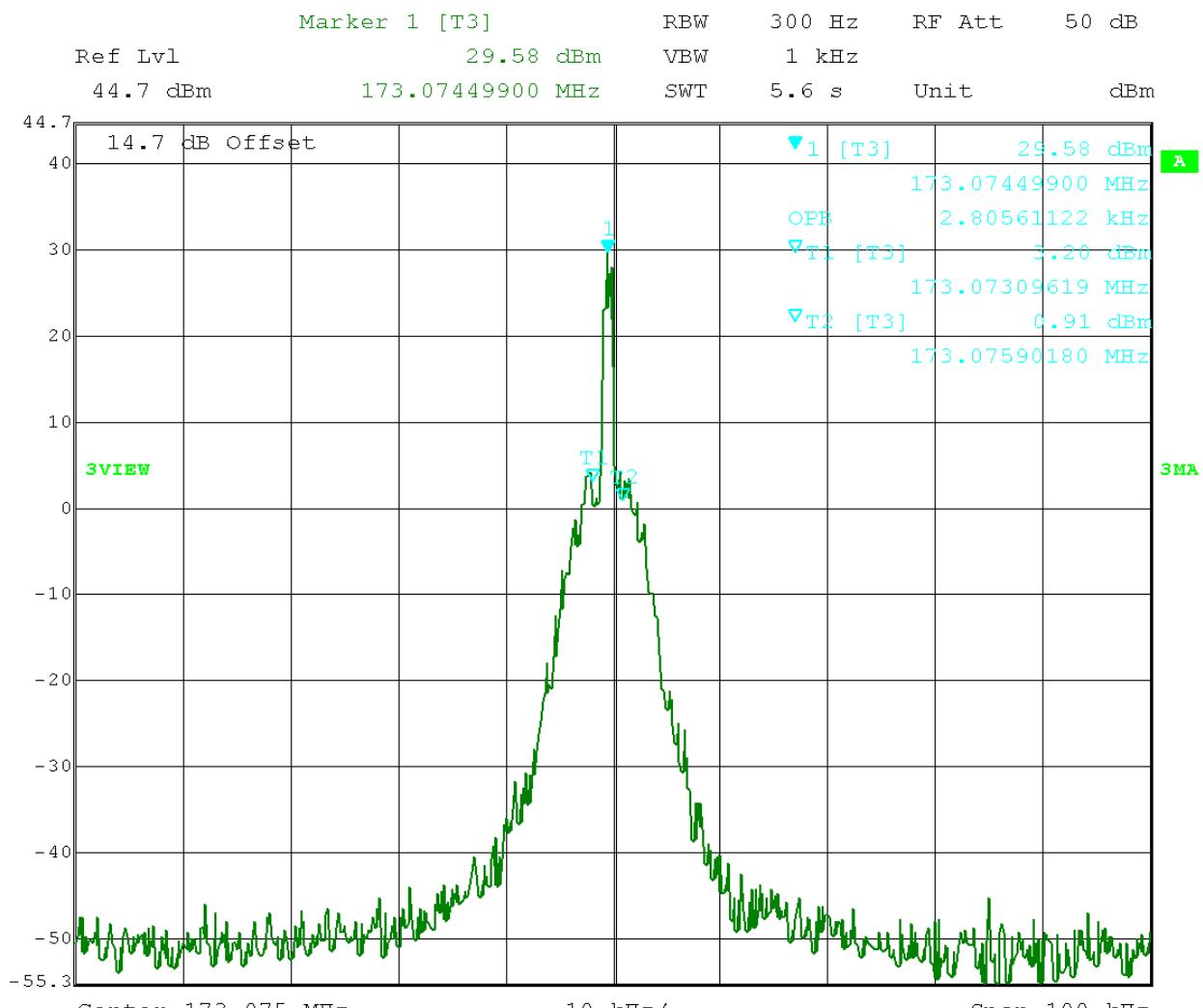
Date: 19.JUN.2009 10:53:19  
 V7E-SP 20 dB Bandwidth, MSK Modulation, 11.4 kHz



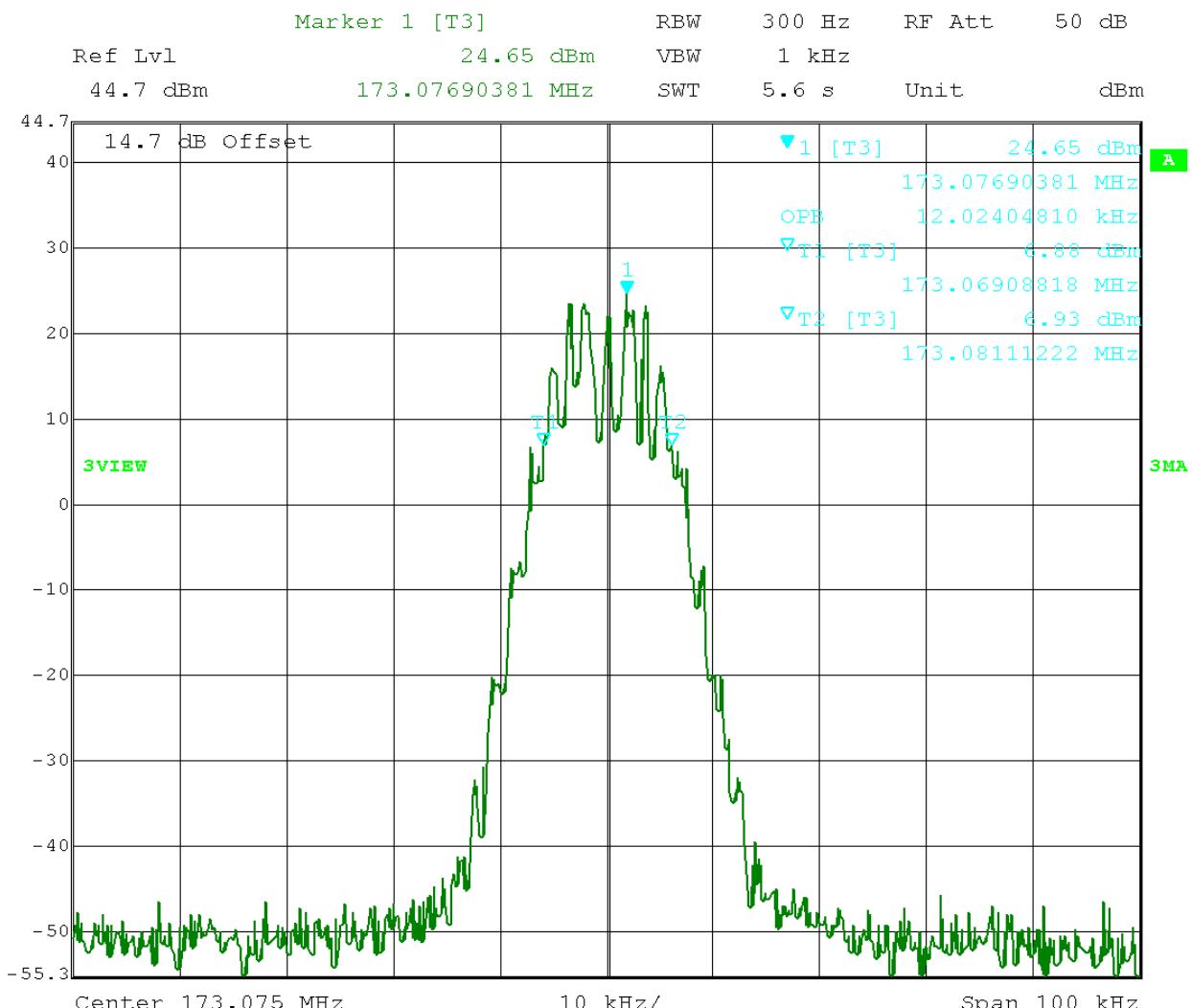
Date: 19.JUN.2009 11:02:55  
 V7E-SP 26 dB Bandwidth, FSK Modulation, 1.6 kHz



Date: 19.JUN.2009 10:52:17  
 V7E-SP 26 dB Bandwidth, MSK Modulation, 15.0 kHz



Date: 19.JUN.2009 11:06:12  
 V7E-SP 99% Power Bandwidth, FSK Modulation, 2.8 kHz



Date: 19.JUN.2009 10:56:38  
V7E-SP 99% Power Bandwidth, MSK Modulation, 12.0 kHz

**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** Emissions Masks

**Performance Criterion:** The transmit waveform must meet the requirements of Emissions Mask C. The fundamental emission waveform must be attenuated below the measured fundamental power P in watts by zero dB for frequencies within 5 kHz of the fundamental center frequency and by  $83*\log(f/5)$  dB (f in kHz) in the bands between 5 and 10 kHz offset from the fundamental center frequency. Emissions offset by 10 kHz to 50 kHz must be attenuated below the measured fundamental power by at either 50 dB or  $29*\log(f^2/11)$ , whichever is the lesser attenuation.

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	21	Humidity (%):	70	Pressure (hPa):	998
Pretest Verification Performed		Yes		Equipment under Test:		V7E-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		01120902900024 (V7E-SP)	
Engineer's Initials:	NNA	Date Test Performed:	06/19/2009	Reviewer's Initials:	JO	Date Reviewed:	06/24/09

**Test Equipment Used:**

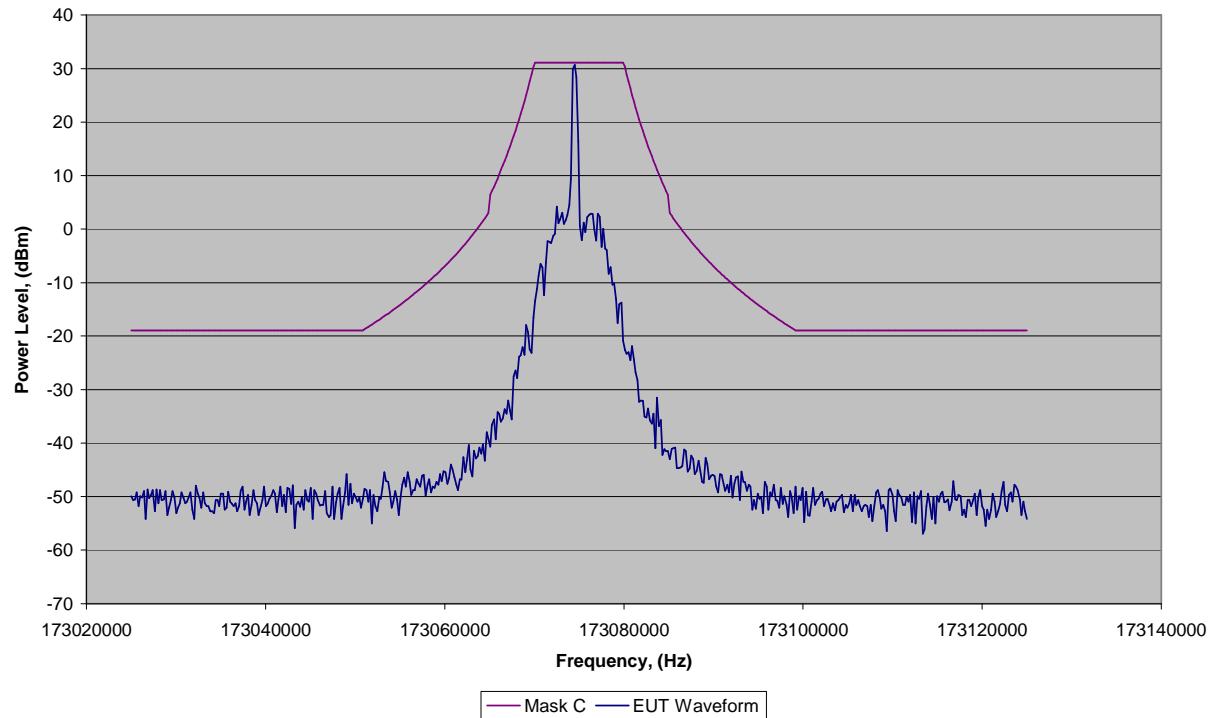
TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80519A93	06/10/2010
2	40 GHz Cable	Megaphase	TM40-K1K1-80	58013901001	05/26/2010
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009

**Software Utilized:**

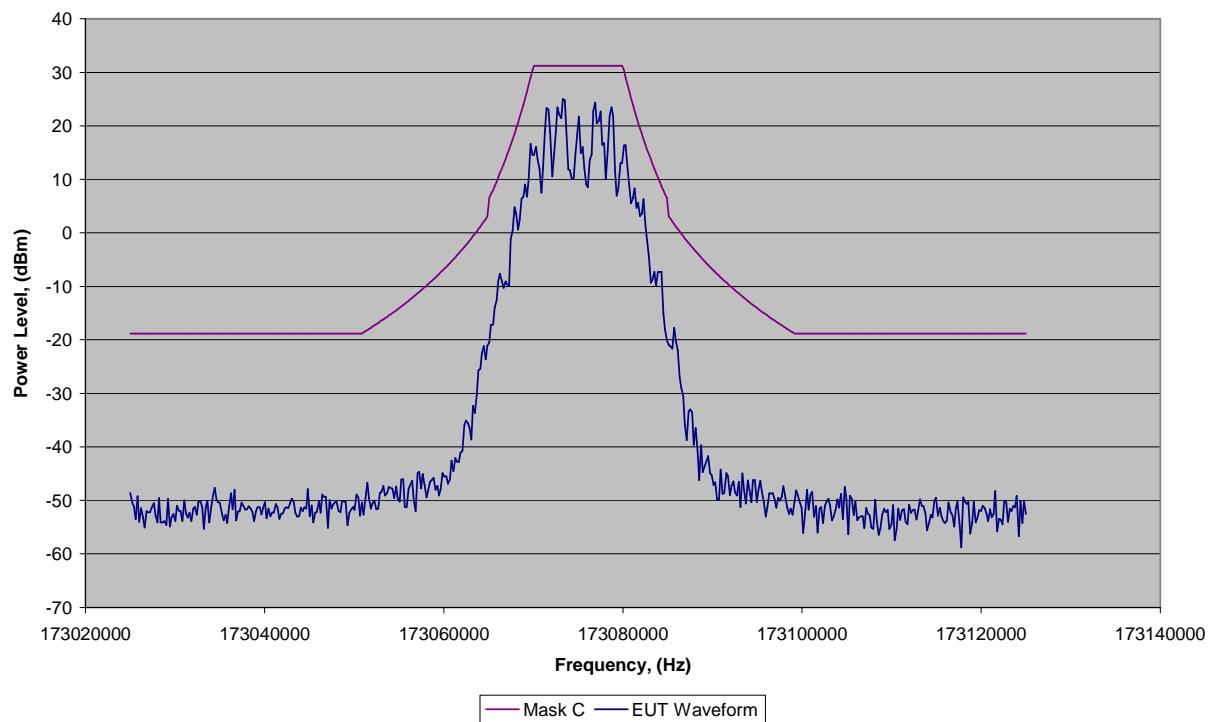
Name	Manufacturer	Version
EXCEL 2003	Microsoft Corporation	11.5612.5606

**Test Details:**

**Emissions Mask C**  
**FSK Modulation V7E-SP**



**Emissions Mask C**  
**MSK Modulation V7E-SP**



**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** Transient Frequency Behavior

**Performance Criterion:** The EUT operates at 173.075 MHz at not more than 2.5 Watts of output power, therefore only the time interval  $t_2$  (5-25 ms after turning the EUT on) is subject to the limits below.

equipment designed to operate on 25 kHz channels			
time intervals <sup>1</sup>	maximum frequency difference, kHz	frequency range, MHz	
		IC: 138-174 FCC: 150-174	IC: 406.1-470 FCC: 421-512
$t_1$	$\pm 25$	5 ms	10 ms
$t_2$	$\pm 12.5$	20 ms	25 ms
$t_3$	$\pm 25$	5 ms	10 ms

NOTES: 1.  $t_{on}$  is the instant when the EUT starts transmitting.

$t_1$  is the time period immediately following  $t_{on}$ .

$t_2$  is the time period immediately following  $t_1$ .

$t_3$  is the time period from the instant when the transmitter is turned off until  $t_{off}$ .

$t_{off}$  is the instant when the transmitter stops transmitting.

- If the transmitter carrier output power is 6 W or less, the frequency difference during the time periods  $t_1$  and  $t_3$  may exceed the maximum frequency difference limit for those periods.

#### Test Environment:

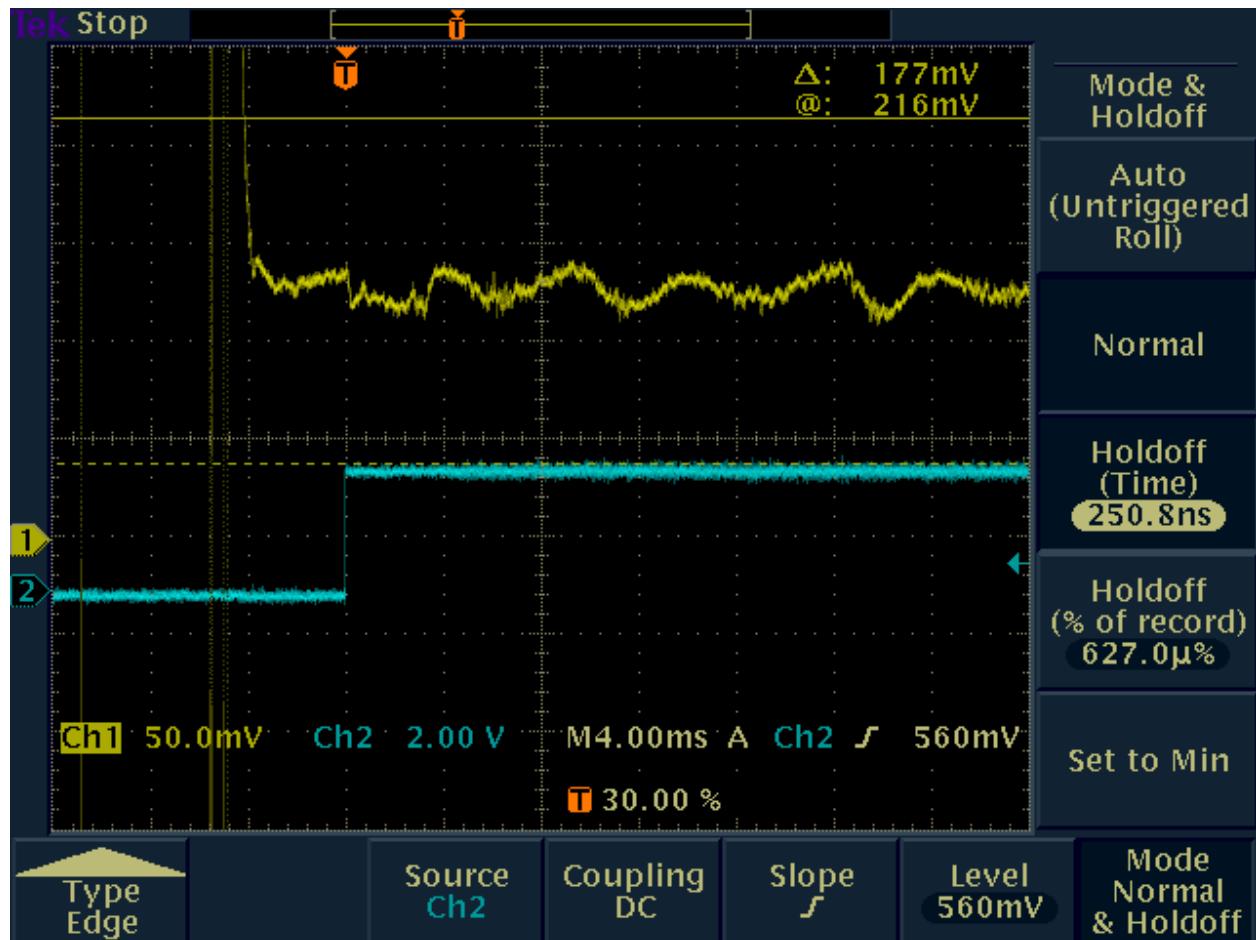
Environmental Conditions During Testing:	Ambient (°C):	23	Humidity (%):	61	Pressure (hPa):	998
Pretest Verification Performed	Yes		Equipment under Test:	V7E-SP		
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:	01120902900024 (V7E-SP)	
Engineer's Initials:	NNA	Date Test Performed:	07-08-2009	Reviewer's Initials:		Date Reviewed:

#### Test Equipment Used:

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80529A39A	06/10/2010
2	Oscilloscope, Digital Storage	Tektronix	TDS3052	B014809	04/03/2010
3	Measuring Receiver	Hewlett Packard	8902A	3749A04397	04/27/2010
4	Generator, Signal	Hewlett Packard	8648C	3847A05291	01/14/2010

## Test Details:

Notes: The upper and lower bounds were set using a signal generator. The purple trace is the trigger, at which point the transmitter will irrevocably turn on. The horizontal cursors correspond to  $\pm 12.5$  kHz from the nominal frequency, 173.075 MHz.



**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** On Time

**Performance Criterion:** On time must not exceed 400 ms over the period of 1 second when the transmitter is in active mode. On time must not exceed 400 ms over the period of 10 seconds when the transmitter is not in active mode. In uplink mode, on time must not exceed 7200 ms over the period of 300 seconds.

**Test Environment:**

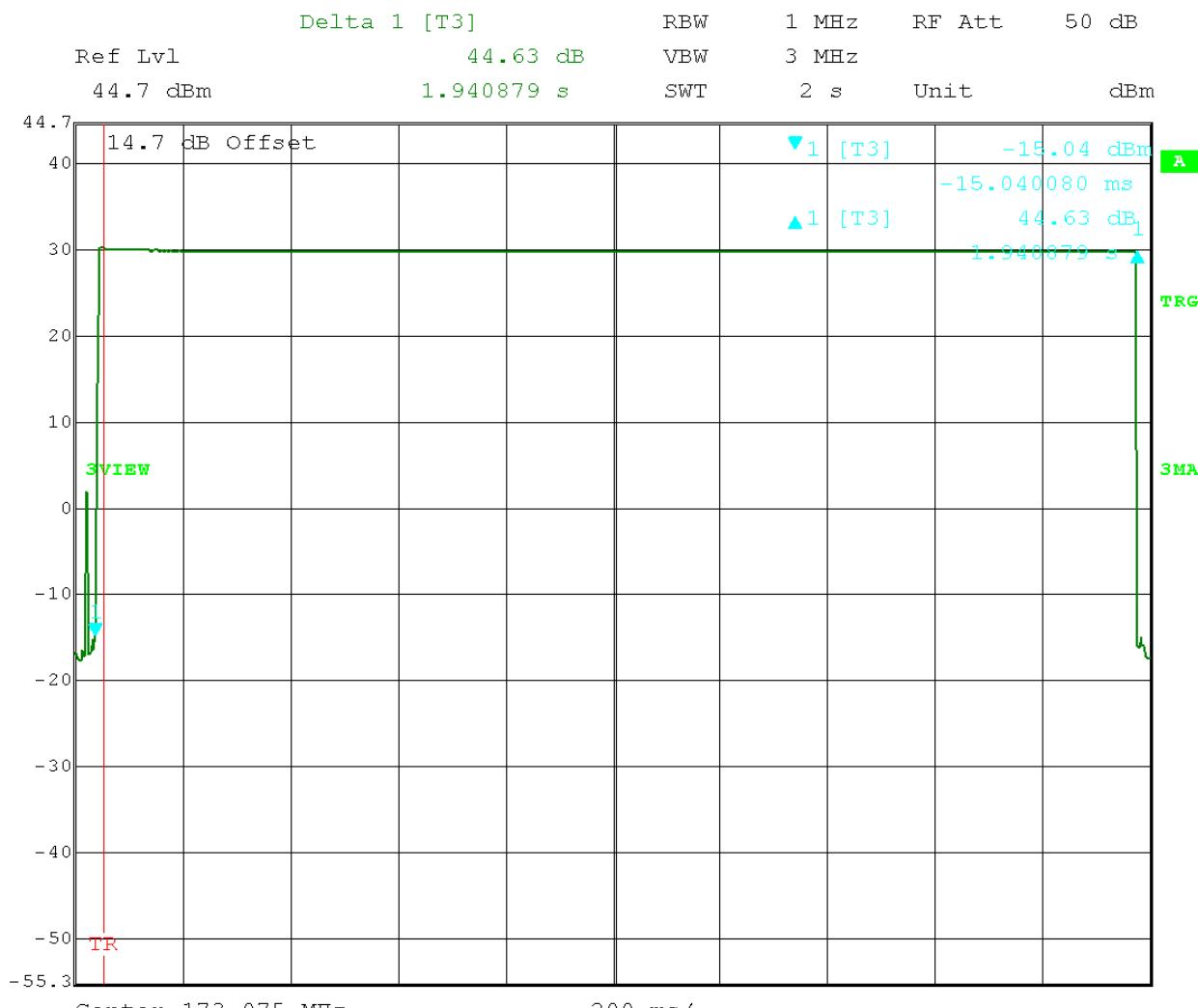
Environmental Conditions During Testing:		Ambient (°C):	24	Humidity (%):	59	Pressure (hPa):	998
Pretest Verification Performed		Yes		Equipment under Test:		V7E-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		01120902900024 (V7E-SP)	
Engineer's Initials:	NNA	Date Test Performed:	06-23-2009	Reviewer's Initials:	JC	Date Reviewed:	06/24/09

**Test Equipment Used:**

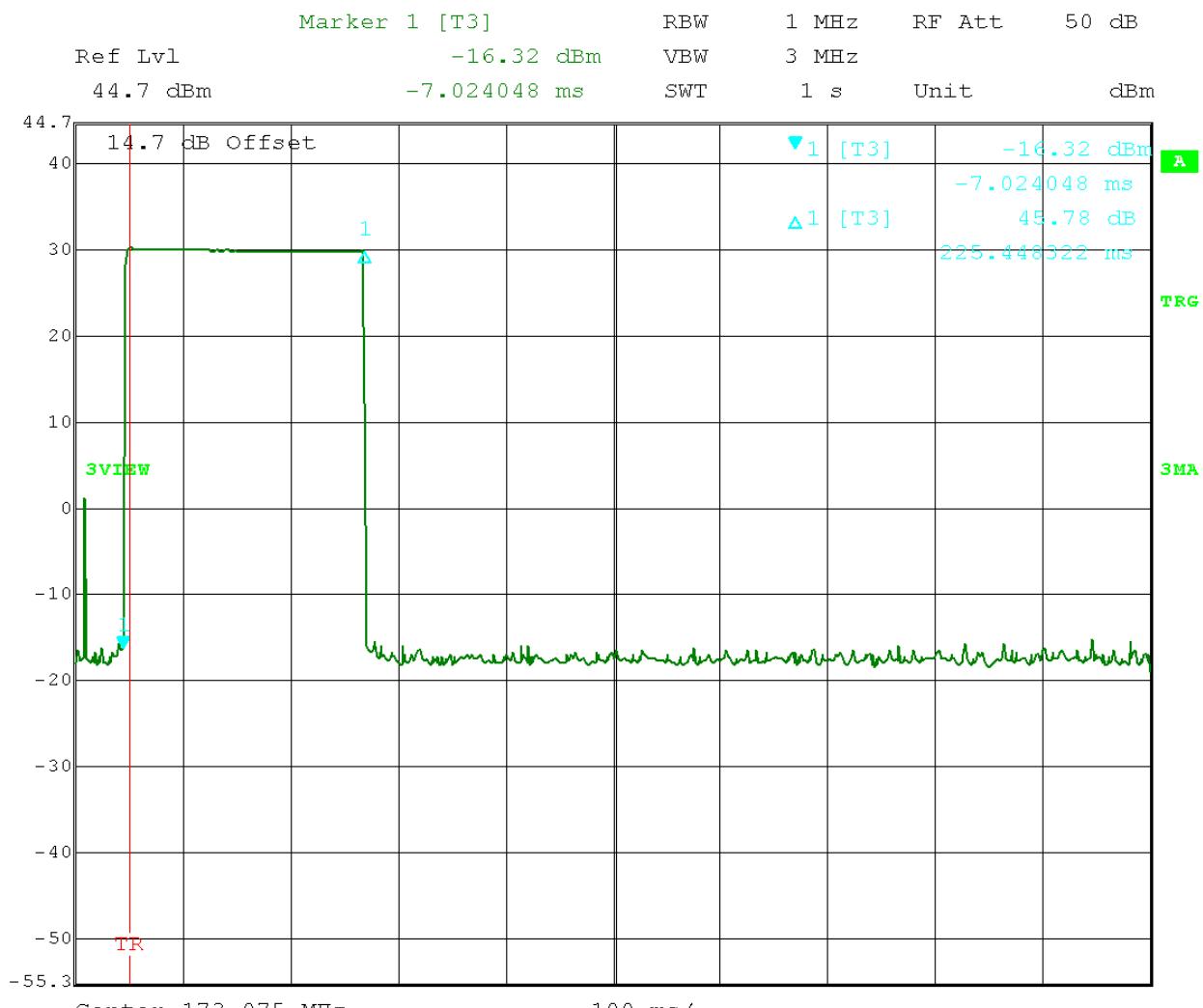
TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80529A39A	06/10/2010
2	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	12/01/2009

**Test Details:**

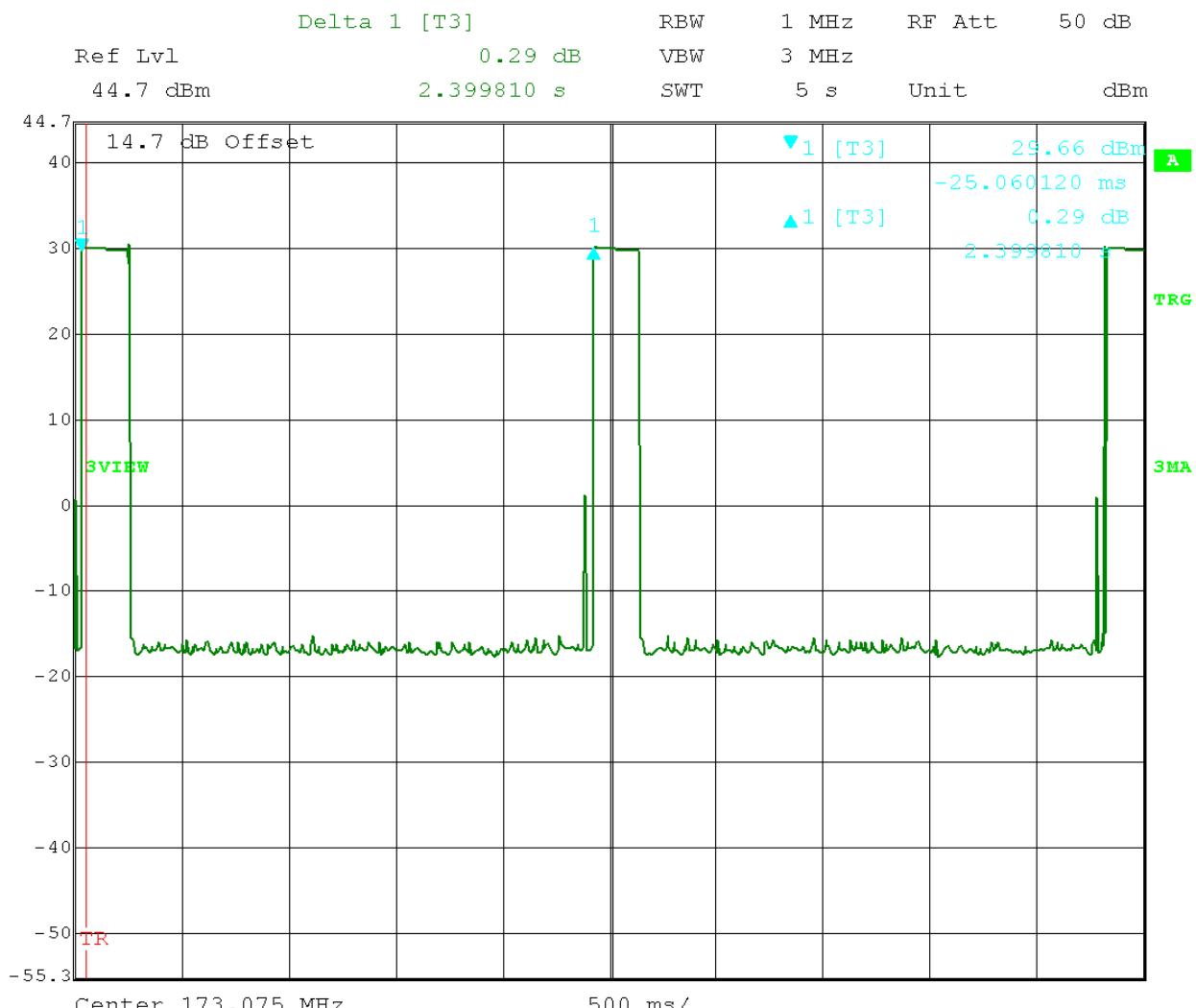
Notes: MSK modulation pulse duration is 225.4 ms. MSK modulation pulse intervals in active mode are 2.4 seconds long. This meets the requirement of not more than 400 ms of on time in any 1 second period in active mode. The transmitter only transmits when instructed to go into active mode or in tower uplink mode. In tower uplink mode (FSK modulation), pulse duration is 1940.9 ms, and LoJack attests that uplink transmissions do not occur more than once in a 300 second time frame.



Date: 23.JUN.2009 18:56:09  
 FSK Modulation Pulse Duration, 1940.9 ms



Date: 23.JUN.2009 18:54:08  
 MSK Pulse Duration, 225.4 ms



Date: 23.JUN.2009 18:53:16  
 MSK Pulse Interval, 2.4 seconds

**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** Frequency Stability

**Performance Criterion:** The frequency drift must not exceed 50 PPM.

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	N/A	Humidity (%):	N/A	Pressure (hPa):	N/A
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		8	
Engineer's Initials:	NNA	Date Test Performed:	11-05-2008	Reviewer's Initials:	JC	Date Reviewed:	06/24/09

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Temp/Humidity Chamber	Envirotronics	SH27C	08015563S11 263	03/18/2009
2	40 GHz Cable	Megaphase	TM40-K1K1-80	7030802 002	06/05/2009
3	Spectrum Analyzer	Hewlett Packard	8591E	3308A01445	02/15/2009
4	10W, 30dB Attenuator	Weinschel Corp	47-30-34	BD43291	10/15/2009

**Software Utilized:**

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	3/07/07 Revision

**Test Details:**

Notes: The VLU7-SP is powered internally by an ~7 Volt battery and a 3.3 Volt battery. When transmissions are occurring, the 7 Volt line drops consistently to 6.1V. Therefore frequency stability over voltage variations was performed on the two different regulators at the appropriate voltage for each, using 6.1 and 3.3 VDC as a nominal voltage for voltage variations.

## Frequency Stability

Company: LoJack Corporation  
 Model #: VLU7-SP  
 Serial #: 8

Engineer(s): Nicholas Abbondante  
 Project #: 3161283  
 Standard: FCC Part 90

Limit: 50 PPM

Nominal f: 173.075 MHz

Test Equipment Used:  
 148012 WEI13 SA0001 MEG004 147239

Location: Littleton

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	5.185	173.075537	0.011	8.65
-10%	5.49	173.075685	0.159	8.65
-5%	5.795	173.075709	0.183	8.65
+0%	6.1	173.075526	0	8.65
+5%	6.405	173.075487	-0.039	8.65
+10%	6.71	173.075454	-0.072	8.65
+15%	7.015	173.075410	-0.116	8.65

Voltage: 6.1 VDC

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-30	173.075171	-0.791	8.65
-20	173.076026	0.064	8.65
-10	173.076460	0.498	8.65
0	173.076536	0.574	8.65
10	173.076334	0.372	8.65
20	173.075962	0	8.65
30	173.075460	-0.502	8.65
40	173.074976	-0.986	8.65
50	173.075016	-0.946	8.65

Voltage: 3.3 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	2.805	173.075450	-0.065	8.65
-10%	2.97	173.075496	-0.019	8.65
-5%	3.135	173.075519	0.004	8.65
+0%	3.3	173.075515	0	8.65
+5%	3.465	173.075432	-0.083	8.65
+10%	3.63	173.075390	-0.125	8.65
+15%	3.795	173.075349	-0.166	8.65

**Test Results:** Pass

**Test Standard:** FCC Part 90

**Test:** Radiated Emissions

**Performance Criterion:** Spurious emissions must not exceed -13 dBm.

**Test Environment:**

Environmental Conditions During Testing:		Ambient (°C):	19 20	Humidity (%):	56 61	Pressure (hPa):	1007 996
Pretest Verification Performed		Yes		Equipment under Test:		V7E-SP	
Test Engineer(s):		Nicholas Abbondante			EUT Serial Number:		01120902900092 (V7E-SP)
Engineer's Initials:	NNA	Date Test Performed:	06-18-2009 06-19-2009	Reviewer's Initials:	JC	Date Reviewed:	06/24/09

**Test Equipment Used:**

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Weather Station	Davis Instruments	7400	PE80519A93	06/10/2010
2	ANTENNA	EMCO	3142	9711-1224	12/12/2009
3	10 Meter in floor cable for site 2	ITS	RG214B/U	S2 10M FLR	02/20/2010
4	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	02/17/2010
5	HORN ANTENNA	EMCO	3115	9602-4675	10/13/2009
6	FILTER, HIGH PASS 250 MHz	Mini-Circuits	NHP-250	882414	09/24/2009
7	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	10/15/2009
8	Synthesized Sweep Generator	Hewlett Packard	83620A	3213A01244	03/19/2010
9	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	12/10/2009
10	BROADBAND ANTENNA	Compliance Design	B100	1649	10/14/2009
11	BROADBAND ANTENNA	Compliance Design	B200	1650	10/02/2009
12	BROADBAND ANTENNA	Compliance Design	B300	00668	10/02/2009
13	HORN ANTENNA	EMCO	3115	9610-4980	02/25/2010

## Software Utilized:

Name	Manufacturer	Version
EXCEL 2003	Microsoft Corporation	11.5612.5606
EMI BOXBOROUGH	Intertek	4/17/09 Revision

## Test Results:

### Radiated Emissions, Substitution

Company: LoJack Corporation  
 Model #: V7E-SP  
 Serial #: 01120902900092 (V7E-SP)  
 Engineer(s): Nicholas Abbondante Location: Site 2  
 Project #: 3178506 Date(s): 06/18/09 6/19/2009  
 Standard: FCC Part 90  
 Barometer: DAV002 Temp/Humidity/Pressure: 19c/20c 56%/61% 1007/996mb ERP or EIRP?: ERP  
 Test Distance (m): 10 Voltage/Frequency: Fresh Battery Frequency Range: 30 MHz-1.8 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)											
PK	V	173.075	104.88	74.04	0.26	-2.31	0.00	26.12	34.00	-7.88	120/300 kHz
Note: FSK Modulation (10m)											
PK	V	173.075	104.97	74.04	0.26	-2.31	0.00	26.21	34.00	-7.79	120/300 kHz
Note: MSK Modulation (10m)											
PK	V	346.150	46.46	67.98	0.39	-0.98	0.00	-25.04	-13.00	-12.04	120/300 kHz
PK	V	519.225	30.18	68.31	0.49	0.97	0.00	-39.80	-13.00	-26.80	120/300 kHz
PK	V	692.300	28.80	63.19	0.58	2.00	0.00	-35.12	-13.00	-22.12	120/300 kHz
PK	V	865.375	28.56	60.93	0.66	0.16	0.00	-35.02	-13.00	-22.02	120/300 kHz
PK	V	1038.450	13.50	63.87	0.72	6.29	0.00	-46.95	-13.00	-33.95	1/3 MHz
PK	V	1211.525	12.35	62.31	0.79	6.92	0.00	-45.98	-13.00	-32.98	1/3 MHz
PK	V	1384.600	13.47	62.02	0.86	7.56	0.00	-44.00	-13.00	-31.00	1/3 MHz
PK	V	1557.675	11.52	63.78	0.92	8.06	0.00	-47.27	-13.00	-34.27	1/3 MHz
PK	V	1730.750	10.56	62.19	0.98	8.31	0.00	-46.45	-13.00	-33.45	1/3 MHz
Note: FSK Modulation (10m)											
PK	V	346.150	47.20	67.98	0.39	-0.98	0.00	-24.30	-13.00	-11.30	120/300 kHz
PK	V	519.225	29.28	68.31	0.49	0.97	0.00	-40.70	-13.00	-27.70	120/300 kHz
PK	V	692.300	29.04	63.19	0.58	2.00	0.00	-34.88	-13.00	-21.88	120/300 kHz
PK	V	865.375	29.00	60.93	0.66	0.16	0.00	-34.58	-13.00	-21.58	120/300 kHz
PK	V	1038.450	13.76	63.87	0.72	6.29	0.00	-46.69	-13.00	-33.69	1/3 MHz
PK	V	1211.525	11.78	62.31	0.79	6.92	0.00	-46.55	-13.00	-33.55	1/3 MHz
PK	V	1384.600	12.17	62.02	0.86	7.56	0.00	-45.30	-13.00	-32.30	1/3 MHz
PK	V	1557.675	13.99	63.78	0.92	8.06	0.00	-44.80	-13.00	-31.80	1/3 MHz
PK	V	1730.750	10.45	62.19	0.98	8.31	0.00	-46.56	-13.00	-33.56	1/3 MHz