



EMISSIONS TEST REPORT

Report Number: 3161283BOX-011

Project Number: 3161283

Testing performed on the

Vehicle Location Unit

Models: VLU7-SP, VLU7-VP

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: 11/12/2008

Reviewed by:

Jeff Goulet

Date: 11/14/08

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 copy or distribute 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. This report must not be used to claim product endorsement by A2LA, NIST nor any other agency of the U.S. Government.

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

1.2 Equipment Under Test

Equipment Type: Vehicle Location Unit

Model Number(s): VLU7-SP, VLU7-VP

Serial number(s): 7, 9 (VLU7-SP); 8, 10 (VLU7-VP)

Manufacturer: LoJack Corporation

EUT receive date: 11-03-2008

EUT received condition: Prototype in Good Condition

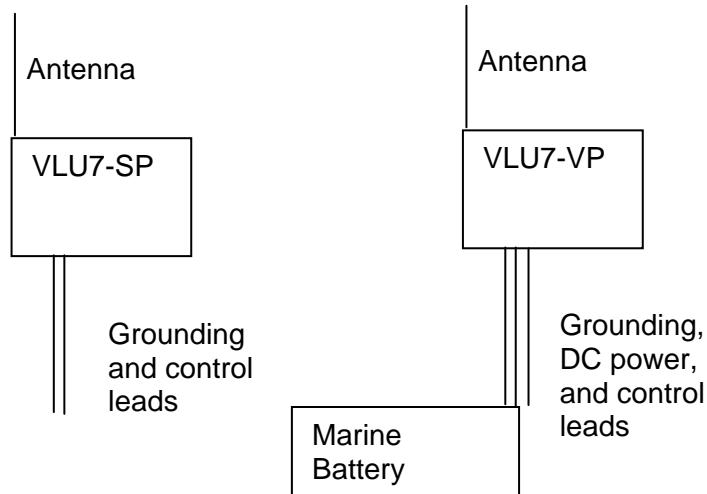
Test start date: 11-03-2008

Test end date: 11-05-2008

1.3 Test Plan Reference: Tested according to the standards listed and with the guidance of ANSI/TIA-603-C-2004

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
DC Power	None	Wire	0.61	1

1.4.3. Support Equipment:

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

Name: Marine Battery
Model No.: N/L
Serial No.: N/L

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 13.8 VDC to the VLU7-VP and 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</u>	<u>Project</u>	<u>Page(s)</u>	<u>Item</u>	<u>Description of Change</u>
<u>No.</u>	<u>Handler</u>				

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 μV or 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:

± 3.5 dB at 10m, ± 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:

± 2.6 dB

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

± 3.2 for ISN and voltage probe measurements
 ± 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 (%):	34	Pressure (hPa):	1026
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP, VLU7-VP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		7, 9	
Engineer's Initials:	NNA	Date Test Performed:	11-03-2008 11-05-2008	Reviewer's Initials:	JS	Date Reviewed:	11/14/08

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR1	06/01/2009
2	Universal Power meter	Gigatronics	8651A	8651298	01/23/2009
3	Power Sensor	Gigatronics	80334A	1835789	01/23/2009
4	10W, 30dB Attenuator	Weinschel Corp	47-30-34	BD43291	10/15/2009

Test Details:

Notes: Output power of the VLU7-SP was measured to be 31.07 dBm for FSK modulation and 31.07 dBm for MSK modulation at the temporary 50 Ohm antenna port.

Output power of the VLU7-VP was measured to be 30.84 dBm for FSK modulation and 30.81 dBm for MSK modulation at the temporary 50 Ohm antenna port.

Test Results: Pass

Test Standard: FCC Part 90

Test: Conducted Spurious Emissions

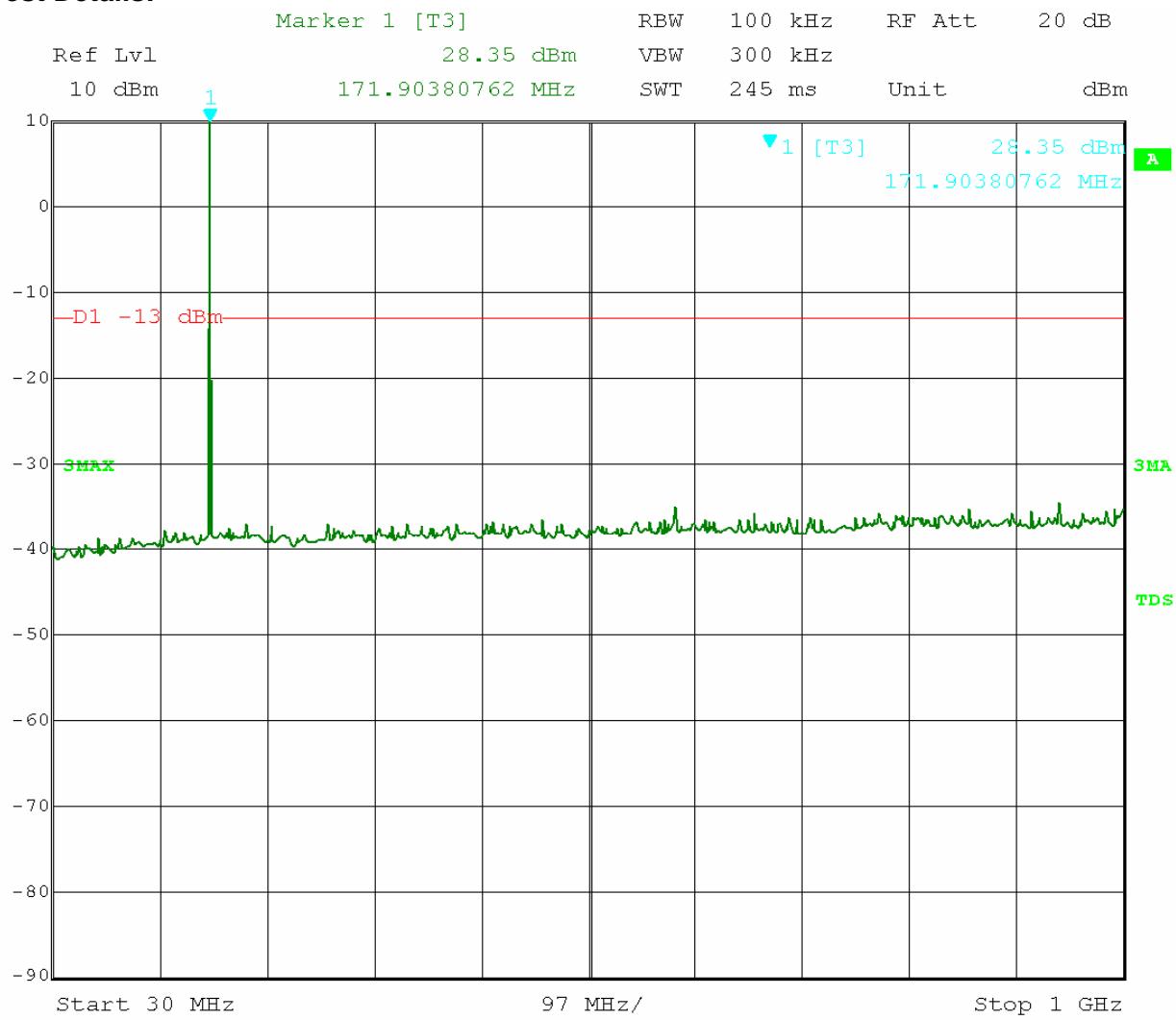
Performance Criterion: Spurious emissions must not exceed -13 dBm.

Test Environment:

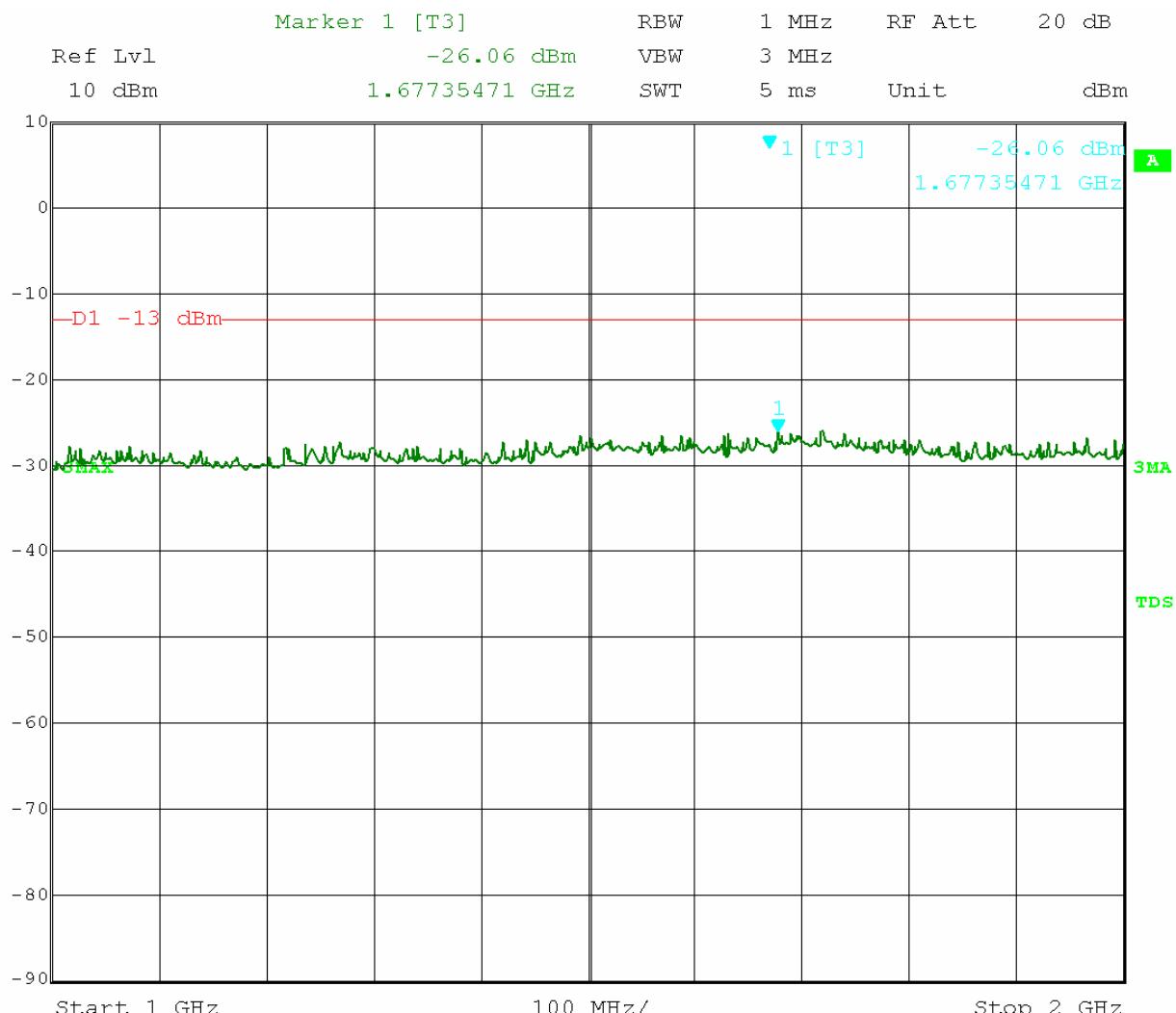
Environmental Conditions During Testing:		Ambient (°C):	20	Humidity (%):	34	Pressure (hPa):	1026
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		7	
Engineer's Initials:	NNA	Date Test Performed:	11-03-2008	Reviewer's Initials:	JO	Date Reviewed:	11/14/08

Test Equipment Used:

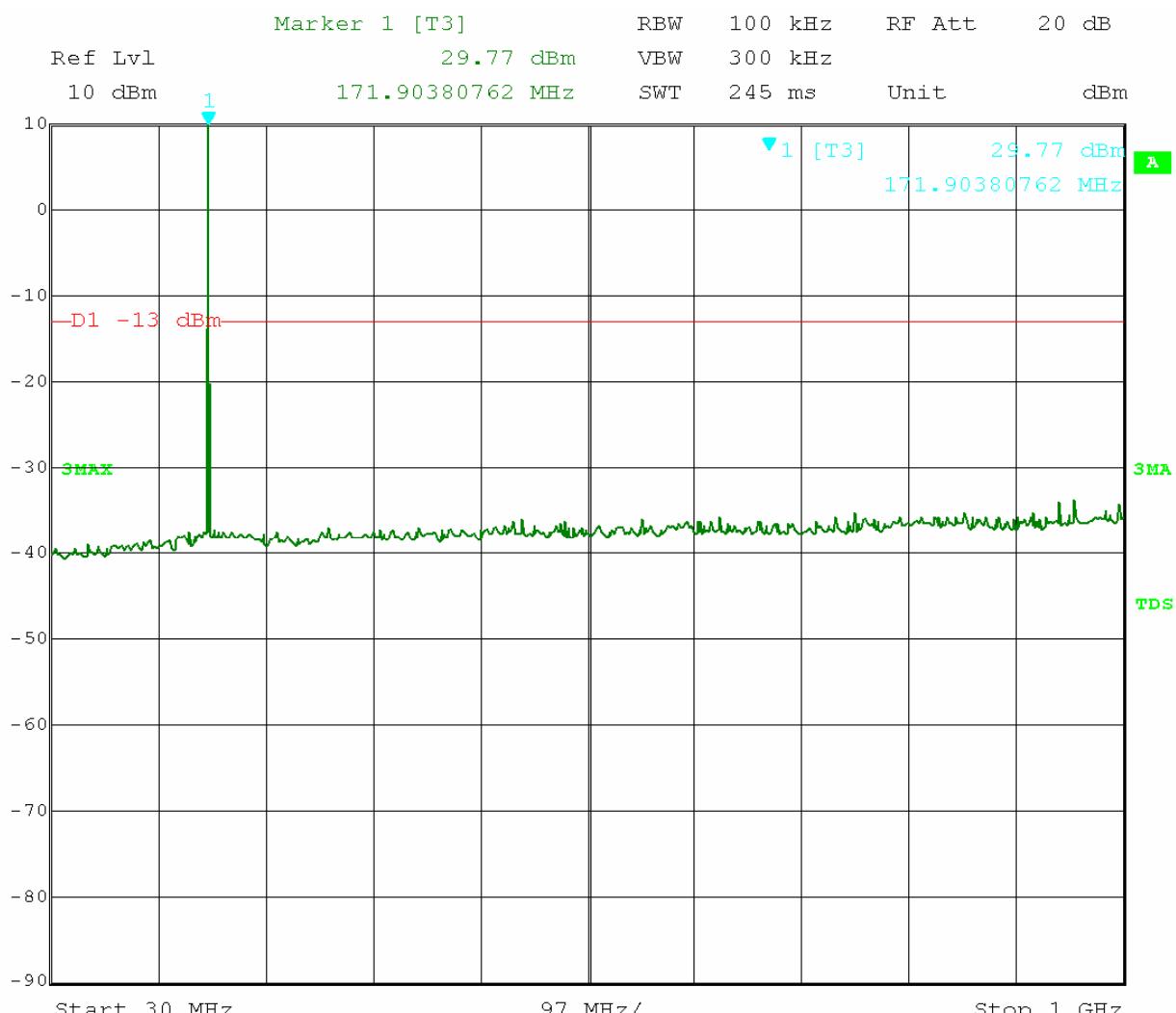
TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR1	06/01/2009
2	40 GHz Cable	Megaphase	TM40-K1K1-197	7030801 002	06/05/2009
3	10W, 30dB Attenuator	Weinschel Corp	47-30-34	BD43291	10/15/2009
4	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	11/26/2008

Test Details:


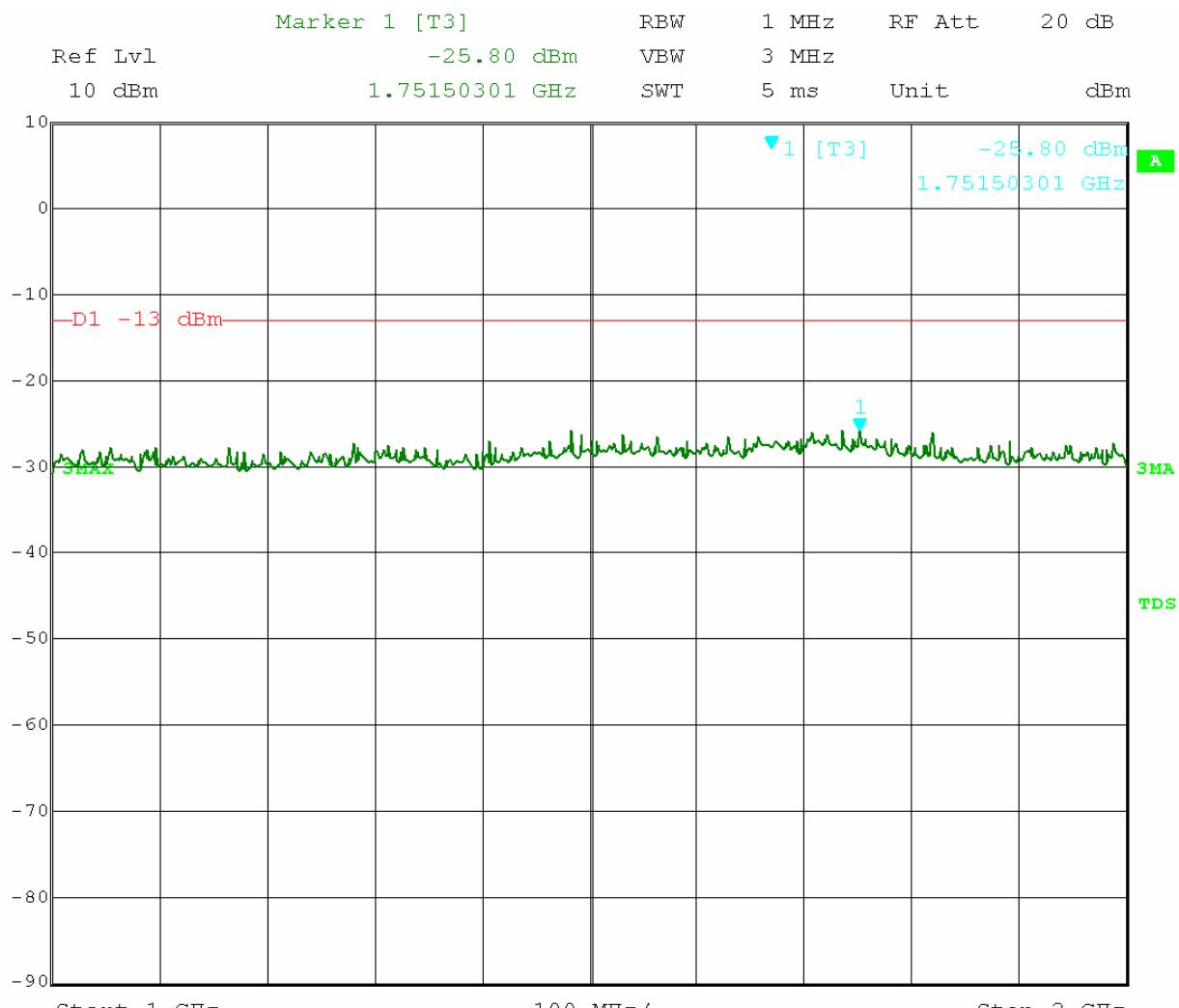
Date: 3.NOV.2008 15:12:14
 Spurious Emissions, 30-1000 MHz, FSK Modulation, VLU7-SP



Date: 3.NOV.2008 15:14:28
Spurious Emissions, 1-2 GHz, FSK Modulation, VLU7-SP



Date: 3.NOV.2008 17:42:45
Spurious Emissions, 30-1000 MHz, MSK Modulation, VLU7-SP



Date: 3.NOV.2008 17:43:30
Spurious Emissions, 1-2 GHz, MSK Modulation, VLU7-SP

Test Results: Pass

Test Standard: FCC Part 90

Test: Occupied Bandwidth

Performance Criterion: The 20 dB bandwidth must not exceed 20 kHz.

Test Environment:

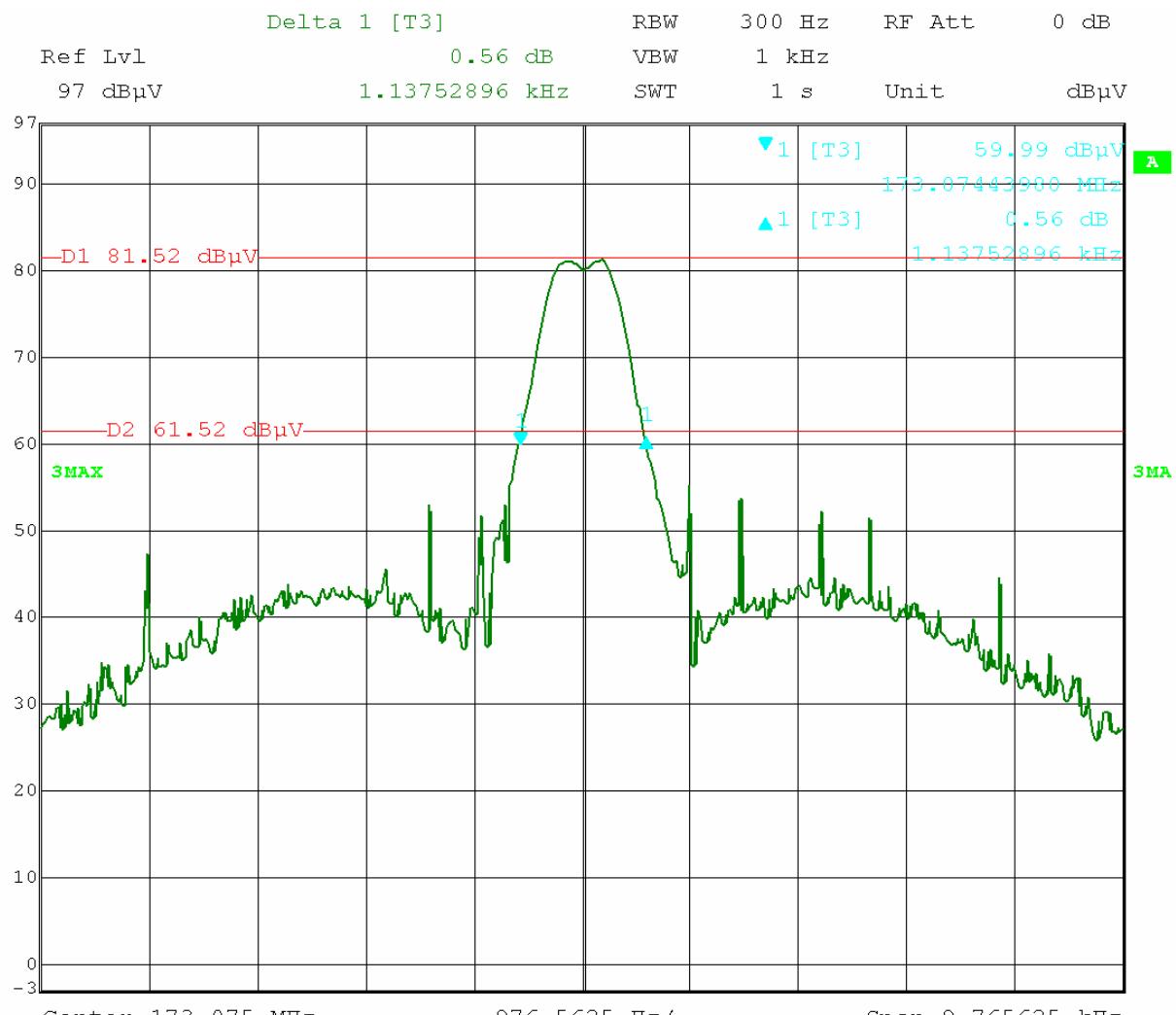
Environmental Conditions During Testing:		Ambient (°C):	N/A	Humidity (%):	N/A	Pressure (hPa):	N/A
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		7	
Engineer's Initials:	NNA	Date Test Performed:	11-04-2008	Reviewer's Initials:	JC	Date Reviewed:	11/14/08

Test Equipment Used:

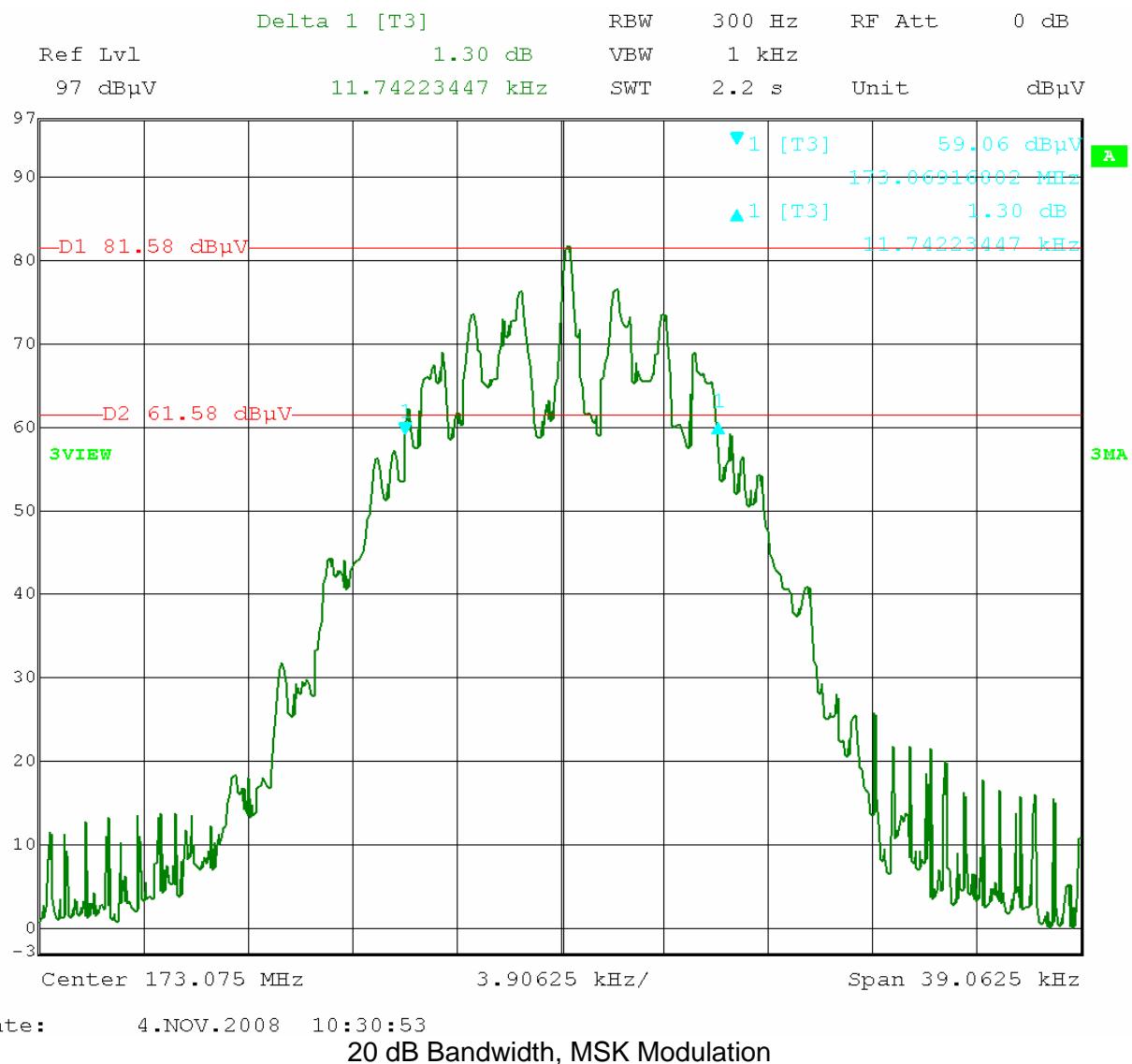
TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	11/26/2008

Test Details:

Notes: The 20 dB bandwidth is 1.14 kHz for FSK modulation and 11.74 kHz for MSK modulation. The measurement is a relative measurement and is referenced to the signal strength when viewed with a 100 kHz bandwidth in the same configuration.



Date: 4.NOV.2008 10:22:30
 20 dB Bandwidth, FSK Modulation, 1.14 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:

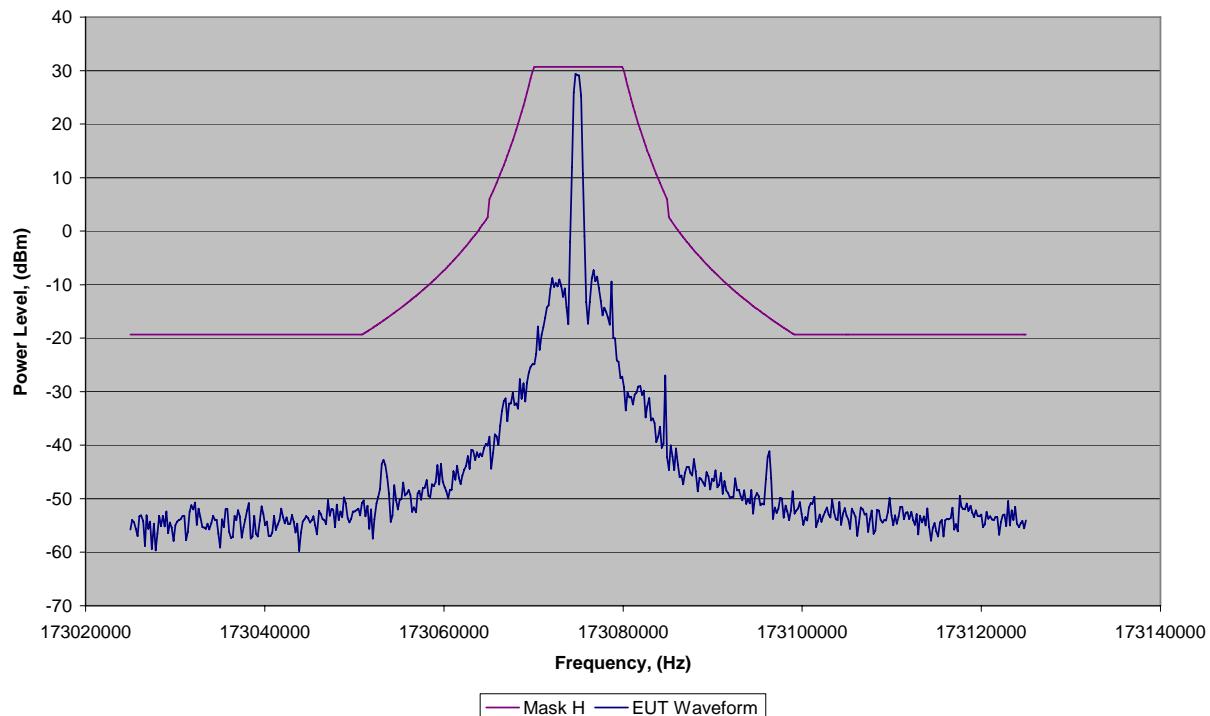
Environmental Conditions During Testing:		Ambient (°C):	19	Humidity (%):	39	Pressure (hPa):	1018
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		7	
Engineer's Initials:	NNA	Date Test Performed:	11-04-2008	Reviewer's Initials:	JO	Date Reviewed:	11/14/08

Test Equipment Used:

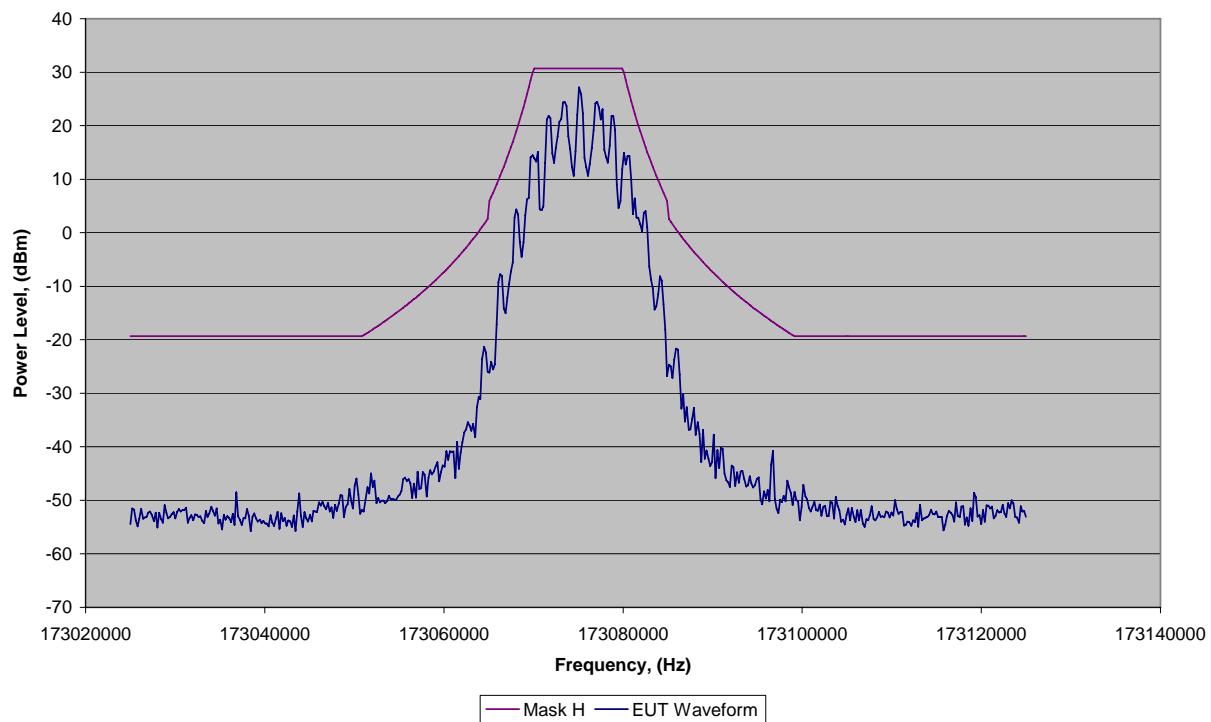
TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	4 Line Digital Barometer *	Mannix	0ABA116	SAF291	01/30/2009
2	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	11/26/2008
3	10W, 30dB Attenuator	Weinschel Corp	47-30-34	BD43291	10/15/2009
4	40 GHz Cable	Megaphase	TM40-K1K1-197	7030801 002	06/05/2009

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3

Test Details:**Emissions Mask C
FSK Modulation**

**Emissions Mask C
MSK Modulation**



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 ¹	maximum frequency difference, kHz	frequency range, MHz	
		IC: 138-174 FCC: 150-174	IC: 406.1-470 FCC: 421-512
t_1	± 25	5 ms	10 ms
t_2	± 12.5	20 ms	25 ms
t_3	± 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.

2. 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:

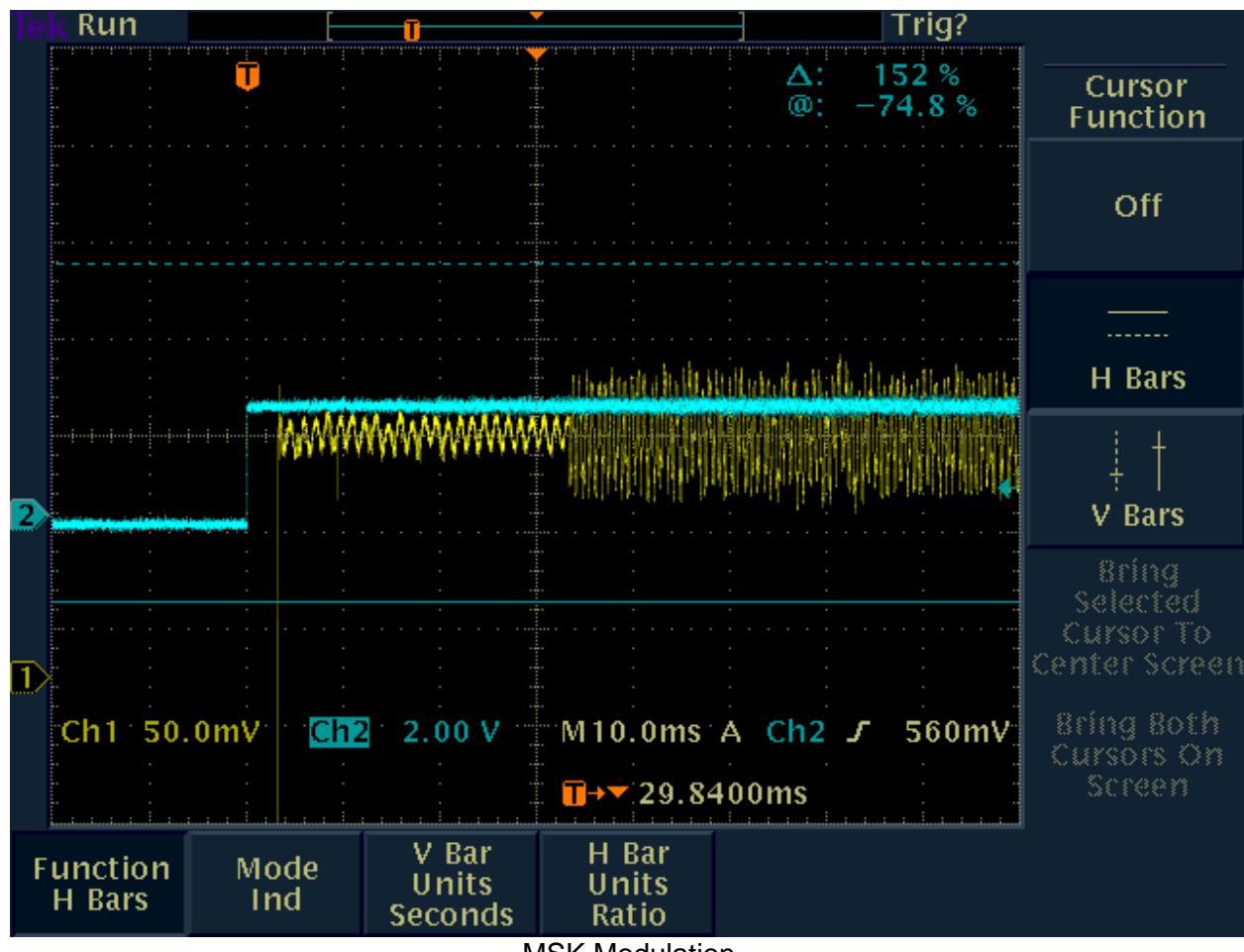
Environmental Conditions During Testing:		Ambient (°C):	19	Humidity (%):	39	Pressure (hPa):	1018
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		7	
Engineer's Initials:	NNA	Date Test Performed:	11-04-2008	Reviewer's Initials:	JO	Date Reviewed:	11/14/08

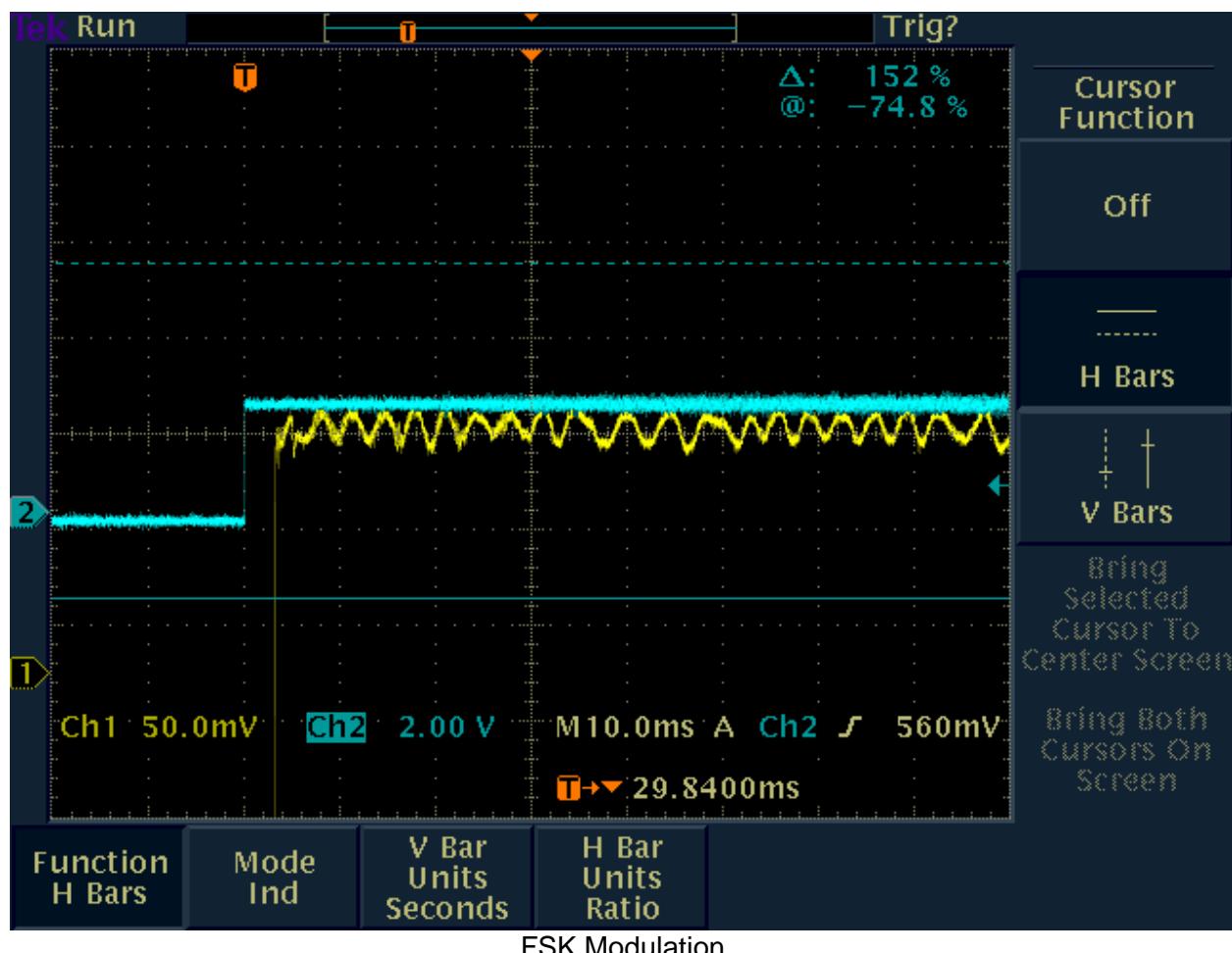
Test Equipment Used:

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	4 Line Digital Barometer *	Mannix	0ABA116	SAF291	01/30/2009
2	Oscilloscope, Digital Storage	Tektronix	TDS3052	B014809	03/21/2009
3	Measuring Receiver	Hewlett Packard	8902A	3749A04397	04/04/2009
4	Generator, Signal	Hewlett Packard	8648B	3537A01040	06/30/2009

Test Details:

Notes: The upper and lower bounds were set using a signal generator. The blue trace is the trigger, at which point the transmitter will irrevocably turn on. The horizontal cursors correspond to ± 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:

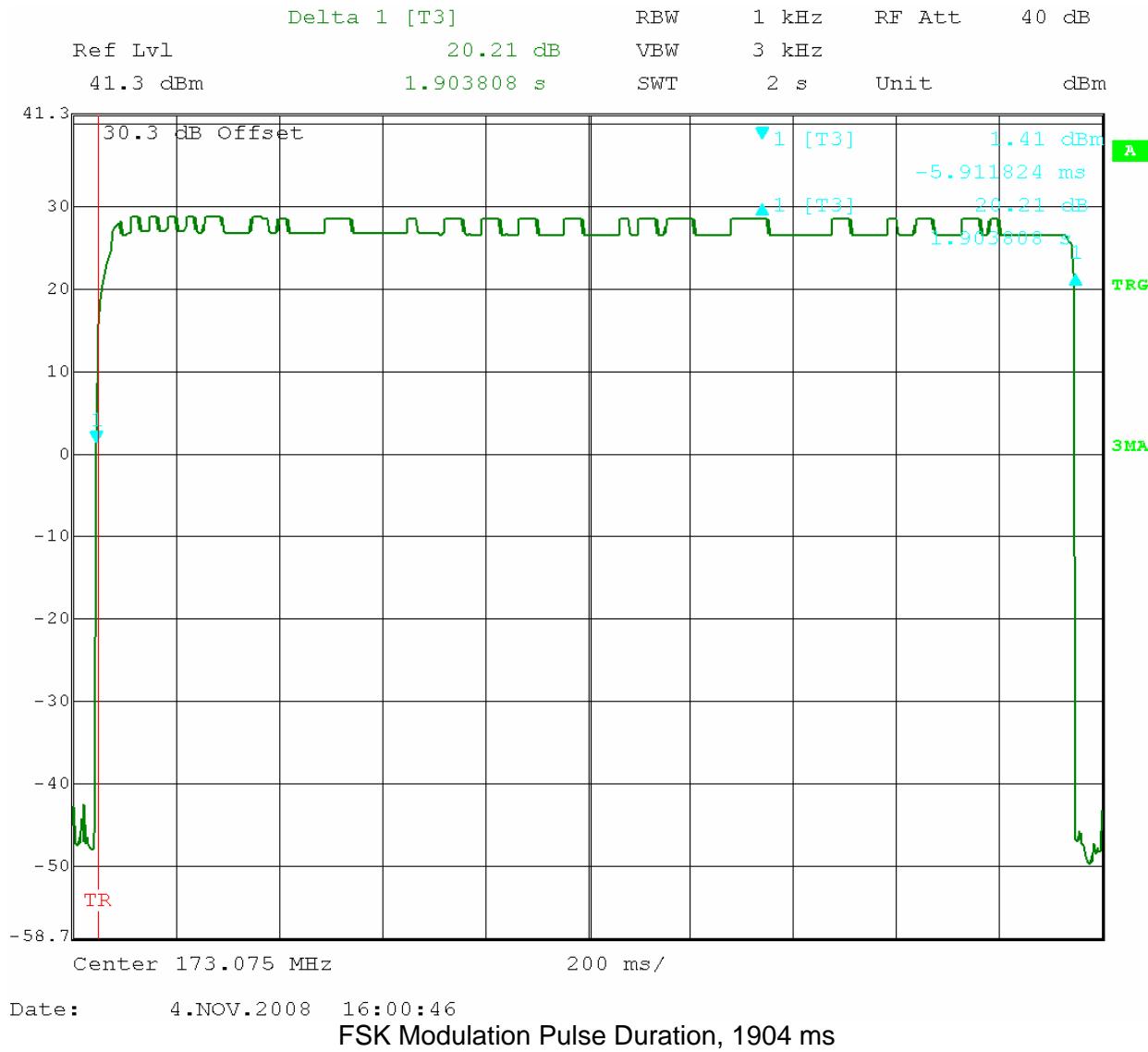
Environmental Conditions During Testing:		Ambient (°C):	19	Humidity (%):	39	Pressure (hPa):	1018
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		7	
Engineer's Initials:	NNA	Date Test Performed:	11-04-2008	Reviewer's Initials:	JO	Date Reviewed:	11/14/08

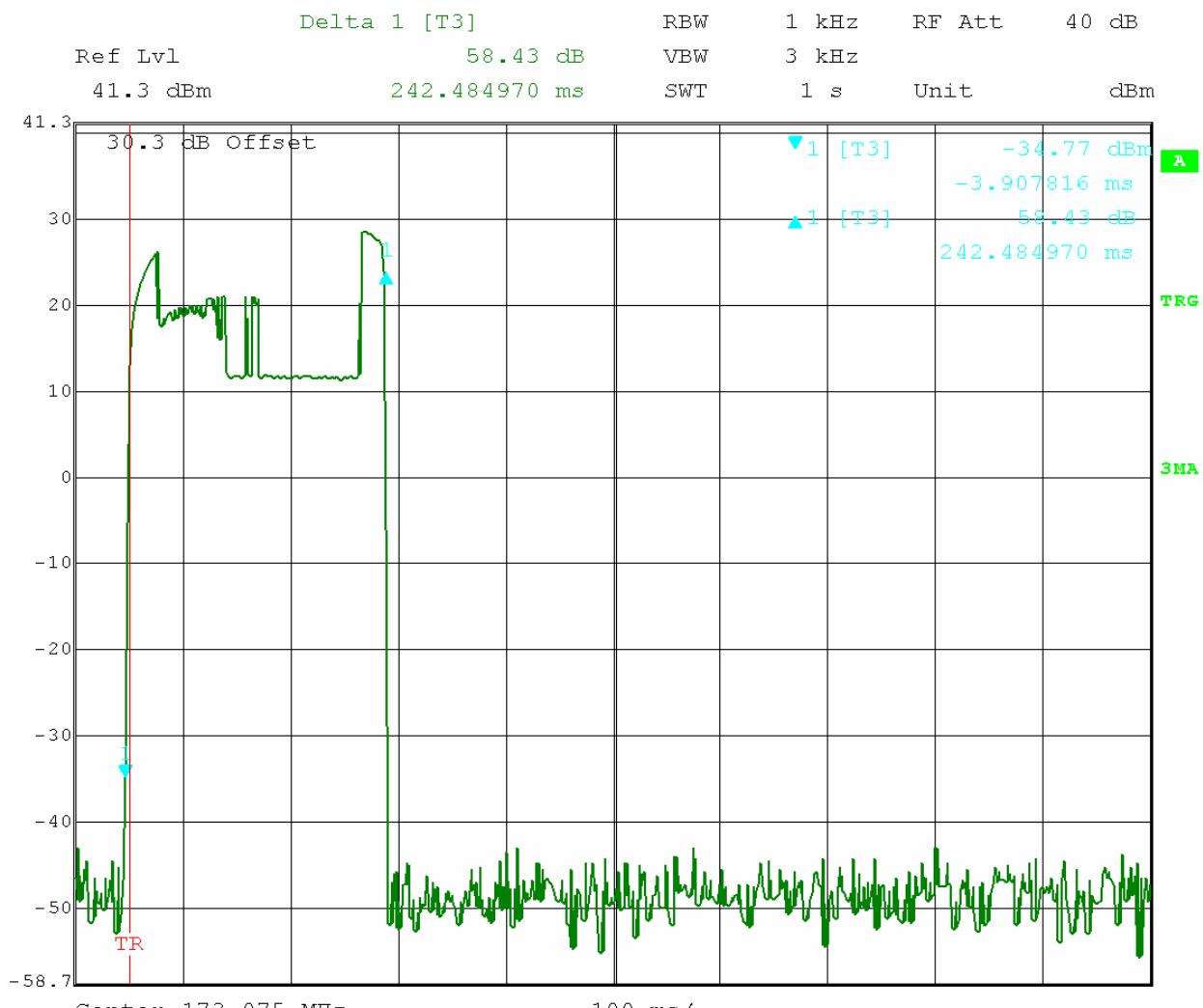
Test Equipment Used:

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	4 Line Digital Barometer	Mannix	0ABA116	SAF291	01/30/2009
2	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	11/26/2008
3	10W, 30dB Attenuator	Weinschel Corp	47-30-34	BD43291	10/15/2009
4	40 GHz Cable	Megaphase	TM40-K1K1-197	7030801 002	06/05/2009

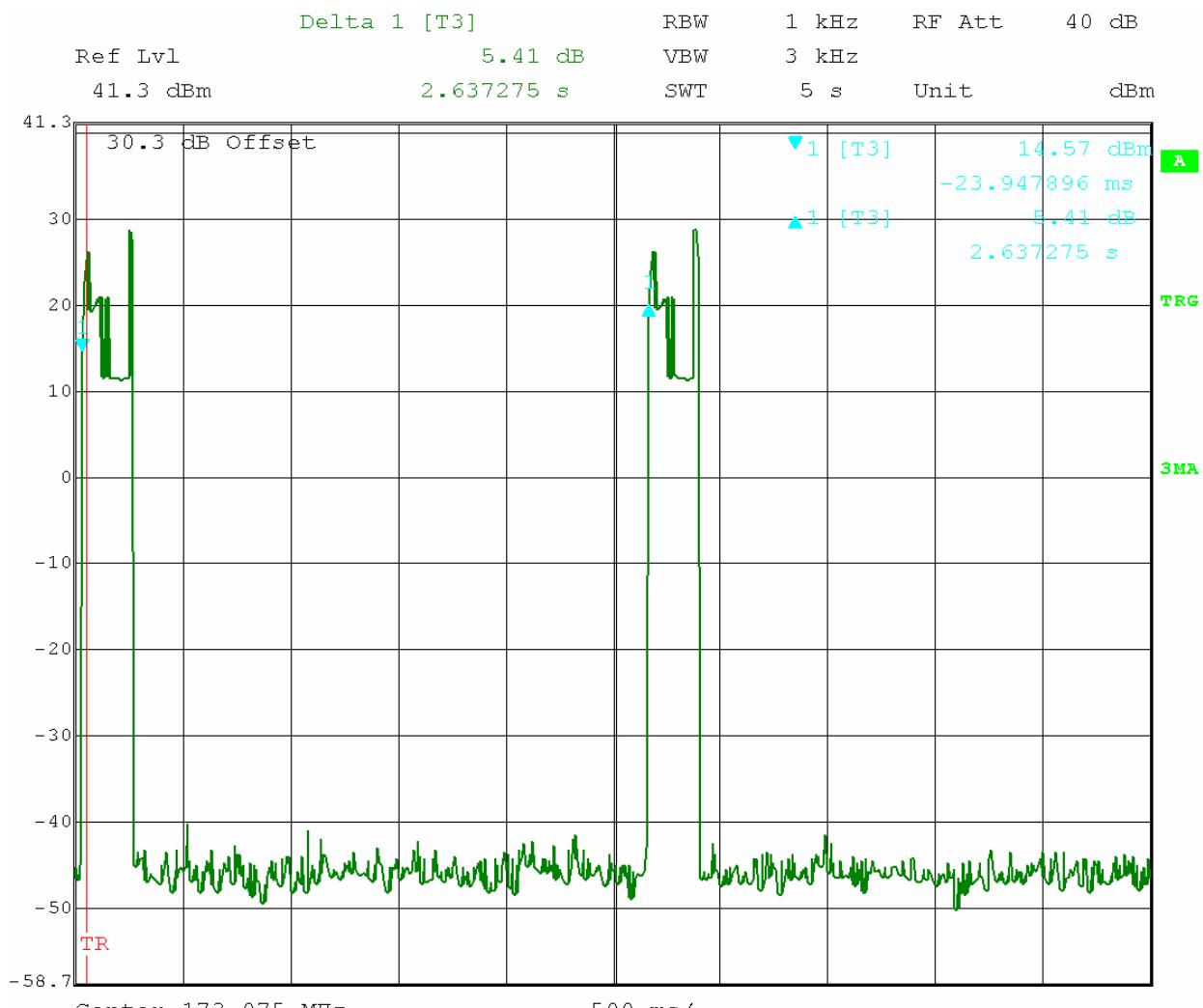
Test Details:

Notes: MSK modulation pulse duration is 242.5 ms. MSK modulation pulse intervals in active mode are 2.637 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 1904 ms, and LoJack attests that uplink transmissions do not occur more than once in a 300 second time frame.





Date: 4.NOV.2008 16:07:35
MSK Pulse Duration, 242.5 ms



Date: 4.NOV.2008 16:10:55
MSK Pulse Interval, 2.637 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, VLU7-VP	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		8, 10	
Engineer's Initials:	NNA	Date Test Performed:	11-05-2008	Reviewer's Initials:	JO	Date Reviewed:	11/14/08

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-VP is powered directly from the car battery through one regulator and therefore 13.8 VDC was used as a nominal voltage for frequency stability over voltage variations. 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

Location: Littleton

Date(s): 11/05/08

Test Equipment Used:

148012 WEI13

SA0001

MEG004

147239

%	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

Frequency Stability

Company: LoJack Corporation

Model #: VLU7-VP

Serial #: 10

Engineer(s): Nicholas Abbondante

Project #: 3161283

Standard: FCC Part 90

Limit:

50 PPM

Test Equipment Used:

148012 WEI13

SA0001

MEG004

147239

Location: Littleton

Date(s): 11/05/08

Nominal f: 173.075 MHz

Voltage: 13.8 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	11.73	173.074490	0.042	8.65
-10%	12.42	173.074563	0.115	8.65
-5%	13.11	173.074732	0.284	8.65
+0%	13.8	173.074448	0	8.65
+5%	14.49	173.074426	-0.022	8.65
+10%	15.18	173.074409	-0.039	8.65
+15%	15.87	173.074364	-0.084	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):	20	Humidity (%):	34	Pressure (hPa):	1026
Pretest Verification Performed		Yes		Equipment under Test:		VLU7-SP, VLU7-VP	
Test Engineer(s):	Vathana Ven, Nicholas Abbondante			EUT Serial Number:		7, 9	
Engineer's Initials:	VFV	Date Test Performed:	11-03-2008	Reviewer's Initials:		Date Reviewed:	11/14/08

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	Equipment Type	Make	Model No.	Serial No.	Next Cal. Due
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR1	06/01/2009
2	Synthesized Sweep Generator	Hewlett Packard	83620A	3213A01244	02/06/2009
3	40 GHz Cable	Megaphase	TM40-K1K1-80	7030802 002	06/05/2009
4	BROADBAND ANTENNA	Compliance Design	B100	1649	10/14/2009
5	BROADBAND ANTENNA	Compliance Design	B200	1650	10/02/2009
6	BROADBAND ANTENNA	Compliance Design	B300	00668	10/02/2009
7	HORN ANTENNA	EMCO	3115	9602-4675	10/13/2009
8	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	11/26/2008
9	40GHz Cable	Megaphase	TM40-K1K1-197	7030801 001	06/05/2009
10	40 GHz Cable	Megaphase	TM40-K1K1-197	7030801 002	06/05/2009
11	10 Meter in floor cable for site 2	ITS	RG214B/U	S2 10M FLR	09/23/2009
12	ANTENNA	EMCO	3142	9711-1223	02/22/2009
13	HORN ANTENNA	EMCO	3115	22023	04/02/2009

Software Utilized:

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

Test Results:

Radiated Emissions, Substitution																	
Test Data						Emissions Data											
Company: LoJack Corporation						Rx Antenna: LOG2 EMC-54											
Model #: VLU7-SP						Rx Cable(s): S2 10M FLR MEG001 MEG002											
Serial #: 7						Rx Preamp: NONE Receiver: ROS001											
Engineer(s): Nicholas Abbondante			Vathana Ven			Location: Site 2			Tx Antenna: ANT1A,B,C HORN2								
Project #: 3161283			Date(s): 11/03/08			Tx Cable(s): MEG004											
Standard: FCC Part 90						Tx Signal Generator: HEW62											
Barometer:	BAR1	Temp/Humidity/Pressure:	20c	34%	1026mB	ERP or EIRP?:	ERP										
Test Distance (m): 10 & 3						Voltage/Frequency: Fresh 3.3 and 6V batteries											
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	Ant.	EUT	Generator	Transmit	Transmit	Generator											
Pol.	Frequency	Reading	Reading	Cable	Antenna	Level	Net	Limit	Margin	Bandwidth							
Type	(V/H)	MHz	dB(uV)	dB(uV)	Loss dB	dBi	dBm	dBm	dBm	dB							
Note: FSK Modulation																	
PK	V	173.075	104.6	73.3	0.3	-2.3	0.0	26.5	34.0	-7.5	100/300kHz						
Note: MSK Modulation																	
PK	V	173.075	103.8	73.3	0.3	-2.3	0.0	25.8	34.0	-8.2	100/300kHz						
PK	V	346.159	53.3	65.7	0.4	-0.8	0.0	-15.8	-13.0	-2.8	100/300kHz						
PK	V	435.872	23.6	67.2	0.5	1.4	0.0	-44.9	-13.0	-31.9	100/300kHz						
PK	V	519.228	53.0	66.5	0.5	1.0	0.0	-15.2	-13.0	-2.2	100/300kHz						
PK	V	692.315	25.0	50.5	0.6	2.0	0.0	-26.3	-13.0	-13.3	100/300kHz						
PK	V	865.375	23.0	61.2	0.7	0.9	0.0	-40.2	-13.0	-27.2	100/300kHz						
PK	V	1006.713	38.6	93.5	0.8	4.9	0.0	-53.0	-13.0	-40.0	1/3MHz						
PK	H	1038.570	60.0	101.8	0.8	4.9	0.0	-39.9	-13.0	-26.9	1/3MHz						
PK	H	1211.552	59.9	96.2	0.8	4.9	0.0	-34.4	-13.0	-21.4	1/3MHz						
PK	H	1384.720	59.0	101.4	0.9	8.6	0.0	-36.9	-13.0	-23.9	1/3MHz						
PK	H	1557.723	50.2	101.1	0.9	8.6	0.0	-45.4	-13.0	-32.4	1/3MHz						
PK	H	1730.810	47.0	93.1	1.0	8.6	0.0	-40.7	-13.0	-27.7	1/3MHz						
Note: FSK Modulation																	
PK	V	346.152	52.0	65.0	0.4	-0.8	0.0	-16.4	-13.0	-3.4	100/300kHz						
PK	V	435.872	23.0	67.2	0.5	1.4	0.0	-45.5	-13.0	-32.5	100/300kHz						
PK	V	519.233	52.5	66.8	0.5	1.0	0.0	-16.0	-13.0	-3.0	100/300kHz						
PK	V	692.332	24.4	50.5	0.6	2.0	0.0	-26.9	-13.0	-13.9	100/300kHz						
PK	V	865.375	23.7	61.2	0.7	0.9	0.0	-39.5	-13.0	-26.5	100/300kHz						
PK	H	1006.713	35.0	93.5	0.8	4.9	0.0	-56.6	-13.0	-43.6	1/3MHz						
PK	H	1038.534	60.0	101.8	0.8	4.9	0.0	-39.9	-13.0	-26.9	1/3MHz						
PK	H	1211.512	62.8	96.2	0.8	4.9	0.0	-31.5	-13.0	-18.5	1/3MHz						
PK	H	1384.604	60.9	101.4	0.9	8.6	0.0	-35.0	-13.0	-22.0	1/3MHz						
PK	H	1557.696	54.3	101.2	0.9	8.6	0.0	-41.4	-13.0	-28.4	1/3MHz						
PK	H	1730.810	45.5	93.1	1.0	8.6	0.0	-42.2	-13.0	-29.2	1/3MHz						

Radiated Emissions, Substitution

Company: LoJack Corporation

Model #: VLU7-VP

Serial #: 9

Engineer(s): Nicholas Abbondante

Vathana Ven

Location: Site 2

Rx Antenna: LOG2 EMC-54

Rx Cable(s): S2 10M FLR MEG001 MEG002

Rx Preamp: NONE Receiver: ROS001

Tx Antenna: ANT1A,B,C HORN2

Tx Cable(s): MEG004

Tx Signal Generator: HEW62

Barometer: BAR1 Temp/Humidity/Pressure: 20c 34% 1026mB

ERP or EIRP?: ERP

Test Distance (m): 10 & 3 Voltage/Frequency: Fresh 3.3 and 6V batteries Frequency Range: 30-1800 MHz

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											
PK	V	173.075	104.3	72.2	0.3	-2.3	0.0	27.3	34.0	-6.7	100/300kHz
PK	V	346.159	51.0	67.4	0.4	-0.8	0.0	-19.8	-13.0	-6.8	100/300kHz
PK	V	435.833	21.5	65.8	0.5	1.4	0.0	-45.6	-13.0	-32.6	100/300kHz
PK	V	519.224	51.5	66.8	0.5	1.0	0.0	-17.0	-13.0	-4.0	100/300kHz
PK	H	692.307	25.5	64.5	0.6	2.0	0.0	-39.8	-13.0	-26.8	100/300kHz
PK	V	865.375	23.7	53.0	0.7	0.9	0.0	-31.3	-13.0	-18.3	100/300kHz
PK	V	1006.691	39.0	95.0	0.8	4.9	0.0	-54.1	-13.0	-41.1	1/3MHz
PK	H	1038.456	58.8	99.4	0.8	4.9	0.0	-38.7	-13.0	-25.7	1/3MHz
PK	H	1211.552	59.0	95.1	0.8	4.9	0.0	-34.2	-13.0	-21.2	1/3MHz
PK	H	1384.600	58.5	101.9	0.9	8.6	0.0	-37.9	-13.0	-24.9	1/3MHz
PK	H	1557.690	52.4	101.2	0.9	8.6	0.0	-43.3	-13.0	-30.3	1/3MHz
PK	H	1730.810	47.0	93.6	1.0	8.6	0.0	-41.2	-13.0	-28.2	1/3MHz
Note: FSK Modulation											
PK	V	173.098	102.9	72.2	0.3	-2.3	0.0	25.9	34.0	-8.1	100/300kHz
PK	V	346.152	49.5	67.4	0.4	-0.8	0.0	-21.3	-13.0	-8.3	100/300kHz
PK	V	435.872	20.6	65.8	0.5	1.4	0.0	-46.5	-13.0	-33.5	100/300kHz
PK	V	519.234	49.8	66.8	0.5	1.0	0.0	-18.7	-13.0	-5.7	100/300kHz
PK	V	692.313	24.2	57.9	0.6	2.0	0.0	-34.5	-13.0	-21.5	100/300kHz
PK	V	865.375	23.7	53.0	0.7	0.9	0.0	-31.3	-13.0	-18.3	100/300kHz
PK	V	1006.713	37.0	94.5	0.8	4.9	0.0	-55.6	-13.0	-42.6	1/3MHz
PK	H	1038.458	55.8	99.4	0.8	4.9	0.0	-41.7	-13.0	-28.7	1/3MHz
PK	H	1211.546	60.5	95.1	0.8	4.9	0.0	-32.7	-13.0	-19.7	1/3MHz
PK	H	1384.640	60.0	101.9	0.9	8.6	0.0	-36.4	-13.0	-23.4	1/3MHz
PK	H	1557.696	58.0	101.2	0.9	8.6	0.0	-37.7	-13.0	-24.7	1/3MHz
PK	H	1730.810	44.5	93.6	1.0	8.6	0.0	-43.7	-13.0	-30.7	1/3MHz