intertek
Total Quality. Assured.

LOJACK CORPORATION
TEST REPORT

SCOPE OF WORK
EMC TESTING – VLU10

REPORT NUMBER
103364832BOX-005

ISSUE DATE
01/31/2018

PAGES
45

DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. December 2017

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 103364832BOX-005
Project Number: G103364832

Report Issue Date: 01/31/2018

Model(s) Tested: VLU10
Model(s) Partially Tested: None
Model(s) Not Tested but declared equivalent by the client: None

Standards: FCC 47CFR Part 90: 01/2018
FCC 47CFR Part 15 Subpart B: 01/2018

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

Client:
LoJack Corporation
40 Pequot Way
Canton, MA 02021
USA

Report prepared by Naga Suryadevara

Naga Suryadevara/Project Engineer, EMC

Report reviewed by Kouma Sinn

Kouma Sinn/Staff Engineer, EMC

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. 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. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Output Power (FCC Part 2.1046 and FCC Part 90.20(e)(6))	Pass
7	Occupied and 26dB Bandwidth (FCC Part 2.1049 and FCC Part 90.20(e)(6))	Pass
8	Transmitter Frequency Stability (FCC Part 2.1055 and FCC Part 90.213)	Pass
9	Transient Frequency Behavior (FCC Part 2.1055 and FCC Part 90.214)	Pass
10	Transmitter Emissions Mask (FCC Part 90.210)	Pass
11	Transmitter Radiated Spurious Emissions (FCC Part 2.1053 and FCC Part 90.210)	Pass
12	Digital Device and Receiver Radiated Emissions (FCC Part 15 Subpart B)	Pass
13	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: LoJack Corporation
40 Pequot Way
Canton, MA 02021
USA

Contact: Vincent Ricci
Telephone: (781) 302-4332
Fax: None
Email: vricci@lojack.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: LoJack Corporation
40 Pequot Way
Canton, MA 02021
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Vehicle Locator transmitting MSK NB	LoJack Corporation	VLU10	CJ525017108 20
Vehicle Locator transmitting MSK WB	LoJack Corporation	VLU10	CJ525017108 06
Vehicle locator transmitting FSK WB	LoJack Corporation	VLU10	CJ525017108 06
Vehicle locator in receive mode	LoJack Corporation	VLU10	CJ525017108 12

Receive Date:	01/09/2018
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The EUT is a vehicle locator.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
12 VDC	Not provided	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmit mode: a) MSK Wide band b) MSK Narrow band c) FSK Wide band
2	Receive mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Not provided

Radio/Receiver Characteristics	
Frequency Band(s)	173.075 MHz
Modulation Type(s)	MSK and FSK
Maximum Output Power	MSK NB – 29.88 dBm MSK WB – 31.33 dBm FSK WB – 31.19 dBm
Test Channels	173.075 MHz
Occupied Bandwidth	MSK NB – 7.89 kHz MSK WB – 13.20 kHz FSK WB – 4.28 kHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	N/A
Equipment Type	Standalone host
ETSI LBT/Adaptivity	N/A
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	N/A
Antenna Type and Gain	Integral antenna, gain is not provided by the customer.

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

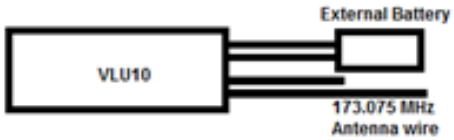
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	DC wires (2)	0.5	None	None	12V battery
2	Antenna wire	1	None	None	Unterminated

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	Lenovo	T440P	None listed

5.1 Method:

Configuration as required by FCC 47CFR Part 90, FCC Part 15 Subpart B, ANSI C 63.4: 2014 and ANSI C 63.26: 2015.

5.2 EUT Block Diagram:



6 Output Power

6.1 Method

Tests are performed in accordance with FCC Part 2.1046, FCC Part 90.20(e)(6) and ANSI C 63.26.

TEST SITE: EMC Lab

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

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/07/2017	11/07/2018
MIN24'	2 watt 10dB attenuator DC-18GHz	Mini Circuits	BW-S10W2+	MIN24	05/26/2017	05/26/2018
MIN25'	attenuator 2watt 10dB DC-18GHz	Mini Circuits	BW-S10W2+	MIN25	05/26/2017	05/26/2018

Software Utilized:

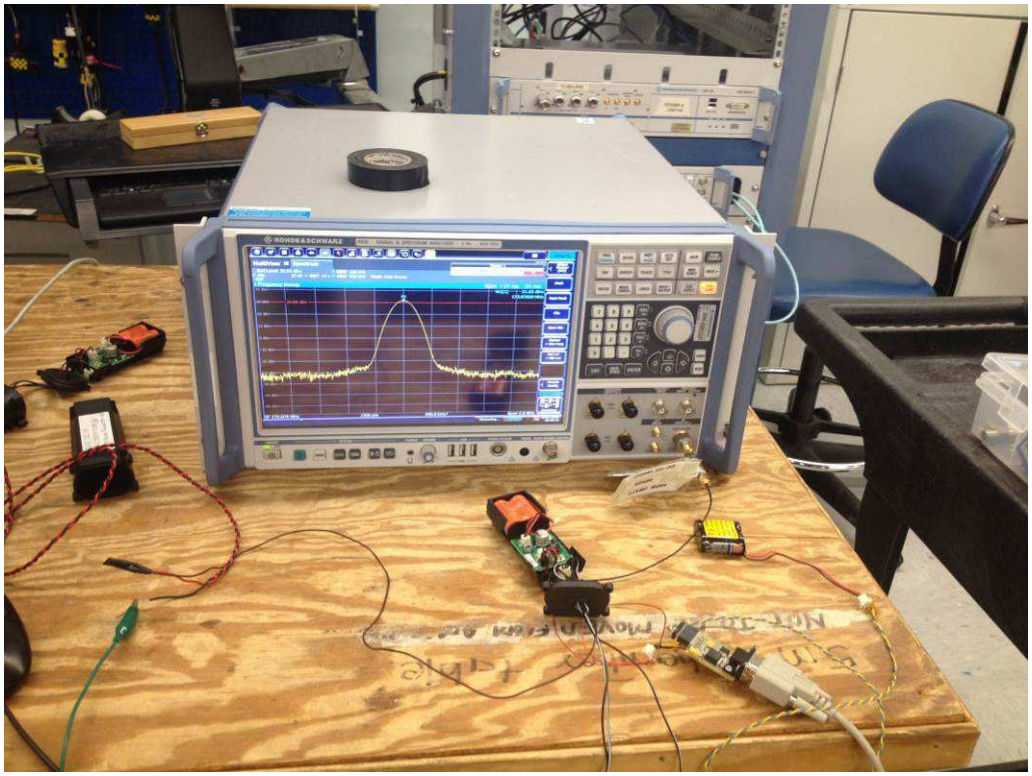
Name	Manufacturer	Version
None		

6.3 Results:

The sample tested was found to Comply.

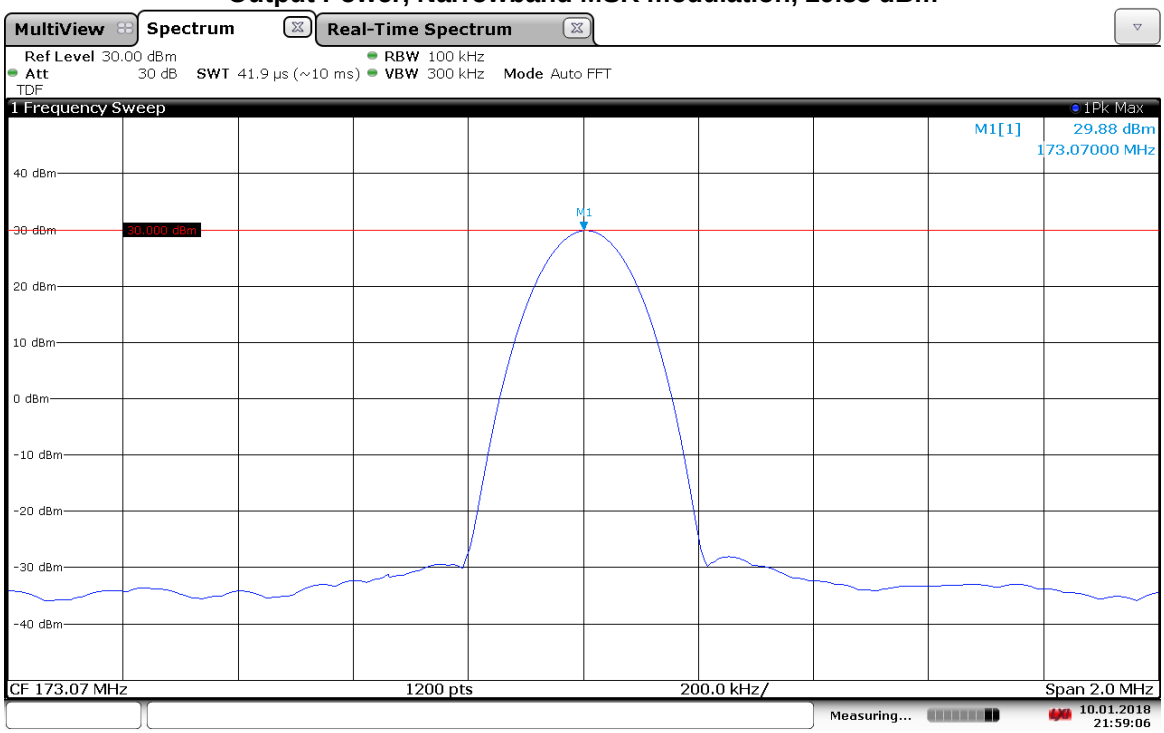
Mobile transmitters operating on this frequency with emissions authorized in a maximum bandwidth of 12.5 kHz are limited to 5.0 watts power output. Mobile transmitters operating on this frequency with emissions authorized in a maximum bandwidth of 20 kHz are limited to 2.5 watts power output.

6.4 Setup Photograph:



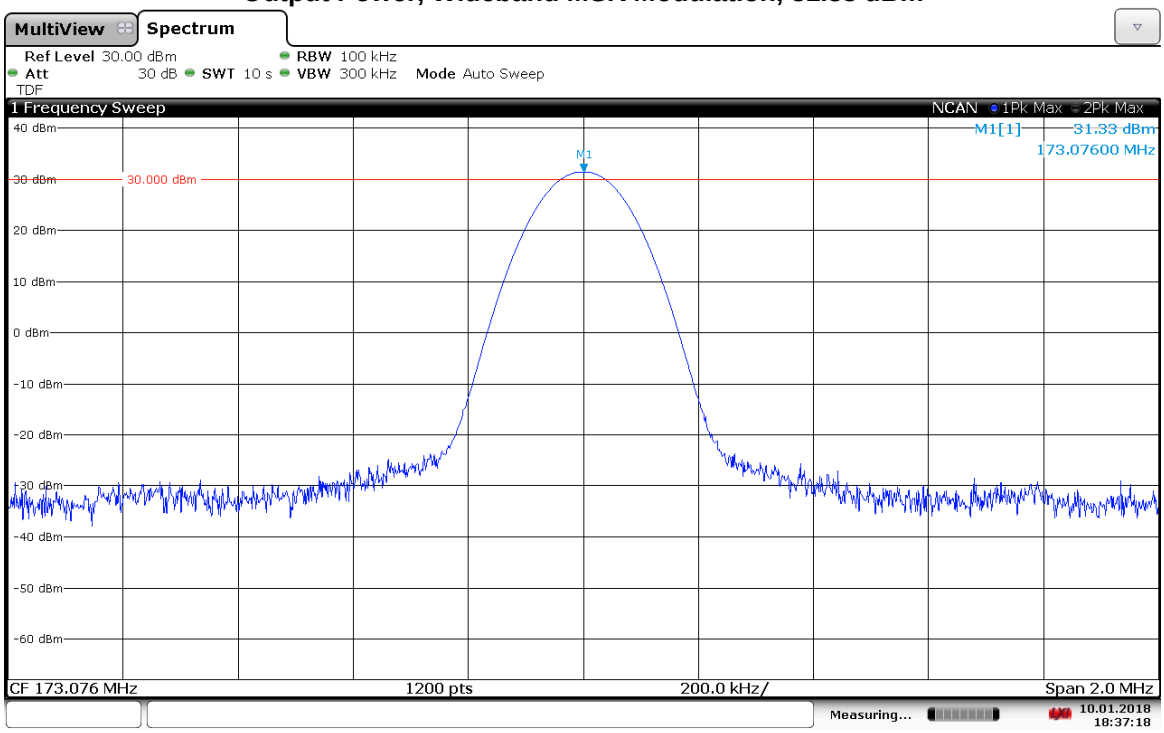
6.5 Plots/Data:

Output Power, Narrowband MSK modulation, 29.88 dBm



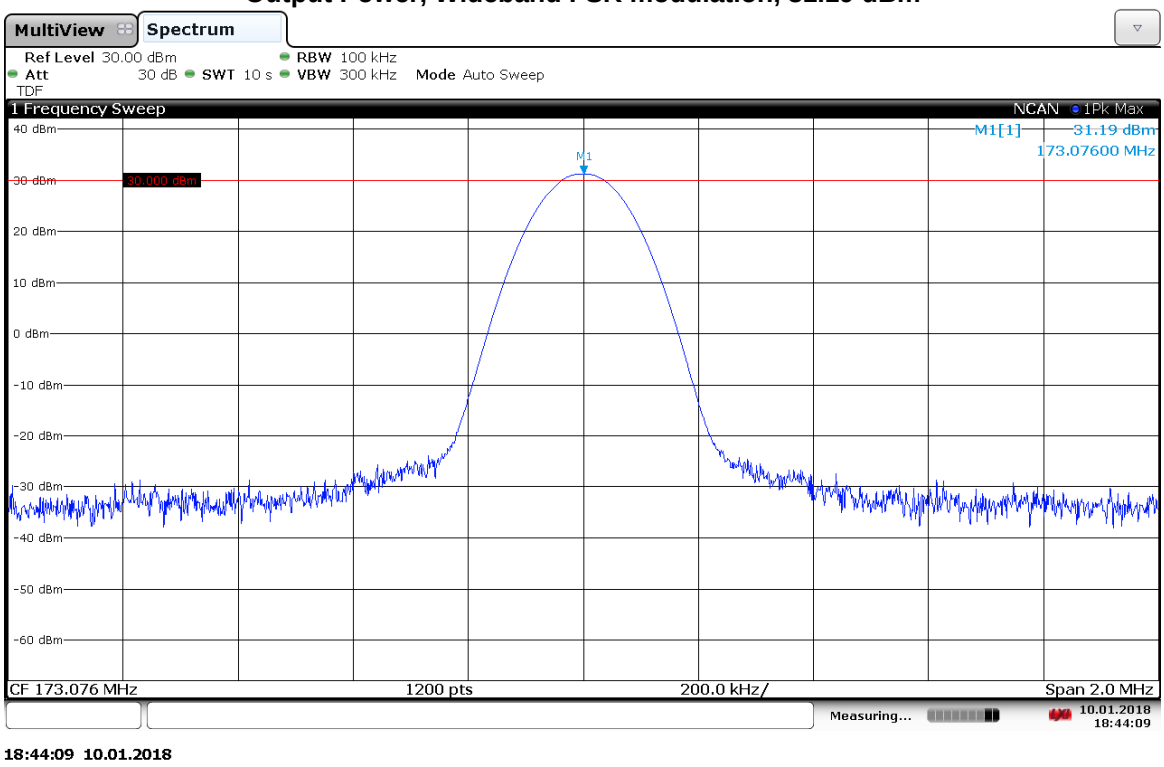
21:59:06 10.01.2018

Output Power, Wideband MSK Modulation, 31.33 dBm



18:37:18 10.01.2018

Output Power, Wideband FSK modulation, 31.19 dBm



18:44:09 10.01.2018

Test Personnel:	Vathana Ven VSV	Test Date:	01/10/2018
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 90	Limit Applied:	See section 6.3
Input Voltage:	12 VDC		
Pretest Verification w/ Ambient Signals or BB Source:	Yes – signal generator	Ambient Temperature:	21 ºC
		Relative Humidity:	19 %
		Atmospheric Pressure:	997 mbars

Deviations, Additions, or Exclusions: None

7 Occupied and 26dB Bandwidth

7.1 Method

Tests are performed in accordance with FCC Part 2.1049, FCC Part 90.20(e)(6) and ANSI C 63.26.

TEST SITE: EMC Lab

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

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/07/2017	11/07/2018
MIN24'	2 watt 10dB attenuator DC-18GHz	Mini Circuits	BW-S10W2+	MIN24	05/26/2017	05/26/2018
MIN25'	attenuator 2watt 10dB DC-18GHz	Mini Circuits	BW-S10W2+	MIN25	05/26/2017	05/26/2018

Software Utilized:

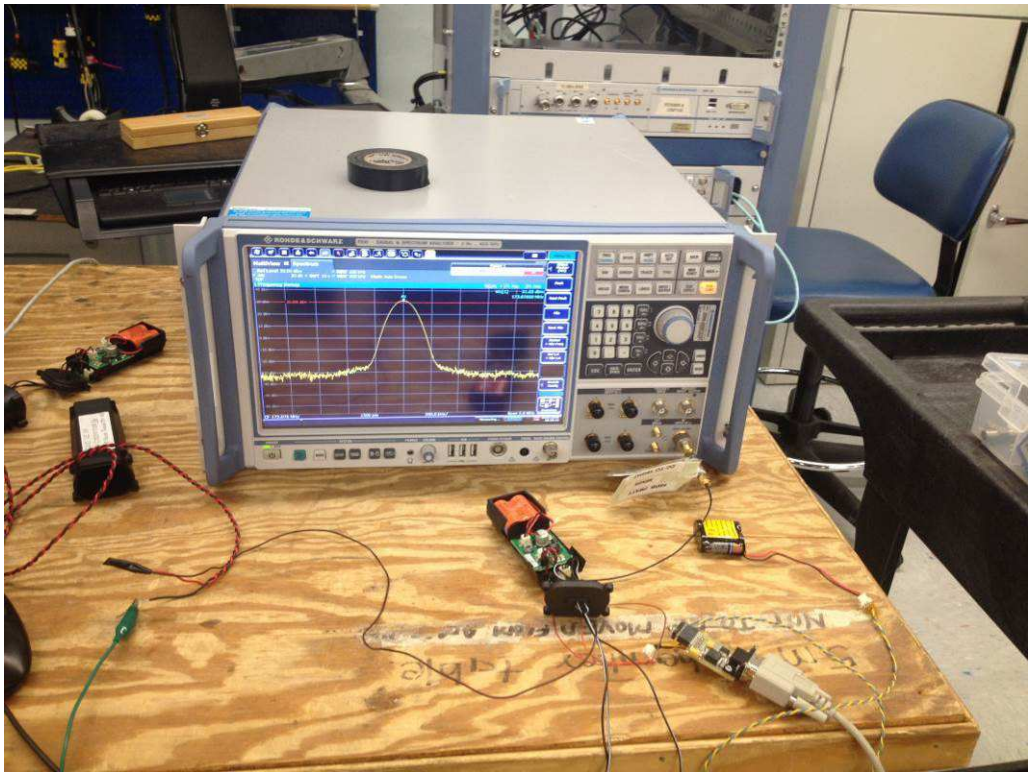
Name	Manufacturer	Version
None		

7.3 Results:

The sample tested was found to Comply.

Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth.

7.4 Setup Photograph:

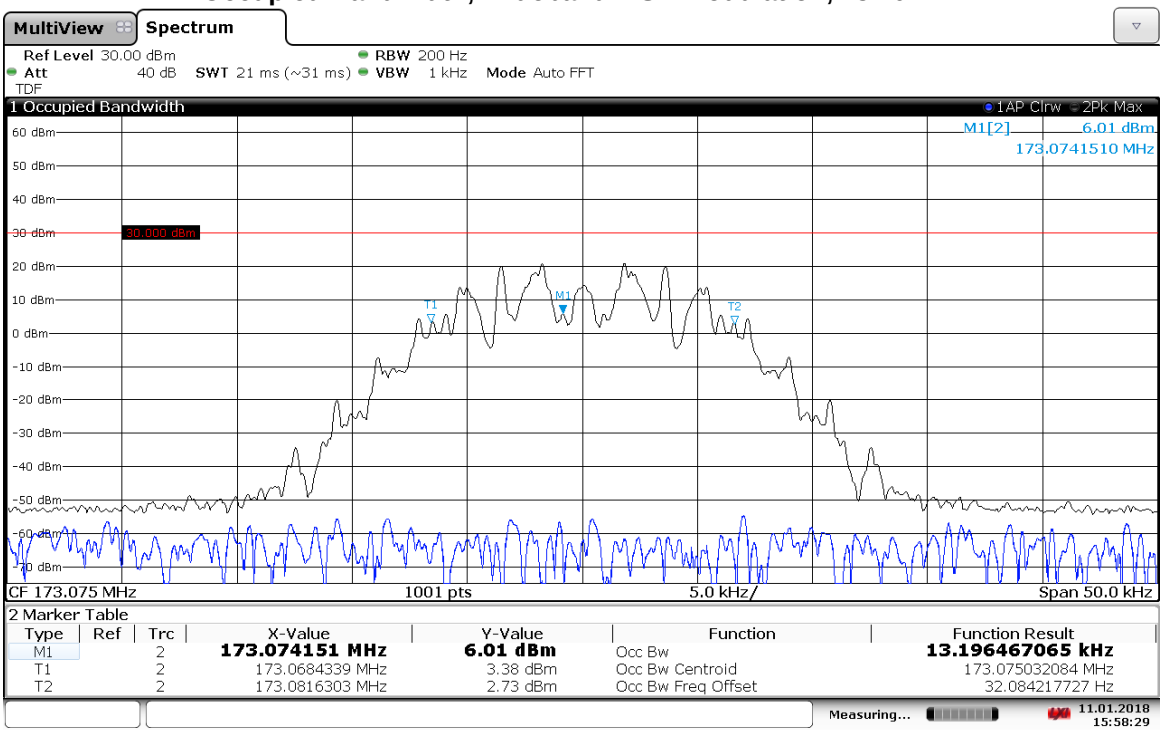


7.5 Plots/Data:

Occupied Bandwidth, Narrowband MSK Modulation, 7.89 kHz

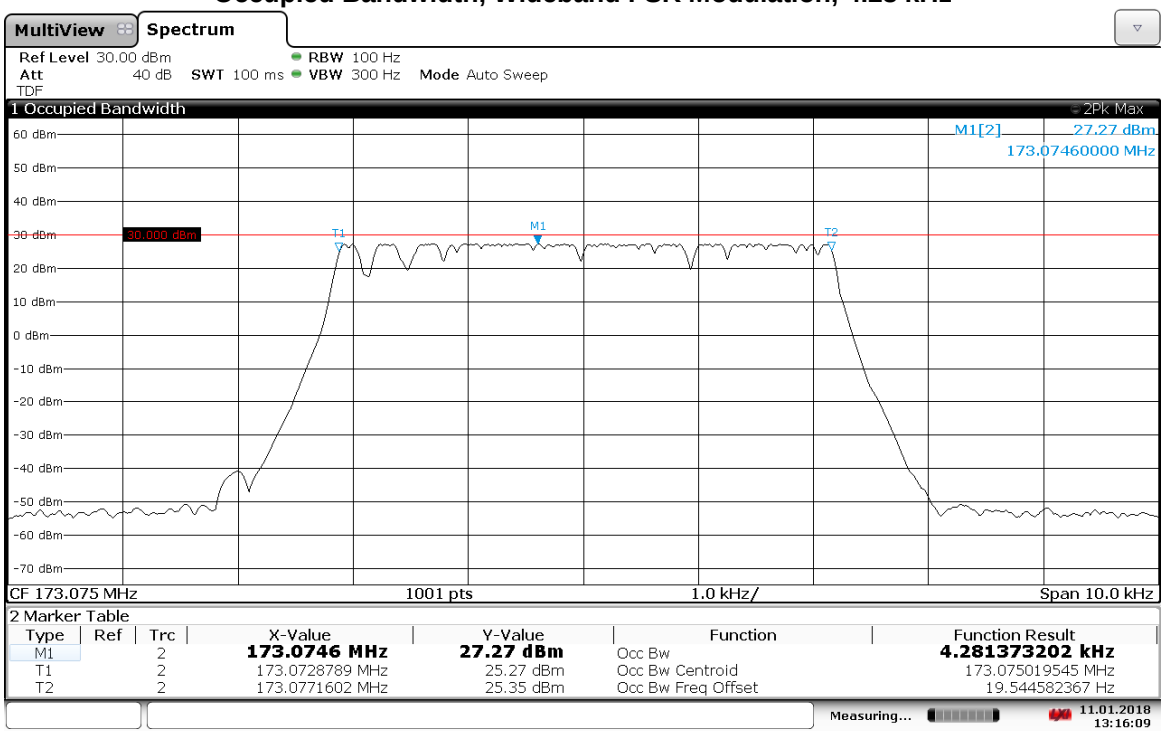
14:50:10 11.01.2018

Occupied Bandwidth, Wideband MSK Modulation, 13.20 kHz



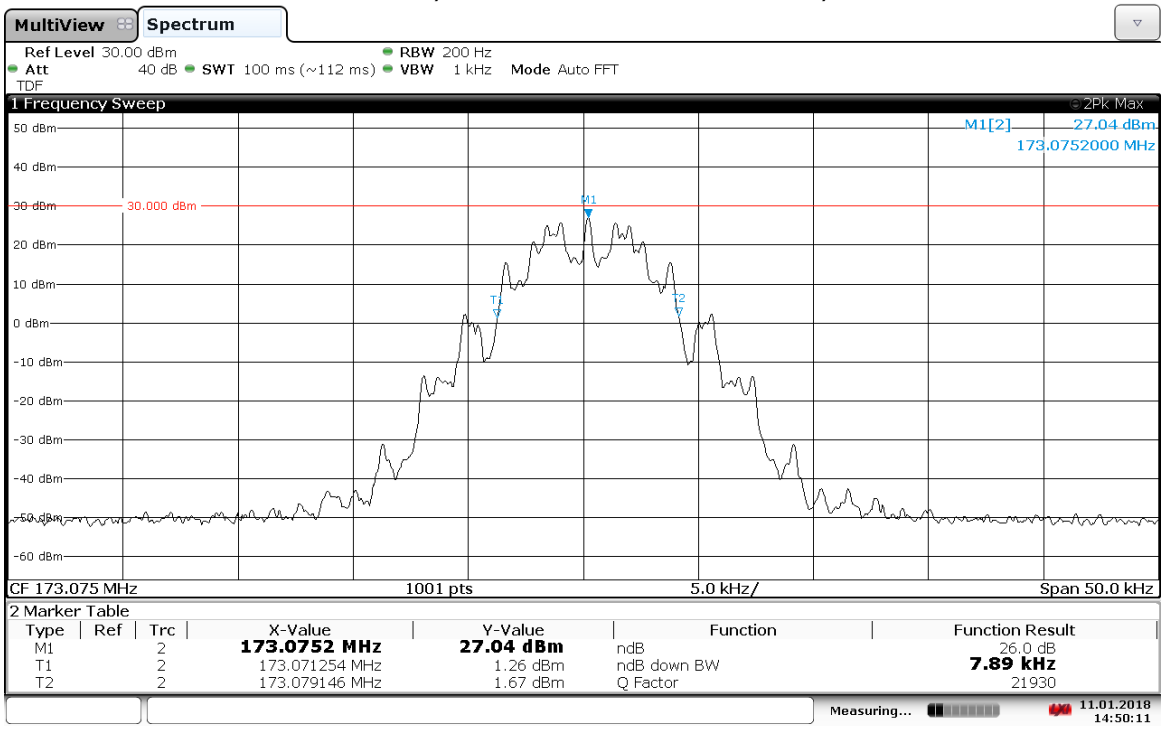
15:58:29 11.01.2018

Occupied Bandwidth, Wideband FSK Modulation, 4.28 kHz



13:16:09 11.01.2018

26dB Bandwidth, Narrowband MSK Modulation, 7.89 kHz

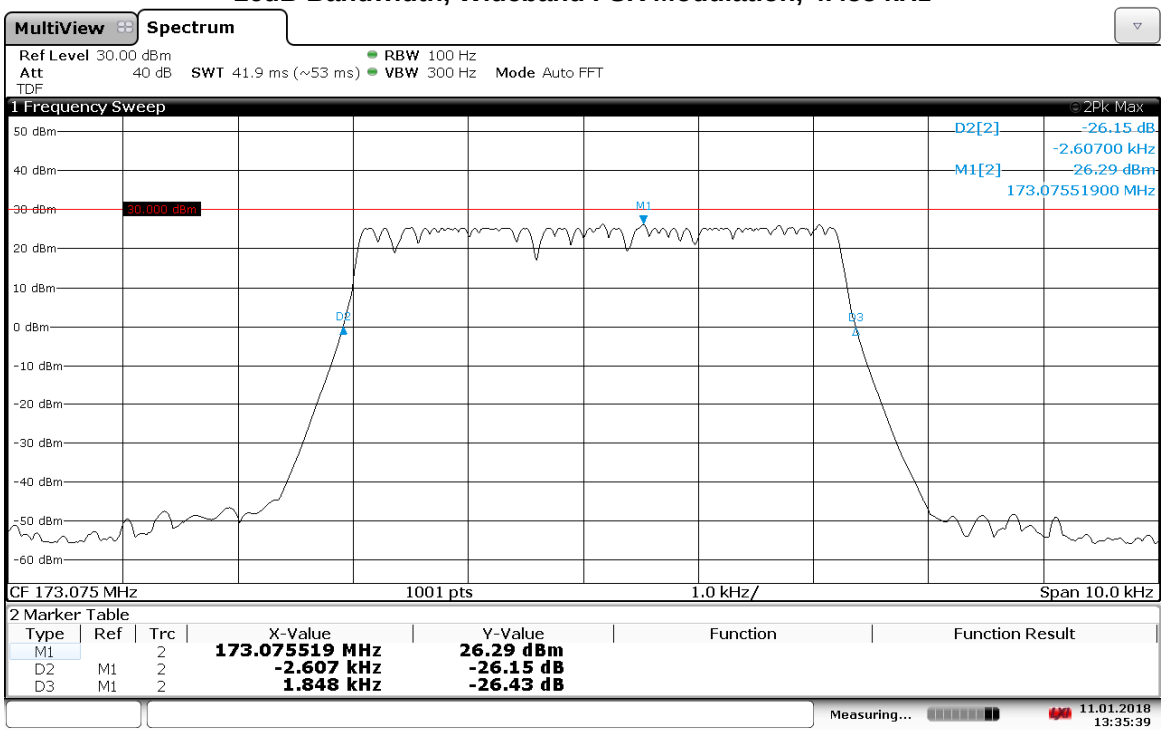


14:50:12 11.01.2018

26dB Bandwidth, Wideband MSK Modulation, 14.88 kHz

14:32:09 11.01.2018

26dB Bandwidth, Wideband FSK Modulation, 4.455 kHz



13:35:39 11.01.2018

Test Personnel:	Vathana Ven VSV	Test Date:	01/11/2018
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 90	Limit Applied:	See report section 7.3
Input Voltage:	12 VDC		
Pretest Verification w/ Ambient Signals or BB Source:	Yes – signal generator	Ambient Temperature:	22 ºC
		Relative Humidity:	09 %
		Atmospheric Pressure:	1003 mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Frequency Stability

8.1 Method

Tests are performed in accordance with FCC Part 2.1055, FCC Part 90.213 and ANSI C 63.26.

TEST SITE: Safety/Performance Lab

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/08/2017	02/08/2018
MIN23'	Attenuator 2 watt 20dB DC-26GHz	Mini Circuits	BW-S20-2W263+	MIN23	05/26/2017	05/26/2018
MIN24'	2 watt 10dB attenuator DC-18GHz	Mini Circuits	BW-S10W2+	MIN24	05/26/2017	05/26/2018
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	08/03/2017	08/03/2018
SAF1153'	Freezing Rain\Icing\Temp\Humidity\ -73deg C to +190deg C, 95% humidity, Ice Freezing Rain	Cincinnati Sub-Zero	CTH-(FR)64-6-6-SC/AC	12-CT15628	10/31/2017	10/31/2018

Software Utilized:

Name	Manufacturer	Version
None	--	--

8.3 Results:

The sample tested was found to Comply.

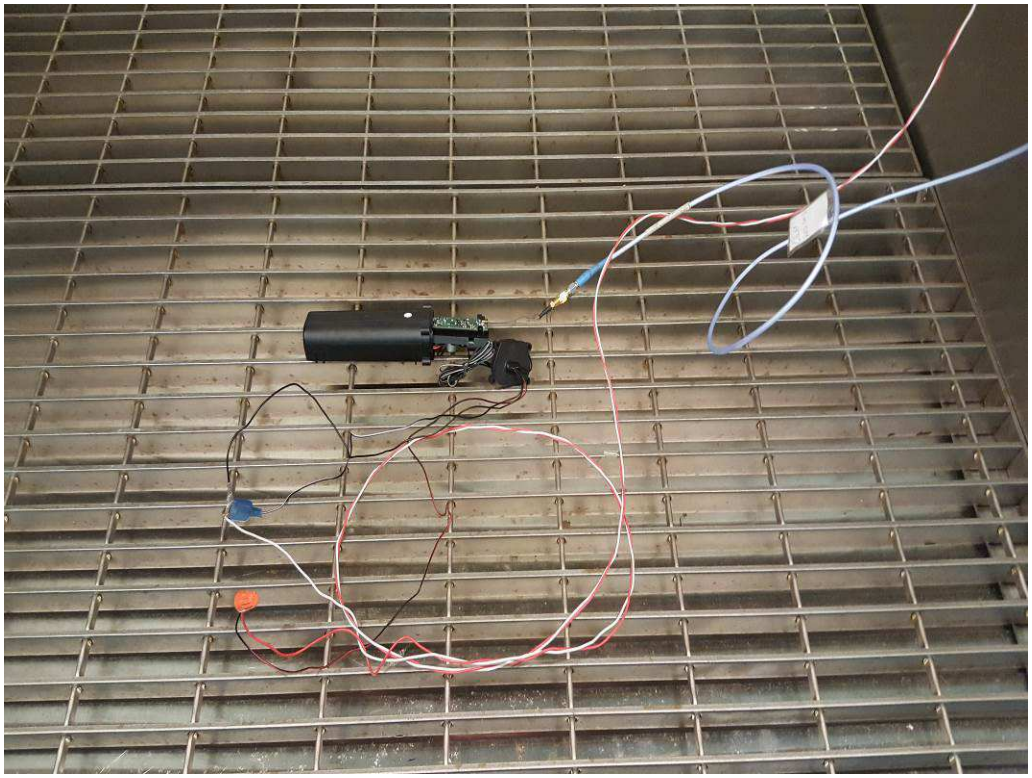
MINIMUM FREQUENCY STABILITY

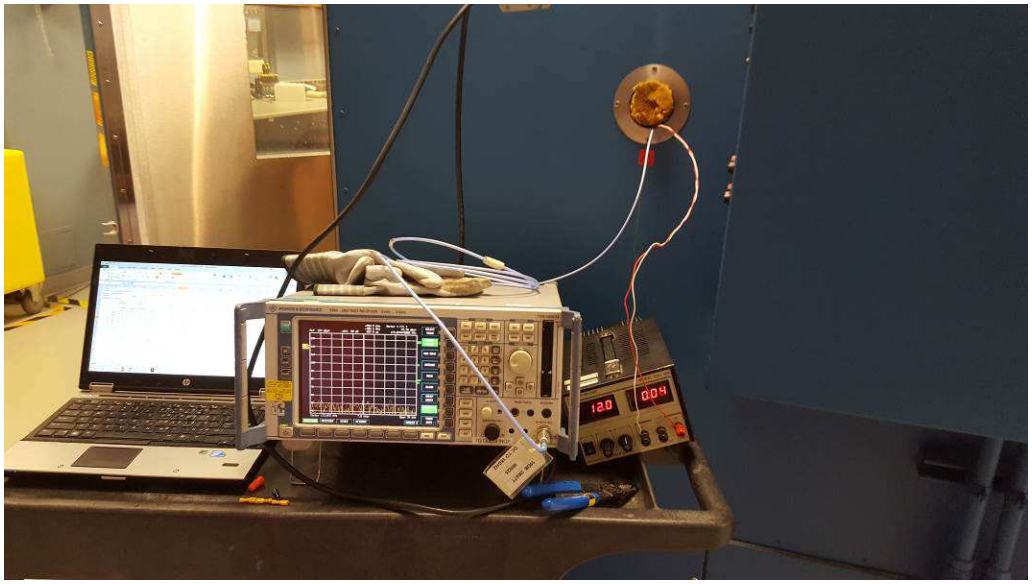
[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1][2][3]100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5][11]5	[6]5	[4][6]50
216-220	1.0		1.0
220-222[12]	0.1	1.5	1.5
421-512	[7][11][14]2.5	[8]5	[8]5
806-809	[14]1.0	1.5	1.5
809-824	[14]1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14]0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928[13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	[9]300	300	300
Above 2450[10]			

A limit of 5ppm was used for this device.

8.4 Setup Photographs:





8.5 Test Data:

Note: Device was set to transmit CW signal for this test, temperature was varied from -30C to +50C during the test.

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-30	173.075325	0.225	0.87
-20	173.075310	0.21	0.87
-10	173.075308	0.208	0.87
0	173.075450	0.35	0.87
10	173.075200	0.1	0.87
20	173.075100	0	0.87
30	173.075555	0.455	0.87
40	173.075750	0.65	0.87
50	173.075450	0.35	0.87

Note: Device was set to transmit CW signal for this test, test was performed using an external DC power supply, the below recorded values are at a temperature of 20C, no change in emission frequency beyond the specified limit was detected at other temperatures (-30C to 50C) with change in voltage.

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	10.2	173.075365	-0.285	0.87
-10%	10.8	173.075365	-0.285	0.87
-5%	11.4	173.075360	-0.29	0.87
+0%	12	173.075650	0	0.87
+5%	12.6	173.075600	-0.05	0.87
+10%	13.2	173.075600	-0.05	0.87
+15%	13.8	173.075650	0	0.87

Test Personnel: Steven Caruso S.C. | Test Date: 01/12/2018
Supervising/Reviewing Engineer: (Where Applicable) Naga Suryadevara N.S
Product Standard: FCC Part 90 | Limit Applied: See report section 8.3
Input Voltage: 12 VDC
Pretest Verification w/ Ambient Signals or BB Source: Yes – signal generator | Ambient Temperature: 21 ºC | Relative Humidity: 38 % | Atmospheric Pressure: 997 mbars

Deviations, Additions, or Exclusions: None

9 Transient Frequency Behavior

9.1 Method

Tests are performed in accordance with FCC Part 2.1055, FCC Part 90.214 and ANSI C 63.26.

TEST SITE: EMC Lab

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

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
CBLBNC20 12-3'	50 Ohm Coaxial Cable	Pomona	RG58C/U	CBLBNC2012-3	03/09/2017	03/09/2018
CBLBNC20 12-4	50 Ohm Coaxial Cable	Pomona	RG58C/U	CBLBCN2012-4	04/06/2017	04/06/2018
145-107	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/07/2017	11/07/2018
AGL005'	1GHz oscillscope	Agilent	DSO6104A	MY44008020	07/06/2017	07/06/2018
MIN23'	Attenuator 2 watt 20dB DC-26GHz	Mini Circuits	BW-S20-2W263+	MIN23	05/26/2017	05/26/2018
MIN25'	attenuator 2watt 10dB DC-18GHz	Mini Circuits	BW-S10W2+	MIN25	05/26/2017	05/26/2018
MIN003'	Splitter/Combiner 2-Way DC-2000 MHz	Mini Circuits	ZFRSC-2050	none	12/02/2003	Verified
MIN004'	Splitter/Combiner	Mini Circuits	ZFRSC-2050	none	12/02/2003	Verified
Ddetector'	Agilent 8473C detector	Agilent	8473C	None	VBU	Verified
HEW65'	Measuring Receiver	Hewlett Packard	8902A	3749A04397	01/21/2016	01/21/2018
CBLHF2012 -5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None		

9.3 Results:

The sample tested was found to comply.

Time intervals[1] [2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

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

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 1 kHz test signal starts to rise.

[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.

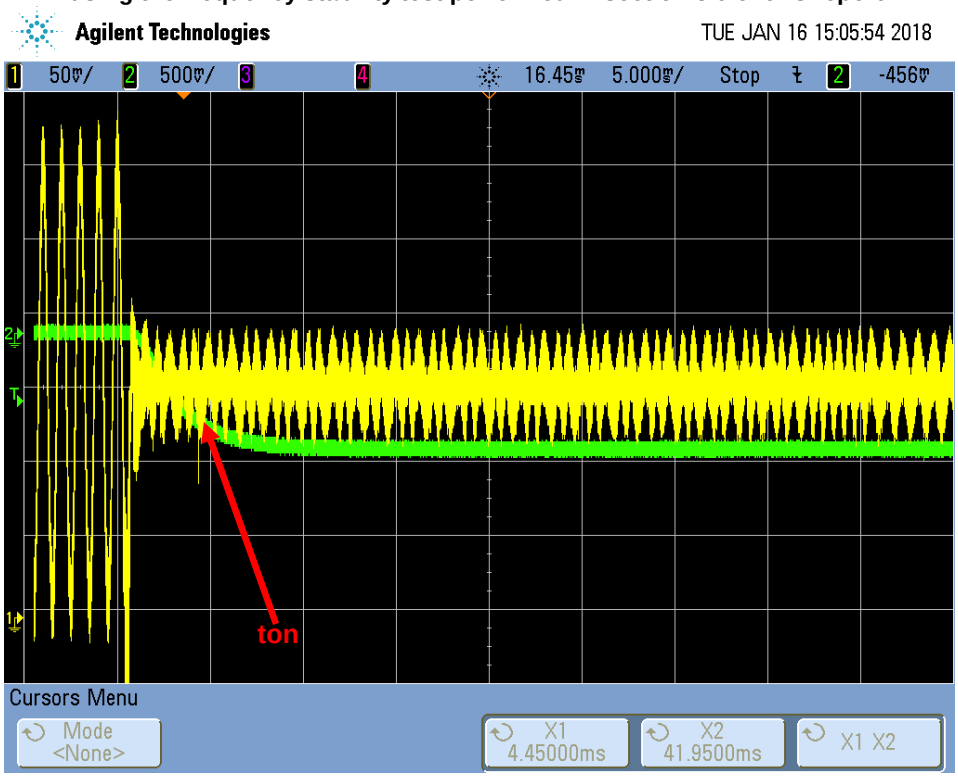
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.

[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

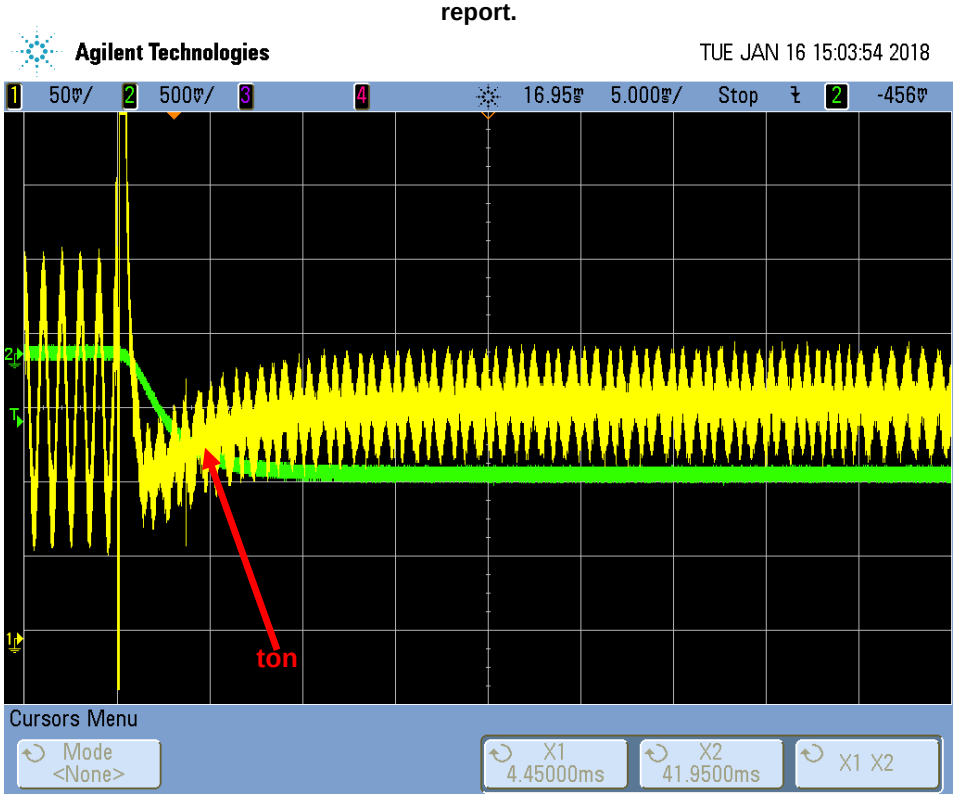
9.4 Setup Photograph:

9.5 Plots/Data:

Note: EUT was set to transmit CW signal, signal generator was set to FM deviation of 25 kHz. Before 'ton' the signal on the scope indicates the FM demodulated signal, 7 vertical units indicate 25 kHz. After ton the FM demodulated signal stays within 2 vertical units indicating an error of less than 7.5 kHz for 45 milliseconds after 'ton' on the oscilloscope. Transmitters with output power less than 6W are excluded from the requirements of t1 and t3, the allowed frequency error is 12.5 kHz for t2 (20msec) is higher than 7.5kHz (frequency error of the device). Compliance to the limit from the end of t2 to the beginning of t3 is shown using the frequency stability test performed in section 8.0 of this report.



Note: EUT was set to transmit CW signal, signal generator was set to FM deviation of 12.5 kHz. Before 'ton' the signal on the scope indicates the FM demodulated signal, 4 vertical units indicate 12.5 kHz. After ton the FM demodulated signal stays within 2 vertical units indicating an error of less than 6.25 kHz for 45 milliseconds after 'ton' on the oscilloscope which meets the requirement of the standard. Transmitters with output power less than 6W are excluded from the requirements of t1 and t3, the allowed frequency error is 6.25 kHz for t2 (20msec) which is higher than the frequency error the device. Compliance to the limit from the end of t2 to the beginning of t3 is shown using the frequency stability test performed in section 8.0 of this report.



Test Personnel:	Naga Suryadevara N.S	Test Date:	01/16/2018
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 90	Limit Applied:	As specified in section 9.3
Input Voltage:	12 VDC		
Pretest Verification w/ Ambient Signals or BB Source:	BB Source	Ambient Temperature:	20 ºC
		Relative Humidity:	10 %
		Atmospheric Pressure:	1009 mbars

Deviations, Additions, or Exclusions: None

10 Emission Mask

10.1 Method

Tests are performed in accordance with FCC Part 90.210 and ANSI C 63.26.

TEST SITE: EMC Lab

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

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/07/2017	11/07/2018
MIN24'	2 watt 10dB attenuator DC-18GHz	Mini Circuits	BW-S10W2+	MIN24	05/26/2017	05/26/2018
MIN25'	attenuator 2watt 10dB DC-18GHz	Mini Circuits	BW-S10W2+	MIN25	05/26/2017	05/26/2018

Software Utilized:

Name	Manufacturer	Version
None		

10.3 Results:

The sample tested was found to comply.

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25[1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174[2]	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512[2 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854[6]	B	H
809-824/854-869[3 5]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925[4]		
All other bands	B	C

Device doesn't have an audio lowpass filter. For wideband Mask C applies and for narrow band Mask D applies.

Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (f_d/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (f_d^2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(4) In the 1427-1432 MHz band, licensees are encouraged to take all reasonable steps to ensure that unwanted emissions power does not exceed the following levels in the 1400-1427 MHz band:

(i) For stations of point-to-point systems in the fixed service: −45 dBW/27 MHz.

(ii) For stations in the mobile service: −60 dBW/27 MHz.

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

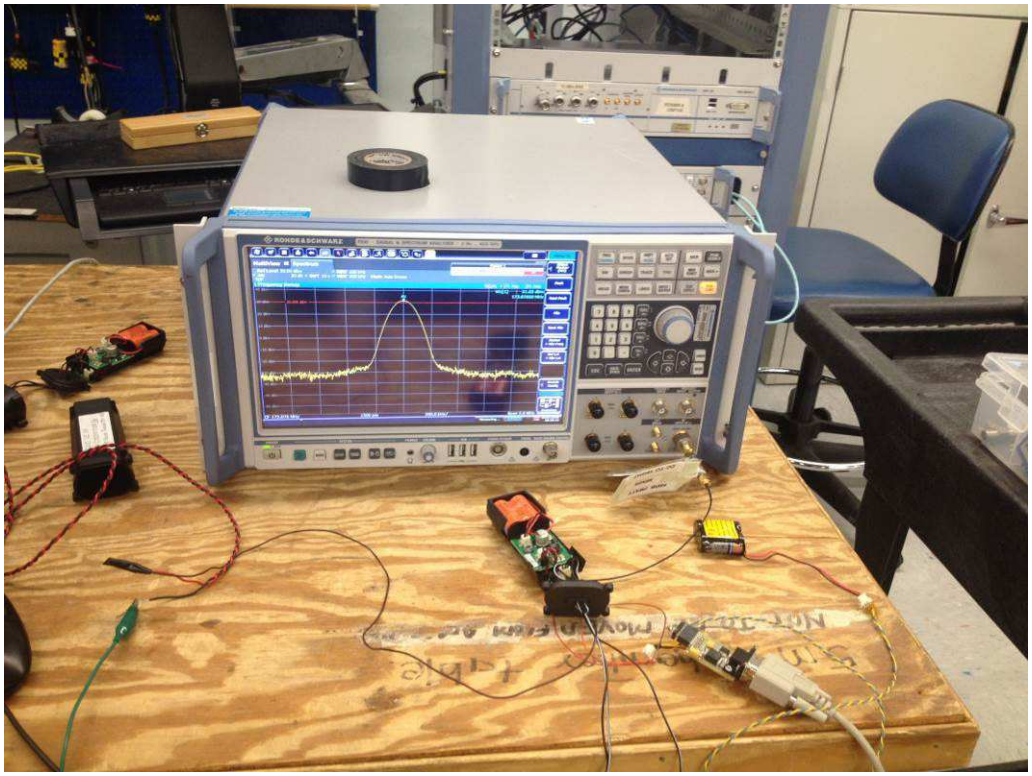
(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

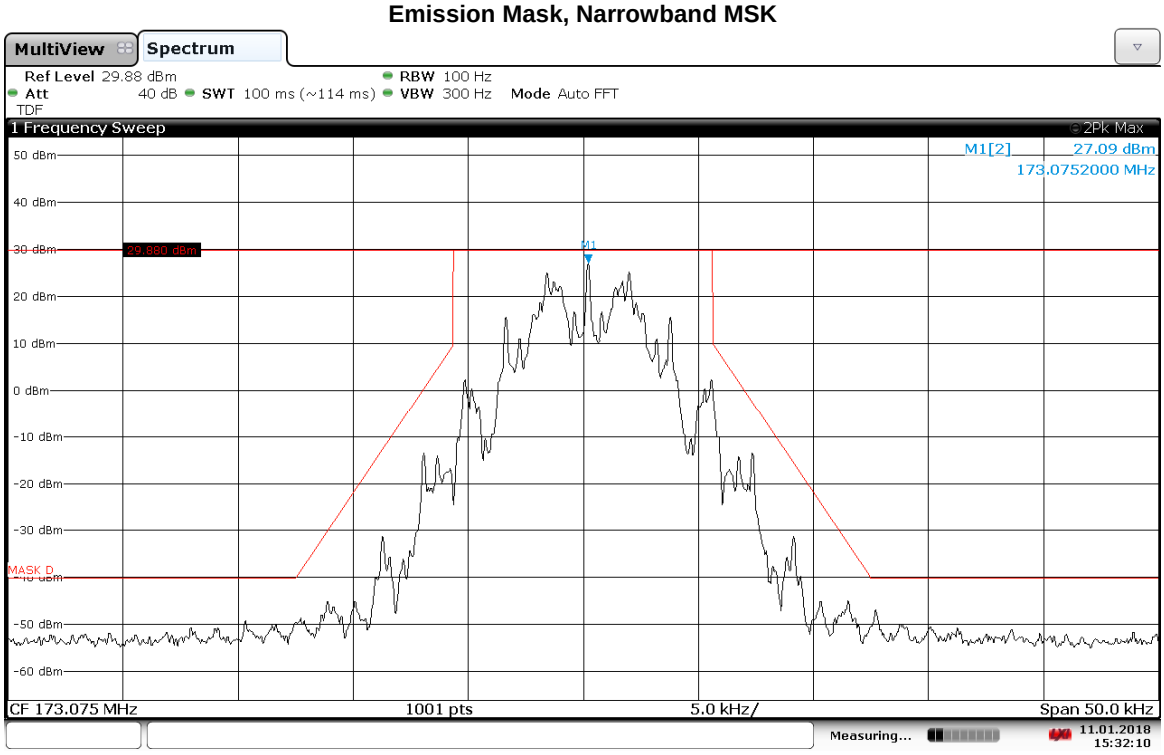
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

10.4 Setup Photograph:



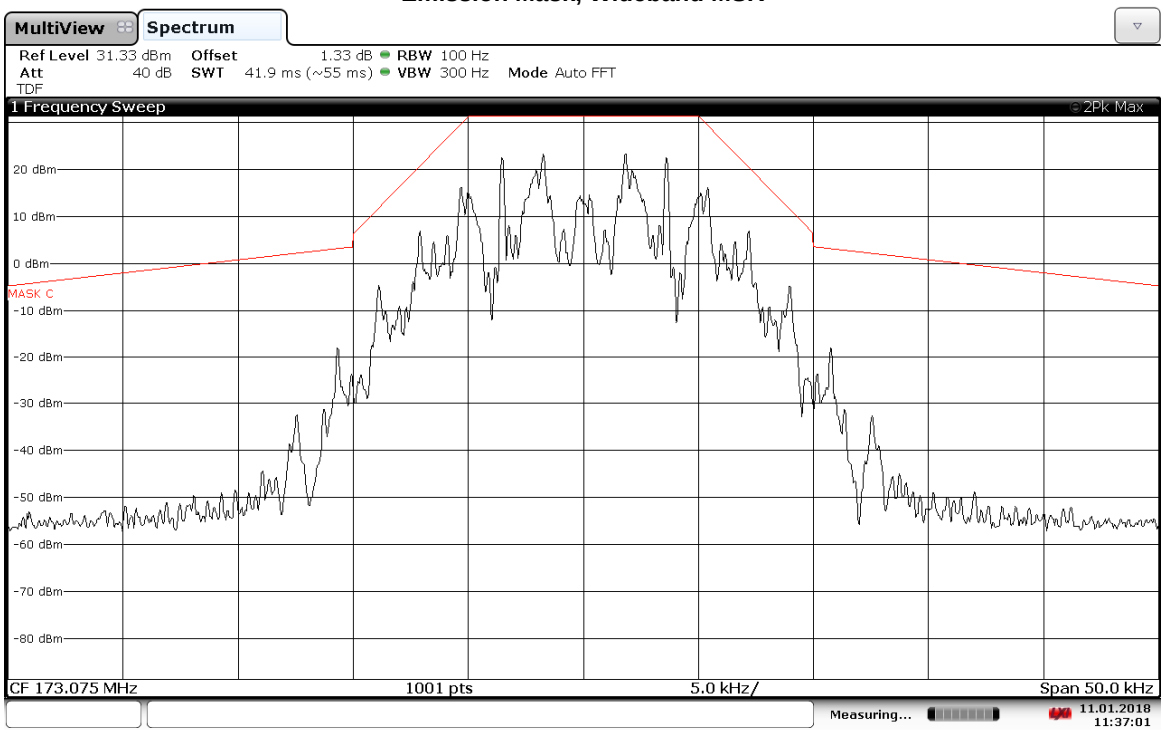
10.5 Plots/Data:

Emission Mask, Narrowband MSK



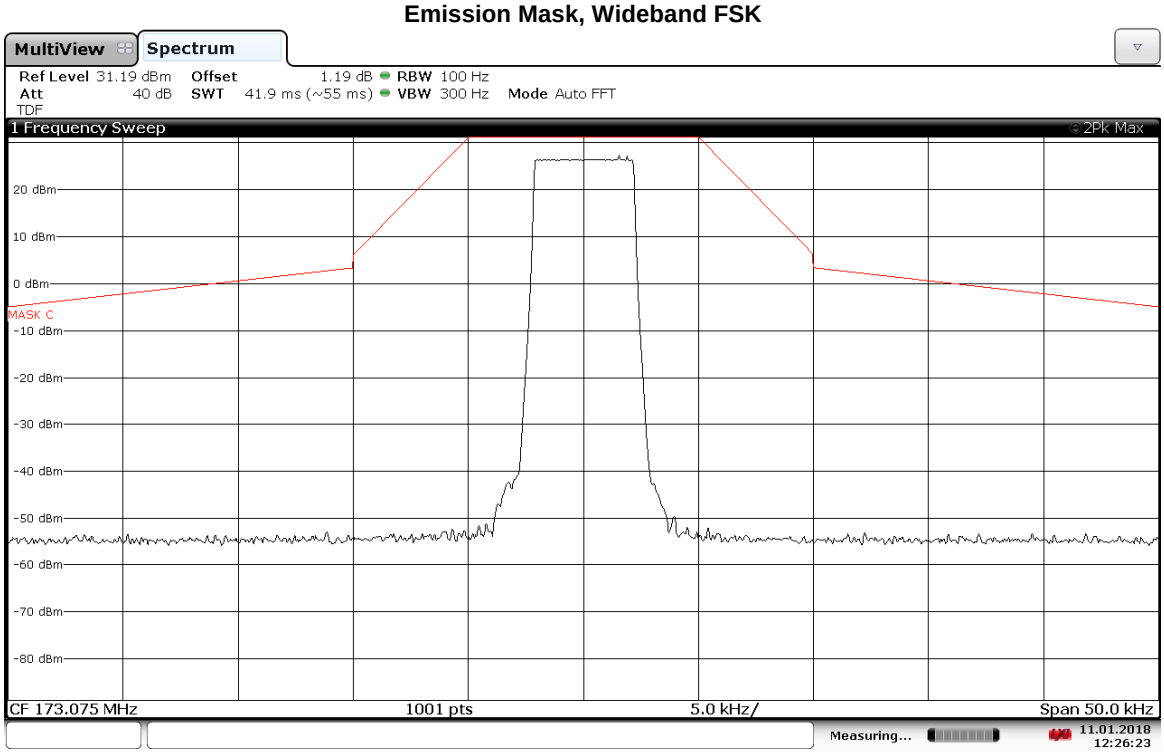
15:32:11 11.01.2018

Emission Mask, Wideband MSK



11:37:01 11.01.2018

Emission Mask, Wideband FSK



12:26:24 11.01.2018

Test Personnel:	Naga Suryadevara N.S	Test Date:	01/11/2018
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 90	Limit Applied:	As specified in section 10.3
Input Voltage:	12 VDC		
Pretest Verification w/ Ambient Signals or BB Source:	BB Source	Ambient Temperature:	22 ºC
		Relative Humidity:	09 %
		Atmospheric Pressure:	1003 mbars

Deviations, Additions, or Exclusions: None

11 Transmitter Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 2.1053, FCC Part 90.210 and ANSI C 63.26.

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 Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} 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 dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
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 dBµV 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 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 52.0 dBµV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBµV/m

To convert from dBµV to µV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in µV
NF = Net Reading in dBµV

Example:

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

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/15/2017	03/15/2018
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2017	07/25/2018
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	12/02/2017	12/02/2018
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/02/2017	05/02/2018
ANT1A'	BROADBAND ANTENNA	Compliance Design	B100	1649	01/12/2017	01/12/2018
ANT1B'	BROADBAND ANTENNA	Compliance Design	B200	1650	01/12/2017	01/12/2018
ROS007'	Signal generator 9kHz-6GHz	Rhode & Schwartz	SMB100A	106505	05/11/2017	05/11/2018
HORN2	HORN ANTENNA	EMCO	3115	9602-4675	03/03/2017	03/03/2018
CBLHF20'2-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
EMI Tables Program	Intertek Boxborough	08/27/2010

11.3 Results:

The sample tested was found to Comply.

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25[1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174[2]	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512[2 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854[6]	B	H
809-824/854-869[3 5]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925[4]		
All other bands	B	C

Device doesn't have an audio lowpass filter. For wideband Mask C applies and for narrow band Mask D applies.

Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (f_d/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (f_d^2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(4) In the 1427-1432 MHz band, licensees are encouraged to take all reasonable steps to ensure that unwanted emissions power does not exceed the following levels in the 1400-1427 MHz band:

(i) For stations of point-to-point systems in the fixed service: −45 dBW/27 MHz.

(ii) For stations in the mobile service: −60 dBW/27 MHz.

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

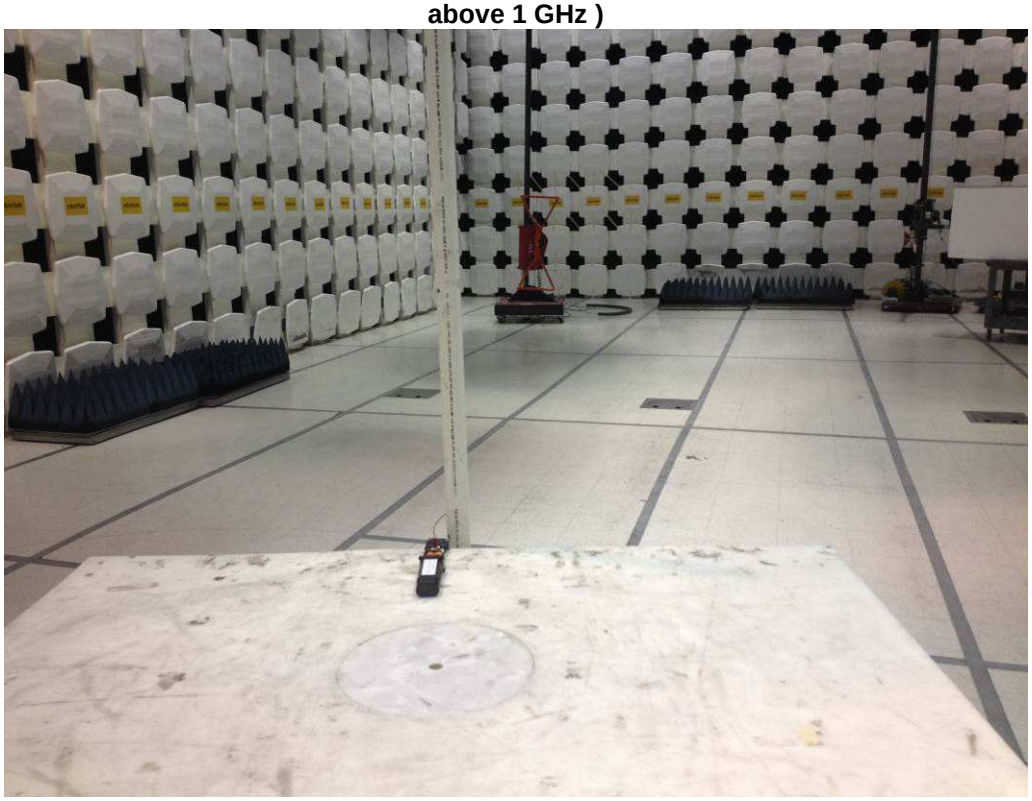
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

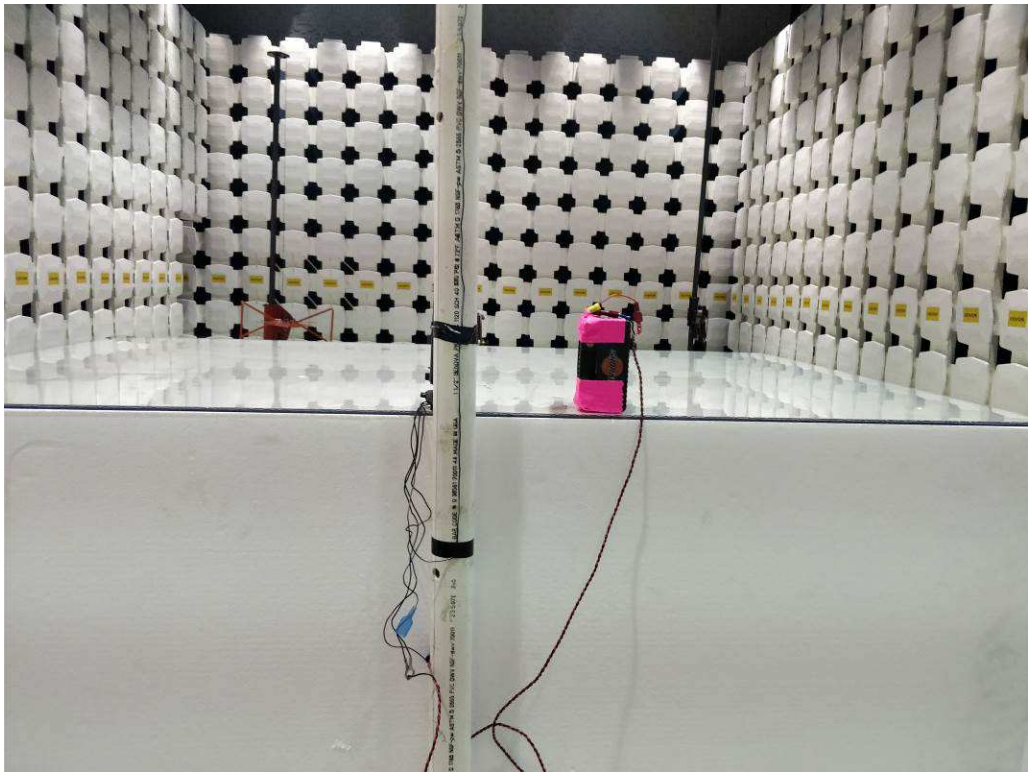
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

11.4 Setup Photographs:

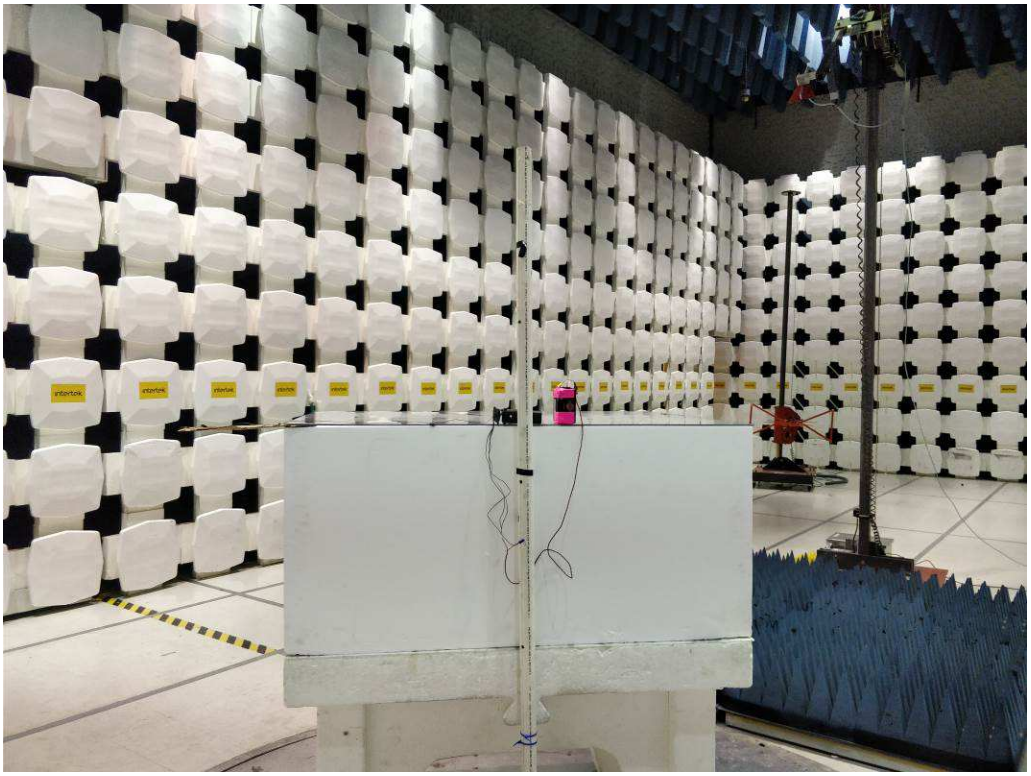
30-1000 MHz (Representative picture for setup, EUT axis was changed exactly similar to the setup above 1 GHz)



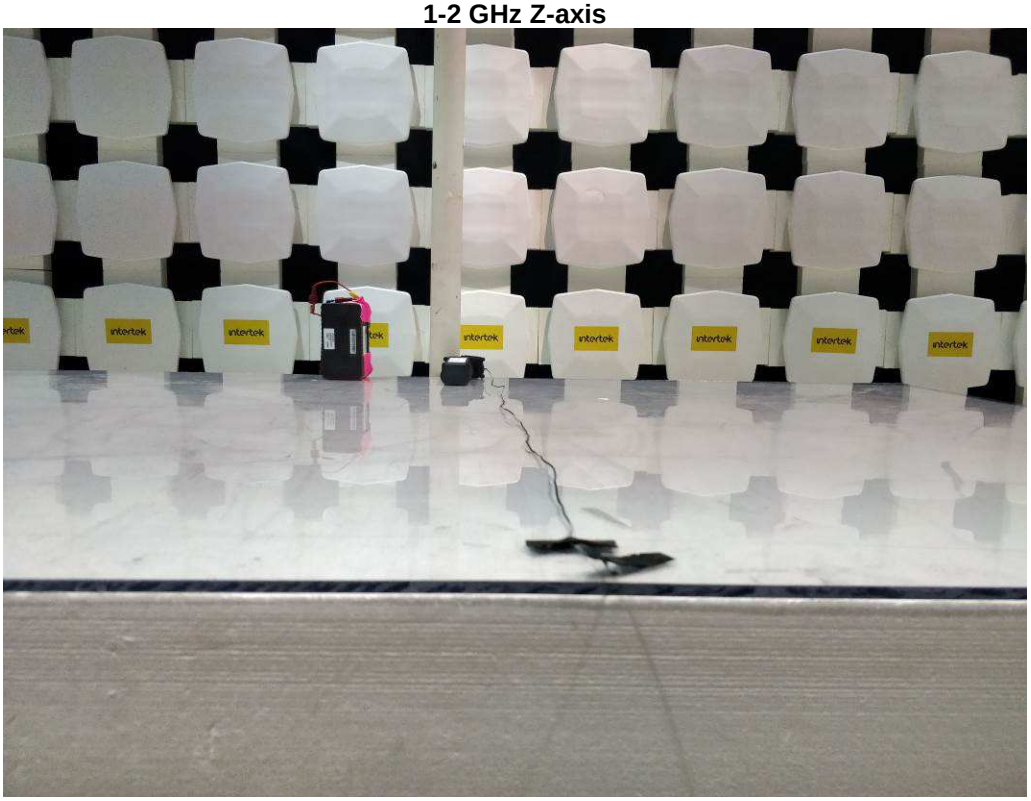
1-2 GHz X-axis



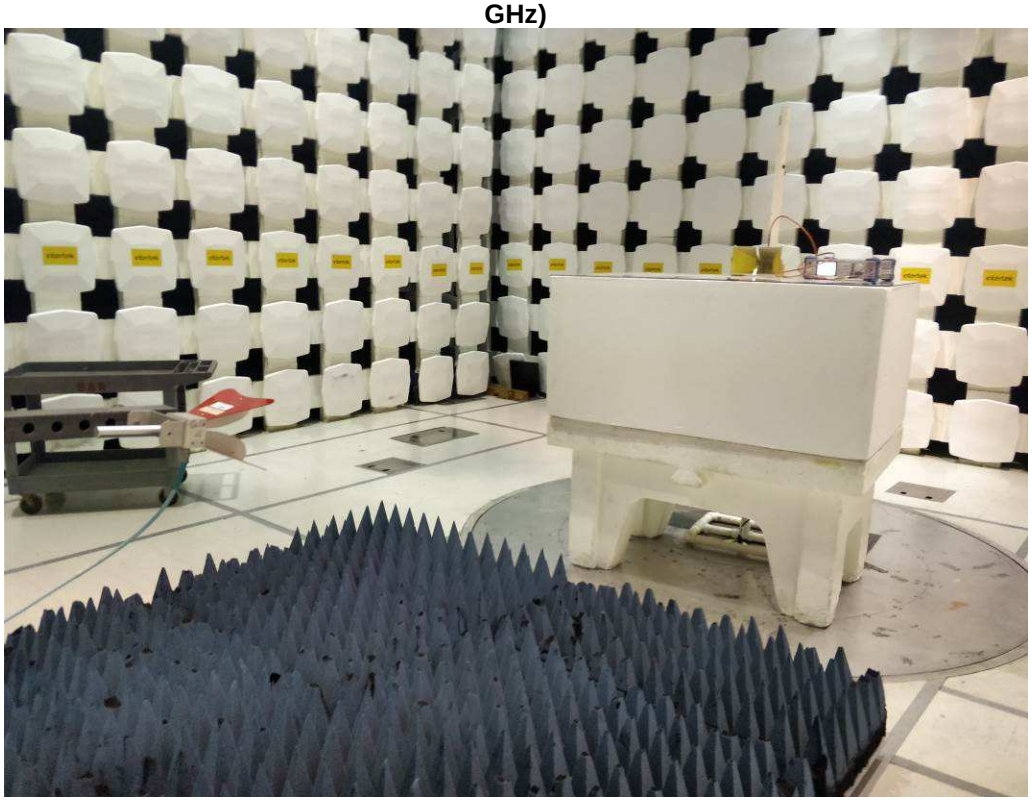
1-2 GHz Y-axis



1-2 GHz Z-axis



Representative picture for substitution setup (test setup was changed to 0.8m for test below 1 GHz)



11.5 Plots/Data:

30-1000 MHz MSK Modulation Wideband

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
MSK Modulation, Tx mode, X-axis											
PK	V	216.232	31.59	46.21	0.06	0.60	-20.00	-36.23	-13.00	-23.23	120/300 kHz
PK	V	346.150	13.26	41.31	0.06	-1.00	-20.00	-51.26	-13.00	-38.26	120/300 kHz
PK	V	519.225	15.55	42.37	0.06	1.50	-20.00	-47.53	-13.00	-34.53	120/300 kHz
PK	V	692.300	13.91	40.38	0.06	1.60	-20.00	-47.08	-13.00	-34.08	120/300 kHz
PK	V	865.375	13.61	37.91	0.06	0.10	-20.00	-46.41	-13.00	-33.41	120/300 kHz
MSK Modulation, Tx mode, Y-axis											
PK	V	216.232	27.35	46.21	0.06	0.60	-20.00	-40.47	-13.00	-27.47	120/300 kHz
PK	V	346.150	14.50	41.31	0.06	-1.00	-20.00	-50.02	-13.00	-37.02	120/300 kHz
PK	V	519.225	15.00	42.37	0.06	1.50	-20.00	-48.08	-13.00	-35.08	120/300 kHz
PK	V	692.300	17.10	40.38	0.06	1.60	-20.00	-43.89	-13.00	-30.89	120/300 kHz
PK	V	865.375	13.65	37.91	0.06	0.10	-20.00	-46.37	-13.00	-33.37	120/300 kHz
MSK Modulation, Tx mode, Z-axis											
PK	V	216.232	33.10	46.21	0.06	0.60	-20.00	-34.72	-13.00	-21.72	120/300 kHz
PK	V	346.150	13.78	41.31	0.06	-1.00	-20.00	-50.74	-13.00	-37.74	120/300 kHz
PK	V	519.225	18.20	42.37	0.06	1.50	-20.00	-44.88	-13.00	-31.88	120/300 kHz
PK	V	692.300	16.16	40.38	0.06	1.60	-20.00	-44.83	-13.00	-31.83	120/300 kHz
PK	V	865.375	13.84	37.91	0.06	0.10	-20.00	-46.18	-13.00	-33.18	120/300 kHz

30-1000 MHz FSK Modulation Wideband

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
FSK Modulation, Tx mode, X-axis											
PK	V	216.232	31.59	46.21	0.06	0.60	-20.00	-36.23	-13.00	-23.23	120/300 kHz
PK	V	346.150	16.90	41.31	0.06	-1.00	-20.00	-47.62	-13.00	-34.62	120/300 kHz
PK	V	519.225	15.55	42.37	0.06	1.50	-20.00	-47.53	-13.00	-34.53	120/300 kHz
PK	V	692.300	13.91	40.38	0.06	1.60	-20.00	-47.08	-13.00	-34.08	120/300 kHz
PK	V	865.375	13.61	37.91	0.06	0.10	-20.00	-46.41	-13.00	-33.41	120/300 kHz
FSK Modulation, Tx mode, Y-axis											
PK	V	216.232	27.18	46.21	0.06	0.60	-20.00	-40.64	-13.00	-27.64	120/300 kHz
PK	V	346.150	14.50	41.31	0.06	-1.00	-20.00	-50.02	-13.00	-37.02	120/300 kHz
PK	V	519.225	15.00	42.37	0.06	1.50	-20.00	-48.08	-13.00	-35.08	120/300 kHz
PK	V	692.300	17.10	40.38	0.06	1.60	-20.00	-43.89	-13.00	-30.89	120/300 kHz
PK	V	865.375	13.65	37.91	0.06	0.10	-20.00	-46.37	-13.00	-33.37	120/300 kHz
FSK Modulation, Tx mode, Z-axis											
PK	V	216.232	33.10	46.21	0.06	0.60	-20.00	-34.72	-13.00	-21.72	120/300 kHz
PK	V	346.150	13.78	41.31	0.06	-1.00	-20.00	-50.74	-13.00	-37.74	120/300 kHz
PK	V	519.225	18.20	42.37	0.06	1.50	-20.00	-44.88	-13.00	-31.88	120/300 kHz
PK	V	692.300	16.16	40.38	0.06	1.60	-20.00	-44.83	-13.00	-31.83	120/300 kHz
PK	V	865.375	13.84	37.91	0.06	0.10	-20.00	-46.18	-13.00	-33.18	120/300 kHz

30-1000 MHz MSK Modulation Narrowband

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
MSK Modulation, NB, Tx mode, X-axis											
PK	V	216.232	17.28	46.21	0.06	0.60	-20.00	-50.54	-20.00	-30.54	120/300 kHz
PK	V	346.150	13.26	41.31	0.06	-1.00	-20.00	-51.26	-20.00	-31.26	120/300 kHz
PK	V	519.225	15.55	42.37	0.06	1.50	-20.00	-47.53	-20.00	-27.53	120/300 kHz
PK	V	692.300	13.91	40.38	0.06	1.60	-20.00	-47.08	-20.00	-27.08	120/300 kHz
PK	V	865.375	13.61	37.91	0.06	0.10	-20.00	-46.41	-20.00	-26.41	120/300 kHz
MSK Modulation, NB, Tx mode, Y-axis											
PK	V	216.232	26.02	46.21	0.06	0.60	-20.00	-41.80	-20.00	-21.80	120/300 kHz
PK	V	346.150	12.90	41.31	0.06	-1.00	-20.00	-51.62	-20.00	-31.62	120/300 kHz
PK	V	519.225	15.37	42.37	0.06	1.50	-20.00	-47.71	-20.00	-27.71	120/300 kHz
PK	V	692.300	15.86	40.38	0.06	1.60	-20.00	-45.13	-20.00	-25.13	120/300 kHz
PK	V	865.375	14.47	37.91	0.06	0.10	-20.00	-45.55	-20.00	-25.55	120/300 kHz
MSK Modulation, NB, Tx mode, Z-axis											
PK	V	216.232	27.73	46.21	0.06	0.60	-20.00	-40.09	-20.00	-20.09	120/300 kHz
PK	V	346.150	13.78	41.31	0.06	-1.00	-20.00	-50.74	-20.00	-30.74	120/300 kHz
PK	V	519.225	15.57	42.37	0.06	1.50	-20.00	-47.51	-20.00	-27.51	120/300 kHz
PK	V	692.300	14.33	40.38	0.06	1.60	-20.00	-46.66	-20.00	-26.66	120/300 kHz
PK	V	865.375	13.84	37.91	0.06	0.10	-20.00	-46.18	-20.00	-26.18	120/300 kHz

1-2 GHz MSK Modulation Wideband

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
			X-Axis-MSK modulation 25 kHz bandwidth								
PK	V	1211.360	55.57	81.71	2.51	6.47	-20.00	-44.33	-13.00	-31.33	1/3 MHz
PK	V	1730.680	54.38	79.77	3.20	8.76	-20.00	-41.98	-13.00	-28.98	1/3 MHz
			Y-Axis-MSK modulation 25kHz bandwidth								
PK	H	1211.530	54.46	81.71	2.51	6.47	-20.00	-45.44	-13.00	-32.44	1/3 MHz
PK	H	2596.219	51.94	78.60	4.54	9.88	-20.00	-43.47	-13.00	-30.47	1/3 MHz
			Z-Axis-MSK modulation 25kHz bandwidth								
PK	H	1211.530	57.64	81.71	2.51	6.47	-20.00	-42.26	-13.00	-29.26	1/3 MHz
PK	H	2076.800	52.87	77.40	3.49	9.13	-20.00	-41.04	-13.00	-28.04	1/3 MHz

1-2 GHz FSK Modulation Wideband

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
			X-Axis-FSK modulation 25 kHz bandwidth								
PK	V	1211.360	51.42	81.71	2.51	6.47	-20.00	-48.48	-13.00	-35.48	1/3 MHz
PK	V	1730.680	52.22	79.77	3.20	8.76	-20.00	-44.14	-13.00	-31.14	1/3 MHz
			Y-Axis-FSK modulation 25kHz bandwidth								
PK	H	1211.530	55.31	81.71	2.51	6.47	-20.00	-44.59	-13.00	-31.59	1/3 MHz
PK	H	2596.219	53.78	78.60	4.54	9.88	-20.00	-41.63	-13.00	-28.63	1/3 MHz
			Z-Axis-MSK modulation 25kHz bandwidth								
PK	H	1211.530	53.78	81.71	2.51	6.47	-20.00	-46.12	-13.00	-33.12	1/3 MHz
PK	H	2076.800	51.99	77.40	3.49	9.13	-20.00	-41.92	-13.00	-28.92	1/3 MHz

1-2 GHz MSK Modulation Narrowband

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
			X-Axis-MSK modulation 12.5 kHz bandwidth								
PK	V	1211.360	47.42	81.71	2.51	6.47	-20.00	-52.48	-20.00	-32.48	1/3 MHz
PK	V	1730.680	49.19	79.77	3.20	8.76	-20.00	-47.17	-20.00	-27.17	1/3 MHz
			Y-Axis-MSK modulation 12.5kHz bandwidth								
PK	H	1211.530	49.78	81.71	2.51	6.47	-20.00	-50.12	-20.00	-30.12	1/3 MHz
PK	H	2596.219	50.22	78.60	4.54	9.88	-20.00	-45.19	-20.00	-25.19	1/3 MHz
			Z-Axis-MSK modulation 12.5kHz bandwidth								
PK	H	1211.530	50.10	81.71	2.51	6.47	-20.00	-49.80	-20.00	-29.80	1/3 MHz
PK	H	2076.800	49.19	77.40	3.49	9.13	-20.00	-44.72	-20.00	-24.72	1/3 MHz

Test Personnel: Naga Suryadevara N.S — Test Date: 01/10/2018

Vathana Ven VSV — 01/12/2018

Supervising/Reviewing Engineer: (Where Applicable) N/A

Product Standard: FCC Part 90 — Limit Applied: As specified in section 11.3

Input Voltage: 12 VDC

Pretest Verification w/ Ambient Signals or BB Source: BB Source — Ambient Temperature: 21, 21 ºC

Relative Humidity: 10, 38 %

Atmospheric Pressure: 1003, 997 mbars

Deviations, Additions, or Exclusions: None

12 Digital Device and Receiver Spurious Emissions

12.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B and ANSI C 63.4.

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 Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} 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 dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
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 dBµV 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 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 52.0 dBµV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBµV/m

To convert from dBµV to µV or mV the following was used:

UF = $10^{(NF / 20)}$ where UF = Net Reading in µV
NF = Net Reading in dBµV

Example:

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

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002	Weather Station	Davis Instruments	7400	PE80519A93	06/14/2017	06/14/2018
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/15/2017	03/15/2018
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2017	07/25/2018
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	12/02/2017	12/02/2018
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/02/2017	05/02/2018
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	06/03/2017	06/03/2018
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	02/13/2017	02/13/2018
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3

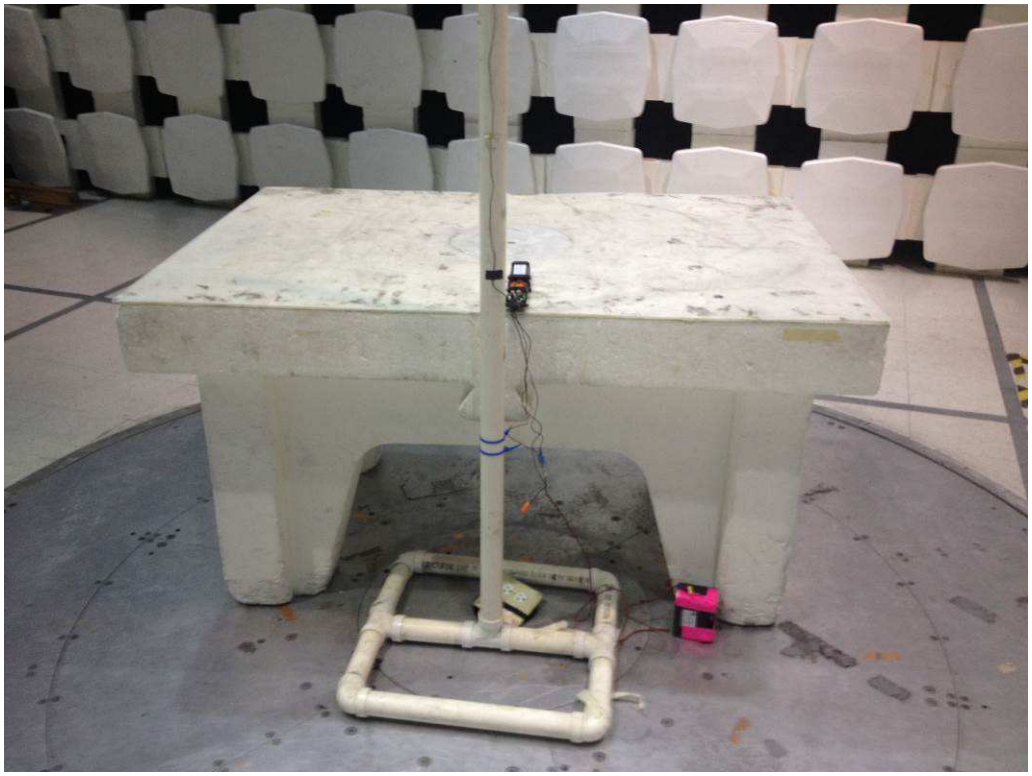
12.3 Results:

The sample tested was found to comply.

§15.109 (a) The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)
30-88	100
88-216	150
216-960	200
Above 960	500

12.4 Setup Photograph:



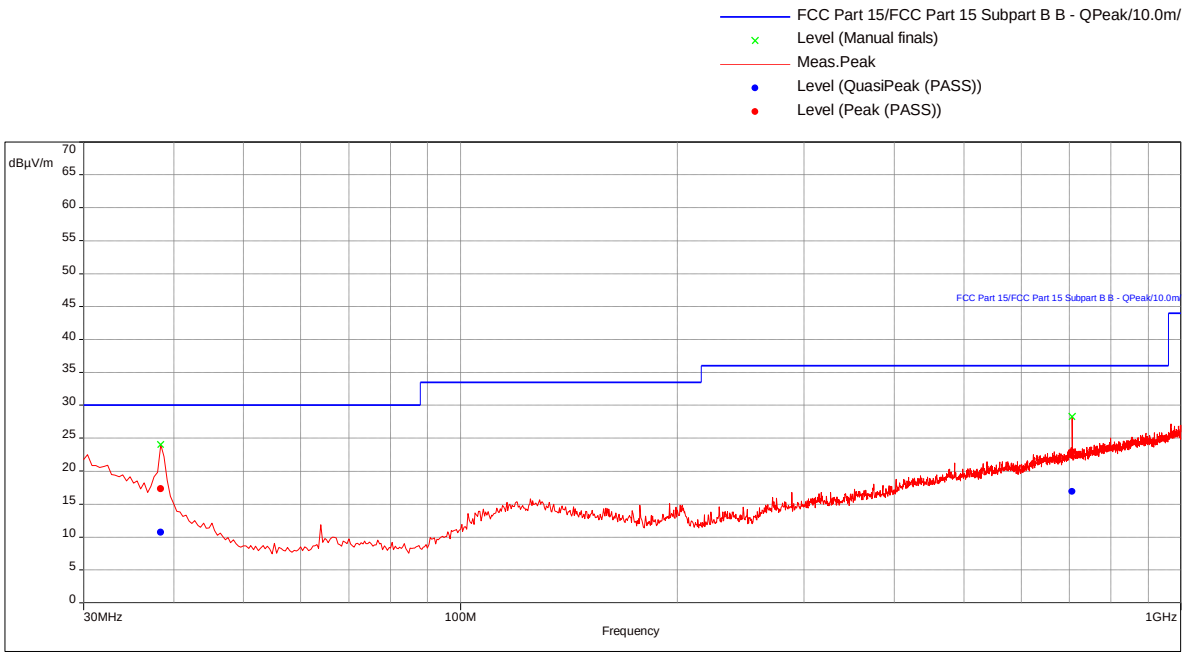
12.5 Plots/Data:

Rx mode 30-1000 MHz

Test Information:

Date and Time	1/12/2018 7:28:36 PM
Client and Project Number	LoJack_G103364832
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	38%
Atmospheric Pressure	997' mB
Comments	RE 30-1000MHz_Rx mode

Graph:



Results:

QuasiPeak (PASS) (2)

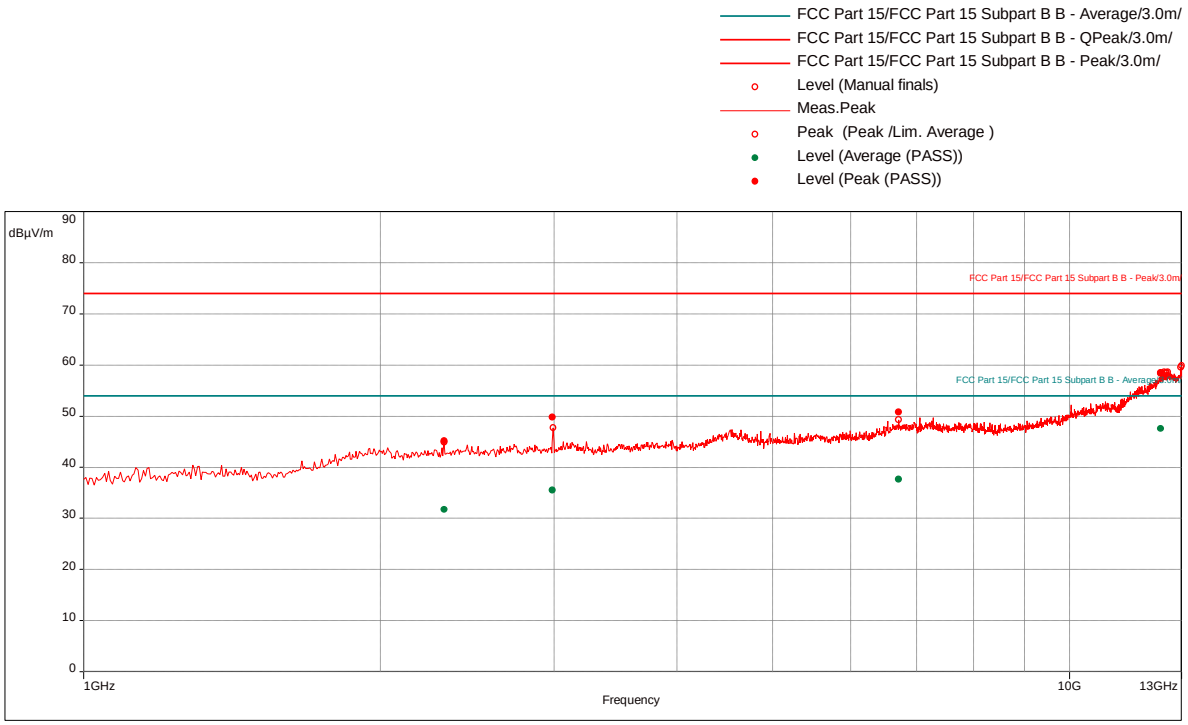
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
38.30526316	10.73	30.00	-19.27	126.00	2.50	Vertical	120000.00	-28.74
706.4	16.89	36.00	-19.11	24.00	1.39	Vertical	120000.00	-19.35

Rx mode 1-13 GHz (Device also has Bluetooth and it was considered the highest operating receiver in the device, hence test was performed up to 13 GHz)

Test Information:

Date and Time	1/9/2018 10:04:04 PM
Client and Project Number	LoJack_G103364832
Engineer	Vathana Ven
Temperature	20 deg C
Humidity	16%
Atmospheric Pressure	1011 mB
Comments	RE 1 to 13 GHz_12VDC_Rx mode

Graph:



Results:

Peak (PASS) (4)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
2319.736842	45.22	74.00	-28.78	197.00	3.01	Vertical	1000000.00	4.99
2992.368421	49.83	74.00	-24.17	120.00	1.92	Vertical	1000000.00	6.01
6714.210526	50.83	74.00	-23.17	147.00	3.34	Vertical	1000000.00	11.59
12372.89474	58.51	74.00	-15.49	63.00	1.99	Vertical	1000000.00	22.35

Average (PASS) (4)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
2319.736842	31.70	54.00	-22.30	197.00	3.01	Vertical	1000000.00	4.99
2992.368421	35.50	54.00	-18.50	120.00	1.92	Vertical	1000000.00	6.01
6714.210526	37.61	54.00	-16.39	147.00	3.34	Vertical	1000000.00	11.59
12372.89474	47.53	54.00	-6.47	63.00	1.99	Vertical	1000000.00	22.35

Test Personnel:	Vathana Ven VSV	Test Date:	01/09/2017 01/12/2018
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B	Limit Applied:	As specified in section 11.3
Input Voltage:	12 VDC		
Pretest Verification w/ Ambient Signals or BB Source:	BB Source	Ambient Temperature:	20, 21 ºC
		Relative Humidity:	16, 38 %
		Atmospheric Pressure:	1011, 997 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	01/31/2018	103364832BOX-006	NS	KPS KPS	Original Issue