



FCC PART 80
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MEASUREMENT AND TEST REPORT

TEST REPORT

For

Garmin International Inc

1200 E. 151st Street, Olathe, KS 66062

FCC ID:IPH-01653
IC: 1792A-01653

Report Type: Original Report	Product Type: Marine VHF Radio
Report Number: RDG160623001	
Report Date: 2016-08-02	
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.(Dongguan). This report may contain data or test methods that are not covered by the NVLAP accreditation scope and shall be marked with an asterisk "*" and noted.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Garmin International Inc*'s product, model number: *A01653(FCC ID: IPH-01653, IC:1792A-01653)* or the "EUT" in this report was a *Marine VHF Radio*, which was measured approximately: 170.mm (L) × 146 mm (W) × 85 mm (H), rated with input voltage: DC 12 V.

** All measurement and test data in this report was gathered from production sample serial number: 160623001 (Assigned by BACL, Dongguan). The EUT supplied by the applicant was received on 2016-06-23.*

Objective

This test report is prepared on behalf of *Garmin International Inc* in accordance with Part 2 and Part 80 of the Federal Communication Commissions rules and in accordance with RSS-182 of the Industry Canada.

Related Submittal(s)/Grant(s)

No related submittal(s)

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the ISED RSS-182 and the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 80 –Stations in the Maritime Services Applicable Standards: TIA 603-D.

Applicable Standards: RSS-182, Issue5 January 2012. Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 156-162.5 MHz.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	$\pm 5\%$
RF output power, conducted	$\pm 0.61\text{dB}$
Unwanted Emissions, conducted	$\pm 2.47\text{dB}$
Frequency Error	$\pm 3\text{kHz}$
All emissions, radiated	$\pm 3.62\text{dB}$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 0.4\%$
Time	1%

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communications Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

Equipment Modifications

No modification was made to the EUT tested.

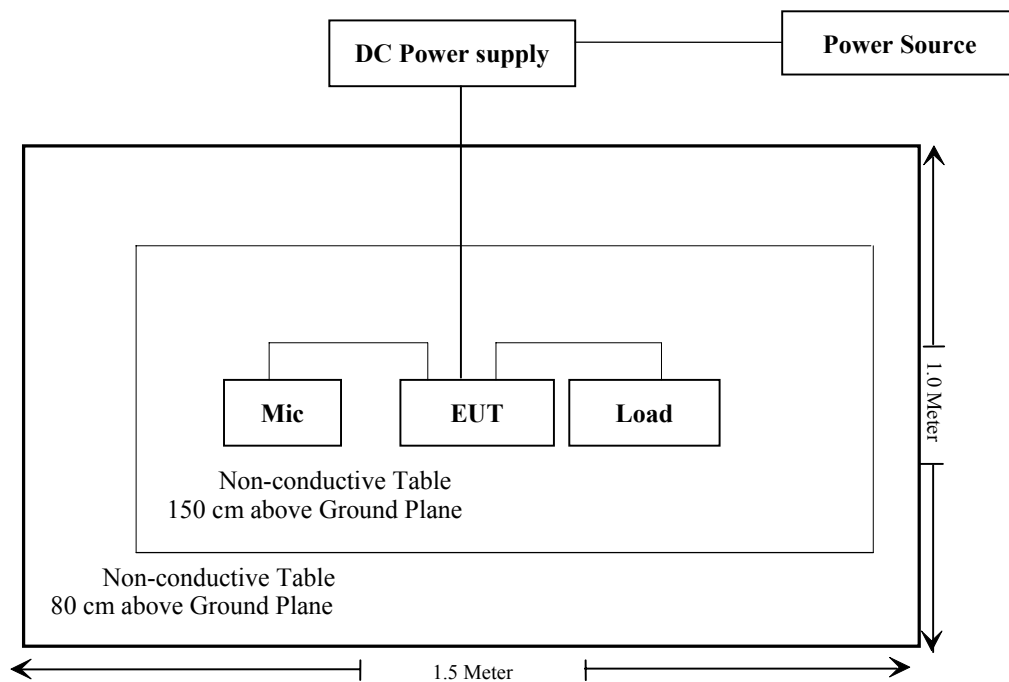
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Pro instrument	DC Power Supply	pps3300	N/A

External I/O Cable

Cable Description	Length (m)	From/Port	To
Shielded Detachable RF Cable	0.5	EUT Transmitter port	Load
Un-shielded Detachable DC Power Cable	3.0	DC Power Supply	EUT
Un-shielded Detachable AC Power Cable	2.0	Power Source	DC Power Supply

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
FCC Part §1.1307 (b)(1), §2.1091;RSS-102	Maximum Permissible Exposure (MPE)	Compliance
FCC Part §2.1046,§80.215; RSS-182 § 7.5	RF Output Power	Compliance
FCC Part §2.1047,§80.213; RSS-182 § 7.3,7.8	Modulation requirements	Compliance
FCC Part §2.1049,§80.205; RSS-182 § 7.3	Bandwidth	Compliance
FCC Part §2.1051,§80.211 RSS-182 § 7.9	Emission limitations	Compliance
FCC Part §80.217	Suppression of Interference Aboard Ships	Compliance
FCC Part §2.1051,§80.211; RSS-182 § 7.9	Radiated Spurious Emissions	Compliance
FCC Part §2.1055,§80.209; RSS-182 § 7.4	Transmitter Frequency Tolerances	Compliance
RSS-182 § 7.11; RSS-Gen §7	Receiver Spurious Emissions	Compliance

Test time: 2016.07.04~2016.08.02

FCC§1.1307 (b) (1) & §2.1091& RSS-102 - MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

According to RSS-102:

**Table 4: RF Field Strength Limits for Devices Used by the General Public
(Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

Table 6: RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²³	170	180	-	Instantaneous*
0.1-10	-	1.6/ f	-	6**
1.29-10	193/ $f^{0.5}$	-	-	6**
10-20	61.4	0.163	10	6
20-48	129.8/ $f^{0.25}$	0.3444/ $f^{0.25}$	44.72/ $f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	15.60 $f^{0.25}$	0.04138 $f^{0.25}$	0.6455 $f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/ $f^{1.2}$
150000-300000	0.354 $f^{0.5}$	9.40 x 10 ⁻⁴ $f^{0.5}$	3.33 x 10 ⁻⁴ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

Result**Calculated Formulary:**

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm² for FCC, and W/m² for IC)

P = power input to the antenna (in appropriate units, e.g., mW for FCC, and W for IC).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm for FCC, and m for IC)

For FCC calculation:

Frequency (MHz)	Antenna Gain		Rated Power (W)	The minimum Distance (cm)	MPE Limit (mW/cm ²)	Note
	(dBi)	(numeric)				
156.8	6	3.98	25	89	1.0	Controlled Environment
156.8	6	3.98	25	199	0.2	UnControlled Environment

For IC calculation:

Frequency (MHz)	Antenna Gain		Rated Power (W)	The minimum Distance (m)	MPE Limit (W/m ²)	Note
	(dBi)	(numeric)				
156.8	6	3.98	25	0.99	8.083	Controlled Environment
156.8	6	3.98	25	2.48	1.291	UnControlled Environment

Note: The Maximum power is 25 W which declared by manufacture

Radiation Exposure Statement:

To comply with RF exposure requirements, the minimum permissible distance is 2.48 m required between the antenna and the body of the user or nearby persons.

Result: Compliance

FCC §2.1046 & §80.215 & RSS-182 - RF OUTPUT POWER

Applicable Standard

FCC §2.1046, §80.215 and RSS-182, Issue 5 §7.5

Ship station limit: 25W

Test Procedure

Conducted RF Output Power:

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer Setting:

R B/W	Video B/W
100 kHz	300 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Weinschel Corp	Attenuator(30dB)	53-30-34	LN839	2016-05-07	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-05	2017-05-04
HP	RF Communications Test Set	8920A	00 235	2015-07-18	2016-07-17

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	100.0~101.0 kPa

The testing was performed by Gavin Xu on 2016-07-03.

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table.

Output power for Radio telephony:

Frequency	Power Level	Output Power (dBm)	Output Power (W)
156.025	High	43.24	21.09
	Low	28.58	0.72
156.8	High	43.34	21.58
	Low	28.64	0.73
157.425	High	43.40	21.88
	Low	28.69	0.74

Output power for DSC:

Frequency	Test Mode	Power Level	Output Power (dBm)	Output Power (W)
156.525	1300 Hz	High	43.41	21.93
		Low	28.64	0.73
	2100 Hz	High	43.35	21.63
		Low	28.71	0.74

Note: Ship station limit (25W)

FCC §2.1047 §80.213 & RSS-182 - MODULATION REQUIREMENTS**Applicable Standard**

FCC §2.1047 and §80.213 §RSS-182, Issue 5 §7.3, §7.8

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
HP	RF Communications Test Set	8920A	00 235	2016-7-11	2017-7-11
Weinschel Corp	Attenuator(30dB)	53-30-34	LN839	2016-05-07	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-05	2017-05-04

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Test Method: TIA/EIA-603 2.2.3

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Xu on 2016-07-04.

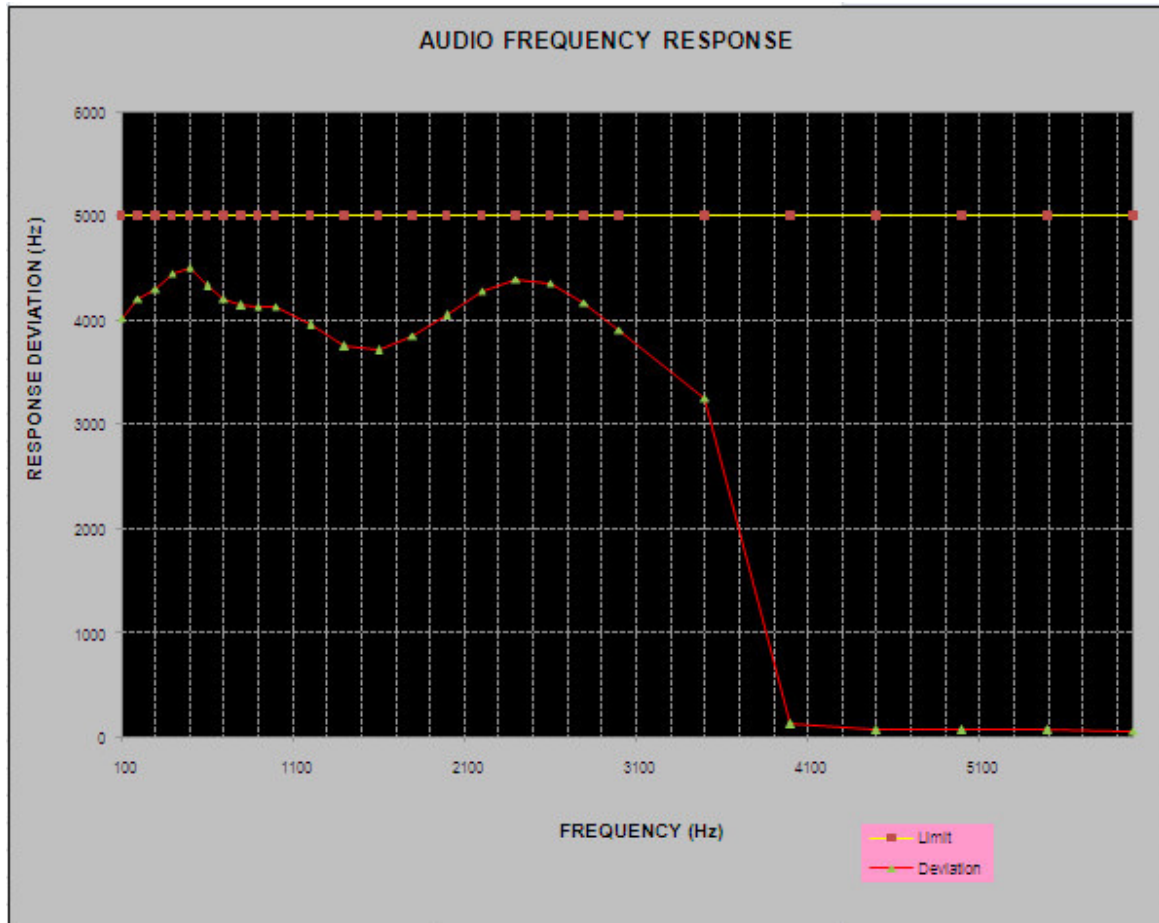
Test Mode: Transmitting

Result: Compliance.

Analog Modulation:**Maximum Deviation**

Carrier Frequency: 156.8 MHz

Modulation Frequency (Hz)	Maximum Deviation (Hz)	Limit (Hz)
100	4019	5000
200	4211	5000
300	4305	5000
400	4453	5000
500	4502	5000
600	4331	5000
700	4202	5000
800	4144	5000
900	4137	5000
1000	4128	5000
1200	3955	5000
1400	3753	5000
1600	3713	5000
1800	3855	5000
2000	4051	5000
2200	4283	5000
2400	4398	5000
2600	4357	5000
2800	4174	5000
3000	3906	5000
3500	3256	5000
4000	127	5000
4500	75	5000
5000	72	5000
5500	68	5000
6000	61	5000



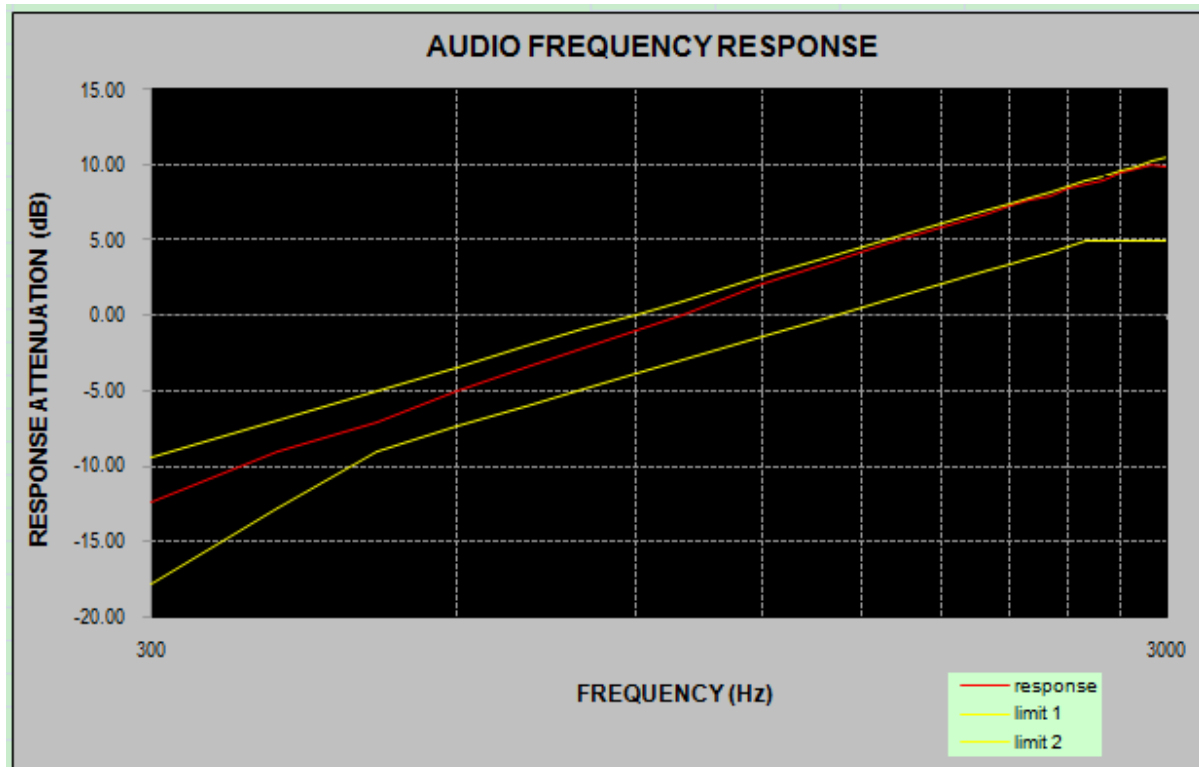
Carrier Frequency: 156.525 MHz, For DSC

Test Mode	Frequency Deviation(kHz)
1300Hz	2.607
2100Hz	4.207

Audio Frequency Response

Carrier Frequency: 156.8 MHz

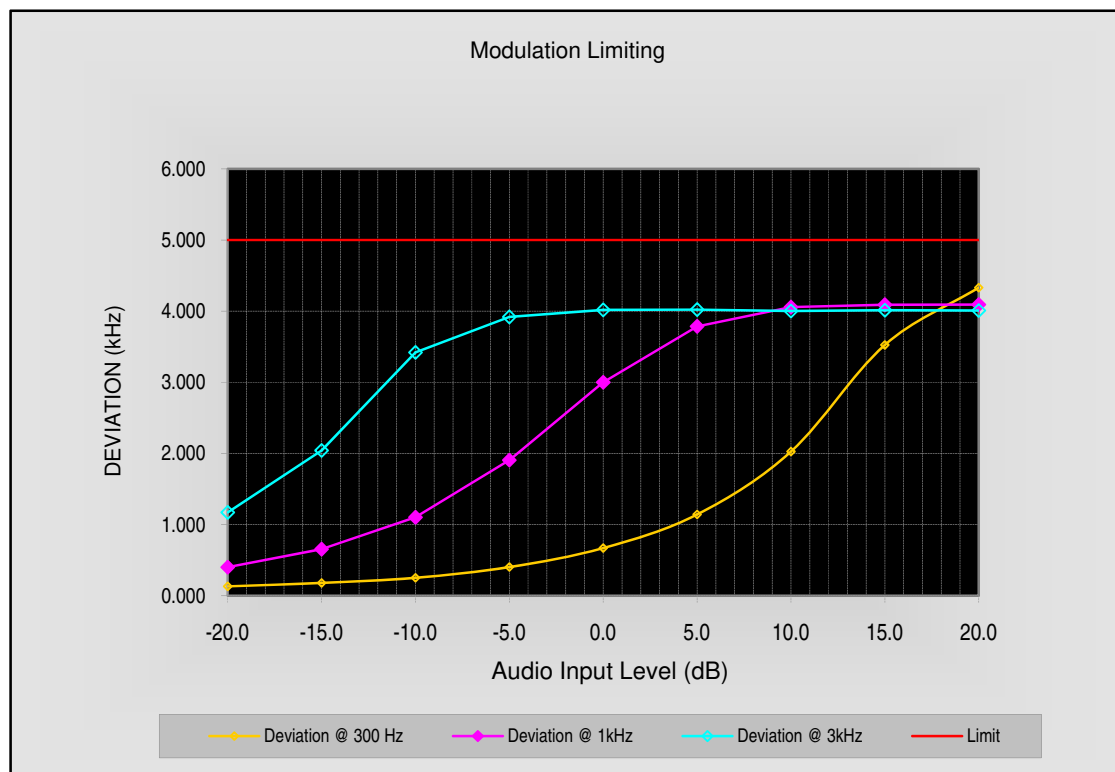
Modulation Frequency (kHz)	Response data (dB)
300	-12.43
400	-9.07
500	-7.09
600	-5.01
700	-3.41
800	-2.14
900	-0.99
1000	0
1200	2.04
1400	3.50
1600	4.78
1800	5.81
2000	6.76
2100	7.26
2200	7.61
2300	7.96
2400	8.39
2500	8.65
2600	9.03
2700	9.49
2800	9.75
2900	9.97
3000	9.86



MODULATION LIMITING

Carrier Frequency: 156.8 MHz

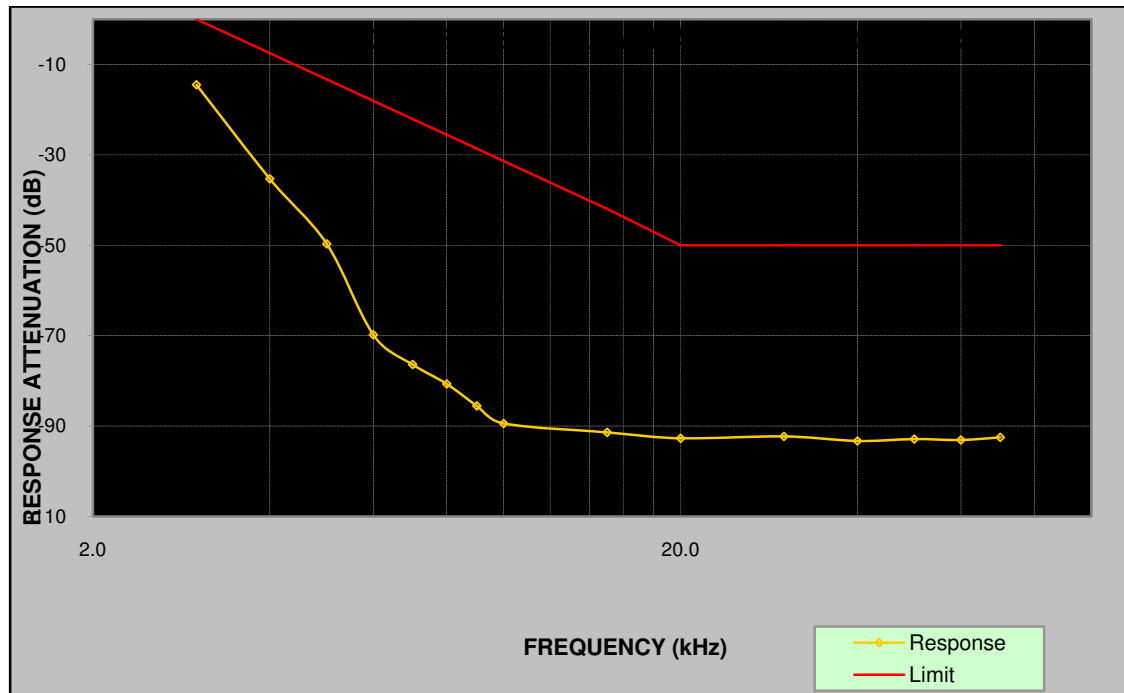
Audio Input Level [dB]	Frequency Deviation (kHz)			Limit [kHz]
	@ 300 Hz	@ 1kHz	@ 3 kHz	
20.0	4.331	4.091	4.009	5.0
15.0	3.526	4.089	4.013	5.0
10.0	2.027	4.056	4.003	5.0
5.0	1.142	3.785	4.021	5.0
0.0	0.671	3.000	4.017	5.0
-5.0	0.403	1.907	3.918	5.0
-10.0	0.252	1.103	3.421	5.0
-15.0	0.181	0.654	2.041	5.0
-20.0	0.132	0.402	1.171	5.0



Audio Frequency Low Pass Filter Response

Carrier Frequency: 156.8 MHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-14.5	0
4.0	-35.3	-7.5
5.0	-49.7	-13.3
6.0	-69.8	-18.1
7.0	-76.4	-22.1
8.0	-80.7	-25.6
9.0	-85.6	-28.6
10.0	-89.4	-31.4
15.0	-91.4	-41.9
20.0	-92.7	-50.0
30.0	-92.3	-50.0
40.0	-93.3	-50.0
50.0	-92.9	-50.0
60.0	-93.1	-50.0
70.0	-92.5	-50.0



FCC §2.1049 & §80.205 & RSS-182 –BANDWIDTH

Applicable Standard

FCC §2.1049 and §80.205, RSS-182 §7.3

(a) An emission designator shows the necessary bandwidth for each class of emission of a station except that in ship earth stations it shows the occupied or necessary bandwidth, whichever is greater. The class of emission and corresponding emission designator and authorized bandwidth can refer to §80.205

(b) For land stations the maximum authorized frequency deviation for F3E or G3E emission is as follows:

(1) 5 kHz in the 72.0-73.0 MHz, 75.4-76.0 MHz and 156-162 MHz bands;

(2) 15 kHz for stations which were authorized for operation before December 1, 1961, in the 73.0-74.6 MHz band.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band ± 30 kHz from the carrier frequency.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
R&S	Spectrum Analyzer	FSEM	DE23437	2015-11-23	2016-11-22
HP	RF Communications Test Set	8920A	00 235	2015-07-11	2016-07-10
HP	RF Communications Test Set	8920A	00 235	2016-07-11	2017-07-11
Weinschel Corp	Attenuator(30dB)	53-30-34	LN839	2016-05-07	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-05	2017-05-04

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

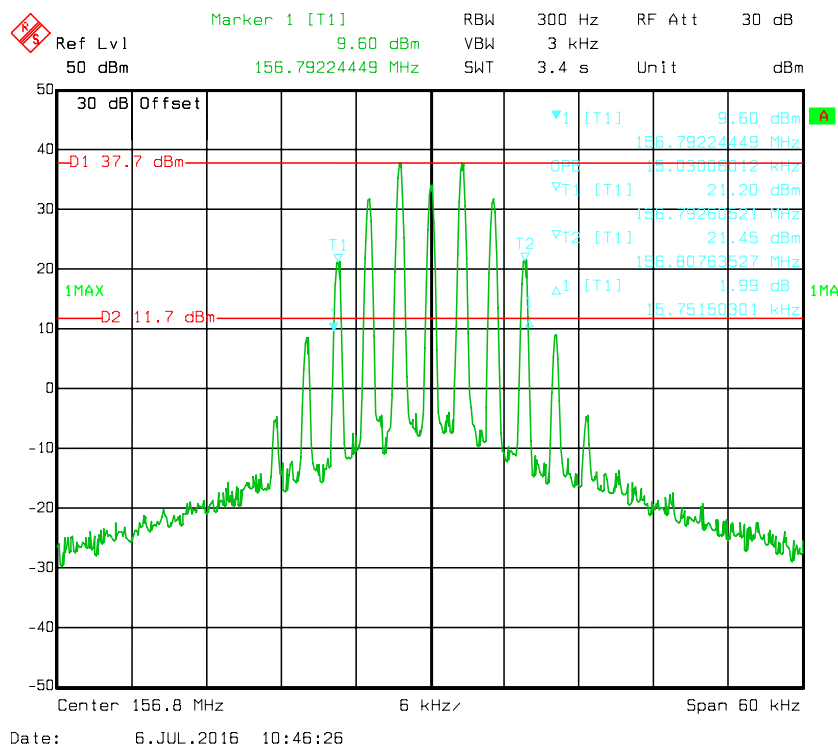
Test Data**Environmental Conditions**

Temperature:	28-30 °C
Relative Humidity:	43-49 %
ATM Pressure:	100.3-101.0 kPa

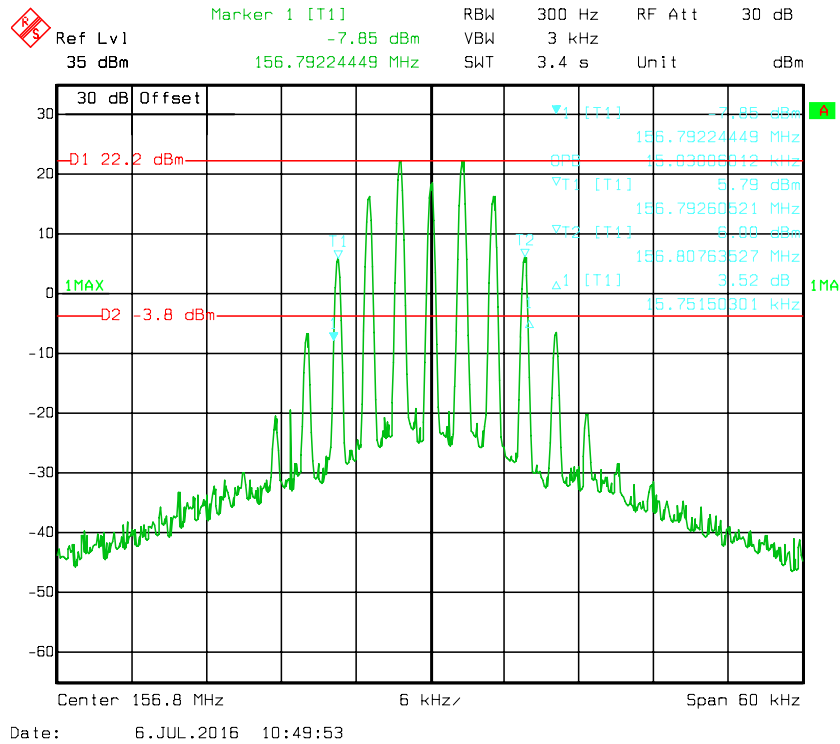
The testing was performed by Gavin Xu from 2016-07-06 to 2016-07-20.

Test Mode: Transmitting

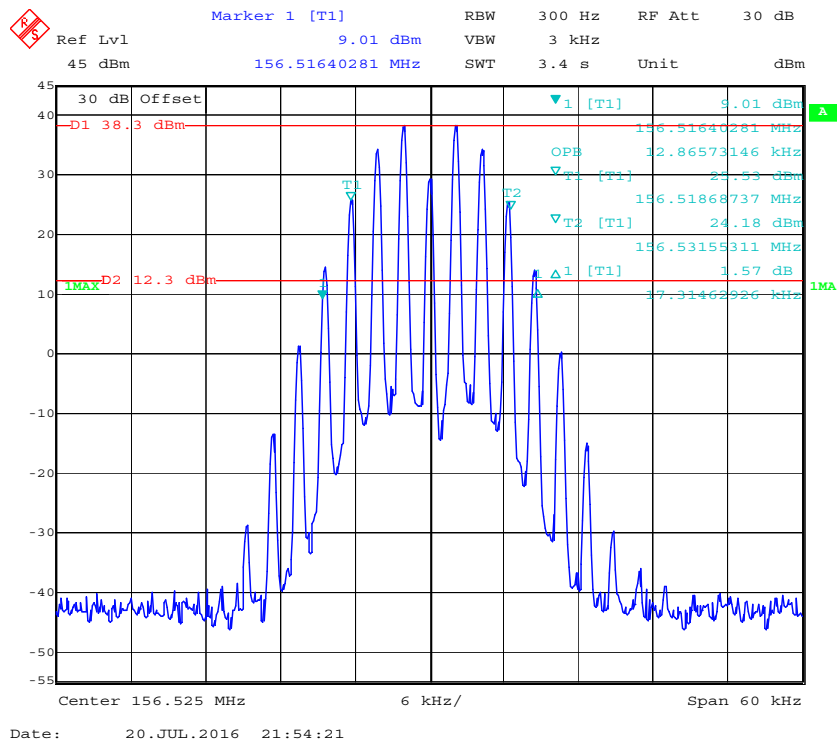
Test mode		Frequency(MHz)	Power level	99% Bandwidth(kHz)	26 dB Emission Bandwidth(kHz)
Radio Telephony		156.8	High	15.03	15.75
			Low	15.03	15.75
DSC	2100Hz	156.525	High	12.87	17.31
			Low	12.87	17.31
	1300Hz		High	8.06	10.82
			Low	8.06	10.82

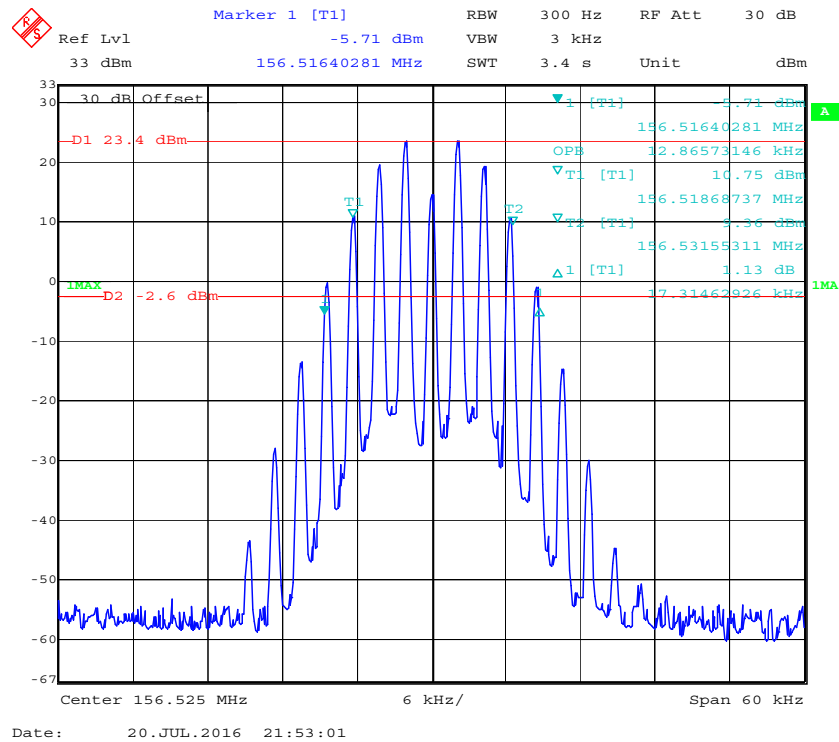
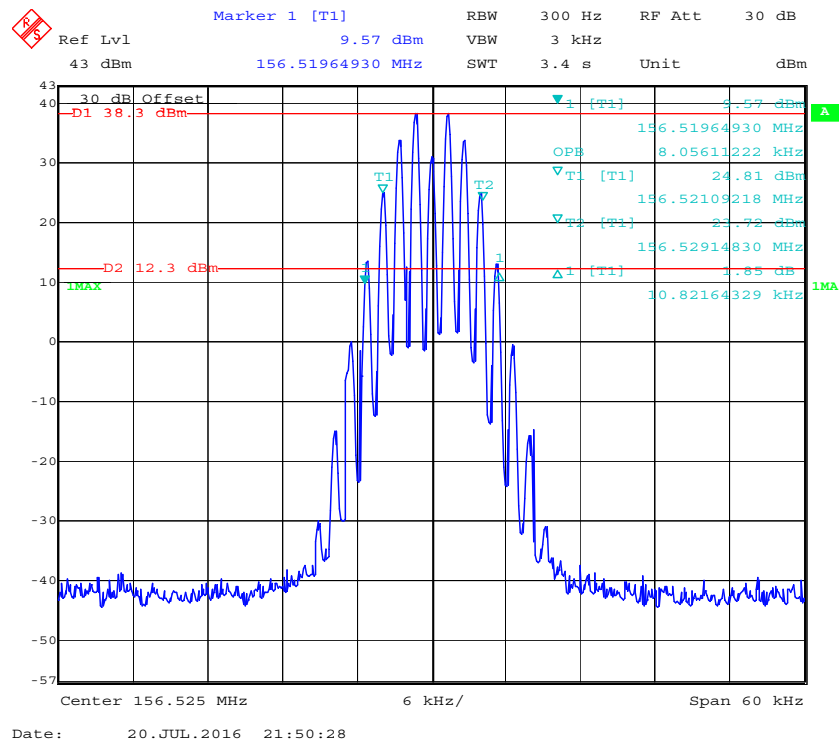
99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.8 MHz, High Power)

99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.8 MHz, Low Power)

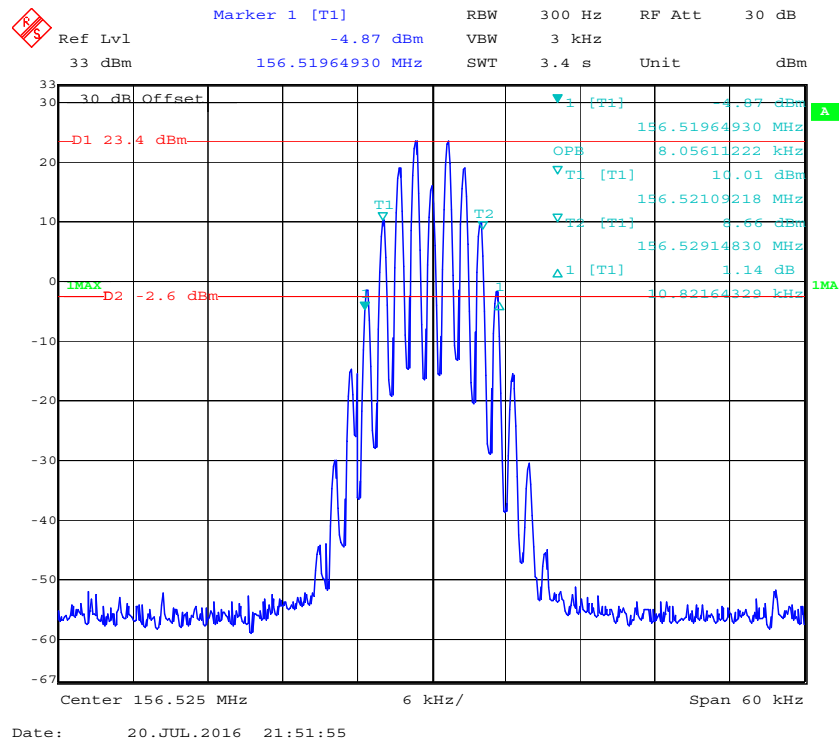


99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC2100, High Power)



99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC2100, Low Power)**99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC1300, High Power)**

99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC1300, Low Power)



§2.1051 & §80.211 & RSS-182 - EMISSION LIMITATIONS.

Applicable Standard

According to FCC §80.211 & RSS-182 §7.9

Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz for below 1GHz, and 1MHz for above 1GHz. sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
R&S	Spectrum Analyzer	FSEM	DE23437	2015-11-23	2016-11-22
HP	RF Communications Test Set	8920A	00 235	2015-07-11	2016-07-10
HP	RF Communications Test Set	8920A	00 235	2016-07-11	2017-07-11
Weinschel Corp	Attenuator(30dB)	53-30-34	LN839	2016-05-07	2017-05-06
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2016-05-05	2017-05-04
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-05	2017-05-04

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28-30 °C
Relative Humidity:	43-49 %
ATM Pressure:	100.3-101.0 kPa

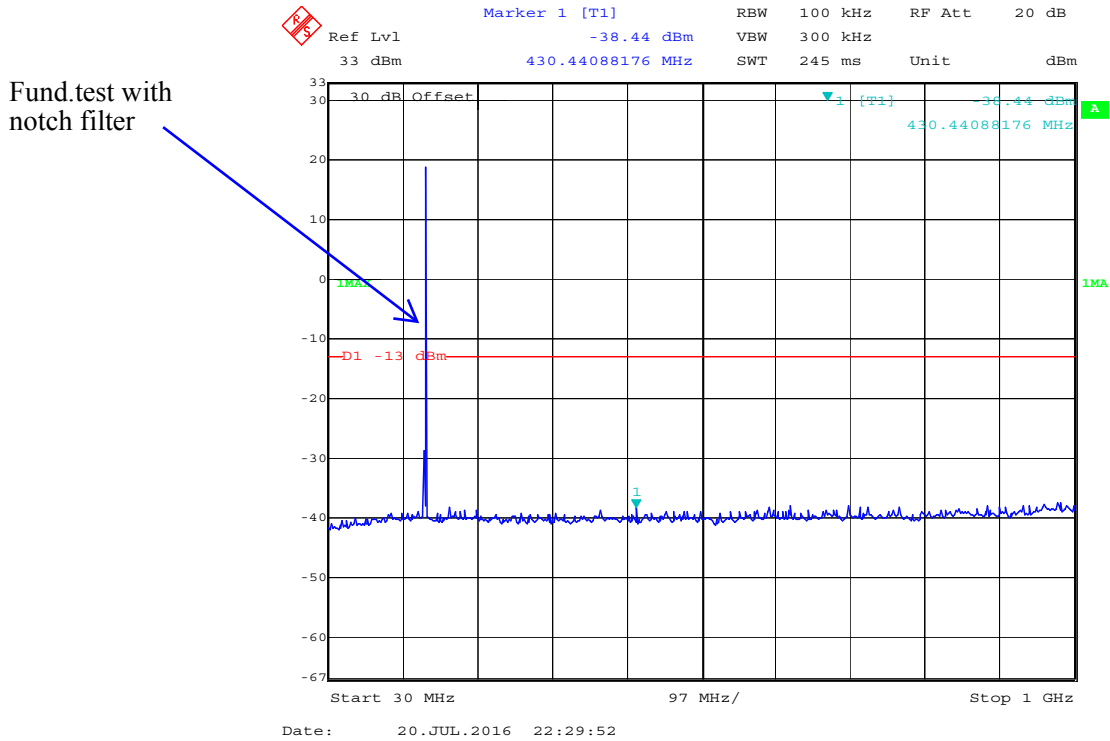
The testing was performed by Gavin Xu from 2016-07-06 to 2016-08-02.

Test Mode: Transmitting

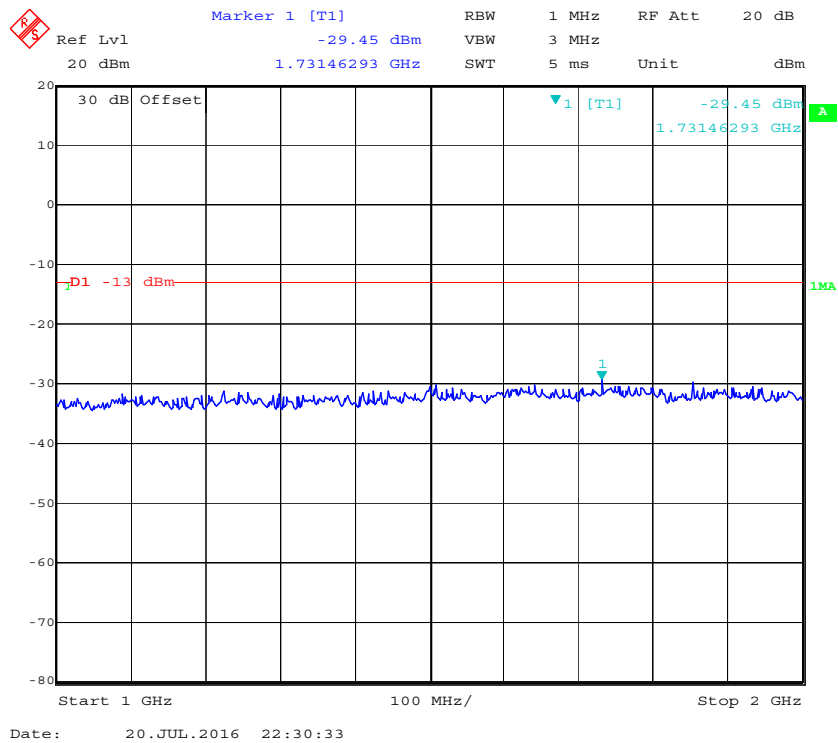
Please refer to the following plots.

Radio Telephony (156.8 MHz):

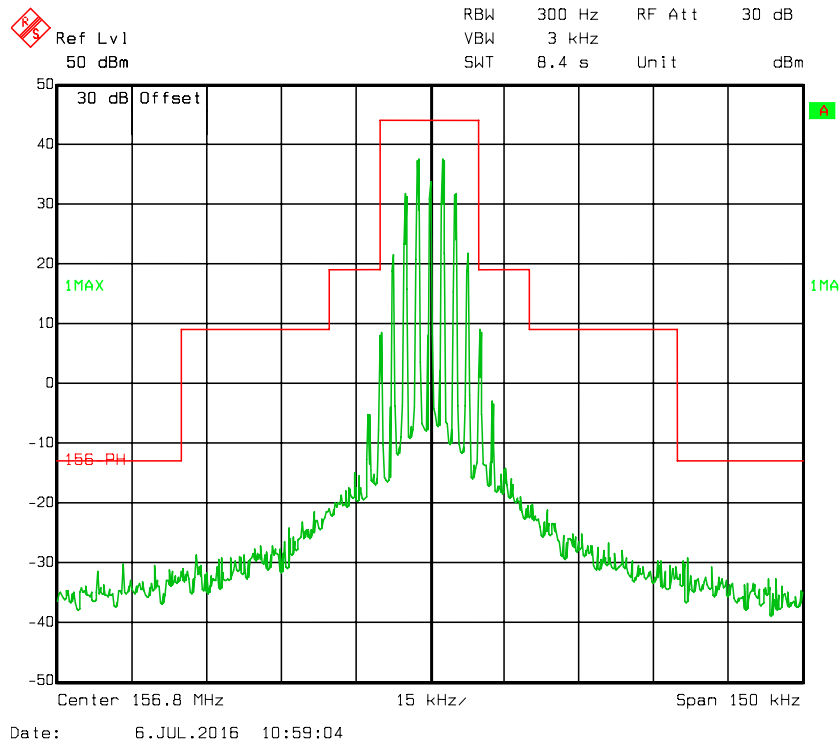
30 MHz – 1 GHz, High Power



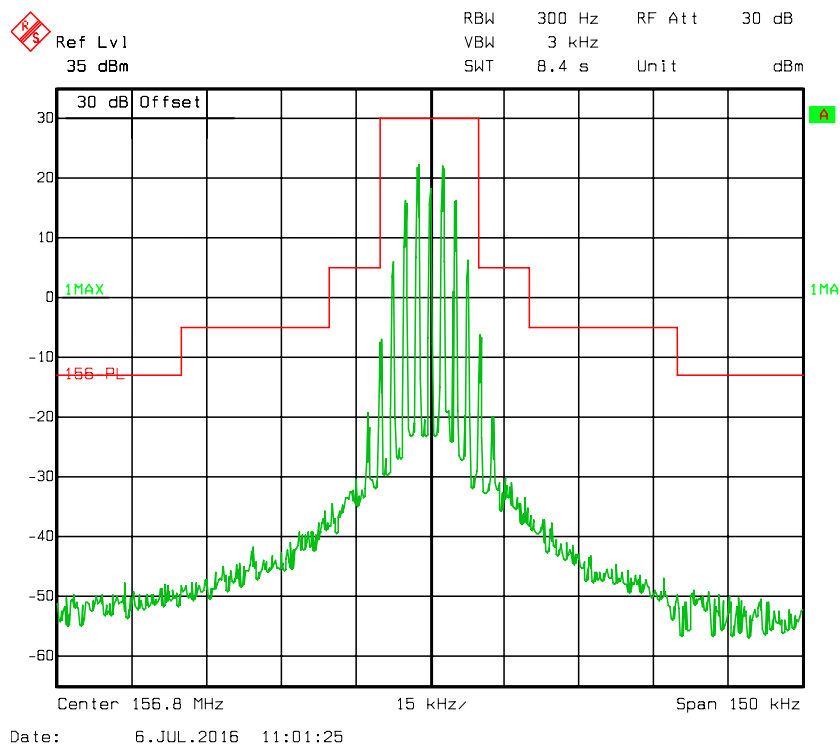
1 GHz – 2 GHz, High Power



Emission Mask, High Power

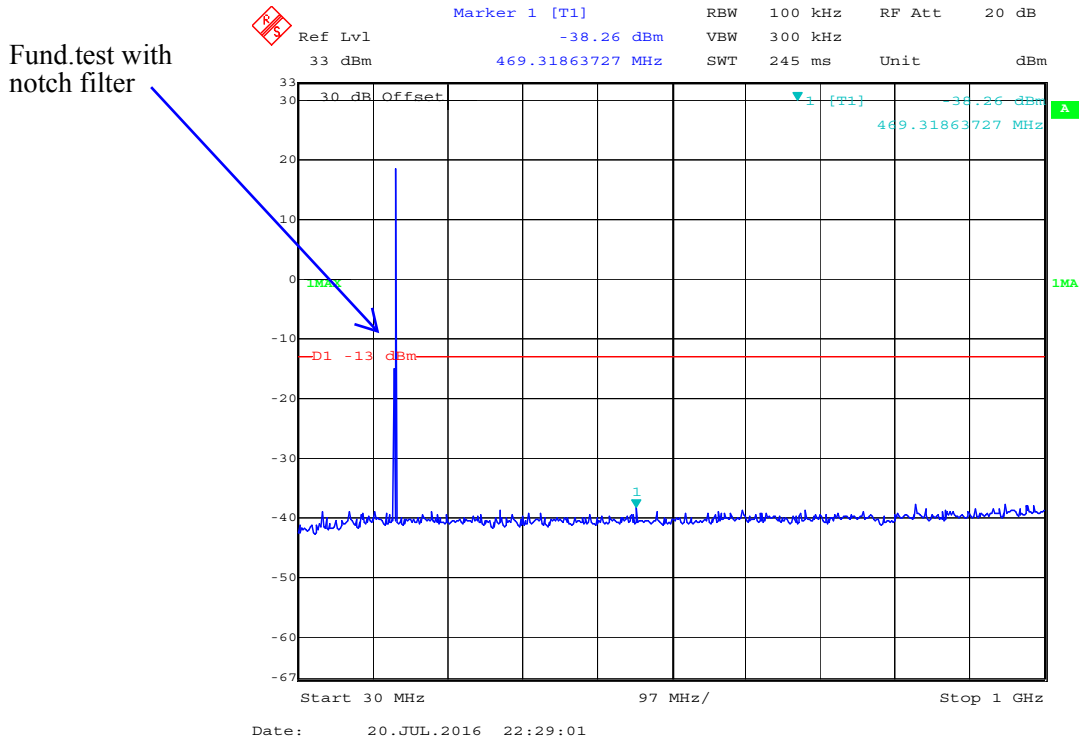


Emission Mask, Low Power

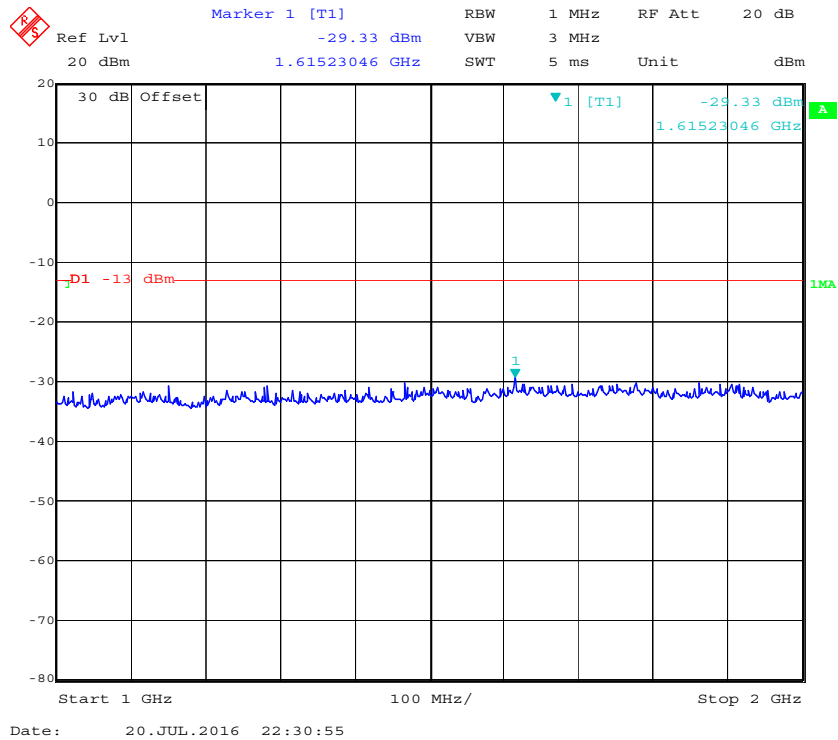


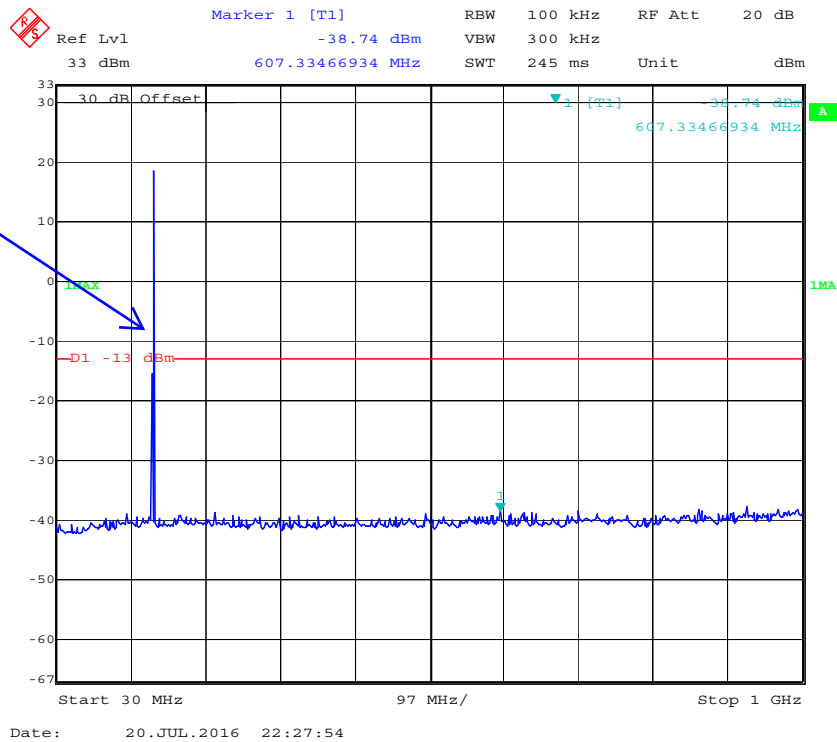
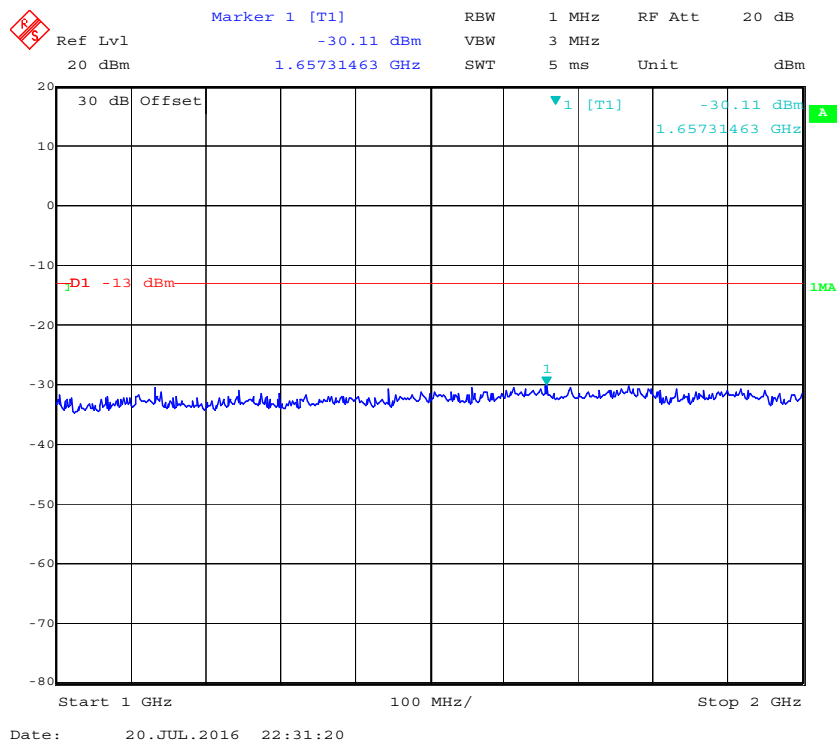
DSC (152.525 MHz):

30 MHz – 1 GHz (DSC1300 Hz) , High Power

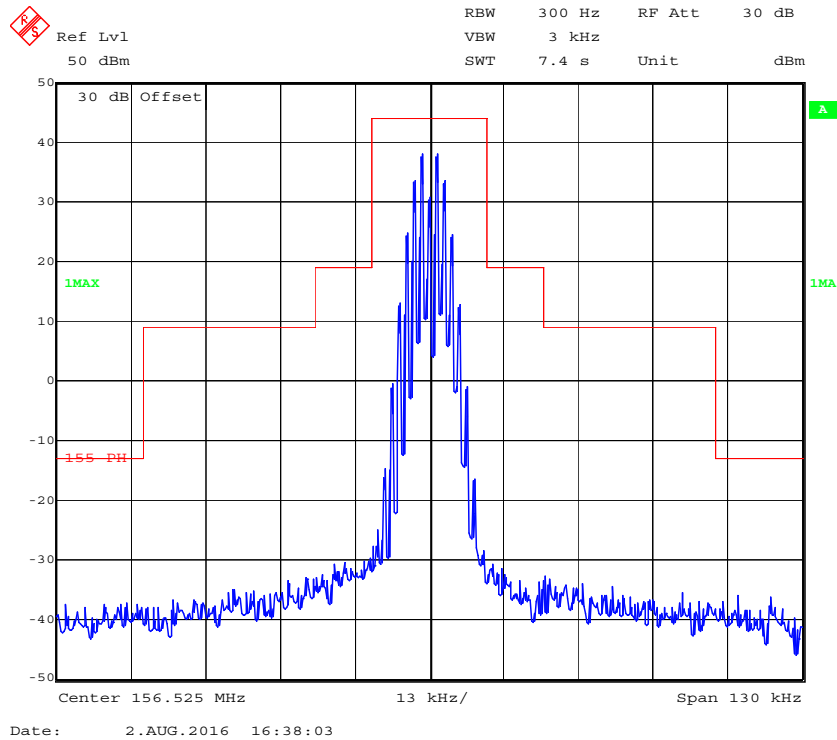


1 GHz – 2 GHz (DSC1300 Hz), High Power

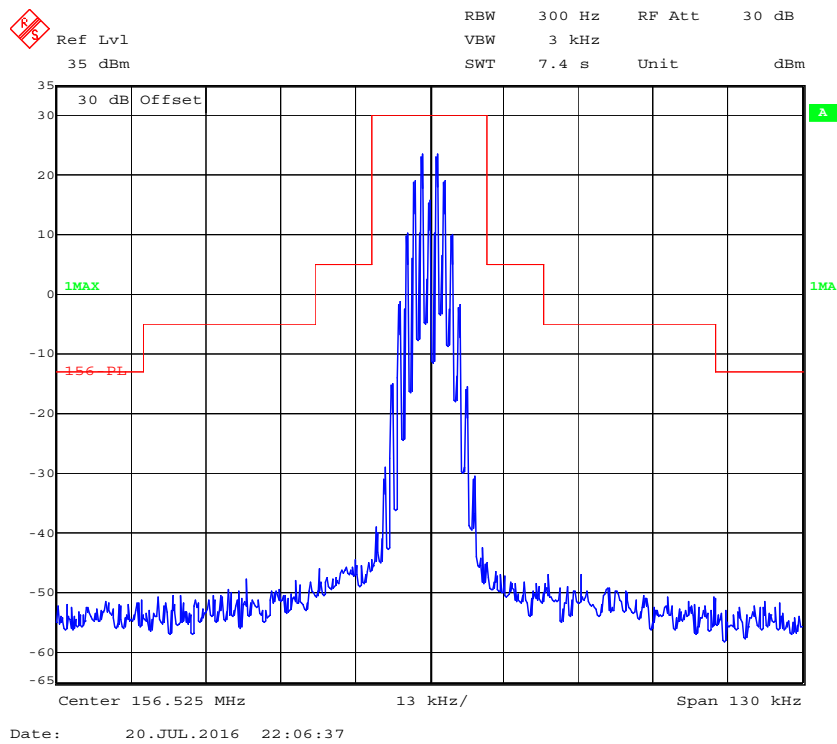


30 MHz – 1 GHz (DSC2100 Hz) , High PowerFund.test with
notch filter**1 GHz – 2 GHz (DSC2100Hz), High Power**

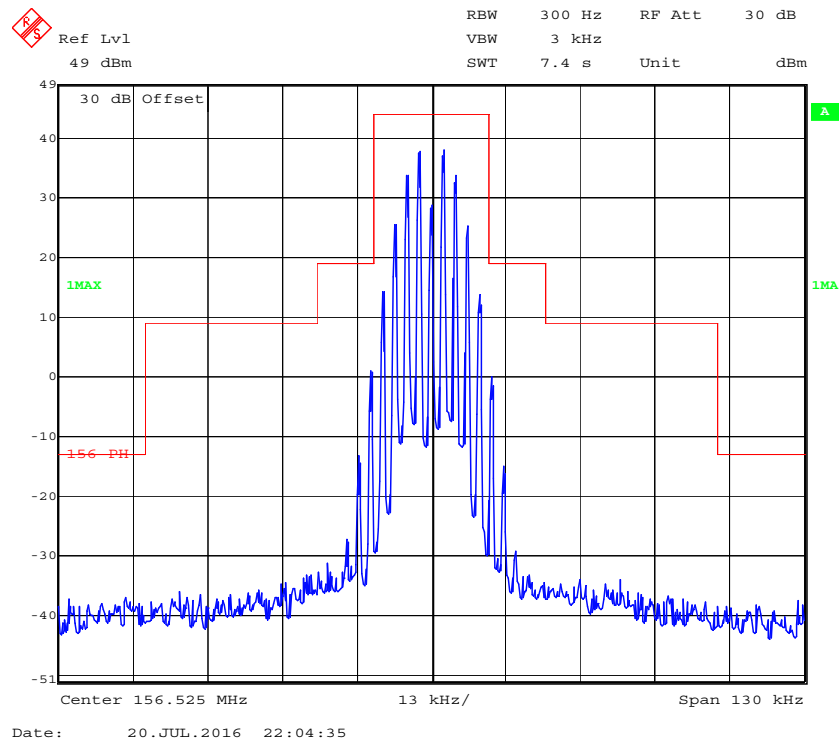
Emission Mask, (DSC1300Hz, High Power)



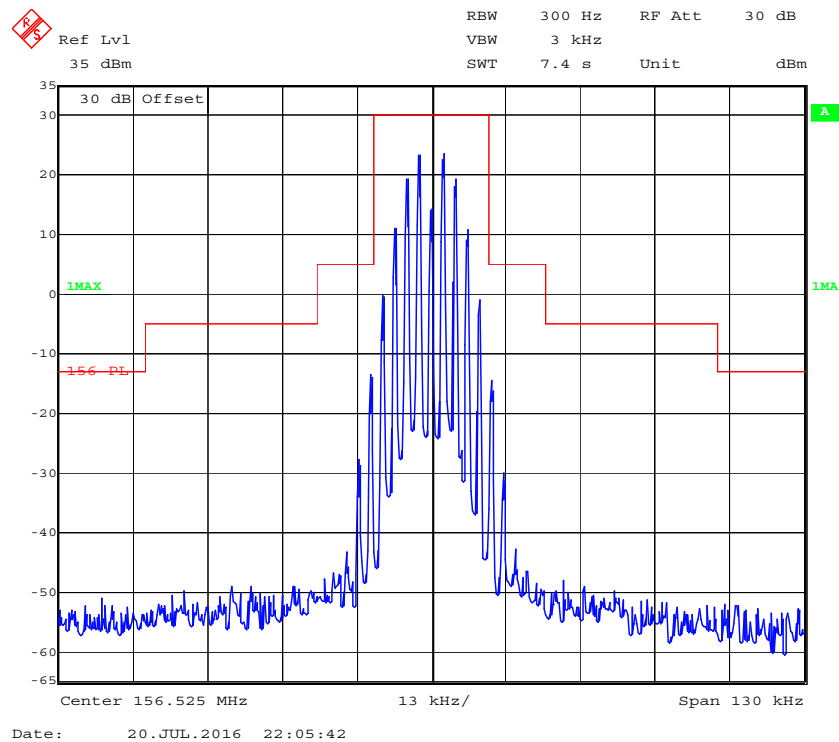
Emission Mask, (DSC1300Hz, Low Power)



Emission Mask, (DSC2100Hz, High Power)



Emission Mask, (DSC2100Hz, Low Power)



FCC§80.217 - SUPPRESSION OF INTERFERENCE ABOARD SHIPS

Applicable Standard

FCC §80.217

(a) A voluntarily equipped ship station receiver must not cause harmful interference to any receiver required by statute or treaty.

(b) The electromagnetic field from receivers required by statute or treaty must not exceed the following value at a distance over sea water of one nautical mile from the receiver or Deliver not more than the following amounts of power, to an artificial antenna having electrical characteristics equivalent to those of the average receiving antenna(s) use on shipboard:

Test Procedure

The EUT was connected to a spectrum analyser via a 30 dB attenuator. The spectrum was measured between 9 kHz to 2 GHz. A resolution bandwidth of 100 kHz was used below 1GHz and 1 MHz was used above 1GHz. The traces were recorded as shown on the following pages.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
HP	RF Communications Test Set	8920A	00 235	2015-07-11	2016-07-11
Weinschel Corp	Attenuator(30dB)	53-30-34	LN839	2016-05-07	2017-05-06
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2016-05-05	2017-05-04
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-05	2017-05-04

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Data

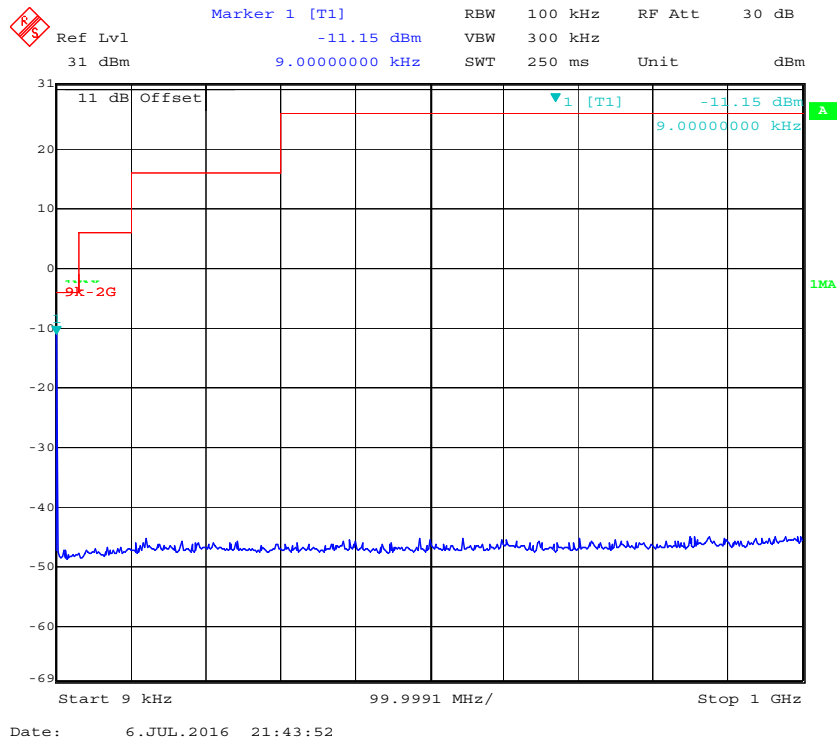
Environmental Conditions

Temperature:	23 °C
Relative Humidity:	43 %
ATM Pressure:	101.0 kPa

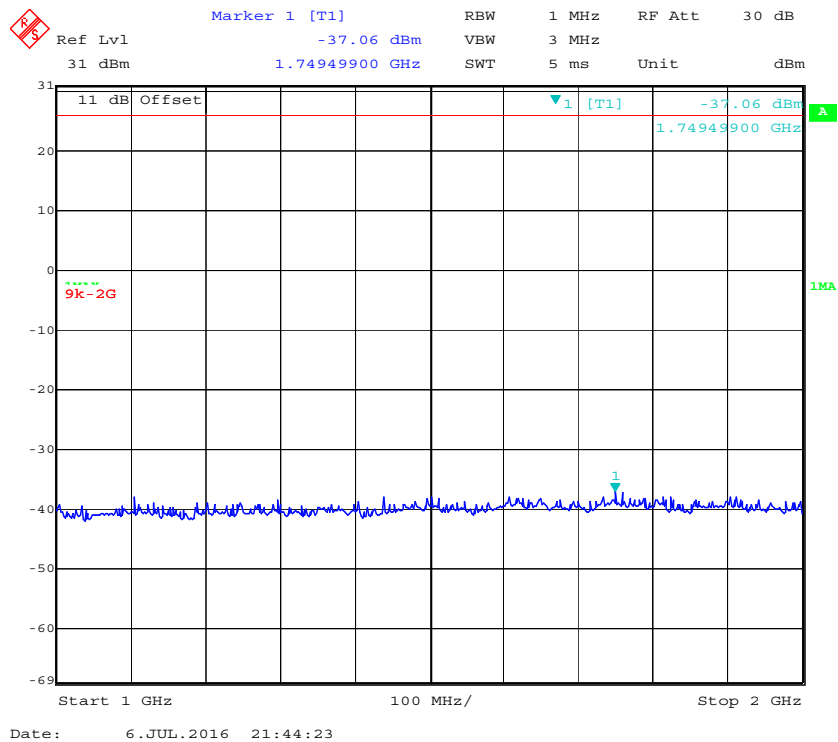
The testing was performed by Gavin Xu on 2016-07-06.

Test Mode: Transmitting

9 kHz – 1 GHz, 156.8 MHz



1 GHz – 2 GHz, 156.8 MHz



FCC §2.1053&§80.211&RSS-182§7.9 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, § 80.211 and RSS-182 §7.9

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB = 43 + 10 Log₁₀ (power out in Watts)

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Signal Generator	1026	320408	2015-11-23	2016-11-22
Sunol Sciences	Antenna	JB3	A060611-3	2014-07-28	2017-07-27
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
R&S	EMI Test Receiver	ESCI	100224	2015-09-01	2016-09-01
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-19
TDK RF	Horn Antenna	HRN-0118	130 084	2015-09-06	2018-09-06
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
N/A	Coaxial Cable	14m	N/A	2016-05-06	2017-05-06
N/A	Coaxial Cable	8m	N/A	2016-05-06	2017-05-06
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2016-05-05	2017-05-04
Weinschel Corp	Terminal Load(100W)	1440-3	MD447	/	/

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	23 °C
Relative Humidity:	47 %
ATM Pressure:	100.0 kPa

The testing was performed by Gavin Xu on 2016-07-20.

Test Mode: Transmitting

30 MHz – 2 GHz:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
Radio telephony: 156.8 MHz								
313.600	H	49.83	-34.8	0.0	0.5	-35.3	-13	22.3
313.600	V	45.21	-37.6	0.0	0.5	-38.1	-13	25.1
470.400	H	52.9	-28.2	0.0	0.7	-28.9	-13	15.9
470.400	V	46.93	-31.2	0.0	0.7	-31.9	-13	18.9
627.200	H	45.97	-32.9	0.0	0.8	-33.7	-13	20.7
627.200	V	38.16	-38.2	0.0	0.8	-39.0	-13	26.0
784.000	H	46.79	-28.7	0.0	0.9	-29.6	-13	16.6
784.000	V	47.33	-25.2	0.0	0.9	-26.1	-13	13.1
940.800	H	43.68	-29.6	0.0	1	-30.6	-13	17.6
940.800	V	40.63	-29.3	0.0	1	-30.3	-13	17.3
1568.000	H	53.91	-47.4	9.9	1.2	-38.7	-13	25.7
1568.000	V	55.27	-46.7	9.9	1.2	-38.0	-13	25.0
DSC: 156.525 MHz								
469.580	H	51.99	-29.2	0.0	0.7	-29.9	-13	16.9
469.580	V	48.02	-30.1	0.0	0.7	-30.8	-13	17.8
782.630	H	47.11	-28.4	0.0	0.9	-29.3	-13	16.3
782.630	V	46.59	-26	0.0	0.9	-26.9	-13	13.9
1252.200	H	57.01	-43.2	7.8	1.3	-36.7	-13	23.7
1252.200	V	55.59	-44.8	7.8	1.3	-38.3	-13	25.3

Note:

Absolute Level = SG Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

FCC §2.1055 & §80.209&§ RSS-182- TRANSMITTER FREQUENCY TOLERANCES

Applicable Standard

FCC §2.1055, §80.209 and RSS-182 §7.4

Test Procedure

Frequency Stability vs. Temperature:

From -20° to $+50^{\circ}$ centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

The frequency stability shall be measured with variation of primary supply voltage as follows

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
- (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
- (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-3	2015-09-10	2016-09-09
UNI-T	Multimeter	UT39A	M130199938	2016-04-02	2017-04-02
Weinschel Corp	Attenuator(30dB)	53-30-34	LN839	2016-05-07	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-05	2017-05-04

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Xu on 2016-07-20.

Test Mode: Transmitting

For Radio Telephony mode:

Reference Frequency: 156.8 MHz, Limit: ± 5.0 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (°C)	Power Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	12	156.799992	-0.0510
40	12	156.799999	-0.0064
30	12	156.799995	-0.0319
20	12	156.799994	-0.0383
10	12	156.799996	-0.0255
0	12	156.799993	-0.0446
-10	12	156.799991	-0.0574
-20	12	156.799997	-0.0191

Reference Frequency: 156.8 MHz, Limit: ± 5.0 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (°C)	Power Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	10.2	156.799994	-0.0383
40	10.2	156.799991	-0.0574
30	10.2	156.799996	-0.0255
20	10.2	156.799995	-0.0319
10	10.2	156.799998	-0.0128
0	10.2	156.799993	-0.0446
-10	10.2	156.799997	-0.0191
-20	10.2	156.799994	-0.0383

Reference Frequency: 156.8 MHz, Limit: ± 5.0 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (°C)	Power Supplied (V _{dc})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	13.8	156.799991	-0.0574
40	13.8	156.799995	-0.0319
30	13.8	156.799996	-0.0255
20	13.8	156.799992	-0.0510
10	13.8	156.799998	-0.0128
0	13.8	156.799995	-0.0319
-10	13.8	156.799994	-0.0383
-20	13.8	156.799996	-0.0255

For DSC mode:

Reference Frequency: 156.525 MHz			
Test Conditions		Transmitter Frequency (Hz)	
Environment Temperature (°C)	Power Supplied (V _{dc})	B-State(2100Hz)	B-State(1300Hz)
25	12	2100.0001	1300.0001

Note: No limit is defined 80.209. Therefore limit from ITU 1371 is used ± 3 ppm

RSS-182 §7.11, RSS-GEN §7 – RECEIVER SPURIOUS EMISSION**Applicable Standard**

According to RSS-182 Issue 4 §7.11 and RSS-Gen §7

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The data was recorded in the QP detection mode for below 1 GHz, and Peak & Average for above 1GHz.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Signal Generator	1026	320408	2015-11-23	2016-11-22
Sunol Sciences	Antenna	JB3	A060611-3	2014-07-28	2017-07-27
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
R&S	EMI Test Receiver	ESCI	100224	2015-09-01	2016-09-01
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-19
TDK RF	Horn Antenna	HRN-0118	130 084	2015-09-06	2018-09-06
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
N/A	Coaxial Cable	14m	N/A	2016-05-06	2017-05-06
N/A	Coaxial Cable	8m	N/A	2016-05-06	2017-05-06
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2016-05-05	2017-05-04
Weinschel Corp	Terminal Load(100W)	1440-3	MD447	/	/

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Xu on 2016-07-20.

Test Mode: Receiving

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Detector	Polar	Factor					
MHz	dBμV	PK/QP/AV	H/V	dB(1/m)	dB	dB	dBμV/m	dBμV/m	dB
68.92	18.21	QP	H	8.40	1.06	21.41	32.28	40.00	7.72
144.72	29.86	QP	V	12.92	1.46	21.43	39.83	43.50	3.67
1205.31	42.14	PK	H	23.04	3.50	28.08	50.68	74.00	23.32
1205.31	27.98	AV	H	23.04	3.50	28.08	36.52	54.00	17.48
1205.31	41.84	PK	V	23.04	3.50	28.08	50.38	74.00	23.62
1205.31	26.95	AV	V	23.04	3.50	28.08	35.49	54.00	18.51

***** END OF REPORT *****