

FCC PART 80 MEASUREMENT AND TEST REPORT

For

Furuno USA Inc

4400 NW Pacific Rim Blvd., Camas, WA 98607, United States

FCC ID: ADB9ZWFM4800

Report Type: Original Report	Product Type: MARINE VHF RADIOTELEPHONE
Report Number: RDG170608005-00A	
Report Date: 2017-08-08	
Reviewed By: RF Engineer	Rocky Kang <i>Rocky Kang</i>
Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn	

Note: This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP* or any agency of the Federal Government. * This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk “*”.

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S).....	4
TEST METHODOLOGY	4
MEASUREMENT UNCERTAINTY	4
TEST FACILITY	5
SYSTEM TEST CONFIGURATION.....	6
DESCRIPTION OF TEST CONFIGURATION	6
EQUIPMENT MODIFICATIONS	6
SUPPORT EQUIPMENT LIST AND DETAILS	6
EXTERNAL I/O CABLE.....	6
LOAD	6
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS.....	7
TEST EQUIPMENT LIST	8
FCC§1.1307 (b) (1) & §2.1091 - MAXIMUM PERMISSIBLE EXPOSURE (MPE)	9
APPLICABLE STANDARD	9
FCC LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE).....	9
RESULT	9
FCC §2.1046 & §80.215 - RF OUTPUT POWER.....	11
APPLICABLE STANDARD	11
TEST PROCEDURE	11
TEST DATA	11
FCC §2.1047 §80.213 - MODULATION REQUIREMENTS.....	13
APPLICABLE STANDARD	13
TEST PROCEDURE	13
TEST DATA	13
FCC §2.1049 & §80.205 –BANDWIDTH	21
APPLICABLE STANDARD	21
TEST PROCEDURE	21
TEST DATA	21
§2.1051 &§80.211 - EMISSION LIMITATIONS.	25
APPLICABLE STANDARD	25
TEST PROCEDURE	25
TEST DATA	25
FCC§80.217 - SUPPRESSION OF INTERFERENCE ABOARD SHIPS.....	32
APPLICABLE STANDARD	32
TEST PROCEDURE	32
TEST DATA	32
FCC §2.1053&§80.211 - RADIATED SPURIOUS EMISSIONS	35
APPLICABLE STANDARD	35
TEST PROCEDURE	35

TEST DATA35

FCC §2.1055 & §80.209- TRANSMITTER FREQUENCY TOLERANCES37

APPLICABLE STANDARD37

TEST PROCEDURE37

TEST DATA37

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Furuno USA Inc's* product, model number: FM-4800 (*FCC ID: ADB9ZWM4800*) or the "EUT" in this report was a *MARINE VHF RADIOTELEPHONE*, which was measured approximately: 200 mm (L) x 153.8 mm (W) x 100 mm(H), rated with input voltage: DC 12V.

Operating frequency band: 156.025~157.425 MHz

Modulation type: G3E, G2B

Power: 1W/25W

** All measurement and test data in this report was gathered from production sample serial number: 170608005 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2017-06-08.*

Objective

This test report is prepared on behalf of *Furuno USA Inc* in accordance with Part 2 and Part 80 of the Federal Communication Commissions rules.

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 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.

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

Measurement Uncertainty

Item		Uncertainty
RF Conducted test with spectrum		±1.92 dB
RF Output Power with Power meter		±0.50 dB
Radiated emission	30MHz~1 GHz	±5.91 dB
	Above 1 GHz	±4.92 dB
Occupied Bandwidth		±0.5 kHz
Temperature		±1.0 °C
Humidity		±6 %

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 382179, the FCC Designation No. : CN5001.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

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.

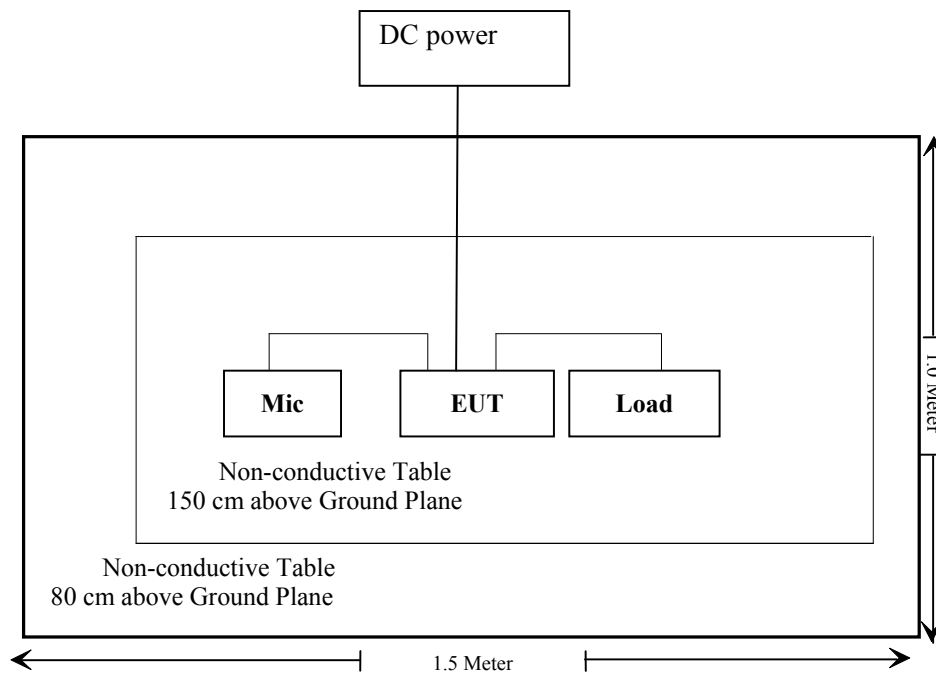
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Proinstrument	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

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
FCC Part §1.1307 (b)(1), §2.1091;	Maximum Permissible Exposure (MPE)	Compliance
FCC Part §2.1046,§80.215	RF Output Power	Compliance
FCC Part §2.1047,§80.213	Modulation requirements	Compliance
FCC Part §2.1049,§80.205	Bandwidth	Compliance
FCC Part §2.1051,§80.211	Emission limitations	Compliance
FCC Part §80.217	Suppression of Interference Aboard Ships	Compliance
FCC Part §2.1051,§80.211	Radiated Spurious Emissions	Compliance
FCC Part §2.1055,§80.209	Transmitter Frequency Tolerances	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Sunol Sciences	Horn Antenna	DRH-118	A052604	2014-12-29	2017-12-28
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2017-04-24	2018-04-24
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2014-12-17	2017-12-16
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-02-14	2018-02-14
HP	Amplifier	HP8447E	1937A01046	2017-05-21	2017-11-19
Anritsu	Signal Generator	68369B	004114	2016-12-05	2017-12-05
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2016-12-07	2017-12-07
COM POWER	Dipole Antenna	AD-100	041000	NCR	NCR
A.H. System	Horn Antenna	SAS-200/571	135	2015-08-18	2018-08-17
Ducommun technologies	RF Cable	UFA210A-1-4724-30050U	MFR64369223410-001	2017-05-21	2017-11-19
Ducommun technologies	RF Cable	104PEA	218124002	2017-05-21	2017-11-19
Ducommun technologies	RF Cable	RG-214	1	2017-05-21	2017-11-19
Ducommun technologies	RF Cable	RG-214	2	2017-05-22	2017-11-22
RF Conducted test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2017-04-24	2018-04-24
HP Agilent	RF Communication test set	8920A	3325U00859	2017-05-07	2018-05-07
Ducommun technologies	RF Cable	RG-214	3	2017-05-22	2017-11-22
JFW	30dB Attenuator	50FH-030-100 RF	170006716507	2017-05-21	2018-05-21
LEADER	MILLIVOLTMETER	LMV-181A	6041126	2016-08-29	2017-08-29
Hewlett-Packard	Frequency Counter	5343A	2232A00827	2016-05-09	2019-05-08
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2016-11-01	2017-10-31
WEINSCHEL	10dB Attenuator	5324	AU 3842	2017-05-23	2017-11-22
Long Wei	DC Power Supply	TPR-6420D	398363	NCR	NCR
N/A	High pass filter	1.3GHz	N/A	2017-05-21	2017-11-19

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

FCC§1.1307 (b) (1) & §2.1091 - 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

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)

P = power input to the antenna (in appropriate units, e.g., mW).

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)

Frequency (MHz)	Antenna Gain		Rated Power (W)	The minimum Distance (cm)	Power density (mW/cm ²)	MPE Limit (mW/cm ²)	Note
	(dBi)	(numeric)					
156.8	6	3.98	12.5	150	0.18	0.2	UnControlledled Environrment

Note: The Maximum power is 25 W which declared by manufacture, the duty cycle is 50%. So the rated average power is 12.5 W.

Radiation Exposure Statement:

To comply with RF exposure requirements, the minimum permissible distance is 1.5 m required between the antenna and the body of the user or nearby persons.

Result: Compliance

FCC §2.1046 & §80.215 - RF OUTPUT POWER

Applicable Standard

FCC §2.1046, §80.215.

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 Data**Environmental Conditions**

Temperature:	24 °C
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2017-07-27.

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	43.85	24.27
	Low	29.08	0.81
156.8	High	43.88	24.43
	Low	29.06	0.81
157.425	High	43.83	24.15
	Low	29.02	0.80

Output power for DSC:

Frequency	Test Mode	Power Level	Output Power (dBm)	Output Power (W)
156.525	1300 Hz	High	43.55	22.65
		Low	29.63	0.92
	2100 Hz	High	43.51	22.44
		Low	29.64	0.92

Note: Ship station limit (25W)

FCC §2.1047 §80.213 - MODULATION REQUIREMENTS**Applicable Standard**

FCC §2.1047 and §80.213

- (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 Procedure

Test Method: TIA/EIA-603D 2.2.3

Test Data**Environmental Conditions**

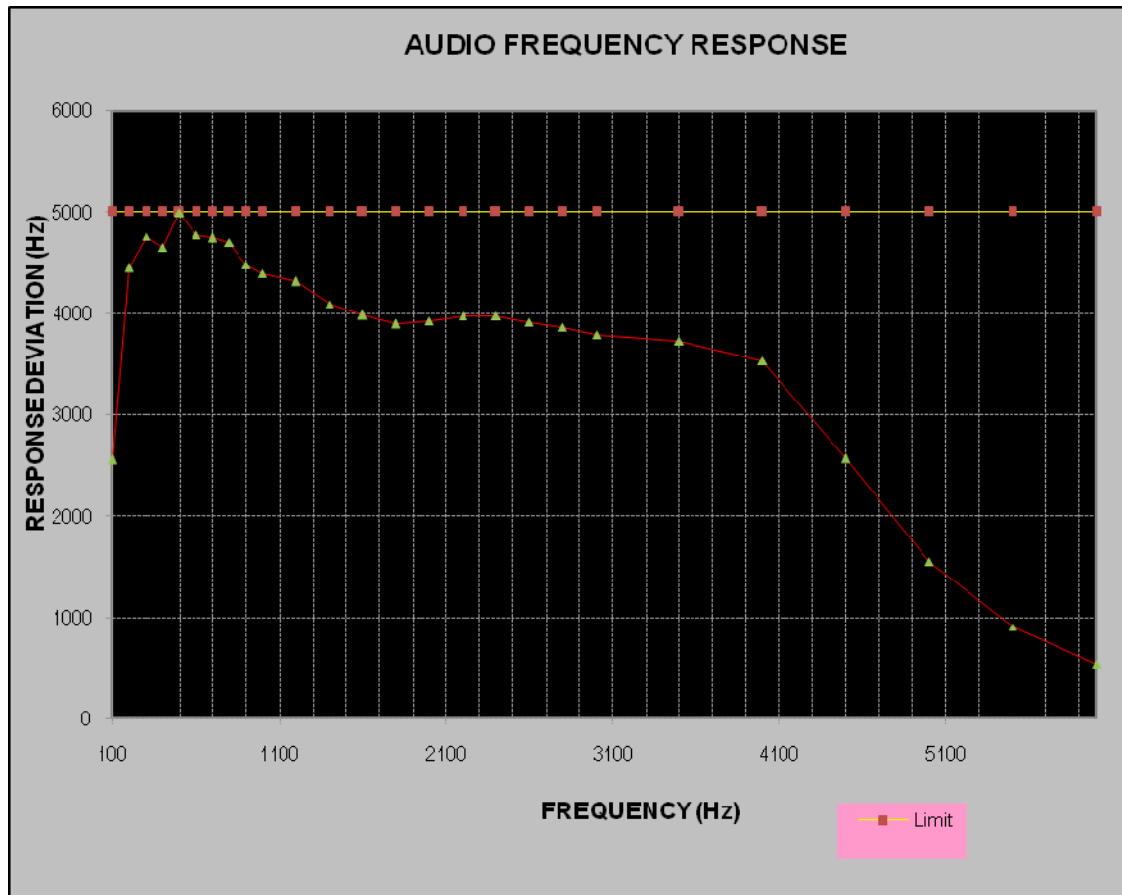
Temperature:	24 °C
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

*The testing was performed by Simon Wang on 2017-07-27.**Test Mode: Transmitting***Result:** Compliance.

Analog Modulation:**Maximum Deviation**

Carrier Frequency: 156.8 MHz

Modulation Frequency (Hz)	Maximum Deviation (Hz)	Limit (Hz)
100	2551	5000
200	4445	5000
300	4760	5000
400	4651	5000
500	4996	5000
600	4768	5000
700	4742	5000
800	4697	5000
900	4479	5000
1000	4387	5000
1200	4311	5000
1400	4091	5000
1600	3980	5000
1800	3892	5000
2000	3925	5000
2200	3970	5000
2400	3972	5000
2600	3913	5000
2800	3866	5000
3000	3785	5000
3500	3725	5000
4000	3530	5000
4500	2564	5000
5000	1553	5000



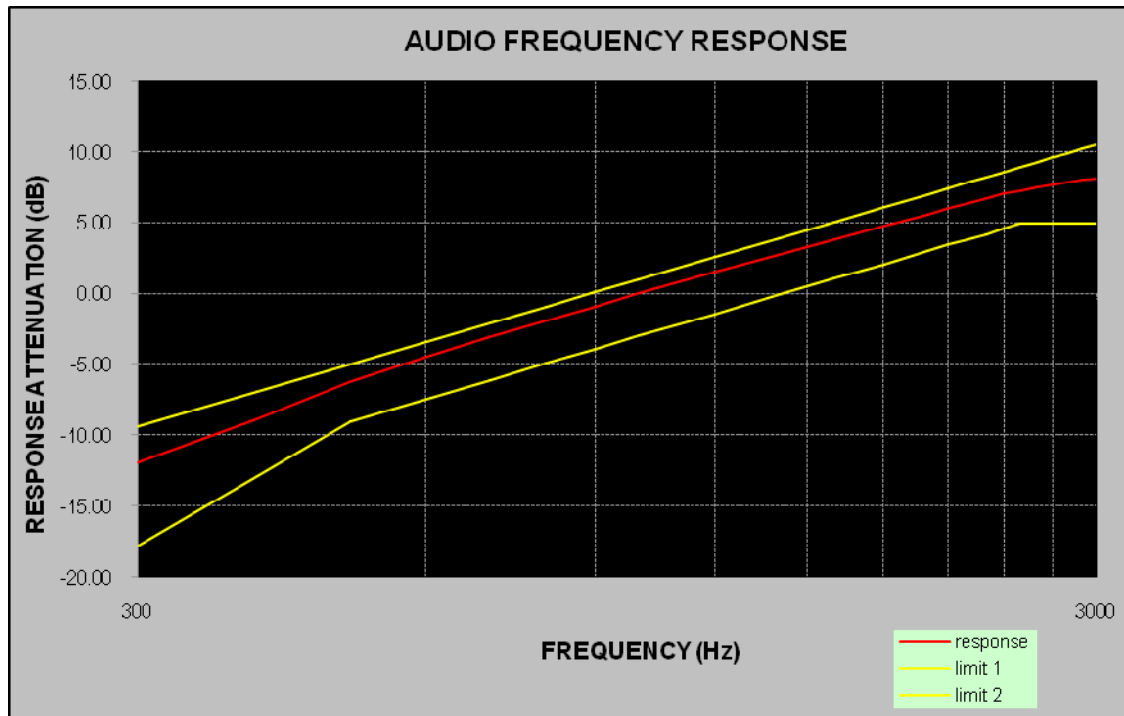
Carrier Frequency: 156.525 MHz, For DSC

Test Mode	Frequency Deviation(kHz)
1300Hz	2.505
2100Hz	4.142

Audio Frequency Response

Carrier Frequency: 156.8 MHz

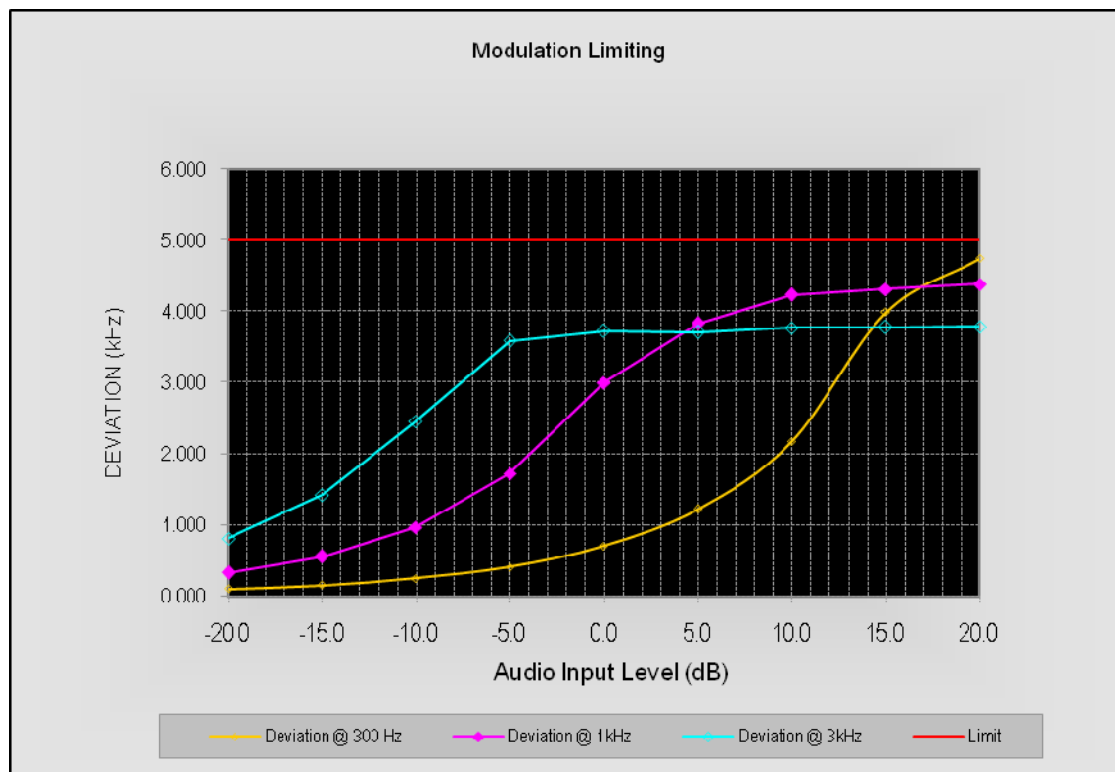
Modulation Frequency (kHz)	Response data (dB)
300	-11.90
400	-8.85
500	-6.20
600	-4.50
700	-3.06
800	-1.86
900	-0.91
1000	0.00
1200	1.53
1400	2.76
1600	3.82
1800	4.77
2000	5.59
2100	6.01
2200	6.36
2300	6.68
2400	7.03
2500	7.28
2600	7.52
2700	7.72
2800	7.89
2900	8.03
3000	8.13



MODULATION LIMITING

Carrier Frequency: 156.8 MHz

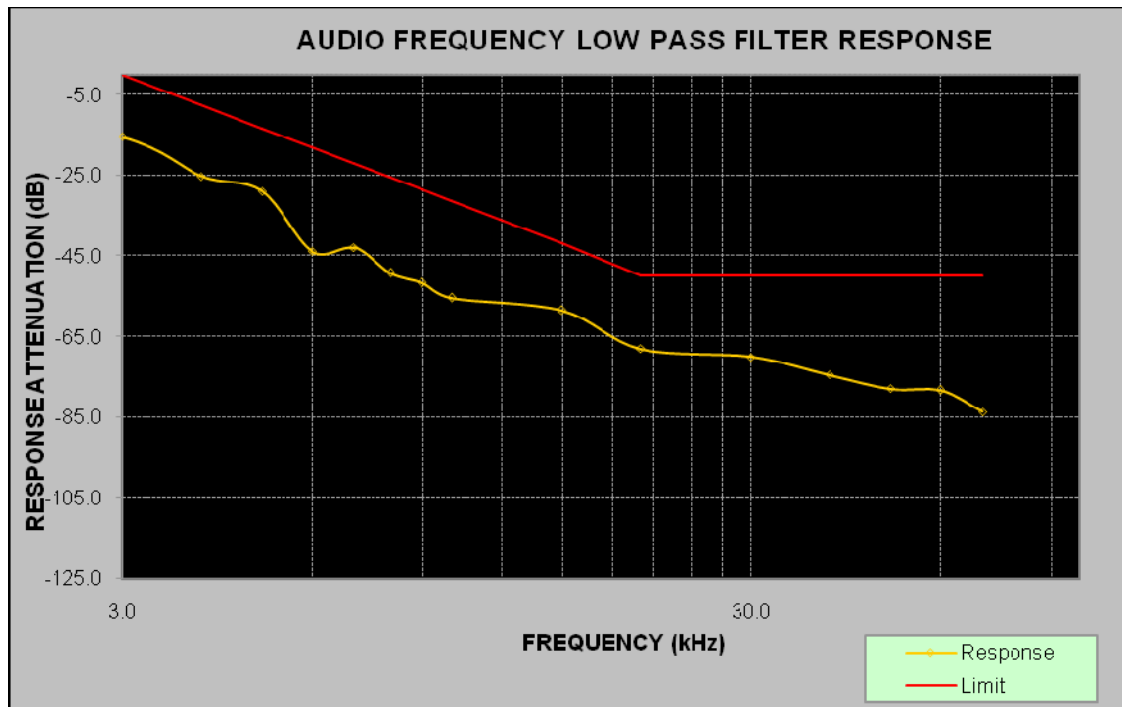
Audio Input Level [dB]	Frequency Deviation (kHz)			Limit [kHz]
	@ 300 Hz	@ 1kHz	@ 3 kHz	
20.0	4.746	4.380	3.787	5.0
15.0	3.990	4.311	3.781	5.0
10.0	2.171	4.235	3.770	5.0
5.0	1.223	3.832	3.711	5.0
0.0	0.703	3.000	3.725	5.0
-5.0	0.413	1.723	3.583	5.0
-10.0	0.255	0.970	2.462	5.0
-15.0	0.156	0.560	1.424	5.0
-20.0	0.105	0.330	0.812	5.0



Audio Frequency Low Pass Filter Response

Carrier Frequency: 156.8 MHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0.0	/
3.0	-15.4	0.0
4.0	-25.2	-7.5
5.0	-28.9	-13.3
6.0	-43.8	-18.1
7.0	-42.9	-22.1
8.0	-49.2	-25.6
9.0	-51.7	-28.6
10.0	-55.4	-31.4
15.0	-58.5	-41.9
20.0	-68.0	-50.0
30.0	-70.1	-50.0
40.0	-74.5	-50.0
50.0	-77.9	-50.0
60.0	-78.3	-50.0
70.0	-83.7	-50.0



FCC §2.1049 & §80.205 –BANDWIDTH

Applicable Standard

FCC §2.1049 and §80.205.

(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 Data

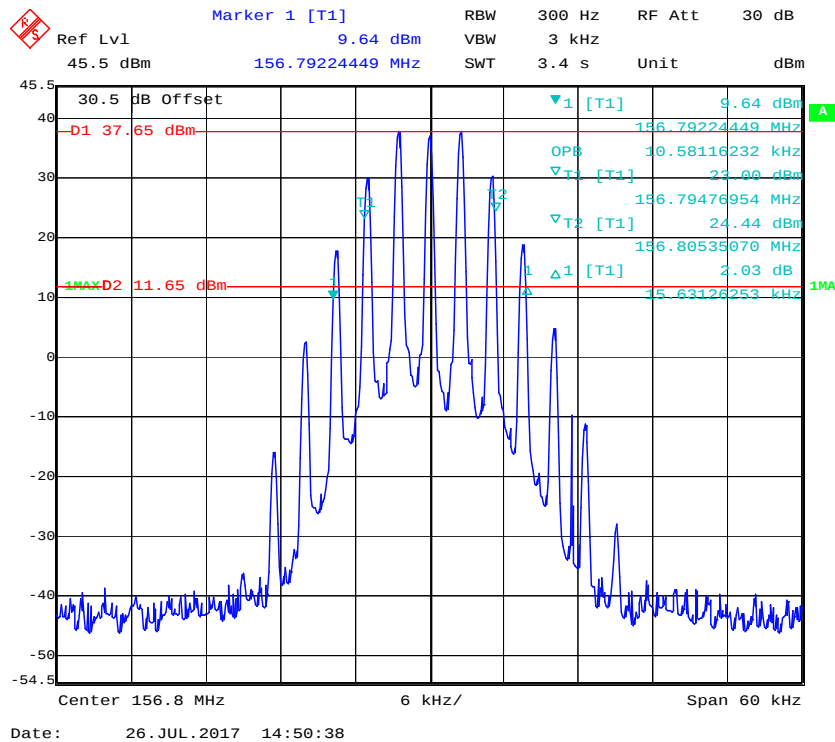
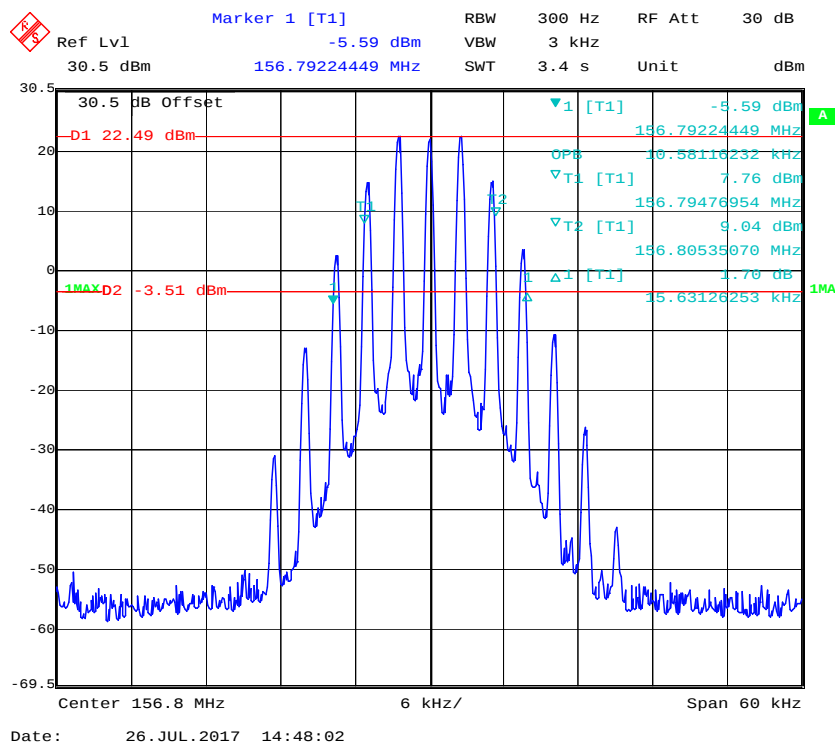
Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

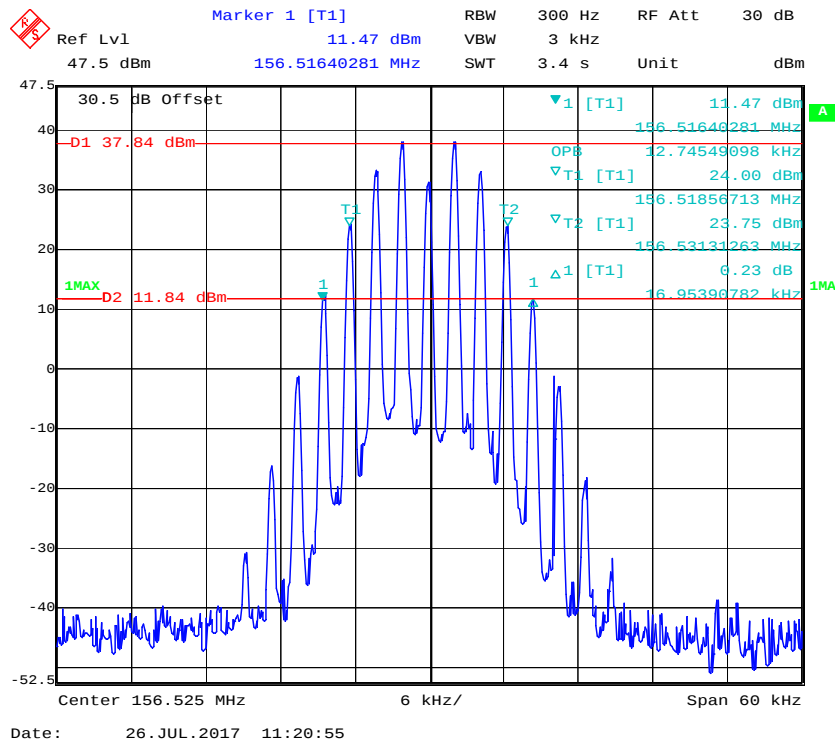
The testing was performed by Simon Wang on 2017-07-26.

Test Mode: Transmitting

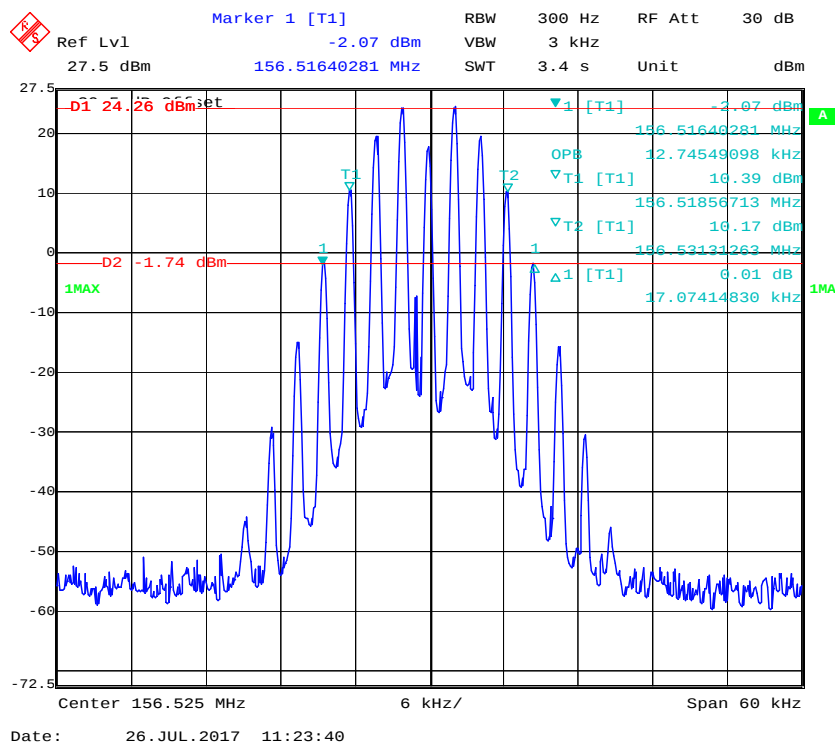
Test mode		Frequency(MHz)	Power level	99% Bandwidth(kHz)	26 dB Emission Bandwidth(kHz)
Radio Telephony		156.8	High	10.581	15.631
			Low	10.581	15.631
DSC	2100Hz	156.525	High	12.745	16.954
			Low	12.745	17.074
	1300Hz		High	7.936	10.581
			Low	7.936	10.581

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)



Ref Lvl 12.20 dBm RBW 300 Hz RF Att 30 dB
 50.5 dBm 156.51964930 MHz SWT 3.4 s Unit dBm

30.5 dB Offset

D1 37.88 dBm

D2 11.88 dBm

1MAX

1

T1

T2

1 [T1] 12.20 dBm
 156.51964930 MHz
 7.93587174 kHz
 T1 [T1] 24.10 dBm
 156.52097194 MHz
 T2 [T1] 23.95 dBm
 156.52896782 MHz
 Δ 1 [T1] -0.25 dB
 30.58116232 kHz

Center 156.525 MHz 6 kHz/ Span 60 kHz

Date: 26.JUL.2017 11:32:31

Marker 1 [T1]

Ref Lvl 27.5 dBm

RBW 300 Hz

VBW 3 kHz

SWT 3.4 s

RF Att 30 dB

Unit dBm

D1 24.24 dBm

D2 -1.76 dBm

1MAX

1

T1

T2

OP8

▽T1 [T1]

▽T2 [T1]

Δ1 [T1]

-1.58 dBm

156.51964930 MHz

7.93587174 kHz

16.37 dBm

156.52097194 MHz

16.28 dBm

156.52806782 MHz

-6.15 dBm

30.58116232 kHz

Center 156.525 MHz

6 kHz/

Span 60 kHz

Date: 26.JUL.2017 11:28:30

§2.1051 & §80.211 - EMISSION LIMITATIONS.

Applicable Standard

According to FCC§80.211.

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 Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2017-07-26.

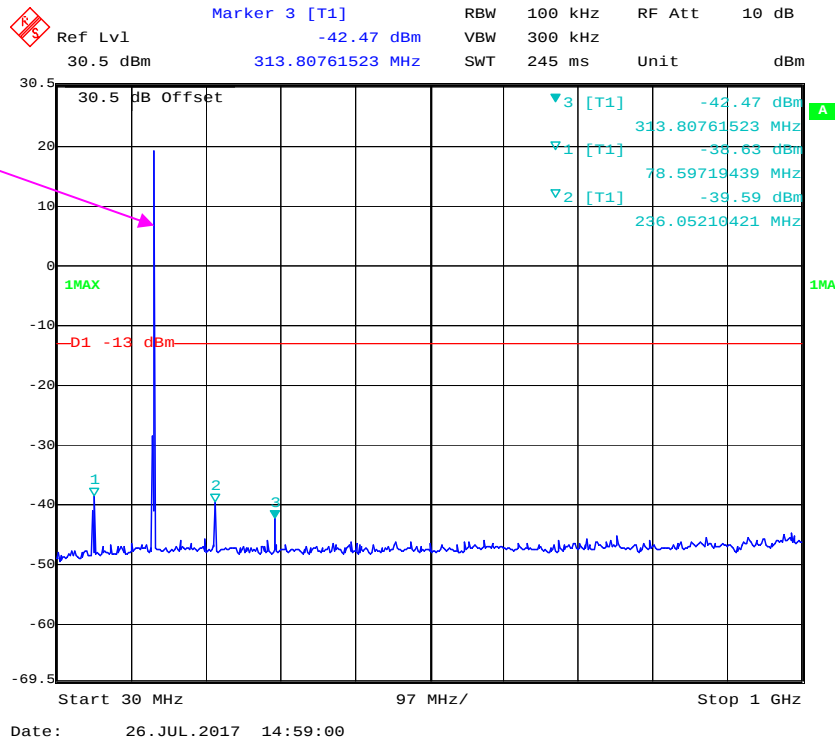
Test Mode: Transmitting

Please refer to the following plots.

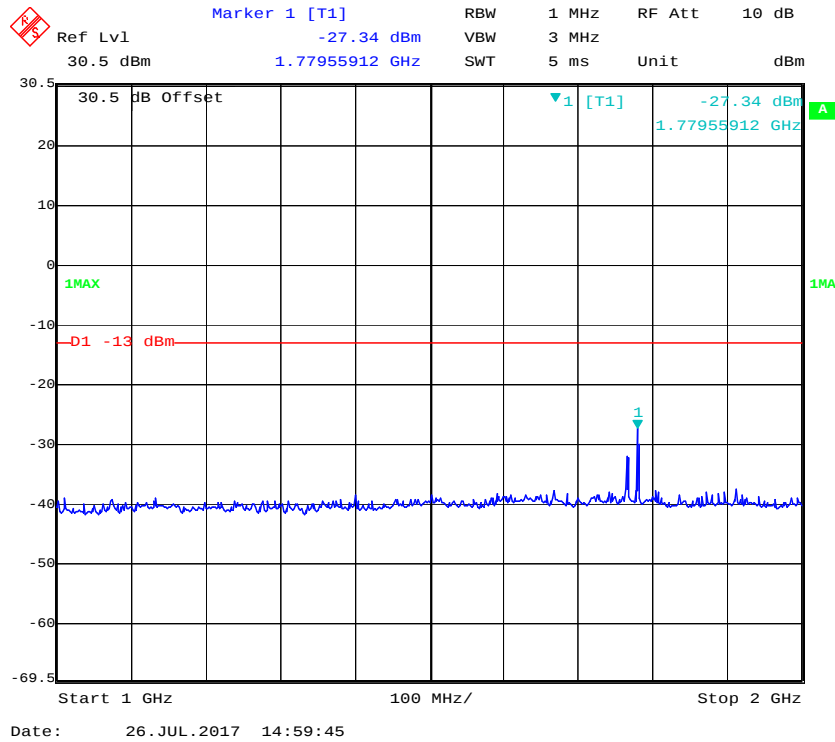
Radio Telephony (156.8 MHz):

30 MHz – 1 GHz, High Power

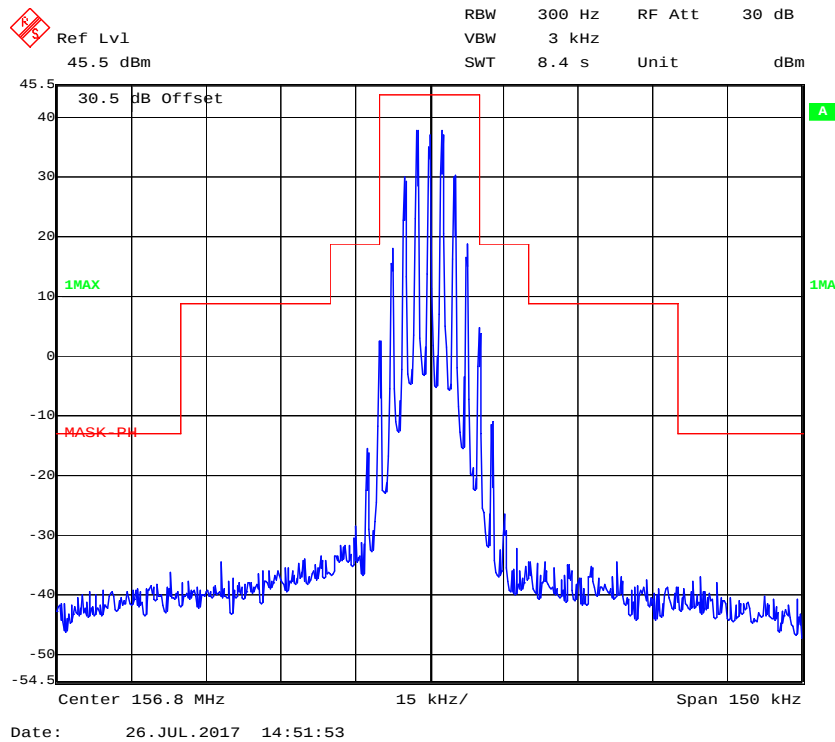
Fund.test with notch filter



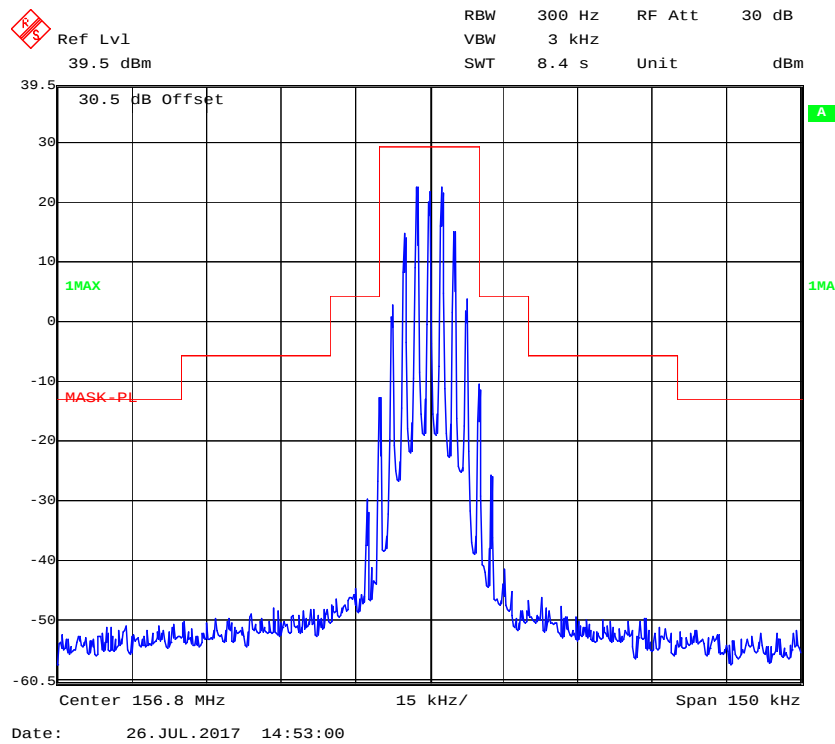
1 GHz – 2 GHz, High Power



Emission Mask, High Power



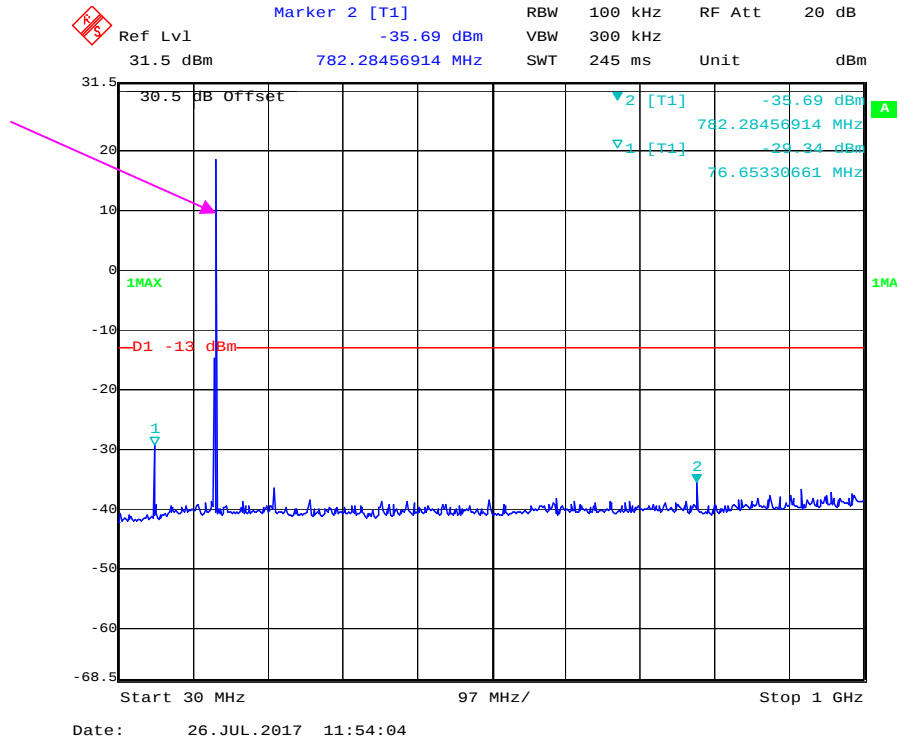
Emission Mask, Low Power



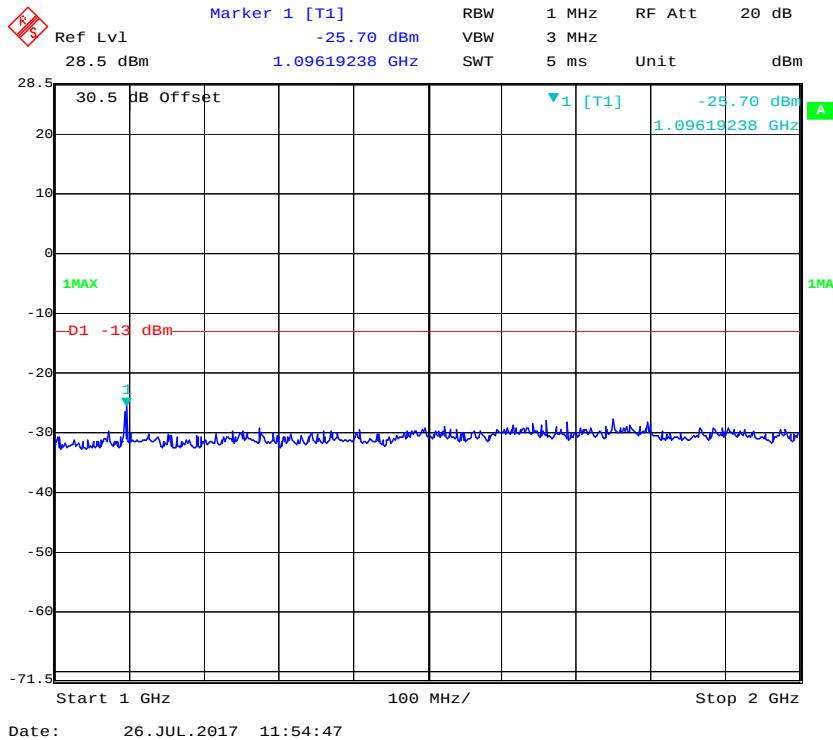
DSC (152.525 MHz):

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

Fund.test with notch filter

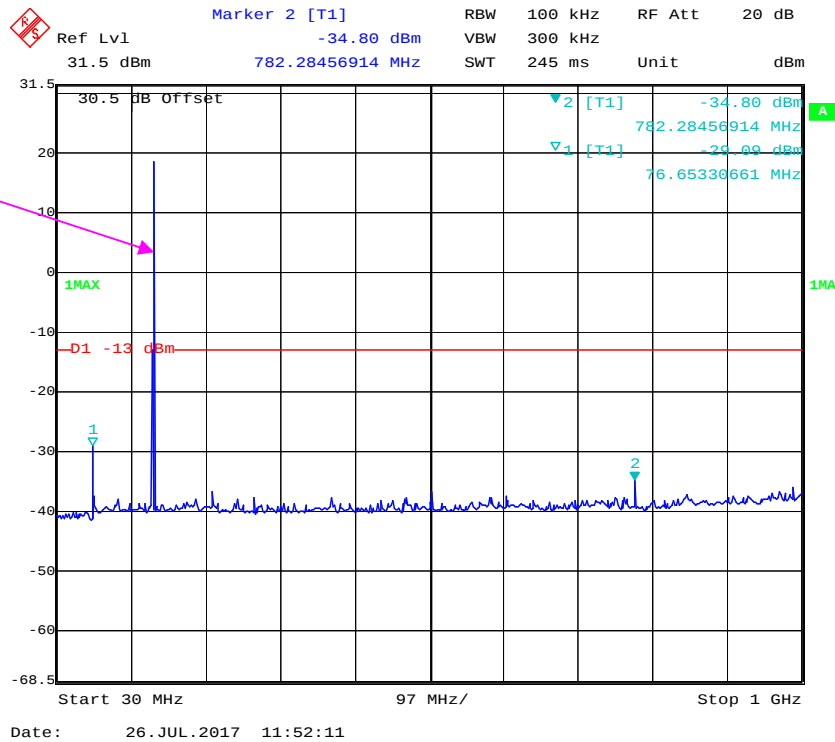


1 GHz – 2 GHz (DSC1300 Hz), High Power

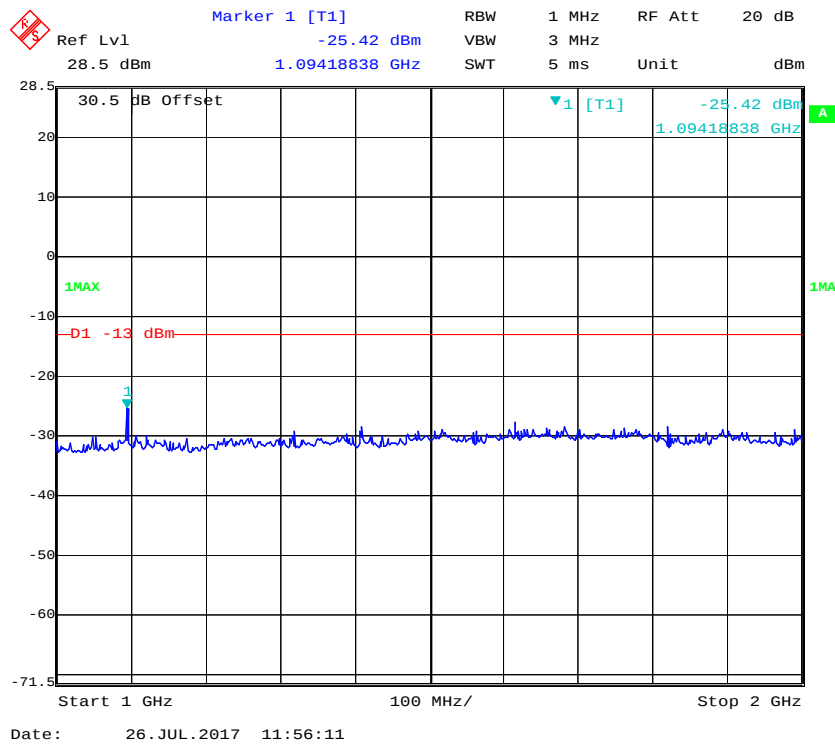


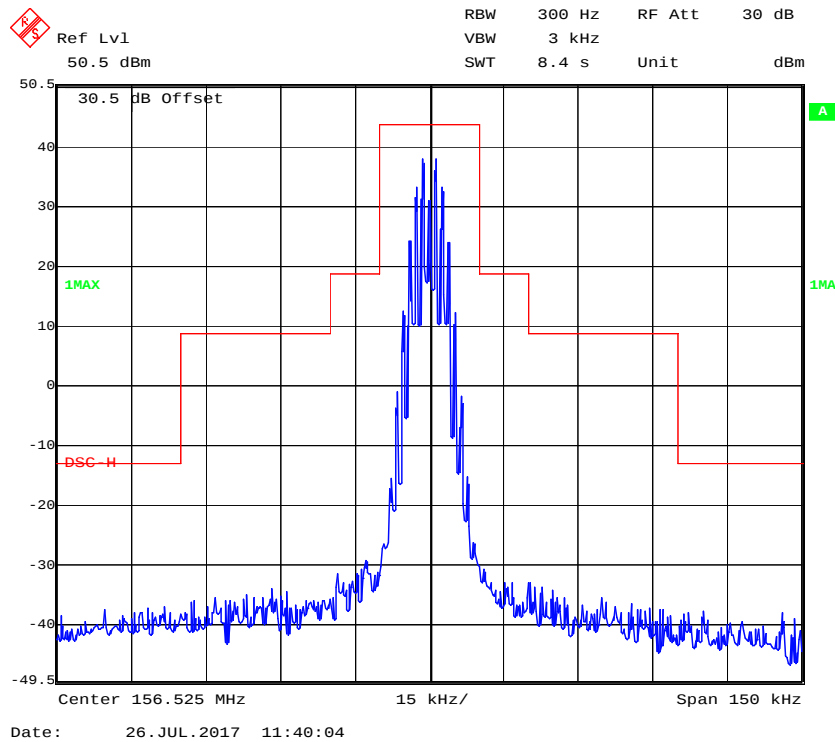
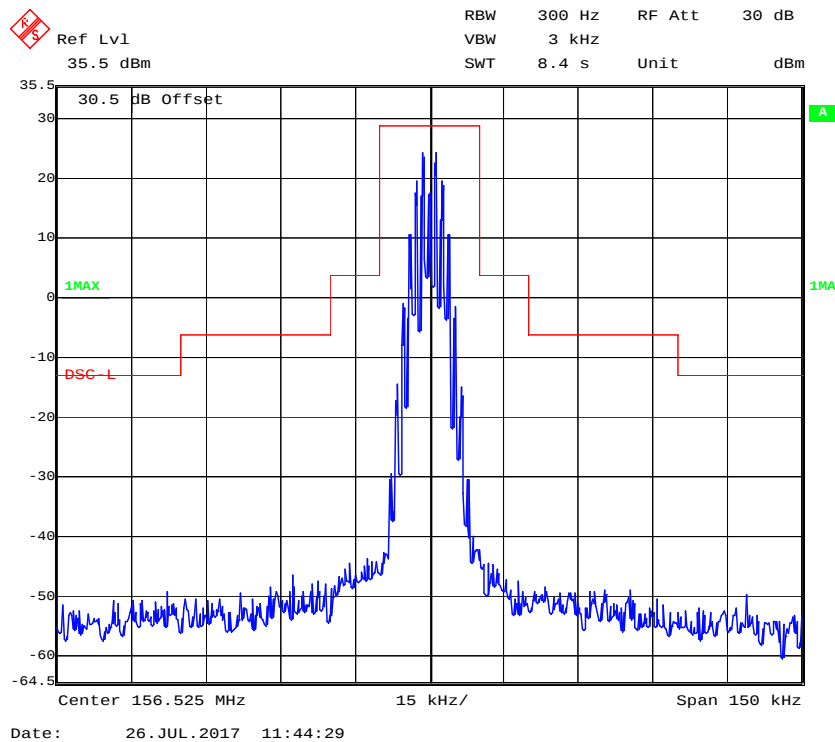
30 MHz – 1 GHz (DSC2100 Hz) , High Power

Fund.test with notch filter

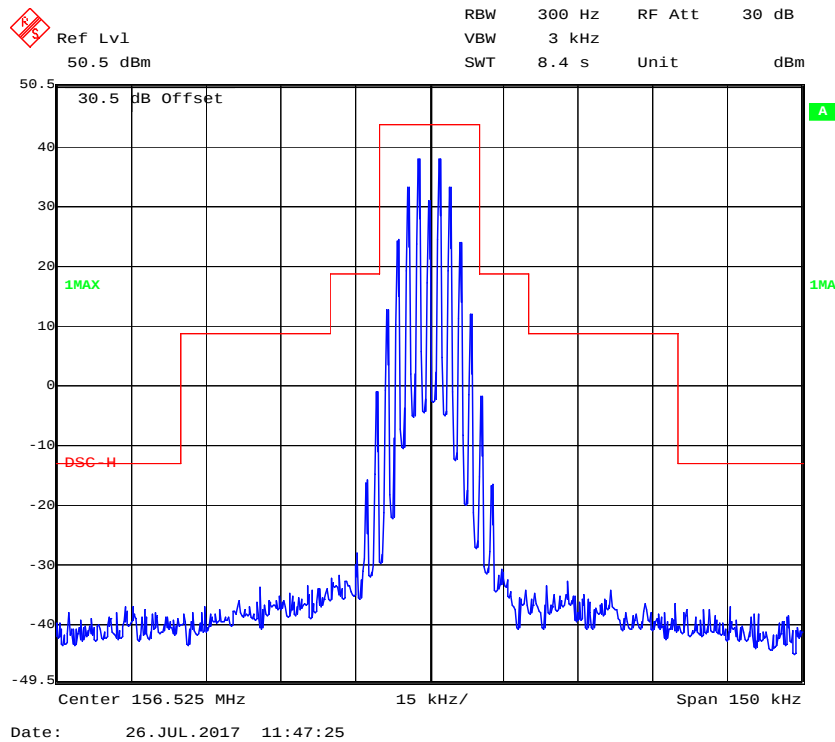


1 GHz – 2 GHz (DSC2100Hz), High Power

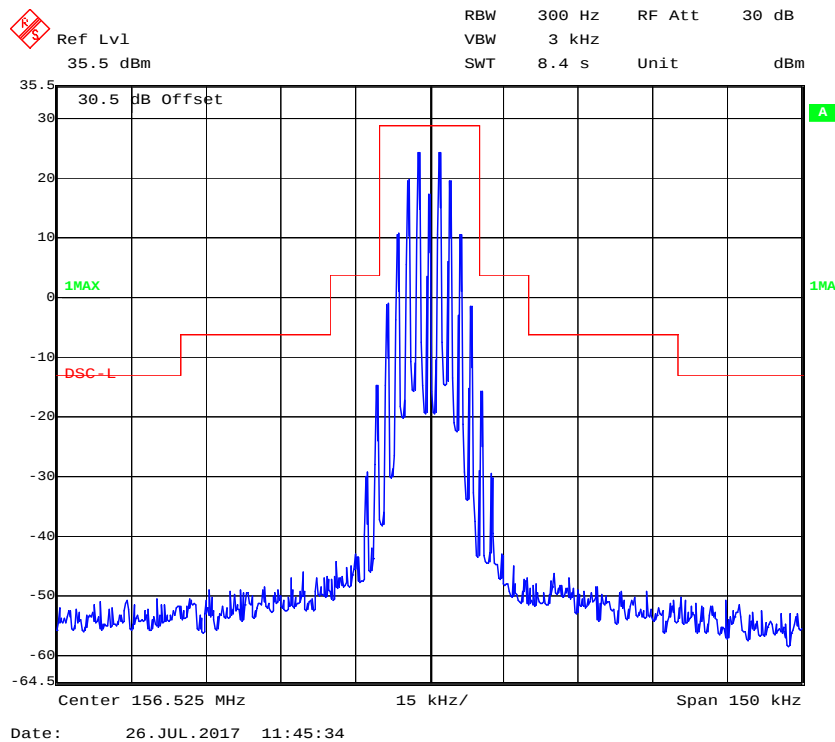


Emission Mask, (DSC1300Hz, High Power)**Emission Mask, (DSC1300Hz, Low Power)**

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 10 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.

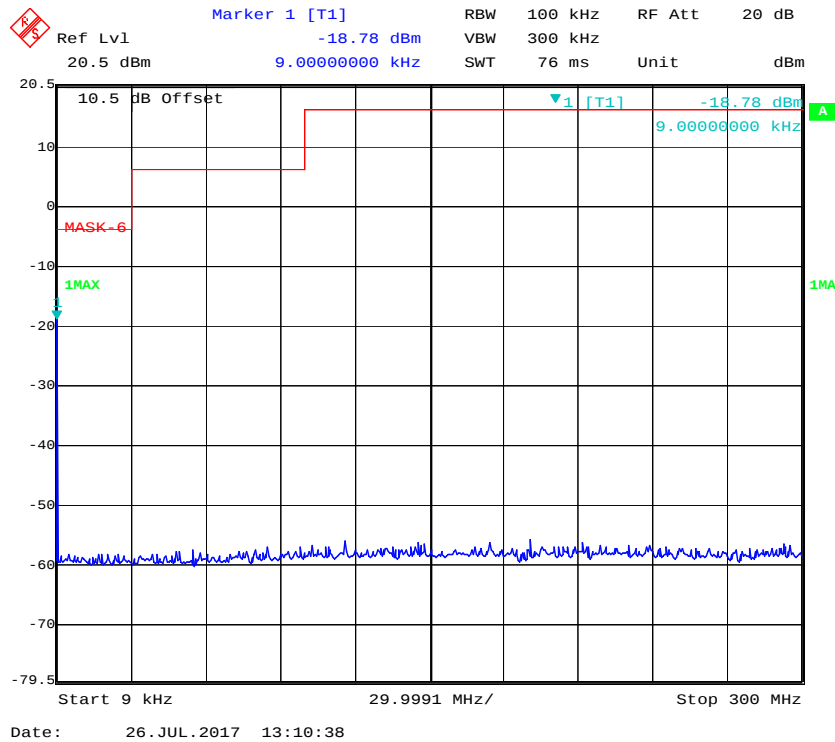
Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

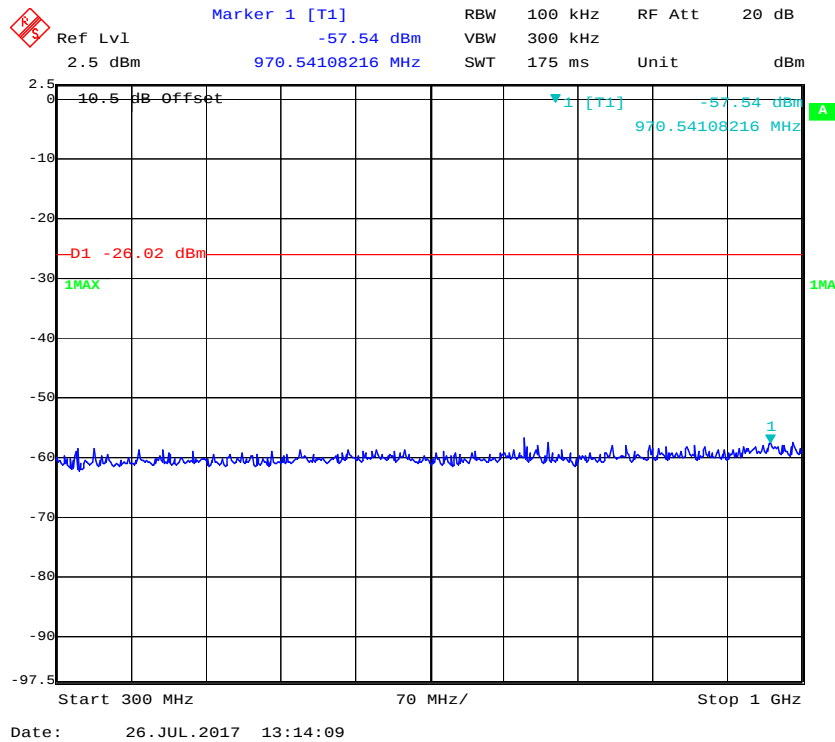
The testing was performed by Simon Wang on 2017-07-26.

Test Mode: Transmitting

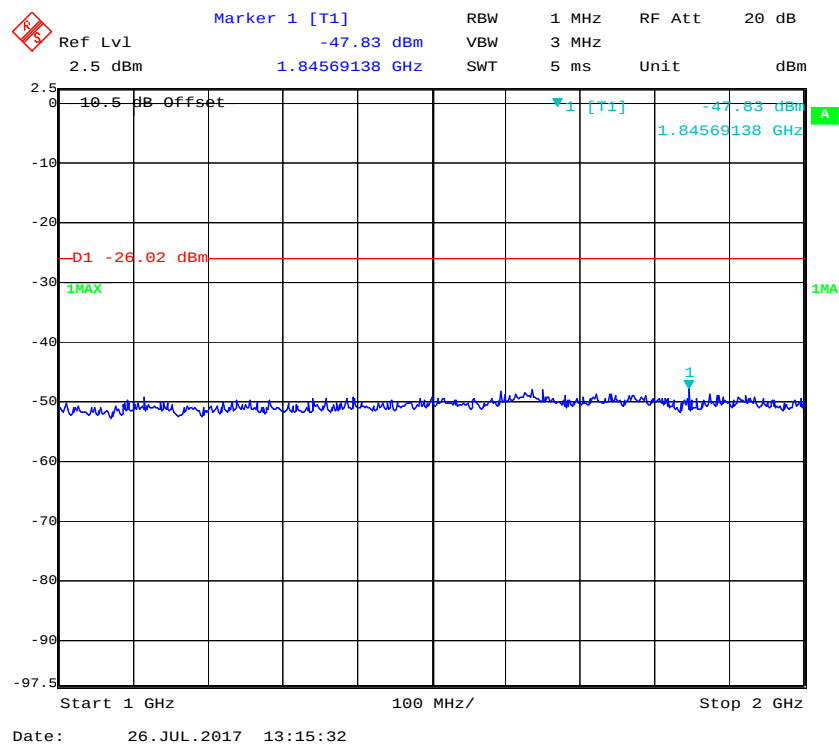
9 kHz – 300 MHz, 156.8 MHz



300 MHz – 1 GHz, 156.8 MHz



1 GHz – 2 GHz, 156.8 MHz



FCC §2.1053&§80.211 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, § 80.211

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 Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2017-07-27.

Test Mode: Transmitting

30 MHz – 2 GHz:

Frequency (MHz)	Receiver Reading (dBμV)	Turn Table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCC Part 80	
			Height (m)	Polar (H/V)	Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		Limit (dBm)	Margin (dB)
Radio telephony: 156.8 MHz										
313.6	44.17	127	1.3	H	-52.8	0.36	0	-53.16	-13	40.16
313.6	34.92	193	1.8	V	-62.1	0.36	0	-62.46	-13	49.46
470.4	35.84	224	2.4	H	-61.2	0.47	0	-61.67	-13	48.67
470.4	34.61	56	2	V	-62.4	0.47	0	-62.87	-13	49.87
627.2	43.06	45	2	H	-53.9	0.57	0	-54.47	-13	41.47
627.2	43.89	273	1.5	V	-53.1	0.57	0	-53.67	-13	40.67
784.0	42.97	169	2.5	H	-54	0.65	0	-54.65	-13	41.65
784.0	47.74	178	1.3	V	-49.3	0.65	0	-49.95	-13	36.95
1411.20	43.47	62	2.0	H	-64.5	1.60	8.30	-57.8	-13	44.8
1411.20	47.13	73	1.9	V	-61.1	1.60	8.30	-54.4	-13	41.4
1724.80	42.56	2	2.5	H	-64.9	1.30	9.10	-57.1	-13	44.1
1724.80	42.40	93	2.1	V	-64.5	1.30	9.10	-56.7	-13	43.7
DSC: 156.525 MHz										
469.58	43.87	43	1.9	H	-53.1	0.47	0	-53.57	-13	40.57
469.58	44.21	249	1.7	V	-52.8	0.47	0	-53.27	-13	40.27
626.1	39.86	300	2.2	H	-57.1	0.57	0	-57.67	-13	44.67
626.1	40.12	91	1.5	V	-56.9	0.57	0	-57.47	-13	44.47
782.63	43.99	103	2	H	-53	0.65	0	-53.65	-13	40.65
782.63	44.1	192	1.8	V	-52.9	0.65	0	-53.55	-13	40.55
1252.2	42.67	216	1.7	H	-65.5	1.60	7.60	-59.50	-13	46.50
1252.2	42.9	139	2.4	V	-65.2	1.60	7.60	-59.20	-13	46.20

Note:

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

FCC §2.1055 & §80.209- TRANSMITTER FREQUENCY TOLERANCES

Applicable Standard

FCC §2.1055, §80.209.

Test Procedure

Frequency Stability vs. Temperature:

From -20° to +50° 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 Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2017-07-27.

Test Mode: Transmitting

For Radio Telephony mode:

Reference Frequency: 156.8 MHz, Limit: ± 10.0 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	156.79960	-2.55
40	12	156.79958	-2.68
30	12	156.79963	-2.36
20	12	156.79954	-2.93
10	12	156.79957	-2.74
0	12	156.79962	-2.42
-10	12	156.79965	-2.23
-20	12	156.79971	-1.85

Reference Frequency: 156.8 MHz, Limit: ± 10.0 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	10.8	156.79970	-1.91
40	10.8	156.79959	-2.61
30	10.8	156.79963	-2.36
20	10.8	156.79954	-2.93
10	10.8	156.79966	-2.17
0	10.8	156.79961	-2.49
-10	10.8	156.79972	-1.79
-20	10.8	156.79974	-1.66

Reference Frequency: 156.8 MHz, Limit: ± 10.0 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	15.6	156.79954	-2.93
40	15.6	156.79968	-2.04
30	15.6	156.79975	-1.59
20	15.6	156.79967	-2.10
10	15.6	156.79974	-1.66
0	15.6	156.79960	-2.55
-10	15.6	156.79959	-2.61
-20	15.6	156.79977	-1.47

For DSC mode:

Reference Frequency: 156.525 MHz			
Test Environment		Transmitter Frequency (Hz)	
Temperature (°C)	Power Supplied (V _{DC})	B-State(2100Hz)	B-State(1300Hz)
Frequency Stability versus Input Temperature			
50	12	2100.02	1300.03
40	12	2100.05	1300.01
30	12	2100.04	1300.02
20	12	2100.06	1300.05
10	12	2100.07	1300.01
0	12	2100.04	1300.04
-10	12	2100.02	1300.01
-20	12	2100.00	1300.02

Reference Frequency: 156.525 MHz			
Test Environment		Transmitter Frequency (Hz)	
Temperature (°C)	Power Supplied (V _{DC})	B-State(2100Hz)	B-State(1300Hz)
Frequency Stability versus Input Temperature			
50	10.8	2100.02	1300.03
40	10.8	2100.05	1300.01
30	10.8	2100.04	1300.02
20	10.8	2100.06	1300.05
10	10.8	2100.07	1300.01
0	10.8	2100.04	1300.04
-10	10.8	2100.02	1300.01
-20	10.8	2100.00	1300.02

Reference Frequency: 156.525 MHz			
Test Environment		Transmitter Frequency (Hz)	
Temperature (°C)	Power Supplied (V _{DC})	B-State(2100Hz)	B-State(1300Hz)
Frequency Stability versus Input Temperature			
50	15.6	2100.01	1300.07
40	15.6	2100.02	1300.02
30	15.6	2100.03	1300.01
20	15.6	2100.04	1300.05
10	15.6	2100.05	1300.02
0	15.6	2100.04	1300.03
-10	15.6	2100.02	1300.01
-20	15.6	2100.01	1300.06

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

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