



FCC PART 80

TEST REPORT

For

Raymarine UK Ltd.

Marine House, Cartwright Drive Segensworth, Fareham, Hampshire, PO15 5RJ,
United Kingdom

FCC ID: PJ5-RAY90

Report Type: Original Report	Product Type: Ray 91 VHF Black Box with AIS Rx
Report Number:	RDG171114005-00A
Report Date:	2017-12-28
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The Raymarine UK Ltd.'s product, model number: *R70625 (FCC ID: PJ5-RAY90)* or the "EUT" in this report was a *Ray 91 VHF Black Box with AIS Rx*, which was measured approximately: 21.0 cm (L) x 16.0 cm (W) x 6.0 cm(H) for base, 6.5 cm (L) x 14.9 cm (W) x 3.2 cm(H) for handset, rated with input voltage: DC 12.0V.

Notes: This series products model: R70625 and R70624 are identical; they have the identical PCB,Material, only model name, product name and AIS module differently. Model R70625 was selected for fully testing, the detailed information can be referred to the declaration which was stated and guaranteed by the applicant.

** All measurement and test data in this report was gathered from production sample serial number: 171114005 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2017-11-14.*

Objective

This test report is prepared on behalf of Raymarine UK Ltd. 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

Parameter		uncertainty
Occupied Channel Bandwidth		±5%
RF output power, conducted		±1.5dB
Unwanted Emission, conducted		±1.5dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1°C
Supply voltages		±0.4%

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.

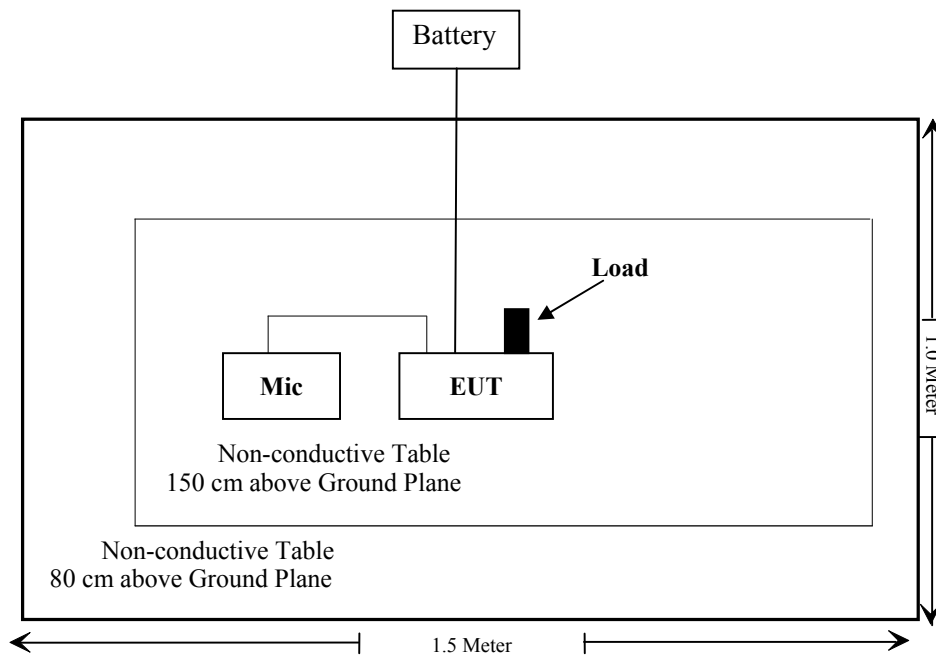
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Matrix	Battery	NP100-12	N/A

External I/O Cable

Cable Description	Length (m)	From/Port	To
/	/	/	/

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 (f)	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 (a) (5) (ii)	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
BIZI	Signal Analyzer	FSEM	845987/005	2017-08-24	2018-08-24
Rohde & Schwarz	Bi-log 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	2017-11-19	2018-05-21
Anritsu	Signal Generator	68369B	004114	2017-12-05	2018-12-05
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2017-12-07	2018-12-07
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	MFR64369 223410-001	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	104PEA	218124002	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	1	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	2	2017-11-22	2018-05-22
RF Conducted test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2016-12-05	2017-12-05
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2017-12-05	2018-12-05
HP Agilent	RF Communication test set	8920A	3325U00859	2017-05-07	2018-05-07
Ducommun technologies	RF Cable	RG-214	3	2017-11-22	2018-05-22
JFW	30dB Attenuator	50FH-030-100 RF	170006716507	2017-05-21	2018-05-21
LEADER	MILLIVOLTMETER	LMV-181A	6041126	2017-10-12	2018-10-12
Hewlett-Packard	Frequency Counter	5343A	2232A00827	2016-05-09	2019-05-08
ESPEC	Temperature & Humidity Chamber	EL-10KA	9107726	2017-11-22	2018-11-22
Long Wei	DC Power Supply	TPR-6420D	398363	NCR	NCR
N/A	High pass filter	1.3GHz	N/A	2017-11-19	2018-05-21

* **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.

Limits for Maximum Permissible Exposure (MPE)

(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		Max average output power	The minimum Distance (cm)	Power density (mW/cm ²)	MPE Limit (mW/cm ²)	Note
	(dBi)	(numeric)					
156.025 - 157.425	3	2	12500	130	0.118	0.2	Uncontrolled Environment

Note: The Maximum power is 25W (25000mW) which declared by manufacture. The duty cycle of 50% for this device, so the average power is 12500 mW

Radiation Exposure Statement:

To comply with RF exposure requirements, the minimum permissible distance is 130 cm 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 2017-11-23.

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	43.92	24.66
	Low	29.13	0.82
156.8	High	43.87	24.38
	Low	29.10	0.81
157.425	High	43.86	24.32
	Low	29.17	0.83

Output power for DSC:

Frequency	Test Mode	Power Level	Output Power (dBm)	Output Power (W)
156.525	1300 Hz	High	43.85	24.27
		Low	29.35	0.86
	2100 Hz	High	43.87	24.38
		Low	29.46	0.88

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 2017-11-23.

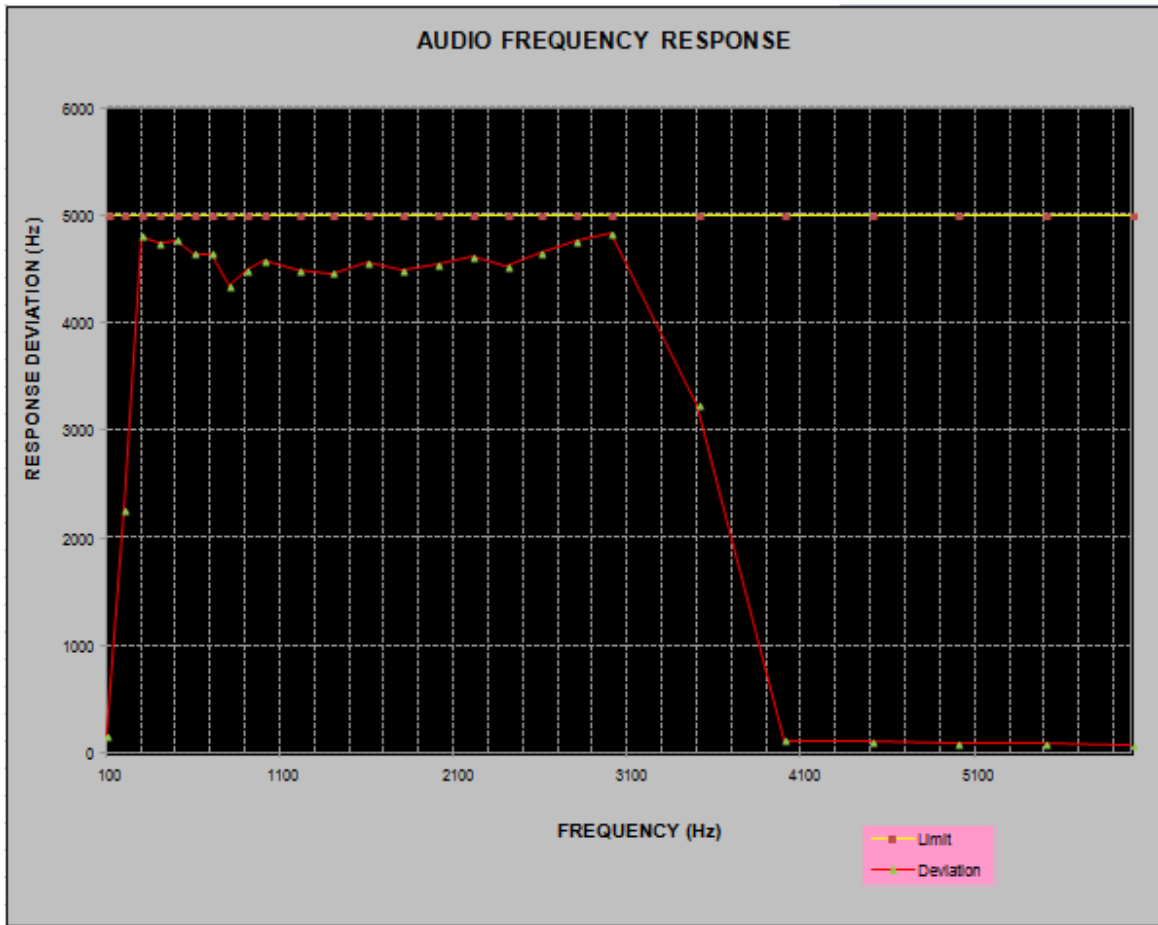
Test Mode: Transmitting

Result: Compliance.

Analog Modulation:**Maximum Deviation**

Carrier Frequency: 156.8 MHz

Modulation Frequency (Hz)	Maximum Deviation (Hz)	Limit (Hz)
100	167	5000
200	2260	5000
300	4802	5000
400	4744	5000
500	4768	5000
600	4640	5000
700	4643	5000
800	4342	5000
900	4488	5000
1000	4581	5000
1200	4488	5000
1400	4460	5000
1600	4564	5000
1800	4482	5000
2000	4542	5000
2200	4611	5000
2400	4529	5000
2600	4654	5000
2800	4762	5000
3000	4825	5000
3500	3239	5000
4000	115	5000
4500	102	5000
5000	95	5000
5500	90	5000
6000	72	5000



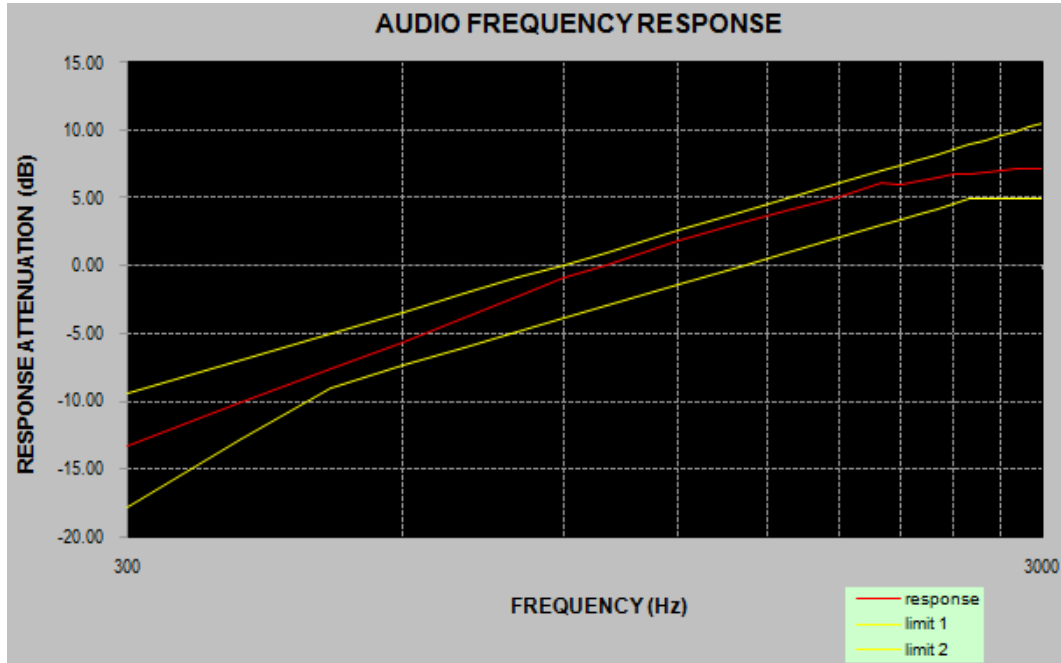
Carrier Frequency: 156.525 MHz, For DSC

Test Mode	Frequency Deviation(kHz)
1300Hz	2.707
2100Hz	4.540

Audio Frequency Response

Carrier Frequency: 156.8 MHz

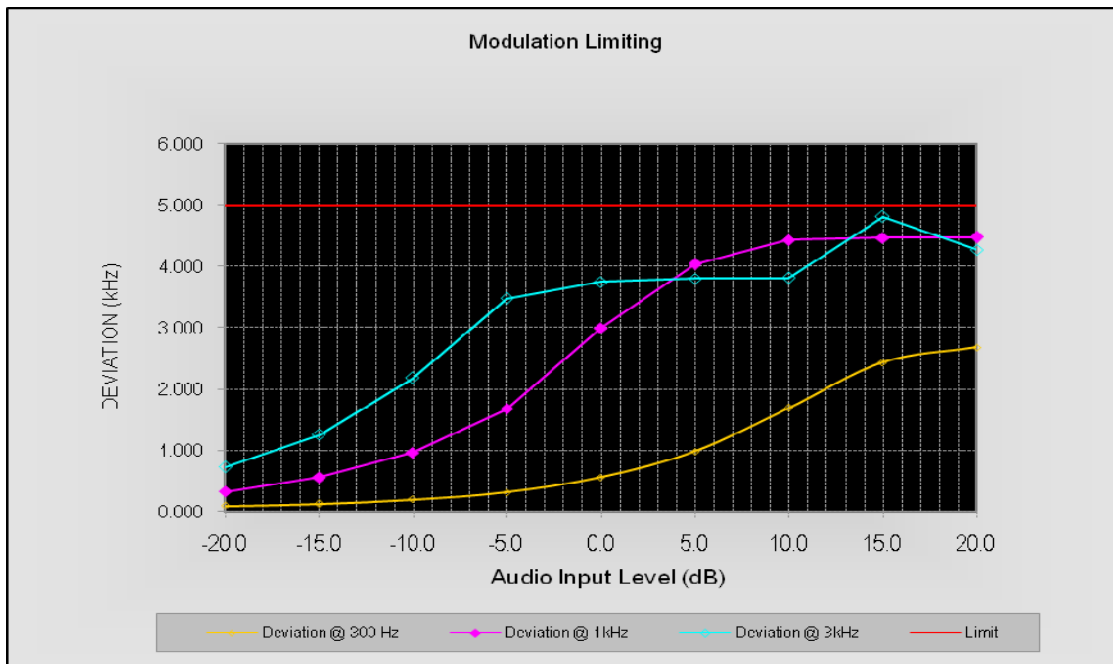
Modulation Frequency (Hz)	Response data (dB)
300	-13.35
400	-10.12
500	-7.62
600	-5.61
700	-3.82
800	-2.30
900	-0.90
1000	0
1200	1.86
1400	3.14
1600	4.15
1800	5.04
2000	6.09
2100	6.03
2200	6.30
2300	6.50
2400	6.71
2500	6.79
2600	6.90
2700	7.00
2800	7.15
2900	7.17
3000	7.12



MODULATION LIMITING

Carrier Frequency: 156.8 MHz, High Power

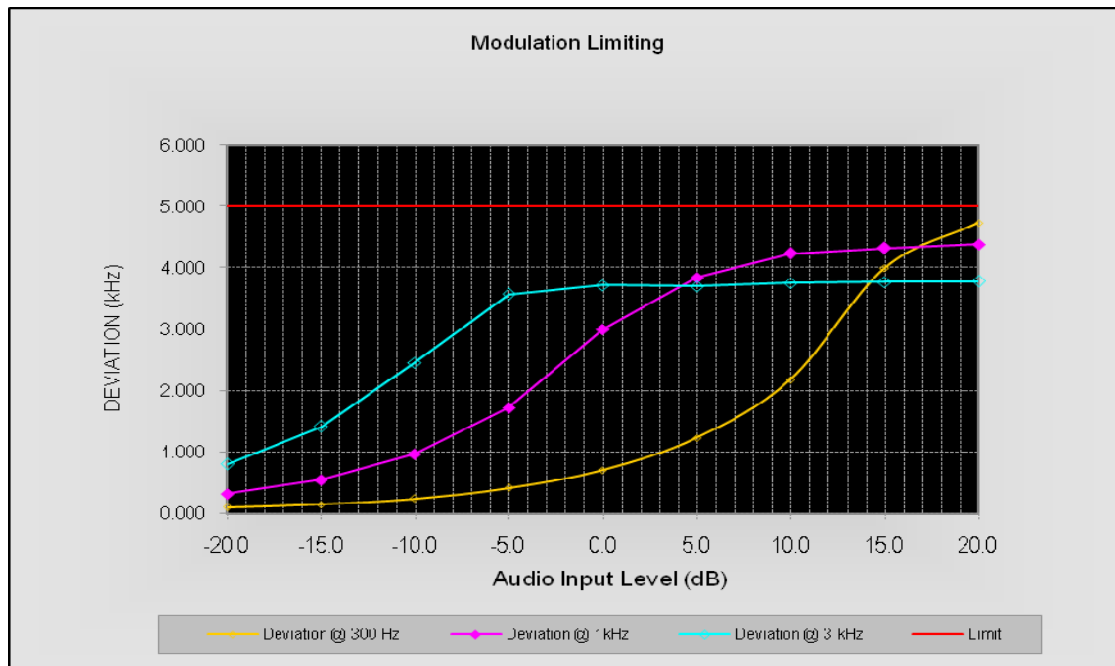
Audio Input Level [dB]	Frequency Deviation (kHz)			Limit [kHz]
	@ 300 Hz	@ 1kHz	@ 3 kHz	
20.0	2.686	4.482	4.283	5.0
15.0	2.439	4.468	4.815	5.0
10.0	1.694	4.435	3.814	5.0
5.0	0.985	4.039	3.808	5.0
0.0	0.569	3.000	3.751	5.0
-5.0	0.324	1.682	3.483	5.0
-10.0	0.211	0.971	2.184	5.0
-15.0	0.136	0.565	1.262	5.0
-20.0	0.103	0.334	0.736	5.0



MODULATION LIMITING

Carrier Frequency: 156.8 MHz, Low Power

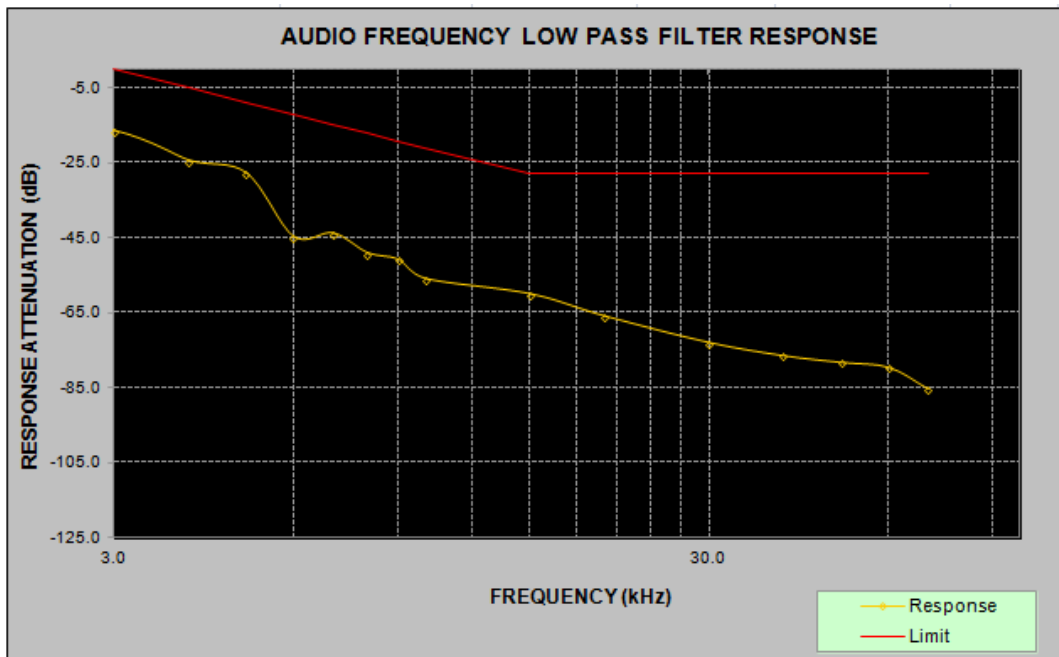
Audio Input Level [dB]	Frequency Deviation (kHz)			Limit [kHz]
	@ 300 Hz	@ 1kHz	@ 3 kHz	
20.0	4.735	4.381	3.778	5.0
15.0	3.997	4.321	3.767	5.0
10.0	2.179	4.234	3.755	5.0
5.0	1.231	3.845	3.698	5.0
0.0	0.707	3.000	3.720	5.0
-5.0	0.415	1.720	3.571	5.0
-10.0	0.242	0.968	2.455	5.0
-15.0	0.150	0.552	1.412	5.0
-20.0	0.102	0.319	0.805	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	-16.3	0
4.0	-24.2	-5.0
5.0	-27.6	-8.9
6.0	-44.5	-12.0
7.0	-43.6	-14.7
8.0	-48.9	-17.0
9.0	-50.6	-19.1
10.0	-55.7	-20.9
15.0	-59.8	-28.0
20.0	-65.7	-28.0
30.0	-72.8	-28.0
40.0	-76.3	-28.0
50.0	-78.1	-28.0
60.0	-79.4	-28.0
70.0	-85.2	-28.0



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

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:	24~25 °C
Relative Humidity:	49~53 %
ATM Pressure:	100.0~101.0 kPa

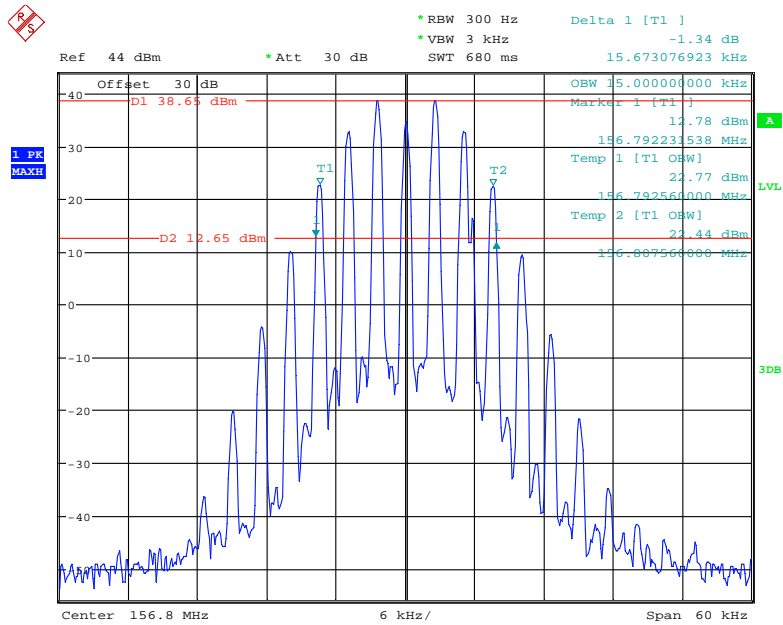
The testing was performed by Simon Wang from 2017-11-23 to 2017-12-06.

Test Mode: Transmitting

Test mode		Frequency(MHz)	Power level	99% Bandwidth(kHz)	26 dB Emission Bandwidth(kHz)
Radio Telephony		156.8	High	15.00	15.67
			Low	15.00	15.67
DSC	1300Hz	156.525	High	7.98	10.77
			Low	7.98	10.77
	2100Hz		High	12.88	17.21
			Low	12.79	17.21

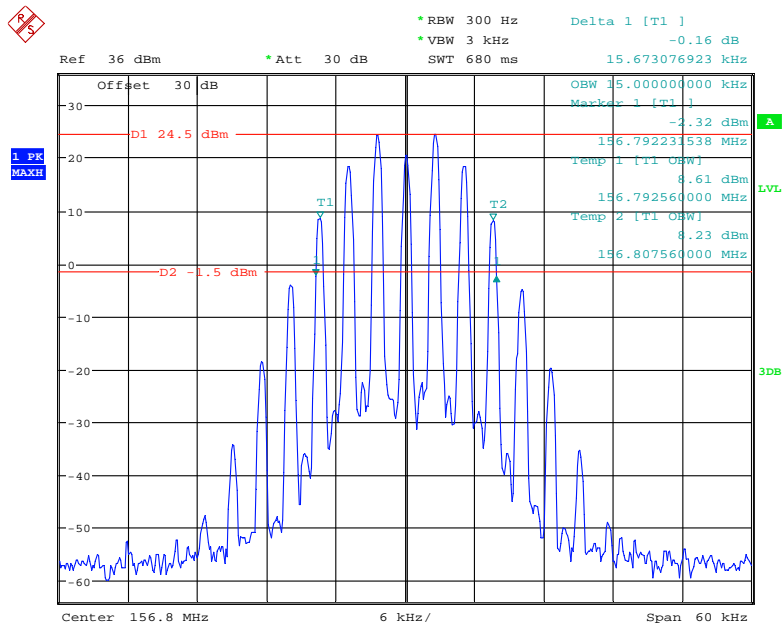
Note: Authorized bandwidth for this device is 20 kHz.

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



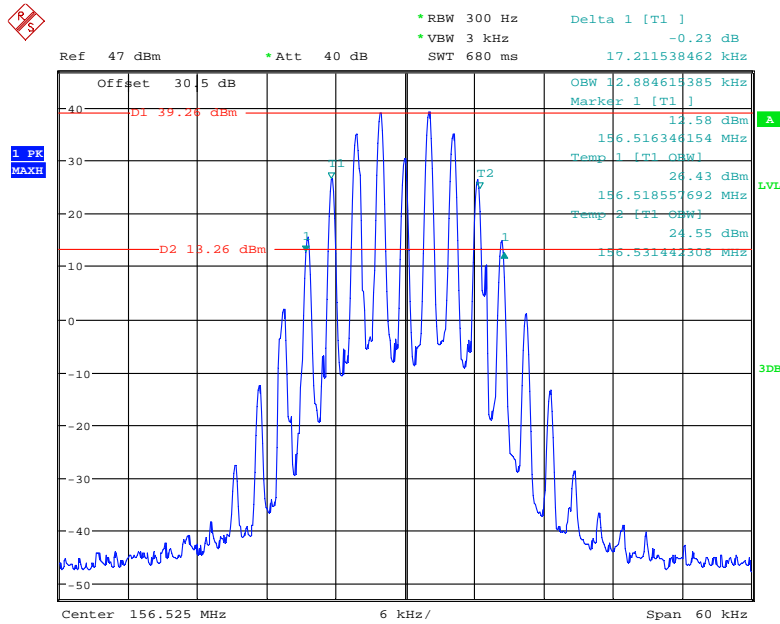
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99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.8 MHz, Low Power)



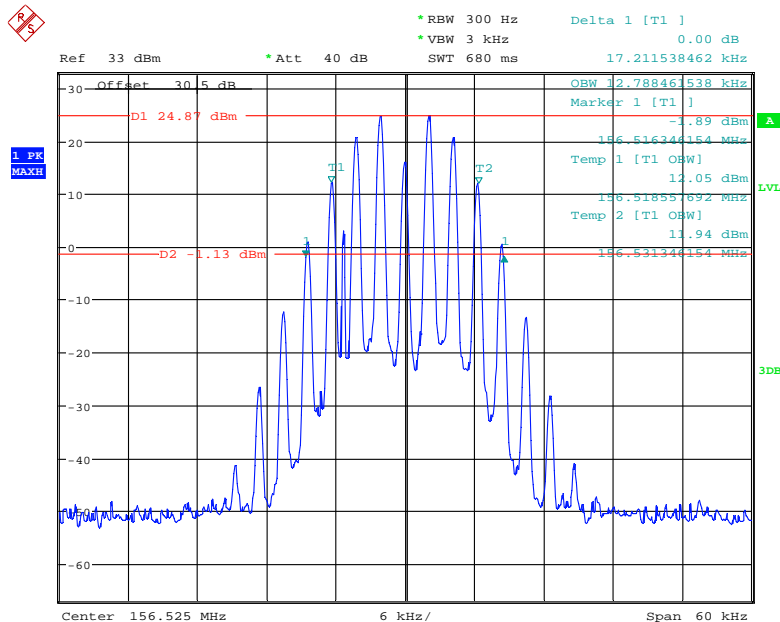
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99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC2100, High Power)



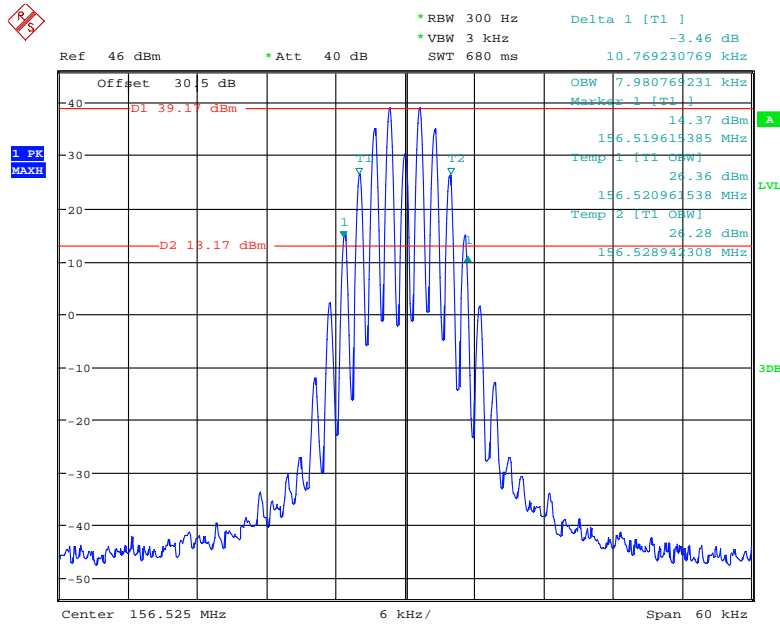
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99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC2100, Low Power)

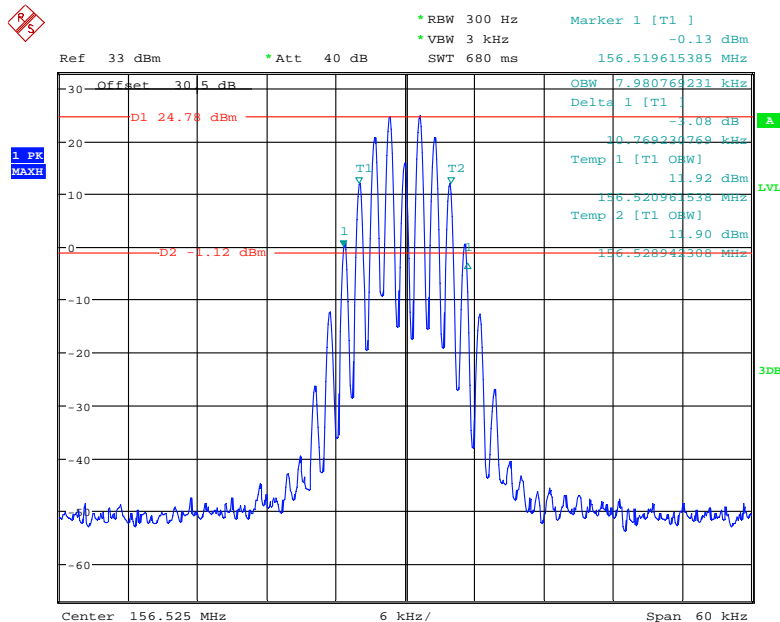


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99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC1300, High Power)



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



§2.1051 & §80.211 (f) - EMISSION LIMITATIONS.

Applicable Standard

According to FCC§80.211 (f):

- (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
- (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

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:	24~25 °C
Relative Humidity:	49~53 %
ATM Pressure:	100.0~101.0 kPa

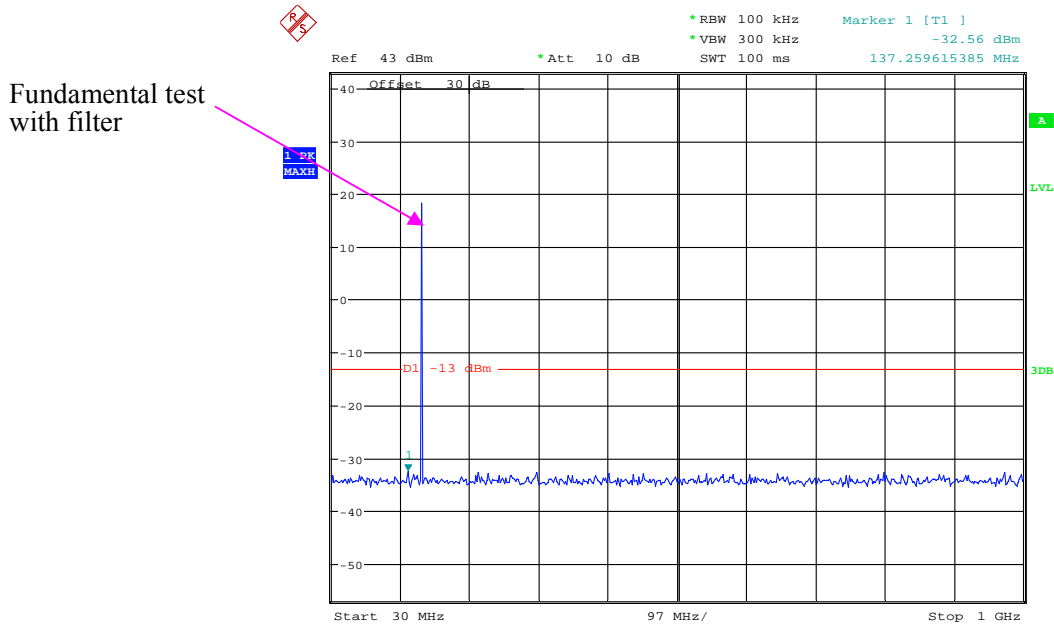
The testing was performed by Simon Wang from 2017-11-23 to 2017-12-06.

Test Mode: Transmitting

Please refer to the following plots.

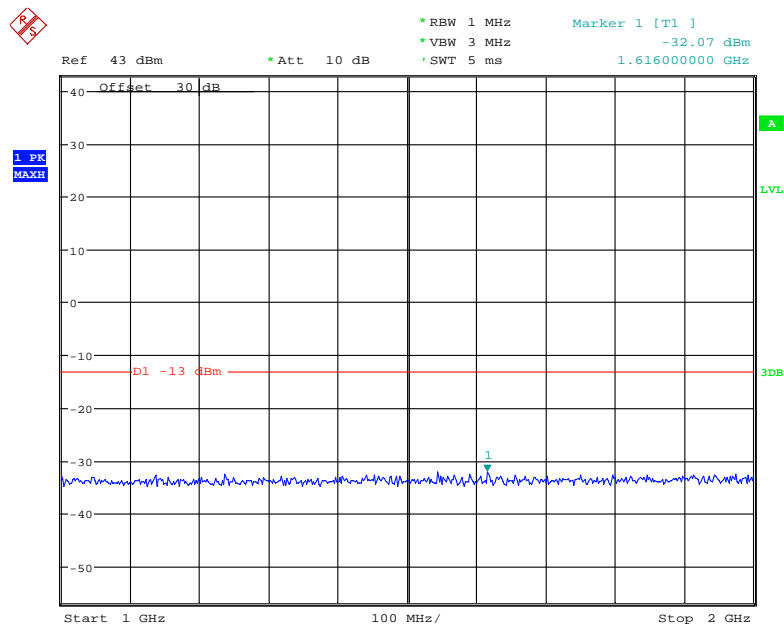
Radio Telephony (156.8 MHz):

30 MHz – 1 GHz, High Power



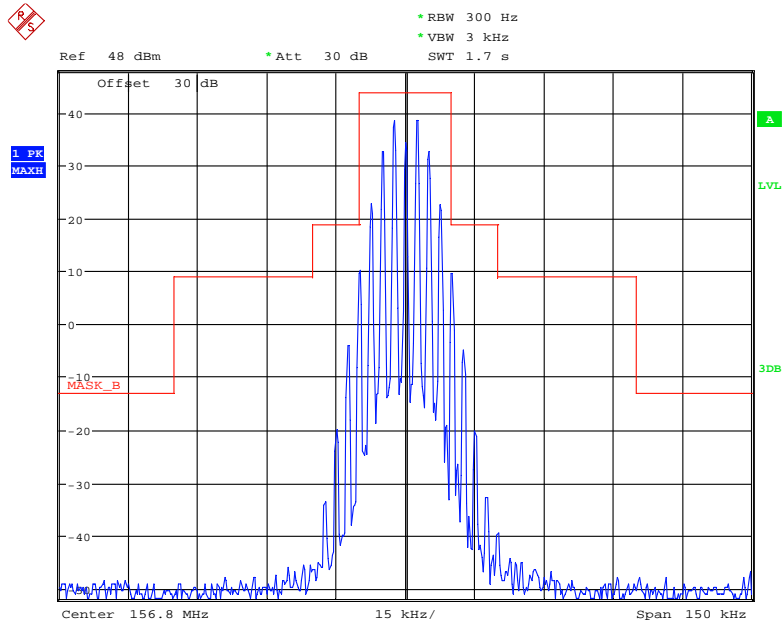
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1 GHz – 2 GHz, High Power



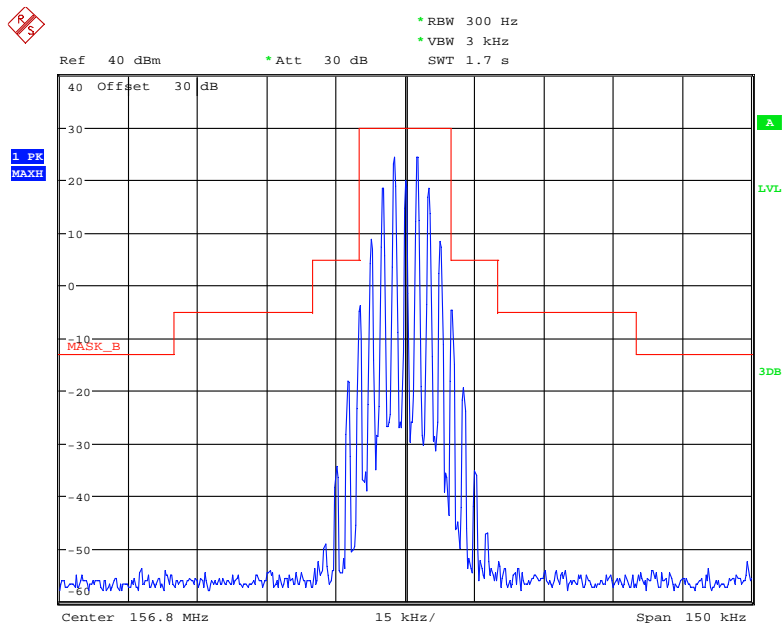
Date: 23.NOV.2017 09:16:45

Emission Mask, High Power



Date: 23.NOV.2017 09:52:07

Emission Mask, Low Power

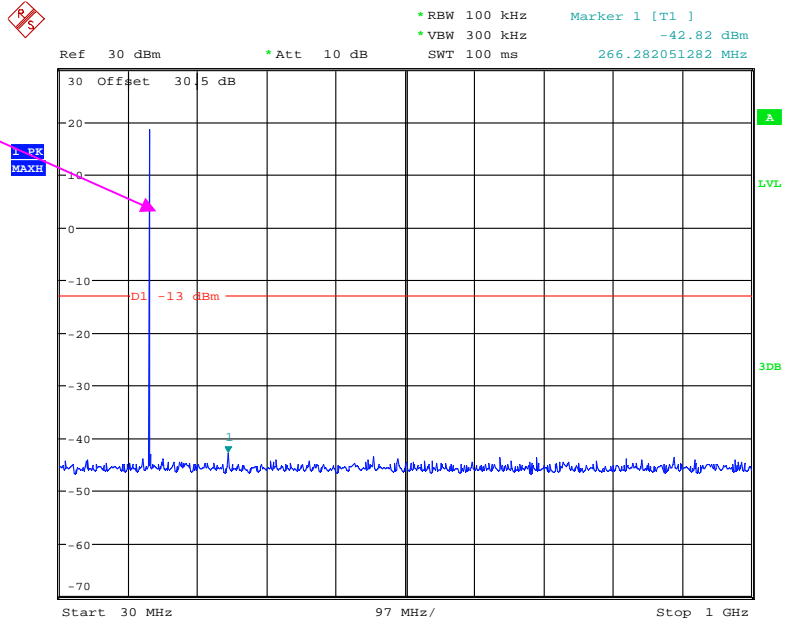


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DSC (152.525 MHz):

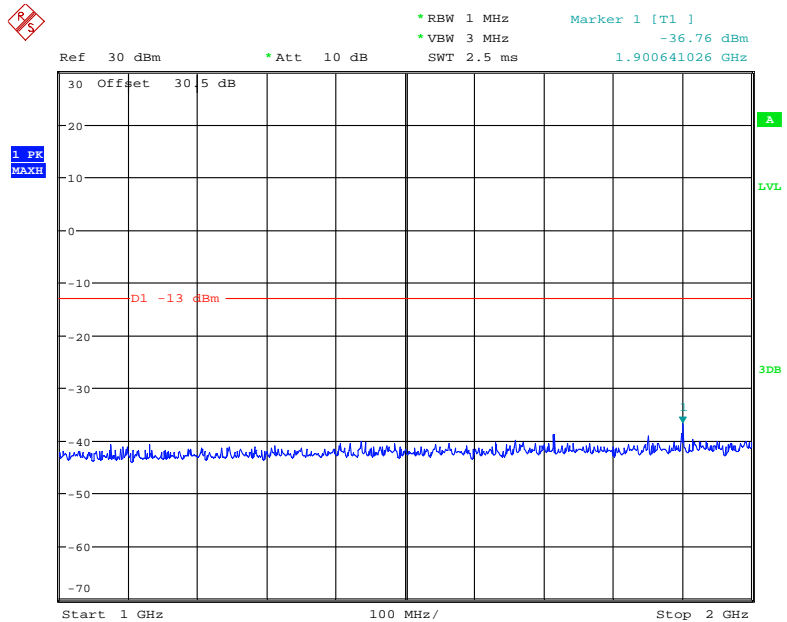
30 MHz – 1 GHz (DSC1300 Hz) , High Power

Fundamental test with filter



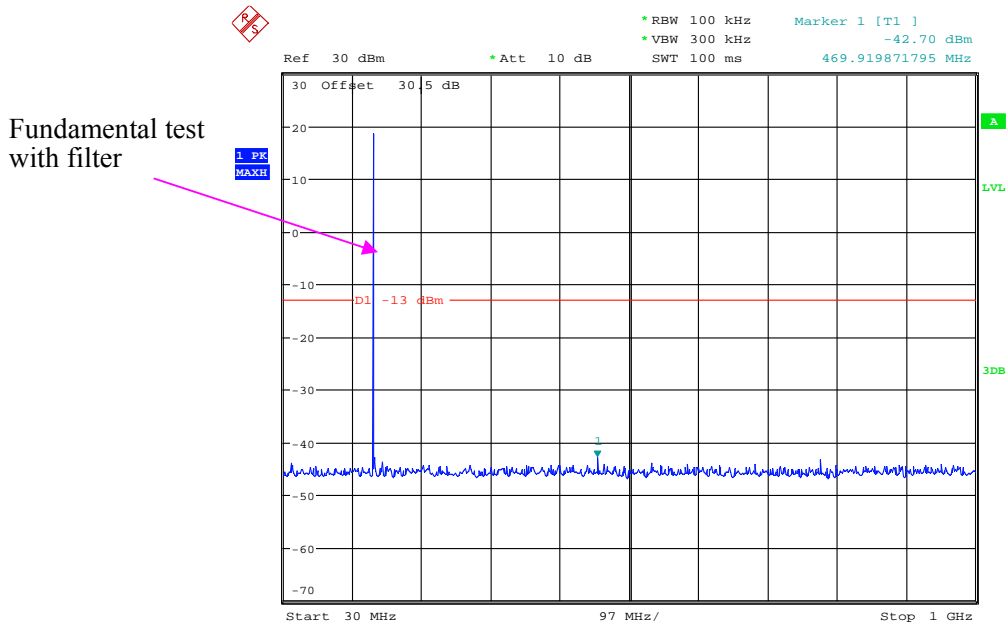
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1 GHz – 2 GHz (DSC1300 Hz), High Power



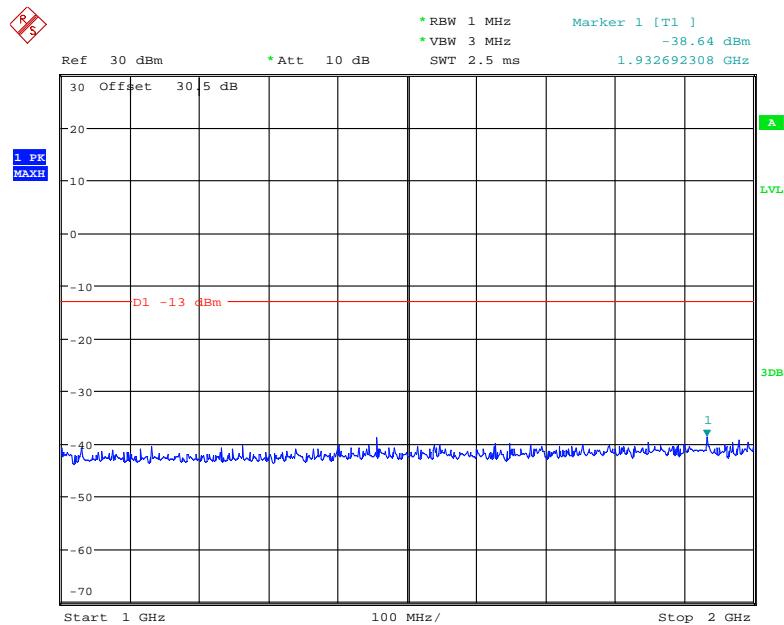
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30 MHz – 1 GHz (DSC2100 Hz) , High Power



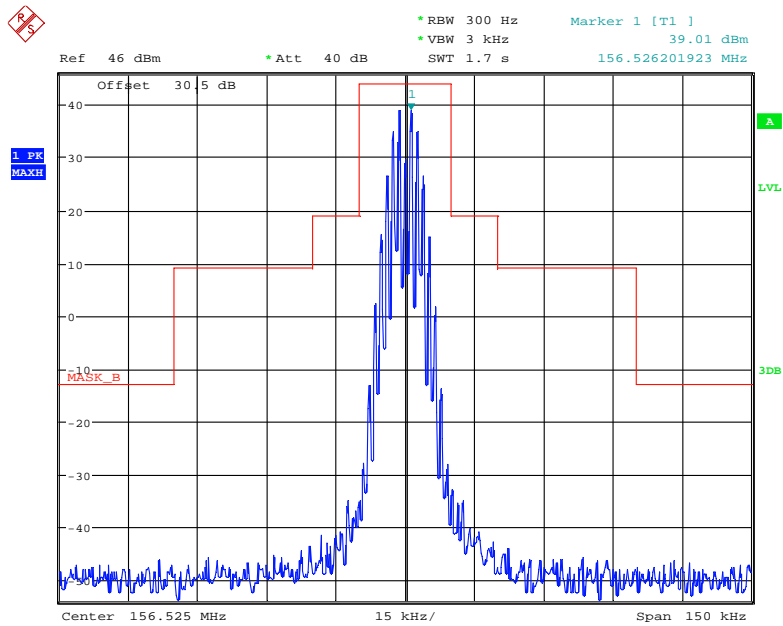
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1 GHz – 2 GHz (DSC2100Hz), High Power



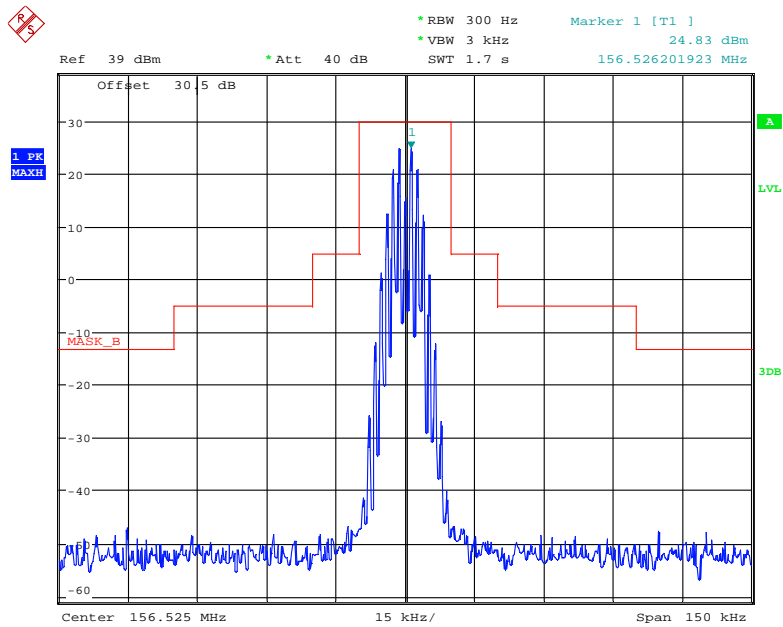
Date: 6.DEC.2017 12:25:40

Emission Mask, (DSC1300Hz, High Power)



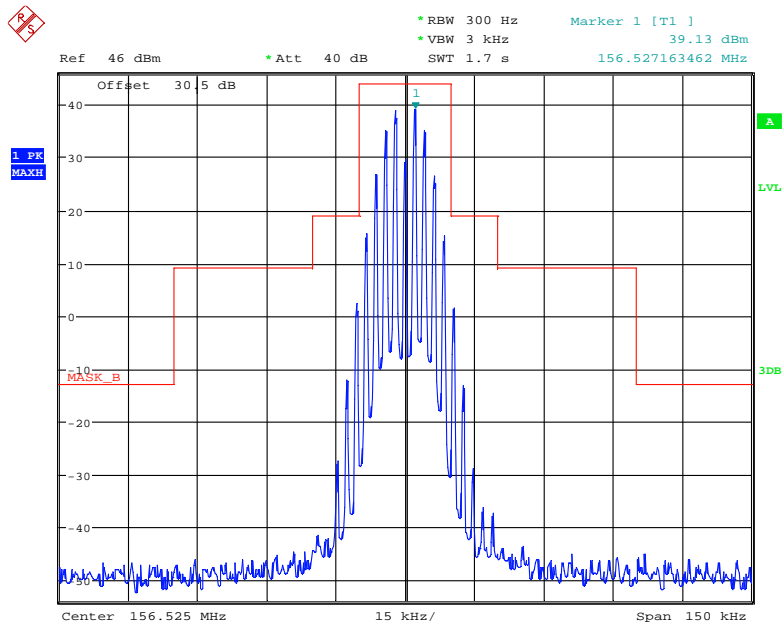
Date: 6.DEC.2017 12:39:36

Emission Mask, (DSC1300Hz, Low Power)



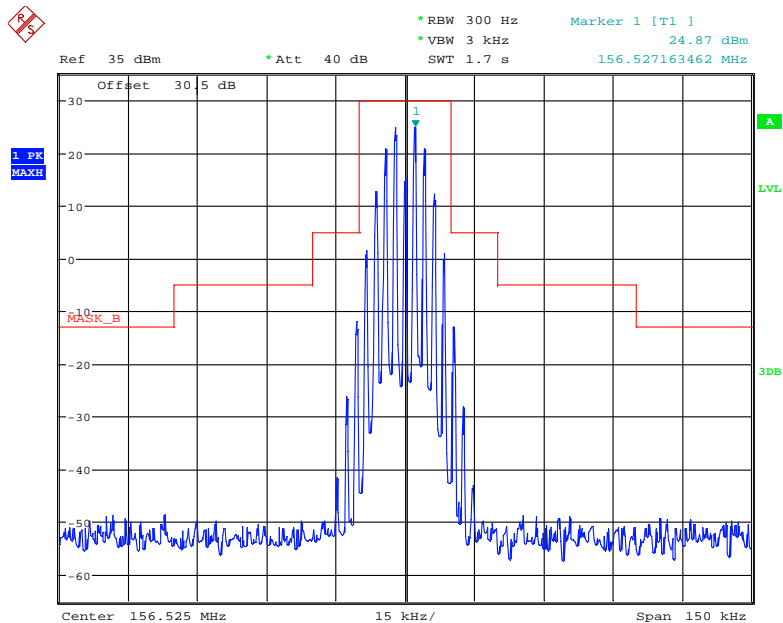
Date: 6.DEC.2017 12:41:45

Emission Mask, (DSC2100Hz, High Power)



Date: 6.DEC.2017 12:38:48

Emission Mask, (DSC2100Hz, Low Power)



Date: 6.DEC.2017 12:42:19

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:

Frequency of interfering emissions	Power to artificial antenna in microwatts	Power to artificial antenna in dBm
Below 30 MHz	400	-3.98
30 to 100 MHz	4000	6.02
100 to 300 MHz	40000	16.02
Over 300 MHz	400000	26.02

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. The traces were recorded as shown on the following pages.

Test Data


Environmental Conditions

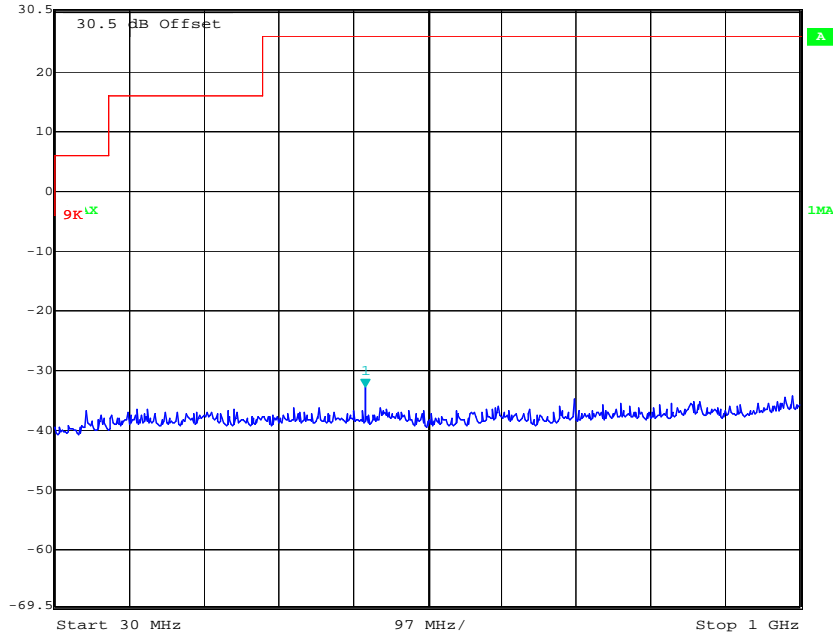
Temperature:	25 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2017-12-27.

Test Mode: Transmitting


30MHz – 1GHz, 156.8 MHz

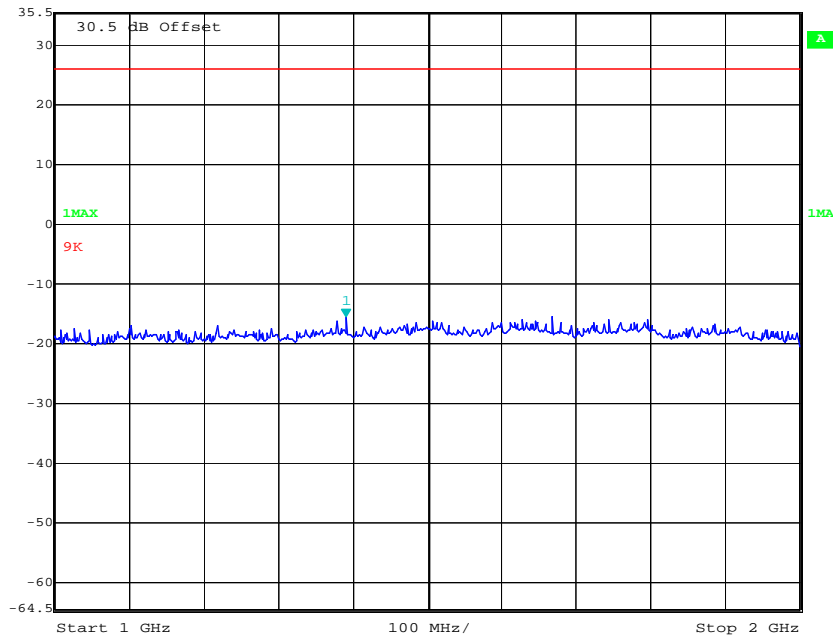
 Marker 1 [T1] RBW 100 kHz RF Att 20 dB
Ref Lvl -32.79 dBm VBW 300 kHz
30.5 dBm 434.32865731 MHz SWT 245 ms Unit dBm



Date: 27.DEC.2017 15:48:24

1 GHz – 2 GHz, 156.8 MHz

 Marker 1 [T1] RBW 1 MHz RF Att 30 dB
Ref Lvl -15.71 dBm VBW 3 MHz
35.5 dBm 1.39078156 GHz SWT 5 ms Unit dBm



Date: 27.DEC.2017 15:44:47

FCC §2.1053&§80.211 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, § 80.211

- (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
- (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

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 = $10 \lg(\text{TXpwr in Watts}/0.001)$ -the absolute level

Spurious attenuation limit in dB = $43 + 10 \text{Log}_{10}(\text{power out in Watts})$

Test Data

Environmental Conditions

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

The testing was performed by Simon Wang on 2017-12-06.

Test Mode: Transmitting

30 MHz – 2 GHz:

For model: R70625

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	39.07	46	1.1	H	-57.9	0.36	0	-58.26	-13	45.26
313.6	40.66	229	1.8	V	-56.3	0.36	0	-56.66	-13	43.66
627.2	49.63	126	1.8	H	-47.4	0.57	0	-47.97	-13	34.97
627.2	51.85	50	1.9	V	-45.1	0.57	0	-45.67	-13	32.67
784.0	46.78	313	2.2	H	-50.2	0.65	0	-50.85	-13	37.85
784.0	43.15	161	1.4	V	-53.8	0.65	0	-54.45	-13	41.45
1097.6	43.47	276	2.3	H	-65.1	1.60	6.90	-59.80	-13	46.80
1097.6	47.13	111	2.3	V	-62.3	1.60	6.90	-57.00	-13	44.00
1254.4	41.96	322	1.4	H	-66.2	1.60	7.60	-60.20	-13	47.20
1254.4	41.24	2	1.7	V	-66.9	1.60	7.60	-60.90	-13	47.90
DSC: 156.525 MHz										
313.05	39.45	125	1.5	H	-57.5	0.36	0	-57.86	-13	44.86
313.05	40.24	214	1.7	V	-56.8	0.36	0	-57.16	-13	44.16
626.1	50.16	158	1.2	H	-46.8	0.57	0	-47.37	-13	34.37
626.1	51.29	240	2.1	V	-45.7	0.57	0	-46.27	-13	33.27
782.625	47.12	65	1.6	H	-49.9	0.65	0	-50.55	-13	37.55
782.625	46.87	308	1.5	V	-50.1	0.65	0	-50.75	-13	37.75
1095.675	43.17	191	1.6	H	-65.4	1.60	6.90	-60.10	-13	47.10
1095.675	45.1	84	1.8	V	-64.3	1.60	6.90	-59.00	-13	46.00
1252.2	41.27	11	2.4	H	-66.9	1.60	7.60	-60.90	-13	47.90
1252.2	41.58	255	2.4	V	-66.5	1.60	7.60	-60.50	-13	47.50

For model: R70624

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	38.82	159	1.7	H	-58.2	0.36	0	-58.56	-13	45.56
313.6	39.75	188	1.5	V	-57.3	0.36	0	-57.66	-13	44.66
627.2	49.41	357	2.4	H	-47.6	0.57	0	-48.17	-13	35.17
627.2	51.29	60	1.6	V	-45.7	0.57	0	-46.27	-13	33.27
784.0	46.61	296	1.8	H	-50.4	0.65	0	-51.05	-13	38.05
784.0	42.57	340	1.4	V	-54.4	0.65	0	-55.05	-13	42.05
1097.6	43.13	77	2.1	H	-65.4	1.60	6.90	-60.10	-13	47.10
1097.6	46.43	118	1.5	V	-63.0	1.60	6.90	-57.70	-13	44.70
1254.4	41.54	98	2.3	H	-66.6	1.60	7.60	-60.60	-13	47.60
1254.4	40.41	330	2.0	V	-67.7	1.60	7.60	-61.70	-13	48.70
DSC: 156.525 MHz										
313.05	38.87	185	1.7	H	-58.1	0.36	0	-58.46	-13	45.46
313.05	40.14	282	1.5	V	-56.9	0.36	0	-57.26	-13	44.26
626.1	49.99	254	1.5	H	-47.0	0.57	0	-47.57	-13	34.57
626.1	50.75	61	1.4	V	-46.3	0.57	0	-46.87	-13	33.87
782.625	46.63	100	1.3	H	-50.4	0.65	0	-51.05	-13	38.05
782.625	46.59	332	1.7	V	-50.4	0.65	0	-51.05	-13	38.05
1095.675	42.29	32	2.2	H	-66.3	1.60	6.90	-61.00	-13	48.00
1095.675	44.85	82	2.1	V	-64.6	1.60	6.90	-59.30	-13	46.30
1252.2	41.09	185	1.3	H	-67.1	1.60	7.60	-61.10	-13	48.10
1252.2	41.36	91	2.0	V	-66.7	1.60	7.60	-60.70	-13	47.70

Note:

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

FCC §2.1055 & §80.209 (a) (5) (ii) - TRANSMITTER FREQUENCY TOLERANCES

Applicable Standard

FCC §2.1055, §80.209 (a) (5) (ii)

Test Procedure

Frequency Stability vs. Temperature:

From -20° to $+60^{\circ}$ 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 Data

Environmental Conditions

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

The testing was performed by Simon Wang on 2017-12-26.

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)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
60	12	156.80015	0.957
50	12	156.80013	0.829
40	12	156.80003	0.191
30	12	156.80002	0.128
20	12	156.80003	0.191
10	12	156.80001	0.064
0	12	156.80004	0.255
-10	12	156.80005	0.319
-20	12	156.80010	0.638

Reference Frequency: 156.8 MHz, Limit: ±10.0 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (°C)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
60	10.2	156.80012	0.765
50	10.2	156.80009	0.574
40	10.2	156.80002	0.128
30	10.2	156.80004	0.255
20	10.2	156.80003	0.191
10	10.2	156.80004	0.255
0	10.2	156.80005	0.319
-10	10.2	156.80002	0.128
-20	10.2	156.80006	0.383

Reference Frequency: 156.8 MHz, Limit: ± 10.0 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (°C)	Voltage Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
60	16	156.80010	0.638
50	16	156.80007	0.446
40	16	156.80010	0.638
30	16	156.80004	0.255
20	16	156.80003	0.191
10	16	156.80008	0.510
0	16	156.80005	0.319
-10	16	156.80006	0.383
-20	16	156.80012	0.765

Note 1: The extreme temperature and voltage is declared by manufacturer.

For DSC mode:

Reference Frequency: 156.525 MHz			
Test Conditions		Transmitter Frequency (Hz)	
Environment Temperature (°C)	Voltage Supplied (V _{DC})	B-State(2100Hz)	B-State(1300Hz)
25	12	2100.06	1300.05

Note 2: No limit is defined 80.209. Therefore limit from ITU 1371 is used ± 3 ppm

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