ACCREDITED
TESTING LABORATORY
CERTIFICATE # 4821.01

BACL
Bay Area Compliance Labs Corp.

FCC PART 80

TEST REPORT

For

Garmin International Inc

1200 E. 151st Street, Olathe, KS 66062, United States

FCC ID: IPH-02047

Report Type:	**Product Type:**
Original Report	VHF315 Main Black Box VHF Radio

Report Number: RDG180211001-00A

Report Date: 2018-04-08

Reviewed By: Rocky Kang, RF Engineer

Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen)
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Garmin International Inc*'s product, model number: *A02047 (FCC ID: IPH-02047)* or the "EUT" in this report was a *VHF315 Main Black Box VHF Radio*, which was measured approximately: 6.0 cm (H) x 20.5 cm (W) x 18.1 cm (D) for base, 15.4 cm (H) x 6.9 cm (W) x 4.0 cm (D) for handset, rated with input voltage: DC 12.0V.

** All measurement and test data in this report was gathered from production sample serial number: 180211001 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2018-02-11.*

Frequency Range	156.025-157.425 MHz
Modulation Type	G3E, G2B
Channel Separation	25kHz
Rated Output Power	High power level 25W Low power level 1.0W

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.

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℃
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.: 342867, the FCC Designation No.: CN1221.

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.

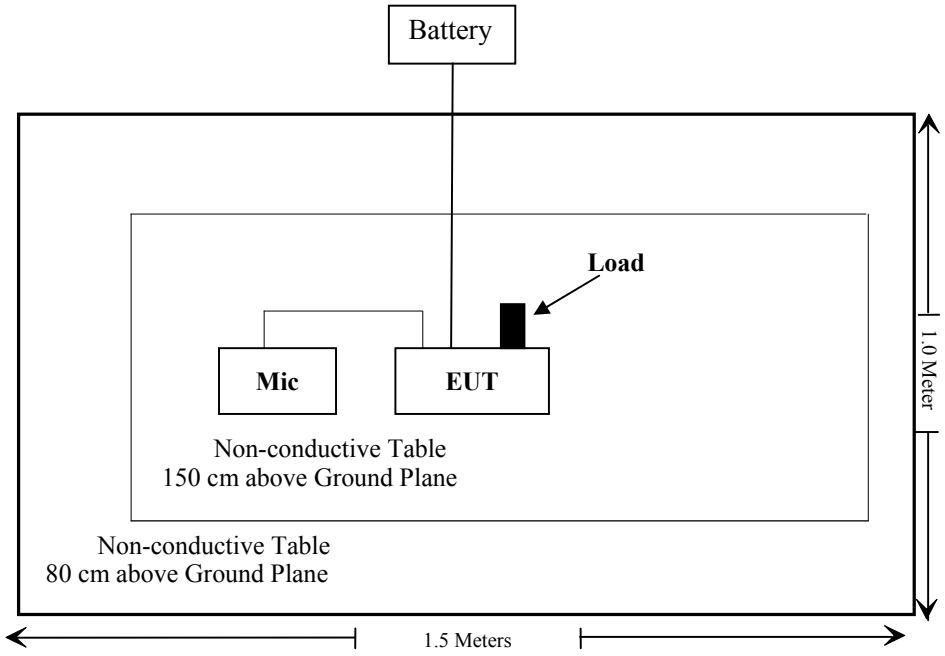
Support Equipment List and Details

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	2017-12-22	2020-12-21
Rohde & Schwarz	Signal Analyzer	FSEM	845987/005	2017-04-24	2018-04-24
Sunol Sciences	Bi-log Antenna	JB1	A040904-2	2017-12-13	2020-12-13
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-05-21	2018-05-21
HP	Amplifier	HP8447E	1937A01046	2017-11-19	2018-05-17
Anritsu	Signal Generator	68369B	004114	2017-12-24	2018-12-24
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2018-01-11	2019-01-11
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	2017-12-24	2018-12-24
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2017-08-19	2018-08-19
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

*** 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/cm^2)
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	9	7.94	12500	250	0.13	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 250 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:	26 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2018-03-23.

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	43.89	24.49
	Low	29.54	0.90
156.8	High	43.72	23.55
	Low	29.10	0.81
157.425	High	43.92	24.66
	Low	29.38	0.87

Output power for DSC:

Frequency	Test Mode	Power Level	Output Power (dBm)	Output Power (W)
156.525	1300 Hz	High	43.71	23.50
		Low	29.58	0.91
	2100 Hz	High	43.89	24.49
		Low	29.51	0.89

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:	26 ℃
Relative Humidity:	54 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2018-03-30.

Test Mode: Transmitting

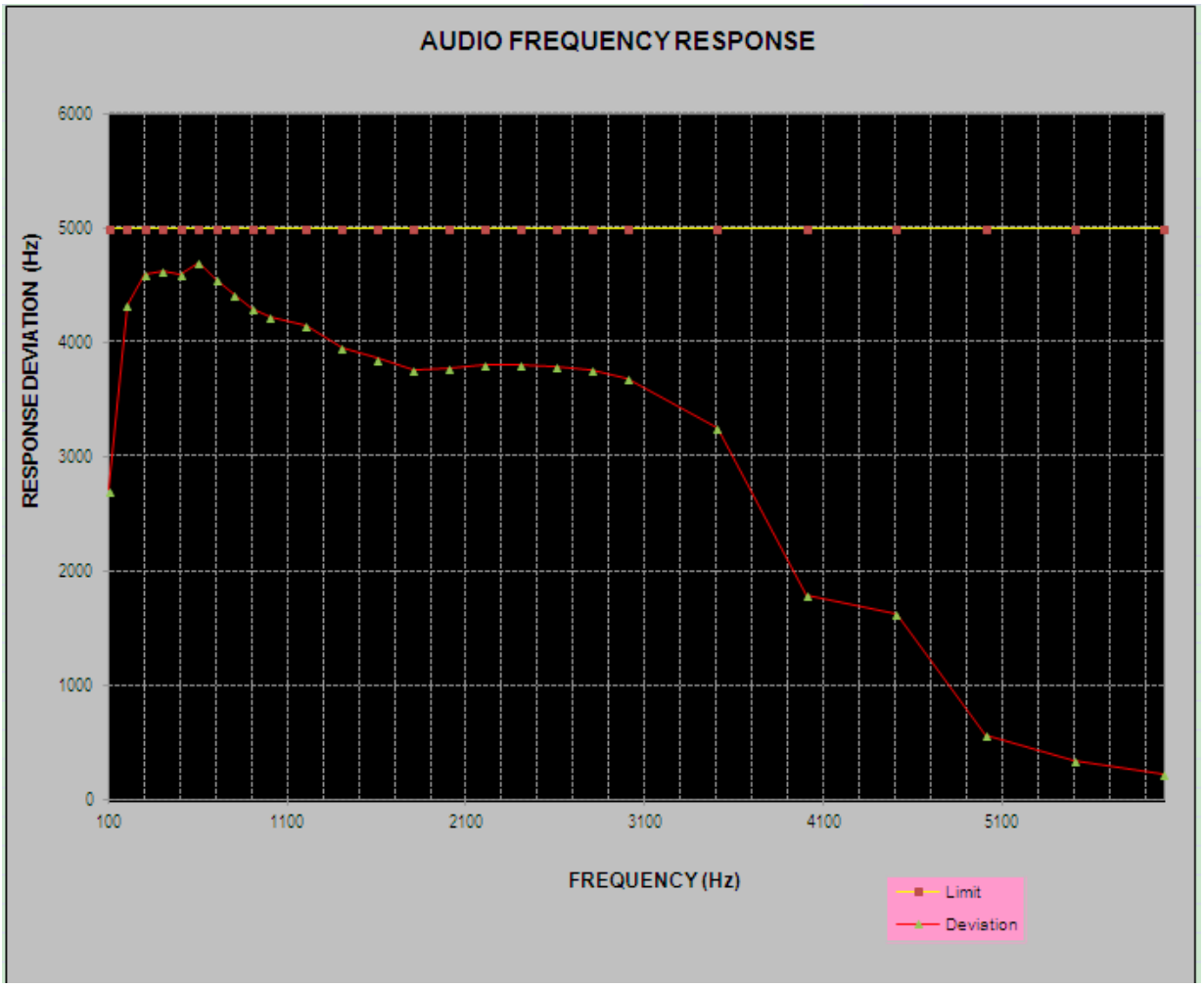
Result: Compliance.

Analog Modulation:

Maximum Deviation

Carrier Frequency: 156.8 MHz

Modulation Frequency (Hz)	Maximum Deviation (Hz)	Limit (Hz)
100	2710	5000
200	4326	5000
300	4601	5000
400	4630	5000
500	4601	5000
600	4705	5000
700	4545	5000
800	4412	5000
900	4302	5000
1000	4229	5000
1200	4142	5000
1400	3955	5000
1600	3858	5000
1800	3763	5000
2000	3773	5000
2200	3809	5000
2400	3801	5000
2600	3795	5000
2800	3760	5000
3000	3681	5000
3500	3252	5000
4000	1797	5000
4500	1623	5000
5000	574	5000
5500	343	5000
6000	224	5000



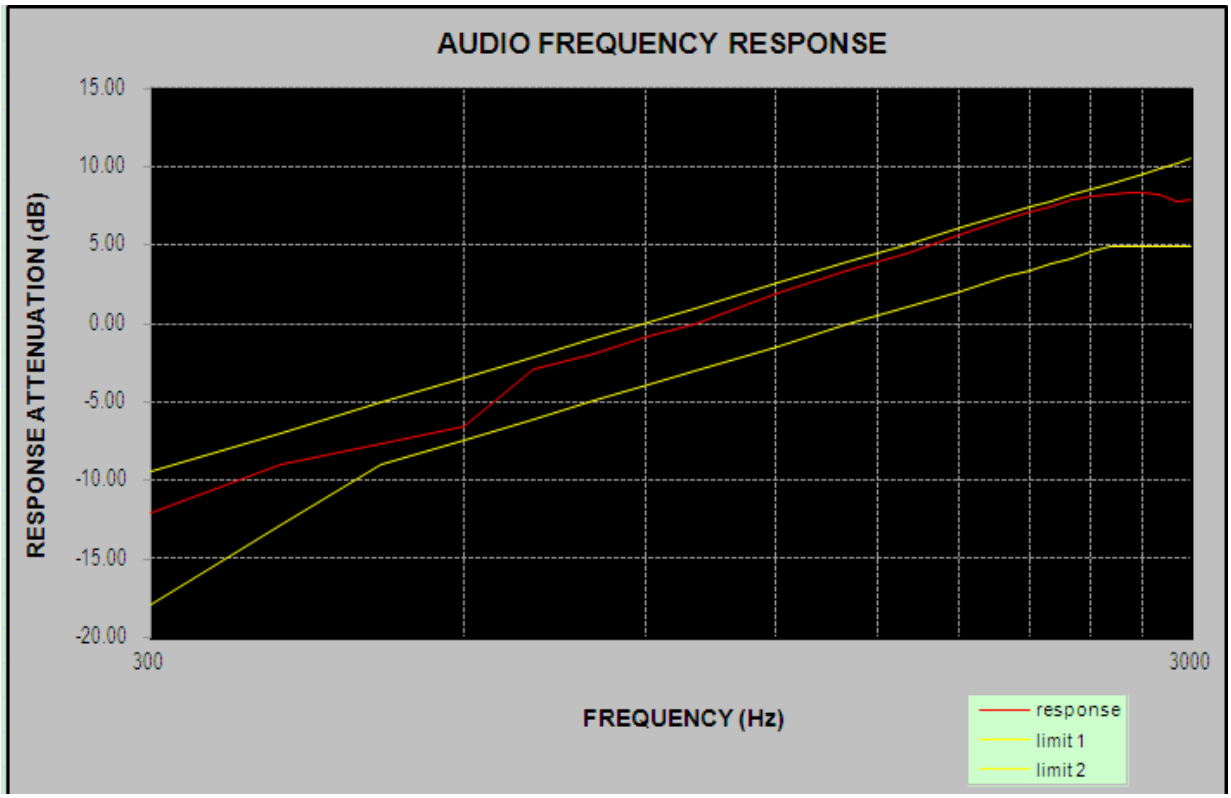
Carrier Frequency: 156.525 MHz, For DSC

Test Mode	Frequency Deviation(kHz)
1300Hz	2.574
2100Hz	4.325

Audio Frequency Response

Carrier Frequency: 156.8 MHz

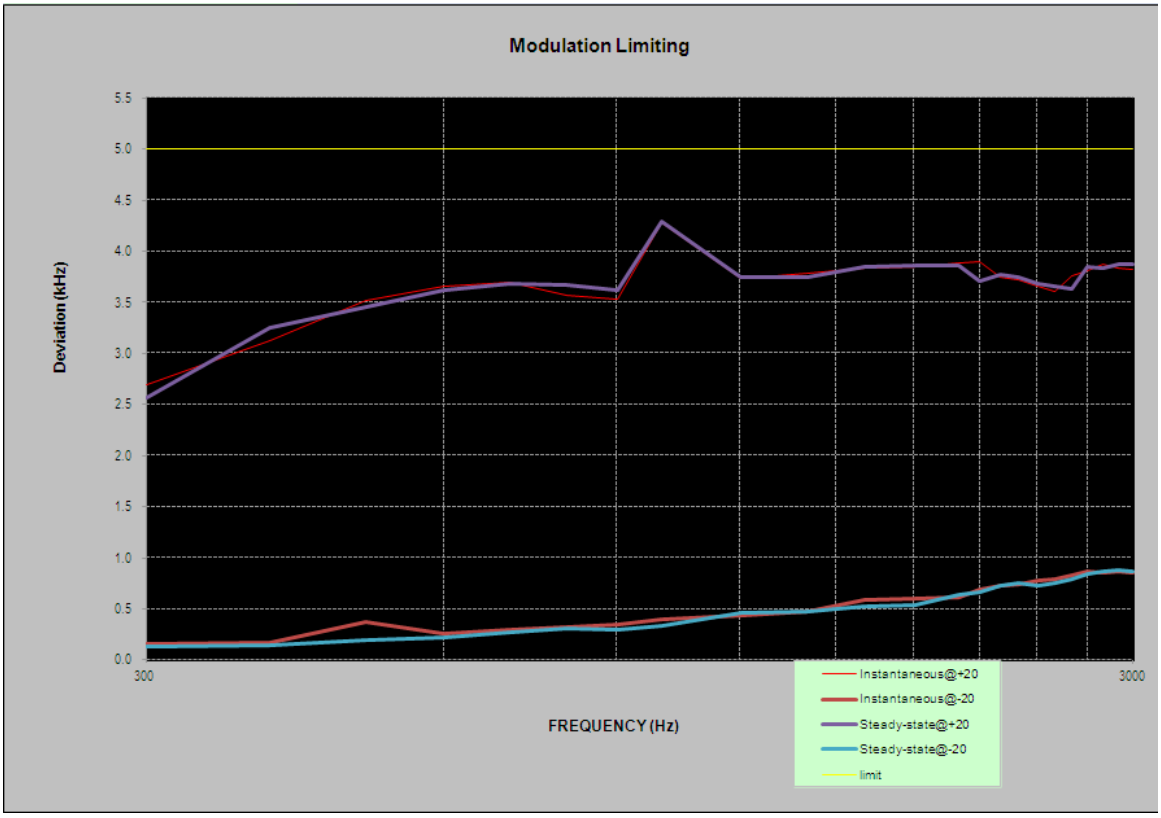
Modulation Frequency (Hz)	Response data (dB)
300	-12.01
400	-8.95
500	-7.62
600	-6.52
700	-2.95
800	-1.92
900	-0.77
1000	0.00
1200	1.90
1400	3.41
1600	4.49
1800	5.72
2000	6.68
2100	7.14
2200	7.50
2300	7.86
2400	8.08
2500	8.26
2600	8.33
2700	8.33
2800	8.26
2900	7.75
3000	7.91


AUDIO FREQUENCY RESPONSE
RESPONSE ATTENUATION (dB)
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
300
3000
FREQUENCY (Hz)
response
limit 1
limit 2

MODULATION LIMITING

Carrier Frequency: 156.8 MHz

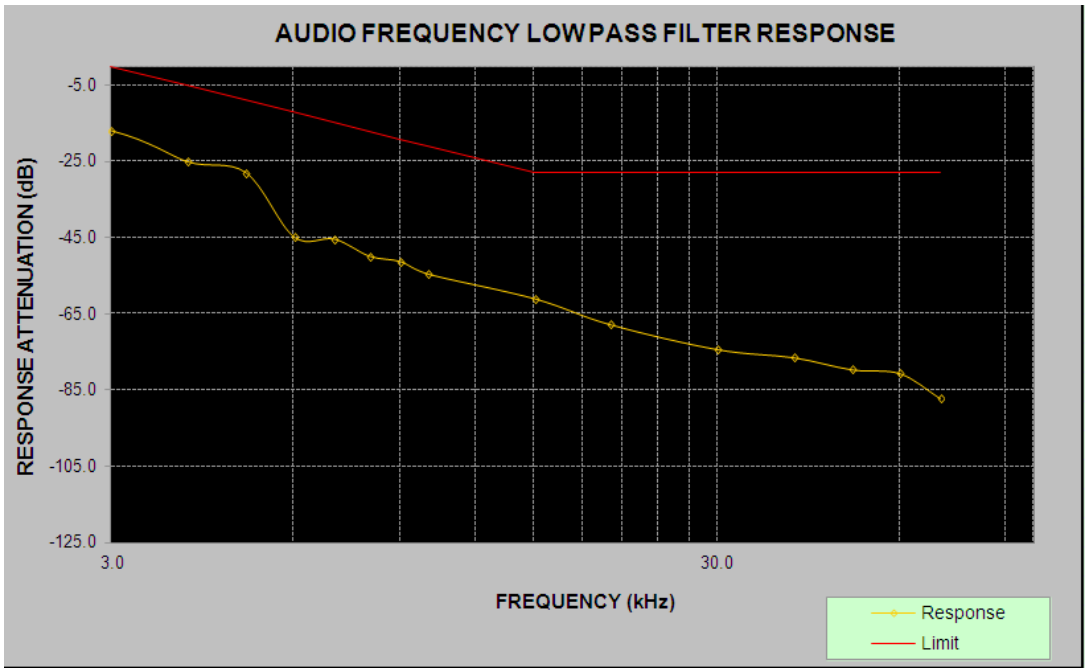
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit (Hz)
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	2.696	0.158	2.569	0.137	5.000
400	3.124	0.165	3.258	0.141	5.000
500	3.519	0.372	3.456	0.191	5.000
600	3.653	0.263	3.625	0.216	5.000
700	3.696	0.294	3.689	0.265	5.000
800	3.574	0.321	3.674	0.312	5.000
900	3.528	0.345	3.625	0.298	5.000
1000	4.284	0.396	4.292	0.329	5.000
1200	3.734	0.435	3.741	0.463	5.000
1400	3.784	0.472	3.752	0.475	5.000
1600	3.837	0.589	3.852	0.528	5.000
1800	3.845	0.597	3.863	0.542	5.000
2000	3.885	0.614	3.856	0.638	5.000
2100	3.899	0.687	3.715	0.662	5.000
2200	3.742	0.726	3.769	0.724	5.000
2300	3.718	0.745	3.746	0.750	5.000
2400	3.663	0.776	3.689	0.734	5.000
2500	3.610	0.787	3.658	0.756	5.000
2600	3.758	0.834	3.637	0.797	5.000
2700	3.815	0.867	3.853	0.836	5.000
2800	3.875	0.853	3.836	0.864	5.000
2900	3.836	0.871	3.874	0.881	5.000
3000	3.826	0.853	3.871	0.863	5.000


Modulation Limiting
Deviation (kHz)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
3000
FREQUENCY (Hz)
Instantaneous@+20
Instantaneous@-20
Steady-state@+20
Steady-state@-20
limit

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	-16.8	0.0
4.0	-24.9	-5.0
5.0	-27.8	-8.9
6.0	-44.6	-12.0
7.0	-45.2	-14.7
8.0	-49.7	-17.0
9.0	-51.1	-19.1
10.0	-54.4	-20.9
15.0	-60.9	-28.0
20.0	-67.7	-28.0
30.0	-74.2	-28.0
40.0	-76.3	-28.0
50.0	-79.5	-28.0
60.0	-80.5	-28.0
70.0	-87.1	-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 ℃
Relative Humidity:	50~53 %
ATM Pressure:	100.6~101.0 kPa

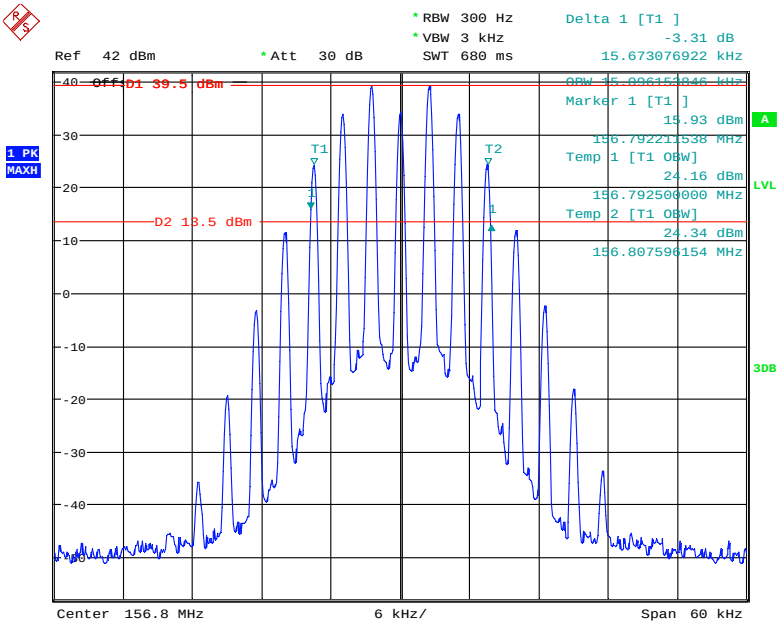
The testing was performed by Simon Wang from 2018-03-13 to 2018-04-08.

Test Mode: Transmitting

Test mode		Frequency(MHz)	Power level	99% Bandwidth(kHz)	26 dB Emission Bandwidth(kHz)
Radio Telephony		156.8	High	15.10	15.67
			Low	15.10	15.67
DSC	1300Hz	156.525	High	7.98	10.58
			Low	7.98	10.58
	2100Hz		High	12.84	16.84
			Low	12.84	16.84

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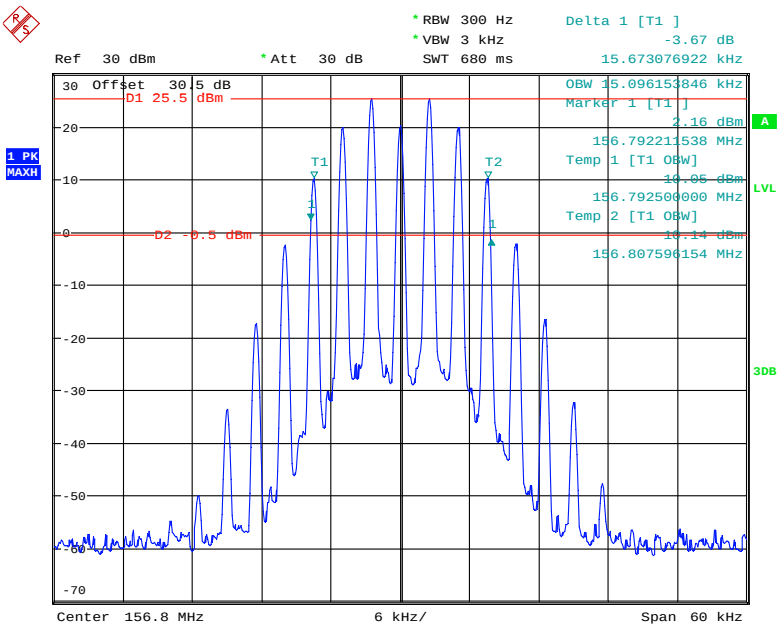
99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.8 MHz, Low Power)



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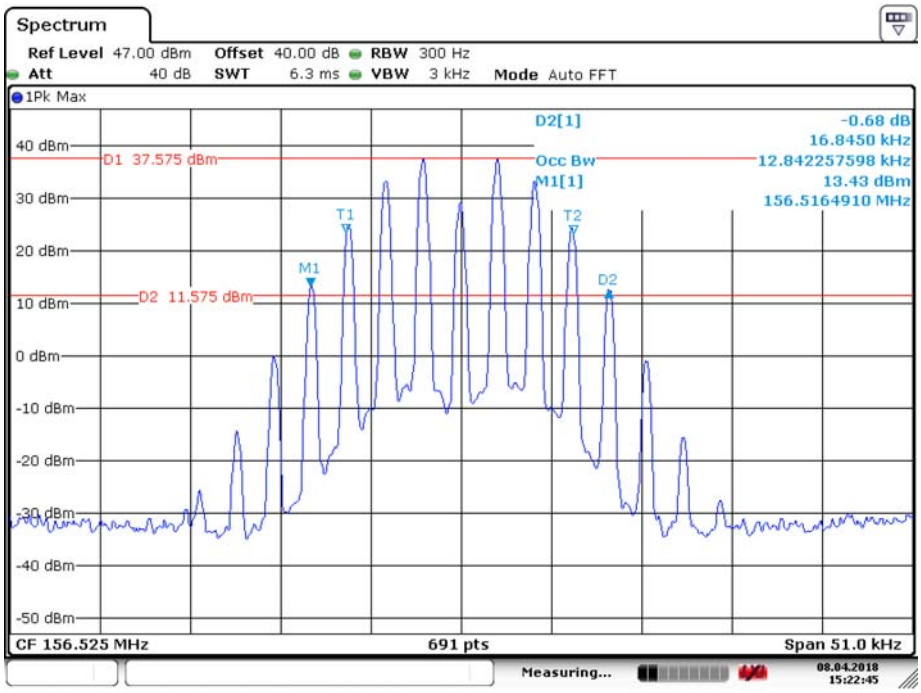
99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC2100, High Power)



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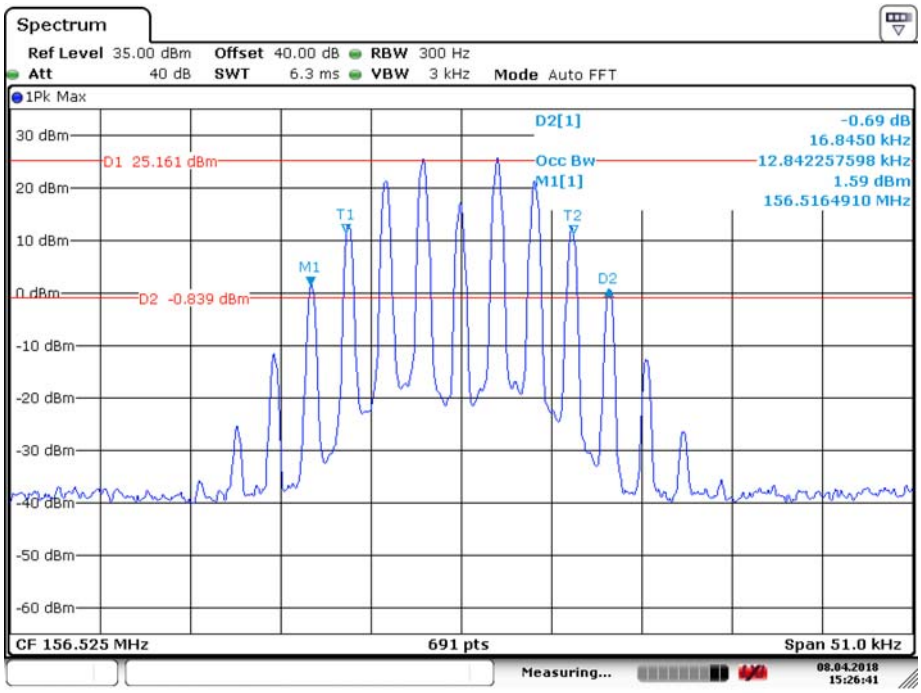
99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC2100, Low Power)



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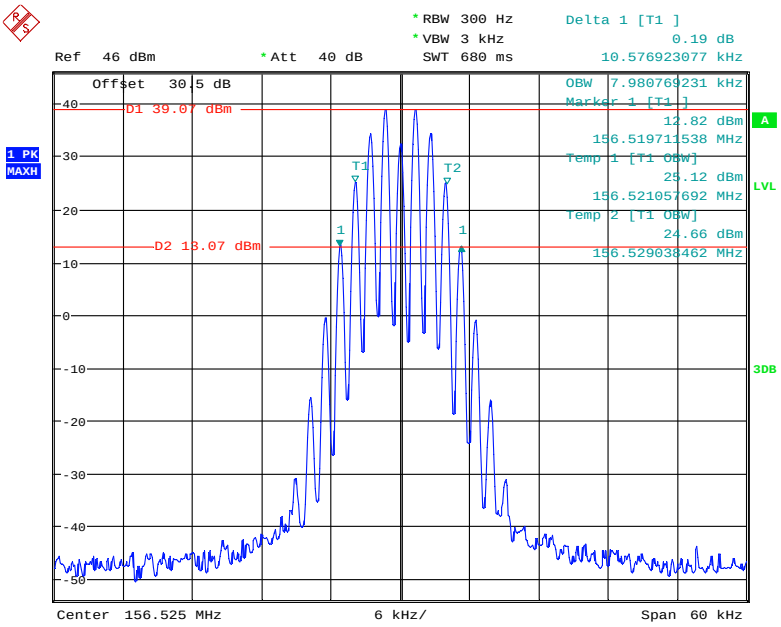
99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC1300, High Power)



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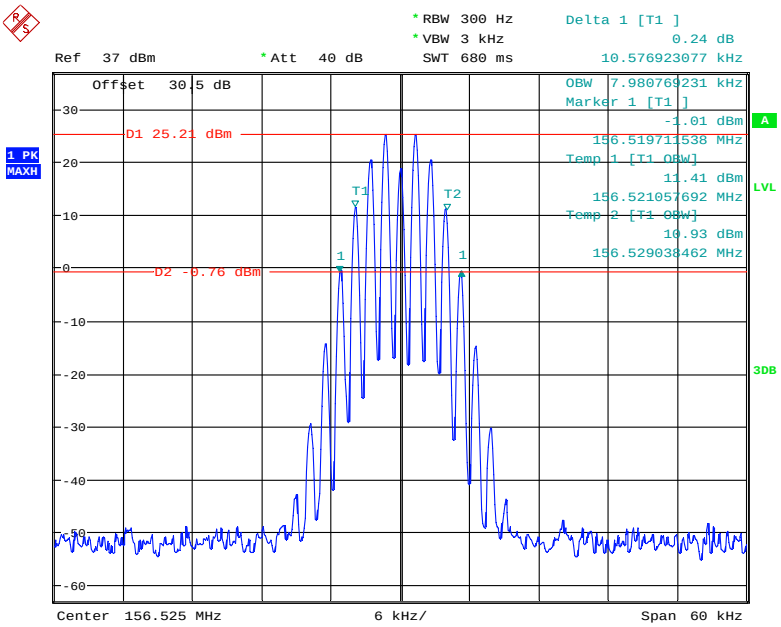
99% Occupied Bandwidth & 26 dB Emissions Bandwidth (156.525 MHz, DSC1300, Low Power)



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§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 10^{th} harmonic.

Test Data

Environmental Conditions

Temperature:	24~25 ℃
Relative Humidity:	49~53 %
ATM Pressure:	100.0~101.0 kPa

The testing was performed by Simon Wang on 2018-03-13 and 2018-03-23.

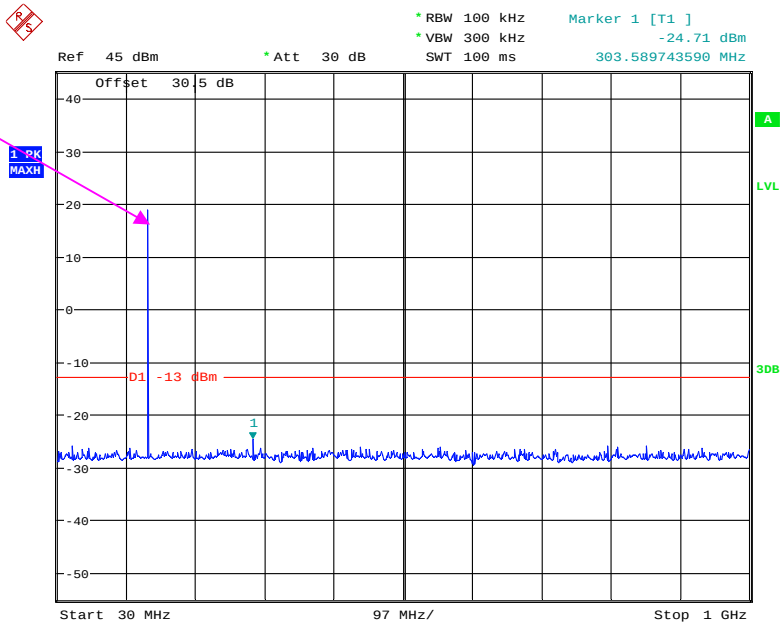
Test Mode: Transmitting

Please refer to the following plots.

Radio Telephony (156.8 MHz):

30 MHz – 1 GHz, High Power

Fundamental test with filter



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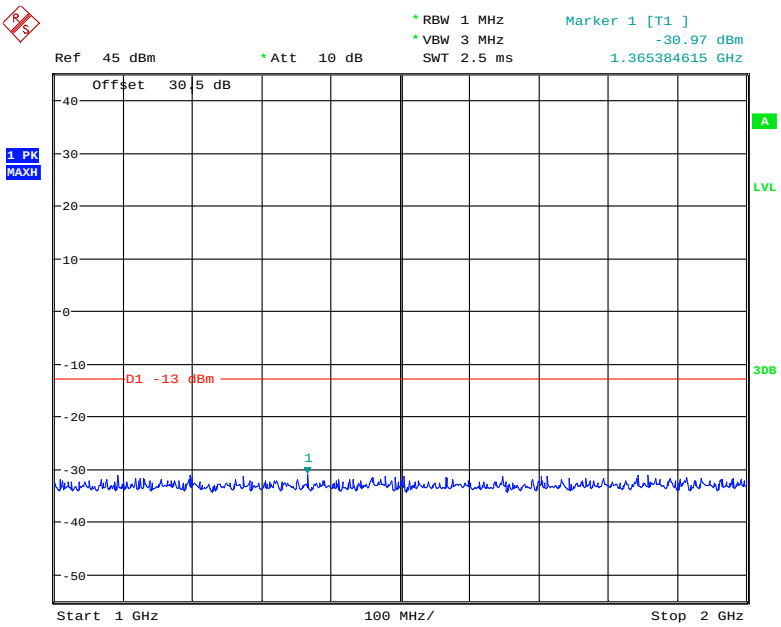
1 GHz – 2 GHz, High Power



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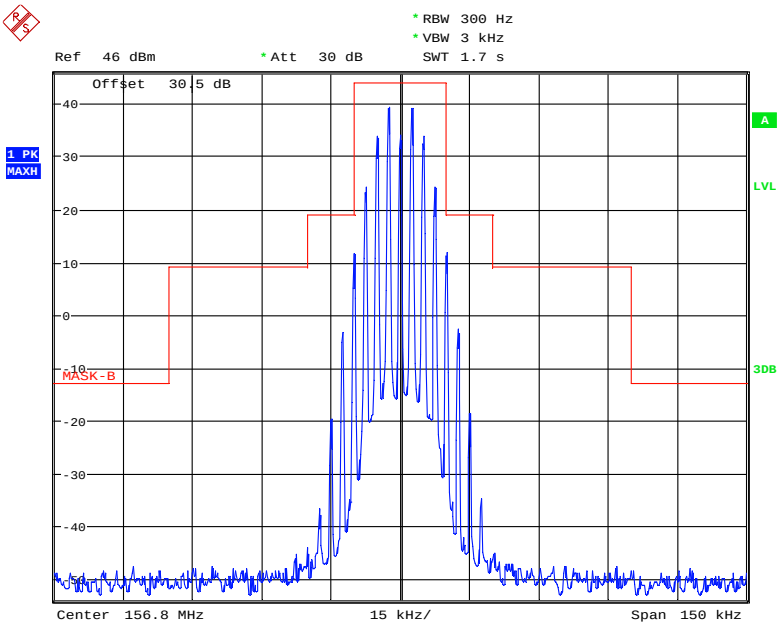
Emission Mask, High Power



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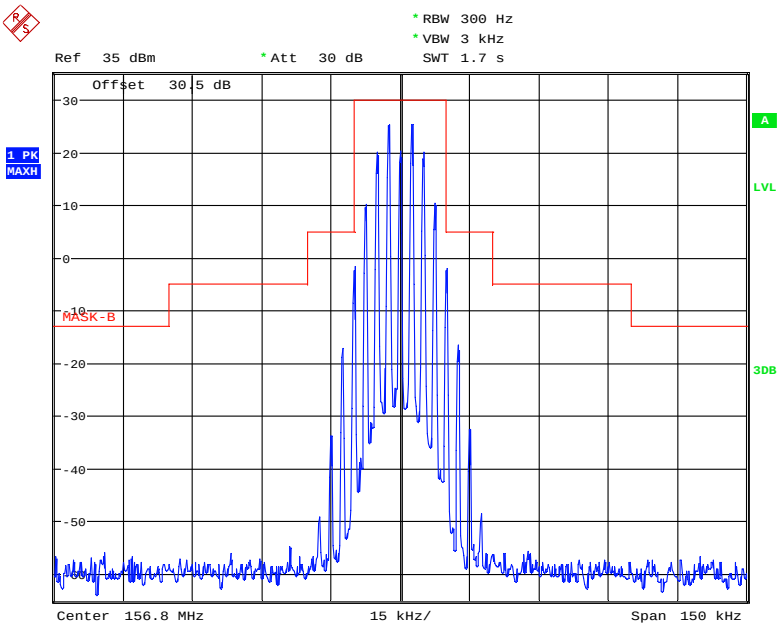
Emission Mask, Low Power



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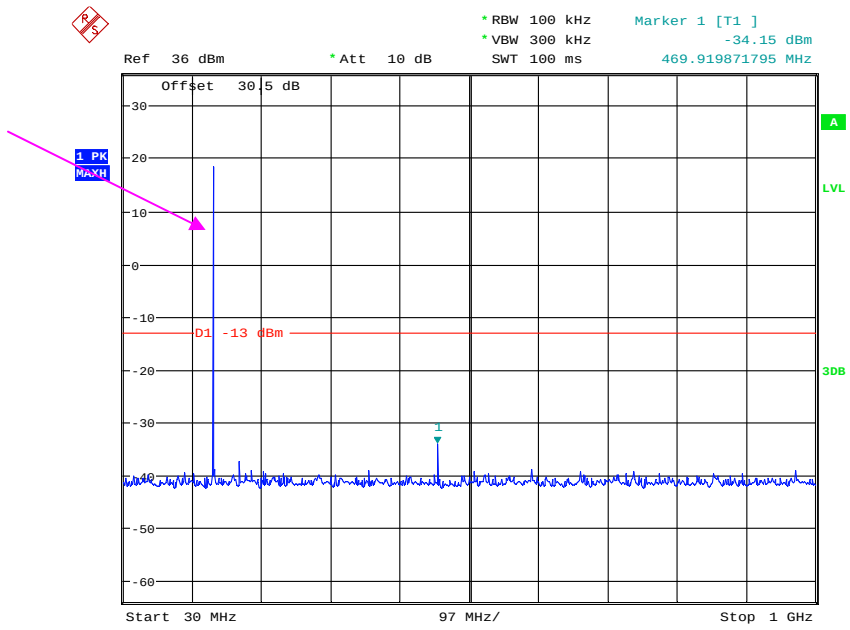
DSC (152.525 MHz):

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

Fundamental test with filter



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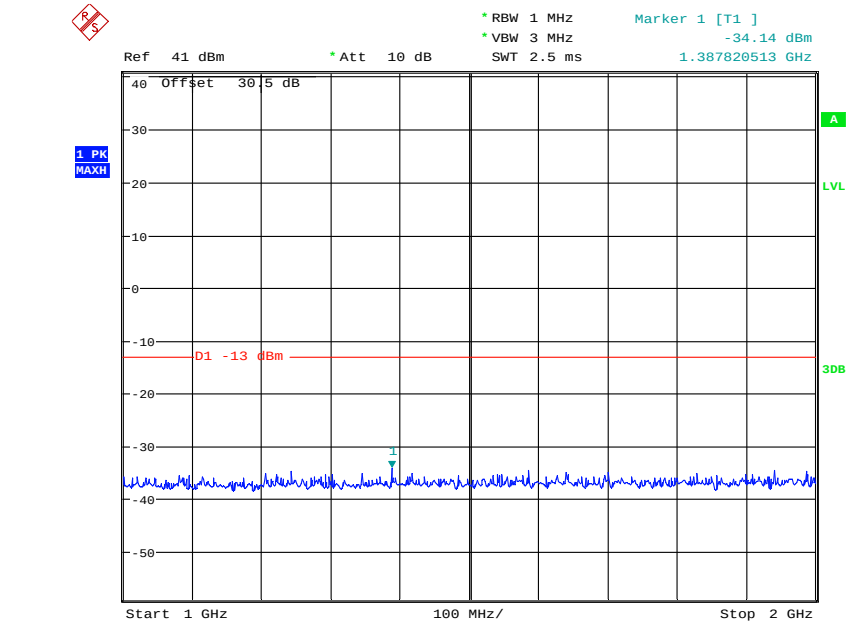
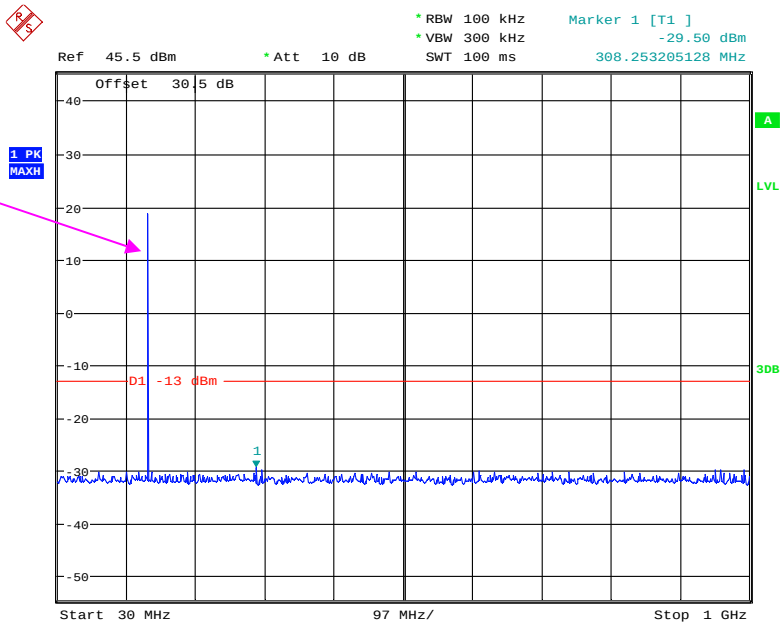
1 GHz – 2 GHz (DSC1300 Hz), High Power



Date: 23.MAR.2018 15:02:49

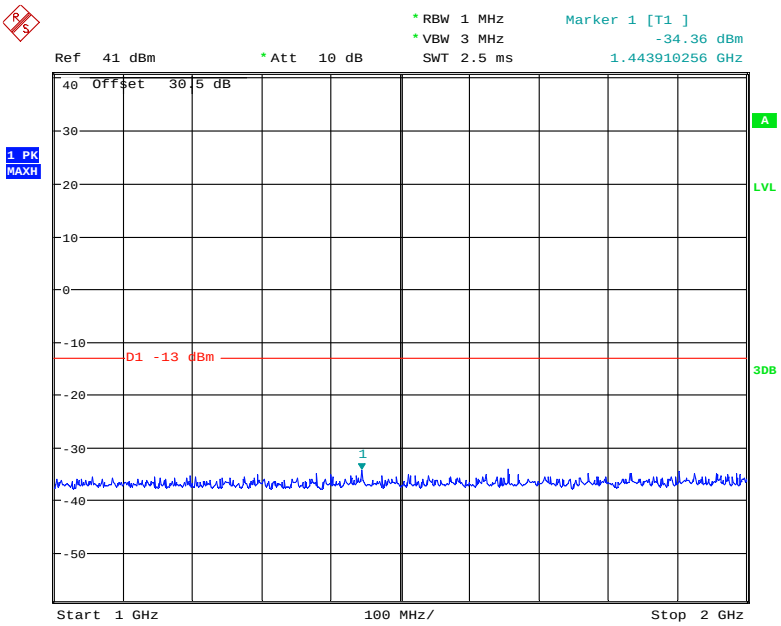
30 MHz – 1 GHz (DSC2100 Hz) , High Power

Fundamental test with filter



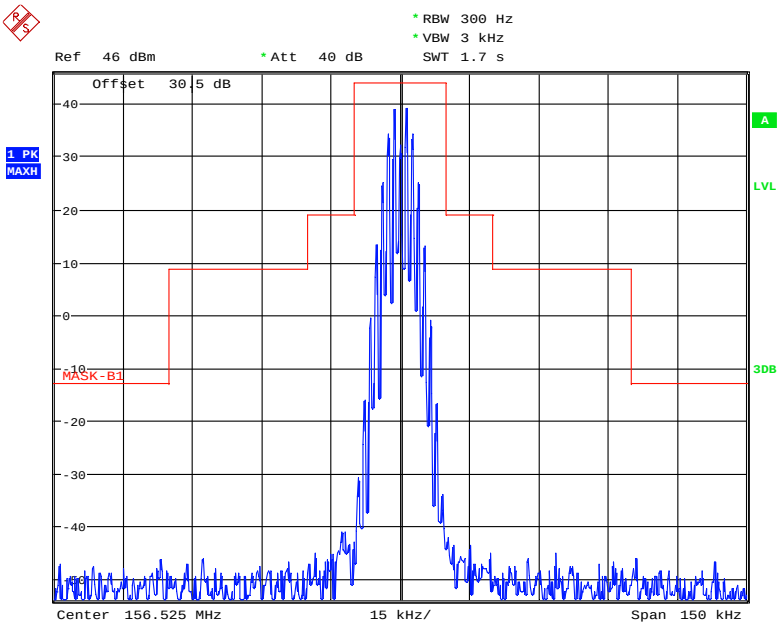
Date: 23.MAR.2018 15:00:47

1 GHz – 2 GHz (DSC2100Hz), High Power



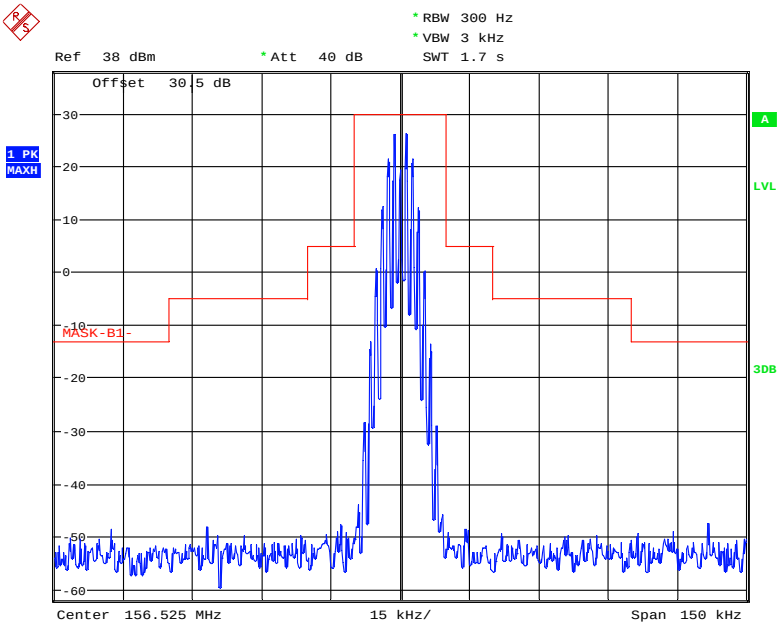
Date: 23.MAR.2018 15:02:11

Emission Mask, (DSC1300Hz, High Power)



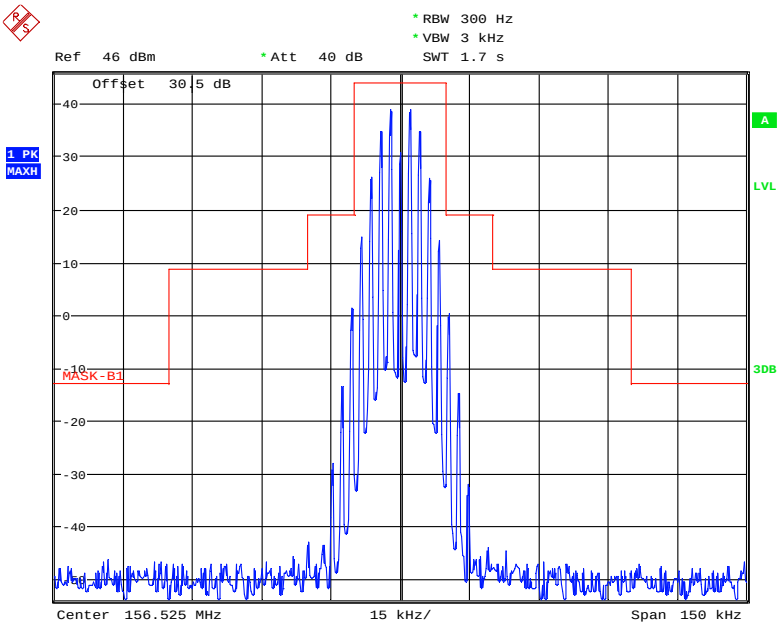
Date: 23.MAR.2018 14:43:20

Emission Mask, (DSC1300Hz, Low Power)



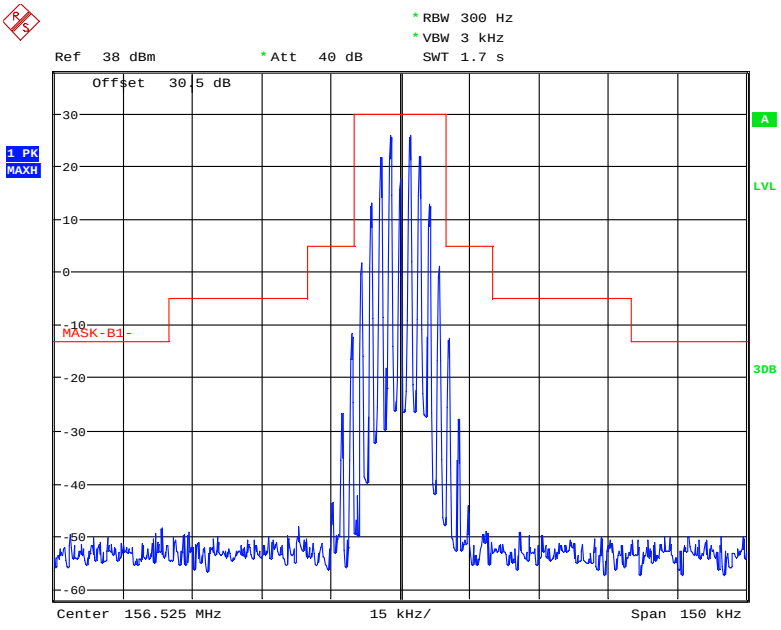
Date: 23.MAR.2018 14:52:17

Emission Mask, (DSC2100Hz, High Power)



Date: 23.MAR.2018 14:44:30

Emission Mask, (DSC2100Hz, Low Power)



Date: 23.MAR.2018 14:54:00

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

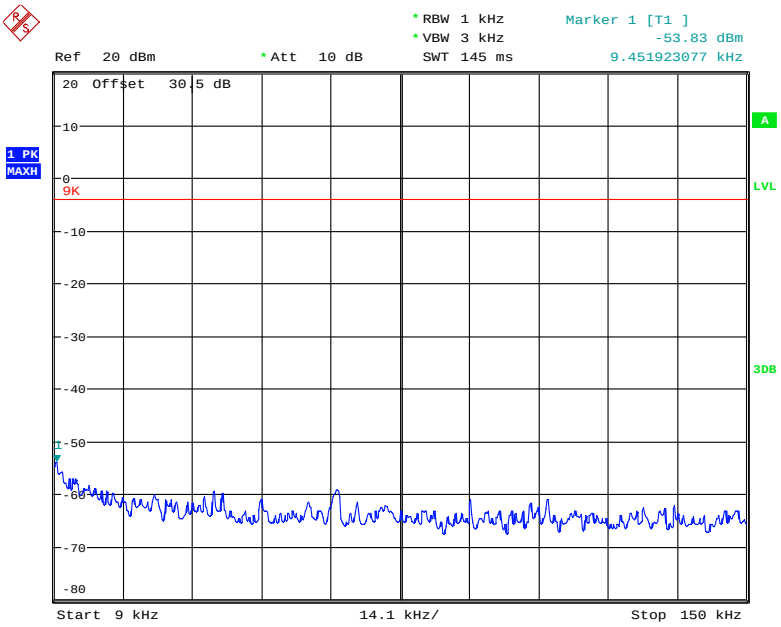
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2018-03-13.

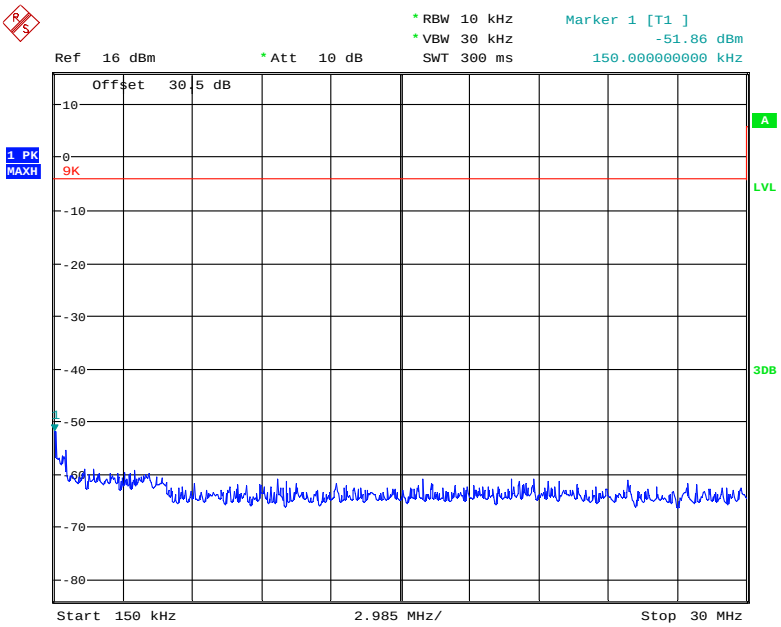
Test Mode: Transmitting

9 kHz – 150kHz, 156.8 MHz



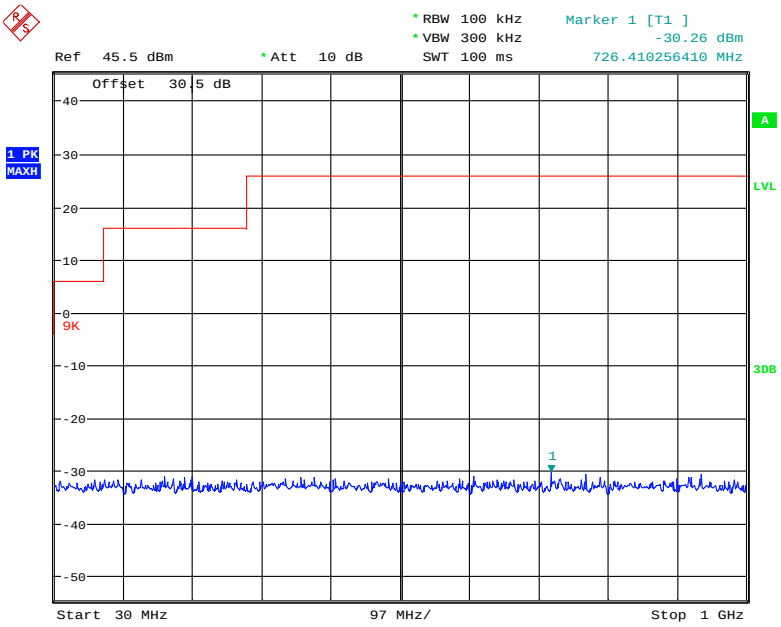
Date: 13.MAR.2018 15:51:15

150kHz – 30MHz, 156.8 MHz



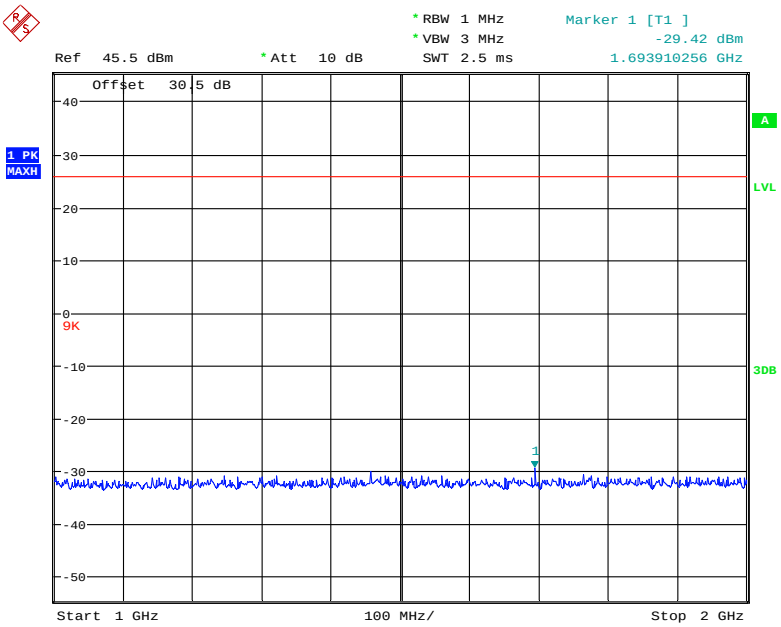
Date: 13.MAR.2018 15:53:28

30MHz – 1GHz, 156.8 MHz



Date: 13.MAR.2018 15:52:14

1 GHz – 2 GHz, 156.8 MHz



Date: 13.MAR.2018 15:54:04

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 1g (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB =43+10 Log_{10} (power out in Watts)

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2018-03-13.

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	38.86	311	2.0	H	-58.1	0.36	0	-58.46	-13	45.46
313.6	39.14	253	1.8	V	-57.9	0.36	0	-58.26	-13	45.26
627.2	42.55	69	1.8	H	-54.4	0.57	0	-54.97	-13	41.97
627.2	41.39	39	1.7	V	-55.6	0.57	0	-56.17	-13	43.17
784.0	42.23	84	1.5	H	-54.8	0.65	0	-55.45	-13	42.45
784.0	42.04	71	1.1	V	-55.0	0.65	0	-55.65	-13	42.65
1568.0	43.12	96	2.3	H	-65.2	1.40	8.70	-57.90	-13	44.90
1568.0	43.45	109	1.9	V	-64.7	1.40	8.70	-57.40	-13	44.40
1724.8	43.25	69	1.1	H	-64.2	1.30	8.90	-56.60	-13	43.60
1724.8	43.34	243	1.9	V	-63.5	1.30	8.90	-55.90	-13	42.90
DSC: 156.525 MHz										
313.05	38.96	4	2.0	H	-58.0	0.36	0	-58.36	-13	45.36
313.05	39.70	254	1.3	V	-57.3	0.36	0	-57.66	-13	44.66
626.1	42.37	272	1.2	H	-54.6	0.57	0	-55.17	-13	42.17
626.1	41.46	357	1.8	V	-55.5	0.57	0	-56.07	-13	43.07
782.63	42.28	20	2.4	H	-54.7	0.65	0	-55.35	-13	42.35
782.63	41.79	256	1.6	V	-55.2	0.65	0	-55.85	-13	42.85
1565.25	43.94	322	1.7	H	-64.4	1.40	8.70	-57.10	-13	44.10
1565.25	43.78	43	2.1	V	-64.3	1.40	8.70	-57.00	-13	44.00
1721.78	43.62	67	2.3	H	-63.9	1.30	8.90	-56.30	-13	43.30
1721.78	43.29	253	2.1	V	-63.6	1.30	8.90	-56.00	-13	43.00

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° 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 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2018-03-24.

Test Mode: Transmitting

For Radio Telephony mode:

Reference Frequency: 156.8 MHz, Limit: ±10.0 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (℃)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	12	156.80030	1.913265
40	12	156.80008	0.510204
30	12	156.80007	0.446429
20	12	156.80001	0.063776
10	12	156.80018	1.147959
0	12	156.80026	1.658163
-10	12	156.80024	1.530612
-20	12	156.80023	1.466837

Reference Frequency: 156.8 MHz, Limit: ±10.0 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (℃)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	10.8	156.80027	1.721939
40	10.8	156.80026	1.658163
30	10.8	156.80029	1.84949
20	10.8	156.80033	2.104592
10	10.8	156.80037	2.359694
0	10.8	156.80034	2.168367
-10	10.8	156.80038	2.423469
-20	10.8	156.80030	1.913265

Reference Frequency: 156.8 MHz, Limit: ±10.0 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (℃)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	15.6	156.80039	2.487245
40	15.6	156.80028	1.785714
30	15.6	156.80027	1.721939
20	15.6	156.80022	1.403061
10	15.6	156.80020	1.27551
0	15.6	156.80029	1.84949
-10	15.6	156.80025	1.594388
-20	15.6	156.80026	1.658163

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)
50	12	2100.03	1300.02
40	12	2100.00	1300.01
30	12	2100.06	1300.03
20	12	2100.08	1300.04
10	12	2099.97	1300.03
0	12	2100.05	1300.11
-10	12	2100.01	1300.05
-20	12	2100.10	1300.06

Reference Frequency: 156.525 MHz			
Test Conditions		Transmitter Frequency (Hz)	
Environment Temperature (°C)	Voltage Supplied (V_{DC})	B-State(2100Hz)	B-State(1300Hz)
50	10.8	2100.02	1300.04
40	10.8	2099.98	1300.05
30	10.8	2100.07	1300.01
20	10.8	2100.04	1300.02
10	10.8	2099.99	1300.05
0	10.8	2100.05	1300.04
-10	10.8	2100.03	1300.03
-20	10.8	2100.08	1300.10

Reference Frequency: 156.525 MHz			
Test Conditions		Transmitter Frequency (Hz)	
Environment Temperature (°C)	Voltage Supplied (V_{DC})	B-State(2100Hz)	B-State(1300Hz)
50	15.6	2100.04	1300.05
40	15.6	2100.01	1300.03
30	15.6	2100.02	1300.05
20	15.6	2100.07	1300.02
10	15.6	2099.99	1300.09
0	15.6	2100.02	1300.12
-10	15.6	2100.03	1300.04
-20	15.6	2100.06	1300.07

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

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

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