



中认信通
CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



TEST REPORT

APPLICANT: Navico Inc.

ADDRESS: 4500 S. 129th East Avenue, Ste. 200 Tulsa Oklahoma United States

FCC ID: RAYVHFRS40A

PRODUCT NAME: Marine VHF Radio

STANDARD(S): FCC Part 80
FCC Part 1.1310 & 2.1091

The above equipment has been tested and found compliance with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: CR22030041-00C

Date Of Issue: 2022-07-02

Reviewed By: Sun Zhong

Title: Manager

Sun Zhong

Test Laboratory: China Certification ICT Co., Ltd (Dongguan)

No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China

Tel: +86-769-82016888

Test Facility

The Test site used by *China Certification ICT Co., Ltd (Dongguan)* to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

Product Name:	Marine VHF Radio
Test Model:	RS40 (Trade Brand: SIMRAD)
Multiple Model(s):	V60 (Trade Brand: B&G)
Product Category:	Ship Station
AIS Class:	Class B (Receive Only)
Rated Input Voltage:	DC 12V
Serial Number:	CR22030041-RF-S1
EUT Received Date:	2022.3.11
EUT Received Status:	Good
Note: The Multiple models are electrically identical with the test model. Please refer to the declaration letter for more detail, which was provided by manufacturer.	

1.2 Technical Specification

Operation Frequency Range (MHz):	Transmit:	156.025-157.425
	Receive:	156.050-163.275
Rated RF Output Power (Conducted) (W):	High power level: 25 Low power level: 1	
Modulation Type:	FM, DSC(for 156.525MHz)	
Channel Spacing (kHz):	25	
Antenna Information[▲]:	External antenna, 50 Ohm input impedance, 9dBi(Max), with a 1.0dB cable loss Coaxial Cable	

1.3 Description of Test Configuration

1.3.1 EUT Operation Condition:

EUT Operation Mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer [▲] .
Equipment Modifications:	No
EUT Exercise Software:	No

1.3.2 Support Equipment List and Details

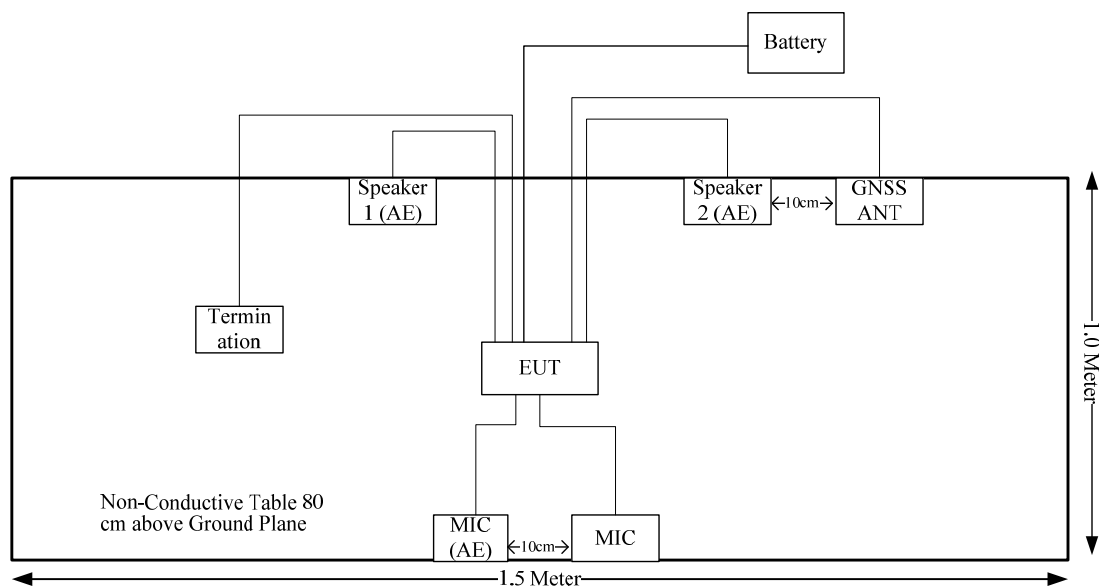
Manufacturer	Description	Model	Serial Number
FENGFAN	Battery	46B24L-H	/
SIMRAD	GNSS Antenna	GPS-500	1807L30302
/	Speaker 1(AE)	/	/
/	Speaker 2(AE)	/	/
NAVICO	MIC (AE)	/	/
BEW	Coaxial Termination	TF300-6-B	/

1.3.3 Support Cable List and Details

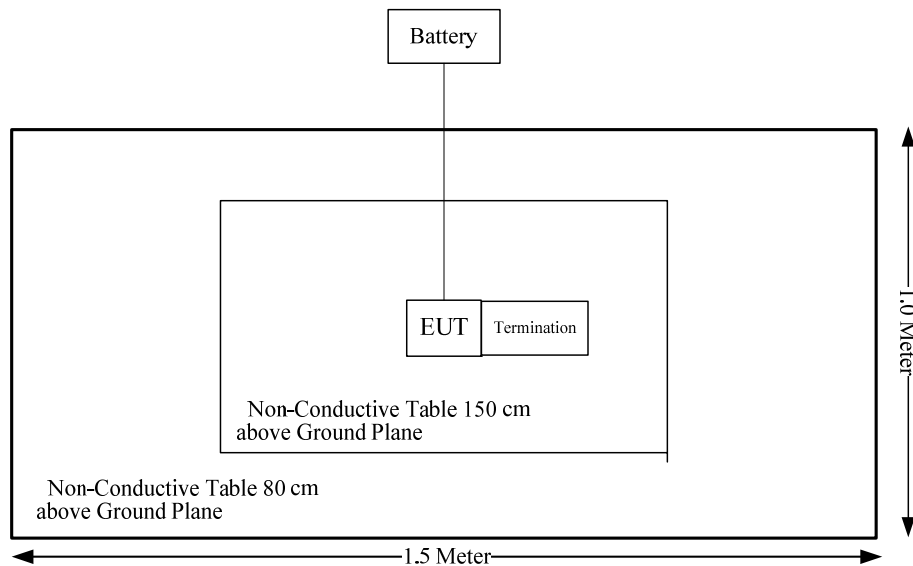
Cable Description	Shielding Cable	Ferrite Core	Length (m)	From Port	To
DC Line	No	No	3	Battery	EUT
Coaxial Cable	Yes	No	2.5	EUT	GNSS Antenna
Audio Line*2	No	No	0.6	EUT	Speaker 1(AE)/Speaker 2(AE)
MIC Cable*2	No	No	1.0	EUT	MIC/MIC (AE)
Coaxial Cable	Yes	No	1.5	EUT	Termination

1.3.4 Block Diagram of Test Setup

RE Below 1GHz



RE Above 1GHz



1.4 Measurement Uncertainty

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.15 dB, 200M~1GHz: 5.61 dB, 1G~6GHz: 5.14 dB, 6G~18GHz: 5.93 dB, 18G~26.5G: 5.47 dB, 26.5G~40G: 5.63 dB
Unwanted Emissions, conducted	±1.26 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	2.8 dB (150 kHz to 30 MHz)

2. SUMMARY OF TEST RESULTS

Rules	Description of Test	Results
§1.1307	Maximum Permissible Exposure (MPE)	Compliance
§2.1046; §80.215;	Transmitter Power	Compliance
§2.1047; §80.213;	Modulation Requirements	Compliance
§2.1049; §80.205;	Bandwidth	Compliance
§2.1051; §80.211(f);	Emission Limitations	Compliance
§80.217;	Suppression of Interference Aboard Ships	Compliance
§2.1053; §80.211;	Spurious Radiated Emissions	Compliance
§2.1055; §80.209(a)(5)(ii);	Transmitter Frequency Tolerances	Compliance

3. REQUIREMENTS AND TEST PROCEDURES

3.1 Transmitter Power

Applicable Standard

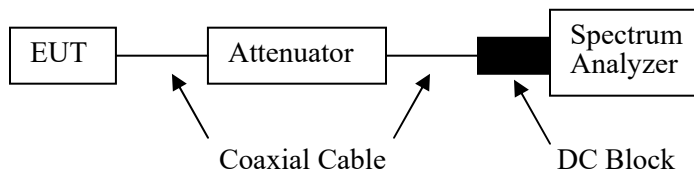
FCC §80.215.

(e) Ship stations frequencies above 27500 kHz. The maximum power must not exceed the values listed below.

(1) Ship stations 156-162 MHz - 25W

Note: Reducible to 1 watt or less, except for transmitters limited to public correspondence channels and used in an automated system.

Block Diagram of Test Setup



Note: Path loss from EUT to Spectrum Analyzer is 40.2 dB.

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:

RBW	VBW
100 kHz	300 kHz

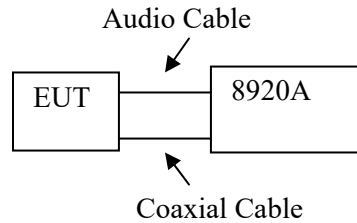
3.2 Modulation Requirements

Applicable Standard

FCC §80.213.

Ship and coast station transmitters operating in the 156-162 MHz and 216-220 bands must be capable of proper operation with a frequency deviation that does not exceed ± 5 kHz when using any emission authorized by § 80.207.

Block Diagram of Test Setup



Test Procedure

Test Method: TIA-603-E 2.2.3

3.3 Bandwidth

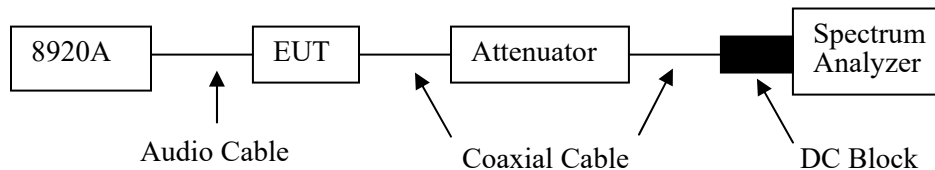
Applicable Standard

FCC §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

Block Diagram of Test Setup



Note: Path loss from EUT to Spectrum Analyzer is 40.2 dB.

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 appropriate frequency span from the carrier frequency.

3.4 Emission Limitations

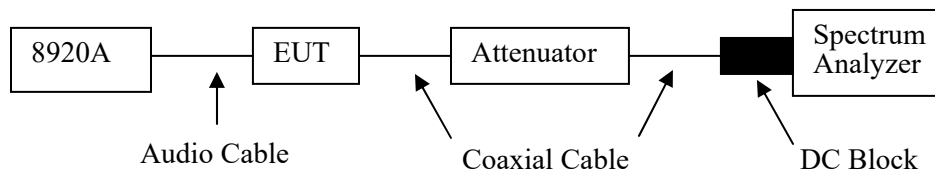
Applicable Standard

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.

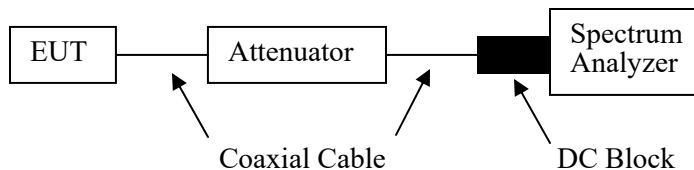
Block Diagram of Test Setup

For Mask Test:



Note: Path loss from EUT to Spectrum Analyzer is 40.2 dB.

For Conducted Emission Test:



Note: Path loss from EUT to Spectrum Analyzer is 40.2 dB.

Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation.

For Mask test, the resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band more than ± 50 kHz from the carrier frequency.

For Conducted Emission test, the resolution bandwidth of the spectrum analyzer was set at 100kHz for below 1GHz, and 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

3.5 Suppression of Interference Aboard Ships

Applicable Standard

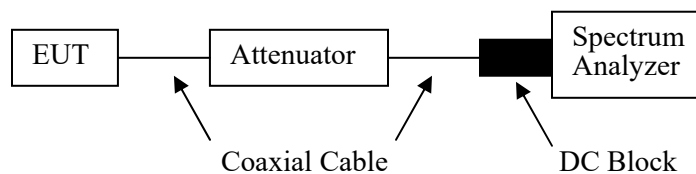
FCC §80.217.

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

(b) 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

Block Diagram of Test Setup



Note: Path loss from EUT to Spectrum Analyzer is 40.2 dB.

Test Procedure

The EUT was connected to a spectrum analyzer via a appropriate attenuator. The spectrum was measured between 9 kHz to 2 GHz. The traces were recorded as shown on the following pages.

3.6 Spurious Radiated Emissions

Applicable Standard

FCC §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.

Block Diagram of Test Setup

Please refer to section 1.3.4.

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

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

3.7 Transmitter Frequency Tolerances

Applicable Standard

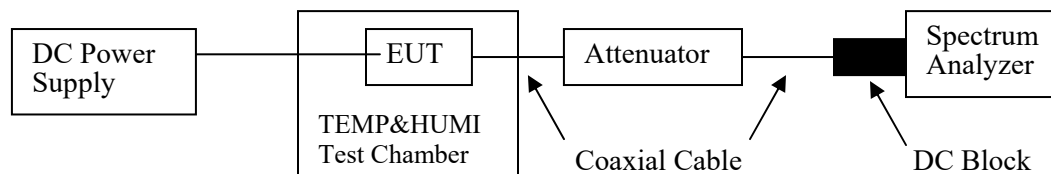
FCC §80.209(a)(5)(ii).

(a) The frequency tolerance requirements applicable to transmitters in the maritime services are shown in the following table. Tolerances are given as parts in 10^6 unless shown in Hz.

(5) Band 156-162 MHz:

(ii) Ship stations 10ppm.

Block Diagram of Test Setup



Note: Path loss from EUT to Spectrum Analyzer is 40.2 dB.

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.

4. TEST DATA AND RESULTS

4.1 Test Environmental Conditions & Test Equipment List and Details

4.1.1 Radiation Emission Below 1GHz Test

Test Date:		2022-05-13			
Tester:		Gary Ling			
Environmental Conditions:					
Temperature: (°C)	23.5	Relative Humidity: (%)	68	ATM Pressure: (kPa)	100.5

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB6	A082520-5	2020-10-19	2023-10-18
R&S	EMI Test Receiver	ESR3	102724	2021-07-22	2022-07-21
TIMES MICROWAVE	Coaxial Cable	LMR-600- UltraFlex	C-0470-02	2021-07-18	2022-07-17
TIMES MICROWAVE	Coaxial Cable	LMR-600- UltraFlex	C-0780-01	2021-07-18	2022-07-17
Sonoma	Amplifier	310N	186165	2021-07-18	2022-07-17
EMCO	Adjustable Dipole Antenna	3121C	9109-756	N/A	N/A
MICRO-COAX	Coaxial Cable	UFA210B-0-0720- 300300	99G1448	2021-07-25	2022-07-24
Agilent	Signal Generator	E8247C	MY43321352	2021-04-25	2022-04-24

Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

4.1.2 Radiation Emission Above 1GHz Test

Test Date:		2022-05-12			
Tester:		Tommy Luo			
Environmental Conditions:					
Temperature: (°C)	21.7	Relative Humidity: (%)	69	ATM Pressure: (kPa)	100.7

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020-10-13	2023-10-12
R&S	Spectrum Analyzer	FSV40	101591	2021-07-22	2022-07-21
MICRO-COAX	Coaxial Cable	UFA210A-1-1200- 70U300	217423-008	2021-08-08	2022-08-07
MICRO-COAX	Coaxial Cable	UFA210A-1-2362- 300300	235780-001	2021-08-08	2022-08-07
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2021-11-10	2022-11-09
AH	Double Ridge Guide Horn Antenna	SAS-571	1396	2021-10-18	2024-10-17
MICRO-COAX	Coaxial Cable	UFA210B-0-0720- 300300	99G1448	2021-07-25	2022-07-24
Agilent	Signal Generator	E8247C	MY43321352	2021-04-25	2022-04-24

Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

4.1.3 RF Conducted Test

Test Date:		2022-05-13~2022-05-19			
Tester:		Morpheus Shi			
Environmental Conditions:					
Temperature: (°C)	25.9~26.1	Relative Humidity: (%)	50~63	ATM Pressure: (kPa)	100.5~100.8

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2021-10-10	2022-10-09
R&S	Signal Analyzer	FSIQ26	831929/006	2021-07-22	2022-07-21
YINSAIGE	Coaxial Cable	SS402	SJ0100003	2021-08-08	2022-08-07
YINSAIGE	Coaxial Cable	LMR300	NJ0100001	2021-08-08	2022-08-07
Mini-Circuits	DC Block	BLK-18-S+	1554404	2021-08-08	2022-08-07
Weinschel	Coaxial Attenuators	53-20-34	LN751	2021-08-08	2022-08-07
BEW	Coaxial Attenuator	TS300-6-40	213311	2021-08-08	2022-08-07
HP	RF Communications Test Set	8920A	3438A05209	2021-07-22	2022-07-21
BACL	TEMP&HUMI Test Chamber	BTH-150	30026	2021-07-22	2022-07-21
UNI-T	Multimeter	UT39A+	C210582554	2021-09-30	2022-09-29
ZHAOXIN	DC Power Supply	RXN-6010D	21R6010D0912386	N/A	N/A

Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

4.2 Transmitter Power

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

General:

Modulation Mode	Channel Separation	f_c	High Power Level (dBm)		Low Power Level (dBm)	
		MHz	Reading	Limit	Reading	Limit
FM	25kHz	156.025	43.60	43.98	28.68	30.00
		156.800	43.61	43.98	28.69	30.00
		157.425	43.63	43.98	28.93	30.00
DSC 1300		156.525	43.77	43.98	29.19	30.00
DSC 2100		156.525	43.79	43.98	29.27	30.00

Low Power Only:

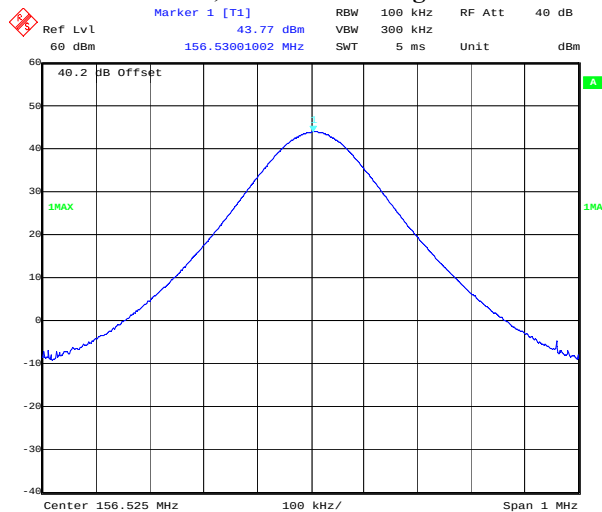
Modulation Mode	Channel Separation	f_c	Low Power Level (dBm)	
		MHz	Reading	Limit
FM	25kHz	156.375	28.80	30
		156.650	28.81	30
		156.775	28.83	30
		156.825	28.80	30
		156.850	28.72	30
		156.875	28.54	30

Note:

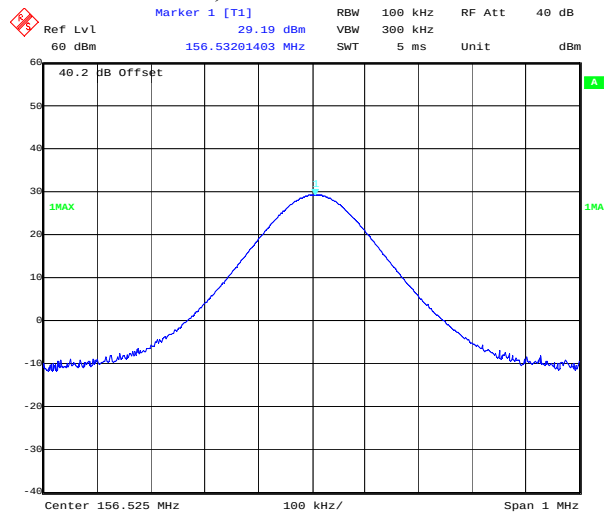
The high rated power level is 25W(43.98dBm), and low rated power level is 1W(30dBm).

DSC:

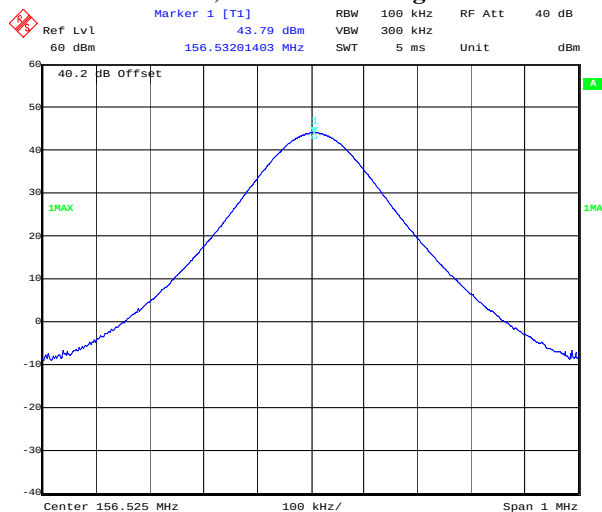
DSC 1300, 156.525 MHz High Power



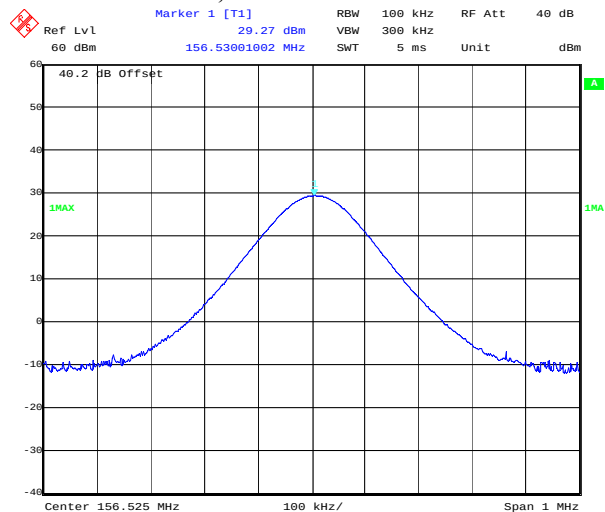
DSC 1300, 156.525 MHz Low Power



DSC 2100, 156.525 MHz High Power

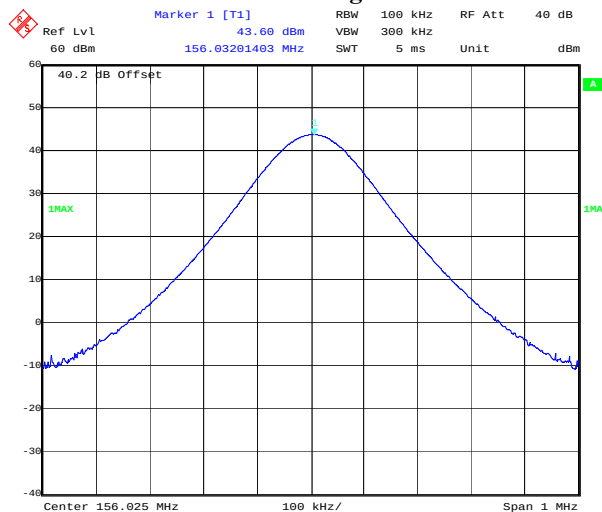


DSC 2100, 156.525 MHz Low Power

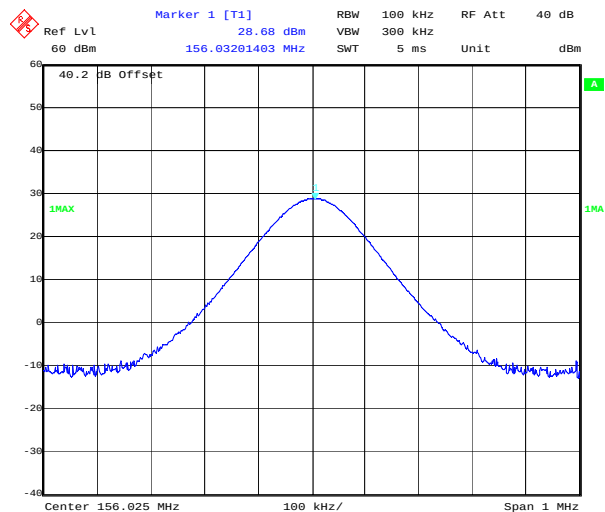


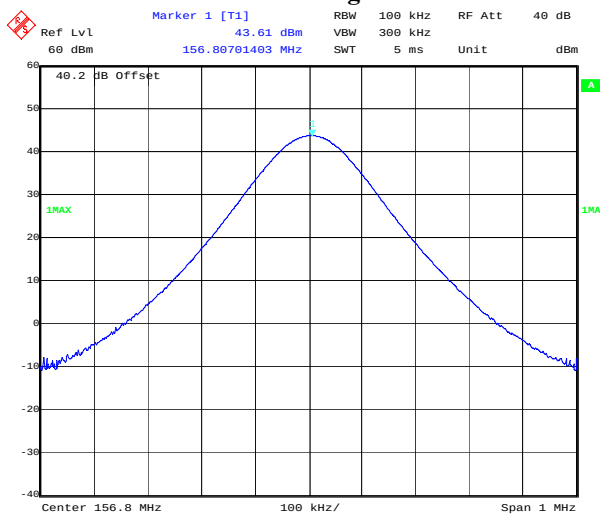
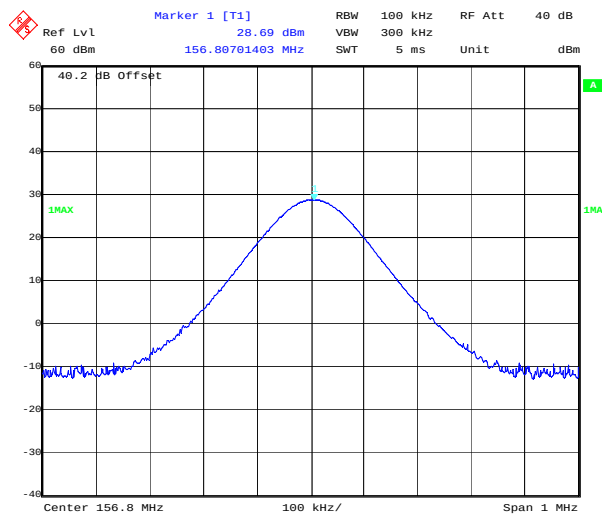
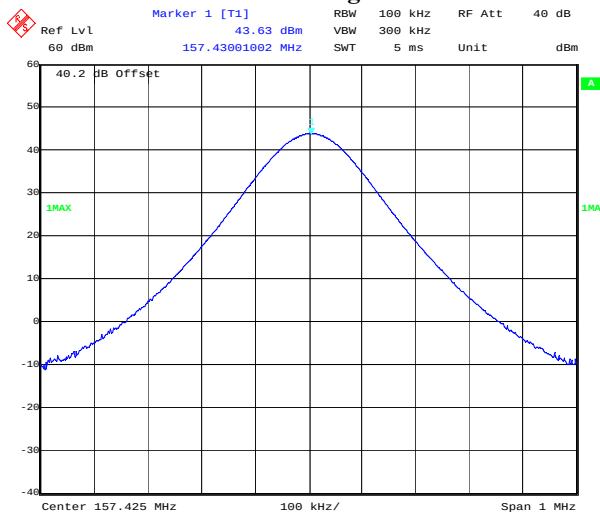
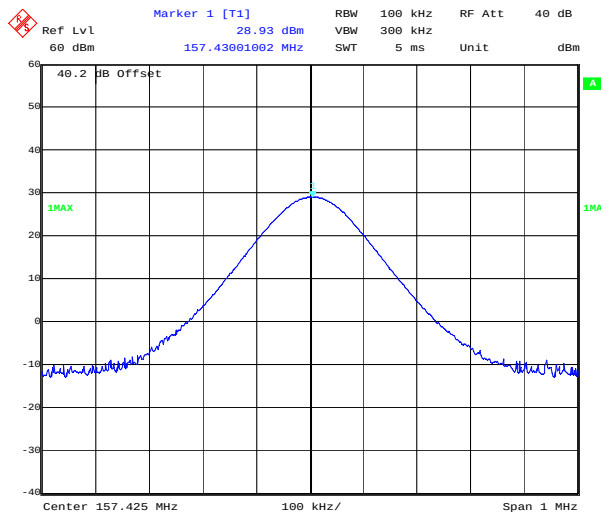
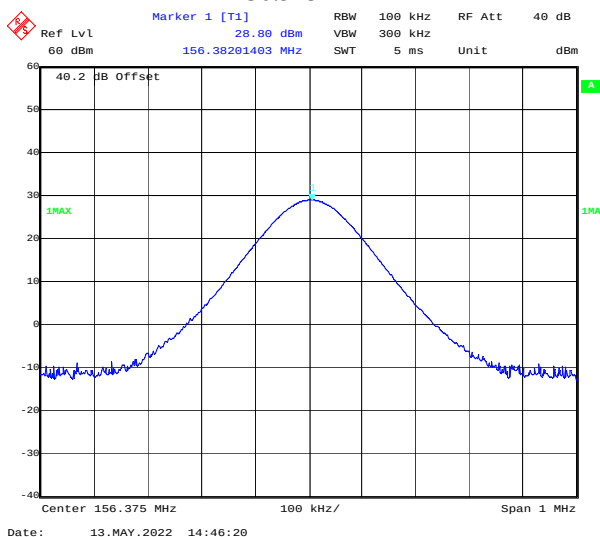
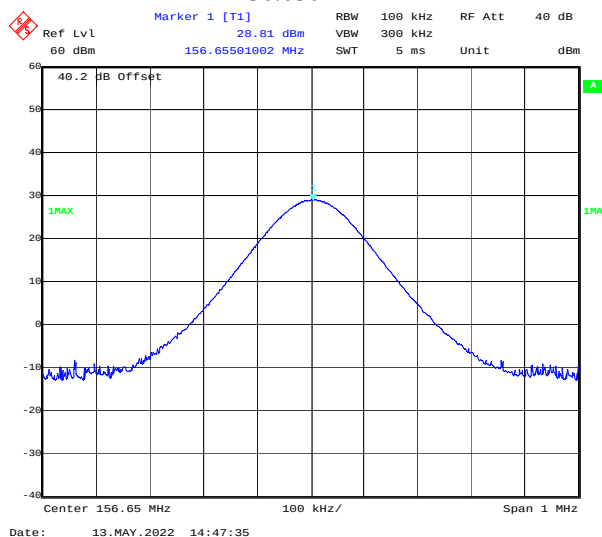
FM, 25kHz (General):

156.025 MHz High Power

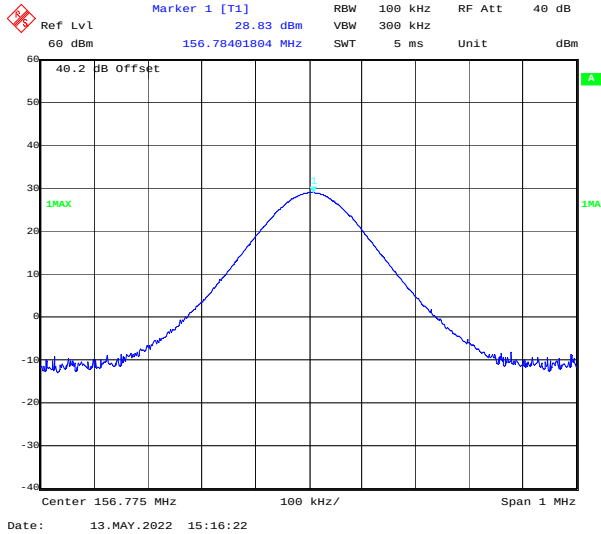


156.025 MHz Low Power

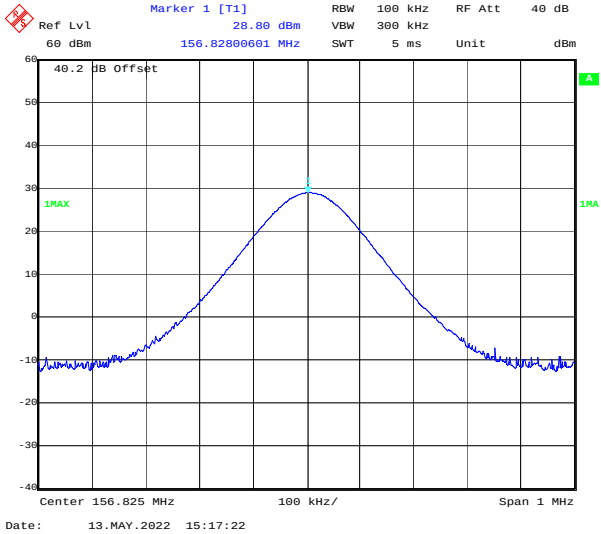


156.800 MHz High Power**156.800 MHz Low Power****157.425 MHz High Power****157.425 MHz Low Power****FM, 25kHz (Low Power Only):****156.375 MHz****156.650 MHz**

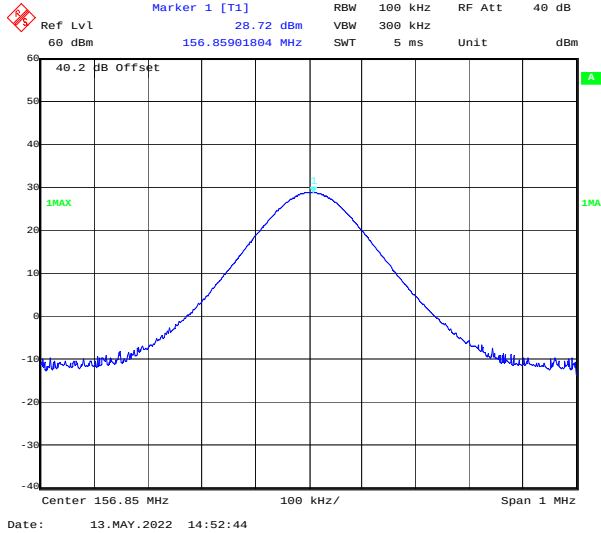
156.775 MHz



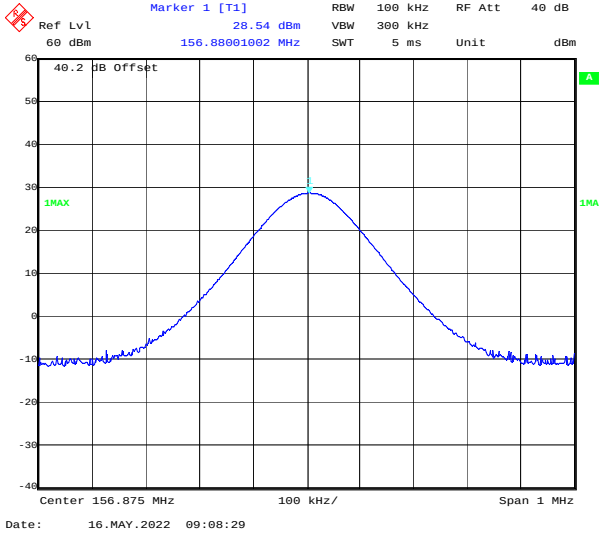
156.825 MHz



156.850 MHz



156.875 MHz



4.3 Modulation Requirements

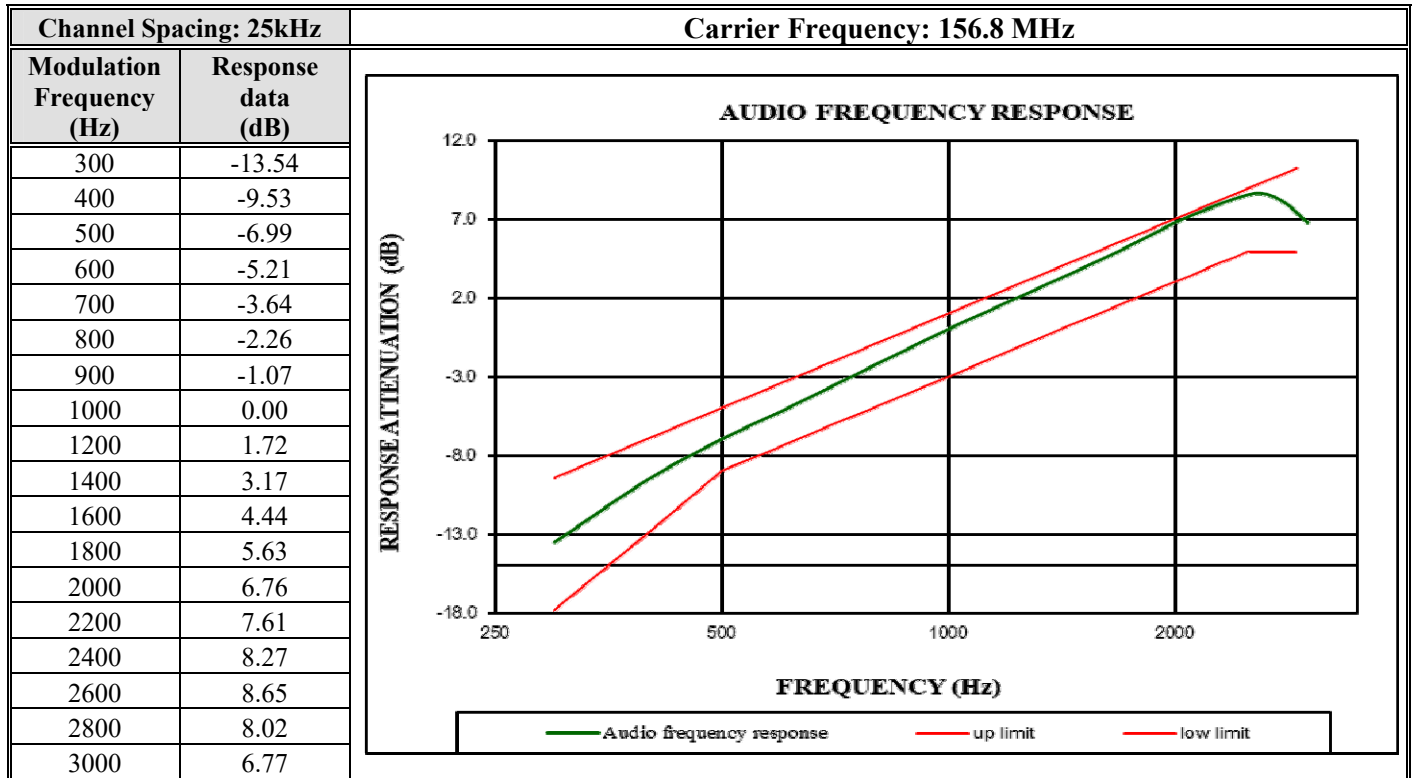
Test Mode: Transmitting

Test Result: Compliance.

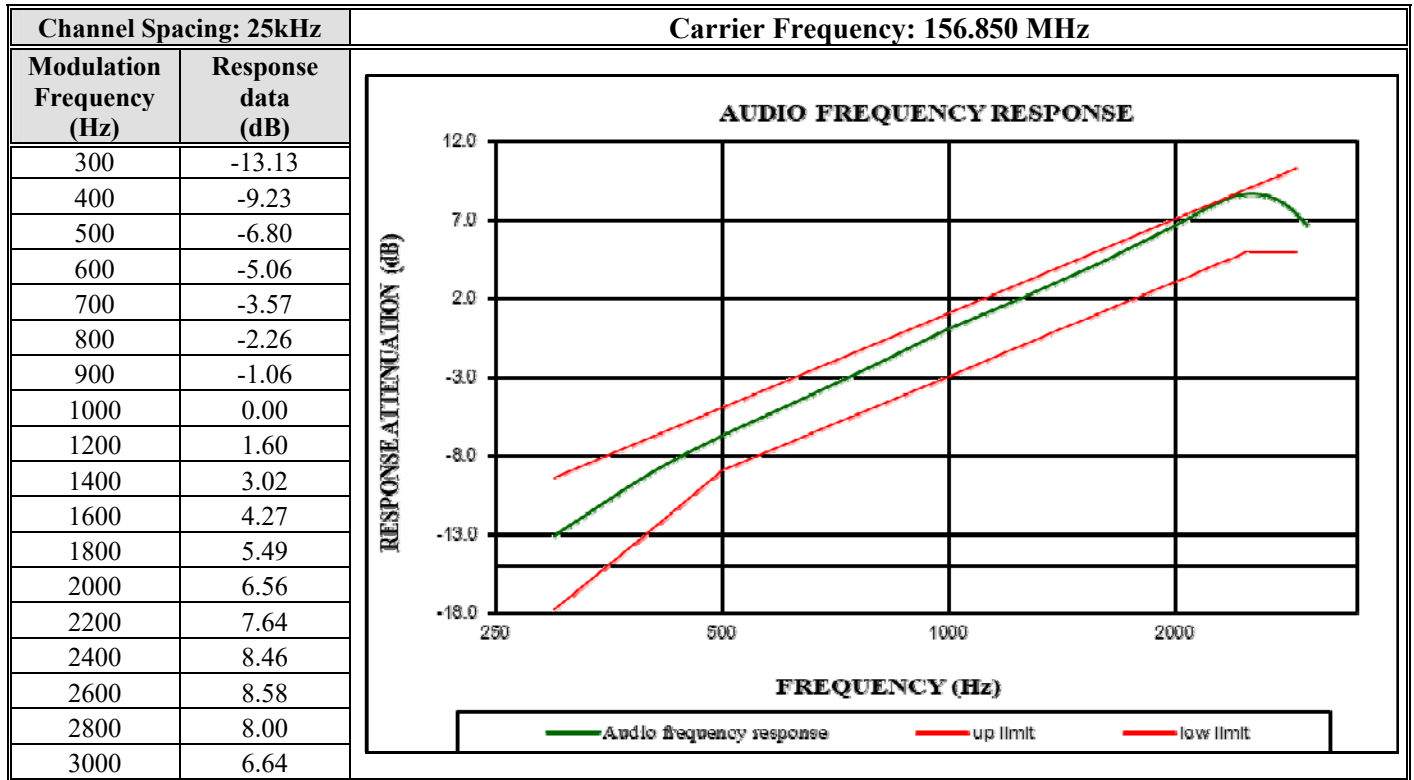
Please refer to the following tables and plots.

Audio Frequency Response – General

Note: Test performed at high power level.



Audio Frequency Response – Low Power Only

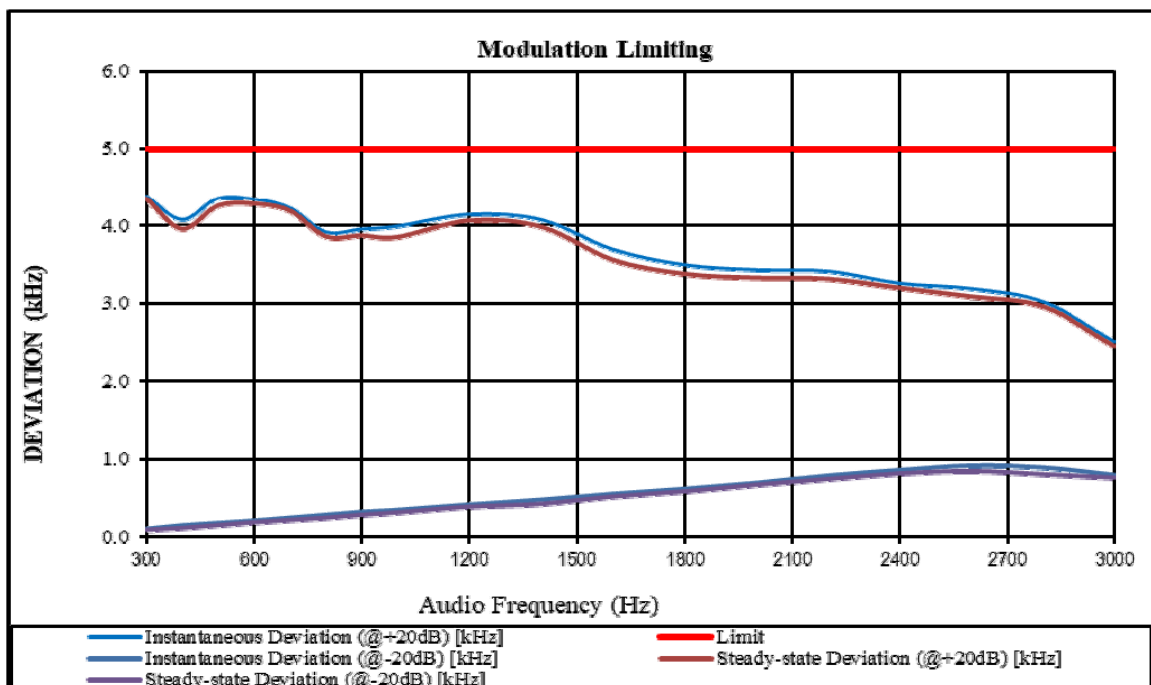


Modulation Limiting – General

Note: Test performed at high power level.

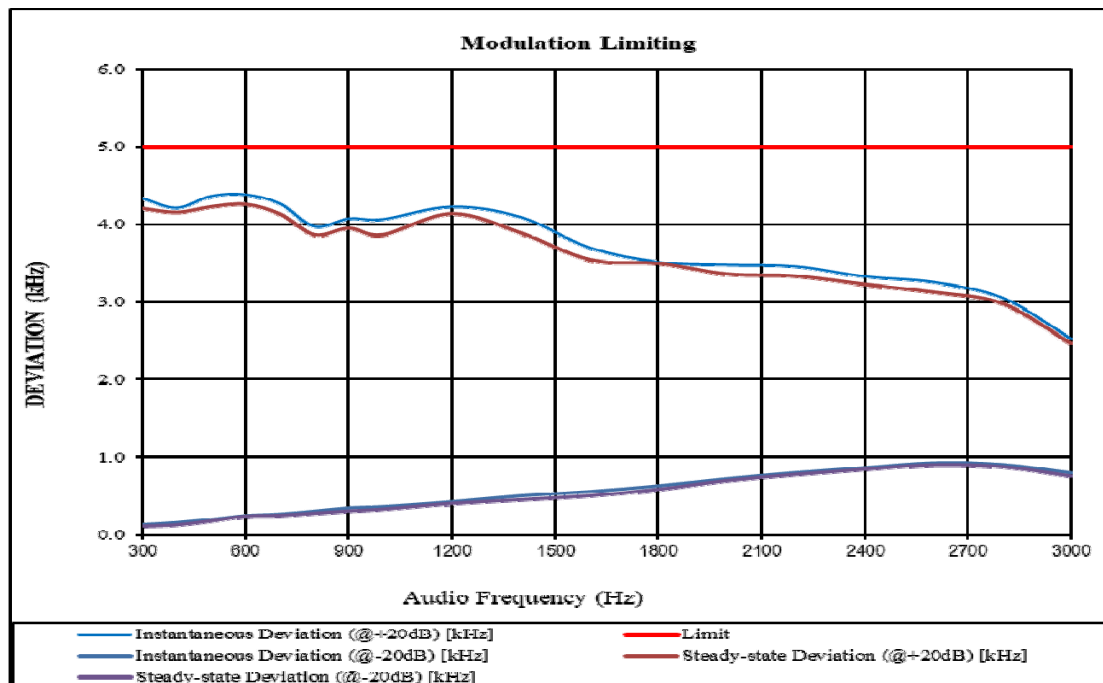
DSC Mode	Maximum Deviation (kHz)	Limit (kHz)
DSC 1300Hz	2.436	5
DSC 2100Hz	3.948	5

FM 25kHz		Carrier Frequency: 156.8 MHz			
Audio Frequency (Hz)	Instantaneous-state		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	4.383	0.101	4.352	0.088	5
400	4.077	0.146	3.956	0.112	5
500	4.354	0.177	4.257	0.148	5
600	4.343	0.207	4.284	0.185	5
700	4.229	0.244	4.191	0.215	5
800	3.915	0.281	3.858	0.243	5
900	3.953	0.319	3.869	0.281	5
1000	3.991	0.344	3.850	0.312	5
1200	4.144	0.414	4.063	0.385	5
1400	4.074	0.475	3.982	0.422	5
1600	3.691	0.551	3.556	0.516	5
1800	3.492	0.615	3.375	0.582	5
2000	3.428	0.692	3.325	0.667	5
2200	3.410	0.786	3.311	0.742	5
2400	3.254	0.857	3.195	0.813	5
2600	3.186	0.916	3.084	0.844	5
2800	3.016	0.890	2.955	0.802	5
3000	2.504	0.794	2.447	0.759	5



Modulation Limiting – Low Power Only

FM 25kHz	Carrier Frequency: 156.850 MHz				
Audio Frequency (Hz)	Instantaneous-state		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	4.332	0.127	4.203	0.107	5
400	4.211	0.154	4.153	0.124	5
500	4.362	0.193	4.225	0.176	5
600	4.381	0.243	4.256	0.237	5
700	4.263	0.263	4.130	0.247	5
800	3.970	0.301	3.864	0.275	5
900	4.071	0.343	3.947	0.304	5
1000	4.064	0.361	3.865	0.328	5
1200	4.225	0.424	4.136	0.403	5
1400	4.091	0.501	3.887	0.451	5
1600	3.697	0.554	3.542	0.502	5
1800	3.513	0.628	3.497	0.583	5
2000	3.479	0.720	3.358	0.697	5
2200	3.457	0.799	3.331	0.776	5
2400	3.325	0.862	3.224	0.843	5
2600	3.252	0.925	3.127	0.901	5
2800	3.051	0.903	2.976	0.876	5
3000	2.524	0.795	2.463	0.753	5



4.4 Bandwidth

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

General:

Modulation Mode	Channel Separation	f_c	High Power Level		Low Power Level	
			99% Occupied Bandwidth	26 dB Bandwidth	99% Occupied Bandwidth	26 dB Bandwidth
		MHz	kHz	kHz	kHz	kHz
FM	25kHz	156.025	10.421	15.631	10.421	15.631
		156.800	10.421	15.631	10.421	15.631
		157.425	10.421	15.631	10.421	15.631
DSC 1300		156.525	8.016	8.818	8.016	8.818
DSC 2100		156.525	12.826	17.234	12.826	17.234

Low Power Only:

Modulation Mode	Channel Separation	f_c	99% Occupied Bandwidth	26 dB Bandwidth
		MHz	kHz	kHz
FM	25kHz	156.850	10.421	15.631

Note 1: Authorized bandwidth for this device is 20 kHz.

Note 2:

Emission bandwidth was based on calculation method instead of measurement.

Emission Designator: BW = 2M + 2D

For FM Mode (Channel Spacing: 25 kHz)

Emission Designator 16K0G3E

In this case, the maximum modulating frequency is 3.0 kHz with a 5.0 kHz deviation.

$BW = 2(M+D) = 2*(3.0 \text{ kHz} + 5.0 \text{ kHz}) = 16 \text{ kHz} = 16K0$

G3E portion of the designator represents an voice transmission

Therefore, the entire designator for 25 kHz channel spacing voice mode is 16K0G3E.

For DSC Mode (Channel Spacing: 25 kHz)

Emission Designator 20K0G2B

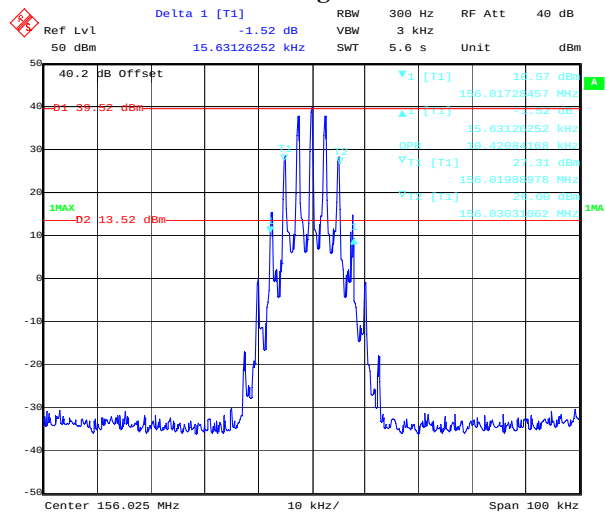
The 99% energy rule was used for DSC mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 20 kHz.

G2B portion of the designator indicates DSC information.

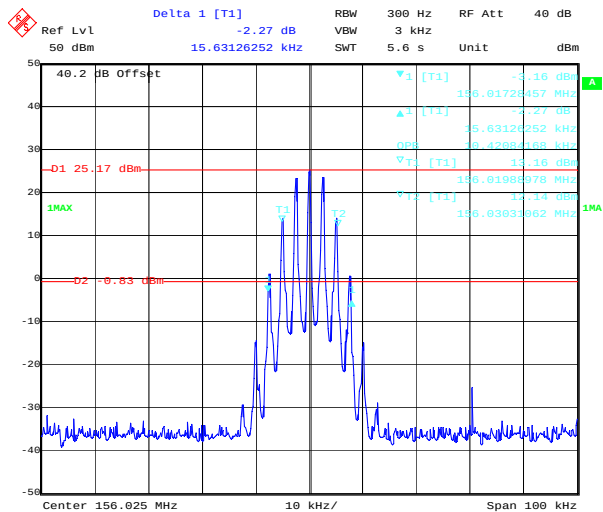
Therefore, the entire designator for 25 kHz channel spacing DSC mode is 20K0G2B.

General:

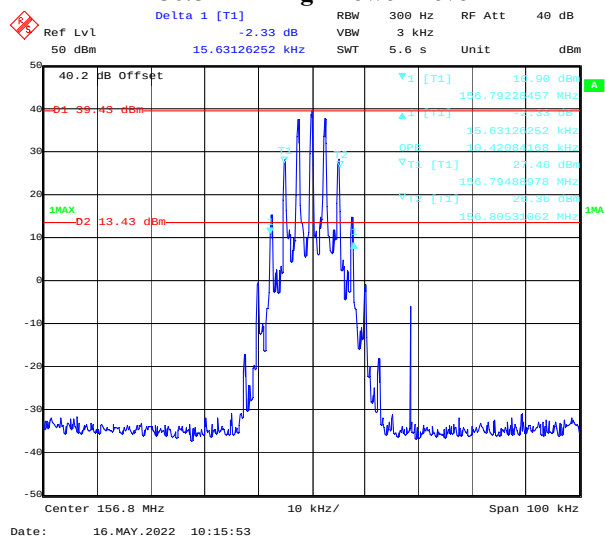
156.025 MHz-High Power Level



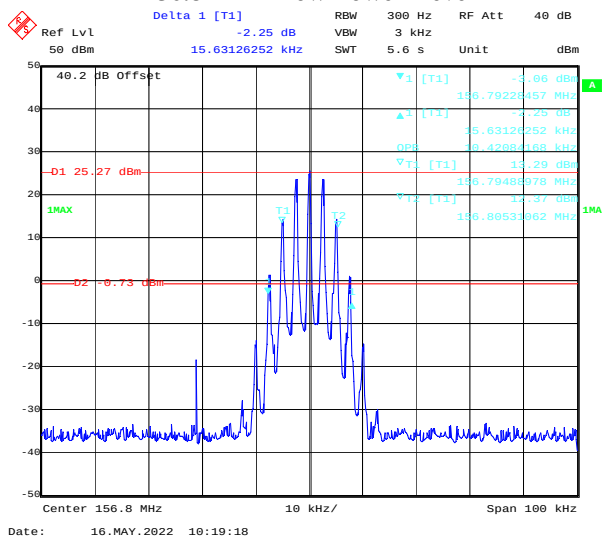
156.025 MHz-Low Power Level



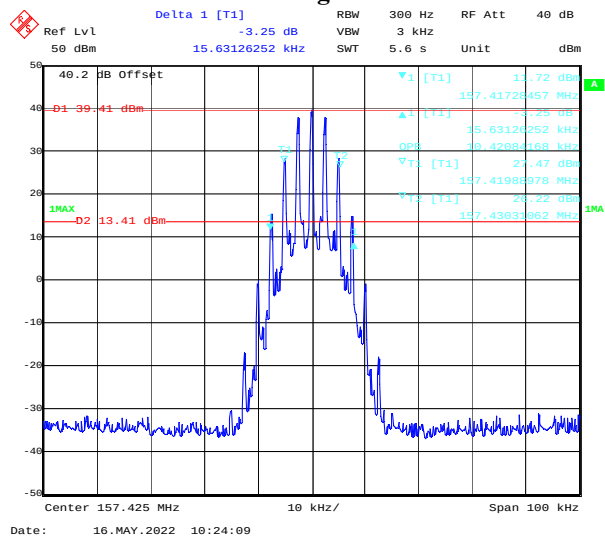
156.8MHz-High Power Level



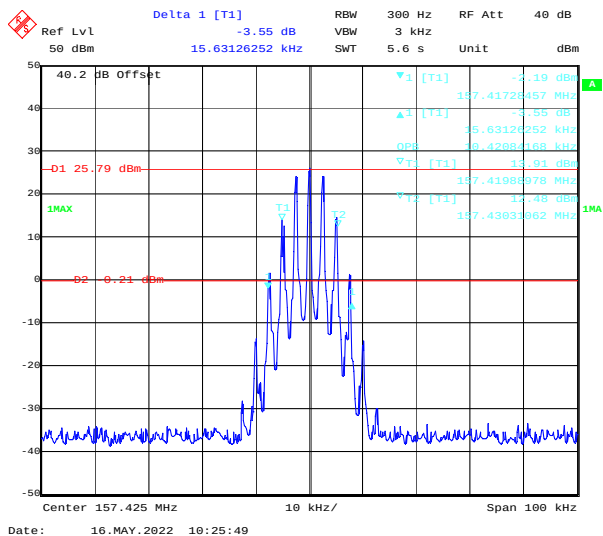
156.8MHz- Low Power Level



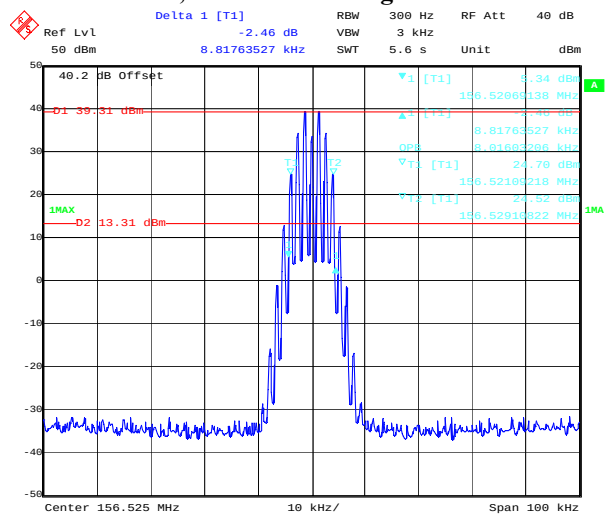
157.425 MHz-High Power Level



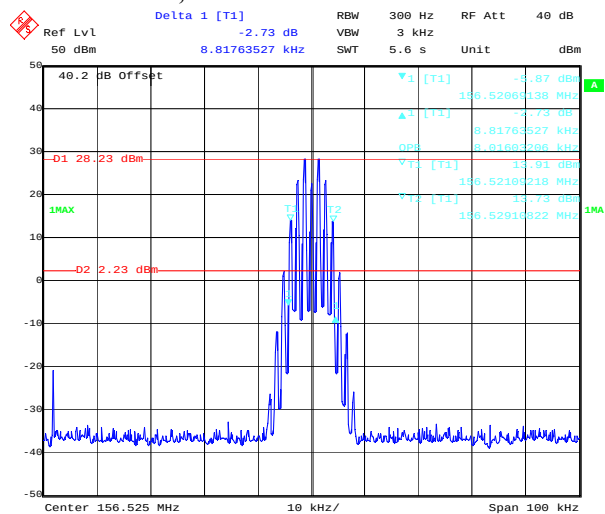
157.425 MHz- Low Power Level



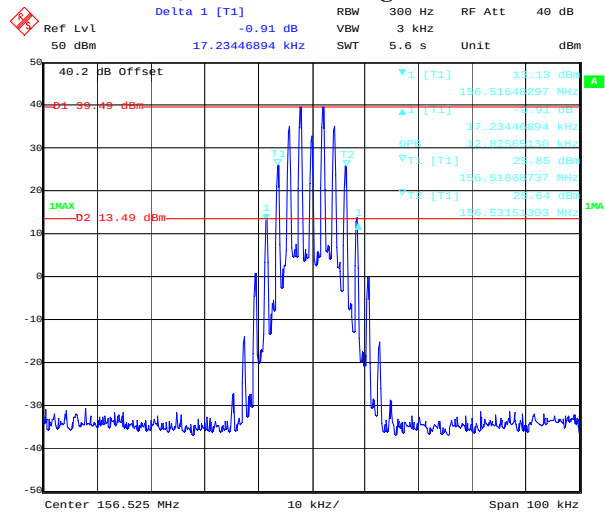
DSC 1300, 156.525 MHz-High Power Level



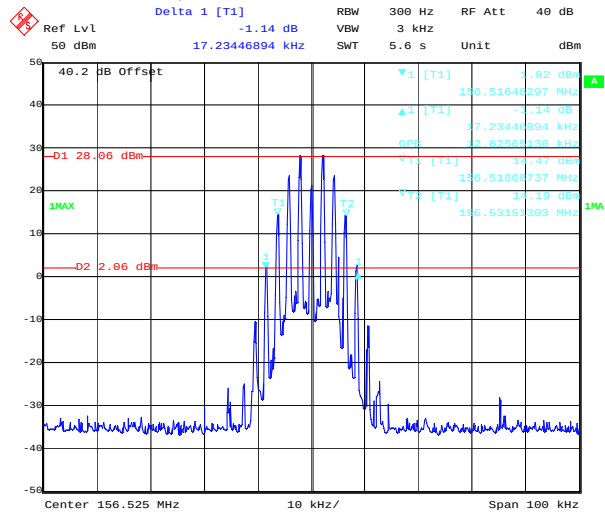
DSC 1300, 156.525 MHz- Low Power Level



DSC 2100, 156.525 MHz-High Power Level

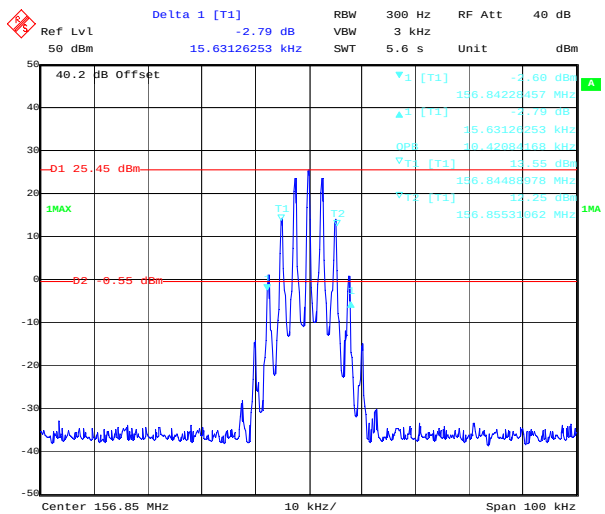


DSC 2100, 156.525 MHz- Low Power Level



Low Power Only:

156.850 MHz



4.5 Emission Limitations

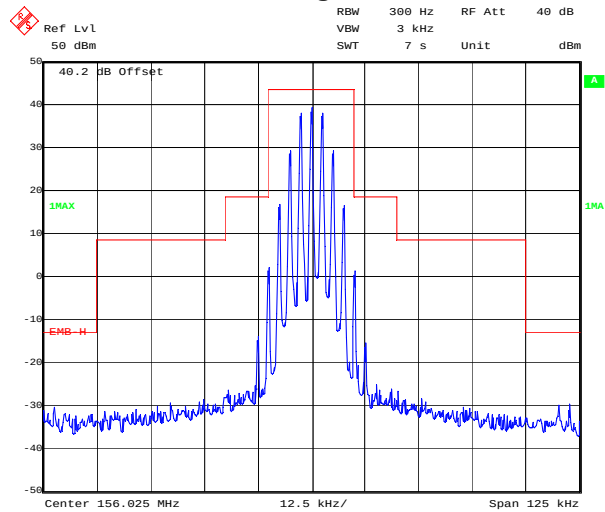
Test Mode: Transmitting

Test Result: Compliance. Please refer to following plots.

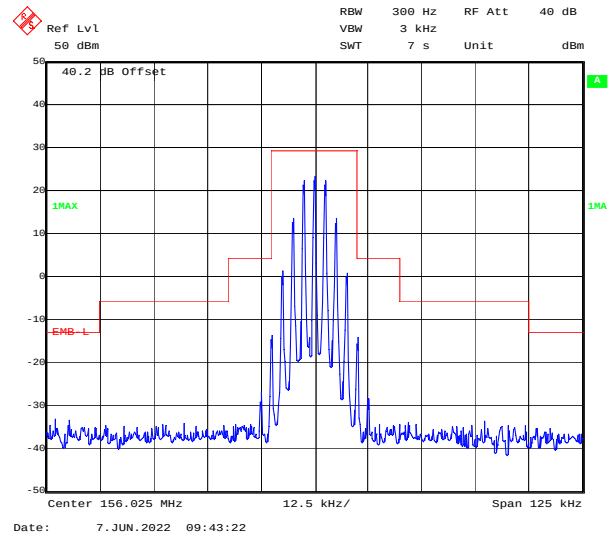
Mask:

General:

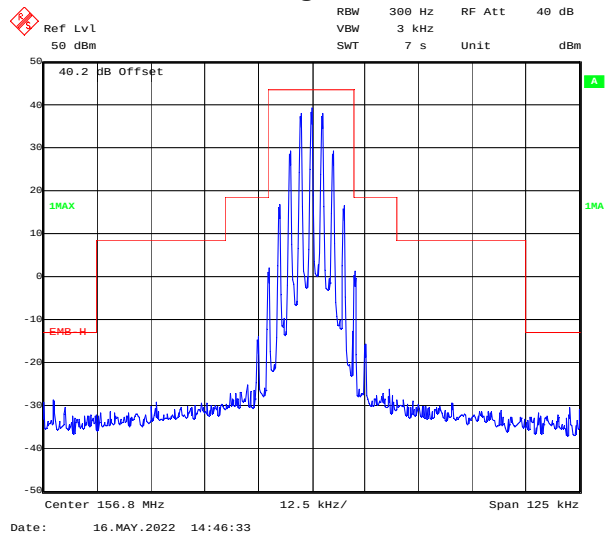
156.025 MHz-High Power Level



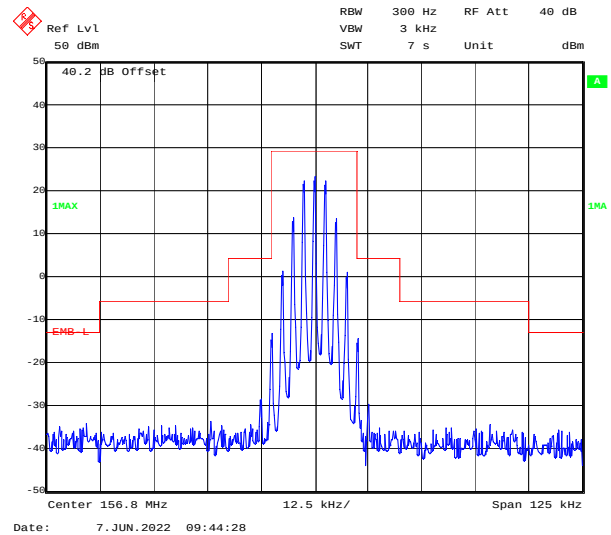
156.025 MHz-Low Power Level

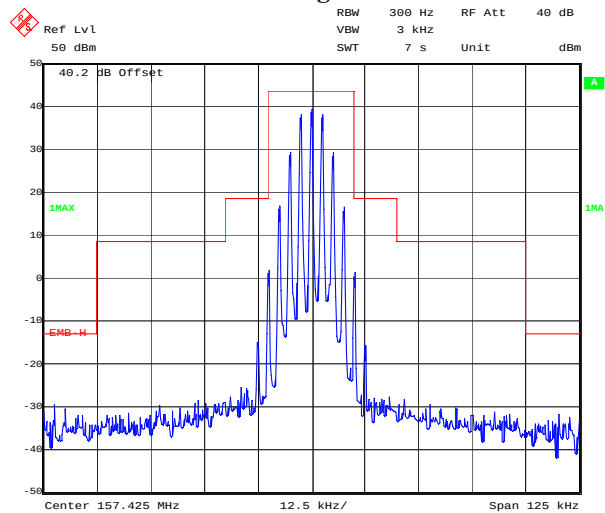


156.8MHz-High Power Level

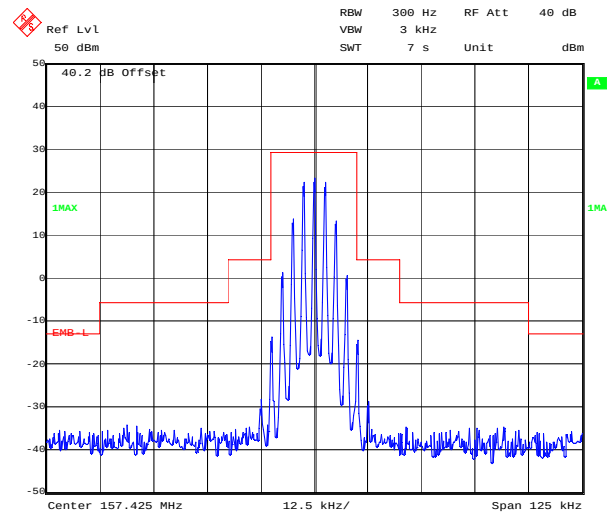


156.8MHz- Low Power Level

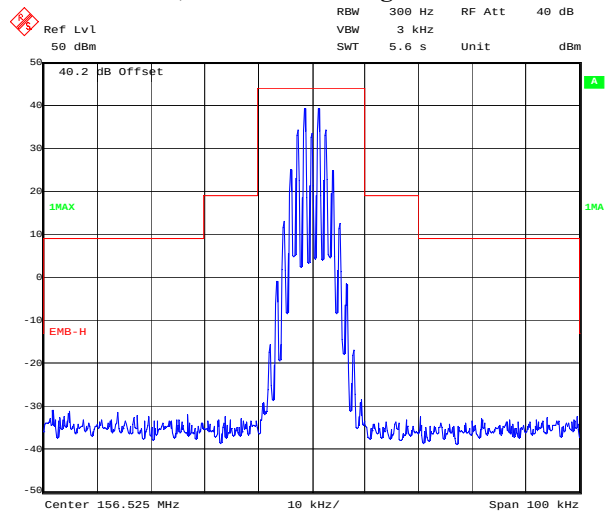


157.425 MHz-High Power Level

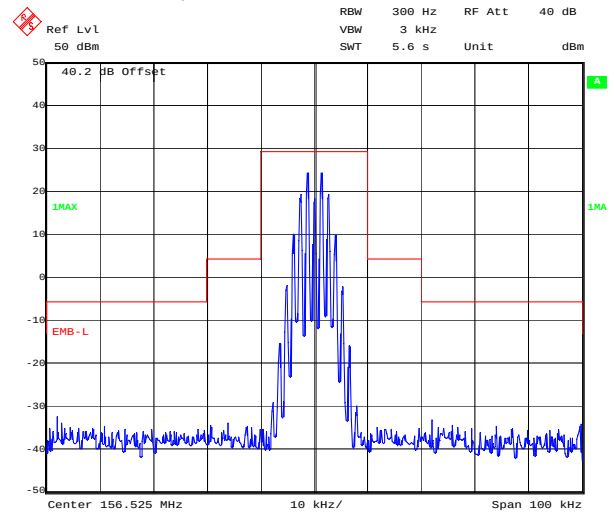
Date: 16.MAY.2022 14:50:40

157.425 MHz- Low Power Level

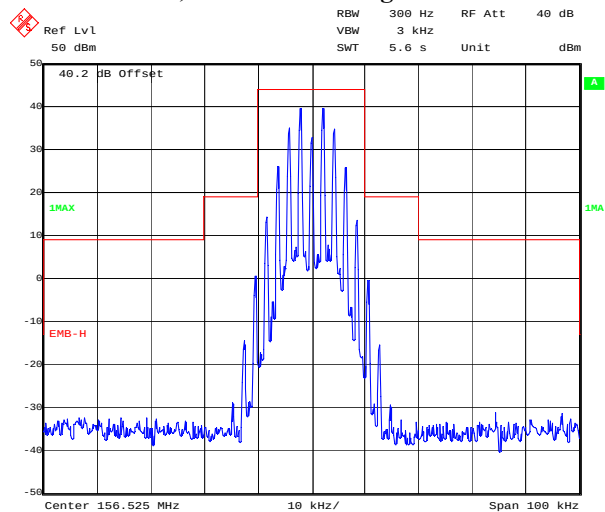
Date: 7.JUN.2022 09:47:29

DSC 1300, 156.525 MHz-High Power Level

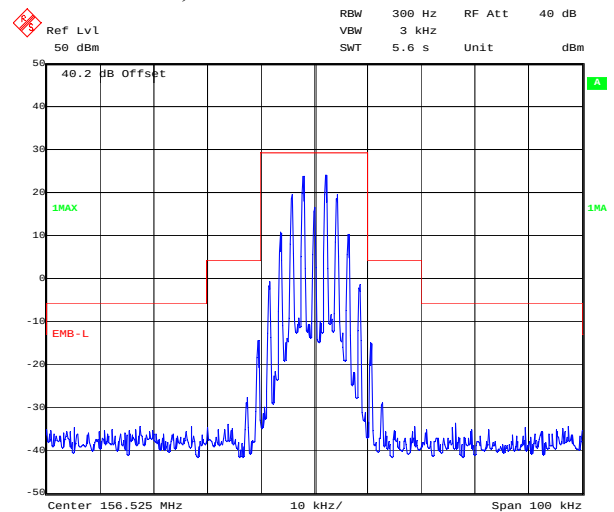
Date: 19.MAY.2022 17:11:37

DSC 1300, 156.525 MHz- Low Power Level

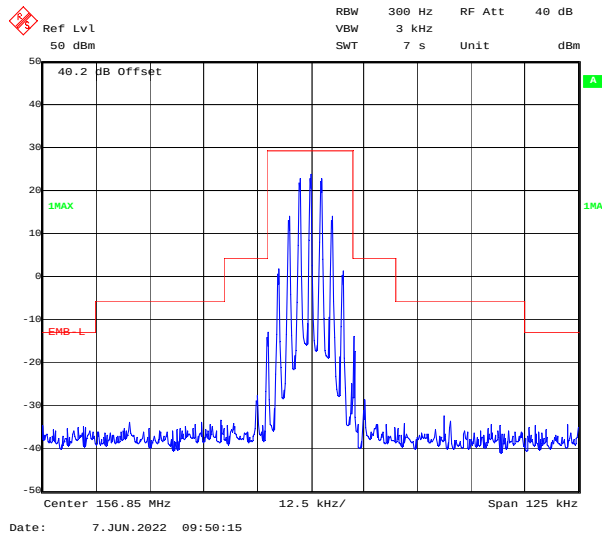
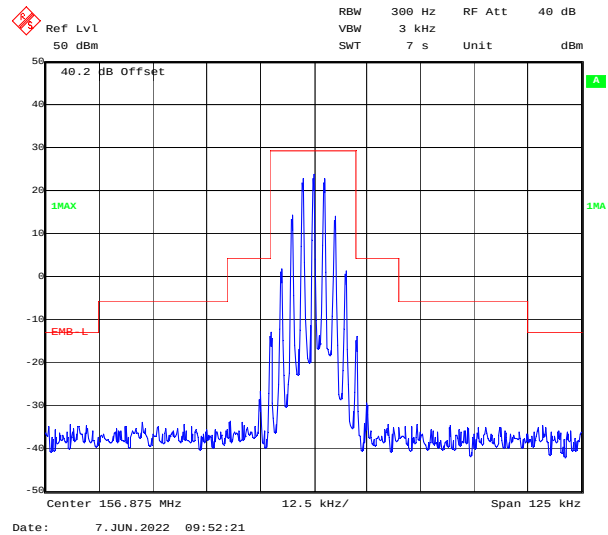
Date: 7.JUN.2022 11:09:35

DSC 2100, 156.525 MHz-High Power Level

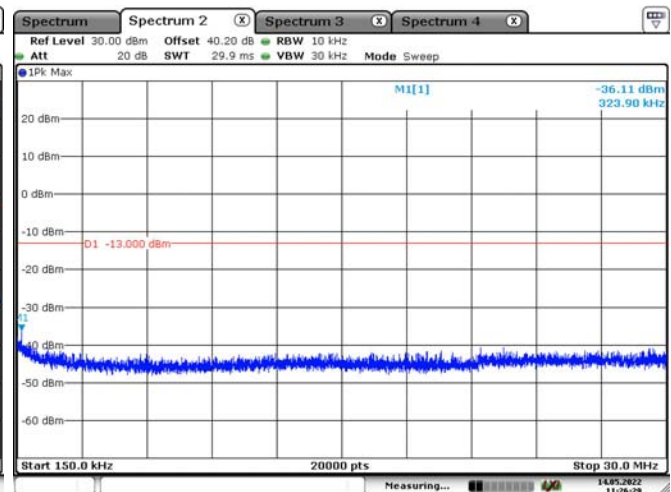
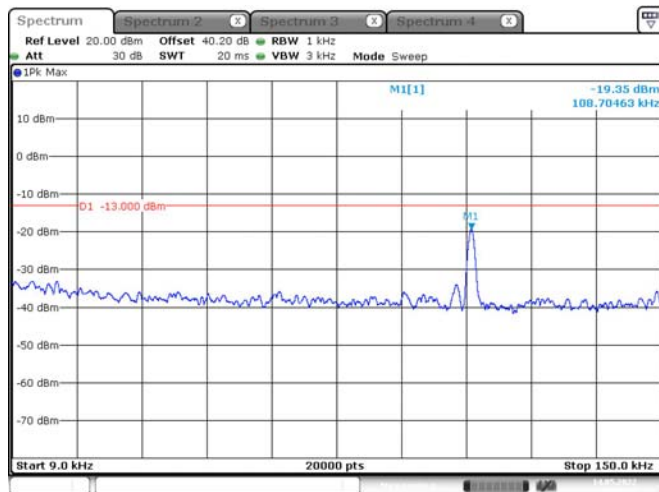
Date: 19.MAY.2022 17:12:45

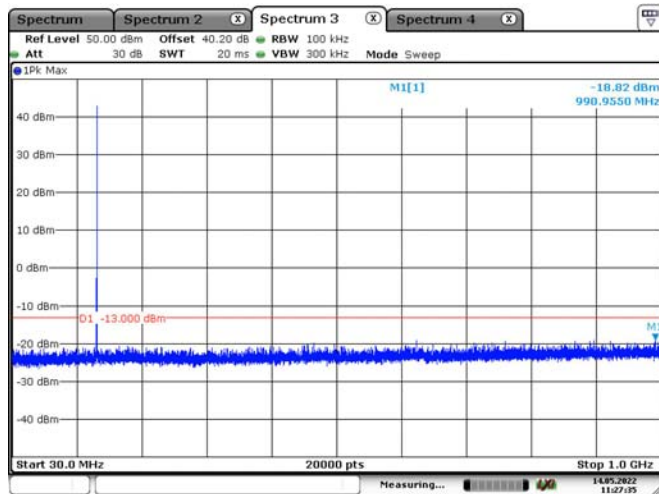
DSC 2100, 156.525 MHz- Low Power Level

Date: 7.JUN.2022 11:10:32

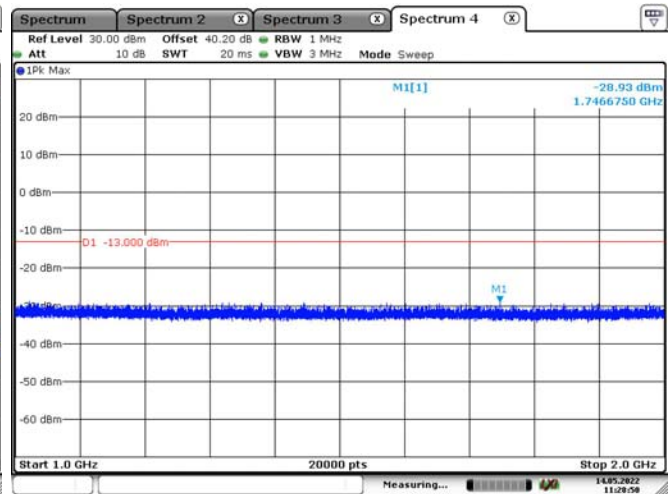
Low Power Only:**156.850 MHz****156.875 MHz****Conducted Emission:****General:**

Note: Test performed at high power level, *please refer to the following plots.*

156.025 MHz

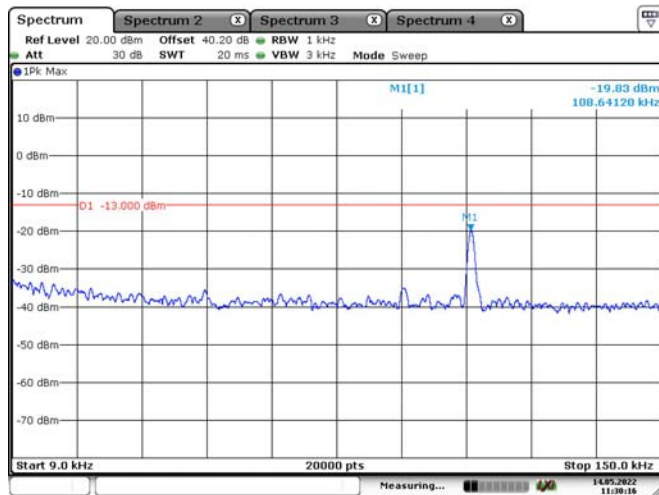


Date: 14.MAY.2022 11:27:35

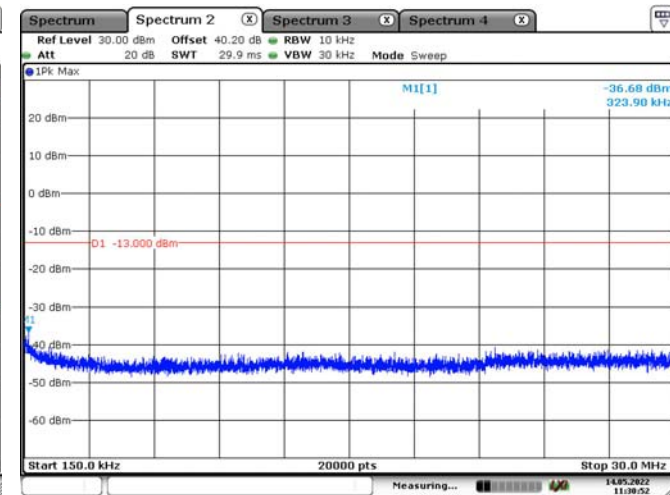


Date: 14.MAY.2022 11:28:50

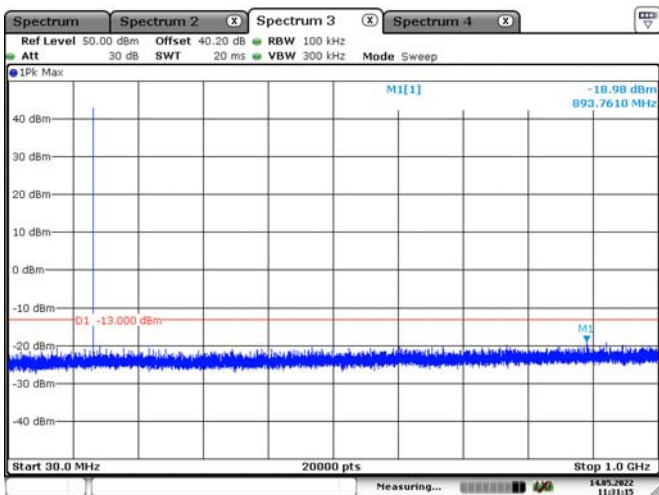
156.8 MHz



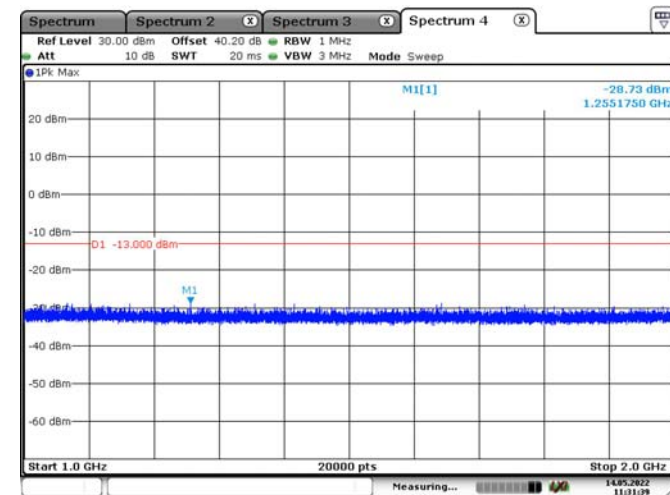
Date: 14.MAY.2022 11:30:16



Date: 14.MAY.2022 11:30:52

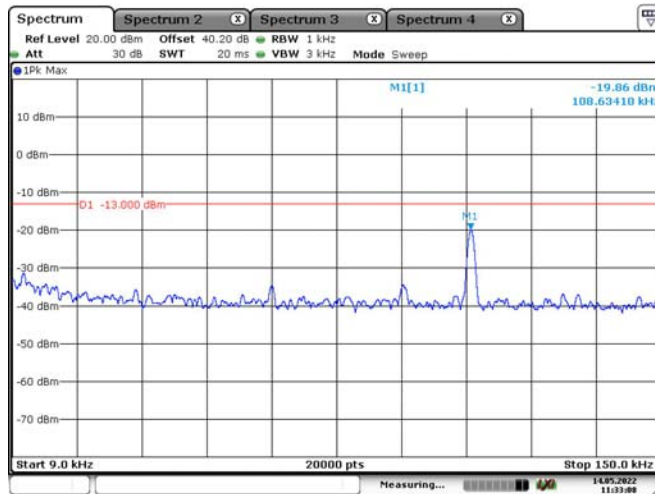


Date: 14.MAY.2022 11:31:15

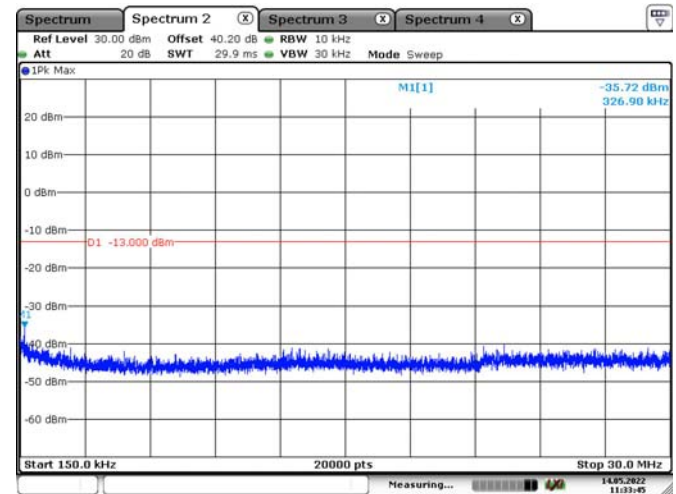


Date: 14.MAY.2022 11:31:39

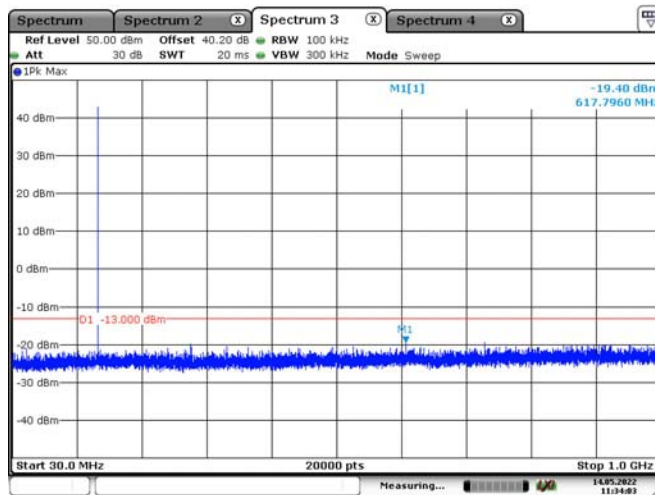
157.425 MHz



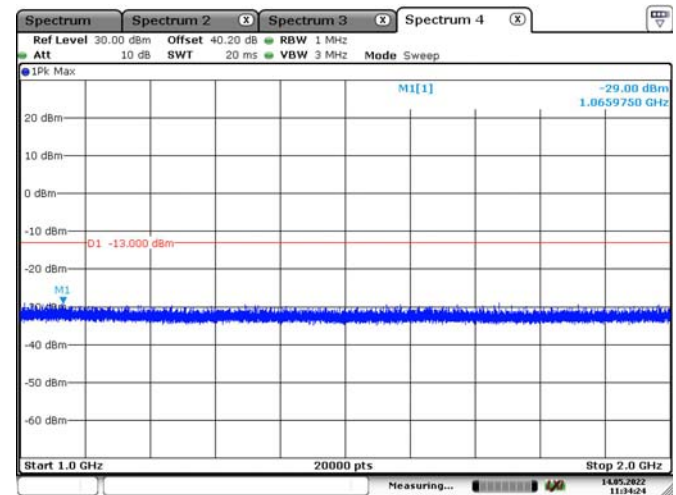
Date: 14.MAY.2022 11:33:08



Date: 14.MAY.2022 11:33:45

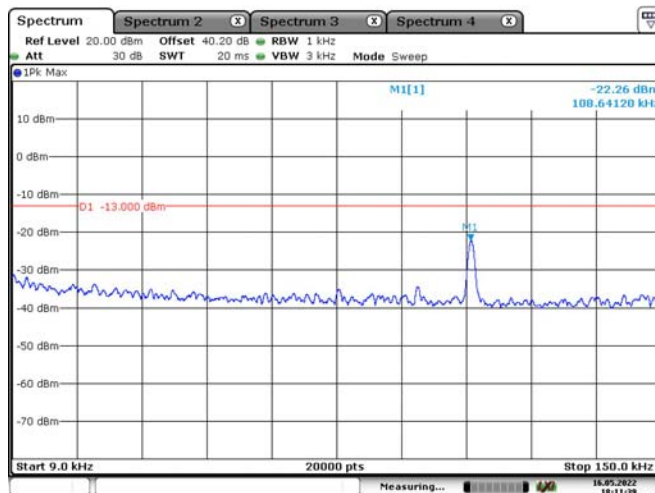


Date: 14.MAY.2022 11:34:03

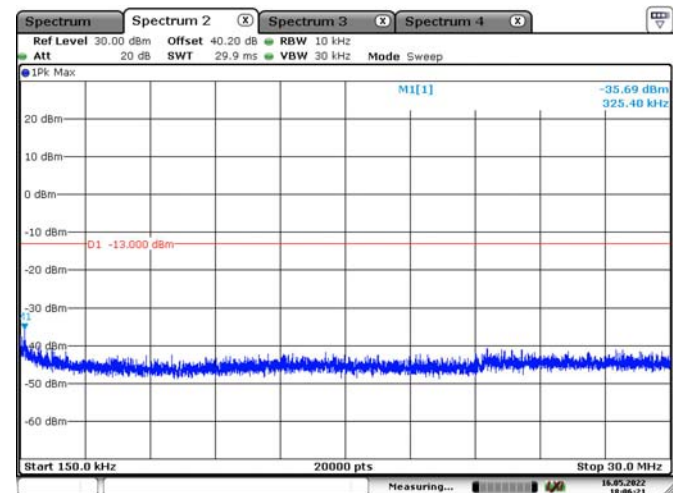


Date: 14.MAY.2022 11:34:24

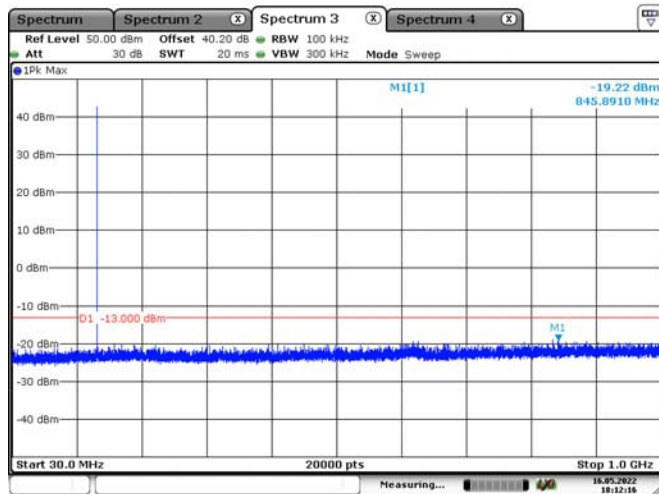
DSC 1300, 156.525MHz



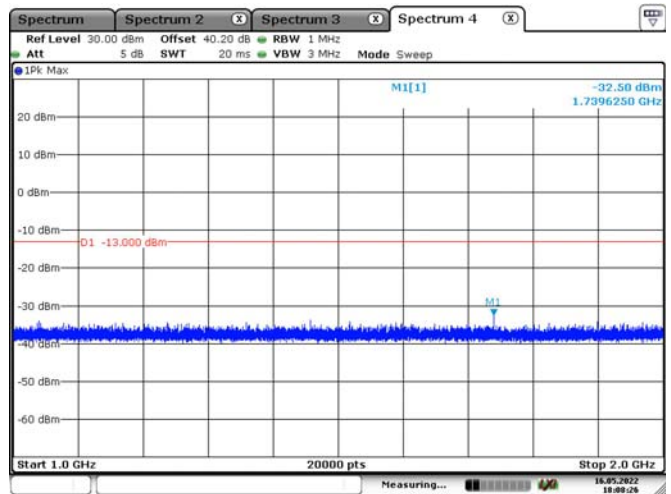
Date: 16.MAY.2022 18:11:40



Date: 16.MAY.2022 18:06:22

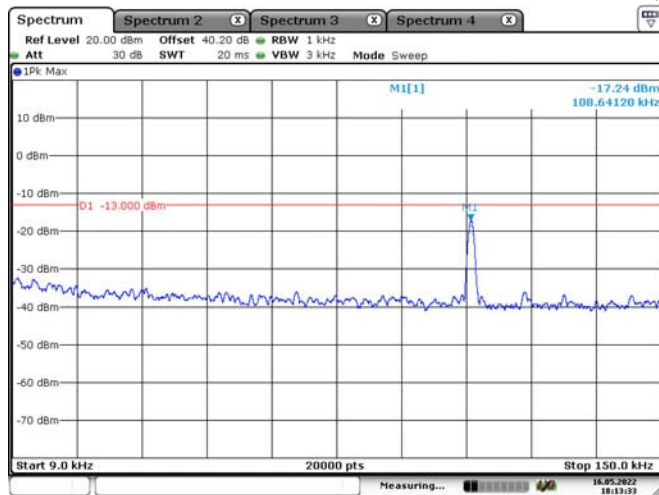


Date: 16.MAY.2022 18:12:17

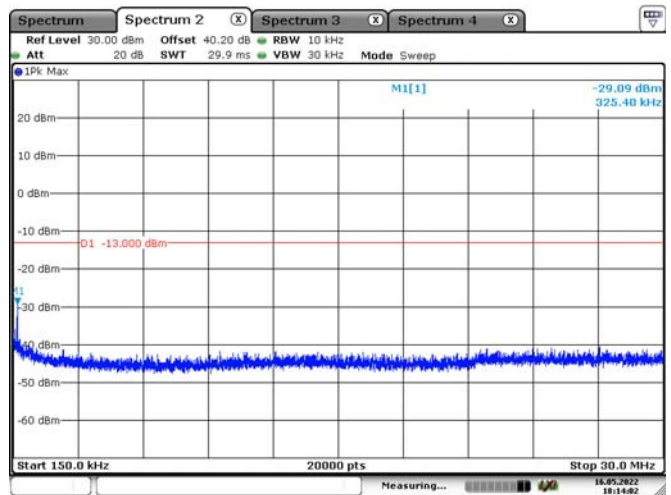


Date: 16.MAY.2022 18:08:26

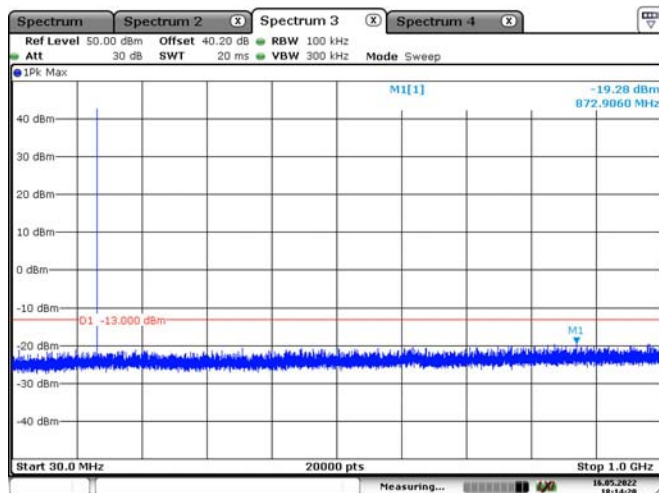
DSC 2100, 156.525MHz



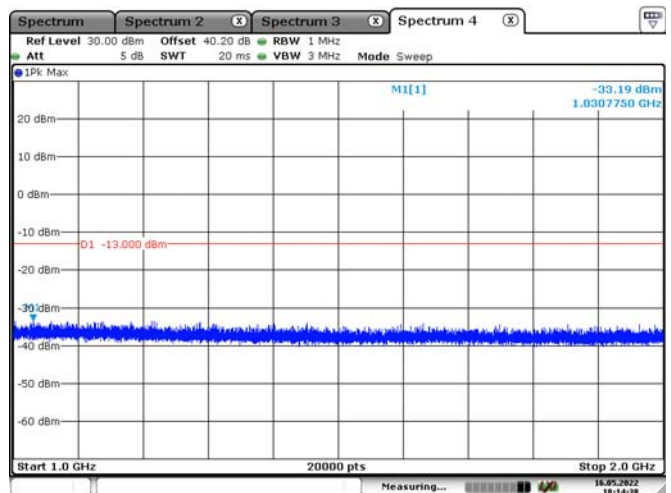
Date: 16.MAY.2022 18:13:34



Date: 16.MAY.2022 18:14:03



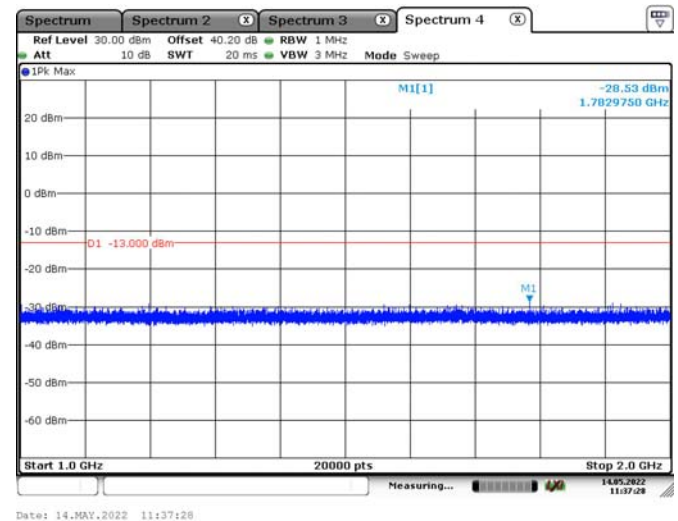
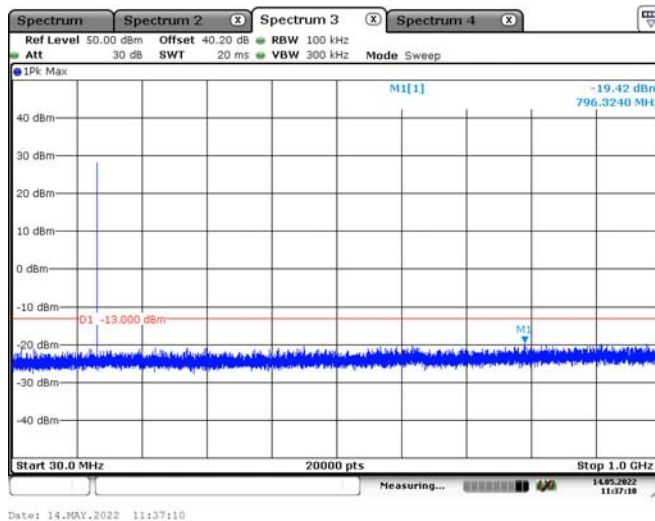
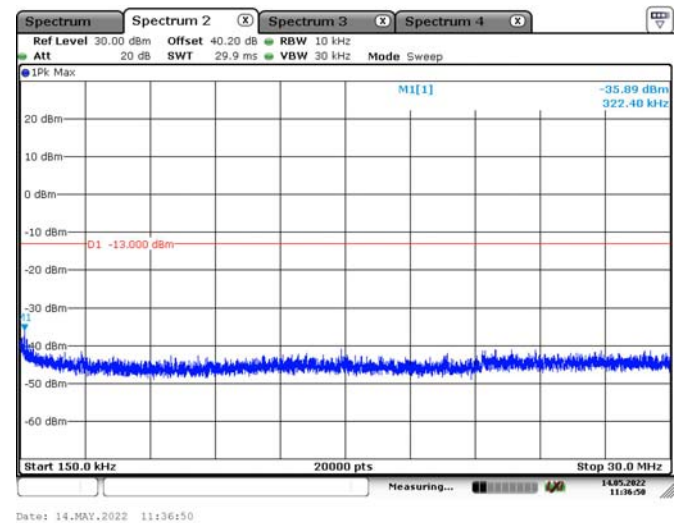
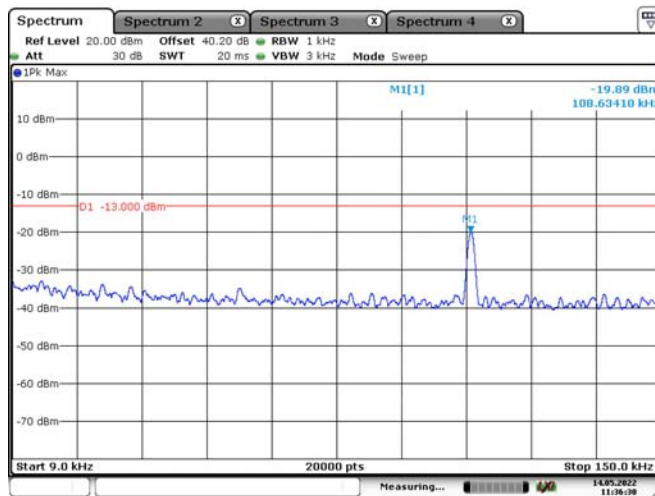
Date: 16.MAY.2022 18:14:21



Date: 16.MAY.2022 18:14:38

Low Power Only:

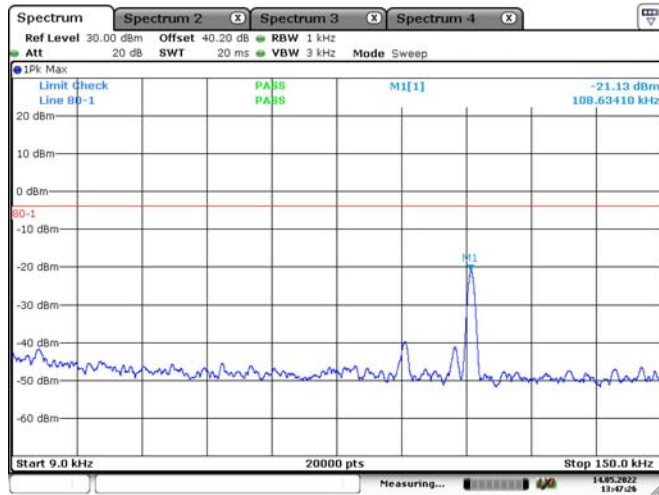
Please refer to the following plots.

156.850 MHz

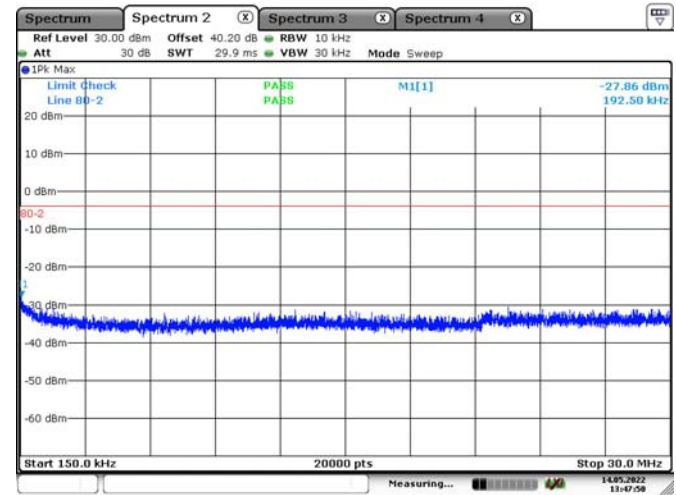
4.6 Suppression of Interference Aboard Ships

Test Mode: Transmitting

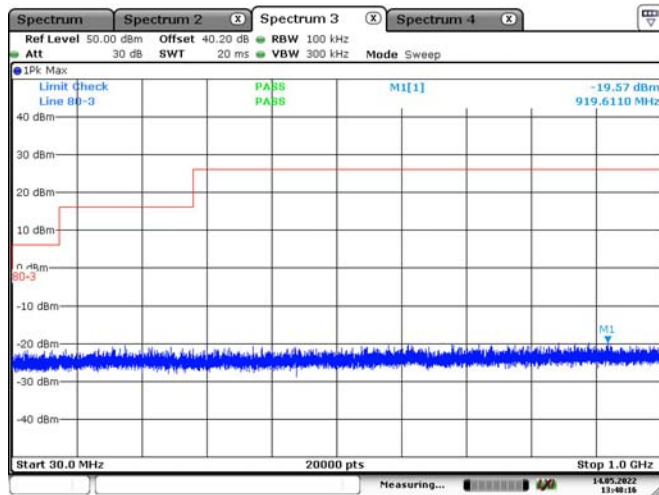
Test Result: Compliance. Please refer to following plots (worst case).



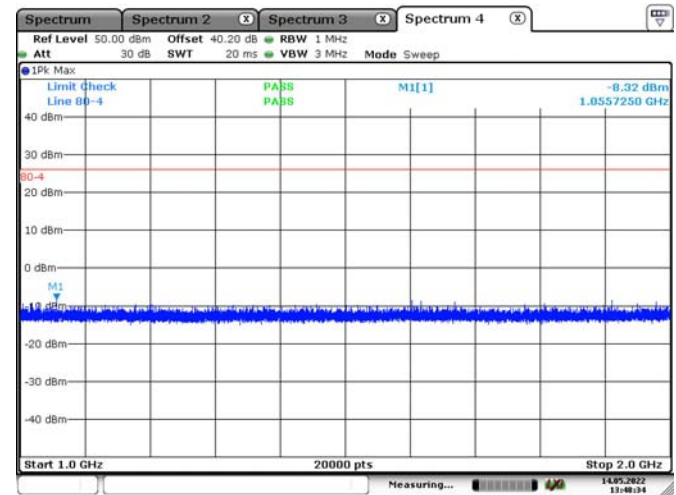
Date: 14.MAY.2022 13:47:26



Date: 14.MAY.2022 13:47:50



Date: 14.MAY.2022 13:48:17



Date: 14.MAY.2022 13:48:35

4.7 Spurious Radiated Emissions

Test Mode: Transmitting

Test Result: Compliance.

General:

Note: Test performed at high power level, *please refer to the following table.*

30MHz - 5GHz:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
FM 25k, Frequency: 156.025MHz								
312.05	H	60.77	-49.77	0.00	0.34	-50.11	-13.00	37.11
312.05	V	46.45	-62.05	0.00	0.34	-62.39	-13.00	49.39
468.08	H	53.72	-53.89	0.00	0.43	-54.32	-13.00	41.32
468.08	V	51.17	-52.64	0.00	0.43	-53.07	-13.00	40.07
624.10	H	36.86	-67.90	0.00	0.48	-68.38	-13.00	55.38
624.10	V	31.77	-71.35	0.00	0.48	-71.83	-13.00	58.83
780.13	H	38.99	-63.79	0.00	0.54	-64.33	-13.00	51.33
780.13	V	24.37	-74.87	0.00	0.54	-75.41	-13.00	62.41
936.15	H	31.91	-66.30	0.00	0.66	-66.96	-13.00	53.96
936.15	V	26.49	-69.15	0.00	0.66	-69.81	-13.00	56.81
1092.18	H	35.90	-65.92	7.36	0.67	-59.23	-13.00	46.23
1092.18	V	36.61	-65.68	7.36	0.67	-58.99	-13.00	45.99
1248.20	H	36.60	-66.20	7.79	0.68	-59.09	-13.00	46.09
1248.20	V	36.62	-66.78	7.79	0.68	-59.67	-13.00	46.67
1404.23	H	36.88	-66.82	8.23	0.71	-59.30	-13.00	46.30
1404.23	V	36.68	-67.06	8.23	0.71	-59.54	-13.00	46.54
1560.25	H	35.74	-68.26	8.57	0.80	-60.49	-13.00	47.49
1560.25	V	35.41	-68.65	8.57	0.80	-60.88	-13.00	47.88
FM 25k, Frequency: 156.8MHz								
313.60	H	61.90	-48.61	0.00	0.34	-48.95	-13.00	35.95
313.60	V	49.34	-59.12	0.00	0.34	-59.46	-13.00	46.46
470.40	H	51.49	-56.07	0.00	0.43	-56.50	-13.00	43.50
470.40	V	49.24	-54.49	0.00	0.43	-54.92	-13.00	41.92
627.20	H	34.12	-70.64	0.00	0.48	-71.12	-13.00	58.12
627.20	V	28.56	-74.49	0.00	0.48	-74.97	-13.00	61.97
784.00	H	40.92	-61.77	0.00	0.56	-62.33	-13.00	49.33
784.00	V	29.81	-69.34	0.00	0.56	-69.90	-13.00	56.90
940.80	H	31.55	-66.52	0.00	0.63	-67.15	-13.00	54.15
940.80	V	27.03	-68.51	0.00	0.63	-69.14	-13.00	56.14
1097.60	H	35.63	-66.08	7.37	0.67	-59.38	-13.00	46.38
1097.60	V	36.14	-66.05	7.37	0.67	-59.35	-13.00	46.35

1254.40	H	36.00	-66.79	7.81	0.68	-59.66	-13.00	46.66
1254.40	V	36.21	-67.17	7.81	0.68	-60.04	-13.00	47.04
1411.20	H	36.59	-67.09	8.25	0.72	-59.56	-13.00	46.56
1411.20	V	36.88	-66.85	8.25	0.72	-59.32	-13.00	46.32
1568.00	H	35.51	-68.56	8.58	0.80	-60.78	-13.00	47.78
1568.00	V	35.76	-68.36	8.58	0.80	-60.58	-13.00	47.58
FM 25k, Frequency: 157.425MHz								
314.85	H	64.14	-46.36	0.00	0.34	-46.70	-13.00	33.70
314.85	V	51.35	-57.07	0.00	0.34	-57.41	-13.00	44.41
472.28	H	49.17	-58.34	0.00	0.43	-58.77	-13.00	45.77
472.28	V	47.16	-56.51	0.00	0.43	-56.94	-13.00	43.94
629.70	H	33.53	-71.22	0.00	0.48	-71.70	-13.00	58.70
629.70	V	29.68	-73.31	0.00	0.48	-73.79	-13.00	60.79
787.13	H	40.11	-62.51	0.00	0.58	-63.09	-13.00	50.09
787.13	V	28.63	-70.44	0.00	0.58	-71.02	-13.00	58.02
944.55	H	31.29	-66.66	0.00	0.60	-67.26	-13.00	54.26
944.55	V	27.32	-68.14	0.00	0.60	-68.74	-13.00	55.74
1101.98	H	36.88	-64.80	7.39	0.67	-58.08	-13.00	45.08
1101.98	V	36.80	-65.38	7.39	0.67	-58.66	-13.00	45.66
1259.40	H	36.02	-66.76	7.83	0.68	-59.61	-13.00	46.61
1259.40	V	36.85	-66.51	7.83	0.68	-59.36	-13.00	46.36
1416.83	H	36.98	-66.68	8.27	0.72	-59.13	-13.00	46.13
1416.83	V	36.22	-67.49	8.27	0.72	-59.94	-13.00	46.94
1574.25	H	35.56	-68.57	8.59	0.81	-60.79	-13.00	47.79
1574.25	V	35.57	-68.61	8.59	0.81	-60.83	-13.00	47.83
Frequency: 156.525MHz, DSC 1300								
313.05	H	57.50	-53.02	0.00	0.34	-53.36	-13.00	40.36
313.05	V	43.58	-64.89	0.00	0.34	-65.23	-13.00	52.23
469.58	H	44.74	-62.83	0.00	0.43	-63.26	-13.00	50.26
469.58	V	41.13	-62.63	0.00	0.43	-63.06	-13.00	50.06
626.10	H	39.70	-65.06	0.00	0.48	-65.54	-13.00	52.54
626.10	V	32.35	-70.73	0.00	0.48	-71.21	-13.00	58.21
782.63	H	36.97	-65.76	0.00	0.55	-66.31	-13.00	53.31
782.63	V	24.53	-74.65	0.00	0.55	-75.20	-13.00	62.20
939.15	H	30.77	-67.35	0.00	0.64	-67.99	-13.00	53.99
939.15	V	27.14	-68.44	0.00	0.64	-69.08	-13.00	56.08
1102.68	H	35.74	-65.95	7.39	0.67	-59.23	-13.00	46.23
1102.68	V	36.68	-65.51	7.39	0.67	-58.79	-13.00	45.79
1260.20	H	36.80	-65.98	7.83	0.68	-58.83	-13.00	45.83
1260.20	V	36.92	-66.43	7.83	0.68	-59.28	-13.00	46.28
1417.73	H	36.79	-66.87	8.27	0.72	-59.32	-13.00	46.32
1417.73	V	35.63	-68.08	8.27	0.72	-60.53	-13.00	47.53
1575.25	H	35.09	-69.05	8.59	0.81	-61.27	-13.00	48.27
1575.25	V	35.71	-68.48	8.59	0.81	-60.70	-13.00	47.70
Frequency: 156.525MHz, DSC 2100								
313.05	H	57.12	-53.40	0.00	0.34	-53.74	-13.00	40.74

313.05	V	43.18	-65.29	0.00	0.34	-65.63	-13.00	52.63
469.58	H	45.31	-62.26	0.00	0.43	-62.69	-13.00	49.69
469.58	V	41.48	-62.28	0.00	0.43	-62.71	-13.00	49.71
626.10	H	38.32	-66.44	0.00	0.48	-66.92	-13.00	53.92
626.10	V	32.88	-70.20	0.00	0.48	-70.68	-13.00	57.68
782.63	H	37.79	-64.94	0.00	0.55	-65.49	-13.00	52.49
782.63	V	24.74	-74.44	0.00	0.55	-74.99	-13.00	61.99
939.15	H	30.99	-67.13	0.00	0.64	-67.77	-13.00	54.77
939.15	V	27.27	-68.31	0.00	0.64	-68.95	-13.00	55.95
1102.68	H	36.04	-65.65	7.39	0.67	-58.93	-13.00	45.93
1102.68	V	37.00	-65.19	7.39	0.67	-58.47	-13.00	45.47
1260.20	H	35.66	-67.12	7.83	0.68	-59.97	-13.00	46.97
1260.20	V	36.71	-66.64	7.83	0.68	-59.49	-13.00	46.49
1417.73	H	37.78	-65.88	8.27	0.72	-58.33	-13.00	45.33
1417.73	V	36.39	-67.32	8.27	0.72	-59.77	-13.00	46.77
1575.25	H	35.99	-68.15	8.59	0.81	-60.37	-13.00	47.37
1575.25	V	35.71	-68.48	8.59	0.81	-60.70	-13.00	47.70

Note 1: The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.

Note 2:

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

Low Power Only:

Please refer to the following table.

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
FM 25k, Frequency: 156.850MHz								
313.70	H	46.75	-63.76	0.00	0.34	-64.10	-13.00	51.10
313.70	V	34.15	-74.30	0.00	0.34	-74.64	-13.00	61.64
470.55	H	36.25	-71.30	0.00	0.43	-71.73	-13.00	58.73
470.55	V	34.29	-69.44	0.00	0.43	-69.87	-13.00	56.87
627.40	H	25.12	-79.64	0.00	0.48	-80.12	-13.00	67.12
627.40	V	25.53	-77.51	0.00	0.48	-77.99	-13.00	64.99
784.25	H	25.78	-76.91	0.00	0.56	-77.47	-13.00	64.47
784.25	V	24.75	-74.39	0.00	0.56	-74.95	-13.00	61.95
941.10	H	26.58	-71.48	0.00	0.63	-72.11	-13.00	59.11
941.10	V	25.93	-69.60	0.00	0.63	-70.23	-13.00	57.23
1097.60	H	35.32	-66.39	7.37	0.67	-59.69	-13.00	46.69
1097.60	V	35.89	-66.30	7.37	0.67	-59.60	-13.00	46.60
1254.40	H	35.82	-66.97	7.81	0.68	-59.84	-13.00	46.84
1254.40	V	35.93	-67.45	7.81	0.68	-60.32	-13.00	47.32
1411.20	H	35.32	-68.36	8.25	0.72	-60.83	-13.00	47.83
1411.20	V	35.62	-68.11	8.25	0.72	-60.58	-13.00	47.58
1568.00	H	35.28	-68.79	8.58	0.80	-61.01	-13.00	48.01
1568.00	V	35.56	-68.56	8.58	0.80	-60.78	-13.00	47.78

Note 1: The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.

Note 2:

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit - Absolute Level

4.8 Transmitter Frequency Tolerances

Test Mode: Transmitting

Test Result: Compliance. Please refer to following tables.

General:

FM,25kHz, Reference Frequency: 156.8MHz,Limit: ±10 ppm			
Temperature (°C)	Voltage Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
-20	12	156.8000189	0.12
-10		156.8000257	0.16
0		156.8000336	0.21
10		156.8000452	0.29
20		156.8000601	0.38
30		156.7999521	-0.31
40		156.8000326	0.21
50		156.7999853	-0.09
55		156.8000055	0.04
20	10.5	156.8000264	0.17
20	15.8	156.8000233	0.15

DSC 1300, Reference Frequency: 156.525MHz,Limit: ±10.0 ppm			
Temperature (°C)	Voltage Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
-20	12	156.5250359	0.23
-10		156.5250547	0.35
0		156.5250016	0.01
10		156.5250113	0.07
20		156.5250601	0.38
30		156.5250124	0.08
40		156.5250584	0.37
50		156.5250069	0.04
55		156.5250387	0.25
20	10.5	156.5250487	0.31
20	15.8	156.5250384	0.25

DSC 2100, Reference Frequency: 156.525MHz,Limit: ±10.0 ppm			
Temperature (°C)	Voltage Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
-20	12	156.5249966	-0.02
-10		156.5249754	-0.16
0		156.5250466	0.30
10		156.5250533	0.34
20		156.5250601	0.38
30		156.5250154	0.10
40		156.5250533	0.34
50		156.5250416	0.27
55		156.5250258	0.16
20	10.5	156.5250186	0.12
20	15.8	156.5250100	0.06

Low Power Only:

FM,25kHz, Reference Frequency: 156.850MHz,Limit: ±10.0 ppm			
Temperature (°C)	Voltage Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
-20	12	156.8750178	0.11
-10		156.8750215	0.14
0		156.8750297	0.19
10		156.8750316	0.20
20		156.8750601	0.38
30		156.8750488	0.31
40		156.8750315	0.20
50		156.8750411	0.26
55		156.8750557	0.36
20	10.5	156.8750224	0.14
20	15.8	156.8750184	0.12

5. RF EXPOSURE EVALUATION

5.1 For WIFI:

5.1.1 Applicable Standard

FCC §15.247 (i) & §1.1310 & §2.1091

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

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

According to §1.1310 and §2.1091 RF exposure is calculated.

5.1.2 MPE Calculation

Prediction of power density at the distance of the applicable MPE limit

$$S = PG/4\pi R^2$$

Where: 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

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

5.1.3 Calculated Result

Operation Modes	Frequency (MHz)	Conducted Output Power Including Tune-up Tolerance		Antenna Gain		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBm)	(mW)	(dBi)	(numeric)			
Wi-Fi	2412-2462	18	63.1	1.5	1.41	20.00	0.018	≤1

Result: Device meet MPE requirement at 20 cm distance away from Antenna to human body.

5.2 For VHF:

5.2.1 Applicable Standard

According to 1.1310, 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 (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (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;

5.1.2 MPE Calculation

Prediction of power density at the distance of the applicable MPE limit

$$S = PG/4\pi R^2$$

Where: 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

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

5.1.3 Calculated Result

Frequency (MHz)	Maximum Average Output Power Including Tune-up Tolerance (dBm)	Maximum Allowable Antenna Gain (dBi)	Cable Loss (dB)	Operating Duty Cycle (%)	Evaluation Distance (cm)	Power Density (mW/cm ²)	Power Density Limit (mW/cm ²)
156.025-157.425	43.98	9	1	50	221	0.129	0.2

Note: Maximum target power is 25 W

Result: Device meet MPE requirement at 221 cm distance away from Antenna to human body.

5.3 For Simultaneously:

The 2.4G Wi-Fi can transmit simultaneously with VHF:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$$=S_{WIFI}/S_{limit- WIFI} + S_{VHF}/S_{limit- VHF}$$

$$=0.018/1+0.129/0.2$$

$$=0.018+0.645$$

$$=0.663$$

$$< 1.0$$

Result: The device compliant the MPE for transmit simultaneously.

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