



**中认信通**

CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



Certificate #6356.01

## TEST REPORT

**APPLICANT: Garmin International Inc**

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

**FCC ID: IPH-A1653**

**PRODUCT NAME: MARINE VHF RADIO**

**STANDARD(S): FCC Part 80**

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:** CR21100080-00A

**Date Of Issue:** 2021-10-28

**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.

This report cannot be reproduced except in full, without prior written approval of the Company.

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk “★”.

## CONTENTS

|   |           |
|---|-----------|
| <b>TEST FACILITY .....</b>  | <b>2</b>  |
| <b>DECLARATIONS .....</b>   | <b>2</b>  |
| <b>1. GENERAL INFORMATION .....</b>   | <b>5</b>  |
| <b>1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....</b>                  | <b>5</b>  |
| <b>1.2 TECHNICAL SPECIFICATION .....</b>  | <b>5</b>  |
| <b>1.3 DESCRIPTION OF TEST CONFIGURATION .....</b>                                  | <b>6</b>  |
| 1.3.2 Support Equipment List and Details.....                                       | 6         |
| 1.3.3 Support Cable List and Details.....   | 6         |
| 1.3.4 Block Diagram of Test Setup .....   | 6         |
| <b>1.3 MEASUREMENT UNCERTAINTY .....</b>  | <b>7</b>  |
| <b>2. SUMMARY OF TEST RESULTS .....</b>   | <b>8</b>  |
| <b>3. REQUIREMENTS AND TEST PROCEDURES .....</b>                                    | <b>9</b>  |
| <b>3.1 TRANSMITTER POWER.....</b>   | <b>9</b>  |
| Applicable Standard .....   | 9         |
| Test Procedure.....   | 9         |
| <b>3.2 MODULATION REQUIREMENTS .....</b>  | <b>9</b>  |
| Applicable Standard .....   | 9         |
| Test Procedure.....   | 9         |
| <b>3.3 BANDWIDTH .....</b>  | <b>10</b> |
| Applicable Standard .....   | 10        |
| Test Procedure.....   | 10        |
| <b>3.4 EMISSION LIMITATIONS.....</b>  | <b>10</b> |
| Applicable Standard .....   | 10        |
| Test Procedure.....   | 10        |
| <b>3.5 SUPPRESSION OF INTERFERENCE ABOARD SHIPS .....</b>                           | <b>11</b> |
| Applicable Standard .....   | 11        |
| Test Procedure.....   | 11        |
| <b>3.6 SPURIOUS RADIATED EMISSIONS .....</b>  | <b>11</b> |
| Applicable Standard .....   | 11        |
| Test Procedure.....   | 12        |
| <b>3.7 TRANSMITTER FREQUENCY TOLERANCES.....</b>                                    | <b>12</b> |
| Applicable Standard .....   | 12        |
| Test Procedure.....   | 13        |
| <b>4. Test DATA AND RESULTS .....</b>   | <b>14</b> |
| <b>4.1 TEST ENVIRONMENTAL CONDITIONS &amp; TEST EQUIPMENT LIST AND DETAILS.....</b> | <b>14</b> |
| 4.1.1 Radiation Emission Below 1GHz Test.....                                       | 14        |
| 4.1.2 Radiation Emission Above 1GHz Test.....                                       | 14        |
| 4.1.3 RF Conducted Test.....  | 15        |
| <b>4.2 TRANSMITTER POWER.....</b>   | <b>16</b> |
| <b>4.3 MODULATION REQUIREMENTS .....</b>  | <b>18</b> |
| <b>4.4 BANDWIDTH .....</b>  | <b>20</b> |
| <b>4.5 EMISSION LIMITATIONS.....</b>  | <b>22</b> |

---

|  |           |
|--|-----------|
| <b>4.5 SUPPRESSION OF INTERFERENCE ABOARD SHIPS.....</b> | <b>28</b> |
| <b>4.6 SPURIOUS RADIATED EMISSIONS .....</b>             | <b>29</b> |
| <b>4.7 TRANSMITTER FREQUENCY TOLERANCES.....</b>         | <b>32</b> |
| <b>5. RF EXPOSURE EVALUATION .....</b>                   | <b>33</b> |
| <b>5.1 MAXIMUM PERMISSIBLE EXPOSURE (MPE).....</b>       | <b>33</b> |
| <b>5.1.1 APPLICABLE STANDARD .....</b>                   | <b>33</b> |
| <b>5.1.2 MPE CALCULATION.....</b>                        | <b>33</b> |
| <b>5.1.3 CALCULATED RESULT.....</b>                      | <b>33</b> |

## 1. GENERAL INFORMATION

### 1.1 Product Description for Equipment under Test (EUT)

|                             |   |
|-----------------------------|---|
| <b>Product Name:</b>        | MARINE VHF RADIO  |
| <b>Test Model:</b>          | CA1654  |
| <b>Multiple Models:</b>     | BA1653, DA1654  |
| <b>Model Difference:</b>    | Refer to the DOS letter   |
| <b>Rated Input Voltage:</b> | DC 12V  |
| <b>Serial Number:</b>       | CA1654: CR21100080-RF-RF-S1<br>BA1653: CR21100080-RF-RF-S2<br>DA1654: CR21100080-RF-RF-S3 |
| <b>EUT Received Date:</b>   | 2021.10.18  |
| <b>EUT Received Status:</b> | Good  |

### 1.2 Technical Specification

|   |  |                 |
|---|--|-----------------|
| <b>Operation Frequency Range (MHz):</b>       | <b>Transmit:</b>                           | 156.025-157.425 |
|   | <b>Receive:</b>                            | 156.050-163.275 |
| <b>Rated RF Output Power (Conducted) (W):</b> | High power level: 25<br>Low power level: 1 |                 |
| <b>Modulation Type:</b>                       | FM   |                 |
| <b>Channel Spacing (kHz):</b>                 | 25   |                 |

### 1.3 Description of Test Configuration

#### 1.3.1 EUT Operation Condition:

|                                 |  |
|---------------------------------|--|
| <b>EUT Operation Mode:</b>      | The system was configured for testing in Engineering Mode, which was provided by the manufacturer <sup>▲</sup> . |
| <b>Equipment Modifications:</b> | No   |
| <b>EUT Exercise Software:</b>   | No   |

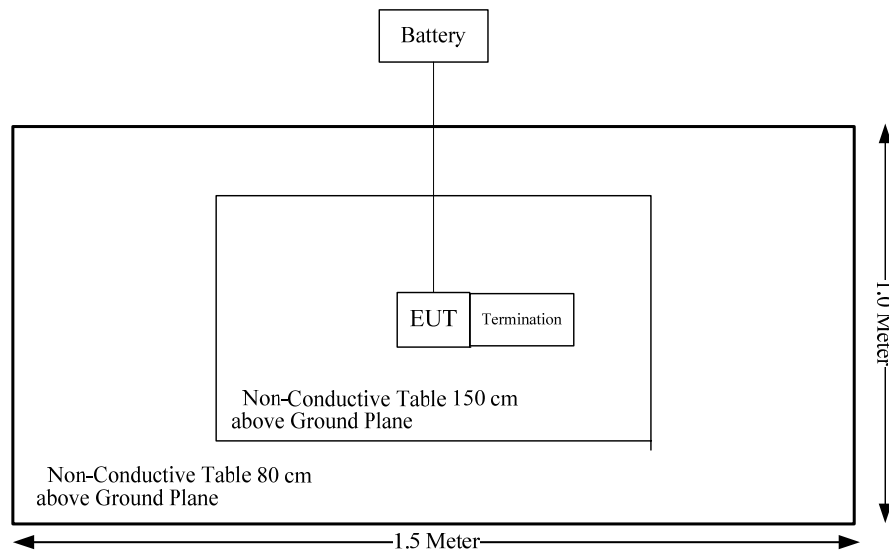
#### 1.3.2 Support Equipment List and Details

| Manufacturer | Description  | Model    | Serial Number |
|--------------|--------------|----------|---------------|
| FENGFAN      | Battery      | 46B24L-H | S1            |
| Wenschel     | Terminations | 1440     | MD477         |

#### 1.3.3 Support Cable List and Details

| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port | To  |
|-------------------|----------------|--------------|------------|-----------|-----|
| DC Cable          | No             | No           | 2          | Battery   | EUT |

#### 1.3.4 Block Diagram of Test Setup



### 1.3 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   |
| Unwanted Emissions, radiated  | 30M~200MHz: 4.15 dB,200M~1GHz: 5.61 dB,1G~6GHz: 5.14 dB,<br>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%   |

**2. SUMMARY OF TEST RESULTS**

| <b>Rules</b>                | <b>Description of Test</b>               | <b>Results</b> |
|-----------------------------|--|----------------|
| §1.1307(b); §2.1091;        | 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

##### 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:

|            |            |
|------------|------------|
| <u>RBW</u> | <u>VBW</u> |
| 100 kHz    | 300 kHz    |

#### 3.2 Modulation Requirements

##### Applicable Standard

FCC §2.1047, §80.213.

(a) ***Voice modulated communication equipment.*** A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) ***Equipment which employs modulation limiting.*** A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

##### Test Procedure

Test Method: TIA-603-E 2.2.3

### 3.3 Bandwidth

#### Applicable Standard

FCC §2.1049, §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 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.

#### 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  $\pm 50$  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 10<sup>th</sup> 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                                       | -33.98                             |
| 30 to 100 MHz                      | 4000                                      | -23.98                             |
| 100 to 300 MHz                     | 40000                                     | -13.98                             |
| Over 300 MHz                       | 400000                                    | -3.98                              |

#### 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 §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 =  $10 \cdot \lg(TX_{pwr} \text{ in Watts}/0.001)$  - 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 §2.1055, §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.

## Test Procedure

Frequency Stability vs. Temperature:

From  $-20^{\circ}$  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:                       |      | 2021.10.25                   |    |                           |       |
| Tester:                          |      | Great Qiao                   |    |                           |       |
| <b>Environmental Conditions:</b> |      |                              |    |                           |       |
| Temperature:<br>(°C)             | 25.7 | Relative<br>Humidity:<br>(%) | 62 | ATM<br>Pressure:<br>(kPa) | 101.3 |

| 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<br>MICROWAVE | Coaxial Cable             | LMR-600-<br>UltraFlex     | C-0470-02     | 2021-07-18       | 2022-07-17           |
| TIMES<br>MICROWAVE | Coaxial Cable             | LMR-600-<br>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                     | 9109-753      | /                | /                    |
| MICRO-COAX         | Coaxial Cable             | UFA210B-0-0720-<br>300300 | 99G1448       | 2021-07-25       | 2022-07-24           |
| Agilent            | Signal Generator          | E8247C                    | MY43321350    | 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:                       |      | 2021.10.25                   |    |                           |       |
| Tester:                          |      | Carl Liang                   |    |                           |       |
| <b>Environmental Conditions:</b> |      |                              |    |                           |       |
| Temperature:<br>(°C)             | 25.7 | Relative<br>Humidity:<br>(%) | 62 | ATM<br>Pressure:<br>(kPa) | 101.3 |

| 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-<br>70U300 | 217423-008    | 2021-08-08       | 2022-08-07           |
| MICRO-COAX   | Coaxial Cable                      | UFA210A-1-2362-<br>300300 | 235780-001    | 2021-08-08       | 2022-08-07           |
| AH           | Pre-amplifier                      | PAM-0118P                 | 530           | 2021-11-04       | 2022-11-03           |
| AH           | Double Ridge Guide Horn<br>Antenna | SAS-571                   | 1396          | 2021-10-18       | 2023-10-17           |
| MICRO-COAX   | Coaxial Cable                      | UFA210B-0-0720-<br>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:                       | 2021.10.23~2021.10.25 |                              |       |                           |             |
| Tester:                          | Morpheus Shi          |                              |       |                           |             |
| <b>Environmental Conditions:</b> |                       |                              |       |                           |             |
| Temperature:<br>(°C)             | 26.8~28.9             | Relative<br>Humidity:<br>(%) | 51~71 | ATM<br>Pressure:<br>(kPa) | 101.3~102.1 |

| Manufacturer  | Description                | Model      | Serial Number | Calibration Date | Calibration Due Date |
|---------------|----------------------------|------------|---------------|------------------|----------------------|
| R&S           | Spectrum Analyzer          | FSV40      | 101591        | 2021-07-22       | 2022-07-21           |
| YINSAIGE      | Coaxial Cable              | SS402      | SJ0100004     | 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           |

**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.

| Modulation Mode | Channel Separation | $f_c$   | Reading (dBm)    |                 | Limit (dBm) |
|-----------------|--------------------|---------|------------------|-----------------|-------------|
|                 |                    | MHz     | High Power Level | Low Power Level |             |
| FM              | 25kHz              | 156.025 | 43.21            | 29.58           | 43.98       |
|                 |                    | 156.800 | 43.27            | 29.67           | 43.98       |
|                 |                    | 157.425 | 43.33            | 29.89           | 43.98       |
| DSC 1300        |                    | 156.525 | 43.24            | 29.69           | 43.98       |
| DSC 2100        |                    | 156.525 | 43.23            | 29.69           | 43.98       |

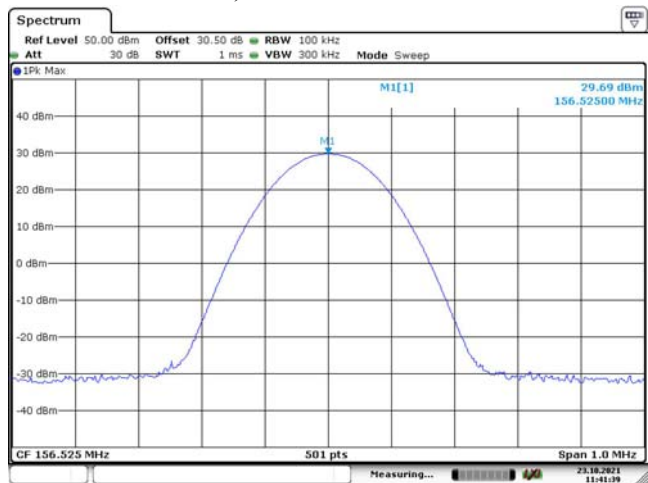
Note:  
The high rated power level is 25W(43.98dBm), and low rated power level is 1W(30dBm).

DSC:

DSC 1300, 156.525 MHz High Power



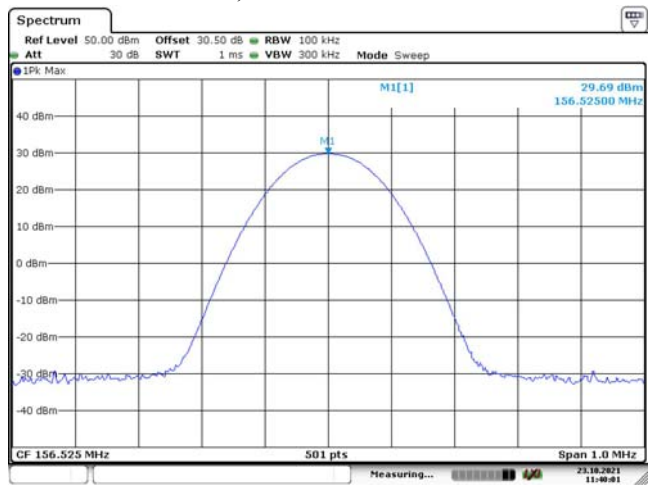
DSC 1300, 156.525 MHz Low Power



DSC 2100, 156.525 MHz High Power



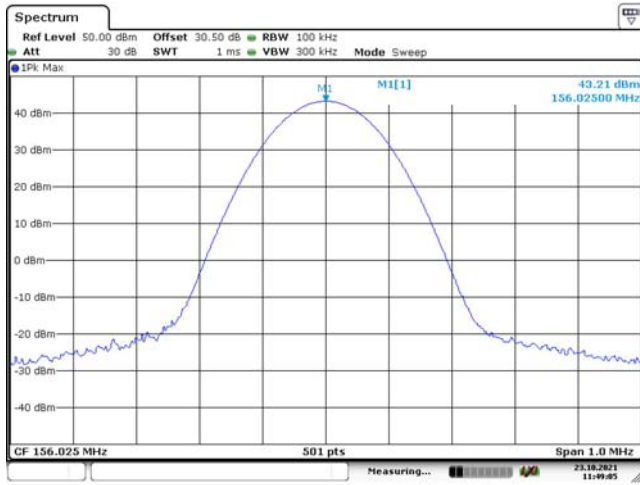
DSC 2100, 156.525 MHz Low Power





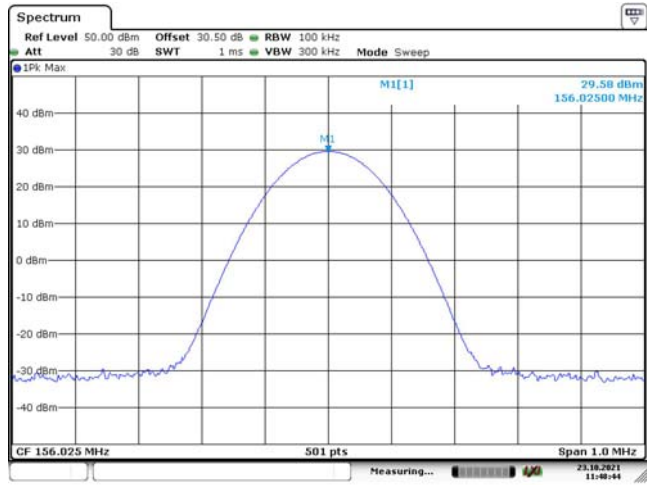
FM, 25kHz:

156.025 MHz High Power



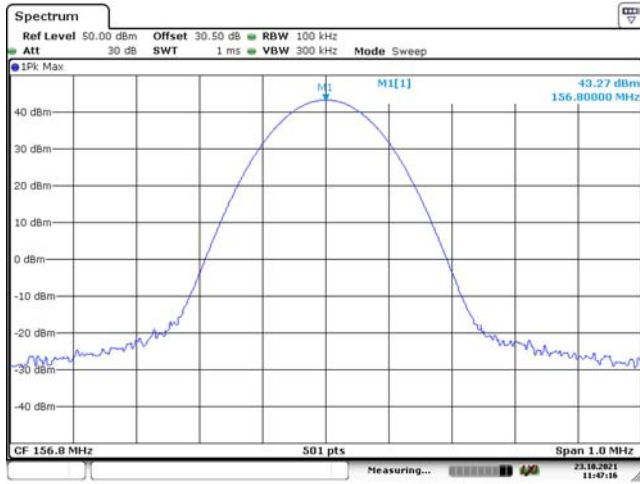
Date: 23.OCT.2021 11:49:05

156.025 MHz Low Power



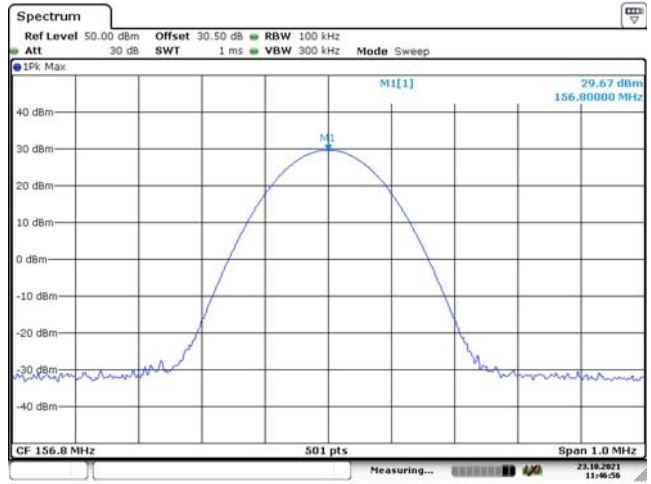
Date: 23.OCT.2021 11:48:44

156.800 MHz High Power



Date: 23.OCT.2021 11:47:16

156.800 MHz Low Power



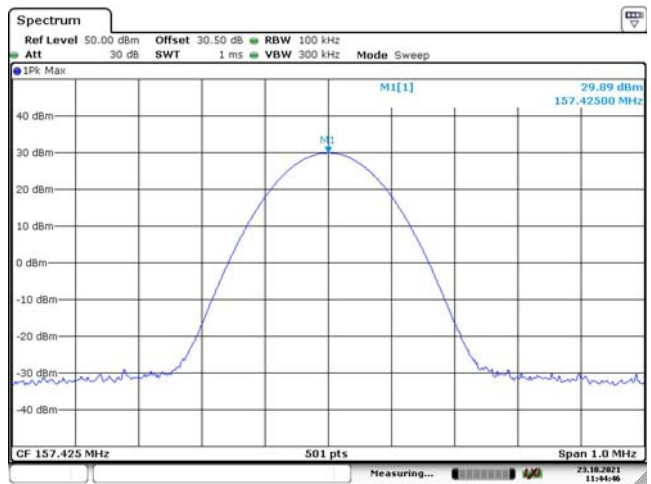
Date: 23.OCT.2021 11:46:56

157.425 MHz High Power



Date: 23.OCT.2021 11:45:10

157.425 MHz Low Power



Date: 23.OCT.2021 11:44:46

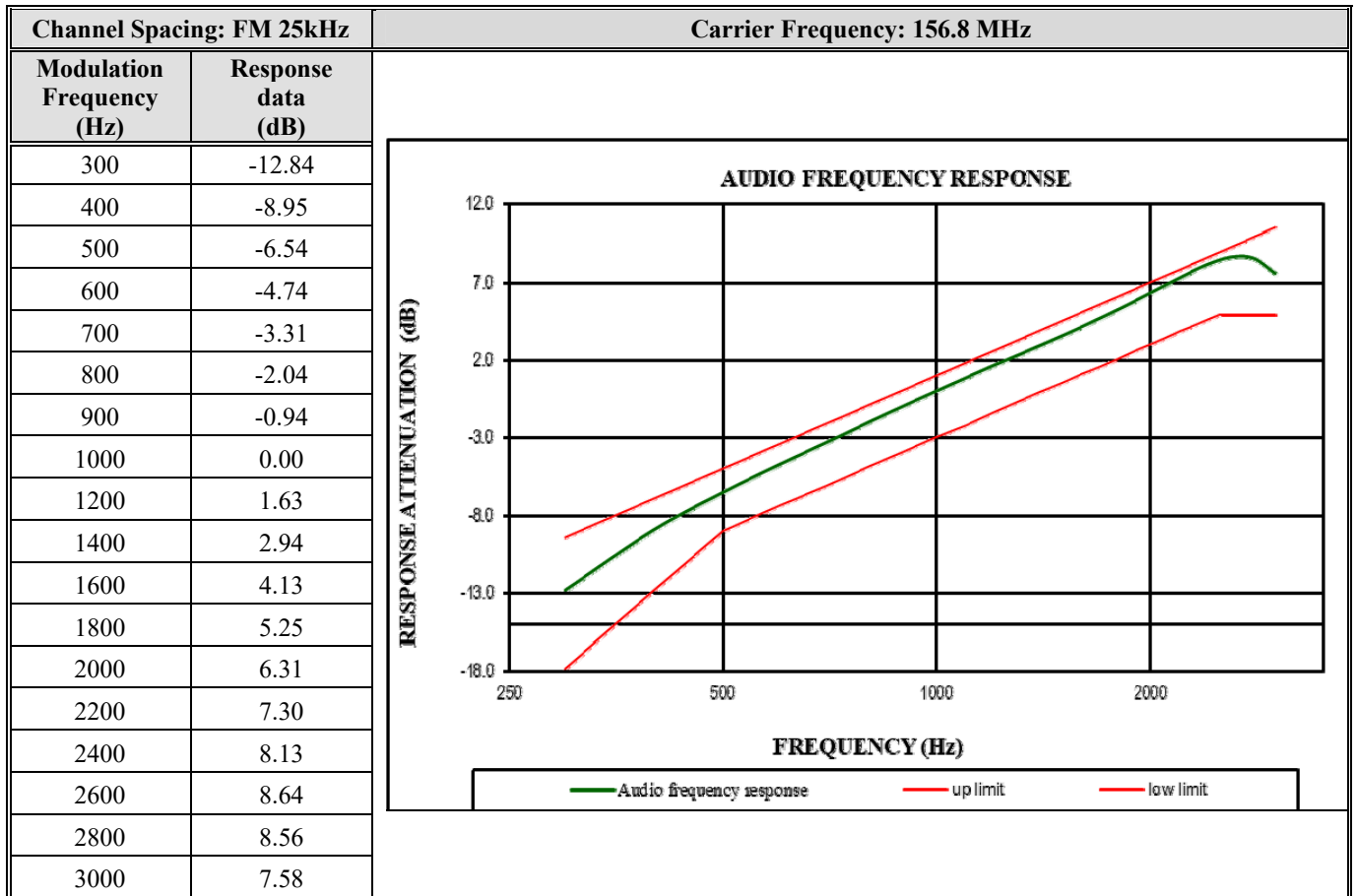
### 4.3 Modulation Requirements

Test Mode: Transmitting

**Test Result: Compliance.**

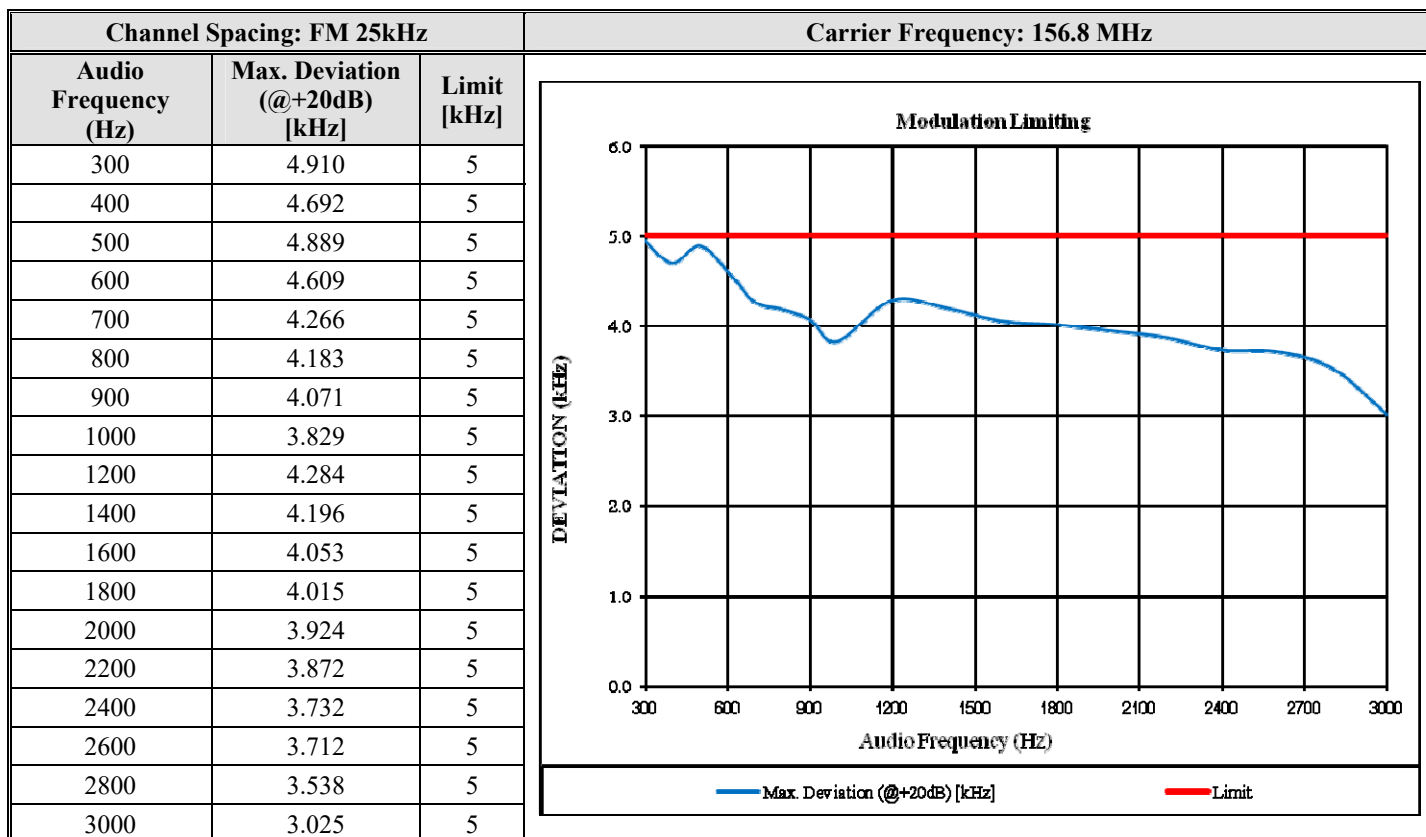
Please refer to the following tables and plots.

#### Audio Frequency Response – High Power



**Modulation Limiting – High Power**

| DSC Mode   | Maximum Deviation (kHz) | Limit (kHz) |
|------------|-------------------------|-------------|
| DSC 1300Hz | 2.553                   | 5           |
| DSC 2100Hz | 3.971                   | 5           |



### 4.4 Bandwidth

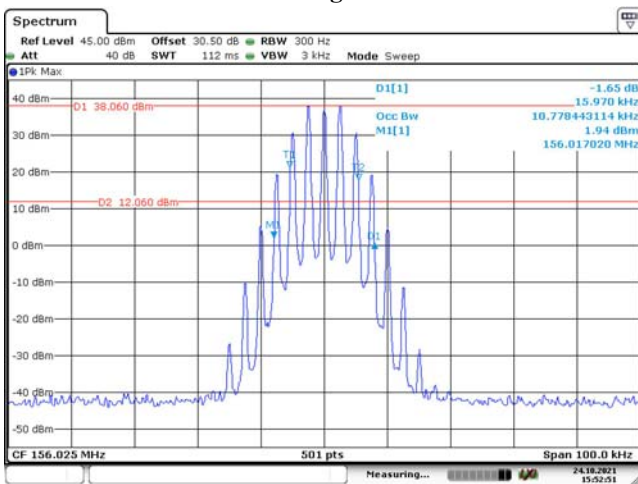
Test Mode: Transmitting

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

| Modulation Mode | Channel Separation | f <sub>c</sub> | 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        | 10.778                 | 15.970          | 10.778                 | 15.970          |
|                 |                    | 156.800        | 10.778                 | 15.970          | 10.778                 | 15.970          |
|                 |                    | 157.425        | 10.778                 | 15.970          | 10.778                 | 15.970          |
| DSC 1300        |                    | 156.525        | 7.984                  | 10.780          | 7.984                  | 10.680          |
| DSC 2100        |                    | 156.525        | 12.774                 | 17.370          | 12.774                 | 17.370          |

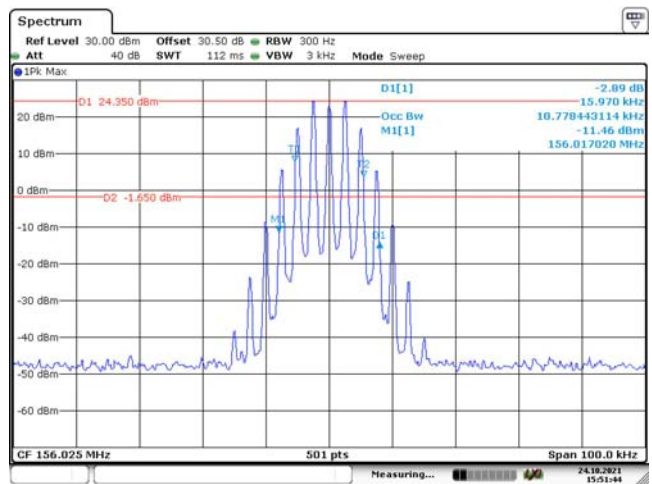
Note: Authorized bandwidth for this device is 20 kHz.

156.025 MHz-High Power Level



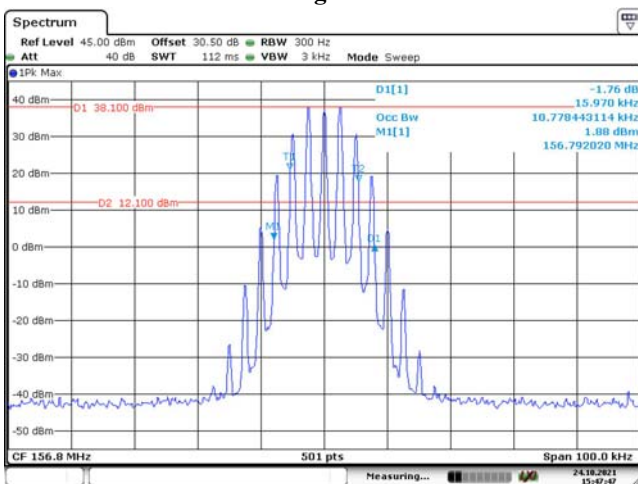
Date: 24.OCT.2021 15:52:51

156.025 MHz-Low Power Level



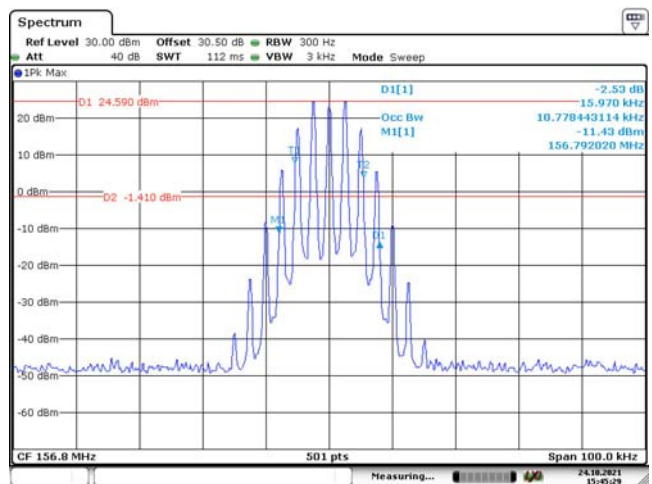
Date: 24.OCT.2021 15:51:44

156.8MHz-High Power Level



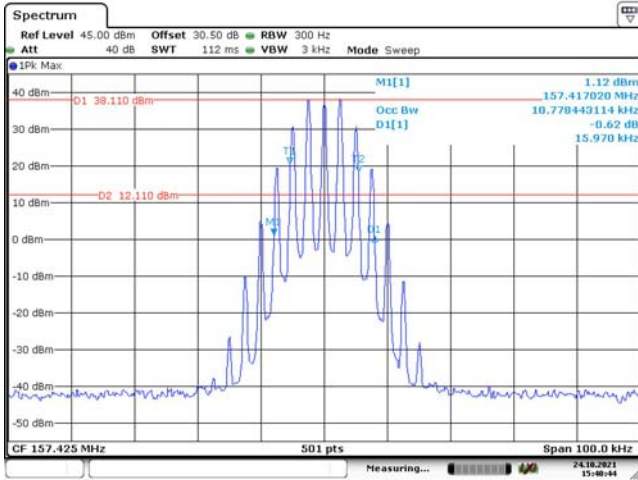
Date: 24.OCT.2021 15:47:47

156.8MHz- Low Power Level



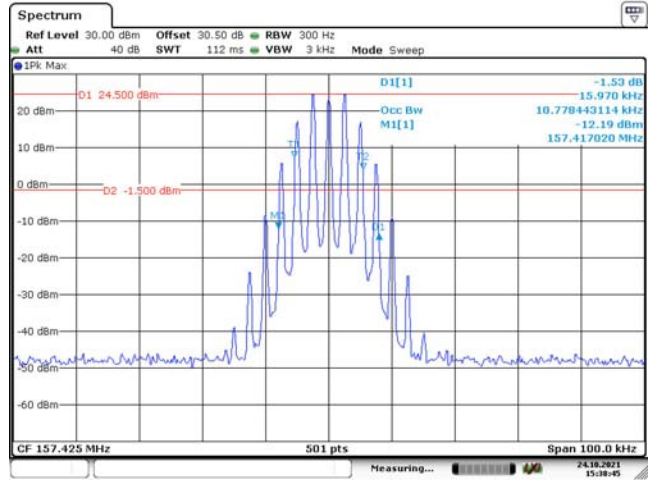
Date: 24.OCT.2021 15:45:29

157.425 MHz-High Power Level



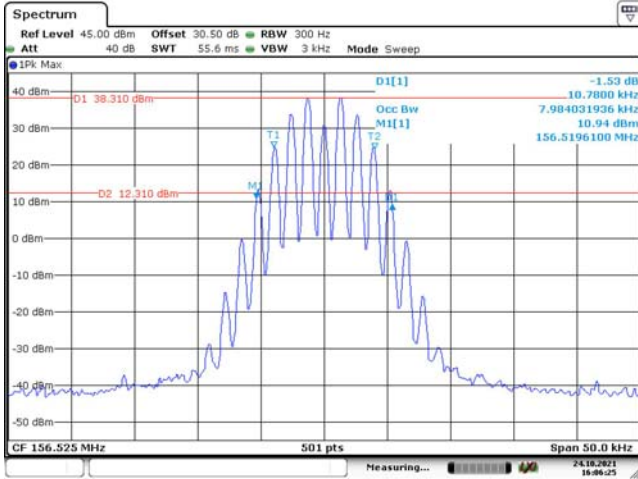
Date: 24.OCT.2021 15:40:44

157.425 MHz- Low Power Level



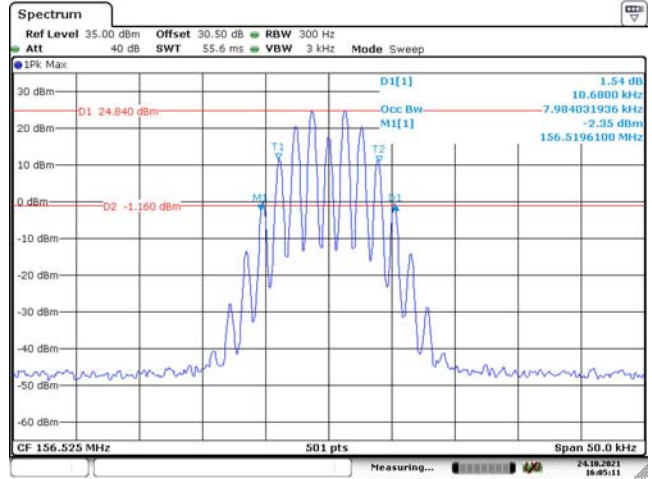
Date: 24.OCT.2021 15:38:45

DSC 1300, 156.525 MHz-High Power Level



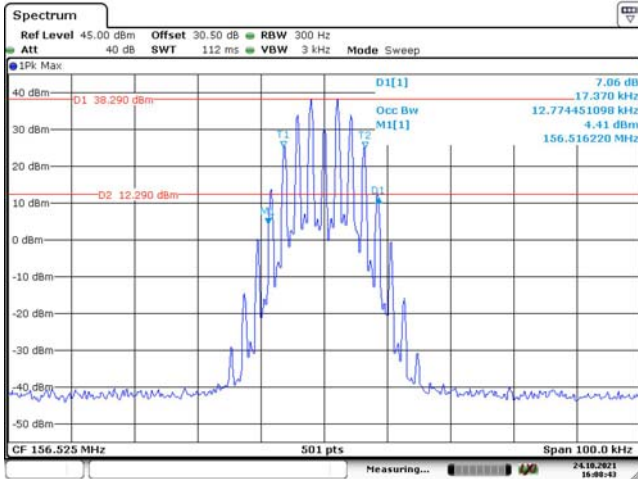
Date: 24.OCT.2021 16:06:25

DSC 1300, 156.525 MHz- Low Power Level



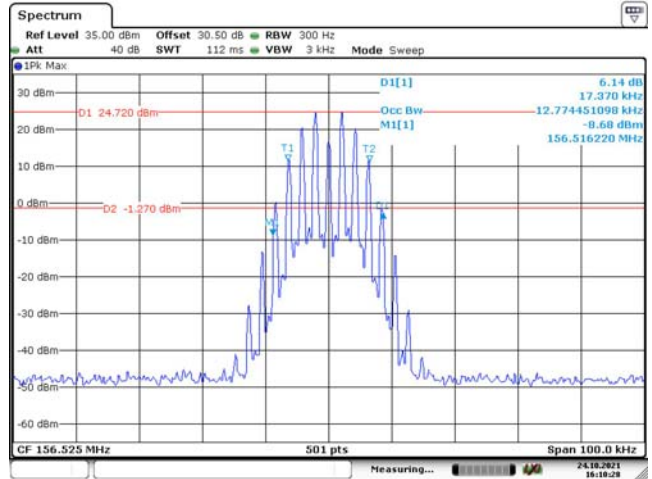
Date: 24.OCT.2021 16:05:11

DSC 2100, 156.525 MHz-High Power Level



Date: 24.OCT.2021 16:08:43

DSC 2100, 156.525 MHz- Low Power Level



Date: 24.OCT.2021 16:10:28

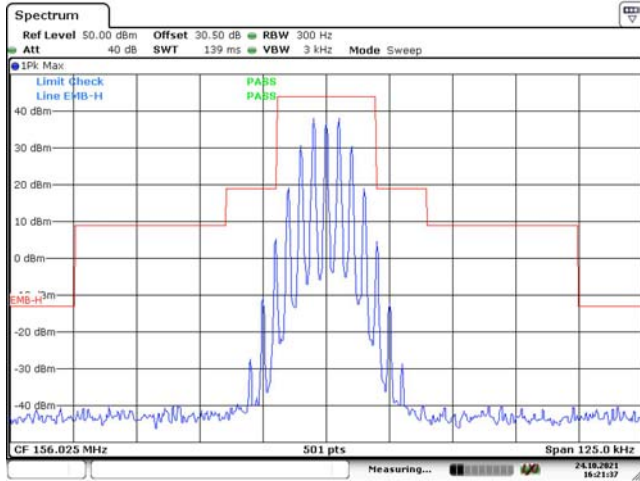
### 4.5 Emission Limitations

Test Mode: Transmitting

Test Result: Compliance. Please refer to following plots.

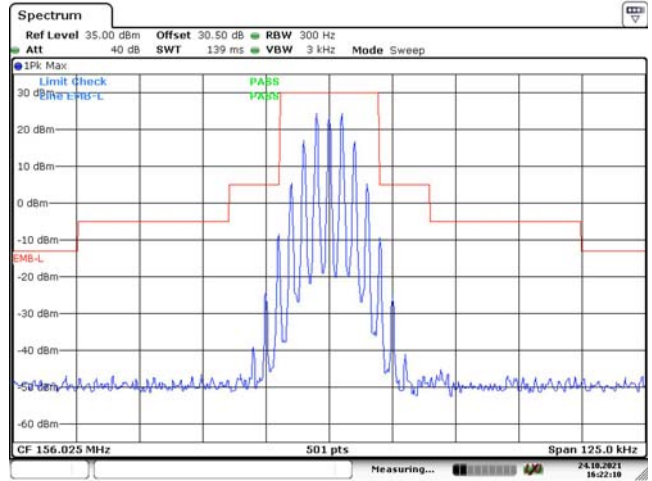
Mask:

156.025 MHz-High Power Level



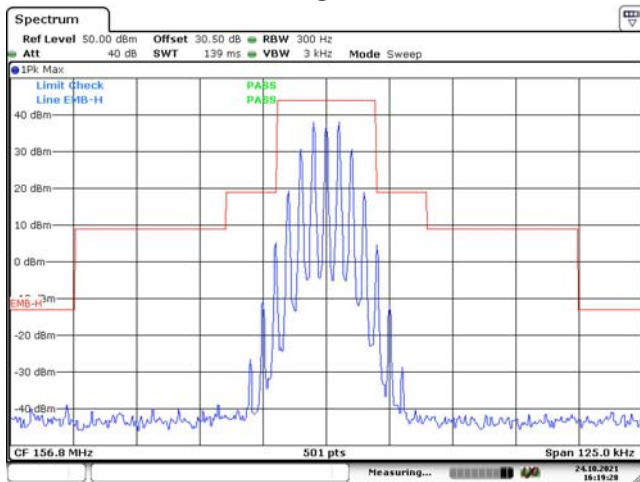
Date: 24.OCT.2021 16:21:37

156.025 MHz-Low Power Level



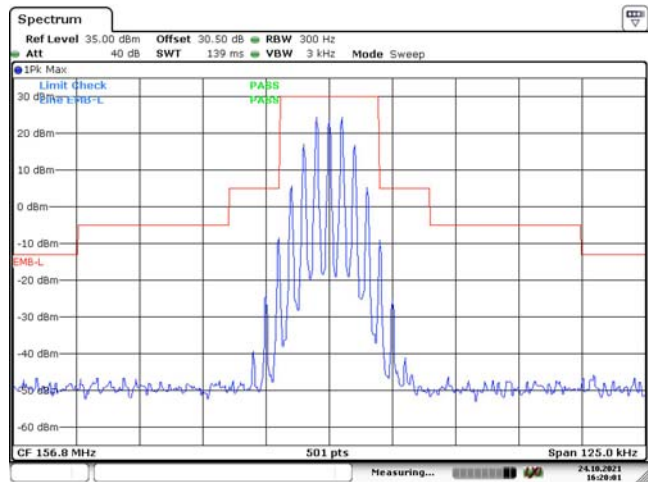
Date: 24.OCT.2021 16:22:11

156.8MHz-High Power Level



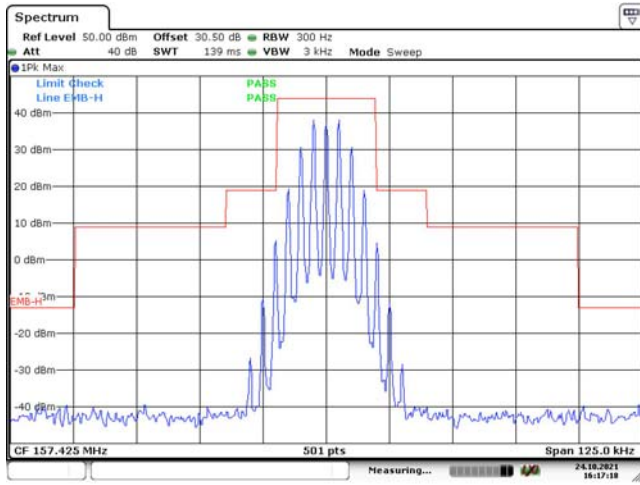
Date: 24.OCT.2021 16:19:28

156.8MHz- Low Power Level

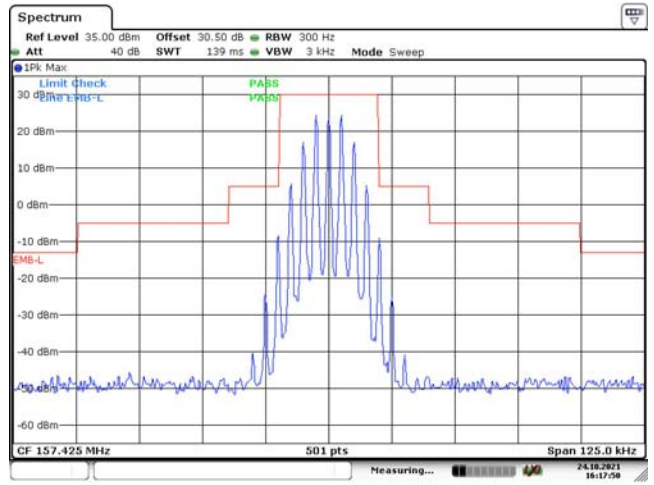


Date: 24.OCT.2021 16:20:02

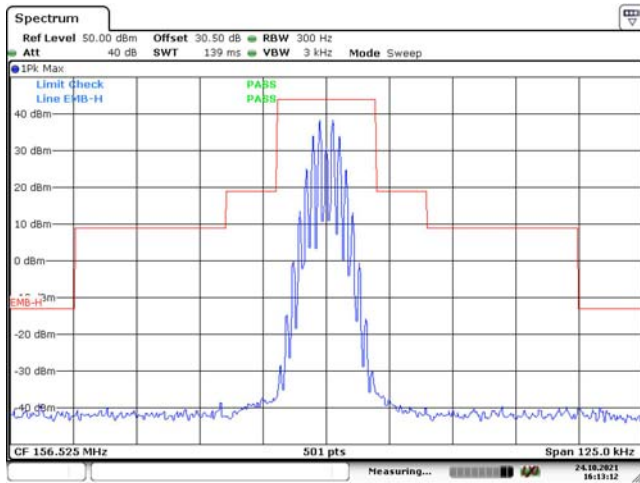
### 157.425 MHz-High Power Level



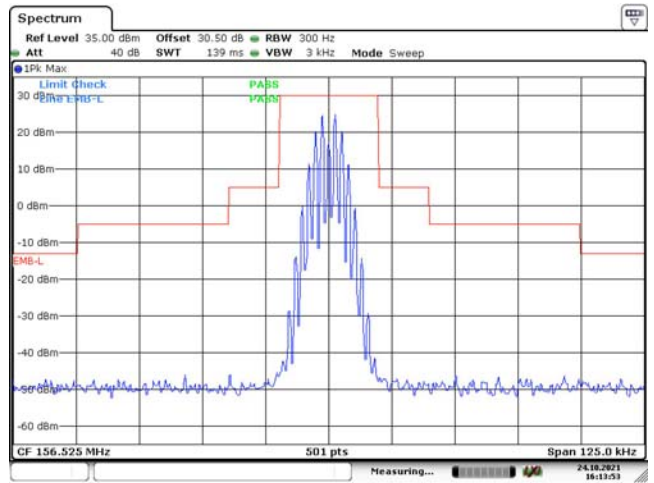
### 157.425 MHz- Low Power Level



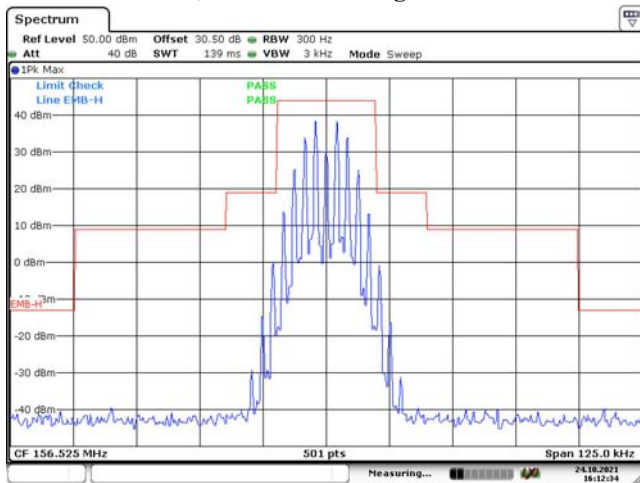
### DSC 1300, 156.525 MHz-High Power Level



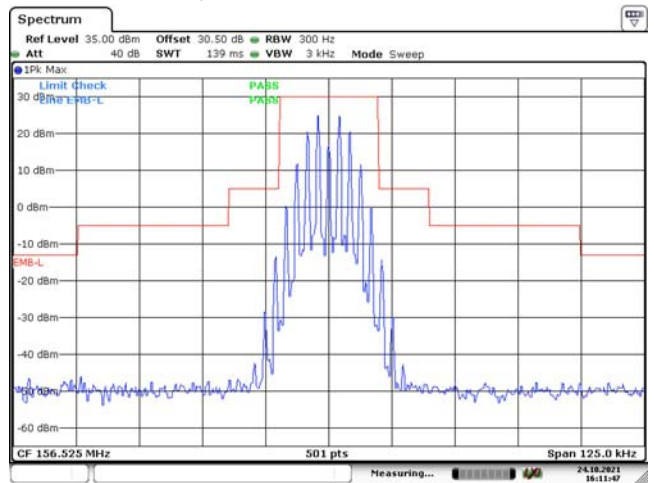
### DSC 1300, 156.525 MHz- Low Power Level



### DSC 2100, 156.525 MHz-High Power Level



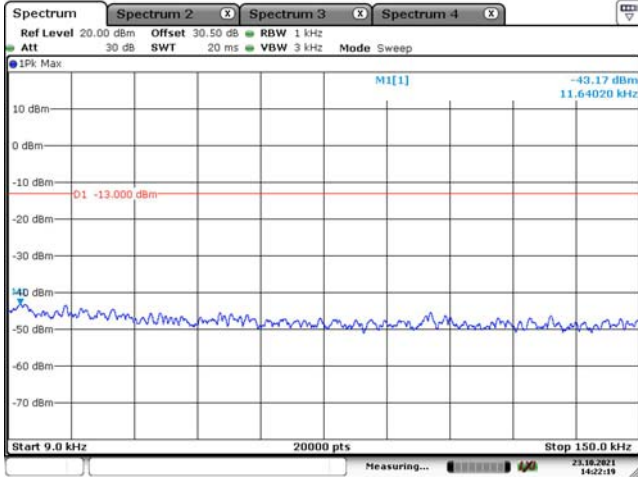
### DSC 2100, 156.525 MHz- Low Power Level



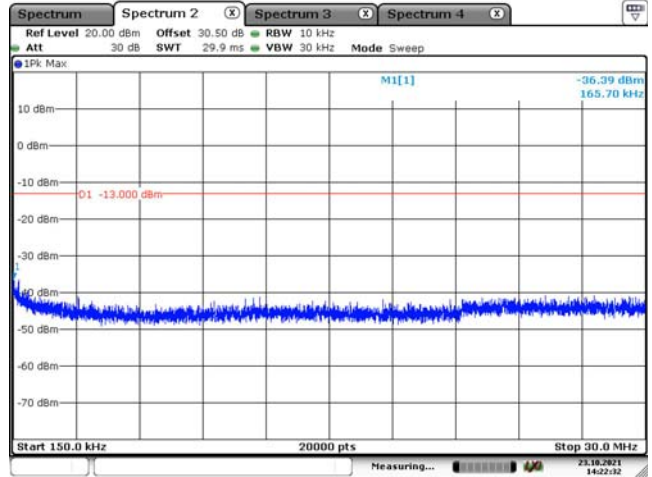
**Conducted Emission:**

Note: Test performed at high power level with Band Rejector Filter, please refer to the following table.

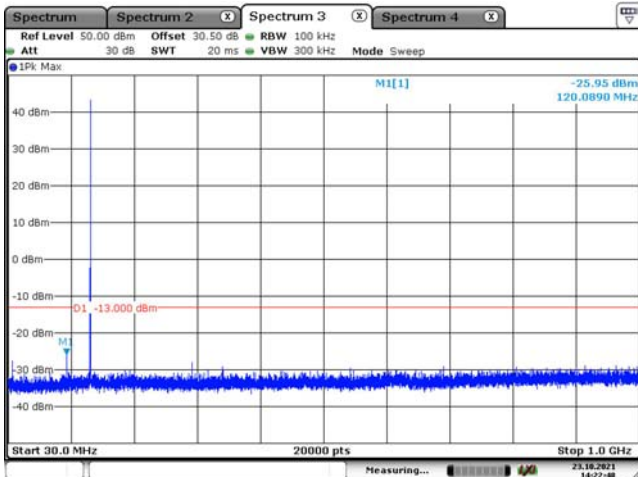
**156.025 MHz**



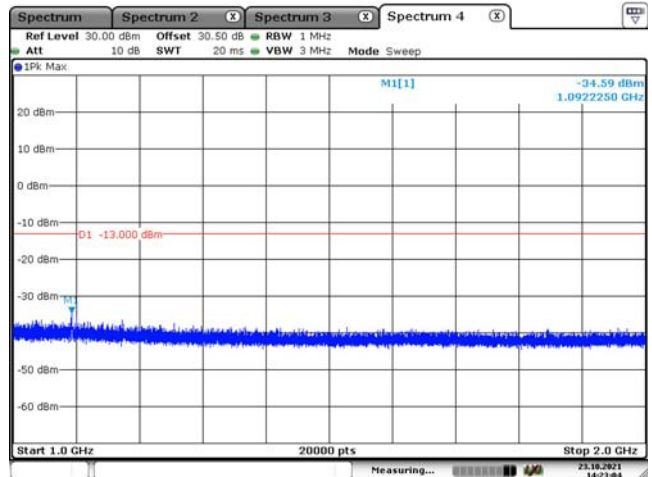
Date: 23.OCT.2021 14:22:19



Date: 23.OCT.2021 14:22:32

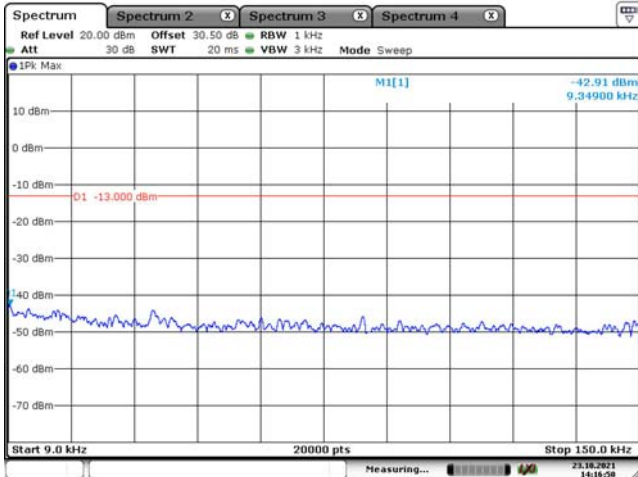


Date: 23.OCT.2021 14:22:48

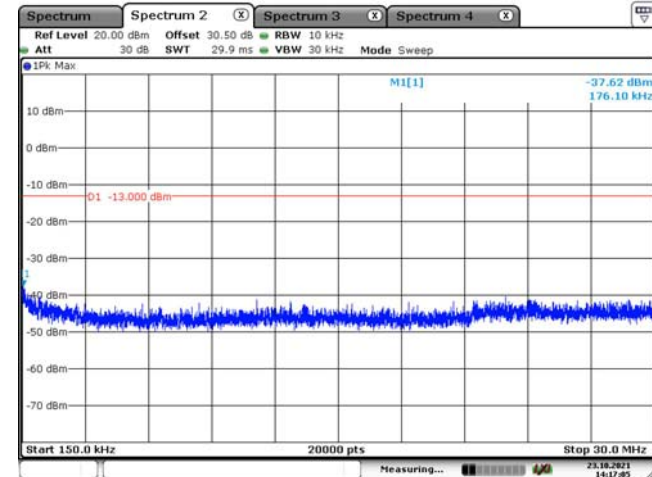


Date: 23.OCT.2021 14:23:04

**156.8 MHz**

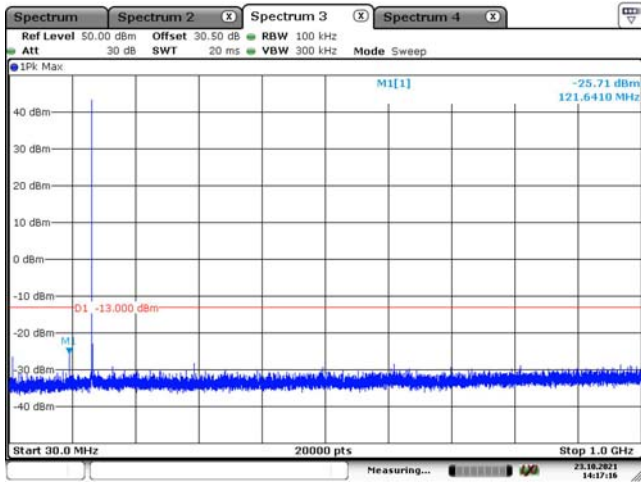


Date: 23.OCT.2021 14:16:50

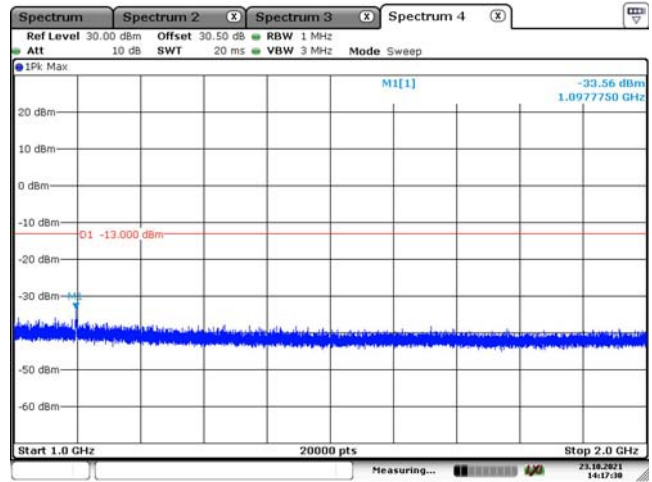


Date: 23.OCT.2021 14:17:05



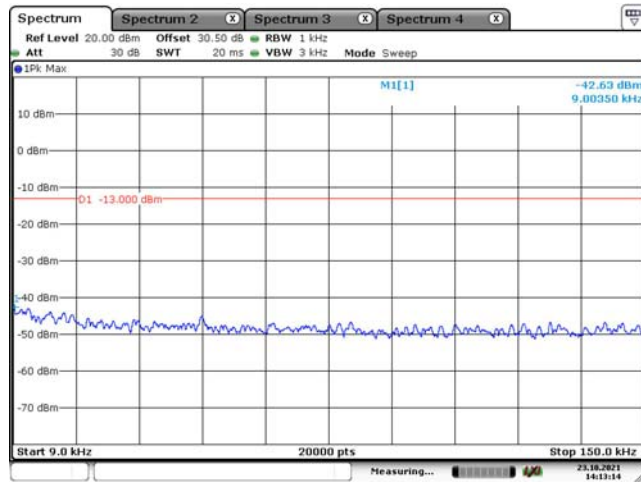


Date: 23.OCT.2021 14:17:16

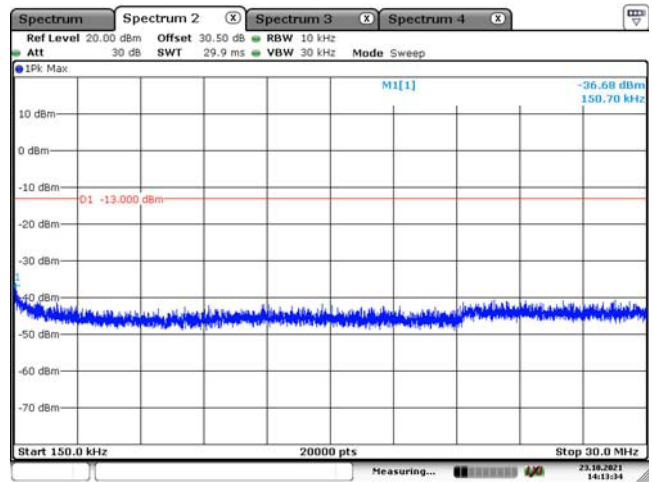


Date: 23.OCT.2021 14:17:30

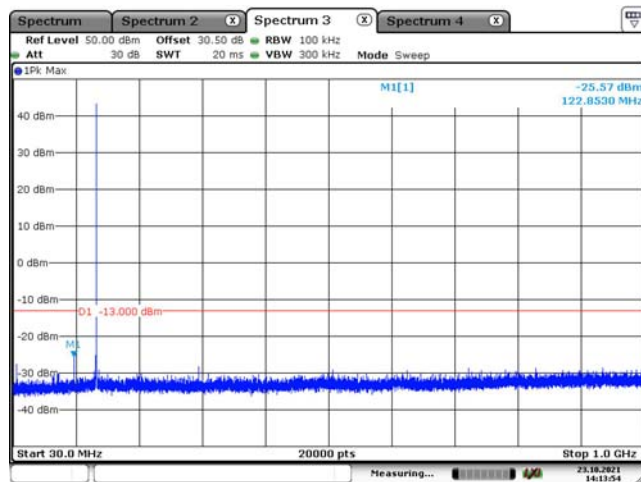
157.425 MHz



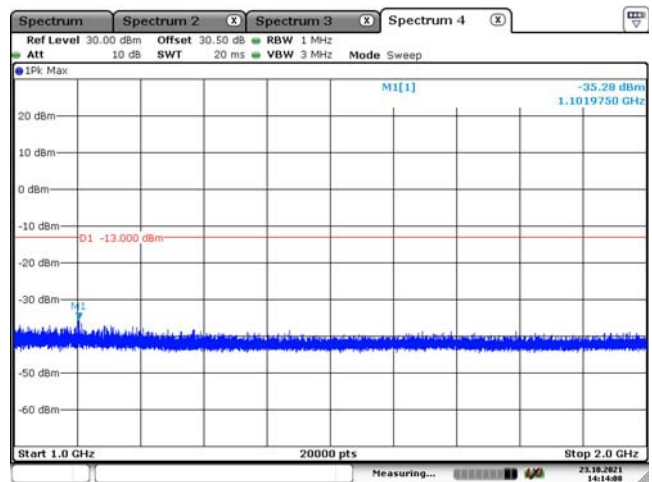
Date: 23.OCT.2021 14:13:14



Date: 23.OCT.2021 14:13:35

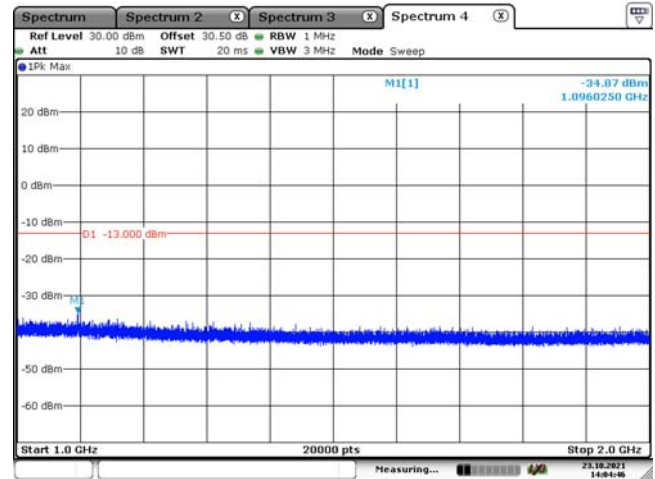
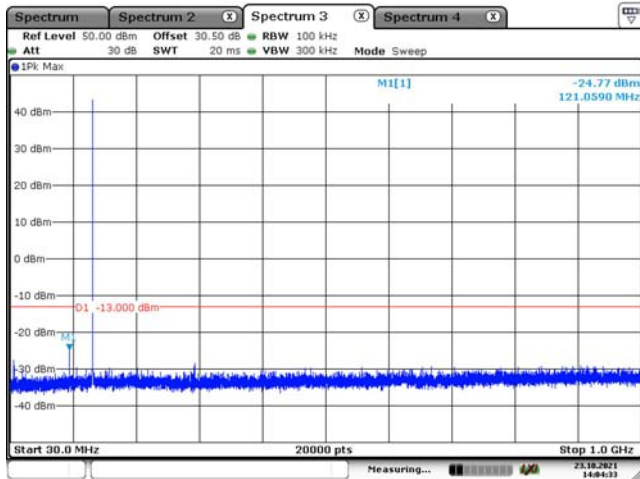
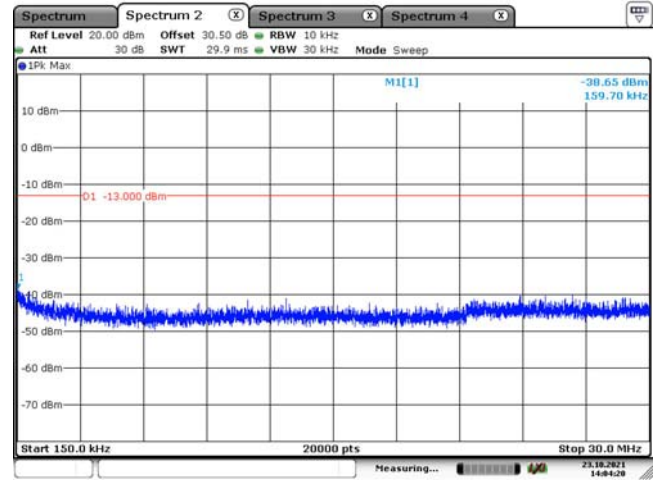
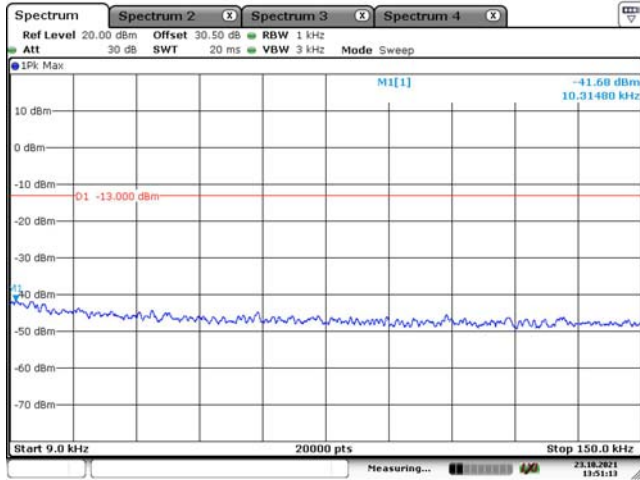


Date: 23.OCT.2021 14:13:55

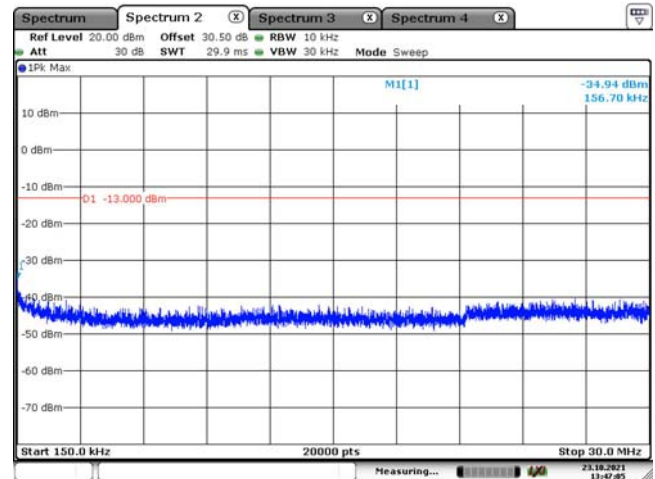
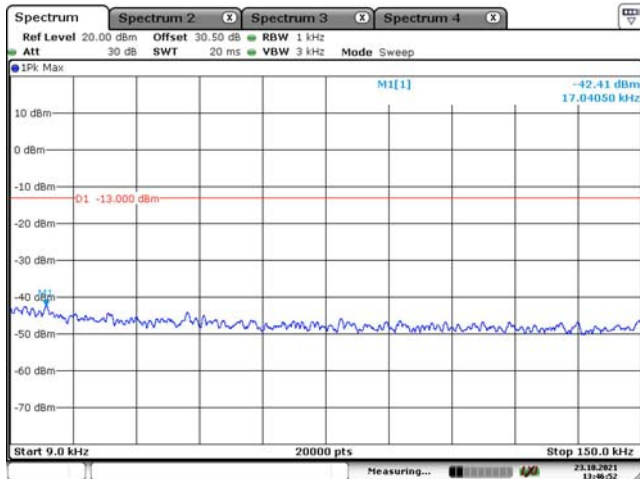


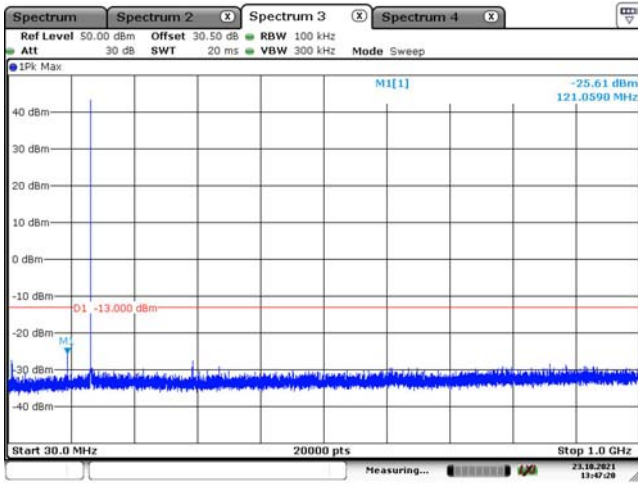
Date: 23.OCT.2021 14:14:09

### DSC 1300, 156.525MHz

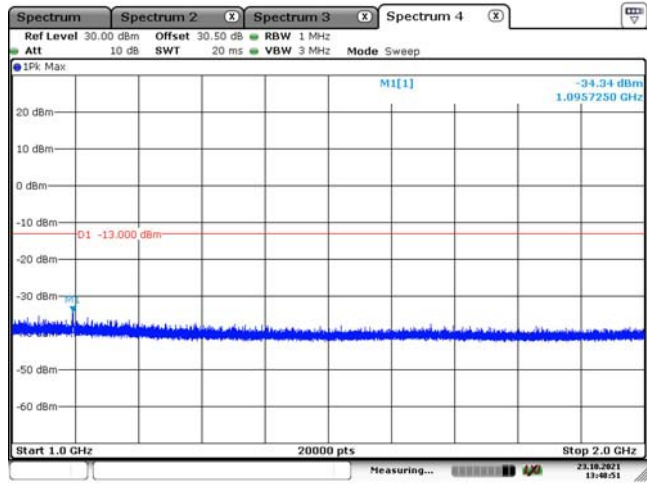


### DSC 2100, 156.525MHz





Date: 23.OCT.2021 13:47:20

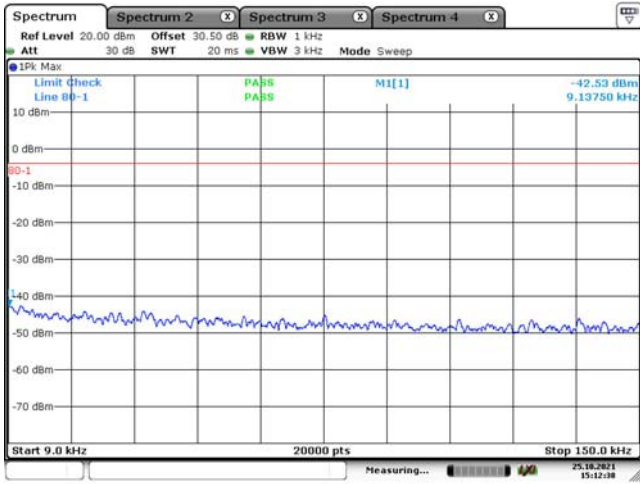


Date: 23.OCT.2021 13:48:52

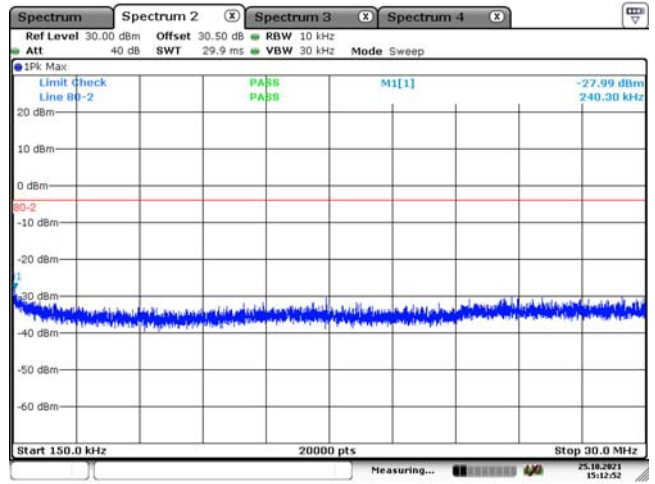
### 4.5 Suppression of Interference Aboard Ships

Test Mode: Transmitting

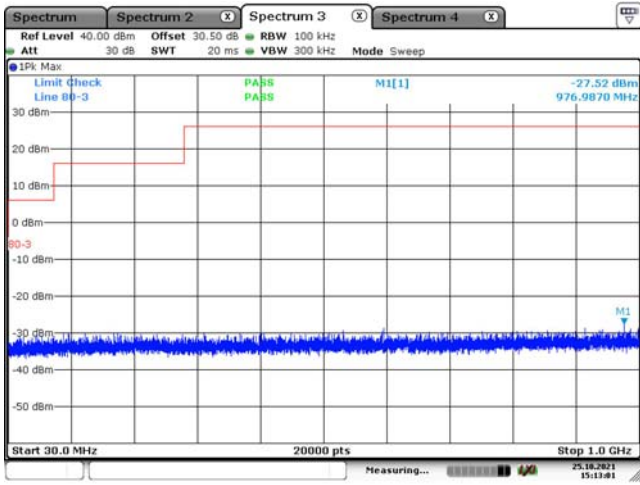
Test Result: Compliance. Please refer to following plots (worst case).



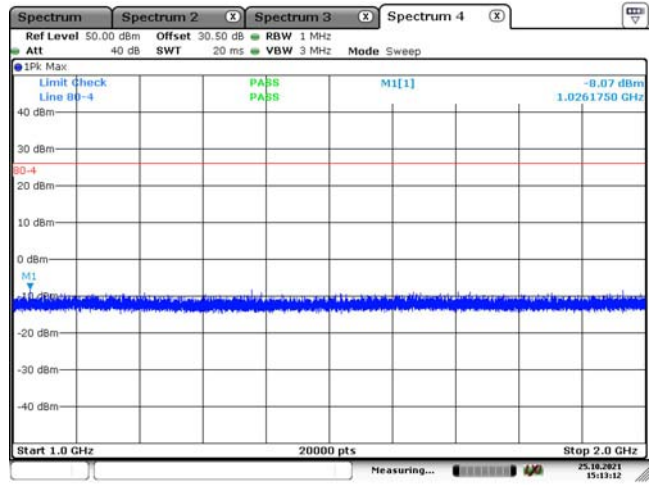
Date: 25.OCT.2021 15:12:38



Date: 25.OCT.2021 15:12:52



Date: 25.OCT.2021 15:13:01



Date: 25.OCT.2021 15:13:12

## 4.6 Spurious Radiated Emissions

Test Mode: Transmitting

**Test Result: Compliance.**

Note 1: Pre-scan all models, the worst case is model CA1654.

Note 2: Test performed at high power level with Band Rejector Filter.

Please refer to the following table.

### 30MHz - 2GHz:

| Frequency (MHz)               | Polar (H/V) | Receiver Reading (dB $\mu$ V) | 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           | 60.54                         | -50.00                  | 0.00                   | 0.34            | -50.34               | -13.00      | 37.34       |
| 312.05                        | V           | 54.43                         | -54.07                  | 0.00                   | 0.34            | -54.41               | -13.00      | 41.41       |
| 468.08                        | H           | 57.44                         | -50.17                  | 0.00                   | 0.43            | -50.60               | -13.00      | 37.60       |
| 468.08                        | V           | 61.57                         | -42.24                  | 0.00                   | 0.43            | -42.67               | -13.00      | 29.67       |
| 624.10                        | H           | 49.25                         | -55.51                  | 0.00                   | 0.48            | -55.99               | -13.00      | 42.99       |
| 624.10                        | V           | 49.51                         | -53.61                  | 0.00                   | 0.48            | -54.09               | -13.00      | 41.09       |
| 780.13                        | H           | 45.69                         | -57.09                  | 0.00                   | 0.54            | -57.63               | -13.00      | 44.63       |
| 780.13                        | V           | 50.63                         | -48.61                  | 0.00                   | 0.54            | -49.15               | -13.00      | 36.15       |
| 936.15                        | H           | 36.42                         | -61.79                  | 0.00                   | 0.66            | -62.45               | -13.00      | 49.45       |
| 936.15                        | V           | 36.35                         | -59.29                  | 0.00                   | 0.66            | -59.95               | -13.00      | 46.95       |
| 1092.18                       | H           | 36.54                         | -65.33                  | 7.36                   | 0.67            | -58.64               | -13.00      | 45.64       |
| 1092.18                       | V           | 36.25                         | -66.08                  | 7.36                   | 0.67            | -59.39               | -13.00      | 46.39       |
| 1248.20                       | H           | 35.94                         | -66.82                  | 7.79                   | 0.68            | -59.71               | -13.00      | 46.71       |
| 1248.20                       | V           | 35.26                         | -68.10                  | 7.79                   | 0.68            | -60.99               | -13.00      | 47.99       |
| 1404.23                       | H           | 35.87                         | -67.65                  | 8.23                   | 0.71            | -60.13               | -13.00      | 47.13       |
| 1404.23                       | V           | 35.64                         | -67.93                  | 8.23                   | 0.71            | -60.41               | -13.00      | 47.41       |
| 1560.25                       | H           | 35.22                         | -68.78                  | 8.57                   | 0.80            | -61.01               | -13.00      | 48.01       |
| 1560.25                       | V           | 35.67                         | -68.38                  | 8.57                   | 0.80            | -60.61               | -13.00      | 47.61       |
| FM 25k, Frequency: 156.8MHz   |             |                               |                         |                        |                 |                      |             |             |
| 313.60                        | H           | 60.54                         | -49.97                  | 0.00                   | 0.34            | -50.31               | -13.00      | 37.31       |
| 313.60                        | V           | 55.10                         | -53.36                  | 0.00                   | 0.34            | -53.70               | -13.00      | 40.70       |
| 470.40                        | H           | 56.80                         | -50.76                  | 0.00                   | 0.43            | -51.19               | -13.00      | 38.19       |
| 470.40                        | V           | 61.03                         | -42.70                  | 0.00                   | 0.43            | -43.13               | -13.00      | 30.13       |
| 627.20                        | H           | 41.97                         | -62.79                  | 0.00                   | 0.48            | -63.27               | -13.00      | 50.27       |
| 627.20                        | V           | 47.56                         | -55.49                  | 0.00                   | 0.48            | -55.97               | -13.00      | 42.97       |
| 784.00                        | H           | 44.29                         | -58.40                  | 0.00                   | 0.56            | -58.96               | -13.00      | 45.96       |
| 784.00                        | V           | 51.51                         | -47.64                  | 0.00                   | 0.56            | -48.20               | -13.00      | 35.20       |
| 940.80                        | H           | 44.19                         | -53.88                  | 0.00                   | 0.63            | -54.51               | -13.00      | 41.51       |
| 940.80                        | V           | 36.56                         | -58.98                  | 0.00                   | 0.63            | -59.61               | -13.00      | 46.61       |
| 1097.60                       | H           | 37.19                         | -64.57                  | 7.37                   | 0.67            | -57.87               | -13.00      | 44.87       |

|                                 |   |       |        |      |      |        |        |       |
|---------------------------------|---|-------|--------|------|------|--------|--------|-------|
| 1097.60                         | V | 36.90 | -65.35 | 7.37 | 0.67 | -58.65 | -13.00 | 45.65 |
| 1254.40                         | H | 36.59 | -66.12 | 7.81 | 0.68 | -58.99 | -13.00 | 45.99 |
| 1254.40                         | V | 35.91 | -67.39 | 7.81 | 0.68 | -60.26 | -13.00 | 47.26 |
| 1411.20                         | H | 36.52 | -67.01 | 8.25 | 0.72 | -59.48 | -13.00 | 46.48 |
| 1411.20                         | V | 36.29 | -67.28 | 8.25 | 0.72 | -59.75 | -13.00 | 46.75 |
| 1568.00                         | H | 35.87 | -68.18 | 8.58 | 0.80 | -60.40 | -13.00 | 47.40 |
| 1568.00                         | V | 36.32 | -67.78 | 8.58 | 0.80 | -60.00 | -13.00 | 47.00 |
| FM 25k, Frequency: 157.425MHz   |   |       |        |      |      |        |        |       |
| 314.85                          | H | 64.51 | -45.99 | 0.00 | 0.34 | -46.33 | -13.00 | 33.33 |
| 314.85                          | V | 56.83 | -51.59 | 0.00 | 0.34 | -51.93 | -13.00 | 38.93 |
| 472.28                          | H | 55.84 | -51.67 | 0.00 | 0.43 | -52.10 | -13.00 | 39.10 |
| 472.28                          | V | 61.16 | -42.51 | 0.00 | 0.43 | -42.94 | -13.00 | 29.94 |
| 629.70                          | H | 43.70 | -61.05 | 0.00 | 0.48 | -61.53 | -13.00 | 48.53 |
| 629.70                          | V | 47.38 | -55.61 | 0.00 | 0.48 | -56.09 | -13.00 | 43.09 |
| 787.13                          | H | 43.50 | -59.12 | 0.00 | 0.58 | -59.70 | -13.00 | 46.70 |
| 787.13                          | V | 49.42 | -49.65 | 0.00 | 0.58 | -50.23 | -13.00 | 37.23 |
| 944.55                          | H | 36.14 | -61.81 | 0.00 | 0.60 | -62.41 | -13.00 | 49.41 |
| 944.55                          | V | 36.30 | -59.16 | 0.00 | 0.60 | -59.76 | -13.00 | 46.76 |
| 1101.98                         | H | 36.59 | -65.16 | 7.39 | 0.67 | -58.44 | -13.00 | 45.44 |
| 1101.98                         | V | 36.30 | -65.94 | 7.39 | 0.67 | -59.22 | -13.00 | 46.22 |
| 1259.40                         | H | 35.99 | -66.69 | 7.83 | 0.68 | -59.54 | -13.00 | 46.54 |
| 1259.40                         | V | 35.31 | -67.94 | 7.83 | 0.68 | -60.79 | -13.00 | 47.79 |
| 1416.83                         | H | 35.92 | -67.61 | 8.27 | 0.72 | -60.06 | -13.00 | 47.06 |
| 1416.83                         | V | 35.69 | -67.89 | 8.27 | 0.72 | -60.34 | -13.00 | 47.34 |
| 1574.25                         | H | 35.27 | -68.82 | 8.59 | 0.81 | -61.04 | -13.00 | 48.04 |
| 1574.25                         | V | 35.72 | -68.42 | 8.59 | 0.81 | -60.64 | -13.00 | 47.64 |
| Frequency: 156.525MHz, DSC 1300 |   |       |        |      |      |        |        |       |
| 313.05                          | H | 63.66 | -46.86 | 0.00 | 0.34 | -47.20 | -13.00 | 34.20 |
| 313.05                          | V | 51.98 | -56.49 | 0.00 | 0.34 | -56.83 | -13.00 | 43.83 |
| 469.58                          | H | 53.82 | -53.75 | 0.00 | 0.43 | -54.18 | -13.00 | 41.18 |
| 469.58                          | V | 58.81 | -44.95 | 0.00 | 0.43 | -45.38 | -13.00 | 32.38 |
| 626.10                          | H | 38.38 | -66.38 | 0.00 | 0.48 | -66.86 | -13.00 | 53.86 |
| 626.10                          | V | 41.26 | -61.82 | 0.00 | 0.48 | -62.30 | -13.00 | 49.30 |
| 782.63                          | H | 40.58 | -62.15 | 0.00 | 0.55 | -62.70 | -13.00 | 49.70 |
| 782.63                          | V | 46.26 | -52.92 | 0.00 | 0.55 | -53.47 | -13.00 | 40.47 |
| 939.15                          | H | 36.79 | -61.33 | 0.00 | 0.64 | -61.97 | -13.00 | 48.97 |
| 939.15                          | V | 36.78 | -58.80 | 0.00 | 0.64 | -59.44 | -13.00 | 46.44 |
| 1095.68                         | H | 37.63 | -64.17 | 7.37 | 0.67 | -57.47 | -13.00 | 44.47 |
| 1095.68                         | V | 37.76 | -64.52 | 7.37 | 0.67 | -57.82 | -13.00 | 44.82 |
| 1252.20                         | H | 38.03 | -64.70 | 7.81 | 0.68 | -57.57 | -13.00 | 44.57 |
| 1252.20                         | V | 36.92 | -66.40 | 7.81 | 0.68 | -59.27 | -13.00 | 46.27 |
| 1408.73                         | H | 36.97 | -66.56 | 8.24 | 0.72 | -59.04 | -13.00 | 46.04 |
| 1408.73                         | V | 36.43 | -67.14 | 8.24 | 0.72 | -59.62 | -13.00 | 46.62 |
| 1565.25                         | H | 36.88 | -67.15 | 8.58 | 0.80 | -59.37 | -13.00 | 46.37 |
| 1565.25                         | V | 35.19 | -68.89 | 8.58 | 0.80 | -61.11 | -13.00 | 48.11 |
| Frequency: 156.525MHz, DSC 2100 |   |       |        |      |      |        |        |       |

|         |   |       |        |      |      |        |        |       |
|---------|---|-------|--------|------|------|--------|--------|-------|
| 313.05  | H | 60.17 | -50.35 | 0.00 | 0.34 | -50.69 | -13.00 | 37.69 |
| 313.05  | V | 51.79 | -56.68 | 0.00 | 0.34 | -57.02 | -13.00 | 44.02 |
| 469.58  | H | 56.00 | -51.57 | 0.00 | 0.43 | -52.00 | -13.00 | 39.00 |
| 469.58  | V | 62.13 | -41.63 | 0.00 | 0.43 | -42.06 | -13.00 | 29.06 |
| 626.10  | H | 42.70 | -62.06 | 0.00 | 0.48 | -62.54 | -13.00 | 49.54 |
| 626.10  | V | 46.07 | -57.01 | 0.00 | 0.48 | -57.49 | -13.00 | 44.49 |
| 782.63  | H | 44.48 | -58.25 | 0.00 | 0.55 | -58.80 | -13.00 | 45.80 |
| 782.63  | V | 50.41 | -48.77 | 0.00 | 0.55 | -49.32 | -13.00 | 36.32 |
| 939.15  | H | 36.47 | -61.65 | 0.00 | 0.64 | -62.29 | -13.00 | 49.29 |
| 939.15  | V | 36.18 | -59.40 | 0.00 | 0.64 | -60.04 | -13.00 | 47.04 |
| 1095.68 | H | 38.10 | -63.70 | 7.37 | 0.67 | -57.00 | -13.00 | 44.00 |
| 1095.68 | V | 38.26 | -64.02 | 7.37 | 0.67 | -57.32 | -13.00 | 44.32 |
| 1252.20 | H | 37.50 | -65.23 | 7.81 | 0.68 | -58.10 | -13.00 | 45.10 |
| 1252.20 | V | 37.15 | -66.17 | 7.81 | 0.68 | -59.04 | -13.00 | 46.04 |
| 1408.73 | H | 37.82 | -65.71 | 8.24 | 0.72 | -58.19 | -13.00 | 45.19 |
| 1408.73 | V | 36.58 | -66.99 | 8.24 | 0.72 | -59.47 | -13.00 | 46.47 |
| 1565.25 | H | 36.09 | -67.94 | 8.58 | 0.80 | -60.16 | -13.00 | 47.16 |
| 1565.25 | V | 36.39 | -67.69 | 8.58 | 0.80 | -59.91 | -13.00 | 46.91 |

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

#### 4.7 Transmitter Frequency Tolerances

Test Mode: Transmitting

**Test Result: Compliance.** *Please refer to following tables.*

| FM,25kHz, Reference Frequency: 156.8MHz,Limit: ±10 ppm |                                     |                          |                       |
|--|-------------------------------------|--------------------------|-----------------------|
| Temperature (°C)                                       | Voltage Supplied (V <sub>DC</sub> ) | Measured Frequency (MHz) | Frequency Error (ppm) |
| -30  | 12                                  | 156.8000343              | 0.22                  |
| -20  |                                     | 156.7999752              | -0.16                 |
| -10  |                                     | 156.7999822              | -0.11                 |
| 0  |                                     | 156.7999638              | -0.23                 |
| 10   |                                     | 156.7999850              | -0.10                 |
| 20   |                                     | 156.8000000              | 0.00                  |
| 30   |                                     | 156.7999394              | -0.39                 |
| 40   |                                     | 156.8000364              | 0.23                  |
| 50   |                                     | 156.7999780              | -0.14                 |
| 20   |                                     | 10.8                     | 156.8000178           |
| 20   | 15.6                                | 156.7999584              | -0.27                 |



## 5. RF EXPOSURE EVALUATION

### 5.1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

#### 5.1.1 Applicable Standard

According to 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)

| Limits for Occupational/Controlled Exposure |                               |                               |                                     |                          |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                       | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (minutes) |
| 0.3- 3.0                                    | 614                           | 1.63                          | (100)*                              | 6                        |
| 3.0 - 30                                    | 1842/f                        | 4.89/f                        | (900/f <sup>2</sup> )*              | 6                        |
| 30-300                                      | 61.4                          | 0.163                         | 1.0                                 | 6                        |
| 300-1500                                    | /                             | /                             | f/300                               | 6                        |
| 1500-100,000                                | /                             | /                             | 5                                   | 6                        |

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/cm<sup>2</sup>);

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 Allowable Antenna Gain (dBi) | Cable Loss (dB) | Maximum Average output power including Tune-up Tolerance (dBm) | Operation Duty Cycle (%) | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | Power Density Limit (mW/cm <sup>2</sup> ) |
|-----------------|--------------------------------------|-----------------|--|--------------------------|--------------------------|-------------------------------------|---|
| 156.025-157.425 | 9                                    | 1               | 44   | 50                       | 80                       | 0.988                               | 1   |

**Result:** Device meet MPE requirement at 80 cm distance away from Antenna.

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