RF TEST REPORT

VHF Marine Transceiver
Model No (s).: IC-M510
FCC ID: AFJ419510
IC:202D-419510

Applicant:
ICOM Incorporated
1-1-32, Kamiminami,
Hirano-ku, Osaka
Japan 547-0003

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Part 2, Part 80 (Marine in 156.025-157.425Hz)
Industry Canada RSS-182, Issue 6
Maritime Radio Equipment Operating in the 156-162.5 MHz Band

UltraTech's File No.: 24ICOM-619_F80RSS182

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: January 17, 2024	
Report Prepared by: Santhosh Fernandez Issued Date: January 17, 2024	Tested by: Nimisha Desai Test Dates: January 3-12, 2024

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0685 APEC TELCA0001 1309 CA 0001/2049 AT-1945 SL2-IN-E-1119R Korea KCC-RRA CA0001

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 80 Industry Canada RSS-182, Issue 6
Title:	Telecommunication - Code of Federal Regulations, 47CFR, Parts 2 and 80 Maritime Radio Equipment Operating in the 156-162.5 MHz Band
Purpose of Test:	To gain FCC Equipment Authorization for Radio operating in the frequency bands, 156.025-161.600 MHz (Marine) and Industry Canada Type Acceptance Authorization for Maritime Radio Equipment Operating in the 156-162.5 MHz Band
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA/EIA-603 E – Land Mobile FM or PM Communications Equipment Measurement and performance Standards.
Categories of Station:	Ship station transceiver operating in 156.025-157.425 MHz band

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2024	Code of Federal Regulations – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA/EIA 603, Edition E	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CISPR 16-1-1	2010	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
RSS-182, Issue 6	2021	Maritime Radio Equipment Operating in the 156-162.5 MHz Band
RSS-Gen, Issue 6	2018	General Requirements for Compliance of Radio Apparatus
ICES-003, Issue 7	2020	Digital Apparatus
ITU-R M.493-13	2009	Digital selective-calling system for use in the maritime mobile service

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Oaska Japan, 547-0003
Contact Person:	Mr. Atsushi Tomiyama Phone #: +81-66-793-8424 Fax #: +81-66-793-3336 Email Address: world_support@icom.co.jp

Manufacturer	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Oaska Japan, 547-0003
Contact Person:	Mr. Atsushi Tomiyama Phone #: +81-66-793-8424 Fax #: +81-66-793-3336 Email Address: world_support@icom.co.jp

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	ICOM Incorporated
Product Name:	VHF Marine Transceiver
Model Name or Number:	IC-M510
Serial Number:	00000205
Type of Equipment:	Licensed Non-Broadcast Transmitter
Power Supply Requirement:	13.8 V DC
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	VHF Marine Transceiver for Ship Station

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Marine
Power Supply Requirement:	13.8 V DC
RF Output Power Rating:	25 Watts (High) and 1 Watt (Low)
Operating Frequency Range:	156.025-157.425 MHz (Marine), 156.525 MHz (DSC)
RF Output Impedance:	50 Ohm
Channel Spacing:	25 kHz
Modulation Employed:	Variable reactance FM (frequency modulation)
Occupied Bandwidth (99%):	14.98 kHz, 12.79 kHz (DSC)
Emission Designation*:	FM (16K0G3E) DSC(16K0G2B)
Antenna Connector Type:	UHF

*For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

Channel Spacing = 25 KHz, D = 5 KHz max, K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(5)(1) = **16 kHz**
Emission designation: 16K0G3E

Receiver	
Operating Frequency Range:	156.050-163.275 MHz
Intermediate Frequencies:	30.15 MHz , 21.7 MHz

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type
1	Antenna Connector	1	PL-259
2	NMEA IN/OUT	1	Leads
3	AF OUT bundle	1	Leads
4	DC Power	1	Leads(pair)
5	Ground terminal	1	Lead
6	GNSS receiver connector	1	SMA
7	Microphone Connector	2	8 pin
8	Command Mic	1	8 pin

2.5. ANCILLARY EQUIPMENT

Description:	GNSS Antenna
Brand Name:	ICOM
Model Name or Number:	UX-241

Description:	Microphone
Brand Name:	ICOM
Model Name or Number:	HM-205RB

Description:	Command Mic
Brand Name:	ICOM
Model Name or Number:	HM-195GW

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C to 24°C
Humidity:	45 to 55%
Pressure:	102 kPa
Power input source:	13.8 V DC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohm RF Load.

Transmitter Test Signals	
Frequency Band(s):	156.025-157.425 MHz
Test Frequency(ies):	156.050and 157.425 MHz, 156.525 MHz (DSC)
Transmitter Wanted Output Test Signals:	
Transmitter Power (rated output power):	25 Watts High, 1 Watt Low
Normal Test Modulation:	Variable reactance frequency modulation
Modulating signal source:	External

3.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

3.4. DEVIATION OF STANDARD TEST PROCEDURES

None

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC/RSS Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 80.215 RSS-182, Section 5.6	RF Power Output	Yes
2.1047(a) & 80.213(e)	Modulation Characteristics - Audio Frequency Response	Yes
2.1047(b) & 80.213	Modulation Characteristics - Modulation Limiting	Yes
2.1049, 80.205 & 80.211(f) RSS-182, Sections 5.4, 5.9	Occupied Bandwidth and Emission Limitations	Yes
2.1051, 2.1057 & 80.211(f)(3) RSS-182, Section 5.9	Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057 & 80.211(f)(3) RSS-182, Section 5.9	Field Strength of Spurious Emissions	Yes
2.1055 & 80.209 RSS-182, Section 5.5	Frequency Stability	Yes
80.217	Suppression of Interference aboard ships	Yes
1.1307, 1.1310, 2.1091 & 2.1093 RSS-Gen, §3.4 & RSS-102	RF Exposure Limit	Yes
RSS-182, Section 4.3	Transport Canada Requirements	Yes
RSS-182, Section 7.7	VHF AIS Transponders	N/A
RSS-182, Section 7.10	Data Modem	N/A
RSS-182, Section 7.11	Receiver Spurious Emissions	Yes
RSS-Gen, Section B6	Modular Construction	N/A
RSS-Gen, Section 6.4	External Controls	Yes
RSS-Gen, §3.4 & RSS-102	Exposure of Humans to RF Fields	Yes
RSS-Gen, Section 6.8	Transmitter Antenna	Yes
ICES-003, Issue 7	Digital Apparatus	Yes

EXHIBIT 5. TEST DATA

5.1. RF POWER OUTPUT [§§ 2.1046 & 80.215] [RSS-182, SECTION 5.6]

5.1.1. Limits

§ 80.215(e)(1) Ship stations 156–162 MHz - 25W(1,2)
Marine utility stations and hand-held portable transmitters: 156–162 MHz -10W

1 Reducible to 1 watt or less, except for transmitters limited to public correspondence channels and used in an automated system.
2 The frequencies 156.775 and 156.825 MHz are available for navigation-related port operations or ship movement only, and all precautions must be taken to avoid harmful interference to channel 16. Transmitter output power is limited to 1 watt for ship stations, and 10 watts for coast stations.

[RSS-182, SECTION 5.6]
The transmitter output power for equipment certified under this standard shall not exceed the limits specified in table 3.

RSS-182, Table 3 - Transmitter Power

Stations	Maximum Power
Coast stations	50 W
Ship stations	25 W
Shipborne hand-held portable transmitter	6 W
Survival two-way radiotelephones	Should have a minimum e.i.r.p. of 0.25 watt

Ship station transmitters shall have power control features implemented to reduce the carrier power to one watt or less for use at short ranges, except for DSC equipment operating on the 156.525 MHz (channel 70) frequency, for which the power reduction facility is optional.

The VHF radio transmitters shall be equipped with an automatic timing device that deactivates the transmitter and reverts the transmitter to the receive mode after an uninterrupted transmission period of five minutes, plus or minus 10 percent. Furthermore, these transmitters shall have a device that indicates when the automatic timer has deactivated the transmitter.

5.1.2. Method of Measurements

Refer to Section 8.1 of this report for measurement details.

5.1.3. Test Data

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured (Average) Conducted Power (W)	Power Rating (W)
Power Setting: High			
Lowest	156.050	23.50	25
Highest	157.425	23.55	25
DSC	156.525	23.55	25
Power Setting: Low			
Lowest	156.050	0.84	1.0
Highest	157.425	0.84	1.0
DSC	156.525	0.83	1.0

5.2. MODULATION CHARACTERISTICS & AUDIO FREQUENCY RESPONSE [§§ 2.1047(a) & 80.213(e)]

5.2.1. Limits

(e) Coast station transmitters operated in the 156–162 MHz band must be equipped with an audio low-pass filter. The filter must be installed between the modulation limiter and the modulated radio frequency stage. At frequencies between 3 kHz and 20 kHz it must have an attenuation greater than at 1 kHz by at least 60log10(f/3) dB where ‘‘f’’ is the audio frequency in kilohertz. At frequencies above 20 kHz the attenuation must be at least 50 dB greater than at 1 kHz

5.2.2. Method of Measurements

The rated audio input signal was applied to the input of the audio low pass filter(or of all modulation stages) using an output of Bode network analyzer. This input signal level and it’s corresponding output signal were then measured and recorded using the Bode Network Analyzer. Tests were repeated at different audio signal frequencies from 0 to 50 KHz.

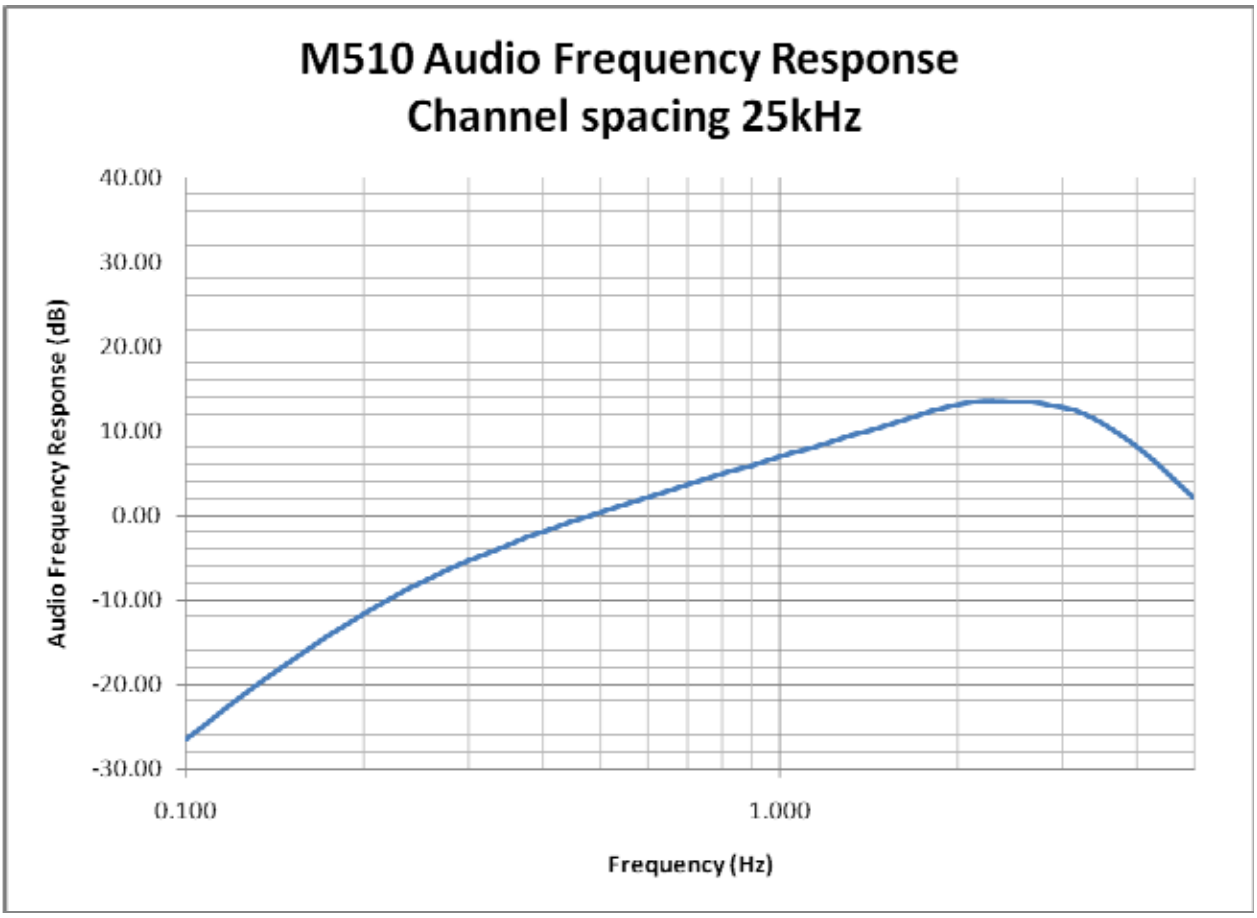
Refer to Section 6 for Test Set up block diagram and equipment used.

5.2.3. Test Data

5.2.3.1. 25 KHz Channel Spacing, CH01A 156.05 MHz

5.2.3.1.1. Audio frequency response

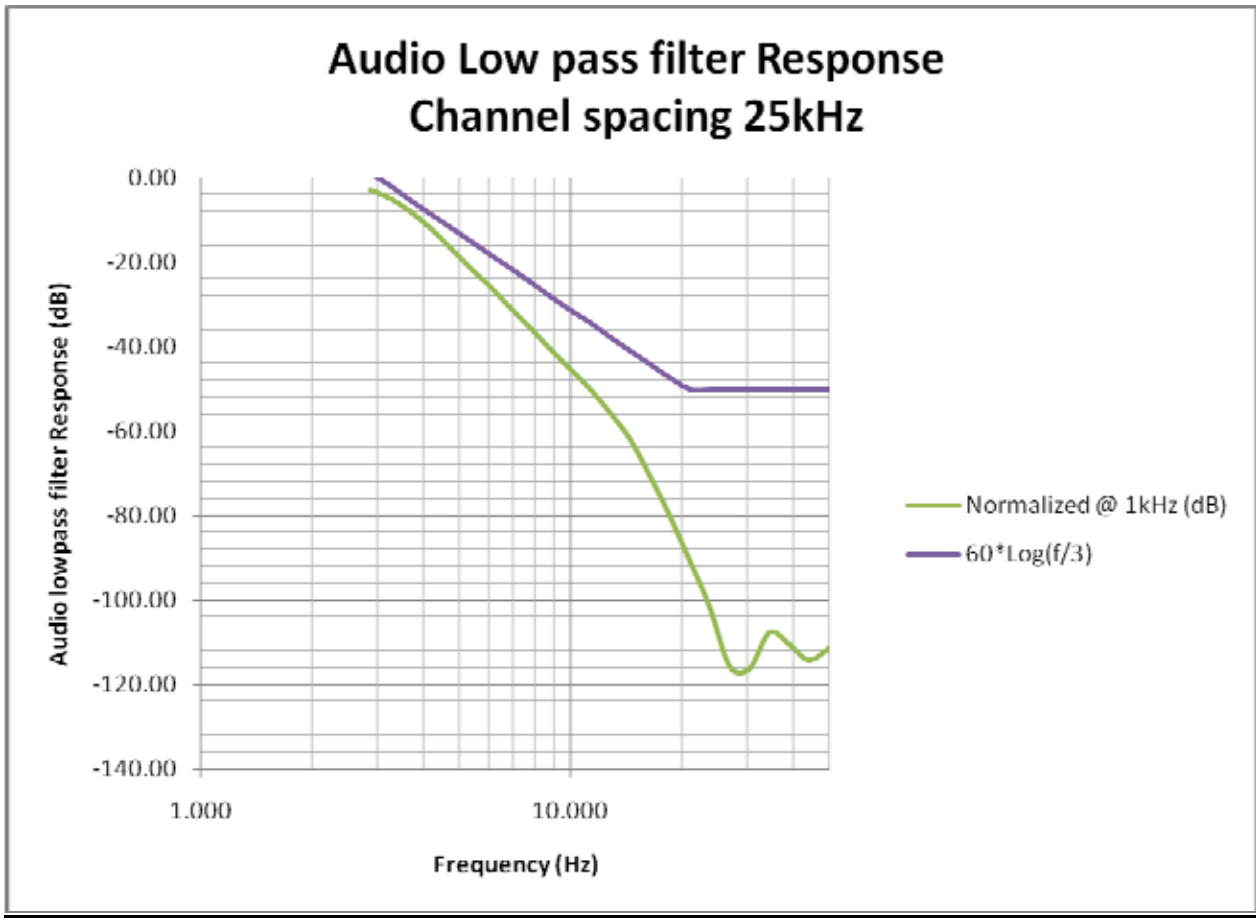
Frequency (KHz)	Trace 1: Gain: Magnitude (dB)	**Frequency (KHz)**	Trace 1: Gain: Magnitude (dB)
0.100	-26.55	0.765	4.49
0.108	-24.64	0.827	5.21
0.117	-22.75	0.894	5.93
0.126	-20.91	0.967	6.62
0.137	-19.21	1.046	7.34
0.148	-17.50	1.131	8.05
0.160	-15.88	1.223	8.75
0.173	-14.28	1.322	9.47
0.187	-12.80	1.430	10.18
0.202	-11.37	1.546	10.89
0.219	-10.01	1.672	11.61
0.236	-8.72	1.808	12.32
0.256	-7.55	1.955	12.96
0.277	-6.43	2.114	13.45
0.299	-5.36	2.287	13.55
0.323	-4.36	2.473	13.51
0.350	-3.43	2.674	13.37
0.378	-2.51	2.891	13.05
0.409	-1.66	3.127	12.46
0.442	-0.82	3.381	11.51
0.478	-0.03	3.656	10.15
0.517	0.77	3.954	8.43
0.559	1.54	4.276	6.45
0.605	2.30	4.624	4.29
0.654	3.04	5.000	2.03
0.707	3.76		



5.2.3.1.2. Audio Low pass filter Response

Frequency (KHz)	Trace 1: Gain: Magnitude (dB)	Normalized @ 1kHz (dB)	60*Log(f/3)
0.100	-7.56	-21.03	
0.113	-4.84	-18.31	
0.128	-2.13	-15.60	
0.145	0.30	-13.17	
0.164	2.49	-10.98	
0.186	4.49	-8.98	
0.211	6.25	-7.22	
0.239	7.81	-5.66	
0.270	9.03	-4.44	
0.306	10.05	-3.42	
0.347	10.90	-2.57	
0.392	11.56	-1.91	
0.444	12.09	-1.38	
0.503	12.50	-0.97	

0.570	12.82	-0.65	
0.645	13.06	-0.41	
0.731	13.23	-0.24	
0.827	13.35	-0.12	
0.937	13.43	-0.04	
1.061	13.47	0.00	
1.201	13.49	0.02	
1.360	13.48	0.01	
1.540	13.47	0.00	
1.744	13.46	-0.01	
1.975	13.40	-0.07	
2.236	13.06	-0.41	
2.532	11.98	-1.49	
2.867	10.53	-2.94	1.18
3.247	8.42	-5.05	-2.06
3.676	5.35	-8.12	-5.30
4.163	1.39	-12.08	-8.54
4.714	-3.10	-16.57	-11.78
5.338	-7.79	-21.27	-15.02
6.044	-12.56	-26.03	-18.25
6.844	-17.33	-30.80	-21.49
7.750	-22.11	-35.58	-24.73
8.775	-26.91	-40.38	-27.97
9.937	-31.74	-45.21	-31.21
11.252	-36.71	-50.18	-34.45
12.741	-42.09	-55.56	-37.68
14.427	-48.57	-62.04	-40.92
16.336	-56.89	-70.36	-44.16
18.498	-66.69	-80.16	-47.40
20.947	-77.32	-90.79	-50.00
23.719	-87.95	-101.42	-50.00
26.858	-102.36	-115.83	-50.00
30.413	-102.80	-116.27	-50.00
34.438	-94.12	-107.59	-50.00
38.995	-97.12	-110.59	-50.00
44.156	-100.76	-114.23	-50.00
50.000	-97.76	-111.23	-50.00



5.3. MODULATION LIMITING [§ 80.213 & § 2.1047(b)]

5.3.1. Limits

§ 80.213 (a)(2) When phase or frequency modulation is used in the 156-162 MHz band the peak modulation must be maintained between 75 and 100 percent. A frequency deviation of ±5 kHz is defined as 100 percent peak modulation; and

§ 80.213 (b) Radiotelephone transmitters using A3E, F3E and G3E emission must have a modulation limiter to prevent any modulation over 100 percent. This requirement does not apply to survival craft transmitters, to transmitters that do not require a license or to transmitters whose output power does not exceed 3 watts.

§ 80.213 (d) 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 Sec. 80.207.

5.3.2. Method of Measurements

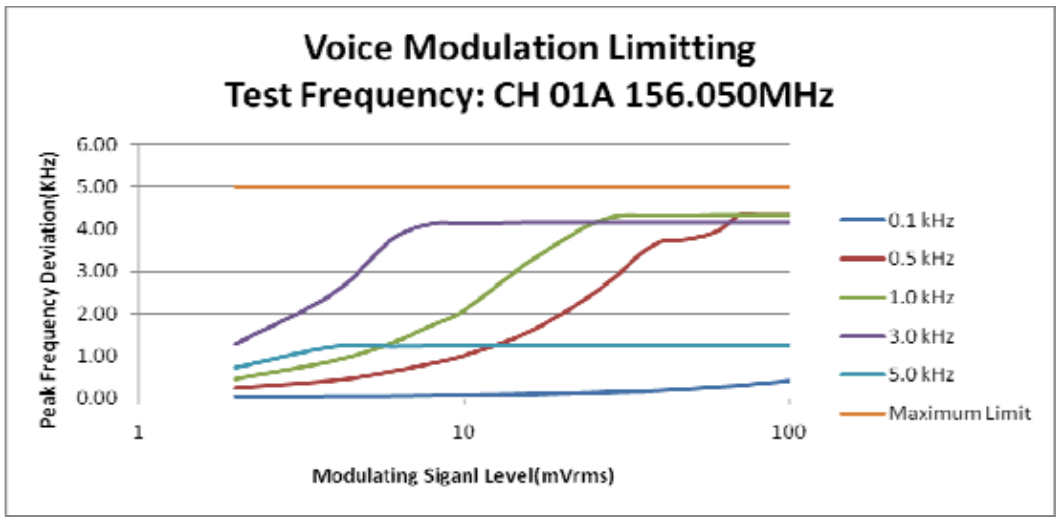
For Audio Transmitter:- The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

5.3.3. Test Data

Test Channel: 156.050MHz High Power

5.3.3.1. Voice Modulation Limiting

Modulating Signal Level	Peak Frequency Deviation (kHz)					Maximum Limit
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(kHz)
2	0.05	0.25	0.45	1.28	0.72	5.0
4	0.05	0.43	0.88	2.49	1.22	5.0
6	0.06	0.64	1.30	3.74	1.23	5.0
8	0.07	0.83	1.72	4.13	1.24	5.0
10	0.07	1.01	2.06	4.14	1.24	5.0
15	0.09	1.49	3.08	4.16	1.24	5.0
20	0.12	2.00	3.71	4.16	1.24	5.0
25	0.14	2.48	4.13	4.16	1.24	5.0
30	0.16	2.95	4.30	4.16	1.24	5.0
35	0.17	3.42	4.31	4.16	1.24	5.0
40	0.19	3.70	4.31	4.16	1.24	5.0
45	0.21	3.74	4.31	4.16	1.24	5.0
50	0.23	3.78	4.31	4.16	1.24	5.0
60	0.28	3.95	4.32	4.16	1.24	5.0
70	0.31	4.33	4.32	4.16	1.24	5.0
80	0.36	4.34	4.32	4.16	1.24	5.0
90	0.39	4.34	4.32	4.16	1.24	5.0
100	0.43	4.34	4.32	4.16	1.24	5.0



Voice Signal Input Level	= STD MOD Level + 16 dB =14.5mV+16dB =39.23 dB(mVrms) = 91.49 mVrms	
Modulation Frequency (KHz)	**Peak Deviation (KHz)**	**Maximum Limit (KHz)**
0.1	0.39	5.0
0.2	2.16	5.0
0.4	4.36	5.0
0.6	4.35	5.0
0.8	4.32	5.0
1.0	4.34	5.0
1.2	4.32	5.0
1.4	4.26	5.0
1.6	4.23	5.0
1.8	4.24	5.0
2.0	4.27	5.0
2.5	4.38	5.0
3.0	4.14	5.0
3.5	3.39	5.0
4.0	2.47	5.0
4.5	1.74	5.0
5.0	1.24	5.0
6.0	0.68	5.0
7.0	0.41	5.0
8.0	0.27	5.0
9.0	0.19	5.0
10.0	0.14	5.0

5.4. EMISSION MASK [§§2.1049, 80.205 & 80.211] [RSS-182, SECTIONS 5.4, 5.9.1 & 5.9.2]

5.4.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

Emission designator	Maximum Authorized BW (kHz)	Channel Spacing (kHz)	Recommended Frequency Deviation (kHz)	Applicable Mask
16K0G3E	20	25	5	See § 80.211 (f)

§ 80.211 (f) Emission Limitations:

(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 10log10 (mean power in watts) dB.

RSS-182, Section 5.4:

(v) the authorized channel bandwidth for voice shall be 16 kHz; and
(vi) the authorized channel bandwidth for data shall be 20 kHz.

RSS-182, Section 5.9.1 Emission Mask B for Equipment with 25 kHz Channel Spacing

Emission mask B is for FM or PM equipment with 25 kHz channel spacing and an authorized bandwidth of 16 kHz for voice or 20 kHz for data, with or without an audio low-pass filter. The power of unwanted emissions shall be attenuated below the transmitter's output power "p" (dBW) as follows:

i. at least 25 dB, measured with a bandwidth of 300 Hz, on any frequency removed from the carrier frequency by more than 50%, but not more than 100% of the authorized bandwidth;
ii. at least 35 dB, measured with a bandwidth of 300 Hz, on any frequency removed from the carrier frequency by more than 100%, but not more than 250% of the authorized bandwidth; and
iii. at least $43 + 10 \log_{10} p$ (W) dB, measured with a bandwidth of 30 kHz, on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth.

RSS-182, Section 5.9.2 Emission Mask C for equipment with 12.5 kHz Channel Spacing

Emission mask C is for equipment with channel spacing of 12.5 kHz and an authorized bandwidth of 11.25 kHz, with or without an audio low-pass filter. The power of unwanted emissions shall be attenuated below the transmitter's output power "p" (dBW) as follows:

i. 0 dB, measured with a bandwidth of 100 Hz, on any frequency removed from the carrier frequency up to a displacement frequency of 5.625 kHz;
ii. at least 7.27 (f_d - 2.88 kHz) dB, measured with a bandwidth of 100 Hz, on any frequency removed from the carrier frequency by a displacement frequency (f_d in kHz) of more than 5.625 kHz, but no more than 12.5 kHz; and
iii. at least 50 + 10 $\log_{10}$ p (W) dB or 70 dB, whichever is the lesser attenuation, on any frequency removed from the carrier frequency by a displacement frequency (f_d in kHz) of more than 12.5 kHz, and measured as follows:
    - o with a bandwidth of 100 Hz for a displacement frequency of more than 12.5 kHz, but no more than 50 kHz; and
    - o with a bandwidth of 10 kHz for a displacement frequency of more than 50 kHz.

5.4.2. Method of Measurements

Refer to Section 8.4 of this report for measurement details

5.4.3. Test Data

5.4.3.1. 99% Occupied Bandwidth

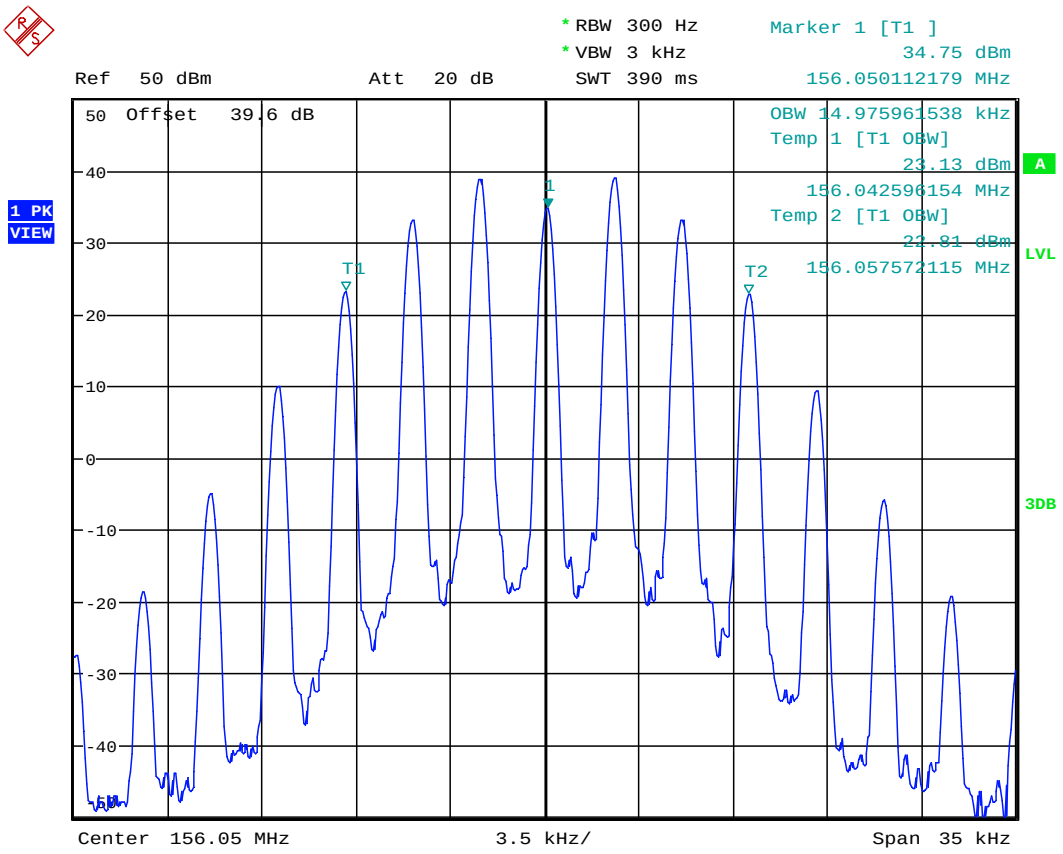
Remark: 99% Occupied Bandwidth measurements were done using the built-in auto function of the analyzer.

Frequency (MHz)	Channel Spacing (kHz)	Measured 99% OBW (kHz)	Authorized Bandwidth (kHz)
156.050	25	14.98	16*/20
157.425	25	14.98	16*/20
DSC (1300 Hz)156.525	25	8.01	16*/20
DSC (2100 Hz)156.525	25	12.79	16*/20

*RSS 182 voice limit
See the following plots for details of measurements.

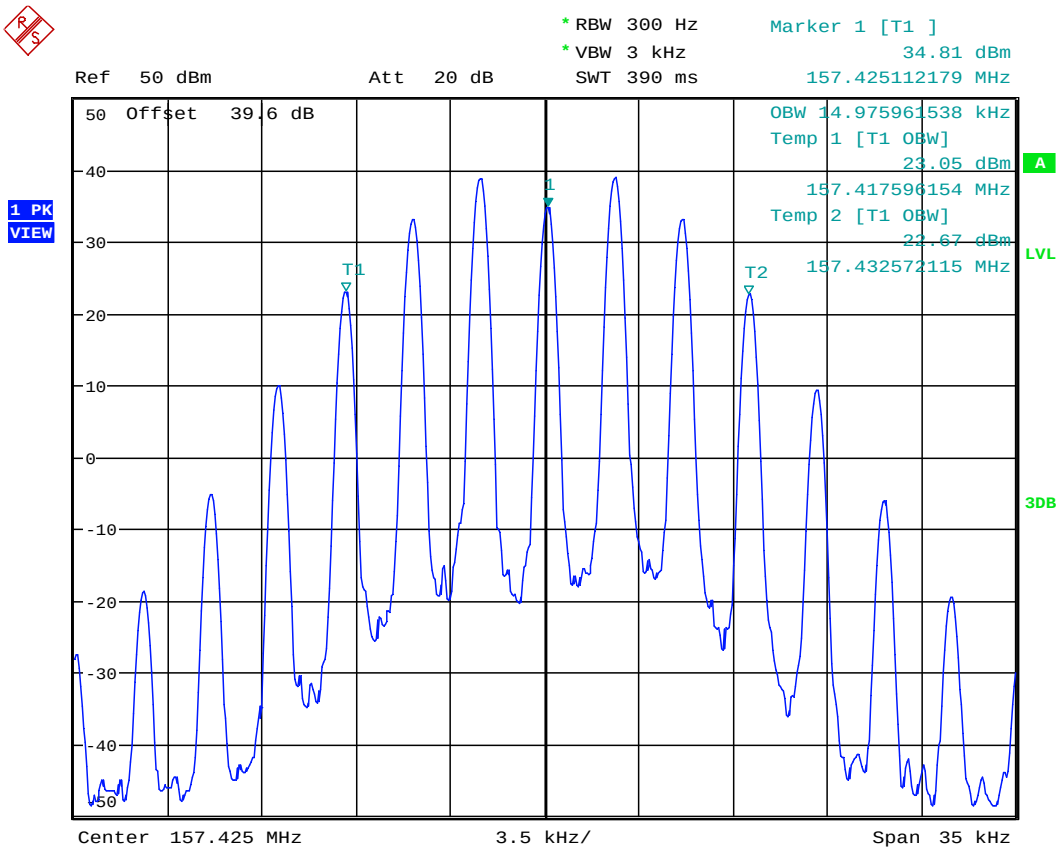
5.4.3.2. Configuration: 99% OBW, CH 01A 156.050MHz, 25 KHz, High power

OBW: 14.98 KHz



5.4.3.3. Configuration: 99% OBW, CH 88 157.425MHz, 25 KHz, High power

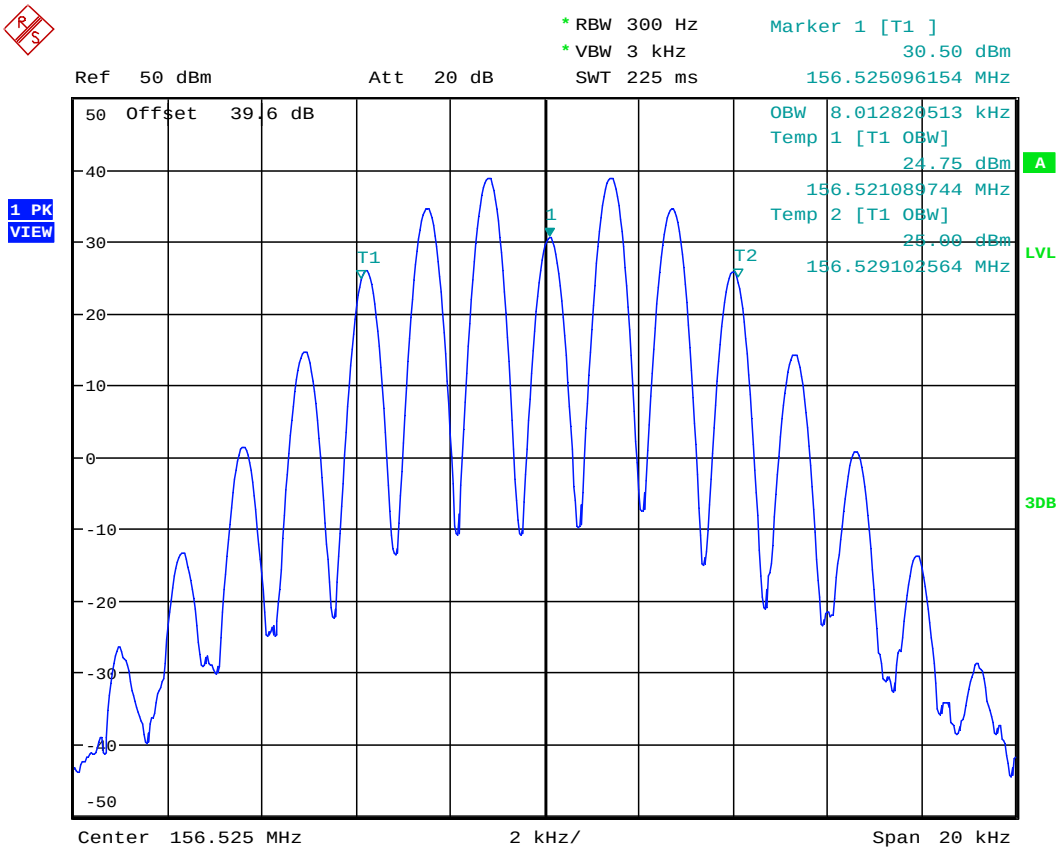
OBW: 14.98 KHz



Date: 5.JAN.2024 12:30:44

5.4.3.4. Configuration: 99% OBW, DSC (1300Hz) 156.525MHz, High power

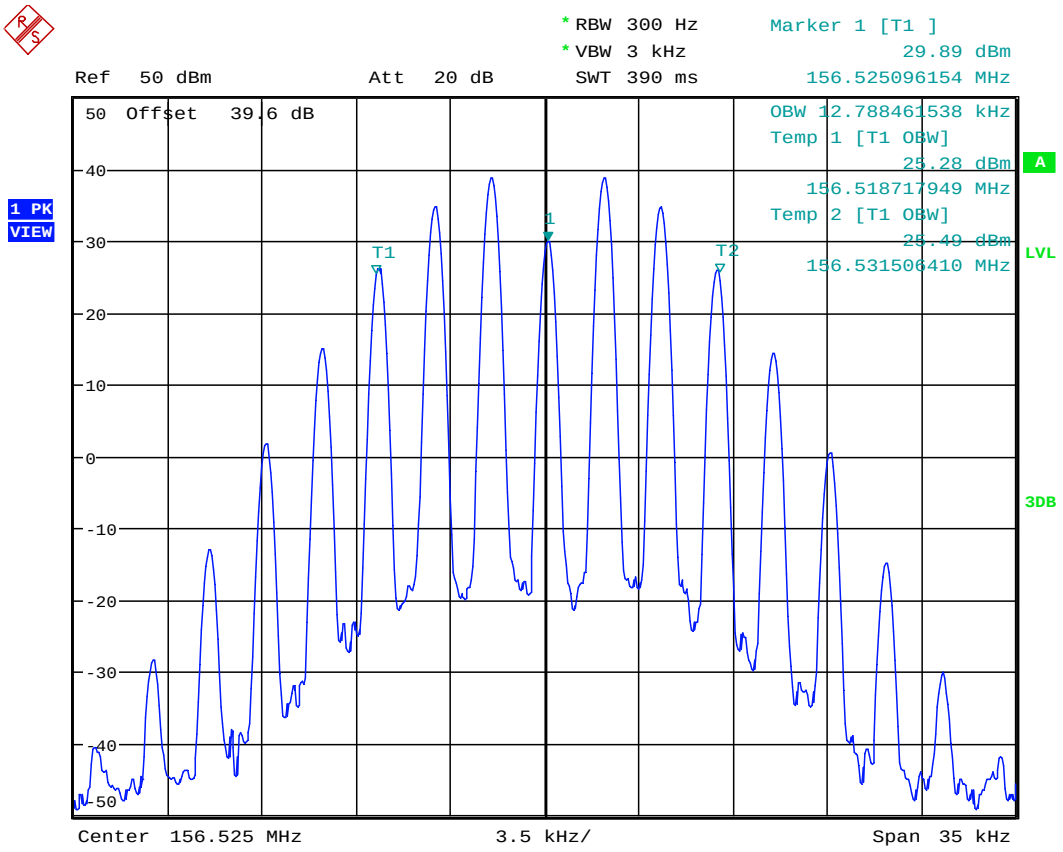
OBW: 8.01 KHz



Date: 5.JAN.2024 12:32:43

5.4.3.5. Configuration: 99% OBW, DSC (2100Hz) 156.525MHz, High power

OBW: 12.79 KHz

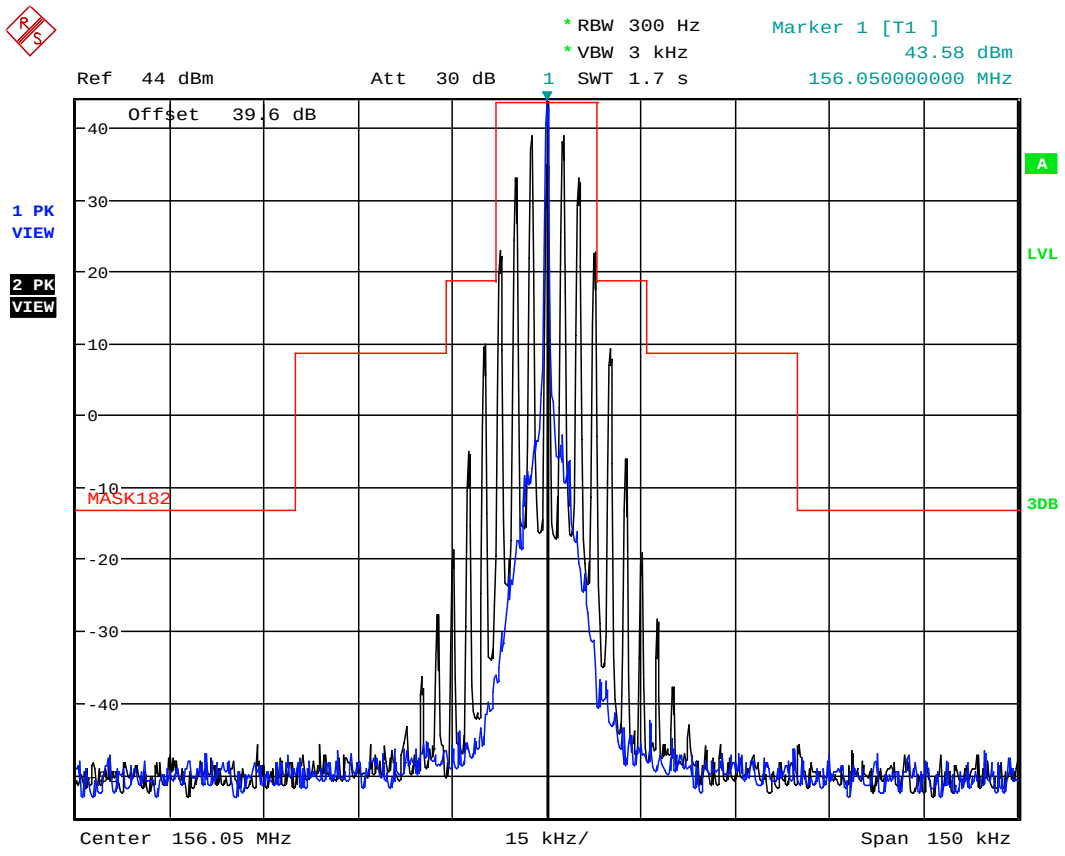


Date: 5.JAN.2024 12:33:36

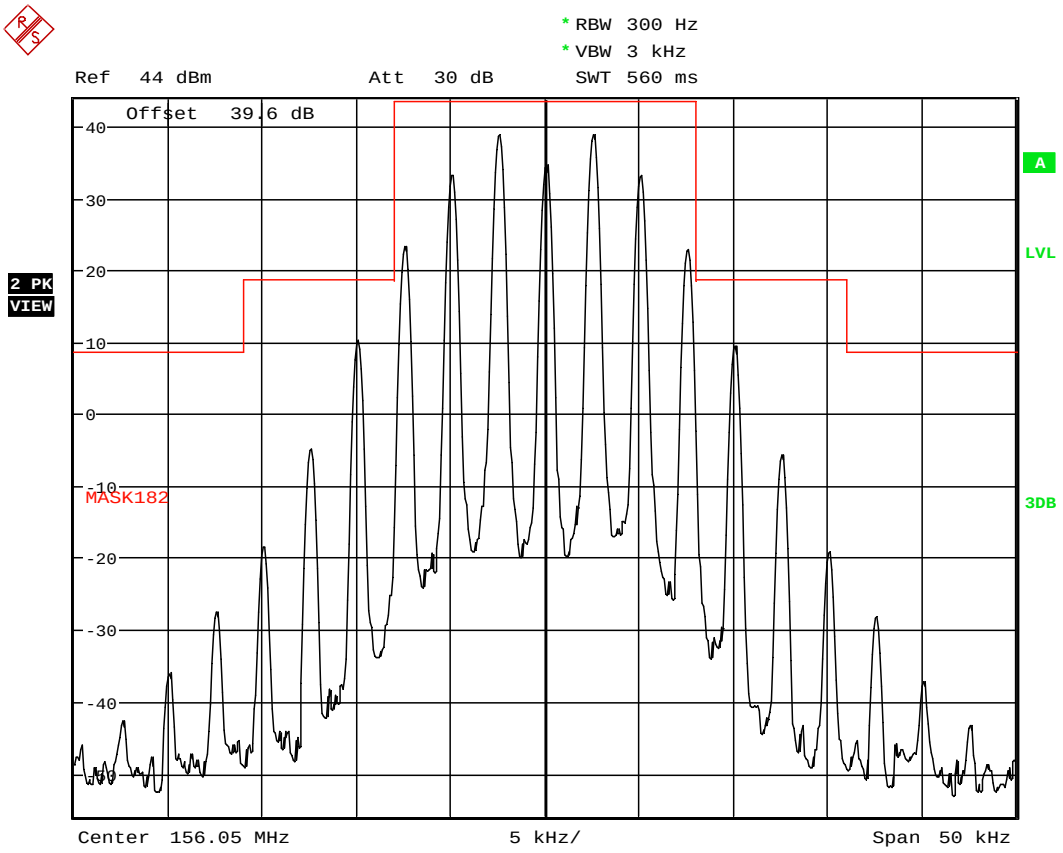
MASK B

High Power

5.4.3.6. Configuration: Mask B, CH 01A 156.05MHz, 25 KHz, High power

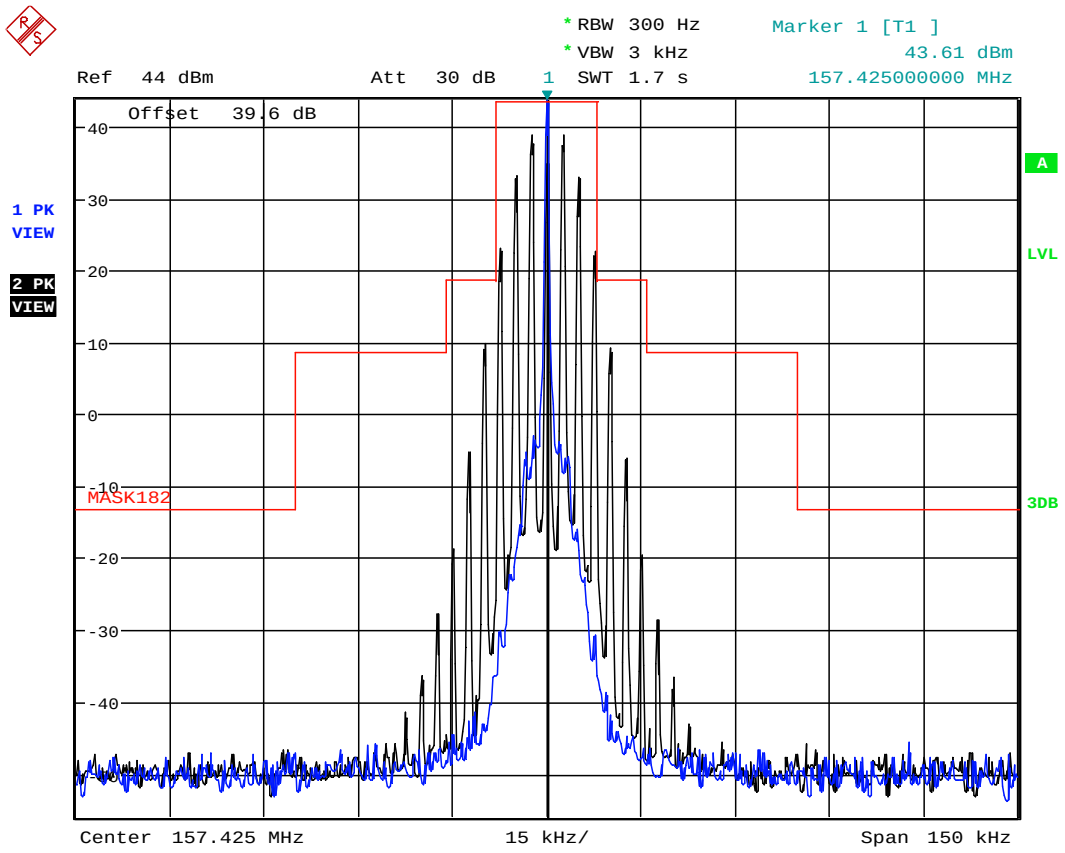


Date: 5.JAN.2024 13:56:33

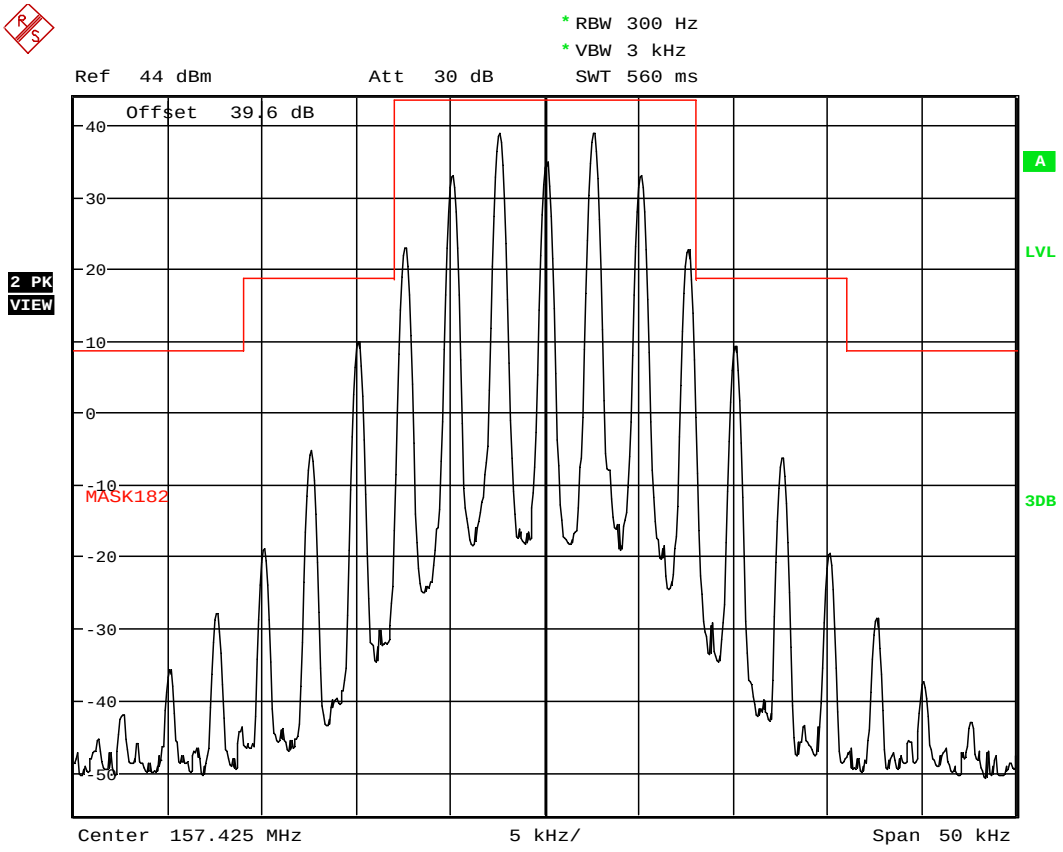


Date: 5.JAN.2024 13:57:46

5.4.3.7. Configuration: Mask B, CH 88 157.425MHz, 25 KHz, High power



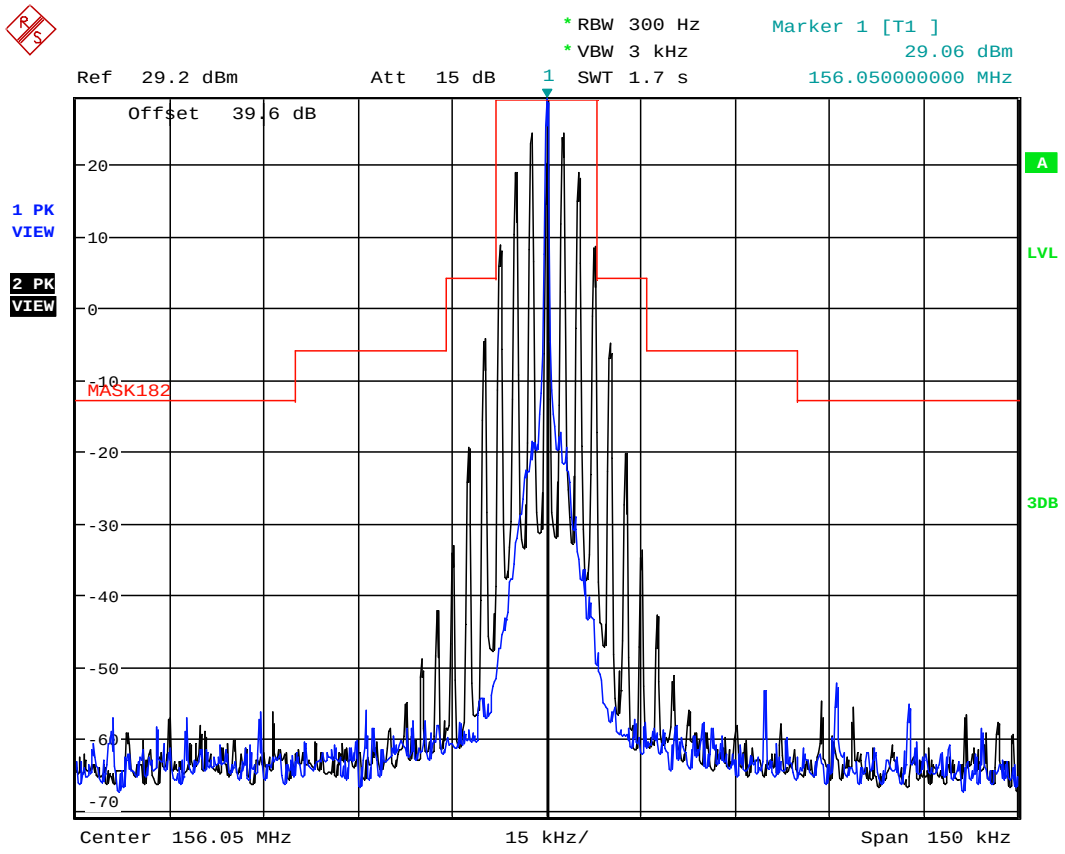
Date: 5.JAN.2024 14:03:10



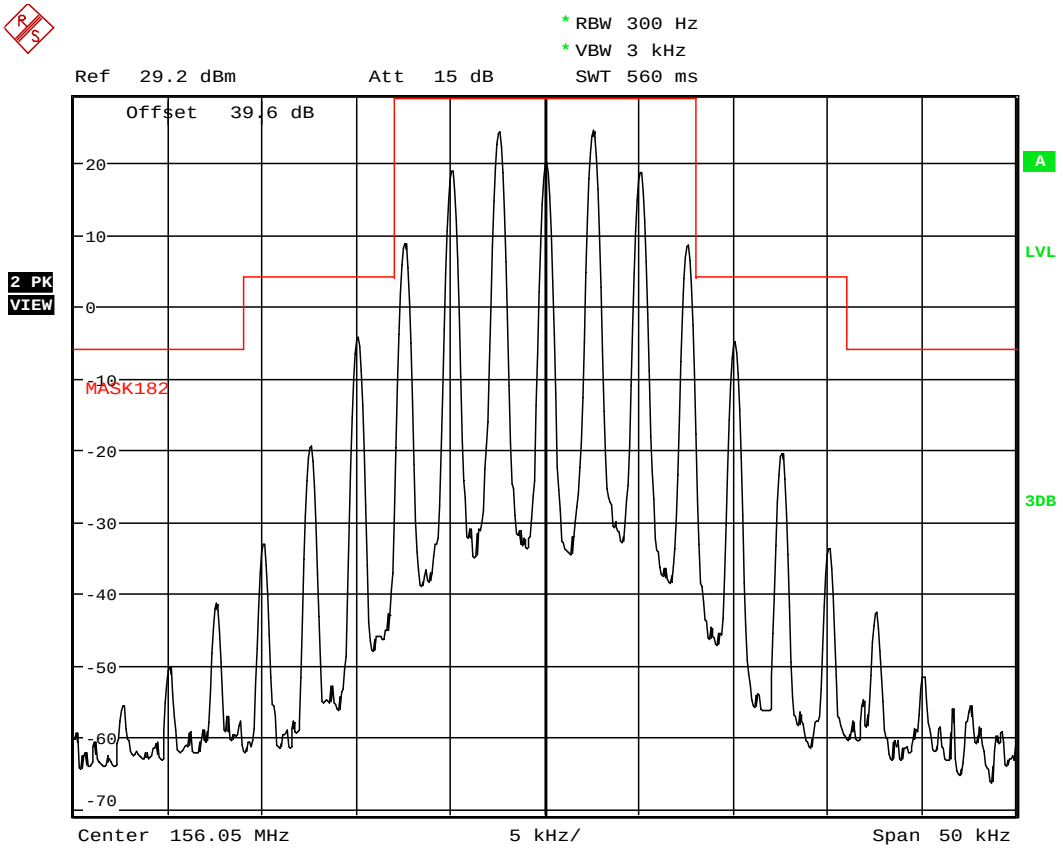
Date: 5.JAN.2024 14:04:09

Low Power

5.4.3.8. Configuration: Mask B, CH 01A 156.05MHz, 25 KHz, Low power

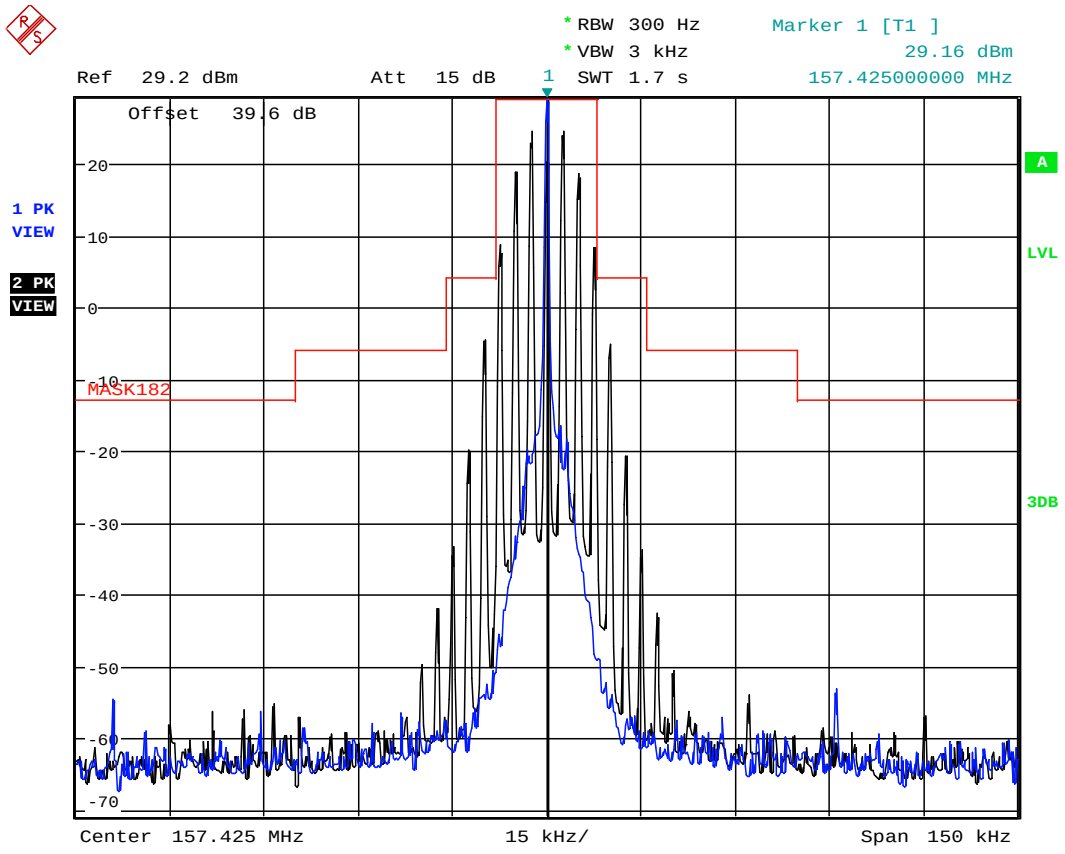


Date: 5.JAN.2024 14:24:33

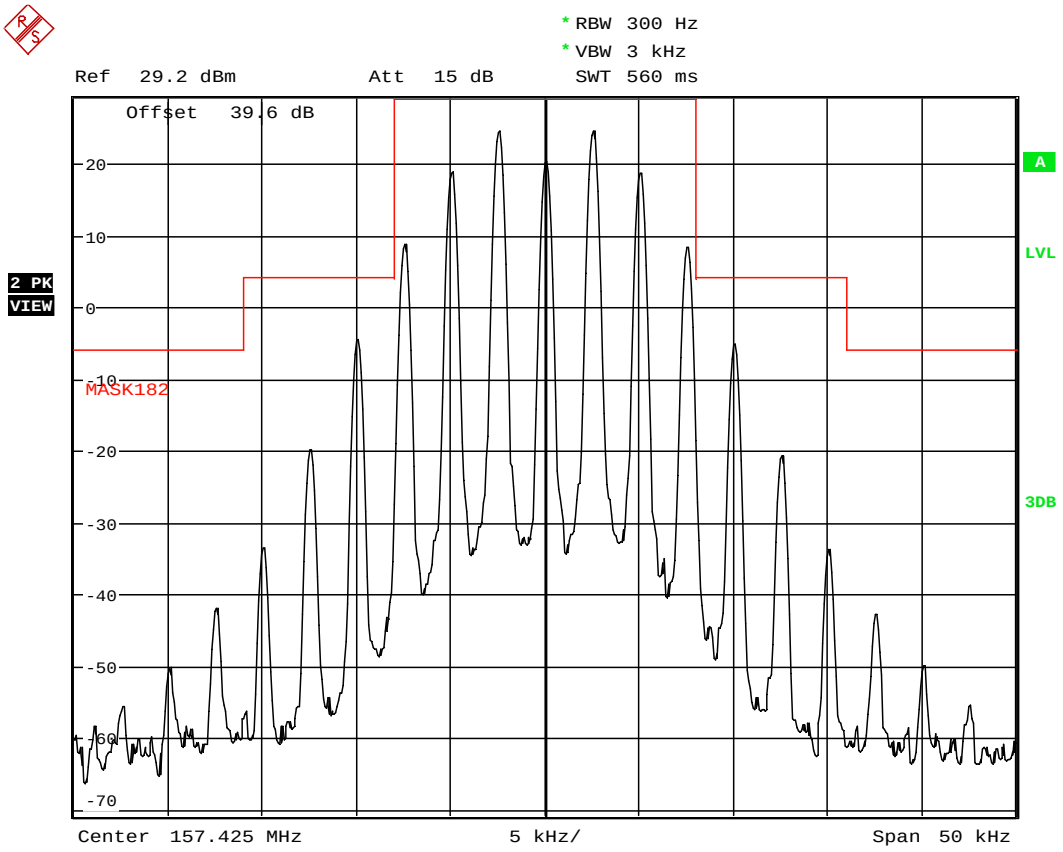


Date: 5.JAN.2024 14:25:18

5.4.3.9. Configuration: Mask B, CH 88 157.425MHz, 25 KHz, Low power



Date: 5.JAN.2024 14:28:09

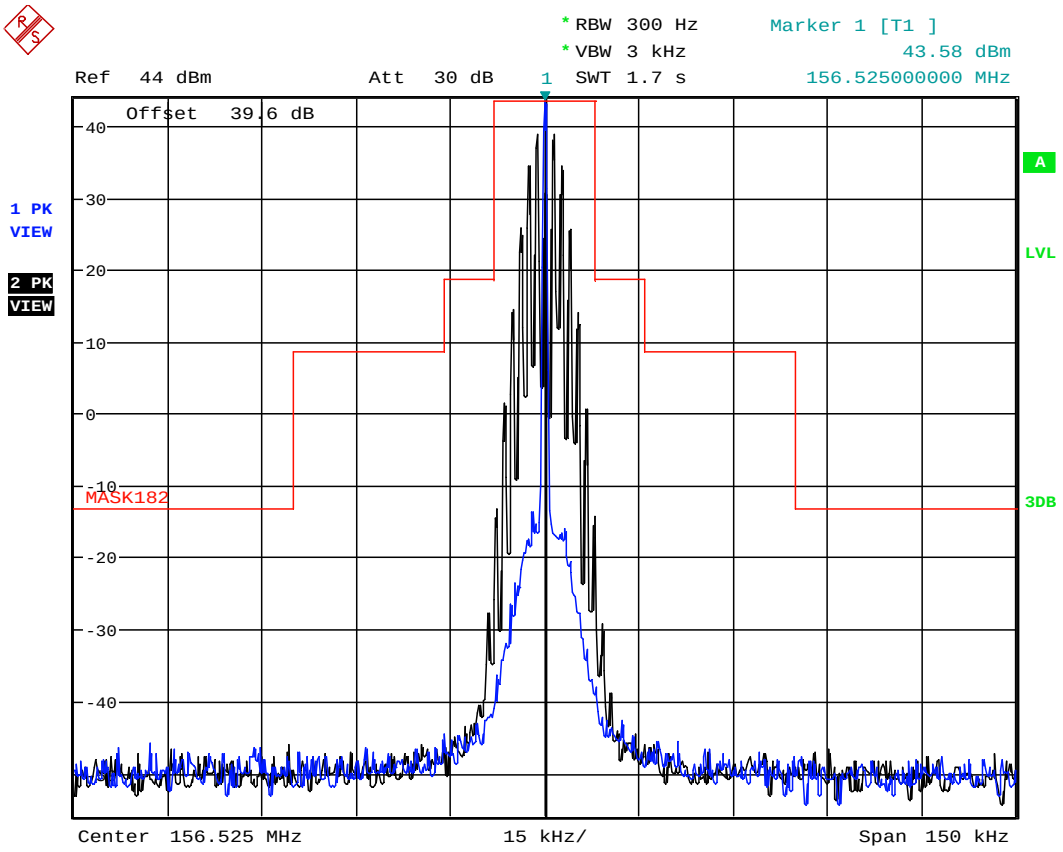


Date: 5.JAN.2024 14:28:50

DSC MASK B

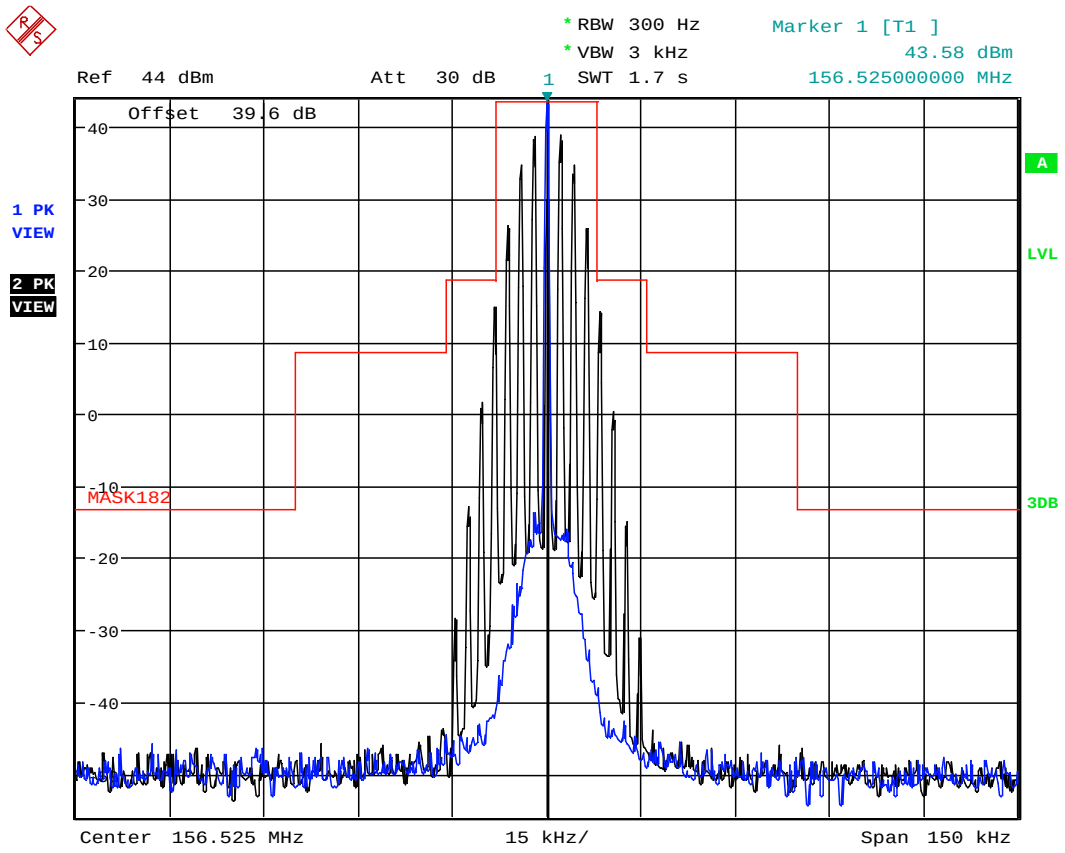
High Power

5.4.3.10. Configuration: Mask B, DSC 156.525MHz, 1300Hz, High power



Date: 5.JAN.2024 14:09:17

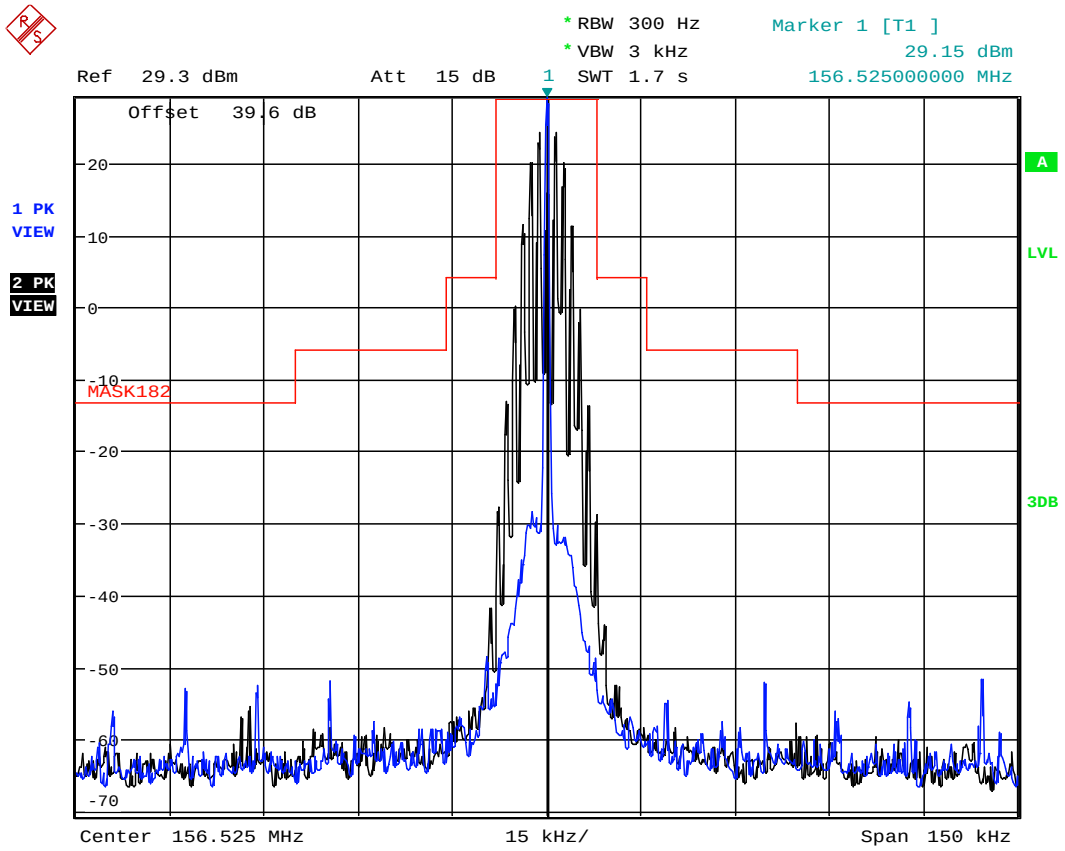
5.4.3.11. Configuration: Mask B, DSC 156.525MHz, 2100Hz, High power



Date: 5.JAN.2024 14:10:12

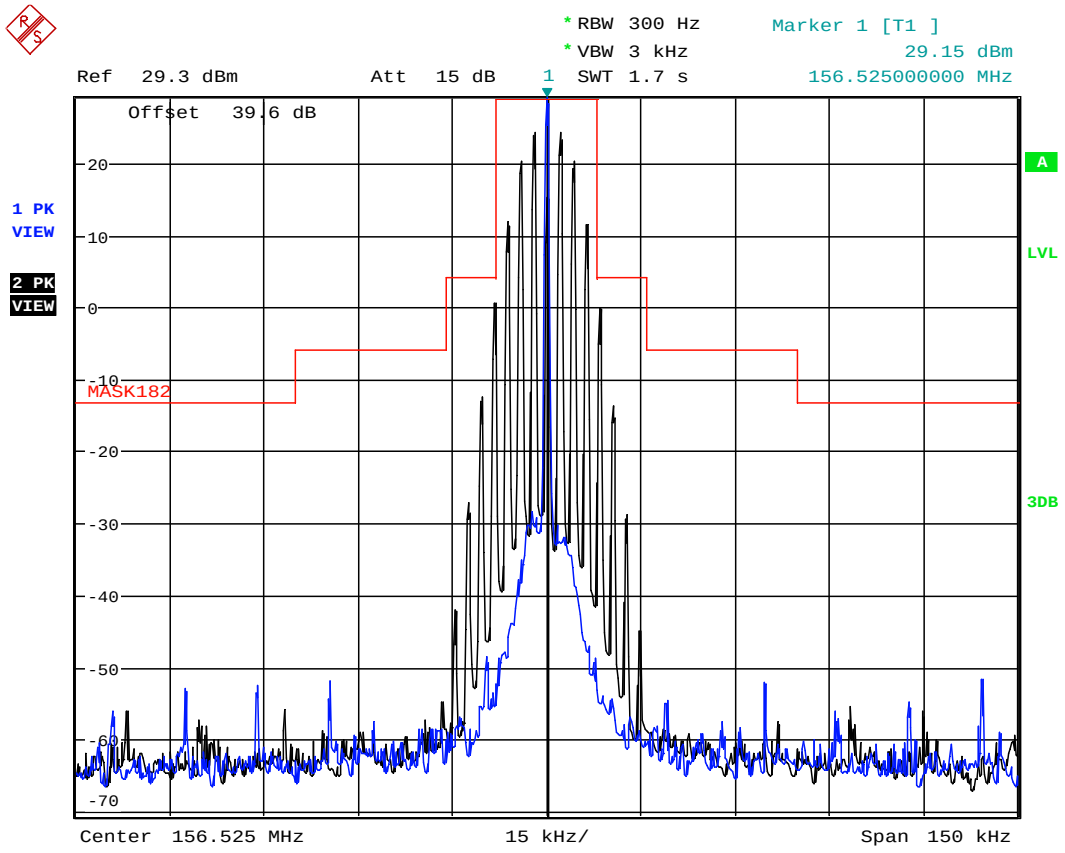
Low Power

5.4.3.12. Configuration: Mask B, DSC 156.525MHz, 1300Hz, Low power



Date: 5.JAN.2024 14:20:12

5.4.3.13. Configuration: Mask B, DSC 156.525MHz, 2100Hz, Low power



Date: 5.JAN.2024 14:21:06

5.5. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§80.211(f)(3)] [RSS-182, SECTION 7.9]

5.5.1. Limits

§ 80.211 (f)(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

[RSS-182, SECTION 5.9]
Equipment with 25 kHz channel spacing (equipment designator G and D) shall comply with emission mask B. Radio equipment with 12.5 kHz channel spacing, with or without an audio low-pass filter, shall comply with emission mask C.

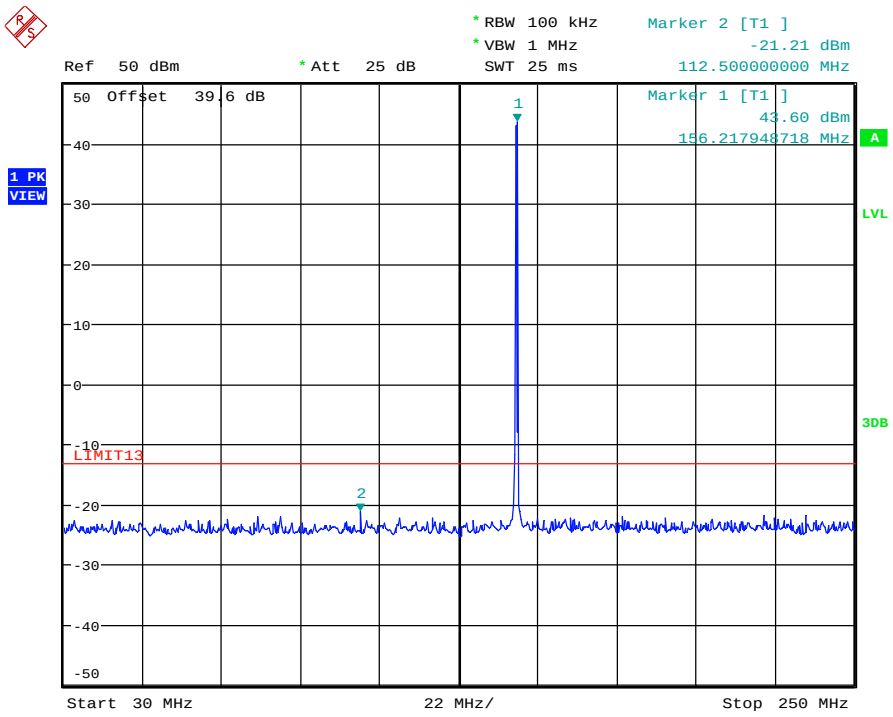
5.5.2. Method of Measurements

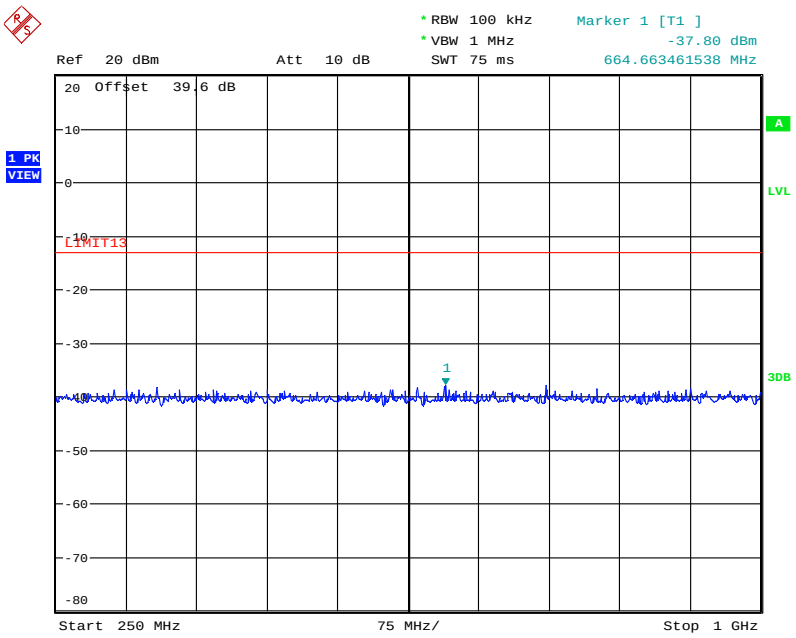
Refer to Section 8.5 of this report for measurement details

5.5.3. Test Data

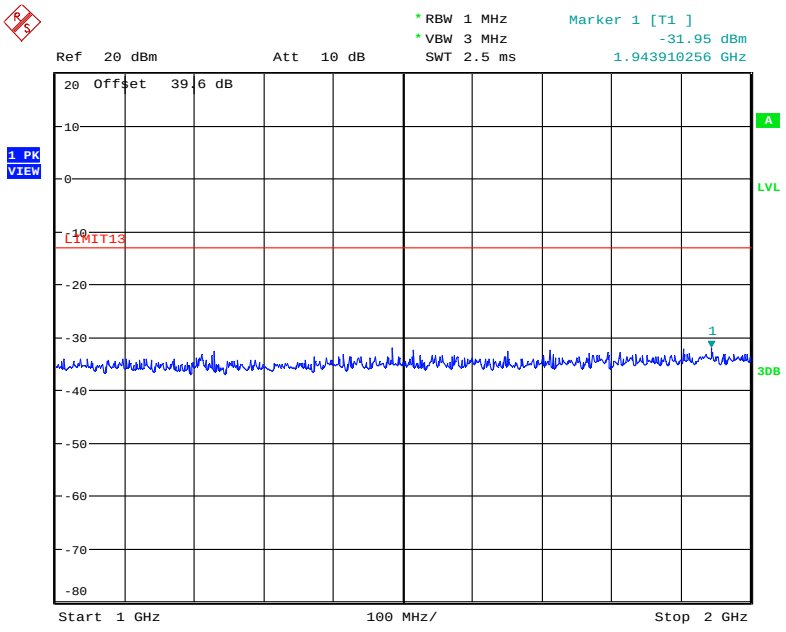
High Power

5.5.3.1. Configuration: Tx Conducted, CH 01A 156.05MHz, 25 KHz, High power



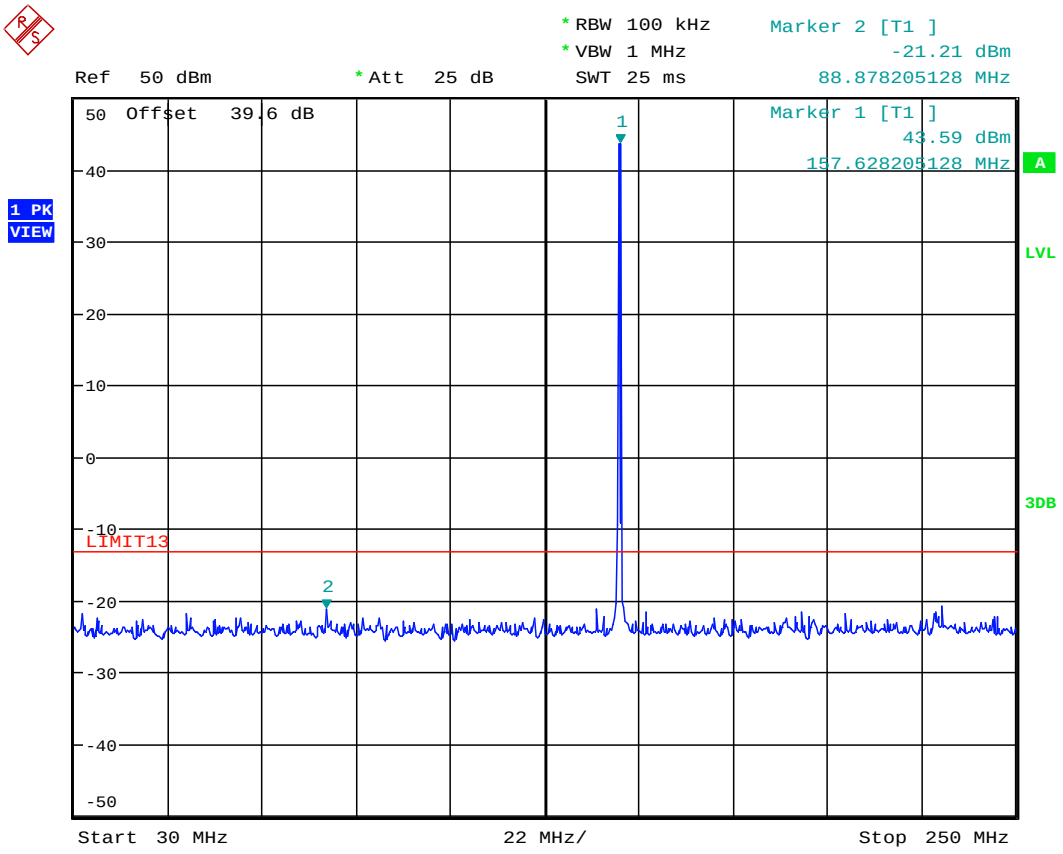


Date: 5.JAN.2024 15:04:59

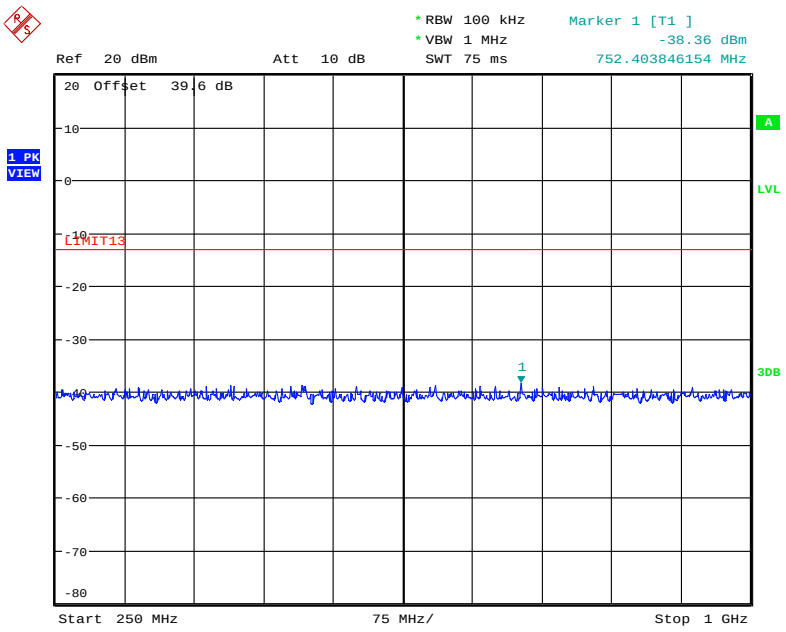


Date: 5.JAN.2024 15:11:06

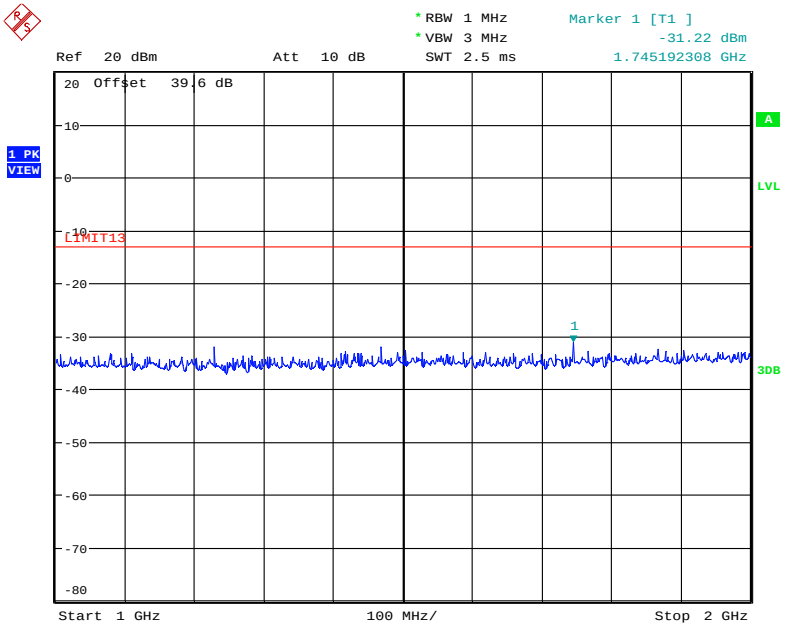
5.5.3.2. Configuration: Tx Conducted, CH 88 157.425MHz, 25 KHz, High power



Date: 5.JAN.2024 14:51:29



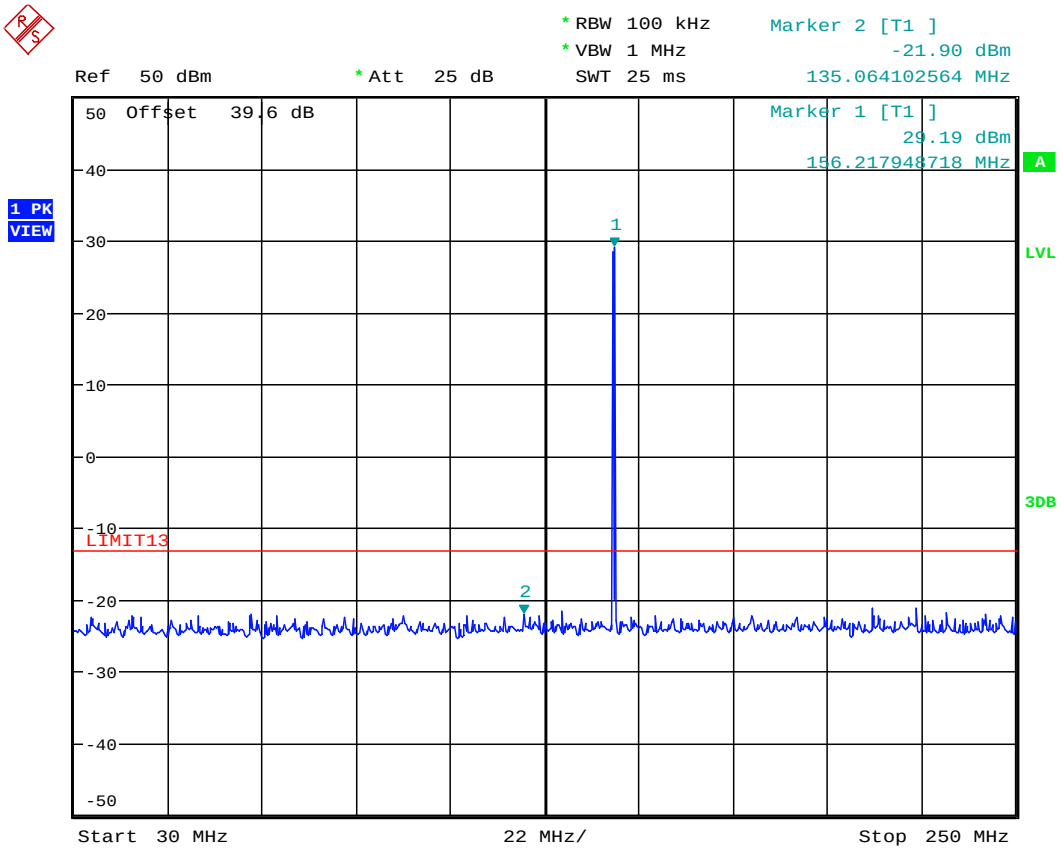
Date: 5.JAN.2024 15:05:39



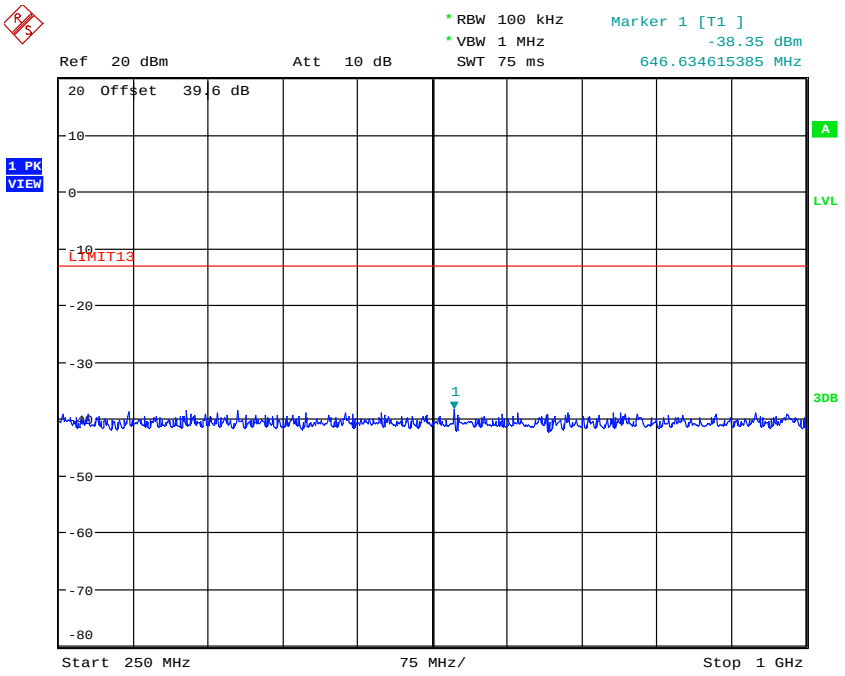
Date: 5.JAN.2024 15:11:41

Low Power

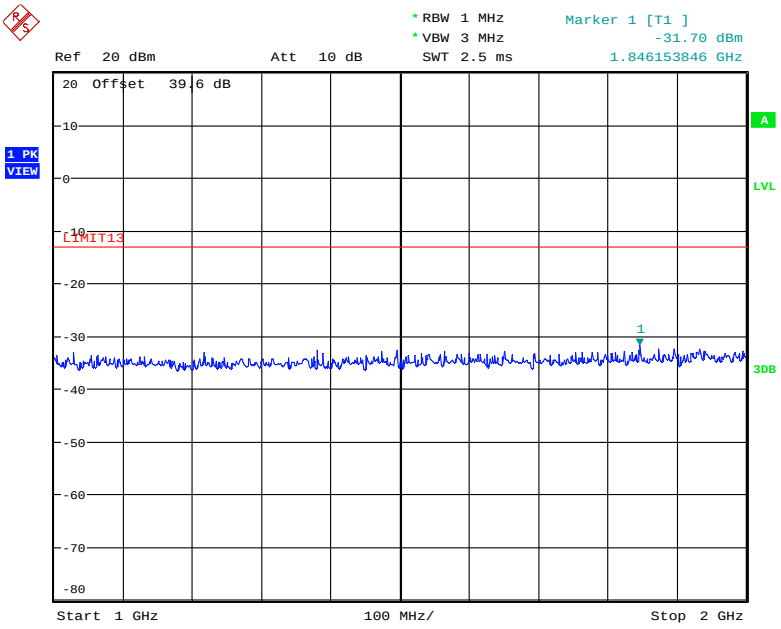
5.5.3.3. Configuration: Tx Conducted, CH 01A 156.05MHz, 25 KHz, Low power



Date: 5.JAN.2024 14:58:30

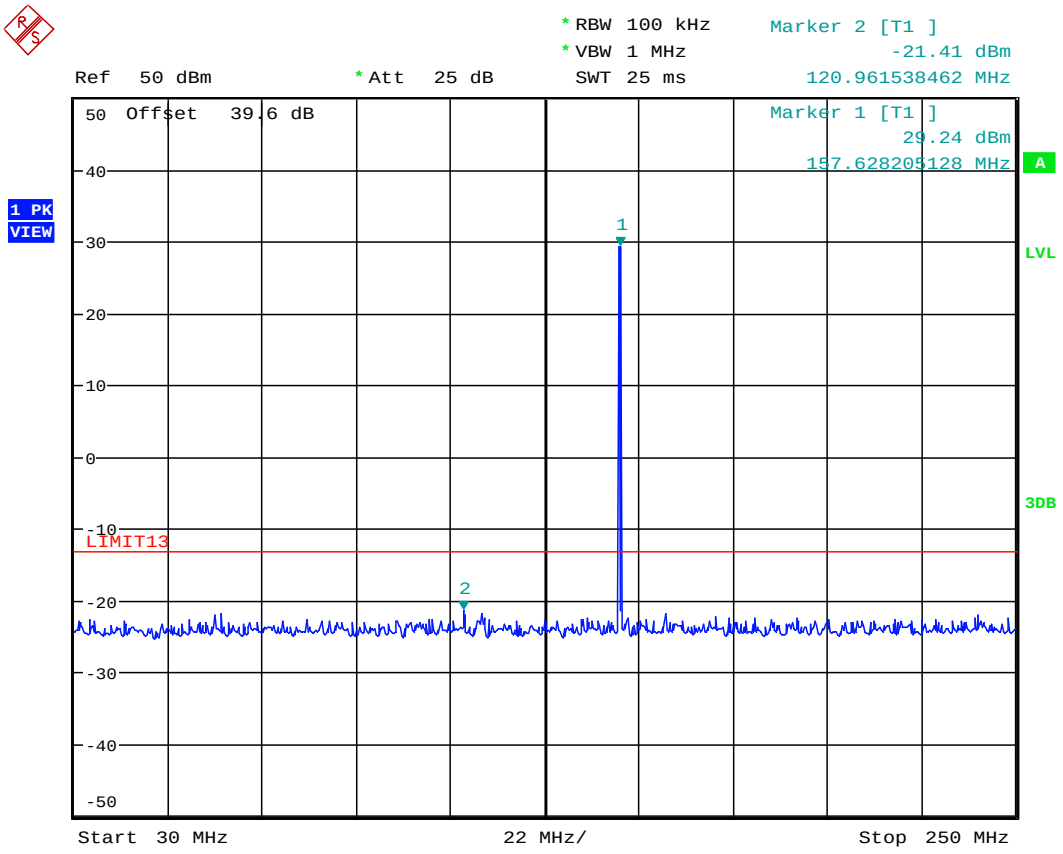


Date: 5.JAN.2024 15:09:25

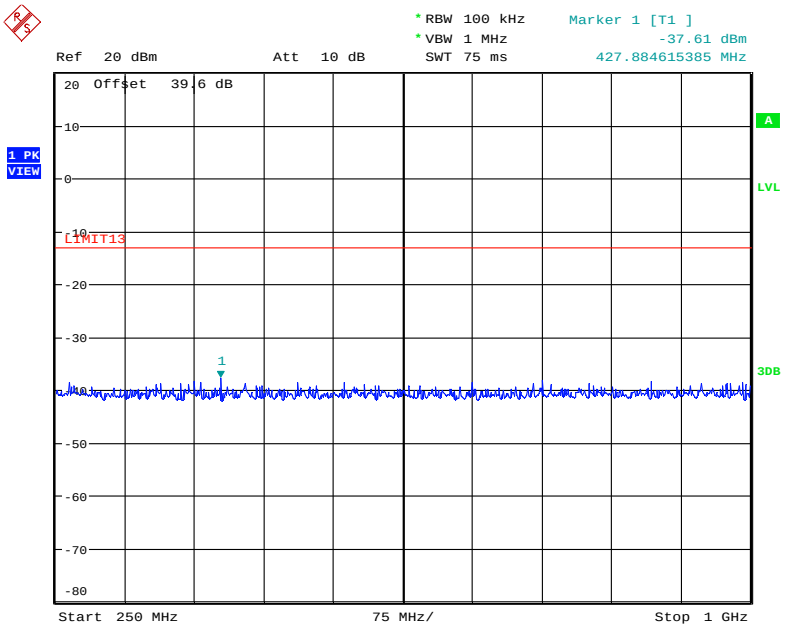


Date: 5.JAN.2024 15:15:45

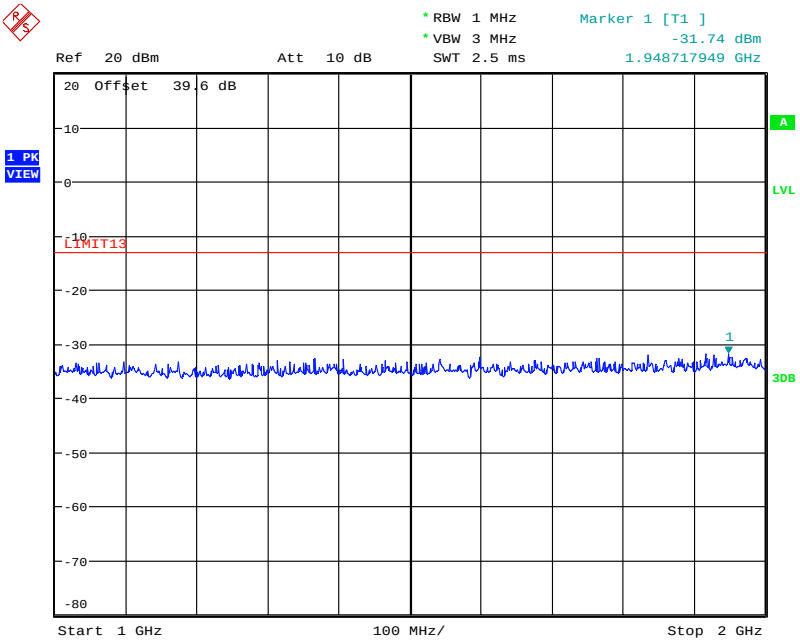
5.5.3.4. Configuration: Tx Conducted, CH 88 157.425MHz, 25 KHz, Low power



Date: 5.JAN.2024 14:59:55



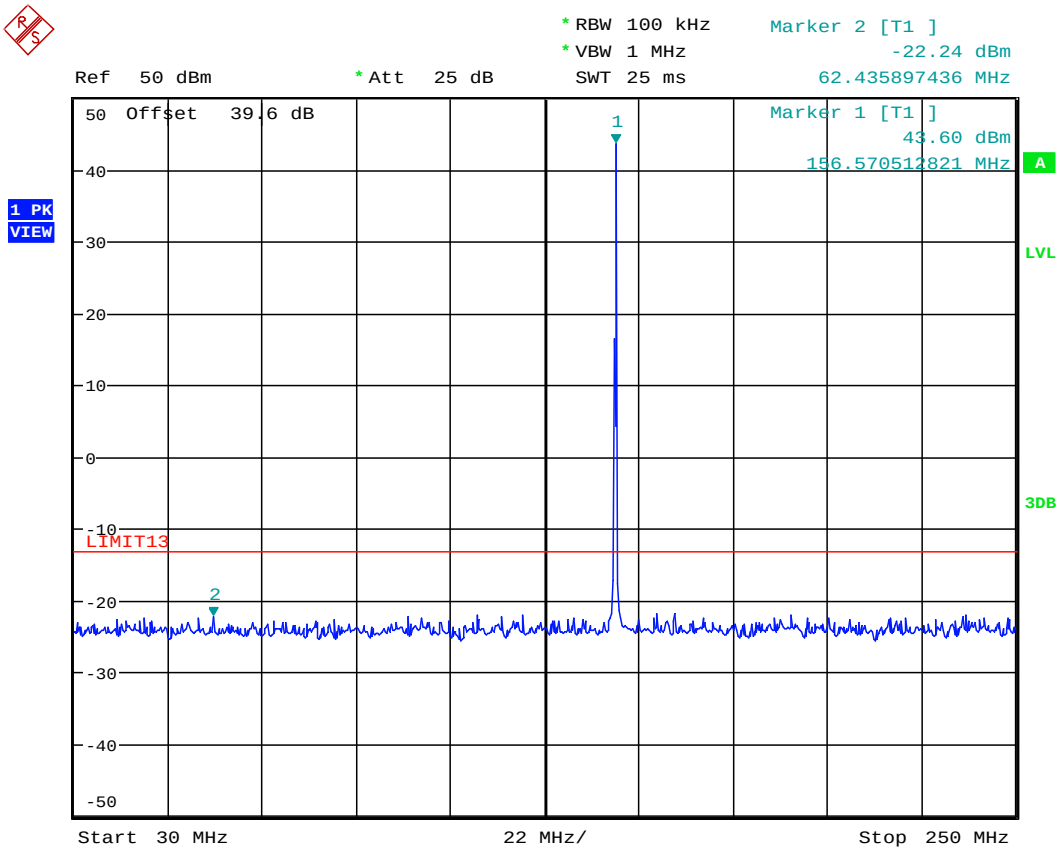
Date: 5.JAN.2024 15:09:59



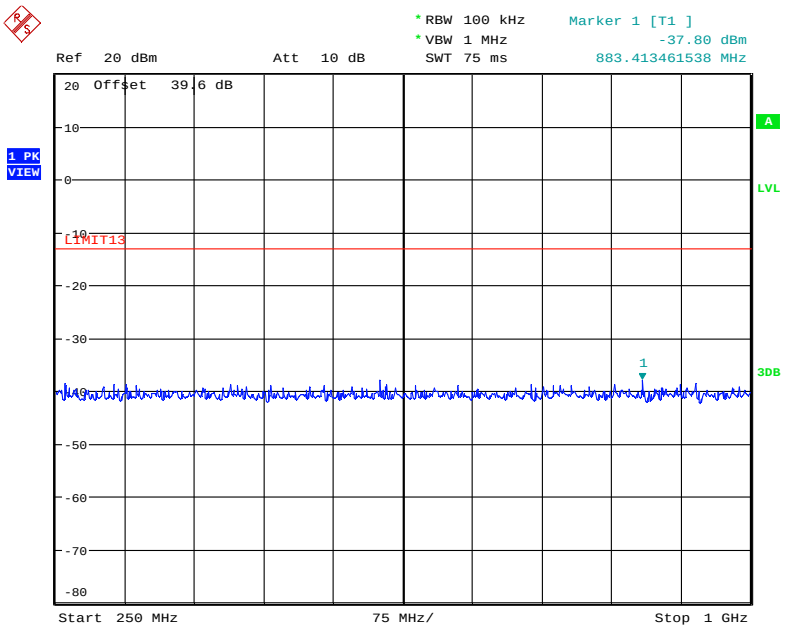
Date: 5.JAN.2024 15:16:21

High Power

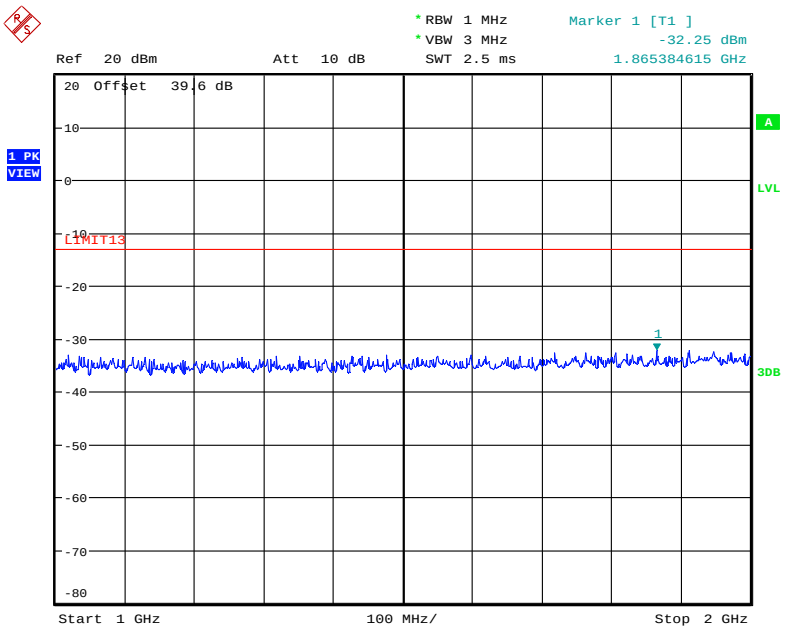
5.5.3.5. Configuration: Tx Conducted, DSC 156.525MHz, 1300Hz, High power



Date: 5.JAN.2024 14:54:15

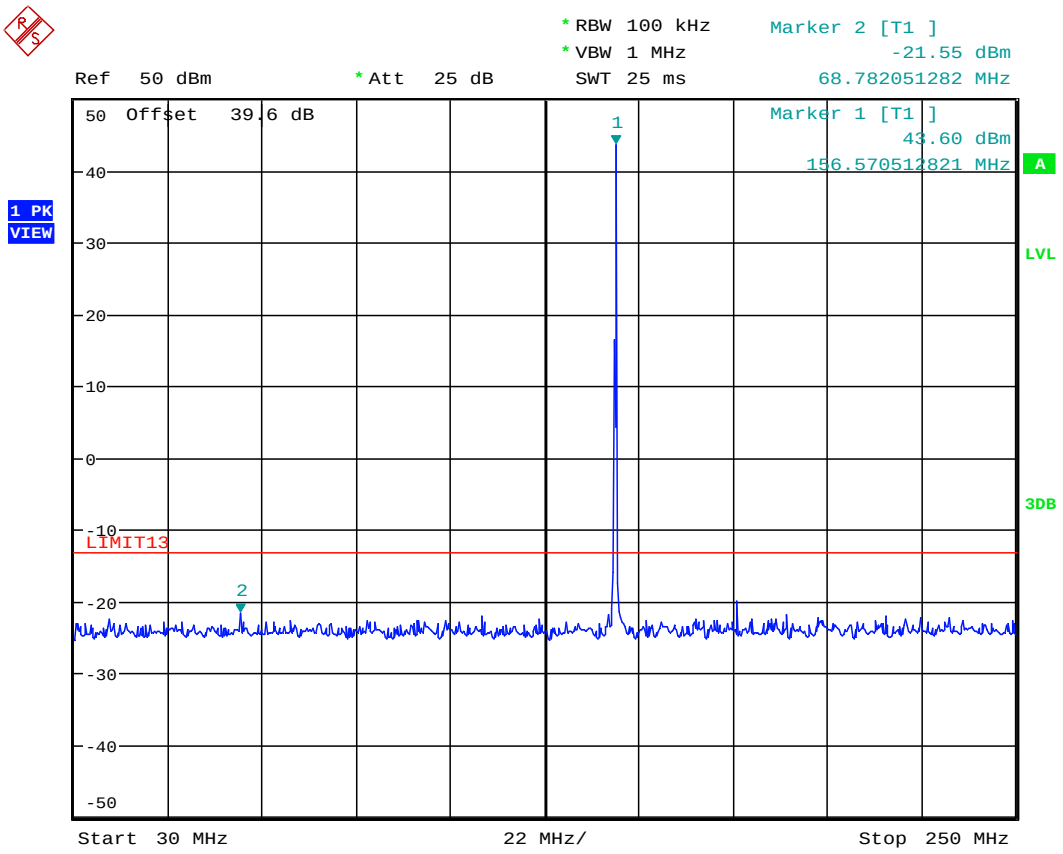


Date: 5.JAN.2024 15:06:31

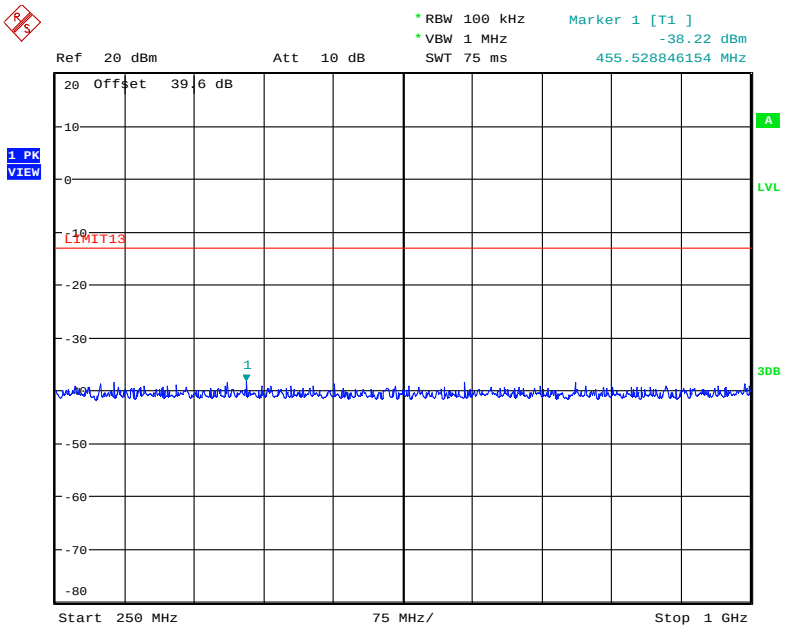


Date: 5.JAN.2024 15:12:34

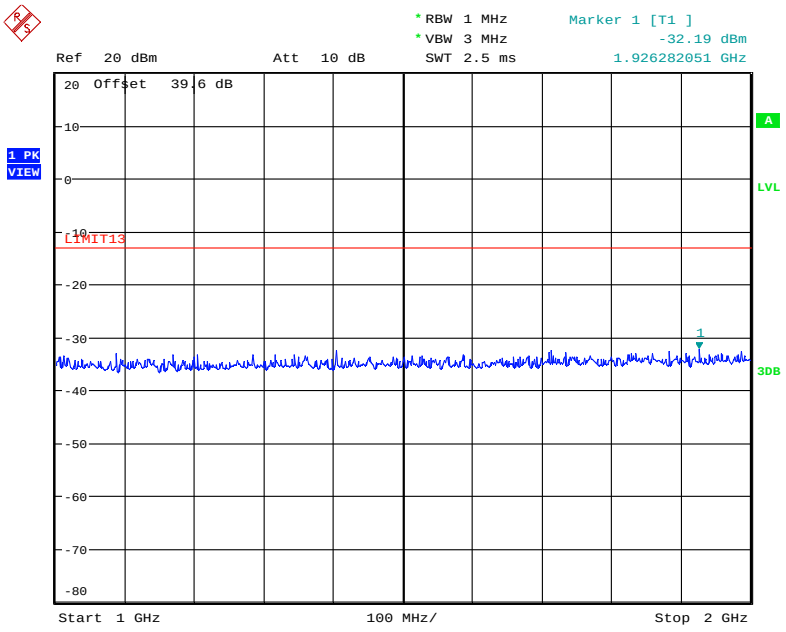
5.5.3.6. Configuration: Tx Conducted, DSC 156.525MHz, 2100Hz, High power



Date: 5.JAN.2024 14:54:58



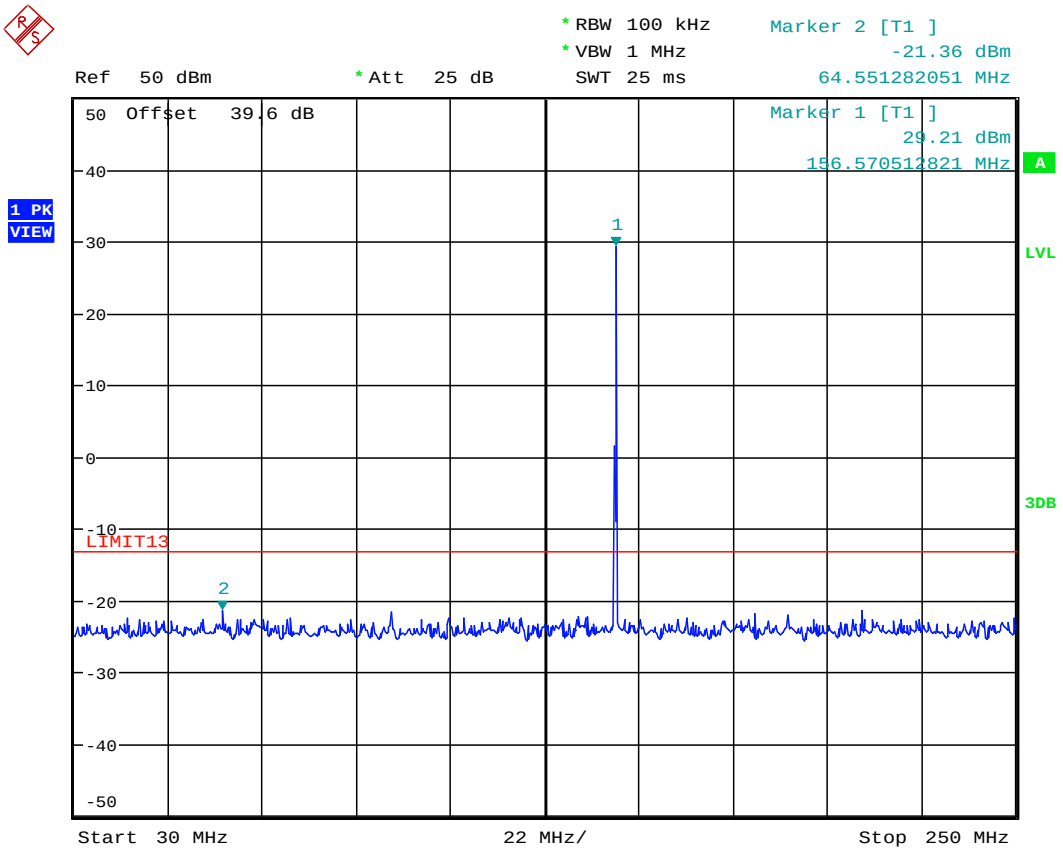
Date: 5.JAN.2024 15:07:07



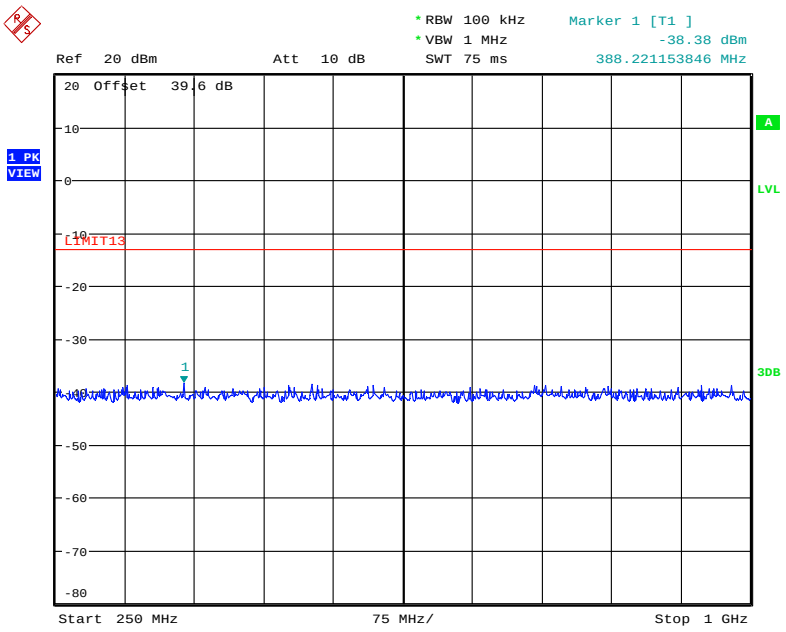
Date: 5.JAN.2024 15:13:10

Low Power

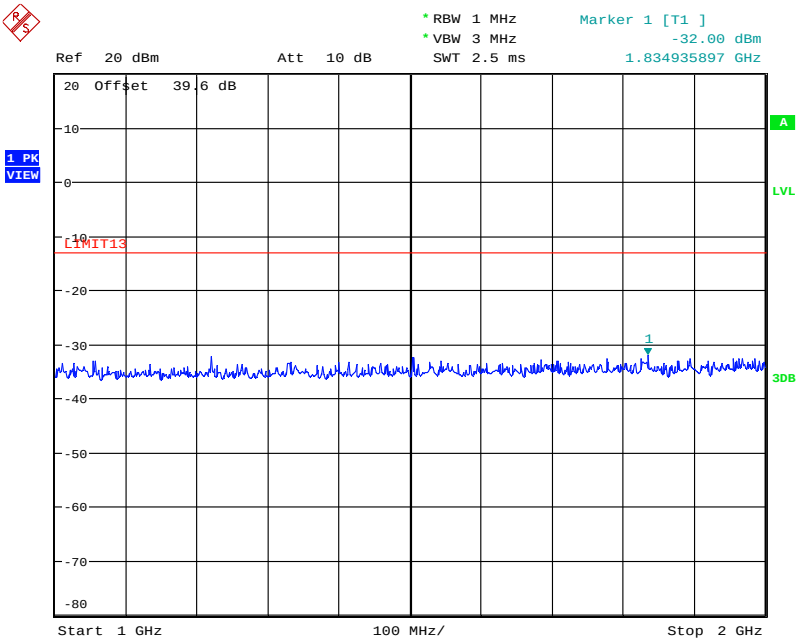
5.5.3.7. Configuration: Tx Conducted, DSC 156.525MHz, 1300Hz, Low power



Date: 5.JAN.2024 14:56:13

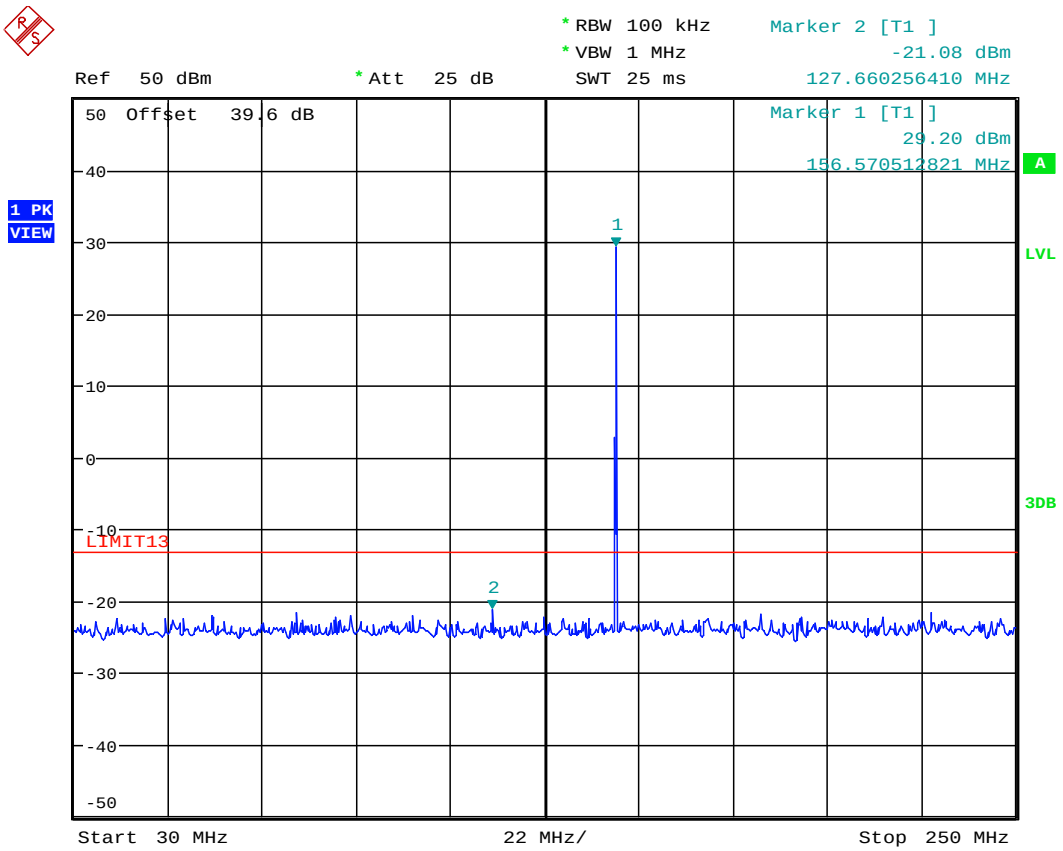


Date: 5.JAN.2024 15:07:59

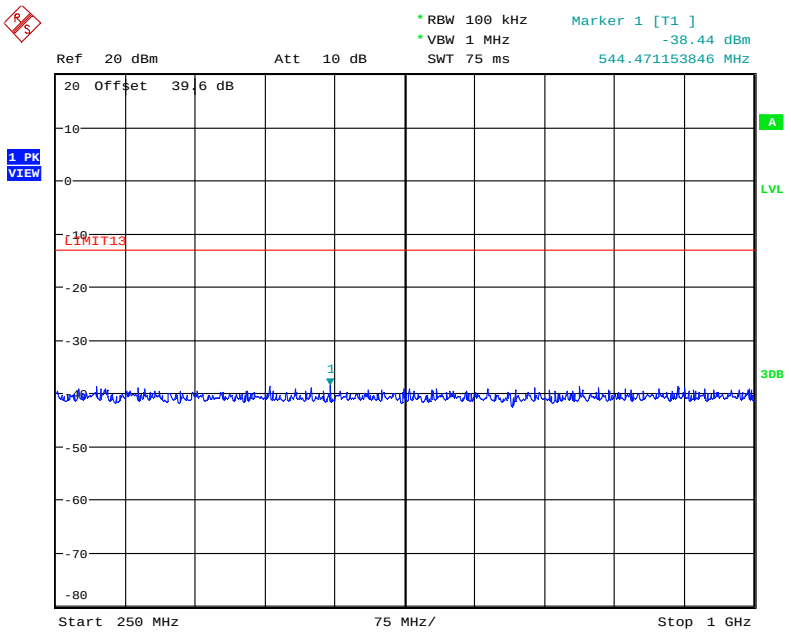


Date: 5.JAN.2024 15:14:06

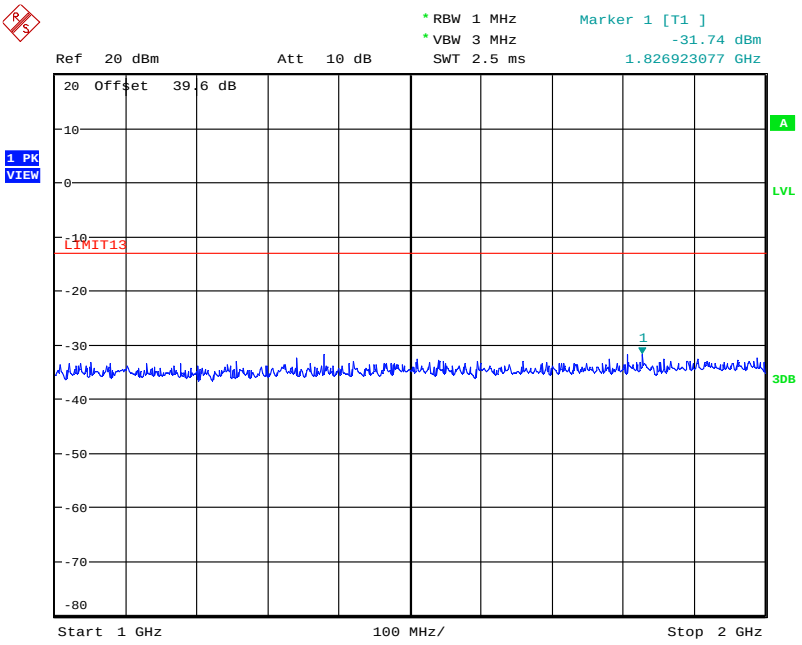
5.5.3.8. Configuration: Tx Conducted, DSC 156.525MHz, 2100Hz, Low power



Date: 5.JAN.2024 14:56:56



Date: 5.JAN.2024 15:08:32



Date: 5.JAN.2024 15:14:42

5.6. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§ 80.211(f)(3)] [RSS-182, SECTION 5.9]

5.6.1. Limits

§ 80.211 (f)(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

[RSS-182, SECTION 5.9]
Equipment with 25 kHz channel spacing (equipment designator G and D) shall comply with emission mask B. Radio equipment with 12.5 kHz channel spacing, with or without an audio low-pass filter, shall comply with emission mask C.

5.6.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in 8.2 of this report and its value in dBc is calculated as follows:
(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = Pc dBm (conducted) + 0 dBi – 2.15 dB

5.6.3. Test Data

Remarks:

- The radiated emissions were performed with high power setting and 25 kHz channel spacing at 3 m distance to represent the worst-case test configuration.
- The emissions were scanned from 30 MHz to 2 GHz; all significant emissions were recorded.

Carrier Frequency:	156.050 MHz
Power:	High
Limit:	-13.0 dBm

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP Measured (dBm)	Limit (dBm)	Margin (dB)
312.100	66.68	**PEAK**	**V**	-31.20	**-13**	-18.20
312.100	67.70	**PEAK**	**H**	-30.60	**-13**	-17.60
All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.						

Carrier Frequency:	157.425MHz
Power:	High
Limit:	-13.0 dBm

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP Measured (dBm)	Limit (dBm)	Margin (dB)
314.850	66.93	**PEAK**	**V**	-31.05	**-13**	-18.05
314.850	66.90	**PEAK**	**H**	-30.36	**-13**	-17.35
629.700	67.57	**PEAK**	**V**	-31.56	**-13**	-18.56
629.700	66.84	**PEAK**	**H**	-32.66	**-13**	-19.66

All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:	156.525MHz
Power:	High
Limit:	-13.0 dBm

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP Measured (dBm)	Limit (dBm)	Margin (dB)
313.050	65.36	**PEAK**	**V**	-32.52	**-13**	-19.52
313.050	67.39	**PEAK**	**H**	-30.42	**-13**	-17.42

All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.7. FREQUECNY STABILITY [§§ 2.1055 & 80.209] [RSS-182, SECTION 5.5]

5.7.1. Limits

Frequency Band	Coast Stations		Ship Stations
	Below 3 W	3 to 100 W	
156–162 MHz	10 ppm	[1]5 ppm	[2]10 ppm

[1] For transmitters operated at private coast stations with antenna heights less than 6 meters (20 feet) above ground and output power of 225 Watts or less the frequency tolerance is 10 parts in 10^6.

[2] For transmitters in the radiolocation and associated telecommand service operating on 154.585 MHz, 159.480 MHz, 160.725 MHz and 160.785 MHz the frequency tolerance is 15 parts in 10^6.

[RSS-182, SECTION 5.5]

With the exception of DSC emissions, the RF carrier frequency shall not depart from the reference frequency in excess of the limits listed in Table 2.

RSS-182, Table 2 - Frequency Stability Limits

Type of Equipment	Frequency Stability Limit
Coast stations	±10.0 ppm for transmitter power less than 3 watts ±5.0 ppm for transmitter power between 3 and 100 watts
Ship stations	±10 ppm

5.7.2. Method of Measurements

Refer to Section 8.3 of this report for measurement details

5.7.3. Test Data

Center Frequency:	156.050MHz
Full Power Level:	23.5 W
Frequency Tolerance Limit (Worst Case):	±10 ppm or 1560.5 Hz/ 500 Hz (Manufacturer's spec)
Max. Frequency Tolerance Measured:	112Hz or 0.72 ppm
Input Voltage Rating:	13.8 VDC

Ambient Temperature (°C)	**Frequency Drift (Hz)**		
	Supply Voltage (Nominal) 13.8 Volts	**Supply Voltage (85%) 11.73 Volts**	**Supply Voltage (115% of Nominal) 15.87 Volts**
-20	47	--	--
-10	48	--	--
0	94	--	--
10	64	--	--
20	87	64	69
30	66	--	--
40	94	--	--
50	112	--	--
60	-80	--	--

5.8. RF EXPOSURE REQUIREMENTS [§§ 1.1310 & 2.1091] [RSS Gen Sec 5.6 & RSS-102]

5.8.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
30-300	61.4	0.163	1.0	6
(B) Limits for General Population/Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30

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

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

[RSS Gen Sec 5.6 & RSS-102]

RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
100-6000	$15.60\ f^{0.25}$	$0.04138\ f^{0.25}$	$0.6455 f^{0.5}$	6
Note: f is frequency in MHz.				

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
48-300	22.06	0.05852	1.291	6
Note: f is frequency in MHz.				

5.8.2. Method of Measurements

Calculation Method of RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$$r = \sqrt{\frac{PG}{4\pi \cdot S}} = \sqrt{\frac{EIRP}{4\pi \cdot S}}$$

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device.
Evaluation of RF Exposure Compliance Requirements

Maximum RF Power conducted, **$P_{conducted}$[W]:**	25
Maximum Antenna Gain, **G[dBi]**:	9
Maximum EIRP, **P_{EIRP}[W]**:	198.6
User-based time-average for PTT	50%
FCC MPE Limit for General Population/Un-controlled Exposure, **$S_{UNcontrolled}$[mW/cm2]**:	0.2
ISED MPE Limit for General Population/Un-controlled Exposure, **$S_{UNcontrolled}$[mW/cm2]**:	0.1291
Min Calculated RF Safety Distance for General Population/Un-controlled Exposure Exposure,**$r_{safety\_uncontrolled}$[cm]**: FCC	**199**
Min Calculated RF Safety Distance for General Population/Un-controlled Exposure Exposure, **$r_{safety\_uncontrolled}$[m]**: ISED	**2.48**

MPE distance: FCC Requirement=2m, ISED Requirement=2.5m
User manual specified distance (MPE Radius) =**300cm from VHF Antenna**
Calculated power density S for this distance=0.0878 mW/Cm^2 (0.88 W/m^2)

Distance Required for Approved wifi module from Device to user=20 cm as per module grant condition and module user manual. The antennas of the wifi module and marine radio antenna are not to be collocated as per installation instruction is the user manual of IC-M510.

5.9. SUPPRESSION OF INTERFERENCE ABOARD SHIPS [§ FCC 80.217]

5.9.1. Limits

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

(b) The electromagnetic field from receivers required by statute or treaty must not exceed the following value at a distance over sea water of one nautical mile from the receiver:

or
Deliver not more than the following amounts of power, to an artificial antenna having electrical characteristics equivalent to those of the average receiving antenna(s) use on shipboard:

Frequency of interfering emissions	Field intensity in microvolts per meter	Power to artificial antenna in	
		MicroWatts	dBm
< 30 MHz	0.1	400	-3.98
30-100 MHz	0.3	4000	6.02
100-300 MHz	1.0	40000	16.02
>300 MHz	3.0	400000	26.02

5.9.2. Method of Measurements

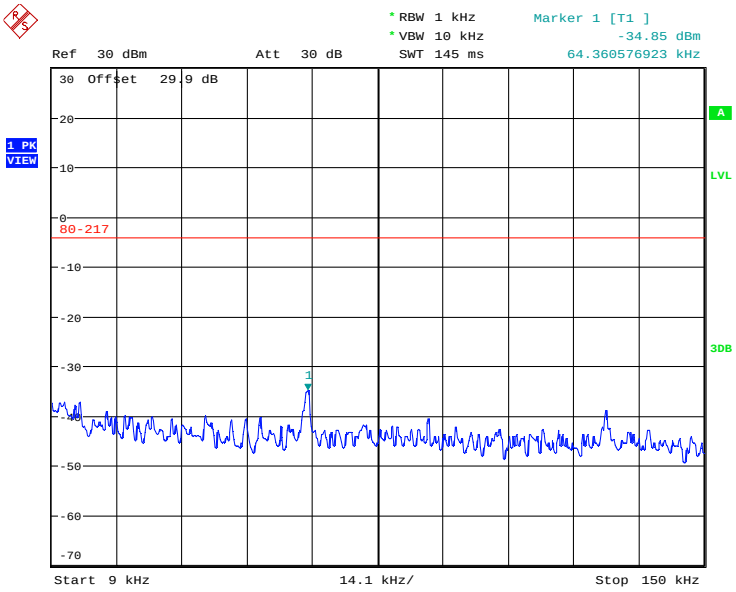
As per ANSI C63.4.

Test Procedure

The EUT was connected to a spectrum analyser via a 30 dB attenuator. The spectrum was measured between 9 kHz to 2 GHz. The traces were recorded as shown on the following pages.

5.9.3. Test Data

5.9.3.1. Configuration: Rx Conducted, CH 01A, 156.050MHz



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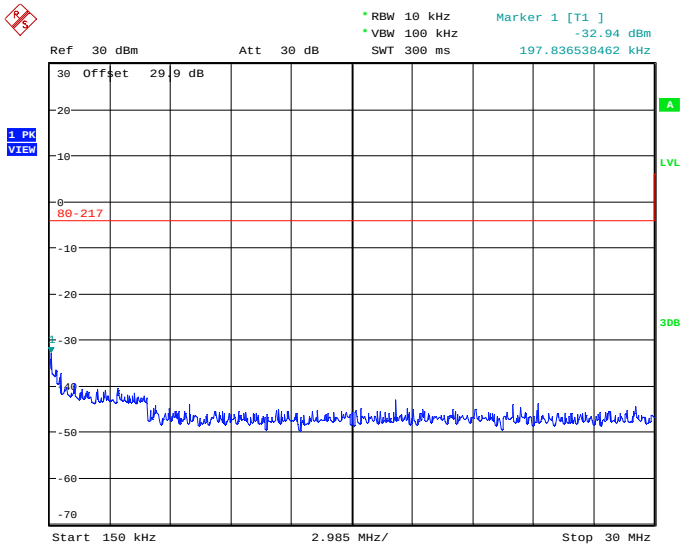
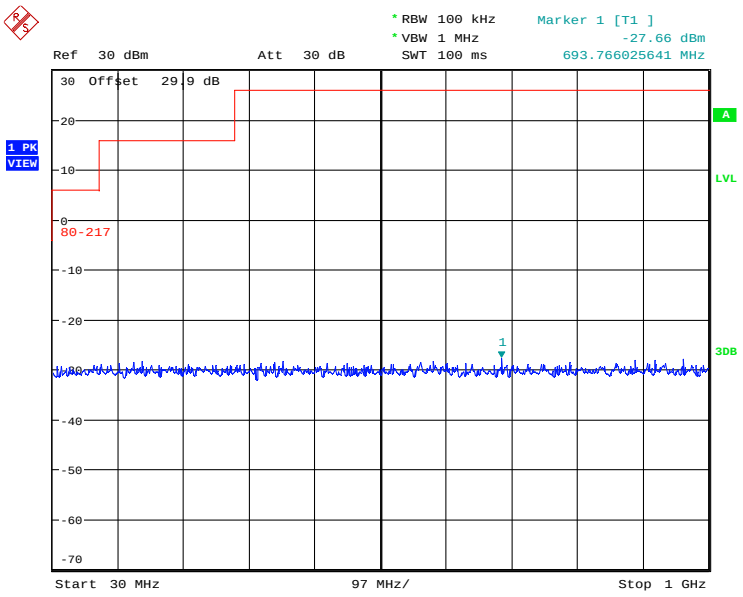


Date: 5.JAN.2024 16:51:08



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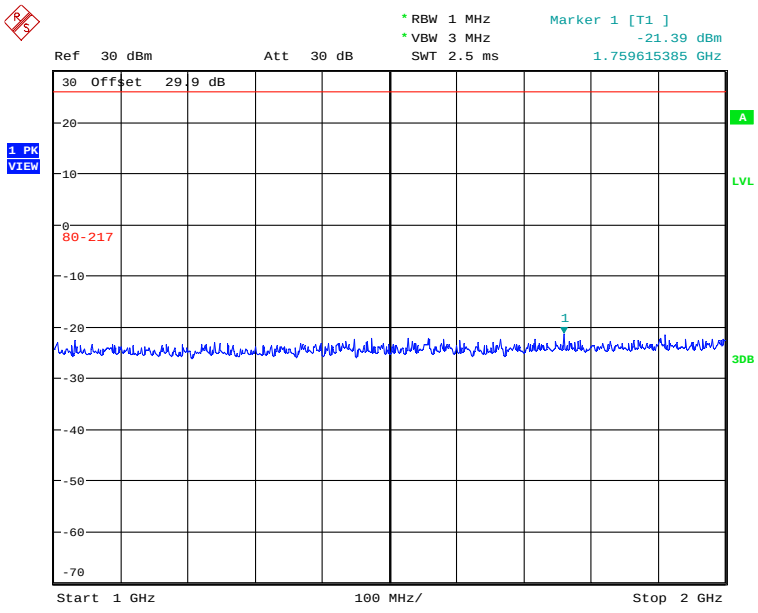
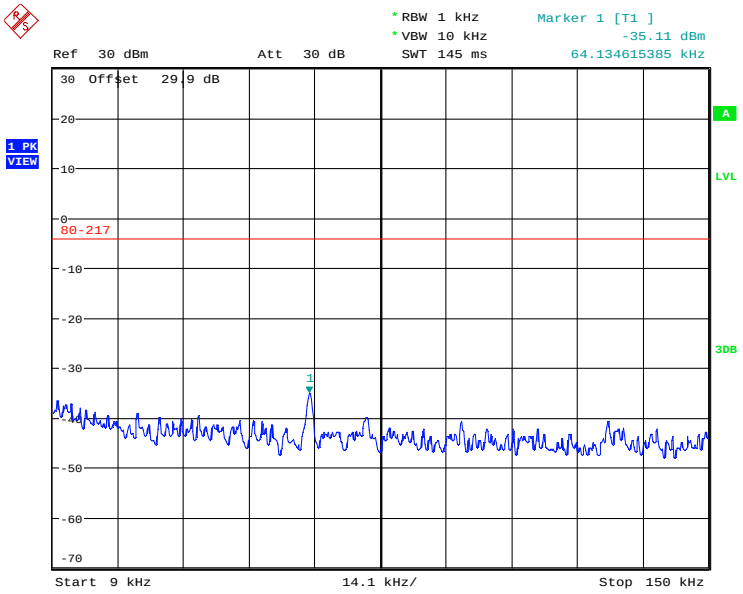
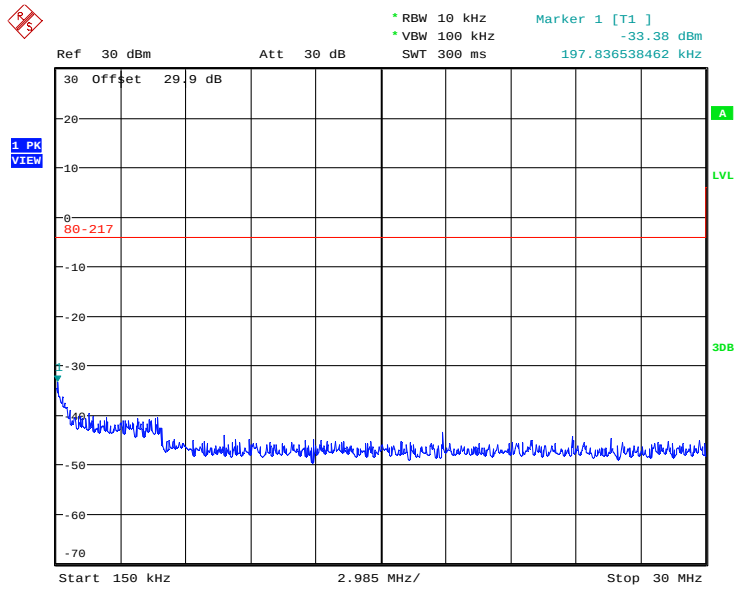


Date: 5.JAN.2024 16:52:25

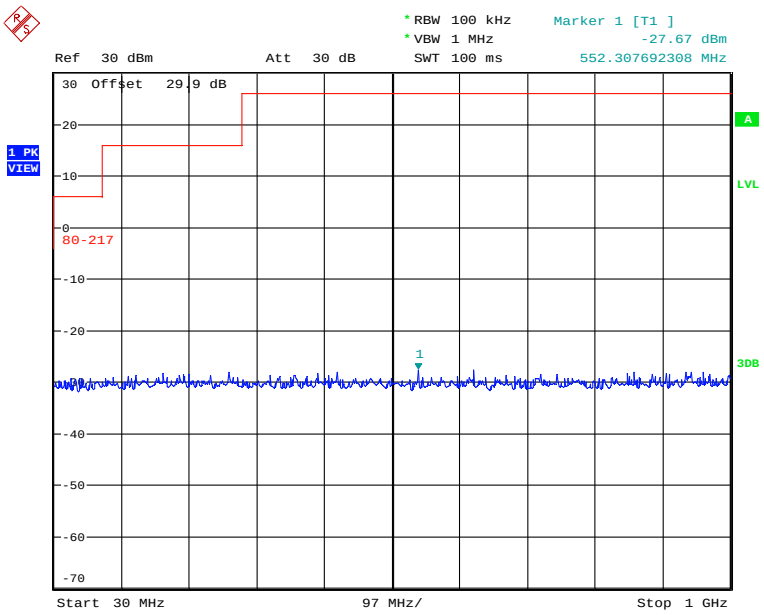
5.9.3.2. Configuration: Rx Conducted, CH Wx 10, 163.275MHz



Date: 5.JAN.2024 16:54:00



Date: 5.JAN.2024 16:54:58



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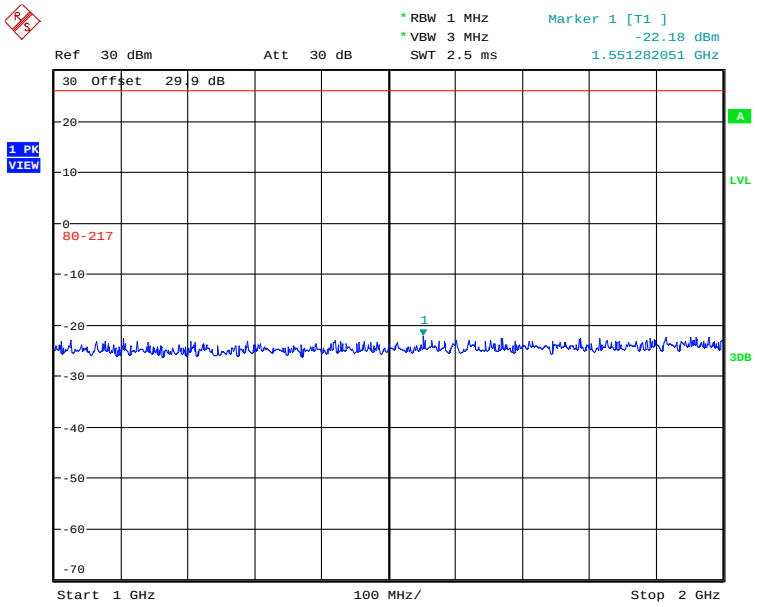


Date: 5.JAN.2024 16:56:11

5.9.4. RECEIVER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [RSS-1182 § 7.11, RSS-Gen §§ 7.4]

5.9.5. Limits

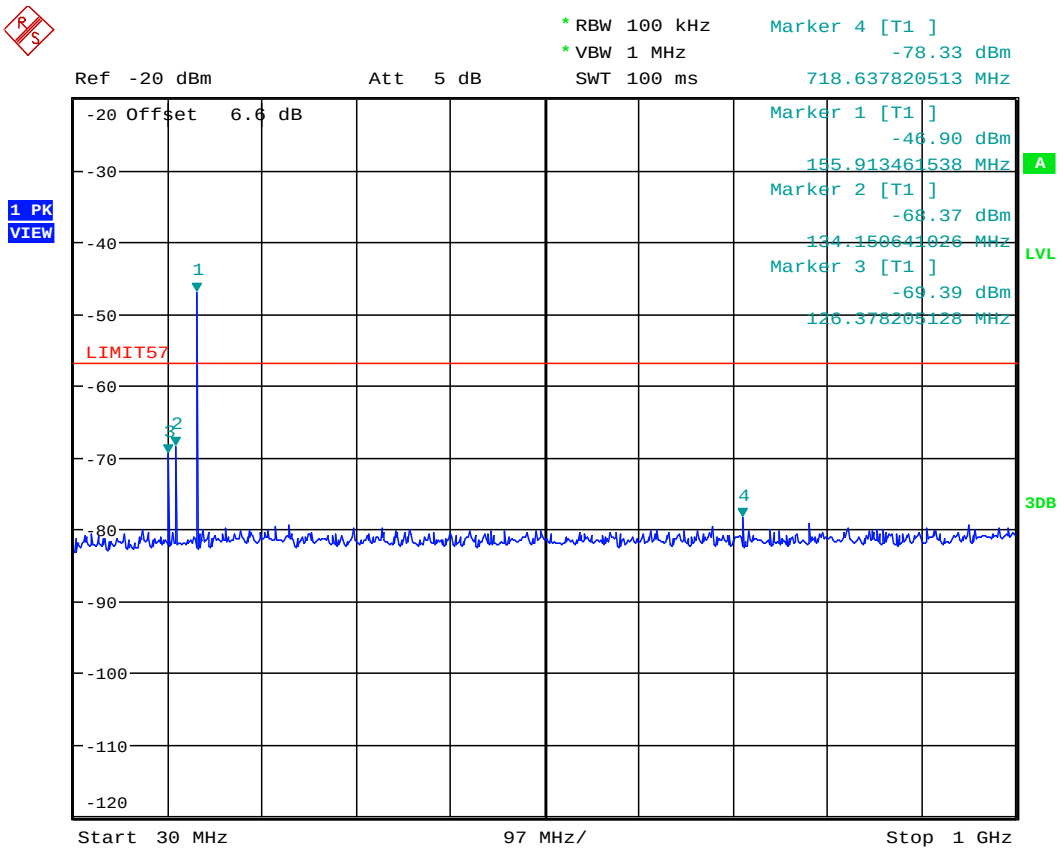
No spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

5.9.6. Method of Measurements

Refer to Industry Canada RSS-Gen and ANSI C63.4.

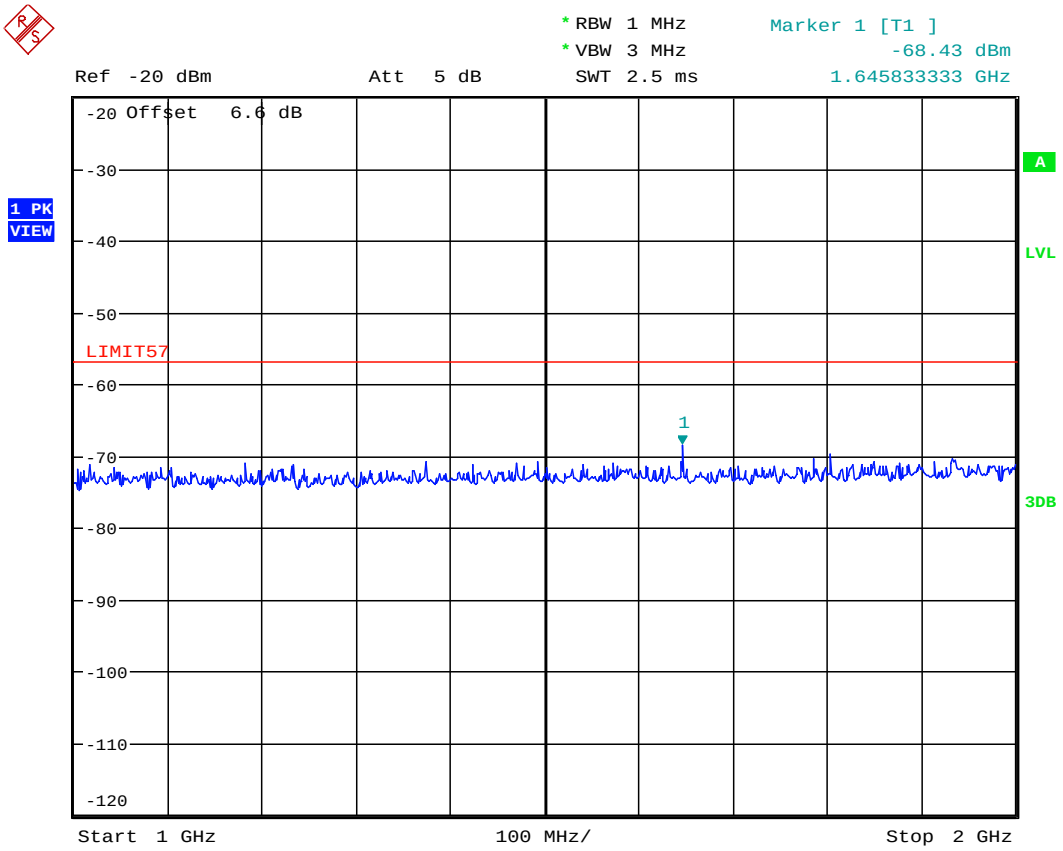
5.9.7. Test Data

5.9.7.1. Configuration: Rx Conducted, CH 01A, 156.050MHz



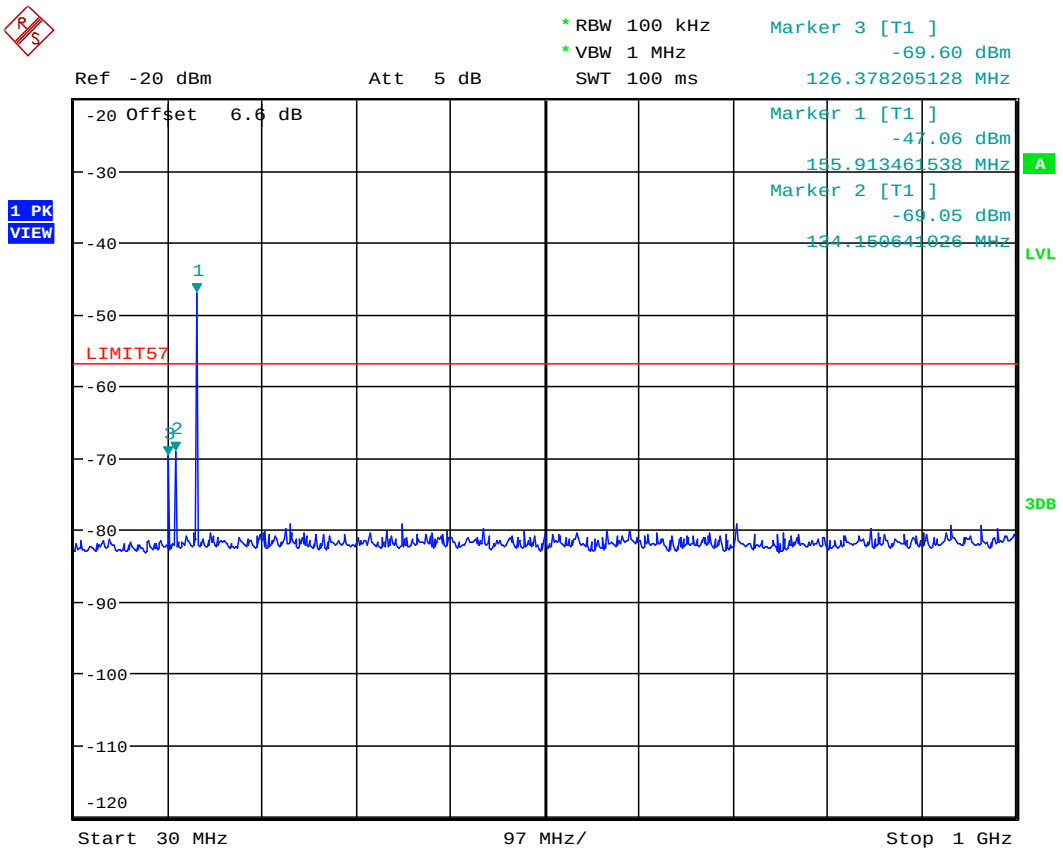
Date: 5.JAN.2024 17:16:20

Highest peak is Rx Signal input (1mV rms)

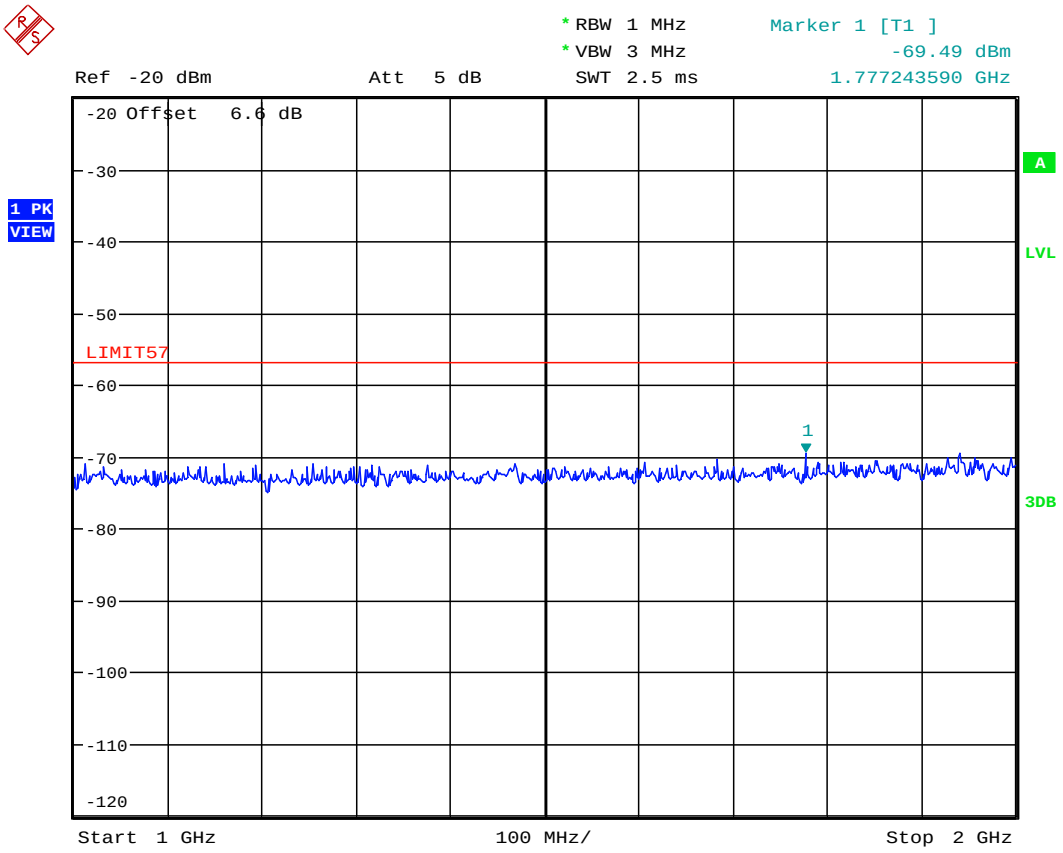


Date: 5.JAN.2024 17:17:07

5.9.7.2. Configuration: Rx Conducted, DSC, 156.525MHz

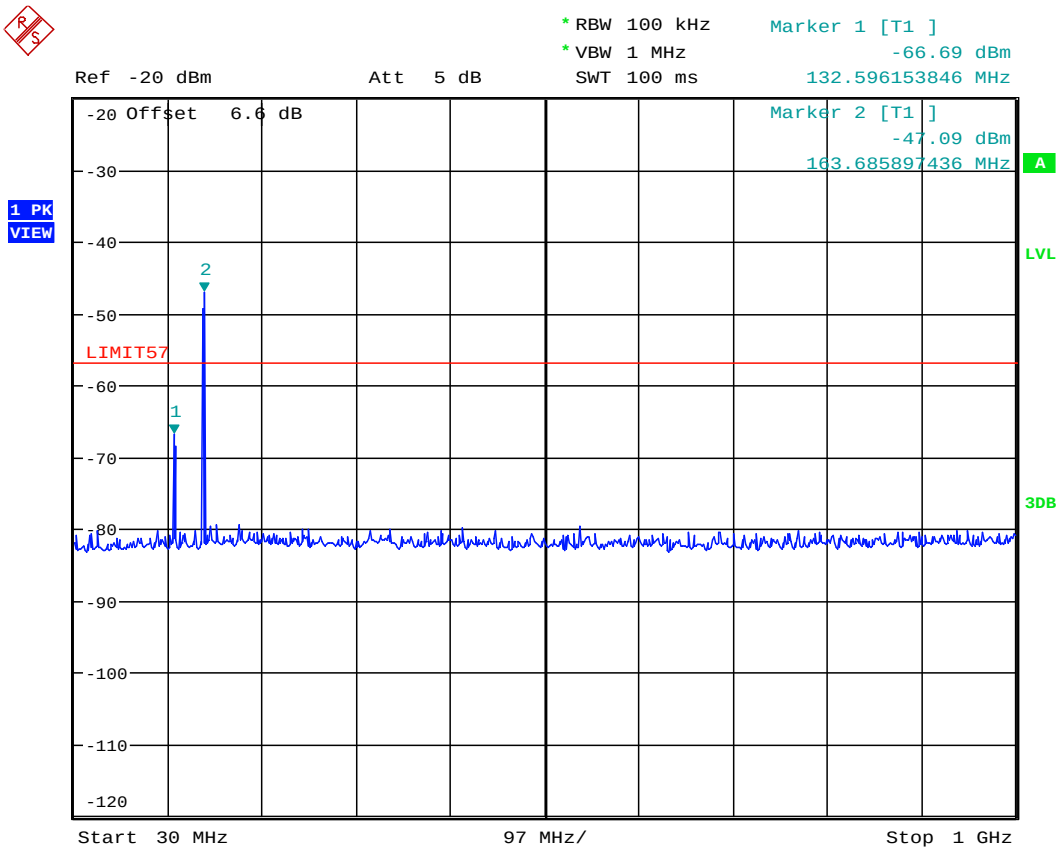


Highest peak is Rx Signal input (1mV rms)



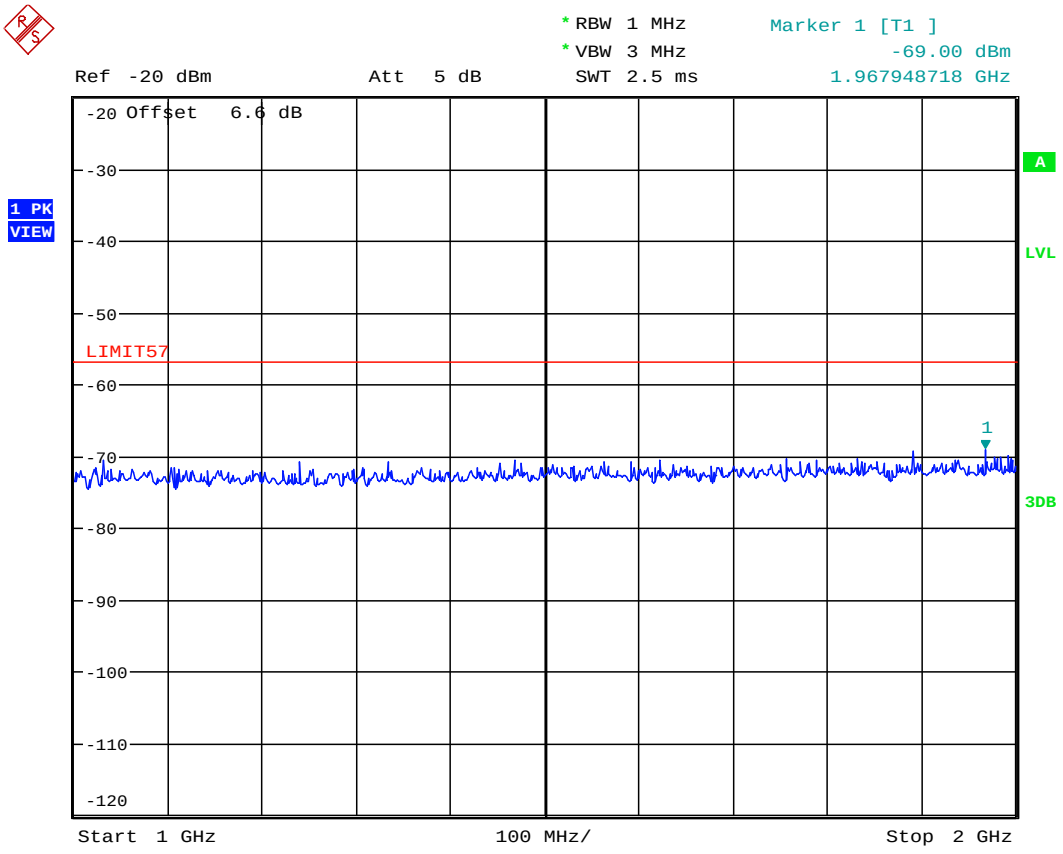
Date: 5.JAN.2024 17:25:12

5.9.7.3. Configuration: Rx Conducted, CH Wx 10, 163.275MHz



Date: 5.JAN.2024 17:19:32

Highest peak is Rx Signal input (1mV rms)



Date: 5.JAN.2024 17:18:27

5.10. RECEIVER SPURIOUS EMISSIONS (RADIATED) [RSS-182 § 7.11, RSS-Gen §§ 7.3]

5.10.1. Limits

The equipment shall meet the limits of the following table:

Spurious Frequency (MHz)	Field Strength at 3 meters	
	(μV/m)	(dBμV/m)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

5.10.2. Method of Measurements

RSS-Gen and ANSI C63.4

5.10.3. Test Data

- The measuring receiver shall be tuned over the frequency range 30 MHz to2 GHz.
- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- IF=30.15 MHz, DSC IF=21.7 MHz
- Tests @ 3m

Test Frequency (MHz)	Frequency (MHz)	Peak Measurement dBuV/m		QP/Avg Measurement dBuV/m		Limit dBuV/m	Margin (dB)	
		Vertical	Horizontal	Vertical	Horizontal	QP	Vertical	Horizontal
156.050	125.900	25.00	16.76	-	-	43.52	-18.52	-26.76
	251.800	21.55	21.71	-	-	46.02	-24.47	-24.31
	377.700	-	23.15	-	-	46.02	-	-22.87
156.525 DSC	134.825	34.30	28.00	-	-	43.52	-9.22	-15.52
163.275	133.125	23.76	17.00	-	-	43.52	-19.76	-26.52
(WX 10)	266.250	20.81	27.08	-		46.02	-25.21	-18.94

5.11. POWERLINE CONDUCTED Emissions [ICES-003]

5.11.1. Limits

The equipment shall meet the limits of the following table:

	CLASS B LIMITS		
Test Frequency Range (MHz)	**Quasi-Peak (dBµV)**	**Average* (dBµV)**	**Measuring Bandwidth**
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 10 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 10 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 10 Hz for Average

* Decreasing linearly with logarithm of frequency

5.11.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

Calculation of Conducted Emission Voltage (dBµV):

This is calculated by adding the L.I.S.N factor, Cable loss factor, and Attenuator factor to the measured reading. The basic equation with a sample calculation is as follows:

Voltage (dBµV) = RA + AF + CF + LF

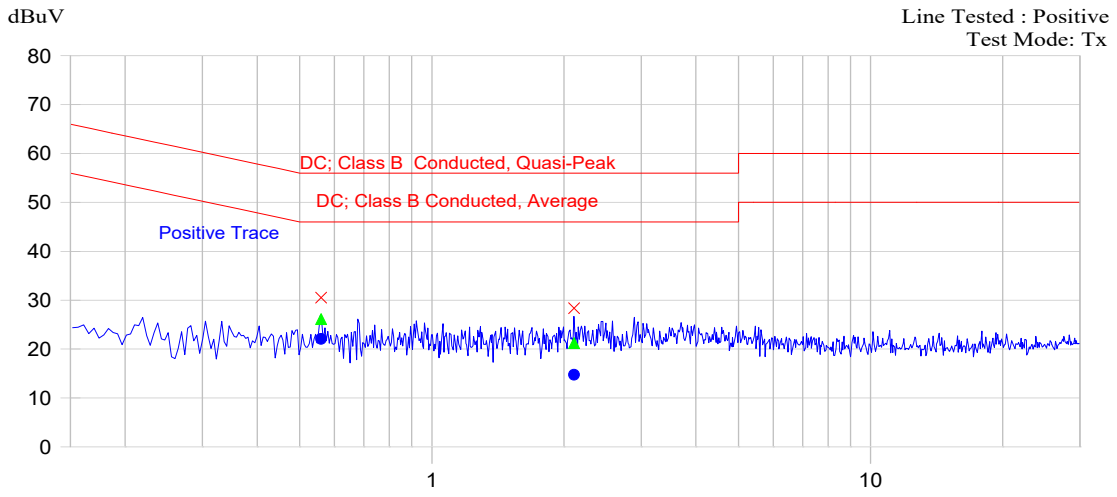
Where

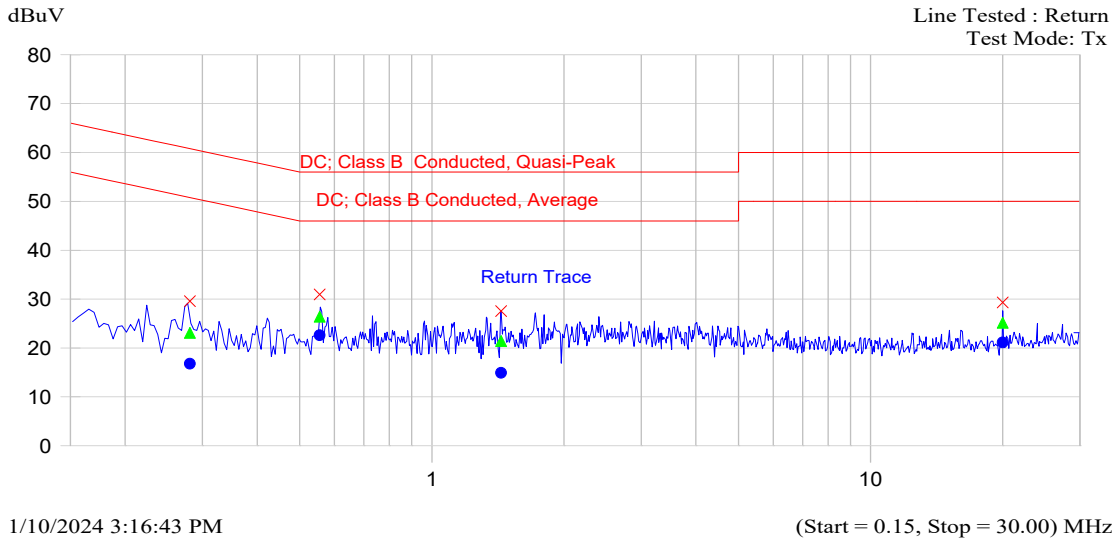
RA = Receiver/Analyzer Reading in dBµV
AF = Attenuation Factor in dB
CF = Cable loss Factor in dB
LF = L.I.S.N Factor in dB

5.11.3. Test Data

The emissions were scanned from 150 kHz to 30 MHz at Mains Terminal via a LISN, and all emissions less than 20 dB below the limits were recorded.

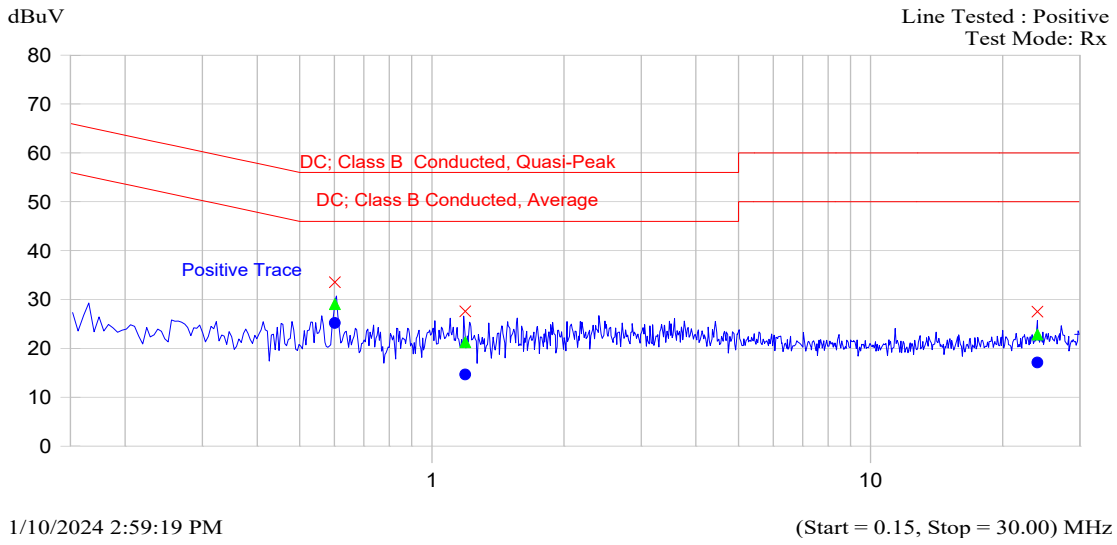
5.11.3.1. Tx Mode

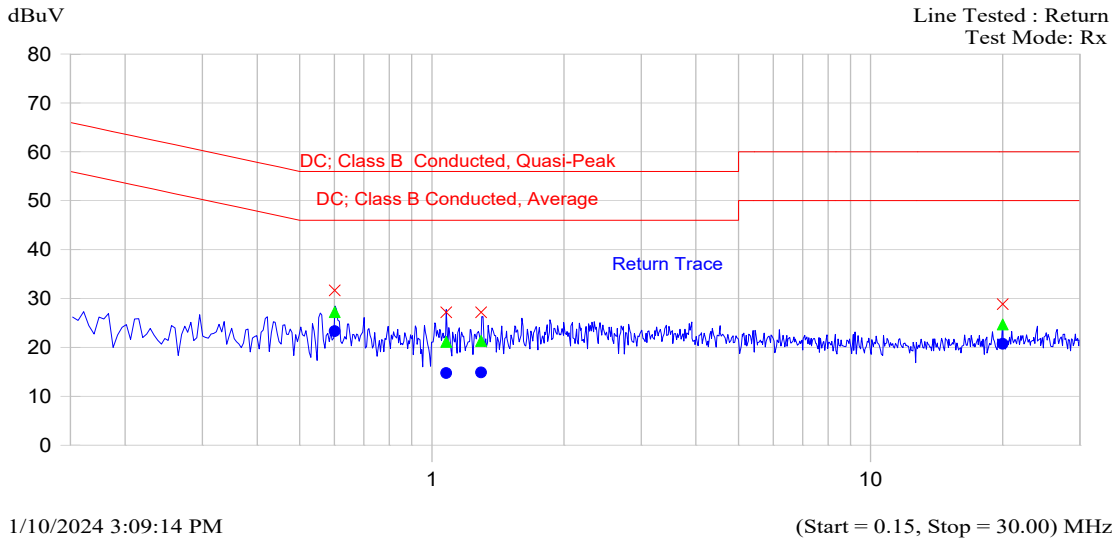




All emissions are less than 20 dB below the limits

5.11.3.2. Rx Mode





All emissions are less than 20 dB below the limits

5.12. Radiated Emissions-Unintentional [ICES-003]

5.12.1. Limits

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	ICES-Class B Limits*		FCC Part 15 B -Class B Limits*	
	(dBμV/m at 3 m)	(dBμV/m at 10 m)	(dBμV/m at 3 m)	(dBμV/m at 10 m)
30 – 88	40.0	30	40.0	29.5
88 – 216	43.5	33.1	43.5	33.1
216-230	46	35.6	46	35.6
230 – 960	47	37		
Above 960	54.0	43.5	54.0	43.5

*below 1000 MHz limits are in QP, above 1GHz limits are average with peaks not to exceed 20dB above this limit.

5.12.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

5.12.3. Test Data

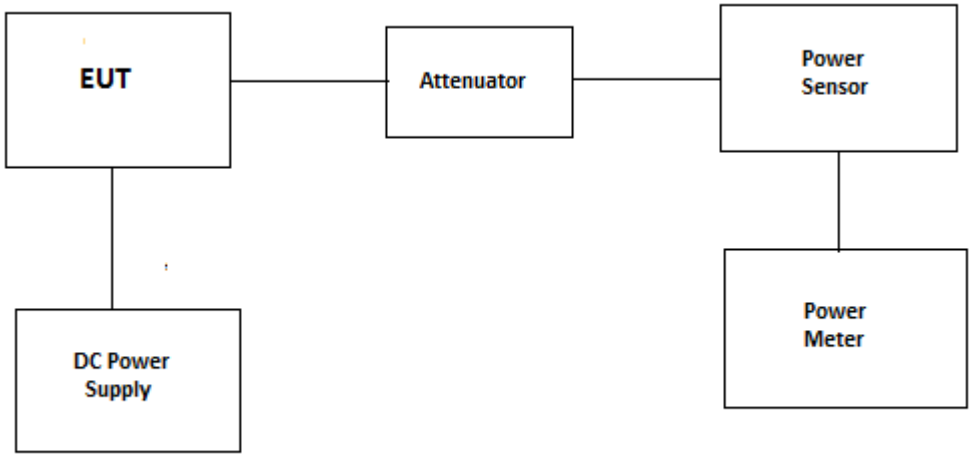
The emissions were scanned from 1 GHz to 18 GHz at 3 meters distance and all emissions less than 20 dB below the limits were recorded.

Frequency	Peak Measurement dBuV/m		QP/Avg Measurement dBuV/m		Limit dBuV/m	Margin dB	
(MHz)	Vertical	Horizontal	Vertical	Horizontal	QP/AVG	Vertical	Horizontal
61.08	-	24.74	-	-	40	-	-15.26
124.82	25.21	-	-	-	43.5	-18.29	-
134.15	29.94	25.84	-	-	43.5	-13.56	-17.66
250.73	24.82	29.24	-	-	46	-21.18	-16.76
331.57	-	26.74	-	-	46	-	-19.26
715.52	33.47	35.35	-	-	46	-12.53	-10.65
838.33	33.76	31.87	-	-	46	-12.24	-14.13
897.4	33.01	-	-	-	46	-12.99	-
958.02	34	-	-	-	46	-12	-
3043	-	45.1	-	-	54	-	-8.9

*FCC limits applied as compliance with it also ensures compliance with the ICES-003 limits.

EXHIBIT 6. TEST EQUIPMENT LIST AND SETUP

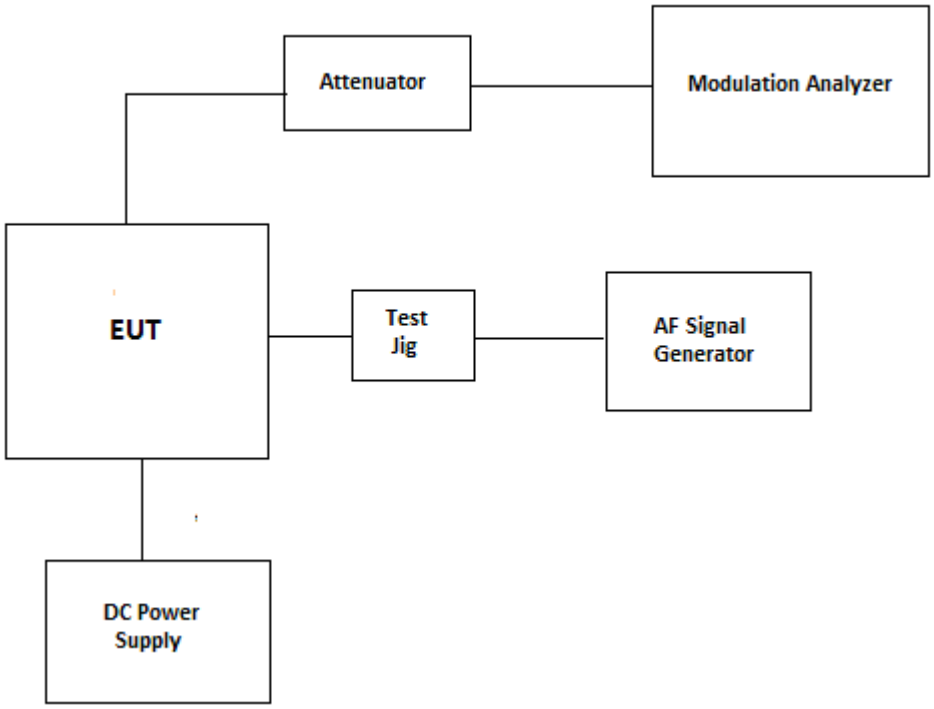
6.1. Conducted Power



Test Date: Jan 03, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Power Meter	HP	436A	210A11242	100KHz-sensor dependant	30 Aug 2024
Power Sensor	HP	8482A	MY44175182	0.1MHz-4.2GHz	07 Feb 2024
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

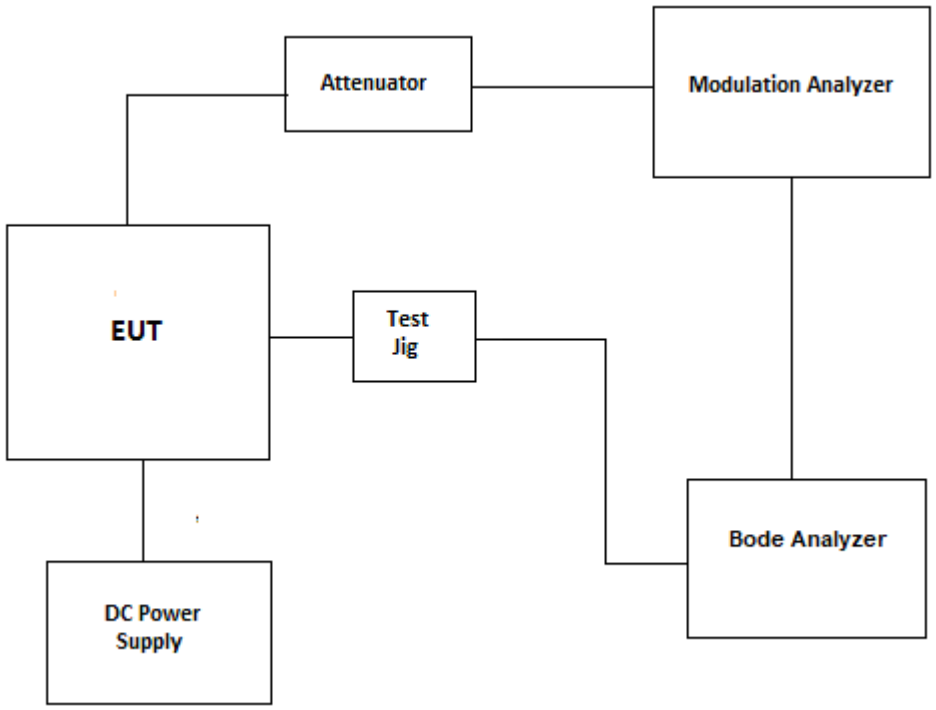
6.2. Modulation Limit



Test date: Jan 03, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Modulation Analyzer	HP	HP-8901B	3226A04606	150KHz-1300MHz	29 Mar 2024
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	29 Mar 2024
Digital Voltmeter	HP	3456A	2015A04523	--	08 Feb 2024
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

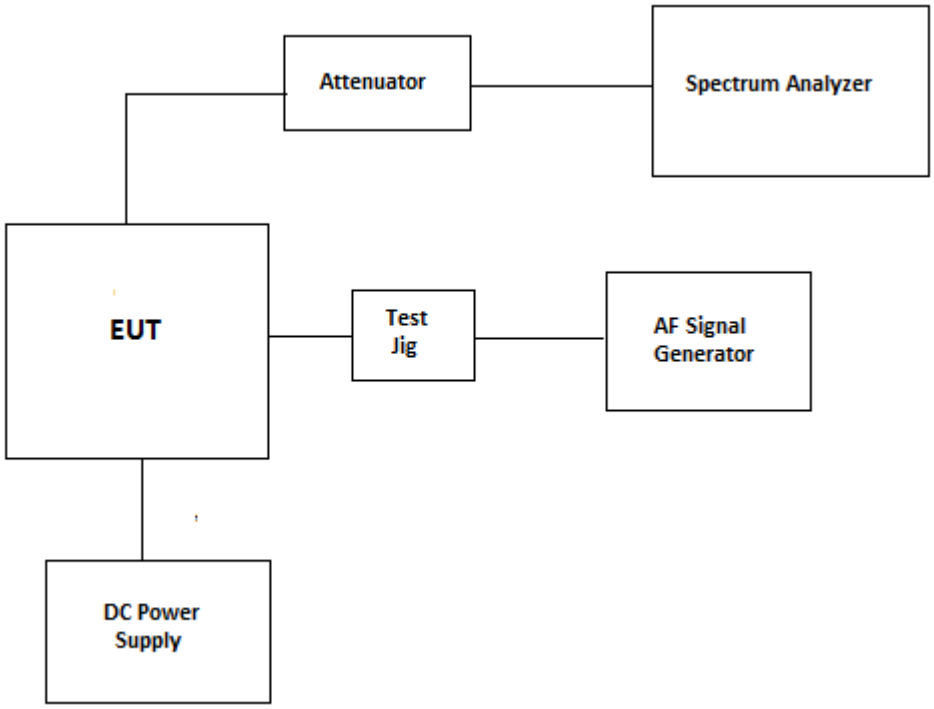
6.3. Audio Frequency Response/ Audio Low pass filter Response



Test Date: Jan 04, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Modulation Analyzer	HP	HP-8901B	3226A04606	150KHz-1300MHz	29 Mar 2024
Network Analyzer	Omicron Labs	Bode 100	PM453H	1Hz-50MHz	08 Feb 2024
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

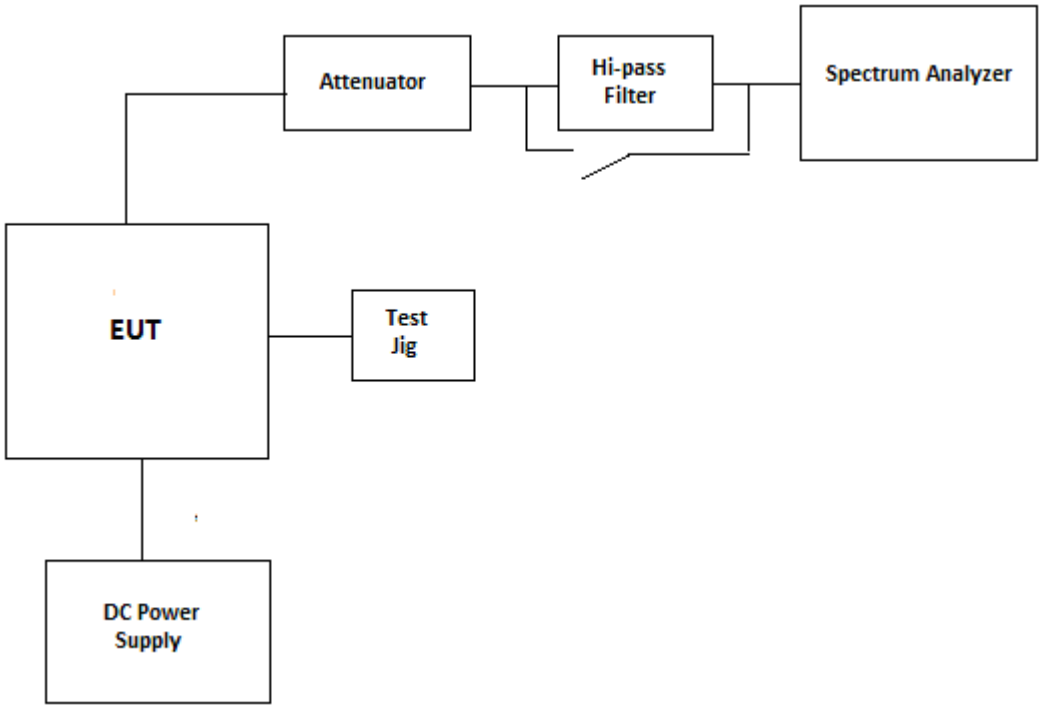
6.4. 99% OBW and Mask



Test Date: Jan 05, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	21 Sep 2025
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	29 Mar 2024
Digital Voltmeter	HP	3456A	2015A04523	--	08 Feb 2024
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

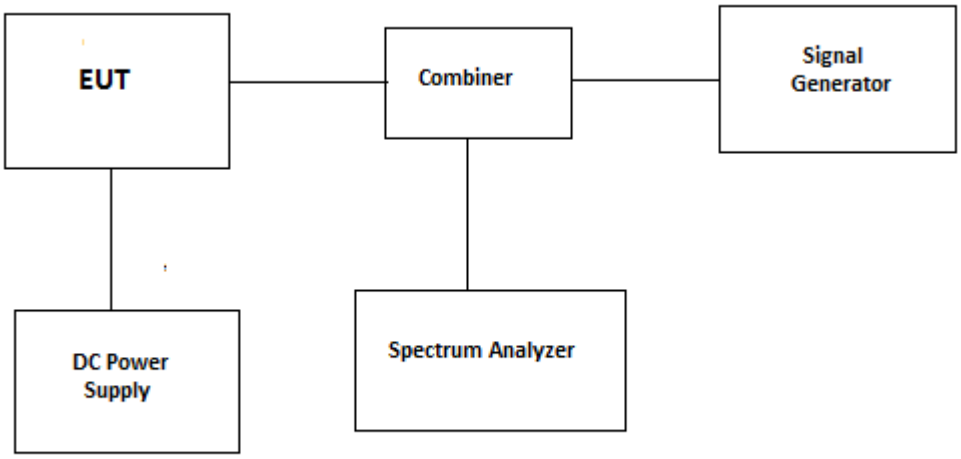
6.5. Tx Conducted Emission



Test Date: Jan 05, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	21 Sep 2025
Hi-pass filter	Mini-Circuit	SHP-250	--	Cut off 250MHz	Cal before use
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

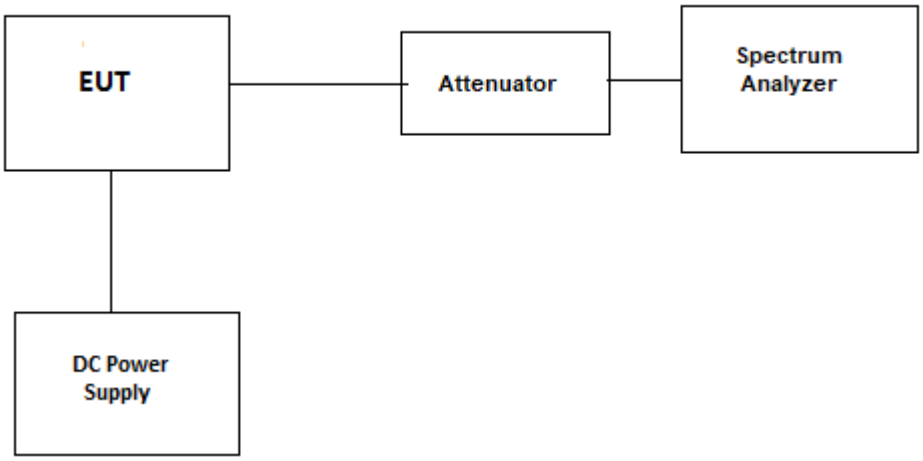
6.6. Rx Conducted Emission



Test Date: Jan 05, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	21 Sep 2025
Signal Generator	HP	8648C	3537A02098	100KHz-3.2GHz	08 Sep 2025
Combiner	Weinschel 93458	1515	PS119	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

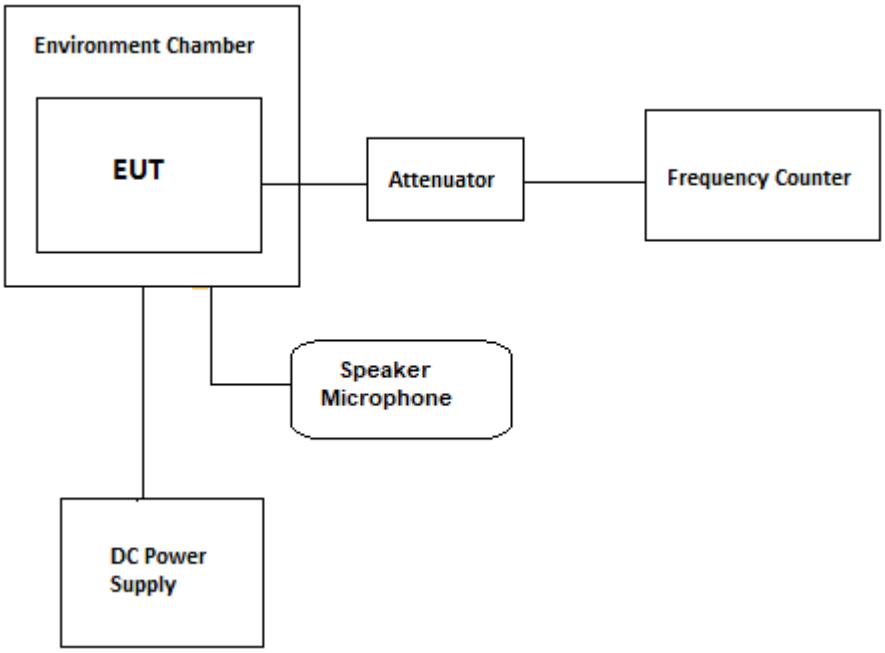
6.7. Suppression of Interference aboard ships



Test Date: Jan 08, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	21 Sep 2025
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

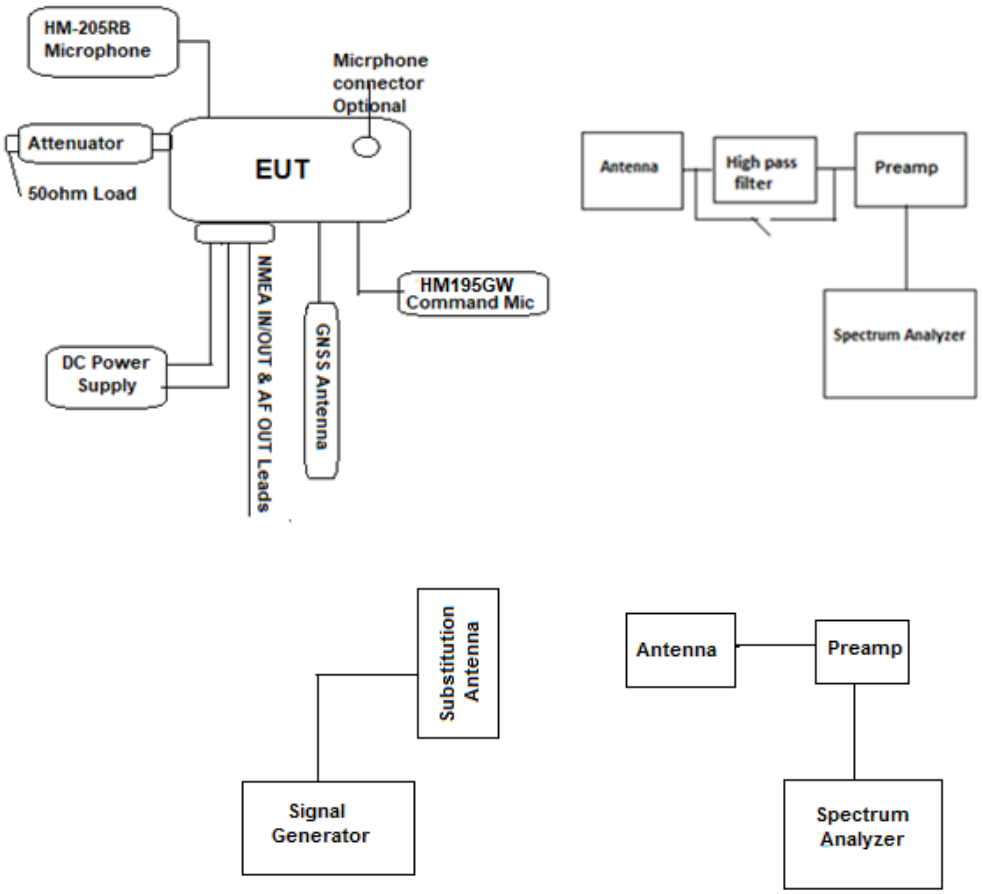
6.8. Frequency Stability



Test Date: Jan 11&12, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177° C	29 Aug 2025
Frequency Counter	HP	5352B	3049A04423	10Hz-40GHz	15 Sep 2024
Attenuator(20dB)	Aeroflex\Weinschel	34-20-34	BP6023	DC-18GHz	Cal before use
Attenuator(20dB)	Narda	26298	A577	DC-1GHz	Cal before use
Power Supply	XANTREX	XKW 60-50	--	1-60V, DC 50A	----
Multimeter	Fluke	8842A	5021295	---	10 Mar 2025

6.9. Tx Radiated

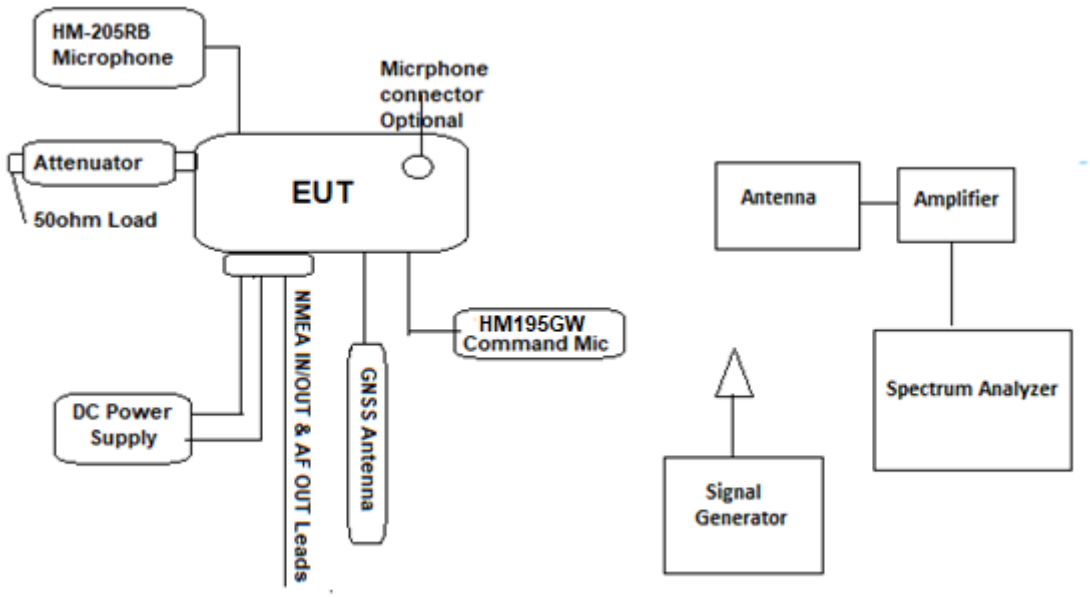


Test Date: Jan 10, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	21 Sep 2025
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz-40GHz	21 Sep 2024
Biconilog Antenna	EMCO	3142B	1575	26-2000MHz	09 May 2024
Log Periodic Antenna	ETS	3148	00023845	200-2000MHz	15 May 2025
Horn Antenna	ETS	3115	9701-5061	1-18GHz	15 Aug 2024
Signal Generator	HP	8648C	3537A02098	100KHz-3.2GHz	08 Sep 2025
Dipole Antenna	EMCO	3121C- DB3 & DB4	434	400-1000MHz	29 May 2025
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	01 Mar 2024
Preamplifier	Com-Power	PAM-103	18020181	1MHz-1000MHz	01 Mar 2024
Hi-pass filter	Mini-Circuit	SHP-250	--	Cut off 250MHz	Cal before use
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Load(50ohm)	Narda	377 BNM	--	DC-18GHz	Cal before use

Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

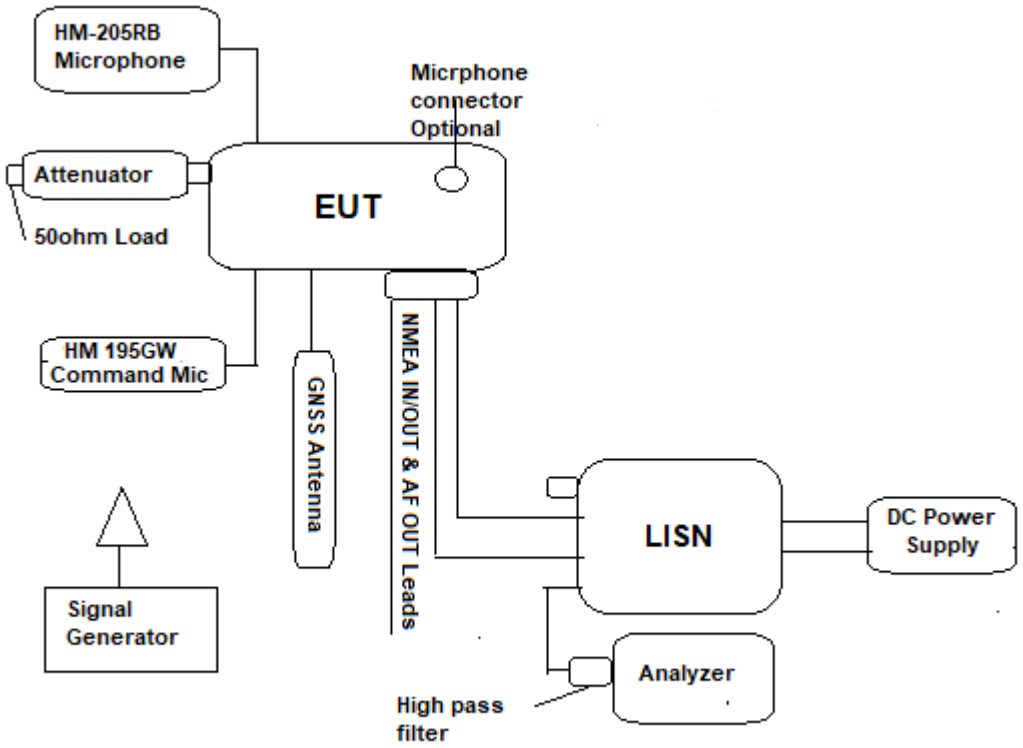
6.10. Rx /Unintentional Radiated



Test Date: Jan 09, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	21 Sep 2025
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz-40GHz	21 Sep 2024
Biconilog Antenna	EMCO	3142B	1575	26-2000MHz	09 May 2024
Log Periodic Antenna	ETS	3148	00023845	200-2000MHz	15 May 2025
Signal Generator	HP	8648C	3537A02098	100KHz-3.2GHz	08 Sep 2025
Horn Antenna	ETS	3115	9701-5061	1-18GHz	15 Aug 2024
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	01 Mar 2024
Preamplifier	Com-Power	PAM-103	18020181	1MHz-1000MHz	01 Mar 2024
Attenuator(30dB)	Aeroflex/Weinschel	49-30-34-LIM	RA725	DC-8.5GHz	Cal before use
Attenuator(10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18GHz	Cal before use
Load(50ohm)	Narda	377 BNM	--	DC-18GHz	Cal before use
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

6.11. Power Line Conducted Emission



Test Date: Jan 10, 2024

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Analyzer	HP	8593EM	3710A00223	9KHz-26.5GHz	14 Feb 2024
High pass filter	Rhode&Schwarz	EZ-25	100064	150KHz-30MHz	09 Nov 2024
LISN	Schwarzbeck	NDTV8160	9443	150KHz-30MHz	03 Mar 2024
Signal Generator	HP	8648C	3537A02098	100KHz-3.2GHz	08 Sep 2025
Power supply	Pyramid	PS-36KX	--	12-15 Vdc, 35A	--
Multimeter	Fluke	8842A	4142058	---	26 Oct 2024

EXHIBIT 7. MEASUREMENT UNCERTAINTY

Test description		Uncertainty
Conducted Output Power		+/- 0.62 dB
Occupied bandwidth		+/-0.2Hz
Emission Mask	Amplitude	+/- 0.63 dB
	Frequency	+/-0.2Hz
Conducted Out of Band/Spurious Emissions		+/- 0.72 dB
Radiated Out of Band/Spurious Emissions	<30 MHz	+/-2.69dB
	30-1000 MHz	+/-4.20dB
	>1 GHz	+/-2.70dB
Frequency Stability		+/-1.2 Hz
Power Line Conducted Emission		+ 2.62dB

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

The following shall be applied to the combination(s) of the radio device and its intended antenna(e).

- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
  - The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
  - The measurement shall be performed using normal operation of the equipment with modulation.

- Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

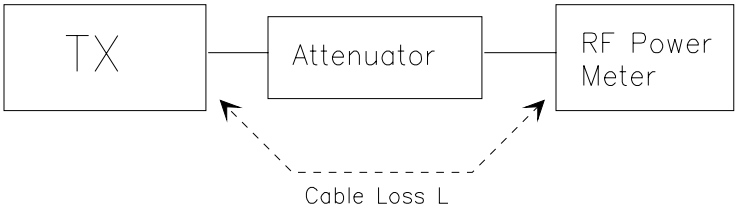
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	100 kHz
Video BW:	VBW > RBW
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

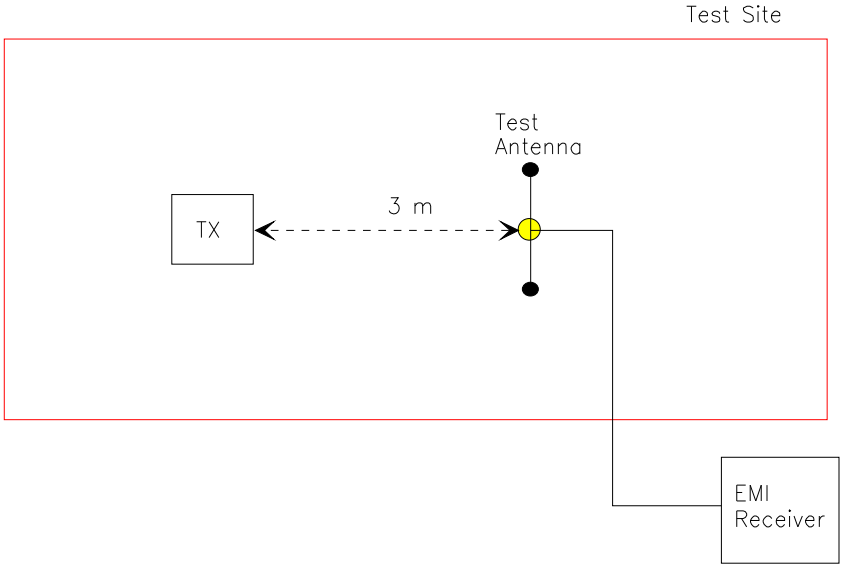
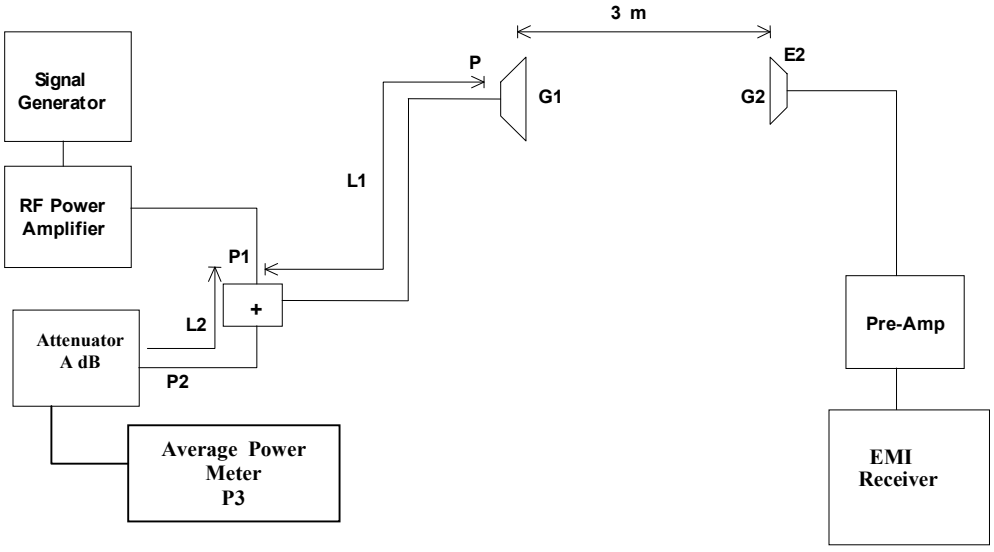


Figure 3



8.3. FREQUENCY STABILITY

Refer to § 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply 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 provide 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.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. EMISSION MASK

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h):- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

For 25 kHz Channel Spacing: RBW = 300 Hz
For 12.5 kHz or 6.25 kHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC 47 CFR 2.1057 - Frequency Spectrum to be investigated: The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The
amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC 47 CFR 2.1051 - Spurious Emissions at Antenna Terminal: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

*** END OF REPORT ***