Shenzhen Huatongwei International Inspection Co., Ltd.
1/F,Bldg 3,Hongfa Hi-tech Industrial Park,Genyu Road,Tianliao,Gongming,Shenzhen,China
Phone:86-755-26748019 Fax:86-755-26748089 http://www.szhtw.com.cn

TEST REPORT

Report Reference No.....:	**TRE1709011504**	R/C…….: 17710
FCC ID.....:	**AMW70001**	
Applicant's name.....:	**Uniden America Corporation**	
Address .....:	3001 Gateway Drive Suite 130, Irving, Texas, United States	
Manufacturer.....:	Uniden America Corporation	
Address.....:	3001 Gateway Drive Suite 130, Irving, Texas, United States	
Test item description .....:	**FLOATING VHF MARINE RADIO**	
Trade Mark .....:	UNIDEN, West Marine	
Model/Type reference .....:	MHS335BT	
Listed Model(s).....:	VHF470B, VHF470G	
Standard.....:	**IEC 62238**	
Date of receipt of test sample…….:	Sept. 15, 2017	
Date of testing……..:	Sept. 18, 2017 – Oct. 16, 2017	
Date of issue……:	Oct. 16, 2017	
Result ……...:	**PASS**	

Compiled by (position+printed name+signature) .:	File administrators Shayne Zhu	Shayne Zhu
Supervised by (position+printed name+signature) .:	Project Engineer Jerry Wang	Jerry Wang
Approved by (position+printed name+signature) .:	RF Manager Hans Hu	Hans Hu

Testing Laboratory Name.....:	**Shenzhen Huatongwei International Inspection Co., Ltd**
Address .....:	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Contents

1. TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

The tests were performed according to following standards:
IEC 62238:2003-Maritime navigation and radiocommunication equipment and systems –VHF radiotelephone equipment incorporating Class "D" Digital Selective Calling (DSC) – Methods of testing and required test results

1.2. Report version

Version No.	Date of issue	Description
00	Oct. 16, 2017	Original

1.3. Test Description

Environmental Requirement			
Test item	Standards requirement (IEC62238)	Result	
		Pass	N/A
Vibration test	Sub-clause 7.4	☒	
Temperature tests	Sub-clause 7.5	☒	
Transmitter Requirement			
Test item	Standards requirement (IEC62238)	Result	
		Pass	N/A
Frequency error	Sub-clause 8.1	☒	
Carrier power	Sub-clause 8.2	☒	
Frequency deviation	Sub-clause 8.3	☒	
Sensitivity of the modulator, including microphone	Sub-clause 8.4	☒	
Audiofrequency response	Sub-clause 8.5	☒	
Audiofrequency harmonic distortion of the emission	Sub-clause 8.6	☒	
Adjacent channel power	Sub-clause 8.7	☒	
Conducted spurious emissions conveyed to the antenna	Sub-clause 8.8	☒	
Transient frequency behaviour of the transmitter	Sub-clause 8.9	☒	
Residual modulation of the transmitter	Sub-clause 8.10	☒	
Frequency error (DSC signal)	Sub-clause 8.11	☒	
Modulation index for DSC	Sub-clause 8.12	☒	
Modulation rate for DSC	Sub-clause 8.13	☒	
Testing of generated call sequences	Sub-clause 8.14	☒	
Receiver for Radiotelephone Requirement			
Test item	Standards requirement (IEC62238)	Result	
		Pass	N/A
Harmonic distortion and rated audiofrequency output power	Sub-clause 9.1	☒	
Audiofrequency response	Sub-clause 9.2	☒	
Maximum usable sensitivity	Sub-clause 9.3	☒	
Co-channel rejection	Sub-clause 9.4	☒	
Adjacent channel selectivity	Sub-clause 9.5	☒	
Spurious response rejection	Sub-clause 9.6	☒	
Intermodulation response	Sub-clause 9.7	☒	
Blocking or desensitization	Sub-clause 9.8	☒	
Spurious emissions	Sub-clause 9.9	☒	
Receiver residual noise level	Sub-clause 9.10	☒	
Squelch operation	Sub-clause 9.11	☒	
Squelch hysteresis	Sub-clause 9.12	☒	
Multiple watch characteristic	Sub-clause 9.13	☒	

Receiver for DSC Requirement			
Test item	Standards requirement (IEC62238)	Result	
		Pass	N/A
Maximum usable sensitivity	Sub-clause 10.1	☒	
Co-channel rejection	Sub-clause 10.2	☒	
Adjacent channel selectivity	Sub-clause 10.3	☒	
Spurious response and blocking immunity	Sub-clause 10.4	☒	
Intermodulation response	Sub-clause 10.5	☒	
Dynamic range	Sub-clause 10.6	☒	
Spurious emissions	Sub-clause 10.7	☒	
Verification of correct decoding of various types of DSC calls	Sub-clause 10.8	☒	
Reaction to VTS and AIS channel management DSC transmissions	Sub-clause 10.9	☒	
Simultaneous reception	Sub-clause 10.10	☒	
Maximum usable sensitivity	Sub-clause 10.1	☒	

Note:
N/A means not applicable

2. SUMMARY

2.1. Client Information

Applicant:	Uniden America Corporation
Address:	3001 Gateway Drive Suite 130, Irving, Texas, United States
Manufacturer:	Uniden America Corporation
Address:	3001 Gateway Drive Suite 130, Irving, Texas, United States

2.2. Product Description

Name of EUT:	FLOATING VHF MARINE RADIO	
Trade mark:	UNIDEN, West Marine	
Model/Type reference:	MHS335BT	
Listed Model(s):	VHF470B, VHF470G	
Power supply:	DC 7.4V from re-charge Lion battery DC 6.0V from dry battery	
Adapter information:	Model:SAW12-120-1000UD Input:100-240Va.c.,50/60Hz,0.3A Output: 12Vd.c., 1000mA	
Marine Radio		
Operation Frequency Range:	Tx: 156.05MHz to 157.425MHz Rx: 156.05MHz to 161.6MHz	
Rated Output Power:	6W (37.78dBm) for DSC	
Modulation Type:	Analog Voice:	FM
	Digital Data:	FSK
Channel Separation:	Analog Voice:	☐ 12.5kHz ☒ 25kHz
Emission Designator:	Analog Voice:	☐12.5kHz Channel Separation: ☒25kHz Channel Separation: 16K0F3E
	Digital Data:	☐12.5kHz Channel Separation:
		☒25kHz Channel Separation: 16K0G2B
Antenna Type:	External	

Note:
Pre-scan the test voltage 7.4V and 6.0V, only show the worst test result at 7.4V.

2.3. Test frequency list

Mode	Modulation	Test Channel	Test Frequency (MHz)	
			TX	RX
Analog Voice	FM	CH_L(CH60)	156.025	160.025
		CH_M(CH16)	156.8	156.8
		CH_H(CH88)	157.425	157.425

Mode	Modulation	Test Channel	Test Frequency (MHz)	
			TX	RX
Digital Data(DSC)	FSK	CH_{M1} (CH70)	156.525	156.525

2.4. EUT operation mode

Test mode	Transmitting	Receiving	Power level			Analog/FM
			High	Mid	Low	25kHz
TX1	√		√			√
TX2	√			√		√
TX3	√				√	√
RX1		√				√

Test mode	Transmitting	Receiving	States			Digital Data(DSC)/FSK
			B	Y	B+Y	25kHz
TX4	√		√			√
TX5	√			√		√
TX6	√				√	√
RX2		√				√

√ : is operation mode.

2.5. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	Unshielded
		Detachable :	Undetachable
○	Multimeter	Manufacturer :	/
		Model No. :	/

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Laboratory:Shenzhen Huatongwei International Inspection Co., Ltd.
Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China
Phone: 86-755-26748019 Fax: 86-755-26748089

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 3902.01

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 762235

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files.

IC-Registration No.:5377B-1

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No.: 5377B-1.

ACA

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

3.3. Environmental conditions

Normal Conditon	Temperature	15 °C to 35 °C	
	Relative humidity	20 % to 75 %.	
	Voltage	☒Mains voltage	Nominal mains voltage
		☐Lead-acid battery	1.1 * the nominal voltage of the battery
		☐Other	the normal test voltage shall be that declared by the equipment provider
Extreme Conditon	Temperature	☐ –15 °C and +55 °C for equipment intended for mounting below deck	
		☒ –25 °C and +55 °C for equipment intended for mounting above deck.	
		☐ -10 °C to +55 °C for Base stations for indoor/controlled climate conditions	
	Voltage	☐Mains voltage	±10 %* the nominal mains voltage
		☐Secondary battery power sources	1,3 and 0,9 multiplied by the nominal voltage of the battery
		☒Other	For equipment using other power sources, the extreme test voltages shall be as stated by the manufacturer.

Normal Conditon	V_N=nominal Voltage	DC 7.4V
	T_N=normal Temperature	25 °C
Extreme Conditon	V_L=lower Voltage	DC 6.0V
	T_L=lower Temperature	-20 °C
	V_H=higher Voltage	DC 7.4V
	T_H=higher Temperature	55 °C

3.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Huatongwei International Inspection Co., Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen Huatongwei laboratory is reported:

Test Items	Measurement Uncertainty	Notes
Frequency stability	25 Hz	(1)
Transmitter power conducted	0.57 dB	(1)
Transmitter power Radiated	2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	1.60 dB	(1)
Conducted Emission 9KHz-30MHz	3.39 dB	(1)
Radiated Emission 9KHz-30MHz	2.20 dB	(1)
Radiated Emission 30~1000MHz	4.65 dB	(1)
Radiated Emission 1~18GHz	5.16 dB	(1)
Radiated Emission 18-40GHz	5.54 dB	(1)
Occupied Bandwidth	35 Hz	(1)
FM deviation	25 Hz	(1)
Audio level	0.62 dB	(1)
Low Pass Filter Response	0.76 dB	(1)
Modulation Limiting	0.42 %	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

3.5. Equipments Used during the Test

AC&DC Power Conducted Emission				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Artificial Mains	Rohde&Schwarz	ESH2-Z5	100028	2016/11/13
EMI Test Receiver	Rohde&Schwarz	ESCS 30	100038	2016/11/13
Pulse Limiter	Rohde&Schwarz	ESHSZ2	100044	2016/11/13
EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	N/A	N/A
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Artificial Mains	Rohde&Schwarz	ESH3-Z6	100210	2016/11/13
Artificial Mains	Rohde&Schwarz	ESH3-Z6	100211	2016/11/13
Test cable	ENVIROFLEX	3651	1101902	2016/11/13

Modulation Characteristic				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13

Frequency Stability				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Signal Generator	Rohde&Schwarz	SMT03	100059	2016/11/13
Climate Chamber	ESPEC	EL-10KA	05107008	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13

Transmitter Radiated Spurious Emission& Effective Radiated Power				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Ultra-Broadband Antenna	Rohde&Schwarz	HL562	100015	2016/11/13
EMI Test Receiver	Rohde&Schwarz	ESI 26	100009	2016/11/13
RF Test Panel	Rohde&Schwarz	TS / RSP	335015/ 0017	N/A
HORN ANTENNA	Rohde&Schwarz	HF906	100039	2016/11/13
Loop Antenna	Rohde&Schwarz	HZ-9	838622\013	2016/11/13
Turntable	ETS	2088	2149	N/A
Antenna Mast	ETS	2075	2346	N/A
EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	N/A	N/A
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	2016/11/13
Ultra-Broadband Antenna	ShwarzBeck	VULB9163	539	2016/11/13
HORN ANTENNA	ShwarzBeck	9120D	1012	2016/11/13
HORN ANTENNA	ShwarzBeck	9120D	1011	2016/11/13
TURNTABLE	MATURO	TT2.0	----	N/A
ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A
Test cable	Siva Cables Italy	RG 58A/U	W14.02	2016/11/13

Maximum Transmitter Power & Spurious Emssion On Antenna Port & Occupied Bandwidth & Emission Mask				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Receiver	Rohde&Schwarz	ESI 26	100009	2016/11/13
Attenuator	R&S	ESH3-22	100449	2016/11/13
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
High-Pass Filter	Anritsu	MP526B	6220875256	2016/11/13
High-Pass Filter	Anritsu	MP526D	6220878392	2016/11/13
Spectrum Analzyer	Aglient	E4407B	MY44210775	2016/11/13
Spectrum Analzyer	Rohde&Schwarz	FSP40	1164.4391.40	2016/11/13
SPECTRUM ANALYZER	Agilent	E4407B	MY44210775	2016/11/13
Attenuator	Chengdu E-Microwave	EMCAXX-10RNZ-3	----	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13
Combiner	Chengdu E-Microwave	EMPD-T-2-180-10-600	----	2016/11/13

Transient Frequency Behavior				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Signal Generator	Rohde&Schwarz	SMT03	100059	2016/11/13
Storage Oscilloscope	Tektronix	TDS3054B	B033027	2016/11/13
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2016/11/13
RF Cable	Chengdu E-Microwave	----	----	2016/11/13

The calibration interval was one year.

4. TEST CONDITIONS AND RESULTS

4.1. Environmental Requirement

4.1.1. Vibration test

TEST RESULTS:
Complies

Please refer to the below test data:

Frequency Error:

Operation Mode	Test conditions		Frequency Error(kHz)			Limit (kHz)	Result
	Temperature(℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX1	T_N	V_N	0.05	0.06	0.05	±1.5	Pass

Operation Mode	Test conditions		Frequency Error(kHz)			Limit (kHz)	Result
	Temperature(℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX3	T_N	V_N	0.05	0.04	0.06	±1.5	Pass

Carrier power:

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured power (dBm)	Limit (dB)	Result
TX1	T_N	V_N	CH_L	37.38	34.77~37.78	Pass
			CH_M	37.62		
			CH_H	37.55		

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured power (dBm)	Limit (dB)	Result
TX3	T_N	V_N	CH_L	29.15	20~30	Pass
			CH_M	29.18		
			CH_H	29.32		

Maximum usable sensitivity:

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured (dBuV)	Limit (dB)	Result
RX1	T_N	V_N	CH_L	-5.3	≤+6.0	Pass
			CH_M	-4.7		
			CH_H	-5.3		

4.1.2. Temperature tests

TEST RESULTS:

Complies

Please refer to the below test data:

Frequency Error:

Operation Mode	Test conditions		Frequency Error(kHz)			Limit (kHz)	Result
	Temperature(℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX1	T_N	V_N	0.04	0.04	0.04	±1.5	Pass

Operation Mode	Test conditions		Frequency Error(kHz)			Limit (kHz)	Result
	Temperature(℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX3	T_N	V_N	0.05	0.04	0.05	±1.5	Pass

Carrier power:

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured power (dBm)	Limit (dB)	Result
TX1	T_N	V_N	CH_L	37.69	34.77~37.78	Pass
			CH_M	37.74		
			CH_H	37.68		

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured power (dBm)	Limit (dB)	Result
TX3	T_N	V_N	CH_L	29.33	20~30	Pass
			CH_M	29.34		
			CH_H	29.25		

Maximum usable sensitivity:

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured (dBuV)	Limit (dB)	Result
RX1	T_N	V_N	CH_L	-5.3	≤+6.0	Pass
			CH_M	-6.0		
			CH_H	-6.2		

4.2. Transmitter Requirement

4.2.1. Frequency error (demodulated DSC signal)

The frequency error is the difference between the measured carrier frequency and its nominal value.

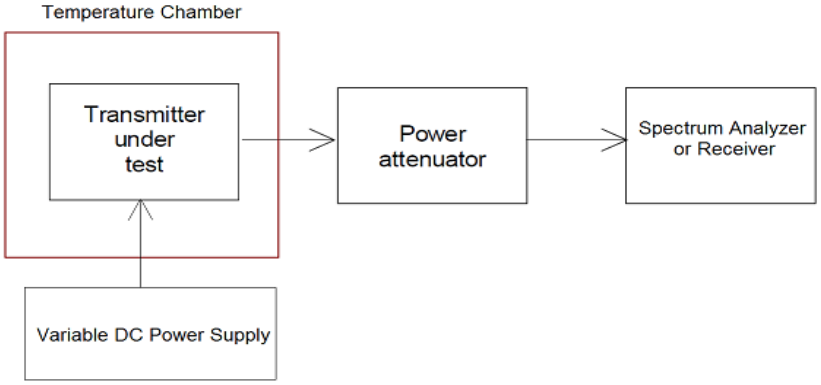
LIMIT

IEC 62238 Sub-clause 8.1.3
The frequency error shall be within ±1,5 kHz.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.1.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test conditions		Frequency Error (kHz)			Limit (kHz)	Result
	Temperature (℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX1	T_N	V_N	0.115	0.118	0.112	±1.5	Pass
	V_L	V_H	0.101	0.104	0.103		
		V_L	0.119	0.111	0.112		
	T_H	V_H	0.117	0.106	0.110		
		V_L	0.111	0.101	0.113		

Operation Mode	Test conditions		Frequency Error (kHz)			Limit (kHz)	Result
	Temperature (℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX2	T_N	V_N	0.113	0.124	0.104	±1.5	Pass
	V_L	V_H	0.102	0.112	0.110		
		V_L	0.102	0.120	0.113		
	T_H	V_H	0.112	0.110	0.118		
		V_L	0.108	0.121	0.103		

Operation Mode	Test conditions		Frequency Error (kHz)			Limit (kHz)	Result
	Temperature (℃)	Voltage (V)	CH_L	CH_M	CH_H		
TX3	T_N	V_N	0.114	0.121	0.105	±1.5	Pass
	V_L	V_H	0.114	0.115	0.105		
		V_L	0.110	0.112	0.100		
	T_H	V_H	0.114	0.116	0.118		
		V_L	0.104	0.104	0.106		

4.2.2. Carrier Power (Conducted)

The carrier power is the mean power delivered to the artificial antenna during one radio frequency cycle in the absence of modulation. The rated output power is the carrier power declared by the manufacturer.

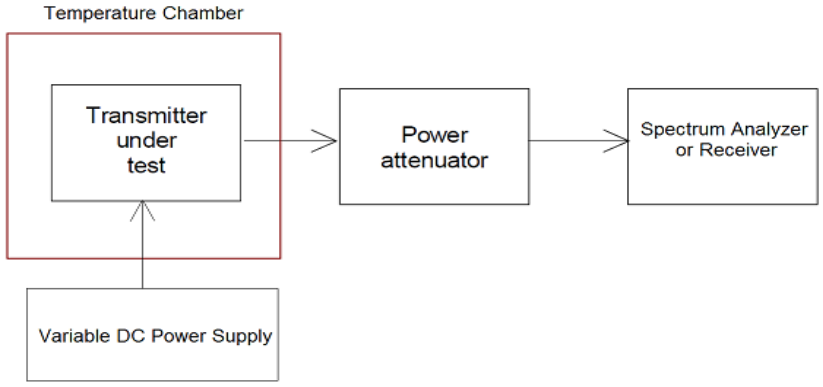
LIMIT

IEC 62238 Sub-clause 8.2.3
with the output power switch set at maximum, the carrier power shall remain between 3 W and 6 W.
With the output power switch at minimum, the carrier power shall remain between 0,1 W and 1 W.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.2.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured power (dBm)	Limit (dB)	Result
TX1	T_N	V_N	CH_L	37.76	34.77~37.78	Pass
			CH_M	37.69		
			CH_H	37.77		
	V_L	V_H	CH_L	37.56	34.77~37.78	
			CH_M	37.52		
			CH_H	37.59		
		V_L	CH_L	37.57		
			CH_M	37.52		
			CH_H	37.58		
	V_H	V_H	CH_L	37.58	34.77~37.78	
			CH_M	37.58		
			CH_H	37.60		
		V_L	CH_L	37.56		
			CH_M	37.54		
			CH_H	37.58		

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured power (dBm)	Limit (dB)	Result
TX3	T_N	V_N	CH_L	29.37	20~30	Pass
			CH_M	29.62		
			CH_H	29.53		
	V_L	V_H	CH_L	29.33	20~30	
			CH_M	29.58		
			CH_H	29.49		
		V_L	CH_L	29.30		
			CH_M	29.55		
			CH_H	29.46		
	V_H	V_H	CH_L	29.26	20~30	
			CH_M	29.51		
			CH_H	29.42		
		V_L	CH_L	29.22		
			CH_M	29.47		
			CH_H	29.38		

4.2.3. Frequency Deviation

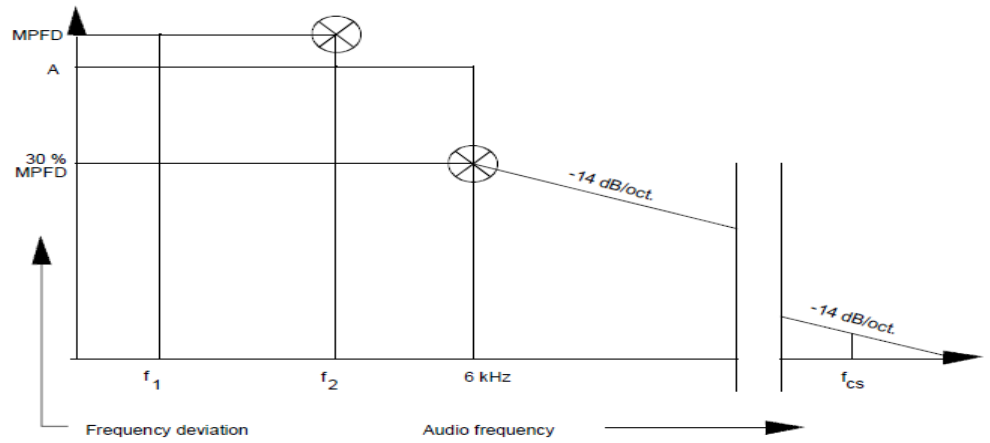
For the purpose of the present document, the frequency deviation is the difference between the instantaneous frequency of the modulated radio frequency signal and the carrier frequency.

LIMIT

IEC 62238 Sub-clause 8.3.3
with the output power switch set at maximum, the carrier power shall remain between 3 W and 6 W.
With the output power switch at minimum, the carrier power shall remain between 0,1 W and 1 W.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.3.2 for the measurement method.
The maximum permissible frequency deviation shall be:
25 kHz channels: ±5 kHz.
12,5 kHz channels: ±2,5 kHz.
between 3,0 kHz/2,55 kHz and 6,0 kHz: shall not exceed the frequency deviation at a modulation frequency of 3,0 kHz/2,55 kHz.
At 6,0 kHz the deviation shall be not more than 30,0 % of the maximum permissible frequency deviation.
between 6,0 kHz and a frequency equal to the channel separation for which the equipment is intended shall not exceed that given by a linear representation of the frequency deviation (dB) relative to the modulation frequency, starting at the 6,0 kHz limit and having a slope of -14,0 dB per octave.
These limits are illustrated in figure 1.

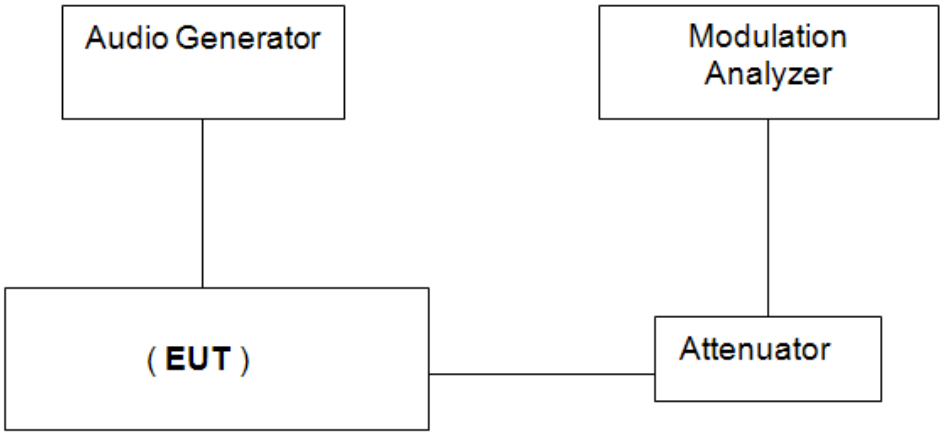


NOTE:
Abbreviations:

f_1	lowest appropriate frequency
f_2	3,0 kHz (for 25 kHz channel separation), or 2,55 kHz (for 12,5 kHz channel separation)
MPFD	Maximum Permissible Frequency Deviation, clause 8.3.2.1
A	measured frequency deviation at f2
f_{cs}	frequency equal to channel separation

Figure 1: Frequency deviation

TEST CONFIGURATION



TEST MODE:

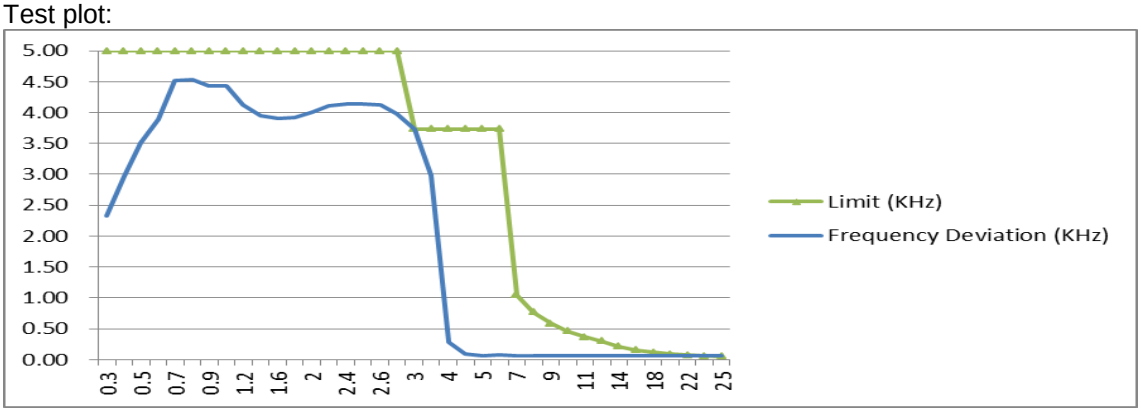
Please reference to the section 2.4

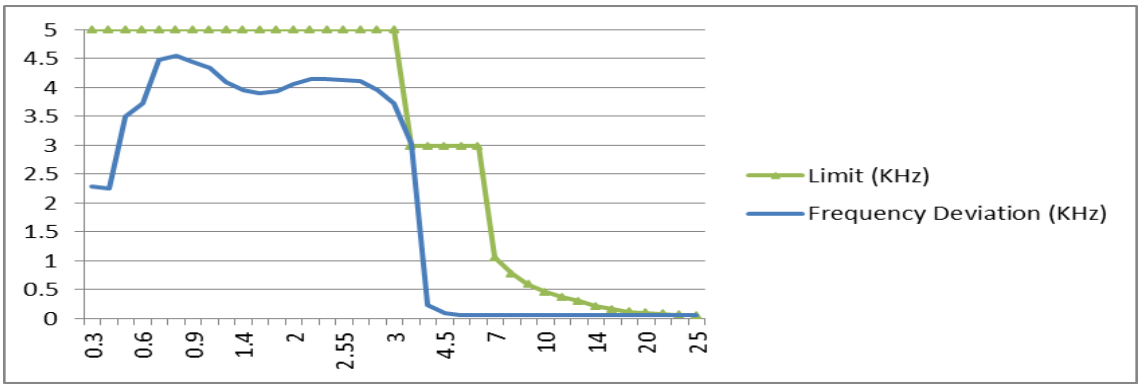
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Test plot:





Test Result:

TX1:CH_M			
Modulation Frequency (kHz)	Frequency Deviation (kHz)	Limit (kHz)	Result
0.30	2.33	5.00	Pass
0.40	2.97	5.00	Pass
0.50	3.52	5.00	Pass
0.60	3.89	5.00	Pass
0.70	4.53	5.00	Pass
0.80	4.54	5.00	Pass
0.90	4.44	5.00	Pass
1.00	4.44	5.00	Pass
1.20	4.12	5.00	Pass
1.40	3.95	5.00	Pass
1.60	3.90	5.00	Pass
1.80	3.92	5.00	Pass
2.00	4.01	5.00	Pass
2.20	4.11	5.00	Pass
2.40	4.14	5.00	Pass
2.55	4.13	5.00	Pass
2.60	4.12	5.00	Pass
2.80	3.97	5.00	Pass
3.00	3.74	3.74	Pass
3.50	2.98	3.74	Pass
4.00	0.28	3.74	Pass
4.50	0.09	3.74	Pass
5.00	0.07	3.74	Pass
6.00	0.08	3.74	Pass
7.00	0.07	1.05	Pass
8.00	0.07	0.77	Pass
9.00	0.07	0.58	Pass
10.00	0.07	0.46	Pass
11.00	0.07	0.37	Pass
12.00	0.07	0.30	Pass
14.00	0.07	0.21	Pass
16.00	0.07	0.15	
18.00	0.07	0.12	Pass
20.00	0.07	0.09	Pass
22.00	0.07	0.07	Pass
24.00	0.07	0.06	Pass
25.00	0.07	0.05	Pass

TX3:CH_M			
Modulation Frequency (kHz)	Frequency Deviation (kHz)	Limit (kHz)	Result
0.30	2.29	5.00	Pass
0.40	2.24	5.00	Pass
0.50	3.49	5.00	Pass
0.60	3.73	5.00	Pass
0.70	4.48	5.00	Pass
0.80	4.55	5.00	Pass
0.90	4.44	5.00	Pass
1.00	4.33	5.00	Pass
1.20	4.10	5.00	Pass
1.40	3.95	5.00	Pass
1.60	3.90	5.00	Pass
1.80	3.94	5.00	Pass
2.00	4.05	5.00	Pass
2.20	4.14	5.00	Pass
2.40	4.15	5.00	Pass
2.55	4.13	5.00	Pass
2.60	4.11	5.00	Pass
2.80	3.95	5.00	Pass
3.00	3.72	5.00	Pass
3.50	3.02	3.72	Pass
4.00	0.23	3.72	Pass
4.50	0.09	3.72	Pass
5.00	0.05	3.72	Pass
6.00	0.05	2.98	Pass
7.00	0.05	1.05	Pass
8.00	0.05	0.77	Pass
9.00	0.05	0.58	Pass
10.00	0.05	0.46	Pass
11.00	0.05	0.37	Pass
12.00	0.05	0.30	Pass
14.00	0.05	0.21	Pass
16.00	0.05	0.15	Pass
18.00	0.05	0.12	Pass
20.00	0.05	0.09	Pass
22.00	0.05	0.07	Pass
24.00	0.05	0.06	Pass
25.00	0.05	0.05	Pass

4.2.4. Sensitivity of the modulator, including microphone

This characteristic expresses the capability of the transmitter to produce sufficient modulation when an audio frequency signal corresponding to the normal mean speech level is applied to the microphone.

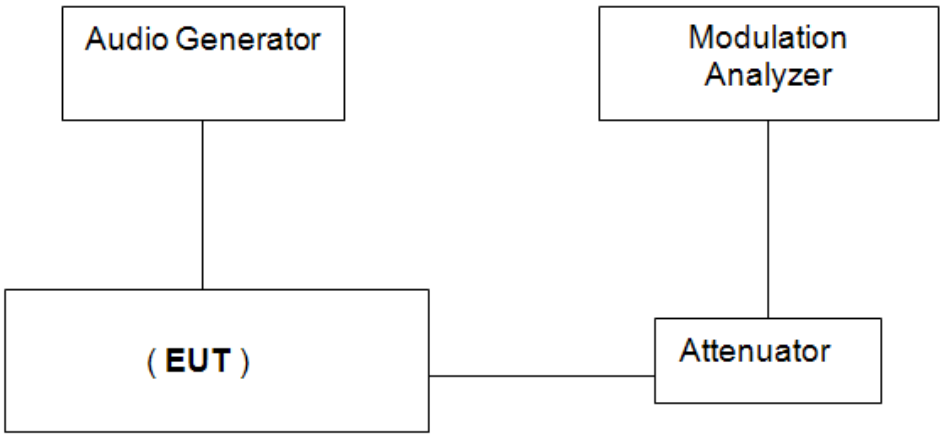
LIMIT

IEC 62238 Sub-clause 8.4.3
The resulting frequency deviation shall be between ±1,5 kHz and ±3 kHz.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.4.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Measured (kHz)	Limit (kHz)	Result
TX1	CH_L	2.21	±1.5～ ±3	Pass
	CH_M	2.17		
	CH_H	2.08		

Operation Mode	Test Channel	Measured (kHz)	Limit (kHz)	Result
TX2	CH_L	2.14	±1.5～ ±3	Pass
	CH_M	2.18		
	CH_H	2.08		

4.2.5. Audio frequency response

The audio frequency response is the frequency deviation of the transmitter as a function of the modulating frequency.

LIMIT

IEC 62238 Sub-clause 8.5.3
The audio frequency response shall be within +1 dB and -3 dB of a 6 dB/octave line passing through the reference point (see figure 2). The upper limit frequency shall be 2,55 kHz for 12,5 kHz channels.

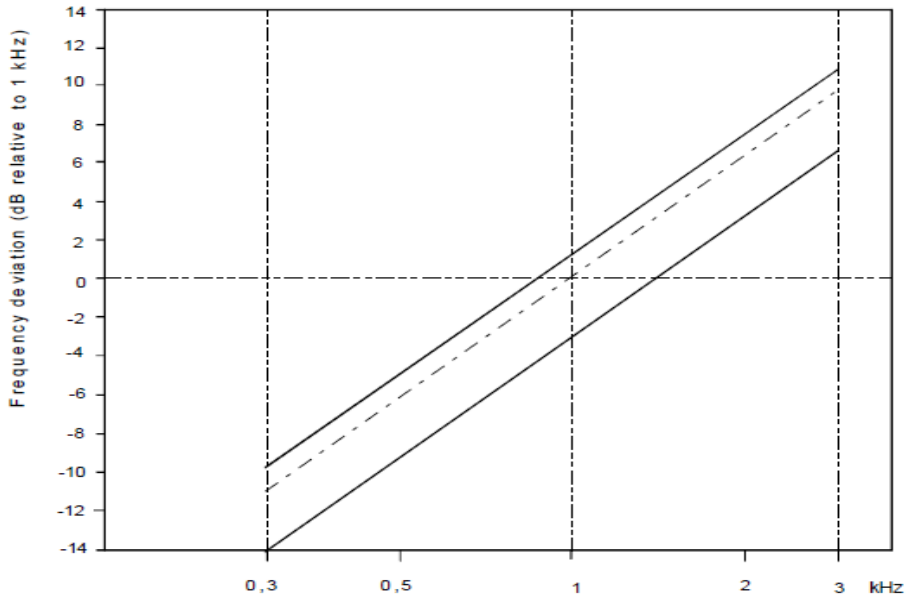
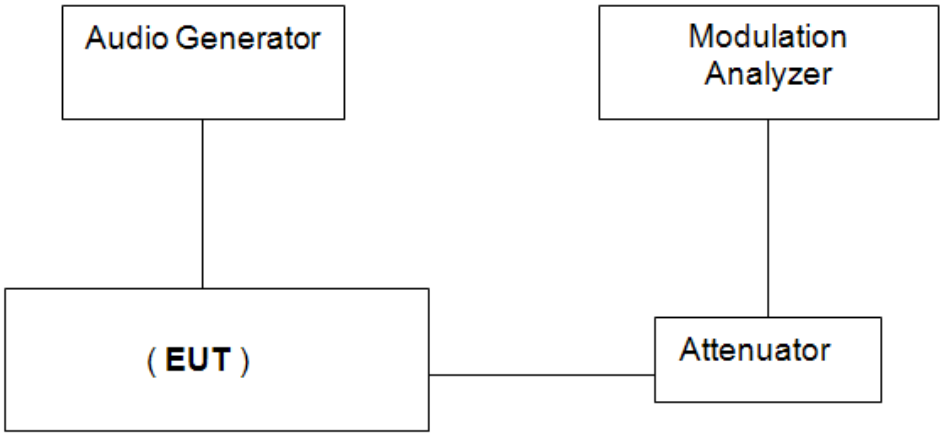


Figure 2: Audio frequency response

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.5.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

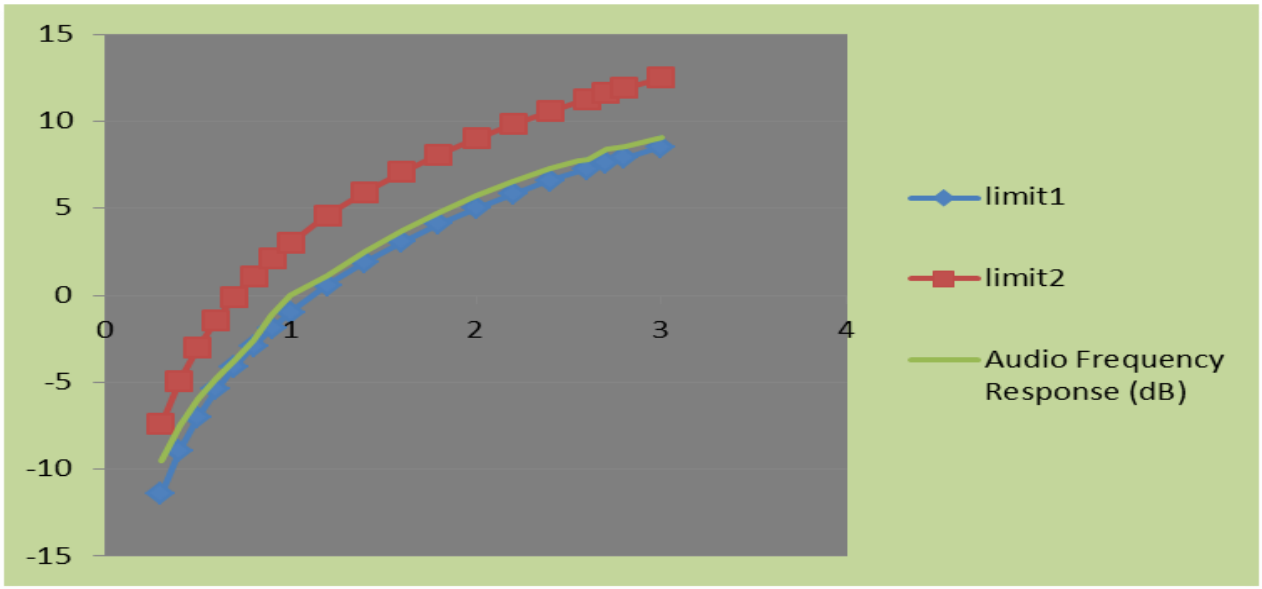
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Note：

We tested TX1 and TX2 all channel, recorded worst case TX1 for CH_M .

TX1:CH_M			
Frequency (kHz)	Frequency Deviation (kHz)	1kHz Reference Deviation (kHz)	Audio Frequency Response (dB)
0.3	0.334	1	-9.52
0.4	0.420	1	-7.54
0.5	0.504	1	-5.96
0.6	0.577	1	-4.77
0.7	0.649	1	-3.75
0.8	0.743	1	-2.58
0.9	0.880	1	-1.11
1	1.000	1	0.00
1.2	1.139	1	1.13
1.4	1.335	1	2.51
1.6	1.533	1	3.71
1.8	1.726	1	4.74
2	1.932	1	5.72
2.2	2.123	1	6.54
2.55	2.312	1	7.28
2.4	2.429	1	7.71
2.6	2.446	1	7.77
2.7	2.621	1	8.37
2.8	2.679	1	8.56
3	2.841	1	9.07



4.2.6. Audio frequency harmonic distortion of the emission

The harmonic distortion of the emission modulated by an audio frequency signal is defined as the ratio, expressed as a percentage, of the root mean square (rms) voltage of all the harmonic components of the fundamental modulation frequency to the total rms voltage of the modulation signal after linear demodulation

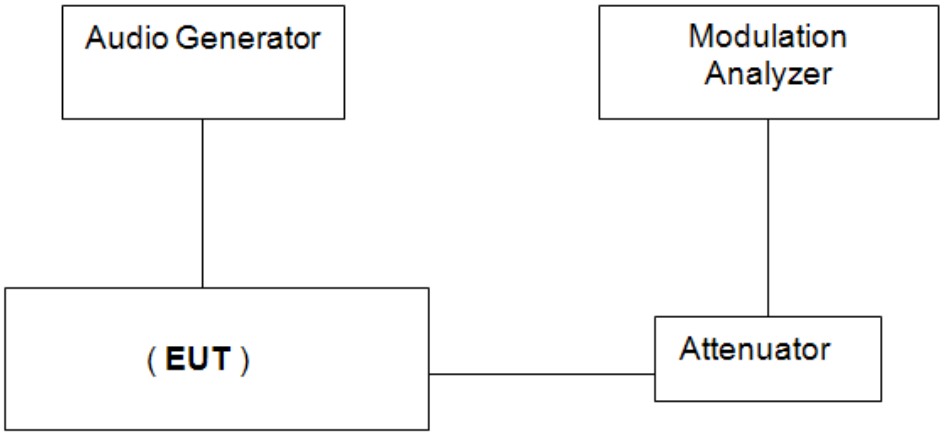
LIMIT

IEC 62238 Sub-clause 8.6.3
The harmonic distortion shall not exceed 10 %.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.6.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Operation Mode	Temperature (℃)	Voltage (V)	Modulated Frequency (kHz)	Test Channel	Measured (%)	Limit (%)	Result
TX1	T_N	V_N	0.3	CH_L	4.80	⩽10	Pass
				CH_M	4.80		
				CH_H	4.90		
			0.5	CH_L	2.40		
				CH_M	2.60		
				CH_H	2.50		
			1.0	CH_L	1.70		
				CH_M	1.70		
				CH_H	1.60		
	T_L	V_H	1.0	CH_L	3.89	⩽10	
				CH_M	2.75		
				CH_H	4.00		
		V_L	1.0	CH_L	3.16		
				CH_M	2.96		
				CH_H	3.23		
	T_H	V_H	1.0	CH_L	2.13		
				CH_M	3.37		
				CH_H	2.49		
		V_L	1.0	CH_L	3.01		
				CH_M	2.75		
				CH_H	2.19		
TX3	T_N	V_N	0.3	CH_L	4.70	⩽10	Pass
				CH_M	5.20		
				CH_H	5.30		
			0.5	CH_L	2.60		
				CH_M	2.70		
				CH_H	2.70		
			1.0	CH_L	1.90		
				CH_M	1.80		
				CH_H	1.90		
	T_L	V_H	1.0	CH_L	3.42	⩽10	
				CH_M	2.61		
				CH_H	2.96		
		V_L	1.0	CH_L	2.85		
				CH_M	2.18		
				CH_H	3.85		
	T_H	V_H	1.0	CH_L	2.08		
				CH_M	2.43		
				CH_H	3.35		
		V_L	1.0	CH_L	3.95		
				CH_M	3.17		
				CH_H	3.45		

4.2.7. Adjacent Channel Power

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within a specified passband centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

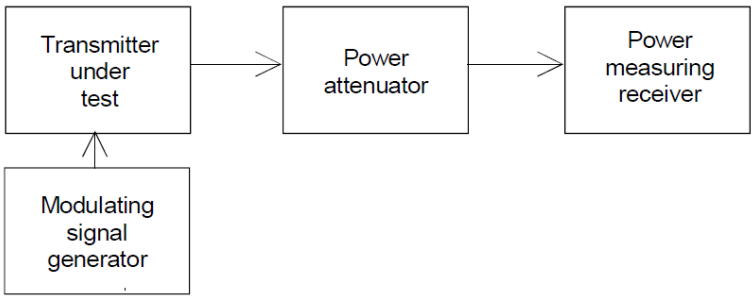
LIMIT

IEC 62238 Sub-clause 8.7.3
The adjacent channel power shall not exceed a value of:
25 kHz channel: 70 dB below the carrier power of the transmitter without any need to be below 0,2 μW.
12 kHz channel: 60 dB below the carrier power of the transmitter without any need to be below 0,2 μW.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.7.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

TX1				
Test Channel	Test Channel	Measurement Power (dBc)	Limit (dB)	Result
CH_L	Lower adjacent	-72.24	⩽-70	Pass
	Upper adjacent	-71.98		
CH_M	Lower adjacent	-72.75	⩽-70	Pass
	Upper adjacent	-73.74		
CH_H	Lower adjacent	-73.95	⩽-70	Pass
	Upper adjacent	-72.74		

TX3				
Test Channel	Test Channel	Measurement Power (dBc)	Limit (dB)	Result
CH_L	Lower adjacent	-73.21	⩽-70	Pass
	Upper adjacent	-73.14		
CH_M	Lower adjacent	-72.16	⩽-70	Pass
	Upper adjacent	-74.51		
CH_H	Lower adjacent	-73.40	⩽-70	Pass
	Upper adjacent	-73.30		

4.2.8. Conducted spurious emissions conveyed to the antenna

Conducted spurious emissions are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions.
.

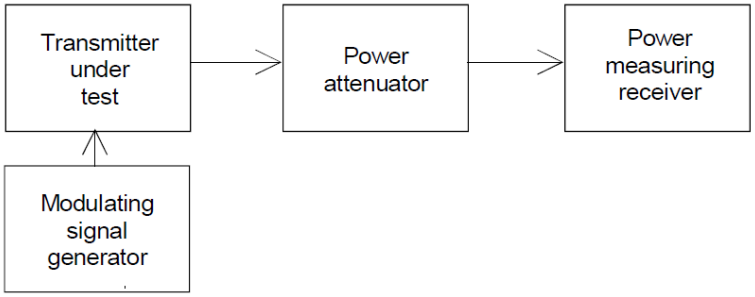
LIMIT

IEC 62238 Sub-clause 8.8.3
The power of any conducted spurious emission on any discrete frequency shall not exceed 0,25μW(-36dBm).

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.8.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

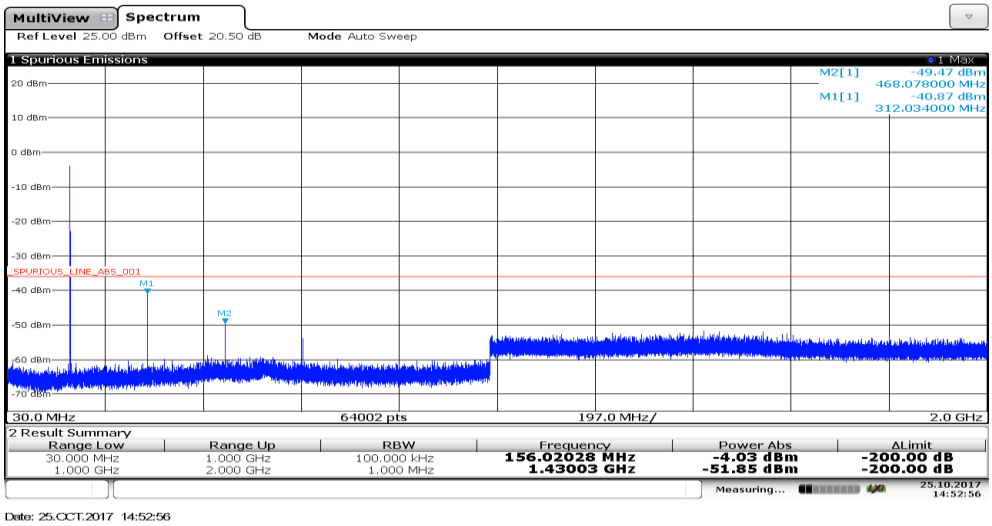
☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Note：

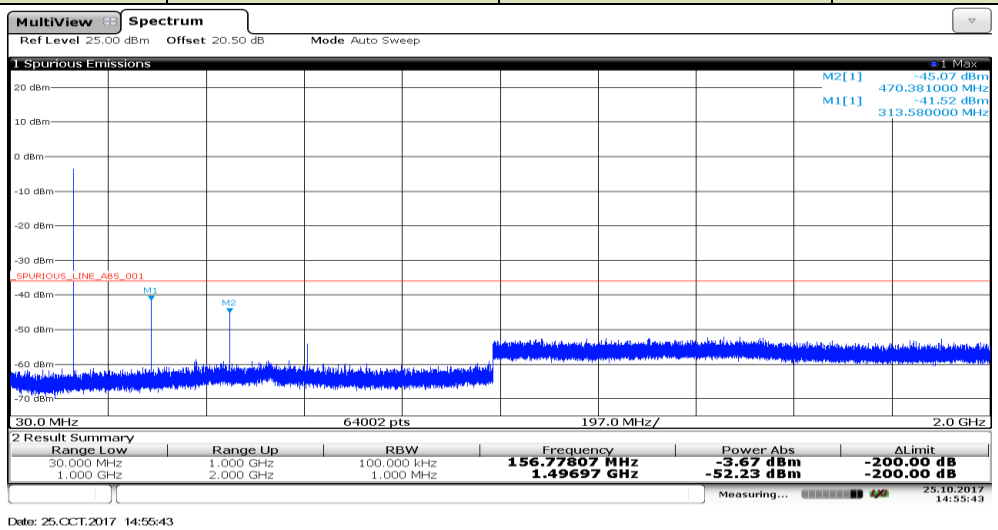
We tested TX1 to TX6, recorded worst case for TX1.

Test mode:	TX1	Test Frequency:	CH_L



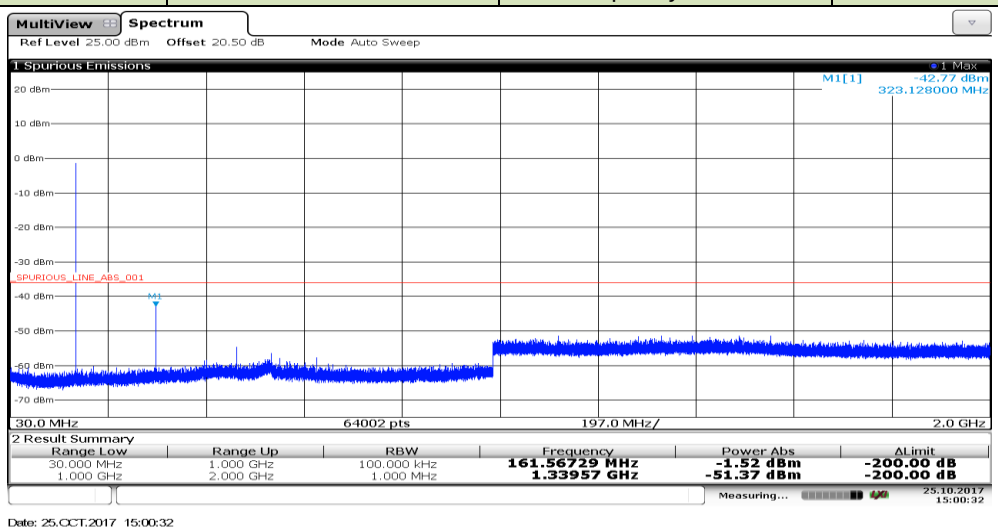
9kHz-2GHz

Test mode:	TX1	Test Frequency:	CH_M



9kHz-2GHz

Test mode:	TX1	Test Frequency:	CH_H



9kHz-2GHz

4.2.9. Transient frequency behaviour of the transmitter

The residual modulation of the transmitter is the ratio, in decibels, of the demodulated radiofrequency signal in the absence of wanted modulation, to the modulated radiofrequency signal produced when the normal test modulation is applied.

.

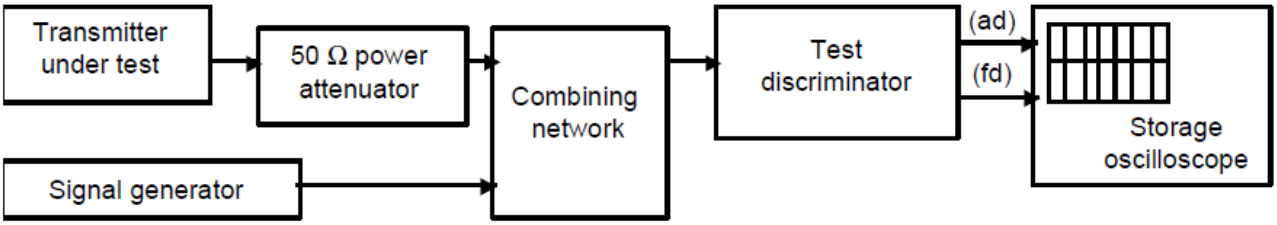
LIMIT

IEC 62238 Sub-clause 8.9.3
During the period of time t_1 and t_3 the frequency difference shall not exceed the value of one channel separation. The frequency difference, after the end of t_2, shall be within the limit of the frequency error of ±1,5 kHz.
During the period of time t_2 the frequency difference shall not exceed the value of half a channel separation. Before the start of t_3 the frequency difference shall be within the limit of the frequency error of ±1,5 kHz.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.9.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

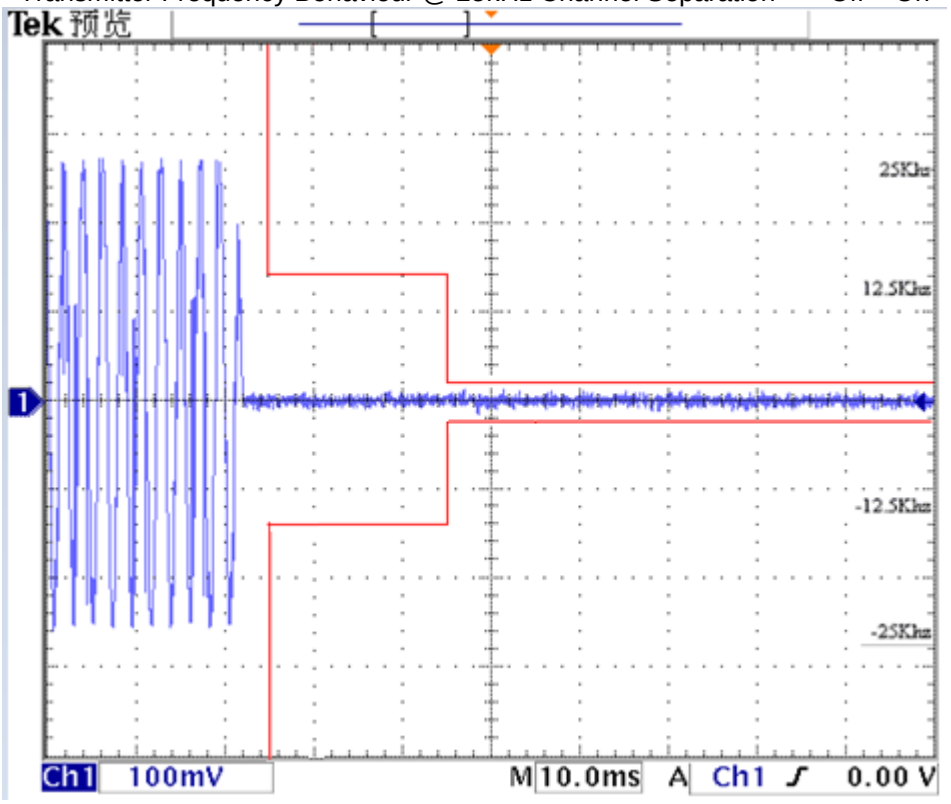
☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

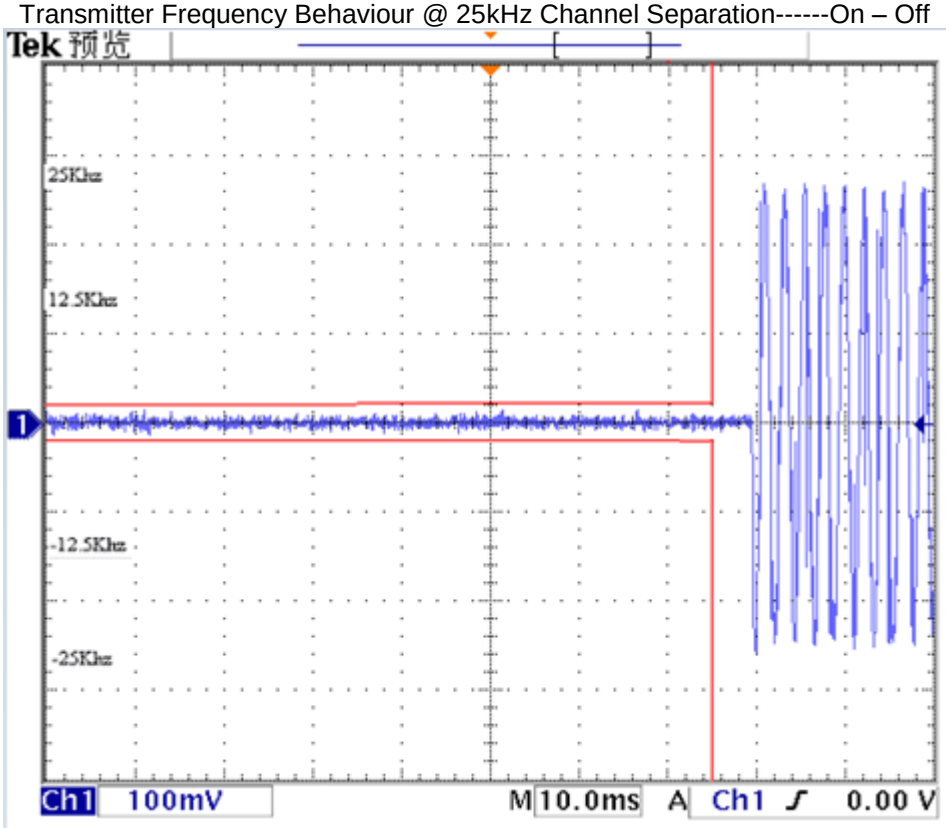
Note：

We tested TX1 to TX3,recorded worst case at TX1 for CH_M.

Transmitter Frequency Behaviour @ 25kHz Channel Separation------Off – On



Transmitter Frequency Behaviour @ 25kHz Channel Separation------On – Off



4.2.10. Residual modulation of the transmitter

The residual modulation of the transmitter is the ratio, in dB, of the demodulated RF signal in the absence of wanted modulation, to the demodulated RF signal produced when the normal test modulation is applied.
.

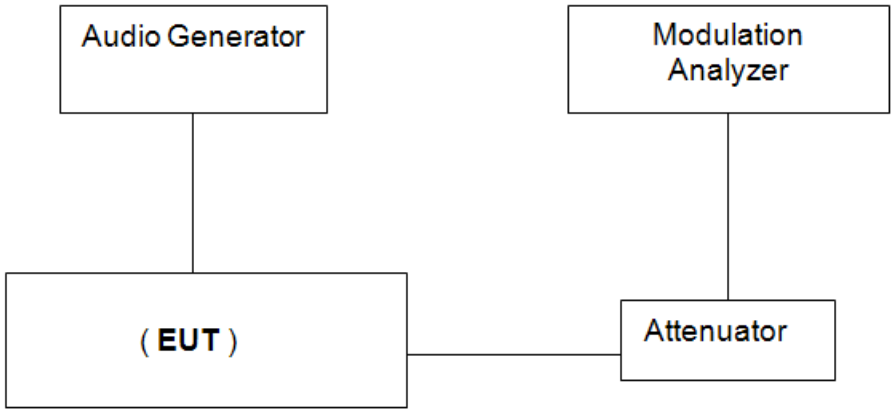
LIMIT

IEC 62238 Sub-clause 8.10.3
The residual modulation shall not exceed -40 dB on either 25 kHz or 12,5 kHz channels.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.10.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Measured (dB)	Limit (dB)	Result
TX1	CH_L	-43.89	⩽-40	Pass
	CH_M	-45.23		
	CH_H	-45.15		

Operation Mode	Test Channel	Measured (dB)	Limit (dB)	Result
TX3	CH_L	-45.02	⩽-40	Pass
	CH_M	-45.03		
	CH_H	-44.18		

4.2.11. Frequency error (demodulated DSC signal)

The frequency error for the B- and the Y-state is the difference between the measured frequency from the demodulator and the nominal values.

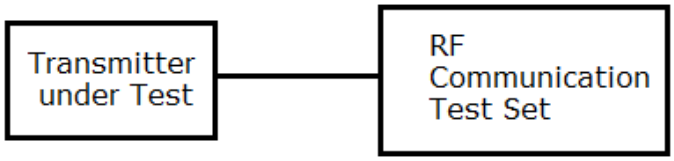
LIMIT

IEC 62238 Sub-clause 8.11.3
The measured frequency from the demodulator at any time for the B-state shall be within 2 100 Hz ±10 Hz and for the Y-state within 1 300 Hz ± 10 Hz.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.11.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test conditions		Frequency Error (kHz)	Limit (Hz)	Result
	Temperature(℃)	Voltage(V)	CH_{M1}		
TX4	T_N	V_N	2100.002	2100 ± 10	Pass
	T_L	V_H	2100.001		
		V_L	2100.002		
	T_H	V_H	2100.003		
		V_L	2100.003		

Operation Mode	Test conditions		Frequency Error (KHz)	Limit (Hz)	Result
	Temperature(℃)	Voltage(V)	CH_{M1}		
TX5	T_N	V_N	1300.002	1300 ± 10	Pass
	T_L	V_H	1300.002		
		V_L	1300.002		
	T_H	V_H	1300.003		
		V_L	1300.002		

4.2.12. Modulation index for DSC

This test measures the modulation index in the B and Y states.

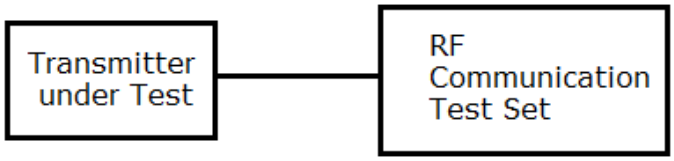
LIMIT

IEC 62238 Sub-clause 8.12.3
The modulation index shall be 2,0 ± 10 %.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.12.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Modulation index	Limit	Result
TX4	CH_{M1}	2.03	2.0 ± 10 %	Pass
TX5	CH_{M1}	2.01	2.0 ± 10 %	Pass

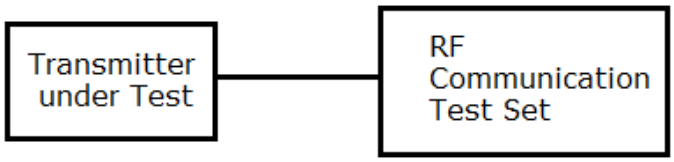
4.2.13. Modulation rate for DSC

The modulation rate is the bit stream speed measured in bit/s.

LIMIT

IEC 62238 Sub-clause 8.13.3
The frequency shall be 600 Hz ± 30 ppm corresponding to a modulation rate of 1 200 baud.

TEST CONFIGURATION



TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 8.13.2 for the measurement method.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Modulation rate (Hz)	Limit	Result
TX6	CH_{M1}	600.002	600Hz ± 30 ppm	Pass

4.2.14. Testing of generated call sequences

Generated call sequences are call which comply with the requirements of ITU-R. Recommendation M.493-10.

Requirement

IEC 62238 Sub-clause 8.14.3
The requirements of ITU-R Recommendation M.493-14 regarding message composition and content shall be met.
The generated calls shall be analyzed with the calibrated apparatus for correct configuration of the signal format, including time diversity. It shall be verified that, after transmission of a DSC call, the transmitter re-tunes to the original channel. However, in the case of a distress call, the transmitter shall tune to channel 16 and automatically select the maximum power. The telecommands used and the channels tested for switching shall be stated in the test report.

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Call Sent	Received without error	Telecommand 1	Telecommand 2
Distress	Yes	100	126
All Ships Urgency	Yes	100	126
All Ships Safety	Yes	100	126
Individual Routine	Yes	100	126
Group Routine	Yes	100	126

4.3. Receiver for Radiotelephone Requirement

4.3.1. Harmonic distortion and rated audio frequency output power

The harmonic distortion at the receiver output is defined as the ratio, expressed as a percentage, of the total rms voltage of all the harmonic components of the modulation audio frequency to the total rms voltage of the signal delivered by the receiver.
The rated audio frequency output power is the value stated by the manufacturer to be the maximum power available at the output, for which all the requirements of the present document are met.

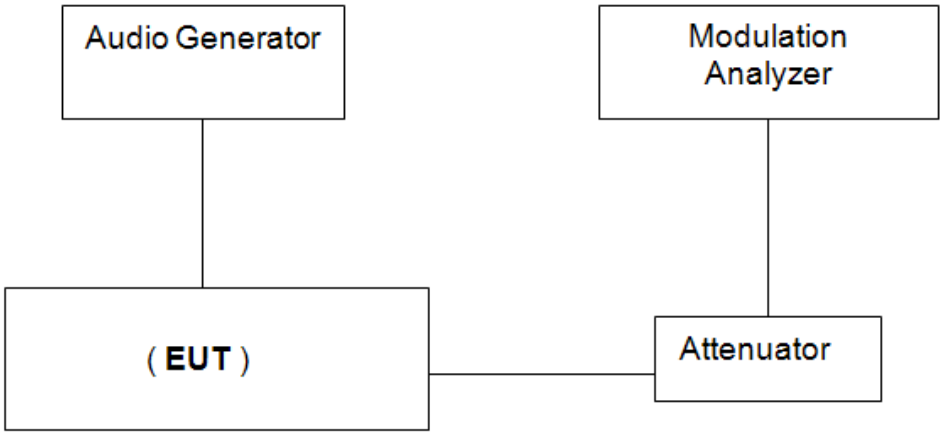
LIMIT

IEC 62238 Sub-clause 9.1.3
The rated audio frequency output power shall be at least 0,2 W in the loudspeaker.
The harmonic distortion shall not exceed 10 %

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.1.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Harmonic distortion:

RX1					
Signals Level (dBμV)	Modulated Frequency (kHz)	Test Frequency (MHz)	Measured (%)	Limit (%)	Result
60	0.3	CH_L	2.60	⩽10	Pass
		CH_M	2.40		
		CH_H	2.60		
	0.5	CH_L	1.80		
		CH_M	1.80		
		CH_H	1.70		
	1.0	CH_L	1.20		
		CH_M	1.00		
		CH_H	1.10		
100	0.3	CH_L	3.10	⩽10	Pass
		CH_M	3.20		
		CH_H	3.20		
	0.5	CH_L	2.80		
		CH_M	2.70		
		CH_H	2.80		
	1.0	CH_L	3.70		
		CH_M	3.70		
		CH_H	3.60		

rated audio frequency output power:

RX1			
Test Channel	Measured (W)	Limit (W)	Result
CH_L	2.02	⩾0.2	Pass
CH_M	2.03		
CH_H	2.02		

4.3.2. Audio frequency response

The audio frequency response is the variation in the receiver's audio frequency output level as a function of the modulating frequency of a received radio frequency signal modulated with constant deviation.

LIMIT

IEC 62238 Sub-clause 9.2.3
The audio frequency response shall not deviate by more than +1 dB or -3 dB from a characteristic giving the output level as a function of the audio frequency, decreasing by 6 dB per octave and passing through the measured point at 1 kHz (figure 5).
Certified Intrinsically Safe equipment need not comply with the limits below 700 Hz.

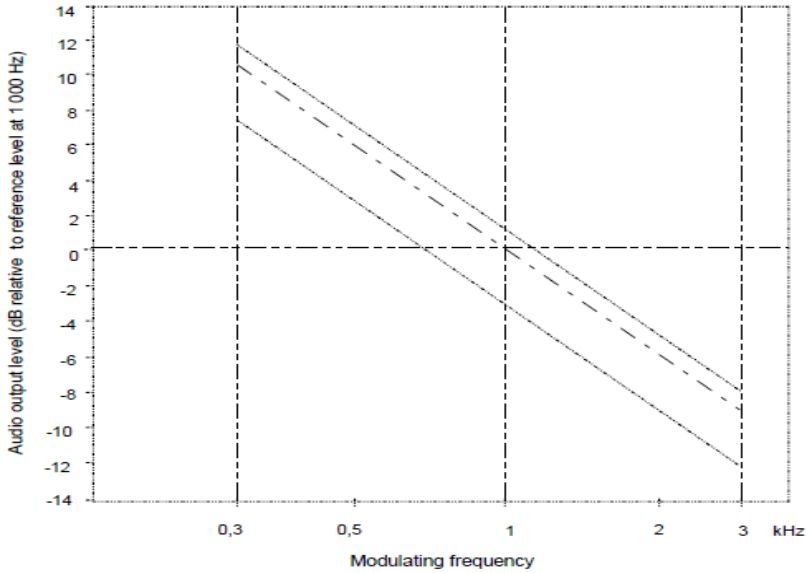
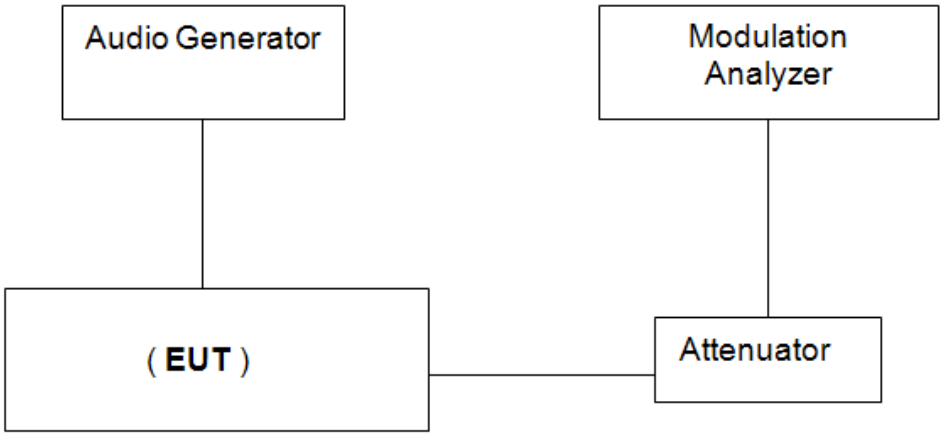


Figure 5: Audio frequency response

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.2.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

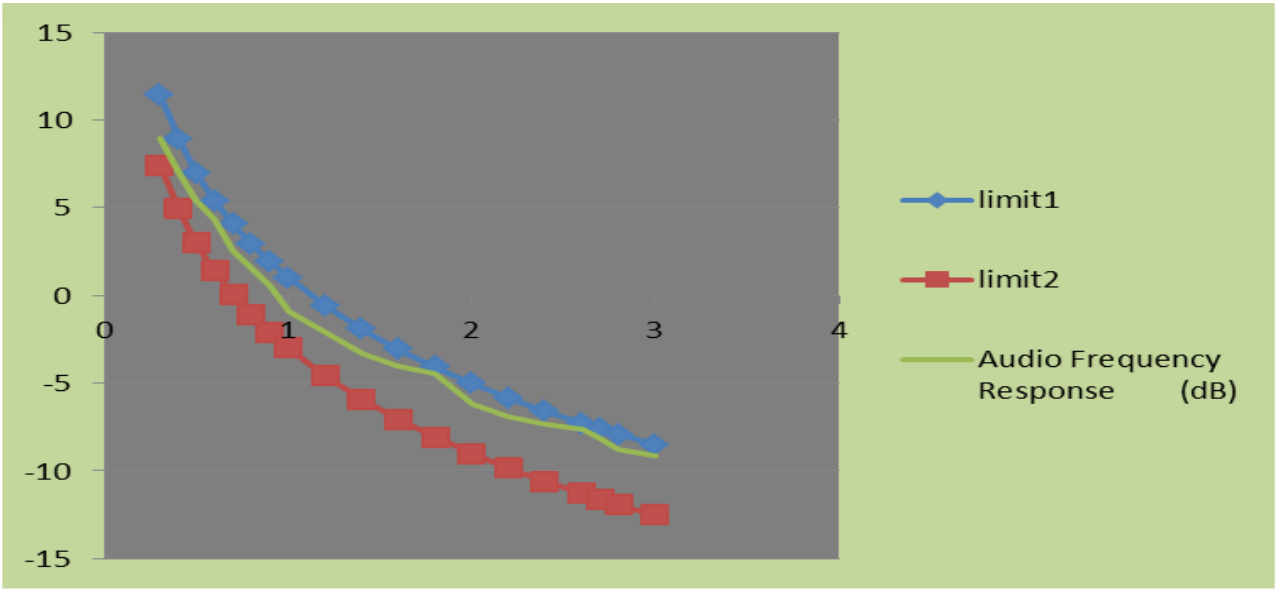
Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1:CH$_M$			
Frequency (kHz)	Frequency Deviation (kHz)	1kHz Reference Deviation (kHz)	Audio Frequency Response (dB)
0.3	0.37	1	8.98
0.4	0.47	1	6.98
0.5	0.56	1	5.39
0.6	0.63	1	4.34
0.7	0.78	1	2.54
0.8	0.87	1	1.56
0.9	0.98	1	0.49
1	1.16	1	-0.94
1.2	1.32	1	-2.10
1.4	1.52	1	-3.30
1.6	1.65	1	-3.99
1.8	1.74	1	-4.46
2	2.12	1	-6.19
2.2	2.31	1	-6.92
2.4	2.42	1	-7.34
2.6	2.49	1	-7.60
2.7	2.64	1	-8.09
2.8	2.86	1	-8.79
3	2.97	1	-9.11



4.3.3. Maximum Usable Sensitivity

The maximum usable sensitivity of the receiver is the minimum level of the signal (emf) at the nominal frequency of the receiver which, when applied to the receiver input with normal test modulation (clause 6.4), will produce:
- in all cases, an audio frequency output power of at least 50 % of the rated output power (clause 9.1); and
- a SINAD ratio of 20 dB, measured at the receiver output through a psophometric telephone filtering network such as described in ITU-T Recommendation O.41 [6].

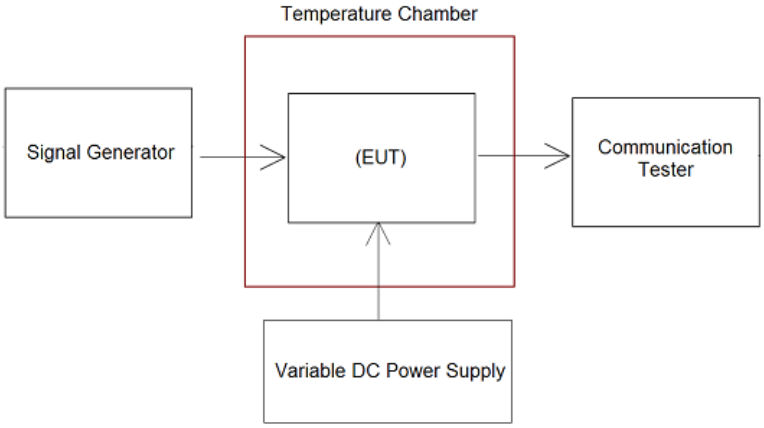
LIMIT

IEC 62238 Sub-clause 9.3.3
The maximum usable sensitivity for either 25 kHz or 12,5 kHz channels shall not exceed +6 dBμV (emf) under normal test conditions and +12 dBμV (emf) under extreme test conditions.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.3.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Temperature (℃)	Voltage (V)	Test Channel	Measured (dBuV)	Limit (dB)	Result
RX1	T_N	V_N	CH_L	-7.00	⩽+6.0	Pass
			CH_M	-7.30		
			CH_H	-7.50		
	T_L	V_H	CH_L	-7.20	⩽+12.0	
			CH_M	-7.20		
			CH_H	-7.30		
		V_L	CH_L	-7.30		
			CH_M	-7.40		
			CH_H	-7.00		
	T_H	V_H	CH_L	-7.00		
			CH_M	-7.50		
			CH_H	-7.30		
		V_L	CH_L	-7.30		
			CH_M	-7.50		
			CH_H	-7.50		

4.3.4. Co-channel rejection

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

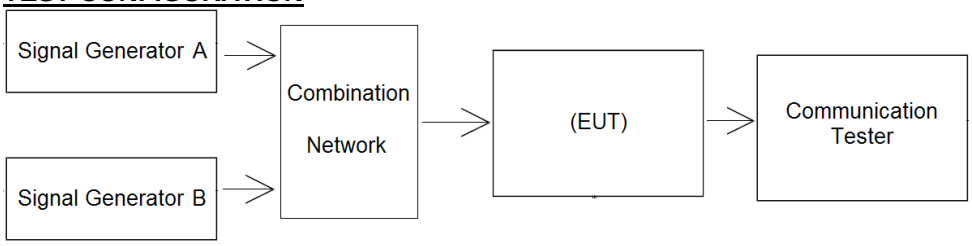
LIMIT

IEC 62238 Sub-clause 9.4.3
The co-channel rejection ratio, at any frequency of the unwanted signal within the specified range, shall be between:
-10 dB and 0 dB for 25 kHz channels
-12 dB and 0 dB for 12,5 kHz channels

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.4.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1				
Test Channel	Measurement Offset (kHz)	SG B – SG A (dB)	Limit (dB)	Result
CH_L	-3	-8.30	-10～0	Pass
	0	-9.70		
	3	-9.80		
CH_M	-3	-8.20	-10～0	Pass
	0	-9.50		
	3	-9.30		
CH_H	-3	-8.70	-10～0	Pass
	0	-9.40		
	3	-9.30		

4.3.5. Adjacent channel selectivity

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by the nominal channel spacing.

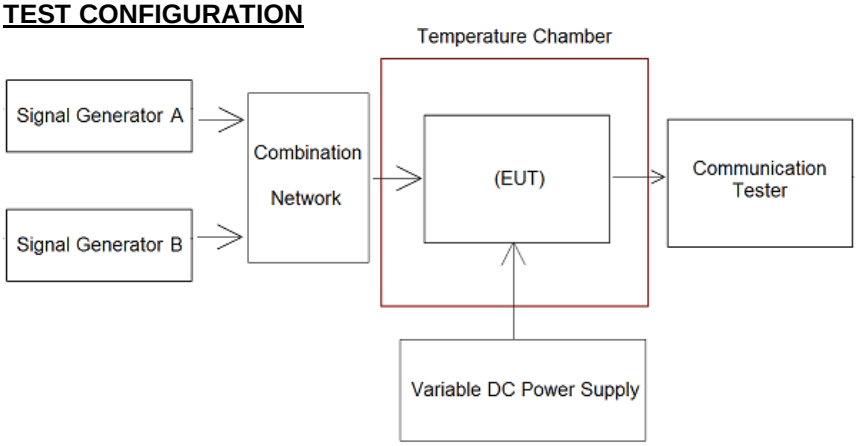
LIMIT

IEC 62238 Sub-clause 9.5.3
25 kHz channels: the adjacent channel selectivity shall be not less than 70 dB under normal test conditions and not less than 60 dB under extreme test conditions.
12,5 kHz channels: the adjacent channel selectivity shall be not less than 60 dB under normal test conditions and not less than 50 dB under extreme test conditions.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.5.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1						
Test Condition		Test Channel	Measurement Position	SG B – SG A (dB)	Limit (dB)	Result
Temperature (℃)	Voltage (V)					
T_N	V_N	CH_L	Lower adjacent	78.80	⩾70	Pass
			Upper adjacent	79.00		
		CH_M	Lower adjacent	78.40		
			Upper adjacent	79.00		
		CH_H	Lower adjacent	85.00		
			Upper adjacent	78.40		
T_L	V_H	CH_L	Lower adjacent	78.40	⩾60	Pass
			Upper adjacent	79.80		
		CH_M	Lower adjacent	80.20		
			Upper adjacent	78.40		
		CH_H	Lower adjacent	80.00		
			Upper adjacent	79.40		
	V_L	CH_L	Lower adjacent	80.20	⩾60	Pass
			Upper adjacent	78.80		
		CH_M	Lower adjacent	80.40		
			Upper adjacent	79.00		
		CH_H	Lower adjacent	78.50		
			Upper adjacent	80.10		
T_H	V_H	CH_L	Lower adjacent	79.80	⩾60	Pass
			Upper adjacent	79.20		
		CH_M	Lower adjacent	79.40		
			Upper adjacent	79.50		
		CH_H	Lower adjacent	79.20		
			Upper adjacent	79.10		
	V_L	CH_L	Lower adjacent	79.80	⩾60	Pass
			Upper adjacent	79.30		
		CH_M	Lower adjacent	79.90		
			Upper adjacent	79.20		
		CH_H	Lower adjacent	78.60		
			Upper adjacent	80.30		

4.3.6. Spurious Response Rejection

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

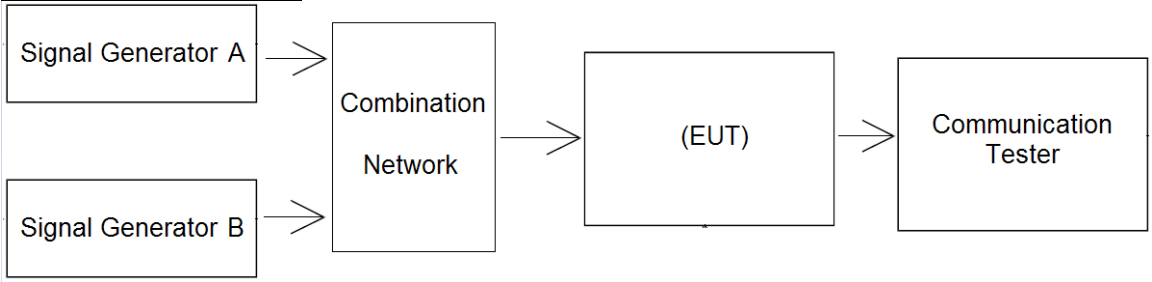
LIMIT

IEC 62238 Sub-clause 9.6.3
At any frequency separated from the nominal frequency of the receiver by more than 25 kHz, the spurious response rejection ratio shall be not less than 70 dB.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.6.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1				
Test Channel	Spurious Frequency (MHz)	SG B – SG A (dB)	Limit (dB)	Result
CH_L	203.425	81.5	≥70	Pass
	567.475	81.5		
	524.675	80.8		
	160.850	81.2		
CH_M	199.600	81.2	≥70	Pass
	556.000	81.7		
	513.200	80.3		
	157.025	82.1		
CH_H	204.400	82.4	≥70	Pass
	570.400	80.9		
	527.600	81.0		
	161.825	82.2		

An increment sweep was made between 100 kHz - 2000 MHz with no other significant responses detected.

4.3.7. Intermodulation response

The intermodulation response is a measure of the capability of a receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

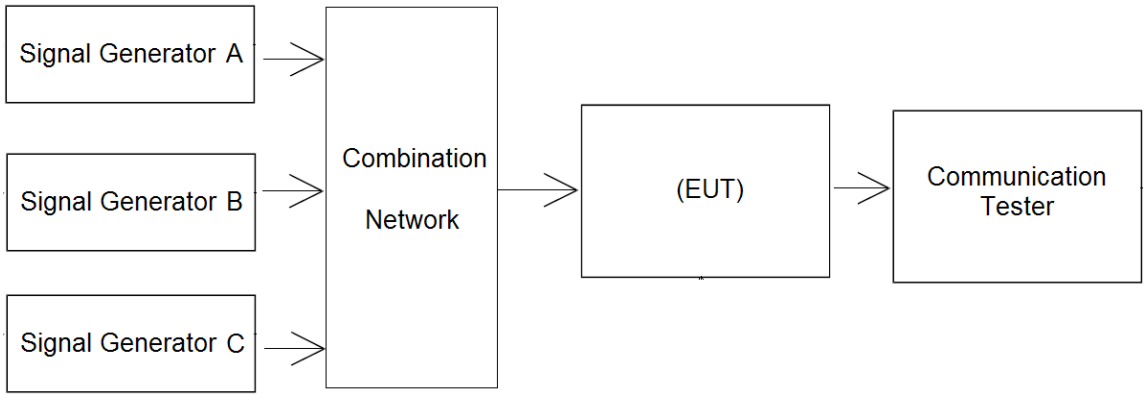
LIMIT

IEC 62238 Sub-clause 9.7.3
The intermodulation response ratio shall not be less than 68 dB.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.7.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1					
Test Channel	Measurement Offset (kHz)		SG B/C – SG A (dB)	Limit (dB)	Result
	SG B	SG C			
CH_L	-50	-100	71.20	⩾68	Pass
	50	100	71.00		
CH_M	-50	-100	71.00	⩾68	Pass
	50	100	70.90		
CH_H	-50	-100	71.30	⩾68	Pass
	50	100	71.40		

4.3.8. Blocking or Desensitization

Blocking is a change (generally a reduction) in the wanted output power of the receiver or a reduction of the SINAD ratio due to an unwanted signal on another frequency.

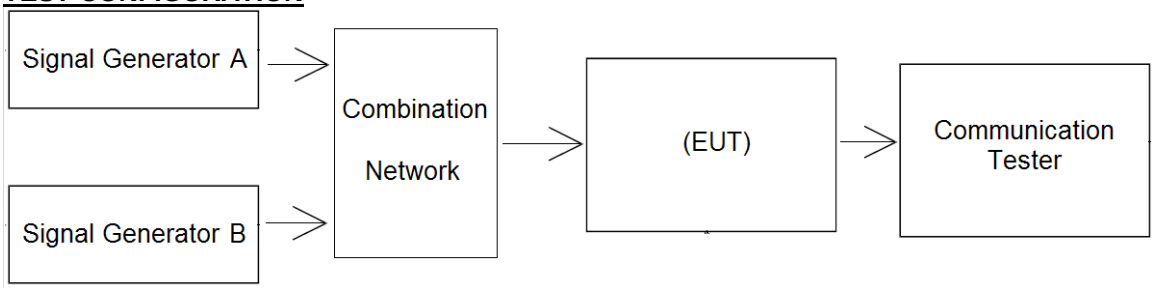
LIMIT

IEC 62238 Sub-clause 9.8.3
The blocking level for any frequency within the specified ranges, shall be not less than 90 dBμV (emf), except at frequencies on which spurious responses are found

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.8.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1				
Test Channel	Measurement Offset (MHz)	SG B (dBμV)	Limit (dBμV)	Result
CH_L	-10	96.80	⩾90	Pass
	-5	95.00		
	-2	95.30		
	-1	92.70		
	1	90.90		
	2	95.20		
	5	96.90		
	10	96.80		
CH_M	-10	96.30	⩾90	Pass
	-5	97.40		
	-2	96.00		
	-1	93.40		
	1	95.80		
	2	95.40		
	5	92.30		
	10	96.70		
CH_H	-10	95.30	⩾90	Pass
	-5	93.50		
	-2	93.20		
	-1	92.10		
	1	94.20		
	2	95.00		
	5	95.30		
	10	95.20		

4.3.9. Conducted spurious emissions

Conducted spurious emissions from the receiver are components at any frequency, present at the receiver input port.

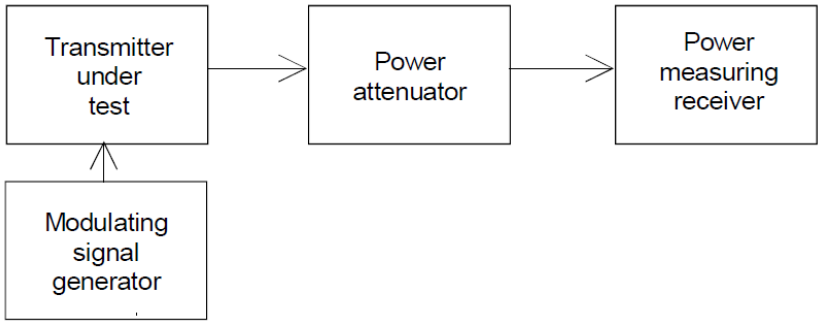
LIMIT

IEC 62238 Sub-clause 9.9.3
The power of any spurious radiation shall not exceed 2 nw(-57dBm) at any frequency in the range between 9 kHz and 2 GHz.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.9.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

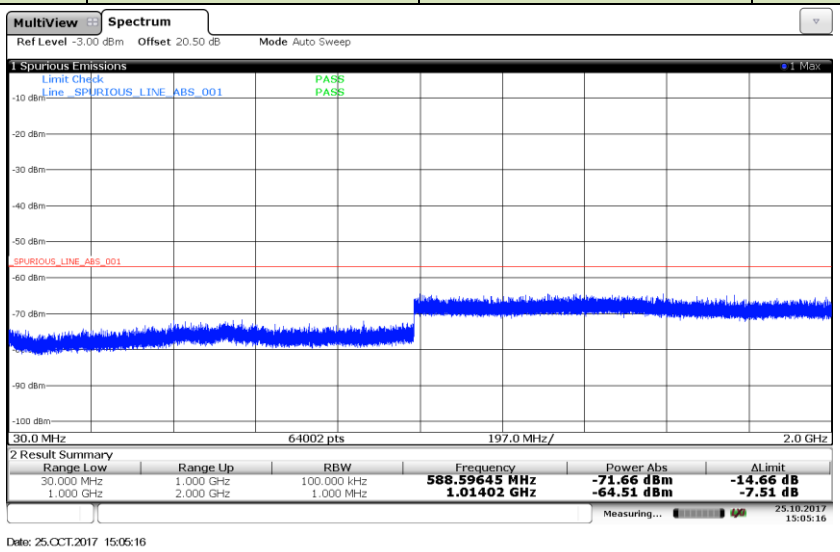
Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

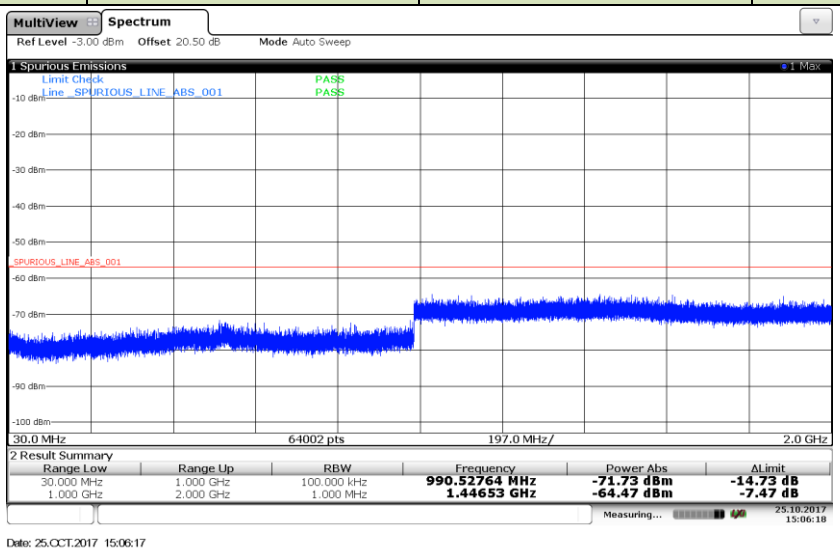
Please refer to the below test data:

Test mode:	RX1	Test Frequency:	CH_L



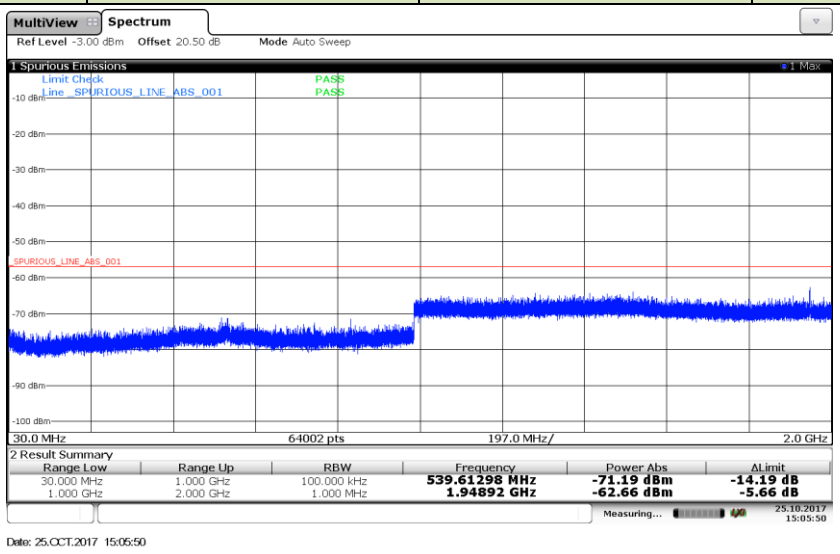
9kHz-2GHz

Test mode:	RX1	Test Frequency:	CH_M



9kHz-2GHz

Test mode:	RX1	Test Frequency:	CH_H



9kHz-2GHz

4.3.10. Receiver noise and hum level

The receiver noise and hum level is defined as the ratio, in dB, of the audio frequency power of the noise and hum resulting from spurious effects of the power supply system or from other causes, to the audio frequency power produced by a high frequency signal of average level, modulated by the normal test modulation and applied to the receiver input.

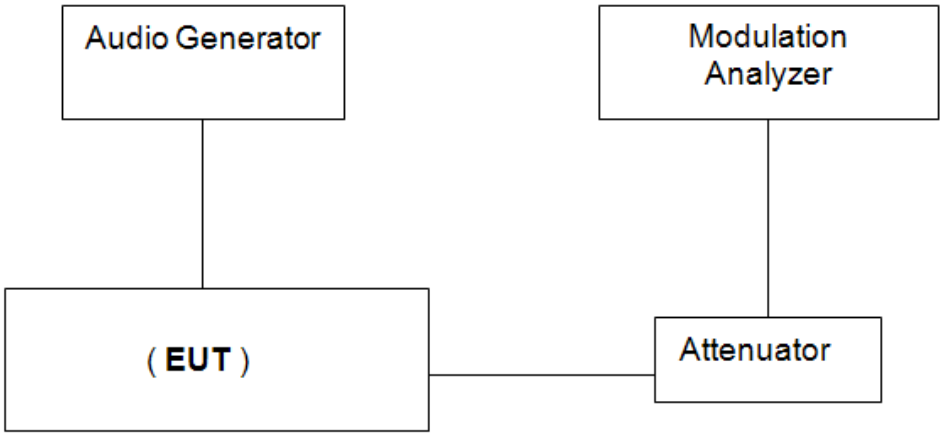
LIMIT

IEC 62238 Sub-clause 9.10.3
The receiver noise and hum level shall not exceed -40 dB, relative to the modulated signal.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.10.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Measured (dB)	Limit (dB)	Result
RX1	CH_L	-43.25	⩽-40	Pass
	CH_M	-43.93		
	CH_H	-43.60		

4.3.11. Squelch operation

The purpose of the squelch facility is to mute the receiver audio output signal when the level of the signal at the receiver input is less than a given value.

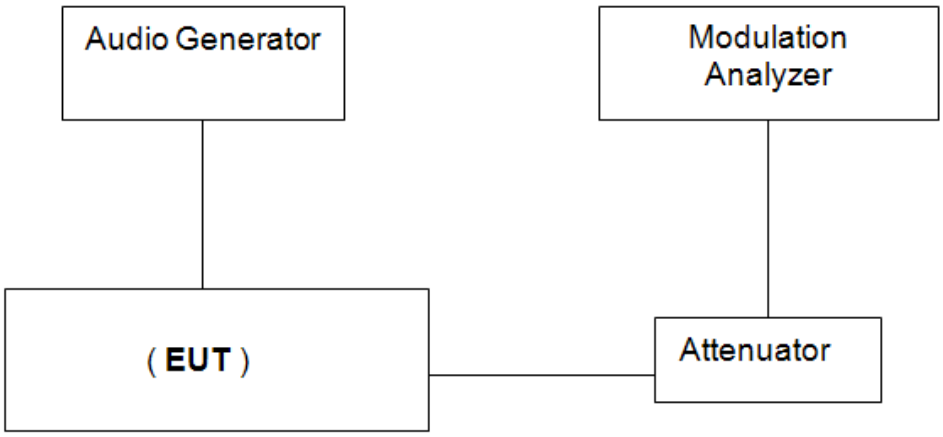
LIMIT

IEC 62238 Sub-clause 9.11.3
Under the conditions specified in a) clause 9.11.2, the audio frequency output power shall not exceed -40 dB relative to the rated output power.
Under the conditions specified in b) clause 9.11.2, the input level shall not exceed +6 dBμV (emf).
Under the conditions specified in c) clause 9.11.2, the input signal shall not exceed +6 dBμV (emf) when the control is set at maximum.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.11.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Under the conditions specified in a):

RX1			
Test Channel	Measured (dB)	Limit (dB)	Result
CH_L	-45.26	≤-40	Pass
CH_M	-45.05		
CH_H	-44.33		

Under the conditions specified in b):

RX1			
Test Channel	Measured (dBμV)	Limit (dBμV)	Result
CH_L	2.18	≤+6.0	Pass
CH_M	2.20		
CH_H	2.15		
CH_L	22.92	⩾20	Pass
CH_M	23.81		
CH_H	24.04		

Under the conditions specified in c):

RX1			
Test Channel	Measured (dBμV)	Limit (dBμV)	Result
CH_L	0.85	≤+6.0	Pass
CH_M	0.84		
CH_H	0.68		

4.3.12. Squelch hysteresis

Squelch hysteresis is the difference in dB between the receiver input signal levels at which the squelch opens and closes.

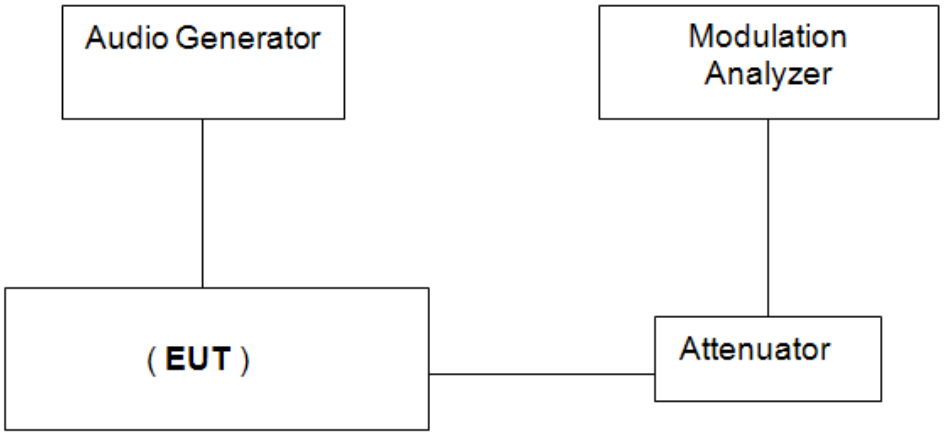
LIMIT

IEC 62238 Sub-clause 9.12.3
The squelch hysteresis shall be between 3 dB and 6 dB.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.12.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

RX1			
Test Channel	Measured (dB)	Limit (dB)	Result
CH_L	4.31	3～6	Pass
CH_M	4.50		
CH_H	4.41		

4.3.13. Multiple watch characteristic

The scanning period is the time between the start of two successive samples of the priority channel in the absence of a signal on that channel.

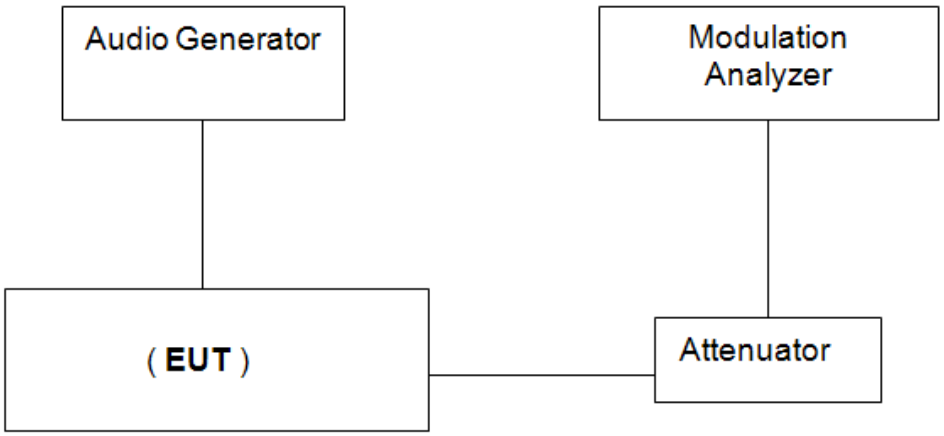
LIMIT

IEC 62238 Sub-clause 9.13.3
The scanning period shall not exceed 2s.
The dwell time on the priority channel shall not exceed 150ms.

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 9.13.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	scanning period (s)	Limit (s)	Result
	CH_M		
TX1	1	≤2	Pass

Operation Mode	Dwell Time(ms)	Limit (ms)	Result
	CH_M		
TX1	100	≤150	Pass

4.4. Receiver for DSC Requirement

4.4.1. Receiver for DSC decoder

The maximum usable sensitivity of the receiver is the minimum level of the signal (e.m.f.) at the nominal frequency of the receiver which when applied to the receiver input with a test modulation will produce a bit error ratio of 10-2

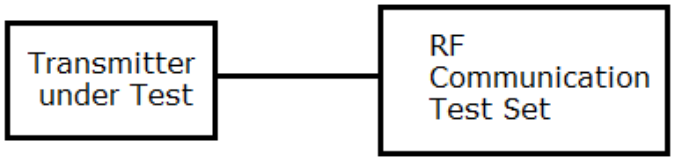
LIMIT

IEC 62238 Sub-clause 10.1.3
The bit error ratio shall be equal to or less than 10-2

TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 10.1.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Condition		Test Channel	Measured (error ratio)	Limit (error ratio)	Result
	Temperature (℃)	Voltage (V)				
RX2	T_N	V_N	CH_{M1}	0.0062	$\leqslant 10^{-2}$	Pass
				0.0055		
	T_L	V_H		0.0064	$\leqslant 10^{-2}$	Pass
				0.0067		
		V_L		0.0058	$\leqslant 10^{-2}$	Pass
				0.0052		
	T_H	V_H		0.0051	$\leqslant 10^{-2}$	Pass
				0.0059		
		V_L		0.0057	$\leqslant 10^{-2}$	Pass
				0.0058		

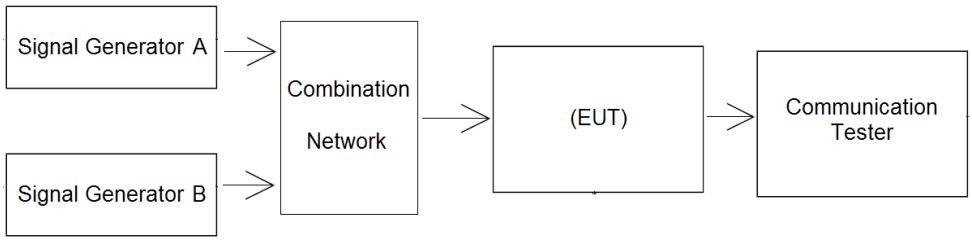
4.4.2. Co-channel rejection

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

LIMIT

IEC 62238 Sub-clause 10.2.3
The bit error ratio shall be equal to or less than 10^{-2}

TEST CONFIGURATION



TEST PROCEDURE

1) Configure the EUT as shown in figure .
2) Adjust the audio input for 20% of rated system deviation at 1kHz using this level as a reference.
3) Vary the Audio frequency from 300Hz to 3 kHz and record the frequency deviation.
4) Audio Frequency Response =20log10 (VFREQ/VREF).

TEST MODE:

Please refer to IEC 62238 Sub-clause 10.2.2 for the measurement method.

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Measurement Offset(kHz)	Measured (error ratio)	Limit(error ratio)	Result
RX2	CH_{M1}	-3	0.0034	$\leqslant 10^{-2}$	Pass
		0	0.0025		
		3	0.0017		

4.4.3. Adjacent channel selectivity

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by 25 kHz.

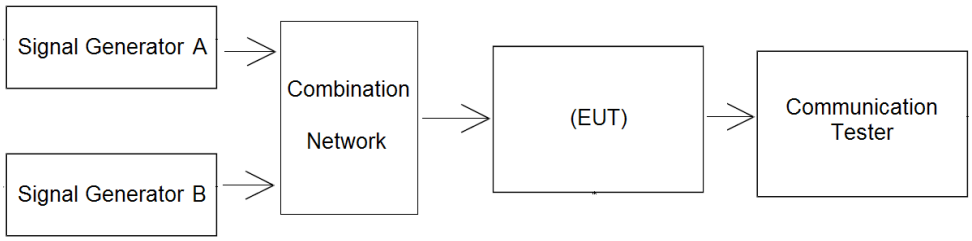
LIMIT

IEC 62238 Sub-clause 10.3.3
The bit error ratio shall be equal to or less than 10^{-2}

TEST PROCEDURE

Please refer to IEC61138 Sub-clause 10.3.2 for the measurement method.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Condition		Test Channel	Measurement Position	Measured (error ratio)	Limit (error ratio)	Result
	Temperature (℃)	Voltage (V)					
RX2	T_N	V_N	CH_{M1}	Lower adjacent	0.0052	$\leqslant 10^{-2}$	Pass
				Upper adjacent	0.0064		
	T_L	V_H		Lower adjacent	0.0039	$\leqslant 10^{-2}$	Pass
				Upper adjacent	0.0084		
		V_L		Lower adjacent	0.0035	$\leqslant 10^{-2}$	Pass
				Upper adjacent	0.0062		
	T_H	V_H		Lower adjacent	0.0077	$\leqslant 10^{-2}$	Pass
				Upper adjacent	0.0065		
		V_L		Lower adjacent	0.0087	$\leqslant 10^{-2}$	Pass
				Upper adjacent	0.0075		

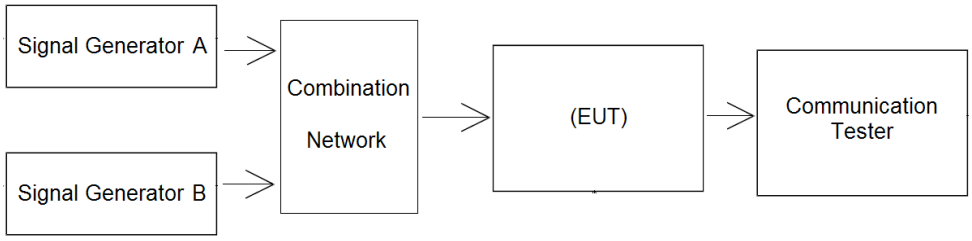
4.4.4. Spurious response and blocking immunity

The spurious response and blocking immunity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the pass band of the receiver.

LIMIT

IEC 62238 Sub-clause 10.4.3
The bit error ratio shall be equal to or less than 10^{-2}

TEST CONFIGURATION



TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 10.4.2 for the measurement method

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Spurious response test result：

Operation Mode	Test Channel	Spurious Frequency (MHz)	Measured (error ratio)	Limit (error ratio)	Result
RX2	CH_{M1}	156.298	0.0068	$\leqslant 10^{-2}$	Pass
		156.753	0.0074		
		138.625	0.0056		
		174.425	0.0065		

Blocking immunity test result：

Operation Mode	Test Channel	Measurement Offset (MHz)	Measured (error ratio)	Limit (error ratio)	Result
RX2	CH_{M1}	-10	0.0077	$\leqslant 10^{-2}$	Pass
		-5	0.0085		
		-2	0.0079		
		-1	0.0078		
		1	0.0081		
		2	0.0067		
		5	0.0075		
		10	0.0074		

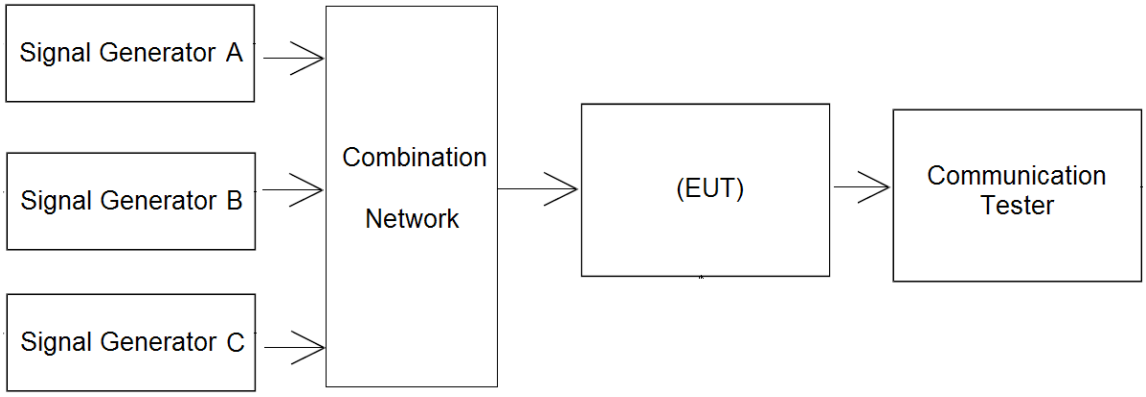
4.4.5. Intermodulation response

The intermodulation response is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

LIMIT

IEC 62238 Sub-clause 10.5.3
The bit error ratio shall be equal to or less than 10^{-2}

TEST CONFIGURATION



TEST PROCEDURE

Please refer to IEC 62238 Sub-clause 10.5.2 for the measurement method.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

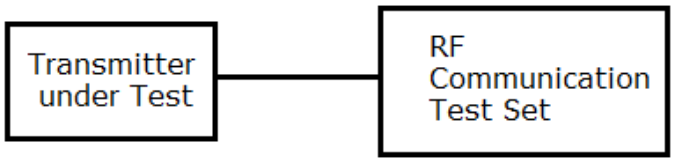
Operation Mode	Test Channel	Measurement Offset(kHz)		Measured (error ratio)	Limit (error ratio)	Result
		SG B	SG C			
RX2	CH_{M1}	-50	-100	0.0088	$\leqslant 10^{-2}$	Pass
		50	100	0.0074		

4.4.6. Dynamic range

The dynamic range of the equipment is the range from the minimum to the maximum level of a radio frequency input signal at which the bit error ratio in the output of the decoder does not exceed a specified value.

Limit
IEC 62238 Sub-clause 10.6.3
The bit error ratio shall be equal to or less than 10^{-2}

TEST CONFIGURATION



TEST PROCEDURE
Please refer to IEC 62238 Sub-clause 10.6.2 for the measurement method

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

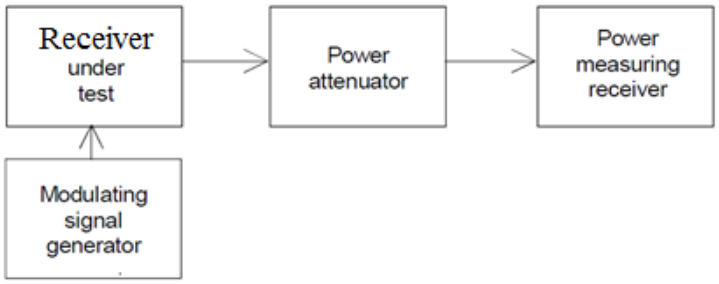
Operation Mode	Test Channel	Measured(error ratio)	Limit(error ratio)	Result
RX2	CH_{M1}	0.0072	$\leqslant 10^{-2}$	Pass

4.4.7. Spurious emissions

Spurious emissions from the receiver are components at any frequency, present at the receiver input port.
The level of spurious emissions shall be measured as the power level at the antenna.

Limit
IEC 62238 Sub-clause 10.7.3
The power of any spurious emission shall not exceed 2 nW at any frequency in the range between 9 kHz and 2 GHz.

TEST CONFIGURATION



TEST PROCEDURE
Please refer to IEC 62238 Sub-clause 10.7.2 for the measurement method.

TEST MODE:

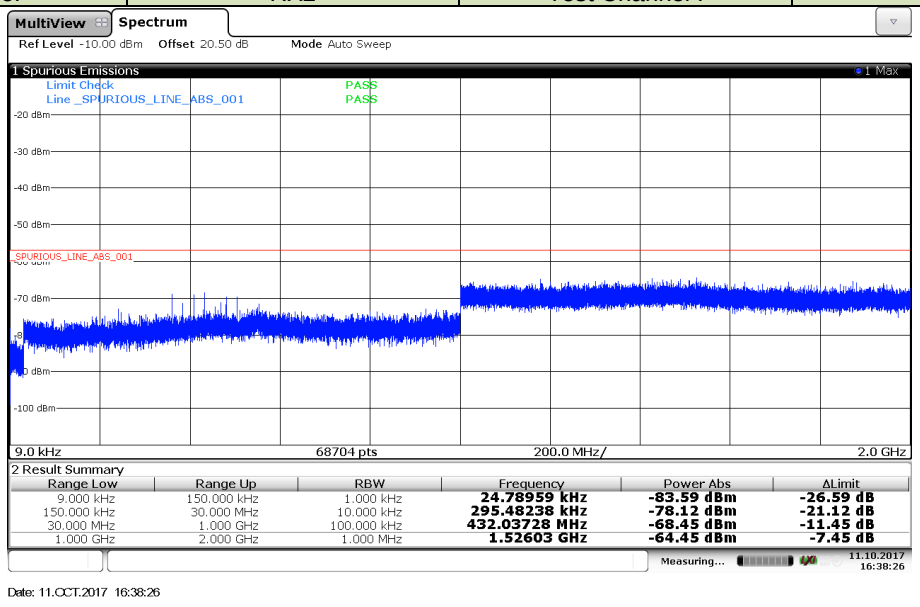
Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Test mode:	RX2	Test Channel :	CH_{M1}



4.4.8. Verification of correct decoding of various types of DSC calls

DSC call sequences are calls that comply with ITU-R Recommendation M.493-14.

Requirement
The requirements of ITU-R Recommendation M.493-14 regarding message composition and content shall be met.
The decoded call sequences at the output of the receiver shall be examined for correct technical format, including error-check characters.
When receiver measurements are made by use of a printer or a computer, a check shall be made to ensure accordance between printer output and display indication.
It shall be verified that the equipment is capable of switching to a channel identified in the DSC call.

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Call Sent	Received (Y or N)	Telecommand 1	Telecommand 2
Distress	Y	100	126
All Ships Distress Ack	Y	110	126
All Ships Distress Relay	Y	112	126
All Ships Urgency	Y	110	126
All Ships Safety	Y	100	126
Individual Urgency	Y	100	126
Individual Safety	Y	100	126
Individual Routine	Y	100	126
Group Routine	v	100	126

Function Check	Result
Confirm that the decoded call sequences at the output of the receiver have been examined for correct technical format, including error check characteristics.	Yes
Errors found:	No
Confirm that the checks have been made to ensure accordance between printer output and display	Yes
Errors found:	No
It has been verified that the equipment is capable of switching to a channel identified in the DSC call:	Yes

4.4.9. Reaction to VTS and AIS channel management DSC transmissions

VTS and AIS channel management DSC transmissions are any DSC transmissions that are in accordance with Recommendation ITU-R M.825 or M.1371.

Requirement
The equipment shall not sound an alarm, display a message (an accurate, imformative display is permissible but not required), transmit a response or suggest a transmitted response, lock up, or require operator intervention.

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

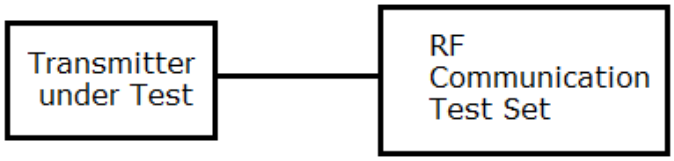
Function Check	Received (Y or N)
Not sound an alarm	Y
Not display a message(An accurate informative display is permissible but not required)	Y
Not transmit a response	Y
Not suggest a transmitted response	Y
Not lock up	Y
Not require operator intervention	Y

4.4.10. Simultaneous reception

Simultaneous reception is the ability of the unit to correctly receive DSC traffic and radiotelephony traffic at the same time.

Limit
IEC 62238 Sub-clause 10.10.3
The bit error ratio shall be equal to or less than 10^{-2}

TEST CONFIGURATION



TEST PROCEDURE
Please refer to IEC 62238 Sub-clause 10.10.2 for the measurement method.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Operation Mode	Test Channel	Measured(SINAD ratio)	Limit (SINAD ratio)	Result
RX1	CH_M	38.5	⩾20	Pass

Operation Mode	Test Channel	Measured(error ratio)	Limit(error ratio)	Result
RX2	CH_{M1}	0.0062	$\leqslant 10^{-2}$	Pass

5. External and Internal Photos of the EUT

Reference to the test report No.: TRE1709011501.

----------End of Report----------