Radio Testing of the
Uniden America Corporation
VHF Marine Transceiver. Model: VHF490
In accordance with IEC 62238

Prepared for: TÜV SÜD America Inc.
Centennial Drive
Peabody
01960-7900
USA

Product Service

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Date: October 2017
Document Number: 75938884-01 | Issue: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Sarah Jones	31 October 2017	
Authorised Signatory	Nic Forsyth	31 October 2017	
Authorised Signatory	Gareth Stephens	31 October 2017	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with IEC 62238: Edition 1 (2003-03) for the tests detailed in section 1.3.

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Product Service

Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	31 October 2017

Table 1

1.2 Introduction

Applicant	TÜV SÜD America Inc.
Manufacturer	Uniden America Corporation
Model Number(s)	VHF490
Serial Number(s)	Not Serialised (75938884-TSR-0001 VT655ZV T/A Sample No 2 VT655ZV T/A Sample No 4
Hardware Version(s)	EPP
Software Version(s)	1.00.01
Number of Samples Tested	3
Test Specification/Issue/Date	IEC 62238: Edition 1 (2003-03)
Order Number Date	72127187 24-April-2017
Date of Receipt of EUT	08-August-2017, 21-August-2017 and 25-September-2017
Start of Test	02-August-2017
Finish of Test	17-October-2017
Name of Engineer(s)	Malcolm Musgrave & Matthew Russell
Related Document(s)	IEC 60945: 2002

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1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 62238 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: DC Powered - VHF & DSC				
2.1	7.4	Vibration Test	Pass	IEC 60945:2002
2.2	7.5	Temperature Tests - Dry Heat Functional Test	Pass	IEC 60945:2002
2.3	7.5	Temperature Tests - Damp Heat Functional Test	Pass	IEC 60945:2002
2.4	7.5	Temperature Tests - Low Temperature Functional Test	Pass	IEC 60945:2002
2.5	8.1	Frequency Error	Pass	
2.6	8.2	Carrier Power	Pass	
2.7	8.3	Frequency Deviation	Pass	
2.8	8.4	Sensitivity of the Modulator including Microphone	Pass	
2.9	8.5	Audiofrequency Response	Pass	
2.10	8.6	Audiofrequency Harmonic Distortion of the Emission	Pass	
2.11	8.7	Adjacent Channel Power	Pass	
2.12	8.8	Conducted Spurious Emissions Conveyed to the Antenna	Pass	
2.13	8.9	Transient Frequency Behaviour of the Transmitter	Pass	
2.14	8.10	Residual Modulation of the Transmitter	Pass	
2.15	8.11	Frequency Error (DSC Signal)	Pass	
2.16	8.12	Modulation Index for DSC	Pass	
2.17	8.13	Modulation Rate for DSC	Pass	
2.18	8.14	Testing of Generated Call Sequences	Pass	
2.19	9.1	Harmonic Distortion and Rated Audiofrequency Output Power	Pass	
2.20	9.2	Audiofrequency Response	Pass	

Section	Specification Clause	Test Description	Result	Comments/Base Standard
2.21	9.3	Maximum Usable Sensitivity	Pass	
2.22	9.4	Co-channel Rejection	Pass	
2.23	9.5	Adjacent Channel Selectivity	Pass	
2.24	9.6	Spurious Response Rejection	Pass	
2.25	9.7	Intermodulation Response	Pass	
2.26	9.8	Blocking or Desensitization	Pass	
2.27	9.9	Spurious Emissions	Pass	
2.28	9.10	Receiver Residual Noise Level	Pass	
2.29	9.11	Squelch Operation	Pass	
2.30	9.12	Squelch Hysterisis	Pass	
2.31	9.13	Multiple Watch Characteristic	Pass	
2.32	10.1	DSC - Maximum Usable Sensitivity	Pass	
2.33	10.2	DSC - Co-channel Rejection	Pass	
2.34	10.3	DSC - Adjacent Channel Selectivity	Pass	
2.35	10.4	DSC - Spurious Response and Blocking Immunity	Pass	
2.36	10.5	DSC - Intermodulation Response	Pass	
2.37	10.6	DSC - Dynamic Range	Pass	
2.38	10.7	DSC - Spurious Emissions	Pass	
2.39	10.8	Verification of Correct Decoding of Various Types of DSC Calls	Pass	
2.40	10.9	Reaction to VTS and AIS Channel Management DSC Transmissions	Pass	
2.41	10.10	Simultaneous Reception	Pass	

Table 2

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	VHF490
Part Number	1 and 2
Hardware Version	EPP
Software Version	1.00.01
Technical Description (Please provide a brief description of the intended use of the equipment)	See Owner's Manual

EXTREME TEMPERATURE RANGE (over which equipment is to be type tested)	
☐	Not Applicable (no extreme temperature testing required)
☐	Category I (General)
☐	Category II (Portable equipments)
☒	Other (please specify): -20 - +55 (IEC 60945 Protected)

TYPE OF EQUIPMENT							
☒	Fixed Station	☐	Transmitter	☐	Simplex	☐	Integral Antenna
		☐	Receiver	☐	Duplex	☒	Single Antenna
☐	Mobile Station	☒	Transceiver			☐	Two Antenna Connector
						☐	Multiple Antenna Connectors No.
☐	Portable Station	☐					
☐	Transponder (Tag)	☐	Active	☐	Passive		

TRANSMITTER TECHNICAL CHARACTERISTICS		
FREQUENCY CHARACTERISTICS		
Transmitter frequency alignment range	NA to NA	MHz
Transmitter channel switching frequency range	156.050MHz to 161.600MHz	MHz

TRANSMITTER RF POWER CHARACTERISTICS							
Maximum rated transmitter output power as stated by manufacturer (if applicable)							
25	W	At transmitter permanent external 50 Ω RF output connector					
and/or							
	W	Effective radiated power (for equipment with integral antenna)					
Minimum rated transmitter output power as stated by manufacturer (if applicable)							
1	W	At transmitter permanent external 50 Ω RF output connector					
and/or							
	W	Effective radiated power (for equipment with integral antenna)					
Is transmitter intended for :							
Continuous duty					☐	Yes	☒ No
Intermittent duty only					☒	Yes	☐ No
If intermittent duty state DUTY CYCLE							
Transmitter ON	300	Seconds	Transmitter OFF	300	Seconds		

TRANSMITTER - MODULATION			
Amplitude	☐	Other	☐
Frequency	☒	Details :	FM , FSK
Phase	☐	Channel Spacing	25kHz
Can the transmitter be operated without modulation? * See definition below		☒ Yes	☐ No

RECEIVER TECHNICAL CHARACTERISTICS	
FREQUENCY CHARACTERISTICS	
Receiver frequency alignment range	NA to NA
Receiver channel switching frequency range	156.050MHz to 162.550MHz
Channel Separation (if applicable)	25kHz
State the maximum number of channels over which the equipment can operate:	102

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RECEIVER TECHNICAL CHARACTERISTICS			
POWER SOURCE			
☐ AC mains		State voltage	
AC supply frequency	(Hz)		
VAC			
Max Current			
Hz			
☐ Single phase		☐ Three phase	
And / Or			
☒ External DC supply			
Nominal voltage	13.8 V	Max Current	6 A
Extreme upper voltage	15.6 V		
Extreme lower voltage	10.8 V		
Battery			
☐ Nickel Cadmium		☐ Lead acid (Vehicle regulated)	
☐ Alkaline		☐ Leclanche	
☐ Lithium		☐ Other Details :	
Volts nominal.			
End point voltage as quoted by equipment manufacturer		V	

AUTOMATIC EQUIPMENT SWITCH OFF	
If the equipment is designed to automatically switch off at a predetermined voltage level which is higher or lower in value than the battery minimum and minimum calculated values this shall be clearly stated.	
☐ Applies	V cut-off voltage
☒ Does not apply	

CHANNEL IDENTIFICATION

Each equipment, whether one or more submitted for tests shall carry clear identification (such as a serial number), together with the frequencies associated with the channel identification displayed on the equipment.

Equipment Identification eg Serial Number	Channel No.	Transmit Nominal Freq MHz	Receive Nominal Freq MHz
1	16	156.800	156.800
2	16	156.800	156.800

I hereby declare that that the information supplied is correct and complete.

Name: Tetsuro Otake Position held: Senior Engineering Director

Date: 6, June 2017

1.5 Product Information

1.5.1 Technical Description

Fixed Mount Marine DSC Radio.

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: Not Serialised (75938884-TSR-0001)			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: VT655ZV T/A Sample No 2			
1	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: VT655ZV T/A Sample No 4			
2	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: DC Powered - VHF & DSC		
Vibration Test	Malcolm Musgrave	UKAS
Temperature Tests - Dry Heat Functional Test	Malcolm Musgrave	UKAS
Temperature Tests - Damp Heat Functional Test	Malcolm Musgrave	UKAS
Temperature Tests - Low Temperature Functional Test	Malcolm Musgrave	UKAS
Frequency Error	Malcolm Musgrave	UKAS
Carrier Power	Malcolm Musgrave	UKAS
Frequency Deviation	Malcolm Musgrave	UKAS
Sensitivity of the Modulator including Microphone	Malcolm Musgrave	UKAS
Audiofrequency Response	Malcolm Musgrave	UKAS
Audiofrequency Harmonic Distortion of the Emission	Malcolm Musgrave	UKAS

Test Name	Name of Engineer(s)	Accreditation
Adjacent Channel Power	Malcolm Musgrave	UKAS
Conducted Spurious Emissions Conveyed to the Antenna	Malcolm Musgrave	Not UKAS
Transient Frequency Behaviour of the Transmitter	Malcolm Musgrave	UKAS
Residual Modulation of the Transmitter	Malcolm Musgrave	UKAS
Frequency Error (DSC Signal)	Matthew Russell	UKAS
Modulation Index for DSC	Malcolm Musgrave	UKAS
Modulation Rate for DSC	Malcolm Musgrave	UKAS
Testing of Generated Call Sequences	Malcolm Musgrave	UKAS
Harmonic Distortion and Rated Audiofrequency Output Power	Malcolm Musgrave	UKAS
Audiofrequency Response	Malcolm Musgrave	UKAS
Maximum Usable Sensitivity	Malcolm Musgrave	UKAS
Co-channel Rejection	Malcolm Musgrave	UKAS
Adjacent Channel Selectivity	Malcolm Musgrave	UKAS
Spurious Response Rejection	Malcolm Musgrave	UKAS
Intermodulation Response	Malcolm Musgrave	UKAS
Blocking or Desensitization	Malcolm Musgrave	UKAS
Spurious Emissions	Malcolm Musgrave	UKAS
Receiver Residual Noise Level	Malcolm Musgrave	UKAS
Squelch Operation	Malcolm Musgrave	UKAS
Squelch Hysterisis	Malcolm Musgrave	UKAS
Multiple Watch Characteristic	Malcolm Musgrave	UKAS
DSC - Maximum Usable Sensitivity	Malcolm Musgrave	UKAS
DSC - Co-channel Rejection	Malcolm Musgrave	UKAS
DSC - Adjacent Channel Selectivity	Malcolm Musgrave	UKAS
DSC - Spurious Response and Blocking Immunity	Malcolm Musgrave	UKAS
DSC - Intermodulation Response	Malcolm Musgrave	UKAS
DSC - Dynamic Range	Malcolm Musgrave	UKAS
DSC - Spurious Emissions	Malcolm Musgrave	UKAS
Verification of Correct Decoding of Various Types of DSC Calls	Malcolm Musgrave	UKAS
Reaction to VTS and AIS Channel Management DSC Transmissions	Malcolm Musgrave	UKAS
Simultaneous Reception	Malcolm Musgrave	UKAS

Table 4

Product Service

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Vibration Test

2.1.1 Specification Reference

IEC 62238, Clause 7.4

2.1.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.1.3 Date of Test

07-August-2017 to 08-August-2017

2.1.4 Test Method

IEC60945 main extract and application:

- EUT fastened to vibration table
- EUT subjected to sinusoidal vertical vibration at all frequencies between:
- 2 Hz to 5 Hz up to 13.2 Hz with excursion ±1 mm ±10%
  (7 m/s^2 maximum acceleration at 13.2Hz); and
- 13.2Hz to 100Hz with constant maximum acceleration of 7 m/s^2
- Frequency sweep rate 0.5octaves/min
- Resonance search carried out throughout the test
- During the resonance search, EUT externally observed for obvious signs of resonance
- Resonance(s) measured by sensor at resonance location(s)
- If magnitude ratio ≥5, EUT subjected to vibration endurance test at each resonant frequency for 2 h.

  When resonant frequencies with magnitude ratio ≥ 5 are harmonically related, only fundamental frequency tested.
- If no resonance with magnitude ratio ≥5, endurance test carried out at one single observed frequency.
- If no resonance occurred, endurance test carried out at 30 Hz.
- Performance check(s) were carried out once during (approximately mid-way) and once before the end of each endurance test period.
- Procedure was repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

2.1.5 Environmental Conditions

Ambient Temperature 21.4 - 24.0 °C
Relative Humidity 56.2 - 62.6 %

2.1.6 Test Results

DC Powered - VHF & DSC

Parameter	Unit	Value
DC Power Supply Voltage	V DC	13.8

Table 5 - General Setup Parameters for Vibration Test

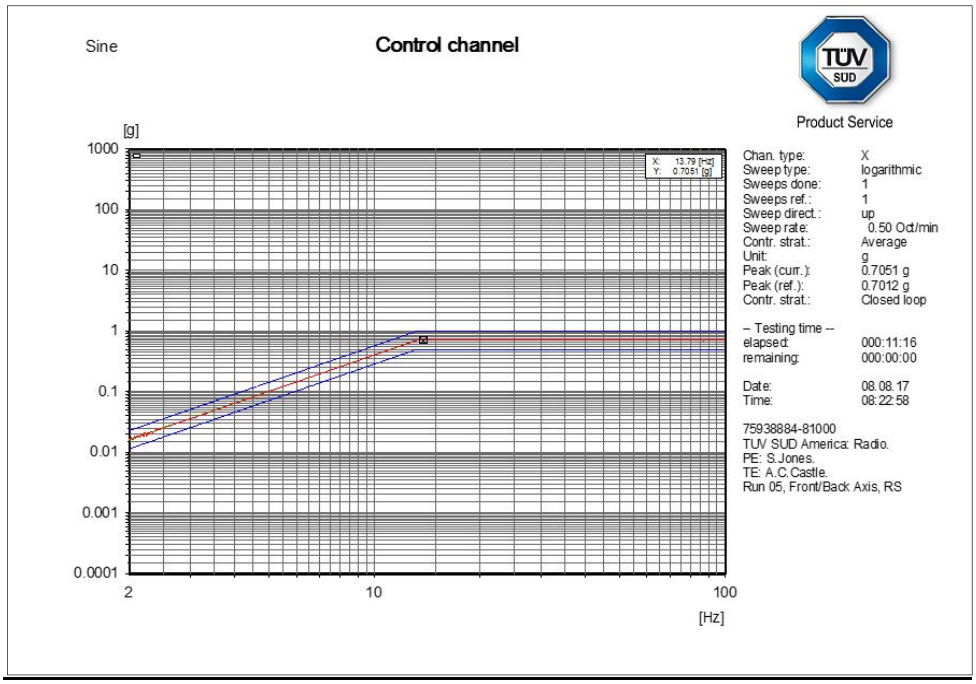
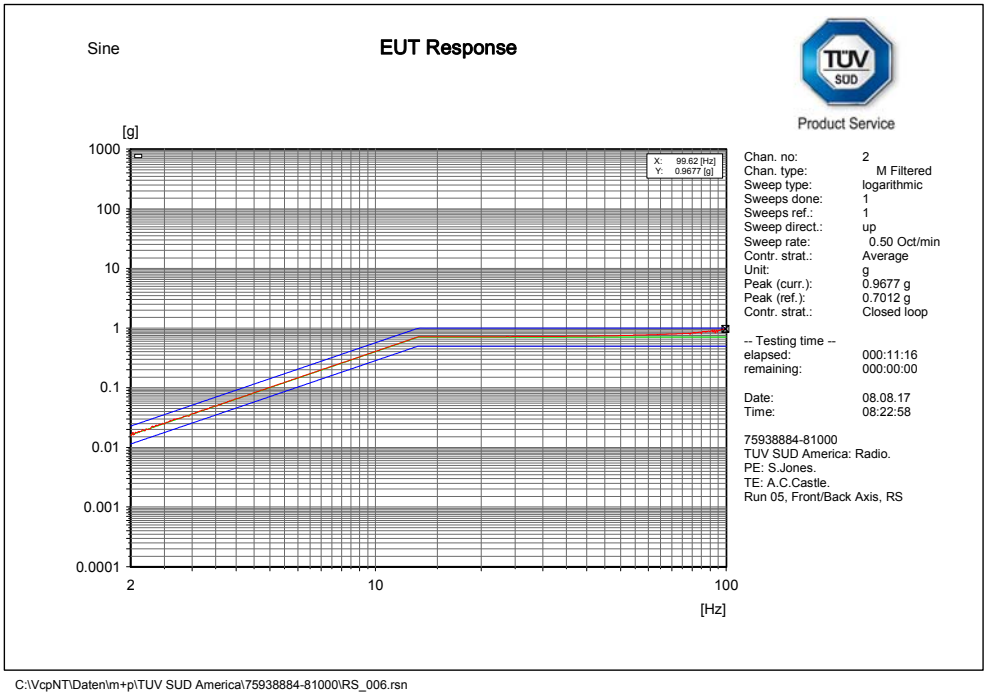


Figure 1 - Resonance Search (Control) - Fore-Aft



C:\VcpNT\Daten\m+p\TUV SUD America\75938884-81000\RS_006.rsn

Figure 2 - Resonance Search (EUT) - Fore-Aft

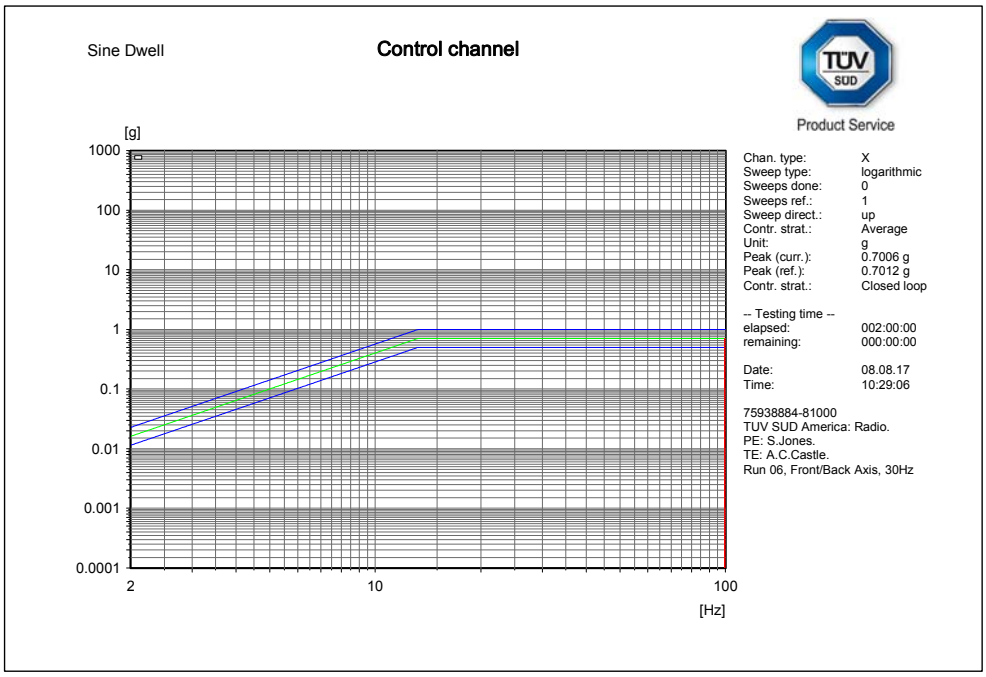


Figure 3 – Endurance Run (Control) - Fore-Aft

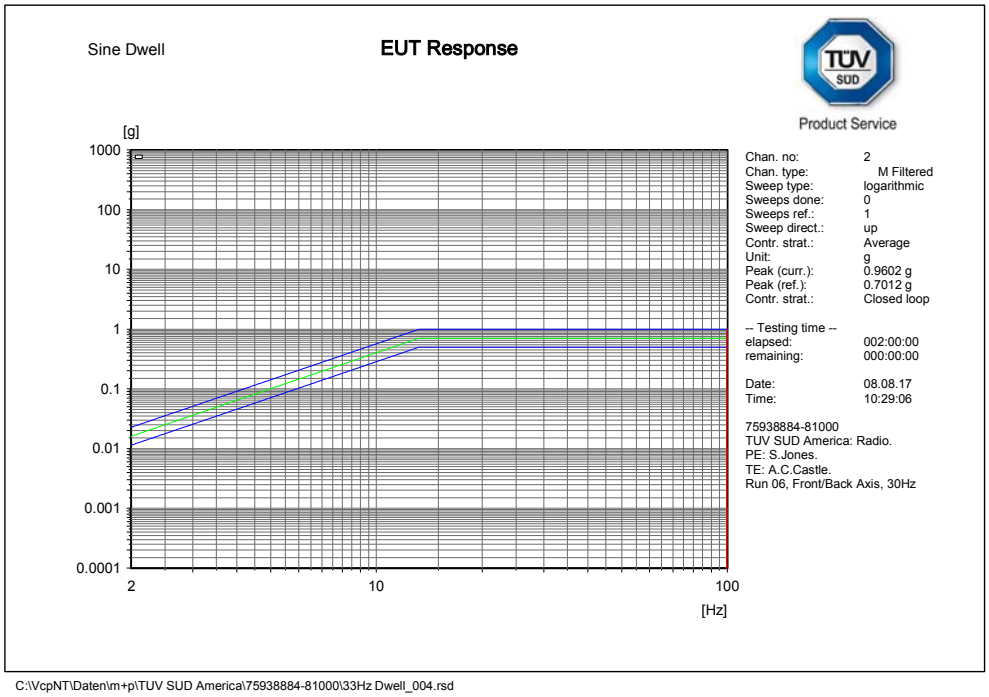


Figure 4 – Endurance Run (EUT) - Fore-Aft

Endurance Run		
Frequency (Hz)	Duration (hours)	Applied Acceleration Set Point (m/s^2)
99.62	2	7

Table 6 - Vibration Test Data - Fore-Aft

Performance Check	Frequency Error (Hz)	Carrier Power	Sensitivity - SINAD (dB)	DSC Sensitivity - BER (%)
During Endurance Test	-384	43.33 dBm / 21.53 W	36.6	0
Near end of Endurance Test	-395	43.33 dBm / 21.53 W	36.7	0

Table 7 - Performance Check Results - Fore-Aft

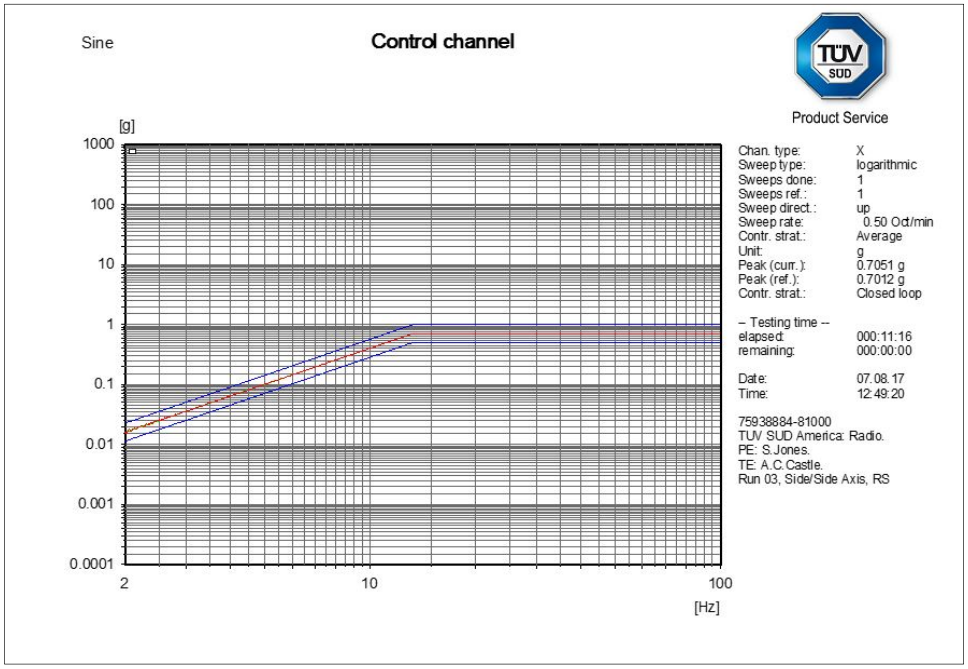


Figure 5 - Resonance Search (Control) – Side to Side

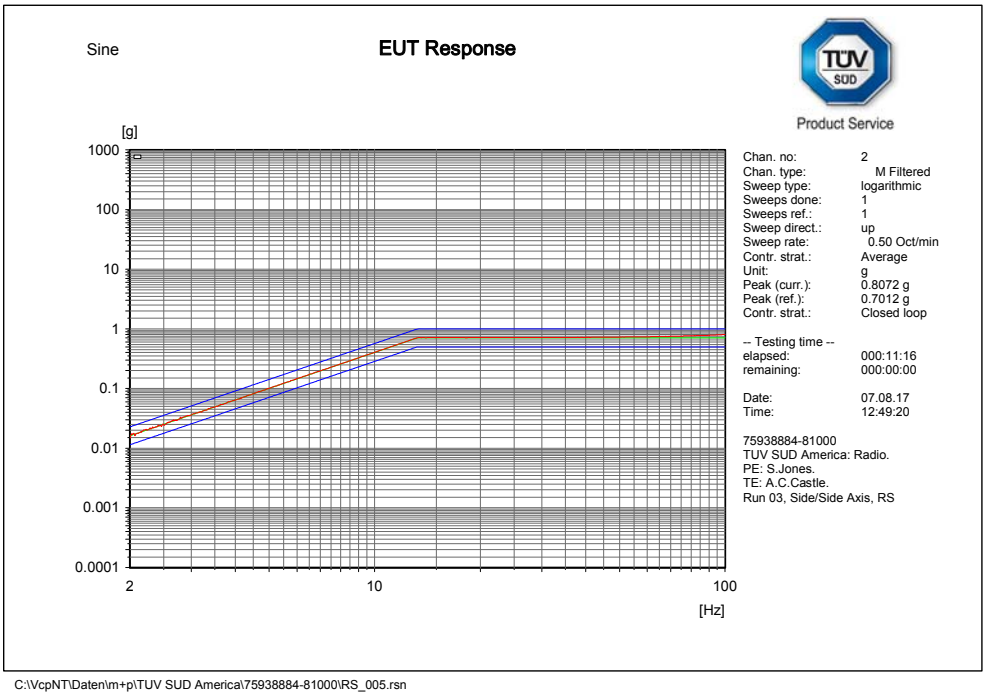


Figure 6 - Resonance Search (EUT) – Side to Side

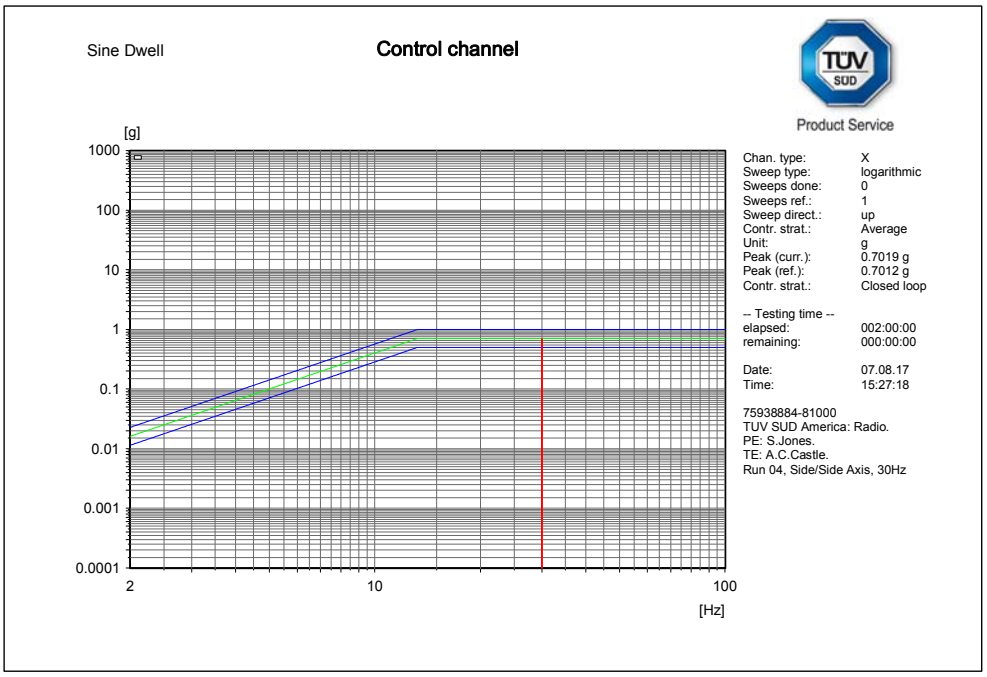


Figure 7 – Endurance Run (Control) – Side to Side

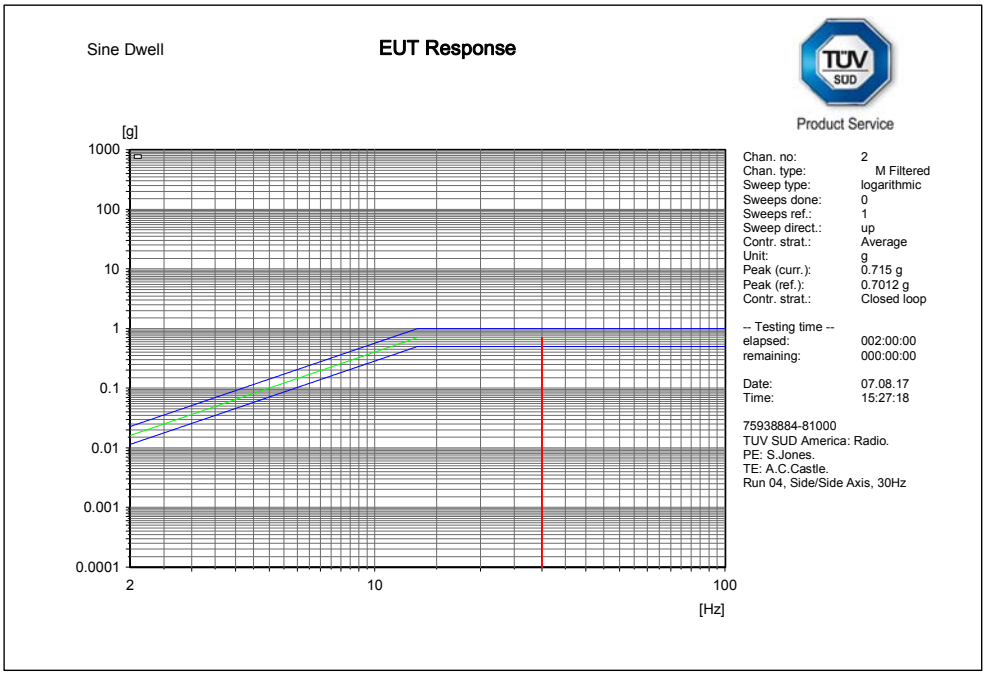


Figure 8 – Endurance Run (EUT) – Side to Side

Endurance Run		
Frequency (Hz)	Duration (hours)	Applied Acceleration Set Point (m/s^2)
30	2	7

Table 8 - Vibration Test Data - Horizontal

Performance Check	Frequency Error (Hz)	Carrier Power	Sensitivity - SINAD (dB)	DSC Sensitivity - BER (%)
During Endurance Test	-387	43.35 dBm / 21.63 W	36.7	0
Near end of Endurance Test	-403	43.34 dBm / 21.58 W	36.4	0

Table 9 - Performance Check Results - Horizontal

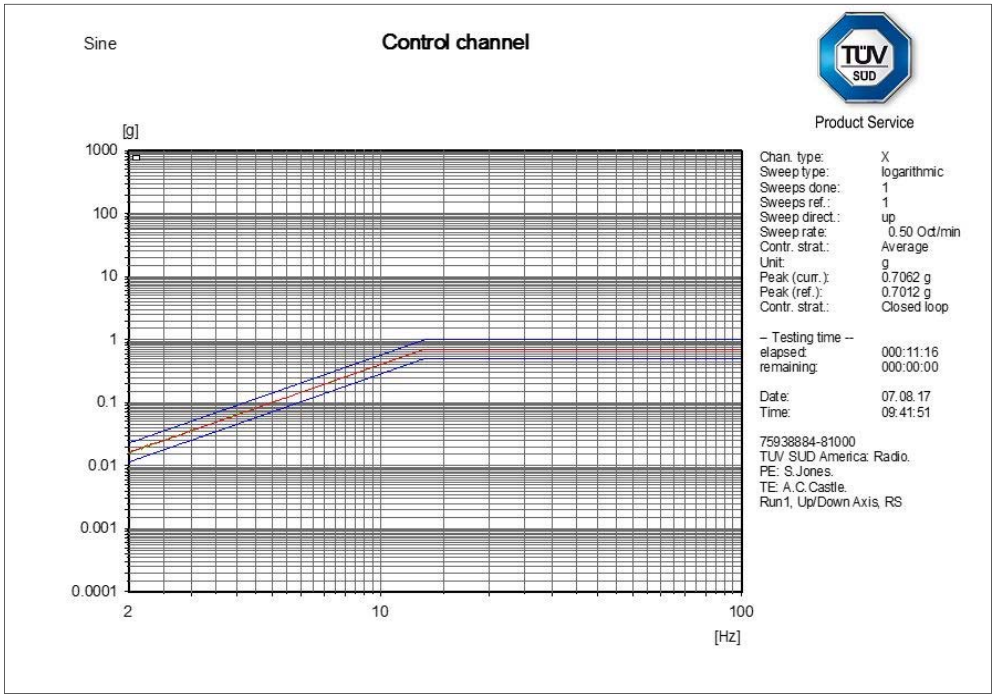


Figure 9 - Resonance Search (Control) – Up and Down

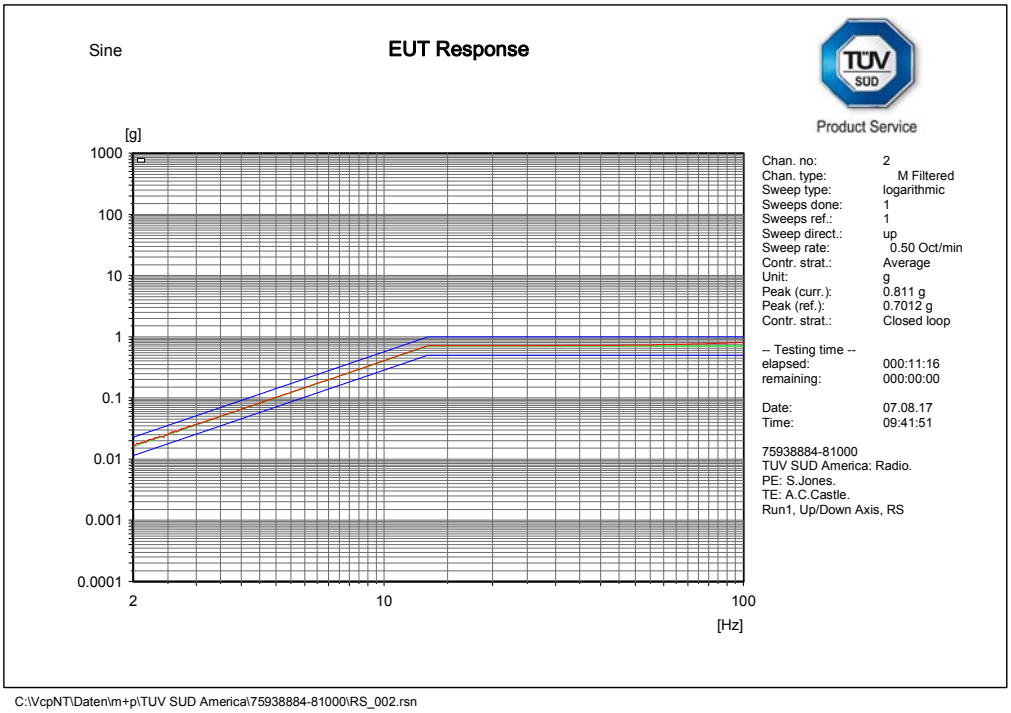


Figure 10 - Resonance Search (EUT) – Up and Down

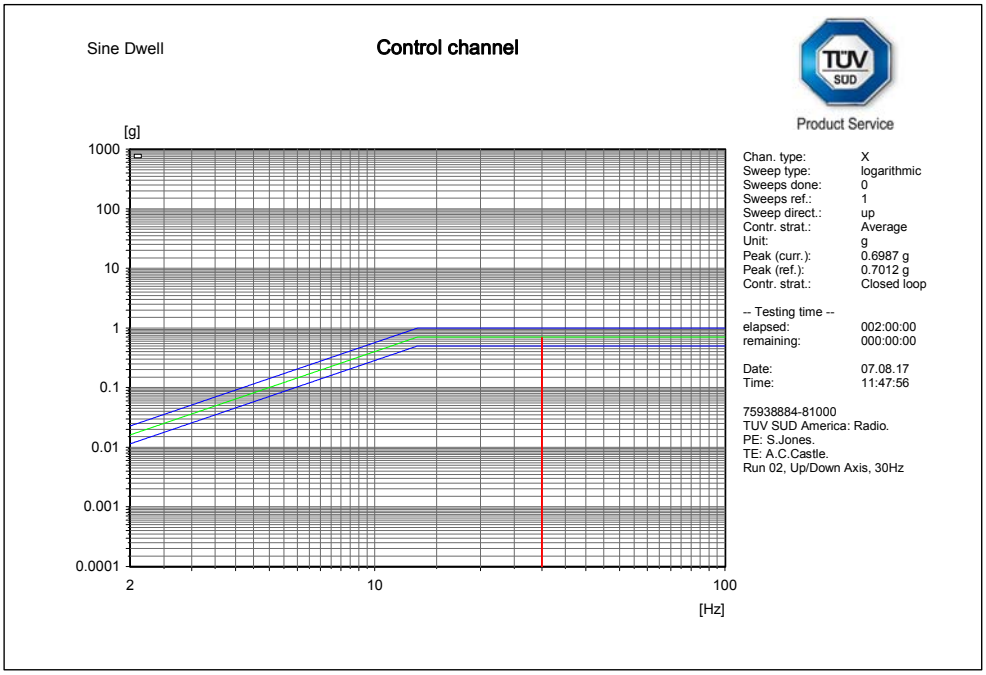


Figure 11 – Endurance Run (Control) – Up and Down

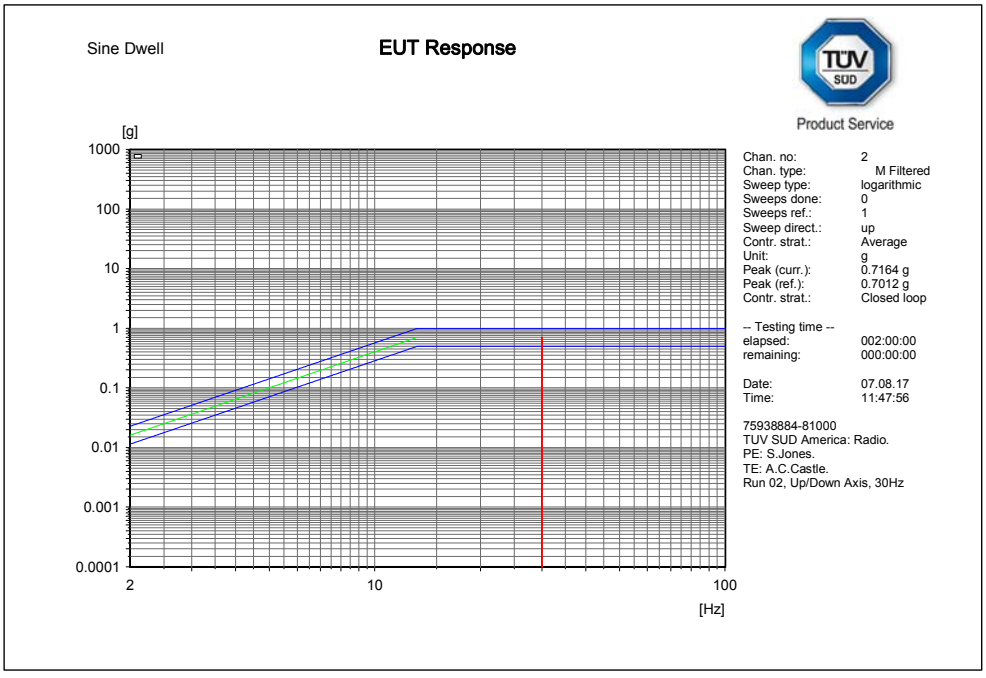


Figure 12 – Endurance Run (EUT) – Up and Down

Endurance Run		
Frequency (Hz)	Duration (hours)	Applied Acceleration Set Point (m/s^2)
30	2	7

Table 10 - Vibration Test Data - Vertical

Performance Check	Frequency Error (Hz)	Carrier Power	Sensitivity - SINAD (dB)	DSC Sensitivity - BER (%)
During Endurance Test	-268	43.35 dBm / 21.63 W	37.0	0
Near end of Endurance Test	-380	43.34 dBm / 21.58 W	37.5	0

Table 11 - Performance Check Results - Vertical

Remarks

Following all the endurance runs the EUT was visually inspected and there was no sign of harmful deterioration visible to the naked eye.

IEC 62238, Limit Clause 7.3

Where the term “performance check” is used, this shall be taken to mean a visual inspection of the equipment, a test of the transmitter output power and frequency error, and the receiver sensitivity to show that the equipment is functioning and that there is no visible damage or deterioration.

a) For the transmitter:

The transmitter shall be connected to the artificial antenna and tuned to channel 16. The measurements shall be made in the absence of modulation with the power switch set at maximum. The output power shall be between 6 W and 25 W, and the frequency error shall be less than ±1,5 kHz.

b) For the radiotelephone receiver:

A test signal with a level of +12 dBµV shall be applied to the receiver input as in 9.3.2. The SINAD ratio at the receiver output shall be equal to or greater than 20 dB.

c) For the DSC receiver:

A standard DSC test signal (see 6.8) with a level of +6 dBµV shall be applied to the receiver input. The symbol error ratio in the decoder output shall be equal to or less than 10^{-2}.

2.1.7 Test Location and Test Equipment Used

This test was carried out in LDS 875 Shaker.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	05-Sep-2017
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81		O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Hygromer	Rotronic	A1	2138	12	02-Feb-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2017
GPS/SBAS Simulator	Spirent	STR4500	3056	-	30-Sep-2017
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD Product Service	RAB 200701	3314	12	03-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA40	3548	12	02-Oct-2017
Calibration Kit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 12

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.2 Temperature Tests - Dry Heat Functional Test

2.2.1 Specification Reference

IEC 62238, Clause 7.5

2.2.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.2.3 Date of Test

14-August-2017 to 15-August-2017

2.2.4 Test Method

IEC60945 main extract and application:

- Performance Check at normal environmental conditions as per IEC60945 Clause 8.1 was carried out prior to testing.
- EUT placed in a chamber at normal conditions
- EUT (and climatic control devices as appropriate) switched on
- Temperature raised to and maintained at +55°C±3°C
- Soak for 10 h to 16 h at +55°C±3°C
- Chamber maintained at +55°C±3°C for:
- Performance Test at Normal power supply
- Performance Check at Low Extreme and High Extreme power supply
- EUT returned to normal environmental conditions in not less than 1 hour.

2.2.5 Environmental Conditions

Ambient Temperature	23.0 °C
Relative Humidity	56.2 %

2.2.6 Test Results

DC Powered - VHF & DSC

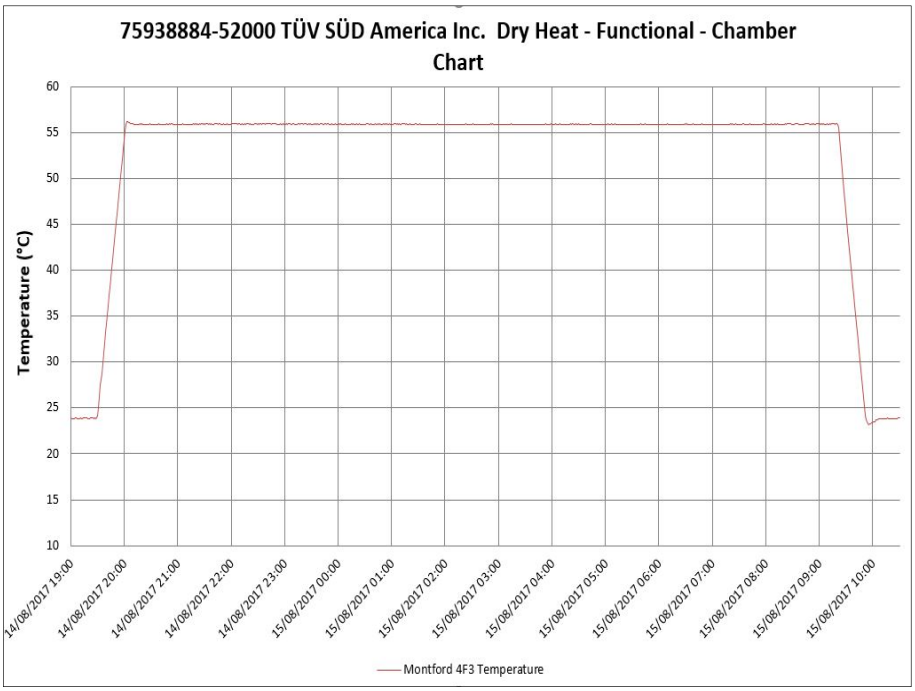


Figure 13 - Temperature % Humidity Versus Time

Performance Check	Frequency Error (Hz)		Carrier Power		Sensitivity - SINAD (dB)		DSC Sensitivity - BER (%)	
	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC
During Operational Period	+395	+356	43.33 dBm / 21.53 W	42.22 dBm / 16.67 W	35.4	35.4	0	0

Table 13 - Performance Check Results - Dry Heat Functional Test

Remarks

It was confirmed that the temperature remained within +55 °C ± 3 °C and that the rate of change of temperature did not exceed 1 °C/min.

IEC 62238, Limit Clause 7.3

Where the term “performance check” is used, this shall be taken to mean a visual inspection of the equipment, a test of the transmitter output power and frequency error, and the receiver sensitivity to show that the equipment is functioning and that there is no visible damage or deterioration.

a) For the transmitter:

The transmitter shall be connected to the artificial antenna and tuned to channel 16. The measurements shall be made in the absence of modulation with the power switch set at maximum. The output power shall be between 6 W and 25 W, and the frequency error shall be less than ±1,5 kHz.

b) For the radiotelephone receiver:

A test signal with a level of +12 dBµV shall be applied to the receiver input as in 9.3.2. The SINAD ratio at the receiver output shall be equal to or greater than 20 dB.

c) For the DSC receiver:

A standard DSC test signal (see 6.8) with a level of +6 dBµV shall be applied to the receiver input. The symbol error ratio in the decoder output shall be equal to or less than 10^{-2}.

2.2.7 Test Location and Test Equipment Used

This test was carried out in Montford 4ft³ Chamber.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	05-Sep-2017
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81		O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Montford F43	Montford	4FT CUBED	2126	12	25-Nov-2017
Hygromer	Rotronic	I-1000	2496	-	TU
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2017
GPS/SBAS Simulator	Spirent	STR4500	3056	-	30-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD Product Service	RAB 200701	3314	12	03-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA40	3548	12	02-Oct-2017
Calibration Kit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 14

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.3 Temperature Tests - Damp Heat Functional Test

2.3.1 Specification Reference

IEC 62238, Clause 7.5

2.3.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.3.3 Date of Test

17-August-2017 to 18-August-2017

2.3.4 Test Method

IEC60945 main extract and application:

- Performance Check at normal environmental conditions as per IEC60945 Clause 8.1 was carried out prior to testing.
- EUT placed in a chamber at normal conditions
- Temperature raised to +40°C±2°C
- Relative humidity raised to 93%±3% over a period of 3h±0.5h
- Conditions shall be maintained for 10h to 16h
- Where appropriate, climatic control devices switched on for 30min
- EUT switched on and kept operational for ≥2h
- Chamber maintained at above conditions for:
- During operational period (where check duration allows):
- Performance check at Normal power supply
- EUT returned to normal environmental conditions in not less than 1 h

2.3.5 Environmental Conditions

Ambient Temperature	24.0 - 41.0 °C
Relative Humidity	52.5 - 91.0 %

2.3.6 Test Results

DC Powered - VHF & DSC

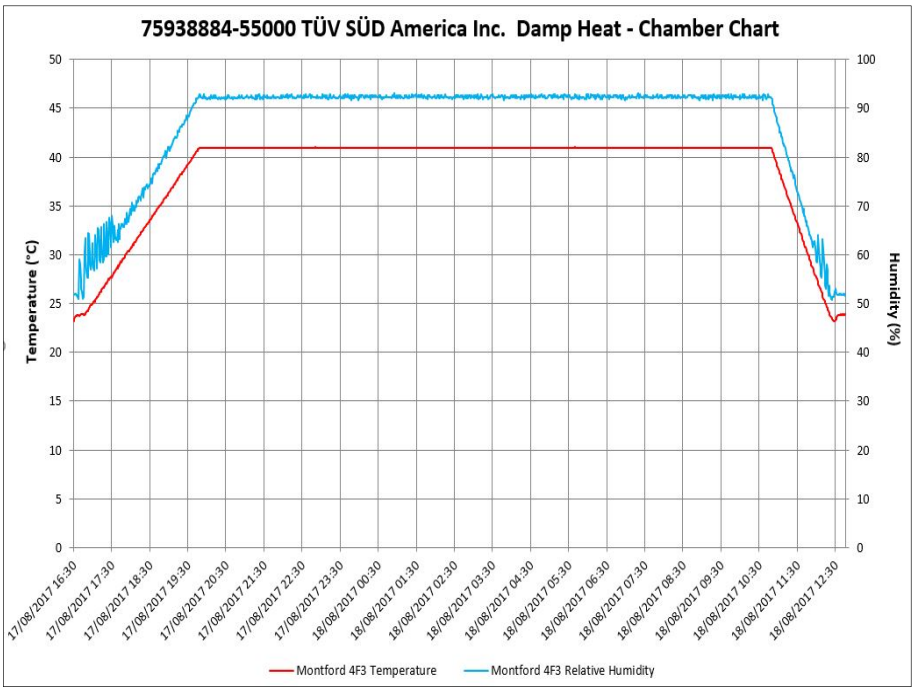


Figure 14 - Temperature & Humidity Versus Time

Performance Check	Frequency Error (Hz)		Carrier Power		Sensitivity - SINAD (dB)		DSC Sensitivity - BER (%)	
	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC
During Operational Period	-410	-390	43.31 dBm / 21.43 W	42.7 dBm / 18.62 W	34.8	34.8	0	0

Table 15 - Performance Check Results - Damp Heat Functional Test

Remarks

It was confirmed that the temperature remained within +40 °C ± 3 °C and that the rate of change of temperature did not exceed 1 °C/min. The humidity also remained within 93% ± 3% after the 3.5 h ± 0.5 h period.

IEC 62238, Limit Clause 7.3

Where the term “performance check” is used, this shall be taken to mean a visual inspection of the equipment, a test of the transmitter output power and frequency error, and the receiver sensitivity to show that the equipment is functioning and that there is no visible damage or deterioration.

a) For the transmitter:

The transmitter shall be connected to the artificial antenna and tuned to channel 16. The measurements shall be made in the absence of modulation with the power switch set at maximum. The output power shall be between 6 W and 25 W, and the frequency error shall be less than ±1,5 kHz.

b) For the radiotelephone receiver:

A test signal with a level of +12 dBµV shall be applied to the receiver input as in 9.3.2. The SINAD ratio at the receiver output shall be equal to or greater than 20 dB.

c) For the DSC receiver:

A standard DSC test signal (see 6.8) with a level of +6 dBµV shall be applied to the receiver input. The symbol error ratio in the decoder output shall be equal to or less than 10^{-2}.

2.3.7 Test Location and Test Equipment Used

This test was carried out in Montford 4ft³ Chamber.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	05-Sep-2017
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81		O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Montford F43	Montford	4FT CUBED	2126	12	25-Nov-2017
Hygromer	Rotronic	I-1000	2496	-	TU
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2017
GPS/SBAS Simulator	Spirent	STR4500	3056	-	30-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD Product Service	RAB 200701	3314	12	03-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA40	3548	12	02-Oct-2017
Calibration Kit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 16

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.4 Temperature Tests - Low Temperature Functional Test

2.4.1 Specification Reference

IEC 62238, Clause 7.5

2.4.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.4.3 Date of Test

16-August-2017 to 17-August-2017

2.4.4 Test Method

IEC60945 main extract and application:

- Performance Check at normal environmental conditions as per IEC60945 Clause 8.1 was carried out prior to testing.
- EUT placed in a chamber at normal conditions
- Temperature reduced to, and maintained at –15°C±3°C
- Soak for 10 h to 16 h
- Where appropriate, climatic control devices switched on for 30min
- EUT switched on and kept operational ≥2h
- Chamber maintained at –15°C±3°C for:
- At start of 2 hour operational period:
- Performance test at Normal power supply
- Performance check at Extreme Low and Extreme High power supply
- At end of 2 hour operational period:
- Performance test at Normal power supply (where test duration allows)
- Performance check at Extreme Low and Extreme High power supply
- EUT returned to normal environmental conditions

2.4.5 Environmental Conditions

Ambient Temperature	24.4 °C
Relative Humidity	61.0 %

2.4.6 Test Results

DC Powered - VHF & DSC

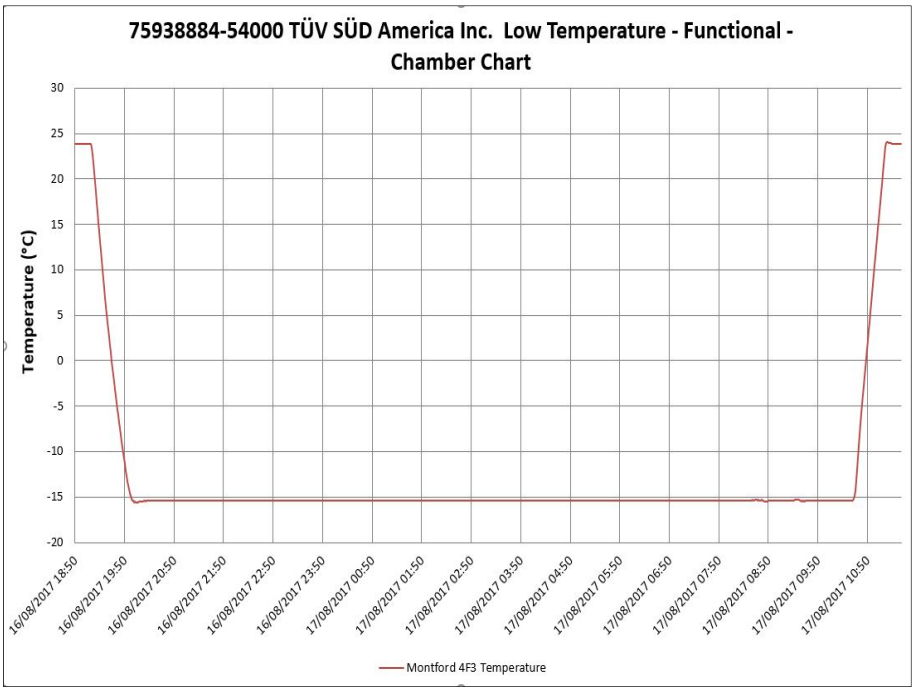


Figure 15 - Temperature & Humidity Versus Time

Performance Check	Frequency Error (Hz)		Carrier Power		Sensitivity - SINAD (dB)		DSC Sensitivity - BER (%)	
	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC	15.6 V DC	10.8 V DC
During Operational Period	-409	-310	43.23 dBm / 21.04 W	42.6 dBm / 18.20 W	31.7	31.8	0	0

Table 17 - Performance Check Results - Low Temperature Functional Test

Remarks

It was confirmed that the temperature remained within -15 °C ± 3 °C during the soak period and that the rate of change of temperature did not exceed 1 °C/min.

IEC 62238, Limit Clause 7.3

Where the term “performance check” is used, this shall be taken to mean a visual inspection of the equipment, a test of the transmitter output power and frequency error, and the receiver sensitivity to show that the equipment is functioning and that there is no visible damage or deterioration.

a) For the transmitter:

The transmitter shall be connected to the artificial antenna and tuned to channel 16. The measurements shall be made in the absence of modulation with the power switch set at maximum. The output power shall be between 6 W and 25 W, and the frequency error shall be less than ±1,5 kHz.

b) For the radiotelephone receiver:

A test signal with a level of +12 dBµV shall be applied to the receiver input as in 9.3.2. The SINAD ratio at the receiver output shall be equal to or greater than 20 dB.

c) For the DSC receiver:

A standard DSC test signal (see 6.8) with a level of +6 dBµV shall be applied to the receiver input. The symbol error ratio in the decoder output shall be equal to or less than 10^{-2}.

2.4.7 Test Location and Test Equipment Used

This test was carried out in Montford 4ft³ Chamber.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	05-Sep-2017
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81		O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Montford F43	Montford	4FT CUBED	2126	12	25-Nov-2017
Hygromer	Rotronic	I-1000	2496	-	TU
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2017
GPS/SBAS Simulator	Spirent	STR4500	3056	-	30-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD Product Service	RAB 200701	3314	12	03-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA40	3548	12	02-Oct-2017
Calibration Kit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU

Table 18

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.5 Frequency Error

2.5.1 Specification Reference

IEC 62238, Clause 8.1

2.5.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.5.3 Date of Test

21-August-2017 to 29-August-2017

2.5.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.1.2.

2.5.5 Environmental Conditions

Ambient Temperature	21.3 - 22.1 °C
Relative Humidity	59.9 - 77.2 %

2.5.6 Test Results

DC Powered - VHF & DSC

Test Conditions		Frequency Error (Hz)
Temperature	Voltage	156.8 MHz
+21.3 °C	13.8 V DC	-376
-20.0 °C	15.6 V DC	-538
-20.0 °C	10.8 V DC	-647
+55.0 °C	15.6 V DC	+326
+55.0 °C	10.8 V DC	+314

Table 19 - Frequency Error Results

IEC 62238, Limit Clause 8.1.3

The frequency error shall be within ± 1.5 kHz.

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz - 18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 20

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.6 Carrier Power

2.6.1 Specification Reference

IEC 62238, Clause 8.2

2.6.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.6.3 Date of Test

29-August-2017 to 30-August-2017

2.6.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.2.2.

2.6.5 Environmental Conditions

Ambient Temperature	22.1 °C
Relative Humidity	59.9 %

2.6.6 Test Results

DC Powered - VHF & DSC

Maximum Rated Output Power: 25.0 W.

Test Conditions		156.050 MHz*		156.800 MHz		161.600 MHz	
Temperature	Voltage	Carrier Power (W)	Δ from rated Power (dB)	Carrier Power (W)	Δ from rated Power (dB)	Carrier Power (W)	Δ from rated Power (dB)
+22.1 °C	13.8 V DC	21.60	-0.7	21.56	-0.7	21.10	-0.8
-20.0 °C	15.6 V DC	N/A	N/A	21.03	-0.8	N/A	N/A
-20.0 °C	10.8 V DC	N/A	N/A	18.03	-1.4	N/A	N/A
+55.0 °C	15.6 V DC	N/A	N/A	21.50	-0.7	N/A	N/A
+55.0 °C	10.8 V DC	N/A	N/A	16.20	-1.9	N/A	N/A

*Measurements also made at 156.025 MHz: 21.27 W

Table 21 - Carrier Power Results at Maximum Rated Power

Parameter	Time (Min, Secs)
The output power fell to zero after 5 minutes and before 6 minutes of continuous transmission.	5.00

Table 22 - Time-out Timer at Maximum Rated Power on 156.8 MHz

Minimum Rated Output Power: 1 W.

Test Conditions		Carrier Power (w)		
Temperature	Voltage	156.050 MHz*	156.8 MHz	161.6 MHz
+22.1 °C	13.8 V DC	0.795	0.722	0.781
-20.0 °C	15.6 V DC	N/A	0.586	N/A
-20.0 °C	10.8 V DC	N/A	0.583	N/A
+55.0 °C	15.6 V DC	N/A	0.842	N/A
+55.0 °C	10.8 V DC	N/A	0.839	N/A

*Measurements also made at 156.025 MHz: 0.685 W

Table 23 - Carrier Power Results at Minimum Rated Power

Parameter	Time (Min, Secs)
The output power fell to zero after 5 minutes and before 6 minutes of continuous transmission.	5.00

Table 24 - Time-out Timer at Minimum Rated Power on 156.8 MHz

IEC 62238, Limit Clause 8.2.3

Normal Test Conditions:

With the output power switch set at maximum, the carrier power shall remain between 6 W and 25 W and be within ±1.5 dB of the rated output power under normal test conditions. The output power shall never, however, exceed 25 W. With the output power switch set at minimum, the carrier power shall remain between 0.1 W and 1 W.

Extreme test conditions:

With the output power switch set at maximum, the carrier power shall remain between 6 W and 25 W and be within +2 dB, –3 dB of the rated output power under extreme conditions. The output power shall never however exceed 25 W. With the output power switch set at minimum, the carrier power shall remain between 0.1 W and 1 W.

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz - 18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
Stop Watch	R.S Components	309RS	4553	12	26-Jul-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 25

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.7 Frequency Deviation

2.7.1 Specification Reference

IEC 62238, Clause 8.3

2.7.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.7.3 Date of Test

21-August-2017

2.7.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.3.2.1 and 8.3.3.1.

2.7.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	73.6 %

2.7.6 Test Results

DC Powered - VHF & DSC

Modulation Frequency (Hz)	Frequency Deviation (kHz)	
	Maximum Power Setting - 25.0 W	Minimum Power Setting - 1 W
100	1.26	1.17
200	4.12	4.12
300	4.83	4.79
400	4.70	4.70
500	4.55	4.56
1000	4.41	4.35
1500	4.31	4.28
2000	4.35	4.34
2500	4.53	4.50
3000	4.38	4.40

Table 26 - Maximum Permissible Frequency Deviation

Modulation Frequency (Hz)	Frequency Deviation (kHz)	
	Maximum Power Setting - 25.0 W	Minimum Power Setting - 1 W
3000	4.18	4.24
4000	2.48	2.51
5000	1.28	1.29
6000	0.75	0.76
8000	0.36	0.335
10000	0.225	0.185
12000	0.17	0.172
15000	0.15	0.14
20000	0.03	0.03
25000	0.03	0.03

Table 27 - Reduction of Frequency Deviation at Modulation Frequencies above 3 kHz

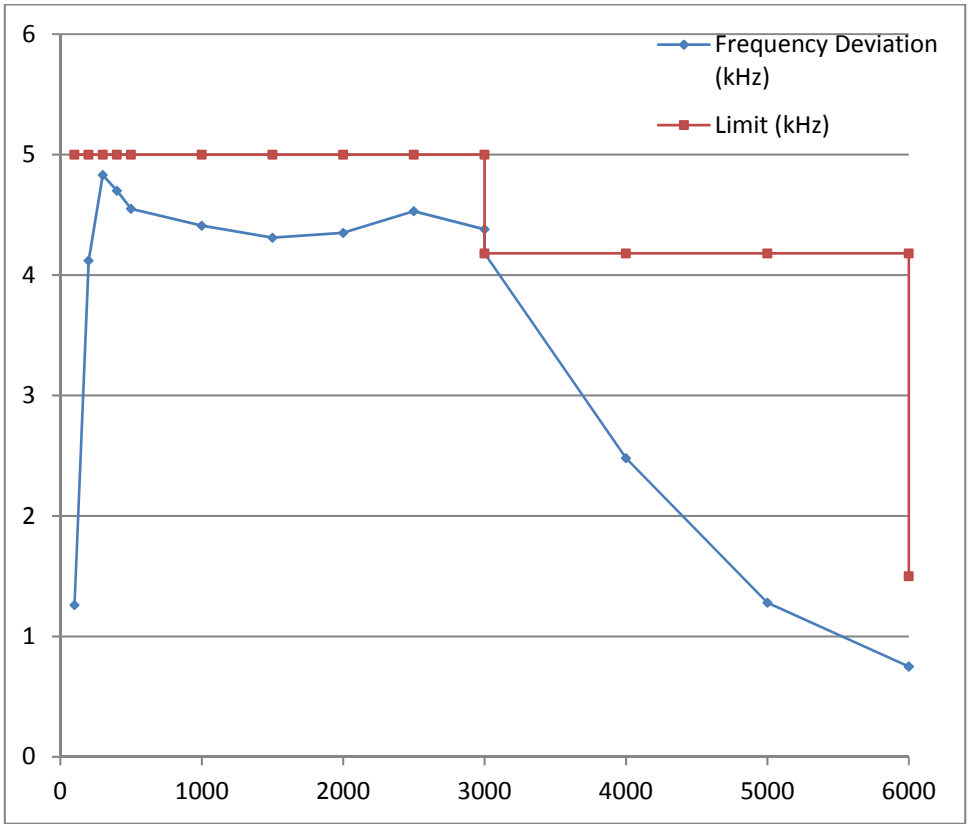


Figure 16 - Frequency Deviation (AF < 6 kHz) - Maximum Power Setting

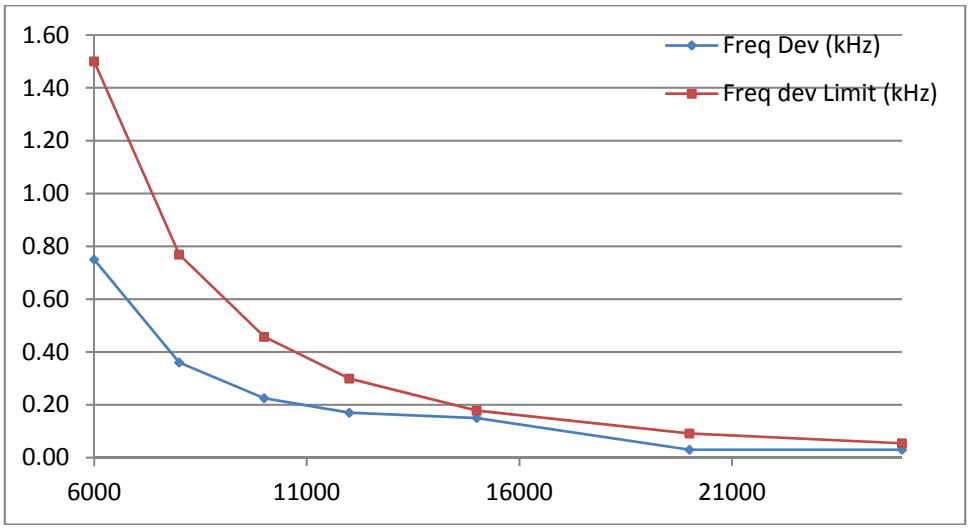


Figure 17 - Frequency Deviation (AF > 6 kHz) - Maximum Power Setting

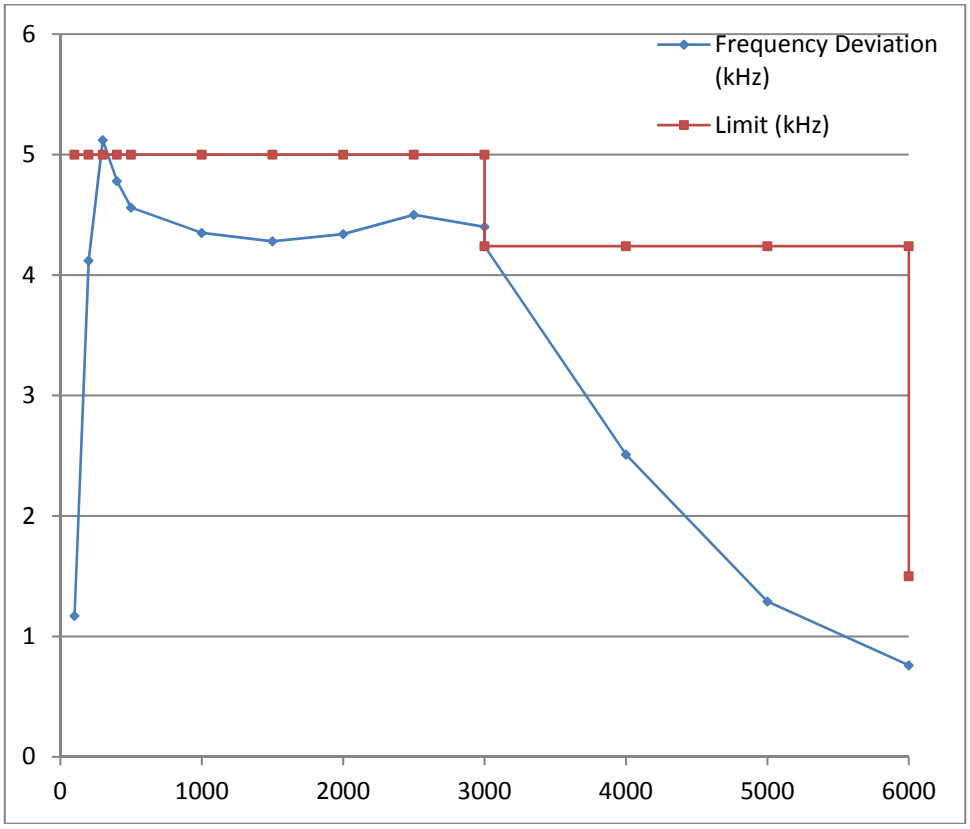


Figure 18 - Frequency Deviation (AF < 6 kHz) - Minimum Power Setting

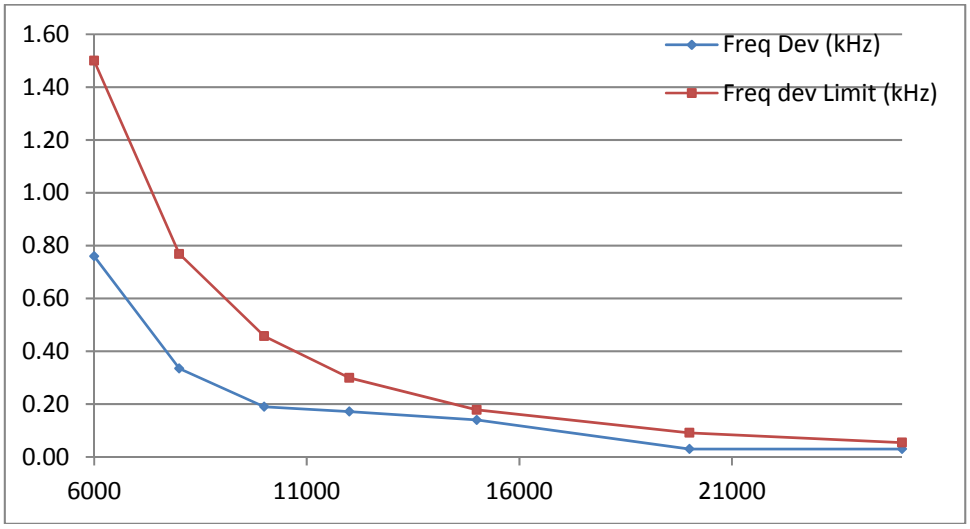


Figure 19 - Frequency Deviation (AF < 6 kHz) - Minimum Power Setting

IEC 62238, Limit Clause 8.3.2.2 and 8.3.3.2

The maximum frequency deviation shall be ± 5 kHz for modulation frequencies less than 3 kHz.

For modulation frequencies greater than 3 kHz, the Frequency deviation shall not exceed the value specified in the table below:

Modulation Frequency (Hz)	Frequency Deviation Limit (kHz)
3000	-
4000	Result at 3 kHz
5000	Result at 3 kHz
6000	1.50
8000	0.77
10000	0.46
12000	0.30
15000	0.18
20000	0.09
25000	0.05

Table 28 - Frequency Deviation Limit for Modulation Frequencies above 3 kHz

*For modulation frequencies between 3 kHz and 6 kHz the frequency deviation shall not exceed the frequency deviation with a modulation frequency of 3 kHz. For a modulation frequency of 6 kHz, the frequency deviation shall not exceed ±1.5 kHz.

For modulation frequencies between 6 kHz and 25 kHz, the frequency deviation shall not exceed that given by a linear response of frequency deviation against modulation frequency, starting at the point where the modulation frequency is 6 kHz and the frequency deviation is ±1.5 kHz and inclined at 14 dB/octave. The limit of frequency deviation for the points measured has been calculated and is as shown in the table above.

2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Audio Analyser	Hewlett Packard	8903B	44	12	23-May-2018
Modulation Analyser	Hewlett Packard	8901B	45	12	05-Sep-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 29

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.8 Sensitivity of the Modulator including Microphone

2.8.1 Specification Reference

IEC 62238, Clause 8.4

2.8.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 4 - Modification State 1

2.8.3 Date of Test

03-October-2017

2.8.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.4.2.

2.8.5 Environmental Conditions

Ambient Temperature	20.5 °C
Relative Humidity	45.1 %

2.8.6 Test Results

DC Powered - VHF & DSC

Microphone Under Test	Frequency Deviation (kHz)
1 kHz	3.92
500 Hz	4.21
300 Hz	3.37

Table 30 - Frequency Deviation Results

IEC 62238, Limit Clause 8.4.3

The resulting frequency deviation shall be between ±2.5 kHz and ±4.5 kHz.

2.8.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Audio Analyser	Hewlett Packard	8903B	44	12	23-May-2018
Amplifier (Measuring)	Bruel & Kjaer	T2609	247		O/P Mon
Amplifier (Acoustic Power)	Bruel & Kjaer	2706	249	-	O/P Mon
Mouth Simulator	Bruel & Kjaer	4227	255	-	O/P Mon
Power Supply Unit	Thurlby	PL33OQMD	449	-	O/P Mon
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Sound Level Calibrator	Bruel & Kjaer	4231	3260	12	21-Sep-2018
Sensor Module	Hewlett Packard	11722A	3293	12	08-Dec-2017
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2018

Table 31

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.9 Audiofrequency Response

2.9.1 Specification Reference

IEC 62238, Clause 8.5

2.9.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.9.3 Date of Test

31-August-2017 to 07-September-2017

2.9.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.5.2.

2.9.5 Environmental Conditions

Ambient Temperature	21.7 - 22.9 °C
Relative Humidity	46.7 - 54.1 %

2.9.6 Test Results

DC Powered - VHF & DSC

Modulation Frequency (Hz)	Frequency Deviation (dB relative to 1 kHz)
300	-9.81
400	-7.20
500	-5.28
600	-3.70
800	-1.56
1000	0
1500	2.85
2000	4.97
2500	6.54
3000	7.29

Table 32 - Results for Audiofrequency Response

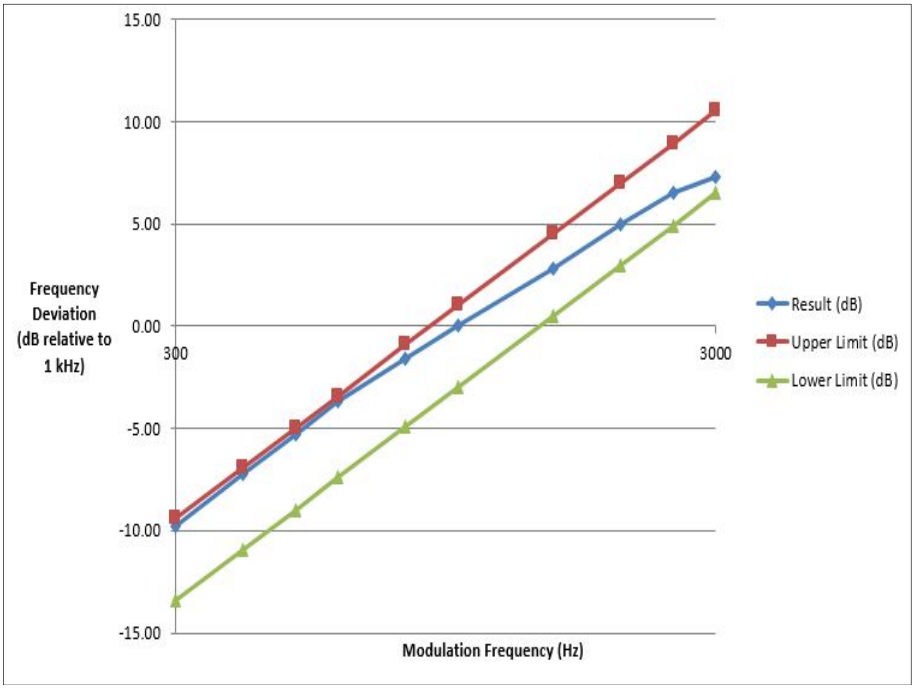


Figure 20 - Graph showing the Transmitter Modulation Frequency versus Frequency Deviation relative to 1 kHz

IEC 62238, Limit Clause 8.5.3

The audiofrequency response shall be within +1 dB and -3 dB of a 6 dB/octave line passing through the reference point.

2.9.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Sensor Module	Hewlett Packard	11722A	3293	12	08-Dec-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 33

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.10 Audiofrequency Harmonic Distortion of the Emission

2.10.1 Specification Reference

IEC 62238, Clause 8.6

2.10.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.10.3 Date of Test

30-August-2017

2.10.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.6.2.

2.10.5 Environmental Conditions

Ambient Temperature	21.8 °C
Relative Humidity	52.0 %

2.10.6 Test Results

DC Powered - VHF & DSC

Modulation Frequency (Hz)	Modulation Index	Harmonic Distortion (%)	
		Maximum Power Setting – 25.0 W	Minimum Power Setting – 1 W
300	3	1.32	2.00
500	3	0.70	0.97
1000	3	0.35	0.60

Table 34 – Audiofrequency Harmonic Distortion

IEC 62238, Limit Clause 8.6.3

The harmonic distortion shall not exceed 10%.

2.10.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 35

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.11 Adjacent Channel Power

2.11.1 Specification Reference

IEC 62238, Clause 8.7

2.11.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.11.3 Date of Test

23-August-2017

2.11.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.7.2.

2.11.5 Environmental Conditions

Ambient Temperature	22.7 °C
Relative Humidity	63.8 %

2.11.6 Test Results

DC Powered - VHF & DSC

The measurement was performed with a modulated carrier.

156.800 MHz	
Lower Adjacent Channel Power (dBc)	Upper Adjacent Channel Power (dBc)
-71.50	-71.31

Table 36 - Adjacent Channel Power Results

IEC 62238, Limit Clause 8.7.3

The adjacent channel power shall not exceed a value of 70 dB below the carrier power of the transmitter without any need to be below 0,2 µW.

2.11.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	6-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 37

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.12 Conducted Spurious Emissions Conveyed to the Antenna

2.12.1 Specification Reference

IEC 62238, Clause 8.8

2.12.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.12.3 Date of Test

12-September-2017

2.12.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.8.2.

2.12.5 Environmental Conditions

Ambient Temperature	21.9 - 23.3 °C
Relative Humidity	45.7 - 45.9 %

2.12.6 Test Results

DC Powered - VHF & DSC

Frequency (MHz)	Level (µW)
0.15	0.0081
150	0.0398
313.62	0.0339
470.40	0.1000
627.21	0.0043
784.02	0.0091
1097.76	0.0257
1254.81	0.0234
1410.26	0.0151
1568.91	0.0245

Table 38 - Conducted Spurious Emissions Results

IEC 62238, Limit Clause 8.8.3

The power of any conducted spurious emission on any discrete frequency shall not exceed 0.25 µW.

2.12.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Feb-2018
Filter (Hi Pass)	Mini-Circuits	NHP-600	2834	12	21-Oct-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	2-May-2018
Network Analyser	Rohde & Schwarz	ZVA40	3548	12	02-Oct-2017
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
2 Metre SMA Type Cable	Rhophase	3PS-1801A-2000-3PS	4111	-	O/P Mon
Calibration Kit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	22-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 39

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.13 Transient Frequency Behaviour of the Transmitter

2.13.1 Specification Reference

IEC 62238, Clause 8.9

2.13.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.13.3 Date of Test

19-September-2017

2.13.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.9.2.

2.13.5 Environmental Conditions

Ambient Temperature	21.1 °C
Relative Humidity	49.7 %

2.13.6 Test Results

DC Powered - VHF & DSC

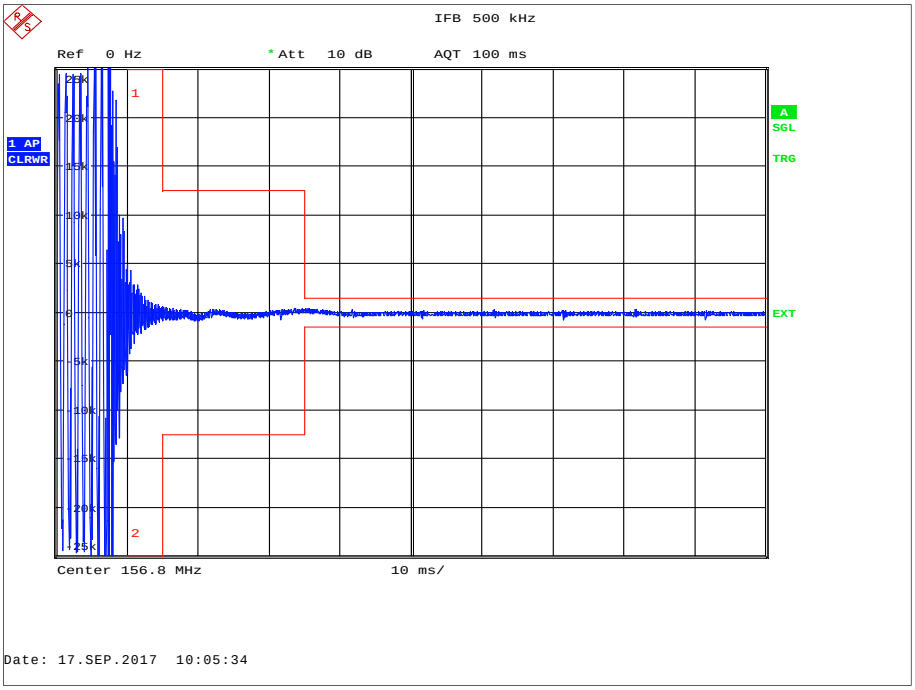


Figure 21 - Switch On

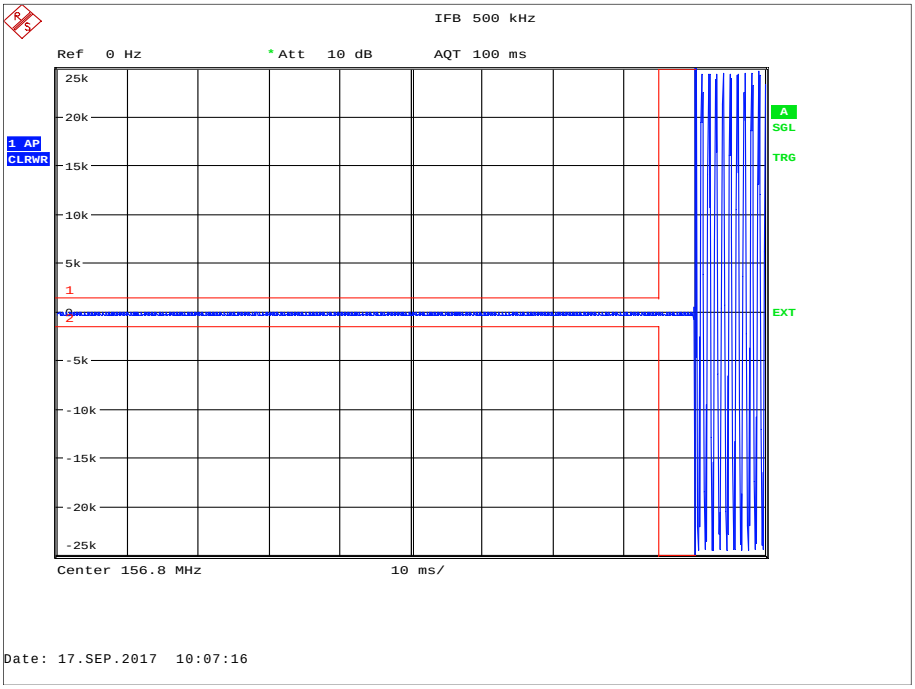


Figure 22 - Switch Off

IEC 62238, Limit Clause 11.9.3

During the periods of time t1 and t3 the frequency difference shall not exceed ±25 kHz.

The frequency difference after the end of t2 shall be within the limit of the frequency error given in clause 8.1 of the specification.

During the period of time t2 the frequency difference shall not exceed ±12,5 kHz.

Before the start of t3 the frequency difference shall be within the limit of the frequency error given in clause 8.1 of the specification.

2.13.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	12-Mar-2018
Signal Generator	Rohde & Schwarz	SMY 01	1389	12	09-May-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Attenuator (20dB, 150W)	Narda	769-20	3367	12	31-May-2018
Attenuator (10dB, 150W)	Narda	769-10	3368	12	31-May-2018
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	09-Oct-2017
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	12-Mar-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 40

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.14 Residual Modulation of the Transmitter

2.14.1 Specification Reference

IEC 62238, Clause 8.10

2.14.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.14.3 Date of Test

30-August-2017

2.14.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.10.2.

2.14.5 Environmental Conditions

Ambient Temperature	20.9 °C
Relative Humidity	48.3 %

2.14.6 Test Results

DC Powered - VHF & DSC

Residual Modulation (dB)
-44.8

Table 41 - Residual Modulation

IEC 62238, Limit Clause 8.10.3

The residual modulation shall not exceed -40 dB.

2.14.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	8-Sep-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	6-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	1-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 42

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.15 Frequency Error (DSC Signal)

2.15.1 Specification Reference

IEC 62238, Clause 8.11

2.15.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.15.3 Date of Test

16-October-2017 to 17-October-2017

2.15.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.11.2.

2.15.5 Environmental Conditions

Ambient Temperature	21.4 °C
Relative Humidity	60.0 %

2.15.6 Test Results

DC Powered - VHF & DSC

Temperature	Voltage	Frequency Error (Hz)	
		B-state	Y-state
+21.7 °C	13.8 V DC	-0.02	-0.03
-20.0 °C	15.6 V DC	-0.03	0.02
-20.0 °C	10.8 V DC	0.02	0.05
+55.0 °C	15.6 V DC	-0.03	-0.03
+55.0 °C	10.8 V DC	-0.04	-0.02

Table 43 - Demodulated DSC Signal Frequency Error

IEC 62238, Limit Clause 8.11.3

The measured frequency from the demodulator at any time for the B-state shall be within 2100 Hz ± 10 Hz and for the Y-state within 1300 Hz ± 10 Hz.

2.15.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Multimeter	Fluke	75 Mk3	455	12	14-Sep-2018
Attenuator (10dB, 75W)	Bird	8308-100	469	12	14-Dec-2017
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	12-Mar-2018
Digital Temperature Indicator	Fluke	51	2267	12	5-Jul-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Sensor Module	Hewlett Packard	11722A	3293	12	8-Dec-2017

Table 44

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.16 Modulation Index for DSC

2.16.1 Specification Reference

IEC 62238, Clause 8.12

2.16.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.16.3 Date of Test

30-August-2017

2.16.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.12.2.

2.16.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	52.0 %

2.16.6 Test Results

DC Powered - VHF & DSC

Signal Pattern	Frequency (Hz)	Frequency Deviation (kHz)	Modulation Index
B-state	2100	4.15	1.976
Y-state	1300	2.41	1.855

Table 45 - Modulation Index for DSC Signal

IEC 62238, Limit Clause 8.12.3

The modulation index shall be 2.0 ± 10%.

2.16.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 46

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.17 Modulation Rate for DSC

2.17.1 Specification Reference

IEC 62238, Clause 8.13

2.17.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.17.3 Date of Test

13-September-2017

2.17.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.13.2.

2.17.5 Environmental Conditions

Ambient Temperature	23.5 °C
Relative Humidity	44.2 %

2.17.6 Test Results

DC Powered - VHF & DSC

156.525 MHz		
Modulation Rate (Hz)	Frequency Error (ppm)	Corresponding Baud Rate
599.995856	6.907	1199.991712

Table 47 - Modulation Rate Results Table

IEC 62238, Limit Clause 8.13.3

The frequency shall be 600 Hz ± 30 $\times 10^{-6}$ corresponding to a modulation rate of 1 200 baud.

2.17.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	TU
Counter	Hewlett Packard	53181A	159	12	26-May-2018
Multimeter	White Gold	WG022	190	12	24-Nov-2017
Attenuator (10dB, 75W)	Bird	8308-100	469	12	14-Dec-2017
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Power Supply	Iso-tech	IPS 2010	2440	-	O/P Mon
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor Module	Hewlett Packard	11722A	3293	12	08-Dec-2017

Table 48

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.18 Testing of Generated Call Sequences

2.18.1 Specification Reference

IEC 62238, Clause 8.14

2.18.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.18.3 Date of Test

02-August-2017

2.18.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.14.2.

2.18.5 Environmental Conditions

Ambient Temperature	20.5 °C
Relative Humidity	52.0 %

2.18.6 Test Results

DC Powered - VHF & DSC

Call Sent	Channel (MHz)	Received Without Error	Telecommand 1	Telecommand 2	Expansion Data Specifier
Distress	156.525	Yes	107	100	100
All Ships Urgency	156.525	Yes	100	126	100
All Ships Safety	156.525	Yes	100	126	100
Individual Routine	156.525	Yes	100	126	100
Group Routine	156.525	Yes	100	126	100

Table 49 - Received Calls

Requirement	Check Performed (Yes/No)	Errors Found (Yes/No)
Confirm after transmission of a DSC call, the transmitter re-tunes to the original channel	Yes	No
in the case of a distress call, the transmitter shall tune to channel 16 and automatically select the maximum power	Yes	No

Table 50 - Performed Checks

IEC 62238, Limit Clause 8.14.3

The requirements of ITU-R Recommendation M.493-10 regarding message composition and content shall be met.

The generated call shall be analysed 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.

2.18.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modem (MF/HF/VHF DSC)	ICS	PLT02249	120	12	3-Aug-2018
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor Module	Hewlett Packard	11722A	3293	12	8-Dec-2017
Communications Receiver, AM, FM,& WFM	ICOM	IC-R5	3330	-	O/P Mon
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 51

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.19 Harmonic Distortion and Rated Audiofrequency Output Power

2.19.1 Specification Reference

IEC 62238, Clause 9.1

2.19.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.19.3 Date of Test

07-September-2017

2.19.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.1.2.

2.19.5 Environmental Conditions

Ambient Temperature	23.6 °C
Relative Humidity	51.4 %

2.19.6 Test Results

DC Powered - VHF & DSC

Modulation Frequency (Hz)	Signal Level: +60 dBµV (e.m.f)		Signal Level: +100 dBµV (e.m.f)	
	Power (W)	Harmonic Distortion (%)	Power (W)	Harmonic Distortion (%)
300	2.06	5.45	2.08	9.43
500	2.07	4.95	2.06	7.44
1000	2.40	2.50	2.03	5.37

**Table 52 - External Loudspeaker -
Audio Output Power and Harmonic Distortion**

IEC 62238, Limit Clause 9.1.3

The rated audiofrequency output power shall be at least:

- 2 W in a loudspeaker;
- 1 mW in the handset earphone.

The harmonic distortion shall not exceed 10%.

2.19.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB, 75W)	Bird	8308-100	469	12	14-Dec-2017
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 53

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.20 Audiofrequency Response

2.20.1 Specification Reference

IEC 62238, Clause 9.2

2.20.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.20.3 Date of Test

30-August-2017 to 07-September-2017

2.20.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.2.2.

2.20.5 Environmental Conditions

Ambient Temperature	22.3 °C
Relative Humidity	56.4 %

2.20.6 Test Results

DC Powered - VHF & DSC

Modulation Frequency (Hz)	Frequency Deviation (dB relative to 1 kHz)
300	7.90
400	6.60
500	5.02
600	3.62
800	1.63
1000	0
1500	-3.25
2000	-5.82
2500	-8.16
3000	-10.12

Table 54 - Results for Audiofrequency Response at Nominal Centre Frequency

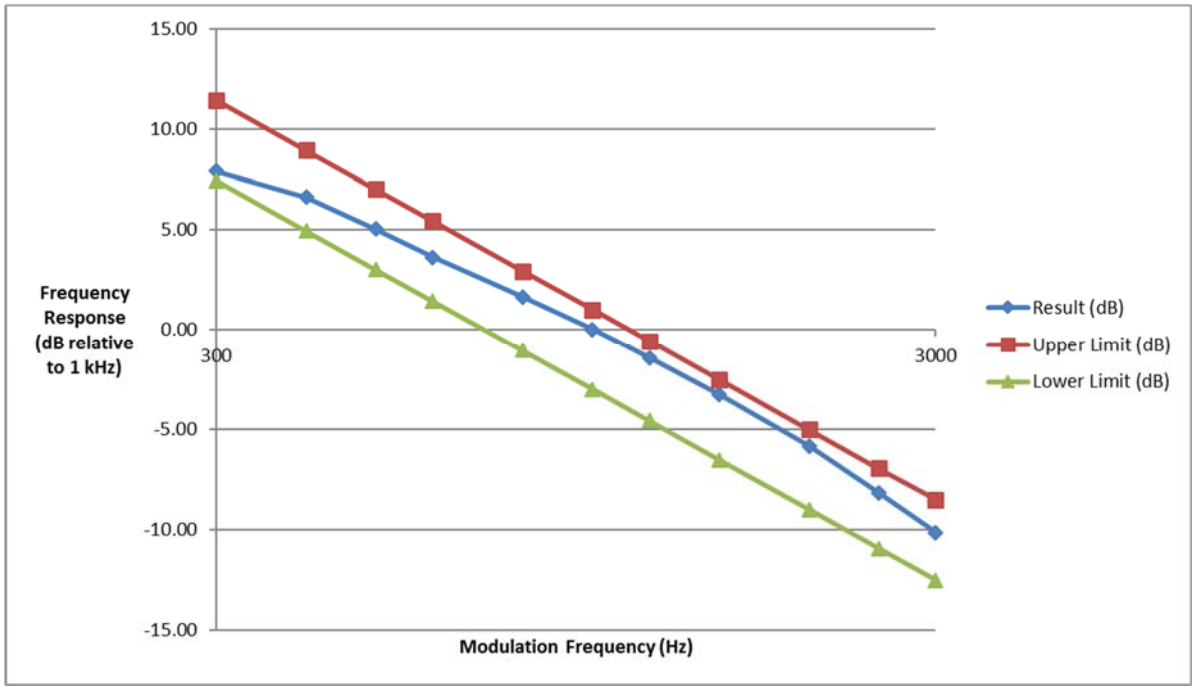


Figure 23 - Graph showing the Receiver Modulation Frequency versus Frequency Deviation relative to 1 kHz at Nominal Centre Frequency

Modulation Frequency (Hz)	Frequency Deviation (dB relative to 1 kHz)
300	7.80
400	6.60
500	5.02
600	3.64
800	1.69
1000	0.00
1500	-3.06
2000	-5.62
2500	-7.98
3000	-10.30

Table 55 - Results for Audiofrequency Response at +1.5 kHz frequency offset

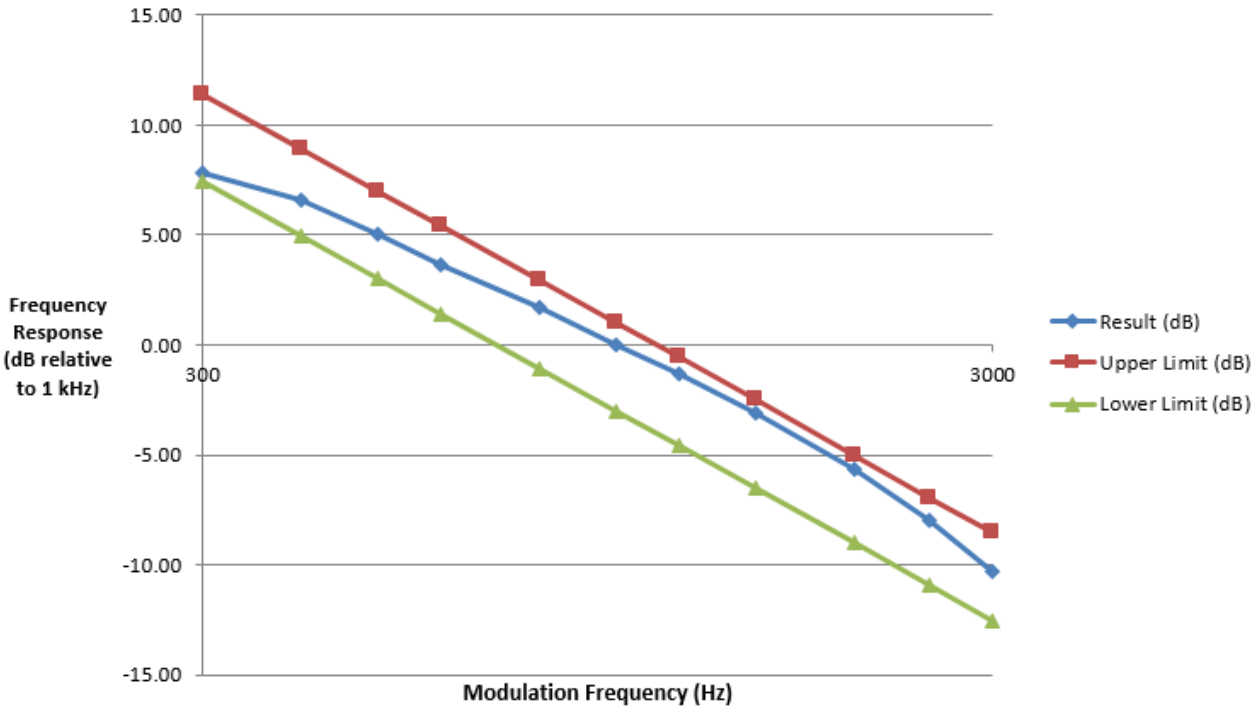


Figure 24 - Graph showing the Receiver Modulation Frequency versus Frequency Deviation relative to 1 kHz at +1.5 kHz frequency offset

Modulation Frequency (Hz)	Frequency Deviation (dB relative to 1 kHz)
300	8.12
400	6.89
500	5.27
600	3.85
800	1.76
1000	0.00
1500	-3.56
2000	-6.48
2500	-9.11
3000	-10.97

Table 56 - Results for Audiofrequency Response at -1.5 kHz frequency offset

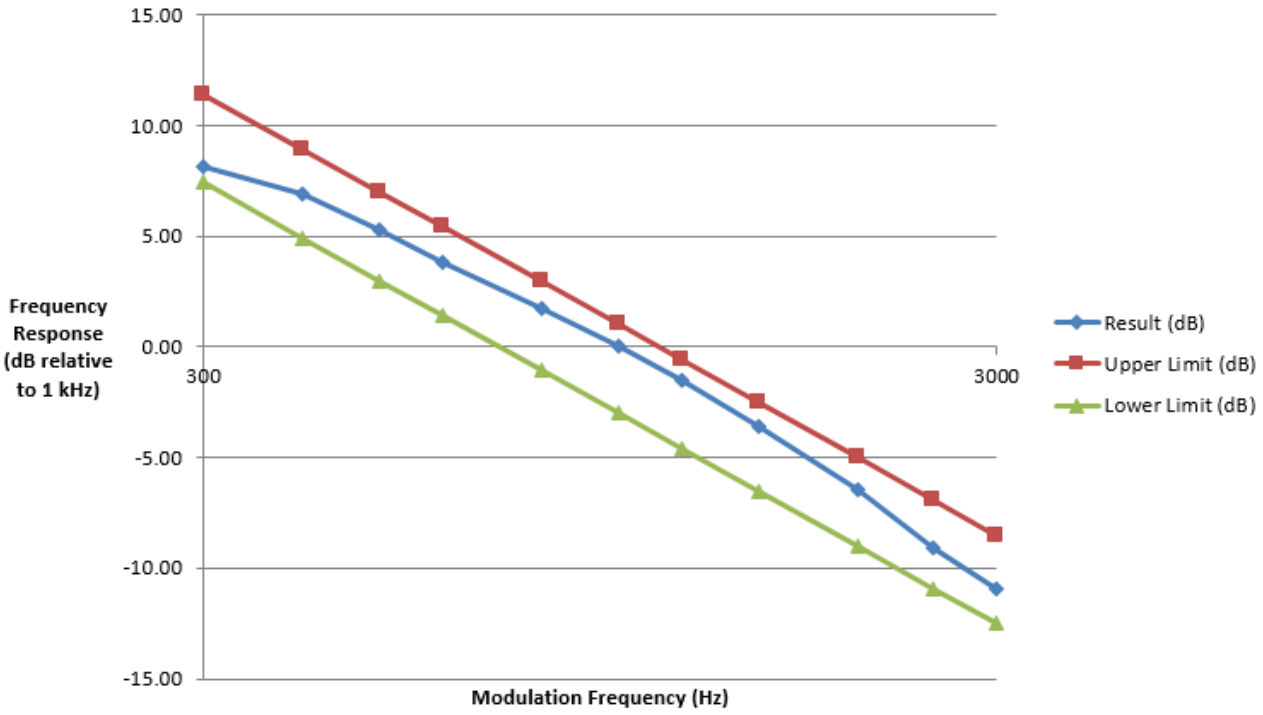


Figure 25 - Graph showing the Receiver Modulation Frequency versus Frequency Deviation relative to 1 kHz at -1.5 kHz frequency offset

IEC 62238, Limit Clause 9.2.3

The audiofrequency response shall not deviate by more than +1 dB or –3 dB from a characteristic giving the output level as a function of the audiofrequency, decreasing by 6 dB/octave and passing through the measured point at 1 kHz.

2.20.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 57

O/P Mon – Output Monitored using calibrated equipment

2.21 Maximum Usable Sensitivity

2.21.1 Specification Reference

IEC 62238, Clause 9.3

2.21.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.21.3 Date of Test

29-August-2017

2.21.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.3.2.

2.21.5 Environmental Conditions

Ambient Temperature	22.1 - 22.9 °C
Relative Humidity	52.9 - 59.9 %

2.21.6 Test Results

DC Powered - VHF & DSC

Temperature	Voltage	Maximum Usable Sensitivity - dBµV (e.m.f.)
+22.1 °C	13.8 V DC	-6.40
-20.0 °C	15.6 V DC	-6.78
-20.0 °C	10.8 V DC	-6.78
+55.0 °C	15.6 V DC	-3.58
+55.0 °C	10.8 V DC	-3.58

Table 58 - Maximum Usable Sensitivity for VHF Receiver

IEC 62238, Limit Clause 9.3.3

The maximum usable sensitivity shall not exceed +6 dBµV (e.m.f.) under normal test conditions and +12 dBµV (e.m.f.) under extreme test conditions.

2.21.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 59

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.22 Co-channel Rejection

2.22.1 Specification Reference

IEC 62238, Clause 9.4

2.22.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.22.3 Date of Test

31-August-2017

2.22.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.4.2.

2.22.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	50.2 %

2.22.6 Test Results

DC Powered - VHF & DSC

Displacement of Unwanted Signal (kHz)	Co-channel Rejection (dB)
-3	-7.6
0	-8.0
+3	-7.8

Table 60 - Co-channel Rejection Ratio Results for VHF Receiver

IEC 62238, Limit Clause 9.4.3

The co-channel rejection ratio shall be between -10 dB and 0 dB.

2.22.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 61

O/P Mon – Output Monitored using calibrated equipment

2.23 Adjacent Channel Selectivity

2.23.1 Specification Reference

IEC 62238, Clause 9.5

2.23.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.23.3 Date of Test

26-August-2017

2.23.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.5.2.

2.23.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	52.9 %

2.23.6 Test Results

DC Powered - VHF & DSC

Temperature	Voltage	Adjacent Channel Selectivity (dB)	
		-25 kHz	+25 kHz
+22.9 °C	13.8 V DC	71.7	71.5
-20.0 °C	15.6 V DC	73.1	73.1
-20.0 °C	10.8 V DC	73.1	73.1
+55.0 °C	15.6 V DC	69.7	69.7
+55.0 °C	10.8 V DC	69.7	69.7

Table 62 - Adjacent Channel Selectivity Results for VHF Receiver

IEC 62238, Limit Clause 9.5.3

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.

2.23.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	8-Sep-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Digital Temperature Indicator	Fluke	51	2267	12	5-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	12	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	6-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	2-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 63

O/P Mon – Output Monitored using calibrated equipment

2.24 Spurious Response Rejection

2.24.1 Specification Reference

IEC 62238, Clause 9.6

2.24.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.24.3 Date of Test

07-September-2017 to 11-September-2017

2.24.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.6.2.

2.24.5 Environmental Conditions

Ambient Temperature	21.5 °C
Relative Humidity	50.5 %

2.24.6 Test Results

DC Powered - VHF & DSC

The unwanted signal generator was swept from 100 kHz to 2 GHz, below is a list of any spurious responses that were obtained as a result of the search:

Frequency (MHz)	Spurious Resonse Rejection Ratio (dB)
135.835	82.1
145.815	82.0
151.350	82.6
154.075	81.5

Table 64 - List of Detected Spurious Responses for VHF Receiver

IEC 62238, Limit Clause 9.6.2

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.

2.24.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	8644A	96	12	27-Apr-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412		TU
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 65

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.25 Intermodulation Response

2.25.1 Specification Reference

IEC 62238, Clause 9.7

2.25.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.25.3 Date of Test

08-September-2017

2.25.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.7.2.

2.25.5 Environmental Conditions

Ambient Temperature	23.4 °C
Relative Humidity	50.9 %

2.25.6 Test Results

DC Powered - VHF & DSC

Signal Generator A Frequency (MHz)	Signal Generator B Frequency Offset (kHz)	Signal Generator C Frequency Offset (kHz)	Intermodulation Response Ratio (dB)
156.800	-50	-100	70.2
156.800	+50	+100	70.0

Table 66 - Intermodulation Response Rejection Results for VHF Receiver

IEC 62238, Limit Clause 9.7.3.

The intermodulation response rejection ratio shall be greater than 68 dB.

2.25.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	8644A	96	12	27-Apr-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator (10dB, 75W)	Bird	8308-100	469	12	14-Dec-2017
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Power Splitter	Weinschel	1506A	606	12	05-Apr-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 67

O/P Mon – Output Monitored using calibrated equipment

2.26 Blocking or Desensitization

2.26.1 Specification Reference

IEC 62238, Clause 9.8

2.26.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.26.3 Date of Test

31-August-2017

2.26.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.8.2.

2.26.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	50.2 %

2.26.6 Test Results

DC Powered - VHF & DSC

The unwanted signal generator was swept from -10 MHz to -1 MHz and +1 MHz to +10 MHz offset from the centre of frequency of the wanted signal. The following responses were found and are shown in the table below:

Frequency (MHz)	Blocking Level (dBuV e.m.f)
153.530	95.5
153.685	92.0
155.495	94.2
155.525	99.9
155.785	91.7
157.825	91.0
158.270	99.0
159.245	91.8
160.155	90.8
160.490	97.7
163.620	99.9
165.325	94.3

Table 68 - Swept Frequency Blocking Results for VHF Receiver

No other responses were identified during the Limited Frequency Range Sweep.

IEC 62238, Limit Clause 6.8.2

The blocking level for any frequency within the specified ranges, shall be not less than 90 dBµV (e.m.f.), except at frequencies on which spurious responses are found.

2.26.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	8644A	96	12	27-Apr-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	1-Jun-2018
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	2-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 69

O/P Mon – Output Monitored using calibrated equipment

2.27 Spurious Emissions

2.27.1 Specification Reference

IEC 62238, Clause 9.9

2.27.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.27.3 Date of Test

12-September-2017

2.27.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.9.2.

2.27.5 Environmental Conditions

Ambient Temperature	21.1 °C
Relative Humidity	49.8 %

2.27.6 Test Results

DC Powered - VHF & DSC

Frequency (MHz)	Level (nW)
0.15	0.105
114.87	0.331
134.83	0.417
344.62	0.085
574.38	0.031

Table 70 - Conducted Spurious Emissions Results for VHF Receiver

IEC 62238, Limit Clause 9.9.3

The power of any spurious emission shall not exceed 2 nW at any frequency in the range between 9 kHz and 2 GHz.

2.27.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	-	O/P Mon
Filter (Hi Pass)	Mini-Circuits	NHP-600	2834	12	21-Oct-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	2-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
2 Metre SMA Type Cable	Rhophase	3PS-1801A-2000-3PS	4111	-	O/P Mon
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	22-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 71

O/P Mon – Output Monitored using calibrated equipment

2.28 Receiver Residual Noise Level

2.28.1 Specification Reference

IEC 62238, Clause 9.10

2.28.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.28.3 Date of Test

11-September-2017

2.28.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.10.2.

2.28.5 Environmental Conditions

Ambient Temperature	22.6 °C
Relative Humidity	50.7 %

2.28.6 Test Results

DC Powered - VHF & DSC

Residual Noise Level (dB)
-55.0

Table 72 - Residual Noise Level

IEC 62238, Limit Clause 9.10.3.

The receiver residual noise level shall not exceed -40 dB.

2.28.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 73

O/P Mon – Output Monitored using calibrated equipment

2.29 Squelch Operation

2.29.1 Specification Reference

IEC 62238, Clause 9.11

2.29.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.29.3 Date of Test

07-September-2017

2.29.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.11.2.

Test	Method
A	With the squelch facility switched off, a test signal of +30 dBµV (e.m.f.), at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation specified in 6.3, shall be applied to the input terminals of the receiver. An audiofrequency load and a psophometric filtering network shall be connected to the output terminals of the receiver. The receiver's audiofrequency power control shall be set so as to produce the rated output power defined in 9.1. The output signal shall be measured with the aid of an r.m.s. voltmeter. The input signal shall then be suppressed, the squelch facility switched on and the audiofrequency output level measured again.
B	With the squelch facility switched off again, a test signal modulated by the normal test modulation shall be applied to the receiver input at a level of +6 dBµV (e.m.f.) and the receiver shall be set to produce 50 % of the rated output power. The level of the input signal shall then be reduced and the squelch facility shall be switched on. The input signal shall then be increased until the above-mentioned output power is reached. The SINAD ratio and the input level shall then be measured.
C	(Applicable only to equipment with continuously adjustable squelch control.) With the squelch facility switched off, a test signal with normal test modulation shall be applied to the receiver input at a level of +6 dBµV (e.m.f.), and the receiver shall be adjusted to give 50 % of the rated audio output power. The level of the input signal shall then be reduced and the squelch facility shall be switched on at its maximum position and the level of the input signal increased until the output power again is 50 % of the rated audio output power.

Table 74 - Details of steps

2.29.5 Environmental Conditions

Ambient Temperature	23.6 °C
Relative Humidity	51.4 %

2.29.6 Test Results

DC Powered - VHF & DSC

Step A	Step B		Step C
Audiofrequency Output Power (dB)	Input Level (dBuV)	SINAD (dB)	Input Level (dBuV)
>-40	1.71	28	2

Table 75 - Squelch Operation Results

IEC 62238, Limit Clause 9.11.3

Under the conditions specified in 9.11.2 a), the audiofrequency output power shall not exceed –40 dB relative to the rated output power.

Under the conditions specified in 9.11.2 b), the input level shall not exceed +6 dBµV (e.m.f.) and the SINAD ratio shall be at least 20 dB.

Under the conditions specified in 9.11.2 c), the input signal shall not exceed +6 dBµV (e.m.f.) when the control is set at maximum.

2.29.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB, 75W)	Bird	8308-100	469	12	14-Dec-2017
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 76

O/P Mon – Output Monitored using calibrated equipment

2.30 Squelch Hysteresis

2.30.1 Specification Reference

IEC 62238, Clause 9.12

2.30.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.30.3 Date of Test

07-September-2017

2.30.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.12.2.

2.30.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	46.7 %

2.30.6 Test Results

DC Powered - VHF & DSC

Input Level (dBµV e.m.f.)		Difference (dB)
Squelch Open	Squelch Closed	
-4.71	-8.11	3.4

Table 77 - Squelch Hysteresis

IEC 62238, Limit Clause 9.12.3

The squelch hysteresis shall be between 3 dB and 6 dB.

2.30.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 78

O/P Mon – Output Monitored using calibrated equipment

2.31 Multiple Watch Characteristic

2.31.1 Specification Reference

IEC 62238, Clause 9.13

2.31.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 4 - Modification State 1

2.31.3 Date of Test

25-September-2017

2.31.4 Test Method

This test was performed in accordance with IEC 62238, clause 9.13.2.

2.31.5 Environmental Conditions

Ambient Temperature	23.4 °C
Relative Humidity	61.9 %

2.31.6 Test Results

DC Powered - VHF & DSC

Temperature	Voltage	Priority Channel Frequency (MHz)	Additional Channel Frequency (MHz)	Scanning period (s)	Dwell on Priority Channel (ms)	Dwell on Additional Channel (s)
+23.4 °C	13.8 V DC	156.8	156.45	1.979	134	1.84
-20.0 °C	15.6 V DC	156.8	156.45	1.980	133	1.84
-20.0 °C	10.8 V DC	156.8	156.45	1.991	133	1.85
+55.0 °C	15.6 V DC	156.8	156.45	1.988	134	1.85
+55.0 °C	10.8 V DC	156.8	156.45	1.985	133	1.85

Table 79 - Multiple Watch Characteristics for Simplex Channels

IEC 62238, Limit Clause 9.13.3

- The scanning period on the period shall not exceed 2 s.
- The dwell time on the priority channel shall not exceed 150 ms.
- The dwell time on the additional channel shall be between 850 ms and 2 s as indicated by the time of the gap between two output bursts.

2.31.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMY 01	49	12	25-Oct-2017
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Cystal Detector (Pos O/P)	ASL (TUV)	RAB1	479	-	TU
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Power Splitter	Weinschel	1506A	606	12	05-Apr-2018
Step Attenuator	Rohde & Schwarz	DPSP	1672	-	O/P Mon
Power Supply	Iso-tech	IPS 2010	2440	-	O/P Mon
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Climatic Chamber	TAS	Micro 225	2892	-	O/P Mon
Thermocouple Thermometer	Fluke	51	3174	12	22-Dec-2017
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	26-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	26-Sep-2017
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2018
Oscilloscope	Agilent Technologies	DSO9104A	4142	12	19-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 80

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.32 DSC - Maximum Usable Sensitivity

2.32.1 Specification Reference

IEC 62238, Clause 10.1

2.32.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.32.3 Date of Test

29-August-2017

2.32.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.1.2.

2.32.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	52.9 %

2.32.6 Test Results

DC Powered - VHF & DSC

Temperature	Voltage	Input Level (dBµV e.m.f.)	Bit Error Ratio
+22.9 °C	13.8 V DC	0	0
-20.0 °C	15.6 V DC	6	0
-20.0 °C	10.8 V DC	6	0
+55.0 °C	15.6 V DC	6	0
+55.0 °C	10.8 V DC	6	0

Table 81 - Maximum Usable Sensitivity for DSC Receiver

IEC 62238, Limit Clause 10.1.3

The bit error ratio shall be equal to or less than 10^{-2}.

2.32.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	8-Sep-2018
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Digital Temperature Indicator	Fluke	51	2267	12	5-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	6-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	1-Jun-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	2-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	3-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Modulation Analyser	Hewlett Packard	8901B	45	12	8-Sep-2018

Table 82

O/P Mon – Output Monitored using calibrated equipment

2.33 DSC - Co-channel Rejection

2.33.1 Specification Reference

IEC 62238, Clause 10.2

2.33.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.33.3 Date of Test

31-August-2017

2.33.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.2.2.

2.33.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	50.2 %

2.33.6 Test Results

DC Powered - VHF & DSC

Displacement of Unwanted Signal (kHz)	Level of Wanted Signal (dBµV e.m.f.)	Level of Unwanted Signal (dBµV e.m.f.)	Bit Error Ratio
-3	3	-5	6.1 E-3
0	3	-5	4.5 E-3
+3	3	-5	6.1 E-3

Table 83 - Co-channel Rejection Ratio Results for DSC Receiver

IEC 62238, Limit Clause 10.2.3

The bit error ratio shall be equal to or less than 10^{-2}.

2.33.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 84

O/P Mon – Output Monitored using calibrated equipment

2.34 DSC - Adjacent Channel Selectivity

2.34.1 Specification Reference

IEC 62238, Clause 10.3

2.34.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.34.3 Date of Test

26-August-2017

2.34.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.3.2.

2.34.5 Environmental Conditions

Ambient Temperature	23.2 °C
Relative Humidity	52.9 %

2.34.6 Test Results

DC Powered - VHF & DSC

Temperature	Voltage	Level of Wanted Signal (dBµV e.m.f)	Level of Unwanted Signal (dBµV e.m.f)	Bit Error Ratio	
				-25 kHz	+25 kHz
+23.2 °C	13.8 V DC	3	73	0	0
-20.0 °C	15.6 V DC	9	63	0	0
-20.0 °C	10.8 V DC	9	63	0	0
+55.0 °C	15.6 V DC	9	63	0	0
+55.0 °C	10.8 V DC	9	63	0	0

Table 85 - Adjacent Channel Selectivity Results for DSC Receiver

IEC 62238, Limit Clause 10.3.3

The bit error ratio shall be equal to or less than 10^{-2}.

2.34.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	05-Sep-2017
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz - 18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
2 Metre SMA Type Cable	Rhophase	3PS-1801A-2000-3PS	4111	-	O/P Mon
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 86

O/P Mon – Output Monitored using calibrated equipment

2.35 DSC - Spurious Response and Blocking Immunity

2.35.1 Specification Reference

IEC 62238, Clause 10.4

2.35.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.35.3 Date of Test

03-August-2017 to 04-August-2017

2.35.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.4.2

2.35.5 Environmental Conditions

Ambient Temperature	20.1 - 22.7 °C
Relative Humidity	50.2 - 73.0 %

2.35.6 Test Results

DC Powered - VHF & DSC

The unwanted signal generator was swept from -10 MHz to -1 MHz and +1 MHz to +10 MHz offset from the centre of frequency of the wanted signal. The following responses were found and are shown in the table below:

Unwanted Signal Generator Frequency (MHz)	Wanted Signal Generator Level (dBµV e.m.f)	Unwanted Signal Generator Level (dBµV e.m.f)	Bit Error Ratio
154.01	+3	+93	5.5 E-3
161.46	+3	+93	7.2 E-5

Table 87 - Swept Frequency Blocking Results for DSC Receiver

No other responses were identified during the Limited Frequency Range Sweep.

Unwanted Signal Generator Frequency (MHz)	Wanted Signal Generator Level (dBµV e.m.f)	Unwanted Signal Generator Level (dBµV e.m.f)	Bit Error Ratio
*			

Table 88 - Spurious Response Rejection Results for DSC Receiver

*No responses were identified during the Limited Frequency Range Sweep.

IEC 62238, Limit Clause 10.4.3

The bit error ratio shall be equal to or less than 10^{-2}.

2.35.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	96	12	27-Apr-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	TU
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 89

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.36 DSC - Intermodulation Response

2.36.1 Specification Reference

IEC 62238, Clause 10.5

2.36.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.36.3 Date of Test

05-September-2017

2.36.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.5.2.

2.36.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	73.2 %

2.36.6 Test Results

DC Powered - VHF & DSC

Signal Generator A		Signal Generator B		Signal Generator C		Intermodulation Response Ratio (dB)
Frequency (MHz)	Level (dBµV e.m.f)	Frequency Offset (kHz)	Level (dBµV e.m.f)	Frequency Offset (kHz)	Level (dBµV e.m.f)	
156.525	3	-50	68	-100	68	1.6 E-3
156.525	3	50	68	100	68	2.5 E-3

Table 90 - Intermodulation Response Rejection Results for DSC Receiver

IEC 62238, Limit Clause 10.5.3

The bit error ratio shall be equal to or less than 10^{-2}.

2.36.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	96	12	27-Apr-2018
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Power Divider	Weinschel	1506A	604	12	13-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	15-Sep-2017
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 91

O/P Mon – Output Monitored using calibrated equipment

2.37 DSC - Dynamic Range

2.37.1 Specification Reference

IEC 62238, Clause 10.6

2.37.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.37.3 Date of Test

01-September-2017

2.37.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.6.2.

2.37.5 Environmental Conditions

Ambient Temperature	20.6 °C
Relative Humidity	50.1 %

2.37.6 Test Results

DC Powered - VHF & DSC

Input Level (dBµV e.m.f.)	Bit Error Ratio
100	0 -E0
0	0 -E0

Table 92 - Dynamic Range for DSC Receiver

IEC 62238, Limit Clause 10.6.3

The bit error ratio shall be equal to or less than 10^{-2}.

2.37.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3068	12	01-Jun-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 93

O/P Mon – Output Monitored using calibrated equipment

2.38 DSC - Spurious Emissions

2.38.1 Specification Reference

IEC 62238, Clause 10.7

2.38.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.38.3 Date of Test

12-September-2017

2.38.4 Test Method

This test was performed in accordance with IEC 62238, clause 8.8.2.

2.38.5 Environmental Conditions

Ambient Temperature	21.1 °C
Relative Humidity	49.8 %

2.38.6 Test Results

DC Powered - VHF & DSC

Frequency (MHz)	Level (nW)
0.15	0.105
114.87	0.331
134.83	0.417
344.62	0.085
574.38	0.031

Table 94 - Conducted Spurious Emissions Results for DSC Receiver

IEC 62238, Limit 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.

2.38.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	2-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	22-Jun-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 95

O/P Mon – Output Monitored using calibrated equipment

2.39 Verification of Correct Decoding of Various Types of DSC Calls

2.39.1 Specification Reference

IEC 62238, Clause 10.8

2.39.2 Equipment Under Test and Modification State

VHF490, S/N: Not Serialised (75938884-TSR-0001) - Modification State 0

2.39.3 Date of Test

02-August-2017

2.39.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.8.2.

2.39.5 Environmental Conditions

Ambient Temperature	20.5 °C
Relative Humidity	52.0 %

2.39.6 Test Results

DC Powered - VHF & DSC

Call Sent	Channel (MHz)	Received Without Error	Telecommand 1	Telecommand 2	Expansion Data Specifier
Distress	156.525	Yes	107	100	100
All Ships Distress Ack	156.525	Yes	110	100	100
All Ships Relay	156.525	Yes	112	107	100
All Ships Urgency	156.525	Yes	100	126	100
All Ships Safety	156.525	Yes	100	126	100
Individual Urgency	156.525	Yes	100	126	100
Individual Safety	156.525	Yes	100	126	100
Individual Routine	156.525	Yes	100	126	100
Group Routine	156.525	Yes	100	126	100

Table 96 - Received Calls

Requirement	Check Performed (Yes/No)	Errors Found (Yes/No)
Confirm that the decoded call sequences at the output of the receiver have been examined for correct technical format, including error check characteristics.	Yes	No
It has been verified that the equipment is capable of switching to a channel identified in the DSC call:	Yes	No

Table 97 - Performed Checks

IEC 62238, Limit Clause 10.8.3

The requirements of ITU-R Recommendation M.493-10 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 the channels identified in the DSC call.

2.39.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Modem (MF/HF/VHF DSC)	ICS	PLT02249	120	12	3-Aug-2018
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Balun Transformer	Minolta	DDF-12A	1280	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Sensor Module	Hewlett Packard	11722A	3293	12	08-Dec-2017
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD Product Service	RAB 200701	3314	12	03-Aug-2018
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 98

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.40 Reaction to VTS and AIS Channel Management DSC Transmissions

2.40.1 Specification Reference

IEC 62238, Clause 10.9

2.40.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.40.3 Date of Test

18-September-2017

2.40.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.9.2.

2.40.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	49.2 %

2.40.6 Test Results

DC Powered - VHF & DSC

Requirement	Requirement was Met (Yes/No)
Not sound an alarm	Yes
Not display a message (An accurate informative display is permissible but not required)	Yes
Not transmit a response	Yes
Not suggest a transmitted response	Yes
Not lock up	Yes
Not require operator intervention	Yes

Table 99 - Reaction to VTS and AIS Channel Management DSC Transmissions

IEC 62238, Limit Clause 10.9.3

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

2.40.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Modem (MF/HF/VHF DSC)	ICS	PLT02249	120	12	03-Aug-2018
Modulation Analyser	Hewlett Packard	8901B	773	12	27-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Power Supply	Iso-tech	IPS 2010	2440	-	O/P Mon
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Sensor Module	Hewlett Packard	11722A	3293	12	08-Dec-2017
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2018
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018

Table 100

O/P Mon – Output Monitored using calibrated equipment

2.41 Simultaneous Reception

2.41.1 Specification Reference

IEC 62238, Clause 10.10

2.41.2 Equipment Under Test and Modification State

VHF490, S/N: VT655ZV T/A Sample No 2 - Modification State 0

2.41.3 Date of Test

31-August-2017

2.41.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.10.2.

2.41.5 Environmental Conditions

Ambient Temperature	21.2 °C
Relative Humidity	50.0 %

2.41.6 Test Results

DC Powered - VHF & DSC

SINAD (dB) - No DSC Signal	SINAD (dB) DSC Signal Applied	Bit Error Rate
38.3	38.3	5.2 E-3

Table 101 - Simultaneous Reception Results

IEC 62238, Limit Clause 10.10.3

For radiotelephony operation the SINAD ratio shall be no less than 20 dB in the presence of the DSC test signal.

The DSC bit error ratio shall be equal to or less than 10^{-2}.

2.41.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD Product Service	DSC TPOO1	81	-	TU
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Attenuator: 10dB/20W	Narda	766-10	480	12	14-Dec-2017
Rubidium Standard	Rohde & Schwarz	XSRM	1316	12	12-Sep-2017
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2017
Power Attenuator (30dB)	Rohde & Schwarz	RBU	2746	-	O/P Mon
Multimeter	Fluke	79 Series II	3057	12	19-May-2018
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	29-Sep-2017
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2017
DSC Pre-empahsis Unit	TUV SUD Product Service	n/a	4369	12	03-Aug-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 102

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Equipment Under Test (EUT)

Figure 26 – Sample 2 Front View

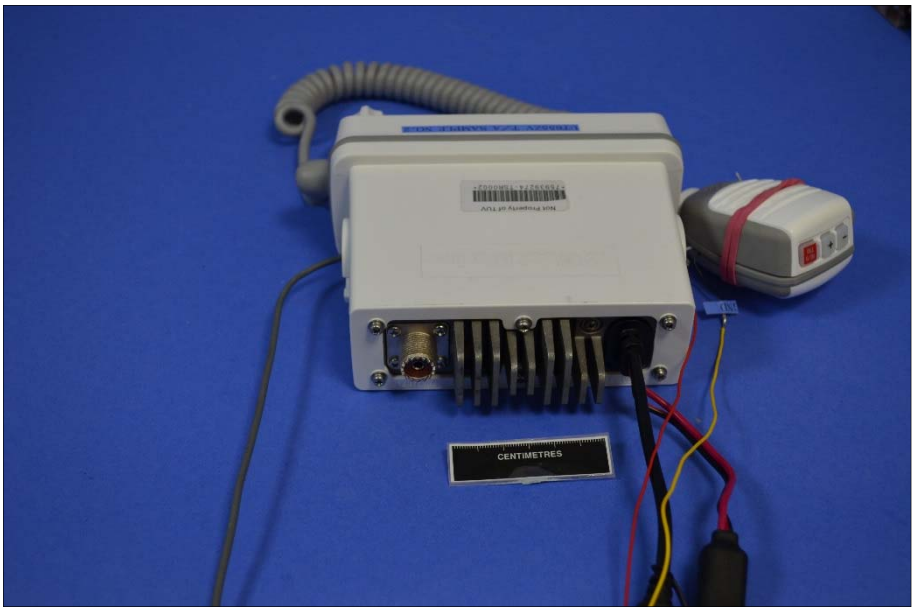


Figure 27 – B Sample 2 Rear View

Figure 28 – Sample 4 Front View

Figure 29 – B Sample 4 Rear View

4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Vibration Test	Carrier Power: ±0.4 dB Frequency Error: ±11 Hz Sensitivity: ±1.8 dB
Temperature Tests - Dry Heat Functional Test	Carrier Power: ±0.4 dB Frequency Error: ±11 Hz Sensitivity: ±1.8 dB
Temperature Tests - Damp Heat Functional Test	Carrier Power: ±0.4 dB Frequency Error: ±11 Hz Sensitivity: ±1.8 dB
Temperature Tests - Low Temperature Functional Test	Carrier Power: ±0.4 dB Frequency Error: ±11 Hz Sensitivity: ±1.8 dB
Frequency Error	±11 Hz
Carrier Power	±0.4 dB
Frequency Deviation	±88.5 Hz
Sensitivity of the Modulator including Microphone	±1.73%
Audiofrequency Response	±1.5 dB
Audiofrequency Harmonic Distortion of the Emission	±14.12%
Adjacent Channel Power	±3.0 dB
Conducted Spurious Emissions Conveyed to the Antenna	± 3.54 dB
Transient Frequency Behaviour of the Transmitter	± 0.2 kHz
Residual Modulation of the Transmitter	±1.0 dB
Frequency Error (DSC Signal)	±0.15 Hz
Modulation Index for DSC	±1.53%
Modulation Rate for DSC	±1.53%
Testing of Generated Call Sequences	-
Harmonic Distortion and Rated Audiofrequency Output Power	±2.0 dB
Audiofrequency Response	±2.0 dB
Maximum Usable Sensitivity	±1.8 dB
Co-channel Rejection	±2.6 dB
Adjacent Channel Selectivity	±2.6 dB
Spurious Response Rejection	±2.6 dB
Intermodulation Response	±2.6 dB
Blocking or Desensitization	±2.6 dB
Spurious Emissions	± 3.54 dB
Receiver Residual Noise Level	± 1.8 dB

Test Name	Measurement Uncertainty
Squelch Operation	± 0.4 dB ≤+6 dBµV emf: ± 2.1 dB ≥ 20 dB: ± 0.4 dB ≤ +6 dBµV emf: ± 2.1 dB
Squelch Hysteresis	±1.8 dB
Multiple Watch Characteristic	-
DSC - Maximum Usable Sensitivity	±1.8 dB
DSC - Co-channel Rejection	±2.6 dB
DSC - Adjacent Channel Selectivity	±2.6 dB
DSC - Spurious Response and Blocking Immunity	±2.6 dB
DSC - Intermodulation Response	±2.6 dB
DSC - Dynamic Range	±1.8 dB
DSC - Spurious Emissions	± 3.54 dB
Verification of Correct Decoding of Various Types of DSC Calls	-
Reaction to VTS and AIS Channel Management DSC Transmissions	-
Simultaneous Reception	±1.8 dB

Table 103