

Radio Test Report

Vesper Marine Ltd

VHF DSC Radio Transceiver, Model: Cortex M1

Handset, Model: Cortex H1

In accordance with IEC 62238

Prepared for: Vesper Marine Ltd
45 Sale Street
Auckland
1142
New Zealand



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Document 75943855-08 Issue 03

FCC ID: Cortex M1: YJDVESPM1
IC: Cortex M1: 9118A-M1

Cortex H1: YJDVESPH1
Cortex H1: 9118A-H1

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Ryan Henley	Sales Manager	Authorised Signatory	18 June 2020

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

EXECUTIVE SUMMARY

A sample of this product was tested in accordance with IEC 62238: Edition 1 (2003-03). A summary of the results for the tests performed are detailed in section 1.3.



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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	29 May 2020
2	Non-technical change to results table	01 June 2020
3	FCC & IC ID's added to the front page of the report	18 June 2020

Table 1

1.2 Introduction

Applicant	Vesper Marine Ltd
Manufacturer	Vesper Marine Ltd
Model Number(s)	Cortex M1 Cortex H1
Serial Number(s)	M1.0000006B and M1.0000006F H1.0000000F and H1 – TUV H1-8
Hardware Version(s)	B C
Software Version(s)	0.2 0.9
Number of Samples Tested	2 Cortex M1 2 Cortex H1
Test Specification/Issue/Date	IEC 62238: Edition 1 (2003-03)
Order Number	13976
Date	20-September-2018
Date of Receipt of EUT	07-August-2019 and 17-December-2019
Start of Test	11-September-2019
Finish of Test	29-April-2020
Name of Engineer(s)	Ibrahim Bukhari, Jonathan Kenny, Daniel Bishop, Neil Rousell and Francis Kane



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: POD + Handset - VHF Transceiver				
2.1	8.1	Frequency Error	Pass	
2.2	8.2	Carrier Power	Pass	
2.3	8.3	Frequency Deviation	Pass	
2.4	8.4	Sensitivity of the Modulator including Microphone	Pass	
2.5	8.5	Audio frequency Response	Pass	
2.6	8.6	Audio frequency Harmonic Distortion of the Emission	Pass	
-	8.7	Adjacent Channel Power	-	Refer to report held by manufacturer for alternate results.
2.7	8.8	Conducted Spurious Emissions Conveyed to the Antenna	Pass	
2.8	8.9	Transient Frequency Behaviour of the Transmitter	Pass	
2.9	8.10	Residual Modulation of the Transmitter	Pass	
2.10	8.11	Frequency Error (DSC Signal)	Pass	
2.11	8.12	Modulation Index for DSC	Pass	
2.12	8.13	Modulation Rate for DSC	Pass	
2.13	8.14	Testing of Generated Call Sequences	Pass	
2.14	9.1	Harmonic Distortion and Rated Audio Frequency Output Power	Pass	
2.15	10.10	Simultaneous Reception	Pass	
2.16	10.9	Reaction to VTS and AIS Channel Management DSC Transmissions	Pass	
2.17	10.8	Verification of Correct Decoding of Various Types of DSC Calls	Pass	
-	10.7	DSC - Spurious Emissions	Waiver	Receiver is shared with Radiotelephone Receiver therefore covered under clause 9.9
2.18	10.6	DSC - Dynamic Range	Pass	



2.19	10.5	DSC - Intermodulation Response	Pass	
2.20	10.4	DSC - Spurious Response and Blocking Immunity	Pass	
2.21	10.3	DSC - Adjacent Channel Selectivity	Pass	
2.22	10.2	DSC - Co-channel Rejection	Pass	
2.23	10.1	DSC - Maximum Usable Sensitivity	Pass	
2.24	9.13	Multiple Watch Characteristic	Pass	
2.25	9.12	Squelch Hysteresis	Pass	
2.26	9.11	Squelch Operation	Pass	
2.27	9.10	Receiver Residual Noise Level	Pass	
2.28	9.9	Spurious Emissions	Pass	
2.29	9.8	Blocking or Desensitization	Pass	
2.30	9.7	Intermodulation Response	Pass	
2.31	9.6	Spurious Response Rejection	Pass	
2.32	9.5	Adjacent Channel Selectivity	Pass	
2.33	9.4	Co-channel Rejection	Pass	
2.34	9.3	Maximum Usable Sensitivity	Pass	
2.35	9.2	Audio Frequency Response	Pass	

Table 2



1.4 Application Form

Equipment Description

Technical Description: (Please provide a brief description of the intended use of the equipment)	VHF and Class B AIS transponder with integrated Wifi and cellular Connectivity. VHF/DSC/AIS capable.
Manufacturer:	Vesper Marine Ltd
Model:	Cortex M1, Cortex H1
Part Number:	M1, H1
Hardware Version:	B
Software Version:	0.8

Transmitter Technical Characteristics – Frequency Characteristics

Transmitter frequency alignment range:	Click to edit
Transmitter channel switching frequency range:	156-162MHz

Transmitter RF Power Characteristics

Maximum effective rated power (rated as stated by the manufacturer):	25 W
Average effected radiated power (rated as stated by the manufacturer):	25 W
Is transmitter intended for:	Continuous duty: Yes ☒ VHF Only No ☐ Intermittent duty: Yes ☒ No ☐
If intermittent state DUTY CYCLE:	Transmitter ON: Varies by protocol seconds Transmitter OFF: Varies by protocol seconds
Is transmitter output power variable?	Continuous duty: Yes ☒ VHF Only No ☐
Maximum power:	25 W Continuously variable ☐ Stepped ☒ 1W, 5W, 25W (based on protocol) dB per step
Maximum RF output power:	25 W
Minimum RF output power:	1 W

Transmitter Modulation Input Character Characteristics (FM)

Modulation input signal level for 60% of maximum deviation at:	Click to edit
Microphone socket: (Internal, not exposed) 60 mV	100,000 Impedance (Ohms)
Accessory socket: mV	Impedance (Ohms)
Other (4): Click to edit mV	Click to edit Impedance (Ohms)
Lowest audio modulation frequency transmitted by the equipment	300 Hz



Transmitter Modulation

Frequency ☒ Phase ☐ Other ☐ Please Detail: Click to edit	
Channel spacing	25kHz
State the maximum number of channels over which the equipment can operate: Marine band channels 0 - 88	

Receiver Technical Characteristics – Frequency Characteristics

Receiver frequency alignment range:	Click to edit
Receiver channel switching frequency:	Direct Conversion
Method of Frequency Generation	Crystal ☐ Synthesizer ☐ Other ☒ Please Detail: Digital Synthesizer
Intermediate Frequencies:	1 st ☒ 2 nd ☐ 3 rd ☐
Is local oscillator injection frequency higher or lower than the receiver nominal frequency?	Higher ☐ Lower ☒

Receiver Audio (AF) Characteristics – Maximum Rated Audio (AF) Frequency Output Power

Into Loudspeaker:	10 W
Into Line:	Click to edit W
Into H1 Handset Speaker:	2 W
Balanced:	Yes ☒ Click or tap here to enter text. No ☐
Unbalanced:	Yes ☐ No ☐
Does connection carry DC voltage?	Yes ☐ No ☒ if Yes, please state voltage Click to edit
Normal Audio load impedance:	At Loudspeaker: 4 Ohms At Line: Click or tap here to enter text. Ohms At H1 Handset Speaker: 4 Ohms
At audio accessory connection or facility socket (if fitted):	Output: Click to edit W Impedance: Click to edit W
Max input level at audio accessory socket:	Output: Click to edit W Impedance: Click to edit W

AC Power Source

AC supply frequency: Click to edit (Hz)	
Click to edit V	Max current: Click to edit A
Single phase ☐ Three phase ☐	

DC Power Source

Nominal voltage: 12 V
Extreme upper voltage: 32 V
Extreme lower voltage: 10 V
Max current: 6 A



Battery Power Source (Handset Only)

Voltage: 3.7V
End-point voltage: 3.7V
Alkaline ☐ Leclanche ☐ Lithium ☒ Nickel Cadmium ☐ Lead Acid* ☐ *(Vehicle regulated)
Other ☐ Please detail: Click to edit

Temperature (over which equipment is to be type tested)

Minimum Temperature: -25 °C
Maximum Temperature: 55 °C
Other, please specify: Click to edit

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 ☒	Cut off voltage 10 V
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.			
Channel Position	Channel Number	Transmit Nominal Frequency (MHz)	Receive Nominal Frequency (MHz)
Click to edit	Click to edit	Click to edit	Click to edit

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

Name: Carl Omundsen
Position held: CTO
Date: 24-June-2019



1.5 Product Information

1.5.1 Technical Description

VHF and Class B AIS transponder with integrated Wi-Fi and cellular Connectivity. VHF/DSC/AIS capable.

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
Model: Cortex M1, Serial Number: M1.0000006B			
0	As supplied by the customer	Not Applicable	Not Applicable
1	Replaced component capacitor C800 value 36 pF	Manufacturer (NZ)	11-February-2020
2	R1306 100 k -> 1 M (Cold Temp Issue – Audio Codec)	Manufacturer	25-November-2019
3	Replaced component capacitor C800 value 36 pF	Manufacturer	11-February-2020
Model: Cortex M1, Serial Number: M1.0000006F			
14 (See note)	Software update: POD 0.22.22255	TÜV SÜD	28 April 2020
Model: Cortex H1, Serial Number: H1.0000000F			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: Cortex H1, Serial Number: TUV H1-8			
14 (See note)	Software update: Handset 0.9.164	TÜV SÜD	28 April 2020

Table 3

Note: Full modification history of this sample is detailed in Document 75943855-11 and held by the manufacturer.



1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: POD + Handset - VHF Transceiver		
Frequency Error	Ibrahim Bukhari and Jonathan Kenny	UKAS
Carrier Power	Ibrahim Bukhari and Jonathan Kenny	UKAS
Frequency Deviation	Jonathan Kenny	UKAS
Sensitivity of the Modulator including Microphone	Jonathan Kenny	UKAS
Audio frequency Response	Daniel Bishop	UKAS
Audio frequency Harmonic Distortion of the Emission	Daniel Bishop, Ibrahim Bukhari and Jonathan Kenny	UKAS
Conducted Spurious Emissions Conveyed to the Antenna	Daniel Bishop	UKAS
Transient Frequency Behaviour of the Transmitter	Ibrahim Bukhari	UKAS
Residual Modulation of the Transmitter	Daniel Bishop	UKAS
Frequency Error (DSC Signal)	Daniel Bishop and Jonathan Kenny	UKAS
Modulation Index for DSC	Daniel Bishop	UKAS
Modulation Rate for DSC	Daniel Bishop	UKAS
Testing of Generated Call Sequences	Neil Rousell	UKAS
Harmonic Distortion and Rated Audio Frequency Output Power	Daniel Bishop	UKAS
Simultaneous Reception	Jonathan Kenny	UKAS
Reaction to VTS and AIS Channel Management DSC Transmissions	Neil Rousell	UKAS
Verification of Correct Decoding of Various Types of DSC Calls	Neil Rousell	UKAS
DSC - Dynamic Range	Daniel Bishop	UKAS
DSC - Intermodulation Response	Daniel Bishop	UKAS
DSC - Spurious Response and Blocking Immunity	Daniel Bishop and Ibrahim Bukhari	UKAS
DSC - Adjacent Channel Selectivity	Daniel Bishop, Ibrahim Bukhari and Jonathan Kenny	UKAS
DSC - Co-channel Rejection	Daniel Bishop	UKAS
DSC - Maximum Usable Sensitivity	Daniel Bishop, Ibrahim Bukhari and Jonathan Kenny	UKAS
Multiple Watch Characteristic	Ibrahim Bukhari	UKAS
Squelch Hysteresis	Daniel Bishop	UKAS
Squelch Operation	Daniel Bishop	UKAS
Receiver Residual Noise Level	Daniel Bishop	UKAS
Spurious Emissions	Daniel Bishop and Ibrahim Bukhari	UKAS
Blocking or Desensitization	Daniel Bishop	UKAS
Intermodulation Response	Daniel Bishop	UKAS



Test Name	Name of Engineer(s)	Accreditation
Spurious Response Rejection	Ibrahim Bukhari	UKAS
Adjacent Channel Selectivity	Daniel Bishop and Jonathan Kenny	UKAS
Co-channel Rejection	Daniel Bishop	UKAS
Maximum Usable Sensitivity	Daniel Bishop, Ibrahim Bukhari and Jonathan Kenny	UKAS
Audio Frequency Response	Daniel Bishop	UKAS

Table 4

Office Address:

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

2 Test Details

2.1 Frequency Error

2.1.1 Specification Reference

IEC 62238, Clause 8.1

2.1.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.1.3 Date of Test

11-December-2019 to 26-February-2020

2.1.4 Test Method

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

2.1.5 Environmental Conditions

Ambient Temperature 22.2 - 24.2 °C
Relative Humidity 27.6 - 41.3 %

2.1.6 Test Results

POD + Handset - VHF Transceiver

Test Conditions		Frequency Error (Hz)
Temperature	Voltage	156.800 MHz
+22.6 °C	12.0 V DC	+116
-15.0 °C	10.8 V DC	+66
-15.0 °C	31.2 V DC	+54
+55.0 °C	10.8 V DC	+35
+55.0 °C	31.2 V DC	+23

Table 5 - Frequency Error Results

IEC 62238, Limit Clause 8.1.3

The frequency error shall be within ± 1.5 kHz.



2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Thermometer	Digitron	T208	64	12	12-Jun-2020
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
True RMS Multimeter	Fluke	79 Series III	411	12	07-Oct-2020
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2019
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	17-Jul-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	10-Feb-2021
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Attenuator (30dB, 100W)	Weinschel	48-30-43	4863	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5098	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 6

O/P Mon – Output Monitored using calibrated equipment



2.2 Carrier Power

2.2.1 Specification Reference

IEC 62238, Clause 8.2

2.2.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.2.3 Date of Test

13-December-2019 to 28-February-2020

2.2.4 Test Method

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

2.2.5 Environmental Conditions

Ambient Temperature 22.2 - 24.2 °C
Relative Humidity 27.6 - 37.8 %

2.2.6 Test Results

POD + Handset - VHF Transceiver

Maximum Rated Output Power: 25 W

Test Conditions		156.025 MHz		156.800 MHz		162.025 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)
+23.5 °C	12.0 V DC	20.400	-0.900	24.600	-0.500	21.400	-0.800
-15.0 °C	10.8 V DC	17.560	-1.189	23.300	-0.470	18.450	-1.319
-15.0 °C	31.2 V DC	15.990	-1.941	17.560	-1.520	17.470	-1.556
+55.0 °C	10.8 V DC	15.596	-2.049	15.560	-2.059	12.764	-2.919
+55.0 °C	31.2 V DC	15.488	-2.079	15.417	-2.099	12.706	-2.939

Table 7 - 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.	5.01

Table 8 - Time-out Timer at Maximum Rated Power on 156.800 MHz



Minimum Rated Output Power: 1 W.

Test Conditions		156.025 MHz		156.800 MHz		162.025 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)
+23.5 °C	12.0 V DC	0.85	-0.71	0.760	-1.230	0.99	-0.10
-15.0 °C	10.8 V DC	-	-	0.836	-0.680	-	-
-15.0 °C	31.2 V DC	-	-	0.928	-0.470	-	-
+55.0 °C	10.8 V DC	-	-	0.721	-1.420	-	-
+55.0 °C	31.2 V DC	-	-	0.708	-1.500	-	-

Table 9 - 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.	5:01

Table 10 - Time-out Timer at Minimum Rated Power on 156.800 MHz

Remarks

The EUT has software configurable minimum and maximum power settings. The following software parameters and settings were used for the test: -
For low power setting: vhf.tx.gatelevel1W=3800.
For High power setting: vhf.tx.gatelevel25W-4850

For Low temp the settings were

For low power setting: vhf.tx.gatelevel1W=3785.
For High power setting: vhf.tx.gatelevel25W-4850

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.



2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Thermometer	Digitron	T208	64	12	12-Jun-2020
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
True RMS Multimeter	Fluke	79 Series III	411	12	07-Oct-2020
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2019
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	17-Jul-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	10-Feb-2021
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Attenuator (30dB, 100W)	Weinschel	48-30-43	4863	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5098	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 11

O/P Mon – Output Monitored using calibrated equipment



2.3 Frequency Deviation

2.3.1 Specification Reference

IEC 62238, Clause 8.3

2.3.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.3.3 Date of Test

11-December-2019

2.3.4 Test Method

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

2.3.5 Environmental Conditions

Ambient Temperature 22.4 °C
Relative Humidity 39.6 %

2.3.6 Test Results

POD + Handset - VHF Transceiver

Audio Frequency (Hz)	Frequency Deviation (kHz)	
	Maximum Power Setting – 25 W	Minimum Power Setting - 1 W
100	0.316	0.210
200	0.330	1.932
300	1.089	3.990
400	1.285	4.020
500	1.744	4.360
1000	3.683	4.610
1500	3.807	4.560
2000	3.784	4.590
2500	3.774	4.650
3000	3.723	4.280

Table 12 - Maximum Permissible Frequency Deviation

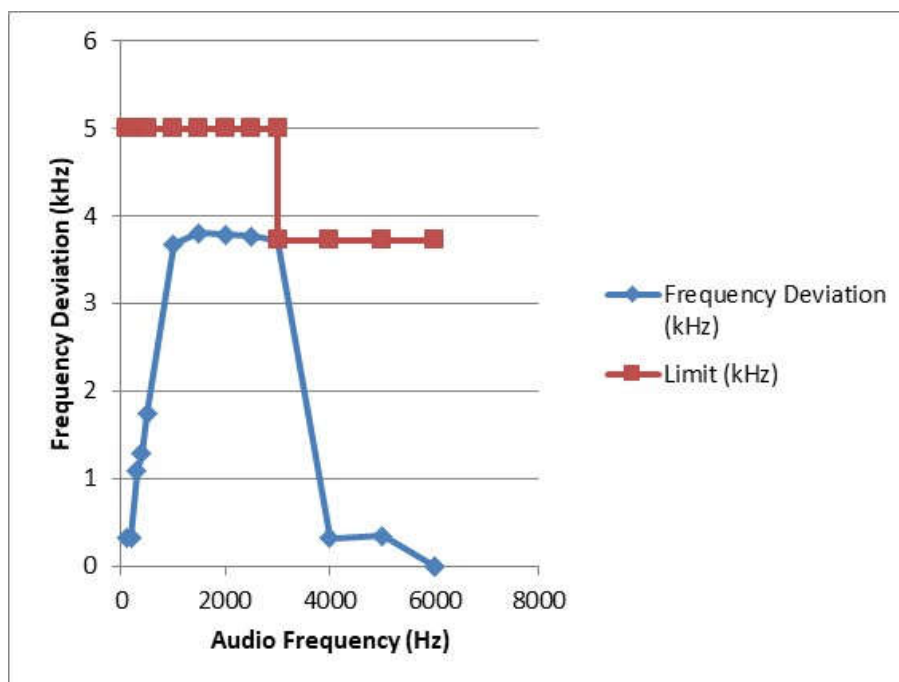


Figure 1 - Frequency Deviation (AF < 6 kHz) - Maximum Power Setting

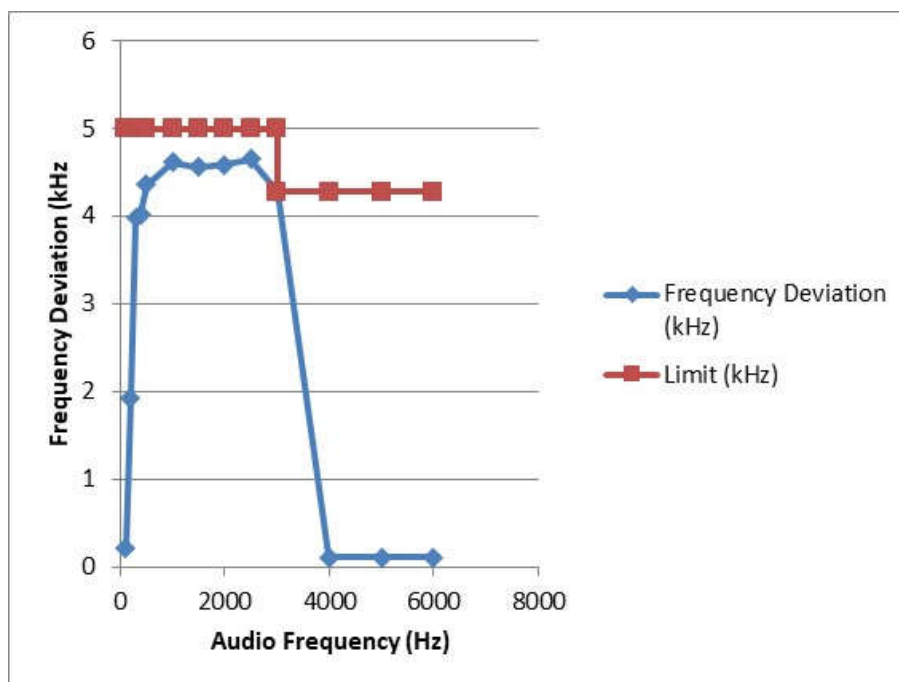


Figure 2 - Frequency Deviation (AF < 6 kHz) - Minimum Power Setting



Audio Frequency (Hz)	Frequency Deviation (kHz)	
	Maximum Power Setting – 25 W	Minimum Power Setting - 1 W
4000	0.320	0.107
5000	0.348	0.106
6000	0.003	0.002
8000	0.001	0.001
10000	0.001	0.001
12000	0.001	0.001
15000	0.001	0.001
20000	0.001	0.001
25000	0.001	0.001

**Table 13 - Reduction of Frequency Deviation at Modulation
Frequencies above 3 kHz**

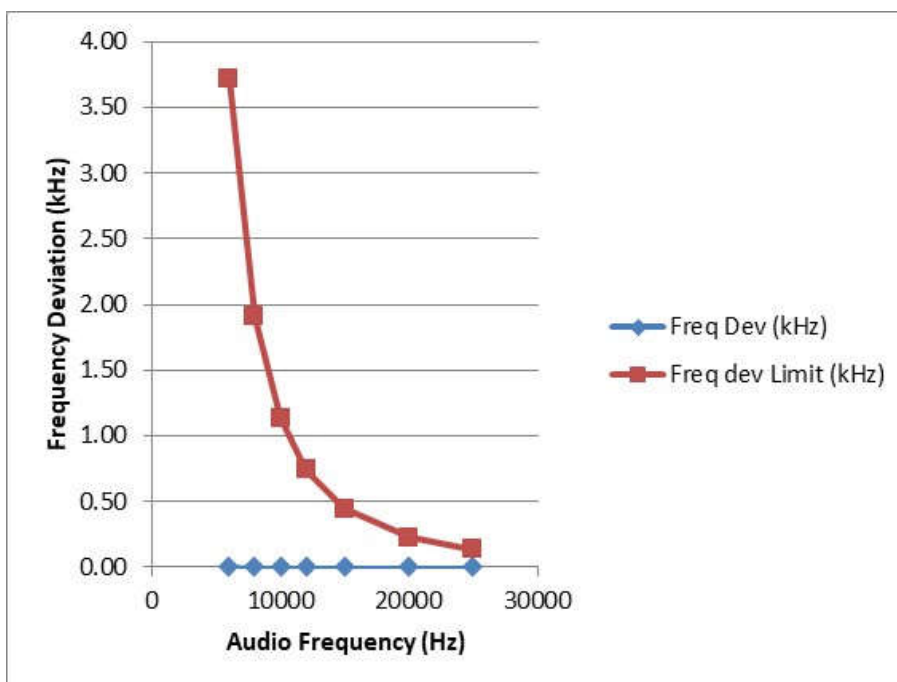


Figure 3 - Frequency Deviation (AF > 6 kHz) - Maximum Power Setting

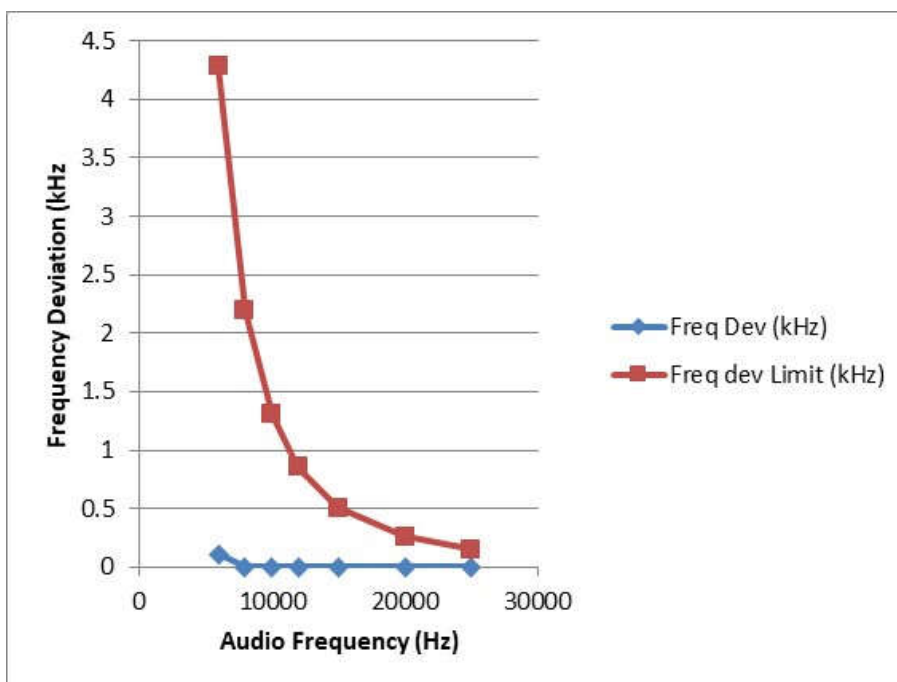


Figure 4 - Frequency Deviation (AF > 6 kHz) - Minimum Power Setting



IEC 62238, Limit Clause 8.3.2.2 and 8.3.3.2

The maximum frequency deviation shall be ± 5 kHz for audio 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:

Audio Frequency (Hz)	Frequency Deviation Limit (kHz)
3000	-
4000	-
5000	-
6000	1.5
8000	0.77
10000	0.46
12000	0.46
15000	0.30
20000	0.09
25000	0.05

**Table 14 - 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.



2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
True RMS Multimeter	Fluke	79 Series III	411	12	07-Oct-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020

Table 15

O/P Mon – Output Monitored using calibrated equipment



2.4 Sensitivity of the Modulator including Microphone

2.4.1 Specification Reference

IEC 62238, Clause 8.4

2.4.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.4.3 Date of Test

18-December-2019

2.4.4 Test Method

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

2.4.5 Environmental Conditions

Ambient Temperature 22.4 °C
Relative Humidity 39.2 %

2.4.6 Test Results

POD + Handset - VHF Transceiver

Microphone Under Test	Frequency Deviation (kHz)
Handset Microphone at 300 Hz	2.690
Handset Microphone at 500 Hz	3.376
Handset Microphone at 1kHz	2.910

Table 16 - Frequency Deviation Results

IEC 62238, Limit Clause 8.4.3

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



2.4.7 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	03-Oct-2020
Amplifier (Acoustic Power)	Bruel & Kjaer	2706	249	-	TU
Amplifier (Measuring)	Bruel & Kjaer	T2609	250	-	TU
Mouth Simulator	Bruel & Kjaer	4227	255	-	TU
True RMS Multimeter	Fluke	79 Series III	411	12	07-Oct-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	2212	12	01-Nov-2020
Programmable Power Supply	Iso-tech	IPS 2010	2435	-	O/P Mon
Noise Meter	Casella	CEL-24X	4529	12	12-Nov-2020

Table 17

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.5 Audio frequency Response

2.5.1 Specification Reference

IEC 62238, Clause 8.5

2.5.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.5.3 Date of Test

16-December-2019

2.5.4 Test Method

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

2.5.5 Environmental Conditions

Ambient Temperature 22.5 °C
Relative Humidity 34.5 %

2.5.6 Test Results

POD + Handset - VHF Transceiver

Modulation Frequency (Hz)	Frequency Deviation (dB relative to 1 kHz)
300	-12.27
400	-9.37
500	-6.30
600	-4.37
800	-2.00
1500	3.46
2000	5.85
2500	7.32
3000	9.41

Table 18 - Results for Audio frequency Response

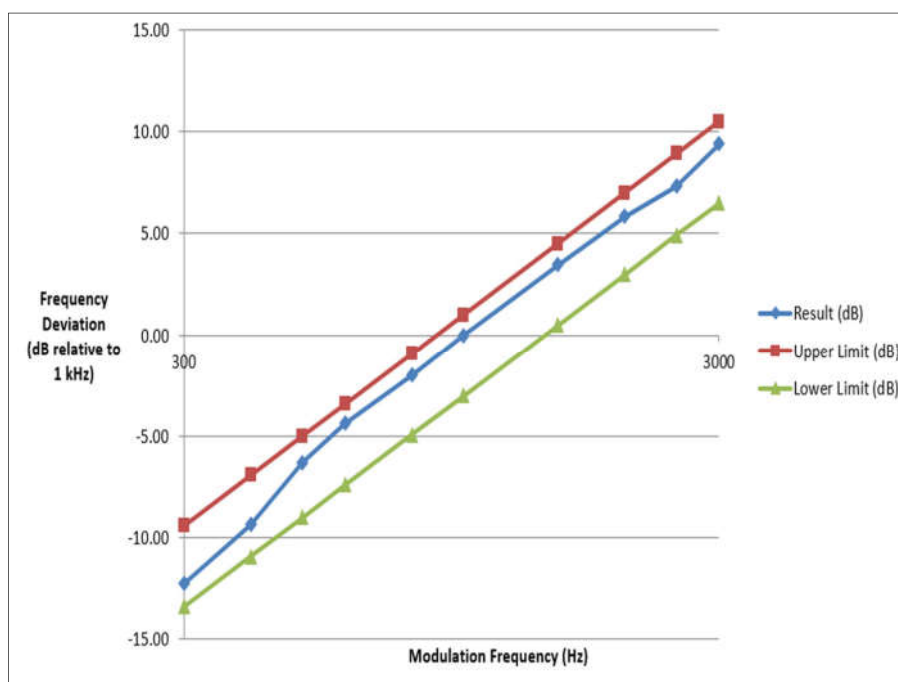


Figure 5 - Graph showing the Transmitter Modulation Frequency versus Frequency Deviation relative to 1 kHz

IEC 62238, Limit Clause 8.5.3

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



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
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Multi-GNSS Simulator (GPS)	Spirent	GSS6700	4596	12	14-Aug-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 19

O/P Mon – Output Monitored using calibrated equipment



2.6 Audio frequency Harmonic Distortion of the Emission

2.6.1 Specification Reference

IEC 62238, Clause 8.6

2.6.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.6.3 Date of Test

16-December-2019 to 05-March-2020

2.6.4 Test Method

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

2.6.5 Environmental Conditions

Ambient Temperature 22.4 - 24.2 °C
Relative Humidity 34.5 - 35.8 %

2.6.6 Test Results

POD + Handset - VHF Transceiver

Modulation Frequency (Hz)	Modulation Index	Harmonic Distortion (%)	
		Maximum Power Setting – 25 W	Minimum Power Setting – 1 W
300	3	3.74	1.54
500	3	3.43	1.01
1000	3	3.36	0.88

Table 20 - Audio frequency Harmonic Distortion

IEC 62238, Limit Clause 8.6.3

The harmonic distortion shall not exceed 10%.



2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Multimeter	Fluke	177	3813	12	09-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Attenuator (30dB, 100W)	Weinschel	48-30-43	4863	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 21

O/P Mon – Output Monitored using calibrated equipment



2.7 Conducted Spurious Emissions Conveyed to the Antenna

2.7.1 Specification Reference

IEC 62238, Clause 8.8

2.7.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex M1, S/N: M1.0000006B - Modification State 2
Cortex H1, S/N: H1.0000000F - Modification State 0

2.7.3 Date of Test

18-February-2020 to 19-February-2020

2.7.4 Test Method

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

The test was performed for some frequency ranges using an RMS detector and increased sweep time (averaging) at the request of the manufacturer.

2.7.5 Environmental Conditions

Ambient Temperature 21.6-26.4 °C
Relative Humidity 29.1-34.9 %

2.7.6 Test Results

POD + Handset - VHF Transceiver

Frequency (MHz)	Level (μW)
146.760	0.086
156.294	0.236
156.381	0.231
156.704	0.114
156.896	0.066
157.264	0.224
158.004	0.177
193.800	0.100
1887	0.150

Table 22 - Conducted Spurious Emissions Results

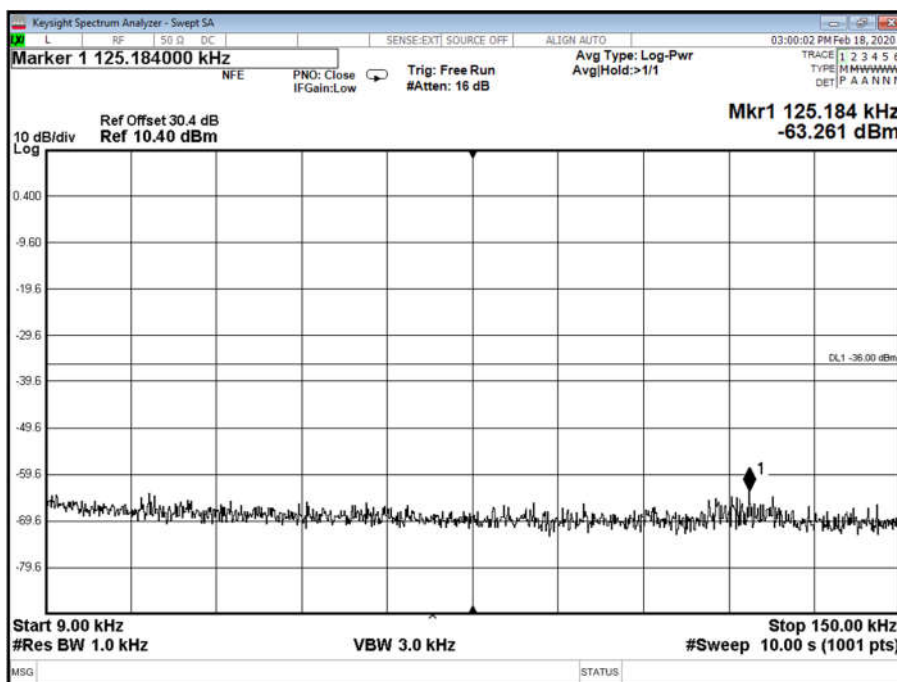


Figure 6 – 156.800 MHz, 9 kHz to 150 kHz

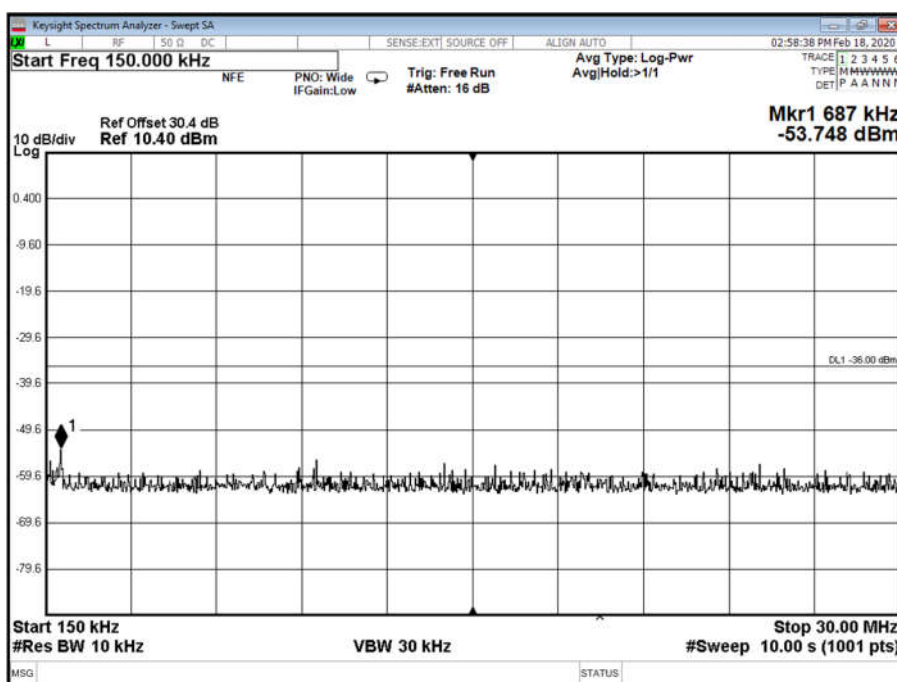


Figure 7 – 156.800 MHz, 150 kHz to 30 MHz

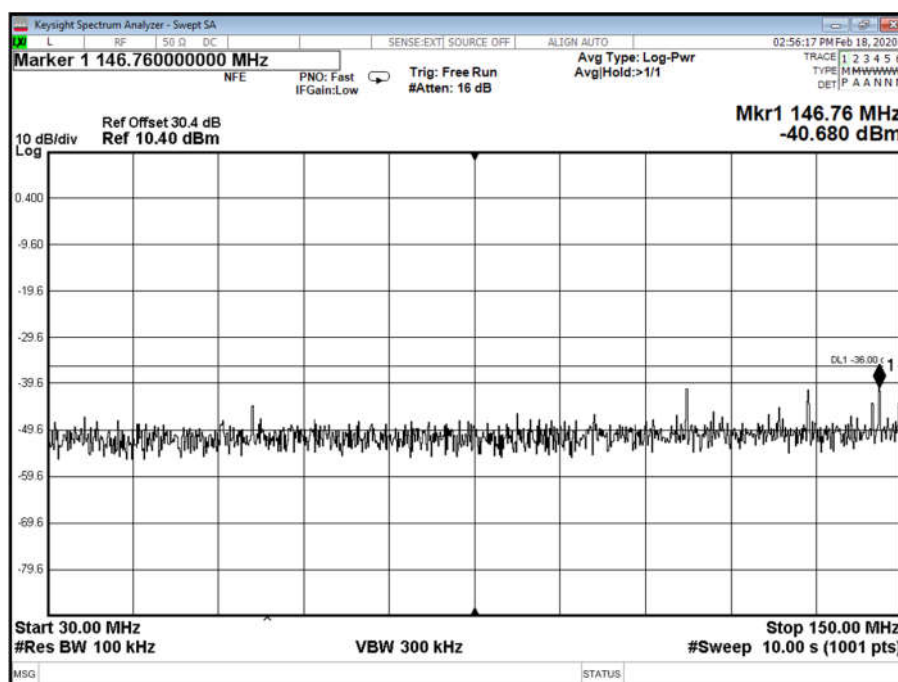


Figure 8– 156.800 MHz, 30 MHz to 150 MHz

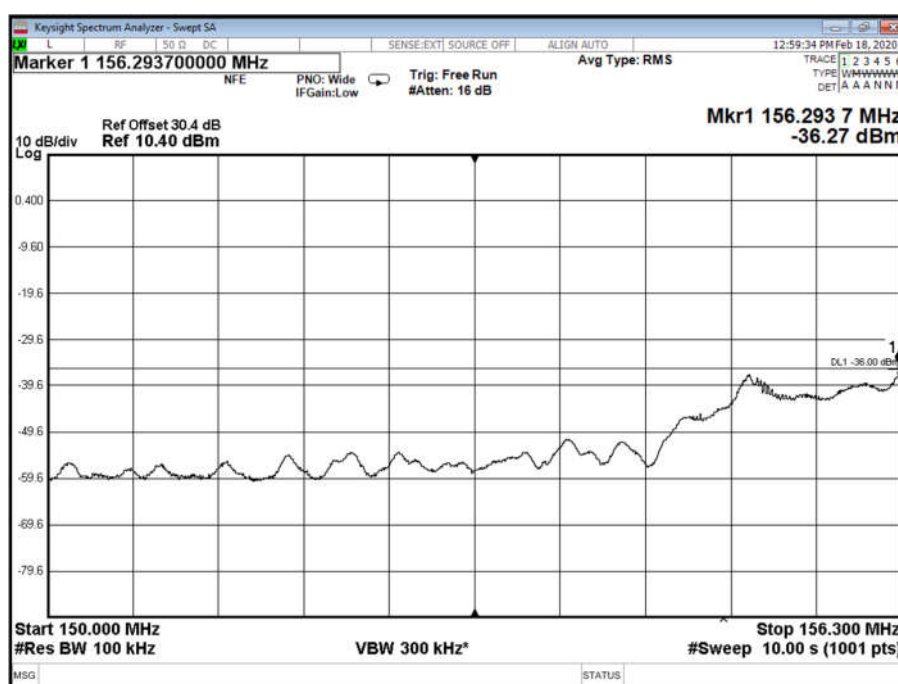


Figure 9 – 156.800 MHz, 150 MHz to 156.300 MHz

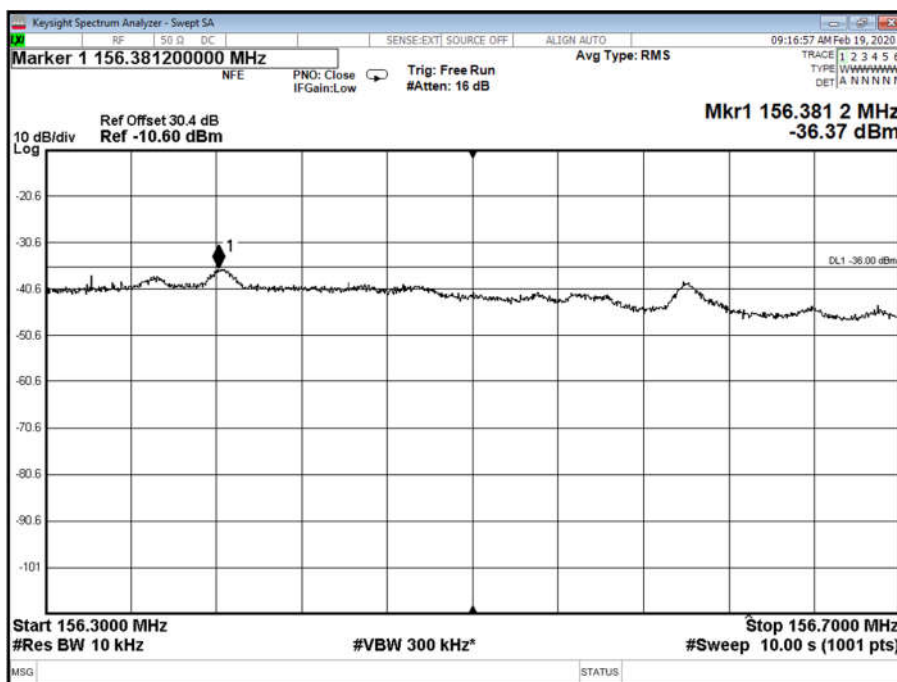


Figure 10 – 156.800 MHz, 156.300 MHz to 156.700 MHz

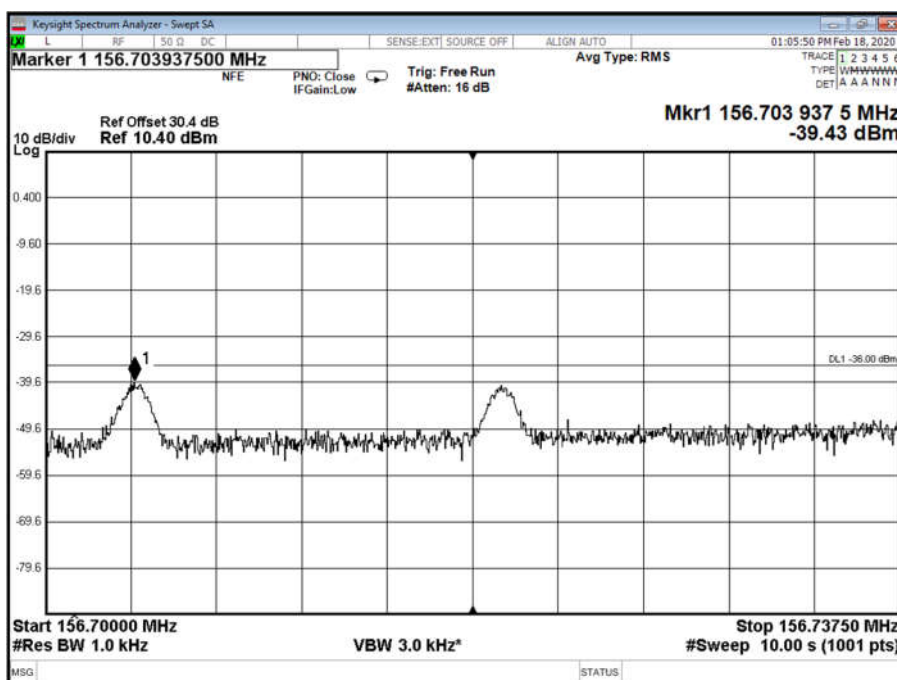


Figure 11 – 156.800 MHz, 156.700 MHz to 156.7375 MHz

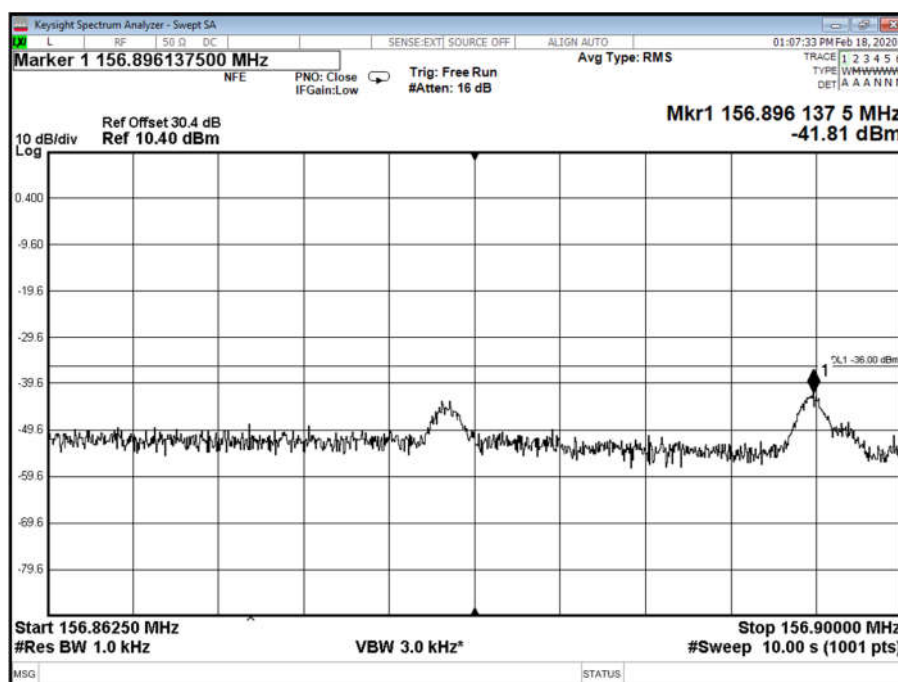


Figure 12 – 156.800 MHz, 156.8625 MHz to 156.900 MHz

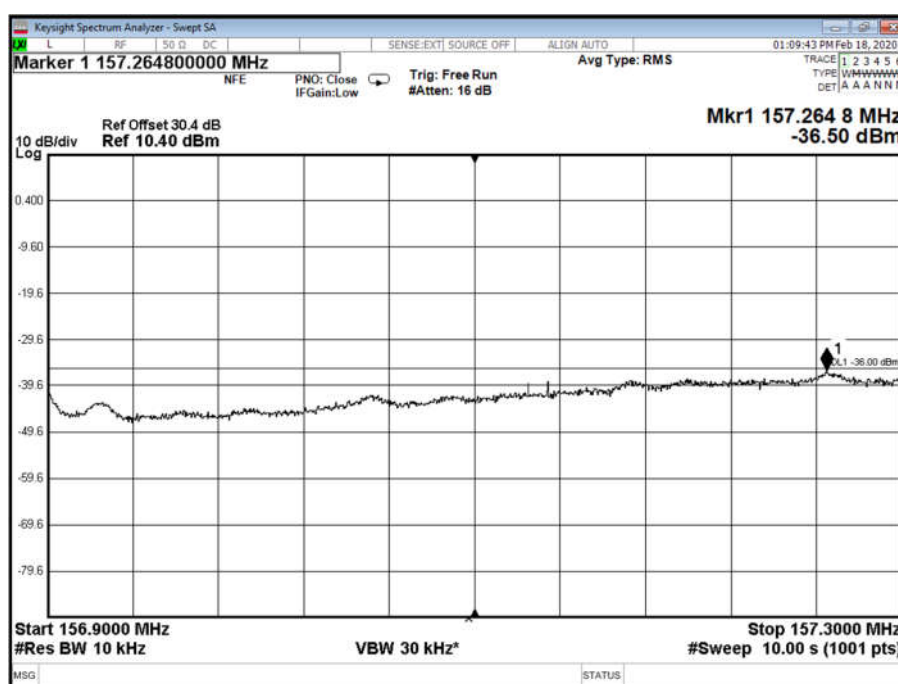


Figure 13 – 156.800 MHz, 156.900 MHz to 157.300 MHz

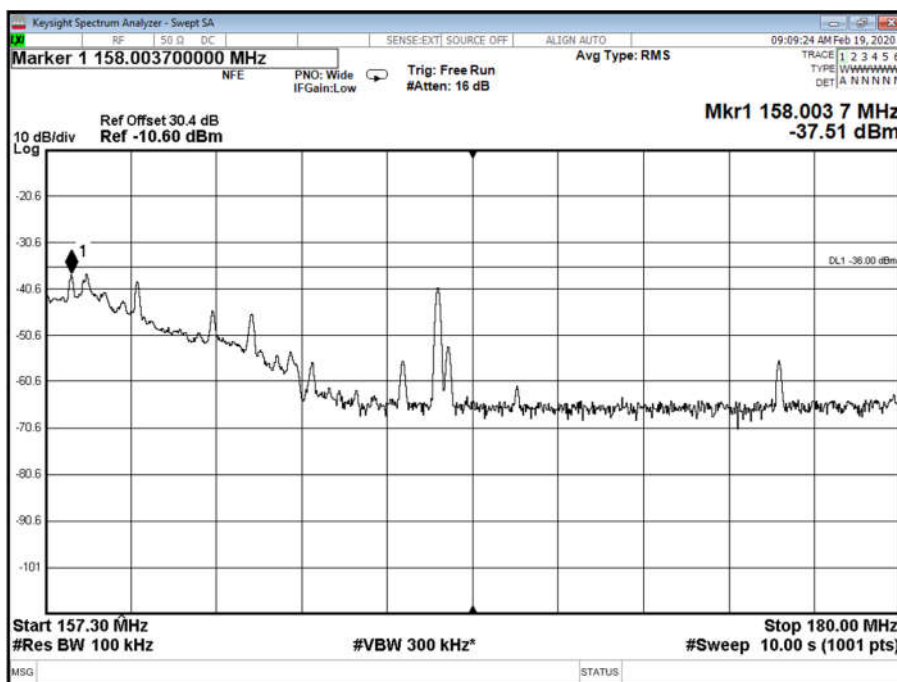


Figure 14– 156.800 MHz, 157.300 MHz to 180 MHz

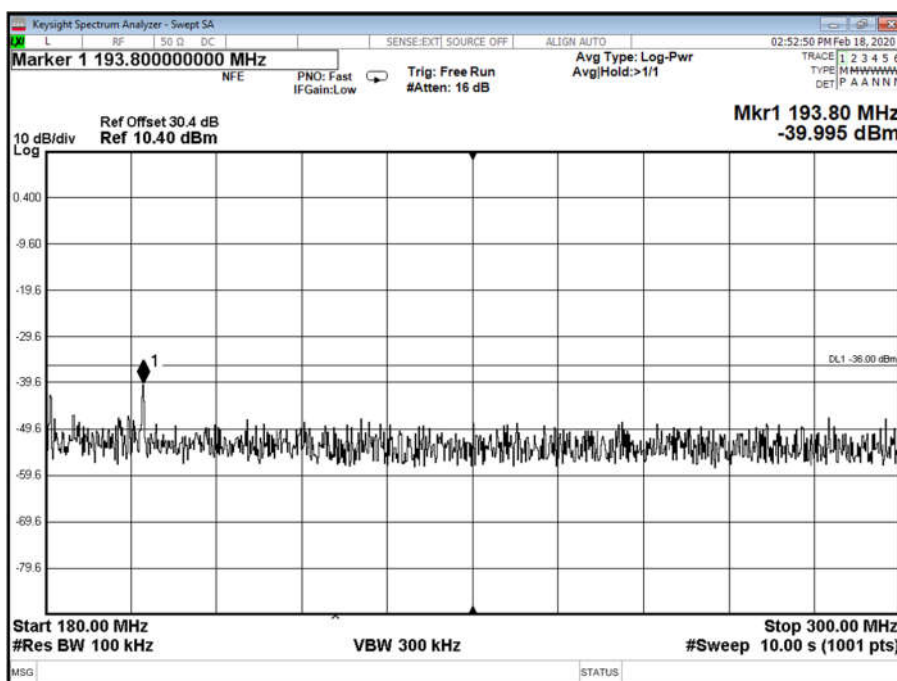


Figure 15 – 156.800 MHz, 180 MHz to 300 MHz

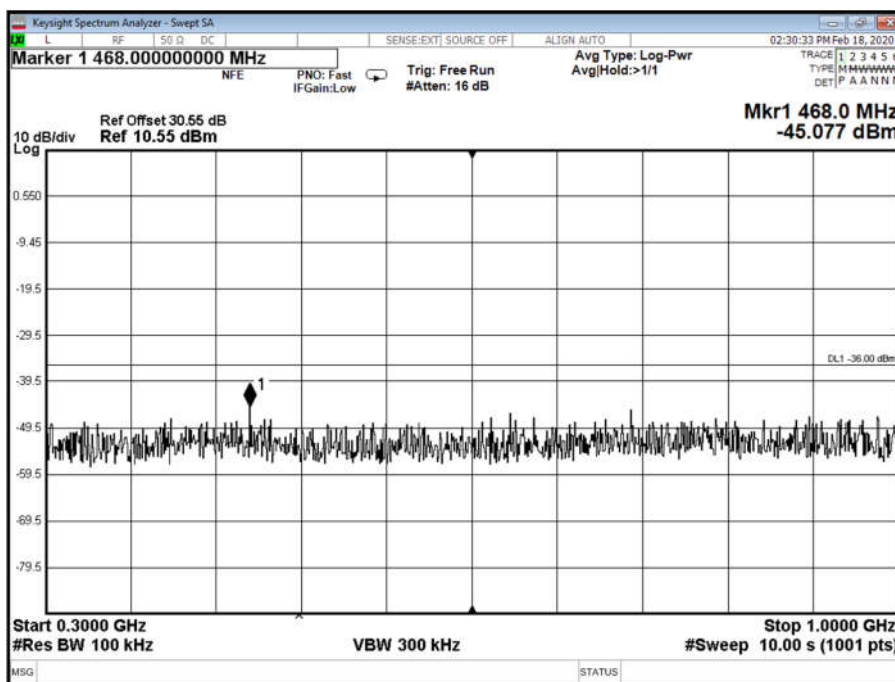


Figure 16 – 156.8 MHz, 300 MHz to 1 GHz

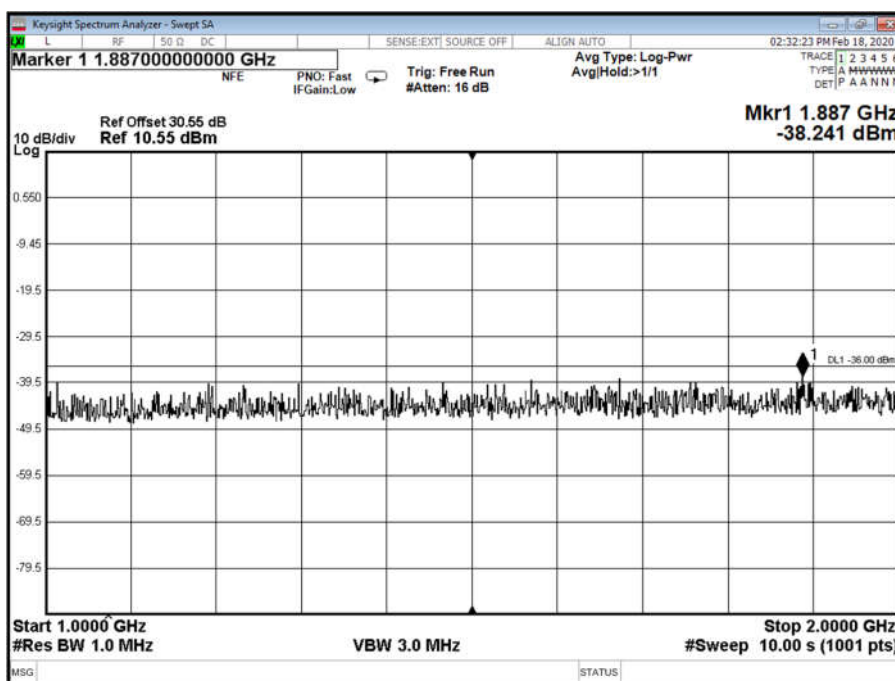


Figure 17 – 1 GHz to 2 GHz

IEC 62238, Limit Clause 8.8.3

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



2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
High Pass Filter	Mini-Circuits	NHP-300	1640	12	O/P Mon
Hygrometer	Rotronic	Hygropalm	2404	12	2-May-2020
Multimeter	Fluke	79 Series II	3057	12	19-Aug-2020
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	17-Jul-2020
Attenuator (10dB, 150W)	Narda	769-10	3368	12	17-Jul-2020
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	O/P Mon
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	10-Feb-2021
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 23

O/P Mon – Output Monitored using calibrated equipment

2.8 Transient Frequency Behaviour of the Transmitter

2.8.1 Specification Reference

IEC 62238, Clause 8.9

2.8.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.8.3 Date of Test

04-March-2020

2.8.4 Test Method

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

2.8.5 Environmental Conditions

Ambient Temperature 24.1 °C
Relative Humidity 30.5 %

2.8.6 Test Results

POD + Handset - VHF Transceiver

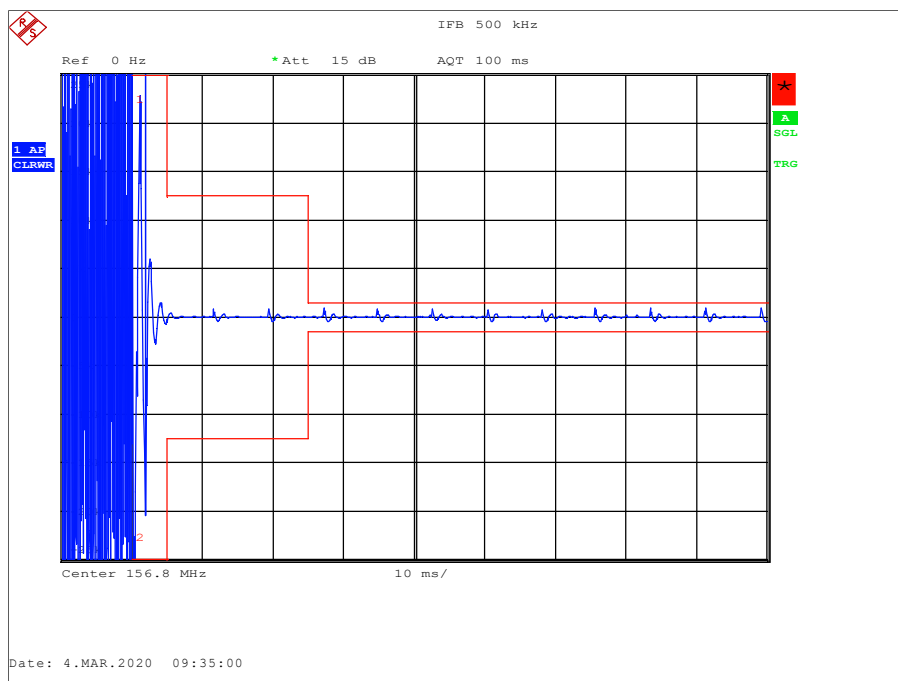


Figure 18 - Switch On

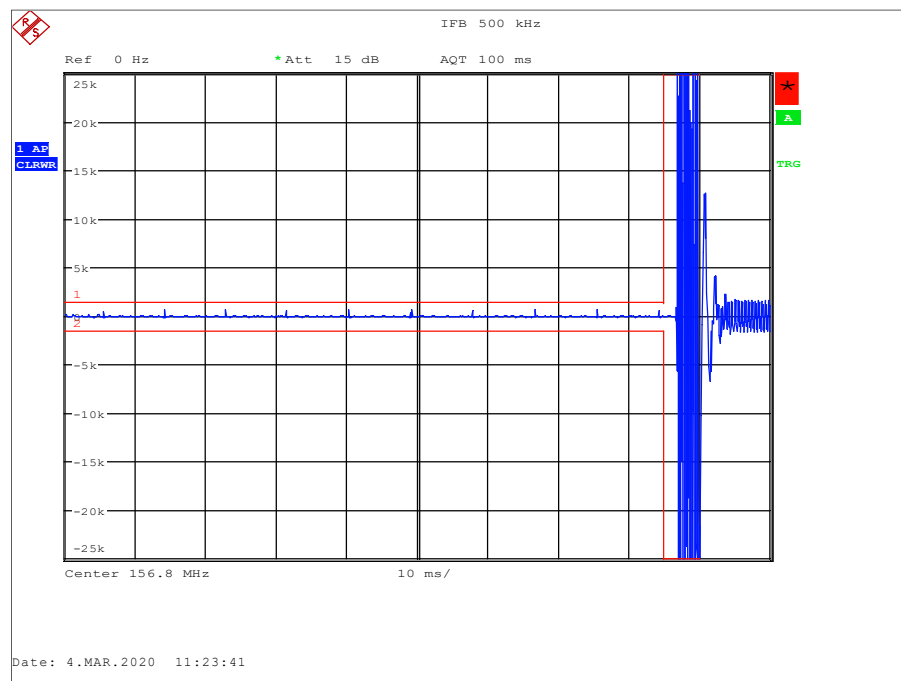


Figure 19 - Switch Off

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 $\pm 12,5$ 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.



2.8.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	18-Mar-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 24

O/P Mon – Output Monitored using calibrated equipment



2.9 Residual Modulation of the Transmitter

2.9.1 Specification Reference

IEC 62238, Clause 8.10

2.9.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.9.3 Date of Test

16-December-2019

2.9.4 Test Method

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

2.9.5 Environmental Conditions

Ambient Temperature 22.5 °C
Relative Humidity 34.5 %

2.9.6 Test Results

POD + Handset - VHF Transceiver

Residual Modulation (dB)
-56.65

Table 25 - Residual Modulation

IEC 62238, Limit Clause 8.10.3

The residual modulation shall not exceed -40 dB.



2.9.7 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
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020

Table 26

O/P Mon – Output Monitored using calibrated equipment



2.10 Frequency Error (DSC Signal)

2.10.1 Specification Reference

IEC 62238, Clause 8.11

2.10.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.10.3 Date of Test

16-December-2019

2.10.4 Test Method

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

2.10.5 Environmental Conditions

Ambient Temperature 22.8 - 24.2 °C
Relative Humidity 27.6 - 35.4 %

2.10.6 Test Results

POD + Handset - VHF Transceiver

Temperature	Voltage	Frequency Error (Hz)	
		B-state	Y-state
+22.8 °C	12.0 V DC	0.06	0.46
-15.0 °C	10.8 V DC	0.04	0.36
-15.0 °C	31.2 V DC	0.03	0.37
+55.0 °C	10.8 V DC	0.08	0.60
+55.0 °C	31.2 V DC	0.09	0.66

Table 27 - 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 $\pm$ 10 Hz and for the Y-state within 1300 Hz $\pm$ 10 Hz.



2.10.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Multimeter	Fluke	177	3813	12	09-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Attenuator (30dB, 100W)	Weinschel	48-30-43	4863	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020

Table 28

O/P Mon – Output Monitored using calibrated equipment



2.11 Modulation Index for DSC

2.11.1 Specification Reference

IEC 62238, Clause 8.12

2.11.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.11.3 Date of Test

16-December-2019

2.11.4 Test Method

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

2.11.5 Environmental Conditions

Ambient Temperature 22.8 °C
Relative Humidity 35.4 %

2.11.6 Test Results

POD + Handset - VHF Transceiver

Signal Pattern	Frequency (Hz)	Frequency Deviation (kHz)	Modulation Index
B-state	2100	4.03	1.92
Y-state	1300	2.53	1.95

Table 29 - Modulation Index for DSC Signal

IEC 62238, Limit Clause 8.12.3

The modulation index shall be $2.0 \pm 10\%$.



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
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020

Table 30

O/P Mon – Output Monitored using calibrated equipment



2.12 Modulation Rate for DSC

2.12.1 Specification Reference

IEC 62238, Clause 8.13

2.12.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.12.3 Date of Test

18-December-2019

2.12.4 Test Method

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

2.12.5 Environmental Conditions

Ambient Temperature 22.9 °C
Relative Humidity 35.4 %

2.12.6 Test Results

POD + Handset - VHF Transceiver

156.525 MHz		
Modulation Rate (Hz)	Frequency Error (ppm)	Corresponding Baud Rate
600	0.0377	1200

Table 31 - Modulation Rate Results Table

IEC 62238, Limit Clause 8.13.3

The frequency shall be 600 Hz $\pm 30 \times 10^{-6}$ corresponding to a modulation rate of 1200 baud.



2.12.7 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
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Counter	Hewlett Packard	53181A	159	12	30-Jul-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020

Table 32

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.13 Testing of Generated Call Sequences

2.13.1 Specification Reference

IEC 62238, Clause 8.14

2.13.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 14
Cortex H1, S/N: H1 – TUV H1-8 – Modification State 14

2.13.3 Date of Test

25-March-2020

2.13.4 Test Method

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

2.13.5 Environmental Conditions

Ambient Temperature 23.2 °C
Relative Humidity 44.6 %

2.13.6 Test Results

POD + Handset - VHF Transceiver

Call Sent	Received Without Error	Telecommand 1	Telecommand 2
Distress	Y	107	100
All Ships Urgency	Y	100	126
All Ships Safety	Y	100	126
Individual Routine	Y	100	126
Group Routine	Y	100	126

Table 33 - Received Calls

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.



2.13.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Load (50ohm, 30W)	JFW	50T-054	351	12	25-Jun-2020
Directional Coupler	Narda	3020A	419	-	O/P Mon
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Oscilloscope	Agilent Technologies	DSO9104A	4142	12	22-Aug-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	29-Nov-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 34

O/P Mon – Output Monitored using calibrated equipment



2.14 Harmonic Distortion and Rated Audio Frequency Output Power

2.14.1 Specification Reference

IEC 62238, Clause 9.1

2.14.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.14.3 Date of Test

26-February-2020

2.14.4 Test Method

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

2.14.5 Environmental Conditions

Ambient Temperature 20.1 °C
Relative Humidity 40.2 %

2.14.6 Test Results

POD + Handset - VHF Transceiver

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	10.56	0.37	10.56	0.37
500	10.10	0.34	10.05	0.34
1000	10.20	0.47	10.20	0.47

**Table 35 - External Loudspeaker -
Audio Output Power and Harmonic Distortion**

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	2.11	0.19	2.22	0.17
500	2.14	0.18	2.25	0.15
1000	2.38	9.33	2.36	9.33

**Table 36 – Handset Internal 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%.



2.14.7 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	ESG4000A	61	12	17-Jul-2020
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Multi-GNSS Simulator (GPS)	Spirent	GSS6700	4596	12	14-Aug-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 37

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



2.15 Simultaneous Reception

2.15.1 Specification Reference

IEC 62238, Clause 10.10

2.15.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.15.3 Date of Test

12-December-2019

2.15.4 Test Method

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

2.15.5 Environmental Conditions

Ambient Temperature 23.6 °C
Relative Humidity 38.7 %

2.15.6 Test Results

POD + Handset - VHF Transceiver

SINAD (dB) - No DSC Signal	SINAD (dB) DSC Signal Applied	Bit Error Rate
30.2	29.98	0.0015

Table 38 - 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} .



2.15.7 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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
True RMS Multimeter	Fluke	79 Series III	411	12	07-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	07-Aug-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020

Table 39

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.16 Reaction to VTS and AIS Channel Management DSC Transmissions

2.16.1 Specification Reference

IEC 62238, Clause 10.9

2.16.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 14
Cortex H1, S/N: H1 – TUV H1-8 – Modification State 14

2.16.3 Date of Test

28-April-2020

2.16.4 Test Method

This test was performed in accordance with IEC 62238, clause 10.9.2. A DSC transmission with format specifier symbol 120 (Individual), category symbol 103 (VTS) and then format specifier symbol 116 (All ships), category symbol 103 (VTS) were sent to the EUT.

2.16.5 Environmental Conditions

Ambient Temperature 21.4°C
Relative Humidity 49.1%

2.16.6 Test Results

POD + Handset - VHF Transceiver

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 40 - 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.



2.16.7 Test Location and Test Equipment Used

This test was carried out in lab 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Signal generator	R&S	SMY01	0042	12	07-Feb-2021
DSC encoder/decoder	TUV	-	0081	-	O/P Mon
Attenuator	Texscan	HFP-50N	0475	-	O/P Mon
Power splitter	Weinschel	1506A	0607	-	O/P Mon
Modulation analyser	Hewlett Packard	8901B	0773	12	28-Jun-2020
Rubidium standard	Rohde & Schwarz	XSRM	1316	12	05-May-2020
GPS simulator	Spirent	STR4500	3056	12	16-Oct-2020
DMM	Fluke	79	3057	12	19-Aug-2020
VHF radio	ICOM	IC-R5	3330	-	OP/Mon
Attenuator	Narda	789-20	3367	12	17-Jul-2020
Attenuator	Narda	789-30	3369	12	17-Jul-2020
DSC Pre-emphasis unit	TUV	-	4369	12	12-Aug-2020
Frequency standard	Spectracom	1200-0408-0601	4393	12	05-May-2020
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5480	12	18-Mar-2021
DSC Test software	ICS electronics	V4 Test Station	-	-	TU
Power supply	Rohde & Schwarz	HMP2020	101883	-	O/P Mon

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

Table 41



2.17 Verification of Correct Decoding of Various Types of DSC Calls

2.17.1 Specification Reference

IEC 62238, Clause 10.8

2.17.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 14
Cortex H1, S/N: H1 – TUV H1-8 – Modification State 14

2.17.3 Date of Test

28-April-2020

2.17.4 Test Method

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

2.17.5 Environmental Conditions

Ambient Temperature 21.4°C
Relative Humidity 49.1%

2.17.6 Test Results

POD + Handset - VHF Transceiver

Call Sent	Received Without Error	Telecommand 1	Telecommand 2
Distress	Y	N/A	N/A
All Ships Distress Ack	Y	107	100
All Ships Relay	Y	112	107
All Ships Urgency	Y	100	126
All Ships Safety	Y	100	126
Individual Urgency	Y	100	126
Individual Safety	Y	100	126
Individual Routine	Y	100	126
Group Routine	Y	100	126

Table 42 - 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.	Y	N
Confirm that the checks have been made to ensure accordance between printer output and display:	N/A	N/A
It has been verified that the equipment is capable of switching to a channel identified in the DSC call:	Y	N

Table 43 - Performed Checks



IEC 62238, Limit Clause 10.8.3

The requirements of ITU-R Recommendation M.493-14 regarding message composition and content shall be met.

The decoded call sequences at the output of the receiver shall be examined for correct technical format, including error-check characters.

When receiver measurements are made by use of a printer or a computer, a check shall be made to ensure accordance between printer output and display indication.

It shall be verified that the equipment is capable of switching to the channels identified in the DSC call.

2.17.7 Test Location and Test Equipment Used

This test was carried out in lab 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Signal generator	R&S	SMY01	0042	12	07-Feb-2021
DSC encoder/decoder	TUV	-	0081	-	O/P Mon
Attenuator	Texscan	HFP-50N	0475	-	O/P Mon
Power splitter	Weinschel	1506A	0607	-	O/P Mon
Modulation analyser	Hewlett Packard	8901B	0773	12	28-Jun-2020
Rubidium standard	Rohde & Schwarz	XSRM	1316	12	05-May-2020
GPS simulator	Spirent	STR4500	3056	12	16-Oct-2020
DMM	Fluke	79	3057	12	19-Aug-2020
VHF radio	ICOM	IC-R5	3330	-	O/P Mon
Attenuator	Narda	789-20	3367	12	17-Jul-2020
Attenuator	Narda	789-30	3369	12	17-Jul-2020
DSC Pre-emphasis unit	TUV	-	4369	12	12-Aug-2020
Frequency standard	Spectracom	1200-0408-0601	4393	12	05-May-2020
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5480	12	18-Mar-2021
DSC Test software	ICS electronics	V4 Test Station	-	-	TU
Power supply	Rohde & Schwarz	HMP2020	101883	-	O/P Mon

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

Table 44



2.18 DSC - Dynamic Range

2.18.1 Specification Reference

IEC 62238, Clause 10.6

2.18.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.18.3 Date of Test

11-December-2019

2.18.4 Test Method

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

2.18.5 Environmental Conditions

Ambient Temperature 23.4 °C
Relative Humidity 33.9 %

2.18.6 Test Results

POD + Handset - VHF Transceiver

Input Level (dBµV e.m.f.)	Bit Error Ratio
100	0.00012
0	0

Table 45 - 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} .



2.18.7 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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 46

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.19 DSC - Intermodulation Response

2.19.1 Specification Reference

IEC 62238, Clause 10.5

2.19.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.19.3 Date of Test

11-December-2019

2.19.4 Test Method

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

2.19.5 Environmental Conditions

Ambient Temperature 22.5 °C
Relative Humidity 34.5 %

2.19.6 Test Results

POD + Handset - VHF Transceiver

Signal Generator A		Signal Generator B		Signal Generator C		BER (%)
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	0
156.525	3	50	68	100	68	0

Table 47 - 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} .



2.19.7 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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Attenuator (10 dB)	Weinschel	47-10-34	481	-	O/P Mon
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	22-May-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 48

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.20 DSC - Spurious Response and Blocking Immunity

2.20.1 Specification Reference

IEC 62238, Clause 10.4

2.20.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.20.3 Date of Test

11-December-2019 to 06-March-2020

2.20.4 Test Method

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

2.20.5 Environmental Conditions

Ambient Temperature 22.3 - 23.4 °C
Relative Humidity 33.9 - 42.6 %

2.20.6 Test Results

POD + Handset - VHF Transceiver

Unwanted Signal Generator Frequency Offset (kHz)	Wanted Signal Generator Level (dBμV e.m.f)	Unwanted Signal Generator Level (dBμV e.m.f)	Bit Error Ratio
-10	3	93	0
-5	3	93	0
-2	3	93	0
-1	3	93	0
1	3	93	0.0008
2	3	93	0.0073
5	3	93	0
10	3	93	0

Table 49 - Fixed Frequency Blocking Results for DSC Receiver

In addition to the above frequencies, 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. Any responses 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
*			

Table 50 - Swept Frequency Blocking Results for DSC Receiver

*No responses were detected within 10 dB of the limit.



Unwanted Signal Generator Frequency (MHz)	Wanted Signal Generator Level (dBμV e.m.f)	Unwanted Signal Generator Level (dBμV e.m.f)	Bit Error Ratio
0.009	3.00	73.00	0.006
0.014	3.00	73.00	0.007
0.019	3.00	73.00	0.009
0.024	3.00	73.00	0.009
52.179	3.00	73.00	0.004
78.264	3.00	73.00	0.004

Table 51 - Spurious Response Rejection Results for DSC Receiver

No other 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} .



2.20.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Power Divider	Weinschel	1506A	3345	12	23-Apr-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 52

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



2.21 DSC - Adjacent Channel Selectivity

2.21.1 Specification Reference

IEC 62238, Clause 10.3

2.21.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.21.3 Date of Test

11-December-2019 to 02-March-2020

2.21.4 Test Method

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

2.21.5 Environmental Conditions

Ambient Temperature 21.5 - 24.2 °C
Relative Humidity 27.6 - 35.4 %

2.21.6 Test Results

POD + Handset - VHF Transceiver

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
+23.4 °C	12.0 V DC	3	73	0	0
-15.0 °C	10.8 V DC	9	63	0	0.008
-15.0 °C	31.2 V DC	9	63	0	0
+55.0 °C	10.8 V DC	9	63	0	0
+55.0 °C	31.2 V DC	9	63	0	0

Table 53 - 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} .



2.21.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Power Divider	Weinschel	1506A	3345	12	23-Apr-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 54

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



2.22 DSC - Co-channel Rejection

2.22.1 Specification Reference

IEC 62238, Clause 10.2

2.22.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.22.3 Date of Test

11-December-2019

2.22.4 Test Method

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

2.22.5 Environmental Conditions

Ambient Temperature 23.4 °C
Relative Humidity 33.9 %

2.22.6 Test Results

POD + Handset - VHF Transceiver

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	0.000036
0	3	-5	0.000020
+3	3	-5	0.000000

Table 55 - 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} .



2.22.7 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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 56

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.23 DSC - Maximum Usable Sensitivity

2.23.1 Specification Reference

IEC 62238, Clause 10.1

2.23.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.23.3 Date of Test

11-December-2019 to 02-March-2020

2.23.4 Test Method

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

2.23.5 Environmental Conditions

Ambient Temperature 21.5 - 24.8 °C
Relative Humidity 27.8 - 35.4 %

2.23.6 Test Results

POD + Handset - VHF Transceiver

Temperature	Voltage	Input Level (dBμV e.m.f.)	Bit Error Ratio
+23.4 °C	12.0 V DC	0	0.00007
-15.0 °C	10.8 V DC	6	0
-15.0 °C	31.2 V DC	6	0
+55.0 °C	10.8 V DC	6	0
+55.0 °C	31.2 V DC	6	0

Table 57 - 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} .



2.23.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 58

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



2.24 Multiple Watch Characteristic

2.24.1 Specification Reference

IEC 62238, Clause 9.13

2.24.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.24.3 Date of Test

19-February-2020 to 04-March-2020

2.24.4 Test Method

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

The EUT does not implement a 'traditional' multiple watch process. Instead the EUT is always monitoring the priority channel and as soon as transmission is observed on that channel it switches to it. Therefore, the scanning period and dwell time on each channels are not applicable. It was confirmed that the switching time to the priority channel occurred within the required time frame.

2.24.5 Environmental Conditions

Ambient Temperature 23.3 °C
Relative Humidity 47.2 %

2.24.6 Test Results

POD + Handset - VHF Transceiver

Temperature	Voltage	Priority Channel Frequency (MHz)	Additional Channel Frequency (MHz)	Scanning period (s)	Dwell on Priority Channel (ms)	Dwell on Additional Channel (s)
+23.3 °C	12.0 V DC	156.800	156.250	N/A	N/A	N/A
-15.0 °C	10.8 V DC	156.800	156.250	N/A	N/A	N/A
-15.0 °C	31.2 V DC	156.800	156.250	N/A	N/A	N/A
+55.0 °C	10.8 V DC	156.800	156.250	N/A	N/A	N/A
+55.0 °C	31.2 V DC	156.800	156.250	N/A	N/A	N/A

Table 59 - Multiple Watch Characteristics for Simplex Channels

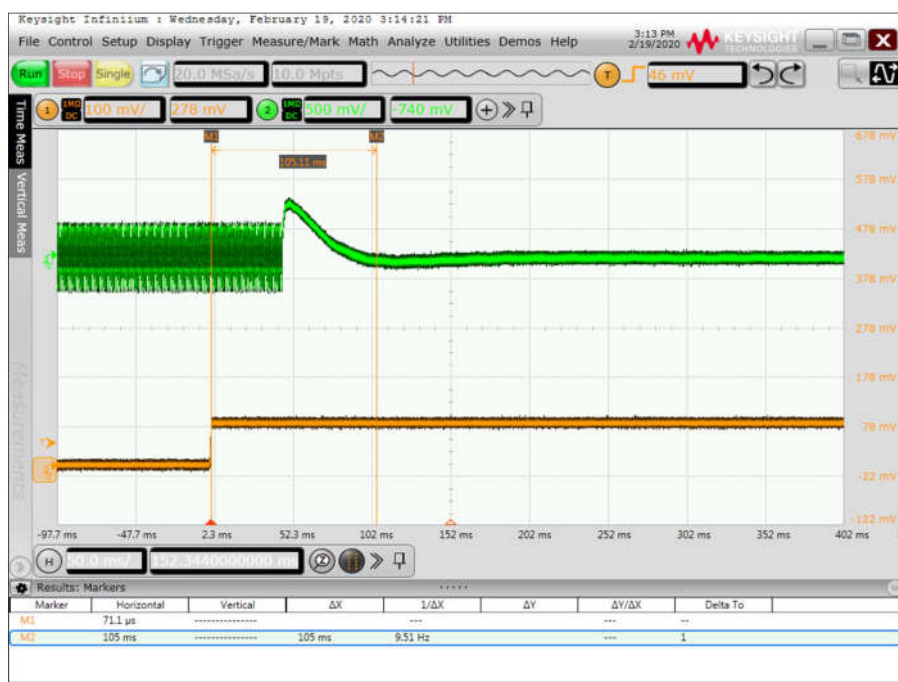


Figure 20 - Switching Time (Simplex), +23.3 °C, 12.0 V DC

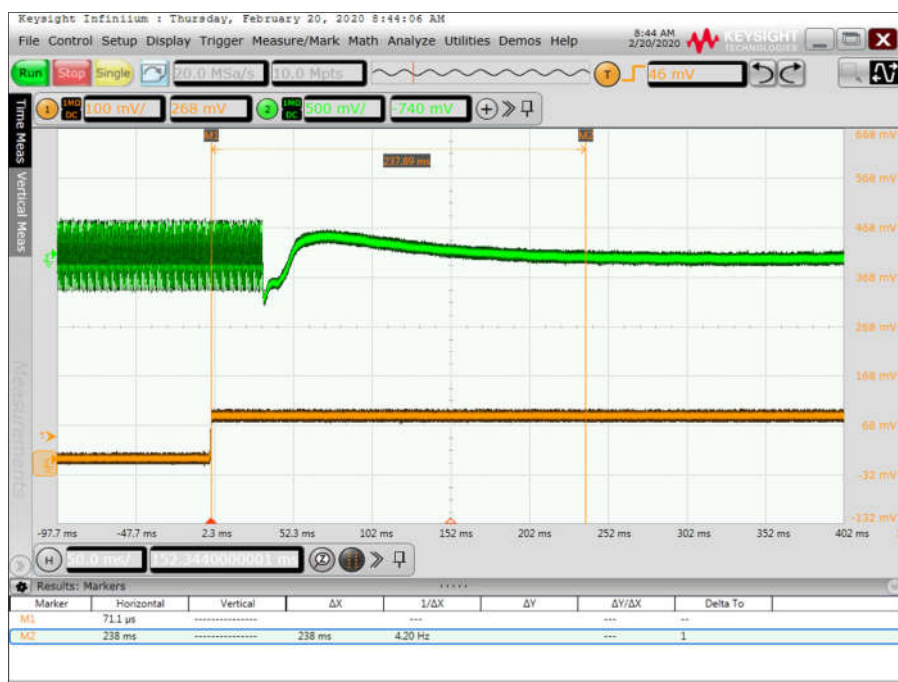


Figure 21 - Switching Time (Simplex), -15.0 °C, 10.8 V DC

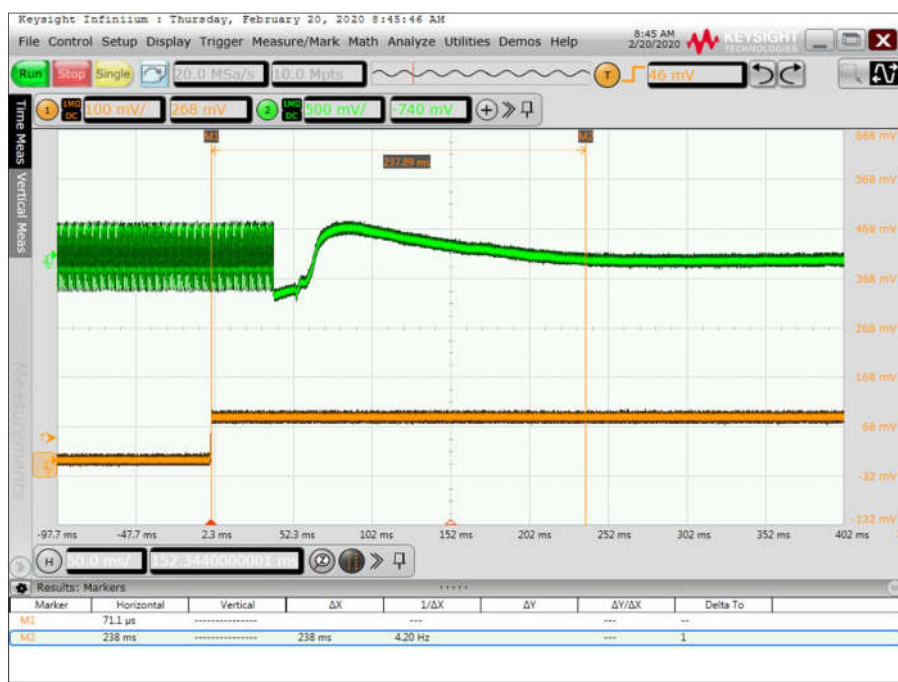


Figure 22 - Switching Time (Simplex), -15.0 °C, 31.2 V DC



Figure 23 - Switching Time (Simplex), +55.0 °C, 10.8 V DC



Figure 24 - Switching Time (Simplex), +55.0 °C, 31.2 V DC

Temperature	Voltage	Priority Channel Frequency (MHz)	Additional Channel Frequency (MHz)	Scanning period (s)	Dwell on Priority Channel (ms)	Dwell on Additional Channel (s)	Time to switch from additional to priority (ms)
+23.3 °C	12.0 V DC	156.800	156.025	N/A	N/A	N/A	207.890
-15.0 °C	10.8 V DC	156.800	156.025	N/A	N/A	N/A	256.780
-15.0 °C	31.2 V DC	156.800	156.025	N/A	N/A	N/A	270.670
+55.0 °C	10.8 V DC	156.800	156.025	N/A	N/A	N/A	622.220
+55.0 °C	31.2 V DC	156.800	156.025	N/A	N/A	N/A	627.780

Table 60 - Multiple Watch Characteristics for Duplex Channels

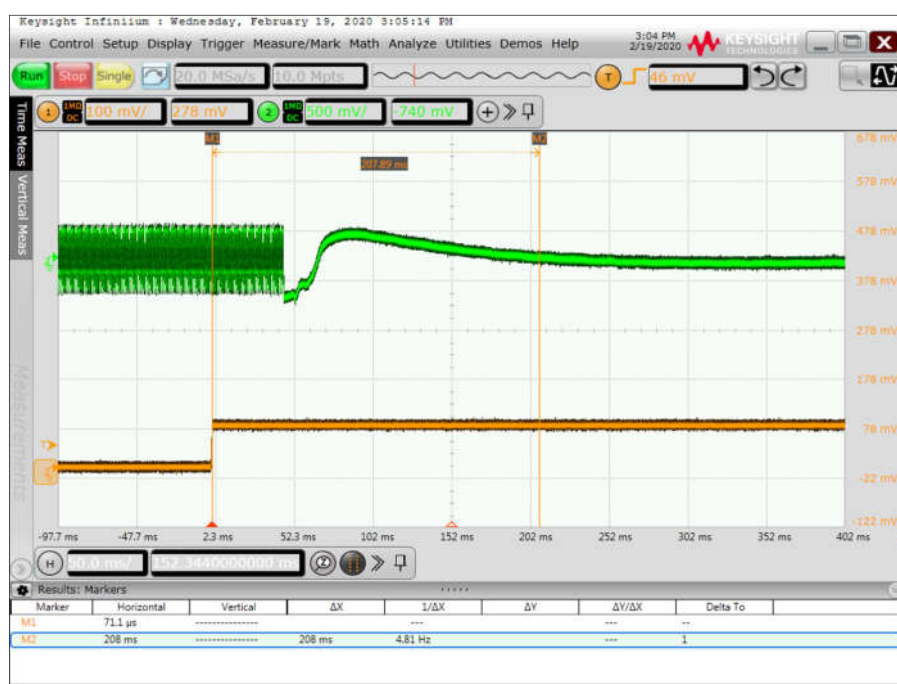


Figure 25 - Switching Time (Duplex), +23.3 °C, 12.0 V DC

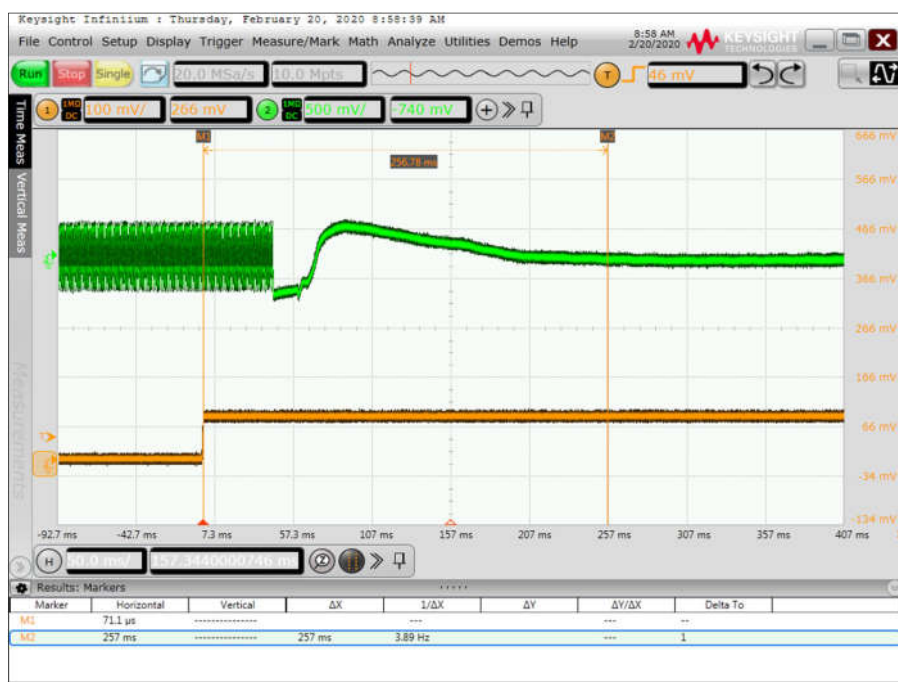


Figure 26 - Switching Time (Duplex), -15.0 °C, 10.8 V DC



Figure 27 - Switching Time (Duplex), -15.0 °C, 31.2 V DC



Figure 28 - Switching Time (Duplex), +55.0 °C, 10.8 V DC



Figure 29 - Switching Time (Duplex), +55.0 °C, 31.2 V DC

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.



2.24.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	2-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Step Attenuator	Rohde & Schwarz	DPSP	1672	-	O/P Mon
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	9-Sep-2020
Power Divider	Weinschel	1506A	3345	12	23-Apr-2020
Multimeter	Fluke	177	3813	12	9-Oct-2020
Oscilloscope	Agilent Technologies	DSO9104A	4142	12	22-Aug-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP- 39.4-NMS	4509	12	6-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP- 39.4-NMS	4511	12	18-Jul-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	5004	12	2-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221- 02000DMS	5426	6	13-Jun-2020

Table 61

O/P Mon – Output Monitored using calibrated equipment



2.25 Squelch Hysteresis

2.25.1 Specification Reference

IEC 62238, Clause 9.12

2.25.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.25.3 Date of Test

11-December-2019

2.25.4 Test Method

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

2.25.5 Environmental Conditions

Ambient Temperature 23.0 °C
Relative Humidity 37.0 %

2.25.6 Test Results

POD + Handset - VHF Transceiver

Input Level (dBµV e.m.f.)		Difference (dB)
Squelch Open	Squelch Closed	
4.8	-1.2	6.0

Table 62 - Squelch Hysteresis

IEC 62238, Limit Clause 9.12.3

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



2.25.7 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
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 63

O/P Mon – Output Monitored using calibrated equipment



2.26 Squelch Operation

2.26.1 Specification Reference

IEC 62238, Clause 9.11

2.26.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.26.3 Date of Test

10-December-2019

2.26.4 Test Method

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

2.26.5 Environmental Conditions

Ambient Temperature 24.3 °C
Relative Humidity 37.4 %

2.26.6 Test Results

POD + Handset - VHF Transceiver

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 64 - Details of steps for results recorded below

Step A	Step B		Step C
Audiofrequency Output Power (dB)	Input Level (dBμV)	SINAD (dB)	Input Level (dBμV)
-78.33	6.0	> 20	N/A

Table 65 - 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 dB μ V (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 dB μ V (e.m.f.) when the control is set at maximum.

2.26.7 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
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 66

O/P Mon – Output Monitored using calibrated equipment



2.27 Receiver Residual Noise Level

2.27.1 Specification Reference

IEC 62238, Clause 9.10

2.27.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.27.3 Date of Test

06-December-2019

2.27.4 Test Method

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

2.27.5 Environmental Conditions

Ambient Temperature 22.2 °C
Relative Humidity 46.4 %

2.27.6 Test Results

POD + Handset - VHF Transceiver

Residual Noise Level (dB)
-56.7

Table 67 - Residual Noise Level

IEC 62238, Limit Clause 9.10.3.

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



2.27.7 Test Location and Test Equipment Used

This test was carried out in EMC Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Sensor	Hewlett Packard	11722A	2787	12	21-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon

Table 68



2.28 Spurious Emissions

2.28.1 Specification Reference

IEC 62238, Clause 9.9

2.28.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.28.3 Date of Test

10-December-2019

2.28.4 Test Method

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

2.28.5 Environmental Conditions

Ambient Temperature 24.4 °C
Relative Humidity 37.5 %

2.28.6 Test Results

POD + Handset - VHF Transceiver

Frequency (MHz)	Level (nW)
*	

Table 69 - Conducted Spurious Emissions Results for VHF Receiver

*No emissions were detected within 6 dB of the limit.



Figure 30 - 9 kHz to 150 kHz



Figure 31 - 150 kHz to 30 MHz

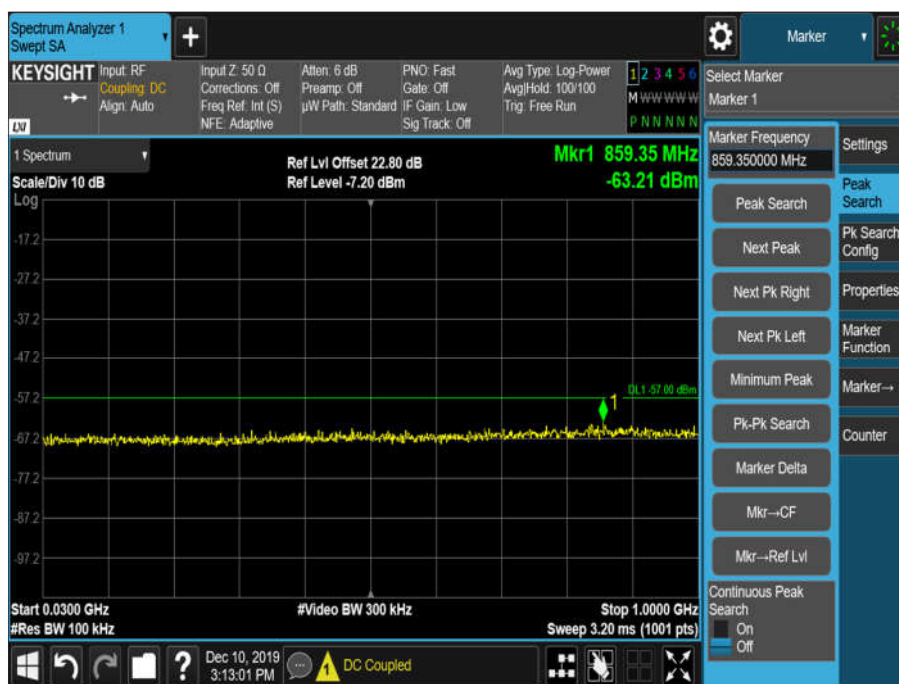


Figure 32 - 30 MHz to 1 GHz

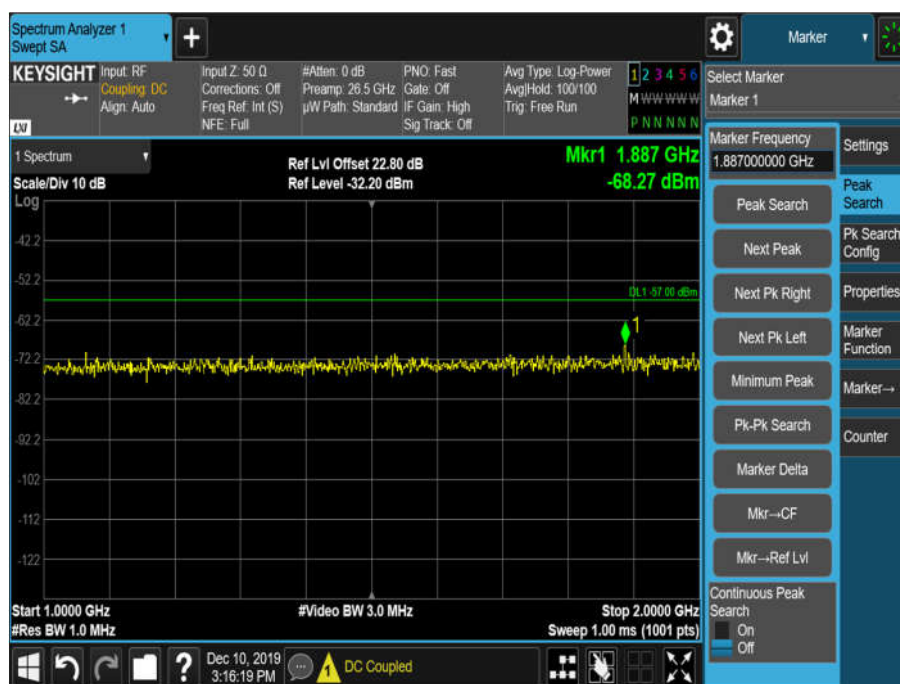


Figure 33 - 1 GHz to 2 GHz

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.



2.28.7 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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	Hygropalm	2404	12	02-May-2020
Multimeter	Fluke	79 Series II	3057	12	19-Aug-2020
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	17-Jul-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 70

O/P Mon – Output Monitored using calibrated equipment



2.29 Blocking or Desensitization

2.29.1 Specification Reference

IEC 62238, Clause 9.8

2.29.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.29.3 Date of Test

10-December-2019

2.29.4 Test Method

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

2.29.5 Environmental Conditions

Ambient Temperature 23.7 °C
Relative Humidity 37.1 %

2.29.6 Test Results

POD + Handset - VHF Transceiver

Unwanted Signal Generator Frequency Offset (kHz)	Blocking Level (dBμV e.m.f)
-10	112.45
-5	112.45
-2	94.95
-1	91.45
1	90.85
2	90.15
5	94.15
10	112.45

Table 71 - Fixed Frequency Blocking Results for VHF Receiver

IEC 62238, Limit Clause 9.8.3

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.



2.29.7 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
Attenuator (10 dB)	Weinschel	47-10-34	481	-	O/P Mon
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	07-Aug-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 72

O/P Mon – Output Monitored using calibrated equipment



2.30 Intermodulation Response

2.30.1 Specification Reference

IEC 62238, Clause 9.7

2.30.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.30.3 Date of Test

09-December-2019

2.30.4 Test Method

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

2.30.5 Environmental Conditions

Ambient Temperature 21.8 °C
Relative Humidity 30.4 %

2.30.6 Test Results

POD + Handset - VHF Transceiver

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	73.8
156.800	+50	+100	77.8

Table 73 - 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.



2.30.7 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
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	07-Aug-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	22-May-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 74

O/P Mon – Output Monitored using calibrated equipment



2.31 Spurious Response Rejection

2.31.1 Specification Reference

IEC 62238, Clause 9.6

2.31.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.31.3 Date of Test

24-February-2020

2.31.4 Test Method

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

2.31.5 Environmental Conditions

Ambient Temperature 20.0-22.8 °C
Relative Humidity 45.2-45.8 %

2.31.6 Test Results

POD + Handset - VHF Transceiver

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 results of the search.

Frequency (MHz)	Spurious Resonse Rejection Ratio (dB)
*	

Table 75 - List of Detected Spurious Responses for VHF Receiver

*No responses were detected within 10 dB of the limit.

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.



2.31.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	TU
Multimeter	Fluke	177	3813	12	09-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 76

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.32 Adjacent Channel Selectivity

2.32.1 Specification Reference

IEC 62238, Clause 9.5

2.32.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.32.3 Date of Test

28-February-2019

2.32.4 Test Method

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

2.32.5 Environmental Conditions

Ambient Temperature 21.9 °C
Relative Humidity 34.7 %

2.32.6 Test Results

POD + Handset - VHF Transceiver

Temperature	Voltage	Adjacent Channel Selectivity (dB)	
		-25 kHz	+25 kHz
+22.3 °C	12.0 V DC	83.90	83.90
-15.0 °C	10.8 V DC	66.06	66.06
-15.0 °C	31.2 V DC	65.54	65.54
+55.0 °C	10.8 V DC	72.18	72.18
+55.0 °C	31.2 V DC	67.40	67.82

Table 77 - 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.



2.32.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	17-Jul-2020
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	22-May-2020
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Vector Signal Generator	Rohde & Schwarz	SMBV100A	4886	36	11-May-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5098	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 78

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



2.33 Co-channel Rejection

2.33.1 Specification Reference

IEC 62238, Clause 9.4

2.33.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.33.3 Date of Test

09-December-2019

2.33.4 Test Method

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

2.33.5 Environmental Conditions

Ambient Temperature 21.8 °C
Relative Humidity 30.4 %

2.33.6 Test Results

POD + Handset - VHF Transceiver

Displacement of Unwanted Signal (kHz)	Co-channel Rejection (dB)
0	-7.5
-3	-7.5
+3	-7.5

Table 79 - 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.



2.33.7 Test Location and Test Equipment Used

This test was carried out in EMC Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMX	115	12	15-Jul-2020
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	17-Jul-2020
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	22-May-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	18-Jul-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Vector Signal Generator	Rohde & Schwarz	SMBV100A	4886	36	11-May-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5098	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 80

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



2.34 Maximum Usable Sensitivity

2.34.1 Specification Reference

IEC 62238, Clause 9.3

2.34.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex M1, S/N: M1.0000006B - Modification State 1
Cortex H1, S/N: H1.0000000F - Modification State 0

2.34.3 Date of Test

06-December-2019 to 02-March-2020

2.34.4 Test Method

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

2.34.5 Environmental Conditions

Ambient Temperature 21.5 - 22.4 °C
Relative Humidity 30.3 - 46.0 %

2.34.6 Test Results

POD + Handset - VHF Transceiver

Temperature	Voltage	Maximum Usable Sensitivity - dBμV (e.m.f.)
+22.0 °C	12.0 V DC	2.00
-15.0 °C	10.8 V DC	5.76
-15.0 °C	31.2 V DC	3.28
+55.0 °C	10.8 V DC	0.00
+55.0 °C	31.2 V DC	0.00

Table 81 - 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.



2.34.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	61	12	17-Jul-2020
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator + T/C	Fluke	51	412	12	23-Sep-2020
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	20-Jan-2021
Modulation Analyser	Hewlett Packard	8901B	773	12	28-Jun-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	A1	2138	12	05-Mar-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	12-Sep-2020
DSC Pre-Emphasis Unit for VHF Modem	TUV SUD	RAB 200701	3314	12	12-Aug-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase		4233	-	O/P Mon
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	06-Dec-2020
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	18-Jul-2020
Multi-GNSS Simulator (GPS)	Spirent	GSS6700	4596	12	14-Aug-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Type T PFA Insulated Thermocouple	TC Limited	Type-T	4739	12	23-Jul-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Hygrometer	Rotronic	HP21	5004	12	02-Oct-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5423	6	13-Jun-2020



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5426	6	13-Jun-2020

Table 82

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



2.35 Audio Frequency Response

2.35.1 Specification Reference

IEC 62238, Clause 9.2

2.35.2 Equipment Under Test and Modification State

Cortex M1, S/N: M1.0000006B - Modification State 0
Cortex H1, S/N: H1.0000000F - Modification State 0

2.35.3 Date of Test

06-December-2019

2.35.4 Test Method

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

2.35.5 Environmental Conditions

Ambient Temperature 22.0 °C
Relative Humidity 46.0 %

2.35.6 Test Results

POD + Handset - VHF Transceiver

Modulation Frequency (Hz)	Frequency Deviation (dB relative to 1 kHz)
200	9.24
400	7.77
500	6.06
600	4.63
800	2.00
1000	0.00
1200	-1.51
1500	-3.59
2000	-6.15

Table 83 - Results for Audio Frequency Response

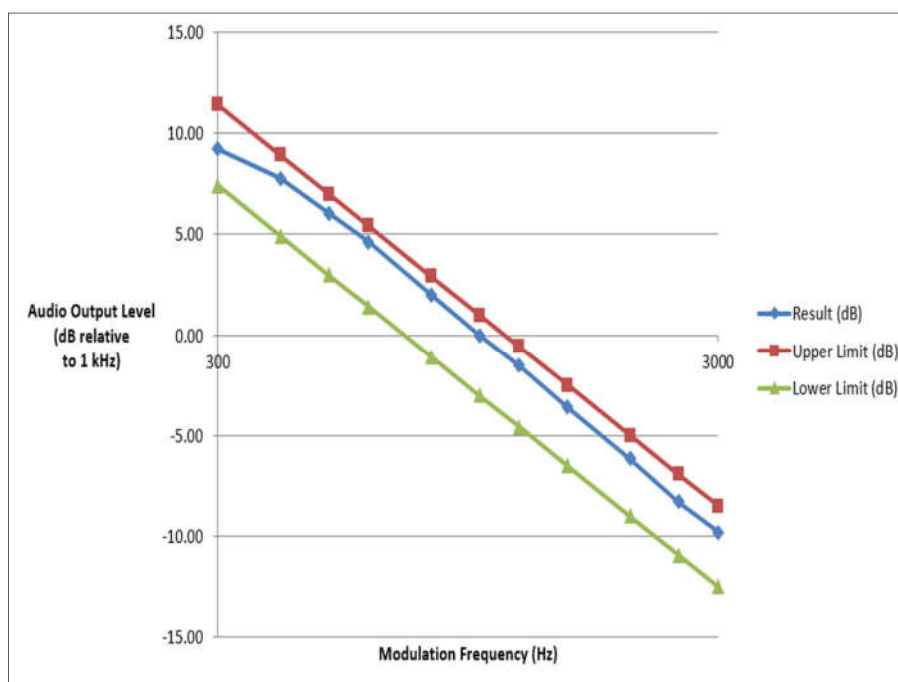


Figure 34 - Graph showing the Receiver Modulation Frequency versus Frequency Deviation relative to 1 kHz at the Nominal Frequency of the Receiver, 156.800 MHz

IEC 62238, Limit Clause 9.2.3

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



2.35.7 Test Location and Test Equipment Used

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

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
AF Load (4ohm)	ASL (TUV)	4ohm	430	12	02-Apr-2020
Attenuator (30 dB, 50 W)	Bird	8321	494	12	24-Oct-2020
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Coaxial Cable 5 m	Rosenberger	FA210B-1-050M-50X51	4045	6	29-Feb-2020
1m N-Type Cable	Rhophase	-	4233	-	O/P Mon
Multi-GNSS Simulator (GPS)	Spirent	GSS6700	4596	12	14-Aug-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 84

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Equipment Under Test (EUT)



Figure 35 – POD - General View



Figure 36 – POD - Rear View



Figure 37 – Handset – Front View

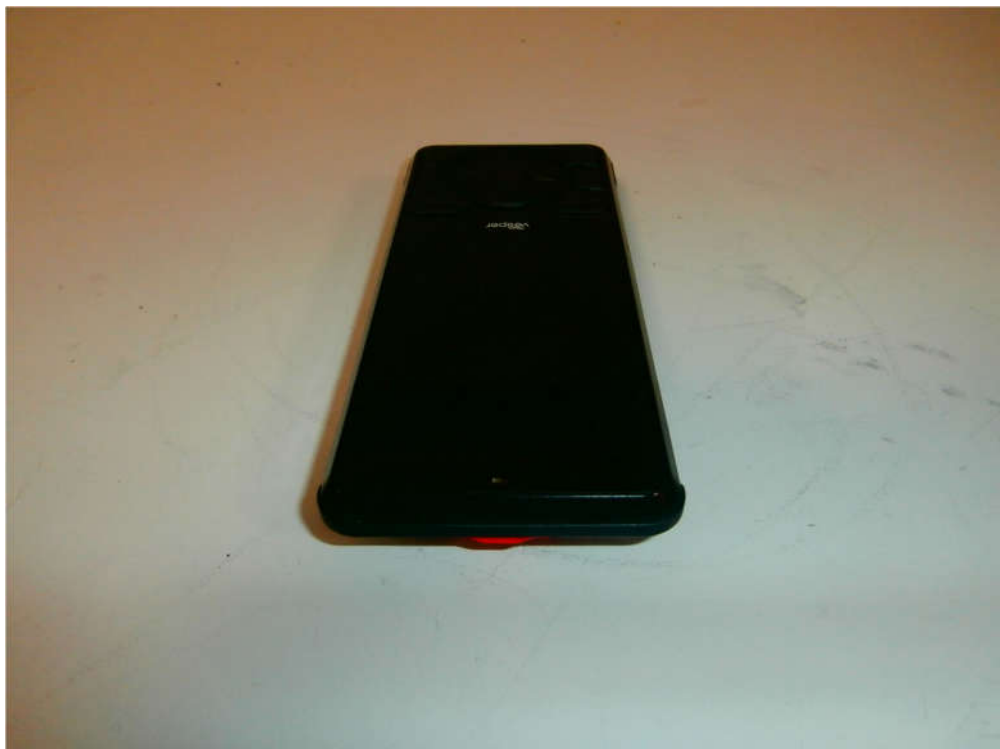


Figure 38 – Handset – Rear View

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Audio Frequency 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
Squelch Operation	= - 40 dB: ± 0.4 dB = +6 dB μ V emf: ± 2.1 dB = 20 dB: ± 0.4 dB = +6 dB μ V 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
Harmonic Distortion and Rated Audio Frequency Output Power	± 2.0 dB
Testing of Generated Call Sequences	-
Modulation Rate for DSC	± 46 Hz
Modulation Index for DSC	± 46 Hz
Frequency Error (DSC Signal)	± 0.15 Hz
Residual Modulation of the Transmitter	± 1.0 dB
Transient Frequency Behaviour of the Transmitter	± 0.2 kHz
Conducted Spurious Emissions Conveyed to the Antenna	± 3.54 dB
Audiofrequency Harmonic Distortion of the Emission	$\pm 14.12\%$
Audiofrequency Response	± 1.5 dB
Sensitivity of the Modulator including Microphone	$\pm 1.73\%$
Frequency Deviation	$\pm 1.73\%$



Test Name	Measurement Uncertainty
Carrier Power	± 0.4 dB
Frequency Error	± 11 Hz

Table 85

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.