

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

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



Product Service

Choose certainty.  
 Add value.

COMMERCIAL-IN-CONFIDENCE

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

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

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

EXECUTIVE SUMMARY

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

|  |                                                                                                                                                                                                                                                                                                                                                                                          |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>DISCLAIMER AND COPYRIGHT</b><br/>         This non-binding report has been prepared by TÜV SÜD Product Service with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD Product Service. No part of this document may be reproduced without the prior written approval of TÜV SÜD Product Service. © 2017 TÜV SÜD Product Service.</p> |
|  | <p><b>ACCREDITATION</b><br/>         Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).</p>                                                                                                     |

TÜV SÜD Product Service  
 is a trading name of TÜV SÜD Ltd  
 Registered in Scotland at East Kilbride,  
 Glasgow G75 0QF, United Kingdom  
 Registered number: SC215164

TÜV SÜD Ltd is a  
 TÜV SÜD Group Company

Phone: +44 (0) 1489 558100  
 Fax: +44 (0) 1489 558101  
[www.tuv-sud.co.uk](http://www.tuv-sud.co.uk)

TÜV SÜD Product Service  
 Octagon House  
 Concorde Way  
 Fareham  
 Hampshire PO15 5RL  
 United Kingdom



## Contents

|          |                                                                      |            |
|----------|----------------------------------------------------------------------|------------|
| <b>1</b> | <b>Report Summary .....</b>                                          | <b>3</b>   |
| 1.1      | Report Modification Record.....                                      | 3          |
| 1.2      | Introduction.....                                                    | 3          |
| 1.3      | Brief Summary of Results .....                                       | 4          |
| 1.4      | Application Form .....                                               | 6          |
| 1.5      | Product Information .....                                            | 9          |
| 1.6      | Deviations from the Standard.....                                    | 9          |
| 1.7      | EUT Modification Record .....                                        | 9          |
| 1.8      | Test Location.....                                                   | 9          |
| <b>2</b> | <b>Test Details .....</b>                                            | <b>12</b>  |
| 2.1      | Vibration Test .....                                                 | 12         |
| 2.2      | Temperature Tests - Dry Heat Functional Test.....                    | 25         |
| 2.3      | Temperature Tests - Damp Heat Functional Test.....                   | 29         |
| 2.4      | Temperature Tests - Low Temperature Functional Test.....             | 33         |
| 2.5      | Frequency Error .....                                                | 37         |
| 2.6      | Carrier Power .....                                                  | 39         |
| 2.7      | Frequency Deviation .....                                            | 42         |
| 2.8      | Sensitivity of the Modulator including Microphone.....               | 48         |
| 2.9      | Audiofrequency Response .....                                        | 50         |
| 2.10     | Audiofrequency Harmonic Distortion of the Emission.....              | 52         |
| 2.11     | Adjacent Channel Power.....                                          | 54         |
| 2.12     | Conducted Spurious Emissions Conveyed to the Antenna .....           | 56         |
| 2.13     | Transient Frequency Behaviour of the Transmitter.....                | 58         |
| 2.14     | Residual Modulation of the Transmitter .....                         | 61         |
| 2.15     | Frequency Error (DSC Signal) .....                                   | 63         |
| 2.16     | Modulation Index for DSC .....                                       | 65         |
| 2.17     | Modulation Rate for DSC .....                                        | 67         |
| 2.18     | Testing of Generated Call Sequences .....                            | 69         |
| 2.19     | Harmonic Distortion and Rated Audiofrequency Output Power.....       | 71         |
| 2.20     | Audiofrequency Response .....                                        | 73         |
| 2.21     | Maximum Usable Sensitivity .....                                     | 77         |
| 2.22     | Co-channel Rejection .....                                           | 79         |
| 2.23     | Adjacent Channel Selectivity.....                                    | 81         |
| 2.24     | Spurious Response Rejection.....                                     | 83         |
| 2.25     | Intermodulation Response .....                                       | 85         |
| 2.26     | Blocking or Desensitization .....                                    | 87         |
| 2.27     | Spurious Emissions.....                                              | 89         |
| 2.28     | Receiver Residual Noise Level .....                                  | 91         |
| 2.29     | Squelch Operation.....                                               | 93         |
| 2.30     | Squelch Hysteresis.....                                              | 95         |
| 2.31     | Multiple Watch Characteristic.....                                   | 97         |
| 2.32     | DSC - Maximum Usable Sensitivity .....                               | 99         |
| 2.33     | DSC - Co-channel Rejection .....                                     | 101        |
| 2.34     | DSC - Adjacent Channel Selectivity.....                              | 103        |
| 2.35     | DSC - Spurious Response and Blocking Immunity.....                   | 105        |
| 2.36     | DSC - Intermodulation Response .....                                 | 107        |
| 2.37     | DSC - Dynamic Range .....                                            | 109        |
| 2.38     | DSC - Spurious Emissions.....                                        | 111        |
| 2.39     | Verification of Correct Decoding of Various Types of DSC Calls ..... | 113        |
| 2.40     | Reaction to VTS and AIS Channel Management DSC Transmissions.....    | 116        |
| 2.41     | Simultaneous Reception .....                                         | 118        |
| <b>3</b> | <b>Photographs .....</b>                                             | <b>120</b> |



Product Service

|     |                                      |            |
|-----|--------------------------------------|------------|
| 3.1 | Equipment Under Test (EUT).....      | 120        |
| 4   | <b>Measurement Uncertainty .....</b> | <b>122</b> |



# 1 Report Summary

## 1.1 Report Modification Record

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

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

**Table 1**

## 1.2 Introduction

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



### 1.3 Brief Summary of Results

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

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



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

**Table 2**



### 1.4 Application Form

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

| EXTREME TEMPERATURE RANGE<br>(over which equipment is to be type tested)                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Not Applicable (no extreme temperature testing required)<br><input type="checkbox"/> Category I (General)<br><input type="checkbox"/> Category II (Portable equipments)<br><input checked="" type="checkbox"/> Other (please specify): -20 - +55 (IEC 60945 Protected) |

| TYPE OF EQUIPMENT                                 |                                                 |                                  |                                                          |
|---------------------------------------------------|-------------------------------------------------|----------------------------------|----------------------------------------------------------|
| <input checked="" type="checkbox"/> Fixed Station | <input type="checkbox"/> Transmitter            | <input type="checkbox"/> Simplex | <input type="checkbox"/> Integral Antenna                |
| <input type="checkbox"/> Mobile Station           | <input type="checkbox"/> Receiver               | <input type="checkbox"/> Duplex  | <input checked="" type="checkbox"/> Single Antenna       |
|                                                   | <input checked="" type="checkbox"/> Transceiver |                                  | <input type="checkbox"/> Two Antenna Connector           |
|                                                   |                                                 |                                  | <input type="checkbox"/> Multiple Antenna Connectors No. |
| <input type="checkbox"/> Portable Station         | <input type="checkbox"/>                        |                                  |                                                          |
| <input type="checkbox"/> Transponder (Tag)        | <input type="checkbox"/> Active                 | <input type="checkbox"/> Passive |                                                          |

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



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

| TRANSMITTER - MODULATION                                                   |                                     |                 |                                                                     |
|----------------------------------------------------------------------------|-------------------------------------|-----------------|---------------------------------------------------------------------|
| Amplitude                                                                  | <input type="checkbox"/>            | Other           | <input type="checkbox"/>                                            |
| Frequency                                                                  | <input checked="" type="checkbox"/> | Details :       | FM , FSK                                                            |
| Phase                                                                      | <input type="checkbox"/>            | Channel Spacing | 25kHz                                                               |
| Can the transmitter be operated without modulation? * See definition below |                                     |                 | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |

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





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

| AUTOMATIC EQUIPMENT SWITCH OFF                                                                                                                                                                                   |                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| If the equipment is designed to automatically switch off at a predetermined voltage level which is higher or lower in value than the battery minimum and minimum calculated values this shall be clearly stated. |                           |
| <input type="checkbox"/>                                                                                                                                                                                         | Applies V cut-off voltage |
| <input checked="" type="checkbox"/>                                                                                                                                                                              | Does not apply            |

| CHANNEL IDENTIFICATION                                                                                                                                                                                                   |             |                              |                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------|--------------------------|
| Each equipment, whether one or more submitted for tests shall carry clear identification (such as a serial number), together with the frequencies associated with the channel identification displayed on the equipment. |             |                              |                          |
| Equipment Identification<br>eg Serial Number                                                                                                                                                                             | Channel No. | Transmit Nominal Freq<br>MHz | Receive Nominal Freq MHz |
| 1                                                                                                                                                                                                                        | 16          | 156.800                      | 156.800                  |
| 2                                                                                                                                                                                                                        | 16          | 156.800                      | 156.800                  |
|                                                                                                                                                                                                                          |             |                              |                          |
|                                                                                                                                                                                                                          |             |                              |                          |
|                                                                                                                                                                                                                          |             |                              |                          |

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

Name: Tetsuro Otake

Position held:

Senior Engineering Director

Date: 6, June 2017



**1.5 Product Information**

**1.5.1 Technical Description**

Fixed Mount Marine DSC Radio.

**1.6 Deviations from the Standard**

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

**1.7 EUT Modification Record**

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

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

**Table 3**

**1.8 Test Location**

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

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



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

**Table 4**



Product Service

Office Address:

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



## 2 Test Details

### 2.1 Vibration Test

#### 2.1.1 Specification Reference

IEC 62238, Clause 7.4

#### 2.1.2 Equipment Under Test and Modification State

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

#### 2.1.3 Date of Test

07-August-2017 to 08-August-2017

#### 2.1.4 Test Method

IEC60945 main extract and application:

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

When resonant frequencies with magnitude ratio  $\geq 5$  are harmonically related, only fundamental frequency tested.

- If no resonance with magnitude ratio  $\geq 5$ , endurance test carried out at one single observed frequency.
- If no resonance occurred, endurance test carried out at 30 Hz.
- Performance check(s) were carried out once during (approximately mid-way) and once before the end of each endurance test period.
- Procedure was repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.



**2.1.5 Environmental Conditions**

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

**2.1.6 Test Results**

DC Powered - VHF & DSC

| Parameter               | Unit | Value |
|-------------------------|------|-------|
| DC Power Supply Voltage | V DC | 13.8  |

**Table 5 - General Setup Parameters for Vibration Test**

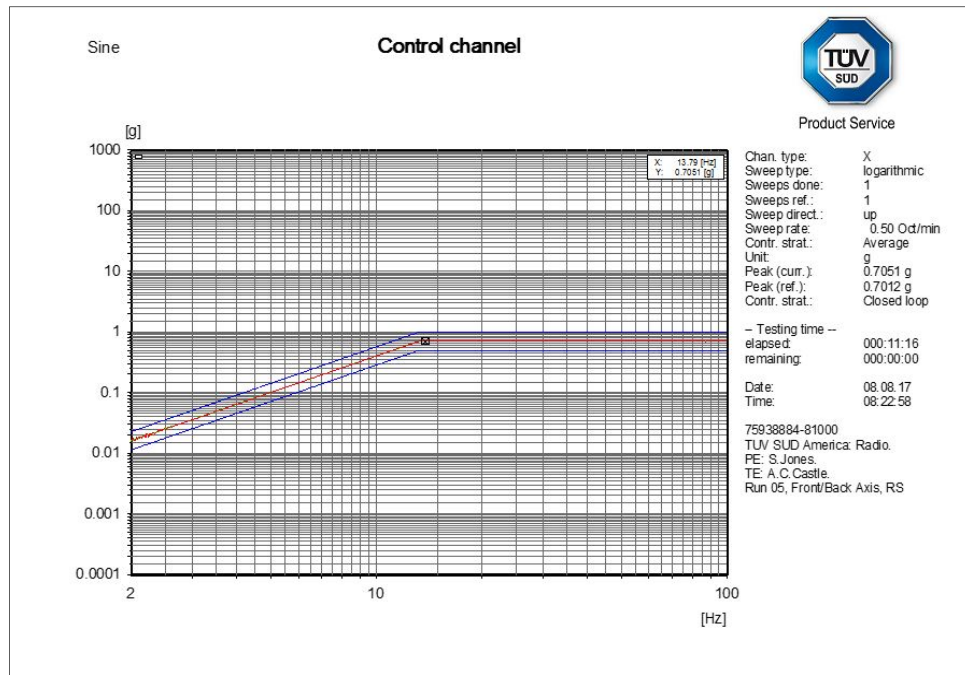
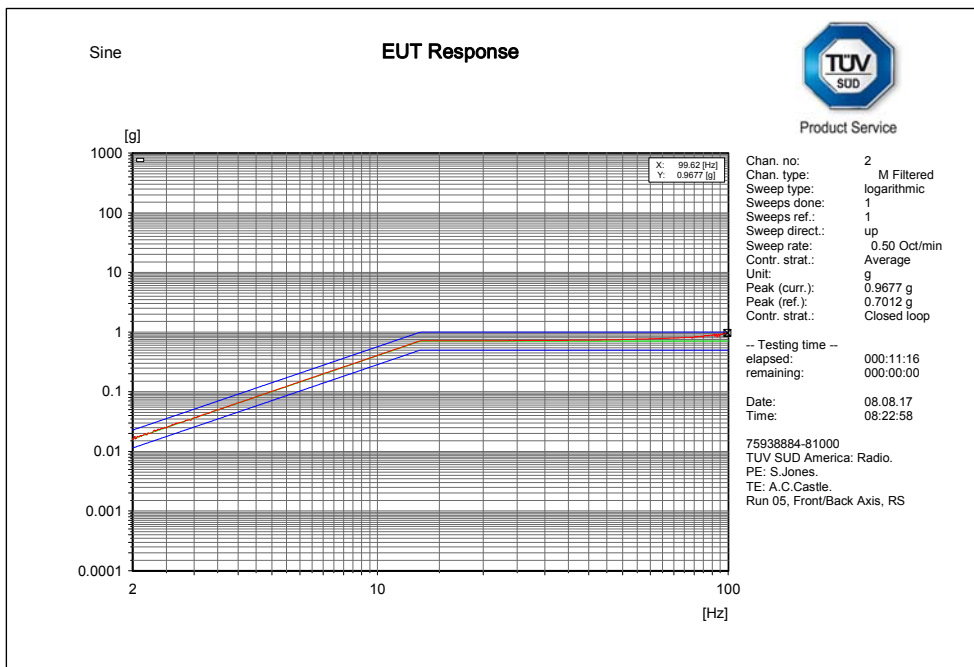


Figure 1 - Resonance Search (Control) - Fore-Aft



C:\VcpNT\Daten\m+p\TUV SUD America\75938884-81000\RS\_006.rsn

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

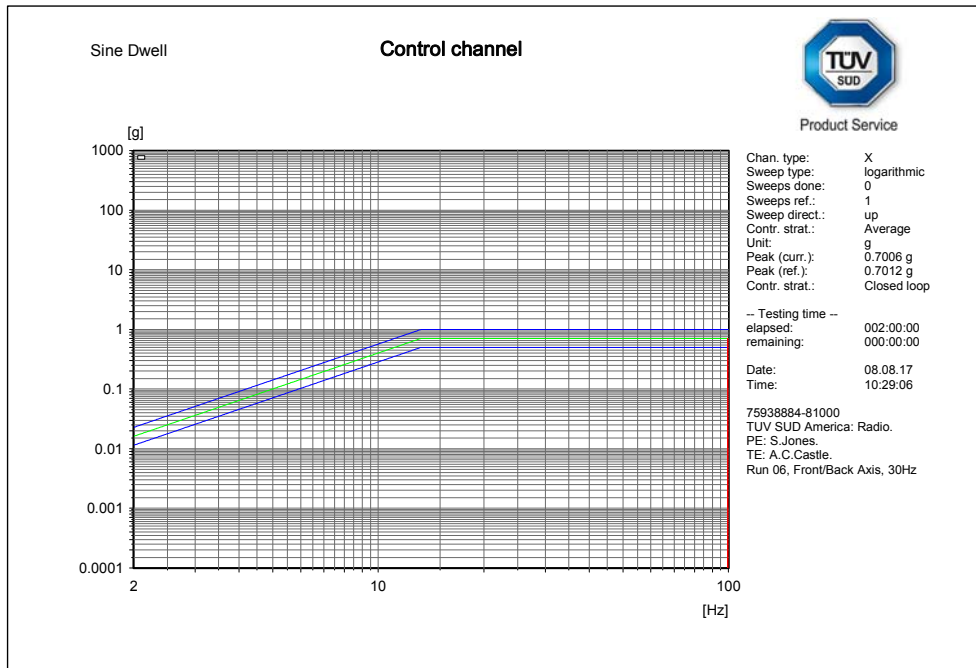


Figure 3 – Endurance Run (Control) - Fore-Aft

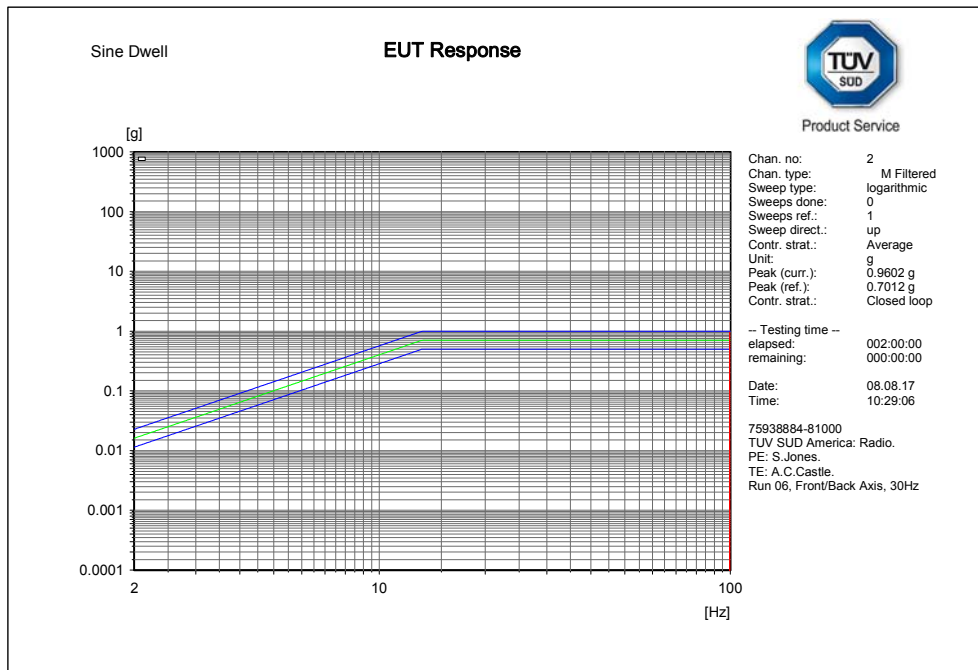


Figure 4 – Endurance Run (EUT) - Fore-Aft





|                |                  |                                                    |
|----------------|------------------|----------------------------------------------------|
| Endurance Run  |                  |                                                    |
| Frequency (Hz) | Duration (hours) | Applied Acceleration Set Point (m/s <sup>2</sup> ) |
| 99.62          | 2                | 7                                                  |

**Table 6 - Vibration Test Data - Fore-Aft**

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

**Table 7 - Performance Check Results - Fore-Aft**

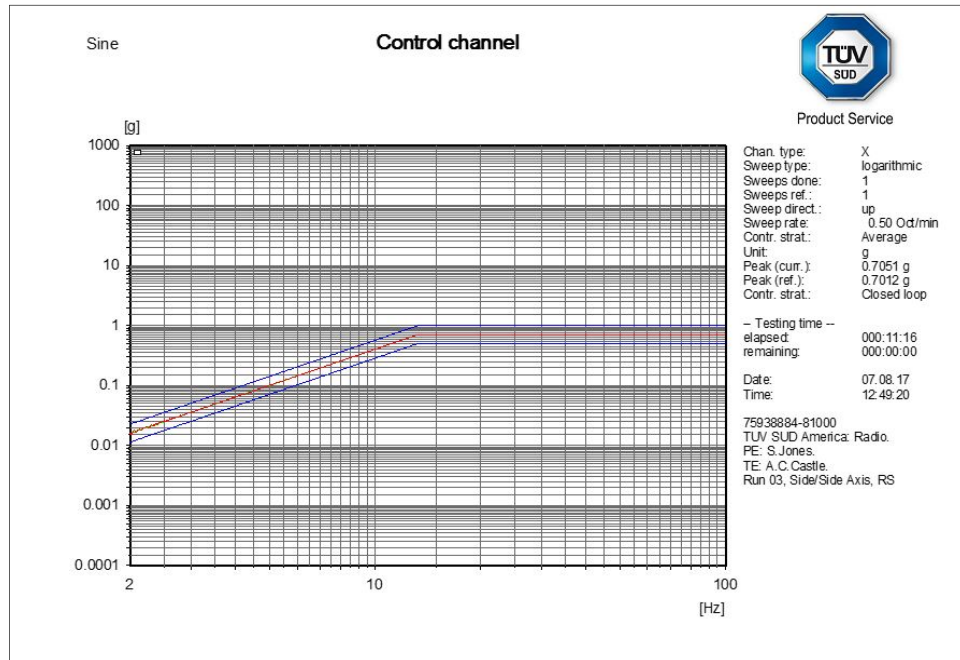
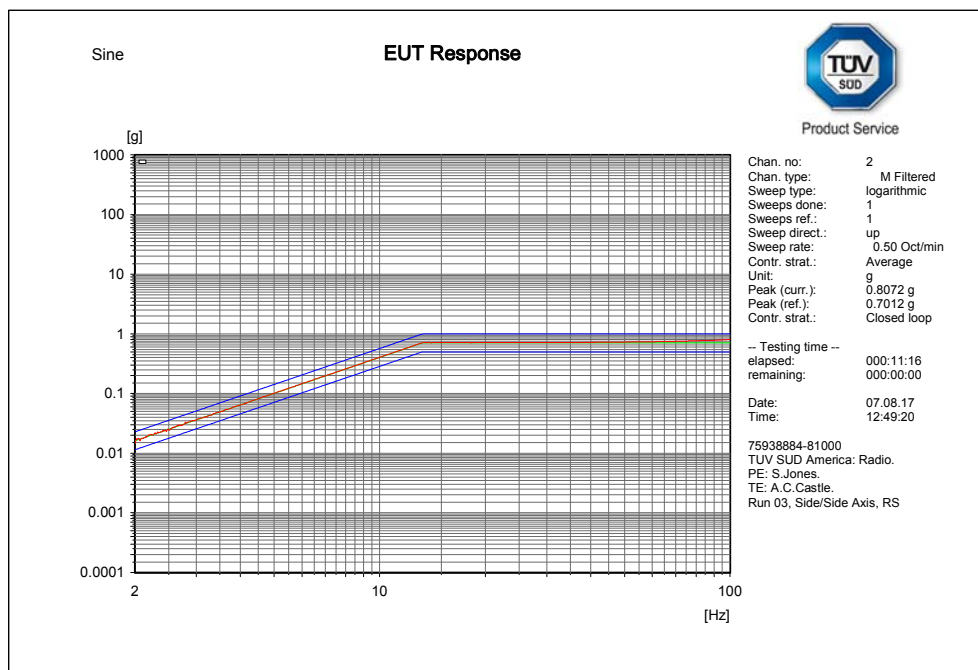
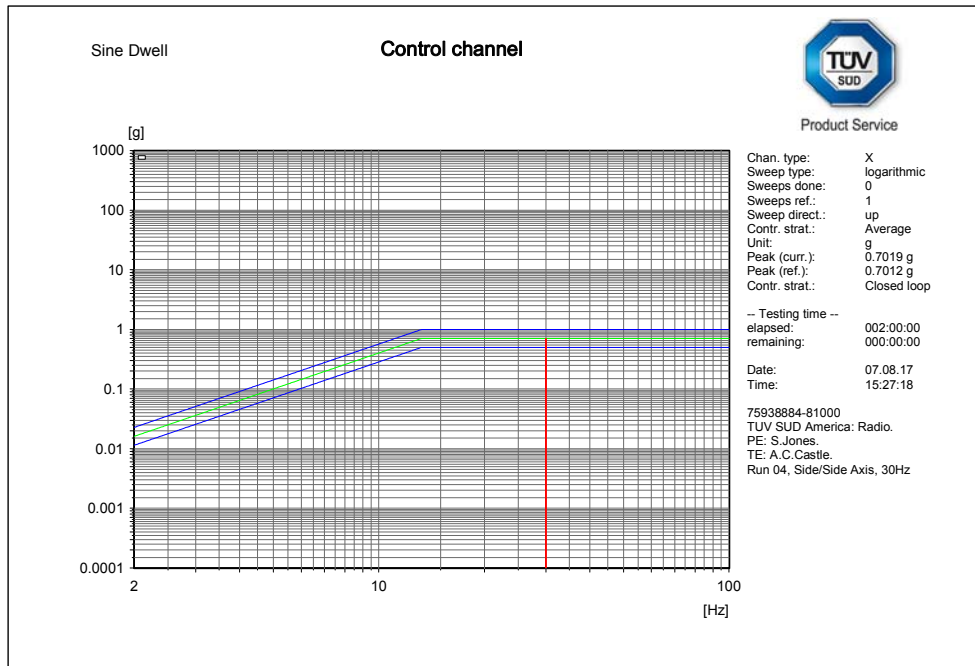


Figure 5 - Resonance Search (Control) – Side to Side



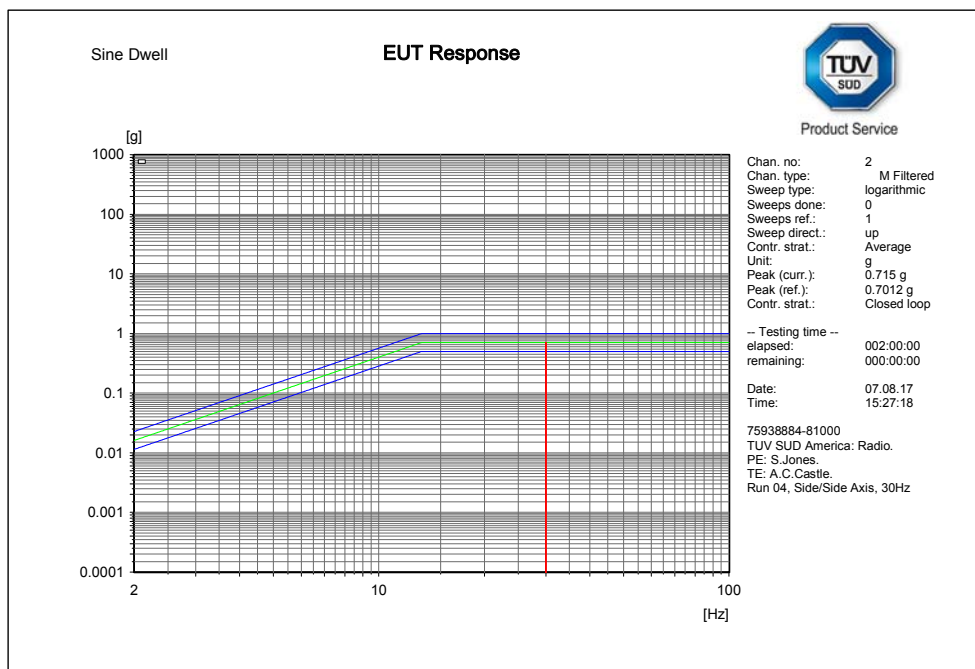
C:\VcpNTDaten\m+p\TUV SUD America\75938884-81000\RS\_005.rsn

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



C:\VepNT\Daten\m+p\TUV SUD America\75938884-81000\33Hz Dwell\_003.rsd

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



C:\VepNT\Daten\m+p\TUV SUD America\75938884-81000\33Hz Dwell\_003.rsd

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



|                |                  |                                                    |
|----------------|------------------|----------------------------------------------------|
| Endurance Run  |                  |                                                    |
| Frequency (Hz) | Duration (hours) | Applied Acceleration Set Point (m/s <sup>2</sup> ) |
| 30             | 2                | 7                                                  |

**Table 8 - Vibration Test Data - Horizontal**

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

**Table 9 - Performance Check Results - Horizontal**

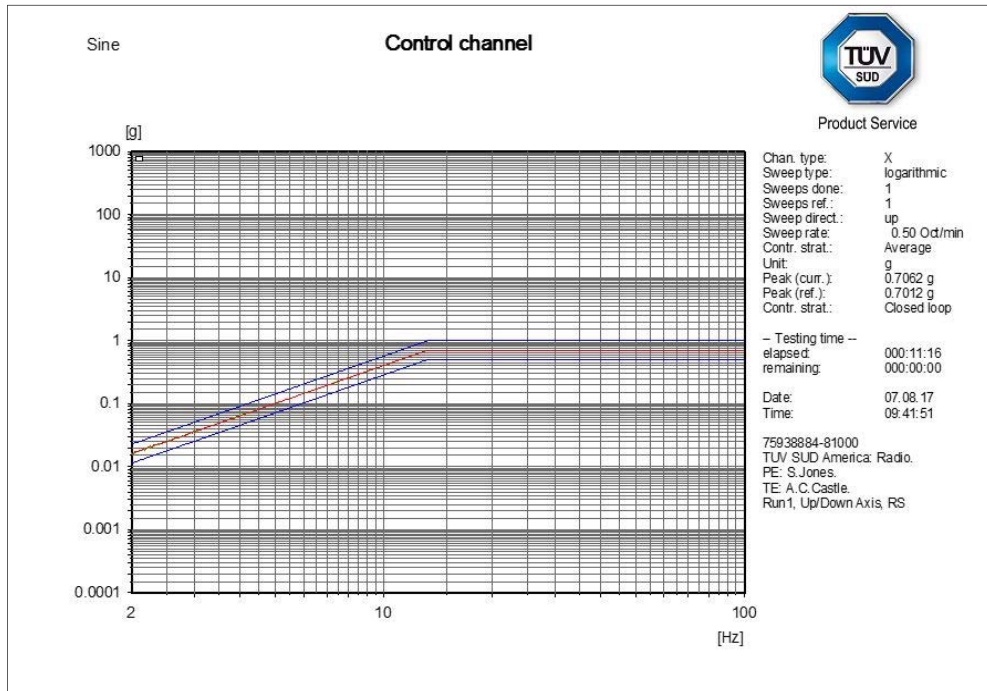
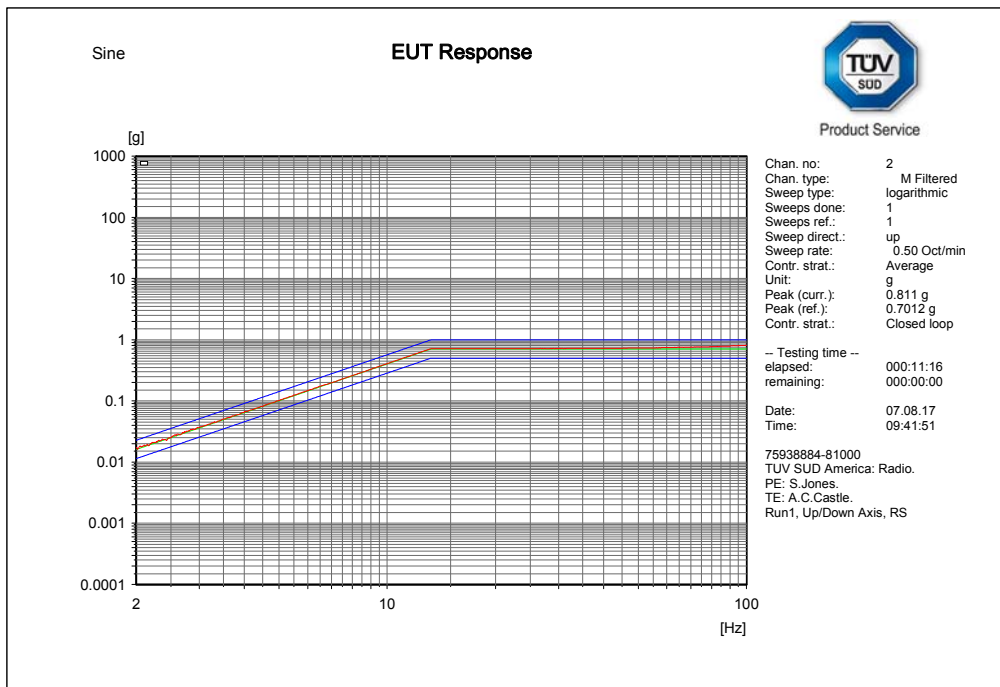


Figure 9 - Resonance Search (Control) – Up and Down



C:\VcpNT\Daten\m+p\TUV SUD America\75938884-81000\IRS\_002.rsn

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

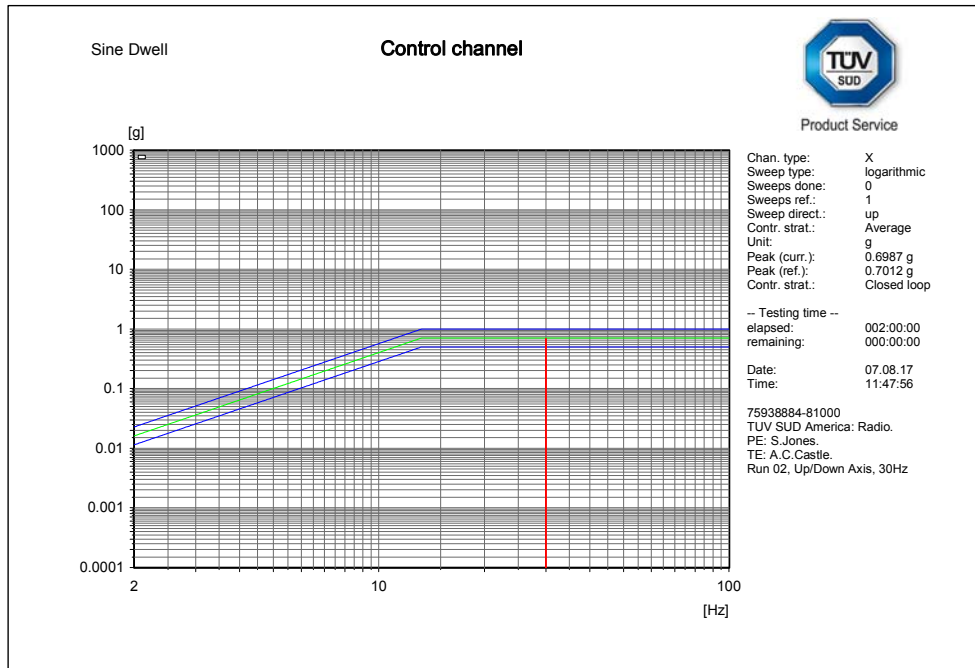


Figure 11 – Endurance Run (Control) – Up and Down

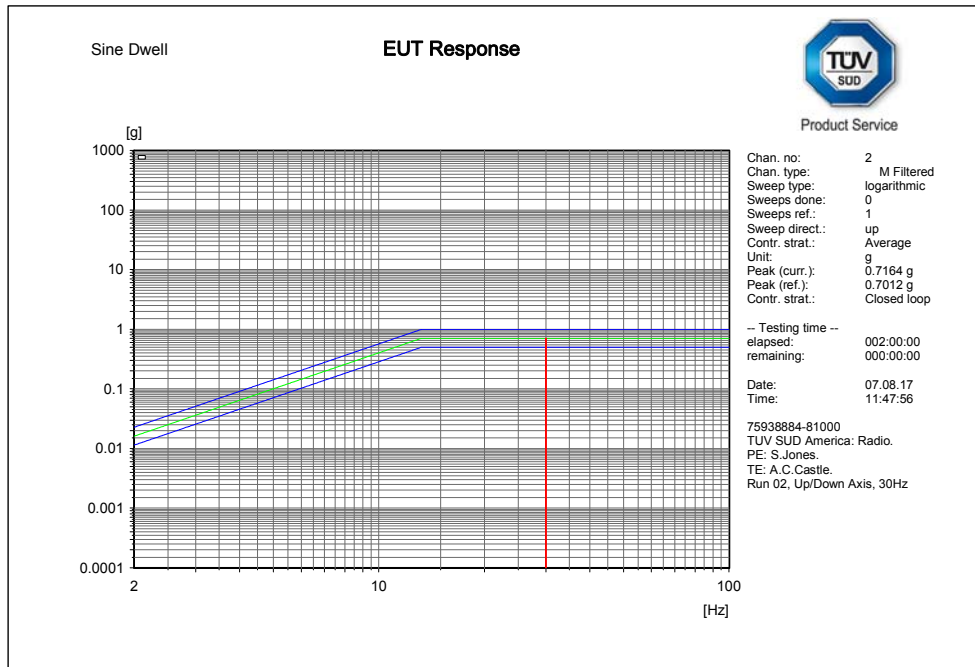


Figure 12 – Endurance Run (EUT) – Up and Down



| Endurance Run  |                  |                                                    |
|----------------|------------------|----------------------------------------------------|
| Frequency (Hz) | Duration (hours) | Applied Acceleration Set Point (m/s <sup>2</sup> ) |
| 30             | 2                | 7                                                  |

**Table 10 - Vibration Test Data - Vertical**

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

**Table 11 - Performance Check Results - Vertical**

Remarks

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



### IEC 62238, Limit Clause 7.3

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

a) For the transmitter:

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

b) For the radiotelephone receiver:

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

c) For the DSC receiver:

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





**2.1.7 Test Location and Test Equipment Used**

This test was carried out in LDS 875 Shaker.

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

**Table 12**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



## **2.2 Temperature Tests - Dry Heat Functional Test**

### **2.2.1 Specification Reference**

IEC 62238, Clause 7.5

### **2.2.2 Equipment Under Test and Modification State**

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

### **2.2.3 Date of Test**

14-August-2017 to 15-August-2017

### **2.2.4 Test Method**

IEC60945 main extract and application:

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

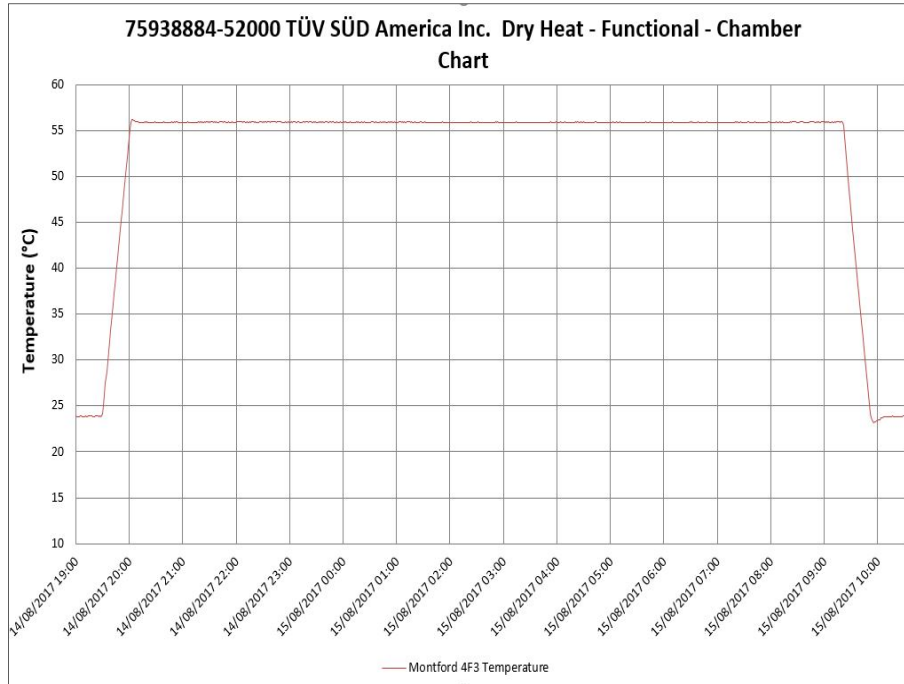
### **2.2.5 Environmental Conditions**

|                     |         |
|---------------------|---------|
| Ambient Temperature | 23.0 °C |
| Relative Humidity   | 56.2 %  |



**2.2.6 Test Results**

DC Powered - VHF & DSC



**Figure 13 - Temperature % Humidity Versus Time**

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

**Table 13 - Performance Check Results - Dry Heat Functional Test**

Remarks

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



### IEC 62238, Limit Clause 7.3

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

a) For the transmitter:

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

b) For the radiotelephone receiver:

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

c) For the DSC receiver:

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



### 2.2.7 Test Location and Test Equipment Used

This test was carried out in Montford 4ft<sup>3</sup> Chamber.

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

**Table 14**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



## **2.3 Temperature Tests - Damp Heat Functional Test**

### **2.3.1 Specification Reference**

IEC 62238, Clause 7.5

### **2.3.2 Equipment Under Test and Modification State**

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

### **2.3.3 Date of Test**

17-August-2017 to 18-August-2017

### **2.3.4 Test Method**

IEC60945 main extract and application:

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

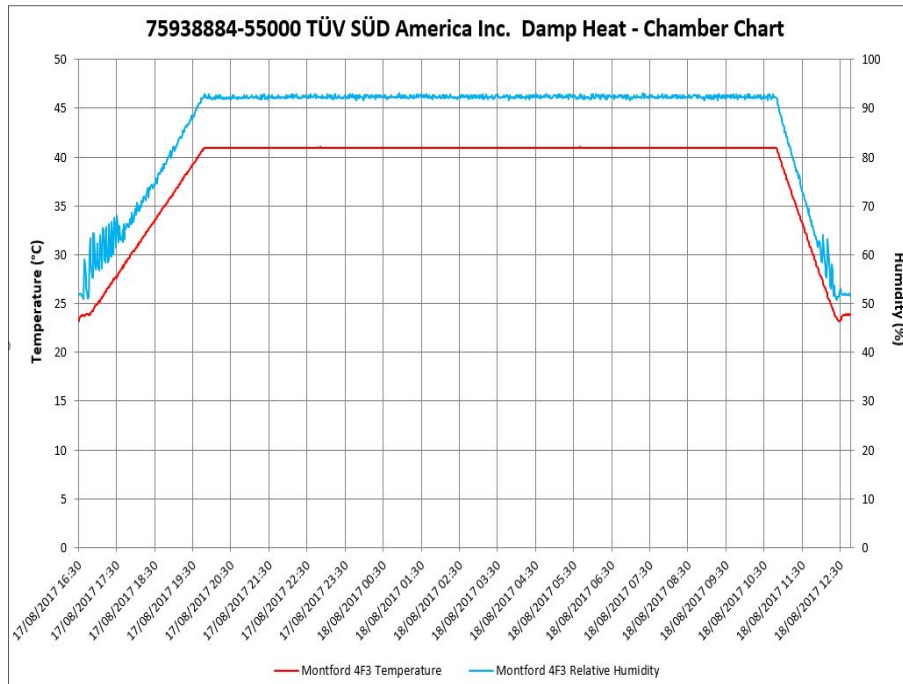
### **2.3.5 Environmental Conditions**

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



**2.3.6 Test Results**

DC Powered - VHF & DSC



**Figure 14 - Temperature & Humidity Versus Time**

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

**Table 15 - Performance Check Results - Damp Heat Functional Test**

Remarks

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



### IEC 62238, Limit Clause 7.3

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

a) For the transmitter:

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

b) For the radiotelephone receiver:

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

c) For the DSC receiver:

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





### 2.3.7 Test Location and Test Equipment Used

This test was carried out in Montford 4ft<sup>3</sup> Chamber.

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

**Table 16**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



## **2.4 Temperature Tests - Low Temperature Functional Test**

### **2.4.1 Specification Reference**

IEC 62238, Clause 7.5

### **2.4.2 Equipment Under Test and Modification State**

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

### **2.4.3 Date of Test**

16-August-2017 to 17-August-2017

### **2.4.4 Test Method**

IEC60945 main extract and application:

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

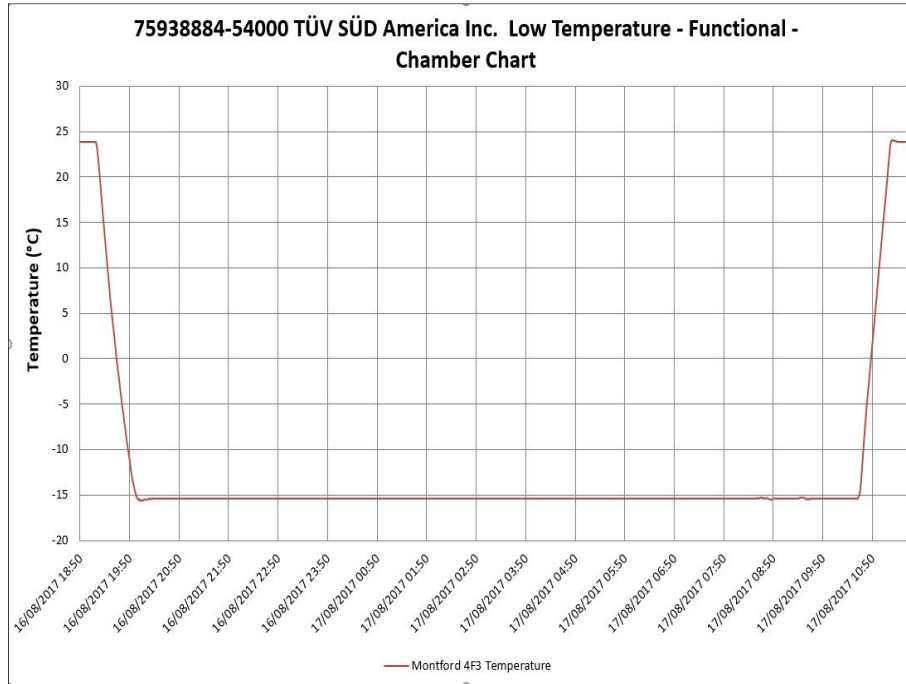
### **2.4.5 Environmental Conditions**

|                     |         |
|---------------------|---------|
| Ambient Temperature | 24.4 °C |
| Relative Humidity   | 61.0 %  |



**2.4.6 Test Results**

DC Powered - VHF & DSC



**Figure 15 - Temperature & Humidity Versus Time**

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

**Table 17 - Performance Check Results - Low Temperature Functional Test**

Remarks

It was confirmed that the temperature remained within  $-15\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  during the soak period and that the rate of change of temperature did not exceed  $1\text{ }^{\circ}\text{C}/\text{min}$ .



### IEC 62238, Limit Clause 7.3

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

a) For the transmitter:

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

b) For the radiotelephone receiver:

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

c) For the DSC receiver:

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



### 2.4.7 Test Location and Test Equipment Used

This test was carried out in Montford 4ft<sup>3</sup> Chamber.

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

**Table 18**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.5 Frequency Error**

**2.5.1 Specification Reference**

IEC 62238, Clause 8.1

**2.5.2 Equipment Under Test and Modification State**

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

**2.5.3 Date of Test**

21-August-2017 to 29-August-2017

**2.5.4 Test Method**

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

**2.5.5 Environmental Conditions**

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

**2.5.6 Test Results**

DC Powered - VHF & DSC

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

**Table 19 - Frequency Error Results**

IEC 62238, Limit Clause 8.1.3

The frequency error shall be within  $\pm 1.5$  kHz.



**2.5.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 3.

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

**Table 20**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.6 Carrier Power**

**2.6.1 Specification Reference**

IEC 62238, Clause 8.2

**2.6.2 Equipment Under Test and Modification State**

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

**2.6.3 Date of Test**

29-August-2017 to 30-August-2017

**2.6.4 Test Method**

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

**2.6.5 Environmental Conditions**

Ambient Temperature 22.1 °C

Relative Humidity 59.9 %

**2.6.6 Test Results**

DC Powered - VHF & DSC

Maximum Rated Output Power: 25.0 W.

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

\*Measurements also made at 156.025 MHz: 21.27 W

**Table 21 - Carrier Power Results at Maximum Rated Power**

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

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





Minimum Rated Output Power: 1 W.

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

\*Measurements also made at 156.025 MHz: 0.685 W

**Table 23 - Carrier Power Results at Minimum Rated Power**

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

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

IEC 62238, Limit Clause 8.2.3

Normal Test Conditions:

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

Extreme test conditions:

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



**2.6.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 3.

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

**Table 25**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



Product Service

**2.7 Frequency Deviation**

**2.7.1 Specification Reference**

IEC 62238, Clause 8.3

**2.7.2 Equipment Under Test and Modification State**

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

**2.7.3 Date of Test**

21-August-2017

**2.7.4 Test Method**

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

**2.7.5 Environmental Conditions**

|                     |         |
|---------------------|---------|
| Ambient Temperature | 22.0 °C |
| Relative Humidity   | 73.6 %  |



**2.7.6 Test Results**

DC Powered - VHF & DSC

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

**Table 26 - Maximum Permissible Frequency Deviation**

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

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

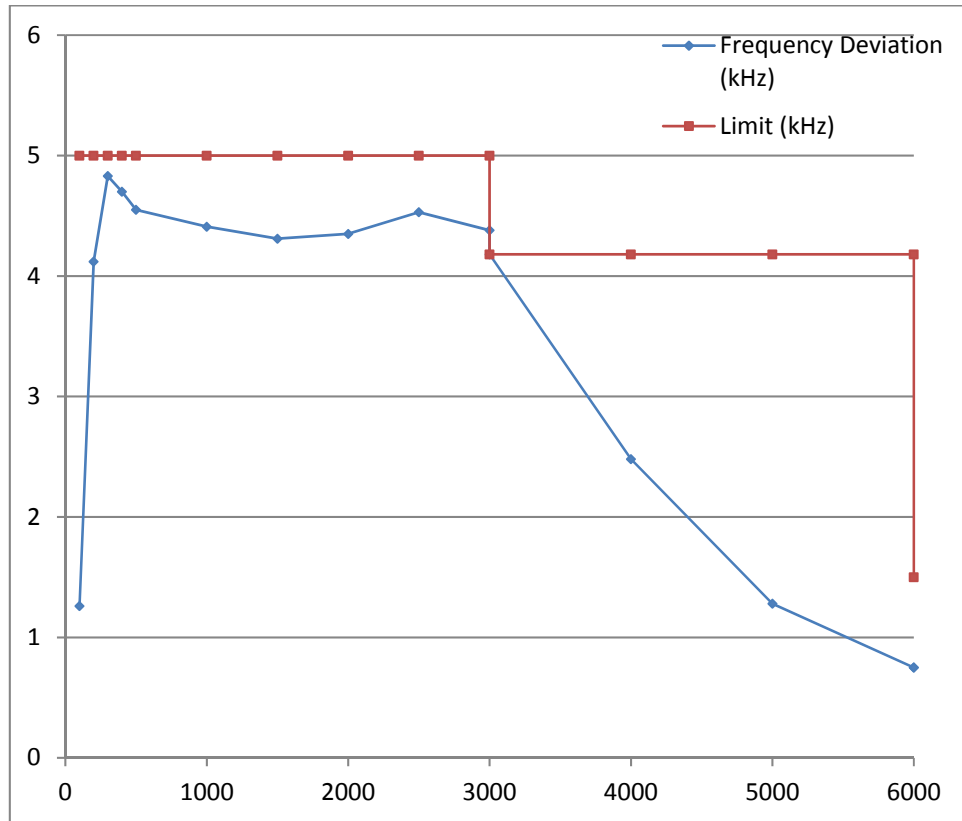


Figure 16 - Frequency Deviation (AF < 6 kHz) - Maximum Power Setting

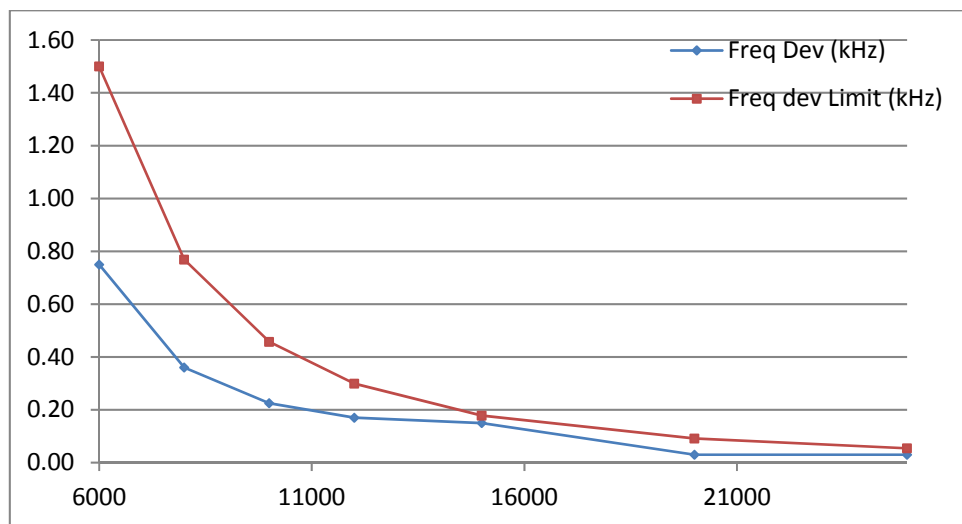
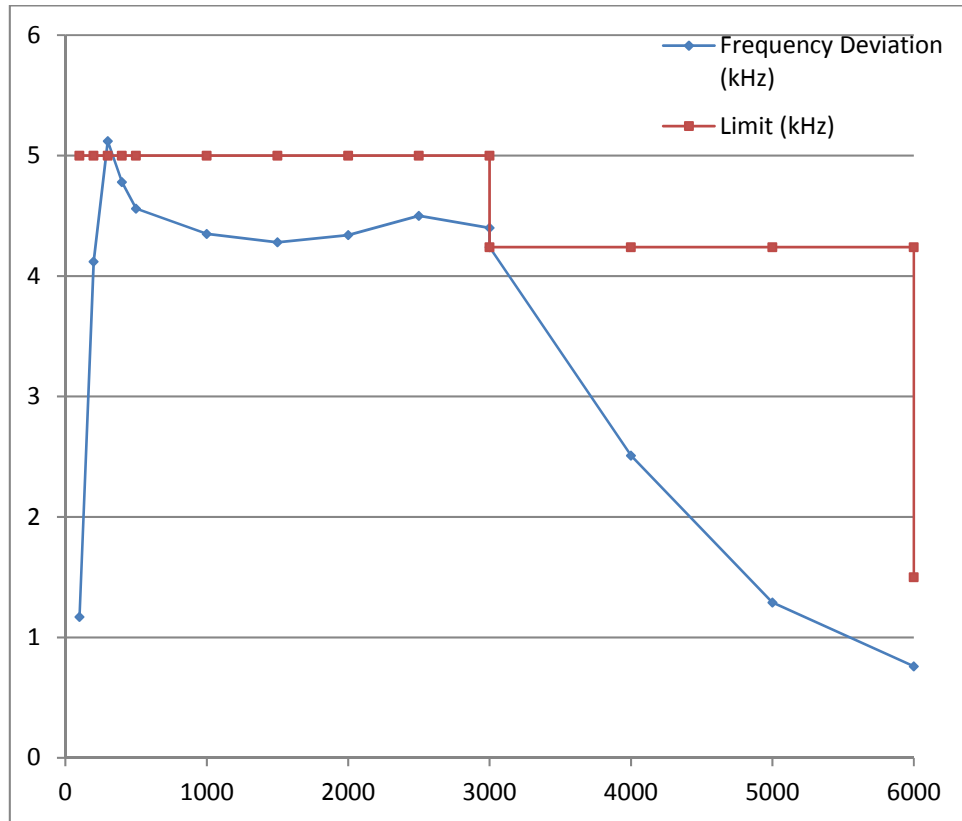
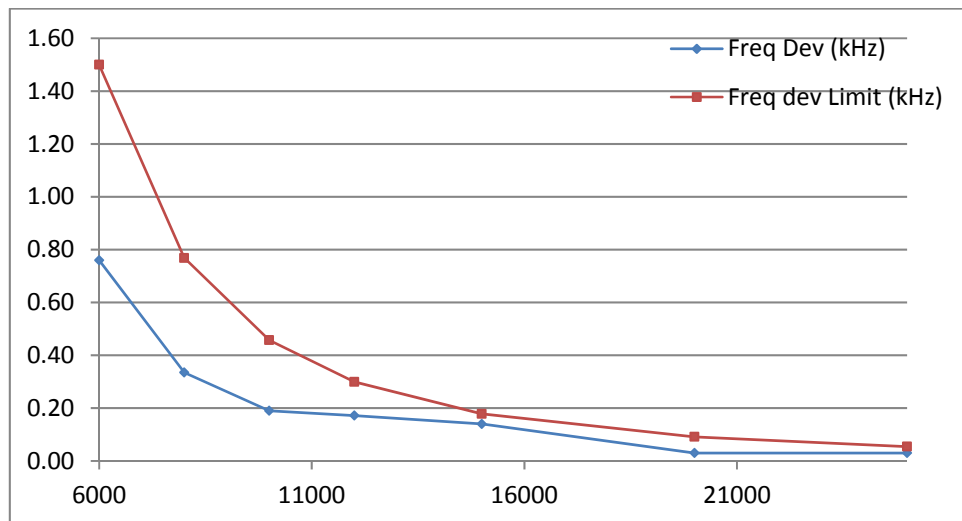


Figure 17 - Frequency Deviation (AF > 6 kHz) - Maximum Power Setting



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



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



IEC 62238, Limit Clause 8.3.2.2 and 8.3.3.2

The maximum frequency deviation shall be  $\pm 5$  kHz for modulation frequencies less than 3 kHz.

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

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

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

\*For modulation frequencies between 3 kHz and 6 kHz the frequency deviation shall not exceed the frequency deviation with a modulation frequency of 3 kHz. For a modulation frequency of 6 kHz, the frequency deviation shall not exceed  $\pm 1.5$  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  $\pm 1.5$  kHz and inclined at 14 dB/octave. The limit of frequency deviation for the points measured has been calculated and is as shown in the table above.



### 2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

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

**Table 29**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment





**2.8 Sensitivity of the Modulator including Microphone**

**2.8.1 Specification Reference**

IEC 62238, Clause 8.4

**2.8.2 Equipment Under Test and Modification State**

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

**2.8.3 Date of Test**

03-October-2017

**2.8.4 Test Method**

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

**2.8.5 Environmental Conditions**

Ambient Temperature 20.5 °C

Relative Humidity 45.1 %

**2.8.6 Test Results**

DC Powered - VHF & DSC

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

**Table 30 - Frequency Deviation Results**

IEC 62238, Limit Clause 8.4.3

The resulting frequency deviation shall be between  $\pm 2.5$  kHz and  $\pm 4.5$  kHz.



**2.8.7 Test Location and Test Equipment Used**

This test was carried out in EMC Chamber 2.

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

**Table 31**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.9 Audiofrequency Response**

**2.9.1 Specification Reference**

IEC 62238, Clause 8.5

**2.9.2 Equipment Under Test and Modification State**

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

**2.9.3 Date of Test**

31-August-2017 to 07-September-2017

**2.9.4 Test Method**

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

**2.9.5 Environmental Conditions**

Ambient Temperature 21.7 - 22.9 °C

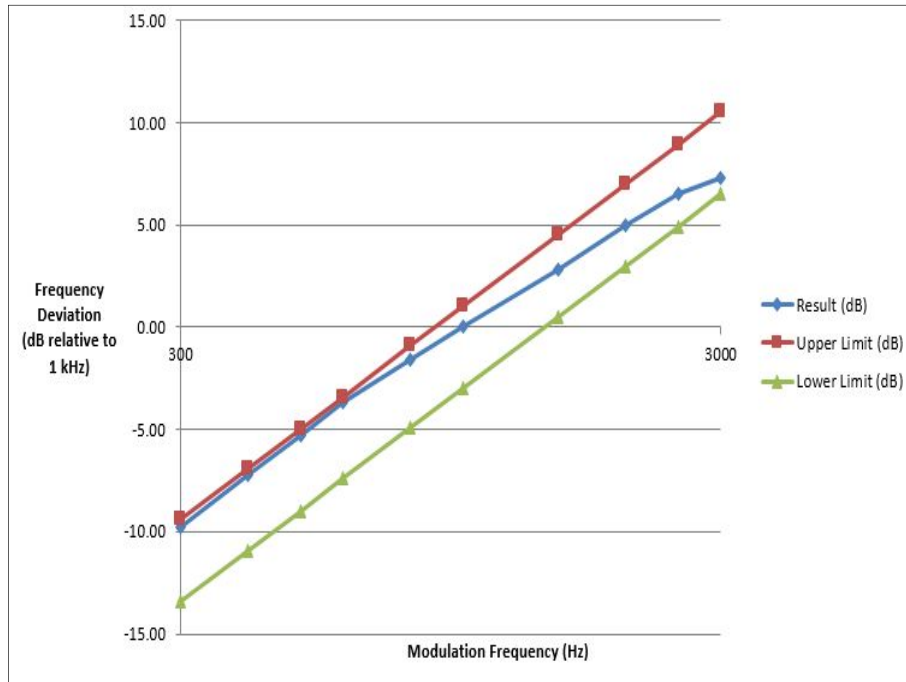
Relative Humidity 46.7 - 54.1 %

**2.9.6 Test Results**

DC Powered - VHF & DSC

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

**Table 32 - Results for Audiofrequency Response**



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

IEC 62238, Limit Clause 8.5.3

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

**2.9.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 33**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.10 Audiofrequency Harmonic Distortion of the Emission**

**2.10.1 Specification Reference**

IEC 62238, Clause 8.6

**2.10.2 Equipment Under Test and Modification State**

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

**2.10.3 Date of Test**

30-August-2017

**2.10.4 Test Method**

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

**2.10.5 Environmental Conditions**

Ambient Temperature 21.8 °C  
Relative Humidity 52.0 %

**2.10.6 Test Results**

DC Powered - VHF & DSC

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

**Table 34 – Audiofrequency Harmonic Distortion**

IEC 62238, Limit Clause 8.6.3

The harmonic distortion shall not exceed 10%.



### 2.10.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

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

**Table 35**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.11 Adjacent Channel Power**

**2.11.1 Specification Reference**

IEC 62238, Clause 8.7

**2.11.2 Equipment Under Test and Modification State**

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

**2.11.3 Date of Test**

23-August-2017

**2.11.4 Test Method**

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

**2.11.5 Environmental Conditions**

Ambient Temperature 22.7 °C

Relative Humidity 63.8 %

**2.11.6 Test Results**

DC Powered - VHF & DSC

The measurement was performed with a modulated carrier.

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

**Table 36 - Adjacent Channel Power Results**

IEC 62238, Limit Clause 8.7.3

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



**2.11.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 3.

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

**Table 37**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment





**2.12 Conducted Spurious Emissions Conveyed to the Antenna**

**2.12.1 Specification Reference**

IEC 62238, Clause 8.8

**2.12.2 Equipment Under Test and Modification State**

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

**2.12.3 Date of Test**

12-September-2017

**2.12.4 Test Method**

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

**2.12.5 Environmental Conditions**

Ambient Temperature 21.9 - 23.3 °C

Relative Humidity 45.7 - 45.9 %

**2.12.6 Test Results**

DC Powered - VHF & DSC

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

**Table 38 - Conducted Spurious Emissions Results**

IEC 62238, Limit Clause 8.8.3

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

**2.12.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.



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

**Table 39**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



## 2.13 Transient Frequency Behaviour of the Transmitter

### 2.13.1 Specification Reference

IEC 62238, Clause 8.9

### 2.13.2 Equipment Under Test and Modification State

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

### 2.13.3 Date of Test

19-September-2017

### 2.13.4 Test Method

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

### 2.13.5 Environmental Conditions

Ambient Temperature 21.1 °C

Relative Humidity 49.7 %

### 2.13.6 Test Results

DC Powered - VHF & DSC

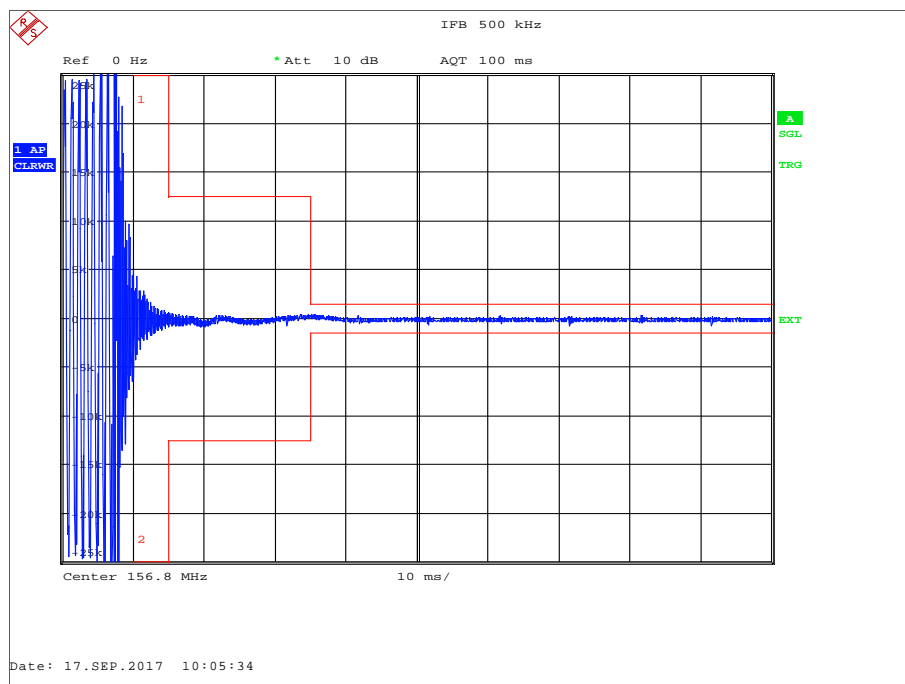


Figure 21 - Switch On

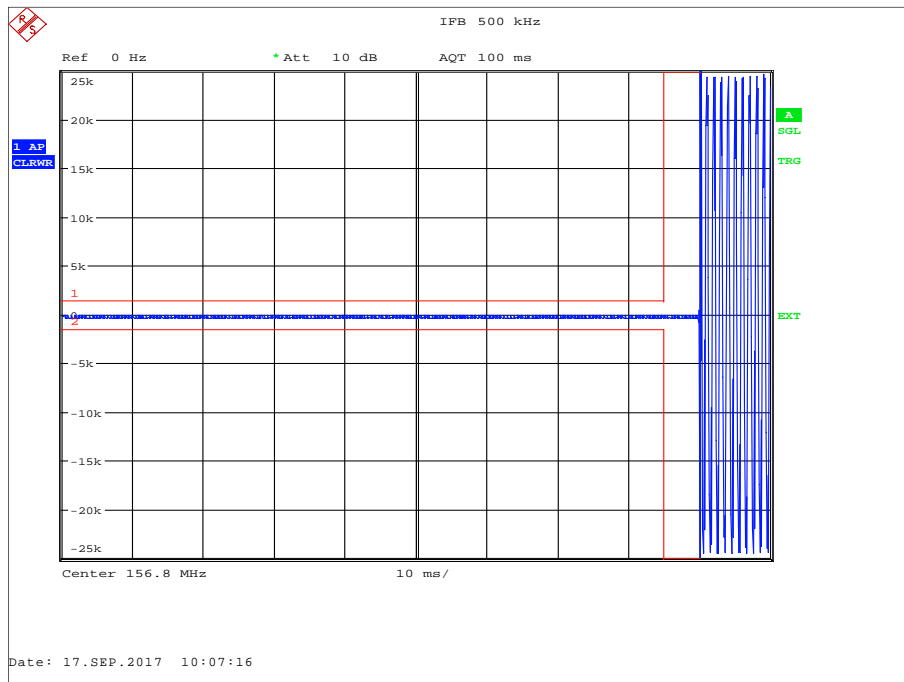


Figure 22 - Switch Off

IEC 62238, Limit Clause 11.9.3

During the periods of time t1 and t3 the frequency difference shall not exceed  $\pm 25$  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.



**2.13.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 40**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.14 Residual Modulation of the Transmitter**

**2.14.1 Specification Reference**

IEC 62238, Clause 8.10

**2.14.2 Equipment Under Test and Modification State**

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

**2.14.3 Date of Test**

30-August-2017

**2.14.4 Test Method**

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

**2.14.5 Environmental Conditions**

Ambient Temperature 20.9 °C

Relative Humidity 48.3 %

**2.14.6 Test Results**

DC Powered - VHF & DSC

|                          |
|--------------------------|
| Residual Modulation (dB) |
| -44.8                    |

**Table 41 - Residual Modulation**

IEC 62238, Limit Clause 8.10.3

The residual modulation shall not exceed -40 dB.



### 2.14.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

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

**Table 42**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.15 Frequency Error (DSC Signal)**

**2.15.1 Specification Reference**

IEC 62238, Clause 8.11

**2.15.2 Equipment Under Test and Modification State**

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

**2.15.3 Date of Test**

16-October-2017 to 17-October-2017

**2.15.4 Test Method**

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

**2.15.5 Environmental Conditions**

Ambient Temperature 21.4 °C

Relative Humidity 60.0 %

**2.15.6 Test Results**

DC Powered - VHF & DSC

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

**Table 43 - Demodulated DSC Signal Frequency Error**

IEC 62238, Limit Clause 8.11.3

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





**2.15.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 44**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.16 Modulation Index for DSC**

**2.16.1 Specification Reference**

IEC 62238, Clause 8.12

**2.16.2 Equipment Under Test and Modification State**

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

**2.16.3 Date of Test**

30-August-2017

**2.16.4 Test Method**

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

**2.16.5 Environmental Conditions**

Ambient Temperature 21.7 °C

Relative Humidity 52.0 %

**2.16.6 Test Results**

DC Powered - VHF & DSC

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

**Table 45 - Modulation Index for DSC Signal**

IEC 62238, Limit Clause 8.12.3

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



### 2.16.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

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

**Table 46**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.17 Modulation Rate for DSC**

**2.17.1 Specification Reference**

IEC 62238, Clause 8.13

**2.17.2 Equipment Under Test and Modification State**

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

**2.17.3 Date of Test**

13-September-2017

**2.17.4 Test Method**

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

**2.17.5 Environmental Conditions**

Ambient Temperature 23.5 °C

Relative Humidity 44.2 %

**2.17.6 Test Results**

DC Powered - VHF & DSC

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

**Table 47 - Modulation Rate Results Table**

IEC 62238, Limit Clause 8.13.3

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



### 2.17.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

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

**Table 48**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.18 Testing of Generated Call Sequences**

**2.18.1 Specification Reference**

IEC 62238, Clause 8.14

**2.18.2 Equipment Under Test and Modification State**

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

**2.18.3 Date of Test**

02-August-2017

**2.18.4 Test Method**

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

**2.18.5 Environmental Conditions**

Ambient Temperature 20.5 °C

Relative Humidity 52.0 %

**2.18.6 Test Results**

DC Powered - VHF & DSC

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

**Table 49 - Received Calls**

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

**Table 50 - Performed Checks**



IEC 62238, Limit Clause 8.14.3

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

The generated call shall be analysed with the calibrated apparatus for correct configuration of the signal format, including time diversity.

It shall be verified that, after transmission of a DSC call, the transmitter re-tunes to the original channel. However, in the case of a distress call, the transmitter shall tune to channel 16 and automatically select the maximum power.

**2.18.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 51**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.19 Harmonic Distortion and Rated Audiofrequency Output Power**

**2.19.1 Specification Reference**

IEC 62238, Clause 9.1

**2.19.2 Equipment Under Test and Modification State**

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

**2.19.3 Date of Test**

07-September-2017

**2.19.4 Test Method**

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

**2.19.5 Environmental Conditions**

Ambient Temperature 23.6 °C

Relative Humidity 51.4 %

**2.19.6 Test Results**

DC Powered - VHF & DSC

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

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

IEC 62238, Limit Clause 9.1.3

The rated audiofrequency output power shall be at least:

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

The harmonic distortion shall not exceed 10%.





### 2.19.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

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

**Table 53**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.20 Audiofrequency Response**

**2.20.1 Specification Reference**

IEC 62238, Clause 9.2

**2.20.2 Equipment Under Test and Modification State**

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

**2.20.3 Date of Test**

30-August-2017 to 07-September-2017

**2.20.4 Test Method**

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

**2.20.5 Environmental Conditions**

Ambient Temperature 22.3 °C

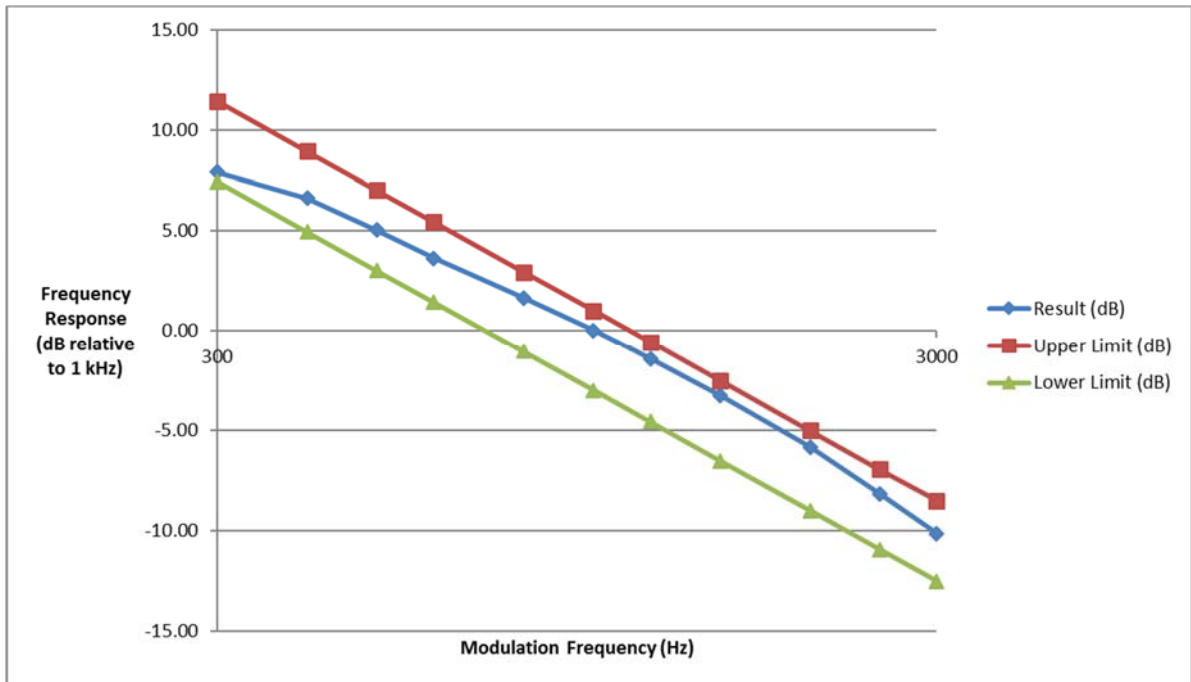
Relative Humidity 56.4 %

**2.20.6 Test Results**

DC Powered - VHF & DSC

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

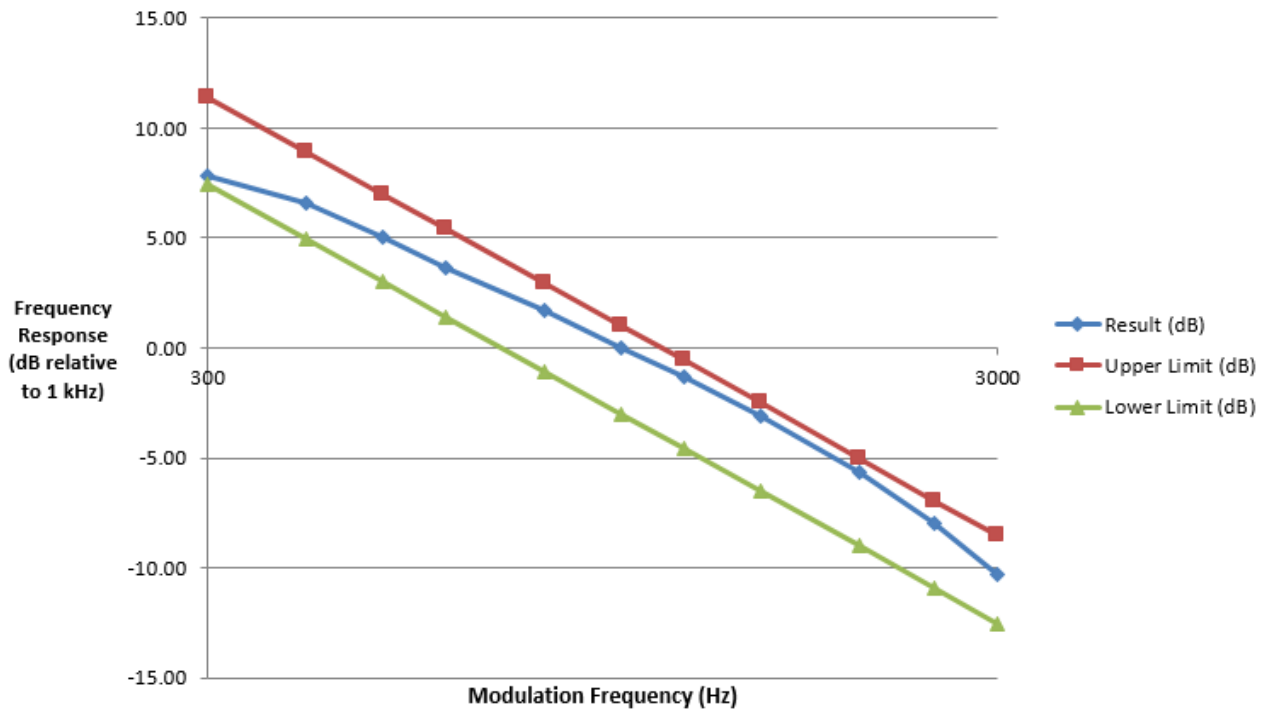
**Table 54 - Results for Audiofrequency Response at Nominal Centre Frequency**



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

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

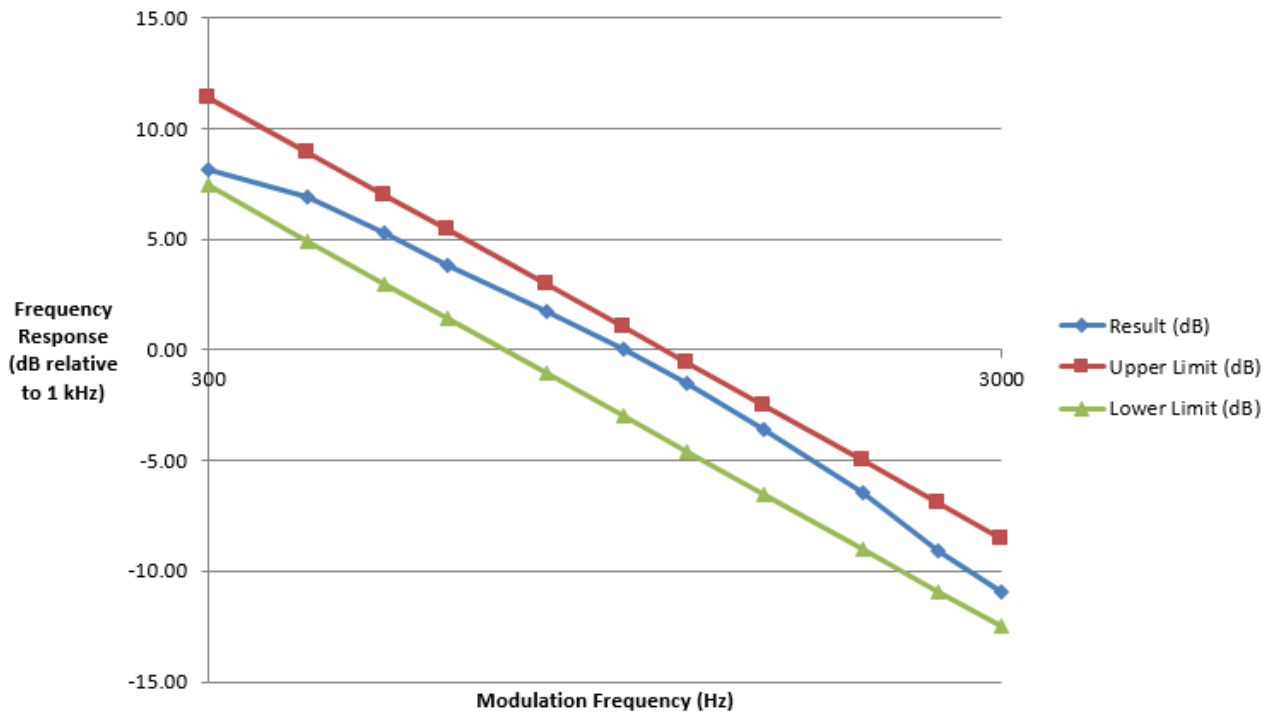
**Table 55 - Results for Audiofrequency Response at +1.5 kHz frequency offset**



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

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

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



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

IEC 62238, Limit Clause 9.2.3

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

**2.20.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 57**

O/P Mon – Output Monitored using calibrated equipment



**2.21 Maximum Usable Sensitivity**

**2.21.1 Specification Reference**

IEC 62238, Clause 9.3

**2.21.2 Equipment Under Test and Modification State**

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

**2.21.3 Date of Test**

29-August-2017

**2.21.4 Test Method**

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

**2.21.5 Environmental Conditions**

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

**2.21.6 Test Results**

DC Powered - VHF & DSC

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

**Table 58 - Maximum Usable Sensitivity for VHF Receiver**

IEC 62238, Limit Clause 9.3.3

The maximum usable sensitivity shall not exceed +6 dB $\mu$ V (e.m.f.) under normal test conditions and +12 dB $\mu$ V (e.m.f.) under extreme test conditions.



**2.21.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 3.

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

**Table 59**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.22 Co-channel Rejection**

**2.22.1 Specification Reference**

IEC 62238, Clause 9.4

**2.22.2 Equipment Under Test and Modification State**

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

**2.22.3 Date of Test**

31-August-2017

**2.22.4 Test Method**

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

**2.22.5 Environmental Conditions**

Ambient Temperature 20.1 °C  
Relative Humidity 50.2 %

**2.22.6 Test Results**

DC Powered - VHF & DSC

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

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

IEC 62238, Limit Clause 9.4.3

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





**2.22.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 61**

O/P Mon – Output Monitored using calibrated equipment



**2.23 Adjacent Channel Selectivity**

**2.23.1 Specification Reference**

IEC 62238, Clause 9.5

**2.23.2 Equipment Under Test and Modification State**

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

**2.23.3 Date of Test**

26-August-2017

**2.23.4 Test Method**

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

**2.23.5 Environmental Conditions**

Ambient Temperature 22.9 °C

Relative Humidity 52.9 %

**2.23.6 Test Results**

DC Powered - VHF & DSC

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

**Table 62 - Adjacent Channel Selectivity Results for VHF Receiver**

IEC 62238, Limit Clause 9.5.3

The adjacent channel selectivity shall be not less than 70 dB under normal test conditions and not less than 60 dB under extreme test conditions.



**2.23.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 3.

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

**Table 63**

O/P Mon – Output Monitored using calibrated equipment



**2.24 Spurious Response Rejection**

**2.24.1 Specification Reference**

IEC 62238, Clause 9.6

**2.24.2 Equipment Under Test and Modification State**

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

**2.24.3 Date of Test**

07-September-2017 to 11-September-2017

**2.24.4 Test Method**

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

**2.24.5 Environmental Conditions**

Ambient Temperature 21.5 °C

Relative Humidity 50.5 %

**2.24.6 Test Results**

DC Powered - VHF & DSC

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

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

**Table 64 - List of Detected Spurious Responses for VHF Receiver**

IEC 62238, Limit Clause 9.6.2

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



**2.24.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 65**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.25 Intermodulation Response**

**2.25.1 Specification Reference**

IEC 62238, Clause 9.7

**2.25.2 Equipment Under Test and Modification State**

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

**2.25.3 Date of Test**

08-September-2017

**2.25.4 Test Method**

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

**2.25.5 Environmental Conditions**

Ambient Temperature 23.4 °C  
Relative Humidity 50.9 %

**2.25.6 Test Results**

DC Powered - VHF & DSC

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

**Table 66 - Intermodulation Response Rejection Results for VHF Receiver**

IEC 62238, Limit Clause 9.7.3.

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



**2.25.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 67**

O/P Mon – Output Monitored using calibrated equipment



**2.26 Blocking or Desensitization**

**2.26.1 Specification Reference**

IEC 62238, Clause 9.8

**2.26.2 Equipment Under Test and Modification State**

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

**2.26.3 Date of Test**

31-August-2017

**2.26.4 Test Method**

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

**2.26.5 Environmental Conditions**

Ambient Temperature 20.1 °C

Relative Humidity 50.2 %

**2.26.6 Test Results**

DC Powered - VHF & DSC

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

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

**Table 68 - Swept Frequency Blocking Results for VHF Receiver**

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





IEC 62238, Limit Clause 6.8.2

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

**2.26.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 69**

O/P Mon – Output Monitored using calibrated equipment



**2.27 Spurious Emissions**

**2.27.1 Specification Reference**

IEC 62238, Clause 9.9

**2.27.2 Equipment Under Test and Modification State**

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

**2.27.3 Date of Test**

12-September-2017

**2.27.4 Test Method**

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

**2.27.5 Environmental Conditions**

Ambient Temperature 21.1 °C

Relative Humidity 49.8 %

**2.27.6 Test Results**

DC Powered - VHF & DSC

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

**Table 70 - Conducted Spurious Emissions Results for VHF Receiver**

IEC 62238, Limit Clause 9.9.3

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



**2.27.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 71**

O/P Mon – Output Monitored using calibrated equipment



**2.28 Receiver Residual Noise Level**

**2.28.1 Specification Reference**

IEC 62238, Clause 9.10

**2.28.2 Equipment Under Test and Modification State**

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

**2.28.3 Date of Test**

11-September-2017

**2.28.4 Test Method**

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

**2.28.5 Environmental Conditions**

Ambient Temperature 22.6 °C

Relative Humidity 50.7 %

**2.28.6 Test Results**

DC Powered - VHF & DSC

|                           |
|---------------------------|
| Residual Noise Level (dB) |
| -55.0                     |

**Table 72 - Residual Noise Level**

IEC 62238, Limit Clause 9.10.3.

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



**2.28.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 73**

O/P Mon – Output Monitored using calibrated equipment



**2.29 Squelch Operation**

**2.29.1 Specification Reference**

IEC 62238, Clause 9.11

**2.29.2 Equipment Under Test and Modification State**

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

**2.29.3 Date of Test**

07-September-2017

**2.29.4 Test Method**

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

| Test | Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A    | With the squelch facility switched off, a test signal of +30 dB $\mu$ V (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 dB $\mu$ V (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 dB $\mu$ V (e.m.f.), and the receiver shall be adjusted to give 50 % of the rated audio output power. The level of the input signal shall then be reduced and the squelch facility shall be switched on at its maximum position and the level of the input signal increased until the output power again is 50 % of the rated audio output power.                                                                                                                                                         |

**Table 74 - Details of steps**

**2.29.5 Environmental Conditions**

Ambient Temperature 23.6 °C  
 Relative Humidity 51.4 %

**2.29.6 Test Results**

DC Powered - VHF & DSC

| Step A                           | Step B                   |            | Step C                   |
|----------------------------------|--------------------------|------------|--------------------------|
| Audiofrequency Output Power (dB) | Input Level (dB $\mu$ V) | SINAD (dB) | Input Level (dB $\mu$ V) |
| >-40                             | 1.71                     | 28         | 2                        |

**Table 75 - Squelch Operation Results**



IEC 62238, Limit Clause 9.11.3

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

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

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

**2.29.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 76**

O/P Mon – Output Monitored using calibrated equipment



**2.30 Squelch Hysteresis**

**2.30.1 Specification Reference**

IEC 62238, Clause 9.12

**2.30.2 Equipment Under Test and Modification State**

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

**2.30.3 Date of Test**

07-September-2017

**2.30.4 Test Method**

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

**2.30.5 Environmental Conditions**

Ambient Temperature 22.9 °C  
Relative Humidity 46.7 %

**2.30.6 Test Results**

DC Powered - VHF & DSC

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

**Table 77 - Squelch Hysteresis**

IEC 62238, Limit Clause 9.12.3

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





### 2.30.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

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

**Table 78**

O/P Mon – Output Monitored using calibrated equipment



**2.31 Multiple Watch Characteristic**

**2.31.1 Specification Reference**

IEC 62238, Clause 9.13

**2.31.2 Equipment Under Test and Modification State**

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

**2.31.3 Date of Test**

25-September-2017

**2.31.4 Test Method**

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

**2.31.5 Environmental Conditions**

Ambient Temperature 23.4 °C

Relative Humidity 61.9 %

**2.31.6 Test Results**

DC Powered - VHF & DSC

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

**Table 79 - Multiple Watch Characteristics for Simplex Channels**

IEC 62238, Limit Clause 9.13.3

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



**2.31.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 80**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.32 DSC - Maximum Usable Sensitivity**

**2.32.1 Specification Reference**

IEC 62238, Clause 10.1

**2.32.2 Equipment Under Test and Modification State**

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

**2.32.3 Date of Test**

29-August-2017

**2.32.4 Test Method**

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

**2.32.5 Environmental Conditions**

Ambient Temperature 22.9 °C

Relative Humidity 52.9 %

**2.32.6 Test Results**

DC Powered - VHF & DSC

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

**Table 81 - Maximum Usable Sensitivity for DSC Receiver**

IEC 62238, Limit Clause 10.1.3

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



**2.32.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 3.

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

**Table 82**

O/P Mon – Output Monitored using calibrated equipment



**2.33 DSC - Co-channel Rejection**

**2.33.1 Specification Reference**

IEC 62238, Clause 10.2

**2.33.2 Equipment Under Test and Modification State**

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

**2.33.3 Date of Test**

31-August-2017

**2.33.4 Test Method**

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

**2.33.5 Environmental Conditions**

Ambient Temperature 20.1 °C

Relative Humidity 50.2 %

**2.33.6 Test Results**

DC Powered - VHF & DSC

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

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

IEC 62238, Limit Clause 10.2.3

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



**2.33.7 Test Location and Test Equipment Used**

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

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

**Table 84**

O/P Mon – Output Monitored using calibrated equipment



**2.34 DSC - Adjacent Channel Selectivity**

**2.34.1 Specification Reference**

IEC 62238, Clause 10.3

**2.34.2 Equipment Under Test and Modification State**

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

**2.34.3 Date of Test**

26-August-2017

**2.34.4 Test Method**

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

**2.34.5 Environmental Conditions**

Ambient Temperature 23.2 °C

Relative Humidity 52.9 %

**2.34.6 Test Results**

DC Powered - VHF & DSC

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

**Table 85 - Adjacent Channel Selectivity Results for DSC Receiver**

IEC 62238, Limit Clause 10.3.3

The bit error ratio shall be equal to or less than 10<sup>-2</sup>.





### 2.34.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

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

**Table 86**

O/P Mon – Output Monitored using calibrated equipment



**2.35 DSC - Spurious Response and Blocking Immunity**

**2.35.1 Specification Reference**

IEC 62238, Clause 10.4

**2.35.2 Equipment Under Test and Modification State**

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

**2.35.3 Date of Test**

03-August-2017 to 04-August-2017

**2.35.4 Test Method**

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

**2.35.5 Environmental Conditions**

Ambient Temperature 20.1 - 22.7 °C

Relative Humidity 50.2 - 73.0 %

**2.35.6 Test Results**

DC Powered - VHF & DSC

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

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

**Table 87 - Swept Frequency Blocking Results for DSC Receiver**

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

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

**Table 88 - Spurious Response Rejection Results for DSC Receiver**

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

IEC 62238, Limit Clause 10.4.3

The bit error ratio shall be equal to or less than 10<sup>-2</sup>.



**2.35.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 89**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



**2.36 DSC - Intermodulation Response**

**2.36.1 Specification Reference**

IEC 62238, Clause 10.5

**2.36.2 Equipment Under Test and Modification State**

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

**2.36.3 Date of Test**

05-September-2017

**2.36.4 Test Method**

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

**2.36.5 Environmental Conditions**

Ambient Temperature 22.4 °C

Relative Humidity 73.2 %

**2.36.6 Test Results**

DC Powered - VHF & DSC

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

**Table 90 - Intermodulation Response Rejection Results for DSC Receiver**

IEC 62238, Limit Clause 10.5.3

The bit error ratio shall be equal to or less than 10<sup>-2</sup>.



**2.36.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 91**

O/P Mon – Output Monitored using calibrated equipment



**2.37 DSC - Dynamic Range**

**2.37.1 Specification Reference**

IEC 62238, Clause 10.6

**2.37.2 Equipment Under Test and Modification State**

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

**2.37.3 Date of Test**

01-September-2017

**2.37.4 Test Method**

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

**2.37.5 Environmental Conditions**

Ambient Temperature 20.6 °C

Relative Humidity 50.1 %

**2.37.6 Test Results**

DC Powered - VHF & DSC

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

**Table 92 - Dynamic Range for DSC Receiver**

IEC 62238, Limit Clause 10.6.3

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



**2.37.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 93**

O/P Mon – Output Monitored using calibrated equipment



**2.38 DSC - Spurious Emissions**

**2.38.1 Specification Reference**

IEC 62238, Clause 10.7

**2.38.2 Equipment Under Test and Modification State**

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

**2.38.3 Date of Test**

12-September-2017

**2.38.4 Test Method**

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

**2.38.5 Environmental Conditions**

Ambient Temperature 21.1 °C  
Relative Humidity 49.8 %

**2.38.6 Test Results**

DC Powered - VHF & DSC

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

**Table 94 - Conducted Spurious Emissions Results for DSC Receiver**

IEC 62238, Limit Clause 10.7.3

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





**2.38.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 95**

O/P Mon – Output Monitored using calibrated equipment



**2.39 Verification of Correct Decoding of Various Types of DSC Calls**

**2.39.1 Specification Reference**

IEC 62238, Clause 10.8

**2.39.2 Equipment Under Test and Modification State**

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

**2.39.3 Date of Test**

02-August-2017

**2.39.4 Test Method**

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

**2.39.5 Environmental Conditions**

Ambient Temperature 20.5 °C

Relative Humidity 52.0 %

**2.39.6 Test Results**

DC Powered - VHF & DSC

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

**Table 96 - Received Calls**



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

**Table 97 - Performed Checks**

IEC 62238, Limit Clause 10.8.3

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

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

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

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



**2.39.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 98**

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



**2.40 Reaction to VTS and AIS Channel Management DSC Transmissions**

**2.40.1 Specification Reference**

IEC 62238, Clause 10.9

**2.40.2 Equipment Under Test and Modification State**

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

**2.40.3 Date of Test**

18-September-2017

**2.40.4 Test Method**

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

**2.40.5 Environmental Conditions**

Ambient Temperature 21.7 °C

Relative Humidity 49.2 %

**2.40.6 Test Results**

DC Powered - VHF & DSC

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

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

IEC 62238, Limit Clause 10.9.3

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



**2.40.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 100**

O/P Mon – Output Monitored using calibrated equipment



**2.41 Simultaneous Reception**

**2.41.1 Specification Reference**

IEC 62238, Clause 10.10

**2.41.2 Equipment Under Test and Modification State**

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

**2.41.3 Date of Test**

31-August-2017

**2.41.4 Test Method**

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

**2.41.5 Environmental Conditions**

Ambient Temperature 21.2 °C

Relative Humidity 50.0 %

**2.41.6 Test Results**

DC Powered - VHF & DSC

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

**Table 101 - Simultaneous Reception Results**

IEC 62238, Limit Clause 10.10.3

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

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



**2.41.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

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

**Table 102**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



### 3 Photographs

#### 3.1 Equipment Under Test (EUT)



Figure 26 – Sample 2 Front View

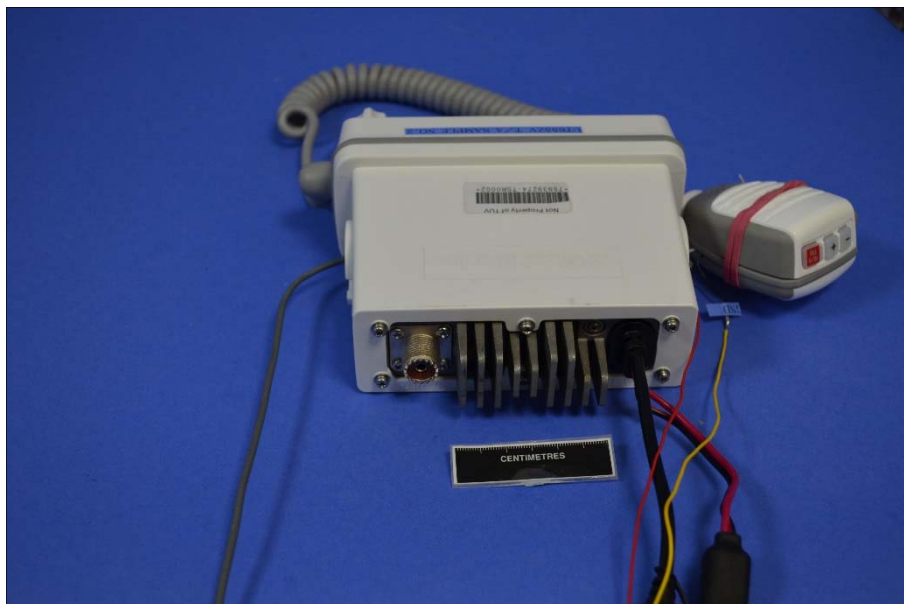


Figure 27 – B Sample 2 Rear View



Figure 28 – Sample 4 Front View



Figure 29 – B Sample 4 Rear View



## 4 Measurement Uncertainty

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

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



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

**Table 103**