



# TEST REPORT

Report Reference No. ....: TRE1811020702 R/C.....: 87587

FCC ID .....: BBOMRF77B

Applicant's name .....: Cobra Electronics Corporation

Address .....: 6500 West Cortland Street Chicago, IL 60707

Manufacturer.....: Cobra Electronics Corporation

Address.....: 6500 West Cortland Street Chicago, IL 60707

Test item description.....: VHF Marine Radio

Trade Mark.....: Cobra

Model/Type reference .....: MR F77W GPS

Listed Model(s).....: MR F77B GPS, MR F57B, MR F57W

Standard.....: IEC 61097-3  
IEC 61097-8

Date of receipt of test sample.....: Nov.27, 2018

Date of testing.....: Nov.27, 2018- Jan.28, 2019

Date of issue.....: Jan.28, 2019

Result .....: PASS

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*The test report merely correspond to the test sample.*

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## 1. TEST STANDARDS AND TEST DESCRIPTION

### 1.1. Test Standards

The tests were performed according to following standards:

[IEC 61097-3:2017](#)-Global maritime distress and safety system (GMDSS) - Part 3: Digital selective calling (DSC) equipment - Operational and performance requirements, methods of testing and required test results  
[IEC 61097-8:1998](#)-Global maritime distress and safety system (GMDSS) – Part 8: Shipborne watchkeeping receivers for the reception of digital selective calling (DSC) in the maritime MF, MF/HF and VHF bands – Operational and performance requirements, methods of testing and required test results

### 1.2. Report version information

| Revision No. | Date of issue | Description |
|--------------|---------------|-------------|
| N/A          | 2019-01-28    | Original    |
|              |               |             |
|              |               |             |
|              |               |             |
|              |               |             |

## 2. Test Description

| Transmitter Requirement                                                       |                                    |        |               |
|-------------------------------------------------------------------------------|------------------------------------|--------|---------------|
| Test item                                                                     | Standards requirement (IEC61097-3) | Result | Test Engineer |
| Frequency error                                                               | Sub-clause 5.4.1                   | Pass   | Gaosheng Pan  |
| Calling Sensitivity                                                           | Sub-clause 5.4.2                   | Pass   | Gaosheng Pan  |
| Nominal modulation rate                                                       | Sub-clause 5.4.3                   | Pass   | Gaosheng Pan  |
| Residual modulation                                                           | Sub-clause 5.4.4                   | Pass   | Gaosheng Pan  |
| Unwanted spectral components of the output signal of non-integrated equipment | Sub-clause 5.4.5                   | Pass   | Gaosheng Pan  |
| Durability and resistance to environmental conditions                         | Sub-clause 5.1                     | Pass   | Gaosheng Pan  |
| Protection of the antenna input circuit                                       | Sub-clause 5.2                     | Pass   | Gaosheng Pan  |
| Frequency bands and channels                                                  | Sub-clause 5.3                     | Pass   | Gaosheng Pan  |
| Mode of reception                                                             | Sub-clause 5.4                     | Pass   | Gaosheng Pan  |
| Scanning receivers                                                            | Sub-clause 5.5                     | Pass   | Gaosheng Pan  |
| Calling sensitivity                                                           | Sub-clause 5.6                     | Pass   | Gaosheng Pan  |
| Adjacent channel selectivity                                                  | Sub-clause 5.7                     | Pass   | Gaosheng Pan  |
| Co-channel rejection                                                          | Sub-clause 5.8                     | Pass   | Gaosheng Pan  |
| Intermodulation response .                                                    | Sub-clause 5.9                     | Pass   | Gaosheng Pan  |
| Interference rejection, spurious response and blocking immunity               | Sub-clause 5.10                    | Pass   | Gaosheng Pan  |
| Dynamic range                                                                 | Sub-clause 5.11                    | Pass   | Gaosheng Pan  |
| Conducted spurious emissions into the antenna                                 | Sub-clause 5.12                    | Pass   | Gaosheng Pan  |
| Frequency stability                                                           | Sub-clause 5.13                    | Pass   | Gaosheng Pan  |

| Environmental Test Requirement                                                           |                                       |        |               |
|------------------------------------------------------------------------------------------|---------------------------------------|--------|---------------|
| Test item                                                                                | Standards requirement<br>(IEC61097-8) | Result | Test Engineer |
| Vibration tests                                                                          | Sub-clause 7.3                        | Pass   | Gaosheng Pan  |
| Temperature tests                                                                        | Sub-clause 7.4                        | Pass   | Gaosheng Pan  |
| Corrosion test                                                                           | Sub-clause 7.5                        | Pass   | Gaosheng Pan  |
| EMC Test Requirement                                                                     |                                       |        |               |
| Test item                                                                                | Standards requirement<br>(IEC61097-3) | Result | Test Engineer |
| Conducted Emissions                                                                      | Clause 9.2                            | Pass   | Gaosheng Pan  |
| Radiated Emissions Enclosure Port                                                        | Clause 9.3                            | Pass   | Gaosheng Pan  |
| Immunity To Continuous Conducted Interference                                            | Clause 10.3                           | Pass   | Gaosheng Pan  |
| Immunity To Radiated Electromagnetic Fields                                              | Clause 10.4                           | Pass   | Gaosheng Pan  |
| Immunity To Electrical Fast Transient Bursts                                             | Clause 10.5                           | N/A    | N/A           |
| Immunity To Surges (all equipment categories except portable)                            | Clause 10.6                           | N/A    | N/A           |
| Immunity to power supply short-term variation (all equipment categories except portable) | Clause 10.7                           | N/A    | N/A           |
| Immunity to power supply failure (all equipment categories except portable)              | Clause 10.8                           | N/A    | N/A           |
| Immunity To Electrostatic Discharge                                                      | Clause 10.9                           | Pass   | Gaosheng Pan  |

Note: N/A means not applicable

### 3. SUMMARY

#### 3.1. Client Information

|               |                                             |
|---------------|---------------------------------------------|
| Applicant:    | Cobra Electronics Corporation               |
| Address:      | 6500 West Cortland Street Chicago, IL 60707 |
| Manufacturer: | Cobra Electronics Corporation               |
| Address:      | 6500 West Cortland Street Chicago, IL 60707 |

#### 3.2. Product Description

|                            |                               |         |
|----------------------------|-------------------------------|---------|
| Name of EUT:               | VHF Marine Radio              |         |
| Trade mark:                | Cobra                         |         |
| Model/Type reference:      | MR F77W GPS                   |         |
| Listed mode(s):            | MR F77B GPS, MR F57B, MR F57W |         |
| Power supply:              | DC 12V                        |         |
| Hardware Version:          | V0.4                          |         |
| Software Version:          | V0.12.05                      |         |
| Marine Radio               |                               |         |
| Operation Frequency Range: | TX:156.025MHz to 157.425MHz   |         |
|                            | RX:156.05MHz to 157.425MHz    |         |
| Rated Output Power:        | 25W (43.98dBm)                |         |
| Modulation Type:           | Analog Voice:                 | FM      |
|                            | Digital Data(DSC):            | FSK     |
| Channel Separation:        | 25kHz                         |         |
|                            | Analog Voice:                 | 16K0G3E |
|                            | Digital Data(DSC):            | 16K0G2B |
| Antenna Type:              | External                      |         |

Remark 1: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Remark 2: As per Client Declaration, MR F77W GPS E and MR F77W GPS are identical, only the cosmetics have different color, so we use MR F77W GPS E as a representative to perform all testing.

### 3.3. Test frequency list

| Modulation Type   | Channel Separation | Test Channel            | Test Frequency (MHz) |         |
|-------------------|--------------------|-------------------------|----------------------|---------|
|                   |                    |                         | TX                   | RX      |
| Analog Voice      | 25kHz              | CH <sub>L</sub> (CH60)  | 156.025              | 160.625 |
|                   |                    | CH <sub>M1</sub> (CH16) | 156.800              | 156.800 |
|                   |                    | CH <sub>H</sub> (CH88)  | 157.425              | 157.425 |
| Digital Data(DSC) | 25kHz              | CH <sub>M2</sub> (CH70) | 156.525              | 156.525 |

### 3.4. EUT operation mode

| Test mode | Transmitting | Receiving | Power level |     | Analog Voice<br>25kHz |
|-----------|--------------|-----------|-------------|-----|-----------------------|
|           |              |           | High        | Low |                       |
| TX-AWH    | √            |           | √           |     | √                     |
| TX-AWL    | √            |           |             | √   | √                     |
| RX-AW     |              | √         |             |     | √                     |

| Test mode | Transmitting | Receiving | States |   |     | Digital<br>Data(DSC)<br>25kHz |
|-----------|--------------|-----------|--------|---|-----|-------------------------------|
|           |              |           | B      | Y | B+Y |                               |
| TX-B      | √            |           | √      |   |     | √                             |
| TX-Y      | √            |           |        | √ |     | √                             |
| TX-(B+Y)  | √            |           |        |   | √   | √                             |
| RX-DSC    |              | √         |        |   |     | √                             |

√ : is operation mode.

### 3.5. EUT configuration

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

● - supplied by the manufacturer

○ - supplied by the lab

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

## **4. TEST ENVIRONMENT**

### **4.1. Address of the test laboratory**

Laboratory: Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Phone: 86-755-26748019 Fax: 86-755-26748089

### **4.2. Test Facility**

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

#### **CNAS-Lab Code: L1225**

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

#### **A2LA-Lab Cert. No.: 3902.01**

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

#### **FCC-Registration No.: 762235**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 762235.

#### **IC-Registration No.: 5377B-1**

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

#### **ACA**

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

### 4.3. Environmental conditions

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

|                  |                                    |          |
|------------------|------------------------------------|----------|
| Normal Conditon  | V <sub>N</sub> =nominal Voltage    | DC 12V   |
|                  | T <sub>N</sub> =normal Temperature | 25 °C    |
| Extreme Conditon | V <sub>L</sub> =lower Voltage      | DC 10.2V |
|                  | T <sub>L</sub> =lower Temperature  | -20 °C   |
|                  | V <sub>H</sub> =higher Voltage     | DC 13.8V |
|                  | T <sub>H</sub> =higher Temperature | 55 °C    |

#### 4.4. Statement of the measurement uncertainty

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

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

| Test Items                               | Measurement Uncertainty              | Notes |
|------------------------------------------|--------------------------------------|-------|
| Frequency stability & Occupied Bandwidth | 18Hz for <1GHz<br>69Hz for >1GHz     | (1)   |
| Conducted Output Power                   | 0.63dB                               | (1)   |
| ERP / EIRP / RSE                         | 2.38dB for <1GHz<br>3.45dB for >1GHz | (1)   |
| Conducted Emission 9KHz-30MHz            | 3.35 dB                              | (1)   |
| Radiated Emission 30~1000MHz             | 4.80 dB                              | (1)   |
| Radiated Emission 1~18GHz                | 5.16 dB                              | (1)   |
| Radiated Emission 18-40GHz               | 5.54 dB                              | (1)   |
| FM deviation                             | 25 Hz                                | (1)   |
| Audio level                              | 0.62 dB                              | (1)   |
| Low Pass Filter Response                 | 0.76 dB                              | (1)   |
| Modulation Limiting                      | 0.42 %                               | (1)   |
| Transient Frequency Behavior             | 6.8 %                                | (1)   |
| Radiated Emission30~1000MHz              | 4.28 dB                              | (1)   |
| Radiated Emission1~18GHz                 | 5.16 dB                              | (1)   |
| Conducted Disturbance0.15~30MHz          | 3.35 dB                              | (1)   |

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

#### 4.5. Equipments Used during the Test

| ● TS8613 Test system |                                       |              |              |            |                           |                           |
|----------------------|---------------------------------------|--------------|--------------|------------|---------------------------|---------------------------|
| Used                 | Test Equipment                        | Manufacturer | Model No.    | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| ●                    | Spectrum Analyzer                     | Agilent      | N9020A       | MY50510187 | 2018/09/29                | 2019/09/28                |
| ●                    | Signal & Spectrum Analyzer            | R&S          | FSW26        | 103440     | 2018/10/28                | 2019/10/27                |
| ●                    | RF Communication Test Set             | HP           | 8920A        | 3813A10206 | 2018/10/28                | 2019/10/27                |
| ●                    | Digital intercom communication tester | Aeroflex     | 3920B        | 1001682041 | 2018/10/28                | 2019/10/27                |
| ●                    | Signal Generator                      | R&S          | SML02        | 100507     | 2018/10/27                | 2019/10/26                |
| ●                    | Signal Generator                      | IFR          | 2032         | 203002\100 | 2018/11/11                | 2019/11/10                |
| ●                    | RF Control Unit                       | Tonscend     | JS0806-2     | N/A        | N/A                       | N/A                       |
| ●                    | Fliter-VHF                            | Microwave    | N26460M1     | 498702     | 2018/03/19                | 2019/03/18                |
| ○                    | Fliter-UHF                            | Microwave    | N25155M2     | 498704     | 2018/03/19                | 2019/03/18                |
| ○                    | Power Divider                         | Microwave    | OPD1040-N-4  | N/A        | 2018/11/15                | 2019/11/14                |
| ○                    | Attenuator                            | JFW          | 50FH-030-100 | N/A        | 2018/11/15                | 2019/11/14                |
| ○                    | Attenuator                            | JFW          | 50-A-MFN-20  | 0322       | 2018/11/15                | 2019/11/14                |
| ●                    | Test software                         | HTW          | Radio ATE    | N/A        | N/A                       | N/A                       |

| ● Auxiliary Equipment |                 |              |           |            |                           |                           |
|-----------------------|-----------------|--------------|-----------|------------|---------------------------|---------------------------|
| Used                  | Test Equipment  | Manufacturer | Model No. | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| ●                     | Climate chamber | ESPEC        | GPL-2     | N/A        | 2018/11/08                | 2019/11/07                |
| ●                     | DC Power Supply | Gwinstek     | SPS-2415  | GER835793  | 2018/10/28                | 2019/10/27                |

| ● Harmonic Current Emissions, Voltage Fluctuations and Flicker |                               |                        |           |            |                           |                           |
|----------------------------------------------------------------|-------------------------------|------------------------|-----------|------------|---------------------------|---------------------------|
| Used                                                           | Test Equipment                | Manufacturer           | Model No. | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| ●                                                              | Purified Power Source         | California instruments | HFS500    | 54513      | 2018/10/28                | 2019/10/27                |
| ●                                                              | Harmonic And Flicker Analyzer | EM TEST                | DPA503S1  | 0500-10    | 2018/11/09                | 2019/11/08                |
| ●                                                              | Test Software                 | EM TEST                | DPA       | N/A        | N/A                       | N/A                       |

| ● Electrostatic Discharge |                |              |           |            |                           |                           |
|---------------------------|----------------|--------------|-----------|------------|---------------------------|---------------------------|
| Used                      | Test Equipment | Manufacturer | Model No. | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| ●                         | ESD Simulator  | EM TEST      | DITO      | 0301-04    | 2018/8/17                 | 2019/8/16                 |

| ● Radio Frequency Electromagnetic Field |                                       |                    |              |            |                           |                           |
|-----------------------------------------|---------------------------------------|--------------------|--------------|------------|---------------------------|---------------------------|
| Used                                    | Test Equipment                        | Manufacturer       | Model No.    | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| ●                                       | Semi-Anechoic Chamber                 | Albatross projects | SAC-3m-02    | C11121     | 2018/09/30                | 2021/09/29                |
| ●                                       | Signal Generator                      | R&S                | SMB100A      | 114360     | 2018/08/21                | 2019/08/20                |
| ●                                       | Amplifier                             | R&S                | BBA150-BC500 | 102664     | 2018/08/21                | 2019/08/20                |
| ●                                       | Amplifier                             | R&S                | BBA150 D200  | 102728     | 2018/01/31                | 2019/01/30                |
| ●                                       | Amplifier                             | R&S                | BBA150 E200  | 102729     | 2018/01/31                | 2019/01/30                |
| ●                                       | Power Head                            | R&S                | NRP18A       | 101010     | 2018/08/21                | 2019/08/20                |
| ●                                       | Power Head                            | R&S                | NRP18A       | 101011     | 2018/08/21                | 2019/08/20                |
| ●                                       | Transmit Antenna                      | Schwarzbeck        | STLP9129     | 00044      | 2017/07/12                | 2020/07/11                |
| ●                                       | Field Probe                           | ETS-LINDGREN       | HI-6153      | 00130812   | 2018/01/17                | 2019/01/16                |
| ●                                       | RF switch                             | R&S                | OSP120       | 101859     | N/A                       | N/A                       |
| ●                                       | Test Software                         | R&S                | EMC32        | 100916     | N/A                       | N/A                       |
| ○                                       | Audio analyzer                        | R&S                | UPL          | 100174     | 2018/09/11                | 2019/09/10                |
| ○                                       | Radio communication tester            | R&S                | CMW500       | 137688     | 2018/09/29                | 2019/09/28                |
| ○                                       | RF Communication Test Set             | HP                 | 8920A        | 3813A10206 | 2018/10/28                | 2019/10/27                |
| ○                                       | Digital intercom communication tester | Aeroflex           | 3920B        | 1001682041 | 2018/10/28                | 2019/10/27                |

| ● Electrical fast transient/burst immunity test, Surge immunity test |                          |              |               |            |                           |                           |
|----------------------------------------------------------------------|--------------------------|--------------|---------------|------------|---------------------------|---------------------------|
| Used                                                                 | Test Equipment           | Manufacturer | Model No.     | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| ●                                                                    | Ultra Compact Simulator  | EM TEST      | UCS500M6      | 0500-19    | 2018/10/27                | 2019/10/26                |
| ●                                                                    | Surge Generator          | EM TEST      | TSS500M4      | 1100-04    | 2018/10/27                | 2019/10/26                |
| ●                                                                    | 3-Phase Coupling Network | EM TEST      | CNI503 S5/16A | 0606-01    | 2018/10/27                | 2019/10/26                |
| ●                                                                    | 4-Lines Coupling Network | EM TEST      | CNV504        | 1200-04    | 2018/10/27                | 2019/10/26                |
| ●                                                                    | Coupling Clamp           | EM TEST      | HFK           | 1501-14    | 2018/10/27                | 2019/10/26                |
| ●                                                                    | Test Software            | EM TEST      | ISM IEC       | N/A        | N/A                       | N/A                       |

● Radio frequency (common mode)

| Used | Test Equipment                        | Manufacturer | Model No.    | Serial No.   | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
|------|---------------------------------------|--------------|--------------|--------------|---------------------------|---------------------------|
| ●    | Signal Generator                      | IFR          | 2023A        | 202304/060   | 2018/10/27                | 2019/10/26                |
| ●    | Amplifier                             | AR           | 75A250       | 302205       | 2018/10/28                | 2019/10/27                |
| ●    | 6db Attenuator                        | EMTEST       | ATT6/75      | 0010230A     | 2018/10/28                | 2019/10/27                |
| ○    | EM Clamp                              | LÜTHI        | EM101        | 335625       | 2018/10/28                | 2019/10/27                |
| ●    | Test Software                         | AR           | SW1004       | N/A          | N/A                       | N/A                       |
| ○    | CDN                                   | EMTEST       | CDN M3       | 0802-03      | 2018/10/28                | 2019/10/27                |
| ○    | CDN                                   | EMTEST       | CDN M2       | 510010010012 | 2018/10/28                | 2019/10/27                |
| ○    | CDN                                   | EMTEST       | CDN M1/32A   | 0202-05      | 2018/10/28                | 2019/10/27                |
| ○    | CDN                                   | EMTEST       | CDN M4-N/32A | 510010660001 | 2018/10/28                | 2019/10/27                |
| ○    | CDN                                   | EMTEST       | CDN M5       | 5100100      | 2018/10/28                | N/A                       |
| ○    | Audio analyzer                        | R&S          | UPL          | 100174       | 2018/09/11                | 2019/09/10                |
| ○    | Radio communication tester            | R&S          | CMW500       | 137688       | 2018/09/29                | 2019/09/28                |
| ○    | RF Communication Test Set             | HP           | 8920A        | 3813A10206   | 2018/10/28                | 2019/10/27                |
| ○    | Digital intercom communication tester | Aeroflex     | 3920B        | 1001682041   | 2018/10/28                | 2019/10/27                |

● Voltage Dips and Interruptions

| Used | Test Equipment        | Manufacturer           | Model No.     | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
|------|-----------------------|------------------------|---------------|------------|---------------------------|---------------------------|
| ●    | Purified Power Source | California instruments | HFS500        | 54513      | 2018/10/28                | 2019/10/27                |
| ●    | Test Software         | California instruments | CIGUII-5001iX | N/A        | N/A                       | N/A                       |

○ Auxiliary Equipment

| Used | Test Equipment                        | Manufacturer | Model No. | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
|------|---------------------------------------|--------------|-----------|------------|---------------------------|---------------------------|
| ○    | Radio communication tester            | R&S          | CMW500    | 137688-Lv  | 2018/09/29                | 2019/09/28                |
| ○    | Universal Radio Communication         | R&S          | CMU200    | 112012     | 2018/10/28                | 2019/10/27                |
| ●    | RF Communication Test Set             | HP           | 8920A     | 3813A10206 | 2018/10/28                | 2019/10/27                |
| ●    | Digital intercom communication tester | Aeroflex     | 3920B     | 1001682041 | 2018/10/28                | 2019/10/27                |

## 5. TEST CONDITIONS AND RESULTS

### 5.1. Transmitter Requirements of IEC61097-3

#### 5.1.1. Frequency Error

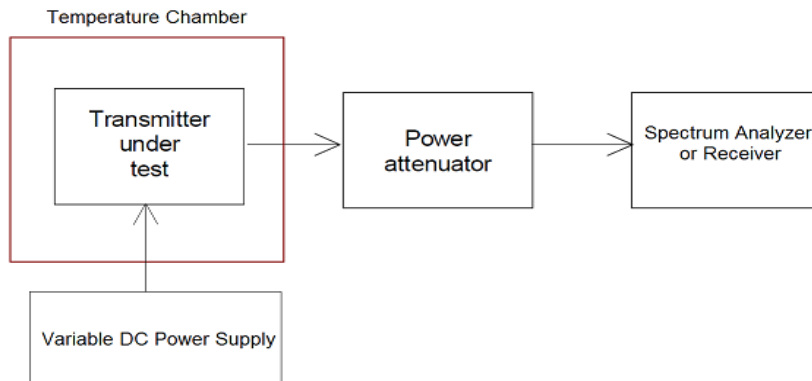
The frequency error is the difference between the measured carrier frequency and its nominal value.

##### Limit

IEC 61097-3 Sub-clause 5.4.1.3

The frequency error shall be within  $\pm 10$  Hz of 1.3 kHz and 2.1kHz respectively.

##### Test configuration



##### Test procedure

- The test conditions.  
☒ normal condition      ☒ Extreme conditions
- Please refer to IEC 61097-3 Sub-clause 5.4.1.2 for the measurement method.

##### Test mode

Please reference to the section 3.4

##### Test results

☒ Passed      ☐ Not Applicable

Please refer to the below test data:

| Operation Mode | Test conditions  |                | Frequency Error (kHz) | Limit (Hz) | Result |
|----------------|------------------|----------------|-----------------------|------------|--------|
|                | Temperature(°C ) | Voltage(V)     | CH <sub>M1</sub>      |            |        |
| TX-B           | T <sub>N</sub>   | V <sub>N</sub> | 2099.98               | 2100±10    | Pass   |
|                | T <sub>L</sub>   | V <sub>H</sub> | 2099.54               |            |        |
|                |                  | V <sub>L</sub> | 2099.56               |            |        |
|                | T <sub>H</sub>   | V <sub>H</sub> | 2099.81               |            |        |
|                |                  | V <sub>L</sub> | 2099.79               |            |        |
| TX-Y           | T <sub>N</sub>   | V <sub>N</sub> | 1300.03               | 1300±10    | Pass   |
|                | T <sub>L</sub>   | V <sub>H</sub> | 1299.78               |            |        |
|                |                  | V <sub>L</sub> | 1299.81               |            |        |
|                | T <sub>H</sub>   | V <sub>H</sub> | 1299.86               |            |        |
|                |                  | V <sub>L</sub> | 1299.83               |            |        |

### 5.1.2. Calling Sensitivity

The sensitivity of the receiver shall be such as to obtain an output character error rate of  $10^{-2}$  or less for an input signal of +5 dBμV(e.m.f.) on MF and 0 dBμV (e.m.f.) on HF and VHF (A.804/C.3, A.806/C.3).

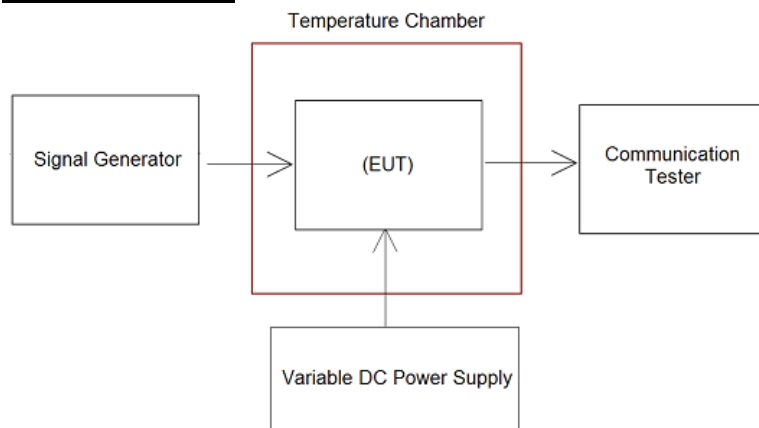
To determine the maximum usable sensitivity as the minimum level of the signal (e.m.f.) at the nominal frequency of the receiver which, when applied to the receiver input with a standard test signal, will produce a specified BER.

#### Limit

The sensitivity shall be less than or equal to 10dB S/N.

For integrated equipment the sensitivity shall be less than 0 dBμV EMF.

#### Test configuration



#### Test procedure

1. The test conditions.

☒ normal condition ☒ Extreme conditions

2. Please refer to IEC 61097-3 Sub-clause 5.4.2.2 for the measurement method.

#### Test mode

Please reference to the section 3.4

#### Test results

☒ Passed ☐ Not Applicable

Please refer to the below test data:

| Operation Mode | Temperature (°C ) | Voltage (V)    | Test Channel    | Measured (dBuV) | Limit (dBuV) | Result |
|----------------|-------------------|----------------|-----------------|-----------------|--------------|--------|
| RX-AW          | T <sub>N</sub>    | V <sub>N</sub> | CH <sub>L</sub> | -4.0            | ≤ 0          | Pass   |
|                |                   |                | CH <sub>M</sub> | -3.9            |              |        |
|                |                   |                | CH <sub>H</sub> | -4.2            |              |        |
|                | T <sub>L</sub>    | V <sub>H</sub> | CH <sub>L</sub> | -3.2            | ≤ 0          |        |
|                |                   |                | CH <sub>M</sub> | -3.7            |              |        |
|                |                   |                | CH <sub>H</sub> | -4.0            |              |        |
|                |                   | V <sub>L</sub> | CH <sub>L</sub> | -3.1            |              |        |
|                |                   |                | CH <sub>M</sub> | -3.2            |              |        |
|                |                   |                | CH <sub>H</sub> | -3.4            |              |        |
|                | T <sub>H</sub>    | V <sub>H</sub> | CH <sub>L</sub> | -3.9            |              |        |
|                |                   |                | CH <sub>M</sub> | -3.6            |              |        |
|                |                   |                | CH <sub>H</sub> | -4.0            |              |        |
|                |                   | V <sub>L</sub> | CH <sub>L</sub> | -3.1            |              |        |
|                |                   |                | CH <sub>M</sub> | -3.4            |              |        |
|                |                   |                | CH <sub>H</sub> | -3.2            |              |        |

### 5.1.3. Nominal modulation rate

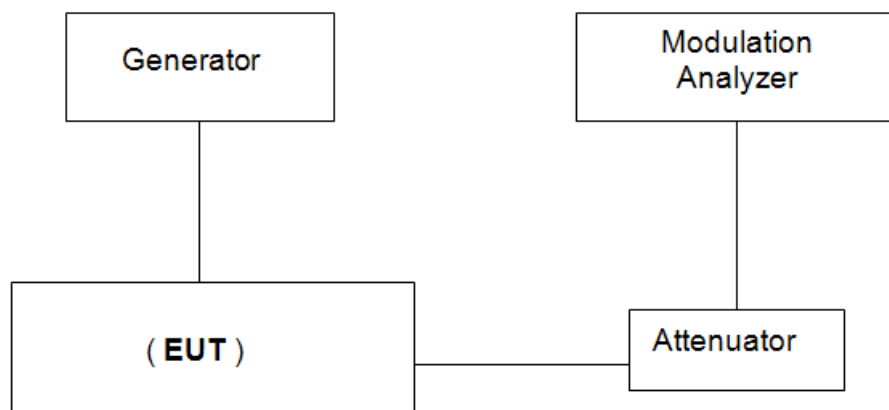
The modulation rate is the bit stream speed measured in bit/s.

#### Limit

IEC 61097-3 Sub-clause 5.4.3.3

The frequency shall be 600 Hz  $\pm$  30 ppm corresponding to a modulation rate of 1 200 baud.

#### Test configuration



#### Test procedure

1. The test conditions.

☒ normal condition

☐ Extreme conditions

2. Please refer to IEC 61097-3 Sub-clause 5.4.3.2 for the measurement method.

#### Test mode

Please reference to the section 3.4

#### Test results

☒ Passed

☐ Not Applicable

Please refer to the below test data:

| Operation Mode | Test Channel     | Modulation rate (Hz) | Limit              | Result |
|----------------|------------------|----------------------|--------------------|--------|
| TX-(B+Y)       | CH <sub>M1</sub> | 599.999              | 600Hz $\pm$ 30 ppm | Pass   |

### 5.1.4. Residual modulation of the transmitter

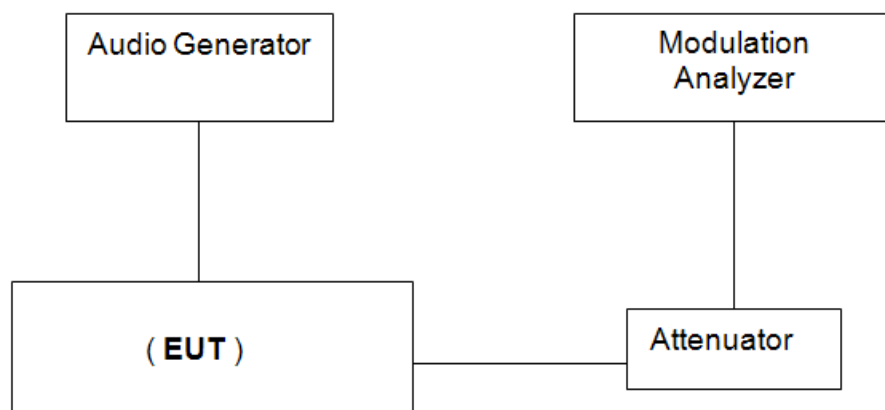
The residual modulation of the transmitter is the ratio, in dB, of the demodulated RF signal in the absence of wanted modulation, to the demodulated RF signal produced when the normal test modulation is applied.

#### Limit

IEC 61097-3 Sub-clause 5.4.4

The residual modulation shall not exceed -36 dB(non-integrated equipment) and -26 dB(integrated equipment) on either 25 kHz or 12,5 kHz channels.

#### Test configuration



#### Test procedure

1. The test conditions.

☒ normal condition

☐ Extreme conditions

2. Please refer to IEC 61097-3 Sub-clause 5.4.4.2 for the measurement method.

#### Test mode

Please reference to the section 3.4

#### Test results

☒ Passed

☐ Not Applicable

Please refer to the below test data:

| Operation Mode | Test Channel    | Measured (dB) | Limit (dB) | Result |
|----------------|-----------------|---------------|------------|--------|
| TX-AWH         | CH <sub>L</sub> | -40.49        | ≤-40       | Pass   |
|                | CH <sub>M</sub> | -40.61        |            |        |
|                | CH <sub>H</sub> | -40.51        |            |        |
| TX-AWL         | CH <sub>L</sub> | -40.52        | ≤-40       | Pass   |
|                | CH <sub>M</sub> | -40.38        |            |        |
|                | CH <sub>H</sub> | -40.15        |            |        |

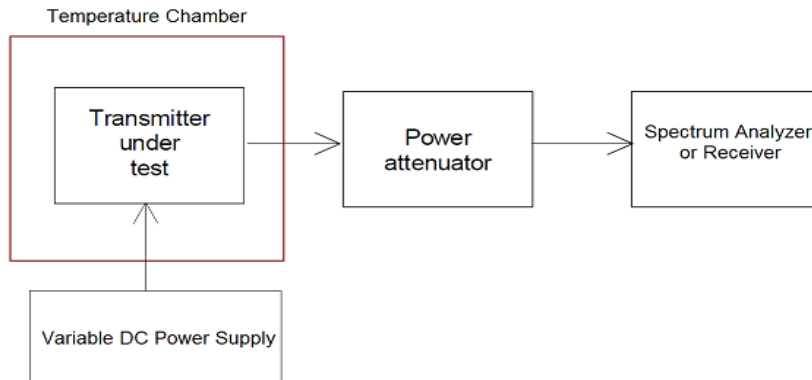
### 5.1.5. Unwanted spectral components of the output signal of non-integrated equipment

Unwanted spectral components are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Unwanted spectral components include harmonic spectral components and intermodulation products.

#### Limit

IEC 61097-3 Sub-clause 5.4.5.3 figure 2

#### Test configuration



#### Test procedure

- The test conditions.  
☒ normal condition      ☐ Extreme conditions
- Please refer to IEC 61097-3 Sub-clause 5.4.5.2 for the measurement method.

#### Test mode:

Please reference to the section 3.4

#### Test results

☒ Passed      ☐ Not Applicable

Please refer to the below test data:

| Unwanted Frequency (KHz ) | Spurious emission level(dB) | Limit                                                                                                                             |
|---------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 0.5                       | -0.57                       | 0.5kHz to 2.9kHz: 0dB<br>2.9kHz to 4.1kHz: -9dB to -25dB<br>4.1kHz to 6.9kHz: -25dB to -47dB<br>6.9kHz to 11.3kHz: -47dB to -60dB |
| 1.5                       | -0.54                       |                                                                                                                                   |
| 2.9                       | -0.51                       |                                                                                                                                   |
| 3.0                       | -15.84                      |                                                                                                                                   |
| 4.0                       | -24.37                      |                                                                                                                                   |
| 4.1                       | -26.85                      |                                                                                                                                   |
| 5.0                       | -43.68                      |                                                                                                                                   |
| 6.0                       | -46.27                      |                                                                                                                                   |
| 6.9                       | -48.06                      |                                                                                                                                   |
| 7.0                       | -53.19                      |                                                                                                                                   |
| 8.0                       | -54.27                      |                                                                                                                                   |
| 9.0                       | -56.33                      |                                                                                                                                   |
| 10.0                      | -57.12                      |                                                                                                                                   |
| 11.0                      | -58.64                      |                                                                                                                                   |
| 11.3                      | -62.05                      |                                                                                                                                   |

## 5.2. Transmitter Requirements of IEC61097-8

### 5.2.1. Durability and resistance to environmental conditions

#### **Test results:**

Complies

Remark: Manufacturer declared the equipment is capable of continuous operation under the conditions of various sea states, vibration, humidity and of temperature likely to be experienced in ships (A.694/5).

### 5.2.2. Protection of the antenna input circuit

The receiver shall not suffer damage when an unmodulated radiofrequency signal at an input level of 30 V r.m.s. at any frequency in the range 100 kHz to 27,5 MHz is applied to its antenna input terminal for a period of 15 min.

#### **Test results:**

Complies

### 5.2.3. Frequency bands and channels

The equipment can be designed as a single-frequency receiver, as a multiple-frequency receiver or as a scanning receiver in one or more of the frequency bands:

MF: 1 605 kHz to 4 000 kHz;

HF: 4 MHz to 27,5 MHz;

VHF: 156 MHz to 174 MHz.

#### **Test results:**

Complies VHF 156MHz to 174 MHz.

### 5.2.4. Mode of reception

Equipment for reception of MF and HF DSC transmissions shall provide for classes of emission F1B or J2B (A.804/C.1.3, A.806/C.1.3).

Equipment for reception of VHF DSC transmissions shall provide for class of emission G2B (see RR appendix 19) (A. 803/3.4).

#### **Test results:**

Complies

### 5.2.5. Scanning receivers

The scanning receiver shall be provided with means for stop and start of the scanning under the control of an external DSC equipment. Such control may be provided by either:

- a stop/start signal in accordance with recommendation ITU-T V.11. The stop signal shall be logic 0 and the start signal shall be logic 1; or
- by direct frequency commands in accordance with IEC 61162-1, or both.

The selected receiver frequency shall be clearly identifiable

#### **Test results:**

Complies

### 5.2.6. Calling sensitivity

The sensitivity of the receiver shall be such as to obtain an output character error rate of 10–2 or less for an input signal of +5 dBμV (e.m.f.) on MF and 0 dBμV (e.m.f.) on HF and VHF (A.804/C.3, A.806/C.3).

#### **Test results:**

Complies

Remark: the result same with IEC61097-3 sub-clause 5.4.2

**5.2.7. Adjacent channel selectivity**

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

The adjacent channel selectivity shall be 40 dB for MF/HF and 70 dB for VHF.

**Test results:**

Complies VHF 156MHz to 174 MHz.

Please refer to the below test data:

| RX-AW              |                |                 |                      |                  |            |        |
|--------------------|----------------|-----------------|----------------------|------------------|------------|--------|
| Test Condition     |                | Test Channel    | Measurement Position | SG B – SG A (dB) | Limit (dB) | Result |
| Temperature ( °C ) | Voltage ( V )  |                 |                      |                  |            |        |
| T <sub>N</sub>     | V <sub>N</sub> | CH <sub>L</sub> | Lower adjacent       | 73.1             | ≥70        | Pass   |
|                    |                |                 | Upper adjacent       | 71.6             |            |        |
|                    |                | CH <sub>M</sub> | Lower adjacent       | 73.8             |            |        |
|                    |                |                 | Upper adjacent       | 71.8             |            |        |
|                    |                | CH <sub>H</sub> | Lower adjacent       | 73.6             |            |        |
|                    |                |                 | Upper adjacent       | 71.4             |            |        |
| T <sub>L</sub>     | V <sub>H</sub> | CH <sub>L</sub> | Lower adjacent       | 72.0             | ≥60        | Pass   |
|                    |                |                 | Upper adjacent       | 70.4             |            |        |
|                    |                | CH <sub>M</sub> | Lower adjacent       | 72.0             |            |        |
|                    |                |                 | Upper adjacent       | 70.1             |            |        |
|                    |                | CH <sub>H</sub> | Lower adjacent       | 71.7             |            |        |
|                    |                |                 | Upper adjacent       | 70.3             |            |        |
|                    | V <sub>L</sub> | CH <sub>L</sub> | Lower adjacent       | 71.9             | ≥60        | Pass   |
|                    |                |                 | Upper adjacent       | 69.8             |            |        |
|                    |                | CH <sub>M</sub> | Lower adjacent       | 72.5             |            |        |
|                    |                |                 | Upper adjacent       | 70.5             |            |        |
| T <sub>H</sub>     | V <sub>H</sub> | CH <sub>L</sub> | Lower adjacent       | 71.2             | ≥60        | Pass   |
|                    |                |                 | Upper adjacent       | 69.9             |            |        |
|                    |                | CH <sub>M</sub> | Lower adjacent       | 72.4             |            |        |
|                    |                |                 | Upper adjacent       | 70.0             |            |        |
|                    |                | CH <sub>H</sub> | Lower adjacent       | 71.8             |            |        |
|                    |                |                 | Upper adjacent       | 70.1             |            |        |
|                    | V <sub>L</sub> | CH <sub>L</sub> | Lower adjacent       | 71.9             | ≥60        | Pass   |
|                    |                |                 | Upper adjacent       | 70.6             |            |        |
|                    |                | CH <sub>M</sub> | Lower adjacent       | 72.0             |            |        |
|                    |                |                 | Upper adjacent       | 70.3             |            |        |
|                    |                | CH <sub>H</sub> | Lower adjacent       | 71.9             |            |        |
|                    |                |                 | Upper adjacent       | 69.8             |            |        |

**5.2.8. Co-channel rejection**

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

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

**Test results:**

Complies VHF 156MHz to 174 MHz

Please refer to the below test data:

| RX-AW           |                          |                  |            |        |
|-----------------|--------------------------|------------------|------------|--------|
| Test Channel    | Measurement Offset (kHz) | SG B – SG A (dB) | Limit (dB) | Result |
| CH <sub>L</sub> | -3                       | -5.7             | -10~0      | Pass   |
|                 | 0                        | -7.5             |            |        |
|                 | 3                        | -7.6             |            |        |
| CH <sub>M</sub> | -3                       | -5.5             | -10~0      | Pass   |
|                 | 0                        | -7.4             |            |        |
|                 | 3                        | -7.6             |            |        |
| CH <sub>H</sub> | -3                       | -5.8             | -10~0      | Pass   |
|                 | 0                        | -7.7             |            |        |
|                 | 3                        | -7.9             |            |        |

**5.2.9. Intermodulation response**

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

The intermodulation response for MF and HF equipment shall be such as to obtain a specified BER at a level of +70 dBμV for each of the two unwanted input signals.

The intermodulation response ratio for VHF equipment shall be 65 dB (M.489/1.3.4).

**Test results:**

Complies VHF

Please refer to the below test data:

| RX-AW           |                          |      |                    |            |        |
|-----------------|--------------------------|------|--------------------|------------|--------|
| Test Channel    | Measurement Offset (kHz) |      | SG B/C – SG A (dB) | Limit (dB) | Result |
|                 | SG B                     | SG C |                    |            |        |
| CH <sub>L</sub> | -50                      | -100 | 72.3               | ≥68        | Pass   |
|                 | 50                       | 100  | 72.1               |            |        |
| CH <sub>M</sub> | -50                      | -100 | 73.5               | ≥68        | Pass   |
|                 | 50                       | 100  | 73.2               |            |        |
| CH <sub>H</sub> | -50                      | -100 | 72.9               | ≥68        | Pass   |
|                 | 50                       | 100  | 72.7               |            |        |

**5.2.10. Interference rejection, spurious response and blocking immunity**

The interference rejection for MF and HF equipment shall be such as to obtain a specified BER at a level of the unwanted input signal of +60 dBμV.

The spurious response immunity for VHF equipment shall be 70 dB (M.489/1.3.3).

The blocking level shall be not less than +90 dBμV for MF/HF equipment and +93 dBμV for VHF equipment.

**Test results:**

Complies

Please refer to the below test data

For Interference rejection

| RX-AW           |                          |                  |            |        |
|-----------------|--------------------------|------------------|------------|--------|
| Test Channel    | Spurious Frequency (MHz) | SG B – SG A (dB) | Limit (dB) | Result |
| CH <sub>L</sub> | 156.075                  | 114.6            | ≥70        | Pass   |
|                 | 156.525                  | 105.5            |            |        |
|                 | 134.900                  | 106.3            |            |        |
|                 | 177.700                  | 107.2            |            |        |
| CH <sub>M</sub> | 156.575                  | 114.1            | ≥70        | Pass   |
|                 | 157.025                  | 105.9            |            |        |
|                 | 135.400                  | 105.7            |            |        |
|                 | 178.200                  | 106.9            |            |        |
| CH <sub>H</sub> | 161.775                  | 111.0            | ≥70        | Pass   |
|                 | 162.225                  | 106.6            |            |        |
|                 | 140.600                  | 107.0            |            |        |
|                 | 183.400                  | 107.4            |            |        |

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

For Blocking immunity

| RX-AW           |                          |             |              |        |
|-----------------|--------------------------|-------------|--------------|--------|
| Test Channel    | Measurement Offset (MHz) | SG B (dBμV) | Limit (dBμV) | Result |
| CH <sub>L</sub> | -10                      | 104.7       | ≥90          | Pass   |
|                 | -5                       | 104.3       |              |        |
|                 | -2                       | 104.9       |              |        |
|                 | -1                       | 103.4       |              |        |
|                 | 1                        | 102.9       |              |        |
|                 | 2                        | 104.3       |              |        |
|                 | 5                        | 105.8       |              |        |
|                 | 10                       | 105.3       |              |        |
| CH <sub>M</sub> | -10                      | 104.3       | ≥90          | Pass   |
|                 | -5                       | 105.1       |              |        |
|                 | -2                       | 104.2       |              |        |
|                 | -1                       | 98.9        |              |        |
|                 | 1                        | 99.5        |              |        |
|                 | 2                        | 104.4       |              |        |
|                 | 5                        | 104.1       |              |        |
|                 | 10                       | 105.4       |              |        |
| CH <sub>H</sub> | -10                      | 104.3       | ≥90          | Pass   |
|                 | -5                       | 105.5       |              |        |
|                 | -2                       | 102.9       |              |        |
|                 | -1                       | 101.1       |              |        |
|                 | 1                        | 103.0       |              |        |
|                 | 2                        | 103.3       |              |        |
|                 | 5                        | 104.3       |              |        |
|                 | 10                       | 105.2       |              |        |

5.2.11. Dynamic range

The dynamic range shall be 80 dB for MF/HF equipment and 100 dB for VHF equipment.

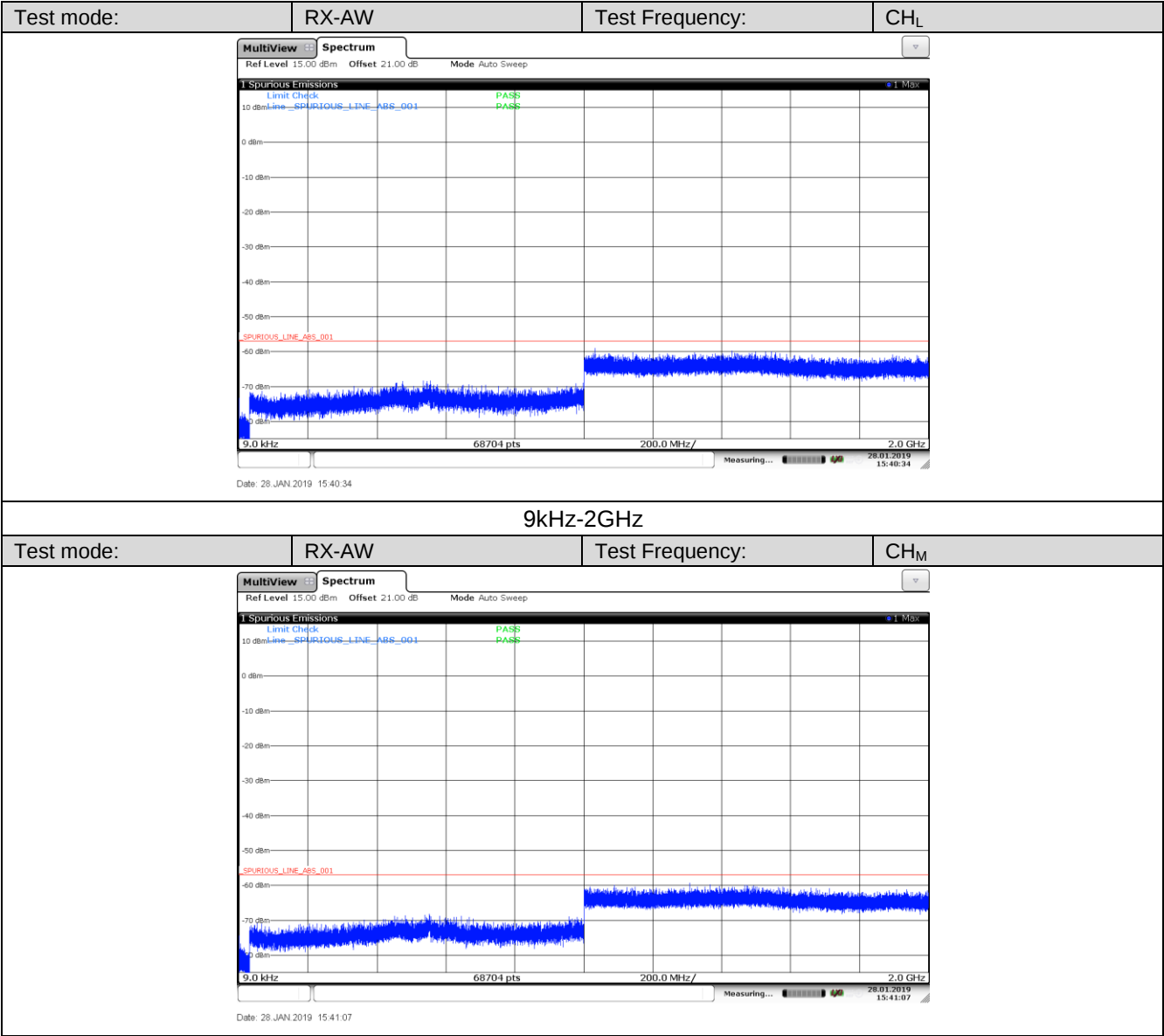
**Test results:**  
Complies

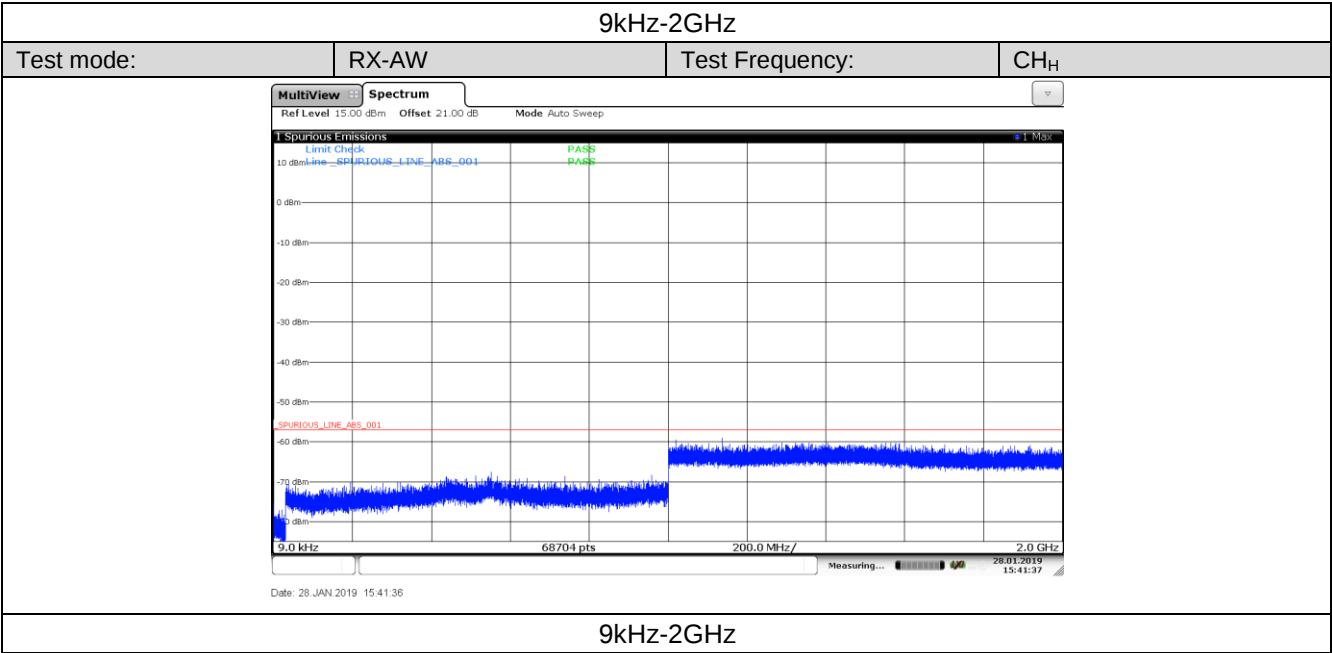
5.2.12. Conducted spurious emissions into the antenna

Conducted spurious emissions into the antenna shall not exceed 2 nW (M.489/1.3.5).

**Test results:**  
Complies

Please refer to the below test data



**9kHz-2GHz**

5.2.13. Frequency stability

For MF/HF equipment, the receiver frequency shall at all times remain within 10 Hz of the required frequency following the warming-up period (A.804/C.2, A.806/C.2).

**Test results:**  
Not applicable

### 5.3. IEC 61097-8 Environmental tests

#### 5.3.1. Vibration Tests

These tests determine the ability of equipment to withstand vibration without resulting in mechanical weakness or degradation in performance. They simulate the effect of vibration induced in a ship's hull by its propeller and machinery. This is generally at frequencies of up to 13 Hz and predominantly vertical. The tests at higher frequencies simulate the effect of slamming which occurs in irregular stormy seas and is predominantly horizontal. The tests do not simulate the effect of regular seas giving the translational components of surging, swaying and heaving, and the corresponding rotational components of rolling, pitching and yawing which generally produce accelerations too small to be of consequence to electronic equipment.

#### Test Method:

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the vibration table by its normal means of support and in its normal attitude. The EUT may be resiliently suspended to compensate for weight not capable of being withstood by the vibration table. Provision may be made to reduce or nullify any adverse effect on EUT performance which could be caused by the presence of an electromagnetic field due to the vibration unit.

The equipment shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 2 Hz to 5 Hz and up to 13,2 Hz with an excursion of  $\pm 1 \text{ mm} \pm 10 \%$  ( $7 \text{ m/s}^2$  maximum acceleration at 13,2 Hz);
- above 13,2 Hz and up to 100 Hz with a constant maximum acceleration of  $7 \text{ m/s}^2$ .

The frequency sweep rate shall be slow enough to allow the detection of resonances in any part of the EUT.

A resonance search shall be carried out throughout the test. If any resonance of the EUT has  $Q \geq 5$  measured relative to the base of the vibration table, the EUT shall be subjected to a vibration endurance test at each resonant frequency at the vibration level specified in the test with a duration of 2 h. If no resonance with  $Q \geq 5$  occurs, the endurance test shall be carried out at one single observed frequency. If no resonance occurred, the endurance test shall be carried out at a frequency of 30 Hz.

Performance check(s) (see 7.2) shall be carried out at least once during each endurance test period, and once before the end of each endurance test period.

The procedure shall be repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

After conducting the vibration tests, the equipment shall be inspected for any mechanical deterioration.

#### Test results:

Meet clause 7.2 performance requirement, no visible harmful deterioration.

### 5.3.2. Temperature tests

The immunity against the effects of temperature is the ability of the equipment to maintain the specified mechanical and electrical performance after the following tests have been carried out.

The maximum rate of raising or reducing the temperature of the chamber in which the equipment is tested shall be 1 °C/min.

#### Test Method:

For Dry heat functional test:

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The EUT and, if appropriate, any climatic control devices with which it is provided shall then be switched on. The temperature shall then be raised to and maintained at +55 °C ± 3 °C.

At the end of a soak period of 10 h to 16 h at +55 °C ± 3 °C, the EUT shall be subjected to the performance check of 8.2 or 9.1 as applicable.

The temperature of the chamber shall be maintained at +55 °C ± 3 °C during the whole test period. At the end of the test, the EUT shall be returned to normal environmental conditions or to those required at the start of the next test.

For Damp heat:

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall then be raised to +40 °C ± 2 °C, and the relative humidity raised to 93 % ± 3 % over a period of 3 h ± 0,5 h. These conditions shall be maintained for a period of 10 h to 16 h. Any climatic control devices provided in the EUT may be switched on at the conclusion of this period.

The EUT shall be switched on 30 min later, or after such period as agreed by the manufacturer, and shall be kept operational for at least 2 h during which period the EUT shall be subjected to the performance check.

The temperature and relative humidity of the chamber shall be maintained as specified during the whole test period.

At the end of the test period and with the EUT still in the chamber, the chamber shall be brought to room temperature in not less than 1 h.

At the end of the test the EUT shall be returned to normal environmental conditions, or to those required at the start of the next test.

For Low temperature

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall then be reduced to and maintained at -15 °C ± 3 °C, for a period of 10 h to 16 h. Any climatic control devices provided in the EUT may be switched on at the conclusion of this period.

The EUT shall be switched on 30 min later, or after such a period as agreed by the manufacturer, and shall be kept operational for at least 2 h, during which period the EUT shall be subjected to the performance check of 8.2 or 9.1 as applicable.

The temperature of the chamber shall be maintained at -15 °C ± 3 °C during the whole test period.

At the end of the test the EUT shall be returned to normal environmental conditions, or to those required at the start of the next test.

#### Test results:

Meet clause 8.2 BER less than  $10^{-2}$

**5.3.3. Corrosion test**

This test shall be waived where the manufacturer is able to produce evidence that the components, materials and finishes employed in the equipment satisfy the requirements of this subclause.

**Test Method:**

The EUT shall be placed in a chamber and sprayed with a salt solution for 2 h at normal temperature. The salt solution shall be prepared by dissolving  $5 \pm 1$  parts by weight of sodium chloride (NaCl) in 95 parts by weight of distilled or de-mineralized water.

At the end of the spraying period the EUT shall be placed in a chamber, which shall be maintained at a temperature of  $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  and a relative humidity between 90 % and 95 % for a period of seven days.

The EUT shall be subjected to a test comprising four spraying periods, each of 2 h duration, with a storage period of seven days after each.

At the conclusion of the test the EUT shall be inspected with the naked eye without magnification. The EUT shall then be subjected to the performance check.

**Test results:**

No undue deterioration. Meet clause 7.2 performance requirement, no visible harmful deterioration.

## 5.4. IEC 61097-8 VHF watchkeeping receiver

### 5.4.1. Calling sensitivity

To determine the maximum usable sensitivity which is the minimum level of the signal (e.m.f.) at the nominal frequency of the receiver which, when applied to the receiver input with a standard test signal, will produce a specified BER.

#### Test Method:

The arrangements for applying the test signals shall be in accordance with clause 6.5.

Standard test signal No. 2 shall be applied at an input level of 0 dBμV under normal test conditions and +6 dBμV under extreme test conditions.

The measurement shall be carried out under normal test conditions (see 6.3) and under extreme test conditions (6.4.1 and 6.4.2 applied simultaneously).

Measurements under extreme conditions may be carried out during environmental tests (see 7.4.1 and 7.4.3).

The measurement shall be repeated at the nominal carrier frequency  $\pm 1,5$  kHz under normal test conditions.

#### Limit:

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

#### Test results:

Please refer to the below test data:

| Operation Mode | Temperature (°C ) | Voltage (V)    | Test Channel     | Measured (error ratio) | Limit (error ratio) | Result |
|----------------|-------------------|----------------|------------------|------------------------|---------------------|--------|
| RX-DSC         | T <sub>N</sub>    | V <sub>N</sub> | CH <sub>M1</sub> | 0.004                  | ≤10 <sup>-2</sup>   | Pass   |
|                | T <sub>L</sub>    | V <sub>H</sub> | CH <sub>M1</sub> | 0.004                  | ≤10 <sup>-2</sup>   |        |
|                |                   | V <sub>L</sub> | CH <sub>M1</sub> | 0.006                  |                     |        |
|                | T <sub>H</sub>    | V <sub>H</sub> | CH <sub>M1</sub> | 0.005                  |                     |        |
|                |                   | V <sub>L</sub> | CH <sub>M1</sub> | 0.007                  |                     |        |

**5.4.2. Adjacent channel selectivity**

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

**Test Method:**

The arrangements for applying the test signals shall be in accordance with clause 6.5.

The wanted signal shall be standard test signal No. 2 at an input level of +3 dBμV.

The unwanted signal shall be modulated by 400 Hz with a deviation of ±3 kHz. The unwanted signal shall be tuned to the centre frequency of the upper adjacent channels. The level of the unwanted signal shall be +73 dBμV.

The BER at the output of the receiver shall be determined as described in 6.8.

The measurement shall be repeated with the unwanted signal tuned to the centre frequency of the lower adjacent channel.

**Limit**

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

**Test results:**

Complies

Please refer to the below test data:

| Operation Mode | Test Condition     |                | Test Channel     | Measurement Position | Measured (error ratio) | Limit (error ratio) | Result |
|----------------|--------------------|----------------|------------------|----------------------|------------------------|---------------------|--------|
|                | Temperature ( °C ) | Voltage (V)    |                  |                      |                        |                     |        |
| RX-DSC         | T <sub>N</sub>     | V <sub>N</sub> | CH <sub>M1</sub> | Lower adjacent       | 0.004                  | $\leq 10^{-2}$      | Pass   |
|                |                    |                |                  | Upper adjacent       | 0.005                  |                     |        |
|                | T <sub>L</sub>     | V <sub>H</sub> | CH <sub>M1</sub> | Lower adjacent       | 0.007                  | $\leq 10^{-2}$      | Pass   |
|                |                    |                |                  | Upper adjacent       | 0.006                  |                     |        |
|                |                    | V <sub>L</sub> | CH <sub>M1</sub> | Lower adjacent       | 0.005                  | $\leq 10^{-2}$      | Pass   |
|                |                    |                |                  | Upper adjacent       | 0.008                  |                     |        |
|                |                    | V <sub>H</sub> | CH <sub>M1</sub> | Lower adjacent       | 0.006                  | $\leq 10^{-2}$      | Pass   |
|                |                    |                |                  | Upper adjacent       | 0.007                  |                     |        |
|                |                    | V <sub>L</sub> | CH <sub>M1</sub> | Lower adjacent       | 0.007                  | $\leq 10^{-2}$      | Pass   |
|                |                    |                |                  | Upper adjacent       | 0.006                  |                     |        |

**5.4.3. Co-channel rejection**

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

**Test Method:**

The arrangements for applying the test signals shall be in accordance with clause 6.5.

The unwanted signal shall be modulated by 400 Hz with a deviation of  $\pm 3$  kHz. The input level of the unwanted signal shall be  $-7$  dB $\mu$ V.

Both input signals shall be at the nominal frequency of the receiver and the measurement shall be repeated for displacements of the unwanted signal of up to  $\pm 3$  kHz.

The BER at the output of the receiver shall be determined as described in 6.8.

**Limit**

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

**Test results:**

Complies

Please refer to the below test data:

| Operation Mode | Test Channel     | Measurement Offset (kHz) | Measured (error ratio) | Limit(error ratio) | Result |
|----------------|------------------|--------------------------|------------------------|--------------------|--------|
| RX-DSC         | CH <sub>M1</sub> | -3                       | 0.006                  | $\leq 10^{-2}$     | Pass   |
|                |                  | 0                        | 0.008                  |                    |        |
|                |                  | 3                        | 0.006                  |                    |        |

**5.4.4. Intermodulation response**

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

**Test Method:**

The arrangements for applying the test signals shall be in accordance with 6.5.

The wanted signal represented by signal generator A shall be at the nominal frequency of the receiver and shall be standard test signal No. 2 at an input level of +3 dBμV.

The two unwanted signals shall be applied, both at the same level of +68 dBμV.

The first unwanted signal from signal generator B shall be unmodulated and adjusted to a frequency 50 kHz above (or below) the nominal frequency of the receiver.

The second unwanted signal from signal generator C shall be modulated by 400 Hz with a deviation of ±3 kHz and adjusted to a frequency 100 kHz above (or below) the nominal frequency of the receiver.

The BER at the output of the receiver shall be determined as described in 6.8.

**Limit**

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

**Test results:**

Complies

Please refer to the below test data:

| Operation Mode | Test Channel     | Measurement Offset (kHz) |      | Measured (error ratio) | Limit (error ratio) | Result |
|----------------|------------------|--------------------------|------|------------------------|---------------------|--------|
|                |                  | SG B                     | SG C |                        |                     |        |
| RX-DSC         | CH <sub>M1</sub> | -50                      | -100 | 0.004                  | $\leq 10^{-2}$      | Pass   |
|                |                  | 50                       | 100  | 0.006                  |                     |        |

**5.4.5. Spurious response and blocking immunity**

To determine the ability to receive a wanted modulated signal without exceeding a specified BER due to the presence of an unwanted unmodulated signal at frequencies outside the passband of the receiver.

**Test Method:**

The arrangements for applying the test signals shall be in accordance with 6.5.

The wanted signal shall be standard test signal No. 2 at an input level of +3 dBμV.

For the spurious response test the unwanted signal shall be unmodulated and at an input level of +73 dBμV. The frequency shall be varied over the range 9 kHz to 2 GHz except for the channel of the wanted signal and its adjacent channels.

For the blocking immunity test the unwanted signal shall be unmodulated and at an input level of +93 dBμV. The frequency shall be varied between -10 MHz and -1 MHz and also between +1 MHz and +10 MHz relative to the nominal frequency of the wanted signal.

**Limit**

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

**Test results:**

Complies

Please refer to the below test data:

Spurious response:

| Operation Mode | Test Channel     | Spurious Frequency (MHz) | Measured (error ratio) | Limit (error ratio) | Result |
|----------------|------------------|--------------------------|------------------------|---------------------|--------|
| RX-DSC         | CH <sub>M1</sub> | 156.3                    | 0.004                  | $\leq 10^{-2}$      | Pass   |
|                |                  | 156.75                   | 0.004                  |                     |        |
|                |                  | 135.125                  | 0.006                  |                     |        |
|                |                  | 177.925                  | 0.004                  |                     |        |

Blocking immunity:

| Operation Mode | Test Channel     | Measurement Offset (MHz) | Measured (error ratio) | Limit (error ratio) | Result |
|----------------|------------------|--------------------------|------------------------|---------------------|--------|
| RX-DSC         | CH <sub>M1</sub> | -10                      | 0.004                  | $\leq 10^{-2}$      | Pass   |
|                |                  | -5                       | 0.005                  |                     |        |
|                |                  | -2                       | 0.005                  |                     |        |
|                |                  | -1                       | 0.006                  |                     |        |
|                |                  | 1                        | 0.007                  |                     |        |
|                |                  | 2                        | 0.004                  |                     |        |
|                |                  | 5                        | 0.006                  |                     |        |
|                |                  | 10                       | 0.005                  |                     |        |

**5.4.6. Dynamic range**

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

**Test Method:**

The arrangements for applying the test signals shall be in accordance with 6.5.

Standard test signal No. 2 shall be applied at an input level of +100 dBμV.

The BER at the output shall be determined as described in 6.8.

**Limit**

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

**Test results:**

Complies

*Please refer to the below test data:*

| Operation Mode | Test Channel     | Measured (error ratio) | Limit (error ratio) | Result |
|----------------|------------------|------------------------|---------------------|--------|
| RX-DSC         | CH <sub>M1</sub> | 0.004                  | $\leq 10^{-2}$      | Pass   |

#### 5.4.7. Conducted spurious emissions into the antenna

To determine internally generated signals conducted to the antenna terminal and which may be radiated.

##### Test Method:

The receiver antenna terminal shall be connected to a 50  $\Omega$  artificial antenna and the spurious emissions shall be measured using a selective measuring instrument. The r.m.s. value of any component of the spurious emission shall then be evaluated.

The measurement shall be made over the frequency range from 9 kHz to 2 GHz.

The bandwidth of the selective measuring instrument shall be:

- 200 kHz in the frequency range from 9 kHz to 150 kHz;
- 9 kHz to 10 kHz in the frequency range from 150 kHz to 30 MHz;
- 100 kHz to 120 kHz in the frequency range from 30 MHz to 1 GHz; and
- 1 MHz above 1 GHz.

The detector shall be a peak detector.

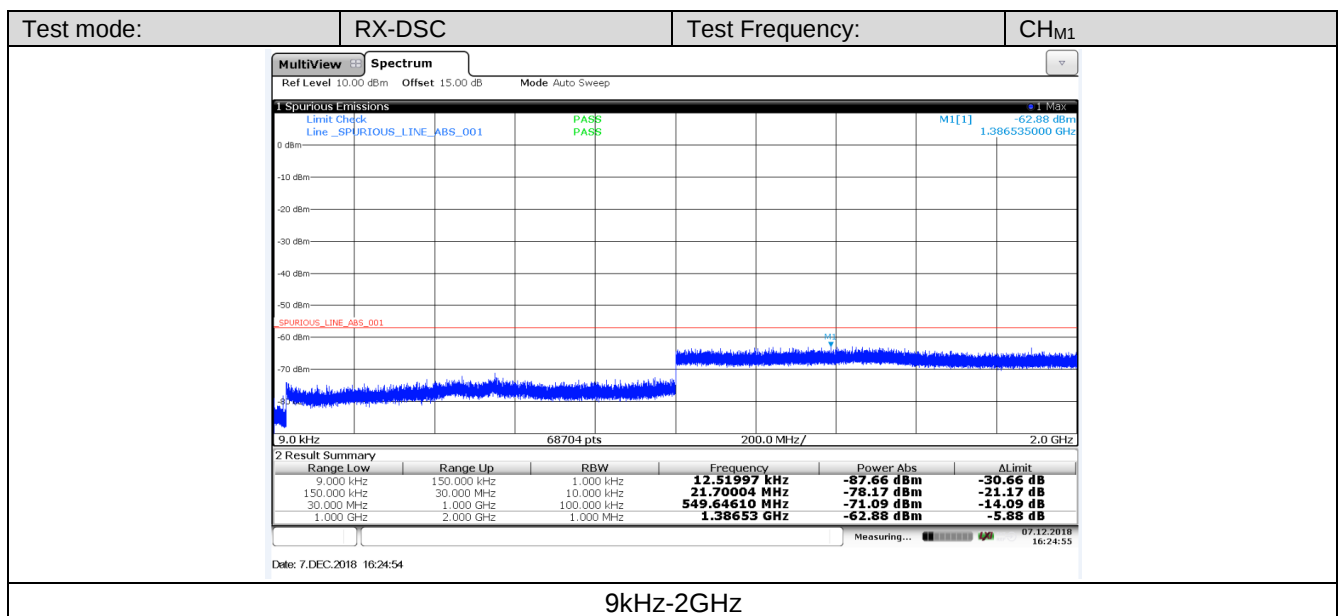
##### Limit

The power of any discrete frequency component shall not exceed 2 nW.

##### Test results:

Complies

Please refer to the below test data:



## 5.5. IEC 61097-8 EMC test according EN60945 Electromagnetic Compatibility (EMC)

### 5.5.1. Radiated Disturbance 150kHz to 2GHz

#### Test Procedure

The quasi-peak measuring receivers specified in CISPR 16-1 shall be used. The receiver bandwidth in the frequency ranges 150 kHz to 30 MHz shall be 9 kHz and in the frequency ranges 30 MHz to 2 GHz shall be 120 kHz.

For frequencies from 150 kHz to 30 MHz measurements shall be made of the magnetic H field. The measuring antenna shall be an electrically screened loop antenna of dimension so that the antenna can be completely enclosed by a square having sides of 60 cm in length, or an appropriate ferrite rod as described in CISPR 16-1.

The correction factor for the antenna shall include the factor +51,5 dB to convert the magnetic field strength to equivalent electric field strength.

For frequencies above 30 MHz measurements shall be made of the electric E field. The measuring antenna shall be a balanced dipole of resonant length, or alternate shortened dipole or higher gain antenna as described in CISPR 16-1. The dimension of the measuring antenna in the direction of the EUT shall not exceed 20 % of its distance from the EUT. At frequencies above 80 MHz it shall be possible to vary the height of the centre of the measuring antenna above the ground over a range of 1 m to 4 m.

The test site shall be compliant with CISPR 16-1, using a metal ground plane and of dimensions to allow a measurement distance of 3 m.

The EUT shall be fully assembled, complete with its associated interconnecting cables and mounted in its normal plane of operation.

When the EUT consists of more than one unit, the interconnecting cables (other than antenna feeders) between the main unit and all other units shall be the maximum length as specified by the manufacturer or 20 m whichever is shorter. Available input and output ports shall be connected to the maximum length of cable as specified by the manufacturer or 20 m whichever is shorter, and terminated to simulate the impedance of the ancillary equipment to which they are normally connected.

The excess length of these cables shall be bundled at the approximate centre of the cable with bundles 30 cm to 40 cm in length running in the horizontal plane from the port to which they are connected. If it is impractical to do so because of cable bulk or stiffness, the disposition of the excess cable shall be as close as possible to that required, and shall be precisely described in the test report.

The test antenna shall be placed at a distance of 3 m from the EUT. The centre of the antenna shall be at least 1,5 m above the ground plane. The E-field antenna only shall be adjusted in height and rotated to give horizontal and vertical polarization, one being parallel to the ground, in order to determine the maximum emission level. Finally the antenna shall either be moved around the EUT, again in order to determine the maximum emission level, or alternatively, the EUT may be placed on a plane orthogonal to the test antenna at its mid-point and rotated to achieve the same effect.

b) In addition, for the frequency band 156 MHz to 165 MHz, the measurement shall be repeated with a receiver bandwidth of 9 kHz, all other conditions of a) hereinbefore remaining unchanged.

c) Alternatively, for the frequency band 156 MHz to 165 MHz, a peak receiver or a frequency analyzer may be used, in accordance with the agreement between the manufacturer and the test house.

#### Test Setup

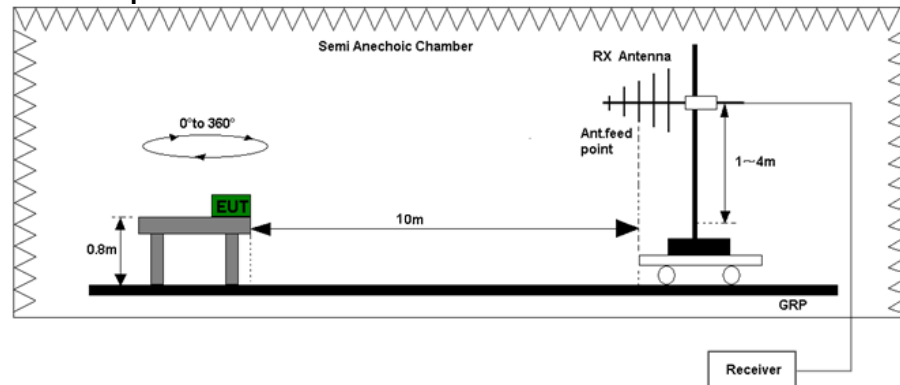


Figure 1. Test set-up of radiated disturbance(30Hz-1GHz)

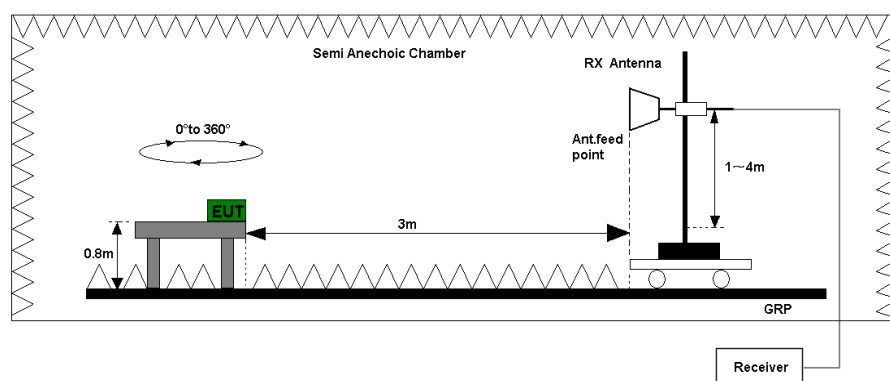


Figure 2. Test set-up of radiated disturbance(above 1GHz)

### Test Results

| Frequency<br>(MHz) | Result<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) | Polar<br>H/V |
|--------------------|-----------------|----------------|----------------|--------------|
| 0.364              | 36.73           | 52.00          | 15.27          | H            |
| 0.805              | 30.85           | 51.70          | 20.85          | H            |
| 5.367              | 32.17           | 48.90          | 16.73          | H            |
| 21.405             | 33.49           | 39.20          | 5.71           | H            |
| 27.371             | 29.67           | 35.60          | 5.93           | H            |
| 29.811             | 31.73           | 34.10          | 2.37           | H            |
| 0.245              | 33.55           | 55.50          | 21.95          | V            |
| 0.536              | 30.73           | 51.90          | 21.17          | V            |
| 0.801              | 32.94           | 51.70          | 18.76          | V            |
| 6.635              | 33.01           | 48.20          | 15.19          | V            |
| 23.107             | 30.74           | 37.90          | 7.16           | V            |
| 28.336             | 31.86           | 34.70          | 2.84           | V            |
| 68.425             | 42.87           | 54.00          | 11.13          | H            |
| 135.067            | 42.96           | 54.00          | 11.04          | H            |
| 155.860            | 29.53           | 54.00          | 24.47          | H            |
| 165.427            | 28.04           | 30.00          | 1.96           | H            |
| 37.680             | 51.62           | 54.00          | 2.38           | V            |
| 69.870             | 44.10           | 54.00          | 9.90           | V            |
| 141.626            | 39.85           | 54.00          | 14.15          | V            |
| 1031.725           | 49.87           | 54.00          | 4.13           | H            |
| 1108.672           | 47.63           | 54.00          | 6.37           | H            |
| 1452.870           | 48.74           | 54.00          | 5.26           | H            |
| 1097.665           | 48.07           | 54.00          | 5.93           | V            |
| 1447.037           | 49.62           | 54.00          | 4.38           | V            |

### 5.5.2. Conducted Disturbance 0.10 MHz to 30MHz

#### Test Procedure

The emission shall be measured by means of the quasi-peak measuring receivers specified in CISPR 16-1. An artificial mains V-network (figure 3) in accordance with CISPR 16-1 shall be used to provide a defined impedance at high frequencies across the terminals of the EUT, and to isolate the test circuit from unwanted radio frequency signals on the supply mains. The measuring bandwidth in the frequency range 10 kHz to 150 kHz shall be 200 Hz, and in the frequency range 150 kHz to 30 MHz shall be 9 kHz.

The power input cables between the a.c. and the d.c. power ports of the EUT and the artificial mains network shall be screened and not exceed 0,8 m in length. If the EUT consists of more than one unit with individual a.c. and/or d.c. power ports, power ports of identical nominal supply voltage may be connected in parallel to the artificial mains supply network.

Measurements shall be made with all measuring equipment and the EUT mounted on, and bonded to, an earth plane. Where provision of an earth plane is not practicable, equivalent arrangements shall be made using the metallic frame or mass of the EUT as the earth reference.

#### Test Setup

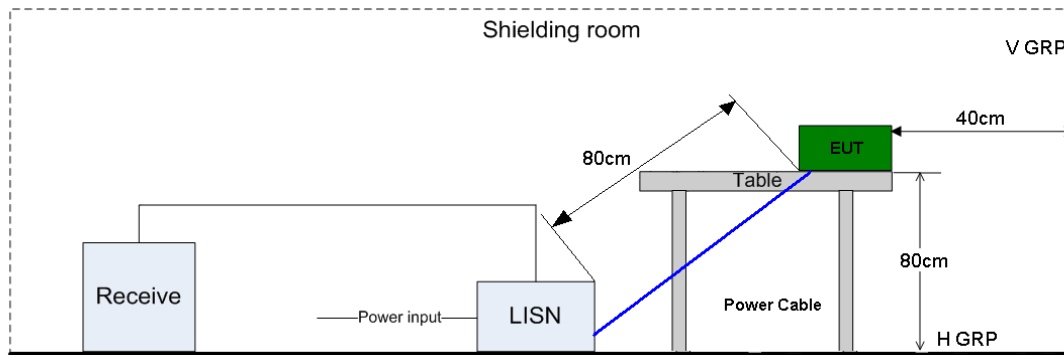


Figure 3. Test set-up of conducted disturbance for power port

#### Test Results

| Frequency (MHz) | QuasiPeak (dBμV) | Limit (dBμV) | Margin (dB) | Line | Corr. (dB) |
|-----------------|------------------|--------------|-------------|------|------------|
| 0.0460          | 32.90            | 70.00        | 37.20       | -    | 10.1       |
| 0.1500          | 10.30            | 50.00        | 39.70       | -    | 10.0       |
| 2.0940          | 26.10            | 50.00        | 23.90       | -    | 10.1       |
| 2.2335          | 30.60            | 50.00        | 19.40       | -    | 10.1       |
| 8.6640          | 24.20            | 50.00        | 25.80       | -    | 10.4       |
| 12.9525         | 15.30            | 50.00        | 34.70       | -    | 10.5       |

| Frequency (MHz) | QuasiPeak (dBμV) | Limit (dBμV) | Margin (dB) | Line | Corr. (dB) |
|-----------------|------------------|--------------|-------------|------|------------|
| 0.5865          | 11.80            | 50.00        | 38.20       | +    | 10.0       |
| 2.1120          | 31.50            | 50.00        | 18.50       | +    | 10.1       |
| 2.2065          | 35.70            | 50.00        | 14.30       | +    | 10.1       |
| 8.6505          | 31.50            | 50.00        | 18.50       | +    | 10.4       |
| 9.1140          | 26.10            | 50.00        | 23.90       | +    | 10.4       |
| 9.3210          | 21.00            | 50.00        | 29.00       | +    | 10.4       |

### 5.5.3. Immunity to Continuous Conducted Interference 0.15MHz to 80MHz

#### Test Procedure

The EUT was configured as described in section 5 for this test. The applied level was Amplitude Modulated by a 1 kHz sinusoidal signal to a modulation depth of 80%. The set-up and test methods were according to IEC 61000-4-6.

#### Test Setup

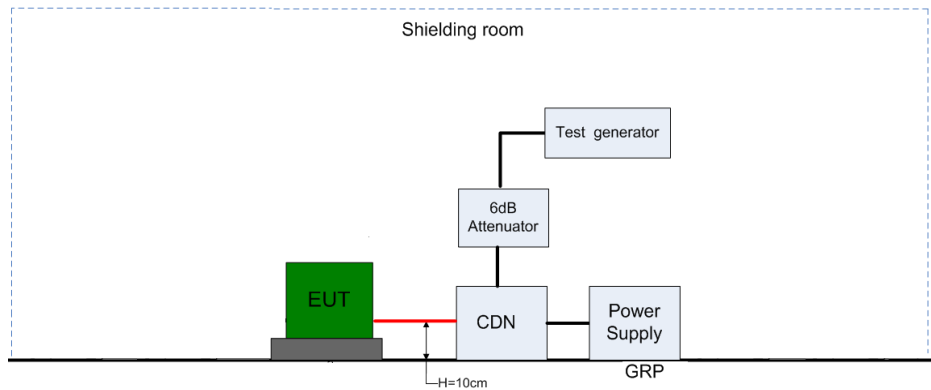


Figure 4. Test set-up of immunity to continuous conducted interference

#### Test Results

| Test Results of Continuous Conducted Interference |                                                                      |               |                  |            |
|---------------------------------------------------|----------------------------------------------------------------------|---------------|------------------|------------|
| Ports                                             | Measuring condition                                                  | Inject method | Description      | Conclusion |
| DC Power Port                                     | Frequency range:<br>0.15 MHz to 80 MHz<br>Induced voltage :3 V (rms) | CDN M2        | No fail detected | Pass       |

#### 5.5.4. Immunity to Radiated Electric Fields 80MHz to 2000MHz

##### Test Procedure

The EUT was configured as described in section 5 for this test. The set-up and test methods were according to EN/IEC 61000-4-3. All sides of the EUT (front, rear, left and right) were tested by antenna with vertical and horizontal polarization.

##### Test Setup

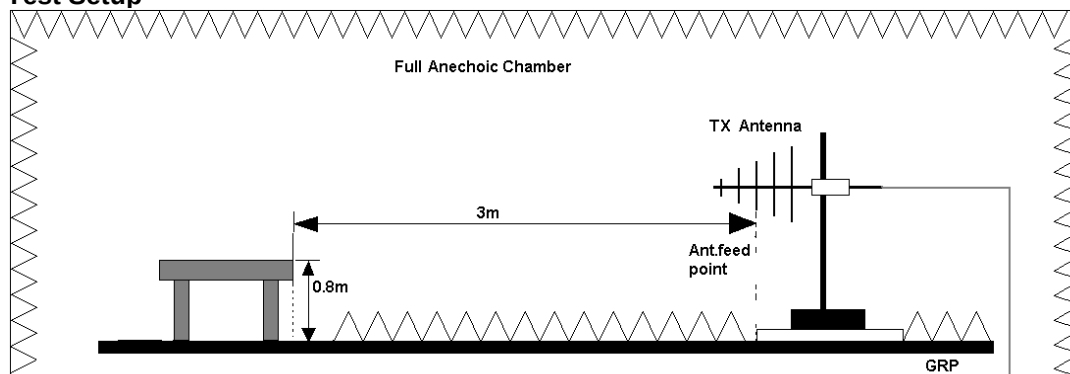


Figure 5. Test set-up of Immunity to Radiated Electric Fields

##### Test Results

| Test Results of Radiated Electric Fields |                                                                                                                    |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Test side of EUT                         | Front, Rear, Left, Right                                                                                           |
| Criterion                                | Performance criterion A                                                                                            |
| Frequency range & Test Level             | 80MHz –1000MHz<br>test level: 10 V/m(Unmodulated, rms)<br>1000MHz –2200MHz<br>test level: 10 V/m(Unmodulated, rms) |
| Modulation                               | 80% AM, 0.4kHz                                                                                                     |
| Conclusion                               | Pass                                                                                                               |

### 5.5.5. Immunity to Electrical Fast Transient Bursts

#### Test Procedure

The EUT was configured as described in section 5 for this test. A series of Fast Transient Bursts meeting the specification were applied for a period of 120 seconds. The Transient Bursts were applied for both Positive and Negative Burst Trains to Power Port. The set-up and test methods were according to IEC 61000-4-4.

#### Test Setup

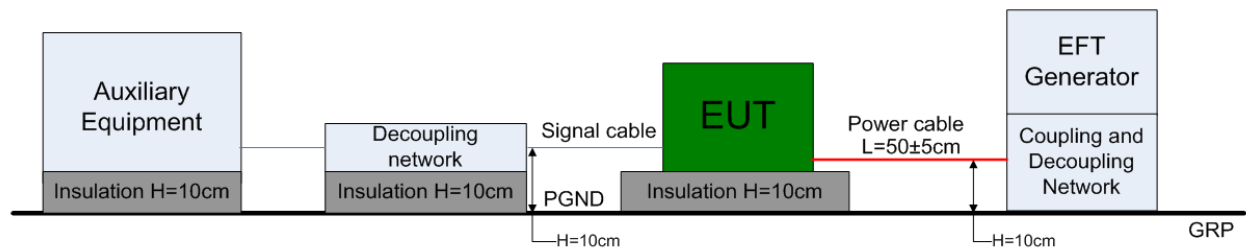


Figure 6. Test set-up of immunity to electrical fast transient bursts

#### Test Results

N/A

Remark: This test is not applicable to EUT intended for operation from battery power sources

### 5.5.6. Immunity to Surges

#### Test Procedure

The EUT was configured as described in section 5 for this test. A series of High Energy Surges were applied to Power Port. The set-up and test methods were according to IEC 61000-4-5.

#### Test Setup

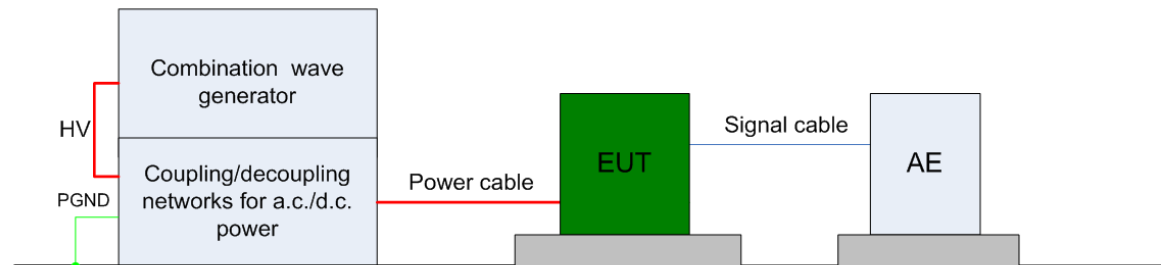


Figure 7. Test set-up of immunity to surge

#### Test Results

N/A

Remark: This test is not applicable to EUT intended for operation from battery power sources

### 5.5.7. Immunity to power supply short-term variation (all equipment categories except portable)

#### Test Procedure

This test is not applicable to d.c. powered equipment.

Power supply variations shall be applied using a programmable power supply.

The EUT shall be submitted to the following power supply variations relative to nominal value

1/min for 10 min (figure 10):

- a) voltage: nominal +  $(20 \pm 1) \%$ , duration  $1,5 \text{ s} \pm 0,2 \text{ s}$ , frequency: nominal +  $(10 \pm 0,5) \%$ , duration  $5 \text{ s} \pm 0,5 \text{ s}$ , superimposed;
- b) voltage: nominal –  $(20 \pm 1) \%$ , duration  $1,5 \text{ s} \pm 0,2 \text{ s}$ , frequency: nominal –  $(10 \pm 0,5) \%$ , duration  $5 \text{ s} \pm 0,5 \text{ s}$ , superimposed. Voltage and frequency variation rise and decay times are  $0,2 \text{ s} \pm 0,1 \text{ s}$  (from 10 % to 90 %). Further information is given in IEC 61000-4-11.

#### Test Setup

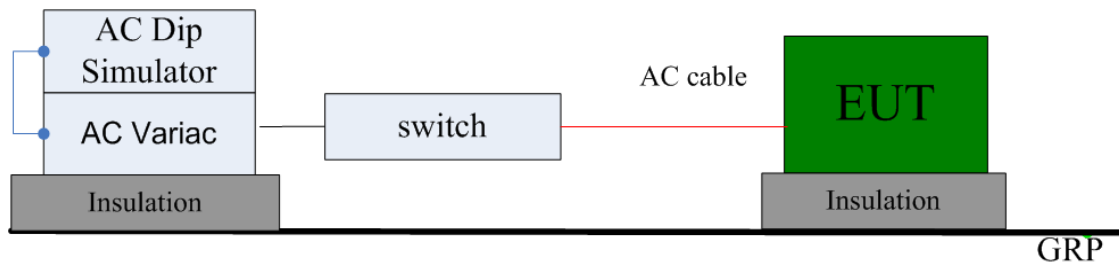


Figure 8. Test set-up of Voltage Dips and Short Interruption of AC Power Port

#### Test Results

N/A

Remark: This test is not applicable to EUT intended for operation from battery power sources

**5.5.8. Immunity to power supply failure (all equipment categories except portable)****Test Procedure**

This test is not applicable to EUT intended for operation from battery power sources or fitted with or connected to back-up batteries.

The EUT shall be subjected to three breaks in power supply of duration 60 s each.

Further information is in IEC 61000-4-11.

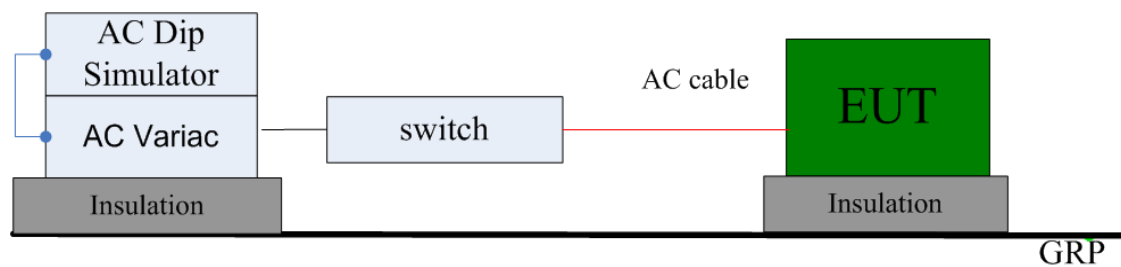
**Test Setup**

Figure 9. Test set-up of Voltage Dips and Short Interruption of AC Power Port

**Test Results**

N/A

Remark: This test is not applicable to EUT intended for operation from battery power sources

