

## **CLASSIFICATION NOTES**

# **Type Approval of Electrical Equipment used for Control, Monitoring, Alarm and Protection, Systems for Use in Ships**

**January, 2016**

### **Contents**

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## General Information

This edition of the Classification Note supersedes “*Type Approval of Electrical Equipment used for Control, Protection, Safety and Internal Communication in Marine Environment - Feb 2008*”

Summary of amendments incorporated in this edition are indicated in Table-1.

**TABLE 1 – AMENDMENTS INCORPORATED IN THIS VERSION OF THE CLASSIFICATION NOTE**

**The amendments are applicable for requests for type approval of equipment received on or after 01 January 2016**

Section / Clause	Subject/amendment
<b>Section 3 Annexure 1</b>	
Test No. 2	Clarification added that specific testing is necessary when required for compliance with international performance standard
Test No. 5	Change in test parameters (test duration) and addition under “other information” column. Under “Other information” a clause has been added for equipment which is to be proven to be suitable to be installed where higher ambient temperature is expected
Test No. 6	The stabilizing period before the start of the first cycle is added for clarification in “other information” column
Test No. 7	A general note has been added that in the case of equipment specified for increased vibration levels, the vibration test has to be carried out at agreed vibration level, frequency range and duration
Test No. 12	Note added under “other information” column to equipment to be examined to ensure that any deterioration or corrosion is superficial in nature
Test No. 15	In “other information” column, it is clarified that it is acceptable to decrease the voltage applied during the test to keep within the power limit
Test No. 18	The test description was inaccurate and contained incorrect symbols which has been corrected
Test No. 19	An editorial correction was made to the table for equipment installed in the bridge and deck zone

## Section 1

### General

1.1 This classification note provides the test specification which is to be applied during type approval of electrical equipment including computing equipment and peripherals used for control, monitoring, alarm and protection, systems for use in ships, where specified in the Rules, for e.g. electronic speed governors, oil mist detectors, alarm systems for unattended machinery spaces, programmable electronic systems, water level detectors etc.

1.2 The general procedure for type approval is given in IRS "Certification Scheme for Type Approval of Products".

1.3 The test requirements are harmonized with IEC 60092-504 "Electrical Installations in Ships : Special features – Control and Instrumentation" and IEC 60533 "Electrical and electronic installations in ships-electromagnetic compatibility".

1.4 Electrical and electronic equipment on board ships, required neither by classification rules nor by International Conventions, liable to cause electromagnetic disturbance, shall be of type which fulfill the test requirements as specified in Sr. no. 19 and 20 of Annexure – I.

1.5 Requirements for electrical equipment fitted on board Non-Combatant Naval Ships are to be as per the *IRS Rules for Naval Ships – 2010* and for electrical equipment fitted onboard Combatant Naval Ships as per *IRS Rules for Indian Naval Combatant Ships – 2015*.

1.6 As used in this document, and in contrast to a complete performance test, a functional test is a simplified test sufficient to verify that the equipment under test (EUT) has not suffered any deterioration caused by the individual environment tests.

1.7 The documentation to be submitted for review should include, where applicable, circuit diagrams of all system modules to circuit board level with parts lists. A "Master list" should be prepared showing all the submitted drawings with the following headings: - Title, type designation, drawing number, date, revision mark.

1.8 Type Approval of composite products containing mechanical, electrical and control components will be based on agreed performance and environmental tests. Assessment of safety features fitted to such units will be carried out.

1.8.1 Separate type approval certificates are not issued for individual components on the basis of tests carried out on a composite product or system.

1.9 Type Approval of products according to this classification note is essentially Type Approval of hardware. Examination of software aspects is restricted to functional operation as demonstrated in the Performance Test.

1.10 Additional tests may be required for specific products depending upon its application and class requirements.

1.11 Special features

1.11.1 Special features will be indicated on the Certificate and in the List of Type Approved products.

1.11.2 Where the Producer's published environmental specification exceeds those required by this document, agreed tests shall be carried out to prove the claims.

## 1.12 Application for Type Approval

1.12.1 The manufacturer is to submit three copies each of the following drawings and documents along with the application for type approval :

- (1) Specification (description of the product, name, type principal particulars, use, construction, performance, material, applicable rules and standards etc.)
- (2) List of equipment
- (3) System diagrams (when systems are composed of various individual units)
- (4) Construction drawings
- (5) Wiring diagram electrical system, piping diagram-pneumatic and hydraulic systems
- (6) Instruction manual (including operating procedures)
- (7) Inspection and testing specification (see 2.3)
- (8) Field service report of the product
- (9) Environmental test procedures prepared according to Annexure - I.

## Section 2

### Testing

2.1 Relevant tests are defined in Annexure - I.

2.2 Test Programme

A test programme should be submitted well in advance before testing commences. The document should contain :

- a) Identification of the Test House and any accreditation for the specific tests.
- b) The proposed equipment to be tested and a technical explanation of how the above is considered to be representative of the range of products to be type approved. The Equipment Under Test' (EUT) should be specified by full type designation to system module/circuit board level, as applicable.
- c) A block diagram showing the proposed configuration of the EUT (if applicable).
- d) The proposed tests demonstrating compliance with the relevant test specification(s) and specified standards.
- e) A detailed performance test specification for demonstrating compliance with the firm's published technical specification (accuracy, repeatability as applicable, functional operation etc.).
- f) Any certificates and reports for relevant tests previously obtained for the product.
- g) A copy of the specified standard(s) where necessary.

2.3 General Requirements

2.3.1 Test area ambient conditions are to be maintained within the standard range of atmospheric conditions as follows :-

Temperature	25°C ± 10°C
Relative humidity	60% ±30%
Air Pressure	960 millibar ± 100 millibar

2.3.2 Rated electrical source voltage and rated electrical source frequency are to be ensured unless otherwise specified.

2.3.3 All measuring instruments shall be calibrated with respect to traceable standards.

2.3.4 Temperatures changes required in the various tests are to be undertaken at approximately 1 °C per minute unless specified otherwise.

2.3.5 The number of test sample is, as a rule, to be one for each type. However, additional sample may be required when deemed necessary by IRS.

2.3.6 During the tests, the Equipment Under Test (EUT) (excepting quiescent units) shall be maintained in it's normal operative condition with power applied.

- 2.3.7 Satisfactory operation of the product shall be demonstrated both during and after each test. In all cases, accuracy shall be maintained within specified limits and there shall be no visible deterioration of the product.
- 2.3.8 Where accuracy is the essence of performance (e.g. transducers, measurement systems) compliance with the manufacturers published specification and any specified standards should be demonstrated during the performance test and under the relevant tests.
- 2.3.9 Static inclination tests are not required to be carried out on equipment having no movable parts.
- 2.3.10 Testing should follow the sequence as set out in Annexure - I unless otherwise agreed.

#### 2.4 Performance Criteria

- 2.4.1 Performance Criterion A: (For continuous phenomena) : The Equipment Under Test shall continue to operate as intended during and after the test. There should be no degradation in the performance parameters and functional requirements specified in the relevant equipment standard and the technical specification of the manufacturer.
- 2.4.2 Performance Criterion B: (For transient phenomena): The EUT shall continue to operate as intended after the tests. There should be no degradation in the performance parameters and functional requirements specified in the relevant equipment standard and the technical specification of the manufacturer. During the test, degradation or loss of function or performance which is self recoverable is however allowed but no change of actual operating state or stored data is allowed.

#### 2.5 Test Report

On completion of tests, manufacturer is to promptly submit test reports to IRS. The test reports shall be signed by the test engineer(s) and//or authorized representative of the test house approving the results. Tests witnessed by IRS Surveyor(s) are to be endorsed by the Surveyor(s) also.

## Section 3

### ANNEXURE – I

#### Type Tests and Related Criteria

NO	TEST	PROCEDURE ACC TO*	TEST PARAMETERS	OTHER INFORMATION
<p>* Note :Indicates the testing procedure which is normally to be applied. However equivalent testing procedure may be accepted by IRS provided that the requirements stated in the other columns are fulfilled. The latest edition of the normative reference would be applicable.</p>				
1.	Visual inspection	-	-	- Conformance to drawings, design data
2.	Performance test	<p>Manufacturer performance test programme based upon specification and relevant Rule requirements. When the EUT is required to comply with an international performance standard, e.g. protection relays, verification of requirements in the standard are to be part of the performance testing required in this initial test and subsequent performance tests after environmental testing where required.</p>	<ul style="list-style-type: none"> <li>- standard atmosphere conditions</li> <li>- temperature : 25°C ± 10°C</li> <li>- relative humidity: 60% ± 30%</li> <li>- air pressure : 960 millibar ± 100 millibar</li> </ul>	<ul style="list-style-type: none"> <li>- confirmation that operation is in accordance with the requirements specified for particular system or equipment.</li> <li>- Checking of self-monitoring features</li> <li>- Checking of specified protection against an access to the memory</li> <li>- Checking against effect of unerroneous use of control elements in the case of computer systems</li> </ul>

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
3.	External power supply failure	-	<ul style="list-style-type: none"> <li>- 3 interruptions during 5 minutes;</li> <li>- switching off time 30s each case</li> </ul>	<ul style="list-style-type: none"> <li>- The time of 5 minutes may be exceeded if the equipment under test needs a longer time for start up, e.g. booting sequence</li> <li>- For equipment which requires booting, an additional interruption in power supply is to be performed during booting operation.</li> <li>- Verification of :               <ul style="list-style-type: none"> <li>- Equipment behaviour upon loss and restoration of supply;</li> <li>- Possible corruption of programme or data held in programmable electronic systems, where applicable.</li> </ul> </li> </ul>



4.	Power supply variations a) electric	-	<p style="text-align: center;"><b>AC SUPPLY</b></p> <table border="1"> <thead> <tr> <th>Combination</th> <th colspan="2">Voltage variation permanent %</th> <th colspan="2">Frequency variation permanent %</th> </tr> </thead> <tbody> <tr> <td>1</td> <td colspan="2">+6</td> <td colspan="2">+5</td> </tr> <tr> <td>2</td> <td colspan="2">+6</td> <td colspan="2">-5</td> </tr> <tr> <td>3</td> <td colspan="2">-10</td> <td colspan="2">-5</td> </tr> <tr> <td>4</td> <td colspan="2">-10</td> <td colspan="2">+5</td> </tr> <tr> <td></td> <td>t</td> <td>%</td> <td>t</td> <td>%</td> </tr> <tr> <td>5</td> <td>1.5 S</td> <td>+20</td> <td>5 S</td> <td>+10</td> </tr> <tr> <td>6</td> <td>1.5 S</td> <td>-20</td> <td>5S</td> <td>-10</td> </tr> </tbody> </table> <p>t - transient</p> <p style="text-align: center;"><b>DC SUPPLY</b></p> <table border="1"> <tbody> <tr> <td>Voltage tolerance continuous</td> <td>± 10%</td> </tr> <tr> <td>Voltage cyclic variation</td> <td>5%</td> </tr> <tr> <td>Voltage ripple</td> <td>10%</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table> <p>Electric battery supply :</p> <ul style="list-style-type: none"> <li>- +30% to -25% for equipment connected to charging battery or as determined by the charging/discharging characteristics, including ripple voltage from the charging device;</li> <li>- +20% to -25% for equipment not connected to the battery during charging.</li> </ul> <p>Pressure : ± 20% Duration : 15 minutes</p>	Combination	Voltage variation permanent %		Frequency variation permanent %		1	+6		+5		2	+6		-5		3	-10		-5		4	-10		+5			t	%	t	%	5	1.5 S	+20	5 S	+10	6	1.5 S	-20	5S	-10	Voltage tolerance continuous	± 10%	Voltage cyclic variation	5%	Voltage ripple	10%		
	Combination	Voltage variation permanent %		Frequency variation permanent %																																															
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	b) pneumatic and hydraulic																																																		

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
5.	Dry heat	IEC 60068-2-2	Temperature : $55^{\circ} \pm 2^{\circ}$ Duration : 16 hours or Temperature : $70^{\circ}\text{C} \pm 2^{\circ} \text{C}$ Duration : 16 hours <u>Note</u> : Equipment to be mounted in consoles, housing etc. together with other equipment are to be tested with $70^{\circ} \text{C}$ .	<ul style="list-style-type: none"> <li>- equipment operating during conditioning and testing</li> <li>- functional test (b) during the last hour at the test temperature.</li> <li>- For equipment specified for increased temperature the dry heat test is to be conducted at the agreed test temperature and duration.</li> </ul>
6.	Damp heat	IEC 60068-2-30 test D <sub>b</sub>	Temperature : $55^{\circ} \text{C}$ Humidity : 95% Duration : 2 cycles 2 X(12+12 hours)	<ul style="list-style-type: none"> <li>- measurement of insulation resistance before test;</li> <li>- the test shall start with <math>25^{\circ}\text{C} \pm 3^{\circ} \text{C}</math> and at least 95% humidity.</li> <li>- equipment operating during the complete first cycle and switched off during second cycle except for functional test</li> <li>- functional test during the first 2 hours of the first cycle at the test temperature and during the last 2 hours of the second cycle at the test temperature; duration of the second cycle can be extended due to more convenient handling of the functional test.</li> <li>- recovery at standard atmosphere conditions</li> <li>- insulation resistance measurements and performance test</li> </ul>

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
7.	Vibration	IEC 60068-2-6 Test F <sub>c</sub>	<p>2 <math>\begin{pmatrix} +3 \\ -0 \end{pmatrix}</math> Hz to 13.2 Hz – amplitude  <math>\pm 1\text{mm}</math>                      13.2 Hz to 100 Hz – acceleration  <math>\pm 0.7\text{g}</math>                      For severe vibration conditions such as e.g on diesel engine's, air compressors, etc.                      2.0 Hz to 25 Hz – amplitude <math>\pm 1.6\text{mm}</math>                      25.0 Hz to 100 Hz – acceleration <math>\pm 4.0\text{g}</math></p> <p><u>Note :</u>                      More severe conditions may exist for example on exhaust manifolds or fuel injection systems of diesel engines. For equipment specified for increased vibration levels, the vibration test is to be conducted at the agreed vibration level, frequency range and duration. Values may be required to be in these cases 40 Hz to 2000 Hz – acceleration <math>\pm 10.0\text{g}</math> at 600 °C, duration 90 min.</p>	<ul style="list-style-type: none"> <li>- duration in case of no resonance condition 90 minutes at 30 Hz</li> <li>- duration at each resonance frequency at which <math>Q \geq 2</math> is recorded- 90 minutes</li> <li>- during the vibration test, functional tests are to be carried out;</li> <li>- tests to be carried out in three mutually perpendicular planes</li> <li>- it is recommended as guidance that Q does not exceed 5.</li> <li>- Where sweep test is to be carried out instead of the discrete frequency test and a number of resonant frequencies is detected close to each other, duration of test is to be 120 min. Sweep over a restricted frequency range between 0.8 and 1.2 times the critical frequencies can be used where appropriate.</li> <li>- Note : Critical frequency is a frequency at which the equipment being tested may exhibit :                         <ul style="list-style-type: none"> <li>o Malfunction and/or performance deterioration</li> <li>o Mechanical resonances and/or other response effects occur, e.g. chatter</li> </ul> </li> </ul> <p>Q = number of cycles after which amplitude drops to <math>1/3^{\text{rd}}</math> of starting value.</p>



NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS		OTHER INFORMATION															
9.	Insulation resistance	<table border="1"> <tr> <td data-bbox="611 337 856 537">Rate supply voltage <math>U_n</math> (V)</td> <td data-bbox="856 337 1066 537">Test voltage (V) (D.C. voltage)</td> <td colspan="2" data-bbox="1066 337 1444 435">Min. Insulation resistance</td> </tr> <tr> <td data-bbox="611 537 856 634"></td> <td data-bbox="856 537 1066 634"></td> <td data-bbox="1066 435 1262 537">Before test M ohms</td> <td data-bbox="1262 435 1444 537">After test M ohms</td> </tr> <tr> <td data-bbox="611 634 856 732"><math>U_n \leq 65</math></td> <td data-bbox="856 634 1066 732"><math>2 \times U_n</math> min 24V</td> <td data-bbox="1066 537 1262 634">10</td> <td data-bbox="1262 537 1444 634">1.0</td> </tr> <tr> <td data-bbox="611 732 856 764"><math>U_n &gt; 65</math></td> <td data-bbox="856 732 1066 764">500</td> <td data-bbox="1066 634 1262 732">100</td> <td data-bbox="1262 634 1444 732">10</td> </tr> </table>	Rate supply voltage $U_n$ (V)	Test voltage (V) (D.C. voltage)	Min. Insulation resistance				Before test M ohms	After test M ohms	$U_n \leq 65$	$2 \times U_n$ min 24V	10	1.0	$U_n > 65$	500	100	10		<ul style="list-style-type: none"> <li>- For high voltage equipment, reference is made to <i>IRS Rules for Construction and Classification of Steel Ships</i> Pt.4, Ch.8, Sec.13;</li> <li>- Insulation resistance test is to be carried out before and after:</li> <li>- damp heat test, cold test, salt mist test and high voltage tests:</li> <li>- Between all phases and earth; and where appropriate' between the phases.</li> </ul> <p><b>Note</b> : Certain components (e.g. for EMC protection) may be required to be disconnected for this test.</p>
Rate supply voltage $U_n$ (V)	Test voltage (V) (D.C. voltage)	Min. Insulation resistance																		
		Before test M ohms	After test M ohms																	
$U_n \leq 65$	$2 \times U_n$ min 24V	10	1.0																	
$U_n > 65$	500	100	10																	
10.	High voltage	<table border="1"> <tr> <td data-bbox="611 769 1024 938">Rated voltage <math>U_n</math> (V)</td> <td data-bbox="1024 769 1451 938">Test voltage (A. C. voltage 50 or 60 Hz) (V)</td> </tr> <tr> <td data-bbox="611 938 1024 997">Up to 65</td> <td data-bbox="1024 938 1451 997"><math>2 \times U_n + 500</math></td> </tr> <tr> <td data-bbox="611 997 1024 1055">66 to 250</td> <td data-bbox="1024 997 1451 1055">1500</td> </tr> <tr> <td data-bbox="611 1055 1024 1114">251 to 500</td> <td data-bbox="1024 1055 1451 1114">2000</td> </tr> <tr> <td data-bbox="611 1114 1024 1166">501 to 690</td> <td data-bbox="1024 1114 1451 1166">2500</td> </tr> </table>	Rated voltage $U_n$ (V)	Test voltage (A. C. voltage 50 or 60 Hz) (V)	Up to 65	$2 \times U_n + 500$	66 to 250	1500	251 to 500	2000	501 to 690	2500		<ul style="list-style-type: none"> <li>- For high voltage equipment, reference is made to <i>IRS Rules for Construction and Classification of Steel Ships</i> Pt.4, Ch.8, Sec.13;</li> <li>- Separate circuits are to be tested against each other and all circuits connected with each other tested against earth;</li> <li>- Printed circuits with electronic components may be removed during the test;</li> <li>- Period of application of the test voltage: 1 minute</li> </ul>						
Rated voltage $U_n$ (V)	Test voltage (A. C. voltage 50 or 60 Hz) (V)																			
Up to 65	$2 \times U_n + 500$																			
66 to 250	1500																			
251 to 500	2000																			
501 to 690	2500																			

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
11	Cold	IEC 60068-2-1	Temperature $+5 \pm 3^\circ$ Duration : 2 hours Or Temperature $-25^\circ\text{C} \pm 3^\circ\text{C}$ Duration : 2 hours <u>Note</u> :- For equipment installed in non-weather protected locations or cold locations test is to be carried out at $-25^\circ\text{C}$	<ul style="list-style-type: none"> <li>- initial measurement of insulation resistance;</li> <li>- equipment not operating during conditioning and testing except for functional test;</li> <li>- functional test during the last hour at the test temperature</li> <li>- insulation resistance measurement and the function test after recovery</li> </ul>
12	Salt Mist	IEC 60068-2-52 Test Kb	Four spraying periods with a Storage of 7 days after each spraying period	<ul style="list-style-type: none"> <li>- Initial measurement of insulation resistance and initial functional test:</li> <li>- Equipment not operating during conditioning</li> <li>- Functional test on the 7<sup>th</sup> day of each storage period;</li> <li>- Insulation resistance measurement and performance test 4 to 6h after recovery.</li> <li>- On completion of exposure, the equipment shall be examined to verify that the deterioration or corrosion (if any) is superficial; in nature.</li> </ul> <p><u>Note</u> :- Salt mist test is to be carried out for equipment installed in weather exposed areas.</p>

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
13	Electrostatic Discharge	IEC 61000-4-2	Contact discharge: 6kV Air discharge: 2kV, 4kV, 8 kV Interval between single discharges: 1 sec No. of pulses: 10 per polarity According to test level 3	<ul style="list-style-type: none"> <li>- to simulate electrostatic discharge as may occur when persons touch the appliance;</li> <li>- the test is to be confined to the points and surfaces that can normally be reached by the operator;</li> <li>- Performance Criteria B (Ref. to 2.4.2)</li> </ul>
14	Electromagnetic Field	IEC 61000-4-3	Frequency range: 80 MHz to 2 GHz Modulation: 80% AM at 1000Hz Field Strength: 10 V/m  Frequency sweep rate: $\leq 1.5 \times 10^{-3}$ Decade/s (or 1%/3 sec) According to test level 3	<ul style="list-style-type: none"> <li>- to simulate electromagnetic fields radiated by different transmitters;</li> <li>- the test is to be confined to the appliances exposed to direct radiation by transmitters at their place of installation.</li> <li>- Performance Criterion A (Ref. to 2.4.1)</li> <li>- If for test of equipment an input signal with a modulation frequency of 1000 Hz is necessary a modulation frequency of 400 Hz may be chosen.</li> </ul>

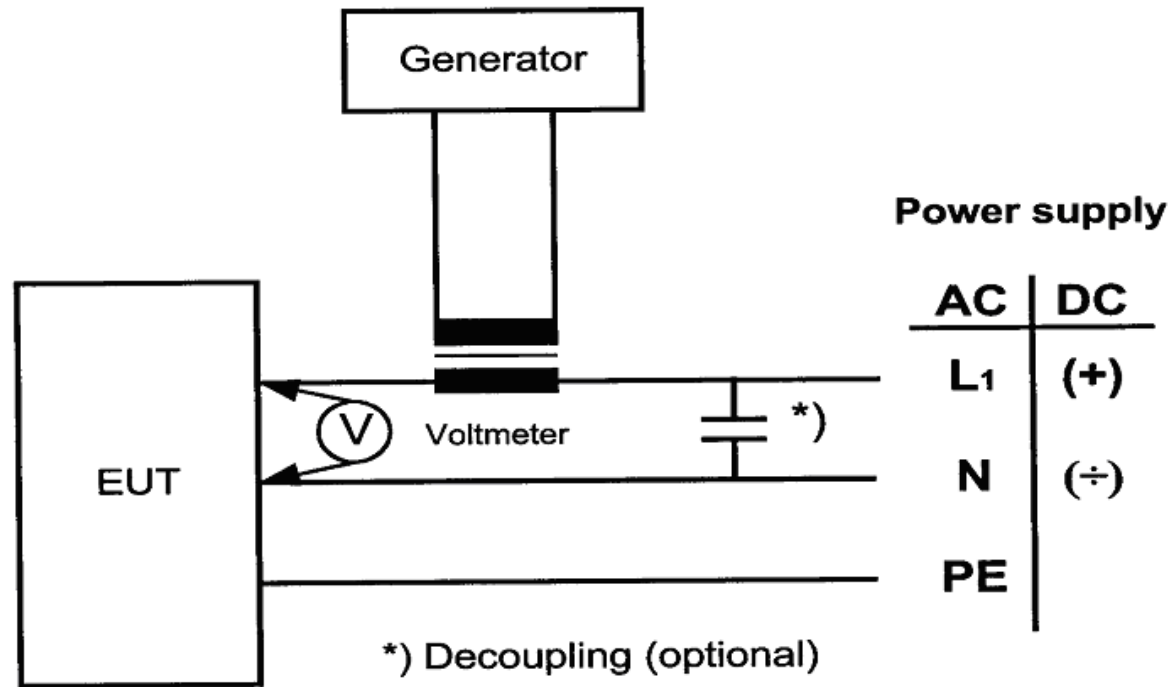
NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
15	Conducted Low Frequency		<p>AC: Frequency range : rated frequency to 200<sup>th</sup> harmonic; Test voltage (rms): 10% of supply to 15<sup>th</sup> harmonic reducing to 1 % at 100<sup>th</sup> harmonic and maintain this level to the 200<sup>th</sup> harmonic, min 3 V r.m.s. max 2W</p> <p>DC: Frequency range :50 Hz – 10 kHz; Test voltage (rms) : 10 % of supply max. 2 W</p>	<ul style="list-style-type: none"> <li>- to stimulate distortions in the power supply system generated for instance by electronic consumers and coupled in as harmonics:</li> <li>- Performance Criteria A (Ref. to 2.4.1)</li> <li>- See Fig.1 – “Test set-up”</li> <li>- For keeping max 2W, the voltage of the test signal may be lower.</li> </ul>
16	Conducted Radio Frequency	IEC 61000-4-6	<p>AC, DC, I/O ports and signal/control lines: Frequency range: 150 kHz – 80 MHz Amplitude: 3 V rms Modulation : 80 % AM at 1000 Hz or If for tests of the equipment an input signal with a modulation frequency of 1000 Hz is necessary a modulation frequency of 400 Hz may be chosen. Frequency sweep range: <math>\leq 1.5 \times 10^{-3}</math> decades/s (or 1%/ 3 Sec.) According to test level 2</p>	<ul style="list-style-type: none"> <li>- Equipment design and the choice of materials is to stimulate to electromagnetic fields coupled as high frequency into the test specimen via the connecting lines.</li> <li>- Performance Criteria A (Ref. to 2.4.1)</li> </ul> <p>Note : For equipment installed on the bridge and deck zone, the test levels shall be increased to 10V rms for spot frequencies in accordance with IEC 60945 at 2,3,4, 6.2, 8.2, 12.6, 16.5, 18.8, 22, 25 MHz.</p>



NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
17	Electrical Fast Transients/ Burst	IEC 61000-4-4	Single Pulse rise time: 5ns (between 10% and 90% value) Single Pulse Width: 50 ns (50% value) Amplitude (peak) 2kv line on power supply port/earth; 1kv on I/O data control and communication ports(coupling clamp) Pulse period: 300 ms; Burst Duration: 15 ms; Duration/Polarity: 5 min According to test level 3	<ul style="list-style-type: none"> <li>- arcs generated when actuating electrical contacts;</li> <li>- interface effect occurring on the power supply, as well as at the external wiring of the test specimen</li> <li>- Performance Criteria B (Ref. to 2.4.2).</li> </ul>
18	Surge	IEC 61000-4-5	Test applicable to AC and DC power ports Open-circuit voltage : Pulse rise time: 1.2 μs(front time) Pulse Width: 50 μs(time to half value) Amplitude (peak) : 1kV line/earth; 0.5 kV line/line Short-circuit current: Pulse rise time : 8 μs (front time) Pulse width : 20 μs (time to half value) Repetition rate: ≥ 1 pulse/min No. of Pulses:5 per polarity Application: Continuous According to test level 2	<ul style="list-style-type: none"> <li>- interference generated for instance, by switching “ON” or “OFF” high power inductive consumers:</li> <li>- Test procedure in accordance with figure 10 of the standard for equipment where power and signal lines are identical;</li> <li>- Performance criterion B (Ref. to 2.4.2)</li> </ul>

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
19	Radiated Emission	CISPR 16-2-3	<p>For equipment installed in the bridge and deck zone.</p> <p>Frequency range: Quasi peak Limits:            0.15-0.3 MHz : 80-52dB<math>\mu</math>V/m            0.3-30 MHz : 52-34dB<math>\mu</math>V/m            30-2000 MHz : 54 dB<math>\mu</math>V/m            except for:            156-165 MHz : 24dB<math>\mu</math>V/m</p> <p>For equipment installed in the general power distribution zone.</p> <p>Frequency range : Quasi peak Limits            0.15-30 mHz : 80-50dB<math>\mu</math>V/m            30-100 MHz : 60-54 dB<math>\mu</math>V/m 100-2000 MHz : 54dB<math>\mu</math>V/m            except for:            156-165 MHz : 24 dB<math>\mu</math>V/m</p>	<ul style="list-style-type: none"> <li>- Procedure in accordance with the standards but distance 3 m between equipment and antenna</li> <li>- Alternatively the radiation limit at a distance of 3m from the enclosure port over the frequency 156 MHz to 165 MHz shall be 30dB micro-V/m peak.</li> </ul>
20	Conducted Emission	CISPR 16-2-1	<p>Test applicable to AC and DC power ports</p> <p>For equipment installed in the bridge and Deck zone</p> <p>Frequency range: limits            10-150kHz 96-50dB<math>\mu</math>V/m            150-350kHz 60-50dB<math>\mu</math>V/m            350kHz-30MHz 50dB<math>\mu</math>V/m</p> <p>For equipment installed in the general power distribution zone.</p> <p>Frequency range: limits:            10-150kHz 120-69dB<math>\mu</math>V/m            150-500kHz 79dB<math>\mu</math>V            0.5kHz-30MHz 73dB<math>\mu</math>V</p>	

NO	TEST	PROCEDURE ACC TO	TEST PARAMETERS	OTHER INFORMATION
21	Flame retardant	IEC 60092-101 or IEC 60695-11-5	<p>Flame application: 5 times 15 s each. Interval between each application: 15s or 1 time 30s</p> <p>Test Criteria based upon application</p> <p>The test is performed with the EUT or housing of the EUT applying needle-flame test method.</p>	<ul style="list-style-type: none"> <li>- The burnt out or damaged part of the specimen is to be not more than 60mm long.</li> <li>- no flame and no incandescence OR</li> <li>- in the event of a flame or incandescence being present, it shall extinguish itself within 30 s of the removal of the needle flame without full combustion of the test specimen.</li> <li>- Any dripping material shall extinguish itself in such a way as not to ignite a wrapping tissue. The drip height is to be less than 200 mm ± 5 mm</li> </ul>



**Fig. 1 - Test Set-up – Conducted Low Frequency Test**