

INDIAN REGISTER OF SHIPPING

CLASSIFICATION NOTES

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

December 2021



IRCLASS
Indian Register of Shipping

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 - July 2019*”

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

CLASSIFICATION NOTES

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December 2021

TABLE 1 – AMENDMENTS INCORPORATED IN THIS VERSION

*The amendments are applicable for requests for type approval of equipment received
on or after 01 July 2022*

Clause	Subject/ Amendments
Section 1 : General	
1/ 1.3	The version of the referred IEC standards is specified.
Section 3 Annexure 1: Type Tests and Related Criteria	
Test No. 5, 6, 7, 8, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21	The version of the referred IEC standards is specified.

CLASSIFICATION NOTES

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- 2 Testing
- 3 Annexure – 1 : Type Tests and Related Criteria

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 60092-504:2016 “Electrical Installations in Ships : Special features – Control and Instrumentation” and IEC 60533:2015 “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
		* 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.		
1.	Visual inspection	-	-	- Conformance to drawings, design data
2.	Performance test	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.	<ul style="list-style-type: none"> - standard atmosphere conditions - temperature : $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ - relative humidity: $60\% \pm 30\%$ - air pressure : $960 \text{ millibar} \pm 100 \text{ millibar}$ 	<ul style="list-style-type: none"> - confirmation that operation is in accordance with the requirements specified for particular system or equipment. - Checking of self-monitoring features - Checking of specified protection against an access to the memory - Checking against effect of unerroneous use of control elements in the case of computer systems

3.	External power supply failure	-	<ul style="list-style-type: none"> - 3 interruptions during 5 minutes; - switching off time 30s each case 	<ul style="list-style-type: none"> - The time of 5 minutes may be exceeded if the equipment under test needs a longer time for start up, e.g. booting sequence - For equipment which requires booting, an additional interruption in power supply is to be performed during booting operation. - Verification of : <ul style="list-style-type: none"> - Equipment behaviour upon loss and restoration of supply; - Possible corruption of programme or data held in programmable electronic systems, where applicable.
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4.	Power supply variations a) electric	-	AC SUPPLY				
			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
			t - transient				
			DC SUPPLY				
			Voltage tolerance continuous		± 10%		
			Voltage cyclic variation		5%		
			Voltage ripple		10%		
	b) pneumatic and hydraulic		Electric battery supply : - +30% to -25% for equipment connected to charging battery or as determined by the charging/discharging characteristics, including ripple voltage from the charging device; - +20% to -25% for equipment not connected to the battery during charging. Pressure : ± 20% Duration : 15 minutes				

5.	Dry heat Note : Dry heat at 70° C is to be carried out to automation, control and instrumentation equipment subject to high degree of heat, for example mounted in consoles, housings, etc. together with other heat dissipating power equipment.	IEC 60068-2-2:2007 Test Bb for non-heat dissipating equipment	Temperature : 55° ± 2° Duration : 16 hours or Temperature : 70°C ± 2° C Duration : 16 hours	<ul style="list-style-type: none"> - equipment operating during conditioning and testing - functional test (b) during the last hour at the test temperature. - For equipment specified for increased temperature the dry heat test is to be conducted at the agreed test temperature and duration.
		IEC 60068-2-2:2007 Test Be for heat dissipating equipment	Temperature: 55° ± 2°C Duration: 16 hours or Temperature: 70°C ± 2°C Duration: 16 hours	<ul style="list-style-type: none"> - Equipment operating during conditioning and testing with cooling system on if provided; - Functional test (b) during the last hour at the test temperature. - For equipment specified for increased temperature the dry heat test is to be conducted at the agreed test temperature and duration.
6.	Damp heat	IEC 60068-2-30:2005 test D _b	Temperature : 55° C Humidity : 95% Duration : 2 cycles 2 X(12+12 hours)	<ul style="list-style-type: none"> - measurement of insulation resistance before test; - the test shall start with 25°C ± 3° C and at least 95% humidity. - equipment operating during the complete first cycle and switched off during second cycle except for functional test - 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

				<p>convenient handling of the functional test.</p> <ul style="list-style-type: none"> - recovery at standard atmosphere conditions - insulation resistance measurements and performance test
7.	Vibration	IEC 60068-2-6:2007 Test F _c	<p>2 $\begin{pmatrix} +3 \\ -0 \end{pmatrix}$ Hz to 13.2 Hz – amplitude $\pm 1\text{mm}$</p> <p>13.2 Hz to 100 Hz – acceleration $\pm 0.7\text{g}$</p> <p>For severe vibration conditions such as e.g on diesel engine's, air compressors, etc.</p> <p>2.0 Hz to 25 Hz – amplitude $\pm 1.6\text{mm}$</p> <p>25.0 Hz to 100 Hz – acceleration $\pm 4.0\text{g}$</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 $\pm 10.0\text{g}$ at 600 °C, duration 90 min.</p>	<ul style="list-style-type: none"> - duration in case of no resonance condition 90 minutes at 30 Hz - duration at each resonance frequency at which $Q \geq 2$ is recorded- 90 minutes - during the vibration test, functional tests are to be carried out; - tests to be carried out in three mutually perpendicular planes - it is recommended as guidance that Q does not exceed 5. - 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. - Note : Critical frequency is a frequency at which the equipment being tested may exhibit : <ul style="list-style-type: none"> o Malfunction and/or

				performance deterioration ○ Mechanical resonances and/or other response effects occur, e.g. chatter Q = number of cycles after which amplitude drops to 1/3 rd of starting value.
8.	Inclination	IEC 60092-504:2016	Static 22.5° Dynamic 22.5°	a) inclined to the vertical at an angle of at least 22.5° b) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (a) c) inclined to the vertical at an angle of at least 22.5° in plane at right angles to that used in (a), d) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (c) Note : The period of testing in each position should be sufficient to fully evaluate the behaviour of the equipment Using the directions defined in a) to d) above, the equipment is to be rolled to an angle of 22.5° each side of the vertical with a period of 10 seconds The test in each direction is to be

					<p>carried out for not less than 15 minutes.</p> <p>On ships for the carriage of liquefied gases and chemicals, the emergency power supply is to remain operational with the ship flooded up to a maximum final athwart ship inclination of 30°.</p> <p>Note : These inclination tests are normally not required for equipment with no moving parts.</p>					
9.	Insulation resistance	-			<ul style="list-style-type: none"> - 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; - Insulation resistance test is to be carried out before and after: - damp heat test, cold test, salt mist test and high voltage tests: - Between all phases and earth; and where appropriate' between the phases. <p>Note : Certain components (e.g. for EMC protection) may be required to be disconnected for this test.</p>					
		Rate supply voltage Un (V)	Test voltage (V) (D.C. voltage)	Min. Insulation resistance						
				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Before test M ohms</th> <th style="width: 50%;">After test M ohms</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">1.0</td> </tr> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">10</td> </tr> </tbody> </table>		Before test M ohms	After test M ohms	10	1.0	100
Before test M ohms	After test M ohms									
10	1.0									
100	10									
		Un ≤ 65	2 X Un min 24V							
		Un > 65	500							

10.	High voltage	Rated voltage Un (V)	Test voltage (A. C. voltage 50 or 60 Hz) (V)	<ul style="list-style-type: none"> - 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; - Separate circuits are to be tested against each other and all circuits connected with each other tested against earth; - Printed circuits with electronic components may be removed during the test; - Period of application of the test voltage: 1 minute
		Up to 65	2X Un + 500	
		66 to 250	1500	
		251 to 500	2000	
		501 to 690	2500	
11	Cold	IEC 60068-2-1:2007	Temperature +5 ± 3° Duration : 2 hours Or Temperature –25°C ±3° 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°C	<ul style="list-style-type: none"> - initial measurement of insulation resistance; - equipment not operating during conditioning and testing except for functional test; - functional test during the last hour at the test temperature - insulation resistance measurement and the function test after recovery
12	Salt Mist	IEC 60068-2-52:2017 Test Kb	Four spraying periods with a Storage of 7 days after each spraying period	<ul style="list-style-type: none"> - Initial measurement of insulation resistance and initial functional test; - Equipment not operating during conditioning - Functional test on the 7th day of each storage period; - Insulation resistance measurement and performance

				<p>test 4 to 6h after recovery.</p> <ul style="list-style-type: none"> - On completion of exposure, the equipment shall be examined to verify that the deterioration or corrosion (if any) is superficial; in nature. <p><u>Note</u> :- Salt mist test is to be carried out for equipment installed in weather exposed areas.</p>
13	Electrostatic Discharge	IEC 61000-4-2:2008	<p>Contact discharge: 6kV Air discharge: 2kV, 4kV, 8 kV <i>Interval between single discharges: 1 sec</i> No. of pulses: 10 per polarity According to test level 3</p>	<ul style="list-style-type: none"> - to simulate electrostatic discharge as may occur when persons touch the appliance; - the test is to be confined to the points and surfaces that can normally be reached by the operator; - Performance Criteria B (Ref. to 2.4.2)
14	Electromagnetic Field	IEC 61000-4-3:2020	<p>Frequency range: 80 MHz to 6 GHz Modulation**: 80% AM at 1000Hz Field Strength: 10 V/m</p> <p>Frequency sweep rate: $\leq 1.5 \times 10^{-3}$ Decade/s (or 1%/3 sec) According to test level 3</p>	<ul style="list-style-type: none"> - to simulate electromagnetic fields radiated by different transmitters; - the test is to be confined to the appliances exposed to direct radiation by transmitters at their place of installation. - Performance Criterion A (Ref. to 2.4.1) - ** 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. - If an equipment is intended to

				receive radio signals for the purpose of radio communication (e.g. wifi router, remote radio controller), then the immunity limits at its communication frequency do not apply, subject to the provisions in Pt. 4, Ch.7, Sec. 6.5.2 of the IRS “Rules and Regulations for the Construction and Classification of Steel Ships”.
15	Conducted Low Frequency		<p>AC: Frequency range : rated frequency to 200th harmonic; Test voltage (rms): 10% of supply to 15th harmonic reducing to 1 % at 100th harmonic and maintain this level to the 200th 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"> - to stimulate distortions in the power supply system generated for instance by electronic consumers and coupled in as harmonics: - Performance Criteria A (Ref. to 2.4.1) - See Fig.1 – “Test set-up” - For keeping max 2W, the voltage of the test signal may be lower.
16	Conducted Radio Frequency	IEC 61000-4-6:2013	<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</p>	<ul style="list-style-type: none"> - 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. - Performance Criteria A (Ref. to 2.4.1) <p>Note : For equipment installed on the bridge and deck zone, the test</p>

			frequency of 400 Hz may be chosen. Frequency sweep range: $\leq 1.5 \times 10^{-3}$ decades/s (or 1%/ 3 Sec.) According to test level 2	levels shall be increased to 10V rms for spot frequencies in accordance with IEC 60945:2002 at 2,3,4, 6.2, 8.2, 12.6, 16.5, 18.8, 22, 25 MHz.
17	Electrical Fast Transients/ Burst	IEC 61000-4-4:2012	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"> - arcs generated when actuating electrical contacts; - interface effect occurring on the power supply, as well as at the external wiring of the test specimen - Performance Criteria B (Ref. to 2.4.2).
18	Surge	IEC 61000-4-5:2017	Test applicable to AC and DC power ports Open-circuit voltage : Pulse rise time: 1.2 μ s(front time) Pulse Width: 50 μ s(time to half value) Amplitude (peak) : 1kV line/earth; 0.5 kV line/line Short-circuit current: Pulse rise time : 8 μ s (front time) Pulse width : 20 μ s (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"> - interference generated for instance, by switching "ON" or "OFF" high power inductive consumers; - Test procedure in accordance with figure 10 of the standard for equipment where power and signal lines are identical; - Performance criterion B (Ref. to 2.4.2)

19	Radiated Emission	CISPR 16-2-3:2016 IEC 60945:2002 for 156-165 MHz	<p>Limits below 1000 MHz</p> <p>For equipment installed in the bridge and deck zone.</p> <p>Frequency range: Quasi peak Limits: 0.15-0.3 MHz : 80-52dBμV/m 0.3-30 MHz : 52-34dBμV/m 30-1000 MHz : 54 dBμV/m except for: 156-165 MHz : 24dBμV/m</p> <p>For equipment installed in the general power distribution zone.</p> <p>Frequency range : Quasi peak Limits 0.15-30 mHz : 80-50dBμV/m 30-100 MHz : 60-54 dBμV/m 100-1000 MHz : 54dBμV/m except for: 156-165 MHz : 24 dBμV/m</p> <p>Limits above 1000 MHz</p> <p>Frequency range : Average Limits 1000-6000 MHz : 54dBμV/m</p>	<ul style="list-style-type: none"> - Procedure in accordance with the standards but distance 3 m between equipment and antenna - For the frequency band 156MHz to 165MHz the measurement is to be repeated with a receiver bandwidth of 9 kHz (as per IEC 60945:2002). - 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 (as per IEC 60945:2002). - Procedure in accordance with the standards but distance 3 m between equipment and antenna - Equipment intended to transmit radio signals for the purpose of radio communication (e.g. wifi router, remote radio controller), may be exempted from limit, within its communication frequency, subject to the provisions in Pt. 4, Ch.7, Sec. 6.5.2 of the IRS "Rules and Regulations for the Construction and Classification of Steel Ships".
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20	Conducted Emission	CISPR 16-2-1:2017	<p>Test applicable to AC and DC power ports</p> <p>For equipment installed in the bridge and Deck zone Frequency range: limits 10-150kHz 96-50dBμV/m 150-350kHz 60-50dBμV/m 350kHz-30MHz 50dBμV/m</p> <p>For equipment installed in the general power distribution zone. Frequency range: limits: 10-150kHz 120-69dBμV/m 150-500kHz 79dBμV 0.5kHz-30MHz 73dBμV</p>	
21	Flame retardant	IEC 60092-101:2018 or IEC 60695-11-5:2016	<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"> - The burnt out or damaged part of the specimen is to be not more than 60mm long. - no flame and no incandescence OR - 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. - 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 \pm 5 mm

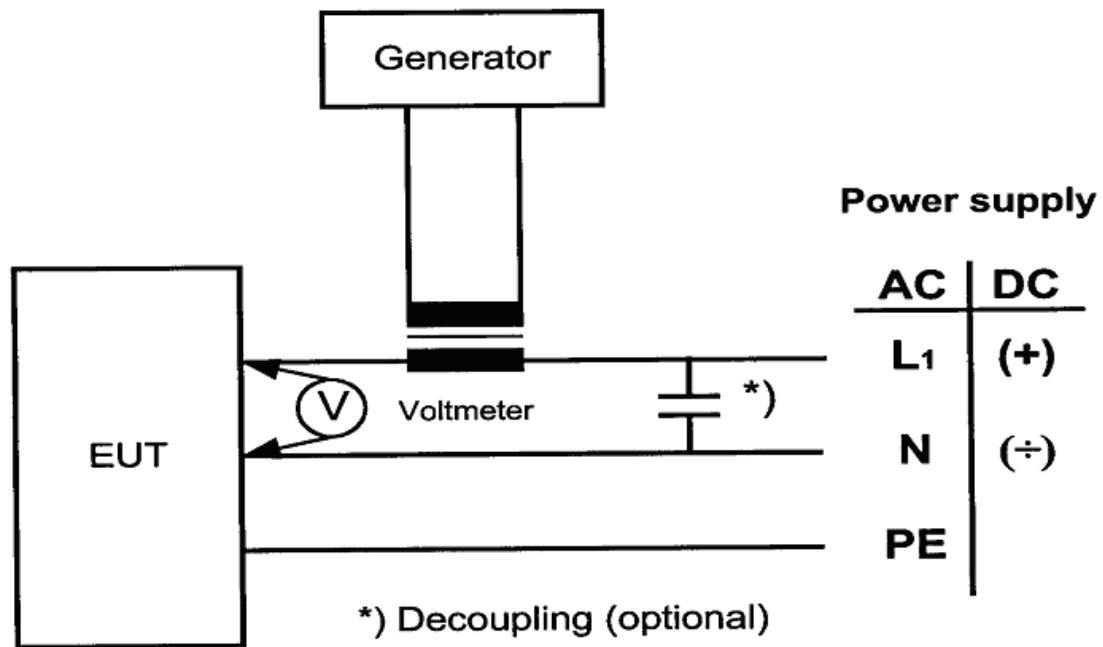


Fig . 1 - Test Set-up – Conducted Low Frequency Test