

EU RO Mutual Recognition Technical Requirements

COMPUTERS AND PROGRAMMABLE LOGIC CONTROLLERS (PLCS)	Version	0.4
	Adoption Date	July 2019
	Application Date	1 January 2020
	Tier	2
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1. PRODUCT DESCRIPTION

1.a General description of the product

Computers and programmable logic controllers (PLC) intended to be used in systems that provide control, monitoring, alarm and safety functions that are subject to classification requirements. Aids to navigation and loading instruments are excluded.

1.b Application limitations†

- a) The approval shall cover hardware only. This excludes firmware, application software, and hardware designed for specific applications subject to classification. Firmware, system software, and application software are subject to additional separate approval, according to UR E22 and the rules of the classing EU RO (FAT and on-board review / tests);
- b) The term PLC is here meant to comprise of elements such as backplanes, power supplies, CPUs, I/O units and bus communication units when these are considered an integral part, or natural extension, of the PLC. Sensors and actuators typically connected to the PLC in a system are not considered part of the PLC and are excluded from the scope of this programme;
- c) Computers or PLCs with integrated display, such as panel PCs, will additionally to the requirements in this TR be subjected to the relevant TR for the display. The TR for "DISPLAY MONITORS, VIDEO SCREENS, TERMINALS" or "TOUCH

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SCREEN I.E. A DISPLAY MONITOR OR A VIDEO SCREEN THAT IS ALSO AN INPUT DEVICE" will be applied, as relevant;

- d) Hardware intended for use in radio- or navigational applications where testing according to IEC Publication 60945 is required is excluded from the scope of this programme. E.g. use in systems covered by the Marine Equipment Directive.

†The EU MR type approved product is generally not used as a stand-alone product, but integrated as component in a sub-system or system. When a product is presented with an EU RO MR Type Approval Certificate for given application, its acceptability with regards to conditions defined in 1b, 1c and 1d of this Technical Requirement will be evaluated by the EU RO in charge of classing the ship or being in charge of the unit/system certification.

1.c Intended use

Control, monitoring, alarm, and safety functions provided by computer / PLC based systems subject to classification requirements.

1.d System context

Application of the control, monitoring, alarm, and safety systems are subject for approval of the individual EU RO classing the vessel.

2. DESIGN EVALUATION

2.a Engineering evaluation requirements

2.a i. Technical Requirements

Ambient Conditions

- a) The ambient condition given in **Table 2.1** shall be applied to the design, selection and arrangement of electrical installations in order to ensure their proper operation;

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- b) Electrical equipment shall be suitable for operations up to 55°C, regardless of location;
- c) Electrical equipment shall be designed to withstand any vibrations that occur under normal conditions;
- d) Electrical equipment, or the installation of electrical equipment, shall be provided with a degree of protection appropriate to the location, as a minimum the requirements of IEC Publication 60092-504. Electrical equipment shall have a minimum degree of protection equivalent to IP20, regardless of location or installation.

Voltage and Frequency

- e) Electrical equipment supplied from main and emergency switchboards shall be designed and manufactured so that it is capable of operating satisfactorily under the normally occurring voltage and frequency fluctuations. Such electrical equipment shall operate satisfactorily under those fluctuations in voltage and frequency that are given in **Table 2.2**. Any special systems, e.g. electronic circuits, whose functions cannot operate satisfactorily, within the limits given in this table, shall be supplied by suitable means, i.e. through stabilized supply.

Construction, Materials, Installations, etc.

- f) All electrical equipment shall be constructed and installed so as not to cause injury when handled and touched in a normal manner;
- g) Insulating materials and insulated windings shall be resistant to moisture, sea air and oil vapours;
- h) Bolts, nuts, pins, screws, terminals, studs, springs and such other small parts shall be made of corrosion resistant material or to be suitably protected against corrosion.

2.a.ii. Technical documents to be submitted:

- a) Drawings, schematics and functional description necessary to describe all parts of the equipment. The functional description can be in the form of user manuals, installation manuals, etc. as relevant;

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- b) Drawings and product specification of physical/electrical and logical interfaces including signal format, converters, I/O-cards, protective circuitry, data protocol, cabling, and required configuration;
- c) Hardware, firmware and system software information necessary to identify the equipment under test. (Application software shall not be reviewed in the framework of type approval of computers / PLC);
- d) Functional tests that are required by tests according to **Table 2.3** have to be defined. The tests shall be suitable to monitor all types of signal interfaces, inputs and outputs reliably. The necessary application program, wiring and description of the functional verification should be part of the submitted test program and test reports;

Note:

The Manufacturer may submit the draft test programmes to the RO for verification prior to the commencement of any environmental & performance type testing. A certificate of accreditation for the selected laboratory/ laboratories) is generally a demand.

End of Note

- e) Environmental- and Performance type test reports;
- f) Special operational limitations, if any;
- g) Documentation about the Production quality assurance system;
- h) Product marking.

2.b Type testing requirements

- a) Tests shall be carried out in accordance with the testing condition and method of the latest revision of IACS UR E10 with modifications given in **Table 2.3** in the presence of the EU RO's surveyor, and they shall be proven to satisfy the criteria of the last revision of IACS UR E10 and **Table 2.3**.
- b) Tests shall be carried out in the presence of the EU RO Surveyor. In cases where the tests are conducted at Nationally Accredited Laboratories, the presence of the EU RO surveyor may be omitted†;
- c) All type testing shall be documented in accordance with ISO/IEC 17025;
- d) It is the manufacturers' responsibility to make sure that the type testing is performed in accordance with approved test programme so being acceptable to the EU RO;

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- e) Test specimens shall be taken from the production line or from stocks†.
- f) All tests are normally to be carried out on the same unit. Using different units for the different type of tests is acceptable provided that all EMC tests are carried out on the same unit (1), and all environmental tests are carried out on the same unit (2).

† For further clarification of witnessing of tests and sampling the test specimen(s), refer to paragraphs 6, 7 and 8 of the EU RO "Design Evaluation Scheme" procedure (Appendix V of EU RO Framework Document for the Mutual Recognition of Type Approval found on <http://www.euromr.org/Guidance%20for%20Mutual%20Recognition>)

3. PRODUCTION REQUIREMENTS

Refer to EU RO "Product Quality Assurance (PQA)" procedure (Appendix VI of EU RO Framework Document for the Mutual Recognition of Type Approval).

4. MARKING REQUIREMENTS

Manufacturers of the approved equipment are, in principle, to mark the product before shipment for identification of approved equipment as per referenced standard. In addition, and as a minimum, the following items to be marked at the suitable place:

- a) Manufacturer's name or equivalent;
- b) Type No. or symbol;
- c) Serial No. and date of manufacture;
- d) Particulars or ratings.

5. TYPE APPROVAL CERTIFICATE CONTENT

The EU RO MR Type Approval Certificate shall contain the minimum information as defined in the "EU RO Framework Document for the Mutual Recognition of Type Approval" - see Appendix I EU RO MR Type Approval Certificate Information.

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The following information is specifically applicable to products relevant to this technical requirement and shall be included on the relevant EU RO MR Type Approval Certificate:

- a) Hardware, firmware, system software names / versions.

6. APPROVAL DATE AND REVISION NUMBER

Date	Revision	Comment
2013-04-30	0.0	Accepted by Advisory Board
2014-01-31	0.1	CRF008 - Reference to EU RO Framework Document for the Mutual Recognition of Type Approval added.
2015-01-31	0.2	CRF018 – Revision to par. 2.a.ii - Test results to be in English; CRF020 – Revision to par. 5 - 'Type Approval Certificate Content'.
1 April 2016	0.3	CRF025 – Updated to new MR TR document format incl. par. 8; CRF026/026a – Witness testing & control of test specimen; CRF028 – addition of 6 month application clause.
July 2019	0.4	CRF041 -Revision to para 1.b.; c added Generic sentence to 1b added

7. BACKGROUND INFORMATION / REFERENCES

- a) EU RO Framework Document for the Mutual Recognition of Type Approval;
- b) IACS UR E10 "Test specification for type approval";
- c) IEC 60092-504 "Electrical installations in ships – Special features, Control and instrumentation";
- d) IEC 60945 "Maritime Navigation and Radio communication Equipment and Systems – General Requirements";
- e) IEC 60533 "Electrical and electronic installations in ships – Electromagnetic compatibility";
- f) IACS UR E22 "On Board Use and Application of Programmable Electronic Systems".

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8. MAINTENANCE / CLARIFICATION OF TECHNICAL REQUIREMENTS

Anyone wishing to propose changes to this document or request clarification of technical issues should contact the EU RO MR Group Secretariat in the first instance: Secretariat@euomr.org.

Review and approval of change requests shall follow the EU RO MR Maintenance Process detailed in the EU RO Framework Document for the Mutual Recognition of Type Approval: <http://www.euomr.org/Guidance%20for%20Mutual%20Recognition>.

Table 2.1 – Angles of Inclination

Static inclination	Dynamic inclination
22.5° (Note 1)	22.5° (Note 1)

Note 1: In ships carrying liquefied gases in bulk and ships carrying dangerous chemicals in bulk, emergency power supplies shall remain operable with the ship flooded to a final athwart ships inclination up to a maximum of 30°. In this case the test level has to be named on the certificate.

Table 2.2 – Voltage and Frequency Fluctuation

(a) Voltage and frequency fluctuations for a.c. distribution systems (Note 1)

Type of fluctuation	Fluctuation (Note 4)	
	Permanent	Transient
Voltage	±10%	±20% (1.5 s duration)
Frequency	±5%	±10% (5 s duration)

(b) Voltage fluctuations for d.c. distribution systems (Note 2)

Type of fluctuation	Fluctuation (Note 4)
Voltage fluctuation (Permanent)	±10%
Voltage cyclic fluctuation deviation	5%
Voltage ripple	10%

(c) Voltage fluctuations for battery systems

Systems	Fluctuation (Note 4)
Components connected to the battery during charging (Note 3)	+30%, -25%
Components not connected to the battery during charging	+20%, -25%
All components	25% (2 s duration)

Note 1: A.C. distribution systems mean *a.c.* generator circuits and *a.c.* power circuits produced by inverters.

Note 2: D.C. distribution systems mean *d.c.* generator circuits and *d.c.* power circuits produced by converters.

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Note 3: Different voltage fluctuations as determined by charging and discharging characteristics, including voltage ripples from the charging devices, may be considered.

Note 4: The numerical values given in the table, excluding those values for time, mean percentages of rated values.

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Table 2.3 – Modified testing condition and method of IACS UR E10

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 the individual EU RO provided that the Unified Requirements stated in the other columns are fulfilled.																															
1.	Visual inspection	-	-	<ul style="list-style-type: none"> - conformance to drawings, design data, marking of product - quality of workmanship and construction 																											
2.	Performance test	Manufacturer performance test programme based upon specification and relevant Rule requirements.	- standard atmosphere conditions - temperature: 25°C ± 10°C - relative humidity: 60% ± 30% - air pressure: 96 kPa ± 10 kPa	<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	-	- 3 interruptions during 5 minutes; - switching-off time 30 s 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 																											
4.	Power supply variations	-	<table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th colspan="3" style="text-align: center;">AC SUPPLY</th> </tr> <tr> <th style="width: 15%;">Combination</th> <th style="width: 25%;">Voltage variation permanent %</th> <th style="width: 20%;">Frequency variation permanent %</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">+10</td> <td style="text-align: center;">+5</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">+10</td> <td style="text-align: center;">-5</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">-10</td> <td style="text-align: center;">-5</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">-10</td> <td style="text-align: center;">+5</td> </tr> <tr> <td></td> <td style="text-align: center;">transient 1,5 s %</td> <td style="text-align: center;">transient 5 s %</td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">+20</td> <td style="text-align: center;">+10</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">-20</td> <td style="text-align: center;">-10</td> </tr> </tbody> </table>	AC SUPPLY			Combination	Voltage variation permanent %	Frequency variation permanent %	1	+10	+5	2	+10	-5	3	-10	-5	4	-10	+5		transient 1,5 s %	transient 5 s %	5	+20	+10	6	-20	-10	<ul style="list-style-type: none"> - for equipment which requires booting, one additional power supply interruption during booting to be performed 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.
AC SUPPLY																															
Combination	Voltage variation permanent %	Frequency variation permanent %																													
1	+10	+5																													
2	+10	-5																													
3	-10	-5																													
4	-10	+5																													
	transient 1,5 s %	transient 5 s %																													
5	+20	+10																													
6	-20	-10																													

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NO.	TEST	PROCEDURE ACC. TO:*	TEST PARAMETERS	OTHER INFORMATION						
			<p style="text-align: center;">DC SUPPLY</p> <table border="1" style="width: 100%;"> <tr> <td>Voltage tolerance Continuous</td> <td style="text-align: center;">±10%</td> </tr> <tr> <td>Voltage cyclic Variation</td> <td style="text-align: center;">5%</td> </tr> <tr> <td>Voltage ripple</td> <td style="text-align: center;">10%</td> </tr> </table> <p>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.</p>	Voltage tolerance Continuous	±10%	Voltage cyclic Variation	5%	Voltage ripple	10%	
Voltage tolerance Continuous	±10%									
Voltage cyclic Variation	5%									
Voltage ripple	10%									
5.	Dry heat	IEC Publication 60068-2-2	Temperature: 55° ± 2°C Duration: 16 hours or Temperature: 70°C ± 2°C Duration: 16 hours (see note 1)	<ul style="list-style-type: none"> - equipment operating during conditioning and testing; - performance test during the last hour at the test temperature. - for equipment specified for increased temperature the dry heat test shall be conducted at the agreed test temperature and duration. 						
6.	Damp heat	IEC Publication 60068-2-30 test Db	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 performance test; - performance 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; - recovery at standard atmosphere conditions; - insulation resistance measurements and - performance test. 						

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NO.	TEST	PROCEDURE ACC. TO:*	TEST PARAMETERS	OTHER INFORMATION
7.	Vibration	IEC Publication 60068-2-6 Test Fc	Hz to 13.2 Hz – amplitude ± 1 mm 13.2 Hz to 100 Hz – acceleration ± 0.7 g. For severe vibration conditions such as, e.g. on diesel engines, air compressors, etc.: 2.0 Hz to 25 Hz – amplitude ± 1.6 mm 25.0 Hz to 100 Hz – acceleration ± 4.0 g. Note: More severe conditions may exist for example on exhaust manifolds or fuel oil injection systems of diesel engines. For equipment specified for increased vibration levels the vibration test shall 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 ± 10.0 g at 600°C, duration 90 min.	<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, performance tests shall be carried out; - tests to be carried out in three mutually perpendicular planes; - Q should not exceed 5, - mechanical resonances with amplification greater than 10 will not be accepted. - where sweep test shall be carried out instead of the discrete frequency test and a number of resonant frequencies is detected close to each other, duration of the test shall 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"> - malfunction and/or performance deterioration - mechanical resonances and/or other response effects occur, e.g. chatter

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NO.	TEST	PROCEDURE ACC. TO:*	TEST PARAMETERS	OTHER INFORMATION										
10.	High voltage		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Rated voltage Un (V)</td> <td style="text-align: center;">Test voltage (A.C. voltage 50 or 60Hz) (V)</td> </tr> <tr> <td style="text-align: center;">Up to 65</td> <td style="text-align: center;">2 x Un + 500</td> </tr> <tr> <td style="text-align: center;">66 to 250</td> <td style="text-align: center;">1500</td> </tr> <tr> <td style="text-align: center;">251 to 500</td> <td style="text-align: center;">2000</td> </tr> <tr> <td style="text-align: center;">501 to 690</td> <td style="text-align: center;">2500</td> </tr> </table>	Rated voltage Un (V)	Test voltage (A.C. voltage 50 or 60Hz) (V)	Up to 65	2 x Un + 500	66 to 250	1500	251 to 500	2000	501 to 690	2500	<ul style="list-style-type: none"> - for high voltage equipment, reference is made to UR E11. - separate circuits shall 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
Rated voltage Un (V)	Test voltage (A.C. voltage 50 or 60Hz) (V)													
Up to 65	2 x Un + 500													
66 to 250	1500													
251 to 500	2000													
501 to 690	2500													
11.	Cold	IEC Publication 60068-2-1	Temperature: +5°C ± 3°C Duration: 2 hours or Temperature: -25°C ± 3°C Duration: 2 hours (see note 2)	<ul style="list-style-type: none"> - initial measurement of insulation resistance; - equipment not operating during conditioning and testing except for performance test; - performance test during the last hour at the test temperature; - insulation resistance measurement and the performance test after recovery 										
12.	Salt mist	IEC Publication 60068-2-52 Test Kb	Four spraying periods with a storage of 7 days after each	<ul style="list-style-type: none"> - initial measurement of insulation resistance and initial performance test; - equipment not operating during conditioning; - performance test on the 7th day of each storage period; - insulation resistance measurement and performance test 4 to 6h after recovery. (see Note 3) - on completion of exposure, the equipment shall be examined to verify that deterioration or corrosion (if any) is superficial in nature. 										
13.	Electrostatic discharge	IEC 61000-4-2	Contact discharge: 6kV Air discharge: 8kV Interval between single discharges: 1 sec. No. of pulses: 10 per polarity According to test level 3.	<ul style="list-style-type: none"> - to simulate electrostatic discharge as may occur when persons touch the appliance; - the test shall be confined to the points and surfaces that can normally be reached by the operator; - Performance Criterion B (See Note 4). 										

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14.	Electromagnetic field	IEC 61000-4-3	Frequency range: 80 MHz to 2 GHz Modulation**: 80% AM at 1000Hz Field strength: 10V/m Frequency sweep rate: $\leq 1.5 \times 10^{-3}$ decades/s (or 1%/3 sec) According to test level 3.	<ul style="list-style-type: none"> - to simulate electromagnetic fields radiated by different transmitters; - the test shall be confined to the appliances exposed to direct radiation by transmitters at their place of installation. - Performance criterion A (See Note 5) <p>**If for tests of equipment an input signal with a modulation frequency of 1000 Hz is necessary a modulation frequency of 400 Hz may be chosen.</p>
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 2 W.</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 criterion A (see Note 5). - See figure - "Test set-up"
16.	Conducted Radio Frequency	IEC 61000-4-6	AC, DC, I/O ports and signal/control lines: Frequency range: 150 kHz - 80 MHz Amplitude: 3 V rms (See Note 6) Modulation ***: 80% AM at 1000 Hz Frequency sweep range: $\leq 1.5 \times 10^{-3}$ decades/s (or 1%/3sec.) According to test level 2	<ul style="list-style-type: none"> - equipment design and the choice of materials shall stimulate electromagnetic fields coupled as high frequency into the test specimen via the connecting lines. - performance criterion A (see Note 5). <p>*** If for tests of equipment an input signal with a modulation frequency of 1000 Hz is necessary a modulation frequency of 400 Hz may be chosen.</p>
17.	Burst/Fast Transients	IEC 61000-4-4	Single pulse rise time: 5 ns (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 criterion B (see Note 4).

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NO.	TEST	PROCEDURE ACC. TO:*	TEST PARAMETERS	OTHER INFORMATION	
18.	Surge immunity	IEC 61000-4-5	<p>Open-circuit voltage: Pulse rise time: 1.2 μs (front time) Pulse width: 50 μs (time to half value) Amplitude (peak): 1kV line/earth; 0.5kV line/line</p> <p>Short-circuit current: Pulse rise time: 8 μs (front time) Pulse width: 20 μs (time to half value) Repetition rate: \geq 1 pulse/min No of pulses: 5 per polarity Application: continuous According to test level 2.</p>	<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 (see Note 4). 	
19.	Radiated Emission	CISPR 16-1, 16-2	For equipment installed in the bridge and deck zone.	<ul style="list-style-type: none"> - procedure in accordance with the standard but distance 3 m between equipment and antenna - alternatively the radiation limit at a distance of 3 m from the enclosure port over the frequency 156 MHz to 165 MHz shall be 30 dBμV/m peak. 	
			Frequency range:		Quasi limits:
			0.15 - 0.3 MHz		80 - 52 dB μ V/m
			0.3 - 30 MHz		50 - 34 dB μ V/m
			30 - 2000 MHz		54 dB μ V/m
			except for: 156 -165 MHz		24 dB μ V/m
For equipment installed in the general power distribution zone.					
Frequency range:	Quasi limits:				
0.15 - 30 MHz	80 - 50 dB μ V/m				
30 - 100 MHz	60 - 54 dB μ V/m				
100 - 2000 MHz	54 dB μ V/m				
except for: 156 - 165 MHz	24 dB μ V/m				

EU RO Mutual Recognition Technical Requirements

COMPUTERS AND PROGRAMMABLE LOGIC CONTROLLERS (PLCS)	Version	0.4
	Adoption Date	July 2019
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NO.	TEST	PROCEDURE ACC. TO:*	TEST PARAMETERS	OTHER INFORMATION
20.	Conducted Emission	CISPR 16-1, 16-2	For equipment installed in the bridge and deck zone.	
			Frequency range: Limits:	
			10 - 150 kHz 96 - 50 dB μ V 150 - 350 kHz 60 - 50 dB μ V 350 kHz - 30 MHz 50 dB μ V	
			For equipment installed in the general power distribution zone.	
			Frequency range: Limits:	
			10 - 150 kHz 120 - 69 dB μ V 150 - 500 kHz 79 dB μ V 0.5 - 30 MHz 73 dB μ V	
21.	Flame retardant	IEC 60092-101	Flame application: 5 times 15 s each. Interval between each application: 15s or 1 time 30s. Test criteria based upon application.	- the burnt out or damaged part of the specimen by not more than 60 mm long.
		or IEC 60695-11-5	The test is performed with the EUT or housing of the EUT applying needle-flame test method.	- no flame, 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.
22.	Compass safe distance measurement	IEC 60945		- the test is applied to equipment intended for installation on the navigation bridge
23.	Acoustic noise and signals measurement	IEC 60945		- the test is applied to equipment intended for installation on the navigation bridge

Notes:

1. Equipment to be mounted in consoles, housing etc. together with other equipment shall be tested with 70°C.
2. For equipment installed in non-weather protected locations or cold locations test shall be carried out at -25°C.
3. Salt mist test shall be carried out for equipment installed in weather exposed areas.
4. Performance Criterion B: (For transient phenomena): The EUT shall continue to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by 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.

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5. Performance Criterion A: (For continuous phenomena): The Equipment Under Test shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed as defined in relevant equipment standard and the technical specification published by the manufacturer.

6. 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.

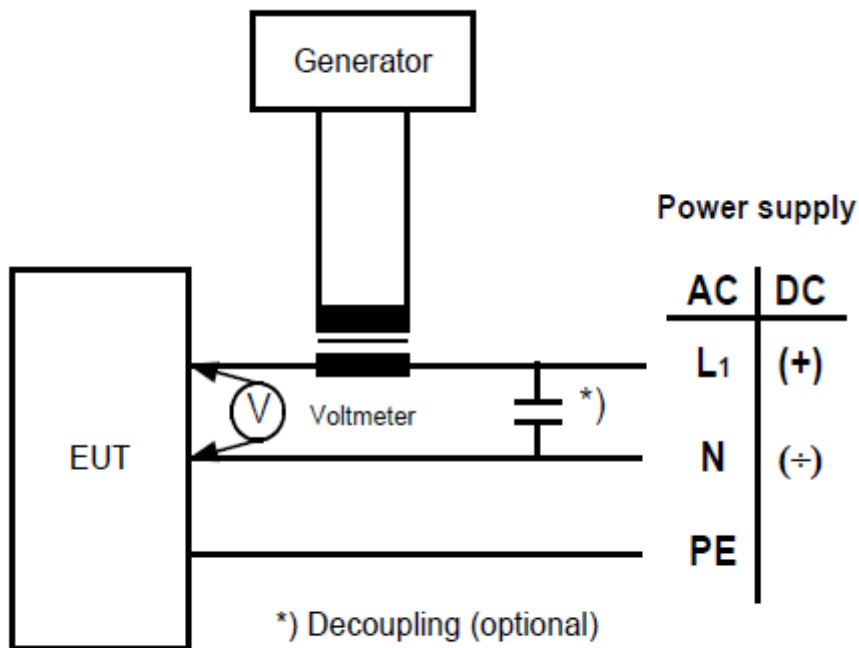


Figure - Test Set-up – Conducted Low Frequency Test

- END -