CE

TEST REPORT

Report No.:	**STE23121902S**
Product:	Adjustable speed electrical power drive systems
Model No.:	G022, (others refer to page 2)
Prepared for:	**DELIXI HANGZHOU INVERTER CO., LTD.**
Address:	No. 8, Economic Plot, Zhuantang Science and Technology Park, Zhuantang Street, Xihu District, Hangzhou, Zhejiang, China
Prepared by:	**Shenzhen STE Testing Laboratory Co., Ltd.**
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TEST REPORT
EN 61800-5-1
Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy

Report Number.....:	STE23121902S
Tested by (name + signature).....:	Ada Lin / Test engineer
Approved by (name + signature).....:	Navy Jiang / Project manager
Date of issue.....:	December 19, 2023
Total number of pages.....:	53
Testing Laboratory .....:	**Shenzhen STE Testing Laboratory Co., Ltd.**
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Applicant's name.....:	**DELIXI HANGZHOU INVERTER CO., LTD.**
Address.....:	No. 8, Economic Plot, Zhuantang Science and Technology Park, Zhuantang Street, Xihu District, Hangzhou, Zhejiang, China
Manufacturer's name.....:	**DELIXI HANGZHOU INVERTER CO., LTD.**
Address.....:	No. 8, Economic Plot, Zhuantang Science and Technology Park, Zhuantang Street, Xihu District, Hangzhou, Zhejiang, China
Test specification:	
Standard.....:	EN 61800-5-1: 2007 EN 61800-5-1: 2007/A1: 2017 EN 61800-5-1: 2007/A11: 2021
Test procedure.....:	Type test
Non-standard test method.....:	DELIXI
Test Report Form No.....:	IEC61800_5_1C
Test Report Form(s) Originator.....:	STE
Master TRF.....:	Dated 2022-02

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Test item description.....:	Adjustable speed electrical power drive systems
Model/Type reference.....:	**G022**, G0R4, G0R75, G1R1, G1R5, G2R2, G3R7, G5R5, G7R5, G011, G015, G018.5
Trade Mark.....:	DELIXI
Ratings.....:	Input: 380V 3~, 50/60Hz, 46.5A; / 550V ⎓, 46.5A; Output: 380V 3~, 50/60Hz, 45A

Summary of testing:

Testing location:

Shenzhen STE Testing Laboratory Co., Ltd.

3/F, Building 9, Dehong Factory Building, No. 63 Yuchang Road, Niuhu Community, Guanlan Street, Longhua District, Shenzhen, China

Tests performed (name of test and test clause):

- EN 61800-5-1: 2007
- EN 61800-5-1: 2007/A1: 2017
- EN 61800-5-1: 2007/A11: 2021

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

DELIXI

Adjustable speed electrical power drive systems

Model: G022

Input: 380V 3~, 50/60Hz, 46.5A; /
550V ⎓, 46.5A;
Output: 380V 3~, 50/60Hz, 45A

CE

DELIXI HANGZHOU INVERTER CO., LTD.
No. 8, Economic Plot, Zhuantang Science and Technology Park,
Zhuantang Street, Xihu District, Hangzhou, Zhejiang, China
Importer: xxxx
Address: xxxx

Made in China

Remarks:

1. Representative markings of G022, markings of all models are identical except for the model name and rating.

2. Height of CE mark is 5mm or more, height of WEEE symbol is 7mm or more, height of other marks is 5mm or more, height of letters and numerals is 2mm or more.

Test item particulars..... :	
Equipment under test .....:	☒ PDS ☐ CDM ☐ BDM ☐ Other:
Equipment location .....:	☐ stand alone ☒ for building-in (open type)
Supply earthing systems and system voltage (V) .....:	TN-S, TT (corner earthed)
Class of equipment .....:	☒ Class I ☐ Class II ☐ Class 0 ☐ Class III
Mains supply overvoltage category (OVC) .....:	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Pollution degree (PD) .....:	[ ] PD 1 [X] PD 2 [ ] PD 3
IP protection class ..... :	IPX0
Altitude during operation (m) .....:	Not over 2000m
Altitude of test laboratory (m) .....:	Not over 2000m
Possible test case verdicts:	
- test case does not apply to the test object..... :	N or N/A (Not Applicable)
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing..... :	
Date of receipt of test item.....:	November 13, 2023
Date (s) of performance of tests..... :	November 13, 2023 to December 19, 2023

General remarks:
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....:	☐ **Yes** ☒ **Not applicable**

General product information

1.. Instructions and equipment marking related to safety is applied in the language that is acceptable in the country in which the equipment is to be sold.

2. The product was submitted and tested for use at the manufacturer's recommended ambient temperature (Tma) of 40°C.

3. All models are same except appearance and rating current. All tests were conducted on model G022 as worst conditions.

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
4	**Protection against electric shock, thermal, and energy hazards**		P
4.1	**General**		P
4.2	**Fault conditions**	See appended table 5.2.3.6 and 5.2.4	P
	PDS shall be designed to avoid operating modes or sequences that can cause a fault condition or component failure leading to a hazard, unless other measures to prevent the hazard are provided by the installation.	Fault can not lead hazard.	P
	Protection against thermal hazards and electric shock shall be maintained in single fault conditions as well as under normal conditions.		P
	Circuit analysis shall be performed to identify components (including insulation systems) whose failure would result in a thermal or electric shock hazard. The analysis shall include the effect of short-circuit and open-circuit conditions of the component. The analysis need not include power semiconductor devices if equivalent testing is accomplished during short-circuit tests, or components which have been determined to have an insignificant probability of failure during the expected lifetime of the PDS. See 5.2.3.6.4 for test.		P
4.3	**Protection against electric shock**		P
4.3.1	**Decisive voltage classification**		P
4.3.1.1	Use of decisive voltage class (DVC)	Class B	P
4.3.1.2	Limits of DVC		P
4.3.1.3	Requirements for protection		P
4.3.1.4	Circuit evaluation		N
4.3.1.4.1	General		N
	The DVC of a given circuit is evaluated by the method set out below, three cases of waveforms being considered.		N
4.3.1.4.2	A.C. working voltage		P
4.3.1.4.3	D.C. working voltage		N
4.3.1.4.4	Pulsating working voltage		N
4.3.2	**Protective separation**	See appended table 5.2.3	P
	Protective separation shall be achieved by application of materials resistant to degradation, as well as by special constructive measures; and		P
	by double or reinforced insulation, or		P

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Clause	Requirement + Test	Result - Remark	Verdict
	by protective screening, i.e. by a conductive screen connected to earth by protective bonding of the PDS, or connected to the protective earth conductor itself, whereby the screen is separated from live parts by at least basic insulation, or	No protective screening.	N
	by protective impedance according to 4.3.4.3 comprising limitation of discharge energy and of current, or by limitation of voltage according to 4.3.4.4.		N
4.3.3	**Protection against direct contact**		N
4.3.3.1	General		N
	Protection against direct contact is employed to prevent persons from touching live parts which do not meet the requirements of 4.3.4. It shall be provided by one or more of the measures given in 4.3.3.2 and 4.3.3.3.		P
	For integrated PDS the motor shall meet the requirements of IEC 60034-5. For the BDM the protection shall be provided by one or more of the measures given in 4.3.3.2 and 4.3.3.3.		P
4.3.3.2	Protection by means of insulation of live parts		P
	Live parts shall be completely surrounded with insulation if their working voltage is greater than the maximum limit of DVC A or if they do not have protective separation from adjacent circuits of DVC C or D. The insulation shall be rated according to the impulse voltage, temporary overvoltage or working voltage (see 4.3.6.2.1), whichever gives the most severe requirement. It shall not be possible to remove the insulation without the use of a tool.	DVC B.	N
	Any conductive part which is not separated from the live parts by at least basic insulation is considered to be a live part. A metallic accessible part is considered to be conductive if its surface is bare or is covered by an insulating layer which does not comply with the requirements of basic insulation.		P
	The grade of insulation – basic, double or reinforced – depends on:		P
	the DVC of the live parts or adjacent circuits, and		P
	the connection of conductive parts to earth by protective bonding.		P
4.3.3.3	Protection by means of enclosures and barriers		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Live parts of DVC B, C or D shall be arranged in enclosures or located behind enclosures or barriers, which meet at least the requirements of the Protective Type IPXXB according to 15.1 of IEC 60529. The top surfaces of enclosures or barriers which are accessible when the equipment is energized shall meet at least the requirements of the Protective Type IP3X with regard to vertical access only. See 5.2.2.3 for test. It shall only be possible to open enclosures or remove barriers with the use of a tool or after de-energization of these live parts.		P
	Where the enclosure is required to be opened and the PDS energised during installation or maintenance:		P
	a) accessible live parts of DVC B, C or D shall be protected to at least IPXXA;		N
	b) live parts of DVC B, C or D that are likely to be touched when making adjustments shall be protected to at least IPXXB;		N
	c) it shall be ensured that persons are aware that live parts of DVC B, C or D are accessible.		P
4.3.4	**Protection in case of direct contact**		P
4.3.4.1	General		P
	Protection in case of direct contact is required to ensure that contact with live parts does not produce a shock hazard.	Live parts do not produce a shock hazard.	P
	The protection against direct contact according to 4.3.3 is not required if the circuit contacted is separated from all other circuits according to 4.3.1.3, and:		P
	is of DVC A and complies with 4.3.4.2, or		N
	is current limited via a protective impedance according to 4.3.4.3, or		N
	is limited in voltage according to 4.3.4.4.		P
4.3.4.2	Protection using DVC A	DVC B	N
	Unearthed circuits of DVC A, and earthed circuits of DVC A used within a zone of equipotential bonding (see 3.44), do not require protection in case of direct contact.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Earthed circuits of DVC A that are not within a zone of equipotential bonding require additional protection in case of direct contact, by one of the measures given in 4.3.4.3 or 4.3.4.4, in order to provide protection in cases where the earth reference potentials of the DVC A circuits are not the same. The instruction manual shall provide information concerning the use of these circuits (see 6.3.6.5).		N
4.3.4.3	Protection by means of protective impedance		N
	The connection of accessible live parts to circuits of DVC B, C or D, or to earthed circuits of DVC A not used within a zone of equipotential bonding, shall only be made through protective impedances (unless 4.3.4.4 applies).		N
	The same constructional provisions as those for protective separation shall be applied for the construction and arrangement of a protective impedance. The current value stated below shall not be exceeded in the event of failure of a single component. The stored charge available between simultaneously accessible parts protected by the protective impedance shall not exceed 50uC.		N
	The protective impedances shall be designed so that the current available through them to earth at the accessible live part does not exceed a value of 3,5 mA a.c. or 10 mA d.c. See 5.2.3.4 for test.		N
	The protective impedances shall be designed and tested to withstand the impulse voltages and temporary overvoltages for the circuits to which they are connected. See 5.2.3.1 and 5.2.3.2 for tests.		N
4.3.4.4	Protection by means of limited voltages		P
	This type of protection implies a voltage division technique from a circuit protected against direct contact, resulting in a voltage to earth not greater than that of DVC A.		N
	This circuit shall be designed so that, even in the event of failure of a single component in the voltage division circuit, the voltage across output terminals as well as the voltage to earth will not become greater than that of DVC A. The same constructional measures as in protective separation shall be employed in this case.		N
4.3.5	**Protection against indirect contact**		P
4.3.5.1	General		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Protection against indirect contact is required to prevent shock currents which can result from accessible conductive parts during an insulation failure. This protection shall comply with the requirements for protective class I, class II or class III.	Comply with the requirements for protective class I.	P
	That part of a PDS which meets the requirements of 4.3.5.2, 4.3.5.3 and 4.3.5.3.2 is defined as protective class I.		P
	That part of a PDS which meets the requirements of 4.3.5.6 is defined as protective class II.		N
	That part of a PDS which meets the requirements of SELV is defined as protective class III.		N
	Protective class 0 is only acceptable for parts of the PDS when instructions are provided to meet the requirements of 4.3.3.3 (closed electrical operating areas) (see 6.3.6.5). In the case of high-voltage PDS, special requirements exist (see 4.3.12).	No high-voltage.	N
4.3.5.2.	Insulation between live parts and accessible conductive parts		P
	Accessible conductive parts of equipment shall be separated from live parts at least by basic insulation or by clearances as in 4.3.6.4.		P
4.3.5.3	Protective bonding circuit		P
4.3.5.3.1	General		P
	Other than in a) or b) below, protective bonding shall be provided between accessible conductive parts of equipment and the means of connection for the protective earthing conductor:		P
	a) when accessible conductive parts are protected by one of the measures in 4.3.4.2 to 4.3.4.4;		N
	b) when accessible conductive parts are separated from live parts using double or reinforced insulation.		P
	For high-voltage PDS, metal ducts and metal sheathing of all connecting cables (e.g. cable armouring, lead sheath) shall be connected to earth by the protective bonding circuit. If only one end of such ducting or sheathing is so connected, it shall not be possible to touch the other end. This shall be connected to earth by the protective bonding circuit via an impedance to limit any induced voltage to a maximum of 50Va.c.	No sheathing used.	N
4.3.5.3.2	Rating of protective bonding		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Protective bonding shall withstand the highest thermal and dynamic stresses that can occur to the PDS/CDM/BDM item(s) concerned when they are subjected to a fault connecting to accessible conductive parts.		P
	The protective bonding shall remain effective for as long as a fault to the accessible conductive parts persists or until an upstream protective device removes power from the part.		P
4.3.5.3.3	Protective bonding impedance		P
4.3.5.4	Protective earthing conductor		P
	A protective earthing conductor shall be connected at all times when power is supplied to the PDS/CDM/BDM, unless the PDS/CDM/BDM complies with the requirements of protective class II (see 4.3.5.6). Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from Table 5 or by calculation according to 543.1 of IEC 60364-5-54.		P
	If the protective earthing conductor is routed through a plug and socket, or similar means of disconnection, it shall not be possible to disconnect it unless power is simultaneously removed from the part to be protected.		N
	The cross-sectional area of every protective earthing conductor which does not form part of the supply cable or cable enclosure shall, in any case, be not less than: 2,5 mm2 if mechanical protection is provided, or 4 mm2 if mechanical protection is not provided. For cord-connected equipment, provisions shall be made so that the protective earthing conductor in the cord shall, in the case of failure of the strain-relief mechanism, be the last conductor to be interrupted.		P
4.3.5.5	Means of connection for the protective earthing conductor		P
4.3.5.5.1	General		P
	Every PDS or PDS element (motor, converter, transformer) requiring connection to earth by protective bonding shall have a means of connection for the protective earthing conductor, located near the terminals for the respective live conductors.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The means of connection shall be corrosion-resistant and shall be suitable for the connection of cables according to Table 5 and of cables in accordance with the wiring rules applicable at the installation.		P
	The means of connection for the protective earthing conductor shall not be used as a part of the mechanical assembly of the equipment or for other connections. A separate means of connection shall be provided for each protective earthing conductor.		P
	For high-voltage PDS, protective shields of high voltage cables shall have provision for connection to earth by protective bonding in accordance with IEC 60204-11 and IEC 61800-4. The protective bonding concept shall be by agreement between the supplier and user and consistent with local requirements in the area of installation.	No high-voltage.	N
	Connection and bonding points shall be designed so that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and/or conductors of aluminium or aluminium alloys are used, particular attention should be given to the problems of electrolytic corrosion.		N
4.3.5.5.2	Touch current in case of failure of protective earthing conductor		P
	For plug-connected single phase PDS/CDM/BDM, not using an industrial connector according to IEC 60309, the touch current (measured in accordance with 5.2.3.5) shall not exceed 3,5mA a.c. or 10mA d.c.		N
	For all other PDS/CDM/BDM, one or more of the following measures shall be applied, unless the touch current (measured in accordance with 5.2.3.5) can be shown to be less than 3,5mA a.c. or 10mA d.c.		P
	a) A fixed connection and: a cross-section of the protective earthing conductor of at least 10 mm2 Cu or 16 mm2 Al, or automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or provision of an additional terminal for a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor,		N

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Clause	Requirement + Test	Result - Remark	Verdict
	b) connection with an industrial connector according to IEC 60309 and a minimum protective earthing conductor cross-section of 2,5 mm2 as part of a multi-conductor power cable. Adequate strain relief shall be provided.		P
4.3.5.6	Special features in equipment for protective class II		N
	If equipment is designed to use double or reinforced insulation between live parts and accessible surfaces in accordance with 4.3.3.2, then the design is considered to meet protective class II, if the following also apply.		N
	Equipment designed to protective class II shall not have means of connection for the protective earthing conductor. However this does not apply if a protective earthing conductor is passed through the equipment to equipment series-connected beyond it. In the latter event, the protective earthing conductor and its means for connection shall be insulated with basic insulation from the accessible surface of the equipment and from circuits which employ protective separation, extra-low voltage, protective impedance and limited discharging energy, according to 4.3.4. This basic insulation shall correspond to the rated voltage of the series-connected equipment. Metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding conductor. Equipment of protective class II may have provision for the connection of an earthing conductor for functional reasons or for the damping of overvoltages; it shall, however, be insulated as though it is a live part. Equipment of protective class II shall be marked according to 6.3.6.6.		N
4.3.6	**Insulation**		P
4.3.6.1	General		P
4.3.6.1.1	Influencing factors		P
	Manufacturing tolerances shall be taken into account during design and installation of the PDS.		P
	For integrated PDS the motor insulation system shall meet the requirements of the relevant part of IEC 60034. The CDM/BDM shall comply with the requirements of 4.3.6.		N
4.3.6.1.2	Pollution degree	Pollution degree 2.	P

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Clause	Requirement + Test	Result - Remark	Verdict
	Insulation, especially when provided by clearances and creepage distances, is affected by pollution which occurs during the expected lifetime of the PDS.		P
	The insulation may be determined according to pollution degree 2 if one of the following applies: a) instructions are provided with the PDS indicating that it shall be installed in a pollution degree 2 environment, or		P
	b) the specific installation application of the PDS is known to be a pollution degree 2 environment, or		N
	c) the PDS enclosure or coatings applied within the PDS according to 4.3.6.8.4.2 or 4.3.6.8.6 provide adequate protection against what is expected in pollution degree 3 and 4 (conductive pollution and condensation).		N
4.3.6.1.3	Overvoltage category	Category II.	P
	The concept of overvoltage categories (based on IEC 60364-4-44 and IEC 60664-1) is used for equipment energized from the supply mains. Four categories are considered:		P
	category IV applies to equipment permanently connected at the origin of an installation (upstream of the main distribution board). Examples are electricity meters, primary overcurrent protection equipment and other equipment connected directly to outdoor open lines; category III applies to equipment permanently connected in fixed installations (downstream of, and including, the main distribution board). Examples are switchgear and other equipment in an industrial installation; category II applies to equipment not permanently connected to the fixed installation. Examples are appliances, portable tools and other plug-connected equipment; category I applies to equipment connected to a circuit where measures have been taken to reduce transient overvoltages to a low level.		P
4.3.6.1.4	Supply earthing systems	TN system	P

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Clause	Requirement + Test	Result - Remark	Verdict
	IEC 60364-1describes the three following basic types of earthing system. TN system: has one point directly earthed, the accessible conductive parts of the installation being connected to that point by protective conductors. Three types of TN system, TN-C, TN-S and TN-C-S, are defined according to the arrangement of the neutral and protective conductors. TT system: has one point directly earthed, the accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system. IT system: has all live parts isolated from earth or one point connected to earth through an impedance, the accessible conductive parts of the installation being earthed independently or collectively to the earthing system.		P
4.3.6.1.5	Insulation voltages		P
4.3.6.2	Insulation to the surroundings		P
4.3.6.2.1	General		P
	Insulation for basic, supplementary, and reinforced insulation between a circuit and its surroundings shall be designed according to: the impulse voltage, or the temporary overvoltage, or the working voltage of the circuit.		P
4.3.6.2.2	Circuits connected directly to the supply mains		P
	Insulation between the surroundings and circuits which are connected directly to the supply mains shall be designed according to the impulse voltage, temporary overvoltage, or working voltage, whichever gives the most severe requirement.		P
	This insulation is normally evaluated to withstand impulses of overvoltage category III, except that overvoltage category IV shall be used when the PDS is connected at the origin of the installation. Overvoltage category II may be used for plug-in equipment connected to a supply for non-industrial purposes without special requirements with regard to reliability.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	If measures are provided which reduce impulses of overvoltage category IV to values category III, or values of category III to values of category II, basic or supplementary insulation may be designed for the reduced values. If the devices used for this purpose can damaged by overvoltages or repeated impulses, thus decreasing their ability to reduce impulses, they shall be monitored and an indication of their status provided. For low-voltage applications, IEC 61643-12 provides information on the selection and use of such devices.		N
4.3.6.2.3	Circuits not connected directly to the supply mains		N
	Insulation between the surroundings and circuits supplied by a transformer providing galvanic isolation from the supply mains shall be designed according to: a) the impulse voltage determined using the transformer secondary voltage as the system voltage; or b) the working voltage, whichever gives the more severe requirement.		N
	This insulation is normally evaluated to withstand impulses of overvoltage category II, except that overvoltage category III shall be used when the PDS is connected at the origin of the installation.		N
	If measures are provided which reduce impulses of overvoltage category III to values of category II, or, for low-voltage PDS only, values of category II to values of category I, basic or supplementary insulation may be designed for the reduced value. If the devices used for this purpose can be damaged by overvoltages or repeated impulses, thus decreasing their ability to reduce impulses, they shall be monitored and an indication of their status provided. For low voltage applications, IEC 61643-12 provides information on the selection and use of such devices.		N
4.3.6.2.4	Insulation between circuits		N
	Insulation between two circuits shall be designed according to the circuit having the more severe requirement.		N
4.3.6.3	Functional insulation		P
	For parts or circuits that are not significantly affected by external transients, functional insulation shall be designed according to the working voltage across the insulation.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	For parts or circuits that are significantly affected by external transients, functional insulation shall be designed according to the impulse voltage of overvoltage category II, except that overvoltage category III shall be used when the PDS is connected at the origin of the installation.		N
4.3.6.4	Clearance distances	See appended table 5.2.2.1	P
4.3.6.4.1	Determination		P
4.3.6.4.2	Electric field homogeneity		P
4.3.6.4.3	Clearance to conductive enclosures		P
	The clearance between any non-insulated live part and the walls of a metal enclosure shall be in accordance with 4.3.6.4.1 following the deformation tests of 5.2.2.5.	Non-metal enclosure.	N
	If the design clearance is at least 12,7 mm and the clearance required by 4.3.6.4.1 does not exceed 8 mm, the deformation tests may be omitted.		P
4.3.6.5	Creepage distances	See appended table 5.2.2.1	N
4.3.6.5.1	General		N
	Creepage distances shall be verified by measurement or inspection (see 5.2.2.1) (see Annex C for examples of creepage distances).		N
4.3.6.5.2	Materials	Insulating material group IIIb	P
	Insulating materials are classified into four groups corresponding to their comparative tracking index (CTI) when tested according to 6.2 of IEC 60112		P
	Creepage distances on printed wiring boards (PWBs) exposed to pollution degree 3 environmental conditions shall be determined based on Table 10 Pollution degree 3 under “Other insulators”.	Pollution degree 2 environmental conditions	N
	If the creepage distance is ribbed, then the creepage distance of insulating material of group I may be applied using insulating material of group II and the creepage distance of insulating material of group II may be applied using insulating material of group III. Except at pollution degree 1 the ribs shall be 2 mm high at least. The spacing of the ribs shall equal or exceed the dimension ‘X’ in Table C.1.		P
4.3.6.6	Coating	No coating.	N
	A coating may be used to provide insulation, to protect a surface against pollution, and to allow a reduction in creepage and clearance distances (see 4.3.6.8.4.2 and 4.3.6.8.6).		N

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Clause	Requirement + Test	Result - Remark	Verdict
4.3.6.7	PWB spacings for functional insulation		P
	Spacings for functional insulation on a PWB which do not comply with 4.3.6.4 and 4.3.6.5 are permitted when all the following are satisfied: the PWB has a flammability rating of V-0 (see IEC 60695-11-10); the PWB base material has a minimum CTI of 100; the equipment complies with the PWB short-circuit test (see 5.2.2.2). On PWB creepage and clearance distances for functional insulation at working voltages less than 80 V (r.m.s.) or 110 V (recurring peak) are permitted to be evaluated according to pollution degree 1 if the tracks are covered with a suitable coating.		P
4.3.6.8	Solid insulation	No solid insulation.	N
4.3.6.8.1	General		N
	Materials selected for solid insulation shall be able to withstand the stresses occurring. These include mechanical, electrical, thermal and climatic stresses which are to be expected in normal use. Insulation materials shall also be resistant to ageing during the expected lifetime of the PDS.		N
	Tests shall be performed on components and subassemblies using solid insulation, in order to ensure that the insulation performance has not been compromised by the design or manufacturing process.		N
4.3.6.8.2	Requirements for electrical withstand capability		N
4.3.6.8.2.1	Basic or supplementary insulation		N
	Test with impulse withstand voltage according to 5.2.3.1, column 2 or column 4 of Table 19, or Table 20, column 2 or 4, as appropriate; and		N
	Test with a.c. or d.c. voltage according to 5.2.3.2, column 2 of Table 21, Table 22, or Table23, as appropriate.		N
4.3.6.8.2.2	Double and reinforced insulation		N
	Test with impulse withstand voltage according to 5.2.3.1 Table 19, column 3 or column 5, or Table 20, column 3 or 5 as appropriate; and		N
	test with a.c. or d.c. voltage according to 5.2.3.2, column 3 of Table 21, Table 22, or Table 23, as appropriate; and		N

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Clause	Requirement + Test	Result - Remark	Verdict
	partial discharge test according to 5.2.3.3, if the recurring peak working voltage across the insulation is greater than 750 V and the voltage stress on the insulation is greater than 1 kV/mm.		N
4.3.6.8.2.3	Functional insulation		N
	Functional insulation shall comply with the requirements of 4.3.6.3. Testing is not required, except where the circuit analysis required by 4.2 shows that failure of the insulation could result in a hazard. In these cases, the insulation shall meet the requirements and tests for basic insulation.		N
4.3.6.8.3	Thin sheet or tape material	Insulating tape used in Transformer as reinforced insulation.	P
4.3.6.8.3.1	General		P
	Subclause 4.3.6.8.3 applies to the use of thin sheet or tape materials in assemblies such as wound components and bus-bars.		P
	Insulation consisting of thin (less than 0,75mm) sheet or tape materials is permitted, provided that it is protected from damage and is not subject to mechanical stress under normal use.		P
4.3.6.8.3.2	Material thickness not less than 0,2 mm		P
	Basic or supplementary insulation shall consist of at least one layer of material		N
	Double insulation shall consist of at least two layers of material		N
	Reinforced insulation shall consist of a single layer of material	3 layers insulating tape.	P
4.3.6.8.3.3	Material thickness less than 0,2 mm	Not less than 0,2 mm	N
	Basic or supplementary insulation shall consist of at least one layer of material		N
	Double insulation shall consist of at least three layers of material		N
	Reinforced insulation consisting of a single layer of material is not permitted.		N
4.3.6.8.3.4	Compliance		P
	When a component or sub-assembly makes use of thin sheet insulating materials, it is permitted to perform the tests on the component rather than on the material.		P
4.3.6.8.4	Printed wiring boards (PWBs)		P
4.3.6.8.4.1	General		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Insulation between conductor layers in double-sided single-layer PWBs, multi-layer PWBs and metal core PWBs, shall meet the requirements of 4.3.6.8.1. Basic, supplementary, double and reinforced insulation shall meet the appropriate requirements of 4.3.6.8.2.1 or 4.3.6.8.2.2. Functional insulation in PWBs shall meet the requirements of 4.3.6.8.2.3.	Double-sided single-layer PWBs	P
	For the inner layers of multi-layer PWBs, the insulation between adjacent tracks on the same layer shall be treated as either: a creepage distance for pollution degree 1 and a clearance as in air (see Example C.14 of Annex C); or solid insulation, in which case it shall meet the requirements of 4.3.6.8.1 and 4.3.6.8.2.		N
4.3.6.8.4.2	Use of coating materials	No coating material used.	N
	Type 1 protection (as defined in IEC 60664-3) improves the microenvironment of the parts under protection. The clearance and creepage distance of Table 9 and Table 10 for pollution degree 1 apply under the protection. Between two conductive parts, it is a requirement that one or both conductive parts, together with all the spacing between them, are covered by the protection.		N
	Type 2 protection is considered to be similar to solid insulation. Under the protection, the requirements for solid insulation specified in 4.3.6.8 are applicable and spacings shall not be less than those specified in Table 1 of IEC 60664-3. The requirements for clearance and creepage in Table 9 and Table 10 do not apply. Between two conductive parts, it is a requirement that both conductive parts, together with the spacing between them, are covered by the protection so that no airgap exists between the protective material, the conductive parts and the printed boards.		N
	The coating material used to provide Type 1 and Type 2 protection shall be designed to withstand the stresses anticipated to occur during the expected lifetime of the PDS/CDM/BDM. A type test on representative PWBs shall be conducted according to IEC 60664-3 Clause 5. For the Cold test (5.7.1), a temperature of -25°C shall be used, and for the Rapid change of temperature test (5.7.3): -25°C to +125°C.		N

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Clause	Requirement + Test	Result - Remark	Verdict
4.3.6.8.5	Wound components		P
	Varnish or enamel insulation of wires shall not be used for basic, supplementary, double or reinforced insulation.	Varnish used in Transformer as reinforced insulation.	P
	Wound components shall meet the requirements of 4.3.6.8.1 and 4.3.6.8.2.		P
	The component itself shall pass the requirements given in 4.3.6.8.1 and 4.3.6.8.2. If the component has reinforced or double insulation, the voltage test of 5.2.3.2 shall be performed as a routine test.		P
4.3.6.8.6	Potting materials	No potting materials used.	N
	A potting material may be used to provide solid insulation or to act as a coating to protect against pollution. If used as solid insulation, it shall comply with the requirements of 4.3.6.8.1and 4.3.6.8.2. If used to protect against pollution, the requirements for Type 1 protection in 4.3.6.8.4.2 apply.		N
4.3.6.9	Insulation requirements above 30 kHz		P
	Where voltages across insulation have fundamental frequencies greater than 30 kHz, further considerations apply. For low-voltage circuits, guidance is provided in IEC 60664-4.		P
	Annex E contains flow-charts for the determination of clearance and creepage distances under these circumstances. For information, Tables 1 and 2 of IEC 60664-4 are also included in Annex E.		N
4.3.7	**Enclosures**		P
4.3.7.1	General		P
	Metal enclosures shall comply with the deflection test of 5.2.2.5.2 or have a thickness as specified in 4.3.7.2 or 4.3.7.3.	Plastic enclosure used.	N
	Polymeric enclosures or polymeric parts, relied on to complete and maintain the integrity of an electrical enclosure, shall comply with the flammability requirements of 4.4.3 and the impact test in 5.2.2.5.3.		P
	For integrated PDS the CDM/BDM enclosure shall comply with the above requirements. The motor enclosure shall meet the requirements of the relevant parts of IEC 60034.		N
	Enclosures shall be suitable for use in their intended environments. The manufacturer shall specify the intended environment (see 6.3.3) and the IP rating of the enclosure (see 5.2.2.4 for test).		P

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Clause	Requirement + Test	Result - Remark	Verdict
	For integrated PDS the combination of motor and CDM/BDM shall be tested according to their intended environment. For external fans and drain holes of the motor part the requirements of IEC 60034-5 apply.		N
4.3.7.2	Cast metal	No cast metal.	N
	Die-cast metal, except at threaded holes for conduit, where a minimum of 6,4 mm is required, shall be: not less than 2,0 mm thick for an area larger than 155 cm2 or having any dimension larger than 150 mm; not less than 1,2 mm thick for an area of 155 cm2 or less and having no dimension larger than 150 mm.		N
	Malleable iron or permanent-mould cast aluminium, brass, bronze, or zinc, except at threaded holes for conduit, where a minimum of 6,4 mm is required, shall be: at least 2,4 mm thick for an area greater than 155 cm2 or having any dimension more than 150 mm; at least 1,5 mm thick for an area of 155 cm2 or less having no dimension more than 150 mm.		N
4.3.7.3	Sheet metal	No sheet metal.	N
	The thickness of a sheet-metal enclosure at points to which a wiring system is to be connected shall be not less than 0,8 mm thick for uncoated steel, 0,9 mm thick for zinc-coated steel, and 1,2 mm thick for non-ferrous metal.		N
	Enclosure thickness at points other than where a wiring system is to be connected shall be not less than that specified in Table 11 or Table 12.		N
	With reference to Table 11 and Table 12, a supporting frame is a structure of angle or channel or folded section of sheet metal, which is attached to and has the same outside dimensions as the enclosure surface, and which has torsional rigidity to resist the bending moments that are applied by the enclosure surface when it is deflected.		N
	A structure which is as rigid as one built with a frame of angles or channels has equivalent reinforcing. Constructions without supporting frame include:		N
	a single sheet with single formed flanges – formed edges		N

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Clause	Requirement + Test	Result - Remark	Verdict
	a single sheet which is corrugated or ribbed		N
	an enclosure surface loosely attached to a frame, for example, with spring clips		N
	an enclosure surface having an unsupported edge.		N
4.3.8	**Wiring and connections**		P
4.3.8.1	General		P
	The wiring and connections between parts of the equipment and within each part shall be protected from mechanical damage during installation. The insulation, conductors and routing of all wires of the equipment shall be suitable for the electrical, mechanical, thermal and environmental conditions of use. Conductors which are able to contact each other shall be provided with insulation rated for the DVC requirements of the relevant circuits.		P
4.3.8.2	Routing		P
	A hole through which insulated wires pass in a sheet metal wall within the enclosure of the equipment shall be provided with a smooth, well-rounded bushing or grommet or shall have smooth, well-rounded surfaces upon which the wires bear to reduce the risk of abrasion of the insulation.		P
	Wires shall be routed away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and similar parts, which abrade the wire insulation. The minimum bend radius specified by the wire manufacturer shall not be violated.	Wires do not touch sharp edges which could damage the insulation and cause hazard.	P
	Clamps and guides, either metallic or non-metallic, used for routing stationary internal wiring shall be provided with smooth, well-rounded edges. The clamping action and bearing surface shall be such that abrasion or cold flow of the insulation does not occur. If a metal clamp is used for conductors having thermoplastic insulation less than 0,8 mm thick, non-conducting mechanical protection shall be provided.	See above.	P
4.3.8.3.	Colour coding		N
	Insulated conductors, other than those which are integral to ribbon cable or multi-cord signal cable, identified by the colour green with or without one or more yellow stripes shall not be used other than for protective bonding.		N
4.3.8.4	Splices and connections		P
	All splices and connections shall be mechanically secure and shall provide electrical continuity.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Electrical connections shall be soldered, welded, crimped, or otherwise securely connected. A soldered joint, other than a component on a PWB, shall additionally be mechanically secured.		P
	When stranded internal wiring is connected to a wire-binding screw, the construction shall be such that loose strands of wire do not contact: other uninsulated live parts not always of the same potential as the wire; de-energized metal parts	No internal wiring is connected to a wire-binding screw.	N
	When screw terminal connections are used, the resulting connections may require routine maintenance (tightening). Appropriate reference shall be made in the maintenance manual (see 6.5.1).		P
4.3.8.5	Accessible connections		N
	In addition to measures given in 4.3.4.1 to 4.3.4.3 it shall be ensured that neither insertion error nor polarity reversal of connectors can lead to a voltage on an accessible connection higher than the maximum of DVC A. This applies for example to plug-in sub-assemblies or other plug-in devices which can be plugged in without the use of a tool (key) or which are accessible without the use of a tool. This does not apply to equipment intended to be installed in closed electrical operating areas.		N
	If relevant, non-interchangeability and protection against polarity reversal of connectors, plugs and socket outlets shall be confirmed by inspection and trial insertion.		N
4.3.8.6	Interconnections between parts of the PDS	No interconnections between parts of the PDS.	N
	In addition to complying with the requirements given in 4.3.8.1 to 4.3.8.5, the means provided for the interconnection between parts of the PDS shall comply with the following requirements or those of 4.3.8.7.		N
	Cable assemblies and flexible cords provided for interconnection between sections of equipment or between units of a system shall be suitable for the service or use involved. Cables shall be protected from physical damage as they leave the enclosure and shall be provided with mechanical strain relief.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Misalignment of male and female connectors, insertion of a multipin male connector in a female connector other than the one intended to receive it, and other manipulations of parts which are accessible to the operator shall not result in mechanical damage or a risk of thermal hazards, electric shock, or injury to persons.		N
	When external interconnecting cables terminate in a plug which mates with a receptacle on the external surface of an enclosure, no risk of electric shock shall exist at accessible contacts of either the plug or receptacle when disconnected.		N
4.3.8.7	Supply connections		N
	A PDS intended for permanent connection to the power supply shall have provision for connection to the applicable wiring system in accordance with the requirements where it is being installed. The connection points provided shall be of appropriate construction to preclude the possibility of loose strands reducing the spacing between conductors when careful attention is paid to installation.		N
4.3.8.8	Terminals		P
4.3.8.8.1	Construction requirements		P
	All parts of terminals which maintain contact and carry current shall be of metal having adequate mechanical strength.		P
	Terminal connections shall be such that the conductors can be connected by means of screws, springs or other equivalent means so as to ensure that the necessary contact pressure is maintained.		P
	Terminals shall be so constructed that the conductors can be clamped between suitable surfaces without any significant damage either to conductors or terminals.		N
	Terminals shall not allow the conductors to be displaced or be displaced themselves in a manner detrimental to the operation of equipment and the insulation shall not be reduced below the rated values.		P
4.3.8.8.2	Connecting capacity		N
	Terminals shall be provided which accommodate the conductors specified in the installation and maintenance manuals (see 6.3.6.4) and cables in accordance with the wiring rules applicable at the installation.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	The terminals shall meet the temperature rise test of 5.2.3.8. The terminals shall also be suitable for conductors of the same type at least two sizes smaller, as given in the appropriate column of Table F.1.		N
4.3.8.8.3	Connection		N
	Terminals for connection to external conductors shall be readily accessible during installation.		N
	Clamping screws and nuts shall not serve to fix any other component although they may hold the terminals in place or prevent them from turning.		N
4.3.8.8.4	Wire bending space for wires 10 mm2 and greater		P
	For low-voltage PDS, the distance between a terminal for connection to the main supply, or between major parts of the PDS (for example, motor, transformer, CDM/BDM), and an obstruction toward which the wire is directed upon leaving the terminal shall be at least that specified in Table 13.		N
	For high-voltage PDS, the minimum wire bending space for conductors for interconnection between parts of the PDS or to the main supply shall be: eight times the overall diameter for non-shielded conductors, or 12 times the overall diameter for shielded or lead-covered conductors.	No high-voltage.	N
4.3.9	**Output short-circuit requirements**		P
	The PDS shall not present a thermal hazard, electric shock or energy hazard under short-circuit conditions at any output that is capable of providing power. In some cases, short-circuit protection may be provided by external measures, the characteristics of which shall be specified by the manufacturer.		P
	For co-ordination with upstream protection devices, the manufacturer shall specify a maximum prospective short-circuit current rating corresponding to each power output of the CDM/BDM. If protection devices with particular characteristics are necessary, these shall also be specified.		P
4.3.10	**Residual current-operated protective (RCD) or monitoring (RCM) device compatibility**		N
	RCD and RCM are used to provide protection against insulation faults in some domestic and industrial installations, additional to that provided by the installed equipment.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	An insulation fault or direct contact with certain types of PDS circuits can cause current with a d.c. component to flow in the protective earthing conductor and thus reduce the ability of an RCD or RCM of type A or AC (see IEC 60755 and IEC 62020) to provide this protection for other equipment in the installation.		P
	PDS shall satisfy one of the following conditions. a) A plug-connected single-phase PDS with rated input current less than or equal to 16 A, not using an industrial connector according to IEC 60309, shall be designed so that, under normal and fault conditions, it does not reduce the ability of RCD and RCM of type A to provide protection for other equipment in the installation. b) For plug-connected PDS other than a) with an industrial connector according to IEC 60309, and PDS having a fixed connection, if a d.c. current can be present in the protective earthing conductor, a caution notice and the symbol ISO 7000-0434 (2004-01) shall be provided in the user manual, and the symbol shall be placed on the PDS (see 6.3.6.7 and Annex H.		P
4.3.11	**Capacitor discharge**		N
	Capacitors within a PDS shall be discharged to a voltage less than 60 V, or to a residual charge less than 50uC, within 5 s after the removal of power from the PDS. If this requirement is not achievable for functional or other reasons, the information and marking requirements of 6.5.2 apply. See 5.2.3.7 for test.		N
	In the case of plugs or similar devices that can be disconnected without the use of a tool, the withdrawal of which results in the exposure of conductors (e.g. pins), the discharge time shall not exceed 1s. Otherwise such conductors shall be protected against direct contact to at least IPXXB. If neither a discharge time of 1 s nor a protection of at least IPXXB can be achieved, additional disconnecting devices or an appropriate warning device shall be applied.		N
4.3.12	**Access conditions for high-voltage PDS**		N
	The high voltage sections (transformer, converter, motor, etc.) shall be protected by an appropriate housing enclosure according to IEC 60204-11 with respect to personnel safety.	Transformer used.	P
4.4	**Protection against thermal hazards**		P
4.4.1	Minimizing the risk of ignition		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The risk of ignition due to high temperature shall be minimized by the appropriate selection and use of components and by suitable construction.		P
	Electrical components shall be used in such a way that their maximum working temperature under normal load conditions is less than that necessary to cause ignition of the surrounding materials with which they are likely to come into contact. The limits in Table 15 shall not be exceeded for the surrounding material.		P
4.4.2	Insulating materials		P
4.4.2.1	General		P
	A material which is used for the direct support of an uninsulated live part shall comply with the following requirements. NOTE A material is typically considered to be in direct support of an uninsulated live part when: a) it is in direct physical contact with the uninsulated live part, and b) it physically supports or maintains the relative position of the uninsulated live part.	The relative position of the uninsulated live part. See appended table 5.2.3.8	P
	The insulating material shall be suitable for the maximum temperature it attains as determined by the temperature rise test of 5.2.3.8. Consideration shall be given as to whether or not the insulating material additionally provides mechanical strength and whether or not the part can be subject to impact during use.		P
4.4.2.2	Material requirements		P
	In other cases, the insulating material shall comply with the glow-wire test described in 5.2.5.2 at a test temperature of 850°C. The alternative hot wire ignition test of 5.2.5.3 may be used.	See appended table 5.2.5.2 and 5.2.5.3	P
	Where an insulating material is used in a device that incorporates switching contacts, and is within 12.7mm of the contacts, it shall comply with the high current arcing ignition test of 5.2.5.1.		P
4.4.3	Flammability of enclosure materials	See appended table 5.2.5.4	P
	Materials used for enclosures of PDS shall meet the test requirements of 5.2.5.4.		P
	Metals, ceramic materials, and glass which is heat-resistant tempered, wired or laminated, are considered to comply without test.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Materials are considered to comply without test if, in the minimum thickness used, the material is of flammability class 5VA, according to IEC 60695-11-20.		N
	Components which fill an opening in an enclosure, and which are intended to be mounted in this way, need not be evaluated for compliance with the flammability requirements of 5.2.5.4, provided that the components comply with the flammability aspects of the relevant IEC component standard.		P
4.4.4	Temperature limits		P
4.4.4.1	Internal parts		P
4.4.4.2	External parts of CDM		N
	The maximum temperature for accessible exterior parts of the CDM shall be in compliance with Table 16. It is permitted that parts have temperatures exceeding these values, but they shall then be marked with a warning statement as given in 6.4.3.4. Under no circumstances shall the temperature of accessible parts exceed 150°C.		N
4.4.5	**Specific requirements for liquid cooled PDS**	No liquid.	N
4.4.5.1	Coolant		N
4.4.5.2	Design requirements		N
4.4.5.2.1	Corrosion resistance		N
	All cooling system components shall be suitable for use with the specified coolant. They shall be corrosion resistant and shall not corrode as a result of electrolytic action or prolonged exposure to the coolant and/or air.		N
4.4.5.2.2	Tubing, joints and seals		N
	Cooling system tubing, joints and seals shall be designed to prevent leakage during excursions of pressure over the life of the equipment. The entire cooling system including tubing shall satisfy the requirements of the Hydrostatic pressure test of 5.2.7.		N
4.4.5.2.3	Provision for condensation		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Where internal condensation occurs during normal operation or maintenance, measures shall be taken to prevent degradation of insulation. In those areas where such condensation is expected, clearance and creepage distances shall be evaluated at least for a pollution degree 3 environment (see Table 6), and provision shall be made to prevent accumulation of water (for example by providing a drain).		N
4.4.5.2.4	Leakage of coolant		N
4.4.5.2.5	Loss of coolant		N
4.4.5.2.6	Conductivity of coolant		N
4.4.5.2.7	Insulation requirements for coolant hoses		N
4.5	**Protection against energy hazards**	Considered electrical test according to appended table 5.2.3	P
4.5.1	Electrical energy hazards		P
	Failure of any component within the PDS shall not release sufficient energy to lead to a hazard, for example, expulsion of material into an area occupied by personnel.		P
4.5.2	Mechanical energy hazards		N
4.5.2.1	General		N
	Mechanical failure due to critical speed considerations or torsional problems can create a hazard to operating personnel. These considerations are applicable to all PDS, although they are increasingly significant with increased equipment size, such as with high-voltage PDS. As these subjects are application-dependent, it is not possible to include specific requirements in this standard.	No torsional problems.	N
4.5.2.2	Critical torsional speed		N
4.5.2.3	Transient torque analysis		N
	Transient torque analysis is an important design tool for PDS to check torsional stresses in the whole mechanical string. For example, the following operating conditions are areas of concern.		N
	start-up; single-phase or three-phase short-circuit at the terminals of an a.c. motor; impact of possible commutation failure of an a.c. CDM;		N

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Clause	Requirement + Test	Result - Remark	Verdict
	impact of the harmonic components of an a.c. CDM; field supply loss in a d.c. CDM; short-circuit at the armature terminals of a d.c. motor.		N
4.5.3	Acoustic noise emission	No acoustic noise emission	N
	Under consideration. Requirements for acoustic noise emission are often present in local regulations. In the absence of such regulations, it is recommended that the limits of IEC 60034-9 should be applied.		N
	Protection against environmental stresses		N
4.6	The PDS/CDM/BDM shall not present any hazards as a result of specified environmental stresses. As a minimum, the PDS/CDM/BDM shall satisfy the environmental endurance tests of 5.2.6. More demanding requirements may be specified by the manufacturer, in which case less demanding tests of this standard do not need to be performed.	See appended table 5.2.6.3.1 and 5.2.6.3.2	P

5	**Test requirements**		P
5.1	**General**		P
5.1.1	Test objectives and classification		P
	The subclauses in this Clause 5 describe the procedures to be adopted for the testing of PDS. The tests are classified as: type tests; routine tests; sample tests.	Type tests.	P
5.1.2	Selection of test samples		P
5.1.3	Sequence of tests		P
5.1.4	Earthing conditions		P
5.1.5	Compliance		P
5.1.6	Test overview		P
5.2	**Test specifications**		P
5.2.1	Visual inspections (type test, sample test and routine test)		P
5.2.2	Mechanical tests		P
5.2.2.1	Clearances and creepage distances (type test)	See appended table 5.2.2.1	P

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Clause	Requirement + Test	Result - Remark	Verdict
5.2.2.2	PWB short-circuit test (type test)		N
5.2.2.3	Non-accessibility test (type test)		N
5.2.2.4	Enclosure integrity test (type test)		N
5.2.2.5	Deformation tests		P
5.2.2.5.1	General		N
5.2.2.5.2	Deflection test (type test)		N
5.2.2.5.3	Impact test (type test)	See appended table 5.2.2.5.3	P
5.2.3	Electrical tests	See appended table 5.2.3	P
5.2.3.1	Impulse voltage test (type test and sample test)		N
5.2.3.2	A.C. or d.c. voltage test (type test and routine test)		N
5.2.3.2.1	Purpose of test		N
5.2.3.2.2	Value and type of test voltage		N
5.2.3.2.3	Performing the voltage test		N
5.2.3.2.4	Duration of the a.c. or d.c. voltage test		N
5.2.3.2.5	Verification of the a.c. or d.c. voltage test		N
5.2.3.3	Partial discharge test (type test, sample test)		N
5.2.3.4	Protective impedance (type test and routine test)		N
5.2.3.5	Touch current measurement (type test)	See appended table 5.2.3.5	P
5.2.3.6	Short-circuit test and Breakdown of components test (type tests)	See appended table 5.2.3.6	P
5.2.3.6.1	General		P
5.2.3.6.2	Test configuration		P
5.2.3.6.2.1	Supply voltage and current		P
5.2.3.6.3	Short-circuit test		P
5.2.3.6.3.1	Load conditions		N
5.2.3.6.3.2	Location of short-circuit		P
5.2.3.6.4	Breakdown of components test		P
5.2.3.6.4.1	Load conditions		P
5.2.3.6.4.2	Application of short-circuit or open-circuit		P
5.2.3.6.5	Test sequence		P
5.2.3.6.6	Pass criteria		P
5.2.3.7	Capacitor discharge (type test)		N
5.2.3.8	Temperature rise test (type test)	See appended table 5.2.3.8	P
5.2.3.9	Protective bonding (type test and routine test)		N

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Clause	Requirement + Test	Result - Remark	Verdict
5.2.4	Abnormal operation tests	See appended table 5.2.4	P
5.2.4.1	General		P
5.2.4.2	Test duration		P
5.2.4.3	Pass criteria		P
5.2.4.4	Loss of phase (type test)		N
5.2.4.5	Cooling failure tests (type tests)		N
5.2.4.5.1	General		N
5.2.4.5.2	Inoperative blower motor		N
5.2.4.5.3	Clogged filter		N
5.2.4.5.4	Loss of coolant		N
5.2.5	Material tests		P
5.2.5.1	High current arcing ignition test (type test)	See appended table 5.2.5.1	P
5.2.5.2	Glow-wire test (type test)	See appended table 5.2.5.2	P
5.2.5.3	Hot wire ignition test (type test – alternative to Glow-wire test)		N
5.2.5.4	Flammability test (type test)	See appended table 5.2.5.4	P
5.2.6	Environmental tests (type tests)		P
5.2.6.1	General		P
5.2.6.2	Acceptance criteria		P
5.2.6.3	Climatic tests		N
5.2.6.3.1	Dry heat test (steady state)	See appended table 5.2.6.3.1	P
5.2.6.3.2	Damp heat test (steady state)	See appended table 5.2.6.3.2	P
5.2.6.4	Vibration test (type test)	Mass<100kg.	N
5.2.7	Hydrostatic pressure (type test and routine test)		N

6	**Information and marking requirements**		P
6.1	**General**		P
	Since any electrical equipment can be installed or operated in such a manner that hazardous conditions can occur, compliance with the design requirements of this part of IEC 61800 does not by itself assure a safe installation. However, when equipment complying with those requirements is properly selected and correctly installed and operated, the hazards will be minimized.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	All information shall be in an appropriate language, and documents shall have identification references. Drawing symbols shall conform to IEC 60417 or IEC 60617 as appropriate. Symbols not shown in IEC 60417 or IEC 60617 shall be identified where used.	English version provided. (Version in other language will be provided when submitted for national approval). All drawing symbols conform to IEC 60417.	P
	Working voltage (Vpeak or Vrms); minimum distance (mm) through insulation		P
6.2	**Information for selection**		P
	the name or trademark of the manufacturer, supplier or importer		P
	catalogue number or equivalent		P
	input and output voltage range, current, and power rating information, including: – number of phases; – frequency range		P
	protective class		P
	the type of electrical supply system (e.g. TN, IT, etc.) to which the PDS/CDM/BDM may be connected	TN system.	P
	prospective short-circuit current rating(s) and protective device characteristics		P
	field supply requirements (if any)		N
	coolant type and design pressure for liquid cooled product	No liquid cooled product.	N
	IP rating	IPX0	P
	operating and storage environment		N
	reference(s) to relevant international standard(s) for manufacture, test, or use		P
	date code, or serial number from which the date of manufacture can be determined		P
	reference to instructions for installation, use and maintenance		P
6.3	**Information for installation and commissioning**		P
6.3.1	General		P
	Safe and reliable installation is the responsibility of the installer, machine builder, and/or user.		N

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
	The manufacturer of any part of the PDS shall provide information to support this task. This information shall be unambiguous, and may be in diagrammatic form.		N
6.3.2	Mechanical considerations		P
	The following drawings shall be prepared by the manufacturer: dimensional drawing, including mass information; mounting drawing.		P
6.3.3	Environment		P
	The following environmental conditions shall be specified, for operation, transportation and storage:		P
	climatic (temperature, humidity, altitude, pollution, ultra-violet light, etc.);		P
	mechanical;		P
	electrical.		P
6.3.4	Handling and mounting	See user manual.	P
	In order to prevent injury or damage, the installation documents shall include warnings of any hazards which can be experienced during installation. Where necessary, instructions shall be provided for:		P
	packing and unpacking;		P
	moving;		P
	lifting;		P
	strength and rigidity of mounting surface;		P
	fastening;		P
	provision of adequate access for operation, adjustment and maintenance.		P
6.3.5	Motor and driven equipment	No motor.	N
6.3.5.1	Motor selection		N
	Where necessary for CDM/BDM, information on suitable motor specifications (for example, based on IEC 60034-1) shall be provided. The possible influence on motor insulation of reflections of the PWM output waveform shall be taken into consideration.		N
6.3.5.2	Motor integrated sensors		N
6.3.5.3	Critical torsional speeds		N
6.3.5.4	Transient torque analysis		N

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
6.3.6	Connections		P
6.3.6.1	General	See user manual.	P
	Information shall be provided to enable the installer to make safe electrical connection to the PDS. This shall include information for protection against hazards (for example, electric shock or availability of energy) that may be encountered during installation, operation or maintenance.		P
6.3.6.2	Interconnection and wiring diagrams		P
6.3.6.3	Conductor (cable) selection		P
	The Installation manual shall define the voltage and current levels for all connections to the PDS/CDM/BDM, together with cable insulation requirements. These shall be worst-case values, taking into account overcurrent and overload conditions and the possible effects of nonsinusoidal currents.		P
6.3.6.4	Terminal capacity and identification		P
	The installation and maintenance manuals shall indicate the range of acceptable conductor sizes and types (solid or stranded) for all terminals, and also the maximum number of conductors which can simultaneously be connected. For user terminals, the manuals shall specify the requirements for tightening torque values and also the insulation temperature rating requirements for the conductor or cable.		P
6.3.6.5	Protection requirements	See user manual.	P
	The manuals shall also indicate the precautions to be taken to ensure that the safety of ELV connections is maintained during installation.		P
	The manuals shall provide instructions for the use of PELV circuits within a zone of equipotential bonding.		P
	The installation, users, and maintenance manuals shall identify all external terminals relating to circuits protected by one of the methods of 4.3.4.2 to 4.3.4.4.		P
6.3.6.6	Earthing		P
	Terminals for connection of the protective earthing conductor shall be clearly and indelibly marked with the symbol IEC 60417-5019 (2006-08) (see Annex H), or with the letters PE, or by the colour coding green or green-yellow.	The green-yellow wire from earthing terminal soldered to PCB considered as protective bonding terminal	P

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
	The indication shall not be placed on or fixed by screws, washers or other parts which might be removed when conductors are being connected.		P
	Equipment of protective class II shall be marked with symbol IEC 60417-5172 (2003-02) (see Annex H). Where such equipment has provision for the connection of an earthing conductor for functional reasons (see 4.3.5.6) it shall be marked with symbol IEC 60417-5018 (2006-10) (see Annex H).		N
6.3.6.7	Protective earthing conductor current		P
	Where the touch current in the protective earthing conductor (see 4.3.5.5.2) exceeds 3,5 mA a.c. or 10 mA d.c., this shall be stated in the installation and maintenance manuals. In addition, a caution symbol ISO 7000-0434 (2004-01) (see Annex H) shall be placed on the product, and a notice shall be provided in the installation manual to instruct the user that the minimum size of the protective earthing conductor shall comply with the local safety regulations for high protective earthing conductor current equipment.		P
	When 4.3.10 b) applies, a caution notice and the symbol ISO 7000-0434 (2004-01) (see Annex H) shall be provided in the user manual, and the symbol shall be placed on the product. The caution notice shall be: “This product can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product..” (See 6.4.3 for general requirements for labels, signs and signals.)	See user manual.	P
6.3.6.8	Special requirements		N
	Any particular cable and connection requirements shall be identified in the installation and maintenance manuals.		N
6.3.7	Overcurrent or short-circuit protection		N
6.3.8	Motor overload protection		N
	The manuals for CDM/BDM not incorporating internal overload protection for the motor and intended to be used with external or remote overload protection shall indicate that such protection shall be provided.		N

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Where CDM/BDM have inputs that can be used with motors which have thermal sensors, the manuals shall contain instructions for the proper connection to these inputs.		N
6.3.9	Commissioning	See user manual.	N
	If commissioning tests are necessary to ensure the electrical and thermal safety of a PDS, information to support these tests shall be provided for each part of the PDS. This information can depend on the specific installation, and close cooperation between manufacturer, installer, and user can be required.		N
6.4	**Information for use**	See user manual.	P
6.4.1	General		P
	The user's manual shall include all information regarding the safe operation of the PDS/CDM/BDM. In particular, it shall identify any hazardous materials and risks of electrical shock, overheating, explosion, excessive acoustic noise, etc.		P
	The manual should also indicate any hazards which can result from reasonably foreseeable misuse of the PDS.		P
6.4.2	Adjustment	See user manual.	P
	Maintenance adjustments may also be described in this manual, but it shall be made clear that they should only be made by qualified personnel.		P
	Clear warnings shall be provided where excessive adjustment could lead to a hazardous state of the PDS/CDM/BDM.		P
6.4.3	Labels, signs and signals	See copy of marking plate	P
6.4.3.1	General		P
	Labeling shall be in accordance with good ergonomic principles so that notices, controls, indications, test facilities, fuses, etc., are sensibly placed and logically grouped to facilitate correct and unambiguous identification.		P
	All safety related equipment labels shall be located so as to be visible after installation or readily visible by opening a door or removing a cover.		P
	Where a hazard is present after the removal of a cover, a warning label shall be placed on the equipment. The label shall be visible before the cover is removed.		P

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
6.4.3.2	Isolators		P
	Where an isolating device is not intended to interrupt load current, a warning shall state: DO NOT OPEN UNDER LOAD.	Approved opto-coupler used. No other parts applied.	P
6.4.3.3	Visual and audible signals	No visual and audible signals.	N
	Visual signals such as flashing lights, and audible signals such as sirens, may be used to warn of an impending hazardous event such as the driven equipment start-up and shall be identified.		N
	It is essential that these signals:		N
	are unambiguous		N
	can be clearly perceived and differentiated from all other signals used		N
	can be clearly recognized by the user		N
	are emitted before the occurrence of the hazardous event		N
6.4.3.4	Hot surfaces	No hot surfaces.	N
	Surfaces which can exceed the temperature limits of Table 16 shall be marked with the warning symbol IEC 60417-5041 (2002-10) (see Annex H). The user's manual shall also contain this information.		N
6.4.3.5	Equipment marking	See user manual.	P
	The identification of each control or indicating device and fuse shall be marked adjacent to the item. Replaceable fuses shall be marked with their rating and time characteristics. Where it is not possible to do this on the product, the information shall be provided pictorially in the manual.		P
	Appropriate identification shall be marked on or adjacent to each movable connector.		N
	Test points shall be individually marked with the circuit diagram reference.		N
	The polarity of any polarized devices shall be marked adjacent to the device.		N
	The diagram reference and if possible the function shall be marked adjacent to each pre-set control in a position where it is clearly visible while the adjustment is being made.		N
6.5	**Information for maintenance**	See user manual.	P
6.5.1	General		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Safety information shall be provided in the maintenance manual including, as appropriate, the following:		P
	preventive maintenance procedures and schedules		P
	safety precautions during maintenance (for example, the use of earthing switches for high voltage PDS)	No high voltage PDS.	N
	location of live parts that can be accessible during maintenance (for example, when covers are removed)		P
	adjustment procedures		P
	subassembly and component repair and replacement procedures		P
	any other relevant information.		P
6.5.2	Capacitor discharge		P
6.5.3	Auto restart/bypass connection		N
	A PDS which is set to provide automatic restart or bypass connection after the removal of power shall be clearly identified at the installation.		N
6.5.4	PT/CT connection		N
	A PDS which has monitoring or control functions using a potential transformer (PT) supplied from high voltage, or a current transformer (CT) supplied from a high current connection, shall be clearly marked to show the possible hazards of voltage transients upon disconnection of the secondary circuit. The hazards shall also be described in the installation and maintenance manuals.		N
6.5.5	Other hazards		N
	The manufacturer shall identify any components and materials of a PDS which require special procedures to prevent hazards.		N

EN 61800-5-1			
Clause	Requirement + Test	Result - Remark	Verdict
A	**ANNEX A, Examples of protection in case of direct contact**		N
A.1	General		N
A.2	Protection by means of DVC A		N
A.3	Protection by means of protective impedance		N
A.4	Protection by using limited voltages		--
B	**ANNEX B, Examples of overvoltage category reduction**		N
B.1	General		N
B.2	Insulation to the surroundings (see 4.3.6.2)		N
B.2.1	Circuits connected directly to the supply mains (see 4.3.6.2.2)		N
B.2.2	Circuits not connected directly to the supply mains (see 4.3.6.2.3)		N
B.2.3	Insulation between circuits (see 4.3.6.2.4)		N
B.3	Functional insulation (see 4.3.6.3)		N
B.4	Further examples		--
C	**ANNEX C, Measurement of clearance and creepage distances**		**P**
C.1	Measurement	See appended table 5.2.2.1	P
C.2	Relationship of measurement to pollution degree		P
C.3	Examples		P
D	**ANNEX D, Altitude correction for clearances**		**N**
E	**ANNEX E, Clearance and creepage distance determination for frequencies greater than 30 kHz**		**P**
E.1	Clearance		P
E.2	Creepage distance		P
F	**ANNEX F, Cross-sections of round conductor**		**N**
G	**ANNEX G, Guidelines for RCD compatibility**		**N**
G.1	Selection of RCD type		N
G.2	Fault current waveforms		N

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Clause	Requirement + Test	Result - Remark	Verdict

H	**ANNEX H, Symbols referred to in this part of IEC 61800**	**P**

Appendix tables

	TABLE: Components				P
Object / part no.	Manufacturer / Trademark	Type / model	Technical data	Standard	Mark(s) of Conformity
Enclosure	Sabic Innovative Plastics Us Ltc	940(f1)	V-0, 80°C	UL 94 UL 746	UL E121562
Terminal block	Dongguan Electronic Technology Co., Ltd.	TJ500-00-3P	3Pin, Horizontal coil out, 15.0*10.0*14.4 interval 5.0mm, 300V, 10A	EN 60998-2-1, EN 60998-2-2	VDE
PCB	Shenzhen Topreach Sci-tech.Co. , Ltd.	SB200-11QD1B	2.2mm	UL 94, UL 746	UL E300871
Fuse	Littelfuse Co., Ltd.		600V~	UL 248-1, UL 248-14	UL E156471
Varistor	FuJian TORCH Electronic Technology Co., Ltd.	CNJU-14D471K	470V~, 85°C	IEC 61051-1, IEC 61051-2, IEC 61051-2-2	VDE 40034186
Earth wire	SiChuan MEIHE Cable Co., Ltd.	1430	105°C, 22AWG 300V	UL 758	UL E41396
Opto-coupler	FAIRCHILD semiconductor	817C	Int. Cr / Ext. Cr / Dti 6,0 mm / >7,5 mm / >0,5mm, 5000V~, 100°C	IEC 60747-5-2	VDE 138213
Y Capacitor	DAIN ELECTRONICS CO., LTD.	X1 Series	400V~, 2200pF, Min.125ºC.	IEC 60384-14	VDE 40025754
Transformer	Hope Senlan Science & Technology Holding Corp., Ltd.	KGBT-7B7	Class B	EN 61800-5-1	Test with appliance
- Core	--	--	PC40	--	--
- Bobbin	Chang Chun Plastics Co Ltd	T375J	Min.0.45mm, V-0, 150°C	UL 94, UL 746	UL E59481
- Winding	Shenzhen Chengwei Industry Co Ltd	2UEW	130°C	UL 1446	UL E227475
- Insulating tape	Jingjiang Yahua Pressure Sensitive Glue Co., Ltd.	PZ, WF	130°C	UL 510	UL E165111
- Three insulated wire	Furakawa Electric Co., Ltd.	TEX-E	130°C	IEC 60950-1	VDE 0006735

Appendix tables

	TABLE: Components				P
Object / part no.	Manufacturer / Trademark	Type / model	Technical data	Standard	Mark(s) of Conformity
Insulated tube	Changyuan Electronics Group Co Ltd	CB-TT-T	200°C, 300V, VW-1	UL 224	UL E180908
- Varnishes	Elantas Electrical Insulation Elantas Pdg Inc	468-2(x)	155°C	UL 1446	UL E75225
Relay	Xiamen Hongfa Electroacoustics Co., Ltd.	OZ-SS-124DM1	16A, 240V~	EN 61810-1	VDE
DC Fan	Shenzhen Huaxia Hengtai Electronic Co., Ltd.	DA09225B24UA	DC24V, 0.5A	UL 507	UL

Appendix tables

5.2.2.1	**TABLE: Clearance and creepage distance measurements** **According to clause of requirement: 4.3.6.1, 4.3.6.4, 4.3.6.5**					**P**
Clearance cl and creepage distance dcr at/of:	Up (V)	U r.m.s. (V)	Required cl (mm)	Cl (mm)	Required dcr (mm)	Dcr (mm)
PWBs:						
L and N before F1	380	268	1.5	>3.0	2.68	>3.0
Different poles of F1	380	268	1.5	>3.0	2.68	>3.0
Other insulators:						
Live parts to enclosure	380	268	3.0	7.6	5.36	7.6
Primary trace of T1 to secondary trace of T1	380	268	3.0	>8.0	5.36	>8.0
Core of T1 to secondary winding of T1	380	268	3.0	>6.5	5.36	>6.5
U1 Primary to secondary	380	268	3.0	5.5	5.36	5.5
Core of T1 to secondary component (E6)	380	268	3.0	>6.0	5.36	>6.0
Test condition : - Pollution degree: class II - Material group: III b						

5.2.2.5	**TABLE: Deformation tests** **According to clause of requirement: 4.3.6.4.3**	**N**
The clearance between any non-insulated live part and the walls of a metal enclosure	Observations(After the test)	Remarks
--	--	--
Notes: 1) Clearances are not less than their minimum permitted values and other insulation is undamaged; 2) Barriers have not been damaged or loosened; 3) No moving parts which could cause a hazard are exposed.		

Appendix tables

5.2.2.5.3	**TABLE: Impact tests** **According to clause of requirement: 4.3.7.1**	**P**

Location	Observations(After the test)		Remarks
	Damage	Hazardous parts accessible	
Top	No	No	--
Bottom	No	No	--
Sides	No	No	--

Notes:

1) The steel sphere shall be suspended by a cord and swung as a pendulum in order to apply a horizontal impact, dropping through a vertical distance of 1300mm.

2) After the impact tests, enclosures show no cracks or openings which could cause a hazard.

5.2.3	**TABLE: Electrical tests** **According to clause of requirement: 4.3.4.1, 4.3.6.8.2**	**P**

Test voltage applied between:	Test voltage (V)	Breakdown Yes / No
Unit: Primary to enclosure with metal foil	2880Vac	No
T1 Primary winding to secondary winding	2880Vac	No
T1 Secondary winding to core	2880Vac	No
One layer of insulation tape used as T1 pri. winding and sec. winding	2880Vac	No
Notes:--		

5.2.3.3	**TABLE: Partial discharge test** **According to clause of requirement: 4.3.6.1, 4.3.6.8.2.2, 4.3.6.8.3**	**N**

Condition	1,875 times UPD (s)	1,5 times UPD (s)	Comments
--	--	--	--

Notes:

1) The rated discharge voltage is the sum of the recurring peak voltages in each of the circuits separated by the insulation.

2) The test shall be considered to have been successfully passed if the partial discharge is less than 10pC during the measurement period.

Appendix tables

5.2.3.4	TABLE: Protective impedance According to clause of requirement: 4.3.4.3	N

Condition	Measured (mA)	Comments
--	--	--

Notes:

1) The rated discharge voltage is the sum of the recurring peak voltages in each of the circuits separated by the insulation.

2) The test shall be considered to have been successfully passed if the partial discharge is less than 10 pC during the measurement period

3) The protective impedances shall be designed so that the current available through them to earth at the accessible live part does not exceed a value of 3,5mA a.c. or 10mA d.c.

5.2.3.5	TABLE: Touch current measurement According to clause of requirement: 4.3.5.5.2	P

Condition	Measured (mA)	Limit (mA)
At terminal block	3.6mA	10mA d.c

Notes:

1) For plug-connected single phase PDS/CDM/BDM, not using an industrial connector according to IEC 60309, the touch current (measured in accordance with 5.2.3.5) shall not exceed 3,5mA a.c. or 10mA d.c.

2) For all other PDS/CDM/BDM, one or more of the following measures shall be applied, unless the touch current (measured in accordance with 5.2.3.5) can be shown to be less than 3,5mA a.c. or 10mA d.c.

5.2.3.6	TABLE: Short-circuit test and Breakdown of components test According to clause of requirement: 4.3.9, 4.2					P
Component No.	Fault	Test voltage (V)	Test time	Fuse No.	Fuse current (A)	Result
T1 pin 1-3	S-C	268	10minute	F1	0.086	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
T1 pin 1-4	S-C	268	10minute	F1	0.074	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
T1 pin 8-9	S-C	268	10minute	F1	0.078	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.

Appendix tables

5.2.3.6	TABLE: Short-circuit test and Breakdown of components test According to clause of requirement: 4.3.9, 4.2					P
Component No.	Fault	Test voltage (V)	Test time	Fuse No.	Fuse current (A)	Result
T1 pin 2-8	S-C	268	10minute	F1	0.054	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
T1 pin 1-7	S-C	268	10minute	F1	0.055	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
U1 pin 1-2	S-C	268	10minute	F1	0.042	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
U1 pin 3-4	S-C	268	10minute	F1	0.039	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
BD1	S-C	268	10minute	F1	0.071	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
E2	S-C	268	10minute	F1	0.077	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
D11	S-C	268	10minute	F1	0.073	After S-C, unit shut down immediately. No damage, no hazard. Recoverable.
Notes: 1) S-C=Short circuit; O-C= Open circuit;						

5.2.3.7	TABLE: Capacitor discharge According to clause of requirement: 4.3.11		N
Condition	Measured (V)	Comments	
--	--	--	
Notes: 1) This requirement also applies to capacitors used for power factor correction, filtering, etc.			

Appendix tables

5.2.3.8	**TABLE: Temperature rise test** **According to clause of requirement: 4.3.8.8.2, 4.4.2.1**	**P**

Test condition: EUT working normally.		
Maximum temperature T of part/at:	T (°C)	Allowed Tmax (°C)
Terminal block	78.2	85
Varistor (YR1)	77.3	85
Relay (RLY1)	82.3	85
Relay (RLY2)	81.4	85
PCB near U1	93.5	130
PCB near PC1	96.5	130
PCB near Q2	99.7	130
Electrolytic capacitor	83.4	105
Varistor	74.5	85
TR1 winding	95.6	110
TR1 bobbin	92.6	110
Fan enclosure	73.4	Ref.
Enclosure inside	71.3	Ref.
Enclosure outside	68.9	75

Notes:
1) The ambient temperature is +40°C.
2) During the test, thermal cutout, overload detection functions and devices shall not operate.

5.2.4	**TABLE: Abnormal operation tests** **According to clause of requirement: 4.2**	**P**

Test condition: Block ventilation		
Maximum temperature T of part/at:	T (°C)	Allowed Tmax (°C)
T1 winding	989.6	--
Surface of fan enclosure	76.2	85
Enclosure, outside	71.9	90

Notes:
1) The ambient temperature is +25°C.
2) Surgical cotton shall be placed at all openings, handles, flanges, joints and similar locations on the outside of the enclosure, and the wire mesh cage (if used), in a manner which will not significantly affect the cooling.

Appendix tables

5.2.5.1	**TABLE: High current arcing ignition test** **According to clause of requirement: 4.4.2.2**	**P**

Test material	Test current	Result
Enclosure material	33A	The average number of arcs: 20
Transformer bobbin	33A	The average number of arcs: 20

Notes:

1) The average number of arcs to ignition of the specimens tested shall be not less than 15 for V-0 class materials and not less than 30 for other materials.

5.2.5.2	**TABLE: Glow-wire test** **According to clause of requirement: 4.4.2.2**	**P**

Part	Test temperature	Result(After the test), Burnting
Enclosure material	550°C	No
Transformer bobbin	850°C	No
Terminal	850°C	No

Notes:

1) The glow-wire test shall be made under the conditions specified in 4.4.2 according to IEC 60695-2-10 and IEC 60695-2-13.

5.2.5.3	**TABLE: Hot wire ignition test- alternative to glow-wire test** **According to clause of requirement: 4.4.2.2**	**N**

Part	Test time	Result
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Remark:

1) Five samples of each insulating material are tested. The samples are 130 mm long minimum by 13 mm wide and of a uniform thickness representing the thinnest section of the part. Edges shall be free from burrs, fins, etc.

2) The average ignition time of the specimens tested shall not be less than 15 s.

Appendix tables

5.2.5.4	**TABLE: Flammability test** **According to clause of requirement: 4.4.3**	**P**

Test temperature	Burn time(second)	Comments
Enclosure material	0	--
Transformer bobbin	0	--

Notes:
1) The material shall not continue to burn for more than 1 min after the fifth 5s application of the test flame, with an interval of 5s between applications of the flame.
2) Flaming drops or flaming or glowing particles that ignite surgical cotton 305mm below the test specimen shall not be emitted by the test sample at any time during the test.

5.2.6.3.1	**TABLE: Dry heat test (steady state)** **According to clause of requirement: 4.6**		**P**
Test condition:	Temperature(°C)	Humidity(%)	Duration(days)
	40	--	16d
Recovery procedure	Time(hours)	Temperature(°C)	Humidity(%)
	Min.1h	Max.35	Max.75

5.2.6.3.2	**TABLE: Damp heat test (steady state)** **According to clause of requirement: 4.6**		**P**
Test condition:	Temperature(°C)	Humidity(%)	Duration(days)
	40	93	4d
Recovery procedure	Time(hours)	Temperature(°C)	Humidity(%)
	Min.1h	Max.35	Max.75

5.2.6.4	**TABLE: Vibration test** **According to clause of requirement: 4.6**	**N**

Duration	Amplitude	Acceleration	Sweep rate	Result
--	--	--	--	--

Notes:
1) For large equipment, the possibility of using a shock test as an alternative to a vibration test is under consideration.
2) Where the manufacturer specifies vibration levels that are greater than those above, the higher levels shall be used for the test. The acceptance criteria shall not be changed.
3) For PDS/CDM/BDM with a mass more than 100 kg, this test may be performed on subassemblies.

Product Photos



Fig. 1

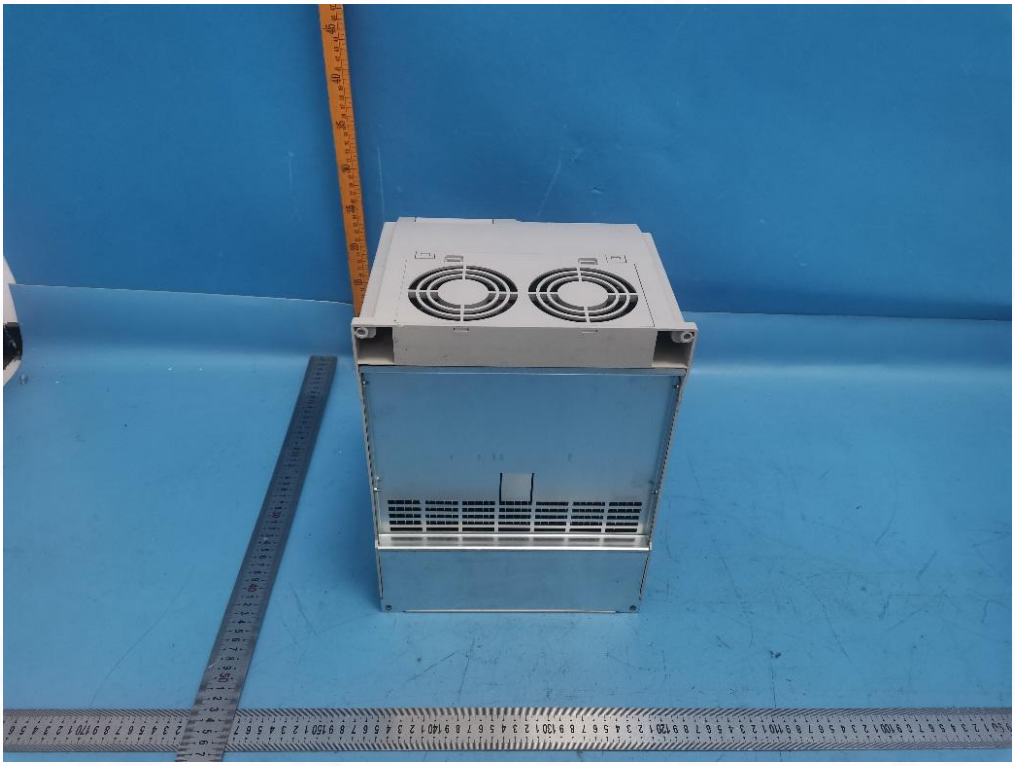

Fig. 2

Product Photos

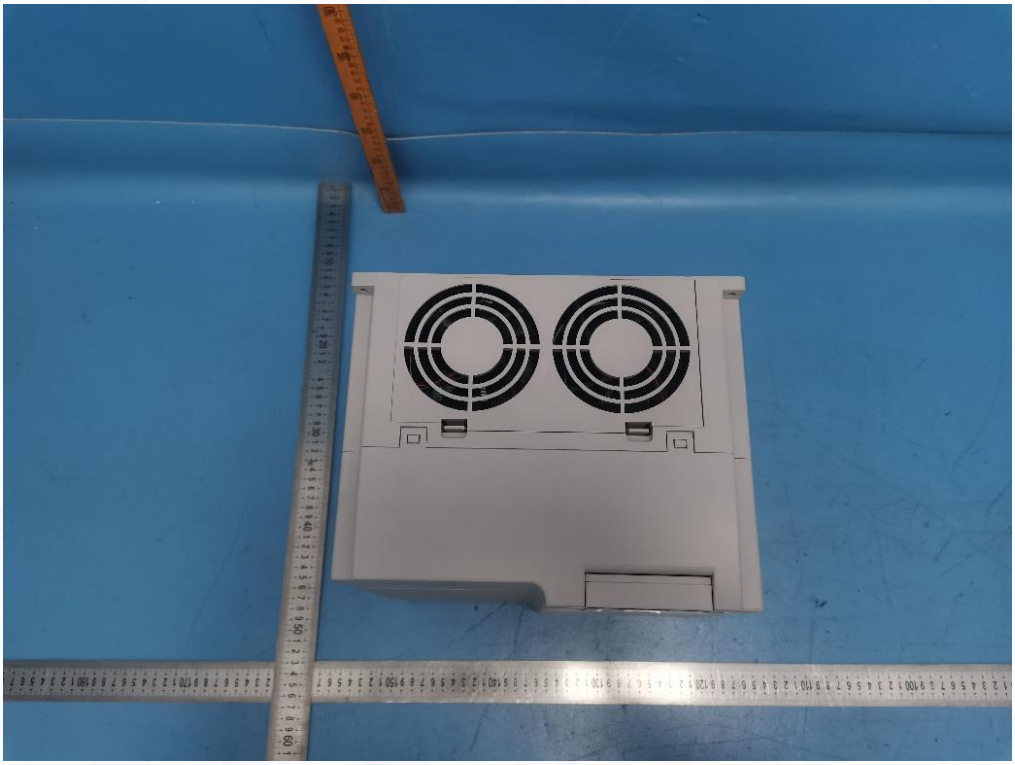

Fig. 3



Fig. 4

Product Photos



Fig. 5

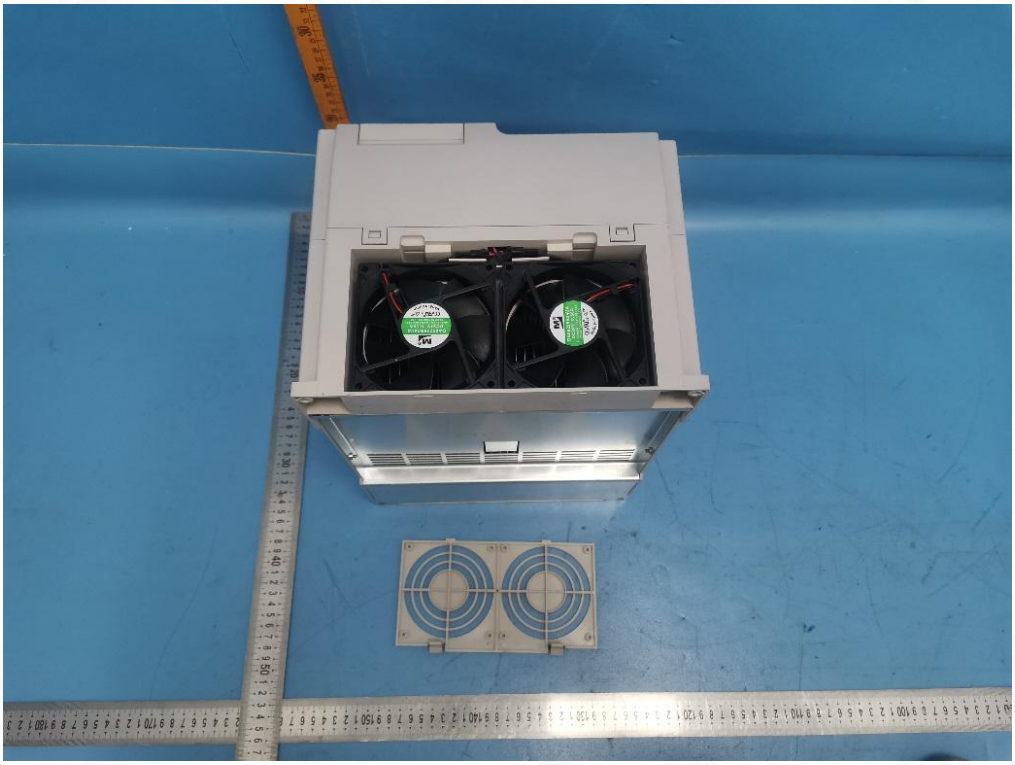

Fig. 6

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