TEST REPORT
EN 61643-11/IEC 61643-11
Low-voltage surge protective devices-Part 11: Surge protective devices connected to low-voltage power systems-Requirements and tests

Report Reference No.....:	ZNCT240724001
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Date of issue.....:	2024-07-22

Testing Laboratory .....:	Zhejiang NewRay Test & Certification Technology Co., Ltd.
Address.....:	5/F, No.9 Fengling Road, Wuchang Street, Yuhang District, Hangzhou, China
Testing location/procedure .....:	CBTL ☐ SMT ☐ TMP ☐
Address.....:	

Applicant's name .....:	BLITZ- Ksquare Energy Private Ltd
Address.....:	B-403/404 Siqnature -2, Sarkhej Sanand Road,Sarkhej. Ahmedabad -382210

Test specification:

Standard .....:	EN 61643-11:2012/A11:2018, IEC 61643-11 ED. 1.0 B:2011
Test procedure .....:	CE-LVD
Non-standard test method……..:	N/A

Test Report Form No.....:	
TRF Originator.....:	SEMKO
Master TRF.....:	Dated 2007-03

Test item description .....:	Surge Protective Device
Trade Mark……..:	BLITZ™
Model/Type reference..... ……..:	BLT-AC;Uc:AC110V,AC230V,AC255V,AC260V,AC275V,AC280V, AC320V,AC340V,AC385V, AC420V,AC800V,AC1000V; In:10KA,20KA,30KA,40KA,50KA; Poles:1P,2P,3P,4P,1P+N,3P+N,1Ph,3Ph,1P+NPE,3P+NPE
Rating……..:	Uc:AC110V,AC230V,AC255V,AC260V,AC275V,AC280V, AC320V,AC340V,AC385V, AC420V,AC800V,AC1000V

Test item particulars.....:	
Classification of installation and use.....:	
Supply Connection.....:	
.....:	
.....:	
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement..... :	P(Pass)
- test object does not meet the requirement ..... :	F(Fail)
Testing ..... :	
Date of receipt of test item..... :	2024-07-05
Date (s) of performance of tests..... :	2024-07-05--2024-07-22

Copy of marking plate and summary of test results (information/comments):

BLITZ™

Product Name: Surge Protective Device

Product Model : BLT-AC

Rating: Uc:AC110V,AC230V,AC255V,AC260V,AC275V,AC280V,AC320V,AC340V,AC385V, AC420V,AC800V,AC1000V;In:10KA,20KA,30KA,40KA,50KA

Manufacturer:

BLITZ- Ksquare Energy Private Ltd

B-403/404 Siqnature -2, Sarkhej Sanand Road,Sarkhej. Ahmedabad -382210

CE

Test Item	Requirement &Test Method	Result	Verdict
3	Definitions		
	For the purpose of this part of IEC 61643,the following definitions apply		
3.1	Surge Protective Device (SPD) A device that is intended to limit transient overvoltage's and diverts surge currents. It contains at least one nonlinear component		P
3.2	One-port SPD An SPD connected in shunt with the circuit to be protected. A one port device may have separate input and output terminals without a specific series impedance between these terminals		P
3.3	Two-port SPD An SPD with two sets of terminals input and output. A specific series impedance is inserted between these terminals		P
3.4	Voltage switching type SPD An SPD that as a high impedance when no surge is present, but can have s sudden change in impedance to & low value in response to a voltage surge. Common examples of components used as voltage switching devices are spark gaps, gas tubes, thrusters (silicon-controlled rectifiers) and traces. These SPDs are sometimes called" crowbar type"		P
3.5	Voltage limiting type SPD An SPD that has high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage. Common examples of components used as non-linear devices are varistors and suppressor diodes. These SPDS are sometimes called "clamping type"		P
3.6	Combination type SPD An SPD that incorporates both voltage switching type components and voltage limiting type components may exhibit voltage switching. Voltage limiting or both voltage switching and voltage limiting behavior depend upon the characteristics of the applied voltage.		P
3.7	Modes of protection An SPDs protective component may be connected line-to-line or line-to earth or line-to-neutral or neutral-to-earth and combinations there of. These paths are referred to as modes of protection		P
3.8	Nominal discharge current/n The crest value of the current through the SPD having a current wave shape of 8/20. This is used for the classification of the SPD for class II test and also for preconditioning of the SPD for class I and II tests		P
3.9	Impulse current /imp It is defined by a current peak value/peak and the charge *Q.* Tested according to the test sequence of the operating duty test. This is used for the classification of the SPD for class I test.		P
3.10	Maximum discharge current/max for class II test Crest value of a current through the SPD having 8/20 wave shape and magnitude according to the test sequence of the class II operating duty test/max is greater than *I*n		P

Test Item	Requirement &Test Method	Result	Verdict
3.11	Maximum continuous operating voltage U_c The maximum r.m.s. or d.c. voltage which may be continuously applied to the SPDs mode of protection. This is equal to the rated voltage		P
3.12	Continuous operating current/c The current flowing through each of protection of the SPD when energized at the maximum continuous operating voltage U_c for each mode NOTE- I_c corresponds to the sum of currents flowing in the protective component of the SPD and in all internal circuits connected in parallel with the protective components of the SPD.		P
3.13	Follow current $/_f$ Current supplied by the electrical power system and flowing through the SPD after a discharge current impulse. The follow current is significantly different from the continuous operating current I_c		P
3.14	Rated load current Maximum continuous rated r.m.s.or d.c. current that can be supplied to a load connected to the protected output of an SPD		P
3.15	Voltage protection level U_p A parameter that characterizes the performance of the SPD in limiting the voltage across terminals, which is selected from a list of preferred values. This value shall be greater than the highest value of the measured limiting voltages.		P
3.16	Measured limiting voltage The maximum magnitude of voltage that is measured across the terminals of the SPD during the application of impulses of specified wave shape and amplitude		P
3.17	Residual voltage U_{res} The peak value of voltage that appear between the terminals an SPD due to the passage of discharge current		P
3.18	Temporary overvoltage U_T The maximum r.m. value or d.c. overvoltage the protective device can withstand and that exceeds the maximum continuous operating voltage U_c for a specified time duration		P
3.19	Load-side surge withstand capability for a two-port SPD Ability of a two-port SPD to withstand surges on the output terminals originated in loads downstream of the SPD		P
3.20	Voltage drop(in percent) $\Delta U=((U_{IN}-U_{OUT})/U_{IN})\times 100\%$ Where U_{IN} is the input voltage and U_{OUT} is the output voltage measured simultaneously with a full rated resistive load connected. This parameter is only used for two-port SPDs.		P
3.21	Insertion loss At a given frequency, the insertion loss of an SPD connected into a given power system is defined as the ratio of voltage appearing, across the mains immediately beyond the point of insertion before and after the insertion of the PSD under test. This result is expressed in decibels NOTE – Requirements and tests are under consideration.		P

Test Item	Requirement &Test Method	Result	Verdict
3.22	1.2/50 voltage impulse A voltage impulse with a virtual font time (time to rise from 10% to 90% of the peak value) of 1.2 μs and a time to half-value of 50μs		P
3.23	8/20 current impulse A current impulse with a virtual front time of 8μs and a time to half value of 20μs		P
3.24	Combination wave The combination wave is delivered by a generator that applies a 1.2/50 voltage impulse across an open circuit and an 8/20 current impulse into a short circuit. The voltage, current amplitude and waveforms that are delivered to the SPD are determined by the generator and the impedance of the SPD to which the surge is applied. The ratio of peak open-circuit voltage to peak short-circuit current is 2Ω; this is defined as the fictive impedance Z_f. The short-circuit current is symbolized I_{sc}. The open-circuit voltage is symbolized by U_{oc}		P
3.25	Thermal runway An operational condition when the sustained power dissipation of an SPD exceeds the thermal dissipation capability of the housing and connections, leading to a cumulative increase in the temperature of the internal elements culminating in failure.		P
3.26	Thermal stability An SPD is thermally stable if after the operating duty test causing temperature rise, the temperature of the SPD decreases with time when the SPD is energized at specified maximum continuous operating voltage and at specified ambient temperature conditions.		P
3.27	Degradation The change of original performance parameters as a result of exporter of the SPD to surge service or unfavorable environment.		P
3.28	Short-circuit withstand Maximum prospective short-circuit current that the SPD is able to withstand		P
3.29	SPD disconnector A device for disconnecting an SPD from the system in the event of SPD failure. It is to prevent a persistent fault on the system and to give visible indication of the SPD failure.		P
3.30	Degrees of protection provided by enclosure(IP code) The extent of protection provided by an enclosure against access to hazardous parts, against ingrees of solid foreign objects and/or against ingress of water (See IEC 60529)		P
3.31	Type tests Tests with are made upon the completion of the development of a new SPD design. They are used to establish representative performance and to demonstrate compliance with the relevant standard. Once made, these tests need not be repeated unless the design is changed so as to modify its performance. In such a case, only the relevant tests need be repeated		P
3.32	Routine tests Tests made on each SPD or on parts and materials as required to ensure that the meets the design specifications		P

Test Item	Requirement &Test Method	Result	Verdict
3.33	Acceptance tests Tests which are made when it has been agreed between the manufacturer and the purchaser that the SPD or representative samples of an order are to be tested		P
3.34	Decoupling network A device intended to prevent surge energy from being propagated to the power network during energized testing of SPD. Sometimes called a “back liter”		P
3.35	Impulse test classification		P
3.35.1	Class I tests Tests carried out with the normal discharge current I_n defined in 3.8, the 1.2/50 voltage impulse defined in 3.22, and the maximum impulse current I_{imp} for class I test defined in 3.9		P
3.35.2	Class II tests Tests carried out with the nominal discharge current I_n defined in 3.8, the 1.2/50 voltage defined in 3.22, and the maximum discharge current I_{imp} for class II test defined in 3.10		P
3.35.3	Class III tests Tests carried out with the combination wave (1.2/50, 8/20) defined in 3.24		P
3.26	Backup over current protection An overcurrent device (e.g. fuse or circuit breaker), which is a part of the electrical installation located externally up-stream of the SPD, to avoid overheating and destruction in case the SPD is unable to interrupt the power frequency short-circuit current		P
3.37	Residual current device(RCD) A mechanical switching device or association of devices intended to cause the opening of the contacts when the residual or unbalanced current attains a given value under specified conditions		P
3.38	Sparkover voltage of a voltage switching SPD Maximum voltage value before disruptive discharge between the electrodes of the gap of a SPD		P
3.39	Specific energy *W/R* for class I test The energy dissipated by the impulse current I_{imp} in a unit resistant of 1Ω. It is equal to the time integral of the square of the current W/R= $\int i^2 dt$		P
4	Classification The manufacture shall classify the SPDs in accordance with the following parameters.		
4.1	Number of ports		P
4.1.1	One		P
4.1.2	TWO		P
4.2	SPD design topology		P
4.2.1	Voltage switching type		P
4.2.2	Voltage limiting type		P
4.2.3	Combination type		P
4.3	SPD class I, II and III tests		P

Test Item	Requirement &Test Method	Result	Verdict
4.4	Location		P
4.4.1	Indoor		P
4.4.2	Outdoor		P
4.5	Accessibility		P
4.5.1	Accessible		P
4.5.2	Inaccessible (out-of-reach) NOTE- Out-reach means no access to live parts without the use of tools or other equipment.		P
4.6	Mounting method		P
4.6.1	Fixed		P
4.6.2	Portable		P
4.7	SPD disconnect or		P
4.7.1	Location		P
4.7.1.1	Internal		P
4.7.1.2	External		P
4.7.1.3	Both(one part internal and one part external)		P
4.7.2	Protection functions		P
4.7.2.1	Thermal		P
4.7.2.2	Leakage current		P
4.7.2.3	Overcurrent NOTE- The disconnector may not be necessary.		P
4.8	Backup overcurrent protection		P
4.8.1	Specified		P
4.8.2	Not specified		P
4.9	Degree of protection provided by enclosures according to IP codes of IEC 60529		P
4.10	Temperature range		P
4.10.1	Normal		P
4.10.2	Extended		P
5	Standard ratings		
5.1	Preferred values of impulse current for class I test I_{imp} I peak 1.0;2;5;10;and 20KA Q harge 0.5;1;5; and 10As		P
5.2	Preferred values of nominal discharge current for class II tests I_n 0.005, 0.1, 0.25, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 5.0, 10, 15 and 20 kA		P
5.3	Preferred values of open-circuit voltage for class III tests U_{oc} 0.1 0.2, 0.2, 1, 2, 3, 4, 5, 6, 10 and 20kV		P
5.4	Preferred values of voltage protection level U_p 0.08 0.09 0.012 0.15 0.22 0.33 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.5 1.8 2.0 2.5 3.0 4.0 5.0 6.0 8.0 and 10kV		P
5.5	Preferred values of r.m.s or d.c. maximum continuous operating voltage U_c 52 63 75 95 110 130 150 175 220 230 240 250 260 275 280 320 420 440 460 510 530 600 660 690 800 900 1000 1500 1800 and 2 000V		P

Test Item	Requirement &Test Method	Result	Verdict
6	Requirements		
6.1	General requirements		P
6.1.1	Identification The following minimum information shall be provided by the manufacturer. Tested accordance with clause7. a) Manufacturer's name or trade mark and model number b) Location category c) Number of ports d) Method of mounting e) Maximum continuous operating voltage U_c (one value for each mode of protection) an nominal/rated frequency f) Test classification and discharge parameters for each mode of protection declared by the manufacturer; - class I test I_{imp} - class II test I_{max} - class III test U_{oc} Nominal discharge current I_n for classes I and II (one value for each mode of protection) a) Voltage protection level U_p (one value for each mode of protection)] i) Rated load current (if required) j) Degree of protection provided by the enclosure (IP code) k) Short-circuit withstand l) Maximum recommended ratings of back-up overcurrent protection (if applicable) m) Indication of disconnector operation (if any) n) Position of normal use if significant o) Identification of terminals (if necessary) p) Installation instructions (e.g. connection, mechanical dimensions, lead lengths, etc.) q) Type of current: a.c. frequency or d.c., or both r) Specific energy *W/R* for class I test only (from 7.1.1) s) Temperature range		P
6.1.2	Marking Marking a),e), f), j), l), o) and q) in 6.1.1 are mandatory on the body, or permanently attached to the body, of the SPD. For some designs of one port SPDs, there may not be need to provide a rated load current. Marking shall be indelible and legible and shall not be placed on screws and removable washers. Compliance is in accordance with the test of 7.2 NOTE – Where space is limited, the manufacturer's name or trade mark model number will appear on the device; other marxings should appear on the smallest package.		P
6.2	Electrical requirements		P

Test Item	Requirement &Test Method	Result	Verdict
6.2.1	Electrical connections Terminals shall be designed for the connection of cables having a minimum and a maximum cross-sectional area according to the manufacturer declaration. Each of the tests must be passed by using the most severe configuration (i.e. the maximum or minimum cross-sectional area depending on the test (see clause7)).The SPD shall be equipped with terminals where electrical connection is possible by means of screws, nuts, plugs, sockets or equal effective means. This is checked in 7.3.		P
6.2.2	Voltage protection level U_p The measured limiting voltage of SPDs shall not exceed the voltage protection level that is specified by the manufacturer. Compliance is in accordance with the test of 7.5.		P
6.2.3	Class I impulse current test(s) An SPDS shall be tested to class I test when the manufacturer declares that it meets those requirements. Compliance is in accordance with the test of 7.6.5.		P
6.2.4	Class II normal discharge current test(s) An SPD shall be tested to class II test when the manufacturer declares that it meets those requirements. Compliance is in accordance with 7.6.5.		P
6.2.5	Operating duty test The SPD shall be capable of withstanding specified distance discharge currents during application of the maximum continuous operating voltage U_c without unacceptable changes in tis characteristics. Compliances is in accordance with the test of 7.6		P
6.2.7	SPD disconnector The SPD may have disconnecting devices (which can be either internal or external or both). Their operation shall be indicated. If the SPD is specified to be coupled with an external disconnecting device, the disconnecting device shall be tested with the SPD during the sequence of type tests. Compliance is in accordance with the test of 7.7. NOTE – In the case of specified disconnecting device being a part of the installation, as for example an RCD, there is no need to test this disconnecting device during the operating duty test (See 7.6.1)		P
6.2.8	Air clearances and creep age distances The SPD shall have sufficient air clearances and creep age distances. Testing is in accordance with 7.9.5		P
6.2.9	Tracking resistance Insulating materials necessary to retain live parts in their position shall be composed of non-tracking material, or they shall be sufficiently dimensioned. Testing in accordance with 7.9.6.		P
6.2.10	Dielectric withstand The dielectric withstand of the housing of the SPD shall be sufficient with respect to insulation breakdown and protection against direct contact, Testing in accordance with 7.9.8		P
6.2.11	Short-circuit withstand capability An overstressed (short-circuited), SPD shall withstand the power short-circuit currents that may occur in service. Testing in accordance with 7.7.3..		P

Test Item	Requirement &Test Method	Result	Verdict
6.3	Mechanical requirements SPDS shall be provided with appropriate means for mounting that will ensure mechanical stability. Testing in accordance with 7.9.2.		P
6.3.1	The SPD shall be equipped with terminals where electrical connection is possible by means of : - terminal with screw - nuts; - plug; - socket; - screwless terminal; - insulation piercing connections; - or equal effective means.		P
6.3.2	Mechanical connections a) Terminals shall be fastened to the SPD in such a way that they will not work loose if the clamping screws or the lock nuts are tightened or loosened. A tool shall be required to loose the clamping screws or the lock nuts. b) Plugs and socket outlets shall correspond to the relevant national requirements, and those clauses of IEC 60884-1 that may apply. c) Screws, current-carrying parts and connections 1) Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use. Screws operated when mounting the SPD during installation shall not be of the thread-cutting type. 2) Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material. Compliance is checked by inspection. The suitability of the material is considered in respect of the stability of the dimensions. 3) Current-carrying parts and connections including parts intended for protective conductors, if any, shall be of either - copper, or - an alloy containing at least 58% copper for parts worked cold, or at least 50% copper for other parts, or - other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable .		P

Test Item	Requirement &Test Method	Result	Verdict
	Mechanical connections d) Terminals shall be fastened to the SPD in such a way that they will not work loose if the clamping screws or the lock nuts are tightened or loosened. A tool shall be required to loose the clamping screws or the lock nuts. e) Plugs and socket outlets shall correspond to the relevant national requirements, and those clauses of IEC 60884-1 that may apply. f) Screws, current-carrying parts and connections 1) Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use. Screws operated when mounting the SPD during installation shall not be of the thread-cutting type. 3) Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material. Compliance is checked by inspection. The suitability of the material is considered in respect of the stability of the dimensions. 3) Current-carrying parts and connections including parts intended for protective conductors, if any, shall be of either - copper, or - an alloy containing at least 58% copper for parts worked cold, or at least 50% copper for other parts, or - other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable . New requirements and appropriate tests for determining the resistances to corrosion are under consideration. These requirements should permit other materials to be used if suitably coated.		P

Test Item	Requirement &Test Method	Result	Verdict
	The requirements of this sub clause do not apply to contacts, magnetic circuits, heater elements, bimetals, current-limiting materials, shunts, parts of electronic devices nor to screws, nuts, washers, clamping plates and similar parts of terminals. d) Terminals with screw for external conductors 1) Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently. Such arrangements may be either of the plug-in or of the bolt-on type. The terminals shall be readily accessible under the intended conditions of use. Compliance is checked by inspection and tested in accordance with 7.3.2.2.2 2) The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning. Compliance is checking by inspection and tested accordance with 7.3.2.2.2. 3) Terminals shall have adequate mechanical strength. Screws and nuts for clamping the conductors shall have a metric ISO thread of a thread comparable in pitch and mechanical strength. Compliance is checked by inspection and tested in accordance with 7.3.2.1 and 7.3.2.2. Provisionally, SI, BA and UN threads may be used as they are virtually equivalent in pitch and mechanical strength to metric ISO threads. 4) Terminals shall be so designed that they clamp the conductor without undue damage to the conductor. Compliance is checked by inspection and tested in accordance with 7.3.2.2.2. 5) Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces. Compliance is checked by inspection and tested in according with 7.3.2.1 and 7.3.2.2.1. 6) Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened. This requirement does not apply lug terminals. Compliance is checked by inspection and tested in accordance with 7.3.2.2.3. 7) Terminals shall be so fixed or located that,		P

Test Item	Requirement &Test Method	Result	Verdict
	when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings to the SPDS. These requirements do not imply that the terminals shall be so designed that their rotation or displacement is prevented, buy any movement shall be sufficiently limited so as to prevent non-compliance with the requirements of this standard. The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that - the sealing compound or resin is not subject to stress during normal use, and - the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavorable conditions specified in this standard. Compliance is checked by inspection, by measurement and tested in accordance with 7.3.2.1. 8) lamping screws or nuts of terminals intended for the connection of protective connection of protective conductors shall be adequately secured against accidental loosening. e) Screw less terminals for external conductors 1) Terminals shall be so designed and constructed that - each conductor is clamped individually During the connection or disconnection the conductors can be connected or disconnected either at the same time or separately; - it is possible to clamp securely any number of conductors up to the maximum provided. Compliance is checked by inspection and tested in accordance with 7.3.3 2) Terminals shall be so designed and constructed that they clamp the conductor without undue damage to the conductor. Compliance is checked by inspection. f) Insulation pierced connections for external conductors. 1) The insulation pierced connections shall make a reliable mechanical connection. Compliance is checked by inspection and tested in accordance with 7.3.4.		P
	2) Screws for making contact-pressure shall not serve to fix any other component, although they may hold the SPD in place or prevent it from turning. Compliance is checked by inspection. 3) Screws shall not be of metal which is soil or liable to creep. Compliance is checked by inspection.		P
6.3.3	Corrosive resistant metals Clamps, except clamping screws, lock nuts, binding clip thrust washers, wire, and similar, shall consist of corrosion resistant metal such as copper, brass, etc.(see IEC 60999).		P

Test Item	Requirement &Test Method	Result	Verdict
6.4	Environmental requirements SPDs shall be designed in such a way that they operate satisfactorily under the environmental conditions given by the normal service conditions. Compliance is tested in accordance with 7.9.9. Outdoor SPDs shall be contained in a weather shield of glass, glazed ceramic or other acceptable material that is resistant to UV radiation, corrosion, erosion, and tracking. They shall have sufficient surface creepage distance between any two parts of different potential.		P
6.5	Safety requirements SPDs shall be safe when operated under normal service conditions in accordance with the recommendation.		P
6.5.1	Protection against direct contact These requirements are valid for accessible SPDS where the maximum continuous operating voltage U_c is above 50 V r.m.s.a.c. For protection against direct contact (inaccessibility of live parts). SPDS shall be designed in such a way that live parts cannot be touched when the SPD is installed for the intended use. Compliance is verified by standardized test methods of IEC 60529 and to 7.4. SPDs, except SPDs classified as inaccessible, shall be so designed that, when they are wired and mounted as for normal use. Live parts are not accessible, even after removal of parts which can be removed without the use of a tool. Compliance is checked by inspection and, if necessary, by the tests of 7.4.1. The connection between the earthing terminals and all accessible parts connected there to shall be of low resistance. Compliance is checked by the test according to 7.4.2		P
6.5.1.1	Mechanical strength All parts of the SPD relating to the protection against direct contact shall have sufficient mechanical strength.		P
6.5.1.2	Heat resistance All parts relating to the protection against direct contact shall be sufficiently heat resistant.		P
6.5.1.3	Insulation resistance The insulation resistance of the SPD shall be sufficient.		P
6.5.2	Fire resistance Insulating parts of the housing shall be either nonflammable or self-extinguishing.		P
6.5.5	Behaviour under temporary overvoltages And SPD shall either withstand a TOV without changes in functionality, or fall in a manner described in 7.7.4 and 7.7.6.		P
6.6	Additional requirements for two port SPDs and one-port SPDs with separate input/output terminals		P
6.6.1	The percent of voltage regulation shall be declared.		P
6.6.2	The rated load current shall be declared by the manufacturer and tested		P

Test Item	Requirement &Test Method	Result	Verdict
6.6.4	Overload behaviour The SPD shall not be damaged or altered by overloads, which may occur in normal use. Compliance with this requirement is checked according to 7.8.5.		P
7	Type tests		
	Type tests are carried out as indicated in Table 2 on three samples per test series. Within any test series, the tests shall be carried out in the order given in Table 2. The order in which test series are carried out may be varied.		P
	If all samples pass a test series, then the design of the SPD is acceptable for that test series. If two or more test samples fail a test series, the SPD doed not comply with this stand.		P
	If the SPD is essentially the same as a product covered by another international Standard except for the fact that it incorporates SPD technology, then the requirements of the other International Standard shall apply to those features of the product not influenced by the presence of the SPD technology.		P
7.1	General testing procedures It not otherwise specified, the reference standard for testing procedure is IEC 61180-1. The SPD shall be mounted and electrically connected in accordance with the manufacturer =s installation procedures. Neither external cooling nor heating shall be employed. When not otherwise specified, the test shall be performed in free air and the ambient temperature shall be 20℃ =15℃. When testing SPDS for which the manufacturer supplies integral cables. The full length of those cables shall form part of the SPD under test. During the test, no maintenance or dismantling of the SPD is allowed. All external switches, circuit breakers, fuse, disconnecting devices and similar shall be set or connected as declared by the manufacturer during normal operation of the SPD, where applicable. For SPDs having more than one mode of protection (see 3.7), for which the manufacturer declares a voltage protection level, the test shall be performed on each mode, with the values chosen according to the manufacturer declaration, using new samples each time. For three phase devices in which the protective component circuitry per given mode is identical, the testing of each of the three phase will fulfill the three samples requirement. It should be noted that good testing techniques are required for impulse testing and measurements. This is needed to ensure that correct test values are recorded.		P
	Unless otherwise specified, a.c. values given in this standard are r.m.s values.		P

<table>
<tr><th>Test Item</th><th>Requirement &Test Method</th><th>Result</th><th>Verdict</th></tr>
<tr><td>7.1.1</td><td>Class I impulse current test

The test impulse current I_{imp} is defined by its parameters peak value I_{peak} and charge Q. The test impulse current shall obtain I_{imp} Q within 10ms. A typical waveshape that can achieve the parameters according to table 3 is that of a unspooled impulse current. The specific energy W/R shall be calculated during this test.

Table 3 – parameters for class test
<table>
<tr><th>I_{peak}
kA</th><th>Q
Q(As)within 10ms</th></tr>
<tr><td>20</td><td>10</td></tr>
<tr><td>10</td><td>5</td></tr>
<tr><td>5</td><td>2.5</td></tr>
<tr><td>2</td><td>1</td></tr>
<tr><td>1</td><td>0.5</td></tr>
<tr><td colspan="2">Note- if the case of values differing from those given in table 3. the relationship between I_{peak} And Q is given by the formula Q(AS)=0.5 I_{peak}(KA)</td></tr>
</table>
The tolerances on the peak value of the current I_{peak} and the charge Q are:

- I_{peak} =10%
- Q =10%</td><td></td><td>P</td></tr>
<tr><td>7.1.2</td><td>Class I and class II nominal discharge current test

The standard waveshape is 8/20. The tolerances on the current waveshape are following :

- peak value =10%
- front time =10%
- time to half value =10%

A small overshoot or oscillations is tolerated provided that the amplitude of any oscillation is not more than 5% of the peak value. Any polarity reversal after the current has fallen to zero shall not be more than 20% of the peak value.

In the case of two port devices, the magnitude of the reversal shall be less than 5%, so that it does not affect the measured limiting voltage.

The measurement of the current flowing into the SPD shall be performed with an accuracy of ±3%.</td><td></td><td>P</td></tr>
</table>

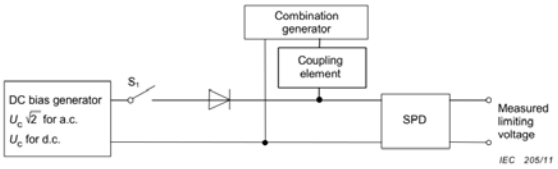
Test Item	Requirement &Test Method	Result	Verdict
7.1.3	Class I and II voltage impulse test The standard voltage waveshape is 1.2/50. The tolerances on the voltage waveshapes are the following: - peak value =3% - front time =30% - time to half value =20% Oscillations or overshoot may occur at the crest of the impulse. If the frequency of such oscillations is more than 500 kHZ or the duration of the overshoot is less than 1μs, a mean curve snail be drawn and ,for the purpose of the measurement, the maximum amplitude of this curve defines the peak value of the test voltage. The measurement of the voltage oscillations exceeding 3% of the peak value are not allowed at the rising portion of the voltage impulse. The measuring devices shall have an overall bandwidth of at least 25 MHz and the overshoot shall be less than 3%. The short-circuit of the test generator shall be less than 20% of the nominal discharge current of the SPD under test.		P

Test Item	Requirement &Test Method	Result	Verdict
7.1.4	Class II combination wave test The standard impulse of a combination waveform generator is characterized by the output voltage under open-circuit conditions and the output current under short-circuits conditions. The open-circuit voltage shall have a front time of 1.2μs and a time to half value of 50μs. The short-circuit current shall have a front time of 8μs and a time half value of 20μs. NOTE – For further guidance on this subject. See IEC 62.45 The following values are measured on the generator without a back filter. The tolerances on open circuit voltage U_{oc} shall be the following: - peak value =3% - front time =30% - time to half value =20% Voltage overshoot or oscillations in the neighborhood of the crest acceptable provided that the single peak amplitude is less than 5% of the peak value. In commonly used impulse generator circuits, oscillations on that part of the wave front during which the voltage does not exceed 90% of the peak value have generally negligible influence on the test results and this may be disregarded. The voltage waveforms shall be essentially unidirectional. The tolerances on the short-circuit current shall be the following: - peak value =10% - front time =10% - time to half value =10% A current overshoot or oscillations are tolerated provided that their single peak amplitude at the crest of the waveform is less than 5% of the peak value. Any polarity reversal after the current has fallen to zero shall be less than 20% of the peak value. In the case of two port devices the magnitude of the current reversal shall be less than 5%, so that it does not affect the measured limiting voltage. The fictive impedance of the generator shall be nominally 2Ω. By definition, the fictive impedance is the ratio of the peak value of the open-circuit voltage U_{oc} divede by the peak value of the short-circuit current I_{sc} The maximum values for peak open-circuit voltage U_{oc} and peak short-circuit current I_{sc} are 20kV and 10 kA respectively. Above these values (20 KV/10KA), type II tests shall be performed.		P
	Insert a decoupling network (back filter) according to figures 1 or 2. This circuit configuration will be used only for deterring the measured limiting voltage of the SPD.		
7.2	Identification and marking		P
7.2.1	Verification of the identification and marking Verification of the identification and marking shall be checked against the respective requirements of 6.1.1 and 6.1.2 by inspection.		P

Test Item	Requirement &Test Method	Result	Verdict
7.2.2	Test of indelibility of markings This test shall be applied on marking of all types except those made by impressing, molding and engraving. The test is made by rubbing the marking by hand for 15s with a piece of cotton soaked with water and again for 15s with a piece of cotton soaked with aliphatic solvent hexane (with a content of aromatics of maximum 0.1% volume) , a kauributanol value of 29, initial boiling-point approximately 65℃ and specific gravity of 0.68g/cm^3 After this test, the marking shall be easily legible .		P
7.3	Terminals and connections Verification of the incorporated terminals and their conformity is met by the requirements of 7.3.1.		P
7.3.1	The SPD is mounted according to the manufacturer=s recommendation, and is protected against undue external heating or cooling. Unless otherwise specified, the SPD terminals (3 samples of each construction used) shall be wired with conductors according to - the manufacture=s instructions for other one-port devices. And fixed on a dull, black-painted wood board of about 20mm thickness. The method of fixing shall comply with any requirements relating to the means of mounting recommended by the manufacturer. Nevertheless SPDs tested according to class I and one-port SPDs with a nominal discharge current ≥5kA tested according to class II shall be capable of clamping conductors up to a cross-section of at least 4 mm^2 During the test, no maintenance or dismantling of the sample is allowed.		P
7.3.2	Terminals with screws		P

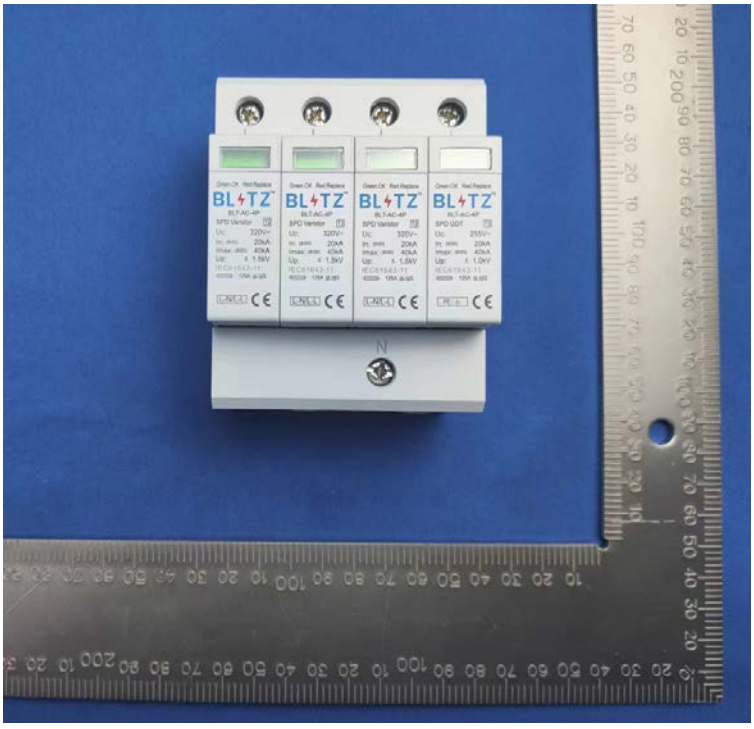
Test Item	Requirement &Test Method	Result	Verdict
7.3.2.1	Test of reliability of screws, current-carrying parts and connections Compliances is checked by inspection and for screws which are operated when connecting up the SPD by the following test. The screws are tightened are loosened - ten times for screws in engagement with a thread of insulating material - five times in all other cases. Screws or nuts in engagement with a thread of insulation material are completely removed and reinserted each time unless the construction of the screw prevent this.] The screws shall not be tightened in jerks. The conductor is moved each time the screw is loosened. Column II applies to screws and nuts which are tightened by means other than a screwdriver Where a screw has a hexagonal head with a slot for tightening with a screwdriver and the values in columns II and III are different, the test is made twice, applying the torque specified in column III to the hexagonal head and, on another sample, applying the torque specified in column II by means of a screwdriver. If the values in column II and III are the same, only the test with the screwdriver is made. During the test, the screwed connections shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups that will impair the further use of the SPD. Moreover enclosure and covers shall not be damaged verification by visual inspection.		P
8	Type tests Type tests are carried out as indicated in Table 3 on three samples per test sequence. Within any test sequence, the tests shall be carried out in the order given in Table 3. The order in which test sequence are carried out may be varied. Test on terminals shall be performed on three terminal samples for each construction/terminal type. (An SPD with at least three identical terminals fulfils this sample requirement).		P
8.1 .1	Impulse discharge current used for class I additional duty test The impulse discharge current passing through the device under test (SPD) is defined by the crest value I imp , the charge Q and the specific energy W/R. The impulse current shall show no polarity reversal and shall reach I imp within 50 µs. The transfer of the charge Q shall occur within 5 ms and the specific energy W/R shall be dissipated within 5 ms.		P

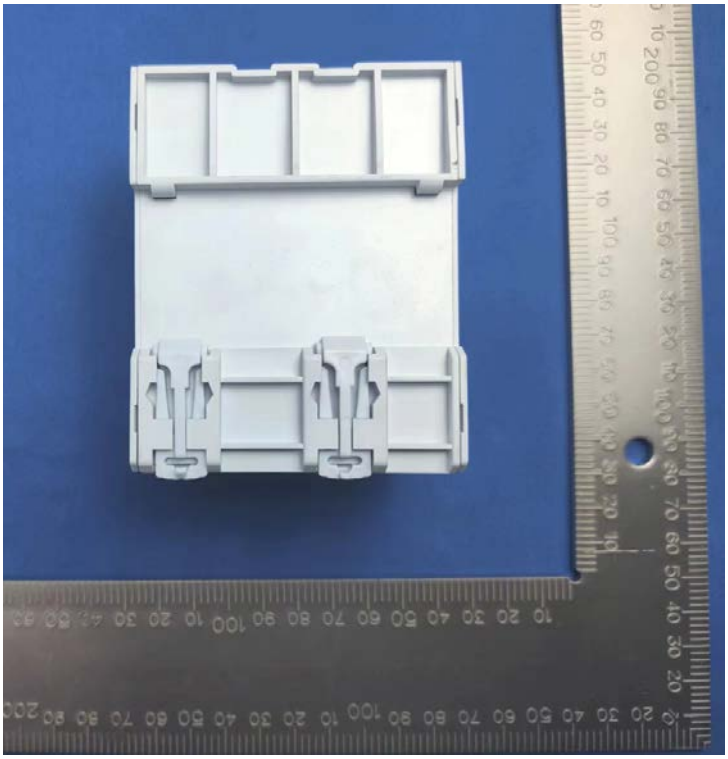
Test Item	Requirement &Test Method	Result	Verdict
8.1.2	Current impulse used for class I and class II residual voltage and operating duty tests The waveshape is 8/20. The tolerances on the current waveshape passing through the device under test are as follows: • crest value ±1 0 % • front time ±1 0 % • time to half value ±1 0 % A small overshoot or oscillation is tolerated provided that the amplitude of any oscillation is not more than 5 % of the crest value. Any polarity reversal after the current has fallen to zero shall not be more than 30 % of the crest value. In the case of two port devices, the magnitude of the reversal shall be less than 5 %, so that it does not affect the measured limiting voltage.		P
8.1.3	Voltage impulse used for class I and II sparkover tests The standard voltage waveshape is 1 ,2/50. The tolerances of the voltage waveshape of the open circuit voltage at the points where the device under test (DUT) will be connected are the following: • crest value ±5 % • front time ±30 % • time to half value ±20 %		P
8.1.4	Combination wave used for class III tests The standard impulse of a combination waveform generator is characterized by the output voltage under open-circuit conditions and the output current under short-circuit conditions. The open-circuit voltage shall have a front time of 1 ,2 µs and a time to half value of 50 µs. The short-circuit current shall have a front time of 8 µs and a time to half value of 20 µs. NOTE 1 For further guidance on this subject see IEEE C62.45:2009 a) The tolerances of the open circuit voltage U oc at the points where the device under test (DUT) will be connected are as follows: • crest value ±5 % • front time ±30 % • time to half value ±20 %.		P

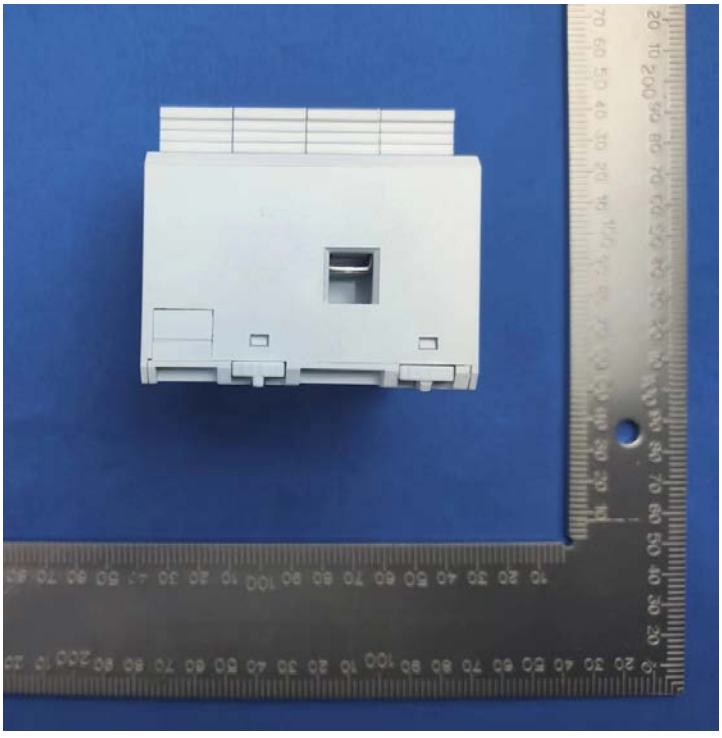
Test Item	Requirement &Test Method	Result	Verdict
8.1.4.1	Alternate test circuit to determine the measured limiting voltage (8.3.3) without a decoupling network Two-port SPDs with reactive components create interaction with the reactive components of a back filter. This can produce artificially low values of measured limiting voltage. Tests in such cases shall use the alternative test circuit according Figure 4.  **Figure 4 – Alternate test for the measured limiting voltage**		P
	8.2 Indelibility of markings This test shall be applied on markings of all types except those made by impressing, molding and engraving. The test is made by rubbing the marking by hand for 1 5 s with a piece of cotton soaked with water and again for 1 5 s with a piece of cotton soaked with aliphatic solvent hexane with a content of aromatics of maximum 0,1 % volume, a kauributanol value of 29, initial boiling- point approximately 65 °C and specific gravity of 0,68 g/cm^3). After this test, the marking shall be easily legible.		P
8.3	Electrical tests		P
8.3.1	Protection against direct contact		P
8.3.1.1	Insulated parts The sample is mounted as for normal use and the test is conducted using conductors of the smallest cross-sectional area and then again using conductors of the largest cross-sectional area specified in 8.4.2. The standard test finger (in accordance with IEC 60529) is applied in every possible position. For plug-in SPDs (which can be changed without a tool), the test finger is applied in every possible position, when the plug is partially inserted or completely inserted in a socket outlet. An electrical continuity indicator operating from a voltage of not less than 40 V and not more than 50 V, one side of which is connected between the all live terminals of the sample linked together and the other side is connected to the test finger to check for the possibility of contact with any live part of the sample.		P

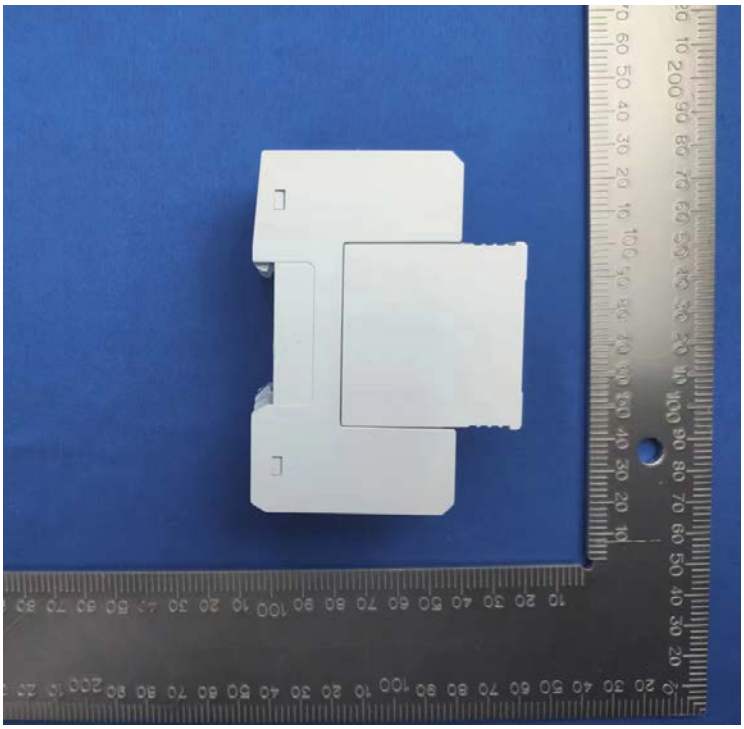
<table>
<tr><th>Test Item</th><th>Requirement &Test Method</th><th>Result</th><th>Verdict</th></tr>
<tr><td>8.3.1.2</td><td>Metal parts
Metal parts which are accessible when the SPD is wired and mounted as for normal use shall
be connected to earth through a low resistance connection, except of small screws and the like, isolated from live parts, for fixing bases and covers or cover plates of socket-outlets.
A current (derived from an a.c. source having a no-load voltage not exceeding 1 2 V) equal to 1,5 times the rated load current or 25 A, whichever is the greater, is passed between the earthing terminal and each of the accessible metal parts in turn.
The voltage drop between the earthing terminal and the accessible metal part is measured and the resistance is calculated from the current and this voltage drop. The resistance shall not exceed 0,05 Ω.</td><td></td><td>P</td></tr>
<tr><td>8.3.2</td><td>Residual current I_{PE}
The SPD shall be connected as for normal use according to the manufacturer’s instructions.
The voltage shall be adjusted to the reference test voltage of (U REF).
The residual current flowing through the PE terminal is measured.</td><td></td><td>P</td></tr>
<tr><td>8.3.3</td><td>Measured limiting voltage
The tests on the different SPD types to determine their measured limiting voltages shall be
performed according to the flow chart in Figure 5 and the following Table 7.
Table 7 – Tests to be performed to determine the measured limiting voltage
<table>
<tr><th></th><th>Class I</th><th>Class II</th><th>Class III</th></tr>
<tr><td>Test 8.3.3.1</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Test 8.3.3.2</td><td>X[a]</td><td>X[a]</td><td></td></tr>
<tr><td>Test 8.3.3.3</td><td></td><td></td><td>X</td></tr>
<tr><td colspan="4">[a] To be performed only on voltage switching and combination type SPDs.</td></tr>
</table></td><td></td><td></td></tr>
</table>

PHOTOS









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