



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

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Applicant's name.....: Guangzhou Sankosha Lightning Protection Technology Co., Ltd.
Address: 3rd floor A2 plant, Wanan Industrial Park, No.110 Lanbei Road, Lanhe Town, NanSha District, Guangzhou City, Guangdong, P. R. China 511480

Test specification:
Standard: IEC 61643-11: 2011 (First Edition)
Test procedure: CB Scheme
Non-standard test method.....: N/A

Test Report Form No.....: IEC61643_11B
Test Report Form(s) Originator.....: OVE
Master TRF.....: Dated 2012-12

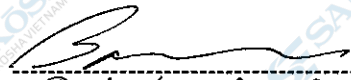

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Test item description: Surge Protective Device
Trade Mark: **SANKOSHA**
Manufacturer.....: Same as applicant
Model/Type reference: MZSR-200*, MZSR-385*, MZSR-ARI
 ("*" = JK1, JK2, JK3, JK4, JK1ARI, JK2ARI, JK3ARI. Total 15 models, see page 6-8 for details)
Ratings.....: See page 6-8 for details

Testing procedure and testing location:	
<input checked="" type="checkbox"/> CB Testing Laboratory:	INTERTEK TESTING SERVICES Shanghai.
Testing location/ address.....:	Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, P. R. China
<input type="checkbox"/> Associated CB Laboratory:	
Testing location/ address.....:	
Tested by (name + signature).....:	Baal He 
Approved by (name + signature)....:	Rachel Wang 
<hr/>	
<input type="checkbox"/> Testing procedure: TMP	
Testing location/ address.....:	
Tested by (name + signature).....:	
Approved by (name + signature)....:	
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<input type="checkbox"/> Testing procedure: WMT	
Testing location/ address.....:	
Tested by (name + signature).....:	
Witnessed by (name + signature)..:	
Approved by (name + signature)....:	
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<input type="checkbox"/> Testing procedure: SMT	
Testing location/ address.....:	
Tested by (name + signature).....:	
Approved by (name + signature)....:	
Supervised by (name + signature) :	

Summary of testing:	
Tests performed (name of test and test clause):	
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Subcontractor information:	
LPD Testing Center of Shanghai Lightning Protection Center No 2030 Laifang Road, Songjiang District, Shanghai, P. R. China	
Summary of compliance with National Differences:	
N/A	
Testing location:	
clause	location
8.2	TL
8.4.1	
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8.5.1	
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Copy of marking plate:

Marking of basic module		
MZSR -200	MZSR -385	MZSR -ARI
U_0 :275V~	U_0 :385V~	U_0 :275V~
U_p :1.4kV	U_p :1.8kV	U_p :1.5kV
I_{max} :40kA	I_{max} :40kA	I_{max} :40kA
I_n :20kA	I_n :20kA	I_n :20kA
Class II	Class II	Class II
125AgG T2	125AgG T2	N/PE T2
IP 20	IP 20	IP 20
 SANKOSHA	 SANKOSHA	 SANKOSHA

The model (i.e. "MZSR-200JK3ARI") is adhesive label which is on bottom of end product. (as an example here for reference).

"L1,L2,L3,N and PE" are marked by printing near terminal portion of the base of end product.

Note: All products are combination of above basic modules MZSR-200, MZSR-385 and MZSR-ARI, see page 6-8 for detail.

Test item particulars	
Number of ports	One port / Two port
SPD design topology	Voltage switching / Voltage limiting / Combination
SPD classified for test class	I / II / III
Location	Indoor / Outdoor
Accessibility	Accessible/ Inaccessible
Mounting method	Fixed / Portable
SPD Disconnector	Internal / External / Both
Protection functions	Thermal / Leakage current / Overcurrent
Overcurrent protection	Specified / Not specified
Degree of protection (IP code)	IP 20
Temperature range	Normal / Extended
Required SPD-disconnectors	Internal thermal disconnecter (integral with MOV and GDT part) / External 125A fuse (as external disconnecter, see manual)
SPD failure behaviour:	open circuit / short circuit
Possible test case verdicts:	
- test case does not apply to the test object	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	2014-03-31
Date (s) of performance of tests	2014-03-31 ~ 2014-06-30
General remarks:	
<p>The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p> <p>Throughout this report a <input checked="" type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.</p> <p>This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.</p>	
Factory: Guangzhou Sankosha Lightning Protection Technology Co., Ltd.	
Address: 3rd floor A2 plant, Wanan Industrial Park, No.110 Lanbei Road, Lanhe Town, NanSha District, Guangzhou City, Guangdong, P. R. China 511480	

General product information:									
Type 2 SPD, inaccessible, with mechanical indicator, with internal disconnecter, with fusible metal Pb/Sn alloy, with signalling contact.									
Ratings:									
<i>Model</i>	<i>Protected mode</i>	<i>I_{max}</i> (kA)	<i>I_n</i> (kA)	<i>U_c</i> (V)	<i>U_p</i> (kV)	<i>I_{SCCR}</i> (kA)	<i>LV System</i>	<i>Client declared external disconnecter</i>	<i>Combined type</i>
MZSR-200JK1	1xL-PE, alternative 1xL-N, 1xN- PE	40	20	275	1.4	25	TN	125A gG fuse	1P
MZSR-200JK2	1xL-PE, 1xN-PE	40	20	275	1.4	25	TN	125A gG fuse	2P
MZSR-200JK3	3xL-PE	40	20	275	1.4	25	TN	125A gG fuse	3P
MZSR-200JK4	3xL-PE, 1xN-PE	40	20	275	1.4	25	TN	125A gG fuse	4P
MZSR-200JK1AR1	1xL-N	40	20	275	1.4	25	TT, TN	125A gG fuse	1P+N
	1xN-PE	40	20	275	1.5	-		-	
MZSR-200JK2AR1	2xL-N	40	20	275	1.4	25		125A gG fuse	2P+N
	1xN-PE	40	20	275	1.5	-		-	
MZSR-200JK3AR1	3xL-N	40	20	275	1.4	25		125A gG fuse	3P+N
	1xN-PE	40	20	275	1.5	-		-	
MZSR-385JK1	1xL-PE, alternative 1xL-N, 1xN- PE	40	20	385	1.8	25	TN	125A gG fuse	1P
MZSR-385JK2	1xL-PE, 1xN-PE	40	20	385	1.8	25	TN	125A gG fuse	2P
MZSR-385JK3	3xL-PE	40	20	385	1.8	25	TN	125A gG fuse	3P
MZSR-385JK4	3xL-PE, 1xN-PE	40	20	385	1.8	25	TN	125A gG fuse	4P

Model	Protected mode	I_{max} (kA)	I_n (kA)	U_c (V)	U_p (kV)	I_{SCCR} (kA)	LV System	Client declared external disconnecter	Combined type
MZSR-385JK1AR1	1xL-N	40	20	385	1.8	25	TT, TN	125A gG fuse	1P+N
	1xN-PE	40	20	275	1.5	-		-	
MZSR-385JK2AR1	2xL-N	40	20	385	1.8	25		125A gG fuse	2P+N
	1xN-PE	40	20	275	1.5	-		-	
MZSR-385JK3AR1	3xL-N	40	20	385	1.8	25		125A gG fuse	3P+N
	1xN-PE	40	20	275	1.5	-		-	
MZSR-AR1	1xN-PE	40	20	275	1.5	-	-	1P	

Version list:

MZSR-200JK1, MZSR-200JK2, MZSR-200JK3, MZSR-200JK4, MZSR-200JK1ARI, MZSR-200JK2ARI, MZSR-200JK3ARI, MZSR-385JK1, MZSR-385JK2, MZSR-385JK3, MZSR-385JK4, MZSR-385JK1ARI, MZSR-385JK2ARI, MZSR-385JK3ARI, MZSR-ARI (Totally 15 versions).

All final products are combination of SPD basic modules MZSR-200, MZSR-385 and MZSR-ARI for corresponding protected mode.

MZSR-200: Surge protector, type 2, voltage limiting type SPD, with fusible metal Sn alloy.

MZSR-385: Surge protector, type 2, voltage limiting type SPD, with fusible metal Sn alloy.

MZSR-ARI: Surge protector, type 2, voltage switching type SPD, with fusible metal Sn alloy.

Model	Protected mode	Module reference	Remark
MZSR-200JK1	L-PE alternative L-N or N-PE	1x MZSR-200	-
MZSR-200JK2	1x L-PE+1x N-PE	2x MZSR-200	-
MZSR-200JK3	3x L-PE	3x MZSR-200	for L-PE as 3 phase respectively
MZSR-200JK4	3x L-PE, 1x N-PE	4x MZSR-200	Three for L-PE as 3 phase respectively, one for N-PE
MZSR-200JK1ARI	1x L-N	1x MZSR-200	-
	1x N-PE	1x MZSR-ARI	-
MZSR-200JK2ARI	2x L-N	2x MZSR-200	-
	1x N-PE	1x MZSR-ARI	-
MZSR-200JK3ARI	3x L-N	3x MZSR-200	for L-N as 3 phase respectively
	1x N-PE	1x MZSR-ARI	-

Model	Protected mode	Module reference	Remark
MZSR-385JK1	L-PE alternative L-N or N-PE	1x MZSR-385	-
MZSR-385JK2	1x L-PE+1x N-PE	2x MZSR-385	-
MZSR-385JK3	3x L-PE	3x MZSR-385	for L-PE as 3 phase respectively
MZSR-385JK4	3x L-PE, 1x N-PE	4x MZSR-385	Three for L-PE as 3 phase respectively, one for N-PE
MZSR-385JK1ARI	1x L-N	1x MZSR-385	-
	1x N-PE	1x MZSR-ARI	-
MZSR-385JK2ARI	2x L-N	2x MZSR-385	-
	1x N-PE	1x MZSR-ARI	-
MZSR-385JK3ARI	3x L-N	3x MZSR-385	for L-N as 3 phase respectively
	1x N-PE	1x MZSR-ARI	-
MZSR-ARI	1x N-PE	1x MZSR-ARI	-

If not otherwise specified all tests have been carried out on three samples per test sequence. Terminal tests have been carried out on three terminals of each construction used.

Impulse tests have been carried out according to chapters 8.1.1 to 8.1.4.

SPDs according test class I: Calculation of charge Q and specific energy W/R applied during additional duty test acc. to 8.3.4.4

I (kA)	Q (As) within 5 ms	W/R (kJ/Ω)
0,1* I _{imp} = _____		
0,25* I _{imp} = _____		
0,5* I _{imp} = _____		
0,75* I _{imp} = _____		
1,0* I _{imp} = _____		

If the SPD is an integral part of a product covered by another standard, the requirements of the other standard were applied to those parts of the product, which do not belong to the SPD section of the product. The SPD section was judged according to the general (7.1), the electrical (7.2), the environmental and material (7.4) requirements. The mechanical requirements of other standards shall also be applied to the SPD.

Unless otherwise specified, a.c. values given in this report are r.m.s. values.

If not otherwise specified the tests have been performed in free air and at an ambient temperature of $(20 \pm 15)^\circ\text{C}$.

If not otherwise specified, for all tests where a power supply at U_{REF} or U_{C} is required, the voltage tolerance for testing was $^{+0}/_{-5}\%$.

If the SPD is supplied with integral cables, the full length of these cables forms part of the SPD under test, except for the determination of the measured limiting voltage 8.3.3, where a lead length of 150 mm was used.

SPD disconnectors have been selected according to the manufacturer's instructions and connected for testing according to Table 3.

For SPDs having more than one mode of protection, for which the manufacturer declares a voltage protection level, the tests have been performed on each mode, with the values chosen according to the manufacturer's declaration, using new samples each time. For three phase devices in which the protective component circuitry per given mode is identical, the testing may be performed on each of the three phases which fulfils the three sample requirement.

For SPDs with a designated N terminal which may be applied in systems without distributed neutral according to the manufacturer's instructions, separate testing has been performed for the L-PE mode of protection with the neutral being unconnected.

If the manufacturer sets different requirements for the external SPD disconnector(s) depending upon the prospective short-circuit current of the supply system, all relevant test sequences have been performed for every combination of required SPD disconnector(s) and corresponding prospective short-circuit currents.

Throughout the entire type testing procedure, the status shown by the indicator(s) give a clear sign of the status of the part to which it is linked. Where there is more than one method of status indication, for example local and remote indication, each type of indication was checked.

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	b7) Orientation for normal installation		N/A
	b8) Installation instructions - type of LV systems (TN-, TT-, IT-system) - intended connection - nominal a.c. system voltages and maximum allowed voltage regulation for which the SPD is designed, mechanical dimensions, lead lengths, etc.	See page 6-8	P
	b9) Temperature and humidity range	Normal / extended	P
	b10) Follow current interrupting rating I_{ff}	100A	P
	b11) Residual current I_{PE}	1 mA	P
	b12) Transition surge current rating for short-circuiting type SPD I_{trans}		N/A
	b13) The minimum distance from any earthed conductive surface at which the SPD can be installed		N/A
	b14) I_{max} (optional)	See page 6-8	P
	<u>Information which shall be available in a datasheet</u>		
	c1) Temporary overvoltage rating U_T and/or the type(s) of power system(s) the SPD is designed for according to Annex B and corresponding connection details	See Table B.1 for U_T	P
	c2) Total discharge current I_{TOTAL} for multipole SPDs (if declared by the manufacturer) and the corresponding test class		N/A
	c3) Voltage drop for two port SPDs		N/A
	c4) Load-side surge withstand capability for two-port SPDs		N/A
	c5) Information about replaceable parts (indicators, fuses, etc.)	no replaceable parts	N/A
	c6) Voltage rate of rise du/dt		N/A
	c7) Current factor k , if different from Table 20		N/A
	c8) Modes of protection (for SPDs with more than one mode of protection)	see page 6-8	P
8.2	Indelibility of markings		
	This test shall be applied on markings of all types except those made by impressing, molding and engraving.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	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 °C and a specific gravity of 0,68 g/cm ³ .		P
	After this test, the marking shall be easily legible.		P
7.3.1	Mounting		
	SPDs shall be provided with appropriate means for mounting that will ensure mechanical stability. Mechanical coding/interlock shall be provided to prevent incorrect combinations of plug-in SPD modules and sockets. Compliance is checked by visual inspection.		P
	Terminals and connections		
7.3.2	Screws, current carrying parts and connections		
8.4.1	Reliability of screws, current-carrying parts and connections		P
	Screws operated when connecting the SPD:		
	The screws are tightened and loosened: - ten times for screws in engagement with a thread of insulating material - five times in all other cases	Five times	P
	Screws or nuts in engagement with a thread of insulating material are completely removed and reinserted each time unless the construction of the screw prevents this.		N/A
	The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 10 or according to the manufacturer's specification, whichever is greater.	Ø 4.80mm 2,0Nm	P
	The screws shall not be tightened in jerks.		P
	The conductor is moved each time the screw is loosened.		P
	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.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Enclosures and covers shall not be damaged. This shall be verified by visual inspection.		P
7.3.3	External connections		
8.4.2	Terminals for external conductors		P
	<p>The SPD is mounted according to the manufacturer's recommendation on a dull, black-painted board of about 20mm thickness, and protected against undue external heating or cooling.</p> <p>SPD terminals wired with conductors according to:</p> <ul style="list-style-type: none"> - table 11, for two-port devices and one port devices with separate input/output terminals or, - the manufacturer's instruction, for other one-port devices 	1,5 to 25 mm ²	P
	SPDs tested according to class I and one-port SPDs with a nominal discharge current ≥ 5 kA tested according to class II shall be capable of clamping conductors up to a cross-section of at least 4 mm ²		P
	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 loosen the clamping screws or the lock nuts.		P
	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. The terminals shall be readily accessible under the intended conditions of use.		P
	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.		P
	Terminals shall have adequate mechanical strength.		P
	Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.		P
	Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.		P
	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.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.3.3.1	Terminals with screws		
	Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.		P
	Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings to the SPDs.		P
	These requirements do not imply that the terminals shall be so designed that their rotation or displacement is prevented, but any movement shall be sufficiently limited so as to prevent non-compliance with the requirements of this standard.		P
	The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that: <ul style="list-style-type: none"> 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 least favourable conditions specified in this standard. 		N/A
	Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening.		P
	Screws shall not be made of metal that is soft or liable to creep, such as zinc or aluminium.		P
8.4.2.1.1	General		
	These tests are made by means of a suitable screwdriver or spanner applying a torque as shown in table 10.	Ø 4.80 mm 2,0 Nm	P
	The terminals are fitted with copper conductors of the smallest or largest cross-sectional areas specified in 8.4.2, solid or stranded, whichever is least favourable	stranded min. 1,5 mm ² max. 25 mm ²	P
	The conductor is inserted into the terminal for the minimum distance prescribed or, where no distance is prescribed, until it just projects from the far side, and in the position most likely to assist the wire to escape		P
	The clamping screws are then tightened with a torque to two-thirds of that shown in the appropriate column of table 10.	Ø 4.80mm 1,33Nm	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Each conductor is then subjected to a pull of the value, in newtons, shown in table 12. The pull is applied without jerks, for 1 min, in the direction of the axes of the conductor space.	50N (for 1,5 mm ²) 100N (for 25 mm ²)	P
	During this test, the conductor shall not move noticeably in the terminal		P
8.4.2.1.2 a)	The terminals are fitted with cooper conductors (solid or stranded), of the smallest or largest-sectional areas as specified in 8.4.2, (whichever is the least favourable) and the terminal screws are tightened with a torque equal to two-thirds of the values shown in the appropriate column of table 10. The terminal screws are then loosened and the part of the conductor which may have been affected by the terminal is inspected.	stranded Min. 1,5 mm ² Max. 25 mm ²	P
	The conductors shall show neither undue damage nor severed wires		P
	Conductors are considered to be unduly damaged if they show deep or sharp indentations.		P
	During the test, terminals 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 terminal.		P
8.4.2.1.2 b)	The terminals are fitted with a rigid stranded cooper conductor according to table 13.	Min. 1,5 mm ² (7 x 0,67 mm ²) Max. 25 mm ² (7 x 2,14 mm ²)	P
	Before insertion in the terminal, the wires of the conductors are suitably reshaped		P
	The conductor is inserted into the terminal until the conductor reaches the bottom of the terminal or just projects from the far side of the terminal and in the position most likely to assist a wire to escape. The clamping screw or nut is then tightened with a torque equal to two-thirds of that shown in the appropriate column of table 10	Ø 4,80 mm 1,33 Nm	P
	After the test, no wire of the conductor shall have slipped out of the SPD terminal.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.3.3.2	Screwless terminals		
	Terminals shall be so designed and constructed that: <ul style="list-style-type: none"> 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 		N/A N/A
8.4.2.2	The terminals are fitted with new cooper conductors (solid or stranded), of the smallest or largest cross-sectional areas as specified in 8.4.2		N/A
	Each conductor is then subjected to a pull of the value shown in table 14. The pull is applied without jerks for 1 min in the direction of the axis of the conductor.	_____ to _____ mm ² _____ N	N/A
8.4.2.3	Insulation piercing connections		
8.4.2.3.1	Pull test on terminals designed for single core conductors		
	The terminals are fitted with new cooper conductors (solid or stranded), of the smallest or largest cross-sectional areas as specified in 8.4.2, (whichever is the least favourable). Screws, if any, are tightened according to Table 10.	_____ mm \varnothing _____ Nm	N/A
	The conductors are connected and disconnected five times, new conductors being used each time. After each connection the conductors are subjected to a pull, without jerks, for 1 min in the axis of the tapping conductor according to the value given in Table 14.	_____ to _____ mm ² _____ N	N/A
	During the test, there shall be no movement of the conductor in the terminal or any sign of damage.		N/A
8.4.2.3.2	Pull test on terminals designed for multi-core cables or cords		
	The pull-out test on the SPD terminals designed for multi-core cables or cords is carried out as for single core conductors, except that the pull force is applied to the entire multi-core cable or cord instead of to the individual core.	min. _____ mm ² max. _____ mm	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The pull force is calculated according to the following formula:</p> $F = F(x)\sqrt{n}$ <p>F is the total force to apply n is the number of cores $F(x)$ is the force for one core according to the cross-section of one conductor (see table 9)</p>	<p>$F(x) = \underline{\hspace{2cm}}$ N $n = \underline{\hspace{2cm}}$ $F = \underline{\hspace{2cm}}$ N</p>	N/A
	During the test, the cable or cord shall not slip out of the terminals.		N/A
8.4.2.4	Flat quick connect terminations		
	Under consideration		
8.4.2.5	Pigtail connections (flying leads)		
8.4.2.5.1	Pull test on flying lead conductors		N/A
	A flying lead and anchorage shall withstand without damage or detachment a direct pull of 89N for one minute, applied to the lead from any angle which the construction or the device will allow.		N/A
	During the test, there shall be no movement of the conductor or any sign of damage.		N/A
7.2.1	Protection against direct contact		
	Test applied to SPDs with $U_C > 50V$ r.m.s.		P
	For protection against direct contact (inaccessibility of live parts), SPDs 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.		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.	<p>Min.1,5 mm² Max.25 mm²</p>	P
	The standard test finger (in accordance with IEC 60529) is applied in every possible position.		P
	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.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	An electrical continuity indicator operating from a voltage of not less than 40V and not more than 50V, one side of which is connected to the test finger to check for the possibility of contact with any live part or the sample.		P
8.3.1.2	Metal parts		
	Metal parts which are accessible when the SPD is wired and mounted as for normal use are 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.	No accessible metal parts	N/A
	A current (derived from an a.c. source having a no-load voltage not exceeding 12 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.	_____ A	N/A
	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 .	_____ mV _____ Ω	N/A
7.4.1	Environment, IP code		
	SPDs shall be provided with an enclosure for protection against ingress of solid objects and water in accordance with the IP code declared by the manufacturer.		P
8.5.1	Test carried out acc. to IEC 60529 to check IP code	IP 20	P
7.2.2	Residual current I_{PE}		
	For all SPDs with a terminal for the protective conductor, the residual current I_{PE} shall be measured when all SPD terminals are connected to a power supply at the reference test voltage (U_{REF}) according to the manufacturer's instructions.		P
8.3.2	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.	U_{REF} 255V I_{PE} 0 mA	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.4/8.3.4	Operating duty		
	The SPD shall be capable of withstanding specified discharge currents during application of the maximum continuous operating voltage U_c without unacceptable changes in its characteristics. The test setup shall comply with the circuit diagram given in Figure 7.		P
	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	Test for version MZSR-200JK3ARI: L-N: Max.1,340kV N-PE: Max.0,494kV	P
	according to 8.3.3.1, but only at I_n for test class II	Test for version MZSR-385JK3ARI: L-N: Max.1,677kV	P
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	Test for version MZSR-200JK3ARI: N-PE: Max.1,18kV	P
	Sample connected to power frequency source at U_c	Test for version MZSR-200JK3ARI: 275Vac (L-N,N-PE) Test for version MZSR-385JK3ARI: 385Vac(L-N)/275Vac (N-PE)	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.4.2.1	SPDs with follow current < 500A: Voltage at SPD terminals does not fall below the peak value of U_C by more than 10% during flow of follow current	100A,fn 50Hz (client declaration)	P
8.3.4.2.2	SPDs with follow current > 500A: Power frequency voltage U_C with a prospective short circuit current equal to the follow current interrupt rating I_{fi} declared by the manufacturer in accordance with Table 8, or 500A, whichever is greater. For SPDs connected between neutral and protective earth only, the prospective short-circuit current shall be at least 100A.	_____ kA $\cos \phi =$ _____	N/A
8.3.4.3	Class I and II operating duty tests		
	Three groups of five impulses of 8/20 current impulses with positive polarity shall be applied. The test samples are connected to a power source according to 8.3.4.2. Each impulse shall be increased in steps of 30° with a tolerance of $\pm 5^\circ$ for each synchronisation angle. time interval between the impulses 50s – 60s time interval between the groups 30 min – 35 min	Test for version MZSR-200JK3ARI: L-N, N-PE:20kA Test for version MZSR-385JK3ARI: L-N:20kA sync. 0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°, 0°, 30°, 60° el.	P
	The SPD shall be energized at U_C . The prospective short-circuit current of the power source shall comply with 8.3.4.2 during the application of groups of impulses. After the application of each group of impulses and after the interruption of the last follow current (if any) the SPD shall remain energized without interruption for at least 1 min to check for reignition. After the last group of impulses and the 1 min period the SPD either remains applied or is reapplied within less than 30s to U_C for another 15 min to check for stability. For that purpose, the short-circuit capability of the power source (at U_C) may be reduced to 5A.	Test for version MZSR-200JK3ARI: L-N: $U_C= 275V_{ac}$; N-PE: $U_C= 275V_{ac}$ Test for version MZSR-385JK3ARI: L-N: $U_C= 385V_{ac}$	P
	When testing SPDs to class I, 8/20 current impulses with a crest corresponding to I_{imp} shall be applied.		N/A
	When testing SPDs to class II, 8/20 current impulses with I_n shall be applied.	see Annex 1	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Current records show no sign of puncture or flashover of the sample		P
8.3.4.5	Class III operating duty tests		
	The SPD is tested with three groups of impulses corresponding to U_{OC} with: <ul style="list-style-type: none"> - five positive impulses initiated at crest value of positive half cycle ($\pm 5^\circ$) - five negative impulses initiated at crest value of positive half cycle ($\pm 5^\circ$) - five positive impulses initiated at crest value of positive half cycle ($\pm 5^\circ$) 		N/A
8.3.4.4	Additional duty test for test class I		
	This test is carried out with current impulses in steps up to I_{imp} passing through the SPD. SPD energized at U_C by a voltage source having a nominal current capability of 5A during the application of impulses.	$U_C = \underline{\hspace{2cm}} V$	N/A
	Current impulses of positive polarity shall be initiated in the corresponding positive crest value of the power frequency voltage source to the energized test sample as follows: <ul style="list-style-type: none"> a) One current impulse at $0,1 I_{imp}$ b) One current impulse at $0,25 I_{imp}$ c) One current impulse at $0,5 I_{imp}$ d) One current impulse at $0,75 I_{imp}$ e) One current impulse at $1,0 I_{imp}$ 	<p>_____ kA</p> <p>_____ kA</p> <p>_____ kA</p> <p>_____ kA</p> <p>_____ kA</p>	N/A
	After each impulse cool down to ambient temperature		N/A
8.3.4.6	Pass criteria		
A	After the application of each impulse and after interruption of each follow current (if any) the SPD shall remain energized without interruption for at least 1 min to check for re-ignition. After that period the SPD either remains applied or is reapplied within less than 30s to U_C for another 15 min to check for stability. For that purpose the short-circuit capability of the power source shall also be 5A.		P

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Clause	Requirement - Test	Result - Remark	Verdict
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
D	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	Test for version MZSR-200JK3ARI: L-N: Max.20,431kA / 1,327kV; N-PE: Max.19,979kA / 0,477kV	P
	according to 8.3.3.1, but only at I_n for test class II	Test for version MZSR-385JK3ARI: L-N: Max.20,264kA / 1,710kV	
	according to 8.3.3.3, but only at U_{OC} for test class III	kA / V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	Test for version MZSR-200JK3ARI: N-PE: Max.1,10kV	P
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		P
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) • shall not exceed a value of 1 mA or • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence	For version MZSR-200JK3ARI: L-N: Max.0,2346mA; N-PE: 0mA For version MZSR-385JK3ARI: L-N: Max.0,1648mA	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_c or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	$U_c = \underline{\hspace{2cm}} \text{ V}$ test voltage $\underline{\hspace{2cm}} \text{ V}$	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_c.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_c = \underline{\hspace{2cm}} \text{ V}$ $I_{PE} = \underline{\hspace{2cm}} \text{ mA}$	N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.		P
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
M	There shall be no explosion or other hazard to either personnel or the facility.		P
7.2.5.2	Thermal protection		
	SPDs shall be protected against overheating due to degradation or overstress		P
	This test is not performed on SPDs containing only switching components and/or ABD devices.		P
7.2.5.4	Status indicator		
	The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.		P
	A status indicator may be composed of two parts (one of which is not replaced on replacement of the SPD), linked by a coupling mechanism which can be mechanical, optical, audio, electromagnetic, etc. The part of the status indicator which is not replaced shall be capable of operating at least 50 times.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Where there is an appropriate standard for the type of indication used, this shall be met by the non-replaced part of the status indicator, with the exception that the indicator need only be tested for 50 operations.	No appropriate standard	N/A
8.3.5.2	Thermal stability		
	If different non-linear components connected in parallel, this test has to be performed for every current path of the SPD by disconnecting/interrupting all the remaining current path. If components of the same type and parameters are connected in parallel, they shall be tested as one current path.		N/A
	Any voltage switching component within the current path under test, which is connected in series with a voltage limiting component shall be short-circuited by a cooper dummy with a diameter such that it does not melt during the test.		N/A
	Test for SPDs containing only voltage limiting components - procedure a)		
	Sample connected to a power frequency source with a voltage high enough to drive a constant current, which is increased by the following steps - 2 mA or 5 % of the previously adjusted test current, whichever is greater - with a tolerance of $\pm 10\%$: 12 mA r.m.s. or corresponding crest value 14 mA r.m.s. or corresponding crest value 16 mA r.m.s. or corresponding crest value 18 mA r.m.s. or corresponding crest value 20 mA r.m.s. or corresponding crest value	Test for version MZSR-200JK3ARI: L-N duration 59 minutes 39 minutes 61 minutes 36 minutes After Max.42 minutes SPD disconnecter operated	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Sample connected to a power frequency source with a voltage high enough to drive a constant current, which is increased by the following steps - 2 mA or 5 % of the previously adjusted test current, whichever is greater - with a tolerance of $\pm 10\%$:</p> <p>8 mA r.m.s. or corresponding crest value</p> <p>10 mA r.m.s. or corresponding crest value</p> <p>12 mA r.m.s. or corresponding crest value</p> <p>14 mA r.m.s. or corresponding crest value</p> <p>16 mA r.m.s. or corresponding crest value</p>	<p>Test for version MZSR-385JK3ARI:</p> <p>L-N</p> <p>duration</p> <p>48 minutes</p> <p>40 minutes</p> <p>63 minutes</p> <p>47 minutes</p> <p>After Max.13 minutes SPD disconnecter operated</p>	P
	Each step is maintained until thermal equilibrium is reached – temperature variation < 2K within 10 min		P
	Surface temperature of the hottest spot and current through the SPD are monitored continuously		P
	Test interrupted if all non-linear components under test are disconnected. The voltage is not increased further in order to avoid any malfunction of the disconnectors.		P
	For the other two samples the starting point shall be changed from 2 mA to a current corresponding to 5 steps below the current value at which the first sample disconnected		P
	<p>If the voltage across the SPD falls below U_{REF} during the test, the current regulation is discontinued and the voltage is adjusted back to U_{REF} and maintained for a duration of 15 min. Continuous current monitoring is no longer required.</p> <p>Source short-circuit current capability does not limit the current before any disconnecter operates. The maximum available current value does not exceed the short circuit withstand capability declared by the manufacturer.</p>	<p>$U_{REF} = \underline{\hspace{2cm}} \text{ V}$</p> <p>$\underline{\hspace{2cm}} \text{ V}$</p> <p>$\underline{\hspace{2cm}} \text{ kA}$</p> <p>$\cos \phi = \underline{\hspace{2cm}}$</p>	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Test for SPDs having a voltage switching component in series with other components – procedure b)		
	SPD energized with a power frequency source at U_{REF} having a short-circuit current capability which will not limit the current before any disconnector operates. The maximum available current value does not exceed the short-circuit withstand capability declared by the manufacturer.	_____ V _____ kA cos phi = _____	N/A
	If no significant current flows – test procedure a) shall be followed		N/A
	Pass criteria		
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	0 mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0 mA	P
M	There shall be no explosion or other hazard to either personnel or the facility		P
O	After completion of this test the samples shall be allowed to return to room temperature and be connected to a power source at U_C for 2 hours. The residual current shall be monitored and not exceed the value measured at the beginning of the test by more than 10%.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	In addition for indoor SPDs the surface temperature rise shall not exceed 120K during and after the test. 5 min. after disconnection of all non-linear components under test the surface temperature rise shall not exceed 80K.	Max.70K (during test) Max.44K (after 5 min)	P
7.3.4/8.4.3	Verification of air clearances and creepage distances		
	SPDs for domestic and similar applications shall be designed for pollution degree 2.		P
	SPDs for more stringent environmental applications may require special precautions, e.g. an appropriate SPD housing or an additional enclosure, which will ensure pollution degree 2 for the SPD		N/A
	For SPDs for outdoor and out of reach applications pollution degree 4 applies. This may be reduced to pollution degree 3 for internal distances, if they are covered by an adequate housing ensuring pollution degree 3 conditions.		N/A
	The electrode spacing of spark gaps shall not be considered for the determination of air clearances and creepage distances.		N/A
	The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Air clearances in millimetres</p> <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD – fastening surfaces (note 2) – screws or other means for fastening the SPD (note 2) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism and</p> <ul style="list-style-type: none"> – bodies (note 1) – screws or other means for fastening the SPD <p>NOTE 1 – Definition see 8.3.6 a)</p> <p>NOTE 2 – If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of lines 1 are sufficient.</p>	<p>(mounted on base)</p> <p>required / measured</p> <p>3mm / >4mm(by gauge)</p> <p>3mm / -</p> <p>6mm / >8mm(by gauge)</p> <p>6mm / >6mm</p> <p>3mm / >4mm(by gauge)</p> <p>3mm / >4mm(by gauge)</p> <p>3mm / >4mm(by gauge)</p>	<p>P</p> <p>N/A</p> <p>P</p> <p>P</p> <p>P</p> <p>P</p> <p>P</p>

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Creepage distances in millimetres</p> <ul style="list-style-type: none"> - r.m.s. voltage - Material group - Pollution - distances required <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> - screws and other means to fasten a covering, having to be detached for mounting the SPD - fastening surfaces (note 2) - screws or other means for fastening the SPD (note 2) - bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism and</p> <ul style="list-style-type: none"> - bodies (note 1) - screws or other means for fastening the SPD <p>Printed wiring material</p> <ul style="list-style-type: none"> - r.m.s. voltage - Material group - Pollution - distances required 	<p>275Vac and 385Vac</p> <p>(L-N,L-PE) / 275Vac(N-PE)</p> <p><u>IIIa</u></p> <p><u>Degree 2</u></p> <p>(mounted on base)</p> <p>required / measured</p> <p>4mm / >4mm(by gauge)</p> <p>4mm / -</p> <p>8mm / >8mm(by gauge)</p> <p>4mm / >6mm</p> <p>4mm / >4mm(by gauge)</p> <p>4mm / >4mm(by gauge)</p> <p>4mm / >4mm(by gauge)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____ / _____</p>	<p>P</p> <p>N/A</p> <p>P</p> <p>P</p> <p>P</p> <p>P</p> <p>P</p> <p>P</p> <p>N/A</p>
7.4.2/8.5.3	Ball pressure test		
	Outer parts of SPDs, consist of insulating material, are submitted to a ball pressure test by means of a tester as shown on Figure 20 and 21.		P
	Parts of insulating material necessary to retain current carrying parts and parts of the earthing circuit in position are tested in a heating cabinet at 125°C ± 2 K.	Enclosure/Live part carrier/Tripping lever	P

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Clause	Requirement - Test	Result - Remark	Verdict
	Parts of insulating material not necessary to retain current carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are tested at 70°C ± 2 K.		P
	The sample to be tested is fastened accordingly, its surface being positioned horizontally; a steel ball having a diameter of 5 mm is pressed against the surface with a force of 20 N.		P
	After 1 h, the steel ball is taken away from the sample; by dipping it into cold water, the temperature of the sample is reduced to ambient temperature within 10 s.		P
	Pass criteria		
	The diameter of the ball indentation is measured and shall not exceed 2 mm.	1,5 mm (Enclosure/Live part carrier/Tripping lever)	P
7.4.3/8.5.4	Resistance to abnormal heat and fire		
	Insulating parts of the housing shall be either non-flammable or self-extinguishing. The glow wire test is performed in accordance with Clauses 4 to 10 of IEC 60695-2-11 under the following conditions: <ul style="list-style-type: none"> for external parts of SPDs made of insulating material necessary to retain in position current-carrying parts and parts of the protective circuit, by the test made at a temperature of 850 °C ± 15 K. for all other external parts made of insulating material, by the test made at a temperature of 650 °C ± 10 K. 	850°C(Enclosure/Live part carrier/Tripping lever) 650°C(Insulating film)	P P
	The test is not made on parts of ceramic material and parts with lower size than defined in 3.1 of IEC 60695-2-11.		N/A
	If the insulating parts are made of the same material, the test is carried out only on one of these parts, according to the appropriate glow-wire test temperature.		N/A
	The test is made on one sample		P
	In case of doubt, the test is repeated on two additional samples.		N/A
	The test is made by applying the glow-wire once.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	The sample shall be positioned during the test in the least favourable position of its intended use (with the surface tested in a vertical position).		P
	The tip of the glow-wire shall be applied to the specified surface of the test sample taking into account the conditions of intended use under which a heated or glowing element may come into contact with the sample.		P
	Pass criteria		
	<p>The sample is regarded as having passed the glow-wire test if</p> <ul style="list-style-type: none"> • there is no visible flame and no sustained glowing or if, • flames and glowing parts on the sample extinguish themselves within 30 s after the removal of the glow-wire. 	<p>No visible flame</p> <p>-</p>	P
	There shall be no ignition of the tissue paper or scorching of the pinewood board.		P
7.4.4/8.5.5	Tracking resistance		
	The test is performed according to IEC 60112, solution A with a test voltage depending on the measured creepage distances and the required material group according to 8.3.4.	175V	P

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.3/8.3.3	Voltage protection level		
	The measured limiting voltage of the SPDs shall not exceed the voltage protection level that is specified by the manufacturer.		P
	All one-port SPDs shall be tested unenergized.		P
	All two-port SPDs shall be tested energized for the tests according 8.3.3.1 and 8.3.3.3 by means of a voltage source having a nominal current of at least 5 A at U_C . Positive impulses are applied at the $(90 \pm 5)^\circ$ point and negative impulses at $(270 \pm 5)^\circ$ point on the sinusoidal voltage waveform.		N/A
	For a one-port SPD having terminals, the test is performed without external disconnectors and the voltage is measured at the terminals. For a one-port SPD having connecting leads the voltage is measured with external lead lengths of 150mm. For a two-port SPD, and a one-port SPD having separate load terminals, the voltage for determining the measured limiting voltage is measured at the output/load port or load terminals of the SPD and the voltage for determining U_{max} is measured at the input/line port or terminals of the SPD.		P
8.3.3.1	Residual voltage with 8/20 current impulses		
	Class I, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times the crest value of I_{imp} shall be applied. 0,1 times I_{imp} 0,2 times I_{imp} 0,5 times I_{imp} 1,0 times I_{imp}	 ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V	N/A

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Class II, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times I_n shall be applied.</p> <p>1,0 times I_n</p> <p>0,1 times I_n</p> <p>0,2 times I_n</p> <p>0,5 times I_n</p> <p>1,0 times I_n</p> <p>If the SPD contains only voltage-limiting components, this test needs only to be performed at a crest values of I_{imp} for test class I or I_n for test class II.</p>	<p>Test for version: MZSR-200JK3ARI:</p> <p>L-N: 1,0 times I_n Max.19,969kA/1,340kV</p> <p>N-PE: Max.2,080kA/0,110kV Max.4,080kA/0,174kV Max.10,087kA/0,286kV Max.20,379kA/0,494kV</p>	P
	<p>Class II, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times I_n shall be applied.</p> <p>1,0 times I_n</p> <p>If the SPD contains only voltage-limiting components, this test needs only to be performed at a crest values of I_{imp} for test class I or I_n for test class II.</p>	<p>Test for version: MZSR-385JK3ARI:</p> <p>L-N: 1,0 times I_n Max.19,857kA/1,677kV</p>	P
	<p>When I_{max} is declared by the manufacturer an additional 8/20 current impulse with a crest value of I_{max} shall be applied and the residual voltage shall be measured and recorded.</p>	<p>Test for version: MZSR-200JK3ARI:</p> <p>L-N Max.40,260kA/1,905kV N-PE Max.40,362kA/0,892kV</p> <p>Test for version: MZSR-385JK3ARI:</p> <p>L-N Max.40,025kA/2,289kV</p>	P
	<p>One sequence of positive polarity and one sequence of negative polarity are applied to the SPD</p>		P
	<p>The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.</p>		P
	<p>Current and voltage oscillogram</p>	see Annex 1	P
	<p>Crest values – discharge current versus residual voltage diagram to I_n or I_{imp}</p>	see Annex 1	P

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for:</p> <ul style="list-style-type: none"> class I: up to I_{imp} class II: up to I_n 	Class II: I_n 20kA	P
	The value for determining U_{max} is the highest residual voltage measured at I_n , I_{max} or I_{imp} , as applicable depending on the SPD test class.	U_{max} 2,289kV	P
8.3.3.2	Front-of-wave sparkover voltage	Test for version: MZSR-200JK3ARI N-PE	
	The 1,2/50 voltage impulse is used. The generator is set to an open circuit output voltage of 6 kV.		P
	10 impulses are applied to the SPD, five of positive and five of negative polarity.		P
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		P
	If sparkover is not observed during each of the 10 impulses on the front of wave, then the above procedure are repeated with the generator output voltage increased up to a maximum 10 kV.		N/A
	Voltage oscillograms	see Annex 1	P
	The value for determining the measured limiting voltage and U_{max} is the maximum sparkover voltage recorded during this test.	Test for version: MZSR-200JK3ARI N-PE: Max.1,18kV	P
8.3.3.3	Limiting voltage with the combination wave		
	To perform this test a combination wave generator is used.		N/A
	The interval between the individual impulses shall be long enough for the sample to cool down to ambient temperature.		

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The voltage of the combination wave generator is set to provide an open-circuit voltage of 0,1; 0,2; 0,5; 1,0 times the U_{OC}.</p> <p>If the SPD only contains voltage-limiting components this test needs to be carried out at U_{OC} only.</p> <p>0,1 times U_{OC} _____ kV _____ kA / _____ V</p> <p>0,2 times U_{OC} _____ kV _____ kA / _____ V</p> <p>0,5 times U_{OC} _____ kV _____ kA / _____ V</p> <p>1,0 times U_{OC} _____ kV _____ kA / _____ V</p>		N/A
	With these generator settings four surges will be applied to the SPD at each amplitude: two with positive and two with negative polarity.		N/A
	Current-voltage oscillograms; voltage at the output port of the SPD		N/A
	The value for determining the measured limiting voltage and U_{max} is the maximum voltage recorded during the test.	_____ V	N/A
8.3.3.4	Pass criteria for all measured limiting voltage tests		
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P

IEC 61643-11 - TEST SEQUENCE 2a Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.2/8.7.3	Load-side surge withstand capability		
	<p>For this test:</p> <ul style="list-style-type: none"> 15 current impulses 8/20 or, 15 combination wave impulses with an open-circuit voltage U_{OC} <p>with a value equal to the load-side surge withstand capability declared by the manufacturer are applied in three groups of five impulses to the output port of the test sample. The SPD is energized at U_C by means of a voltage source having a nominal current of at least 5 A. Each impulse shall be synchronized to the power frequency. Starting from 0° the synchronization angle shall be increased in steps of $(30 \pm 5)^\circ$.</p>	<p>_____ kA</p> <p>_____ kV</p>	N/A
	The interval between the impulses is 50 s to 60 s and the interval between the groups is 30 min to 35 min.		N/A
	The test sample shall be energized during the whole test sequence. The voltage on the output terminals shall be recorded.		N/A
	Pass criteria		
A	Thermal stability shall be achieved		N/A
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_P \leq$ _____ V	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	<p>SPDs tested acc. to class I and II containing switching components:</p> <p>Front-of-wave sparkover voltage acc. to 8.3.3.2</p> <p>All measured peak values (5 pos./5 neg.) below U_P</p>	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		

IEC 61643-11 - TEST SEQUENCE 2a Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.	$U_C = \text{_____ V}$ test voltage _____ V	N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.		N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A

IEC 61643-11 - TEST SEQUENCE 2b Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.1.3	Load-side short-circuit current behaviour		
	The SPD shall be able to carry the currents caused by a power short-circuit on the load side until it is interrupted either by the SPD itself or by an internal or external disconnecter.		
8.6.1.3	This test applies to all SPDs, except those classified for outdoor use and mounted out of reach and those connected N-PE for use in TN and/or TT systems only.		N/A
	The test settings and the test procedure according to 8.3.5.3 (excluding 8.3.5.3.1) are repeated without short-circuiting any components, but with a short-circuit link connected to the following output terminals of the SPD as applicable: <ul style="list-style-type: none"> • short-circuit link across all phase terminals and the neutral terminal (if applicable) on the load side • short-circuit link across all terminals on the load side, with a conductors of the largest cross-section specified under 8.4.2 and with a length of 500 mm each.		N/A
	Pass criteria		
C	No mechanical damage		N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \quad \quad \quad V$	N/A

IEC 61643-11 - TEST SEQUENCE 2b Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	<p>$U_C = \underline{\hspace{2cm}}$ V</p> <p>test voltage</p> <p>$\underline{\hspace{2cm}}$ V</p>	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_C = \underline{\hspace{2cm}}$ V</p> <p>$I_{PE} = \underline{\hspace{2cm}}$ mA</p>	N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>$\underline{\hspace{2cm}}$ V</p> <p>$\underline{\hspace{2cm}}$ mA</p>	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	<p>$\underline{\hspace{2cm}}$ mA</p>	N/A

IEC 61643-11 - TEST SEQUENCE 2b Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		N/A
M	There shall be no explosion or other hazard to either personnel or the facility.		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
	a) Internal disconnecter(s) have operated:		
	After removing the short-circuit links from output terminals and with U_{REF} applied according to the circuit shown in Figure 22, there shall be no voltage on the output terminals.		N/A
	With a power frequency voltage equal to two times U_C applied between all corresponding input and output phase terminals for 1 min there shall be no current flow in excess of 0,5 mA.		N/A
	a) No internal disconnecter has operated:		
D	Determination of the measured limiting voltage:	$U_p \leq \text{_____ V}$	N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	_____ kV	N/A

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.6/8.3.6	Insulation resistance		
	<p>The insulation resistance of the SPD shall be sufficient with respect to leakage currents and protection against direct contact.</p> <p>This test is not applicable to SPDs having a metallic enclosure connected to protective earth.</p>		P
	Additional entry holes for cables, if there are any, are left open. If there are any knockouts, one of them is opened. Coverings and other parts which are detachable without tools, are removed and undergo the same moisture treatment.		N/A
	The moisture treatment is carried out in a humidity cabinet at a relative humidity of $93\% \pm 3\%$ RH. The air temperature is kept at all points, where the test sample can be positioned, within ± 2 K at a suitable temperature T between 20°C and 30°C . Before putting the test samples into the humidity cabinet, they shall have a temperature between T and (T+4) in $^{\circ}\text{C}$.		P
	The samples shall be kept in the humidity cabinet for 2 days (48 h).		P
	After a delay of between 30 min and 60 min following the humidity treatment, the insulation resistance is measured 60 s after having applied a d.c. voltage of 500 V.		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>This measurement is carried out in the humidity cabinet or in the room into which the specimens were brought to reach the determined temperature, after having refitted the parts which might have been detached.</p> <p>a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, the surface on which the SPD is mounted, if necessary covered with metal foil, screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test</p> <p>b) between the live parts of the SPD main circuit and live parts of separate isolated circuits, if there are any.</p>		P
	Pass criteria		
	<p>The insulation resistance shall not be lower than</p> <ul style="list-style-type: none"> 5 MΩ for the measurements according to a), 2 MΩ for the measurements according to b). 	<p>199 MΩ</p> <p>_____ MΩ</p>	P N/A
7.2.7/8.3.7	Dielectric withstand		
	The dielectric withstand of the SPD shall be sufficient with respect to insulation breakdown and protection against direct contact.		
	SPDs classified for outdoor use are tested between the terminals with the internal parts removed. During this test, the SPD is subjected to sprinkling according to 9.1 of IEC 60060-1.		N/A
	SPDs classified for indoor are tested as indicated in a) and b) of 8.3.6.		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>SPDs are tested with an a.c. voltage according to Table 9. Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is maintained for 1 min.</p> <p>a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, the surface on which the SPD is mounted, if necessary covered with metal foil, screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test.</p> <p>b) between the live parts of the SPD main circuit and live parts of separate isolated circuits, if there are any.</p>	2,2 kV	P
	Pass criteria		
	Arcing or puncturing shall not occur, however, partial discharges are accepted if the voltage change the discharge is less than 5%.		P
	The power transformer used for testing shall be designed in such a way that after having been adjusted to the test voltage at its open terminals it will generate a short-circuit current of at least 200 mA after short-circuiting the terminals. An overcurrent relay, if any, shall only react if the test circuit current exceeds 100 mA. The device for measuring the test voltage shall have a precision of $\pm 3\%$.		P
7.3.5/8.4.4	Mechanical strength		
	All parts of the SPD relating to the protection against direct contact shall have sufficient mechanical strength.		
	The samples are subjected to strikes by means of an impact-test apparatus as shown in Figure 18 and Figure 19.		P

IEC 61643-11 - TEST SEQUENCE 3															
Clause	Requirement - Test	Result - Remark	Verdict												
	Samples are mounted on a sheet of plywood, 8 mm thick and 175 mm square, secured at its top and bottom edges to a ridged bracket.		P												
	Portable SPDs are tested as fixed SPDs, but they are fixed to the plywood sheet by auxiliary means.		N/A												
	Flush-type SPDs are mounted in a recess provided in a block of hornbeam or material having similar mechanical characteristics, which is fixed to a sheet of plywood. (They are not tested in their relevant mounting boxes.)		N/A												
	If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.		N/A												
	Flush-type screw fixing SPDs shall be fixed by means of screws to lugs recessed in the block.		N/A												
	Flush-type claw fixing SPDs shall be fixed to the block by means of the claws.		N/A												
	Before applying the strikes, fixing screw of bases and covers are tightened with a torque equal to two-thirds of that specified in Table 10.	_____ Nm	N/A												
	<p>The samples are mounted so that the point of impact lies in the vertical plane through the axis of the pivot. The striking element is allowed to fall from a height which is specified in the following Table 18:</p> <table border="0"> <tr> <td>parts A and B</td> <td>h = 100 mm</td> <td><u>100(front surface)</u></td> <td>P</td> </tr> <tr> <td>parts C</td> <td>h = 150 mm</td> <td></td> <td>N/A</td> </tr> <tr> <td>parts D</td> <td>h = 200 mm</td> <td><u>200(mounting base)</u></td> <td>P</td> </tr> </table> <p>A: parts on the front surface, including parts which are recessed.</p> <p>B: Parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.</p> <p>C: Parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.</p> <p>D: Parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.</p>	parts A and B	h = 100 mm	<u>100(front surface)</u>	P	parts C	h = 150 mm		N/A	parts D	h = 200 mm	<u>200(mounting base)</u>	P		
parts A and B	h = 100 mm	<u>100(front surface)</u>	P												
parts C	h = 150 mm		N/A												
parts D	h = 200 mm	<u>200(mounting base)</u>	P												

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	The heights of the fall determined by the part of the sample which projects most from the mounting surface is applied on all parts of the sample, with the exception of parts A		P
	The samples are subjected to strikes which are evenly distributed over the samples. The strikes are not applied to "knock-out" areas.		P
	<p>The following blows are applied:</p> <ul style="list-style-type: none"> • for parts A, five strikes: one in the centre. After the sample has been moved horizontally: one each on the unfavourable points between the centre and the edges; and then, after the sample has been turned 90° about its axis perpendicular to the plywood, one each on similar points; • for parts B (as far as applicable), C and D, four blows: <ul style="list-style-type: none"> – one on one side of the sample of the sample after the plywood sheet has been turned 60° and one blow on another side of the sample after it has been turned 90° about its axis perpendicular to the plywood sheet, keeping the position of the plywood sheet unchanged; – one blow on each of the other two sides of the sample, with the plywood sheet turned 60° in the opposite direction. 		P
	Pass criteria		
	After the test, the sample shows no damage within the meaning of the standard. In particular, live parts have not become accessible with the standard test finger.		P
	Damage to the finish small dents which do not reduce creepage distances or clearances and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are neglected		P
	Cracks not visible with the normal or corrected vision, without additional magnification, and surface cracks in fibre reinforced mouldings and the like are ignored.		P
7.2.5/8.3.5.1	Temperature withstand		
	The SPD is kept in a heated cabinet at an ambient temperature of 80 °C ± 5 K for 24 h.		P
	Pass criteria		
C	No mechanical damage		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
Remarks:			

IEC 61643-11 - TEST SEQUENCE 3a Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.3	Where a SPD includes a circuit that is electrically isolated from the main circuit, the manufacturer shall provide information about the isolation and dielectric withstand voltages between the circuits as well as the relevant standards that the manufacturer is claiming conformity with.		N/A
	Where there are more than two circuits, declarations shall be made with regard to each combination of circuits.		N/A
8.3.6	Insulation resistance		
	The moisture treatment is carried out in a humidity cabinet at a relative humidity of 93% ± 3% RH. The air temperature is kept at all points, where the test sample can be positioned, within ± 2 K at a suitable temperature T between 20°C and 30°C. Before putting the test samples into the humidity cabinet, they shall have a temperature between T and (T+4) in °C.		N/A
	The samples shall be kept in the humidity cabinet for 2 days (48 h).		N/A
	After a delay of between 30 min and 60 min following the humidity treatment, the insulation resistance is measured 60 s after having applied a d.c. voltage of 500 V.		N/A
	<p>This measurement is carried out in the humidity cabinet or in the room into which the specimens were brought to reach the determined temperature, after having refitted the parts which might have been detached.</p> <p>a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test</p> <p>b) between each combination of separate isolated circuits of the SPD, if there is more than one.</p>		N/A

IEC 61643-11 - TEST SEQUENCE 3a Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
	The insulation resistance shall not be lower than <ul style="list-style-type: none"> • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b). 	_____ MΩ _____ MΩ	N/A N/A
8.3.7	Dielectric withstand		
	SPDs classified for outdoor use are tested between the terminals with the internal parts removed. During this test, the SPD is subjected to sprinkling according to 9.1 of IEC 60060-1.		N/A
	SPDs classified for indoor are tested as indicated in a) and b) of 8.3.6.		N/A
	<p>SPDs are tested with an a.c. voltage according to Table 9. Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is maintained for 1 min.</p> <p>a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test.</p> <p>b) between each combination of separate isolated circuits of the SPD, if there is more than one.</p>		N/A N/A
	Pass criteria		
	Arcing or puncturing shall not occur, however, partial discharges are accepted if the voltage change the discharge is less than 5%.		N/A

IEC 61643-11 - TEST SEQUENCE 3a Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
	The power transformer used for testing shall be designed in such a way that after having been adjusted to the test voltage at its open terminals it will generate a short-circuit current of at least 200 mA after short-circuiting the terminals. An overcurrent relay, if any, shall only react if the test circuit current exceeds 100 mA. The device for measuring the test voltage shall have a precision of $\pm 3\%$.		N/A

IEC 61643-11 - TEST SEQUENCE 3b Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.1/8.7.2	Test to determine the voltage drop (two port SPDs)		
	<p>U_C supplied at the input port</p> <p>SPD loaded with rated load current into a resistive load</p> <p>Input and output voltage measured simultaneously to determine the percentage voltage regulation</p> <p>$\Delta U\% = ((U_{in} - U_{out}) / U_{in}) * 100\%$</p>	<p>_____ V</p> <p>_____ A</p> <p>_____ %</p>	N/A
	Pass criteria		
C	No mechanical damage		N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.1.1/ 8.6.1.1	Rated load current (I_L)		
	The SPD shall be powered at a voltage $U_C^{+0/-5\%}$ at ambient temperature, using a cable with a nominal cross-section as specified in Table 19. The test shall be conducted with rated load current into a resistive load until thermal stability is reached. Additional cooling of the SPD is not permitted.	<p>_____ V</p> <p>_____ A</p> <p>_____ mm²</p>	N/A
	Pass criteria		
	Value complies with the manufacturers		N/A
	External disconnectors shall not operate during the test and shall be in working order after the test.		N/A
	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
	<p>The temperature rise of surfaces which are accessible in normal use shall not exceed the values described in Annex G during the test.</p> <p>Parts of SPD:</p> <ul style="list-style-type: none"> • Built-in components • Terminals for external insulated conductors • Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars • Manual operating means of metal • Manual operating means of insulating material • Accessible external enclosures and covers <ul style="list-style-type: none"> – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections 	<p>Temperature rise:</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p>	N/A
7.5.1.2	Overload behaviour		
	The SPD shall be damaged or altered by overloads, which may occur in normal use.		

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
8.6.1.2	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.		N/A
	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.		N/A
	The test circuit and procedure shall be as described in 8.6.1.1, except that circuits other than the main circuit are disregarded for this test.		N/A
	The test is performed without any external disconnectors being connected (internal removable overcurrent protective devices are replaced by a link of negligible impedance).		N/A
	If a maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to k times that maximum overcurrent protection. The factor k shall be selected from Table 20.	k = _____ I = _____ A	N/A
	If no maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded with 1,1 times the rated load current for 1 h or until an internal disconnector operates. If no disconnector operates within 1 h, the test is continued by increasing the previous value of test current by a factor of 1,1 every hour, until an internal disconnector operates.	_____ A 1h → _____ A 1h → _____ A	N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
	<p>The temperature rise of surfaces which are accessible in normal use shall not exceed the values described in ANNEX G during the test.</p> <p>Parts of SPD:</p> <ul style="list-style-type: none"> • Built-in SPD: • Terminals for external insulated conductors • Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars • Manual operating means of metal • Manual operating means of insulating material • Accessible external enclosures and covers <ul style="list-style-type: none"> – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections 	<p>Temperature rise:</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p> <p>_____ K / _____ K</p>	N/A
	a) Any internal disconnecter has operated:		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>_____ V</p> <p>_____ mA</p>	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	_____ mA	N/A
M	There shall be no explosion or other hazard to either personnel or the facility.		N/A
	b) No internal disconnecter has operated:		
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_p \leq$ _____ V	N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} =$ _____ V	N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_c or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	$U_c = \underline{\hspace{2cm}} \text{ V}$ test voltage $\underline{\hspace{2cm}} \text{ V}$	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_c.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_c = \underline{\hspace{2cm}} \text{ V}$ $I_{PE} = \underline{\hspace{2cm}} \text{ mA}$	N/A
I	<p>SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.</p>		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions		P
	The test sample shall be connected to a power frequency voltage of $U_T^{+0/-5\%}$ for a duration $t_T^{+5/-0\%}$.		P
	Except for loss of neutral tests, this power source for U_T , shall be capable of delivering a current high enough to ensure that the voltage at the SPD terminals does not fall below U_T by more than 5 % during the test. For loss of neutral tests this voltage source shall be capable of delivering a prospective short-circuit current of 10A.		P
	Immediately following the application of U_T , a voltage equal to $U_{REF}^{+0/-5\%}$ with the same current capability, shall be applied to the test sample for a period of 15 min $^{+5/-0\%}$.	L-N $U_T = 336.6$ Vac (for fault in consumer installation) $U_T = 441.67$ Vac (for fault in distribution system and loss neutral) $U_{REF} = 255$ Vac	P
	For loss of neutral tests, this power source for U_{REF} shall be capable of delivering a prospective short-circuit current equal to the declared short-circuit current rating of the SPD.		P
	The time interval between the test periods shall be as short as possible and shall in any case not exceed 100 ms.		P
a)	Pass criteria TOV failure mode	for fault in distribution system and loss neutral of version MZSR-200JK3ARI	
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	0 mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	0 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnectors.		N/A
L	The tissue paper shall not catch fire.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P
b)	Pass criteria TOV withstand mode		
A	Thermal stability shall be achieved		P
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
D	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	Test for of version MZSR-200JK3ARI: L-N Max.20,491kA/1,306kV (for fault in consumer installation); Test for of version MZSR-385JK3ARI: L-N Max.20,167kA/1,676kV (for fault in consumer installation);	P
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = 255 \text{ Vac}$ Max.0mA	P P
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.	$U_C = 275 \text{ Vac}$ test voltage 1000 V	P
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
L	The tissue paper shall not catch fire.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P
7.2.8.2/8.3.8.2	TOVs caused by faults in the high (medium) voltage system	For version MZSR-200JK3ARI and MZSR-385JK3ARI	
	<p>SPDs connected to PE and for use on power distribution systems</p> <ul style="list-style-type: none"> TOV voltages U_T given in Annex B <p>or,</p> <ul style="list-style-type: none"> TOV voltages stated by the manufacturer according to 7.1.1 c1) <p>whichever values are higher.</p>	$U_T = 1200 \text{ Vac}$ (N-PE)	P
	<p>Table B.1 shall be applied to all SPDs</p> <p>Depending on the information given by the manufacturer on 7.1.1 c1), the additional tables according to Clause B.1 of Annex B shall also be applied.</p> <p>For North American systems – Table B.2</p> <p>For Japanese systems – Table B.3</p>	under consideration	P
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions, and connected to a test circuit according to Figure 16 or equivalent		P
	The test voltage $U_T^{+0/-5\%}$ is applied to the test sample at 90 electrical degrees of phase L1 by closing switch S1.		P
	After the TOV application time $t_T^{+0/-5\%}$ switch S2 is closed automatically. This connects the SPD's PE-terminal to the neutral.		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	Test circuit according to Figure 16 and Figure 17 or, alternative test circuit given in Annex E. Other test circuits are permitted as long as they ensure the same stress to the SPD.		P
	The prospective short-circuit current of the power source for U_{REF} shall be equal to five times the rated current of the maximum overcurrent protection is declared. The tolerance for the current is $+10/-0\%$.	625 A	P
	The prospective short-circuit current delivered by the TOV transformer shall be adjusted to $300A +10/-0\%$ by R2.	_____ A	N/A
	With the exception of SPDs connected neutral to ground, U_{REF} remains applied to the test sample for 15 min without interruption until switch S1 is reopened.		P
a)	Pass criteria TOV failure mode		
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	0 mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
L	The tissue paper shall not catch fire.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P
b)	Pass criteria TOV withstand mode		
A	Thermal stability shall be achieved		N/A
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p		N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>		N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \underline{\hspace{2cm}} \text{ V}$ $I_{PE} = \underline{\hspace{2cm}} \text{ mA}$	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		N/A
L	The tissue paper shall not catch fire.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.5.3	Short-circuit current behaviour		
8.3.5.3	This test is not applied to SPDs which are either <ul style="list-style-type: none"> classified for outdoor use and for mounting out of reach, for connection N-PE in TN and/or TT systems only 		N/A
	The test sample shall be mounted in accordance with the manufacturer's published recommendations and connected with conductors of the maximum cross section according to 8.4.2, keeping the cables connecting the sample to a maximum length of 0,5 m each.		P
	Sample preparation		
	For SPDs with non-linear components connected in parallel, separate sets of three samples shall be prepared in the manner below for every current path of the SPD which contains one or more non-linear component in 3.1.4 and 3.1.5.		P
	Current paths containing voltage switching components with combined disconnecter function, having an impulse withstand voltage equal or greater than 6 kV and a dielectric withstand equal or greater than 2500 V/50 Hz for 1 min in normal operating condition, are tested without any preparation and only in conjunction with other current paths prepared in the manner described below. Voltage limiting components and voltage switching components described in 3.1.4 and 3.1.5 shall be replaced by appropriate cooper blocks (dummies) ensuring that the internal connections and their cross-section and surrounding material (e.g. resins) and packaging are not changed.		P
	a) Test at the declared short-circuit current rating	For version MZSR-385JK3ARI:	
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	255 V 25 kA $\cos \varphi = 0,25$	P
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees and at (90 ± 5) electrical degrees after the zero crossing of the voltage.		P
	If a replaceable or resettable internal or external disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	External disconnection occurs	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).	Interrupted in Max.4,34 ms	P
M	There shall be no explosion or other hazard to either personnel or the facility		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	b) Test at low short-circuit current		
	A power frequency source at U_{REF} , having a prospective short-circuit current of five times the rated current of the maximum overcurrent protection (if declared by the manufacturer), and a power factor according to Table 8, shall be applied for $5\text{ s} \pm 0,5\text{ s}$. If no external overcurrent protection is required by the manufacturer, a prospective short-circuit current of 300 A is used.	255 V 0,625 kA $\cos \varphi = 0,95$	P
	The test is carried out once with U_{REF} applied at (45 ± 5) electrical degrees after the zero crossing of the voltage.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
C	No mechanical damage		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
M	There shall be no explosion or other hazard to either personnel or the facility.		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	If disconnection occurs during the test:		
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	Internal disconnection occurs 0 mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).	Interrupted in Max.661.74 ms	P
8.3.5.3.1	Additional test for SPDs with I_{fi} lower than the declared short-circuit current rating (I_{SCCR})	No Isccr for N-PE	
	This test is only performed if the declared follow current interrupt rating I_{fi} is smaller than the test current.		N/A
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	_____ V _____ kA cos ϕ = _____	N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The voltage switching component(s) of the SPD is triggered with a positive surge current (8/20 or other appropriate waveshape) at (35 ± 5) electrical degrees after the zero crossing of the voltage on the positive half wave. The surge current shall be high enough to initiate a follow current but shall in no case exceed I_n.</p> <p>The test is carried out twice.</p>		N/A
	To ensure that no external disconnecter operates due to the trigger surge, all external disconnecters shall be placed in series with the power frequency source as shown in Figure 11.		N/A
	If a replaceable or resettable internal disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		N/A
	Pass criteria		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>_____ V</p> <p>_____ mA</p>	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	_____ mA	N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
8.3.5.3.2	Additional test for SPD's failure mode simulation	For version MZSR-200JK3ARI and MZSR-385JK3ARI:	
	For this test any electronic indicator circuitry may be disconnected.		P
	New samples shall be used and fitted as in normal use, acc. to the manufacturer's instructions and connected with conductors of the maximum cross section acc. to 8.4.2. The maximum length of the cables connection the sample shall be of 0,5 m each.		P
	External disconnectors, if recommended by the manufacturer, shall be used.		P
	The test sample shall be connected to a power frequency voltage source at the following conditioning voltages: <ul style="list-style-type: none"> SPDs rated U_C up to 440V, apply a voltage equal to $1200 V_{rms}^{+5/-0\%}$ SPDs with U_C rated above 440V, apply a voltage equal to 3 times $U_C^{+5/-0\%}$ 	For L-N 1200 Vac	P
	The conditioning voltage is applied for a duration of $5 s^{+5/-0\%}$. The prospective short-circuit current of this power source for conditioning shall be adjusted to a value between 1 A and $20 A_{rms}^{+5/-0\%}$, as provided by the manufacturer according to 7.1.1 d5).	10A (provided by the manufacturer)	P
	Following the application of the conditioning voltage equal to $U_{REF}^{+0/-5\%}$ with a short-circuit current capability as given below, shall be applied to the sample for a period of $5 min^{+5/-0\%}$ or for at least 0,5 s after interruption of the current by an internal or external disconnector.	5 min	P
	The transition from conditioning voltage application to U_{REF} application shall be performed without interruption. The current flow through the SPD shall be monitored. An appropriate test circuit and timing diagram is shown in Figure 12 and Figure 13.		P
	The prospective short-circuit current of the power source at U_{REF} shall have a tolerance of $+5/-0\%$ at the location where the SPD is connected. The power factor of the power source shall comply with Table 8.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Each of the following tests shall be performed on a new set of three preconditioned samples as above at U_{REF} with a short-circuit current of 100A, 500A and 1000A, respectively, unless these values exceed the declared short-circuit rating of the SPD.	100A	P
	A further test shall be performed on three preconditioned samples as above and at U_{REF} with a prospective short-circuit current equal to the manufacturer's declared short-circuit current rating. For this test, the time interval between the completion of the conditioning test and the application of U_{REF} shall be as short as possible and shall not exceed 100 ms.		P
	If all oscillograms of the tests on the first set of samples (100 A test set up) show a disconnection within 5 s during the application of the conditioning voltage, no further test is performed.	Internal disconnecter operate within 5s	P
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		
C	No mechanical damage		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	Additional pass criteria except for: <ul style="list-style-type: none"> • short circuiting type SPDs • SPDs where the current is interrupted during the application of U_{REF} where no disconnection occurs.		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_c and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>For 100A, internal disconnector occurs</p> <p>0 mA</p>	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>		N/A

IEC 61643-11 - TEST SEQUENCE 6 Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.1.1/8.7.1	Total discharge current test for multipole SPDs		
	One side of the test generator is connected to the PE or PEN terminal of the multipole SPD. Each of the remaining SPD terminals is connected via a typical series impedance consisting of a resistance of 30 mΩ and an inductance of 25 μH, to the other side of the generator. Smaller impedances may be used if the tolerances for the proportional surge currents according to Table 21 are met.		N/A
	The multipole SPD shall be tested once with the total discharge current I_{Total} declared by the manufacturer.	_____ kA	N/A
	Pass criteria		
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_p \leq$ _____ V	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A

IEC 61643-11 - TEST SEQUENCE 6 Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}).</p> <p>The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	$U_C = \text{_____ V}$ test voltage _____ V	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A

IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.2/8.6.2	Environmental tests for outdoor SPDs (informative)		
F.1	Accelerated aging test with UV radiation		
	Expose three complete SPDs, as to be installed for outdoor use, to 1000 h of UV radiation (UV-B) and water spray as follows: 500 cycles of 120 min each, consisting of 102 min of UV light at 60 °C, 18 min of UV light and water spray at 65 °C and 65 % RH. The UV radiation shall be according to ISO 4892-2, method A. ISO 4892-1 and ASTM 151 are to be used for general guidance for the test.		N/A
	The samples shall be connected to a power source at U_C during the test and residual current shall be monitored at 120 min intervals. After completion of this test, the samples shall be tested according to F.2.		N/A
	Pass criteria		
	During and after the test the samples shall be visually inspected for voids, cracks, tracking and surface erosion. The residual currents shall not increase by more than 10%. The degree of tracking, surface erosion and cracking shall be assessed to determine if this will compromise the enclosure of the product to meet the other electrical and mechanical performance requirements of this standard.		N/A
F.2	Water immersion test		
	The test is performed in accordance with Figure 8 of IEC 60099-4. The test samples shall kept immersed in a vessel, in boiling de-ionized water with 1 kg/m ³ of NaCl, for 42 h.		N/A
	At the end of boiling, the SPD shall remain in the vessel until the water has cooled down to approximately 20 °C (\pm 15 °C) and shall be maintained in the water till the verification tests are performed. After the water immersion test the samples shall be subjected the dielectric test (see F.3).		N/A

IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
F.3	Dielectric test		
	<p>The test samples shall be subjected to a dielectric test at a power frequency sinusoidal voltage of 1000 V plus twice the reference test voltage U_{REF} for 1 min and the leakage current shall be measured. The test voltage shall be applied as follows:</p> <p>a) SPD with metallic housing with or without mounting bracket The voltage shall be applied between all terminals or external leads which are not internally connected to the housing, neither directly nor through surge protective components, connected together, and the metallic housing. If all terminals and external leads are connected directly or through components to the conductive housing, this test is not performed.</p> <p>b) SPD with non-conductive housing with non-conductive or without mounting bracket The non-conductive housing shall be tightly wrapped in conductive foil to within 15 mm of any non-insulated lead or terminal. The voltage shall be applied between the conductive foil and all terminals or external leads connected together.</p> <p>c) SPD with non-conductive housing with metallic mounting bracket The non-conductive housing shall be tightly wrapped in conductive foil to within 15 mm of any non-insulated lead, terminal and the metallic mounting bracket. The voltage shall be applied between the conductive foil and all terminals, external leads and mounting bracket connected together.</p>		N/A
	Pass criteria		
	The leakage current measured during this test shall not exceed 25 mA.	$I = \text{_____ mA}$	N/A
F.4	Temperature cycle test		
	The test shall be performed according to IEC 60068-2-14 with 5 cycles with a lower temperature of -40 °C and with an upper temperature of +100 °C. The time duration for each half cycle is 3 h and the temperature change shall occur within 30 s.		N/A

IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
	During and after the test, the samples shall be visually inspected for voids, cracks, tracking and surface erosion. The residual currents shall not increase by more than 10 %. The degree of tracking, surface erosion and cracking shall be assessed to determine if this will compromise the enclosure of the product to meet the other electrical and mechanical performance requirements of this standard.		N/A
F.5	Verification of resistance to corrosion		
	<p>SPDs with exposed metal parts shall be subjected to the test and shall be mounted as for normal use according to the manufacturer's instructions.</p> <p>The enclosure or samples shall be new and in a clean condition. The samples shall be subjected to the following test:</p> <ul style="list-style-type: none"> • 12 cycles of 24 h, damp heat cycling test according to test Db of IEC 60068-2-30 at 40 °C and relative humidity of 95 %; • 14 cycles of 24 h, salt mist test according to test Ka of IEC 60068-2-11 at a temperature of (35 ± 2) °C. <p>After the test, the samples shall be washed in running tap water for 5 min, rinsed in distilled or demineralized water then shaken or subjected to air blast to remove water droplets. The specimen under test shall then be stored under normal service conditions for 2 h.</p>		N/A
	Pass criteria		
	<p>Compliance is checked by visual inspection to ensure that:</p> <ul style="list-style-type: none"> • there is no evidence of rust, cracking or other deterioration. However, surface deterioration of any protective coating is allowed. In case of doubt, reference shall be made to ISO 4628-3 to verify that the samples conform to the specimen Ri1; • seals are not damaged; • any moving parts (disconnectors) work without abnormal effort. 		N/A

IEC 61643-11 - TEST SEQUENCE 8 Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.4/8.6.4	Short-circuiting type SPDs		
	<p>These SPDs shall be capable of withstanding a short-circuit current test at their declared short-circuit current rating after having been overstressed by a surge current according to their transition rating I_{trans}.</p> <p>For such SPD's a conditioning into an intentional short-circuit according 8.6.4.1 is carried out, followed by a surge withstand test according 8.6.4.2 and a short-circuit current behaviour test according 8.6.4.3.</p>		N/A
8.6.4.1	Change of characteristic procedure (conditioning test)		
	One impulse of I_{trans} with positive polarity is applied to the de-energised SPD to change of characteristic of the SPD into an internal short-circuit. To check for the internal short-circuit an appropriate measurement shall be performed after this test.	$I_{trans} = \text{_____ kA}$	N/A
8.6.4.2	Surge withstand test (in short-circuited condition)		
	One impulse of I_{trans} with positive polarity is applied to the de-energised SPD.		N/A
	Pass criteria		
C	No mechanical damage		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
8.6.4.3	Short-circuit current behaviour test (in short-circuited condition)		
	The test is performed according to 8.3.5.3 excluding 8.3.5.1 and 8.3.5.3.2, but without any sample preparation.		N/A
8.3.5.3	<p>This test is not applied to SPDs which are either</p> <ul style="list-style-type: none"> • classified for outdoor use and for mounting out of reach, • for connection N-PE in TN and/or TT systems only 		N/A

IEC 61643-11 - TEST SEQUENCE 8 Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
	The test sample shall be mounted in accordance with the manufacturer's published recommendations and connected with conductors of the maximum cross section according to 8.4.2, keeping the cables connecting the sample to a maximum length of 0,5 m each.		N/A
	a) Test at the declared short-circuit current rating		
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	<p style="text-align: center;">_____ V</p> <p style="text-align: center;">_____ kA</p> <p style="text-align: center;">cos φ = _____</p>	N/A
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees and at (90 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
	If a replaceable or resettable internal or external disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		N/A
	b) Test at low short-circuit current		
	A power frequency source at U_{REF} , having a prospective short-circuit current of five times the rated current of the maximum overcurrent protection (if declared by the manufacturer), and a power factor according to Table 8, shall be applied for $5 \text{ s} \pm 0,5 \text{ s}$. If no external overcurrent protection is required by the manufacturer, a prospective short-circuit current of 300 A is used.	<p style="text-align: center;">_____ V</p> <p style="text-align: center;">_____ kA</p> <p style="text-align: center;">cos φ = _____</p>	N/A
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
	Pass criteria		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A

IEC 61643-11 - TEST SEQUENCE 8 Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>_____ V</p> <p>_____ mA</p>	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	_____ mA	N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A

Remarks:

N/A

Critical Component list:

Object / part No.	Manufacturer/ trademark	Type / model	Technical data	Standard	Mark(s) of conformity
Metal Oxide Varistor (for basic module MZSR-200)	Long Ke Electronics (Huiyang) Co Ltd	34S431KN	LxW:34x34mm, Min.thickness 4,0mm; with UL file E326953	IEC 61643-11	Test with appliance
Metal Oxide Varistor (for basic module MZSR-385)		34S621KN	LxW:34x34mm, Min.thickness 5,4mm; with UL file E326953		
Gas discharge tube (for basic module MZSR-ARI)	Sankosha	Y20-950AV1	Nominal DC Sparkover Voltage:800V; Impulse Sparkover Voltage:<1500V	IEC 61643-11	Test with appliance
Enclosure/ Live part carrier/ Tripping lever	SABIC INNOVATIVE PLASTICS B V	3412(f1)(GG)	PC material, all color, Min thickness 0,8mm, with UL file E45329	IEC 61643-11	Test with appliance
Insulating film	DUPONT-TORAY CO LTD KAPTON BUSINESS DIV	500H(a)	Polyimide material, Min thickness 0,14mm;with UL file E73117	IEC 61643-11	Test with appliance
PCB for signalling contact	SHENZHEN KING BROTHER ELECTRONICS TECHNOLOGY CO LTD	KB-01	V-0, Min thickness 1,0mm;with UL file E225430	IEC 61643-11	Test with appliance
Switch for signalling contact	YUEQING DONGNAN ELECTRONICS CO LTD	KW10-Z3P150	3(0.5)A 250VAC, with UL file E176213	IEC 61643-11	Test with appliance
Terminal for signalling contact	PHOENIX CONTACT GMBH & CO KG	BCH- 381H(14),BCH -381V(14)	250VAC, with UL file E60425	IEC 61643-11	Test with appliance
Wire for signalling contact	MISAWA DENSEN CO LTD	-	24AWG, 300VAC; with UL file E192340	IEC 61643-11	Test with appliance

Annex.1	For MZSR-200JK3ARI	Remark
CL 8.3.3	<p>CH1: Shunt 5.000 mOhm Level 100% Sampling 120.000 Ms/s Range 160.0 Vpp Trigger Level 10%</p> <p>No. 5340 ECI Ipk : -19.969 kA T1 : 8.115 us T2 : 21.883 us</p>	<p>For L-N</p> <p>Current oscillogram</p> <p>Surge: 20KA (In)</p> <p>Negative direction</p>
CL 8.3.3	<p>CH2: Divider 18.892 VV Level 100% Sampling 120.000 Ms/s Range 250.0 Vpp Trigger Level 10%</p> <p>No. 5340 ECI U max : -1.340 kV U min : -1.821 kV Manually evaluated</p>	<p>For L-N</p> <p>Voltage oscillogram</p> <p>Surge: 20KA (In)</p> <p>Negative direction</p>

<p>CL 8.3.3</p>		<p>For N-PE Current oscillogram</p> <p>Surge: 20KA (In)</p> <p>Negative direction</p>
		<p>For N-PE voltage oscillogram</p> <p>Surge: 20KA (In)</p> <p>Negative direction</p>
		<p>For N-PE</p> <p>Surge: 6KV (Uoc)</p> <p>Positive direction</p>

Annex.1	For MZSR-385JK3ARI	Remark
CL 8.3.3	<p>CH1: Shunt 5.000 mOhm Level 100% Sampling 120.000 Ms/s Range 160.0 Vpp Trigger Level 10%</p> <p>No. 5346 ECI Ipk : -19.857 kA T1 : 8.040 us T2 : 21.889 us</p>	<p>For L-N</p> <p>Current oscillogram</p> <p>Surge: 20KA (In)</p> <p>Negative direction</p>
CL 8.3.3	<p>CH2: Divider 18.892 V/V Level 100% Sampling 120.000 Ms/s Range 320.0 Vpp Trigger Level 10%</p> <p>No. 5346 ECI U max : -1.677 kV U min : -1.866 kV Manually evaluated</p>	<p>For L-N</p> <p>Voltage oscillogram</p> <p>Surge: 20KA (In)</p> <p>Negative direction</p>

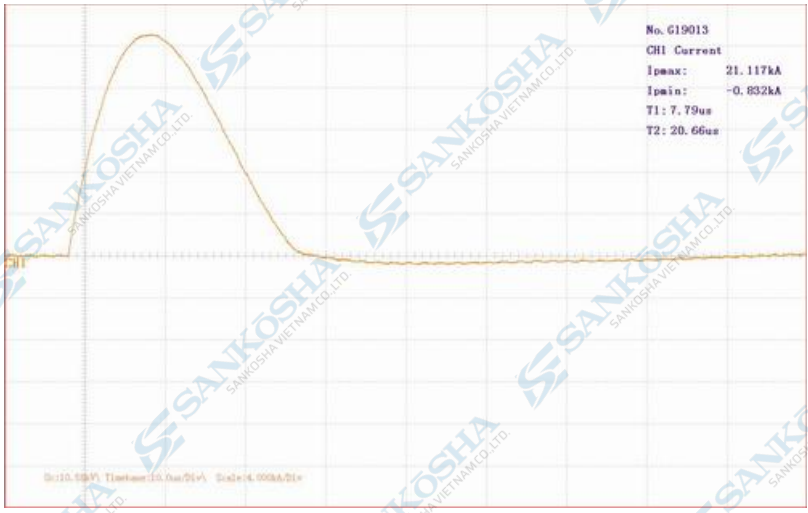
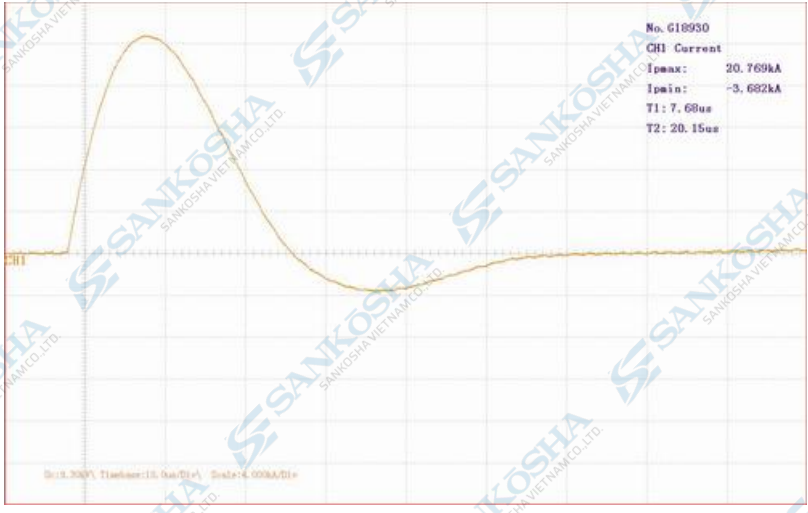
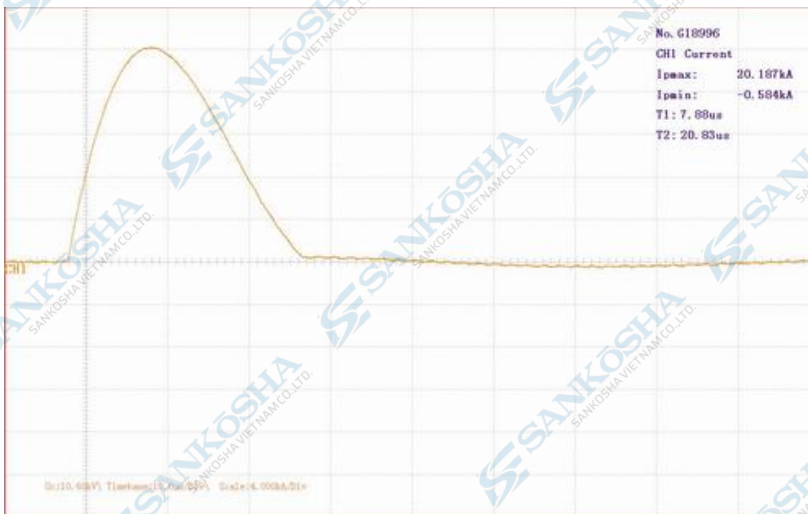
Annex.1	For MZSR-200JK3ARI	Remark
CL 8.3.4	 <p data-bbox="1091 277 1235 394"> No. G19013 CHI Current I_{peak}: 21.117kA I_{min}: -0.832kA T₁: 7.79us T₂: 20.66us </p>	For L-N Current oscillogram Surge: 20KA (In) Positive direction
CL 8.3.4	 <p data-bbox="1091 822 1235 938"> No. G18930 CHI Current I_{peak}: 20.769kA I_{min}: -3.682kA T₁: 7.68us T₂: 20.15us </p>	For N-PE Current oscillogram Surge: 20KA (In) Positive direction
Annex.1	For MZSR-385JK3ARI	Remark
CL 8.3.4	 <p data-bbox="1091 1485 1235 1601"> No. G18986 CHI Current I_{peak}: 20.187kA I_{min}: -0.584kA T₁: 7.88us T₂: 20.83us </p>	For L-N Current oscillogram Surge: 20KA (In) Positive direction

Table 3 – Type test requirements for SPDs

Test sequence	Test description	Subclause requirement/test	External disconnectors connected ^a	Tissue paper used	Metallic screen used	Test class I	Test class II	Test class III
1	Identification and marking	7.1.1/7.1.2/8.2	-	-	-	A	A	A
	Mounting	7.3.1	-	-	-	A	A	A
	Terminals and connections	7.3.2/7.3.3/8.4.2	-	-	-	A	A	A
	Testing for protection against direct contact	7.2.1/8.3.1	-	-	-	A	A	A
	Environment, IP code	7.4.1 / 8.5.1	-	-	-	A	A	A
	Residual current	7.2.2 / 8.3.2	-	-	-	A	A	A
	Operating duty test	7.2.4/8.3.4 ^b						
	Operating duty test for test classes I, II or III	8.3.4.2 / 8.3.4.3/ 8.3.4.5	A	-	-	A	A	A
	Additional duty test for test class I	8.3.4.4	A	-	-	A	-	-
	Thermal stability	7.2.5.2 / 8.3.5.2	A	-	-	A	A	A
	Air clearances and creepage distances	7.3.4 / 8.4.3	-	-	-	A	A	A
	Ball pressure test	7.4.2 / 8.5.3	-	-	-	A	A	A
	Resistance to abnormal heat and fire	7.4.3 / 8.5.4	-	-	-	A	A	A
Tracking resistance	7.4.4 / 8.5.5	-	-	-	A	A	A	
2	Voltage protection level	7.2.3/8.3.3						
	Residual voltage	8.3.3.1	-	-	-	A	A	-
	Front of wave sparkover voltage	8.3.3.2	-	-	-	A	A	-
	Limiting voltage with combination wave	8.3.3.3	-	-	-	-	-	A
2a	See below - only if applicable							
2b	See below - only if applicable							
3	Insulation resistance	7.2.6 / 8.3.6	-	-	-	A	A	A
	Dielectric withstand	7.2.7 / 8.3.7	-	-	-	A	A	A
3a	See below - only if applicable							
	Mechanical strength	7.3.5 / 8.4.4	-	-	-	A	A	A
	Temperature withstand	7.2.5 / 8.3.5.1 ^b	-	-	-	A	A	A
3b ^c	See below - only if applicable							
3c	See below - only if applicable							
4 ^c	Heat resistance	7.4.2 / 8.5.2	-	-	-	A	A	A
	TOV tests	7.2.8 / 8.3.8						
	TOVs caused by faults or disturbances in the low voltage system	7.2.8.1/8.3.8.1 ^b	A	A	-	A	A	A
	TOVs caused by faults in the high (medium) voltage system	7.2.8.2/8.3.8.2 ^b	A	A	-	A	A	A
5 ^c	Short-circuit current behaviour	7.2.5.3 / 8.3.5.3	A	-	A	A	A	A

Table 3 – Type test requirements for SPDs (continued)

Additional tests for specific SPD designs								
Test sequence	Test description	Subclause requirement/test	External disconnectors connected ^a	Tissue paper used	Metallic screen used	Test class I	Test class II	Test class III
Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals								
3c ^c	Rated load current	7.5.1.1 / 8.6.1.1	A	-	-	A	A	A
	Overload behaviour	7.5.1.2 / 8.6.1.2 ^b	-	-	-	A	A	A
2b	Load side short-circuit current behaviour	7.5.1.3 / 8.6.1.3 ^b	A	-	A	A	A	A
Additional tests if declared by the manufacturer								
3b	Voltage drop	7.6.2.1 / 8.7.2	-	-	-	A	A	A
2a ^c	Load side surge withstand	7.6.2.2 / 8.7.3 ^b	A	-	-	A	A	A
6	Total discharge current test for multipole SPDs	7.6.1.1 / 8.7.1 ^b	-	-	-	A	A	-
Additional tests for outdoor use SPDs								
7	For SPDs classified "outdoor"	7.5.2 / 8.6.2	-	O	-	A	A	-
Additional tests for SPDs with separate isolated circuits								
3a	Isolation between separate circuits	7.5.3/ 8.3.6 / 8.3.7	-	-	-	A	A	A
Additional tests for short-circuiting type SPDs								
8	Change of characteristic procedure (preconditioning to short-circuited condition)	7.5.4 / 8.6.4	-	-	-	-	A	-
	Surge withstand test (in short-circuited condition)	7.5.4 / 8.6.4	-	-	-	-	A	-
	Short-circuit current behaviour (in short-circuited condition)	7.5.4 / 8.6.4	A	-	A	-	A	-
<p>A = applicable</p> <p>- = not applicable</p> <p>O = optional</p> <p>^a external disconnectors connected means that all disconnectors as specified by the manufacturer shall be tested with the SPD during the type tests, except for RCDs, which are not tested during the operating duty test according to 8.3.4.</p> <p>^b For these tests initial measurements of leakage currents according to Table 4, pass criterion E may be necessary.</p> <p>^c For this test sequence more than one set of samples may be needed.</p>								

Table 4 – Common pass criteria for type tests

A	Thermal stability shall be achieved. The SPD is considered to be thermally stable if the crest of the resistive component of the current flowing into the SPD or the power dissipation shows either a decreasing tendency or does not increase during 15 min of U_C voltage application immediately after the application of U_C . If the test itself is performed with the SPD energized at U_C , then U_C either remains applied for these 15 min without interruption or is reapplied within less than 30 s.
B	Voltage and current records and visual inspection shall show no indication of puncture or flashover.
C	No visible damage shall occur during the test. After the test, small indents and cracks not impairing the protection against direct contact are disregarded during this check, unless the degree of protection (IP-code) given for the SPD is no longer provided. There shall be no visual evidence of burning of the sample after the test.
D	Values for measured limiting voltage after the test shall be below or equal to U_P . The measured limiting voltage shall be determined, using the tests described in 8.3.3, but the test of 8.3.3.1 is performed only with a 8/20-surge current with a crest value of I_{imp} for Test Class I or with I_n for Test Class II or with the test of 8.3.3.3 but only at U_{OC} for Test class III.
E	No excessive leakage currents shall occur after the test. The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA, or the current shall not have changed by more than 20 % compared to the initial value determined at the beginning of the relevant test sequence. Any resettable or rearmable disconnecter shall be switched off manually, if applicable, and the dielectric withstand shall be checked by application of two times U_C or 1 000 V a.c., whichever is greater. During the test, no flashover, breakdown of insulation either internally (puncture) or externally (tracking) or any other manifestation of disruptive discharge shall occur. In addition for SPD modes connected N-PE only the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at the maximum continuous operating voltage (U_C). Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA, or the current shall not have changed by more than 20 % compared to the initial value determined at the beginning of the relevant test sequence. If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.
F	External disconnectors as specified by the manufacturer shall not operate during the test and shall be in working order after the test. For the purpose of this clause, working order means that there is no damage to the disconnector and that it is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.
G	Internal disconnectors as specified by the manufacturer shall not operate during the test and shall be in working order after the test. For the purpose of this clause, working order means that there is no damage of the disconnector and that it is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.
H	Disconnection shall be provided by one or more internal and/or external disconnector(s). Their correct indication shall be checked.
I	SPDs with an IP degree equal to, or greater than, IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N (see IEC 60529), except the live parts which were already accessible before the test when the SPD is fitted as in normal use.
J	If disconnection (internal or external) occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected as for normal use at the maximum continuous operating voltage U_C and at rated frequency for 1 min. The test source shall have a short-circuit current capability equal or greater than 200 mA. The current that flows through the relevant protective components shall not exceed a value of 1 mA. Currents through components connected in parallel to the relevant protective component(s), or otherwise connected (e.g. indicator circuits), are disregarded for this measurement, as long as they cannot cause a current through the relevant protective component(s). In addition the current through the PE-terminal, including parallel circuits and other circuits (e.g. indicator circuits), if any, shall not exceed 1 mA. If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).
L	The tissue paper shall not catch fire.
M	There shall be no explosion or other hazard to either personnel or the facility.
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.
O	After completion of this test the samples shall be allowed to return to room temperature and be connected to a power source at U_C for 2 h. The residual current shall be monitored and not exceed the value measured at the beginning of the test by more than 10 %.

Table 8 – Prospective short-circuit current and power factor

I_p (kA) $\begin{matrix} +5 \\ 0 \end{matrix}$ %	$\cos \varphi$ $\begin{matrix} 0 \\ -0,05 \end{matrix}$
$I_p \leq 1,5$	0,95
$1,5 < I_p \leq 3,0$	0,9
$3,0 < I_p \leq 4,5$	0,8
$4,5 < I_p \leq 6,0$	0,7
$6,0 < I_p \leq 10,0$	0,5
$10,0 < I_p \leq 20,0$	0,3
$20,0 < I_p \leq 50,0$	0,25
$50,0 < I_p$	0,2

NOTE Recovery voltage according to IEC 60947-1.

Table 10 – Screw thread diameters and applied torques

Nominal diameter of thread mm	Torque Nm		
	I	II	III
Up to and including 2,8	0,2	0,4	0,4
Over 2,8 up to and including 3,0	0,25	0,5	0,5
Over 3,0 up to and including 3,2	0,3	0,6	0,6
Over 3,2 up to and including 3,6	0,4	0,8	0,8
Over 3,6 up to and including 4,1	0,7	1,2	1,2
Over 4,1 up to and including 4,7	0,8	1,8	1,8
Over 4,7 up to and including 5,3	0,8	2,0	2,0
Over 5,3 up to and including 6,0	1,2	2,5	3,0
Over 6,0 up to and including 8,0	2,5	3,5	6,0
Over 8,0 up to and including 10,0	–	4,0	10,0

Table 11 – Cross-sections of copper conductors for screw-type or screwless terminals

Maximum continuous load current for two-port SPDs or one-port SPDs with separate input/output terminals ^a	Range of nominal cross-sections to be clamped (single conductor)	
	mm ²	American Wire Gauge
Up to and including 13	1 to 2,5	18 to 14
Above 13 up to and including 16	1 to 4	18 to 12
Above 16 up to and including 25	1,5 to 6	16 to 10
Above 25 up to and including 32	2,5 to 10	14 to 8
Above 32 up to and including 50	4 to 16	12 to 6
Above 50 up to and including 80	10 to 25	8 to 3
Above 80 up to and including 100	16 to 35	6 to 2
Above 100 up to and including 125	25 to 50	4 to 1

^a It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors; the use of flexible conductors is permitted.

Nevertheless, it is permitted that terminals for conductors having cross-sections from 1 mm² up to 6 mm² be designed to clamp solid conductors only.

Table 12 – Pulling forces (screw terminals)

Cross-section of conductor accepted by the terminal mm ²	Up to 4	Up to 6	Up to 10	Up to 16	Up to 50
Pull N	50	60	80	90	100

Table 13 – Conductor dimensions

Range of nominal cross-sections to be clamped mm ²	Stranded conductor
	Number of wires
1 to 2,5 ^a	7
1 to 4 ^a	7
1,5 to 6 ^a	7
2,5 to 10	7
4 to 16	7
10 to 25	7
16 to 35	19
25 to 50	Under consideration

^a If the terminal is intended to clamp solid conductors only (see table footnote of Table 11), the test is not performed.

Table 14 – Pulling forces (screwless terminals)

Cross-sectional area mm ²	0,5	0,75	1,0	1,25 1,5	2,0 2,5	3,5 4	5,5 6	8,0 10	14 16	22 25	35 38
Pull force N	30	30	35	40	50	60	80	90	100	135	190

Table 15 – Air clearances for SPDs

U_{max}^a	$\leq 2\ 000\ V$	$\leq 4\ 000\ V$	$>4\ 000\ V$ up to 6 000 V	$>6\ 000\ V$ up to 8 000 V
	Air clearances in millimetres			
1) Between live parts of different polarity	1,5	3	5,5	8
2) Between live parts and				
– screws and other means to fasten a covering, having to be detached for mounting the SPD	1,5	3	5,5	8
– fastening surfaces (NOTE 2)	3	6	11	16
– screws or other means for fastening the SPD (NOTE 2)	3	6	11	16
– bodies (NOTES 1 and 2)	1,5	3	5,5	8
3) Between the metal parts of the disconnecter mechanism and				
– bodies (NOTE 1)	1,5	3	5,5	8
– screws or other means for fastening the SPD	1,5	3	5,5	8
^a This column is only applicable for SPDs with U_C lower or equal to 180 V.				
NOTE 1 For definition, see 8.3.6 a)				
NOTE 2 If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of line 1) are sufficient.				

Table 16 – Creepage distances for SPDs

r.m.s. voltage D, c	Minimum creepage distances in millimetres										
	Printed wiring material		Pollution degree								
	Pollution degree		1			2			3		
	V	All material groups	All material groups, except IIIb	All material groups	Material group ^a			Material group ^a			
I					II	III	I	II	III ^d		
10	0,025	0,04	0,08	0,4	0,4	0,4	1	1	1		
12,5	0,025	0,04	0,09	0,42	4,42	4,42	1,0	1,05	1,05		
16	0,025	0,04	0,1	0,45	0,45	0,45	1,1	1,1	1,1		
20	0,025	0,04	0,11	0,48	0,48	0,48	1,2	1,2	1,2		
25	0,025	0,04	0,125	0,5	0,5	0,5	1,2	1,25	1,25		
32	0,025	0,04	0,14	0,53	0,53	0,53	1,3	1,3	1,3		
40	0,025	0,04	0,16	0,56	0,8	1,1	1,4	1,6	1,8		
50	0,025	0,04	0,18	0,6	0,85	1,2	1,5	1,7	1,9		
63	0,04	0,063	0,2	0,63	0,9	1,25	1,6	1,8	2		
80	0,063	0,1	0,22	0,67	0,95	1,3	1,7	1,9	2,1		
100	0,1	0,16	0,25	0,71	1	1,4	1,8	2	2,2		
125	0,16	0,25	0,28	0,75	1,05	1,5	1,9	2,1	2,4		
160	0,25	0,4	0,32	0,8	1,1	1,6	2	2,2	2,5		
200	0,4	0,63	0,42	1	1,4	2	2,5	2,8	3,2		
250	0,56	1	0,56	1,25	1,8	2,5	3,2	3,6	4		
320	0,75	1,6	0,75	1,6	2,2	3,2	4	4,5	5		
400	1	2	1	2	2,8	4	5	5,6	6,3		
500	1,3	2,5	1,3	2,5	3,6	5	6,3	7,1	8		
630	1,8	3,2	1,8	3,2	4,5	6,3	8	9	10		
800	2,4	4	2,4	4	5,6	8	10	11	12,5		
1 000	3,2	5	3,2	5	7,1	10	12,5	14	16		

^a For further information on material groups refer to Table 17.

^b This voltage is
for functional insulation, the working voltage;
for basic and supplementary insulation of the circuit energized directly from the supply mains, the voltage rationalized through Table F.3a or Table F.3b of IEC 60664-1, based on the rated voltage of the equipment, or the rated insulation voltage;
for basic and supplementary insulation of systems, equipment and internal circuits not energized directly from the mains, the highest r.m.s. voltage which can occur in the system, equipment or internal circuit when supplied at rated voltage and under the most onerous combination of conditions of operation within equipment rating.

^c For the main protection circuit, this column refers to U_C .

^d Material IIIb shall not be used for application in pollution degree 3 above 630 V.

NOTE If the actual voltage differs from the values given in the table, it is allowed to interpolate values for intermediate voltages. When interpolating, linear interpolation should be used and values should be rounded to the same number of digits than the values picked from the table.

Table 17 – Relationship between material groups and classifications

Material group I	$600 \leq \text{CTI}$
Material group II	$400 \leq \text{CTI} < 600$
Material group IIIa	$175 \leq \text{CTI} < 400$
Material group IIIb	$100 \leq \text{CTI} < 175$
Relationship between material groups and classifications are according to IEC 60112 (CTI values, using solution A).	

Table 18 – Fall distances for impact requirements

Height of fall mm	Parts of enclosures to be subjected to the impacts	
	Ordinary accessory	Other accessories
100	A and B	A and B
150	C	C
200	D	D

A: parts on the front surface, including parts which are recessed.

B: parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

C: parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

D: parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

Table 19 – Test conductors for rated load current test

Test current [A]		Cross section	
Greater than	Less or equal	[mm ²]	AWG/MCM
0	8	1,0	18
8	12	1,5	16
12	15	2,5	14
15	20	2,5	12
20	25	4,0	10
25	32	6,0	10
32	50	10	8
50	65	16	6
65	85	25	4
85	100	35	3
100	115	35	2
115	130	50	1
130	150	50	0
150	175	70	00
175	200	95	000
200	225	95	0000
225	250	120	250
250	275	150	300
275	300	185	350
300	350	185	400
350	400	240	500

NOTE If other standardized cross-sections are used in specific countries, the next closest cross-section should be used for testing.

Table 20 – Current factor k for overload behaviour

Protective device	Trip current factor k
Circuit breaker	1,45
Fuse	1,6

NOTE 1 If the type of protective device (breaker or fuse) is not specified by the manufacturer, the test is performed with the higher k factor.

NOTE 2 For countries using other values, these values should be declared on the SPD's data sheet according to 7.1.1 c7).

NOTE 3 National condition for Japan: k is 1,25 for circuit-breaker and 1,5 for fuse.

NOTE 4 National condition for North America: k is under consideration.

Table 21 – Tolerances for proportional surge currents

Test classification	Proportional currents and tolerances
Test class I	$I_{imp(1)} = I_{imp(2)} = I_{imp(N)} = I_{Total(imp)} / N$ 10 % $Q_{(1)} = Q_{(2)} = Q_{(N)} = Q_{Total} / N$ -10/+20 % $W/R_{(1)} = W/R_{(2)} = W/R_{(N)} = W/R_{Total} / N^2$ -10/+45 %
Test class II	$I_{8/20(1)} = I_{8/20(2)} = I_{8/20(N)} = I_{Total(8/20)} / N$ ± 10%

Table B.1 – TOV test values for systems complying with IEC 60364 series

Application	TOV test parameters		
	For $t_T=5$ s (LV-system faults in consumer installation) (requirement to 7.2.8.1 and test 8.3.8.1)	For $t_T=120$ min (LV-system faults in distribution system and loss of neutral (requirement to 7.2.8.1 and test 8.3.8.1)	For $t_T=200$ ms (HV-system faults) (requirement to 7.2.8.2 and test 8.3.8.2)
SPDs connected to:	Withstand mode required	Withstand or safe failure mode acceptable	Withstand or safe failure mode acceptable
TOV test values U_T (V)			
TN-systems			
Connected L-(PE)N or L-N	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	
Connected N-PE			
Connected L-L			
TT-systems			
Connected L-PE	$\sqrt{3} \times U_{REF}$	$1,32 \times U_{REF}$	$1\ 200 + U_{REF}$
Connected L-N	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	
Connected N-PE			1 200
Connected L-L			
IT-systems			
Connected L-PE			$1\ 200 + U_{REF}$
Connected L-N	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	
Connected N-PE			$1\ 200 + U_{REF}$
Connected L-L			
U_{REF}	reference test voltage used for testing and taking into account the maximum voltage regulation of the power system (see Annex A).		
U_0	in TN- and TT-systems: nominal a.c. r.m.s. line voltage to earth; in IT-systems: nominal a.c. voltage between line conductor and neutral conductor or midpoint conductor, as appropriate (see 442.1.2 of IEC 60364-4-44:2007).		
1,32 x	U_{REF} equals $1,45 \times U_0$ in case the voltage regulation does not exceed +10 % (see 442.5 of IEC 60364-4-44:2007).		
NOTE As voltage regulation exceeds 10 % in some countries, only U_{REF} is used in this standard for general applicability. Further information on voltage regulation can be found in IEC 60038.			

Table B.3 – TOV test parameters for Japanese systems

Application	TOV test parameters			
	LV system faults	HV system faults		
SPDs connected to:	for $t_T=120$ min	Not specified duration	for $t_T=2$ s	for $t_T=1$ s
	(LV-system faults in distribution system and loss of neutral (requirement to 7.2.8.1 and test 8.3.8.1))	Withstand or safe failure mode acceptable		
TOV test values U_T [V]				
TN systems				
Connected L-N(PE) or L-N	$\sqrt{3} \times U_{REF}$			
Connected N-PE				
Connected L-L				
TT systems				
Connected L-PE	$\sqrt{3} \times U_{REF}$	$150 + U_{REF}$	$300 + U_{REF}$	$600 + U_{REF}$
Connected L-N	$\sqrt{3} \times U_{REF}$			
Connected N-PE		150	300	600
Connected L-L				
IT systems				
Connected L-PE				$1\ 200 + U_{REF}$
Connected L-N	$\sqrt{3} \times U_{REF}$			
Connected N-PE				$1\ 200 + U_{REF}$
Connected L-L				
U_{REF}	reference test voltage used for testing and taking into account the maximum voltage regulation of the power system (see Annex A).			
NOTE 1 These values are required by ministerial ordinance of technical standards for electrical facilities.				
NOTE 2 As voltage regulation exceeds 10 % in some countries, U_{REF} is used in this standard only for general applicability. Further information on voltage regulation can be found in IEC 60038.				

Table G.1 – Temperature-rise limits

Parts of SPD	Temperature rise K
Built-in components ^a	In accordance with the relevant product standard requirements for the individual components or, in accordance with the component manufacturer's instructions ^f , taking into consideration the temperature in the SPD
Terminals for external insulated conductors	70 ^b
Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars	Limited by: <ul style="list-style-type: none"> – mechanical strength of conducting material ^g; – possible effect on adjacent equipment; – permissible temperature limit of the insulating materials in contact with the conductor; – effect of the temperature of the conductor on the apparatus connected to it; – for plug-in contacts, nature and surface treatment of the contact material.
Manual operating means: <ul style="list-style-type: none"> – of metal – of insulating material 	15 ^c 25 ^c
Accessible external enclosures and covers: <ul style="list-style-type: none"> – metal surfaces – insulating surfaces 	30 ^d 40 ^d
Discrete arrangements of plug and socket-type connections	Determined by the limit for those components of the related equipment of which they form part ^e
<p>^a The term "built-in components" means:</p> <ul style="list-style-type: none"> – conventional switchgear and controlgear; – electronic sub-assemblies (e.g. rectifier bridge, printed circuit); – parts of the equipment (e.g. regulator, stabilized power supply unit, operational amplifier). <p>^b An SPD used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test, and a different temperature rise of terminals may result. Where the terminals of the built-in component are also the terminals for external insulated conductors, the lower of the corresponding temperature-rise limits shall be applied.</p> <p>^c Manual operating means within SPDs which are only accessible after the SPD has been opened, for example draw-out handles which are operated infrequently, are allowed to assume a 25 K increase on these temperature-rise limits.</p> <p>^d Unless otherwise specified, in the case of covers and enclosures, which are accessible but need not be touched during normal operation, a 10 K increase on these temperature-rise limits is permissible.</p> <p>^e This allows a degree of flexibility in respect of equipment (e.g. electronic devices) which is subject to temperature-rise limits different from those normally associated with switchgear and controlgear.</p> <p>^f For temperature-rise tests according to 8.6.1.1, the temperature-rise limits shall be specified by the manufacturer of the SPD.</p> <p>^g Assuming all other criteria listed are met, a maximum temperature rise of 105 K for bare copper busbars and conductors shall not be exceeded. The 105 K relates to the temperature above which annealing of copper is likely to occur.</p>	

Photos:



Overall view of version MZSR-200JK1, MZSR-200JK2, MZSR-200JK3, MZSR-200JK4, MZSR-200JK1ARI, MZSR-200JK2ARI, MZSR-200JK3ARI



Overall view of version MZSR-385JK1, MZSR-385JK2, MZSR-385JK3, MZSR-385JK4, MZSR-385JK1ARI, MZSR-385JK2ARI, MZSR-385JK3ARI



Overall view of version MZSR-ARI



Overall view of version MZSR-385JK3ARI



Side view of version MZSR-385JK3ARI



Side view of version MZSR-385JK3ARI



Rear view of version MZSR-385JK3AR1



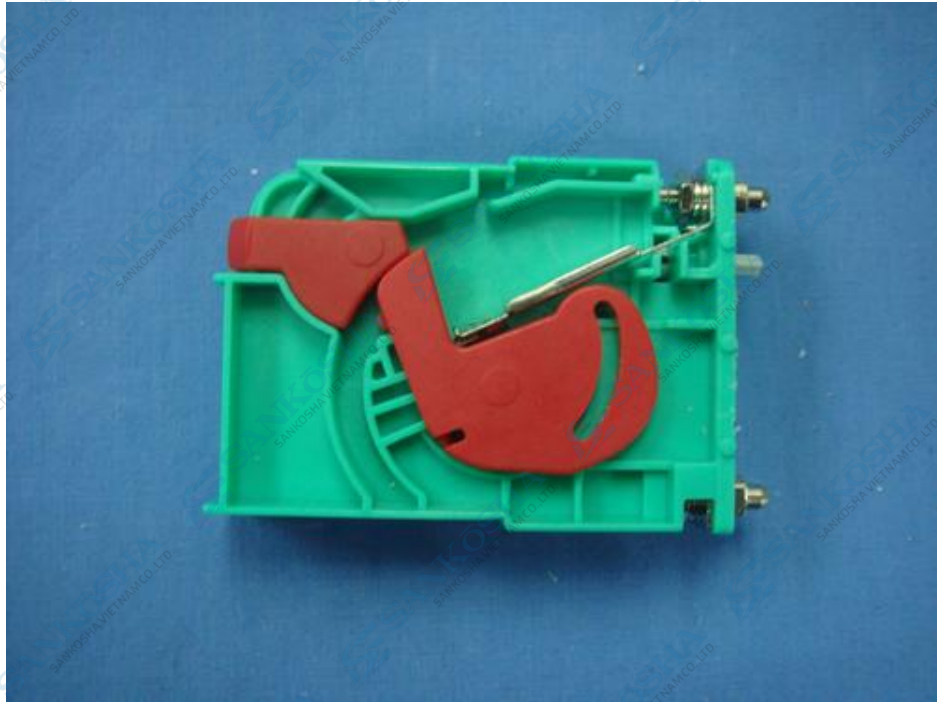
Overall view of module MZSR-385



Side view of module MZSR-385



Internal view of module MZSR-385



Internal view of module MZSR-385



Rear view of module MZSR-385



Varistor of module MZSR-385



Varistor of module MZSR-200



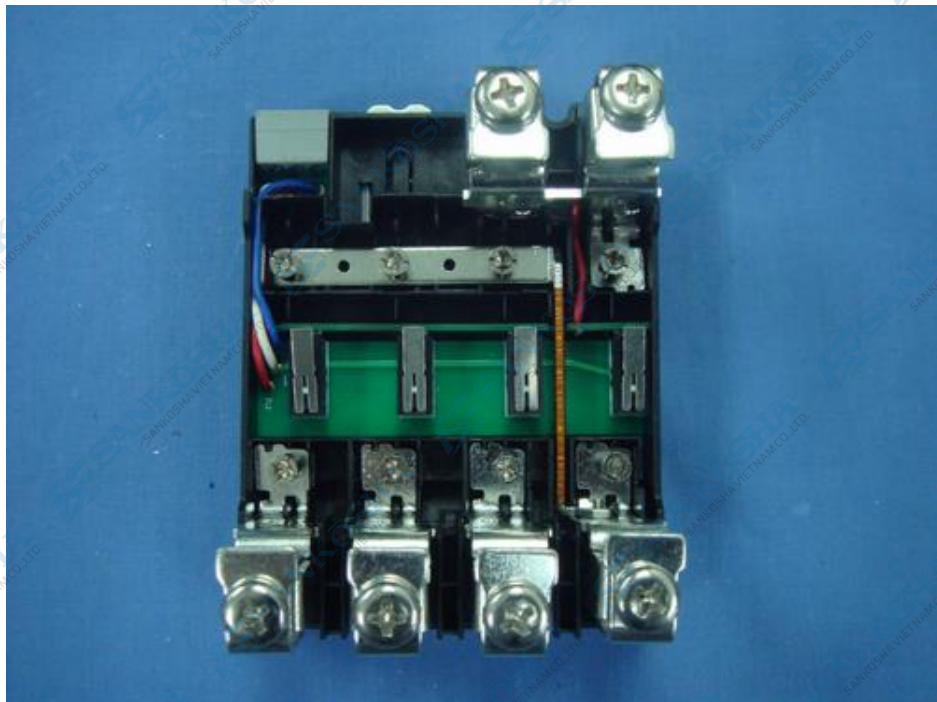
Internal view of module MZSR-ARI



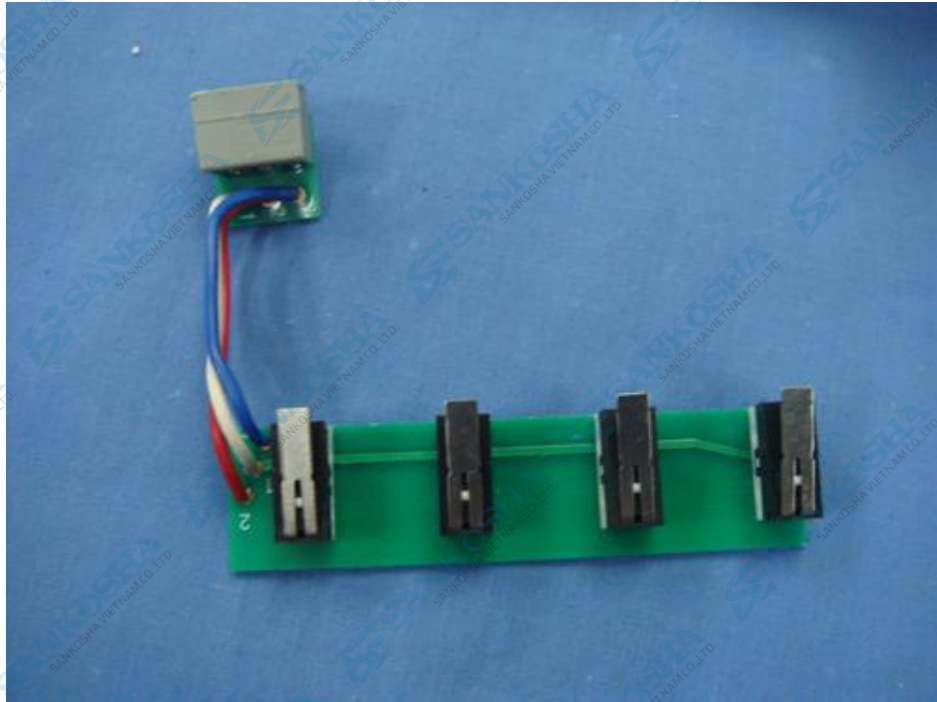
Gas discharge tube of module MZSR-ARI



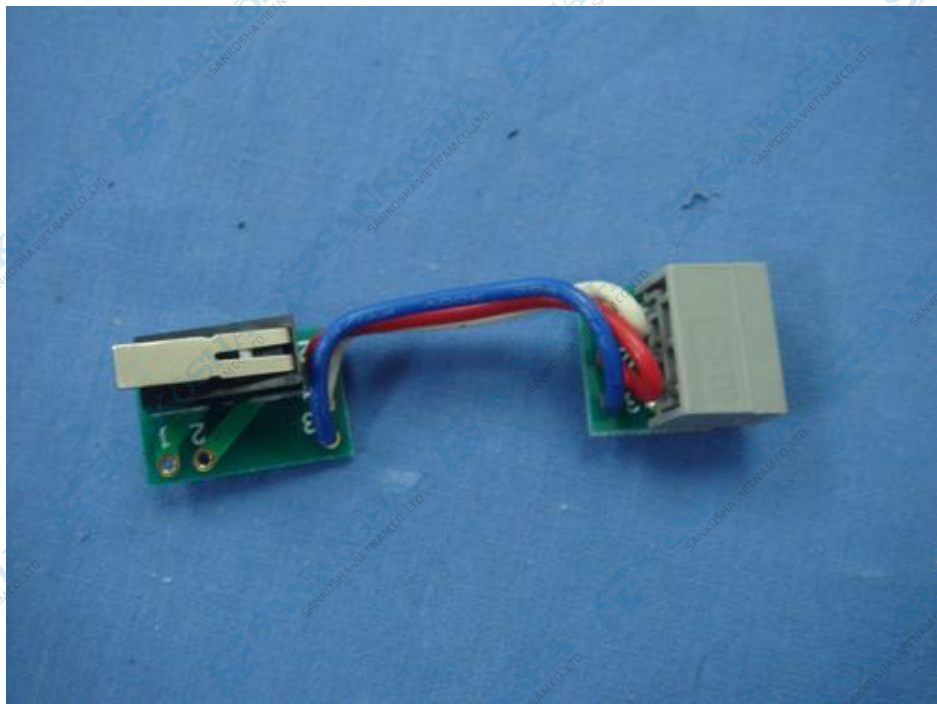
Overall view of base of version MZSR-385JK3ARI



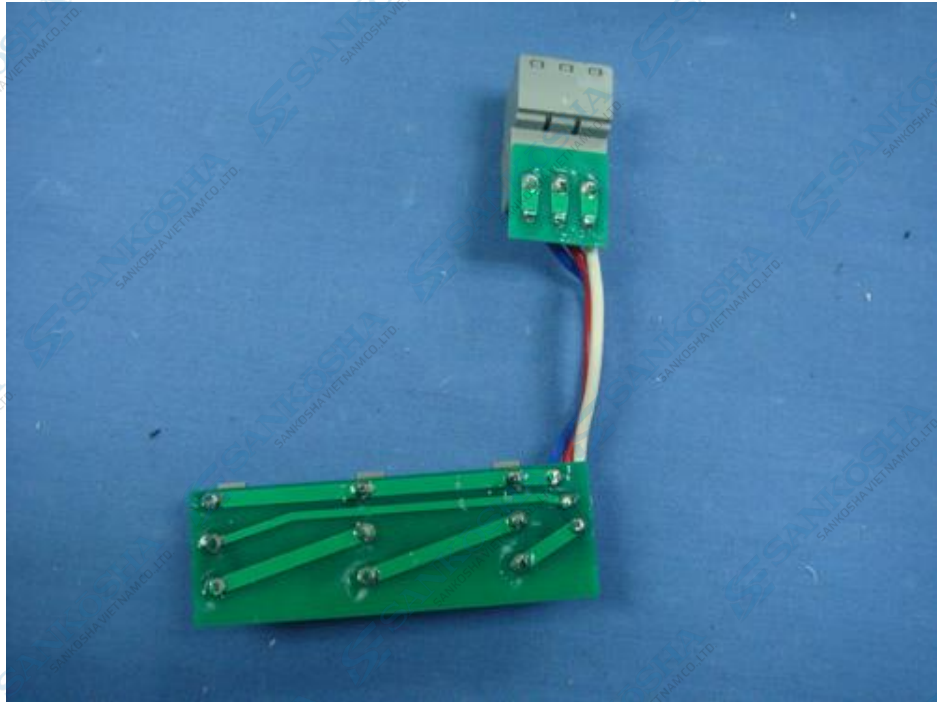
Internal view of base of version MZSR-385JK3ARI



Signalling contact of version MZSR-385JK3ARI



Signalling contact of version MZSR-385JK1



Signalling contact of version MZSR-385JK3



Live part carrier with insulating film



Screw type terminal



Connection of live part carrier