



IEC 61643-11 - TEST SEQUENCE 5

Clause	Requirement - Test	Result - Remark	Verdict
	<p>Additional pass criteria except for:</p> <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 disconnector(s). Their correct indication shall be checked.		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_n and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>_ V</p> <p>_ μA</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>_____ mA</p>	N/A



IEC 61643-11 - TEST SEQUENCE 6 <i>Additional tests if declared by the manufacturer</i>			
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

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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 ($i_{measured}$ 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>$U_{REF} = \text{---} \text{ V}$</p>	<p>N/A</p> <p>N/A</p> <p>N/A</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.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	<p>$U_C = \text{---} \text{ V}$</p> <p>test voltage</p> <p>$\text{---} \text{ V}$</p>	<p>N/A</p> <p>N/A</p>
	<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>$U_C = \text{---} \text{ V}$</p> <p>$I_{PE} = \text{---} \text{ mA}$</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>
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

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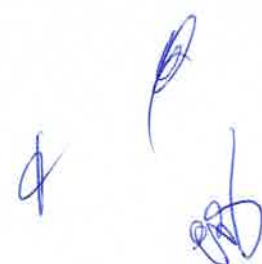
IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.2/8.6.2	Environmental tests for outdoor SPDs (informative)		
F.1	Accelerated aging test with UV radiation		
	Expose three complete SPDs, as to be installed for outdoor use, to 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		N/A
	The leakage current measured during this test shall not exceed 25 mA.	$I = \text{---} \text{ mA}$	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		
	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. The enclosure or samples shall be new and in a clean condition. The samples shall be subjected to the following test: <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. 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.		N/A N/A N/A
	Pass criteria		
	Compliance is checked by visual inspection to ensure that: <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 N/A 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 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.	_____ V _____ kA cos φ = _____	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 disconnector operates, the relevant disconnector shall be replaced or reset each time. If the disconnector 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.	_____ V _____ kA cos φ = _____	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 disconnector(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	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.	____ V ____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	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 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:



Table 3— Type test requirements for SPDs

Test sequence	Test description	Standard reference	External disconnectors connected	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	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	7.2.6.3 / 8.3.6.3	A	-	A	A	A	

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Table 3 – Type test requirements for SPDs (continued)

Additional tests for specific SPD designs								
Test sequence	Test description	Standard reference 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	-

A = applicable
 - = not applicable
 O = optional

^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

^b For these tests initial measurements of leakage currents according to Table 4, pass criterion E may be necessary.

^c For this test sequence more than one set of samples may be needed.



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_{OP} than 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	<p>No excessive leakage currents shall occur after the test.</p> <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 relevant test sequence.</p> <p>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.</p> <p>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.</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>
F	<p>External disconnectors as specified by the manufacturer shall not operate during the test and shall be in working order after the test.</p> <p>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.</p>
G	<p>Internal disconnectors as specified by the manufacturer shall not operate during the test and shall be in working order after the test.</p> <p>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.</p>
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	<p>If disconnection (internal or external) 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 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.</p> <p>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).</p> <p>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.</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</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).
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	<p>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.</p> <p>The residual current shall be monitored and not exceed the value measured at the beginning of the test by more than 10 %.</p>



Table 8 – Prospective short-circuit current and power factor

I_p (kA) ⁺³ / ₀ %	$\cos \varphi$ (⁰ / _{-0,05})
$I_p \leq 1,5$	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	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	7
1,5 to 6	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^a of Table 11), the test is not performed.



Table 14 – Pulling force (screwless terminals)

Cross-sectional area mm ²	0,5	0,75	1,0	1,25 1,6	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	$\leq 2\,000\text{ V}$	$\leq 4\,000\text{ V}$	$>4\,000\text{ V}$ up to 6 000 V	$>6\,000\text{ V}$ 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 disconnector 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 10 Creepage Distances for SPDs

r.m.s. voltage b, c V	Minimum creepage distances in millimetres										
	Printed wiring material		Pollution degree								
	Pollution degree		1			2			3		
	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 IIb	$100 \leq \text{CTI} < 175$
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
<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>		

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.

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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	$I_{imp(1)} = I_{imp(2)} = I_{imp(N)} = I_{Total(imp)} / N \quad 10 \%$ $Q_{(1)} = Q_{(2)} = Q_{(N)} = Q_{Total} / N \quad -10/+20 \%$ $W/R_{(1)} = W/R_{(2)} = W/R_{(N)} = W/R_{Total} / N^2 \quad -10/+45 \%$
Test class II	$I_{8/20(1)} = I_{8/20(2)} = I_{8/20(N)} = I_{Total(8/20)} / N \quad \pm 10\%$

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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.			

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Table B.3 – TOV test parameters for Japanese systems

Application	TOV test parameters			
	LV system faults	HV system faults		
SPDs connected to:	for $t_T \neq 120$ 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 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

^a The term "built-in components" means: **G**

- 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).

^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.

^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.

^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.

^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.

^f For temperature-rise tests according to 6.6.1.1, the temperature-rise limits shall be specified by the manufacturer of the SPD.

^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.



--- End of the report ---



ATTACHMENT

Oscillograms



Page 1 of 9

Report No.: 19031530H

Product: Surge protective devices
Type Designation: BSP2L10RPT;BSP2L10RPT-1;BSP2L10RFT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1

Annex 1: Voltage protection level test curve

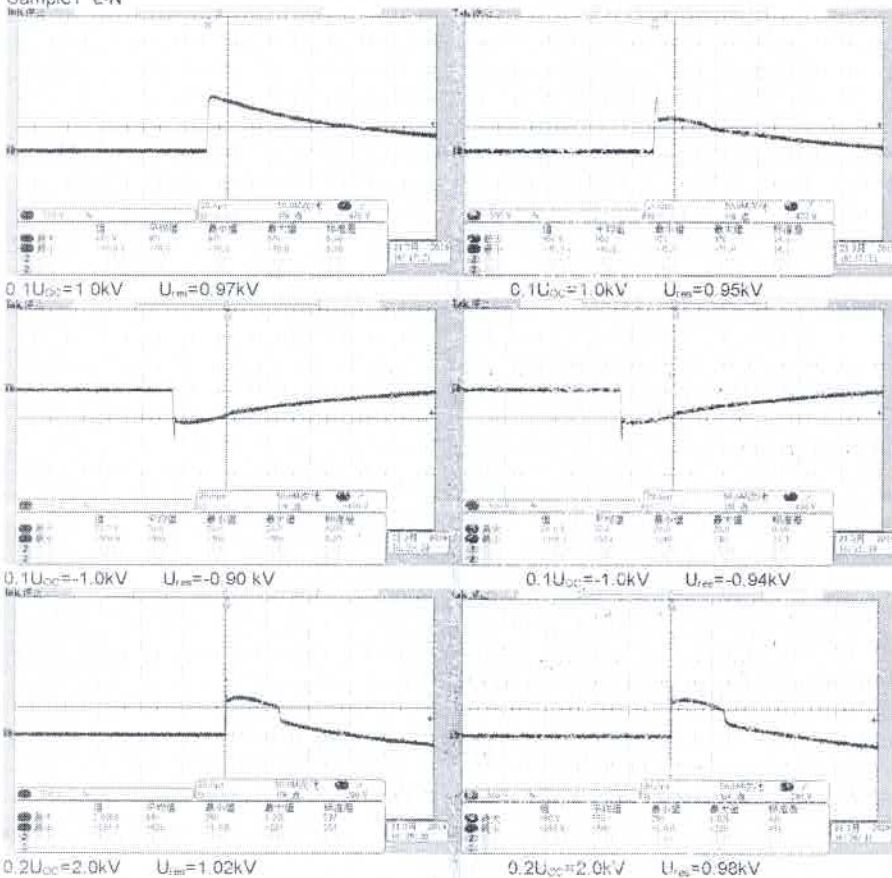
The test current is 0.1, 0.2, 0.5, 1.0 times I_{in} . If the SPD contains only voltage-limiting components, this test needs only to be performed at crest values of I_{in} for test class II or I_{in} for test class I, and one positive and negative polarity are applied to the SPD. The voltage of the combination wave generator is set to provide an open-circuit voltage of 0.1, 0.2, 0.5, 1.0 times the U_{oc} . If the SPD contains only voltage-limiting components, this test needs only to be performed at U_{oc} .

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BSP2L10RST $U_{oc}=10kV$, $U_p=1.3kV(L-N/PE)$, $2.0kV(N-PE)$

Sample1 L-N

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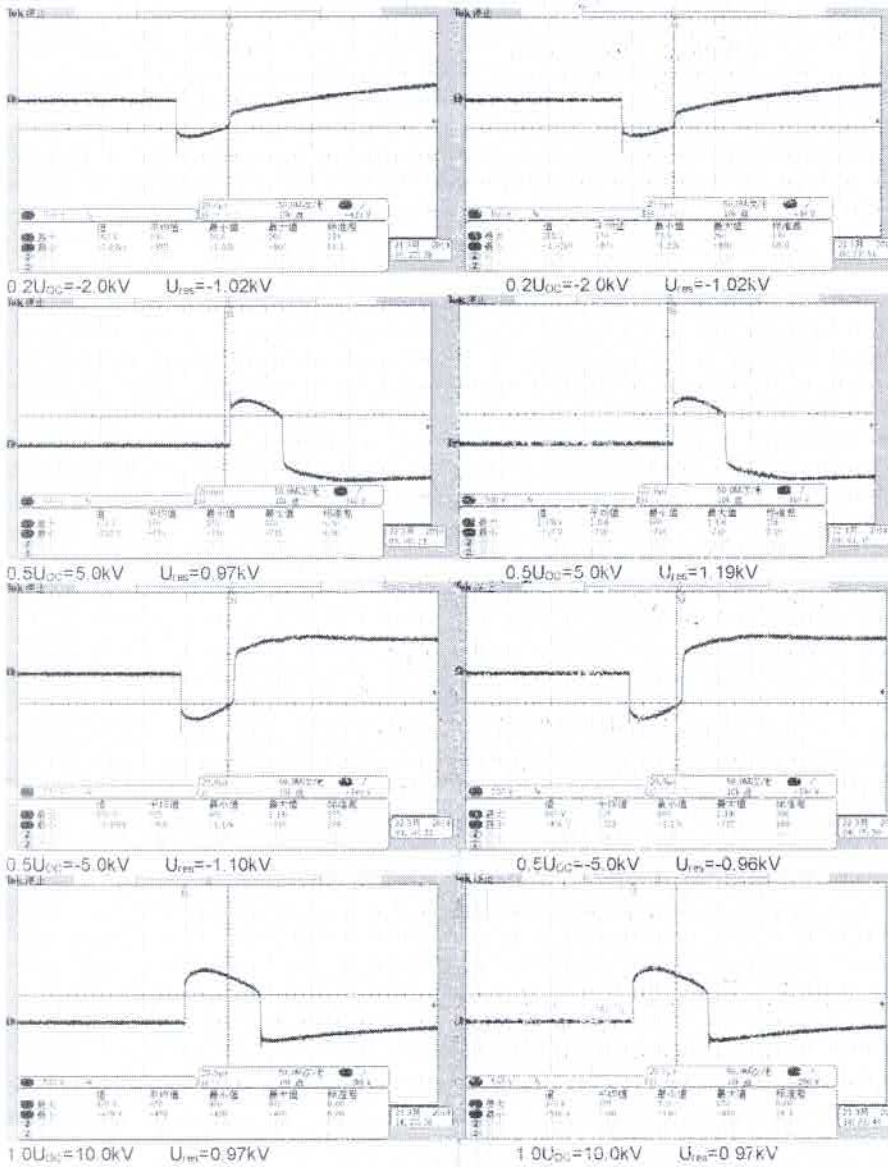
Oscillograms



Page 2 of 9

Report No.: 19031530H

Product: Surge protective devices
 Type Designation: BSP2L10RPT;BSP2L10RPT-1;BSP2L10RPT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1



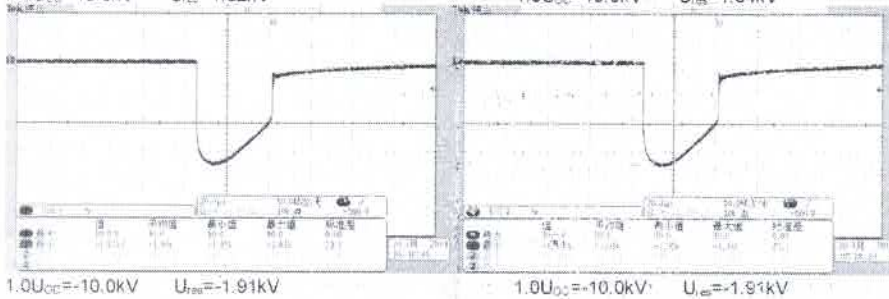
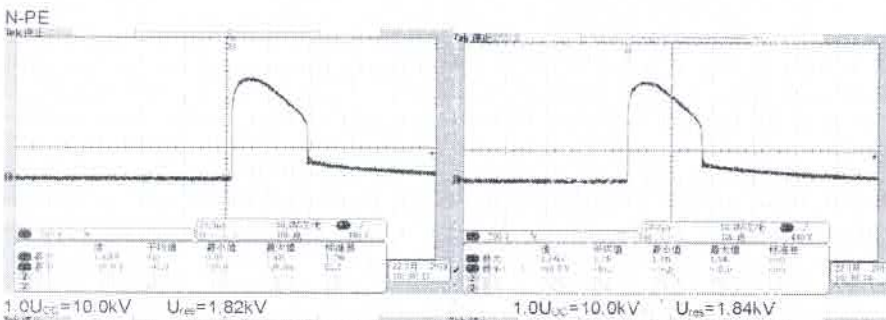
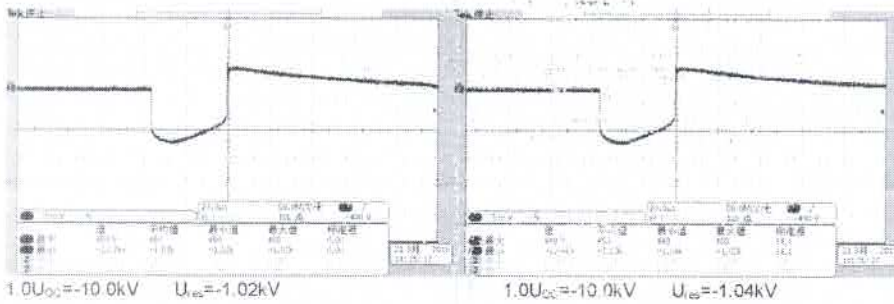
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ATTACHMENT

Oscillograms



Product: Surge protective devices
Type Designation: BSP2L10RPT;BSP2L10RPT-1;BSP2L10RPT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1



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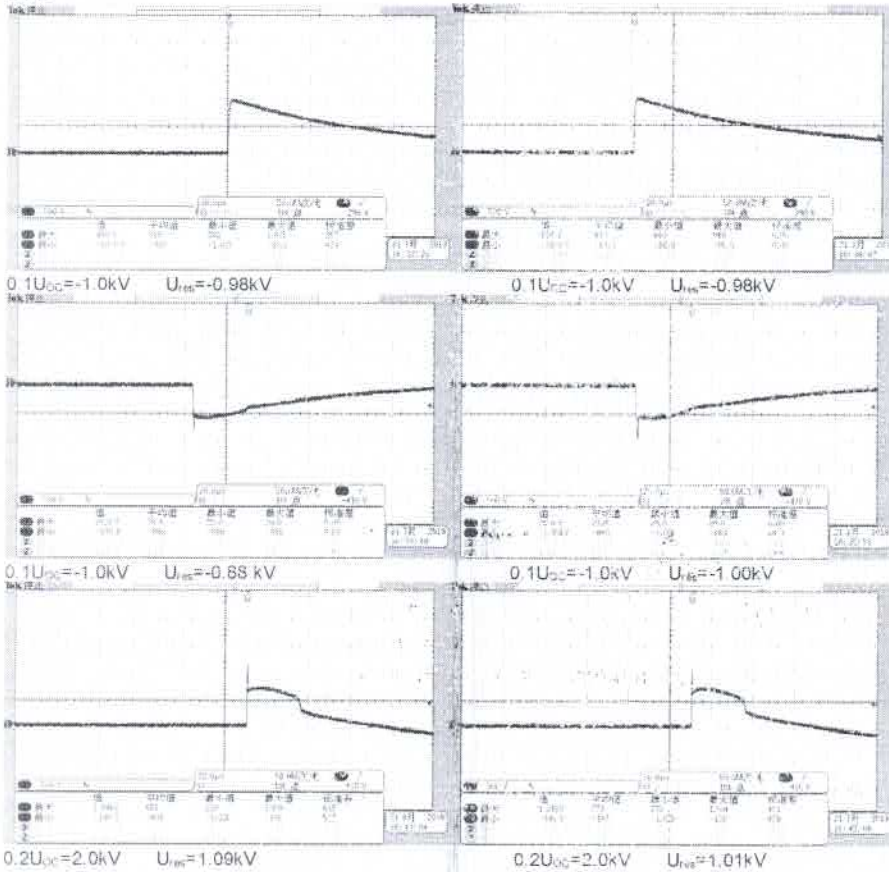
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Oscillograms



Product: Surge protective devices
 Type Designation: BSP2L10RPT;BSP2L10RPT-1;BSP2L1CRFT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1

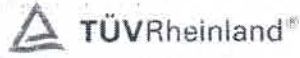
sample2
 L-PE



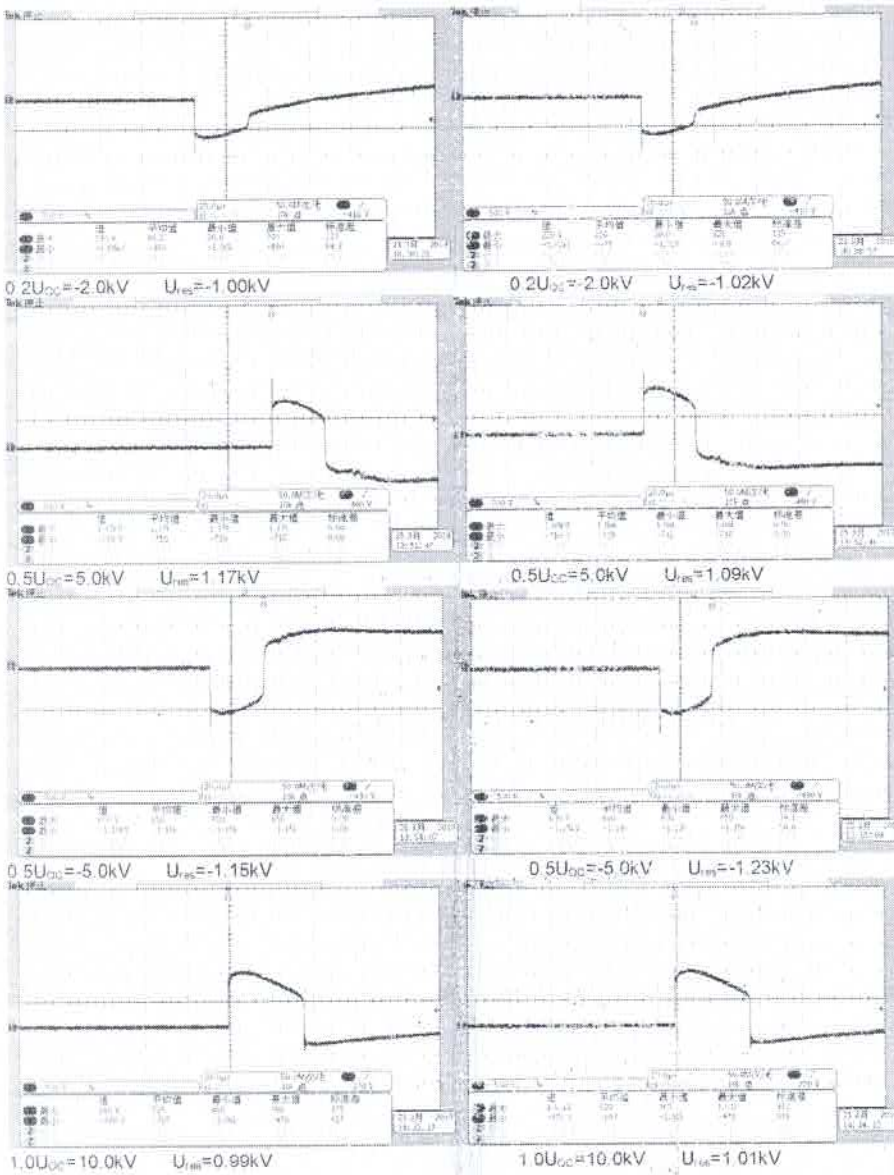
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Oscillograms



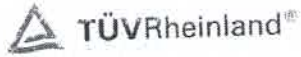
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Type Designation: BSP2L10RPT;BSP2L10RPT-1;BSP2L10RPT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1



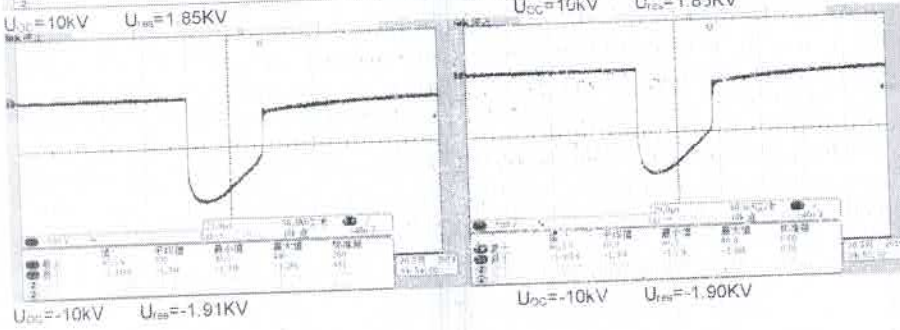
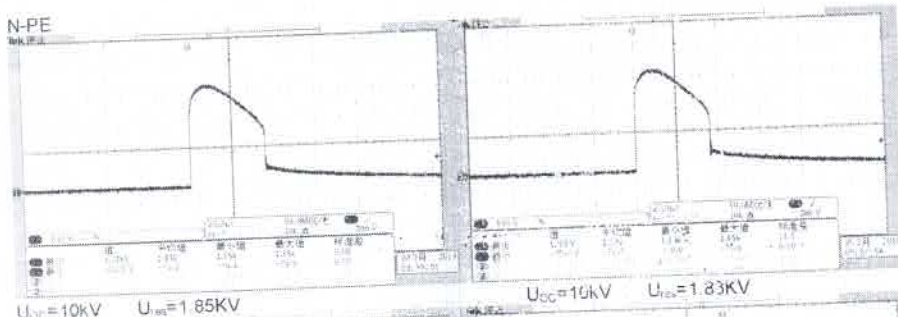
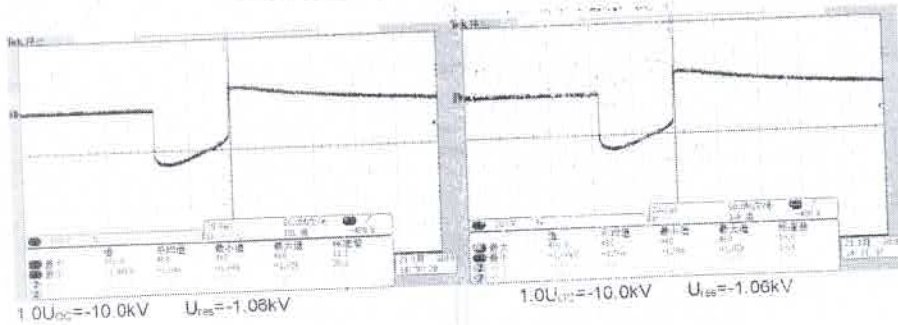
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Oscillograms



Product: Surge protective devices
Type Designation: BSP2L10RPT; BSP2L10RPT-1; BSP2L10RPT-C; BSP2L10RPT-F; C1; BSP2L10RST; BSP2L10RST-1



Sample 3
L-N

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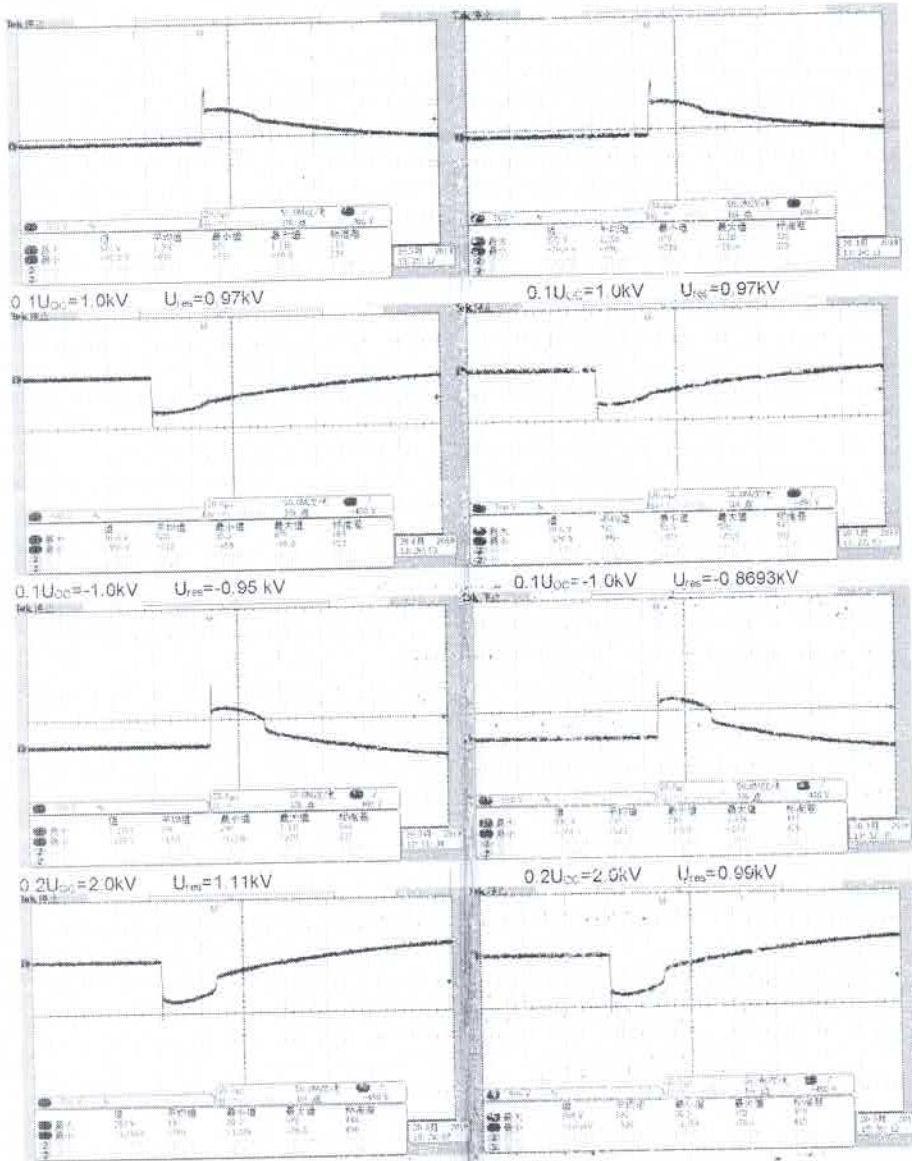
Oscillograms



Page 7 of 9

Report No.: 19031530H

Product: Surge protective devices
Type Designation: BSP2L10RPT;BSP2L10RPT-1;BSP2L10RPT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1



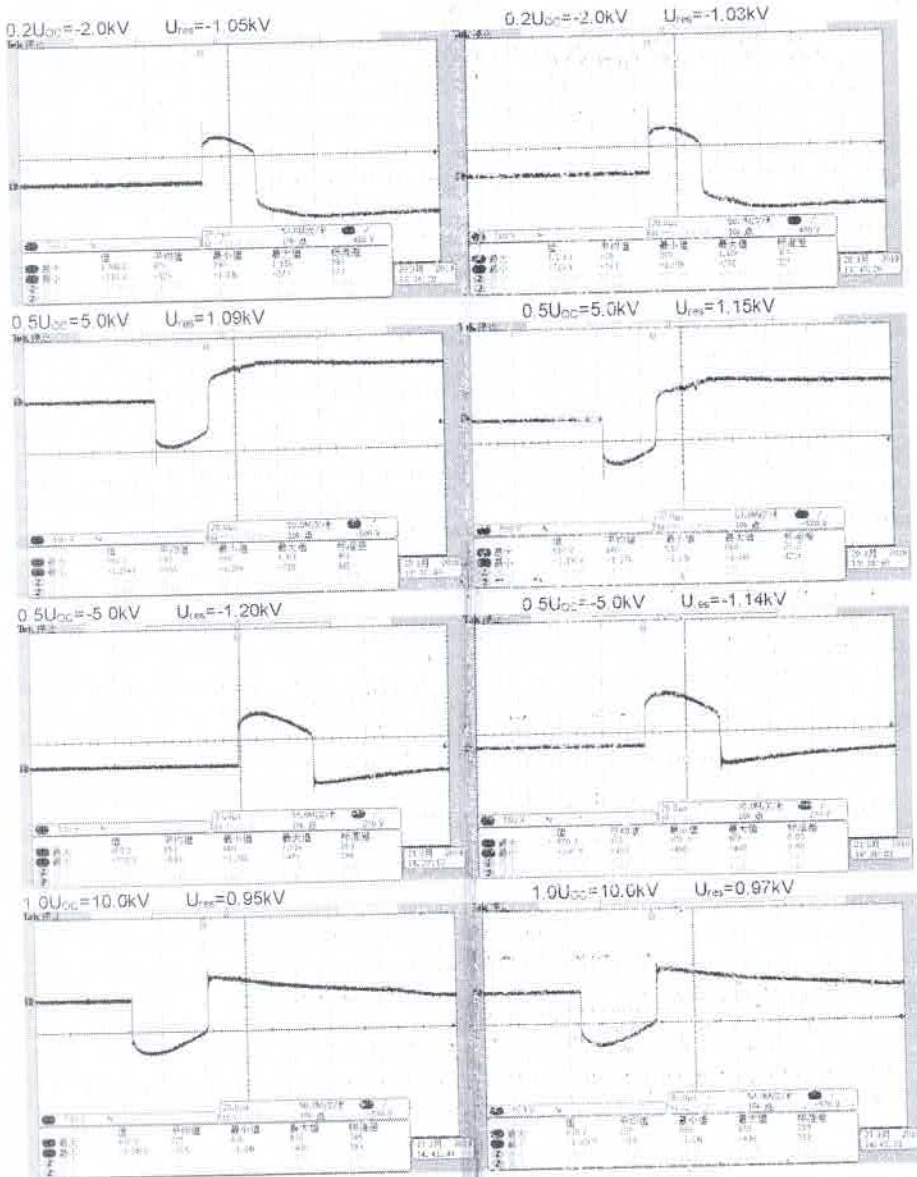
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Oscillograms



Product: Surge protective devices
 Type Designation: BSP2L10RPT; BSP2L10RPT-1; BSP2L10RPT-C; BSP2L10RPT-
 C1; BSP2L10RST; BSP2L10RST-1



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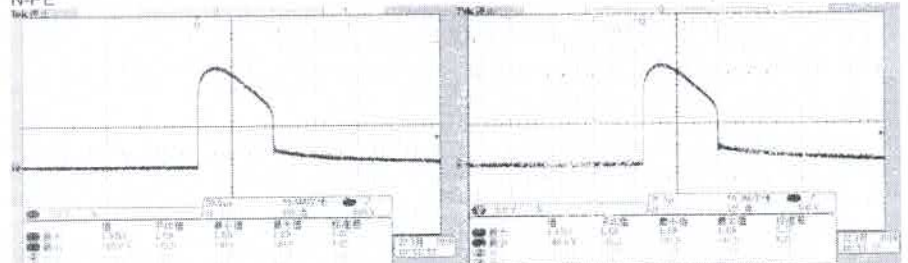
Oscillograms



Product: Surge protective devices
 Type Designation: BSP2L10RPT,BSP2L10RPT-1,BSP2L10RPT-C,BSP2L10RPT-C1;BSP2L10RST,BSP2L10RST-1

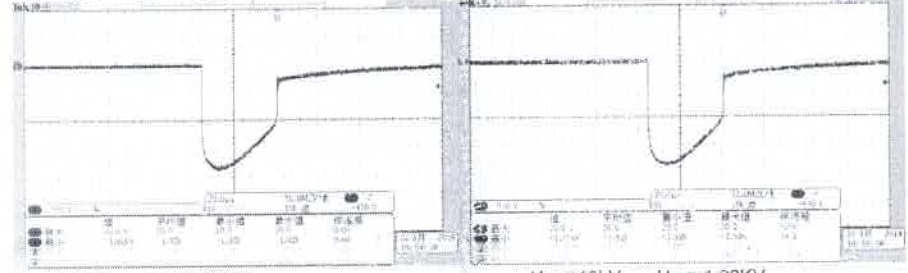
$1.0U_{OC} = -10.0kV$ $U_{res} = -1.04kV$

$1.0U_{OC} = -10.0kV$ $U_{res} = -1.02kV$



$U_{OC} = 10kV$ $U_{res} = 1.82kV$

$U_{OC} = 10kV$ $U_{res} = 1.82kV$



$U_{OC} = -10kV$ $U_{res} = -1.92kV$

$U_{OC} = -10kV$ $U_{res} = -1.90kV$

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Product:

Surge protective devices

Type Designation:

BSP2L10RPT;BSP2L10RPT-1;BSP2L10RPT-C;BSP2L10RPT-C1;BSP2L10RST;BSP2L10RST-1

Test Equipment list 1

Instrument Number	Instrument Name	Technical Parameters	Model Type	Last Cal. Date	Next Cal. Date
AG-11A	Test thrust force	5N	AG-11A	2018.07.12	2019.07.11
TW-201	Regulated voltage decoupling power supply	AC0-800V	/	/	2020.03.15
HKC070113	High-low temperature test chamber	/	KMH-408S	2018.11.14	2019.11.13
TI11102901	Proof tracking tester	/	AG5101B	2018.11.14	2019.11.13
I-33856	Vernier caliper	/	/	2018.08.21	2019.08.20
12022422	standard testing finger forelock probe	/	/	2018.11.21	2019.11.20
013660	Electronic balance	/	UTP313	2018.08.21	2019.08.20
I-34189	Vernier caliper	0~150) mm/0.02mm	/	2018.08.23	2019.08.22
AG-BC031206	Mechanical impact device	/	AG1100K	2018.11.14	2019.11.13
1303	Low voltage TOV tester	/	/	/	/
07A01-1	EMC surge tester	6kV/3kA	EMC pro	2018.12.03	2019.12.03
PT1-100	Probe	100:1 2500V	Tek P5100	/	/
C010276	Digital oscilloscope	500M	DPO4054B	2018.11.09	2019.11.08
PP3-100	Probe	100:1	PP1-100	2019.03.28	2020.03.28
01105	Thermal stability tester	0~10A	TTS2-10	2018.09.27	2019.09.26
SH0140611	Ball pressure tester	/	SH9104C	2018.07.06	2019.07.05
PK000363	Withstand voltage tester	/	5051A	2018.07.06	2019.07.05
1491723	Insulation Resistance Tester	/	3007A	2018.07.06	2019.07.05
111202	induction regulator	0V-650V	TSA-30	/	/
MY53218432	Digital multimeter	/	34461A	2018.08.18	2019.08.17
11340006	Digital multimeter	/	179	2019.03.28	2020.03.28
D062035466	Digital conductivity meter	/	DDS-11A	2018.08.21	2019.08.20
2007092801	Glow-wire testing instrument	/	AG5113B	2018.11.15	2019.11.14
DLFJ-01	Short-circuit additional test rig	1200V/20A 255V/300A	/	/	/
ZX-1302	Temperature and humidity instrument	/	VC230	2018.09.29	2019.09.28
ZX-1303	Temperature and humidity instrument	/	VC230	2018.09.29	2019.09.28
ZX-1801	Temperature and humidity instrument	/	VC230	2018.09.29	2019.09.28
ZX-1802	Temperature and humidity instrument	/	VC230	2018.09.29	2019.09.28
ZX-1803	Temperature and humidity instrument	/	VC230	2018.09.29	2019.09.28

(LPC
P)



Product: Surge protector devices
 Type Designation: BSP2L10RPT; BSP2L10RPT-C; BSP2L10RPT-C1; BSP2L10RST; BSP2L10RST-1

899050	Microscope		ZW-H2100	2018.10.19	2019.10.18
2300117254699	Needle push-pull dynamometer		NK-300	2018.09.09	2019.09.07
17060964883	illuminometer		TES1332A	2018.10.29	2019.10.28
01101	Combination wave generator	30kV/15kA	GT30PS	/	/
C024373	Digital oscilloscope	300M	DPO3034B	2018.07.06	2019.07.05
11540055	A digital power meter	/	FLUKE345	2019.03.28	2020.03.28
080807	Infrared thermometer	0~500°C	FLUKE561	2018.09.10	2019.09.09
37-6	38KW Load ark	/	/	/	/

Equipment list

Page 1 of 1

Test Equipment list 2
 (TÜV Rheinland (Shanghai) Co., Ltd.)

Old ID	Equip.	Description	Model	Manufacturer	Inte. (mon)	Due Date
T056	1811920	Barometer	DYM-3	Ningbo Temperature	12	14.06.2019
H013	1812096	Electron-stopwatch	J9-2II	Shanghai Stopwatch	12	06.01.2020
T1004	1811681	Data Logger	175H1	Testo	12	06.01.2020
L812	1811873	Steel Tape	20m	TAJIMA TOOLS	60	23.09.2019
Z328-3	1811836	Gas meter	G4	ACTARIS	12	27.03.2020
Z328-2	1811607	Pressure Gauge for Dust Test Unit	Y-06, -25mbar-0mbar	KOBOLD	12	06.01.2020
Z328	1811449	Dust Test Unit	ST1000-U	Weiss	12	06.01.2020
L267	1811575	IEC61032 Figure 4-Test probe D	P10.27	PTL Dr. Grabenhorst	36	06.01.2021

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IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.2	Residual current I_{PE}		
	This test is not performed on SPDs for connection N-PE only		P
	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	All modes of protection of the SPD shall be connected as for normal use according to the manufacturer's instructions. The line to PE voltage of the supply system shall be adjusted to the reference test voltage U_{REF} .		P N/A
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. In addition voltage switching type SPDs or combination type SPDs shall be able to interrupt any follow current up to the short-circuit current rating (I_{scrr}) The test setup shall comply with the circuit diagram given in Figure 7.		P
8.3.4.2.2	SPDs with follow current > 500A: The test sample shall be connected to a power frequency voltage at U_c with a prospective short-circuit current equal to the short circuit current rating I_{scrr} declared by the manufacturer and with a power factor in accordance with Table 8, except for SPDs which are only connected between neutral and protective earth in TT- and/or TN-systems, for which the prospective short-circuit current shall be at least 100A.	_____ kA $\cos \varphi =$ _____	N/A N/A
7.3.4/8.4.3	Verification of air clearances and creepage distances		
	The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16, whereby Table 16 shall be applied to items 1), 2) and 3) according to Table 15.	Single pvc cord, not applicable	N/A

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E061643_11B - ATTACHMENT

Clause	Requirement + Test	Result - Remark	Verdict
Creepage distances in millimetres			
	– r.m.s. voltage – Material group – Pollution	320 V(L-N,L/N-PE) <u>Ila</u> <u>2</u>	N/A N/A N/A
	1) Between live parts of different polarity 2) Between live parts and – 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)	___ / ___ ___ / ___ ___ / ___ ___ / ___ ___ / ___	N/A N/A N/A N/A N/A
	3) Between the metal parts of the disconnector mechanism and – bodies (note 1) – screws or other means for fastening the SPD	covered by dielectric test	N/A N/A
Printed wiring material			
	– r.m.s. voltage – Material group – Pollution	___ ___ ___ required / measured ___ / ___	N/A N/A N/A
	1) Between live parts of different polarity 2) Between live parts and – 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)	___ / ___ ___ / ___ ___ / ___ ___ / ___ covered by dielectric test	N/A N/A N/A N/A N/A
	3) Between the metal parts of the disconnector mechanism and – bodies (note 1) – screws or other means for fastening the SPD	___ / ___ ___ / ___	N/A N/A


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IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	NOTE 1 – 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 lines 1 are sufficient.		N/A
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 when e.g. a plug module is changed), linked by a coupling mechanism which can be mechanical, optical, audio, electromagnetic, etc. The part of the status indicator which is not replaced (e.g. base part of socket) shall be capable of operating at least 50 times.		P
	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.		P
8.3.3.1	Residual voltage with 8/20 current impulses	T3	
	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
	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. 0,1 times I_n 0,2 times I_n 0,5 times I_n 1,0 times I_n	I_n , 0,2 I_n , 0,5 I_n , 1,0 I_n 1,0 I_n	N/A
	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.		N/A



IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	One sequence of positive polarity and one sequence of negative polarity are applied to the SPD		N/A
	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 polarity that showed higher residual voltages in the previous tests.		N/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	Current and voltage oscillogram		N/A
	Crest values – discharge current versus residual voltage diagram to I_n or I_{imp}		N/A
	The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for: <ul style="list-style-type: none"> • class I: up to I_{imp} • class II: up to I_n 		N/A
	The value for determining U_{max} is the highest residual voltage measured at surge currents up to I_n , I_{max} or I_{imp} , as applicable depending on the SPD test class.		N/A
7.5.1.2	Overload behaviour		
	If an external maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to 1,6 times the rated current of that maximum overcurrent protection.		N/A
8.3.5.3	a) Test at the declared short-circuit current rating		
	The test is carried out twice with U_{REF} applied once at (45 ± 5) electrical degrees and once at (90 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
8.3.5.3.2	Additional test for SPD's failure mode simulation		
	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

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IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	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 $U_C^{+5/-0\%}$ 	1200V	P N/A
	For all types of SPDs with U_C up to 180V, the conditioning voltage may be reduced to 600V if for voltage switching type SPDs and for combination type SPDs, any voltage switching components operate at this voltage.		N/A
	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).	1A	P
	Following the application of the conditioning voltage equal to $U_{REF}^{+9/-5\%}$ 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 0,5s after interruption of the current by an internal or external disconnector.		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
	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.	300A	P

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IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>If all measurements of the test on the first set of samples (100A test set up):</p> <ul style="list-style-type: none"> either show a disconnection within 5s during the application of the conditioning voltage or the current through the sample during the application of U_{REF} after conditioning does not exceed a value of 1mA or the current through the sample during the application or U_{REF} after conditioning does not exceed the initial value determined at U_{REF} before the test by more than 20% <p>no further test is performed</p>		N/A
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		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 5 N, except the ones which are accessible when the SPD is fitted as in normal use.	IP65	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
	<p>Additional pass criteria except for:</p> <ul style="list-style-type: none"> short circuiting type SPDs SPDs where the current is interrupted or no significant current flows during the application of U_{REF}. <p>where no disconnection occurs.</p>		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A



IEC61643_11B - ATTACHMENT			
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>		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>		N/A
7.6.1.3	Vibration and shock (informative)		
	<p>Vibration and shock tests shall be performed according to</p> <ul style="list-style-type: none"> EN 60068-2-6 for sinusoidal vibration test EN 60068-2-64 for broadband-random vibration test EN 60068-2-27 for shock test 		N/A
ZB-2.2	Transportation		
	Usually SPDs within their packaging are subjected to mechanical stress due to transportation. This should be checked by a vibration and shock test in accordance with EN 60721-3-2		N/A
ZB.2.3	Special applications		
	<p>Special applications of SPDs may require additional vibration and shock tests, on the device itself.</p> <p>Typical values can be found in EN 60721-3-3 and can be as shown in Table ZB.1.</p>		N/A
	Furthermore other applications like railway may require different parameters that are given in corresponding standards or directly from application. For instance required parameters for railway vibration and shock tests are given in EN 61373.		N/A
	During the sinusoidal and random vibration tests (if requested), the sample should be powered under U_c with a short circuit capability of at least 5A.		N/A
ZB.3	Pass criteria		



IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_P \leq \text{---} \text{ V}$	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	$\text{---} \text{ kA} / \text{---} \text{ V}$	N/A
	according to 8.3.3.1, but only at I_n for test class II	$\text{---} \text{ kA} / \text{---} \text{ V}$	N/A
	according to 8.3.3.3, but only at U_{oc} for test class III	$\text{---} \text{ kA} / \text{---} \text{ V}$	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	$\text{---} \text{ kV}$	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) • 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	$U_{REF} = \text{---} \text{ V}$	N/A N/A 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.	$U_C = \text{---} \text{ V}$ test voltage $\text{---} \text{ V}$	N/A N/A

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IEC61043_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<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 	$U_c = \text{---} \text{ V}$ $I_{PE} = \text{---} \text{ mA}$	N/A N/A 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 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A



Tradução de: Laudo de testes

Nº: 210201-001



Laboratório de Testes
 Shenzhen Southern LCS Compliance Testing Laboratory Ltd.



Laudo nº: LCS180508046BS002

LAUDO DO TESTE IESNA LM-80-15

Método Aprovado: Medição de fluxo luminoso e manutenção de cor dos SMD-5050s, matrizes e módulos de LED

Cliente : SHENZHEN CRESCENT OPTOELECTRONIC CO.,LTD
Endereço : Building 12, Shiguan Industrial park, Goming Town, Gongming New Area,
 Shenzhen, China
Nome comercial : 
Laboratório de teste : Shenzhen Southern LCS Compliance Testing Laboratory Ltd.
Endereço : B Area, 2F, Building B, Zhongyu Green High-tech Industrial Park, Wenge Road,
 Heshuikou, Gongming Street, Guangming New District, Shenzhen, Guangdong,
 China
Descrição do produto : SMD-5050
Modelo : S01-E50Q
Classificação : IF:160mA, VF:18-36V
Data do teste : 14 de setembro de 2018 - 20 de abril de 2020
Data de emissão : 30 de setembro de 2020

Testado por:

[Assinatura]

Zero Huang/ Engenheiro de Projetos

Verificado por:

[Assinatura]

Ian Luo/ Diretor

Aprovado por:

[Carimbo e Assinatura]

Jesse Liu/ Gerente

Resumo do teste

Laudo de Testes Nº LM-80-2015

Shenzhen Southern LCS Compliance Testing Laboratory Ltd.
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Condição do teste de vida útil			Resumo dos resultados				
Condição de testagem	Corrente (mA)	Temperatura do invólucro (°C)	Duração do teste (h)	Manutenção média de lúmen (%)	Varição cromática máxima ($\Delta u'v'$)	Densidade de potência média (W/mm ²)	Densidade média de corrente (mA/mm ²)
1	160	55	14000	94,88%	0,0043	0,152	6,4
2	160	85	14000	94,45%	0,0046		
3	160	105	14000	93,84%	0,0048		

1. Número de fontes de luz em LED testadas

- 25 pacotes testados à temperatura real do invólucro de 54,3°C
- 25 pacotes testados à temperatura real do invólucro de 84,1°C
- 25 pacotes testados à temperatura real do invólucro de 104,6°C

2. Descrição das fontes de luz em LED

- Número da peça: .S01-E50Q
- Tipo da peça: SMD-5050
- IF = 160mA, CCT (Nominal) = 2700K-25000K

3. Descrição dos equipamentos auxiliares

- 1) Sistema EVERFINE LT-200A de teste acelerado de vida útil para LEDs
- 2) Esfera integradora de 0,5.
- 3) Sistema fotométrico, colorimétrico e elétrico SENSING SPR-3000 para fontes de luz

4. Tempo de operação

Os SMD-5050s são ativados por uma corrente contínua constante.

- Número de unidades : 25 a 55°C, 85°C e 105°C
- Corrente de ativação: 160mA
- Tensão típica: 18V-36V

5. Condições ambientes incluindo fluxo de ar, temperatura e umidade relativa

O fluxo de ar mínimo é mantido na câmara.

A temperatura ambiente ao redor dos SMD-5050s dentro da câmara é controlada pelo fluxo de ar e as leituras do termopar são monitoradas.

- Temperatura do invólucro: Controlada a -2°C
- Temperatura do ar na cercania: Controlada a -5°C
- Umidade relativa: < 65%RH



Tradução de: Laudo de testes

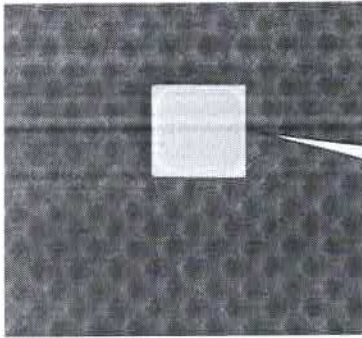


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 Shenzhen Southern LCS Compliance Testing Laboratory Ltd.



Laudo nº: LCS180508046BS002

6. Temperatura do invólucro (temperatura no ponto de teste)



Ts Measurement

7. Corrente de acionamento das fontes de luz de LED durante o teste de vida útil

Consulte as subcláusulas 9.1, 9.2 e 9.3

8. Fluxo luminoso inicial e tensão direta

Ver tabela

9. Dados de manutenção de lúmen para cada fonte de luz de LED individualmente

Ver tabela

Quantidade	Modelo	Número de série
25	S01-E50Q	A01-A25 (55°C)
25	S01-E50Q	B01-B25 (85°C)
25	S01-E50Q	C01-C25 (105°C)

Laudo de Testes Nº LM-80-2015

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Tradução de: Laudo de testes

Nº: 210201-001



Laboratório de Testes
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Laudo nº: LCS180508046BS002

9.1 Condição de testagem 1: 55°C, Corrente de acionamento: 160mA

Item	V _i (V)	Fluxo(lm)	Ra	T=55°C Manutenção de luminosidade (%)													
				No.	0 h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h	11000h	12000h
A01	23,71	652,1	67,8	100,30	100,01	99,75	99,39	99,05	98,77	98,28	98,00	97,60	97,09	96,55	96,14	95,52	94,98
A02	23,75	652,1	67,7	100,25	99,96	99,70	99,41	98,98	98,65	98,14	97,95	97,55	97,01	96,38	95,94	95,30	94,87
A03	23,70	651,9	68,3	100,18	99,91	99,69	99,35	99,09	98,69	98,29	97,96	97,69	97,06	96,45	95,92	95,40	94,96
A04	23,69	651,7	68,1	100,21	99,99	99,64	99,31	99,01	98,65	98,25	97,86	97,54	96,99	96,48	96,03	95,58	95,07
A05	23,75	652,0	68,4	100,07	99,96	99,62	99,39	99,07	98,57	98,55	97,94	97,59	97,05	96,52	96,08	95,43	94,87
A06	23,74	650,7	67,5	100,15	99,94	99,72	99,34	98,99	98,65	98,27	97,97	97,60	97,15	96,61	96,26	95,75	95,27
A07	23,68	651,9	68,0	100,25	100,02	99,76	99,42	99,04	98,71	98,39	97,90	97,68	97,03	96,48	95,93	95,37	94,83
A08	23,72	651,9	68,3	100,14	99,98	99,70	99,41	98,97	98,62	98,54	97,88	97,63	97,12	96,55	96,14	95,59	95,18
A09	23,74	651,7	67,6	100,41	100,22	99,88	99,45	98,96	98,59	98,47	97,94	97,59	97,03	96,40	95,94	95,31	94,87
A10	23,71	650,5	67,8	100,15	100,06	99,82	99,33	98,97	98,72	98,39	97,90	97,46	96,91	96,29	95,84	95,20	94,67
A11	23,70	651,9	68,3	100,24	100,01	99,76	99,39	98,91	98,63	98,25	97,95	97,44	96,81	96,26	95,73	95,20	94,75
A12	23,72	651,9	68,1	100,25	100,08	99,81	99,36	98,96	98,68	98,29	97,86	97,62	96,97	96,35	95,80	95,26	94,72
A13	23,74	652,0	67,9	100,13	100,06	99,79	99,41	98,88	98,59	98,17	97,88	97,47	96,92	96,36	95,91	95,30	94,78
A14	23,76	651,9	68,2	100,08	99,94	99,71	99,35	98,94	98,55	98,31	97,97	97,53	96,90	96,32	95,79	95,13	94,59
A15	23,73	652,1	67,6	100,20	100,06	99,82	99,39	98,87	98,69	98,14	97,86	97,46	96,82	96,19	95,65	95,07	94,65
A16	23,71	651,9	68,4	100,25	99,95	99,70	99,35	98,94	98,70	98,25	97,88	97,46	96,93	96,39	95,96	95,32	94,97
A17	23,74	652,0	68,5	100,33	100,06	99,79	99,41	98,86	98,66	98,15	97,93	97,63	97,09	96,67	96,23	95,72	95,17
A18	23,77	652,0	67,4	100,15	99,97	99,72	99,36	98,91	98,65	98,17	97,96	97,58	96,97	96,44	95,93	95,39	94,98
A19	23,73	651,8	68,3	100,28	100,00	99,75	99,38	98,97	98,72	98,28	97,90	97,56	96,90	96,35	95,79	95,16	94,70
A20	23,76	651,7	68,1	100,33	100,06	99,82	99,41	98,88	98,70	98,18	97,96	97,49	96,91	96,38	95,90	95,35	94,90
A21	23,71	651,8	67,6	100,07	99,99	99,78	99,35	98,93	98,56	98,18	97,88	97,51	96,87	96,22	95,68	95,04	94,51
A22	23,71	651,4	67,7	100,15	99,97	99,69	99,39	98,86	98,61	98,24	97,89	97,47	96,84	96,17	95,64	95,01	94,48
A23	23,74	651,5	68,6	100,23	100,04	99,81	99,37	98,92	98,72	98,40	97,93	97,62	97,10	96,56	96,14	95,62	95,07
A24	23,76	652,2	67,5	100,27	100,03	99,77	99,41	98,88	98,58	98,15	97,90	97,53	97,02	96,49	96,08	95,57	95,12
A25	23,74	651,6	68,4	100,33	100,04	99,76	99,41	98,83	98,67	98,39	97,91	97,56	97,03	96,48	96,05	95,51	94,98
Média	23,73	651,8	68,0	100,22	100,01	99,75	99,38	98,95	98,65	98,29	97,91	97,55	96,98	96,41	95,94	95,36	94,88
Mediana	23,73	651,9	68,1	100,23	100,01	99,76	99,39	98,94	98,65	98,27	97,91	97,56	96,99	96,40	95,93	95,35	94,87
Desvio Padrão	0,0239	0,3953	0,3803	0,0889	0,0638	0,0616	0,0334	0,0694	0,0582	0,1205	0,0401	0,0714	0,0965	0,1297	0,1744	0,2066	0,2108
Máx.	23,77	652,2	68,6	100,41	100,22	99,88	99,45	99,09	98,77	98,55	98,00	97,69	97,15	96,67	96,26	95,75	95,27
Mín.	23,68	650,5	67,4	100,07	99,91	99,62	99,31	98,83	98,55	98,14	97,86	97,44	96,81	96,17	95,64	95,01	94,48

Laudo de Testes Nº LM-80-2015

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Shenzhen Southern LCS Compliance Testing Laboratory Ltd.

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Tradução de: Laudo de testes



Laboratório de Testes
 Shenzhen Southern LCS Compliance Testing Laboratory Ltd.



Laudo nº: LCS180508046BS002

9.1.1 Condição de testagem 1: 55°C, Corrente de acionamento: 160mA

No.	T=55°C Variação cromática (Δu'v')																
	0 h			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h	11000h	12000h	13000h	14000h
	u'	v'	CCT(K)														
A01	0,2501	0,5260	2996	0,0002	0,0005	0,0008	0,0010	0,0014	0,0017	0,0020	0,0025	0,0028	0,0031	0,0033	0,0036	0,0039	0,0043
A02	0,2500	0,5258	2998	0,0005	0,0007	0,0009	0,0010	0,0014	0,0018	0,0021	0,0027	0,0030	0,0032	0,0034	0,0038	0,0040	0,0041
A03	0,2497	0,5263	2987	0,0003	0,0007	0,0011	0,0011	0,0015	0,0018	0,0022	0,0028	0,0034	0,0036	0,0038	0,0040	0,0041	0,0043
A04	0,2495	0,5262	2997	0,0004	0,0006	0,0009	0,0011	0,0014	0,0017	0,0021	0,0025	0,0028	0,0029	0,0032	0,0033	0,0037	0,0040
A05	0,2501	0,5258	2981	0,0003	0,0006	0,0009	0,0012	0,0011	0,0014	0,0019	0,0025	0,0030	0,0033	0,0037	0,0040	0,0043	0,0046
A06	0,2500	0,5258	2992	0,0003	0,0006	0,0011	0,0012	0,0014	0,0017	0,0022	0,0026	0,0027	0,0029	0,0032	0,0034	0,0038	0,0042
A07	0,2502	0,5260	2994	0,0005	0,0007	0,0009	0,0011	0,0015	0,0018	0,0020	0,0025	0,0029	0,0031	0,0035	0,0036	0,0040	0,0043
A08	0,2499	0,5258	2988	0,0002	0,0005	0,0007	0,0012	0,0017	0,0020	0,0024	0,0030	0,0031	0,0032	0,0035	0,0039	0,0041	0,0045
A09	0,2496	0,5263	2989	0,0003	0,0004	0,0006	0,0011	0,0015	0,0018	0,0020	0,0024	0,0028	0,0031	0,0033	0,0036	0,0039	0,0042
A10	0,2495	0,5262	2983	0,0005	0,0008	0,0009	0,0011	0,0014	0,0018	0,0019	0,0025	0,0028	0,0032	0,0036	0,0040	0,0041	0,0043
A11	0,2495	0,5264	2996	0,0001	0,0004	0,0007	0,0009	0,0013	0,0016	0,0023	0,0028	0,0032	0,0036	0,0039	0,0043	0,0045	0,0049
A12	0,2497	0,5263	2992	0,0003	0,0007	0,0009	0,0010	0,0014	0,0018	0,0022	0,0026	0,0028	0,0030	0,0033	0,0035	0,0037	0,0040
A13	0,2495	0,5259	2994	0,0003	0,0005	0,0007	0,0013	0,0017	0,0020	0,0023	0,0024	0,0026	0,0029	0,0031	0,0034	0,0037	0,0040
A14	0,2500	0,5265	2982	0,0003	0,0006	0,0009	0,0013	0,0015	0,0018	0,0020	0,0025	0,0029	0,0031	0,0033	0,0034	0,0038	0,0040
A15	0,2499	0,5262	2993	0,0002	0,0004	0,0007	0,0011	0,0014	0,0017	0,0022	0,0026	0,0030	0,0032	0,0033	0,0035	0,0037	0,0039
A16	0,2496	0,5260	2991	0,0002	0,0005	0,0008	0,0012	0,0016	0,0018	0,0022	0,0029	0,0033	0,0035	0,0037	0,0039	0,0040	0,0041
A17	0,2502	0,5265	2989	0,0004	0,0007	0,0010	0,0013	0,0016	0,0019	0,0024	0,0028	0,0031	0,0035	0,0038	0,0042	0,0044	0,0046
A18	0,2500	0,5262	2986	0,0004	0,0007	0,0010	0,0014	0,0018	0,0023	0,0024	0,0028	0,0030	0,0033	0,0035	0,0038	0,0042	0,0044
A19	0,2497	0,5259	2993	0,0001	0,0004	0,0006	0,0009	0,0012	0,0016	0,0019	0,0026	0,0031	0,0035	0,0039	0,0043	0,0046	0,0048
A20	0,2495	0,5263	2996	0,0003	0,0005	0,0009	0,0012	0,0015	0,0019	0,0022	0,0028	0,0033	0,0035	0,0036	0,0038	0,0042	0,0044
A21	0,2500	0,5264	2983	0,0002	0,0004	0,0008	0,0013	0,0014	0,0018	0,0020	0,0024	0,0029	0,0031	0,0033	0,0035	0,0037	0,0040
A22	0,2499	0,5260	2985	0,0004	0,0007	0,0009	0,0011	0,0014	0,0017	0,0023	0,0026	0,0030	0,0033	0,0036	0,0039	0,0041	0,0045
A23	0,2501	0,5258	2995	0,0002	0,0005	0,0009	0,0014	0,0017	0,0018	0,0022	0,0029	0,0035	0,0036	0,0039	0,0040	0,0043	0,0046
A24	0,2499	0,5264	2986	0,0003	0,0005	0,0006	0,0009	0,0015	0,0018	0,0024	0,0025	0,0030	0,0034	0,0038	0,0042	0,0043	0,0045
A25	0,2497	0,5263	2991	0,0003	0,0006	0,0008	0,0010	0,0016	0,0019	0,0025	0,0027	0,0033	0,0034	0,0037	0,0039	0,0043	0,0046
Média	0,2498	0,5261	2990	0,0003	0,0006	0,0008	0,0011	0,0015	0,0018	0,0022	0,0026	0,0030	0,0033	0,0035	0,0038	0,0041	0,0043
Mediana	0,2499	0,5262	2991	0,0003	0,0006	0,0009	0,0011	0,0015	0,0018	0,0022	0,0026	0,0030	0,0032	0,0035	0,0038	0,0041	0,0043
Desvio Padrão	0,0002	0,0002	5,0787	0,0001	0,0001	0,0001	0,0001	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0003	0,0003	0,0003
Máx.	0,2502	0,5265	2998	0,0005	0,0008	0,0011	0,0014	0,0018	0,0023	0,0025	0,0030	0,0035	0,0036	0,0039	0,0043	0,0046	0,0049
Mín.	0,2495	0,5258	2981	0,0001	0,0004	0,0006	0,0009	0,0011	0,0014	0,0019	0,0024	0,0026	0,0029	0,0031	0,0033	0,0037	0,0039

Laudo de Testes Nº LM-80-2015

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Shenzhen Southern LCS Compliance Testing Laboratory Ltd.

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Tradução de: Laudo de testes

Nº: 210201-001



Laboratório de Testes
 Shenzhen Southern LCS Compliance Testing Laboratory Ltd.



Laudo nº: LCS180508046BS002

9.2 Condição de testagem 2: 85°C, Corrente de acionamento: 160mA

Item	V _i (V)	Fluxo(lm)	Ra	T=85°C Manutenção de luminosidade (%)													
				No.	0 h			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
B01	23,72	651,5	67,7	100,05	99,80	99,42	99,08	98,71	98,22	97,68	97,46	97,00	96,49	96,05	95,64	95,12	94,58
B02	23,78	651,6	67,9	100,23	99,86	99,44	99,02	98,69	98,29	97,73	97,51	96,97	96,43	95,90	95,46	94,92	94,49
B03	23,71	651,4	67,9	100,15	99,84	99,42	99,04	98,68	98,23	97,72	97,48	96,97	96,34	95,83	95,30	94,88	94,44
B04	23,67	651,3	68,5	100,04	99,77	99,41	99,03	98,71	98,29	97,69	97,45	96,91	96,36	95,95	95,50	95,15	94,64
B05	23,76	651,6	68,9	100,00	99,79	99,43	98,97	98,67	98,12	97,76	97,49	96,88	96,34	95,91	95,47	94,92	94,36
B06	23,78	650,1	66,9	100,15	99,85	99,42	98,98	98,68	98,27	97,71	97,53	96,92	96,47	96,03	95,68	95,27	94,79
B07	23,68	651,3	68,9	100,12	99,87	99,41	99,02	98,67	98,23	97,67	97,42	96,89	96,24	95,79	95,24	94,78	94,24
B08	23,75	651,5	68,4	100,05	99,79	99,46	99,04	98,68	98,21	97,73	97,45	96,88	96,37	95,90	95,49	95,04	94,63
B09	23,72	651,3	67,2	100,04	99,80	99,40	99,00	98,69	98,10	97,64	97,49	96,96	96,40	95,87	95,41	94,88	94,44
B10	23,69	649,9	67,5	100,09	99,90	99,42	99,08	98,74	98,25	97,68	97,44	96,91	96,36	95,84	95,39	94,85	94,32
B11	23,71	651,3	68,9	100,05	99,79	99,36	99,01	98,67	98,19	97,73	97,45	96,83	96,20	95,75	95,22	94,79	94,34
B12	23,75	651,5	67,6	100,07	99,85	99,44	99,02	98,68	98,22	97,76	97,49	96,82	96,17	95,65	95,10	94,66	94,12
B13	23,75	651,5	68,3	99,97	99,78	99,41	98,97	98,69	98,13	97,72	97,54	96,95	96,40	95,94	95,49	94,98	94,46
B14	23,74	651,5	68,6	100,03	99,83	99,43	98,98	98,70	98,11	97,75	97,42	96,96	96,33	95,85	95,32	94,76	94,22
B15	23,75	651,5	67,3	100,04	99,87	99,42	98,96	98,61	98,12	97,77	97,44	96,90	96,26	95,73	95,19	94,71	94,29
B16	23,68	651,3	68,7	100,02	99,88	99,47	99,02	98,70	98,20	97,76	97,45	96,95	96,42	95,98	95,55	95,01	94,66
B17	23,70	651,6	68,6	100,05	99,86	99,46	99,01	98,66	98,23	97,71	97,48	96,91	96,37	96,05	95,61	95,20	94,65
B18	23,79	651,4	67,8	100,06	99,79	99,41	99,05	98,67	98,25	97,64	97,46	96,93	96,32	95,89	95,38	94,94	94,53
B19	23,74	651,4	67,8	100,09	99,80	99,39	99,07	98,65	98,16	97,68	97,49	96,95	96,29	95,84	95,28	94,75	94,29
B20	23,71	651,1	68,7	100,11	99,76	99,43	98,97	98,61	98,24	97,73	97,54	96,89	96,31	95,88	95,40	94,95	94,50
B21	23,70	651,3	67,9	100,07	99,81	99,42	99,06	98,59	98,12	97,74	97,42	96,91	96,27	95,72	95,18	94,64	94,11
B22	23,72	651,0	67,3	100,08	99,76	99,41	99,01	98,67	98,23	97,67	97,48	96,93	96,30	95,73	95,20	94,67	94,14
B23	23,72	650,9	68,4	100,06	99,74	99,39	99,02	98,60	98,29	97,72	97,46	96,97	96,45	96,01	95,59	95,17	94,62
B24	23,73	651,8	67,8	100,12	99,83	99,37	99,05	98,68	98,11	97,71	97,45	96,90	96,39	95,96	95,55	95,14	94,69
B25	23,73	651,0	68,5	100,07	99,91	99,50	99,04	98,74	99,20	98,88	97,68	96,97	96,44	95,99	95,56	95,12	94,59
Média	23,73	651,3	68,1	100,07	99,82	99,42	99,02	98,67	98,24	97,76	97,48	96,92	96,35	95,88	95,41	94,93	94,45
Mediana	23,72	651,4	67,9	100,06	99,81	99,42	99,02	98,68	98,22	97,72	97,46	96,92	96,36	95,89	95,41	94,92	94,46
Desvio Padrão	0,0321	0,4398	0,5902	0,0538	0,0463	0,0303	0,0350	0,0383	0,2091	0,2361	0,0542	0,0440	0,0821	0,1101	0,1622	0,1049	0,1944
Máx.	23,79	651,8	68,9	100,23	99,91	99,50	99,08	98,74	99,20	98,88	97,68	97,00	96,49	96,05	95,68	95,27	94,79
Mín.	23,67	649,9	66,9	99,97	99,74	99,36	98,96	98,59	98,10	97,64	97,42	96,82	96,17	95,65	95,10	94,64	94,11

Laudo de Testes Nº LM-80-2015

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Shenzhen Southern LCS Compliance Testing Laboratory Ltd.
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É a o que continha o documento original em inglês.
 Dou fé.

Curitiba, 02 de fevereiro de 2021.
 André Riekés Bruel — JUCEPAR nº 12/171-I



Tradução de: Laudo de testes

Nº: 210201-001



Laboratório de Testes
Shenzhen Southern LCS Compliance Testing Laboratory Ltd.



Laudo nº: LCS180508046BS002

9.2.1 Condição de testagem 2: 85°C, Corrente de acionamento: 160mA

No.	T=85°C Variação cromática (ΔuV)																
	0 h			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h	11000h	12000h	13000h	14000h
	u'	v'	CCT(K)														
B01	0,2503	0,5257	3008	0,0004	0,0008	0,0011	0,0014	0,0016	0,0021	0,0026	0,0029	0,0031	0,0034	0,0036	0,0039	0,0042	0,0046
B02	0,2495	0,5257	3008	0,0004	0,0006	0,0008	0,0011	0,0015	0,0019	0,0025	0,0030	0,0033	0,0035	0,0037	0,0041	0,0043	0,0044
B03	0,2498	0,5260	3002	0,0003	0,0005	0,0007	0,0011	0,0015	0,0019	0,0026	0,0030	0,0032	0,0034	0,0036	0,0038	0,0039	0,0041
B04	0,2493	0,5264	3008	0,0004	0,0008	0,0010	0,0014	0,0019	0,0022	0,0024	0,0028	0,0030	0,0031	0,0034	0,0035	0,0039	0,0042
B05	0,2498	0,5258	2997	0,0003	0,0006	0,0009	0,0015	0,0018	0,0024	0,0025	0,0029	0,0032	0,0035	0,0039	0,0042	0,0045	0,0048
B06	0,2497	0,5261	3005	0,0005	0,0009	0,0010	0,0014	0,0020	0,0024	0,0026	0,0031	0,0033	0,0035	0,0038	0,0040	0,0044	0,0048
B07	0,2504	0,5262	3009	0,0003	0,0007	0,0010	0,0012	0,0017	0,0021	0,0024	0,0030	0,0031	0,0033	0,0037	0,0038	0,0042	0,0045
B08	0,2500	0,5256	3000	0,0005	0,0009	0,0011	0,0013	0,0019	0,0021	0,0026	0,0029	0,0032	0,0033	0,0036	0,0040	0,0042	0,0046
B09	0,2493	0,5262	3007	0,0004	0,0008	0,0010	0,0014	0,0020	0,0024	0,0028	0,0033	0,0035	0,0038	0,0040	0,0043	0,0046	0,0049
B10	0,2494	0,5264	3004	0,0003	0,0007	0,0009	0,0015	0,0019	0,0022	0,0028	0,0034	0,0035	0,0039	0,0043	0,0047	0,0048	0,0050
B11	0,2498	0,5266	3007	0,0004	0,0006	0,0007	0,0010	0,0016	0,0021	0,0025	0,0029	0,0031	0,0035	0,0038	0,0042	0,0044	0,0048
B12	0,2497	0,5265	3003	0,0003	0,0007	0,0010	0,0014	0,0018	0,0021	0,0026	0,0030	0,0033	0,0035	0,0038	0,0040	0,0042	0,0045
B13	0,2493	0,5262	3010	0,0004	0,0006	0,0009	0,0015	0,0017	0,0022	0,0028	0,0032	0,0033	0,0036	0,0038	0,0041	0,0044	0,0047
B14	0,2504	0,5262	2996	0,0003	0,0007	0,0010	0,0014	0,0019	0,0024	0,0027	0,0031	0,0033	0,0035	0,0037	0,0038	0,0042	0,0044
B15	0,2496	0,5264	3003	0,0005	0,0008	0,0011	0,0016	0,0019	0,0023	0,0026	0,0032	0,0034	0,0036	0,0037	0,0039	0,0041	0,0043
B16	0,2498	0,5259	3006	0,0004	0,0006	0,0009	0,0015	0,0018	0,0023	0,0027	0,0030	0,0031	0,0033	0,0035	0,0037	0,0038	0,0039
B17	0,2500	0,5262	3002	0,0005	0,0008	0,0011	0,0012	0,0019	0,0022	0,0026	0,0030	0,0034	0,0038	0,0041	0,0045	0,0047	0,0049
B18	0,2503	0,5262	3002	0,0003	0,0006	0,0010	0,0014	0,0019	0,0022	0,0028	0,0032	0,0033	0,0036	0,0038	0,0041	0,0045	0,0047
B19	0,2499	0,5258	3011	0,0004	0,0006	0,0008	0,0013	0,0017	0,0023	0,0026	0,0031	0,0034	0,0038	0,0042	0,0046	0,0049	0,0051
B20	0,2498	0,5259	3016	0,0003	0,0007	0,0009	0,0012	0,0016	0,0021	0,0028	0,0033	0,0035	0,0037	0,0038	0,0040	0,0044	0,0046
B21	0,2504	0,5265	2997	0,0004	0,0008	0,0010	0,0013	0,0020	0,0025	0,0029	0,0030	0,0033	0,0035	0,0037	0,0039	0,0041	0,0044
B22	0,2497	0,5259	2997	0,0005	0,0009	0,0011	0,0014	0,0018	0,0023	0,0027	0,0030	0,0033	0,0036	0,0039	0,0042	0,0044	0,0048
B23	0,2501	0,5259	3009	0,0003	0,0005	0,0010	0,0015	0,0018	0,0023	0,0026	0,0030	0,0033	0,0034	0,0037	0,0038	0,0041	0,0044
B24	0,2501	0,5267	3002	0,0005	0,0007	0,0010	0,0013	0,0020	0,0024	0,0028	0,0031	0,0032	0,0036	0,0040	0,0044	0,0045	0,0047
B25	0,2496	0,5261	3001	0,0003	0,0008	0,0009	0,0014	0,0017	0,0023	0,0027	0,0030	0,0032	0,0033	0,0036	0,0038	0,0042	0,0045
Média	0,2498	0,5261	3004	0,0004	0,0007	0,0010	0,0013	0,0018	0,0022	0,0026	0,0031	0,0033	0,0035	0,0038	0,0041	0,0043	0,0046
Mediana	0,2498	0,5262	3004	0,0004	0,0007	0,0010	0,0014	0,0018	0,0022	0,0026	0,0030	0,0033	0,0035	0,0038	0,0040	0,0043	0,0046
Desvio Padrão	0,0003	0,0003	5,0000	0,0001	0,0001	0,0001	0,0001	0,0002	0,0002	0,0001	0,0001	0,0001	0,0002	0,0002	0,0003	0,0003	0,0003
Máx.	0,2504	0,5267	3016	0,0005	0,0009	0,0011	0,0016	0,0020	0,0025	0,0029	0,0034	0,0035	0,0039	0,0043	0,0047	0,0049	0,0051
Mín.	0,2493	0,5256	2996	0,0003	0,0005	0,0007	0,0010	0,0015	0,0019	0,0024	0,0028	0,0030	0,0031	0,0034	0,0035	0,0038	0,0039

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Shenzhen Southern LCS Compliance Testing Laboratory Ltd.

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Tradução de: Laudo de testes

Nº: 210201-001



Laboratório de Testes
 Shenzhen Southern LCS Compliance Testing Laboratory Ltd.



9.3 Condição de testagem 3: 105°C, Corrente de acionamento: 160mA

Laudo nº: LCS180508046BS002

Item	Vr(V)	Fluxo(lm)	Ra	T=105°C Manutenção de luminosidade (%)														
				No.	0 h			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h	11000h
C01	23,74	650,9	67,5		99,93	99,64	99,26	98,87	98,27	97,94	97,42	96,84	96,65	96,22	95,68	95,17	94,65	94,11
C02	23,79	651,0	67,6		99,97	99,73	99,27	98,92	98,26	97,99	97,42	96,86	96,48	96,02	95,39	94,85	94,31	93,88
C03	23,73	650,8	68,2		100,01	99,72	99,20	98,90	98,21	97,92	97,41	96,78	96,37	95,82	95,21	94,50	94,16	93,72
C04	23,69	650,9	68,6		99,92	99,60	99,21	98,91	98,21	97,97	97,44	96,85	96,51	96,04	95,53	94,98	94,63	94,12
C05	23,77	651,1	69,3		99,94	99,67	99,23	98,87	98,22	97,95	97,32	96,80	96,53	96,07	95,54	95,00	94,45	93,89
C06	23,77	649,6	66,4		99,91	99,61	99,27	98,89	98,18	98,01	97,36	96,82	96,45	96,08	95,54	95,09	94,68	94,20
C07	23,71	650,7	69,5		100,01	99,69	99,26	98,88	98,17	97,99	97,33	96,86	96,48	95,91	95,36	94,71	94,25	93,71
C08	23,76	650,9	68,7		99,96	99,70	99,30	98,87	98,16	97,99	97,34	96,83	96,37	95,94	95,37	94,86	94,41	94,00
C09	23,73	650,7	67,7		100,00	99,73	99,28	98,92	99,14	97,97	97,39	96,84	96,44	95,96	95,33	94,77	94,24	93,80
C10	23,71	649,4	66,9		100,01	99,69	99,30	98,88	98,18	97,93	97,37	96,81	96,28	95,81	95,19	94,64	94,10	93,57
C11	23,72	650,7	69,2		99,92	99,62	99,32	98,91	99,14	97,89	97,35	96,78	96,43	95,88	95,33	94,70	94,27	93,82
C12	23,77	651,1	67,7		99,99	99,67	99,31	98,90	98,19	97,92	97,43	96,76	96,52	95,95	95,33	94,68	94,24	93,70
C13	23,76	651,1	67,9		99,91	99,74	99,25	98,89	98,15	97,94	97,46	96,80	96,38	95,91	95,35	94,80	94,29	93,77
C14	23,75	650,9	68,3		99,09	99,68	99,33	98,87	98,22	97,92	97,35	96,81	96,28	95,73	95,15	94,52	93,96	93,42
C15	23,74	651,0	67,9		100,01	99,65	99,29	98,86	99,11	97,90	97,34	96,79	96,45	95,89	95,26	94,62	94,14	93,72
C16	23,70	650,8	68,2		100,06	99,74	99,31	98,91	98,20	97,97	97,37	96,87	96,37	95,92	95,38	94,85	94,31	93,96
C17	23,73	651,2	69,0		99,98	99,76	99,23	98,93	98,25	97,94	97,42	96,83	96,47	96,01	95,59	95,05	94,64	94,09
C18	23,80	650,8	68,4		99,93	99,60	99,32	98,86	98,21	97,95	97,37	96,81	96,48	95,95	95,42	94,81	94,37	93,96
C19	23,76	650,9	68,1		99,90	99,58	99,24	98,87	98,22	97,98	97,34	96,85	96,54	95,96	95,41	94,75	94,22	93,76
C20	23,72	650,7	68,3		99,91	99,61	99,26	98,86	98,17	97,90	97,40	96,87	96,50	96,00	95,47	94,89	94,44	93,99
C21	23,72	650,6	67,7		99,97	99,73	99,31	98,84	98,20	97,92	97,37	96,83	96,45	95,89	95,24	94,60	94,06	93,53
C22	23,73	650,6	67,6		100,01	99,62	99,24	98,91	98,22	97,93	97,40	96,88	96,29	95,74	95,07	94,44	93,91	93,38
C23	23,74	650,3	68,5		99,98	99,67	99,26	98,89	98,24	97,97	97,45	96,87	96,33	95,89	95,35	94,83	94,41	93,86
C24	23,75	651,4	67,7		99,93	99,70	99,30	98,87	98,25	97,91	97,34	96,80	96,38	95,95	95,42	94,91	94,50	94,05
C25	23,75	650,6	68,6		99,98	99,74	99,25	98,81	99,24	97,99	97,35	96,82	96,35	95,90	95,35	94,82	94,38	93,85
Media	23,74	650,7	68,1		99,96	99,68	99,27	98,88	98,36	7,95	97,39	96,82	96,44	95,94	95,37	94,80	94,32	93,84
Mediana	23,74	650,8	68,2		99,97	99,68	99,27	98,88	98,22	97,94	97,37	96,83	96,45	95,94	95,36	94,81	94,31	93,85
Desvio Padrão	0,0272	0,4278	0,7217		0,0451	0,0539	0,0361	0,0277	0,3569	0,0337	0,0408	0,0325	0,0903	0,1063	0,1409	0,1798	0,2068	0,2145
Máx.	23,80	651,4	69,5		100,06	99,76	99,33	98,93	99,24	98,01	97,46	96,88	96,65	96,22	95,68	95,17	94,68	94,20
Mín.	23,69	649,4	66,4		99,89	99,58	99,20	98,81	98,15	97,89	97,32	96,76	96,28	95,73	95,07	94,44	93,91	93,38

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