NoiseKen

Lightning Surge Simulator LSS-F03 series

Compliant with IEC61000-4-5 Edition 3 requirements

www.noiseken.com

Lightning Surge Simulator

LSS-F03 series

Feature

- Lightning surge simulator compliant with the IEC61000-4-5 Edition 3 requirements
- Maximum output voltage 15kV (maximum coupling of 15kV to AD/DC CDN and 6kV to Telecom CDN)
  Enable to conduct the more extended reliability test including the destructive test
- Large size LCD for the operation is adopted for realizing better visibility and operatability
- Easy operation for the sequential tests with adoption of MPU control Surge output / Waveform switching / Polarity switching / Sequence can be automated sequentially
- Selectable either MANUAL or PROGRAM mode MANUAL mode is used for the test according to the Standard or performing single conditioned test and PROGRAM mode can perform different conditioned tests sequentially so that the tests can be performed easily along purposes.
- Excellent safety with equipment of interlock
- Standard equipment of terminal for checking the waveforms
  Enable to check the waveforms in connection to an oscilloscope on hand with BNC cable
- Isolation transformers in line-up (Option)
- In order to avoid resonance with the power supply, possible to vary the constant of the decoupling network (1.5, 1.3, 1.0, 0.8mH)(Customized production). When some products like a power conditioner for photovoltaic application are connected to a lightning surge simulator, the resonant phenomena may be happened and the products may not work well. In LSS-F03 series (with customization), possible to change constants of the inductances so as to avoid such trouble.

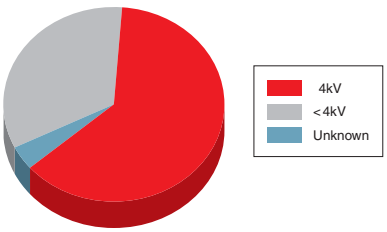
Unit to switch constant of the inductance

"Output voltage 15kV, current 7500A"
which can conduct breakdown resistibility test

Approx. 60% of the users are carrying on the test with voltage more than IEC Standard.

Requirement in IEC Standard < To keep up with quality in the market

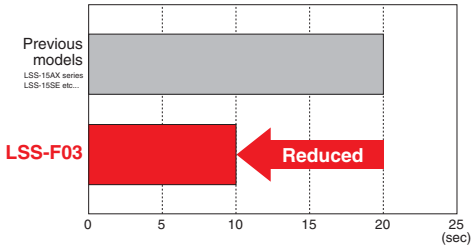
Test voltage of lightning surge immunity test



Quoted from the market investigation by NoiseKen on 2010

"50% reduction of the output interval"
which can drastically reduce the test time

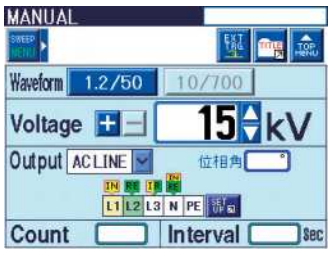
Realize 1/2 of the interval time comparing to our previous models so as to contribute to reduction of the man-hour for the test.
(* in case of the test less than 6kV output)

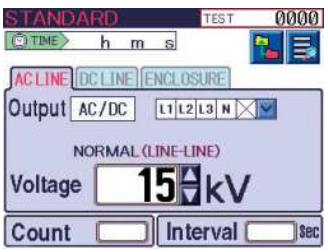


Repetition cycle

"Touch-panel"
adopted for the easy test setting

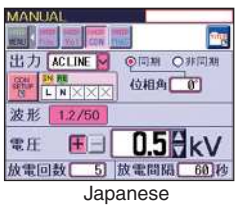
Adopt LCD touch panel for pursuing high visibility and realizing user-friendly operation with affluent icons.
Also, easy operation is realized not only for the test according to IEC Standard but also for the sequential tests with the parameter sweep function.



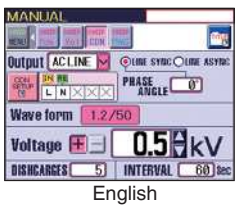


"Multi-languages"
for the easy operation processing available

Not only Japanese and English but also Chinese and Korean available for the easy operation processing.



Japanese



English

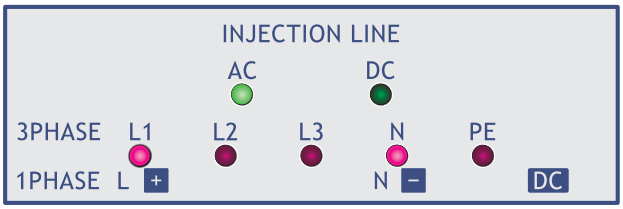
Chinese

Korean

"Indicator"

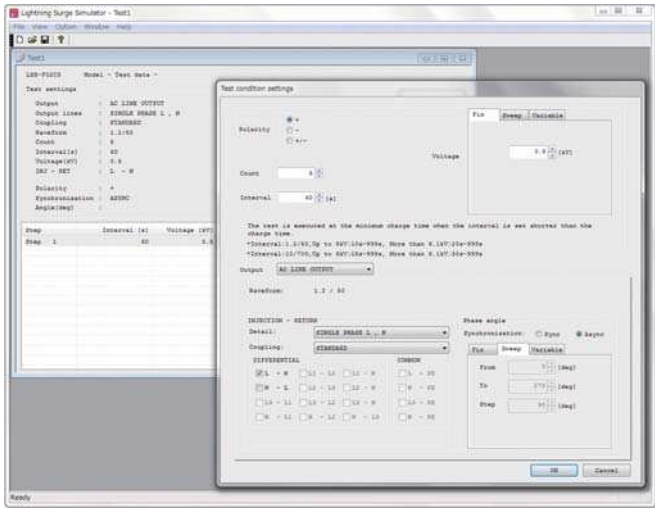
which is linked with the test setting equipped

Indicators which visualize the cables connections in the test equipped.



PC control available with the optional software

Enable to control from external Windows® PC. Also, enable to put the report of the test result in record out.

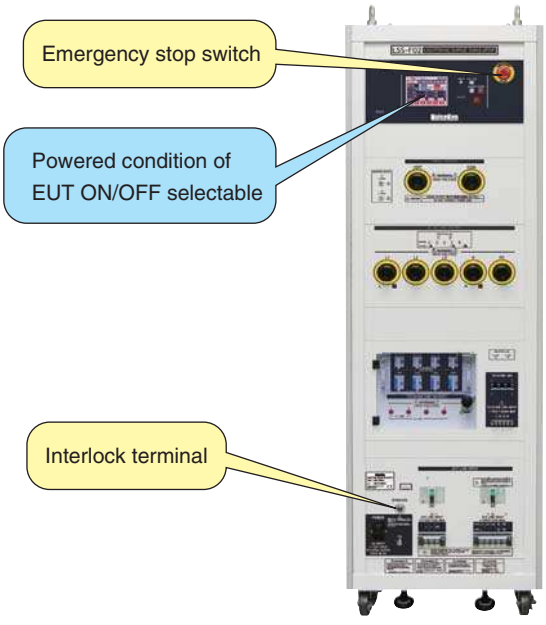


"Emergency stop" & "Interlock terminal"

which secure the test operator equipped.

Emergency stop function which takes safety of the test operator into the account equipped both in the main body and the software. Also, the interlock setting and output voltage control function equipped.

If the protective safety fence and protective safety box are adopted as the options, more safety test can be realized.

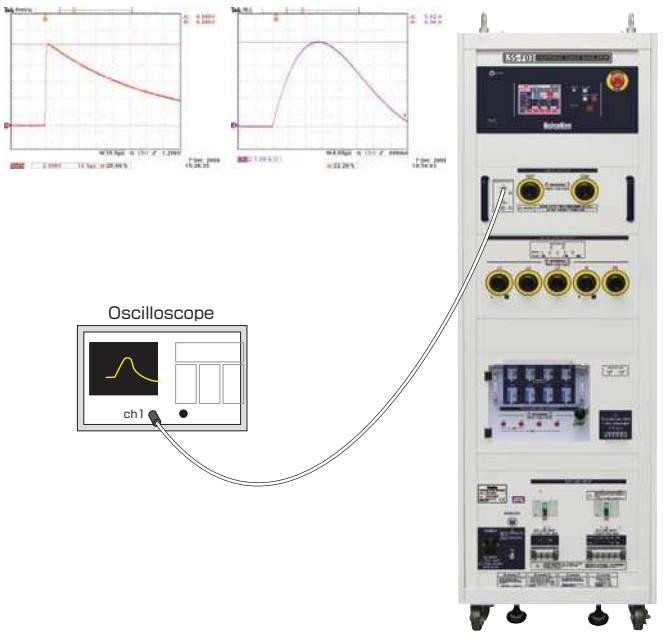


"Output waveform monitor terminal"

which can ease pre-checking of the waveforms prior to the actual test

In order to respond to the request "The simple waveform checking is desired before the test", equip the monitor terminal.

* The terminal is just for the simple checking.
If the accurate measurement is required, the specialized equipments are necessary.
Please contact us for the more details.



How to understand the model numbers

LSS-F03-□□
- 1 : Model for single phase EUT L/N/PE
- 3 : Model for 3-phase EUT L1/L2/L3/N/PE(Available both for single phase & 3-phase)
- A : 1.2/50μs-8/20μs (Totally 1 kind surge generates)
- C : 1.2/50μs-8/20μs、10/700μs-5/320μs (Totally 2 kinds)

Specification

Parameter	Specification		Note
Surge generating unit			
1.2/50μs-8/20μs Combination waveforms	Output voltage	0.5kV ~ 15kV ±10%	
	Front time	1.2μs ±30%	Common for the all models
	Duration	50μs ±20%	Voltage step : 0.1kV step
	Output current	250A ~ 7500A ±10%	The setting can be from 0kV
	Front time	8μs ±20%	
	Duration	20μs ±20%	
10/700μs-5/320μs Combination waveforms	Output voltage	0.5kV ~ 15kV ±10%	
	Front time	10μs ±30%	Models : C1/C3
	Duration	700μs ±20%	Voltage step : 0.1kV step
	Output current	12.5A ~ 375A ±10%	The setting can be from 0kV
	Front time	5μs ±20%	
	Duration	320μs ±20%	
Output polarity	Positive / Negative		
Interval	10 sec.~989 sec., depending on the set voltage 10 sec. (< 6kV)		15 sec.~ in 10/700μs waveform
Output impedance	2Ω ±10%		1.2/50μs waveform
	40Ω ±10%		10/700μs waveform
AC/DC CDN			
Coupling surge waveform	1.2/50μs-8/20μs combination waveforms		
Max. coupling surge voltage / current	Up to the values which can be set		
Coupling network	18μF	Between LINE - LINE (10Ω +9μF selectable)	
Correspondent to IEC61000-4-5	10Ω ±9μF	Between LINE - PE (18μF selectable)	
Injection mode	Between LINE - LINE, Between LINE - PE		
Power supply lines structure for EUT	Single phase AC	: L/N/PE	Model : A1 / C1
	DC	: +/-/PE	
	3-phase AC	: L1/L2/L3/N/PE (Common for single phase and 3-phase)	Model : A3 / C3
	DC	: +/-/PE	
EUT power capacity	AC240V/20A MAX 50/60Hz DC125V/20A MAX		Model : A1 / C1
	AC500V/50A MAX 50/60Hz DC125V/50A MAX		Model : A3 / C3
Decoupling coil	1.5mH		
Phase angle control	0 ~ 360° ±10°		
CDN for Telecom lines (Only in model C1 and C3)			
Coupling surge waveform	1.2/50μs-8/20μs combination waveforms		
	10/700μs-5/320μs combination waveforms		
Max. coupling surge voltage / current	6kV(Waveform specifications can be met up to 2kV for 1.2/50uS waveform and up to 4kV for 10/700 waveform)		
Impedance matching resistors	40Ω	80Ω per 1 line at 2 lines	1.2/50 μs waveform
		160Ω per 1 line at 4 lines	
	25Ω per line		10/700 μs waveform
Coupling mode	Common mode		
Coupling network	Gas arrestor : 90V		
Line for EUT	2 lines / 4 lines DC50V/100mA MAX		Selectable
Decoupling coil	20mH		
Others			
Voltage monitor	BNC output, 1/2000±10%		In open-circuit for SURGE OUT
Current monitor	BNC output, 1mV/A±10%		In short-circuit for SURGE OUT
External communication	RS-232C optical communication		
Power supply	AC100V ~ AC240V ±10%50Hz / 60Hz		
Dimension	W555×H1450×D790 mm(A1/A3), W555×H1800×D790 mm(C1/C3)		Projection excluded (in all models)
Mass	A1:Approx.290kg A3:Approx.300kg C1:Approx.325kg C3:Approx.340kg		

Standard accessory

Item	Specification / Function	Q'ty	Correspondent model
Surge output cable	HOT / COM	2 pcs.	Common
Output cable to power supply lines	For single phase : L / N / PE	3 pcs.	A1 / C1
	For 3-phase : L1 / L2 / L3 / N / PE	5 pcs.	A3 / C3
Output cable to telecom lines	For 1~4 lines and GND	5 pcs.	C1 / C3
Arrestor unit	For coupling : Equipped to main unit panel	4 pcs.	C1 / C3
	For input protection : Equipped to main unit panel	4 pcs.	
Cable for monitor	BNC-BNC cable	1 pc.	Common
External interlock connector	5P plug (Short between #1 - #3)	1 pc.	Common
Power supply cable	For AC100V, 3P equipped with G connector cable	1 pc.	Common
High voltage connector cap	Equipped to main unit panel	5 pcs.	A1 / C1
		7 pcs.	A3 / C3
FG cable	For grounding the body	1 pc.	Common
Instruction manual	-	1 volume	Common

- These products use parts containing mercury. Please comply with lows or regulation in countries or states the products are used for the disposal.
- Certain periodical inspection shall be recommended since consumable parts are contained in the products.
  In the test to 3-phase 5 lines (with PE) power supply lines, a message which alert the inspection per around 200 sets (in the test to single phase (with PE) power supply lines, it is done per around 800 sets).
  (1 set in this case means that the test shall be done with 2 levels (eg. 0.5kV and 1kV) for the test series according to IEC61000-4-5)

* Exchange timing of the parts may differed depending on the operative conditions and environment. Please contact us for the more details.

Option

High-speed communication lines CDN for LSS-F03 series

Defined in the IEC 61000-4-5 , this CDN product is used to apply surges to unshielded symmetrical interconnection lines with speed up to 1000Mbit/s. Conversion cables (05-00147A) are required for the CDN connection to the LSS-F03 simulator.

Parameter	F-130814-1004-2	F-130814-1004-4
Maximum input voltage	2kV	4kV
EUT power capacity	DC65V/1A	
Maximum line Number	8 lines	
EUT/AE connector	RJ-45	
Dimension	(W)400×(H)230×(D)240mm	

CDN for Interconnection Lines for LSS-F03 series **MODEL : LSS-INJ6400SIG**

Used for the surge test to interconnection lines defined in IEC61000-4-5 Standard. The EUT power capacity is DC50V/1A and enable to inject the surge to interconnection lines up to 6,600V. Possible to bypass inductor (20mH) with connecting the attached connection plug to inductor bypass terminal in DC output. Possible to equip the attached surge protective arrestor between each line and ground.
* The conversion (05-H1784)cable is needed additionally.

Parameter	Specification
Surge input voltage	500V~6.600V (Combination wave)
EUT power capacity	DC50V / 1A
Max. line number	4 lines
Decoupling coil	20mH each line
Matching resistor	40Ω±10%
Dimension / Mass	(W) 488x(H)456x (D) 550mm Approx. 45kg

Isolation Transformer **MODEL : TF-2302P**

Model TF-2302P is a single-phase isolation transformer rated AC240V/30A and dielectric strength of 4kV. For safety reason, an isolation transformer is indispensable for AC powered testing for equipment.

Parameter	Specification
Maximum input voltage	Single phase AC240V Max (50/60Hz)
Maximum output current	30A Max
Dielectric strength	Primary winding to core AC4kV (1 minute)
	Secondary winding to core AC4kV (1 minute)
	Primary to secondary windings AC4kV (1 minute)
Insulation resistance	100MΩ or more at DC500V
Dimensions	350(w) x 475(h) x 400(d)mm (Except for eye bolt and handle) Approx. 60kg

Isolation Transformer **MODEL : TF-6503P**

Model TF-6503P is a three-phase isolation transformer rated AC600V/50A and dielectric strength of 4kV. For safety reason, an isolation transformer is indispensable for AC powered testing for equipment.

Parameter	Specification
Maximum input voltage	Single/Three phase AC600V Max (50/60Hz)
Transformer wiring method	Star wiring
Maximum output current	50A Max
Dielectric strength	Primary winding to core AC 4kV (1 minute)
	Secondary winding to core AC 4kV (1 minute)
	Primary to secondary windings AC 4kV (1 minute)
Insulation resistance	100MΩ or more at DC500V
Dimensions	500(w) x 640(h) x 700(d)mm (Except eye bolt and handle) Approx. 350kg

Terminal Connection Board attached with Multi-Outlet (3P) **MODEL : 18-00048B**

Relay terminal board to connect output of LSS-F03 series to EUT. Enable to connect any outlet figure in the world when wiring to the attached multi-outlet.
For single phase / 3-phase
(Voltage resistible capacity 4.5kV)

Terminal Connection Board attached with Multi-Outlet (5P) **MODEL : 18-00058B**

Relay terminal board to connect output of LSS-F03 series to EUT. Enable to connect any outlet figure in the world when wiring to the attached multi-outlet.
For 3-phase 5 lines (Voltage resistible capacity 4.5kV)
* The multi-outlet is only available for single phase

EUT Protective Safety Box **MODEL : 11-00005A / 11-00006A**

Protection box to prevent access to EUT during the test. Further safety is secured together with the safety protective fence

Warning Lamp **MODEL : 11-00008A**

Usable together with LSS-F03 series. The blinking makes the operators or neighbors pay attention to the test processing.

Option

Protective Safety Fence MODEL : 11-00010A

Enable to materialize the safe test environment with connection to interlock function equipped in LSS-F03 series. The safety measure can be sure together with the EUT protective safety box.

Arrester capacitor unit MODEL : 08-00016

5P Terminal Boad for CDN Output MODEL : 18-00044A

3P Terminal Board for CDN Output MODEL : 18-00047B

AC Line Input Cable (Single phase) MODEL : 05-00134A

Optical USB Module MODEL : 07-00022A

Optical conversion adaptor Used for remote control with PC. 5m of optical fiber cable with USB interface attached.

AC line input cable (3-phase) MODEL : 15-00135A

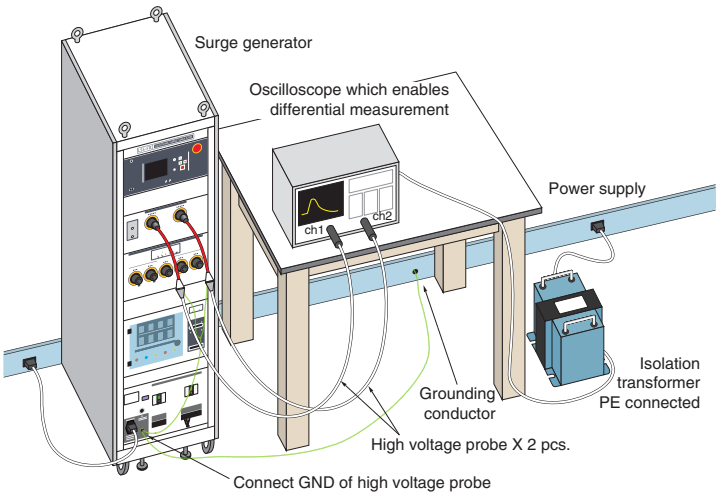
DC line input cable MODEL : 05-00136A

Waveform Pre-Checking Cables Set MODEL : 05-00099A

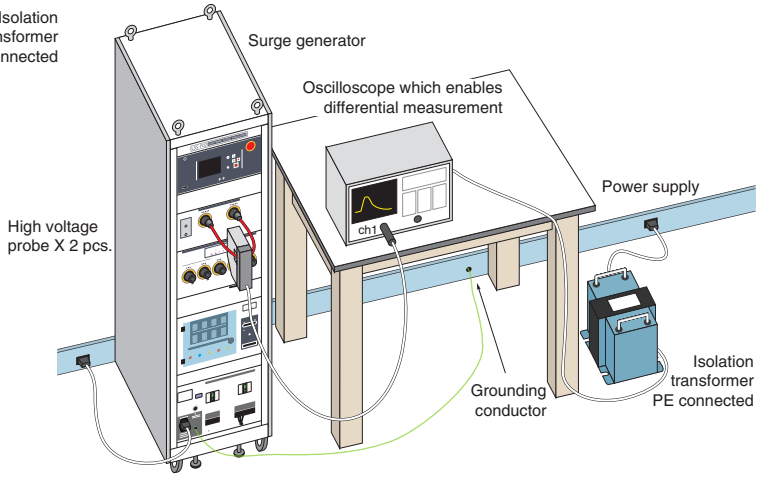
Fixtures for checking voltage waveforms and current waveforms of LSS-F03 series.
Followings are necessary for the checking additionally.

- Oscilloscope (Differential operation function built-in)
- High voltage probes (for surge voltage measurement / Voltage resistibility necessary)
- Current probe (For surge short current measurement)
- Isolation transformer (for oscilloscope)
- Earth cable (for PE connection)

■Surge Waveform Measurement (Setup of measurement from SURGE OUT with 05-00099A)



* Measurement of short current waveform from AC /DC CDN is not possible with the waveform pre-checking cables set (05-00099A)



IEC61000-4-5 Ed.3 Test Standard

1. General

The task of the described laboratory test is to find the reaction of the EUT under specified operational conditions, to surge voltages caused by switching and lightning effects at certain threat levels. This standard specifies 2 kinds of the combination waveforms. One is simulating the injection to power supply lines and interconnections lines (The voltage waveform as 1.2/50µs and current waveform as 8/20µs) and the other is doing the injection to telecommunications lines (The voltage waveform as 10/700µs and current waveform as 5/320µs).
It is not intended to test the capability of the EUT's insulation to withstand high-voltage stress, direct injections of lightning currents, i.e., direct lightning strikes, are not considered in this standard.

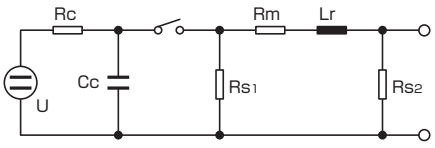
2. Test Level

Level	Open-circuit test voltage kV	
	Normal model	Common mode
1	-	0.5
2	0.5	1.0
3	1.0	2.0
4	2.0	4.0
x	special	special

x: Can be any level, above, below or in between the others. The level shall be agreed upon between the manufacturers and users.

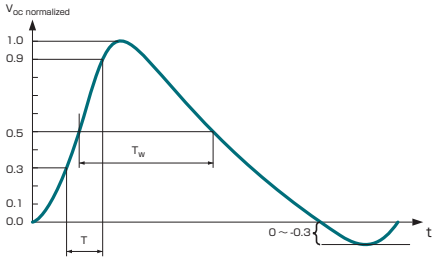
3. Waveforms Generator and Waveforms verification

■Generation Circuit



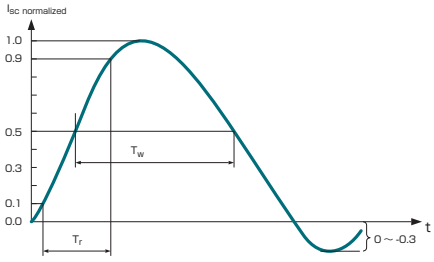
U High-voltage source
Rc Charging resistor
Cc Energy storage capacitor
Rs Pulse duration shaping resistors
Rm Impedance matching resistor
Lr Rise time shaping inductor

■Voltage Surge (1.2/50µs)



Front time: $T_f = 1.67 \times T = 1.2\mu s \pm 30\%$
Duration: $T_d = T_w = 50\mu s \pm 20\%$

■Current Surge (8/20µs)



Front time: $T_f = 1.25 \times T_r = 8\mu s \pm 20\%$
Duration: $T_d = 1.18 \times T_w = 20\mu s \pm 20\%$

■1.2/50µs Combination Waveform specification

	Front time Tf µs	Duration Td µs
Open-circuit voltage	Tf = 1,67 × T = 1,2 ± 30 %	Td = Tw = 50 ± 20 %
Short-circuit current	Tf = 1,25 × Tr = 8 ± 20 %	Td = 1,18 × Tw = 20 ± 20 %

4. Voltage waveform specification at the EUT port of power line CDN

■1.2/50µs Voltage waveform specification at the EUT port of the power line CDN (open-circuit voltage)

Open circuit votlage *	Coupling impedance	
	18 µF (line to line)	9 µF + 10 Ω (line to ground)
Peak voltage		
Current rating ≦ 16 A	Set voltage +10 %/-10 %	Set voltage +10 %/-10 %
16 A < current rating ≦ 32 A	Set voltage +10 %/-10 %	Set voltage +10 %/-10 %
32 A < current rating ≦ 63 A	Set voltage +10 %/-10 %	Set voltage +10 %/-15 %
63 A < current rating ≦ 125 A	Set voltage +10 %/-10 %	Set voltage +10 %/-20 %
125 A < current rating ≦ 200 A	Set voltage +10 %/-10 %	Set voltage +10 %/-25 %
Front time	1,2 µs ± 30 %	1,2 µs ± 30 %
Duration		
Current rating ≦ 16 A	50 µs + 10 µs/ -10 µs	50 µs + 10 µs/ -25 µs
16 A < current rating ≦ 32 A	50 µs + 10 µs/ -15 µs	50 µs + 10 µs/ -30 µs
32 A < current rating ≦ 63 A	50 µs + 10 µs/ -20 µs	50 µs + 10 µs/ -35 µs
63 A < current rating ≦ 125 A	50 µs + 10 µs/ -25 µs	50 µs + 10 µs/ -40 µs
125 A < current rating ≦ 200 A	50 µs + 10 µs/ -30 µs	50 µs + 10 µs/ -45 µs

* A CDN meeting the current rating of the EUT and its relevant waveform specification from this table shall be used.

IEC61000-4-5 Ed.3 Test Standard

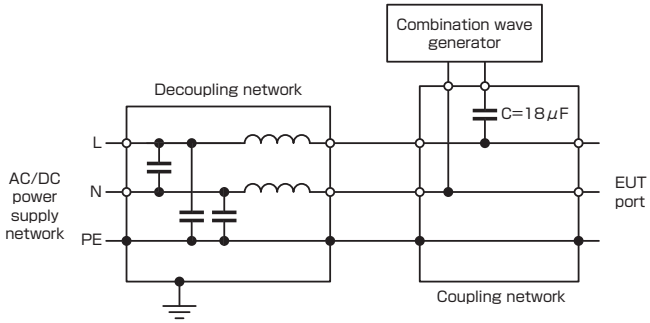
■Current waveform specification at the EUT port of the power line CDN (short-circuit current)

Surge current parameters under short-circuit conditions	Coupling impedance	
	18 μF (line to line)	9 μF + 10 Ω (line to ground)
Front time	Tf = 1,25 × Tr = 8μs ± 20 %	Tf = 1,25 × Tr = 2,5 μs ± 30 %
Duration	Td=1.18×Tw=20μs±20%	Td = 1,04 × Tw = 25 μs ± 30 %

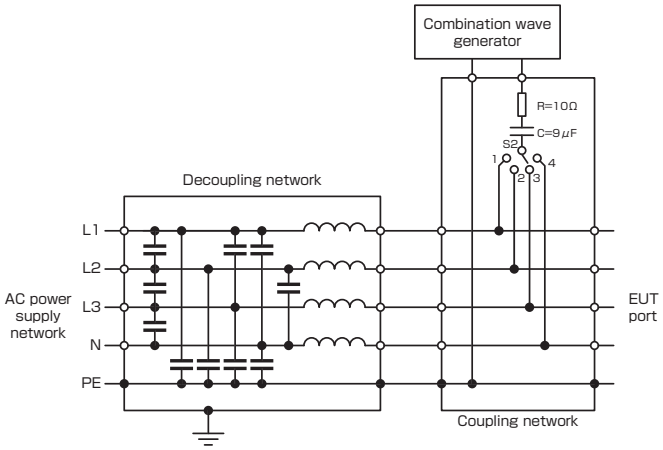
■Relationship between peak open-circuit voltage and peak short-circuit current at the EUT port of the power line CDN

Open-circuit peak voltage +/-10% at EUT port of the CDN	Short-circuit peak current +/-10% at EUT port of the CDN (18μF)	Short-circuit peak current +/-10% at EUT port of the CDN (9 μF + 10 Ω)
0,5 kV	0,25 kA	41,7 A
1,0 kV	0,5 kA	83,3 A
2,0 kV	1,0 kA	166,7 A
4,0 kV	2,0 kA	333,3 A

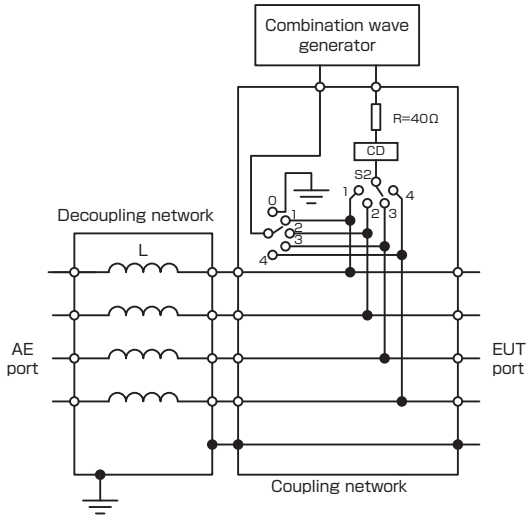
■Single phase power line CDN (line to line mode)



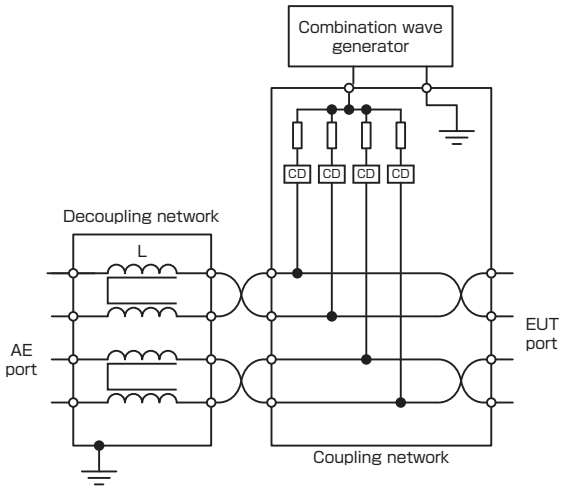
■Three-phase power line CDN (line to ground mode)



■CDN for unshielded unsymmetrical interconnection lines

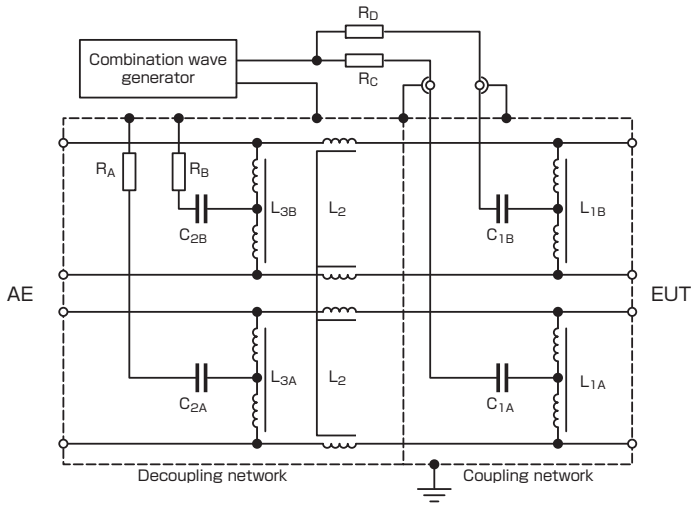


■CDN for unshielded symmetrical interconnection lines



IEC61000-4-5 Ed.3 Test Standard

CDN for unshielded symmetrical high speed communication lines up to 1000Mbit/s



Surge waveform specifications at the EUT port of the CDN for unshielded unsymmetrical interconnection lines

Coupling method	Output voltage from the generator	Voltage at the EUT port of the CDN Voc ±10 %	Voltage front time Tf = 1,67 ×Tr ±30 %	Voltage duration Td = Tw ±30 %	Short-circuit current at the EUT port of the CDN Isc ±20 %	Current front time Tf=1,25xTr ±30 %	Current Duration Td=1,18xTw ±30 %
Line to PE R = 40Ω CD = 0,5 µF	4 kV	4 kV	1,2 µs	38 µs	87 A	1,3 µs	13 µs
Line to PE R = 40Ω CD = GDT	4 kV	4 kV	1,2 µs	42 µs	95 A	1,5 µs	48 µs
Line to line R = 40Ω CD = 0,5 µF	4 kV	4 kV	1,2 µs	42 µs	87 A	1,3 µs	13 µs
Line to line R = 40 Ω CD = GDT	4 kV	4 kV	1,2 µs	47 µs	95 A	1,5 µs	48 µs

Surge waveform specifications at the EUT port of the CDN for unshielded symmetrical interconnection lines

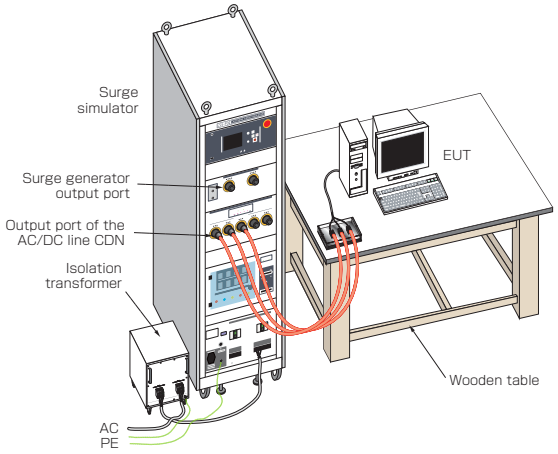
Coupling method	Output voltage from the generator	Voltage at the EUT port of the CDN Voc ±10 %	Voltage front time Tf = 1,67 xTr ±30 %	Voltage duration Td = Tw ±30 %	Short-circuit current at the EUT port of the CDN Isc ±20 %	Current front time Tf=1,25xTr ±30 %	Current Duration Td=1,18xTw ±30 %
Line to PE R = 40Ω Coupling devices*	2 kV	2 kV	1,2 µs	45 µs	48 A	1,5 µs	45 µs

* GDT, Clamping device, Avalanche devices

IEC61000-4-5 Ed.3 Test Standard

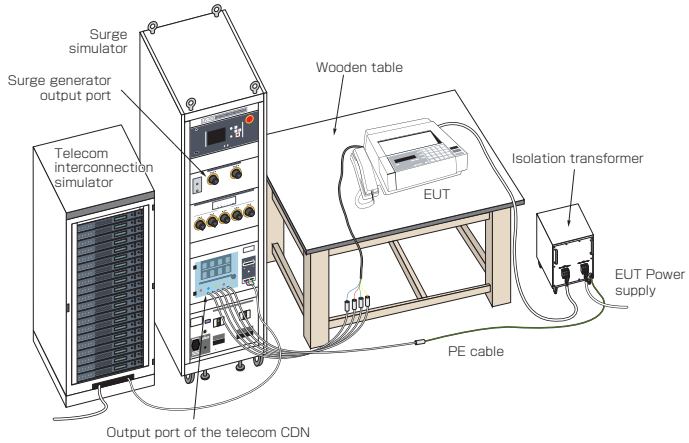
5. Test Set-ups

■Application of surges to power supply lines



The 1.2/50 combination wave (C/W) specified in the IEC61000-4-5 standard is applied through the power lines CDN of the LSS-F03 simulator. Compliant with the standard requirements, the simulator is of floating output. The simulator can conduct a series of tests to preprogrammed settings.

■Application of surges to telecom lines

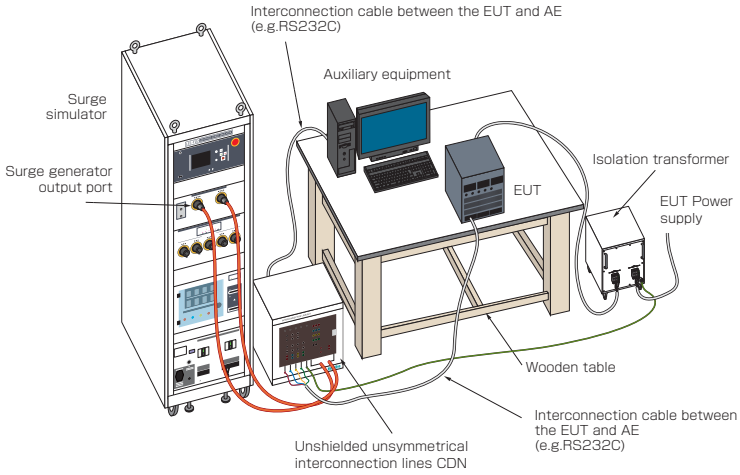


The 1.2/50 combination wave (C/W) specified in the IEC61000-4-5 standard is applied through the telecom lines CDN of the LSS-F03 simulator.

■Application of surges through unshielded unsymmetrical interconnection lines CDN

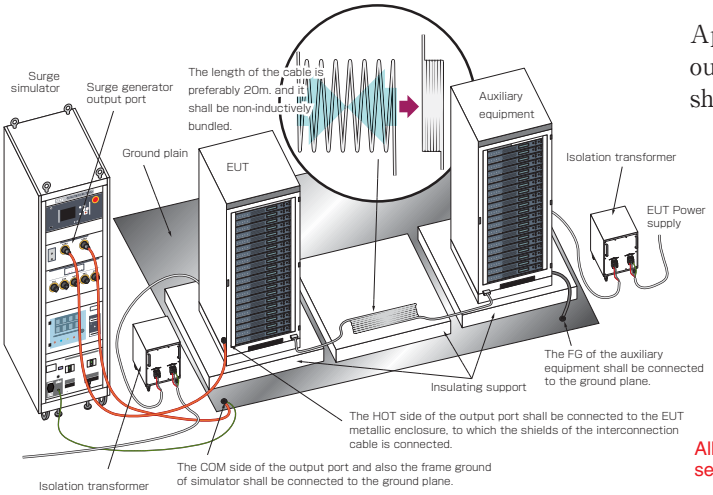
The 1.2/50 uS surge generator of the LSS-F03 simulator shall be used in combination with an optional external CDN. This CDN is connected between the EUT and AE (auxiliary equipment)

For all tests shown here, if it is not otherwise specified, the length of cable between the EUT and CDN should be 2m or shorter.

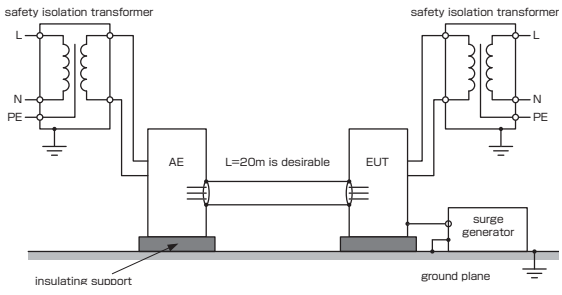


■Test set-up for surges applied to shielded lines

In case of shield lines, surge shall be applied to the metal enclosure of the EUT (for the EUT without a metallic enclosure, surges shall be applied to the shields of the cable)



Application of the surges shall be done from the generator output port via a 18 μ F capacitor. The auxiliary equipment shall be connected to the ground plane while the EUT shall not.



All test set-ups shown here are examples for performing tests by using the LSS-F03 series simulators. Some parts are not requirements of the relevant IEC standard.

IEC61000-4-5 Ed.3 Test Standard

6. Test procedure

Execution of the test

・Number of surges
For DC power ports and interconnection lines five positive and five negative surge pulses.
For AC power ports five positive and five negative pulses each at 0º, 90º, 180º and at 270º;
・Time between successive pulses: 1 min or less

7. Evaluation of Test Results and Test Report

The test results shall be classified in terms of the loss of function or degradation of performance of the equipment under test, relative to a performance level defined by its manufacturer or the requestor of the test, or agreed between the manufacturer and the purchaser of the product. The recommended classification is as follows:

1) Normal performance within limits specified by the manufacturer, requestor or purchaser;
2) Temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention;
3) Temporary loss of function or degradation of performance, the correction of which requires operator intervention;
4) Loss of function or degradation of performance which is not recoverable, owing to damage to hardware or software, or loss of data.

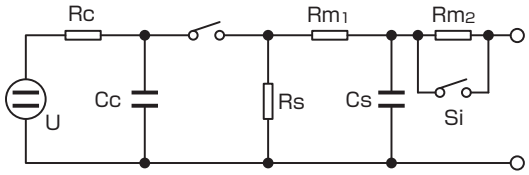
Generally speaking, as far as the EUT can be immune to the surges which is injected in the all specified period and it satisfy the functional requirements according to the product specification, the test result can be judged as “Good”.
The test report shall contain the test conditions and the result.

Note: These test set-ups and procedures are quoted from IEC61000-4-5 Ed.3 (2014) Standard. Please go through the standard if the more details are required.

8. Surge testing for unshielded outdoor symmetrical communication lines

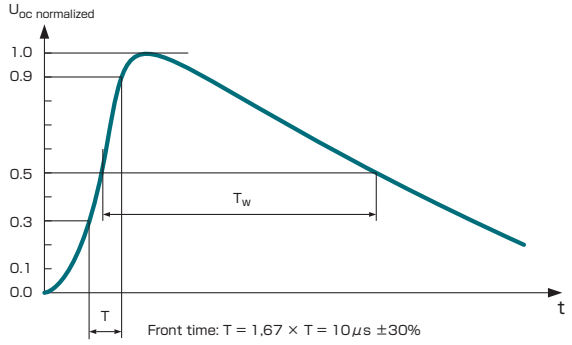
The 3rd edition of the standard requires the 10/700 us combination wave is applied to ports connected to outdoor telecommunication lines only and the Annex A (Normative) dedicatedly address this test. Outdoor telecommunication lines are typically greater than 300 in length, as the result of this length 10/700 uS wave is more representative. Telecommunication lines are usually protected by a primary protector installed at the cable entry to building. Testing shall be performed with the intended primary protector.

10/700 combination waveform (10/700 · 5/320μs) generation circuit



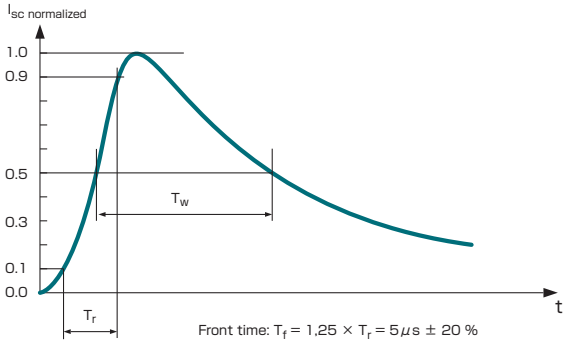
U	High-voltage source
Rc	Charging resistor
Cc	Energy storage capacitor
Rs	Pulse duration shaping resistor
Rm	Impedance matching resistors
Cs	Rise time shaping capacitor
S_1	Switch closed when using external matching resistors

Open circuit voltage waveform



Front time: T = 1.67 × T = 10μs ±30%
Duration: $T_d = T_w = 700\mu s \pm 20\%$

Short circuit current waveform



Front time: $T_f = 1.25 \times T_r = 5\mu s \pm 20\ \%$
Duration: $T_d = T_w = 320\mu s \pm 20\ \%$

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IEC61000-4-5 Ed.3 Test Standard

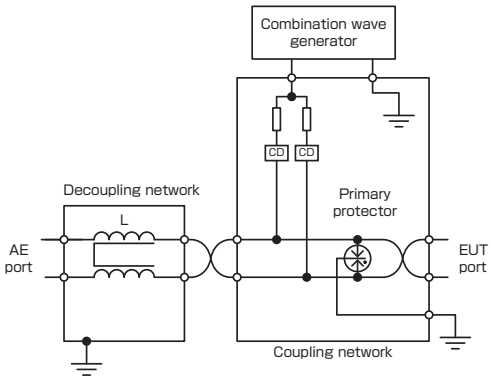
■Definitions of the waveform parameters of 10/700 µs combination waveform

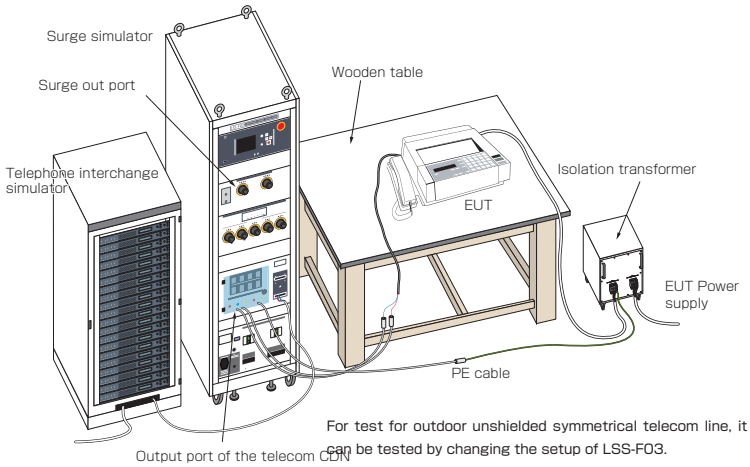
	Front time µs	Duration µs
Open-circuit voltage	10 ± 30 %	700 ± 20 %
Short-circuit current	5 ± 20 %	320 ± 20 %

■Relationship between peak open-circuit voltage and peak short-circuit current of the 10/700µs combination waveform

Peak open-circuit voltage at generator output ± 10 %	Peak short-circuit current at generator output ± 10 %
0.5 kV	12.5 A
1.0 kV	25A
2.0 kV	50A
4.0 kV	100A

■Test set-up example by using the 10/700 us generator and CDN for outdoor unshielded symmetrical communications lines





For test for outdoor unshielded symmetrical telecom line, it can be tested by changing the setup of LSS-F03.

■Surge waveform specifications at the EUT port of the CDN for unshielded outdoor symmetrical communication lines

Coupling method	Output voltage from the generator	Open-circuit voltage at the EUT port of the CDN Voc ± 10 %	Voltage front time Tf = 1.67 xTr ± 30 %	Voltage duration Td = Tw ± 30 %	Short-circuit current at the EUT port of the CDN Isc ± 20 %	Current front time Tf ± 30 %	Current duration Td ± 30 %
Common mode Coupling devices 1 pair 27.5 Ω	4 kV	4 kV	8 µs	250 µs	145 A	3.2 µs	250µs

* Designs, appearances and specifications are subject change without notice.

Authorized Representative

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