

Introduction

This summary provides a review of some of the changes in GR-1089 when Issue 6 was released. Many small individual tables are used to focus on the ESD, surge, and power fault testing per specific application types. The reader is advised to review the official GR-1089 Issue 6 document to insure a comprehensive understanding of all requirements defined in this Ericsson (formerly Telcordia) document. This summary is merely a succinct overview of limited sections of the original GR-1089 and is not a comprehensive review of the entire document. By providing a focus on ESD, surge, and power fault testing, Littelfuse is intending to demonstrate the application's need for Littelfuse type protection components to comply with these specific test requirements.

Summary

This generic requirements document covers EMC (Electro Magnetic Compatibility) and electrical safety needed for equipment to operate in a safe and reliable manner. This document covers equipment used at Central Offices (COs), outside plant (OSP) locations, and customer premises (CPs) locations. Interestingly, it does NOT cover on-hook leakage limits, off-hook input impedance criteria, loop dc resistance, or loop capacitance except for the fact of first level criteria requiring equipment to continue operating after applied events.

ESD Testing (as defined in IEC 61000-4-2)

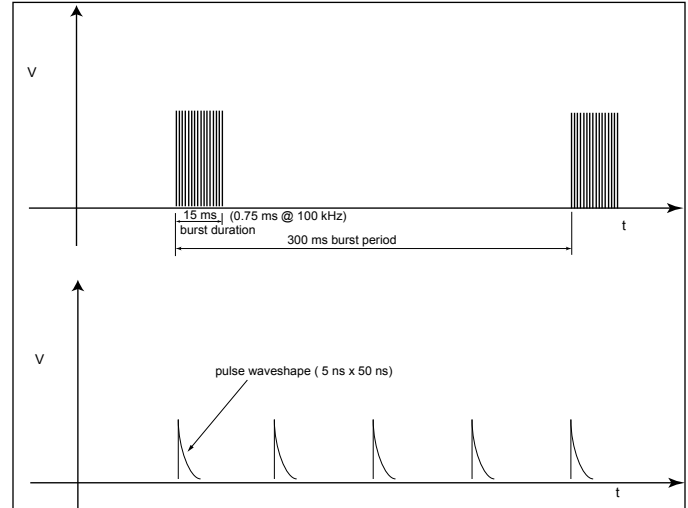
Peak Voltage	Repetitions	Contact or Air Discharge
±4 kV	±20	A
±15 kV	±20	A
±8 kV	±10	C

EFT Test Requirements (5 one-minute burst tests of each polarity as defined in IEC 61000-4-4)

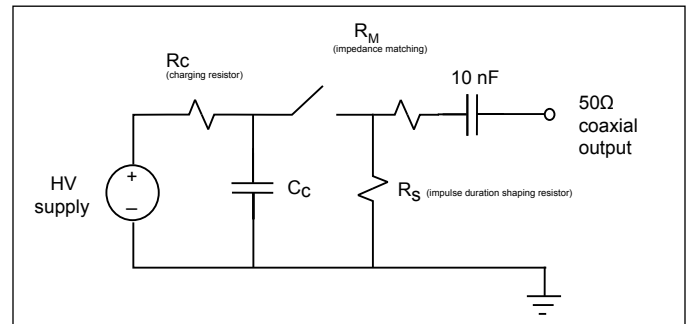
Peak Voltage	Port Type	Repetition Rate
250 V	1 and 2	5 kHz or 100 kHz (higher frequency is closer to actual field conditions)
500 V	3 and 4	
500 V	Non-customer premises AC and DC ports	
1000 V	Customer premises AC and DC ports	

Burst duration: 15ms ± 20% at 5kHz; 0.75ms ± 20% at 100kHz;
 Burst period: 300ms ± 20%
 Waveshape: 5ns ± 30% rise, 50ns ± 30% to half value;
 Termination: 50 Ohm coax, therefore peak voltage into a 50 Ohm load will be 50% of the peak voltages shown above

EFT Waveshape



EFT Generator Schematic



Lightning Surge Waveshape Definition

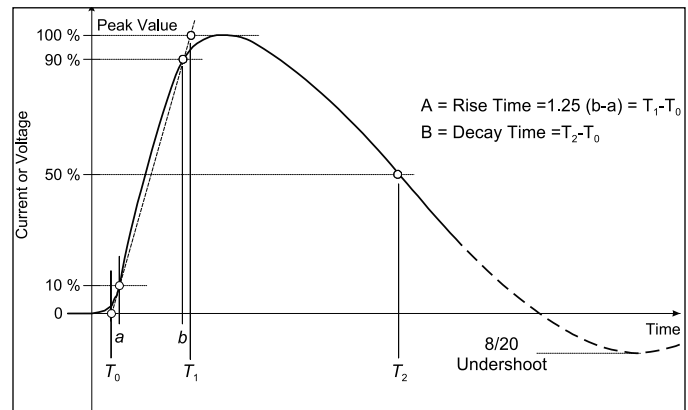
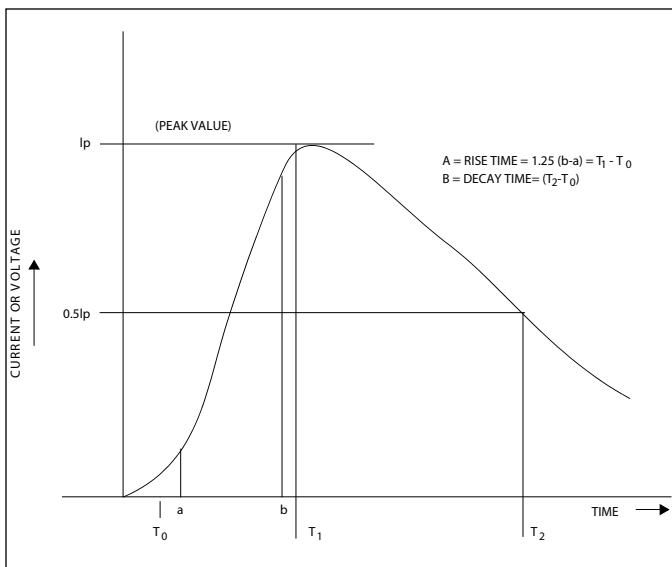


Figure. 1.2x50 and 10x700 voltage lightning surge waveshape definition



EMI

A few revisions were made to Electromagnetic Interference (EMI) regarding the field strength radiated emission requirements for the frequency band of 30 MHz to 47.7 MHz. Clarification for radiated emissions limits now explains that these limits apply to unwanted emissions and NOT the system fundamental frequencies. These levels are to be recorded and provided in a test report but the system fundamental frequency emissions are not to be included as reasons for failure to comply.

Additional frequencies of interest were added to include the following service bands:

1. FM Broadcast range
2. Police & Fire Radio
3. Business
4. Cellular Telephone
5. PCS
6. Public Service Common Carrier

The EUT (equipment under test) is tested at these discrete frequencies for at least one minute for radiated immunity measurement purposes.

Port Types

Seven port type definitions were added to this revision (3a, 3b, 4a, 5a, 5b, 8a and 8b).

Port Type Number	Description
	Issue 6
1	Network inter-building
2	Network intra-building
3	Customer premises (CP) inter-building
3a	Intra-cell site CP ports
3b	Short reach OSP CP ports
4	Customer premises intra-building
4a	Customer side ONT intra-building port
5	OSP inter-building
5a	Intra-cell site
5b	Short reach OSP ports
6	Antenna ports
7	AC power ports
8	Local DC power ports
8a	DC power to antenna
8b	Intra-cell site DC power

1. Type 1 port is CO equipment (inter-building) that connects to outside plant (OSP).
2. Type 2 port is CO equipment (intra-building) that does NOT connect to outside plant.
3. Type 3 port is customer located equipment or cellsite equipment that connects to OSP.
4. Type 3a and 5a ports (intra-cell site location) are located at cell sites or similar sites with large antennas and are considered intra-building types and IF they do have cables that run outdoors it runs ONLY short distances.
5. Type 3b and 5b ports are short reach (< 500 feet) outside cables. Most commonly these are Ethernet or Power over Ethernet (PoE) type ports and therefore considered as intra-building exposure.
6. Type 4 ports are non-CO intra-building types; i.e. do not connect to the outside plant but may be located at cabinets, remote terminals, cell sites, or CP.
7. Type 4a ports customer side ONT (Optical Network Terminal) and NID (Network Interface Device) ports such as POTS (Plain Old Telephone Systems) and Ethernet.

8. Type 5 ports are OSP located equipment with connections to outside plant.
9. Type 6 ports are antenna ports.
10. Type 7 AC power ports.
11. Type 8 DC power ports (but not including DC span powering used in telcom).
12. Type 8a DC power to antenna (i.e. high exposure environment).
13. Type 8b port is an intra-cell site dc power.

The Lightning and Power Fault requirements were extensively edited. Intra-building applications are indeed exposed to transient events due to ground potential rises (GPRs). This updated version now covers the case when outside plant (OSP) wiring becomes short-circuited.

It is assumed a high voltage category primary protector is always used. This allows a let-through impulse maximum voltage of 1000 V peak and a 60 Hz maximum let-through of 425 V rms (600V peak). This replaces the prior assumption of a 3-mil-gap carbon block that would allow a 60 Hz let-through of 600Vrms (850V peak). This assumption results in different maximum voltages for the 1st and 2nd level power fault testing.

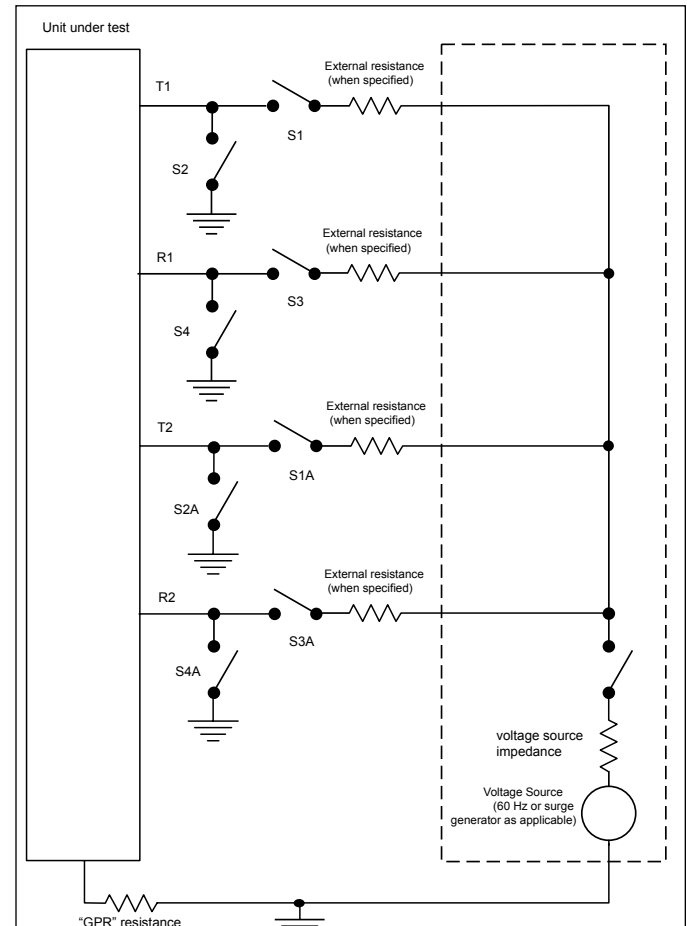
Ethernet Note

All Ethernet interfaces shall be subjected to metallic and longitudinal lightning surge and power fault testing with the exceptions of Type 2 Ethernet ports. For 10/100 BaseT interfaces, some pairs may not be used for data but will have a "Bob Smith" termination circuit. These pairs are also to be tested and the termination components cannot be damaged since their failure could result in increased radiated emissions. PoE interfaces shall also have the inter-powering pair of wires surge tested.

The following Type 2 Ethernet ports are subjected to longitudinal type surges only (no metallic surge testing) if it meets the following criteria.

- LAN cabling is not connected to external environment
- All LAN equipment powered from a single power feed
- Ground referenced SPDs are not installed
- None of the ports are TNV (telecommunication network voltage) circuit type (non-PoE types only)

Test Connection Diagram



Two Wire Telecom Interface

Connection	S1	S2	S3	S4	S1A	S2A	S3A	S4A
A1 (metallic)	Closed	Open	Open	Closed	Open	Open	Open	Open
A2 (metallic)	Open	Closed	Closed	Open	Open	Open	Open	Open
A3 (metallic)	NA	NA	NA	NA	Open	Open	Open	Open
A4 (metallic)	NA	NA	NA	NA	Open	Open	Open	Open
A5 (longitudinal)	Closed	Open	Closed	Open	Open	Open	Open	Open
A6 (longitudinal)	NA	NA	NA	NA	Open	Open	Open	Open
B (longitudinal)	Closed	Open	Closed	Open	Open	Open	Open	Open

Four Wire Telecom Interface

Connection	S1	S2	S3	S4	S1A	S2A	S3A	S4A
A1 (metallic)	Closed	Open	Open	Closed	Open	Closed	Open	Closed
A2 (metallic)	Open	Closed	Closed	Open	Open	Closed	Open	Closed
A3 (metallic)	Open	Closed	Open	Closed	Closed	Open	Open	Closed
A4 (metallic)	Closed	Closed	Open	Closed	Open	Closed	Closed	Open
A5 (longitudinal)	Closed	Open	Closed	Open	Open	Closed	Open	Closed
A6 (longitudinal)	Open	Closed	Open	Closed	Closed	Open	Closed	Open
B (longitudinal)	Closed	Open	Closed	Open	Closed	Open	Closed	Open

1st Level Inter-building Surges for CO and CPE with External Connections
(Short Loop OSP Interface <500 ft only surge #1 and 2 - Type 3b/5b)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μ s)	Reps	Test Connections
1	± 1000	25	10/360	± 5	A (for short loop interface) otherwise B
2	@ \pm Vs of 2nd protector	25 @ 1000V	10/360		A
3	± 100 to ± 1000 (100V increments)	10 to 100	10/1000		
4	± 1000 to $\pm 2000^*$	100 to 200	10/1000		
5	± 2500 (Inductive Kick Test) **	500	2/10	± 10	B
6	@ \pm Vs of 2nd protector	100 @ 1000V	10/1000	± 5	A
7	± 4000 (w primary GDT protector connected)	100	10/700 - 5/310		A5 and A6

* Not required if > 95A drawn during surge #3 (1000V, 100A test condition).

** Not required for applications with primary protectors mounted within 1 meter and longest dimension of the cabinet is ≤ 1 meter. A special termination circuit is used for the 2/10 inductive kick tests to prevent excessive metallic surges due to known characteristics of 2/10 surge generators (a voltage dependent resistor is placed across the simultaneous "high" outputs).

1st Level Surges for Remote Outside Plant Locations (Port Types 3, 5 (3b/5b Surge #1 only))

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	± 1000	200	2/10	± 5	A
2	± 1000*	100	10/1000		A5, A6
3	±100 to ±1000 (High lightning exposure)	50 @ 400V to 500 @ 4000V	10/1000		A

* Test is performed with 5 and 25 ohm resistance added between EUT ground and surge generator return (GPR testing) to simulate high soil resistivity conditions.

1st Level Intra-building Surges for up to 2 Wire Pairs (Port Types 2, 3a/5a, 4, 4a)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1/or	±800 (external 6 ohm per wire if 1.2/50 waveshape used)	100	2/10	± 5	A1, A2, A3, A4
		400 (before external resistance is added)	1.2/50 - 8/20		
2/ or	±1500 (external 10 ohm per wire if 1.2/50 waveshape used)	100	2/10		B
		750 (before external resistance is added)	1.2/50 - 8/20		
3/ or	@ ±Vs (external 6 ohm per wire if 1.2/50 waveshape used)	100 @ 800V	2/10		A1, A2, A3, A4
			1.2/50 - 8/20		
4/ or		100 @ 1500V	2/10		B
		750 @ 1500V	1.2/50 - 8/20		

1st Level Intra-building Surges for 3 or 4 Wire Pairs (Port Types 2, 3a/5a, 4, 4a; test 1 and 3 for unshielded PoE ports)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	±800 (external 6 ohm per wire)	100	1.2/50 - 8/20	± 5	Metallic*
2	±1500 (external 20 ohm per wire if 1.2/50 waveshape used)	46.87/wire for 3 pair			B
		41.6/wire for 4 pair			
3	@ ±Vs	100 @ 800V			Metallic*
4		68 @ 1500V	B		

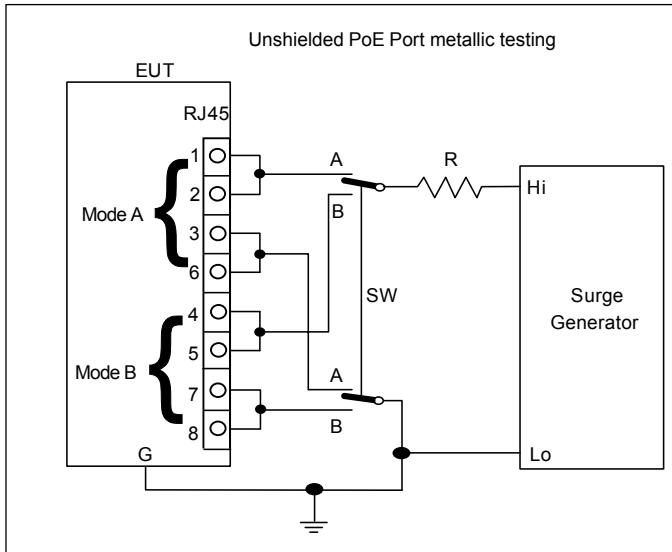
* each wire with all other wires grounded (metallic, one at a time)

1st Level Intra-building Surges for more than 4 Wire Pairs (Port Types 2, 3a/5a, 4, 4a; test 1 and 3 for unshielded PoE ports)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	±800 (external 6 ohm per wire)	100	1.2/50 - 8/20	± 5	Metallic*
2	±1500 (external 40 ohm per wire if 1.2/50 waveshape used)	<25/wire for >4 pair			B
3	@ ±Vs	100 @ 800V			
4		35.7 @ 1500V			B

* each wire with all other wires grounded (metallic, one at a time)

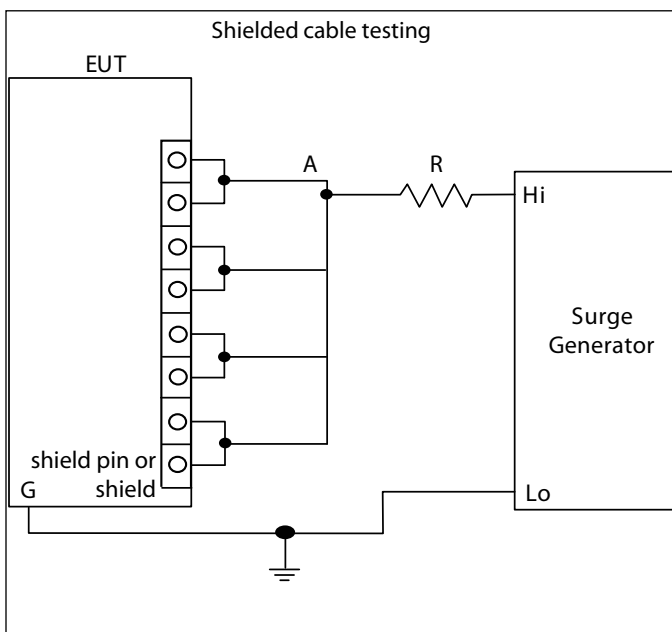
Unshielded PoE Test Configuration



Shielded Cable Testing

For Equipment Port Types 2, 3a/5a, 4, 4a, or 8b that use a shielded cable that is grounded and bonded to earth ground at both ends, then the following tests are conducted instead of those outlined above using the figure below for the surge generator connections.

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	±1500	750 (before external 2 ohm resistor is added resulting in 375)	1.2/50 - 8/20	± 5	See figure below



The Type 2 Ethernet ports are exempted from metallic (differential) testing if

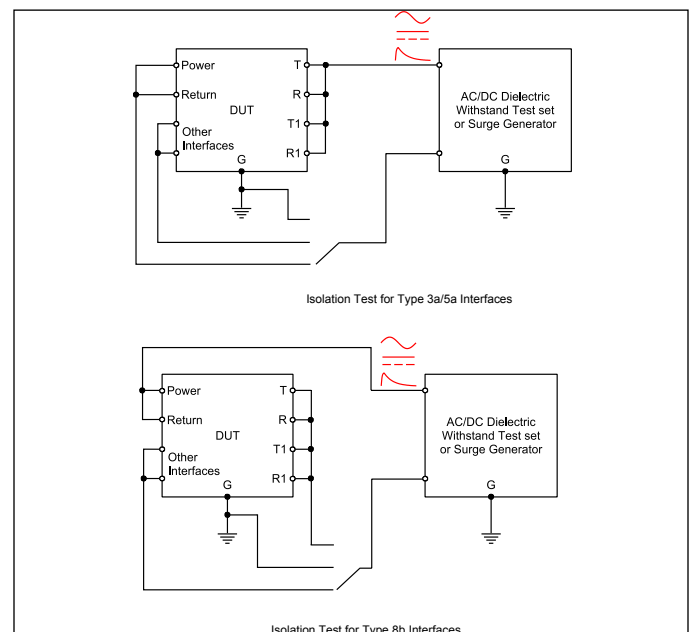
1. the port does not contain a grounded secondary protector
2. any unused pins are not grounded (Bob Smith termination is not considered as a grounded connection in this context)

Type 4 and 4a are exempted from the metallic testing until August 1, 2012.

Option A Isolation Test for Type 3a/5a or 8b at cell sites ONLY (insuring ability to withstand GPRs)

This isolation test is only used when the interface is installed between separate structures, buildings, or cabinets at a cell site to insure resistibility to ground potential rises. The isolation compliance is indicated by lack of arcing or sudden current step increase between test points.

1. 1500 Vrms at 50/60 Hz for 60 seconds, or
2. 2120 Vdc for 60 seconds, or
3. 2400V 1.2/50-8/20 ±10 repetitions



1st Level Surges for customer side ONT interfaces (Port Type 4a)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	± 1000	100	10/1000	± 5	A5, A6

1st Level Surges for Antenna Port (Port Type 6)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	± 600	300	1.2/5-8/20	± 5	Centre conductor to shield
2	@ ± Vs	300 @ 600V			

1st Level Surges for AC Power Port (Port Type 7)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	± 2000 (if external protector present)	1000	1.2/5-8/20	± 5	Phase to neutral, phase to ground and neutral to ground.
2	± 6000 (if no external protector present)	3000			
3	@ ± Vs (if 2nd protector present)	1000 @ 2000V			

1st Level Surges for DC Power Located on a Tower (Port Type 8a)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	± 6000	3000	1.2/5-8/20	± 5	Longitudinal

2nd Level Surges (Port Types 1, 3 and 5)

Surge #	Minimum Voltage Peak Value (V)	Minimum Current Peak Value (A)	Rise/Decay Waveshape (μs)	Reps	Test Connections
1	± 5000	500	2/10	± 5	A

1st Level Power Fault Tests (Port Types 1, 3 and 5)

Test #	Minimum Voltage RMS Value (V)	Minimum RMS Current Per Conductor (A)	Reps	Duration	Test Connections
1	50	0.33	1	15 minutes	A
2	Vs	0.33 @ 50V			
3	100	0.17			
4	Vs	0.17 @ 100V			
5	200	0.47	60	1s	
6	425	1			
7	Vs	1 @ 425V			
8	1000	1	1	4s	
9	425	0.50			
10	425	0.71	5	2s	A

EUTs are required to comply with the following 2nd Level power fault tests without any current limiters in the test circuit.

2nd Level Power Fault Tests (Port Types 1, 3 and 5) (Test 1 also for 3a, 3b, 4, 4a, 5a and 5b)

Test #	Minimum Voltage RMS Value (V)	Minimum RMS Current Per Conductor (A)	Duration	Test Connections
1	120	25	15 minutes	A
2	277			
3	425	40	1.5s	
4	Vs	Vs/10.6		
5	425	7, 10, 12.5, 20, 25 and 30	5s	
6	425	2.2*, 2.6*, 3.0, 3.75 and 5	15mins	
7	Vs	Vs/60.7	5s	
8	Vs	Vs/193.2* and 2.2*	15mins	

* wiring simulator is NOT installed for this test condition