

Testing with Bourns Primary Protection with Cisco xDSL interfaces

1. Surge and Power Cross tests

Summary:

Surge and Power Cross tests were done on Cisco xDSL interfaces: CISCO877, CISCO877W, CISCO877M, HWIC-1VDSL, and EHWIC-VA-DSL-x

All tested units pass 6000 Volts Surge testing with all variations of Bourns 7040-01 NID (Network Interface Devices) devices.

The CISCO877 router passes Power Cross without Bourns NID devices. However the CISCO877M fails due to oscillatory behavior when a standard voltage GDT-only device is used as Primary Protection. The CISCO877M passes Power Cross when used with a GDT with TBU device because the TBU limits circulating current.

The HWIC-1VDSL and EHWIC-VA-DSL-x interfaces pass power cross with GDT devices, with or without TBU support.

Cisco CISCO888E and CISCO888EW, and HWIC-4SHDSL-E , G.SHDSL interfaces were tested per standard K.21 testing. This G.SHDSL interface passed Power Cross with an external GDT network with no issues during normal compliance testing. This includes the HWIC and the fixed version of this port.

Passing was determined by link up with Broadcom multimode CO simulator without loss of rate. Failure was loss of link or lowered data rate indicating damage.

Currently the Cisco877 family is announced as EOS with last sale date of Dec 2011. HWIC-1VDSL and EHWIC-VA-DSL-x are new products.

Conclusions:

All of the tested Cisco DSL products pass 6000 Volts Surge tests with any Bourns GDT Primary Protection NID Device. The Cisco CISCO877M fails Power Cross due to the voltage rating of the Primary Protection GDT versus the voltage rating of the Sidactor in the Secondary/in-circuit protection. The Bourns GDT with the TBU allows the CISCO877M to pass Power Cross testing with transient current blocking, damping the circulating current in the transformer.

Therefore for full coverage of Surge and Power Cross we recommend the Bourns GDT with TBU, 7040-01-, containing a 2377-45-BC-TBU Station Protector. If Power Cross in the field is not an issue, then any of the Bourns GDT three-pin devices, 2377-45-BC, will work. Other low capacitance three pin GDT NID devices should work as well.

2. Surge Tests

Surge testing was done with three versions of Bourns 7040 NID (Network Interface Devices) family, each containing a Station Protector module. Two of these modules are Gas Discharge Tubes without TBU® sneak current blocking and one with a TBU®.

The Surge Test is a standard 10/700 us waveform based on the ITU-T K.44 generator and applied in accordance with ITU-T K.21. The test voltages were 4000 Volts and 6000 Volts. Each voltage was applied 5 times each in the positive and negative polarity. 6000 Volts is the maximum voltage of the Key Tek ECAT, Module E502B.

2.1. Bourns NID devices tested

The NID box part numbers as follows:

7040-01-W with a 2377-45-BC-IDT GDT Station Protection Device as shown in the data sheet below.

7040-01-Z with a 2377-45-BC GDT Station Protection Device as shown in the data sheet below.

7040-01-S01 (temporary nomenclature) with a GDT-TBU balanced GDT Station Protection Device now listed by Bourns as 2377-45-BC-TBU as shown in the image below.

Both the -W and the -S01 NID box use IDC, insulation displacement connectors. The -Z uses 2 threaded posts, 1 post for Tip In/Out and 1 post for Ring In/Out. All have a Grounding post.


Image of 2377-45-BC-TBU Station Protector.



Data Sheet for 7040 series NID boxes with 1 or 2 Station Protector modules



Features

- 10 x 32 stainless steel binding post to connect ground straps and wiring
- Hinged cover and outside mounting feet
- Sectionalized grommet in base for wire entry
-  Listed per UL 497 & 1863 (File: E53117, E116756)

7040 Series – Station Protector Enclosure

The Model 7040 Series Station Protector is designed to protect telecommunication network services from overvoltages at the subscriber end of the loop. The 7040 accommodates up to two Station Protectors or one ADSL/VDSL POTS Splitter and one Station Protector.

The 7040 features a versatile, weather resistant enclosure, manufactured of high-impact resistant, ultraviolet-desensitized, flame retardant, UL Listed plastic. The enclosure can be custom embossed with a company logo or other details (see Custom Logo/Housing in How to Order chart below).

How To Order

7040 - 0X - X X - X1

Model Number Designator _____

Number of Twisted Pair Lines _____
 1 = One Line (Max. for DSL)
 2 = Two Lines

Station Protector Options _____

D¹ = 455HS-MSP (2377-45-HS) Voice/Data/DSL (UL, cUL)
 U³ = 455HS-MSP (2377-45-HS-IDC) Voice/DSL/Data (UL, cUL)
 Z¹ = 455HS-BC* (2377-45-BC) Balance-Sensitive DSL (UL, cUL)
 W² = 455HS-BC* (2377-45-BC-IDC) Balance-Sensitive DSL (UL, cUL)
 E² = 155HS-MSP (2378-35-HS) Voice/DSL/Data (UL, cUL)
 Y² = 155HS-BC* (2378-35-BC) Balance-Sensitive DSL (UL, cUL)
 K = 356G (2377-35-G) Balanced GDT, No Back-Up-Gap (UL, cUL)
 R² = 356G (2377-35-G-IDC) Balanced GDT, No Back-Up-Gap (UL, cUL)
 B = 125EW (2374-01) Dual Gas Tube (UL, cUL, Telcordia)
 C = 125EW-R (2375-01) Dual Gas Tube (UL, cUL, RUS)
 L = 356M (2377-01) Balanced Gas Tube (UL, cUL, RUS)
 T = Ti355M
 O = No Station Protectors (Not available with DSL configurations)

*For DSL systems requiring capacitive balance within 1 pF.
 Note 1 = Digi.Guard - 356 size, RUS Maximum Duty.
 Note 2 = Digi.Guard II - 125 size, RUS Heavy Duty.
 Note 3 = Insulation Displacement Connectors (IDC)

Custom Logo/Housing _____
 Special markings available.
 Leave blank if no special logo desired.

DSL Options _____
 P* = 3610A2 ADSL2+ POTS Splitter (UL Listed)
 P-1* = 3610A2-IDC ADSL2+ POTS Splitter with IDC (UL Listed)

Note 1 = Digi. Guard

*DSL Configuration Note:

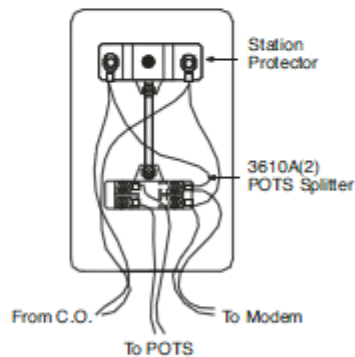
Options P and P-1 can only be ordered in one line configurations.

Product Dimensions

High	Wide	Deep
144.8	86.4	55.9
(5.7)	(3.4)	(2.2)

DIMENSIONS: $\frac{\text{MM}}{\text{(INCHES)}}$

Installation Diagram



Asia-Pacific:

TEL +886- (0)2 25624117
 FAX +886- (0)2 25624116

Europe:

TEL +41-41 7685555
 FAX +41-41 7685510

The Americas:

TEL +1-951 781-5500
 FAX +1-951 781-5700

www.bourns.com



Features

- Multi-Stage Protection (MSP®)
- Balanced TRIGARD®
- Self-resetting sneak current protection with Bourns® TBU devices
- Overcurrent and overvoltage protection
- Quick response to surges
- High energy handling
- Switch-Grade Fail-Short
- Insulation Displacement Connectors (IDCs)
- High-speed network compatible such as ADSL2+ and VDSL2
- UL Listed per UL 497 (File: E53117)

2377 MSP®/TBU™ Series DigiGuard® Station Protector

Bourns® 2377 MSP®/TBU™ series is a new generation telecommunications station protector designed to be the best choice for protection of high-speed network data circuits. Bourns® 2377 MSP®/TBU™ series protectors integrate four advanced technologies: our proprietary advanced TRIGARD® GDT, precision matched metal oxide varistors (MOVs), a patented switch-grade fail-short mechanism, and our patented TBU® (Transient Blocking Unit) technology which protects the circuit by rapidly switching to a blocking state. These technologies are combined to provide robust overvoltage and fast, resettable sneak current protection with extremely low energy let-through. Additionally, the MSP®/TBU™ series has very low loss characteristics, making it the ultimate choice for protection of sensitive, high speed communication lines.

A continuous DC bias such as sealing current or remote powering (span powering) can hold the TBU® device in a high resistance blocking state after the fault has passed. The TBU® device can be reset by momentarily disrupting the loop current or providing a low voltage (V_{reset}) condition on the line.

Characteristics

Test Methods per IEEE C82.31, UL 497, CSA C22.2, Telcordia GR 1361 and applicable sections of Telcordia GR 974.

DC Breakdown	300-400 V
AC Breakdown	60 Hz 300-400 V
Impulse Breakdown.....	100 V/ μ s 600 V
	1000 V/ μ s 650 V
Insulation Resistance	100 Vdc > 1 G Ω
Insertion Loss	100 MHz < 0.4 dB (Category 5)
Return Loss	100 MHz > 14 dB (Category 5)
Capacitance Line to Line.....	1 MHz 14 pF typical
Capacitance Line to Ground	1 MHz 28 pF typical
Line Resistance	12 ohms typical
Impulse Reset ¹52 V, 280 mA < 10 ms ³
	135 V, 200 mA < 10 ms ³
	150 V, 200 mA < 150 ms
Impulse Life Characteristics	100 A, 10/1000 μ s > 3000 operations ²
(Per Side, Simultaneously)	300 A, 10/1000 μ s > 1000 operations ²
	500 A, 10/1000 μ s > 1000 operations ⁴
	2,000 A, 10/250 μ s > 100 operations ²
	5,000 A, 20/100 μ s > 10 operations ²
	20,000 A, 8/20 μ s > 10 operations ⁴
AC Life Characteristics.....	0.5 A rms continuous > 30 seconds
	1 A rms, 1 second, 600 ft. cable > 60 operations
	1 A rms, 1 second, 1 mile cable > 60 operations
	10 A rms, 1 second > 20 operations
	200 A rms, 11 cycles 1 operation ⁵
	120 A rms, 0.1 second 1 operation
Life Test Criteria	
Insulation Resistance Throughout the Life Test.....	100 megohms
Life Test Failures	0.0 %
Failures During Environmental Cycling w/surges.....	0.0 %
Fail-Short (Vented or Non-vented Gas Tube).....	> 30 Arms, simultaneously
Operating Temperature.....	-55 to +85 °C

Notes:

1 Network applied.

2 Exceeds Telcordia (Bellcore) GR 1361.

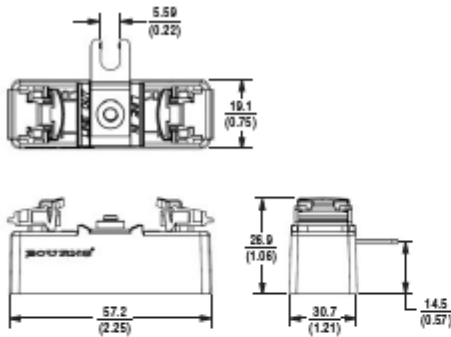
3 Surpasses Telcordia GR 974.

4 RUS (REA) PE-80.

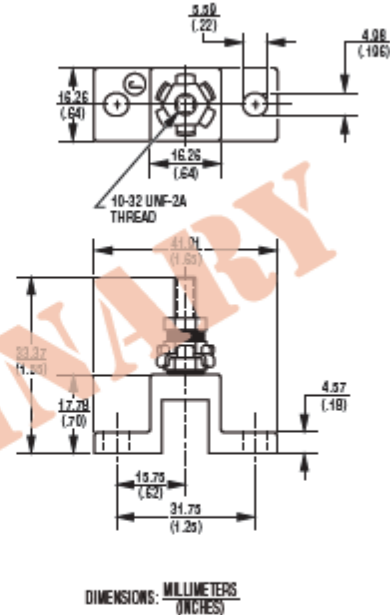
5 Protector may short to ground.

Line to Line voltage is approximately 1.8 to 2 times the stated Line to Ground breakdown voltage.

Product Dimensions



2372-02 Ground Mounting Stud (Order Separately)



How To Order

2377-45-HS-TBU Standard Model
2377-45-BC-TBU* Balanced Capacitance

*BC versions are for xDSL systems that require Tip-to-Ground and Ring-to-Ground capacitive balance of ± 1 pF.

2.2.CPE Equipment Tested

The CPE equipment tested was the CISCO800 series ADSL2+ routers, CISCO877M and CISCO877, and VDSL2 modular HWICs and fixed cards. All are Annex A or M (over POTS) routers with a RJ11 Tip and Ring Interface. The NID device was connected between Tip and Ring and the NID Ground connector was connected to Test Ground.

Previous testing indicates that the failure voltage on the DSL isolation transformers is approximately 4000 Volts. Data sheets indicate that the tested voltage is 1500 Volts. At voltages above the 4000 Volt level, and if a return path found, the transformer will be shorted and components on the tertiary side damaged.

2.3.Grounding

All three of the test NID modules are three point systems: Tip and Ring In, Tip and Ring out, and Ground. Since the CISCO800 family of routers is ground isolated by design, the Ethernet connections were all bonded together and grounded to mimic a high impedance path to ground during the tests. This was done to imitate EOS where the failure path was through the Ethernet cable to a grounded PC.

2.4.10/700uS Surge Generation

The Surge generator was attached to Tip and/or Ring and Ground depending on the test configuration. Both Longitudinal (earth/ground to Tip and Ring) and Metallic (signal between Tip or Ring with Ring or Tip connected to Surge Return and ground).

The peak voltage and peak current were monitored at the surge generator.

3. Surge Test Results

All three NID packages operated about the same when tested in either Longitudinal or Metallic configuration. The recorded peak voltages measured at Tip or Ring were the same for each Surge Pulse.

There were no CPE unit failures with any of the three versions of the NID interface.

The highest voltage sustained by the CPE was with the 6000 Volt pulses, positive and negative polarity, allowing approximately 800 Volts peak to appear at the Isolation transformer primary winding. This is about 0.2 of the maximum voltage sustainable at the transformer. This is due to the response of the GDT.

A representative section of the results is below:

			Grounded Ethernet F3		
Longitudinal	T/R to GND				
	V	A	V	A	Polarity
	833	0	-460	-71	6KV
	457	1	-825	-70	-6KV
	838	2	-460	-70	6KV
	459	1	-826	-75	-6KV
	834	1	-452	-78	6KV
	452	1	-819	-75	-6KV
	840	1	-465	-78	6KV
	455	1	-818	-78	-6KV
	838	2	-466	-78	6KV
	462	1	-799	-79	-6KV
Differential/Metal	T-Gnd/R		with Ethernet F3 and Shield Grounded		
	V	A	V	A	Polarity
	683	1	-284	-78	6KV

	278	1	-672	-76	-6KV
	678	2	-283	-78	6KV
	282	1	-689	-78	-6KV
	684	2	-286	-77	6KV
	281	0	-693	-76	-6KV
	700	0	-286	-78	6KV
	293	0	-774	-68	-6KV
	687	0	-285	-78	6KV
	282	1	-699	-78	-6KV
Differential/Metal	R-Gnd/T	with Ethernet F3 and Shield Grounded			
	V	A	V	A	Polarity
	759	1	-285	-71	6KV
	266	0	-763	-79	-6KV
	771	1	-282	-78	6KV
	247	2	-762	-70	-6KV
	782	1	-283	-79	6KV
	281	0	-828	-76	-6KV
	779	2	-585	-78	6KV
	276	1	-750	-77	-6KV
	769	1	-285	-79	6KV
	278	1	-767	-79	-6KV

Surge tests were also done using the Bourns NID boxes on EHWIC-VA-DSL-x and HWIC-1VDSL and there were no failures.

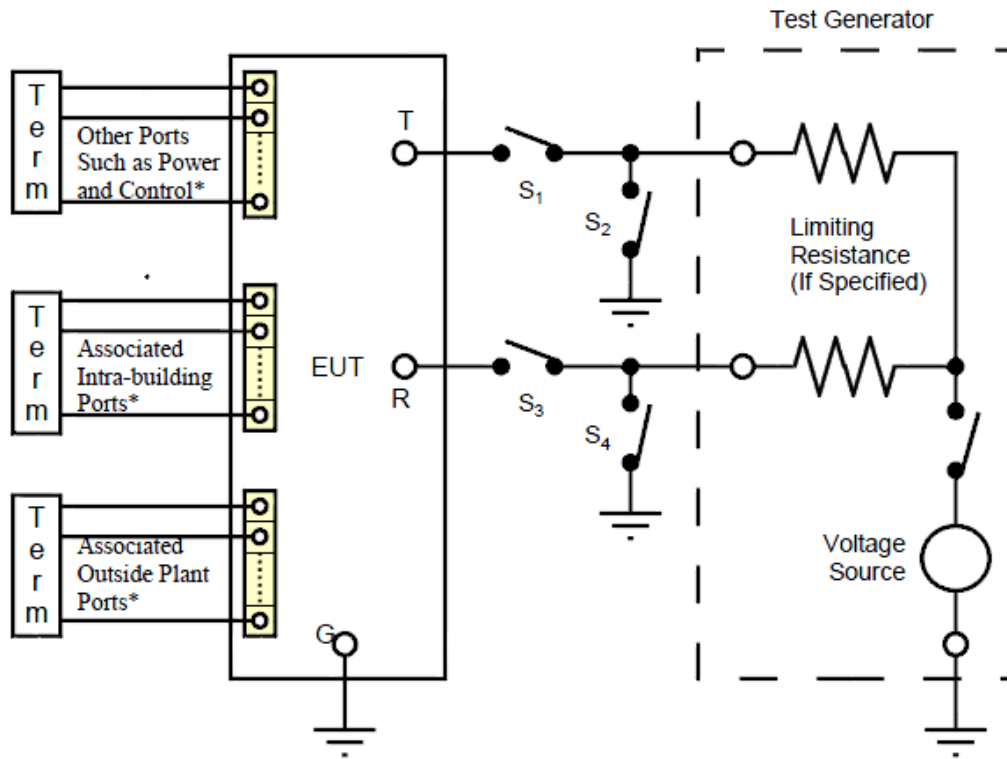
4. Power Cross Experiments in the manner of GR-1089 requirements

4.1. Experimental Setup

Power Cross was done in accordance with the test procedures of ITU-T K.21, ITU-T K.44 and GR-1089. This test is performed using a 600 V, 60 Hertz AC supply with a source (limiting) impedance of 600 Ohms for 1 second. The 600 Volt are applied both tip and ring in Longitudinal and 600 V Return/Ground connected to NID Ground terminal. In Metallic configuration, Tip is connected to 600 V and Ring is connected to 600 V Return/Ground and NID Ground terminal. The metallic configuration was repeated with Ring connected to 600 V and Tip is connected to 600 V Return/Ground and NID Ground terminal. The Bourns 7040-01-Z or 7040-01-x with TBU Station Protector NID box was between the Power Cross generator and the CPE equipment.

The xDSL equipment tested:
CISCO877

Figure 4-2 Application of Lightning and AC Power Fault Test Voltages



* Ports associated with the unit should be terminated as described in Section 4.6.2.

CONNECTIONS TO TEST GENERATOR

	S1	S2	S3	S4
T TO GENERATOR, R TO GROUND (Condition A1 of Table 4-1)	CLOSED	OPEN	OPEN	CLOSED
R TO GENERATOR, T TO GROUND (Condition A2 of Table 4-1)	OPEN	CLOSED	CLOSED	OPEN
T TO GENERATOR, R TO GENERATOR, SIMULTANEOUSLY (Condition A5 of Table 4-1)	CLOSED	OPEN	CLOSED	OPEN

4.2.Results

Results Summary:

Cisco877M failed with GDT Primary Protection 7040-01-Z or -W, but passes without GDT only Primary Protection, and passes with GDT-TBU Primary Protection.

Cisco877 Passed with all NIDs.

HWIC-1VDSL Passed with all NIDs.

EHWIC-VA-DSL-x Passed with all NIDs.

CISCO877 passed with no loss of performance. The CISCO877M with either the 7040-01-W or 7040-01-Z NID failed with either loss of performance leading to failure or failed with full loss of performance after one or two pulses.