

Surgelogic® Surge Protective Devices (SPDs)



ANSI/IEEE C62.41.1, C62.41.2 & C62.45 Surge Performance Testing

Test performance values contained within this document are representative of Square D® brand Surgelogic Surge Protective Devices (SPDs) when tested in accordance with the waveforms as defined in the ANSI/IEEE C62.41.2 – 1991 and 2002 standards.

The testing was conducted inside the Schneider Electric industry certified surge laboratory. Standard testing processes and procedures were followed.

The representative unit from each group (listed in italics) was tested in all of its modes of operation (L-N, L-G, N-G, L-L) and the let-through voltage recorded for each of the modes. The tables in this document provide these measured let-through values. The actual plots can be provided upon request.

TEST SETUP AND INFORMATION

Connection

- All integral and external panel type products (IMA, EMA, EBA) were connected using #6 AWG wire.
- Hard-Wired Assembly (HWA) products were connected using #10 AWG wire.

Surge Injection Phase Angle

The transient was injected at the 90° point of the sine wave unless otherwise noted.

Dynamic Testing

All testing was dynamic, applying the respective nominal system voltages.

Measurements

Measurements were taken with:

- 6" of lead outside the panels for external type products (EMA, EBA)
- 6" of lead from the nipple for the hard wired type products (HWA)
- Backplane connection points for the Internal/ Integral (IMA) products

Let-Through Values

- Recorded let-through values are the averaged value across the similar modes of a 3-phase system +/-10%. (L-N = Ave(L1L2L3-N), L-G = Ave(L1L2L3-G), L-L = Ave(L1L2, L2L3, L1L3)
- All let-through values are peak values referenced from the zero reference point or zero crossing (See Fig. 1).

Note

The voltage peak to which an SPD limits an incoming surge has been given or has taken on many different names, including: clamping voltage, surge residual, surge remnant, protection level, let through voltage and Voltage Protection Level (VPR). Even though all these terms are technically correct it is important when making any product comparison to understand how a manufacturer may be representing their performance numbers.

Table 1: Standard 0.5 micro second – 100 kHz Ring Wave

Category	Peak Voltage (kV)	Peak Current (kA)	Effective
A1*	2	0.067	30 Ohms
A	6	0.2	30 Ohms
B	6	0.5	12 Ohms

*A1-Ringwave used on sine wave tracking systems only

Table 2: Standard 1.2/50 micro second – 8/20 micro second Combination Wave

Category C	Voltage Peak (kV)	Peak Current (kA)
C (low)	6 (Minimum)	3 (Actual)
C (high)*	10 (Minimum)	10 (Actual)

*C (high) impulse testing was conducted at 20 kV, 10 kA

Figure 1

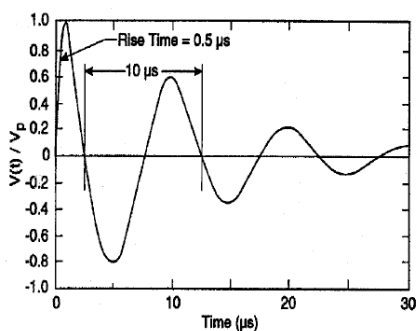
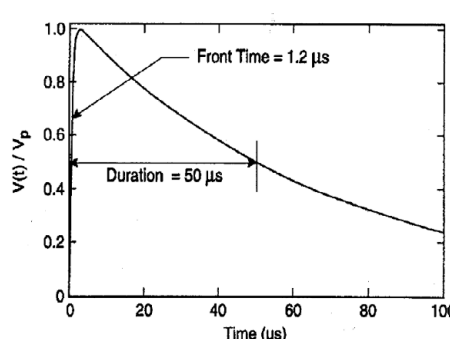


Figure 2



Let-Through Definition

For the purpose of this document we have also introduced the term “True Let-Through” (see Figure 3). True Let-Through we have defined as the amount of surge voltage above the nominal system voltage. If this value is needed for specification purposes it can be easily obtained by a simple calculation:

$$TLTV=LTV-Vnom$$

LTV – Let-Through Voltage
 TLTV – True Let-Through Voltage
 Vnom – Peak value of the nominal AC voltage

Example

An SPD used in a 120 Vac system with a Let-Through voltage of 370 Vac will have a “True Let-Through” voltage of: 370(LTV) – 170(Vnom) = 200 V.

CONTACT INFORMATION

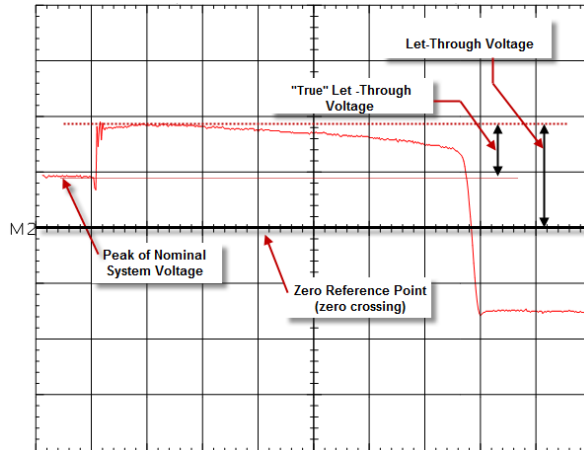
For additional information or supporting documentation regarding these tests please contact the SurgeLogic Technical Assistance Group.

Telephone: (800) 577-7353
 Email: tvsstag@us.schneider-electric.com

Table 3: Test Equipment

Manufacturer	Description	Model	Serial #	Last Cal.	Cal. Due
Tektronix	Oscilloscope	TDS3054B	B010034	3-24-2010	3-24-2011
Tektronix	High Voltage Probe	P0615A	B050063	3-24-2010	3-24-2011
Tektronix	High Voltage Probe	P0615A	B050064	3-23-2010	3-23-2011
Pearson	Current Transformer	101	108855	6-22-2010	6-22-2011
Pearson	Current Transformer	101	108856	7-19-2010	7-19-2011
Fluke	Digital Multi-meter	175	78590012	4-25-2010	4-25-2011
Haefley	Surge Generator	20430	Calibrated before each use		
Haefley	Surge Generator	P-8000	Calibrated before each use		

Figure 3



INTERNAL/INTEGRAL MODELS (IMA SERIES)

Voltages measured at the backplane

**Table 4: 120/240V and 208Y/120V 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
369	375	399		420	428	455		429	428	468		607	627	650	

Internal (panelboards/switchboards/ switchgear)	I-Line Plug-on	QMB Plug-on	MCC	Busway
TVS1/IMA12 TVS1/IMA16 TVS1/IMA24 TVS2/IMA12 TVS2/IMA16 TVS2/IMA24	HL1/IMA12 HL1/IMA16 HL1/IMA24 HL2/IMA12 HL2/IMA16 HL2/IMA24 F1/IMA12 F1/IMA16 F1/IMA24 F2/IMA12 F2/IMA16 F2/IMA24	QMB2/IMA12 QMB2/IMA16 QMB2/IMA24	MCC2/IMA12 MCC2/IMA16 MCC2/IMA24	PIU2/IMA12 PIU2/IMA16 PIU2/IMA24

**Table 5: 120/240V and 208Y/120V 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
384	387	355	670	408	392	391	723	427	416	407	743	583	520	523	863

Internal (panelboards/switchboards/ switchgear)
TVS1/IMA32 TVS1/IMA48 TVS2/IMA36 TVS2/IMA48

**Table 6: 240/120V High-leg Delta 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
369	375	355		420	428	391		429	428	407		607	627	523	
668	655	355		783	703	391		767	763	407		990	990	523	

Row 1 = 120 V leg, Row 2 = 240 V leg

Internal (panelboards/switchboards/ switchgear)	I-Line Plug-on	QMB Plug-on	MCC	Busway
TVS3/IMA12 TVS3/IMA16 TVS3/IMA24	HL3/IMA12 HL3/IMA16 HL3/IMA24 F3/IMA12 F3/IMA16 F3/IMA24	QMB3/IMA12 QMB3/IMA16 QMB3/IMA24	MCC3/IMA12 MCC3/IMA16 MCC3/IMA24	PIU3/IMA12 PIU3/IMA16 PIU3/IMA24

INTERNAL/INTEGRAL MODELS (IMA SERIES)

**Table 7: 240/120V High-leg Delta 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
384	387	356	670	408	392	400	723	427	416	423	743	583	520	523	863
635	628	356	903	683	680	400	945	727	707	423	1008	873	890	523	1070

Row 1 = 120 V leg, Row 2 = 240 V leg

Internal
(panelboards/switchboards/
switchgear)

TVS3/IMA32
TVS3/IMA48

**Table 8: 480Y/277V 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
780	773	793		823	827	780		913	880	930		1057	1070	1160	

Internal
(panelboards/switchboards/
switchgear)

TVS4/IMA12
TVS4/IMA16
TVS4/IMA24

I-Line Plug-on

HL4/IMA12
HL4/IMA16
HL4/IMA24
FI4/IMA12
FI4/IMA16
FI4/IMA24

QMB Plug-on

QMB4/IMA12
QMB4/IMA16
QMB4/IMA24

MCC

MCC4/IMA12
MCC4/IMA16
MCC4/IMA24

Busway

PIU4/IMA12
PIU4/IMA16
PIU4/IMA24

**Table 9: 480Y/277V 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
750	757	793	1390	823	807	893	1450	853	853	887	1523	997	963	937	1693

Internal
(panelboards/switchboards/
switchgear)

TVS4/IMA32
TVS4/IMA48

INTERNAL/INTEGRAL MODELS (IMA SERIES)

**Table 10: 600Y/347 V 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
983	970	1043		1053	1080	1107		1093	1113	1173		1327	1327	1437	

Internal (panelboards/switchboards/ switchgear)	I-Line Plug-on	QMB Plug-on	MCC	Busway
TVS8IMA12 TVS8IMA16 TVS8IMA24	F8IMA12 F8IMA16 F8IMA24	QMB8IMA12 QMB8IMA16 QMB8IMA24	MCC8IMA12 MCC8IMA16 MCC8IMA24	PIU8IMA12 PIU8IMA16 PIU8IMA24

**Table 11: 600Y/347V 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
960	973	887	1793	977	1003	920	1813	1040	1083	1050	1930	1210	1197	1070	2167

Internal (panelboards/switchboards/ switchgear)
TVS8IMA32 TVS8IMA48

EXTERNAL PANEL MOUNT MODELS (EMA, EBA SERIES)

Voltages measured with 6 inches of lead outside housing

**Table 12: 120/240V and 208Y/120V 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
489	496	457	833	640	679	633	993	605	621	600	943	1090	1057	1023	1640
TVS1EMA12A TVS1EMA16A TVS1EMA24A				TVS1EBA12A TVS1EBA16A TVS1EBA24A				TVS2EMA12A TVS2EMA16A TVS2EMA24A				TVS2EBA12A TVS2EBA16A TVS2EBA24A			

**Table 13: 120/240 V and 208Y/120V 120 kA - 240 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
523	543	505	873	740	783	740	1067	673	678	667	997	1527	1497	1467	1993
TVS1EMA12AI TVS1EMA16AI TVS1EMA24AI				TVS1EBA12AI TVS1EBA16AI TVS1EBA24AI				TVS2EMA12AI TVS2EMA16AI TVS2EMA24AI				TVS2EBA12AI TVS2EBA16AI TVS2EBA24AI			

**Table 14: 120/240 V and 208Y/120V 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
513	533	425	817	720	760	700	1007	663	639	619	950	1417	1257	1283	1743
TVS1EMA32A TVS1EMA48A				TVS2EMA32A TVS2EMA48A											

**Table 15: 120/240 V and 208Y/120V 320 kA - 480 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
556	556	465	867	850	840	747	1107	737	743	677	1043	1680	1713	1543	2037
TVS1EMA32AI TVS1EMA48AI				TVS2EMA32AI TVS2EMA48AI											

EXTERNAL PANEL MOUNT MODELS (EMA, EBA SERIES)

**Table 16: 240/120V High-leg Delta 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
489	496	457	833	640	679	633	993	605	621	600	943	1090	1057	1023	1640
757	773	485	1083	960	1027	677	1290	927	937	623	1250	1577	1610	1270	1905

Row 1 = 120 V leg, Row 2 = 240 V leg

TVS3EMA12A TVS3EBA12A
TVS3EMA16A TVS3EBA16A
TVS3EMA24A TVS3EBA24A

**Table 17: 240/120V High-leg Delta 120 kA - 240 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
523	543	505	873	740	783	740	1067	673	678	667	997	1527	1497	1467	1993
867	870	573	965	1147	1167	843	1402	1057	1070	757	1315	2030	2000	1693	2220

Row 1 = 120 V leg, Row 2 = 240 V leg

TVS3EMA12AI TVS3EBA12AI
TVS3EMA16AI TVS3EBA16AI
TVS3EMA24AI TVS3EBA24AI

**Table 18: 240/120V High-leg Delta 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
513	533	425	817	720	760	700	1007	663	639	619	950	1417	1257	1283	1743
800	817	493	1075	1050	1080	813	1325	987	993	700	1258	1987	1920	1530	1987

Row 1 = 120 V leg, Row 2 = 240 V leg

TVS3EMA32A
TVS3EMA48A

**Table 19: 240/120V High-leg Delta 320 kA - 480 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
556	556	465	867	850	840	747	1107	737	743	677	1043	1680	1713	1543	2037
860	853	507	1093	1173	1160	840	1405	1063	1053	737	1300	2230	2280	1797	2287

Row 1 = 120 V leg, Row 2 = 240 V leg

TVS3EMA32AI
TVS3EMA48AI

EXTERNAL PANEL MOUNT MODELS (EMA, EBA SERIES)

**Table 20: 480Y/277V 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
840	857	860	1550	997	1013	1043	1727	997	1007	973	1723	1673	1660	1623	2513

TVS4EMA12A
TVS4EMA16A
TVS4EMA24A

TVS4EBA12A
TVS4EBA16A
TVS4EBA24A

**Table 21: 480Y/277V 120 kA - 240 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
900	897	807	1603	1117	1040	970	1823	1060	1057	1030	1797	1990	1997	1950	2833

TVS4EMA12AI
TVS4EMA16AI
TVS4EMA24AI

TVS4EBA12AI
TVS4EBA16AI
TVS4EBA24AI

**Table 22: 480Y/277V 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
840	850	807	1550	1093	1063	1030	1793	1023	1017	917	1707	1917	1777	1640	2613

TVS4EMA32A
TVS4EMA48A

**Table 23: 480Y/277V 320 kA - 480 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
937	973	883	1590	1193	1233	1147	1817	1093	1130	1050	1777	2230	2317	2133	2813

TVS4EMA32AI
TVS4EMA48AI

EXTERNAL PANEL MOUNT MODELS (EMA, EBA SERIES)

**Table 24: 600Y/347V 120 kA - 240 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
1100	1107	1090	1967	1323	1327	1267	2180	1233	1260	1197	2167	1947	1953	1870	2967

TVS8EMA12A
TVS8EMA16A
TVS8EMA24A

TVS8EBA12A
TVS8EBA16A
TVS8EBA24A

**Table 25: 600Y/347V 120 kA - 240 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
1167	1160	1130	2000	1397	1400	1353	2233	1350	1327	1287	2203	2373	2307	2147	3313

TVS8EMA12AI
TVS8EMA16AI
TVS8EMA24AI

TVS8EBA12AI
TVS8EBA16AI
TVS8EBA24AI

**Table 26: 600Y/347V 320 kA - 480 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
1123	1130	1013	1937	1323	1343	1263	2127	884	1267	1247	2107	2227	2073	1913	3027

TVS8EMA32A
TVS8EMA48A

**Table 27: 600Y/347V 320 kA - 480 kA with Integral Switch
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
1137	1160	1050	1960	1433	1460	1343	2200	1340	1347	2187	1303	2387	2407	2207	3267

TVS8EMA32AI
TVS8EMA48AI

EXTERNAL PANEL MOUNT 10-MODE MODELS (MEMA SERIES)

Voltages measured with 6 inches of lead outside housing

**Table 28: 208Y/120V 120 kA - 360 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
591	597	520	850	833	860	707	1057	730	733	617	953	1757	1647	1380	1750

TVS2MEMA12A
TVS2MEMA18A
TVS2MEMA27A
TVS2MEMA36A

**Table 29: 208Y/120V 120 kA - 360 kA with Sine Wave Tracking
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
427	520	520	547	677	733	707	807	707	733	617	980	1717	1647	1380	1750

TVS2MEMA12ASWT
TVS2MEMA18ASWT
TVS2MEMA27ASWT
TVS2MEMA36ASWT

**Table 30: 208Y/120V 120 kA - 360 kA with Sine Wave Tracking
IEEE C62.41.2 A1 Ringwave (100 kHz)**

2 kV, 67A @ 90°		2 kV, 67A @ 180°		2 kV, 67A @ 270°	
L-N	L-G	N-G	L-L	L-N	L-G
88	85	88	81	88	85

Values shown in Table 30 reference true let-through

TVS2MEMA12ASWT
TVS2MEMA18ASWT
TVS2MEMA27ASWT
TVS2MEMA36ASWT

EXTERNAL PANEL MOUNT 10-MODE MODELS (MEMA SERIES)

Voltages measured with 6 inches of lead outside housing

**Table 31: 480Y/277V 120 kA - 360 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
923	947	880	1390	1157	1140	1060	1647	1130	1093	1000	1643	2173	2107	1840	2560

TVS4MEMA12A
TVS4MEMA18A
TVS4MEMA27A
TVS4MEMA36A

**Table 32: 480Y/277V 120 kA - 360 kA with Sine Wave Tracking
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
690	947	880	917	997	810	1060	1177	1070	1093	1000	1693	2160	2107	1840	2587

TVS4MEMA12ASWT
TVS4MEMA18ASWT
TVS4MEMA27ASWT
TVS4MEMA36ASWT

**Table 33: 480Y/277V 120 kA - 360 kA with Sine Wave Tracking
IEEE C62.41.2 A1 Ringwave (100 kHz)**

2 kV, 67A @ 90°		2 kV, 67A @ 180°		2 kV, 67A @ 270°	
L-N	L-G	N-G	L-L	L-N	L-G
88	80	85	80	87	81

Values shown in Table 30 reference true let-through

TVS4MEMA12ASWT
TVS4MEMA18ASWT
TVS4MEMA27ASWT
TVS4MEMA36ASWT

HARDWIRE NIPPLE MODELS (HWA SERIES)

Voltages measured with 6 inches of lead

**Table 34: 120/240V and 208Y/120V 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
423	547	512	797	680	843	743	1070	923	1143	673	1317	1813	2093	1370	2193

TVS1HWA50X
TVS1HWA80X
TVS1HWA10X

TVS2HWA50X
TVS2HWA80X
TVS2HWA10X

**Table 35: 240/120V High-leg Delta 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
423	547	512	797	680	843	743	1070	923	1143	673	1317	1813	2093	1370	2193
577	635	515	877	870	980	720	1250	1183	1490	1603	673	2127	2393	1347	2467

Row 1 = 120 V leg, Row 2 = 240 V leg

TVS3HWA50X
TVS3HWA80X
TVS3HWA10X

**Table 36: 480Y/277V 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
663	960	887	1163	890	1327	1073	1660	1217	2020	1037	2100	2207	3007	1827	3173

TVS4HWA50X
TVS4HWA80X
TVS4HWA10X

**Table 37: 480V Delta 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
			1313				2080				2613				3760

TVS5HWA50X
TVS5HWA80X
TVS5HWA10X

HARDWIRE NIPPLE MODELS (HWA SERIES)

**Table 38: 240V Delta 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
			883				1110				1387				2160

TVS6HWA50X
TVS6HWA80X
TVS6HWA10X

**Table 39: 600Y/347V 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
723	1157	1107	1313	1083	1497	1277	2080	1570	2527	1303	2613	2507	3547	2093	3760

TVS8HWA50X
TVS8HWA80X
TVS8HWA10X

**Table 40: 600V Delta 50 kA - 100 kA
IEEE C62.41.2-2002 Waveform Let-Through Voltages**

Category A Ringwave (6 kV, 200 A) 100 kHz				Category B Ringwave (6 kV, 500 A) 100 kHz				Category C (low) Impulse (6 kV, 3 kA)				Category C (high) Impulse (20 kV, 10 kA)			
L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L	L-N	L-G	N-G	L-L
			1313				2080				2613				3760

TVS9HWA50X
TVS9HWA80X
TVS9HWA10X