

**TECHNICAL DATA**

**DATASHEET SCP-5282-300-450-3, Preliminary**

**High Voltage, 300V, High Pulse Power Transorb**

(For 210 V Line to Line 3-phase Applications)

Application:

- Stand-Off Voltage of +/- 300V DC systems, or 212V rms Line to Line 3-phase.
- Stand-Off Voltage of +/- 180V DC systems, or 127V rms Line to Neutral 3-phase
- Bi-Directional for AC systems.
- Three Phase TVS Protection for each Line to Line and Line to Neutral.

Protection Level:

- Capable of handling 10/1000µs single pulse up to I<sub>PP</sub>, Tested at 1200 A
- Capable of handling 5 pulses of I<sub>PP</sub>, 10/1000µs pulse, with 5 sec intervals.
- **SCP-5282-300-450-3** is designed to meet MIL-STD-1399 voltage spike requirements for 115V systems under the following conditions:
  - ✓ 1000V spike, 1 ohm source impedance, up to 50usec, per FIGURE 6 of MIL-STD-1399. At least one TVS unit of **SCP-5282-300-450-3** is needed. The corresponding spike peak current is ~ 621A, and the clamping voltage is 378V.
- **SCP-5282-300-450-3** is designed to meet MIL-STD-704 voltage requirements for 115Vac systems under the following conditions:
  - ✓ The typical breakdown voltage at 338V peak is 1mA, or ~ 239V rms line to line.
  - ✓ Notice that for AC systems, source inductance will be the main current limiting element during voltage surges. In the next example, assume that the source inductance is 50 uH, and source resistance is 0.1 ohm.
  - ✓ 180Vrms line to neutral (312Vrms line to line ) voltage surge, 50uH source inductance. The corresponding peak current is ~ 150A, and the clamping line to neutral peak voltage is 225V as shown in Fig. 2.
- **SCP-5282-300-450-3** is designed to meet DO-160 Induced Lightning, Section 22, Table 22-2 at above level 4 (Voc/Isc = 750V/750A, waveform 5B), Figure 22-5 and Figure 22-7.
- **SCP-5282-300-450-3** is designed to meet DO-160 Induced Lightning, Section 22, Table 22-2 at level 5 (Voc/Isc = 1600V/1600A, waveform 5B), Figure 22-5 and Figure 22-7.

Key Features:

- Increase system reliability through eliminating avalanche of sensitive components.
- Line to Neutral Clamping below 253V, and Line to Line Clamping below 421V, at 1100A for 10/1000µs pulse.
- High Pulse Power Capability
- MTBF (MIL STD 217F amended to reflect ANSI Vita S1.0-2008 (2013): 84818 hours for AUC environment and 50°C temperature

**Part Number Ordering:**

Part Number	Bi-Directional
SCP-5282-300-450-3	X

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TECHNICAL DATA @ 25°C

Rating	Condition	Symbol	Min	Max	Units
Peak Pulse Power Dissipation Line to Line Line to Neutral	10/1000 usec waveform, 5 pulses in 10 sec	$P_{pk}$	-	450 275	KW
Device Energy Capability Line to Line Line to Neutral	5 pulses in 10 sec	$E$		3200 2000	Joules
Line to Line DC Stand-Off Voltage AC Vrms	-	$V_{WM}$	-	300 212	V dc V rms
Line to Neutral DC Stand-Off Voltage AC Vrms	-	$V_{WM}$	-	180 127	V dc V rms
Reverse Leakage	@ $V_{WM}$ dc	$I_D$	-	50	$\mu$ A dc
Breakdown Voltage <sup>(1)(2)</sup> Line to Line peak (338V typical) Line to Neutral peak (203V typical)	@ 1 mA	$V_{(BR)}$	328 197	350 210	Volts
Clamping Voltage <sup>(3)</sup> Line to Line peak Line to Neutral peak	@ $I_{PP}$	$V_C$	-	421 253	Volts
Peak Pulse Current <sup>(3)</sup> Line to Line peak Line to Neutral peak	10/1000 usec waveform, 5 pulses in 10 sec	$I_{PP}$		1100	Amps
TVS Resistance Line to Line Line to Neutral	at 1100A	$R_S$ (Typical)		0.0647 0.0388	Ohms
Operating & Storage Temp.	-	Top & Tstg	-55	+ 150	°C

- (1) Breakdown voltage can be trimmed down by 15V (by shorting trimming terminals Pins 1,&2 in Fig 7).
- (1) Breakdown voltage can be trimmed down by 15V (by shorting trimming terminals Pins 3,&4 in Fig 7).
- (2) To calculate VBR vs. junction temperature, use the following formula:  
VBR at TJ = VBR at 25 °C x (1 +  $\alpha T$  x (TJ - 25)), where  $\alpha T$  is typically 0.001/°C.
- (3) Peak Current  $I_P$  at any line to line spike voltage, with a source resistance of  $R_{SP}$ , is  $(V_S - 338V)/(R_S + R_{SP})$ , the corresponding TVS maximum clamping voltage is  $(338 + I_P \cdot R_S)$

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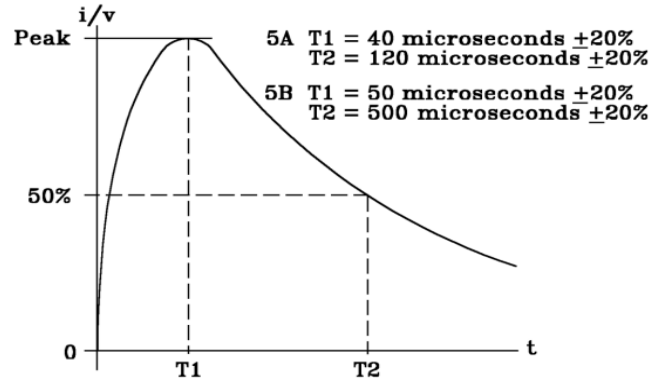


Figure 22-5 Current/Voltage Waveform 5

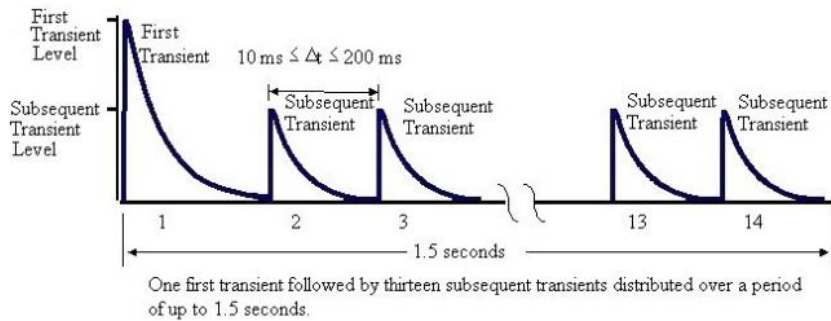


Figure 22-7 Multiple Stroke Application

Table 22-2 Generator Setting Levels for Pin Injection

Level	Waveforms		
	3/3 Voc/Isc	4/1 Voc/Isc	5A/5A Voc/Isc
1	100/4	50/10	50/50
2	250/10	125/25	125/125
3	600/24	300/60	300/300
4	1500/60	750/150	750/750
5	3200/128	1600/320	1600/1600

NOTES:

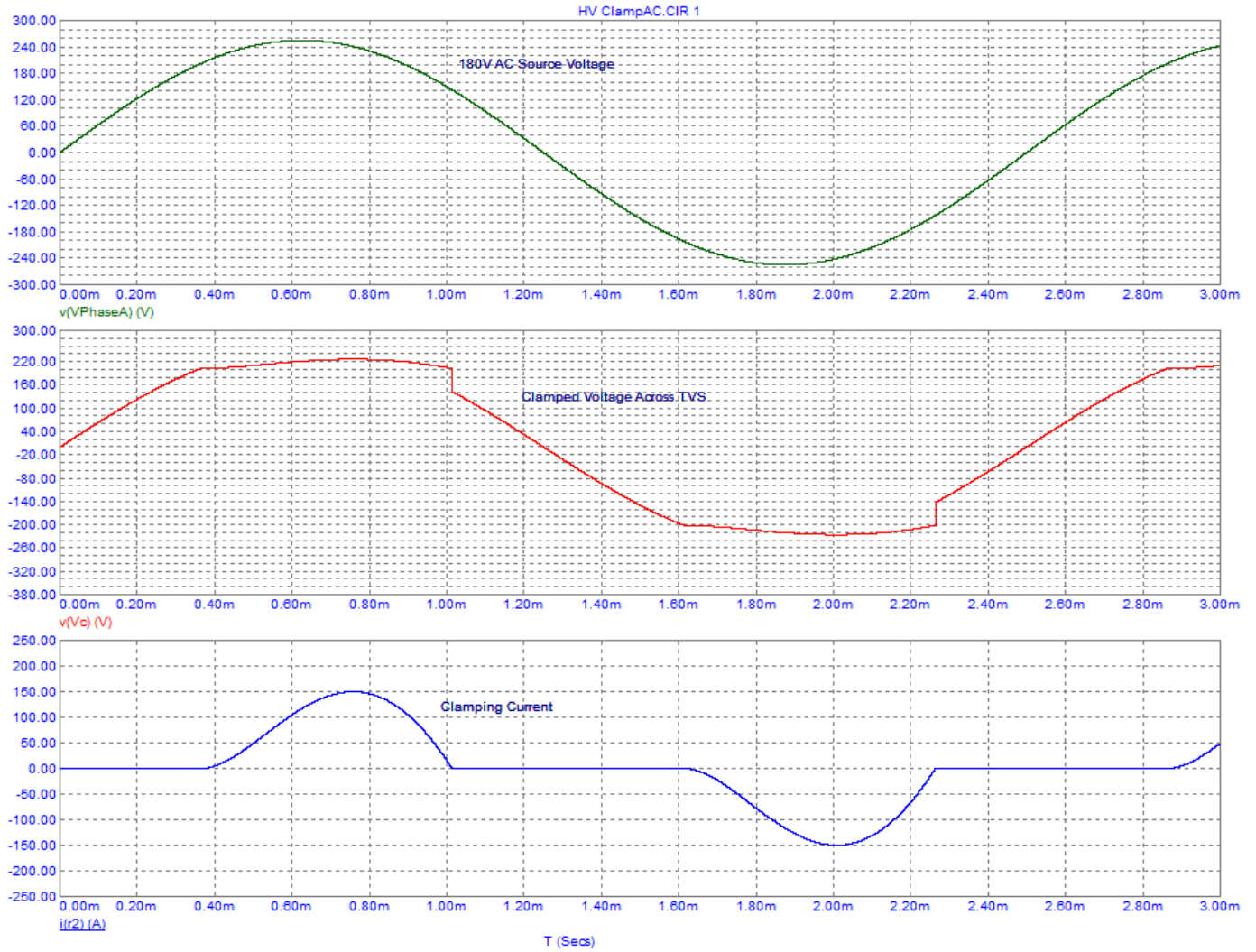
- Voc = Peak Open Circuit Voltage (Volts) available at the calibration point shown in Figure 22-10, Figure 22-11, or Figure 22-12.
- Isc = Peak Short Circuit Current (Amps) available at the calibration point shown in Figure 22-10, Figure 22-11, or Figure 22-12.
- Amplitude Tolerances +10%, -0%.
- The ratio of Voc to Isc is the generator source impedance to be used during the calibration procedure.
- Waveforms 3, 4 and 5A are identified in Figure 22-3, Figure 22-4 and Figure 22-5.

**DO-160 Section 22 Test Waveforms**  
**Fig. 1**

## Application Examples

- SCP-5282-300-450-3 is designed to meet DO-160 Induced Lightning, Section 22, Table 22-2 at above level 4 ( $V_{oc}/I_{sc} = 750V/750A$ , waveform 5B), Figure 22-5 and Figure 22-7.
  - Assume a Line to Neutral surge. At 750V spike with waveform per Figure 22-5, level 5B, and 1 ohm source impedance, the peak surge current will be 527A. The corresponding peak clamped voltage will be  $203V + 0.0388 \text{ ohms} \cdot 527A = 223V$ . The total energy absorbed by the TVS will be ~ 85 Joules in the first pulse of Figure 22-7. The following pulses peak current will be below 166A, peak clamping voltage 209V, TVS energy will be 25 Joules. The total TVS energy will be  $85 + 13 \cdot 25 = 410$  Joules, this is within the device capability of 2000 Joules.
  - Assume a Line to Line surge. At 750V spike with waveform per Figure 22-5, level 5B, and 1 ohm source impedance, the peak surge current will be 387A. The corresponding peak clamped voltage will be  $338V + 0.0647 \text{ ohms} \cdot 387A = 363V$ . The total energy absorbed by the TVS will be ~ 101 Joules in the first pulse of Figure 22-7. The following pulses peak current will be below 35A, peak clamping voltage 340V, TVS energy will be 9 Joules. The total TVS energy will be  $101 + 13 \cdot 9 = 218$  Joules, this is within the device capability of 3200 Joules.
- SCP-5282-180-260 is designed to meet DO-160 Induced Lightning, Section 22, Table 22-2 at level 5 ( $V_{oc}/I_{sc} = 1600V/1600A$ , waveform 5B), Figure 22-5 and Figure 22-7.
  - Assume a Line to Neutral surge. At 1600V spike with waveform per Figure 22-5, level 5B, and 1 ohm source impedance, the peak surge current will be 1345A. The corresponding peak clamped voltage will be 255V. The total energy absorbed by the TVS will be ~ 248 Joules in the first pulse of Figure 22-7. The following pulses peak current will be 575A, peak clamping voltage 225V, TVS energy will be 93 Joules. The total TVS energy will be  $248 + 13 \cdot 93 = 1457$  Joules, this is within the device capability of 2000 Joules.
  - Assume a Line to Line surge. At 1600V spike with waveform per Figure 22-5, level 5B, and 1 ohm source impedance, the peak surge current will be 1185A. The corresponding peak Line to Line clamped voltage will be 415V. The total energy absorbed by the TVS will be ~ 355 Joules in the first pulse of Figure 22-7. The following pulses peak current will be 334A, peak clamping voltage 366V, TVS energy will be 88 Joules. The total TVS energy will be  $355 + 13 \cdot 88 = 1499$  Joules, this is within the device capability of 3200 Joules.

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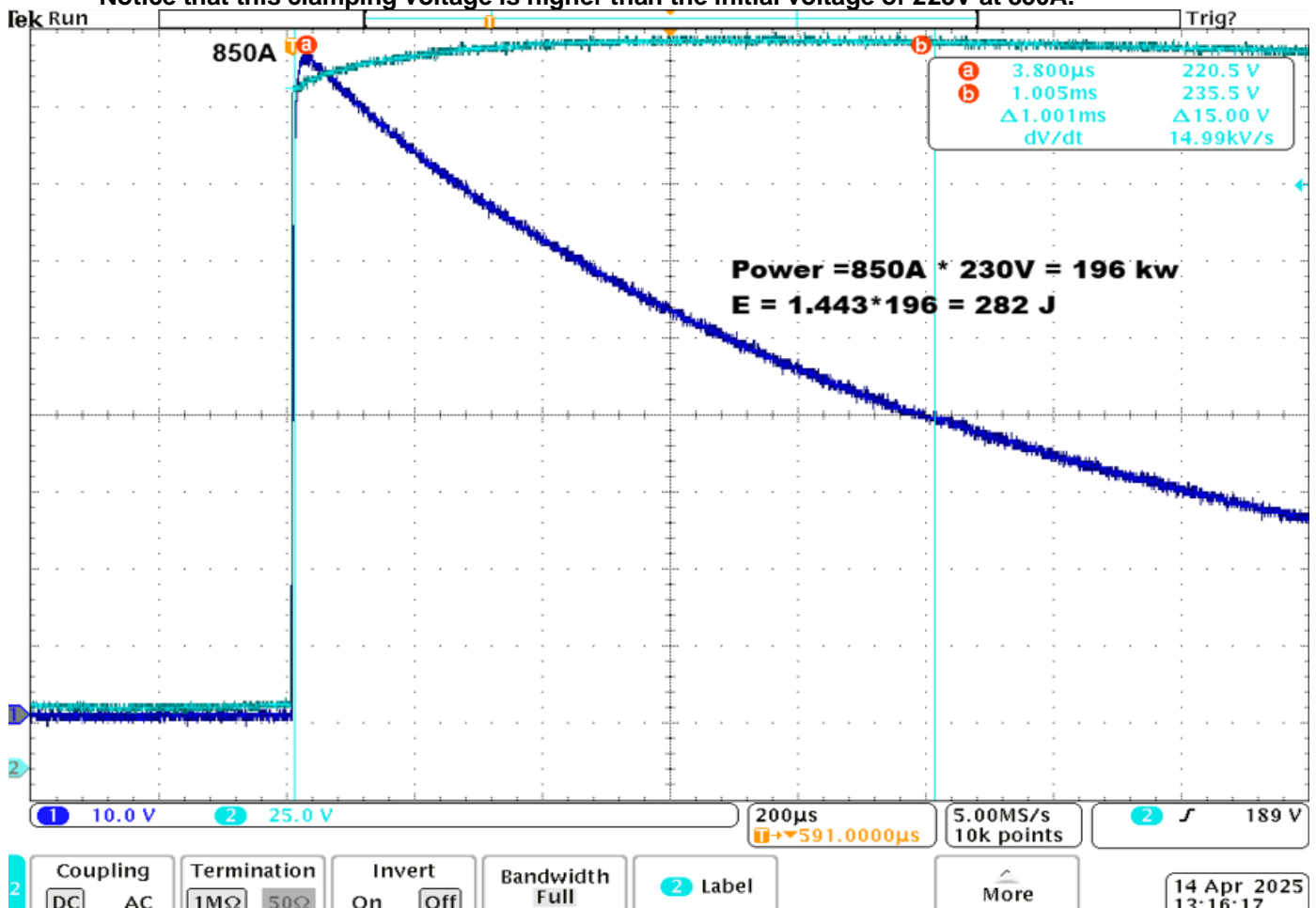
**180Vrms (Line to Neutral Surge), 400Hz, AC Source Surge Voltage and  
Clamped Voltage & Current Waveforms  
(Assuming Source Inductance is 50uH Per Phase)  
Fig. 2**

## Preliminary Line to Neutral Surge Test Data

Line to Neutral Breakdown Voltage is 203V.  
Line to Line Breakdown Voltage is 338V.

- Figure 3 shows test waveforms for 10/1000 usec waveform for Line to Neutral Surge.
- The peak current is 850A
- Peak Pulse Power  $850A * 230V = 196 \text{ Kwatt}$
- Due to junction heating, the maximum clamping voltage is 235V.
- Per 10/1000 usec pulse energy  $= 1.443 * 196 = 282 \text{ Joules}$ .

Due to the effect of junction heating, the maximum clamped voltage at 400A, after ~ 500 us, is 235V.  
Notice that this clamping voltage is higher than the initial voltage of 223V at 850A.

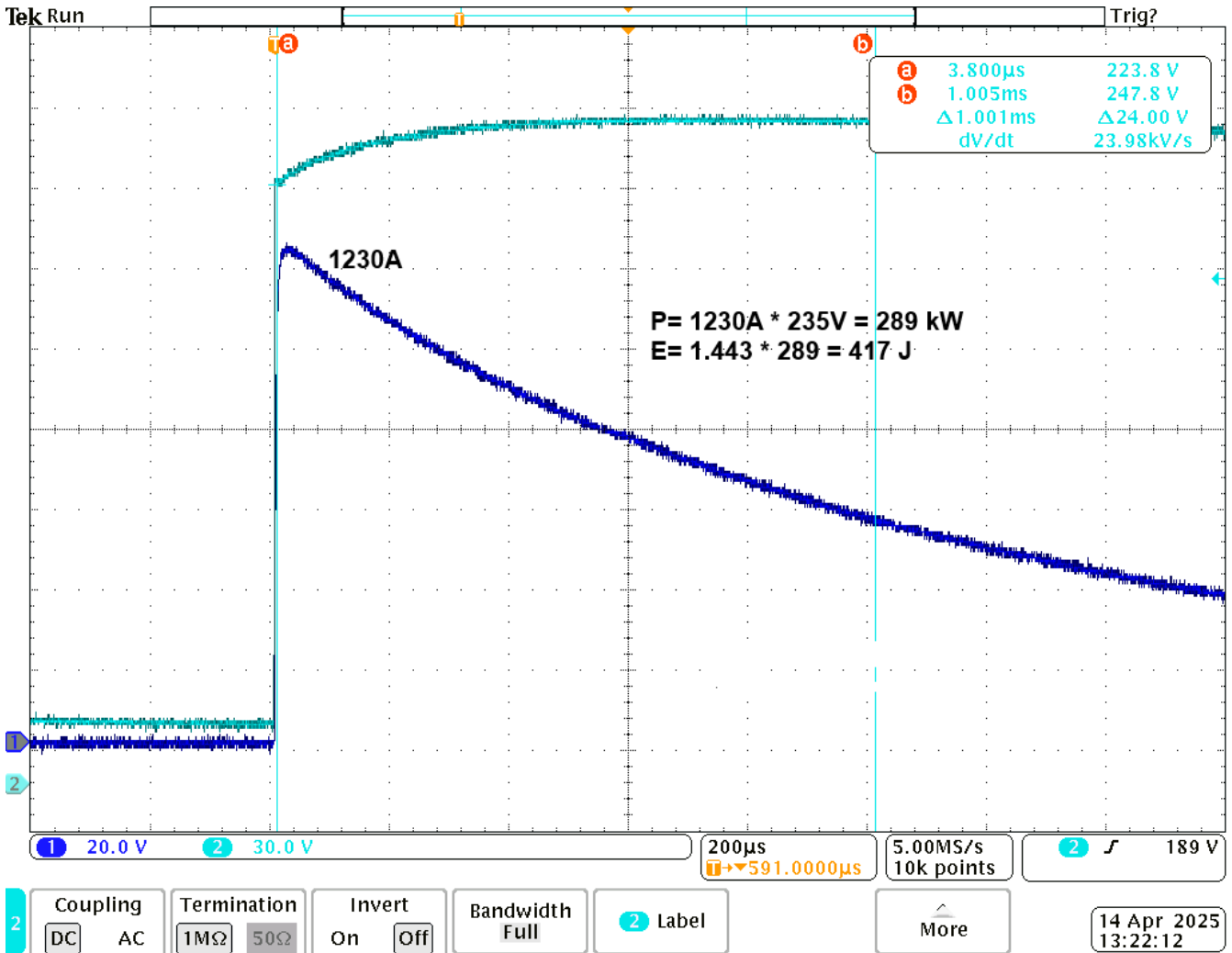


**Voltage & Current Waveforms During Voltage Clamp at 850A  
(10/1000 usec Waveform)  
Fig. 3**

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- Figure 4 shows test waveforms for 10/1000 usec waveform for Line to Neutral Surge.
- The measured peak current is 1230A (current scale is 10A/V).
- The measured clamping voltage is 223V at 1230A.
- The corresponding Power Loss is 274 KW
- The corresponding TVS Energy is  $1.443 \times 274 = 395$  Joules

Due to the effect of junction heating, the Maximum clamped voltage at 800A , after ~ 500 us, is 247V. Notice that this clamping voltage is higher than the initial voltage of 223V at 1230A.

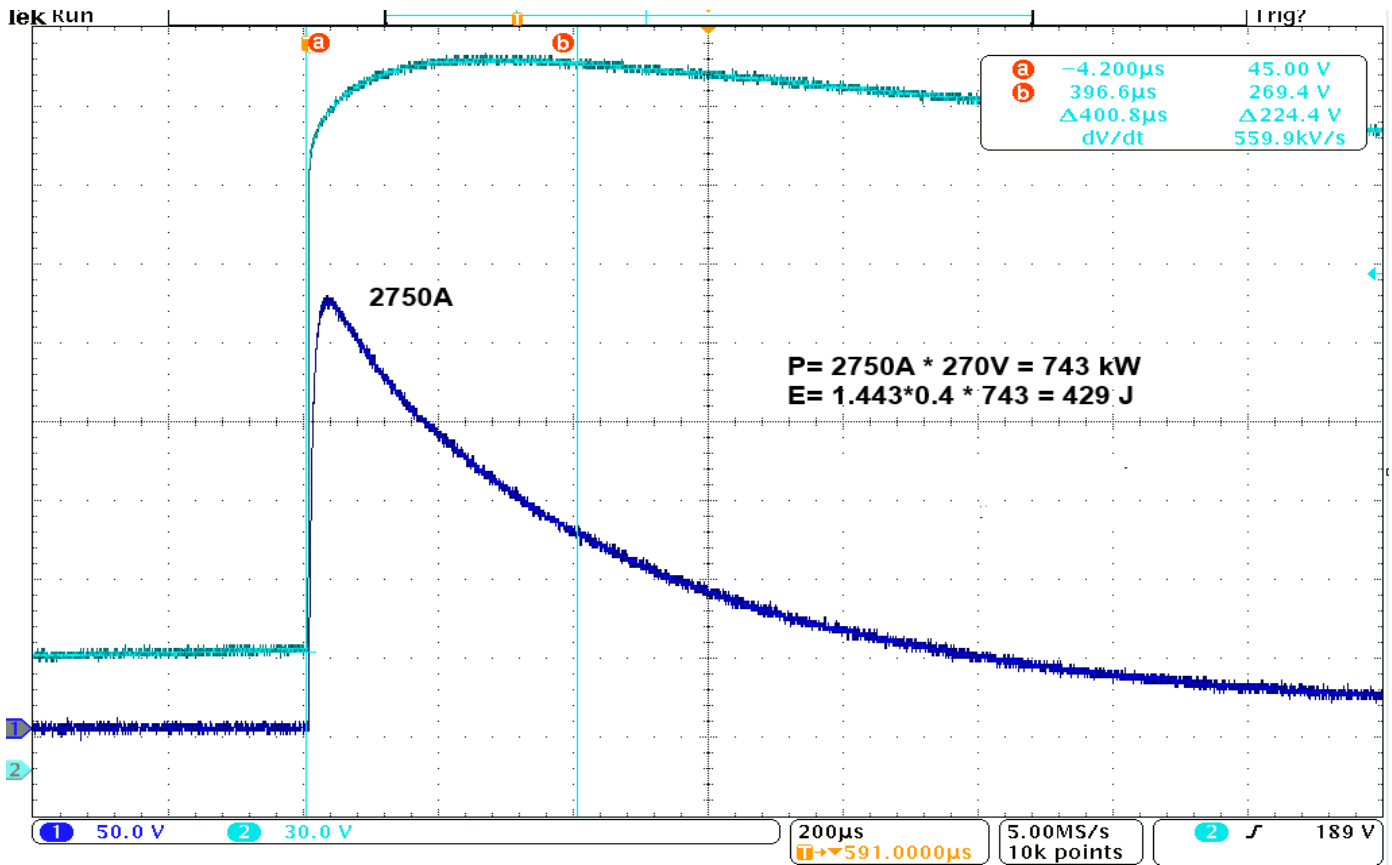


**Voltage & Current Waveforms During Voltage Clamp at 1230A  
(10/1000 usec Waveform)  
Fig. 4**

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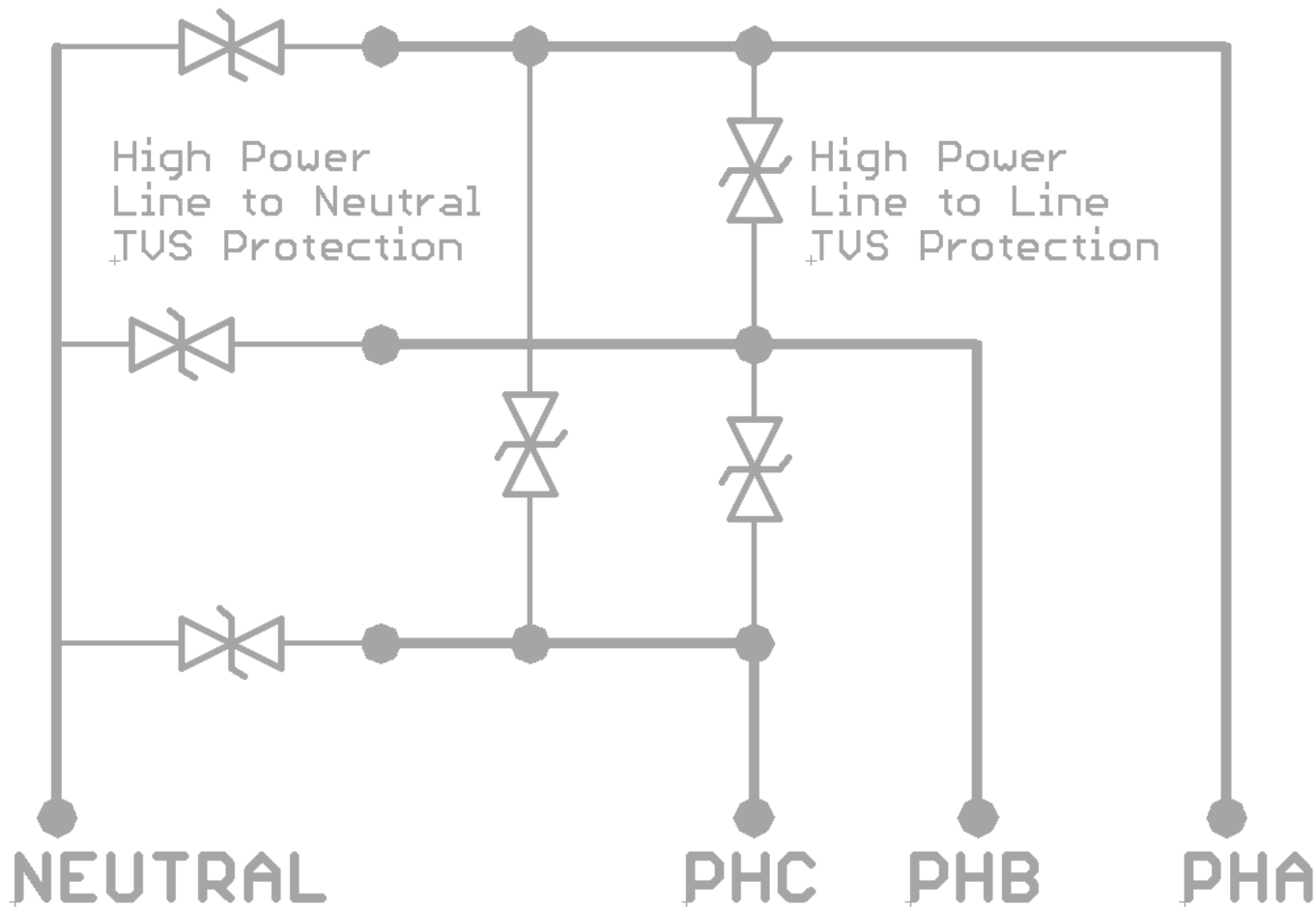
- Figure 5 shows test waveforms for 10/400 usec waveform for Line to Neutral Surge.
- The measured peak current is 2750A (current scale is 10A/V).
- The measured clamping voltage is 270V at 2750A.
- The corresponding Power Loss is 743 kW
- The corresponding TVS Energy is  $1.443 \times 0.4 \times 743 = 429$  Joules

Due to the effect of junction heating, the Maximum clamped voltage at 1300A , after ~ 300 us, is 270V. Notice that this clamping voltage is higher than the initial voltage of 230V at 2750A.



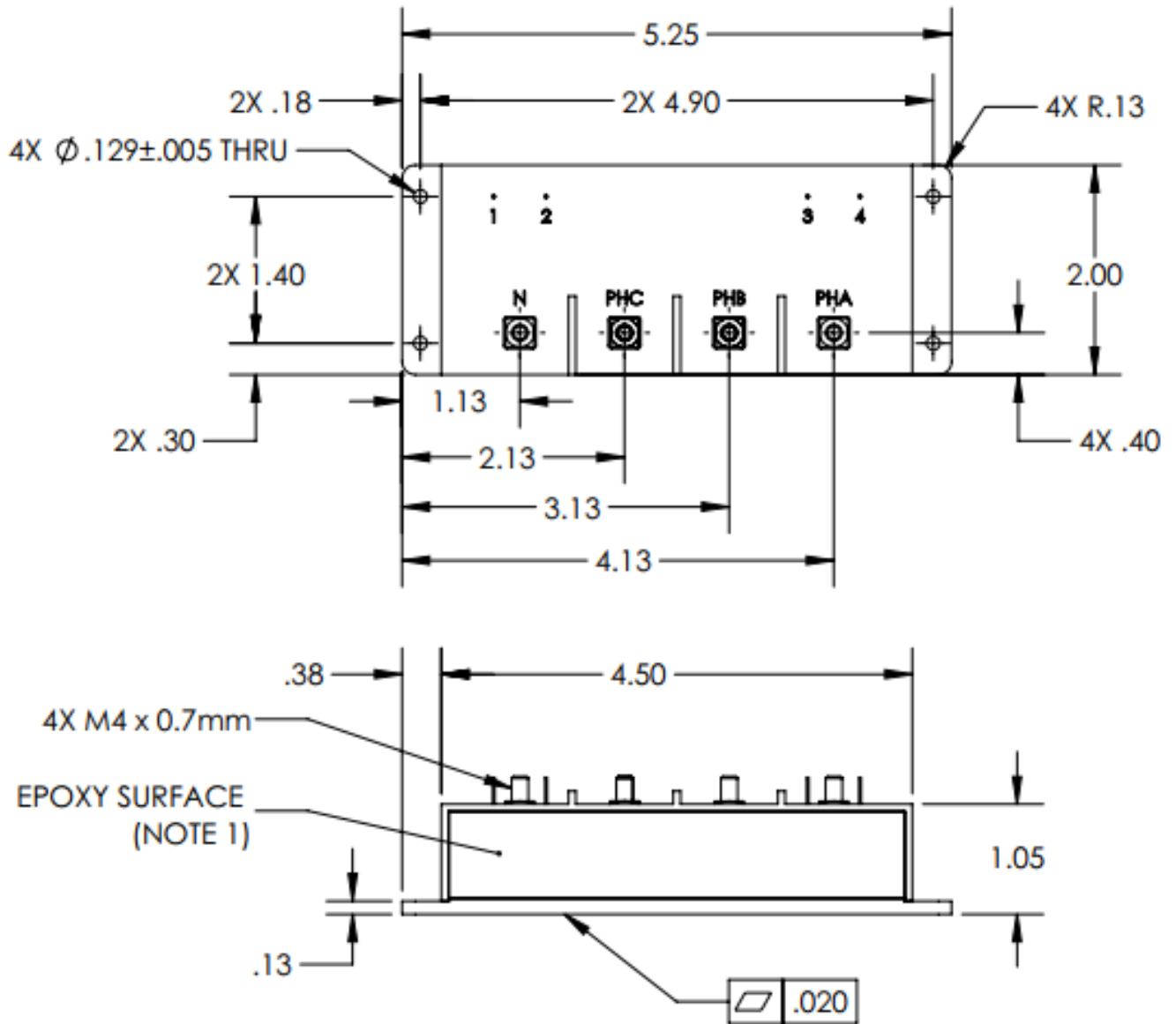
**Voltage & Current Waveforms During Voltage Clamp at 2750A  
(10/1000 usec Waveform)  
Fig. 5**

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**Fig. 6 Three Phase TVS Module Symbol  
(Line to Line & Line to Neutral Protection)**

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NOTES:

1. POTTING SURFACE UNCONTROLLED.
2. DIMENSIONS UNLESS OTHERWISE NOTED ARE IN INCHES.
3. TOLERANCE UNLESS OTHERWISE SPECIFIED:  $\pm .02$

**Fig. 7 Preliminary Package Outline**

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