



ACTP250J1BJ

## BIDIRECTIONAL THYRISTOR OVERVOLTAGE PROTECTORS

### ACTP250J1BJ AC Transient Protector

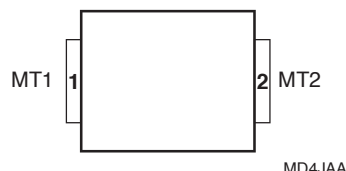
Designed to withstand a 2.5 kV (1.2/50 voltage, 8/20 current) combination wave surge per IEC 61000-4-5 when used in series with an appropriate overvoltage clamp device.\*

- Ion-Implanted Breakdown Region
- Precise and Stable Voltage
- Low Voltage Overshoot Under Surge Conditions

\* Refer to Application section, page 5.

| Device      | V <sub>DRM</sub><br>(V) | V <sub>(BO)</sub><br>(V) |
|-------------|-------------------------|--------------------------|
| ACTP250J1BJ | 190                     | 250                      |

#### SMB Package (Top View)



#### Device Symbol



#### ACTP250J1BJ Overview

The Bourns® Model ACTP250J1BJ is a bidirectional thyristor designed to be used in series with an overvoltage clamp device, such as an MOV, to protect a power supply from damage due to an overvoltage condition on its ac input lines. This device raises the turn-on voltage threshold of the series combination against low frequency overvoltage conditions while having minimal impact on the voltage clamp level when subjected to a lightning surge. Using this series combination will prevent the MOV from conducting when line frequency voltage swells (up to the sum of the breakdown voltages of the two components) occur on the ac input lines of the power supply. This allows a design to avoid the use of a higher voltage MOV, which, if used, would significantly reduce the level of lightning protection. See the Application section for additional information.

#### How to Order

| Device      | Package                  | Carrier                  | Order as       |
|-------------|--------------------------|--------------------------|----------------|
| ACTP250J1BJ | BJ (SMB/DO-214AA J-Bend) | R (Embossed Tape Reeled) | ACTP250J1BJR-S |

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\*RoHS Directive 2002/95/EC Jan. 27, 2003 including annex and RoHS Recast 2011/65/EU June 8, 2011.

\*\*When used as intended; see Application section on page 5.

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## Absolute Maximum Ratings, $T_A = 25\text{ }^{\circ}\text{C}$ (Unless Otherwise Noted)

| Rating                                                                                                                                         | Symbol            | Value       | Unit               |
|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------|--------------------|
| Repetitive peak off-state voltage                                                                                                              | $V_{\text{DRM}}$  | $\pm 190$   | V                  |
| Non-repetitive peak on-state pulse current (see Notes 1,2 and 3)<br>8/20 (IEC 61000-4-5, combination wave generator, 1.2/50 voltage waveshape) | $I_{\text{PPSM}}$ | 1000        | A                  |
| Initial rate of rise of on-state current, Linear current ramp, Maximum ramp value $< 50\text{ A}$                                              | $di_T/dt$         | 800         | A/ $\mu\text{s}$   |
| Junction temperature                                                                                                                           | $T_J$             | -40 to +150 | $^{\circ}\text{C}$ |
| Storage temperature range                                                                                                                      | $T_{\text{stg}}$  | -65 to +150 | $^{\circ}\text{C}$ |

### NOTES:

- Initially, the device must be in thermal equilibrium with  $T_J = 25\text{ }^{\circ}\text{C}$ .
- These non-repetitive rated currents are peak values of either polarity. The surge may be repeated after the device returns to its initial conditions.
- When used as intended; see Application section on page 5.

## Electrical Characteristics, $T_A = 25\text{ }^{\circ}\text{C}$ (Unless Otherwise Noted)

| Parameter                                          | Test Conditions                                                                                                                                                                                                        | Min.     | Typ. | Max.                | Unit          |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|---------------------|---------------|
| $I_{\text{DRM}}$ Repetitive peak off-state current | $V_D = \pm V_{\text{DRM}}$<br>$T_A = 25\text{ }^{\circ}\text{C}$<br>$T_A = 85\text{ }^{\circ}\text{C}$                                                                                                                 |          |      | $\pm 5$<br>$\pm 10$ | $\mu\text{A}$ |
| $V_{\text{(BO)}}$ AC breakover voltage             | $dv/dt = \pm 250\text{ V/ms}$ , $R_{\text{SOURCE}} = 300\text{ ohms}$                                                                                                                                                  |          |      | $\pm 250$           | V             |
| $V_{\text{(BO)}}$ Ramp breakover voltage           | $dv/dt \leq \pm 1000\text{ V}/\mu\text{s}$ , Linear voltage ramp,<br>Maximum ramp value = $\pm 500\text{ V}$<br>$di/dt = \pm 20\text{ A}/\mu\text{s}$ , Linear current ramp,<br>Maximum ramp value = $\pm 10\text{ A}$ |          |      | $\pm 263$           | V             |
| $I_{\text{(BO)}}$ Breakover current                | $dv/dt = \pm 250\text{ V/ms}$ , $R_{\text{SOURCE}} = 300\text{ ohms}$                                                                                                                                                  |          |      | $\pm 600$           | mA            |
| $I_{\text{H}}$ Holding current                     | $I_T = \pm 5\text{ A}$ , $di/dt = \pm 30\text{ mA/ms}$                                                                                                                                                                 | $\pm 20$ |      |                     | mA            |
| $I_{\text{D}}$ Off-state current                   | $V_D = \pm 50\text{ V}$<br>$T_A = 85\text{ }^{\circ}\text{C}$                                                                                                                                                          |          |      | $\pm 10$            | $\mu\text{A}$ |
| $C_{\text{off}}$ Off-state capacitance             | $f = 1\text{ MHz}$ , $V_d = 1\text{ Vrms}$ , $V_D = 0$                                                                                                                                                                 |          | 105  | 125                 | pF            |

## Thermal Characteristics

| Parameter                                                     | Test Conditions                                                                                       | Min. | Typ. | Max. | Unit                 |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------|------|------|----------------------|
| $R_{\theta\text{JA}}$ Junction to free air thermal resistance | EIA/JESD51-2 PCB, $I_T = I_{\text{TSM}}(1000)$ ,<br>$T_A = 25\text{ }^{\circ}\text{C}$ , (see Note 4) |      |      | 90   | $^{\circ}\text{C/W}$ |

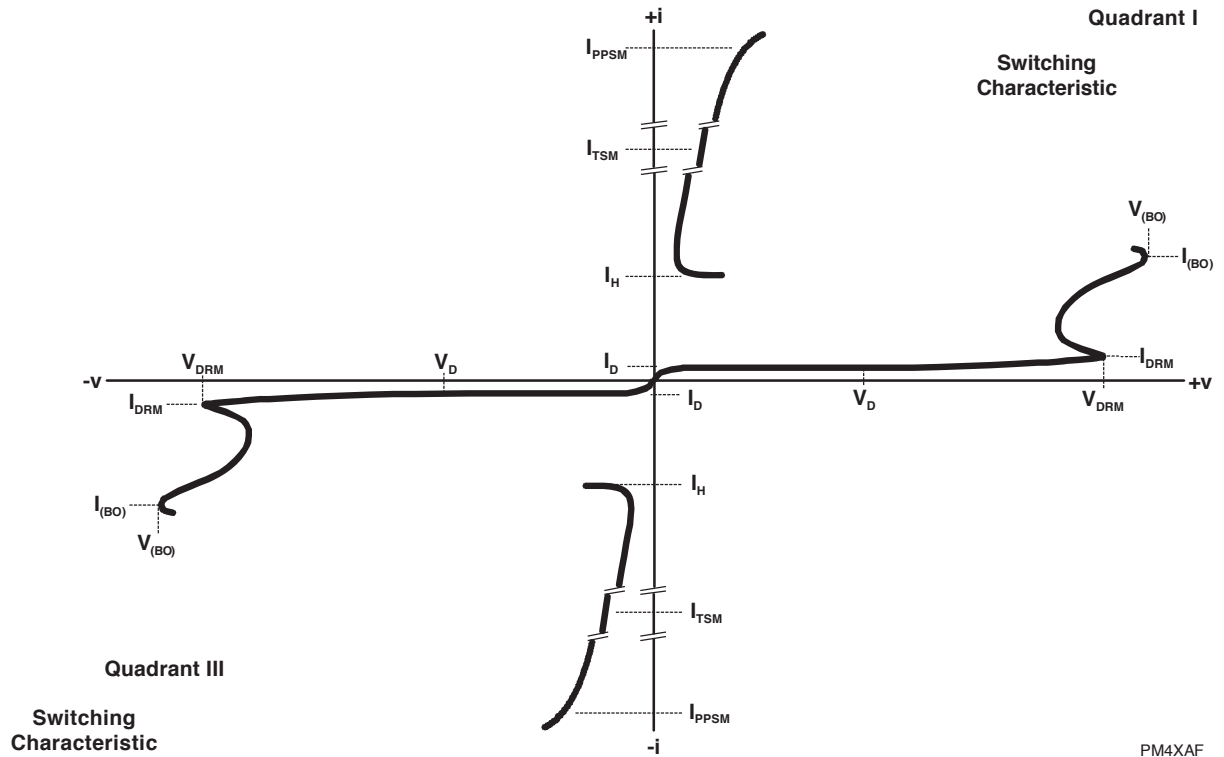
NOTE 4: EIA/JESD51-2 environment and PCB has standard footprint dimensions connected with 5 A rated printed wiring track widths.

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## Parameter Measurement Information



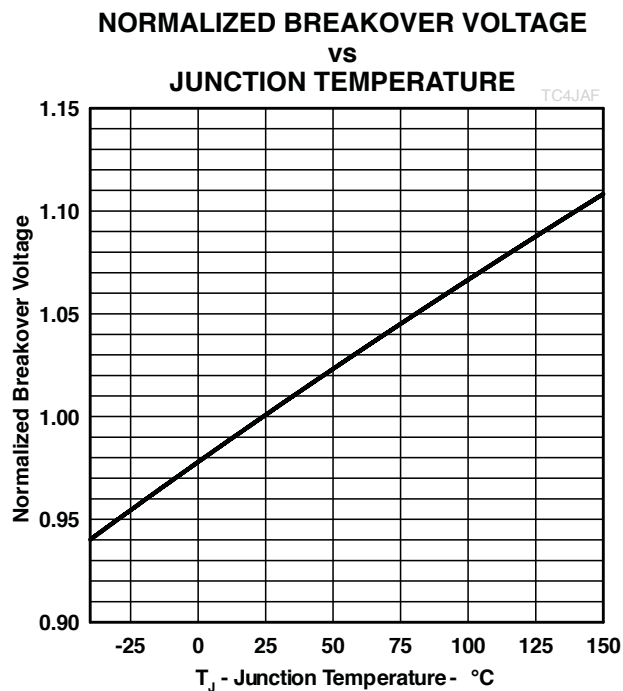
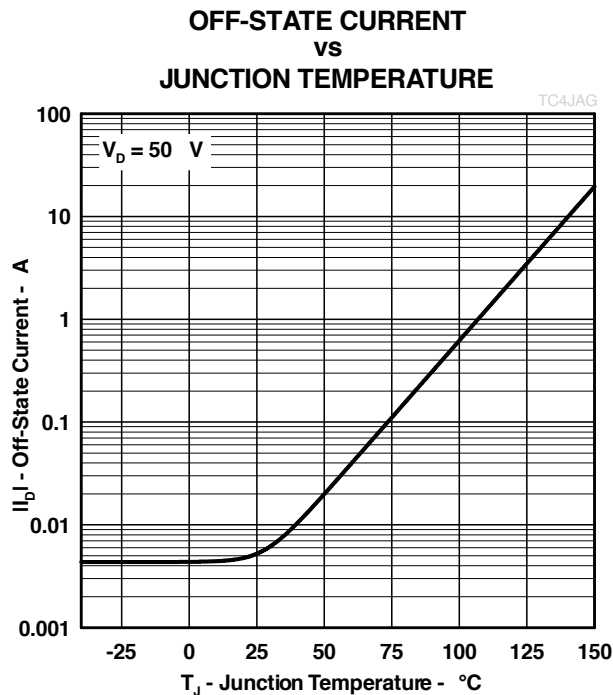
PM4XAF

**Figure 1. Voltage-Current Characteristic for Terminals 1-2**  
**All Measurements are Referenced to Terminal 2**

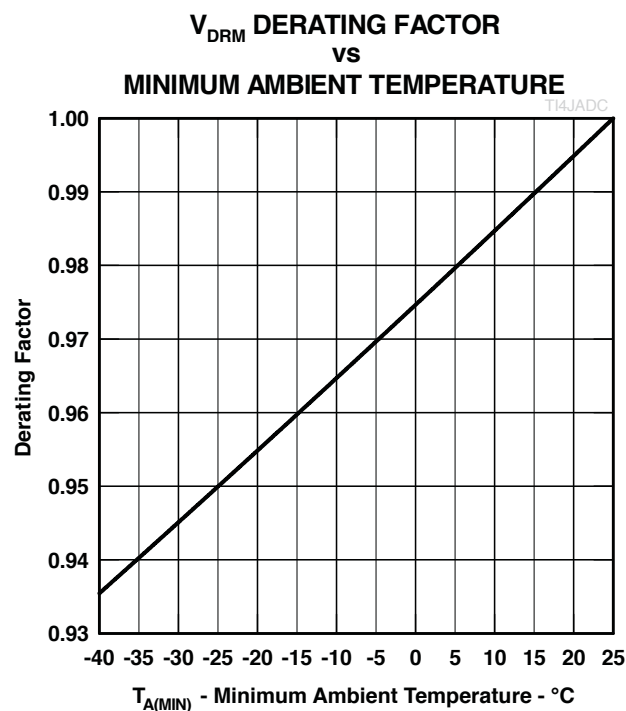
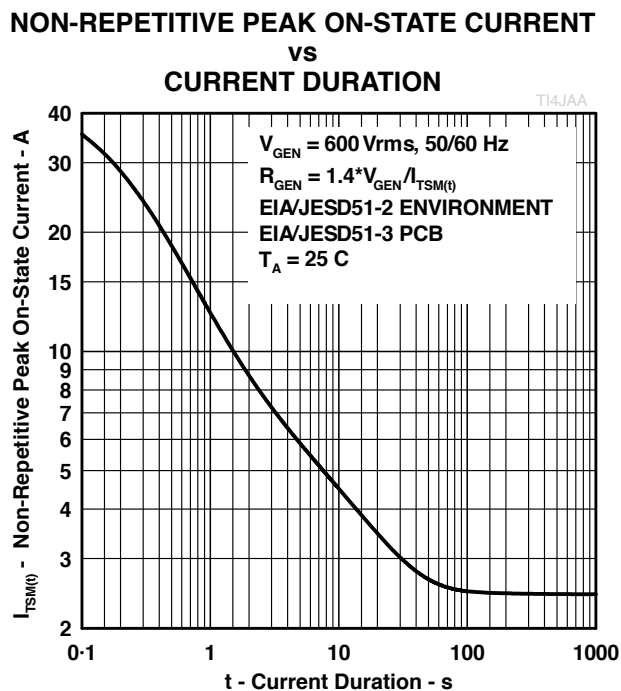
# ACTP250J1BJ AC Transient Protector

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## Typical Characteristics



## Rating and Thermal Information



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## APPLICATION INFORMATION

### Enhancing the Performance of an MOV

In many applications, an offline Switch Mode Power Supply (SMPS) is subjected to possible damage from indirect lightning strikes, switching transients, line voltage swells and other overvoltage conditions. Metal Oxide Varistors (MOVs) are often used to provide protection against lightning and other short duration transients. However, an MOV can be easily overstressed by a power line voltage swell due to the low frequency characteristic of this overvoltage condition. To alleviate this problem, the Model ACTP250J1BJ bidirectional transient protector can be placed in series with the MOV so that it does not conduct during AC line voltage swells up to a specific voltage level while allowing the series combination to clamp at voltage levels just above the MOV clamp voltage during a lightning transient.

For example, say we have an offline SMPS that is designed to operate at a maximum line voltage of 260 Vrms and a 275 Vrms MOV is being used to provide protection against a lightning surge with a peak voltage of 2.5 kV per IEC 61000-4-5 (1.2/50  $\mu$ s voltage, 8/20  $\mu$ s current combination wave). If we would also like to prevent the MOV from being damaged by a line voltage swell as high as 400 Vrms (566 Vpeak), we can use a Model ACTP250J1BJ protector in series with the MOV (as shown in Figure 1 below). At 25 °C, this combination has a minimum breakdown voltage of 577 V (387 + 190 = 577), where 387 V is  $V_{BD}$  of the 275 V<sub>RMS</sub> MOV, and 190 V is the  $V_{DRM}$  of the Model ACTP250J1BJ, guaranteeing that it will not operate at a line voltage that is < 400 Vrms.

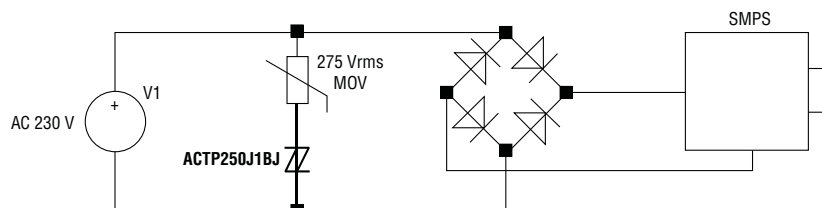


Figure 1. MOV/ACTP250J1BJ AC Line Protection

Adding the Model ACTP250J1BJ device in series with the MOV generates only a small increase in the clamp level. Figure 2 below shows the clamp voltage level of the MOV alone and the MOV/ACTP series combination for a 2.5 kV 1.2/50, 8/20  $\mu$ s combination wave surge. Note that the Model ACTP250J1BJ device only adds a few volts to the MOV clamp voltage.

The waveforms in Figure 3 show that the series combination does not clamp the voltage waveform or conduct current when subjected to a 400 Vrms line voltage.

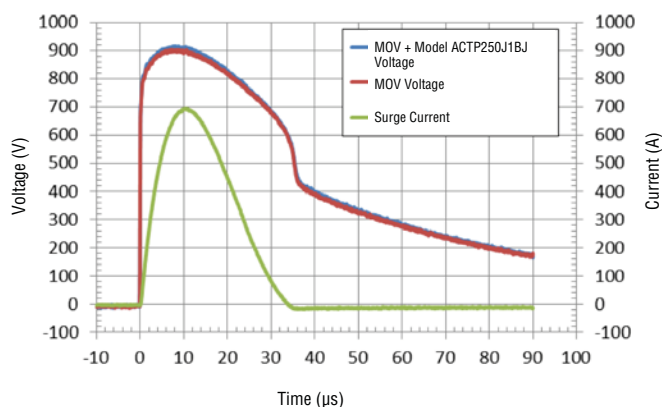


Figure 2. Protection Circuit Clamp Voltages for a 2.5 kV Surge

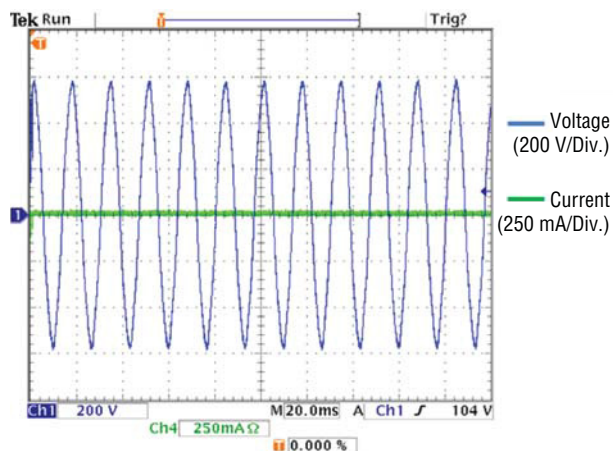


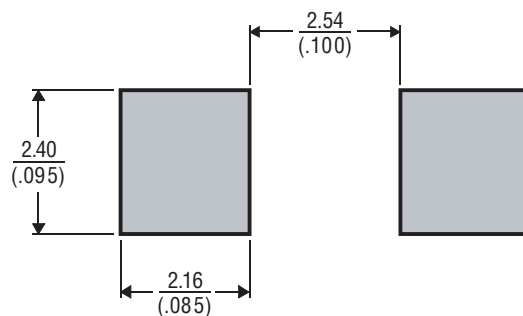
Figure 3. Performance of the Series Protection Circuit when Subjected to a 400 Vrms Line Voltage

In conclusion, adding the Model ACTP250J1BJ in series with the MOV reduces the MOV's susceptibility to damage from a line voltage swell while having a minimal impact on the lightning protection performance of the design.

## MECHANICAL DATA

### Recommended Printed Wiring Land Pattern Dimensions

#### SMB Land Pattern



DIMENSIONS ARE:  $\frac{\text{MILLIMETERS}}{(\text{INCHES})}$

MDXXBID

### Device Symbolization Code

Devices will be coded as below. As the device parameters are symmetrical, terminal 1 is not identified.

| Device      | Symbolization Code |
|-------------|--------------------|
| ACTP250J1BJ | 250J1              |

### Carrier Information

For production quantities, the carrier will be embossed tape reel pack. Evaluation quantities may be shipped in bulk pack or embossed tape.

| Package | Carrier                 | Standard Quantity |
|---------|-------------------------|-------------------|
| SMB     | Embossed Tape Reel Pack | 3000              |

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