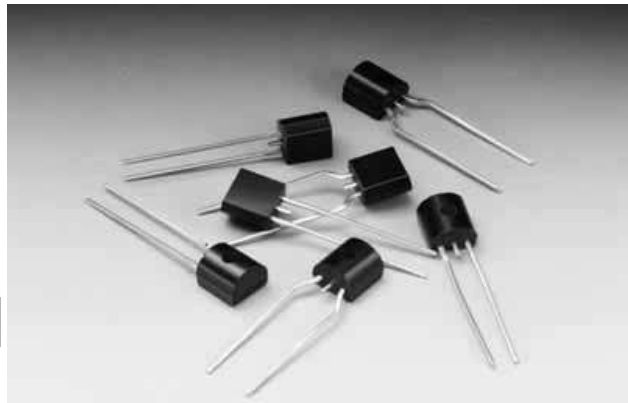


## Thyristor Surge Suppressors

### P0060~P3500EA\_B\_C Serise

#### Description

P0060~P3500EA\_B\_C Serise are designed to protect baseband equipment such as modems, line cards, CPE and DSL from damaging overvoltage transients. The series provides a robust through-hole solution that enables equipment to comply with global regulatory standards.



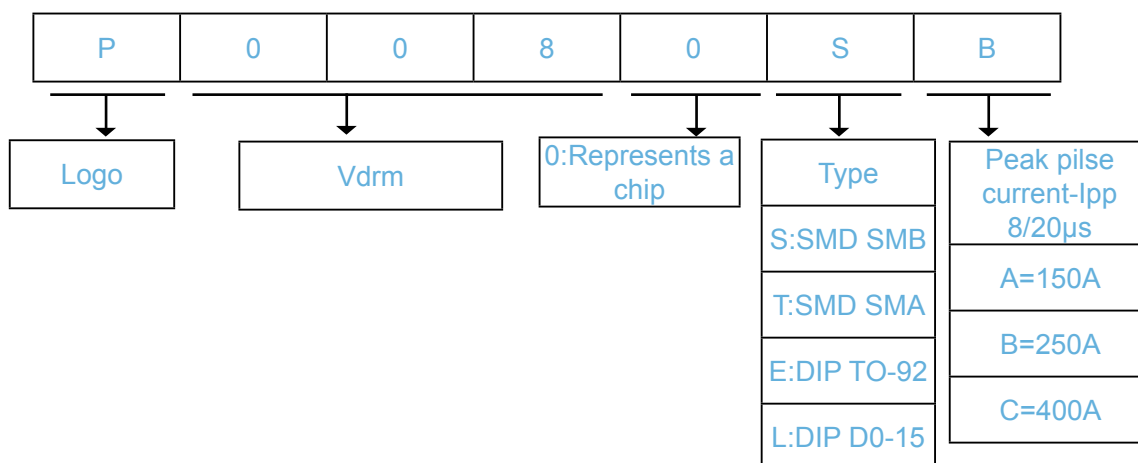
#### Features and Benefits

- Low voltagr overshoot
- Low on-state voltage
- Does not degrade with use
- Fails short circuit when surged in excess of ratings
- Low Capacitance

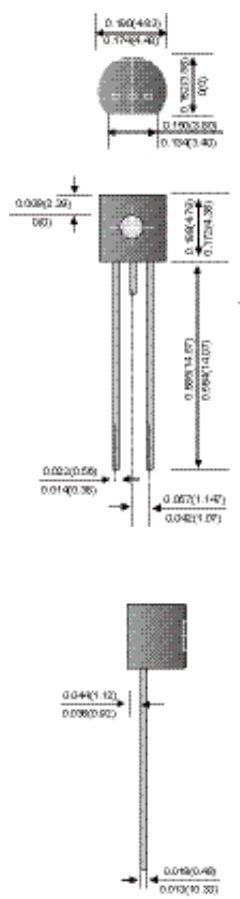
#### Applicable Global Standards

- TIA-968-A
- ITU K.20/21 Enhanced level\*
- ITU K.20/21 Basic Level
- GR 1089 Inter building\*
- GR 1089 Inter building
- IEC 6100-4-5
- YD/T 1082
- YD/T 993
- YD/T 950

#### Product Name



# Electrical Characteristics (@ TA = 25 °C Unless Otherwise Noted)

| Type Number | V <sub>DRM</sub> | I <sub>DRM</sub> | V <sub>BO</sub> | I <sub>H</sub> | I <sub>S</sub> | I <sub>T</sub> | V <sub>T</sub> | C <sub>J</sub>    |                   | Package Dimensions<br>inch(mm)                                                       |
|-------------|------------------|------------------|-----------------|----------------|----------------|----------------|----------------|-------------------|-------------------|--------------------------------------------------------------------------------------|
|             | V                | μA               | V               | MA             | MA             | A              | V              | pF <sub>Min</sub> | pF <sub>Max</sub> |                                                                                      |
| P0080EA     | 6                | 5                | 25              | 50             | 800            | 2.2            | 4              | 25                | 150               |  |
| P0080EB     | 6                | 5                | 25              | 50             | 800            | 2.2            | 4              | 25                | 150               |                                                                                      |
| P0080EC     | 6                | 5                | 25              | 50             | 800            | 2.2            | 4              | 35                | 260               |                                                                                      |
| P0300EA     | 25               | 5                | 40              | 50             | 800            | 2.2            | 4              | 15                | 140               |                                                                                      |
| P0300EB     | 25               | 5                | 40              | 50             | 800            | 2.2            | 4              | 15                | 140               |                                                                                      |
| P0300EC     | 25               | 5                | 40              | 50             | 800            | 2.2            | 4              | 25                | 250               |                                                                                      |
| P0640EA     | 58               | 5                | 77              | 150            | 800            | 2.2            | 4              | 40                | 60                |                                                                                      |
| P0640EB     | 58               | 5                | 77              | 150            | 800            | 2.2            | 4              | 40                | 60                |                                                                                      |
| P0640EC     | 58               | 5                | 77              | 150            | 800            | 2.2            | 4              | 55                | 155               |                                                                                      |
| P0720EA     | 65               | 5                | 88              | 150            | 800            | 2.2            | 4              | 35                | 60                |                                                                                      |
| P0720EB     | 65               | 5                | 88              | 150            | 800            | 2.2            | 4              | 35                | 75                |                                                                                      |
| P0720EC     | 65               | 5                | 88              | 150            | 800            | 2.2            | 4              | 50                | 150               |                                                                                      |
| P0900EA     | 75               | 5                | 98              | 150            | 800            | 2.2            | 4              | 35                | 55                |                                                                                      |
| P0900EB     | 75               | 5                | 98              | 150            | 800            | 2.2            | 4              | 35                | 70                |                                                                                      |
| P0900EC     | 75               | 5                | 98              | 150            | 800            | 2.2            | 4              | 45                | 140               |                                                                                      |
| P1100EA     | 90               | 5                | 130             | 150            | 800            | 2.2            | 4              | 30                | 50                |                                                                                      |
| P1100EB     | 90               | 5                | 130             | 150            | 800            | 2.2            | 4              | 30                | 70                |                                                                                      |
| P1100EC     | 90               | 5                | 130             | 150            | 800            | 2.2            | 4              | 45                | 115               |                                                                                      |
| P1300EA     | 120              | 5                | 160             | 150            | 800            | 2.2            | 4              | 25                | 45                |                                                                                      |
| P1300EB     | 120              | 5                | 160             | 150            | 800            | 2.2            | 4              | 25                | 60                |                                                                                      |
| P1300EC     | 120              | 5                | 160             | 150            | 800            | 2.2            | 4              | 40                | 105               |                                                                                      |
| P1500EA     | 140              | 5                | 180             | 150            | 800            | 2.2            | 4              | 25                | 40                |                                                                                      |
| P1500EB     | 140              | 5                | 180             | 150            | 800            | 2.2            | 4              | 25                | 55                |                                                                                      |
| P1500EC     | 140              | 5                | 180             | 150            | 800            | 2.2            | 4              | 35                | 95                |                                                                                      |
| P1800EA     | 170              | 5                | 220             | 150            | 800            | 2.2            | 4              | 25                | 35                |                                                                                      |
| P1800EB     | 170              | 5                | 220             | 150            | 800            | 2.2            | 4              | 25                | 50                |                                                                                      |
| P1800EC     | 170              | 5                | 220             | 150            | 800            | 2.2            | 4              | 35                | 90                |                                                                                      |
| P2300EA     | 190              | 5                | 260             | 150            | 800            | 2.2            | 4              | 25                | 35                |                                                                                      |
| P2300EB     | 190              | 5                | 260             | 150            | 800            | 2.2            | 4              | 25                | 50                |                                                                                      |
| P2300EC     | 190              | 5                | 260             | 150            | 800            | 2.2            | 4              | 30                | 80                |                                                                                      |
| P2600EA     | 220              | 5                | 300             | 150            | 800            | 2.2            | 4              | 20                | 35                |                                                                                      |
| P2600EB     | 220              | 5                | 300             | 150            | 800            | 2.2            | 4              | 20                | 45                |                                                                                      |
| P2600EC     | 220              | 5                | 300             | 150            | 800            | 2.2            | 4              | 30                | 80                |                                                                                      |
| P3100EA     | 275              | 5                | 350             | 150            | 800            | 2.2            | 4              | 20                | 35                |                                                                                      |
| P3100EB     | 275              | 5                | 350             | 150            | 800            | 2.2            | 4              | 20                | 45                |                                                                                      |
| P3100EC     | 275              | 5                | 350             | 150            | 800            | 2.2            | 4              | 30                | 70                |                                                                                      |
| P3500EA     | 320              | 5                | 400             | 150            | 800            | 2.2            | 4              | 20                | 35                |                                                                                      |
| P3500EB     | 320              | 5                | 400             | 150            | 800            | 2.2            | 4              | 20                | 40                |                                                                                      |
| P3500EC     | 320              | 5                | 400             | 150            | 800            | 2.2            | 4              | 25                | 65                |                                                                                      |

Notes:  
 - Absolute maximum ratings measured at TA= 25°C (unless otherwise noted).  
 - Devices are bi-directional.

| SERIES | Peak Pulse Current-Ipp(A) |        |          |          |           |
|--------|---------------------------|--------|----------|----------|-----------|
|        | 2/10μs                    | 8/20μs | 10/160μs | 10/560μs | 10/1000μs |
| A      | 200                       | 150    | 100      | 60       | 50        |
| B      | 250                       | 250    | 150      | 100      | 80        |
| C      | 500                       | 400    | 200      | 120      | 100       |

## Surge Ratings

| Series | $I_{PP}$                                     |                                        |                                          |                                            |                                            |                                          |                                            |                                              |                                           | $I_{TSM}$<br>50/60 Hz | di/dt    |
|--------|----------------------------------------------|----------------------------------------|------------------------------------------|--------------------------------------------|--------------------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------|-------------------------------------------|-----------------------|----------|
|        | 0.2x310 <sup>1</sup><br>0.5x700 <sup>2</sup> | 2x10 <sup>1</sup><br>2x10 <sup>2</sup> | 8x20 <sup>1</sup><br>1.2x50 <sup>2</sup> | 10x160 <sup>1</sup><br>10x160 <sup>2</sup> | 10x560 <sup>1</sup><br>10x560 <sup>2</sup> | 5x320 <sup>1</sup><br>9x720 <sup>2</sup> | 10x360 <sup>1</sup><br>10x360 <sup>2</sup> | 10x1000 <sup>1</sup><br>10x1000 <sup>2</sup> | 5x310 <sup>1</sup><br>10x700 <sup>2</sup> |                       |          |
|        | A min                                        | A min                                  | A min                                    | A min                                      | A min                                      | A min                                    | A min                                      | A min                                        | A min                                     | A min                 | A/μs max |
| A      | 20                                           | 150                                    | 150                                      | 90                                         | 50                                         | 75                                       | 75                                         | 45                                           | 75                                        | 20                    | 500      |
| B      | 25                                           | 250                                    | 250                                      | 150                                        | 100                                        | 100                                      | 125                                        | 80                                           | 100                                       | 25                    | 500      |
| C      | 50                                           | 500                                    | 400                                      | 200                                        | 150                                        | 200                                      | 175                                        | 100                                          | 200                                       | 30                    | 500      |

Notes:

1 Current waveform in μs  
2 Voltage waveform in μs

- Peak pulse current rating ( $I_{PP}$ ) is repetitive and guaranteed for the life of the product.
- $I_{PP}$  ratings applicable over temperature range of -40°C to +85°C
- The device must initially be in thermal equilibrium with -40°C ≤  $T_J$  ≤ +150°C

## Thermal Considerations

| Package                                                                                    | Symbol          | Parameter                               | Value       | Unit |
|--------------------------------------------------------------------------------------------|-----------------|-----------------------------------------|-------------|------|
| TO-92<br> | $T_J$           | Operating Junction Temperature Range    | -40 to +150 | °C   |
|                                                                                            | $T_S$           | Storage Temperature Range               | -65 to +150 | °C   |
|                                                                                            | $R_{\theta JA}$ | Thermal Resistance: Junction to Ambient | 90          | °C/W |

## Packing Options

| Package Type | Description              | Packing Options Quantity | Added Suffix | Lead Spacing      | Industry Standard |
|--------------|--------------------------|--------------------------|--------------|-------------------|-------------------|
| E            | TO-92 Tape and Reel Pack | 1000                     | RP1          | 0.1 inch (2.54mm) | EIA-481-D         |
|              |                          |                          | RP2          | 0.2 inch (5.08mm) |                   |
|              | TO-92 Ammo Pack          |                          | AP           |                   | EIA-468-B         |
|              | TO-92 Bulk Pack          |                          | N/A          |                   | N/A               |

## Current Energy and Power Dissipation Ratings

Should transients occur in rapid succession, the average power dissipation is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications Table for the specific

device. The operating values of a MOV need to be derated at high temperatures as shown above. Because varistors only dissipate a relatively small amount of average power they are not suitable for repetitive applications that involve substantial amounts of average power dissipation.

Figure 1A - Power Derating for Epoxy Coated

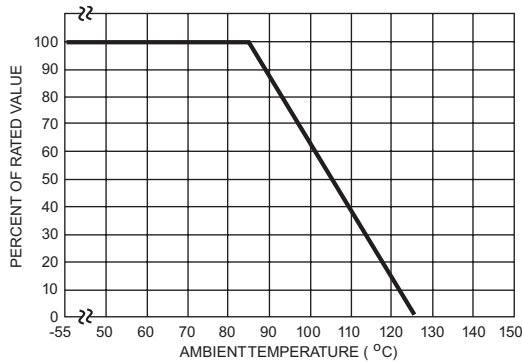
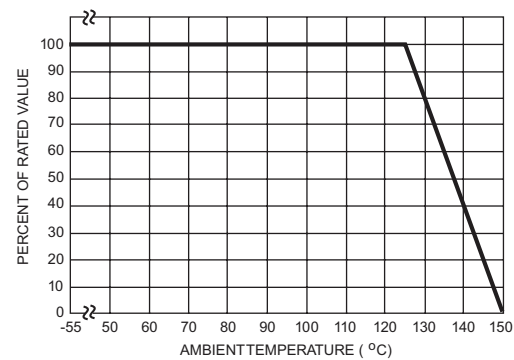


Figure 1B - Power Derating for Pholenic Coated



## Peak Pulse Current Test Waveform

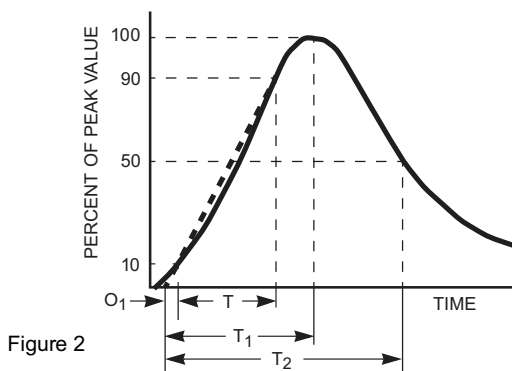


Figure 2

$O_1$  = Virtual Origin of Wave

$T$  = Time from 10% to 90% of Peak

$T_1$  = Rise Time =  $1.25 \times T$

$T_2$  = Decay Time

Example - For an 8/20  $\mu$ s Current Waveform:

$8\mu\text{s} = T_1$  = Rise Time

$20\mu\text{s} = T_2$  = Decay Time

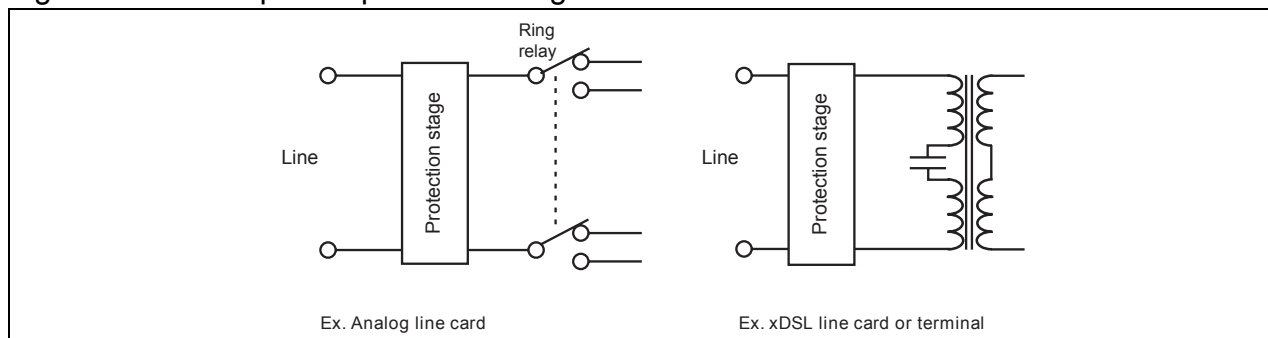
## Physical Specifications

|                 |                                                               |
|-----------------|---------------------------------------------------------------|
| Lead Material   | Copper Alloy                                                  |
| Terminal Finish | 100% Matte-Tin Plated                                         |
| Body Material   | UL recognized epoxy meeting flammability classification 94V-0 |

## Environmental Specifications

|                                  |                                                                                                                       |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| High Temp Voltage Blocking       | 80% Rated $V_{DRM}$ ( $V_{AC}$ Peak) +125°C or +150°C, 504 or 1008 hrs. MIL-STD-750 (Method 1040) JEDEC, JESD22-A-101 |
| Temp Cycling                     | -65°C to +150°C, 15 min. dwell, 10 up to 100 cycles. MIL-STD-750 (Method 1051) EIA/JEDEC, JESD22-A-104                |
| Biased Temp & Humidity           | 52 $V_{DC}$ (+85°C) 85%RH, 504 up to 1008 hrs. EIA/JEDEC, JESD22-A-101                                                |
| High Temp Storage                | +150°C 1008 hrs. MIL-STD-750 (Method 1031) JEDEC, JESD22-A-101                                                        |
| Low Temp Storage                 | -65°C, 1008 hrs.                                                                                                      |
| Thermal Shock                    | 0°C to +100°C, 5 min. dwell, 10 sec. transfer, 10 cycles. MIL-STD-750 (Method 1056) JEDEC, JESD22-A-106               |
| Autoclave (Pressure Cooker Test) | +121°C, 100%RH, 2atm, 24 up to 168 hrs. EIA/JEDEC, JESD22-A-102                                                       |
| Resistance to Solder Heat        | +260°C, 30 secs. MIL-STD-750 (Method 2031)                                                                            |

Figure 1.E xamples of protection stages for line cards



In such a stage, parallel function is assumed by one or several Trisil, and is used to protect against short duration surge (lightning). During this kind of surges the Trisil limits the voltage across the device to be protected at its break over value and then fires. The fuse assumes the series function, and is used to protect the module against long duration or very high current mains disturbances (50/60Hz). It acts by safe circuit opening. Lightning surge and mains disturbance surges are defined by standards like GR1089, FCC part 68, ITU-T K20.

Figure 2. Typical circuits

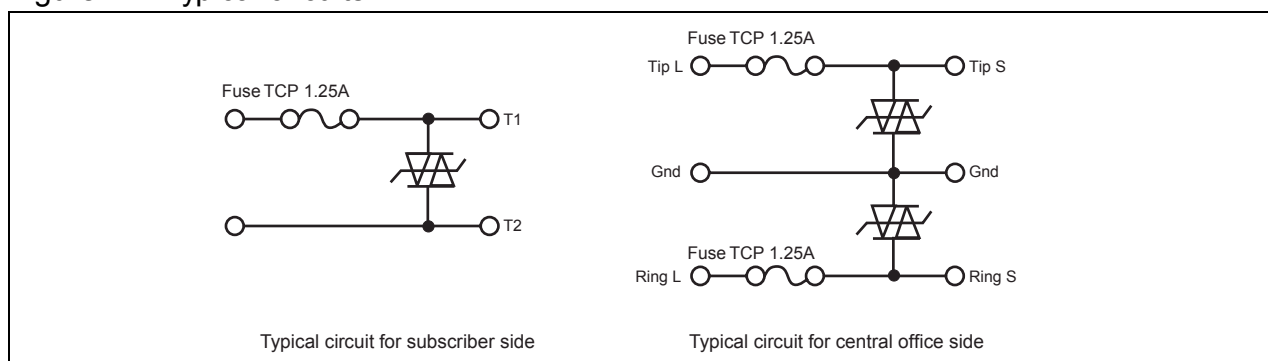


Figure 3.T est circuit 1 for Dynamic  $I_{BO}$  and  $V_{BO}$  parameters

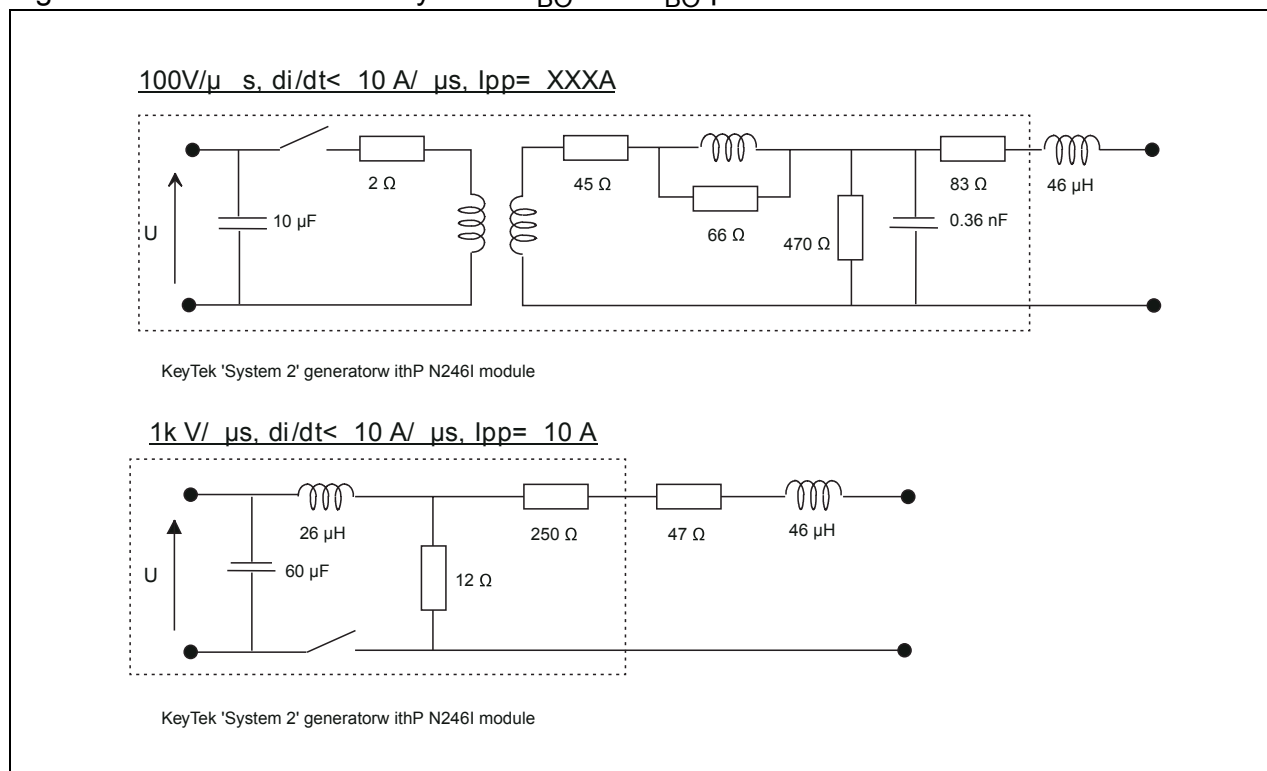
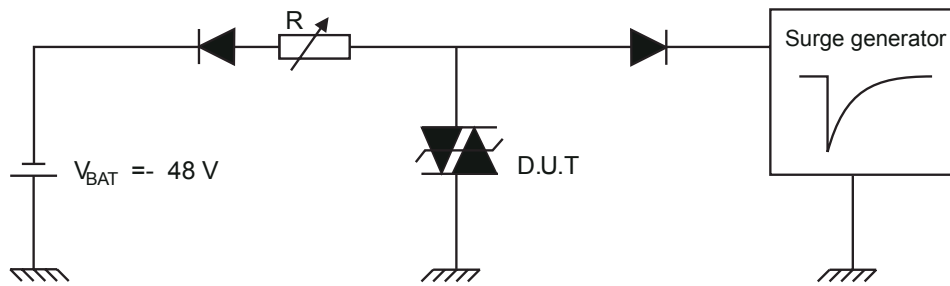


Figure 5. Test circuit 3 for dynamic  $I_H$  parameter

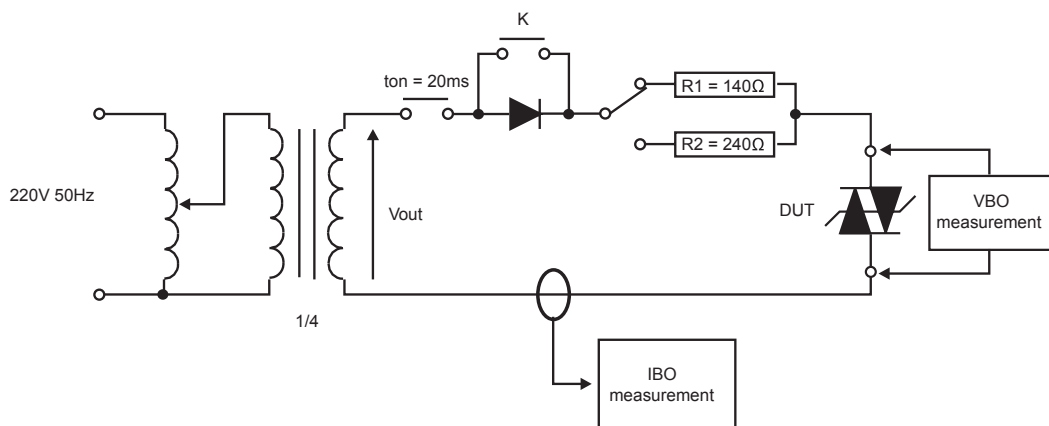


This is a GO-NOGO test which allows to confirm the holding current ( $I_H$ ) level in a functional test circuit.

#### TEST PROCEDURE

- 1/ Adjust the current level at the  $I_V$  value by short circuiting the AK of the D.U.T.
- 2/ Fire the D.U.T. with a surge current  $\rightarrow I_{PP} = 10A, 10/1000\mu s$ .
- 3/ The D.U.T. will come back off-state within 50ms maximum.

Figure 4. Test circuit 2 for  $I_{BO}$  and  $V_{BO}$  parameters



#### TEST PROCEDURE

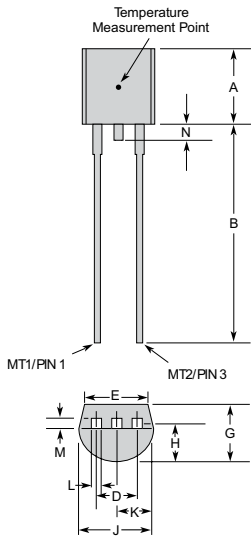
Pulse test duration ( $t_p = 20ms$ ):

- for Bidirectional devices = Switch K is closed
- for Unidirectional devices = Switch K is open

$V_{OUT}$  selection:

- Device with  $V_{BO} < 200V \rightarrow$  OUT  $\approx$  250V MS,  $R1 = 140\Omega$
- Device with  $V_{BO} \geq 200V \rightarrow$  OUT  $\approx$  480V MS,  $R2 = 240\Omega$

## Dimensions — TO-92



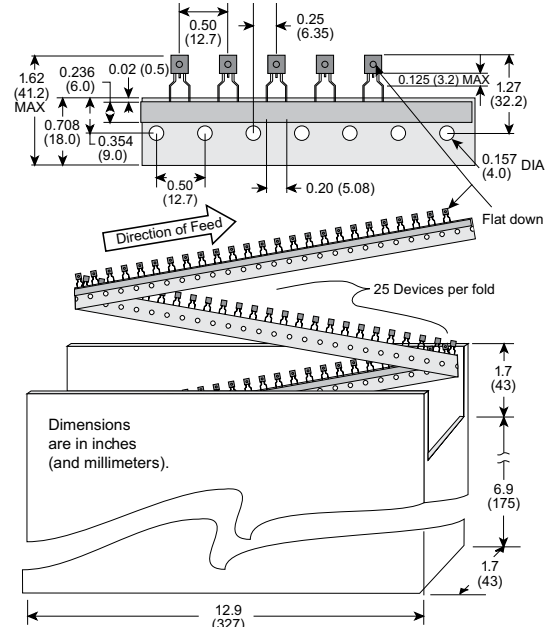
The TO-92 is designed to meet mechanical standards as set forth in JEDEC publication number 95.

|   | Inches |       | Millimeters |      |
|---|--------|-------|-------------|------|
|   | Min    | Max   | Min         | Max  |
| A | 0.176  | 0.196 | 4.47        | 4.98 |
| B | 0.500  |       | 12.70       |      |
| D | 0.095  | 0.105 | 2.41        | 2.67 |
| E | 0.150  |       | 3.81        |      |
| G | 0.135  | 0.145 | 3.43        | 3.68 |
| H | 0.088  | 0.096 | 2.23        | 2.44 |
| J | 0.176  | 0.186 | 4.47        | 4.73 |
| K | 0.088  | 0.096 | 2.23        | 2.44 |
| L | 0.013  | 0.019 | 0.33        | 0.48 |
| M | 0.013  | 0.017 | 0.33        | 0.43 |
| N |        | 0.60  |             | 1.52 |

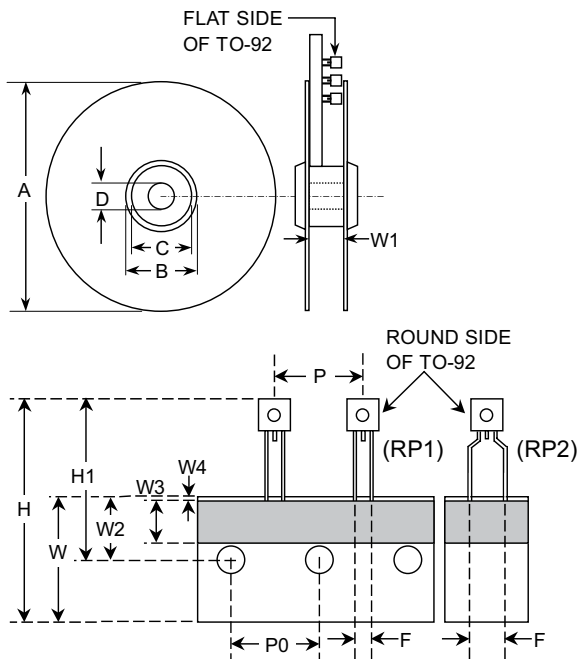
All leads are insulated from case. Case is electrically non-conductive. (Rated at 1600 V<sub>AC</sub> RMS for one minute from leads to case over the operating temperature range.)

Mold flash shall not exceed 0.13 mm per side.

## Ammo Pack Specification — TO-92



## Tape and Reel Specification — TO-92



| Dimensions | Inches |        | Millimeters |       |
|------------|--------|--------|-------------|-------|
|            | Min    | Max    | Min         | Max   |
| A          | N/A    | 14.173 | N/A         | 360.0 |
| B          | 4.016  | N/A    | 102.0       | N/A   |
| C          | 3.386  | N/A    | 86.0        | N/A   |
| D          | 0.795  | N/A    | 20.2        | N/A   |
| W1         | 1.181  | 1.968  | 30.0        | 50.0  |
| P          | 0.496  | 0.504  | 12.60       | 12.80 |
| P0         | 0.498  | 0.502  | 12.65       | 12.75 |
| F(for RP1) | 0.090  | 0.110  | 2.29        | 2.80  |
| F(for RP2) | 0.182  | 0.244  | 4.63        | 6.19  |
| H          | N/A    | 1.673  | N/A         | 42.50 |
| H1         | N/A    | 1.270  | N/A         | 32.26 |
| W          | 0.674  | 0.763  | 17.12       | 19.38 |
| W2         | 0.354  | 0.370  | 8.25        | 9.75  |
| W3         | 0.236  | N/A    | 6.00        | N/A   |
| W4         | 0.020  | N/A    | 0.50        | N/A   |

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