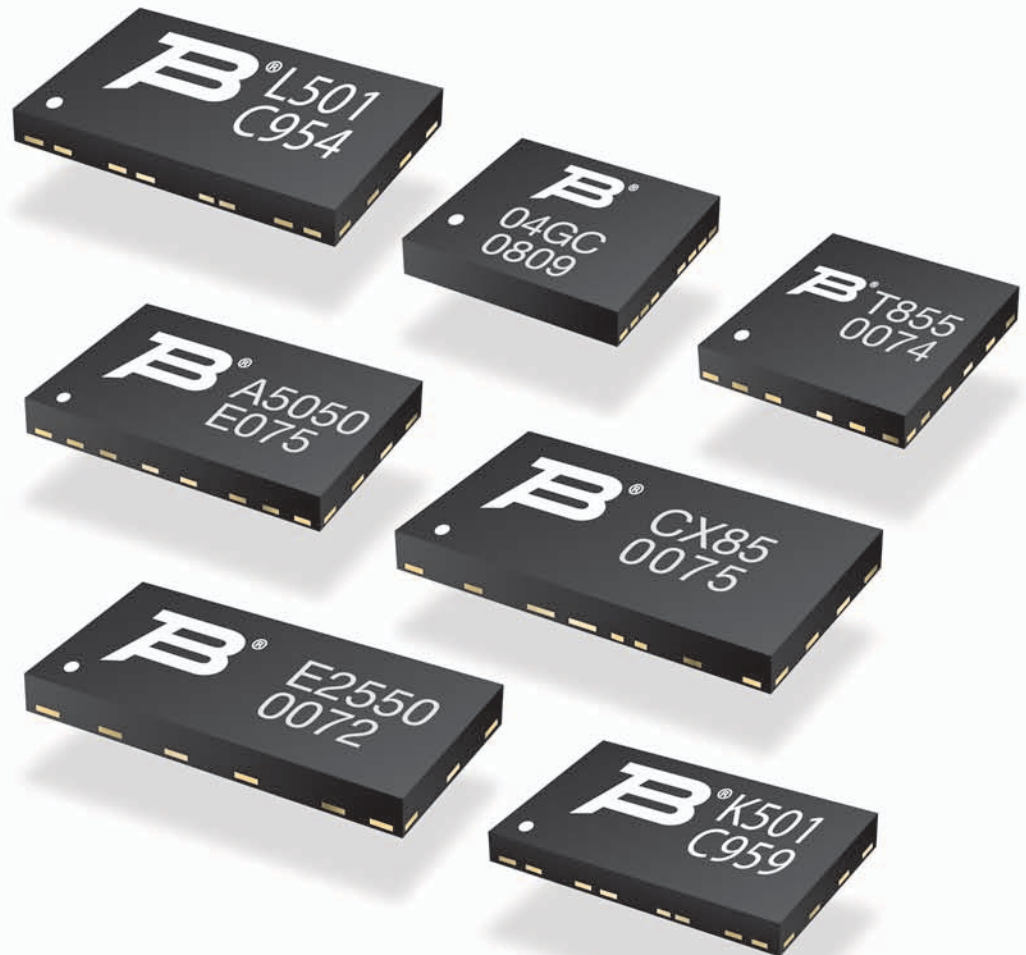


# Bourns® TBU®

## High-Speed Protectors

*Short Form Brochure*



# Bourns® TBU® Product Overview

## Basic TBU® Device Operation

Bourns® TBU® high-speed protectors are circuit protection devices constructed using MOSFET semiconductor technology. When placed in series in the system, the TBU® protector monitors the current flowing through the line. If the current exceeds a preset level, the TBU® device triggers, providing an effective barrier to large, destructive voltages or currents during surge events, thereby protecting sensitive electronics.

The TBU® device operates in approximately 1  $\mu$ s - once line current exceeds the TBU® device's trigger current  $I_{\text{trigger}}$ . When operated, the TBU® device restricts line current to less than 1 mA typically, and blocks voltages including the surge up to rated limits.

After the surge, the TBU® automatically resets itself when the voltage across the TBU® device falls to the  $V_{\text{reset}}$  or below. Therefore, the TBU® device will automatically reset on lines which have no DC bias or have DC bias below  $V_{\text{reset}}$  (such as unpowered signal lines).

If the line has a normal DC bias above  $V_{\text{reset}}$ , the voltage across the TBU® device may not fall below  $V_{\text{reset}}$  after the surge. In such cases, special care needs to be taken to ensure that the TBU® device will reset; software monitoring may be used to accomplish this task. Bourns application engineers can provide further assistance.

## TBU-based Solution Device Selection

### Step 1: Current characterization:

Determine the peak system operating current and maximum operating ambient temperature. Use the TBU® device data sheet's "trigger current versus temperature" derating curve to determine the TBU® device derating value.

### Step 2: Overvoltage selection:

Select an overvoltage device that has the lowest available DC breakdown voltage greater than the normal system voltages and any expected AC power faults. The selected device must also be capable of handling the required lightning current.

### Step 3: TBU® device selection:

Choose a TBU® device with a maximum impulse voltage ( $V_{\text{imp}}$ ) greater than the maximum impulse breakover or clamping voltage of the selected overvoltage protector. The selected TBU® device must also have a minimum specified  $I_{\text{trigger}}$  above the maximum peak system operating current compensating for the temperature derating.

### Step 4: Tertiary protection:

In most applications, the protected circuit sources sufficient current to trigger the TBU® device. If the protected circuit impedance is high, a small avalanche diode to ground or small signal diodes clamping to the power supply rails may be placed after the TBU® device. This will ensure that the TBU® device triggers, preventing the voltage at the interface from rising to unsafe levels.

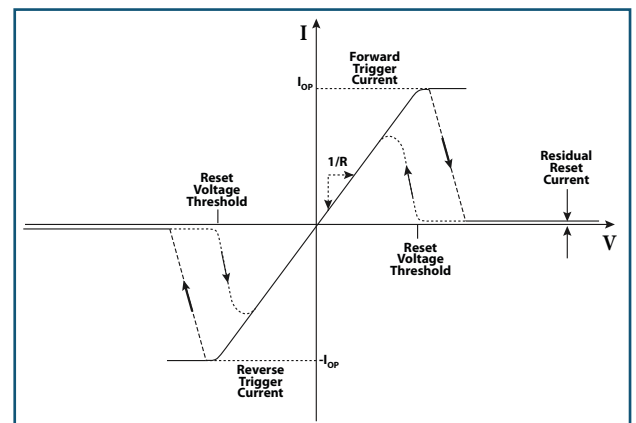
## Key Features:

- TBU® device is used in series with the line
- TBU® device is triggered by current rise
- TBU® device can block voltages up to 850 V, enabling easy coordination
- TBU® device provides superior protection in less than 1  $\mu$ s
- TBU® device resets on voltage
- TBU® device offers an extremely low capacitance per line

## Key Benefits:

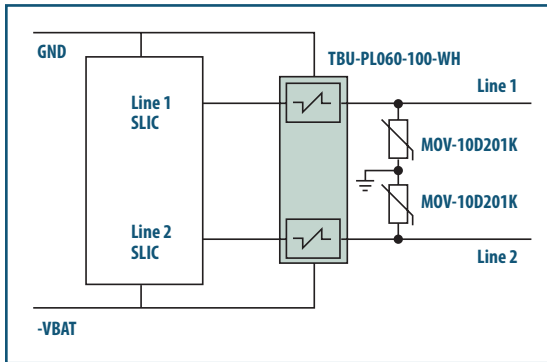
- High-speed performance
- Blocks voltages and currents
- Extremely low let-through energy of 100 nJ
- Self-resetting on non-DC biased lines
- Very high bandwidth up to 3 GHz
- Small size in DFN package
- TBU-PL & TBU-PK series offer voltage triggering
- Smallest PCB area
- Ultra low profile

## TBU-VI Curve



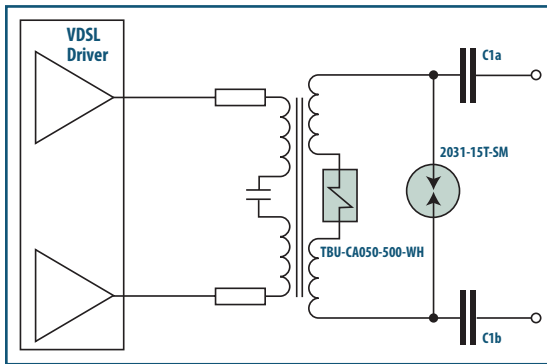
# Bourns® TBU® Product Examples

## VOICE

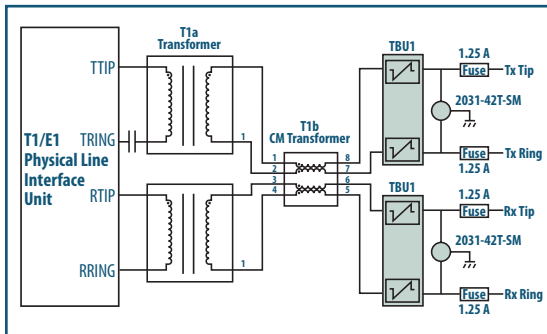


Review VOICE Protection Solution Selection Guide to select TBU® and overvoltage part numbers to meet protection industry standard.

## VDSL



## T1/E1 Interface



## VOICE Protection Solution Selection Guide

| Industry Standard                                  | Surge & AC Withstand   | Bourns® TBU® Device Selection |     |                              |     |
|--|--|-------------------------------|-----|------------------------------|-----|
|  |  | TBU® Device Part Number       | Qty | OVP Device Part Number       | Qty |
| Telcordia GR-1089-CORE Intra-building Port Type 4  | 1500 V, 100 A 2/10 $\mu$ s<br>120 V <sub>rms</sub> , 25 A, 900 s   | TBU-PL050-100-WH              | 1   | <a href="#">MOV-07D201K</a>  | 2   |
| Telcordia GR-1089-CORE Intra-building Port Type 4a | 1000 V, 100 A 10/1000 $\mu$ s<br>120 V <sub>rms</sub> , 25 A, 900 s  | TBU-PL060-100-WH              | 1   | <a href="#">MOV-10D201K</a>  | 2   |
| Non-GR-1089-CORE Intra-building Specifications     | 5000 V, 500 A 2/10 $\mu$ s<br>230 V <sub>rms</sub> , 25 A, 900 s   | TBU-PL085-100-WH              | 1   | <a href="#">MOV-10D361K</a>  | 2   |
|  | 1500 V, 100 A 2/10 $\mu$ s<br>275 V <sub>rms</sub> , 25 A, 900 s   | TBU-PL085-100-WH              | 1   | <a href="#">MOV-10D431K</a>  | 2   |
| ITU-T Basic K.20, K.21, K.45                       | 4000 V, 40 $\Omega$ 10/700 $\mu$ s<br>230 V <sub>rms</sub> 10 $\Omega$ - 1000 $\Omega$ , 900 s<br>600 V <sub>rms</sub> 600 $\Omega$ , 0.2 s  | TBU-PL075-100-WH              | 1   | <a href="#">MOV-10D361K</a>  | 2   |
|  | 4000 V, 40 $\Omega$ 10/700 $\mu$ s<br>230 V <sub>rms</sub> 10 $\Omega$ - 1000 $\Omega$ , 900 s<br>600 V <sub>rms</sub> 600 $\Omega$ , 0.1 s  | TBU-PL060-100-WH              | 1   | <a href="#">TISP4400M3BJ</a> | 2   |
| ITU-T Enhanced K.20, K.21, K.45                    | 6000 V, 40 $\Omega$ 10/700 $\mu$ s<br>240 V <sub>rms</sub> 10 $\Omega$ - 1000 $\Omega$ , 900 s<br>600 V <sub>rms</sub> 600 $\Omega$ , 0.2 s<br>600 V <sub>rms</sub> 600 $\Omega$ , 1 s*<br>1500 V <sub>rms</sub> , 200 $\Omega$ , 2 s* | TBU-PL085-100-WH              | 1   | <a href="#">MOV-10D391K</a>  | 2   |
|  | 6000 V, 40 $\Omega$ 10/700 $\mu$ s<br>240 V <sub>rms</sub> 10 $\Omega$ - 1000 $\Omega$ , 900 s<br>600 V <sub>rms</sub> 600 $\Omega$ , 1 s<br>1500 V <sub>rms</sub> , 200 $\Omega$ , 2 s  | TBU-PL060-100-WH              | 1   | <a href="#">TISP4500H3BJ</a> | 2   |

\* GDT Special Test Protector with DC breakdown (DCBD) of less than 330 V.

Notes:

- The Le9500, Le9520 and Le9530 (VE950 series) require a 200 mA I<sub>trigger</sub> TBU® device for normal operation. Other SLIC types should use the 100 mA device.
- The MOV maximum continuous rms voltage rating should not be exceeded. The exception is where the data sheet highlights withstand capability such as the 600 V rms, 1 A for 0.2 s, for example.
- If EN55024 EMC compliance is required, the TBU® device may require capacitors to be fitted between the Tip and Ring connections and ground (i.e. in parallel with the MOV device). The capacitance value can be chosen to meet levels as follows:
  - 10 nF for EN55024 Level 1
  - 20 nF for EN55024 Level 2
  - 47 nF for EN55024 Level 3

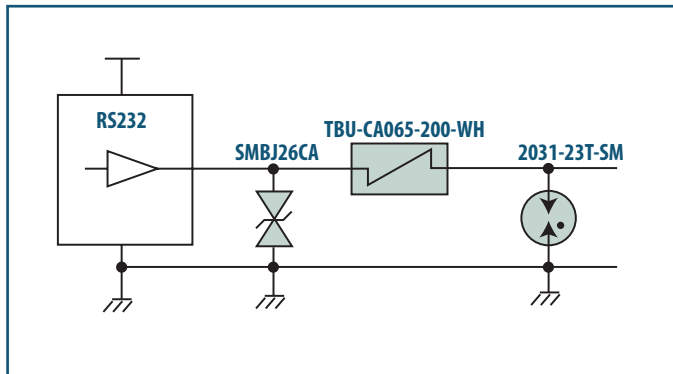
Selection of capacitor voltage rating depends upon TBU® part number selection. Recommendations include:

- TBU-PL050 & TBU-PL060 Series: 120 VAC, 500 V Peak Surge Rated
- TBU-PL075 & TBU-PL085 Series: 240 VAC, 750 V Peak Surge Rated

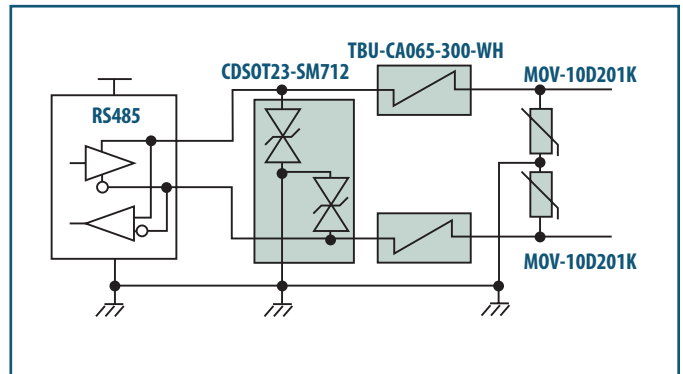
Depending upon the SLIC type, it is usually possible to remove any EMI capacitors present between the output of the SLIC and ground when using capacitors C1 and C2 in parallel with the MOVs.

# Bourns® TBU® Product Examples

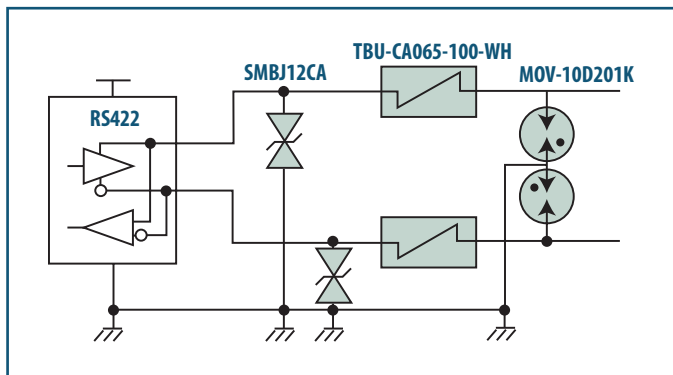
## RS232 Interface



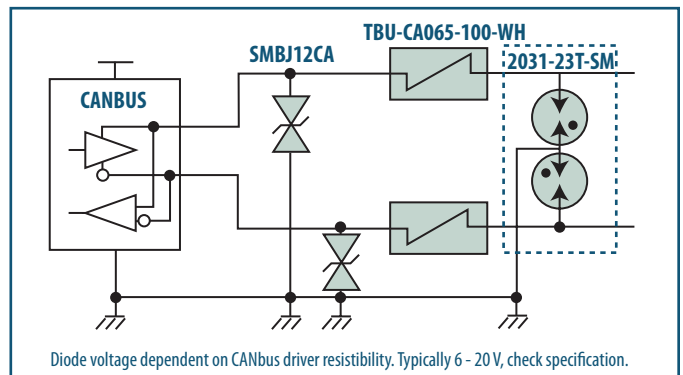
## RS485 Interface



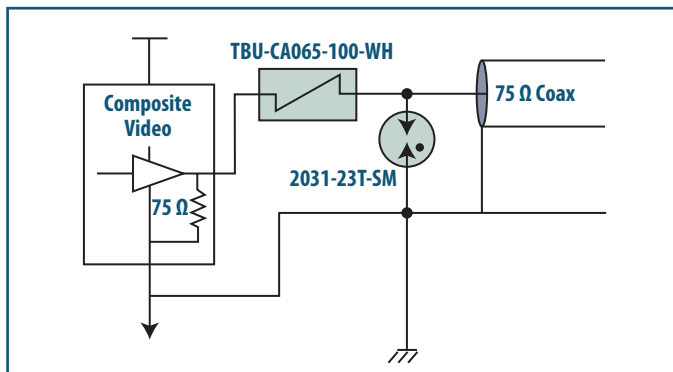
## RS422 Interface



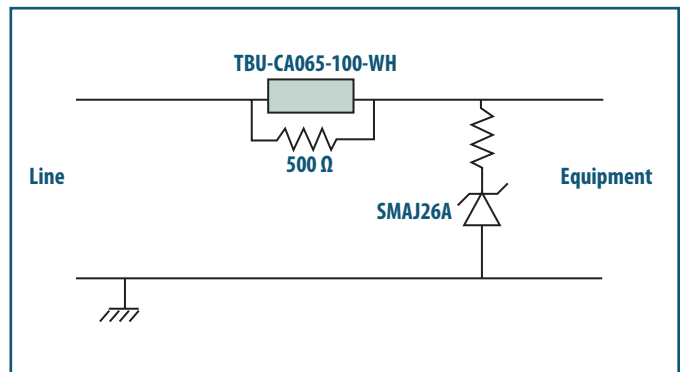
## CANBUS



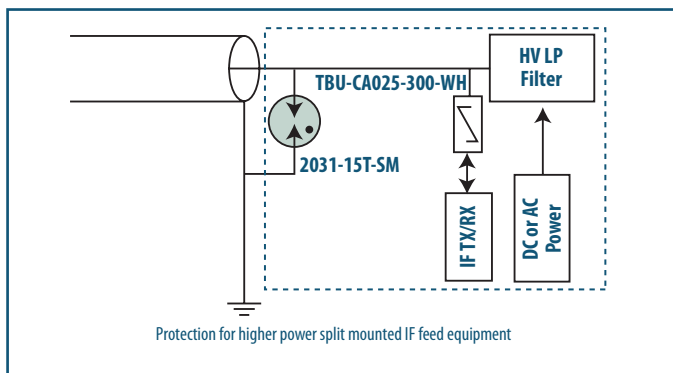
## Intelligent Transport System



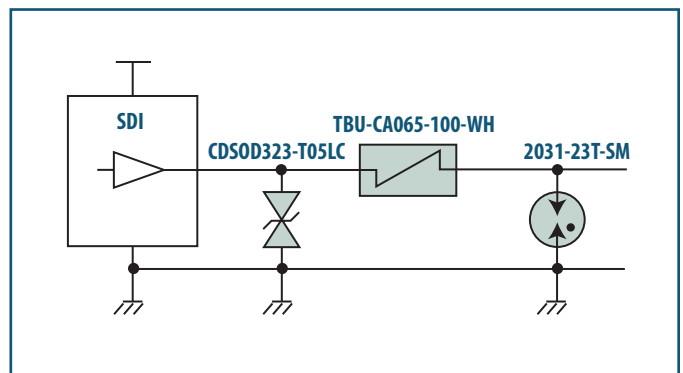
## Intrinsically Safe Sensor



## Microwave Link






## Video Surveillance



# Bidirectional Dual TBU® Protectors

## TBU-PL, TBU-PK & P40 Product Families

| Part Number      | Maximum Ratings |               | Operating Characteristics |                         |                        |                        | Device Size (mm) | Form Factor   |
|------------------|-----------------|---------------|---------------------------|-------------------------|------------------------|------------------------|------------------|---|
|                  | $V_{imp}$ (V)   | $V_{rms}$ (V) | $I_{trigger}$ Min. (mA)   | $I_{trigger}$ Max. (mA) | $t_{block}$ ( $\mu$ s) | $R_{typ}$ ( $\Omega$ ) |                  |   |
| P40-G240-WH      | 40              | 28            | 240                       | 480                     | 0.2                    | 3.6                    | 4.00 x 4.00      |  |
| TBU-PL050-100-WH | 500             | 300           | 100                       | 200                     | 1                      | 50                     | 6.50 x 4.00      |  |
| TBU-PL050-200-WH | 500             | 300           | 200                       | 400                     | 1                      | 50                     |                  |   |
| TBU-PL060-100-WH | 600             | 350           | 100                       | 200                     | 1                      | 50                     |                  |   |
| TBU-PL060-200-WH | 600             | 350           | 200                       | 400                     | 1                      | 50                     |                  |   |
| TBU-PL075-100-WH | 750             | 400           | 100                       | 200                     | 1                      | 50                     |                  |   |
| TBU-PL075-200-WH | 750             | 400           | 200                       | 400                     | 1                      | 50                     |                  |   |
| TBU-PL085-100-WH | 850             | 425           | 100                       | 200                     | 1                      | 50                     |                  |   |
| TBU-PL085-200-WH | 850             | 425           | 200                       | 400                     | 1                      | 50                     | 6.50 x 4.00      |  |
| TBU-PK050-100-WH | 500             | 300           | 100                       | 200                     | 1                      | 80                     |                  |   |
| TBU-PK060-100-WH | 600             | 425           | 100                       | 200                     | 1                      | 80                     |                  |   |
| TBU-PK085-100-WH | 850             | 425           | 100                       | 200                     | 1                      | 80                     |                  |   |

$V_{imp}$  — Maximum peak impulse voltage withstand with duration less than 10 ms.

$V_{rms}$  — Maximum continuous alternating current RMS voltage.

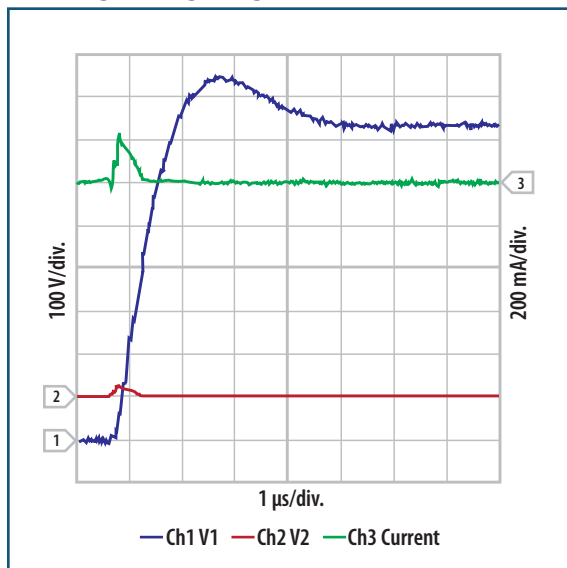
$I_{trigger}$  — Minimum and maximum current required for the device to go from operating state to protected state.

$t_{block}$  — Maximum time for the device to go from normal operating state to protected state.

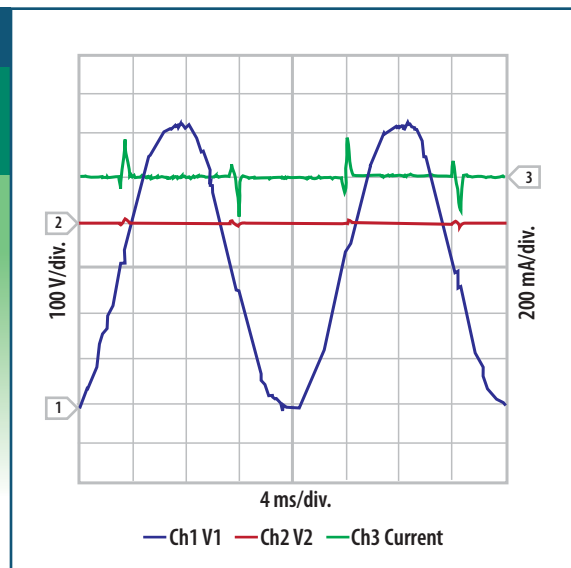
$R_{typ}$  — Typical series resistance of the TBU® device.

Consult factory for alternate specification values. See data sheet for detailed specifications.

### TBU® Lightning Surge Protection





### TBU® Power Fault Protection



# Bidirectional Single TBU® Protectors

## TBU-CA & TBU-CX Product Families

| Part Number      | Maximum Ratings      |                      | Operating Characteristics      |                                |                         |                      | Device Size (mm) | Form Factor   |
|------------------|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|----------------------|------------------|---|
|                  | V <sub>imp</sub> (V) | V <sub>rms</sub> (V) | I <sub>trigger</sub> Min. (mA) | I <sub>trigger</sub> Max. (mA) | t <sub>block</sub> (μs) | R <sub>typ</sub> (Ω) |                  |   |
| TBU-CA025-050-WH | 250                  | 100                  | 50                             | 100                            | 1                       | 13.3                 | 6.50 x 4.00      |    |
| TBU-CA025-100-WH | 250                  | 100                  | 100                            | 200                            | 1                       | 7.1                  |                  |   |
| TBU-CA025-200-WH | 250                  | 100                  | 200                            | 400                            | 1                       | 4.2                  |                  |   |
| TBU-CA025-300-WH | 250                  | 100                  | 300                            | 600                            | 1                       | 3.2                  |                  |   |
| TBU-CA025-500-WH | 250                  | 100                  | 500                            | 1000                           | 1                       | 2.6                  |                  |   |
| TBU-CA040-050-WH | 400                  | 200                  | 50                             | 100                            | 1                       | 14.3                 |                  |   |
| TBU-CA040-100-WH | 400                  | 200                  | 100                            | 200                            | 1                       | 8.1                  |                  |   |
| TBU-CA040-200-WH | 400                  | 200                  | 200                            | 400                            | 1                       | 5.2                  |                  |   |
| TBU-CA040-300-WH | 400                  | 200                  | 300                            | 600                            | 1                       | 4.3                  |                  |   |
| TBU-CA040-500-WH | 400                  | 200                  | 500                            | 1000                           | 1                       | 3.6                  |                  |   |
| TBU-CA050-050-WH | 500                  | 250                  | 50                             | 100                            | 1                       | 15.7                 |                  |   |
| TBU-CA050-100-WH | 500                  | 250                  | 100                            | 200                            | 1                       | 9.5                  |                  |   |
| TBU-CA050-200-WH | 500                  | 250                  | 200                            | 400                            | 1                       | 6.6                  |                  |   |
| TBU-CA050-300-WH | 500                  | 250                  | 300                            | 600                            | 1                       | 5.6                  |                  |   |
| TBU-CA050-500-WH | 500                  | 250                  | 500                            | 1000                           | 1                       | 5.0                  |                  |   |
| TBU-CA065-050-WH | 650                  | 300                  | 50                             | 100                            | 1                       | 17.7                 |                  |   |
| TBU-CA065-100-WH | 650                  | 300                  | 100                            | 200                            | 1                       | 11.5                 |                  |   |
| TBU-CA065-200-WH | 650                  | 300                  | 200                            | 400                            | 1                       | 8.6                  |                  |   |
| TBU-CA065-300-WH | 650                  | 300                  | 300                            | 600                            | 1                       | 7.6                  |                  |   |
| TBU-CA065-500-WH | 650                  | 300                  | 500                            | 1000                           | 1                       | 7.0                  |                  |   |
| TBU-CA085-050-WH | 850                  | 425                  | 50                             | 100                            | 1                       | 21.4                 |                  |   |
| TBU-CA085-100-WH | 850                  | 425                  | 100                            | 200                            | 1                       | 15.2                 |                  |   |
| TBU-CA085-200-WH | 850                  | 425                  | 200                            | 400                            | 1                       | 12.3                 |                  |   |
| TBU-CA085-300-WH | 850                  | 425                  | 300                            | 600                            | 1                       | 11.3                 |                  |   |
| TBU-CA085-500-WH | 850                  | 425                  | 500                            | 1000                           | 1                       | 10.7                 |                  |   |
| TBU-CX025-VTC-WH | 250                  | 100                  | 500                            | 1000                           | 1                       | 2.6                  | 8.25 x 4.00      |  |
| TBU-CX040-VTC-WH | 400                  | 200                  | 500                            | 1000                           | 1                       | 3.6                  |                  |   |
| TBU-CX050-VTC-WH | 500                  | 250                  | 500                            | 1000                           | 1                       | 5.0                  |                  |   |
| TBU-CX065-VTC-WH | 650                  | 300                  | 500                            | 1000                           | 1                       | 7.0                  |                  |   |
| TBU-CX085-VTC-WH | 850                  | 425                  | 500                            | 1000                           | 1                       | 10.7                 |                  |   |


# Unidirectional Single TBU® Protectors

## TBU-KE Product Family

| Part Number      | Maximum Ratings      |                      | Operating Characteristics      |                                |                         |                      | Device Size (mm) | Form Factor   |
|------------------|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|----------------------|------------------|---|
|                  | V <sub>imp</sub> (V) | V <sub>rms</sub> (V) | I <sub>trigger</sub> Min. (mA) | I <sub>trigger</sub> Max. (mA) | t <sub>block</sub> (μs) | R <sub>typ</sub> (Ω) |                  |   |
| TBU-KE025-050-WH | 250                  | 100                  | 50                             | 100                            | 1                       | 12.5                 | 5.00 x 2.50      |  |
| TBU-KE025-100-WH | 250                  | 100                  | 100                            | 200                            | 1                       | 6.3                  |                  |   |
| TBU-KE025-200-WH | 250                  | 100                  | 200                            | 400                            | 1                       | 3.4                  |                  |   |
| TBU-KE025-300-WH | 250                  | 100                  | 300                            | 600                            | 1                       | 2.4                  |                  |   |
| TBU-KE025-500-WH | 250                  | 100                  | 500                            | 1000                           | 1                       | 1.8                  |                  |   |
| TBU-KE040-050-WH | 400                  | 200                  | 50                             | 100                            | 1                       | 13.0                 |                  |   |
| TBU-KE040-100-WH | 400                  | 200                  | 100                            | 200                            | 1                       | 6.8                  |                  |   |
| TBU-KE040-200-WH | 400                  | 200                  | 200                            | 400                            | 1                       | 3.9                  |                  |   |
| TBU-KE040-300-WH | 400                  | 200                  | 300                            | 600                            | 1                       | 3.0                  |                  |   |
| TBU-KE040-500-WH | 400                  | 200                  | 500                            | 1000                           | 1                       | 2.3                  |                  |   |
| TBU-KE050-050-WH | 500                  | 250                  | 50                             | 100                            | 1                       | 13.7                 |                  |   |
| TBU-KE050-100-WH | 500                  | 250                  | 100                            | 200                            | 1                       | 7.5                  |                  |   |
| TBU-KE050-200-WH | 500                  | 250                  | 200                            | 400                            | 1                       | 4.6                  |                  |   |
| TBU-KE050-300-WH | 500                  | 250                  | 300                            | 600                            | 1                       | 3.6                  |                  |   |
| TBU-KE050-500-WH | 500                  | 250                  | 500                            | 1000                           | 1                       | 3.0                  |                  |   |

# Unidirectional Dual TBU® Protectors

## TBU-DT Product Family

| Part Number      | Maximum Ratings      |                      | Operating Characteristics      |                                |                         |                      | Device Size (mm) | Form Factor   |
|------------------|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|----------------------|------------------|---|
|                  | V <sub>imp</sub> (V) | V <sub>rms</sub> (V) | I <sub>trigger</sub> Min. (mA) | I <sub>trigger</sub> Max. (mA) | t <sub>block</sub> (μs) | R <sub>typ</sub> (Ω) |                  |   |
| TBU-DT065-100-WH | 650                  | 300                  | 100                            | 200                            | 1                       | 8.5                  | 5.00 x 5.00      |  |
| TBU-DT065-200-WH | 650                  | 300                  | 200                            | 400                            | 1                       | 5.6                  |                  |   |
| TBU-DT065-300-WH | 650                  | 300                  | 300                            | 600                            | 1                       | 4.6                  |                  |   |
| TBU-DT065-500-WH | 650                  | 300                  | 500                            | 1000                           | 1                       | 4.0                  |                  |   |
| TBU-DT085-100-WH | 850                  | 425                  | 100                            | 200                            | 1                       | 10.3                 |                  |   |
| TBU-DT085-200-WH | 850                  | 425                  | 200                            | 400                            | 1                       | 7.4                  |                  |   |
| TBU-DT085-300-WH | 850                  | 425                  | 300                            | 600                            | 1                       | 6.8                  |                  |   |
| TBU-DT085-500-WH | 850                  | 425                  | 500                            | 1000                           | 1                       | 5.8                  |                  |   |

## Worldwide Sales Offices

| Country                       | Phone              | Fax                |
|-------------------------------|--------------------|--------------------|
| Americas:                     | +1-951-781-5500    | +1-951-781-5006    |
| Brazil:                       | +55 11 5505 0601   | +55 11 5505 4370   |
| China:                        | +86 21 64821250    | +86 21 64821249    |
| Europe:                       | +41 (0)41 768 5555 | +41 (0)41 768 5510 |
| Japan:                        | +81 49 269 3204    | +81 49 269 3297    |
| Singapore:                    | +65 6348 7227      | +65 6348 1272      |
| Taiwan:                       | +886 2 25624117    | +886 2 25624116    |
| Other Asia-Pacific Countries: | +886 2 25624117    | +886 2 25624116    |

### Technical Assistance

| Region                       | Phone              | Fax                |
|------------------------------|--------------------|--------------------|
| Asia-Pacific:                | +886 2 25624117    | +886 2 25624116    |
| Europe, Middle East, Africa: | +41 (0)41 768 5555 | +41 (0)41 768 5510 |
| Americas:                    | +1-951-781-5500    | +1-951-781-5700    |

[www.bourns.com](http://www.bourns.com)

Bourns® products are available through an extensive network of manufacturer's representatives, agents and distributors. To obtain technical applications assistance, a quotation, or to place an order, contact a Bourns representative in your area.

Specifications subject to change without notice. Actual performance in specific customer applications may differ due to the influence of other variables. Customers should verify actual device performance in their specific applications.

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