

Features

- Superior circuit protection
- Overcurrent & overvoltage protection
- Blocks surges up to rated limits
- High speed performance
- Small SMT package
- RoHS compliant*
- Agency recognition:

Applications

- SLIC protection
- Cable & DSL
- MDU/MTU modems
- ONT
- Voice/DSL line cards

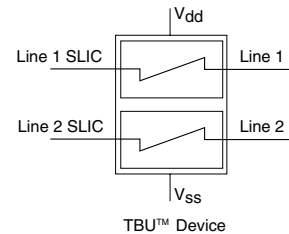
TBU-PL Series - TBU™ High Speed Protectors

General Information

The TBU-PL Series of Bourns® TBU™ products are low capacitance dual bidirectional high speed protection components, constructed using MOSFET semiconductor technology, and designed to protect against faults caused by short circuits, AC power cross, induction and lightning surges.

In addition to overcurrent protection, an added feature is the voltage monitoring on the two lines. If the voltage on the line drops below V_{SS} then the voltage will trigger the device to switch to the blocking state.

The TBU™ high speed protector placed in the system circuit will monitor the current with the MOSFET detection circuit triggering to provide an effective barrier behind which sensitive electronics are not exposed to large voltages or currents during surge events. The TBU™ device is provided in a surface mount DFN package and meets industry standard requirements such as RoHS and Pb Free solder reflow profiles.



Agency Approval

| Description | |
|-------------|----------------------|
| UL | File Number: Pending |

Industry Standards (in Conjunction with OVP Device)

| | Industry Standard | Part Number |
|---|--|------------------|
| Telcordia GR-1089-CORE Intra-building | 1500 V, 100 A 2/10 μ s 120 V RMS, 25 A, 900 s | TBU-PL050-xxx-WH |
| | 5000 V, 500 A 2/10 μ s 120 V RMS, 25 A, 900 s | TBU-PL060-xxx-WH |
| ITU-T | K.20, K.21, K.45 Basic & Enhanced | TBU-PL085-xxx-WH |

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

| Symbol | Parameter | Part Number | Value | Unit |
|------------|--|------------------|-------------|------------------|
| V_{imp} | Peak impulse voltage withstand with duration less than 10 ms | TBU-PL050-xxx-WH | 500 | V |
| | | TBU-PL060-xxx-WH | 600 | |
| | | TBU-PL085-xxx-WH | 850 | |
| V_{rms} | Continuous A.C. RMS voltage | TBU-PL050-xxx-WH | 300 | V |
| | | TBU-PL060-xxx-WH | 350 | |
| | | TBU-PL085-xxx-WH | 425 | |
| T_{op} | Operating temperature range | | -55 to +125 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature range | | -65 to +150 | $^\circ\text{C}$ |
| T_{jmax} | Maximum Junction Temperature | | +125 | $^\circ\text{C}$ |
| ESD | HBM ESD Protection per IEC 61000-4-2 on line pads | | ± 2 | kV |

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

| Symbol | Parameter | Part Number | Min. | Typ. | Max. | Unit |
|---------------|--|------------------|------|-----------|-----------|---------------------------|
| $I_{trigger}$ | Current required for the device to go from operating state to protected state | TBU-PLxxx-100-WH | 100 | 150 | 200 | mA |
| | | TBU-PLxxx-200-WH | 200 | 300 | 400 | |
| R_{TBU} | Series resistance of the TBU™ device | | 40 | 50 | 55 | Ω |
| R_{match} | Package resistance matching of the TBU™ device #1 - TBU™ device #2 | | | ± 0.5 | ± 1.0 | Ω |
| t_{block} | Time taken for the device to go into current limiting | | | | 1 | μ s |
| I_Q | Current through the triggered TBU™ device with 50 Vdc circuit voltage | | 0.25 | 0.70 | 1.50 | mA |
| I_{SS} | Operating current with $V_{SS} = -50$ V applied | | | 100 | | μ A |
| V_{reset} | Voltage below which the triggered TBU™ device will transition to normal operating state | TBU-PLxxx-100-WH | 12 | 15 | 22 | V |
| | | TBU-PLxxx-200-WH | 15 | 20 | 25 | |
| V_{to} | Voltage threshold offset with 60 Hz applied voltage ($V_{SS} - V_{lineSLIC}$) | | -1.0 | | 0.2 | V |
| V_{SS} | Operating voltage range relative to V_{dD} | | -180 | | -20 | V |
| $R_{th(j-l)}$ | Junction to package pads - FR4 using minimum recommended pad layout | | | 65 | | $^\circ\text{C}/\text{W}$ |
| $R_{th(j-l)}$ | Junction to package pads - FR4 using heat sink on board (6 cm ²) (0.5 in. ²) | | | 40 | | $^\circ\text{C}/\text{W}$ |

*RoHS Directive 2002/95/EC Jan 27 2003 including Annex.

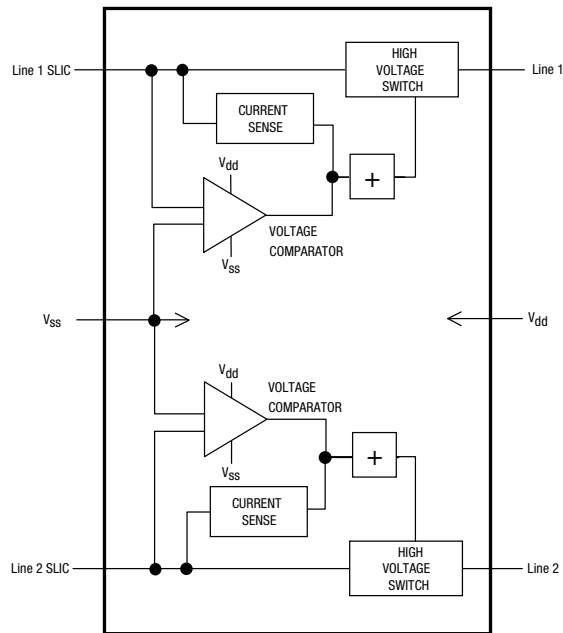
Specifications are subject to change without notice.

Customers should verify actual device performance in their specific applications.

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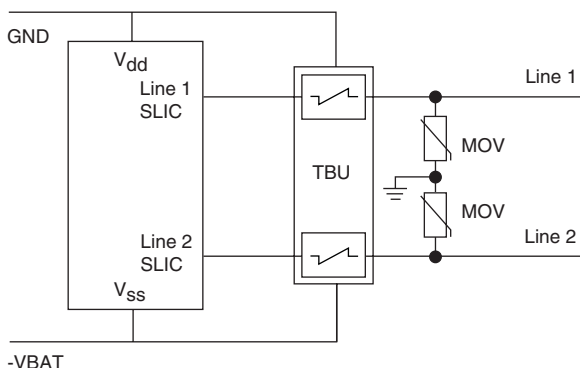
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Functional Block Diagram



Reference Application

The TBU-PL Series are high-speed protectors used in voice/VoIP SLIC applications. The maximum voltage rating of the TBU™ device should never be exceeded. Where necessary, an OVP device should be employed to limit the maximum voltage. A cost-effective protection solution combines Bourns® TBU™ protection devices with a pair of Bourns® MOVs. For bandwidth sensitive applications, a Bourns® GDT may be substituted for the MOV.



Basic TBU Operation

The TBU™ device, constructed using MOSFET semiconductor technology, placed in the system circuit will monitor the current with the MOSFET detection circuit triggering to provide an effective barrier behind which sensitive electronics are not exposed to large voltages or currents during surge events. The TBU™ device operates in approximately 1 μ s - once line current exceeds the TBU™ device's trigger current $I_{trigger}$. When operated, the TBU™ device restricts line current to less than 1 mA typically. When operated, the TBU™ device will block all voltages including the surge up to rated limits.

When the voltage on the SLIC output is driven below ($V_{bat} - V_{to}$) the TBU-PL series device switches to the blocking state, regardless of output current in the device.

After the surge, the TBU™ device resets when the voltage across the TBU™ device falls to the V_{reset} level. The TBU™ device will automatically reset on lines which have no DC bias or have DC bias below V_{reset} (such as unpowered signal lines).

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

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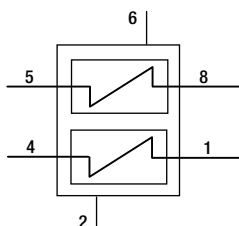
Bourns® TBU™ Device Solution

| Industry Standard | Surge & AC Tests | TBU™ Device P/N | Qty. | OVP Device P/N | Qty. |
|---|--|------------------|------|----------------|------|
| Telcordia GR-1089-CORE Intra-building | 1500 V, 100 A 2/10 μ s 120V RMS, 25 A, 900 s | TBU-PL050-xxx-WH | 1 | MOV-07D201K | 2 |
| Telcordia GR-1089-CORE Enhanced Intra-building | 5000 V, 500 A 2/10 μ s 120V RMS, 25 A, 900 s | TBU-PL060-xxx-WH | 1 | MOV-10D201K | 2 |
| | 1500 V, 100 A 2/10 μ s 277V RMS, 25 A, 900 s | TBU-PL085-xxx-WH | 1 | MOV-10D431K | 2 |
| ITU-T K.20, K.21, K.45 Basic | 1500 V, 40 Ω 10/700 μ s 4000 V, 40 Ω 10/700 μ s 230 V rms 10 Ω -1000 Ω , 900 s 600 V rms 600 Ω , 0.2 s | TBU-PL085-xxx-WH | 1 | MOV-10D391K | 2 |
| | 1500 V, 40 Ω 10/700 μ s 4000 V, 40 Ω 10/700 μ s 230 V rms 10 Ω -1000 Ω , 900 s 600 V rms 600 Ω , 1 s | TBU-PL085-xxx-WH | 1 | TISP4400M3BJ | 2 |
| ITU-T K.20, K.21, K.45 Enhanced | 1500 V, 40 Ω 10/700 μ s 6000 V, 40 Ω 10/700 μ s* 230 V rms 10 Ω -1000 Ω , 900 s 600 V rms 600 Ω , 0.2 s 600 V rms 600 Ω , 1 s* 1500 V rms, 200 Ω 2s* | TBU-PL085-xxx-WH | 1 | MOV-10D391K | 2 |
| | 1500 V, 40 Ω 10/700 μ s 6000 V, 40 Ω 10/700 μ s 230 V rms 10 Ω -1000 Ω , 900 s 600 V rms 600 Ω , 0.2 s 600 V rms 600 Ω , 1 s 1500 V rms, 200 Ω 2s | TBU-PL085-xxx-WH | 1 | TISP4500H3BJ | 2 |

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

Note: The Le9500, Le9520 and Le9530 (VE950 series) require a 200 mA $I_{trigger}$ TBU™ device for normal operation.

Device Pin Out



Pad Designation

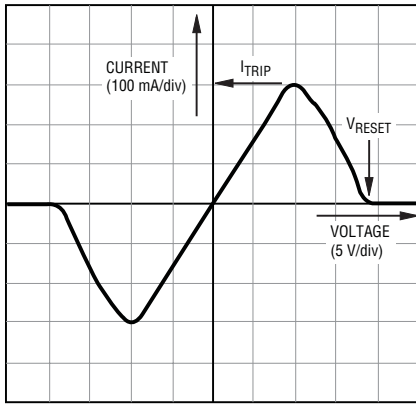
| Pad # | Pin Out |
|-------|-------------|
| 1 | Line 1 |
| 2 | V_{dd} |
| 3 | Not Used |
| 4 | Line 1 SLIC |
| 5 | Line 2 SLIC |
| 6 | V_{ss} |
| 7 | Not Used |
| 8 | Line 2 |

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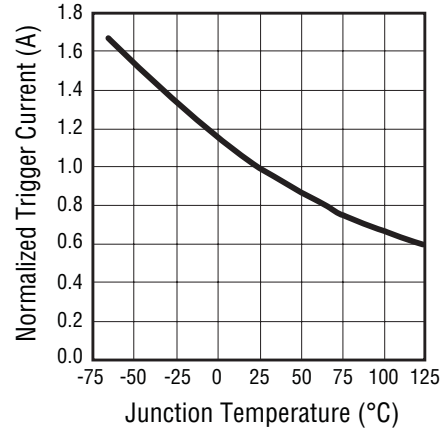
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Performance Graphs

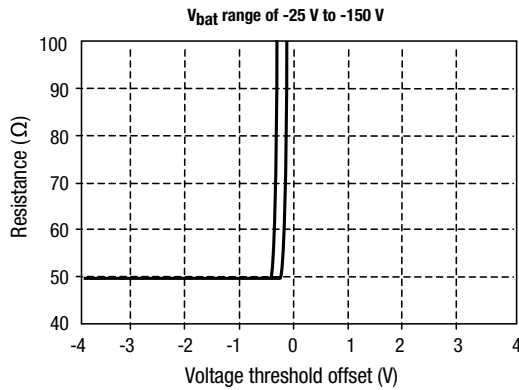
Typical V-I Characteristics (TBU-PL085-200-WH)



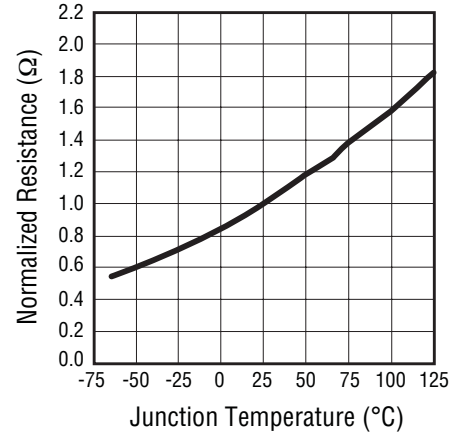
Typical Trigger Current vs. Temperature



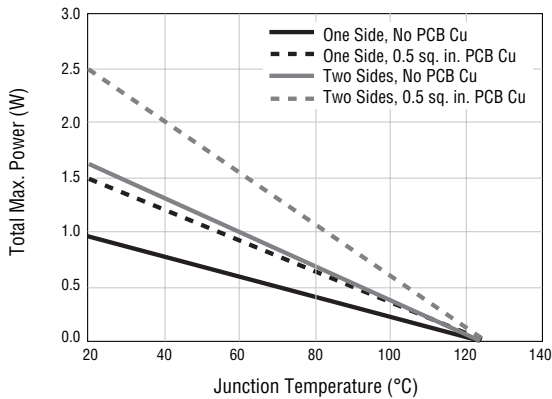
Tracking Voltage Characteristics



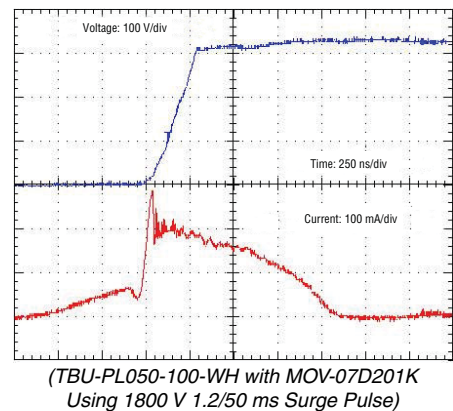
Typical Resistance vs. Temperature



Power Derating Curve



Typical Surge Response

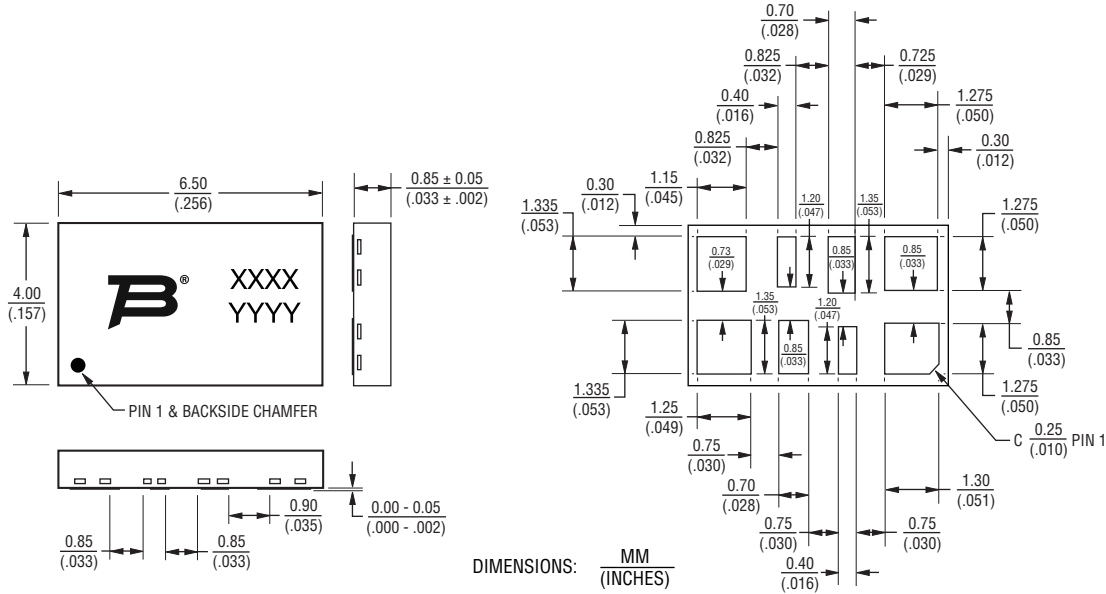


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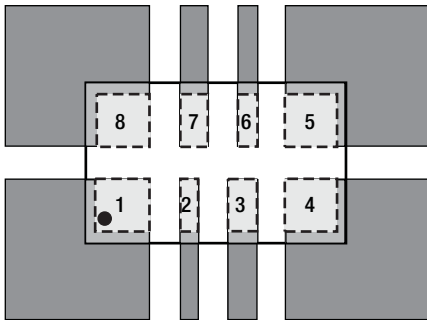
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Product Dimensions



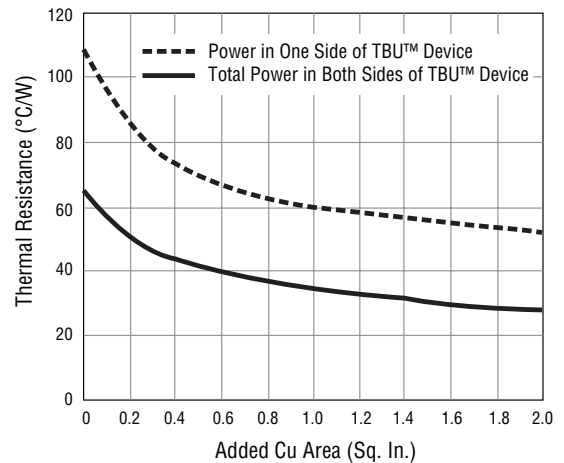
Recommended Pad Layout

TBU™ protectors have matte-tin termination finish. The suggested layout should use Non-Solder Mask Define (NSMD). The recommended stencil thickness is 0.10-0.12 mm (.004-.005 in.) with a stencil opening size 0.025 mm (.0010 in.) less than the device pad size. As when heat sinking any power device, it is recommended that wherever possible, extra PCB copper area is allowed. For minimum parasitic capacitance, do not allow any signal, ground or power signals beneath any of the pads of the device.



Dark grey areas show added PCB copper area for better thermal resistance.

Thermal Resistance vs Additional PCB Cu Area

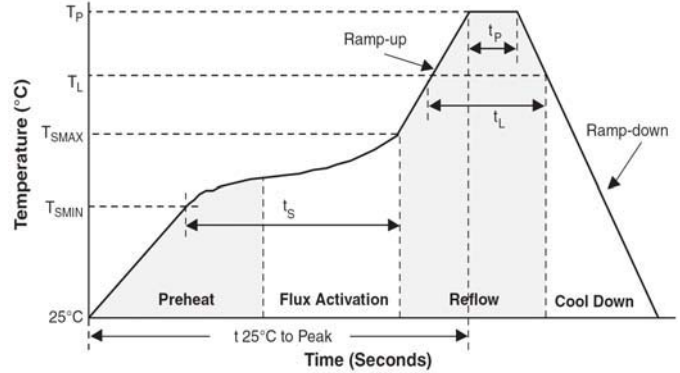


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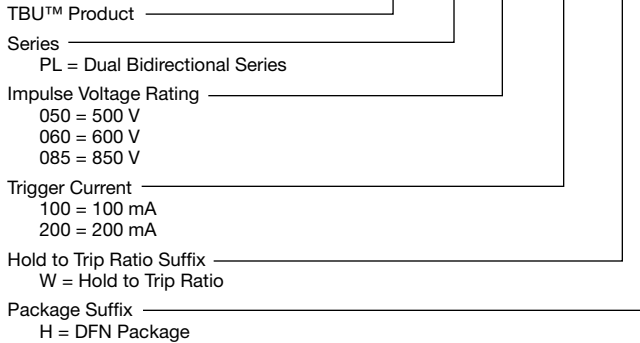
Reflow Profile

| Profile Feature | Pb-Free Assembly |
|---|---------------------------------|
| Average Ramp-Up Rate (T _{smax} to T _p) | 3 °C/sec. max. |
| Preheat <ul style="list-style-type: none"> - Temperature Min. (T_{smin}) - Temperature Max. (T_{smax}) - Time (t_{smin} to t_{smax}) | 150 °C 200 °C 60-180 sec. |
| Time maintained above: <ul style="list-style-type: none"> - Temperature (T_L) - Time (t_L) | 217 °C 60-150 sec. |
| Peak/Classification Temperature (T _p) | 260 °C |
| Time within 5 °C of Actual Peak Temp. (t _p) | 20-40 sec. |
| Ramp-Down Rate | 6 °C/sec. max. |
| Time 25 °C to Peak Temperature | 8 min. max. |

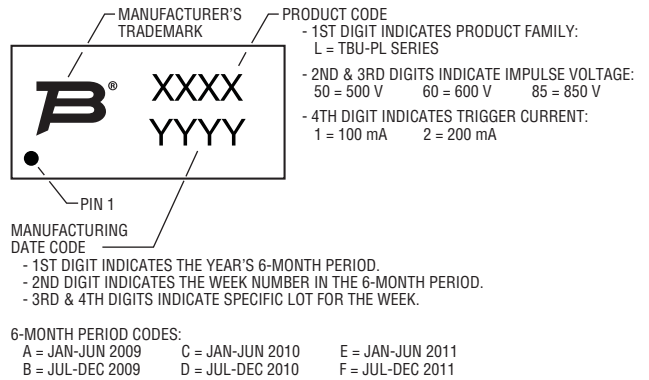


How to Order

TBU - PL 085 - 100 - WH



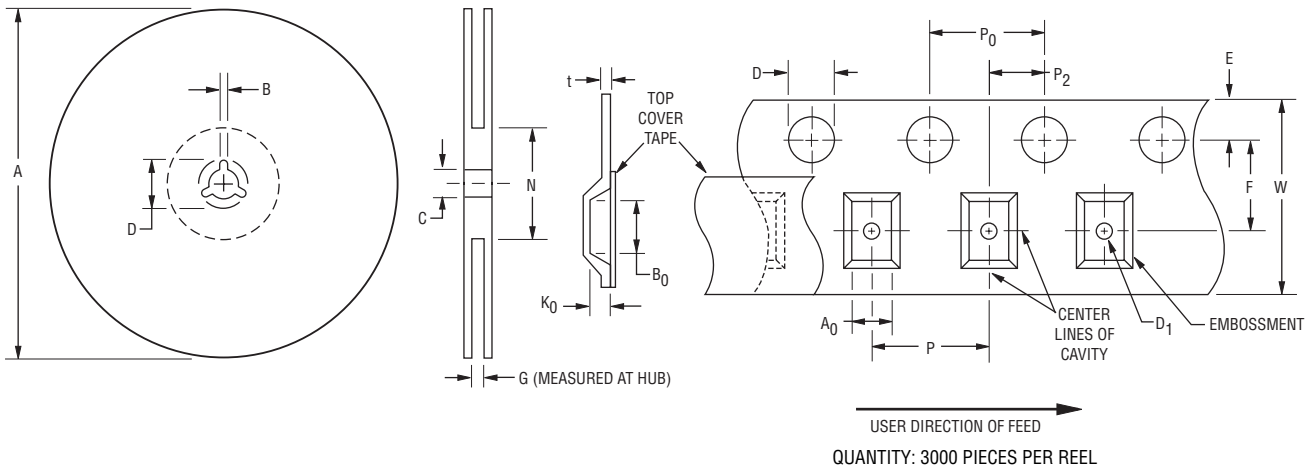
Typical Part Marking



TBU-PL Series - TBU™ High Speed Protectors

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Packaging Specifications



| A | | B | | C | | D | | G | N |
|----------|----------|--------|--------|--------|--------|--------|------|--------|---------|
| Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Ref. | Ref. |
| 326 | 330 | 1.5 | 2.5 | 12.8 | 13.5 | 20.2 | - | 16.5 | 102 |
| (12.835) | (13.002) | (.059) | (.098) | (.504) | (.531) | (.795) | | (.650) | (4.016) |

| A0 | | B0 | | D | | D1 | | E | | F | |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| 4.30 | 4.50 | 6.70 | 6.90 | 1.5 | 1.6 | 1.5 | - | 1.65 | 1.85 | 7.4 | 7.6 |
| (.169) | (.177) | (.264) | (.272) | (.059) | (.063) | (.059) | | (.065) | (.073) | (.291) | (.299) |
| K0 | | P | | P0 | | P2 | | t | | W | |
| Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| 1.0 | 1.2 | 7.9 | 8.1 | 3.9 | 4.1 | 1.9 | 2.1 | 0.25 | 0.35 | 15.7 | 16.3 |
| (.039) | (.047) | (.311) | (.319) | (.159) | (.161) | (.075) | (.083) | (.010) | (.014) | (.618) | (.642) |

DIMENSIONS: $\frac{\text{MM}}{\text{(INCHES)}}$

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