**Features**

- Formerly *FuTec* brand
- Extremely high speed performance
- Blocks high voltages and currents
- Low insertion loss
- Two TBU® protectors in one small package
- Very high bandwidth; GHz compatible
- RoHS compliant*, UL Recognized

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**P650-U and P850-U Series TBU® High-Speed Protectors**

Transient Blocking Units - TBU® Devices

Bourns® Model P650-U and P850-U products are high-speed, unidirectional protection components, constructed using MOSFET semiconductor technology, designed to protect against faults caused by short circuits, AC power cross, induction and lightning surges.

The TBU® high-speed protector, triggering as a function of the MOSFET, blocks surges and provides 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.

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**Agency Approval**

UL recognized component File # E315805.

**Industry Standards**

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telcordia</td>
<td>GR-1089 Port Type 3, 5 P650-U Port Type 2, 4 P850-U</td>
</tr>
</tbody>
</table>

---

**Absolute Maximum Ratings (T_{amb} = 25 °C)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{imp}$</td>
<td>Maximum protection voltage for impulse faults with rise time $\geq 1 \mu\text{s}$</td>
<td>P650-Uxxx-WH 650 V P850-Uxxx-WH 850 V</td>
<td></td>
</tr>
<tr>
<td>$V_{rms}$</td>
<td>Maximum protection voltage for continuous $V_{rms}$ faults connected as a series pair (refer to page 3 Test Configuration Diagram)</td>
<td>P650-Uxxx-WH 300 V P850-Uxxx-WH 425 V</td>
<td></td>
</tr>
<tr>
<td>$T_{op}$</td>
<td>Operating temperature range</td>
<td>-40 to +85 °C</td>
<td></td>
</tr>
<tr>
<td>$T_{etq}$</td>
<td>Storage temperature range</td>
<td>-65 to +150 °C</td>
<td></td>
</tr>
</tbody>
</table>

---

**Electrical Characteristics (T_{amb} = 25 °C)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{op}$</td>
<td>Maximum current through the device that will not cause current blocking</td>
<td>P650-U180-WH 180 mA P650-U260-WH 260 mA P850-U180-WH 180 mA P850-U260-WH 260 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{trigger}$</td>
<td>Typical current for the device to go from normal operating state to protected state</td>
<td>P650-U180-WH 220 mA P650-U260-WH 330 mA P850-U180-WH 220 mA P850-U260-WH 330 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{out}$</td>
<td>Maximum current through the device</td>
<td>P650-U180-WH 360 mA P650-U260-WH 520 mA P850-U180-WH 360 mA P850-U260-WH 520 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{device}$</td>
<td>Series resistance of the TBU® device</td>
<td>P650-Uxxx-WH 6 Ω P850-Uxxx-WH 9 Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{bal}$</td>
<td>Line-to-line series resistance difference between two TBU® devices</td>
<td>0.5 Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_{block}$</td>
<td>Maximum time for the device to go from normal operating state to protected state</td>
<td>P650-Uxxx-WH 1 μs P850-Uxxx-WH 1 μs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{quiescent}$</td>
<td>Current through the triggered TBU® device with 50 Vdc circuit voltage</td>
<td>1 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{reset}$</td>
<td>Voltage below which the triggered TBU® device will transition to normal operating state</td>
<td>P650-Uxxx-WH 11 V P850-Uxxx-WH 14 V</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The P-U Series TBU® devices are unidirectional; specifications are valid for input direction only. For the output direction, the TBU® device is a resistor.

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*RoHS Directive 2002/95/EC Jan. 27, 2003 including annex and RoHS Recast 2011/65/EU June 8, 2011. Specifications are subject to change without notice. The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time. Users should verify actual device performance in their specific applications.

---

The P650-U & P850-U Series are obsolete and not recommended for new designs. Bourns® TBU-DT Series is preferred.
Applications

- Mb Ethernet port protection
- Gb Ethernet port protection
- Isolated and floating interfaces

Typical Performance Characteristics

V-I Characteristics

Time to Block vs. Fault Current

Trigger Current vs. Temperature

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P650-U and P850-U Series TBU® High-Speed Protectors

Operational Characteristics

The graphs below demonstrate the operational characteristics of the TBU® protector. For each graph the fault voltage, protected side voltage, and current is presented.

**TEST CONFIGURATION DIAGRAM**

**P650-U Lightning, 650 V**

**P850-U Lightning, 850 V**

**P650-U Power Fault, 120 Vrms, 25 A**

**P850-U Power Fault, 230 Vrms, 25 A**

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P650-U and P850-U Series TBU® High-Speed Protectors

**Product Dimensions**

---

**Recommended Pad Layout**

<table>
<thead>
<tr>
<th>Pad #</th>
<th>Apply</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Out1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Out2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>In2</td>
<td></td>
</tr>
</tbody>
</table>

NC = Solder to PCB; do not make electrical connection, do not connect to ground.

TBU® devices have matte-tin termination finish. Suggested layout should use non-solder mask define (NSMD). Recommended stencil thickness is 0.10-0.12 mm (.004-.005 in.) with 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.

**Thermal Resistances**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rth(j-a)</td>
<td>Junction to leads (package)</td>
<td>105°C/W</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Junction to leads (per TBU® device)</td>
<td>202°C/W</td>
<td></td>
</tr>
</tbody>
</table>

**Reflow Profile**

- **Profile Feature**
  - Average Ramp-Up Rate (Tmax to Tp)
  - Preheat
    - Temperature Min. (Tmin)
    - Temperature Max. (Tmax)
    - Time (tmin to tmax)
  - Time maintained above:
    - Temperature (TL)
    - Time (TL)
  - Peak/Classification Temperature (Tp)
  - Time within 5 °C of Actual Peak Temp. (tp)
  - Ramp-Down Rate
  - Time 25 °C to Peak Temperature

---

**Block Diagram**

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P650-U and P850-U Series TBU® High-Speed Protectors

How to Order

Form Factor
P = Two TBU® protectors in one device

Impulse Voltage Rating
650 = 650 V
850 = 850 V

Directional Indication for Paired Devices
U = Unidirectional

Iop Indicator
180 = 180 mA
260 = 260 mA

Typical Part Marking

How to Order

P  650  -  U  180  -  WH

Packaging Specifications (per EIA468-B)

Device A B C D G N
P650-U, P850-U 326 330.25 1.5 2.5 12.8 13.5 20.2 - 16.5 102

Device A0 B0 D D1 E F
P650-U, P850-U 6.5 6.7 8.0 8.2 1.5 1.6 - 1.65 1.85 7.4 7.6

Device K0 P0 P2 t W
P650-U, P850-U 1.4 1.6 11.9 12.1 3.9 4.1 1.9 2.1 0.25 0.35 15.7 16.3

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DIMENSIONS: MM (INCHES)

QUANTITY: 3000 PIECES PER REEL
Reference Applications

A cost-effective protection solution utilizes the Bourns® TBU® protection devices. The diagrams below illustrate common configurations of these components. The graph at the bottom demonstrates the operational characteristics of the circuit.

Typical Configuration Diagrams

GbE Ethernet Protection
Up to 1500 V Common-Mode Lightning Protection

GbE Ethernet Protection
Up to 6000 V Common-Mode Lightning Protection

P850-U with G5200AS 4000 V Lightning 10/700 µsec, 150 A

P850-U and P850-U Series TBU® High-Speed Protectors

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