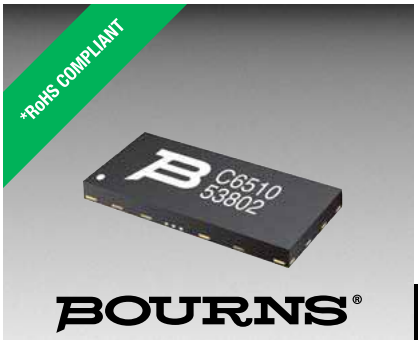



## Features

- Formerly FulTec brand
- Extremely high speed performance
- Blocks high voltages and currents
- Very high bandwidth; GHz compatible
- Small package, minimal PCB area
- Simple, superior circuit protection
- RoHS compliant*, UL Recognized

The C650 & C850 Series are currently available, but not recommended for new designs. Bourns® TBU-CA Series is preferred.

# C650 and C850 Series TBU® High-Speed Protectors

### Transient Blocking Units - TBU® Devices

Bourns® C650 and C850 series products are high-speed bidirectional 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.

### Industry Standards

| Description | | | Model |
|---|---|---|---|
| Telcordia | GR-1089 | Port Type 1, 3, 5 | C650<br>C850 |
| | GR-974 | | |
| ITU-T | K.20, K.20E, K.21, K.21E, K.45 | | C850 |

### Additional Information

Click these links for more information:

PRODUCT SELECTOR | TECHNICAL LIBRARY | INVENTORY | SAMPLES | CONTACT

### Agency Approval

| Description | |
|---|---|
| UL | File Number: E315805 |

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

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{imp}$ | Maximum protection voltage for impulse faults with rise time ≥ 1 µsec | C650-xxx-WH<br>C850-xxx-WH | 650<br>850 | V |
| $V_{rms}$ | Maximum protection voltage for continuous $V_{rms}$ faults | C650-xxx-WH<br>C850-xxx-WH | 300<br>425 | V |
| $T_{op}$ | Operating temperature range | | -40 to +85 | °C |
| $T_{stg}$ | Storage temperature range | | -65 to +150 | °C |

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**www.bourns.com**

**WARNING Cancer and Reproductive Harm** - www.P65Warnings.ca.gov

*RoHS Directive 2015/863, Mar 31, 2015 and Annex.
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## Applications

- Combo voice / xDSL linecards
- Voice linecards
- MDF, primary protection modules
- Process control equipment
- Test and measurement equipment
- General electronics



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

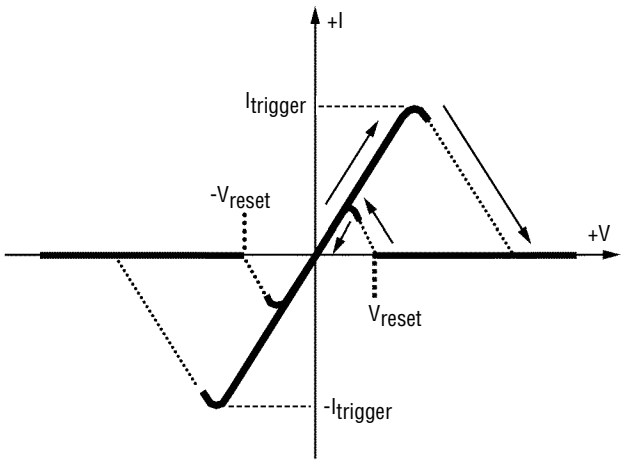
| Symbol | Parameter | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{op}$ | Maximum current through the device that will not cause current blocking | Cx50-100-WH<br>Cx50-180-WH<br>Cx50-260-WH | | | 100<br>180<br>260 | mA |
| $I_{trigger}$ | Typical current for the device to go from normal operating state to protected state | Cx50-100-WH<br>Cx50-180-WH<br>Cx50-260-WH | | 150<br>220<br>330 | | mA |
| $I_{out}$ | Maximum current through the device | Cx50-100-WH<br>Cx50-180-WH<br>Cx50-260-WH | | | 200<br>360<br>520 | mA |
| $R_{device}$ | Series resistance of the TBU® device | C650-100-WH<br>C650-180-WH<br>C650-260-WH<br>C850-100-WH<br>C850-180-WH<br>C850-260-WH | | 12<br>8<br>8<br>17<br>11<br>11 | 14.5<br>10<br>10<br>19<br>14<br>14 | Ω |
| $t_{block}$ | Maximum time for the device to go from normal operating state to protected state | | | | 1 | µs |
| $I_{quiescent}$ | Current through the triggered TBU® device with 50 Vdc circuit voltage | | | 1 | | mA |
| $V_{reset}$ | Voltage below which the triggered TBU® device will transition to normal operating state | | | 14 | | V |

C650 and C850 TBU® High-Speed Protectors are bidirectional; specifications are valid in both directions.

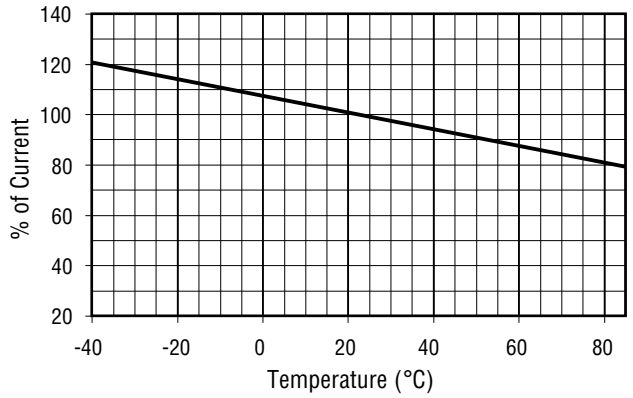
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## Typical Performance Characteristics

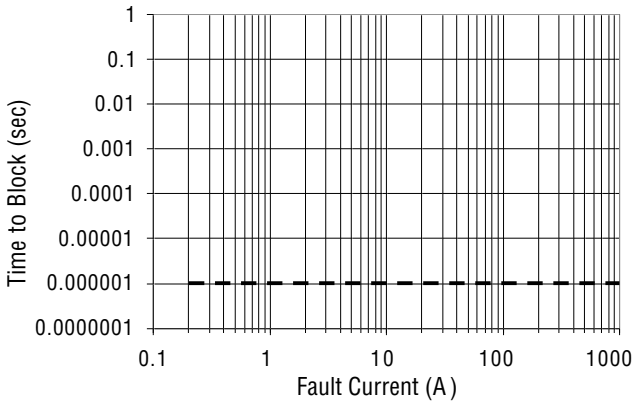
### V-I Characteristics




### Current vs. Temperature




### Time to Block vs. Fault Current

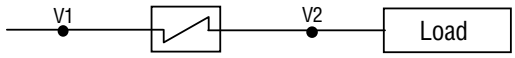



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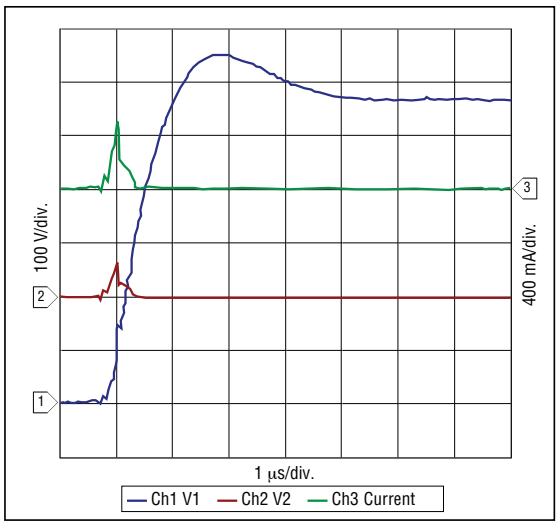
## Operational Characteristics

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

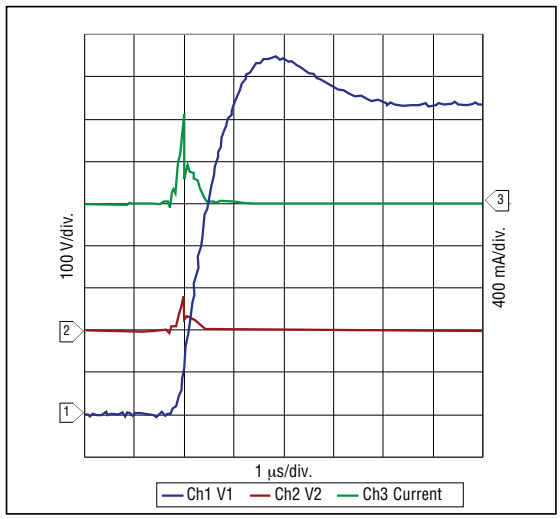
TEST CONFIGURATION DIAGRAM



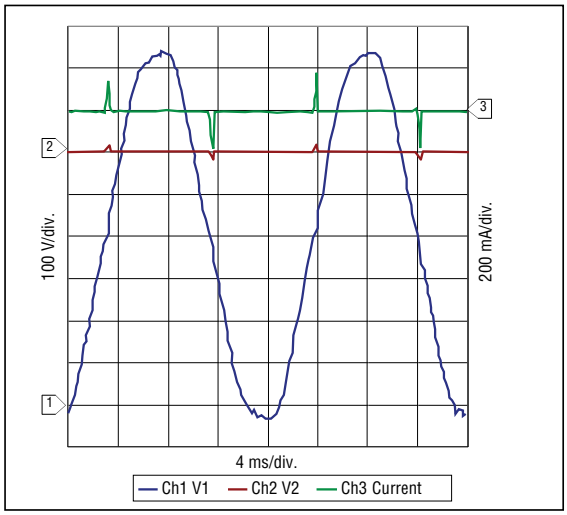

### C650 Lightning, 650 V



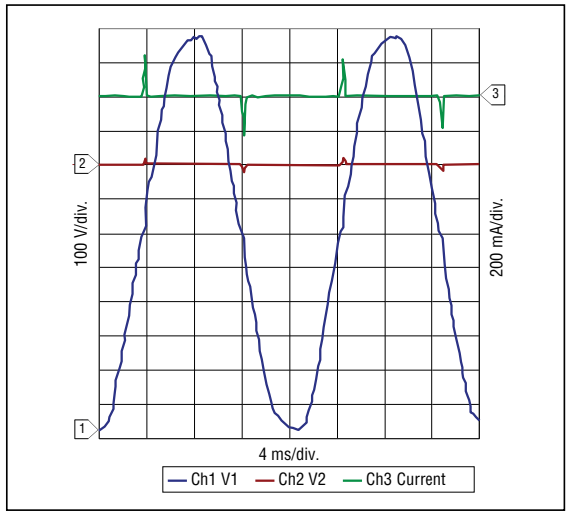

### C850 Lightning, 850 V




### C650 Power Fault, 300 Vrms, 100 A

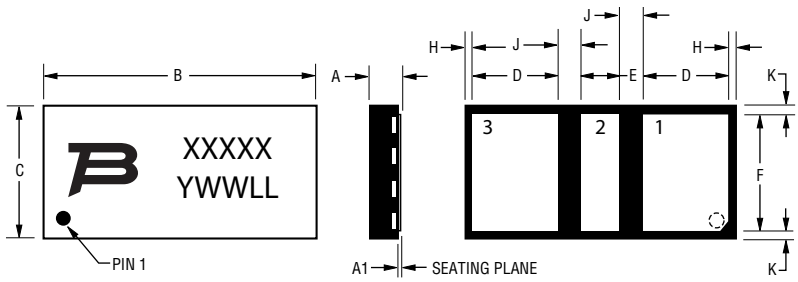



### C850 Power Fault, 425 Vrms, 100 A




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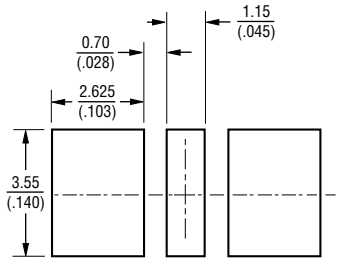
## Product Dimensions




| Dim. | Min. | Typ. | Max. |
|---|---|---|---|
| A | 0.80 (.031) | 0.90 (.035) | 1.00 (.039) |
| A1 | 0.00 (.000) | 0.025 (.001) | 0.050 (.002) |
| B | 8.15 (.321) | 8.25 (.325) | 8.35 (.329) |
| C | 3.90 (.154) | 4.00 (.157) | 4.10 (.161) |
| D | 2.55 (.100) | 2.60 (.102) | 2.65 (.104) |
| E | 1.10 (.043) | 1.15 (.045) | 1.20 (.047) |
| F | 3.45 (.136) | 3.50 (.138) | 3.55 (.140) |
| H | 0.20 (.008) | 0.25 (.010) | 0.30 (.012) |
| J | 0.65 (.026) | 0.70 (.028) | 0.75 (.030) |
| K | 0.20 (.008) | 0.25 (.010) | 0.30 (.012) |

DIMENSIONS: MM / (INCHES)

## Recommended Pad Layout




**Pad Designation**

| Pad # | Apply |
|---|---|
| 1 | In/Out |
| 2 | NC |
| 3 | In/Out |

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

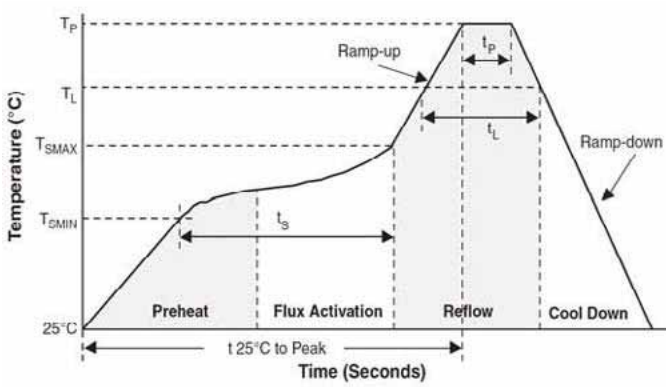
TBU® protectors have matte-tin termination finish. Suggested layout should use non-solder mask define (NSMD). Recommended stencil thickness is 0.10-0.12 mm (.004-.005 in.) with stencil opening size 0.025 mm (.0010 in.) less than the device pad size. As when heatsinking any power device, it is recommended 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

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{th(j-a)}$ | Junction to leads (package) | 116 | °C/W |

## Reflow Profile

| Profile Feature | Pb-Free Assembly |
|---|---|
| Average Ramp-Up Rate ($T_{smax}$ to $T_p$) | 3 °C/sec. max. |
| Preheat<br>- Temperature Min. ($T_{smin}$)<br>- Temperature Max. ($T_{smax}$)<br>- Time ($t_{smin}$ to $t_{smax}$) | <br>150 °C<br>200 °C<br>60-180 sec. |
| Time maintained above:<br>- Temperature ($T_L$)<br>- Time ($t_L$) | <br>217 °C<br>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. |




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## How to Order

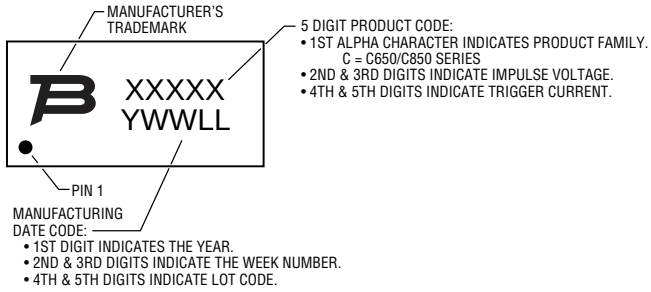
**C 650 - 180 - WH**

Form Factor
C = One TBU® protector in the device

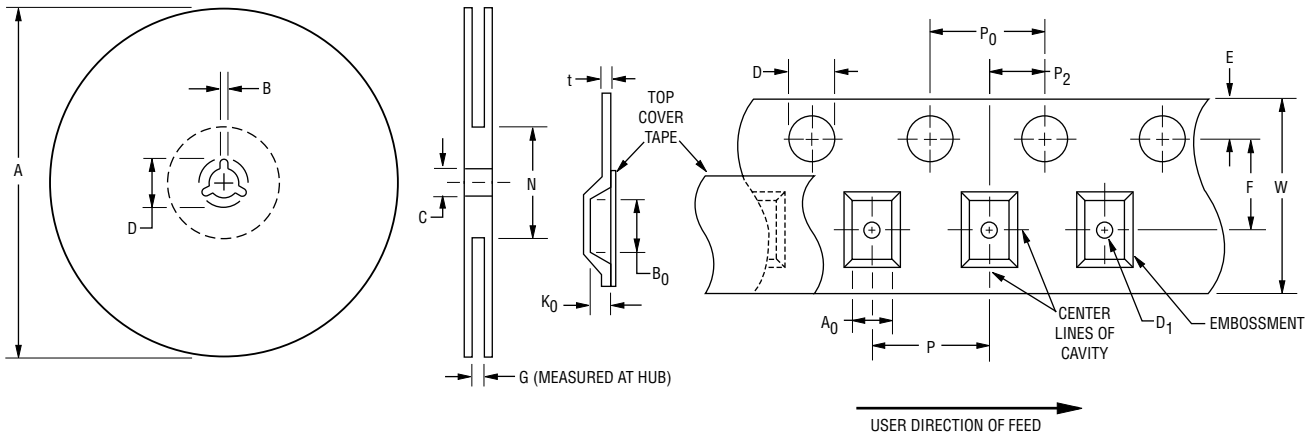
Impulse Voltage Rating
650 = 650 V
850 = 850 V

Iop Indicator
100 = 100 mA
180 = 180 mA
260 = 260 mA

## Typical Part Marking




## Packaging Specifications (per EIA468-B)




QUANTITY: 3000 PIECES PER REEL

| Device | A | | B | | C | | D | | G | N |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Ref. | Ref. |
| C650, C850 | 326 (12.835) | 330.25 (13.002) | 1.5 (.059) | 2.5 (.098) | 12.8 (.504) | 13.5 (.531) | 20.2 (.795) | — | 16.5 (.650) | 102 (4.016) |

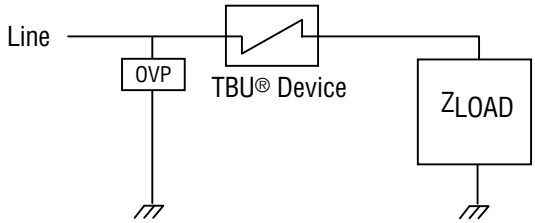
| Device | $A_0$ | | $B_0$ | | D | | $D_1$ | | E | | F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| C650, C850 | 4.2 (.165) | 4.4 (.173) | 8.45 (.333) | 8.65 (.341) | 1.5 (.059) | 1.6 (.063) | 1.5 (.059) | — | 1.65 (.065) | 1.85 (.073) | 7.4 (.291) | 7.6 (.299) |
| **Device** | **$K_0$** | | **P** | | **$P_0$** | | **$P_2$** | | **t** | | **W** | |
| | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| C650, C850 | 1.1 (.043) | 1.3 (.051) | 7.9 (.311) | 8.1 (.319) | 3.9 (.159) | 4.1 (.161) | 1.9 (.075) | 2.1 (.083) | 0.25 (.010) | 0.35 (.014) | 15.7 (.618) | 16.3 (.642) |

DIMENSIONS: MM (INCHES)

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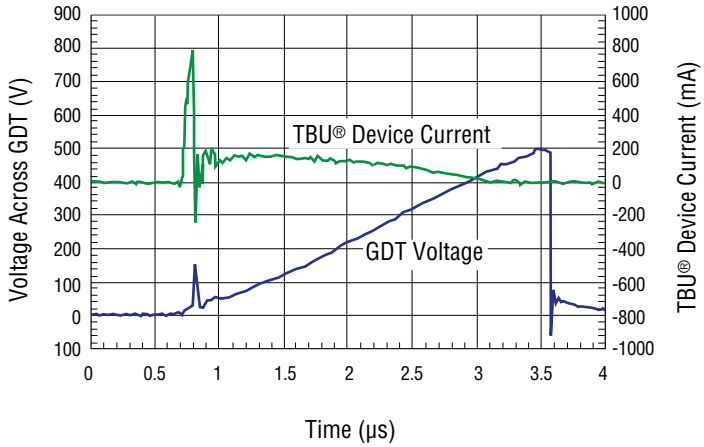
## Reference Application

The C-series devices are general protectors that can be used in a variety of applications. The basic operation of the device will be demonstrated using the single line application shown in the figure below. The test circuit was subjected to a 1000 V, 10/700 μs surge waveform. The devices used were the TBU-C850-100-WH and a 2031-42T-SM-RPLF GDT (OVP) with a 10 ohm resistor for the load impedance.




*General Application Circuit*

The graph below shows the waveforms for the voltage across the overvoltage protector (GDT) and the current through the TBU® device. As the input line voltage increases, the current through the TBU® device increases rapidly until the trip current is reached. Due to finite reaction time for fast transients, the peak level may exceed the low frequency data sheet maximum for a very short period, typically ~100 ns. After this initial overshoot, the TBU® device will transition to the protected state, setting the current to the nominal current limiting level (~150 mA for this example). The TBU® device will then reduce the current down it to its very low quiescent level of 1 mA, typically. As the input line voltage increases to about 500 V, the GDT is triggered, reducing the input line voltage to a very low level which prevents the TBU® device from being subjected to a voltage level which exceeds its maximum rating (850 V in this example). The TBU® High-Speed Orotector and the GDT will remain in these states until the surge ends, which is about 700 μs later in this example. Only the first 4 μs of the surge are shown in the graph. For surges or AC voltages below the GDT breakover voltage, the GDT will not activate, and the TBU® device will stay in the protecting mode, blocking high voltages from the protected equipment.




*TBU-C850-100-WH Response to a 1000 V, 10/700 μs Surge*



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