

## Applications

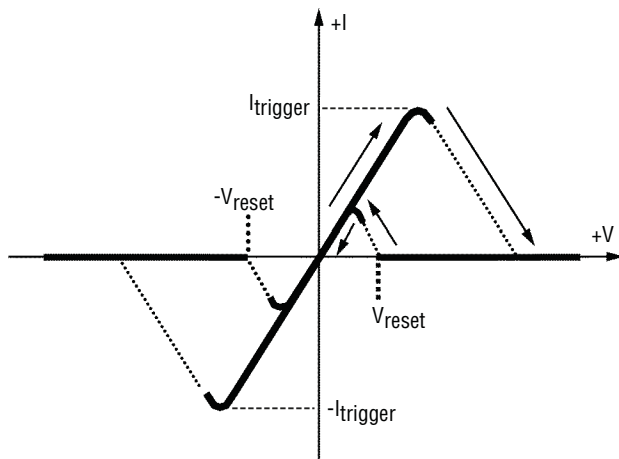
- Combo voice / xDSL linecards
- Voice linecards
- MDF, primary protection modules
- Process control equipment
- Test and measurement equipment
- General electronics

## C650 and C850 Series TBU® High-Speed Protectors

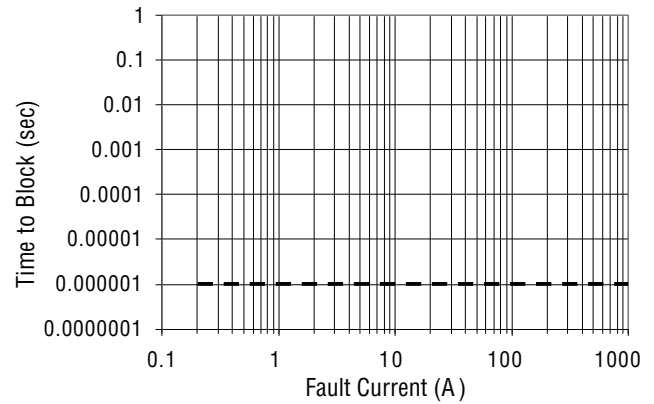
**BOURNS®**

### Typical Performance Characteristics

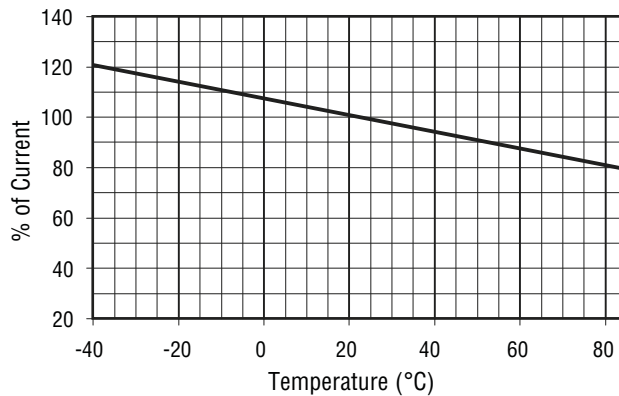
#### V-I Characteristics



#### Time to Block vs. Fault Current



#### Current vs. Temperature



Specifications are subject to change without notice.

Users should verify actual device performance in their specific applications.

The products described herein and this document are subject to specific legal disclaimers as set forth on the last page of this document, and at [www.bourns.com/docs/legal/disclaimer.pdf](http://www.bourns.com/docs/legal/disclaimer.pdf).

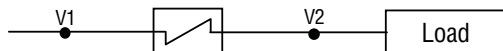
# C650 and C850 Series TBU® High-Speed Protectors

**BOURNS®**

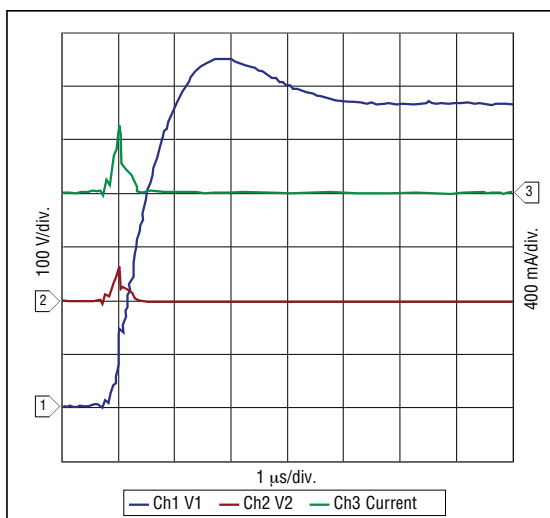
## Operational Characteristics

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

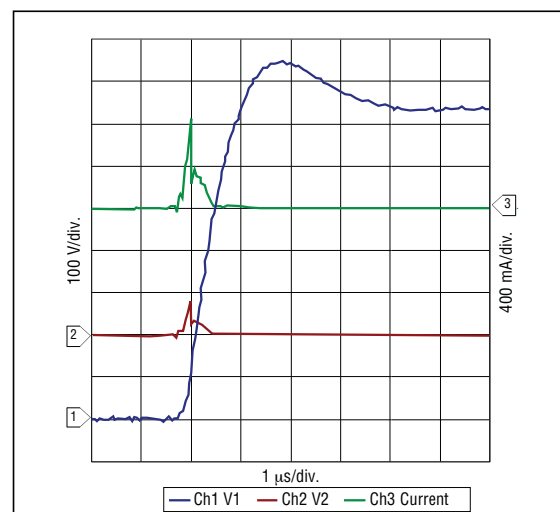
TEST CONFIGURATION DIAGRAM



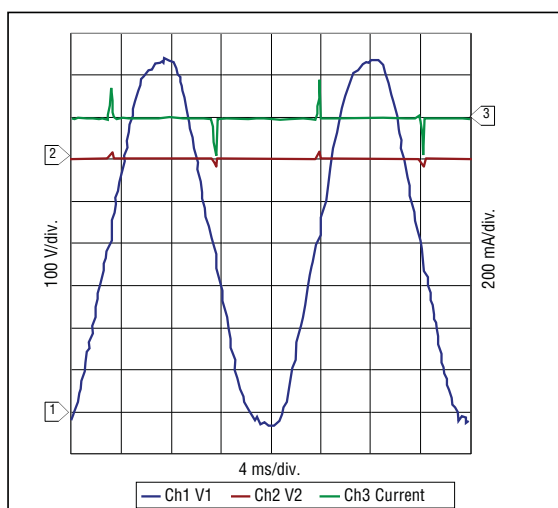
C650 Lightning, 650 V



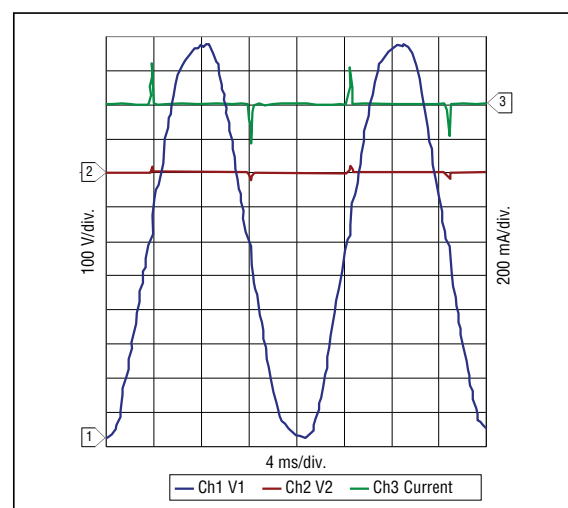
C850 Lightning, 850 V



C650 Power Fault, 300 Vrms, 100 A



C850 Power Fault, 425 Vrms, 100 A



Specifications are subject to change without notice.

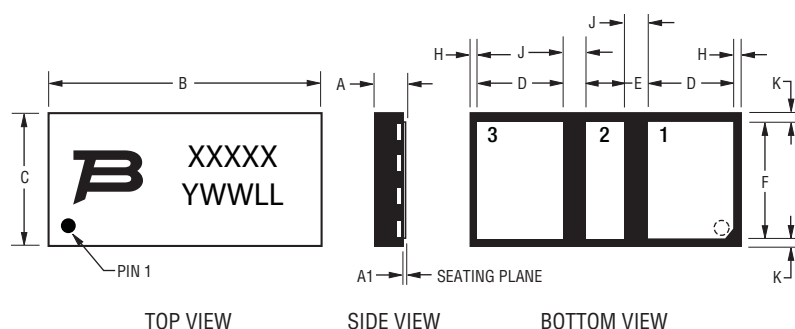
Users should verify actual device performance in their specific applications.

The products described herein and this document are subject to specific legal disclaimers as set forth on the last page of this document, and at [www.bourns.com/docs/legal/disclaimer.pdf](http://www.bourns.com/docs/legal/disclaimer.pdf).

# C650 and C850 Series TBU® High-Speed Protectors

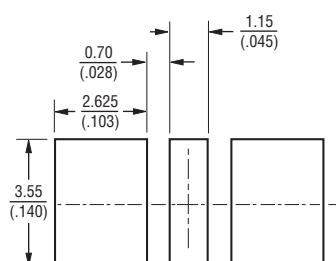
**BOURNS®**

## Product Dimensions



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

## 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.

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

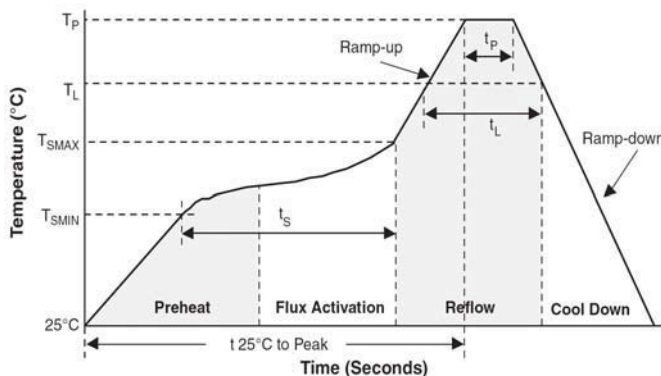
TBU® protectors have matte-tin termination finish. Suggested layout should use non-solder mask define (NSMD). Recommended stencil thickness is 0.10-0.12 mm (.004-.005 in.) with stencil opening size 0.025 mm (.0010 in.) less than the device pad size. As when heat sinking any power device, it is recommended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

| Symbol               | Parameter                   | Value | Unit |
|----------------------|-----------------------------|-------|------|
| R <sub>th(j-a)</sub> | Junction to leads (package) | 116   | °C/W |

## Reflow Profile

| Profile Feature                                             | Pb-Free Assembly |
|-------------------------------------------------------------|------------------|
| Average Ramp-Up Rate (T <sub>smax</sub> to T <sub>p</sub> ) | 3 °C/sec. max.   |
| Preheat                                                     |                  |
| - Temperature Min. (T <sub>smin</sub> )                     | 150 °C           |
| - Temperature Max. (T <sub>smax</sub> )                     | 200 °C           |
| - Time (t <sub>smin</sub> to t <sub>smax</sub> )            | 60-180 sec.      |
| Time maintained above:                                      |                  |
| - Temperature (T <sub>L</sub> )                             | 217 °C           |
| - Time (t <sub>L</sub> )                                    | 60-150 sec.      |
| Peak/Classification Temperature (T <sub>p</sub> )           | 260 °C           |
| Time within 5 °C of Actual Peak Temp. (t <sub>p</sub> )     | 20-40 sec.       |
| Ramp-Down Rate                                              | 6 °C/sec. max.   |
| Time 25 °C to Peak Temperature                              | 8 min. max.      |



Specifications are subject to change without notice.

Users should verify actual device performance in their specific applications.

The products described herein and this document are subject to specific legal disclaimers as set forth on the last page of this document, and at [www.bourns.com/docs/legal/disclaimer.pdf](http://www.bourns.com/docs/legal/disclaimer.pdf).

**BOURNS®**

## Typical Part Marking

The diagram shows a rectangular component with a circular pin on the left. A box is drawn around the right side of the component, containing the text "XXXXXX YWWLL". A line points from the text "MANUFACTURER'S TRADEMARK" to the stylized "B" logo. Another line points from the text "5 DIGIT PRODUCT CODE:" to the "XXXXXX" part of the code. A third line points from the text "C = C650/C850 SERIES" to the "YWWLL" part of the code. A fourth line points from the text "2ND & 3RD DIGITS INDICATE IMPULSE VOLTAGE." to the "WW" part of the code. A fifth line points from the text "4TH & 5TH DIGITS INDICATE TRIGGER CURRENT." to the "LL" part of the code. A sixth line points from the text "PIN 1" to the circular pin. A seventh line points from the text "MANUFACTURING DATE CODE:" to the "YY" part of the code. A eighth line points from the text "1ST DIGIT INDICATES THE YEAR." to the first digit of the date code. A ninth line points from the text "2ND & 3RD DIGITS INDICATE THE WEEK NUMBER." to the next two digits of the date code. A tenth line points from the text "4TH & 5TH DIGITS INDICATE LOT CODE." to the last two digits of the date code.

MANUFACTURER'S TRADEMARK

5 DIGIT PRODUCT CODE:

- 1ST ALPHA CHARACTER INDICATES PRODUCT FAMILY.  
C = C650/C850 SERIES
- 2ND & 3RD DIGITS INDICATE IMPULSE VOLTAGE.
- 4TH & 5TH DIGITS INDICATE TRIGGER CURRENT.

PIN 1

MANUFACTURING DATE CODE:

- 1ST DIGIT INDICATES THE YEAR.
- 2ND & 3RD DIGITS INDICATE THE WEEK NUMBER.
- 4TH & 5TH DIGITS INDICATE LOT CODE.

[illegible]

| Device     | A0                   |                      | B0                    |                       | D                    |                      | D1                   |                      | E                     |                       | F                     |                       |
|------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|            | Min.                 | Max.                 | Min.                  | Max.                  | Min.                 | Max.                 | Min.                 | Max.                 | Min.                  | Max.                  | Min.                  | Max.                  |
| C650, C850 | $\frac{4.2}{(.165)}$ | $\frac{4.4}{(.173)}$ | $\frac{8.45}{(.333)}$ | $\frac{8.65}{(.341)}$ | $\frac{1.5}{(.059)}$ | $\frac{1.6}{(.063)}$ | $\frac{1.5}{(.059)}$ | -                    | $\frac{1.65}{(.065)}$ | $\frac{1.85}{(.073)}$ | $\frac{7.4}{(.291)}$  | $\frac{7.6}{(.299)}$  |
| Device     | K0                   |                      | P                     |                       | P0                   |                      | P2                   |                      | t                     |                       | W                     |                       |
|            | Min.                 | Max.                 | Min.                  | Max.                  | Min.                 | Max.                 | Min.                 | Max.                 | Min.                  | Max.                  | Min.                  | Max.                  |
| C650, C850 | $\frac{1.1}{(.043)}$ | $\frac{1.3}{(.051)}$ | $\frac{7.9}{(.311)}$  | $\frac{8.1}{(.319)}$  | $\frac{3.9}{(.159)}$ | $\frac{4.1}{(.161)}$ | $\frac{1.9}{(.075)}$ | $\frac{2.1}{(.083)}$ | $\frac{0.25}{(.010)}$ | $\frac{0.35}{(.014)}$ | $\frac{15.7}{(.618)}$ | $\frac{16.3}{(.642)}$ |

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

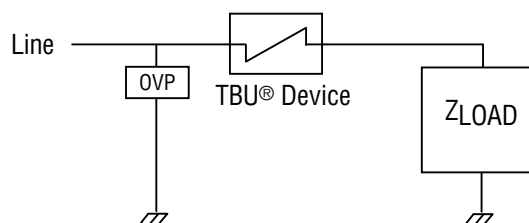
Specifications are subject to change without notice.  
Users should verify actual device performance in their specific applications.  
The products described herein and this document are subject to specific legal disclaimers as set forth on the last page of this document, and at [www.bourns.com/docs/legal/disclaimer.pdf](http://www.bourns.com/docs/legal/disclaimer.pdf).

## C650 and C850 Series TBU® High-Speed Protectors

**BOURNS®**

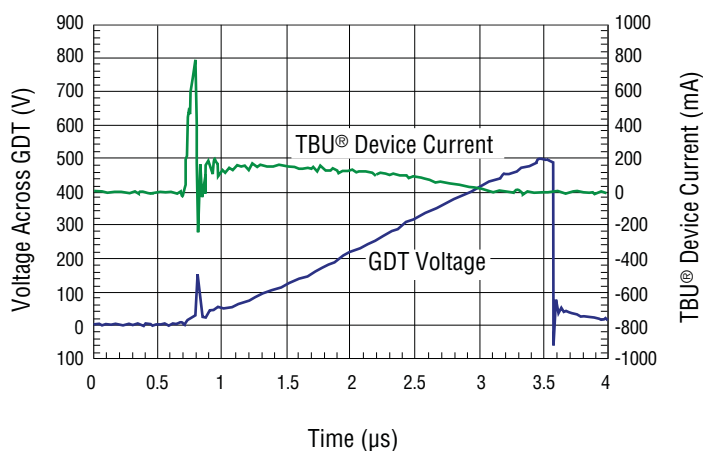
### Reference Application

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  $\mu$ s 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 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 Protector and the GDT will remain in these states until the surge ends, which is about 700  $\mu$ s later in this example. Only the first 4  $\mu$ s 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  $\mu$ s Surge

REV. 09/15

"TBU" is a registered trademark of Bourns, Inc. in the United States and other countries.

Specifications are subject to change without notice.

Users should verify actual device performance in their specific applications.

The products described herein and this document are subject to specific legal disclaimers as set forth on the last page of this document, and at [www.bourns.com/docs/legal/disclaimer.pdf](http://www.bourns.com/docs/legal/disclaimer.pdf).

This legal disclaimer applies to purchasers and users of Bourns® products manufactured by or on behalf of Bourns, Inc. and its affiliates (collectively, "Bourns").

Unless otherwise expressly indicated in writing, Bourns® products and data sheets relating thereto are subject to change without notice. Users should check for and obtain the latest relevant information and verify that such information is current and complete before placing orders for Bourns® products.

The characteristics and parameters of a Bourns® product set forth in its data sheet are based on laboratory conditions, and statements regarding the suitability of products for certain types of applications are based on Bourns' knowledge of typical requirements in generic applications. The characteristics and parameters of a Bourns® product in a user application may vary from the data sheet characteristics and parameters due to (i) the combination of the Bourns® product with other components in the user's application, or (ii) the environment of the user application itself. The characteristics and parameters of a Bourns® product also can and do vary in different applications and actual performance may vary over time. Users should always verify the actual performance of the Bourns® product in their specific devices and applications, and make their own independent judgments regarding the amount of additional test margin to design into their device or application to compensate for differences between laboratory and real world conditions.

Unless Bourns has explicitly designated an individual Bourns® product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949) or a particular qualification (e.g., UL listed or recognized), Bourns is not responsible for any failure of an individual Bourns® product to meet the requirements of such industry standard or particular qualification. Users of Bourns® products are responsible for ensuring compliance with safety-related requirements and standards applicable to their devices or applications.

Bourns® products are not recommended, authorized or intended for use in nuclear, lifesaving, life-critical or life-sustaining applications, nor in any other applications where failure or malfunction may result in personal injury, death, or severe property or environmental damage. Unless expressly and specifically approved in writing by two authorized Bourns representatives on a case-by-case basis, use of any Bourns® products in such unauthorized applications might not be safe and thus is at the user's sole risk. Life-critical applications include devices identified by the U.S. Food and Drug Administration as Class III devices and generally equivalent classifications outside of the United States.

Bourns expressly identifies those Bourns® standard products that are suitable for use in automotive applications on such products' data sheets in the section entitled "Applications." Unless expressly and specifically approved in writing by two authorized Bourns representatives on a case-by-case basis, use of any other Bourns® standard products in an automotive application might not be safe and thus is not recommended, authorized or intended and is at the user's sole risk. If Bourns expressly identifies a sub-category of automotive application in the data sheet for its standard products (such as infotainment or lighting), such identification means that Bourns has reviewed its standard product and has determined that if such Bourns® standard product is considered for potential use in automotive applications, it should only be used in such sub-category of automotive applications. Any reference to Bourns® standard product in the data sheet as compliant with the AEC-Q standard or "automotive grade" does not by itself mean that Bourns has approved such product for use in an automotive application.

Bourns® standard products are not tested to comply with United States Federal Aviation Administration standards generally or any other generally equivalent governmental organization standard applicable to products designed or manufactured for use in aircraft or space applications. Bourns expressly identifies Bourns® standard products that are suitable for use in aircraft or space applications on such products' data sheets in the section entitled "Applications." Unless expressly and specifically approved in writing by two authorized Bourns representatives on a case-by-case basis, use of any other Bourns® standard product in an aircraft or space application might not be safe and thus is not recommended, authorized or intended and is at the user's sole risk.

The use and level of testing applicable to Bourns® custom products shall be negotiated on a case-by-case basis by Bourns and the user for which such Bourns® custom products are specially designed. Absent a written agreement between Bourns and the user regarding the use and level of such testing, the above provisions applicable to Bourns® standard products shall also apply to such Bourns® custom products.

Users shall not sell, transfer, export or re-export any Bourns® products or technology for use in activities which involve the design, development, production, use or stockpiling of nuclear, chemical or biological weapons or missiles, nor shall they use Bourns® products or technology in any facility which engages in activities relating to such devices. The foregoing restrictions apply to all uses and applications that violate national or international prohibitions, including embargos or international regulations. Further, Bourns® products and Bourns technology and technical data may not under any circumstance be exported or re-exported to countries subject to international sanctions or embargoes. Bourns® products may not, without prior authorization from Bourns and/or the U.S. Government, be resold, transferred, or re-exported to any party not eligible to receive U.S. commodities, software, and technical data.

To the maximum extent permitted by applicable law, Bourns disclaims (i) any and all liability for special, punitive, consequential, incidental or indirect damages or lost revenues or lost profits, and (ii) any and all implied warranties, including implied warranties of fitness for particular purpose, non-infringement and merchantability.

*For your convenience, copies of this Legal Disclaimer Notice with German, Spanish, Japanese, Traditional Chinese and Simplified Chinese bilingual versions are available at:*

*Web Page:* <http://www.bourns.com/legal/disclaimers-terms-and-policies>

*PDF:* <http://www.bourns.com/docs/Legal/disclaimer.pdf>