


## Features

- Superior circuit protection
- Overcurrent and overvoltage protection
- Blocks surges up to rated limits
- High-speed performance
- Small SMT package
- Agency listing: 

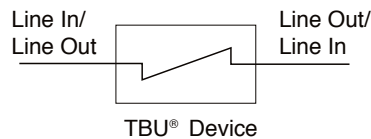
## Applications

- Voice / VDSL cards
- Protection modules and dongles
- Process control equipment
- Test and measurement equipment
- General electronics

# TBU-CA Series - TBU® High-Speed Protectors

### General Information

The TBU-CA Series of Bourns® TBU® products are low capacitance single 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.



### Agency Listing

Description	
UL	File Number: E315805

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 will not be 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.

### Absolute Maximum Ratings (@ T<sub>A</sub> = 25 °C Unless Otherwise Noted)

Symbol	Parameter	Part Number	Value	Unit
V <sub>imp</sub>	Peak impulse voltage withstand with duration less than 10 ms	TBU-CA025-xxx-WH	250	V
		TBU-CA040-xxx-WH	400	
		TBU-CA050-xxx-WH	500	
		TBU-CA065-xxx-WH	650	
		TBU-CA085-xxx-WH	850	
V <sub>rms</sub>	Continuous A.C. RMS voltage	TBU-CA025-xxx-WH	100	V
		TBU-CA040-xxx-WH	200	
		TBU-CA050-xxx-WH	250	
		TBU-CA065-xxx-WH	300	
		TBU-CA085-xxx-WH	425	
T <sub>op</sub>	Operating temperature range		-55 to +125	°C
T <sub>stg</sub>	Storage temperature range		-65 to +150	°C
T <sub>jmax</sub>	Maximum Junction Temperature		+125	°C
ESD	HBM ESD protection per IEC 61000-4-2		±2	kV

## BOURNS®

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



**WARNING Cancer and Reproductive Harm - [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)**

\* 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. 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)

# TBU-CA Series - TBU® High-Speed Protectors

# BOURNS®

## Electrical Characteristics (@ T<sub>A</sub> = 25 °C Unless Otherwise Noted)

Symbol	Parameter	Part Number	Min.	Typ.	Max.	Unit	
I <sub>trigger</sub>	Current required for the device to go from operating state to protected state	TBU-CAxxx-050-WH	50	75	100	mA	
		TBU-CAxxx-100-WH	100	150	200		
		TBU-CAxxx-200-WH	200	300	400		
		TBU-CAxxx-300-WH	300	450	600		
		TBU-CAxxx-500-WH	500	750	1000		
R <sub>device</sub>	Series resistance of the TBU device	V <sub>imp</sub> = 250 V I <sub>trigger</sub> (min.) = 50 mA	TBU-CA025-050-WH		13.3	15.3	Ω
		V <sub>imp</sub> = 250 V I <sub>trigger</sub> (min.) = 100 mA	TBU-CA025-100-WH		7.1	8.2	
		V <sub>imp</sub> = 250 V I <sub>trigger</sub> (min.) = 200 mA	TBU-CA025-200-WH		4.2	4.8	
		V <sub>imp</sub> = 250 V I <sub>trigger</sub> (min.) = 300 mA	TBU-CA025-300-WH		3.2	3.8	
		V <sub>imp</sub> = 250 V I <sub>trigger</sub> (min.) = 500 mA	TBU-CA025-500-WH		2.6	3.0	
		V <sub>imp</sub> = 400 V I <sub>trigger</sub> (min.) = 50 mA	TBU-CA040-050-WH		14.3	16.5	
		V <sub>imp</sub> = 400 V I <sub>trigger</sub> (min.) = 100 mA	TBU-CA040-100-WH		8.1	9.4	
		V <sub>imp</sub> = 400 V I <sub>trigger</sub> (min.) = 200 mA	TBU-CA040-200-WH		5.2	6.0	
		V <sub>imp</sub> = 400 V I <sub>trigger</sub> (min.) = 300 mA	TBU-CA040-300-WH		4.3	5.0	
		V <sub>imp</sub> = 400 V I <sub>trigger</sub> (min.) = 500 mA	TBU-CA040-500-WH		3.6	4.2	
		V <sub>imp</sub> = 500 V I <sub>trigger</sub> (min.) = 50 mA	TBU-CA050-050-WH		15.7	18.0	
		V <sub>imp</sub> = 500 V I <sub>trigger</sub> (min.) = 100 mA	TBU-CA050-100-WH		9.5	10.9	
		V <sub>imp</sub> = 500 V I <sub>trigger</sub> (min.) = 200 mA	TBU-CA050-200-WH		6.6	7.5	
		V <sub>imp</sub> = 500 V I <sub>trigger</sub> (min.) = 300 mA	TBU-CA050-300-WH		5.6	6.5	
		V <sub>imp</sub> = 500 V I <sub>trigger</sub> (min.) = 500 mA	TBU-CA050-500-WH		5.0	5.7	
		V <sub>imp</sub> = 650 V I <sub>trigger</sub> (min.) = 50 mA	TBU-CA065-050-WH		17.7	20.3	
		V <sub>imp</sub> = 650 V I <sub>trigger</sub> (min.) = 100 mA	TBU-CA065-100-WH		11.5	13.2	
		V <sub>imp</sub> = 650 V I <sub>trigger</sub> (min.) = 200 mA	TBU-CA065-200-WH		8.6	9.8	
		V <sub>imp</sub> = 650 V I <sub>trigger</sub> (min.) = 300 mA	TBU-CA065-300-WH		7.6	8.8	
		V <sub>imp</sub> = 650 V I <sub>trigger</sub> (min.) = 500 mA	TBU-CA065-500-WH		7.0	8.0	
		V <sub>imp</sub> = 850 V I <sub>trigger</sub> (min.) = 50 mA	TBU-CA085-050-WH		21.4	24.5	
		V <sub>imp</sub> = 850 V I <sub>trigger</sub> (min.) = 100 mA	TBU-CA085-100-WH		15.2	17.4	
		V <sub>imp</sub> = 850 V I <sub>trigger</sub> (min.) = 200 mA	TBU-CA085-200-WH		12.3	14.0	
		V <sub>imp</sub> = 850 V I <sub>trigger</sub> (min.) = 300 mA	TBU-CA085-300-WH		11.3	13.0	
V <sub>imp</sub> = 850 V I <sub>trigger</sub> (min.) = 500 mA	TBU-CA085-500-WH		10.7	12.2			
t <sub>block</sub>	Time for the device to go from normal operating state to protected state				1	μs	
I <sub>Q</sub>	Current through the triggered TBU® device with 50 Vdc circuit voltage		0.25	0.50	1.00	mA	
V <sub>reset</sub>	Voltage below which the triggered TBU® device will transition to normal operating state		12	16	20	V	
R <sub>th(j-l)</sub>	Junction to package pads - FR4 using recommended pad layout			98		°C/W	
R <sub>th(j-l)</sub>	Junction to package pads - FR4 using heat sink on board (6 cm <sup>2</sup> ) (1 in <sup>2</sup> )			40		°C/W	

## Environmental Characteristics

Parameter	Value
Moisture Sensitivity Level	1
ESD Classification (HBM)	1B

Specifications are subject to change without notice.

Users should verify actual device performance in their specific applications.

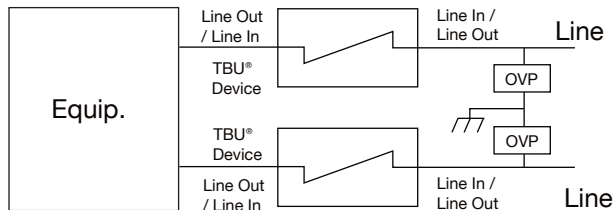
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# TBU-CA Series - TBU® High-Speed Protectors

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## Reference Application

The TBU® devices are general use protectors used in a wide variety of applications. The maximum voltage rating of the TBU® device should never be exceeded. Where necessary, an OVP 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

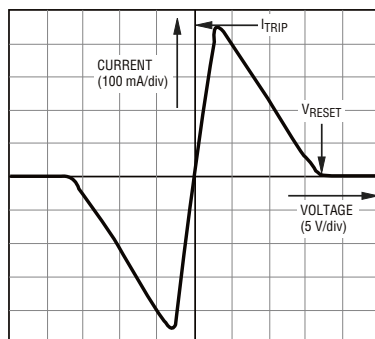
The TBU® device, constructed using MOSFET semiconductor technology, placed in the system circuit will monitor the current with the MOSFET detection circuit triggering to provide an effective barrier behind which sensitive electronics are not exposed to large voltages or currents during surge events. The TBU® device operates in approximately 1  $\mu$ s - once line current exceeds the TBU® device's trigger current  $I_{trigger}$ . When operated, the TBU® device will limit the current to less than the  $I_{trigger}$  value within the  $t_{block}$  duration. If voltage above  $V_{reset}$  is continuously sustained, the TBU® device will subsequently reduce the current to a quiescent current level within a period of time that is dependent upon the applied voltage.

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).

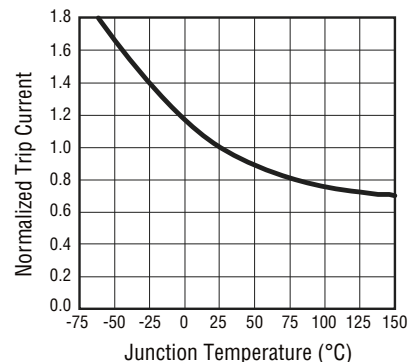
If the line has a normal DC bias above  $V_{reset}$ , the voltage across the TBU® device may not fall below  $V_{reset}$  after the surge. In such cases, special care needs to be taken to ensure that the TBU® device will reset, with software monitoring as one method used to accomplish this. Bourns application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

## Performance Graphs

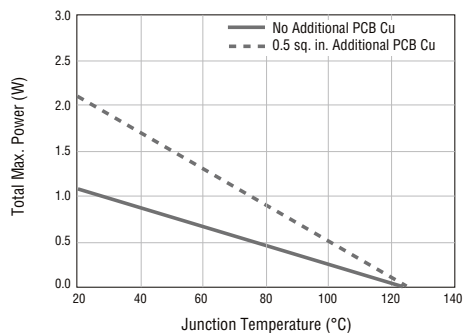
### Typical V-I Characteristics (TBU-CA050-300-WH)



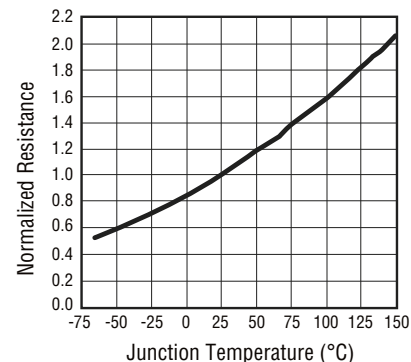
### Typical Trigger Current vs. Temperature



### Power Derating Curve



### Typical Resistance vs. Temperature

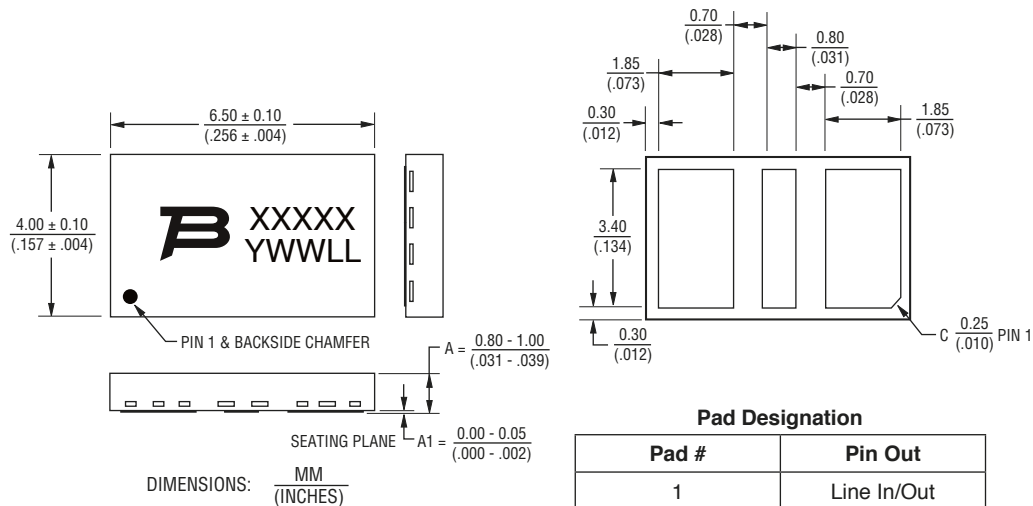


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## Product Dimensions

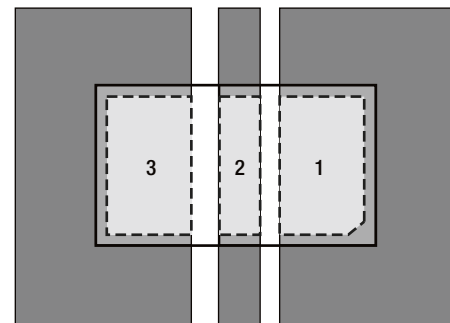


Pad Designation

Pad #	Pin Out
1	Line In/Out
2	NU
3	Line Out/In

## Recommended Pad Layout

TBU® High-Speed Protectors have a 100 % matte-tin termination finish. For improved thermal dissipation, the recommended layout uses PCB copper areas which extend beyond the exposed solder pad. The exposed solder pads should be defined by a solder mask which matches the pad layout of the TBU® device in size and spacing. It is recommended that they should be the same dimension as the TBU® pads but if smaller solder pads are used, they should be centered on the TBU® package terminal pads and not more than 0.10-0.12 mm (0.004-0.005 in.) smaller in overall width or length. Solder pad areas should not be larger than the TBU® pad sizes to ensure adequate clearance is maintained. The recommended stencil thickness is 0.10-0.12 mm (0.004-0.005 in.) with a stencil opening size 0.025 mm (0.0010 in.) less than the solder pad size. Extended copper areas beyond the solder pad significantly improve the junction to ambient thermal resistance, resulting in operation at lower junction temperatures with a corresponding benefit of reliability. All pads should soldered to the PCB, including pads marked as NC or NU but no electrical connection should be made to these pads. For minimum parasitic capacitance, it is recommended that signal, ground or power signals are not routed beneath any pad.



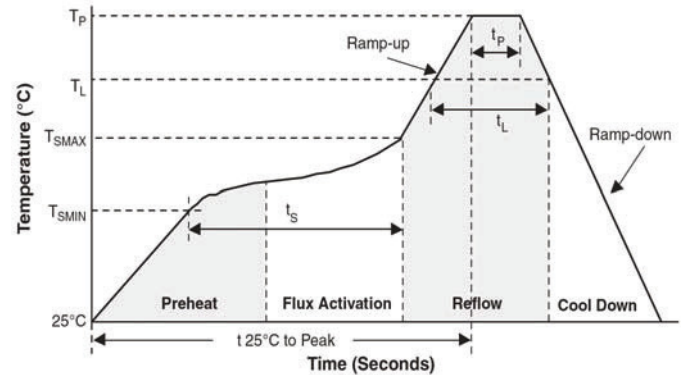
Dark grey areas show added PCB copper area for better thermal resistance.

# TBU-CA Series - TBU® High-Speed Protectors

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## Reflow Profile

Profile Feature	Pb-Free Assembly
Average Ramp-Up Rate (T <sub>S</sub> max to T <sub>P</sub> )	3 °C/sec. max.
Preheat <ul style="list-style-type: none"> <li>- Temperature Min. (T<sub>S</sub>min)</li> <li>- Temperature Max. (T<sub>S</sub>max)</li> <li>- Time (t<sub>S</sub>min to t<sub>S</sub>max)</li> </ul>	150 °C 200 °C 60-180 sec.
Time maintained above: <ul style="list-style-type: none"> <li>- Temperature (T<sub>L</sub>)</li> <li>- Time (t<sub>L</sub>)</li> </ul>	217 °C 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.



## How to Order

**TBU - CA 085 - 500 - WH**

TBU® Product \_\_\_\_\_

Series \_\_\_\_\_  
CA = Bi-Series

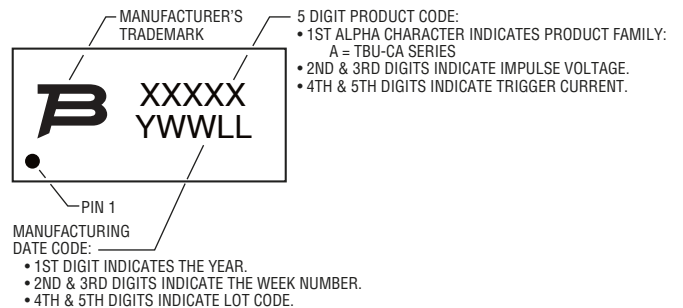
Impulse Voltage Rating \_\_\_\_\_  
025 = 250 V  
040 = 400 V  
050 = 500 V  
065 = 650 V  
085 = 850 V

Trigger Current \_\_\_\_\_  
050 = 50 mA  
100 = 100 mA  
200 = 200 mA  
300 = 300 mA  
500 = 500 mA

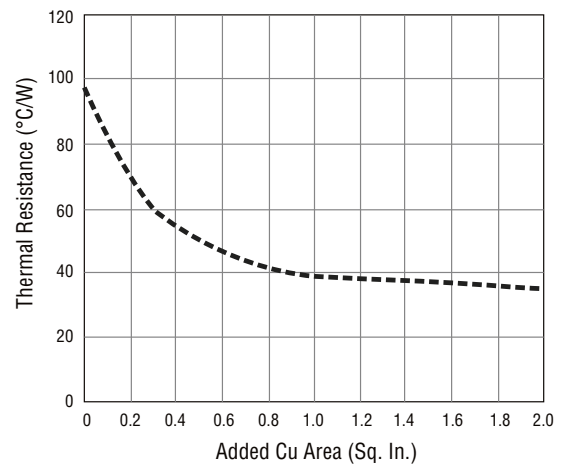
Hold to Trip Ratio Suffix \_\_\_\_\_  
W = Hold to Trip Ratio

Package Suffix \_\_\_\_\_  
H = DFN Package

## Typical Part Marking



## Thermal Resistance vs Additional PCB Cu Area

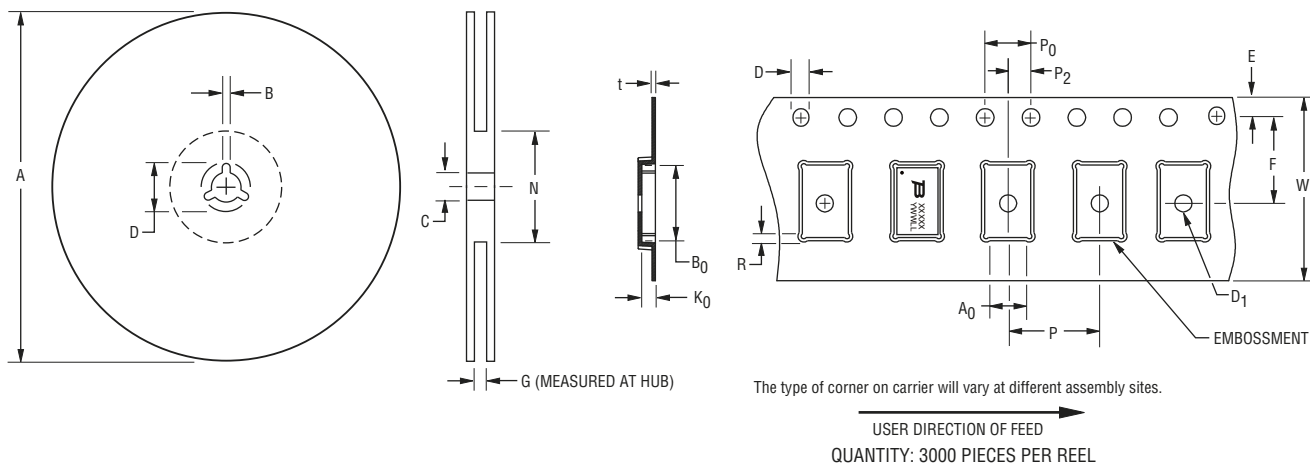


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# TBU-CA Series - TBU® High-Speed Protectors

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## Packaging Specifications



A		B		C		D		G	N
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Ref.	Ref.
$\frac{326}{(.12835)}$	$\frac{330}{(.13002)}$	$\frac{1.5}{(.059)}$	$\frac{2.5}{(.098)}$	$\frac{12.8}{(.504)}$	$\frac{13.5}{(.531)}$	$\frac{20.2}{(.795)}$	-	$\frac{16.5}{(.650)}$	$\frac{102}{(4.016)}$

A <sub>0</sub>		B <sub>0</sub>		D		D <sub>1</sub>		E		F	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	max.
$\frac{4.3}{(.169)}$	$\frac{4.5}{(.177)}$	$\frac{6.7}{(.264)}$	$\frac{6.9}{(.272)}$	$\frac{1.5}{(.059)}$	$\frac{1.6}{(.063)}$	$\frac{1.5}{(.059)}$	-	$\frac{1.65}{(.065)}$	$\frac{1.85}{(.073)}$	$\frac{7.4}{(.291)}$	$\frac{7.6}{(.299)}$

K <sub>0</sub>		P		P <sub>0</sub>		P <sub>2</sub>		R		t	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
$\frac{1.0}{(.039)}$	$\frac{1.2}{(.047)}$	$\frac{7.9}{(.311)}$	$\frac{8.1}{(.319)}$	$\frac{3.9}{(.159)}$	$\frac{4.1}{(.161)}$	$\frac{1.9}{(.075)}$	$\frac{2.1}{(.083)}$	$\frac{0}{(0)}$	$\frac{0.5}{(.020)}$	$\frac{0.25}{(.010)}$	$\frac{0.35}{(.014)}$

W	
Min.	Max.
$\frac{15.7}{(.618)}$	$\frac{16.3}{(.642)}$

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

REV. 03/18

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



## Features

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

## Applications

- Ethernet ports
- Protection modules and dongles
- Process control equipment
- Test and measurement equipment
- General electronics

# TBU-DT Series - TBU® High-Speed Protectors

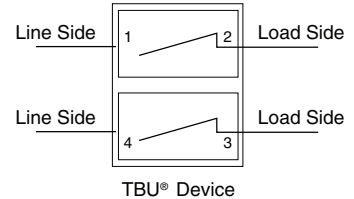
## General Information

The TBU-DT Series of Bourns® TBU® (Transient Blocking Unit) products are very low capacitance dual unidirectional high-speed surge protection components designed to protect against faults caused by short circuits, AC power cross, induction and lightning surges.

The TBU-DT series is a unidirectional TBU® device; the TBU® protector will trip in less than 1  $\mu$ s when the current reaches the maximum value in one direction only, that is when Pin 1 is positive in voltage with respect to Pin 2, and Pin 4 is positive with respect to Pin 3. No current limiting exists in the opposite polarity, and the TBU® device appears as resistive in nature. The reverse current should not exceed the maximum trigger current level of the TBU® device. An external diode may be used to prevent reverse current in DC biased applications.

The TBU® protector blocks surges and provides an effective barrier behind which sensitive electronics will not be exposed to large voltages or currents during surge events. 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).

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 Listing

Description	
UL	File Number: E315805

## 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-DT065-xxx-WH	650	V
		TBU-DT085-xxx-WH	850	
$V_{rms}$	Continuous A.C. RMS voltage	TBU-DT065-xxx-WH	300	V
		TBU-DT085-xxx-WH	425	
$T_{op}$	Operating temperature range		-40 to +125	$^\circ\text{C}$
$T_{stg}$	Storage temperature range		-65 to +150	$^\circ\text{C}$

## 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-DTxxx-100-WH	100	150	200	mA
		TBU-DTxxx-200-WH	200	300	400	
		TBU-DTxxx-300-WH	300	450	600	
		TBU-DTxxx-500-WH	500	750	1000	
$R_{device}$	Series resistance of the TBU® device	$V_{imp} = 650\text{ V}$ $I_{trigger}(\text{min.}) = 100\text{ mA}$	TBU-DT065-100-WH	8.5	10.0	$\Omega$
		$V_{imp} = 650\text{ V}$ $I_{trigger}(\text{min.}) = 200\text{ mA}$	TBU-DT065-200-WH	5.6	6.6	
		$V_{imp} = 650\text{ V}$ $I_{trigger}(\text{min.}) = 300\text{ mA}$	TBU-DT065-300-WH	4.6	5.6	
		$V_{imp} = 650\text{ V}$ $I_{trigger}(\text{min.}) = 500\text{ mA}$	TBU-DT065-500-WH	4.0	4.8	
		$V_{imp} = 850\text{ V}$ $I_{trigger}(\text{min.}) = 100\text{ mA}$	TBU-DT085-100-WH	10.3	12.1	
		$V_{imp} = 850\text{ V}$ $I_{trigger}(\text{min.}) = 200\text{ mA}$	TBU-DT085-200-WH	7.4	8.7	
		$V_{imp} = 850\text{ V}$ $I_{trigger}(\text{min.}) = 300\text{ mA}$	TBU-DT085-300-WH	6.5	7.7	
		$V_{imp} = 850\text{ V}$ $I_{trigger}(\text{min.}) = 500\text{ mA}$	TBU-DT085-500-WH	5.8	6.9	
$R_{match}$	Package resistance matching of the TBU® device #1 - TBU® device #2		-0.5		+0.5	$\Omega$
$t_{block}$	Time for the device to go from normal operating state to protected state				1	$\mu\text{s}$
$I_Q$	Current through the triggered TBU® device with 50 Vdc circuit voltage		0.25	0.50	1.00	mA
$V_{reset}$	Voltage below which the triggered TBU® device will transition to normal operating state		10	14	18	V
$R_{th(j-l)}$	Junction to package pads - FR4 using recommended pad layout			116		$^\circ\text{C/W}$
$R_{th(j-l)}$	Junction to package pads - FR4 using heat sink on board (6 cm <sup>2</sup> )			96		$^\circ\text{C/W}$

\*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.

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# TBU-DT Series - TBU® High-Speed Protectors

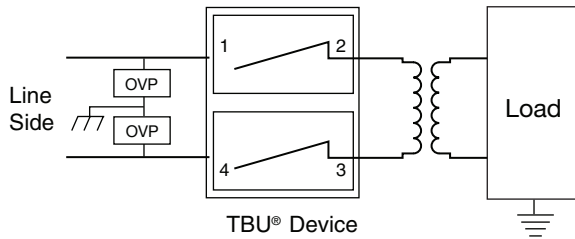
**BOURNS®**

## Environmental Characteristics

Parameter	Value
Moisture Sensitivity Level	1
ESD Classification (HBM)	1B

## Reference Application

The TBU® device can be used to protect against excessive voltage surges in transformer coupled equipment, as shown in the figure below. The TBU® protector prevents any surges from causing damage. An overvoltage protection device, such as an MOV or GDT, may be used to provide additional overvoltage protection if the surge voltage is likely to be above the maximum rating of the TBU® device.



## Basic TBU Operation

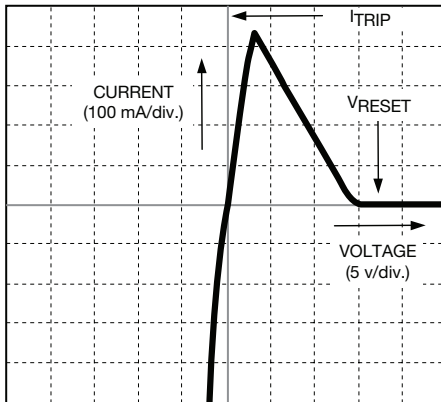
The TBU® device is a silicon-based, solid-state, resettable device which is placed in series with a signal path. The TBU® device operates in approximately 1  $\mu$ s - once line current exceeds the TBU® device's trigger current  $I_{\text{trigger}}$ . When operated, the TBU® device will limit the current to less than the  $I_{\text{trigger}}$  value within the  $t_{\text{block}}$  duration. If voltage above  $V_{\text{reset}}$  is continuously sustained, the TBU® device will subsequently reduce the current to a quiescent current level within a period of time that is dependent upon the applied voltage.

After the surge, the TBU® device resets when the voltage across the TBU® device falls to the  $V_{\text{reset}}$  level. 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).

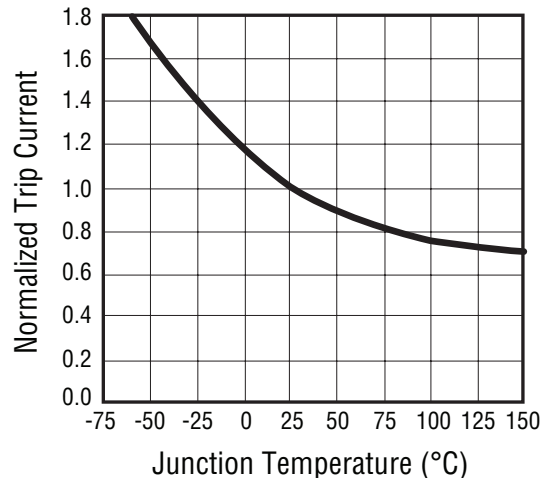
If the line has a normal DC bias above  $V_{\text{reset}}$ , the voltage across the TBU® device may not fall below  $V_{\text{reset}}$  after the surge. In such cases, special care needs to be taken to ensure that the TBU® device will reset, otherwise an automatic or manual power down will be required. Bourns application engineers can provide further assistance.

## Performance Graphs

### V-I Characteristic - TBU-DT085-300-WH (Pin 2-1 & Pin 3-4)



### Typical Trigger Current vs. Temperature



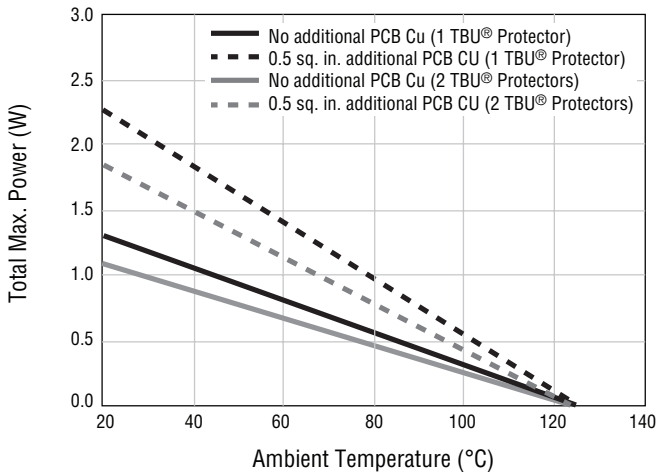
Specifications are subject to change without notice.

Users should verify actual device performance in their specific applications.

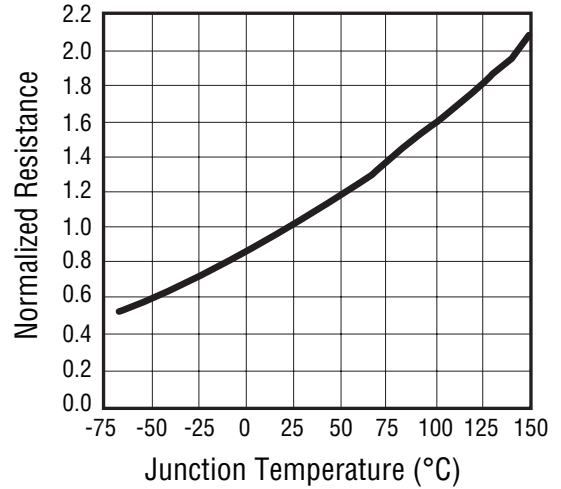
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## Performance Graphs (Continued)

### Power Derating Curve

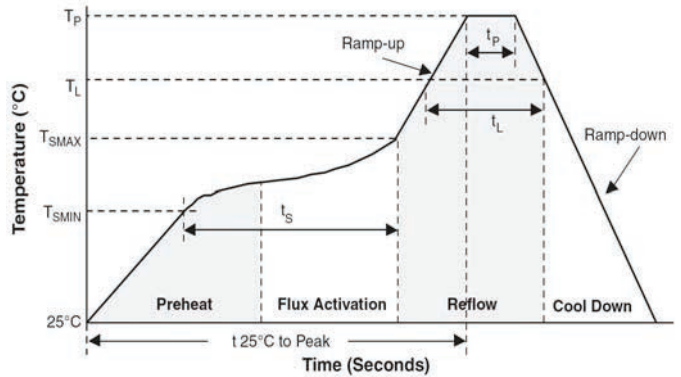


### Typical Resistance vs. Temperature



## 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.

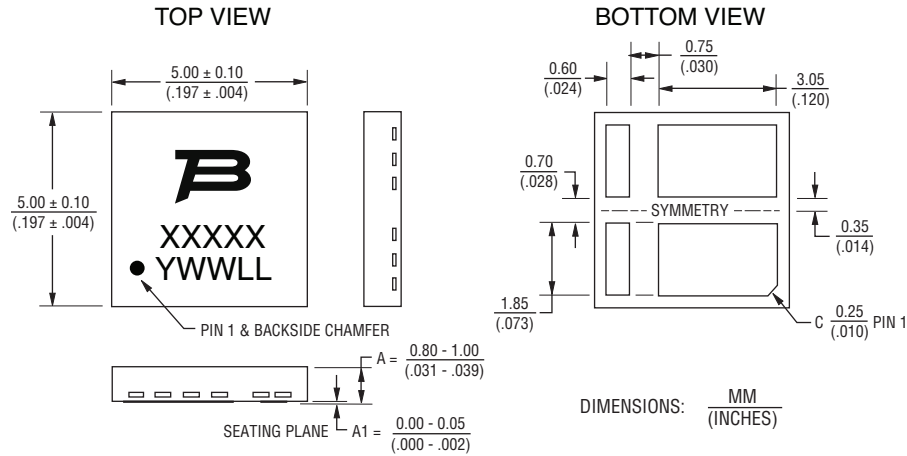


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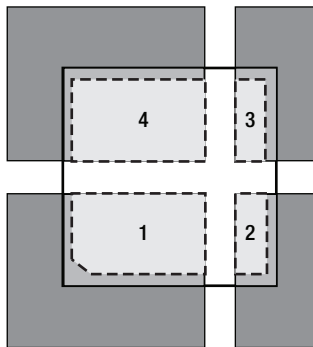
## Product Dimensions



## Recommended Pad Layout

TBU® High-Speed Protectors have a 100 % matte-tin termination finish. For improved thermal dissipation, the recommended layout uses PCB copper areas which extend beyond the exposed solder pad. The exposed solder pads should be defined by a solder mask which matches the pad layout of the TBU® device in size and spacing. It is recommended that they should be the same dimension as the TBU® pads but if smaller solder pads are used, they should be centered on the TBU® package terminal pads and not more than 0.10-0.12 mm (0.004-0.005 in.) smaller in overall width or length. Solder pad areas should not be larger than the TBU® pad sizes to ensure adequate clearance is maintained. The recommended

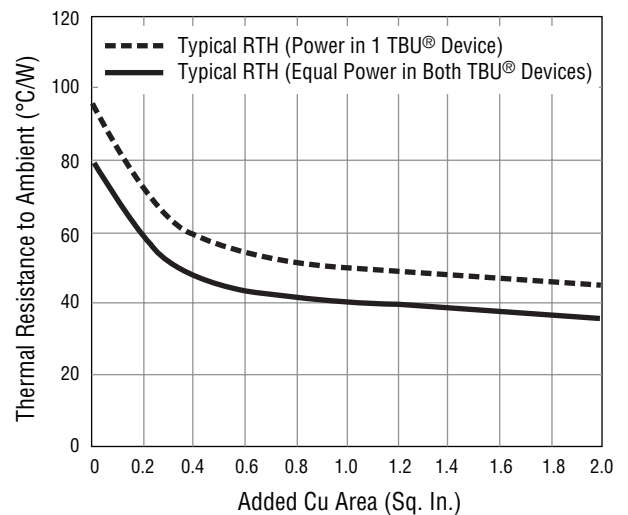
stencil thickness is 0.10-0.12 mm (0.004-0.005 in.) with a stencil opening size 0.025 mm (0.0010 in.) less than the solder pad size. Extended copper areas beyond the solder pad significantly improve the junction to ambient thermal resistance, resulting in operation at lower junction temperatures with a corresponding benefit of reliability. All pads should soldered to the PCB, including pads marked as NC or NU but no electrical connection should be made to these pads. For minimum parasitic capacitance, it is recommended that signal, ground or power signals are not routed beneath any pad.



Pad Designation	
Pad #	Pin Out
1	Line Side 1
2	Load Side 1
3	Load Side 2
4	Line Side 2

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

## Thermal Resistance vs. Additional PCB Cu Area



Specifications are subject to change without notice.

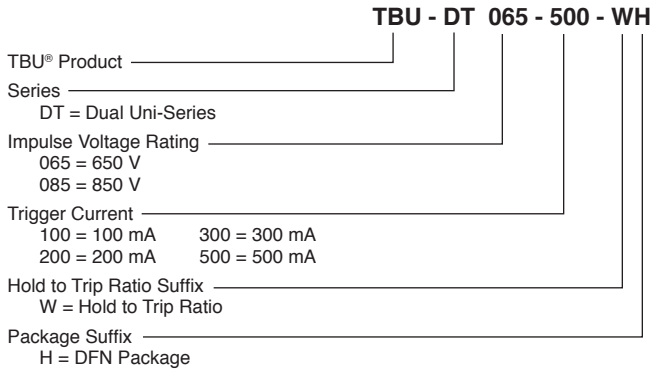
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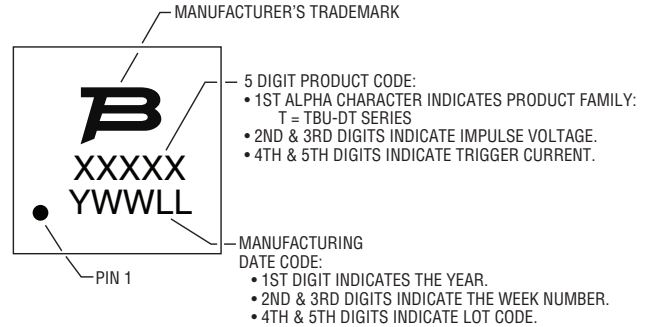
# TBU-DT Series - TBU® High-Speed Protectors

**BOURNS®**

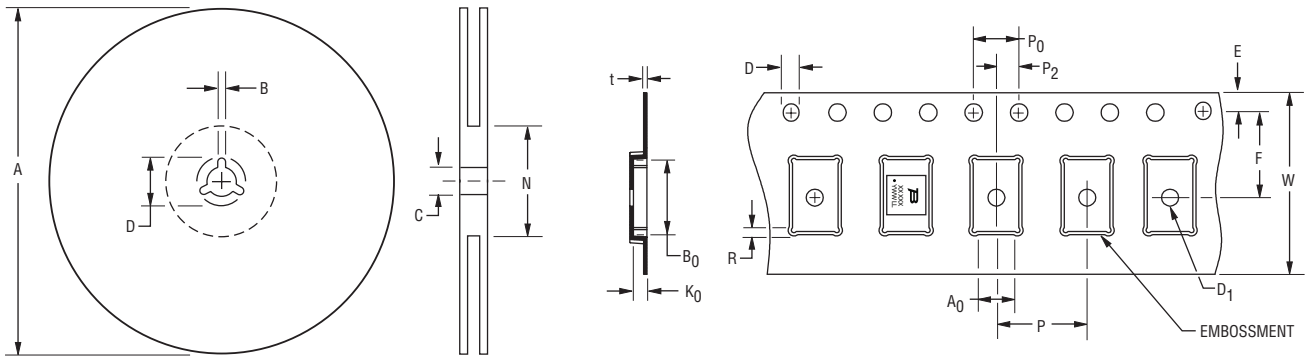
## How to Order



## Typical Part Marking



## 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)

A <sub>0</sub>		B <sub>0</sub>		D		D <sub>1</sub>		E		F	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	max.
5.15	5.35	5.15	5.35	1.5	1.6	1.5	-	1.65	1.85	5.45	5.55
(.203)	(.211)	(.203)	(.211)	(.059)	(.063)	(.059)		(.065)	(.073)	(.214)	(.218)

K <sub>0</sub>		P		P <sub>0</sub>		P <sub>2</sub>		R		t	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1.0	1.2	7.9	8.1	3.8	4.2	1.95	2.05	0	0.5	0.25	0.35
(.039)	(.047)	(.311)	(.319)	(.150)	(.165)	(.077)	(.081)	(0)	(.020)	(.010)	(.014)

W	
Min.	Max.
11.7	12.3
(.461)	(.484)

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

REV. 02/19

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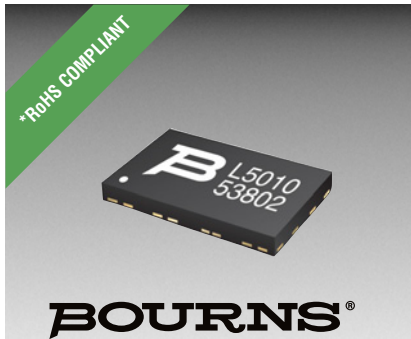
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## Features

- 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 will not be 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: E315805

### Industry Standards (in Conjunction with OVP Device)

Solutions available for GR-1089-CORE, ITU-T and a combination of both.

### 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-PL075-xxx-WH	750	
		TBU-PL085-xxx-WH	850	
$V_{rms}$	Continuous A.C. RMS voltage	TBU-PL050-xxx-WH	300	V
		TBU-PL060-xxx-WH	350	
		TBU-PL075-xxx-WH	400	
		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		$\pm 2$	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		
$R_{device}$	Series resistance of the TBU® device		40	50	55	$\Omega$	
$R_{match}$	Package resistance matching of the TBU® device #1 - TBU® device #2			$\pm 0.5$	$\pm 1.0$	$\Omega$	
$t_{block}$	Time taken for the device to go into current limiting				1	$\mu\text{s}$	
$I_Q$	Current through the triggered TBU® device with 50 Vdc circuit voltage		0.25	0.70	1.50	mA	
$I_{ss}$	Operating current with $V_{SS} = -50\text{ V}$			100		$\mu\text{A}$	
$V_{reset}$	Voltage below which the triggered TBU® device will transition to normal operating state	TBU-PLxxx-100-WH	Forward Mode	12	15	22	V
			Reverse Mode	10	13	20	
		TBU-PLxxx-200-WH	Forward Mode	15	20	25	
			Reverse Mode	12	17	22	
$V_{to}$	Voltage threshold offset with 60 Hz applied voltage, with $V_{SS} = -50\text{ V}$ ( $V_{SS} - V_{lineSLIC}$ )		-1.0		0.2	V	
$V_{SS}$	Operating voltage range relative to $V_{dd}$		-180		-20	V	
$R_{th(j-l)}$	One side junction to package pads - FR4 using minimum recommended pad layout			110		$^\circ\text{C/W}$	
$R_{th(j-l)}$	Both sides junction to package pads - FR4 using minimum recommended pad layout			65		$^\circ\text{C/W}$	
$R_{th(j-l)}$	One side junction to package pads - FR4 using heat sink on board (6 cm <sup>2</sup> ) (0.5 in. <sup>2</sup> )			70		$^\circ\text{C/W}$	
$R_{th(j-l)}$	Both sides junction to package pads - FR4 using heat sink on board (6 cm <sup>2</sup> ) (0.5 in. <sup>2</sup> )			40		$^\circ\text{C/W}$	



**WARNING**  
**Cancer and Reproductive Harm**  
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# TBU-PL Series - TBU® High-Speed Protectors

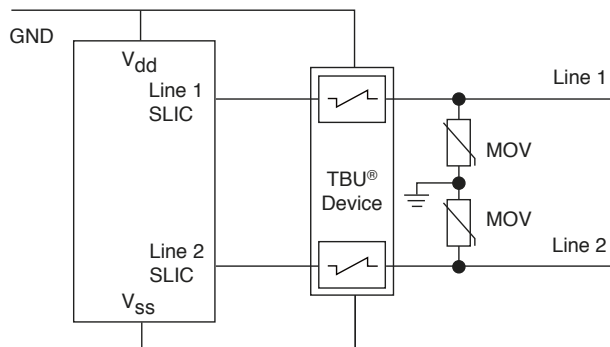
**BOURNS®**

## Environmental Characteristics

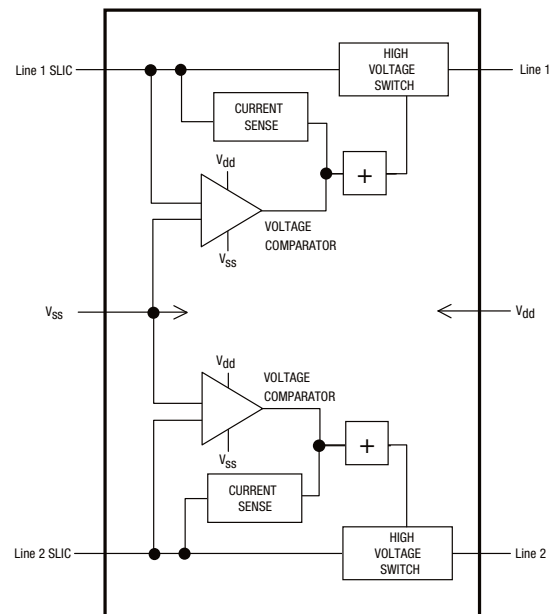
Parameter	Value
Moisture Sensitivity Level	1
ESD Classification (HBM)	1B

## 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. If EN55024 EMC compliance is required, the TBU® device may require capacitors to be fitted between the Tip and Ring connections and ground.



## Functional Block Diagram



## 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  $\mu$ s - once line current exceeds the TBU® device's trigger current  $I_{trigger}$ . When operated, the TBU® device will limit the current to less than the  $I_{trigger}$  value within the  $t_{block}$  duration. If voltage above  $V_{reset}$  is continuously sustained, the TBU® device will subsequently reduce the current to a quiescent current level within a period of time that is dependent upon the applied voltage.

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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# TBU-PL Series - TBU® High-Speed Protectors

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## Bourns® TBU® Device Solutions

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

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

### Notes:

- 1) 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<sub>rms</sub>, 1 A for 0.2 s, for example.
- 2) 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.

Specifications are subject to change without notice.

Users should verify actual device performance in their specific applications.

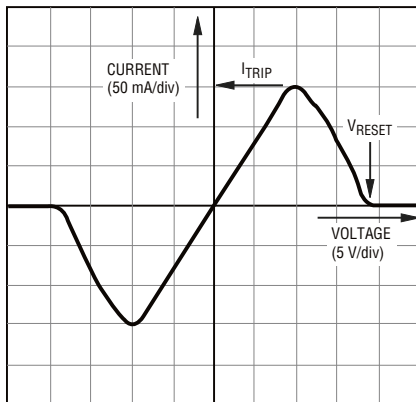
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# TBU-PL Series - TBU® High-Speed Protectors

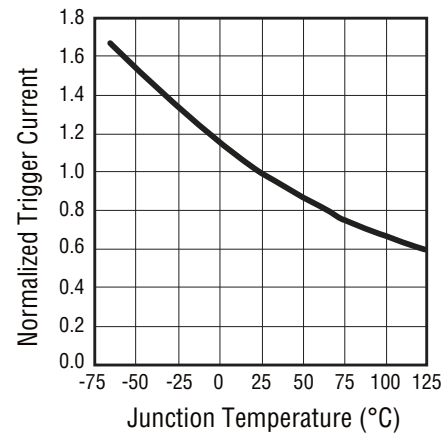
**BOURNS®**

## Performance Graphs

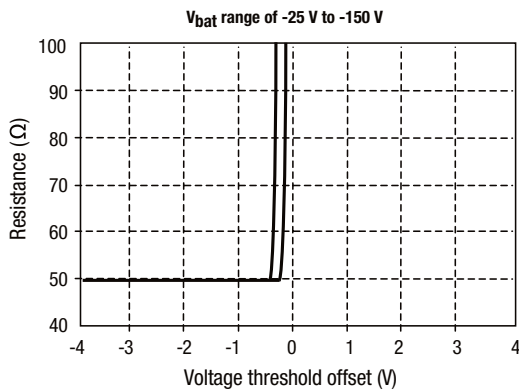
### Typical V-I Characteristics (TBU-PL085-200-WH)



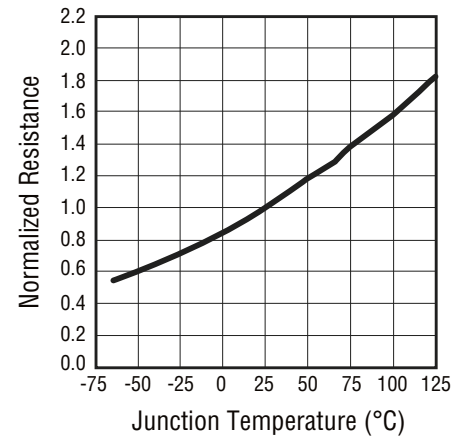
### Typical Trigger Current vs. Temperature



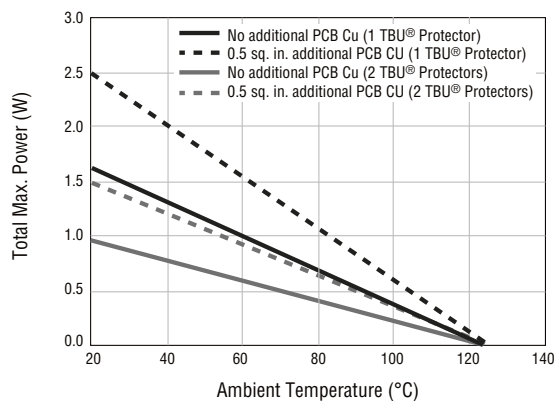
### Tracking Voltage Characteristics



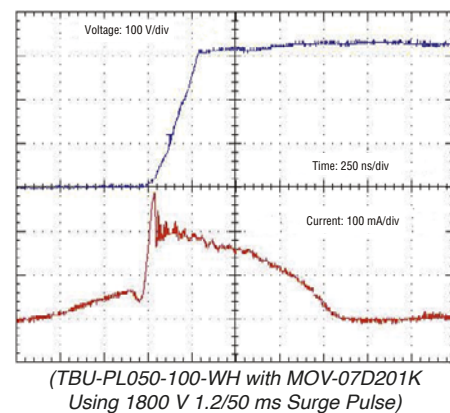
### Typical Resistance vs. Temperature



### Power Derating Curve

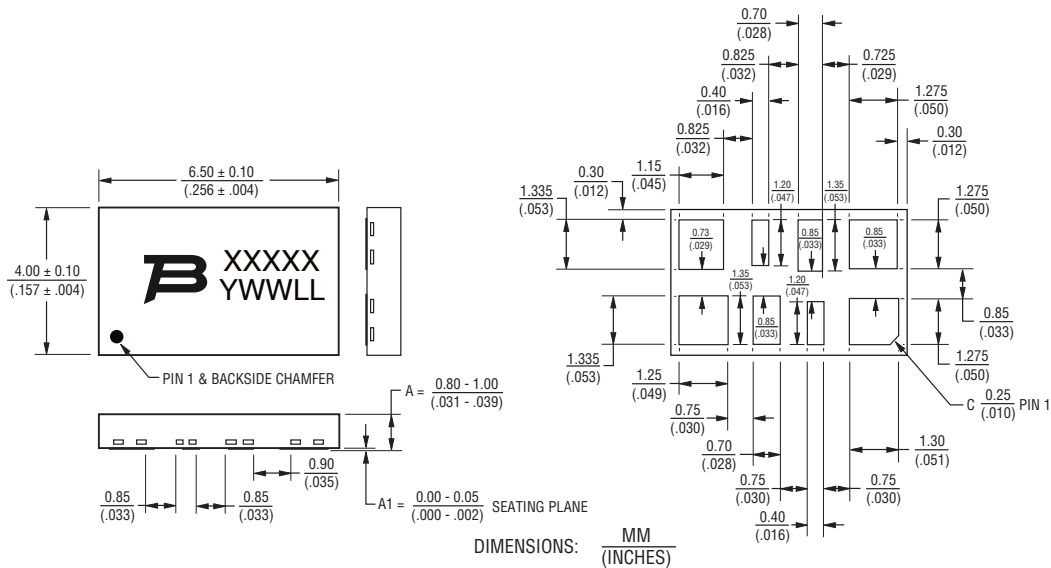


### Typical Surge Response



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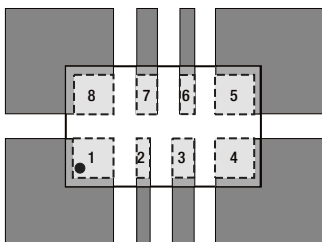
## Product Dimensions



## Recommended Pad Layout

TBU® High-Speed Protectors have a 100 % matte-tin termination finish. For improved thermal dissipation, the recommended layout uses PCB copper areas which extend beyond the exposed solder pad. The exposed solder pads should be defined by a solder mask which matches the pad layout of the TBU® device in size and spacing. It is recommended that they should be the same dimension as the TBU® pads but if smaller solder pads are used, they should be centered on the TBU® package terminal pads and not more than 0.10-0.12 mm (0.004-0.005 in.) smaller in overall width or length. Solder pad areas should not be larger than the TBU® pad sizes to ensure adequate clearance is maintained. The recommended

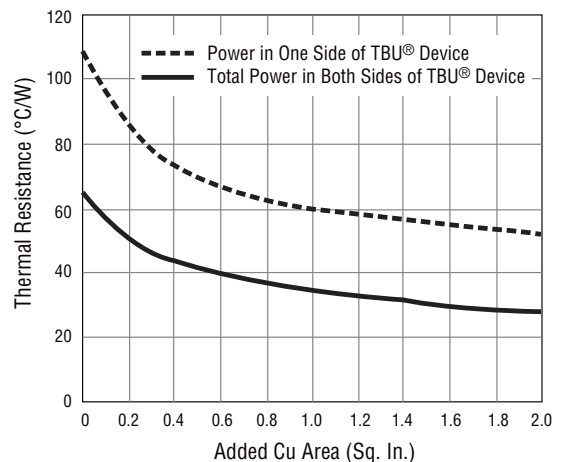
stencil thickness is 0.10-0.12 mm (0.004-0.005 in.) with a stencil opening size 0.025 mm (0.0010 in.) less than the solder pad size. Extended copper areas beyond the solder pad significantly improve the junction to ambient thermal resistance, resulting in operation at lower junction temperatures with a corresponding benefit of reliability. All pads should be soldered to the PCB, including pads marked as NC or NU but no electrical connection should be made to these pads. For minimum parasitic capacitance, it is recommended that signal, ground or power signals are not routed beneath any pad.



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

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## Thermal Resistance vs Additional PCB Cu Area

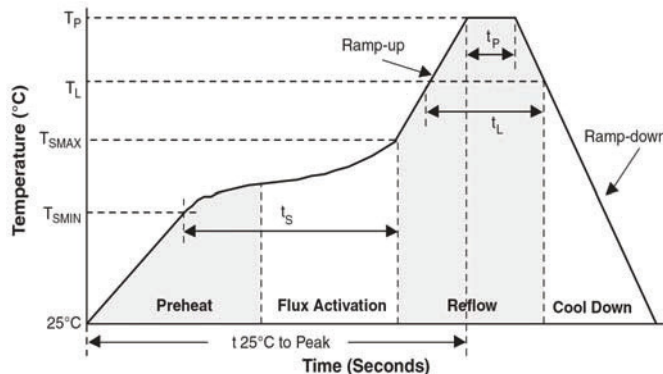


# TBU-PL Series - TBU® High-Speed Protectors



## 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 <ul style="list-style-type: none"> <li>- Temperature Min. (T<sub>smin</sub>)</li> <li>- Temperature Max. (T<sub>smax</sub>)</li> <li>- Time (t<sub>smin</sub> to t<sub>smax</sub>)</li> </ul>	150 °C 200 °C 60-180 sec.
Time maintained above: <ul style="list-style-type: none"> <li>- Temperature (T<sub>L</sub>)</li> <li>- Time (t<sub>L</sub>)</li> </ul>	217 °C 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.

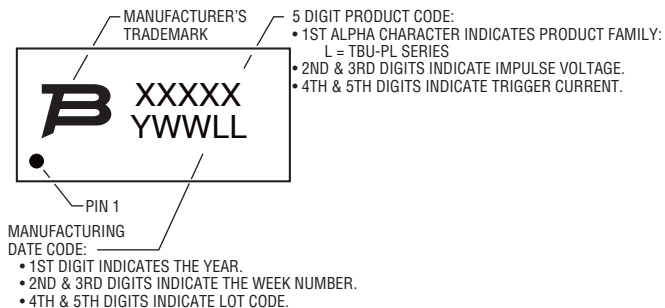


## How to Order

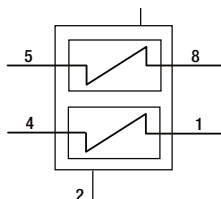
**TBU - PL 085 - 100 - WH**

TBU® Product	_____
Series	_____
PL = Dual Bidirectional Series	
Impulse Voltage Rating	_____
050 = 500 V	
060 = 600 V	
075 = 750 V	
085 = 850 V	
Trigger Current	_____
100 = 100 mA	
200 = 200 mA	
Hold to Trip Ratio Suffix	_____
W = Hold to Trip Ratio	
Package Suffix	_____
H = DFN Package	

## Typical Part Marking



## Device Pin Out



## Pad Designation

Pad #	Pin Out
1	Line 1
2	V <sub>dd</sub> (SLIC Ground or 0 V)
3	Not Used
4	Line 1 SLIC

Pad #	Pin Out
5	Line 2 SLIC
6	V <sub>SS</sub> (SLIC Negative Supply or -V <sub>bat</sub> )
7	Not Used
8	Line 2

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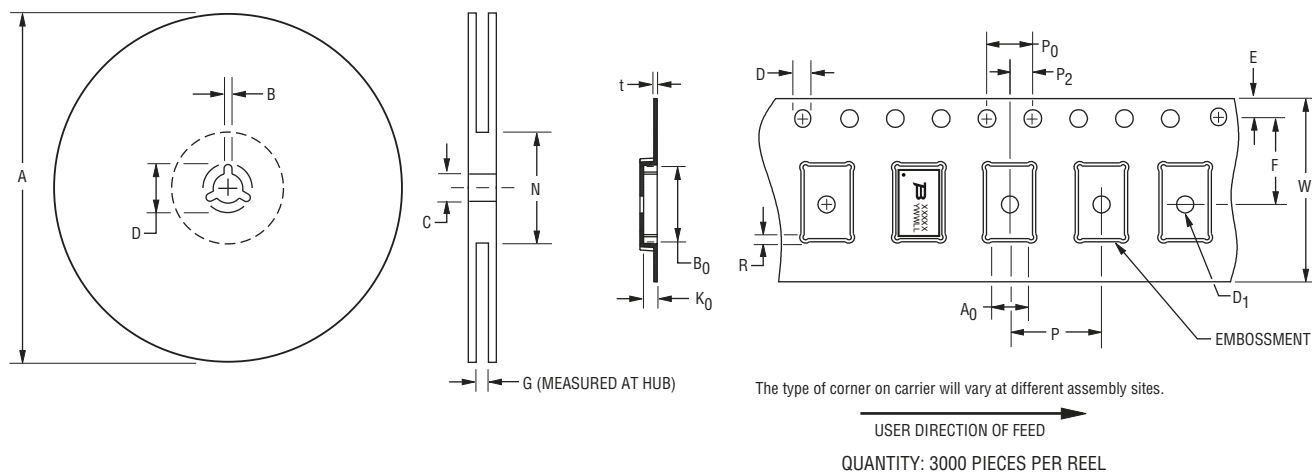
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# TBU-PL Series - TBU® High-Speed Protectors

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## Packaging Specifications



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

A0		B0		D		D1		E		F	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	max.
$\frac{4.30}{(.169)}$	$\frac{4.50}{(.177)}$	$\frac{6.70}{(.264)}$	$\frac{6.90}{(.272)}$	$\frac{1.5}{(.059)}$	$\frac{1.6}{(.063)}$	$\frac{1.5}{(.059)}$	-	$\frac{1.65}{(.065)}$	$\frac{1.85}{(.073)}$	$\frac{7.4}{(.291)}$	$\frac{7.6}{(.299)}$

K0		P		P0		P2		R		t	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
$\frac{1.0}{(.039)}$	$\frac{1.2}{(.047)}$	$\frac{7.9}{(.311)}$	$\frac{8.1}{(.319)}$	$\frac{3.9}{(.159)}$	$\frac{4.1}{(.161)}$	$\frac{1.9}{(.075)}$	$\frac{2.1}{(.083)}$	$\frac{0}{(0)}$	$\frac{0.5}{(.020)}$	$\frac{0.25}{(.010)}$	$\frac{0.35}{(.014)}$

W	
Min.	Max.
$\frac{15.7}{(.618)}$	$\frac{16.3}{(.642)}$

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

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REV. 03/18

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