

Features

- High-speed performance
- Superior overcurrent protection
- Bidirectional
- Low resistance
- Excellent channel to channel resistance matching
- Small SMT package
- RoHS compliant* and halogen free**

Applications

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

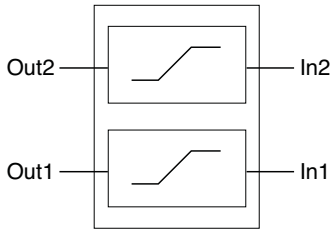
TCS-DL Series - TCS™ Dual Transient Current Suppressors

General Information

The Bourns® TCS™ DL Series High-Speed Protector products contain dual, well-matched, low resistance, bidirectional, very high-speed Transient Current Suppressors. By limiting the maximum current to a safe level, a Bourns® TCS™ DL device offers superior protection for very high data rate differential lines against faults caused by short circuits, induction and lightning surges.

Bourns® TCS™ High-Speed Protectors are typically used in conjunction with low capacitance TVS devices to form an extremely low let-through energy barrier to excessive voltages and currents during surge events which may cause damage to unprotected high-speed, low voltage driver and receiver components.

The Bourns® TCS™ High-Speed Protector is provided in a space-saving, surface mount DFN package meeting industry standard requirements such as RoHS and Pb Free solder reflow profiles.



TCS™ Device

Absolute Maximum Ratings (@ T_A = 25 °C Unless Otherwise Noted)

Symbol	Parameter	Value	Unit
V_{imp}	Peak impulse voltage withstand with duration less than 1 ms	40	V
T_{op}	Operating temperature range	-40 to +125	°C
T_{stg}	Storage temperature range	-65 to +150	°C
T_{JMAX}	Maximum junction temperature	+125	°C

Electrical Characteristics (@ T_A = 25 °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	TCS-DL004-250-WH TCS-DL004-500-WH TCS-DL004-750-WH	250 500 750	375 750 1100	500 1000 1500	mA
R_{ON}	Series resistance of the TCS™ device	TCS-DL004-250-WH TCS-DL004-500-WH TCS-DL004-750-WH	1.6 1.0 0.7	2.3 1.4 1.0	3.0 1.8 1.3	Ω
Δ_{RON}	Channel to channel resistance match	TCS-DL004-250-WH TCS-DL004-500-WH TCS-DL004-750-WH			±0.05 ±0.03 ±0.02	Ω
t_{limit}	Time for the device to go from normal operating state to current limiting state			50		ns
$R_{\theta JA}$	Junction to air thermal resistance, FR4 PCB. 0.035 sq. in. of copper in addition to solder pads			130		°C/W

Asia-Pacific: Tel: +886-2 2562-4117 • Fax: +886-2 2562-4116
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www.bourns.com

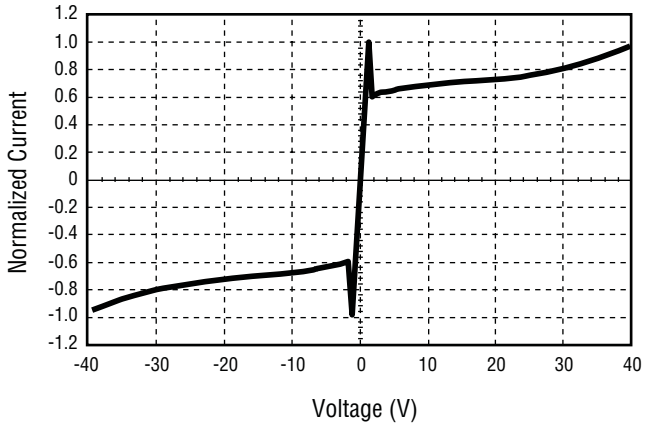
* RoHS Directive 2002/95/EC Jan. 27, 2003 including annex and RoHS Recast 2011/65/EU June 8, 2011.
** Bourns follows the prevailing definition of "halogen free" in the industry. Bourns considers a product to be "halogen free" if (a) the Bromine (Br) content is 900 ppm or less; (b) the Chlorine (Cl) content is 900 ppm or less; and (c) the total Bromine (Br) and Chlorine (Cl) content is 1500 ppm or less.

Specifications are subject to change without notice.
Customers should verify actual device performance in their specific applications.

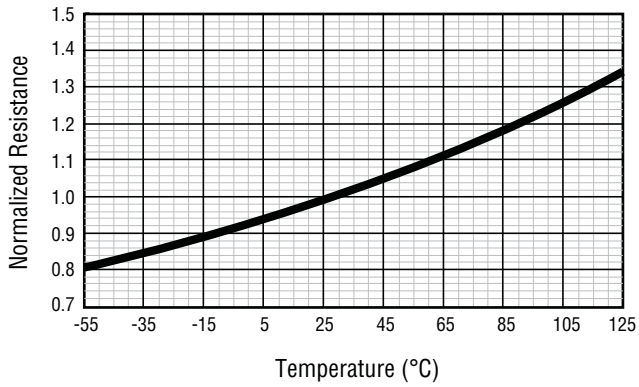
Performance Graphs

Graph 1 below shows a normalized Typical V-I curve for Bourns® TCS™ DL Series High-Speed Protector products under surge conditions. Graphs 2 and 3 show the change in resistance and trip current versus temperature, respectively.

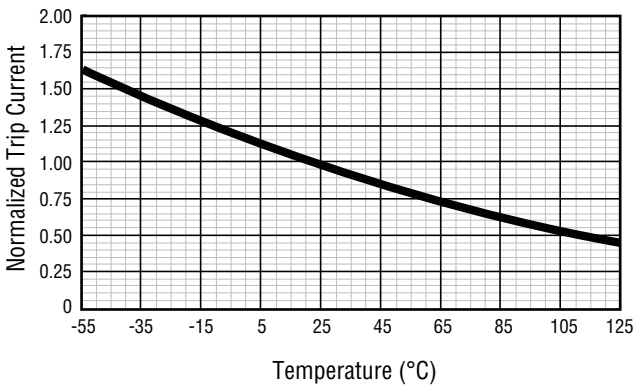
Normalized V-I Curve Under Surge Conditions



Resistance Change vs. Temperature



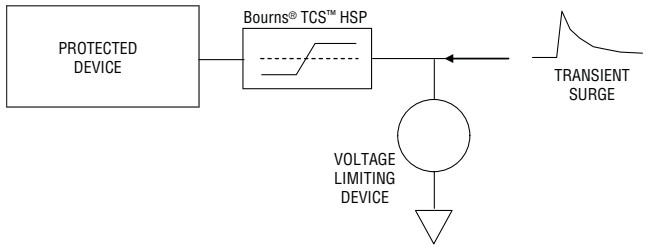
Trip Current Change vs. Temperature



Basic Device Operation

SURGE PROTECTION

The Bourns® TCS™ High-Speed Protector is designed to be used in conjunction with a suitable overvoltage limiting device, such as a TVS diode or a TISP® thyristor as shown below, to provide comprehensive current and voltage limiting protection against surges.



Coordination of Bourns® TCS™ High-Speed Protector with Overvoltage Limiting Device

This two-stage protection limits the maximum voltage at the interface to the clamping voltage of the overvoltage device, while also limiting the current into the protected device to the defined limit of the Bourns® TCS™ High-Speed Protector. Designers should choose a Bourns® TCS™ High-Speed Protector with a current limit that the protected device can handle for the duration of the surge event.

The Bourns® TCS™ High-Speed Protector acts like a low value resistor during normal operation. As the Bourns® TCS™ High-Speed Protector has no electrical connection to anything other than the signal line it protects, the capacitance to ground is purely dictated by the capacitance of the device to surrounding components and PCB traces, which with careful layout can be kept to an absolute minimum.

The Bourns® TCS™ High-Speed Protector can block voltages up to 40 V. This enables very low voltage electronics to be protected by a lower capacitance, higher voltage TVS device, thus achieving very low capacitive loading on high-speed signal lines. For example, on a 3.3 V driver, a 12 V rated TVS may be used, having much lower and more linear capacitance than a lower voltage type. Even though a high voltage TVS is used, the maximum stress seen by the protected device is much lower than would be seen by using a low voltage TVS by itself, as the current is limited to within the maximum limits of the Bourns® TCS™ High-Speed Protector.

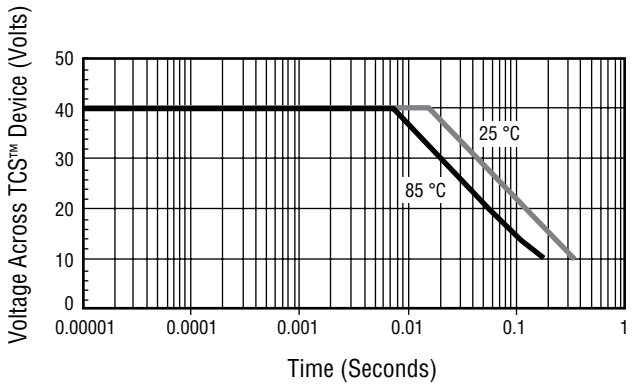
The Bourns® TCS™ High-Speed Protector is primarily designed to offer superior and cost-effective protection of sensitive electronics against high energy surges that are transient in nature. Unlike the more complex TBU® High-Speed Protector device, the TCS™ Protector does not exhibit a strong foldback

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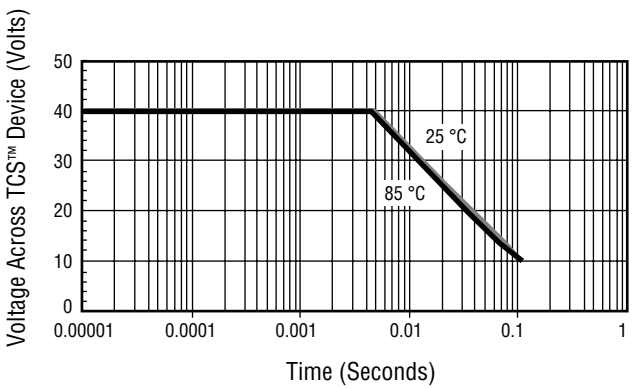
Basic Device Operation (Continued)

characteristic after reaching the current limit, and therefore doesn't protect against DC and low frequency stresses (typically achieved through the use of a transformer or capacitive coupling). This is analogousto comparing the shunting characteristics of a Transient Voltage Suppressor device to a thyristor type of protector, such as Bourns® TISP® devices. Both the Bourns® TCS™ High-Speed Protector and TVS device have limited or no foldback characteristic, and therefore have relatively low short term surge energy limits. When used together in a protection circuit, the surge must not exceed the thermal capability of either device. The following three graphs show the maximum surge duration with respect to voltage of the three TCS-DL devices at both +25 °C and +85 °C.

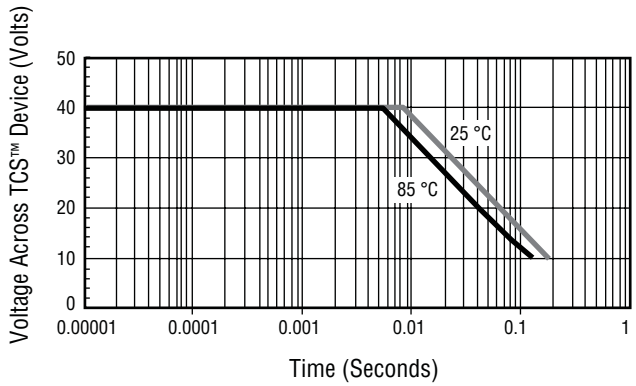
TCS-DL004-250-WH SOA Single Surge Duration



TCS-DL004-750-WH SOA Single Surge Duration



TCS-DL004-500-WH SOA Single Surge Duration



Specifications are subject to change without notice.
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Basic Device Operation (Continued)

COORDINATION

In all applications, the overvoltage protection device should be chosen to limit the maximum voltage across the Bourns® TCS™ High-Speed Protector to less than the maximum voltage rating of the device. If this maximum voltage limit is exceeded, the Bourns® TCS™ High-Speed Protector may begin to avalanche, and it will cease to effectively block the current into the protected device, which may result in damage.

USING MULTIPLE TCS-DL DEVICES IN SERIES OR PARALLEL

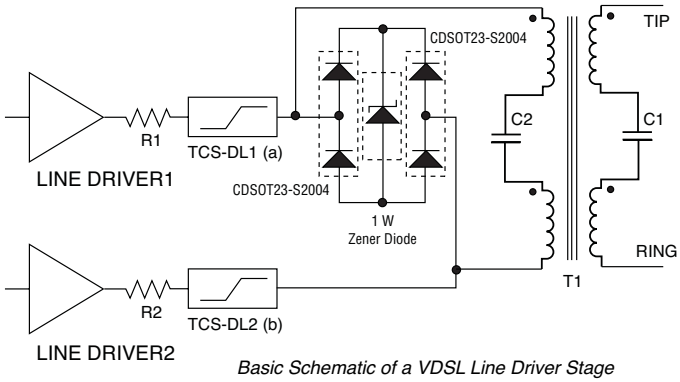
Bourns® TCS™ High-Speed Protectors may be connected in parallel to achieve even lower on-state resistance. If matching is required, use two Bourns® TCS-DL Series HSPs, and connect one Bourns® TCS™ High-Speed Protector from each DL device in parallel. In addition, because of their ultra-fast response, multiple Bourns® TCS™ High-Speed Protectors may be connected in series to achieve multiples of the breakdown voltage.

Reference Applications

Two good examples of applications where the combination of a Bourns® TCS™ High-Speed Protector and a voltage limiting device provides exceptional performance are in VDSL and Ethernet circuits, where the line is driven differentially by a transformer.

VDSL

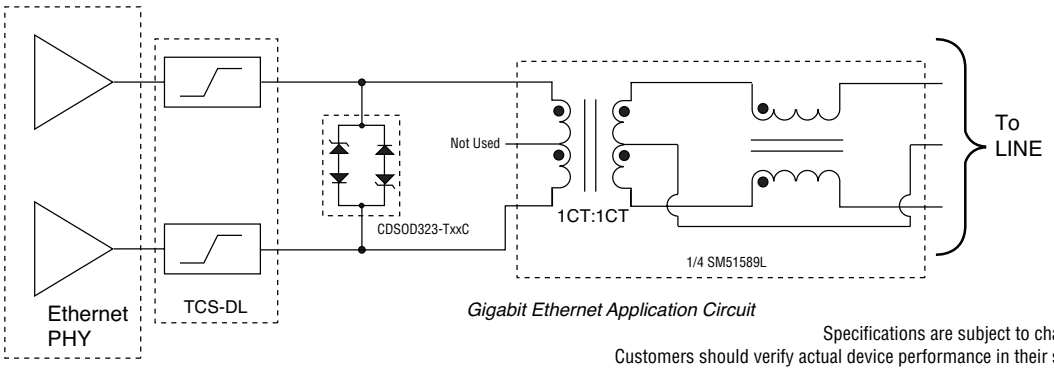
In the VDSL application shown below, the transformer provides additional protection against sustained DC faults and the coupling capacitors, C1 and C2, provide protection against DC and mains frequency power faults. The termination resistors R1 and R2 are reduced in value by the nominal resistance of the Bourns® TCS™ High-Speed Protector to maintain the overall termination resistance.



Basic Schematic of a VDSL Line Driver Stage

GbE

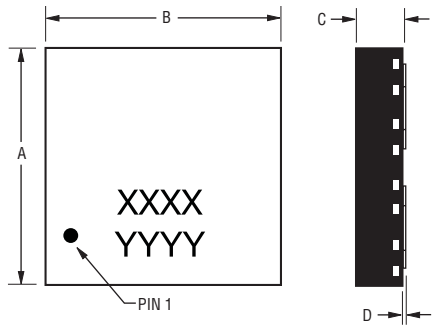
In the Gigabit Ethernet (GbE) application circuit shown below, the transformer provides additional protection against sustained DC faults and provides some isolation from surge conditions such as lightning strikes. The TCS™ device limits the current that the PHY will be subjected to under a surge condition. It also provides voltage isolation so that the peak voltage that the PHY is subjected to will be lower than the TVS diode clamp voltage. The TVS diode will sink the majority of the transformer secondary current and clamp the voltage to a level that is below the 40 V maximum rating of the TCS™ device.

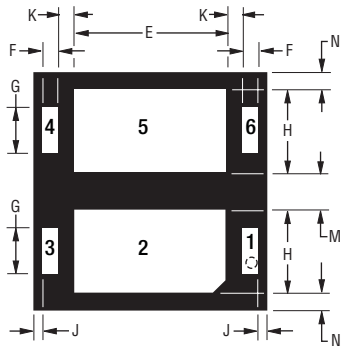


Gigabit Ethernet Application Circuit

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Product Dimensions

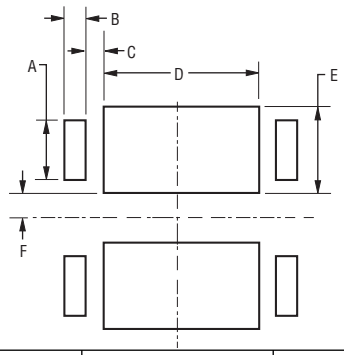




Dim.	TCS-DL004-250-WH			TCS-DL004-500-WH			TCS-DL004-750-WH		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
A	3.90 (.154)	4.00 (.157)	4.10 (.161)	3.90 (.154)	4.00 (.157)	4.10 (.161)	3.90 (.154)	4.00 (.157)	4.10 (.161)
B	2.40 (.094)	2.50 (.098)	2.60 (.102)	3.4 (.134)	3.5 (.138)	3.6 (.142)	4.4 (.173)	4.5 (.177)	4.6 (.181)
C	0.80 (.031)	0.85 (.033)	0.90 (.035)	0.80 (.031)	0.85 (.033)	0.90 (.035)	0.80 (.031)	0.85 (.033)	0.90 (.035)
D	0.00 (.000)	0.025 (.001)	0.05 (.002)	0.00 (.000)	0.025 (.001)	0.05 (.002)	0.00 (.000)	0.025 (.001)	0.05 (.002)
E	1.05 (.041)	1.1 (.043)	1.15 (.045)	2.05 (.081)	2.1 (.083)	2.15 (.085)	3.05 (.120)	3.1 (.122)	3.15 (.124)
F	0.2 (.008)	0.25 (.010)	0.3 (.012)	0.2 (.008)	0.25 (.010)	0.3 (.012)	0.2 (.008)	0.25 (.010)	0.3 (.012)
G	0.75 (.030)	0.8 (.031)	0.85 (.033)	0.75 (.030)	0.8 (.031)	0.85 (.033)	0.75 (.030)	0.8 (.031)	0.85 (.033)
H	1.4 (.055)	1.45 (.057)	1.5 (.059)	1.4 (.055)	1.45 (.057)	1.5 (.059)	1.4 (.055)	1.45 (.057)	1.5 (.059)
J	0.1 (.004)	0.15 (.006)	0.2 (.008)	0.1 (.004)	0.15 (.006)	0.2 (.008)	0.1 (.004)	0.15 (.006)	0.2 (.008)
K	0.25 (.010)	0.3 (.012)	0.35 (.014)	0.25 (.010)	0.3 (.012)	0.35 (.014)	0.25 (.010)	0.3 (.012)	0.35 (.014)
M	0.55 (.022)	0.6 (.024)	0.65 (.026)	0.55 (.022)	0.6 (.024)	0.65 (.026)	0.55 (.022)	0.6 (.024)	0.65 (.026)
N	0.2 (.008)	0.25 (.010)	0.3 (.012)	0.2 (.008)	0.25 (.010)	0.3 (.012)	0.2 (.008)	0.25 (.010)	0.3 (.012)

DIMENSIONS: MM / (INCHES)

Recommended Pad Layout

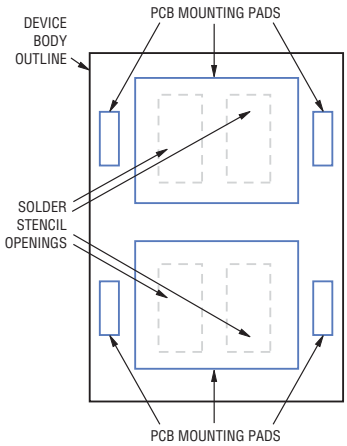


Dim.	TCS-DL004-250-WH	TCS-DL004-500-WH	TCS-DL004-750-WH
A	0.80 (.031)	0.80 (.031)	0.80 (.031)
B	0.25 (.010)	0.25 (.010)	0.25 (.010)
C	0.30 (.012)	0.30 (.012)	0.30 (.012)
D	1.1 (.043)	2.1 (.083)	3.1 (.122)
E	1.45 (.057)	1.45 (.057)	1.45 (.057)
F	0.30 (.012)	0.30 (.012)	0.30 (.012)

Pad Designation

Pad #	Apply	Pad #	Apply
1	In1	4	Out2
2	NC	5	NC
3	Out1	6	In2

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

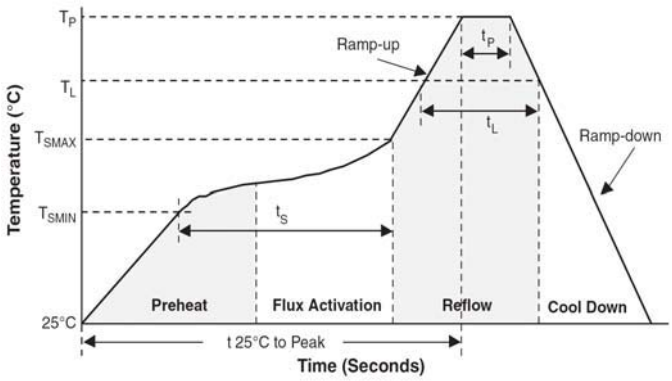


Bourns® TCS™ High-Speed Protectors have a matte-tin termination. The recommended solder stencil thickness is 0.10 to 0.12 mm (0.004 to 0.005 in.). The stencil opening for pins 1,3,4 and 6 should be the same size as the recommended PCB pad size. The stencil openings for pins 2 and 5 of the device should cover 60-70 % of the area of the PCB pad and should be divided into smaller areas as shown in the solder stencil figure.

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Reflow Profile

Profile Feature	Pb-Free Assembly
Average Ramp-Up Rate (Tsmax to Tp)	3 °C/sec. max.
Preheat - Temperature Min. (Tsmin) - Temperature Max. (Tsmax) - Time (tsmin to tsmax)	 150 °C 200 °C 60-180 sec.
Time maintained above: - Temperature (TL) - Time (tL)	 217 °C 60-150 sec.
Peak/Classification Temperature (Tp)	260 °C
Time within 5 °C of Actual Peak Temp. (tp)	20-40 sec.
Ramp-Down Rate	6 °C/sec. max.
Time 25 °C to Peak Temperature	8 min. max.



How to Order

TCS - DL 004 - 500 - WH

TCS™ Product

Series
DL = Dual Series

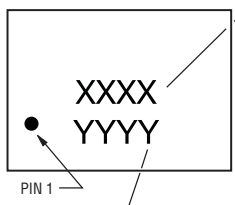
Impulse Voltage Rating
004 = 40 V

Minimum Trigger Current
250 = 250 mA
500 = 500 mA
750 = 750 mA

Hold to Trip Ratio Suffix
W = 2:1 Maximum to Minimum Trigger Current Ratio

Package Suffix
H = DFN Package

Typical Part Marking



MARKING NO.
D042 = TCS-DL004-250-WH
D045 = TCS-DL004-500-WH
D047 = TCS-DL004-750-WH

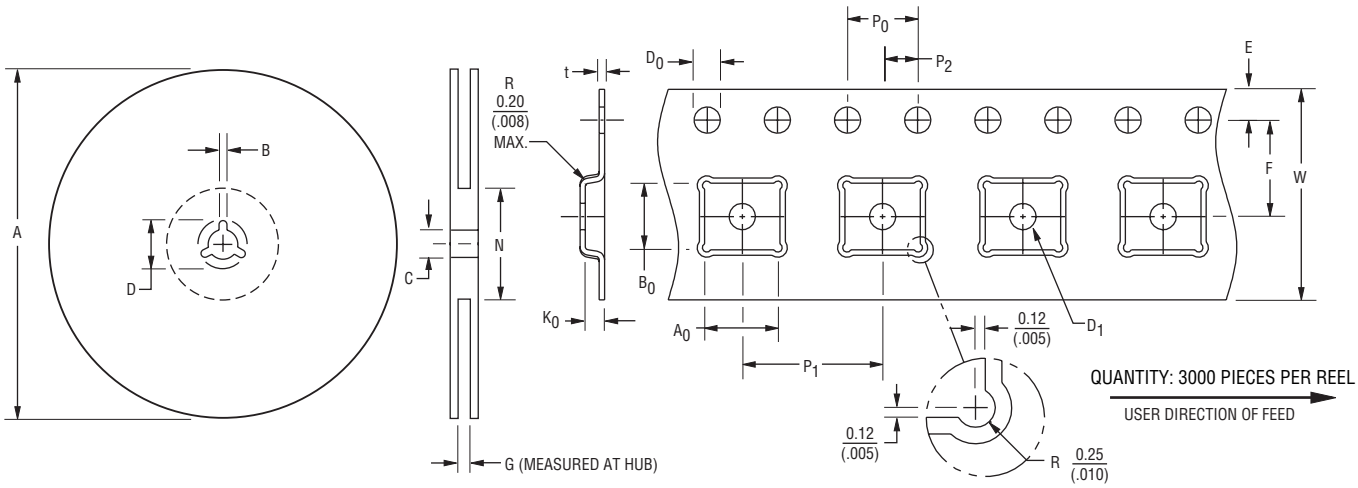
MANUFACTURING DATE CODE*
- 1ST DIGIT INDICATES THE YEAR'S 6-MONTH PERIOD.
- 2ND DIGIT INDICATES THE WEEK NUMBER IN THE 6-MONTH PERIOD.
- 3RD & 4TH DIGITS INDICATE SPECIFIC LOT FOR THE WEEK.

6-MONTH PERIOD CODES:
A = JAN-JUN 2012 D = JUL-DEC 2013
B = JUL-DEC 2012 E = JAN-JUN 2014
C = JAN-JUN 2013 F = JUL-DEC 2014

EXAMPLE: ARBC
- 1ST DIGIT 'A' = JAN-JUN 2012, - 2ND DIGIT 'R' = WEEK 18 (WEEK OF APRIL 27),
- 3RD & 4TH DIGITS 'BC' = LOT SPECIFIC INFO.

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Packaging Specifications



A		B		C		D		G	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
326 (12.835)	330 (13.002)	1.5 (.059)	2.5 (.098)	12.8 (.504)	13.5 (.531)	20.2 (.795)	—	12.4 (.488)	14.4 (.567)

N	A_0		D_0		D_1		E	
Ref.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
100 (3.937)	4.20 (.165)	4.40 (.173)	1.50 (.059)	1.60 (.063)	1.50 (.059)	-	1.65 (.065)	1.85 (.073)

F		K_0		P_0		P_1		P_2	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
5.45 (.215)	5.55 (.219)	1.00 (.039)	1.20 (.047)	3.90 (.154)	4.10 (.161)	7.90 (.311)	8.10 (.319)	1.95 (.077)	2.05 (.081)

t		W	
Min.	Max.	Min.	Max.
0.25 (.010)	0.35 (.014)	11.70 (.461)	12.30 (.484)

DIMENSIONS: MM / (INCHES)

TCS-DL004-250-WH		TCS-DL004-500-WH		TCS-DL004-750-WH	
B_0					
Min.	Max.	Min.	Max.	Min.	Max.
2.70 (.106)	2.90 (.114)	3.70 (.146)	3.90 (.154)	4.70 (.185)	4.90 (.193)

08/12

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"TCS" is a trademark of Bourns, Inc.
"TISP" is a registered trademark of Bourns Ltd., a Bourns Company, in the United States and other countries, except that "TISP" is a registered trademark of Bourns, Inc. in China.
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http://moschip.ru/get-element

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В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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