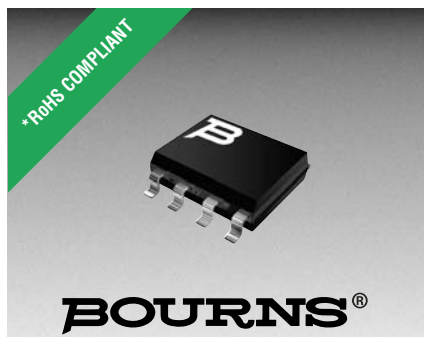




TISP3240F3, TISP3260F3,
TISP3290F3, TISP3320F3, TISP3380F3

HIGH-VOLTAGE DUAL BIDIRECTIONAL THYRISTOR OVERVOLTAGE PROTECTORS

TISP3xxxF3 (HV) Overvoltage Protector Series

Ion-Implanted Breakdown Region
Precise and Stable Voltage
Low Voltage Overshoot under Surge

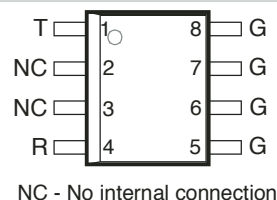
DEVICE	V_{DRM} V	$V_{(BO)}$ V
'3240F3	180	240
'3260F3	200	260
'3290F3	220	290
'3320F3	240	320
'3380F3	270	380

Planar Passivated Junctions
Low Off-State Current <10 μ A

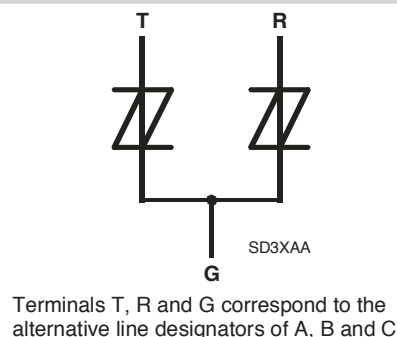
Rated for International Surge Wave Shapes

Waveshape	Standard	I_{TSP} A
2/10 μ s	GR-1089-CORE	175
8/20 μ s	IEC 61000-4-5	120
10/160 μ s	FCC Part 68	60
10/700 μ s	ITU-T K.20/21 FCC Part 68	50
10/560 μ s	FCC Part 68	45
10/1000 μ s	GR-1089-CORE	35

D Package (Top View)



Device Symbol



UL Recognized Component

Description

These high-voltage dual bidirectional thyristor protectors are designed to protect ground backed ringing central office, access and customer premise equipment against overvoltages caused by lightning and a.c. power disturbances. Offered in five voltage variants to meet battery and protection requirements, they are guaranteed to suppress and withstand the listed international lightning surges in both polarities. Overvoltages are initially clipped by breakdown clamping until the voltage rises to the breakover level, which causes the device to switch. The high crowbar holding current helps prevent d.c. latchup as the current subsides.

These monolithic protection devices are fabricated in ion implanted planar structures to ensure precise and matched breakover control and are virtually transparent to the system in normal operation.

How To Order

Device	Package	Carrier	Order As
TISP3xxxF3	D, Small-outline	Tape And Reeled	TISP3xxxF3DR-S

Insert xxx value corresponding to protection voltages of 240 through 380



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

MARCH 1994 - REVISED SEPTEMBER 2008

*RoHS Directive 2002/95/EC Jan. 27, 2003 including Annex.

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.

TISP3xxxF3 (HV) Overvoltage Protector Series

BOURNS®

Absolute Maximum Ratings, $T_A = 25\text{ °C}$ (Unless Otherwise Noted)

Rating	Symbol	Value	Unit
Repetitive peak off-state voltage, $0\text{ °C} < T_A < 70\text{ °C}$	V_{DRM}	± 180 ± 200 ± 220 ± 240 ± 270	V
Non-repetitive peak on-state pulse current (see Notes 1 and 2)	I_{PPSM}		A
1/2 (Gas tube differential transient, 1/2 voltage wave shape)		350	
2/10 (Telcordia GR-1089-CORE, 2/10 voltage wave shape)		175	
1/20 (ITU-T K.22, 1.2/50 voltage wave shape, 25 Ω resistor)		90	
8/20 (IEC 61000-4-5, combination wave generator, 1.2/50 voltage wave shape)		120	
10/160 (FCC Part 68, 10/160 voltage wave shape)		60	
4/250 (ITU-T K.20/21, 10/700 voltage wave shape, simultaneous)		55	
0.2/310 (CNET I 31-24, 0.5/700 voltage wave shape)		38	
5/310 (ITU-T K.20/21, 10/700 voltage wave shape, single)		50	
5/320 (FCC Part 68, 9/720 voltage wave shape, single)		50	
10/560 (FCC Part 68, 10/560 voltage wave shape)		45	
10/1000 (Telcordia GR-1089-CORE, 10/1000 voltage wave shape)		35	
Non-repetitive peak on-state current, $0\text{ °C} < T_A < 70\text{ °C}$ (see Notes 1 and 3) 50 Hz, 1 s	I_{TSM}	4.3	A
Initial rate of rise of on-state current, Linear current ramp, Maximum ramp value $< 38\text{ A}$	di_T/dt	250	A/ μ s
Junction temperature	T_J	-65 to +150	$^{\circ}\text{C}$
Storage temperature range	T_{stg}	-65 to +150	$^{\circ}\text{C}$

- NOTES: 1. Further details on surge wave shapes are contained in the Applications Information section.
2. Initially, the TISP® device must be in thermal equilibrium with $0\text{ °C} < T_J < 70\text{ °C}$. The surge may be repeated after the TISP® device returns to its initial conditions.
3. Above 70 °C , derate linearly to zero at 150 °C lead temperature.

Electrical Characteristics for R and T Terminal Pair, $T_A = 25\text{ °C}$ (Unless Otherwise Noted)

Parameter	Test Conditions	Min	Typ	Max	Unit
I_{DRM} Repetitive peak off-state current	$V_D = \pm 2V_{DRM}$, $0\text{ °C} < T_A < 70\text{ °C}$			± 10	μA
I_D Off-state current	$V_D = \pm 50\text{ V}$			± 10	μA
C_{off} Off-state capacitance	$f = 100\text{ kHz}$, $V_d = 100\text{ mV}$, $V_D = 0$, Third terminal voltage = -50 V to +50 V (see Notes 4 and 5)		0.05	0.15	pF

- NOTES: 4. These capacitance measurements employ a three terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.
5. Further details on capacitance are given in the Applications Information section.

MARCH 1994 - REVISED SEPTEMBER 2008

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.

TISP3xxxF3 (HV) Overvoltage Protector Series

BOURNS®

Electrical Characteristics for T and G or R and G Terminals, $T_A = 25\text{ °C}$ (Unless Otherwise Noted)

Parameter	Test Conditions	Min	Typ	Max	Unit
I_{DRM} Repetitive peak off-state current	$V_D = \pm V_{\text{DRM}}$, $0\text{ °C} < T_A < 70\text{ °C}$			± 10	μA
$V_{\text{(BO)}}$ Breakover voltage	$dv/dt = \pm 250\text{ V/ms}$, $R_{\text{SOURCE}} = 300\ \Omega$			± 240 ± 260 ± 290 ± 320 ± 380	V
$V_{\text{(BO)}}$ Impulse breakover voltage	$dv/dt \leq \pm 1000\text{ V}/\mu\text{s}$, Linear voltage ramp, Maximum ramp value = $\pm 500\text{ V}$ $R_{\text{SOURCE}} = 50\ \Omega$		± 267 ± 287 ± 317 ± 347 ± 407		V
$I_{\text{(BO)}}$ Breakover current	$dv/dt = \pm 250\text{ V/ms}$, $R_{\text{SOURCE}} = 300\ \Omega$	± 0.1		± 0.6	A
V_T On-state voltage	$I_T = \pm 5\text{ A}$, $t_W = 100\ \mu\text{s}$			± 3	V
I_H Holding current	$I_T = \pm 5\text{ A}$, $di/dt = -/+30\text{ mA/ms}$	± 0.15			A
dv/dt Critical rate of rise of off-state voltage	Linear voltage ramp, Maximum ramp value $< 0.85V_{\text{DRM}}$	± 5			$\text{kV}/\mu\text{s}$
I_D Off-state current	$V_D = \pm 50\text{ V}$			± 10	μA
C_{off} Off-state capacitance	$f = 1\text{ MHz}$, $V_d = 0.1\text{ V r.m.s.}$, $V_D = 0$ $f = 1\text{ MHz}$, $V_d = 0.1\text{ V r.m.s.}$, $V_D = -5\text{ V}$ $f = 1\text{ MHz}$, $V_d = 0.1\text{ V r.m.s.}$, $V_D = -50\text{ V}$ (see Notes 5 and 6)		57 26 11	95 45 20	pF

NOTES: 6 These capacitance measurements employ a three terminal capacitance bridge incorporating a guard circuit. The third terminal is connected to the guard terminal of the bridge.

7. Further details on capacitance are given in the Applications Information section.

Thermal Characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
$R_{\theta\text{JA}}$ Junction to free air thermal resistance	$P_{\text{tot}} = 0.8\text{ W}$, $T_A = 25\text{ °C}$ 5 cm^2 , FR4 PCB			160	$\text{°C}/\text{W}$

MARCH 1994 - REVISED SEPTEMBER 2008

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.

Parameter Measurement Information

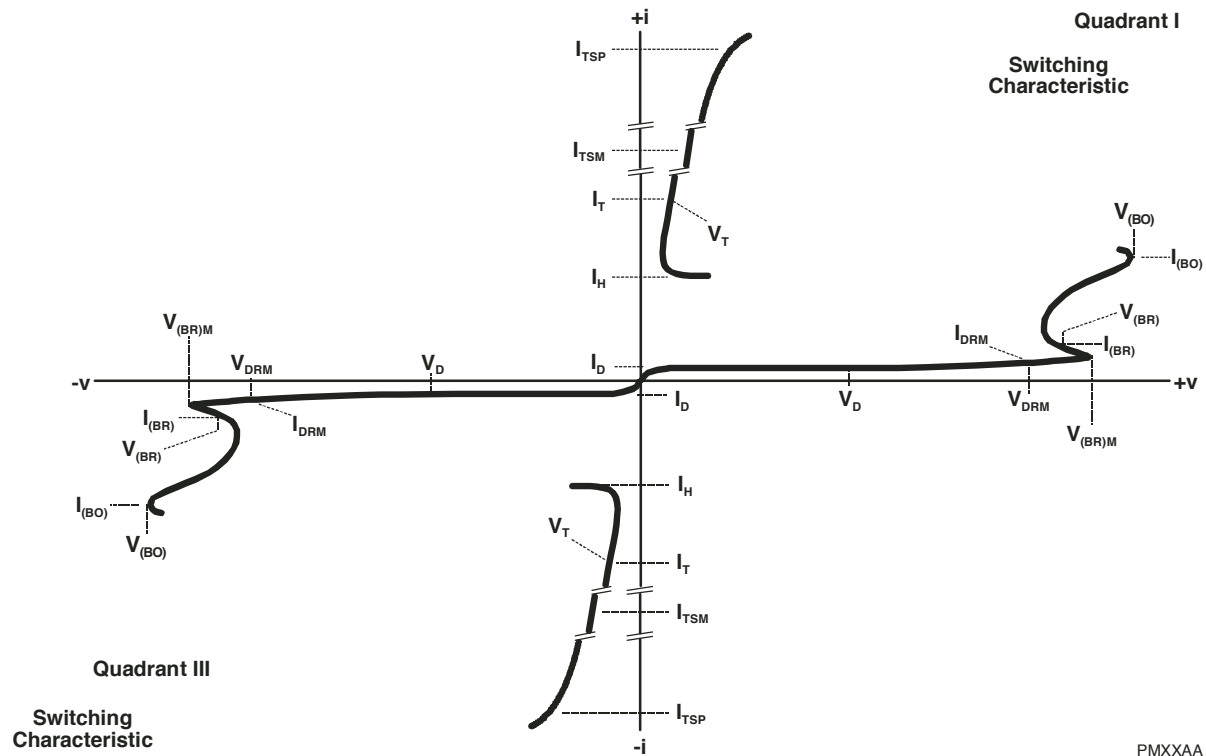


Figure 1. Voltage-Current Characteristics for any Terminal Pair

PMXXAA

Typical Characteristics - R and G or T and G Terminals

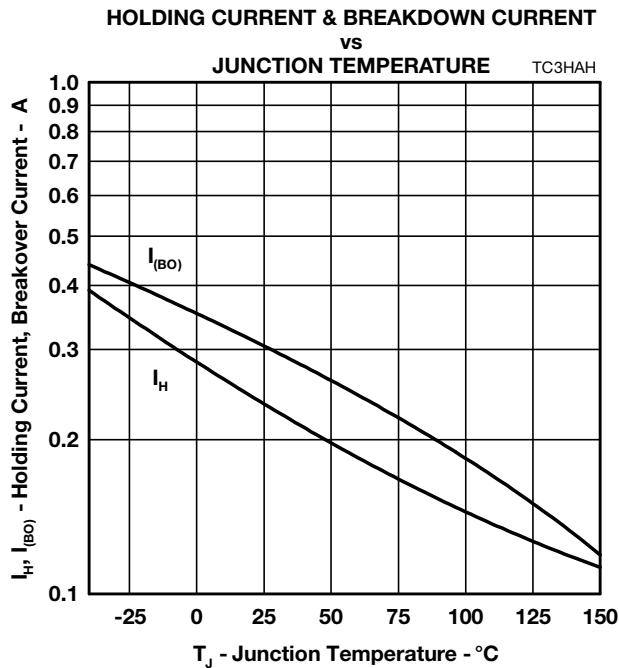


Figure 6.

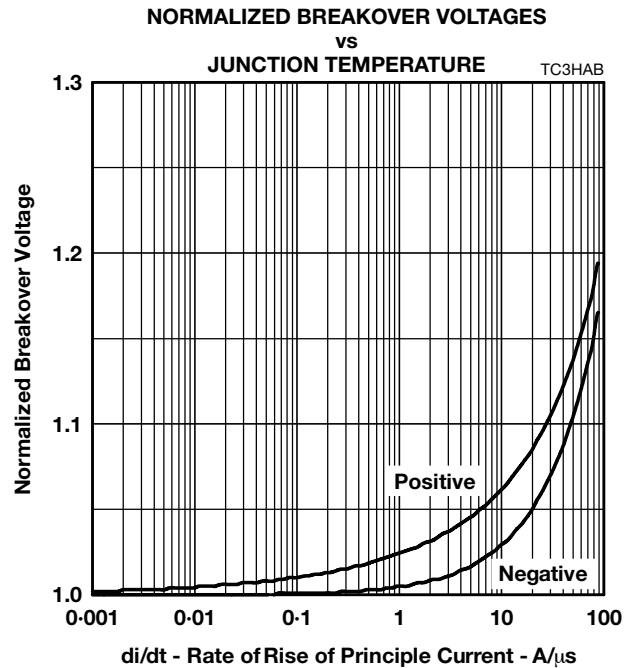


Figure 7.

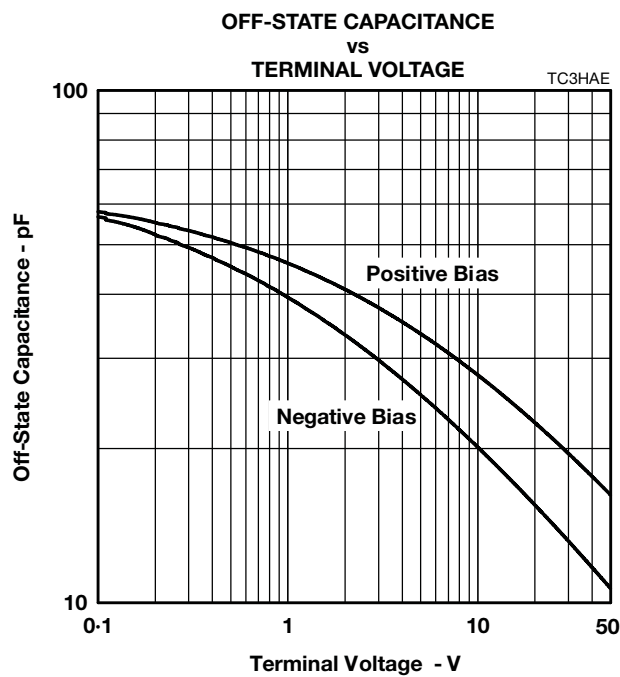


Figure 8.

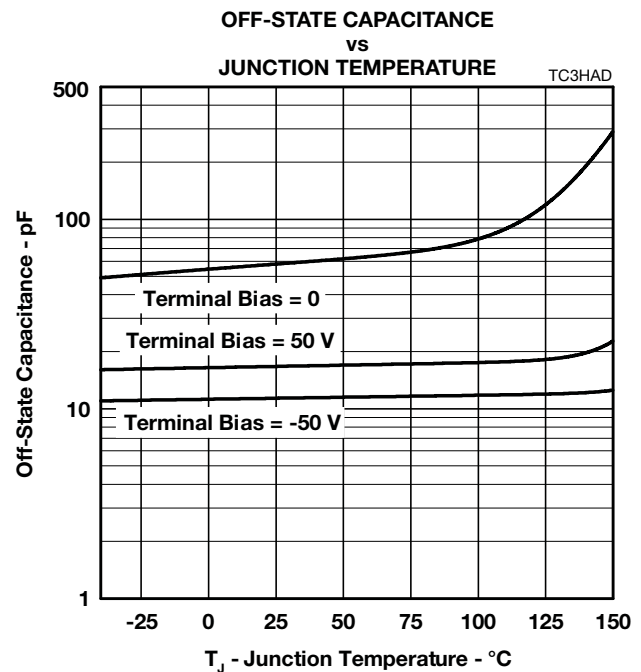


Figure 9.

Typical Characteristics - R and G or T and G Terminals

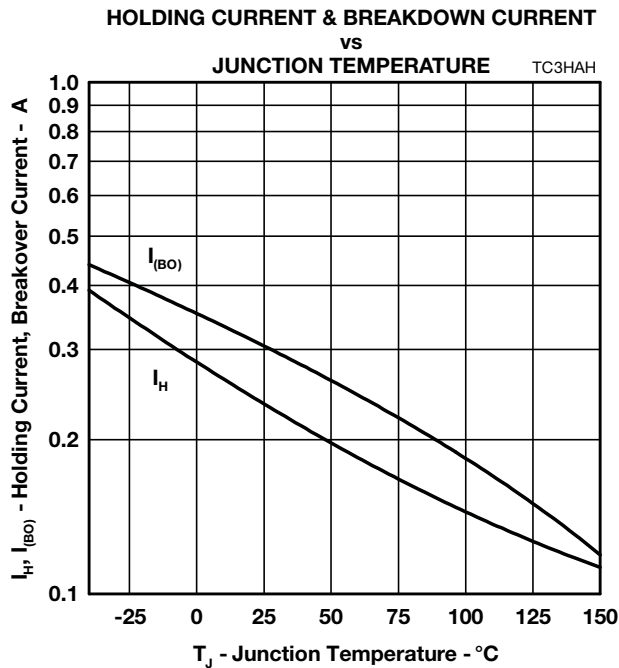


Figure 6.

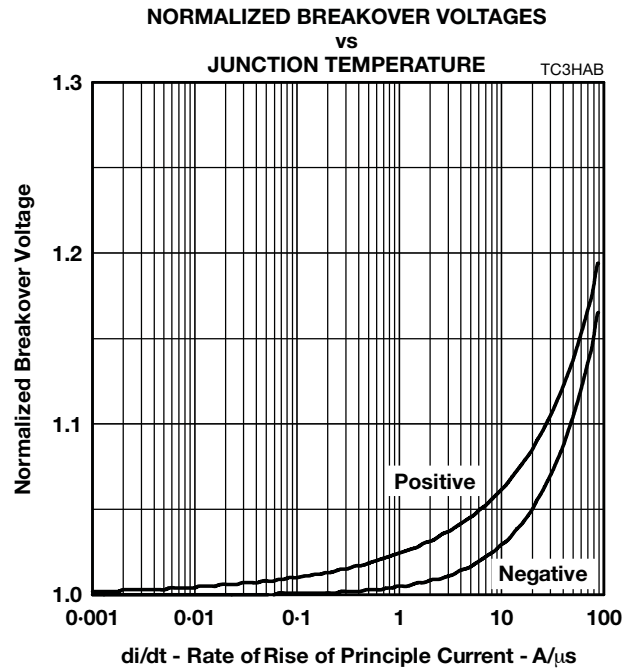


Figure 7.

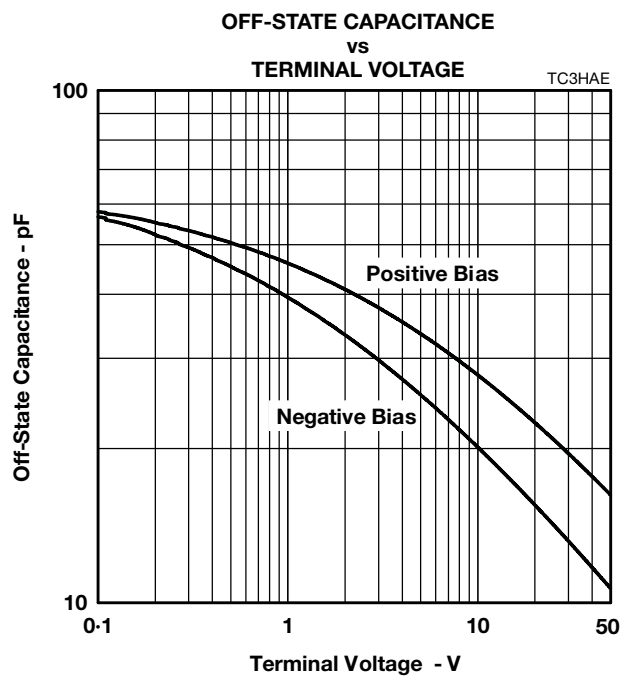


Figure 8.

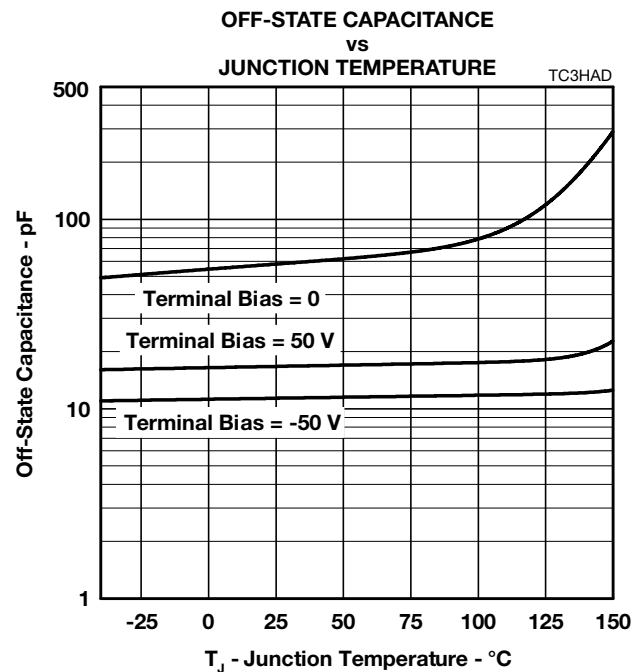


Figure 9.

Typical Characteristics - R and G or T and G Terminals

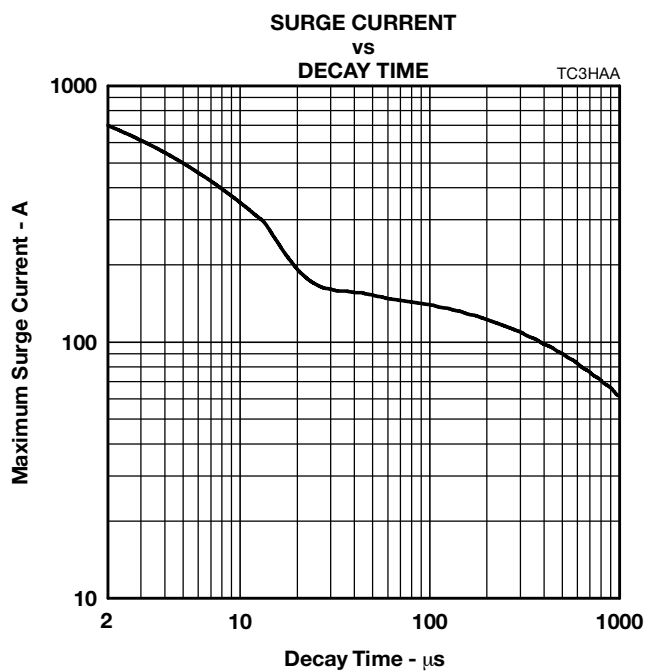


Figure 10.

Typical Characteristics - R and T Terminals

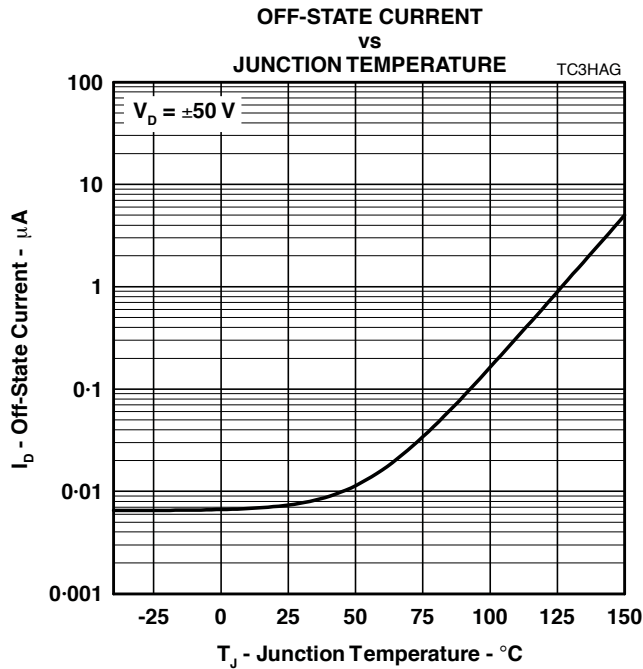


Figure 11.

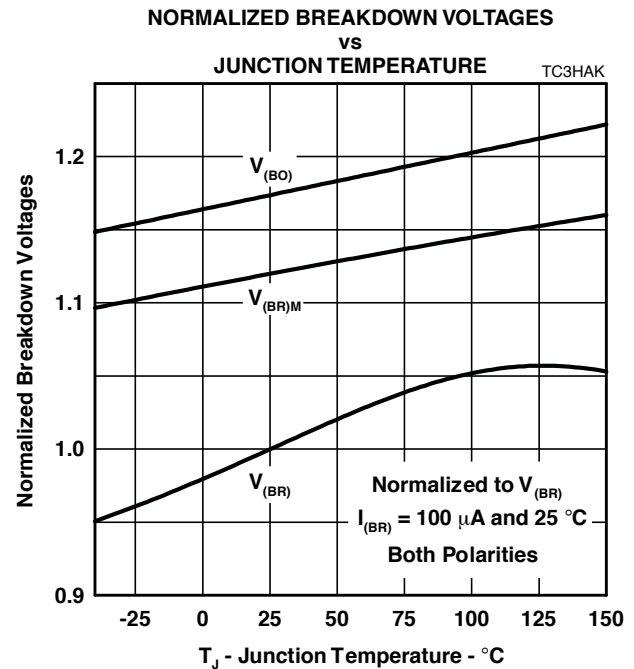


Figure 12.

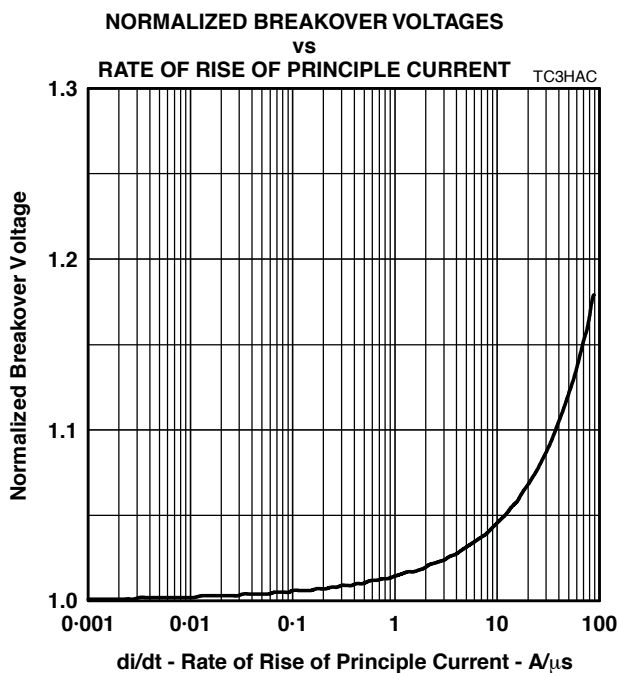
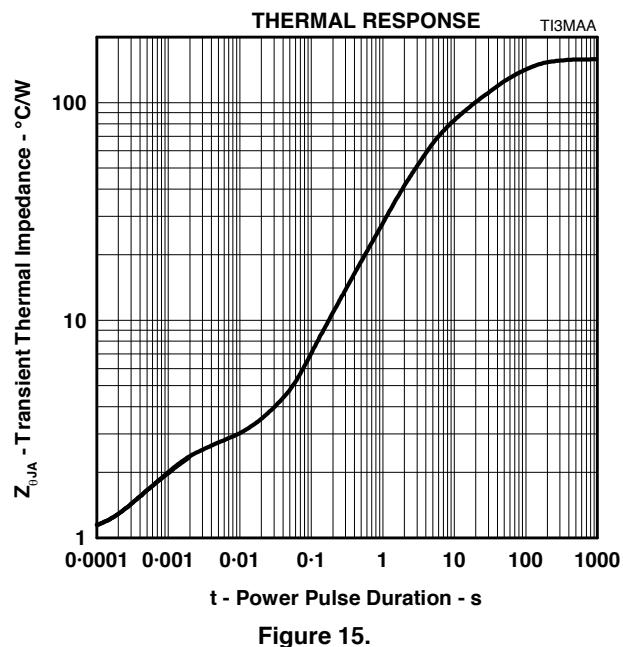
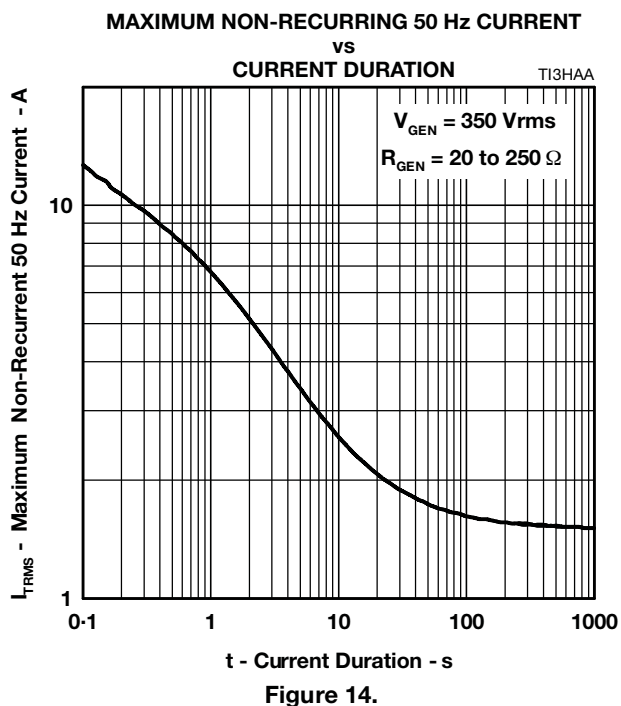


Figure 13.

Thermal Information



APPLICATIONS INFORMATION

Electrical Characteristics

The electrical characteristics of a TISP® device are strongly dependent on junction temperature, T_J . Hence, a characteristic value will depend on the junction temperature at the instant of measurement. The values given in this data sheet were measured on commercial testers, which generally minimize the temperature rise caused by testing. Application values may be calculated from the parameters' temperature coefficient, the power dissipated and the thermal response curve, Z_θ (see M. J. Maytum, "Transient Suppressor Dynamic Parameters." TI Technical Journal, vol. 6, No. 4, pp. 63-70, July-August 1989).

Lightning Surge

Wave Shape Notation

Most lightning tests, used for equipment verification, specify a unidirectional sawtooth waveform which has an exponential rise and an exponential decay. Wave shapes are classified in terms of peak amplitude (voltage or current), rise time and a decay time to 50 % of the maximum amplitude. The notation used for the wave shape is *amplitude, rise time/decay time*. A 50 A, 5/310 μ s wave shape would have a peak current value of 50 A, a rise time of 5 μ s and a decay time of 310 μ s. The TISP® surge current graph comprehends the wave shapes of commonly used surges.

Generators

There are three categories of surge generator type, single wave shape, combination wave shape and circuit defined. Single wave shape generators have essentially the same wave shape for the open circuit voltage and short circuit current (e.g. 10/1000 μ s open circuit voltage and short circuit current). Combination generators have two wave shapes, one for the open circuit voltage and the other for the short circuit current (e.g. 1.2/50 μ s open circuit voltage and 8/20 μ s short circuit current). Circuit specified generators usually equate to a combination generator, although typically only the open circuit voltage waveshape is referenced (e.g. a 10/700 μ s open circuit voltage generator typically produces a 5/310 μ s short circuit current). If the combination or circuit defined generators operate into a finite resistance, the wave shape produced is intermediate between the open circuit and short circuit values.

Current Rating

When the TISP® device switches into the on-state it has a very low impedance. As a result, although the surge wave shape may be defined in terms of open circuit voltage, it is the current wave shape that must be used to assess the required TISP® surge capability. As an example, the ITU-T K.21 1.5 kV, 10/700 μ s open circuit voltage surge is changed to a 38 A, 5/310 μ s current waveshape when driving into a short circuit. Thus, the TISP® surge current capability, when directly connected to the generator, will be found for the ITU-T K.21 waveform at 310 μ s on the surge graph and not 700 μ s. Some common short circuit equivalents are tabulated below:

Standard	Open Circuit Voltage	Short Circuit Current
ITU-T K.21	1.5 kV, 10/700 μ s	37.5 A, 5/310 μ s
ITU-T K.20	1 kV, 10/700 μ s	25 A, 5/310 μ s
IEC 61000-4-5, combination wave generator	1.0 kV, 1.2/50 μ s	500 A, 8/20 μ s
Telcordia GR-1089-CORE	1.0 kV, 10/1000 μ s	100 A, 10/1000 μ s
Telcordia GR-1089-CORE	2.5 kV, 2/10 μ s	500 A, 2/10 μ s
FCC Part 68, Type A	1.5 kV, <10/>160 μ s	200 A, <10/>160 μ s
FCC Part 68, Type A	800 V, <10/>560 μ s	100 A, <10/>160 μ s
FCC Part 68, Type B	1.5 kV, 9/720 μ s	37.5 A, 5/320 μ s

Any series resistance in the protected equipment will reduce the peak circuit current to less than the generators' short circuit value. A 1 kV open circuit voltage, 100 A short circuit current generator has an effective output impedance of 10 Ω (1000/100). If the equipment has a series resistance of 25 Ω , then the surge current requirement of the TISP® device becomes 29 A (1000/35) and not 100 A.

APPLICATIONS INFORMATION

Protection Voltage

The protection voltage, ($V_{(BO)}$), increases under lightning surge conditions due to thyristor regeneration. This increase is dependent on the rate of current rise, di/dt , when the TISP® device is clamping the voltage in its breakdown region. The $V_{(BO)}$ value under surge conditions can be estimated by multiplying the 50 Hz rate $V_{(BO)}$ (250 V/ms) value by the normalized increase at the surge's di/dt (Figure 7). An estimate of the di/dt can be made from the surge generator voltage rate of rise, dv/dt , and the circuit resistance.

As an example, the ITU-T K.21 1.5 kV, 10/700 μ s surge has an average dv/dt of 150 V/ μ s, but, as the rise is exponential, the initial dv/dt is higher, being in the region of 450 V/ μ s. The instantaneous generator output resistance is 25 Ω . If the equipment has an additional series resistance of 20 Ω , the total series resistance becomes 45 Ω . The maximum di/dt then can be estimated as $450/45 = 10$ A/ μ s. In practice, the measured di/dt and protection voltage increase will be lower due to inductive effects and the finite slope resistance of the TISP® breakdown region.

Capacitance

Off-state Capacitance

The off-state capacitance of a TISP® device is sensitive to junction temperature, T_J , and the bias voltage, comprising of the d.c. voltage, V_D , and the a.c. voltage, V_d . All the capacitance values in this data sheet are measured with an a.c. voltage of 100 mV. The typical 25 °C variation of capacitance value with a.c. bias is shown in Figure 17. When $V_D \gg V_d$, the capacitance value is independent on the value of V_d . The capacitance is essentially constant over the range of normal telecommunication frequencies.

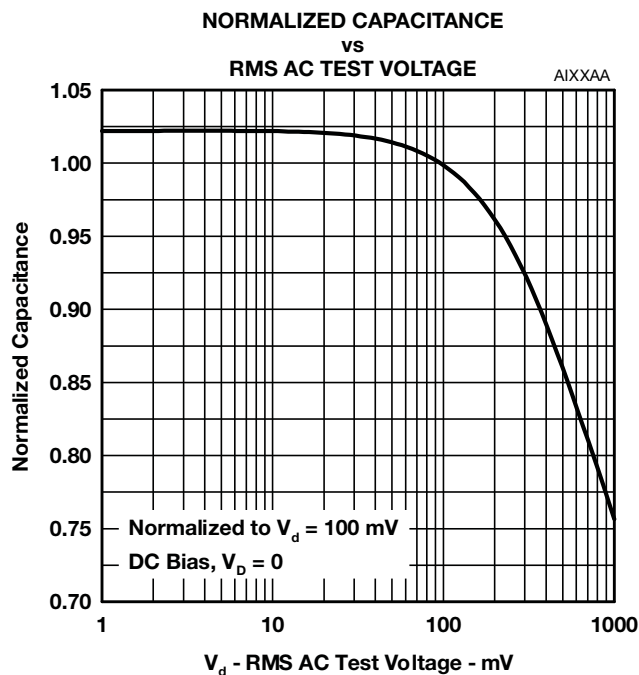


Figure 16.

APPLICATIONS INFORMATION

Longitudinal Balance

Figure 17 shows a three terminal TISP® device with its equivalent “delta” capacitance. Each capacitance, C_{TG} , C_{RG} and C_{TR} , is the true terminal pair capacitance measured with a three terminal or guarded capacitance bridge. If wire R is biased at a larger potential than wire T, then $C_{TG} > C_{RG}$. Capacitance C_{TG} is equivalent to a capacitance of C_{RG} in parallel with the capacitive difference of $(C_{TG} - C_{RG})$. The line capacitive unbalance is due to $(C_{TG} - C_{RG})$ and the capacitance shunting the line is $C_{TR} + C_{RG}/2$.

All capacitance measurements in this data sheet are three terminal guarded to allow the designer to accurately assess capacitive unbalance effects. Simple two terminal capacitance meters (unguarded third terminal) give false readings as the shunt capacitance via the third terminal is included.

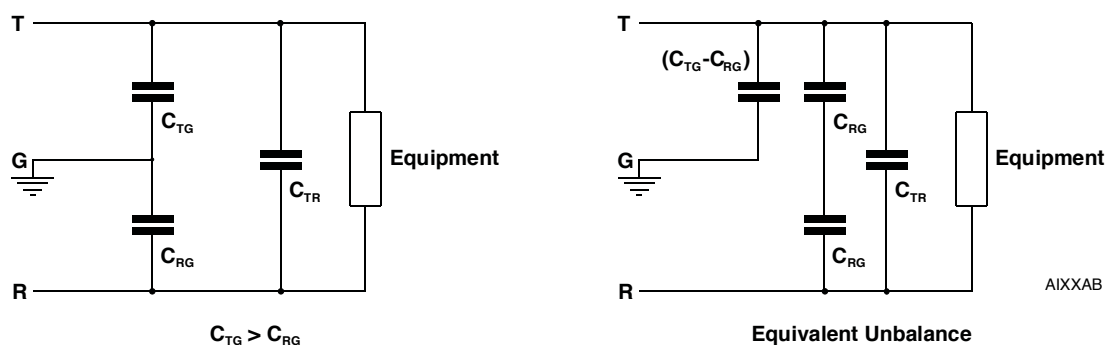


Figure 17.

“TISP” is a trademark of Bourns, Ltd., a Bourns Company, and is Registered in U.S. Patent and Trademark Office.

“Bourns” is a registered trademark of Bourns, Inc. in the U.S. and other countries.

MARCH 1994 - REVISED SEPTEMBER 2008

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.

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>