

TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

Copyright © 2000, Power Innovations Limited, UK

AUGUST 1999 - REVISED OCTOBER 2000

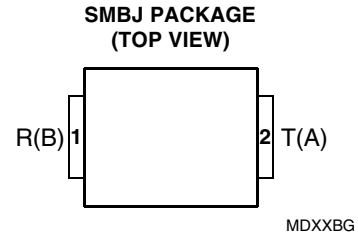
SELV TELECOMMUNICATION LINE OVERVOLTAGE PROTECTION

- **Digital Line Signal Level Protection**
 - ISDN “U” and “S” Interface
 - Pair Gain
 - HDSL
 - Home Phonenumber Networking
- **Safety Extra Low Voltage, SELV, values**

DEVICE	V _{DRM} V	V _(BO) V
'4015	± 5	± 15
'4020	± 8	± 20

- **Low Capacitance “L” Series for ITU-T K21 and FCC Part 68**
 - 35 pF for '4020
 - 40 pF for '4015

SURGE TYPE	STANDARD	WAVE SHAPE	I _{TSP} A
A	FCC Part 68	10/160 µs	65
		10/560 µs	40
B	FCC Part 68 ITU-T K21	9/720 µs	50
		10/700 µs	
First Level	GR-1089-CORE	2/10 µs	125
First Level	GR-1089-CORE	10/1000 µs	30



device symbol



Terminals T and R correspond to the alternative line designators of A and B

description

These devices are designed to limit overvoltages on digital telecommunication lines. Overvoltages are normally caused by a.c. power system or lightning flash disturbances which are induced or conducted on to the telephone line. A single device provides 2-point protection and is typically used for the protection of transformer windings and low voltage electronics.

HOW TO ORDER

DEVICE	PACKAGE	CARRIER	ORDER AS
TISP40xxL1	BJ (J-Bend DO-214AA/SMB)	Embossed Tape Reeled	TISP40xxL1BJR
TISP40xxL1	BJ (J-Bend DO-214AA/SMB)	Bulk Pack	TISP40xxL1BJ

Insert xx value corresponding to protection voltages of 15 V and 20 V

The protector consists of a symmetrical voltage-triggered bidirectional thyristor. Overvoltages are initially clipped by breakdown clamping until the voltage rises to the breakover level, which causes the device to crowbar into a low-voltage on-state condition. This low-voltage on state causes the current resulting from the overvoltage to be safely diverted through the device. The device switches off when the diverted current falls below the holding current value.

ADVANCE INFORMATION

Information relates to new products in the sampling or preproduction phase of development. Characteristic data and other specifications are subject to change without notice.



A Bourns Company

ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

absolute maximum ratings, $T_A = 25\text{ }^\circ\text{C}$ (unless otherwise noted)

RATING	SYMBOL	VALUE	UNIT
Repetitive peak off-state voltage	V_{DRM}	± 5 ± 8	V
Non-repetitive peak on-state pulse current (see Notes 1 and 2) 2/10 μs (Telcordia GR-1089-CORE, 2/10 μs voltage wave shape) 8/20 μs (IEC 61000-4-5, combination wave generator, 1.2/50 voltage, 8/20 current) 10/160 μs (FCC Part 68, 10/160 μs voltage wave shape) 5/310 μs (ITU-T K20/21, 10/700 μs voltage wave shape) 5/320 μs (FCC Part 68, 9/720 μs voltage wave shape) 10/560 μs (FCC Part 68, 10/560 μs voltage wave shape) 10/1000 μs (Telcordia GR-1089-CORE, 10/1000 μs voltage wave shape)	I_{TSP}	± 125 ± 100 ± 65 ± 50 ± 50 ± 40 ± 30	A
Non-repetitive peak on-state current (see Notes 1 and 2) 20 ms (50 Hz) full sine wave 16.7 ms (60 Hz) full sine wave 1 s 50/60 Hz a.c. 1000 s 50 Hz/60 Hz a.c.	I_{TSM}	15 17 6 1	A
Initial rate of rise of current (2/10 waveshape)	di/dt	100	A/ μs
Maximum junction temperature	T_{JM}	150	$^\circ\text{C}$
Storage temperature range	T_{stg}	-65 to +150	$^\circ\text{C}$

NOTES: 1. Initially the device must be in thermal equilibrium with $T_J = 25\text{ }^\circ\text{C}$.
 2. The surge may be repeated after the device returns to its initial conditions.

electrical characteristics for the R and T terminals, $T_A = 25\text{ }^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{DRM} Repetitive peak off-state current	$V_D = V_{\text{DRM}}$			± 5	μA
$V_{(\text{BO})}$ Breakover voltage	$di/dt = \pm 0.8\text{ A/ms}$			± 15 ± 20	V
$V_{(\text{BO})}$ Impulse breakover voltage	$dv/dt \leq \pm 1000\text{ V}/\mu\text{s}$, Linear voltage ramp, Maximum ramp value = $\pm 500\text{ V}$ $di/dt = \pm 20\text{ A}/\mu\text{s}$, Linear current ramp, Maximum ramp value = $\pm 10\text{ A}$			± 20 ± 25	V
$I_{(\text{BO})}$ Breakover current	$di/dt = \pm 0.8\text{ A/ms}$			± 0.8	A
I_D Off-state current	$V_D = \pm 4\text{ V}$ $V_D = \pm 6\text{ V}$			± 2	μA
I_H Holding current	$I_T = \pm 5\text{ A}$, $di/dt = +/- 30\text{ mA/ms}$	± 50			mA
C_{off} Off-state capacitance	$f = 1\text{ MHz}$, $V_d = 1\text{ V rms}$, $V_D = 0$ $f = 1\text{ MHz}$, $V_d = 1\text{ V rms}$, $V_D = 1\text{ V}$ $f = 1\text{ MHz}$, $V_d = 1\text{ V rms}$, $V_D = 2\text{ V}$		50 45 45 40 40 35		pF

ADVANCE INFORMATION

ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

thermal characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
R _{θJA} Junction to free air thermal resistance	EIA/JESD51-3 PCB, I _T = I _{TSM(1000)} , T _A = 25 °C, (see Note 3)			115	°C/W
	265 mm x 210 mm populated line card, 4-layer PCB, I _T = I _{TSM(1000)} , T _A = 25 °C		52		

NOTE 3: EIA/JESD51-2 environment and PCB has standard footprint dimensions connected with 5 A rated printed wiring track widths.

ADVANCE INFORMATION

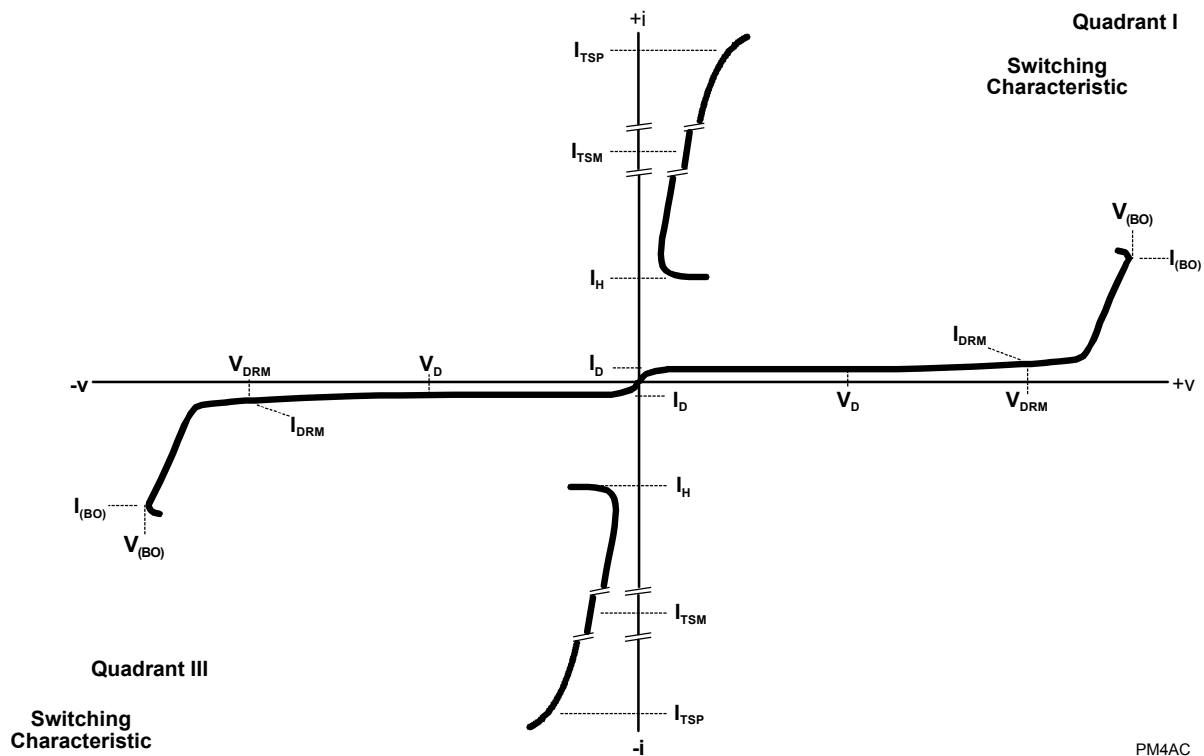
ADVANCE INFORMATION



TISP4015L1BJ, TISP4020L1BJ
**VERY LOW VOLTAGE
 BIDIRECTIONAL OVERVOLTAGE PROTECTORS**

AUGUST 1999 - REVISED OCTOBER 2000

PARAMETER MEASUREMENT INFORMATION



**Figure 1. VOLTAGE-CURRENT CHARACTERISTIC FOR T AND R TERMINALS
 ALL MEASUREMENTS ARE REFERENCED TO THE R TERMINAL**

APPLICATIONS INFORMATION

transformer protection

The inductance of a transformer winding reduces considerably when the magnetic core material saturates. Saturation occurs when the magnetising current through the winding inductance exceeds a certain value. It should be noted that this is a different current to the transformed current component from primary to secondary. The standard inductance-current relationship is:

$$E = -\left(L \frac{di}{dt}\right)$$

where:

L = unsaturated inductance value in H

di = current change in A

dt = time period in s for current change di

E = winding voltage in V

Re-arranging this equation and working large Δ changes to saturation gives the useful circuit relationship of:

$$E \times \Delta t = L \times \Delta i$$

A transformer winding volt-second value for saturation gives the designer an idea of circuit operation under overvoltage conditions. The volt-second value is not normally quoted, but most manufacturers should provide

ADVANCE INFORMATION

ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

it on request. A 50 V μ s winding will support rectangular voltage pulses of 50 V for 1 μ s, 25 V for 2 μ s, 1 V for 50 μ s and so on. Once the transformer saturates, primary to secondary coupling will be lost and the winding resistance, RW, shunts the overvoltage protector, Th1, see Figure 2. This saturated condition is a concern for long duration impulses and a.c. fault conditions because the current capability of the winding wire may be exceeded. For example, if the on-state voltage of the protector is 1 V and the winding resistance is 0.2 Ω , the winding would bypass a current of 1/0.2 = 5 A, even through the protector was in the low voltage condition.

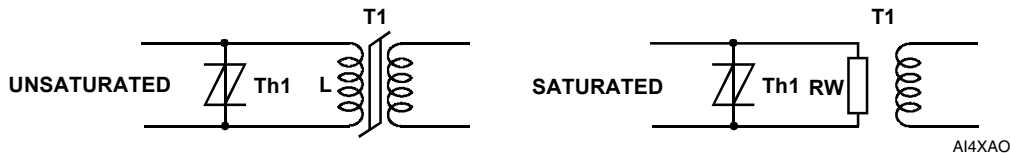


Figure 2. TRANSFORMER SATURATION

Figure 3 shows a generic protection arrangement. Resistors R1 and R2, together with the overcurrent protection, prevent excessive winding current flow under a.c. conditions. Alternatively, a split winding could be used with a single resistor connecting the windings. This resistor could be by-passed by a small capacitor to reduce signal attenuation.

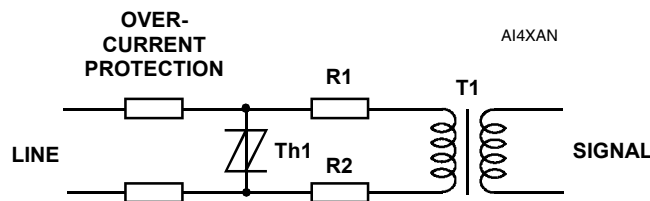


Figure 3. TRANSFORMER WINDING PROTECTION

Overcurrent protection upstream from the overvoltage protector can be fuse, PTC or thick film resistor based. For very high frequency circuits, fuse inductance due to spiral wound elements may need to be evaluated.

TISP[®] voltage selection

Normally the working voltage value of the protector, V_{DRM} , would be chosen to be just greater than the peak signal amplitude over the equipment temperature range. This would give the lowest possible protection voltage, $V_{(BO)}$. This would minimise the peak voltage applied to the transformer winding and increase the time to core saturation.

In high frequency circuits there are two further considerations. Low voltage protectors have a higher capacitance than high voltage protectors. So a higher voltage protector might be chosen specifically to reduce the protector capacitive effects on the signal.

Low energy short duration spikes will be clipped by the protector. This will extend the spike duration and the data loss time. A higher protector voltage will reduce the data loss time. Generally this will not be a significant factor for inter-conductor protection.

However, clipping is significant for protection to ground, where there is continuous low-level a.c. common mode induction. In some cases the induced a.c. voltage can be over 10 V. Repetitive clipping at the induced a.c. peaks by the protector would cause severe data corruption. The expected a.c. voltage induced should be added to the maximum signal level for setting the protector V_{DRM} value.

ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ VERY LOW VOLTAGE BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

2-wire digital systems

Typical systems using a single twisted pair connection are: Integrated Services Digital Network (ISDN) and Pair Gain.

Signal level protection at the transformer winding is given by protectors Th3 and Th5, see Figure 4. Typically these would be TISP4020L1 type devices with a 20 V voltage protection level. For a 15 V protection level, with a slight increase in capacitance, the TISP4015L1 could be used.

Two line protection circuits are given; one referenced to ground using Th1 and Th2 and the other inter-wire using protector Th4, see Figure 4. For ISDN circuits compliant to ETSI ETR 080:1993, ranges 1 and 2 can be protected by the following device types: TISP4095M3, TISP4095H3, TISP3095H3 (combines Th1 and Th2) and TISP7095H3 (combines Th1, Th2 and Th4). Ranges 4 through 5 can be protected by: TISP4145M3, TISP4145H3, TISP3145H3 (combines Th1 and Th2) and TISP7145H3 (combines Th1, Th2 and Th4). Device surge requirement, H or M, will be set by the overcurrent protection components and the standards complied with. Protection of just the d.c. feed and the ETSI ranges is covered in the TISP5xxxH3 data sheet.

When loop test voltages exceed the normal d.c. feed levels, higher voltage protectors need to be selected. For two terminal protectors, for levels up to 190 V (135 V rms) the TISP4250, H3 or M3, can be used and for 210 V (150 V rms) the TISP4290, H3 or M3, can be used.

In Pair Gain systems, the protector V_{DRM} is normally set by the d.c. feed value. The following series of devices have a 160 V working voltage at 25 °C: TISP4220M3, TISP4220H3, TISP3210H3 (combines Th1 and Th2) and TISP7210H3 (combines Th1, Th2 and Th4). These devices can be used on 150 V d.c. feed voltages down to an ambient temperature of -25 °C. Where the subscriber equipment may be exposed to POTS (Plain Old Telephone Service) voltage levels, protector Th4 needs a higher working voltage of about 275 V. Suitable device types are: TISP4350M3, TISP4350H3, TISP3350H3 (combines Th1 and Th2) and TISP7350H3 (combines Th1, Th2 and Th4).

The overcurrent protection for the overvoltage protector can be fuse, PTC or thick film resistor based. Its a.c. limiting capability should be less than the ratings of the intended overvoltage protector. Equipment complying with forthcoming international K.20, K.21 and K.45 recommendations from the ITU-T, may be required to demonstrate protection co-ordination with the intended primary protector. Without adding series resistance, a simple series fuse overcurrent protection is likely to fail the equipment for this part of the recommendation.

If the d.c. feed consists of equal magnitude positive and negative voltage supplies, appropriately connected TISP5xxxH3 unidirectional protectors could replace Th1 and Th2.

ADVANCE INFORMATION

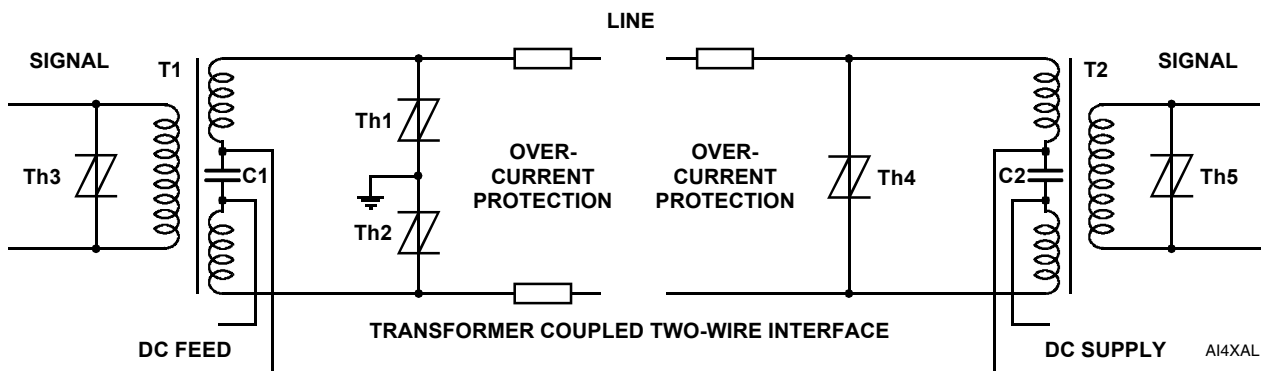


Figure 4. 2-WIRE SYSTEM

ADVANCE INFORMATION

4-wire digital systems

A typical system using a two twisted pair connection is the High-bit-rate Digital Subscriber Line (HDSL) and the "S" interface of ISDN.

Figure 5 shows a generic two line system. HDSL tends to have ground referenced protection at both ends of the lines (Th1, Th2, Th3 and Th4). The ISDN "S" interface is often inside the premises and simple inter-wire protection is used at the terminating adaptor (Th7 and Th8). In all cases, signal protection, Th5, Th6, Th9 and Th10, can be TISP4020L1 type devices with a 20 V voltage protection level. For a 15 V protection level, with a slight increase in capacitance, the TISP4015L1 could be used.

For an HDSL d.c. feed voltage of 180 V or less and operation down to an ambient of -25 °C, the following Th1, Th2, Th3 and Th4 protectors are suitable: TISP4250M3 or TISP4250H3, TISP3250H3 (combines Th1 and Th2 or Th3 and Th4) and TISP7250H3 (combines Th1, Th2 and Th7 or Th3, Th4 and Th8). Possible overcurrent protection components are covered in the 2-wire digital systems clause.

ISDN interfaces powered with ± 40 V (ETSI, ETS 300 012 1992) the following Th1, Th2, Th3 and Th4 protectors are suitable: TISP4070M3 or TISP4070H3 or TISP4070L3, TISP3070F3 or TISP3070H3 (combines Th1 and Th2 or Th3 and Th4) and TISP7070F3 or TISP7070H3 (combines Th1, Th2 and Th7 or Th3, Th4 and Th8). At the terminating adaptor, the Th7 and Th8 protectors do not "see" the d.c. feed voltage and should be selected to not clip the maximum signal level. Generally the TISP40xxL1 series will be suitable.

Internal ISDN lines are not exposed to high stress levels and the chances of a.c. power intrusion are low (ETSI EN 300 386-2 1997). Accordingly the equipment port protection need is lower than ports connected to outside lines.

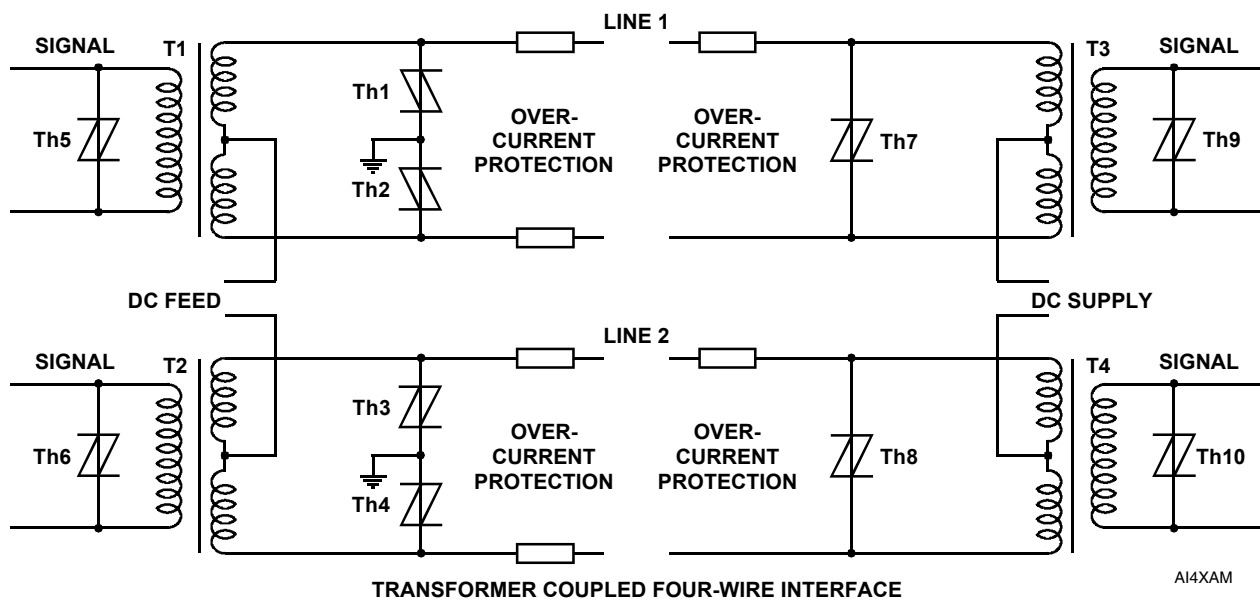


Figure 5. 4-WIRE SYSTEM

home phoneline networking

Using the existing house telephone wiring, home phoneline networking systems place the local network traffic in a high band above the POTS and ADSL (Asymmetrical Digital Subscriber Line) spectrum. Local network rates are 1 Mbps or more. To reject noise and harmonics, an in-line protection and 5 MHz to 10 MHz bandpass filter module is used for the equipment. These modules are available from magnetic component

ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

manufacturers (e.g. Bel Fuse Inc.) A typical circuit for the telephone line magnetics module is shown in Figure 6. Transformer T1 isolates the equipment from the house wiring. Any overvoltages produced by the isolated winding output are voltage limited by a very low-voltage protector, Th1. With a differential voltage of about 12 V peak to peak, the TISP4020L1 could be used for Th1. After filtering, connection is made to the differential transceiver of the processing IC.

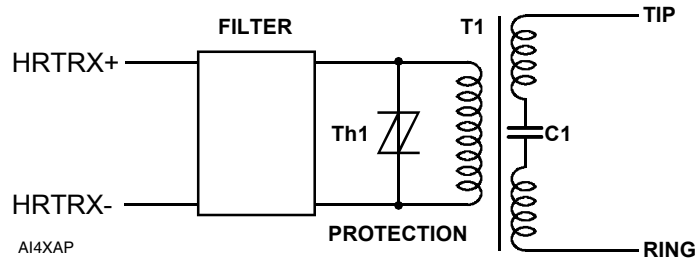


Figure 6. HOME PHONE NETWORKING ISOLATION/FILTER/PROTECTION CIRCUIT

ADVANCE INFORMATION

ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ
**VERY LOW VOLTAGE
 BIDIRECTIONAL OVERVOLTAGE PROTECTORS**

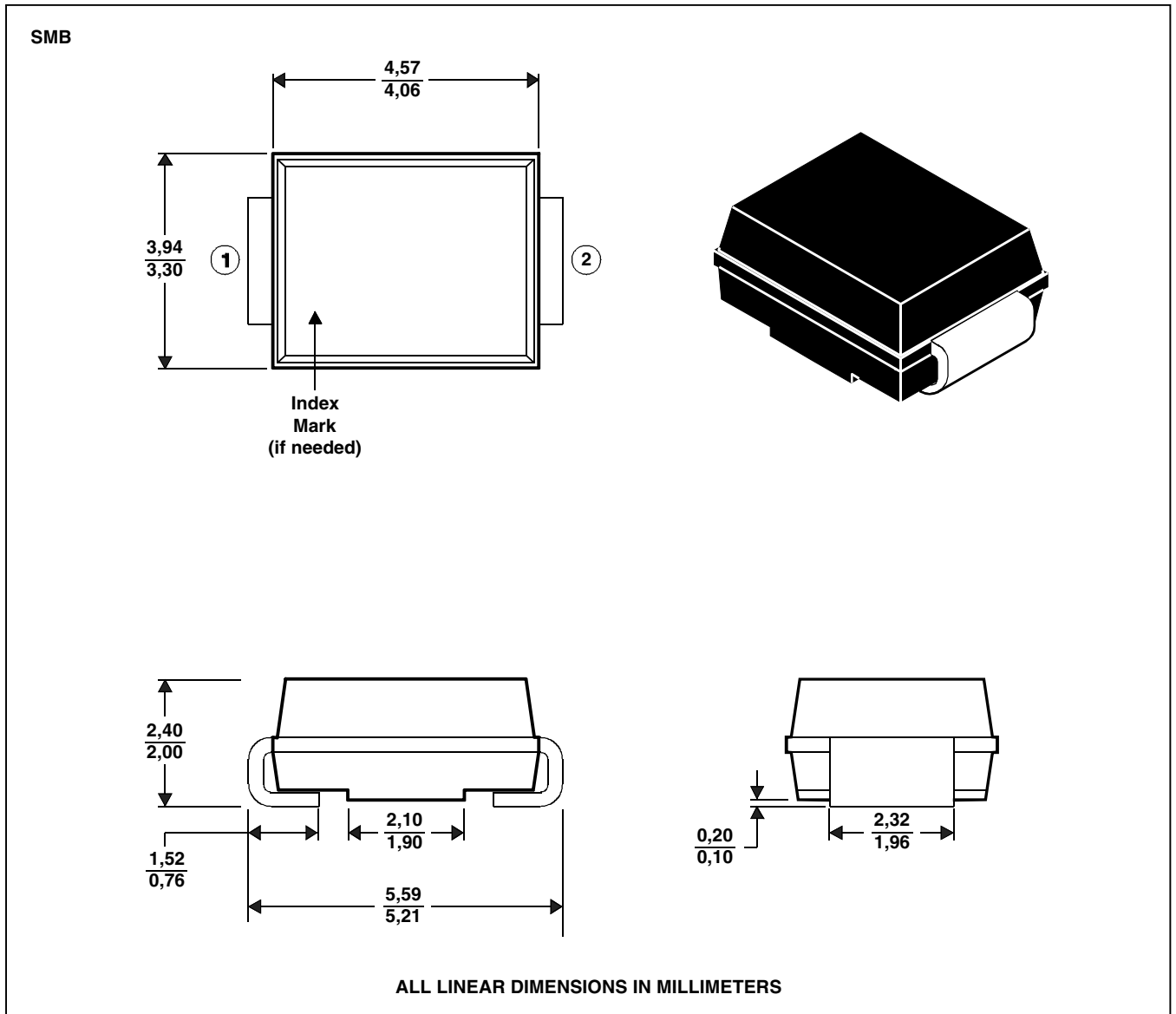
AUGUST 1999 - REVISED OCTOBER 2000

MECHANICAL DATA

SMBJ (DO-214AA)

plastic surface mount diode package

This surface mount package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



ADVANCE INFORMATION

MDXXBHA

ADVANCE INFORMATION

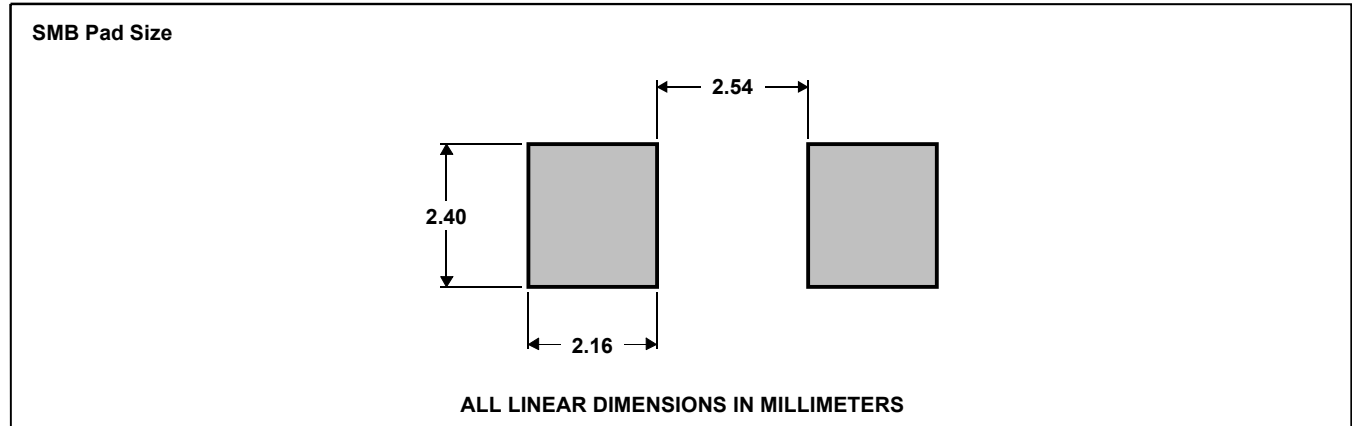


TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

MECHANICAL DATA

recommended printed wiring footprint.



MDXXBI

ADVANCE INFORMATION

device symbolization

Devices are coded as below. As the device parameters are symmetrical, terminal 1 is not identified.

DEVICE	SYMBOLIZATION
TISP4015L1BJ	4015L1
TISP4020L1BJ	4020L1

carrier information

Devices are shipped in one of the carriers below. Unless a specific method of shipment is specified by the customer, devices will be shipped in the most practical carrier. For production quantities the carrier will be embossed tape reel pack. Evaluation quantities may be shipped in bulk pack or embossed tape.

CARRIER	STANDARD QUANTITY
Embossed Tape Reeled	3 000
Bulk Pack	2 000

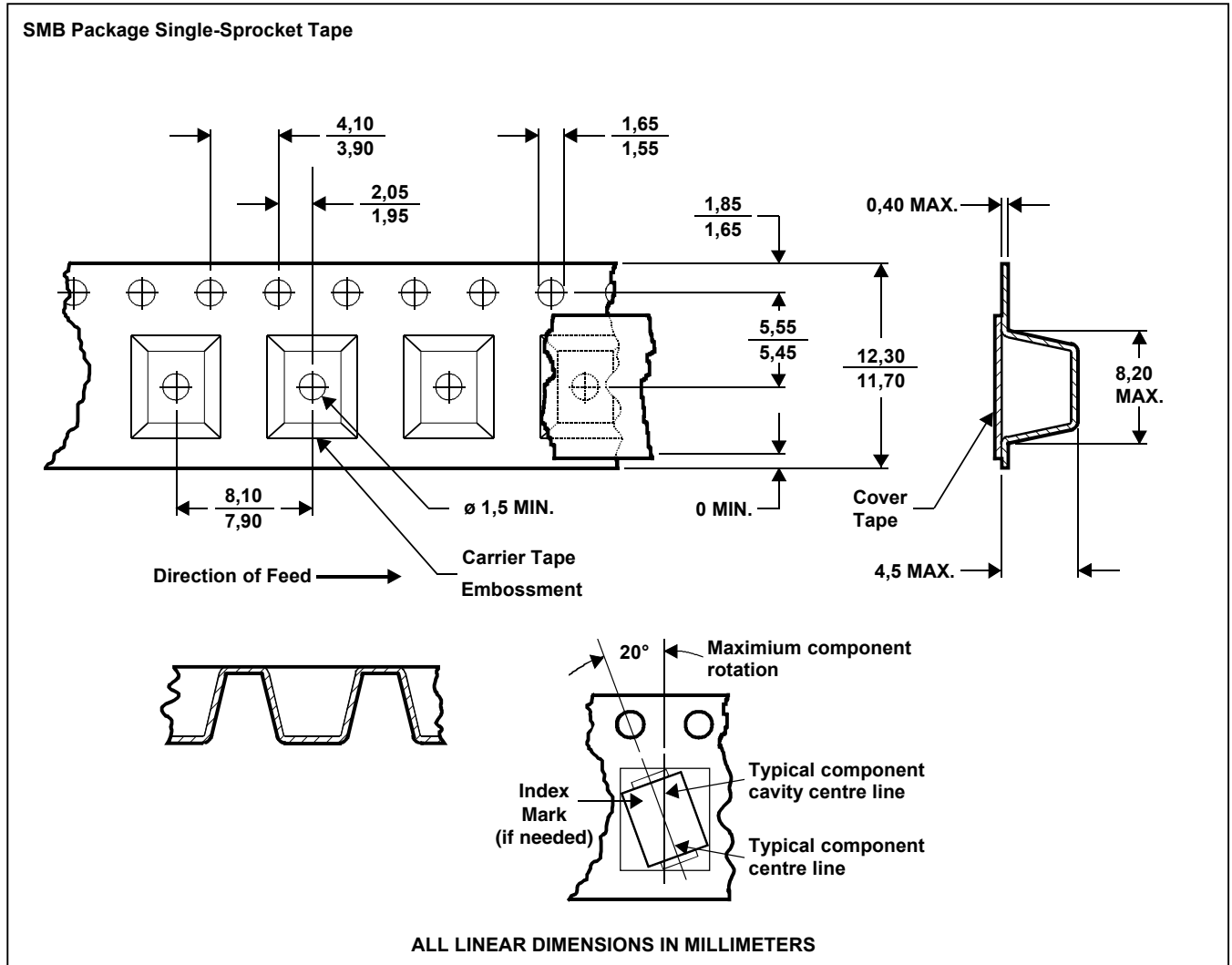
ADVANCE INFORMATION

TISP4015L1BJ, TISP4020L1BJ
**VERY LOW VOLTAGE
 BIDIRECTIONAL OVERVOLTAGE PROTECTORS**

AUGUST 1999 - REVISED OCTOBER 2000

MECHANICAL DATA

tape dimensions



ADVANCE INFORMATION

NOTES: A. The clearance between the component and the cavity must be within $0,05$ mm MIN. to $0,65$ mm MAX. so that the component cannot rotate more than 20° within the determined cavity. MDXXBJ
 B. Taped devices are supplied on a reel of the following dimensions:-

Reel diameter: $330 \pm 3,0$ mm
 Reel hub diameter: 75 mm MIN.
 Reel axial hole: $13,0 \pm 0,5$ mm

C. 3000 devices are on a reel.

ADVANCE INFORMATION



TISP4015L1BJ, TISP4020L1BJ
VERY LOW VOLTAGE
BIDIRECTIONAL OVERVOLTAGE PROTECTORS

AUGUST 1999 - REVISED OCTOBER 2000

IMPORTANT NOTICE

Power Innovations Limited (PI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to verify, before placing orders, that the information being relied on is current.

PI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with PI's standard warranty. Testing and other quality control techniques are utilized to the extent PI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

PI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor is any license, either express or implied, granted under any patent right, copyright, design right, or other intellectual property right of PI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.

PI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORISED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS.

Copyright © 2000, Power Innovations Limited

ADVANCE INFORMATION

ADVANCE INFORMATION