TSI

Terminal set interface protection and diode bridge

Features

- Stand-off voltage from 62 V to 265 V
- Peak pulse current: 30 A (10/1000 µs)
- Maximum DC current: I_F = 0.2 A
- Holding current: 150 mA

Benefits

- Trisil™ technology is not subject to ageing and provides a fail safe mode in short circuit for a better protection.
- Diode bridge for polarity guard and crowbar protection within one device
- Single chip for greater reliability
- Reduces component count versus discrete solution
- Saves space on the board

Applications

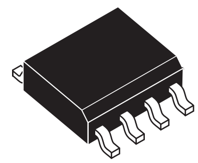
Telecom equipment requiring combined protection against transient overvoltages and rectification by diode bridge:

- Telephone set
- Base station for cordless set
- Fax machine
- Modem
- Caller ID equipment
- Set top box

Description

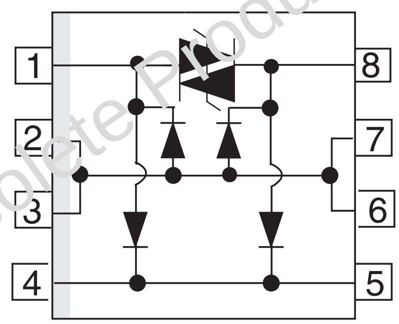
The TSI provides the diode bridge and the crowbar protection function that can be found in most of telecom terminal equipment.

Integrated on a single chip in an SO8 package, this A.S.D.® device allows space saving on the board and greater reliability.



SO-8

Figure 1. Schematic diagram



A.S.D. = Application specific discrete

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TM: Trisil is a trademark of STMicroelectronics.

1 Characteristics

Table 1. Compliant with the following standards

Standard	Peak surge voltage (V)	Voltage waveform (µs)[1]	Required peak current (A)	Current waveform (µs)[1]
ITT K17 - K20	1500	10/700	38	5/310
VDE 0433	2000	10/700	40A[2]	5/310

1. See *Figure 2*.
2. With series resistors or PTC

Table 2. Absolute maximum ratings (T_{amb} = 25 °C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current[1] 10/1000 µs 5/310 µs 2/10 µs		 30 40 75	A
I_{TSM}	Non repetitive surge peak on-state current (F = 50 Hz)	t = 10ms t = 1s	5 3.5	A
Tstg Tj	Storage temperature range Maximum junction temperature range		- 55 to + 150	°C
T_L	Maximum lead temperature for soldering during 10 s		260	°C

1. See *Figure 2*.

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{th(j-a)}$	Junction to ambient	170	°C/W

Figure 2. Pulse waveform

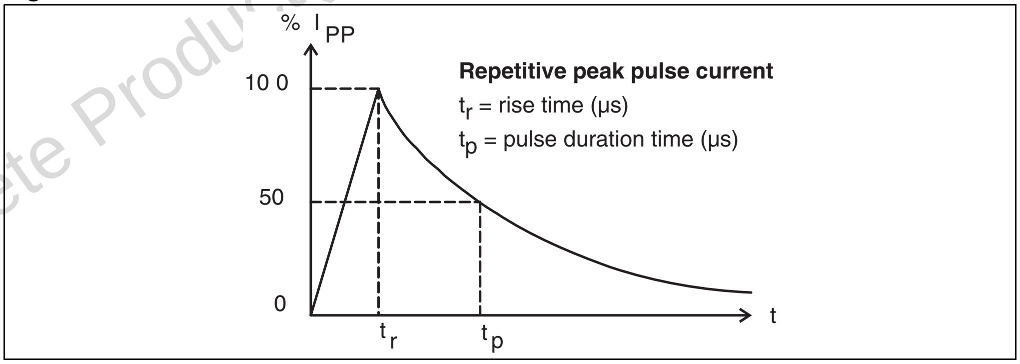


Table 4. Electrical characteristics - definitions (T_{amb} = 25 °C)

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BO}	Breakover voltage
V_{BR}	Breakdown voltage
I_H	Holding current
I_{BO}	Breakover current
I_{RM}	Leakage current at V_{RM}
I_{PP}	Peak pulse current
C	Capacitance
αT	Temperature coefficient

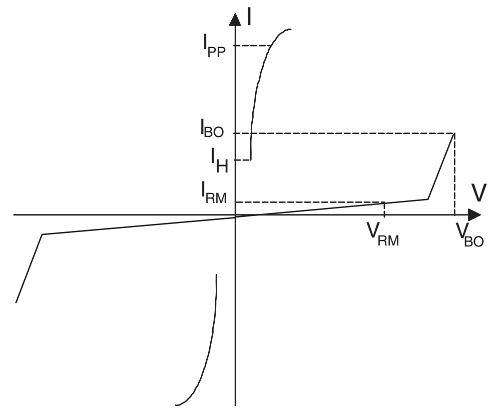


Table 5. Electrical characteristics - values (T_{amb} = 25 °C)

Order code	I_{RM} @ V_{RM} max.		V_{BO}(1) max.	I_H min.	I_{BO}(1) min.	I_{BO}(1) max.	C(2) typ.
	µA	V	V	mA	mA	mA	pF
TSI220B1	1 5	50 220	330	150	50	400	200

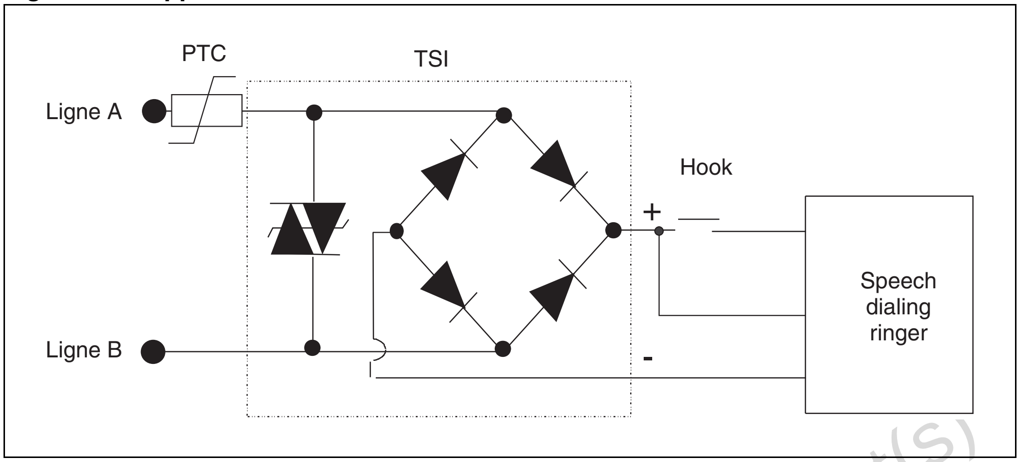
1. Measured at 50 Hz, one cycle
2. V_R = 0 V, F = 1 MHz, between pins 1 and 8

Table 6. Thermal resistances

Symbol	Parameter	Value	Unit
V_F (for one diode)	I_F = 20 mA I_F = 100 mA	0.9 1.1	V

2 Typical application

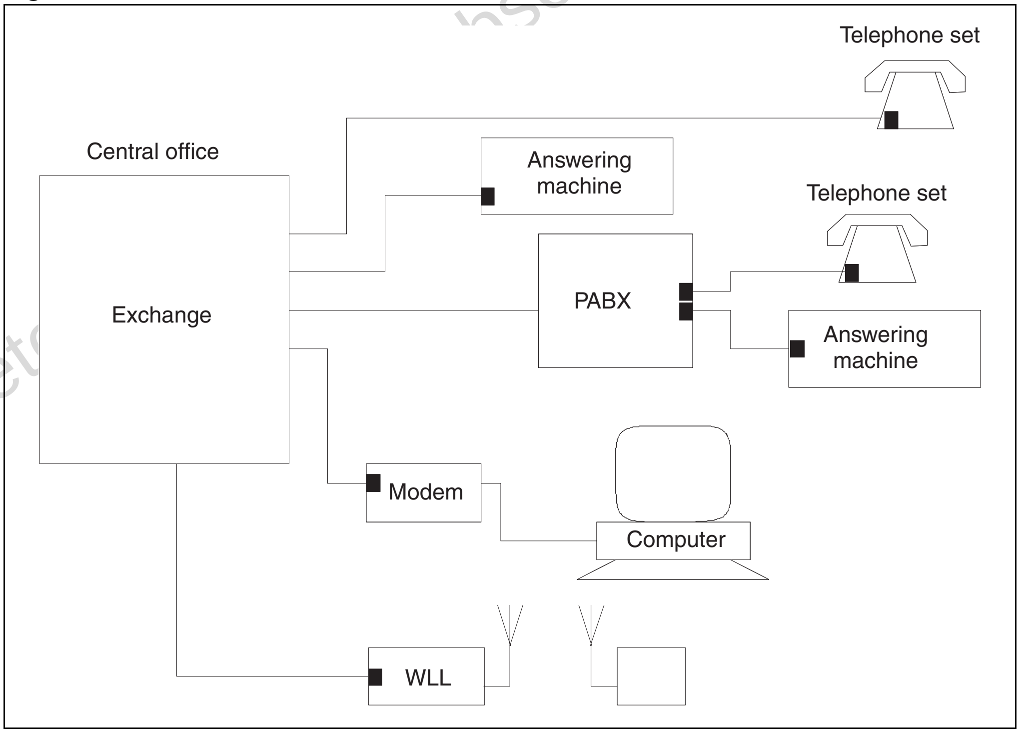
Figure 3. Application schematic



Telecom terminals have a diode bridge for polarity guard located at the line interface stage. They also have above this diode bridge one crowbar protection device that is mandatory to prevent atmospheric effects and AC mains disturbances from damaging the electronic circuitry that follows the diode bridge.

STMicroelectonics proposes a single-chip device that includes both protection and the diode bridge. This is the concept of the TSI devices.

Figure 4. Uses of the TSI in a conventional telecom network



3 Electrical parameters

The V_{RM} value corresponds to the maximum voltage of the application in normal operation. For instance, if the maximum line voltage is ranging between 100 V_{RMS} of ringing plus 48 V of battery voltage, then the protection chosen for this application shall have a V_{RM} close to 200 V.

V_{BO} is the triggering voltage. This indicates the voltage limit for which the component short-circuits. Passing this V_{BO} makes the device turn on.

I_{BO} is the current that makes the device turn on. Indeed, if we want a Trisil to be turned on not only the voltage across it shall pass the V_{BO} value but the current through it shall also pass the I_{BO} value.

In other words, if a voltage surge occurring on the line is higher than the V_{BO} value of a Trisil, but the line surge current is limited to a value that does not exceed the Trisil's I_{BO} value, then the Trisil will never turn into a short-circuit. At this time the surge will be clamped by the Trisil.

The electronic circuitry located after the Trisil will always be protected whatever the Trisil state is (crowbar or clamping mode).

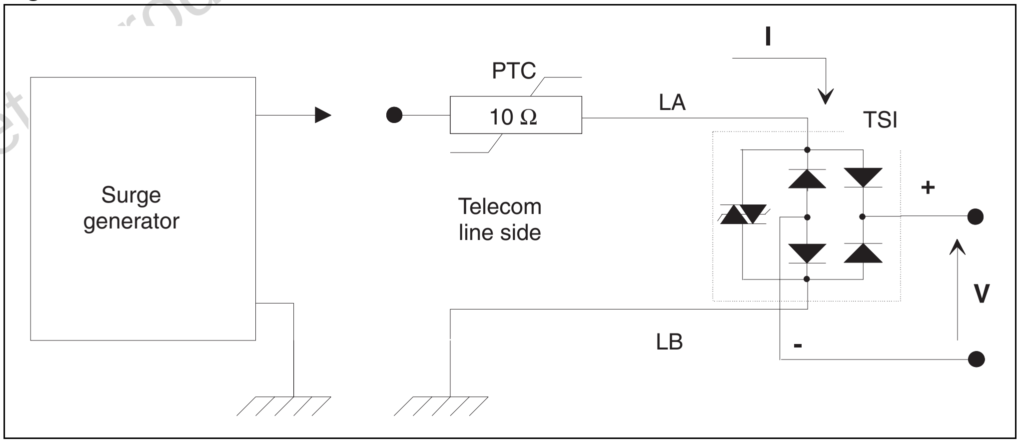
I_H is the holding current. When the Trisil is turned on, as soon as the crossing current surge gets lower than this I_H value, the Trisil protection device turns back in its idle state. For this reason the Trisil's I_H value shall be chosen to be higher than the maximum telecom line current can be.

3.1 TSI behavior with regard to surge standard

The TSI replaces both diode bridge and usual discrete protection on telecom terminals. Furthermore, it complies with the ITT K17 recommendations:

- 10/700 µs waveform surge test ±1.5 kV
- AC power induction test
- AC power contact test

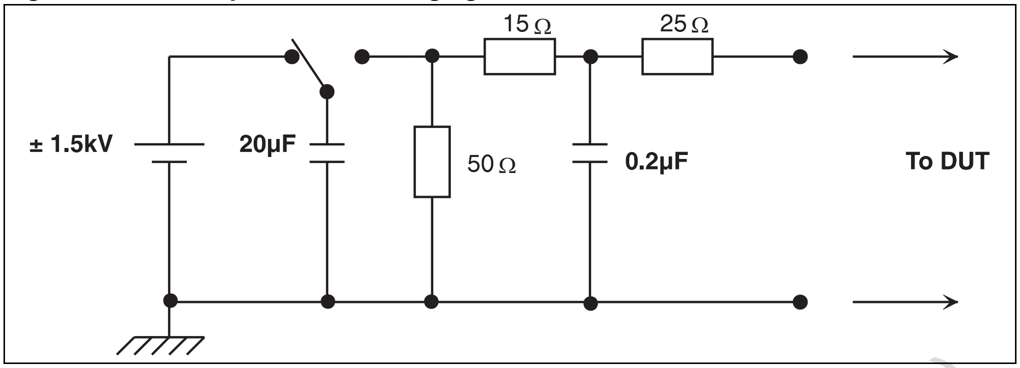
Figure 5. Test circuit for the ITT K17 recommendations



3.1.1 10/700 µs waveform surge - lightning simulation

This test concerns the 10/700 µs waveform surge ±1.5 kV.The surge generator used for the test has the following circuitry (*Figure 6*).

Figure 6. 10/700 µs waveform surge generator circuit



The behaviour of the TSI to this lightning surge is given below (*Figure 7* and *Figure 8*).

Figure 7. Voltage across + and - terminals of TSI and current for 1.5 kV positive surge

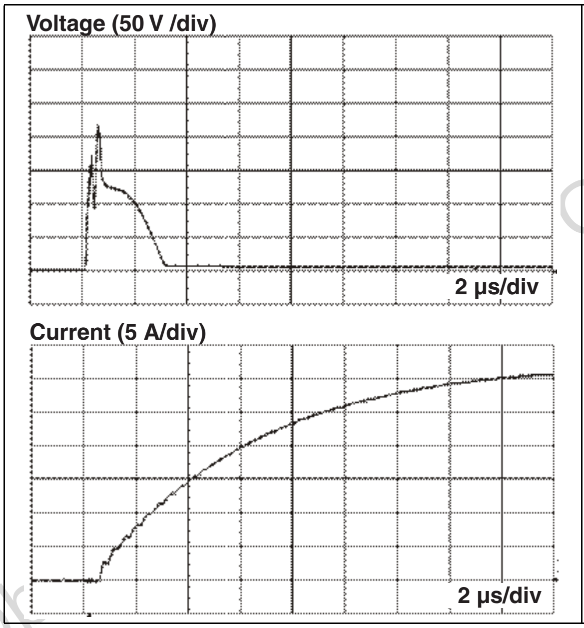
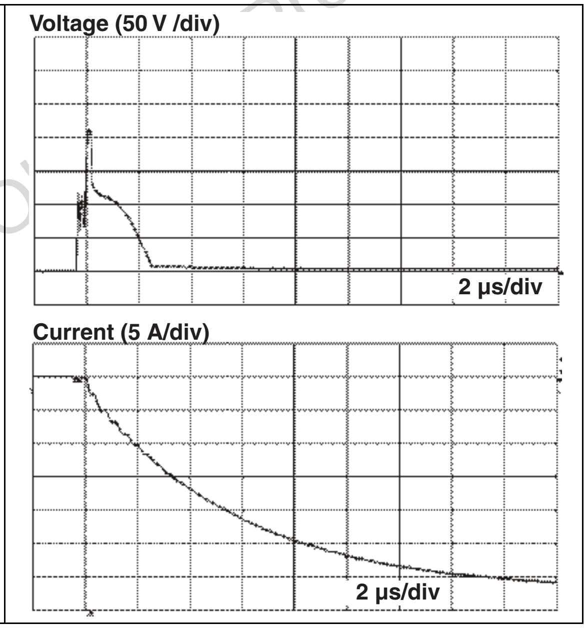


Figure 8. Voltage across + and - terminals of TSI and current for 1.5 kV negative surge



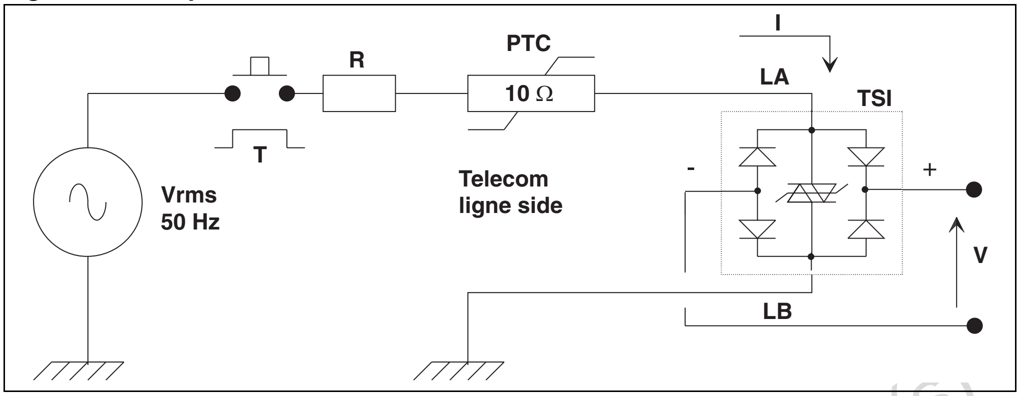
These curves show the peak voltage the surge generates across the TSI + and - terminals. This lasts a short time (2 µs) and after, as the internal protection behaves like a short circuit, the voltage drop across the TS1 becomes a few volts. In the meantime all the surge current flows through the protection device.

As far as the 10/700 µs waveform surge test is concerned,the TSI withstands the ±1.5 kV test.

3.1.2 AC power induction test

This test simulates the induction phenomena that can happen between telecom lines and AC mains lines (*Figure 9*).

Figure 9. AC power induction test circuit



Part 1

Test conditions:

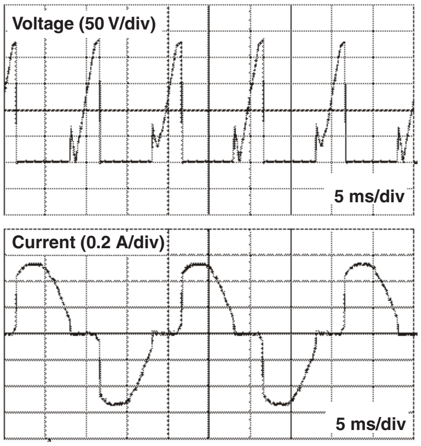
- V_{RMS} = 240 V
- R = 600 Ω
- t = 0.2 s

Part 2

Test condition :

- V_{RMS} = 600 V
- R = 600 Ω
- t = 0.2 s

Figure 10. Voltage across + and - terminals of TSI and current during test part 1



The TSI withstands the AC power induction test in both cases.

3.1.3 AC power contact test

This test simulates the direct contact between the telecom lines and the AC mains lines.

The AC power contact test consists in applying 240 V_{RMS} through a 10 Ω PTC for 15 minutes to the device under test. The ITT K17 recommendation specifies an internal generator impedance allowing 10 A_{RMS} when in short circuit.

The behavior of the TSI with respect to this surge is given in *Figure 11*.

Figure 11. Voltage across + and - terminals of TSI and current during the test

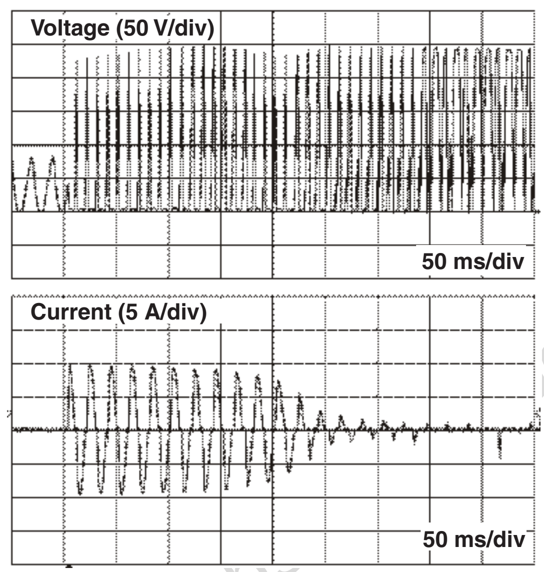
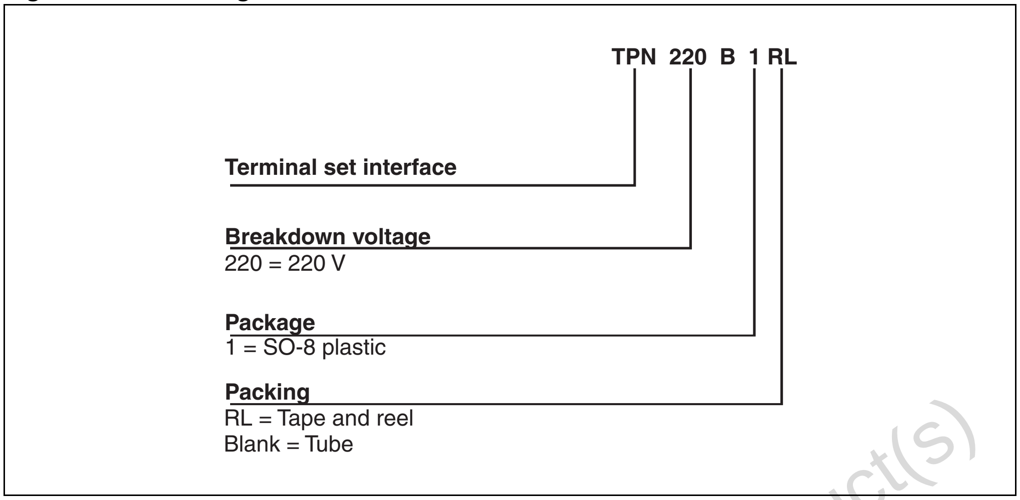


Figure 11 shows that after 250 ms there is no current flowing through the TSI device. This is due to the action of the serial PTC that limits the current through the line. This PTC is mandatory for this test. It can also be replaced by a fuse or any other serial protection that “opens” the line loop under AC contact test.

4 Ordering information scheme

Figure 12. Ordering information scheme

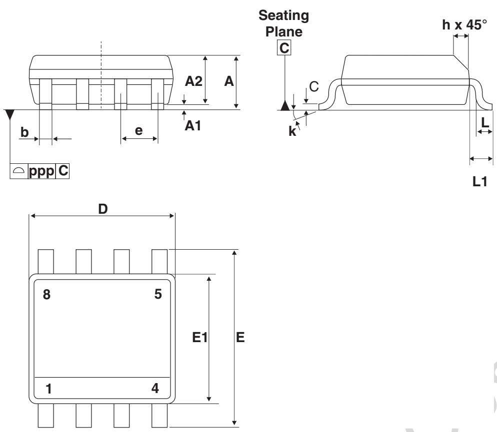


5 Package information

- Epoxy meets UL94, V0
- Lead-free package

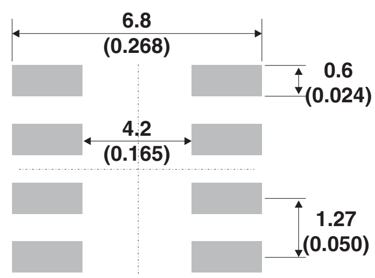
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

Table 7. SO-8 dimensions



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.1		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
C	0.17		0.23	0.007		0.009
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.041	
k	0°		8°	0°		8°
ppp			0.10			0.004

Figure 13. Footprint, dimensions in mm (inches)



6 Ordering information

Table 8. Ordering information

Ordering code	Marking	Package	Weight
TSI220B1	TSI220	SO-8	0.08g

7 Revision history

Table 9. Document revision history

Date	Revision	Changes
Oct-2003	4	Last release
14-Dec-2010	5	Updated trademark statements. Removed order codes that are no longer available.

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