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# THBT15011, THBT20011, THBT27011

## Tripolar overvoltage protection for telecom line

### Features

- bidirectional crowbar protection between TIP and GND, RING and GND and between TIP and RING
- peak pulse current:  
 $I_{PP} = 30 \text{ A}$  for 10/1000  $\mu\text{s}$  surge
- holding current:  $I_H = 150 \text{ mA}$

### Complies with Bellcore standard

- TR-NWT-001089-Core, (second level) with line series resistors:
  - 10/1000  $\mu\text{s}$ , 1000 V
  - 2/10  $\mu\text{s}$ , 2500 V (first level)
  - 2/10  $\mu\text{s}$ , 5000 V

### Description

Dedicated to telecommunication equipment protection, these devices provide a triple bidirectional protection function.

They ensure the same protection capability with the same breakdown voltage both in longitudinal mode and transversal mode.

A particular attention has been given to the internal wire bonding. The "4-point" configuration ensures a reliable protection, eliminating overvoltages introduced by the parasitic inductances of the wiring ( $Ldi/dt$ ), especially for very fast transient overvoltages.

Dynamic characteristics have been defined for several types of surges to meet the SLIC maximum ratings.

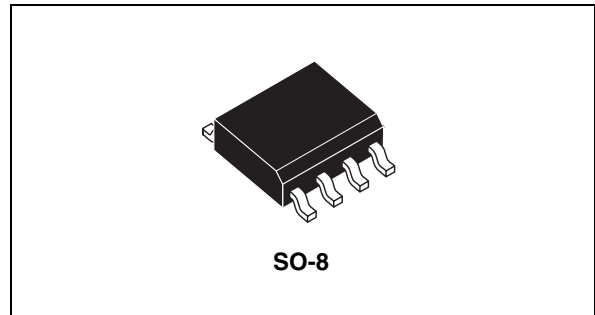
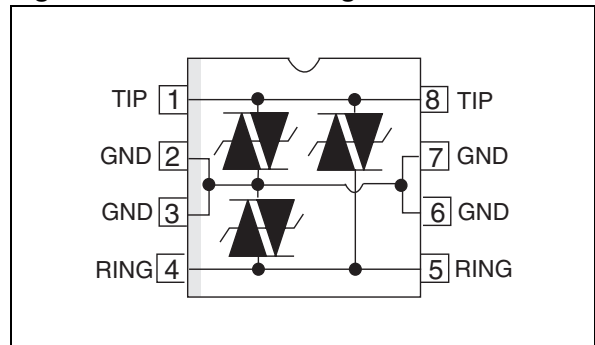


Figure 1. Schematic diagram



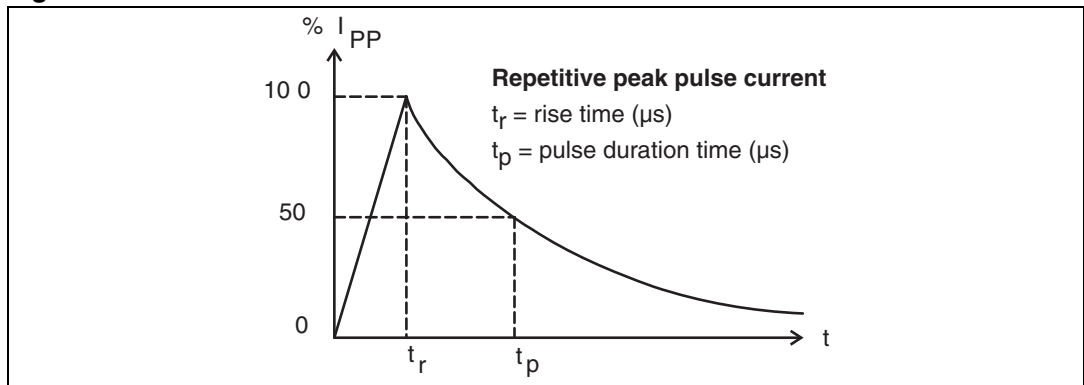
# 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

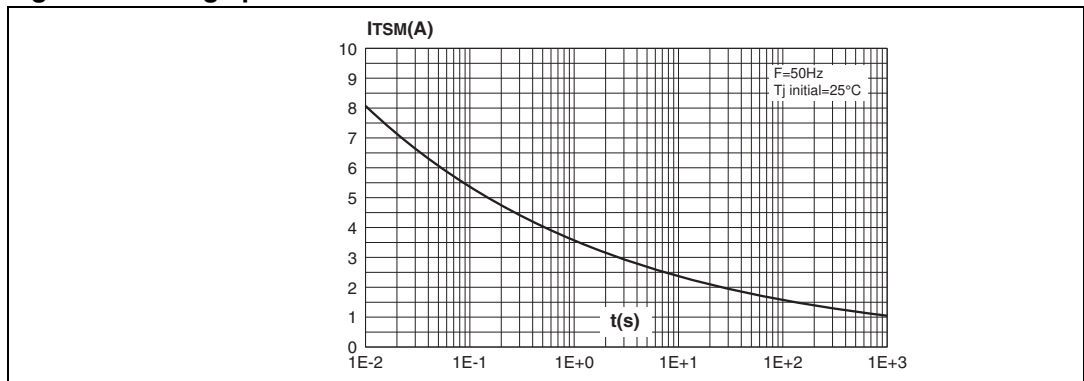
Symbol	Parameter	Value	Unit
$I_{PP}$	Peak pulse current <sup>(1) (2)</sup>	10 / 1000 $\mu\text{s}$	A
$I_{TSM}$	Non repetitive surge peak on-state current ( $F = 50\text{ Hz}$ )	$t_p = 10\text{ ms}$ $t = 1\text{ s}$	8 3.5 A
$T_{stg}$	Storage temperature range	- 40 to + 150	$^{\circ}\text{C}$
$T_j$	Maximum junction temperature	150	$^{\circ}\text{C}$
$T_L$	Maximum lead temperature for soldering during 10s	260	$^{\circ}\text{C}$

- For pulse waveform see [Figure 2](#)
- See [Figure 7: Test circuit 4 for  \$I\_{PP}\$  parameter](#)

**Figure 2. Pulse waveform**



**Figure 3. Surge peak current versus overload duration**



**Table 2. Thermal resistance**

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

**Table 3. Electrical characteristics (T<sub>amb</sub> = 25 °C)**

Symbol	Parameter
V <sub>RM</sub>	Stand-off voltage
I <sub>RM</sub>	Leakage current at stand-off voltage
V <sub>R</sub>	Continuous reverse voltage
V <sub>BR</sub>	Breakdown voltage
V <sub>BO</sub>	Breakover voltage
I <sub>H</sub>	Holding current
I <sub>BO</sub>	Breakover current
V <sub>F</sub>	Forward voltage drop
I <sub>PP</sub>	Peak pulse current
C	Capacitance

**Table 4. Static parameters**

Order code	I <sub>RM</sub> @ V <sub>RM</sub>		I <sub>R</sub> <sup>(1)</sup> @ V <sub>R</sub>		V <sub>BO</sub> <sup>(2)</sup> @ I <sub>BO</sub>			I <sub>H</sub> <sup>(3)</sup>	C <sup>(4)</sup>
	max.		max.		max.	min.	max.	min.	max.
	μA	V	μA	V	V	V	mA	mA	pF
THBT15011D	5	135	50	150	210	50	400	150	80
THBT20011D	5	180	50	200	290	50	400	150	80
THBT27011D	5	240	50	270	380	50	400	150	80

- I<sub>R</sub> measured at V<sub>R</sub> guarantee V<sub>BR</sub> min ≥ V<sub>R</sub>
- Measured at 50 Hz (1 cycle) - See [Figure 4: Test circuit 1 for I<sub>BO</sub> and V<sub>BO</sub> parameters.](#)
- See [Figure 5: Test circuit 2 for dynamic I<sub>H</sub> parameter.](#)
- V<sub>R</sub> = 1 V, F = 1 MHz.

**Table 5. Dynamic breakover voltages (transversal mode)**

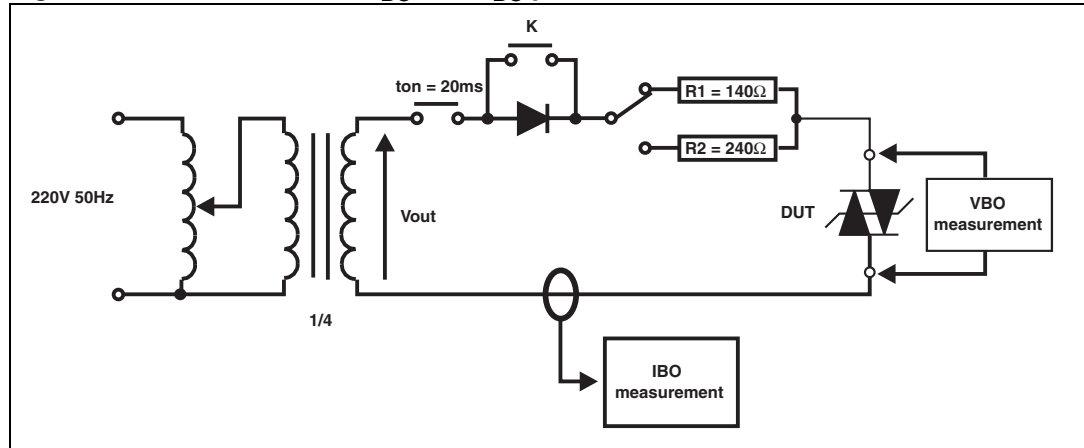
Type	Symbol	Test conditions <sup>(1)</sup>				Max	Unit
THBT15011D	V <sub>BO</sub>	10/700 μs	1.5 kV	R <sub>p</sub> = 10 Ω	I <sub>PP</sub> = 30 A	190	V
		1.2/50 μs	1.5 kV	R <sub>p</sub> = 10 Ω	I <sub>PP</sub> = 30 A	190	
		2/10 μs	2.5 kV	R <sub>p</sub> = 62 Ω	I <sub>PP</sub> = 38 A	200	
THBT20011D	V <sub>BO</sub>	10/700 μs	1.5 kV	R <sub>p</sub> = 10 Ω	I <sub>PP</sub> = 30 A	270	V
		1.2/50 μs	1.5 kV	R <sub>p</sub> = 10 Ω	I <sub>PP</sub> = 30 A	270	
		2/10 μs	2.5 kV	R <sub>p</sub> = 62 Ω	I <sub>PP</sub> = 38 A	280	
THBT27011D	V <sub>BO</sub>	10/700 μs	1.5 kV	R <sub>p</sub> = 10 Ω	I <sub>PP</sub> = 30 A	360	V
		1.2/50 μs	1.5 kV	R <sub>p</sub> = 10 Ω	I <sub>PP</sub> = 30 A	360	
		2/10 μs	2.5 kV	R <sub>p</sub> = 62 Ω	I <sub>PP</sub> = 38 A	400	

- See [Figure 6: Test circuit 3 for V<sub>BO</sub> parameters.](#) R<sub>p</sub> is the protection resistor located on the line card.

## 2 Test circuits

### 2.1 Test procedure for test circuit 1 for $I_{BO}$ and $V_{BO}$ parameters

Figure 4. Test circuit 1 for  $I_{BO}$  and  $V_{BO}$  parameters



Pulse test duration ( $t_p = 20\text{ ms}$ ):

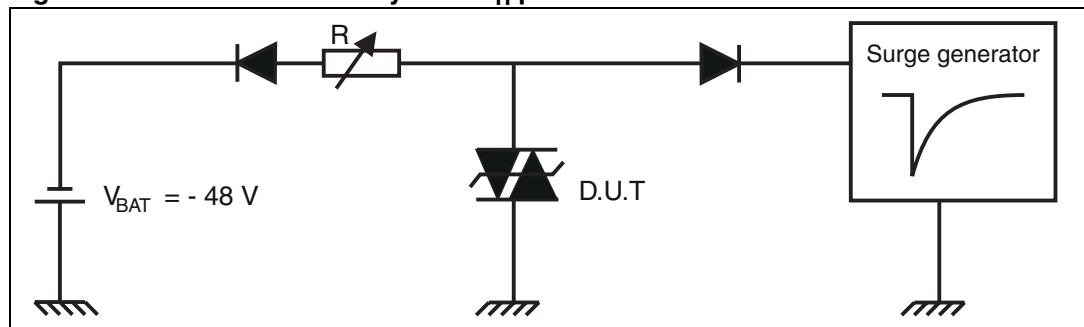
- For bidirectional devices switch K is closed.
- For unidirectional devices switch K is open.

$V_{OUT}$  selection:

- For device with  $V_{BO} < 200\text{ V}$ ,  $V_{OUT} = 250\text{ V}_{RMS}$ ,  $R1 = 140\ \Omega$ .
- For device with  $V_{BO} \geq 200\text{ V}$ ,  $V_{OUT} = 480\text{ V}_{RMS}$ ,  $R2 = 240\ \Omega$ .

### 2.2 Test procedure for test circuit 2 for dynamic $I_H$ parameter

Figure 5. Test circuit 2 for dynamic  $I_H$  parameter



This is a go no-go test, which can confirm the holding current ( $I_H$ ) level.

#### Procedure

1. Adjust the current level at the  $I_H$  value by short circuiting the AK of the D.U.T.
2. Fire the D.U.T. with a surge current  $I_{PP} = 10\text{A}$ ,  $10/1000\mu\text{s}$ .
3. The D.U.T. will come back off-state within 50 ms maximum.

### 2.3 Test circuit 3 for $V_{BO}$ parameters

Figure 6. Test circuit 3 for  $V_{BO}$  parameters

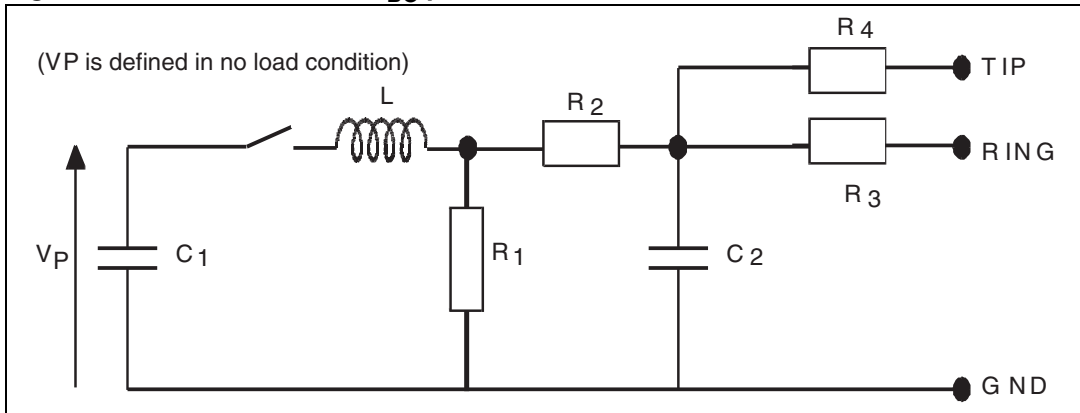
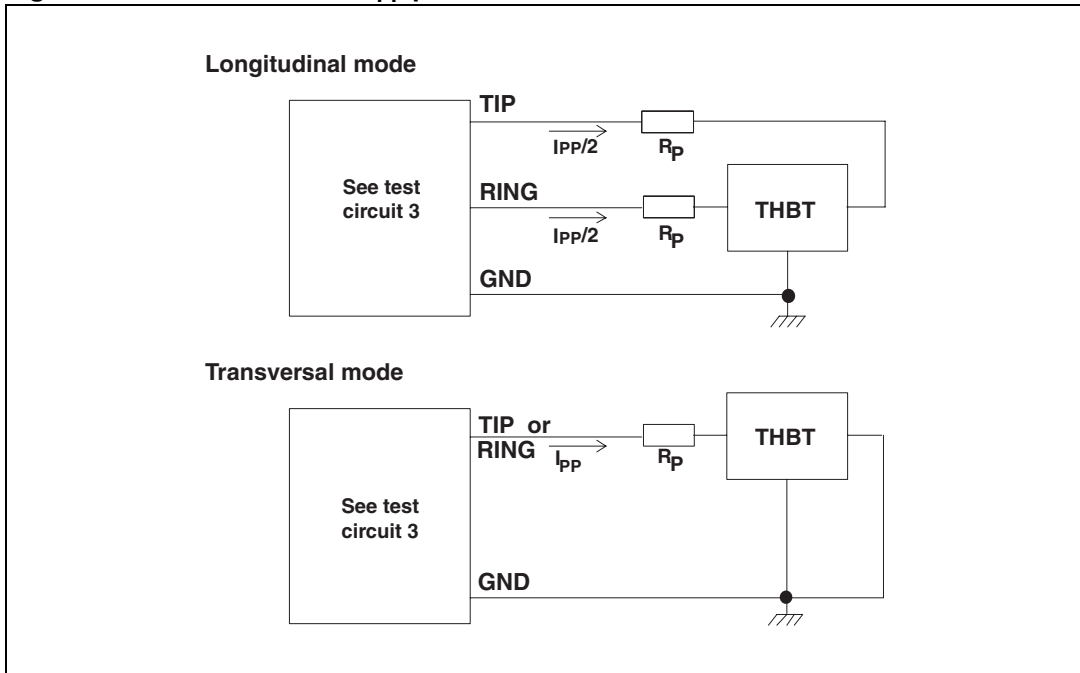


Table 6. Parameters for test circuit 3 for selected pulse characteristics

Pulse ( $\mu s$ )		$V_p$ (V)	$C_1$ ( $\mu F$ )	$C_2$ (nF)	L ( $\mu H$ )	$R_1$ ( $\Omega$ )	$R_2$ ( $\Omega$ )	$R_3$ ( $\Omega$ )	$R_4$ ( $\Omega$ )	$I_{pp}$ (A)	$R_p$ ( $\Omega$ )
$t_r$	$t_p$										
10	700	1500	20	200	0	50	15	25	25	30	10
1.2	50	1500	1	33	0	76	13	25	25	30	10
2	10	2500	10	0	1.1	1.3	0	3	3	38	62

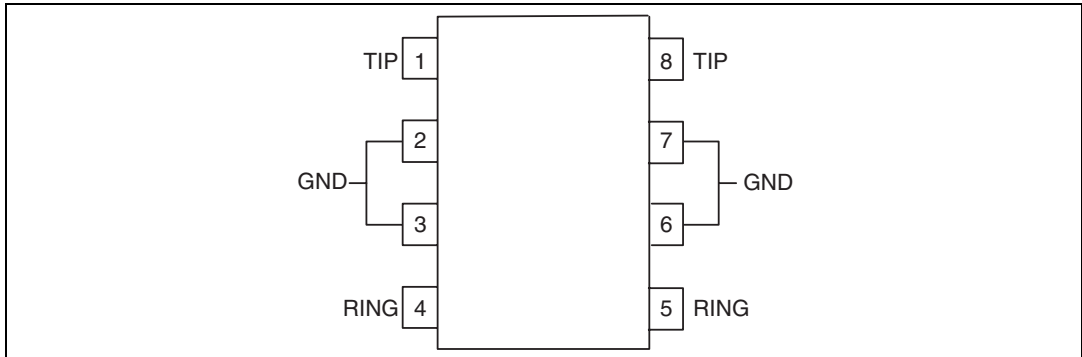
### 2.4 Test circuit 4 for $I_{pp}$ parameter

Figure 7. Test circuit 4 for  $I_{pp}$  parameter



### 3 Application information

Figure 8. Device connections



Connect pins 2, 3, 6 and 7 to ground to guarantee a good surge current capability for long duration disturbances.

To take advantage of the “4-point” structure of the THBT, the TIP and RING lines have to cross the device. In this case, the device will eliminate the overvoltages generated by the parasitic inductances of the wiring ( $Ldi/dt$ ), especially for very fast transients.

### 3.1 Application circuits

Figure 9. Line card protection

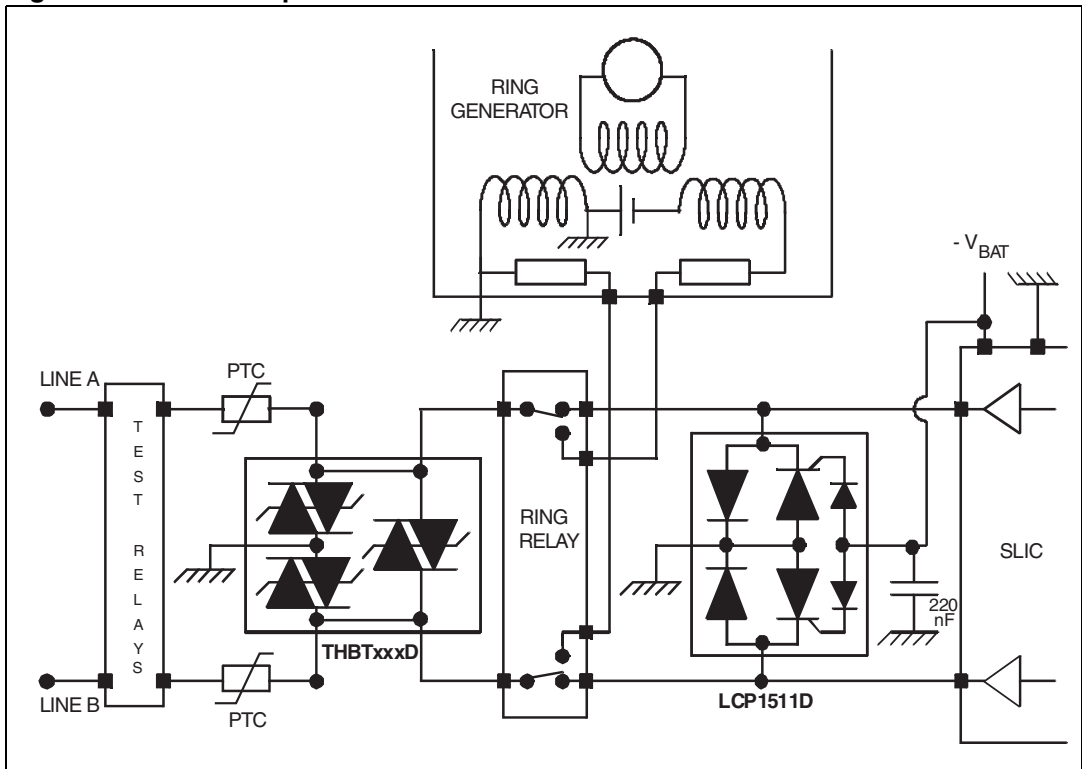
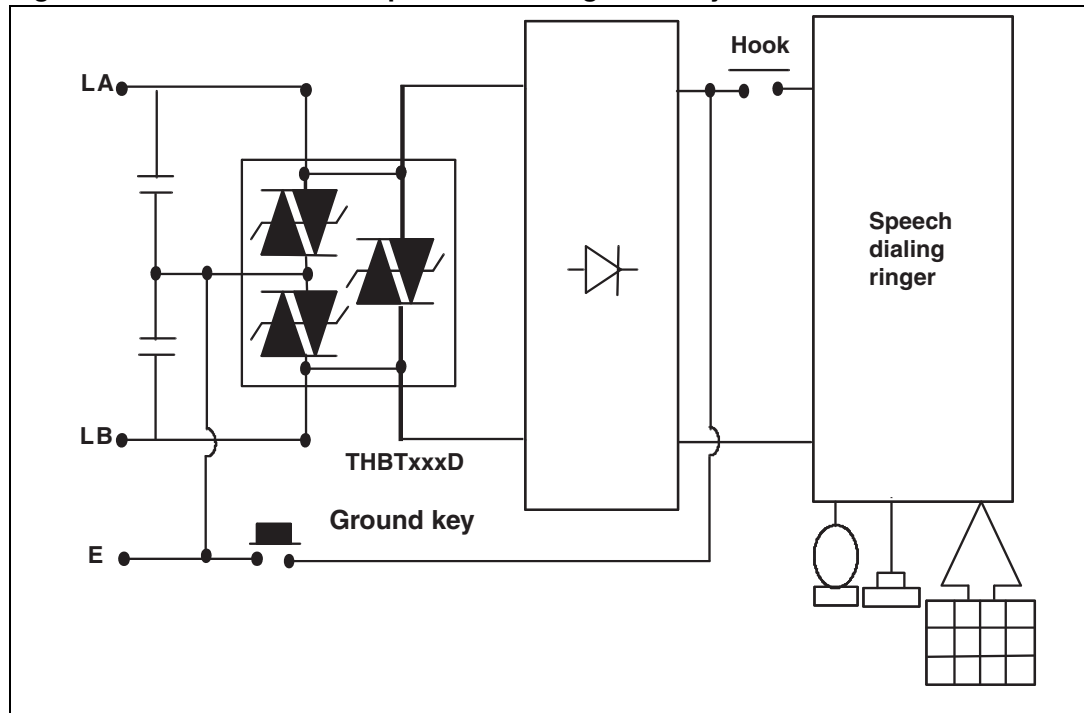


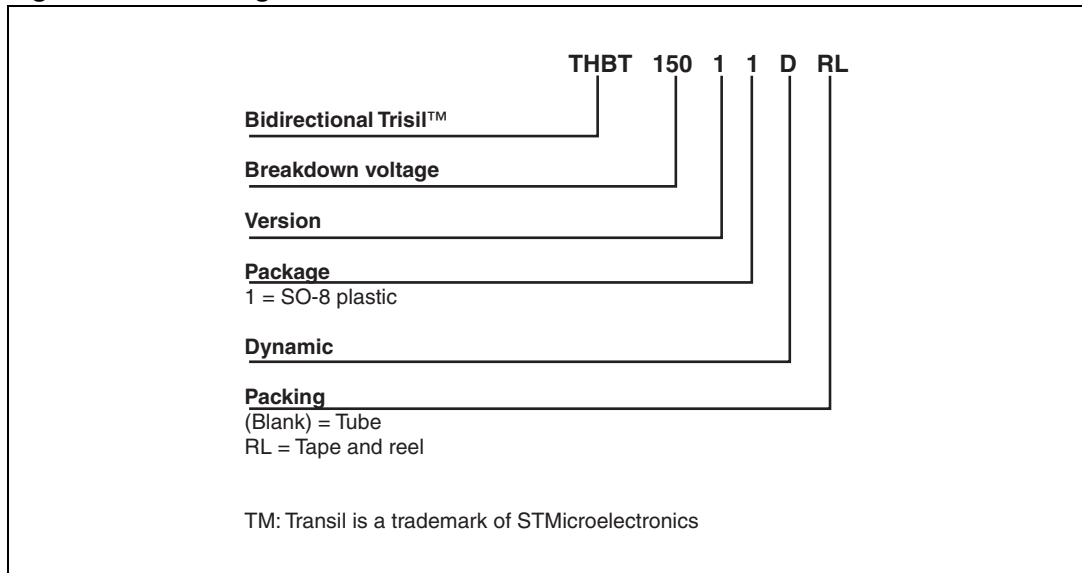
Figure 10. Protection for telephone set with ground key





## 4 Ordering information scheme

Figure 11. Ordering information scheme



## 5 Package information

- Epoxy meets UL94, V0
- Lead-free package

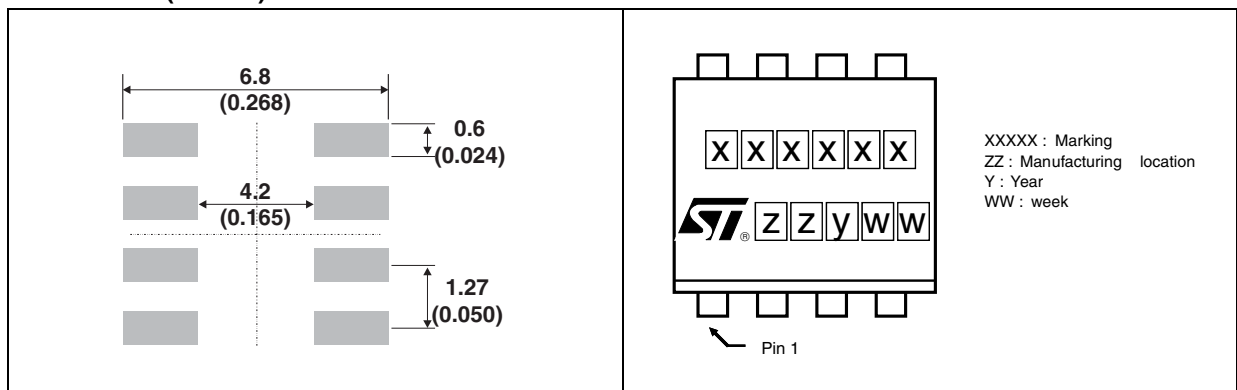
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

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 12. Footprint, dimensions in mm (inches)

Figure 13. Marking



## 6 Ordering information

**Table 8. Ordering information**

Order code	Marking	Package	Weight
THBT15011D	BT151D	SO-8	0.077 g
THBT20011D	BT201D		
THBT27011D	BT271D		

## 7 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
Oct-2003	7A	Previous release
19-Feb-2008	8	Reformatted to current standards. Removed THBT16011D from <a href="#">Table 4</a> and <a href="#">Table 8</a> . Updated <a href="#">Figure 4</a> , <a href="#">Figure 5</a> , and <a href="#">Figure 9</a> . Added ECOPACK paragraph in <a href="#">Section 5</a> . Added <a href="#">Figure 13: Marking</a> .
09-Dec-2010	9	Restructured for conformity with other products in this class. Updated trademark statement for Trisil in <a href="#">Figure 11</a> .

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