

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 A for 10/1000 µs surge
- holding current: I_H = 150 mA

Complies with Bellcore standard

- TR-NWT-001089-Core, (second level) with line series resistors:
 - 10/1000 μs, 1000 V
 - 2/10 μs, 2500 V (first level)
 - 2/10 μs, 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.

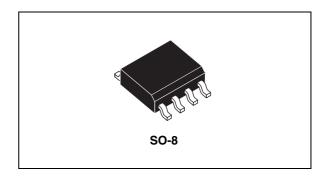
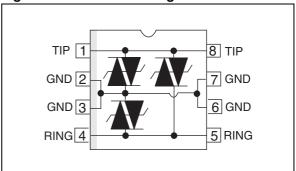


Figure 1. Schematic diagram



1 Characteristics

Table 1. Absolute maximum ratings ($T_{amb} = 25$ °C)

| Symbol | Parameter | Value | Unit | |
|------------------|---|----------------------|------|----|
| I _{PP} | Peak pulse current ^{(1) (2)} | 30 | Α | |
| I _{TSM} | Non repetitive surge peak on-state current (F = 50 Hz) | 8 3.5 | Α | |
| Tstg Tj | Storage temperature range Maximum junction temperature | - 40 to + 150 150 | °C | |
| T _L | Maximum lead temperature for soldering du | ring 10s | 260 | °C |

^{1.} For pulse waveform see Figure 2

Figure 2. Pulse waveform

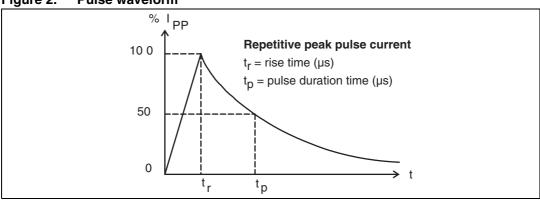


Figure 3. Surge peak current versus overload duration

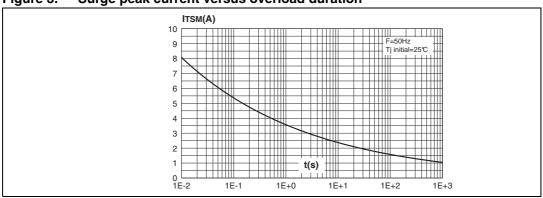


Table 2. Thermal resistance

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

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^{2.} See Figure 7: Test circuit 4 for I_{PP} parameter

Table 3. Electrical characteristics ($T_{amb} = 25 \, ^{\circ}C$)

| Symbol | Parameter |
|-----------------|--------------------------------------|
| V_{RM} | Stand-off voltage |
| I _{RM} | Leakage current at stand-off voltage |
| V _R | Continuos reverse voltage |
| V_{BR} | Breakdown voltage |
| V _{BO} | Breakover voltage |
| I _H | Holding current |
| I _{BO} | Breakover current |
| V _F | Forward voltage drop |
| I _{PP} | Peak pulse current |
| С | Capacitance |

Table 4. Static parameters

| | I _{RM} @ V _{RM} | | I _R ⁽¹⁾ @ V _R | | V _{BO} ⁽²⁾ @ I _{BO} | | | I _H ⁽³⁾ | C ⁽⁴⁾ |
|------------|-----------------------------------|-----|--|-----|--|------|------|-------------------------------|------------------|
| Order code | max. | | max. | | max. | min. | max. | min. | max. |
| | μΑ | V | μΑ | V | V | ٧ | 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 |

- 1. I_R measured at V_R guarantee V_{BR} min $\geq V_R$
- 2. Measured at 50 Hz (1 cycle) See Figure 4: Test circuit 1 for IBO and VBO parameters.
- 3. See Figure 5: Test circuit 2 for dynamic IH parameter.
- 4. $V_R = 1 V$, F = 1 MHz.

 Table 5.
 Dynamic breakover voltages (transversal mode)

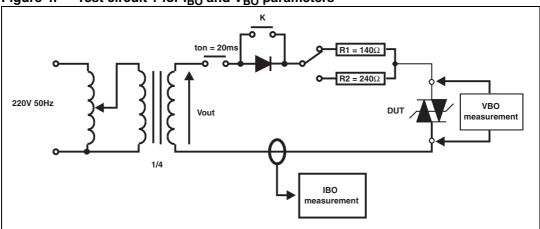
| Туре | Symbol | | Max | Unit | | | |
|------------|----------|-----------|--------|-------------------|-------------------------|-----|---|
| | | 10/700 μs | 1.5 kV | $R_p = 10 \Omega$ | I _{PP} = 30 A | 190 | |
| THBT15011D | V_{BO} | 1.2/50 μs | 1.5 kV | $R_p = 10 \Omega$ | $I_{PP} = 30 \text{ A}$ | 190 | V |
| | | 2/10µs | 2.5 kV | $R_p = 62 \Omega$ | $I_{PP} = 38 \text{ A}$ | 200 | |
| | | 10/700 μs | 1.5 kV | $R_p = 10 \Omega$ | I _{PP} = 30 A | 270 | |
| THBT20011D | V_{BO} | 1.2/50 μs | 1.5 kV | $R_p = 10 \Omega$ | $I_{PP} = 30 \text{ A}$ | 270 | V |
| | | 2/10 μs | 2.5 kV | $R_p = 62 \Omega$ | $I_{PP} = 38 A$ | 280 | |
| | | 10/700 μs | 1.5 kV | $R_p = 10 \Omega$ | I _{PP} = 30 A | 360 | |
| THBT27011D | V_{BO} | 1.2/50 μs | 1.5 kV | $R_p = 10 \Omega$ | $I_{PP} = 30 \text{ A}$ | 360 | V |
| | | 2/10 μs | 2.5 kV | $R_p = 62 \Omega$ | $I_{PP} = 38 A$ | 400 | |

1. See Figure 6: Test circuit 3 for V_{BO} parameters. R_p 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 ($t_p = 20 \text{ ms}$):

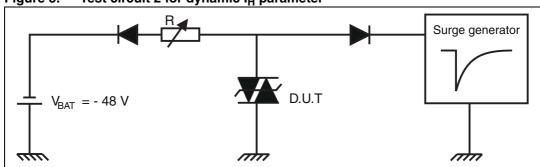
- For bidirectional devices switch K is closed.
- For unidirectional devices switch K is open.

V_{OUT} selection:

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

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 $I_{PP} = 10A$, $10/1000\mu s$.
- 3. The D.U.T. will come back off-state within 50 ms maximum.

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2.3 Test circuit 3 for V_{BO} parameters

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

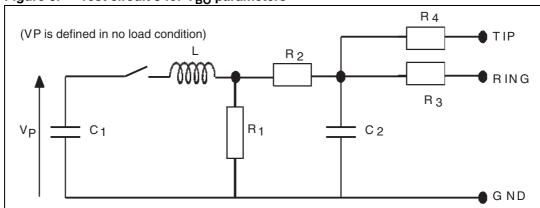
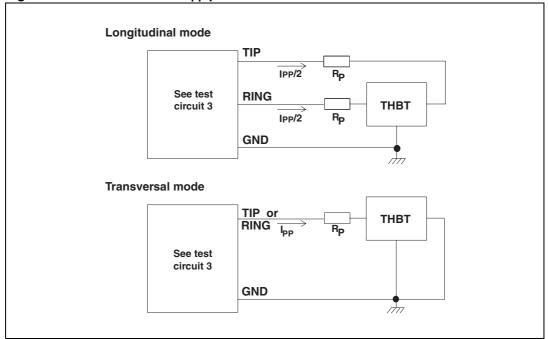


Table 6. Parameters for test crcuit 3 for selected pulse characteristics

| Pulse | e (µs) | V _p | C ₁ | C ₂ | L | R ₁ | R ₂ | R ₃ | R ₄ | I _{PP} | Rp |
|----------------|--------|----------------|----------------|----------------|------|---------------------|---------------------|----------------|----------------|-----------------|---------------------|
| t _r | tp | (V) | (μ F) | (nF) | (μH) | (Ω) | (Ω) | (Ω) | (Ω) | (A) | (Ω) |
| 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 |

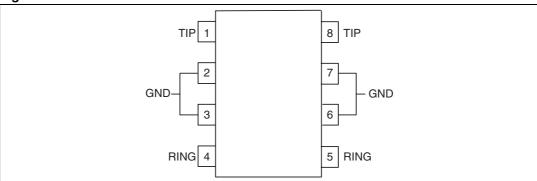
2.4 Test circuit 4 for I_{PP} parameter

Figure 7. Test circuit 4 for I_{PP} parameter



3 Application information

Figure 8. Device connections

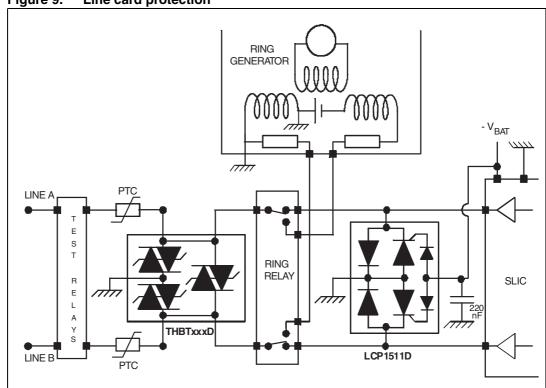


Connect pins 2, 3, 6 and 7 to ground to guarantee a good surge current capability for long duration disturbances.

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



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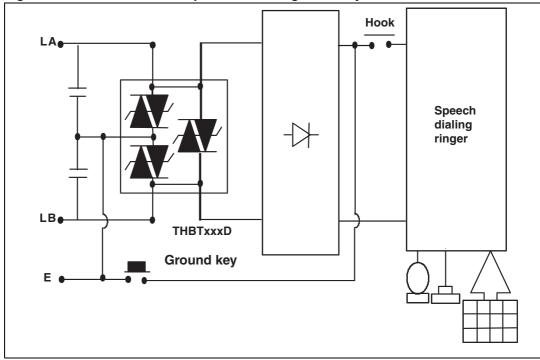
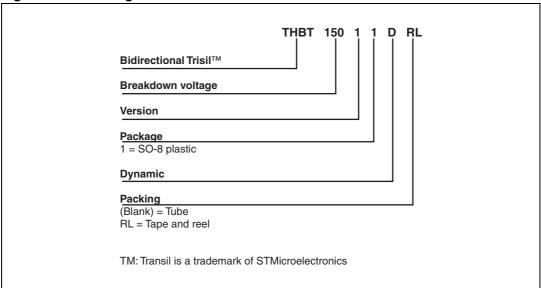


Figure 10. Protection for telephone set with ground key

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. ECOPACK[®] is an ST trademark.

Table 7. SO-8 dimensions

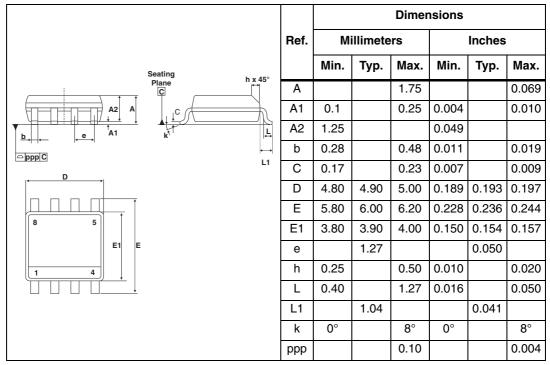
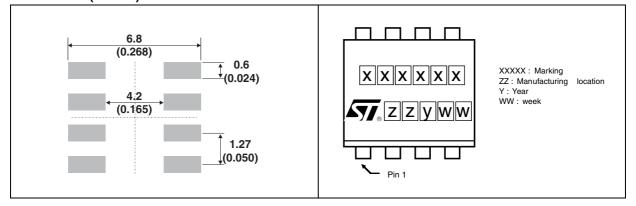


Figure 12. Footprint, dimensions in mm (inches)

Figure 13. Marking



6 Ordering information

 Table 8.
 Ordering information

| Order code Marking | | Package | Weight |
|--------------------|--------|---------|---------|
| THBT15011D | BT151D | | |
| THBT20011D | BT201D | SO-8 | 0.077 g |
| 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 <i>Table 4</i> and <i>Table 8</i> . Updated <i>Figure 4</i> , <i>Figure 5</i> , and <i>Figure 9</i> . Added ECOPACK paragraph in <i>Section 5</i> . Added <i>Figure 13: Marking</i> . |
| 09-Dec-2010 | | Restructured for conformity with other products in this class. Updated trademark statement for Trisil in <i>Figure 11</i> . |

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