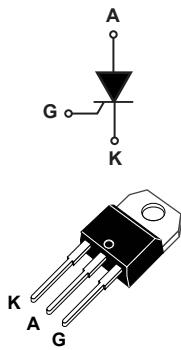


High temperature 50 A SCRs



TO-220AB insulated

Features

- High junction temperature: $T_j = 150 \text{ }^\circ\text{C}$
- High noise immunity $dV/dt = 500\text{V}/\mu\text{s}$ up to $150 \text{ }^\circ\text{C}$
- Gate triggering current $I_{GT} = 15 \text{ mA}$
- Peak off-state voltage $V_{DRM}/V_{RRM} = 600 \text{ V}$
- High turn-on current rise $dl/dt = 100 \text{ A}/\mu\text{s}$
- ECOPACK®2 compliant
- Insulated package TO-220AB:
 - Insulated voltage: 2500 V_{RMS}
 - Complies with UL 1557 (File ref : E81734)

Applications

- Motorbike voltage regulator circuits
- Inrush current limiting circuits
- Motor control circuits and starters
- Solid state relays
- Overvoltage crowbar protection

Description

The **TN5015H-6I** offers high thermal performance operation up to 50 A thanks to its junction temperature T_j up to $150 \text{ }^\circ\text{C}$. Its fully tab insulated (thanks to ceramic inside) TO-220AB package allows a back to back configuration.

Its trade-off noise immunity ($dV/dt = 500 \text{ V}/\mu\text{s}$) versus its gate triggering current ($I_{GT} = 15 \text{ mA}$) and its turn-on current rise ($dl/dt = 100 \text{ A}/\mu\text{s}$) allow to design robust and compact control circuit for voltage regulator in motorbikes and industrial drives, overvoltage crowbar protection, motor control circuits in power tools and kitchen appliances, inrush current limiting circuits.

| Product status | |
|-------------------|---------------|
| TN5015H-6I | |
| Product summary | |
| | |
| Order code | TN5015H-6I |
| Package | TO-220AB Ins. |
| V_{DRM}/V_{RRM} | 600 V |
| I_{GT} | 15 mA |

1 Characteristics

Table 1. Absolute maximum ratings (limiting values), $T_j = 25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | | Value | Unit | |
|-------------------------|---|-------------------------------|---------------------------|------------------------|----|
| $I_{T(\text{RMS})}$ | RMS on-state current (180 ° conduction angle) | $T_c = 75^\circ\text{C}$ | 50 | A | |
| $I_{T(\text{AV})}$ | Average on-state current (180 ° conduction angle) | $T_c = 81^\circ\text{C}$ | 30 | A | |
| | | $T_c = 97^\circ\text{C}$ | 25 | | |
| | | $T_c = 111^\circ\text{C}$ | 20 | | |
| I_{TSM} | Non repetitive surge peak on-state current (T_j initial = 25 °C) | $t_p = 8.3\text{ ms}$ | 493 | A | |
| | | $t_p = 10\text{ ms}$ | 450 | | |
| I_{PP} ⁽¹⁾ | $R_{G-A} = 3\text{ k}\Omega$, 8/20 us current shape, 10 pulses | | 1500 | A | |
| I^2t | I^2t value for fusing | $t_p = 10\text{ ms}$ | 1012 | A^2s | |
| dl/dt | $I_G = 2 \times I_{GT}$, $t_r \leq 100\text{ ns}$ | $f = 60\text{ Hz}$ | 100 | $\text{A}/\mu\text{s}$ | |
| | Critical rate of rise of on-state current | | | | |
| V_{DRM}/V_{RRM} | Repetitive peak off-state voltage | $T_j = 150^\circ\text{C}$ | 600 | V | |
| V_{DSM}/V_{RSM} | Non repetitive surge peak off-state voltage | $t_p = 10\text{ ms}$ | $V_{DRM}/V_{RRM} + 100$ | V | |
| I_{GM} | Peak gate current | $t_p = 20\text{ }\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | 4 | A |
| $P_{G(\text{AV})}$ | Average gate power dissipation | | $T_j = 150^\circ\text{C}$ | 1 | W |
| V_{RGM} | Maximum peak reverse gate voltage | | | 5 | V |
| T_{stg} | Storage junction temperature range | | | -40 to +150 | °C |
| T_j | Maximum operating junction temperature | | | -40 to +150 | °C |
| T_I | Maximum lead temperature soldering during 10 s | | | 260 | °C |
| V_{Ins} | Insulation RMS voltage, 1 minute | | | 2500 | V |

1. According to IEC61000-4-5 standard (See Section 2)

Table 2. Electrical characteristics ($T_j = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Test conditions | | Value | Unit | |
|----------|---|---------------------------|-------|------|------------------------|
| I_{GT} | $V_D = 12\text{ V}$, $R_L = 33\text{ }\Omega$ | Max. | 15 | mA | |
| V_{GT} | | Max. | 1.3 | V | |
| V_{GD} | $V_D = V_{DRM}$, $R_L = 3.3\text{ k}\Omega$ | $T_j = 150^\circ\text{C}$ | Min. | 0.15 | V |
| I_H | $I_T = 500\text{ mA}$, gate open | | Max. | 60 | mA |
| I_L | $I_G = 1.2 \times I_{GT}$ | | Max. | 80 | mA |
| dV/dt | $V_D = 402\text{ V}$, gate open | $T_j = 150^\circ\text{C}$ | Min. | 500 | $\text{V}/\mu\text{s}$ |
| t_{gt} | $I_{TM} = 100\text{ A}$, $V_D = 402\text{ V}$, $I_G = 30\text{ mA}$, $(dl_G/dt)_{\text{max}} = 0.2\text{ A}/\mu\text{s}$ | | Typ. | 1.9 | μs |
| t_q | $I_{TM} = 100\text{ A}$, $V_D = 402\text{ V}$, $(dl_T/dt)_{\text{max}} = 30\text{ A}/\mu\text{s}$, $V_R = 25\text{ V}$, $dV_D/dt = 50\text{ V}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | Typ. | 85 | μs |

Table 3. Static characteristics

| Symbol | Test conditions | | | Value | Unit |
|--------------------|--|---------------------------|------|-------|------------------|
| V_{TM} | $I_{TM} = 100 \text{ A}$, $t_p = 380 \mu\text{s}$ | $T_j = 25^\circ\text{C}$ | Max. | 1.65 | V |
| V_{TO} | Threshold voltage | $T_j = 150^\circ\text{C}$ | Max. | 0.85 | |
| R_D | Dynamic resistance | $T_j = 150^\circ\text{C}$ | Max. | 9 | $\text{m}\Omega$ |
| I_{DRM}, I_{RRM} | $V_D = V_{DRM} = V_{RRM}$ | $T_j = 25^\circ\text{C}$ | Max. | 10 | μA |
| | | $T_j = 150^\circ\text{C}$ | | 6 | mA |

Table 4. Thermal parameters

| Symbol | Parameter | Value | Unit |
|---------------|--------------------------|-------|---------------------------|
| $R_{th(j-c)}$ | Junction to case (DC) | Max. | 1.5 |
| $R_{th(j-a)}$ | Junction to ambient (DC) | Typ. | $^\circ\text{C}/\text{W}$ |

1.1 Characteristics curves

Figure 1. Maximum average power dissipation versus average on-state current

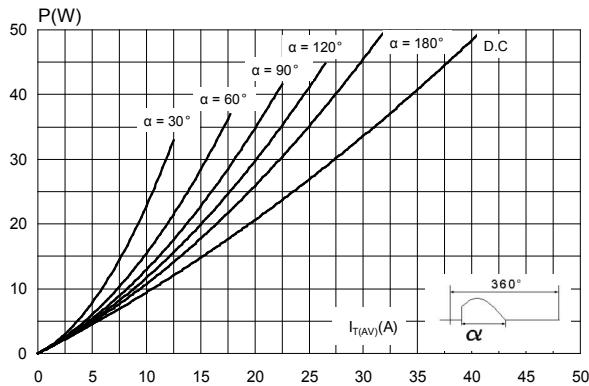


Figure 2. Average and DC on-state current versus case temperature

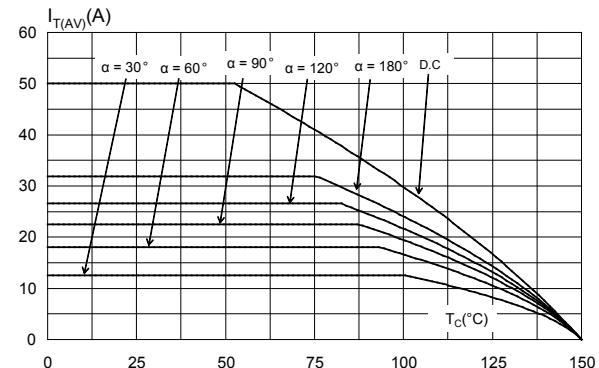


Figure 3. Average and D.C. on state current versus ambient temperature

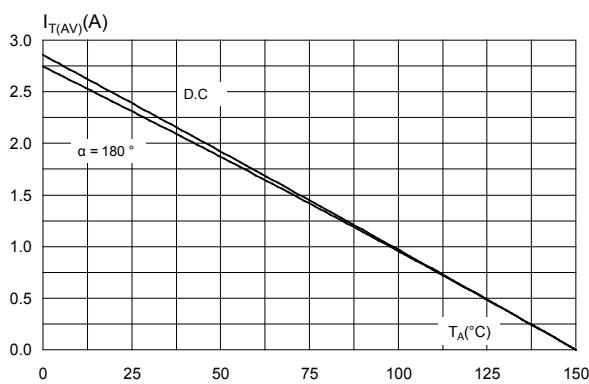


Figure 4. Relative variation of thermal impedance versus pulse duration

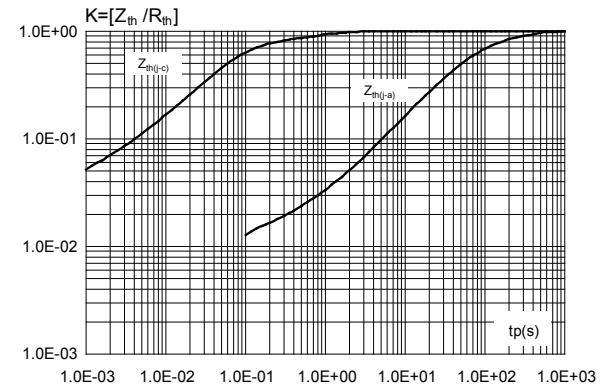


Figure 5. Relative variation of gate trigger current and gate voltage versus junction temperature (typical values)

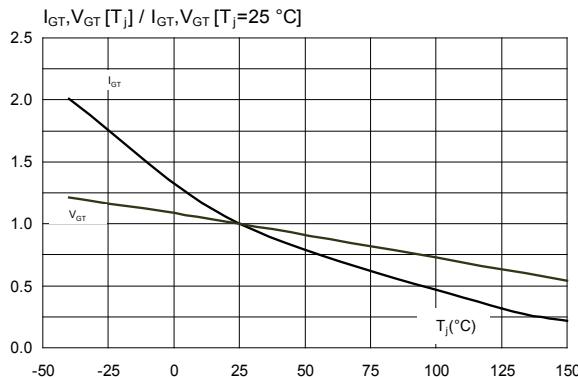


Figure 6. Relative variation of holding and latching current versus junction temperature (typical values)

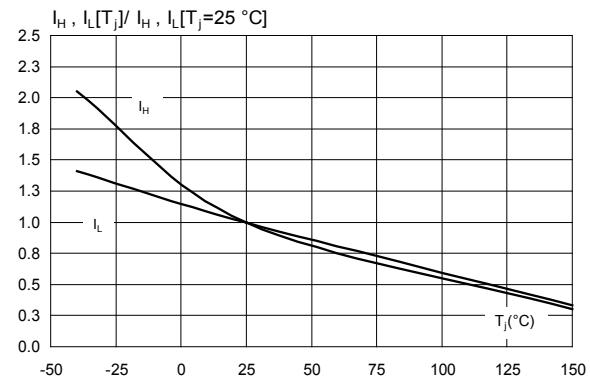


Figure 7. Relative variation of static dV/dt immunity versus junction temperature (typical values)

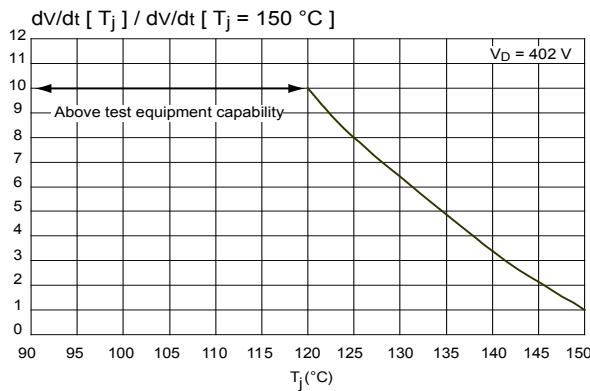


Figure 8. Surge peak on-state current versus number of cycles

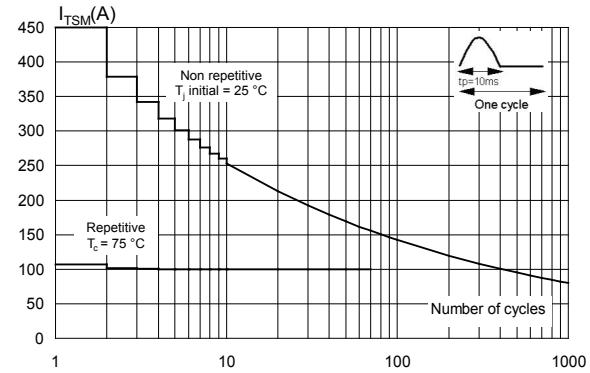


Figure 9. Non repetitive surge peak on-state current for a sinusoidal pulse with width tp < 10 ms

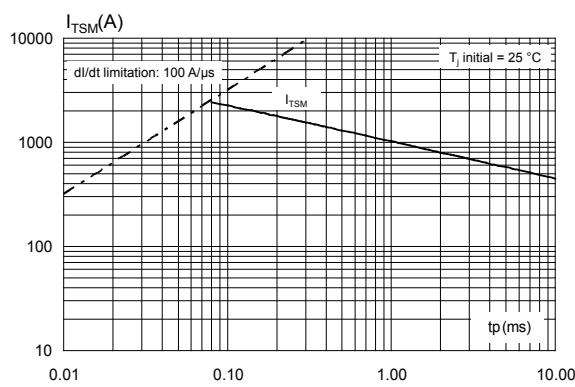


Figure 10. On-state characteristics (maximum values)

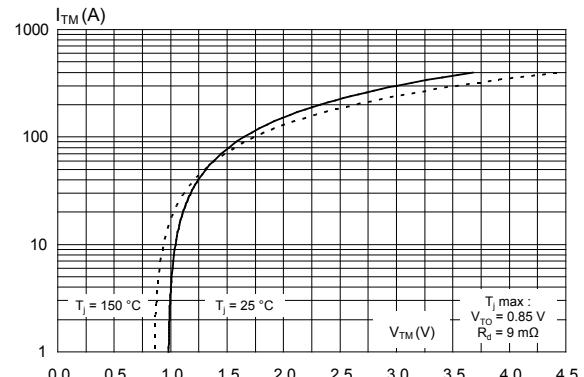
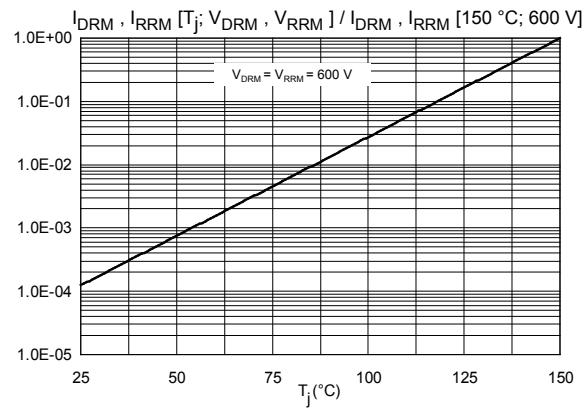


Figure 11. Relative variation of leakage current versus junction temperature

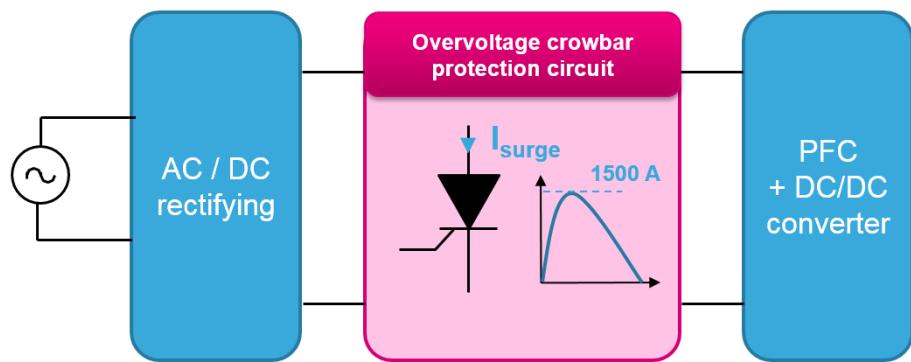


2 Application information

2.1 Overvoltage crowbar protection

An application featuring the strong current robustness of TN5015H-6I is the overvoltage crowbar protection, implemented in AC/DC switch mode power supply. An application global schematic is shown [Figure 12. Global schematic of a crowbar overvoltage protection application](#).

Figure 12. Global schematic of a crowbar overvoltage protection application



In case of overvoltage on line power terminals (example: lightning event), the voltage is rising quickly across the DC/DC module and can reach voltages limitations of devices, leading to possible application failure. The overvoltage crowbar protection answers to this issue by placing the SCR in parallel of the rectifier bridge output, and limiting the induced surge current during electrical over-stress.

The protection principle is to trig the TN5015H-6I when the overvoltage reaches the maximum authorized voltage. At TN5015H-6I turn-on, the electrical overvoltage stress becomes an overcurrent stress, flowing through the TN5015H-6I. No more voltage stress is applied across the down stream converter and the TN5015H-6I absorbs the overcurrent, making the application safe.

Additionally, the AC/DC SMPS efficiency and stand-by losses are not impacted by the protection thanks to the very low leakage current of the TN5015H-6I.

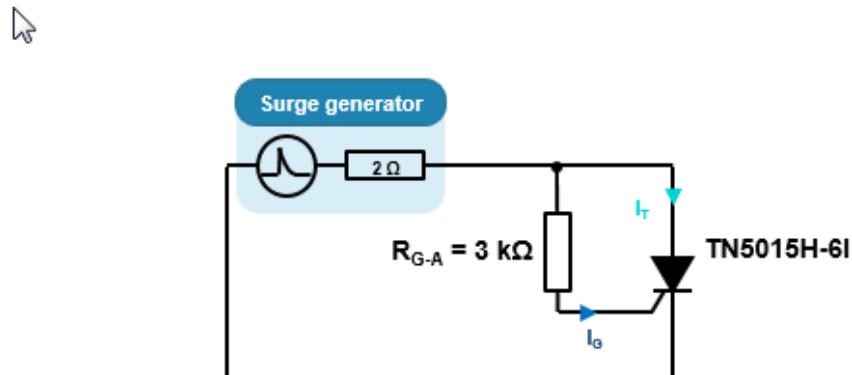
2.2

Peak pulse current robustness

The TN5015H-6I overcurrent capability is guaranteed through a specific parameter called peak pulse current: I_{PP} . This is the maximum current robustness of TN5015H-6I for an 8/20 μ s current waveform, as described in the IEC61000-4-5 standard.

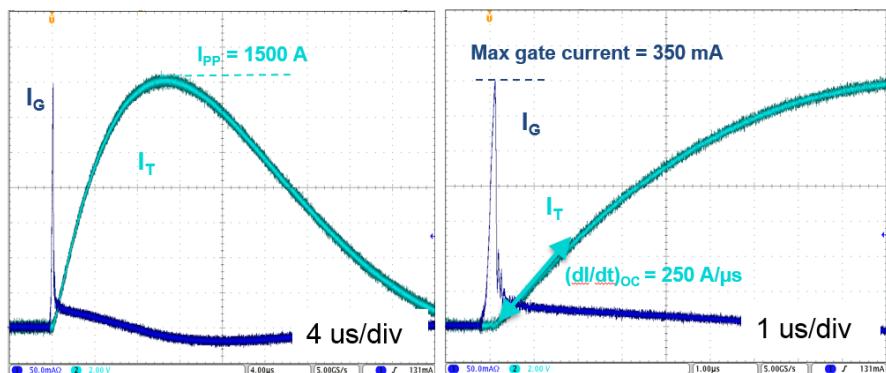
The Figure 13. I_{PP} 8/20 μ s test circuit illustrates the test circuit for the I_{PP} parameter. The overstress is applied 10 times (according to the same standard) with a 1.2/50 μ s overvoltage and 8/20 μ s overcurrent stress generator.

Figure 13. I_{PP} 8/20 μ s test circuit



The Figure 14. I_{PP} 8/20 μ s test waveform (left part) is the 8/20 μ s waveform of current through the TN5015H-6I under test. The maximum gate current in this case is 350 mA (zoom at SCR triggering in the right part) and the maximum non-repetitive rate of current (dl/dt)_{OC} is 250 A/ μ s.

Figure 14. I_{PP} 8/20 μ s test waveform



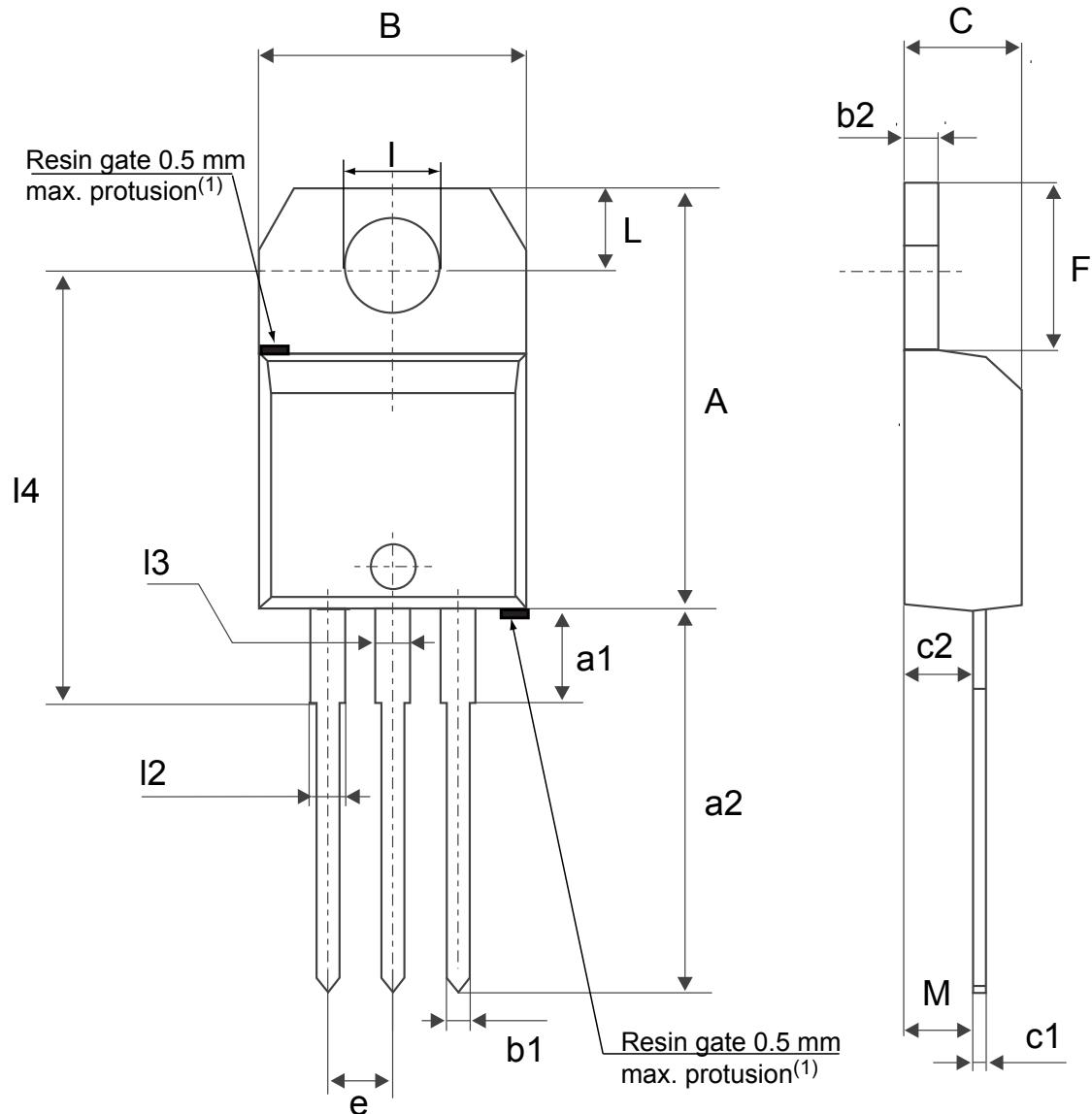
3 Package information

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.

3.1 TO-220AB insulated package information

- Molding compound resin is halogen-free and meets UL standard level V0
- Lead-free package leads finishing
- **ECOPACK®2** compliant

Figure 15. TO-220AB insulated package outline



(1)Resin gate position accepted in one of the two positions or in the symmetrical opposites.

Table 5. TO-220AB insulated package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|-------|-------|-----------------------|--------|--------|
| | Millimeters | | | Inches ⁽¹⁾ | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 15.20 | | 15.90 | 0.5984 | | 0.6260 |
| a1 | | 3.75 | | | 0.1476 | |
| a2 | 13.00 | | 14.00 | 0.5118 | | 0.5512 |
| B | 10.00 | | 10.40 | 0.3937 | | 0.4094 |
| b1 | 0.61 | | 0.88 | 0.0240 | | 0.0346 |
| b2 | 1.23 | | 1.32 | 0.0484 | | 0.0520 |
| C | 4.40 | | 4.60 | 0.1732 | | 0.1811 |
| c1 | 0.49 | | 0.70 | 0.0193 | | 0.0276 |
| c2 | 2.40 | | 2.72 | 0.0945 | | 0.1071 |
| e | 2.40 | | 2.70 | 0.0945 | | 0.1063 |
| F | 6.20 | | 6.60 | 0.2441 | | 0.2598 |
| I | 3.73 | | 3.88 | 0.1469 | | 0.1528 |
| L | 2.65 | | 2.95 | 0.1043 | | 0.1161 |
| I2 | 1.14 | | 1.70 | 0.0449 | | 0.0669 |
| I3 | 1.14 | | 1.70 | 0.0449 | | 0.0669 |
| I4 | 15.80 | 16.40 | 16.80 | 0.6220 | 0.6457 | 0.6614 |
| M | | 2.6 | | | 0.1024 | |

1. Inch dimensions are for reference only.

4 Ordering information

Figure 16. Ordering information scheme

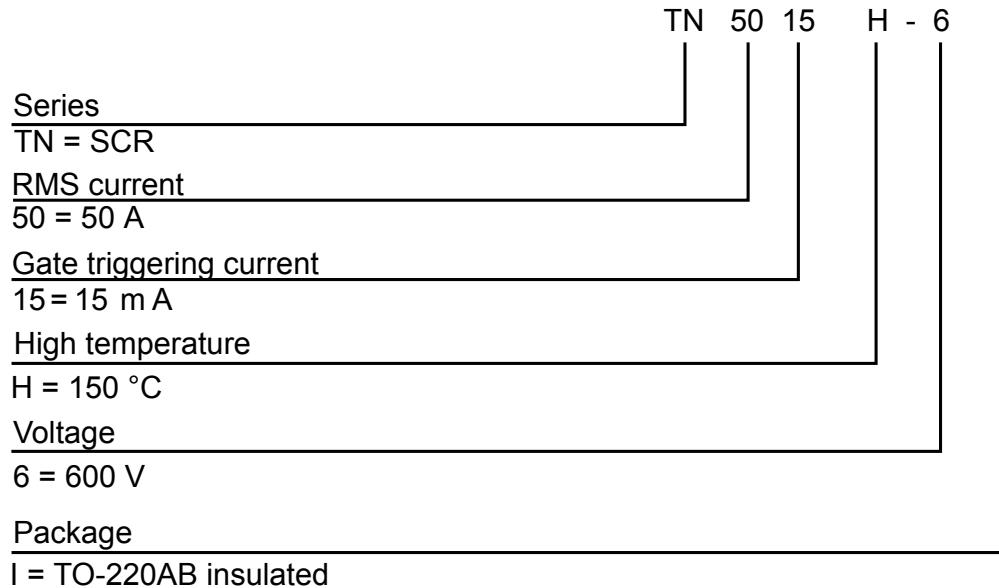


Table 6. Ordering information

| Order code | Marking | Package | Weight | Base qty. | Delivery mode |
|------------|-----------|---------------|--------|-----------|---------------|
| TN5015H-6I | TN5015H6I | TO-220AB ins. | 2.3 g | 50 | Tube |

Revision history

Table 7. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 02-Jun-2017 | 1 | Initial release. |
| 01-Dec-2017 | 2 | Inserted Section 6: "Application information" and updated Table 2: "Absolute maximum ratings (limiting values), $T_j = 25^\circ\text{C}$ unless otherwise specified" |
| 08-Oct-2018 | 3 | Updated Section Cover image . |

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