

BT138E-800E



FOUR-QUADRANTS TRIAC

VOLTAGE: 800 Volts

CURRENT: 12 Ampers

Package: TO-251

FEATURES

- Highly di/dt For High Reliability
- Low Thermal Resistance Increases Carrying Capacity
- High Commutation Capability
- Packages Are RoHS (2011/65/EU) Compliant

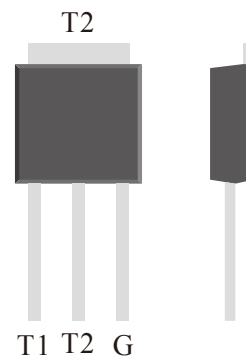
TYPICAL APPLICATIONS

- Phase Control Operation Of Light Dimmers And Motor Speed Controllers
- ON/OFF Control Operation Of Heating Regulation And Induction Motor

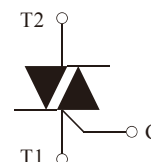
PRODUCT SUMMARY

| Gear                            | E   | Unit |
|---------------------------------|-----|------|
| $I_{GT(I-II-III)} \text{ Max.}$ | 10  | mA   |
| $I_{GTIV} \text{ Max.}$         | 25  |      |
| $V_{DRM}/V_{RRM} \text{ Min.}$  | 800 | V    |
| $I_{T(RMS)}$                    | 12  | A    |

Diagram:



Polarity:



Absolute Maximum Ratings (Ta=25°C Unless otherwise specified)

| Parameter                                  | Test Conditions                                                         | Symbol       | Ratings | Unit             |
|--------------------------------------------|-------------------------------------------------------------------------|--------------|---------|------------------|
| Repetitive Peak Off-State Voltage          |                                                                         | $V_{DRM}$    | 800     | V                |
| Repetitive Peak Reverse Voltage            |                                                                         | $V_{RRM}$    | 800     | V                |
| RMS On-State Current                       | $T_c \leq 70^\circ\text{C}$                                             | $I_{T(RMS)}$ | 12      | A                |
| Non Repetitive Surge Peak On-State Current | F= 50 Hz, $T_p = 20 \text{ ms}$                                         | $I_{TSM}$    | 95      | A                |
|                                            | F= 50 Hz, $T_p = 16.6 \text{ ms}$                                       |              | 104     |                  |
| $I^2T$ Value For Fusing                    | $T_p = 10 \text{ ms}$                                                   | $I^2t$       | 51      | A                |
| Critical Rate Of Rise Of On-State Current  | IG=2*IGT, $t_r \leq 100\text{ns}$<br>F=100Hz, $T_j = 125^\circ\text{C}$ | $di/dt$      | 80      | A/ $\mu\text{s}$ |
|                                            |                                                                         |              | 50      |                  |
| Peak Gate Current                          | $T_p = 20\mu\text{s}, T_j = 125^\circ\text{C}$                          | $I_{GM}$     | 4       | A                |
| Average Gate Power Dissipation             | $T_j = 125^\circ\text{C}$                                               | $P_{G(AV)}$  | 0.5     | W                |
| Peak Gate Power Dissipation                |                                                                         | $P_{GM}$     | 10      | W                |

Thermal Characteristics (Ta=25°C Unless otherwise specified)

| Parameter                                                   | Test Conditions                                        | Symbol          | Typ.       | Unit               |
|-------------------------------------------------------------|--------------------------------------------------------|-----------------|------------|--------------------|
| Operating Junction Temperature Range                        |                                                        | $T_j$           | -40 to 125 | $^\circ\text{C}$   |
| Storage Temperature Range                                   |                                                        | $T_{STD}$       | -40 to 150 |                    |
| Thermal Resistance Junction To Ambient<br>With Steady-State | Still Air Environment<br>With $T_a = 25^\circ\text{C}$ | $R_{\theta JA}$ | 100        | $^\circ\text{C/W}$ |
| Thermal Resistance Junction-Case<br>With Steady-State       | Device Mounted On<br>75mm x 45mm x 2.5mm Alu. Heat.    | $R_{\theta JC}$ | 3.0        |                    |

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**FOUR-QUADRANTS TRIAC**
**Electrical Characteristics (Ta=25°C Unless otherwise specified )**

| Parameter                  | Test Conditions                                      | Symbol   | Quadrant          | Value |          | Unit |
|----------------------------|------------------------------------------------------|----------|-------------------|-------|----------|------|
|                            |                                                      |          |                   | Gear  | E        |      |
| Gate Trigger Current       | $V_D=12V, R_L=33\Omega$                              | $I_{GT}$ | I - II -III<br>IV | Max.  | 10<br>25 | mA   |
| Max. Gate Trigger Voltage  | $V_D=12V, R_L=33\Omega$                              | $V_{GT}$ | ALL               | Max.  | 1        | V    |
| Min. Gate Trigger Voltage  | $V_D=V_{DRM}, T_j=125^\circ C, R_L=3.3K\Omega$       | $V_{GD}$ | ALL               | Min.  | 0.2      | V    |
| Holding Current            | $I_T=500\text{ mA}$                                  | $I_H$    |                   | Max.  | 25       | mA   |
| Latching Current           | $I_G=1.2 \cdot I_{GT}$                               | $I_L$    | I -III-IV<br>II   | Max.  | 25<br>35 | mA   |
| Rise Of Off- State Voltage | $V_D=2/3 V_{DRM}, T_j=125^\circ C, \text{Gate Open}$ | $dv/dt$  |                   | Min.  | 150      | V/us |

**Static Characteristics (Ta=25°C Unless otherwise specified )**

| Parameter                                | Test Conditions   | Symbol    | $T_j$ | Value |     | Unit |
|------------------------------------------|-------------------|-----------|-------|-------|-----|------|
| Peak On-State Voltage                    | $I_T=15\text{ A}$ | $V_{TM}$  | 25°C  | Max.  | 1.6 | V    |
| Threshold Voltage                        |                   | $V_{TO}$  | 125°C | Max.  | 0.8 | V    |
| Dynamic resistance                       |                   | $R_D$     | 125°C | Max.  | 41  | mΩ   |
| Peak Repetitive Forward Blocking Current | $V_D=V_{DRM}$     | $I_{DRM}$ | 25°C  | Max.  | 5   | uA   |
|                                          | $V_D=V_{DRM}$     |           | 125°C |       | 0.5 | mA   |
| Peak Repetitive Reverse Blocking Current | $V_R=V_{RRM}$     | $I_{RRM}$ | 25°C  | Max.  | 5   | uA   |
|                                          | $V_R=V_{RRM}$     |           | 125°C |       | 0.5 | mA   |

**Model and identification instructions**

|                                                                        |     |   |   |     |   |
|------------------------------------------------------------------------|-----|---|---|-----|---|
| BT                                                                     | 138 | E | - | 800 | E |
| Product Type<br>BT=TRIAC                                               |     |   |   |     |   |
| Insulation Spec.:<br>A=Ins.=Insulation<br>Empty=No Ins.=No Insulation  |     |   |   |     |   |
| $I_{T(RMS)}$ Spec.:<br>138=12A                                         |     |   |   |     |   |
| Package Spec.:<br>E=TO-251                                             |     |   |   |     |   |
| "-"=Connection Symbol<br>Constant And Unchanging                       |     |   |   |     |   |
| $V_{DRM}/V_{RRM}$ Spec.:<br>800≅800V                                   |     |   |   |     |   |
| $I_{GT}$ Spec.:<br>E:IGT I - II -III ≅ 10mA;IGT IV ≅ 25mA              |     |   |   |     |   |
| Temperature Spec.:<br>Empty=Standard Temperature<br>H=high temperature |     |   |   |     |   |

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### Typical Characteristics Curves

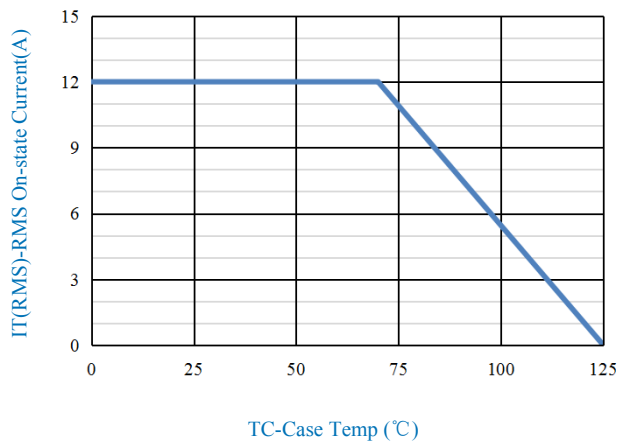


Fig.1-RMS on-state current vs. case temperature

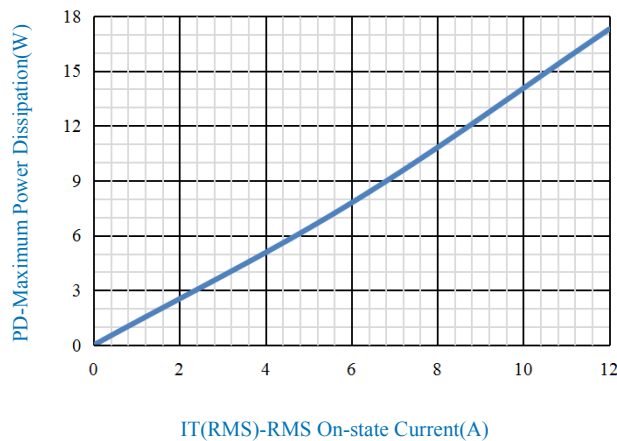


Fig.2- Maximum Power Dissipation Vs. on-state current

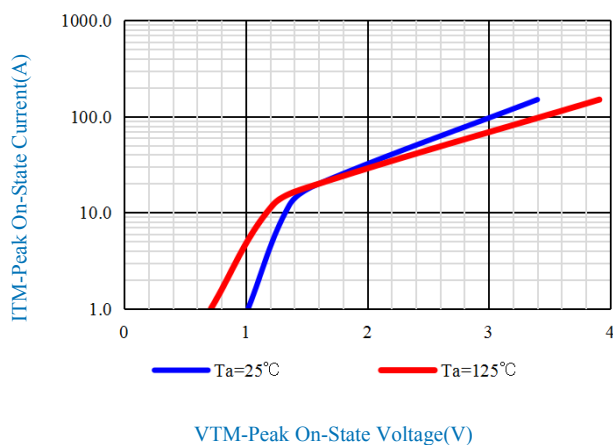


Fig.3-On-State Characteristics

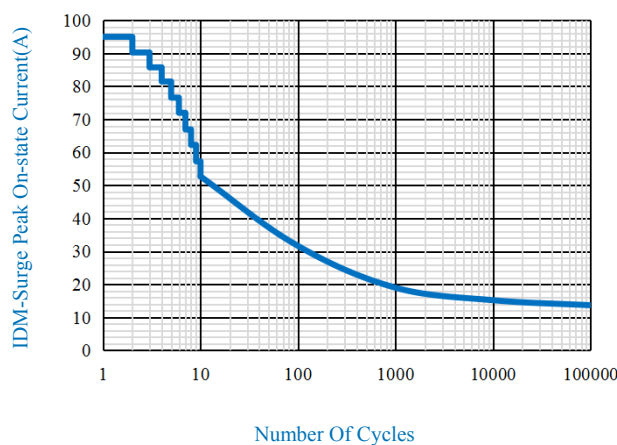


Fig.4- Surge Peak On-state Current Vs. Number Cycles

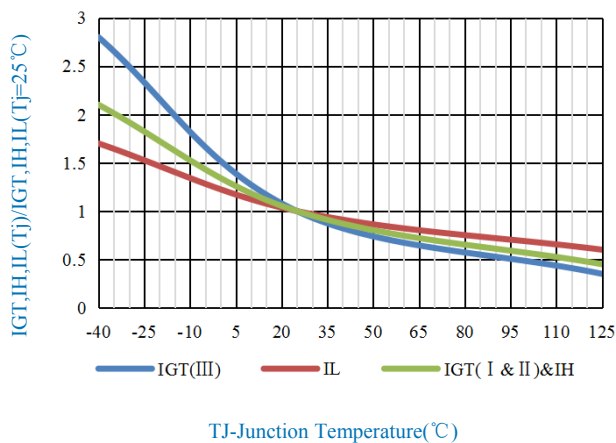


Fig.5- Relative Variation Of Gate Trigger Current , Holding Current And Latching Current Versus Junction Temperature (Typical Value)

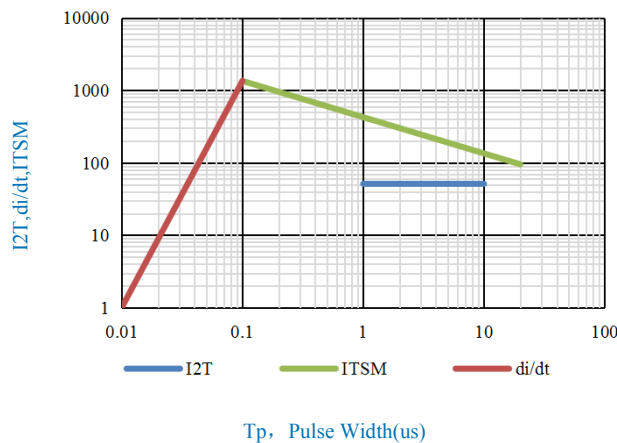


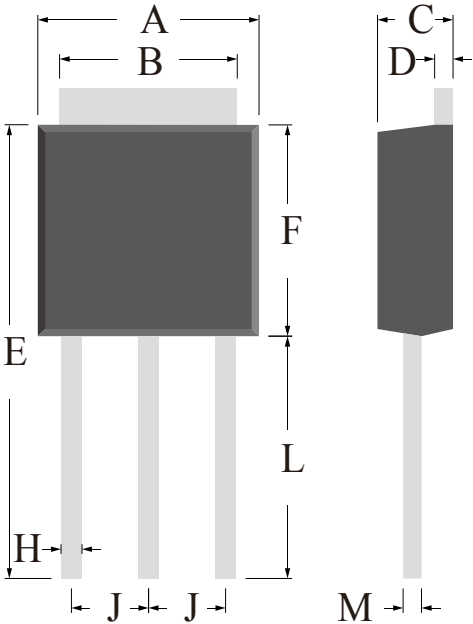
Fig.6- Non-repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 20\text{ms}$ , and corresponding value of  $I_2t$  ( $di/dt < 50\text{A}/\mu\text{s}$ )

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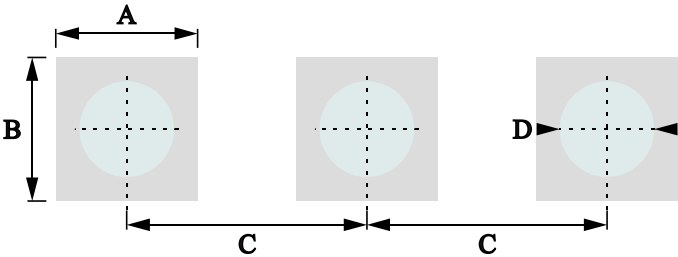
OUTLINE DRAWINGS



TO-251

| OUTLINE DIMENSIONS |            |      |       |        |      |        |
|--------------------|------------|------|-------|--------|------|--------|
| Dim.               | Milimeters |      |       | Inches |      |        |
|                    | Min.       | Typ. | Max.  | Min.   | Typ. | Max.   |
| A                  | 6.10       | -    | 7.10  | 0.2402 | -    | 0.2795 |
| B                  | 4.80       | -    | 5.80  | 0.1890 | -    | 0.2283 |
| C                  | 1.95       | -    | 2.55  | 0.0768 | -    | 0.1004 |
| D                  | 0.35       | -    | 0.75  | 0.0138 | -    | 0.0295 |
| E                  | 13.50      | -    | 15.00 | 0.5315 | -    | 0.5906 |
| F                  | 5.60       | -    | 6.60  | 0.2205 | -    | 0.2598 |
| H                  | 0.40       | -    | 0.85  | 0.0157 | -    | 0.0335 |
| J                  | 2.10       | -    | 2.50  | 0.0827 | -    | 0.0984 |
| L                  | 6.00       | -    | 8.00  | 0.2362 | -    | 0.3150 |
| M                  | 0.35       | -    | 0.75  | 0.0138 | -    | 0.0295 |

RECOMMEDND LAYOUT DRAWINGS



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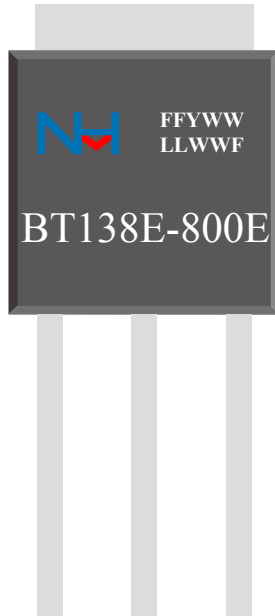
| OUTLINE DIMENSIONS |            |      |      |        |        |      |
|--------------------|------------|------|------|--------|--------|------|
| Dim.               | Milimeters |      |      | Inches |        |      |
|                    | Min.       | Typ. | Max. | Min.   | Typ.   | Max. |
| A                  | -          | 1.60 | -    | -      | 0.0630 | -    |
| B                  | -          | 1.60 | -    | -      | 0.0630 | -    |
| C                  | -          | 2.30 | -    | -      | 0.0906 | -    |
| D                  | -          | 0.90 | -    | -      | 0.0354 | -    |

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#### MARKING INFORMATION



#### MARKING INSTRUCTIONS

NH=Niuhan Trademark  
FF=Product Line Code,According To Actual Changes  
YWW=Date Code,According To Actual Changes  
LLWWF=Inernal Code,According To Actual Changes  
BT138E-800E=Model

#### PACKING INFORMATION

| Package Type | Package Code | Product Weight Approx(g/Pcs) | Package Method | Quantity (Pcs/Min. Pack.) | Quantity (Pcs/Inner Box) | Quantity (Pcs/Carton) |
|--------------|--------------|------------------------------|----------------|---------------------------|--------------------------|-----------------------|
| TO-251       | P1           | 0.361                        | Tube           | 50                        | 4000                     | 20000                 |

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# FOUR-QUADRANTS TRIAC

## Recommended wave soldering condition

| Product         | Peak Temperature | Soldering Time  |
|-----------------|------------------|-----------------|
| Pb-free devices | 260 +0/-5 °C     | 5 +1/-1 seconds |

## Recommended temperature profile for IR reflow

|  | Profile feature                                                                                                                          | Sn-Pb eutectic Assembly          | Pb-free Assembly                 |
|--|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|
|  | Average ramp-up rate (T <sub>smax</sub> to T <sub>p</sub> )                                                                              | 3°C/second max.                  | 3°C/second max.                  |
|  | Preheat-Temperature Min (T <sub>S</sub> min)<br>-Temperature Max (T <sub>S</sub> max)<br>-Time(t <sub>s</sub> min to t <sub>s</sub> max) | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
|  | Time maintained above:<br>-Temperature (T <sub>L</sub> )<br>- Time (t <sub>L</sub> )                                                     | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
|  | Peak Temperature(T <sub>P</sub> )                                                                                                        | 240 +0/-5 °C                     | 260 +0/-5 °C                     |
|  | Time within 5°C of actual peak temperature (t <sub>p</sub> )                                                                             | 10-30 seconds                    | 20-40 seconds                    |
|  | Ramp down rate                                                                                                                           | 6°C/second max.                  | 6°C/second max.                  |
|  | Time 25 °C to peak temperature                                                                                                           | 6 minutes max.                   | 8 minutes max.                   |

Note : All temperatures refer to topside of the package, measured on the package body surface.

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Specification Revision History

| Rev.        | Date       | Changed Items | Pre-Changed Content | Changed Content |
|-------------|------------|---------------|---------------------|-----------------|
| A/1         | 2014-10-20 | First Issue   |                     |                 |
| Blank Below |            |               |                     |                 |