

# High Efficiency Thyristor

$$V_{RRM} = 1200\text{ V}$$

$$I_{TAV} = 30\text{ A}$$

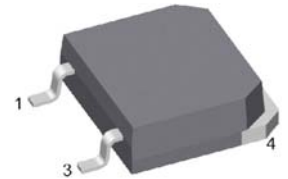
$$V_T = 1,25\text{ V}$$

Three Quadrants operation: QI - QIII  
 1~ Triac

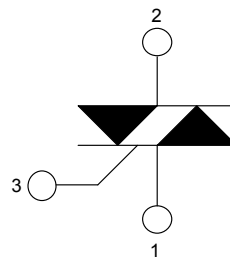
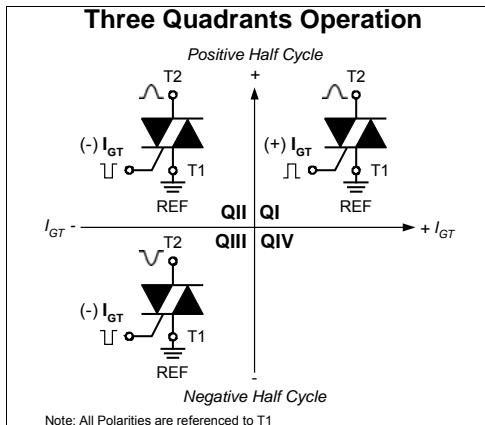
Part number

**CLA60MT1200NTZ**

Marking on Product: CLA60MT1200NTZ



Backside: anode/cathode



### Features / Advantages:

- Triac for line frequency
- Three Quadrants Operation
  - QI - QIII
- Planar passivated chip
- Long-term stability of blocking currents and voltages

### Applications:

- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

### Package: TO-268AA (D3Pak-HV)

- Industry standard outline
- RoHS compliant
- Epoxy meets UL 94V-0
- High creepage distance between terminals

### Disclaimer Notice

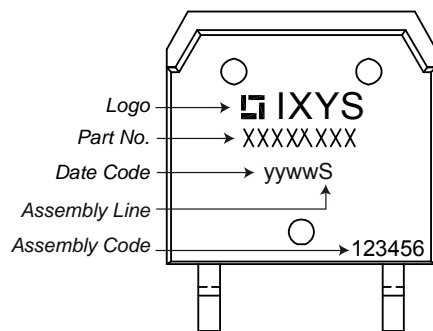
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| Rectifier      |  |   | Ratings                  |      |          |                  |
|----------------|--|---|--------------------------|------|----------|------------------|
| Symbol         | Definition   | Conditions  | min.                     | typ. | max.     | Unit             |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$  |                          |      | 1300     | V                |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$  |                          |      | 1200     | V                |
| $I_{RD}$       | reverse current, drain current                       | $V_{RD} = 1200 V$   | $T_{VJ} = 25^{\circ}C$   |      | 10       | $\mu A$          |
|                |  | $V_{RD} = 1200 V$   | $T_{VJ} = 125^{\circ}C$  |      | 2        | mA               |
| $V_T$          | forward voltage drop                                 | $I_T = 30 A$  | $T_{VJ} = 25^{\circ}C$   |      | 1,28     | V                |
|                |  | $I_T = 60 A$  |                          |      | 1,56     | V                |
|                |  | $I_T = 30 A$  | $T_{VJ} = 125^{\circ}C$  |      | 1,25     | V                |
|                |  | $I_T = 60 A$  |                          |      | 1,61     | V                |
| $I_{TAV}$      | average forward current                              | $T_C = 120^{\circ}C$  | $T_{VJ} = 150^{\circ}C$  |      | 30       | A                |
| $I_{RMS}$      | RMS forward current per phase                        | 180° sine   |                          |      | 66       | A                |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only                                   | $T_{VJ} = 150^{\circ}C$  |      | 0,86     | V                |
| $r_T$          | slope resistance                                     |   |                          |      | 12,5     | m $\Omega$       |
| $R_{thJC}$     | thermal resistance junction to case                  |   |                          |      | 0,55     | K/W              |
| $R_{thCH}$     | thermal resistance case to heatsink                  |   |                          | 0,15 |          | K/W              |
| $P_{tot}$      | total power dissipation                              |   | $T_C = 25^{\circ}C$      |      | 230      | W                |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                  | $T_{VJ} = 45^{\circ}C$   |      | 380      | A                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                 | $V_R = 0 V$              |      | 410      | A                |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                  | $T_{VJ} = 150^{\circ}C$  |      | 325      | A                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                 | $V_R = 0 V$              |      | 350      | A                |
| $I^2t$         | value for fusing                                     | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                  | $T_{VJ} = 45^{\circ}C$   |      | 720      | A <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                 | $V_R = 0 V$              |      | 700      | A <sup>2</sup> s |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                  | $T_{VJ} = 150^{\circ}C$  |      | 530      | A <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                 | $V_R = 0 V$              |      | 510      | A <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400 V \quad f = 1 \text{ MHz}$                               | $T_{VJ} = 25^{\circ}C$   |      | 25       | pF               |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30 \mu s$  | $T_C = 150^{\circ}C$     |      | 10       | W                |
|                |  | $t_p = 300 \mu s$   |                          |      | 5        | W                |
| $P_{GAV}$      | average gate power dissipation                       |   |                          |      | 0,5      | W                |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 150^{\circ}C; f = 50 \text{ Hz}$                          | repetitive, $I_T = 90 A$ |      | 150      | A/ $\mu s$       |
|                |  | $t_p = 200 \mu s; di_G/dt = 0,3 A/\mu s;$                           | non-repet., $I_T = 30 A$ |      | 500      | A/ $\mu s$       |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V_D = \frac{2}{3} V_{DRM}$   | $T_{VJ} = 150^{\circ}C$  |      | 500      | V/ $\mu s$       |
|                |  | $R_{GK} = \infty; \text{method 1 (linear voltage rise)}$            |                          |      |          |                  |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$   |      | 1,7      | V                |
|                |  |   | $T_{VJ} = -40^{\circ}C$  |      | 1,9      | V                |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$   |      | $\pm 60$ | mA               |
|                |  |   | $T_{VJ} = -40^{\circ}C$  |      | $\pm 80$ | mA               |
| $V_{GD}$       | gate non-trigger voltage                             | $V_D = \frac{2}{3} V_{DRM}$   | $T_{VJ} = 150^{\circ}C$  |      | 0,2      | V                |
| $I_{GD}$       | gate non-trigger current                             |   |                          |      | $\pm 1$  | mA               |
| $I_L$          | latching current                                     | $t_p = 10 \mu s$  | $T_{VJ} = 25^{\circ}C$   |      | 90       | mA               |
|                |  | $I_G = 0,3 A; di_G/dt = 0,3 A/\mu s$                                |                          |      |          |                  |
| $I_H$          | holding current                                      | $V_D = 6 V \quad R_{GK} = \infty$                                   | $T_{VJ} = 25^{\circ}C$   |      | 60       | mA               |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$   | $T_{VJ} = 25^{\circ}C$   |      | 2        | $\mu s$          |
|                |  | $I_G = 0,3 A; di_G/dt = 0,3 A/\mu s$                                |                          |      |          |                  |
| $t_q$          | turn-off time  | $V_R = 100 V; I_T = 30 A; V_D = \frac{2}{3} V_{DRM}$                | $T_{VJ} = 125^{\circ}C$  |      | 150      | $\mu s$          |
|                |  | $di/dt = 10 A/\mu s \quad dv/dt = 20 V/\mu s \quad t_p = 200 \mu s$ |                          |      |          |                  |

| Package TO-268AA (D3Pak-HV) |  |                      | Ratings |      |      |      |
|-----------------------------|--|----------------------|---------|------|------|------|
| Symbol                      | Definition   | Conditions           | min.    | typ. | max. | Unit |
| $I_{RMS}$                   | RMS current  | per terminal         |         |      | 70   | A    |
| $T_{VJ}$                    | virtual junction temperature                                 |                      | -40     |      | 150  | °C   |
| $T_{op}$                    | operation temperature  |                      | -40     |      | 125  | °C   |
| $T_{stg}$                   | storage temperature  |                      | -40     |      | 150  | °C   |
| <b>Weight</b>               |  |                      |         | 4    |      | g    |
| $F_C$                       | mounting force with clip                                     |                      | 20      |      | 120  | N    |
| $d_{Spp/App}$               | creepage distance on surface   striking distance through air | terminal to terminal | 9,4     |      |      | mm   |
| $d_{Spb/Apb}$               |  | terminal to backside | 5,6     |      |      | mm   |

### Product Marking



### Part description

C = Thyristor (SCR)  
 L = High Efficiency Thyristor  
 A = (up to 1200V)  
 60 = Current Rating [A]  
 MT = 1~ Triac  
 1200 = Reverse Voltage [V]  
 N = Three Quadrants operation: QI - QIII  
 TZ = TO-268AA (D3Pak) (2HV)

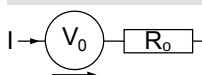
| Ordering    | Ordering Number    | Marking on Product | Delivery Mode | Quantity | Code No. |
|-------------|--------------------|--------------------|---------------|----------|----------|
| Standard    | CLA60MT1200NTZ-TUB | CLA60MT1200NTZ     | Tube          | 30       | 512767   |
| Alternative | CLA60MT1200NTZ-TRL | CLA60MT1200NTZ     | Tape & Reel   | 400      | 525122   |

| Similar Part   | Package      | Voltage class |
|----------------|--------------|---------------|
| CLA60MT1200NHB | TO-247AD (3) | 1200          |
| CLA60MT1200NHR | ISO247 (3)   | 1200          |

### Equivalent Circuits for Simulation

\* on die level

$T_{VJ} = 150^{\circ}\text{C}$

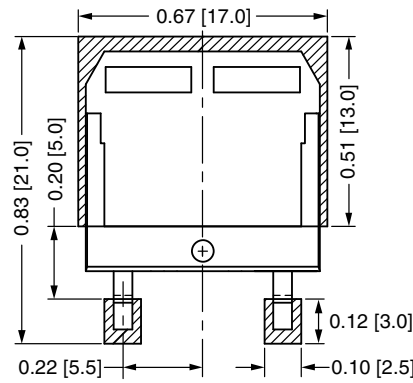
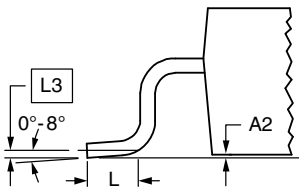
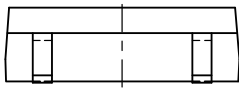
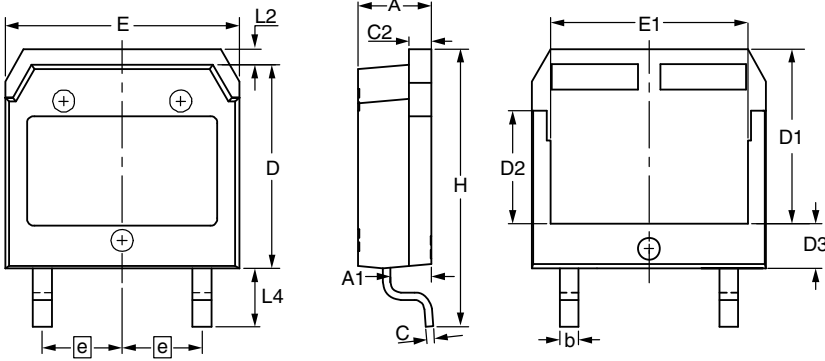


Thyristor

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage  | 0,86 | V  |
| $R_{0\ max}$ | slope resistance * | 10   | mΩ |

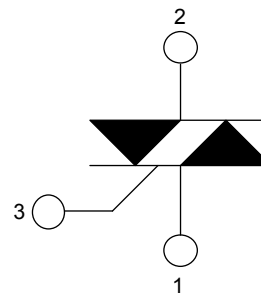


**Outlines TO-268AA (D3Pak-HV)**



**RECOMMENDED MINIMUM FOOT PRINT**

| Dim. | Millimeter |       | Inches    |       |
|------|------------|-------|-----------|-------|
|      | min        | max   | min       | max   |
| A    | 4.90       | 5.10  | 0.193     | 0.201 |
| A1   | 2.70       | 2.90  | 0.106     | 0.114 |
| A2   | 0.02       | 0.25  | 0.001     | 0.010 |
| b    | 1.15       | 1.45  | 0.045     | 0.057 |
| C    | 0.40       | 0.65  | 0.016     | 0.026 |
| C2   | 1.45       | 1.60  | 0.057     | 0.063 |
| D    | 13.80      | 14.00 | 0.543     | 0.551 |
| D1   | 11.80      | 12.10 | 0.465     | 0.476 |
| D2   | 7.50       | 7.80  | 0.295     | 0.307 |
| D3   | 2.90       | 3.20  | 0.114     | 0.126 |
| E    | 15.85      | 16.05 | 0.624     | 0.632 |
| E1   | 13.30      | 13.60 | 0.524     | 0.535 |
| e    | 5.450 BSC  |       | 0.215 BSC |       |
| H    | 18.70      | 19.10 | 0.736     | 0.752 |
| L    | 1.70       | 2.00  | 0.067     | 0.079 |
| L2   | 1.00       | 1.15  | 0.039     | 0.045 |
| L3   | 0.250 BSC  |       | 0.010 BSC |       |
| L4   | 3.80       | 4.10  | 0.150     | 0.161 |



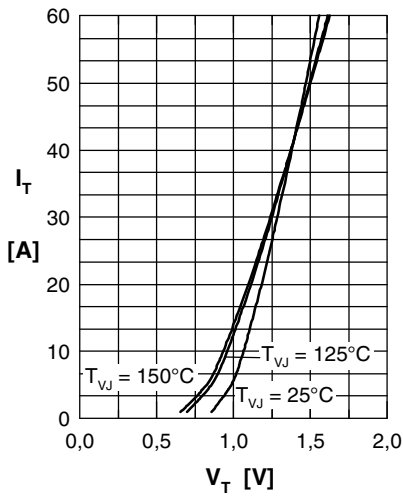
**Thyristor**


Fig. 1 Forward characteristics

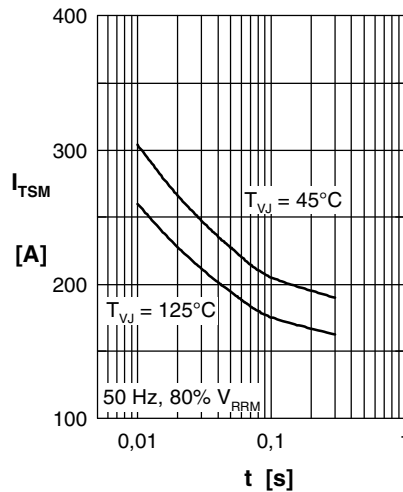
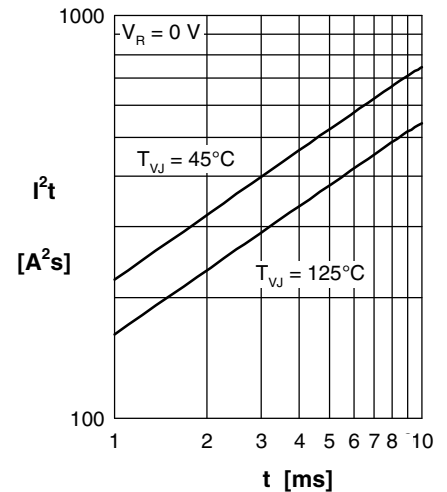
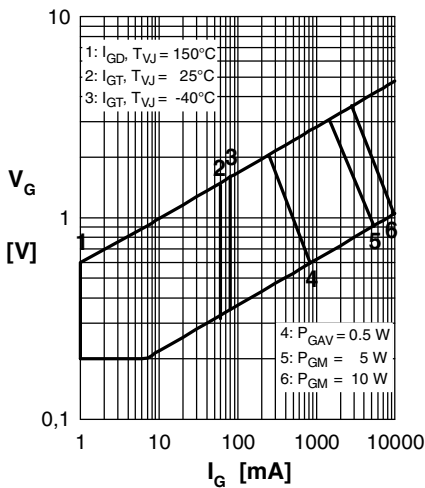

 Fig. 2 Surge overload current  
 $I_{TSM}$ : crest value,  $t$ : duration

 Fig. 3  $I^2t$  versus time (1-10 s)


Fig. 4 Gate voltage &amp; gate current

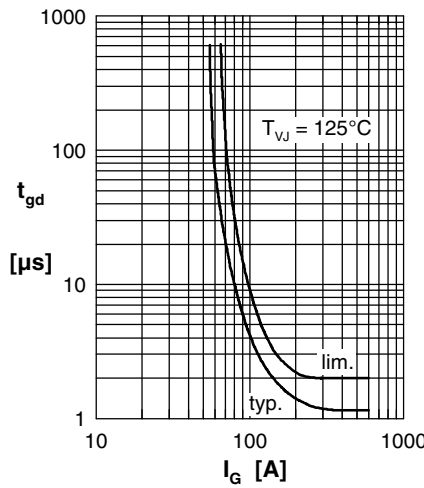
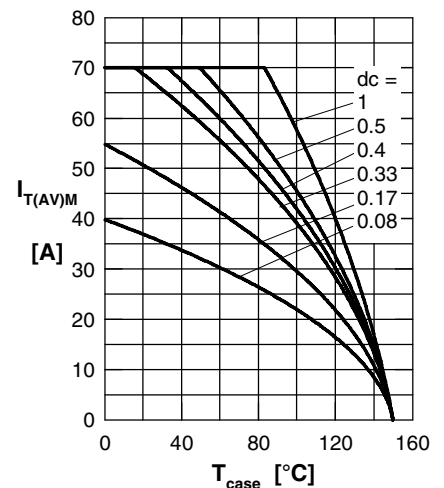

 Fig. 5 Gate controlled delay time  $t_{gd}$ 


Fig. 6 Max. forward current at case temperature

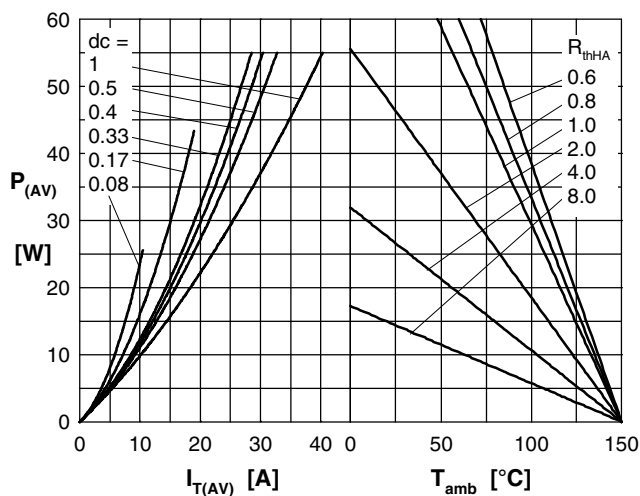
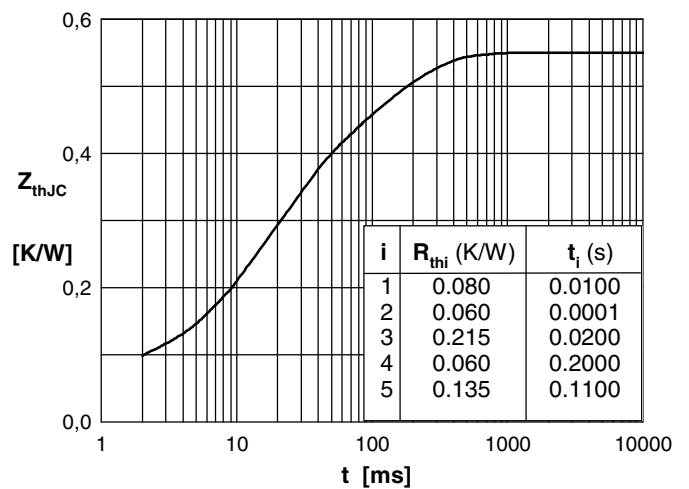

 Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature


Fig. 7 Transient thermal impedance junction to case