



# Thyristor

$$V_{RRM} = 1600\text{ V}$$

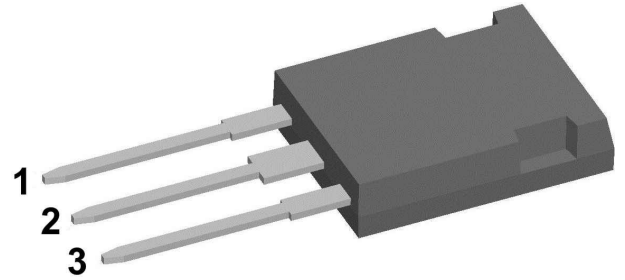
$$I_{TAV} = 60\text{ A}$$

$$V_T = 1.14\text{ V}$$

## Single Thyristor

Part number

**CS60-16io1**



Backside: anode



### Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability

### Applications:

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

### Package: PLUS247

- Industry standard outline
- RoHS compliant
- Epoxy meets UL 94V-0

### Disclaimer Notice

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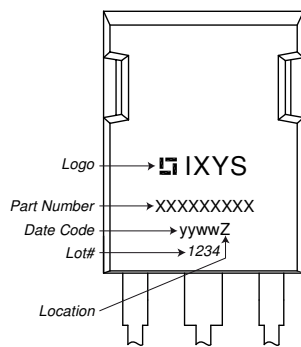


| Thyristor      |  |   | Ratings                   |      |      |                   |
|----------------|--|---|---------------------------|------|------|-------------------|
| Symbol         | Definition   | Conditions  | min.                      | typ. | max. | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$  |                           |      | 1700 | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$  |                           |      | 1600 | V                 |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 1600 V$  | $T_{VJ} = 25^{\circ}C$    |      | 200  | $\mu A$           |
|                |  | $V_{R/D} = 1600 V$  | $T_{VJ} = 140^{\circ}C$   |      | 10   | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 60 A$  | $T_{VJ} = 25^{\circ}C$    |      | 1.18 | V                 |
|                |  | $I_T = 120 A$   |                           |      | 1.44 | V                 |
|                |  | $I_T = 60 A$  | $T_{VJ} = 125^{\circ}C$   |      | 1.14 | V                 |
|                |  | $I_T = 120 A$   |                           |      | 1.46 | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 110^{\circ}C$  | $T_{VJ} = 140^{\circ}C$   |      | 60   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine   |                           |      | 75   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only   | $T_{VJ} = 140^{\circ}C$   |      | 0.82 | V                 |
| $r_T$          | slope resistance                                     |   |                           |      | 5.3  | m $\Omega$        |
| $R_{thJC}$     | thermal resistance junction to case                  |   |                           |      | 0.32 | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |   |                           | 0.15 |      | K/W               |
| $P_{tot}$      | total power dissipation                              |   | $T_C = 25^{\circ}C$       |      | 360  | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$  | $T_{VJ} = 45^{\circ}C$    |      | 1.40 | kA                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$   | $V_R = 0 V$               |      | 1.51 | kA                |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$  | $T_{VJ} = 140^{\circ}C$   |      | 1.19 | kA                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$   | $V_R = 0 V$               |      | 1.29 | kA                |
| $I^2t$         | value for fusing                                     | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$  | $T_{VJ} = 45^{\circ}C$    |      | 9.80 | kA <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$   | $V_R = 0 V$               |      | 9.49 | kA <sup>2</sup> s |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$  | $T_{VJ} = 140^{\circ}C$   |      | 7.08 | kA <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$   | $V_R = 0 V$               |      | 6.87 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400 V \quad f = 1 \text{ MHz}$   | $T_{VJ} = 25^{\circ}C$    |      | 74   | pF                |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30 \mu s$  | $T_C = 140^{\circ}C$      |      | 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                     | $T_{VJ} = 140^{\circ}C; f = 50 \text{ Hz}$  | repetitive, $I_T = 180 A$ |      | 150  | A/ $\mu s$        |
|                |  | $t_p = 200 \mu s; di_G/dt = 0.3 A/\mu s;$<br>$I_G = 0.3 A; V = \frac{2}{3} V_{DRM}$                                       | non-repet., $I_T = 60 A$  |      | 500  | A/ $\mu s$        |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$<br>$R_{GK} = \infty; \text{ method 1 (linear voltage rise)}$                                    | $T_{VJ} = 140^{\circ}C$   |      | 1000 | V/ $\mu s$        |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$    |      | 1.5  | V                 |
|                |  |   | $T_{VJ} = -40^{\circ}C$   |      | 1.6  | V                 |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$    |      | 100  | mA                |
|                |  |   | $T_{VJ} = -40^{\circ}C$   |      | 200  | mA                |
| $V_{GD}$       | gate non-trigger voltage                             | $V_D = \frac{2}{3} V_{DRM}$   | $T_{VJ} = 140^{\circ}C$   |      | 0.2  | V                 |
| $I_{GD}$       | gate non-trigger current                             |   |                           |      | 10   | mA                |
| $I_L$          | latching current                                     | $t_p = 10 \mu s$  | $T_{VJ} = 25^{\circ}C$    |      | 450  | mA                |
|                |  | $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$  |                           |      |      |                   |
| $I_H$          | holding current                                      | $V_D = 6 V \quad R_{GK} = \infty$   | $T_{VJ} = 25^{\circ}C$    |      | 200  | mA                |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$   | $T_{VJ} = 25^{\circ}C$    |      | 2    | $\mu s$           |
|                |  | $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$  |                           |      |      |                   |
| $t_q$          | turn-off time  | $V_R = 100 V; I_T = 60 A; V = \frac{2}{3} V_{DRM}$<br>$di/dt = 10 A/\mu s \quad dv/dt = 20 V/\mu s \quad t_p = 200 \mu s$ | $T_{VJ} = 125^{\circ}C$   |      | 150  | $\mu s$           |



| Package PLUS247 |  | Ratings              |      |      |      |      |
|-----------------|--|----------------------|------|------|------|------|
| Symbol          | Definition   | Conditions           | min. | typ. | max. | Unit |
| $I_{RMS}$       | RMS current  | per terminal         |      |      | 70   | A    |
| $T_{VJ}$        | virtual junction temperature                                 |                      | -40  |      | 140  | °C   |
| $T_{op}$        | operation temperature  |                      | -40  |      | 125  | °C   |
| $T_{stg}$       | storage temperature  |                      | -40  |      | 140  | °C   |
| <b>Weight</b>   |  |                      |      | 6    |      | g    |
| $F_C$           | mounting force with clip                                     |                      | 20   |      | 120  | N    |
| $d_{Spp/App}$   | creepage distance on surface / striking distance through air | terminal to terminal | 5.5  |      |      | mm   |
| $d_{Spb/Apb}$   |  | terminal to backside | 5.5  |      |      | mm   |

**Product Marking**



| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | CS60-16io1      | CS60-16io1         | Tube          | 30       | 503360   |

| Similar Part | Package        | Voltage class |
|--------------|----------------|---------------|
| CS60-12io1   | PLUS247 (3)    | 1200          |
| CS60-14io1   | PLUS247 (3)    | 1400          |
| CS60-16io1R  | ISOPLUS247 (3) | 1600          |

**Equivalent Circuits for Simulation**

\* on die level

$T_{VJ} = 140^{\circ}C$

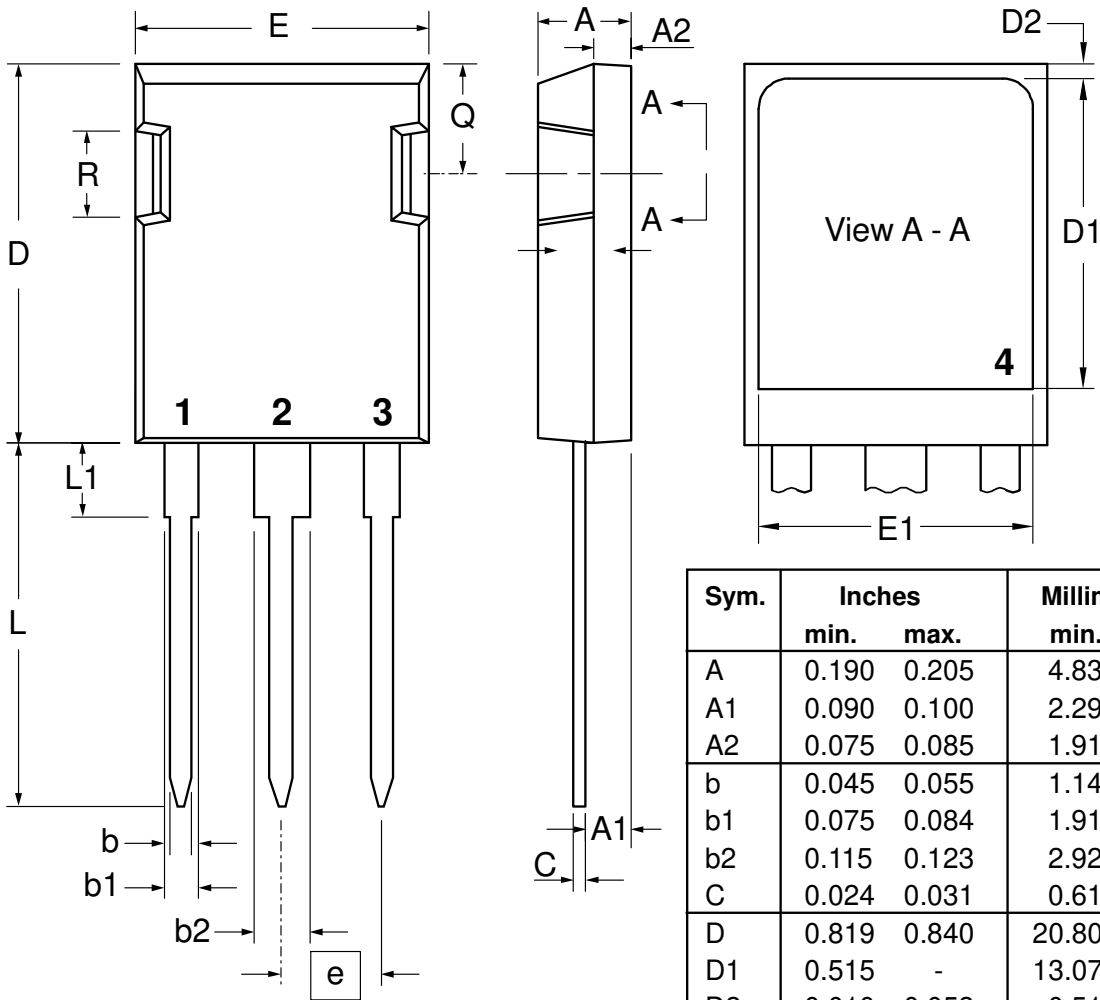


**Thyristor**

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0 \max}$ | threshold voltage  | 0.82 | V  |
| $R_{0 \max}$ | slope resistance * | 3    | mΩ |



**Outlines PLUS247**



| Sym. | Inches    |       | Millimeter |       |
|------|-----------|-------|------------|-------|
|      | min.      | max.  | min.       | max.  |
| A    | 0.190     | 0.205 | 4.83       | 5.21  |
| A1   | 0.090     | 0.100 | 2.29       | 2.54  |
| A2   | 0.075     | 0.085 | 1.91       | 2.16  |
| b    | 0.045     | 0.055 | 1.14       | 1.40  |
| b1   | 0.075     | 0.084 | 1.91       | 2.13  |
| b2   | 0.115     | 0.123 | 2.92       | 3.12  |
| C    | 0.024     | 0.031 | 0.61       | 0.80  |
| D    | 0.819     | 0.840 | 20.80      | 21.34 |
| D1   | 0.515     | -     | 13.07      | -     |
| D2   | 0.010     | 0.053 | 0.51       | 1.35  |
| E    | 0.620     | 0.635 | 15.75      | 16.13 |
| E1   | 0.530     | -     | 13.45      | -     |
| e    | 0.215 BSC |       | 5.45 BSC   |       |
| L    | 0.780     | 0.800 | 19.81      | 20.32 |
| L1   | 0.150     | 0.170 | 3.81       | 4.32  |
| Q    | 0.220     | 0.244 | 5.59       | 6.20  |
| R    | 0.170     | 0.190 | 4.32       | 4.83  |



**Thyristor**

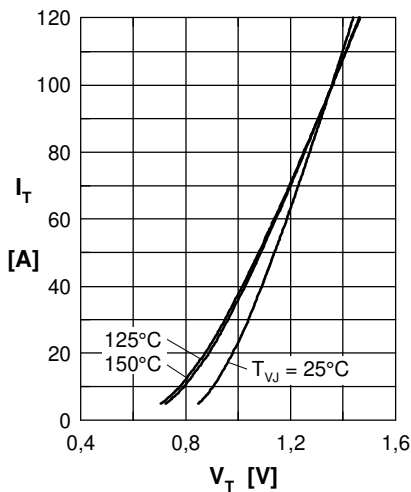


Fig. 1 Forward characteristics

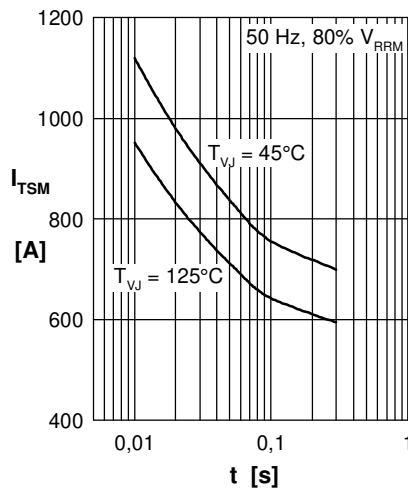


Fig. 2 Surge overload current

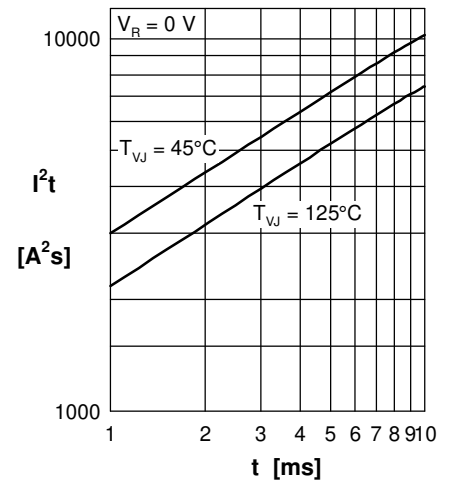


Fig. 3  $I^2t$  versus time (1-10 ms)

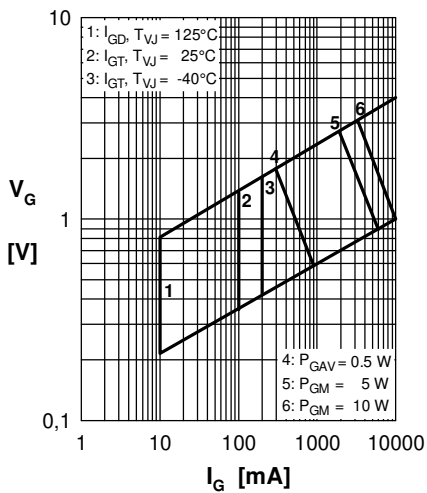


Fig. 4 Gate trigger characteristics

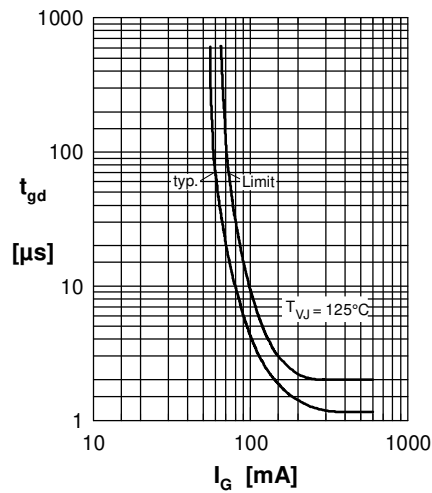


Fig. 5 Gate controlled delay time

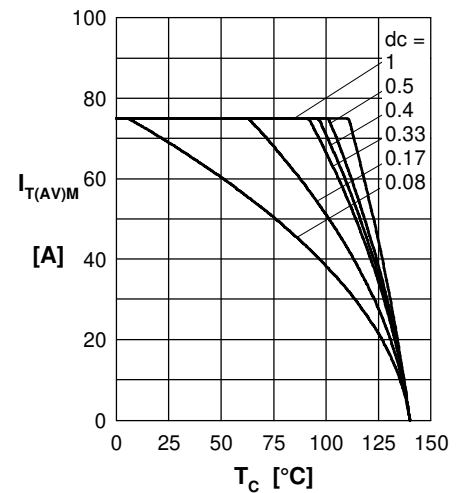


Fig. 6 Max. forward current at case temperature

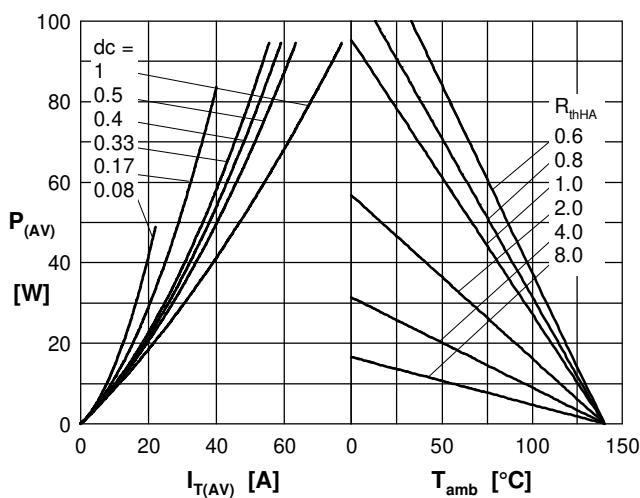


Fig. 7a Power dissipation versus direct output current  
Fig. 7b and ambient temperature

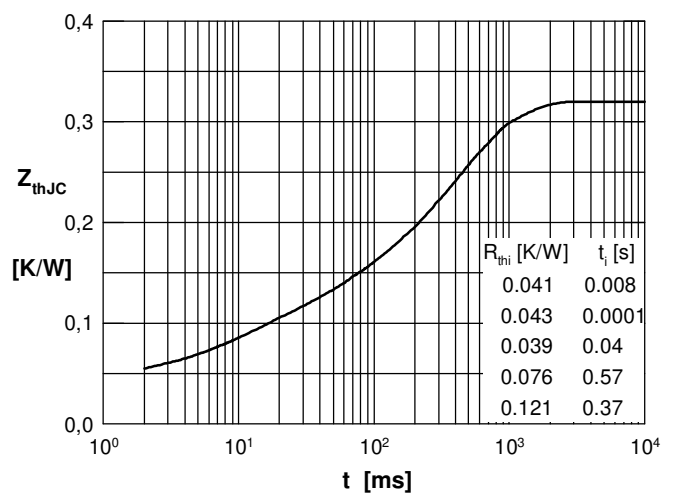


Fig. 8 Transient thermal impedance junction to case