

# High Efficiency Thyristor

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

$$I_{TAV} = 20 \text{ A}$$

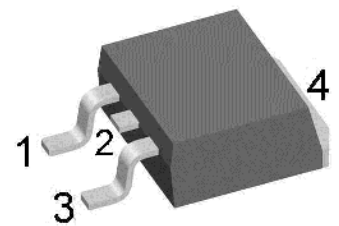
$$V_T = 1.31 \text{ V}$$

## Single Thyristor

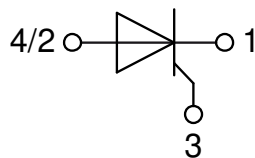
### Part number

**CS19-12ho1S**

Marking on Product: CS19-12ho1S



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: TO-263 (D2Pak)

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

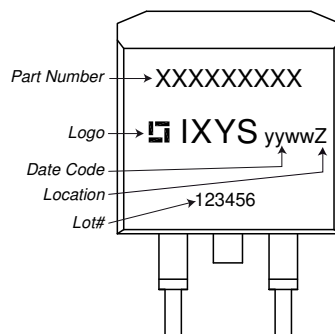
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| Thyristor      |  |   | Ratings                 |      |      |                  |
|----------------|--|---|-------------------------|------|------|------------------|
| Symbol         | Definition   | Conditions  | min.                    | typ. | max. | Unit             |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$  |                         |      | 1300 | V                |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$  |                         |      | 1200 | V                |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 1200 V$  | $T_{VJ} = 25^{\circ}C$  |      | 50   | $\mu A$          |
|                |  | $V_{R/D} = 1200 V$  | $T_{VJ} = 125^{\circ}C$ |      | 1    | mA               |
| $V_T$          | forward voltage drop                                 | $I_T = 20 A$  | $T_{VJ} = 25^{\circ}C$  |      | 1.32 | V                |
|                |  | $I_T = 40 A$  |                         |      | 1.65 | V                |
|                |  | $I_T = 20 A$  | $T_{VJ} = 125^{\circ}C$ |      | 1.31 | V                |
|                |  | $I_T = 40 A$  |                         |      | 1.73 | V                |
| $I_{TAV}$      | average forward current                              | $T_C = 110^{\circ}C$  | $T_{VJ} = 125^{\circ}C$ |      | 20   | A                |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine   |                         |      | 31   | A                |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only   | $T_{VJ} = 125^{\circ}C$ |      | 0.86 | V                |
| $r_T$          | slope resistance                                     |   |                         |      | 22   | m $\Omega$       |
| $R_{thJC}$     | thermal resistance junction to case                  |   |                         |      | 0.7  | K/W              |
| $R_{thCH}$     | thermal resistance case to heatsink                  |   |                         | 0.5  |      | K/W              |
| $P_{tot}$      | total power dissipation                              |   | $T_C = 25^{\circ}C$     |      | 170  | W                |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 ms$ ; (50 Hz), sine   | $T_{VJ} = 45^{\circ}C$  |      | 180  | A                |
|                |  | $t = 8,3 ms$ ; (60 Hz), sine  | $V_R = 0 V$             |      | 195  | A                |
|                |  | $t = 10 ms$ ; (50 Hz), sine   | $T_{VJ} = 125^{\circ}C$ |      | 155  | A                |
|                |  | $t = 8,3 ms$ ; (60 Hz), sine  | $V_R = 0 V$             |      | 165  | A                |
| $I^2t$         | value for fusing                                     | $t = 10 ms$ ; (50 Hz), sine   | $T_{VJ} = 45^{\circ}C$  |      | 160  | A <sup>2</sup> s |
|                |  | $t = 8,3 ms$ ; (60 Hz), sine  | $V_R = 0 V$             |      | 160  | A <sup>2</sup> s |
|                |  | $t = 10 ms$ ; (50 Hz), sine   | $T_{VJ} = 125^{\circ}C$ |      | 120  | A <sup>2</sup> s |
|                |  | $t = 8,3 ms$ ; (60 Hz), sine  | $V_R = 0 V$             |      | 115  | A <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 230 V$ $f = 1 MHz$   | $T_{VJ} = 25^{\circ}C$  | 9    |      | pF               |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30 \mu s$  | $T_C = 125^{\circ}C$    |      | 5    | W                |
|                |  | $t_p = 300 \mu s$   |                         |      | 2.5  | W                |
| $P_{GAV}$      | average gate power dissipation                       |   |                         |      | 0.5  | W                |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 150^{\circ}C$ ; $f = 50 Hz$ repetitive, $I_T = 60 A$  |                         |      | 150  | A/ $\mu s$       |
|                |  | $t_p = 200 \mu s$ ; $di_G/dt = 0.15 A/\mu s$ ;<br>$I_G = 0.15 A$ ; $V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 20 A$                           |                         |      | 500  | A/ $\mu s$       |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$   | $T_{VJ} = 150^{\circ}C$ |      | 500  | V/ $\mu s$       |
|                |  | $R_{GK} = \infty$ ; method 1 (linear voltage rise)  |                         |      |      |                  |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$  |      | 1.5  | V                |
|                |  |   | $T_{VJ} = -40^{\circ}C$ |      | 2.5  | V                |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$  |      | 28   | mA               |
|                |  |   | $T_{VJ} = -40^{\circ}C$ |      | 50   | 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                             |   |                         |      | 3    | mA               |
| $I_L$          | latching current                                     | $t_p = 10 \mu s$  | $T_{VJ} = 25^{\circ}C$  |      | 75   | mA               |
|                |  | $I_G = 0.1 A$ ; $di_G/dt = 0.1 A/\mu s$   |                         |      |      |                  |
| $I_H$          | holding current                                      | $V_D = 6 V$ $R_{GK} = \infty$   | $T_{VJ} = 25^{\circ}C$  |      | 50   | mA               |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$   | $T_{VJ} = 25^{\circ}C$  |      | 2    | $\mu s$          |
|                |  | $I_G = 0.1 A$ ; $di_G/dt = 0.1 A/\mu s$   |                         |      |      |                  |
| $t_q$          | turn-off time  | $V_R = 100 V$ ; $I_T = 20 A$ ; $V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 100^{\circ}C$<br>$di/dt = 10 A/\mu s$ $dv/dt = 20 V/\mu s$ $t_p = 200 \mu s$ |                         | 150  |      | $\mu s$          |

| Package TO-263 (D2Pak) |                              |              | Ratings |      |      |      |
|------------------------|------------------------------|--------------|---------|------|------|------|
| Symbol                 | Definition                   | Conditions   | min.    | typ. | max. | Unit |
| $I_{RMS}$              | RMS current                  | per terminal |         |      | 35   | A    |
| $T_{VJ}$               | virtual junction temperature |              | -40     |      | 125  | °C   |
| $T_{op}$               | operation temperature        |              | -40     |      | 100  | °C   |
| $T_{stg}$              | storage temperature          |              | -40     |      | 150  | °C   |
| <b>Weight</b>          |                              |              |         | 1.5  |      | g    |
| $F_C$                  | mounting force with clip     |              | 20      |      | 60   | N    |

### Product Marking



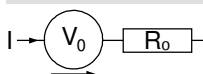
| Ordering    | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|-------------|-----------------|--------------------|---------------|----------|----------|
| Standard    | CS19-12ho1S-TRL | CS19-12ho1S        | Tape & Reel   | 800      | 501313   |
| Alternative | CS19-12ho1S-TUB | CS19-12ho1S        | Tube          | 50       | 473340   |

| Similar Part | Package              | Voltage class |
|--------------|----------------------|---------------|
| CS19-12ho1   | TO-220AB (3)         | 1200          |
| CS19-08ho1   | TO-220AB (3)         | 800           |
| CS19-08ho1S  | TO-263AB (D2Pak) (2) | 800           |

### Equivalent Circuits for Simulation

\* on die level

$T_{VJ} = 125^{\circ}\text{C}$

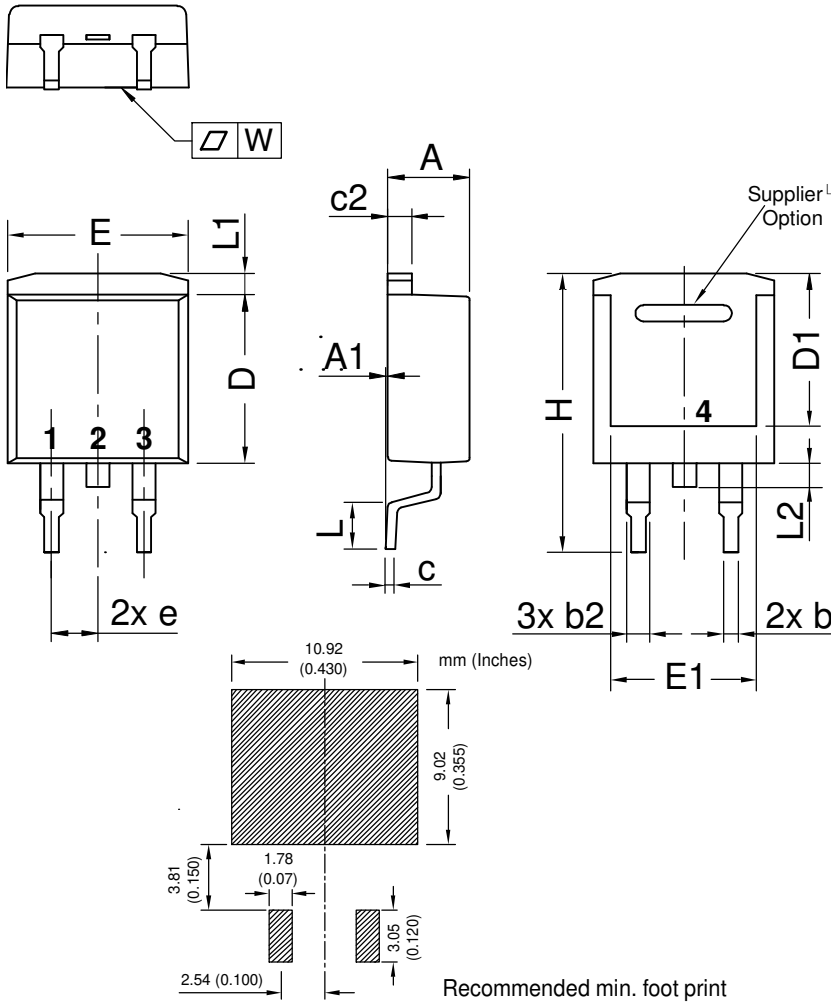


Thyristor

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage  | 0.86 | V  |
| $R_{0\ max}$ | slope resistance * | 19   | mΩ |

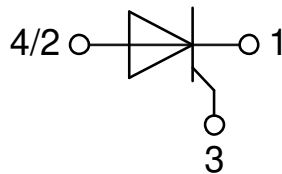


**Outlines TO-263 (D2Pak)**



| Dim. | Millimeter |       | Inches      |       |
|------|------------|-------|-------------|-------|
|      | min        | max   | min         | max   |
| A    | 4.06       | 4.83  | 0.160       | 0.190 |
| A1   | typ. 0.10  |       | typ. 0.004  |       |
| A2   | 2.41       |       | 0.095       |       |
| b    | 0.51       | 0.99  | 0.020       | 0.039 |
| b2   | 1.14       | 1.40  | 0.045       | 0.055 |
| c    | 0.40       | 0.74  | 0.016       | 0.029 |
| c2   | 1.14       | 1.40  | 0.045       | 0.055 |
| D    | 8.38       | 9.40  | 0.330       | 0.370 |
| D1   | 8.00       | 8.89  | 0.315       | 0.350 |
| D2   | 2.5        |       | 0.098       |       |
| E    | 9.65       | 10.41 | 0.380       | 0.410 |
| E1   | 6.22       | 8.50  | 0.245       | 0.335 |
| e    | 2,54 BSC   |       | 0,100 BSC   |       |
| e1   | 4.28       |       | 0.169       |       |
| H    | 14.61      | 15.88 | 0.575       | 0.625 |
| L    | 1.78       | 2.79  | 0.070       | 0.110 |
| L1   | 1.02       | 1.68  | 0.040       | 0.066 |
| W    | typ. 0.02  | 0.040 | typ. 0.0008 | 0.002 |

*All dimensions conform with and/or within JEDEC standard.*



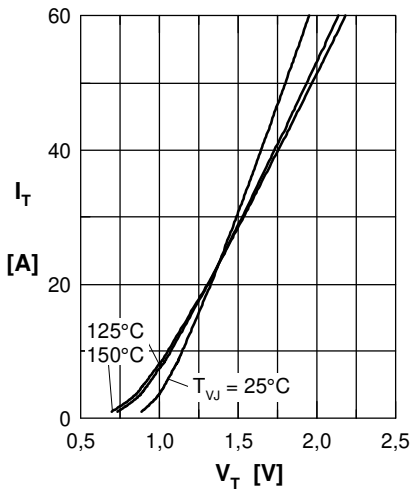
**Thyristor**


Fig. 1 Forward characteristics

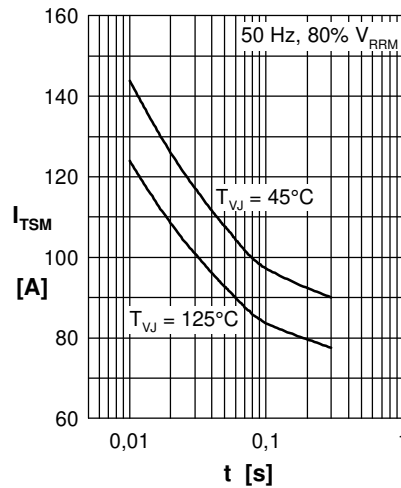


Fig. 2 Surge overload current

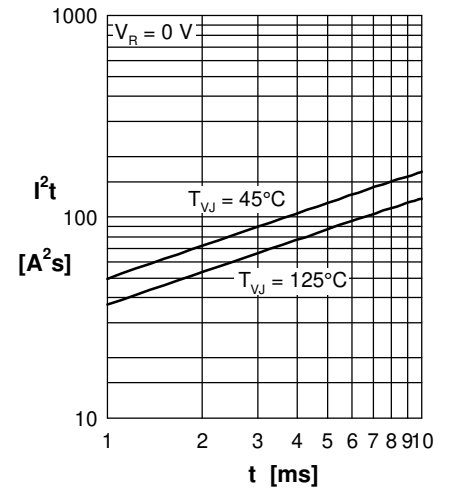
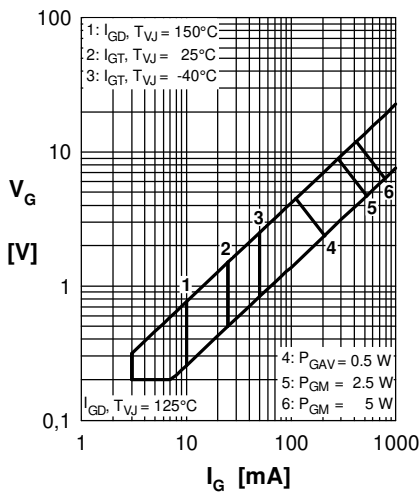

 Fig. 3  $I^2t$  versus time (1-10 ms)


Fig. 4 Gate trigger characteristics

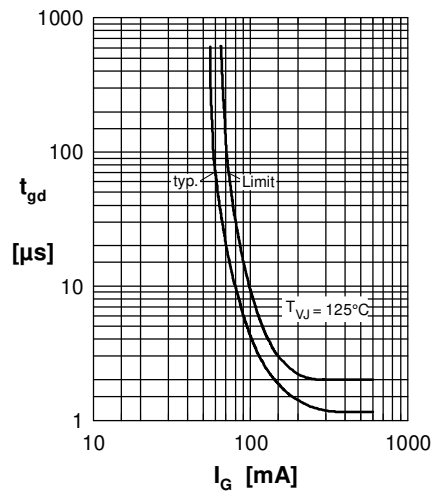


Fig. 5 Gate controlled delay time

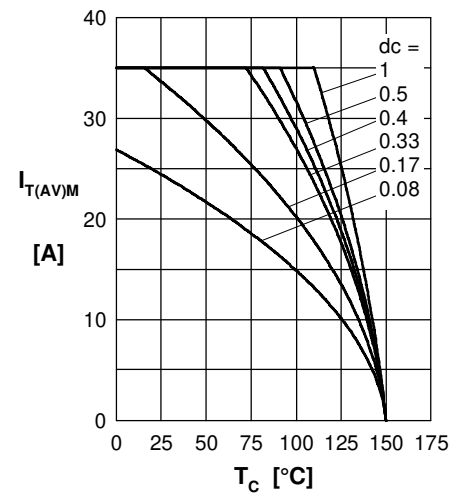


Fig. 6 Max. forward current at case temperature

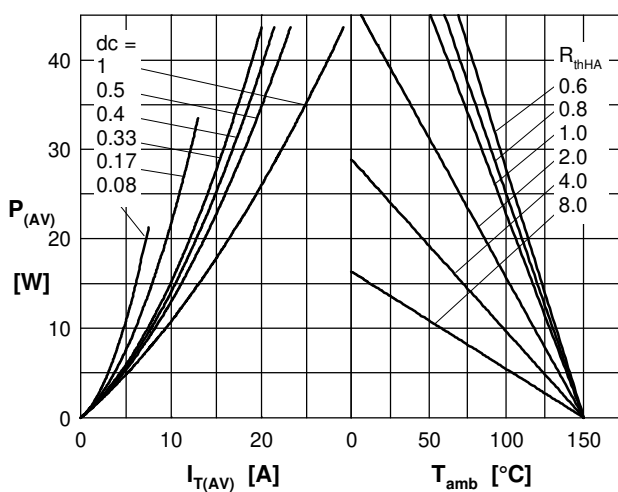
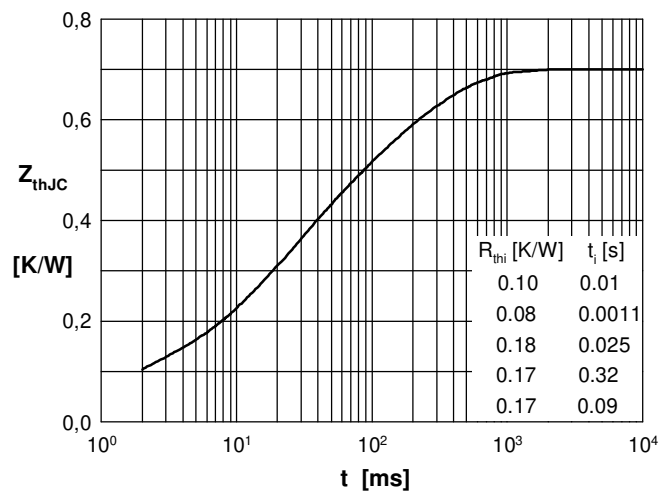

 Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature


Fig. 8 Transient thermal impedance junction to case