

# High Efficiency Thyristor

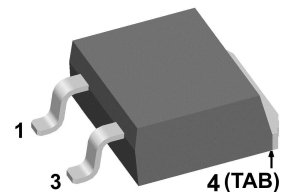
$$\begin{aligned} V_{RRM} &= 1200 \text{ V} \\ I_{TAV} &= 30 \text{ A} \\ V_T &= 1.27 \text{ V} \end{aligned}$$

Two Quadrants Operation QI & QII  
 Single Thyristor with two gate polarities

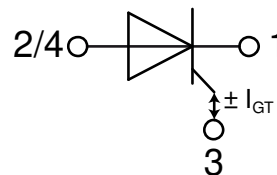
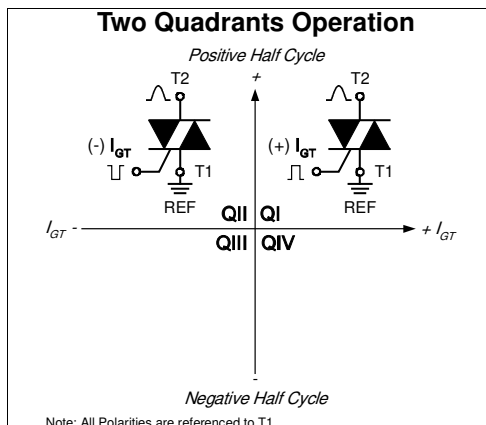
Part number

**CLA30E1200NPZ**

Marking on Product: CLA30E1200NPZ



Backside: anode



## Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Two gate current polarities usable
  - positive -> quadrant I
  - negative -> quadrant II
- Thyristor can be used as Triac
  - anti-parallel combination with AGT
  - Anode-Gated-Thyristor covers quadrant III
  - AGT-counterpart: CLB30I1200PZ

## 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-HV)

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

## Disclaimer Notice

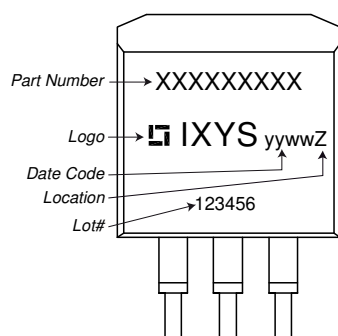
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| Thyristor      |                                                      |                                                                                                                                                                                                       |                                | Ratings |      |          |                  |
|----------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------|------|----------|------------------|
| Symbol         | Definition                                           | Conditions                                                                                                                                                                                            |                                | min.    | typ. | max.     | Unit             |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                                                         |                                |         |      | 1300     | V                |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                                                         |                                |         |      | 1200     | V                |
| $I_{R/D}$      | reverse current, drain current                       | $V_{R/D} = 1200\text{ V}$                                                                                                                                                                             | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 10       | $\mu\text{A}$    |
|                |                                                      | $V_{R/D} = 1200\text{ V}$                                                                                                                                                                             | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 2        | mA               |
| $V_T$          | forward voltage drop                                 | $I_T = 30\text{ A}$                                                                                                                                                                                   | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.30     | V                |
|                |                                                      | $I_T = 60\text{ A}$                                                                                                                                                                                   |                                |         |      | 1.59     | V                |
|                |                                                      | $I_T = 30\text{ A}$                                                                                                                                                                                   | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1.27     | V                |
|                |                                                      | $I_T = 60\text{ A}$                                                                                                                                                                                   |                                |         |      | 1.65     | V                |
| $I_{TAV}$      | average forward current                              | $T_C = 115^{\circ}\text{C}$                                                                                                                                                                           | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 30       | A                |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine                                                                                                                                                                                             |                                |         |      | 47       | A                |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only                                                                                                                                                                     | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 0.86     | V                |
| $r_T$          | slope resistance                                     |                                                                                                                                                                                                       |                                |         |      | 13.2     | m $\Omega$       |
| $R_{thJC}$     | thermal resistance junction to case                  |                                                                                                                                                                                                       |                                |         |      | 0.5      | K/W              |
| $R_{thCH}$     | thermal resistance case to heatsink                  |                                                                                                                                                                                                       |                                |         | 0.25 |          | K/W              |
| $P_{tot}$      | total power dissipation                              |                                                                                                                                                                                                       | $T_C = 25^{\circ}\text{C}$     |         |      | 250      | W                |
| $I_{TSM}$      | max. forward surge current                           | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 300      | A                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 325      | A                |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 255      | A                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 275      | A                |
| $I^2t$         | value for fusing                                     | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 450      | A <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 440      | A <sup>2</sup> s |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 325      | A <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 315      | A <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400\text{ V}$ $f = 1\text{ MHz}$                                                                                                                                                               | $T_{VJ} = 25^{\circ}\text{C}$  |         | 13   |          | pF               |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30\text{ }\mu\text{s}$                                                                                                                                                                         | $T_C = 150^{\circ}\text{C}$    |         |      | 10       | W                |
|                |                                                      | $t_p = 300\text{ }\mu\text{s}$                                                                                                                                                                        |                                |         |      | 5        | W                |
| $P_{GAV}$      | average gate power dissipation                       |                                                                                                                                                                                                       |                                |         |      | 0.5      | W                |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 150^{\circ}\text{C}; f = 50\text{ Hz}$ repetitive, $I_T = 90\text{ A}$                                                                                                                      |                                |         |      | 150      | A/ $\mu\text{s}$ |
|                |                                                      | $t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.3\text{ A}/\mu\text{s};$<br>$I_G = 0.3\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 30\text{ A}$                                                  |                                |         |      | 500      | A/ $\mu\text{s}$ |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$                                                                                                                                                                             | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 500      | V/ $\mu\text{s}$ |
|                |                                                      | $R_{GK} = \infty$ ; method 1 (linear voltage rise)                                                                                                                                                    |                                |         |      |          |                  |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6\text{ V}$                                                                                                                                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.3      | V                |
|                |                                                      |                                                                                                                                                                                                       | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | 1.6      | V                |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6\text{ V}$                                                                                                                                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | $\pm 30$ | mA               |
|                |                                                      |                                                                                                                                                                                                       | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | $\pm 50$ | mA               |
| $V_{GD}$       | gate non-trigger voltage                             | $V_D = \frac{2}{3} V_{DRM}$                                                                                                                                                                           | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 0.2      | V                |
| $I_{GD}$       | gate non-trigger current                             |                                                                                                                                                                                                       |                                |         |      | $\pm 1$  | mA               |
| $I_L$          | latching current                                     | $t_p = 10\text{ }\mu\text{s}$                                                                                                                                                                         | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 90       | mA               |
|                |                                                      | $I_G = 0.3\text{ A}; di_G/dt = 0.3\text{ A}/\mu\text{s}$                                                                                                                                              |                                |         |      |          |                  |
| $I_H$          | holding current                                      | $V_D = 6\text{ V}$ $R_{GK} = \infty$                                                                                                                                                                  | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 60       | mA               |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$                                                                                                                                                                           | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 2        | $\mu\text{s}$    |
|                |                                                      | $I_G = 0.3\text{ A}; di_G/dt = 0.3\text{ A}/\mu\text{s}$                                                                                                                                              |                                |         |      |          |                  |
| $t_q$          | turn-off time                                        | $V_R = 100\text{ V}; I_T = 30\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 125^{\circ}\text{C}$<br>$di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 20\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$ |                                |         | 150  |          | $\mu\text{s}$    |

| Package TO-263 (D2Pak-HV) |                                                              |                      | Ratings |      |      |      |
|---------------------------|--------------------------------------------------------------|----------------------|---------|------|------|------|
| Symbol                    | Definition                                                   | Conditions           | min.    | typ. | max. | Unit |
| $I_{RMS}$                 | RMS current                                                  | per terminal         |         |      | 35   | 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>             |                                                              |                      |         | 1.5  |      | g    |
| $F_c$                     | mounting force with clip                                     |                      | 20      |      | 60   | N    |
| $d_{Spp/App}$             | creepage distance on surface / striking distance through air | terminal to terminal | 4.2     |      |      | mm   |
| $d_{Spb/Apb}$             |                                                              | terminal to backside | 4.7     |      |      | mm   |

### Product Marking



### Part description

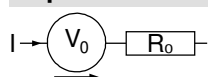
C = Thyristor (SCR)  
 L = High Efficiency Thyristor  
 A = (up to 1200V)  
 30 = Current Rating [A]  
 E = Single Thyristor with two gate polarities  
 1200 = Reverse Voltage [V]  
 N = Three Quadrants operation: QI - QIII  
 PZ = TO-263AB (D2Pak) (2HV)

| Ordering    | Ordering Number   | Marking on Product | Delivery Mode | Quantity | Code No. |
|-------------|-------------------|--------------------|---------------|----------|----------|
| Standard    | CLA30E1200NPZ-TRL | CLA30E1200NPZ      | Tape & Reel   | 800      | 516330   |
| Alternative | CLA30E1200NPZ-TUB | CLA30E1200NPZ      | Tube          | 50       | 525248   |

### Equivalent Circuits for Simulation

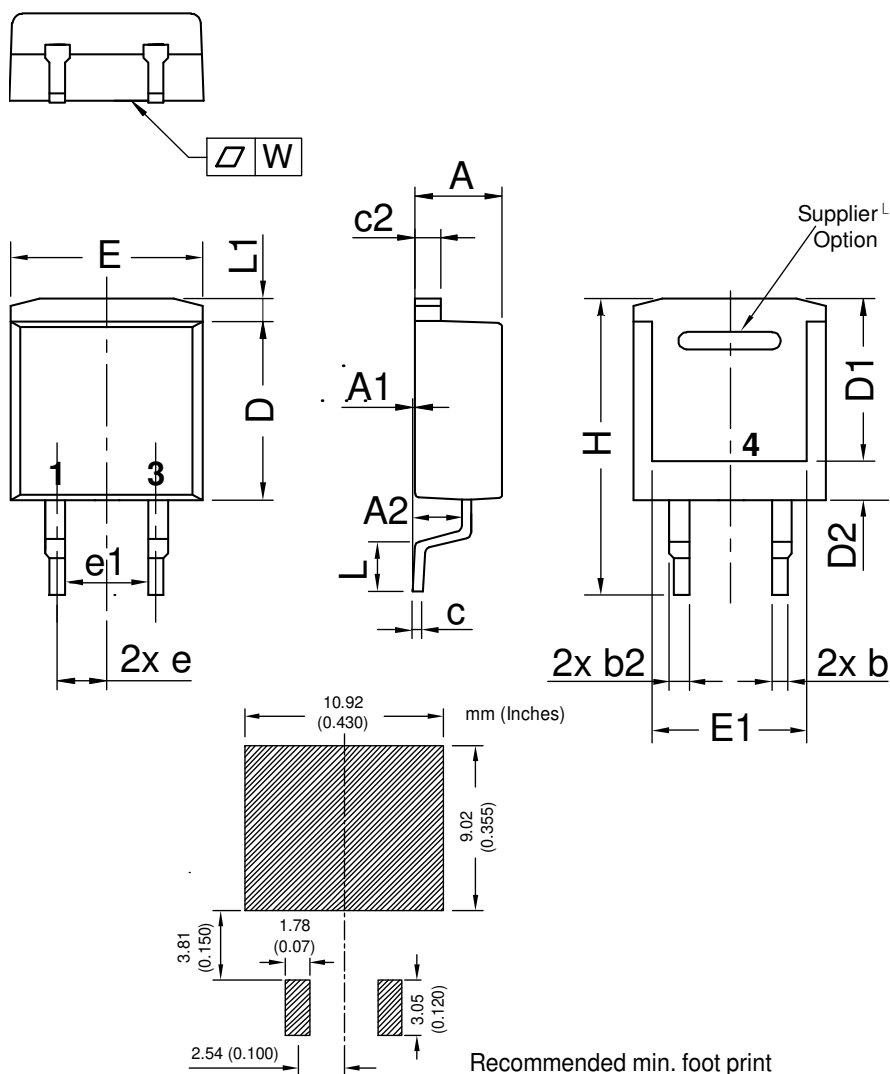
\* on die level

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



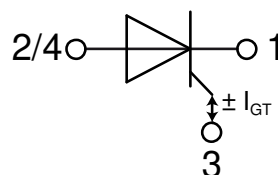
Thyristor

|             |                    |      |    |
|-------------|--------------------|------|----|
| $V_{0\max}$ | threshold voltage  | 0.86 | V  |
| $R_{0\max}$ | slope resistance * | 10   | mΩ |

**Outlines TO-263 (D2Pak-HV)**


| 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   | 2.3        |       | 0.091       |       |
| 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

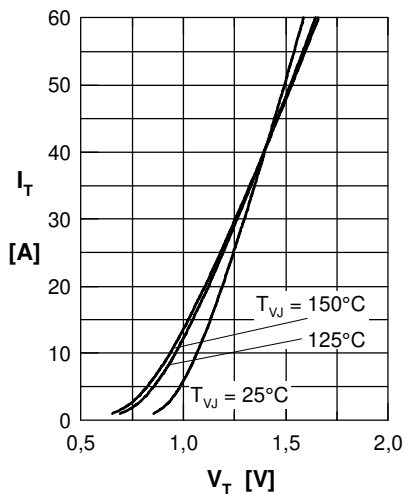


Fig. 1 Forward characteristics

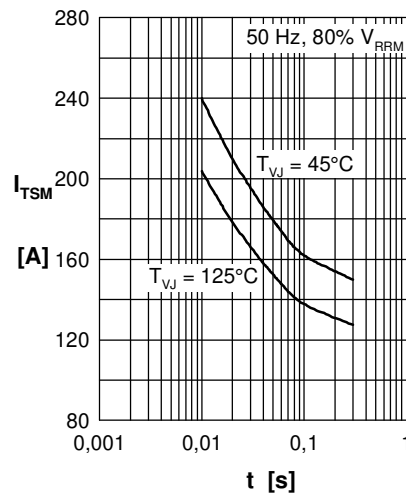


Fig. 2 Surge overload current  
 $I_{TSM}$ : crest value,  $t$ : duration

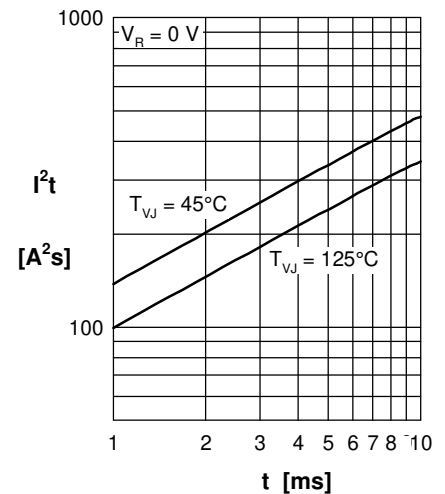


Fig. 3  $I^2t$  versus time (1-10 s)

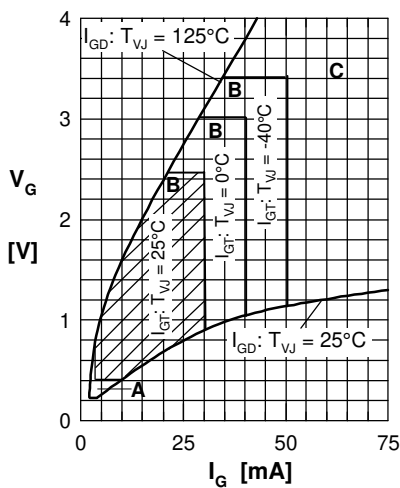


Fig. 4 Gate voltage & gate current  
 Triggering: A = no; B = possible; C = safe

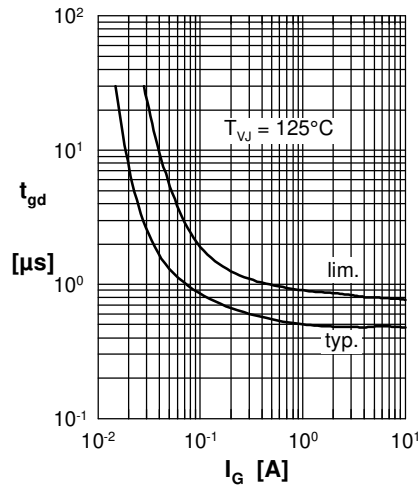


Fig. 5 Gate controlled delay time  $t_{gd}$

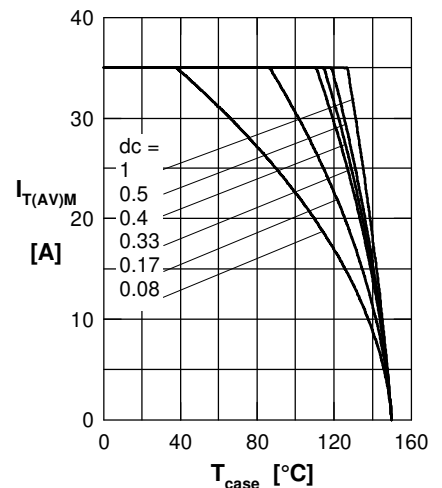


Fig. 6 Max. forward current at case temperature

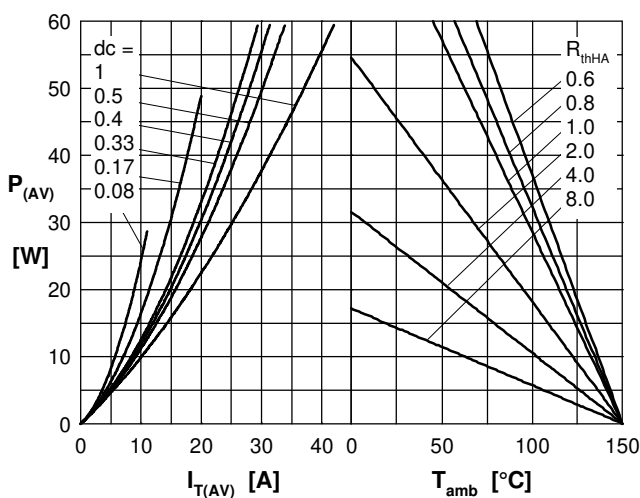


Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature

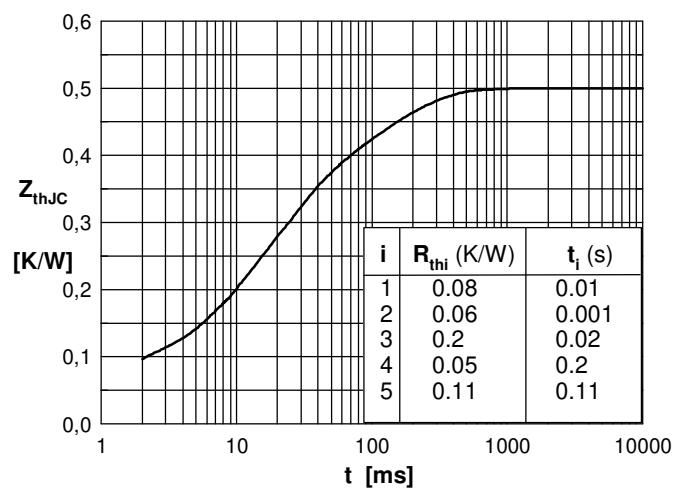


Fig. 7 Transient thermal impedance junction to case