

# High Efficiency Thyristor

$$V_{RRM} = 2 \times 1200 \text{ V}$$

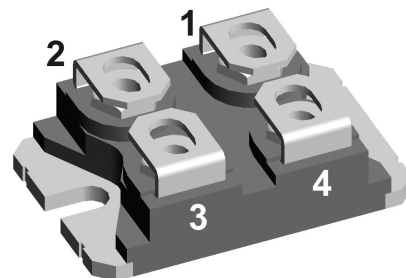
$$I_{TAV} = 60 \text{ A}$$

$$V_T = 1.09 \text{ V}$$

Phase leg

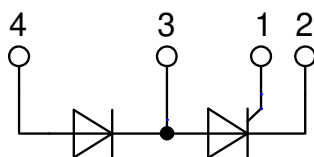
Part number

**CLA60PD1200NA**



Backside: Isolated

 E72873



## 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: SOT-227B (minibloc)

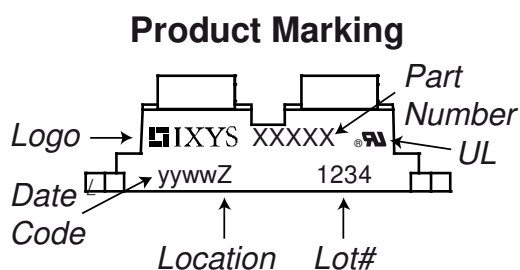
- Isolation Voltage: 3000 V~
- Industry standard outline
- RoHS compliant
- Epoxy meets UL 94V-0
- Base plate: Copper internally DCB isolated
- Advanced power cycling

## 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 | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                                                         |                                |         |      | 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                       | $V_{R/D} = 1200\text{ V}$                                                                                                                                                                             | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 50   | $\mu\text{A}$     |
|                |                                                      | $V_{R/D} = 1200\text{ V}$                                                                                                                                                                             | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 5    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 60\text{ A}$                                                                                                                                                                                   | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.16 | V                 |
|                |                                                      | $I_T = 120\text{ A}$                                                                                                                                                                                  |                                |         |      | 1.39 | V                 |
|                |                                                      | $I_T = 60\text{ A}$                                                                                                                                                                                   | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1.09 | V                 |
|                |                                                      | $I_T = 120\text{ A}$                                                                                                                                                                                  |                                |         |      | 1.38 | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 100^{\circ}\text{C}$                                                                                                                                                                           | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 60   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine                                                                                                                                                                                             |                                |         |      | 94   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only                                                                                                                                                                     | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 0.79 | V                 |
| $r_T$          | slope resistance                                     |                                                                                                                                                                                                       |                                |         |      | 4.8  | m $\Omega$        |
| $R_{thJC}$     | thermal resistance junction to case                  |                                                                                                                                                                                                       |                                |         |      | 0.55 | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |                                                                                                                                                                                                       |                                |         | 0.1  |      | K/W               |
| $P_{tot}$      | total power dissipation                              |                                                                                                                                                                                                       | $T_C = 25^{\circ}\text{C}$     |         |      | 220  | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 1.10 | kA                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 1.19 | kA                |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 935  | A                 |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 1.01 | kA                |
| $I^2t$         | value for fusing                                     | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 6.05 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 5.89 | kA <sup>2</sup> s |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                      | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 4.37 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                     | $V_R = 0\text{ V}$             |         |      | 4.25 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400\text{ V}$ $f = 1\text{ MHz}$                                                                                                                                                               | $T_{VJ} = 25^{\circ}\text{C}$  |         | 43   |      | pF                |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30\text{ }\mu\text{s}$                                                                                                                                                                         | $T_C = 150^{\circ}\text{C}$    |         |      | 10   | W                 |
|                |                                                      | $t_p = 300\text{ }\mu\text{s}$                                                                                                                                                                        |                                |         |      | 1    | 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, $I_T = 180\text{ A}$                                                                                                                     |                                |         |      | 150  | A/ $\mu\text{s}$  |
|                |                                                      | $t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$<br>$I_G = 0.45\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 60\text{ A}$                                                |                                |         |      | 500  | A/ $\mu\text{s}$  |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$                                                                                                                                                                             | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 1000 | V/ $\mu\text{s}$  |
|                |                                                      | $R_{GK} = \infty$ ; method 1 (linear voltage rise)                                                                                                                                                    |                                |         |      |      |                   |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6\text{ V}$                                                                                                                                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.5  | V                 |
|                |                                                      |                                                                                                                                                                                                       | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | 1.6  | V                 |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6\text{ V}$                                                                                                                                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 40   | mA                |
|                |                                                      |                                                                                                                                                                                                       | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | 80   | 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                             |                                                                                                                                                                                                       |                                |         |      | 5    | mA                |
| $I_L$          | latching current                                     | $t_p = 10\text{ }\mu\text{s}$                                                                                                                                                                         | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 150  | mA                |
|                |                                                      | $I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$                                                                                                                                            |                                |         |      |      |                   |
| $I_H$          | holding current                                      | $V_D = 6\text{ V}$ $R_{GK} = \infty$                                                                                                                                                                  | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 100  | mA                |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$                                                                                                                                                                           | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 2    | $\mu\text{s}$     |
|                |                                                      | $I_G = 0.5\text{ A}; di_G/dt = 0.5\text{ A}/\mu\text{s}$                                                                                                                                              |                                |         |      |      |                   |
| $t_q$          | turn-off time                                        | $V_R = 100\text{ V}; I_T = 60\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 125^{\circ}\text{C}$<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 SOT-227B (minibloc) |                                                              |                      |                                     | Ratings |      |      |      |
|-----------------------------|--------------------------------------------------------------|----------------------|-------------------------------------|---------|------|------|------|
| Symbol                      | Definition                                                   | Conditions           |                                     | min.    | typ. | max. | Unit |
| $I_{RMS}$                   | RMS current                                                  | per terminal         |                                     |         |      | 150  | 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>               |                                                              |                      |                                     |         | 30   |      | g    |
| $M_D$                       | mounting torque                                              |                      |                                     | 1.1     |      | 1.5  | Nm   |
| $M_T$                       | terminal torque                                              |                      |                                     | 1.1     |      | 1.5  | Nm   |
| $d_{Spp/App}$               | creepage distance on surface   striking distance through air | terminal to terminal | 10.5                                | 3.2     |      |      | mm   |
| $d_{Spb/Apb}$               |                                                              | terminal to backside | 8.6                                 | 6.8     |      |      | mm   |
| $V_{ISOL}$                  | isolation voltage                                            | t = 1 second         | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA | 3000    |      |      | V    |
|                             |                                                              | t = 1 minute         |                                     | 2500    |      |      | V    |

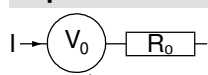

**Part description**

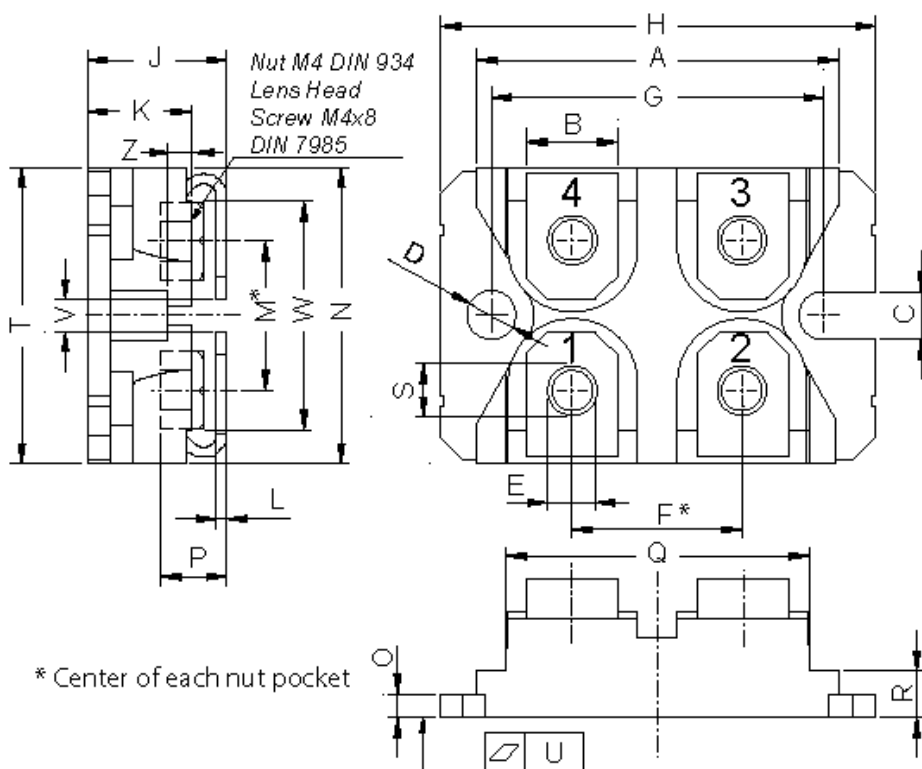
C = Thyristor (SCR)  
 L = High Efficiency Thyristor  
 A = (up to 1200V)  
 60 = Current Rating [A]  
 PD = Phase leg  
 1200 = Reverse Voltage [V]  
 NA = SOT-227B (minibloc)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | CLA60PD1200NA   | CLA60PD1200NA      | Tube          | 10       | 513121   |

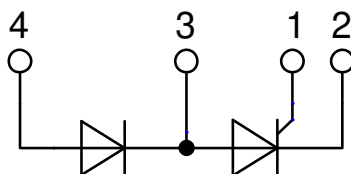
| Similar Part   | Package             | Voltage class |
|----------------|---------------------|---------------|
| CLA100PD1200NA | SOT-227B (minibloc) | 1200          |

**Equivalent Circuits for Simulation**
*\* on die level*
 $T_{VJ} = 150^{\circ}\text{C}$ 

|                                                                                     |                    |                  |    |
|-------------------------------------------------------------------------------------|--------------------|------------------|----|
|  |                    | <b>Thyristor</b> |    |
| $V_{0\max}$                                                                         | threshold voltage  | 0.79             | V  |
| $R_{0\max}$                                                                         | slope resistance * | 3                | mΩ |

**Outlines SOT-227B (minibloc)**


| Dim. | Millimeter |       | Inches |       |
|------|------------|-------|--------|-------|
|      | min        | max   | min    | max   |
| A    | 31.50      | 31.88 | 1.240  | 1.255 |
| B    | 7.80       | 8.20  | 0.307  | 0.323 |
| C    | 4.09       | 4.29  | 0.161  | 0.169 |
| D    | 4.09       | 4.29  | 0.161  | 0.169 |
| E    | 4.09       | 4.29  | 0.161  | 0.169 |
| F    | 14.91      | 15.11 | 0.587  | 0.595 |
| G    | 30.12      | 30.30 | 1.186  | 1.193 |
| H    | 37.80      | 38.23 | 1.488  | 1.505 |
| J    | 11.68      | 12.22 | 0.460  | 0.481 |
| K    | 8.92       | 9.60  | 0.351  | 0.378 |
| L    | 0.74       | 0.84  | 0.029  | 0.033 |
| M    | 12.50      | 13.10 | 0.492  | 0.516 |
| N    | 25.15      | 25.42 | 0.990  | 1.001 |
| O    | 1.95       | 2.13  | 0.077  | 0.084 |
| P    | 4.95       | 6.20  | 0.195  | 0.244 |
| Q    | 26.54      | 26.90 | 1.045  | 1.059 |
| R    | 3.94       | 4.42  | 0.155  | 0.167 |
| S    | 4.55       | 4.85  | 0.179  | 0.191 |
| T    | 24.59      | 25.25 | 0.968  | 0.994 |
| U    | -0.05      | 0.10  | -0.002 | 0.004 |
| V    | 3.20       | 5.50  | 0.126  | 0.217 |
| W    | 19.81      | 21.08 | 0.780  | 0.830 |
| Z    | 2.50       | 2.70  | 0.098  | 0.106 |



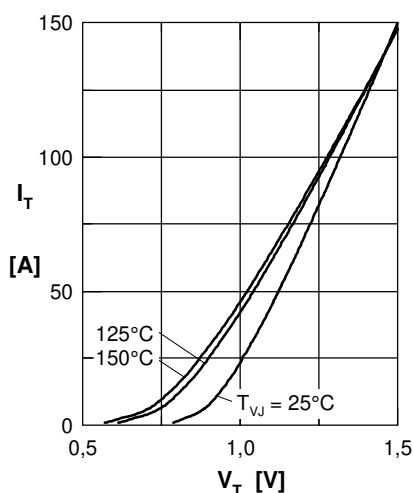
**Thyristor**


Fig. 1 Forward characteristics

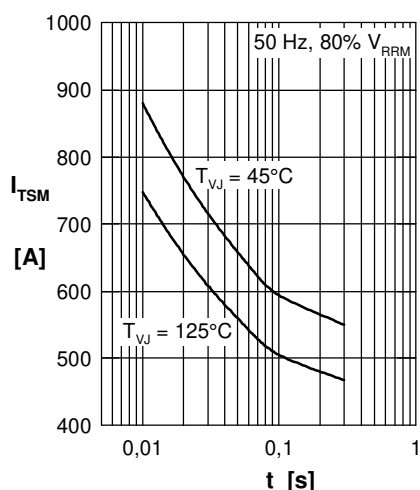


Fig. 2 Surge overload current

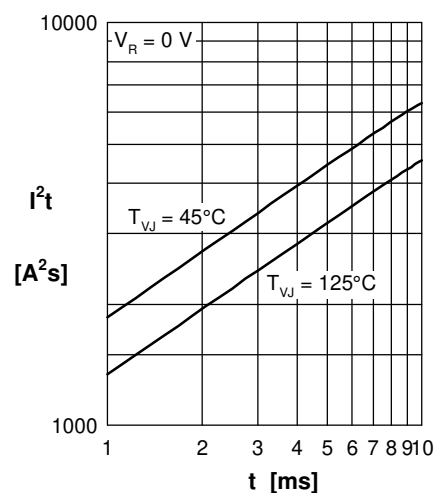
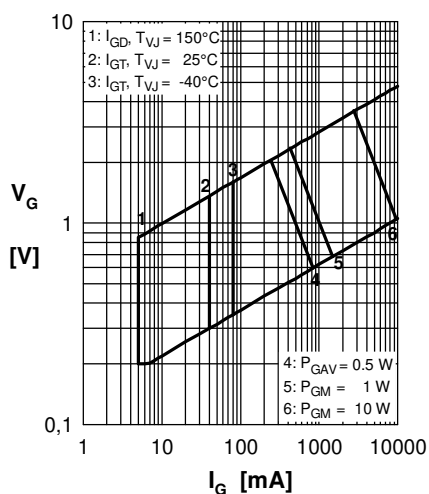

 Fig. 3  $I^2t$  versus time (1-10 ms)


Fig. 4 Gate trigger characteristics

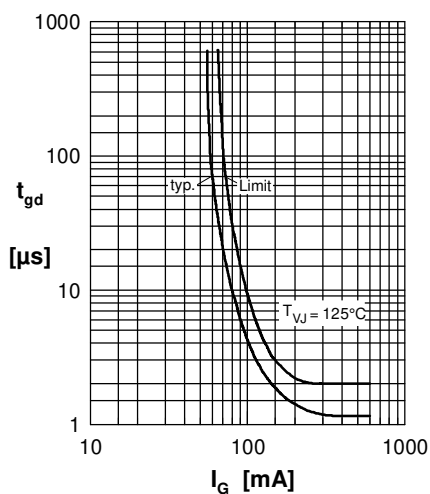


Fig. 5 Gate controlled delay time

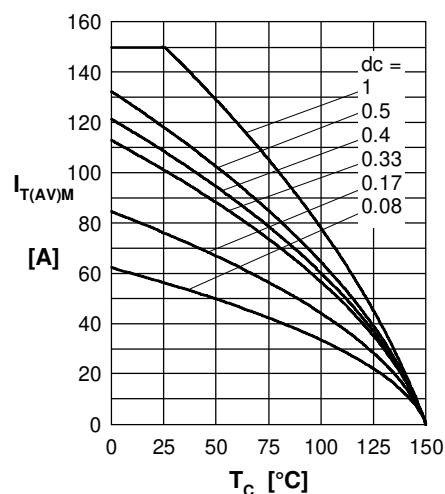


Fig. 6 Max. forward current at case temperature

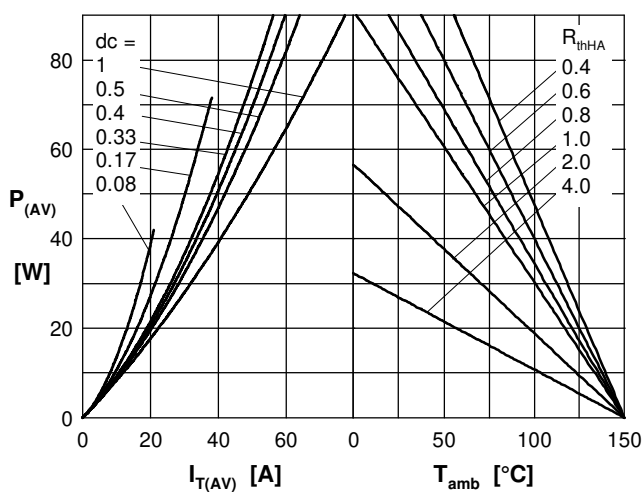
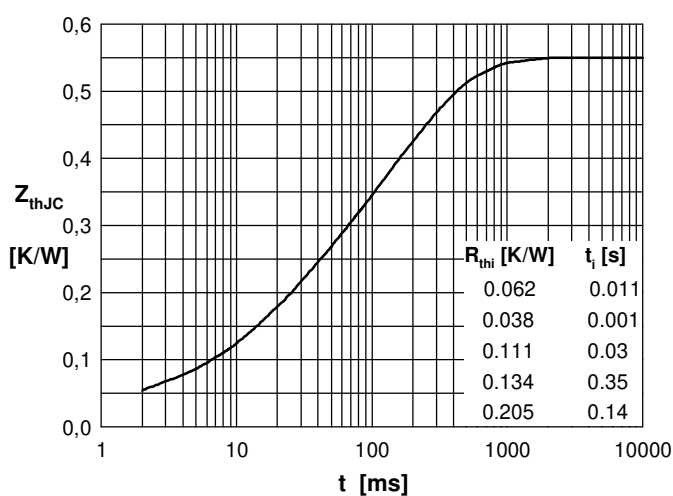

 Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature


Fig. 8 Transient thermal impedance junction to case