

High Efficiency Thyristor

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

$$I_{TAV} = 40 \text{ A}$$

$$V_T = 1.23 \text{ V}$$

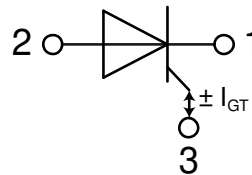
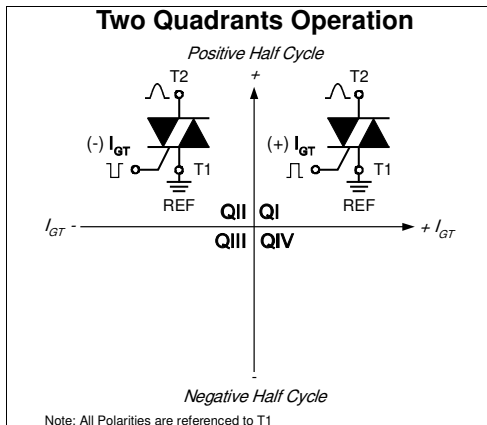
Two Quadrants Operation QI & QII
 Single Thyristor with two gate polarities

Part number

CLA40E1200NHB



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: CLB40I1200PZ

Applications:

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

Package: TO-247

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

Disclaimer Notice

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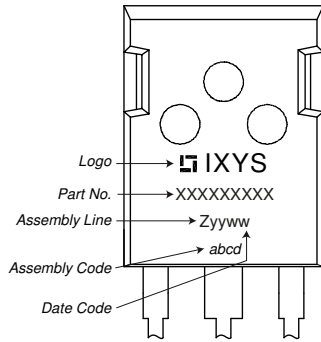


| Thyristor | | | Ratings | | | |
|----------------|--|---|-------------------------|------|----------|-------------------|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
| $V_{RSM/DSM}$ | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 1300 | V |
| $V_{RRM/DRM}$ | max. repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 1200 | V |
| I_{RD} | reverse current, drain current | $V_{R/D} = 1200 V$ | $T_{VJ} = 25^{\circ}C$ | | 10 | μA |
| | | $V_{R/D} = 1200 V$ | $T_{VJ} = 125^{\circ}C$ | | 2 | mA |
| V_T | forward voltage drop | $I_T = 40 A$ | $T_{VJ} = 25^{\circ}C$ | | 1.28 | V |
| | | $I_T = 80 A$ | | | 1.55 | V |
| | | $I_T = 40 A$ | $T_{VJ} = 125^{\circ}C$ | | 1.23 | V |
| | | $I_T = 80 A$ | | | 1.59 | V |
| I_{TAV} | average forward current | $T_C = 120^{\circ}C$ | $T_{VJ} = 150^{\circ}C$ | | 40 | A |
| $I_{T(RMS)}$ | RMS forward current | 180° sine | | | 63 | A |
| V_{T0} | threshold voltage | } for power loss calculation only | $T_{VJ} = 150^{\circ}C$ | | 0.85 | V |
| r_T | slope resistance | | | | 9.2 | m Ω |
| R_{thJC} | thermal resistance junction to case | | | | 0.4 | K/W |
| R_{thCH} | thermal resistance case to heatsink | | | 0.25 | | K/W |
| P_{tot} | total power dissipation | | $T_C = 25^{\circ}C$ | | 310 | W |
| I_{TSM} | max. forward surge current | $t = 10 ms$; (50 Hz), sine | $T_{VJ} = 45^{\circ}C$ | | 520 | A |
| | | $t = 8,3 ms$; (60 Hz), sine | $V_R = 0 V$ | | 560 | A |
| | | $t = 10 ms$; (50 Hz), sine | $T_{VJ} = 150^{\circ}C$ | | 440 | A |
| | | $t = 8,3 ms$; (60 Hz), sine | $V_R = 0 V$ | | 475 | A |
| I^2t | value for fusing | $t = 10 ms$; (50 Hz), sine | $T_{VJ} = 45^{\circ}C$ | | 1.35 | kA ² s |
| | | $t = 8,3 ms$; (60 Hz), sine | $V_R = 0 V$ | | 1.31 | kA ² s |
| | | $t = 10 ms$; (50 Hz), sine | $T_{VJ} = 150^{\circ}C$ | | 970 | A ² s |
| | | $t = 8,3 ms$; (60 Hz), sine | $V_R = 0 V$ | | 940 | A ² s |
| C_J | junction capacitance | $V_R = 400 V$ $f = 1 MHz$ | $T_{VJ} = 25^{\circ}C$ | | 19 | 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 | $T_{VJ} = 150^{\circ}C$; $f = 50 Hz$ repetitive, $I_T = 120 A$ | | | 150 | A/ μs |
| | | $t_p = 200 \mu s$; $di_G/dt = 0.3 A/\mu s$; $I_G = 0.3 A$; $V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 40 A$ | | | 500 | A/ μs |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage | $V = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$; method 1 (linear voltage rise) | $T_{VJ} = 150^{\circ}C$ | | 500 | V/ μs |
| 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 | $V_D = 6 V$ | $T_{VJ} = 25^{\circ}C$ | | ± 35 | mA |
| | | | $T_{VJ} = -40^{\circ}C$ | | ± 55 | 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 | | | | ± 1 | mA |
| I_L | latching current | $t_p = 10 \mu s$ | $T_{VJ} = 25^{\circ}C$ | | 100 | mA |
| | | $I_G = 0.3 A$; $di_G/dt = 0.3 A/\mu s$ | | | | |
| I_H | holding current | $V_D = 6 V$ $R_{GK} = \infty$ | $T_{VJ} = 25^{\circ}C$ | | 70 | mA |
| t_{gd} | gate controlled delay time | $V_D = \frac{1}{2} V_{DRM}$ | $T_{VJ} = 25^{\circ}C$ | | 2 | μs |
| | | $I_G = 0.3 A$; $di_G/dt = 0.3 A/\mu s$ | | | | |
| t_q | turn-off time | $V_R = 100 V$; $I_T = 40 A$; $V = \frac{2}{3} V_{DRM}$ $di/dt = 10 A/\mu s$ $dv/dt = 20 V/\mu s$ $t_p = 200 \mu s$ | $T_{VJ} = 125^{\circ}C$ | | 150 | μs |



| Package TO-247 | | | 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 |
| Weight | | | | 6 | | g |
| M_D | mounting torque | | 0.8 | | 1.2 | Nm |
| F_C | mounting force with clip | | 20 | | 120 | N |

Product Marking



Part description

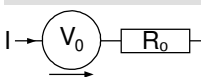
- C = Thyristor (SCR)
- L = High Efficiency Thyristor
- A = (up to 1200V)
- 40 = Current Rating [A]
- E = Single Thyristor with two gate polarities
- 1200 = Reverse Voltage [V]
- N = Three Quadrants operation: QI - QIII
- HB = TO-247AD (3)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | CLA40E1200NHB | CLA40E1200NHB | Tube | 30 | 524548 |

Equivalent Circuits for Simulation

* on die level

$T_{VJ} = 150\text{ °C}$



Thyristor

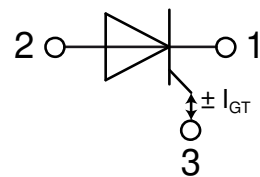
| | | | |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage | 0.85 | V |
| $R_{0\ max}$ | slope resistance * | 6.7 | mΩ |



Outlines TO-247



| Sym. | Inches | | Millimeter | |
|------|-----------|-------|------------|-------|
| | min. | max. | min. | max. |
| A | 0.185 | 0.209 | 4.70 | 5.30 |
| A1 | 0.087 | 0.102 | 2.21 | 2.59 |
| A2 | 0.059 | 0.098 | 1.50 | 2.49 |
| D | 0.819 | 0.845 | 20.79 | 21.45 |
| E | 0.610 | 0.640 | 15.48 | 16.24 |
| E2 | 0.170 | 0.216 | 4.31 | 5.48 |
| e | 0.215 BSC | | 5.46 BSC | |
| L | 0.780 | 0.800 | 19.80 | 20.30 |
| L1 | - | 0.177 | - | 4.49 |
| Ø P | 0.140 | 0.144 | 3.55 | 3.65 |
| Q | 0.212 | 0.244 | 5.38 | 6.19 |
| S | 0.242 BSC | | 6.14 BSC | |
| b | 0.039 | 0.055 | 0.99 | 1.40 |
| b2 | 0.065 | 0.094 | 1.65 | 2.39 |
| b4 | 0.102 | 0.135 | 2.59 | 3.43 |
| c | 0.015 | 0.035 | 0.38 | 0.89 |
| D1 | 0.515 | - | 13.07 | - |
| D2 | 0.020 | 0.053 | 0.51 | 1.35 |
| E1 | 0.530 | - | 13.45 | - |
| Ø P1 | - | 0.29 | - | 7.39 |



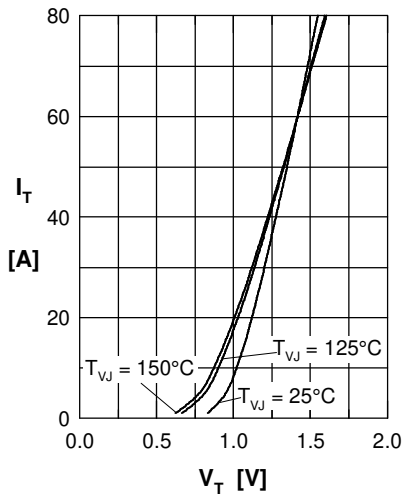
Thyristor


Fig. 1 Forward characteristics

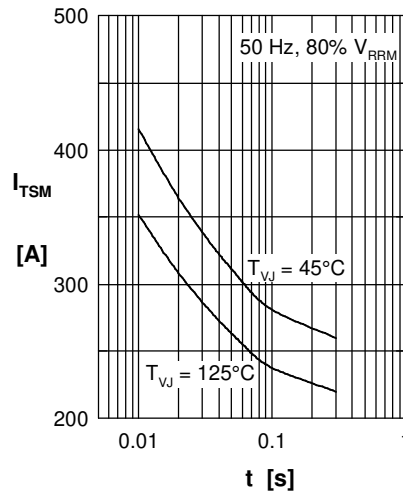
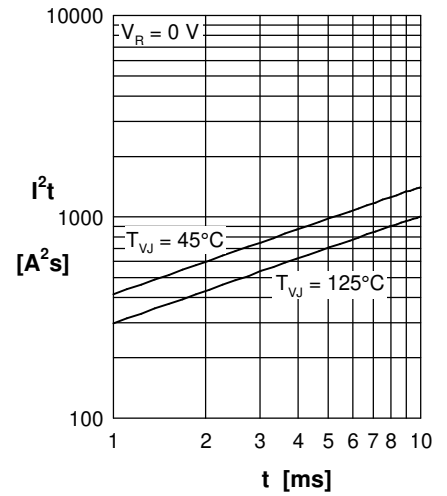
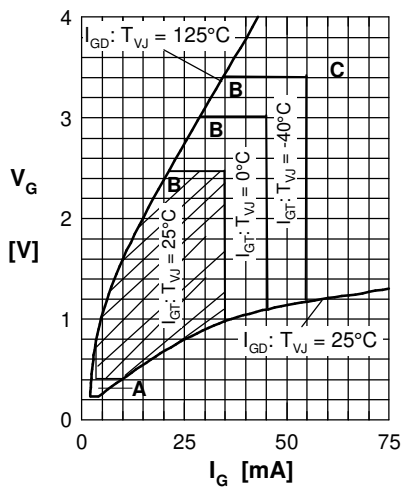

 Fig. 2 Surge overload current
 I_{TSM} : crest value, t : duration

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


Fig. 4 Gate voltage & gate current

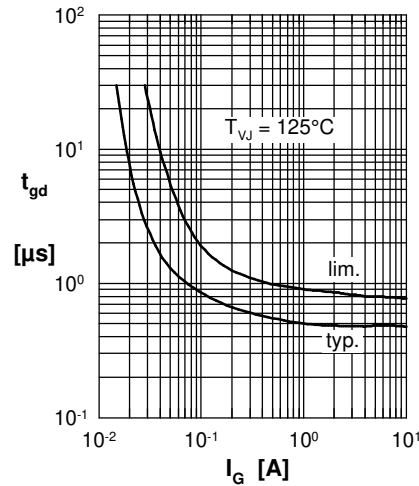
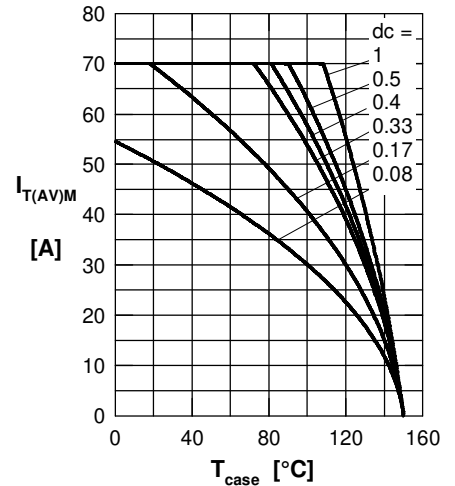

 Fig. 5 Gate controlled delay time t_{gd}


Fig. 6 Max. forward current at case temperature

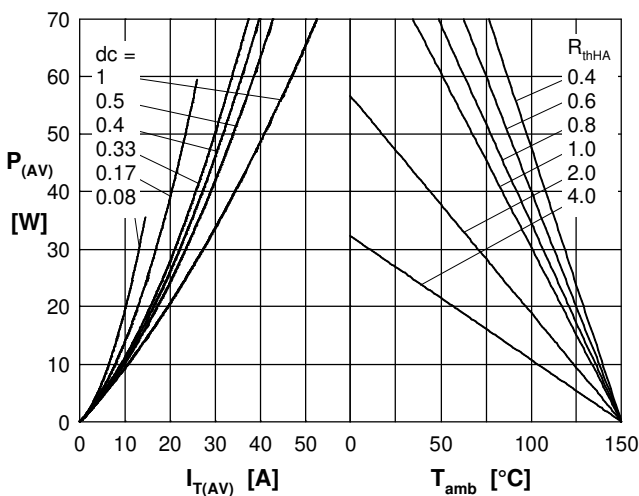
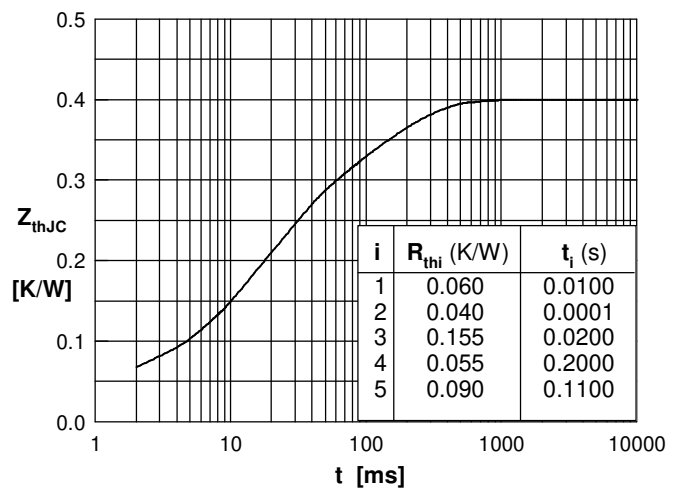

 Fig. 7a Power dissipation versus direct output current
 Fig. 7b and ambient temperature


Fig. 7 Transient thermal impedance junction to case

