

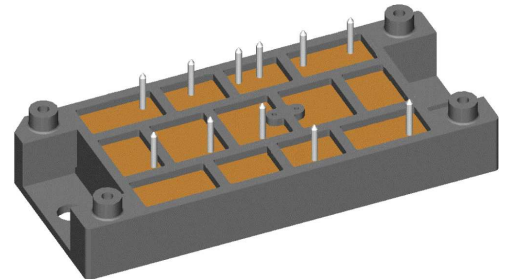
Thyristor Module

| 3~ Rectifier | Brake Chopper |
|----------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$ |
| $I_{DAV} = 180 \text{ A}$ | $I_{C25} = 180 \text{ A}$ |
| $I_{FSM} = 700 \text{ A}$ | $V_{CE(sat)} = 1.7 \text{ V}$ |

3~ Rectifier Bridge, half-controlled (high-side) + Brake Unit

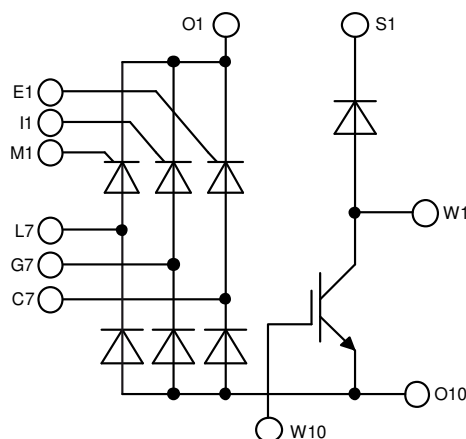
Part number

VVZB120-16ioX



Backside: isolated

 E72873



Features / Advantages:

- Package with DCB ceramic base plate
- Improved temperature and power cycling
- Planar passivated chips
- Very low forward voltage drop
- Very low leakage current
- X2PT - 2nd generation Xtreme light Punch Through
- Rugged X2PT design results in:
 - short circuit rated for 10 μsec .
 - very low gate charge
 - low EMI
 - square RBSOA @ 2x I_c
- Thin wafer technology combined with X2PT design results in a competitive low $V_{CE(sat)}$ and low thermal resistance

Applications:

- 3~ Rectifier with brake unit for drive inverters

Package: V2-Pack

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Height: 17 mm
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

Disclaimer Notice

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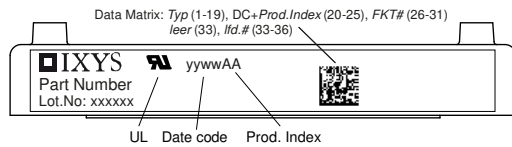
| Rectifier | | | | Ratings | | | |
|----------------|--|--|-------------------------|---------|------|-------------------|--|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit | |
| $V_{RSM/DSM}$ | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 1700 | V | |
| $V_{RRM/DRM}$ | max. repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 1600 | V | |
| I_{RD} | reverse current, drain current | $V_{R/D} = 1600 V$ | $T_{VJ} = 25^{\circ}C$ | | 50 | μA | |
| | | $V_{R/D} = 1600 V$ | $T_{VJ} = 150^{\circ}C$ | | 20 | mA | |
| V_T | forward voltage drop | $I_T = 60 A$ | $T_{VJ} = 25^{\circ}C$ | | 1.27 | V | |
| | | $I_T = 180 A$ | | | 1.90 | V | |
| | | $I_T = 60 A$ | $T_{VJ} = 125^{\circ}C$ | | 1.25 | V | |
| | | $I_T = 180 A$ | | | 2.04 | V | |
| I_{DAV} | bridge output current | $T_C = 85^{\circ}C$ | $T_{VJ} = 150^{\circ}C$ | | 180 | A | |
| | | rectangular $d = 1/3$ | | | | | |
| V_{T0} | threshold voltage | } for power loss calculation only | $T_{VJ} = 150^{\circ}C$ | | 0.83 | V | |
| r_T | slope resistance | | | | 6.9 | m Ω | |
| R_{thJC} | thermal resistance junction to case | | | | 0.5 | K/W | |
| R_{thCH} | thermal resistance case to heatsink | | | 0.1 | | K/W | |
| P_{tot} | total power dissipation | | $T_C = 25^{\circ}C$ | | 250 | W | |
| I_{TSM} | max. forward surge current | $t = 10 ms; (50 Hz), sine$ | $T_{VJ} = 45^{\circ}C$ | | 700 | A | |
| | | $t = 8,3 ms; (60 Hz), sine$ | $V_R = 0 V$ | | 755 | A | |
| | | $t = 10 ms; (50 Hz), sine$ | $T_{VJ} = 150^{\circ}C$ | | 595 | A | |
| | | $t = 8,3 ms; (60 Hz), sine$ | $V_R = 0 V$ | | 645 | A | |
| I^2t | value for fusing | $t = 10 ms; (50 Hz), sine$ | $T_{VJ} = 45^{\circ}C$ | | 2.45 | kA ² s | |
| | | $t = 8,3 ms; (60 Hz), sine$ | $V_R = 0 V$ | | 2.37 | kA ² s | |
| | | $t = 10 ms; (50 Hz), sine$ | $T_{VJ} = 150^{\circ}C$ | | 1.77 | kA ² s | |
| | | $t = 8,3 ms; (60 Hz), sine$ | $V_R = 0 V$ | | 1.73 | kA ² s | |
| C_J | junction capacitance | $V_R = 400 V f = 1 MHz$ | $T_{VJ} = 25^{\circ}C$ | | 54 | 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, $I_T = 180 A$ | | | 150 | A/ μs | |
| | | $t_p = 200 \mu s; di_G/dt = 0.45 A/\mu s;$ $I_G = 0.45 A; V = 2/3 V_{DRM}$ non-repet., $I_T = 60 A$ | | | 500 | A/ μs | |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage | $V = 2/3 V_{DRM}$ $R_{GK} = \infty; \text{method 1 (linear voltage rise)}$ | $T_{VJ} = 150^{\circ}C$ | | 1000 | V/ μs | |
| 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 | $V_D = 6 V$ | $T_{VJ} = 25^{\circ}C$ | | 95 | mA | |
| | | | $T_{VJ} = -40^{\circ}C$ | | 200 | mA | |
| V_{GD} | gate non-trigger voltage | $V_D = 2/3 V_{DRM}$ | $T_{VJ} = 150^{\circ}C$ | | 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 | $V_D = 6 V R_{GK} = \infty$ | $T_{VJ} = 25^{\circ}C$ | | 200 | mA | |
| t_{gd} | gate controlled delay time | $V_D = 1/2 V_{DRM}$ | $T_{VJ} = 25^{\circ}C$ | | 2 | μs | |
| | | $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$ | | | | | |
| t_q | turn-off time | $V_R = 100 V; I_T = 60 A; V = 2/3 V_{DRM}$ $di/dt = 10 A/\mu s dv/dt = 20 V/\mu s t_p = 200 \mu s$ | $T_{VJ} = 125^{\circ}C$ | | 150 | μs | |



| Brake IGBT + Diode | | | | Ratings | | | |
|--------------------|--------------------------------------|--|-------------------------|---------|----------|---------|--|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit | |
| V_{CES} | collector emitter voltage | $T_{VJ} = 25^{\circ}C$ | | | 1200 | V | |
| V_{GES} | max. DC gate voltage | | | | ± 20 | V | |
| V_{GEM} | max. transient gate emitter voltage | | | | ± 30 | V | |
| I_{C25} | collector current | $T_C = 25^{\circ}C$ | | | 180 | A | |
| I_{C80} | | $T_C = 80^{\circ}C$ | | | 140 | A | |
| P_{tot} | total power dissipation | $T_C = 25^{\circ}C$ | | | 500 | W | |
| $V_{CE(sat)}$ | collector emitter saturation voltage | $I_C = 100\text{ A}; V_{GE} = 15\text{ V}$ | | | 1.7 | V | |
| | | | | | 1.9 | V | |
| $V_{GE(th)}$ | gate emitter threshold voltage | $I_C = 4\text{ mA}; V_{GE} = V_{CE}$ | 6 | 6.8 | 7.5 | V | |
| I_{CES} | collector emitter leakage current | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$ | | | 0.1 | mA | |
| | | | | | 0.1 | mA | |
| I_{GES} | gate emitter leakage current | $V_{GE} = \pm 20\text{ V}$ | | | 500 | nA | |
| $Q_{G(on)}$ | total gate charge | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 100\text{ A}$ | | 340 | | nC | |
| $t_{d(on)}$ | turn-on delay time | inductive load $V_{CE} = 600\text{ V}; I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 6.8\ \Omega$ | $T_{VJ} = 125^{\circ}C$ | | 230 | ns | |
| t_r | current rise time | | | | 70 | ns | |
| $t_{d(off)}$ | turn-off delay time | | | | 380 | ns | |
| t_f | current fall time | | | | 230 | ns | |
| E_{on} | turn-on energy per pulse | | | | 12.5 | mJ | |
| E_{off} | turn-off energy per pulse | | | | 11.5 | mJ | |
| RBSOA | reverse bias safe operating area | $V_{GE} = \pm 15\text{ V}; R_G = 6.8\ \Omega$ | | | | | |
| I_{CM} | | $V_{CEK} = 1200\text{ V}$ | | | 300 | A | |
| SCSOA | short circuit safe operating area | $V_{CEK} = 1200\text{ V}$ | | | | | |
| t_{SC} | short circuit duration | $V_{CE} = 720\text{ V}; V_{GE} = \pm 15$ | $T_{VJ} = 125^{\circ}C$ | | 10 | μs | |
| I_{SC} | short circuit current | $R_G = 6.8\ \Omega$; non-repetitive | | 450 | | A | |
| R_{thJC} | thermal resistance junction to case | | | | 0.25 | K/W | |
| R_{thCH} | thermal resistance case to heatsink | | | 0.10 | | K/W | |
| Brake Diode | | | | | | | |
| V_{RRM} | max. repetitive reverse voltage | | | | 1200 | V | |
| I_{F25} | forward current | | $T_C = 25^{\circ}C$ | | 48 | A | |
| I_{F80} | | | $T_C = 80^{\circ}C$ | | 32 | A | |
| V_F | forward voltage | $I_F = 30\text{ A}$ | $T_{VJ} = 25^{\circ}C$ | | 2.75 | V | |
| | | | $T_{VJ} = 125^{\circ}C$ | 1.60 | | V | |
| I_R | reverse current | $V_R = V_{RRM}$ | $T_{VJ} = 25^{\circ}C$ | | 0.25 | mA | |
| | | | $T_{VJ} = 125^{\circ}C$ | | 1 | mA | |
| Q_{rr} | reverse recovery charge | $V_R = 600\text{ V}$ $-di_f/dt = 1000\text{ A}/\mu s$ $I_F = 30\text{ A}; V_{GE} = 0\text{ V}$ | $T_{VJ} = 125^{\circ}C$ | | 5.2 | μC | |
| I_{RM} | max. reverse recovery current | | | | 50 | A | |
| t_{rr} | reverse recovery time | | | | 300 | ns | |
| E_{rec} | reverse recovery energy | | | | 1.9 | mJ | |
| R_{thJC} | thermal resistance junction to case | | | | 0.9 | K/W | |
| R_{thCH} | thermal resistance case to heatsink | | | 0.3 | | K/W | |



| Package V2-Pack | | Ratings | | | | |
|-----------------|--|----------------------|------|------|------|------|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
| I_{RMS} | RMS current | per terminal | | | 100 | A |
| T_{VJ} | virtual junction temperature | | -40 | | 150 | °C |
| T_{op} | operation temperature | | -40 | | 125 | °C |
| T_{stg} | storage temperature | | -40 | | 125 | °C |
| Weight | | | | 76 | | g |
| M_D | mounting torque | | 2 | | 2.5 | Nm |
| $d_{Spp/App}$ | creepage distance on surface / striking distance through air | terminal to terminal | 6.0 | | | mm |
| $d_{Spb/Apb}$ | | terminal to backside | 12.0 | | | mm |
| V_{ISOL} | isolation voltage | t = 1 second | 3600 | | | V |
| | | t = 1 minute | 3000 | | | V |

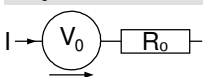


| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | VVZB120-16ioX | VVZB120-16ioX | Box | 6 | 511152 |

Equivalent Circuits for Simulation

* on die level

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



| | Thyristor | Brake Diode | |
|--------------|--------------------|-------------|--------|
| $V_{0\ max}$ | threshold voltage | 0.83 | 1.31 V |
| $R_{0\ max}$ | slope resistance * | 3.7 | 8 mΩ |

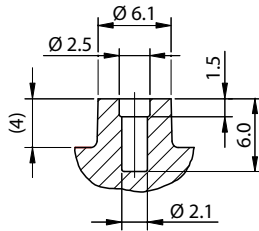


Outlines V2-Pack

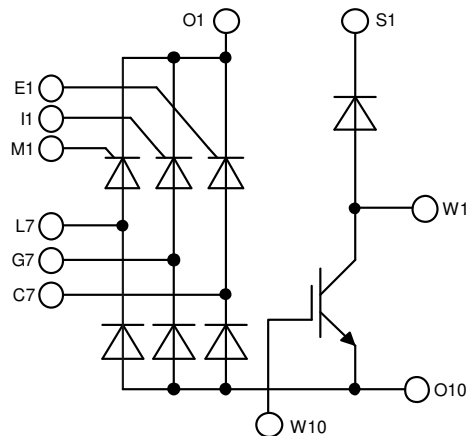
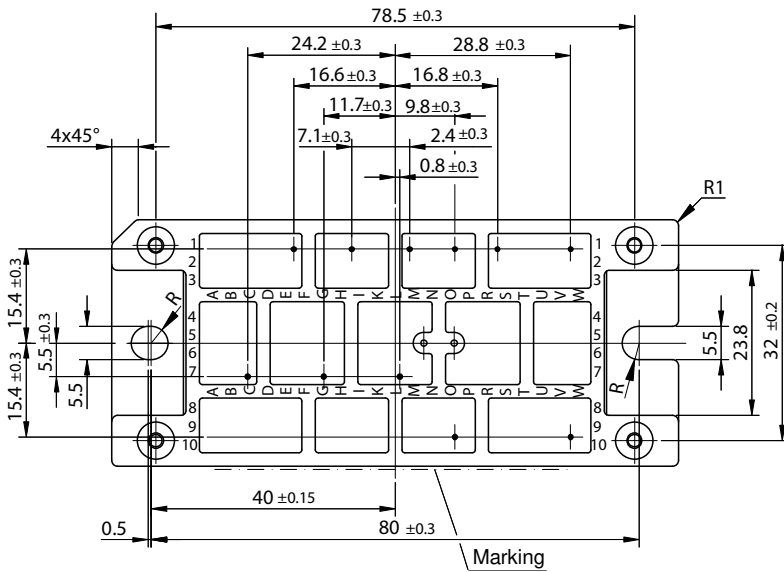
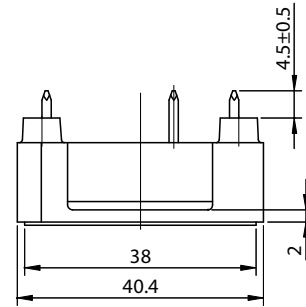
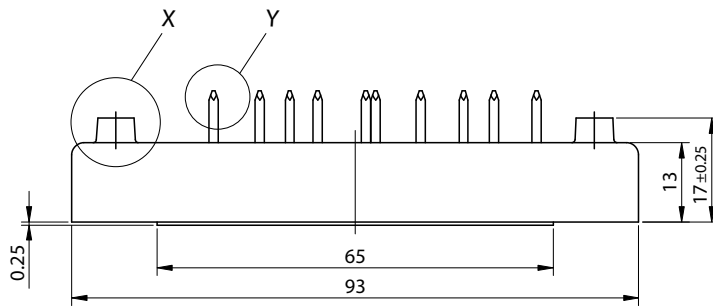
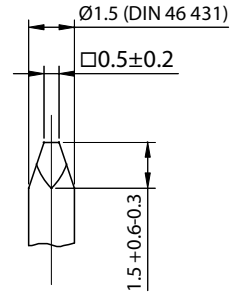
Remarks:

EJOT PT® self-tapping screws of the dimension K25 are recommended for the mechanical connection between module and PCB. Choose the right length according to your board thickness at a maximum depth of 6 mm of the module holes.¹ The recommended mounting torque is 1.5 Nm.

Detail X M 2:1



Detail Y M 5:1



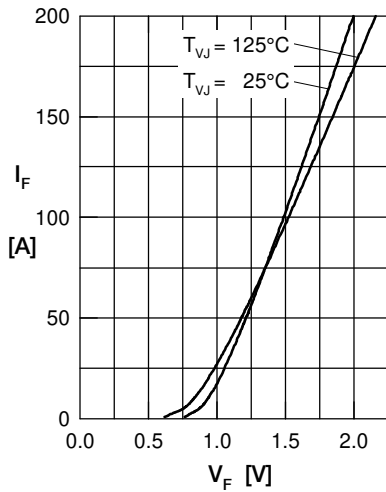
Thyristor


Fig. 1 Forward current vs. voltage drop per thyristor

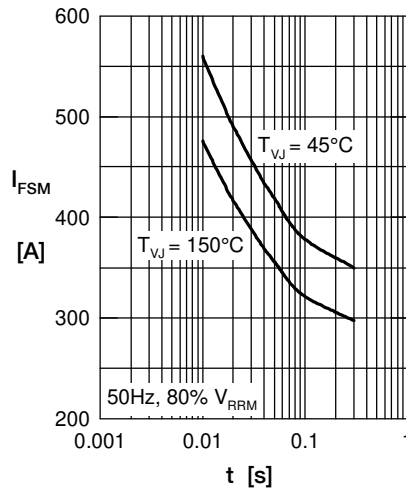


Fig. 2 Surge overload current vs. time per thyristor

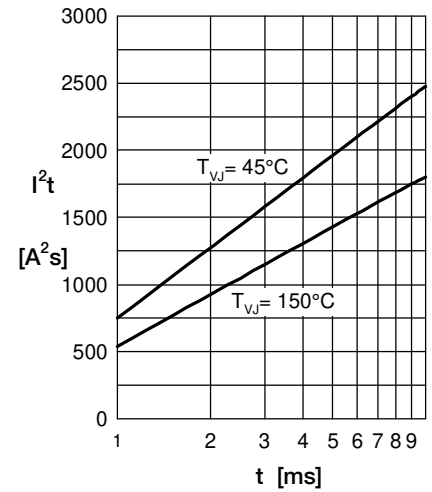
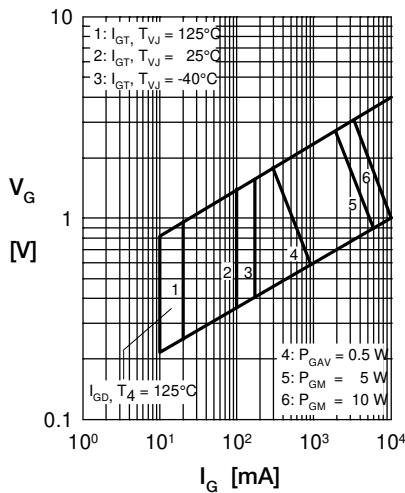

 Fig. 3 I^2t vs. time per thyristor


Fig. 4 Gate trigger characteristics

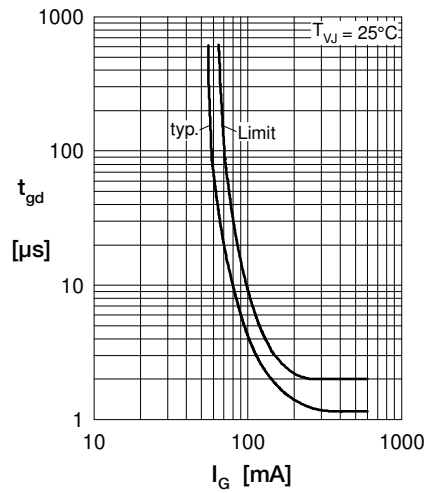


Fig. 5 Gate trigger delay time

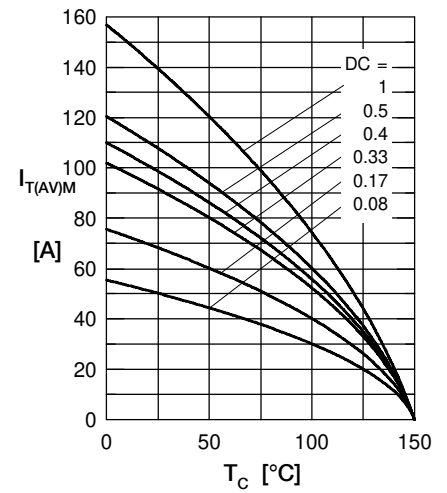


Fig. 5 Max. forward current vs. case temperature per thyristor

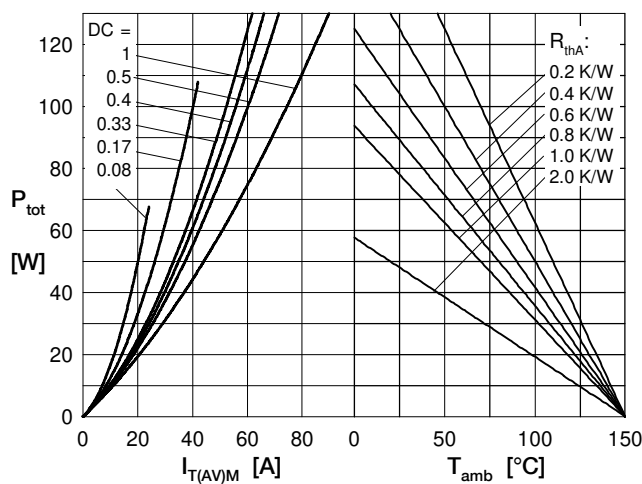


Fig. 4 Power dissipation vs. forward current and ambient temperature per thyristor

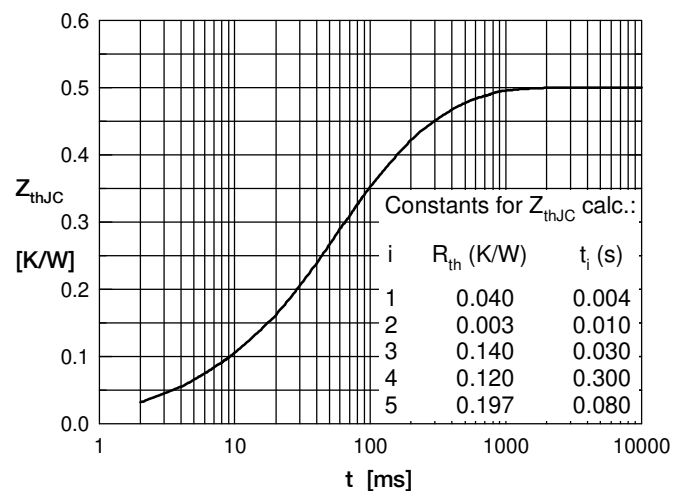


Fig. 6 Transient thermal impedance junction to case vs. time per thyristor

Brake IGBT + Diode


Fig.1 Output characteristics IGBT



Fig.2 Typ. output characteristics IGBT



Fig.3 Typ. transfer charact. IGBT



Fig.4 Typ. turn-on energy & switch. times vs. collector current



Fig.5 Typ. turn-off energy & switch. times vs. collector current

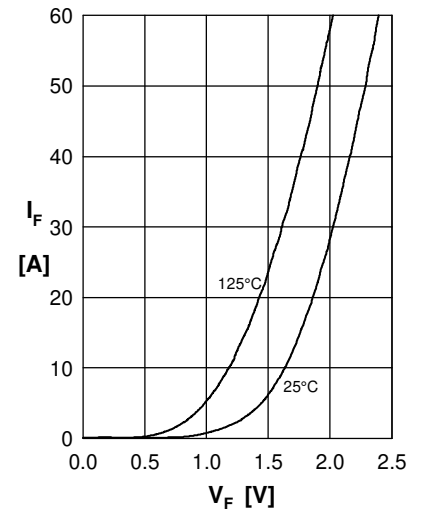


Fig.6 Typ. forward characteristics Diode

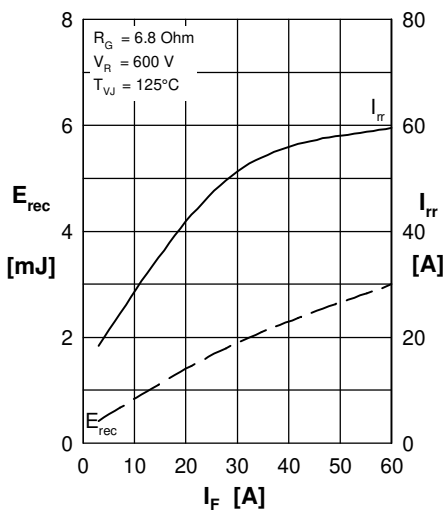


Fig.7 Typ. reverse recovery characteristics Diode

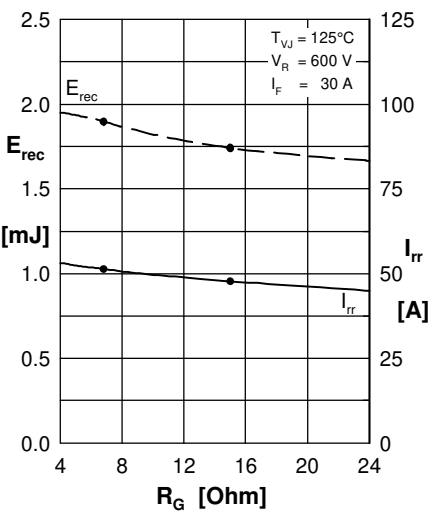


Fig.8 Typ. reverse recovery characteristics Diode

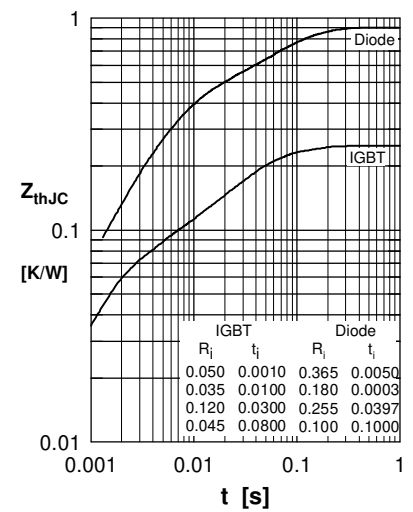


Fig.9 Transient thermal resistance junction to case