

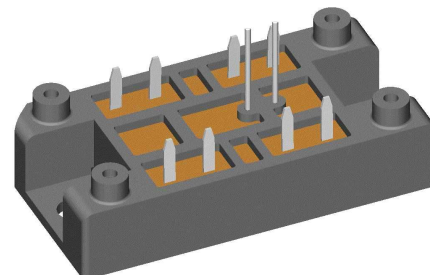
## Standard Rectifier Module

| 3~ Rectifier               | Brake Chopper                  |
|----------------------------|--------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$     |
| $I_{DAV} = 75 \text{ A}$   | $I_{C25} = 58 \text{ A}$       |
| $I_{FSM} = 600 \text{ A}$  | $V_{CE(sat)} = 1.85 \text{ V}$ |

3~ Rectifier Bridge + Brake Unit + NTC

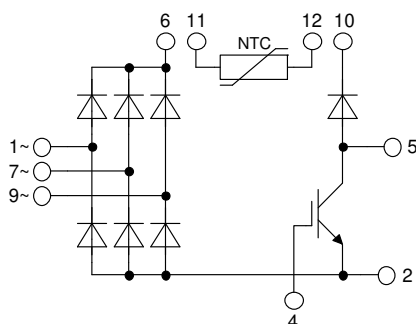
Part number

**VUB72-16NOXT**



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
- NTC

### Applications:

- 3~ Rectifier with brake unit for drive inverters

### Package: V1-A-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

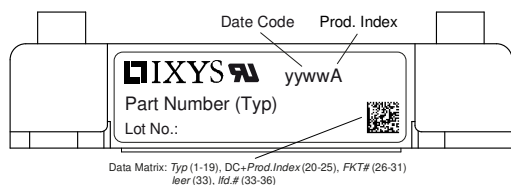
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| Rectifier  |                                              |                                                   |                                                     | Ratings                        |      |      |                   |
|------------|----------------------------------------------|---------------------------------------------------|-----------------------------------------------------|--------------------------------|------|------|-------------------|
| Symbol     | Definition                                   | Conditions                                        |                                                     | min.                           | typ. | max. | Unit              |
| $V_{RSM}$  | max. non-repetitive reverse blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$                     |                                                     |                                |      | 1700 | V                 |
| $V_{RRM}$  | max. repetitive reverse blocking voltage     | $T_{VJ} = 25^{\circ}\text{C}$                     |                                                     |                                |      | 1600 | V                 |
| $I_R$      | reverse current                              | $V_R = 1600\text{ V}$                             | $T_{VJ} = 25^{\circ}\text{C}$                       |                                |      | 40   | $\mu\text{A}$     |
|            |                                              | $V_R = 1600\text{ V}$                             | $T_{VJ} = 150^{\circ}\text{C}$                      |                                |      | 1.5  | mA                |
| $V_F$      | forward voltage drop                         | $I_F = 25\text{ A}$                               | $T_{VJ} = 25^{\circ}\text{C}$                       |                                |      | 1.10 | V                 |
|            |                                              | $I_F = 75\text{ A}$                               |                                                     |                                |      | 1.38 | V                 |
|            |                                              | $I_F = 25\text{ A}$                               | $T_{VJ} = 125^{\circ}\text{C}$                      |                                |      | 1.01 | V                 |
|            |                                              | $I_F = 75\text{ A}$                               |                                                     |                                |      | 1.37 | V                 |
| $I_{DAV}$  | bridge output current                        | $T_C = 110^{\circ}\text{C}$<br>rectangular        | $T_{VJ} = 150^{\circ}\text{C}$<br>$d = \frac{1}{3}$ |                                |      | 75   | A                 |
| $V_{F0}$   | threshold voltage                            | } for power loss calculation only                 |                                                     | $T_{VJ} = 150^{\circ}\text{C}$ |      | 0.79 | V                 |
| $r_F$      | slope resistance                             |                                                   |                                                     |                                |      | 7.7  | m $\Omega$        |
| $R_{thJC}$ | thermal resistance junction to case          |                                                   |                                                     |                                |      | 1.1  | K/W               |
| $R_{thCH}$ | thermal resistance case to heatsink          |                                                   |                                                     |                                | 0.3  |      | K/W               |
| $P_{tot}$  | total power dissipation                      | $T_C = 25^{\circ}\text{C}$                        |                                                     |                                |      | 110  | W                 |
| $I_{FSM}$  | max. forward surge current                   | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 45^{\circ}\text{C}$                       |                                |      | 600  | A                 |
|            |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$                                  |                                |      | 650  | A                 |
|            |                                              | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 150^{\circ}\text{C}$                      |                                |      | 510  | A                 |
|            |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$                                  |                                |      | 550  | A                 |
| $I^2t$     | value for fusing                             | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 45^{\circ}\text{C}$                       |                                |      | 1.80 | kA <sup>2</sup> s |
|            |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$                                  |                                |      | 1.76 | kA <sup>2</sup> s |
|            |                                              | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 150^{\circ}\text{C}$                      |                                |      | 1.30 | kA <sup>2</sup> s |
|            |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$                                  |                                |      | 1.26 | kA <sup>2</sup> s |
| $C_J$      | junction capacitance                         | $V_R = 400\text{ V}; f = 1\text{ MHz}$            |                                                     |                                | 19   |      | pF                |



| Brake IGBT    |                                      |                                                                                                              |                                | Ratings |      |          |               |
|---------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------|---------|------|----------|---------------|
| Symbol        | Definition                           | Conditions                                                                                                   |                                | min.    | typ. | max.     | Unit          |
| $V_{CES}$     | collector emitter voltage            | $T_{VJ} = 25^{\circ}\text{C}$                                                                                |                                |         |      | 1200     | V             |
| $V_{GES}$     | max. DC gate voltage                 |                                                                                                              |                                |         |      | $\pm 20$ | V             |
| $V_{GEM}$     | max. transient gate emitter voltage  |                                                                                                              |                                |         |      | $\pm 30$ | V             |
| $I_{C25}$     | collector current                    | $T_C = 25^{\circ}\text{C}$                                                                                   |                                |         |      | 58       | A             |
| $I_{C80}$     |                                      | $T_C = 80^{\circ}\text{C}$                                                                                   |                                |         |      | 40       | A             |
| $P_{tot}$     | total power dissipation              | $T_C = 25^{\circ}\text{C}$                                                                                   |                                |         |      | 195      | W             |
| $V_{CE(sat)}$ | collector emitter saturation voltage | $I_C = 35\text{ A}; V_{GE} = 15\text{ V}$                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         | 1.85 | 2.15     | V             |
|               |                                      |                                                                                                              | $T_{VJ} = 125^{\circ}\text{C}$ |         | 2.15 |          | V             |
| $V_{GE(th)}$  | gate emitter threshold voltage       | $I_C = 2\text{ mA}; V_{GE} = V_{CE}$                                                                         | $T_{VJ} = 25^{\circ}\text{C}$  | 5.4     | 5.9  | 6.5      | V             |
| $I_{CES}$     | collector emitter leakage current    | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$                                                                      | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 0.1      | mA            |
|               |                                      |                                                                                                              | $T_{VJ} = 125^{\circ}\text{C}$ |         | 0.1  |          | mA            |
| $I_{GES}$     | gate emitter leakage current         | $V_{GE} = \pm 20\text{ V}$                                                                                   |                                |         |      | 500      | nA            |
| $Q_{G(on)}$   | total gate charge                    | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 35\text{ A}$                                             |                                |         | 110  |          | nC            |
| $t_{d(on)}$   | turn-on delay time                   | inductive load<br>$V_{CE} = 600\text{ V}; I_C = 35\text{ A}$<br>$V_{GE} = \pm 15\text{ V}; R_G = 27\ \Omega$ | $T_{VJ} = 125^{\circ}\text{C}$ |         | 70   |          | ns            |
| $t_r$         | current rise time                    |                                                                                                              |                                |         | 40   |          | ns            |
| $t_{d(off)}$  | turn-off delay time                  |                                                                                                              |                                |         | 250  |          | ns            |
| $t_f$         | current fall time                    |                                                                                                              |                                |         | 100  |          | ns            |
| $E_{on}$      | turn-on energy per pulse             |                                                                                                              |                                |         | 3.8  |          | mJ            |
| $E_{off}$     | turn-off energy per pulse            |                                                                                                              |                                |         | 4.1  |          | mJ            |
| <b>RBSOA</b>  | reverse bias safe operating area     | $V_{GE} = \pm 15\text{ V}; R_G = 27\ \Omega$                                                                 | $T_{VJ} = 125^{\circ}\text{C}$ |         |      |          |               |
| $I_{CM}$      |                                      | $V_{CEK} = 1200\text{ V}$                                                                                    |                                |         |      | 105      | A             |
| <b>SCSOA</b>  | short circuit safe operating area    | $V_{CEK} = 1200\text{ V}$                                                                                    |                                |         |      |          |               |
| $t_{SC}$      | short circuit duration               | $V_{CE} = 900\text{ V}; V_{GE} = \pm 15$                                                                     | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 10       | $\mu\text{s}$ |
| $I_{SC}$      | short circuit current                | $R_G = 27\ \Omega$ ; non-repetitive                                                                          |                                |         | 140  |          | A             |
| $R_{thJC}$    | thermal resistance junction to case  |                                                                                                              |                                |         |      | 0.65     | K/W           |
| $R_{thCH}$    | thermal resistance case to heatsink  |                                                                                                              |                                |         | 0.25 |          | K/W           |
| Brake Diode   |                                      |                                                                                                              |                                |         |      |          |               |
| $V_{RRM}$     | max. repetitive reverse voltage      |                                                                                                              | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1200     | V             |
| $I_{F25}$     | forward current                      |                                                                                                              | $T_C = 25^{\circ}\text{C}$     |         |      | 31       | A             |
| $I_{F80}$     |                                      |                                                                                                              | $T_C = 80^{\circ}\text{C}$     |         |      | 21       | A             |
| $V_F$         | forward voltage                      | $I_F = 25\text{ A}$                                                                                          | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 2.97     | V             |
|               |                                      |                                                                                                              | $T_{VJ} = 125^{\circ}\text{C}$ |         | 2.43 |          | V             |
| $I_R$         | reverse current                      | $V_R = V_{RRM}$                                                                                              | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 0.1      | mA            |
|               |                                      |                                                                                                              | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 0.5      | mA            |
| $Q_{rr}$      | reverse recovery charge              | $V_R = 600\text{ V}$<br>$-di_F/dt = 400\text{ A}/\mu\text{s}$<br>$I_F = 25\text{ A}; V_{GE} = 0\text{ V}$    | $T_{VJ} = 125^{\circ}\text{C}$ |         | 1.2  |          | $\mu\text{C}$ |
| $I_{RM}$      | max. reverse recovery current        |                                                                                                              |                                |         | 18   |          | A             |
| $t_{rr}$      | reverse recovery time                |                                                                                                              |                                |         | 130  |          | ns            |
| $R_{thJC}$    | thermal resistance junction to case  |                                                                                                              |                                |         |      | 1.6      | K/W           |
| $R_{thCH}$    | thermal resistance case to heatsink  |                                                                                                              |                                |         | 0.55 |          | K/W           |

| Package V1-A-Pack                       |                                                              |                      |  | Ratings |      |      |      |
|-----------------------------------------|--------------------------------------------------------------|----------------------|--|---------|------|------|------|
| Symbol                                  | Definition                                                   | Conditions           |  | min.    | typ. | max. | Unit |
| I <sub>RMS</sub>                        | RMS current                                                  | per terminal         |  |         |      | 100  | A    |
| T <sub>VJ</sub>                         | virtual junction temperature                                 |                      |  | -40     |      | 150  | °C   |
| T <sub>op</sub>                         | operation temperature                                        |                      |  | -40     |      | 125  | °C   |
| T <sub>stg</sub>                        | storage temperature                                          |                      |  | -40     |      | 125  | °C   |
| Weight                                  |                                                              |                      |  |         | 37   |      | g    |
| M <sub>D</sub>                          | mounting torque                                              |                      |  | 2       |      | 2.5  | Nm   |
| d <sub>Spp/App</sub>                    | creepage distance on surface   striking distance through air | terminal to terminal |  | 6.0     |      |      | mm   |
| d <sub>Spb/Apb</sub>                    |                                                              | terminal to backside |  | 12.0    |      |      | mm   |
| V <sub>ISOL</sub>                       | isolation voltage                                            | t = 1 second         |  | 3600    |      |      | V    |
|                                         |                                                              | t = 1 minute         |  | 3000    |      |      | V    |
| 50/60 Hz, RMS; I <sub>ISOL</sub> ≤ 1 mA |                                                              |                      |  |         |      |      |      |



| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | VUB72-16NOXT    | VUB72-16NOXT       | Blister       | 24       | 515894   |

| Similar Part | Package   | Voltage class |
|--------------|-----------|---------------|
| VUB72-12NOXT | V1-A-Pack | 1200          |

### Temperature Sensor NTC

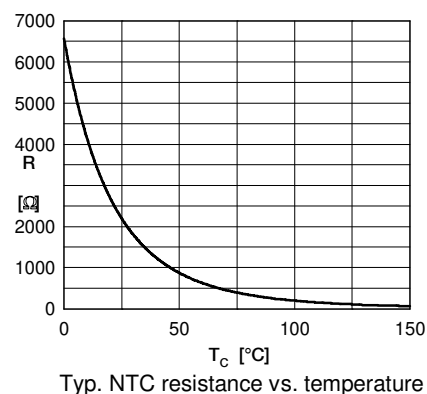
| Symbol      | Definition              | Conditions          | min. | typ. | max. | Unit |
|-------------|-------------------------|---------------------|------|------|------|------|
| $R_{25}$    | resistance              | $T_{VJ} = 25^\circ$ | 2.13 | 2.2  | 2.27 | kΩ   |
| $B_{25/50}$ | temperature coefficient |                     |      | 3560 |      | K    |

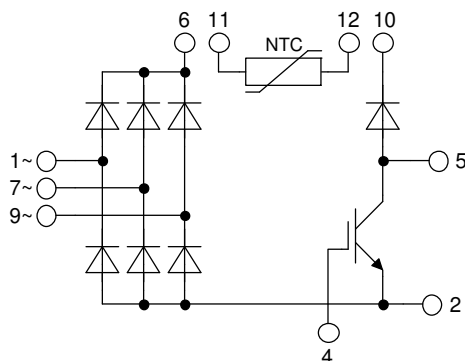
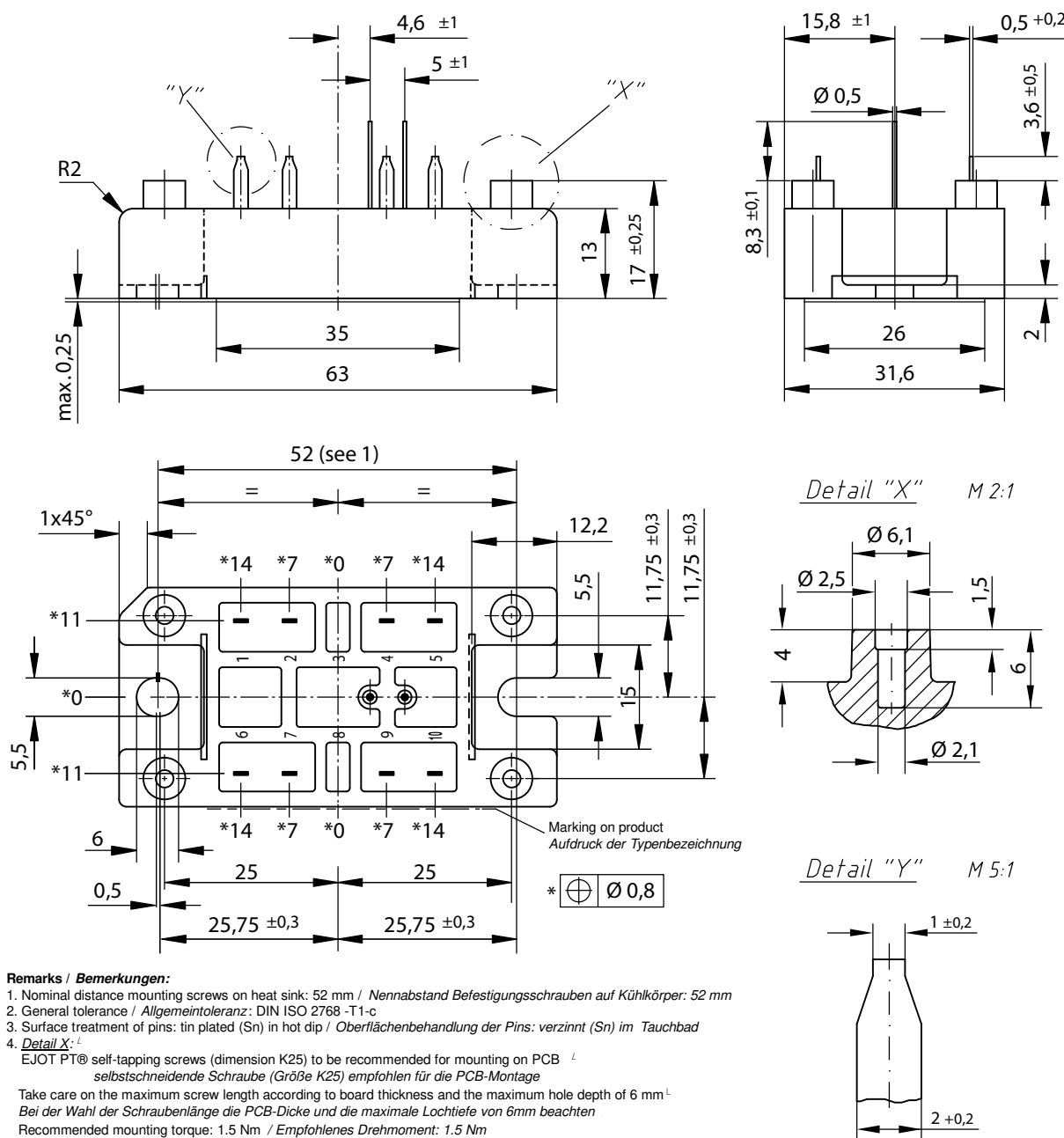
### Equivalent Circuits for Simulation

\* on die level

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

|       |                    | Rectifier | Brake IGBT | Brake Diode |    |
|-------|--------------------|-----------|------------|-------------|----|
| $V_0$ | threshold voltage  | 0.79      | 1.1        | 1.16        | V  |
| $R_0$ | slope resistance * | 6.5       | 40         | 43          | mΩ |



**Outlines V1-A-Pack**


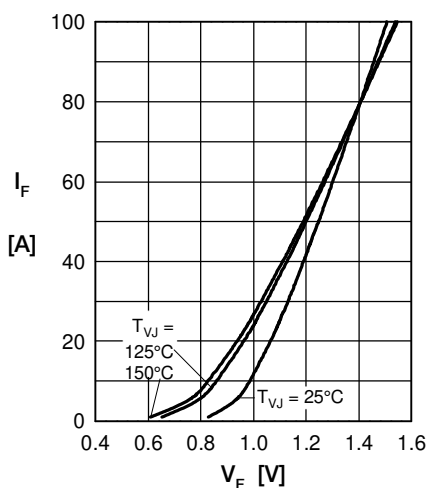
**Rectifier**


Fig. 1 Forward current vs. voltage drop per diode

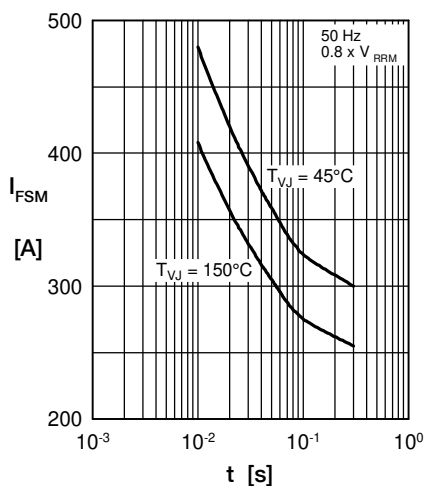


Fig. 2 Surge overload current vs. time per diode

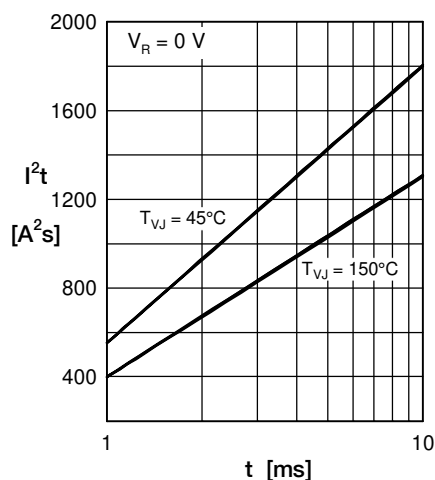


Fig. 3  $I^2t$  vs. time per diode

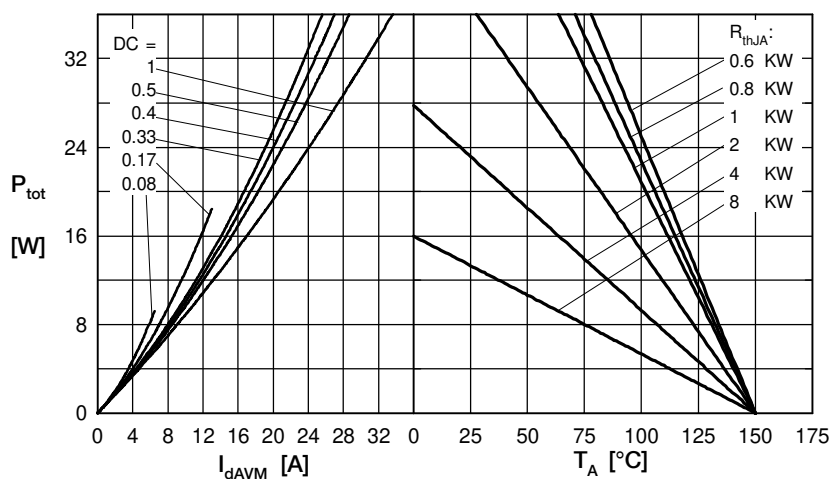


Fig. 4 Power dissipation vs. forward current and ambient temperature per diode

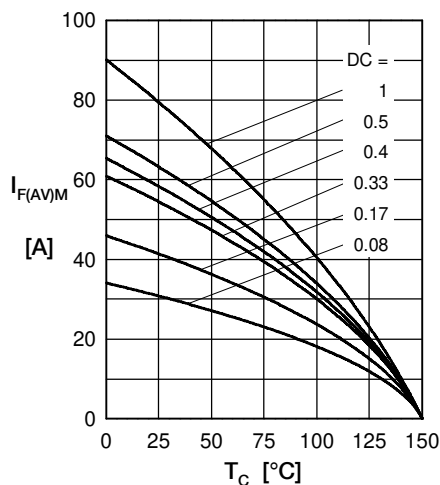


Fig. 5 Max. forward current vs. case temperature per diode

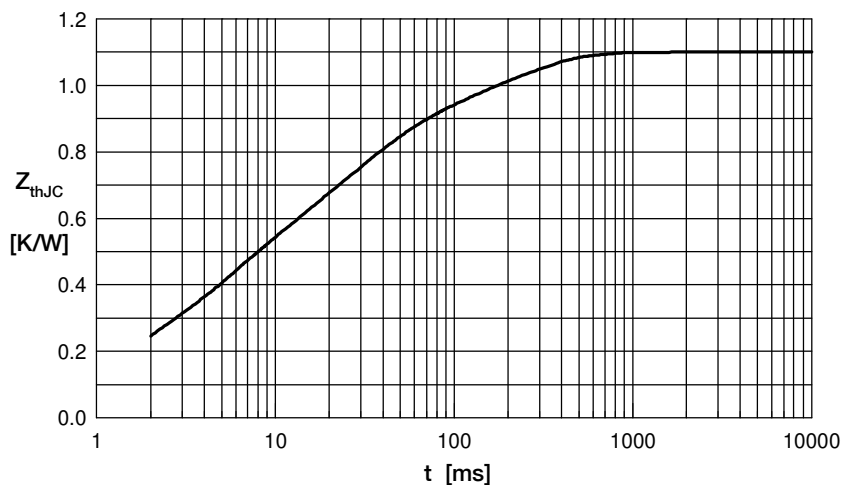


Fig. 6 Transient thermal impedance junction to case vs. time per diode

Constants for  $Z_{thJC}$  calculation:

| i | $R_{th}$ (K/W) | $t_i$ (s) |
|---|----------------|-----------|
| 1 | 0.0607         | 0.0004    |
| 2 | 0.1230         | 0.00256   |
| 3 | 0.2305         | 0.0045    |
| 4 | 0.4230         | 0.0242    |
| 5 | 0.2628         | 0.1800    |

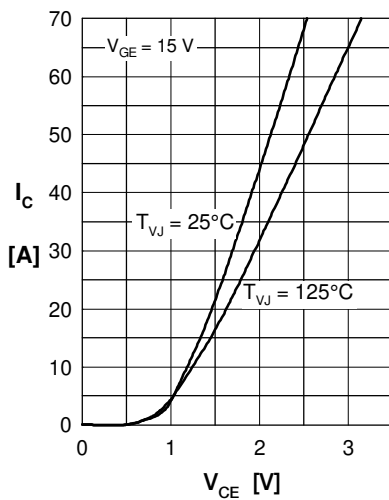
**Brake IGBT**


Fig. 1 Typ. output characteristics

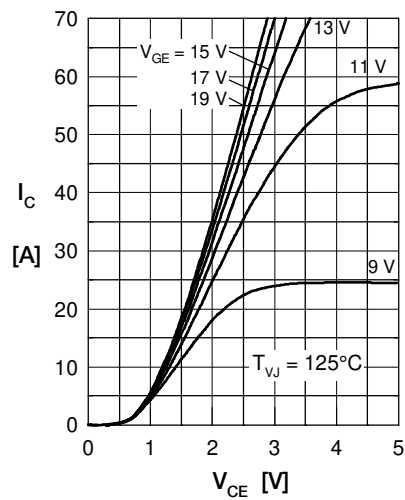


Fig. 2 Typ. output characteristics

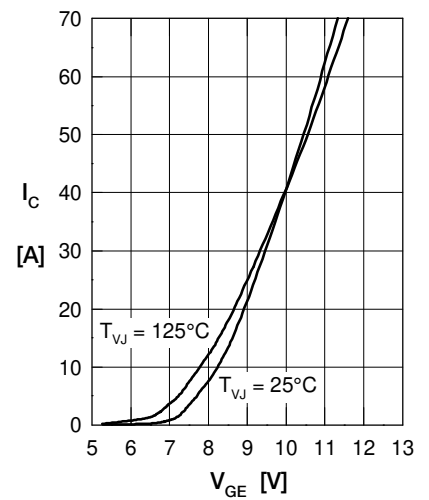


Fig. 3 Typ. tranfer characteristics

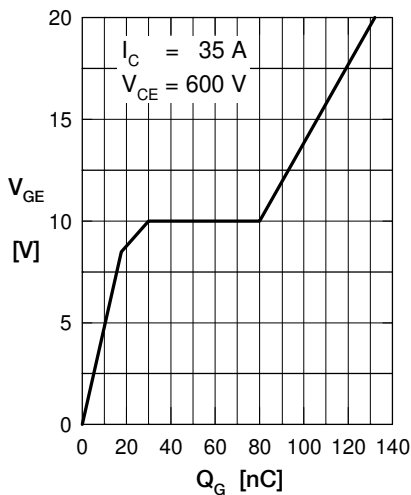


Fig. 4 Typ. turn-on gate charge

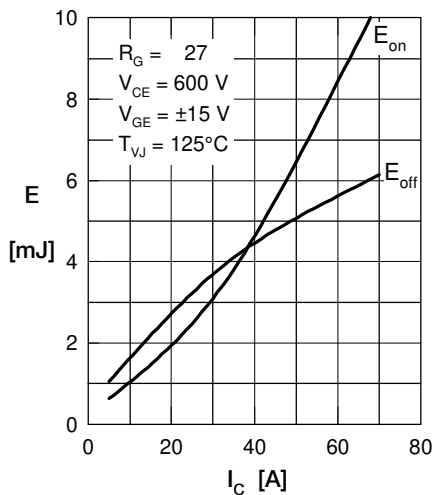


Fig. 5 Typ. switching energy versus collector current

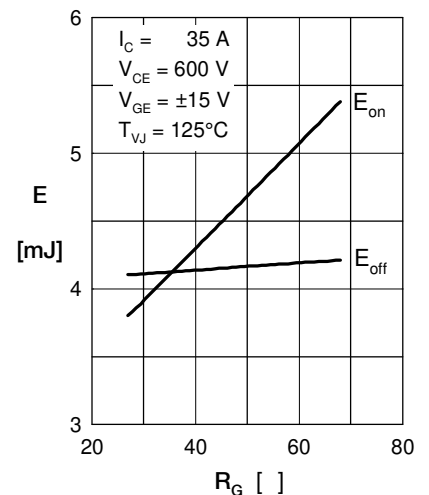


Fig. 6 Typ. switching energy versus gate resistance

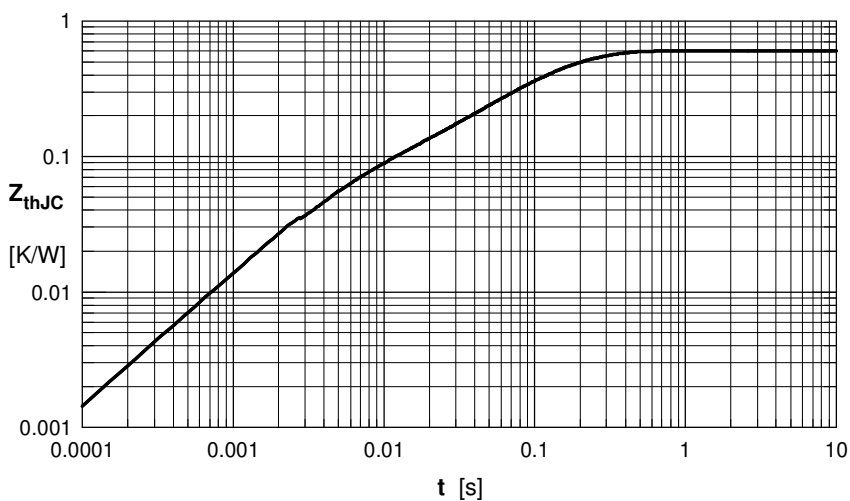


Fig. 7 Typ. transient thermal impedance

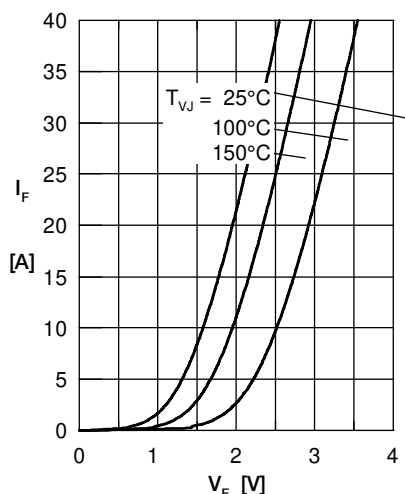
**Brake Diode**


Fig. 1 Forward current  $I_F$  versus  $V_F$

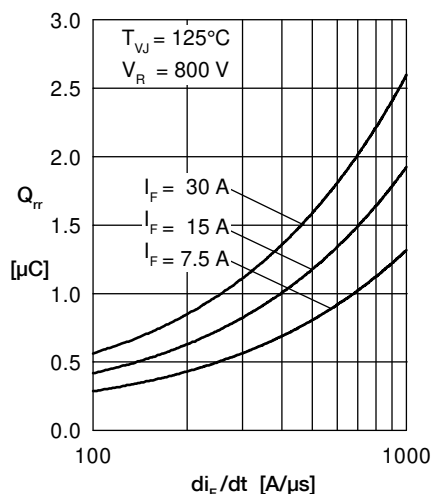


Fig. 2 Typ. reverse recov. charge  $Q_r$  versus  $di_F/dt$

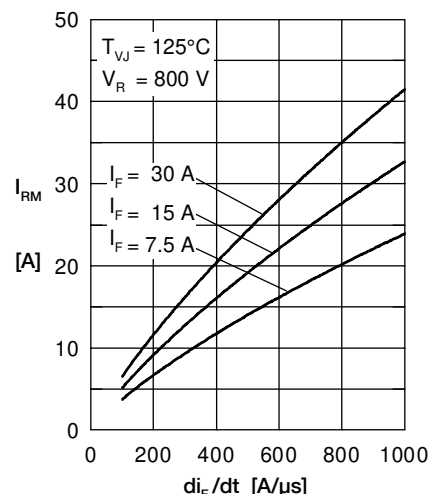


Fig. 3 Typ. peak reverse current  $I_{RM}$  versus  $di_F/dt$

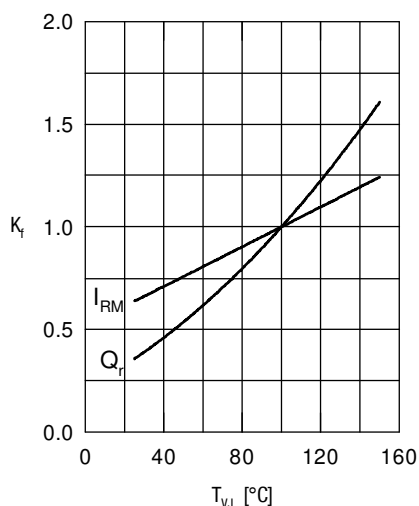


Fig. 4 Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

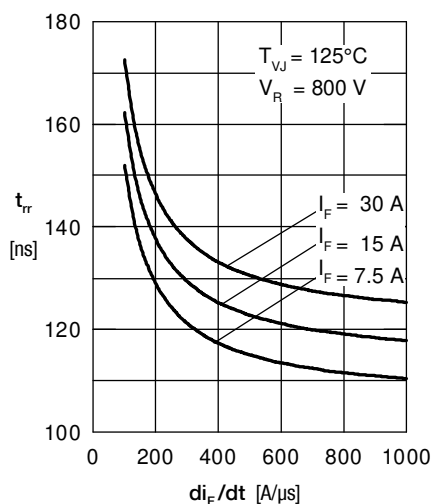


Fig. 5 Typ. recovery time  $t_{rr}$  versus  $di_F/dt$

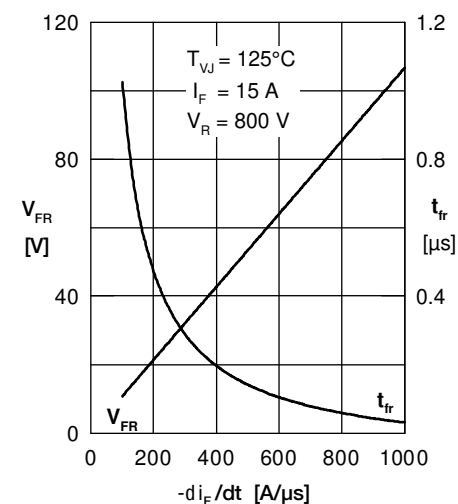


Fig. 6 Typ. peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

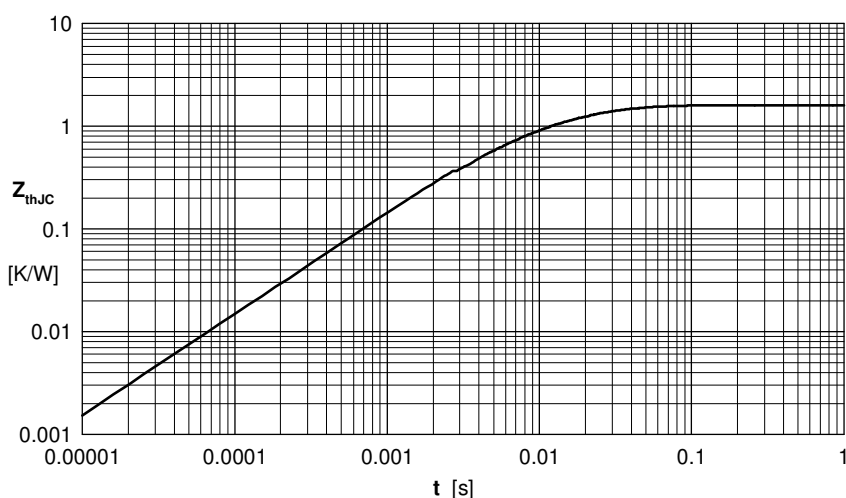


Fig. 7 Transient thermal impedance junction to case