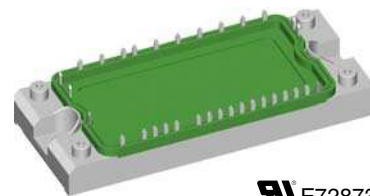
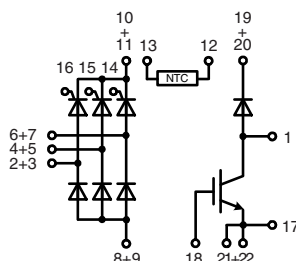


# Three Phase Rectifier Bridge with IGBT and Fast Recovery Diode for Braking System

$$V_{RRM} = 1600 \text{ V}$$

$$I_{dAVM} = 135 \text{ A}$$

| $V_{RRM}$<br>V | Type            |
|----------------|-----------------|
| 1600           | VVZB 135-16 NO1 |



E72873

See outline drawing for pin arrangement

| Symbol         | Conditions                                                                                                                        | Maximum Ratings |                  |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|
| $V_{RRM}$      |                                                                                                                                   | 1600            | V                |
| $I_{dAVM}$     | $T_C = 85^\circ\text{C}$ ; sinusoidal 120°                                                                                        | 135             | A                |
| $I_{FSM}$      | $T_{VJ} = 45^\circ\text{C}$ ; $t = 10 \text{ ms}$ ; $V_R = 0 \text{ V}$                                                           | 700             | A                |
|                | $T_{VJ} = 150^\circ\text{C}$ ; $t = 10 \text{ ms}$ ; $V_R = 0 \text{ V}$                                                          | 610             | A                |
| $I^2t$         | $T_{VJ} = 45^\circ\text{C}$ ; $t = 10 \text{ ms}$ ; $V_R = 0 \text{ V}$                                                           | 2450            | A                |
|                | $T_{VJ} = 150^\circ\text{C}$ ; $t = 10 \text{ ms}$ ; $V_R = 0 \text{ V}$                                                          | 1860            | A                |
| $P_{tot}$      | $T_C = 25^\circ\text{C}$ per diode                                                                                                | 190             | W                |
| $(di/dt)_{cr}$ | $T_{VJ} = T_{VJM}$ ; $f = 50 \text{ Hz}$ ; $t_p = 200 \mu\text{s}$ repetitive; $I_T = 150 \text{ A}$                              | 100             | A/ $\mu\text{s}$ |
|                | $V_D = \frac{2}{3} V_{DRM}$ ; $I_G = 0.45 \text{ A}$ ; $di_G/dt = 0.45 \text{ A}/\mu\text{s}$ non repetitive; $I_T = I_{d(AV)}/3$ | 500             | A/ $\mu\text{s}$ |
| $(dv/dt)_{cr}$ | $T_{VJ} = T_{VJM}$ ; $V_{DR} = \frac{2}{3} V_{DRM}$ ; $R_{GK} = \infty$ ; method 1 (linear voltage rise)                          | 1000            | V/ $\mu\text{s}$ |
| $P_{GM}$       | $T_{VJ} = T_{VJM}$ ; $t_p = 30 \mu\text{s}$                                                                                       | 10              | W                |
|                | $I_T = I_{d(AV)}/3$ ; $t_p = 300 \mu\text{s}$                                                                                     | 5               | W                |
| $P_{GAVM}$     |                                                                                                                                   | 0.5             | W                |
| $V_{CES}$      | $T_{VJ} = 25^\circ\text{C}$ to $150^\circ\text{C}$                                                                                | 1200            | V                |
| $V_{GE}$       | Continuous                                                                                                                        | $\pm 20$        | V                |
| $I_{C25}$      | $T_C = 25^\circ\text{C}$ ; DC                                                                                                     | 95              | A                |
| $I_{C80}$      | $T_C = 80^\circ\text{C}$ ; DC                                                                                                     | 67              | A                |
| $I_{CM}$       | $t_p = \text{Pulse width limited by } T_{VJM}$                                                                                    | 100             | A                |
| $P_{tot}$      | $T_C = 25^\circ\text{C}$                                                                                                          | 380             | W                |
| $V_{RRM}$      |                                                                                                                                   | 1200            | V                |
| $I_{FAV}$      | $T_C = 80^\circ\text{C}$ ; rectangular $d = 0.5$                                                                                  | 27              | A                |
| $I_{FRMS}$     | $T_C = 80^\circ\text{C}$ ; rectangular $d = 0.5$                                                                                  | 38              | A                |
| $I_{FRM}$      | $T_C = 80^\circ\text{C}$ ; $t_p = 10 \mu\text{s}$ ; $f = 5 \text{ kHz}$                                                           | tbd             | A                |
| $I_{FSM}$      | $T_{VJ} = 45^\circ\text{C}$ ; $t = 10 \text{ ms}$                                                                                 | 200             | A                |
| $P_{tot}$      | $T_C = 25^\circ\text{C}$                                                                                                          | 130             | W                |

Data according to IEC 60747

## Features

- Soldering connections for PCB mounting
- Convenient package outline
- Thermistor
- Isolation voltage 2500 V~

## Applications

- Drive Inverters with brake system

## Advantages

- 2 functions in one package
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability

| Symbol                                               | Conditions                                                                                                                                                                                                     | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |                      |                                   |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------|-----------------------------------|
|                                                      |                                                                                                                                                                                                                | min.                                                                                   | typ.                 | max.                              |
| $I_R, I_D$                                           | $V_R = V_{RRM}; T_{VJ} = 25^{\circ}\text{C}$<br>$V_R = V_{RRM}; T_{VJ} = 150^{\circ}\text{C}$                                                                                                                  |                                                                                        |                      | 0.1 mA<br>20 mA                   |
| $V_F, V_T$                                           | $I_F = 80 \text{ A}; T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                                              |                                                                                        |                      | 1.43 V                            |
| $V_{T0}$<br>$r_T$                                    | for power-loss calculations only<br>$T_{VJ} = 150^{\circ}\text{C}$                                                                                                                                             |                                                                                        |                      | 0.85 V<br>7.1 m $\Omega$          |
| $V_{GT}$<br>$I_{GT}$                                 | $V_D = 6 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$<br>$V_D = 6 \text{ V}; T_{VJ} = -40^{\circ}\text{C}$<br>$V_D = 6 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$<br>$V_D = 6 \text{ V}; T_{VJ} = -40^{\circ}\text{C}$ |                                                                                        |                      | 1.5 V<br>1.6 V<br>78 mA<br>200 mA |
| $V_{GD}$<br>$I_{GD}$                                 | $T_{VJ} = T_{VJM}; V_D = \frac{2}{3} V_{DRM}$<br>$T_{VJ} = T_{VJM}; V_D = \frac{2}{3} V_{DRM}$                                                                                                                 |                                                                                        |                      | 0.2 V<br>5 mA                     |
| $I_L$                                                | $V_D = 6 \text{ V}; t_G = 10 \mu\text{s};$<br>$di_G/dt = 0.45 \text{ A}/\mu\text{s}; I_G = 0.45 \text{ A}$                                                                                                     |                                                                                        |                      | 450 mA                            |
| $I_H$                                                | $T_{VJ} = T_{VJM}; V_D = 6 \text{ V}; R_{GK} = \infty$                                                                                                                                                         |                                                                                        |                      | 100 mA                            |
| $t_{gd}$                                             | $V_D = \frac{1}{2} V_{DRM};$<br>$di_G/dt = 0.45 \text{ A}/\mu\text{s}; I_G = 0.45 \text{ A}$                                                                                                                   |                                                                                        |                      | 2 $\mu\text{s}$                   |
| $t_q$                                                | $T_{VJ} = T_{VJM}; V_R = 100 \text{ V};$<br>$V_D = \frac{2}{3} V_{DRM}; t_p = 200 \mu\text{s};$<br>$dv/dt = 15 \text{ V}/\mu\text{s}; I_T = 20 \text{ A};$<br>$-di/dt = 10 \text{ A}/\mu\text{s}$              |                                                                                        |                      | 150 $\mu\text{s}$                 |
| $R_{thJC}$<br>$R_{thCH}$                             | per diode                                                                                                                                                                                                      |                                                                                        | 0.2                  | 0.65 K/W<br>K/W                   |
| $V_{BR(CES)}$<br>$V_{GE(th)}$                        | $V_{GS} = 0 \text{ V}; I_C = 0.1 \text{ mA}$<br>$I_C = 8 \text{ mA}$                                                                                                                                           | 1200<br>4.5                                                                            |                      | V<br>V                            |
| $I_{CES}$                                            | $V_{CE} = 1200 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$<br>$V_{CE} = 0.8 \cdot V_{CES}; T_{VJ} = 125^{\circ}\text{C}$                                                                                           |                                                                                        |                      | 0.1 mA<br>0.5 mA                  |
| $V_{CEsat}$                                          | $V_{GE} = 15 \text{ V}; I_C = 100 \text{ A}$                                                                                                                                                                   |                                                                                        |                      | 3.5 V                             |
| $t_{SC}(\text{SCSOA})$                               | $V_{GE} = 15 \text{ V}; V_{CE} = 900 \text{ V}; T_{VJ} = 125^{\circ}\text{C}$                                                                                                                                  |                                                                                        |                      | 10 $\mu\text{s}$                  |
| <b>RBSOA</b>                                         | $V_{GE} = 15 \text{ V}; V_{CE} = 1200 \text{ V}; T_{VJ} = 125^{\circ}\text{C};$<br>clamped inductive load; $L = 100 \mu\text{H};$<br>$R_G = 22 \Omega$                                                         |                                                                                        |                      | 100 A                             |
| $C_{ies}$                                            | $V_{CE} = 25 \text{ V}; f = 1 \text{ MHz}; V_{GE} = 0 \text{ V}$                                                                                                                                               |                                                                                        | 3.8                  | nF                                |
| $t_{d(on)}$<br>$t_{d(off)}$<br>$E_{on}$<br>$E_{off}$ | $V_{CE} = 720 \text{ V}; I_C = 50 \text{ A}$<br>$V_{GE} = 15 \text{ V}; R_G = 22 \Omega$<br>Inductive load; $L = 100 \mu\text{H};$<br>$T_{VJ} = 125^{\circ}\text{C}$                                           |                                                                                        | 150<br>680<br>6<br>5 | ns<br>ns<br>mJ<br>mJ              |
| $R_{thJC}$<br>$R_{thCH}$                             |                                                                                                                                                                                                                |                                                                                        | 0.1                  | 0.33 K/W<br>K/W                   |

| Symbol      | Conditions                                                                                            | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |      |                 |
|-------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------|-----------------|
|             |                                                                                                       | min.                                                                                   | typ. | max.            |
| $I_R$       | $V_R = V_{RRM}; T_{VJ} = 25^{\circ}\text{C}$<br>$V_R = 1200\text{ V}; T_{VJ} = 125^{\circ}\text{C}$   |                                                                                        | 1    | 0.25 mA<br>mA   |
| $V_F$       | $I_F = 30\text{ A}; T_{VJ} = 25^{\circ}\text{C}$                                                      |                                                                                        |      | 2.76 V          |
| $V_{T0}$    | For power-loss calculations only                                                                      |                                                                                        |      | 1.3 V           |
| $r_T$       | $T_{VJ} = 150^{\circ}\text{C}$                                                                        |                                                                                        |      | 16 m $\Omega$   |
| $I_{RM}$    | $I_F = 50\text{ A}; -di_F/dt = 100\text{ A}/\mu\text{s}; V_R = 100\text{ V}$                          | 5.5                                                                                    | 11   | A               |
| $t_{rr}$    | $I_F = 1\text{ A}; -di_F/dt = 200\text{ A}/\mu\text{s}; V_R = 30\text{ V}$                            | 40                                                                                     |      | ns              |
| $R_{thJC}$  |                                                                                                       |                                                                                        |      | 0.9 K/W         |
| $R_{thCH}$  |                                                                                                       | 0.25                                                                                   |      | K/W             |
| $R_{25}$    | NTC $\left\{ R(T) = R_{25} \cdot e^{B_{25/100} \left( \frac{1}{T} - \frac{1}{298K} \right)} \right\}$ | 4.75                                                                                   | 5.0  | 5.25 k $\Omega$ |
| $B_{25/50}$ |                                                                                                       |                                                                                        | 3375 | K               |

| Symbol     | Conditions                                                                  | Maximum Ratings |                    |
|------------|-----------------------------------------------------------------------------|-----------------|--------------------|
| $T_{VJ}$   |                                                                             | -40...+150      | $^{\circ}\text{C}$ |
| $T_{VJM}$  |                                                                             | 150             | $^{\circ}\text{C}$ |
| $T_{stg}$  |                                                                             | -40...+125      | $^{\circ}\text{C}$ |
| $V_{ISOL}$ | 50/60 Hz; $t = 1\text{ min}$<br>$I_{ISOL} \leq 1\text{ mA}; t = 1\text{ s}$ | 2500<br>3000    | V~<br>V~           |
| $M_d$      | Mounting torque                                                             | 2.7...3.3       | Nm                 |
| $d_s$      | Creep distance on surface                                                   | 12.7            | mm                 |
| $d_A$      | Strike distance in air                                                      | 9.6             | mm                 |
| $a$        | Maximum allowable acceleration                                              | 50              | m/s <sup>2</sup>   |
| Weight     | typ.                                                                        | 180             | g                  |

Dimensions in mm (1 mm = 0.0394")

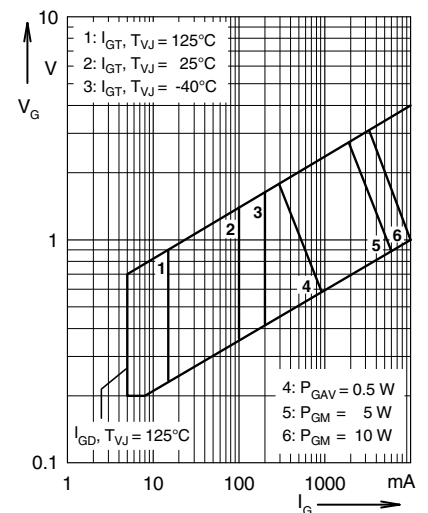
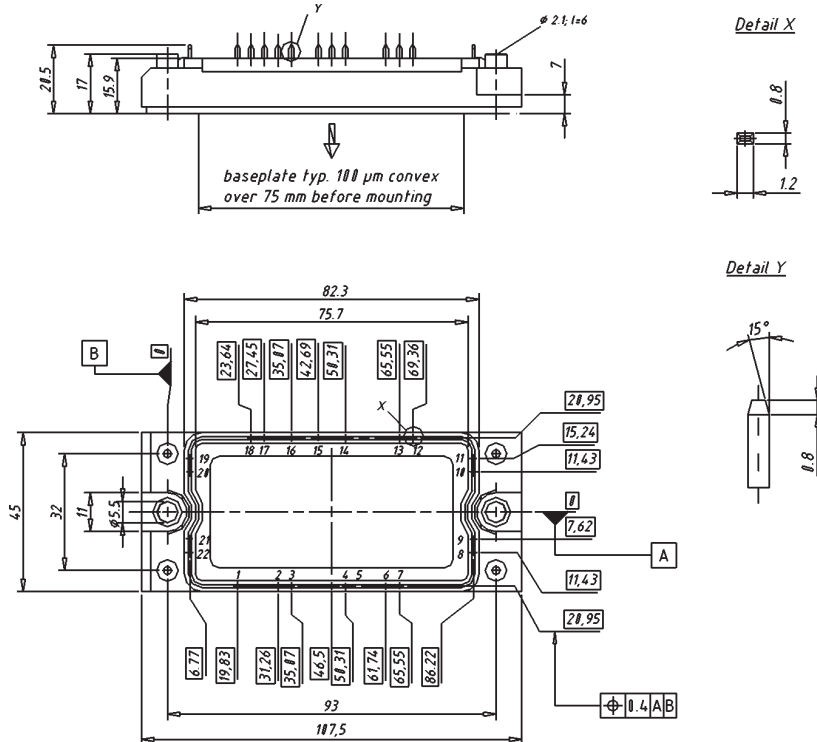


Fig. 1 Gate trigger characteristics

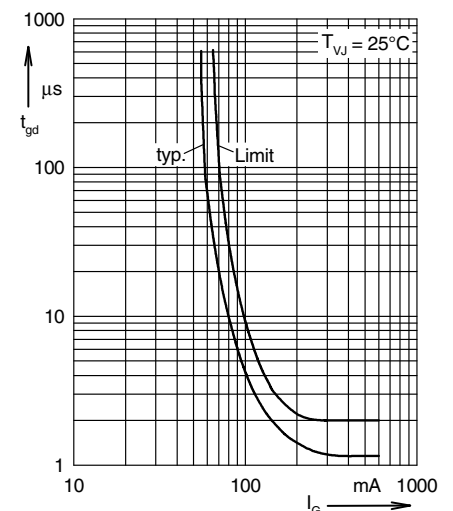


Fig. 2 Gate trigger delay time

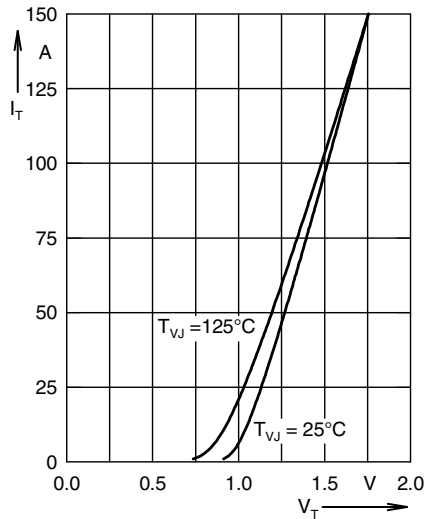


Fig. 3 Forward current versus voltage drop per leg

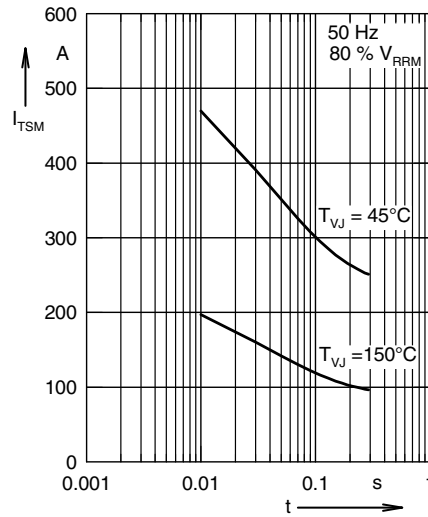


Fig. 4 Surge overload current

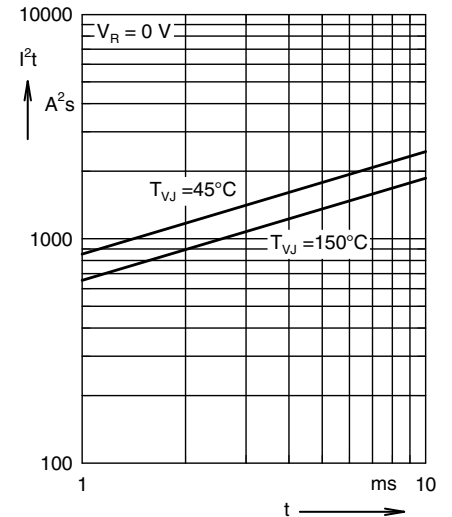


Fig. 5  $I^2t$  versus time  
(per thyristor/diode)

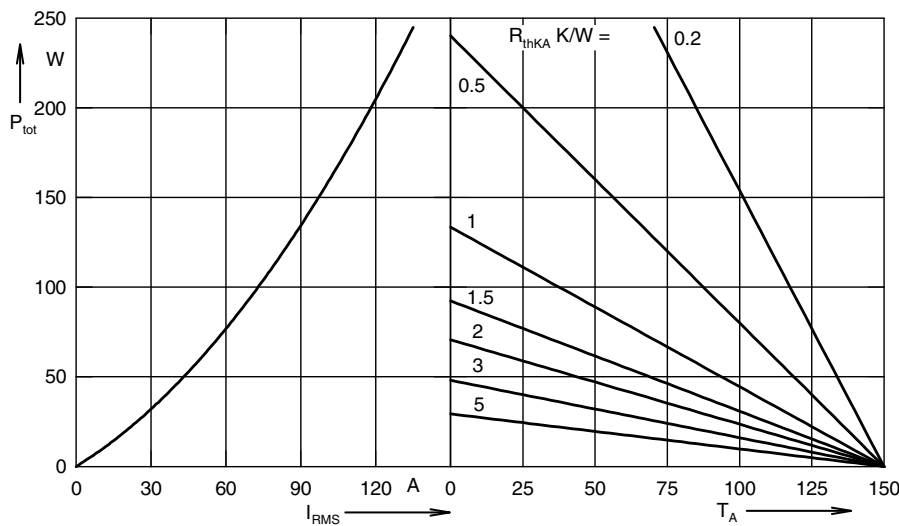


Fig. 6 Power dissipation versus direct output current and ambient temperature

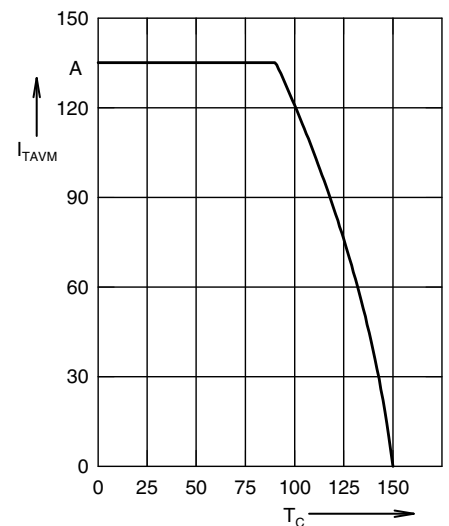


Fig. 7 Maximum forward current  
at case temperature

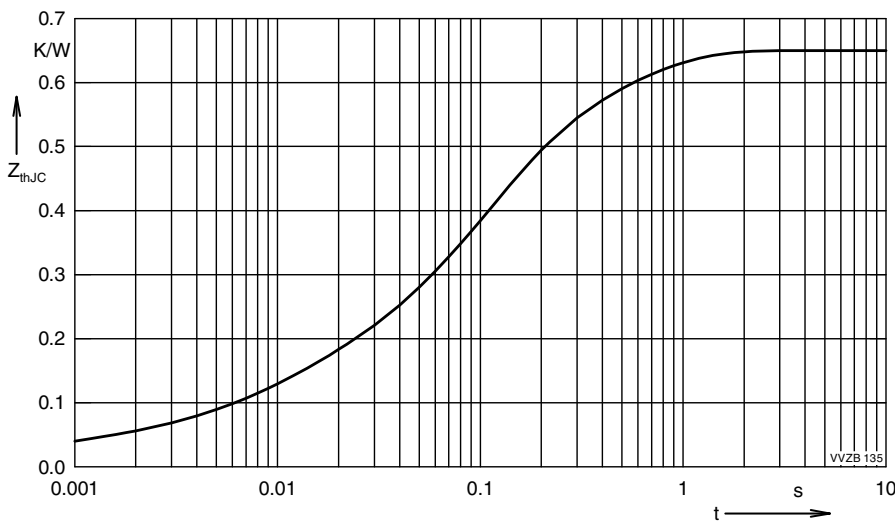


Fig. 8 Transient thermal impedance junction to case (per thyristor/diode)

| Constants for $Z_{thJC}$ calculation: |             |
|---------------------------------------|-------------|
| $R_{thi}$ / (K/W)                     | $t_i$ / (s) |
| 0.03                                  | 0.0005      |
| 0.083                                 | 0.008       |
| 0.361                                 | 0.094       |
| 0.176                                 | 0.45        |

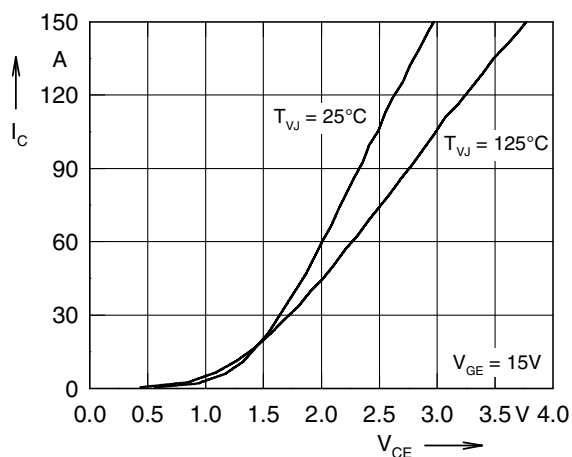


Fig. 9 Typ. output characteristics

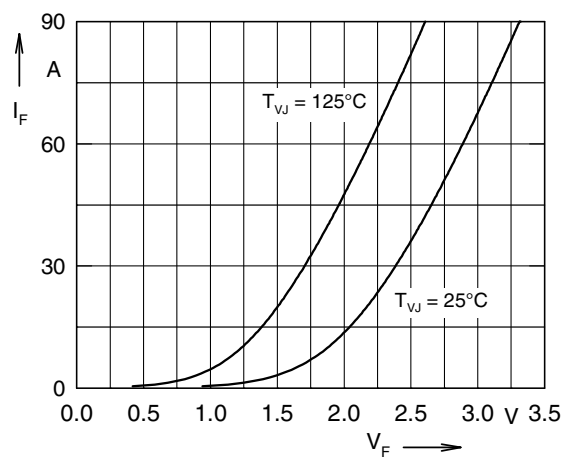


Fig. 10 Typ. forward characteristics of free wheeling diode

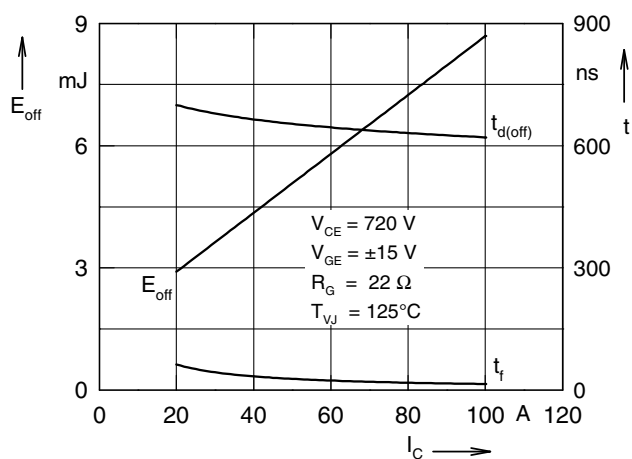


Fig. 11 Typ. turn off energy and switching times versus collector current

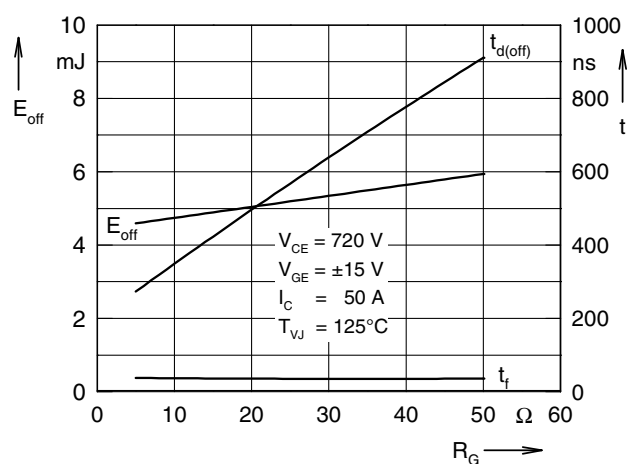


Fig. 12 Typ. turn off energy and switching times versus gate resistor

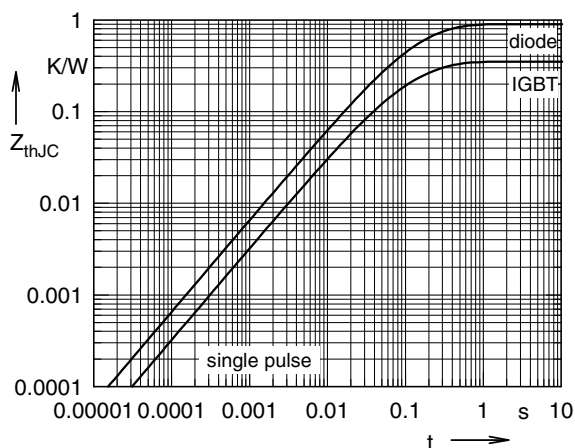


Fig. 13 Typ. transient thermal impedance

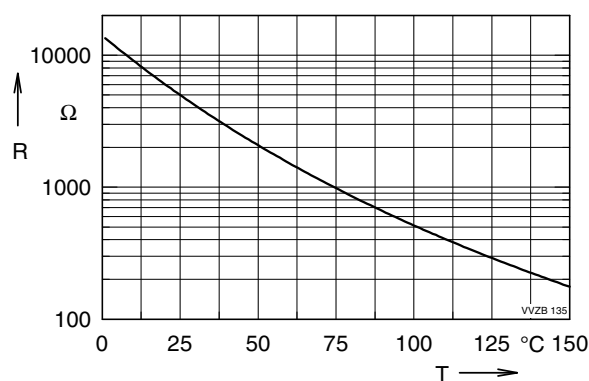


Fig. 14 Typ. thermistor resistance versus temperature