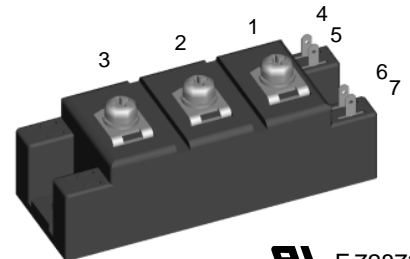
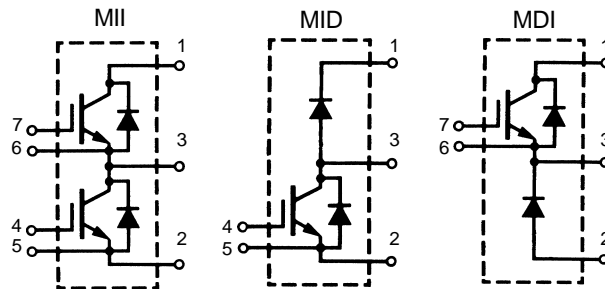


# IGBT Modules

Short Circuit SOA Capability

Square RBSOA

$I_{C25} = 90 \text{ A}$   
 $V_{CES} = 1200 \text{ V}$   
 $V_{CE(sat) \text{ typ.}} = 2.2 \text{ V}$



E72873

| Symbol              | Conditions  | Maximum Ratings                          |                              |
|---------------------|---|--|------------------------------|
| $V_{CES}$           | $T_J = 25^\circ\text{C to } 150^\circ\text{C}$  | 1200                                     | V                            |
| $V_{CGR}$           | $T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 20 \text{ k}\Omega$   | 1200                                     | V                            |
| $V_{GES}$           | Continuous  | $\pm 20$                                 | V                            |
| $V_{GEM}$           | Transient   | $\pm 30$                                 | V                            |
| $I_{C25}$           | $T_C = 25^\circ\text{C}$  | 90                                       | A                            |
| $I_{C80}$           | $T_C = 80^\circ\text{C}$  | 60                                       | A                            |
| $I_{CM}$            | $T_C = 80^\circ\text{C}, t_p = 1 \text{ ms}$  | 120                                      | A                            |
| $t_{sc}$<br>(SCSOA) | $V_{GE} = \pm 15 \text{ V}, V_{CE} = V_{CES}, T_J = 125^\circ\text{C}$<br>$R_G = 22 \Omega, \text{ non repetitive}$                 | 10                                       | $\mu\text{s}$                |
| <b>RBSOA</b>        | $V_{GE} = \pm 15 \text{ V}, T_J = 125^\circ\text{C}, R_G = 22 \Omega$<br>Clamped inductive load, $L = 100 \mu\text{H}$              | $I_{CM} = 100$<br>$V_{CEK} \leq V_{CES}$ | A                            |
| $P_{tot}$           | $T_C = 25^\circ\text{C}$  | 370                                      | W                            |
| $T_J$               |   | 150                                      | $^\circ\text{C}$             |
| $T_{stg}$           |   | -40 ... +150                             | $^\circ\text{C}$             |
| $V_{ISOL}$          | 50/60 Hz, RMS $t = 1 \text{ min}$<br>$I_{ISOL} \leq 1 \text{ mA}$ $t = 1 \text{ s}$<br>Insulating material: $\text{Al}_2\text{O}_3$ | 4000<br>4800                             | V~<br>V~                     |
| $M_d$               | Mounting torque (module)<br><br>(terminals)   | 2.25-2.75<br>20-25<br>2.5-3.7<br>22-33   | Nm<br>lb.in.<br>Nm<br>lb.in. |
| $d_s$               | Creepage distance on surface  | 12.7                                     | mm                           |
| $d_A$               | Strike distance through air   | 9.6                                      | mm                           |
| $a$                 | Max. allowable acceleration   | 50                                       | $\text{m/s}^2$               |
| <b>Weight</b>       | Typical   | 130<br>4.6                               | g<br>oz.                     |

### Features

- NPT IGBT technology
- low saturation voltage
- low switching losses
- switching frequency up to 30 kHz
- square RBSOA, no latch up
- high short circuit capability
- positive temperature coefficient for easy paralleling
- MOS input, voltage controlled
- ultra fast free wheeling diodes
- package with DCB ceramic base plate
- isolation voltage 4800 V
- UL registered E72873

### Advantages

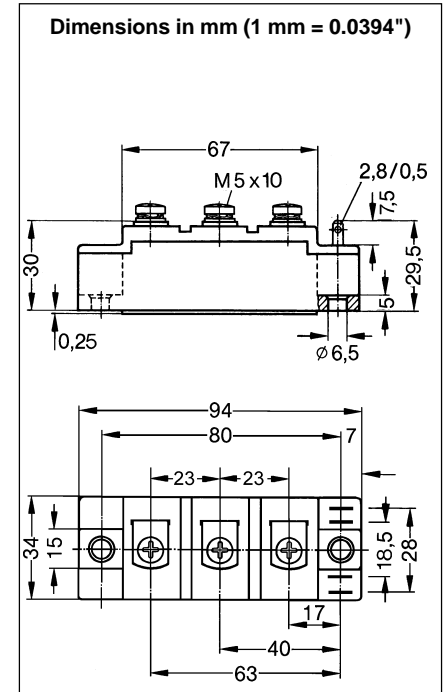
- space and weight savings
- reduced protection circuits

### Typical Applications

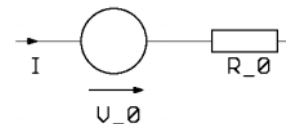
- AC and DC motor control
- AC servo and robot drives
- power supplies
- welding inverters

Data according to a single IGBT/FRED unless otherwise stated.

| Symbol        | Conditions  | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |                     |
|---------------|---|---|------|---------------------|
|               |   | min.  | typ. | max.                |
| $V_{(BR)CES}$ | $V_{GE} = 0\text{ V}$   | 1200  |      | V                   |
| $V_{GE(th)}$  | $I_C = 2\text{ mA}$ , $V_{CE} = V_{GE}$   | 4.5   |      | 6.5 V               |
| $I_{CES}$     | $V_{CE} = V_{CES}$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$   |   | 6    | 4 mA<br>mA          |
| $I_{GES}$     | $V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$  |   |      | $\pm 200\text{ nA}$ |
| $V_{CE(sat)}$ | $I_C = 50\text{ A}$ , $V_{GE} = 15\text{ V}$  | 2.2   | 2.7  | V                   |
| $C_{ies}$     | $V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$   |   | 3.3  | nF                  |
| $C_{oes}$     |   |   | 0.5  | nF                  |
| $C_{res}$     |   |   | 0.22 | nF                  |
| $t_{d(on)}$   | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b><br>$I_C = 50\text{ A}$ , $V_{GE} = \pm 15\text{ V}$<br>$V_{CE} = 600\text{ V}$ , $R_G = 22\ \Omega$ |   | 100  | ns                  |
| $t_r$         |   |   | 70   | ns                  |
| $t_{d(off)}$  |   |   | 500  | ns                  |
| $t_f$         |   |   | 70   | ns                  |
| $E_{on}$      |   |   | 7.6  | mJ                  |
| $E_{off}$     |   |   | 5.6  | mJ                  |
| $R_{thJC}$    |   |   |      | 0.33 K/W            |
| $R_{thJS}$    | with heatsink compound  | 0.66  |      | K/W                 |

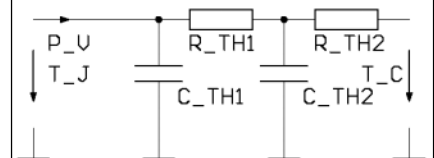


| Reverse Diode (FRED) |   | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|----------------------|---|---|------|----------|
|                      |   | min.  | typ. | max.     |
| $V_F$                | $I_F = 50\text{ A}$ , $V_{GE} = 0\text{ V}$ ,                                       | 2.2   | 2.5  | V        |
|                      | $I_F = 50\text{ A}$ , $V_{GE} = 0\text{ V}$ , $T_J = 125^\circ\text{C}$             | 1.8   | 1.9  | V        |
| $I_F$                | $T_C = 25^\circ\text{C}$  |   |      | 100 A    |
|                      | $T_C = 80^\circ\text{C}$  |   |      | 60 A     |
| $I_{RM}$             | $I_F = 50\text{ A}$ , $V_{GE} = 0\text{ V}$ , $-di_F/dt = 400\text{ A}/\mu\text{s}$ | 40  |      | A        |
| $t_{rr}$             | $T_J = 125^\circ\text{C}$ , $V_R = 600\text{ V}$                                    | 200   |      | ns       |
| $R_{thJC}$           |   |   |      | 0.66 K/W |
| $R_{thJS}$           | with heatsink compound  | 1.32  |      | K/W      |

**Equivalent Circuits for Simulation**
**Conduction**


IGBT (typ. at  $V_{GE} = 15\text{ V}$ ;  $T_J = 125^\circ\text{C}$ )  
 $V_0 = 1.5\text{ V}$ ;  $R_0 = 20.1\text{ m}\Omega$

Free Wheeling Diode (typ. at  $T_J = 125^\circ\text{C}$ )  
 $V_0 = 1.3\text{ V}$ ;  $R_0 = 10.8\text{ m}\Omega$

**Thermal Response**


IGBT (typ.)

$C_{th1} = 0.13\text{ J/K}$ ;  $R_{th1} = 0.323\text{ K/W}$   
 $C_{th2} = 0.32\text{ J/K}$ ;  $R_{th2} = 0.008\text{ K/W}$

Free Wheeling Diode (typ.)

$C_{th1} = 0.10\text{ J/K}$ ;  $R_{th1} = 0.645\text{ K/W}$   
 $C_{th2} = 0.18\text{ J/K}$ ;  $R_{th2} = 0.013\text{ K/W}$

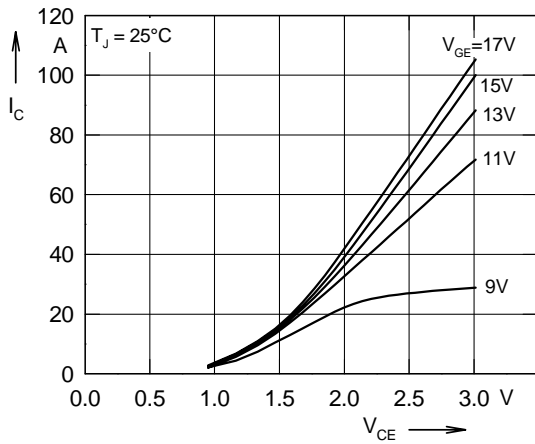


Fig. 1 Typ. output characteristics

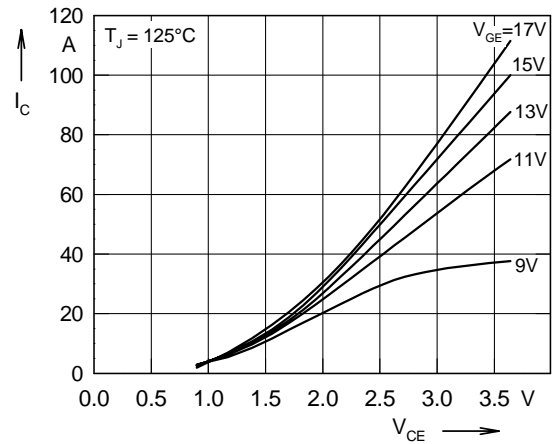


Fig. 2 Typ. output characteristics

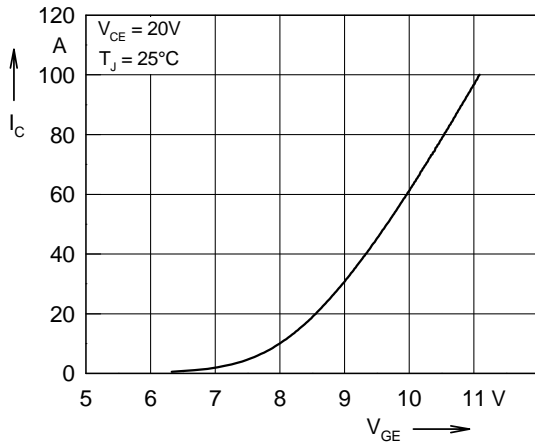


Fig. 3 Typ. transfer characteristics

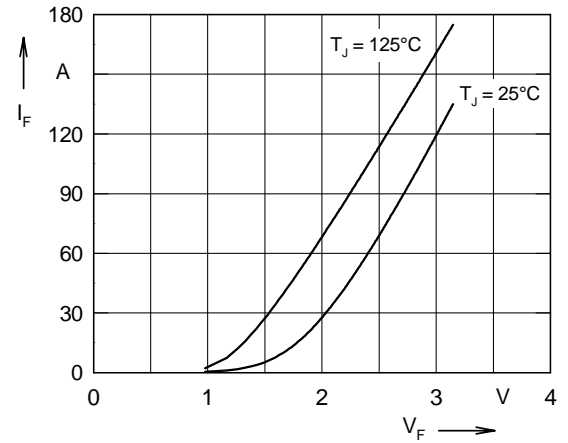


Fig. 4 Typ. forward characteristics of free wheeling diode

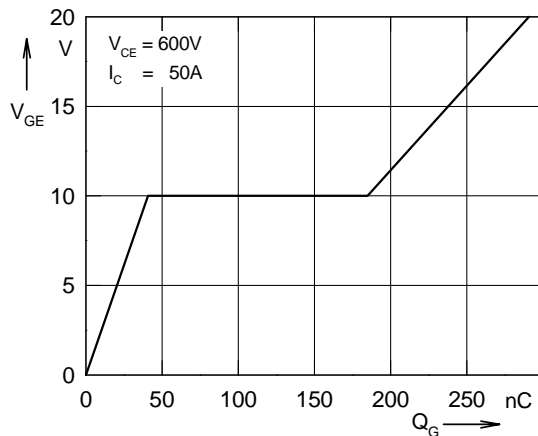


Fig. 5 Typ. turn on gate charge

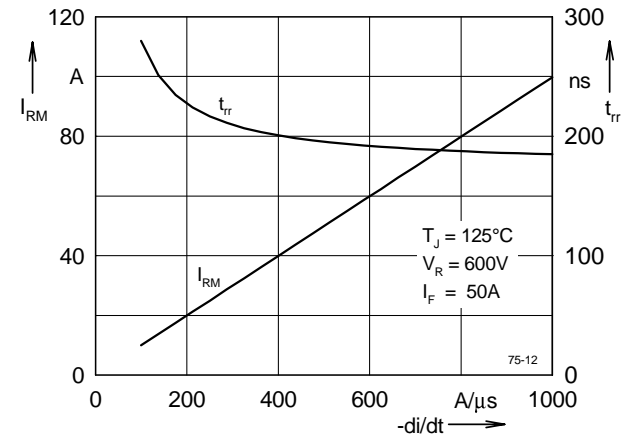


Fig. 6 Typ. turn off characteristics of free wheeling diode

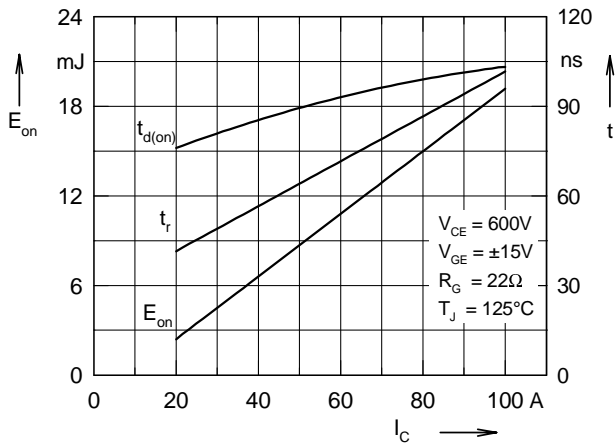


Fig. 7 Typ. turn on energy and switching times versus collector current

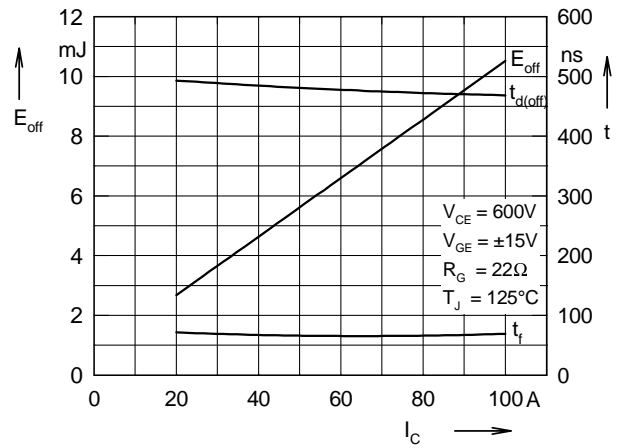


Fig. 8 Typ. turn off energy and switching times versus collector current

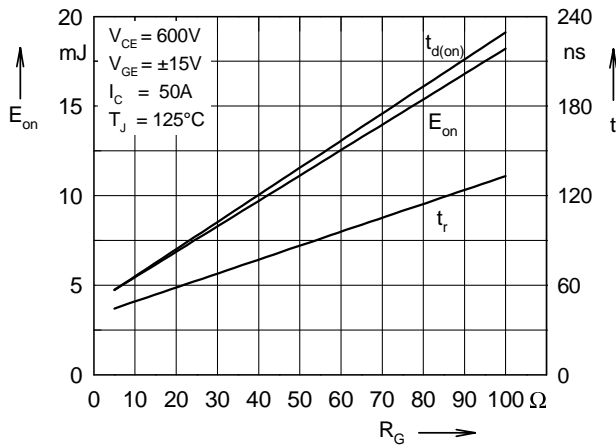


Fig. 9 Typ. turn on energy and switching times versus gate resistor

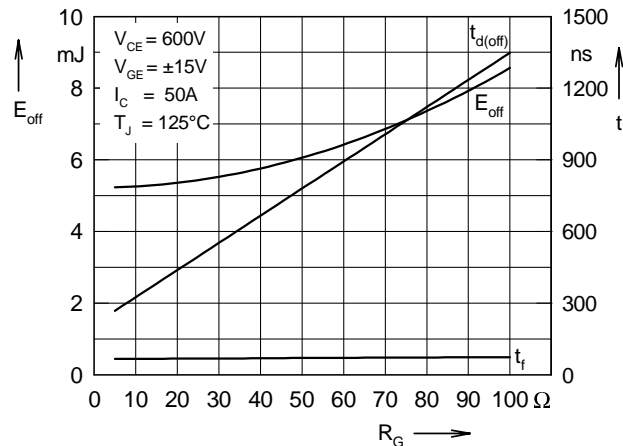


Fig.10 Typ. turn off energy and switching times versus gate resistor

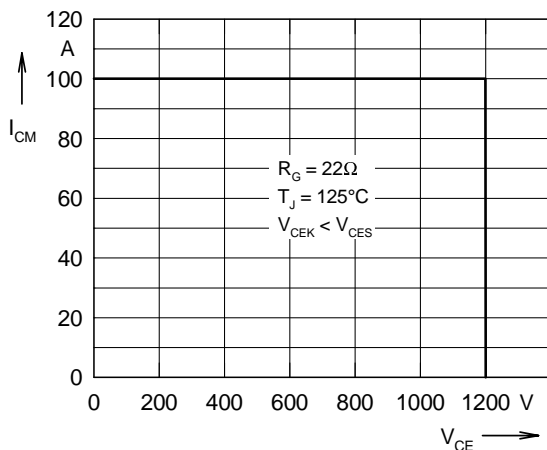


Fig. 11 Reverse biased safe operating area RBSOA

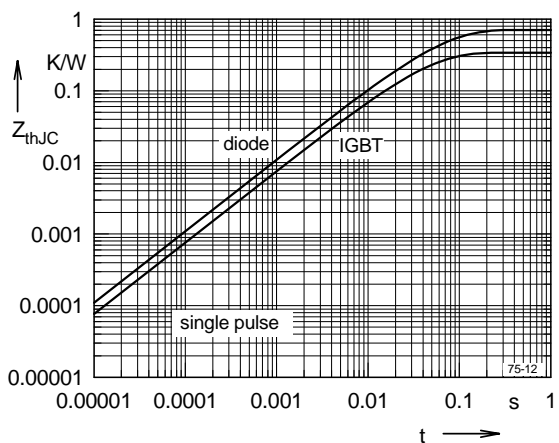


Fig. 12 Typ. transient thermal impedance