

IGBT Modules

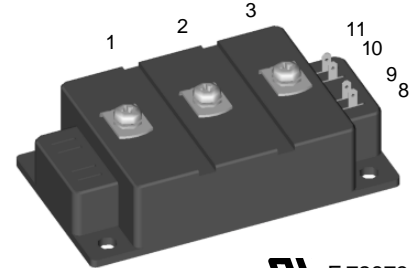
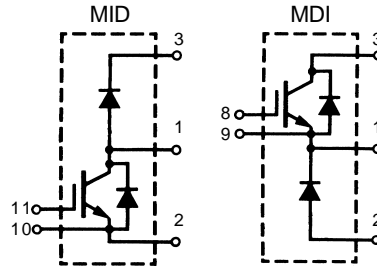
Short Circuit SOA Capability

Square RBSOA

$$I_{C25} = 670 \text{ A}$$

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

$$V_{CE(sat) \text{ typ.}} = 2.3 \text{ V}$$



| Symbol | Conditions | Maximum Ratings | |
|----------------------------|---|--|------------------------------|
| V_{CES} | $T_J = 25^\circ\text{C}$ to 150°C | 1200 | V |
| V_{CGR} | $T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 20 \text{ k}\Omega$ | 1200 | V |
| V_{GES} | Continuous | ± 20 | V |
| V_{GEM} | Transient | ± 30 | V |
| I_{C25} | $T_C = 25^\circ\text{C}$ | 670 | A |
| I_{C80} | $T_C = 80^\circ\text{C}$ | 460 | A |
| I_{CM} | $T_C = 80^\circ\text{C}$, $t_p = 1 \text{ ms}$ ① | 920 | A |
| t_{SC} (SCSOA) | $V_{GE} = \pm 15 \text{ V}$, $V_{CE} = V_{CES}$, $T_J = 125^\circ\text{C}$ $R_G = 1.8 \Omega$, non repetitive | 10 | μs |
| RBSOA | $V_{GE} = \pm 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 1.8 \Omega$ Clamped inductive load, $L = 100 \mu\text{H}$ | $I_{CM} = 800$ $V_{CEK} \leq V_{CES}$ | A |
| $P_{totIGBT}$ | $T_C = 25^\circ\text{C}$ | 2750 | W |
| T_J | | 150 | $^\circ\text{C}$ |
| T_{stg} | | -40 ... +150 | $^\circ\text{C}$ |
| V_{ISOL} | 50/60 Hz, RMS $t = 1 \text{ min}$ $I_{ISOL} \leq 1 \text{ mA}$ $t = 1 \text{ s}$ Insulating material: Al_2O_3 | 4000 4800 | V~ V~ |
| M_d | Mounting torque (module) (terminals) | 2.25-2.75 20-25 2.5-3.7 22-33 | Nm lb.in. Nm lb.in. |
| d_s | Creepage distance on surface | 14 | mm |
| d_A | Strike distance through air | 9.6 | mm |
| a | Max. allowable acceleration | 50 | m/s^2 |
| Weight | Typical | 250 8.8 | g 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

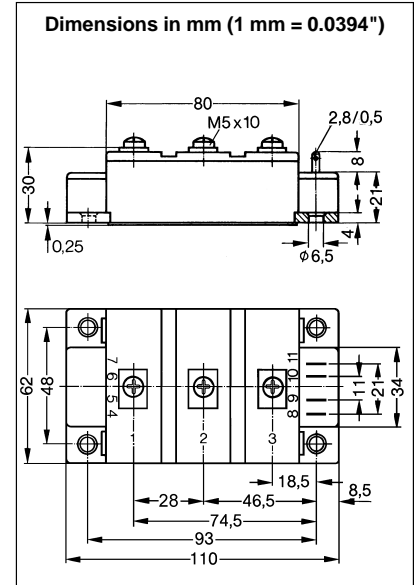
Typical Applications

- AC and DC motor control
- power supplies
- welding inverters

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

① Additional current limitation by external leads

| Symbol | Conditions | Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified) | | |
|---------------|---|---|------|-------------------|
| | | min. | typ. | max. |
| $V_{(BR)CES}$ | $V_{GE} = 0\text{ V}$ | 1200 | | V |
| $V_{GE(th)}$ | $I_C = 16\text{ mA}$, $V_{CE} = V_{GE}$ | 4.5 | | 6.5 V |
| I_{CES} | $V_{CE} = V_{CES}$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ | | 30 | 21 mA mA |
| I_{GES} | $V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$ | | | 1.6 μA |
| $V_{CE(sat)}$ | $I_C = 400\text{ A}$, $V_{GE} = 15\text{ V}$ | | 2.3 | 2.8 V |
| C_{ies} | $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$ | | 26 | nF |
| C_{oes} | | 4 | nF | |
| C_{res} | | 2 | nF | |
| $t_{d(on)}$ | Inductive load, $T_J = 125^\circ\text{C}$ $I_C = 400\text{ A}$, $V_{GE} = \pm 15\text{ V}$ $V_{CE} = 600\text{ V}$, $R_G = 1.8\ \Omega$ | | 100 | ns |
| t_r | | 60 | ns | |
| $t_{d(off)}$ | | 600 | ns | |
| t_f | | 90 | ns | |
| E_{on} | | 64 | mJ | |
| E_{off} | | 59 | mJ | |
| R_{thJC} | | | | 0.05 K/W |
| R_{thJS} | with heatsink compound | 0.09 | | K/W |



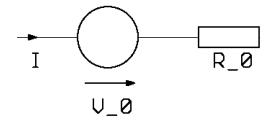
| Symbol | Conditions | Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified) | | |
|------------|--|---|------------|----------------|
| | | min. | typ. | max. |
| V_F | $I_F = 400\text{ A}$, $V_{GE} = 0\text{ V}$ $I_F = 400\text{ A}$, $V_{GE} = 0\text{ V}$, $T_J = 125^\circ\text{C}$ | | 2.4 1.9 | 2.6 V 2.0 V |
| I_F | $T_C = 25^\circ\text{C}$ ① $T_C = 80^\circ\text{C}$ | | | 750 A 460 A |
| I_{RM} | $I_F = 400\text{ A}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 3000\text{ A}/\mu\text{s}$ | | 300 | A |
| t_{rr} | $T_J = 125^\circ\text{C}$, $V_R = 600\text{ V}$ | | 200 | ns |
| R_{thJC} | | | | 0.09 K/W |
| R_{thJS} | | 0.18 | | K/W |

| Symbol | Conditions | Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified) | | |
|------------|--|---|------------|----------------|
| | | min. | typ. | max. |
| V_F | $I_F = 100\text{ A}$, $V_{GE} = 0\text{ V}$ $I_F = 100\text{ A}$, $V_{GE} = 0\text{ V}$, $T_J = 125^\circ\text{C}$ | | 2.4 1.9 | 2.6 V 2.0 V |
| I_F | $T_C = 25^\circ\text{C}$ $T_C = 80^\circ\text{C}$ | | | 150 A 95 A |
| I_{RM} | $I_F = 100\text{ A}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 600\text{ A}/\mu\text{s}$ | | 62 | A |
| t_{rr} | $T_J = 125^\circ\text{C}$, $V_R = 600\text{ V}$ | | 200 | ns |
| R_{thJC} | | | | 0.45 K/W |
| R_{thJS} | | 0.9 | | K/W |

① Additional current limitation by external leads

Equivalent Circuits for Simulation

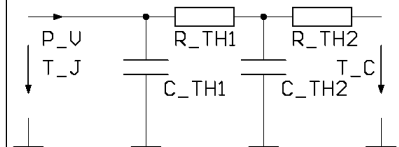
Conduction



IGBT (typ. at $V_{GE} = 15\text{ V}$; $T_J = 125^\circ\text{C}$)
 $V_0 = 1.3\text{ V}$; $R_0 = 3.2\text{ m}\Omega$

Free Wheeling Diode (typ. at $T_J = 125^\circ\text{C}$)
 $V_0 = 1.3\text{ V}$; $R_0 = 1.5\text{ m}\Omega$

Thermal Response



IGBT (typ.)
 $C_{th1} = 0.90\text{ J/K}$; $R_{th1} = 0.049\text{ K/W}$
 $C_{th2} = 2.07\text{ J/K}$; $R_{th2} = 0.001\text{ K/W}$

Free Wheeling Diode (typ.)
 $C_{th1} = 0.71\text{ J/K}$; $R_{th1} = 0.090\text{ K/W}$
 $C_{th2} = 1.30\text{ J/K}$; $R_{th2} = 0.002\text{ K/W}$

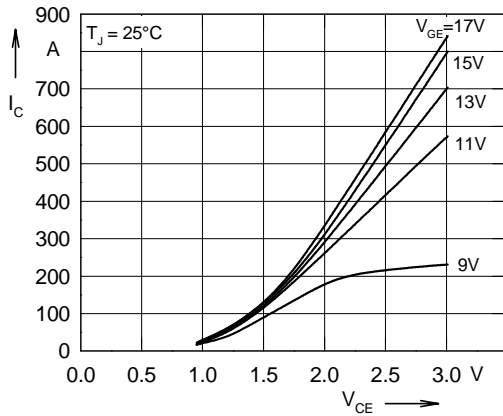


Fig. 1 Typ. output characteristics

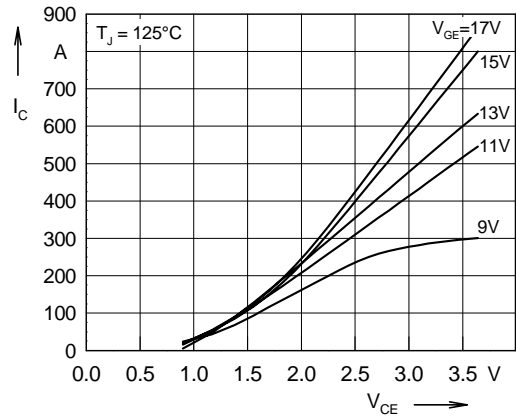


Fig. 2 Typ. output characteristics

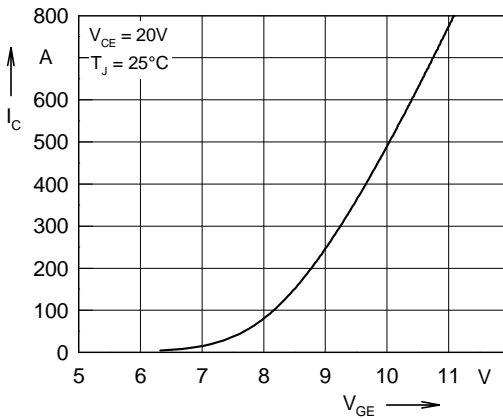


Fig. 3 Typ. transfer characteristics

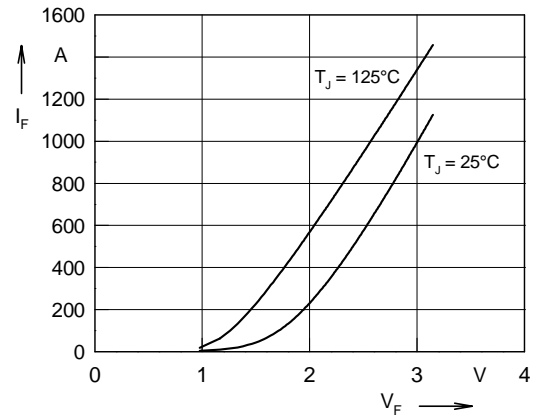


Fig. 4 Typ. forward characteristics of free wheeling diode

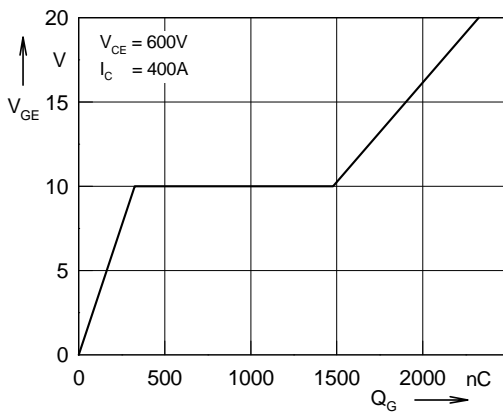


Fig. 5 Typ. turn on gate charge

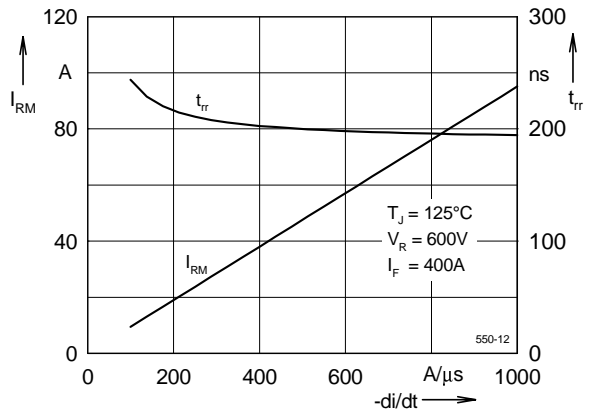


Fig. 6 Typ. turn off characteristics of free wheeling diode

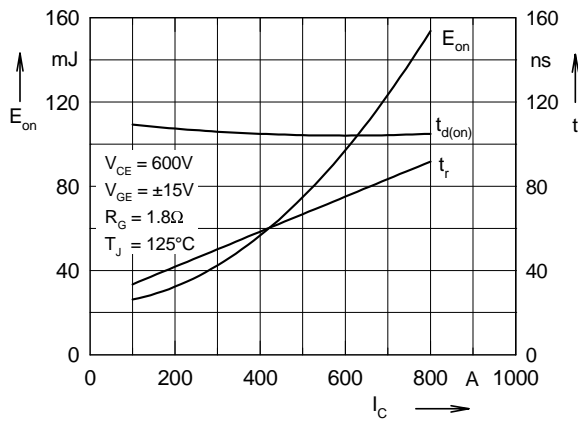


Fig. 7 Typ. turn on energy and switching times versus collector current

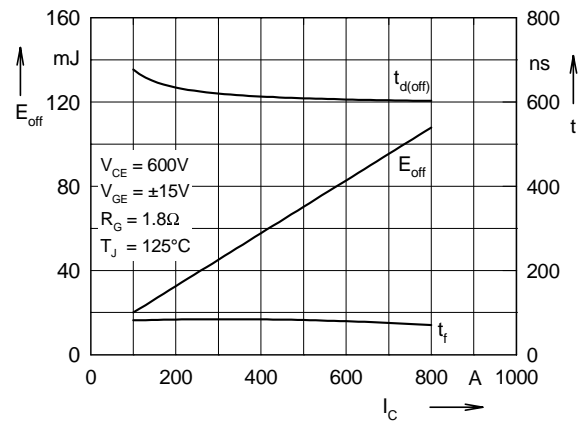


Fig. 8 Typ. turn off energy and switching times versus collector current

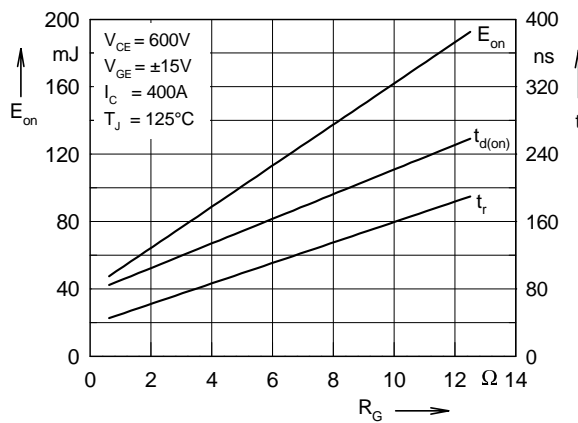


Fig. 9 Typ. turn on energy and switching times versus gate resistor

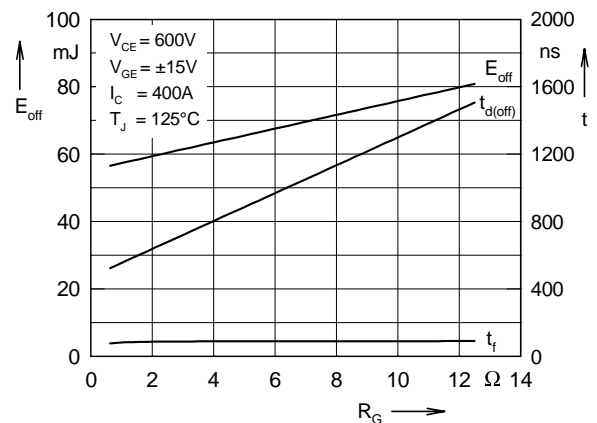


Fig.10 Typ. turn off energy and switching times versus gate resistor

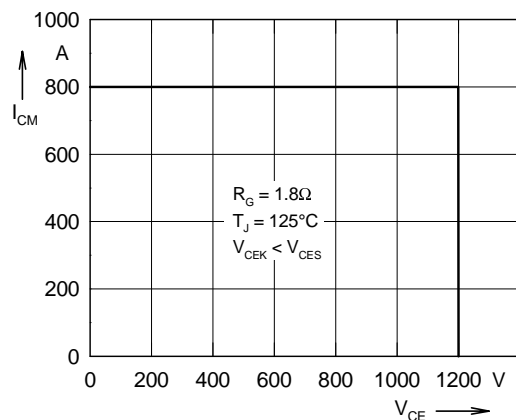


Fig. 11 Reverse biased safe operating area RBSOA

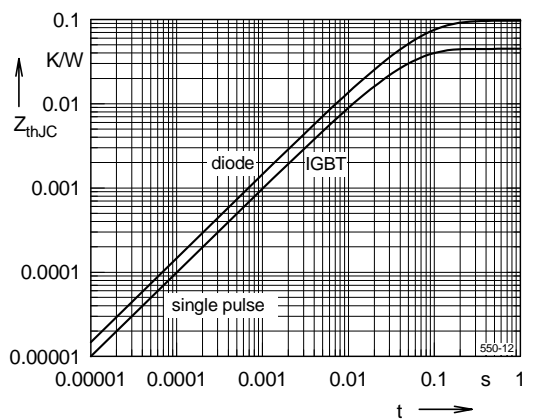


Fig. 12 Typ. transient thermal impedance