

# IGBT Module

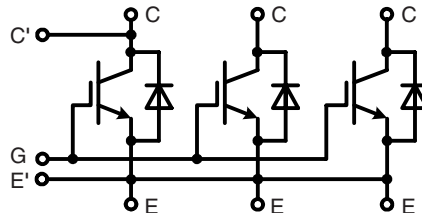
## Single switch

Short Circuit SOA Capability  
Square RBSOA

$$I_{C80} = 1200 \text{ A}$$

$$V_{CES} = 3300 \text{ V}$$

$$V_{CE(sat) \text{ typ.}} = 3.1 \text{ V}$$



IGBT		
Symbol	Conditions	Maximum Ratings
$V_{CES}$	$V_{GE} = 0 \text{ V}$	3300 V
$V_{GES}$		$\pm 20 \text{ V}$
$I_{C80}$	$T_C = 80^\circ\text{C}$	1200 A
$I_{CM}$	$t_p = 1 \text{ ms}; T_C = 80^\circ\text{C}$	2400 A
$t_{SC}$	$V_{CC} = 2500 \text{ V}; V_{CEM \text{ CHIP}} \leq 3300 \text{ V};$ $V_{GE} \leq 15 \text{ V}; T_{VJ} \leq 125^\circ\text{C}$	10 $\mu\text{s}$

### Features

- NPT<sup>3</sup> IGBT
  - Low-loss
  - Smooth switching waveforms for good EMC
- Industry standard package
  - High power density
  - AISiC base-plate for high power cycling capacity
  - AlN substrate for low thermal resistance

### Typical Applications

- AC power converters for
  - industrial drives
  - windmills
  - traction
- LASER pulse generator

Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^\circ\text{C}$ , unless otherwise specified)			
		min.	typ.	max.	
$V_{CE(sat)} \text{ ①}$	$I_C = 1200 \text{ A}; V_{GE} = 15 \text{ V}; T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$		3.1 3.8	V V	
$V_{GE(th)}$	$I_C = 240 \text{ mA}; V_{CE} = V_{GE}$	6		8 V	
$I_{CES}$	$V_{CE} = 3300 \text{ V}; V_{GE} = 0 \text{ V}; T_{VJ} = 125^\circ\text{C}$			120 mA	
$I_{GES}$	$V_{CE} = 0 \text{ V}; V_{GE} = \pm 20 \text{ V}; T_{VJ} = 125^\circ\text{C}$			500 nA	
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$ $E_{on}$ $E_{off}$	Inductive load; $T_{VJ} = 125^\circ\text{C};$ $V_{GE} = \pm 15 \text{ V}; V_{CC} = 1800 \text{ V};$ $I_C = 1200 \text{ A}; R_G = 1.5 \Omega;$ $L_\sigma = 100 \text{ nH}$		400 200 1070 440 1890 1950	ns ns ns ns mJ mJ	
$C_{ies}$ $C_{oes}$ $C_{res}$		$V_{CE} = 25 \text{ V}; V_{GE} = 0 \text{ V}; f = 1 \text{ MHz}$		187 11.6 2.2	nF nF nF
$Q_{ge}$			$I_C = 1200 \text{ A}; V_{CE} = 1800 \text{ V}; V_{GE} = \pm 15 \text{ V}$	12.1	$\mu\text{C}$
$R_{thJC}$					0.0085 K/W

① Collector emitter saturation voltage is given at chip level

IXYS reserves the right to change limits, test conditions and dimensions.

**Diode**

Symbol	Conditions	Maximum Ratings	
$I_{F80}$	$T_C = 80^\circ\text{C}$	1200	A
$I_{FSM}$	$V_R = 0\text{ V}; T_{VJ} = 125^\circ\text{C}; t_p = 10\text{ ms};$ half-sinewave	11000	A

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$V_F$ ②	$I_F = 1200\text{ A}; T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$	2.30		V
		2.35		V
$I_{RM}$ $t_{rr}$ $Q_{RR}$ $E_{rec}$	$V_{CC} = 1800\text{ V}; I_C = 1200\text{ A};$ $V_{GE} = \pm 15\text{ V}; R_G = 1.5\ \Omega; T_{VJ} = 125^\circ\text{C}$ Inductive load; $L_\sigma = 100\text{ nH}$	1350		A
		1450		ns
		1280		$\mu\text{C}$
		1530		mJ
$R_{thJC}$				0.017 K/W

② Forward voltage is given at chip level

**Module**

Symbol	Conditions	Maximum Ratings	
$T_{JM}$	max junction temperature	+150	$^\circ\text{C}$
$T_{VJ}$	Operating temperature	-40...+125	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-40...+125	$^\circ\text{C}$
$V_{ISOL}$	50 Hz	6000	V~
$M_d$	Mounting torque	Base-heatsink, M6 screws	4 - 6 Nm
		Main terminals, M8 screws	8 - 10 Nm

Symbol	Conditions	Characteristic Values		
		min.	typ.	max.
$d_A$	Clearance distance	terminal to base	23	mm
		terminal to terminal	19	mm
$d_S$	Surface creepage distance	terminal to base	33	mm
		terminal to terminal	33	mm
$L_\sigma$	Module stray inductance, C to E terminal		10	nH
$R_{term-chip}$ *)	Resistance terminal to chip		0.085	m $\Omega$
$R_{thCH}$	per module; $\lambda$ grease = 1 W/m·K		0.006	K/W
<b>Weight</b>			1500	g

 \*)  $V = V_{CE(sat)} + R_{term-chip} \cdot I_C$  resp.  $V = V_F + R_{term-chip} \cdot I_F$

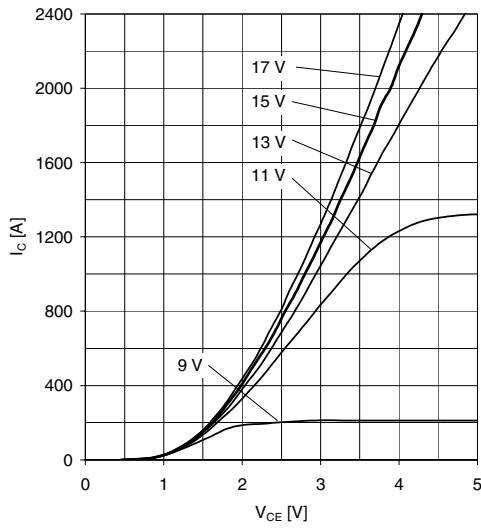


Fig. 1 Typical output characteristics, chip level

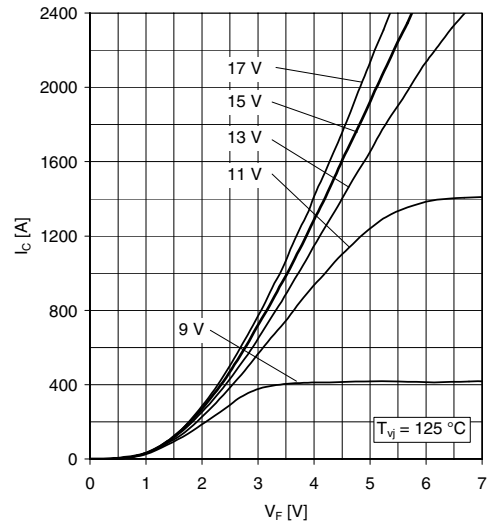


Fig. 2 Typical output characteristics, chip level

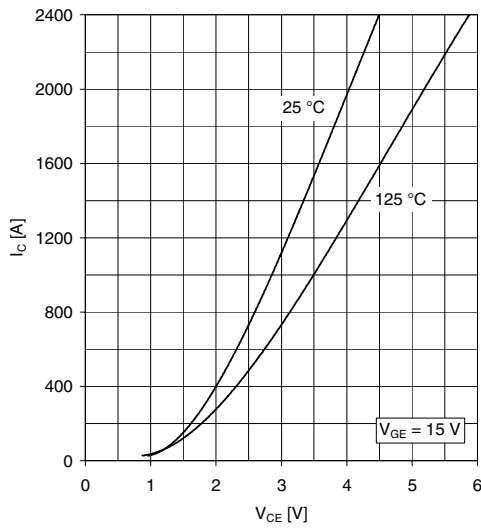


Fig. 3 Typical onstate characteristics, chip level

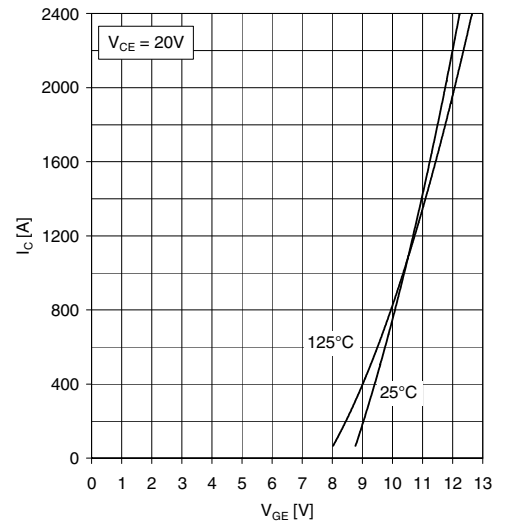


Fig. 4 Typical transfer characteristics, chip level

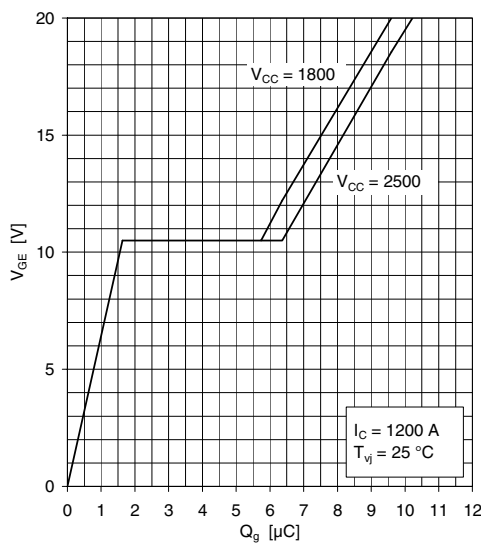


Fig. 5 Typical gate charge characteristics

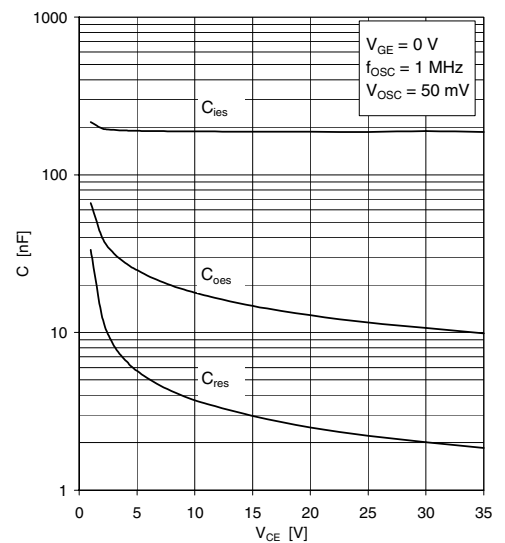


Fig. 6 Typical capacitances vs collector-emitter voltage

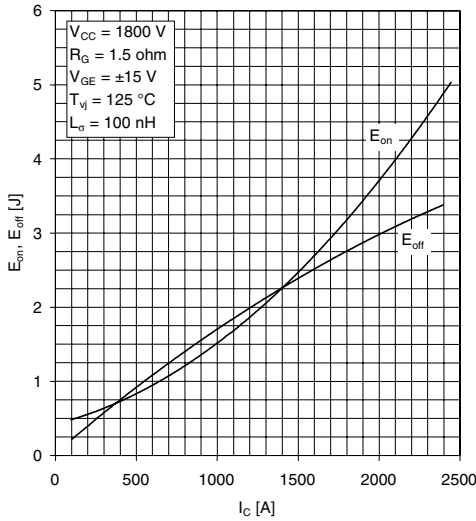


Fig. 7 Typical switching energies per pulse vs collector current

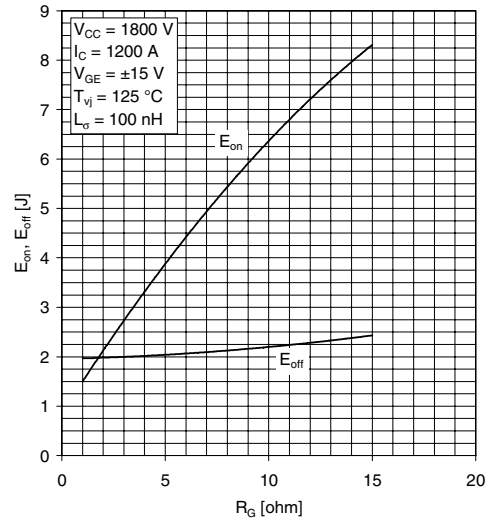


Fig. 8 Typical switching energies per pulse vs gate resistor

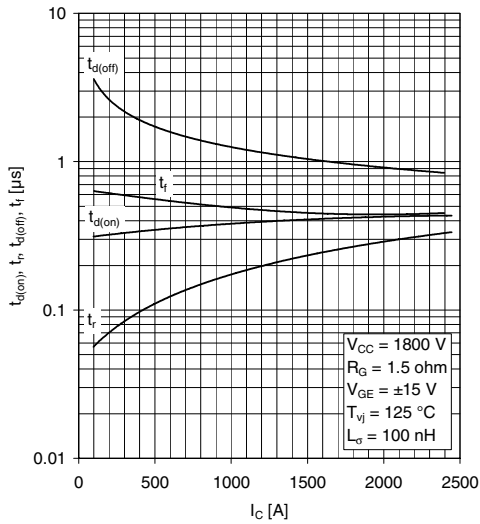


Fig. 9 Typical switching times vs collector current

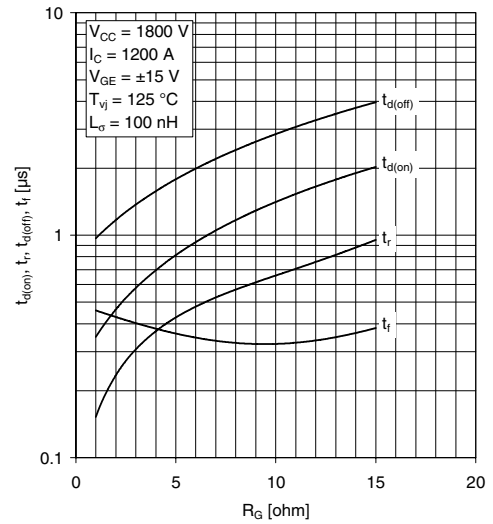


Fig. 10 Typical switching times vs gate resistor

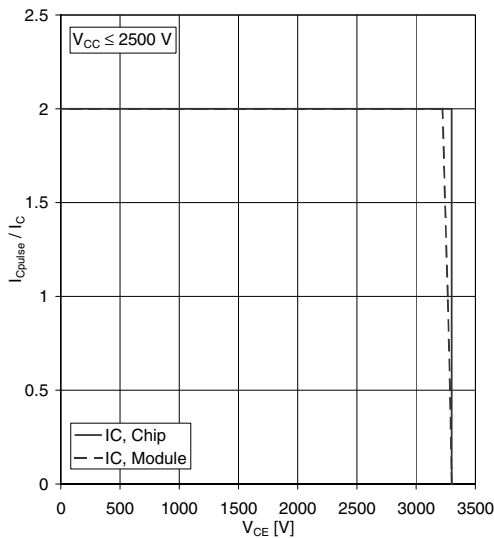


Fig. 11 Turn-off safe operating area (RBSOA)

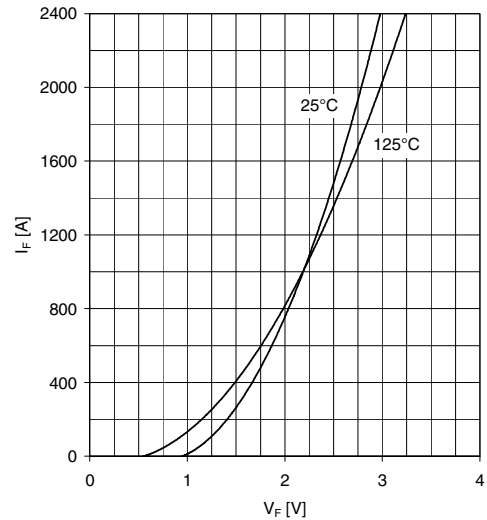


Fig. 12 Typical diode forward characteristics, chip level

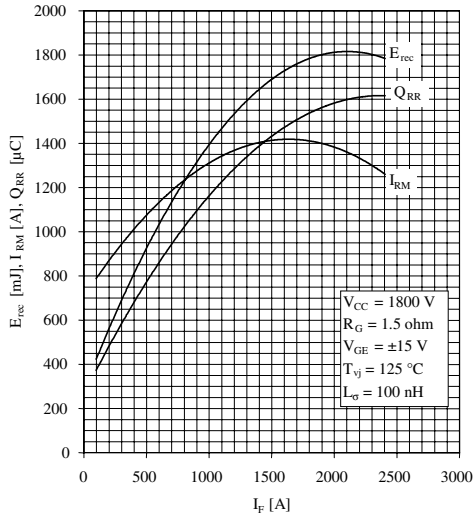


Fig. 13 Typical reverse recovery characteristics vs forward current

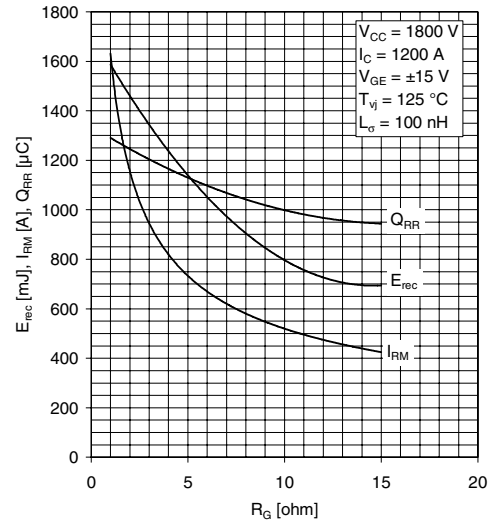


Fig. 14 Typical reverse recovery characteristics vs gate resistor

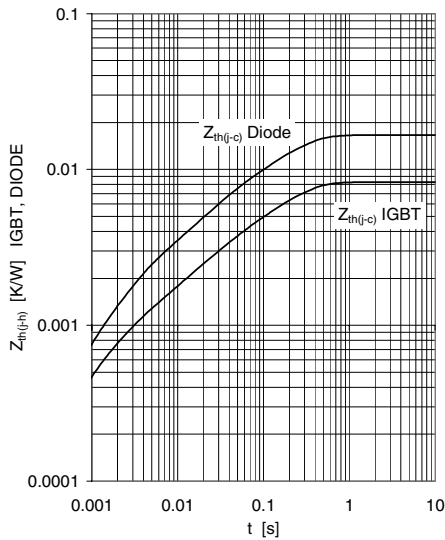


Fig. 15 Thermal impedance vs time

$$Z_{thJC}(t) = \sum_{i=1}^n R_i(1 - e^{-t/\tau_i})$$

	i	1	2	3	4
IGBT	R <sub>i</sub> (K/kW)	5.50	1.53	0.621	0.646
	τ <sub>i</sub> (ms)	193	31.2	8.0	1.48
DIODE	R <sub>i</sub> (K/kW)	11.2	3.73	1.30	0.42
	τ <sub>i</sub> (ms)	189	24.5	2.69	2.36

