

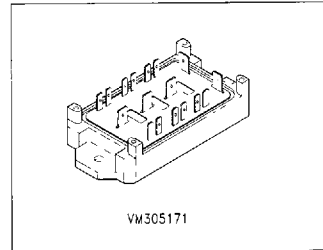
**SIEMENS**

SIEMENS AKTIENGESELLSCHAFT

T-23-07

**IGBT Module**  
Preliminary Data**BSM 15 GD 100 D** $V_{CE} = 1000 \text{ V}$  $I_C = 6 \times 25 \text{ A at } T_C = 25 \text{ }^\circ\text{C}$  $I_C = 6 \times 15 \text{ A at } T_C = 80 \text{ }^\circ\text{C}$ 

- Power module
- 3-phase full bridge
- Including fast free-wheel diodes
- Package with insulated metal base plate
- Package outlines/Circuit diagram: 3a<sup>1)</sup>



Type	Ordering Code
BSM 15 GD 100 D	C67076-A2500-A2

**Maximum Ratings**

Parameter	Symbol	Values	Unit
Collector-emitter voltage	$V_{CE}$	1000	V
Collector-gate voltage, $R_{GE} = 20 \text{ k}\Omega$	$V_{CGR}$	1000	
Gate-emitter voltage	$V_{GE}$	$\pm 20$	
Continuous collector current, $T_C = 25 \text{ }^\circ\text{C}$ $T_C = 80 \text{ }^\circ\text{C}$	$I_C$	25 15	A
Pulsed collector current, $T_C = 25 \text{ }^\circ\text{C}$ $T_C = 80 \text{ }^\circ\text{C}$	$I_{C \text{ puls}}$	50 30	
Operating and storage temperature range	$T_J, T_{stg}$	- 55 ... + 150	$^\circ\text{C}$
Power dissipation, $T_C = 25 \text{ }^\circ\text{C}$	$P_{tot}$	150	W
Thermal resistance, chip-case	$R_{thJC}$	$\leq 0.8$	K/W
Insulation test voltage <sup>2)</sup> , $t = 1 \text{ min.}$	$V_{is}$	2500	$V_{ac}$
Creepage distance	—	16	mm
Clearance	—	11	
DIN humidity category, DIN 40 040	—	F	—
IEC climatic category, DIN IEC 68-1	—	55/150/56	

<sup>1)</sup> See chapter Package Outline and Circuit Diagrams.

<sup>2)</sup> Insulation test voltage between collector and metal base plate referred to standard climate 23/50 in acc. with DIN 50 014, IEC 146, para. 492 1.

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## Electrical Characteristics

at  $T_j = 25\text{ °C}$ , unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

## Static Characteristics

Collector-emitter breakdown voltage $V_{GE} = 0, I_C = 0.5\text{ mA}$	$V_{(BR)CES}$	1000	–	–	V
Gate threshold voltage $V_{GE} = V_{CE}, I_C = 1\text{ mA}$	$V_{GE(th)}$	4.8	5.5	6.2	
Collector-emitter saturation voltage $V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	$V_{CE(sat)}$	– –	2.8 4.0	3.3 4.5	
Zero gate voltage collector current $V_{CE} = 1000\text{ V}, V_{GE} = 0$ $T_j = 25\text{ °C}$ $T_j = 125\text{ °C}$	$I_{CES}$	– –	– –	500 2000	$\mu\text{A}$
Gate-emitter leakage current $V_{GE} = 20\text{ V}, V_{CE} = 0$	$I_{GES}$	–	–	100	nA

## AC Characteristics

Forward transconductance $V_{CE} = 20\text{ V}, I_C = 15\text{ A}$	$g_{fs}$	4.5	–	–	S
Input capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0, f = 1\text{ MHz}$	$C_{iss}$	–	2000	–	pF
Output capacitance, $V_{GS} = 0$ $V_{CE} = 25\text{ V}, V_{GE} = 0, f = 1\text{ MHz}$	$C_{oss}$	–	160	–	
Reverse transfer capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0, f = 1\text{ MHz}$	$C_{rss}$	–	65	–	

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**Switching Characteristics**

at  $T_j = 125\text{ }^\circ\text{C}$ , unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**Resistive Load**

Turn-on delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(on)}$	10	15	20	ns
Rise time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_r$	—	200	—	
Turn-off delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(off)}$	—	150	—	
Fall time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_f$	—	300	—	

**Inductive Load**

Turn-on delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(on)}$	10	15	20	ns
Rise time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_r$	5	10	15	
Turn-off delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(off)}$	110	150	180	
Fall time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_f$	15	20	25	
Turn-off loss ( $E_{off} = E_{off1} + E_{off2}$ ) $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$E_{off1}$ $E_{off2}$	— —	0.7 0.8	— —	mWs

## SIEMENS AKTIENGESELLSCHAFT

**Electrical Characteristics**at  $T_J = 25\text{ °C}$ , unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

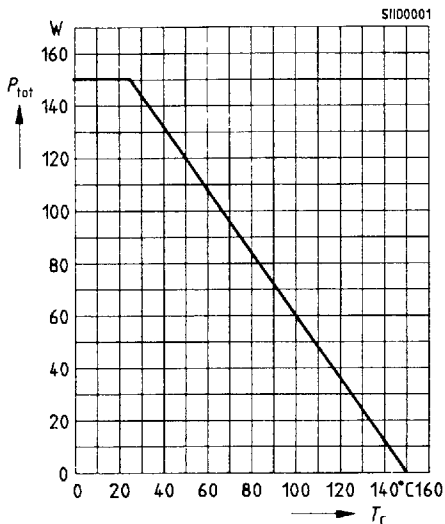
**Free-Wheel Diode**

Diode forward voltage $I_F = 15\text{ A}$ , $V_{GE} = 0$ $T_J = 25\text{ °C}$ $T_J = 125\text{ °C}$	$V_F$	— —	1.85 1.5	— —	V
Reverse recovery time $I_F = 15\text{ A}$ , $V_R = 600\text{ V}$ $V_{GE} = 0$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ $T_J = 125\text{ °C}$	$t_{rr}$	—	0.1	—	$\mu\text{s}$
Reverse recovery charge $I_F = 15\text{ A}$ , $V_R = 600\text{ V}$ $V_{GE} = 0$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ $T_J = 25\text{ °C}$ $T_J = 125\text{ °C}$	$Q_{rr}$	— —	1 4	— —	$\mu\text{C}$
Soft factor $I_F = 15\text{ A}$ , $V_R = 600\text{ V}$ $V_{GE} = 0$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ $T_J = 125\text{ °C}$	$S$	—	1	—	—
Thermal resistance Chip-case	$R_{thJC}$	—	—	1.7	K/W

Characteristics at  $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

**Power dissipation**  $P_{\text{tot}} = f(T_C)$

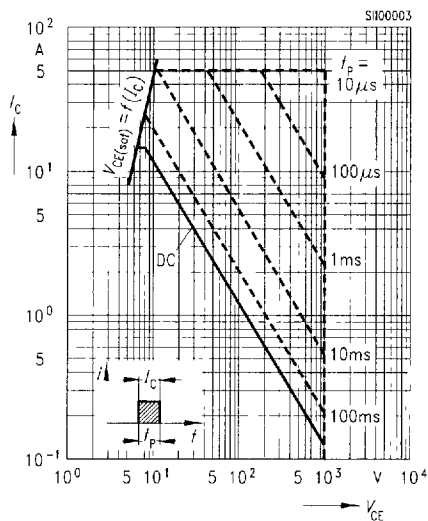
parameter:  $T_j = 150\text{ }^\circ\text{C}$



**Safe operating area**  $I_C = f(V_{CE})$

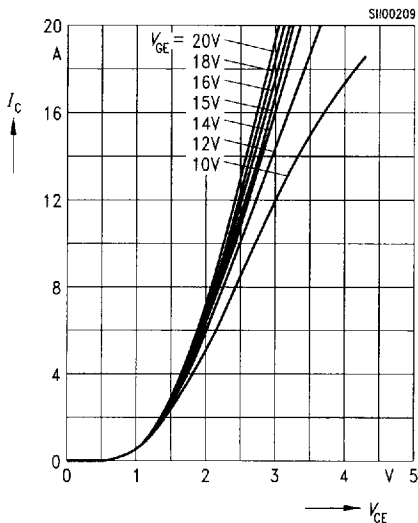
parameter: single pulse,  $T_C = 25\text{ }^\circ\text{C}$

$T_j \leq 150\text{ }^\circ\text{C}$



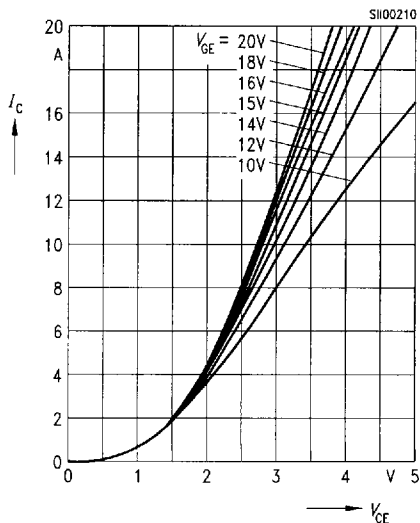
**Typ. output characteristics**  $I_C = f(V_{CE})$

parameter:  $t_p = 80\text{ }\mu\text{s}$ ,  $T_j \leq 25\text{ }^\circ\text{C}$



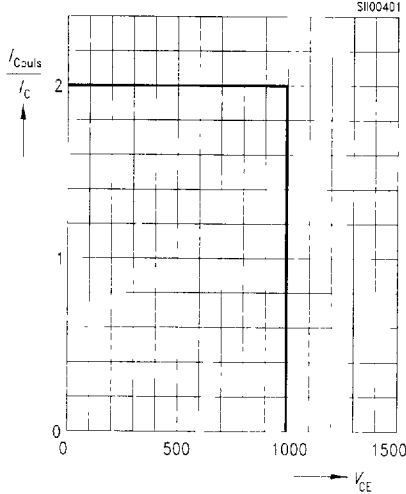
**Typ. output characteristics**  $I_C = f(V_{CE})$

parameter:  $t_p = 80\text{ }\mu\text{s}$ ,  $T_j \leq 125\text{ }^\circ\text{C}$



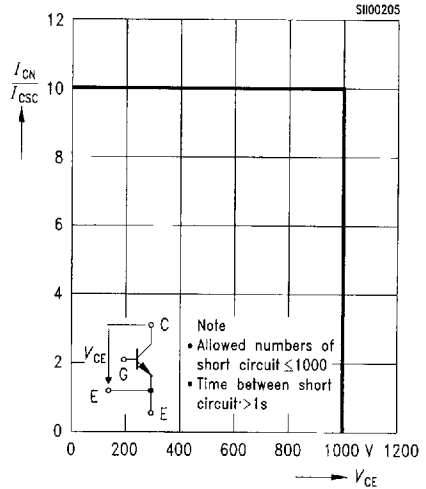
**Reverse biased safe operating area**

$I_C = f(V_{CE})$ , parameter:  $T_J = 125^\circ\text{C}$ ,  
 $V_{GE} = 15\text{ V}$ ,  $R_{g(off)} = 3.3\ \Omega$ ,  
 $L$  (parasitic inductance, module)  $< 50\text{ nH}$



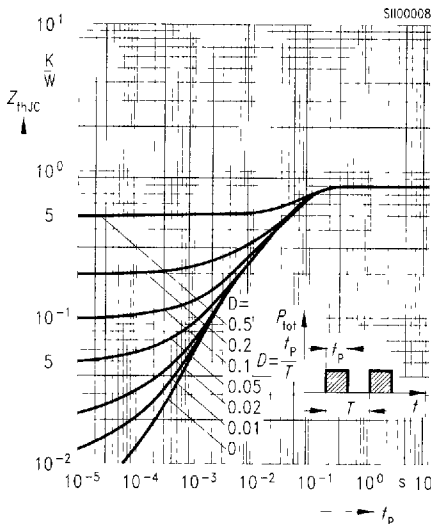
**Safe operating area,**

**short circuit**  $I_C = f(V_{CE})$ ,  $V_{GE} = \pm 15\text{ V}$   
 $T_J \leq 150^\circ\text{C}$ ,  $t_{SC} \leq 10\ \mu\text{s}$ ,  $L < 50\text{ nH}$



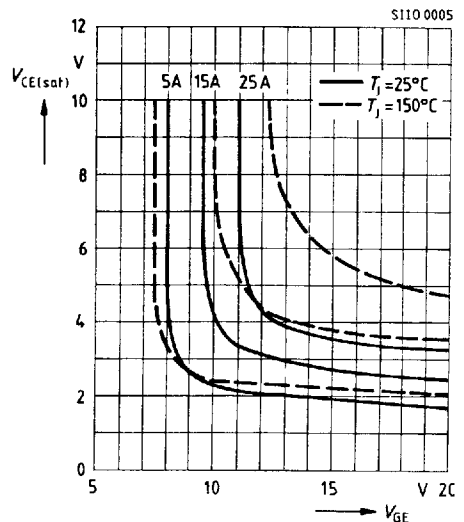
**Transient thermal impedance**

$Z_{thJC} = f(t_p)$ , parameter:  $D = t_p / T$

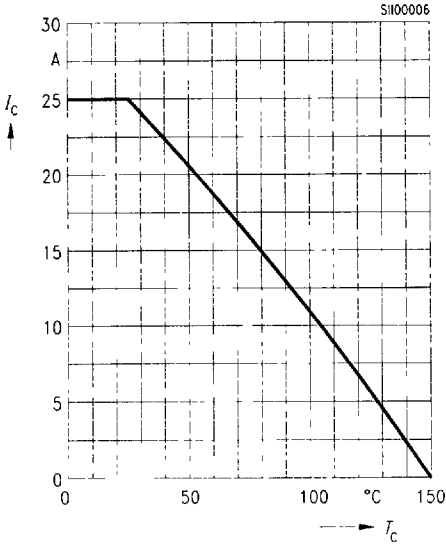


**Typ. on-state characteristics**

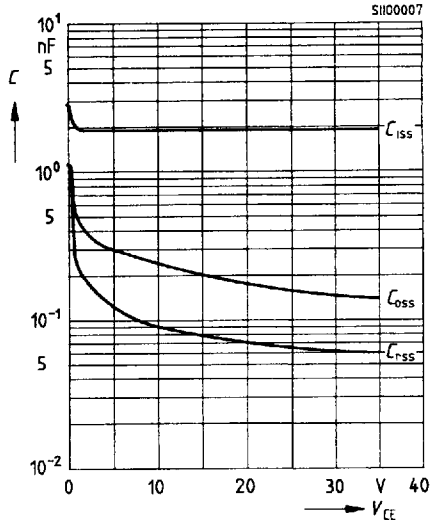
$V_{CE(sat)} = f(V_{GE})$ , parameter:  $I_C$ ,  $T_J$



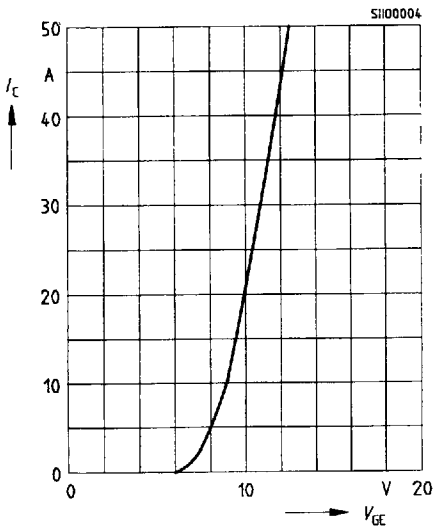
**Collector current  $I_C = f(T_C)$**   
 parameter:  $V_{GE} \geq 15 \text{ V}$ ,  $T_j = 150 \text{ }^\circ\text{C}$



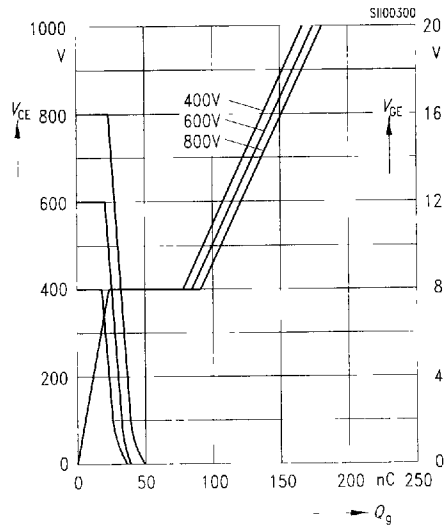
**Typ. capacitances  $C = f(V_{CE})$**   
 parameter:  $V_{GE} = 0$ ,  $f = 1 \text{ MHz}$



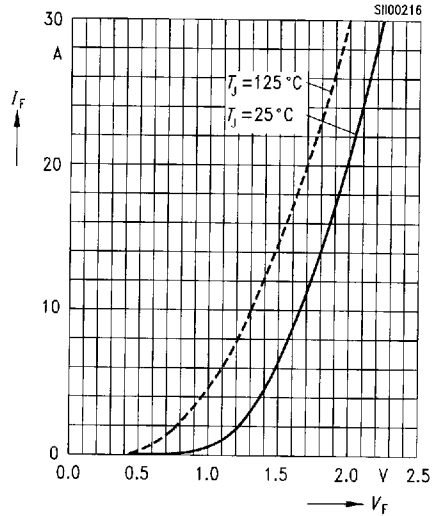
**Typ. transfer characteristics  $I_C = f(V_{GE})$**   
 parameter:  $t_p = 80 \text{ } \mu\text{s}$ ,  $V_{CE} = 20 \text{ V}$



**Typ. gate charge  $V_{CE}, V_{GE} = f(Q_G)$**

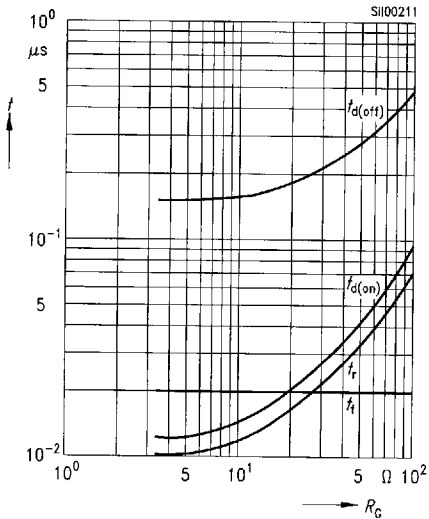


**Forward characteristics of fast recovery reverse diode  $I_F = f(V_F)$**   
parameter:  $T_j$



**Typ. switching time  $t = f(R_G)$**

Inductive load, parameter:  $T_j = 125\text{ °C}$   
 $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 15\text{ A}$



**Typ. switching time  $t = f(I_C)$**

Inductive load, parameter:  $T_j = 125\text{ °C}$   
 $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $R_G = 22\text{ Ω}$

