

# SIEMENS

SIEMENS AKTIENGESELLSCHAFT

T-23-09

## IGBT Module Preliminary Data

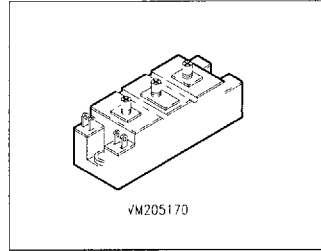
**BSM 50 GB 100 D**  
**BSM 50 GAL 100 D**

$V_{CE} = 1000 \text{ V}$

$I_C = 2 \times 70 \text{ A at } T_C = 25 \text{ °C}$

$I_C = 2 \times 50 \text{ A at } T_C = 80 \text{ °C}$

- Power module
- Half-bridge/Chopper
- Including fast free-wheel diodes
- Package with insulated metal base plate
- Package outlines/Circuit diagram: 2b, 2c<sup>1)</sup>



Half-bridge		Chopper	
Type	Ordering Code	Type	Ordering code
BSM 50 GB 100 D	C67076-A2100-A2	BSM 50 GAL 100 D	C67076-A2002-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, $T_C = 25 \text{ °C}$ $T_C = 80 \text{ °C}$	$I_C$	70 50	A
Pulsed collector current, $T_C = 25 \text{ °C}$ $T_C = 80 \text{ °C}$	$I_{C \text{ puls}}$	140 100	
Operating and storage temperature range	$T_p, T_{stg}$	- 55 ... + 150	°C
Power dissipation, $T_C = 25 \text{ °C}$	$P_{tot}$	500	W
Thermal resistance, chip-case	$R_{thJC}$	$\leq 0.25$	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 $V_{GE} = 0, I_C = 1\text{ mA}$	$V_{(BR)CES}$	1000	–	–	V
Gate threshold voltage $V_{GE} = V_{CE}, I_C = 4\text{ mA}$	$V_{GE(th)}$	4.8	5.5	6.2	
Collector-emitter saturation voltage $V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	$V_{CE(sat)}$	–	2.8 4.0	3.3 4.5	
Zero gate voltage collector current $V_{CE} = 1000\text{ V}, V_{GE} = 0$ $T_j = 25\text{ °C}$ $T_j = 125\text{ °C}$	$I_{CES}$	–	–	1000 4000	$\mu\text{A}$
Gate-emitter leakage current $V_{GE} = 20\text{ V}, V_{CE} = 0$	$I_{GES}$	–	–	100	nA

**AC Characteristics**

Forward transconductance $V_{CE} = 20\text{ V}, I_C = 50\text{ A}$	$g_{fs}$	18	–	–	S
Input capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0, f = 1\text{ MHz}$	$C_{iss}$	–	8000	–	$\mu\text{F}$
Output capacitance, $V_{GS} = 0$ $V_{CE} = 25\text{ V}, V_{GE} = 0, f = 1\text{ MHz}$	$C_{oss}$	–	640	–	
Reverse transfer capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0, f = 1\text{ MHz}$	$C_{rss}$	–	250	–	

**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 $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(on)}$	20	30	40	ns
Rise time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_r$	–	140	–	
Turn-off delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(off)}$	–	300	–	
Fall time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_f$	–	300	–	

**Inductive Load**

Turn-on delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(on)}$	20	30	40	ns
Rise time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_r$	10	20	25	
Turn-off delay time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_{d(off)}$	220	300	360	
Fall time $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$t_f$	25	35	45	
Turn-off loss ( $E_{off} = E_{off1} + E_{off2}$ ) $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $R_{g(on)} = 3.3\ \Omega, R_{g(off)} = 3.3\ \Omega$	$E_{off1}$ $E_{off2}$	– –	2.0 2.0	– –	

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

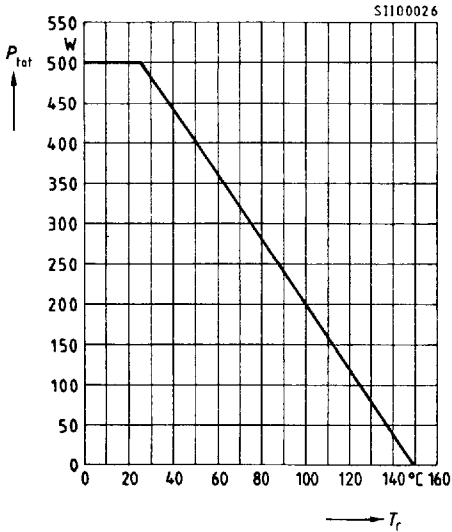
**Free-Wheel Diode**

Diode forward voltage $I_F = 50\text{ A}$ , $V_{GE} = 0$ $T_J = 25\text{ °C}$ $T_J = 125\text{ °C}$	$V_F$	–	1.85 1.45	–	V
Reverse recovery time $I_F = 50\text{ A}$ , $V_R = 600\text{ V}$ $V_{GE} = 0$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ $T_J = 125\text{ °C}$	$t_{rr}$	–	0.2	–	$\mu\text{s}$
Reverse recovery charge $I_F = 50\text{ A}$ , $V_R = 600\text{ V}$ $V_{GE} = 0$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ $T_J = 25\text{ °C}$ $T_J = 125\text{ °C}$	$Q_{rr}$	–	3.6 10	–	$\mu\text{C}$
Soft factor $I_F = 50\text{ A}$ , $V_R = 600\text{ V}$ $V_{GE} = 0$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ $T_J = 125\text{ °C}$	$S$	–	1	–	–
Thermal resistance Chip-case	$R_{thJC}$	–	–	0.9	K/W

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

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

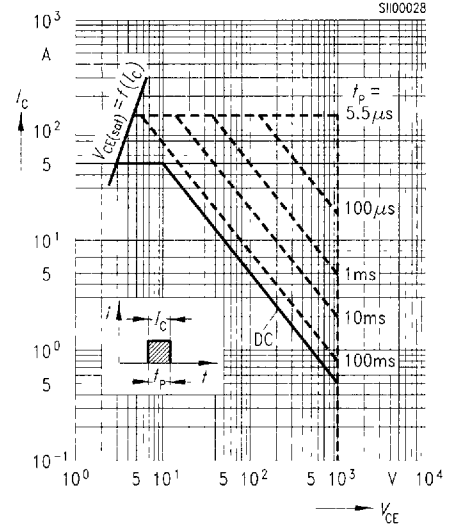
parameter:  $T_j = 150\text{ }^\circ\text{C}$



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

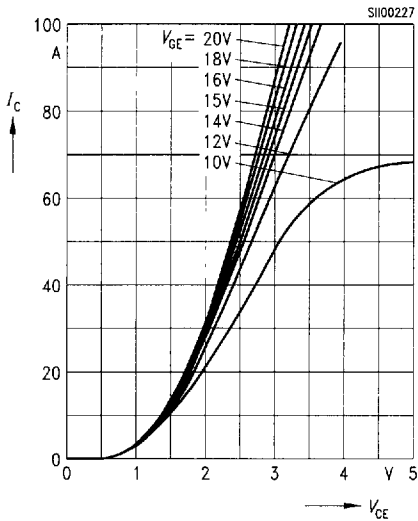
parameter: single pulse,  $T_c = 25\text{ }^\circ\text{C}$

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



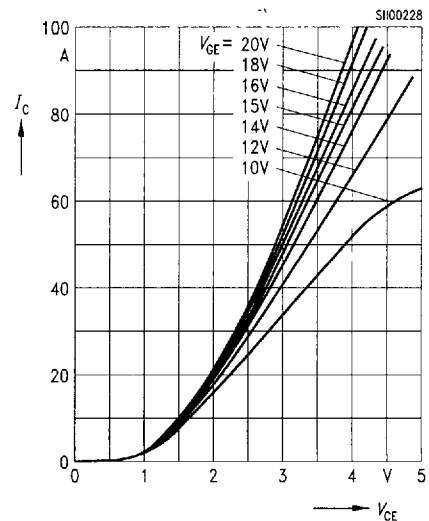
**Typ. output characteristics  $I_C = f(V_{CE})$**

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



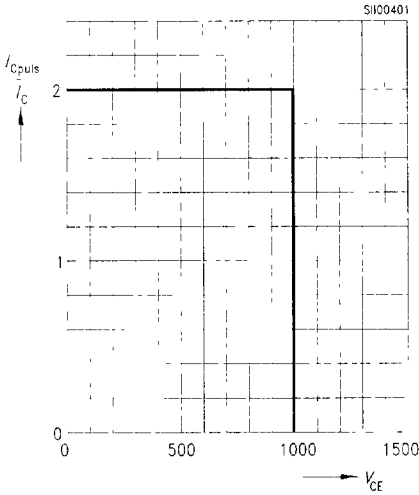
**Typ. output characteristics  $I_C = f(V_{CE})$**

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



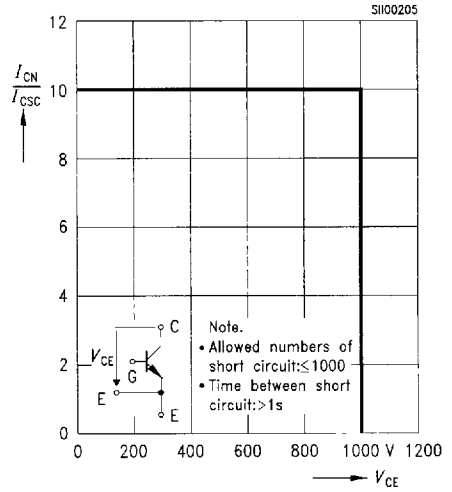
**Reverse biased safe operating area**

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



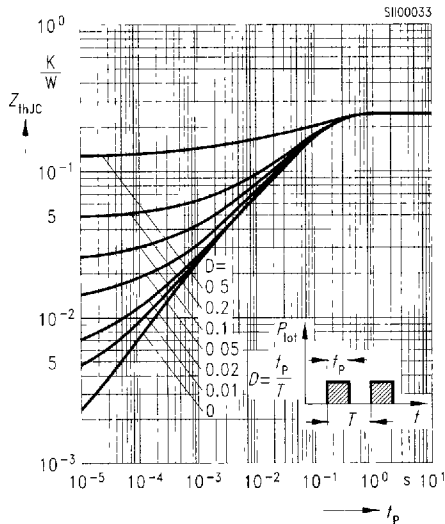
**Safe operating area,**

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



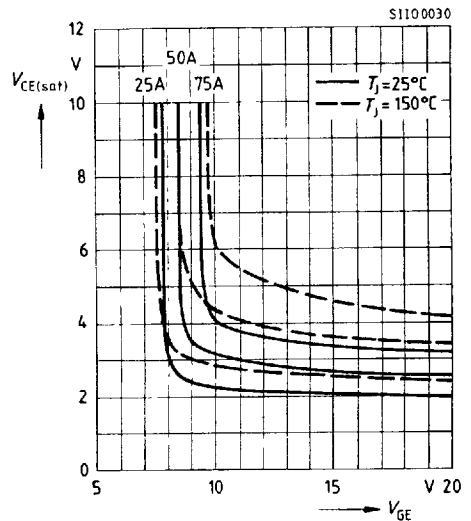
**Transient thermal impedance**

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



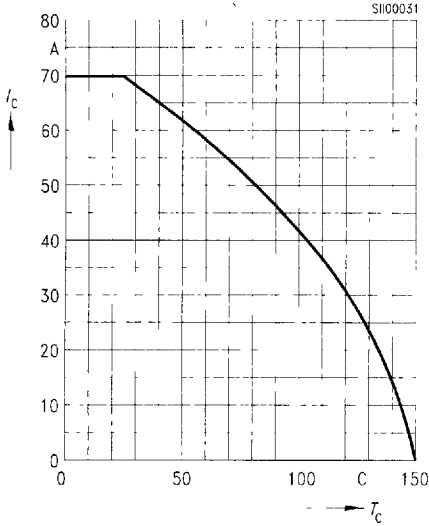
**Typ. on-state characteristics**

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



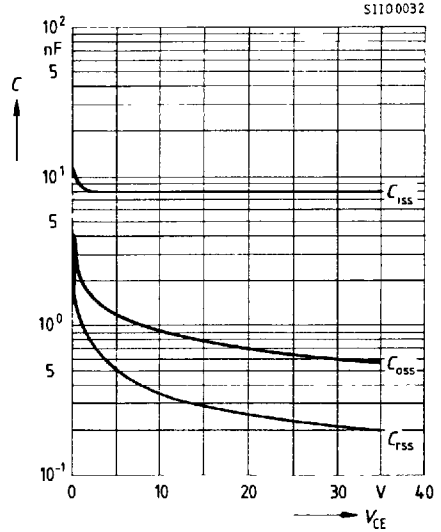
**Collector current  $I_C = f(T_C)$**

parameter:  $V_{GE} \geq 15 \text{ V}$ ,  $T_J = 150 \text{ }^\circ\text{C}$



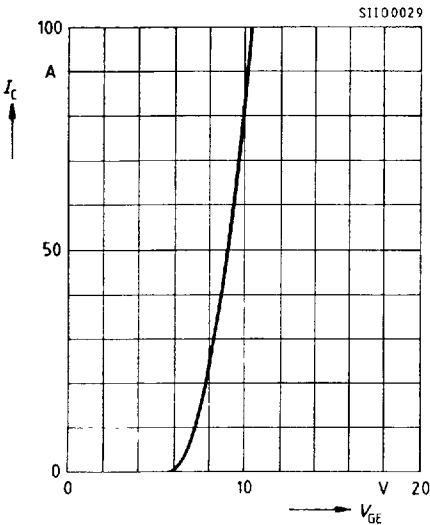
**Typ. capacitances  $C = f(V_{CE})$**

parameter:  $V_{GE} = 0$ ,  $f = 1 \text{ MHz}$

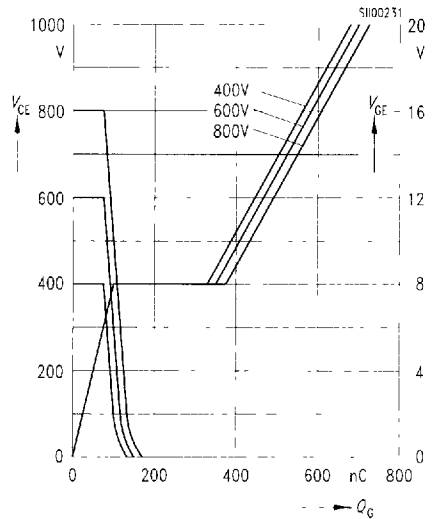


**Typ. transfer characteristics  $I_C = f(V_{GE})$**

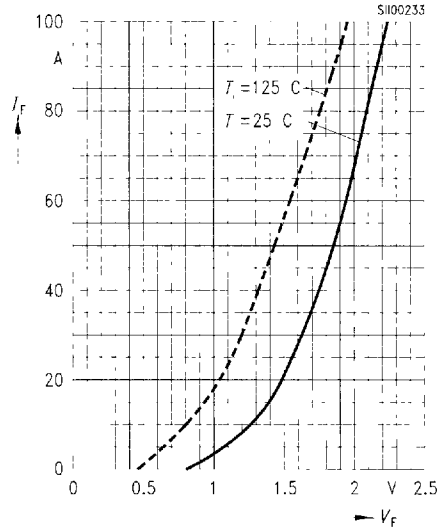
parameter:  $t_p = 80 \text{ } \mu\text{s}$ ,  $V_{CE} = 20 \text{ V}$



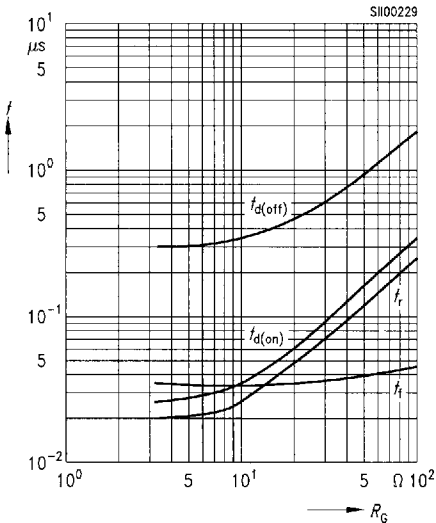
**Typ. gate charge  $V_{CE}, V_{GE} = f(Q_G)$**



**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:  $T_j = 125\text{ C}$   
 $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 50\text{ A}$



**Typ. switching time**  $t = f(I_C)$   
Inductive load, parameter:  $T_j = 125\text{ C}$   
 $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $R_G = 22\text{ }\Omega$

