SKM400GAL176DL3

SEMITRANS™ 9

Trench IGBT Modules

SKM400GAL176DL3

Features*

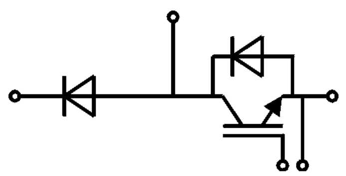
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability, self limiting to 6 x I_{cnom}
- Insulated copper baseplate using aluminum nitride ceramic
- Large clearance (13mm) and creepage distance (20mm), to ground: 50mm

Typical Applications

- AC inverter drives
- Mains 575 – 750 V AC
- Public transport
- Wind power

Remarks

- Terminals 1,4 – 2,5 – 3,6 need to be connected externally



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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT				
V_{CES}	T_j = 25 °C		1700	V
I_C	T_j = 150 °C	T_c = 25 °C	442	A
		T_c = 80 °C	314	A
I_{Cnom}			300	A
I_{CRM}	I_{CRM} = 2 x I_{Cnom}		600	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 1000 V $V_{GE} \leq$ 20 V $V_{CES} \leq$ 1700 V	T_j = 125 °C	10	µs
T_j			-40 ... 150	°C
Inverse diode				
I_F	T_j = 150 °C	T_c = 25 °C	283	A
		T_c = 80 °C	187	A
I_{Fnom}			200	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		400	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		1530	A
T_j			-40 ... 150	°C
Freewheeling diode				
I_F	T_j = 150 °C	T_c = 25 °C	392	A
		T_c = 80 °C	259	A
I_{Fnom}			300	A
I_{FRM}	I_{FRM} = 2xI_{Fnom}		600	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		2448	A
T_j			-40 ... 150	°C
Module				
$I_{t(RMS)}$			-	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min		9500	V

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
$V_{CE(sat)}$	I_C = 300 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.99	2.45	V
		T_j = 125 °C		2.46	2.90	V
V_{CE0}	chiplevel	T_j = 25 °C		1.00	1.20	V
		T_j = 125 °C		0.90	1.10	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		3.3	4.2	mΩ
		T_j = 125 °C		5.2	6.0	mΩ
$V_{GE(th)}$	V_{GE}=V_{CE}, I_C = 12 mA		5.2	5.8	6.4	V
I_{CES}	V_{GE} = 0 V V_{CE} = 1700 V	T_j = 25 °C			4	mA
		T_j = 125 °C		-		mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		26.4		nF
C_{oes}		f = 1 MHz		1.10		nF
C_{res}		f = 1 MHz		0.88		nF
Q_G	V_{GE} = - 8 V...+ 15 V			2500		nC
R_{Gint}	T_j = 25 °C			4.9		Ω

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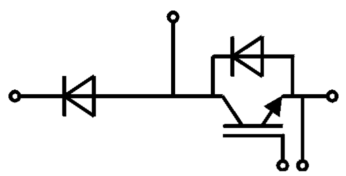

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Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
$t_{d(on)}$	V_{CC} = 1200 V I_C = 300 A V_{GE} = +15/-15 V $R_{G\,on}$ = 4 Ω $R_{G\,off}$ = 4 Ω di/dt$_{on}$ = 2100 A/µs di/dt$_{off}$ = 2100 A/µs	T_j = 125 °C		933		ns
t_r		T_j = 125 °C		159		ns
E_{on}		T_j = 125 °C		143		mJ
$t_{d(off)}$		T_j = 125 °C		1250		ns
t_f		T_j = 125 °C		150		ns
E_{off}		T_j = 125 °C		109		mJ
$R_{th(j-c)}$	per IGBT				0.072	K/W
Inverse diode						
$V_F = V_{EC}$	I_F = 200 A V_{GE} = 0 V chiplevel	T_j = 25 °C		1.71	2.01	V
		T_j = 125 °C		1.75	2.04	V
V_{F0}	chiplevel	T_j = 25 °C		1.24	1.52	V
		T_j = 125 °C		1.07	1.38	V
r_F	chiplevel	T_j = 25 °C		2.3	2.5	mΩ
		T_j = 125 °C		3.4	3.3	mΩ
I_{RRM}	I_F = 300 A di/dt$_{off}$ = 2100 A/µs V_{GE} = -15 V V_{CC} = 1200 V	T_j = 125 °C		120		A
Q_{rr}		T_j = 125 °C		45		µC
E_{rr}		T_j = 125 °C		22		mJ
$R_{th(j-c)}$	per diode				0.19	K/W
Freewheeling diode						
$V_F = V_{EC}$	I_F = 300 A V_{GE} = 0 V chiplevel	T_j = 25 °C		1.72	2.03	V
		T_j = 125 °C		1.79	2.08	V
V_{F0}	chiplevel	T_j = 25 °C		1.24	1.52	V
		T_j = 125 °C		1.07	1.33	V
r_F	chiplevel	T_j = 25 °C		1.61	1.71	mΩ
		T_j = 125 °C		2.4	2.5	mΩ
I_{RRM}	I_F = 300 A di/dt$_{off}$ = 2100 A/µs V_{GE} = -15 V V_{CC} = 1200 V	T_j = 125 °C		145		A
Q_{rr}		T_j = 125 °C		53		µC
E_{rr}		T_j = 125 °C		26		mJ
$R_{th(j-c)}$	per diode				0.14	K/W
Module						
L_{CE}				-		nH
$R_{CC'+EE'}$	measured per switch	T_C = 25 °C		0.35		mΩ
		T_C = 125 °C		0.5		mΩ
$R_{th(c-s)}$	calculated without thermal coupling (λ_{grease}=0.81 W/(m*K))			t.b.d.	0.038	K/W
M_s	to heat sink M6		3		5	Nm
M_t		M6	2.5		5	Nm
						Nm
w					460	g

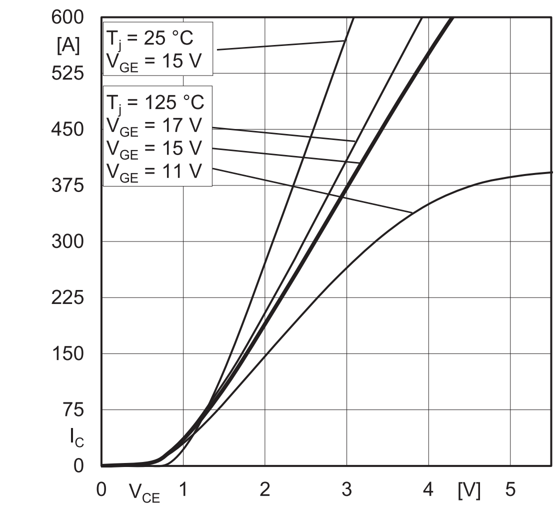


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

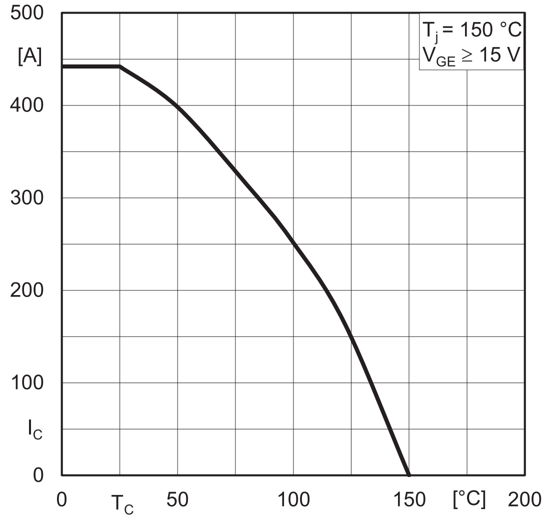


Fig. 2: Rated current vs. temperature $I_C = f (T_C)$

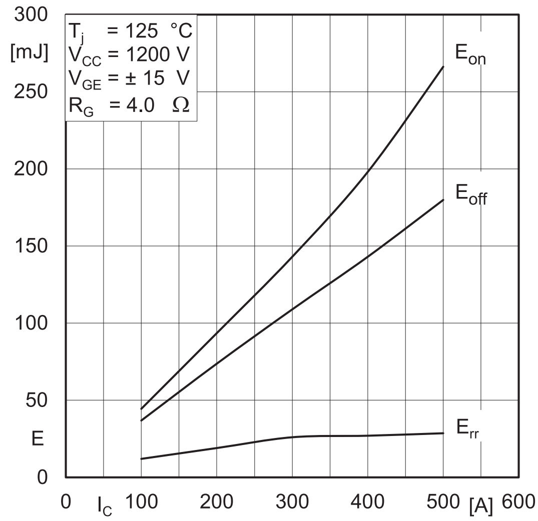


Fig. 3: Typ. turn-on /-off energy = f (I_C)

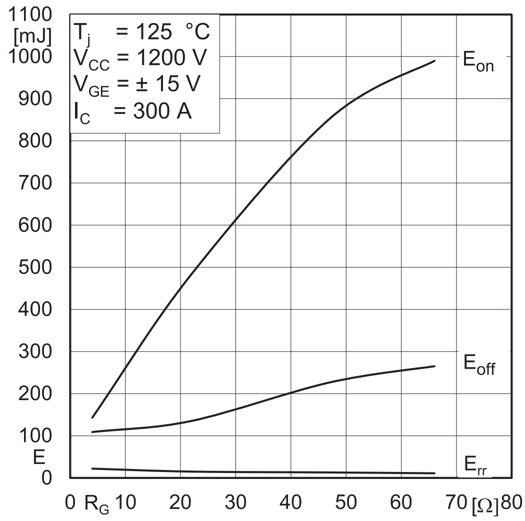


Fig. 4: Typ. turn-on /-off energy = f (R_G)

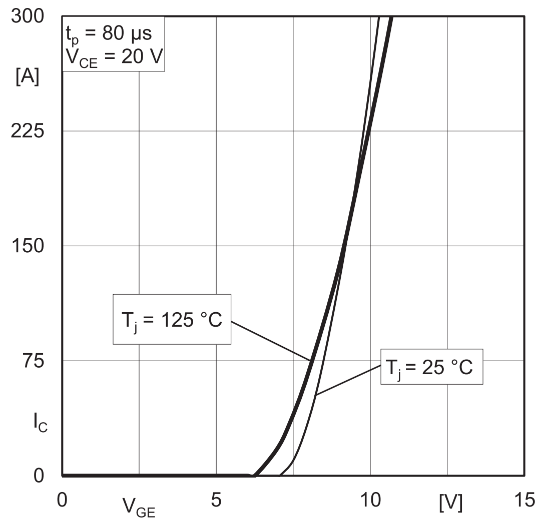


Fig. 5: Typ. transfer characteristic

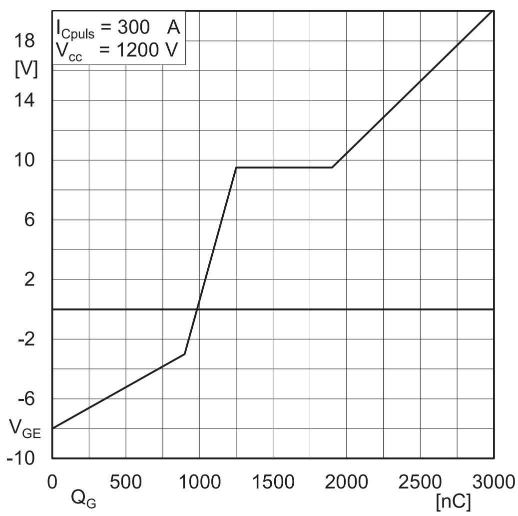


Fig. 6: Typ. gate charge characteristic

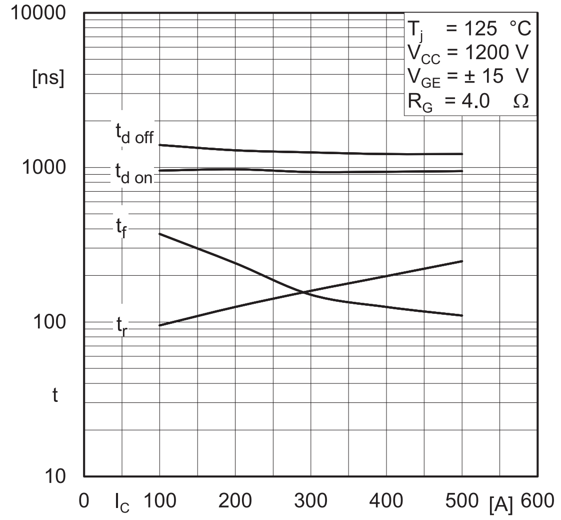


Fig. 7: Typ. switching times vs. I_C

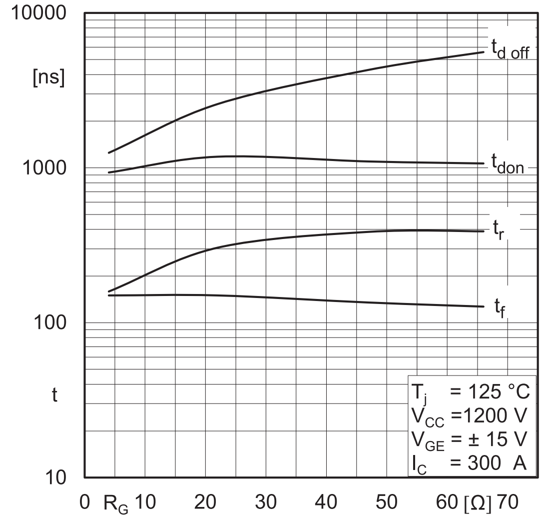


Fig. 8: Typ. switching times vs. gate resistor R_G

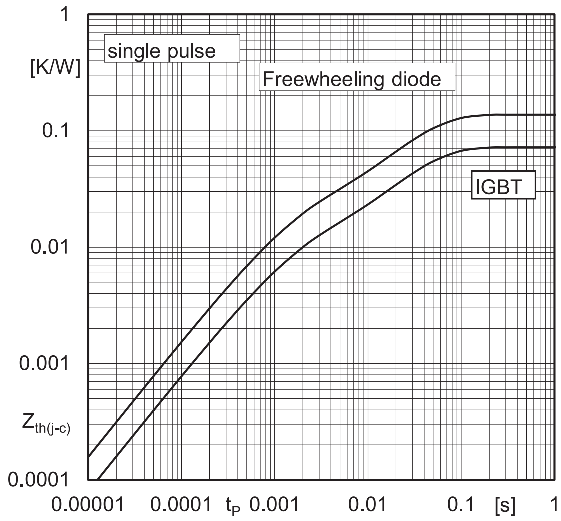


Fig. 9: Transient thermal impedance

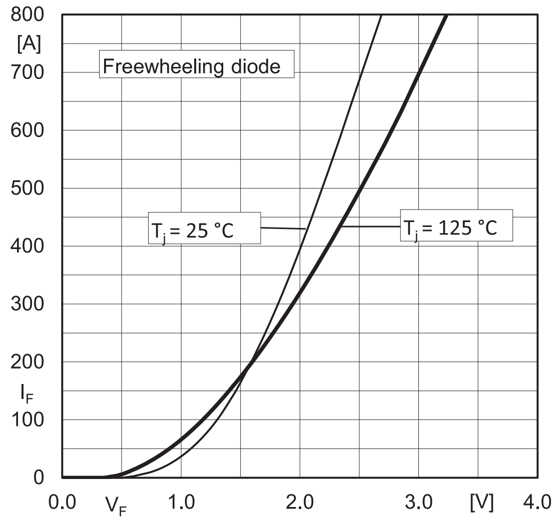
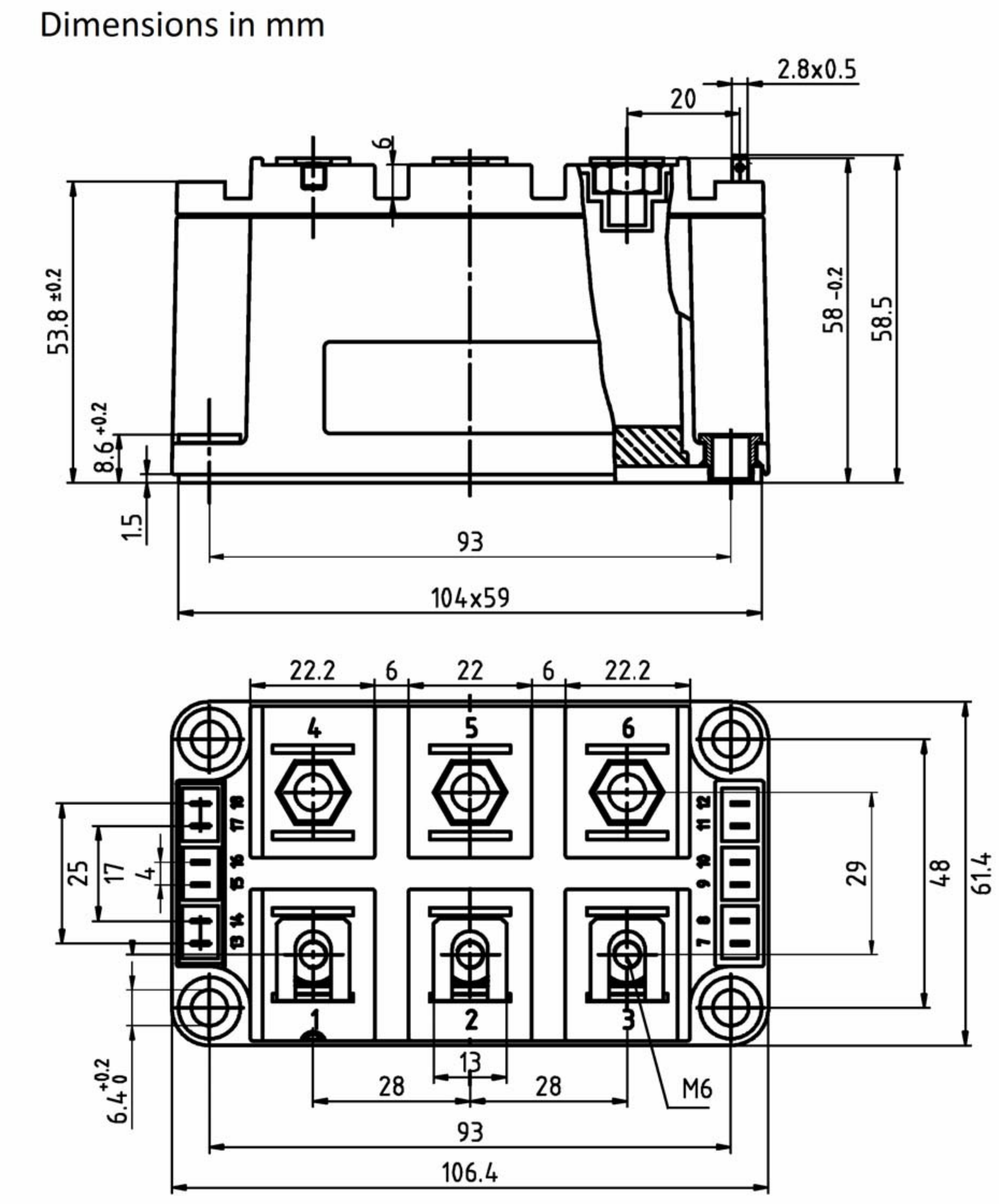


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$



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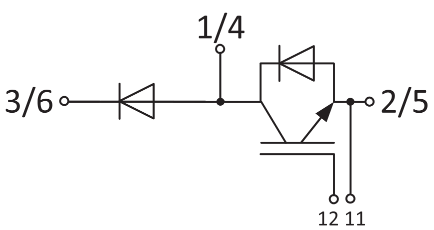

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This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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