

SK20DGDLE07E3ETE1



SEMITOP®E1

3-phase Converter-Inverter-Brake (CIB)

SK20DGDLE07E3ETE1

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- PEP rectifier diode technology for enhanced power and environmental robustness
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

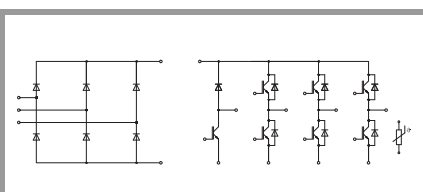
Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

- Recommended $T_{j,op} = -40 \dots +150 \text{ } ^\circ\text{C}$

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V_{CES}	$T_j = 25 \text{ } ^\circ\text{C}$		650	V
I_C	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	25	A
		$T_j = 175 \text{ } ^\circ\text{C}$	20	A
I_C	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	29	A
		$T_j = 175 \text{ } ^\circ\text{C}$	23	A
I_{Chom}			20	A
I_{CRM}			40	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 360 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ $V_{CES} \leq 650 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$	6	μs
T_j			-40 ... 175	$^\circ\text{C}$
Chopper - IGBT				
V_{CES}	$T_j = 25 \text{ } ^\circ\text{C}$		650	V
I_C	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	25	A
		$T_j = 175 \text{ } ^\circ\text{C}$	20	A
I_C	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	29	A
		$T_j = 175 \text{ } ^\circ\text{C}$	24	A
I_{Chom}			20	A
I_{CRM}			40	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 360 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ $V_{CES} \leq 650 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$	6	μs
T_j			-40 ... 175	$^\circ\text{C}$
Inverse - Diode				
V_{RRM}	$T_j = 25 \text{ } ^\circ\text{C}$		650	V
I_F	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	29	A
		$T_j = 175 \text{ } ^\circ\text{C}$	23	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	34	A
		$T_j = 175 \text{ } ^\circ\text{C}$	27	A
I_{FRM}			60	A
I_{FSM}	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150 \text{ } ^\circ\text{C}$		150	A
T_j			-40 ... 175	$^\circ\text{C}$
Freewheeling - Diode				
V_{RRM}	$T_j = 25 \text{ } ^\circ\text{C}$		650	V
I_F	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	29	A
		$T_j = 175 \text{ } ^\circ\text{C}$	23	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 70 \text{ } ^\circ\text{C}$	34	A
		$T_j = 175 \text{ } ^\circ\text{C}$	27	A
I_{FRM}			60	A
I_{FSM}	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150 \text{ } ^\circ\text{C}$		150	A
T_j			-40 ... 175	$^\circ\text{C}$



DGDL-ET

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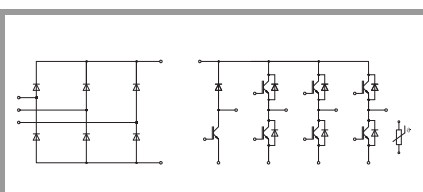
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Remarks

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Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
Rectifier - Diode				
V_{RRM}	$T_j = 25 \text{ }^\circ\text{C}$	1600	V	
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	46	A
	$T_j = 175 \text{ }^\circ\text{C}$	$T_s = 100 \text{ }^\circ\text{C}$	36	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	54	A
	$T_j = 175 \text{ }^\circ\text{C}$	$T_s = 100 \text{ }^\circ\text{C}$	43	A
I_{FSM}	$t_p = 10 \text{ ms}$	$T_j = 25 \text{ }^\circ\text{C}$	370	A
	$\sin 180^\circ$	$T_j = 150 \text{ }^\circ\text{C}$	270	A
i^2t	$t_p = 10 \text{ ms}$	$T_j = 25 \text{ }^\circ\text{C}$	685	A^2s
	$\sin 180^\circ$	$T_j = 150 \text{ }^\circ\text{C}$	365	A^2s
T_j		-40 ... 175	$^\circ\text{C}$	
Module				
$I_{t(RMS)}$	$\Delta T_{terminal}$ at PCB joint = 30 K, per pin	30	A	
T_{stg}	module without TIM	-40 ... 125	$^\circ\text{C}$	
V_{isol}	AC, sinusoidal, 1 min	2500	V	

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
$V_{CE(sat)}$	$I_C = 20 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$	1.45	1.87	V
		$T_j = 150 \text{ }^\circ\text{C}$	1.83	2.10	V
V_{CE0}	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$	0.90	1.00	V
		$T_j = 150 \text{ }^\circ\text{C}$	0.82	0.90	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$	28	44	$\text{m}\Omega$
		$T_j = 150 \text{ }^\circ\text{C}$	51	60	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.29 \text{ mA}$	5.1	5.8	6.4	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 650 \text{ V}, T_j = 25 \text{ }^\circ\text{C}$			1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	1.10		nF
C_{oes}		$f = 1 \text{ MHz}$	0.07		nF
C_{res}		$f = 1 \text{ MHz}$	0.03		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		203		nC
R_{Gint}	$T_j = 25 \text{ }^\circ\text{C}$		0		Ω
$t_{d(on)}$	$V_{CC} = 300 \text{ V}$ $I_C = 20 \text{ A}$	$T_j = 150 \text{ }^\circ\text{C}$	5		ns
t_r	$R_{G on} = 15 \text{ }\Omega$	$T_j = 150 \text{ }^\circ\text{C}$	30		ns
E_{on}	$R_{G off} = 15 \text{ }\Omega$	$T_j = 150 \text{ }^\circ\text{C}$	0.72		mJ
$t_{d(off)}$	$di/dt_{on} = 550 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ }^\circ\text{C}$	139		ns
t_f	$di/dt_{off} = 450 \text{ A}/\mu\text{s}$ $dv/dt = 4300 \text{ V}/\mu\text{s}$	$T_j = 150 \text{ }^\circ\text{C}$	37		ns
E_{off}	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ }^\circ\text{C}$	0.57		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$		1.72		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$		1.35		K/W

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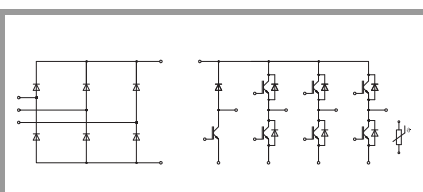
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Chopper - IGBT						
$V_{CE(sat)}$	$I_C = 20 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.45	1.87	V
		$T_j = 150 \text{ } ^\circ\text{C}$		1.83	2.10	V
V_{CE0}	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		0.90	1.00	V
		$T_j = 150 \text{ } ^\circ\text{C}$		0.82	0.90	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		28	44	m Ω
		$T_j = 150 \text{ } ^\circ\text{C}$		51	60	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.29 \text{ mA}$		5.1	5.8	6.4	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 650 \text{ V}, T_j = 25 \text{ } ^\circ\text{C}$				1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$		1.10		nF
C_{oes}		$f = 1 \text{ MHz}$		0.07		nF
C_{res}		$f = 1 \text{ MHz}$		0.03		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$			203		nC
R_{Gint}	$T_j = 25 \text{ } ^\circ\text{C}$			0		Ω
$t_{d(on)}$	$V_{CC} = 300 \text{ V}$ $I_C = 20 \text{ A}$	$T_j = 150 \text{ } ^\circ\text{C}$		5		ns
t_r		$T_j = 150 \text{ } ^\circ\text{C}$		30		ns
E_{on}	$R_{G on} = 15 \text{ } \Omega$ $R_{G off} = 15 \text{ } \Omega$	$T_j = 150 \text{ } ^\circ\text{C}$		0.72		mJ
$t_{d(off)}$	$di/dt_{on} = 550 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ } ^\circ\text{C}$		139		ns
t_f	$di/dt_{off} = 450 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ } ^\circ\text{C}$		37		ns
E_{off}	$dv/dt = 4300 \text{ V}/\mu\text{s}$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$		0.57		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8 \text{ W}/(\text{mK})$			1.72		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5 \text{ W}/(\text{mK})$			1.35		K/W
Inverse - Diode						
$V_F = V_{EC}$	$I_F = 20 \text{ A}$ chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.41	1.78	V
		$T_j = 150 \text{ } ^\circ\text{C}$		1.41	1.80	V
V_{F0}	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.04	1.24	V
		$T_j = 150 \text{ } ^\circ\text{C}$		0.85	0.99	V
r_F	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		19	27	m Ω
		$T_j = 150 \text{ } ^\circ\text{C}$		28	41	m Ω
I_{RRM}	$I_F = 20 \text{ A}$	$T_j = 150 \text{ } ^\circ\text{C}$		15		A
Q_{rr}	$di/dt_{off} = 540 \text{ A}/\mu\text{s}$ $V_{GE} = -15 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$		2.4		μC
E_{rr}	$V_{CC} = 300 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$		0.38		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8 \text{ W}/(\text{mK})$			1.75		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5 \text{ W}/(\text{mK})$			1.38		K/W
Freewheeling - Diode						
$V_F = V_{EC}$	$I_F = 20 \text{ A}$ chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.41	1.78	V
		$T_j = 150 \text{ } ^\circ\text{C}$		1.41	1.80	V
V_{F0}	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.04	1.24	V
		$T_j = 150 \text{ } ^\circ\text{C}$		0.85	0.99	V
r_F	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		19	27	m Ω
		$T_j = 150 \text{ } ^\circ\text{C}$		28	41	m Ω
I_{RRM}	$I_F = 20 \text{ A}$	$T_j = 150 \text{ } ^\circ\text{C}$		15		A
Q_{rr}	$di/dt_{off} = 540 \text{ A}/\mu\text{s}$ $V_{GE} = -15 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$		2.4		μC
E_{rr}	$V_{CC} = 300 \text{ V}$	$T_j = 150 \text{ } ^\circ\text{C}$		0.38		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8 \text{ W}/(\text{mK})$			1.75		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5 \text{ W}/(\text{mK})$			1.38		K/W

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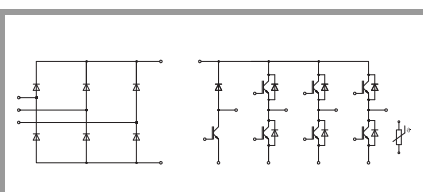
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Remarks

- Recommended $T_{j,op} = -40 \dots +150 \text{ °C}$

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V_F	$I_F = 20 \text{ A}$ chipelevel	$T_j = 25 \text{ °C}$		1.01	1.26	V
		$T_j = 150 \text{ °C}$		0.91	1.15	V
V_{F0}	chipelevel	$T_j = 25 \text{ °C}$		0.89	1.09	V
		$T_j = 150 \text{ °C}$		0.73	0.92	V
r_F	chipelevel	$T_j = 25 \text{ °C}$		6.2	8.5	mΩ
		$T_j = 150 \text{ °C}$		8.8	12	mΩ
I_R	$T_j = 150 \text{ °C}, V_{RRM}$				2	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8 \text{ W/(mK)}$			1.56		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5 \text{ W/(mK)}$			1.21		K/W
Module						
M_s	to heatsink		1.6		2.3	Nm
w				25		g
L_{CE}				30		nH
Temperature Sensor						
R_{100}	$T_c = 100 \text{ °C}$ ($R_{25} = 5 \text{ k}\Omega$)			$493 \pm 5\%$		Ω
$B_{25/85}$	$R_{(T)} = R_{25} \cdot \exp[B_{25/85} \cdot (1/T - 1/298)]$, T[K]			3420		K



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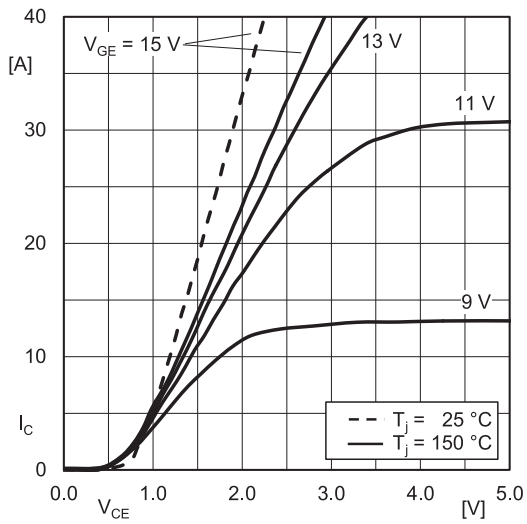


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

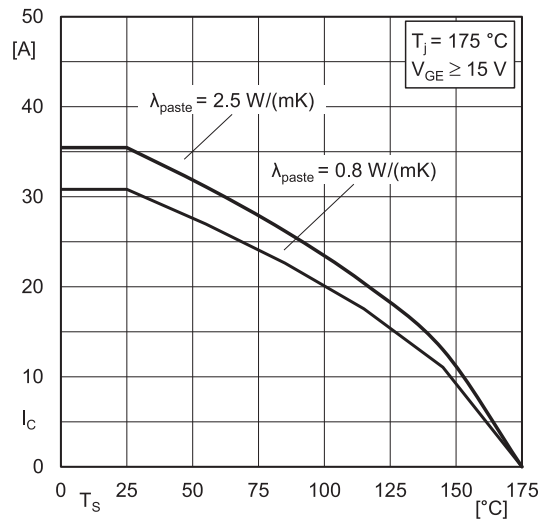


Fig. 2: IGBT rated current vs. temperature $I_c=f(T_s)$

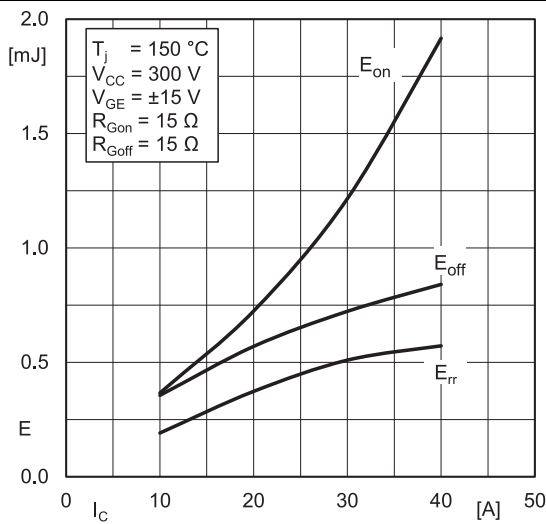


Fig. 3: Typ. turn-on /-off energy = $f(I_c)$

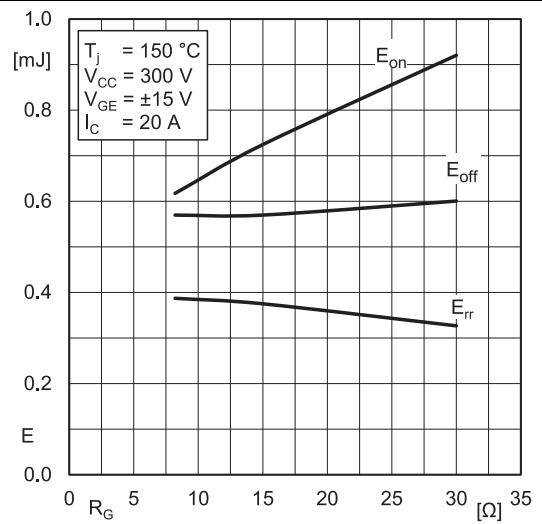


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

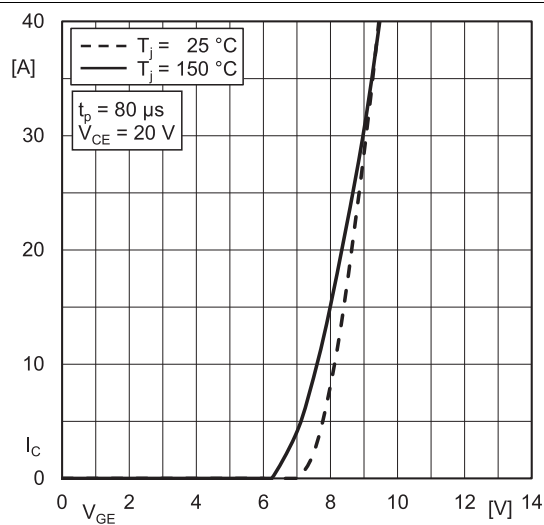


Fig. 5: Typ. IGBT transfer characteristic

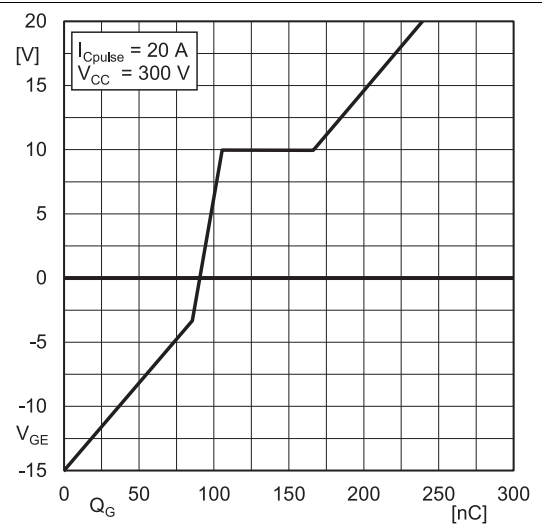


Fig. 6: Typ. IGBT gate charge characteristic

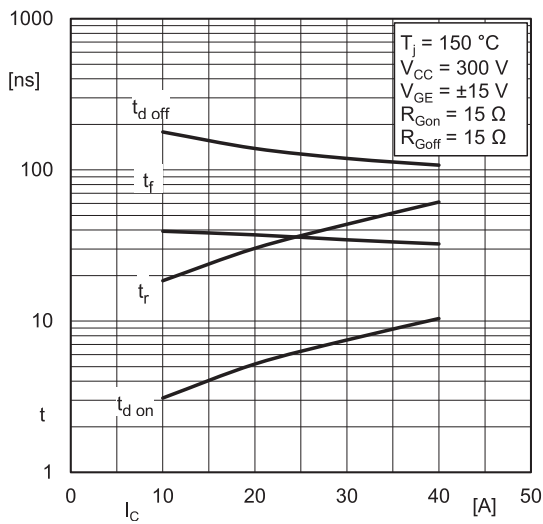


Fig. 7: Typ. switching times = $f(I_C)$

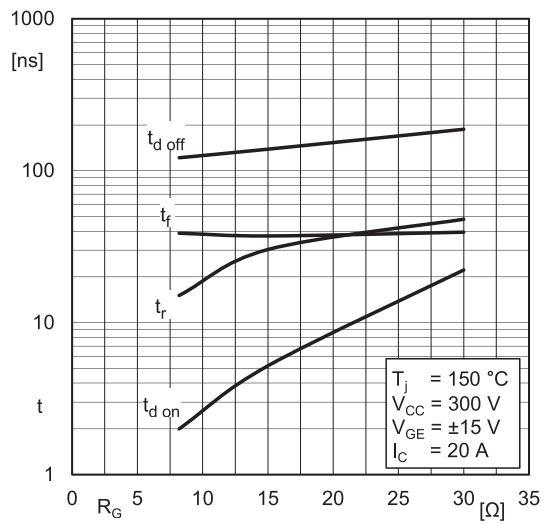


Fig. 8: Typ. switching times = $f(R_G)$

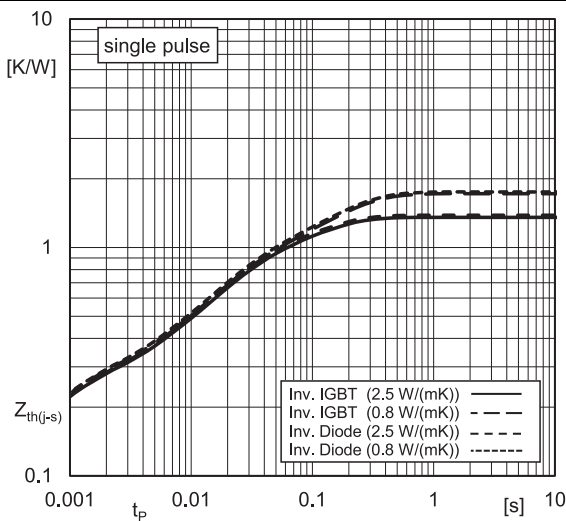


Fig. 9: Typ. transient thermal impedance

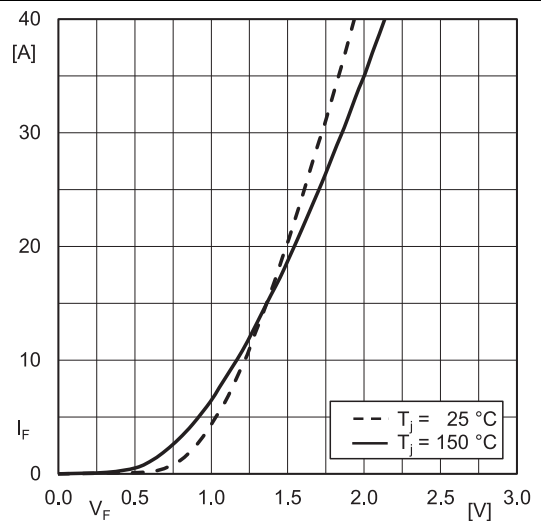


Fig. 10: Typ. Inv. diode forward charact., incl. R_{CC+EE}

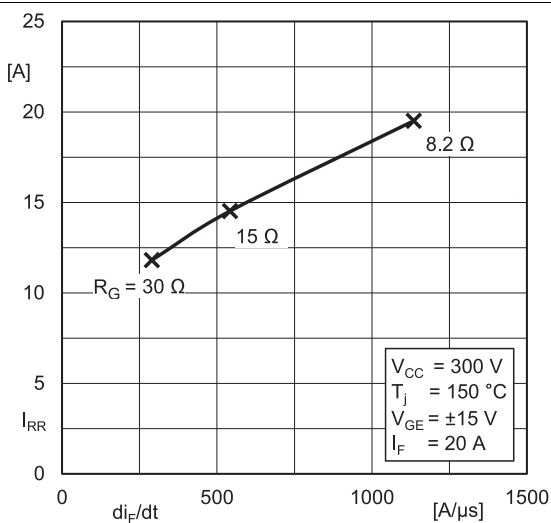


Fig. 11: Typ. Inv. diode peak reverse recovery current

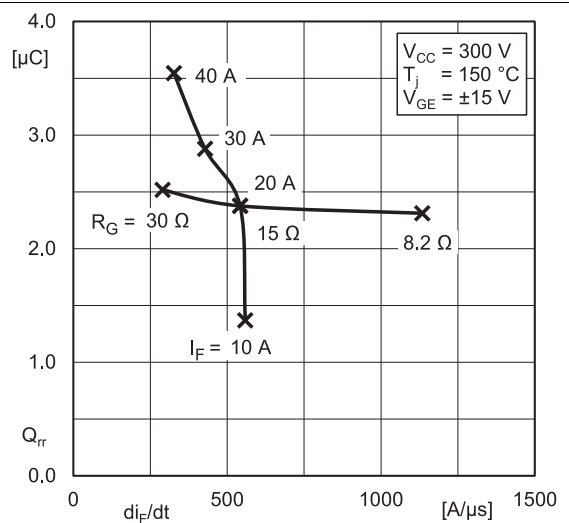


Fig. 12: Typ. Inv. diode reverse recovery charge

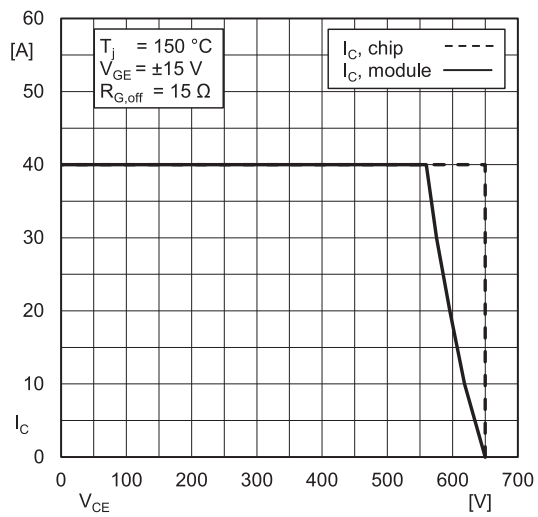


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

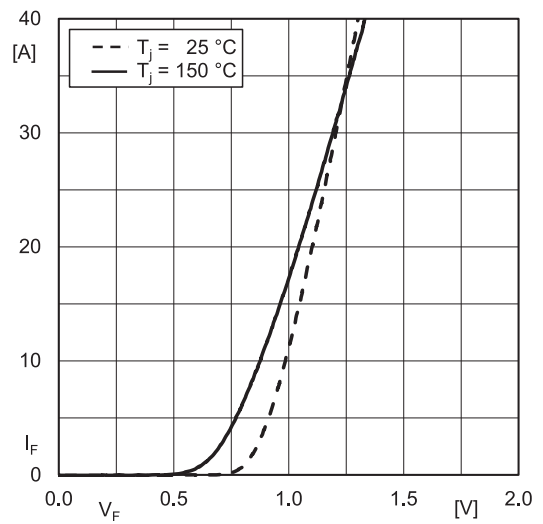
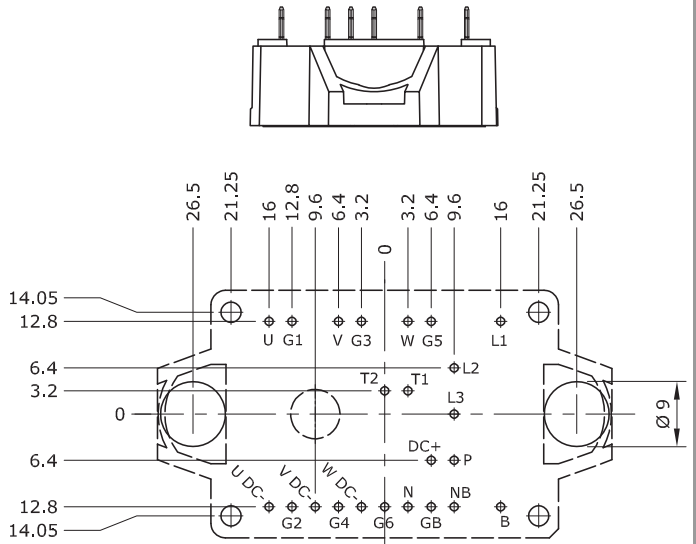
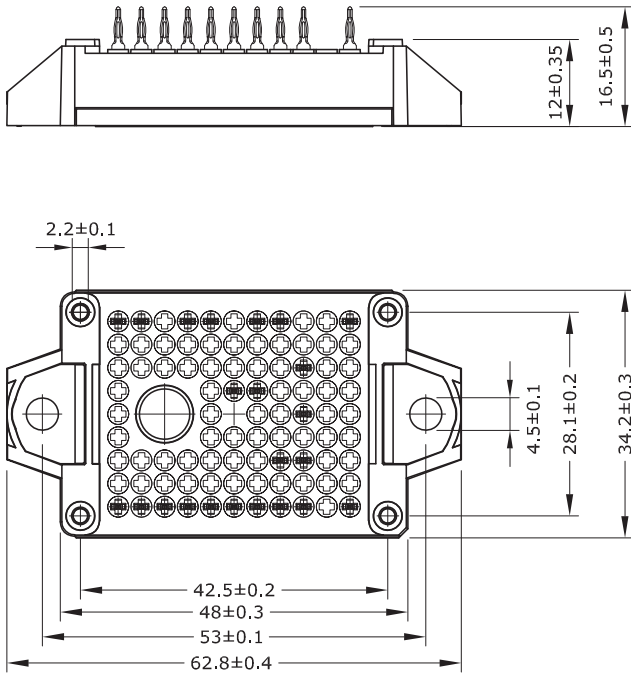


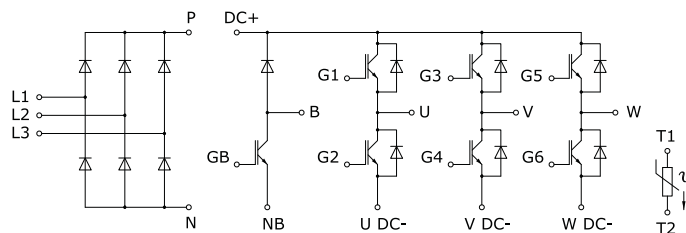
Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$

SK20DGDL07E3ETE1



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\phi \pm 0.1$
- Diameters of drill ϕ 1.15mm
- Copper thickness in hole 25 - 50 μ m
- Hole specification for contacts:
refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E1



DGDL-ET

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

***IMPORTANT INFORMATION AND WARNINGS**

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