

SK25DGDL12T7ETE1



SEMITOP®E1

3-phase Converter-Inverter-Brake (CIB)

SK25DGDL12T7ETE1

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 1200V Generation 7 IGBT (T7)
- 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

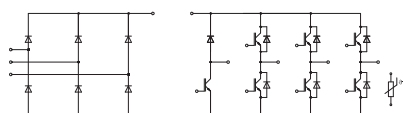
Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$
- $T_{j,op} > 150 \text{ }^{\circ}\text{C}$ during overload (details on AN19-002)

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V _{CES}	T _j = 25 °C		1200	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	33	A
	T _j = 175 °C	T _s = 100 °C	27	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	38	A
	T _j = 175 °C	T _s = 100 °C	31	A
I _{Cnom}			25	A
I _{CRM}			50	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 175 °C	7	μs
T _j			-40 ... 175	°C
Chopper - IGBT				
V _{CES}	T _j = 25 °C		1200	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	33	A
	T _j = 175 °C	T _s = 100 °C	27	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	38	A
	T _j = 175 °C	T _s = 100 °C	31	A
I _{Cnom}			25	A
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t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 175 °C	7	μs
T _j			-40 ... 175	°C
Inverse - Diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	17	A
	T _j = 175 °C	T _s = 100 °C	14	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	20	A
	T _j = 175 °C	T _s = 100 °C	16	A
I _{FRM}			45	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		65	A
T _j			-40 ... 175	°C
Freewheeling - Diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	12	A
	T _j = 175 °C	T _s = 100 °C	10	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	13	A
	T _j = 175 °C	T _s = 100 °C	11	A
I _{FRM}			20	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		36	A
T _j			-40 ... 175	°C



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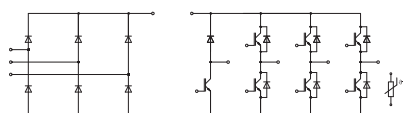
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Absolute Maximum Ratings

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

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
$V_{CE(sat)}$	$I_C = 25 \text{ A}$	$T_j = 25 \text{ }^{\circ}\text{C}$	1.60	1.75	V
	$V_{GE} = 15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$	1.78	1.93	V
	chiplevel	$T_j = 175 \text{ }^{\circ}\text{C}$	1.82	1.97	V
V_{CE0}	$T_j = 25 \text{ }^{\circ}\text{C}$		1.00	1.05	V
	$T_j = 150 \text{ }^{\circ}\text{C}$		0.80	0.85	V
	$T_j = 175 \text{ }^{\circ}\text{C}$		0.75	0.80	V
r_{CE}	$V_{GE} = 15 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$	24	28	$\text{m}\Omega$
	chiplevel	$T_j = 150 \text{ }^{\circ}\text{C}$	39	43	$\text{m}\Omega$
	$T_j = 175 \text{ }^{\circ}\text{C}$		43	47	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.53 \text{ mA}$		5.15	5.8	6.45
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25 \text{ }^{\circ}\text{C}$			1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	4.80		nF
C_{oes}		$f = 1 \text{ MHz}$	0.06		nF
C_{res}		$f = 1 \text{ MHz}$	0.02		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		354		nC
R_{Gint}	$T_j = 25 \text{ }^{\circ}\text{C}$		0		Ω
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$	28		ns
	$I_C = 25 \text{ A}$	$T_j = 150 \text{ }^{\circ}\text{C}$	30		ns
	$R_{G on} = 6.2 \Omega$	$T_j = 175 \text{ }^{\circ}\text{C}$	32		ns
t_r	$R_{G off} = 6.2 \Omega$	$T_j = 25 \text{ }^{\circ}\text{C}$	23		ns
	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$	25		ns
	$(T_j = 150 \text{ }^{\circ}\text{C})$	$T_j = 175 \text{ }^{\circ}\text{C}$	26		ns
E_{on}	$di/dt_{on} = 880 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ }^{\circ}\text{C}$	1.41		mJ
	$di/dt_{off} = 210 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$	2.06		mJ
	$dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 175 \text{ }^{\circ}\text{C}$	2.32		mJ



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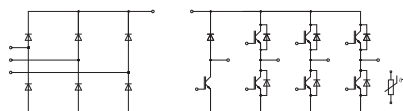
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- $T_{j,op} > 150 \text{ }^{\circ}\text{C}$ during overload (details on AN19-002)



DGDL-ET

Characteristics					
Symbol	Conditions		min.	typ.	max. Unit
Inverter - IGBT					
$t_{d(off)}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$	$T_j = 25 \text{ }^{\circ}\text{C}$		191	ns
		$T_j = 150 \text{ }^{\circ}\text{C}$		231	ns
	$R_{G on} = 6.2 \text{ } \Omega$	$T_j = 175 \text{ }^{\circ}\text{C}$		251	ns
t_f	$R_{G off} = 6.2 \text{ } \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$		66	ns
		$T_j = 150 \text{ }^{\circ}\text{C}$		101	ns
		$T_j = 175 \text{ }^{\circ}\text{C}$		108	ns
E_{off}	$(T_j = 150 \text{ }^{\circ}\text{C})$ $di/dt_{on} = 880 \text{ A}/\mu\text{s}$ $di/dt_{off} = 210 \text{ A}/\mu\text{s}$ $dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ }^{\circ}\text{C}$		2.04	mJ
		$T_j = 150 \text{ }^{\circ}\text{C}$		2.71	mJ
		$T_j = 175 \text{ }^{\circ}\text{C}$		3.09	mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			1.32	K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.06	K/W
Chopper - IGBT					
$V_{CE(sat)}$	$I_C = 25 \text{ A}$	$T_j = 25 \text{ }^{\circ}\text{C}$		1.60	1.75 V
	$V_{GE} = 15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$		1.78	1.93 V
	chipelevel	$T_j = 175 \text{ }^{\circ}\text{C}$		1.82	1.97 V
V_{CE0}		$T_j = 25 \text{ }^{\circ}\text{C}$		1.00	1.05 V
	chipelevel	$T_j = 150 \text{ }^{\circ}\text{C}$		0.80	0.85 V
		$T_j = 175 \text{ }^{\circ}\text{C}$		0.75	0.80 V
r_{CE}	$V_{GE} = 15 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$		24	28 m Ω
	chipelevel	$T_j = 150 \text{ }^{\circ}\text{C}$		39	43 m Ω
		$T_j = 175 \text{ }^{\circ}\text{C}$		43	47 m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.53 \text{ mA}$		5.15	5.8	6.45 V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25 \text{ }^{\circ}\text{C}$				1 mA
C_{ies}	$V_{CE} = 25 \text{ V}$	$f = 1 \text{ MHz}$		4.80	nF
C_{oes}	$V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$		0.06	nF
C_{res}		$f = 1 \text{ MHz}$		0.02	nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$			354	nC
R_{Gint}	$T_j = 25 \text{ }^{\circ}\text{C}$			0	Ω
$t_{d(on)}$		$T_j = 25 \text{ }^{\circ}\text{C}$		28	ns
		$T_j = 150 \text{ }^{\circ}\text{C}$		30	ns
		$T_j = 175 \text{ }^{\circ}\text{C}$		32	ns
t_r		$T_j = 25 \text{ }^{\circ}\text{C}$		23	ns
		$T_j = 150 \text{ }^{\circ}\text{C}$		25	ns
		$T_j = 175 \text{ }^{\circ}\text{C}$		26	ns
E_{on}	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$ $R_{G on} = 6.2 \text{ } \Omega$ $R_{G off} = 6.2 \text{ } \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$		1.41	mJ
		$T_j = 150 \text{ }^{\circ}\text{C}$		2.06	mJ
		$T_j = 175 \text{ }^{\circ}\text{C}$		2.32	mJ
$t_{d(off)}$		$T_j = 25 \text{ }^{\circ}\text{C}$		191	ns
	$(T_j = 150 \text{ }^{\circ}\text{C})$ $di/dt_{on} = 880 \text{ A}/\mu\text{s}$ $di/dt_{off} = 210 \text{ A}/\mu\text{s}$ $dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$		231	ns
		$T_j = 175 \text{ }^{\circ}\text{C}$		251	ns
t_f		$T_j = 25 \text{ }^{\circ}\text{C}$		66	ns
		$T_j = 150 \text{ }^{\circ}\text{C}$		101	ns
		$T_j = 175 \text{ }^{\circ}\text{C}$		108	ns
E_{off}		$T_j = 25 \text{ }^{\circ}\text{C}$		2.04	mJ
		$T_j = 150 \text{ }^{\circ}\text{C}$		2.71	mJ
		$T_j = 175 \text{ }^{\circ}\text{C}$		3.09	mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			1.32	K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.06	K/W

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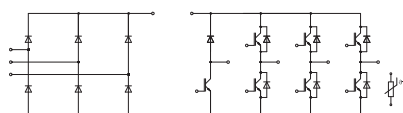
Typical Applications

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Remarks

- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$
- $T_{j,op} > 150 \text{ }^{\circ}\text{C}$ during overload (details on AN19-002)

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
V _F = V _{EC}	I _F = 15 A	T _j = 25 °C		2.38	2.71	V
		T _j = 150 °C		2.44	2.77	V
		chiplevel	T _j = 175 °C		2.26	2.58
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
		T _j = 175 °C		0.82	0.98	V
r _F	chiplevel	T _j = 25 °C		72	81	mΩ
		T _j = 150 °C		103	111	mΩ
		T _j = 175 °C		96	107	mΩ
I _{RRM}	V _{CC} = 600 V I _F = 25 A V _{GE} = -15 V (T _j = 150 °C) di/dt _{off} = 1050 A/μs	T _j = 25 °C		16		A
		T _j = 150 °C		23		A
		T _j = 175 °C		24		A
Q _{rr}		T _j = 25 °C		1.01		μC
		T _j = 150 °C		2.69		μC
		T _j = 175 °C		3.04		μC
E _{rr}		T _j = 25 °C		0.37		mJ
		T _j = 150 °C		1.17		mJ
		T _j = 175 °C		1.79		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			2.13		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.74		K/W
Freewheeling - Diode						
V _F = V _{EC}	I _F = 10 A	T _j = 25 °C		2.59	2.94	V
		T _j = 150 °C		2.71	3.08	V
		chiplevel	T _j = 175 °C		2.53	2.89
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
		T _j = 175 °C		0.82	0.98	V
r _F	chiplevel	T _j = 25 °C		129	144	mΩ
		T _j = 150 °C		181	198	mΩ
		T _j = 175 °C		171	191	mΩ
I _{RRM}	V _{CC} = 600 V I _F = 10 A V _{GE} = -15 V (T _j = 150 °C) di/dt _{off} = 790 A/μs	T _j = 25 °C		8		A
		T _j = 150 °C		14		A
		T _j = 175 °C		16		A
Q _{rr}		T _j = 25 °C		0.58		μC
		T _j = 150 °C		2.01		μC
		T _j = 175 °C		2.37		μC
E _{rr}		T _j = 25 °C		0.36		mJ
		T _j = 150 °C		0.91		mJ
		T _j = 175 °C		1.16		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			2.64		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			2.24		K/W



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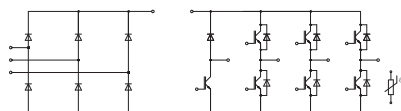
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V _F	I _F = 25 A chiplevel	T _j = 25 °C		1.04	1.30	V
		T _j = 150 °C		0.95	1.21	V
		T _j = 175 °C		0.94	1.21	V
V _{F0}	chiplevel	T _j = 25 °C		0.89	1.09	V
		T _j = 150 °C		0.73	0.92	V
		T _j = 175 °C		0.69	0.88	V
r _F	chiplevel	T _j = 25 °C		6.2	8.5	mΩ
		T _j = 150 °C		8.8	12	mΩ
		T _j = 175 °C		10.0	13	mΩ
I _R	T _j = 150 °C, V _{RRM}				2	mA
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.48		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.14		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°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{25/85}	R(T)=R ₂₅ *exp[B _{25/85} *(1/T-1/298)], T[K]			3420		K



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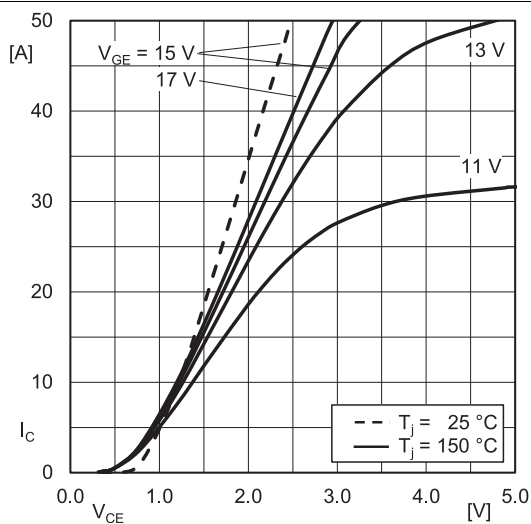


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

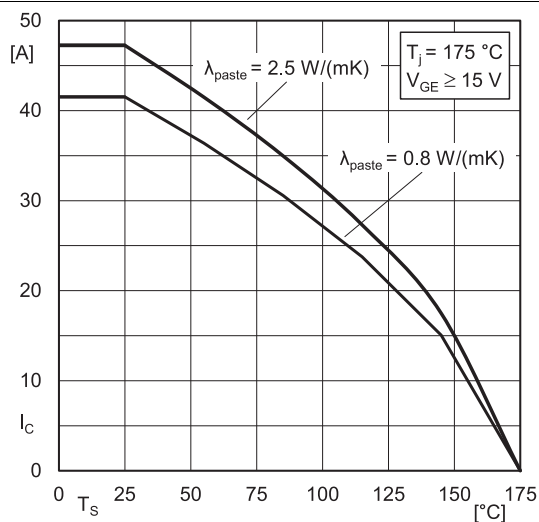


Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$

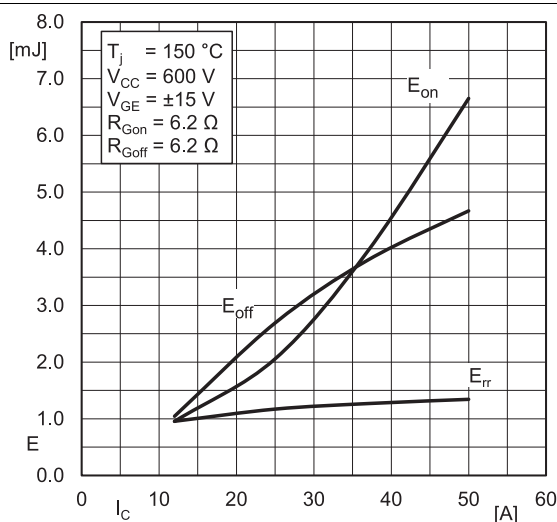


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

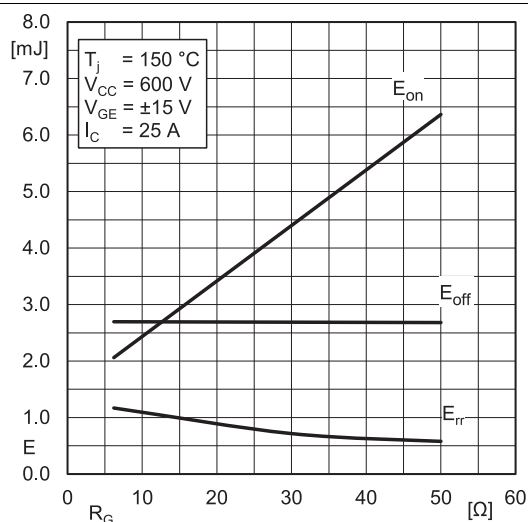


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

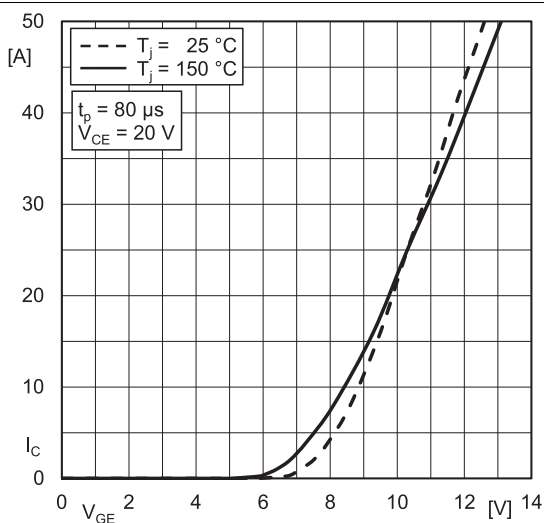


Fig. 5: Typ. IGBT transfer characteristic

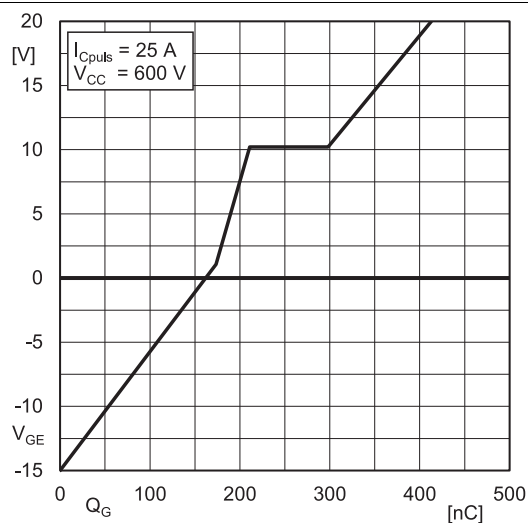


Fig. 6: Typ. IGBT gate charge characteristic

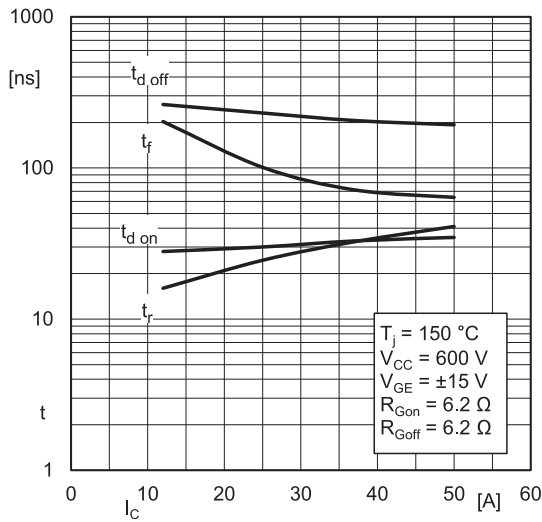


Fig. 7: Typ. switching times = f (I_C)

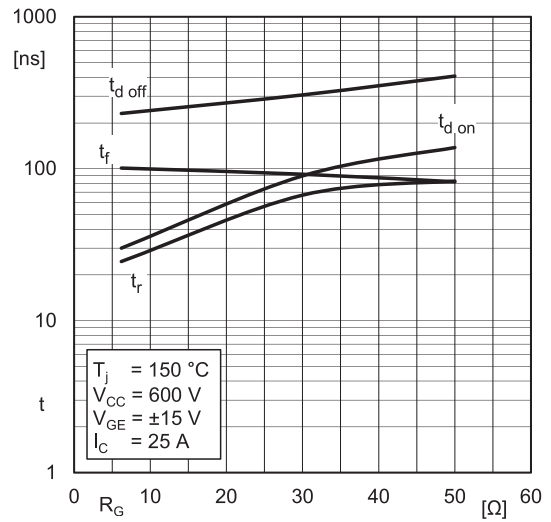


Fig. 8: Typ. switching times = f (R_G)

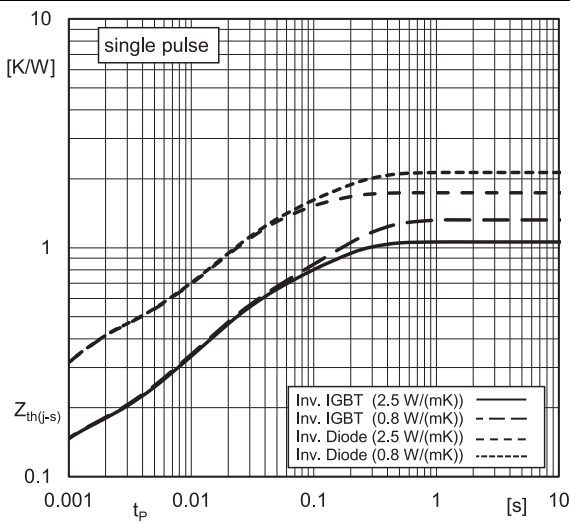


Fig. 9: Typ. transient thermal impedance

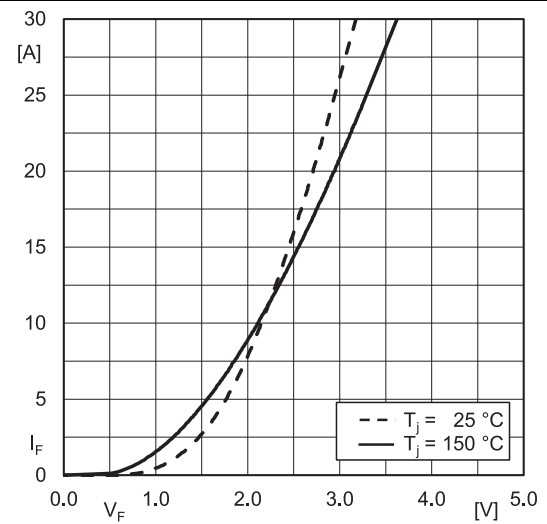


Fig. 10: Typ. Inv. diode forward charact., incl. R_{CC}+EE'

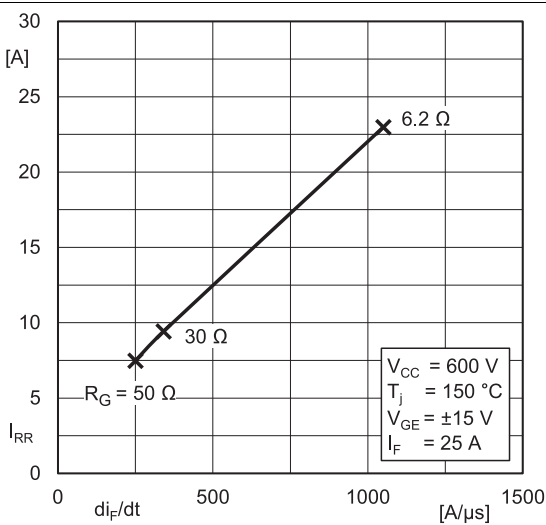


Fig. 11: Typ. Inv. diode peak reverse recovery current

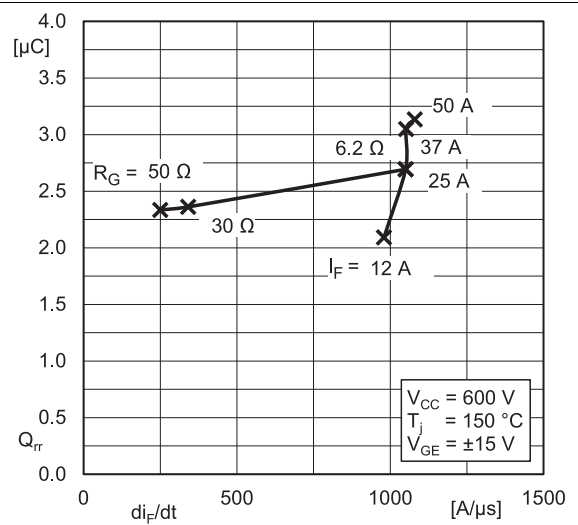


Fig. 12: Typ. Inv. diode reverse recovery charge

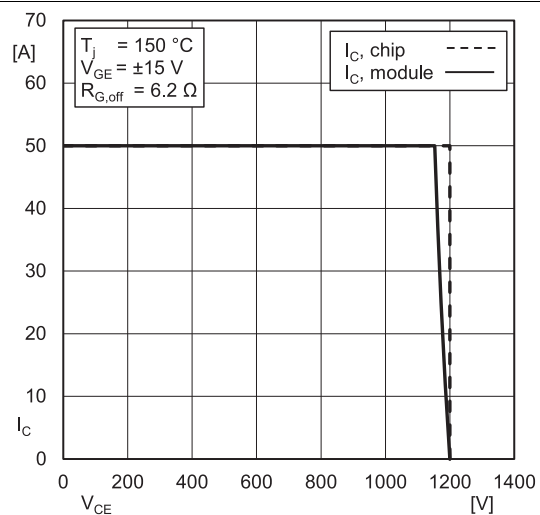


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

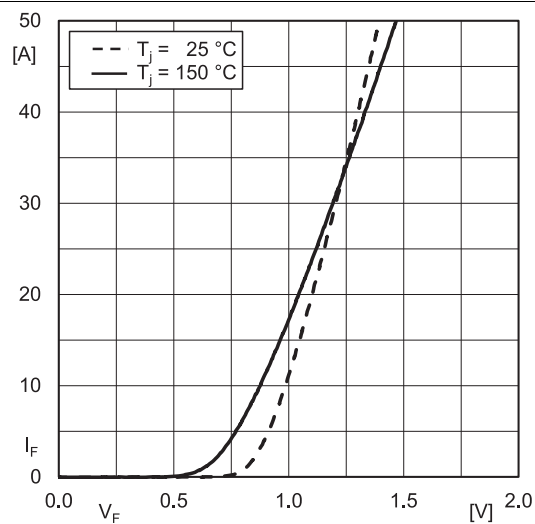
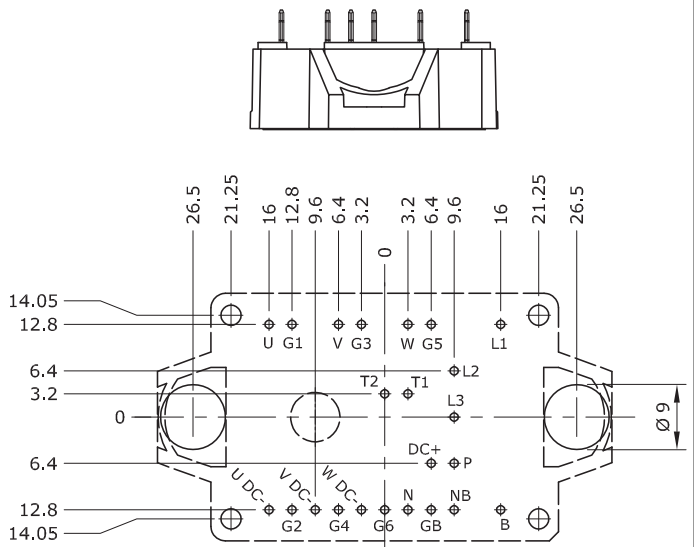
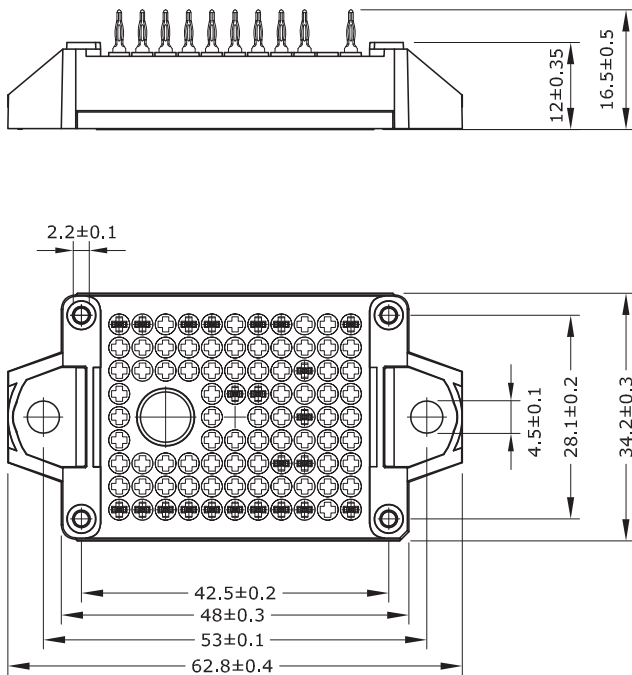


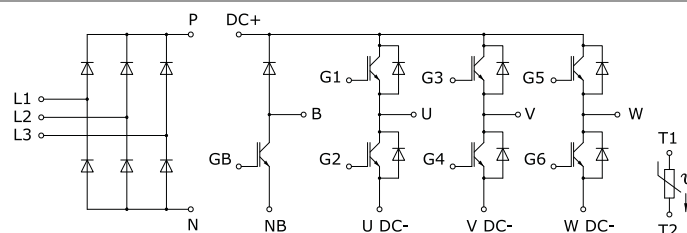
Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$

SK25DGDL12T7ETE1



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\varnothing \pm 0.1$
- Diameters of drill $\varnothing 1.15\text{mm}$
- Copper thickness in hole 25 - 50 μm
- Hole specification for contacts:
refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E1



DGDLE-T

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

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