

SK15DGDL12T7ETE1s



SEMISTOP®E1 Solder

3-phase Converter-Inverter-Brake (CIB)

SK15DGDL12T7ETE1s

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Solder 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

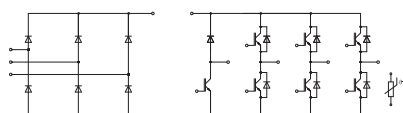
Typical Applications

- 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}	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	23	A
		$T_j = 175 \text{ }^\circ\text{C}$	18	A
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	26	A
		$T_j = 175 \text{ }^\circ\text{C}$	21	A
I_{Chom}			15	A
I_{CRM}			30	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ $V_{CES} \leq 1200 \text{ V}$	$T_j = 175 \text{ }^\circ\text{C}$	7	μs
T_j			-40 ... 175	$^\circ\text{C}$
Chopper - IGBT				
V_{CES}	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	23	A
		$T_j = 175 \text{ }^\circ\text{C}$	18	A
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	26	A
		$T_j = 175 \text{ }^\circ\text{C}$	21	A
I_{Chom}			15	A
I_{CRM}			30	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ $V_{CES} \leq 1200 \text{ V}$	$T_j = 175 \text{ }^\circ\text{C}$	7	μs
T_j			-40 ... 175	$^\circ\text{C}$
Inverse - Diode				
V_{RRM}	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	17	A
		$T_j = 175 \text{ }^\circ\text{C}$	14	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	20	A
		$T_j = 175 \text{ }^\circ\text{C}$	16	A
I_{FRM}			30	A
I_{FSM}	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150 \text{ }^\circ\text{C}$		65	A
T_j			-40 ... 175	$^\circ\text{C}$
Freewheeling - Diode				
V_{RRM}	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	12	A
		$T_j = 175 \text{ }^\circ\text{C}$	10	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	13	A
		$T_j = 175 \text{ }^\circ\text{C}$	11	A
I_{FRM}			20	A
I_{FSM}	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150 \text{ }^\circ\text{C}$		36	A
T_j			-40 ... 175	$^\circ\text{C}$



DGDL-ET

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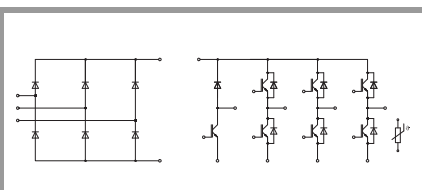
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Remarks

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

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Rectifier - Diode				
V_{RRM}	$T_j = 25 \text{ °C}$		1600	V
I_F	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 70 \text{ °C}$	36	A
		$T_s = 100 \text{ °C}$	29	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 70 \text{ °C}$	40	A
		$T_s = 100 \text{ °C}$	32	A
I_{FSM}	$t_p = 10 \text{ ms}$ $\sin 180^\circ$	$T_j = 25 \text{ °C}$	220	A
		$T_j = 150 \text{ °C}$	200	A
i^2t	$t_p = 10 \text{ ms}$ $\sin 180^\circ$	$T_j = 25 \text{ °C}$	242	A ² s
		$T_j = 150 \text{ °C}$	200	A ² s
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$, $\Delta T_{terminal}$ at PCB joint = 30 K, per pin		30	A
T_{stg}	module without TIM		-40 ... 125	°C
V_{isol}	AC, sinusoidal, 1 min		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$V_{CE(sat)}$	$I_C = 15 \text{ A}$ $V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25 \text{ °C}$	1.60	1.75		V
		$T_j = 150 \text{ °C}$	1.78	1.93		V
		$T_j = 175 \text{ °C}$	1.82	1.97		V
V_{CE0}	chiplevel	$T_j = 25 \text{ °C}$	1.00	1.05		V
		$T_j = 150 \text{ °C}$	0.80	0.85		V
		$T_j = 175 \text{ °C}$	0.75	0.80		V
r_{CE}	$V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25 \text{ °C}$	40	47		mΩ
		$T_j = 150 \text{ °C}$	65	72		mΩ
		$T_j = 175 \text{ °C}$	71	78		mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.33 \text{ mA}$		5.15	5.8	6.45	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25 \text{ °C}$				1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	2.80			nF
C_{oes}		$f = 1 \text{ MHz}$	0.04			nF
C_{res}		$f = 1 \text{ MHz}$	0.01			nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		207			nC
R_{Gint}	$T_j = 25 \text{ °C}$		0			Ω
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $I_C = 15 \text{ A}$ $R_{G on} = 7.5 \text{ Ω}$	$T_j = 25 \text{ °C}$	31			ns
		$T_j = 150 \text{ °C}$	33			ns
		$T_j = 175 \text{ °C}$	35			ns
t_r	$R_{G off} = 7.5 \text{ Ω}$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ °C}$	25			ns
		$T_j = 150 \text{ °C}$	27			ns
		$T_j = 175 \text{ °C}$	28			ns
E_{on}	$(T_j = 150 \text{ °C})$ $di/dt_{on} = 730 \text{ A/μs}$ $di/dt_{off} = 150 \text{ A/μs}$ $dv/dt = 2600 \text{ V/μs}$	$T_j = 25 \text{ °C}$	0.79			mJ
		$T_j = 150 \text{ °C}$	1.16			mJ
		$T_j = 175 \text{ °C}$	1.31			mJ



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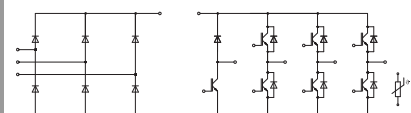
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$t_{d(off)}$	$V_{CC} = 600 \text{ V}$ $I_C = 15 \text{ A}$ $R_{G, on} = 7.5 \text{ } \Omega$	$T_j = 25 \text{ }^\circ\text{C}$		209		ns
		$T_j = 150 \text{ }^\circ\text{C}$		254		ns
t_f	$R_{G, off} = 7.5 \text{ } \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 175 \text{ }^\circ\text{C}$		275		ns
		$T_j = 25 \text{ }^\circ\text{C}$		72		ns
		$T_j = 150 \text{ }^\circ\text{C}$		111		ns
		$T_j = 175 \text{ }^\circ\text{C}$		119		ns
E_{off}	$di/dt_{on} = 730 \text{ A}/\mu\text{s}$ $di/dt_{off} = 150 \text{ A}/\mu\text{s}$ $dv/dt = 2600 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		1.29		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		1.71		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		1.95		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			1.81		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.43		K/W
Chopper - IGBT						
$V_{CE(sat)}$	$I_C = 15 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.60	1.75	V
		$T_j = 150 \text{ }^\circ\text{C}$		1.78	1.93	V
		$T_j = 175 \text{ }^\circ\text{C}$		1.82	1.97	V
V_{CE0}	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		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}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		40	47	m Ω
		$T_j = 150 \text{ }^\circ\text{C}$		65	72	m Ω
		$T_j = 175 \text{ }^\circ\text{C}$		71	78	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.33 \text{ mA}$		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}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$		2.80		nF
C_{oes}		$f = 1 \text{ MHz}$		0.04		nF
C_{res}		$f = 1 \text{ MHz}$		0.01		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$			207		nC
R_{Gint}	$T_j = 25 \text{ }^\circ\text{C}$			0		Ω
$t_{d(on)}$		$T_j = 25 \text{ }^\circ\text{C}$		31		ns
		$T_j = 150 \text{ }^\circ\text{C}$		33		ns
		$T_j = 175 \text{ }^\circ\text{C}$		35		ns
t_r		$T_j = 25 \text{ }^\circ\text{C}$		25		ns
		$T_j = 150 \text{ }^\circ\text{C}$		27		ns
		$T_j = 175 \text{ }^\circ\text{C}$		28		ns
E_{on}	$V_{CC} = 600 \text{ V}$ $I_C = 15 \text{ A}$ $R_{G, on} = 7.5 \text{ } \Omega$ $R_{G, off} = 7.5 \text{ } \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$		0.79		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		1.16		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		1.31		mJ
$t_{d(off)}$	$(T_j = 150 \text{ }^\circ\text{C})$ $di/dt_{on} = 730 \text{ A}/\mu\text{s}$ $di/dt_{off} = 150 \text{ A}/\mu\text{s}$ $dv/dt = 2600 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		209		ns
		$T_j = 150 \text{ }^\circ\text{C}$		254		ns
		$T_j = 175 \text{ }^\circ\text{C}$		275		ns
t_f		$T_j = 25 \text{ }^\circ\text{C}$		72		ns
		$T_j = 150 \text{ }^\circ\text{C}$		111		ns
		$T_j = 175 \text{ }^\circ\text{C}$		119		ns
E_{off}		$T_j = 25 \text{ }^\circ\text{C}$		1.29		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		1.71		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		1.95		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			1.81		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.43		K/W

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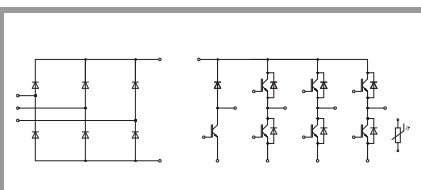
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- Recommended $T_{j,op} = -40 \dots +150 \text{ °C}$
- $T_{j,op} > 150 \text{ °C}$ during overload (details on AN19-002)



DGDL-ET

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
$V_F = V_{EC}$	$I_F = 15 \text{ A}$	$T_j = 25 \text{ °C}$		2.38	2.71	V
		$T_j = 150 \text{ °C}$		2.44	2.77	V
		chipelevel	$T_j = 175 \text{ °C}$		2.26	2.58
V_{F0}	chipelevel	$T_j = 25 \text{ °C}$		1.30	1.50	V
		$T_j = 150 \text{ °C}$		0.90	1.10	V
		$T_j = 175 \text{ °C}$		0.82	0.98	V
r_F	chipelevel	$T_j = 25 \text{ °C}$		72	81	mΩ
		$T_j = 150 \text{ °C}$		103	111	mΩ
		$T_j = 175 \text{ °C}$		96	107	mΩ
I_{RRM}		$T_j = 25 \text{ °C}$		11		A
		$T_j = 150 \text{ °C}$		15		A
		$T_j = 175 \text{ °C}$		18		A
Q_{rr}	$V_{CC} = 600 \text{ V}$ $I_F = 15 \text{ A}$	$T_j = 25 \text{ °C}$		1.03		μC
		$T_j = 150 \text{ °C}$		2.29		μC
		$T_j = 175 \text{ °C}$		2.58		μC
E_{rr}	$V_{GE} = -15 \text{ V}$ ($T_j = 150 \text{ °C}$) $di/dt_{off} = 870 \text{ A/μs}$	$T_j = 25 \text{ °C}$		0.31		mJ
		$T_j = 150 \text{ °C}$		0.97		mJ
		$T_j = 175 \text{ °C}$		1.49		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W/(mK)}$			2.13		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W/(mK)}$			1.74		K/W
Freewheeling - Diode						
$V_F = V_{EC}$	$I_F = 10 \text{ A}$	$T_j = 25 \text{ °C}$		2.59	2.94	V
		$T_j = 150 \text{ °C}$		2.71	3.08	V
		chipelevel	$T_j = 175 \text{ °C}$		2.53	2.89
V_{F0}	chipelevel	$T_j = 25 \text{ °C}$		1.30	1.50	V
		$T_j = 150 \text{ °C}$		0.90	1.10	V
		$T_j = 175 \text{ °C}$		0.82	0.98	V
r_F	chipelevel	$T_j = 25 \text{ °C}$		129	144	mΩ
		$T_j = 150 \text{ °C}$		181	198	mΩ
		$T_j = 175 \text{ °C}$		171	191	mΩ
I_{RRM}		$T_j = 25 \text{ °C}$		8		A
		$T_j = 150 \text{ °C}$		14		A
		$T_j = 175 \text{ °C}$		16		A
Q_{rr}	$V_{CC} = 600 \text{ V}$ $I_F = 10 \text{ A}$	$T_j = 25 \text{ °C}$		0.58		μC
		$T_j = 150 \text{ °C}$		2.01		μC
		$T_j = 175 \text{ °C}$		2.37		μC
E_{rr}	$V_{GE} = -15 \text{ V}$ ($T_j = 150 \text{ °C}$) $di/dt_{off} = 790 \text{ A/μs}$	$T_j = 25 \text{ °C}$		0.36		mJ
		$T_j = 150 \text{ °C}$		0.91		mJ
		$T_j = 175 \text{ °C}$		1.16		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W/(mK)}$			2.64		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W/(mK)}$			2.24		K/W

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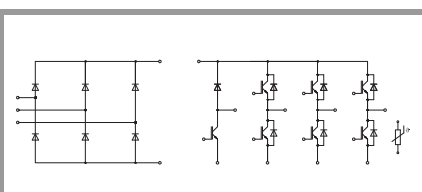
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V_F	$I_F = 15 \text{ A}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.04	1.30	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.94	1.20	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.93	1.20	V
V_{F0}	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		0.89	1.09	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.73	0.92	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.69	0.88	V
r_F	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		10	14	m Ω
		$T_j = 150 \text{ }^\circ\text{C}$		14	19	m Ω
		$T_j = 175 \text{ }^\circ\text{C}$		16	21	m Ω
I_R	$T_j = 150 \text{ }^\circ\text{C}, V_{RRM}$				2	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W/(mK)}$			1.75		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W/(mK)}$			1.51		K/W
Module						
M_s	to heatsink		1.6		2.3	Nm
w				25		g
L_{CE}				30		nH
Temperature Sensor						
R_{100}	$T_c=100^\circ\text{C} (R_{25}=5 \text{ k}\Omega)$			$493 \pm 5\%$		Ω
$B_{25/85}$	$R_{(T)}=R_{25} \cdot \exp[B_{25/85} \cdot (1/T - 1/298)]$, T[K]			3420		K



DGDL-ET

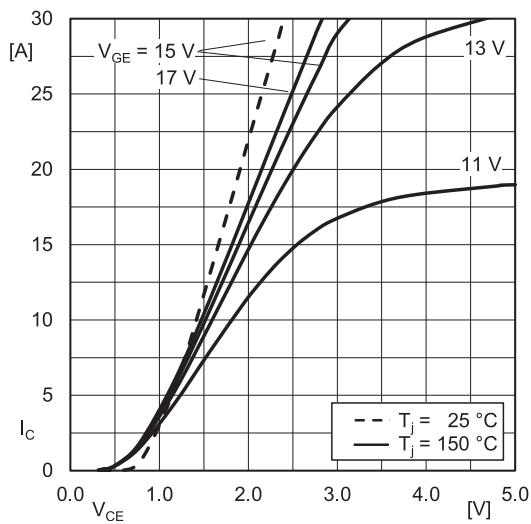


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

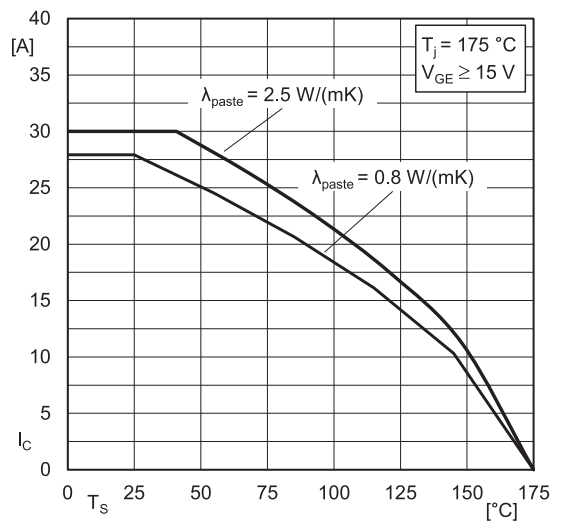


Fig. 2: IGBT rated current vs. temperature $I_c=f(T_s)$

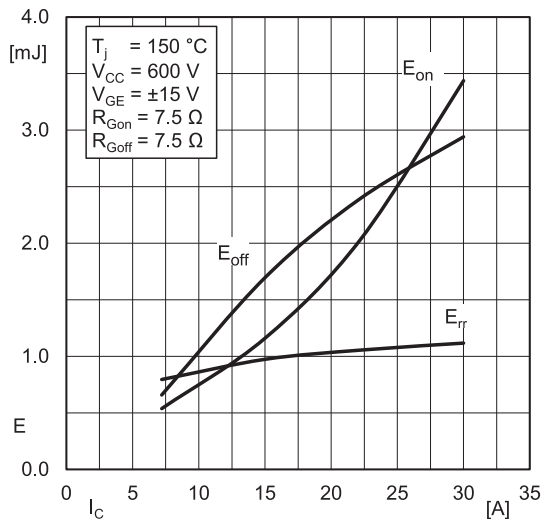


Fig. 3: Typ. turn-on /-off energy = $f(I_c)$

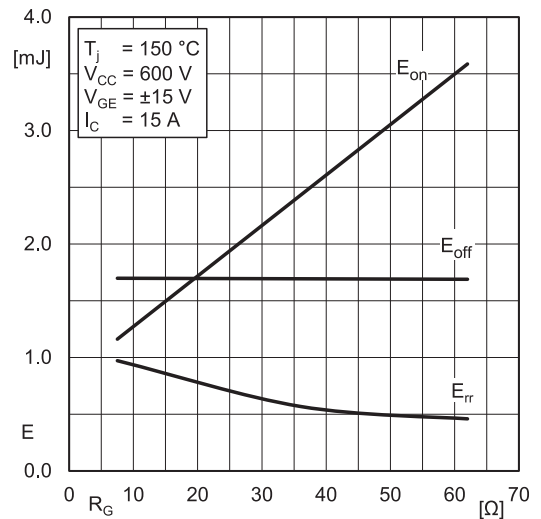


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

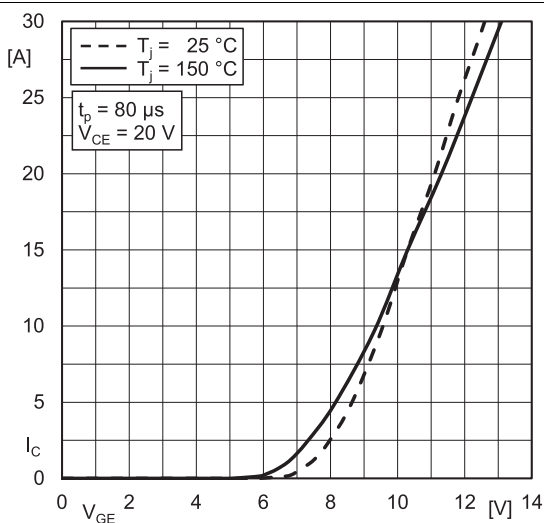


Fig. 5: Typ. IGBT transfer characteristic

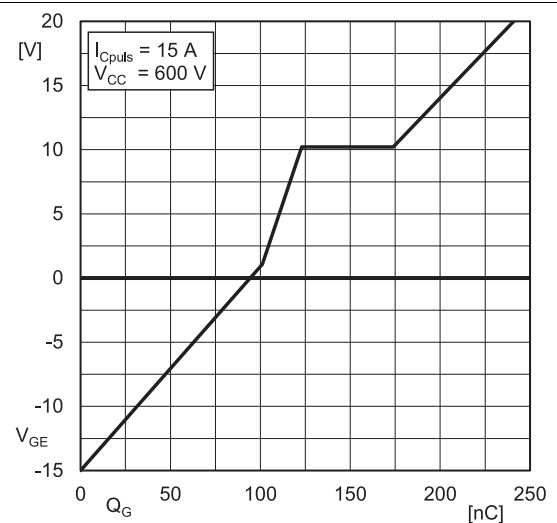


Fig. 6: Typ. IGBT gate charge characteristic

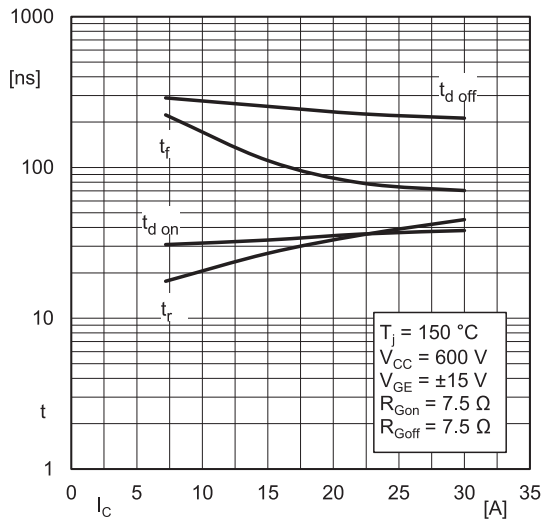


Fig. 7: Typ. switching times = $f(I_C)$

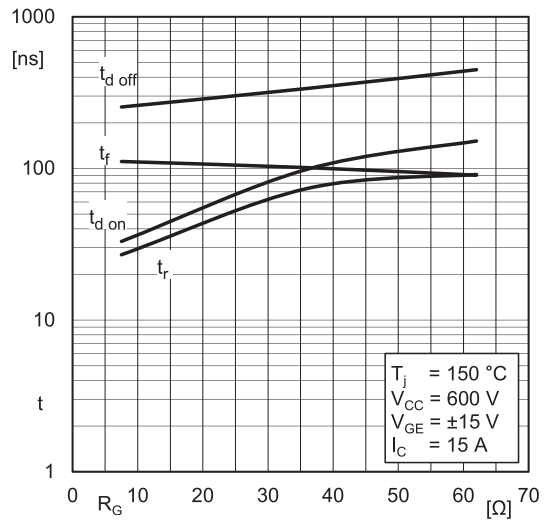


Fig. 8: Typ. switching times = $f(R_G)$

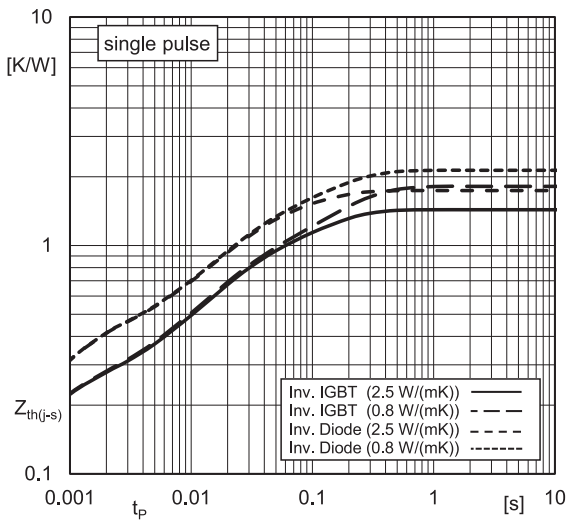


Fig. 9: Typ. transient thermal impedance

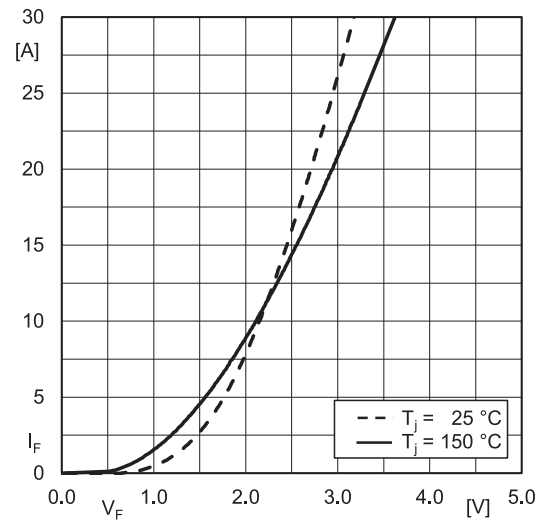


Fig. 10: Typ. Inv. diode forward charact., incl. R_{CC+EE}

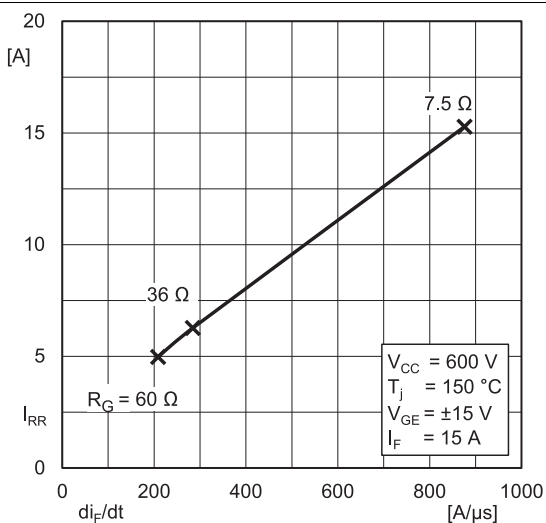


Fig. 11: Typ. Inv. diode peak reverse recovery current

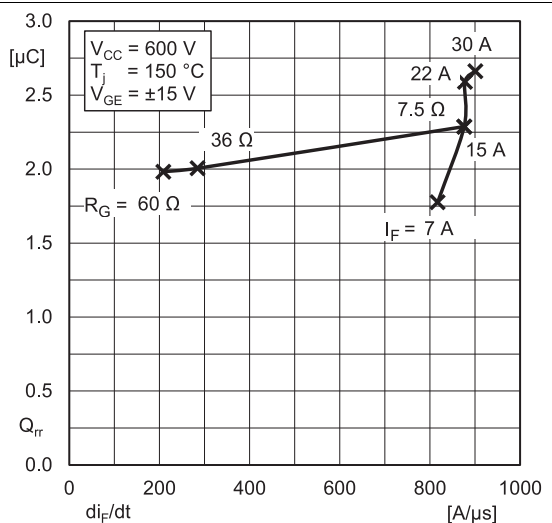


Fig. 12: Typ. Inv. diode reverse recovery charge

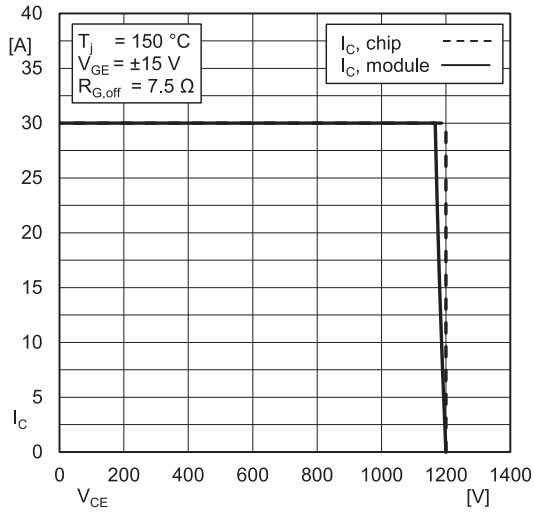


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

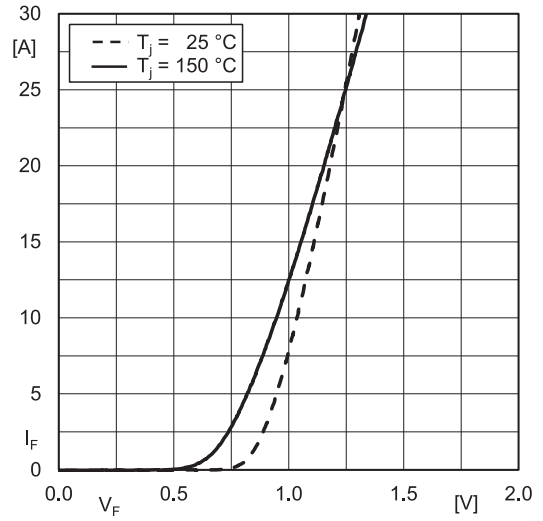
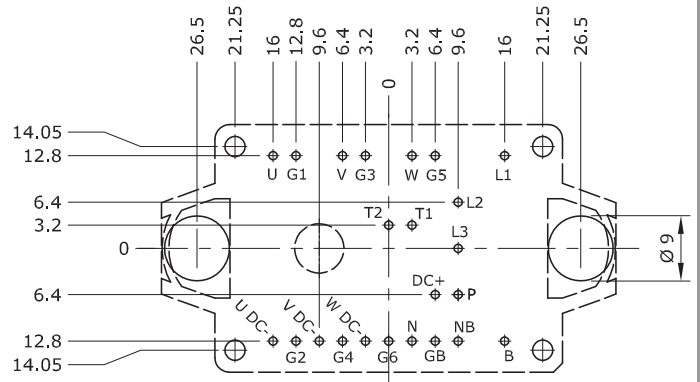
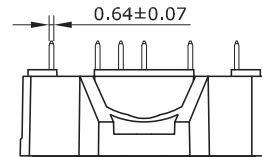
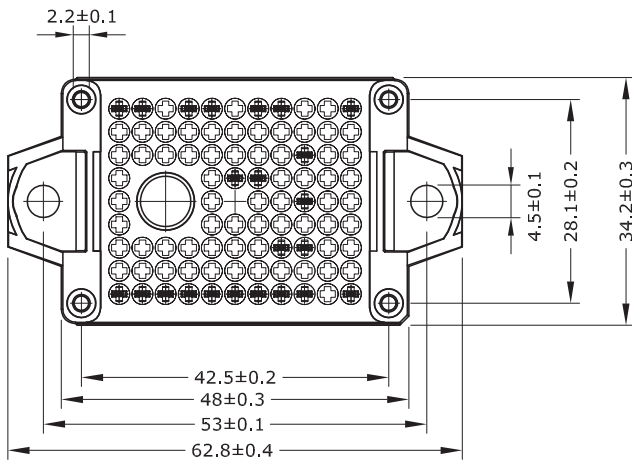
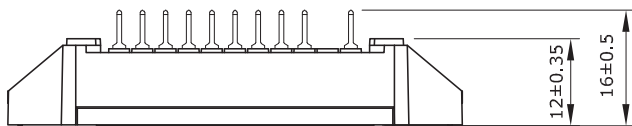


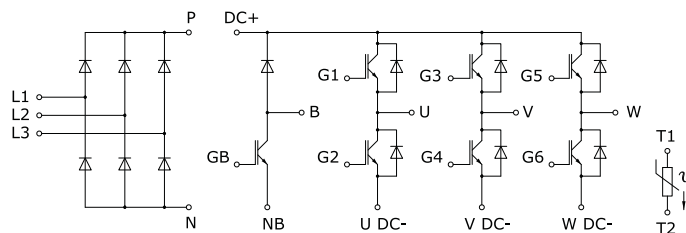
Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$

SK15DGDLE12T7ETE1s



- Pin-Grid 3.2 mm
- Tolerance of pinpositions $\boxed{\oplus \ominus \varnothing 0.4}$

SEMITOP®E1 Solder



DGDLE12T7

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

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