

SK25DGDL12T7ETE1s



SEMISTOP® E1 Solder

3-phase Converter-Inverter-Brake (CIB)

Engineering Sample SK25DGDL12T7ETE1s

Target Data

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

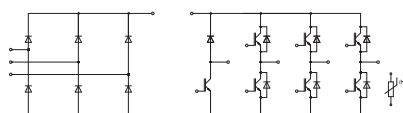
Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

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

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V_{CES}	$T_j = 25 \text{ } ^\circ\text{C}$		1200	V
I_C	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	41	A
		$T_j = 175 \text{ } ^\circ\text{C}$	33	A
I_C	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	47	A
		$T_j = 175 \text{ } ^\circ\text{C}$	38	A
I_{Chom}			25	A
I_{CRM}			50	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	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	41	A
		$T_j = 175 \text{ } ^\circ\text{C}$	33	A
I_C	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	47	A
		$T_j = 175 \text{ } ^\circ\text{C}$	38	A
I_{Chom}			25	A
I_{CRM}			50	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	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	21	A
		$T_j = 175 \text{ } ^\circ\text{C}$	17	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	24	A
		$T_j = 175 \text{ } ^\circ\text{C}$	20	A
I_{FRM}			45	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	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	15	A
		$T_j = 175 \text{ } ^\circ\text{C}$	12	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	16	A
		$T_j = 175 \text{ } ^\circ\text{C}$	13	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	$^\circ\text{C}$



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Typical Applications

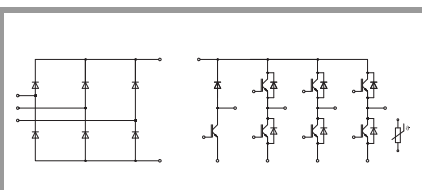
- Motor drives
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- Auxiliary Inverters

Remarks

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

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Rectifier - Diode				
V_{RRM}	$T_j = 25 \text{ } ^\circ\text{C}$		1600	V
I_F	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	61	A
		$T_j = 175 \text{ } ^\circ\text{C}$	47	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 25 \text{ } ^\circ\text{C}$	72	A
		$T_s = 70 \text{ } ^\circ\text{C}$	57	A
I_{FSM}	$t_p = 10 \text{ ms}$ $\sin 180^\circ$	$T_j = 25 \text{ } ^\circ\text{C}$	370	A
		$T_j = 150 \text{ } ^\circ\text{C}$	270	A
i^2t	$t_p = 10 \text{ ms}$ $\sin 180^\circ$	$T_j = 25 \text{ } ^\circ\text{C}$	685	A^2s
		$T_j = 150 \text{ } ^\circ\text{C}$	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						
$V_{CE(sat)}$	$I_C = 25 \text{ A}$ $V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25 \text{ } ^\circ\text{C}$	1.60	1.75		V
		$T_j = 150 \text{ } ^\circ\text{C}$	1.82	1.96		V
		$T_j = 175 \text{ } ^\circ\text{C}$	1.86	2.00		V
V_{CE0}	chiplevel	$T_j = 25 \text{ } ^\circ\text{C}$	0.90	1.00		V
		$T_j = 150 \text{ } ^\circ\text{C}$	0.75	0.83		V
		$T_j = 175 \text{ } ^\circ\text{C}$	0.72	0.80		V
r_{CE}	$V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25 \text{ } ^\circ\text{C}$	28	30		$\text{m}\Omega$
		$T_j = 150 \text{ } ^\circ\text{C}$	43	45		$\text{m}\Omega$
		$T_j = 175 \text{ } ^\circ\text{C}$	46	48		$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.53 \text{ mA}$		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}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	4.8			nF
C_{oes}		$f = 1 \text{ MHz}$	0.0615			nF
C_{res}		$f = 1 \text{ MHz}$	0.017			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
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$ $R_{G on} = 6.2 \text{ } \Omega$	$T_j = 25 \text{ } ^\circ\text{C}$	28			ns
		$T_j = 150 \text{ } ^\circ\text{C}$	30			ns
		$T_j = 175 \text{ } ^\circ\text{C}$	32			ns
t_r	$R_{G off} = 6.2 \text{ } \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ } ^\circ\text{C}$	23			ns
		$T_j = 150 \text{ } ^\circ\text{C}$	25			ns
		$T_j = 175 \text{ } ^\circ\text{C}$	26			ns
		($T_j = 150 \text{ } ^\circ\text{C}$)				
E_{on}	$di/dt_{on} = 880 \text{ A}/\mu\text{s}$ $di/dt_{off} = 210 \text{ A}/\mu\text{s}$ $dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ } ^\circ\text{C}$	1.41			mJ
		$T_j = 150 \text{ } ^\circ\text{C}$	2.06			mJ
		$T_j = 175 \text{ } ^\circ\text{C}$	2.32			mJ



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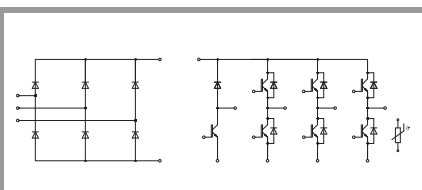
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Typical Applications

- Motor drives
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Remarks

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



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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$t_{d(off)}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$ $R_{G on} = 6.2 \text{ } \Omega$	$T_j = 25 \text{ }^\circ\text{C}$		191		ns
		$T_j = 150 \text{ }^\circ\text{C}$		231		ns
		$T_j = 175 \text{ }^\circ\text{C}$		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						
$V_{CE(sat)}$	$I_C = 25 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.60	1.75	V
		$T_j = 150 \text{ }^\circ\text{C}$		1.82	1.96	V
		$T_j = 175 \text{ }^\circ\text{C}$		1.86	2.00	V
V_{CE0}	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		0.90	1.00	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.75	0.83	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.72	0.80	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		28	30	m Ω
		$T_j = 150 \text{ }^\circ\text{C}$		43	45	m Ω
		$T_j = 175 \text{ }^\circ\text{C}$		46	48	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}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$		4.8		nF
C_{oes}		$f = 1 \text{ MHz}$		0.0615		nF
C_{res}		$f = 1 \text{ MHz}$		0.017		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
$t_{d(off)}$	$(T_j = 150 \text{ }^\circ\text{C})$ $di/dt_{on} = 880 \text{ A}/\mu\text{s}$ $di/dt_{off} = 210 \text{ A}/\mu\text{s}$ $dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		191		ns
		$T_j = 150 \text{ }^\circ\text{C}$		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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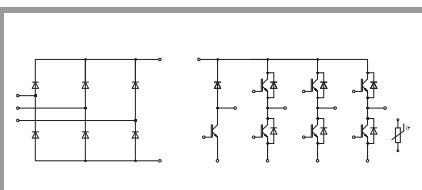
Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

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

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
$V_F = V_{EC}$	$I_F = 15 \text{ A}$	$T_j = 25 \text{ } ^\circ\text{C}$		2.38	2.71	V
		$T_j = 150 \text{ } ^\circ\text{C}$		2.44	2.77	V
		chipelevel	$T_j = 175 \text{ } ^\circ\text{C}$		2.26	2.58
V_{F0}	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.30	1.50	V
		$T_j = 150 \text{ } ^\circ\text{C}$		0.90	1.10	V
		$T_j = 175 \text{ } ^\circ\text{C}$		0.82	0.98	V
r_F	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		72	81	m Ω
		$T_j = 150 \text{ } ^\circ\text{C}$		103	111	m Ω
		$T_j = 175 \text{ } ^\circ\text{C}$		96	107	m Ω
I_{RRM}		$T_j = 25 \text{ } ^\circ\text{C}$		16		A
		$T_j = 150 \text{ } ^\circ\text{C}$		23		A
		$T_j = 175 \text{ } ^\circ\text{C}$		24		A
Q_{rr}	$V_{CC} = 600 \text{ V}$ $I_F = 25 \text{ A}$	$T_j = 25 \text{ } ^\circ\text{C}$		1.01		μC
		$T_j = 150 \text{ } ^\circ\text{C}$		2.69		μC
		$T_j = 175 \text{ } ^\circ\text{C}$		3.04		μC
E_{rr}	$V_{GE} = -15 \text{ V}$ ($T_j = 150 \text{ } ^\circ\text{C}$) $di/dt_{off} = 1050 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ } ^\circ\text{C}$		0.37		mJ
		$T_j = 150 \text{ } ^\circ\text{C}$		1.17		mJ
		$T_j = 175 \text{ } ^\circ\text{C}$		1.79		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8 \text{ W}/(\text{mK})$			2.13		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5 \text{ W}/(\text{mK})$			1.74		K/W
Freewheeling - Diode						
$V_F = V_{EC}$	$I_F = 10 \text{ A}$	$T_j = 25 \text{ } ^\circ\text{C}$		2.59	2.94	V
		$T_j = 150 \text{ } ^\circ\text{C}$		2.71	3.08	V
		chipelevel	$T_j = 175 \text{ } ^\circ\text{C}$		2.53	2.89
V_{F0}	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.30	1.50	V
		$T_j = 150 \text{ } ^\circ\text{C}$		0.90	1.10	V
		$T_j = 175 \text{ } ^\circ\text{C}$		0.82	0.98	V
r_F	chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		129	144	m Ω
		$T_j = 150 \text{ } ^\circ\text{C}$		181	198	m Ω
		$T_j = 175 \text{ } ^\circ\text{C}$		171	191	m Ω
I_{RRM}		$T_j = 25 \text{ } ^\circ\text{C}$		8		A
		$T_j = 150 \text{ } ^\circ\text{C}$		14		A
		$T_j = 175 \text{ } ^\circ\text{C}$		16		A
Q_{rr}	$V_{CC} = 600 \text{ V}$ $I_F = 10 \text{ A}$	$T_j = 25 \text{ } ^\circ\text{C}$		0.58		μC
		$T_j = 150 \text{ } ^\circ\text{C}$		2.01		μC
		$T_j = 175 \text{ } ^\circ\text{C}$		2.37		μC
E_{rr}	$V_{GE} = -15 \text{ V}$ ($T_j = 150 \text{ } ^\circ\text{C}$) $di/dt_{off} = 790 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ } ^\circ\text{C}$		0.36		mJ
		$T_j = 150 \text{ } ^\circ\text{C}$		0.91		mJ
		$T_j = 175 \text{ } ^\circ\text{C}$		1.16		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8 \text{ W}/(\text{mK})$			2.64		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5 \text{ W}/(\text{mK})$			2.24		K/W



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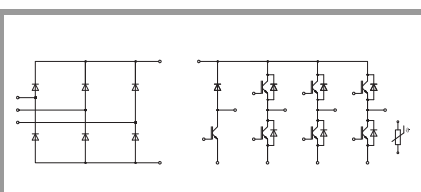
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V_F	$I_F = 25 \text{ A}$ chipelevel	$T_j = 25 \text{ } ^\circ\text{C}$		1.04	1.30	V
		$T_j = 150 \text{ } ^\circ\text{C}$		0.95	1.21	V
		$T_j = 175 \text{ } ^\circ\text{C}$		0.94	1.21	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	$T_j = 25 \text{ } ^\circ\text{C}$		6.2	8.5	m Ω
		$T_j = 150 \text{ } ^\circ\text{C}$		8.8	12	m Ω
		$T_j = 175 \text{ } ^\circ\text{C}$		10.0	13	m Ω
I_R	$T_j = 150 \text{ } ^\circ\text{C}, V_{RRM}$				2	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W/(mK)}$			1.48		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W/(mK)}$			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}	$T_c=100^\circ\text{C} (R_{25}=5 \text{ k}\Omega)$			$493 \pm 5\%$		Ω
$B_{25/85}$	$R_{(T)}=R_{25} \cdot \exp[B_{25/85} \cdot (1/T-1/298)]$, T[K]			3420		K



DGDL-ET

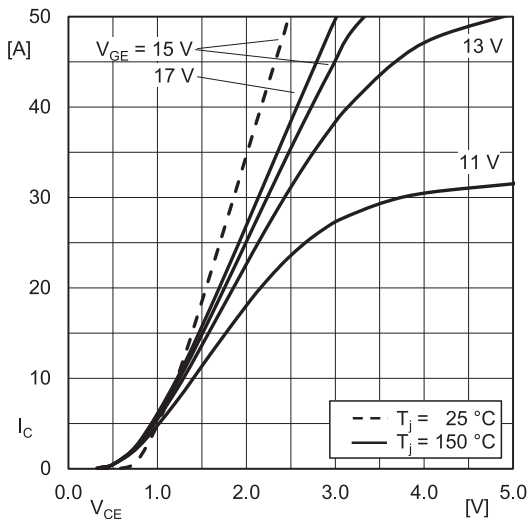


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

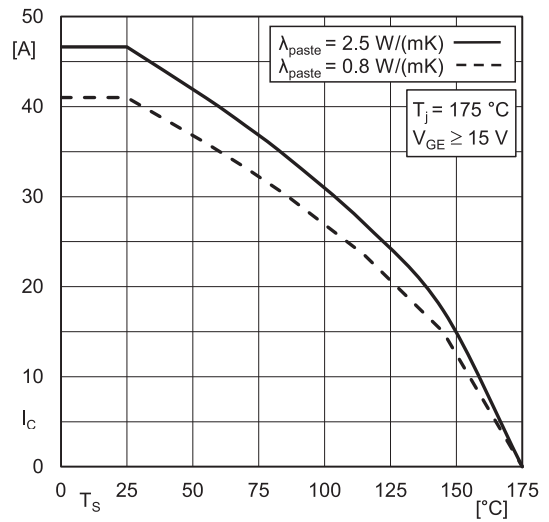


Fig. 2: IGBT rated current vs. temperature $I_c=f(T_s)$

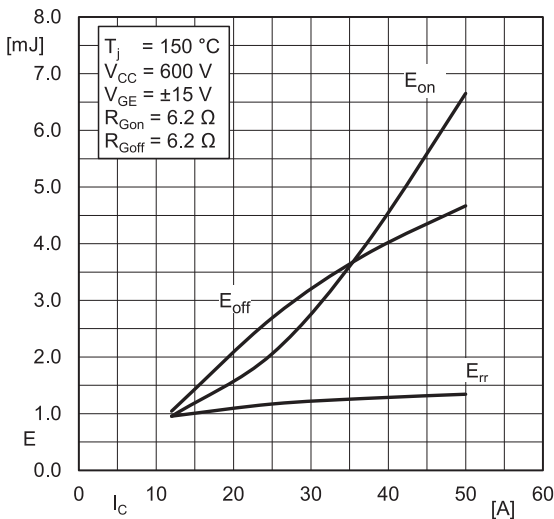


Fig. 3: Typ. turn-on /-off energy = $f(I_c)$

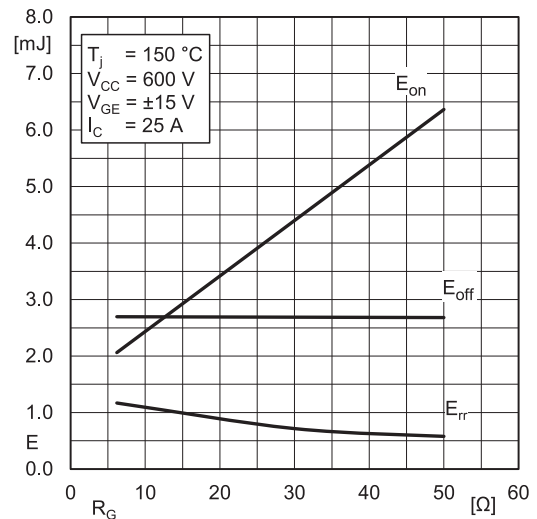


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

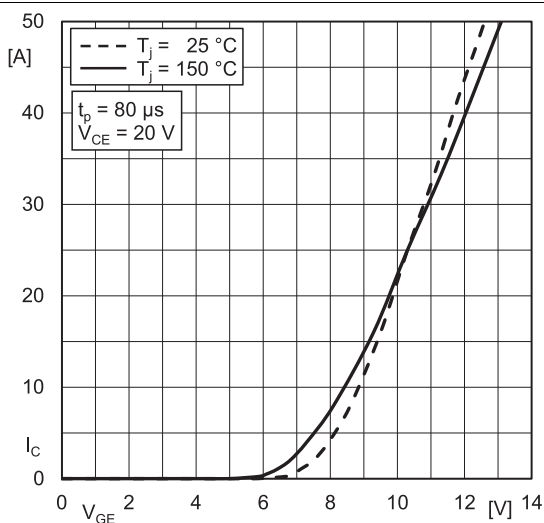


Fig. 5: Typ. IGBT transfer characteristic

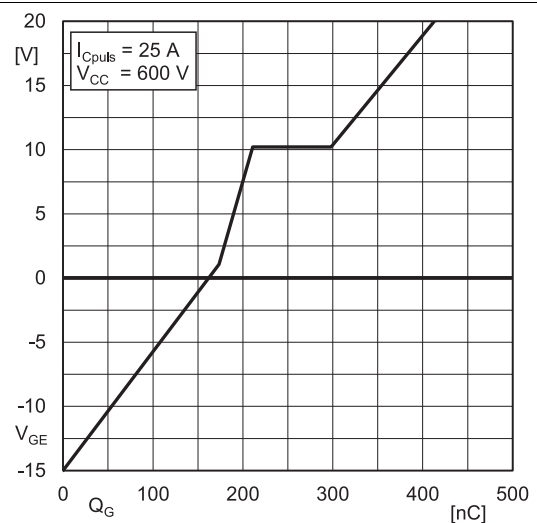


Fig. 6: Typ. IGBT gate charge characteristic

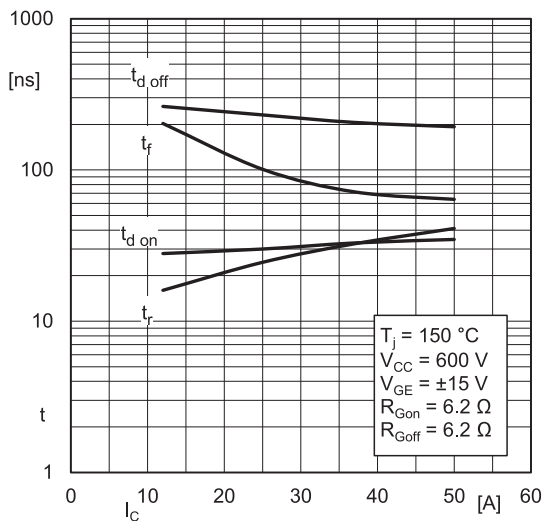


Fig. 7: Typ. switching times = $f(I_C)$

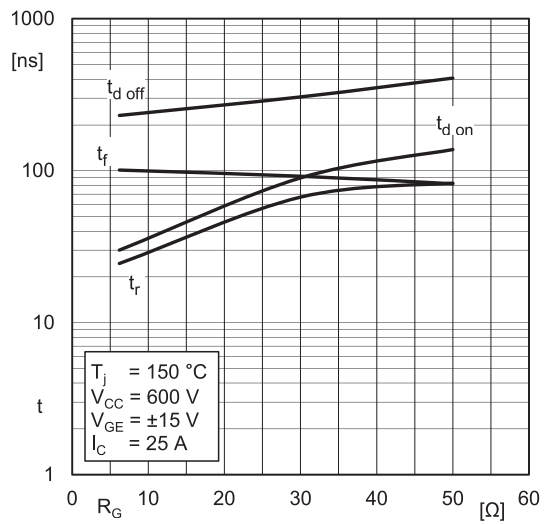


Fig. 8: Typ. switching times = $f(R_G)$

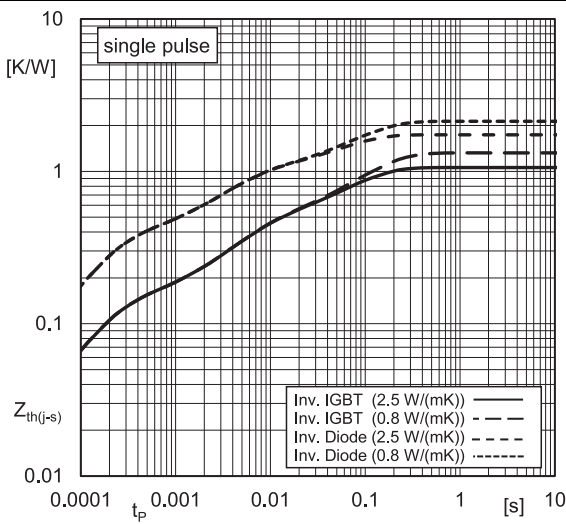


Fig. 9: Typ. transient thermal impedance

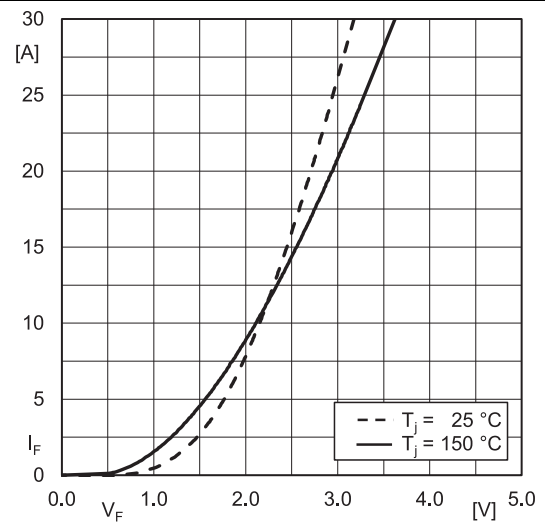


Fig. 10: Typ. Inv. diode forward charact., incl. R_{CC+EE}

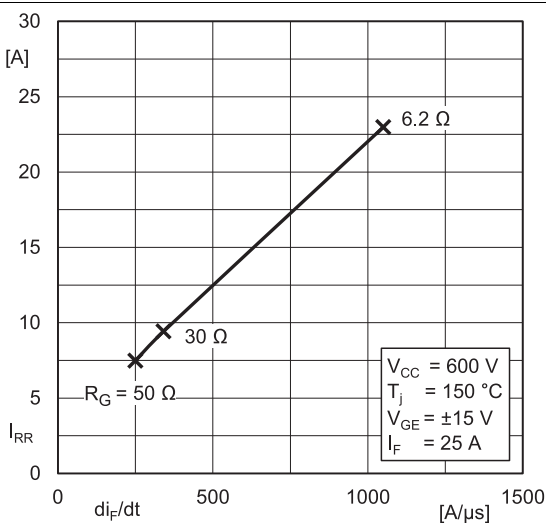


Fig. 11: Typ. Inv. diode peak reverse recovery current

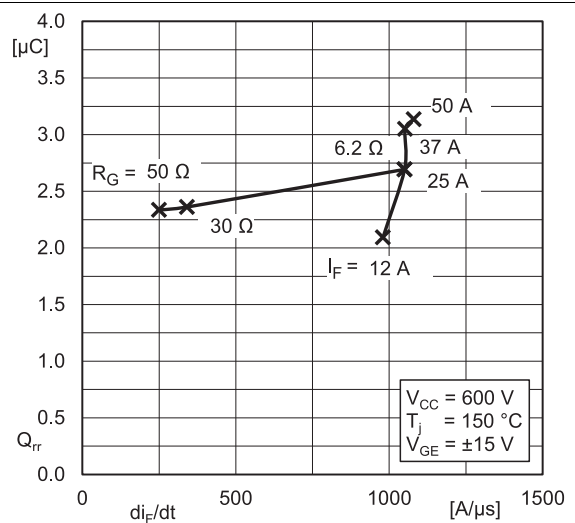


Fig. 12: Typ. Inv. diode reverse recovery charge

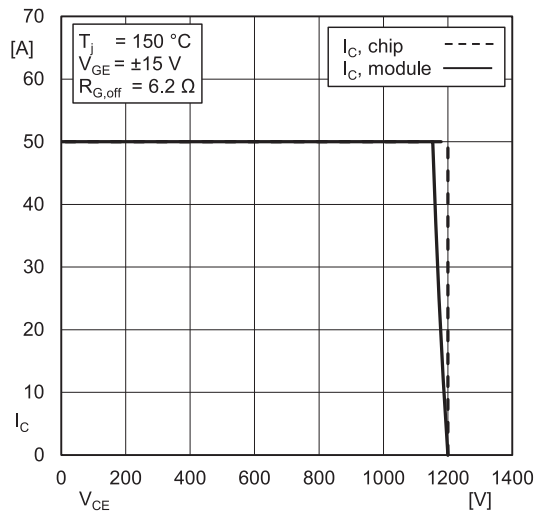


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

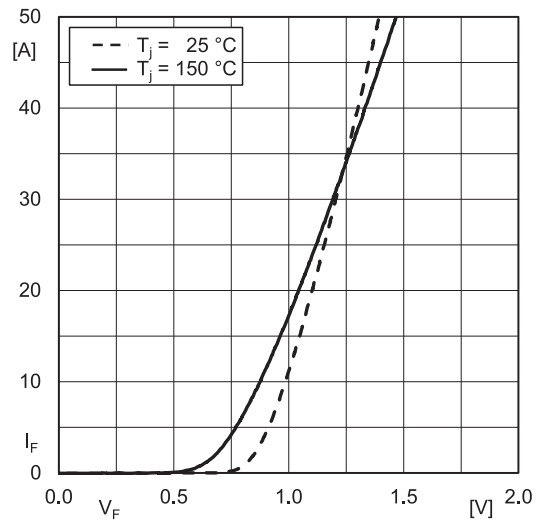


Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$

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

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