

SK15DGDL12T7ETE1



SEMITOP®E1

3-phase Converter-Inverter-Brake (CIB)

SK15DGDL12T7ETE1

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

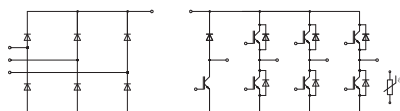
Typical Applications

- 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	23	A
	T _j = 175 °C	T _s = 100 °C	18	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	26	A
	T _j = 175 °C	T _s = 100 °C	21	A
I _{Cnom}			15	A
I _{CRM}			30	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	23	A
	T _j = 175 °C	T _s = 100 °C	18	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	26	A
	T _j = 175 °C	T _s = 100 °C	21	A
I _{Cnom}			15	A
I _{CRM}			30	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
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}			30	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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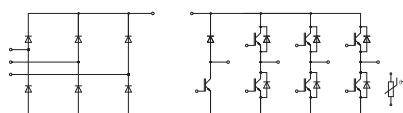
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- $T_{j,op} > 150 \text{ °C}$ during overload (details on AN19-002)

Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
Rectifier - Diode			
V_{RRM}	$T_j = 25 \text{ °C}$	1600	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ °C}$	A
	$T_j = 175 \text{ °C}$	$T_s = 100 \text{ °C}$	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ °C}$	A
	$T_j = 175 \text{ °C}$	$T_s = 100 \text{ °C}$	A
I_{FSM}	$t_p = 10 \text{ ms}$	$T_j = 25 \text{ °C}$	A
	$\sin 180^\circ$	$T_j = 150 \text{ °C}$	A
i^2t	$t_p = 10 \text{ ms}$	$T_j = 25 \text{ °C}$	A ² s
	$\sin 180^\circ$	$T_j = 150 \text{ °C}$	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 A	T _j = 25 °C		1.60	1.75	V
	V _{GE} = 15 V	T _j = 150 °C		1.78	1.93	V
	chiplevel	T _j = 175 °C		1.82	1.97	V
V _{CE0}		T _j = 25 °C		1.00	1.05	V
	chiplevel	T _j = 150 °C		0.80	0.85	V
		T _j = 175 °C		0.75	0.80	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		40	47	mΩ
	chiplevel	T _j = 150 °C		65	72	mΩ
		T _j = 175 °C		71	78	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.33 mA		5.15	5.8	6.45	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		2.80		nF
C _{oes}		f = 1 MHz		0.04		nF
C _{res}		f = 1 MHz		0.01		nF
Q _G	V _{GE} = -15 V ... +15 V			207		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 25 °C		31		ns
	I _C = 15 A	T _j = 150 °C		33		ns
	R _{G on} = 7.5 Ω	T _j = 175 °C		35		ns
t _r	R _{G off} = 7.5 Ω	T _j = 25 °C		25		ns
	V _{GE} = +15/-15 V	T _j = 150 °C		27		ns
	(T _j = 150 °C)	T _j = 175 °C		28		ns
E _{on}	di/dt _{on} = 730 A/μs	T _j = 25 °C		0.79		mJ
	di/dt _{off} = 150 A/μs	T _j = 150 °C		1.16		mJ
	dv/dt = 2600 V/μs	T _j = 175 °C		1.31		mJ



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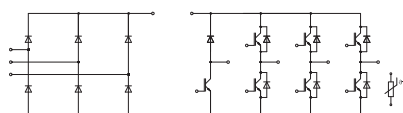
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DGDL-ET

Characteristics					
Symbol	Conditions		min.	typ.	max. Unit
Inverter - IGBT					
$t_{d(off)}$	$V_{CC} = 600 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$		209	ns
	$I_C = 15 \text{ A}$	$T_j = 150 \text{ }^{\circ}\text{C}$		254	ns
	$R_{G on} = 7.5 \text{ } \Omega$	$T_j = 175 \text{ }^{\circ}\text{C}$		275	ns
t_f	$R_{G off} = 7.5 \text{ } \Omega$	$T_j = 25 \text{ }^{\circ}\text{C}$		72	ns
	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$		111	ns
		$T_j = 175 \text{ }^{\circ}\text{C}$		119	ns
E_{off}	$(T_j = 150 \text{ }^{\circ}\text{C})$	$T_j = 25 \text{ }^{\circ}\text{C}$		1.29	mJ
	$di/dt_{on} = 730 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$		1.71	mJ
	$di/dt_{off} = 150 \text{ A}/\mu\text{s}$	$T_j = 175 \text{ }^{\circ}\text{C}$		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					
$V_{CE(sat)}$	$I_C = 15 \text{ A}$	$T_j = 25 \text{ }^{\circ}\text{C}$		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}	$V_{GE} = 15 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$		40	47 m Ω
	chipelevel	$T_j = 150 \text{ }^{\circ}\text{C}$		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}		$f = 1 \text{ MHz}$		2.80	nF
C_{oes}	$V_{CE} = 25 \text{ V}$	$f = 1 \text{ MHz}$		0.04	nF
C_{res}	$V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$		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}	$V_{CC} = 600 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$		0.79	mJ
	$I_C = 15 \text{ A}$	$T_j = 150 \text{ }^{\circ}\text{C}$		1.16	mJ
	$R_{G on} = 7.5 \text{ } \Omega$	$T_j = 175 \text{ }^{\circ}\text{C}$		1.31	mJ
	$R_{G off} = 7.5 \text{ } \Omega$				
	$V_{GE} = +15/-15 \text{ V}$				
$t_{d(off)}$		$T_j = 25 \text{ }^{\circ}\text{C}$		209	ns
	$(T_j = 150 \text{ }^{\circ}\text{C})$	$T_j = 150 \text{ }^{\circ}\text{C}$		254	ns
	$di/dt_{on} = 730 \text{ A}/\mu\text{s}$	$T_j = 175 \text{ }^{\circ}\text{C}$		275	ns
t_f	$di/dt_{off} = 150 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ }^{\circ}\text{C}$		72	ns
	$dv/dt = 2600 \text{ V}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$		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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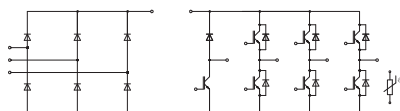
Typical Applications

- Motor drives
- Air conditioning
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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}		T _j = 25 °C		11		A
		T _j = 150 °C		15		A
		T _j = 175 °C		18		A
Q _{rr}	V _{CC} = 600 V I _F = 15 A	T _j = 25 °C		1.03		μC
		T _j = 150 °C		2.29		μC
		T _j = 175 °C		2.58		μC
E _{rr}	V _{GE} = -15 V (T _j = 150 °C) di/dt _{off} = 870 A/μs	T _j = 25 °C		0.31		mJ
		T _j = 150 °C		0.97		mJ
		T _j = 175 °C		1.49		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}		T _j = 25 °C		8		A
		T _j = 150 °C		14		A
		T _j = 175 °C		16		A
Q _{rr}	V _{CC} = 600 V I _F = 10 A	T _j = 25 °C		0.58		μC
		T _j = 150 °C		2.01		μC
		T _j = 175 °C		2.37		μC
E _{rr}	V _{GE} = -15 V (T _j = 150 °C) di/dt _{off} = 790 A/μs	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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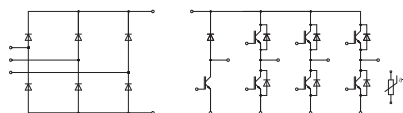
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V _F	I _F = 15 A chiplevel	T _j = 25 °C		1.04	1.30	V
		T _j = 150 °C		0.94	1.20	V
		T _j = 175 °C		0.93	1.20	V
V _{F0}	chiplevel	T _j = 25 °C		0.89	1.09	V
		T _j = 150 °C		0.73	0.92	V
		T _j = 175 °C		0.69	0.88	V
r _F	chiplevel	T _j = 25 °C		10	14	mΩ
		T _j = 150 °C		14	19	mΩ
		T _j = 175 °C		16	21	mΩ
I _R	T _j = 150 °C, V _{RRM}				2	mA
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.75		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 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°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{25/85}	R(Τ)=R ₂₅ *exp[B _{25/85} *(1/T-1/298)], T[K]			3420		K



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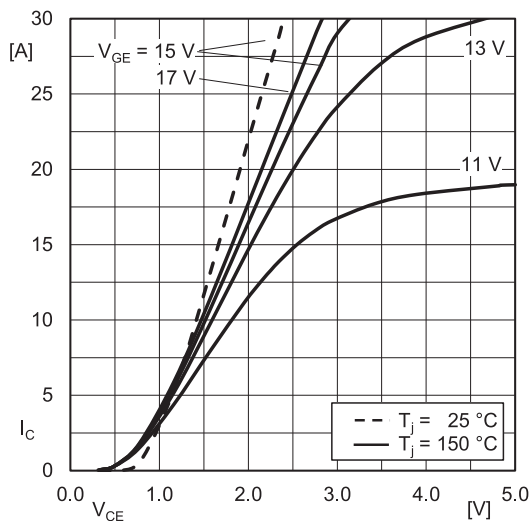


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

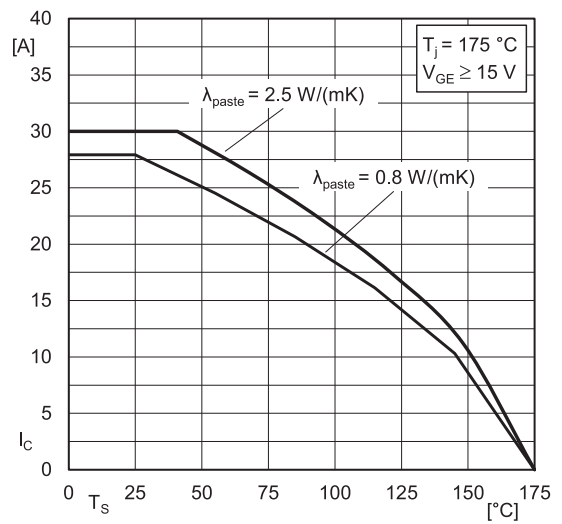


Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$

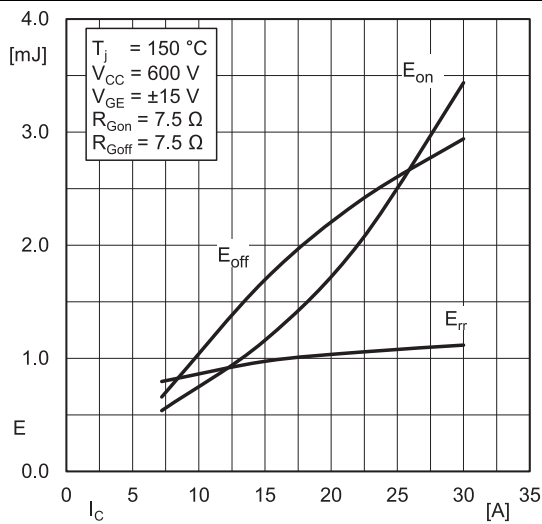


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

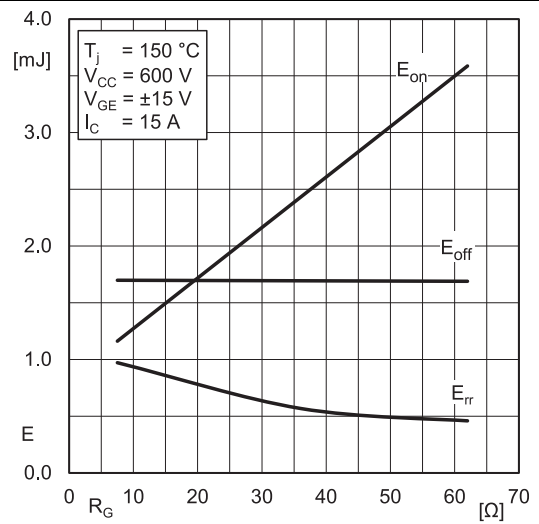


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

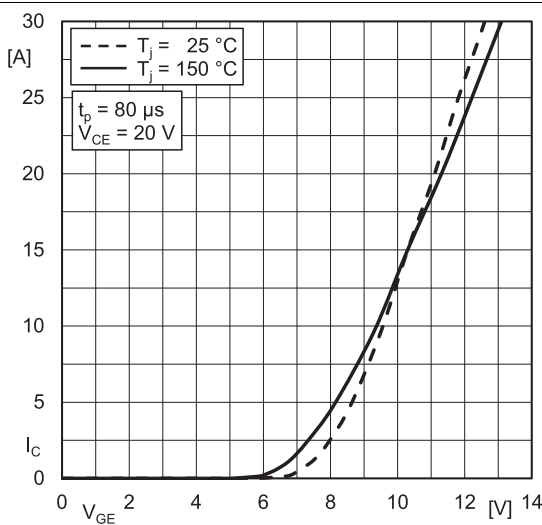


Fig. 5: Typ. IGBT transfer characteristic

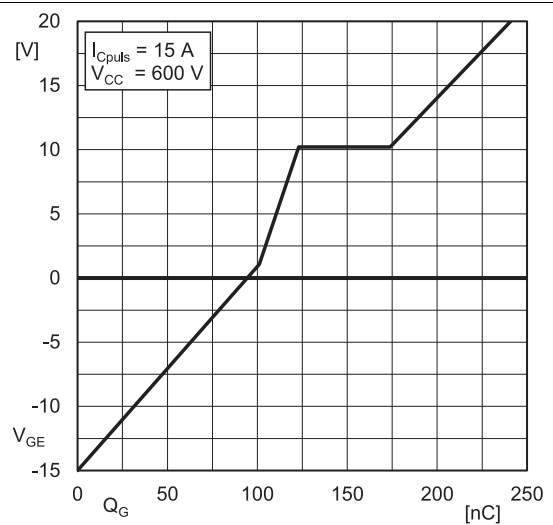


Fig. 6: Typ. IGBT gate charge characteristic

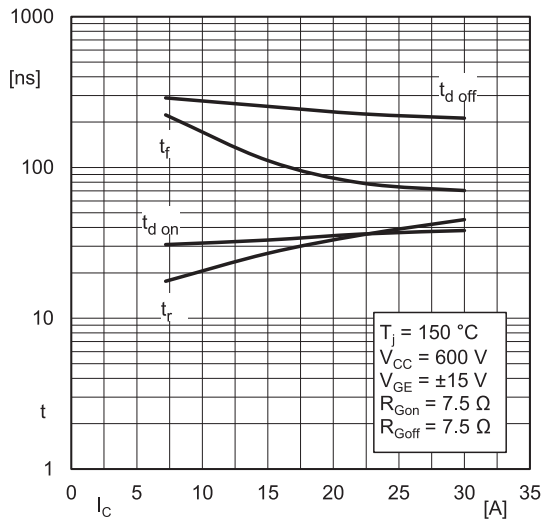


Fig. 7: Typ. switching times = f (I_C)

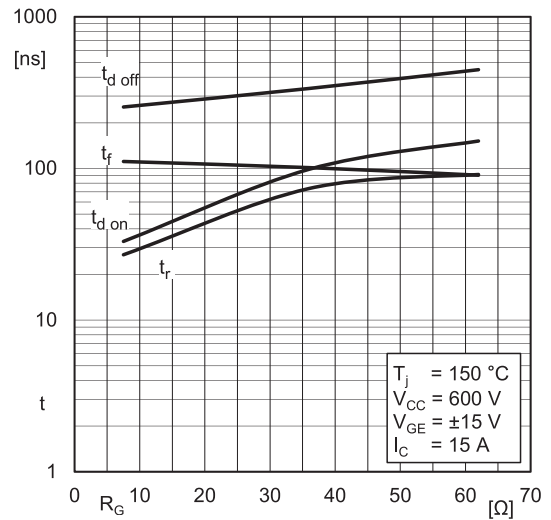


Fig. 8: Typ. switching times = f (R_G)

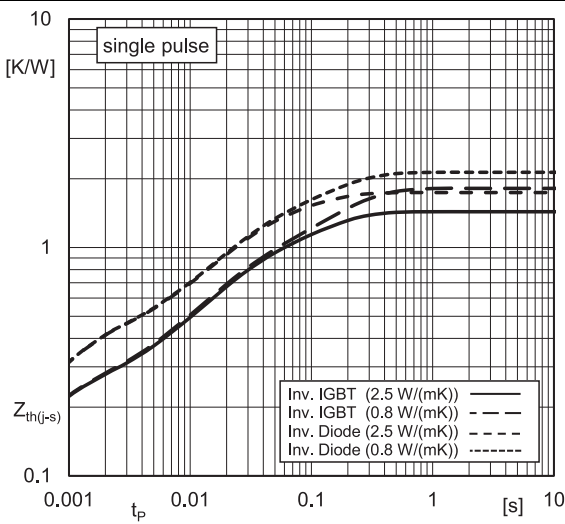


Fig. 9: Typ. transient thermal impedance

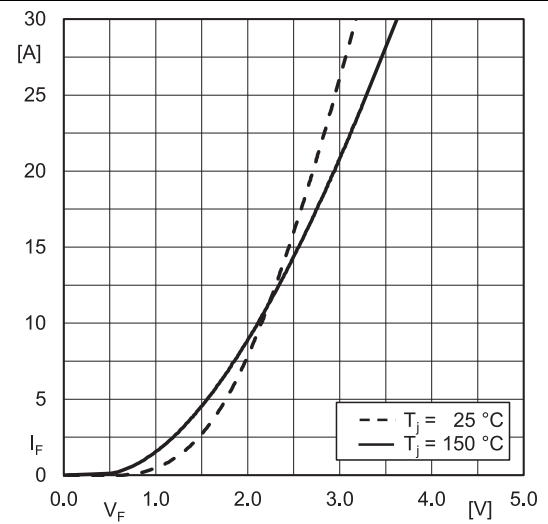


Fig. 10: Typ. Inv. diode forward charact., incl. R_{CC'+EE'}

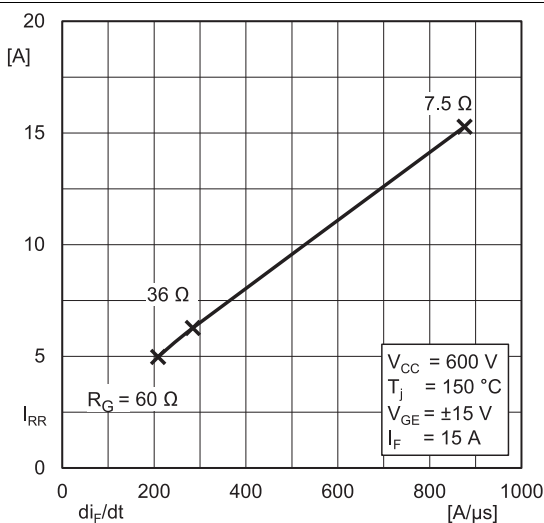


Fig. 11: Typ. Inv. diode peak reverse recovery current

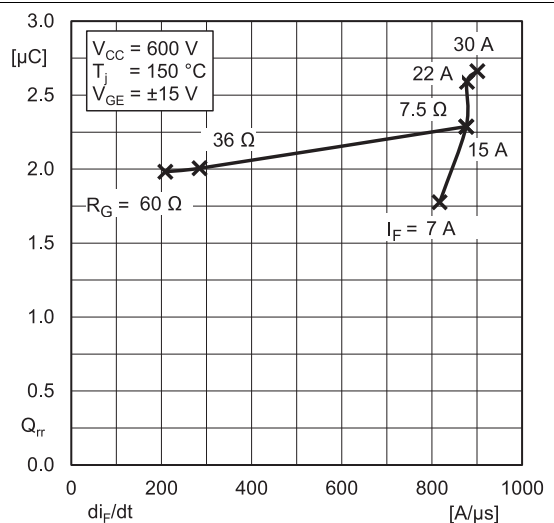


Fig. 12: Typ. Inv. diode reverse recovery charge

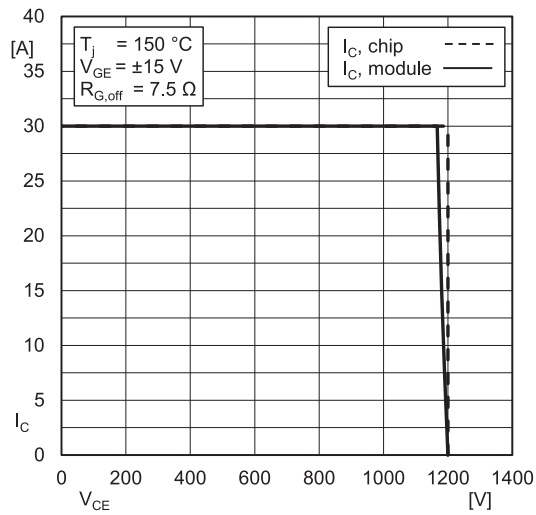


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

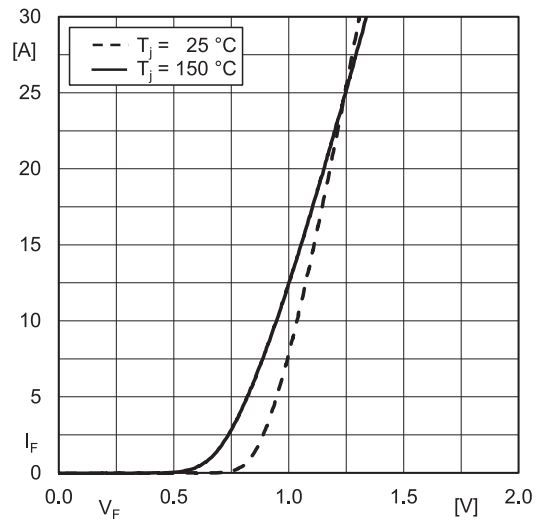
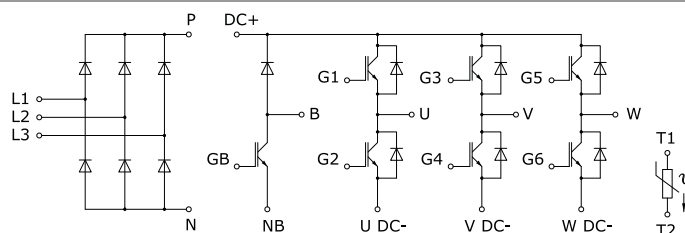
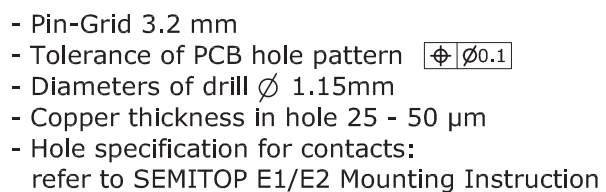
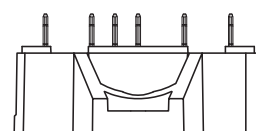


Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$



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

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