



SEMITOP®E1

3-phase Converter-Inverter-Brake (CIB)

SK10DGDLO7E3ETE1

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

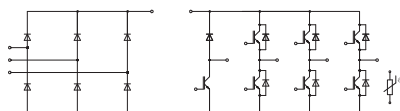
Typical Applications

- 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 °C		650	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	15	A
	T _j = 175 °C	T _s = 100 °C	13	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	17	A
	T _j = 175 °C	T _s = 100 °C	14	A
I _{Cnom}			10	A
I _{CRM}			20	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V V _{GE} ≤ 15 V V _{CES} ≤ 650 V	T _j = 150 °C	6	μs
T _j			-40 ... 175	°C
Chopper - IGBT				
V _{CES}	T _j = 25 °C		650	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	15	A
	T _j = 175 °C	T _s = 100 °C	13	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	17	A
	T _j = 175 °C	T _s = 100 °C	14	A
I _{Cnom}			10	A
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t _{psc}	V _{CC} = 360 V V _{GE} ≤ 15 V V _{CES} ≤ 650 V	T _j = 150 °C	6	μs
T _j			-40 ... 175	°C
Inverse - Diode				
V _{RRM}	T _j = 25 °C		650	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	29	A
	T _j = 175 °C	T _s = 100 °C	23	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	34	A
	T _j = 175 °C	T _s = 100 °C	27	A
I _{FRM}			60	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		150	A
T _j			-40 ... 175	°C
Freewheeling - Diode				
V _{RRM}	T _j = 25 °C		650	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	29	A
	T _j = 175 °C	T _s = 100 °C	23	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	34	A
	T _j = 175 °C	T _s = 100 °C	27	A
I _{FRM}			60	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		150	A
T _j			-40 ... 175	°C



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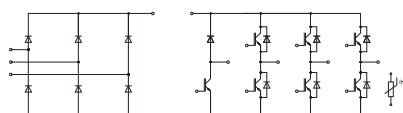
- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$

Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
Rectifier - Diode			
V_{RRM}	$T_j = 25 \text{ }^{\circ}\text{C}$	1600	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^{\circ}\text{C}$	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	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					
$V_{CE(sat)}$	$I_C = 10 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^{\circ}\text{C}$	1.45	1.87	V
		$T_j = 150 \text{ }^{\circ}\text{C}$	1.70	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	$T_j = 25 \text{ }^{\circ}\text{C}$	55	87	$\text{m}\Omega$
		$T_j = 150 \text{ }^{\circ}\text{C}$	88	120	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.15 \text{ mA}$	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}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	0.55		nF
C_{oes}		$f = 1 \text{ MHz}$	0.04		nF
C_{res}		$f = 1 \text{ MHz}$	0.02		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		102		nC
R_{Gint}	$T_j = 25 \text{ }^{\circ}\text{C}$		0		Ω
$t_{d(on)}$	$V_{CC} = 300 \text{ V}$ $I_C = 10 \text{ A}$	$T_j = 150 \text{ }^{\circ}\text{C}$	5		ns
t_r	$R_{G on} = 30 \Omega$	$T_j = 150 \text{ }^{\circ}\text{C}$	30		ns
E_{on}	$R_{G off} = 30 \Omega$	$T_j = 150 \text{ }^{\circ}\text{C}$	0.39		mJ
$t_{d(off)}$	$di/dt_{on} = 270 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$	139		ns
t_f	$di/dt_{off} = 300 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$	37		ns
E_{off}	$dv/dt = 4300 \text{ V}/\mu\text{s}$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$	0.31		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$		2.42		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$		2.07		K/W



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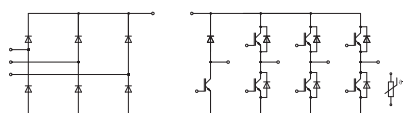
Typical Applications

- 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
Chopper - IGBT						
V _{CE(sat)}	I _C = 10 A	T _j = 25 °C		1.45	1.87	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.70	2.10	V
V _{CE0}	chiplevel	T _j = 25 °C		0.90	1.00	V
		T _j = 150 °C		0.82	0.90	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		55	87	mΩ
		T _j = 150 °C		88	120	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.15 mA		5.1	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		0.55		nF
C _{oes}		f = 1 MHz		0.04		nF
C _{res}		f = 1 MHz		0.02		nF
Q _G	V _{GE} = -15 V ... +15 V			102		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		5		ns
t _r	I _C = 10 A	T _j = 150 °C		30		ns
E _{on}	R _{G on} = 30 Ω	T _j = 150 °C		0.39		mJ
t _{d(off)}	R _{G off} = 30 Ω	T _j = 150 °C		139		ns
t _f	di/dt _{on} = 270 A/μs	T _j = 150 °C		37		ns
E _{off}	di/dt _{off} = 300 A/μs	T _j = 150 °C		0.31		mJ
	dv/dt = 4300 V/μs					
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			2.42		K/W
	per IGBT, λ _{paste} =2.5 W/(mK)			2.07		K/W
Inverse - Diode						
V _F = V _{EC}	I _F = 10 A	T _j = 25 °C		1.23	1.51	V
	chiplevel	T _j = 150 °C		1.13	1.40	V
V _{F0}	chiplevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chiplevel	T _j = 25 °C		19	27	mΩ
		T _j = 150 °C		28	41	mΩ
I _{RRM}	I _F = 10 A	T _j = 150 °C		10		A
Q _{rr}	di/dt _{off} = 270 A/μs	T _j = 150 °C		1.7		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 300 V	T _j = 150 °C		0.23		mJ
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)			1.38		K/W
Freewheeling - Diode						
V _F = V _{EC}	I _F = 10 A	T _j = 25 °C		1.23	1.51	V
	chiplevel	T _j = 150 °C		1.13	1.40	V
V _{F0}	chiplevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chiplevel	T _j = 25 °C		19	27	mΩ
		T _j = 150 °C		28	41	mΩ
I _{RRM}	I _F = 10 A	T _j = 150 °C		10		A
Q _{rr}	di/dt _{off} = 270 A/μs	T _j = 150 °C		1.7		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 300 V	T _j = 150 °C		0.23		mJ
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)			1.38		K/W



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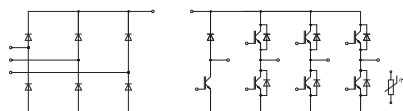
Typical Applications

- Motor drives
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Remarks

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

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V _F	I _F = 10 A	T _j = 25 °C		0.99	1.23	V
	chiplevel	T _j = 150 °C		0.87	1.11	V
V _{F0}	chiplevel	T _j = 25 °C		0.89	1.09	V
		T _j = 150 °C		0.73	0.92	V
r _F	chiplevel	T _j = 25 °C		10	14	mΩ
		T _j = 150 °C		14	19	mΩ
I _R	T _j = 150 °C, V _{RRM}				2	mA
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.99		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.64		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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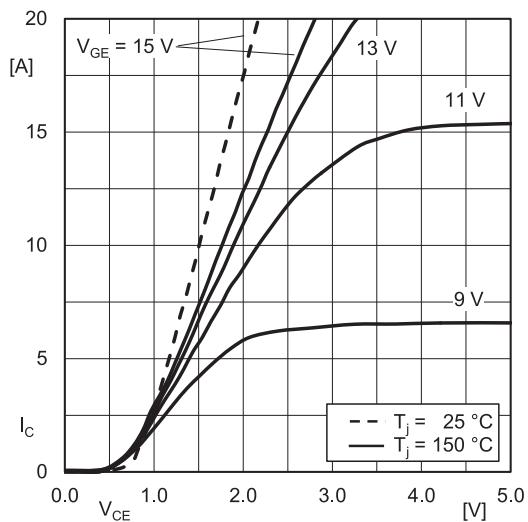
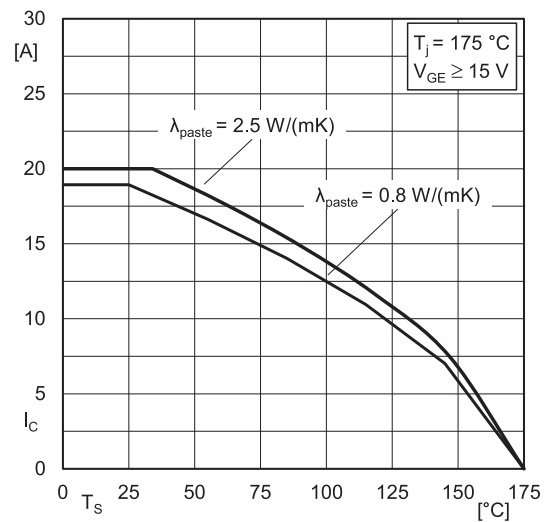
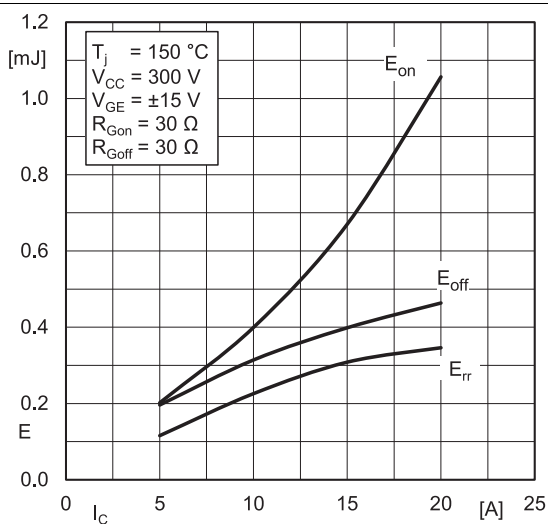
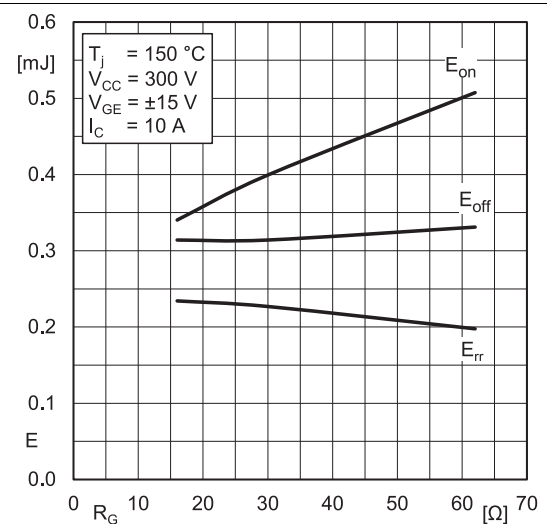
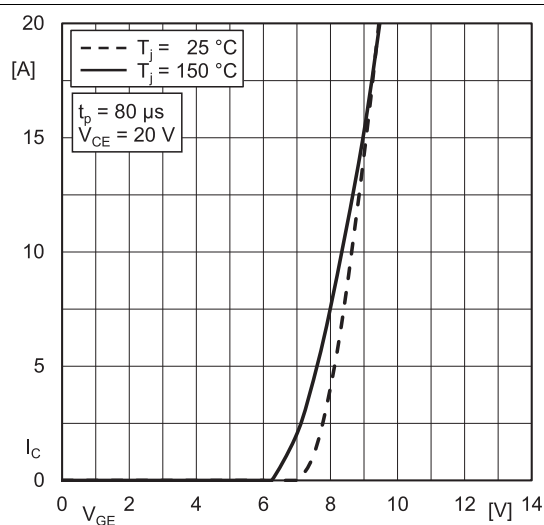
Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$ Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$ Fig. 3: Typ. turn-on /-off energy = $f(I_C)$ Fig. 4: Typ. turn-on /-off energy = $f(R_G)$ 

Fig. 5: Typ. IGBT transfer characteristic

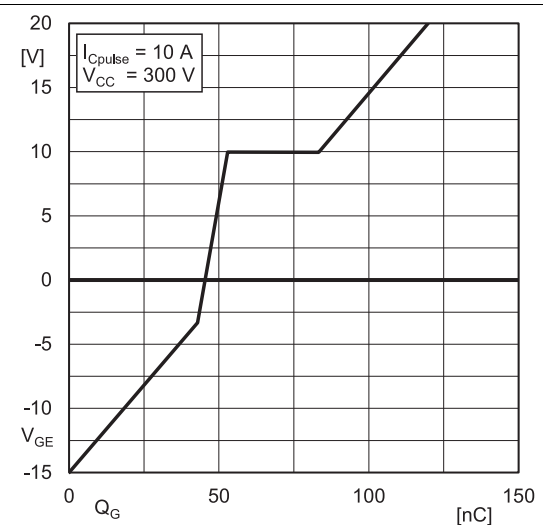


Fig. 6: Typ. IGBT gate charge characteristic

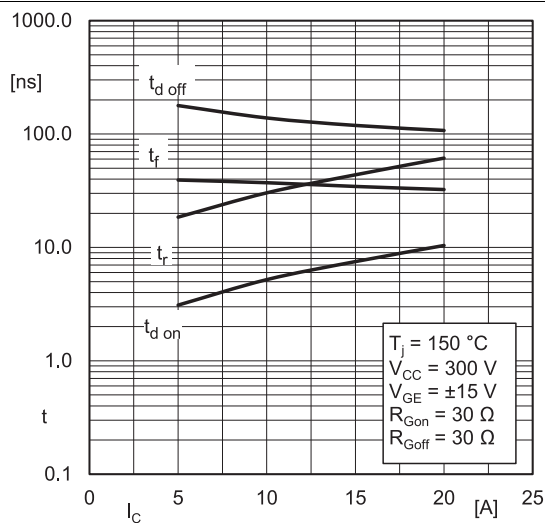


Fig. 7: Typ. switching times = $f(I_C)$

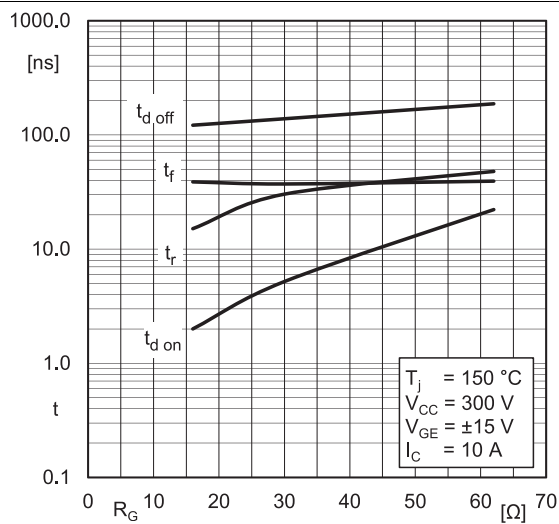


Fig. 8: Typ. switching times = $f(R_G)$

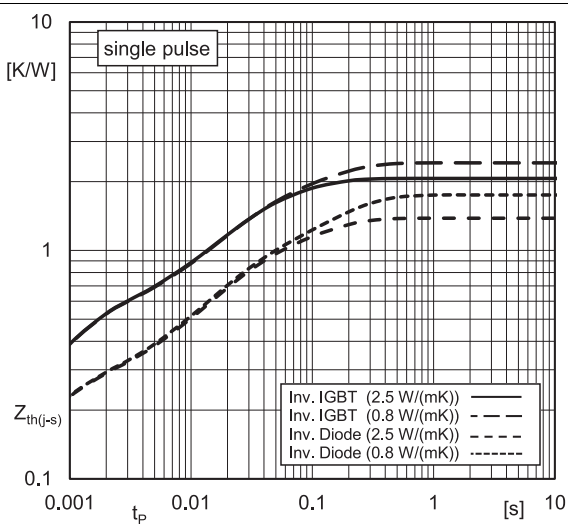


Fig. 9: Typ. transient thermal impedance

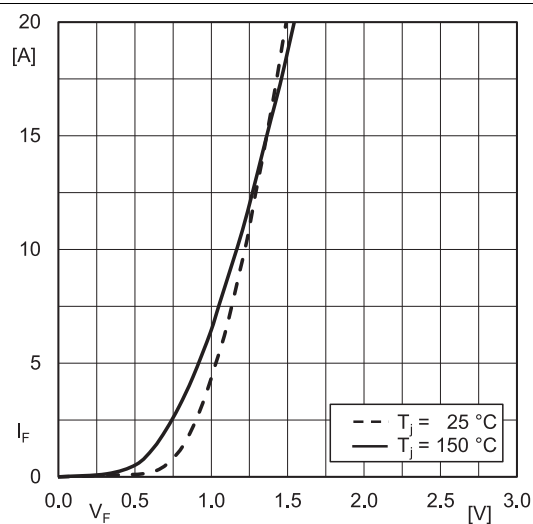


Fig. 10: Typ. Inv. diode forward charact., incl. $R_{CC} + EE'$

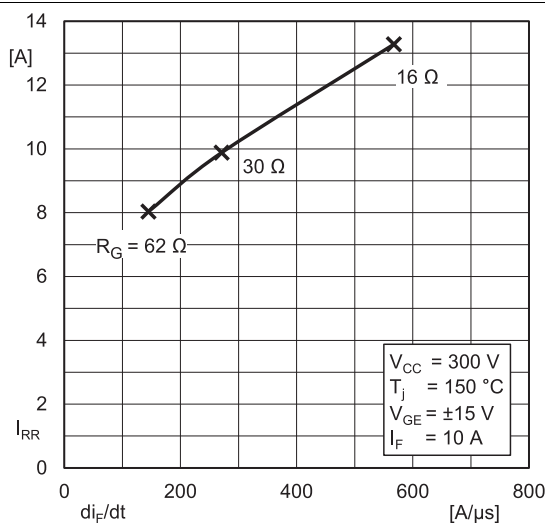


Fig. 11: Typ. Inv. diode peak reverse recovery current

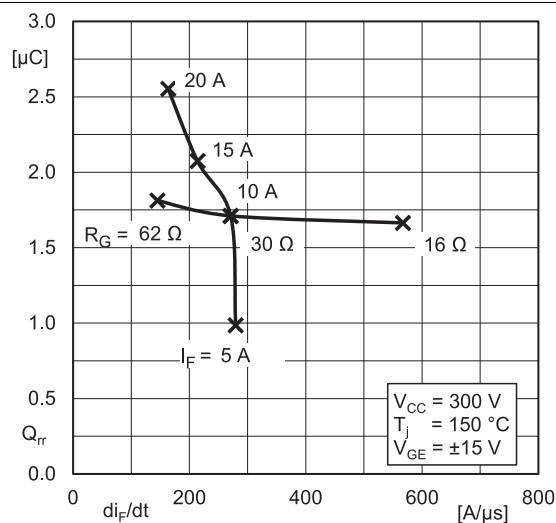


Fig. 12: Typ. Inv. diode reverse recovery charge

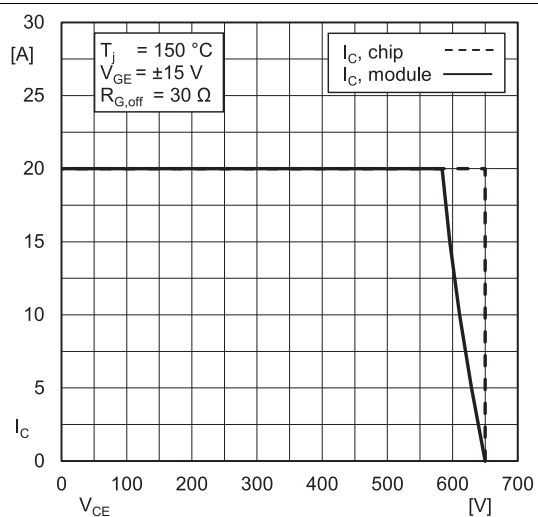


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

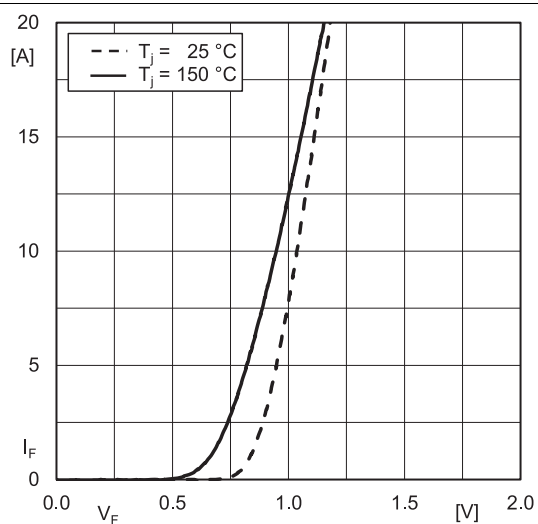
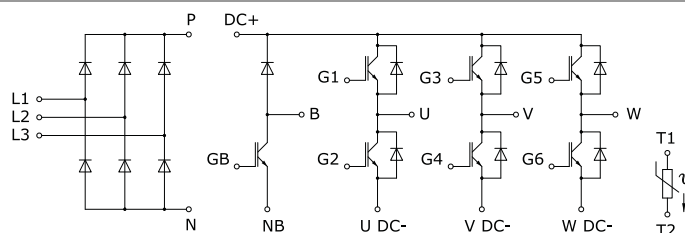
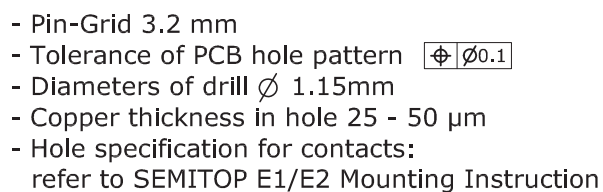
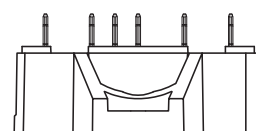


Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE}$



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

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