SEMITOP®E1

3-phase
Converter-Inverter-Brake
(CIB)

SK15DGDL07E3ETE1

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

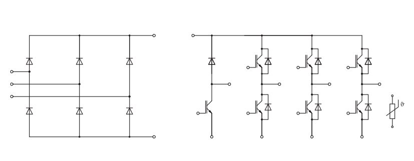
Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

- Recommended $T_{j,op}$=-40 ...+150 °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_j = 175 °C	T_s = 70 °C	20	A
		T_s = 100 °C	17	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	23	A
		T_s = 100 °C	19	A
I_{Cnom}			15	A
I_{CRM}			30	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_j = 175 °C	T_s = 70 °C	20	A
		T_s = 100 °C	17	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	23	A
		T_s = 100 °C	19	A
I_{Cnom}			15	A
I_{CRM}			30	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
Inverse - Diode				
V_{RRM}	T_j = 25 °C		650	V
I_F	λ_{paste}=0.8 W/(mK) T_j = 175 °C	T_s = 70 °C	29	A
		T_s = 100 °C	23	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	34	A
		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_j = 175 °C	T_s = 70 °C	29	A
		T_s = 100 °C	23	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	34	A
		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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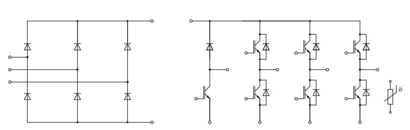

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Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
Rectifier - Diode				
V_{RRM}	T_j = 25 °C		1600	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 70 °C	33	A
	T_j = 175 °C	T_s = 100 °C	26	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 70 °C	38	A
	T_j = 175 °C	T_s = 100 °C	30	A
I_{FSM}	t_p = 10 ms	T_j = 25 °C	220	A
	sin 180°	T_j = 150 °C	200	A
i^2t	t_p = 10 ms	T_j = 25 °C	242	A^2s
	sin 180°	T_j = 150 °C	200	A^2s
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		1.45	1.87	V
	V_{GE} = 15 V chiplevel	T_j = 150 °C		1.83	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	T_j = 25 °C		37	58	mΩ
	chiplevel	T_j = 150 °C		67	80	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 0.21 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	f = 1 MHz		0.80		nF
C_{oes}	V_{GE} = 0 V	f = 1 MHz		0.06		nF
C_{res}		f = 1 MHz		0.02		nF
Q_G	V_{GE} = -15 V ... +15 V			148		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 = 15 A	T_j = 150 °C		30		ns
E_{on}	$R_{G\ on}$ = 20 Ω $R_{G\ off}$ = 20 Ω	T_j = 150 °C		0.57		mJ
$t_{d(off)}$	di/dt_{on} = 410 A/µs	T_j = 150 °C		139		ns
t_f	di/dt_{off} = 340 A/µs	T_j = 150 °C		37		ns
E_{off}	dv/dt = 4300 V/µs V_{GE} = +15/-15 V	T_j = 150 °C		0.45		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			1.97		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			1.61		K/W

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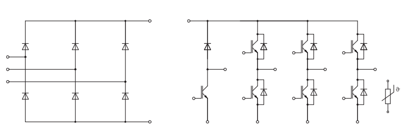
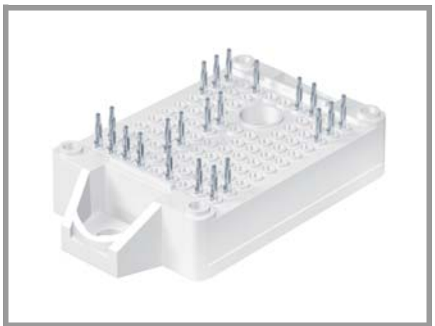


DGDL-ET

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Chopper - IGBT						
$V_{CE(sat)}$	I_C = 15 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.45	1.87	V
		T_j = 150 °C		1.83	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		37	58	mΩ
		T_j = 150 °C		67	80	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 0.21 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		0.80		nF
C_{oes}		f = 1 MHz		0.06		nF
C_{res}		f = 1 MHz		0.02		nF
Q_G	V_{GE} = -15 V ... +15 V			148		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CC} = 300 V I_C = 15 A $R_{G\ on}$ = 20 Ω $R_{G\ off}$ = 20 Ω di/dt_{on} = 410 A/µs di/dt_{off} = 340 A/µs dv/dt = 4300 V/µs V_{GE} = +15/-15 V	T_j = 150 °C		5		ns
t_r		T_j = 150 °C		30		ns
E_{on}		T_j = 150 °C		0.57		mJ
$t_{d(off)}$		T_j = 150 °C		139		ns
t_f		T_j = 150 °C		37		ns
E_{off}		T_j = 150 °C		0.45		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			1.97		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			1.61		K/W
Inverse - Diode						
$V_F = V_{EC}$	I_F = 15 A chiplevel	T_j = 25 °C		1.32	1.65	V
		T_j = 150 °C		1.27	1.60	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 = 15 A di/dt_{off} = 410 A/µs V_{GE} = -15 V V_{CC} = 300 V	T_j = 150 °C		12		A
Q_{rr}		T_j = 150 °C		2.1		µC
E_{rr}		T_j = 150 °C		0.31		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 = 15 A chiplevel	T_j = 25 °C		1.32	1.65	V
		T_j = 150 °C		1.27	1.60	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 = 15 A di/dt_{off} = 410 A/µs V_{GE} = -15 V V_{CC} = 300 V	T_j = 150 °C		12		A
Q_{rr}		T_j = 150 °C		2.1		µC
E_{rr}		T_j = 150 °C		0.31		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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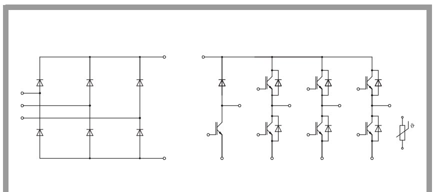


DGDL-ET

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
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

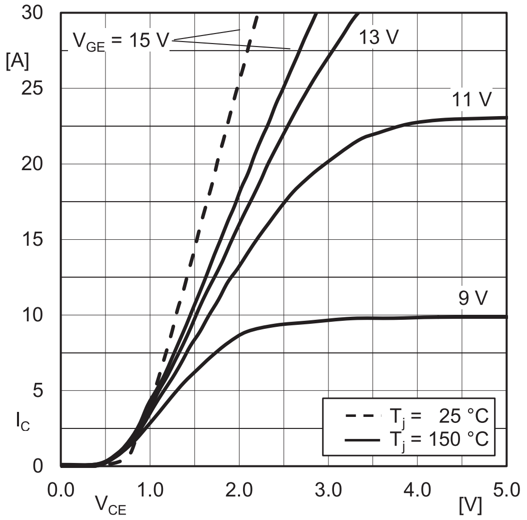


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+ EE'}$

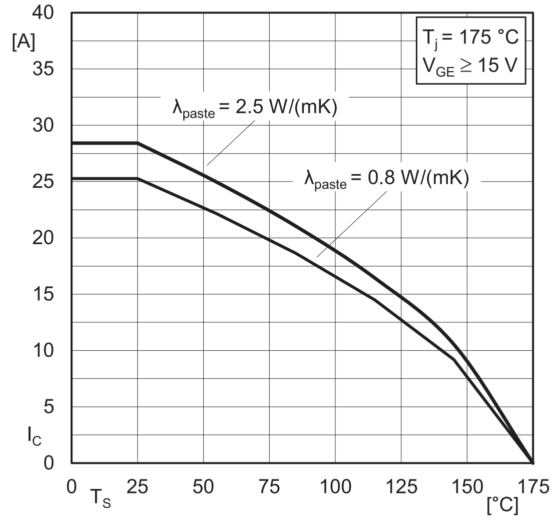


Fig. 2: IGBT rated current vs. temperature $I_c=f(T_s)$

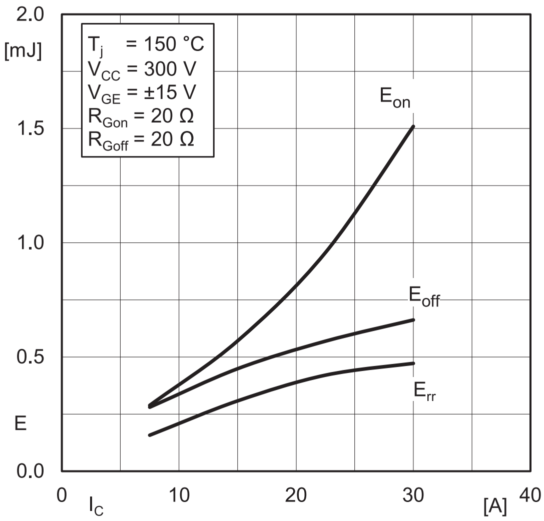


Fig. 3: Typ. turn-on /-off energy = f (I_C)

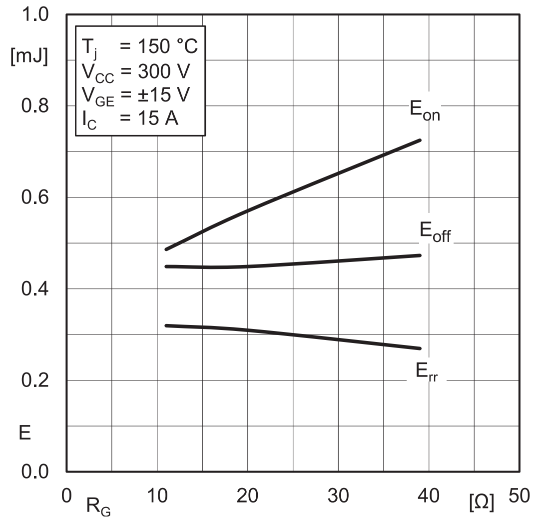


Fig. 4: Typ. turn-on /-off energy = f (R_G)

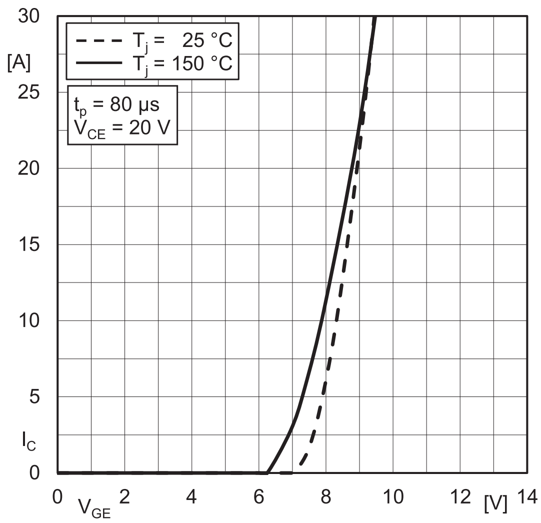


Fig. 5: Typ. IGBT transfer characteristic

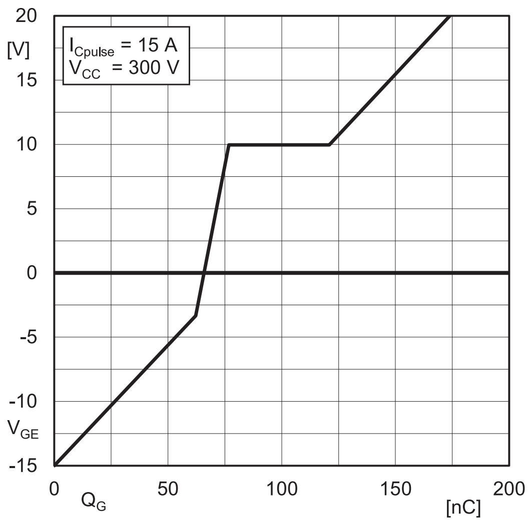


Fig. 6: Typ. IGBT gate charge characteristic

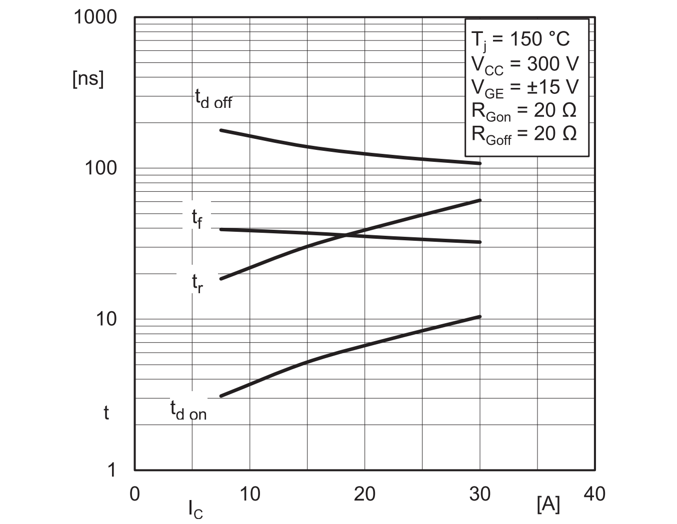


Fig. 7: Typ. switching times = f (I_C)

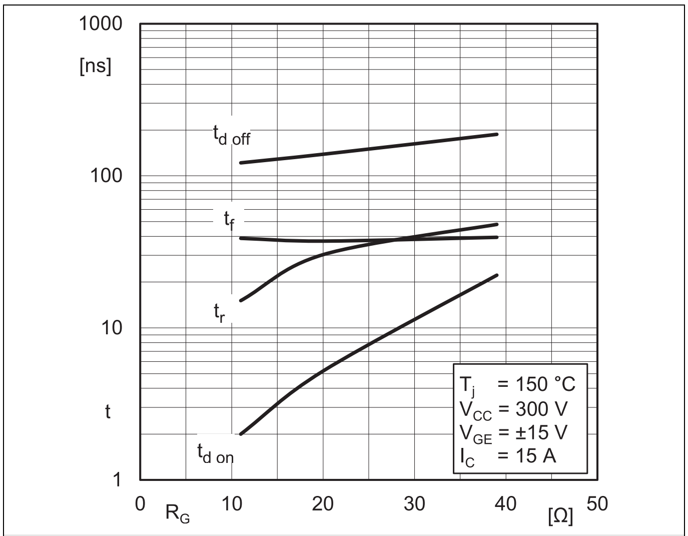


Fig. 8: Typ. switching times = f (R_G)

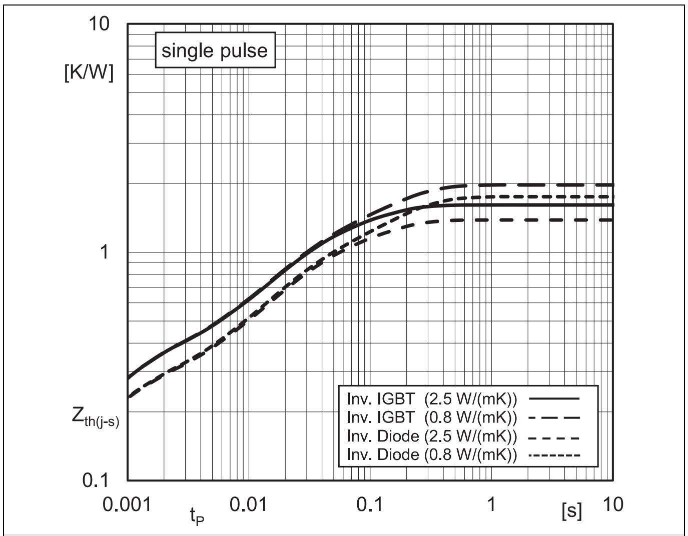


Fig. 9: Typ. transient thermal impedance

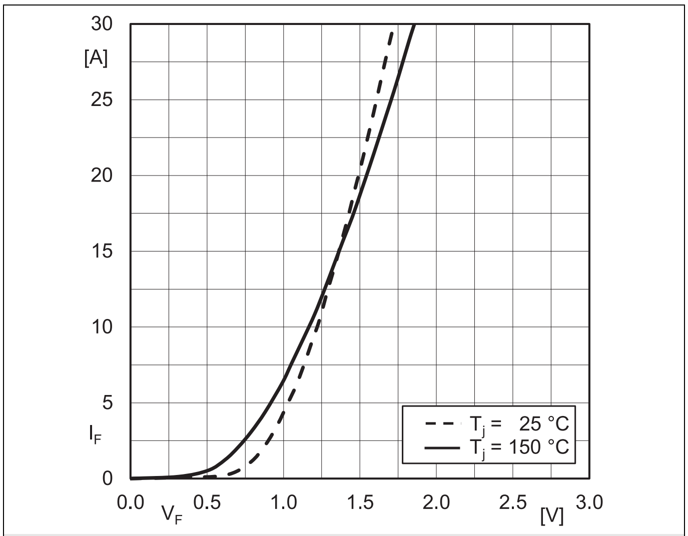


Fig. 10: Typ. Inv. diode forward charact., incl. $R_{CC'+EE'}$

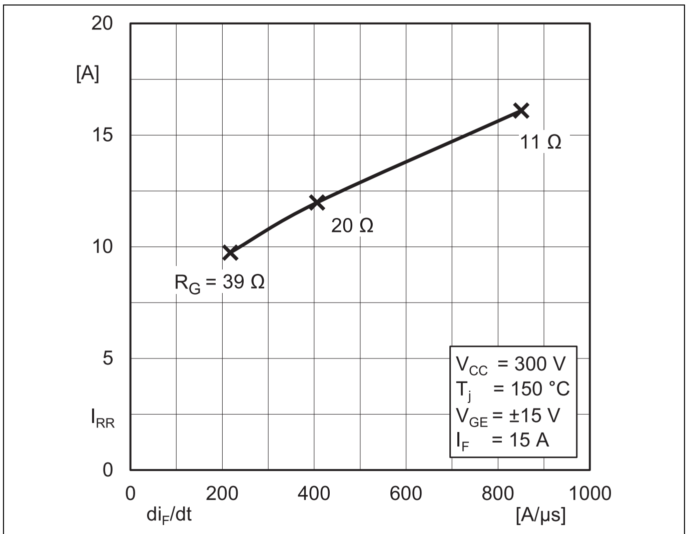


Fig. 11: Typ. Inv. diode peak reverse recovery current

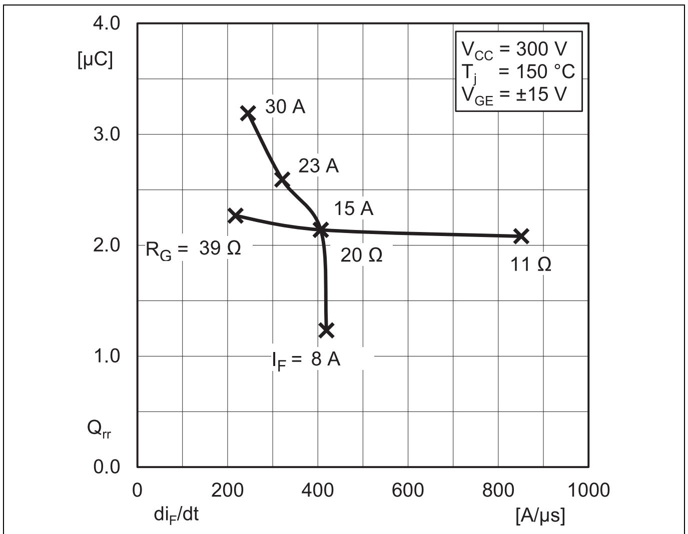


Fig. 12: Typ. Inv. diode reverse recovery charge

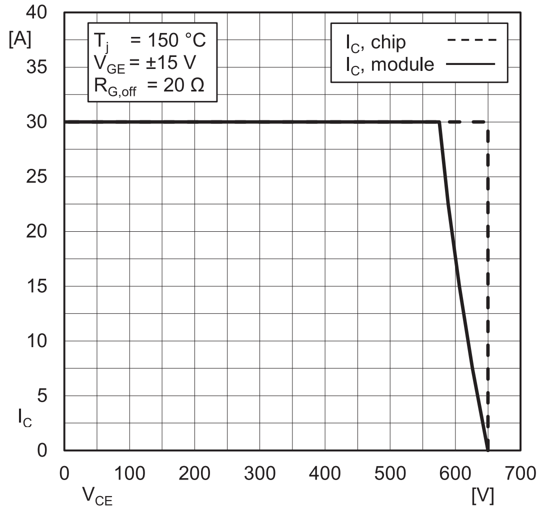


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

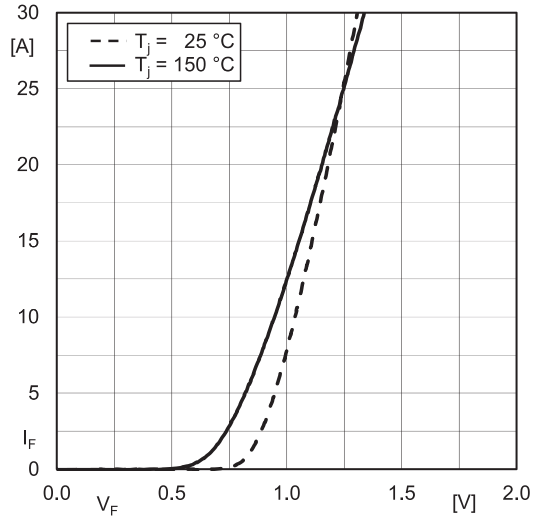
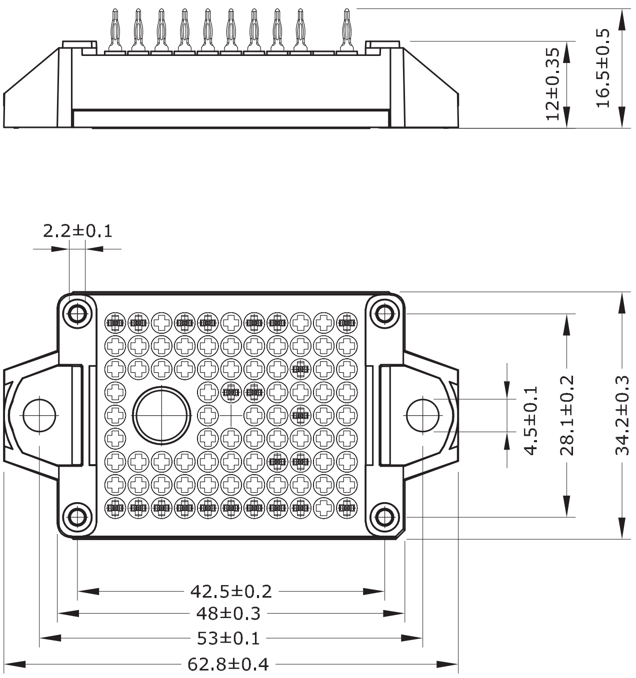
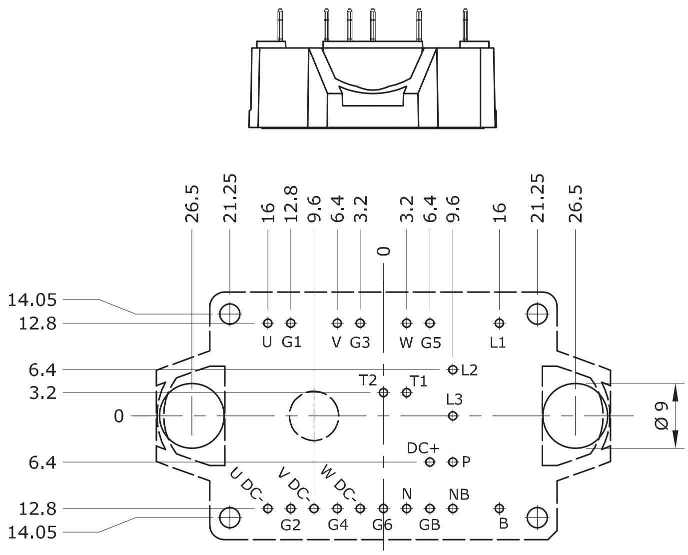


Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+ EE'}$





- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern ⌖ Ø0.1
- Diameters of drill Ø 1.15mm
- Copper thickness in hole 25 - 50 µm
- Hole specification for contacts: refer to SEMITOP E1/E2 Mounting Instruction

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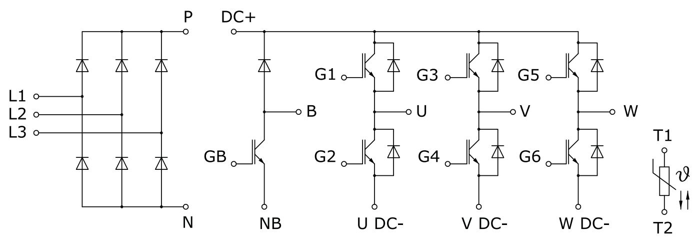

DGDL-ET

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

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