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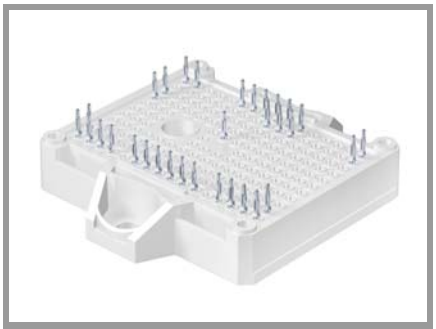


SEMITOP®E2

3-phase bridge rectifer + brake chopper + 3-phase bridge inverter

SK35DGDL12T4ETE2V1

Features*

- Low inductive design
- Press-Fit contact technology
- Rugged mounting due to integrated mounting clamps
- Heat transfer and insulation through direct copper bonded aluminium oxide ceramic (DBC)
- Trench4 IGBT technology
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

- IGBT1: inverter IGBT
- IGBT2: brake IGBT
- Diode1: rectifier diode
- Diode2: APD inverter
- Diode3: FWD brake

Absolute Maximum Ratings

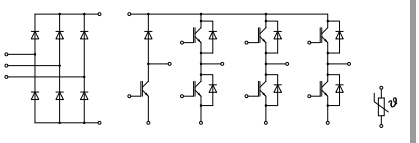
Symbol	Conditions		Values	Unit
IGBT 1				
V_{CES}	T_j = 25 °C		1200	V
I_C	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	49	A
	T_j = 175 °C	T_s = 70 °C	40	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	60	A
	T_j = 175 °C	T_s = 70 °C	49	A
I_{Cnom}			35	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		105	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V $V_{GE} \leq$ 15 V $V_{CES} \leq$ 1200 V	T_j = 150 °C	10	µs
T_j			-40 ... 175	°C

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT 2				
V_{CES}	T_j = 25 °C		1200	V
I_C	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	49	A
	T_j = 175 °C	T_s = 70 °C	40	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	60	A
	T_j = 175 °C	T_s = 70 °C	49	A
I_{Cnom}			35	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		105	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V $V_{GE} \leq$ 15 V $V_{CES} \leq$ 1200 V	T_j = 150 °C	10	µs
T_j			-40 ... 175	°C

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Diode 1				
V_{RRM}	T_j = 25 °C		1600	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	47	A
	T_j = 150 °C	T_s = 70 °C	35	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	56	A
	T_j = 150 °C	T_s = 70 °C	42	A
I_{Fnom}			13	A
I_{FSM}	10 ms, sin 180°, T_j = 150 °C		270	A
i^2t	10 ms, sin 180°, T_j = 150 °C		364	A^2s
T_j			-40 ... 150	°C



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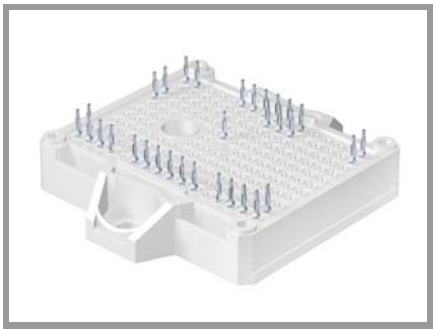

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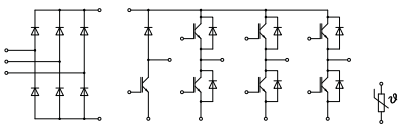

DGDL-ET

Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
Diode 2				
V_{RRM}	T_j = 25 °C		1200	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	41	A
	T_j = 175 °C	T_s = 70 °C	33	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	49	A
	T_j = 175 °C	T_s = 70 °C	40	A
I_{Fnom}			35	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		70	A
I_{FSM}	10 ms	T_j = 25 °C	170	A
	sin 180°	T_j = 150 °C	170	A
T_j			-40 ... 175	°C

Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
Diode 3				
V_{RRM}	T_j = 25 °C		1200	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	15	A
	T_j = 175 °C	T_s = 70 °C	12	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	16	A
	T_j = 175 °C	T_s = 70 °C	13	A
I_{Fnom}			8	A
I_{FRM}	I_{FRM} = 3 x I_{Fnom}		24	A
I_{FSM}	10 ms	T_j = 25 °C	36	A
	sin 180°	T_j = 150 °C	36	A
T_j			-40 ... 175	°C

Absolute Maximum Ratings			
Symbol	**Conditions**	**Values**	**Unit**
Module			
$I_{t(RMS)}$	$\Delta T_{terminal}$ at PCB joint = 30 K, per pin	30	A
T_{stg}		-40 ... 125	°C
V_{isol}	AC, sinusoidal, t = 1 min	2500	V

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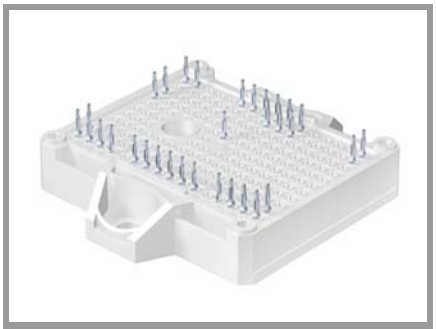

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Remarks

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- IGBT2: brake IGBT
- Diode1: rectifier diode
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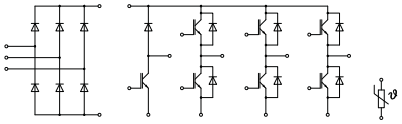


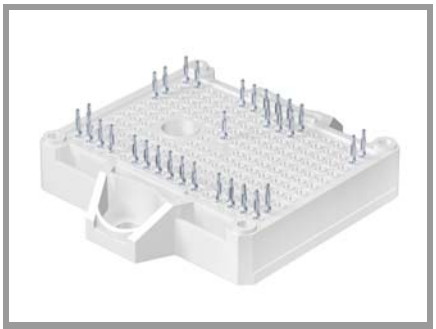
DGDL-ET

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT 1						
$V_{CE(sat)}$	I_C = 35 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.85	2.10	V
		T_j = 150 °C		2.25	2.45	V
V_{CE0}	chiplevel	T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		30	34	mΩ
		T_j = 150 °C		44	47	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.2 mA		5	5.8	6.5	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		1.95		nF
C_{oes}		f = 1 MHz		0.155		nF
C_{res}		f = 1 MHz		0.115		nF
Q_G	V_{GE} = -15V ... +15V			258		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CC} = 600 V, I_C = 35 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 8 Ω, $R_{G\,off}$ = 8 Ω, di/dt$_{on}$ = 1083 A/µs, di/dt$_{off}$ = 693 A/µs, dv/dt = 4508 V/µs	T_j = 150 °C		14		ns
t_r		T_j = 150 °C		31		ns
E_{on}		T_j = 150 °C		2.52		mJ
$t_{d(off)}$		T_j = 150 °C		248		ns
t_f		T_j = 150 °C		67		ns
E_{off}		T_j = 150 °C		3.11		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.96		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.67		K/W

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT 2						
$V_{CE(sat)}$	I_C = 35 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.85	2.10	V
		T_j = 150 °C		2.25	2.45	V
V_{CE0}	chiplevel	T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		30	34	mΩ
		T_j = 150 °C		44	47	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.2 mA		5	5.8	6.5	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		1.95		nF
C_{oes}		f = 1 MHz		0.155		nF
C_{res}		f = 1 MHz		0.115		nF
Q_G	V_{GE} = -15V ... +15V			258		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CC} = 600 V, I_C = 35 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 16 Ω, $R_{G\,off}$ = 16 Ω, di/dt$_{on}$ = 595 A/µs, di/dt$_{off}$ = 528 A/µs	T_j = 150 °C		38		ns
t_r		T_j = 150 °C		49		ns
E_{on}		T_j = 150 °C		3.19		mJ
$t_{d(off)}$		T_j = 150 °C		272		ns
t_f		T_j = 150 °C		88		ns
E_{off}		T_j = 150 °C		3.15		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.96		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.67		K/W



SEMITOP®E2

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SK35DGDL12T4ETE2V1

Features*

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Typical Applications

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Remarks

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- Diode1: rectifier diode
- Diode2: APD inverter
- Diode3: FWD brake

Characteristics

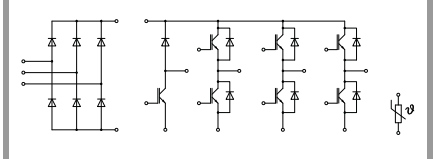
Symbol	Conditions		min.	typ.	max.	Unit
Diode 1						
V_F	I_F = 13 A	T_j = 25 °C		1.00	1.21	V
	chiplevel	T_j = 125 °C		0.90	1.10	V
V_{F0}	chiplevel	T_j = 25 °C		0.88	0.98	V
		T_j = 125 °C		0.73	0.83	V
r_F	chiplevel	T_j = 25 °C		9.2	18	mΩ
		T_j = 125 °C		13	21	mΩ
I_R	T_j = 145 °C, V_{RRM}				2	mA
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			1.46		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			1.12		K/W

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Diode 2						
V_F	I_F = 35 A	T_j = 25 °C		2.30	2.62	V
	chiplevel	T_j = 150 °C		2.29	2.62	V
V_{F0}	chiplevel	T_j = 25 °C		1.30	1.50	V
		T_j = 150 °C		0.90	1.10	V
r_F	chiplevel	T_j = 25 °C		29	32	mΩ
		T_j = 150 °C		40	43	mΩ
I_{RRM}	I_F = 35 A di/dt_{off} = 1083 A/µs V_{GE} = -15 V V_{CC} = 600 V	T_j = 150 °C		34		A
Q_{rr}		T_j = 150 °C		5.72		µC
E_{rr}		T_j = 150 °C		2.38		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			1.34		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			1		K/W

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Diode 3						
V_F	I_F = 8 A	T_j = 25 °C		2.33	2.65	V
	chiplevel	T_j = 150 °C		2.35	2.68	V
V_{F0}	chiplevel	T_j = 25 °C		1.30	1.50	V
		T_j = 150 °C		0.90	1.10	V
r_F	chiplevel	T_j = 25 °C		129	144	mΩ
		T_j = 150 °C		181	198	mΩ
I_{RRM}	I_F = 10 A di/dt_{off} = 595 A/µs V_{GE} = -15 V V_{CC} = 600 V	T_j = 150 °C		12		A
Q_{rr}		T_j = 150 °C		1.1		µC
E_{rr}		T_j = 150 °C		0.49		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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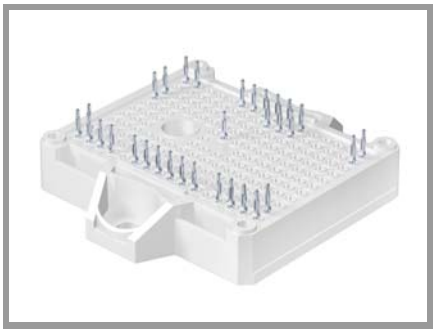

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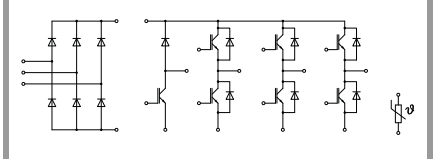


DGDL-ET

Characteristics					
Symbol	**Conditions**	**min.**	**typ.**	**max.**	**Unit**
Module					
M_s	to heatsink	1.6		2.3	Nm
w	weight		35		g

Characteristics					
Symbol	**Conditions**	**min.**	**typ.**	**max.**	**Unit**
Temperature Sensor					
R_{100}	T_r = 100 °C		493 ± 5%		Ω
$B_{100/125}$	$R_{(T)}=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; T[K];		3550 ±2%		K

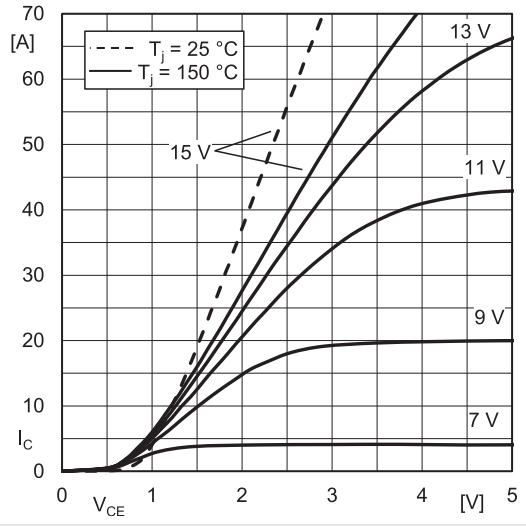


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC'+EE'}$

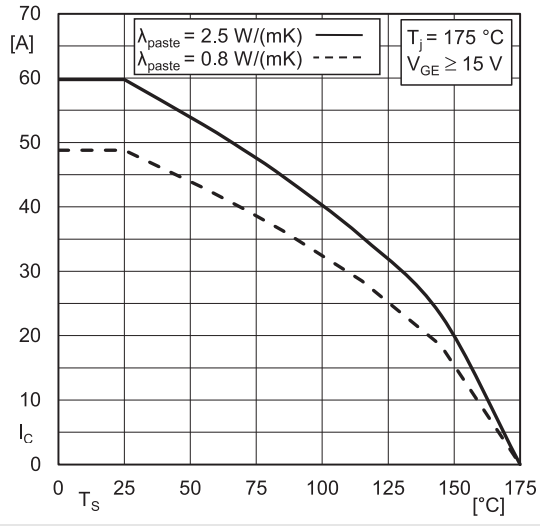


Fig. 2: IGBT rated current vs. temperature $I_c=f(T_s)$

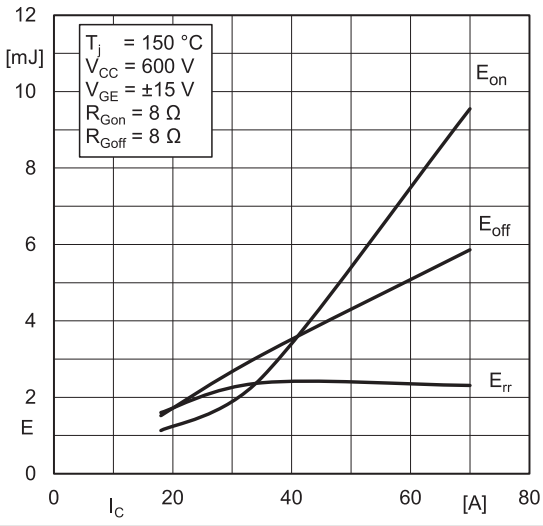


Fig. 3: Typ. turn-on /-off energy = f (I_C)

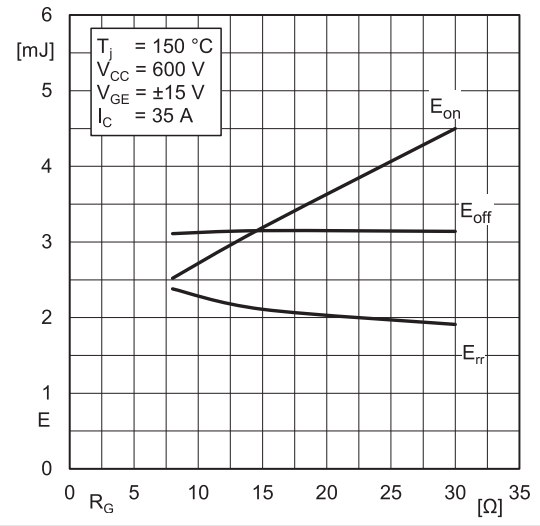


Fig. 4: Typ. turn-on /-off energy = f (R_G)

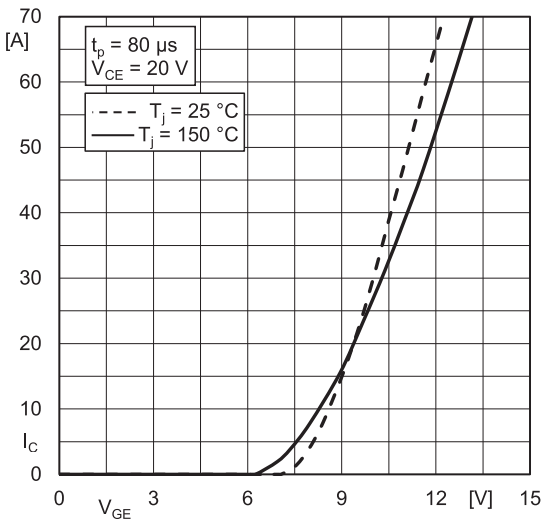


Fig. 5: Typ. IGBT transfer characteristic

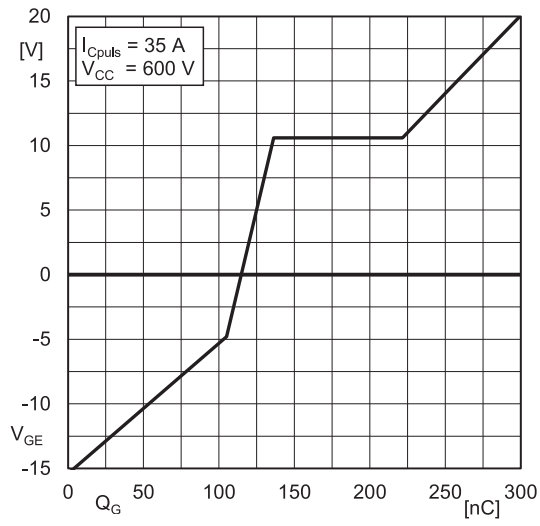


Fig. 6: Typ. IGBT gate charge characteristic

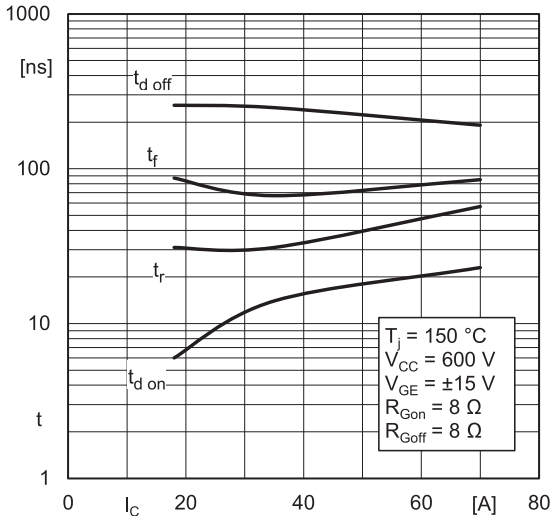


Fig. 7: Typ. switching times = f (I_C)

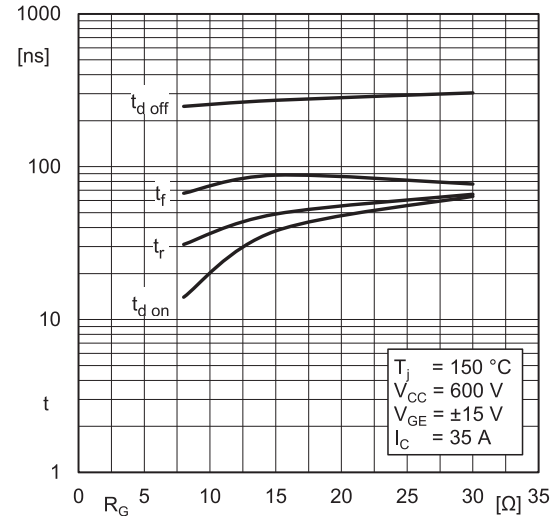


Fig. 8: Typ. switching times = f (R_G)

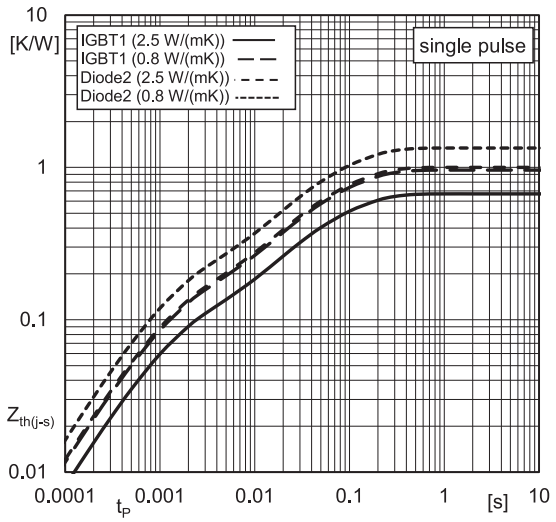


Fig. 9: Typ. transient thermal impedance

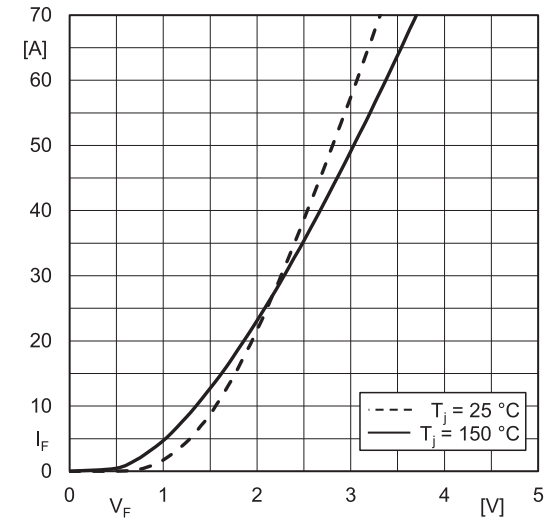


Fig. 10: Typ. Diode2 forward characteristic, incl. $R_{CC'+EE'}$

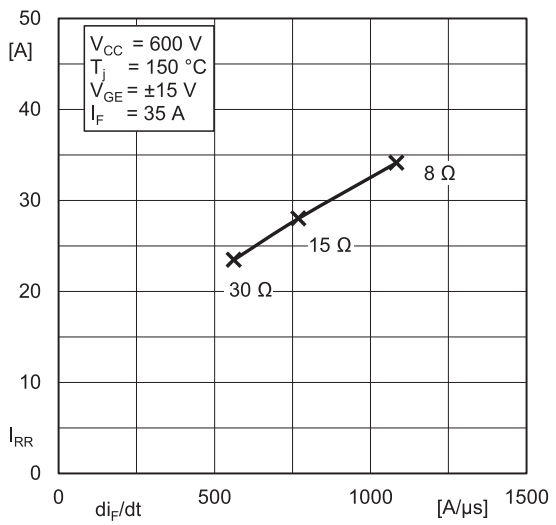


Fig. 11: Typ. Diode2 peak reverse recovery current

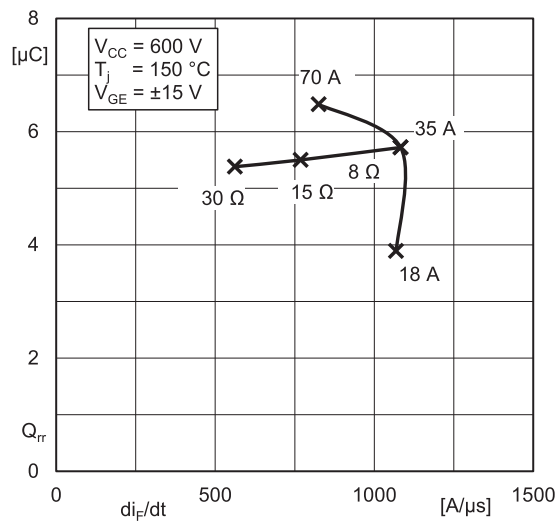


Fig. 12: Typ. Diode2 reverse recovery charge

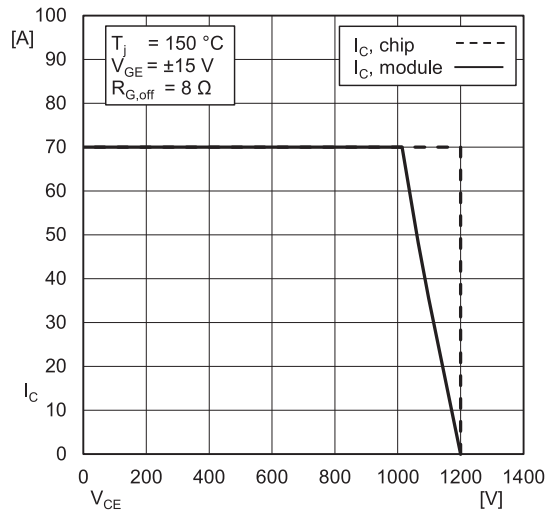


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

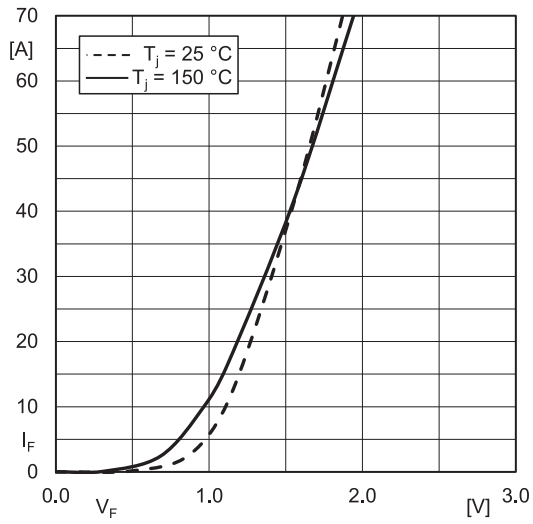
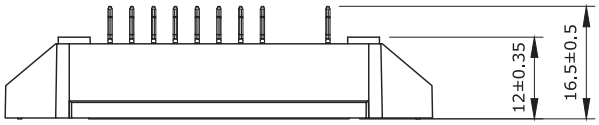
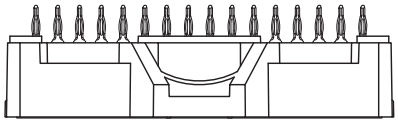
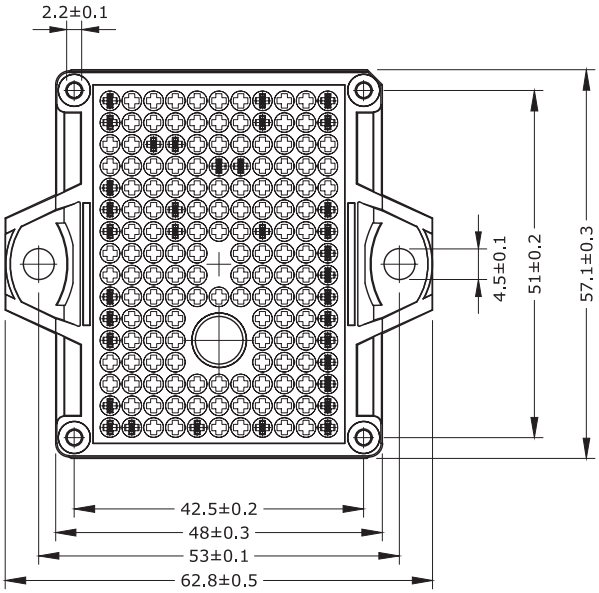


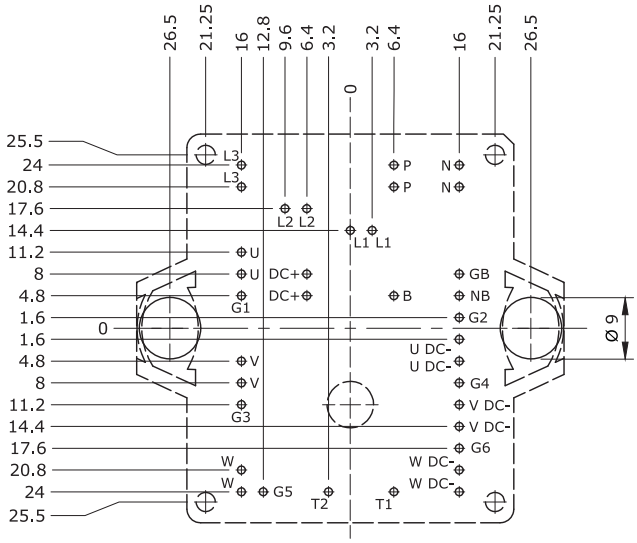
Fig. 14: Typ. Diode1 forward characteristic, incl. $R_{CC'+EE'}$



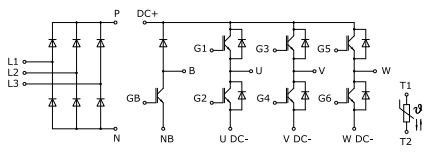




- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern ⌖ 0.025
- Diameters of drill ∅ 1.15mm
- Copper thickness in hole 25 - 50 µm
- Hole specification for contacts: refer to SEMITOP E1, E2 mounting instructions



SEMITOP®E2



DGDL-ET

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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