

SK15DGD12T4ETE1



SEMITOP®E1

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

SK15DGD12T4ETE1

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

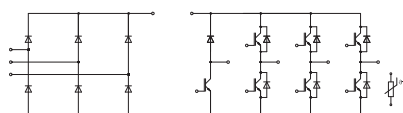
Remarks

- 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 _j = 175 °C	T _s = 25 °C	26	A
		T _s = 70 °C	21	A
I _C	λ _{paste} =2.5 W/(mK) T _j = 175 °C	T _s = 25 °C	30	A
		T _s = 70 °C	25	A
I _{Cnom}			15	A
I _{CRM}	I _{CRM} = 3 x I _{Cnom}		45	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 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	26	A
	T _j = 175 °C	T _s = 70 °C	21	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	30	A
	T _j = 175 °C	T _s = 70 °C	25	A
I _{Cnom}			15	A
I _{CRM}	I _{CRM} = 3 x I _{Cnom}		45	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 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	34	A
		T _j = 150 °C	25	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	38	A
		T _j = 150 °C	29	A
I _{Fnom}			8	A
I _{FSM}	10 ms, sin 180°, T _j = 150 °C		200	A
i ² t	10 ms, sin 180°, T _j = 150 °C		200	A ² s
T _j			-40 ... 150	°C



DGD1-ET

SK15DGDL12T4ETE1



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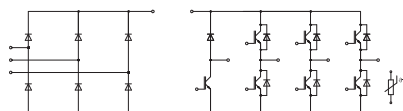
Symbol	Conditions		Values	Unit
Diode 2				
V _{RRM}	T _j = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	22	A
	T _j = 175 °C	T _s = 70 °C	17	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	24	A
	T _j = 175 °C	T _s = 70 °C	20	A
I _{Fnom}			15	A
I _{FRM}	I _{FRM} = 2 x I _{Fnom}		30	A
I _{FSM}	10 ms	T _j = 25 °C	65	A
	sin 180°	T _j = 150 °C	65	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 _i			-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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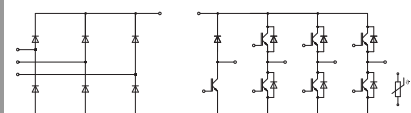
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 1						
V _{CE(sat)}	I _C = 15 A	T _j = 25 °C		1.85	2.10	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.25	2.45	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		70	80	mΩ
	chiplevel	T _j = 150 °C		103	110	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.5 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		0.9		nF
C _{oes}		f = 1 MHz		0.08		nF
C _{res}		f = 1 MHz		0.055		nF
Q _G	V _{GE} = -15V ... +15V			111		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		12		ns
t _r	I _C = 15 A	T _j = 150 °C		17		ns
E _{on}	V _{GE} = +15V/-15 V	T _j = 150 °C		1.09		mJ
t _{d(off)}	R _{G on} = 8.2 Ω	T _j = 150 °C		120		ns
	R _{G off} = 8.2 Ω	T _j = 150 °C		30		ns
t _f	di/dt _{on} = 893 A/μs	T _j = 150 °C				
E _{off}	di/dt _{off} = 170 A/μs	T _j = 150 °C		0.93		mJ
	dv/dt = 7114 V/μs					
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			1.53		K/W
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			1.17		K/W

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 2						
V _{CE(sat)}	I _C = 15 A	T _j = 25 °C		1.85	2.10	V
	V _{GE} = 15 V chiplevel	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	T _j = 25 °C		70	80	mΩ
	chiplevel	T _j = 150 °C		103	110	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.5 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		0.9		nF
C _{oes}		f = 1 MHz		0.08		nF
C _{res}		f = 1 MHz		0.055		nF
Q _G	V _{GE} = -15V ... +15V			111		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		24		ns
t _r	I _C = 15 A	T _j = 150 °C		32		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		1.22		mJ
	R _{G on} = 16 Ω	T _j = 150 °C				
t _{d(off)}	R _{G off} = 16 Ω	T _j = 150 °C		164		ns
t _f	di/dt _{on} = 595 A/μs	T _j = 150 °C		44		ns
	di/dt _{off} = 116 A/μs					
E _{off}		T _j = 150 °C		0.98		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			1.53		K/W
R _{th(i-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			1.17		K/W

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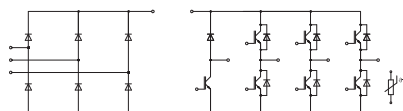
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- IGBT1: inverter IGBT
- IGBT2: brake IGBT
- Diode1: rectifier diode
- Diode2: APD inverter
- Diode3: FWD brake

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 1						
V _F	I _F = 8 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		15	29	mΩ
		T _j = 125 °C		21	34	mΩ
I _R	T _j = 145 °C, V _{RRM}			2		mA
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.89	K/W	
R _{th(l-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.52	K/W	

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 2						
V _F	I _F = 15 A	T _j = 25 °C		2.38	2.71	V
	chiplevel	T _j = 150 °C		2.44	2.77	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		72	81	mΩ
		T _j = 150 °C		103	111	mΩ
I _{RRM}	I _F = 15 A	T _j = 150 °C		16		A
Q _{rr}	di/dt _{off} = 893 A/μs	T _j = 150 °C		2.3		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 600 V	T _j = 150 °C		0.97		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

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	T _j = 150 °C		12		A
Q _{rr}	di/dt _{off} = 595 A/μs	T _j = 150 °C		1.1		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 600 V	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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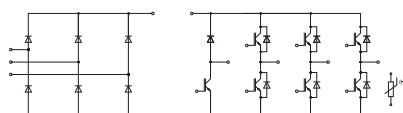
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Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Module					
M_s	to heatsink	1.6		2.3	Nm
w	weight		25		g

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



DGD1-ET

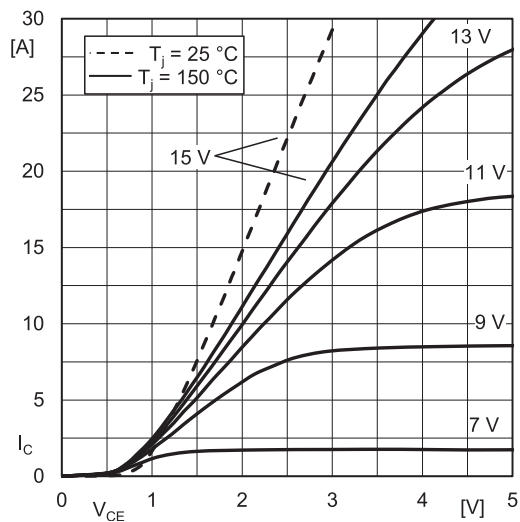


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC'+EE'}$

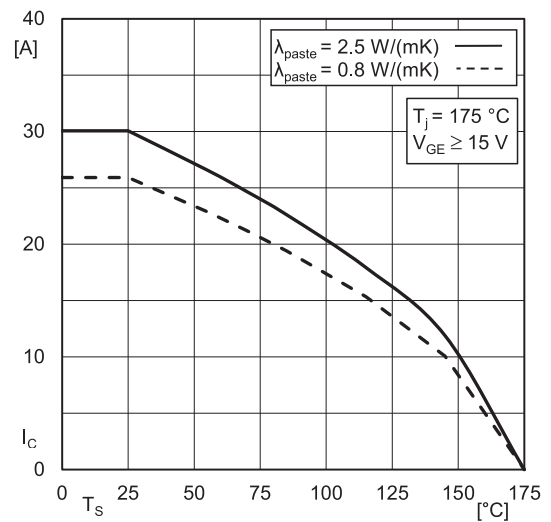


Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$

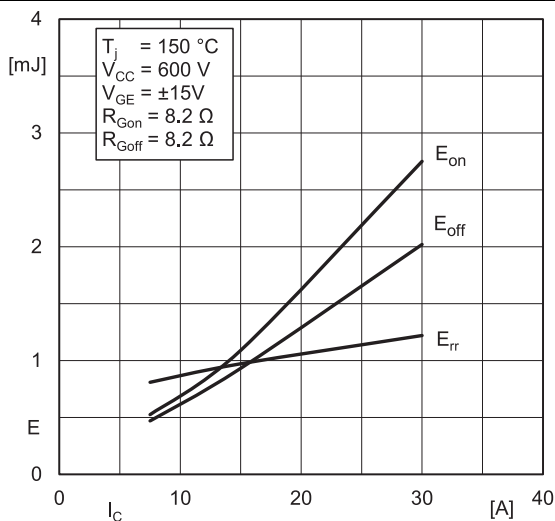


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

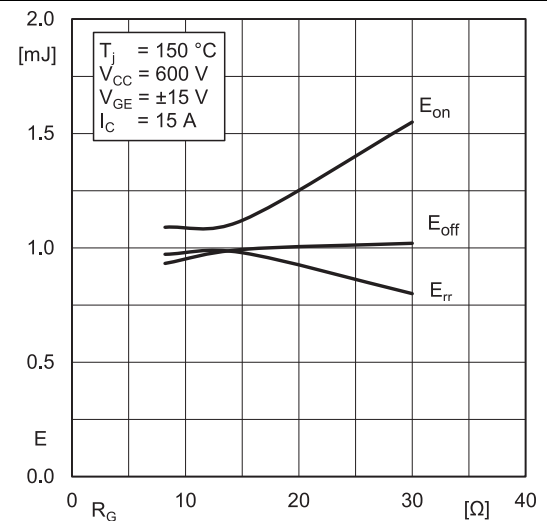


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

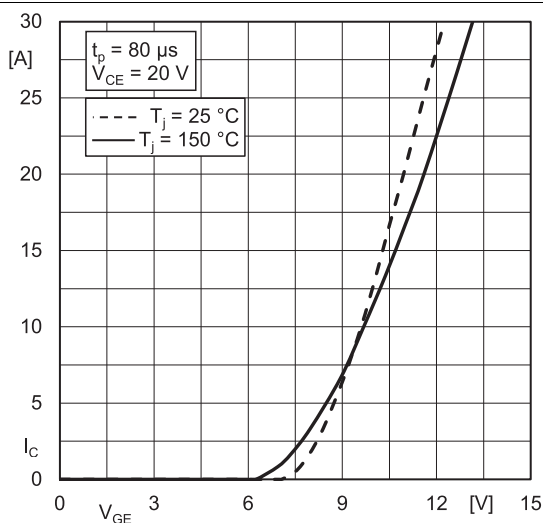


Fig. 5: Typ. IGBT transfer characteristic

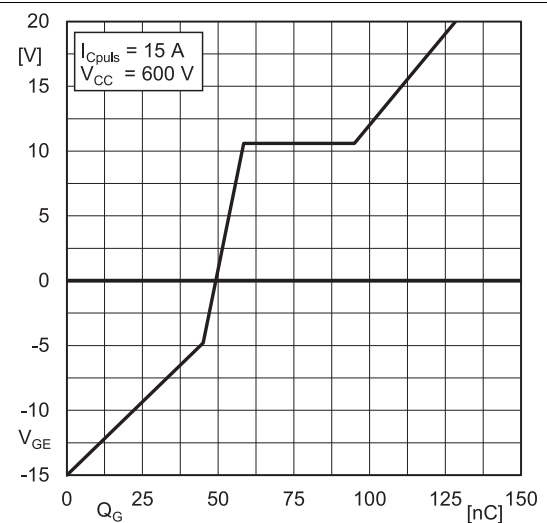


Fig. 6: Typ. IGBT gate charge characteristic

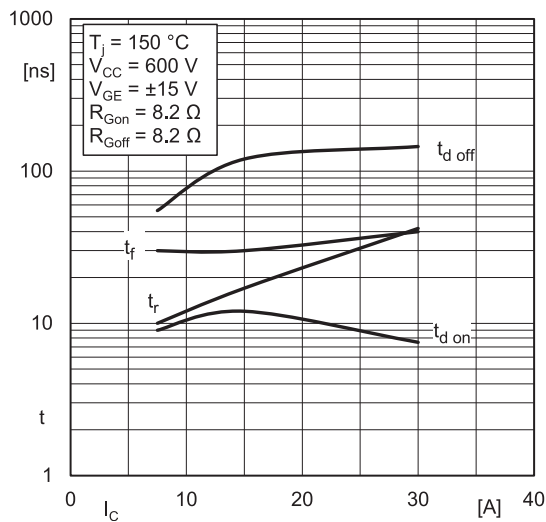


Fig. 7: Typ. switching times = $f(I_C)$

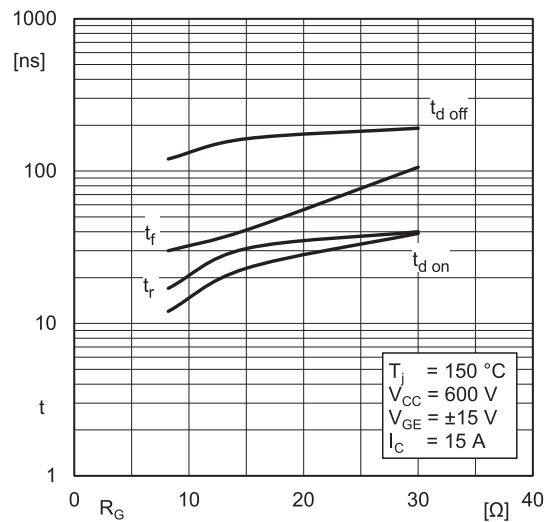


Fig. 8: Typ. switching times = $f(R_G)$

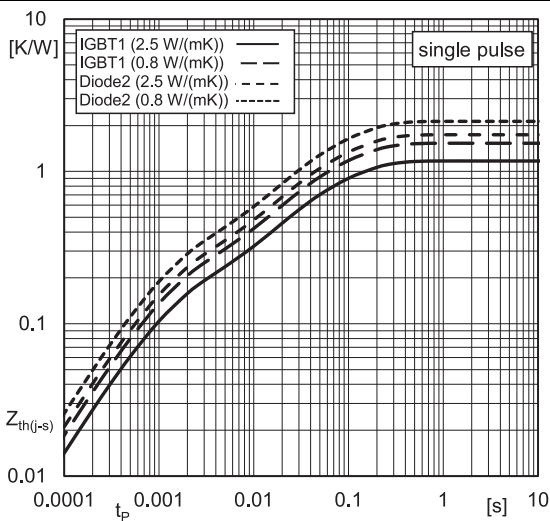


Fig. 9: Typ. transient thermal impedance

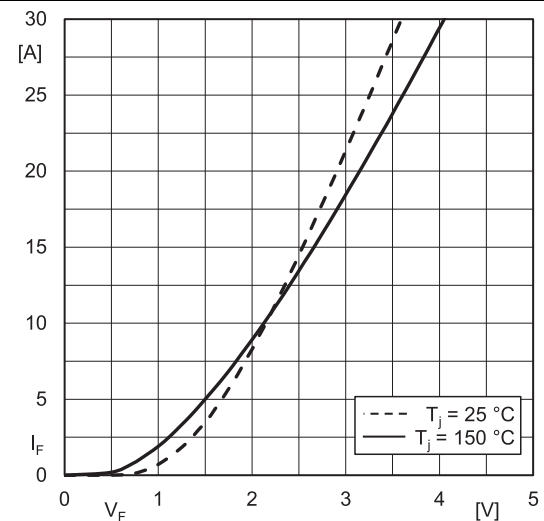


Fig. 10: Typ. Diode2 forward characteristic, incl. $R_{CC'} + EE'$

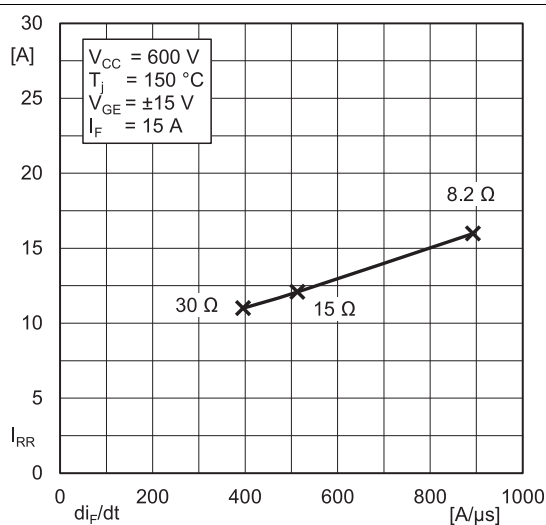


Fig. 11: Typ. Diode2 peak reverse recovery current

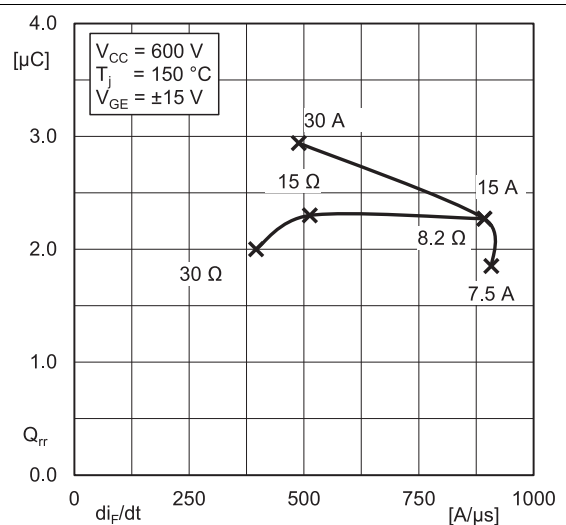


Fig. 12: Typ. Diode2 reverse recovery charge

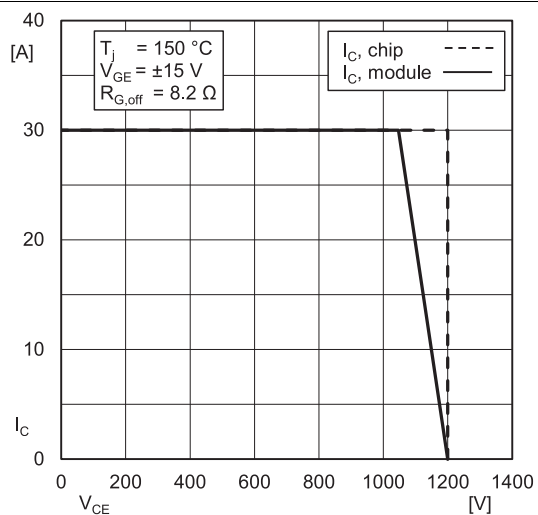


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

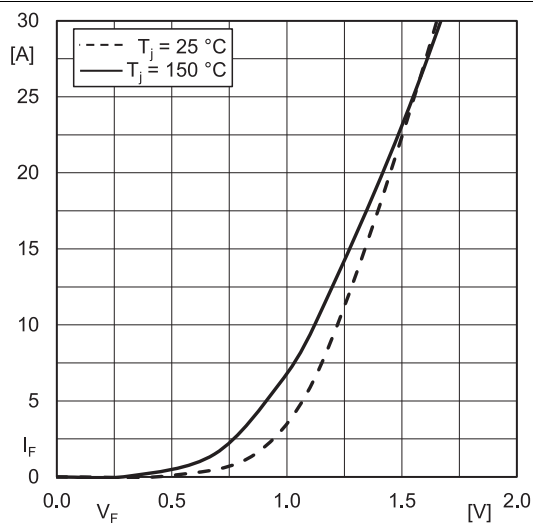
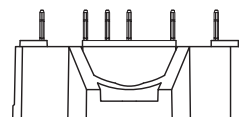
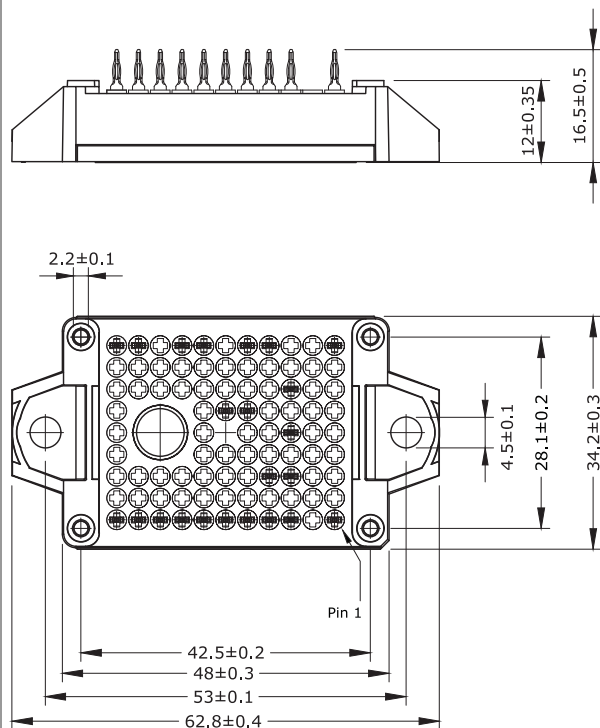
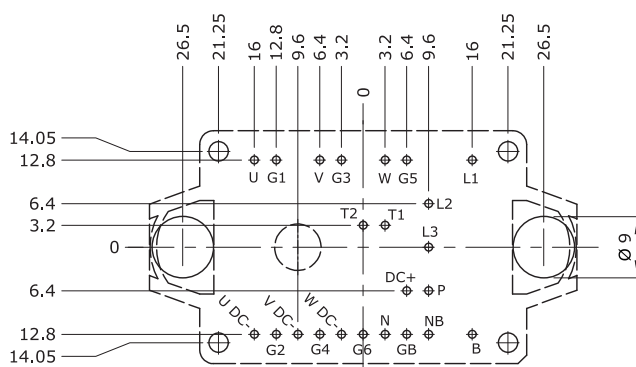


Fig. 14: Typ. Diode1 forward characteristic, incl. $R_{CC'+EE'}$

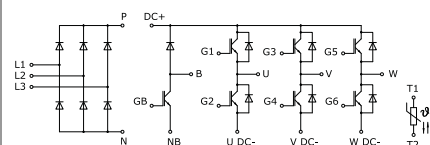
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- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern ± 0.025
- Diameters of drill $\varnothing 1.15\text{mm}$
- Copper thickness in hole 25 - 50 μm
- Hole specification for contacts: refer to SEMITOP E1, E2 mounting instructions



SEMITOP®E1



DGDL-ET

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

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