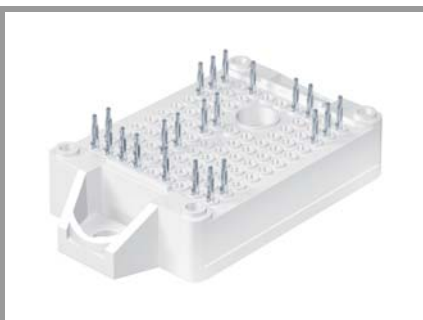


SK15DGDL12T4ETE1



SEMITOP®E1

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

SK15DGDL12T4ETE1

Features*

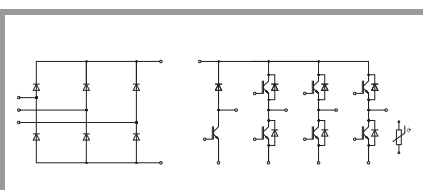
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- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

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



DGDL-ET

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT 1				
V_{CES}	$T_j = 25\text{ °C}$		1200	V
I_C	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25\text{ °C}$	26	A
		$T_j = 175\text{ °C}$	21	A
I_C	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25\text{ °C}$	30	A
		$T_j = 175\text{ °C}$	25	A
I_{Cnom}			15	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		45	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$	$T_j = 150\text{ °C}$	10	μs
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
T_j			-40 ... 175	$^{\circ}\text{C}$

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT 2				
V_{CES}	$T_j = 25\text{ °C}$		1200	V
I_C	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25\text{ °C}$	26	A
		$T_j = 175\text{ °C}$	21	A
I_C	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25\text{ °C}$	30	A
		$T_j = 175\text{ °C}$	25	A
I_{Cnom}			15	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		45	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$	$T_j = 150\text{ °C}$	10	μs
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
T_j			-40 ... 175	$^{\circ}\text{C}$

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Diode 1				
V_{RRM}	$T_j = 25\text{ °C}$		1600	V
I_F	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25\text{ °C}$	34	A
		$T_j = 150\text{ °C}$	25	A
I_F	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25\text{ °C}$	38	A
		$T_j = 150\text{ °C}$	29	A
I_{Fnom}			8	A
I_{FSM}	10 ms, sin 180°, $T_j = 150\text{ °C}$		200	A
i^2t	10 ms, sin 180°, $T_j = 150\text{ °C}$		200	A^2s
T_j			-40 ... 150	$^{\circ}\text{C}$

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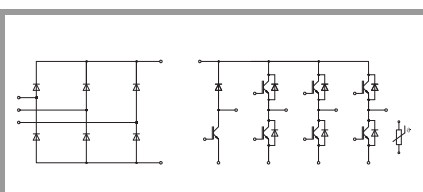
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DGDL-ET

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Diode 2				
V_{RRM}	$T_j = 25\text{ °C}$		1200	V
I_F	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25\text{ °C}$	22	A
		$T_j = 175\text{ °C}$	17	A
I_F	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25\text{ °C}$	24	A
		$T_j = 175\text{ °C}$	20	A
I_{Fnom}			15	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$		30	A
I_{FSM}	10 ms	$T_j = 25\text{ °C}$	65	A
		$T_j = 150\text{ °C}$	65	A
T_j			-40 ... 175	°C

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Diode 3				
V_{RRM}	$T_j = 25\text{ °C}$		1200	V
I_F	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25\text{ °C}$	15	A
		$T_j = 175\text{ °C}$	12	A
I_F	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25\text{ °C}$	16	A
		$T_j = 175\text{ °C}$	13	A
I_{Fnom}			8	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		24	A
I_{FSM}	10 ms	$T_j = 25\text{ °C}$	36	A
		$T_j = 150\text{ °C}$	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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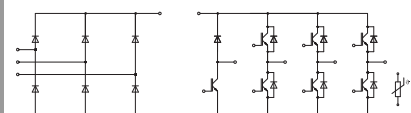
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DGDL-ET

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 1						
$V_{CE(sat)}$	$I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25\text{ °C}$		1.85	2.10	V
		$T_j = 150\text{ °C}$		2.25	2.45	V
V_{CE0}	chipllevel	$T_j = 25\text{ °C}$		0.80	0.90	V
		$T_j = 150\text{ °C}$		0.70	0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25\text{ °C}$		70	80	mΩ
		$T_j = 150\text{ °C}$		103	110	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.5\text{ mA}$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25\text{ °C}$				1	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		0.9		nF
C_{oes}		$f = 1\text{ MHz}$		0.08		nF
C_{res}		$f = 1\text{ MHz}$		0.055		nF
Q_G	$V_{GE} = -15\text{ V} \dots +15\text{ V}$			111		nC
R_{Gint}	$T_j = 25\text{ °C}$			0		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150\text{ °C}$		12		ns
t_r	$I_C = 15\text{ A}$	$T_j = 150\text{ °C}$		17		ns
	$V_{GE} = +15/-15\text{ V}$	$T_j = 150\text{ °C}$				
E_{on}	$R_{G on} = 8.2\text{ Ω}$	$T_j = 150\text{ °C}$		1.09		mJ
$t_{d(off)}$	$R_{G off} = 8.2\text{ Ω}$	$T_j = 150\text{ °C}$		120		ns
t_f	$di/dt_{on} = 893\text{ A/μs}$	$T_j = 150\text{ °C}$		30		ns
	$di/dt_{off} = 170\text{ A/μs}$	$T_j = 150\text{ °C}$				
E_{off}	$dv/dt = 7114\text{ V/μs}$	$T_j = 150\text{ °C}$		0.93		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W/(mK)}$			1.53		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W/(mK)}$			1.17		K/W

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 2						
$V_{CE(sat)}$	$I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25\text{ °C}$		1.85	2.10	V
		$T_j = 150\text{ °C}$		2.25	2.45	V
V_{CE0}	chipllevel	$T_j = 25\text{ °C}$		0.80	0.90	V
		$T_j = 150\text{ °C}$		0.70	0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25\text{ °C}$		70	80	mΩ
		$T_j = 150\text{ °C}$		103	110	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.5\text{ mA}$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25\text{ °C}$			-	1	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		0.9		nF
C_{oes}		$f = 1\text{ MHz}$		0.08		nF
C_{res}		$f = 1\text{ MHz}$		0.055		nF
Q_G	$V_{GE} = -15\text{ V} \dots +15\text{ V}$			111		nC
R_{Gint}	$T_j = 25\text{ °C}$			0		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150\text{ °C}$		24		ns
t_r	$I_C = 15\text{ A}$	$T_j = 150\text{ °C}$		32		ns
	$V_{GE} = +15/-15\text{ V}$	$T_j = 150\text{ °C}$				
E_{on}	$R_{G on} = 16\text{ Ω}$	$T_j = 150\text{ °C}$		1.22		mJ
$t_{d(off)}$	$R_{G off} = 16\text{ Ω}$	$T_j = 150\text{ °C}$		164		ns
t_f	$di/dt_{on} = 595\text{ A/μs}$	$T_j = 150\text{ °C}$		44		ns
	$di/dt_{off} = 116\text{ A/μs}$	$T_j = 150\text{ °C}$				
E_{off}		$T_j = 150\text{ °C}$		0.98		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W/(mK)}$			1.53		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W/(mK)}$			1.17		K/W

SK15DGDL12T4ETE1



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- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

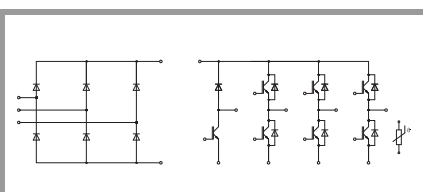
Remarks

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

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 1						
V_F	$I_F = 8\text{ A}$	$T_j = 25\text{ °C}$		1.00	1.21	V
	chipelevel	$T_j = 125\text{ °C}$		0.90	1.10	V
V_{F0}	chipelevel	$T_j = 25\text{ °C}$		0.88	0.98	V
		$T_j = 125\text{ °C}$		0.73	0.83	V
r_F	chipelevel	$T_j = 25\text{ °C}$		15	29	mΩ
		$T_j = 125\text{ °C}$		21	34	mΩ
I_R	$T_j = 145\text{ °C}, V_{RRM}$				2	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W/(mK)}$			1.89		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W/(mK)}$			1.52		K/W

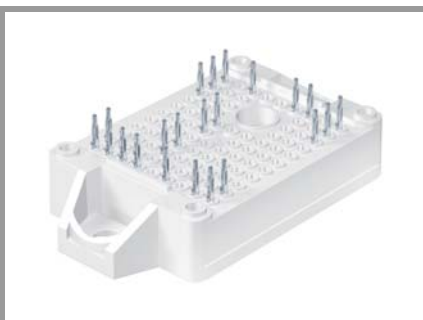
Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 2						
V_F	$I_F = 15\text{ A}$	$T_j = 25\text{ °C}$		2.38	2.71	V
	chipelevel	$T_j = 150\text{ °C}$		2.44	2.77	V
V_{F0}	chipelevel	$T_j = 25\text{ °C}$		1.30	1.50	V
		$T_j = 150\text{ °C}$		0.90	1.10	V
r_F	chipelevel	$T_j = 25\text{ °C}$		72	81	mΩ
		$T_j = 150\text{ °C}$		103	111	mΩ
I_{RRM}	$I_F = 15\text{ A}$	$T_j = 150\text{ °C}$		16		A
Q_{rr}	$di/dt_{off} = 893\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$		2.3		μC
E_{rr}	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150\text{ °C}$		0.97		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W/(mK)}$			2.13		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W/(mK)}$			1.74		K/W

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 3						
V_F	$I_F = 8\text{ A}$	$T_j = 25\text{ °C}$		2.33	2.65	V
	chipelevel	$T_j = 150\text{ °C}$		2.35	2.68	V
V_{F0}	chipelevel	$T_j = 25\text{ °C}$		1.30	1.50	V
		$T_j = 150\text{ °C}$		0.90	1.10	V
r_F	chipelevel	$T_j = 25\text{ °C}$		129	144	mΩ
		$T_j = 150\text{ °C}$		181	198	mΩ
I_{RRM}	$I_F = 10\text{ A}$	$T_j = 150\text{ °C}$		12		A
Q_{rr}	$di/dt_{off} = 595\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$		1.1		μC
E_{rr}	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150\text{ °C}$		0.49		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W/(mK)}$			2.64		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W/(mK)}$			2.24		K/W



DGDL-ET

SK15DGDL12T4ETE1



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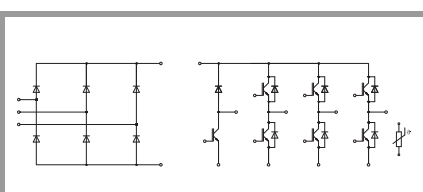
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Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Module					
M_s	to heatsink	1.6		2.3	Nm
w	weight		25		g

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



DGDLE-T

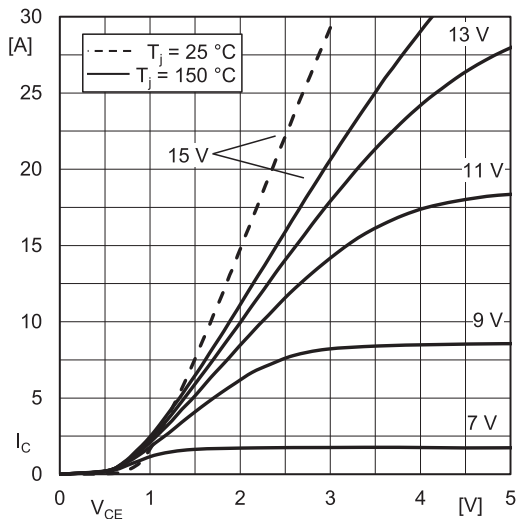


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC'+EE'}$

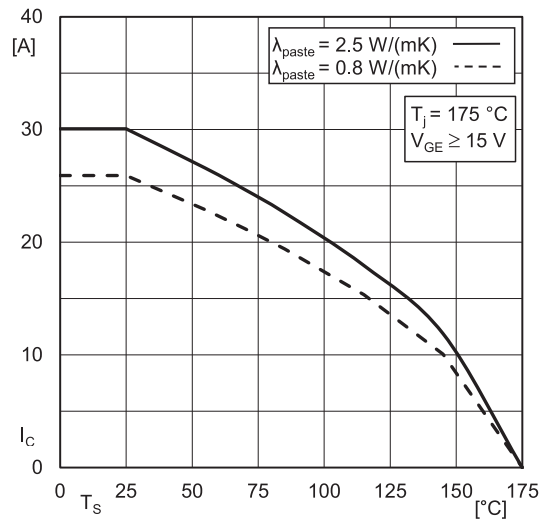


Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$

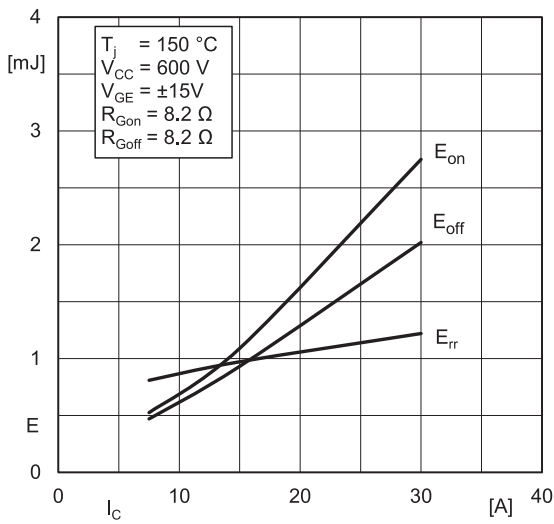


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

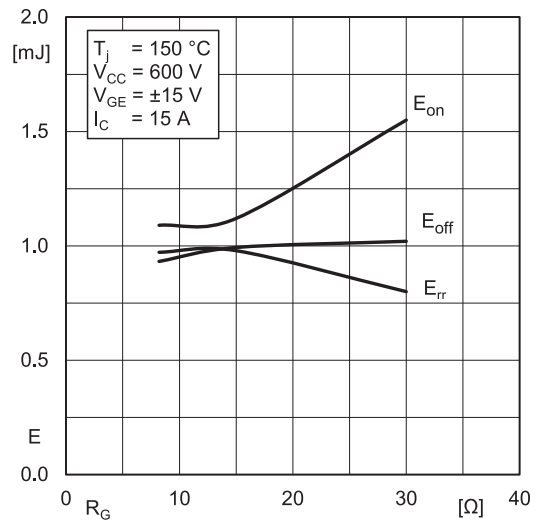


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

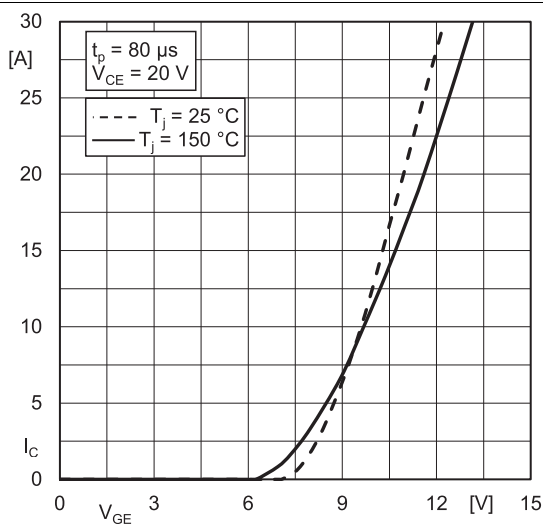


Fig. 5: Typ. IGBT transfer characteristic

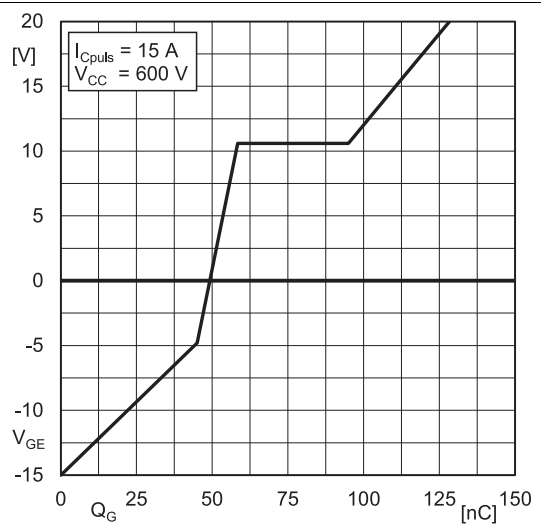


Fig. 6: Typ. IGBT gate charge characteristic

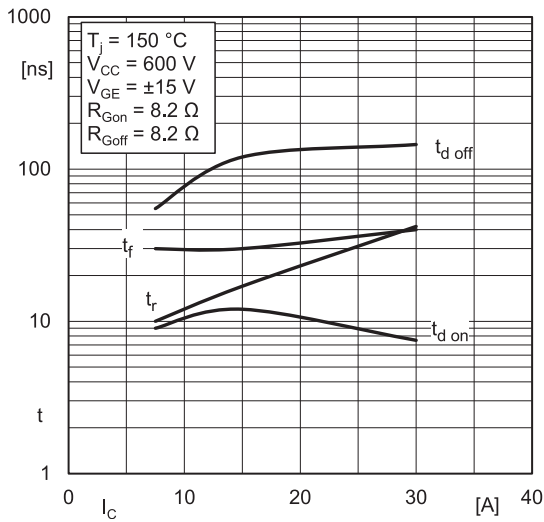


Fig. 7: Typ. switching times = $f(I_C)$

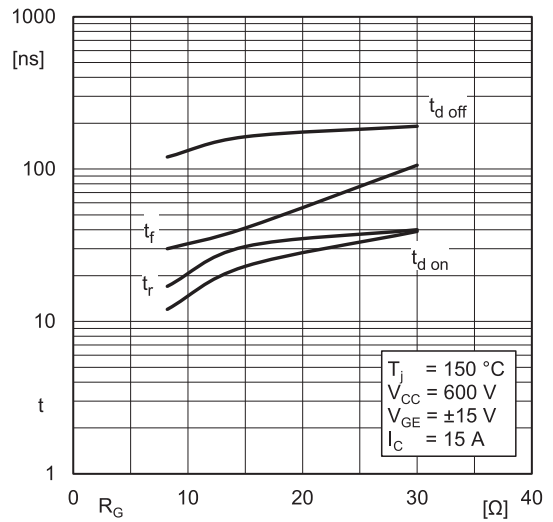


Fig. 8: Typ. switching times = $f(R_G)$

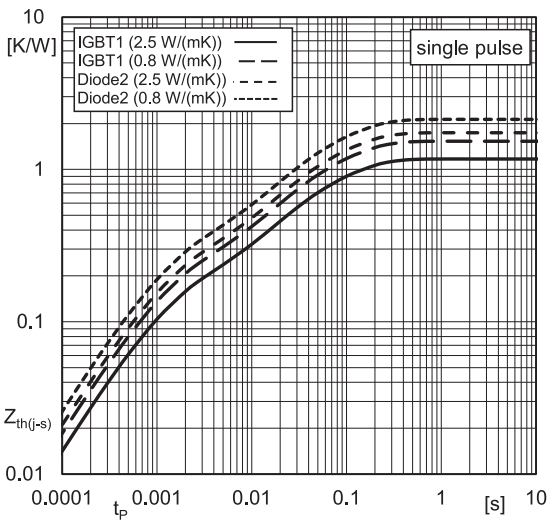


Fig. 9: Typ. transient thermal impedance

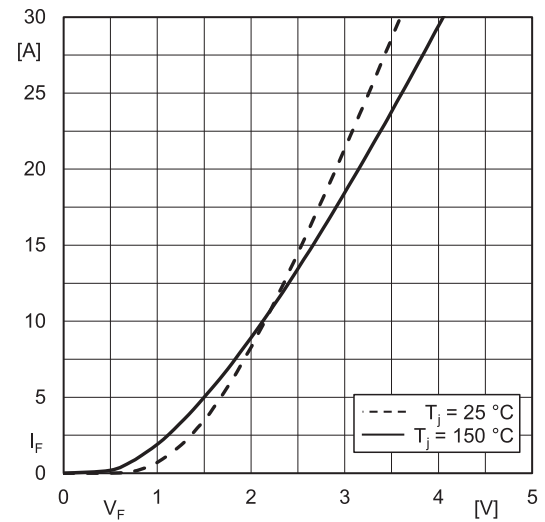


Fig. 10: Typ. Diode2 forward characteristic, incl. $R_{CC+EE'}$

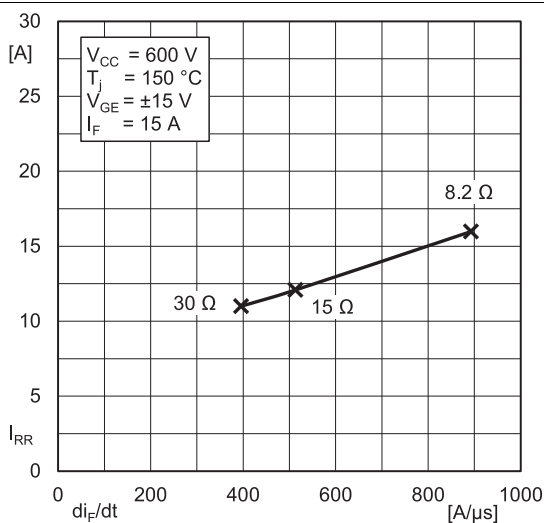


Fig. 11: Typ. Diode2 peak reverse recovery current

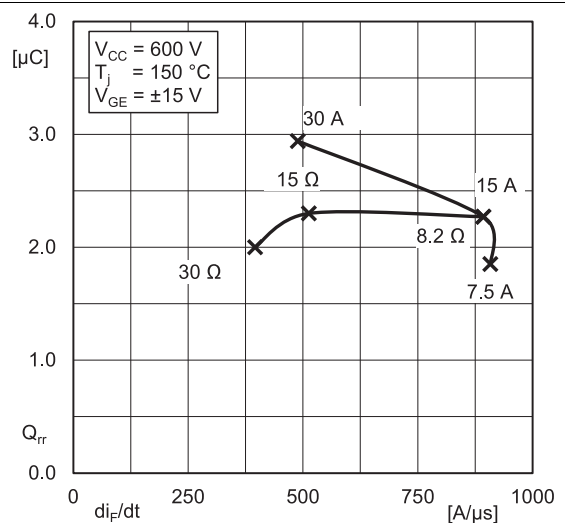


Fig. 12: Typ. Diode2 reverse recovery charge

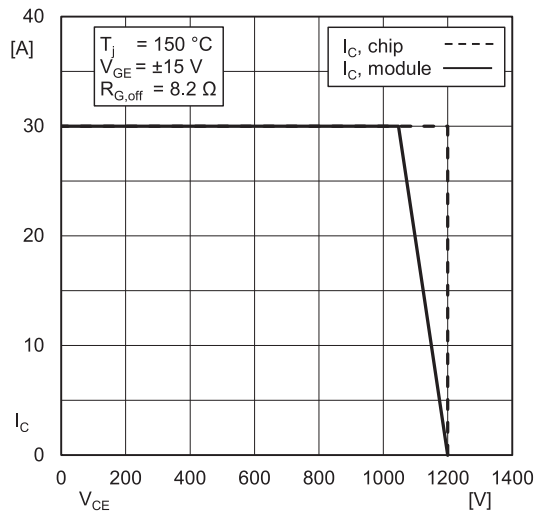


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

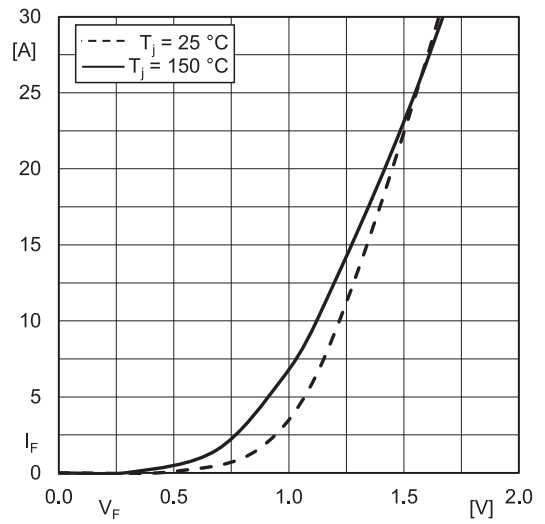
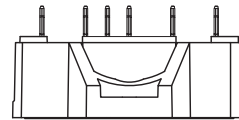
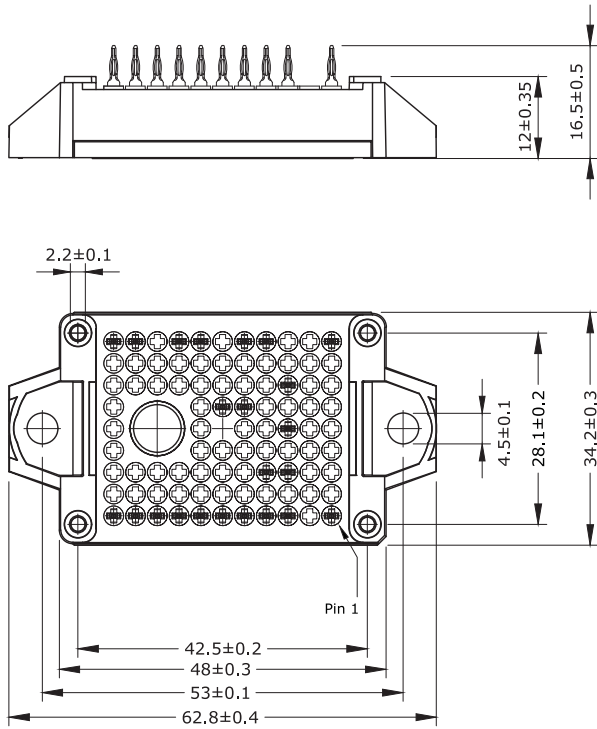
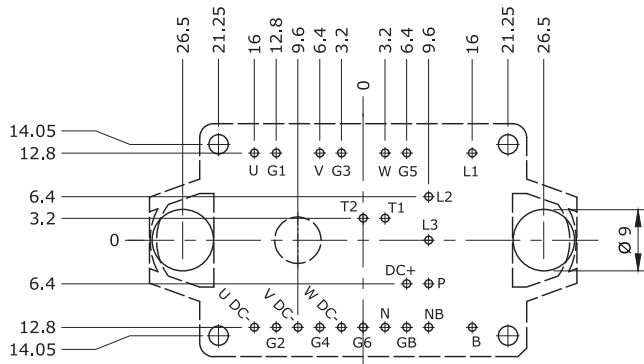


Fig. 14: Typ. Diode1 forward characteristic, incl. R_{CC+EE}

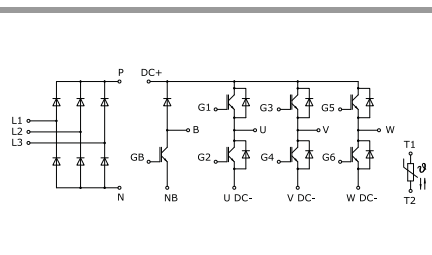
SK15DGD12T4ETE1



- 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



DGD1-ET

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

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