



SEMITOP®E1

3-phase Converter-Inverter-Brake (CIB)

SK10DGDL12T7ETE1

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 1200V Generation 7 IGBT (T7)
- 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

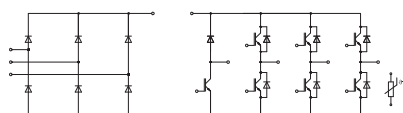
- Motor drives
- Air conditioning
- Auxiliary Inverters

Remarks

- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$
- $T_{j,op} > 150 \text{ }^{\circ}\text{C}$ during overload (details on AN19-002)

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Inverter - IGBT				
V _{CES}	T _j = 25 °C		1200	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	19	A
	T _j = 175 °C	T _s = 100 °C	15	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	20	A
	T _j = 175 °C	T _s = 100 °C	17	A
I _{Cnom}			10	A
I _{CRM}			20	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 175 °C	7	μs
T _j			-40 ... 175	°C
Chopper - IGBT				
V _{CES}	T _j = 25 °C		1200	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	19	A
	T _j = 175 °C	T _s = 100 °C	15	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	20	A
	T _j = 175 °C	T _s = 100 °C	17	A
I _{Cnom}			10	A
I _{CRM}			20	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 175 °C	7	μs
T _j			-40 ... 175	°C
Inverse - Diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	12	A
	T _j = 175 °C	T _s = 100 °C	10	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	13	A
	T _j = 175 °C	T _s = 100 °C	11	A
I _{FRM}			20	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		36	A
T _j			-40 ... 175	°C
Freewheeling - Diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	12	A
	T _j = 175 °C	T _s = 100 °C	10	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	13	A
	T _j = 175 °C	T _s = 100 °C	11	A
I _{FRM}			20	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		36	A
T _j			-40 ... 175	°C



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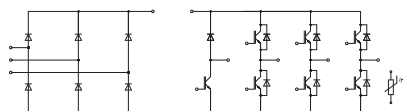
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Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
Rectifier - Diode			
V_{RRM}	$T_j = 25 \text{ }^{\circ}\text{C}$	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					
$V_{CE(sat)}$	$I_C = 10 \text{ A}$	$T_j = 25 \text{ }^{\circ}\text{C}$	1.60	1.75	V
	$V_{GE} = 15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$	1.78	1.93	V
	chiplevel	$T_j = 175 \text{ }^{\circ}\text{C}$	1.82	1.97	V
V_{CE0}	$T_j = 25 \text{ }^{\circ}\text{C}$		1.00	1.05	V
	$T_j = 150 \text{ }^{\circ}\text{C}$		0.80	0.85	V
	$T_j = 175 \text{ }^{\circ}\text{C}$		0.75	0.80	V
r_{CE}	$V_{GE} = 15 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$	60	70	m Ω
	chiplevel	$T_j = 150 \text{ }^{\circ}\text{C}$	98	108	m Ω
	$T_j = 175 \text{ }^{\circ}\text{C}$		107	117	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.22 \text{ mA}$	5.15	5.8	6.45	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25 \text{ }^{\circ}\text{C}$			1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$	$f = 1 \text{ MHz}$	1.90		nF
C_{oes}	$V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	0.02		nF
C_{res}		$f = 1 \text{ MHz}$	0.01		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		140		nC
R_{Gint}	$T_j = 25 \text{ }^{\circ}\text{C}$		0		Ω
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$	$T_j = 25 \text{ }^{\circ}\text{C}$	13		ns
	$I_C = 10 \text{ A}$	$T_j = 150 \text{ }^{\circ}\text{C}$	16		ns
	$R_{G on} = 8.2 \text{ }^{\circ}\Omega$	$T_j = 175 \text{ }^{\circ}\text{C}$	17		ns
t_r	$R_{G off} = 8.2 \text{ }^{\circ}\Omega$	$T_j = 25 \text{ }^{\circ}\text{C}$	18		ns
	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150 \text{ }^{\circ}\text{C}$	19		ns
	$(T_j = 150 \text{ }^{\circ}\text{C})$	$T_j = 175 \text{ }^{\circ}\text{C}$	20		ns
E_{on}	$di/dt_{on} = 700 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ }^{\circ}\text{C}$	0.42		mJ
	$di/dt_{off} = 120 \text{ A}/\mu\text{s}$	$T_j = 150 \text{ }^{\circ}\text{C}$	0.74		mJ
	$dv/dt = 3700 \text{ V}/\mu\text{s}$	$T_j = 175 \text{ }^{\circ}\text{C}$	0.81		mJ



DGDLE-T



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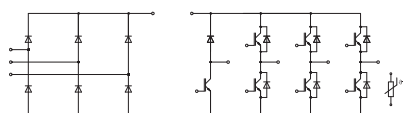
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- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$
- $T_{j,op} > 150 \text{ }^{\circ}\text{C}$ during overload (details on AN19-002)



DGDL-ET

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
t _{d(off)}	V _{CC} = 600 V	T _j = 25 °C		199		ns
	I _C = 10 A	T _j = 150 °C		270		ns
	R _{G on} = 8.2 Ω	T _j = 175 °C		293		ns
t _f	R _{G off} = 8.2 Ω	T _j = 25 °C		52		ns
	V _{GE} = +15/-15 V	T _j = 150 °C		69		ns
	(T _j = 150 °C)	T _j = 175 °C		95		ns
E _{off}	di/dt _{on} = 700 A/μs	T _j = 25 °C		0.75		mJ
	di/dt _{off} = 120 A/μs	T _j = 150 °C		1.26		mJ
	dv/dt = 3700 V/μs	T _j = 175 °C		1.37		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			1.91		K/W
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			1.56		K/W
Chopper - IGBT						
V _{CE(sat)}	I _C = 10 A	T _j = 25 °C		1.60	1.75	V
	V _{GE} = 15 V	T _j = 150 °C		1.78	1.93	V
	chiplevel	T _j = 175 °C		1.82	1.97	V
V _{CE0}		T _j = 25 °C		1.00	1.05	V
	chiplevel	T _j = 150 °C		0.80	0.85	V
		T _j = 175 °C		0.75	0.80	V
r _{CE}		T _j = 25 °C		60	70	mΩ
	V _{GE} = 15 V	T _j = 150 °C		98	108	mΩ
	chiplevel	T _j = 175 °C		107	117	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.22 mA		5.15	5.8	6.45	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		1.90		nF
C _{oes}		f = 1 MHz		0.02		nF
C _{res}		f = 1 MHz		0.01		nF
Q _G	V _{GE} = -15 V ... +15 V			140		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CC} = 600 V I _C = 10 A R _{G on} = 8.2 Ω R _{G off} = 8.2 Ω V _{GE} = +15/-15 V	T _j = 25 °C		13		ns
		T _j = 150 °C		16		ns
		T _j = 175 °C		17		ns
t _r		T _j = 25 °C		18		ns
		T _j = 150 °C		19		ns
		T _j = 175 °C		20		ns
E _{on}		T _j = 25 °C		0.42		mJ
		T _j = 150 °C		0.74		mJ
		T _j = 175 °C		0.81		mJ
t _{d(off)}		(T _j = 150 °C)	T _j = 25 °C		199	
	di/dt _{on} = 700 A/μs	T _j = 150 °C		270		ns
	di/dt _{off} = 120 A/μs	T _j = 175 °C		293		ns
t _f	dv/dt = 3700 V/μs	T _j = 25 °C		52		ns
		T _j = 150 °C		69		ns
		T _j = 175 °C		95		ns
E _{off}		T _j = 25 °C		0.75		mJ
		T _j = 150 °C		1.26		mJ
		T _j = 175 °C		1.37		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			1.91		K/W
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			1.56		K/W



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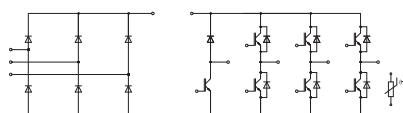
Typical Applications

- Motor drives
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Remarks

- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$
- $T_{j,op} > 150 \text{ }^{\circ}\text{C}$ during overload (details on AN19-002)

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
V _F = V _{EC}	I _F = 10 A	T _j = 25 °C		2.59	2.94	V
		T _j = 150 °C		2.71	3.08	V
		chiplevel	T _j = 175 °C		2.53	2.89
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
		T _j = 175 °C		0.82	0.98	V
r _F	chiplevel	T _j = 25 °C		129	144	mΩ
		T _j = 150 °C		181	198	mΩ
		T _j = 175 °C		171	191	mΩ
I _{RRM}	V _{CC} = 600 V I _F = 10 A V _{GE} = -15 V (T _j = 150 °C) di/dt _{off} = 790 A/μs	T _j = 25 °C		8		A
		T _j = 150 °C		14		A
		T _j = 175 °C		16		A
Q _{rr}		T _j = 25 °C		0.58		μC
		T _j = 150 °C		2.01		μC
		T _j = 175 °C		2.37		μC
E _{rr}		T _j = 25 °C		0.36		mJ
		T _j = 150 °C		0.91		mJ
		T _j = 175 °C		1.16		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
Freewheeling - Diode						
V _F = V _{EC}	I _F = 10 A	T _j = 25 °C		2.59	2.94	V
		T _j = 150 °C		2.71	3.08	V
		chiplevel	T _j = 175 °C		2.53	2.89
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
		T _j = 175 °C		0.82	0.98	V
r _F	chiplevel	T _j = 25 °C		129	144	mΩ
		T _j = 150 °C		181	198	mΩ
		T _j = 175 °C		171	191	mΩ
I _{RRM}	V _{CC} = 600 V I _F = 10 A V _{GE} = -15 V (T _j = 150 °C) di/dt _{off} = 790 A/μs	T _j = 25 °C		8		A
		T _j = 150 °C		14		A
		T _j = 175 °C		16		A
Q _{rr}		T _j = 25 °C		0.58		μC
		T _j = 150 °C		2.01		μC
		T _j = 175 °C		2.37		μC
E _{rr}		T _j = 25 °C		0.36		mJ
		T _j = 150 °C		0.91		mJ
		T _j = 175 °C		1.16		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



DGDLE-T



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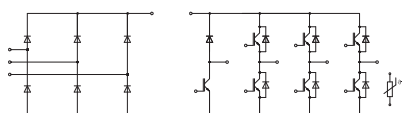
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V _F	I _F = 10 A chiplevel	T _j = 25 °C		0.99	1.23	V
		T _j = 150 °C		0.87	1.11	V
		T _j = 175 °C		0.85	1.09	V
V _{F0}	chiplevel	T _j = 25 °C		0.89	1.09	V
		T _j = 150 °C		0.73	0.92	V
		T _j = 175 °C		0.69	0.88	V
r _F	chiplevel	T _j = 25 °C		10	14	mΩ
		T _j = 150 °C		14	19	mΩ
		T _j = 175 °C		16	21	mΩ
I _R	T _j = 150 °C, V _{RRM}				2	mA
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)			1.51		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



DGD1-ET

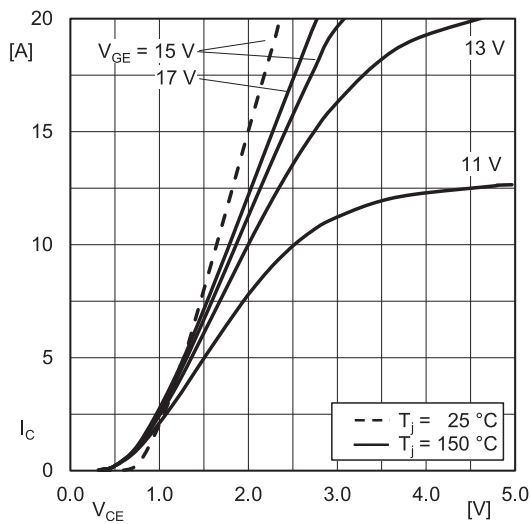


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

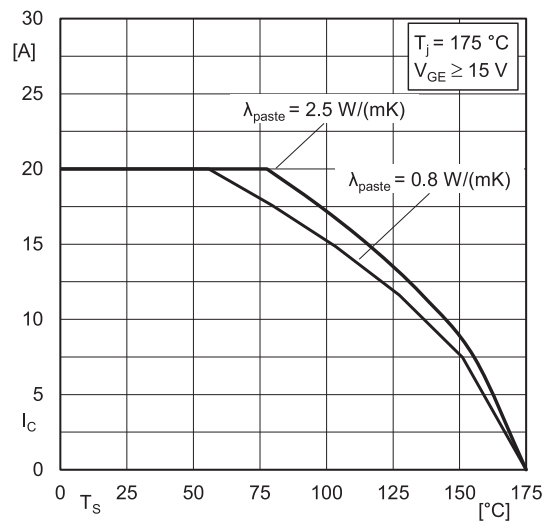


Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$

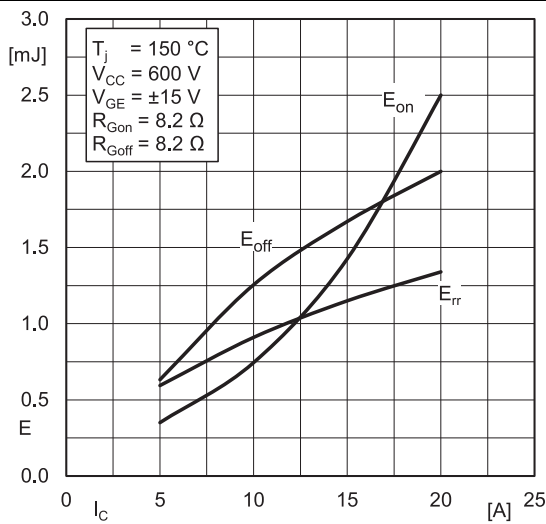


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

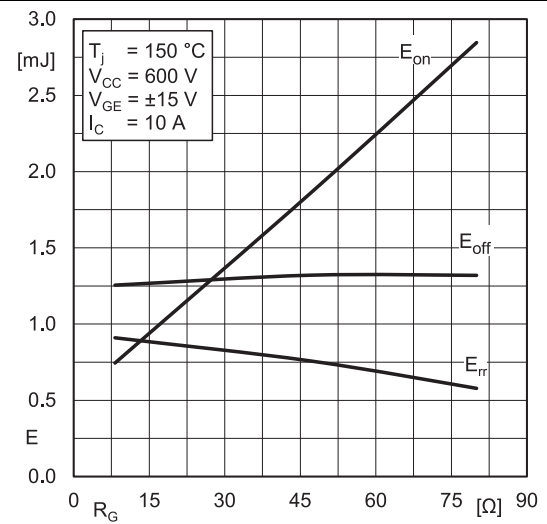


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

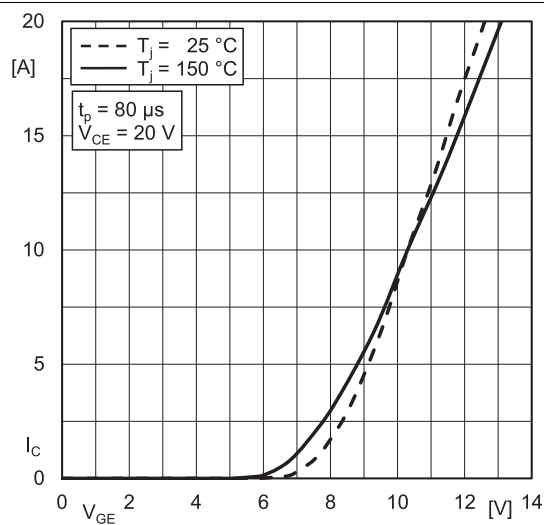


Fig. 5: Typ. IGBT transfer characteristic

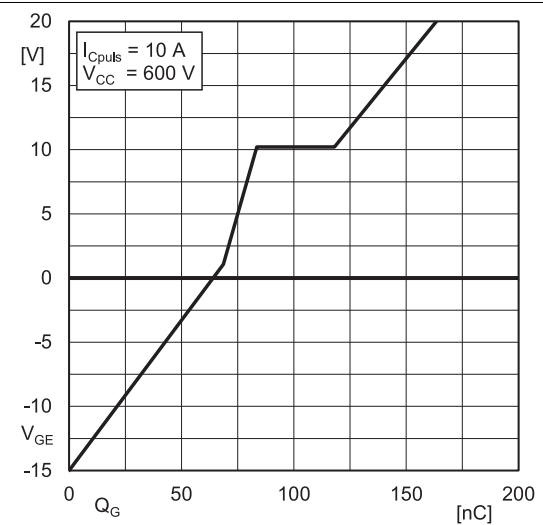


Fig. 6: Typ. IGBT gate charge characteristic

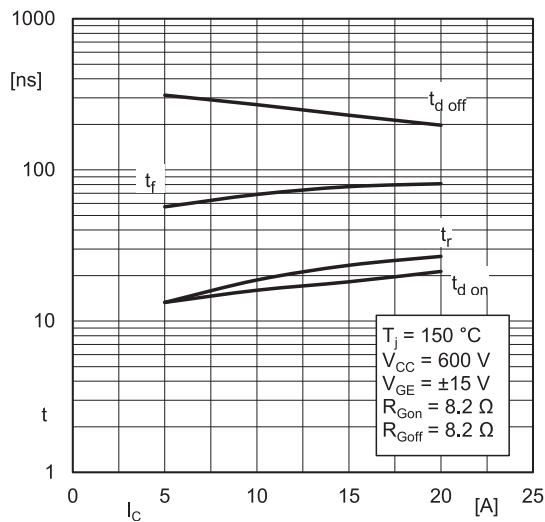
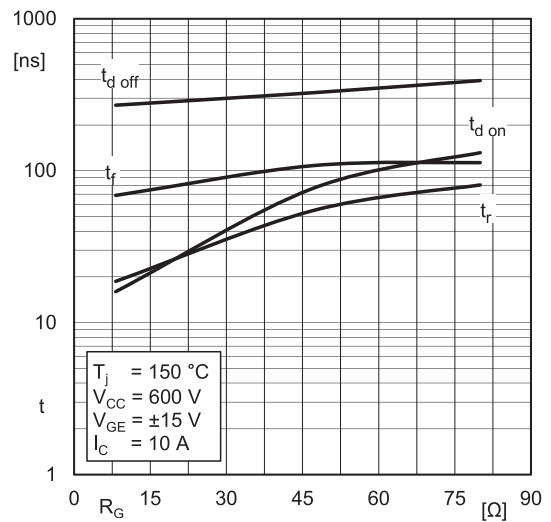
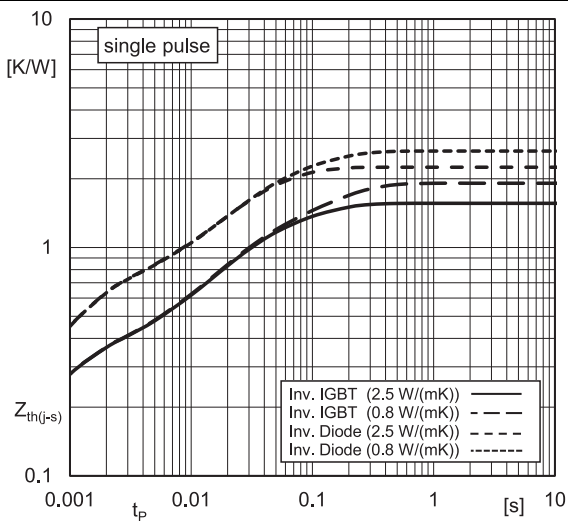
Fig. 7: Typ. switching times = $f(I_C)$ Fig. 8: Typ. switching times = $f(R_G)$ 

Fig. 9: Typ. transient thermal impedance

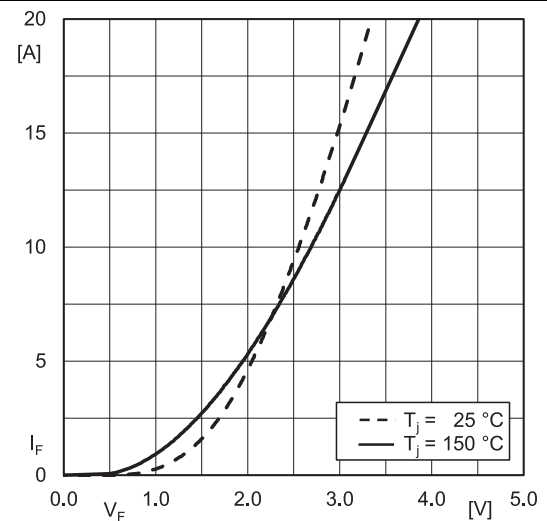
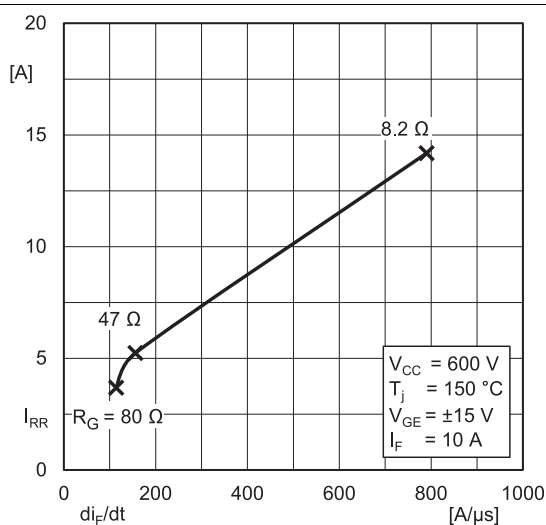
Fig. 10: Typ. Inv. diode forward charact., incl. $R_{GG} + EE'$ 

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

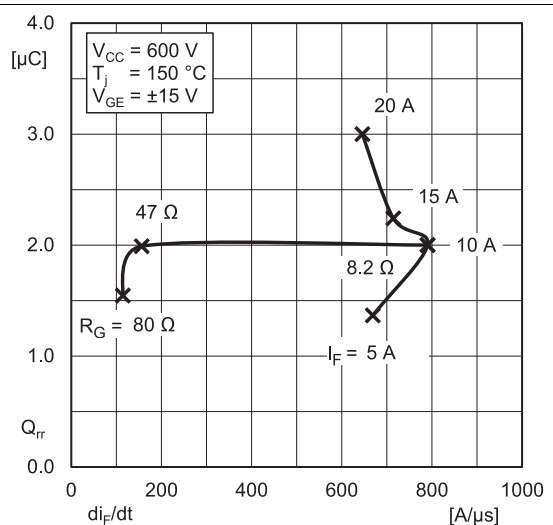


Fig. 12: Typ. Inv. diode reverse recovery charge

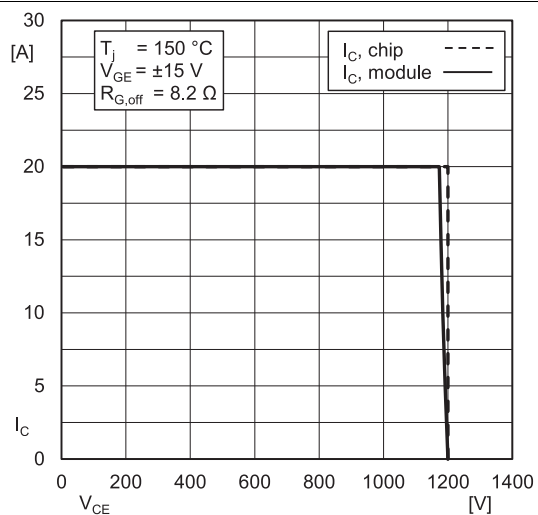


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

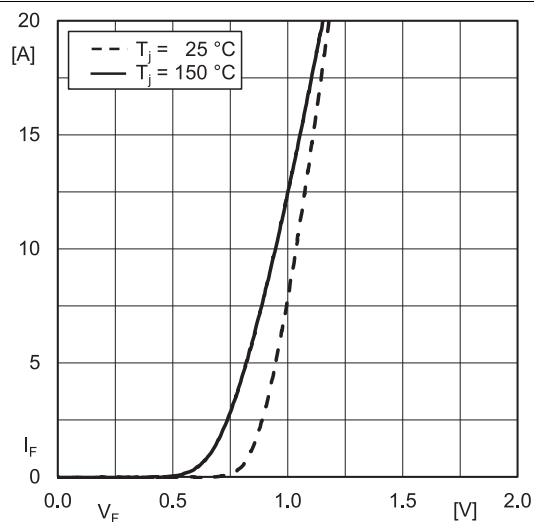
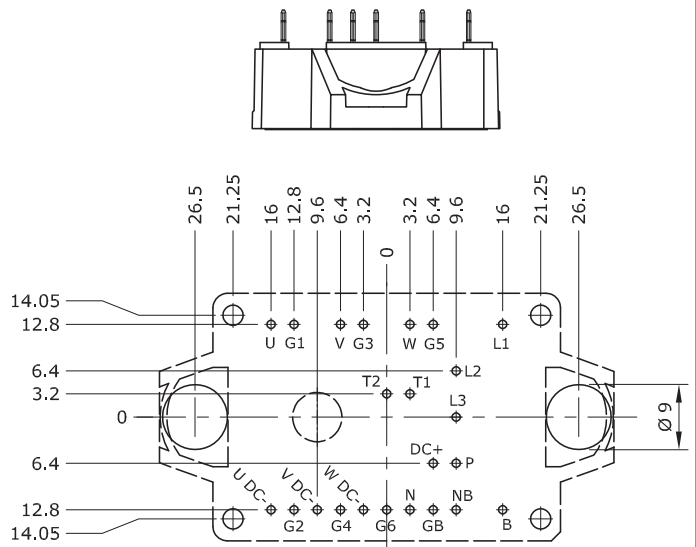
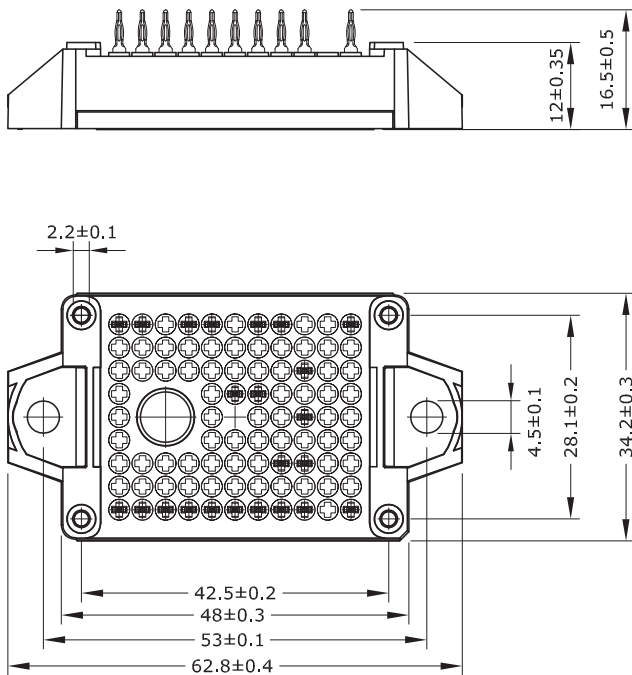
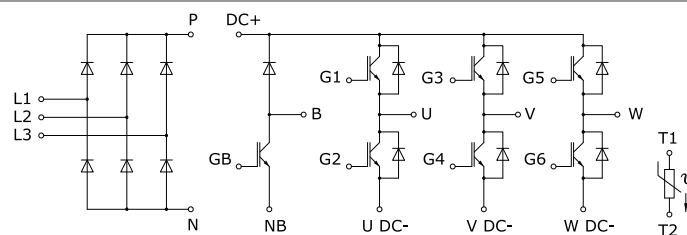


Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\Phi \pm 0.1$
- Diameters of drill $\Phi 1.15\text{mm}$
- Copper thickness in hole 25 - 50 μm
- Hole specification for contacts:
refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E1



DGDLE-T

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

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