

SK15DGD12T7ETE1



SEMITOP®E1

3-phase Converter-Inverter (CI)

SK15DGD12T7ETE1

Features*

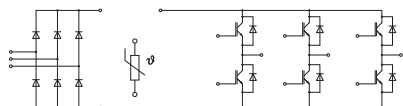
- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 1200V Generation 7 IGBT (T7)
- Robust and soft switching CAL4F diode technology
- PEP rectifier diode technology for enhanced power and environmental robustness
- Integrated NTC temperature sensor
- 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 in AN19-002)



DGD-ET

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Inverter - IGBT				
V _{CES}			1200	V
I _C	P12	T _s = 70 °C	23	A
	T _j = 175 °C	T _s = 100 °C	18	A
I _C	HPTP / HP-PCM	T _s = 70 °C	26	A
	T _j = 175 °C	T _s = 100 °C	21	A
I _{Cnom}			15	A
I _{CRM}			30	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	P12	T _s = 70 °C	17	A
	T _j = 175 °C	T _s = 100 °C	14	A
I _F	HPTP / HP-PCM	T _s = 70 °C	20	A
	T _j = 175 °C	T _s = 100 °C	16	A
I _{FRM}			30	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		65	A
T _j			-40 ... 175	°C
Rectifier - Diode				
V _{RRM}	T _j = 25 °C		1600	V
I _F	P12	T _s = 70 °C	36	A
	T _j = 175 °C	T _s = 100 °C	29	A
I _F	HPTP / HP-PCM	T _s = 70 °C	40	A
	T _j = 175 °C	T _s = 100 °C	32	A
I _{FSM}	t _p = 10 ms sin 180°	T _j = 25 °C	220	A
		T _j = 150 °C	200	A
i ² t	t _p = 10 ms sin 180°	T _j = 25 °C	242	A ² s
		T _j = 150 °C	200	A ² s
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}	, ΔT _{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		1.60	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}	V _{GE} = 15 V chiplevel	T _j = 25 °C		40	47	mΩ
		T _j = 150 °C		65	72	mΩ
		T _j = 175 °C		71	78	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.33 mA		5.15	5.8	6.45	V



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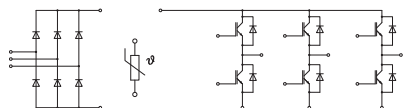
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Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
I_{CES}	$V_{GE} = 0 \text{ V}$, $V_{CE} = 1200 \text{ V}$, $T_j = 25 \text{ }^{\circ}\text{C}$			1	mA
C_{ies}	$f = 1 \text{ MHz}$		2.80		nF
C_{oes}	$V_{CE} = 25 \text{ V}$, $f = 1 \text{ MHz}$		0.04		nF
C_{res}	$V_{GE} = 0 \text{ V}$, $f = 1 \text{ MHz}$		0.01		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		207		nC
R_{Gint}	$T_j = 25 \text{ }^{\circ}\text{C}$		0		Ω
$t_{d(on)}$	$T_j = 25 \text{ }^{\circ}\text{C}$		31		ns
	$T_j = 150 \text{ }^{\circ}\text{C}$		33		ns
	$T_j = 175 \text{ }^{\circ}\text{C}$		35		ns
t_r	$T_j = 25 \text{ }^{\circ}\text{C}$		25		ns
	$T_j = 150 \text{ }^{\circ}\text{C}$		27		ns
	$T_j = 175 \text{ }^{\circ}\text{C}$		28		ns
E_{on}	$V_{CC} = 600 \text{ V}$ $I_C = 15 \text{ A}$ $R_{G on} = 7.5 \text{ } \Omega$ $R_{G off} = 7.5 \text{ } \Omega$		0.79		mJ
	$T_j = 25 \text{ }^{\circ}\text{C}$		1.16		mJ
	$T_j = 150 \text{ }^{\circ}\text{C}$		1.31		mJ
$t_{d(off)}$	$V_{GE} = +15/-15 \text{ V}$ $(T_j = 150 \text{ }^{\circ}\text{C})$ $di/dt_{on} = 730 \text{ A}/\mu\text{s}$ $di/dt_{off} = 150 \text{ A}/\mu\text{s}$		209		ns
	$T_j = 25 \text{ }^{\circ}\text{C}$		254		ns
	$T_j = 150 \text{ }^{\circ}\text{C}$		275		ns
t_f	$dv/dt = 2600 \text{ V}/\mu\text{s}$		72		ns
	$T_j = 25 \text{ }^{\circ}\text{C}$		111		ns
	$T_j = 150 \text{ }^{\circ}\text{C}$		119		ns
E_{off}	$T_j = 25 \text{ }^{\circ}\text{C}$		1.29		mJ
	$T_j = 150 \text{ }^{\circ}\text{C}$		1.71		mJ
	$T_j = 175 \text{ }^{\circ}\text{C}$		1.95		mJ
$R_{th(j-s)}$	per IGBT, P12 (Reference)		1.81		K/W
$R_{th(j-s)}$	per IGBT, HPTP / HP-PCM		1.43		K/W
Inverse - Diode					
$V_F = V_{EC}$	$I_F = 15 \text{ A}$	$T_j = 25 \text{ }^{\circ}\text{C}$	2.38	2.71	V
		$T_j = 150 \text{ }^{\circ}\text{C}$	2.44	2.77	V
	chiplevel	$T_j = 175 \text{ }^{\circ}\text{C}$	2.26	2.58	V
V_{F0}		$T_j = 25 \text{ }^{\circ}\text{C}$	1.30	1.50	V
	chiplevel	$T_j = 150 \text{ }^{\circ}\text{C}$	0.90	1.10	V
		$T_j = 175 \text{ }^{\circ}\text{C}$	0.82	0.98	V
r_F		$T_j = 25 \text{ }^{\circ}\text{C}$	72	81	m Ω
	chiplevel	$T_j = 150 \text{ }^{\circ}\text{C}$	103	111	m Ω
		$T_j = 175 \text{ }^{\circ}\text{C}$	96	107	m Ω
I_{RRM}		$T_j = 25 \text{ }^{\circ}\text{C}$	11		A
		$T_j = 150 \text{ }^{\circ}\text{C}$	15		A
		$T_j = 175 \text{ }^{\circ}\text{C}$	18		A
Q_{rr}	$I_F = 15 \text{ A}$ $V_{GE} = -15 \text{ V}$ $V_{CC} = 600 \text{ V}$ $(T_j = 150 \text{ }^{\circ}\text{C})$	$T_j = 25 \text{ }^{\circ}\text{C}$	1.03		μC
		$T_j = 150 \text{ }^{\circ}\text{C}$	2.29		μC
		$T_j = 175 \text{ }^{\circ}\text{C}$	2.58		μC
E_{rr}	$di/dt_{off} = 870 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ }^{\circ}\text{C}$	0.31		mJ
		$T_j = 150 \text{ }^{\circ}\text{C}$	0.97		mJ
		$T_j = 175 \text{ }^{\circ}\text{C}$	1.49		mJ
$R_{th(j-s)}$	per Diode, P12 (Reference)		2.13		K/W
$R_{th(j-s)}$	per Diode, HPTP / HP-PCM		1.74		K/W

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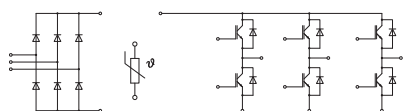
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V _F = V _{EC}	I _F = 15 A chiplevel	T _j = 25 °C		1.04	1.30	V
		T _j = 150 °C		0.94	1.20	V
		T _j = 175 °C		0.93	1.20	V
V _{F0}	chiplevel	T _j = 25 °C		0.89	1.09	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, P12 (Reference)			1.75		K/W
R _{th(j-s)}	per Diode, HPTP / HP-PCM			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



DGD-ET

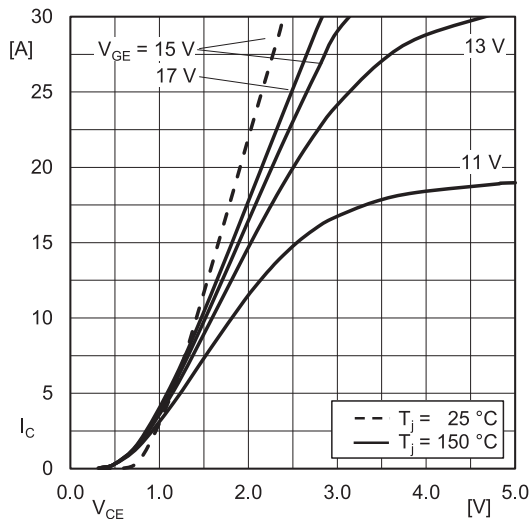


Fig. 1: Typ. IGBT output characteristic, incl. $R_{CC+EE'}$

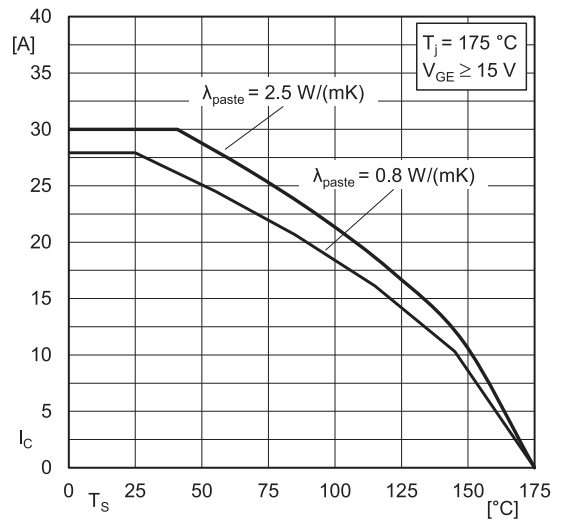


Fig. 2: IGBT rated current vs. temperature $I_C=f(T_s)$

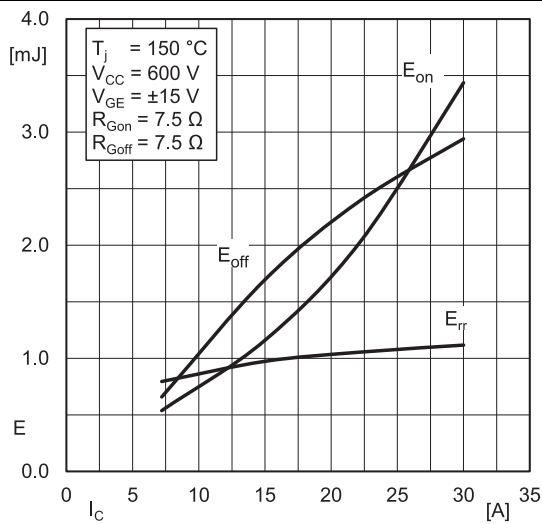


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

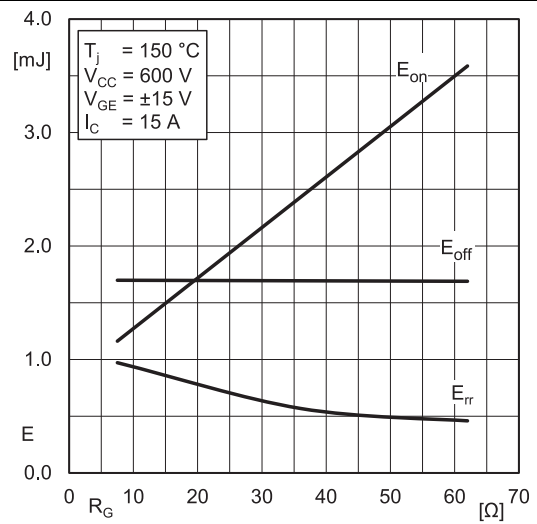


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

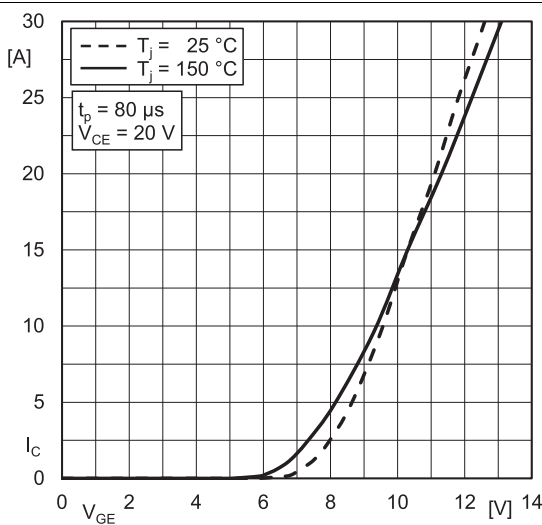


Fig. 5: Typ. IGBT transfer characteristic

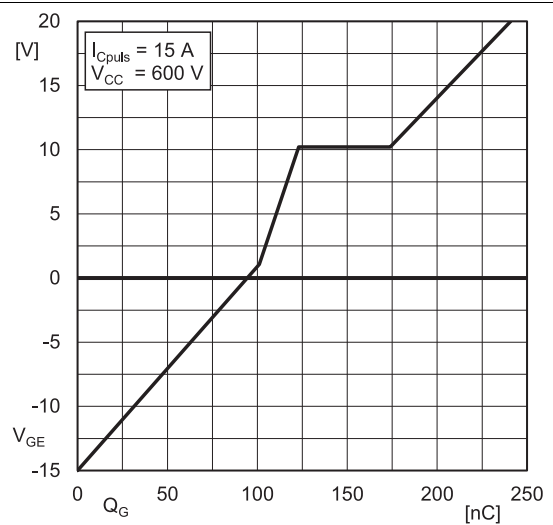


Fig. 6: Typ. IGBT gate charge characteristic

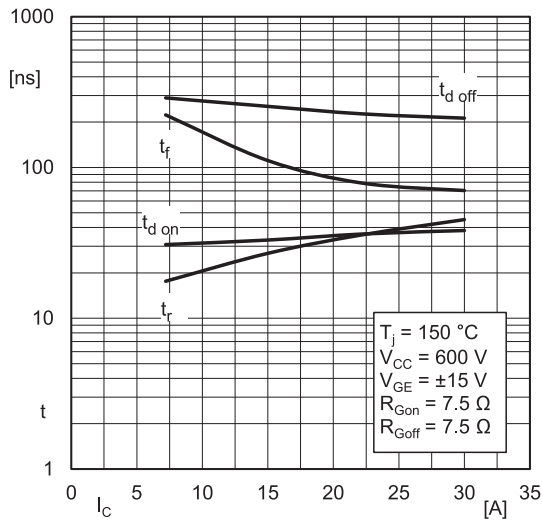


Fig. 7: Typ. switching times = f(I_C)

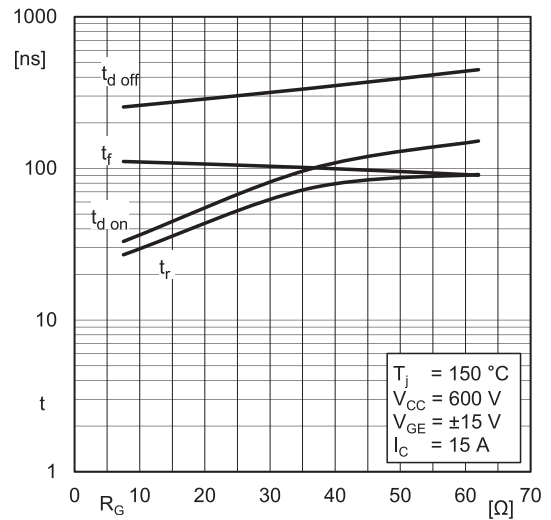


Fig. 8: Typ. switching times = f(R_G)

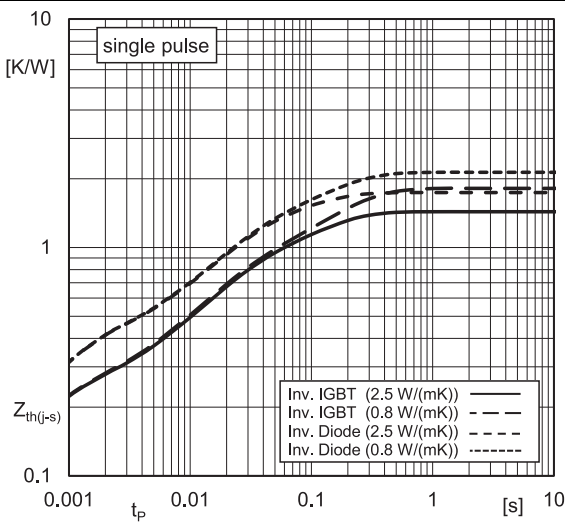


Fig. 9: Typ. transient thermal impedance

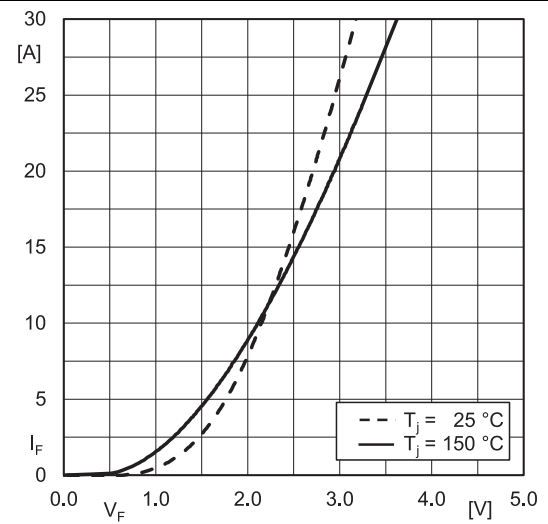


Fig. 10: Typ. Inv. diode forward charact., incl. R_{CC'+EE'}

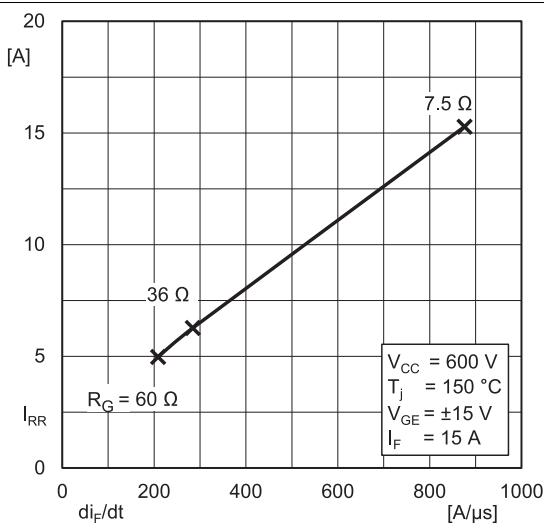


Fig. 11: Typ. Inv. diode peak reverse recovery current

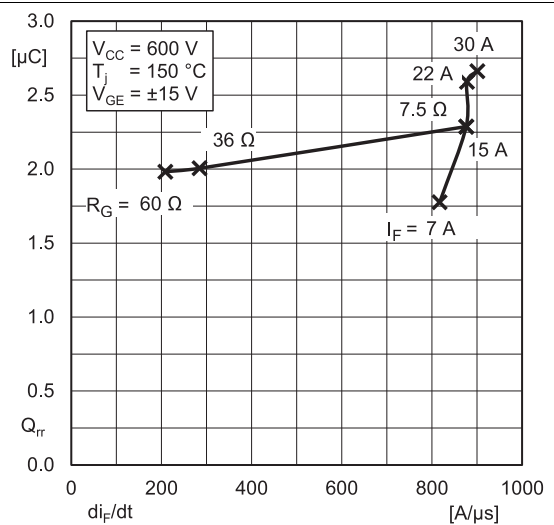


Fig. 12: Typ. Inv. diode reverse recovery charge

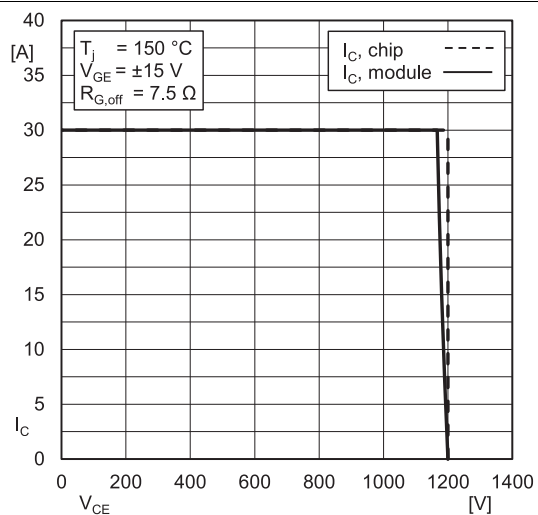


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

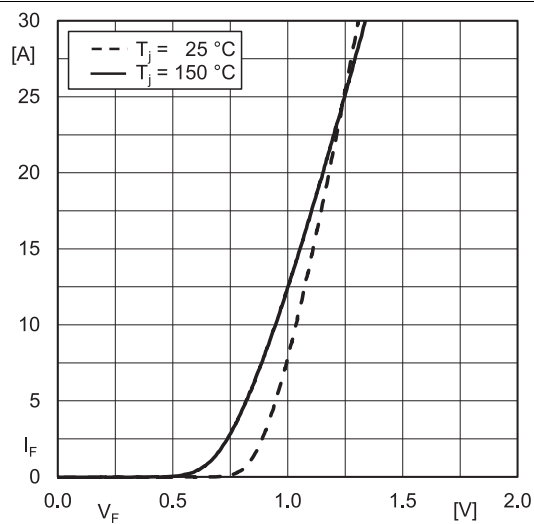
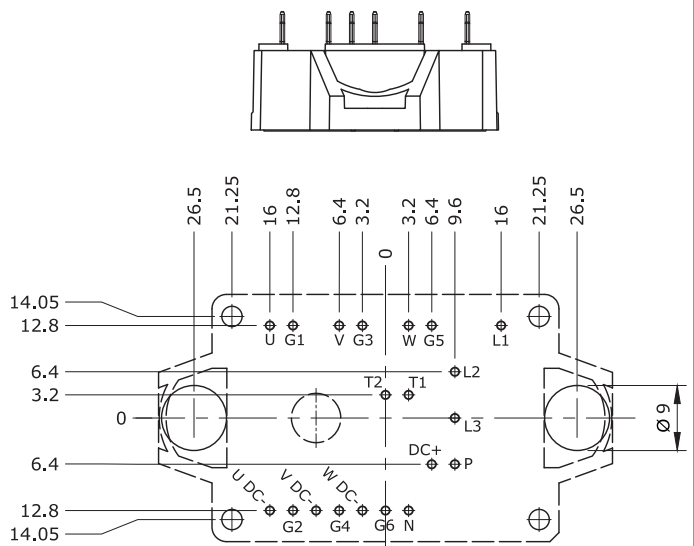
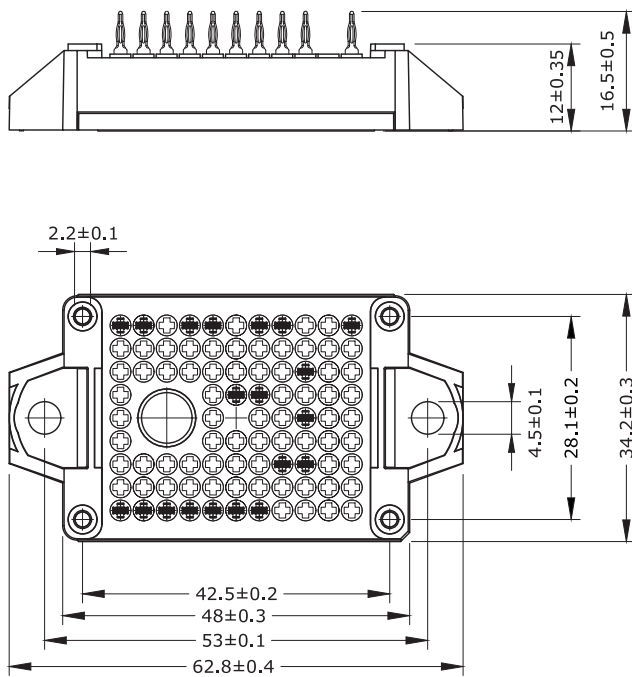
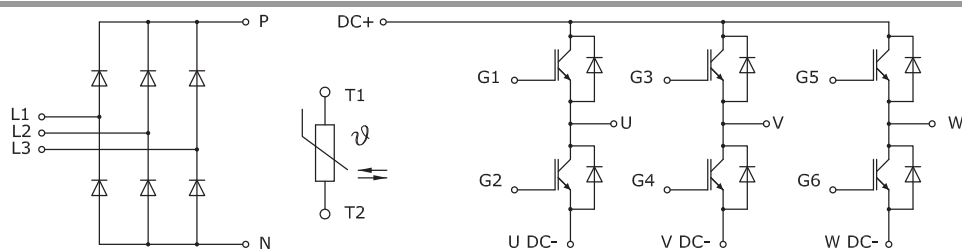


Fig. 14: Typ. Rect. diode forward charact., incl. $R_{CC'+EE'}$



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\varnothing \pm 0.1$
- 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 Instruction

SEMITOP®E1



DGD-ET

IMPORTANT INFORMATION AND WARNINGS

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

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