MiniSKiiP® 3

3-phase Converter-Inverter-Brake (CIB)

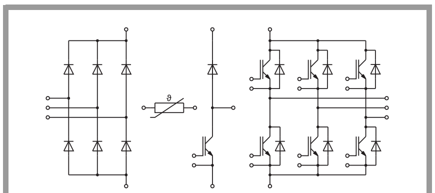
SKiiP 35NAB12T7V1

Features*

- 1200V Generation 7 IGBTs (T7)
- Robust and soft switching freewheeling diodes in CAL technology
- New SKR PEP diode technology for enhanced power and environmental robustness
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

Remarks

- Max. case temperature limited to TC=TS=125 °C
- Product reliability results valid for Tj≤150 °C; Tj,op >150°C during overload (Details see AN19-002)
- MiniSKiiP ″Technical Explanations″ and ″Mounting Instructions″ are part of the data sheet Please refer to both documents for further information
- For storage and case temperature with TIM see document ″Technical Explanations Thermal Interface Materials″
- Inverter IGBT: T1 – T6
- Chopper IGBT: T14
- Inverse Diode: D1 – D6
- Freewheeling Diode: D13
- Rectifier Diode: D7 – D12



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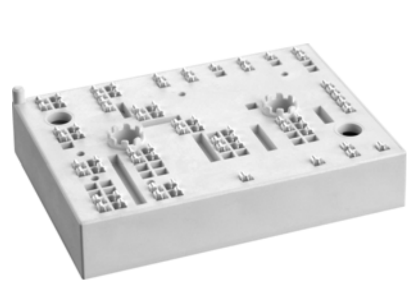
Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
Inverter - IGBT				
V_{CES}	T_j = 25 °C		1200	V
I_C	λ_{paste}=0.8 W/(mK) T_j = 175 °C	T_s = 70 °C	60	A
		T_s = 100 °C	48	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	68	A
		T_s = 100 °C	55	A
I_{Cnom}			50	A
I_{CRM}			100	A
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_j = 175 °C	T_s = 70 °C	60	A
		T_s = 100 °C	48	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	68	A
		T_s = 100 °C	55	A
I_{Cnom}			50	A
I_{CRM}			100	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_j = 175 °C	T_s = 70 °C	48	A
		T_s = 100 °C	39	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	54	A
		T_s = 100 °C	44	A
I_{FRM}			100	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 150 °C		270	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_j = 175 °C	T_s = 70 °C	48	A
		T_s = 100 °C	39	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	54	A
		T_s = 100 °C	44	A
I_{FRM}			100	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 150 °C		270	A
T_j			-40 ... 175	°C



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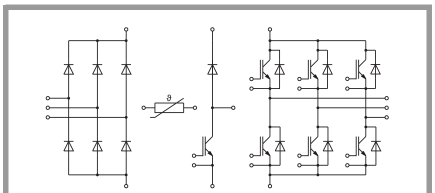

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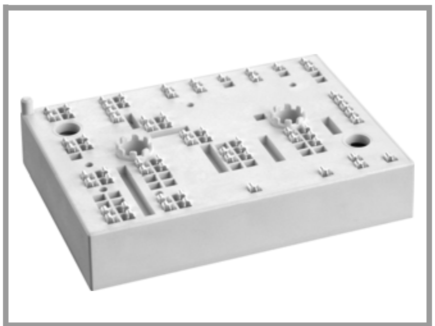
Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Rectifier - Diode				
V_{RRM}	T_j = 25 °C		1600	V
I_F	λ_{paste}=0.8 W/(mK) T_j = 175 °C	T_s = 70 °C	84	A
		T_s = 100 °C	66	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 70 °C	95	A
		T_s = 100 °C	74	A
I_{FSM}	t_p = 10 ms sin 180°	T_j = 25 °C	635	A
		T_j = 150 °C	490	A
i^2t	t_p = 10 ms sin 180°	T_j = 25 °C	2020	A^2s
		T_j = 150 °C	1200	A^2s
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$	$T_{terminal}$ = 80 °C, 20 A per spring		80	A
T_{stg}	module without TIM		-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, 1 min		2500	V

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$V_{CE(sat)}$	I_C = 50 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.55	1.70	V
		T_j = 150 °C		1.73	1.88	V
		T_j = 175 °C		1.77	1.92	V
V_{CE0}	chiplevel	T_j = 25 °C		1.00	1.05	V
		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		11	13	mΩ
		T_j = 150 °C		19	21	mΩ
		T_j = 175 °C		20	22	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.27 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		10.00		nF
C_{oes}		f = 1 MHz		0.13		nF
C_{res}		f = 1 MHz		0.04		nF
Q_G	V_{GE} = - 8V ... + 15 V			700		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CC} = 600 V I_C = 50 A $R_{G\ on}$ = 6.4 Ω $R_{G\ off}$ = 6.4 Ω V_{GE} = +15/-15 V	T_j = 25 °C		32		ns
		T_j = 150 °C		36		ns
		T_j = 175 °C		36		ns
t_r		T_j = 25 °C		37		ns
		T_j = 150 °C		42		ns
		T_j = 175 °C		45		ns
E_{on}	@ T_j = 150 °C: di/dt_{on} = 1270 A/µs di/dt_{off} = 530 A/µs dv/dt = 3620 V/µs	T_j = 25 °C		4		mJ
		T_j = 150 °C		5.7		mJ
		T_j = 175 °C		6		mJ



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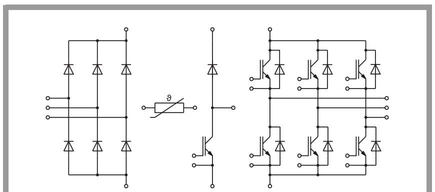

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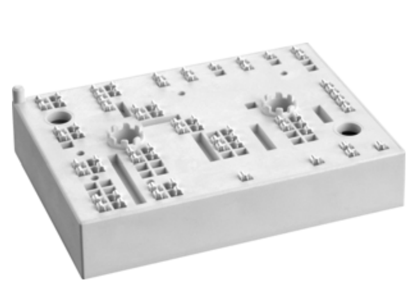
Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$t_{d(off)}$	V_{CC} = 600 V I_C = 50 A $R_{G\,on}$ = 6.4 Ω $R_{G\,off}$ = 6.4 Ω V_{GE} = +15/-15 V	T_j = 25 °C		250		ns
		T_j = 150 °C		340		ns
		T_j = 175 °C		365		ns
t_f		T_j = 25 °C		51		ns
		T_j = 150 °C		79		ns
		T_j = 175 °C		94		ns
E_{off}	@ T_j = 150 °C: di/dt$_{on}$ = 1270 A/µs di/dt$_{off}$ = 530 A/µs dv/dt = 3620 V/µs	T_j = 25 °C		3.3		mJ
		T_j = 150 °C		5.5		mJ
		T_j = 175 °C		6		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.83		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.67		K/W
Chopper - IGBT						
$V_{CE(sat)}$	I_C = 50 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.55	1.70	V
		T_j = 150 °C		1.73	1.88	V
		T_j = 175 °C		1.77	1.92	V
V_{CE0}	chiplevel	T_j = 25 °C		1.00	1.05	V
		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		11	13	mΩ
		T_j = 150 °C		19	21	mΩ
		T_j = 175 °C		20	22	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.27 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		10.00		nF
C_{oes}		f = 1 MHz		0.13		nF
C_{res}		f = 1 MHz		0.04		nF
Q_G	V_{GE} = - 8V ... + 15 V			700		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CC} = 600 V I_C = 50 A $R_{G\,on}$ = 6.4 Ω $R_{G\,off}$ = 6.4 Ω V_{GE} = +15/-15 V	T_j = 25 °C		32		ns
		T_j = 150 °C		36		ns
		T_j = 175 °C		36		ns
t_r		T_j = 25 °C		37		ns
		T_j = 150 °C		42		ns
		T_j = 175 °C		45		ns
E_{on}		T_j = 25 °C		4		mJ
		T_j = 150 °C		5.7		mJ
		T_j = 175 °C		6		mJ
$t_{d(off)}$	@ T_j = 150 °C: di/dt$_{on}$ = 1270 A/µs di/dt$_{off}$ = 530 A/µs dv/dt = 3620 V/µs	T_j = 25 °C		250		ns
		T_j = 150 °C		340		ns
		T_j = 175 °C		365		ns
t_f		T_j = 25 °C		51		ns
		T_j = 150 °C		79		ns
		T_j = 175 °C		94		ns
E_{off}		T_j = 25 °C		3.3		mJ
		T_j = 150 °C		5.7		mJ
		T_j = 175 °C		6		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.83		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.67		K/W



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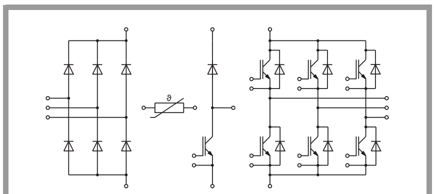

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Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Inverse - Diode						
$V_F = V_{EC}$	I_F = 50 A	T_j = 25 °C		2.22	2.54	V
	V_{GE} = 0 V	T_j = 150 °C		2.18	2.50	V
	chiplevel	T_j = 175 °C		2.03	2.34	V
V_{F0}		T_j = 25 °C		1.30	1.50	V
	chiplevel	T_j = 150 °C		0.90	1.10	V
		T_j = 175 °C		0.82	0.98	V
r_F		T_j = 25 °C		18	21	mΩ
	chiplevel	T_j = 150 °C		26	28	mΩ
		T_j = 175 °C		24	27	mΩ
I_{RRM}		T_j = 25 °C		32		A
		T_j = 150 °C		42		A
	V_{CC} = 600 V	T_j = 175 °C		50		A
Q_{rr}	I_F = 50 A	T_j = 25 °C		2.8		µC
	V_{GE} = -15 V	T_j = 150 °C		7.6		µC
	@ T_j = 150 °C:	T_j = 175 °C		8.2		µC
E_{rr}	di/dt_{off} = 1270 A/µs	T_j = 25 °C		0.9		mJ
		T_j = 150 °C		3		mJ
		T_j = 175 °C		4		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.96		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.8		K/W
Freewheeling - Diode						
$V_F = V_{EC}$	I_F = 50 A	T_j = 25 °C		2.22	2.54	V
	V_{GE} = 0 V	T_j = 150 °C		2.18	2.50	V
	chiplevel	T_j = 175 °C		2.03	2.34	V
V_{F0}		T_j = 25 °C		1.30	1.50	V
	chiplevel	T_j = 150 °C		0.90	1.10	V
		T_j = 175 °C		0.82	0.98	V
r_F		T_j = 25 °C		18	21	mΩ
	chiplevel	T_j = 150 °C		26	28	mΩ
		T_j = 175 °C		24	27	mΩ
I_{RRM}		T_j = 25 °C		32		A
		T_j = 150 °C		42		A
	V_{CC} = 600 V	T_j = 175 °C		50		A
Q_{rr}	I_F = 50 A	T_j = 25 °C		2.8		µC
	V_{GE} = -15 V	T_j = 150 °C		7.6		µC
	@ T_j = 150 °C:	T_j = 175 °C		8.2		µC
E_{rr}	di/dt_{off} = 1270 A/µs	T_j = 25 °C		0.9		mJ
		T_j = 150 °C		3		mJ
		T_j = 175 °C		4		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.96		K/W
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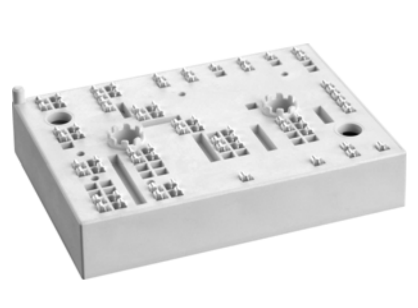

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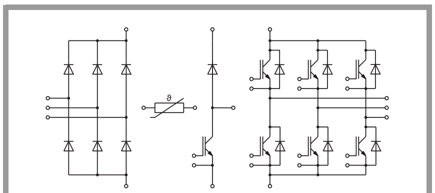


NAB

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Rectifier - Diode						
V_F	I_F = 26 A chiplevel	T_j = 25 °C		0.97	1.20	V
		T_j = 150 °C		0.84	1.07	V
		T_j = 175 °C		0.82	1.05	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		3.1	4.2	mΩ
		T_j = 150 °C		4.4	5.9	mΩ
		T_j = 175 °C		5.0	6.5	mΩ
I_R	T_j = 150 °C, V_{RRM}				1.7	mA
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.87		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.74		K/W
Module						
M_s	to heat sink		2		2.5	Nm
w				82		g
L_{CE}				-		nH
Temperature Sensor						
R_{100}	T_r=100°C (R_{25}=1000Ω)			1670 ± 3%		Ω
$R_{(T)}$	$R_{(T)}$=1000Ω[1+A(T-25°C)+B(T-25°C)^2] , A = 7.635*10^{-3}°C^{-1}, B = 1.731*10^{-5}°C^{-2}					

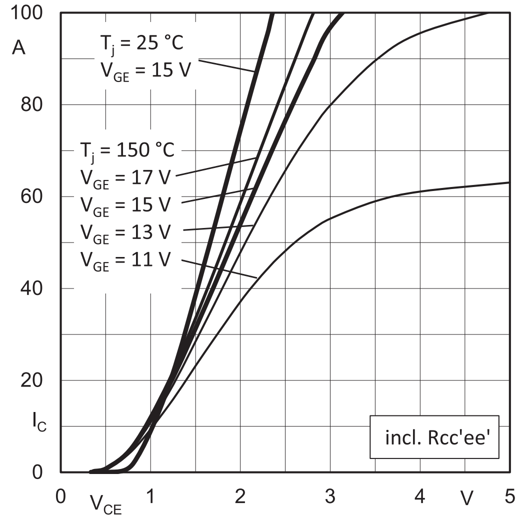


Fig. 1: Typ. output characteristic

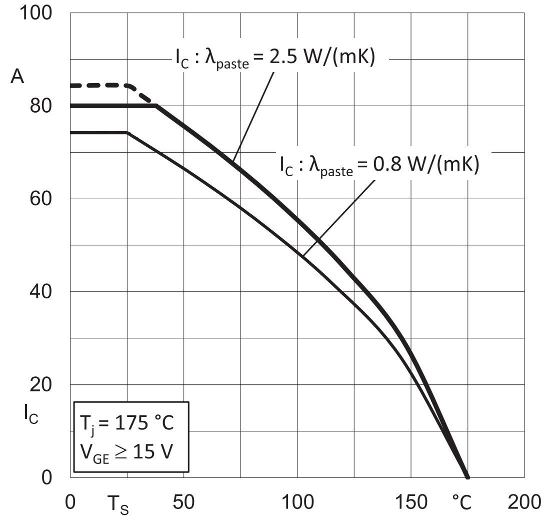


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_S)$

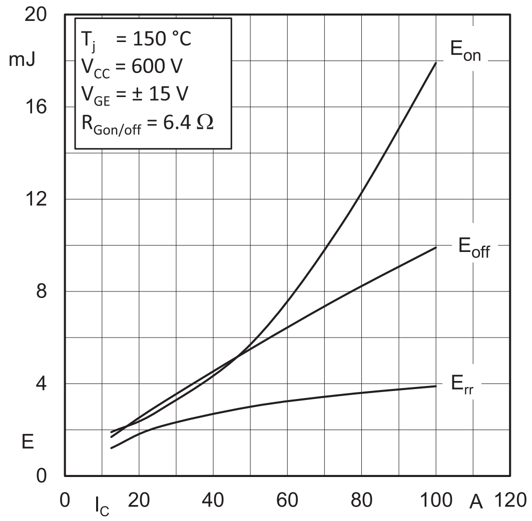


Fig. 3: Typ. turn-on /-off energy = f (I_C)

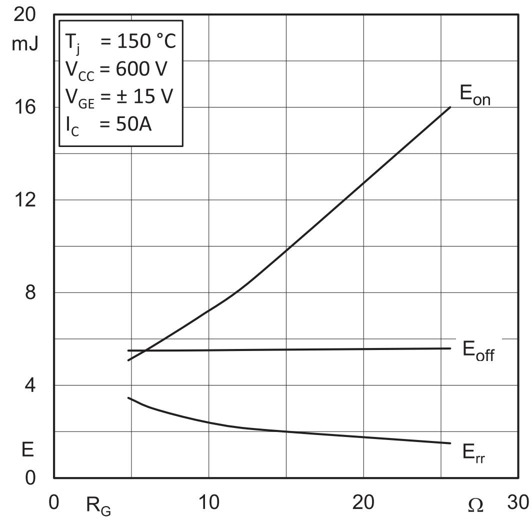


Fig. 4: Typ. turn-on /-off energy = f (R_G)

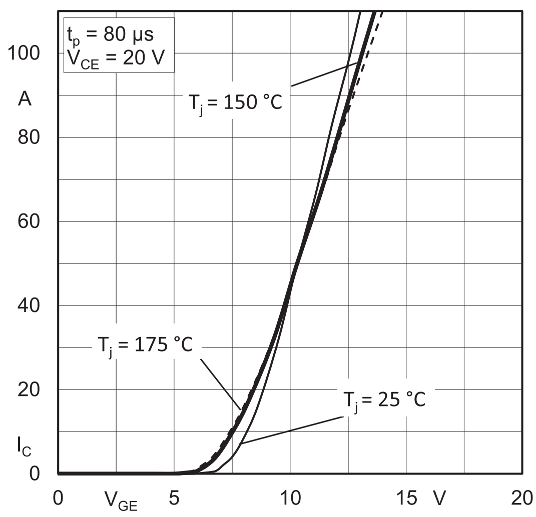


Fig. 5: Typ. transfer characteristic

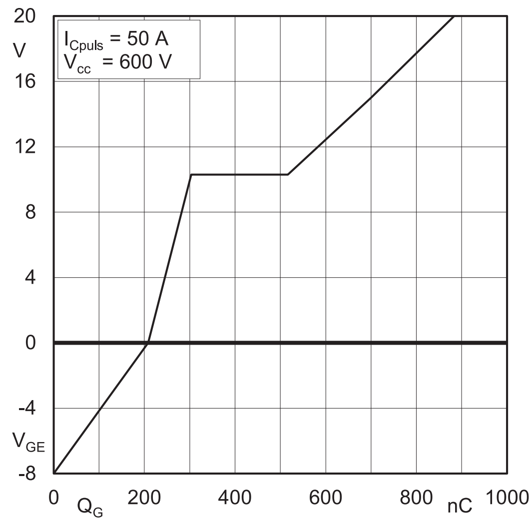


Fig. 6: Typ. gate charge characteristic

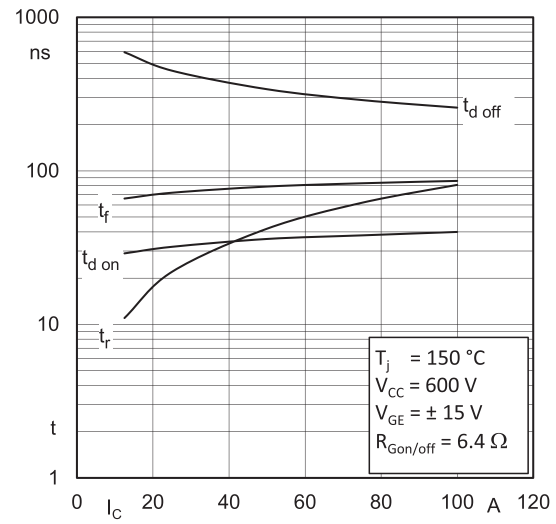


Fig. 7: Typ. switching times vs. I_C

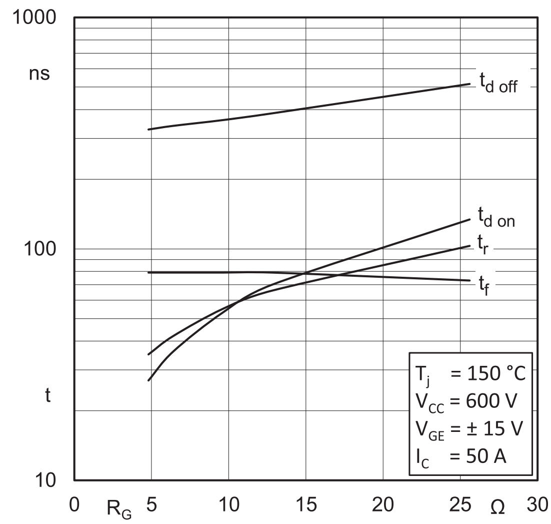


Fig. 8: Typ. switching times vs. gate resistor R_G

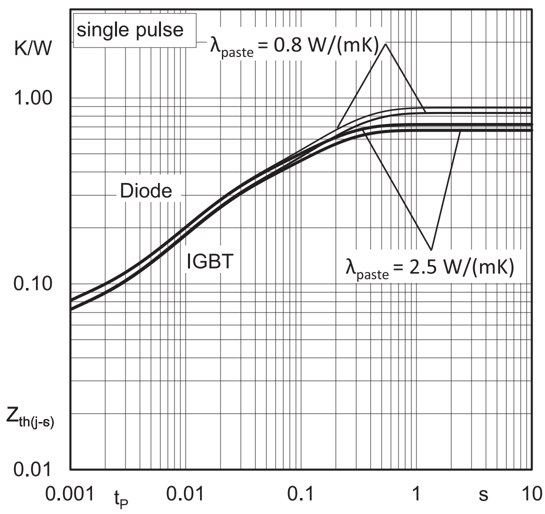


Fig. 9: Typ. transient thermal impedance

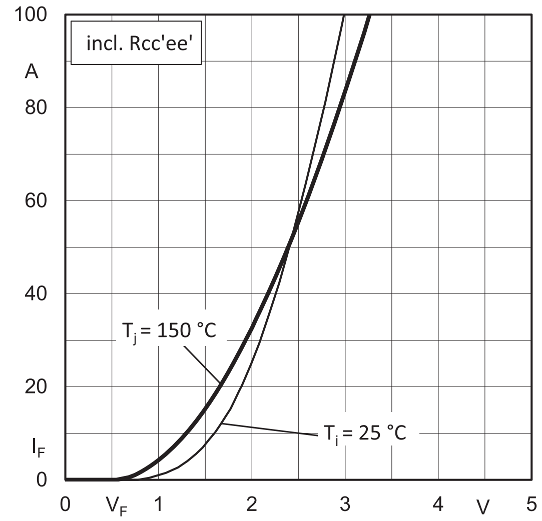


Fig. 10: Typ. CAL diode forward characteristic

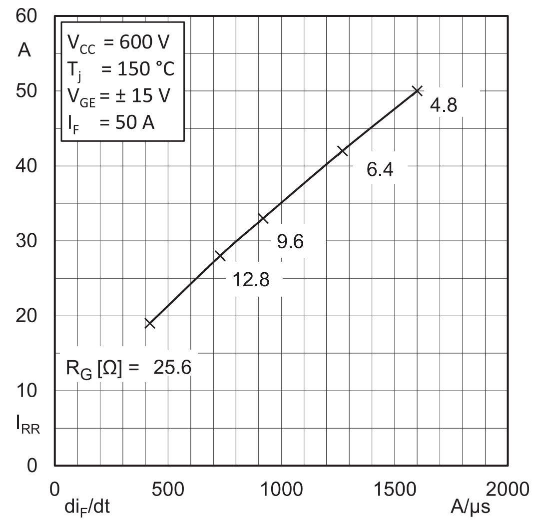


Fig. 11: Typ. CAL diode peak reverse recovery current

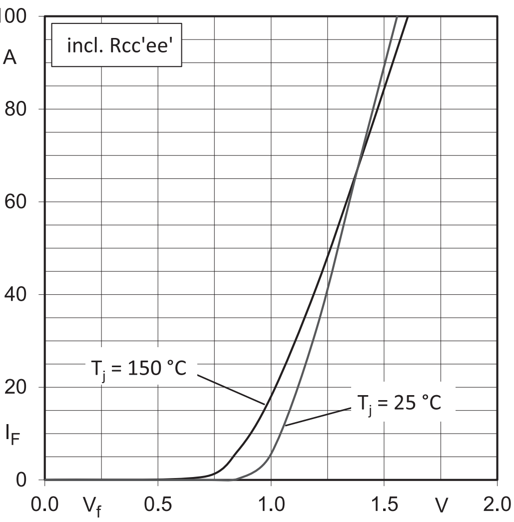
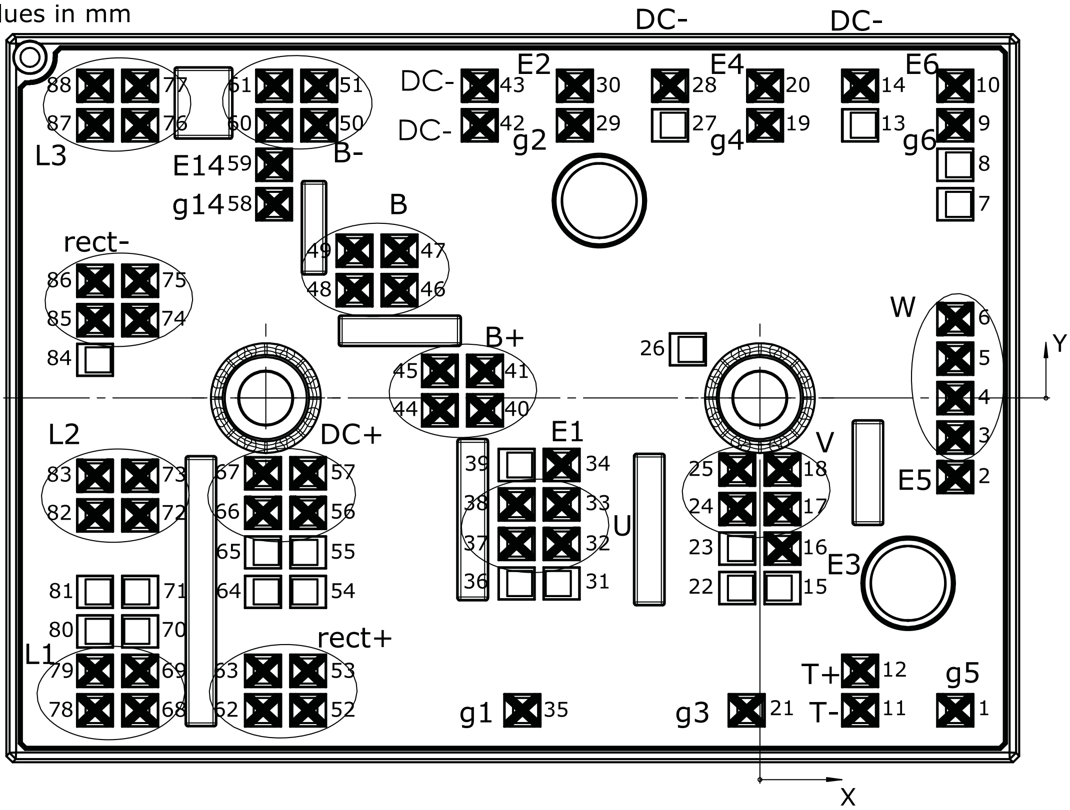


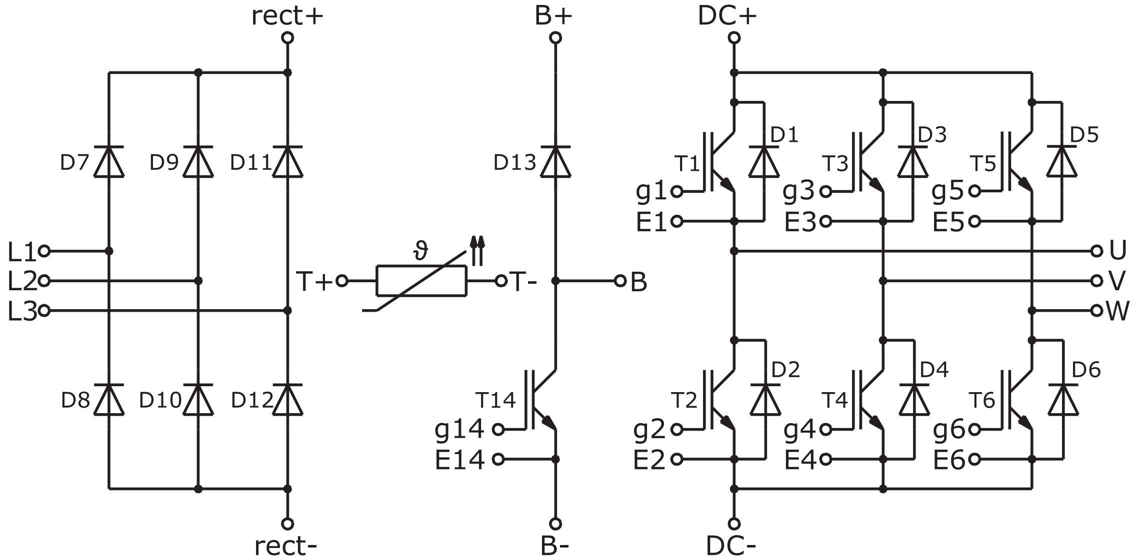
Fig. 12: Typ. input bridge forward characteristic

Pin out											
Pin	*X*	*Y*	*Function*	*Pin*	*X*	*Y*	*Function*	*Pin*	*X*	*Y*	*Function*
1	15,83	-25,30	g5	31	-16,05	-15,02		61	-39,33	25,30	B-
2	15,83	-6,40	E5	32	-16,05	-11,82	U	62	-40,23	-25,30	rect+
3	15,83	-3,20	W	33	-16,05	-8,62	U	63	-40,23	-22,10	rect+
4	15,83	0	W	34	-16,05	-5,42	E1	64	-40,23	-15,70	
5	15,83	3,20	W	35	-19,23	-25,30	g1	65	-40,23	-12,50	
6	15,83	6,40	W	36	-19,70	-15,02		66	-40,23	-9,30	DC+
7	15,83	15,70		37	-19,70	-11,82	U	67	-40,23	-6,10	DC+
8	15,83	18,90		38	-19,70	-8,62	U	68	-50,18	-25,30	L1
9	15,83	22,10	g6	39	-19,70	-5,42		69	-50,18	-22,10	L1
10	15,83	25,30	E6	40	-22,26	-1,00	B+	70	-50,18	-18,90	
11	8,13	-25,30	T-	41	-22,26	2,20	B+	71	-50,18	-15,70	
12	8,13	-22,10	T+	42	-22,68	22,10	DC-	72	-50,18	-9,50	L2
13	8,13	22,10		43	-22,68	25,30	DC-	73	-50,18	-6,30	L2
14	8,13	25,30	DC-	44	-25,91	-1,00	B+	74	-50,18	6,30	rect-
15	1,83	-15,39		45	-25,91	-2,20	B+	75	-50,18	9,50	rect-
16	1,83	-12,19	E3	46	-29,18	8,74	B	76	-50,18	22,10	L3
17	1,83	-8,99	V	47	-29,18	11,94	B	77	-50,18	25,30	L3
18	1,83	-5,79	V	48	-32,83	8,74	B	78	-53,83	-25,30	L1
19	0,43	22,10	g4	49	-32,83	11,94	B	79	-53,83	-22,10	L1
20	0,43	25,30	E4	50	-35,68	22,10	B-	80	-53,83	-18,90	
21	-1,08	-25,30	g3	51	-35,68	25,30	B-	81	-53,83	-15,70	
22	-1,83	-15,39		52	-36,58	-25,30	rect+	82	-53,83	-9,50	L2
23	-1,83	-12,19		53	-36,58	-22,10	rect+	83	-53,83	-6,30	L2
24	-1,83	-8,99	V	54	-36,58	-15,70		84	-53,83	3,10	
25	-1,83	-5,79	V	55	-36,58	-12,50		85	-53,83	6,30	rect-
26	-5,83	3,95		56	-36,58	-9,30	DC+	86	-53,83	9,50	rect-
27	-7,28	22,10		57	-36,58	-6,10	DC+	87	-53,83	22,10	L3
28	-7,28	25,30	DC-	58	-39,33	15,70	g14	88	-53,83	25,30	L3
29	-14,98	22,10	g2	59	-39,33	18,90	E14				
30	-14,98	25,30	E2	60	-39,33	22,10	B-				

all values in mm



Pinout



Pinout

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

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