

MiniSKiiP® 3

3-phase Converter-Inverter-Brake (CIB)

SKiiP 34NAB12T7V1

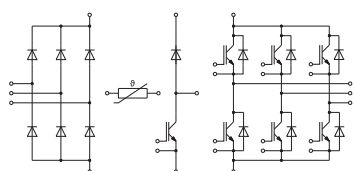
Features*

- 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

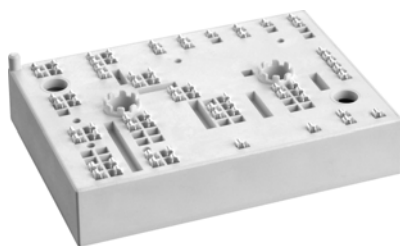
- Max. case temperature limited to $T_C = T_S = 125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$; $T_{j,op} > 150^\circ\text{C}$ during overload (Details see AN19-002)
- MiniSKiiP "Technical Explanations" and "Mounting Instructions" are part of the data sheet Please 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

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	45	A
	T _j = 175 °C	T _s = 100 °C	37	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	50	A
	T _j = 175 °C	T _s = 100 °C	41	A
I _{Cnom}			35	A
I _{CRM}			70	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	45	A
	T _j = 175 °C	T _s = 100 °C	37	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	50	A
	T _j = 175 °C	T _s = 100 °C	41	A
I _{Cnom}			35	A
I _{CRM}			70	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	35	A
	T _j = 175 °C	T _s = 100 °C	28	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	39	A
	T _j = 175 °C	T _s = 100 °C	32	A
I _{FRM}			70	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		170	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	35	A
	T _j = 175 °C	T _s = 100 °C	28	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	39	A
	T _j = 175 °C	T _s = 100 °C	32	A
I _{FRM}			70	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		170	A
T _j			-40 ... 175	°C



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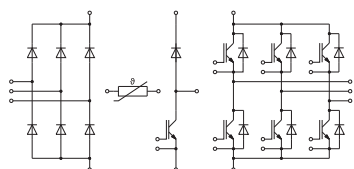
- Max. case temperature limited to $T_C = T_S = 125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$; $T_{j,op} > 150^\circ\text{C}$ during overload (Details see AN19-002)
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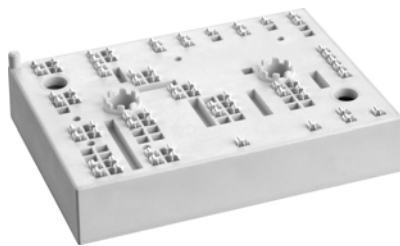
Symbol	Conditions		Values	Unit
Rectifier - Diode				
V _{RRM}	T _j = 25 °C		1600	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 70 °C	53	A
	T _j = 175 °C	T _s = 100 °C	42	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 70 °C	59	A
	T _j = 175 °C	T _s = 100 °C	47	A
I _{FSM}	t _p = 10 ms	T _j = 25 °C	370	A
	sin 180°	T _j = 150 °C	270	A
i ² t	t _p = 10 ms	T _j = 25 °C	685	A ² s
	sin 180°	T _j = 150 °C	365	A ² s
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					
$V_{CE(sat)}$	$I_C = 35 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.60	1.75	V
		$T_j = 150^\circ\text{C}$	1.78	1.93	V
		$T_j = 175^\circ\text{C}$	1.82	1.97	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$	1.00	1.05	V
		$T_j = 150^\circ\text{C}$	0.80	0.85	V
		$T_j = 175^\circ\text{C}$	0.75	0.80	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	17	20	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	28	31	$\text{m}\Omega$
		$T_j = 175^\circ\text{C}$	31	33	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 0.75 \text{ mA}$	5.15	5.8	6.45	V
I_{CES}	$V_{GE} = 0 \text{ V}$, $V_{CE} = 1200 \text{ V}$, $T_j = 25^\circ\text{C}$			1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	6.60		nF
C_{oes}		$f = 1 \text{ MHz}$	0.09		nF
C_{res}		$f = 1 \text{ MHz}$	0.02		nF
Q_G	$V_{GE} = -8 \text{ V} \dots +15 \text{ V}$		490		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		0		Ω
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $I_C = 35 \text{ A}$ $R_{G on} = 9.1 \Omega$ $R_{G off} = 9.1 \Omega$	$T_j = 25^\circ\text{C}$	37		ns
		$T_j = 150^\circ\text{C}$	39		ns
		$T_j = 175^\circ\text{C}$	40		ns
t_r	$V_{GE} = +15/-15 \text{ V}$	$T_j = 25^\circ\text{C}$	37		ns
		$T_j = 150^\circ\text{C}$	43		ns
		$T_j = 175^\circ\text{C}$	46		ns
E_{on}	@ $T_j = 150^\circ\text{C}$: $di/dt_{on} = 860 \text{ A}/\mu\text{s}$ $di/dt_{off} = 380 \text{ A}/\mu\text{s}$ $dv/dt = 3610 \text{ V}/\mu\text{s}$	$T_j = 25^\circ\text{C}$	2.8		mJ
		$T_j = 150^\circ\text{C}$	4		mJ
		$T_j = 175^\circ\text{C}$	4.2		mJ



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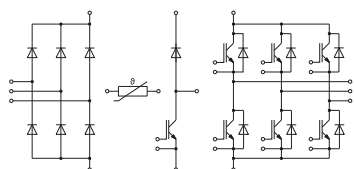
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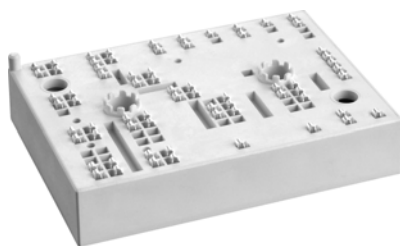
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Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
$t_{d(off)}$	$V_{CC} = 600\text{ V}$ $I_C = 35\text{ A}$ $R_{G\ on} = 9.1\ \Omega$ $R_{G\ off} = 9.1\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	231 321 346		ns
t_f	$V_{GE} = +15/-15\text{ V}$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	48 74 90		ns
E_{off}	@ $T_j = 150^\circ\text{C}$: $di/dt_{on} = 860\text{ A}/\mu\text{s}$ $di/dt_{off} = 380\text{ A}/\mu\text{s}$ $dv/dt = 3610\text{ V}/\mu\text{s}$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	2.3 3.9 4.2		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$		1.02		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$		0.85		K/W
Chopper - IGBT					
$V_{CE(sat)}$	$I_C = 35\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	1.60 1.78 1.82	1.75 1.93 1.97	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	1.00 0.80 0.75	1.05 0.85 0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	17 28 31	20 31 33	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 0.75\text{ mA}$		5.15	5.8	6.45
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_j = 25^\circ\text{C}$			1	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	6.60		nF
C_{oes}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	0.09		nF
C_{res}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	0.02		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		490		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		0		Ω
$t_{d(on)}$		$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	37 39 40		ns
t_r		$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	37 43 46		ns
E_{on}	$V_{CC} = 600\text{ V}$ $I_C = 35\text{ A}$ $R_{G\ on} = 9.1\ \Omega$ $R_{G\ off} = 9.1\ \Omega$ $V_{GE} = +15/-15\text{ V}$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	2.8 4 4.2		mJ
$t_{d(off)}$		$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	231 321 346		ns
t_f		$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	48 74 90		ns
E_{off}		$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$	2.3 3.9 4.2		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$		1.02		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$		0.85		K/W

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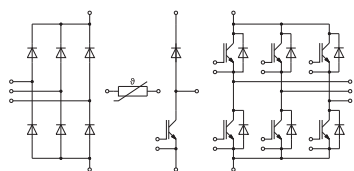
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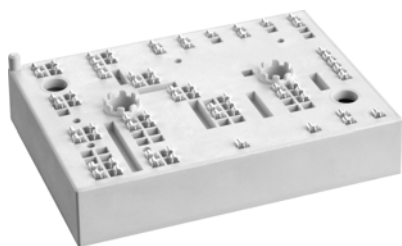
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- Rectifier Diode: D7 – D12

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
V _F = V _{EC}	I _F = 35 A	T _j = 25 °C		2.30	2.62	V
	V _{GE} = 0 V	T _j = 150 °C		2.29	2.62	V
	chiplevel	T _j = 175 °C		2.14	2.46	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		29	32	mΩ
	chiplevel	T _j = 150 °C		40	43	mΩ
		T _j = 175 °C		38	42	mΩ
I _{RRM}		T _j = 25 °C		22		A
		T _j = 150 °C		28		A
	V _{CC} = 600 V	T _j = 175 °C		33		A
Q _{rr}	I _F = 35 A	T _j = 25 °C		2		μC
	V _{GE} = -15 V	T _j = 150 °C		5.2		μC
	@ T _j = 150 °C:	T _j = 175 °C		5.7		μC
E _{rr}	di/dt _{off} = 870 A/μs	T _j = 25 °C		0.65		mJ
		T _j = 150 °C		2.1		mJ
		T _j = 175 °C		2.7		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.22		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.03		K/W
Freewheeling - Diode						
V _F = V _{EC}	I _F = 35 A	T _j = 25 °C		2.30	2.62	V
	V _{GE} = 0 V	T _j = 150 °C		2.29	2.62	V
	chiplevel	T _j = 175 °C		2.14	2.46	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		29	32	mΩ
	chiplevel	T _j = 150 °C		40	43	mΩ
		T _j = 175 °C		38	42	mΩ
I _{RRM}		T _j = 25 °C		22		A
		T _j = 150 °C		28		A
	V _{CC} = 600 V	T _j = 175 °C		33		A
Q _{rr}	I _F = 35 A	T _j = 25 °C		2		μC
	V _{GE} = -15 V	T _j = 150 °C		5.2		μC
	@ T _j = 150 °C:	T _j = 175 °C		5.7		μC
E _{rr}	di/dt _{off} = 870 A/μs	T _j = 25 °C		0.65		mJ
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R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.22		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.03		K/W



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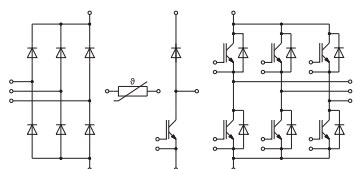
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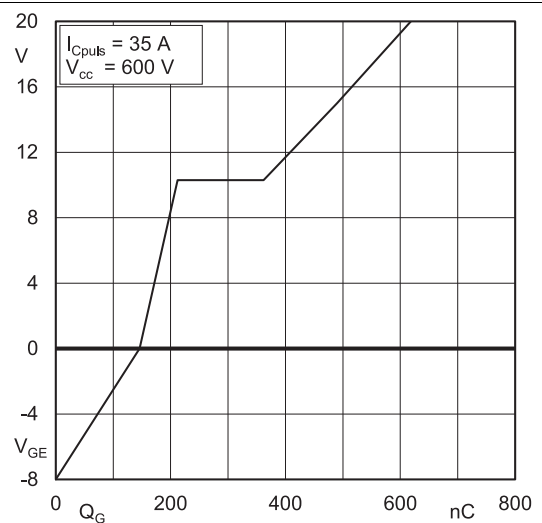
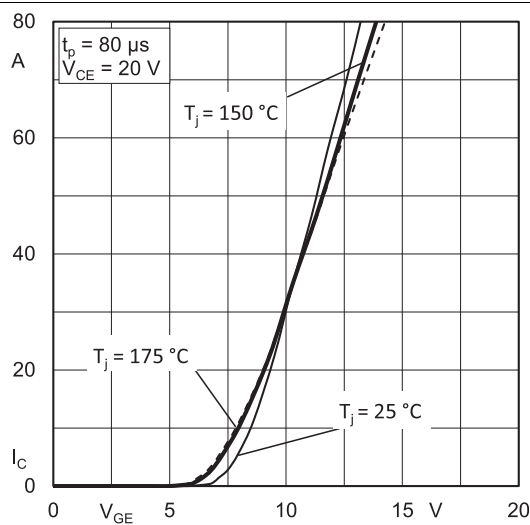
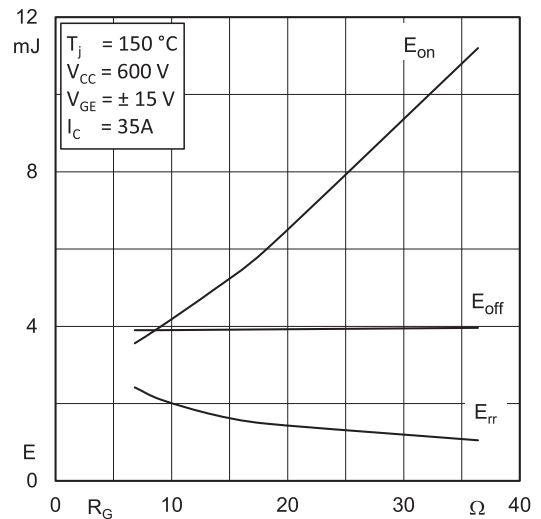
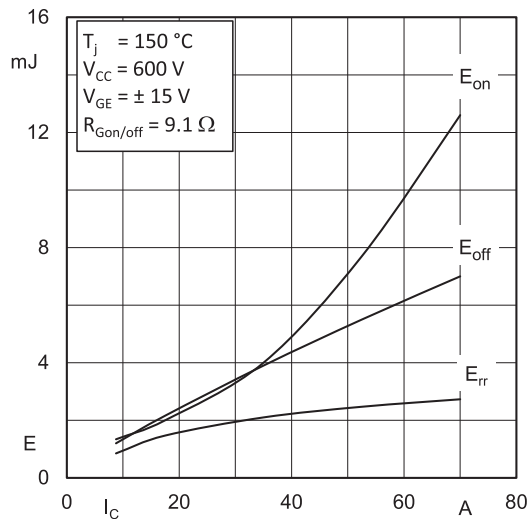
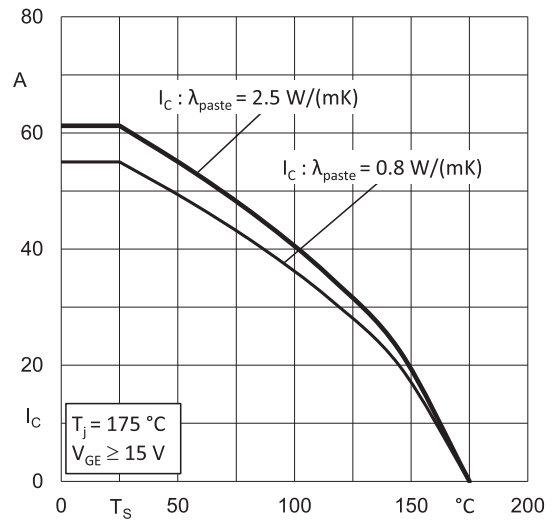
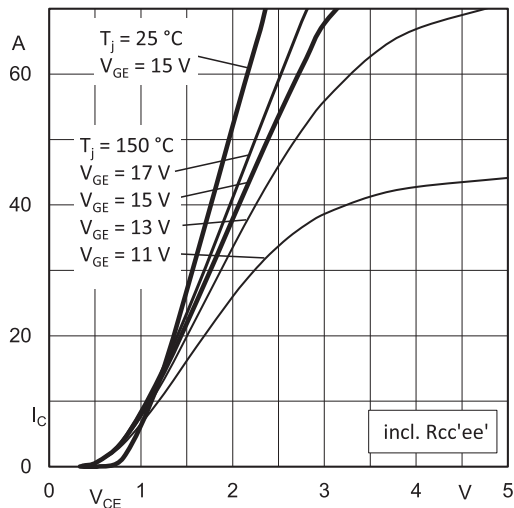
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Characteristics						
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Rectifier - Diode						
V _F	I _F = 13 A chiplevel	T _j = 25 °C		0.97	1.20	V
		T _j = 150 °C		0.84	1.07	V
		T _j = 175 °C		0.82	1.05	V
V _{F0}	chiplevel	T _j = 25 °C		0.89	1.09	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		6.2	8.5	mΩ
		T _j = 150 °C		8.8	12	mΩ
		T _j = 175 °C		10.0	13	mΩ
I _R	T _j = 150 °C, V _{RRM}				1.7	mA
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.26		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.08		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					



NAB



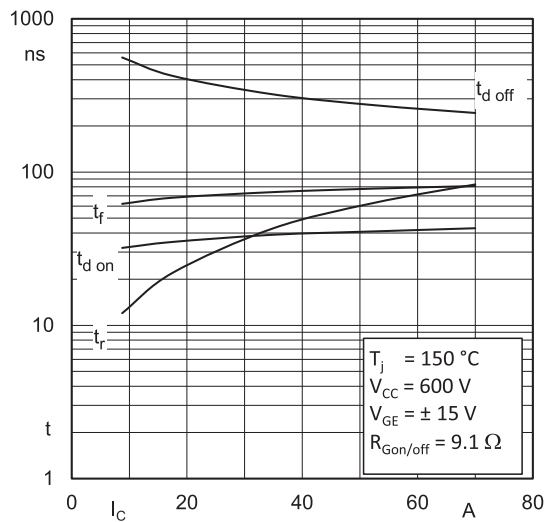


Fig. 7: Typ. switching times vs. I_C

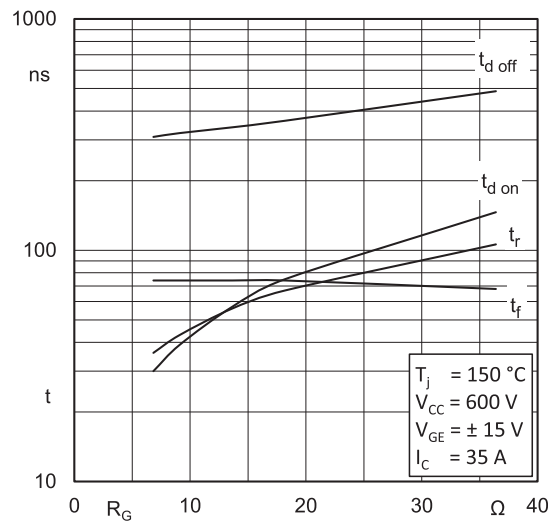


Fig. 8: Typ. switching times vs. gate resistor R_G

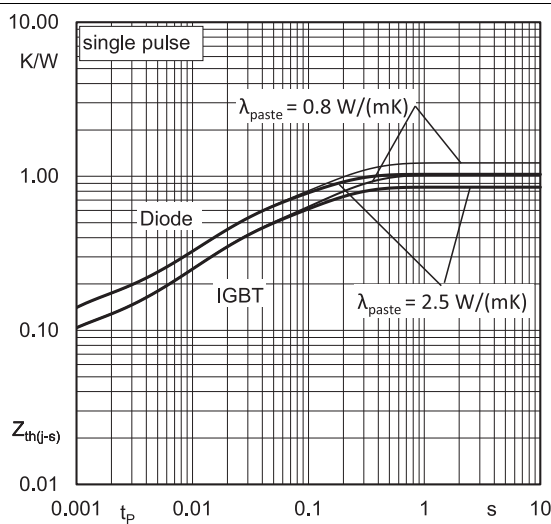


Fig. 9: Typ. transient thermal impedance

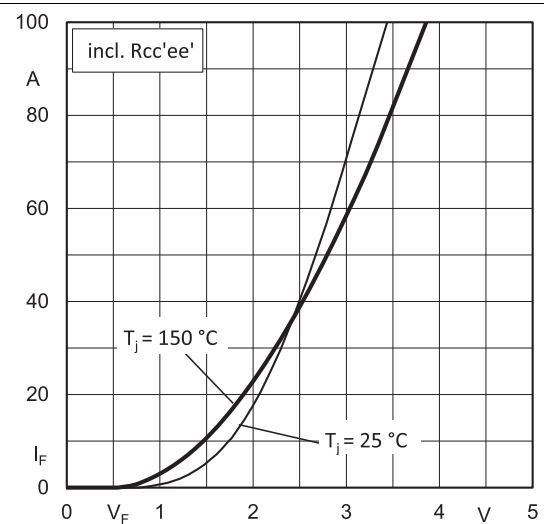


Fig. 10: Typ. CAL diode forward characteristic

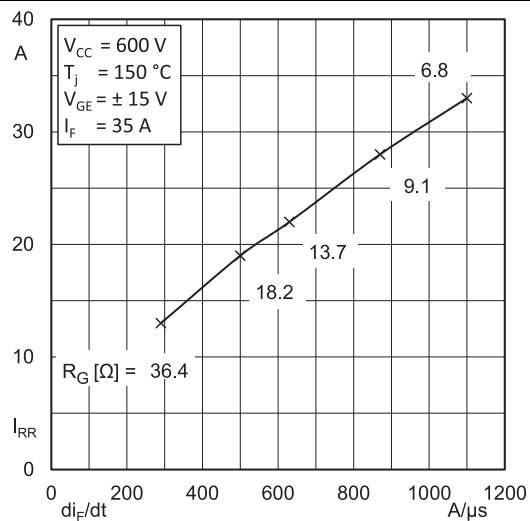


Fig. 11: Typ. CAL diode peak reverse recovery current

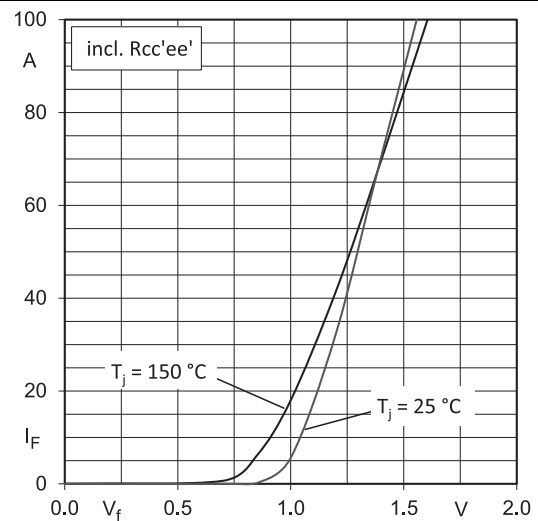
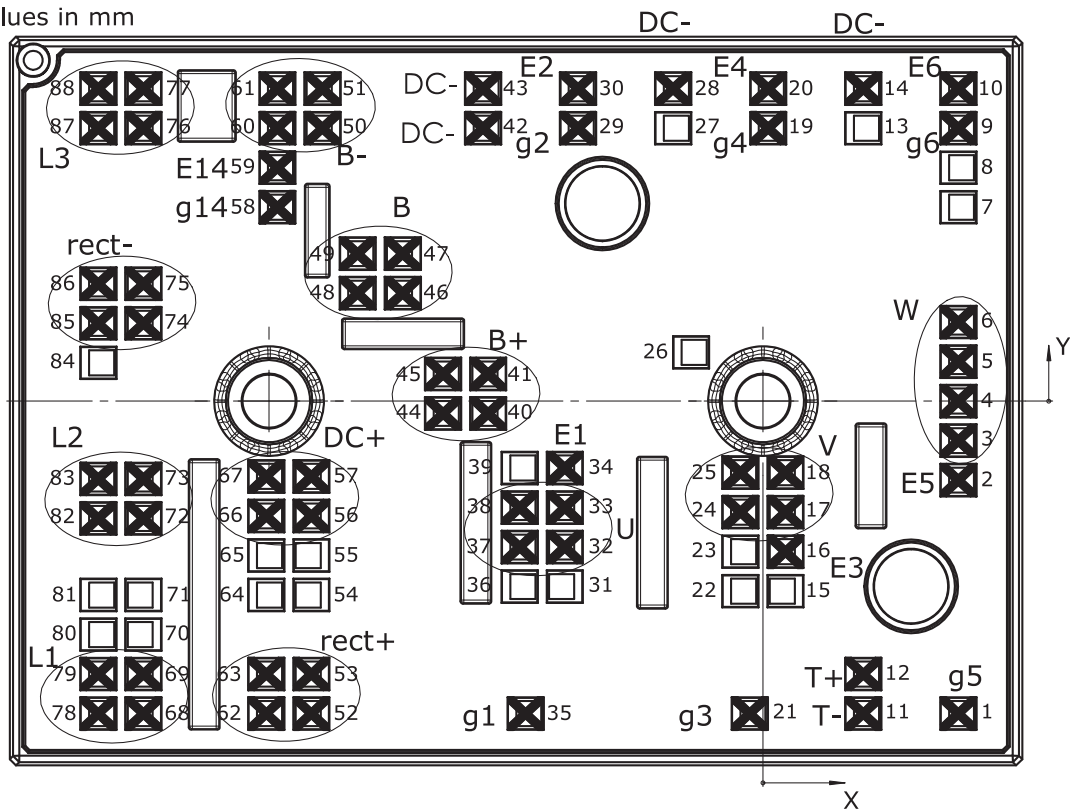


Fig. 12: Typ. input bridge forward characteristic

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	-19,70	-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



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