

SKiiP 12NAB12T7V1



MiniSKiiP® 1

3-phase Converter-Inverter-Brake (CIB)

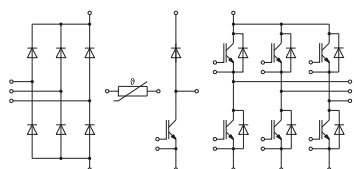
SKiiP 12NAB12T7V1

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

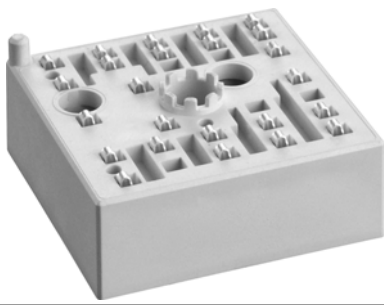
- Max. case temperature limited to $T_C = T_S = 125\text{ °C}$
- Product reliability results valid for $T_j \leq 150\text{ °C}$; $T_{j,op} > 150\text{ °C}$ during overload (Details see AN19-002)
- MiniSKiiP "Technical Explanations" and "Mounting Instructions" are part of the data sheet Please refer to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



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Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V_{CES}	$T_j = 25\text{ °C}$		1200	V
I_C	$\lambda_{paste} = 0.8\text{ W/(mK)}$	$T_s = 70\text{ °C}$	26	A
		$T_j = 175\text{ °C}$	22	A
I_C	$\lambda_{paste} = 2.5\text{ W/(mK)}$	$T_s = 70\text{ °C}$	29	A
		$T_j = 175\text{ °C}$	24	A
I_{Chom}			15	A
I_{CRM}			30	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 175\text{ °C}$	7	μs
T_j			-40 ... 175	$^{\circ}\text{C}$
Chopper - IGBT				
V_{CES}	$T_j = 25\text{ °C}$		1200	V
I_C	$\lambda_{paste} = 0.8\text{ W/(mK)}$	$T_s = 70\text{ °C}$	26	A
		$T_j = 175\text{ °C}$	22	A
I_C	$\lambda_{paste} = 2.5\text{ W/(mK)}$	$T_s = 70\text{ °C}$	29	A
		$T_j = 175\text{ °C}$	24	A
I_{Chom}			15	A
I_{CRM}			30	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 175\text{ °C}$	7	μs
T_j			-40 ... 175	$^{\circ}\text{C}$
Inverse - Diode				
V_{RRM}	$T_j = 25\text{ °C}$		1200	V
I_F	$\lambda_{paste} = 0.8\text{ W/(mK)}$	$T_s = 70\text{ °C}$	19	A
		$T_j = 175\text{ °C}$	16	A
I_F	$\lambda_{paste} = 2.5\text{ W/(mK)}$	$T_s = 70\text{ °C}$	21	A
		$T_j = 175\text{ °C}$	17	A
I_{FRM}			30	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^{\circ}, T_j = 150\text{ °C}$		65	A
T_j			-40 ... 175	$^{\circ}\text{C}$
Freewheeling - Diode				
V_{RRM}	$T_j = 25\text{ °C}$		1200	V
I_F	$\lambda_{paste} = 0.8\text{ W/(mK)}$	$T_s = 70\text{ °C}$	19	A
		$T_j = 175\text{ °C}$	16	A
I_F	$\lambda_{paste} = 2.5\text{ W/(mK)}$	$T_s = 70\text{ °C}$	21	A
		$T_j = 175\text{ °C}$	17	A
I_{FRM}			30	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^{\circ}, T_j = 150\text{ °C}$		65	A
T_j			-40 ... 175	$^{\circ}\text{C}$

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Features*

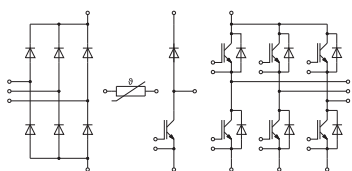
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- New SKR PEP diode technology for enhanced power and environmental robustness
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

Remarks

- Max. case temperature limited to $T_C = T_S = 125\text{ °C}$
- Product reliability results valid for $T_j \leq 150\text{ °C}$; $T_{j,op} > 150\text{ °C}$ during overload (Details see AN19-002)
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- Chopper IGBT: T14
- Inverse Diode: D1 – D6
- Freewheeling Diode: D13
- Rectifier Diode: D7 – D12

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Rectifier - Diode				
V_{RRM}	$T_j = 25\text{ °C}$		1600	V
I_F	$\lambda_{paste} = 0.8\text{ W/(mK)}$	$T_s = 70\text{ °C}$	41	A
		$T_s = 100\text{ °C}$	33	A
I_F	$\lambda_{paste} = 2.5\text{ W/(mK)}$	$T_s = 70\text{ °C}$	46	A
		$T_s = 100\text{ °C}$	37	A
I_{FSM}	$t_p = 10\text{ ms}$ $\sin 180^\circ$	$T_j = 25\text{ °C}$	220	A
		$T_j = 150\text{ °C}$	200	A
i^2t	$t_p = 10\text{ ms}$ $\sin 180^\circ$	$T_j = 25\text{ °C}$	242	A^2s
		$T_j = 150\text{ °C}$	200	A^2s
T_j			-40 ... 175	$^\circ\text{C}$
Module				
$I_{t(RMS)}$	$T_{terminal} = 80\text{ °C}$, 20 A per spring		20	A
T_{stg}	module without TIM		-40 ... 125	$^\circ\text{C}$
V_{isol}	AC sinus 50 Hz, 1 min		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$V_{CE(sat)}$	$I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25\text{ °C}$	1.60	1.75		V
		$T_j = 150\text{ °C}$	1.78	1.93		V
		$T_j = 175\text{ °C}$	1.82	1.97		V
V_{CE0}	chipelevel	$T_j = 25\text{ °C}$	1.00	1.05		V
		$T_j = 150\text{ °C}$	0.80	0.85		V
		$T_j = 175\text{ °C}$	0.75	0.80		V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25\text{ °C}$	40	47		$m\Omega$
		$T_j = 150\text{ °C}$	65	72		$m\Omega$
		$T_j = 175\text{ °C}$	71	78		$m\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 0.33\text{ mA}$		5.15	5.8	6.45	V
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_j = 25\text{ °C}$				1	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	2.80			nF
C_{oes}		$f = 1\text{ MHz}$	0.04			nF
C_{res}		$f = 1\text{ MHz}$	0.01			nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		210			nC
R_{Gint}	$T_j = 25\text{ °C}$		0			Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 15\text{ A}$ $R_{G on} = 21.3\text{ }\Omega$ $R_{G off} = 21.3\text{ }\Omega$	$T_j = 25\text{ °C}$	43			ns
		$T_j = 150\text{ °C}$	44			ns
		$T_j = 175\text{ °C}$	46			ns
t_r	$V_{GE} = +15/-15\text{ V}$	$T_j = 25\text{ °C}$	38			ns
		$T_j = 150\text{ °C}$	44			ns
		$T_j = 175\text{ °C}$	47			ns
E_{on}	@ $T_j = 150\text{ °C}$: $di/dt_{on} = 320\text{ A}/\mu\text{s}$ $di/dt_{off} = 180\text{ A}/\mu\text{s}$ $dv/dt = 3590\text{ V}/\mu\text{s}$	$T_j = 25\text{ °C}$	1.2			mJ
		$T_j = 150\text{ °C}$	1.7			mJ
		$T_j = 175\text{ °C}$	1.8			mJ



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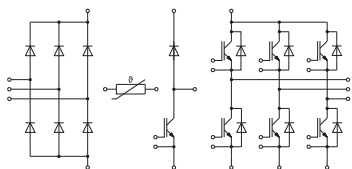
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Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
$t_{d(off)}$	$V_{CC} = 600\text{ V}$ $I_C = 15\text{ A}$ $R_{G\ on} = 21.3\ \Omega$ $R_{G\ off} = 21.3\ \Omega$	$T_j = 25\text{ °C}$	205		ns
		$T_j = 150\text{ °C}$	295		ns
		$T_j = 175\text{ °C}$	320		ns
t_f	$V_{GE} = +15/-15\text{ V}$	$T_j = 25\text{ °C}$	44		ns
		$T_j = 150\text{ °C}$	66		ns
		$T_j = 175\text{ °C}$	85		ns
E_{off}	@ $T_j = 150\text{ °C}$: $di/dt_{on} = 320\text{ A}/\mu\text{s}$ $di/dt_{off} = 180\text{ A}/\mu\text{s}$ $dv/dt = 3590\text{ V}/\mu\text{s}$	$T_j = 25\text{ °C}$	0.98		mJ
		$T_j = 150\text{ °C}$	1.7		mJ
		$T_j = 175\text{ °C}$	1.8		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$		1.4		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$		1.2		K/W
Chopper - IGBT					
$V_{CE(sat)}$	$I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25\text{ °C}$	1.60	1.75	V
		$T_j = 150\text{ °C}$	1.78	1.93	V
		$T_j = 175\text{ °C}$	1.82	1.97	V
V_{CE0}	chipelevel	$T_j = 25\text{ °C}$	1.00	1.05	V
		$T_j = 150\text{ °C}$	0.80	0.85	V
		$T_j = 175\text{ °C}$	0.75	0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25\text{ °C}$	40	47	m Ω
		$T_j = 150\text{ °C}$	65	72	m Ω
		$T_j = 175\text{ °C}$	71	78	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 0.33\text{ mA}$	5.15	5.8	6.45	V
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_j = 25\text{ °C}$			1	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	2.80		nF
C_{oes}		$f = 1\text{ MHz}$	0.04		nF
C_{res}		$f = 1\text{ MHz}$	0.01		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		210		nC
R_{Gint}	$T_j = 25\text{ °C}$		0		Ω
$t_{d(on)}$		$T_j = 25\text{ °C}$	43		ns
		$T_j = 150\text{ °C}$	44		ns
		$T_j = 175\text{ °C}$	46		ns
t_r	$V_{CC} = 600\text{ V}$ $I_C = 15\text{ A}$ $R_{G\ on} = 21.3\ \Omega$ $R_{G\ off} = 21.3\ \Omega$ $V_{GE} = +15/-15\text{ V}$	$T_j = 25\text{ °C}$	38		ns
		$T_j = 150\text{ °C}$	44		ns
		$T_j = 175\text{ °C}$	47		ns
E_{on}	$R_{G\ on} = 21.3\ \Omega$ $R_{G\ off} = 21.3\ \Omega$ $V_{GE} = +15/-15\text{ V}$	$T_j = 25\text{ °C}$	1.2		mJ
		$T_j = 150\text{ °C}$	1.7		mJ
		$T_j = 175\text{ °C}$	1.8		mJ
$t_{d(off)}$		$T_j = 25\text{ °C}$	205		ns
		$T_j = 150\text{ °C}$	295		ns
		$T_j = 175\text{ °C}$	320		ns
t_f	$di/dt_{on} = 320\text{ A}/\mu\text{s}$ $di/dt_{off} = 180\text{ A}/\mu\text{s}$ $dv/dt = 3590\text{ V}/\mu\text{s}$	$T_j = 25\text{ °C}$	44		ns
		$T_j = 150\text{ °C}$	66		ns
		$T_j = 175\text{ °C}$	85		ns
E_{off}	@ $T_j = 150\text{ °C}$: $di/dt_{on} = 320\text{ A}/\mu\text{s}$ $di/dt_{off} = 180\text{ A}/\mu\text{s}$ $dv/dt = 3590\text{ V}/\mu\text{s}$	$T_j = 25\text{ °C}$	0.98		mJ
		$T_j = 150\text{ °C}$	1.7		mJ
		$T_j = 175\text{ °C}$	1.8		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$		1.4		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$		1.2		K/W

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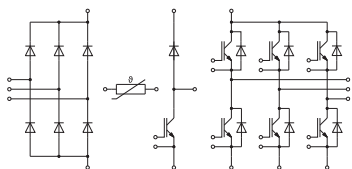
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- Inverse Diode: D1 – D6
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
$V_F = V_{EC}$	$I_F = 15\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25\text{ °C}$		2.38	2.71	V
		$T_j = 150\text{ °C}$		2.44	2.77	V
		$T_j = 175\text{ °C}$		2.26	2.58	V
V_{F0}	chipelevel	$T_j = 25\text{ °C}$		1.30	1.50	V
		$T_j = 150\text{ °C}$		0.90	1.10	V
		$T_j = 175\text{ °C}$		0.82	0.98	V
r_F	chipelevel	$T_j = 25\text{ °C}$		72	81	mΩ
		$T_j = 150\text{ °C}$		103	111	mΩ
		$T_j = 175\text{ °C}$		96	107	mΩ
I_{RRM}		$T_j = 25\text{ °C}$		9		A
		$T_j = 150\text{ °C}$		11		A
		$T_j = 175\text{ °C}$		13		A
Q_{rr}	$V_{CC} = 600\text{ V}$ $I_F = 15\text{ A}$ $V_{GE} = -15\text{ V}$	$T_j = 25\text{ °C}$		0.9		μC
		$T_j = 150\text{ °C}$		2.1		μC
		$T_j = 175\text{ °C}$		2.4		μC
E_{rr}	@ $T_j = 150\text{ °C}$: $di/dt_{off} = 350\text{ A/μs}$	$T_j = 25\text{ °C}$		0.29		mJ
		$T_j = 150\text{ °C}$		0.86		mJ
		$T_j = 175\text{ °C}$		1.1		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8\text{ W/(mK)}$			1.78		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5\text{ W/(mK)}$			1.53		K/W
Freewheeling - Diode						
$V_F = V_{EC}$	$I_F = 15\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25\text{ °C}$		2.38	2.71	V
		$T_j = 150\text{ °C}$		2.44	2.77	V
		$T_j = 175\text{ °C}$		2.26	2.58	V
V_{F0}	chipelevel	$T_j = 25\text{ °C}$		1.30	1.50	V
		$T_j = 150\text{ °C}$		0.90	1.10	V
		$T_j = 175\text{ °C}$		0.82	0.98	V
r_F	chipelevel	$T_j = 25\text{ °C}$		72	81	mΩ
		$T_j = 150\text{ °C}$		103	111	mΩ
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I_{RRM}		$T_j = 25\text{ °C}$		9		A
		$T_j = 150\text{ °C}$		11		A
		$T_j = 175\text{ °C}$		13		A
Q_{rr}	$V_{CC} = 600\text{ V}$ $I_F = 15\text{ A}$ $V_{GE} = -15\text{ V}$	$T_j = 25\text{ °C}$		0.9		μC
		$T_j = 150\text{ °C}$		2.1		μC
		$T_j = 175\text{ °C}$		2.4		μC
E_{rr}	@ $T_j = 150\text{ °C}$: $di/dt_{off} = 350\text{ A/μs}$	$T_j = 25\text{ °C}$		0.29		mJ
		$T_j = 150\text{ °C}$		0.86		mJ
		$T_j = 175\text{ °C}$		1.1		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8\text{ W/(mK)}$			1.78		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5\text{ W/(mK)}$			1.53		K/W



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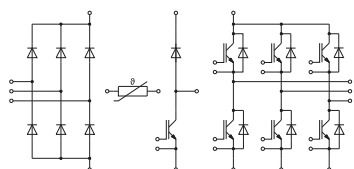
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V_F	$I_F = 8\text{ A}$ chiplevel	$T_j = 25\text{ °C}$		0.97	1.20	V
		$T_j = 150\text{ °C}$		0.84	1.07	V
		$T_j = 175\text{ °C}$		0.82	1.05	V
V_{F0}	chiplevel	$T_j = 25\text{ °C}$		0.89	1.09	V
		$T_j = 150\text{ °C}$		0.73	0.92	V
		$T_j = 175\text{ °C}$		0.69	0.88	V
r_F	chiplevel	$T_j = 25\text{ °C}$		10	14	mΩ
		$T_j = 150\text{ °C}$		14	19	mΩ
		$T_j = 175\text{ °C}$		16	21	mΩ
I_R	$T_j = 150\text{ °C}, V_{RRM}$				1.7	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8\text{ W/(mK)}$			1.44		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5\text{ W/(mK)}$			1.23		K/W
Module						
M_s	to heat sink		2		2.5	Nm
w				30		g
L_{CE}				-		nH
Temperature Sensor						
R_{100}	$T_j = 100\text{ °C}$ ($R_{25} = 1000\text{ Ω}$)			$1670 \pm 3\%$		Ω
$R_{(T)}$	$R_{(T)} = 1000\text{ Ω} [1 + A(T - 25\text{ °C}) + B(T - 25\text{ °C})^2]$, $A = 7.635 \cdot 10^{-3}\text{ °C}^{-1}$, $B = 1.731 \cdot 10^{-5}\text{ °C}^{-2}$					

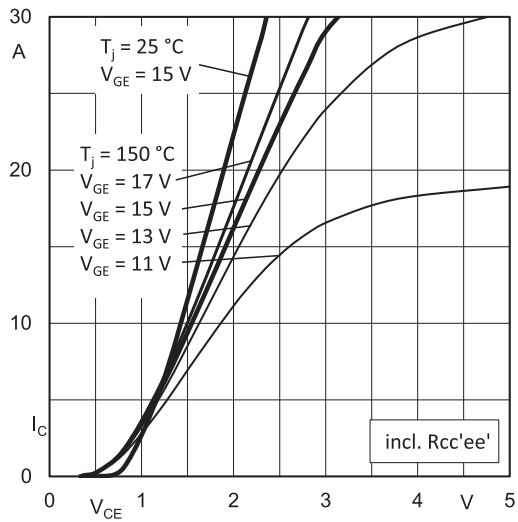


Fig. 1: Typ. output characteristic

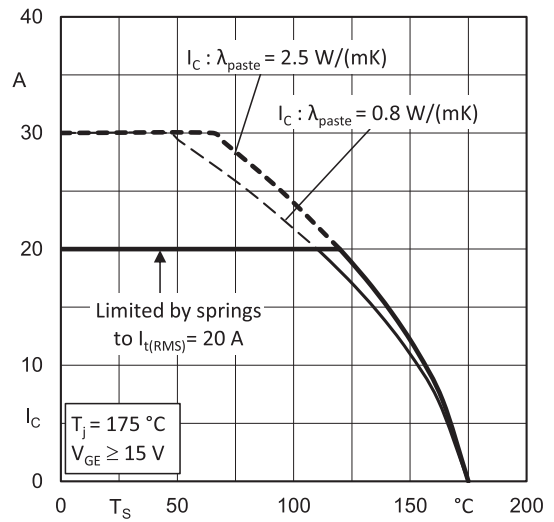


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_s)$

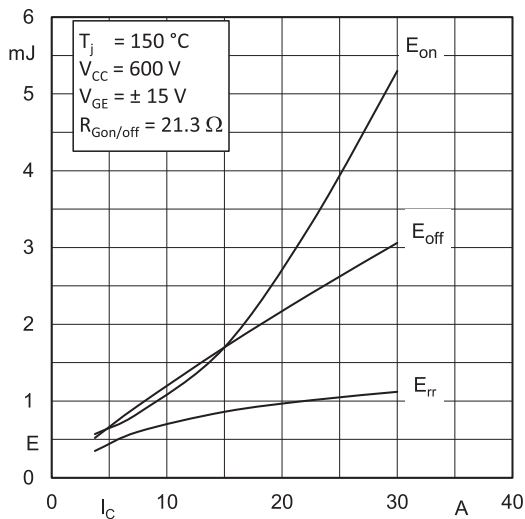


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

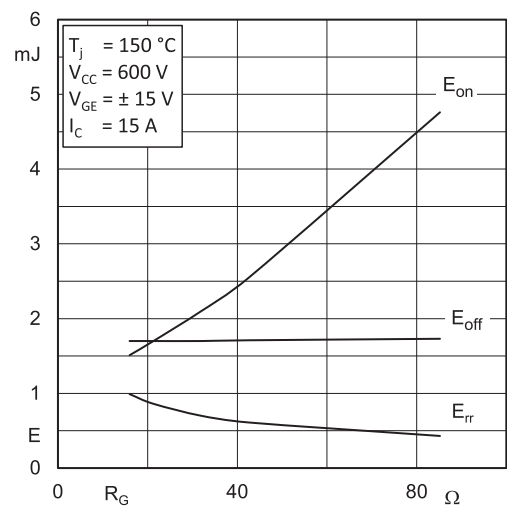


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

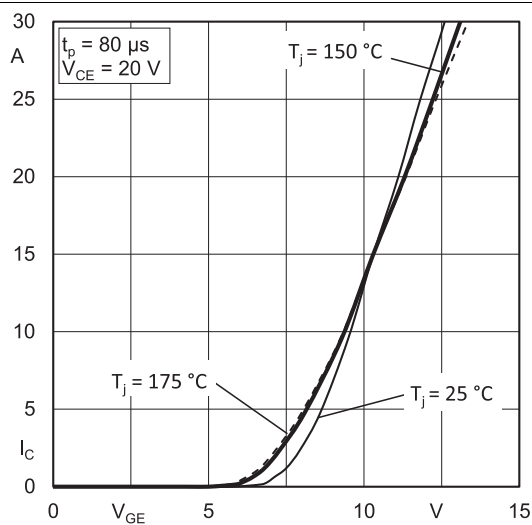


Fig. 5: Typ. transfer characteristic

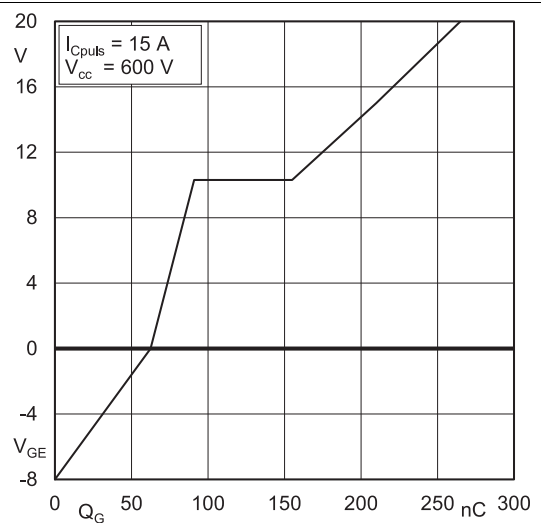


Fig. 6: Typ. gate charge characteristic

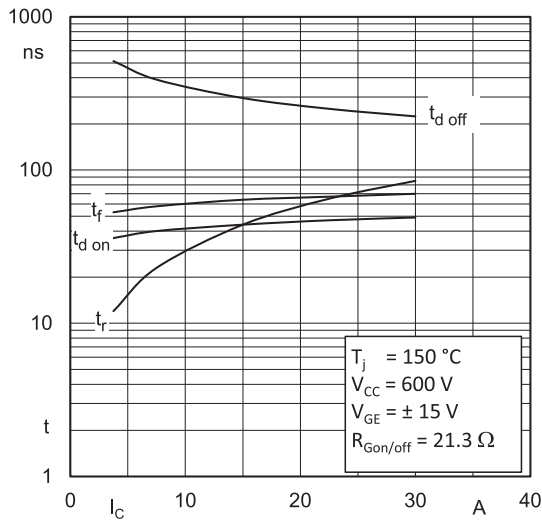


Fig. 7: Typ. switching times vs. I_C

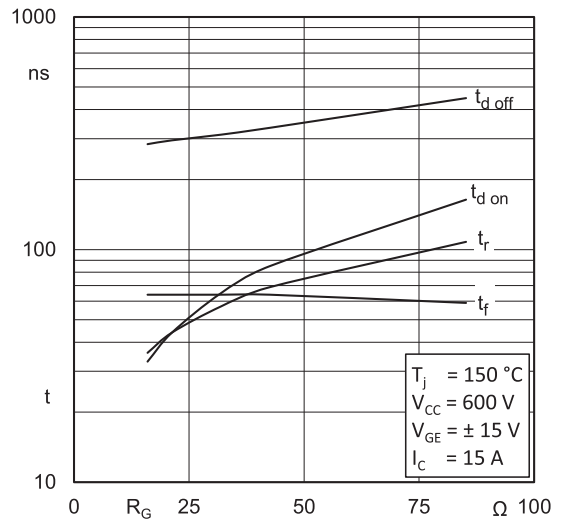


Fig. 8: Typ. switching times vs. gate resistor R_G

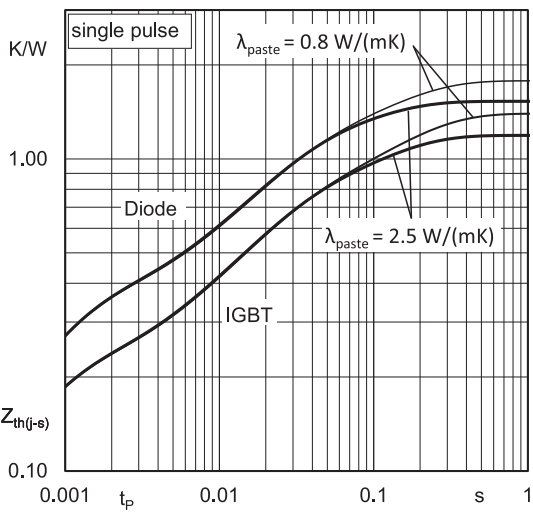


Fig. 9: Typ. transient thermal impedance

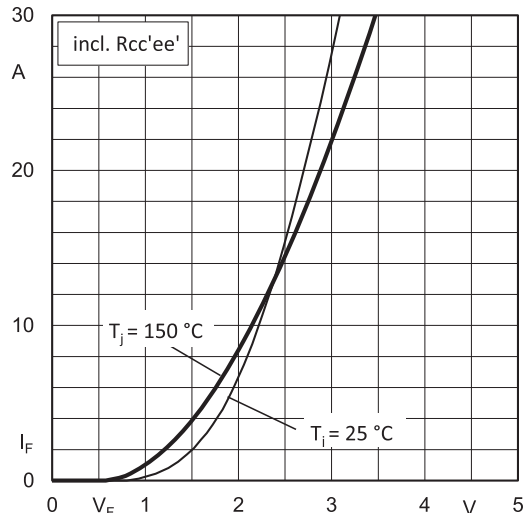


Fig. 10: Typ. CAL diode forward characteristic

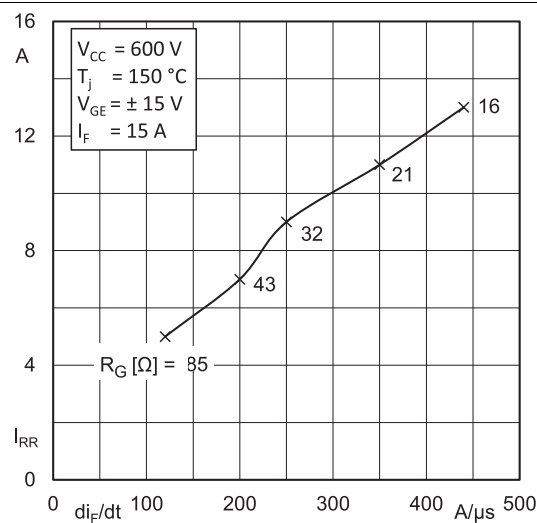


Fig. 11: Typ. CAL diode peak reverse recovery current

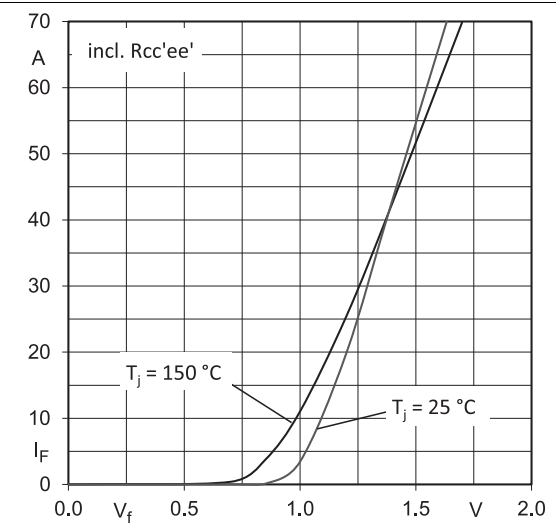
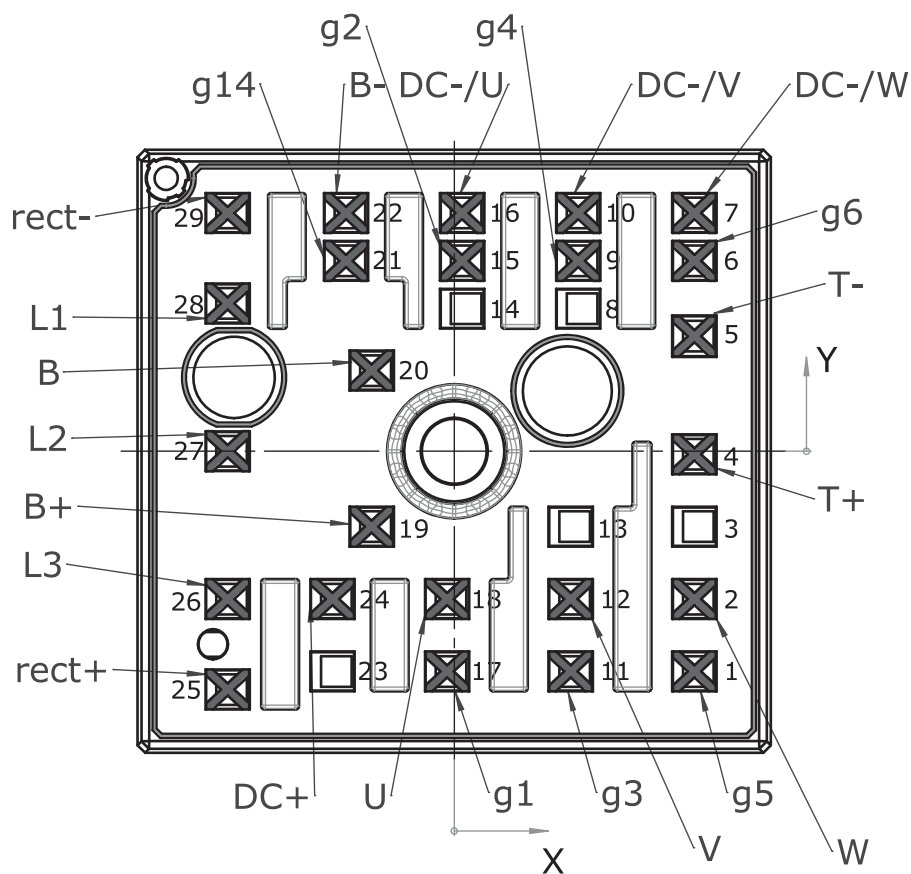
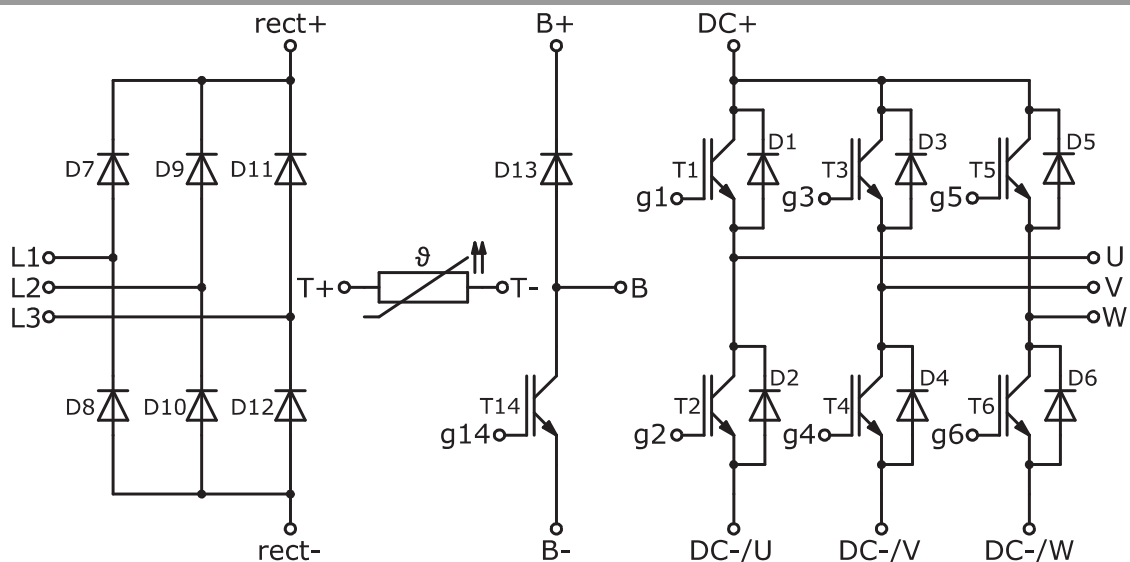


Fig. 12: Typ. input bridge forward characteristic

Pin out							
Pin	X	Y	Function	Pin	X	Y	Function
1	15,93	-14,60	g5	16	0,53	15,80	DC-/U
2	15,93	-9,80	W	17	-0,48	-14,60	g1
3				18	-0,48	-9,80	U
4	15,93	-0,20	T+	19	-5,48	-5,0	B+
5	15,93	7,63	T-	20	-5,48	5,35	B
6	15,93	12,63	g6	21	-7,18	12,63	g14
7	15,93	15,80	DC-/W	22	-7,18	15,80	B-
8				23			
9	8,23	12,63	g4	24	-8,08	-9,80	DC+
10	8,23	15,80	DC-/V	25	-15,03	-15,80	rect+
11	7,73	-14,60	g3	26	-15,03	-9,80	L3
12	7,73	-9,80	V	27	-15,03	0	L2
13				28	-15,03	9,80	L1
14				29	-15,03	15,80	rect-
15	0,53	12,63	g2				

all values in mm





Pinout

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

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