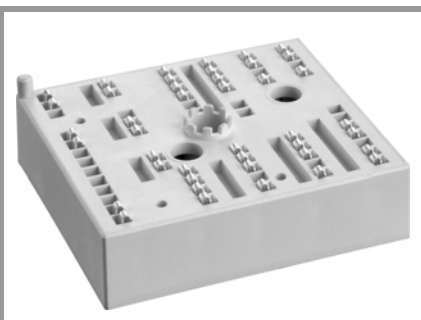


# SKiiP 24NAB12T4V4



MiniSKiiP® 2

## Converter-Inverter-Brake (CIB)

### SKiiP 24NAB12T4V4

#### Features\*

- Trench 4 IGBTs
- Robust and soft switching freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

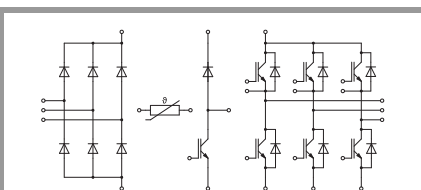
#### Typical Applications

- Inverter up to 22 kVA
- Typical motor power 11 kW

#### Remarks

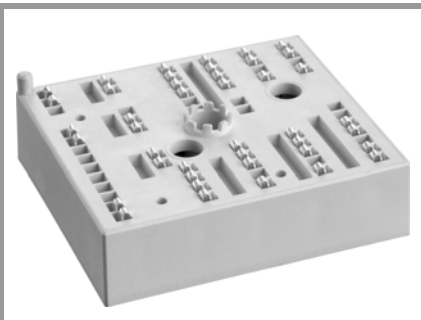
- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$  (recommended  $T_{j,op} = -40 \dots +150^\circ\text{C}$ )
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"
- Chopper is limited to  $I_{t(RMS)} = 20\text{A}$  (one spring only)
- All graphs are referring to inverter/rectifier part

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>Inverter - IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$		1200	V
$I_C$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	48	A
		$T_j = 175^\circ\text{C}$	39	A
$I_C$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	53	A
		$T_j = 175^\circ\text{C}$	43	A
$I_{Chom}$			35	A
$I_{CRM}$			105	A
$V_{GES}$			-20 ... 20	V
$t_{psc}$	$V_{CC} = 800\text{ V}$	$T_j = 150^\circ\text{C}$	10	$\mu\text{s}$
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Chopper - IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$		1200	V
$I_C$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	39	A
		$T_j = 175^\circ\text{C}$	32	A
$I_C$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	43	A
		$T_j = 175^\circ\text{C}$	35	A
$I_{Chom}$			25	A
$I_{CRM}$			75	A
$V_{GES}$			-20 ... 20	V
$t_{psc}$	$V_{CC} = 800\text{ V}$	$T_j = 150^\circ\text{C}$	10	$\mu\text{s}$
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Inverse - Diode</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$		1200	V
$I_F$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	40	A
		$T_j = 175^\circ\text{C}$	32	A
$I_F$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	44	A
		$T_j = 175^\circ\text{C}$	35	A
$I_{FRM}$			70	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 150^\circ\text{C}$		170	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Freewheeling - Diode</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$		1200	V
$I_F$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	33	A
		$T_j = 175^\circ\text{C}$	27	A
$I_F$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	36	A
		$T_j = 175^\circ\text{C}$	29	A
$I_{FRM}$			50	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 150^\circ\text{C}$		100	A
$T_j$			-40 ... 175	$^\circ\text{C}$



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# SKiiP 24NAB12T4V4



MiniSKiiP® 2

## Converter-Inverter-Brake (CIB)

### SKiiP 24NAB12T4V4

#### Features\*

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- Robust and soft switching freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

#### Typical Applications

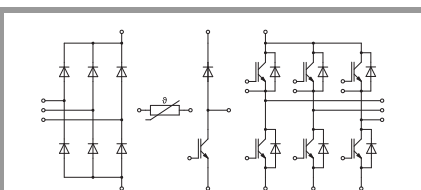
- Inverter up to 22 kVA
- Typical motor power 11 kW

#### Remarks

- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$  (recommended  $T_{j,op} = -40 \dots +150^\circ\text{C}$ )
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"
- Chopper is limited to  $I_{t(RMS)} = 20\text{A}$  (one spring only)
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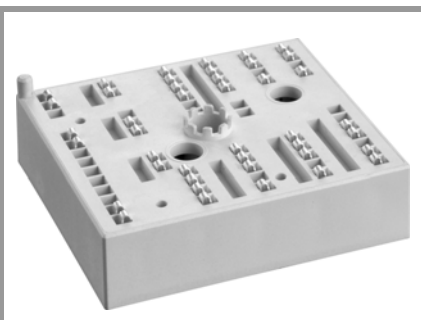
Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>Rectifier - Diode</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$		1600	V
$I_F$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	52	A
		$T_j = 150^\circ\text{C}$	39	A
$I_F$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	57	A
		$T_j = 150^\circ\text{C}$	43	A
$I_{FSM}$	$t_p = 10\text{ ms}$ $\sin 180^\circ$	$T_j = 25^\circ\text{C}$	370	A
		$T_j = 150^\circ\text{C}$	270	A
$i^2t$	$t_p = 10\text{ ms}$ $\sin 180^\circ$	$T_j = 25^\circ\text{C}$	685	$\text{A}^2\text{s}$
		$T_j = 150^\circ\text{C}$	365	$\text{A}^2\text{s}$
$T_j$			-40 ... 150	$^\circ\text{C}$
<b>Module</b>				
$I_{t(RMS)}$	$T_{terminal} = 80^\circ\text{C}$ , 20 A per spring		40	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
<b>Inverter - IGBT</b>						
$V_{CE(sat)}$	$I_C = 35\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.85	2.10		V
		$T_j = 150^\circ\text{C}$	2.25	2.45		V
$V_{CE0}$	chipelevel	$T_j = 25^\circ\text{C}$	0.80	0.90		V
		$T_j = 150^\circ\text{C}$	0.70	0.80		V
$r_{CE}$	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	30	34		$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	44	47		$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}$ , $I_C = 1.2\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ , $V_{CE} = 1200\text{ V}$ , $T_j = 25^\circ\text{C}$				1	$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	1.95			$\text{nF}$
$C_{oes}$		$f = 1\text{ MHz}$	0.16			$\text{nF}$
$C_{res}$		$f = 1\text{ MHz}$	0.12			$\text{nF}$
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		200			$\text{nC}$
$R_{Gint}$	$T_j = 25^\circ\text{C}$		0			$\Omega$
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 35\text{ A}$	$T_j = 150^\circ\text{C}$	30			ns
$t_r$		$T_j = 150^\circ\text{C}$	35			ns
$E_{on}$	$R_{G\ on} = 18\ \Omega$ $R_{G\ off} = 18\ \Omega$	$T_j = 150^\circ\text{C}$	4.3			$\text{mJ}$
$t_{d(off)}$		$T_j = 150^\circ\text{C}$	300			ns
$t_f$	$\text{di}/\text{dt}_{on} = 830\text{ A}/\mu\text{s}$ $\text{di}/\text{dt}_{off} = 600\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	55			ns
$E_{off}$	$V_{GE} = +15/-15\text{ V}$		3.25			$\text{mJ}$
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W/(mK)}$		1			$\text{K/W}$
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W/(mK)}$		0.82			$\text{K/W}$



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# SKiiP 24NAB12T4V4



MiniSKiiP® 2

## Converter-Inverter-Brake (CIB)

### SKiiP 24NAB12T4V4

#### Features\*

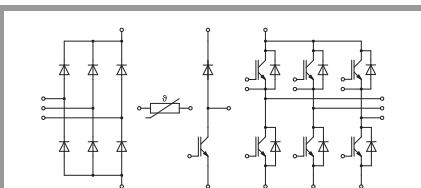
- Trench 4 IGBTs
- Robust and soft switching freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognized: File no. E63532

#### Typical Applications

- Inverter up to 22 kVA
- Typical motor power 11 kW

#### Remarks

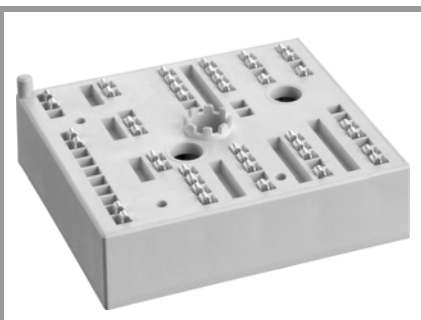
- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$  (recommended  $T_{j,op} = -40 \dots +150^\circ\text{C}$ )
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"
- Chopper is limited to  $I_{t(RMS)} = 20\text{A}$  (one spring only)
- All graphs are referring to inverter/rectifier part



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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Chopper - IGBT</b>						
$V_{CE(sat)}$	$I_C = 25\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.85	2.10	V	
		$T_j = 150^\circ\text{C}$	2.25	2.45	V	
$V_{CE0}$	chipllevel	$T_j = 25^\circ\text{C}$	0.80	0.90	V	
		$T_j = 150^\circ\text{C}$	0.70	0.80	V	
$r_{CE}$	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	42	48	m $\Omega$	
		$T_j = 150^\circ\text{C}$	62	66	m $\Omega$	
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.85\text{ mA}$		5.3	5.8	6.3	V
$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				1	mA
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	1.45		nF	
$C_{oes}$		$f = 1\text{ MHz}$	0.12		nF	
$C_{res}$		$f = 1\text{ MHz}$	0.05		nF	
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		142		nC	
$R_{Gint}$	$T_j = 25^\circ\text{C}$		0		$\Omega$	
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 35\text{ A}$	$T_j = 150^\circ\text{C}$	12		ns	
$t_r$	$R_{Gon} = 18\ \Omega$ $R_{Goff} = 18\ \Omega$	$T_j = 150^\circ\text{C}$	55		ns	
$E_{on}$		$T_j = 150^\circ\text{C}$	4.5		mJ	
$t_{d(off)}$	$di/dt_{on} = 710\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	300		ns	
$t_f$	$di/dt_{off} = 400\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	72		ns	
$E_{off}$	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	3.9		mJ	
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$		1.1		K/W	
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$		0.92		K/W	
<b>Inverse - Diode</b>						
$V_F = V_{EC}$	$I_F = 35\text{ A}$ $V_{GE} = 0\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	2.30	2.62	V	
		$T_j = 150^\circ\text{C}$	2.29	2.62	V	
$V_{F0}$	chipllevel	$T_j = 25^\circ\text{C}$	1.30	1.50	V	
		$T_j = 150^\circ\text{C}$	0.90	1.10	V	
$r_F$	chipllevel	$T_j = 25^\circ\text{C}$	29	32	m $\Omega$	
		$T_j = 150^\circ\text{C}$	40	43	m $\Omega$	
$I_{RRM}$	$I_F = 35\text{ A}$	$T_j = 150^\circ\text{C}$	34		A	
$Q_{rr}$	$di/dt_{off} = 1250\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$	5.6		$\mu\text{C}$	
$E_{rr}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	2.4		mJ	
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$		1.4		K/W	
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$		1.2		K/W	
<b>Freewheeling - Diode</b>						
$V_F = V_{EC}$	$I_F = 25\text{ A}$ $V_{GE} = 0\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	2.41	2.74	V	
		$T_j = 150^\circ\text{C}$	2.45	2.79	V	
$V_{F0}$	chipllevel	$T_j = 25^\circ\text{C}$	1.30	1.50	V	
		$T_j = 150^\circ\text{C}$	0.90	1.10	V	
$r_F$	chipllevel	$T_j = 25^\circ\text{C}$	44	50	m $\Omega$	
		$T_j = 150^\circ\text{C}$	62	68	m $\Omega$	
$I_{RRM}$	$I_F = 25\text{ A}$	$T_j = 150^\circ\text{C}$	30		A	
$Q_{rr}$	$di/dt_{off} = 1160\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$	5		$\mu\text{C}$	
$E_{rr}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	2		mJ	
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$		1.44		K/W	
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$		1.22		K/W	

# SKiiP 24NAB12T4V4



MiniSKiiP® 2

## Converter-Inverter-Brake (CIB)

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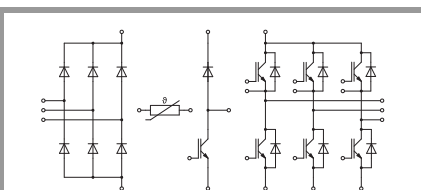
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- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"
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- All graphs are referring to inverter/rectifier part

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Rectifier - Diode</b>						
$V_F = V_{EC}$	$I_F = 13\text{ A}$ chipelevel	$T_j = 25^\circ\text{C}$		1.00	1.21	V
		$T_j = 125^\circ\text{C}$		0.90	1.10	V
$V_{F0}$	chipelevel	$T_j = 25^\circ\text{C}$		0.88	0.98	V
		$T_j = 125^\circ\text{C}$		0.73	0.83	V
$r_F$	chipelevel	$T_j = 25^\circ\text{C}$		9.2	18	m $\Omega$
		$T_j = 125^\circ\text{C}$		13	21	m $\Omega$
$I_R$	$T_j = 145^\circ\text{C}, V_{RRM}$				1.1	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W/(mK)}$			1.25		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W/(mK)}$			1.1		K/W
<b>Module</b>						
$M_s$	to heat sink		2		2.5	Nm
$W$				55		g
$L_{CE}$				-		nH
<b>Temperature Sensor</b>						
$R_{100}$	$T_r=100^\circ\text{C}$ ( $R_{25}=1000\Omega$ )			1670 $\pm$ 3%		$\Omega$
$R_{(T)}$	$R_{(T)}=1000\Omega[1+A(T-25^\circ\text{C})+B(T-25^\circ\text{C})^2]$ , $A = 7.635 \cdot 10^{-3} \text{ }^\circ\text{C}^{-1}$ , $B = 1.731 \cdot 10^{-5} \text{ }^\circ\text{C}^{-2}$					



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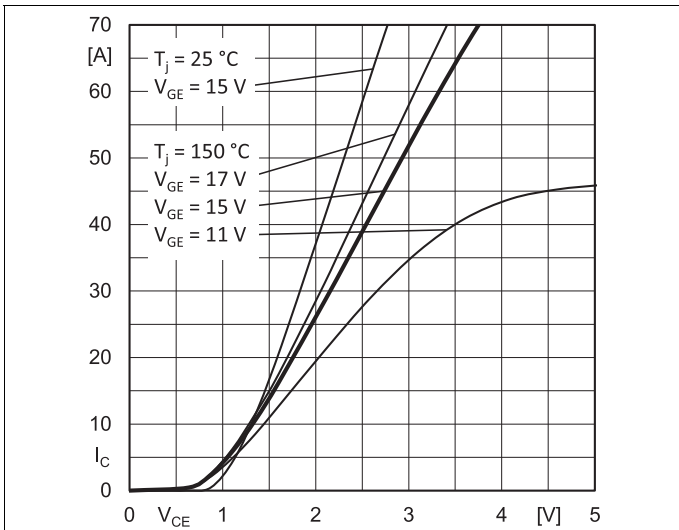


Fig. 1: Typ. output characteristic

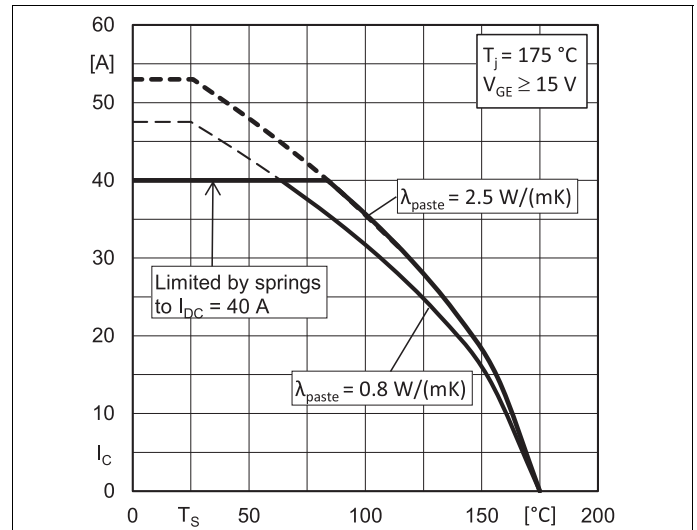


Fig. 2: Typ. rated current vs. temperature  $I_c = f(T_s)$

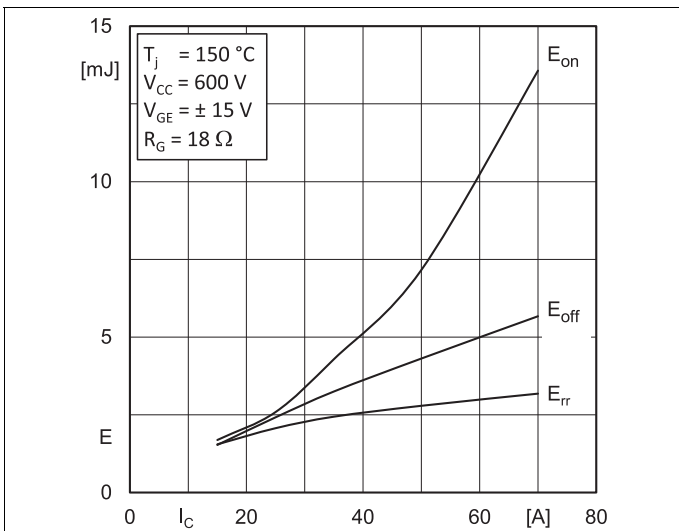


Fig. 3: Typ. turn-on /-off energy =  $f(I_c)$

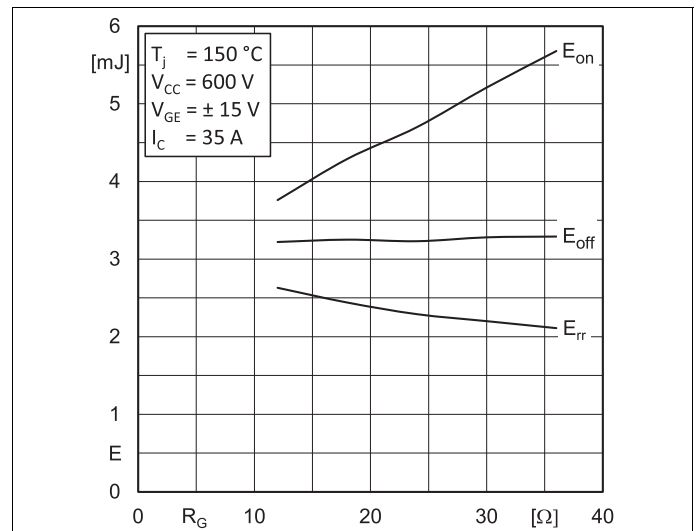


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

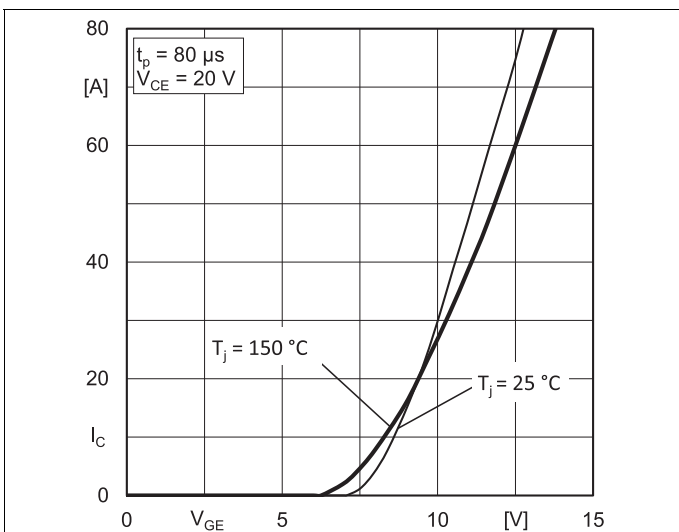


Fig. 5: Typ. transfer characteristic

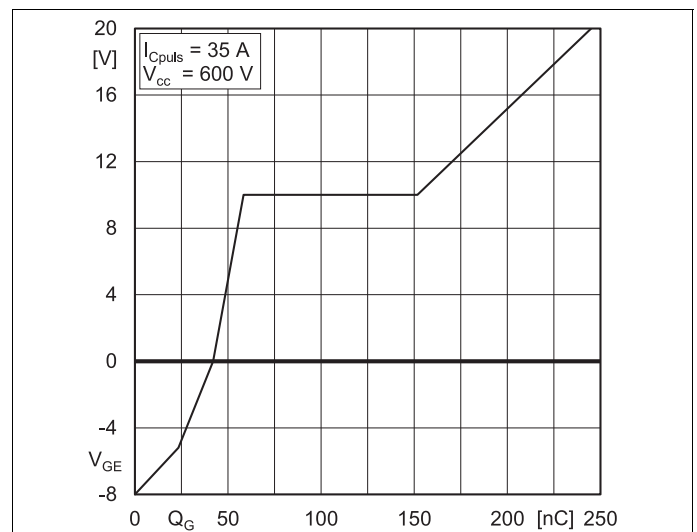


Fig. 6: Typ. gate charge characteristic

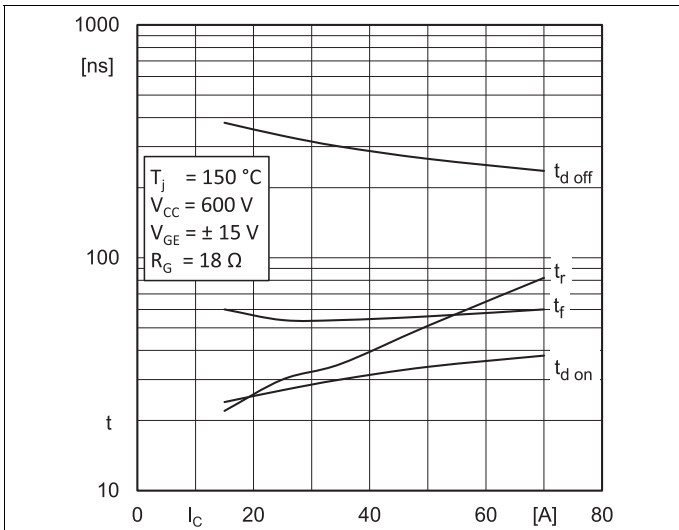


Fig. 7: Typ. switching times vs.  $I_C$

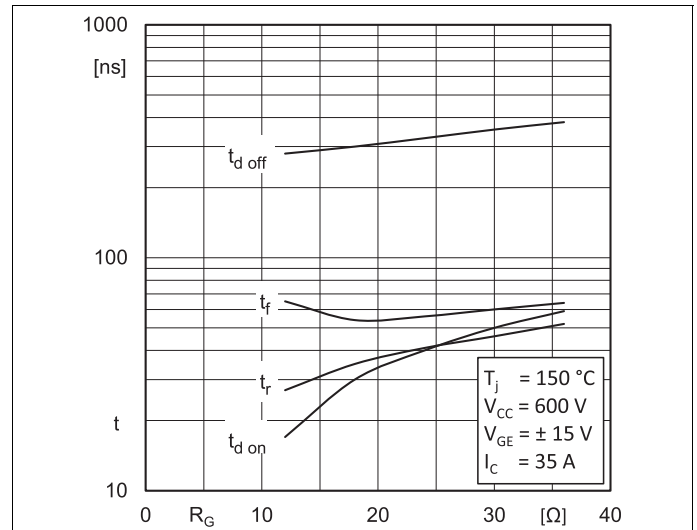


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

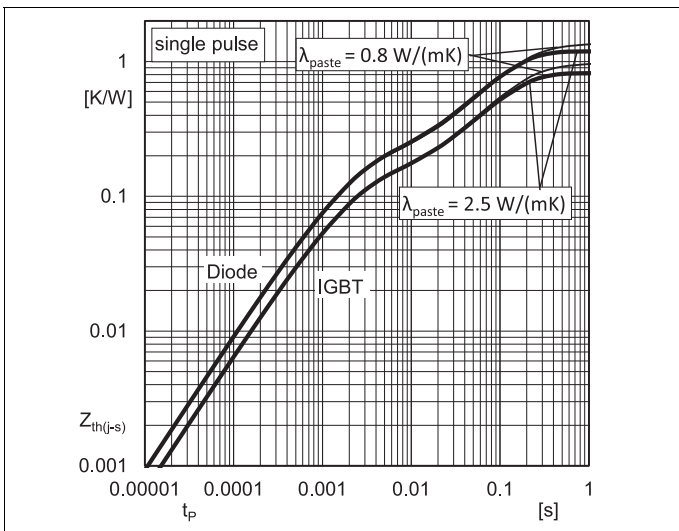


Fig. 9: Typ. transient thermal impedance

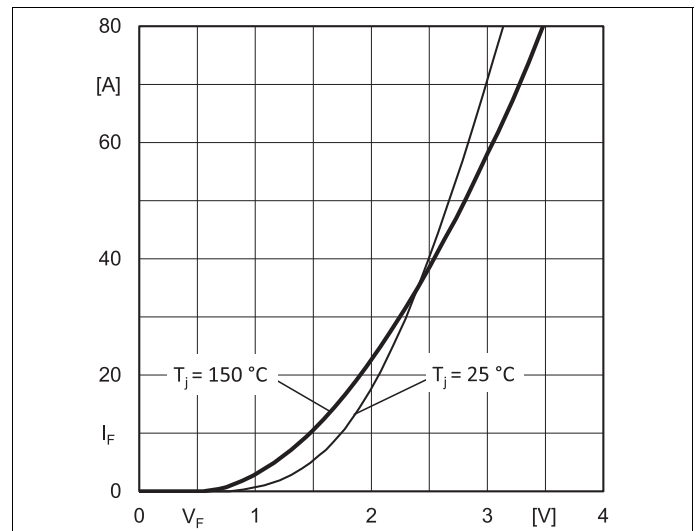


Fig. 10: Typ. CAL diode forward characteristic

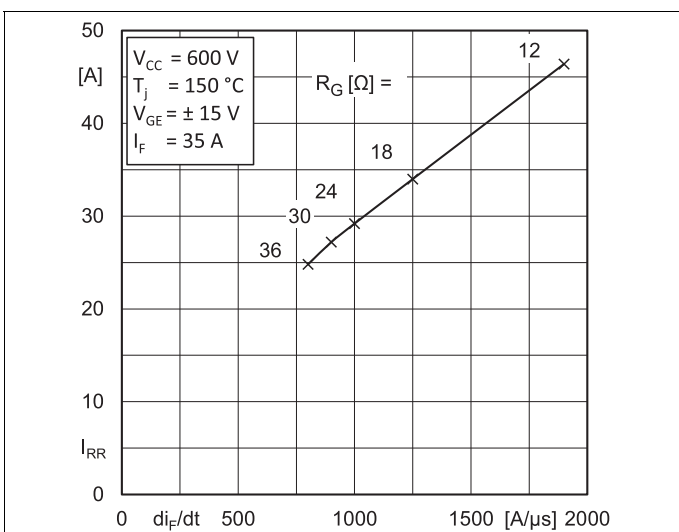


Fig. 11: Typ. CAL diode peak reverse recovery current

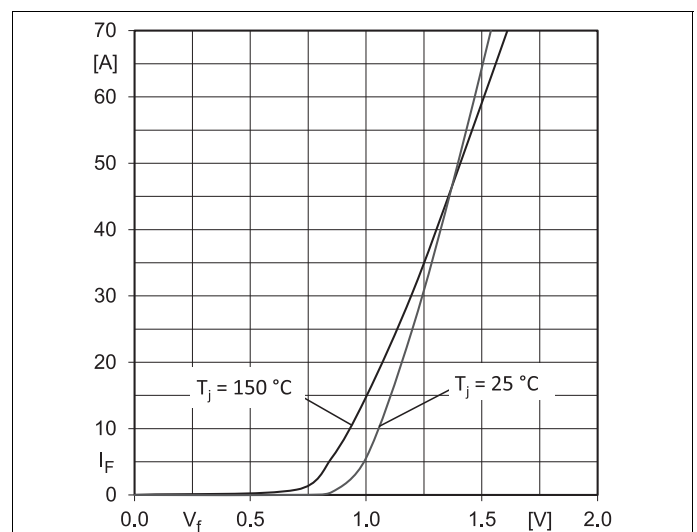
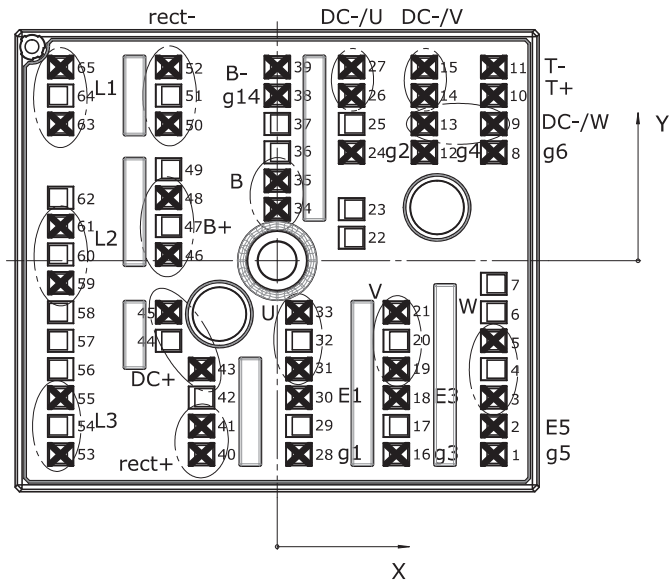


Fig. 12: Typ. input bridge forward characteristic

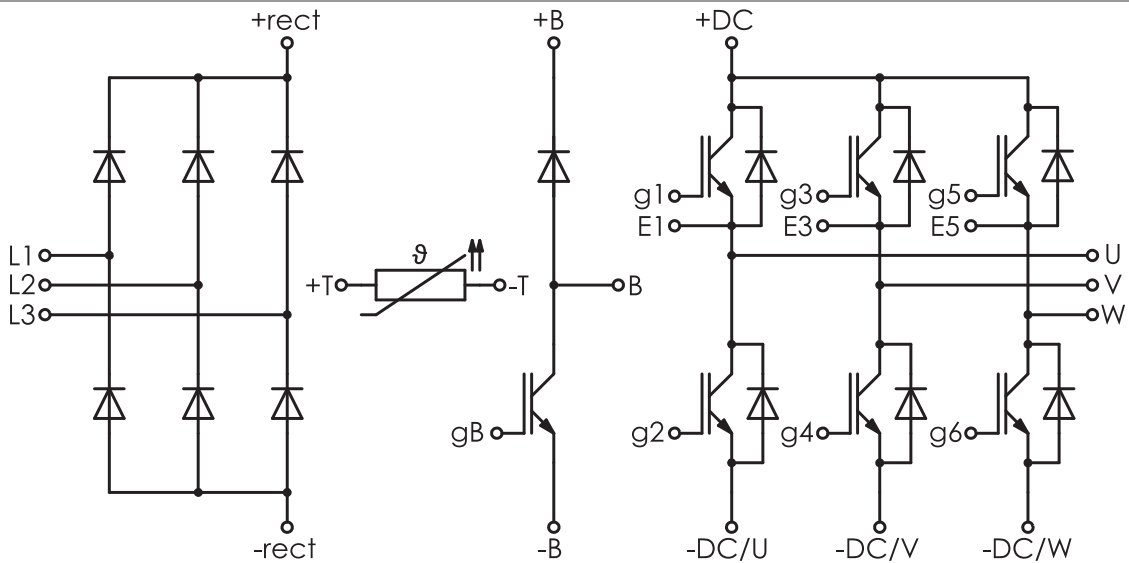
# SKiP 24NAB12T4V4

Pin out											
Pin	X	Y	Function	Pin	X	Y	Function	Pin	X	Y	Function
1	24,38	-21,80	g5	23	8,38	5,80		45	-12,23	-5,80	DC+
2	24,38	-18,60	E5	24	8,38	12,20	g2	46	-12,23	0,70	B+
3	24,38	-15,40	W	25	8,38	15,40		47	-12,23	3,90	
4	24,38	-12,20		26	8,38	18,60	DC-/U	48	-12,23	7,10	B+
5	24,38	-9,00	W	27	8,38	21,80	DC-/U	49	-12,23	10,30	
6	24,38	-5,80		28	2,46	-21,80	g1	50	-12,23	15,40	rect-
7	24,38	-2,60		29	2,46	-18,60		51	-12,23	18,60	
8	24,38	12,20	g6	30	2,46	-15,40	E1	52	-12,23	21,80	rect-
9	24,38	15,40	DC-/W	31	2,46	-12,20	U	53	-24,38	-21,80	L3
10	24,38	18,60	T+	32	2,46	-9,00		54	-24,38	-18,60	
11	24,38	21,80	T-	33	2,46	-5,80	U	55	-24,38	-15,40	L3
12	16,58	12,20	g4	34	0,03	5,80	B	56	-24,38	-12,20	
13	16,58	15,40	DC-/W	35	0,03	9,00	B	57	-24,38	-9,00	
14	16,58	18,60	DC-/V	36	0,03	12,20		58	-24,38	-5,80	
15	16,58	21,80	DC-/V	37	0,03	15,40		59	-24,38	-2,50	L2
16	13,42	-21,80	g3	38	0,03	18,60	g14	60	-24,38	0,70	
17	13,42	-18,60		39	0,03	21,80	B-	61	-24,38	3,90	L2
18	13,42	-15,40	E3	40	-8,51	-21,80	rect+	62	-24,38	7,10	
19	13,42	-12,20	V	41	-8,51	-18,60	rect+	63	-24,38	15,40	L1
20	13,42	-9,00		42	-8,51	-15,40		64	-24,38	18,60	
21	13,42	-5,80	V	43	-8,51	-12,20	DC+	65	-24,38	21,80	L1
22	8,38	2,60		44	-12,23	-9,00					

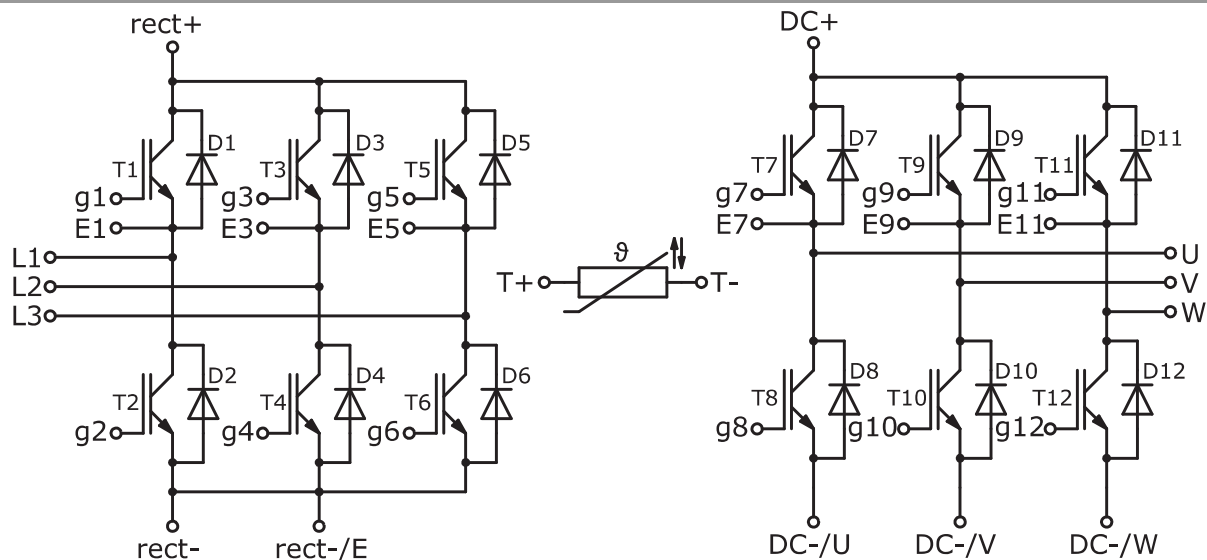
all values in mm



Pinout and Dimensions



Pinout



Pinout

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

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