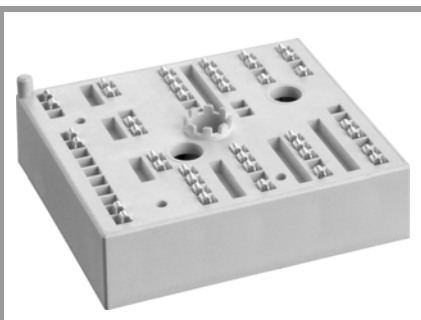


# SKiiP 23NAB12T4V2



MiniSKiiP® 2

## SKiiP 23NAB12T4V2

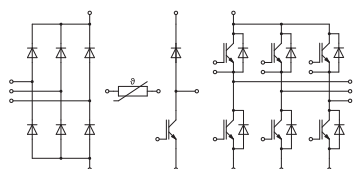
### Features

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

### Remarks

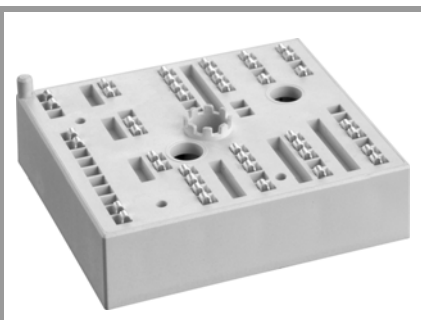
- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$  (recommended  $T_{j,op} = -40 \dots +150^\circ\text{C}$ )
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>Inverter - IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$		1200	V
$I_C$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	37	A
		$T_j = 175^\circ\text{C}$	30	A
$I_C$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	41	A
		$T_j = 175^\circ\text{C}$	34	A
$I_{Cnom}$			25	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$		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>Chopper - IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$		1200	V
$I_C$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	37	A
		$T_j = 175^\circ\text{C}$	30	A
$I_C$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	41	A
		$T_j = 175^\circ\text{C}$	34	A
$I_{Cnom}$			25	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$		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
$I_F$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	32	A
		$T_j = 175^\circ\text{C}$	26	A
$I_F$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	35	A
		$T_j = 175^\circ\text{C}$	28	A
$I_{Fnom}$			25	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$		50	A
$I_{FSM}$	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150^\circ\text{C}$		100	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Freewheeling - Diode</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$		1200	V
$I_F$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	32	A
		$T_j = 175^\circ\text{C}$	26	A
$I_F$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	35	A
		$T_j = 175^\circ\text{C}$	28	A
$I_{Fnom}$			25	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$		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 23NAB12T4V2



MiniSKiiP® 2

## SKiiP 23NAB12T4V2

### Features

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

### Remarks

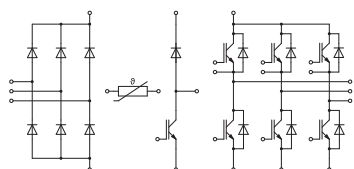
- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$  (recommended  $T_{j,op} = -40 \dots +150^\circ\text{C}$ )
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"

### 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
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	39	A
$I_F$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	57	A
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	43	A
$I_{Fnom}$		13	A	
$I_{FSM}$	10 ms	$T_j = 25^\circ\text{C}$	370	A
	sin 180°	$T_j = 150^\circ\text{C}$	270	A
$I^2t$	10 ms	$T_j = 25^\circ\text{C}$	685	A <sup>2</sup> s
	sin 180°	$T_j = 150^\circ\text{C}$	365	A <sup>2</sup> s
$T_j$		-40 ... 150	°C	
<b>Module</b>				
$I_{t(RMS)}$	$T_{terminal} = 80^\circ\text{C}$ , 20 A per spring	40	A	
$T_{stg}$		-40 ... 125	°C	
$V_{isol}$	AC sinus 50 Hz, 1 min	2500	V	

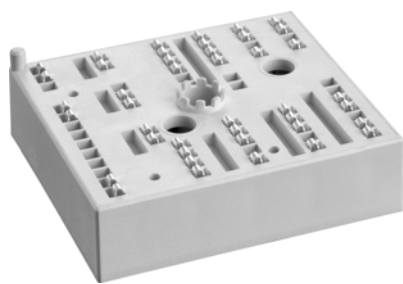
### Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
<b>Inverter - IGBT</b>					
$V_{CE(sat)}$	$I_C = 25 \text{ A}$ $V_{GE} = 15 \text{ V}$ 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	$T_j = 25^\circ\text{C}$	42	48	mΩ
		$T_j = 150^\circ\text{C}$	62	66	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE} \text{ V}$ , $I_C = 1 \text{ mA}$	5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0 \text{ V}$ , $V_{CE} = 1200 \text{ V}$ , $T_j = 25^\circ\text{C}$		0.1	0.3	mA
$C_{ies}$	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	1.43		nF
$C_{oes}$		$f = 1 \text{ MHz}$	0.12		nF
$C_{res}$		$f = 1 \text{ MHz}$	0.09		nF
$Q_G$	$V_{GE} = -8 \text{ V} \dots +15 \text{ V}$		142		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$		0		Ω
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$	$T_j = 150^\circ\text{C}$	63		ns
$t_r$		$T_j = 150^\circ\text{C}$	65		ns
$E_{on}$	$R_{G on} = 24 \Omega$ $R_{G off} = 24 \Omega$	$T_j = 150^\circ\text{C}$	3.1		mJ
$t_{d(off)}$		$T_j = 150^\circ\text{C}$	330		ns
$t_f$		$T_j = 150^\circ\text{C}$	84		ns
$E_{off}$	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150^\circ\text{C}$	2.56		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$		1.2		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$		1		K/W



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# SKiiP 23NAB12T4V2



MiniSKiiP® 2

## SKiiP 23NAB12T4V2

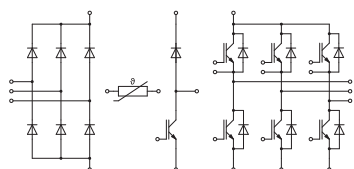
### Features

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

### Remarks

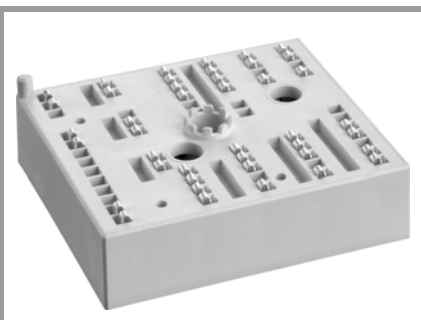
- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Product reliability results valid for  $T_j \leq 150^\circ\text{C}$  (recommended  $T_{j,op} = -40 \dots +150^\circ\text{C}$ )
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information
- No functional isolation between temperature sensor and "-DC/V" and "-DC/W"

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 $\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}\text{ V}, I_C = 1\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$			0.1	0.3	mA
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$			142		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$			0		$\Omega$
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		28		ns
$t_r$	$I_C = 25\text{ A}$	$T_j = 150^\circ\text{C}$		40		ns
$E_{on}$	$R_{G\ on} = 24\ \Omega$	$T_j = 150^\circ\text{C}$		2.65		mJ
$t_{d(off)}$	$R_{G\ off} = 24\ \Omega$	$T_j = 150^\circ\text{C}$		295		ns
$t_f$		$T_j = 150^\circ\text{C}$		68		ns
$E_{off}$	$V_{GE} = +15/-15\text{ V}$			2.3		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			1.2		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			1		K/W
<b>Inverse - 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 $\Omega$
$I_{RRM}$	$I_F = 25\text{ A}$	$T_j = 150^\circ\text{C}$		18		A
$Q_{rr}$	$di/dt_{off} = 500\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		3.7		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		1.4		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			1.52		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			1.3		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 $\Omega$
$I_{RRM}$	$I_F = 25\text{ A}$	$T_j = 150^\circ\text{C}$		24		A
$Q_{rr}$	$di/dt_{off} = 850\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		3.7		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		1.6		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			1.52		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			1.3		K/W



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# SKiIP 23NAB12T4V2



MiniSKiIP® 2

## SKiIP 23NAB12T4V2

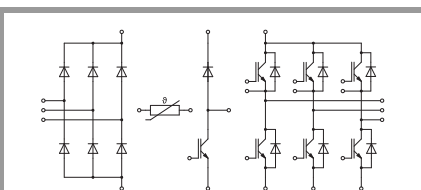
### Features

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

### 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"

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Rectifier - Diode</b>						
$V_F = V_{EC}$	$I_F = 13 \text{ A}$ $V_{GE} = 0 \text{ V}$ 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 $\Omega$
$R_{th(j-s)}$	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>						
$R_{100}$	$T_r = 100^\circ\text{C}$ , tolerance = 3 %			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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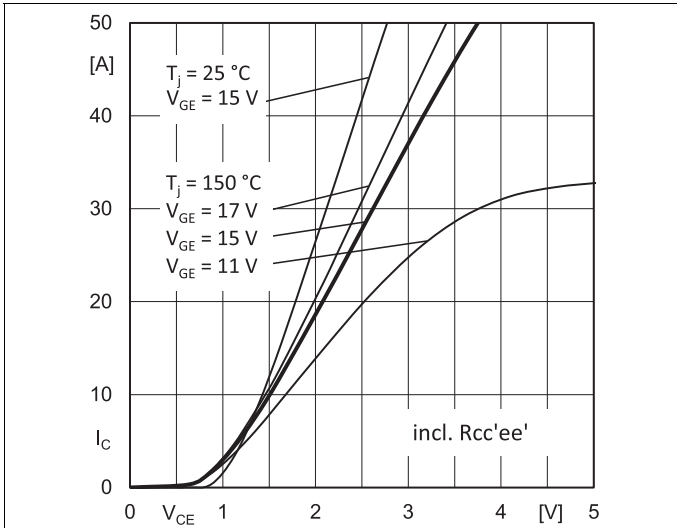


Fig. 1: Typ. output characteristic

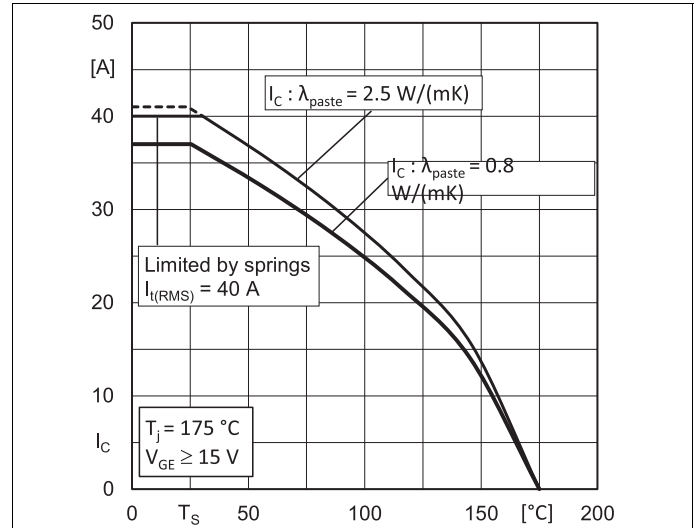


Fig. 2: Typ. rated current vs. temperature  $I_C = f(T_S)$

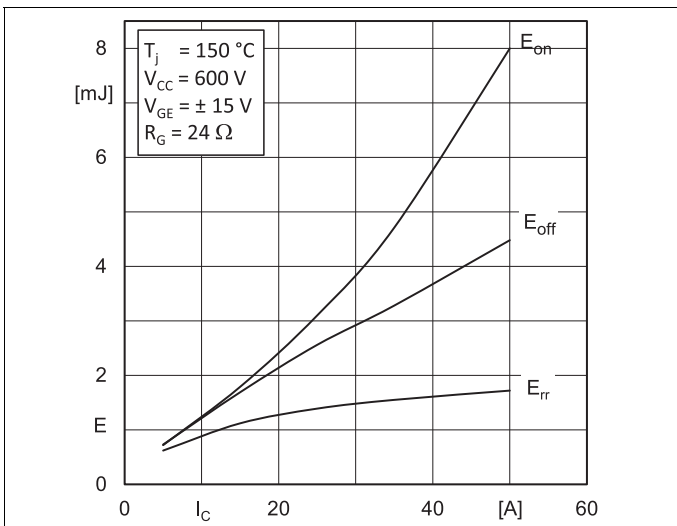


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

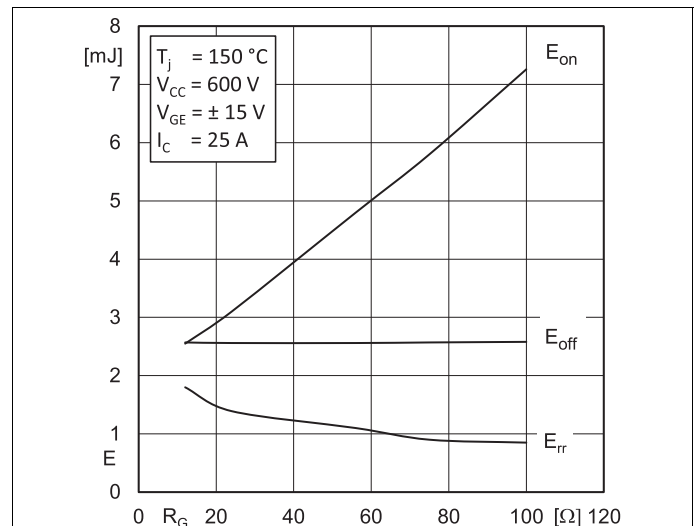


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

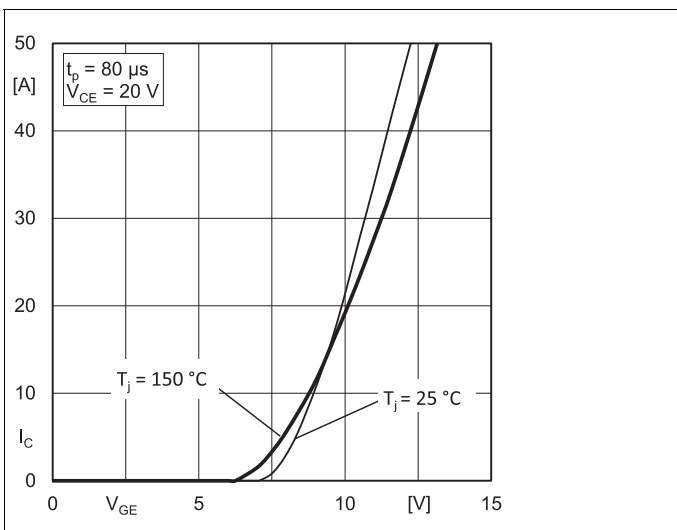


Fig. 5: Typ. transfer characteristic

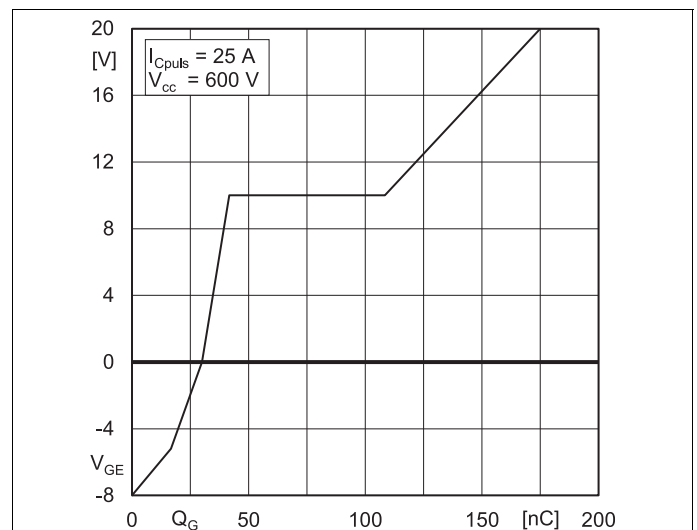


Fig. 6: Typ. gate charge characteristic

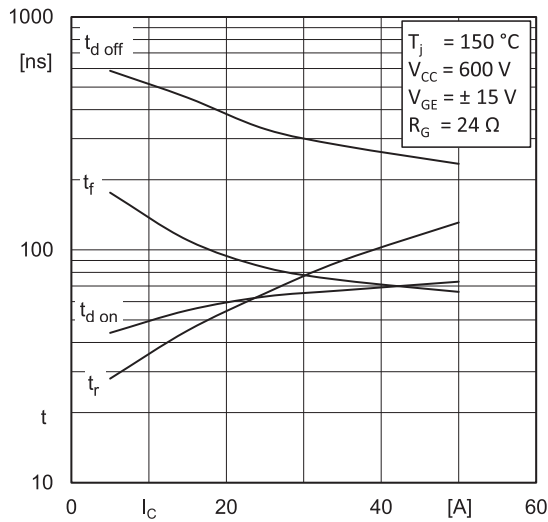


Fig. 7: Typ. switching times vs.  $I_C$

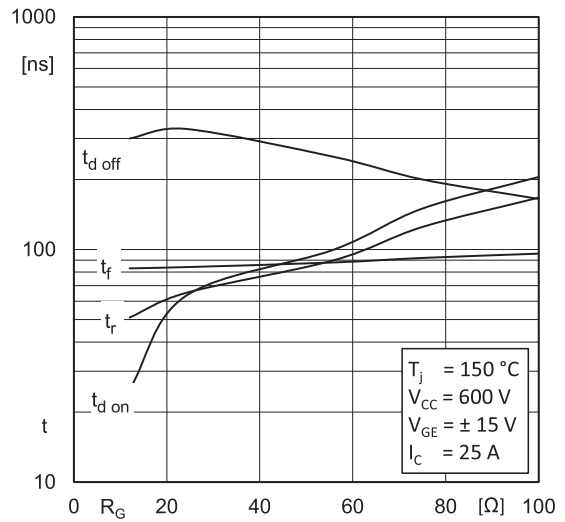


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

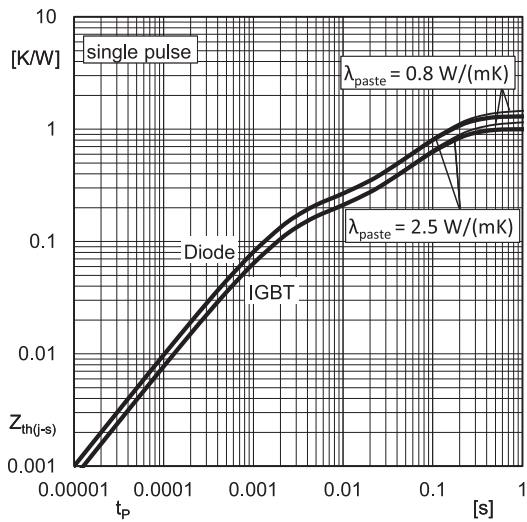


Fig. 9: Transient thermal impedance of IGBT and Diode

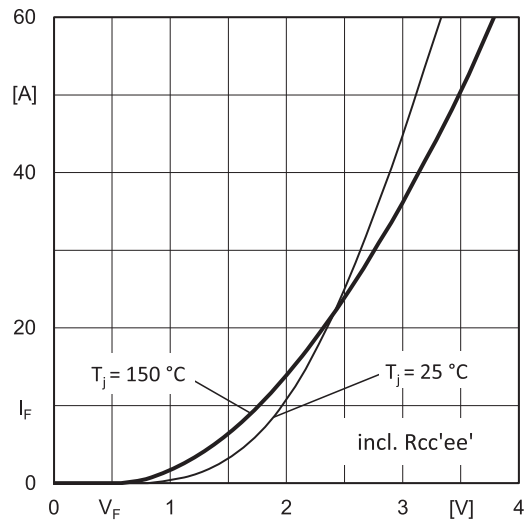


Fig. 10: CAL diode forward characteristic

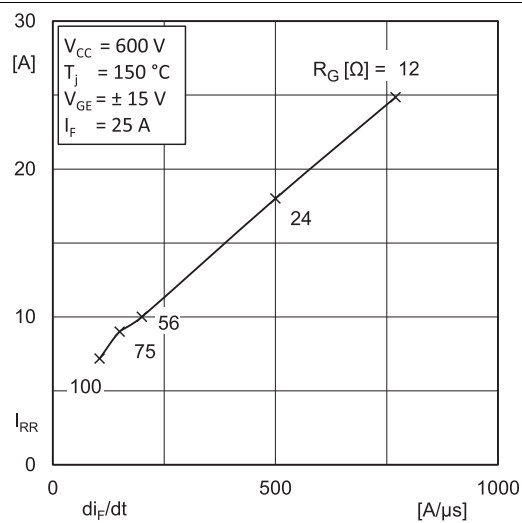


Fig. 11: Typ. CAL diode peak reverse recovery current

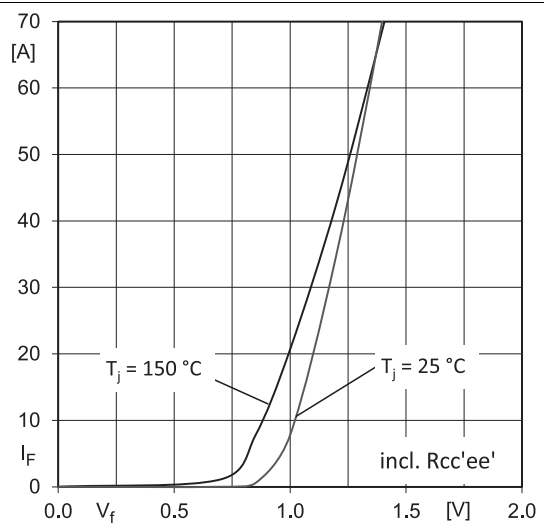
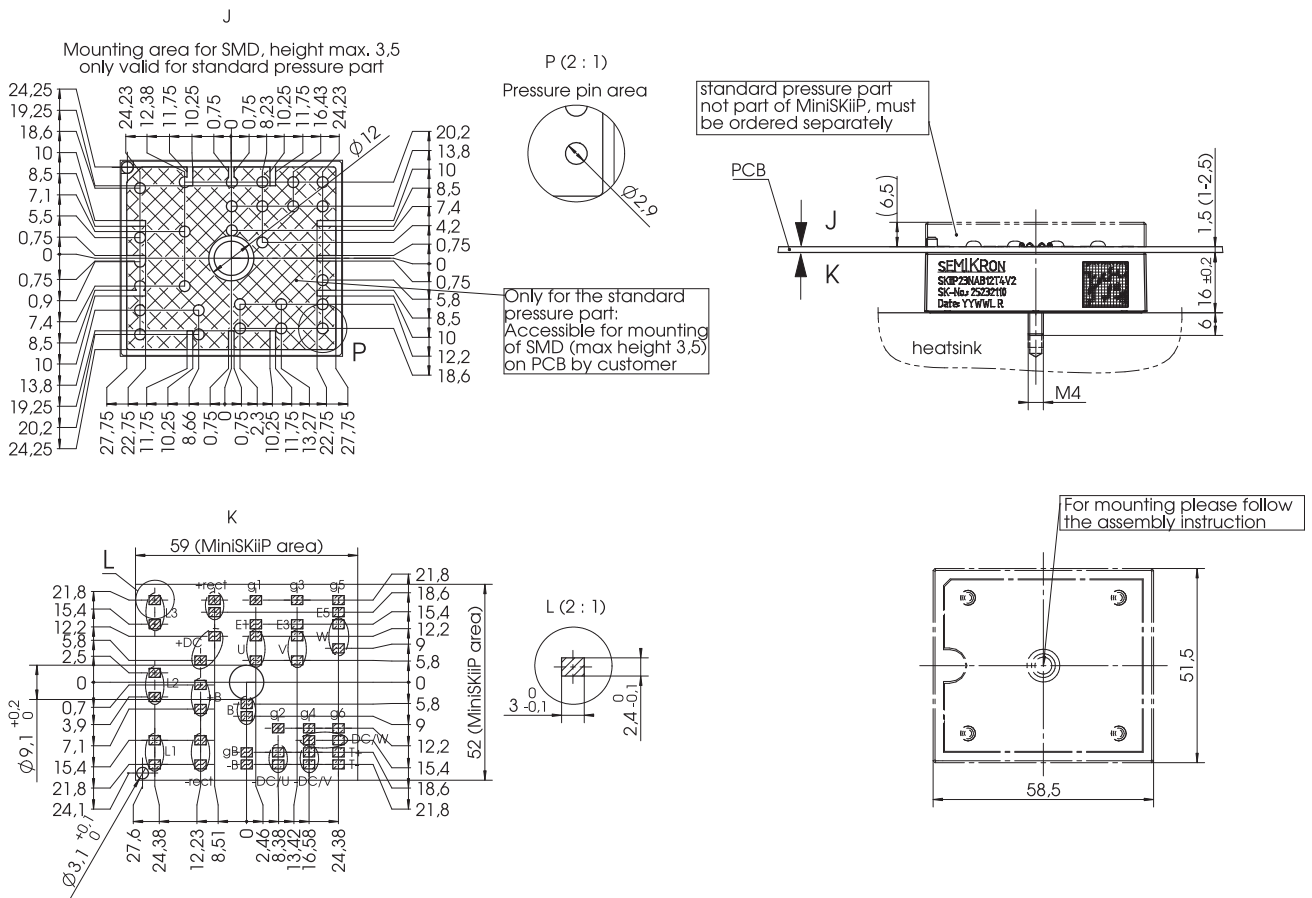
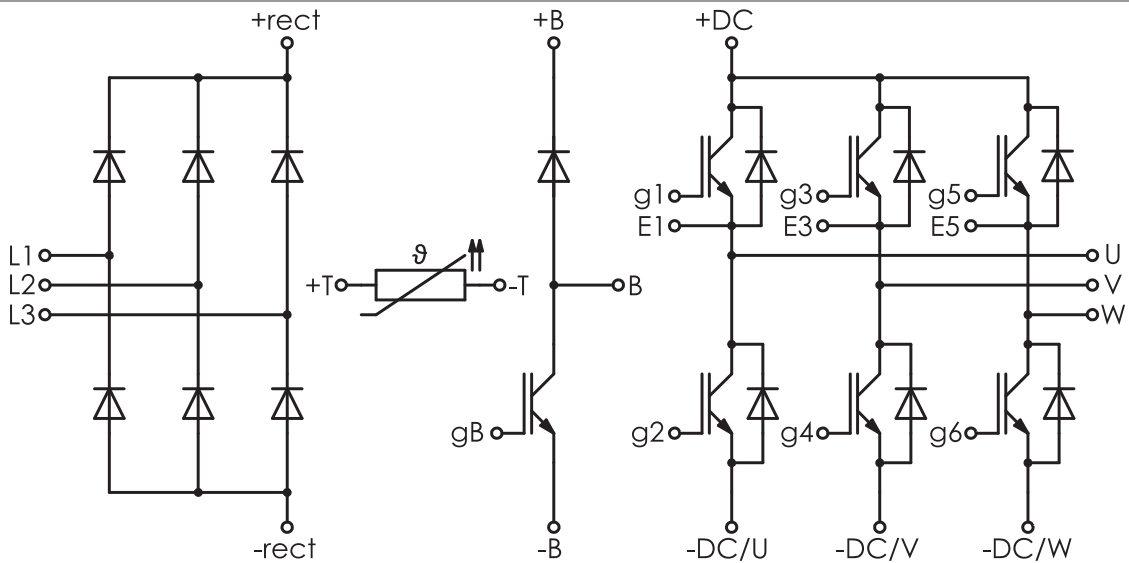


Fig. 12: Typ. input bridge forward characteristic

# SKiiP 23NAB12T4V2



pinout, dimensions



pinout

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

## **\*IMPORTANT INFORMATION AND WARNINGS**

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