

# SKiIP 23NAB12T4V10



MiniSKiIP® 2

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### Features

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

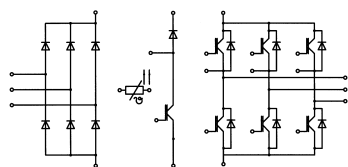
### Typical Applications\*

- Inverter up to 14 kVA
- Typical motor power 7,5 kW

### Remarks

- $V_{CEsat}$ ,  $V_F$  = chip level value
- Case temp. limited to  $T_C = 125^\circ\text{C}$  max. (for baseplateless modules  $T_C = T_S$ )
- product rel. results valid for  $T_j \leq 150$  (recomm.  $T_{op} = -40 \dots +150^\circ\text{C}$ )

Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
<b>Inverter - IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_C$	$T_j = 150^\circ\text{C}$	$T_s = 25^\circ\text{C}$	33	A
		$T_s = 70^\circ\text{C}$	26	A
$I_C$	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	37	A
		$T_s = 70^\circ\text{C}$	30	A
$I_{Cnom}$		25	A	
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	75	A	
$V_{GES}$		-20 ... 20	V	
$t_{psc}$	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	10	$\mu\text{s}$
$T_j$		-40 ... 175	$^\circ\text{C}$	
<b>Chopper - IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_C$	$T_j = 150^\circ\text{C}$	$T_s = 25^\circ\text{C}$	33	A
		$T_s = 70^\circ\text{C}$	26	A
$I_C$	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	37	A
		$T_s = 70^\circ\text{C}$	30	A
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$T_j$		-40 ... 175	$^\circ\text{C}$	
<b>Inverse - Diode</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_F$	$T_j = 150^\circ\text{C}$	$T_s = 25^\circ\text{C}$	29	A
		$T_s = 70^\circ\text{C}$	22	A
$I_F$	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	30	A
		$T_s = 70^\circ\text{C}$	26	A
$I_{Fnom}$		25	A	
$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$	75	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	
$I_F$	$T_j = 150^\circ\text{C}$	$T_s = 25^\circ\text{C}$	29	A
		$T_s = 70^\circ\text{C}$	22	A
$I_F$	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	32	A
		$T_s = 70^\circ\text{C}$	26	A
$I_{Fnom}$		25	A	
$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$	75	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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### Features

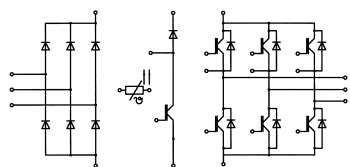
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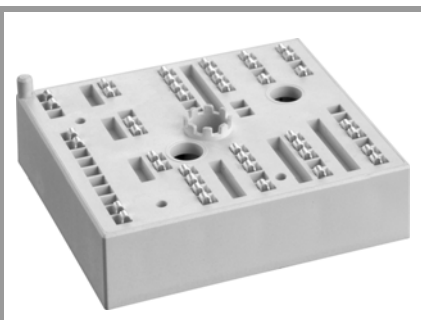


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Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
<b>Rectifier - Diode</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1600	V	
$I_F$	$T_s = 25^\circ\text{C}, T_j = 150^\circ\text{C}$	81	A	
$I_{Fnom}$		25	A	
$I_{FSM}$	10 ms	$T_j = 25^\circ\text{C}$	700	A
	sin 180°	$T_j = 150^\circ\text{C}$	490	A
$I^2t$	10 ms	$T_j = 25^\circ\text{C}$	2400	A <sup>2</sup> s
	sin 180°	$T_j = 150^\circ\text{C}$	1200	A <sup>2</sup> s
$T_j$		-40 ... 150	°C	
<b>Module</b>				
$I_{t(RMS)}$	$T_{terminal} = 80^\circ\text{C}, 20\text{A per spring}$	40	A	
$T_{stg}$		-40 ... 125	°C	
$V_{isol}$	AC sinus 50Hz, 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
$V_{CE0}$		$T_j = 25^\circ\text{C}$	0.8	0.9	V
		$T_j = 150^\circ\text{C}$	0.7	0.8	V
$r_{CE}$	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	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
					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
$Q_G$	- 8 V...+ 15 V		142		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$		0.00		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	28		ns
$t_r$	$I_C = 25\text{ A}$	$T_j = 150^\circ\text{C}$	40		ns
$E_{on}$	$R_{Gon} = 24\ \Omega$	$T_j = 150^\circ\text{C}$	2.65		mJ
$t_{d(off)}$	$R_{Goff} = 24\ \Omega$	$T_j = 150^\circ\text{C}$	295		ns
$t_f$		$T_j = 150^\circ\text{C}$	68		ns
$E_{off}$	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	2.3		mJ
$R_{th(j-s)}$	per IGBT		1.2		K/W
<b>Chopper - 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
$V_{CE0}$		$T_j = 25^\circ\text{C}$	0.8	0.9	V
		$T_j = 150^\circ\text{C}$	0.7	0.8	V
$r_{CE}$	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	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
		$T_j = 150^\circ\text{C}$			mA
$Q_G$	- 8 V...+ 15 V		142		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$		0.00		Ω

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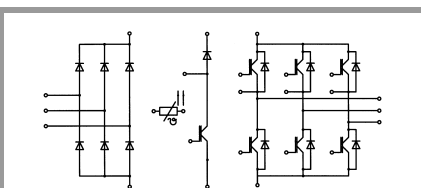
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Chopper - IGBT</b>						
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		28		ns
$t_r$	$I_C = 25\text{ A}$	$T_j = 150^\circ\text{C}$		40		ns
$E_{on}$	$R_{G\ on} = 24\ \Omega$	$T_j = 150^\circ\text{C}$		2.65		mJ
	$R_{G\ off} = 24\ \Omega$	$T_j = 150^\circ\text{C}$		295		ns
$t_{d(off)}$		$T_j = 150^\circ\text{C}$		68		ns
$t_f$		$T_j = 150^\circ\text{C}$		68		ns
$E_{off}$	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		2.3		mJ
$R_{th(j-s)}$	per IGBT			1.2		K/W
<b>Inverse - Diode</b>						
$V_F = V_{EC}$	$I_F = 25\text{ A}$	$T_j = 25^\circ\text{C}$		2.4	2.7	V
	$V_{GE} = 0\text{ V}$ chiplevel	$T_j = 150^\circ\text{C}$		2.5	2.8	V
$V_{F0}$		$T_j = 25^\circ\text{C}$		1.3	1.5	V
		$T_j = 150^\circ\text{C}$		0.9	1.1	V
$r_F$		$T_j = 25^\circ\text{C}$		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			1.52		K/W
<b>Freewheeling - Diode</b>						
$V_F = V_{EC}$	$I_F = 25\text{ A}$	$T_j = 25^\circ\text{C}$		2.4	2.7	V
	$V_{GE} = 0\text{ V}$ chiplevel	$T_j = 150^\circ\text{C}$		2.5	2.8	V
$V_{F0}$		$T_j = 25^\circ\text{C}$		1.3	1.5	V
		$T_j = 150^\circ\text{C}$		0.9	1.1	V
$r_F$		$T_j = 25^\circ\text{C}$		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			1.52		K/W
<b>Rectifier - Diode</b>						
$V_F = V_{EC}$	$I_F = 25\text{ A}$	$T_j = 25^\circ\text{C}$		1	1.21	V
	$V_{GE} = 0\text{ V}$ chiplevel	$T_j = 125^\circ\text{C}$			1.1	V
$V_{F0}$		$T_j = 25^\circ\text{C}$			1.0	V
		$T_j = 125^\circ\text{C}$			0.8	V
$r_F$		$T_j = 25^\circ\text{C}$		4.8	9.3	m $\Omega$
		$T_j = 125^\circ\text{C}$			11	m $\Omega$
$R_{th(j-s)}$	per Diode			0.9		K/W
<b>Module</b>						
$M_s$	to heat sink		2		2.5	Nm
$w$				65		g
<b>Temperatur Sensor</b>						
$R_{100}$	$T_r = 100^\circ\text{C}$ , tolerance = 3 %			1670 $\pm$ 3%		$\Omega$
$R(T)$	$R(T) = 1000\ \Omega [1 + A(T - 25^\circ\text{C}) + B(T - 25^\circ\text{C})^2]$ $A = 7.635 \cdot 10^{-3}\ \text{C}^{-1}$ , $B = 1.731 \cdot 10^{-5}\ \text{C}^{-2}$					

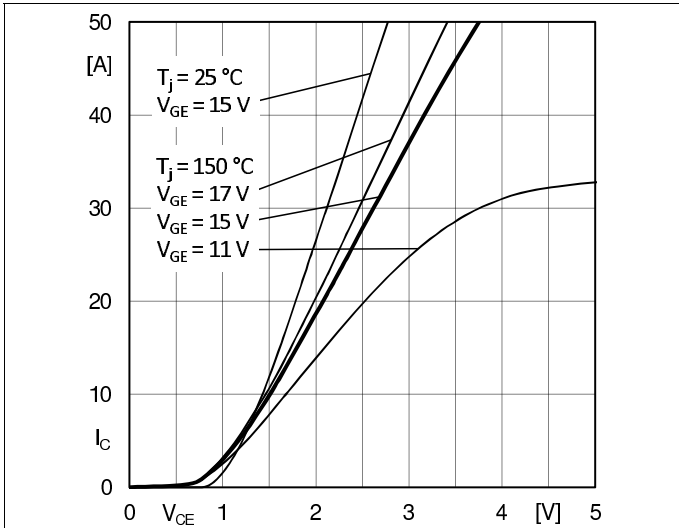


Fig. 1: Typ. output characteristic

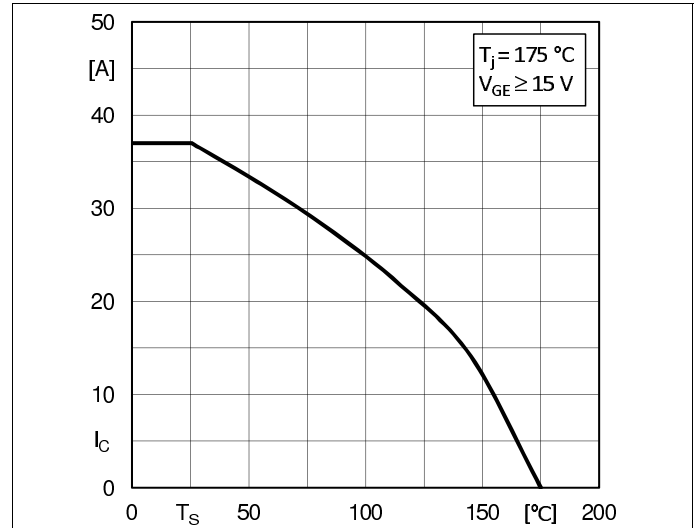


Fig. 2: Typ. rated current vs. temperature  $I_C = f(T_s)$

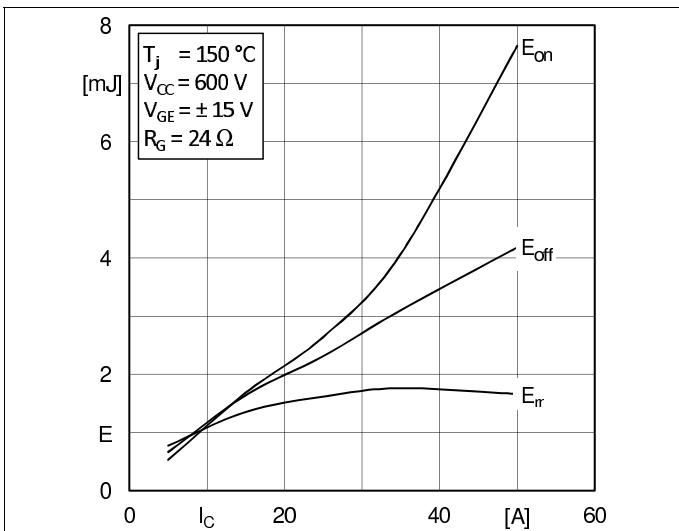


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

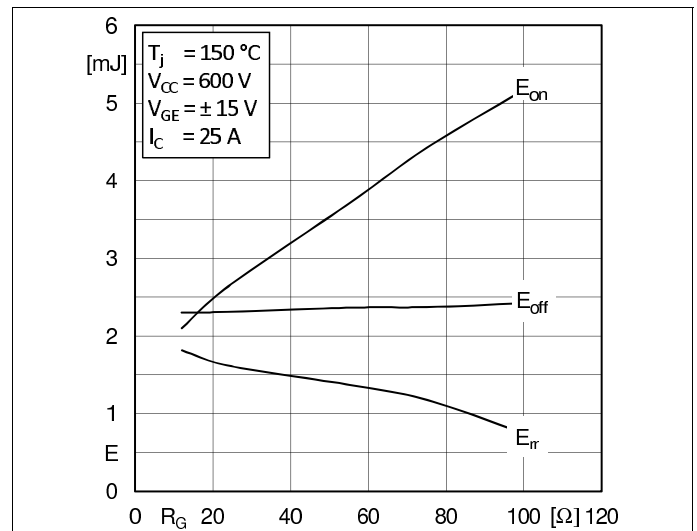


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

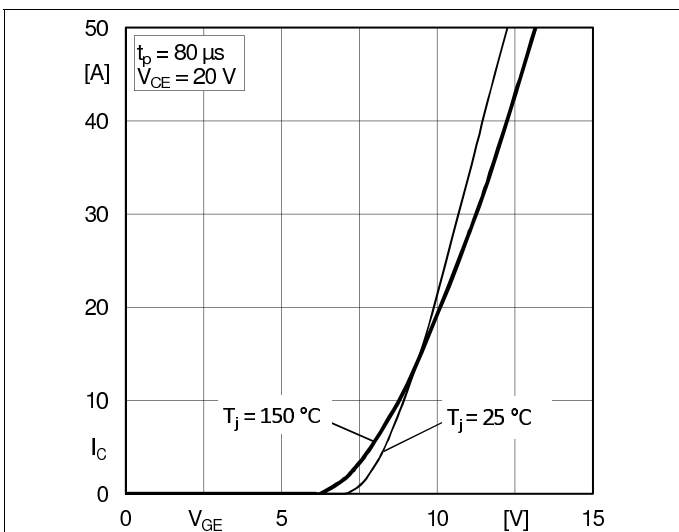


Fig. 5: Typ. transfer characteristic

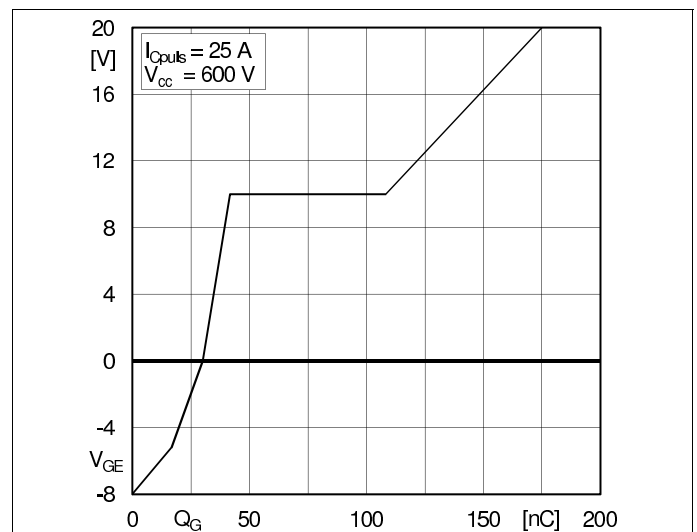


Fig. 6: Typ. gate charge characteristic

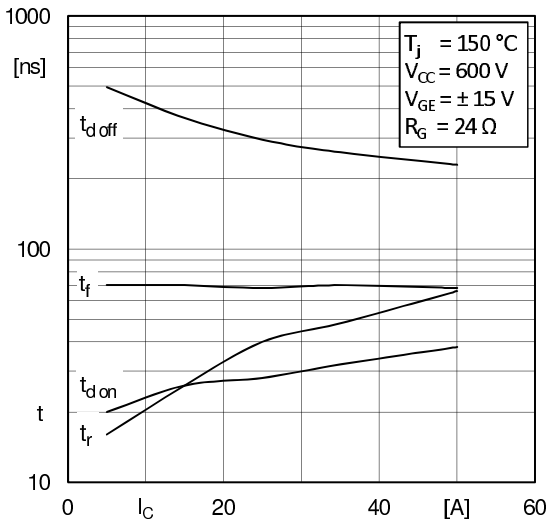


Fig. 7: Typ. switching times vs.  $I_C$

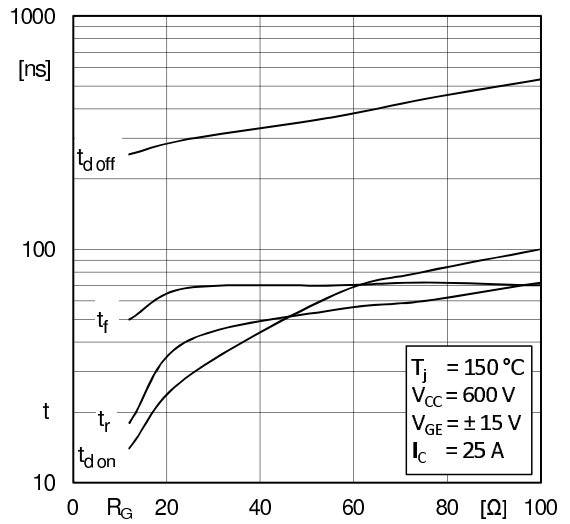


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

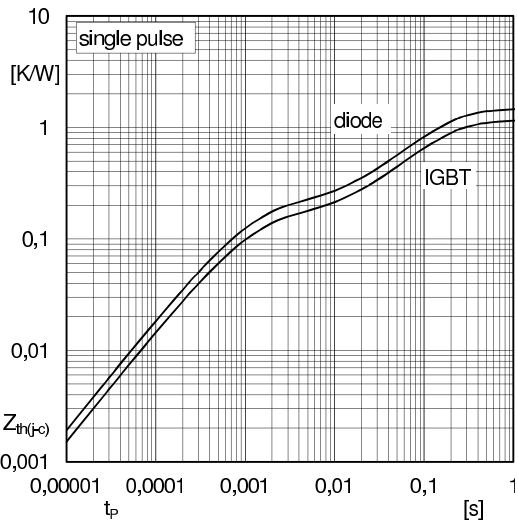


Fig. 9: Transient thermal impedance of IGBT and Diode

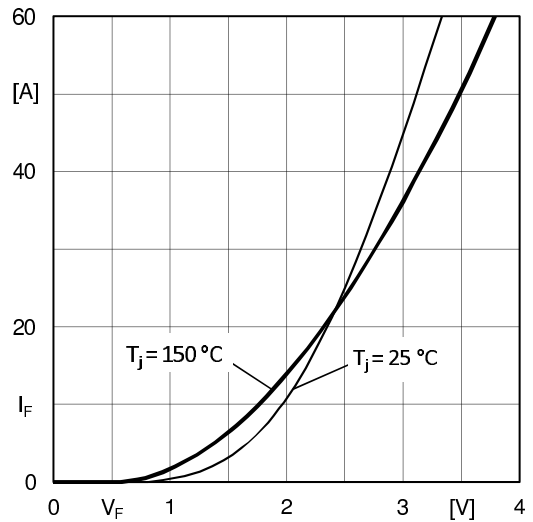


Fig. 10: CAL diode forward characteristic

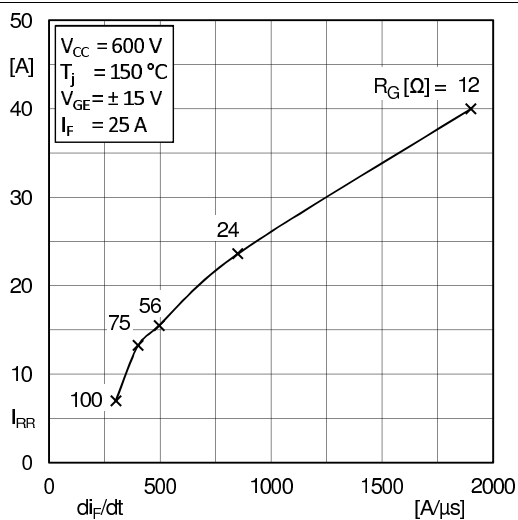


Fig. 11: Typ. CAL diode peak reverse recovery current

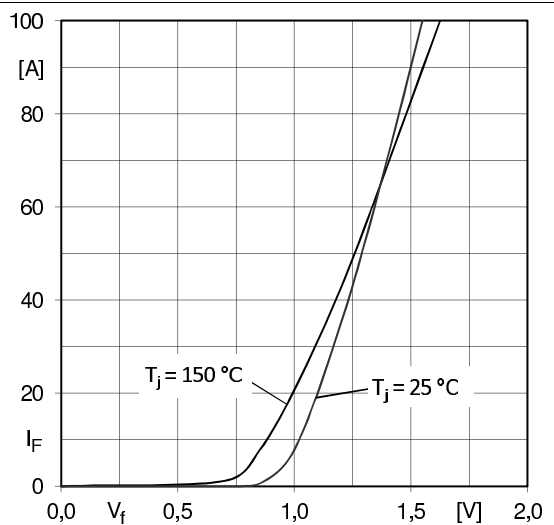


Fig. 12: Typ. input bridge forward characteristic

