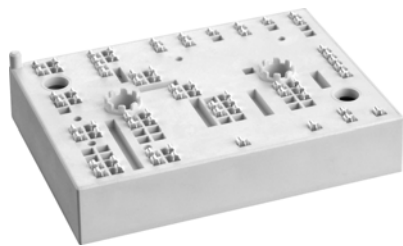


SKiiP 34NAB176V3



MiniSKiiP® 3

3-phase bridge rectifier +
brake chopper + 3-phase
bridge inverter

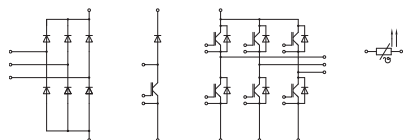
SKiiP 34NAB176V3

Features

- Trench 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 $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 40A for L1, L2, L3, U, V, W, -B, +B, B power connectors
- $I_{t(RMS)}$ limited to 20A for -DC/U, -DC/V, -DC/W power connectors
- Distance between terminals +T1-T and -DC/W; +B and +DC; -BI-DC/UI-DC/V and -DC/W is not sufficient for basic insulation
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information

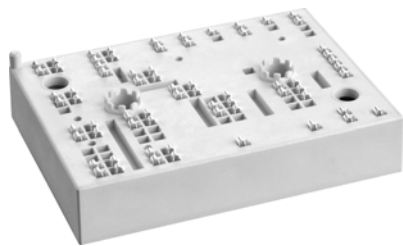


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Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
Inverter - IGBT			
V_{CES}	$T_j = 25^\circ\text{C}$	1700	V
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	67
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	51
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	80
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	61
I_{Cnom}		58	A
I_{CRM}	$I_{CRM} = 2 \times I_{Cnom}$	116	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 1200 \text{ V}$	$T_j = 125^\circ\text{C}$	10
	$V_{GE} \leq 20 \text{ V}$		
	$V_{CES} \leq 1700 \text{ V}$		
T_j		-55 ... 150	$^\circ\text{C}$
Chopper - IGBT			
V_{CES}	$T_j = 25^\circ\text{C}$	1700	V
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	67
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	51
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	80
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	61
I_{Cnom}		58	A
I_{CRM}	$I_{CRM} = 2 \times I_{Cnom}$	116	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 1200 \text{ V}$	$T_j = 125^\circ\text{C}$	10
	$V_{GE} \leq 20 \text{ V}$		
	$V_{CES} \leq 1700 \text{ V}$		
T_j		-55 ... 150	$^\circ\text{C}$
Inverse - Diode			
V_{RRM}	$T_j = 25^\circ\text{C}$	1700	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	66
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	47
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	77
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	55
I_{Fnom}		55	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	110	A
I_{FSM}	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150^\circ\text{C}$	550	A
T_j		-40 ... 150	$^\circ\text{C}$
Freewheeling - Diode			
V_{RRM}	$T_j = 25^\circ\text{C}$	1700	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	66
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	47
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	77
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	55
I_{Fnom}		55	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	110	A
I_{FSM}	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150^\circ\text{C}$	550	A
T_j		-40 ... 150	$^\circ\text{C}$

SKiiP 34NAB176V3



MiniSKiiP® 3

3-phase bridge rectifier +
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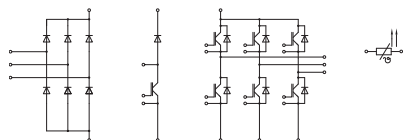
SKiiP 34NAB176V3

Features

- Trench 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 $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 40A for L1, L2, L3, U, V, W, -B, +B, B power connectors
- $I_{t(RMS)}$ limited to 20A for -DC/U, -DC/V, -DC/W power connectors
- Distance between terminals +TI-T and -DC/W; +B and +DC; -BI-DC/UI-DC/V and -DC/W is not sufficient for basic insulation
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information



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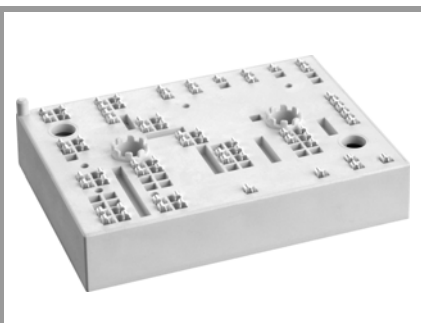
Absolute Maximum Ratings

Symbol	Conditions	Values	Unit	
Rectifier - Diode				
V_{RRM}	$T_j = 25^\circ\text{C}$	1800	V	
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	97	A
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	70	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	110	A
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	80	A
I_{Fnom}	DC current	57	A	
I_{FSM}	10 ms	$T_j = 25^\circ\text{C}$	635	A
	sin 180°	$T_j = 150^\circ\text{C}$	490	A
I^2t	10 ms	$T_j = 25^\circ\text{C}$	2000	A ² s
	sin 180°	$T_j = 150^\circ\text{C}$	1200	A ² s
T_j		-40 ... 150	°C	
Module				
$I_{t(RMS)}$	$T_{terminal} = 80^\circ\text{C}$, 20 A per spring	60	A	
T_{stg}		-40 ... 125	°C	
V_{isol}	AC sinus 50 Hz, 1 min	2500	V	

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
$V_{CE(sat)}$	$I_c = 58 \text{ A}$ $V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$	2.00	2.45	V
		$T_j = 125^\circ\text{C}$	2.45	2.90	V
V_{CE0}	chiplevel	$T_j = 25^\circ\text{C}$	1.00	1.20	V
		$T_j = 125^\circ\text{C}$	0.90	1.10	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$	17	22	mΩ
		$T_j = 125^\circ\text{C}$	27	31	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE} \text{ V}$, $I_c = 2.4 \text{ mA}$	5.2	5.8	6.4	V
I_{CES}	$V_{GE} = 0 \text{ V}$, $V_{CE} = 1700 \text{ V}$, $T_j = 25^\circ\text{C}$		0.1	0.3	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	5.00		nF
C_{oes}		$f = 1 \text{ MHz}$	0.21		nF
C_{res}		$f = 1 \text{ MHz}$	0.17		nF
Q_G	- 8 V...+ 15 V		480		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		16		Ω
$t_{d(on)}$	$V_{CC} = 900 \text{ V}$ $I_c = 40 \text{ A}$	$T_j = 125^\circ\text{C}$	290		ns
t_r	$R_{G on} = 1 \Omega$	$T_j = 125^\circ\text{C}$	40		ns
E_{on}	$R_{G off} = 1 \Omega$	$T_j = 125^\circ\text{C}$	11.2		mJ
$t_{d(off)}$	$di/dt_{on} = 990 \text{ A}/\mu\text{s}$	$T_j = 125^\circ\text{C}$	650		ns
t_f	$di/dt_{off} = 250 \text{ A}/\mu\text{s}$	$T_j = 125^\circ\text{C}$	100		ns
E_{off}	$du/dt = 4000 \text{ V}/\mu\text{s}$ $V_{GE} = +15/-15 \text{ V}$ $L_s = 45 \text{ nH}$	$T_j = 125^\circ\text{C}$	12.8		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$		0.57		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$		0.42		K/W

SKiiP 34NAB176V3



MiniSKiiP® 3

3-phase bridge rectifier +
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bridge inverter

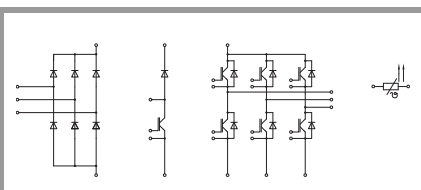
SKiiP 34NAB176V3

Features

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

Remarks

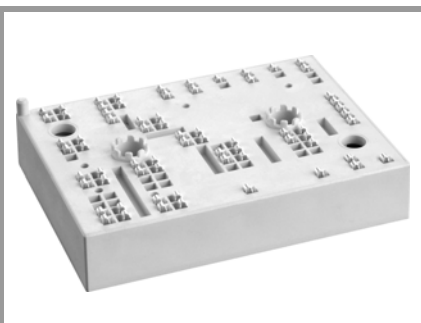
- Max. case temperature limited to $T_C=125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 40A for L1, L2, L3, U, V, W, -B, +B, B power connectors
- $I_{t(RMS)}$ limited to 20A for -DC/U, -DC/V, -DC/W power connectors
- Distance between terminals +T1-T and -DC/W; +B and +DC; -BI-DC/UIDC/V and -DC/W is not sufficient for basic insulation
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information



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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Chopper - IGBT						
$V_{CE(sat)}$	$I_C = 58 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.00	2.45	V
		$T_j = 125^\circ\text{C}$		2.45	2.90	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$		1.00	1.20	V
		$T_j = 125^\circ\text{C}$		0.90	1.10	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		17	22	mΩ
		$T_j = 125^\circ\text{C}$		27	31	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE} \text{ V}, I_C = 2.4 \text{ mA}$		5.2	5.8	6.4	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 1700 \text{ V}, T_j = 25^\circ\text{C}$			0.1	0.3	mA
Q_G	- 8 V...+ 15 V			480		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			16		Ω
$t_{d(on)}$	$V_{CC} = 900 \text{ V}$ $I_C = 40 \text{ A}$	$T_j = 125^\circ\text{C}$		290		ns
t_r	$R_{G on} = 1 \Omega$	$T_j = 125^\circ\text{C}$		40		ns
E_{on}	$R_{G off} = 1 \Omega$	$T_j = 125^\circ\text{C}$		11.2		mJ
$t_{d(off)}$	$di/dt_{on} = 990 \text{ A}/\mu\text{s}$	$T_j = 125^\circ\text{C}$		650		ns
t_f	$di/dt_{off} = 250 \text{ A}/\mu\text{s}$ $du/dt = 4000 \text{ V}/\mu\text{s}$	$T_j = 125^\circ\text{C}$		100		ns
E_{off}	$V_{GE} = +15/-15 \text{ V}$ $L_s = 45 \text{ nH}$	$T_j = 125^\circ\text{C}$		12.8		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			0.57		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			0.42		K/W
Inverse - Diode						
$V_F = V_{EC}$	$I_F = 55 \text{ A}$ $V_{GE} = 0 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.06	2.51	V
		$T_j = 125^\circ\text{C}$		1.79	2.22	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.52	1.94	V
		$T_j = 125^\circ\text{C}$		1.17	1.57	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		9.7	10	mΩ
		$T_j = 125^\circ\text{C}$		11	12	mΩ
I_{RRM}	$I_F = 40 \text{ A}$	$T_j = 125^\circ\text{C}$		62		A
Q_{rr}	$di/dt_{off} = 1050 \text{ A}/\mu\text{s}$ $V_{GE} = -15 \text{ V}$	$T_j = 125^\circ\text{C}$		13.5		μC
E_{rr}	$V_{CC} = 900 \text{ V}$	$T_j = 125^\circ\text{C}$		6.6		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			0.84		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			0.68		K/W
Freewheeling - Diode						
$V_F = V_{EC}$	$I_F = 55 \text{ A}$ $V_{GE} = 0 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.06	2.51	V
		$T_j = 125^\circ\text{C}$		1.79	2.22	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.52	1.94	V
		$T_j = 125^\circ\text{C}$		1.17	1.57	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		9.7	10	mΩ
		$T_j = 125^\circ\text{C}$		11	12	mΩ
I_{RRM}	$I_F = 40 \text{ A}$	$T_j = 125^\circ\text{C}$		62		A
Q_{rr}	$di/dt_{off} = 1050 \text{ A}/\mu\text{s}$ $V_{GE} = -15 \text{ V}$	$T_j = 125^\circ\text{C}$		13.5		μC
E_{rr}	$V_{CC} = 900 \text{ V}$	$T_j = 125^\circ\text{C}$		6.6		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			0.84		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			0.68		K/W

SKiiP 34NAB176V3



MiniSKiiP® 3

3-phase bridge rectifier +
brake chopper + 3-phase
bridge inverter

SKiiP 34NAB176V3

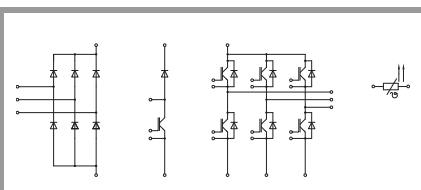
Features

- Trench 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 $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 40A for L1, L2, L3, U, V, W, -B, +B, B power connectors
- $I_{t(RMS)}$ limited to 20A for -DC/U, -DC/V, -DC/W power connectors
- Distance between terminals +TI-T and -DC/W; +B and +DC; -BI-DC/UI-DC/V and -DC/W is not sufficient for basic insulation
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
$V_F = V_{EC}$	$I_F = 57 \text{ A}$ $V_{GE} = 0 \text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$		1.09	1.34	V
		$T_j = 125^\circ\text{C}$		1.04	1.29	V
V_{F0}	chiplevel	$T_j = 25^\circ\text{C}$	0.6	0.87	1.10	V
		$T_j = 125^\circ\text{C}$		0.75	0.97	V
r_F	chip	$T_j = 25^\circ\text{C}$		4.0	4.3	m Ω
		$T_j = 125^\circ\text{C}$		5.1	5.6	m Ω
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W/(mK)}$			0.86		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W/(mK)}$			0.72		K/W
Module						
M_s	to heat sink		2		2.5	Nm
w				82		g
L_{CE}				26		nH
Temperature Sensor						
R_{100}	$T_r = 100^\circ\text{C}$, tolerance = 3 %			1670 \pm 3%		Ω
$R(T)$	$R(T)=1000\Omega[1+A(T-25^\circ\text{C})+B(T-25^\circ\text{C})^2]$], $A = 7.635 \cdot 10^{-3} \text{ }^\circ\text{C}^{-1}$, $B = 1.731 \cdot 10^{-5} \text{ }^\circ\text{C}^{-2}$					



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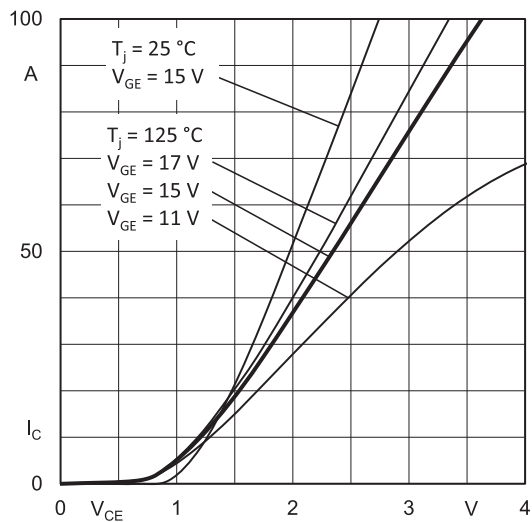


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

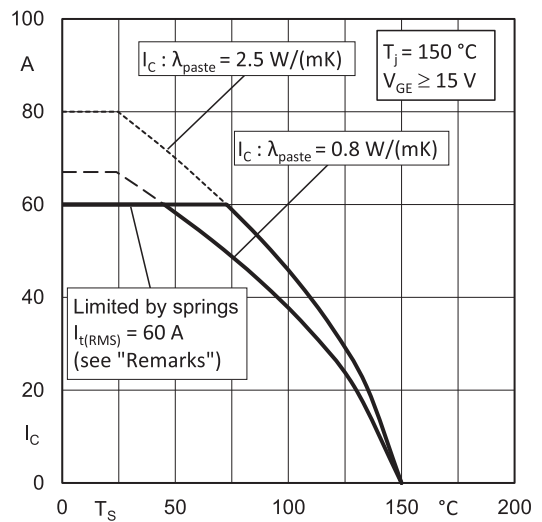


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_s)$

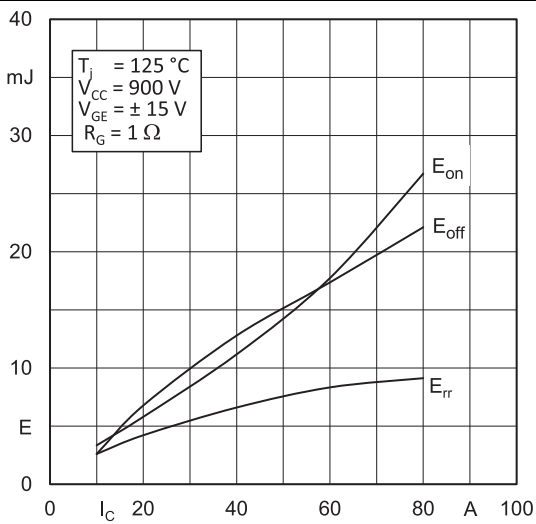


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

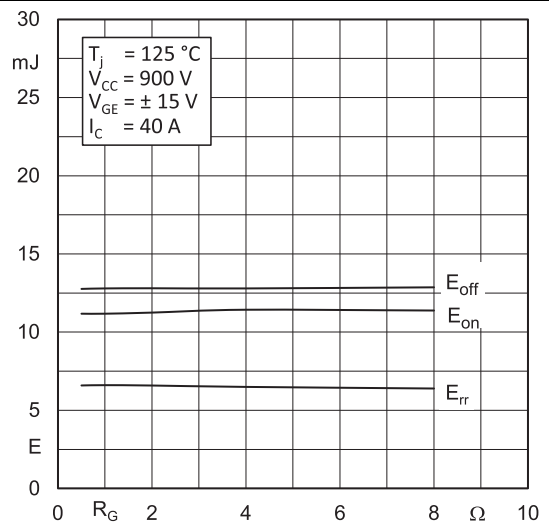


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

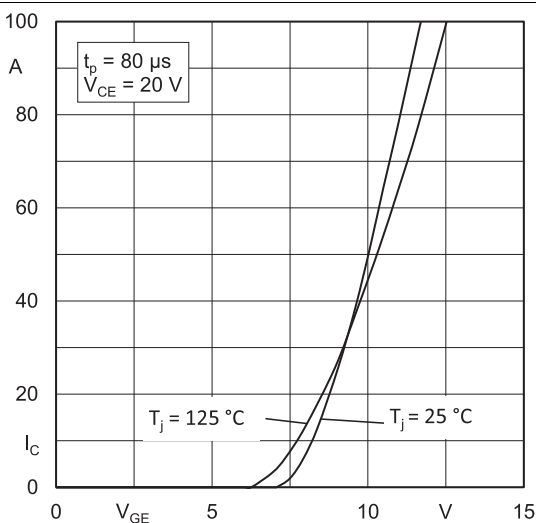


Fig. 5: Typ. transfer characteristic

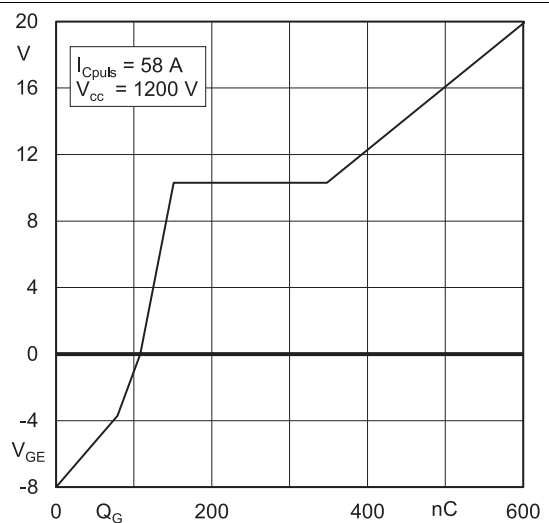


Fig. 6: Typ. gate charge characteristic

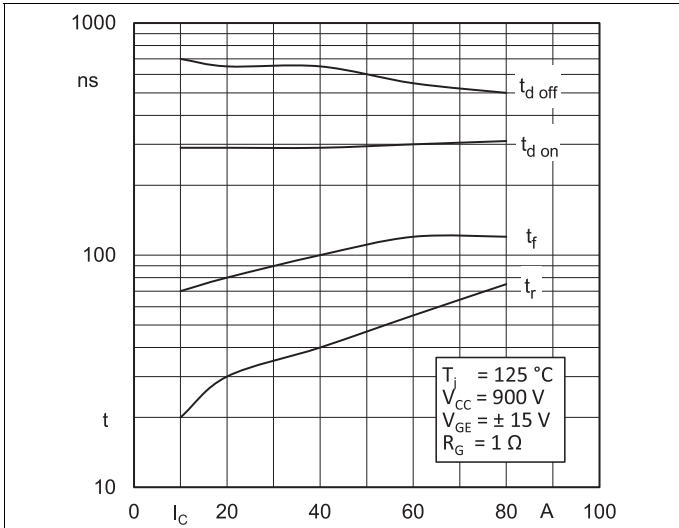


Fig. 7: Typ. switching times vs. I_C

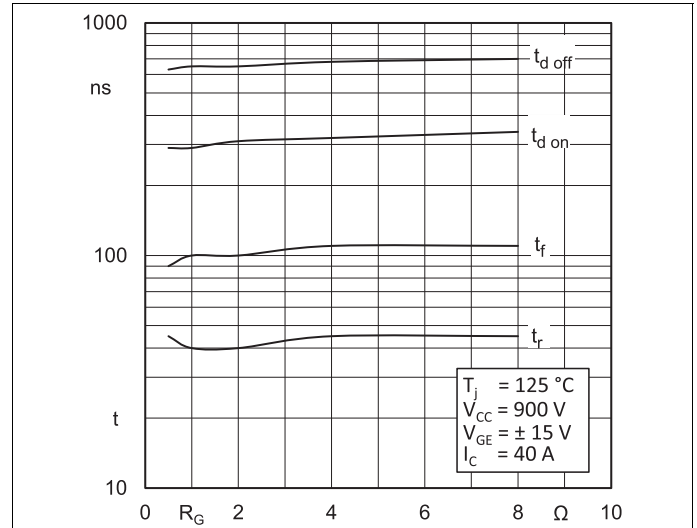


Fig. 8: Typ. switching times vs. gate resistor R_G

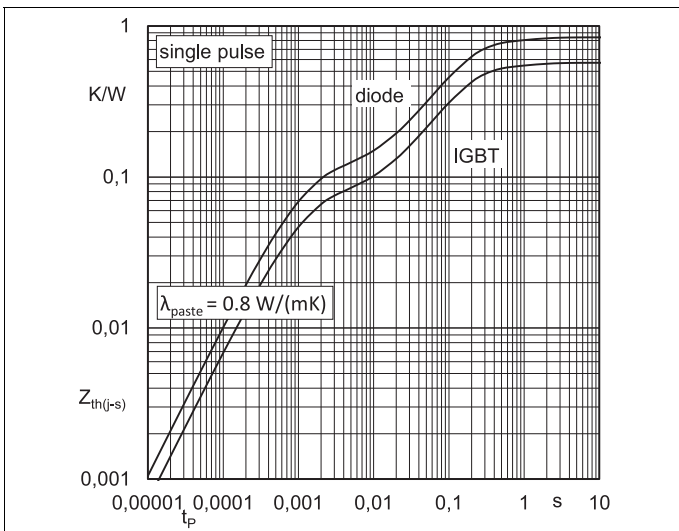


Fig. 9: Transient thermal impedance of IGBT and Diode

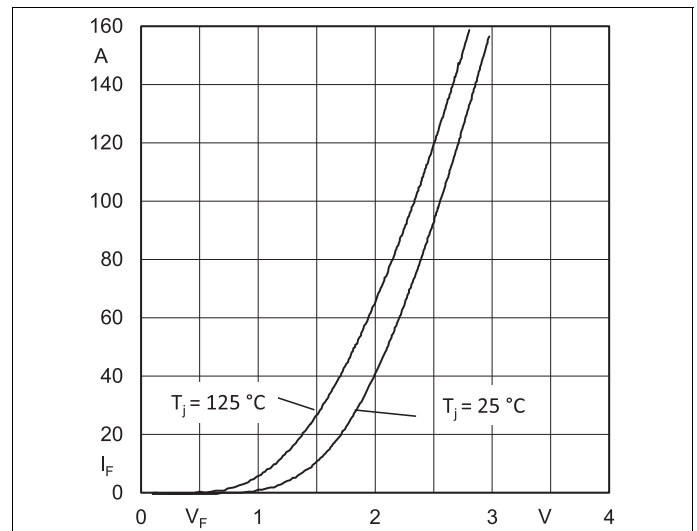


Fig. 10: CAL diode forward characteristic

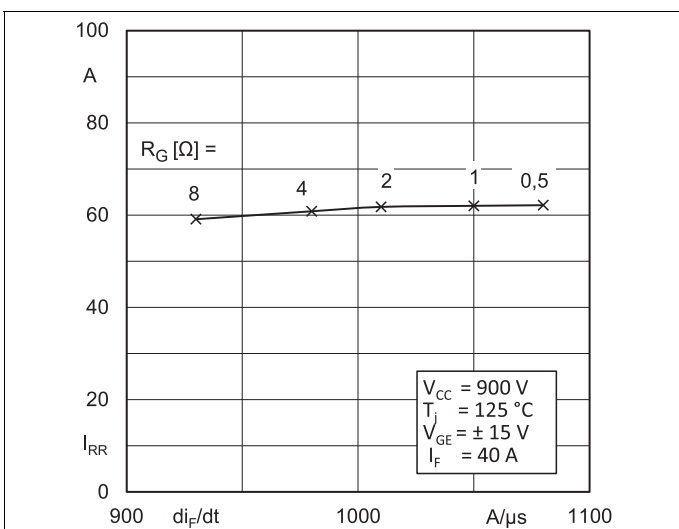


Fig. 11: Typ. CAL diode peak reverse recovery current

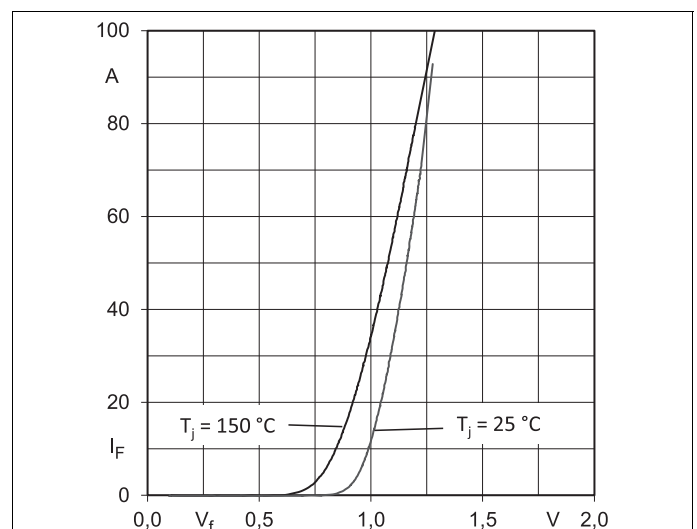


Fig. 12: Typ. input bridge forward characteristic

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

***IMPORTANT INFORMATION AND WARNINGS**

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