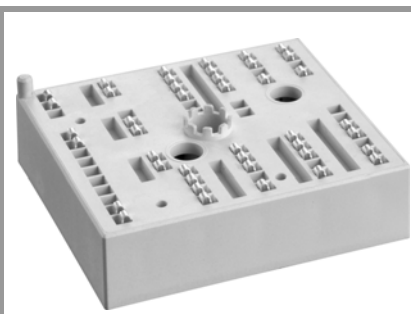


SKiiP 24NAB176V1



MiniSKiiP® 2

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

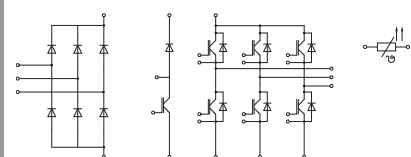
SKiiP 24NAB176V1

Features*

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

Remarks

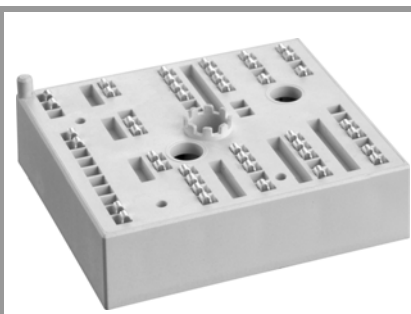
- Max. case temperature limited to $T_C=125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 20A for +B, B, -B, -DC/U, -DC/V, -DC/W power connectors
- The distance between terminals of temperature sensor and -DC/W is not sufficient for basic insulation
- The distance between terminals of +rect, +B and +DC not sufficient for basic insulation
- The distance between terminals of -B, -DC/U, DC/V and -DC/W not sufficient for basic insulation



NAB

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V _{CES}	T _j = 25 °C		1700	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	38	A
	T _j = 150 °C	T _s = 70 °C	29	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	43	A
	T _j = 150 °C	T _s = 70 °C	33	A
I _{Cnom}			29	A
I _{CRM}			58	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 1200 V V _{GE} ≤ 20 V V _{CES} ≤ 1700 V	T _j = 125 °C	10	µs
T _j			-55 ... 150	°C
Chopper - IGBT				
V _{CES}	T _j = 25 °C		1700	V
I _C	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	38	A
	T _j = 150 °C	T _s = 70 °C	29	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	43	A
	T _j = 150 °C	T _s = 70 °C	33	A
I _{Cnom}			29	A
I _{CRM}			58	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 1200 V V _{GE} ≤ 20 V V _{CES} ≤ 1700 V	T _j = 125 °C	10	µs
T _j			-55 ... 150	°C
Inverse - Diode				
V _{RRM}	T _j = 25 °C		1700	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	48	A
	T _j = 175 °C	T _s = 70 °C	38	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	54	A
	T _j = 175 °C	T _s = 70 °C	43	A
I _{FRM}			80	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		280	A
T _j			-40 ... 175	°C
Freewheeling - Diode				
V _{RRM}	T _j = 25 °C		1700	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	48	A
	T _j = 175 °C	T _s = 70 °C	38	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	54	A
	T _j = 175 °C	T _s = 70 °C	43	A
I _{FRM}			80	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 150 °C		280	A
T _j			-40 ... 175	°C

SKiiP 24NAB176V1



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Features*

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- Highly reliable spring contacts for electrical connections
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- NTC T-Sensor

Remarks

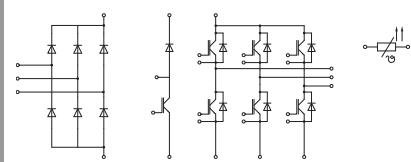
- Max. case temperature limited to $T_C=125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 20A for +B, B, -B, -DC/U, -DC/V, -DC/W power connectors
- The distance between terminals of temperature sensor and -DC/W is not sufficient for basic insulation
- The distance between terminals of +rect, +B and +DC not sufficient for basic insulation
- The distance between terminals of -B, -DC/U, DC/V and -DC/W not sufficient for basic insulation

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Rectifier - Diode				
V _{RRM}	T _j = 25 °C		1800	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	59	A
	T _j = 150 °C	T _s = 70 °C	42	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	66	A
	T _j = 150 °C	T _s = 70 °C	48	A
I _{FSM}	t _p = 10 ms	T _j = 25 °C	370	A
	sin 180°	T _j = 150 °C	270	A
i ² t	t _p = 10 ms	T _j = 25 °C	685	A ² s
	sin 180°	T _j = 150 °C	365	A ² s
T _j			-40 ... 150	°C
Module				
I _{t(RMS)}	T _{terminal} = 80 °C, 20 A per spring		40	A
T _{stg}	module without TIM		-40 ... 125	°C
V _{isol}	AC sinus 50 Hz, 1 min		2500	V

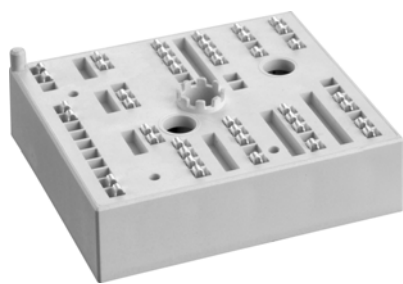
Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
Inverter - IGBT					
$V_{CE(sat)}$	$I_C = 29 \text{ A}$ $V_{GE} = 15 \text{ V}$ 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	$T_j = 25^\circ\text{C}$	34	43	$\text{m}\Omega$
		$T_j = 125^\circ\text{C}$	53	62	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 1.2 \text{ mA}$	5.2	5.8	6.4	V
I_{CES}	$V_{GE} = 0 \text{ V}$, $V_{CE} = 1700 \text{ V}$, $T_j = 25^\circ\text{C}$			1	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	2.50		nF
C_{oes}		$f = 1 \text{ MHz}$	0.11		nF
C_{res}		$f = 1 \text{ MHz}$	0.08		nF
Q_G	$V_{GE} = -8 \text{ V} \dots +15 \text{ V}$		240		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		32		Ω
$t_{d(on)}$	$V_{CC} = 900 \text{ V}$ $I_C = 20 \text{ A}$	$T_j = 125^\circ\text{C}$	290		ns
t_r	$R_{G on} = 1 \Omega$	$T_j = 125^\circ\text{C}$	40		ns
E_{on}	$R_{G off} = 1 \Omega$	$T_j = 125^\circ\text{C}$	5.1		mJ
$t_{d(off)}$	$di/dt_{on} = 580 \text{ A}/\mu\text{s}$	$T_j = 125^\circ\text{C}$	690		ns
t_f	$di/dt_{off} = 120 \text{ A}/\mu\text{s}$ $dv/dt = 4000 \text{ V}/\mu\text{s}$	$T_j = 125^\circ\text{C}$	120		ns
E_{off}	$V_{GE} = +15/-15 \text{ V}$ $L_s = 47 \text{ nH}$	$T_j = 125^\circ\text{C}$	6.3		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$		0.91		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$		0.73		K/W



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SKiiP 24NAB176V1



MiniSKiiP® 2

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

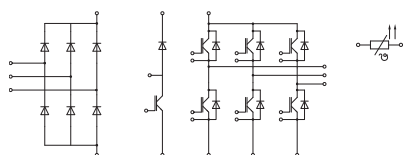
SKiiP 24NAB176V1

Features*

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

Remarks

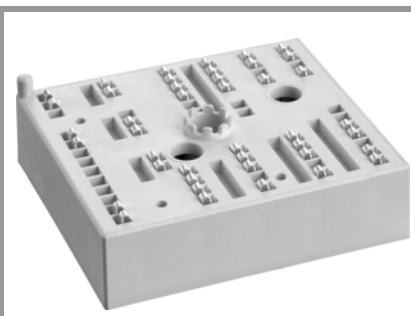
- Max. case temperature limited to $T_C=125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 125^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +125^\circ\text{C}$)
- $I_{t(RMS)}$ limited to 20A for +B, B, -B, -DC/-U, -DC/V, -DC/W power connectors
- The distance between terminals of temperature sensor and -DC/W is not sufficient for basic insulation
- The distance between terminals of +rect, +B and +DC not sufficient for basic insulation
- The distance between terminals of -B, -DC/U, DC/V and -DC/W not sufficient for basic insulation



NAB

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Chopper - IGBT						
V _{CE(sat)}	I _C = 29 A	T _j = 25 °C		2.00	2.45	V
	V _{GE} = 15 V chiplevel	T _j = 125 °C		2.45	2.90	V
V _{CE0}	chiplevel	T _j = 25 °C		1.00	1.20	V
		T _j = 125 °C		0.90	1.10	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		34	43	mΩ
		T _j = 125 °C		53	62	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 1.2 mA		5.2	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1700 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		2.50		nF
C _{oes}		f = 1 MHz		0.11		nF
C _{res}		f = 1 MHz		0.08		nF
Q _G	V _{GE} = - 8 V...+ 15 V			240		nC
R _{Gint}	T _j = 25 °C			32		Ω
t _{d(on)}	V _{CC} = 900 V	T _j = 125 °C		290		ns
t _r	I _C = 20 A	T _j = 125 °C		40		ns
E _{on}	R _{G on} = 1 Ω	T _j = 125 °C		5.1		mJ
	R _{G off} = 1 Ω	T _j = 125 °C				
t _{d(off)}	di/dt _{on} = 580 A/μs	T _j = 125 °C		690		ns
t _f	di/dt _{off} = 120 A/μs	T _j = 125 °C		120		ns
	dv/dt = 4000 V/μs					
E _{off}	V _{GE} = +15/-15 V	T _j = 125 °C		6.3		mJ
	L _s = 47 nH					
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			0.91		K/W
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			0.73		K/W
Inverse - Diode						
V _F = V _{EC}	I _F = 40 A	T _j = 25 °C		2.00	2.38	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.14	2.56	V
V _{F0}	chiplevel	T _j = 25 °C		1.32	1.56	V
		T _j = 150 °C		1.08	1.22	V
r _F	chiplevel	T _j = 25 °C		17	20	mΩ
		T _j = 150 °C		27	33	mΩ
I _{RRM}	I _F = 20 A	T _j = 125 °C		32.7		A
Q _{rr}	di/dt _{off} = 620 A/μs	T _j = 125 °C		8.7		μC
E _{rr}	V _{GE} = -15 V	T _j = 125 °C		4.9		mJ
	V _{CC} = 900 V					
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.14		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.95		K/W
Freewheeling - Diode						
V _F = V _{EC}	I _F = 40 A	T _j = 25 °C		2.00	2.38	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.14	2.56	V
V _{F0}	chiplevel	T _j = 25 °C		1.32	1.56	V
		T _j = 150 °C		1.08	1.22	V
r _F	chiplevel	T _j = 25 °C		17	20	mΩ
		T _j = 150 °C		27	33	mΩ
I _{RRM}	I _F = 20 A	T _j = 125 °C		32.7		A
Q _{rr}	di/dt _{off} = 620 A/μs	T _j = 125 °C		8.7		μC
E _{rr}	V _{GE} = -15 V	T _j = 125 °C		4.9		mJ
	V _{CC} = 900 V					
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.14		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.95		K/W

SKiiP 24NAB176V1



MiniSKiiP® 2

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

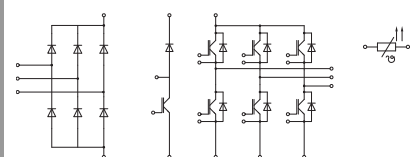
SKiiP 24NAB176V1

Features*

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

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 20A for +B, B, -B, -DC/U, -DC/V, -DC/W power connectors
- The distance between terminals of temperature sensor and -DC/W is not sufficient for basic insulation
- The distance between terminals of +rect, +B and +DC not sufficient for basic insulation
- The distance between terminals of -B, -DC/U, DC/V and -DC/W not sufficient for basic insulation



NAB

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Rectifier - Diode						
V _F = V _{EC}	I _F = 41 A chiplevel	T _j = 25 °C		1.19	1.45	V
		T _j = 125 °C		1.17	1.42	V
V _{F0}	chiplevel	T _j = 25 °C	0.6	0.87	1.10	V
		T _j = 125 °C		0.75	0.97	V
r _F	chiplevel	T _j = 25 °C		7.9	8.7	mΩ
		T _j = 125 °C		10	11	mΩ
I _R	T _j = 145 °C, V _{RRM}				1.1	mA
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			1.32		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			1.12		K/W
Module						
M _s	to heat sink		2		2.5	Nm
w				55		g
L _{CE}				31		nH
Temperature Sensor						
R ₁₀₀	T _r =100°C (R ₂₅ =1000Ω)			1670 ± 3%		Ω
R _(T)	R _(T) =1000Ω[1+A(T-25°C)+B(T-25°C) ²] , A = 7.635*10 ⁻³ °C ⁻¹ , B = 1.731*10 ⁻⁵ °C ⁻²					

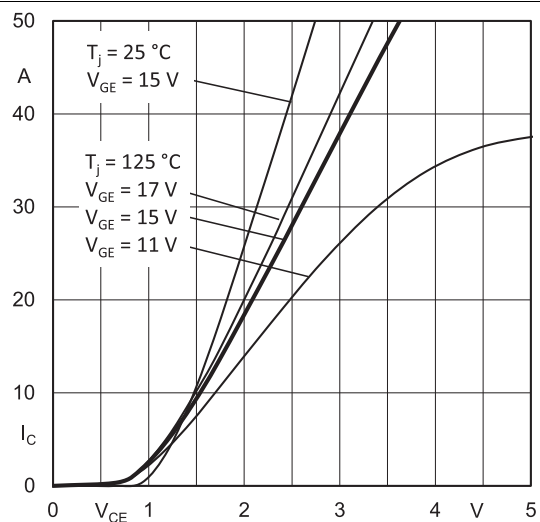


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

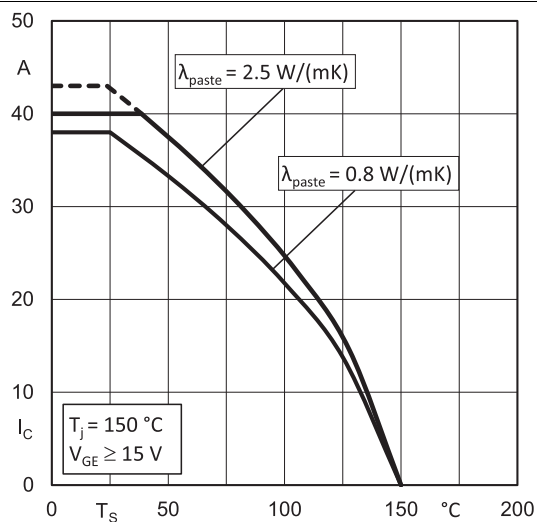


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_s)$

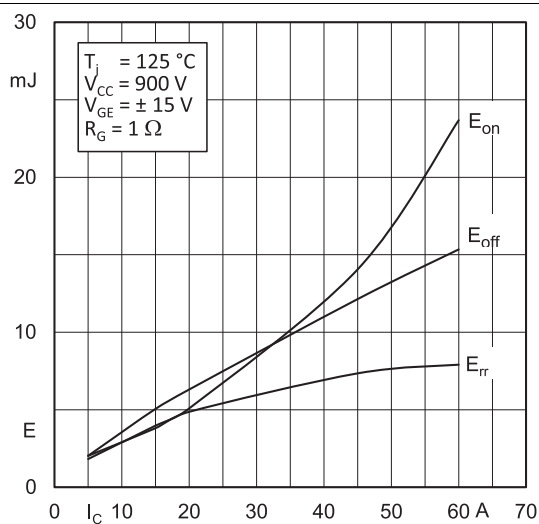


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

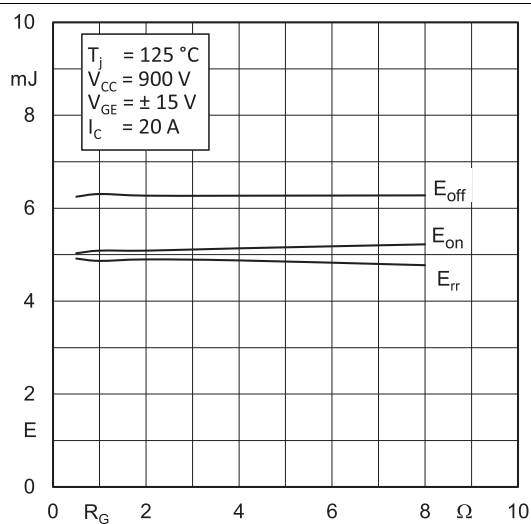


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

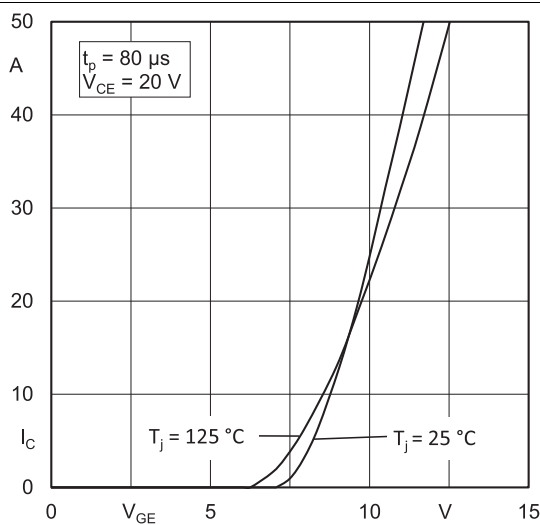


Fig. 5: Typ. transfer characteristic

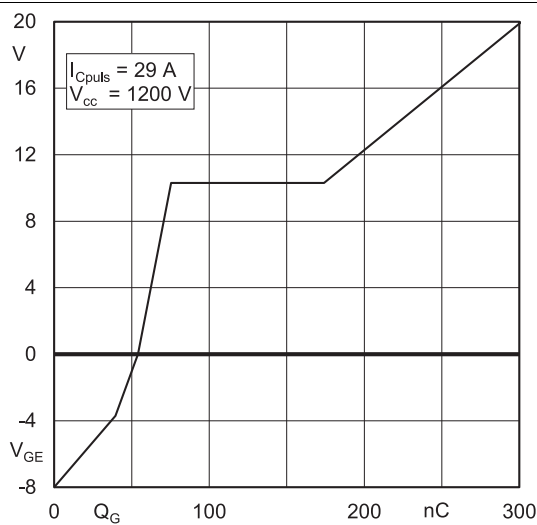
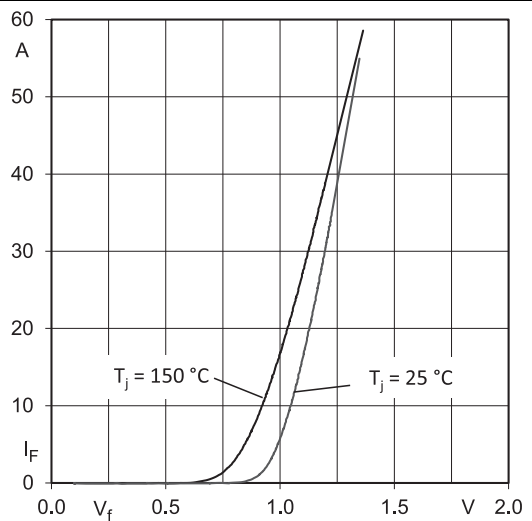
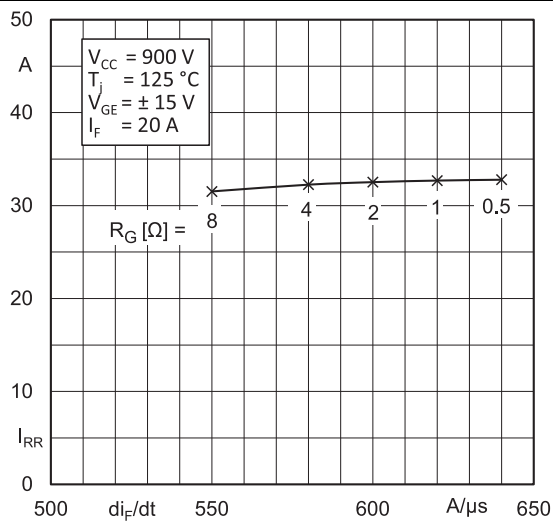
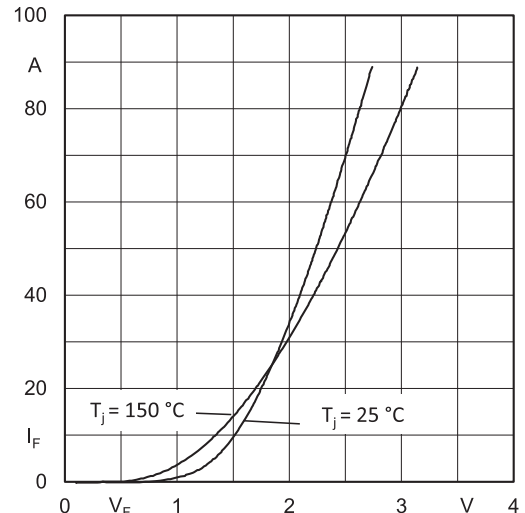
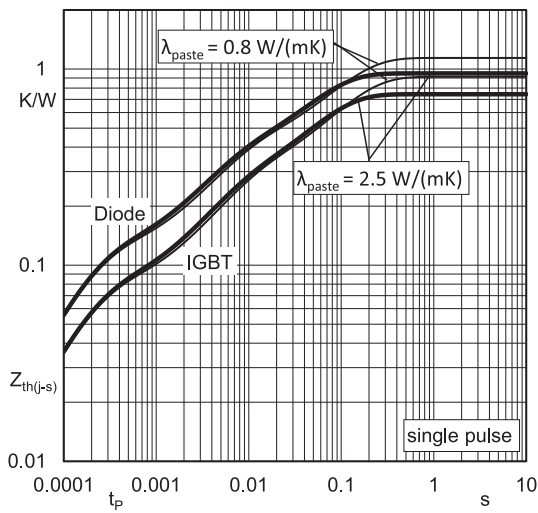
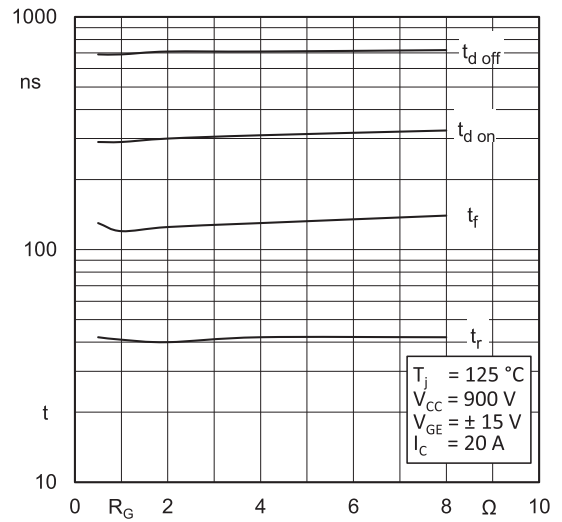
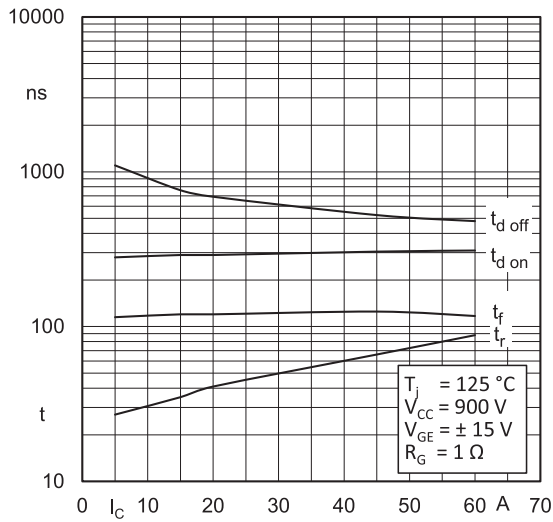
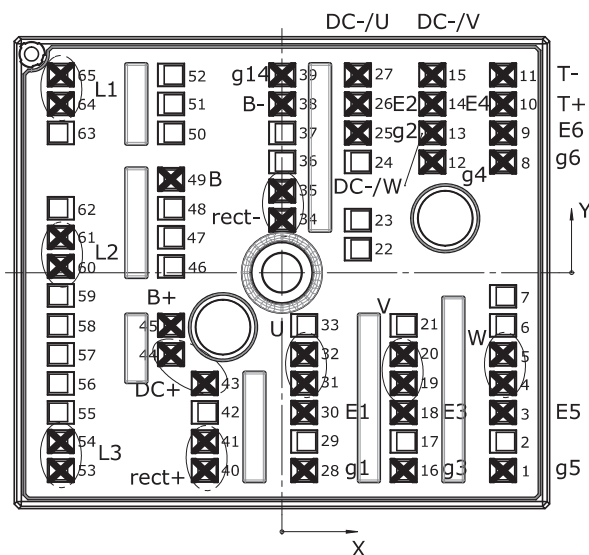


Fig. 6: Typ. gate charge characteristic

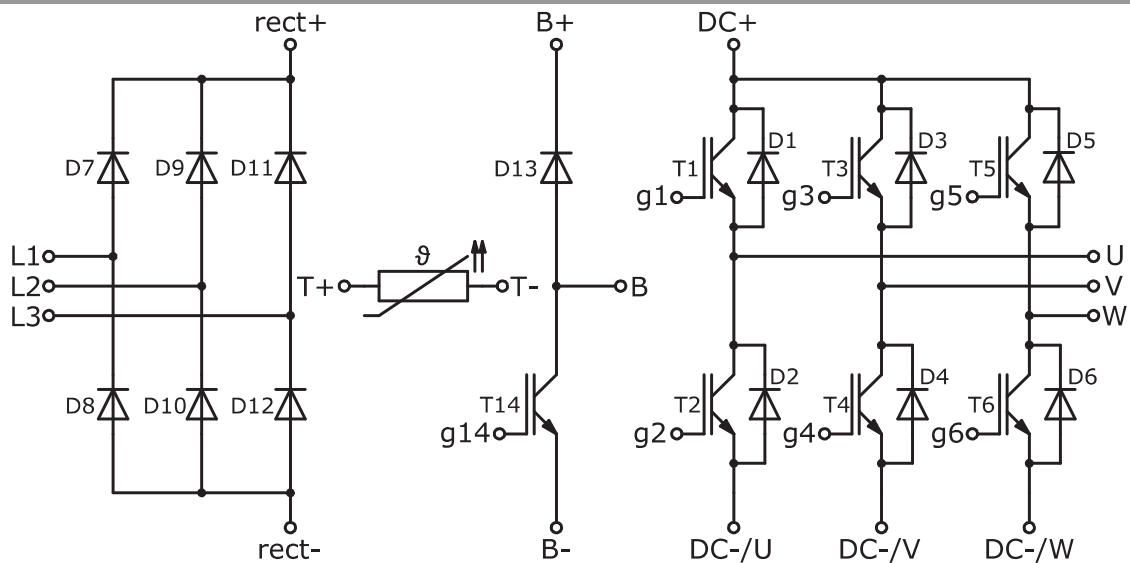


Pin out											
Pin	X	Y	Function	Pin	X	Y	Function	Pin	X	Y	Function
1	24,38	-21,80	g5	23	8,38	5,80		45	-12,23	-5,80	B+
2	24,38	-18,60		24	8,38	12,20		46	-12,23	0,70	
3	24,38	-15,40	E5	25	8,38	15,40	g2	47	-12,23	3,90	
4	24,38	-12,20	W	26	8,38	18,60	E2	48	-12,23	7,10	
5	24,38	-9,00	W	27	8,38	21,80	DC-/U	49	-12,23	10,30	B
6	24,38	-5,80		28	2,46	-21,80	g1	50	-12,23	15,40	
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	
9	24,38	15,40	E6	31	2,46	-12,20	U	53	-24,38	-21,80	L3
10	24,38	18,60	T+	32	2,46	-9,00	U	54	-24,38	-18,60	L3
11	24,38	21,80	T-	33	2,46	-5,80		55	-24,38	-15,40	
12	16,58	12,20	g4	34	0,03	5,80	rect-	56	-24,38	-12,20	
13	16,58	15,40	DC-/W	35	0,03	9,00	rect-	57	-24,38	-9,00	
14	16,58	18,60	E4	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	
16	13,42	-21,80	g3	38	0,03	18,60	B-	60	-24,38	0,70	L2
17	13,42	-18,60		39	0,03	21,80	g14	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	
20	13,42	-9,00	V	42	-8,51	-15,40		64	-24,38	18,60	L1
21	13,42	-5,80		43	-8,51	-12,20	DC+	65	-24,38	21,80	L1
22	8,38	2,60		44	-12,23	-9,00	DC+				

all values in mm



Pinout and Dimensions



Pinout

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

***IMPORTANT INFORMATION AND WARNINGS**

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