

## Technische Information/technical information

IGBT-Module  
IGBT-modules

## FS10R06VL4B2

power electronics in motion  
**eupec**Vorläufige Daten  
preliminary data

## IGBT-Wechselrichter/IGBT-inverter

## Höchstzulässige Werte/maximum rated values

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	600	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}$	$I_{C\ nom}$ $I_C$	10 16	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_P = 1\ \text{ms}$ , $T_C = 80^{\circ}\text{C}$	$I_{CRM}$	20	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}$	$P_{tot}$	78,0	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		$V_{GES}$	+/-20	V

## Charakteristische Werte/characteristic values

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 10\ \text{A}$ , $V_{GE} = 15\ \text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ $I_C = 10\ \text{A}$ , $V_{GE} = 15\ \text{V}$ , $T_{vj} = 125^{\circ}\text{C}$	$V_{CE\ sat}$		1,95 2,20	2,55	V V
Gate-Schwellenspannung gate threshold voltage	$I_C = 0,40\ \text{mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25^{\circ}\text{C}$	$V_{GEth}$	4,5	5,5	6,5	V
Gateladung gate charge	$V_{GE} = -15\ \text{V} \dots +15\ \text{V}$	$Q_G$		0,05		$\mu\text{C}$
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$	$R_{Gint}$		0,0		$\Omega$
Eingangskapazität input capacitance	$f = 1\ \text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\ \text{V}$ , $V_{GE} = 0\ \text{V}$	$C_{ies}$		0,45		nF
Rückwirkungskapazität reverse transfer capacitance	$f = 1\ \text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\ \text{V}$ , $V_{GE} = 0\ \text{V}$	$C_{res}$		0,04		nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{CE} = 600\ \text{V}$ , $V_{GE} = 0\ \text{V}$ , $T_{vj} = 25^{\circ}\text{C}$	$I_{CES}$			5,0	mA
Gate-Emitter Reststrom gate-emitter leakage current	$V_{CE} = 0\ \text{V}$ , $V_{GE} = 20\ \text{V}$ , $T_{vj} = 25^{\circ}\text{C}$	$I_{GES}$			400	nA
Einschaltverzögerungszeit (ind. Last) turn-on delay time (inductive load)	$I_C = 10\ \text{A}$ , $V_{CE} = 300\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 27\ \Omega$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 27\ \Omega$ , $T_{vj} = 125^{\circ}\text{C}$	$t_{d\ on}$		0,012 0,012		$\mu\text{s}$ $\mu\text{s}$
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 10\ \text{A}$ , $V_{CE} = 300\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 27\ \Omega$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 27\ \Omega$ , $T_{vj} = 125^{\circ}\text{C}$	$t_r$		0,012 0,013		$\mu\text{s}$ $\mu\text{s}$
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	$I_C = 10\ \text{A}$ , $V_{CE} = 300\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 27\ \Omega$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 27\ \Omega$ , $T_{vj} = 125^{\circ}\text{C}$	$t_{d\ off}$		0,085 0,105		$\mu\text{s}$ $\mu\text{s}$
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 10\ \text{A}$ , $V_{CE} = 300\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 27\ \Omega$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 27\ \Omega$ , $T_{vj} = 125^{\circ}\text{C}$	$t_f$		0,017 0,03		$\mu\text{s}$ $\mu\text{s}$
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 10\ \text{A}$ , $V_{CE} = 300\ \text{V}$ , $L_S = 60\ \text{nH}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 27\ \Omega$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 27\ \Omega$ , $T_{vj} = 125^{\circ}\text{C}$	$E_{on}$		0,18 0,25		mJ mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 10\ \text{A}$ , $V_{CE} = 300\ \text{V}$ , $L_S = 60\ \text{nH}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 27\ \Omega$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 27\ \Omega$ , $T_{vj} = 125^{\circ}\text{C}$	$E_{off}$		0,18 0,27		mJ mJ
Kurzschlußverhalten SC data	$t_P \leq 10\ \mu\text{s}$ , $V_{GE} \leq 15\ \text{V}$ $T_{vj} \leq 125^{\circ}\text{C}$ , $V_{CC} = 360\ \text{V}$ , $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$I_{SC}$		45		A
Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT per IGBT	$R_{thJC}$		1,60	1,80	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro IGBT / per IGBT $\lambda_{Paste} = 1\ \text{W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1\ \text{W}/(\text{m}\cdot\text{K})$	$R_{thCH}$		0,80		K/W

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## Diode-Wechselrichter/diode-inverter

## Höchstzulässige Werte/maximum rated values

Periodische Spitzensperrspannung repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{RRM}$	600	V
Dauergleichstrom DC forward current		$I_F$	10	A
Periodischer Spitzenstrom repetitive peak forward current	$t_p = 1 \text{ ms}$	$I_{FRM}$	20	A
Grenzlastintegral $I^2t$ - value	$V_R = 0 \text{ V}, t_p = 10 \text{ ms}, T_{vj} = 125^{\circ}\text{C}$	$I^2t$	12,0	$\text{A}^2\text{s}$

## Charakteristische Werte/characteristic values

			min.	typ.	max.	
Durchlassspannung forward voltage	$I_F = 10 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $I_F = 10 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 125^{\circ}\text{C}$	$V_F$		1,85 1,90	2,25	V V
Rückstromspitze peak reverse recovery current	$I_F = 10 \text{ A}, -di_F/dt = 1000 \text{ A}/\mu\text{s}$ $V_R = 300 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 300 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$	$I_{RM}$		16,0 17,0		A A
Sperrverzögerungsladung recovered charge	$I_F = 10 \text{ A}, -di_F/dt = 1000 \text{ A}/\mu\text{s}$ $V_R = 300 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 300 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$	$Q_r$		0,50 0,85		$\mu\text{C}$ $\mu\text{C}$
Abschaltenergie pro Puls reverse recovery energy	$I_F = 10 \text{ A}, -di_F/dt = 1000 \text{ A}/\mu\text{s}$ $V_R = 300 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 300 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$	$E_{rec}$		0,10 0,18		mJ mJ
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode per diode	$R_{thJC}$		3,60	3,95	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Diode / per diode $\lambda_{paste} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$	$R_{thCH}$		1,35		K/W

## NTC-Widerstand/NTC-thermistor

## Charakteristische Werte/characteristic values

			min.	typ.	max.	
Nennwiderstand rated resistance	$T_C = 25^{\circ}\text{C}$	$R_{25}$		5,00		k $\Omega$
Abweichung von $R_{100}$ deviation of $R_{100}$	$T_C = 100^{\circ}\text{C}, R_{100} = 493 \Omega$	$\Delta R/R$	-5		5	%
Verlustleistung power dissipation	$T_C = 25^{\circ}\text{C}$	$P_{25}$			20,0	mW
B-Wert B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298, 15\text{K}))]$	$B_{25/50}$		3375		K

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## Modul/module

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min.	V <sub>ISO</sub>	2,5		kV
Kollektor-Emitter-Gleichsperrspannung DC stability	T <sub>vj</sub> = 25°C, 100 fit	V <sub>CE D</sub>	600		V
Material für innere Isolation material for internal insulation			Al <sub>2</sub> O <sub>3</sub>		
Kriechstrecke creepage distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		5,00 5,00		mm
Luftstrecke clearance distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		3,20 3,20		mm
Vergleichszahl der Kriechwegbildung comparative tracking index		CTI	> 225		
			min.	typ.	max.
Modulinduktivität stray inductance module		L <sub>sCE</sub>		25	nH
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	T <sub>C</sub> = 25°C, pro Zweig / per arm	R <sub>CC'-EE'</sub>		9,50	mΩ
Höchstzulässige Sperrschichttemperatur maximum junction temperature		T <sub>vj max</sub>			150 °C
Temperatur im Schaltbetrieb temperature under switching conditions		T <sub>vj op</sub>	-40		125 °C
Lagertemperatur storage temperature		T <sub>stg</sub>	-40		125 °C
Anpreßkraft für mech. Bef. pro Feder mounting force per clamp		F	30	-	50 N
Gewicht weight		G		10	g

**Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen technischen Erläuterungen.**

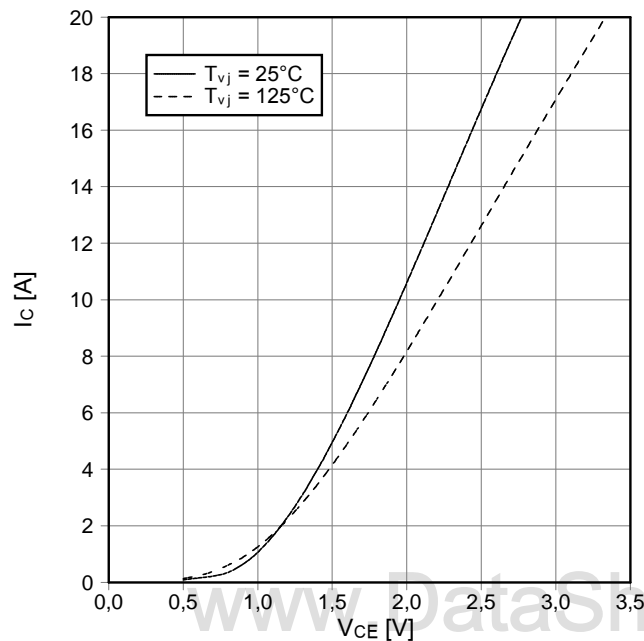
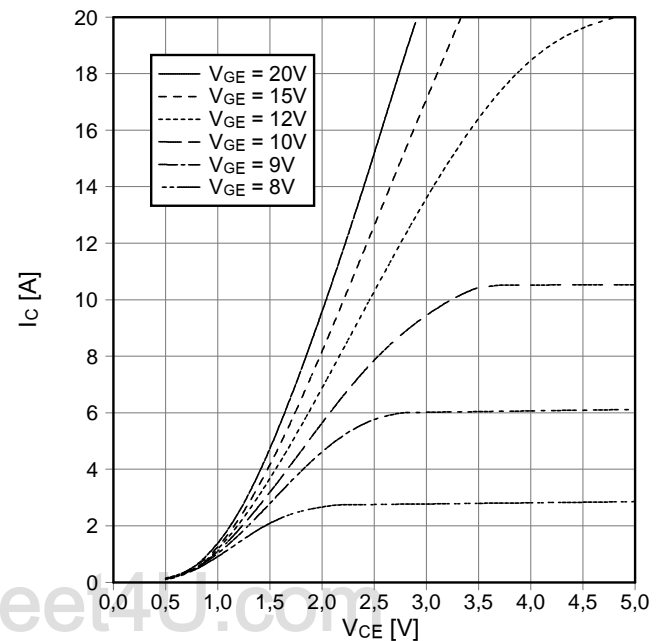
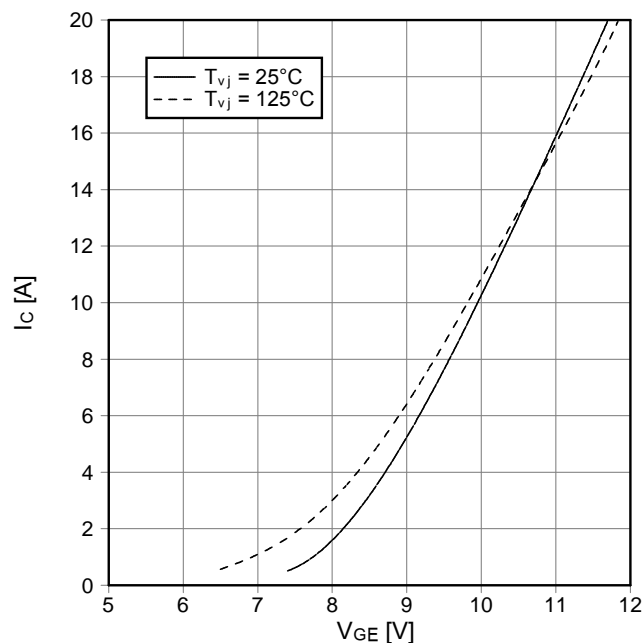
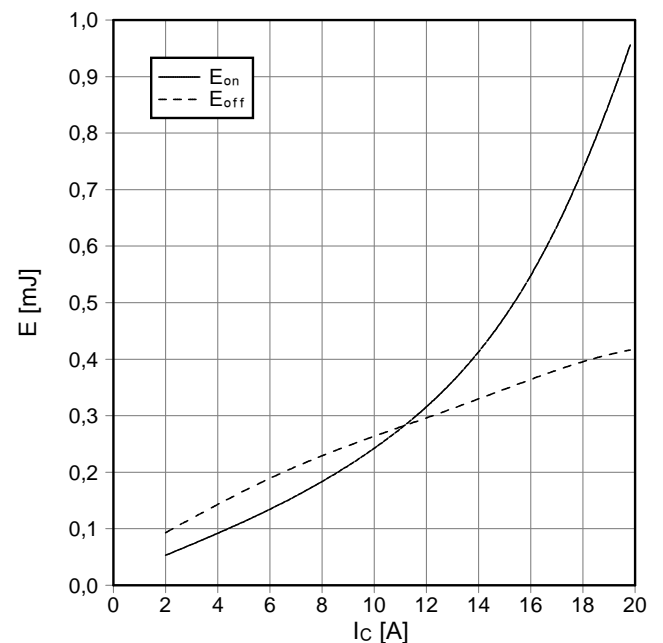
**This technical information specifies semiconductor devices but guarantees no characteristics. It is valid with the appropriate technical explanations.**

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preliminary dataAusgangskennlinie IGBT-Wechselr. (typisch)  
output characteristic IGBT-inverter (typical) $I_c = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$ Ausgangskennlinienfeld IGBT-Wechselr. (typisch)  
output characteristic IGBT-inverter (typical) $I_c = f(V_{CE})$   
 $T_{vj} = 125^\circ\text{C}$ Übertragungscharakteristik IGBT-Wechselr. (typisch)  
transfer characteristic IGBT-inverter (typical) $I_c = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$ Schaltverluste IGBT-Wechselr. (typisch)  
switching losses IGBT-inverter (typical) $E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 27\ \Omega$ ,  $R_{Goff} = 27\ \Omega$ ,  $V_{CE} = 300\text{ V}$ ,  
 $T_{vj} = 125^\circ\text{C}$ 

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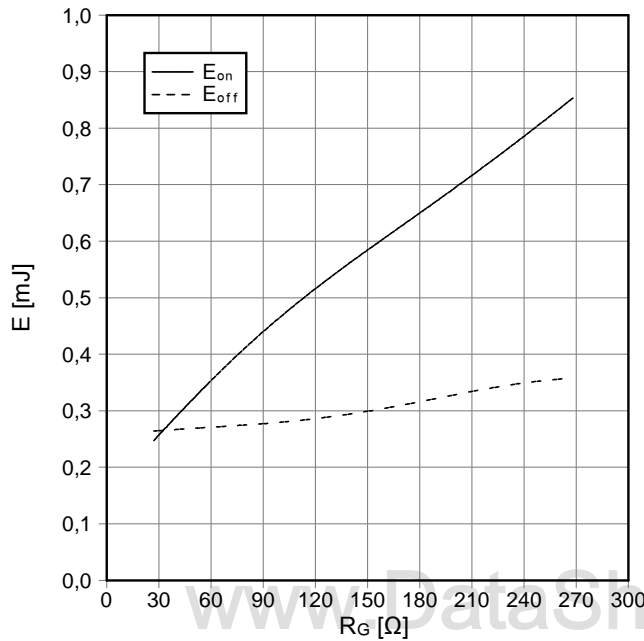
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Vorläufige Daten  
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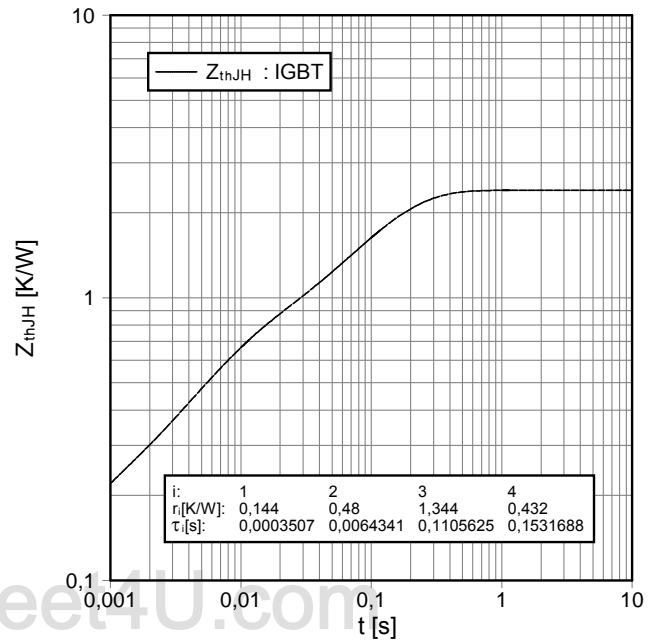
Schaltverluste IGBT-Wechselr. (typisch)  
switching losses IGBT-inverter (typical)

$E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_c = 10\text{ A}$ ,  $V_{CE} = 300\text{ V}$ ,  $T_{vj} = 125^\circ\text{C}$



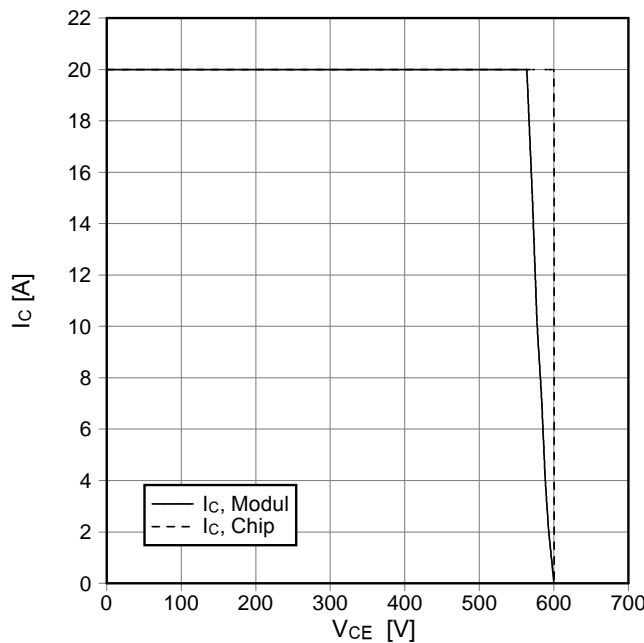
Transienter Wärmewiderstand IGBT-Wechselr.  
transient thermal impedance IGBT-inverter

$Z_{thJH} = f(t)$



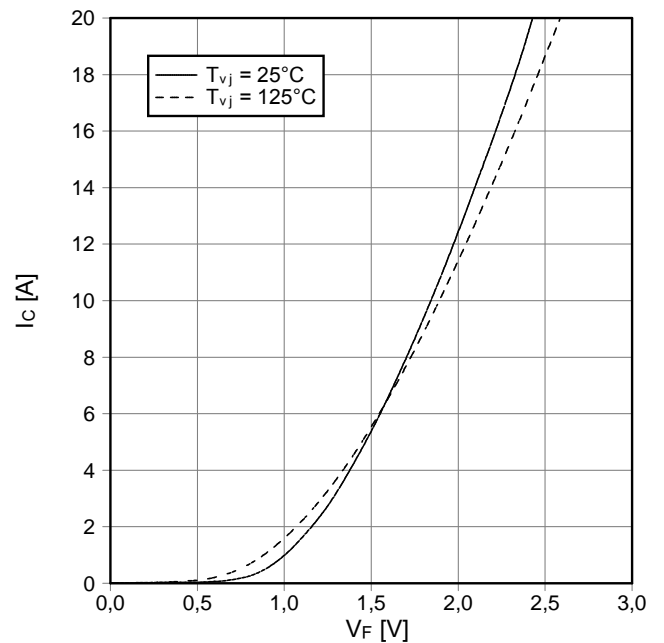
Sicherer Rückwärts-Arbeitsbereich IGBT-Wr. (RBSOA)  
reverse bias safe operating area IGBT-inv. (RBSOA)

$I_c = f(V_{CE})$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Goff} = 27\ \Omega$ ,  $T_{vj} = 125^\circ\text{C}$



Durchlaßkennlinie der Diode-Wechselr. (typisch)  
forward characteristic of diode-inverter (typical)

$I_F = f(V_F)$



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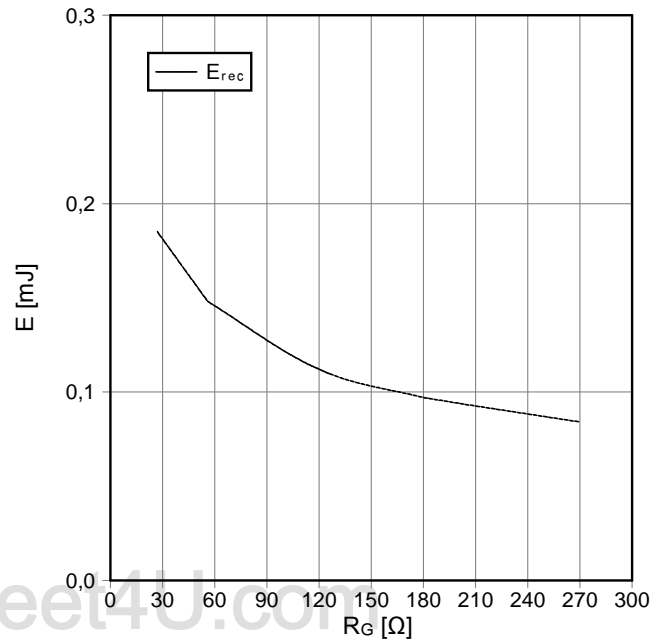
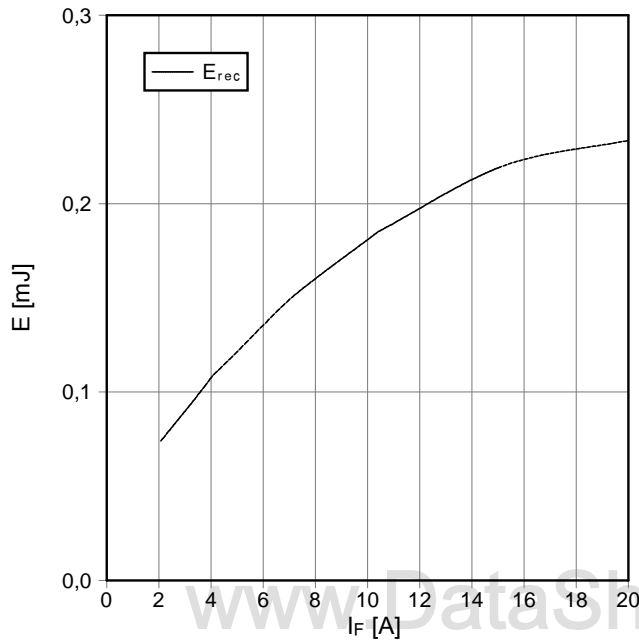
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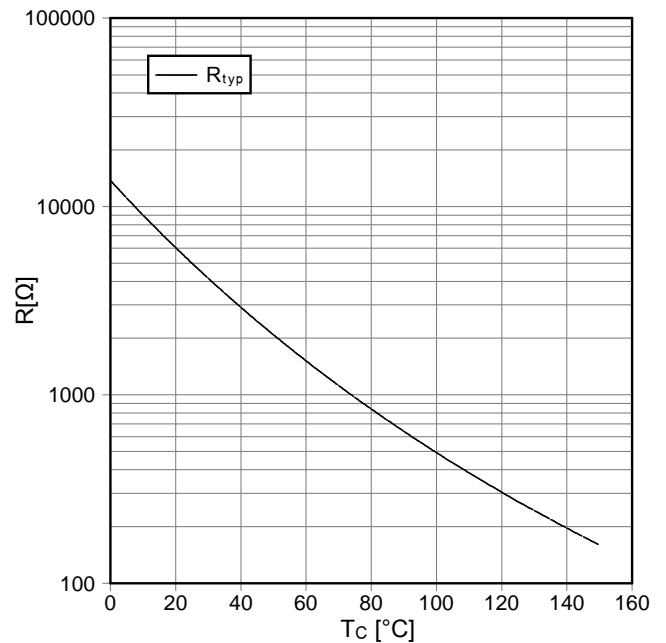
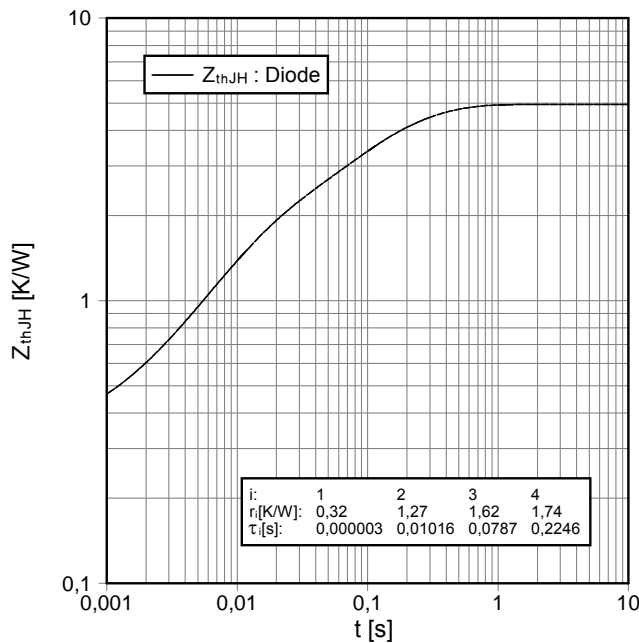
Schaltverluste Diode-Wechselr. (typisch)  
switching losses diode-inverter (typical)  
 $E_{rec} = f(I_F)$   
 $R_{Gon} = 27 \Omega$ ,  $V_{CE} = 300 V$ ,  $T_{vj} = 125^\circ C$

Schaltverluste Diode-Wechselr. (typisch)  
switching losses diode-inverter (typical)  
 $E_{rec} = f(R_G)$   
 $I_F = 10 A$ ,  $V_{CE} = 300 V$ ,  $T_{vj} = 125^\circ C$



Transienter Wärmewiderstand Diode-Wechselr.  
transient thermal impedance diode-inverter  
 $Z_{thJH} = f(t)$

NTC-Temperaturkennlinie (typisch)  
NTC-temperature characteristic (typical)  
 $R = f(T)$



i:	1	2	3	4
$r_i$ [K/W]:	0,32	1,27	1,62	1,74
$\tau_i$ [s]:	0,000003	0,01016	0,0787	0,2246

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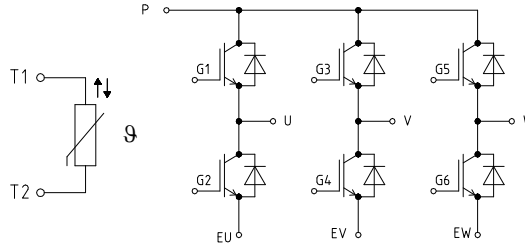
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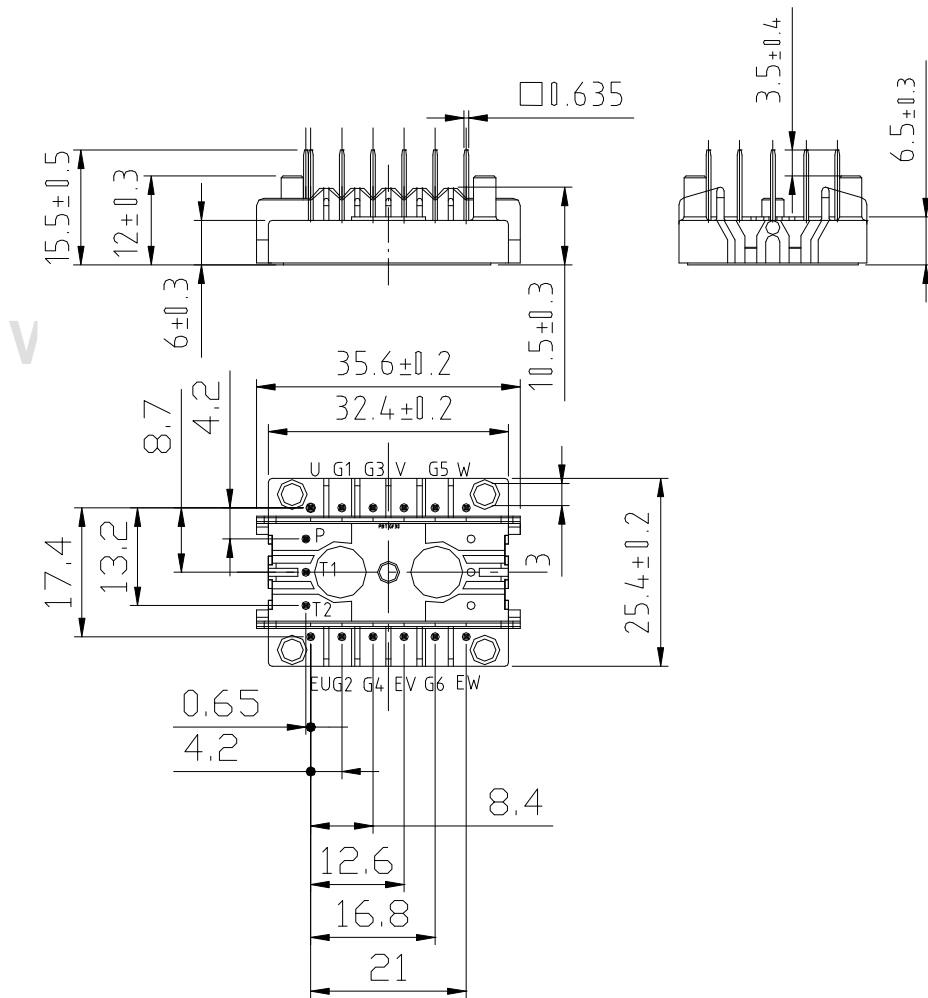


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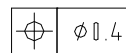
Schaltplan/circuit diagram



Gehäuseabmessungen/package outlines



Pinpositions with tolerance



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