

Technische Information / Technical Information

IGBT-Module
IGBT-Modules

FZ 1600 R 17 KF6 B2

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Höchstzulässige Werte / Maximum rated values

Elektrische Eigenschaften / Electrical properties

Kollektor-Emitter-Sperrspannung collector-emitter voltage		V_{CES}	1700	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^\circ\text{C}$	$I_{C,nom.}$	1600	A
	$T_C = 25^\circ\text{C}$	I_C	3200	A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_C = 80^\circ\text{C}$	I_{CRM}	3200	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^\circ\text{C}, \text{ Transistor}$	P_{tot}	12,5	kW
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V
Dauergleichstrom DC forward current		I_F	1600	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	I_{FRM}	3200	A
Grenzlastintegral der Diode I^2t - value, Diode	$V_R = 0V, t_p = 10\text{ms}, T_{vj} = 125^\circ\text{C}$	I^2t	980	kA^2s
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50\text{ Hz}, t = 1\text{ min.}$	V_{ISOL}	4	kV

Charakteristische Werte / Characteristic values

Transistor / Transistor

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 1600A, V_{GE} = 15V, T_{vj} = 25^\circ\text{C}$	$V_{CE\text{ sat}}$		2,6	3,1	V
	$I_C = 1600A, V_{GE} = 15V, T_{vj} = 125^\circ\text{C}$			3,1	3,6	V
Gate-Schwellenspannung gate threshold voltage	$I_C = 130\text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$	$V_{GE(th)}$	4,5	5,5	6,5	V
Gateladung gate charge	$V_{GE} = -15V \dots +15V$	Q_G		19		μC
Eingangskapazität input capacitance	$f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25V, V_{GE} = 0V$	C_{res}		105		nF
Rückwirkungskapazität reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25V, V_{GE} = 0V$	C_{res}		5,3		nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{CE} = 1700V, V_{GE} = 0V, T_{vj} = 25^\circ\text{C}$	I_{CES}		0,04	3	mA
	$V_{CE} = 1700V, V_{GE} = 0V, T_{vj} = 125^\circ\text{C}$			20	160	mA
Gate-Emitter Reststrom gate-emitter leakage current	$V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25^\circ\text{C}$	I_{GES}			400	nA

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Charakteristische Werte / Characteristic values

Transistor / Transistor

			min.	typ.	max.	
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = 1600A, V_{CE} = 900V$	$t_{d,on}$				
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 25^\circ C$			0,3		μs
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 125^\circ C$			0,3		μs
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 1600A, V_{CE} = 900V$	t_r				
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 25^\circ C$			0,19		μs
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 125^\circ C$			0,19		μs
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 1600A, V_{CE} = 900V$	$t_{d,off}$				
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 25^\circ C$			1,2		μs
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 125^\circ C$			1,2		μs
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 1600A, V_{CE} = 900V$	t_f				
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 25^\circ C$			0,15		μs
	$V_{GE} = \pm 15V, R_G = 0,9\Omega, T_{vj} = 125^\circ C$			0,16		μs
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 1600A, V_{CE} = 900V, V_{GE} = 15V$ $R_G = 0,9\Omega, T_{vj} = 125^\circ C, L_S = 50nH$	E_{on}		430		mWs
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 1600A, V_{CE} = 900V, V_{GE} = 15V$ $R_G = 0,9\Omega, T_{vj} = 125^\circ C, L_S = 50nH$	E_{off}		670		mWs
Kurzschlußverhalten SC Data	$t_p \leq 10\mu sec, V_{GE} \leq 15V$ $T_{vj} \leq 125^\circ C, V_{CC} = 1000V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	I_{SC}		6400		A
Modulinduktivität stray inductance module		L_{sCE}		12		nH
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	pro Zweig / per arm	R_{CC+EE}		0,08		m Ω

Charakteristische Werte / Characteristic values

Diode / Diode

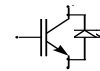
			min.	typ.	max.	
Durchlaßspannung forward voltage	$I_F = 1600A, V_{GE} = 0V, T_{vj} = 25^\circ C$	V_F		2,1	2,5	V
	$I_F = 1600A, V_{GE} = 0V, T_{vj} = 125^\circ C$			1,95	2,3	V
Rückstromspitze peak reverse recovery current	$I_F = 1600A, -di_F/dt = 9600A/\mu sec$	I_{RM}		920		A
	$V_R = 900V, V_{GE} = -10V, T_{vj} = 25^\circ C$			1350		A
	$V_R = 900V, V_{GE} = -10V, T_{vj} = 125^\circ C$					
Sperrverzögerungsladung recovered charge	$I_F = 1600A, -di_F/dt = 9600A/\mu sec$	Q_r		220		μAs
	$V_R = 900V, V_{GE} = -10V, T_{vj} = 25^\circ C$			460		μAs
	$V_R = 900V, V_{GE} = -10V, T_{vj} = 125^\circ C$					
Abschaltenergie pro Puls reverse recovery energy	$I_F = 1600A, -di_F/dt = 9600A/\mu sec$	E_{rec}		125		mWs
	$V_R = 900V, V_{GE} = -10V, T_{vj} = 25^\circ C$			240		mWs
	$V_R = 900V, V_{GE} = -10V, T_{vj} = 125^\circ C$					

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Thermische Eigenschaften / Thermal properties

			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC	R_{thJC}			0,01	K/W
	Diode/Diode, DC				0,017	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{paste} = 1 \text{ W/m}^2\text{K}$ / $\lambda_{grease} = 1 \text{ W/m}^2\text{K}$	R_{thCK}		0,008		K/W
Höchstzulässige Sperrschichttemperatur maximum junction temperature		T_{vj}			150	°C
Betriebstemperatur operation temperature		T_{op}	-40		125	°C
Lagertemperatur storage temperature		T_{stg}	-40		125	°C

Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see appendix					
Innere Isolation internal insulation				AlN	
Kriechstrecke creepage distance				17	mm
Luftstrecke clearance				10	mm
CTI comperative tracking index		min.		275	
Anzugsdrehmoment f. mech. Befestigung mounting torque		M1		5	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	terminals M4	M2		2	Nm
	terminals M8			8 - 10	Nm
Gewicht weight		G		1050	g

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

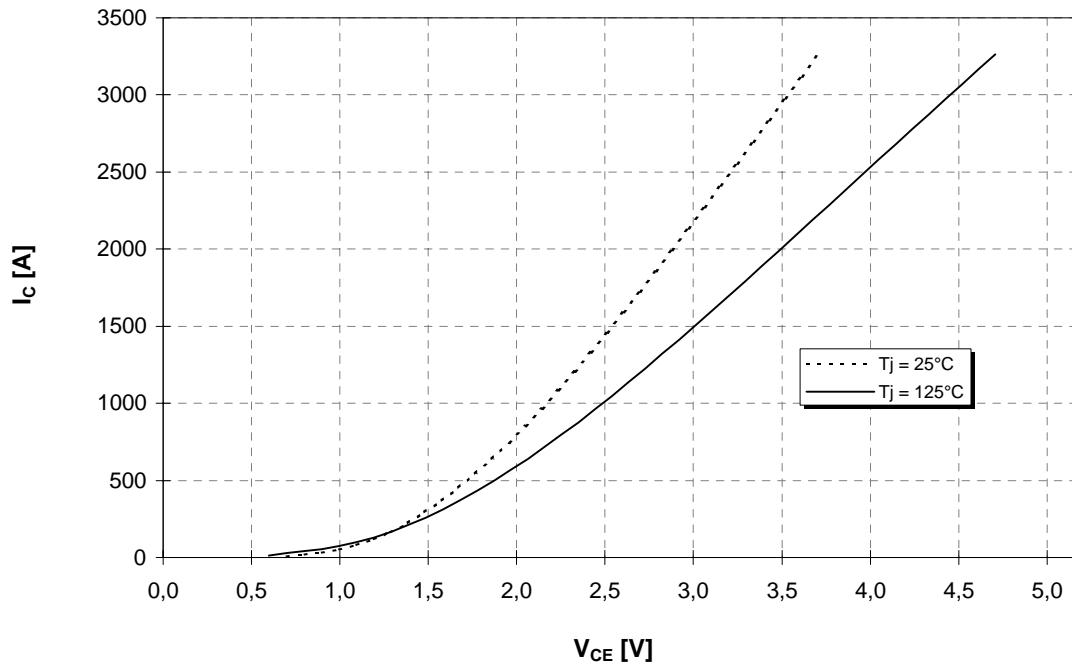
This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.



Ausgangskennlinie (typisch)
Output characteristic (typical)

$I_C = f(V_{CE})$

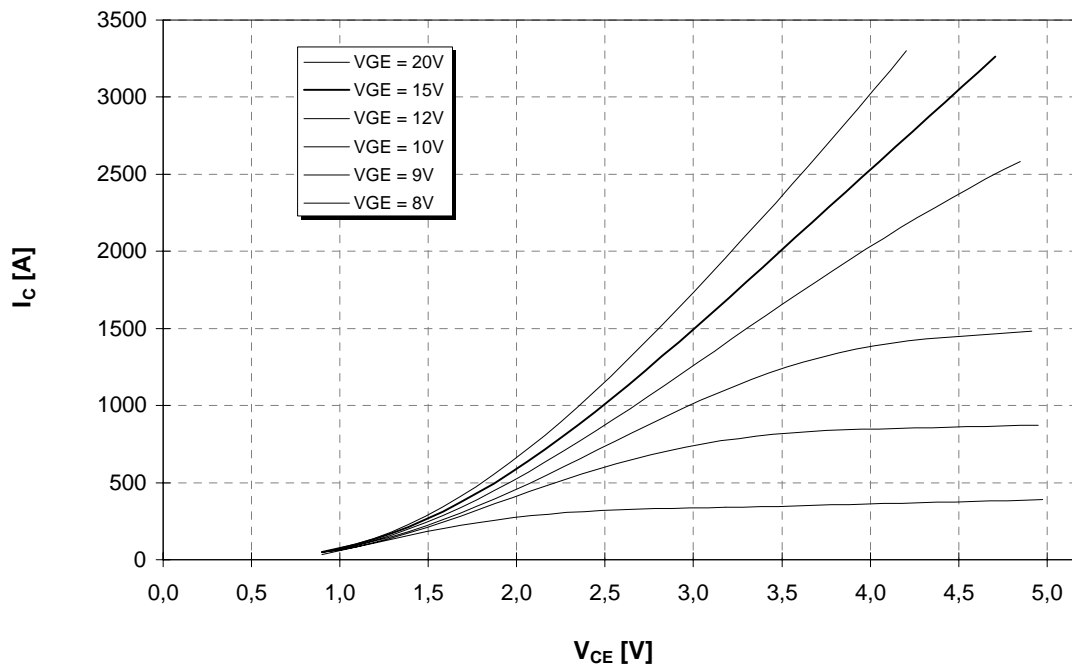
$V_{GE} = 15V$



Ausgangskennlinienfeld (typisch)
Output characteristic (typical)

$I_C = f(V_{CE})$

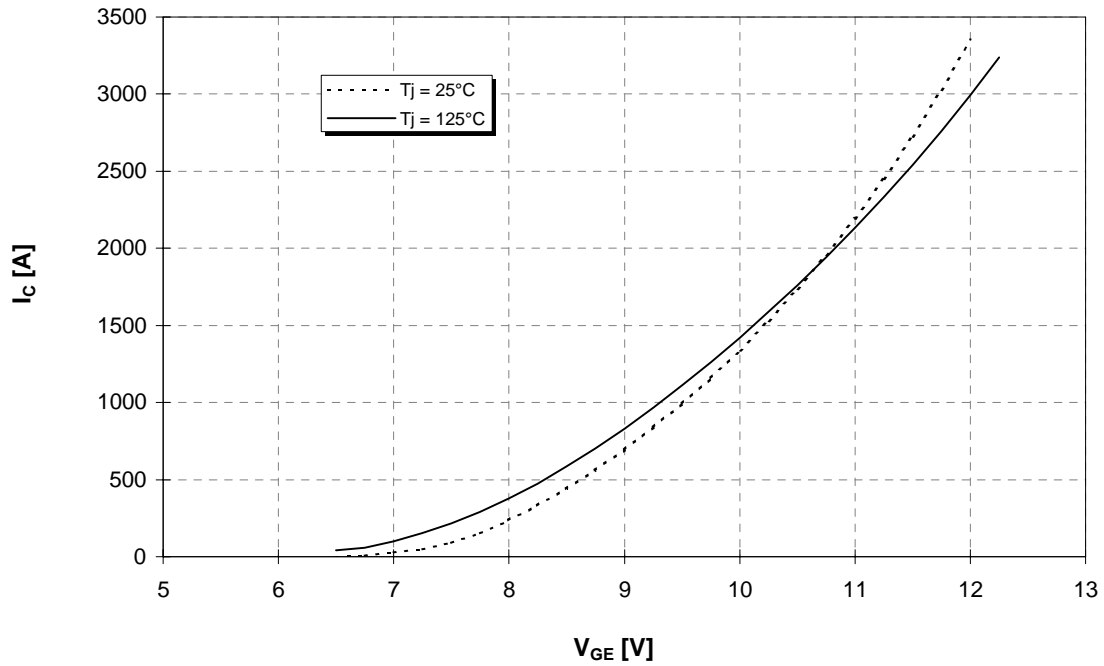
$T_{vj} = 125^\circ C$





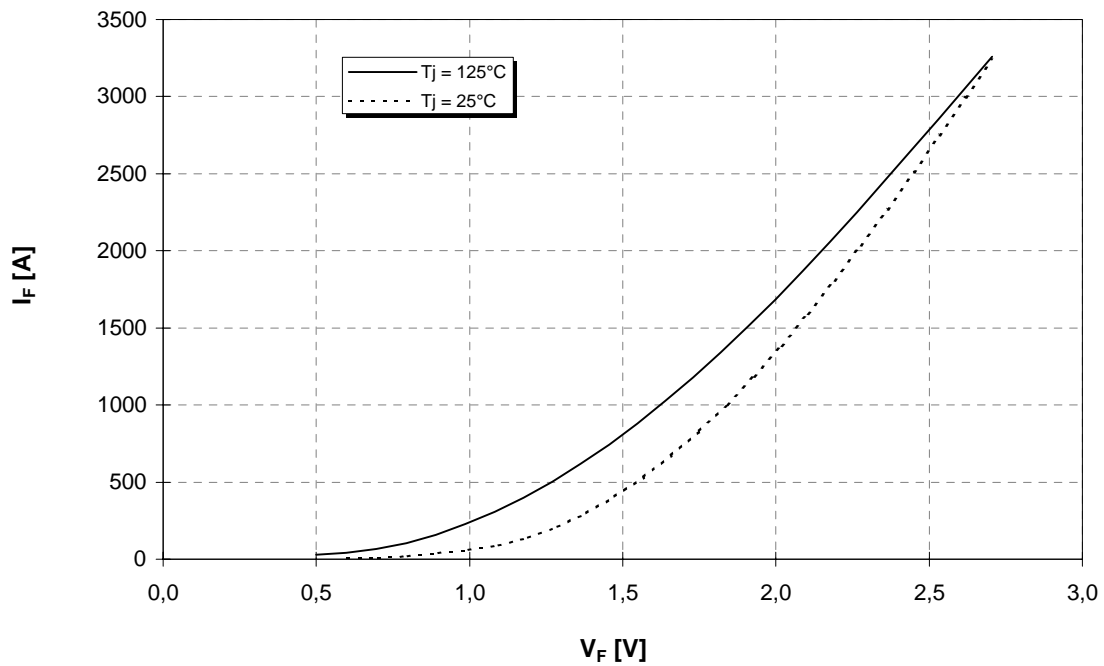
Übertragungscharakteristik (typisch)
Transfer characteristic (typical)

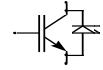
$I_C = f(V_{GE})$
 $V_{CE} = 20V$



Durchlaßkennlinie der Inversdiode (typisch)
Forward characteristic of inverse diode (typical)

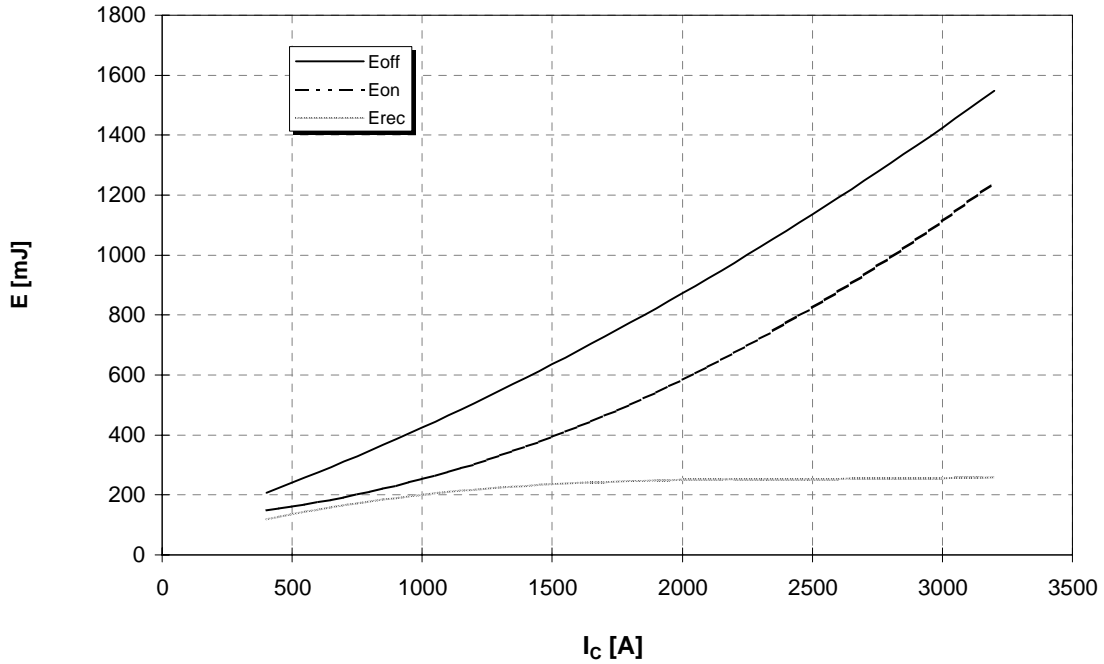
$I_F = f(V_F)$





Schaltverluste (typisch) $E_{on} = f(I_C)$, $E_{off} = f(I_C)$, $E_{rec} = f(I_C)$

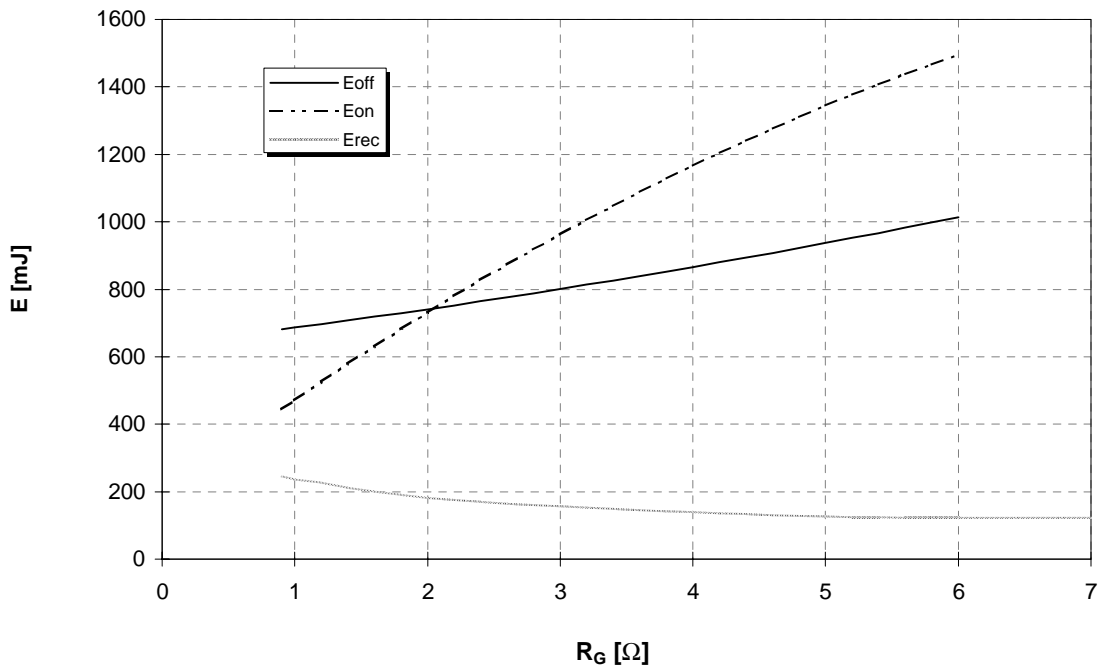
Switching losses (typical) $R_{gon} = R_{goff} = 0,9\Omega$, $V_{CE} = 900V$, $T_j = 125^\circ C$, $V_{GE} = \pm 15V$



Schaltverluste (typisch)
Switching losses (typical)

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$, $E_{rec} = f(R_G)$

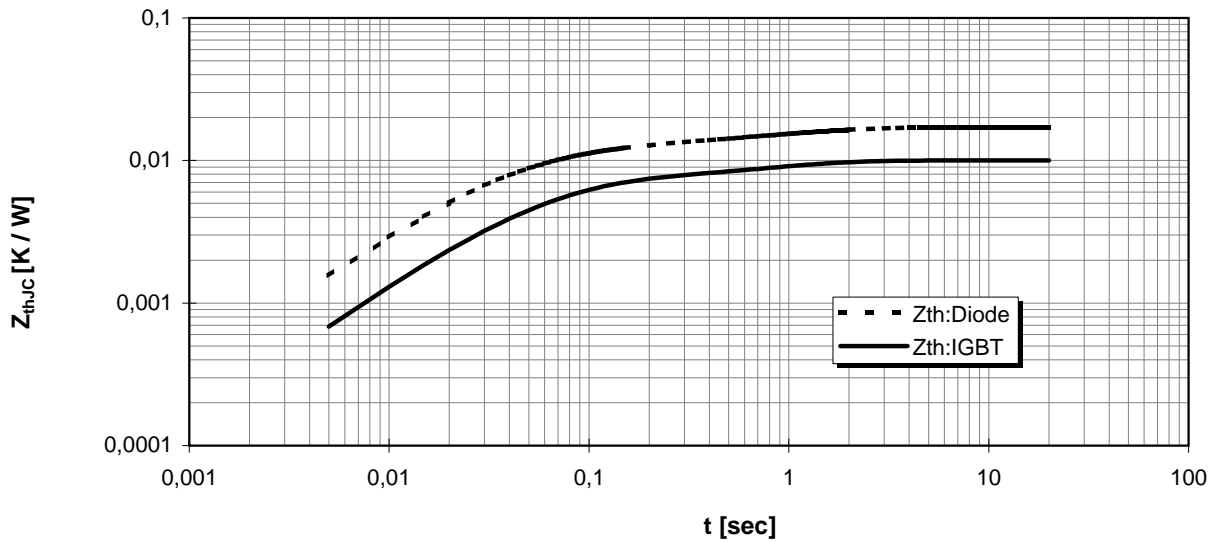
$I_C = 1600A$, $V_{CE} = 900V$, $T_j = 125^\circ C$, $V_{GE} = \pm 15V$





Transienter Wärmewiderstand
Transient thermal impedance

$$Z_{thJC} = f(t)$$

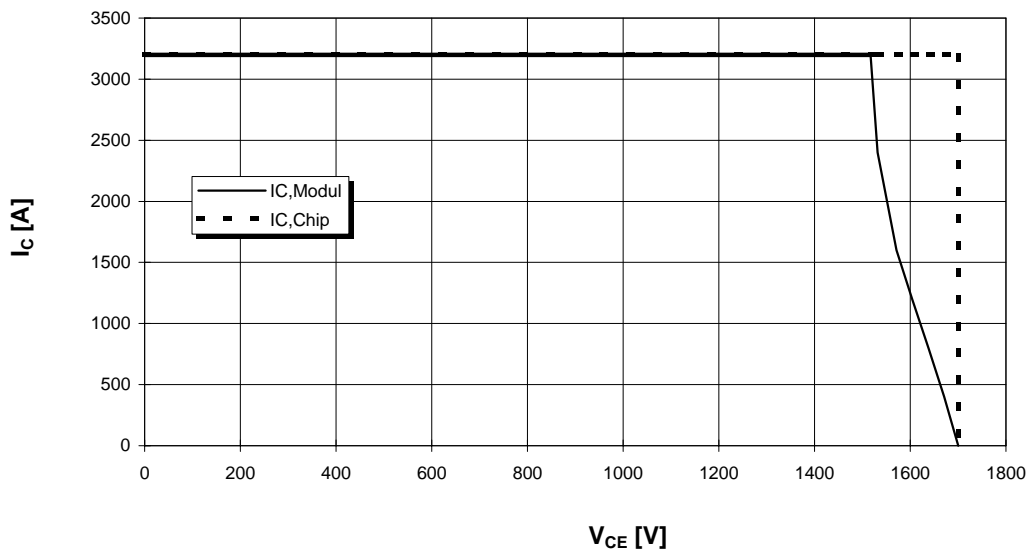


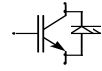
i	1	2	3	4
r_i [K/kW] : IGBT	0,94	4,72	1,425	2,92
τ_i [sec] : IGBT	0,027	0,052	0,09	0,838
r_i [K/kW] : Diode	7,85	3,53	1,12	4,52
τ_i [sec] : Diode	0,0287	0,0705	0,153	0,988

Sicherer Arbeitsbereich (RBSOA)

Reverse bias safe operation area (RBSOA)

$R_g = 0,9 \text{ Ohm}$, $T_{vj} = 125^\circ\text{C}$





Äußere Abmessungen / external dimensions

