Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Values	Unit
			max.	
Input Rectifier Bridge **Gleichrichter**				
Repetitive peak reverse voltage Periodische Rückw. Spitzensperrspannung		V_{RRM}	1600	V
Forward current per diode Dauergrenzstrom	DC current T_h=80°C; Tc=80°C	I_{FAV}	40 limited by power terminal 40 limited by power terminal	A
Surge forward current Stoßstrom Grenzwert	t_p=10ms T_j=25°C	I_{FSM}	370	A
I^2t-value Grenzlastintegral	t_p=10ms T_j=25°C	I^2t	680	A^2s
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C T_h=80°C T_c=80°C	P_{tot}	50 76	W
max. chip temperature max. Chiptemperatur		T_{jmax}	150	°C
Transistor Inverter **Transistor Wechselrichter**				
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	T_j=T_{jmax} T_h=80°C, T_c=80°C	I_C	28 36	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p limited by T_{jmax}	I_{cpuls}	90	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=T_{jmax} T_h=80°C T_c=80°C	P_{tot}	54 82	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	±20	V
SC withstand time * Kurzschlußverhalten *	Tj≤150°C V_{GE}=15V V_{CC}=360V	t_{SC}	5	us
max. chip temperature max. Chiptemperatur		T_{jmax}	175	°C
Diode Inverter **Diode Wechselrichter**				
DC forward current Dauergleichstrom	T_j=T_{jmax} T_h=80°C, T_c=80°C	I_F	26 34	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p limited by T_{jmax}	I_{FRM}	90	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=T_{jmax} T_h=80°C T_c=80°C	P_{tot}	40 60	W
max. chip temperature max. Chiptemperatur		T_{jmax}	175	°C

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Values	Unit
			max.	
Transistor BRC **Transistor BRC**				
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	$T_j=T_{jmax}$ T_h=80°C, T_c=80°C	I_C	28 36	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p limited by T_{jmax}	I_{cpuls}	90	A
Power dissipation per IGBT Verlustleistung pro IGBT	$T_j=T_{jmax}$ T_h=80°C T_c=80°C	P_{tot}	54 82	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	±20	V
SC withstand time * Kurzschlußverhalten *	Tj≤150°C V_{GE}=15V V_{CC}=360V	t_{SC}	5	us
max. chip temperature max. Chiptemperatur		T_{jmax}	175	°C
Diode BRC **Diode BRC**				
DC forward current Dauergleichstrom	$T_j=T_{jmax}$ T_h=80°C, T_c=80°C	I_F	26 34	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p limited by T_{jmax}	I_{FRM}	90	A
Power dissipation per Diode Verlustleistung pro Diode	$T_j=T_{jmax}$ T_h=80°C T_c=80°C	P_{tot}	40 60	W
max. chip temperature max. Chiptemperatur		T_{jmax}	175	°C
Thermal properties **Thermische Eigenschaften**				
Storage temperature Lagertemperatur		T_{stg}	-40…+125	°C
Operation temperature Betriebstemperatur		T_{op}	-40…+125	°C
Insulation properties **Modulisolation**				
Insulation voltage Isolationsspannung	t=1min	V_{is}	4000	Vdc
Creepage distance Kriechstrecke			min 12,7	mm
Clearance Luftstrecke			min 12,7	mm

* Allowed number of short circuits must be less than 1000 times, and time duration between short circuits should be more than 1 second!

Characteristic values

Description	Symbol	Conditions					Values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	V_{GE}(V) V_{GS}(V)	V_R(V) V_{CE}(V) V_{DS}(V)	Ic(A) IF(A) Id(A)	Min	Typ	Max	
Input Rectifier Bridge **Gleichrichter**										
Forward voltage Durchlaßpannung	V_F	Tj=25°C Tj=125°C				25	0,8	1,08 1,03	1,35	V
Threshold voltage (for power loss calc. only) Schleusenspannung	V_{to}	Tj=25°C Tj=125°C				25		0,89 0,78		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	r_t	Tj=25°C Tj=125°C				25		0,008 0,01		Ohm
Reverse current Sperrstrom	I_r	Tj=25°C Tj=140±10°C			1500 1500		0 0		0,1 1,5	mA
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					1,39		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,92		K/W
Transistor Inverter **Transistor Wechselrichter**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,00043	5	5,8	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15		30	1	1,67 1,9	2,2	V
Collector-emitter cut-off current incl. Diode Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	600				0,2	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		±20	0		0		350	nA
Integrated Gate resistor Integrirter Gate Widerstand	R_{gint}							-		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	0/15	300	30		18		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	0/15	300	30		18		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	15/0	300	30		175		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	15/0	300	30		105		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	0/15	300	30		0,71		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	15/0	300	30		0,9		mWs
Input capacitance Eingangskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			tbd		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			tbd		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	Tj=25°C Tj=125°C	f=1MHz	0	25			tbd		nF
Gate charge Gate Ladung	Q_{Gate}	Tj=25°C Tj=125°C		15/0	300	30		220		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					1,8		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Dicke≤50um λ = 0,61 W/mK					1,2		K/W
Coupled thermal resistance inverter diode-transistor Gekoppelte Wärmewiderstand Wechselrichter Diode-Transistor	R_{thJH}		Thermal grease thickness≤50um Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					tbd		K/W

Characteristic values

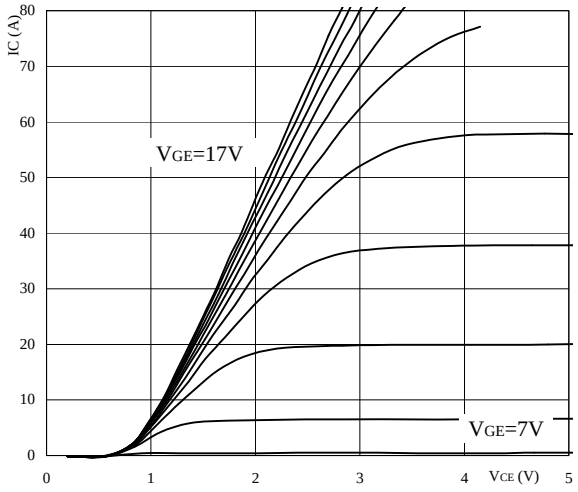
Description	Symbol	Conditions					Values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	V_{GE}(V) V_{GS}(V)	V_R(V) V_{CE}(V) V_{DS}(V)	Ic(A) IF(A) Id(A)	Min	Typ	Max	
Diode Inverter **Diode Wechselrichter**										
Diode forward voltage Durchlaßspannung	V_F	Tj=25°C Tj=125°C				30	1	1,65 1,66	2,3	V
Peak reverse recovery current Rückstromspitze	I_{RM}	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		28		A
Reverse recovery time Sperreverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		260		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		2,5		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		0,55		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					2,4		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,6		K/W
Transistor BRC **Transistor BRC**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,00043	5	5,8	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15		30	1	1,67 1,9	2,2	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	600				0,2	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		±20	0		0		350	nA
Integrated Gate resistor Integrirter Gate Widerstand	R_{gint}							-		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	0/15	300	30		18		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	0/15	300	30		18		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	15/0	300	30		175		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	15/0	300	30		105		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	0/15	300	30		0,71		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgoff= 8 Ohm Rgon= 4 Ohm	15/0	300	30		0,9		mWs
Input capacitance Eingangskapazität	C_{iss}	Tj=25°C Tj=125°C	f=1MHz	0	25			tbd		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			tbd		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			tbd		nF
Gate charge Gate Ladung	Q_{gate}	Tj=25°C Tj=125°C		15/0	300	30		220		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					1,8		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,2		K/W

Characteristic values

Description	Symbol	Conditions					Values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	V_{GE}(V) V_{GS}(V)	V_R(V) V_{CE}(V) V_{DS}(V)	Ic(A) IF(A) Id(A)	Min	Typ	Max	
Diode BRC **Diode BRC**										
Diode forward voltage Durchlaßspannung	V_F	Tj=25°C Tj=125°C				30	1	1,65 1,66	2,3	V
Reverse current Sperrstrom	I_r	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		28		A
Reverse recovery time Sperreverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		260		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		2,5		uC
Reverse recovery energy Sperrverzögerungsenergie	E_{rec}	Tj=25°C Tj=125°C	Rgon= 8 Ohm diF/dt = 1820 A/us	15/0	600	30		0,55		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					2,4		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,6		K/W
PTC-Thermistor **PTC-Widerstand**										
Nominal resistance Nominaler Widerstand	R_{25} R_{100}	Tj=25°C Tj=100°C	tolerance = 3% tolerance = 2%				0,97 1,637	1 1,67	1,03 1,703	kOhm kOhm
Typical temperature coefficient Tipischer Temperaturkoeffizient	α	Tj=25°C Tj=125°C						0,76		%/K
Recommended measuring current Empfohlener Messstrom	I_m	Tj=25°C Tj=125°C					1		3	mA
Measured values Gemessene Werte	V_{PTC}	Tj=25°C	I_m = 1mA I_m = 3mA				0,93 2,84		1,03 3,4	V

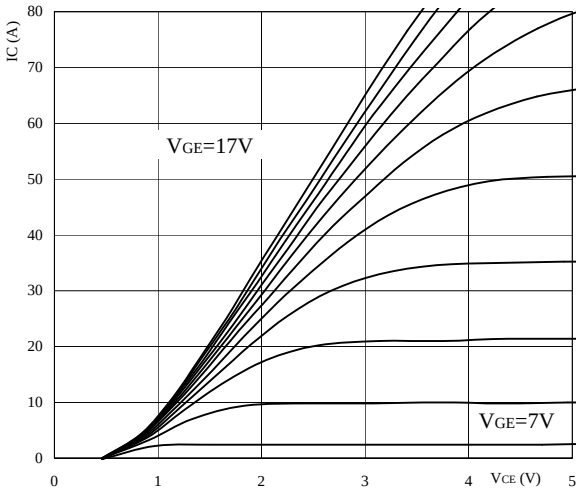
Output inverter

Figure 1. **Typical output characteristics**
Output inverter IGBT
Ic= f(VCE)



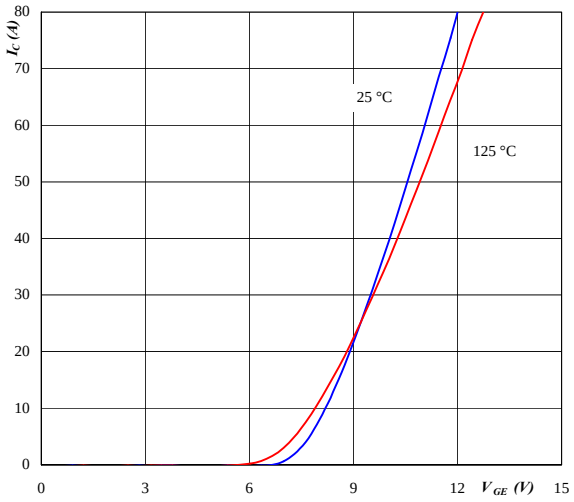
parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

Figure 2. **Typical output characteristics**
Output inverter IGBT
Ic= f(VCE)



parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

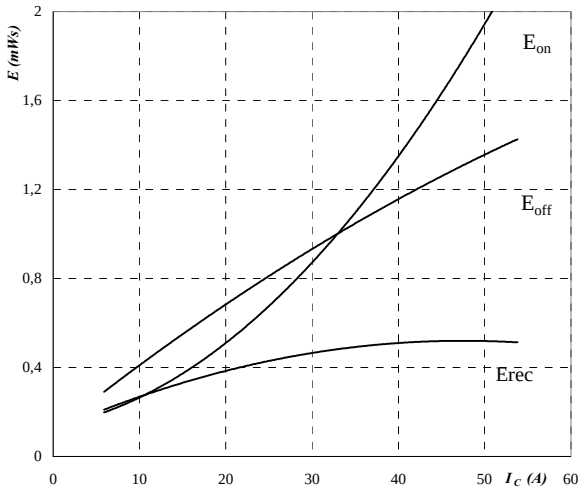
Figure 3. **Typical transfer characteristics**
Output inverter IGBT
Ic= f(VGE)



parameter: tp = 250 us VCE = 10 V

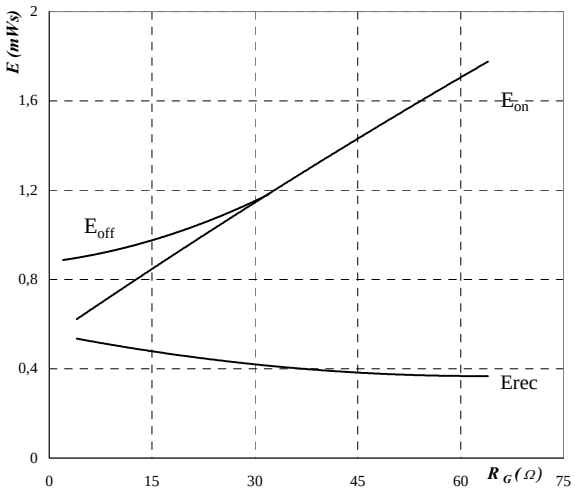
Output inverter

Figure 4. **Typical switching energy losses as a function of collector current**
Output inverter IGBT
E = f (Ic)



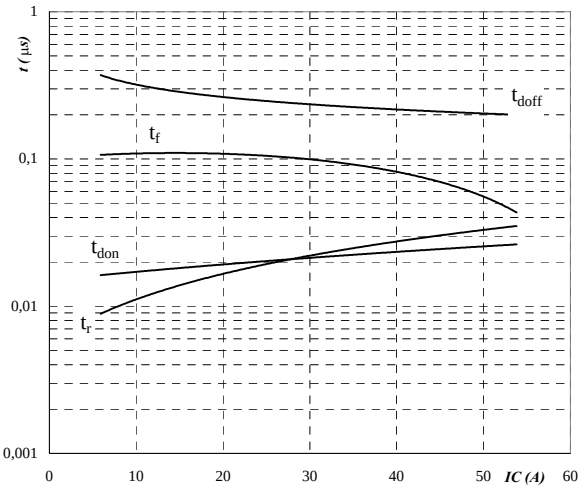
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Rgon= 16 Ω
Rgoff= 8 Ω

Figure 5. **Typical switching energy losses as a function of gate resistor**
Output inverter IGBT
E = f (RG)



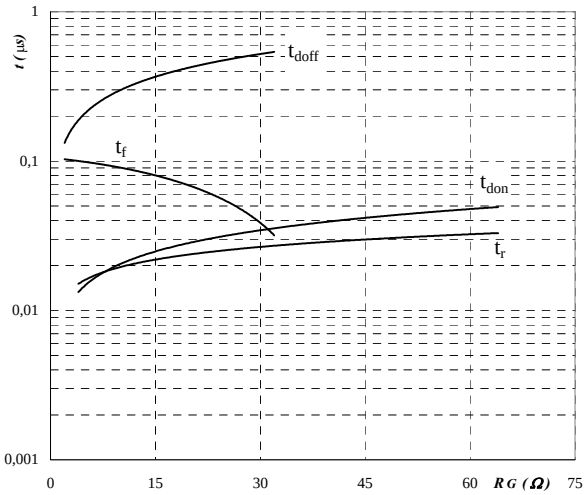
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 30 A

Figure 6. **Typical switching times as a function of collector current**
Output inverter IGBT
t = f (Ic)



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Rgon= 16 Ω
Rgoff= 8 Ω

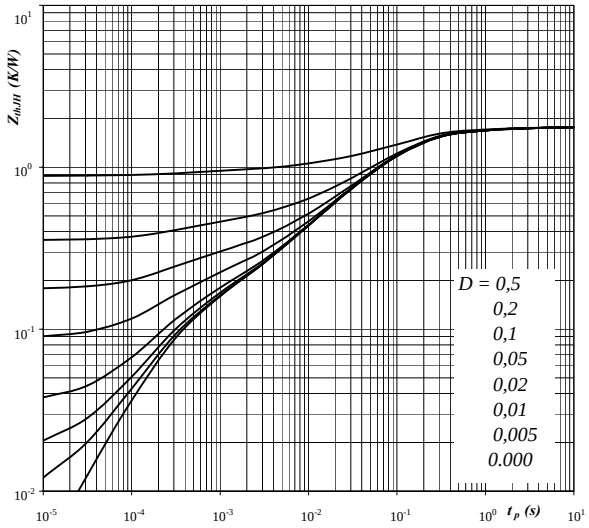
Figure 7. **Typical switching times as a function of gate resistor**
Output inverter IGBT
t = f (RG)



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 30 A

Output inverter

Figure 8. IGBT transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



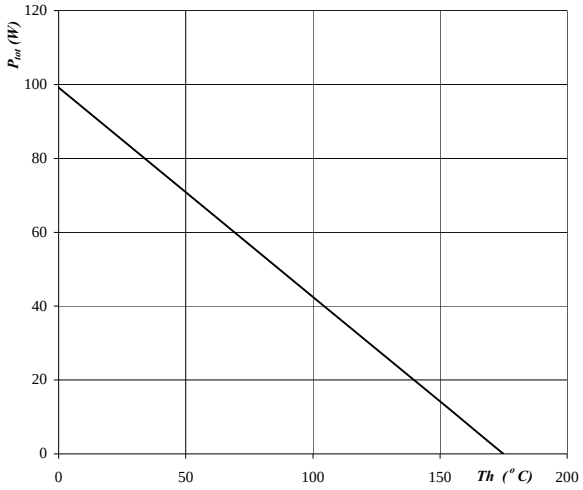
Parameter: D = tp / T RthJH= 1,80 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,06	4,6E+00
0,22	5,4E-01
0,94	1,0E-01
0,34	2,0E-02
0,11	3,1E-03
0,11	3,0E-04

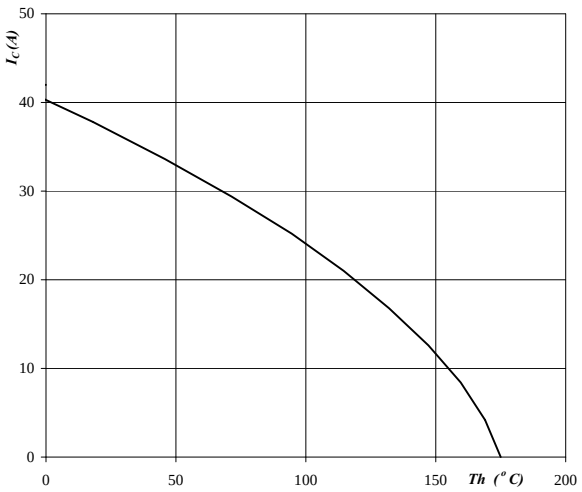
Output inverter

Figure 9. **Power dissipation as a function of heatsink temperature**
Output inverter IGBT
P_{tot} = f (Th)



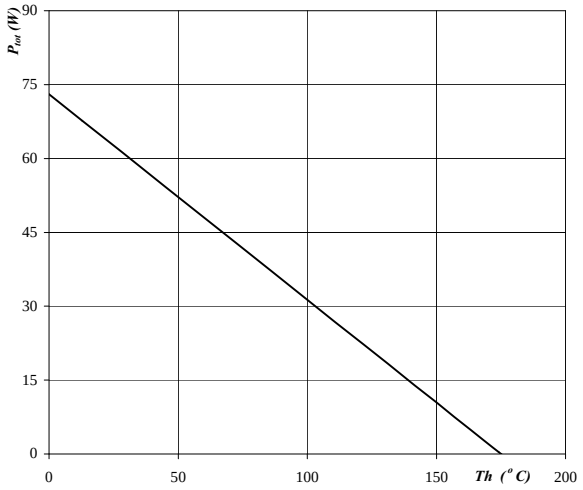
parameter: Tj = 175°C

Figure 10. **Collector current as a function of heatsink temperature**
Output inverter IGBT
I_C = f (Th)



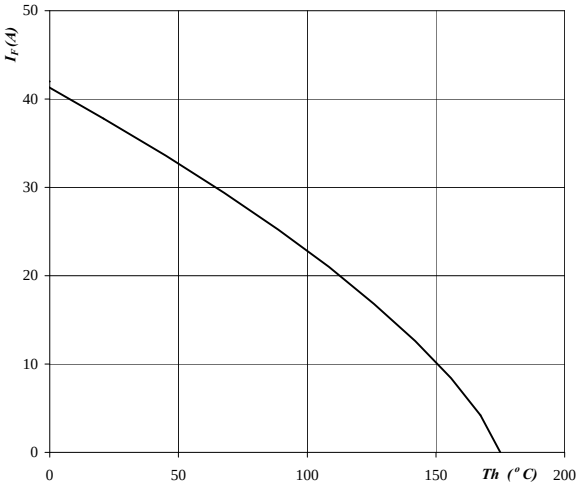
parameter: Tj = 175°C
V_{GE}= 15 V

Figure 11. **Power dissipation as a function of heatsink temperature**
Output inverter FRED
P_{tot} = f (Th)



parameter: Tj = 175°C

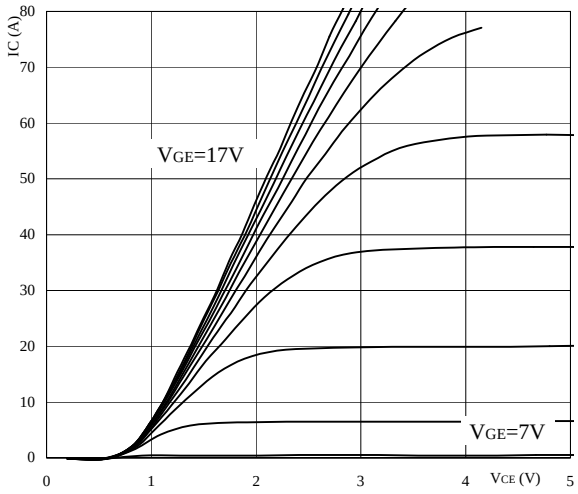
Figure 12. **Forward current as a function of heatsink temperature**
Output inverter FRED
I_F = f (Th)



parameter: Tj = 175°C

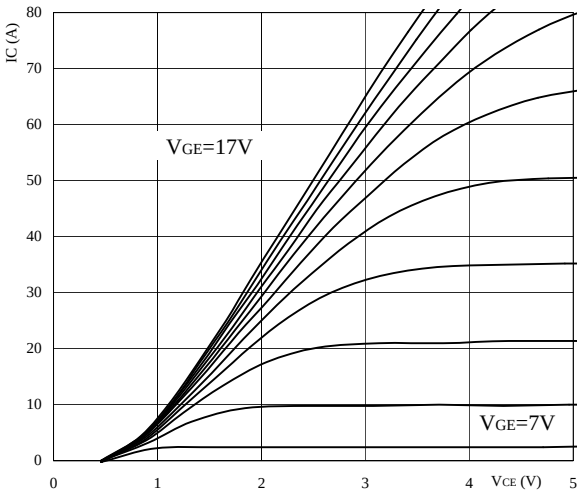
Brake

Figure 13. Typical output characteristics
Brake IGBT
Ic= f(VCE)



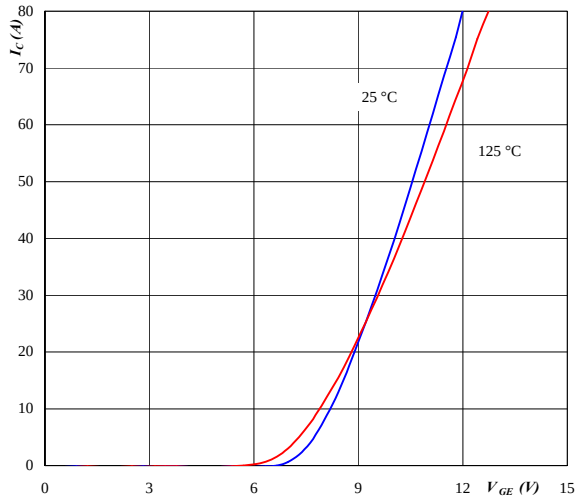
parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

Figure 14. Typical output characteristics
Brake IGBT
Ic= f(VCE)



parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

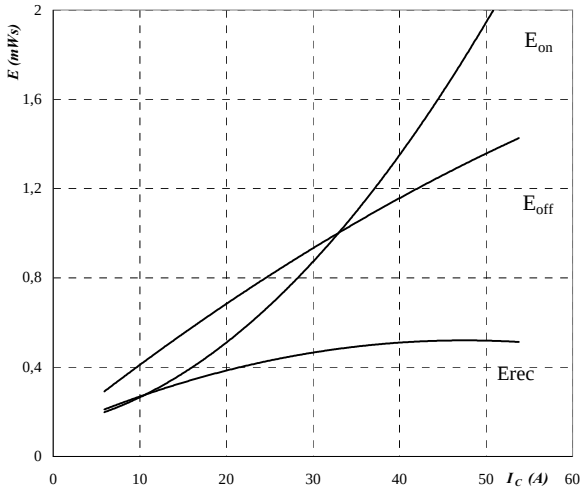
Figure 15. Typical transfer characteristics
Brake IGBT
Ic= f(VGE)



parameter: tp = 250 us VCE = 10 V

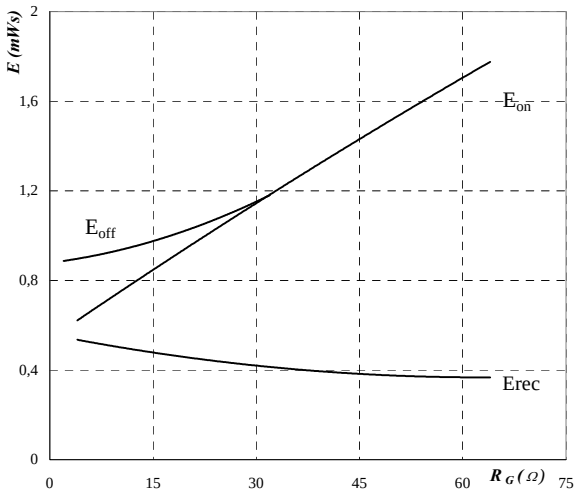
Brake

Figure 16. Typical switching energy losses as a function of collector current
Brake IGBT
E = f (Ic)



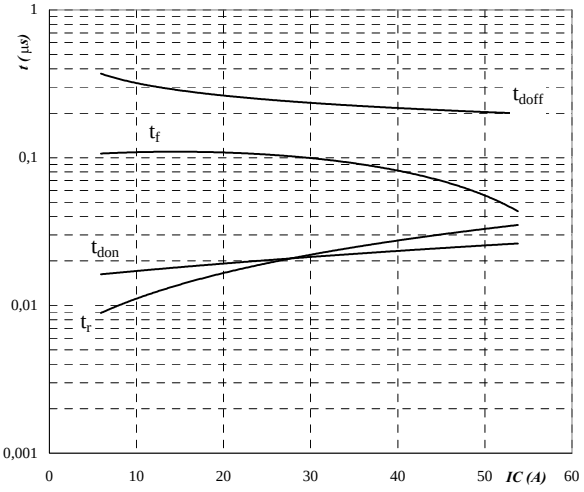
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Rgon = 16 Ω
Rgoff = 8 Ω

Figure 17. Typical switching energy losses as a function of gate resistor
Brake IGBT
E = f (RG)



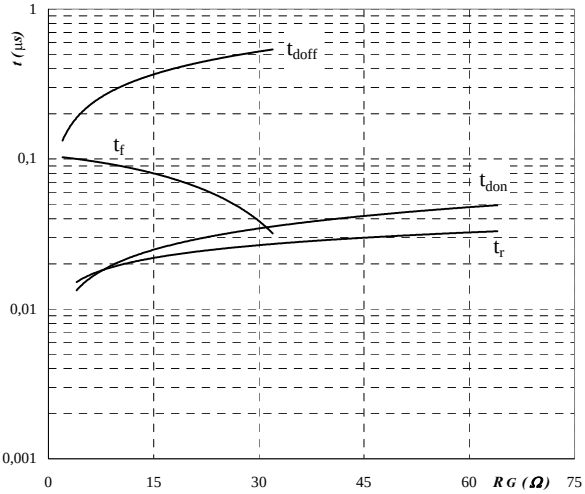
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 30 A

Figure 18. Typical switching times as a function of collector current
Brake IGBT
t = f (Ic)



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Rgon = 16 Ω
Rgoff = 8 Ω

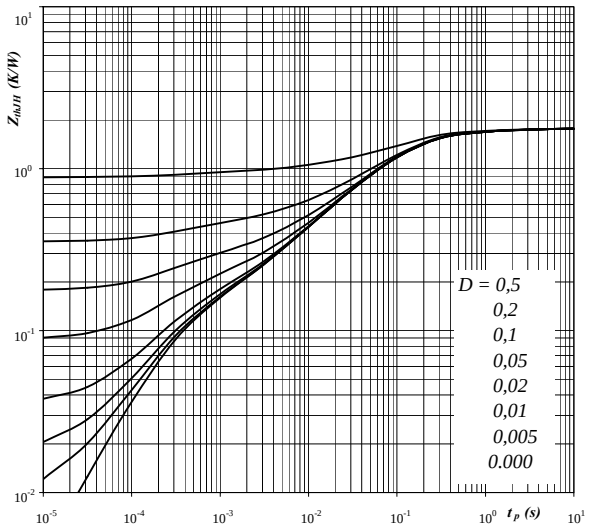
Figure 19. Typical switching times as a function of gate resistor
Brake IGBT
t = f (RG)



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 30 A

Brake

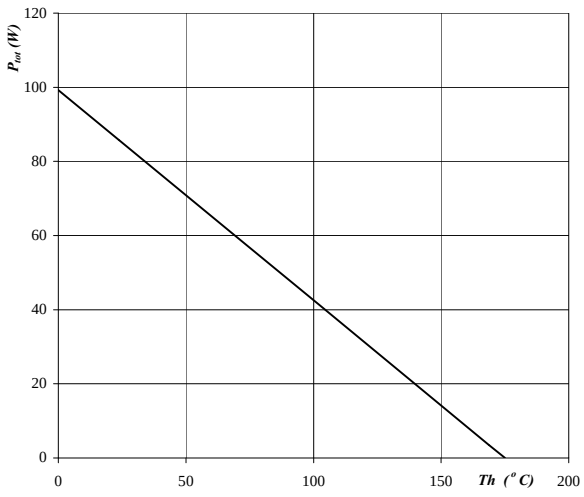
Figure 20. IGBT transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



Parameter: D = tp / T RthJH= 1,80 K/W

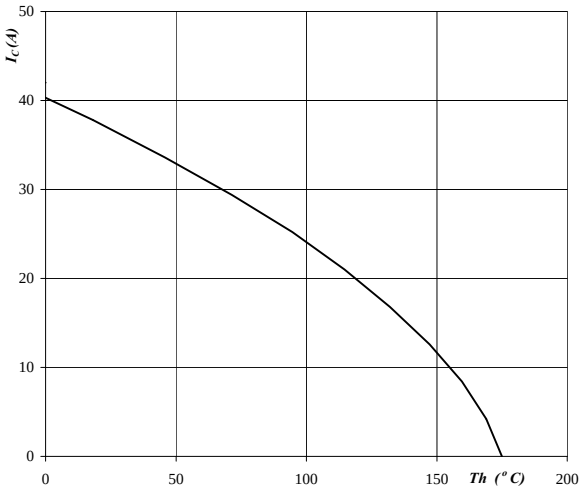
R (C/W)	Tau (s)
0,06	4,6E+00
0,22	5,4E-01
0,94	1,0E-01
0,34	2,0E-02
0,11	3,1E-03
0,11	3,0E-04

Figure 21. Power dissipation as a function of heatsink temperature
Brake IGBT
$P_{tot} = f(Th)$



parameter: Tj = 175°C

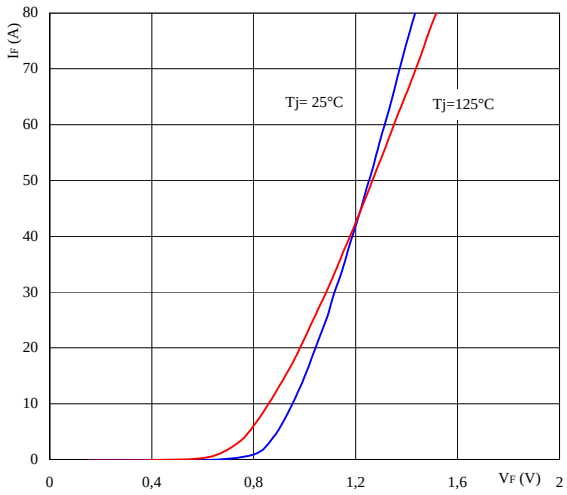
Figure 22. Collector current as a function of heatsink temperature
Brake IGBT
$I_C = f(Th)$



parameter: Tj = 175°C
V_{GE}= 15 V

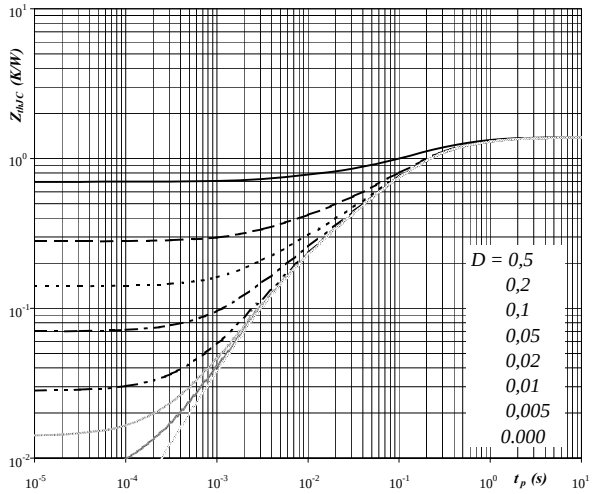
Input rectifier bridge

Figure 23. Typical diode forward current as a function of forward voltage
Rectifier diode $I_F=f(V_F)$



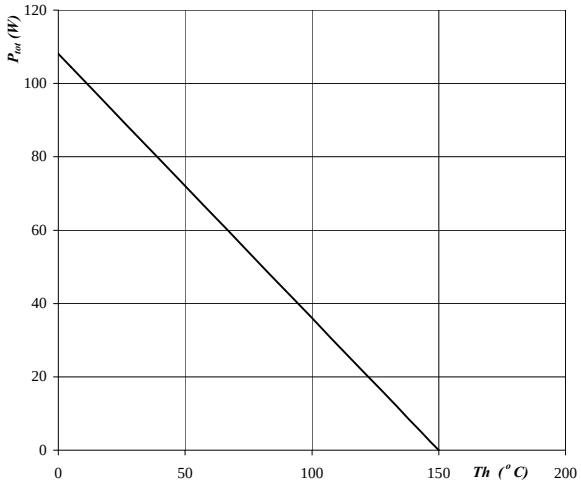
parameter: tp = 250 us

Figure 24. Diode transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



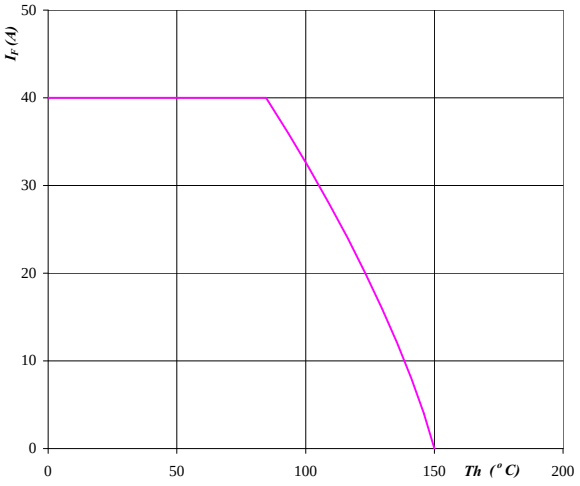
Parameter: D = tp / T RthJH= 1,39 K/W

Figure 25. Power dissipation as a function of heatsink temperature
Rectifier diode
$P_{tot} = f(Th)$



parameter: Tj = 150°C

Figure 26. Forward current as a function of heatsink temperature
Rectifier diode
$I_F = f(Th)$



parameter: Tj = 150°C

Thermistor

Figure 27. Typical PTC characteristic as afunction of temperature

$R_T = f(T)$