

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Values	Unit
			max.	
Input Rectifier Bridge				
Gleichrichter				
Repetitive peak reverse voltage		V_{RRM}	1600	V
Periodische Rückw. Spitzensperrspannung				
Forward current per diode	DC current $T_h=80^\circ\text{C}$;	I_{FAV}	58	A
Dauergrenzstrom	$T_c=80^\circ\text{C}$		80	
Surge forward current	$t_p=10\text{ms}$ $T_j=25^\circ\text{C}$	I_{FSM}	700	A
Stoßstrom Grenzwert				
I ^t -value	$t_p=10\text{ms}$ $T_j=25^\circ\text{C}$	I^t	2450	A ² s
Grenzlastintegral				
Power dissipation per Diode	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$	P_{tot}	62	W
Verlustleistung pro Diode	$T_c=80^\circ\text{C}$		93	
max. chip temperature		T_{jmax}	150	°C
max. Chiptemperatur				
Transistor Inverter				
Transistor Wechselrichter				
Collector-emitter break down voltage		V_{CE}	600	V
Kollektor-Emitter-Sperrspannung				
DC collector current	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$	I_C	80	A
Kollektor-Dauergleichstrom	$T_c=80^\circ\text{C}$		104	
Repetitive peak collector current	t_p limited by T_{jmax}	I_{cpuls}	300	A
Periodischer Kollektorspitzenstrom				
Power dissipation per IGBT	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$	P_{tot}	120	W
Verlustleistung pro IGBT	$T_c=80^\circ\text{C}$		185	
Gate-emitter peak voltage		V_{GE}	±20	V
Gate-Emitter-Spitzenspannung				
SC withstand time *	$T_j \leq 150^\circ\text{C}$ $V_{GE}=15\text{V}$	t_{SC}	5	us
Kurzschlußverhalten *	$V_{CC}=360\text{V}$			
max. chip temperature		T_{jmax}	175	°C
max. Chiptemperatur				
Diode Inverter				
Diode Wechselrichter				
DC forward current	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$,	I_F	63	A
Dauergleichstrom	$T_c=80^\circ\text{C}$		65, limited by bond wires	
Repetitive peak forward current	t_p limited by T_{jmax}	I_{FRM}	300	A
Periodischer Spitzenstrom				
Power dissipation per Diode	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$	P_{tot}	85	W
Verlustleistung pro Diode	$T_c=80^\circ\text{C}$		125	
max. chip temperature		T_{jmax}	175	°C
max. Chiptemperatur				

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	$T_j = T_{jmax}$ $T_h = 80^\circ C$ $T_c = 80^\circ C$	I_C	80 104	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p limited by T_{jmax}	I_{cpuls}	300	A
Power dissipation per IGBT Verlustleistung pro IGBT	$T_j = T_{jmax}$ $T_h = 80^\circ C$ $T_c = 80^\circ C$	P_{tot}	120 185	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	± 20	V
SC withstand time * Kurzschlußverhalten *	$T_j \leq 150^\circ C$ $V_{GE} = 15V$ $V_{CC} = 360V$	t_{SC}	5	us
max. chip temperature max. Chiptemperatur		T_{jmax}	175	$^\circ C$
Diode BRC				
Diode BRC				
DC forward current Dauergleichstrom	$T_j = T_{jmax}$ $T_h = 80^\circ C$, $T_c = 80^\circ C$	I_F	63 65, limited by bond wires	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p limited by T_{jmax}	I_{FRM}	300	A
Power dissipation per Diode Verlustleistung pro Diode	$T_j = 150^\circ C$ $T_h = 80^\circ C$ $T_c = 80^\circ C$	P_{tot}	85 125	W
max. chip temperature max. Chiptemperatur		T_{jmax}	175	$^\circ C$
Thermal properties				
Thermische Eigenschaften				
Storage temperature Lagertemperatur		T_{stg}	-40...+125	$^\circ C$
Operation temperature Betriebstemperatur		T_{op}	-40...+125	$^\circ C$
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)	I _C (A) I _F (A) I _d (A)	Min	Typ	Max		
Input Rectifier Bridge											
Gleichrichter											
Forward voltage	V _F	T _J =25°C				35	0,8	1,02	1,35	V	
Durchlaßspannung		T _J =125°C						0,94			
Threshold voltage (for power loss calc. only)	V _{to}	T _J =25°C						0,88		V	
Schleusenspannung		T _J =125°C				35		0,75			
Slope resistance (for power loss calc. only)	r _t	T _J =25°C						0,004		Ohm	
Ersatzwiderstand		T _J =125°C				35		0,006			
Reverse current	I _r	T _J =25°C				1500	0		0,1	mA	
Sperrstrom		T _J =140±10°C				1500	0		2		
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50um					1,14		K/W	
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,75		K/W	
Transistor Inverter											
Transistor Wechselrichter											
Gate emitter threshold voltage	V _{GE(th)}	T _J =25°C	VCE=VGE				0,002	4	5,8	8	V
Gate-Schwellenspannung		T _J =125°C									
Collector-emitter saturation voltage	V _{CE(sat)}	T _J =25°C					100	1,3	1,5	2,15	V
Kollektor-Emitter Sättigungsspannung		T _J =125°C						1,65			
Collector-emitter cut-off current incl. Diode	I _{CES}	T _J =25°C		0	600				0,75	mA	
Kollektor-Emitter Reststrom		T _J =125°C									
Gate-emitter leakage current	I _{GES}	T _J =25°C		20	0				900	nA	
Gate-Emitter Reststrom		T _J =125°C									
Integrated Gate resistor	R _{gint}							-		Ohm	
Integrierter Gate Widerstand											
Turn-on delay time	t _{d(on)}	T _J =25°C	Rgoff= 6 Ohm							ns	
Einschaltverzögerungszeit		T _J =125°C	Rgon= 6 Ohm	±15	300	100		75			
Rise time	t _r	T _J =25°C	Rgoff= 6 Ohm							ns	
Anstiegszeit		T _J =125°C	Rgon= 6 Ohm	±15	300	100		28			
Turn-off delay time	t _{d(off)}	T _J =25°C	Rgoff= 6 Ohm							ns	
Abschaltverzögerungszeit		T _J =125°C	Rgon= 6 Ohm	±15	300	100		260			
Fall time	t _f	T _J =25°C	Rgoff= 6 Ohm							ns	
Fallzeit		T _J =125°C	Rgon= 6 Ohm	±15	300	100		75			
Turn-on energy loss per pulse	E _{on}	T _J =25°C	Rgoff= 6 Ohm							mWs	
Einschaltverlustenergie pro Puls		T _J =125°C	Rgon= 6 Ohm	±15	300	100		1,1			
Turn-off energy loss per pulse	E _{off}	T _J =25°C	Rgoff= 6 Ohm							mWs	
Abschaltverlustenergie pro Puls		T _J =125°C	Rgon= 6 Ohm	±15	300	100		3			
Input capacitance	C _{ies}	T _J =25°C	f=1MHz	0	25			6,2		nF	
Eingangskapazität		T _J =125°C									
Output capacitance	C _{oss}	T _J =25°C	f=1MHz	0	25			0,4		nF	
Ausgangskapazität		T _J =125°C									
Reverse transfer capacitance	C _{rss}	T _J =25°C	f=1MHz	0	25			0,2		nF	
Rückwirkungskapazität		T _J =125°C									
Gate charge	Q _{Gate}	T _J =25°C	Rgoff= 6 Ohm							nC	
Gate Ladung		T _J =125°C	Rgon= 6 Ohm	±15	300	100		850			
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50um					0,8		K/W	
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,5		K/W	
Diode Inverter											
Diode Wechselrichter											
Diode forward voltage	V _F	T _J =25°C				100	1	1,65	2,6	V	
Durchlaßspannung		T _J =125°C						1,7			
Peak reverse recovery current	I _{RM}	T _J =25°C	Rgon= 6 Ohm							A	
Rückstromspitze		T _J =125°C	diF/dt = 4900 A/us	-15	300	100		130			
Reverse recovery time	t _{rr}	T _J =25°C	Rgon= 6 Ohm							ns	
Sperrverzögerungszeit		T _J =125°C	diF/dt = 4900 A/us	-15	300	100		145			
Reverse recovered charge	Q _{rr}	T _J =25°C	Rgon= 6 Ohm							uC	
Sperrverzögerungsladung		T _J =125°C	diF/dt = 4900 A/us	-15	300	100		7,5			
Reverse recovered energy	E _{rec}	T _J =25°C	Rgon= 6 Ohm							mWs	
Sperrverzögerungsenergie		T _J =125°C	diF/dt = 4900 A/us	-15	300	100		1,9			
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50um					1,15		K/W	
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,75		K/W	

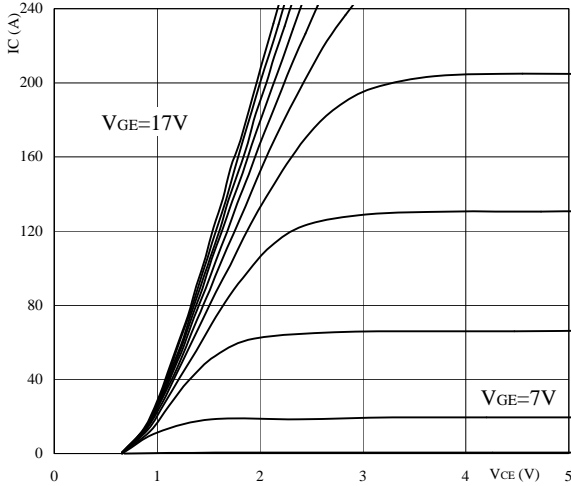
Characteristic values

Description	Symbol	Conditions					Values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VR(V) VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Min	Typ	Max	
Transistor BRC										
Transistor BRC										
Gate emitter threshold voltage Gate-Schwellenspannung	V _{GE(th)}	T _j =25°C T _j =125°C	VCE=VGE			0,002	4	5,8	8	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	V _{CE(sat)}	T _j =25°C T _j =125°C				100	1,3	1,5 1,65	2,15	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I _{CES}	T _j =25°C T _j =125°C		0	600				0,75	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I _{GES}	T _j =25°C T _j =125°C		20	0				900	nA
Integrated Gate resistor Integrierter Gate Widerstand	R _{gint}							-		Ohm
Turn-on delay time Einschaltverzögerungszeit	t _{d(on)}	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		75		ns
Rise time Anstiegszeit	t _r	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		28		ns
Turn-off delay time Abschaltverzögerungszeit	t _{d(off)}	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		260		ns
Fall time Fallzeit	t _f	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		75		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E _{on}	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		1,1		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E _{off}	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		3		mWs
Input capacitance Eingangskapazität	C _{iss}	T _j =25°C T _j =125°C	f=1MHz	0	25			6,2		nF
Output capacitance Ausgangskapazität	C _{oss}	T _j =25°C T _j =125°C	f=1MHz	0	25			0,4		nF
Reverse transfer capacitance Rückwirkungskapazität	C _{ies}	T _j =25°C T _j =125°C	f=1MHz	0	25			0,2		nF
Gate charge Gate Ladung	Q _{gate}	T _j =25°C T _j =125°C	Rgoff= 6 Ohm Rgon= 6 Ohm	±15	300	100		850		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50um					0,8		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,5		K/W
Diode BRC										
Diode BRC										
Diode forward voltage Durchlaßspannung	V _F	T _j =25°C T _j =125°C				100	1	1,65 1,7	2,6	V
Reverse current Sperrstrom	I _r	T _j =25°C T _j =125°C	Rgon= 6 Ohm diF/dt = 4900 A/us	-15	300	100		130		A
Reverse recovery time Sperrverzögerungszeit	t _{rr}	T _j =25°C T _j =125°C	Rgon= 6 Ohm diF/dt = 4900 A/us	-15	300	100		145		ns
Reverse recovered charge Sperrverzögerungsladung	Q _r	T _j =25°C T _j =125°C	Rgon= 6 Ohm diF/dt = 4900 A/us	-15	300	100		7,5		uC
Reverse recovery energy Sperrverzögerungsenergie	E _{rec}	T _j =25°C T _j =125°C	Rgon= 6 Ohm diF/dt = 4900 A/us	-15	300	100		1,9		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50um					1,15		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,75		K/W
PTC-Thermistor										
PTC-Widerstand										
Nominal resistance Nominaler Widerstand	R ₂₅ R ₁₀₀	T _j =25°C T _j =100°C	tolerance = 3% tolerance = 2%				0,97 1,637	1 1,67	1,03 1,703	kOhm kOhm
Typical temperature coefficient Typischer Temperaturkoeffizient	α	T _j =25°C T _j =125°C						0,76		%/K
Recommended measuring current Empfohlener Messstrom	I _m	T _j =25°C T _j =125°C					1		3	mA
Measured values Gemessene Werte	V _{PTC}	T _j =25°C	I _m = 1mA I _m = 3mA				0,93 2,84		1,03 3,4	V

Output inverter

Figure 1. Typical output characteristics

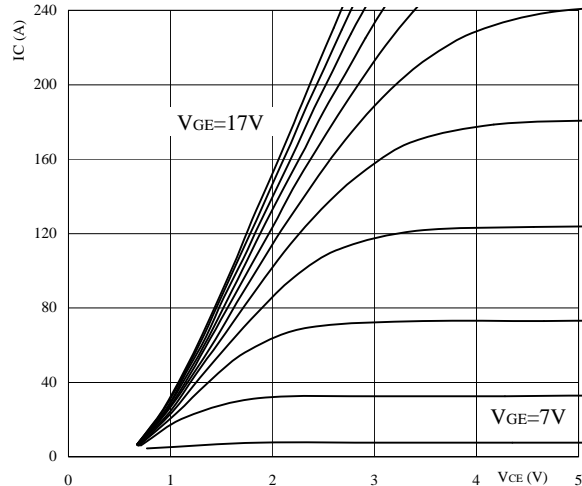
Output inverter IGBT
 $I_c = f(V_{CE})$



parameter: $t_p = 250 \mu s$ $T_j = 25 \text{ }^\circ C$
 V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 2. Typical output characteristics

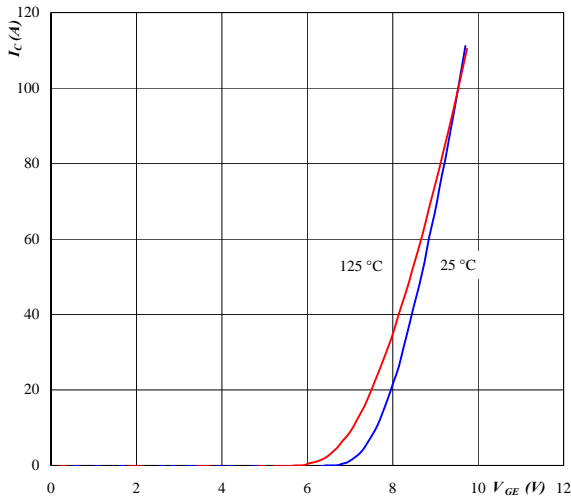
Output inverter IGBT
 $I_c = f(V_{CE})$



parameter: $t_p = 250 \mu s$ $T_j = 125 \text{ }^\circ C$
 V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 3. Typical transfer characteristics

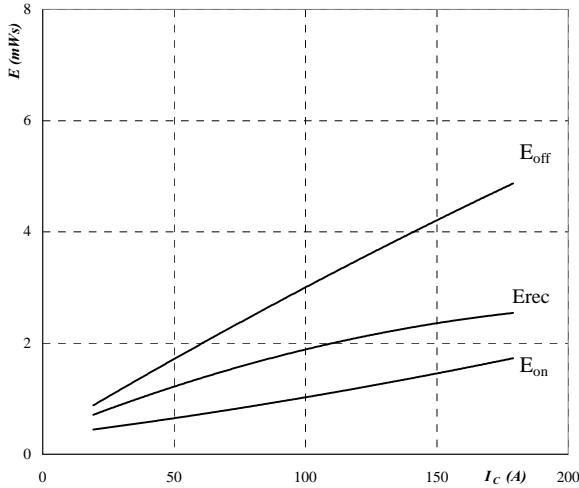
Output inverter IGBT
 $I_c = f(V_{GE})$



parameter: $t_p = 250 \mu s$ $V_{CE} = 10 \text{ V}$

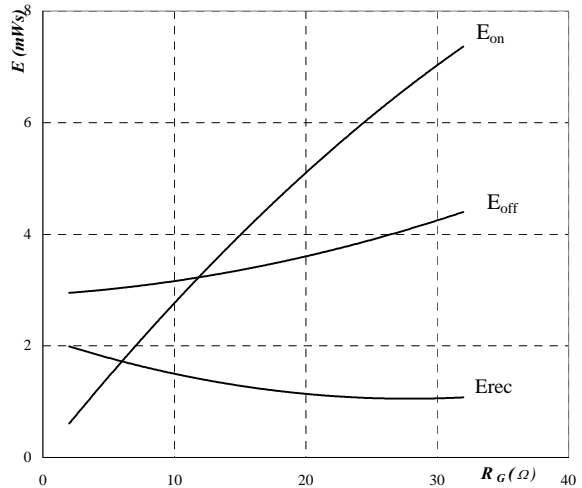
Output inverter

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



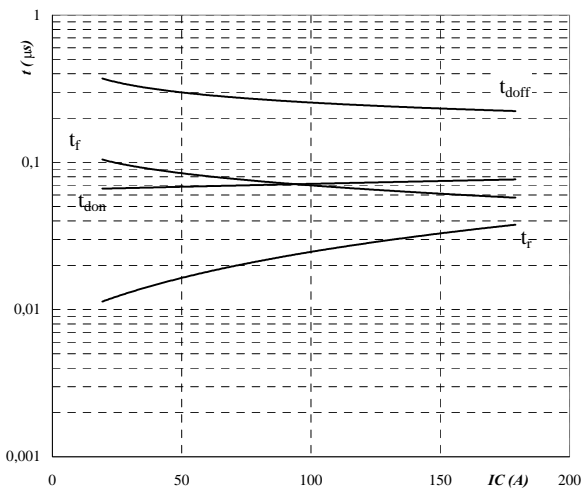
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $R_{gon} = 6\ \Omega$
 $R_{goff} = 6\ \Omega$

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



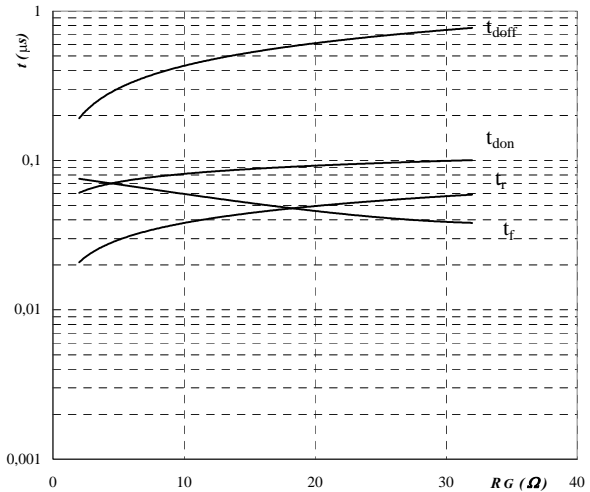
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $I_c = 100\text{ A}$

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

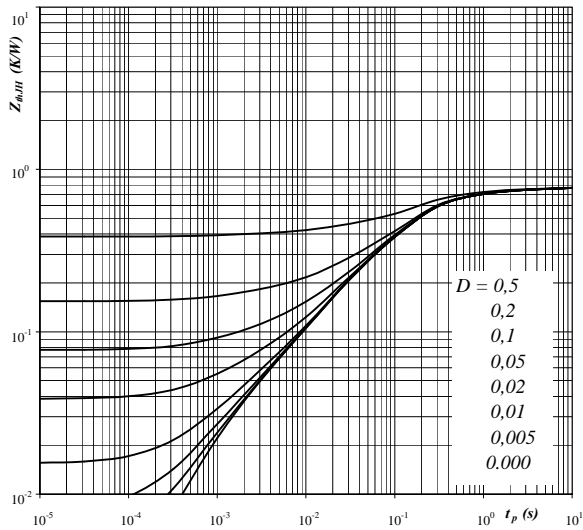


inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $R_{gon} = 6\ \Omega$
 $R_{goff} = 6\ \Omega$

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



inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $I_c = 100\text{ A}$

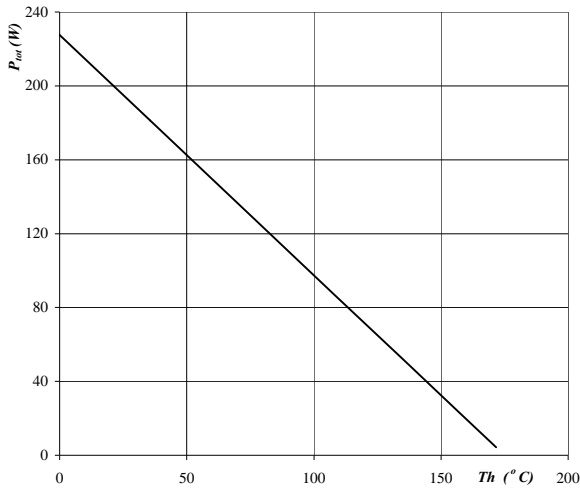
Output inverter
Figure 8. IGBT transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$

 Parameter: $D = t_p / T$
 $R_{thJH} = 0,80 \text{ K/W}$
IGBT thermal model values

R (C/W)	Tau (s)
0,06	3,2E+00
0,16	5,0E-01
0,43	1,3E-01
0,10	1,5E-02
0,02	1,4E-03

Output inverter

Figure 9. Power dissipation as a function of heatsink temperature

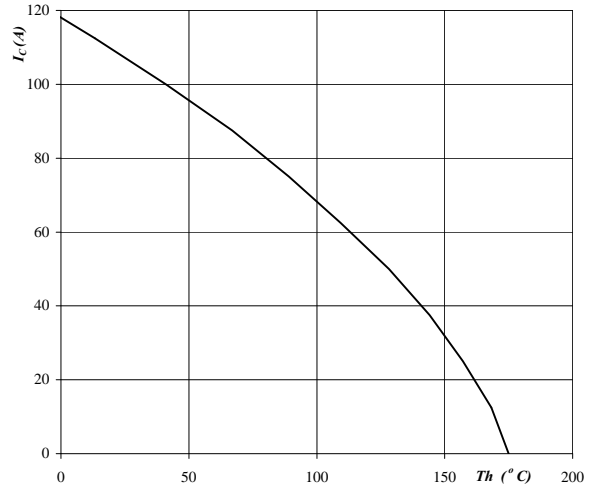
Output inverter IGBT
 $P_{tot} = f(T_h)$



parameter: $T_j = 175^\circ\text{C}$

Figure 10. Collector current as a function of heatsink temperature

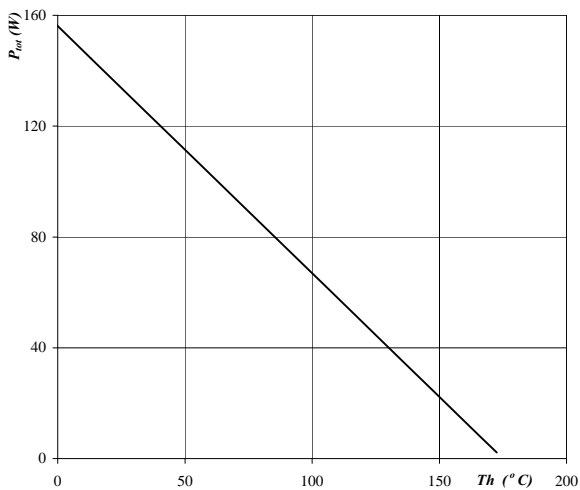
Output inverter IGBT
 $I_c = f(T_h)$



parameter: $T_j = 175^\circ\text{C}$
 $V_{GE} = 15\text{ V}$

Figure 11. Power dissipation as a function of heatsink temperature

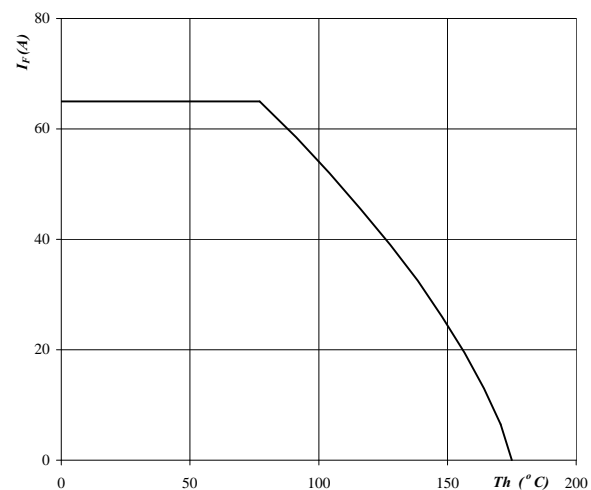
Output inverter FRED
 $P_{tot} = f(T_h)$



parameter: $T_j = 175^\circ\text{C}$

Figure 12. Forward current as a function of heatsink temperature

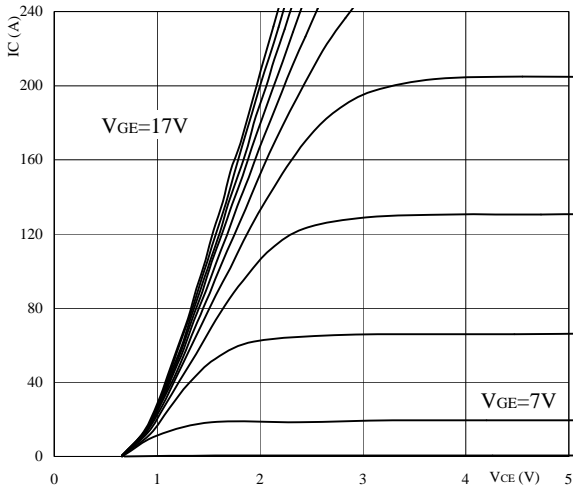
Output inverter FRED
 $I_F = f(T_h)$



parameter: $T_j = 175^\circ\text{C}$

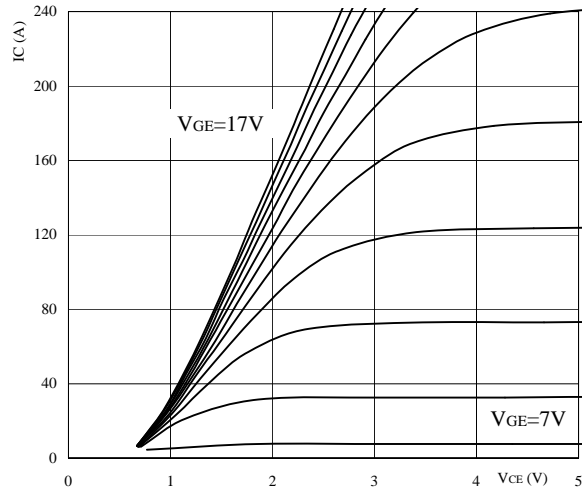
Brake

Figure 13. Typical output characteristics
Brake IGBT
 $I_C = f(V_{CE})$



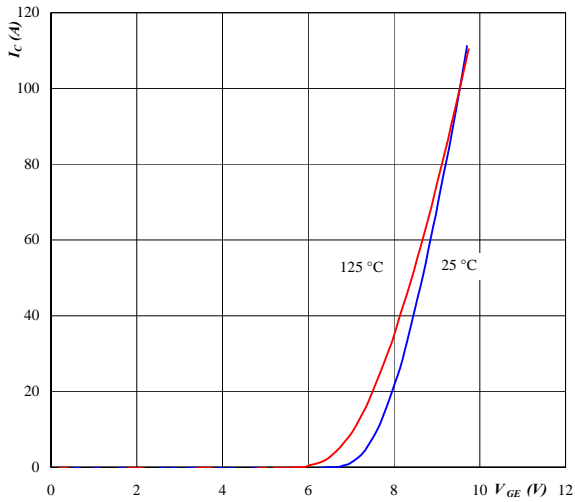
parameter: $t_p = 250 \mu s$ $T_j = 25 \text{ }^\circ C$
 V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 14. Typical output characteristics
Brake IGBT
 $I_C = f(V_{CE})$



parameter: $t_p = 250 \mu s$ $T_j = 125 \text{ }^\circ C$
 V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

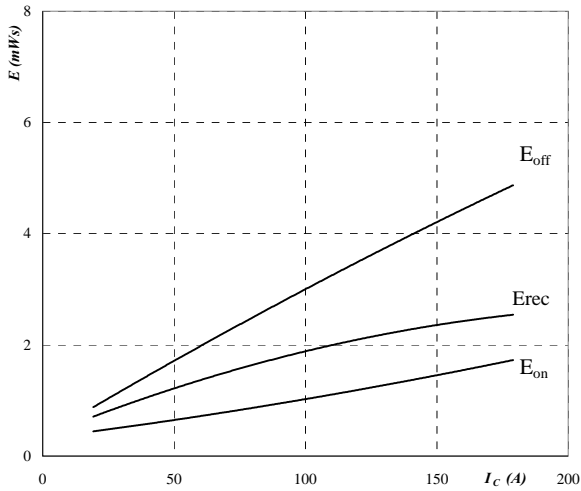
Figure 15. Typical transfer characteristics
Brake IGBT
 $I_C = f(V_{GE})$



parameter: $t_p = 250 \mu s$ $V_{CE} = 10 \text{ V}$

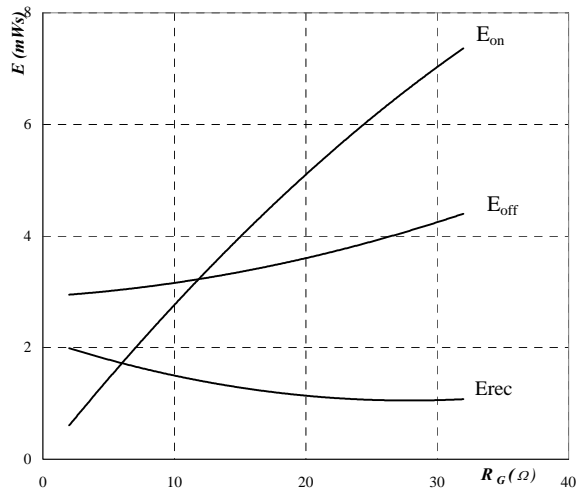
Brake

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



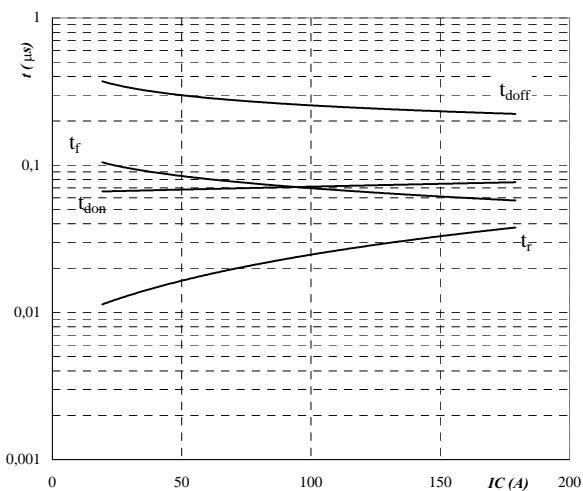
inductive load, T_j = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
R_{gon} = 6 Ω
R_{goff} = 6 Ω

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



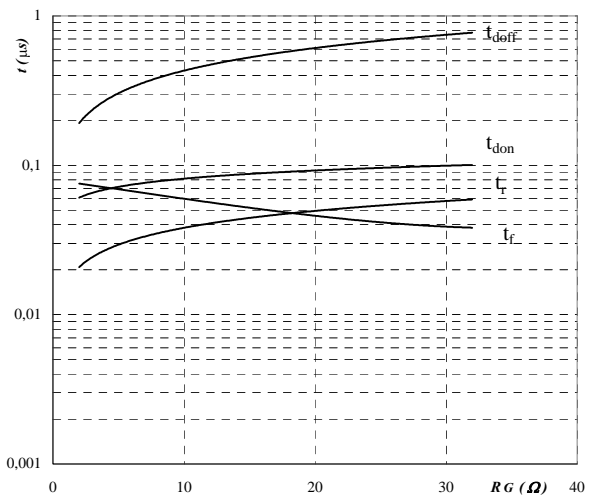
inductive load, T_j = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
I_C = 100 A

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



inductive load, T_j = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
R_{gon} = 6 Ω
R_{goff} = 6 Ω

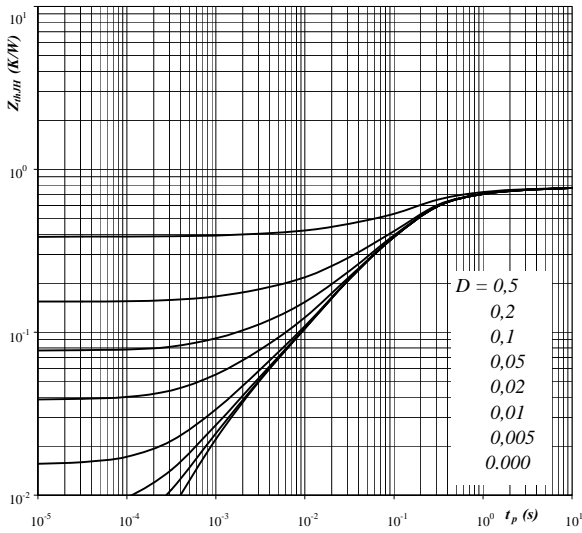
Figure 19. Typical switching times as a function of gate resistor
Brake IGBT
 $t = f(R_G)$



inductive load, T_j = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
I_C = 100 A

Brake

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

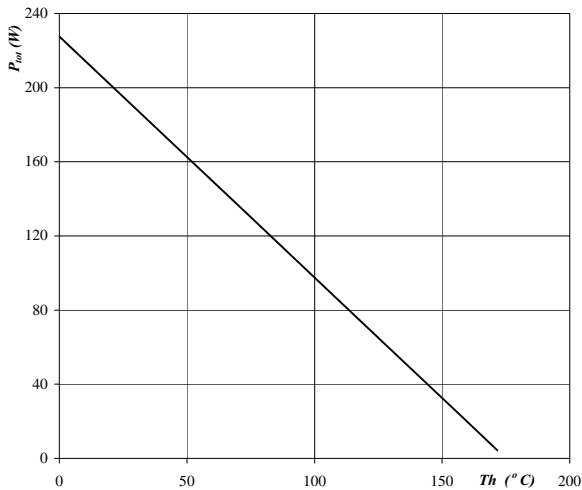


Parameter: $D = t_p / T$ $R_{thJH} = 0,80 \text{ K/W}$

IGBT thermal model values

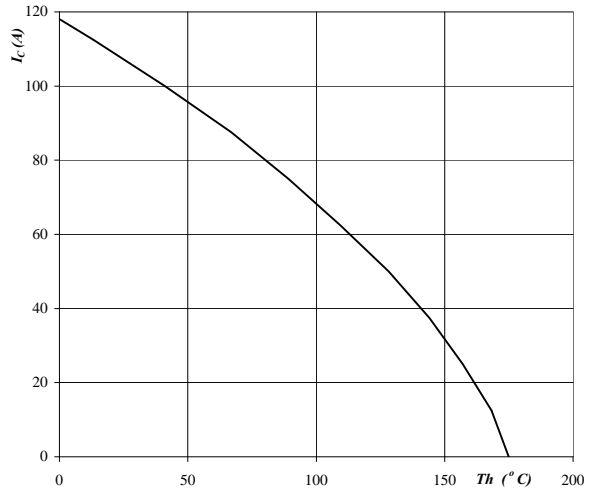
R (C/W)	Tau (s)
0,06	3,2E+00
0,16	5,0E-01
0,43	1,3E-01
0,10	1,5E-02
0,02	1,4E-03

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



parameter: $T_j = 175^\circ\text{C}$

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



parameter: $T_j = 175^\circ\text{C}$
 $V_{GE} = 15 \text{ V}$

Input rectifier bridge

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

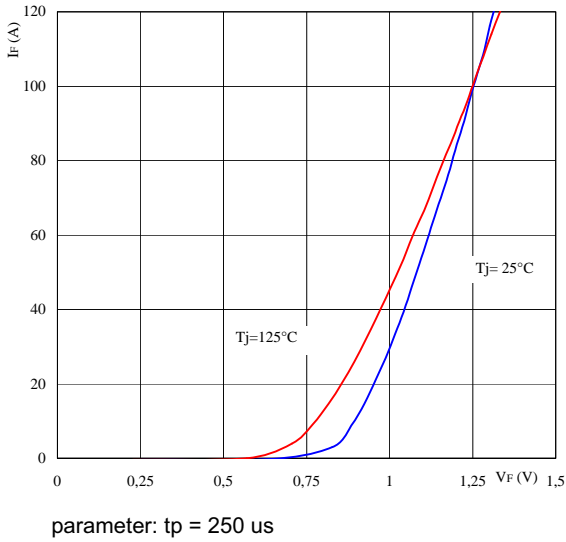


Figure 24. Diode transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$

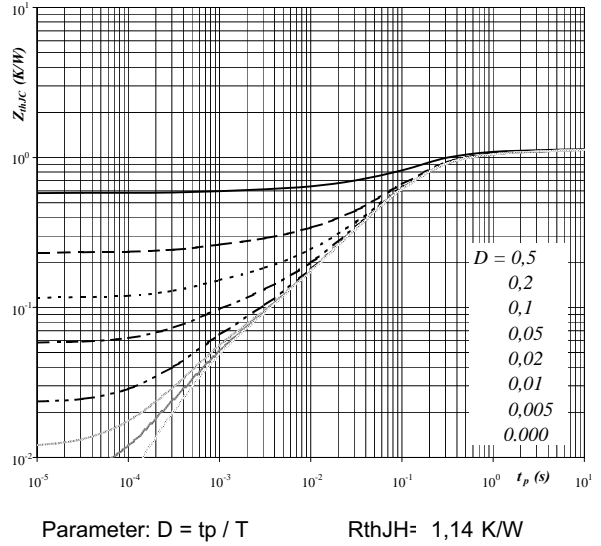


Figure 25. Power dissipation as a function of heatsink temperature
Rectifier diode $P_{tot} = f(T_h)$

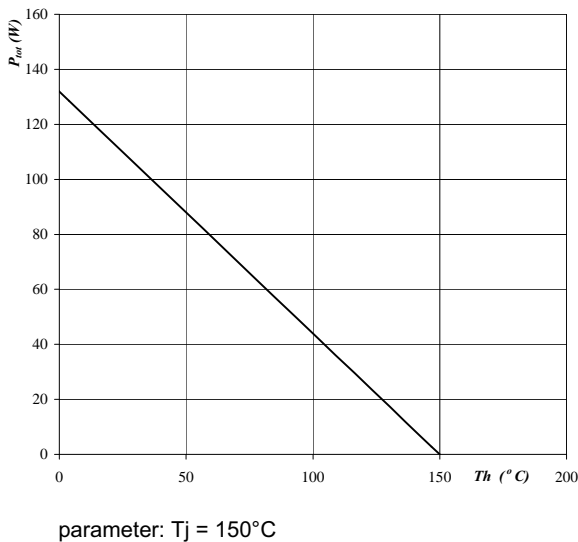
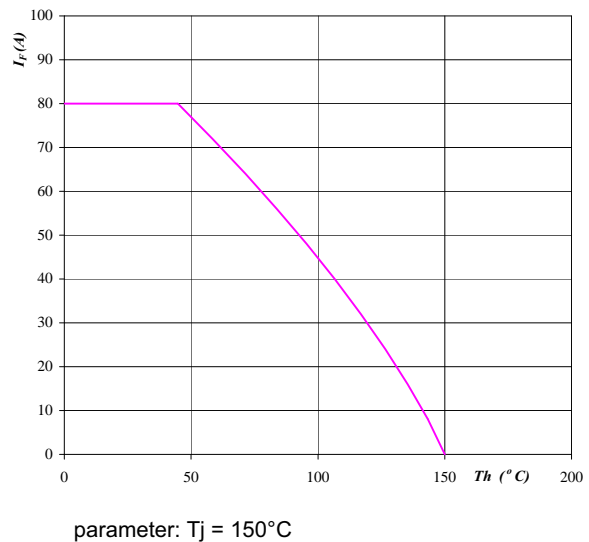


Figure 26. Forward current as a function of heatsink temperature
Rectifier diode $I_F = f(T_h)$



Thermistor**Figure 27. Typical PTC characteristic
as a function of temperature**

$$R_T = f(T)$$

