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}	52 68	W
Transistor Inverter **Transistor Wechselrichter**					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	1200	V
DC collector current Kollektor-Dauergleichstrom	T_j=150°C	T_h=80°C, T_c=80°C	I_C	33 40 limited by power terminal	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	66	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C T_c=80°C	P_{tot}	64 96	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time Kurzschlußverhalten	Tj≤125°C V_{CC}=900V	V_{GE}=15V	t_{SC}	10	us
Diode Inverter **Diode Wechselrichter**					
DC forward current Dauergleichstrom	T_j=150°C	T_h=80°C, T_c=80°C	I_F	29 39	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms	T_h=80°C	I_{FRM}	57	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C T_c=80°C	P_{tot}	45 44	W
Transistor BRC **Transistor BRC**					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	1200	V
DC collector current Kollektor-Dauergleichstrom	T_j=150°C T_j=150°C	T_h=80°C T_c=80°C	I_C	36 40 limited by power terminal	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	71	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C T_c=80°C	P_{tot}	70 107	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time Kurzschlußverhalten	Tj≤125°C VCE=900 V	VGE=15V	t_{SC}	10	us

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Values	Unit
			max.	
Diode BRC **Diode BRC**				
DC forward current Dauergleichstrom	T_j=150°C T_h=80°C T_j=150°C T_c=80°C	I_F	31 40 limited by power terminal	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms T_h=80°C	I_{FRM}	62	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C T_h=80°C T_c=80°C	P_{tot}	52 79	W
Thermal properties **Thermische Eigenschaften**				
max. Chip temperature max. Chiptemperatur		T_{jmax}	150	°C
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

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) IF(A) I_d(A)	Min	Typ	Max	
Input Rectifier Bridge **Gleichrichter**										
Forward voltage Durchlaßpannung	V_F	Tj=25°C Tj=125°C				25	0,8	1,09 1,03	1,35	V
Threshold voltage (for power loss calc. only) Schleusenspannung	V_{to}	Tj=25°C Tj=125°C				 25		0,89 0,77		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	r_t	Tj=25°C Tj=125°C				 25		0,008 0,1		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					1,34		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,88		K/W
Transistor Inverter **Transistor Wechselrichter**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,0015	5	5,8	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15 15		35 35	1,35	1,75 1,95	2,15	V
Collector-emitter cut-off current incl. Diode Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	1224		0		0,05	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		±25	0		0		300	nA
Integrated Gate resistor Integrirter Gate Widerstand	R_{gint}							6		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 80		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 29		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 486		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 188		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 4,982		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 3,568		mWs
Input capacitance Eingangskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			2,4		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,5		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,3		nF
Gate charge Gate Ladung	Q_{Gate}	Tj=25°C Tj=125°C	VCE=600V ICpulse=35A	±15				250		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					1,1		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,73		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					0,4		K/W

Characteristic values

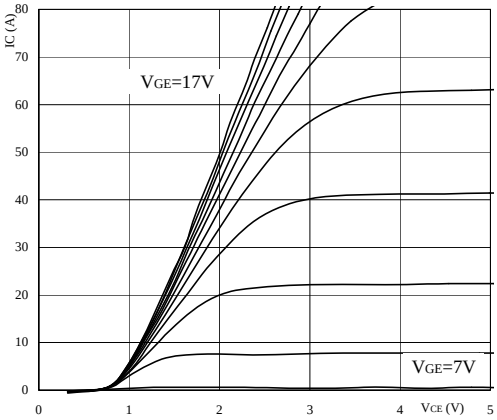
Description	Symbol	Conditions					Values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	V_{GE}(V) V_{GS}(V)	V_R(V) V_{CE}(V) V_{DS}(V)	I_C(A) IF(A) I_d(A)	Min	Typ	Max	
Diode Inverter **Diode Wechselrichter**										
Diode forward voltage Durchlaßspannung	V_F	Tj=25°C Tj=125°C				35 35	1,4	1,6 1,67	2,2	V
Peak reverse recovery current Rückstromspitze	I_{RM}	Tj=25°C Tj=125°C	Rgon=28 Ohm diF/dt = 1169 A/us	 0	600 600	35 35		 33,9		A
Reverse recovery time Sperreverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	Rgon=28 Ohm diF/dt = 1169 A/us	 0	600 600	35 35		 715		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	Rgon=28 Ohm diF/dt = 1169 A/us	 0	600 600	35 35		 9,12		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	Rgon=28 Ohm diF/dt = 1169 A/us	 0	600 600	35 35		 3,663		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					1,56		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		K/W
Transistor BRC **Transistor BRC**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,0015	5	5,8	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15 15		35 35	1,35	1,71 1,9	2,15	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	1224		0		0,05	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		±25	0		0		300	nA
Integrated Gate resistor Integrirter Gate Widerstand	R_{gint}							6		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 79		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 29		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 487,7		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 194		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 5,04		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgoff=28 Ohm Rgon=28 Ohm	 ±15	 600	 35		 3,59		mWs
SC withstand time Kurzschlußverhalten	t_{SC}	Tj=150°C		15	1200			10		us
Input capacitance Eingangskapazität	C_{iss}	Tj=25°C Tj=125°C	f=1MHz	0	25			2,4		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,5		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,3		nF
Gate charge Gate Ladung	Q_{gate}	Tj=25°C Tj=125°C	VCE=600V ICpulse=35A	±15				250		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					0,99		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,66		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)	I_C(A) IF(A) I_d(A)	Min	Typ	Max	
Diode BRC										
Diode BRC										
Diode forward voltage	V_F	Tj=25°C				35	1,4	1,69	2,2	V
Durchlaßspannung		Tj=125°C				35		1,74		
Reverse current	I_r	Tj=25°C			1224		0		50	uA
Sperrstrom		Tj=125°C								
Reverse recovery time	t_{rr}	Tj=25°C	Rgon= 28 Ohm							ns
Sperreverzögerungszeit		Tj=125°C	diF/dt = 1671 A/us	0	600	35		761,9		
Reverse recovered charge	Q_{rr}	Tj=25°C	Rgon= 28 Ohm							uC
Sperrverzögerungsladung		Tj=125°C	diF/dt = 1671 A/us	0	600	35		8,45		
Reverse recovery energy	E_{rec}	Tj=25°C	Rgon= 28 Ohm							mWs
Sperrverzögerungsenergie		Tj=125°C	diF/dt =1671 A/us	0	600	35		3,38		
Thermal resistance chip to heatsink per chip			Thermal grease							
Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		thickness≤50um					1,35		K/W
Thermal resistance chip to case per chip			Warmeleitpaste Dicke≤50um							
Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		λ = 0,61 W/mK					0,89		K/W
PTC-Thermistor										
PTC-Widerstand										
Nominal resistance	R_{25}	Tj=25°C	tolerance = 3%				0,97	1	1,03	kOhm
Nominaler Widerstand	R_{100}	Tj=100°C	tolerance = 2%				1,637	1,67	1,703	kOhm
Typical temperature coefficient	α	Tj=25°C						0,76		%/K
Tipischer Temperaturkoeffizient		Tj=125°C								
Recommended measuring current		Tj=25°C					1		3	
Empfohlener Messstrom	I_m	Tj=125°C								mA
Measured values		Tj=25°C	I_m = 1mA				0,93		1,03	
Gemessene Werte	V_{PTC}		I_m = 3mA				2,84		3,4	V

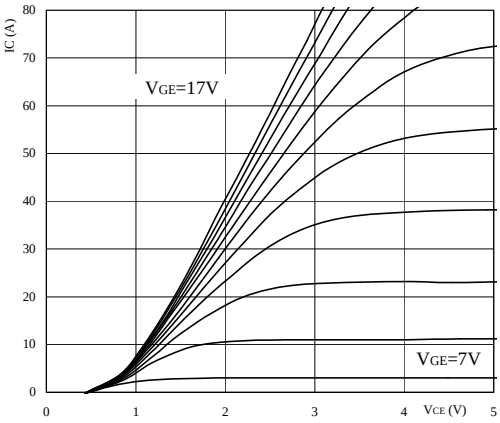
Output inverter

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



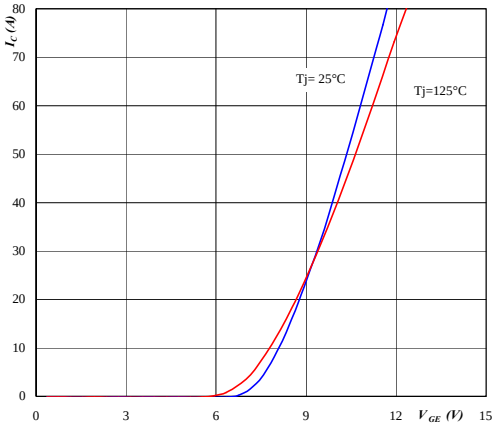
parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



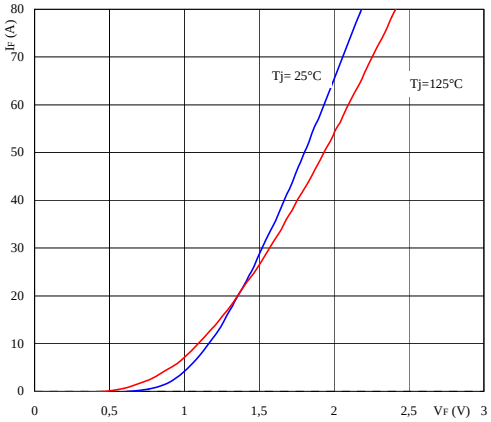
parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



parameter: tp = 250 us VCE = 10 V

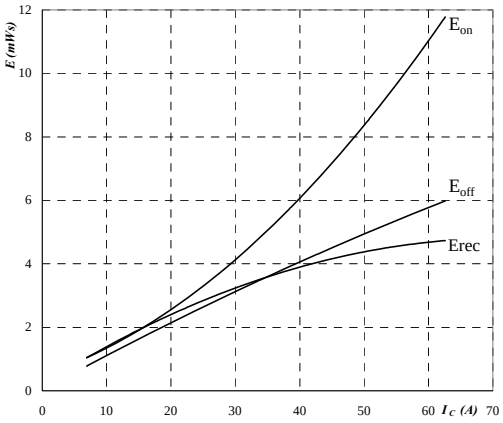
Figure 4. **Typical diode forward current as a function of forward voltage**
Output inverter FRED IF=f(VF)



parameter: tp = 250 us

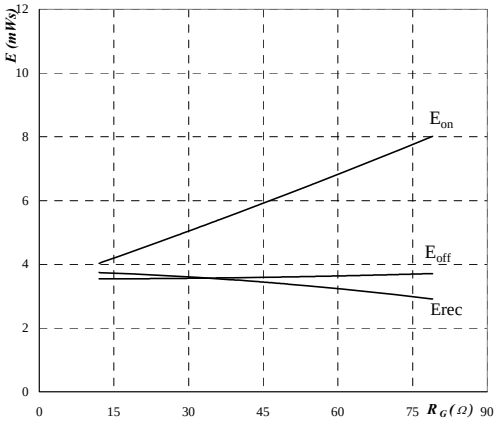
Output inverter

Figure 5. **Typical switching energy losses as a function of collector current**
Output inverter IGBT
E = f (Ic)



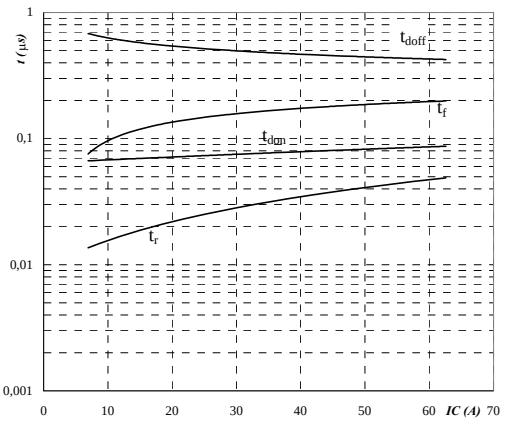
inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Rgon= 28 Ω
Rgoff= 28 Ω

Figure 6. **Typical switching energy losses as a function of gate resistor**
Output inverter IGBT
E = f (RG)



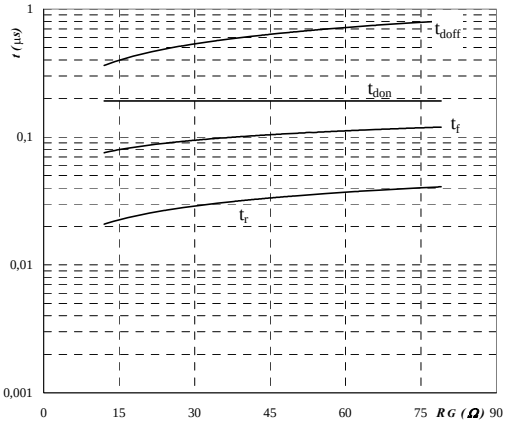
inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Ic = 35 A

Figure 7. **Typical switching times as a function of collector current**
Output inverter IGBT
t = f (Ic)



inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Rgon= 28 Ω
Rgoff= 28 Ω

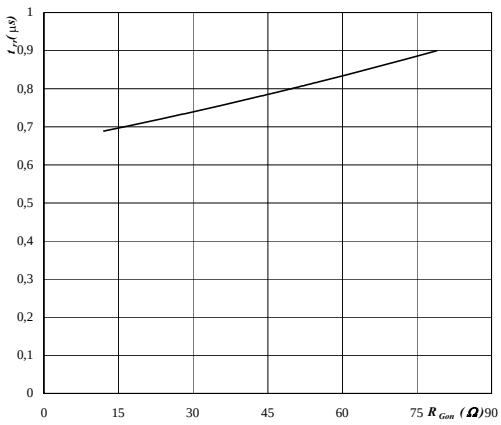
Figure 8. **Typical switching times as a function of gate resistor**
Output inverter IGBT
t = f (RG)



inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Ic = 35 A

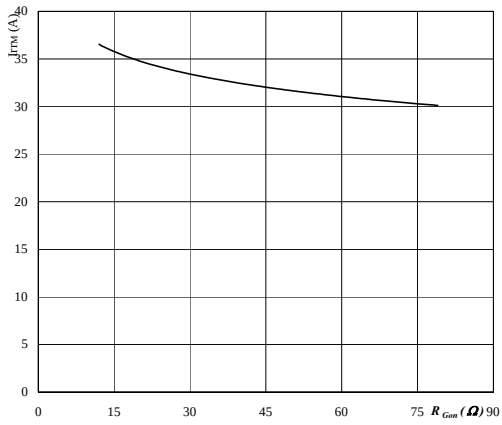
Output inverter

Figure 9. Typical reverse recovery time as a function of IGBT turn on gate resistor
Output inverter FRED diode
t_{rr} = f (Rgon)



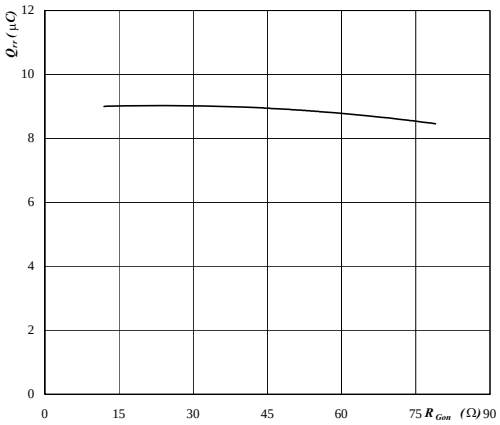
Tj = 125 °C
V_R = 600 V
I_F = 35 A
V_{GE} = ±15 V

Figure 10. Typical reverse recovery current as a function of IGBT turn on gate resistor
Output inverter FRED diode
I_{RRM} = f (Rgon)



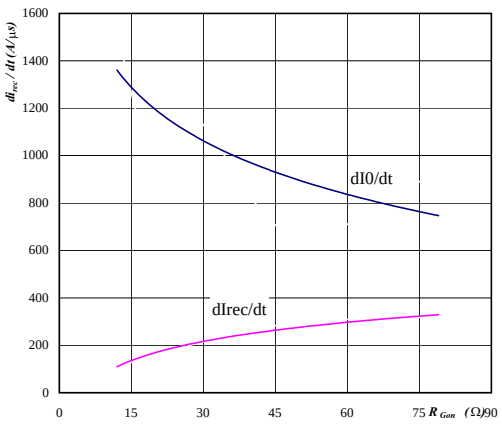
Tj = 125 °C
V_R = 600 V
I_F = 35 A
V_{GE} = ±15 V

Figure 11. Typical reverse recovery charge as a function of IGBT turn on gate resistor
Output inverter FRED diode
Q_{rr} = f (Rgon)



Tj = 125 °C
V_R = 600 V
I_F = 35 A
V_{GE} = ±15 V

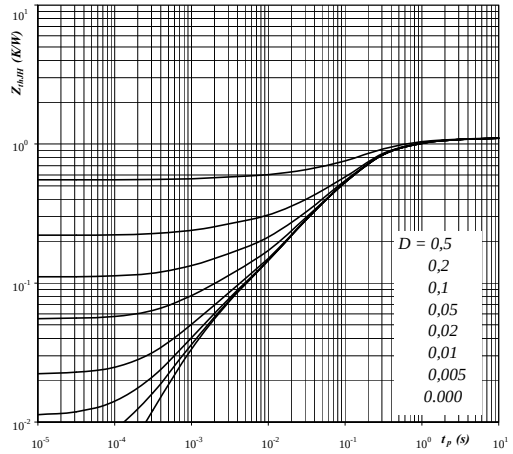
Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
Output inverter FRED diode
dI0/dt,dIrec/dt= f (Rgon)



Tj = 125 °C
V_R = 600 V
I_F = 35 A
V_{GE} = ±15 V

Output inverter

Figure 13. IGBT transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$

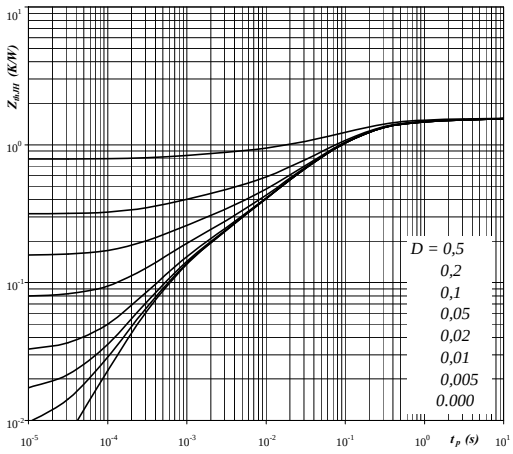


Parameter: D = tp / T RthJH= 1,10 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,06	4,0E+00
0,24	6,0E-01
0,63	1,5E-01
0,13	2,0E-02
0,05	1,5E-03
0,02	5,5E-04
0,05	1,2E-04
0,00	0,0E+00

Figure 14. FRED transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



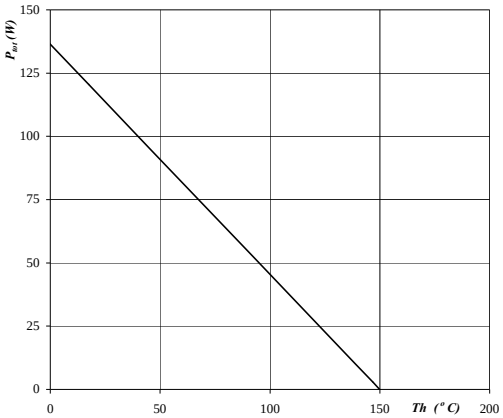
Parameter: D = tp / T RthJH= 1,56 K/W

FRED thermal model values

R (C/W)	Tau (s)
0,03	6,8E+01
0,07	3,5E+00
0,22	4,4E-01
0,71	1,0E-01
0,33	2,1E-02
0,13	2,9E-03
0,09	4,7E-04
0,06	1,4E-04
0,00	0,0E+00
0,00	0,0E+00

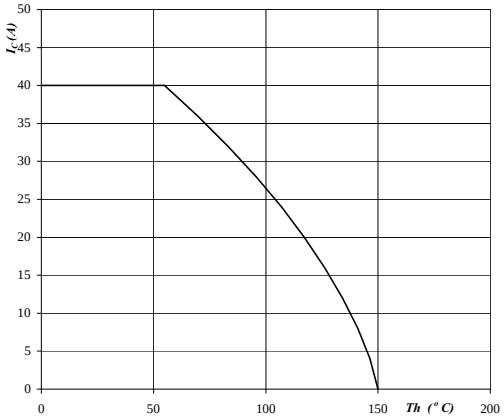
Output inverter

Figure 15. Power dissipation as a function of heatsink temperature
Output inverter IGBT
P_{tot} = f (Th)



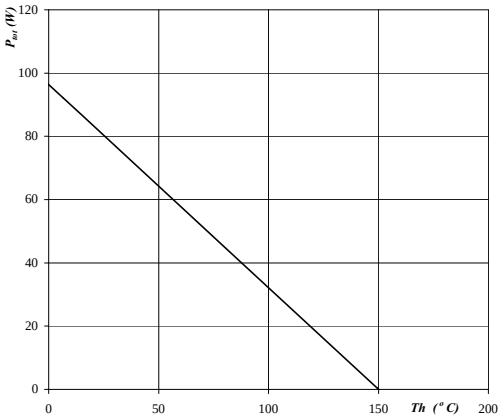
parameter: Tj = 150°C

Figure 16. Collector current as a function of heatsink temperature
Output inverter IGBT
I_C = f (Th)



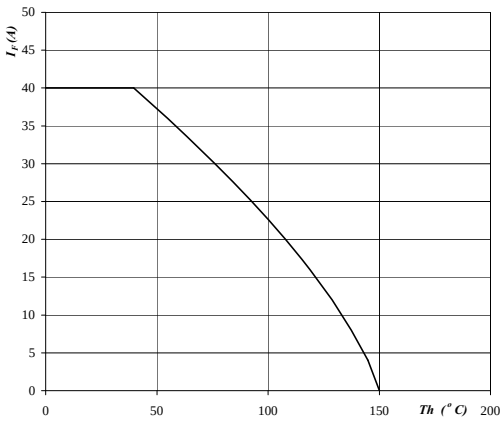
parameter: Tj = 150°C
V_{GE}= 15 V

Figure 17. Power dissipation as a function of heatsink temperature
Output inverter FRED
P_{tot} = f (Th)



parameter: Tj = 150°C

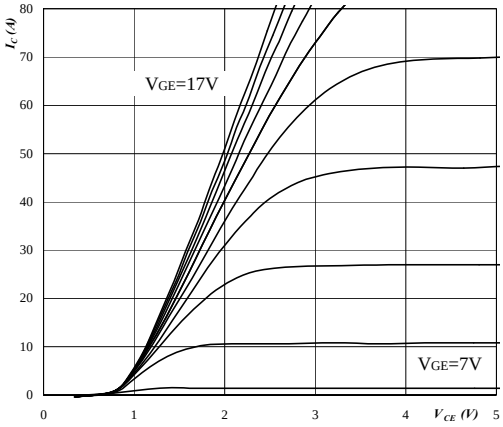
Figure 18. Forward current as a function of heatsink temperature
Output inverter FRED
I_F = f (Th)



parameter: Tj = 150°C

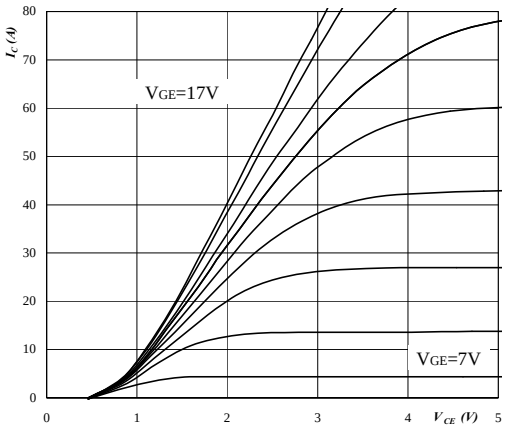
Brake

Figure 19. Typical output characteristics
Brake IGBT
Ic= f(VCE)



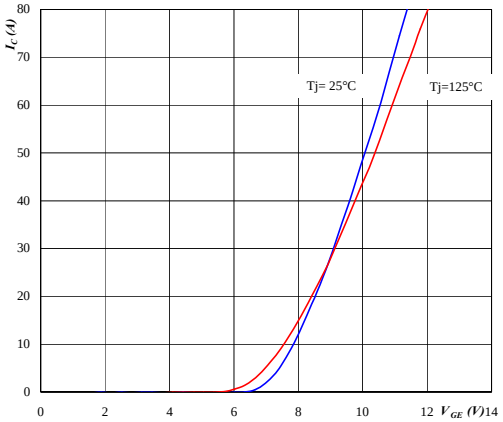
parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

Figure 20. Typical output characteristics
Brake IGBT
Ic= f(VCE)



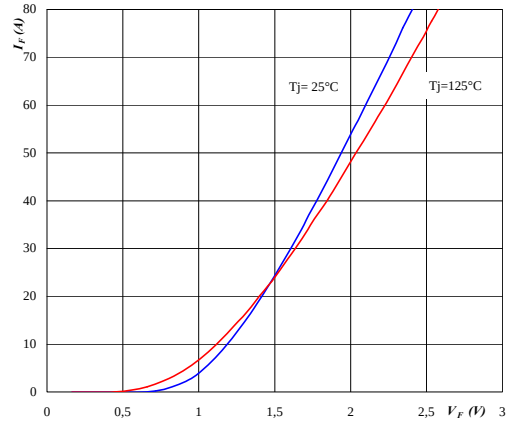
parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

Figure 21. Typical transfer characteristics
Brake IGBT
Ic= f(VGE)



parameter: tp = 250 us VCE = 10 V

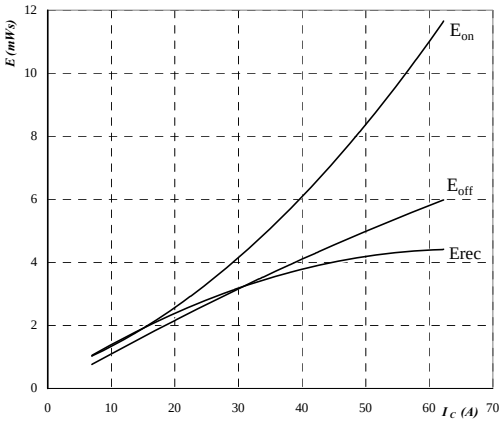
Figure 22. Typical diode forward current as a function of forward voltage
Brake FRED IF=f(VF)



parameter: tp = 250 us

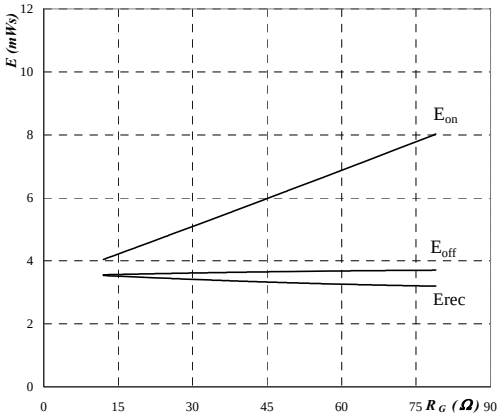
Brake

Figure 23. Typical switching energy losses as a function of collector current
Brake IGBT
E = f (Ic)



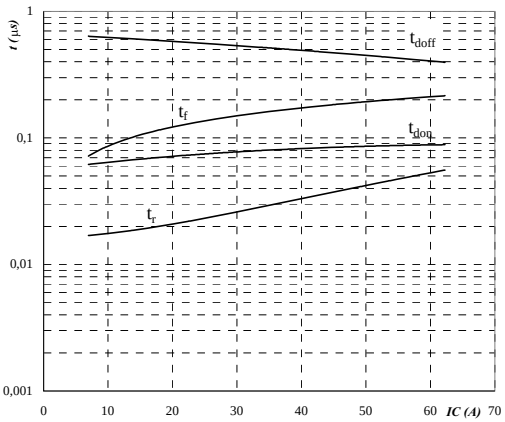
inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Rgon = 28 Ω
Rgoff = 28 Ω

Figure 24. Typical switching energy losses as a function of gate resistor
Brake IGBT
E = f (RG)



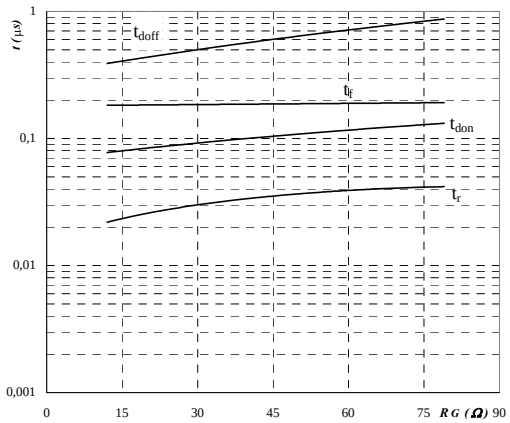
inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Ic = 35 A

Figure 25. Typical switching times as a function of collector current
Brake IGBT
t = f (Ic)



inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Rgon = 28 Ω
Rgoff = 28 Ω

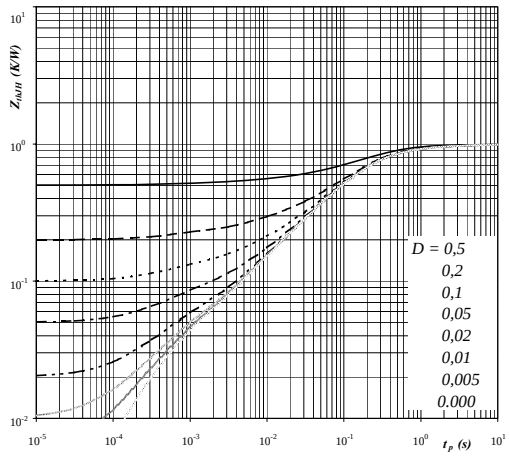
Figure 26. Typical switching times as a function of gate resistor
Brake IGBT
t = f (RG)



inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Ic = 35 A

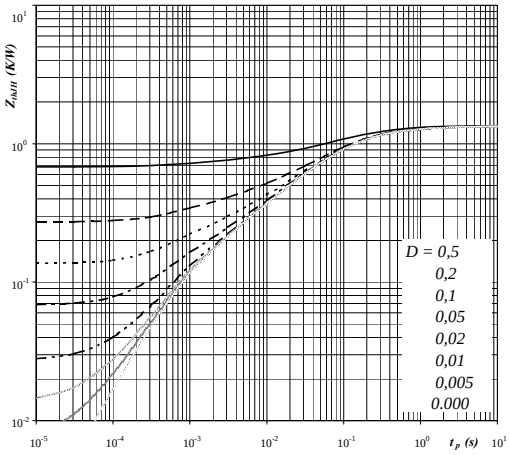
Brake

Figure 27. IGBT transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



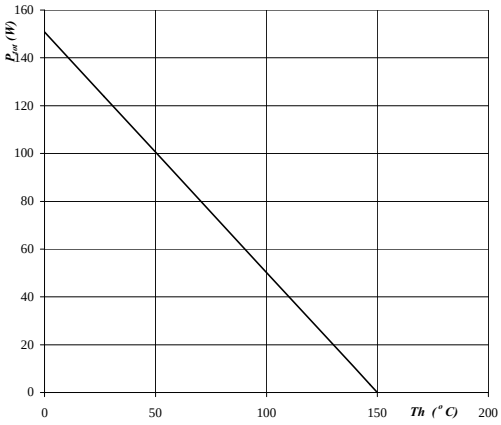
Parameter: D = tp / T RthJH= 0,99 K/W

Figure 28. FRED transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



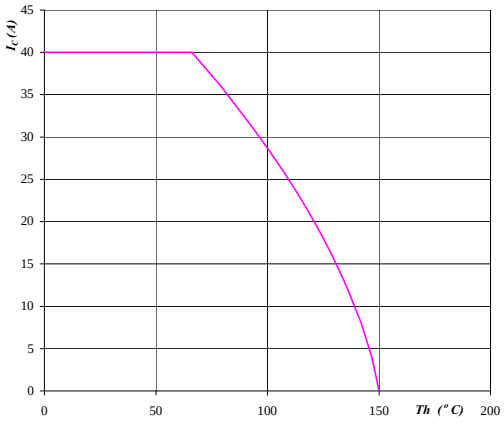
Parameter: D = tp / T RthJH= 1,35 K/W

Figure 29. Power dissipation as a function of heatsink temperature
Brake IGBT
$P_{tot} = f(Th)$



parameter: Tj = 150°C

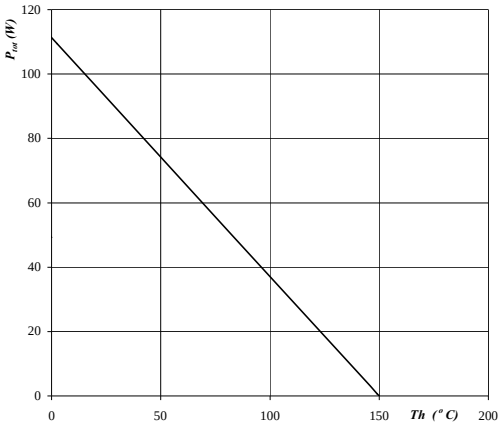
Figure 30. Collector current as a function of heatsink temperature
Brake IGBT
$I_C = f(Th)$



parameter: Tj = 150°C
V_{GE}= 15 V

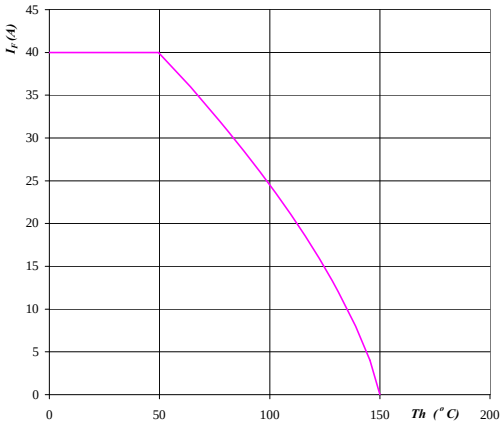
Brake

Figure 31. Power dissipation as a function of heatsink temperature
Brake FRED
P_{tot} = f (Th)



parameter: Tj = 150°C

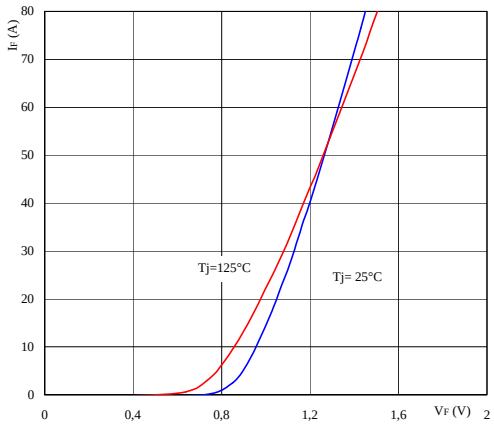
Figure 32. Forward current as a function of heatsink temperature
Brake FRED
I_F = f (Th)



parameter: Tj = 150°C

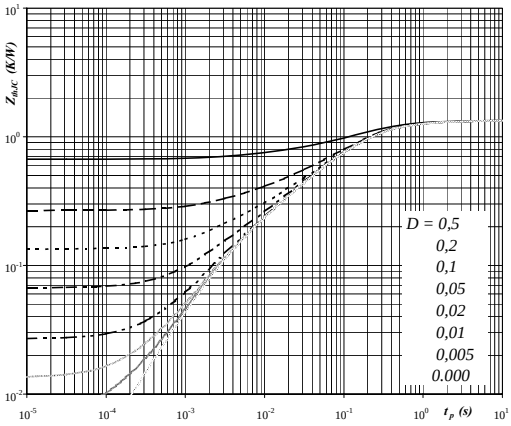
Input rectifier bridge

Figure 33. Typical diode forward current as a function of forward voltage
Rectifier diode $I_F=f(V_F)$



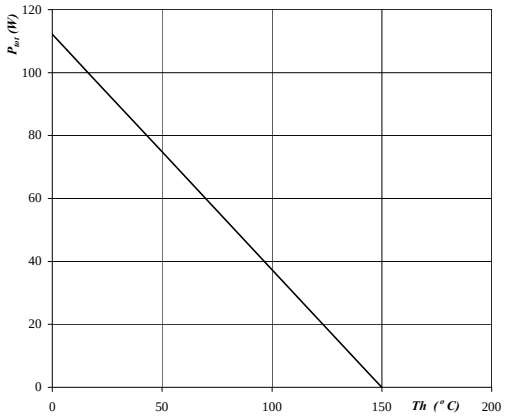
parameter: tp = 250 us

Figure 34. Diode transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



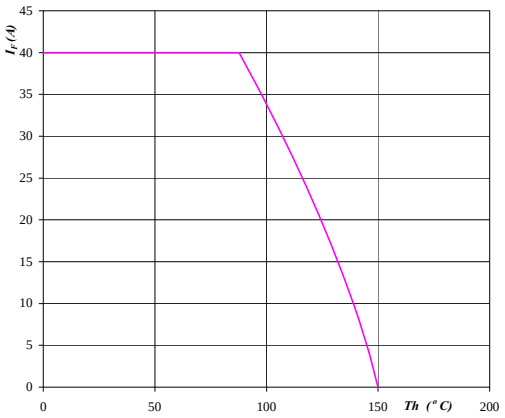
Parameter: D = tp / T RthJH= 1,34 K/W

Figure 35. Power dissipation as a function of heatsink temperature
Rectifier diode
$P_{tot} = f(Th)$



parameter: Tj = 150°C

Figure 36. Forward current as a function of heatsink temperature
Rectifier diode
$I_F = f(Th)$



parameter: Tj = 150°C

Thermistor

Figure 37. Typical PTC characteristic as afunction of temperature

$R_T = f(T)$