***flow* PHASE 0 600V/ 100A** V23990-P563-F10-01-14

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Datasheet values max.	Unit
Transistor Inverter				
Transistor Wechselrichter				
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	T_j=175°C T_h=80°C, T_c=80°C	I_C	80 104	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	tp limited by Tj max	I_{cpuls}	300	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=175°C T_h=80°C T_c=80°C	P_{tot}	124 187	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
Diode Inverter				
Diode Wechselrichter				
DC forward current Dauergleichstrom	T_j=175°C T_h=80°C, T_c=80°C	I_F	63 65, limited by bondwires	A
Repetitive peak forward current Periodischer Spitzenstrom	tp limited by Tj max	I_{FRM}	300	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=175°C T_h=80°C T_c=80°C	P_{tot}	85 128	W
Thermal properties				
Thermische Eigenschaften				
max. Chip temperature max. Chiptemperatur		T_{jmax}	175	°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

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

***flow* PHASE 0 600V/ 100A** V23990-P563-F10-01-14

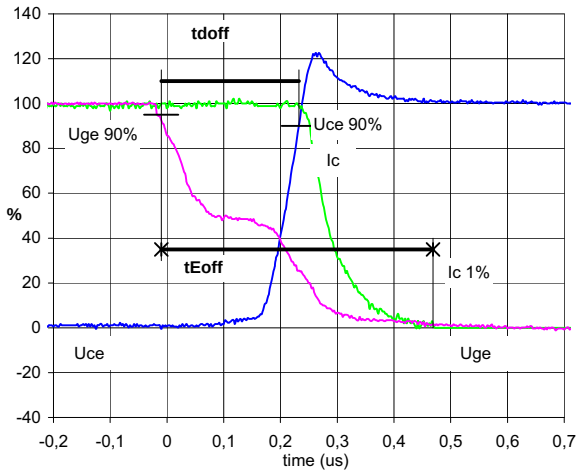
Characteristic values/ Charateristische Werte

Description	Symbol	Conditions					Datasheet values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Min	Typ	Max	
Transistor Inverter										
Transistor Wechselrichter										
Gate emitter threshold voltage	$V_{GE(th)}$	Tj=25°C	VCE=VGE			0,0016	4	5,8	8	
Gate-Schwellenspannung		Tj=125°C								
Collector-emitter saturation voltage	$V_{CE(sat)}$	Tj=25°C		15		100	1,3	1,48	2,1	V
Kollektor-Emitter Sättigungsspannung		Tj=125°C						1,65		
Collector-emitter cut-off	I_{CES}	Tj=25°C		0	600				0,66	mA
Kollektor-Emitter Reststrom		Tj=125°C								
Gate-emitter leakage current	I_{GES}	Tj=25°C		20	0				700	nA
Gate-Emitter Reststrom		Tj=125°C								
Integrated Gate resistor	R_{gint}							2		Ohm
Integrirter Gate Widerstand										
Turn-on delay time	$t_{d(on)}$	Tj=25°C	Rgoff=4 Ω							ns
Einschaltverzögerungszeit		Tj=125°C	Rgon=4 Ω	±15	300	100		71		
Rise time	t_r	Tj=25°C	Rgoff=4 Ω							ns
Anstiegszeit		Tj=125°C	Rgon=4 Ω	±15	300	100		26		
Turn-off delay time	$t_{d(off)}$	Tj=25°C	Rgoff=4 Ω							ns
Abschaltverzögerungszeit		Tj=125°C	Rgon=4 Ω	±15	300	100		248		
Fall time	t_f	Tj=25°C	Rgoff=4 Ω							ns
Fallzeit		Tj=125°C	Rgon=4 Ω	±15	300	100		71		
Turn-on energy loss per pulse	E_{on}	Tj=25°C	Rgoff=4 Ω							mWs
Einschaltverlustenergie pro Puls		Tj=125°C	Rgon=4 Ω	±15	300	100		1,04		
Turn-off energy loss per pulse	E_{off}	Tj=25°C	Rgoff=4 Ω							mWs
Abschaltverlustenergie pro Puls		Tj=125°C	Rgon=4 Ω	±15	300	100		3		
Input capacitance	C_{ies}	Tj=25°C	f=1MHz	0	25			6,16		nF
Eingangskapazität		Tj=125°C								
Output capacitance	C_{oss}	Tj=25°C	f=1MHz	0	25			0,384		nF
Ausgangskapazität		Tj=125°C								
Reverse transfer capacitance	C_{rss}	Tj=25°C	f=1MHz	0	25			0,183		nF
Rückwirkungskapazität		Tj=125°C								
Gate charge	Q_{Gate}	Tj=25°C	Rgoff=4 Ω							nC
Gate Ladung		Tj=125°C	Rgon=4 Ω	±15	300	100		838,41		
Thermal resistance chip to heatsink per chip	R_{thJH}		Thermal foil					0,77		K/W
Wärmewiderstand Chip-Kühlkörper pro Chip			thickness=76um							
Thermal resistance chip to case per chip	R_{thJC}		Warmeleitfolie					0,51		K/W
Wärmewiderstand Chip-Gehause pro Chip			Dicke=76um Kunze Folien KU-ALF5							
Coupled thermal resistance inverter diode-transistor	R_{thJH}		Thermal foil					0,05		K/W
Gekoppelte Wärmewiderstand Wechselrichter Diode-Transistor			thickness=76um							
Coupled thermal resistance inverter transistor-transistor	R_{thJH}		Warmeleitfolie					0,03		K/W
Gekoppelte Wärmewiderstand Wechselrichter Transistor-Transistor			Dicke=76um Kunze Folien KU-ALF5							
Diode Inverter										
Diode Wechselrichter										
Diode forward voltage	V_F	Tj=25°C				100	1	1,63	2,55	V
Durchlaßspannung		Tj=125°C						1,64		
Peak reverse recovery current	I_{RM}	Tj=25°C	Rgon=4 ohm							A
Rückstromspitze		Tj=125°C	di0/dt = 4894 A/us	-15	300	100		126,8		
Reverse recovery time	t_{rr}	Tj=25°C	Rgon=4 ohm							ns
Sperreverzögerungszeit		Tj=125°C	di0/dt = 4894 A/us	-15	300	100		141		
Reverse recovered charge	Q_{rr}	Tj=25°C	Rgon=4 ohm							uC
Sperrverzögerungsladung		Tj=125°C	di0/dt = 4894 A/us	-15	300	100		7,47		
Reverse recovered energy	Erec	Tj=25°C	Rgon=4 ohm							mWs
Sperrverzögerungsenergie		Tj=125°C	di0/dt = 4894 A/us	-15	300	100		1,85		
Thermal resistance chip to heatsink per chip	R_{thJH}		Thermal foil					1,12		K/W
Wärmewiderstand Chip-Kühlkörper pro Chip			thickness=76um							
Thermal resistance chip to case per chip	R_{thJC}		Warmeleitfolie					0,74		K/W
Wärmewiderstand Chip-Gehause pro Chip			Dicke=76um Kunze Folien KU-ALF5							
Coupled thermal resistance inverter transistor-diode	R_{thJH}		Thermal foil					0,05		K/W
Gekoppelte Wärmewiderstand Wechselrichter Transistor-Diode			thickness=76um							
Coupled thermal resistance inverter diode-diode	R_{thJH}		Warmeleitfolie					0,02		K/W
Gekoppelte Wärmewiderstand Wechselrichter Diode-Diode			Dicke=76um Kunze Folien KU-ALF5							

Switching definitions

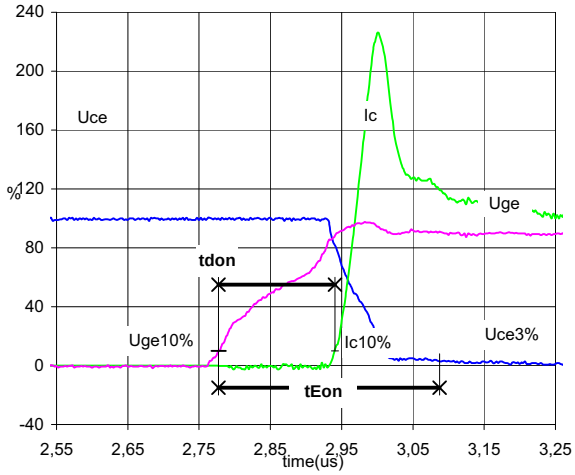
General conditions: Tj= 125 °C Rgon= 4 ohms Rgoff= 4,0 ohms

Figure 1. **Turn-off Switching Waveforms & definition of tdoff, t_{Eoff} (t_{Eoff} = integrating time for E_{off})**
Output inverter IGBT



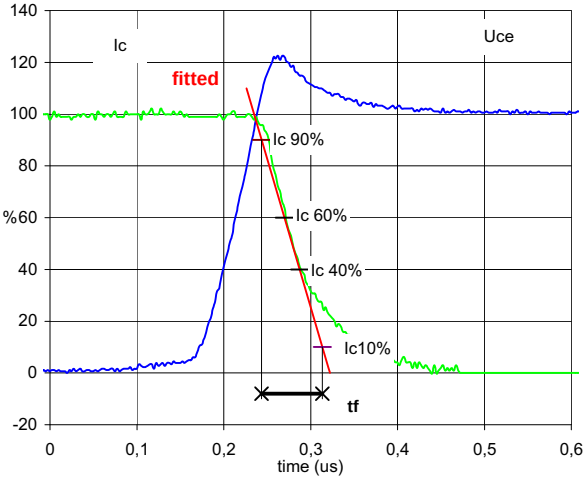
Uge(0%)= -15 V
Uge(100%)= 15 V
Uc(100%)= 300 V
Ic(100%)= 100 A
tdoff= 0,25 us
t_{Eoff}= 0,48 us

Figure 2. **Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})**
Output inverter IGBT



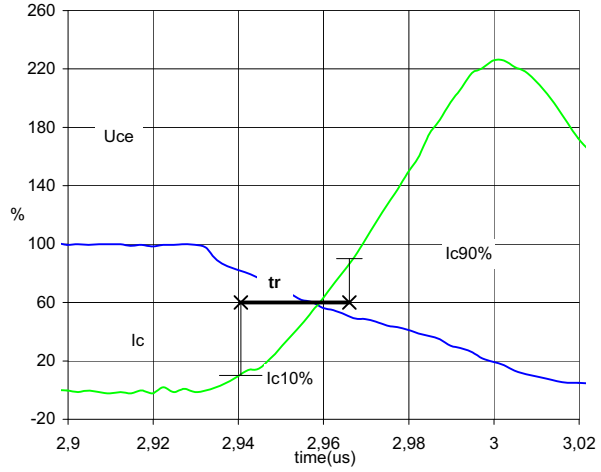
Uge(0%)= -15 V
Uge(100%)= 15 V
Uc(100%)= 300 V
Ic(100%)= 99,7 A
tdon= 0,07 us
t_{Eon}= 0,31 us

Figure 3. **Turn-off Switching Waveforms & definition of t_f**
Output inverter IGBT



Uc(100%)= 300 V
Ic(100%)= 100 A
t_f= 0,071 us

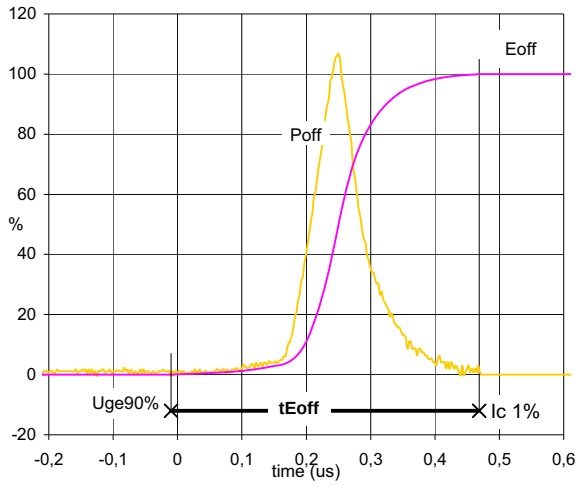
Figure 4. **Turn-on Switching Waveforms & definition of t_r**
Output inverter IGBT



Uc(100%)= 300 V
Ic(100%)= 99,7 A
t_r= 0,026 us

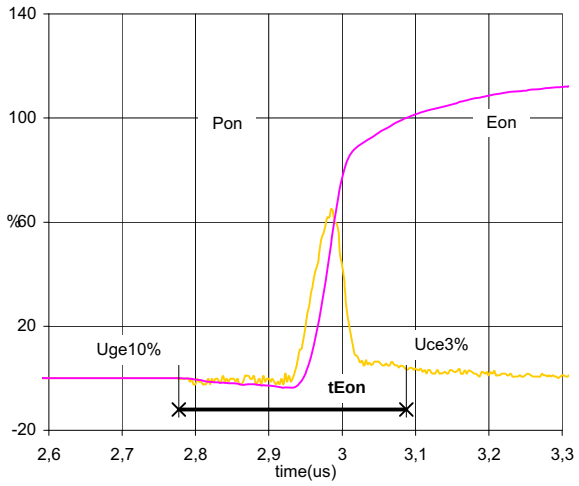
Switching definitions

Figure 5. **Turn-off Switching Waveforms & definition of t_{Eoff}**
Output inverter IGBT



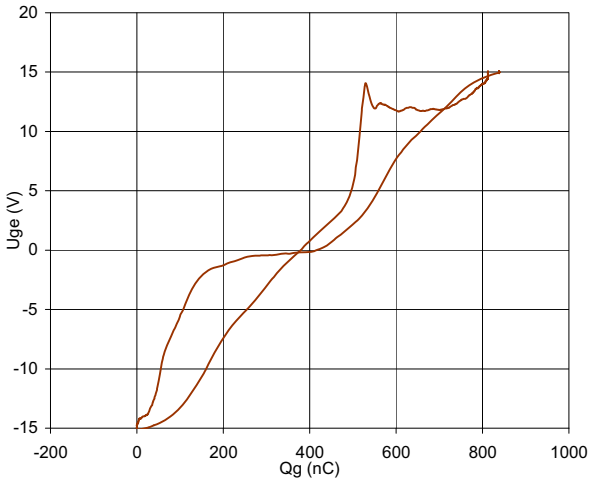
Poff(100%)= 29,91 kW
Eoff(100%)= 3,00 mJ
t_{Eoff}= 0,48 us

Figure 6. **Turn-on Switching Waveforms & definition of t_{Eon}**
Output inverter IGBT



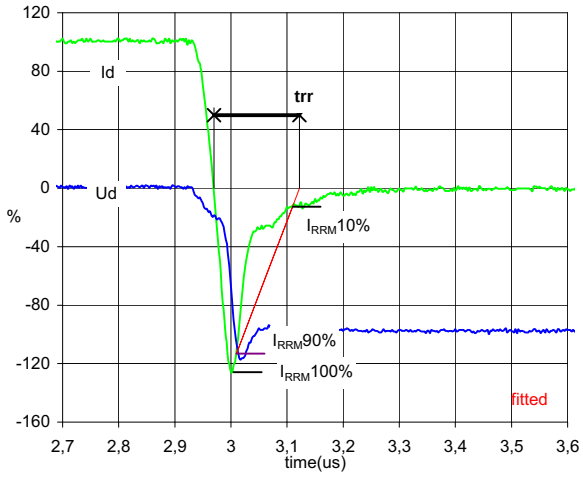
Pon(100%)= 29,9 kW
Eon(100%)= 1,04 mJ
t_{Eon}= 0,31 us

Figure 7. **Gate voltage vs Gate charge**
Output inverter IGBT



Ugeoff= -15 V
Ugeon= 15 V
Uc(100%)= 300 V
Ic(100%)= 100 A
Qg= 838,4 nC

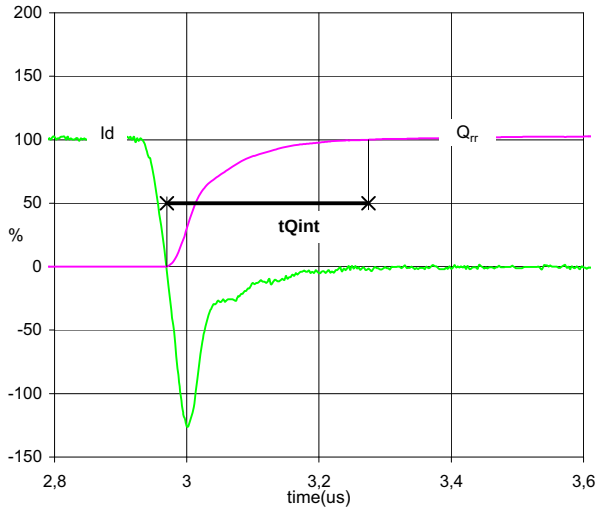
Figure 8. **Turn-off Switching Waveforms & definition of t_{rr}**
Output inverter FRED



Ud(100%)= 300 V
Id(100%)= 99,7 A
I_{RRM}(100%)= 127 A
trr= 0,14 us

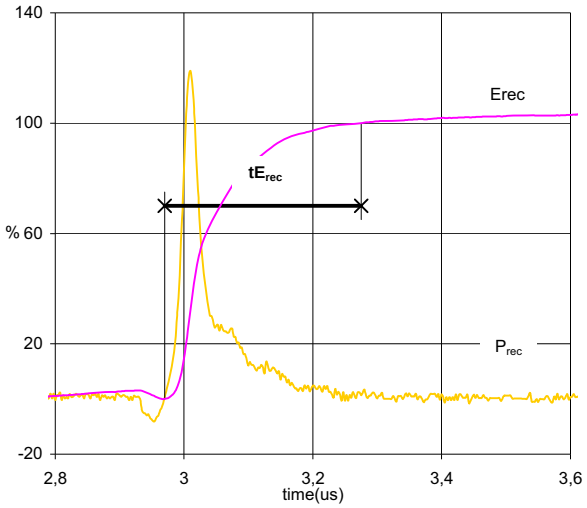
Switching definitions

Figure 9. Turn-on Switching Waveforms & definition of t_{Qrr}
(tQrr= integrating time for Qrr)
Output inverter FRED



Id(100%)= 100 A
Qrr(100%)= 7,474 uC
tQint= 0,30 us

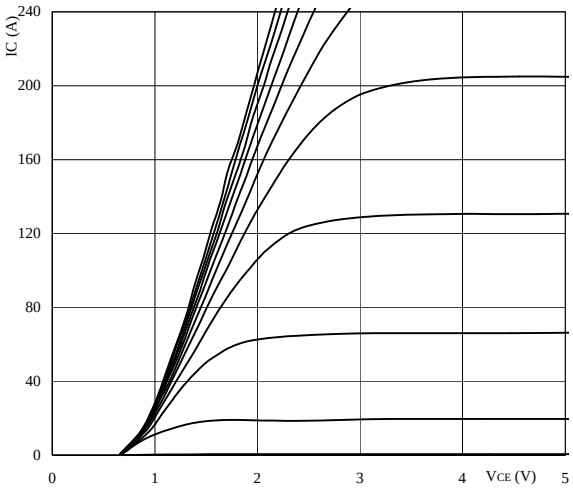
Figure 10. Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})
Output inverter FRED



Prec(100%)= 29,9 kW
Erec(100%)= 1,85 mJ
tErec= 0,30 us

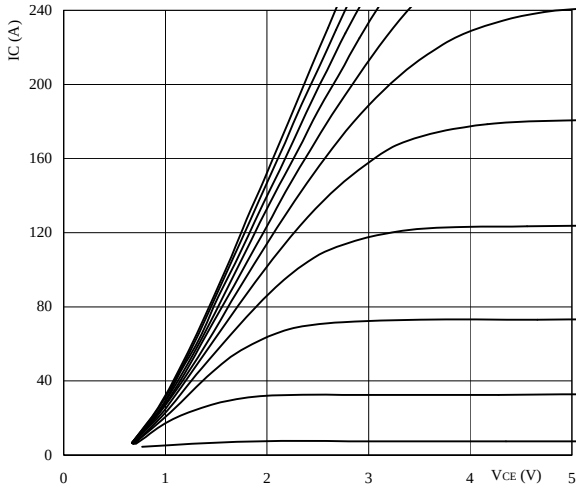
Output inverter

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



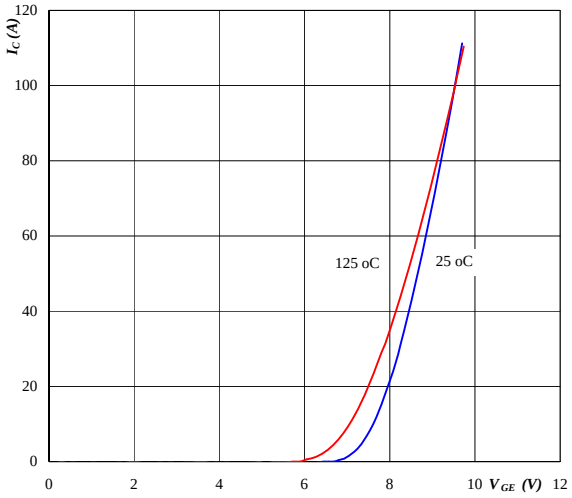
parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



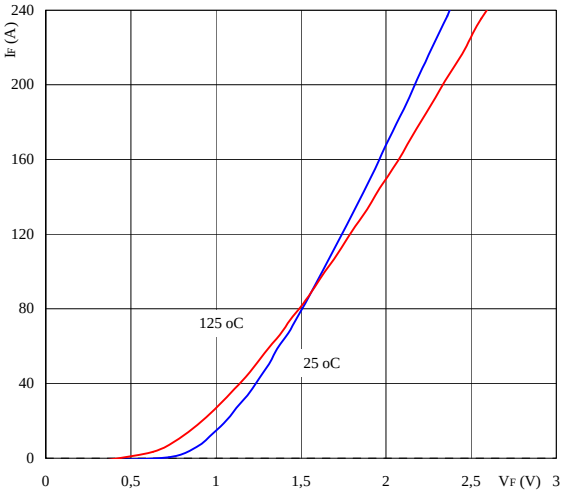
parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



parameter: tp = 250 us VCE = 10 V

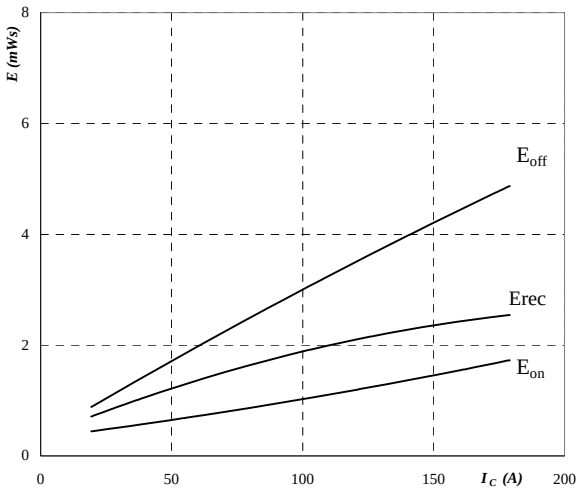
Figure 4. **Typical diode forward current as a function of forward voltage**
Output inverter FRED IF=f(VF)



parameter: tp = 250 us

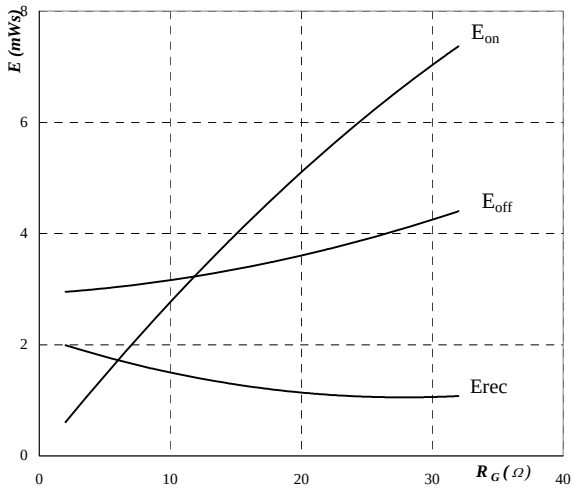
Output inverter

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



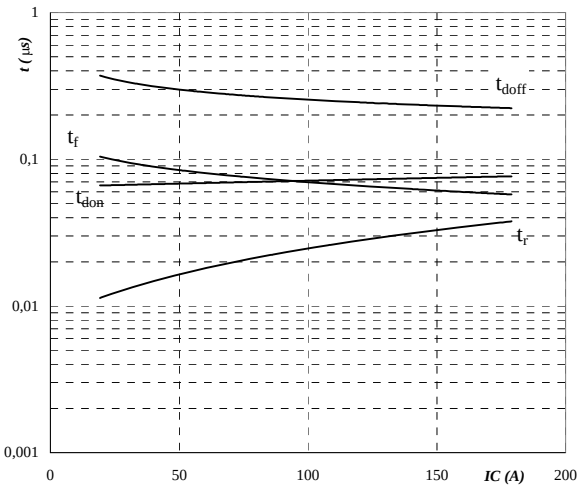
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
Rgon = 4 Ω
Rgoff = 4 Ω

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



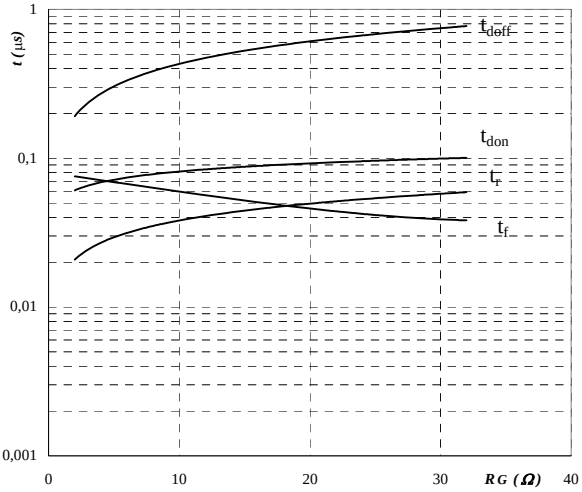
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
Ic = 100 A

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



inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = ±15 V
Rgon = 4 Ω
Rgoff = 4 Ω

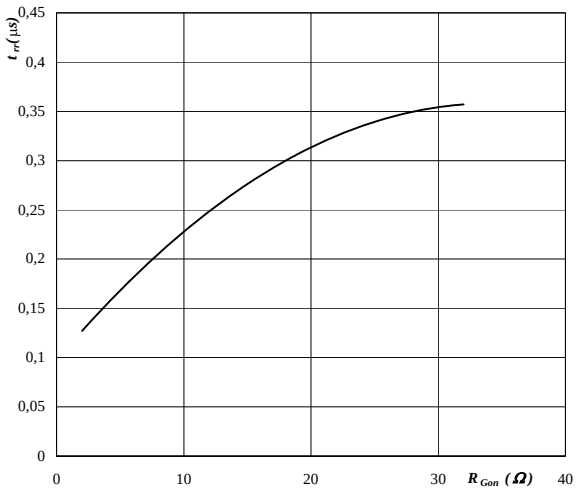
Figure 8. Typical switching times as a function of gate resistor
Output inverter IGBT
t = f (R_G)



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

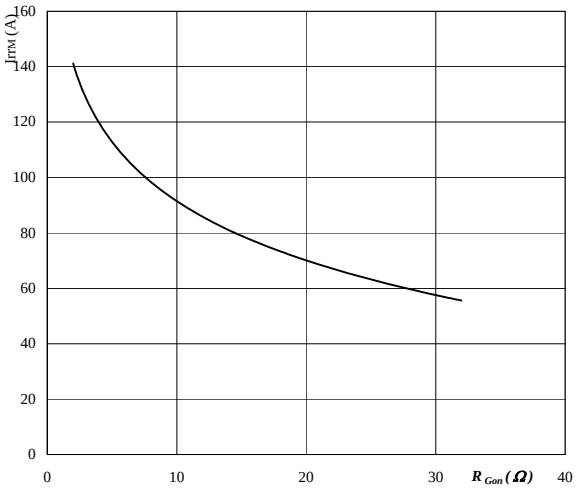
Output inverter

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



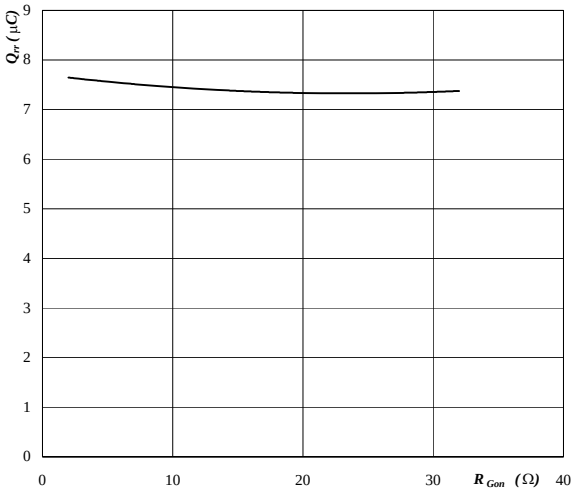
Tj = 125 °C
V_R = 300 V
I_F = 100 A
V_{GE} = ±15 V

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



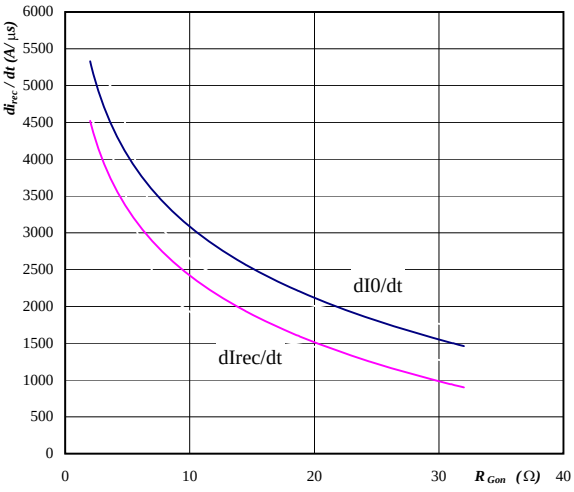
Tj = 125 °C
V_R = 300 V
I_F = 100 A
V_{GE} = ±15 V

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 = 300 V
I_F = 100 A
V_{GE} = ±15 V

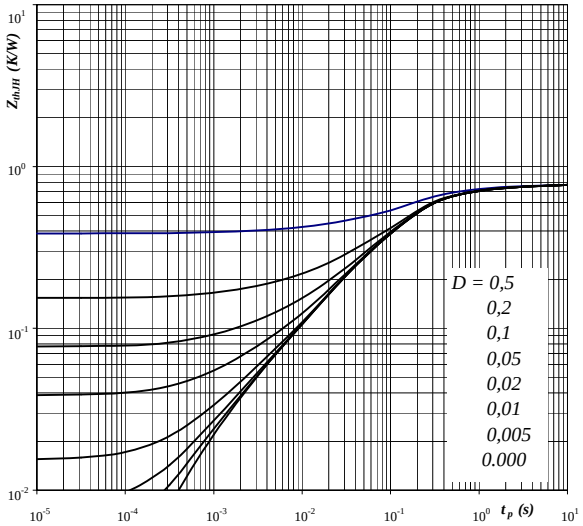
Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
Output inverter FRED diode
dI0/dt,dIrec/dt= f (Rgon)



Tj = 125 °C
V_R = 300 V
I_F = 100 A
V_{GE} = ±15 V

Output inverter

Figure 13. IGBT transient thermal impedance as a function of pulse width
ZthJH = f(tp)

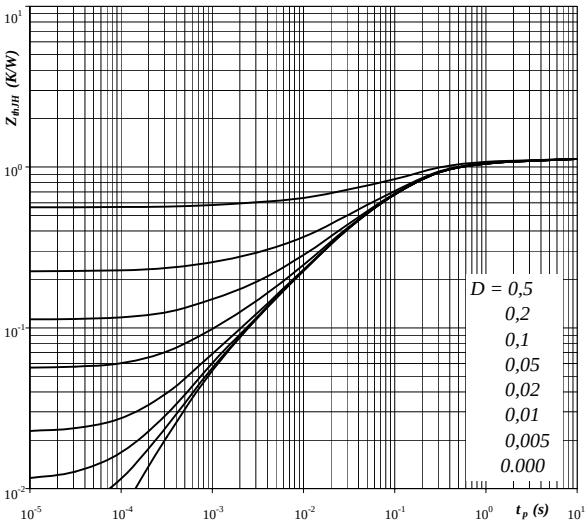


Parameter: D = tp / T RthJH= 0,77 K/W

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 14. FRED transient thermal impedance as a function of pulse width
ZthJH = f(tp)



Parameter: D = tp / T RthJH= 1,12 K/W

FRED thermal model values

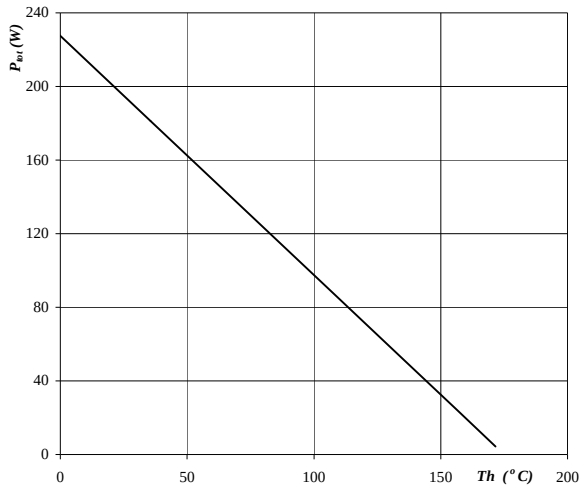
R (C/W)	Tau (s)
0,08	3,2E+00
0,23	3,8E-01
0,56	9,7E-02
0,21	1,3E-02
0,05	1,0E-03

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

Output inverter IGBT

P_{tot} = f (Th)

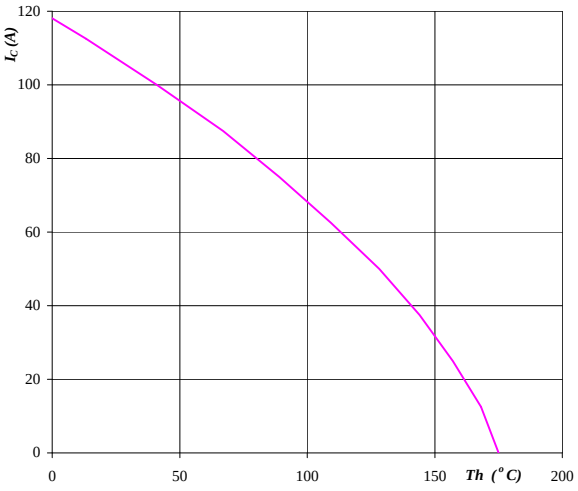


parameter: Tj= 175 ºC

Figure 16. Collector current as a function of heatsink temperature

Output inverter IGBT

I_C = f (Th)



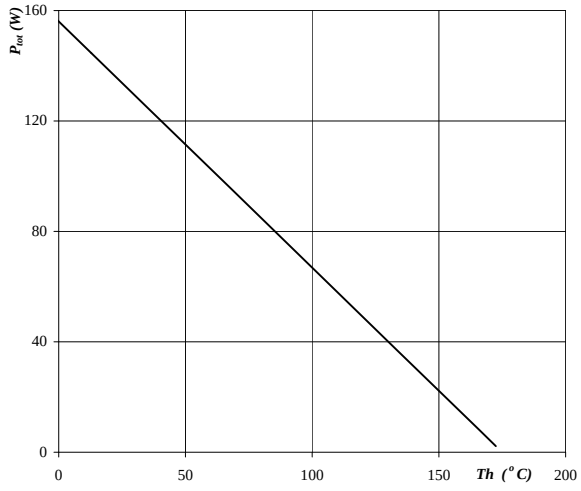
parameter: Tj= 175 ºC

V_{GE}= 15 V

Figure 17. Power dissipation as a function of heatsink temperature

Output inverter FRED

P_{tot} = f (Th)

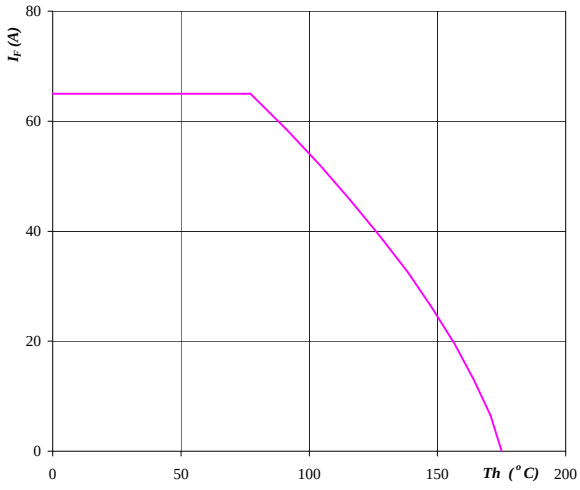


parameter: Tj= 175 ºC

Figure 18. Forward current as a function of heatsink temperature

Output inverter FRED

I_F = f (Th)



parameter: Tj= 175 ºC