

flowPACK 0, 600V, 15A

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Datasheet values	Unit
			max.	

Transistor Inverter

Transistor Wechselrichter

Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	$T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$, $T_c=80^{\circ}\text{C}$	I_C	17 20-limited by wires	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	$t_p=1\text{ms}$ $T_h=80^{\circ}\text{C}$	I_{cpuls}	34	A
Power dissipation per IGBT Verlustleistung pro IGBT	$T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$, $T_c=80^{\circ}\text{C}$	P_{tot}	43 66	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	± 20	V
SC withstand time Kurzschlußverhalten	$T_j \leq 125^{\circ}\text{C}$ $V_{GE}=15\text{V}$ $V_{CE}=400\text{V}/900\text{V}$	t_{SC}	10 @400V	us

Diode Inverter

Diode Wechselrichter

DC forward current Dauergleichstrom	$T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$, $T_c=80^{\circ}\text{C}$	I_F	20 20-limited by wires	A
Repetitive peak forward current Periodischer Spitzenstrom	$t_p=1\text{ms}$ $T_h=80^{\circ}\text{C}$	I_{FRM}	39	A
Power dissipation per Diode Verlustleistung pro Diode	$T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$, $T_c=80^{\circ}\text{C}$	P_{tot}	29 44	W

Thermal properties

Thermische Eigenschaften

max. Chip temperature max. Chiptemperatur		T_{jmax}	150	$^{\circ}\text{C}$
Storage temperature Lagertemperatur		T_{stg}	-40...+125	$^{\circ}\text{C}$
Operation temperature Betriebstemperatur		T_{op}	-40...+125	$^{\circ}\text{C}$

Insulation properties

Modulisolation

Insulation voltage Isolationsspannung	$t=1\text{min}$	V_{is}	4000	Vdc
Creepage distance Kriechstrecke			min 12,7	mm
Clearance Luftstrecke			min 12,7	mm

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Characteristic values

Description	Symbol	Conditions					Datasheet 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 Inverter, inductive load
Transistor Wechselrichter

Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$V_{CE}=V_{GE}$			0,0004	3	4	5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$		15		15		2,1 2,35	2,65	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$		0	600				0,1 2	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$		25	0				200	nA
Integrated Gate resistor Integrierter Gate Widerstand	R_{gint}							-		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$ $R_{goff}=20\Omega$	15	300	15		19		ns
Rise time Anstiegszeit	t_r	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$ $R_{goff}=20\Omega$	15	300	15		16		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$ $R_{goff}=20\Omega$	15	300	15		242		ns
Fall time Fallzeit	t_f	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$ $R_{goff}=20\Omega$	15	300	15		27		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$ $R_{goff}=20\Omega$	15	300	15		0,300		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$ $R_{goff}=20\Omega$	15	300	15		0,349		mWs
Input capacitance Eingangskapazität	C_{ies}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$f=1MHz$	0	25			0,8	0,96	nF
Output capacitance Ausgangskapazität	C_{oss}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$f=1MHz$	0	25			0,084	0,101	nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$f=1MHz$	0	25			0,052	0,062	nF
Gate charge Gate Ladung	Q_{Gate}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$		15	480	15		76	99	nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda = 0,61 W/mK$					1,63		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R_{thJC}							1,0758		K/W
Coupled thermal resistance inverter diode-transistor	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda = 0,61 W/mK$					TBD		K/W
Gekoppelte Wärmewiderstand Wechselrichter Diode-Transistor										

Diode Inverter
Diode Wechselrichter

Diode forward voltage Durchlaßspannung	V_F	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$				15		1,69 1,39	2,2	V
Peak reverse recovery current Rückstromspitze	I_{RRM}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$	15	300	15		27,3		A
Reverse recovery time Sperrverzögerungszeit	t_{rr}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$	15	300	15		56		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$	15	300	15		0,86		uC
Reverse recovered energy Sperrverzögerungsenergie	E_{rec}	$T_J=25^{\circ}C$ $T_J=125^{\circ}C$	$R_{gon}=40\Omega$	15	300	15		0,127		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda = 0,61 W/mK$					2,43		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R_{thJC}							1,6038		K/W
Coupled thermal resistance inverter transistor-diode	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda = 0,61 W/mK$					TBD		K/W
Gekoppelte Wärmewiderstand Wechselrichter Transistor-Diode										

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Characteristic values

Description	Symbol	Conditions					Datasheet 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	

NTC-Thermistor
NTC-Widerstand

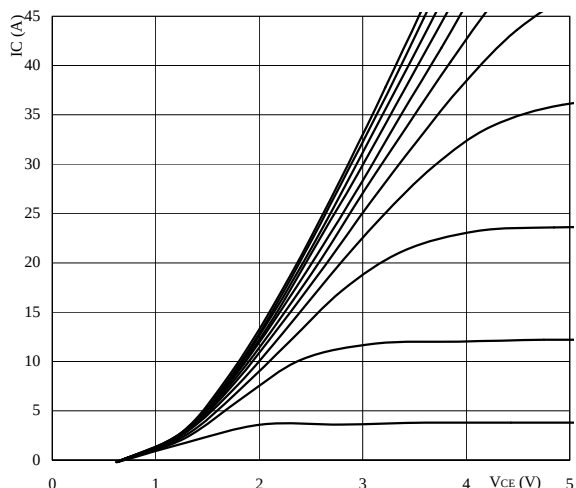
Rated resistance Nennwiderstand	R ₂₅	Tj=25°C	Tol. ±5%				20,9	22	23,1	kOhm
Deviation of R100 Abweichung von R100	D _{R/R}	Tc=100°C	R100=1503Ohm					2,9		%/K
Power dissipation given Epcos-Typ Verlustleistung Epcos-Typ angeben	P	Tj=25°C						210		mW
B-value B-Wert	B _(25/100)	Tj=25°C	Tol. ±3%					3980		K

Output inverter

Figure 1. Typical output characteristics

Output inverter IGBT

$I_C = f(V_{CE})$

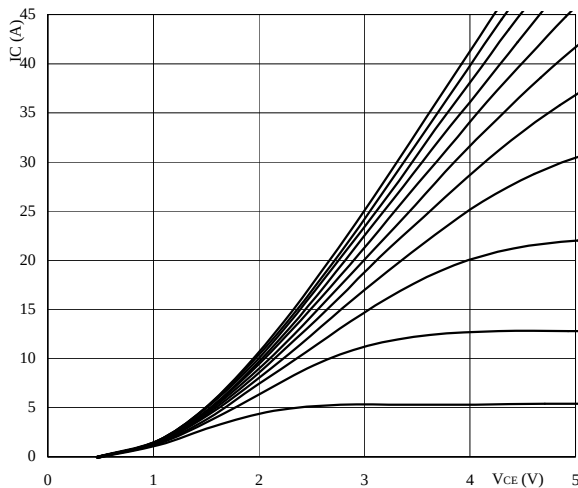


parameter: $t_p = 250 \mu s$ $T_j = 25 \text{ }^\circ\text{C}$
 V_{GE} parameter: from: 6 V to 16 V
in 1 V steps

Figure 2. Typical output characteristics

Output inverter IGBT

$I_C = f(V_{CE})$

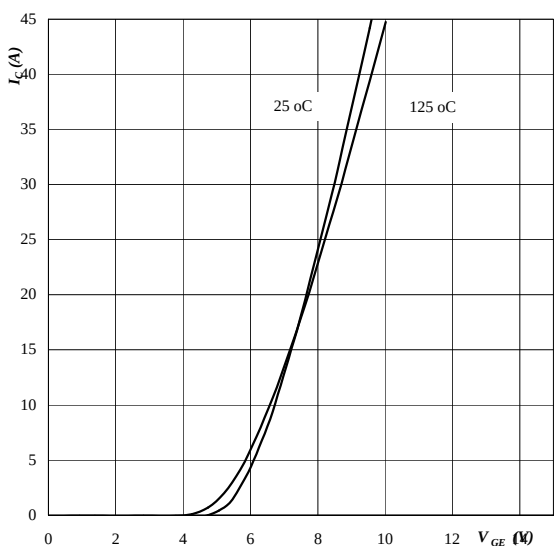


parameter: $t_p = 250 \mu s$ $T_j = 125 \text{ }^\circ\text{C}$
 V_{GE} parameter: from: 6 V to 16 V
in 1 V steps

Figure 3. Typical transfer characteristics

Output inverter IGBT

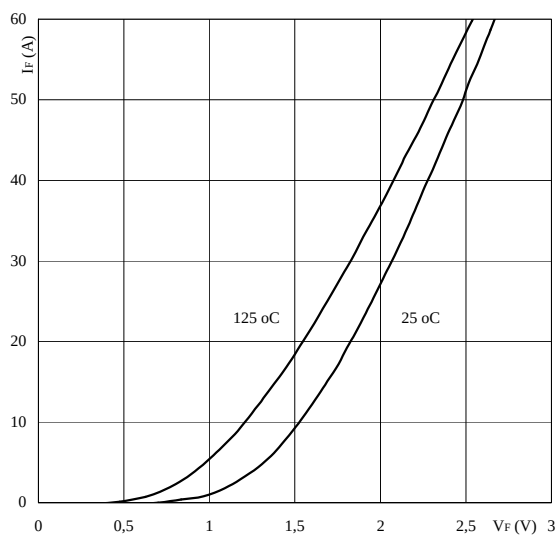
$I_C = f(V_{GE})$



parameter: $t_p = 250 \mu s$ $V_{CE} = 17 \text{ V}$

Figure 4. Typical diode forward current as a function of forward voltage

Output inverter FRED $I_F = f(V_F)$



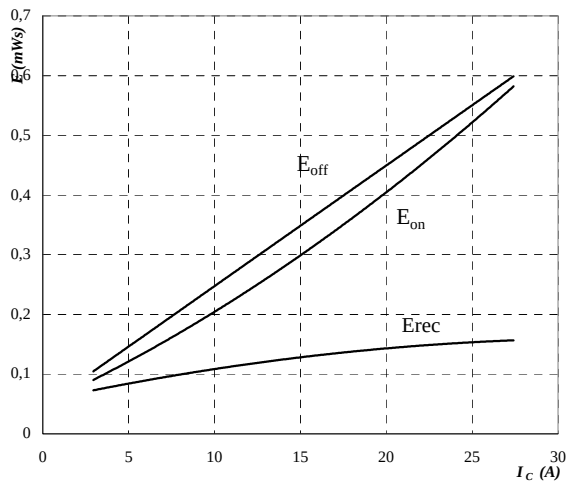
parameter: $t_p = 250 \mu s$

Output inverter

Figure 5. Typical switching energy losses as a function of collector current

Output inverter IGBT

$$E = f(I_C)$$



inductive load, $T_j = 125^\circ\text{C}$

$V_{CE} = 300\text{ V}$

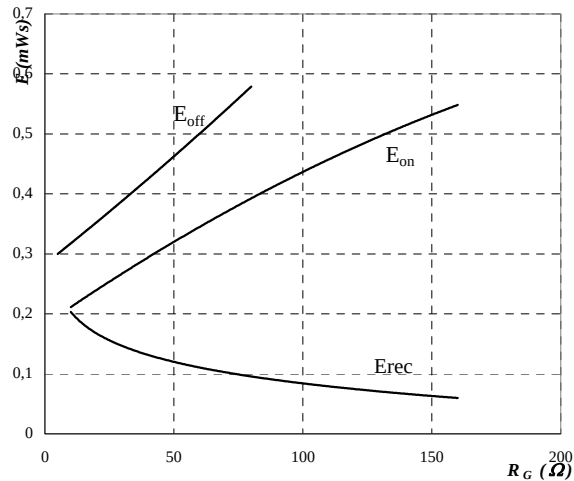
$V_{GE} = 15\text{ V}$

$R_{Gon} = 2 \cdot R_{Goff} = 40\ \Omega$

Figure 6. Typical switching energy losses as a function of gate resistor

Output inverter IGBT

$$E = f(R_G)$$



inductive load, $T_j = 125^\circ\text{C}$

$V_{CE} = 300\text{ V}$

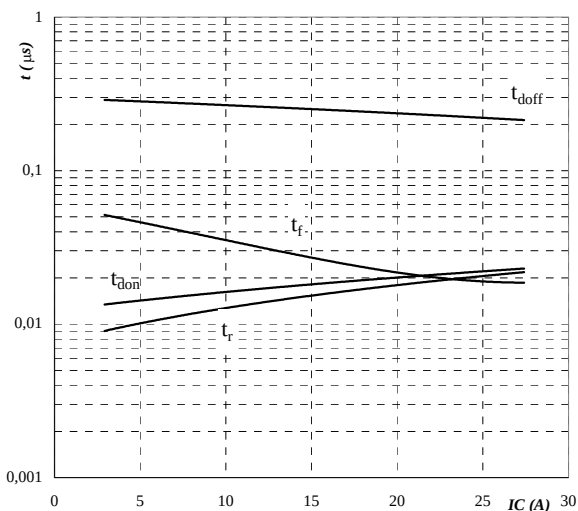
$V_{GE} = 15\text{ V}$

$I_C = 15\text{ A}$

Figure 7. Typical switching times as a function of collector current

Output inverter IGBT

$$t = f(I_C)$$



inductive load, $T_j = 125^\circ\text{C}$

$V_{CE} = 300\text{ V}$

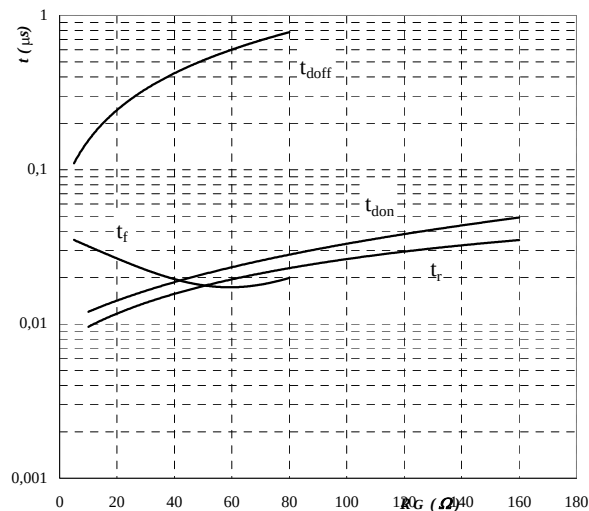
$V_{GE} = 15\text{ V}$

$R_{Gon} = 2 \cdot R_{Goff} = 40\ \Omega$

Figure 8. Typical switching times as a function of gate resistor

Output inverter IGBT

$$t = f(R_G)$$



inductive load, $T_j = 125^\circ\text{C}$

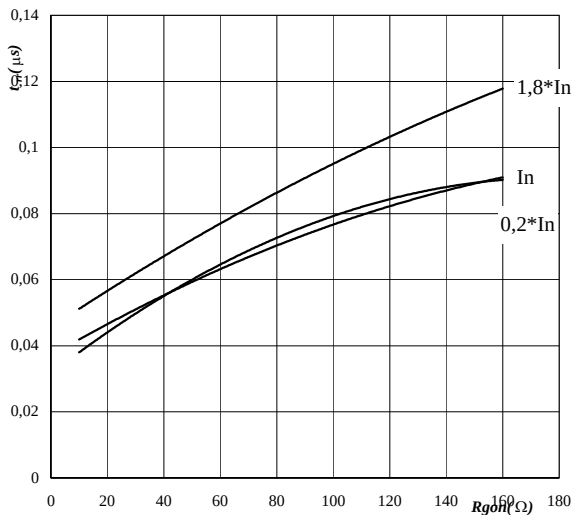
$V_{CE} = 300\text{ V}$

$V_{GE} = 15\text{ V}$

$I_C = 15\text{ A}$

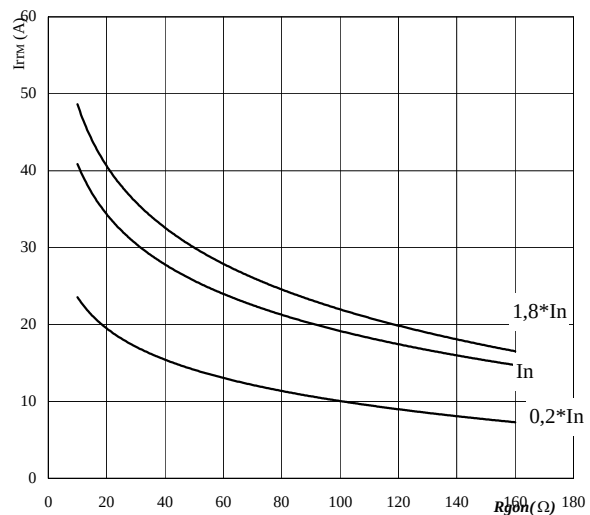
Output inverter

Figure 9. Typical reverse recovery time as a function of gate resistor
Output inverter FRED diode
 $t_{rr} = f(R_{gon})$



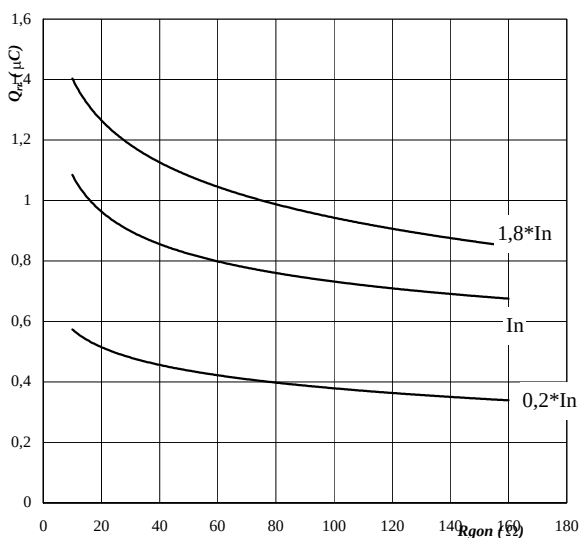
$T_j = 125\text{ }^{\circ}\text{C}$
 $V_R = 300\text{ V}$
 $I_n = 15\text{ A}$

Figure 10. Typical reverse recovery current as a function of gate resistor
Output inverter FRED diode
 $I_{RRM} = f(R_{gon})$



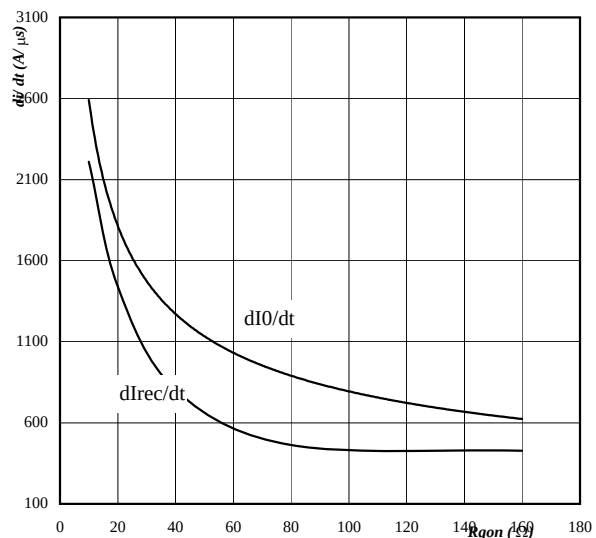
$T_j = 125\text{ }^{\circ}\text{C}$
 $V_R = 300\text{ V}$
 $I_n = 15\text{ A}$

Figure 11. Typical reverse recovery charge as a function of gate resistor
Output inverter FRED diode
 $Q_{rr} = f(R_{gon})$



$T_j = 125\text{ }^{\circ}\text{C}$
 $V_R = 300\text{ V}$
 $I_n = 15\text{ A}$

Figure 12. Typical diode peak rate of fall of forward and reverse recovery current as a function of gate resistor
Output inverter FRED diode
 $di_0/dt, dI_{rec}/dt = f(R_{gon})$

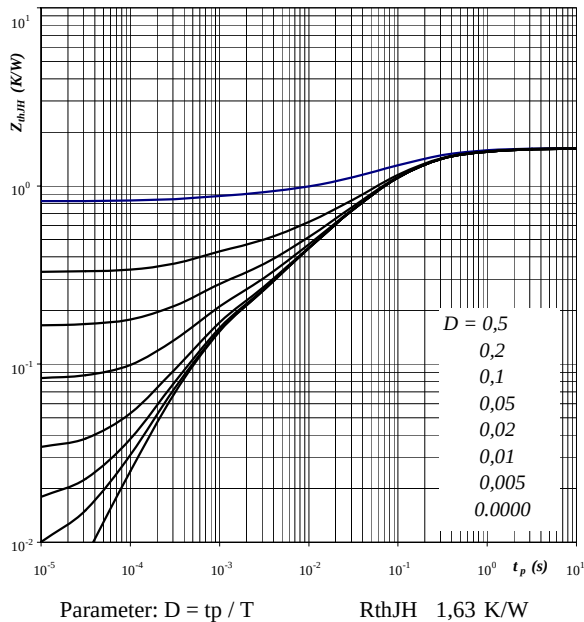


$T_j = 125\text{ }^{\circ}\text{C}$
 $V_R = 300\text{ V}$
 $I_F = 15\text{ A}$

Output inverter

**Figure 13. IGBT transient thermal impedance
as a function of pulse width**

$$Z_{thJH} = f(t_p)$$

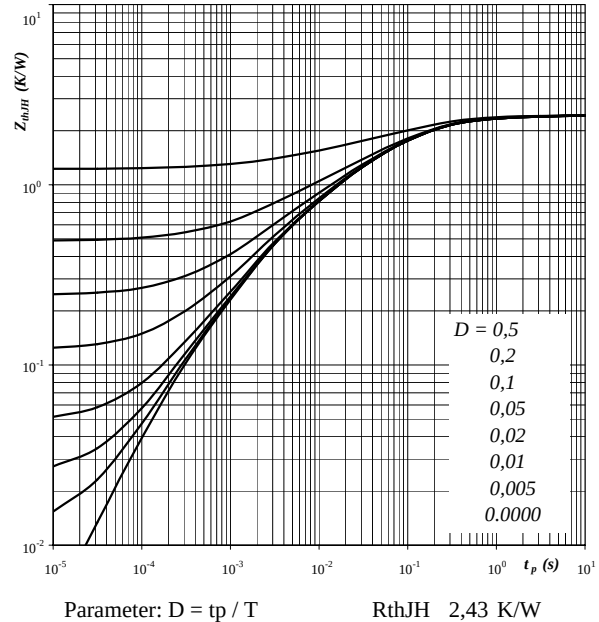


IGBT thermal model values

R (C/W)	Tau (s)
0,03	4,6E+01
0,14	1,2E+00
0,62	1,6E-01
0,50	4,1E-02

**Figure 14. FRED transient thermal impedance
as a function of pulse width**

$$Z_{thJH} = f(t_p)$$



FRED thermal model values

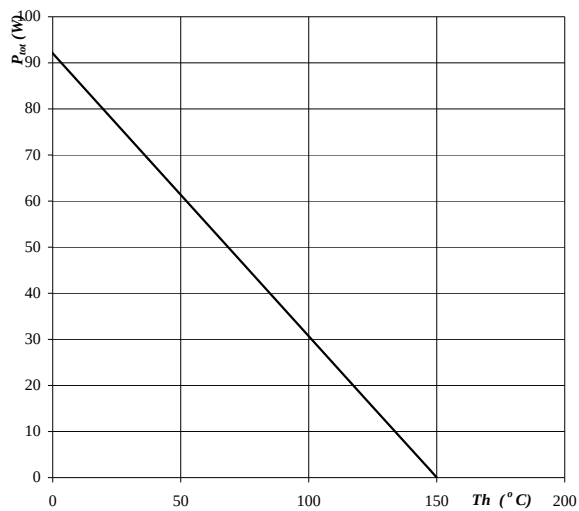
R (C/W)	Tau (s)
0,03	4,2E+01
0,15	1,8E+00
0,67	2,0E-01
0,73	5,4E-02
0,51	1,1E-02

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

Output inverter IGBT

$$P_{tot} = f(T_h)$$

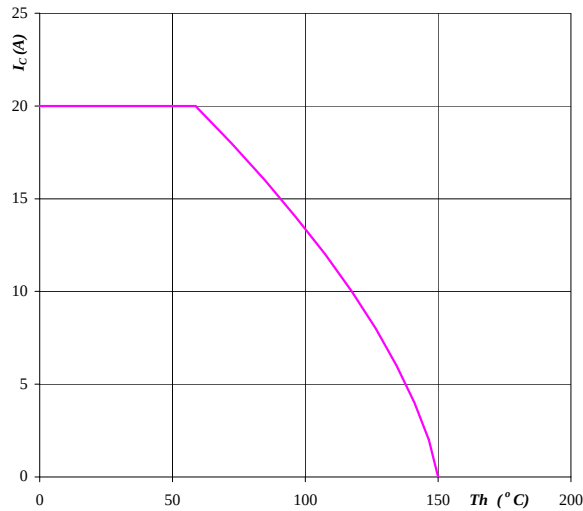


parameter: $T_j = 150^\circ\text{C}$

Figure 16. Collector current as a function of heatsink temperature

Output inverter IGBT

$$I_c = f(T_h)$$



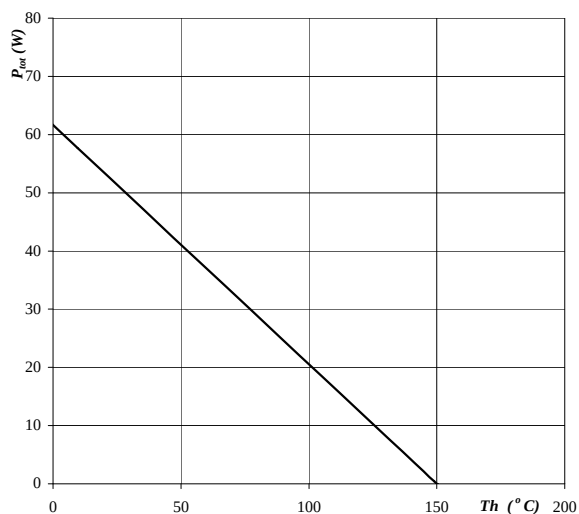
parameter: $T_j = 150^\circ\text{C}$

$V_{GE} = 15\text{ V}$

Figure 17. Power dissipation as a function of heatsink temperature

Output inverter FRED

$$P_{tot} = f(T_h)$$

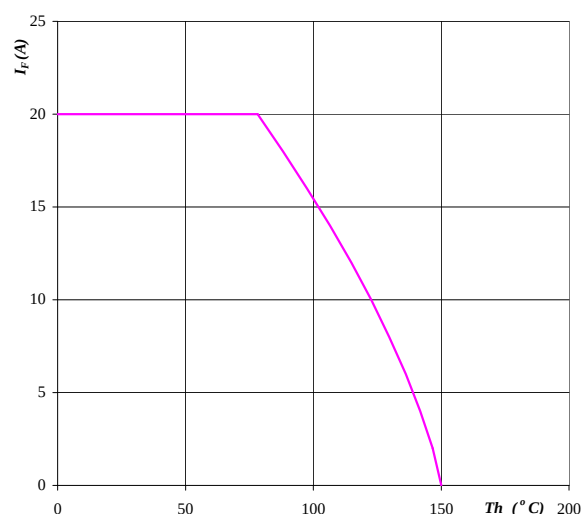


parameter: $T_j = 150^\circ\text{C}$

Figure 18. Forward current as a function of heatsink temperature

Output inverter FRED

$$I_F = f(T_h)$$



parameter: $T_j = 150^\circ\text{C}$

Thermistor

**Figure 23. Typical NTC characteristic
as a function of temperature**

NTC

$$R_T = f(T)$$

