

flowPIM®1, 1200V
Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Datasheet values max.	Unit
-----------	-----------	--------	--------------------------	------

**Input Rectifier Bridge
Gleichrichter**

Repetitive peak reverse voltage Periodische Rückw. Spitzensperrspannung		V_{RRM}	1600	V
Forward current per diode Dauergrenzstrom	DC current $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	I_{FAV}	34,7 40, limited by nr. of wires	A
Surge forward current Stoßstrom Grenzwert	$t_p=10\text{ms}$ $T_j=25^\circ\text{C}$	I_{FSM}	250	A
I^2t -value Grenzlastintegral	$t_p=10\text{ms}$ $T_j=25^\circ\text{C}$	I^2t	310	A ² s
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}	40 60	W

**Transistor Inverter
Transistor Wechselrichter**

Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	1200	V
DC collector current Kollektor-Dauergleichstrom	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	I_C	15,9 16, limited by nr. of wires	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	$t_p=1\text{ms}$ $T_h=80^\circ\text{C}$	I_{cpuls}	32	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}	44,8 68	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	± 20	V
SC withstand time Kurzschlußverhalten	$T_j \leq 150^\circ\text{C}$ $V_{GE}=15\text{V}$ $V_{CE}=1200\text{V}$	t_{SC}	10	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	16, limited by nr. of wires 16, limited by nr. of wires	A
Repetitive peak forward current Periodischer Spitzenstrom	$t_p=1\text{ms}$ $T_h=80^\circ\text{C}$	I_{FRM}	38	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}	32,6 49,4	W

**Transistor BRC
Transistor BRC**

Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	1200	V
DC collector current Kollektor-Dauergleichstrom	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	I_C	11,2 14,7	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	$t_p=1\text{ms}$ $T_h=80^\circ\text{C}$	I_{cpuls}	22,4	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}	33 50,5	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	± 20	V
SC withstand time Kurzschlußverhalten	$T_j \leq 150^\circ\text{C}$ $V_{GE}=15\text{V}$ $V_{CE}=600/1200\text{V}$	t_{SC}	10	us

flowPIM®1, 1200V
Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Datasheet values max.	Unit
Diode BRC				
DC forward current Dauergleichstrom	$T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	I_F	11,8 16	A
Repetitive peak forward current Periodischer Spitzenstrom	$t_p=1\text{ms}$ $T_h=80^{\circ}\text{C}$	I_{FRM}	24	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}	21 32	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
Modulisation

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

flowPIM®1, 1200V
Characteristic values/ Charakteristische Werte

Description	Symbol	Conditions					Datasheet 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 Durchlaßspannung	V _F	T _J =25°C				30	0,8	1,16	1,3	V
Threshold voltage (for power loss calc. only) Schleusenspannung	V _{to}	T _J =25°C				30		0,91		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	r _t	T _J =25°C				30		9		mOhm
Reverse current Sperrstrom	I _r	T _J =25°C			1500				0,02	mA
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-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,2		K/W

Transistor Inverter, inductive load
Transistor Wechselrichter

Gate emitter threshold voltage Gate-Schwellenspannung	V _{GE(th)}	T _J =25°C T _J =125°C	V _{CE} =V _{GE}			0,0006	4,5	5,5	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	V _{CE(sat)}	T _J =25°C T _J =125°C		15		15	1,5	2,27 2,55	2,75	V
Collector-emitter cut-off incl.FRED Kollektor-Emitter Reststrom inkl.FRED	I _{CES}	T _J =25°C T _J =125°C		0	1200				0,25	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I _{GES}	T _J =25°C T _J =150°C		25	0				120	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	Rgon=46,7 Ohm	15	600	15		34		ns
Rise time Anstiegszeit	t _r	T _J =25°C T _J =125°C	Rgon=46,7 Ohm	15	600	15		30		ns
Turn-off delay time Abschaltverzögerungszeit	t _{d(off)}	T _J =25°C T _J =125°C	Rgoff=23,35 Ohm	15	600	15		351		ns
Fall time Fallzeit	t _f	T _J =25°C T _J =125°C	Rgoff=23,35 Ohm	15	600	15		105		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E _{on}	T _J =25°C T _J =125°C	Rgon=46,7 Ohm	15	600	15		2,136		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E _{off}	T _J =25°C T _J =125°C	Rgoff=23,35 Ohm	15	600	15		1,513		mWs
Input capacitance Eingangskapazität	C _{ies}	T _J =25°C T _J =125°C	f=1MHz	0	25			1,1		nF
Output capacitance Ausgangskapazität	C _{oss}	T _J =25°C T _J =125°C	f=1MHz	0	25					nF
Reverse transfer capacitance Rückwirkungskapazität	C _{rss}	T _J =25°C T _J =125°C	f=1MHz	0	25			0,07		nF
Gate charge Gate Ladung	Q _{Gate}	T _J =25°C T _J =125°C		15	600	14		85		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50um					1,6		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,1		K/W

flowPIM®1, 1200V
Characteristic values/ Charakteristische Werte

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	
Diode Inverter										
Diode Wechselrichter										
Diode forward voltage Durchlaßspannung	VF	Tj=25°C Tj=125°C				15	1	1,9 1,45	2,8	V
Peak reverse recovery current Rückstromspitze	IRM	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		24		A
Reverse recovery time Sperrverzögerungszeit	trr	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		260		ns
Reverse recovered charge Sperrverzögerungsladung	Qrr	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		2,54		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		0,599		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	RthJH		Thermal grease thikness≤50um					2,1		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	RthJC		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,4		K/W
Transistor BRC										
Transistor BRC										
Gate emitter threshold voltage Gate-Schwellenspannung	VGE(th)	Tj=25°C Tj=125°C	VCE=VGE			0,0004	4,5	5,5	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	VCE(sat)	Tj=25°C Tj=125°C		15		10	1,9	2,3 2,7	2,95	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	ICES	Tj=25°C Tj=125°C		0	600				0,05	mA
Gate-emitter leakage current Gate-Emitter Reststrom	IGES	Tj=25°C Tj=150°C		25	0				120	nA
Integrated Gate resistor Integrirter Gate Widerstand	Rgint									Ohm
Turn-on delay time Einschaltverzögerungszeit	td(on)	Tj=25°C Tj=125°C	Rgon=48 Ohm	15	600	10		25		ns
Rise time Anstiegszeit	tr	Tj=25°C Tj=125°C	Rgon=48 Ohm	15	600	10		25		ns
Turn-off delay time Abschaltverzögerungszeit	td(off)	Tj=25°C Tj=125°C	Rgoff=24 Ohm	15	600	10		240		ns
Fall time Fallzeit	tf	Tj=25°C Tj=125°C	Rgoff=24 Ohm	15	600	10		84		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	Eon	Tj=25°C Tj=125°C	Rgon=48 Ohm	15	600	10		1,166		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	Eoff	Tj=25°C Tj=125°C	Rgoff=24 Ohm	15	600	10		0,744		mWs
Input capacitance Eingangskapazität	Ciss	Tj=25°C Tj=125°C	f=1MHz	0	25			0,7		nF
Output capacitance Ausgangskapazität	Coss	Tj=25°C Tj=125°C	f=1MHz	0	25					nF
Reverse transfer capacitance Rückwirkungskapazität	Crss	Tj=25°C Tj=125°C	f=1MHz	0	25			0,04		nF
Gate charge Gate Ladung	QGate	Tj=25°C Tj=125°C		15	600	8		53		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	RthJH		Thermal grease thikness≤50um					2,1		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	RthJC		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,4		K/W

flowPIM®1, 1200V
Characteristic values/ Charakteristische Werte

Description	Symbol	Conditions					Datasheet 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	

Diode BRC
Diode BRC

Diode forward voltage Durchlaßspannung	V _F	T _J =25°C T _J =125°C				10	1	2,2 1,8	3	V
Reverse current Sperrstrom	I _r	T _J =25°C			1200				0,06	µA
Peak reverse recovery current Rückstromspitze	I _{RM}	T _J =25°C T _J =125°C	Rgon=48 Ohm	15	600	15		23		A
Reverse recovery time Sperreverzögerungszeit	t _{rr}	T _J =25°C T _J =125°C	Rgon=48 Ohm	15	600	15		260		ns
Reverse recovered charge Sperrverzögerungsladung	Q _{rr}	T _J =25°C T _J =125°C	Rgon=48 Ohm	15	600	15		2,54		µC
Reverse recovered energy Sperrverzögerungsenergie	E _{rec}	T _J =25°C T _J =125°C	Rgon=48 Ohm	15	600	15		0,599		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{thJH}		Thermal grease thickness≤50µm					3,3		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{thJC}		Wärmeleitpaste Dicke≤50µm λ = 0,61 W/mK					2,2		K/W

NTC-Thermistor
NTC-Widerstand

Rated resistance Nennwiderstand	R ₂₅	TC=25°C	Tol. ±5%				4,2	4,7	5,3	kOhm
Deviation of R100 Abweichung von R100	D _{R/R}	TC=100°C						2,56		%/K
Power dissipation given Epcos-Typ Verlustleistung Epcos-Typ angeben	P	TC=25°C						210		mW
B-value B-Wert	B _(25/100)		Tol. ±3%					3530		K

flowPIM[®]1, 1200V

Output inverter

Figure 1. Typical output characteristics
Output inverter IGBT
 $I_C = f(V_{CE})$

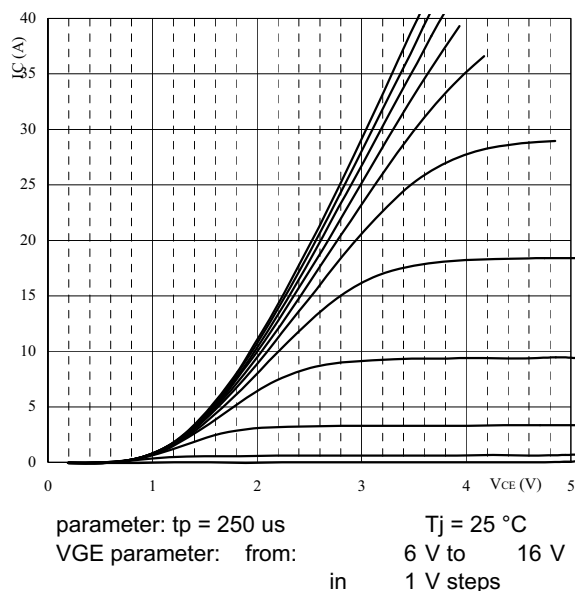


Figure 2. Typical output characteristics
Output inverter IGBT
 $I_C = f(V_{CE})$

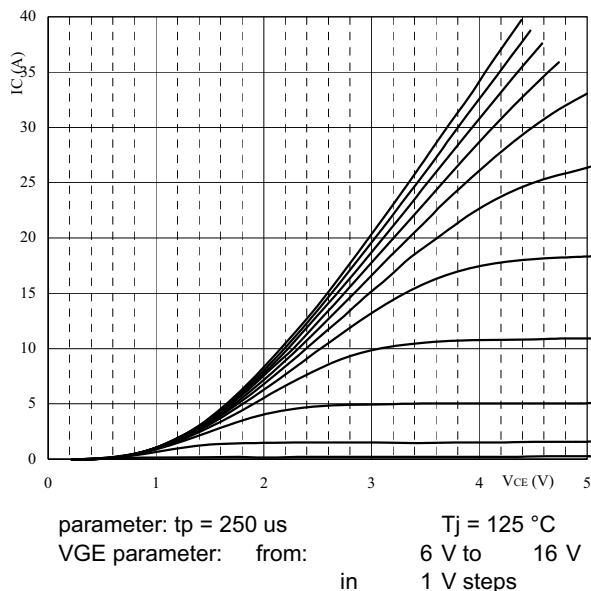


Figure 3. Typical transfer characteristics
Output inverter IGBT
 $I_C = f(V_{GE})$

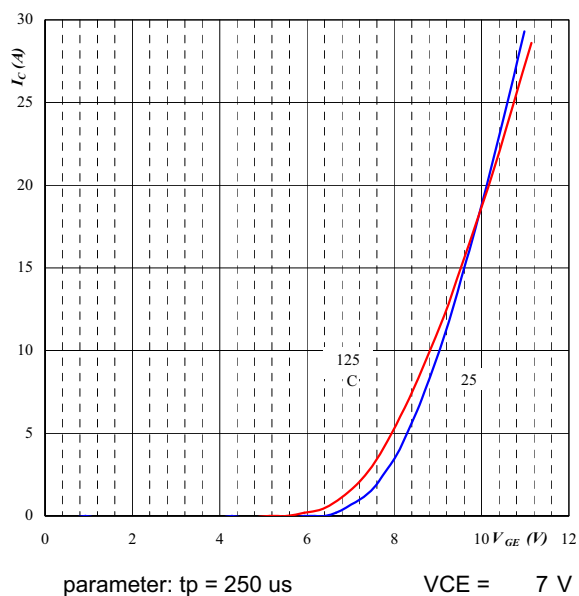
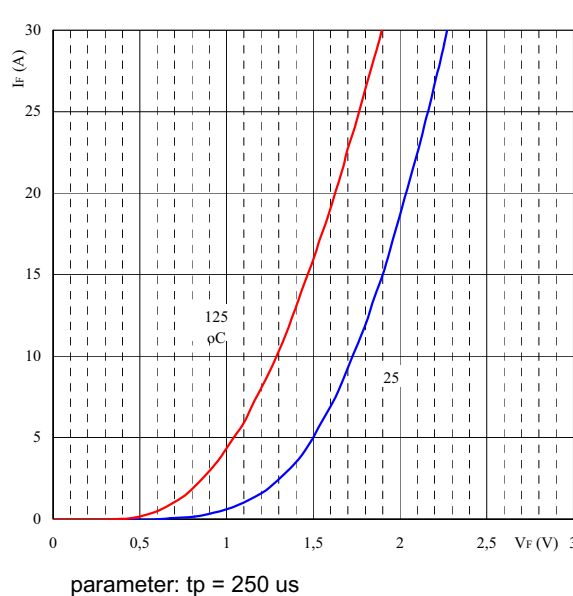


Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED $I_F = f(V_F)$



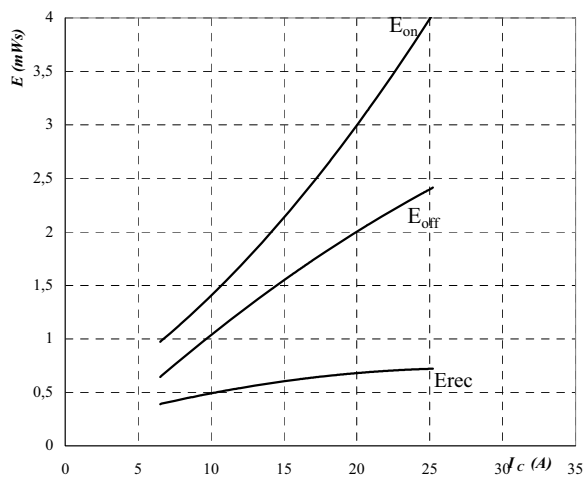
flowPIM[®]1, 1200V

Output inverter

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

Output inverter IGBT

$$E = f(I_c)$$



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

VCE = 600 V

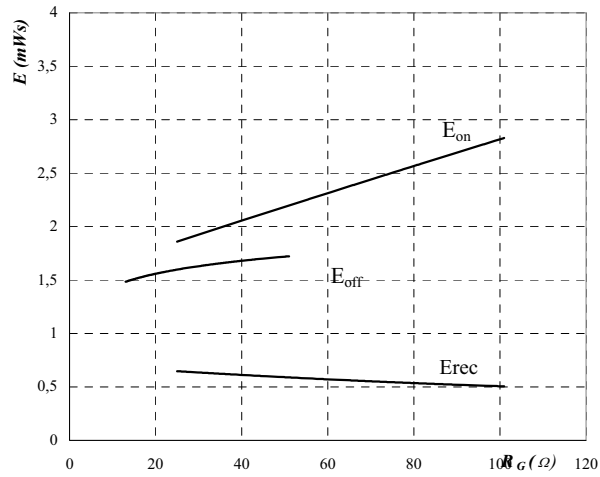
VGE = 15 V

RGon = 2*RGoff = 46,7 Ω

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

Output inverter IGBT

$$E = f(R_G)$$



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

VCE = 600 V

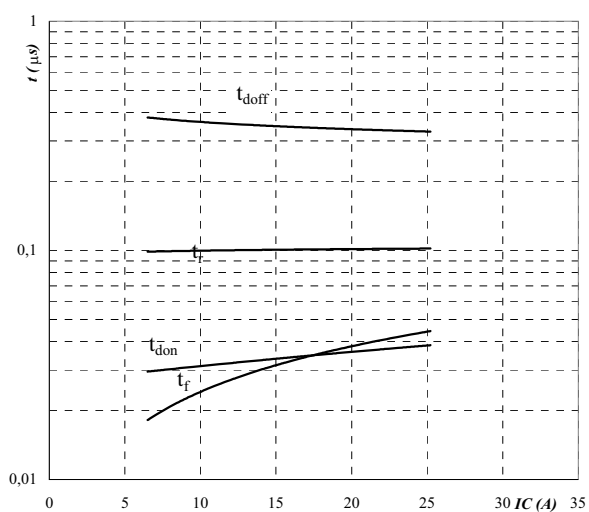
VGE = 15 V

Ic = 15 A

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

Output inverter IGBT

$$t = f(I_c)$$



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

VCE = 600 V

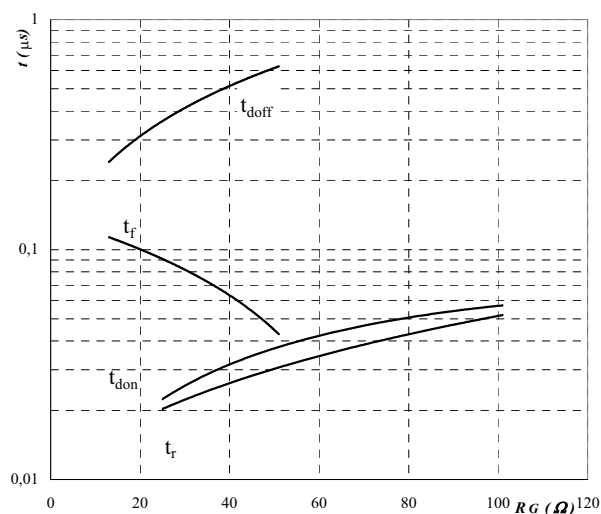
VGE = 15 V

RGon = 2*RGoff = 46,7 Ω

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

Output inverter IGBT

$$t = f(R_G)$$



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

VCE = 600 V

VGE = 15 V

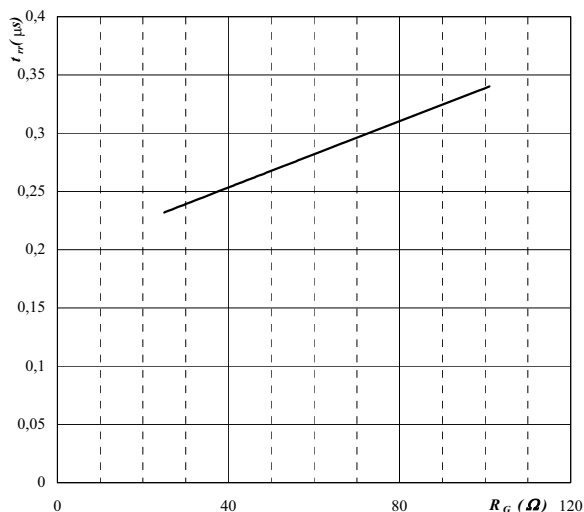
Ic = 15 A

flowPIM®1, 1200V

Output inverter

Figure 9. Typical reverse recovery time as a function of IGBT turn on gate resistor

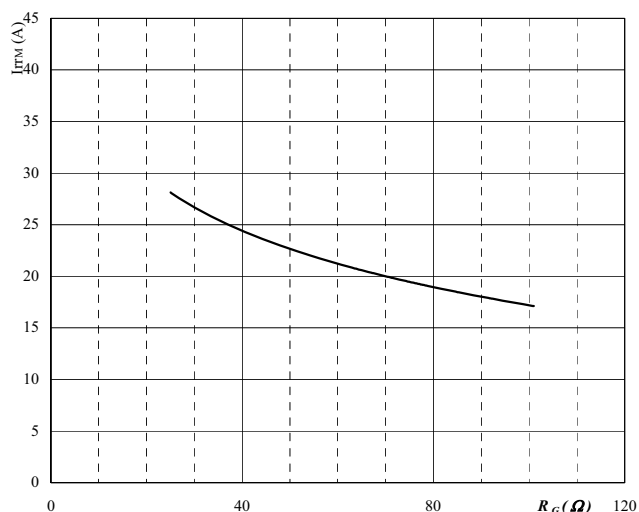
Output inverter FRED diode
 $t_{rr} = f(R_{gon})$



$T_j = 125^\circ C$
 $V_R = 600 V$
 $I_F = 15 A$

Figure 10. Typical reverse recovery current as a function of IGBT turn on gate resistor

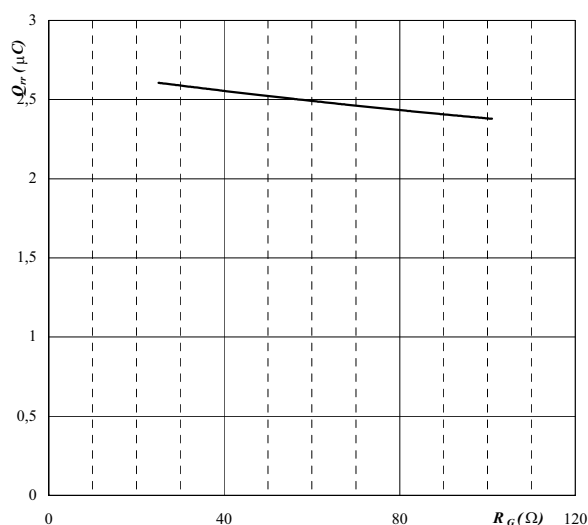
Output inverter FRED diode
 $I_{RRM} = f(R_{gon})$



$T_j = 125^\circ C$
 $V_R = 600 V$
 $I_F = 15 A$

Figure 11. Typical reverse recovery charge as a function of IGBT turn on gate resistor

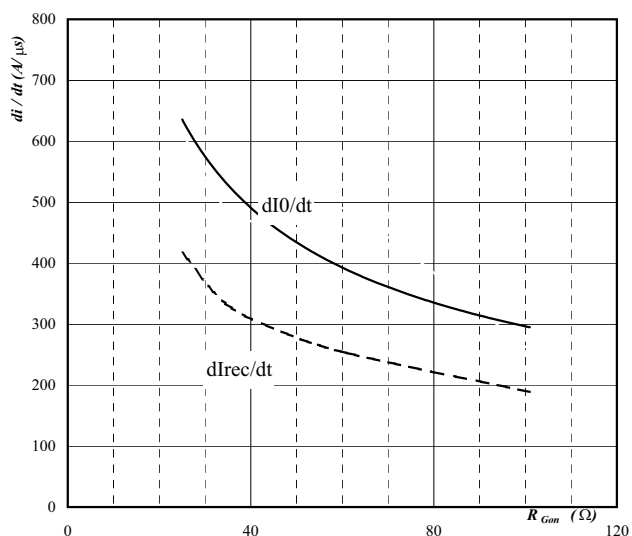
Output inverter FRED diode
 $Q_{rr} = f(R_{gon})$



$T_j = 125^\circ C$
 $V_R = 600 V$
 $I_F = 15 A$

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
 $dI_O/dt, dI_{rec}/dt = f(R_{gon})$

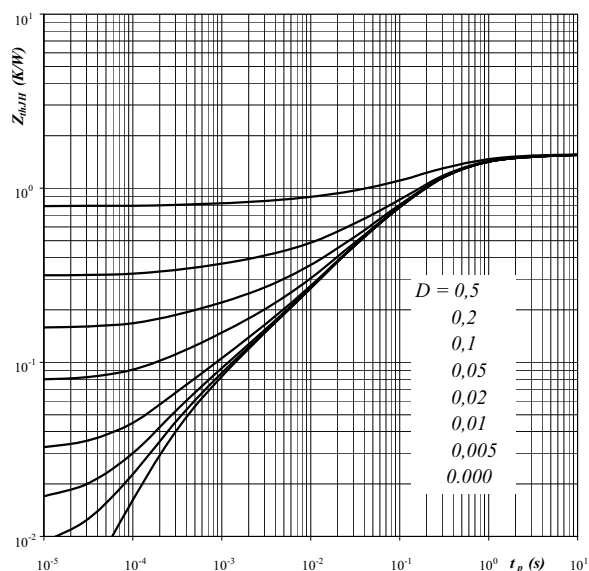


$T_j = 125^\circ C$
 $V_R = 600 V$
 $I_F = 15 A$

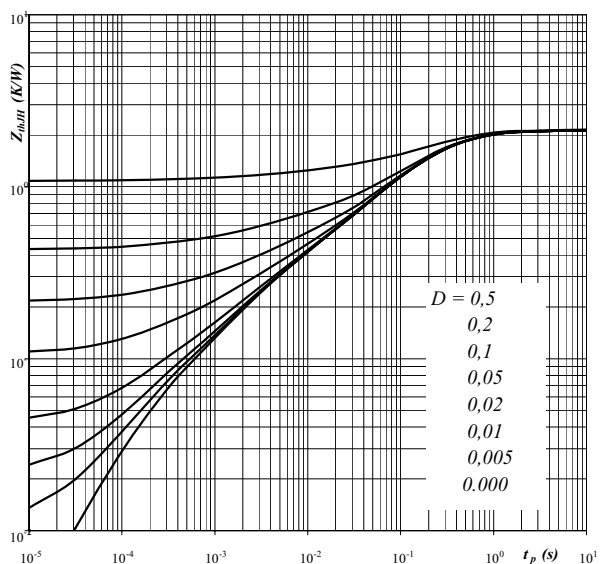
flowPIM®1, 1200V

Output inverter

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


Parameter: $D = t_p / T$ RthJH 1,6 K/W

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


Parameter: $D = t_p / T$ RthJH= 2,1 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,03	6,9E+01
0,10	3,0E+00
0,45	5,0E-01
0,64	1,3E-01
0,24	2,1E-02
0,08	2,7E-03
0,04	3,2E-04

FRED thermal model values

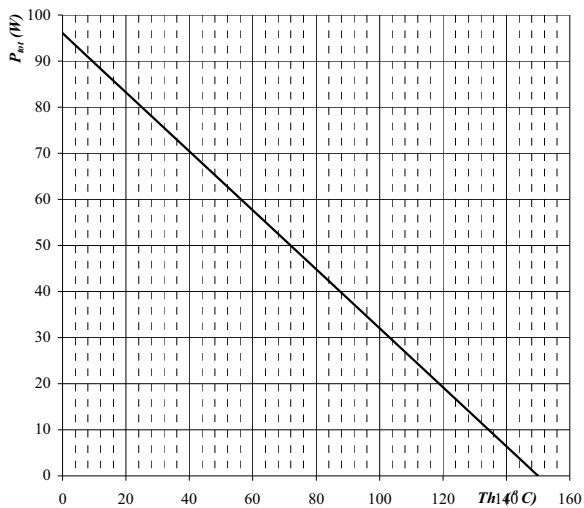
R (C/W)	Tau (s)
0,04	3,4E+01
0,18	1,5E+00
1,02	2,5E-01
0,56	6,8E-02
0,22	7,9E-03
0,10	1,3E-03
0,04	1,7E-04

flowPIM[®]1, 1200V

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

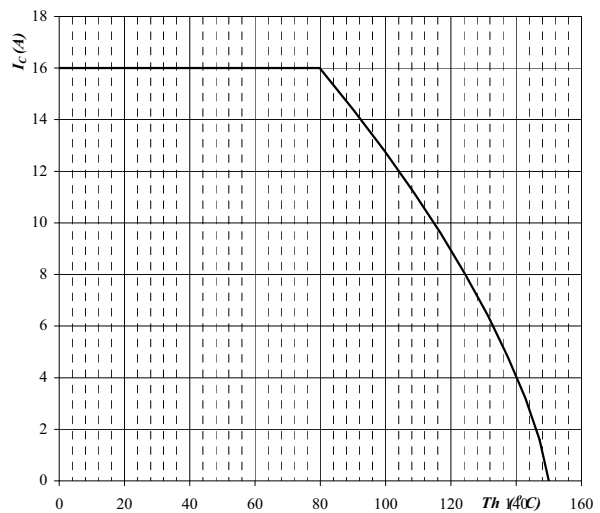
Output inverter IGBT
 $P_{tot} = f(T_h)$



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

Figure 16. Collector current as a function of heatsink temperature

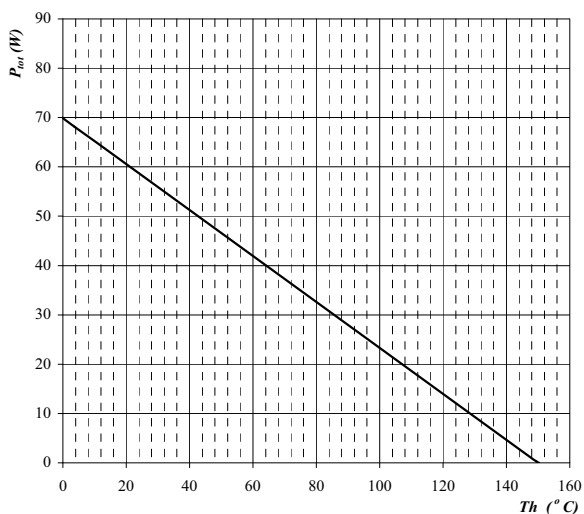
Output inverter IGBT
 $I_c = f(T_h)$



parameter: $T_j = 150^\circ\text{C}$
 $V_{GE} = 15\text{ V}$

Figure 17. Power dissipation as a function of heatsink temperature

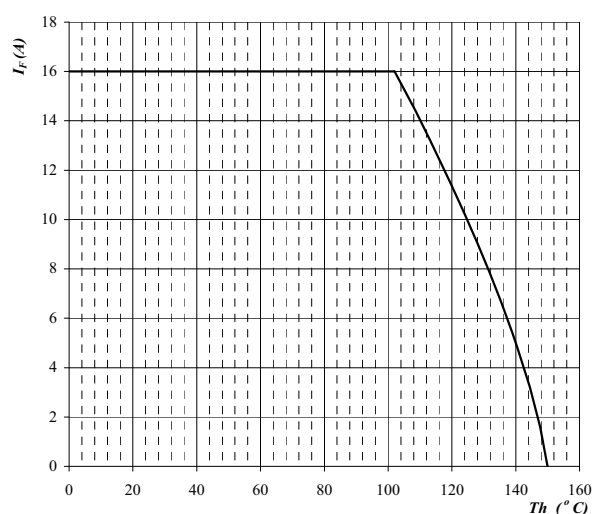
Output inverter FRED
 $P_{tot} = f(T_h)$



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

flowPIM®1, 1200V

Brake

Figure 19. Typical output characteristics
Brake IGBT
 $I_c = f(V_{CE})$

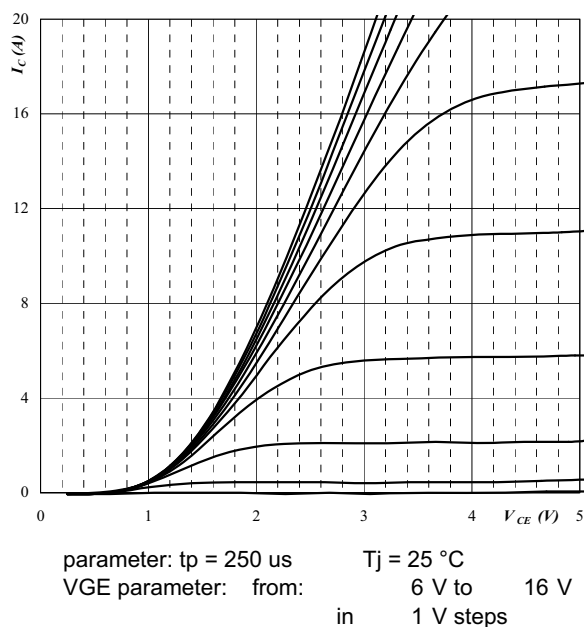


Figure 20. Typical output characteristics
Brake IGBT
 $I_c = f(V_{CE})$

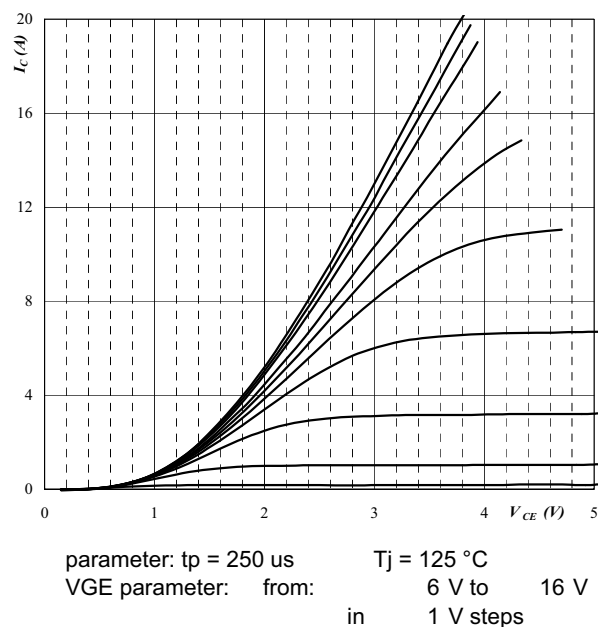


Figure 21. Typical transfer characteristics
Brake IGBT
 $I_c = f(V_{GE})$

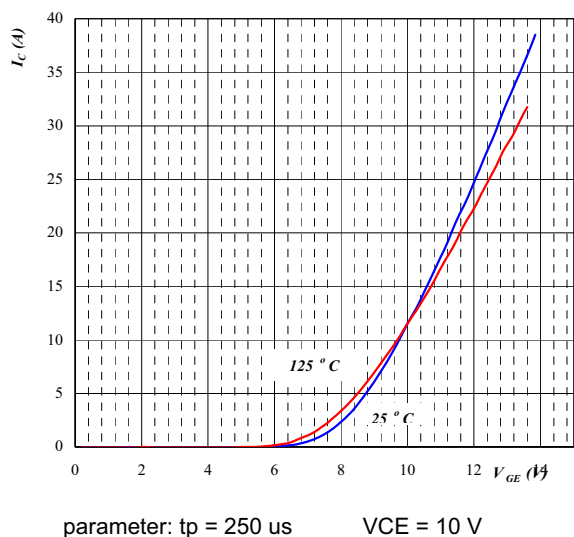
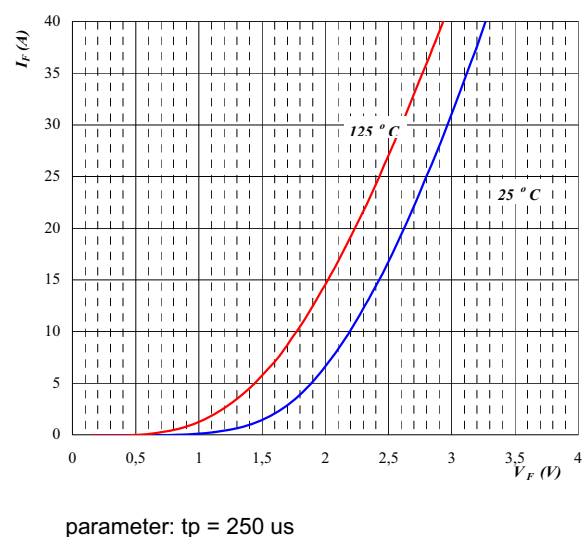


Figure 22. Typical diode forward current as a function of forward voltage
Brake FRED $I_F = f(V_F)$

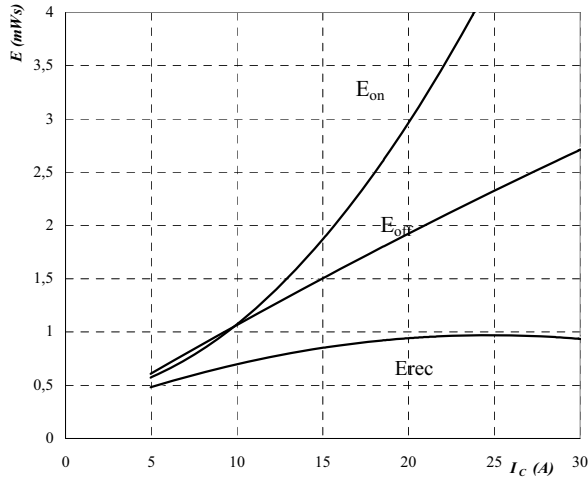


flowPIM[®]1, 1200V

Brake

Figure 23. Typical switching energy losses as a function of collector current
Brake IGBT

$E = f(I_c)$



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

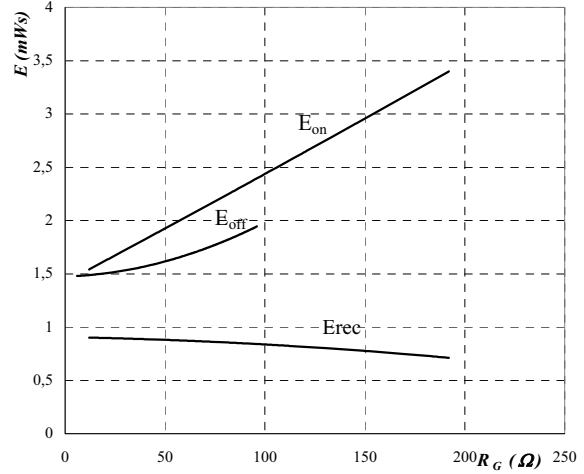
VCE = 600 V

VGE = 15 V

R_{Gon} = 2 * R_{Goff} = 48 W

Figure 24. Typical switching energy losses as a function of gate resistor
Brake IGBT

$E = f(R_G)$



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

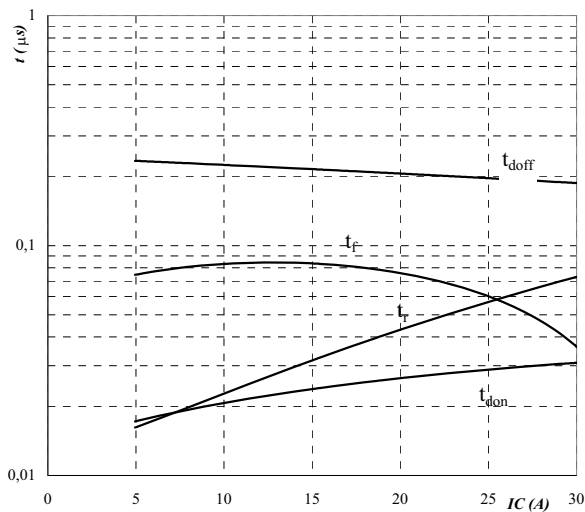
VCE = 600 V

VGE = 15 V

I_c = 15 A

Figure 25. Typical switching times as a function of collector current
Brake IGBT

$t = f(I_c)$



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

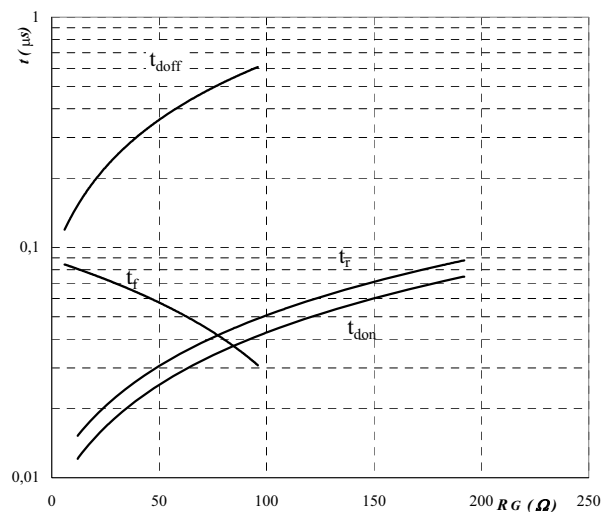
VCE = 600 V

VGE = 15 V

R_{Gon} = 2 * R_{Goff} = 48 W

Figure 26. Typical switching times as a function of gate resistor
Brake IGBT

$t = f(R_G)$



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

VCE = 600 V

VGE = 15 V

I_c = 15 A

flowPIM[®]1, 1200V

Brake

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

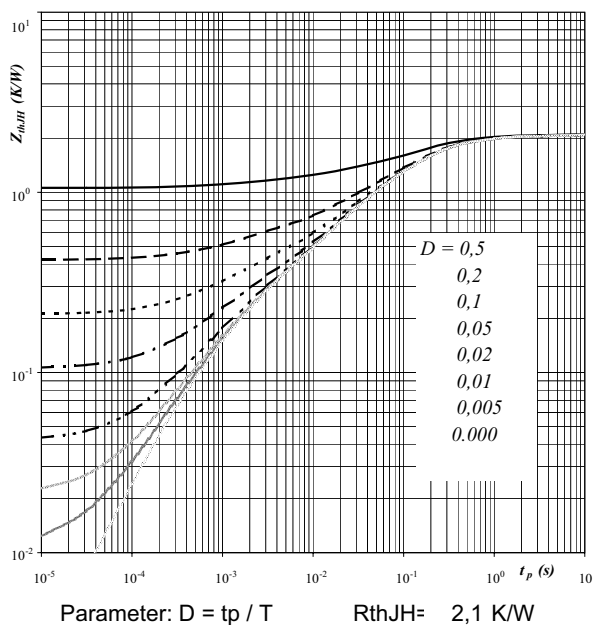


Figure 28. FRED transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$

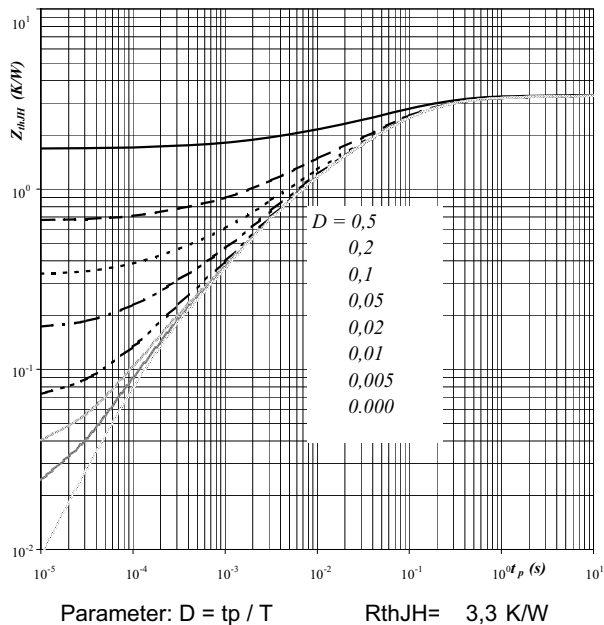


Figure 29. Power dissipation as a function of heatsink temperature
Brake IGBT
 $P_{tot} = f(T_h)$

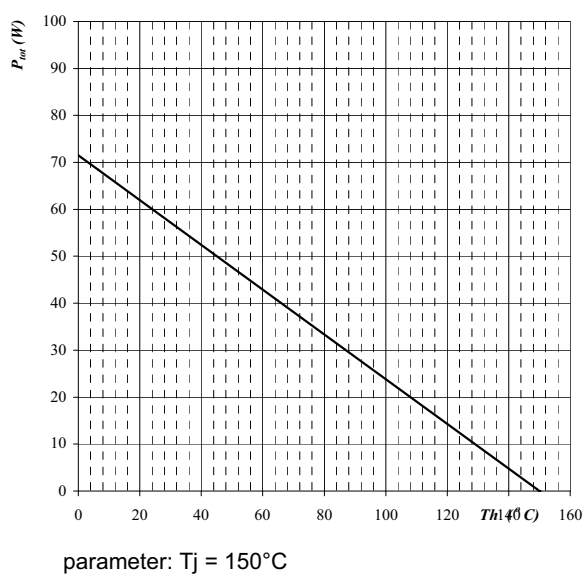
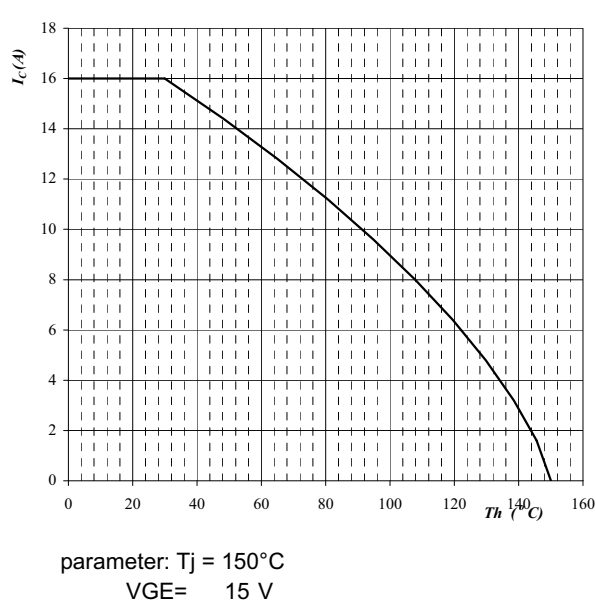


Figure 30. Collector current as a function of heatsink temperature
Brake IGBT
 $I_c = f(T_h)$



flowPIM[®]1, 1200V

Brake

Figure 31. Power dissipation as a function of heatsink temperature

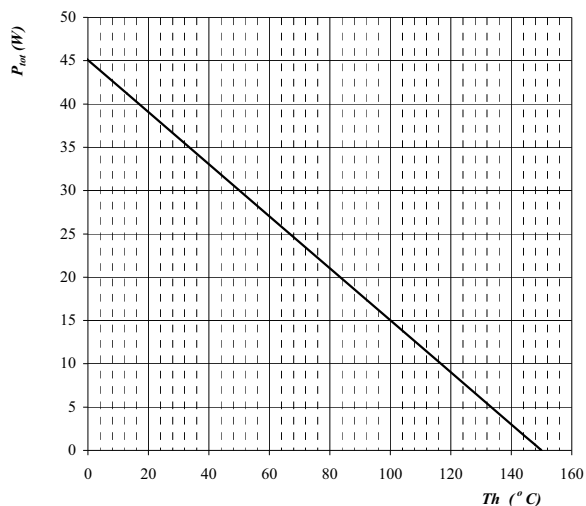
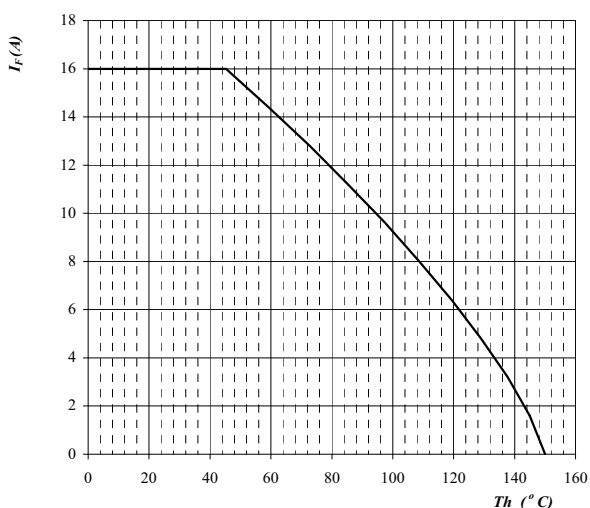
Brake FRED
 $P_{tot} = f(T_h)$

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

Figure 32. Forward current as a function of heatsink temperature

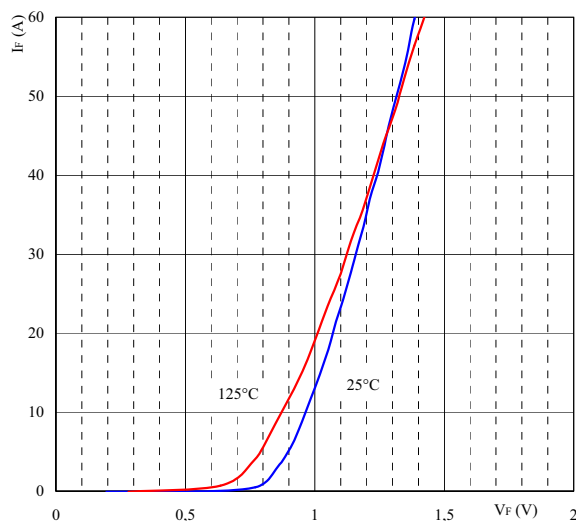
Brake FRED
 $I_F = f(T_h)$

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

flowPIM[®]1, 1200V

Input rectifier bridge

Figure 33. Typical diode forward current as a function of forward voltage

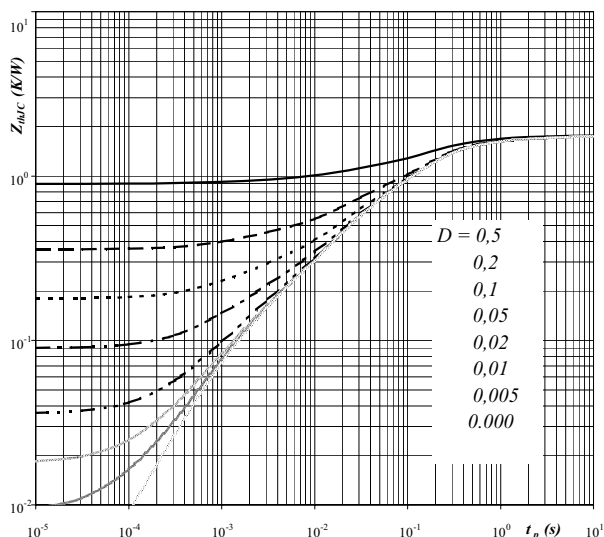
Rectifier diode $I_F = f(V_F)$



parameter: $t_p = 250 \text{ us}$

Figure 34. Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



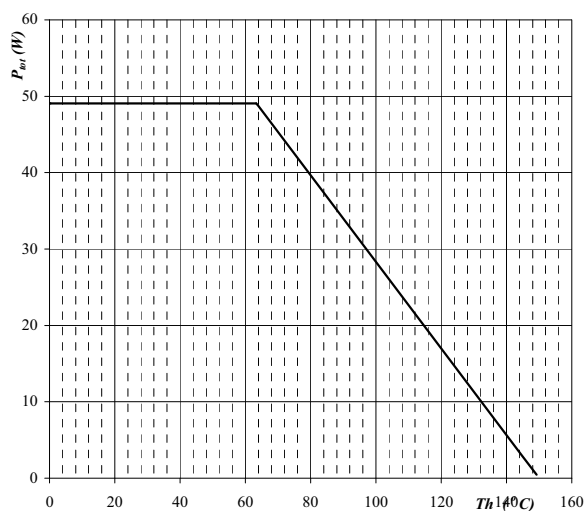
Parameter: $D = t_p / T$

$R_{thJH} = 1.8 \text{ K/W}$

Figure 35. Power dissipation as a function of heatsink temperature

Rectifier diode

$P_{tot} = f(T_h)$

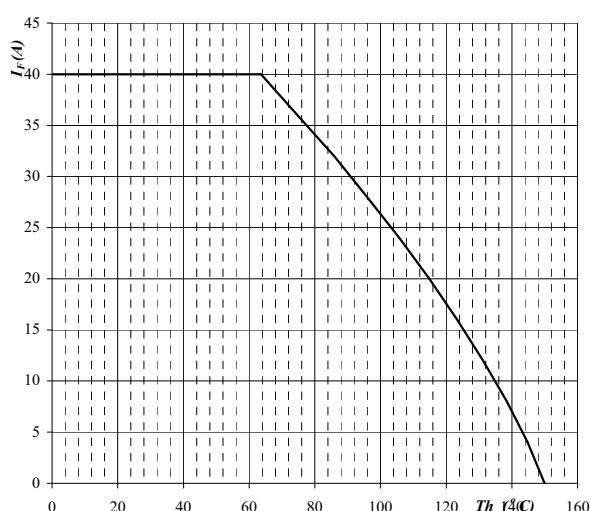


parameter: $T_j = 150^\circ\text{C}$

Figure 36. Forward current as a function of heatsink temperature

Rectifier diode

$I_F = f(T_h)$



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

flowPIM[®]1, 1200V

Thermistor

**Figure 37. Typical NTC characteristic
as a function of temperature**

$$R_T = f(T)$$

