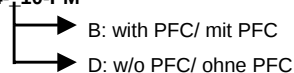


Standard Power Integrated Module with PFC and Shunts

flowPIM® 1 + P; 600V, 15A

V23990-P304-_10-PM



Maximum Ratings / Höchstzulässige Werte

at T_j=25°C, unless otherwise specified

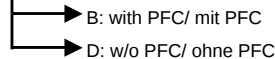
Parameter	Condition		Symbol	Value	Unit
Input Rectifier Bridge Gleichrichter					
Repetitive peak reverse voltage Periodische Rückw. Spitzensperrspannung			VRRM	1200	V
Forward average current Dauergrenzstrom	sine d=0.5	TC=25°C TC=80°C	IFAV	29	A
Surge forward current Stoßstrom Grenzwert	tp=10ms	TJ=25°C	IFSM	250	A
I2t-value Grenzlastintegral	tp=10ms	TJ=25°C	I2t	310	A2s
Power dissipation per Diode Verlustleistung pro Diode	Tj=150°C	TC=25°C TC=80°C	Ptot	53	W
Transistor Inverter Transistor Wechselrichter					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			VCE	600	V
DC collector current Kollektor-Dauergleichstrom	Tj=150°C	TC=25°C TC=80°C	IC	16	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	Icpuls	32	A
Power dissipation per IGBT Verlustleistung pro IGBT	Tj=150°C	TC=25°C TC=80°C	Ptot	40	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			VGE	±20	V
Diode Inverter Diode Wechselrichter					
DC forward current Dauergleichstrom	Tj=150°C	TC=25°C TC=80°C	IF	16	A
Repetitive peak forward current Periodischer Spitzenstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	IFRM	32	A
Power dissipation per Diode Verlustleistung pro Diode	Tj=150°C	TC=25°C TC=80°C	Ptot	25	W
PFC Transistor					
Drain to source breakdown voltage Drain-Source Sperrspannung			Vbr	500	V
DC drain current Drain-Dauergleichstrom	Tj=150°C	TC=25°C TC=80°C	Id	19 15	A
Pulsed drain current Periodischer Drainstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	Idpuls	38 30	A
Power dissipation Verlustleistung	Tj=150°C	TC=25°C TC=80°C	Ptot	156 88	W
Gate-source peak voltage Gate-Source-Spitzenspannung			Vgs	±20	V

PFC Diode				
DC forward current Dauergleichstrom	T _j =150°C	TC=25°C TC=80°C	I _F	15 A
Repetitive peak forward current Periodischer Spitzenstrom	T _j =150°C t _p =1ms	TC=25°C TC=80°C	I _{FRM}	30 A
Power dissipation per Diode Verlustleistung pro Diode	T _j =150°C	TC=25°C TC=80°C	P _{tot}	20 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
Thermal resistance, chip to case Wärmewiderstand Chip-Bodenplatte per chip	Diode Rectifier		R _{thJC}	1,30 K/W
	Transistor Inverter		R _{thJC}	1,80 K/W
	Diode Inverter		R _{thJC}	2,80 K/W
	Transistor PFC		R _{thJC}	0,80 K/W
	Diode PFC		R _{thJC}	2,10 K/W
Insulation properties Modulisolation				
Insulation test voltage Isolationsspannung	t=1min	V _{is}	4000	V _{dc}
Creepage distance Kriechstrecke			12,7	mm
Clearance Luftstrecke			12,7	mm

Standard Power Integrated Module with PFC and Shunts

flowPIM® 1 + P; 600V, 15A

V23990-P304-_10-PM



Characteristic values / Charakteristische Werte
at T_j=25°C, unless otherwise specified

Parameter FET Parameter	Symbol	Condition:	T	RG	VGE	VCE	IF	IC	Value			Unit
				RG	VGS	VDS		Id				
			(°C)	(W)	(V)	(V)	(A)	(A)	min.	typ.	max.	
Input Rectifier Bridge												
Gleichrichter												
Forward voltage Durchlaßspannung	VF		TJ=25°C					15		1,11		V
Threshold voltage (for pwr. loss calc. only) Schleusenspannung	Vto		TJ=25°C					15		0,89		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	rt		TJ=25°C					15		14,68		mΩ
Reverse current Sperrstrom	lr	VR=VRmax	TJ=25°C								0,02	mA
Transistor Inverter, inductive load												
Transistor Wechselrichter												
Gate emitter threshold voltage Gate-Schwellenspannung	VGE(th)	Vge=Vce	Tj=25°C					400μ	4,5	5,5	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	VCE(sat)		TC=25°C			15		15,0	1,7	2	2,5	V
Collector-emitter cut-off current incl. FRED Kollektor-Emitter Reststrom inkl. FRED	ICES		TC=25°C			0	600				50	μA
Gate-emitter leakage current Gate-Emitter Reststrom	IGES		Tj=25°C			30	0				120	nA
Turn-on delay time Einschaltverzögerungszeit	td(on)	Rg(on)=Rg(off)	TJ=25°C TJ=125°C	62	15	400		15,0		18 17	42 42	ns
Rise time Anstiegszeit	tr	Rg(on)=Rg(off)	TJ=25°C TJ=125°C	62	15	400		15,0		11 12	28 28	ns
Turn-off delay time Abschaltverzögerungszeit	td(off)	Rg(on)=Rg(off)	TJ=25°C TJ=125°C	62	15	400		15,0		123 136	256 284	ns
Fall time Fallzeit	tf	Rg(on)=Rg(off)	TJ=25°C TJ=125°C	62	15	400		15,0		19 26	52 64	ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	Eon	Rg(on)=Rg(off)	TJ=125°C		15	400		15,0		527		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	Eoff	Rg(on)=Rg(off)	TJ=125°C		25	400		15,0		696		mWs
SC withstand time Kurzschlußverhalten	tSC	@ 10*Ic(max)	TJ£125°C								10	μs
Input capacitance Eingangskapazität	Cies	f=1MHz	TJ=25°C		0	25				0,8		nF
Output capacitance Ausgangskapazität	Coss	f=1MHz	TJ=25°C									nF
Diode Inverter												
Diode Wechselrichter												
Diode forward voltage Durchlaßspannung	VF		TJ=25°C					15		1,93		V
Peak reverse recovery current Rückstromspitze	IRM	diF/dt=-200 A/μs	TJ=25°C TJ=125°C			400	15			6,3		A
Reverse recovery time Sperreverzögerungszeit	trr	diF/dt=-200 A/μs	TJ=125°C			400	15			80		ns
Reverse recovered charge Sperrverzögerungsladung	Qrr	diF/dt=-200 A/μs	TJ=125°C			400	15			0,31		μC

Transistor PFC												
Static drain to source ON resistance Statische drain-source Widerstand	Rds(on)	TJ=25°C		10				13,0			0,26	Ω
Gate threshold voltage Gate Spitzenspannung	V(GS)th	VDS=VGS TJ=25°C							2		4	V
Drain to Source breakdown voltage Drain source Leckstrom	V(BR)DSS	VDS=VGS, ID=250A TJ=25°C		0					500			V
Drain to Source Leakage Current Drain source Leckstrom	Igss	TJ=25°C		30							100	nA
Turn On Delay Time Einschaltverzögerung	td(ON)	VDD=350V TJ=25°C	4,3					22,0		26		ns
Rise Time Anstiegszeit	tr	VDD=350V TJ=25°C	4,3					22,0		94		ns
Turn off delay time Abschaltverzögerung	td(OFF)	VDD=350V TJ=25°C	4,3					22,0		47		ns
Fall time Abstiegszeit	tf	VDD=350V TJ=25°C	4,3					22,0		47		ns
Total gate charge Gate Ladung	Qg	VDD=350V TJ=25°C		10	400			22,0			120	nC
Gate to source charge Gate source Ladung	Qgs	TJ=25°C		10	400			22,0			32	nC
Input capacitance Eingangskapazität	Ciss	f=1MHz TJ=25°C		0	25					3450		pF
Output capacitance Ausgangskapazität	Coss	f=1MHz TJ=25°C		0	400					137		pF
Diode PFC												
Forward voltage Durchlaßspannung	VF	TJ=25°C TJ=25°C TJ=125°C					15 30 15			1,3 1,5 1,2	1,7 2 1,6	V
Breakdown voltage Sperrspannung	Vr	Ir=100µA									600	V
Reverse leakage current Leckstrom	Irm	Vr=Vr rated Vr=0.8*Vr rated TJ=25°C TJ=125°C							1 400	10 1000		µA
Reverse recovery time Sperrverzögerungszeit	trr	Vr=200V dif/dt=-200A/µs TJ=25°C TJ=125°C				15			42 74	60 120		ns
Peak recovery current Rückstromspitze	Irrm	Vr=200V dif/dt=-200A/µs TJ=25°C TJ=125°C				15			4 6,5	6 10		A
Reverse recovery charge Sperrverzögerungsladung	Qrr	Vr=200V dif/dt=-200A/µs TJ=25°C TJ=125°C				15			80 220	180 600		nC
Peak rate of fall of recovery current Sitzensteilheit von Rückstrom	di(rec)max /dt	Vr=200V dif/dt=-200A/µs TJ=25°C TJ=125°C				15			188 160			A/µs
NTC-Thermistor												
NTC-Widerstand												
Rated resistance Nennwiderstand	R25	Tol. ±5% Tc=25°C								22		kΩ
Deviation of R100 Abweichung von R100	DR/R	R100=1503W Tc=100°C								1486		%/K
Power dissipation Verlustleistung	P	Tc=25°C									210	mW
B-value B-Wert	B(25/100)	Tol. ±3%								4000		K
Shunts												
Shuntwiderstände												
R1 value R1 Wert	R	Tol. 1% Tc=25°C								22		mΩ
Power dissipation Verlustleistung	P	Tc=25°C									3	W
R2 value R2 Wert	R	Tol. 1% Tc=25°C								33		mΩ
Power dissipation Verlustleistung	P	Tc=25°C									3	W
R3 value R3 Wert	R	Tol. 1% Tc=25°C								33		mΩ
Power dissipation Verlustleistung	P	Tc=25°C									3	W

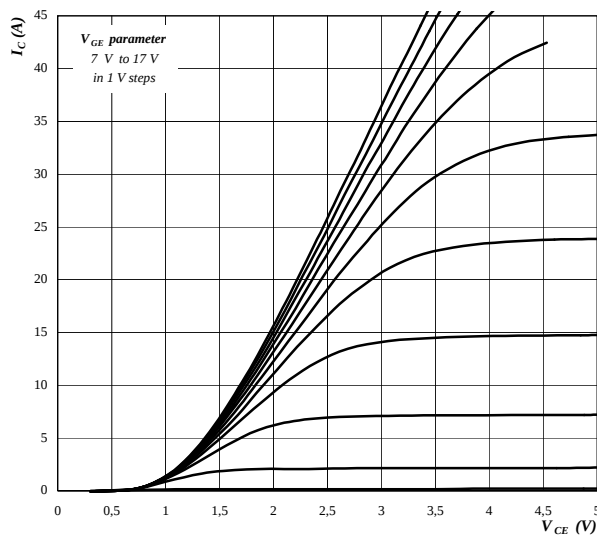
Output inverter

Typ. output characteristics

Output inverter IGBT

$$I_C = f(V_{CE})$$

parameter: $t_p = 250 \mu s$, $T_j = 25^\circ C$

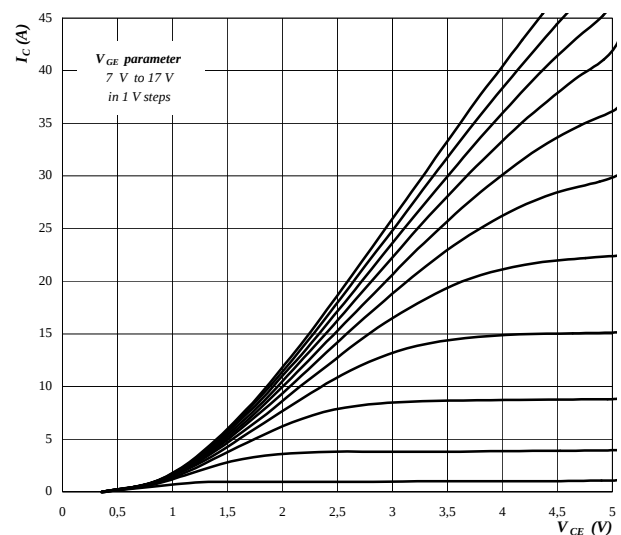


Typ. output characteristics

Output inverter IGBT

$$I_C = f(V_{CE})$$

parameter: $t_p = 250 \mu s$, $T_j = 125^\circ C$

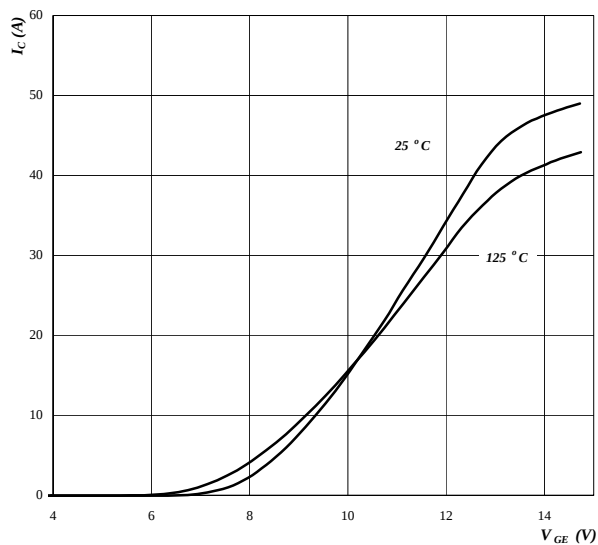


Typ. transfer characteristics

Output inverter IGBT

$$I_C = f(V_{GE})$$

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

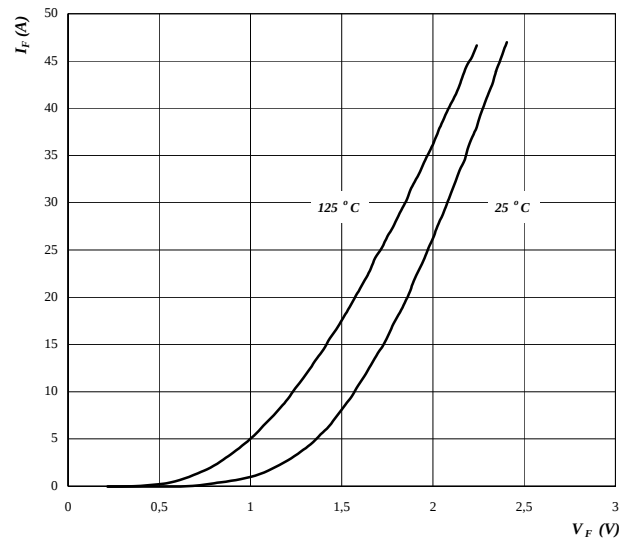


Typ. diode characteristics

Output inverter FRED

$$I_F = f(V_F)$$

parameter: $t_p = 250 \mu s$



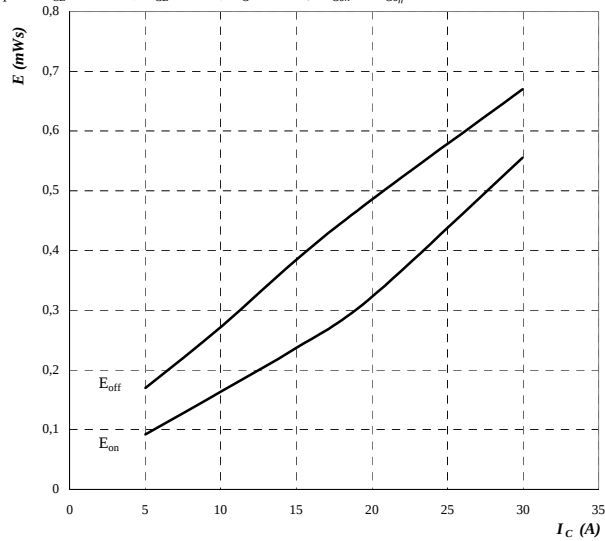
Output inverter

Typ. Switching losses

Output inverter IGBT

$E = f(I_C)$, inductive load, $T_j = 25^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 20\ \Omega$, $R_{Gon} = R_{Goff}$

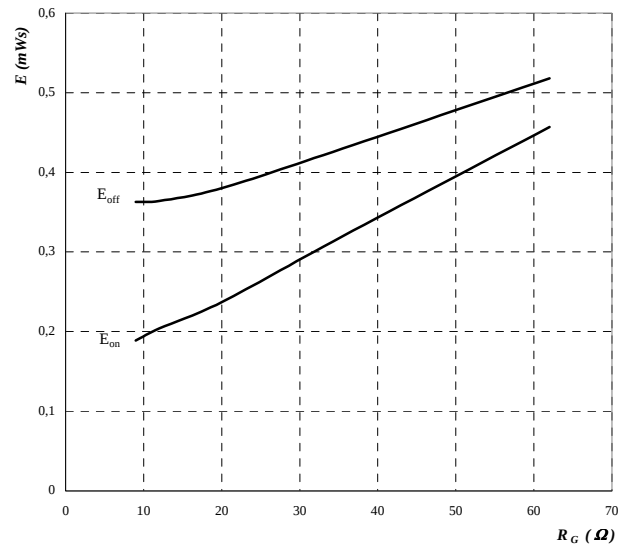


Typ. Switching losses

Output inverter IGBT

$E = f(R_G)$, inductive load, $T_j = 25^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = R_{Goff}$

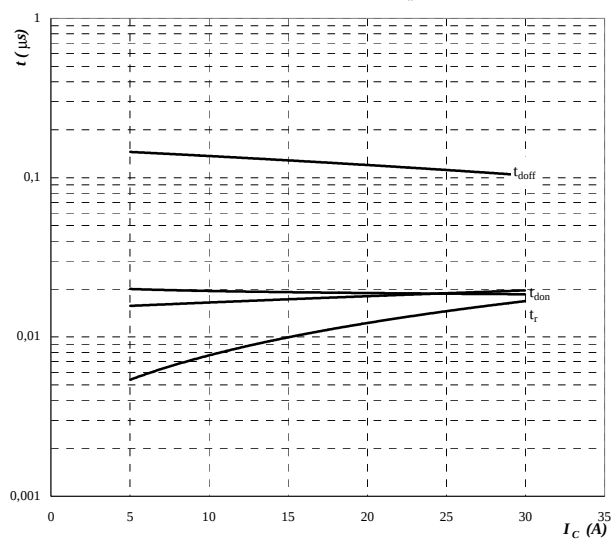


Typ. Switching time

Output inverter IGBT

$t = f(I_C)$, inductive load, $T_j = 25^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 20\ \Omega$, $R_{Gon} = R_{Goff}$

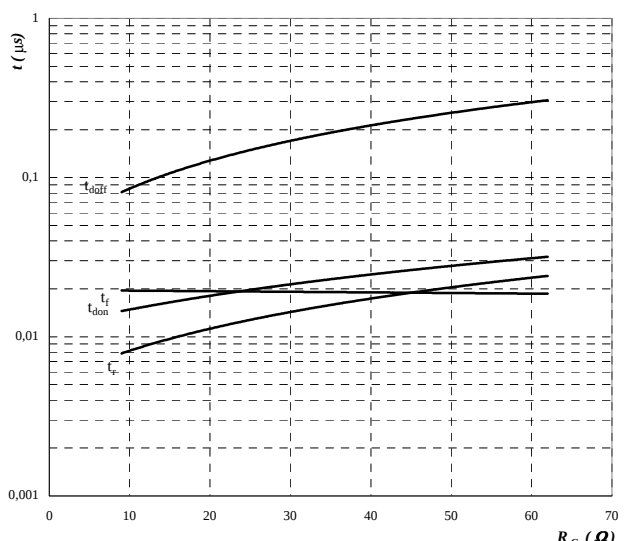


Typ. Switching time

Output inverter IGBT

$t = f(R_G)$, inductive load, $T_j = 25^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = R_{Goff}$



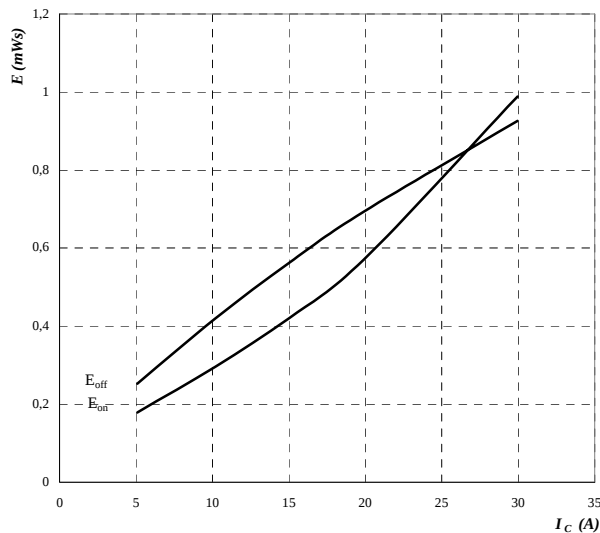
Output inverter

Typ. Switching losses

Output inverter IGBT

$E = f(I_C)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 20\ \Omega$, $R_{Gon} = R_{Goff}$

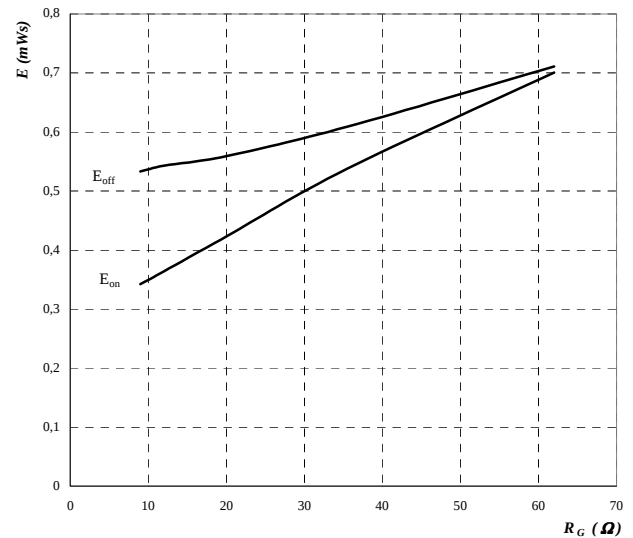


Typ. Switching losses

Output inverter IGBT

$E = f(R_G)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = R_{Goff}$

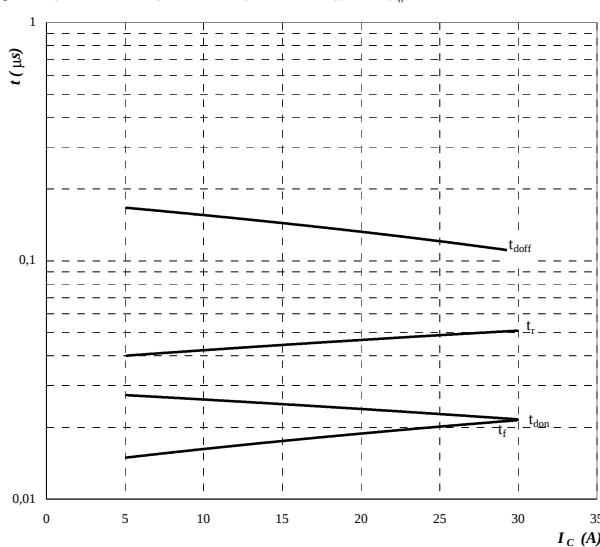


Typ. Switching time

Output inverter IGBT

$t = f(I_C)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 20\ \Omega$, $R_{Gon} = R_{Goff}$

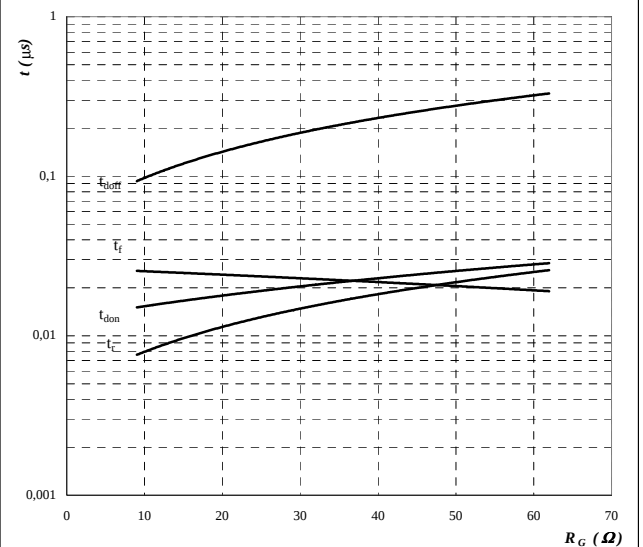


Typ. Switching time

Output inverter IGBT

$t = f(R_G)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = R_{Goff}$



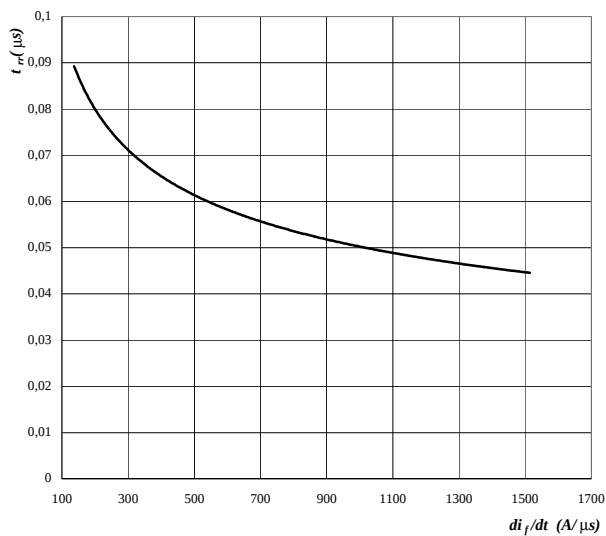
FRED diode

Typ. Reverse recovery time

Output inverter FRED diode

$$t_{rr} = f(di_f / dt)$$

par.: $V_R = 400$ V, $T_J = 125$ °C

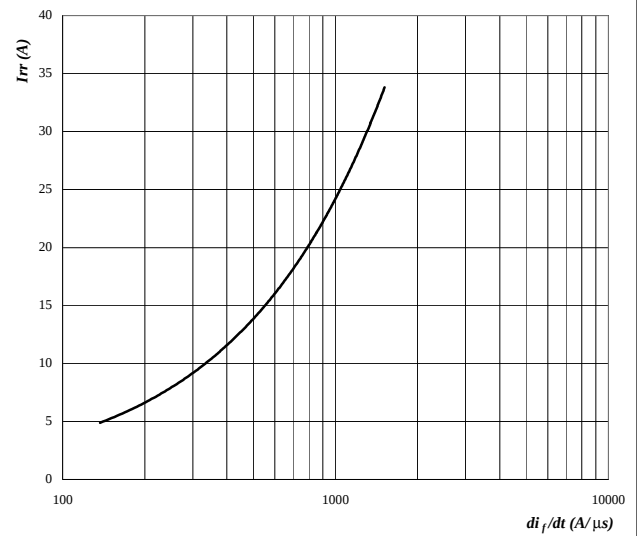


Typ. Reverse recovery current

Output inverter FRED diode

$$I_{rr} = f(di_f / dt)$$

par.: $V_R = 400$ V, $T_J = 125$ °C

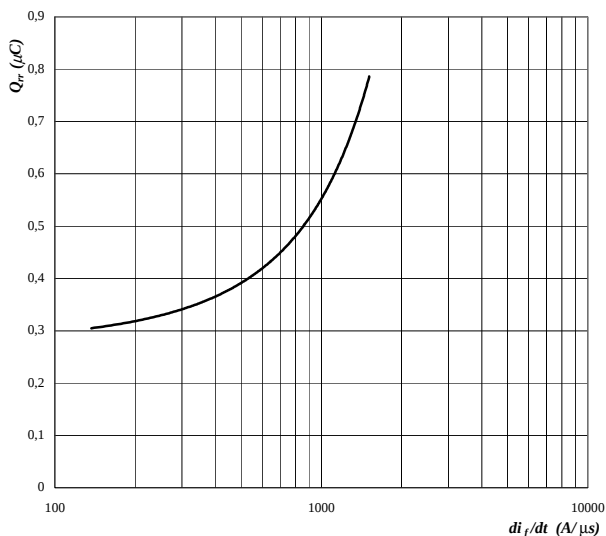


Typ. Reverse stored charge

Output inverter FRED diode

$$Q_{rr} = f(di_f / dt)$$

par.: $V_R = 400$ V, $T_J = 125$ °C

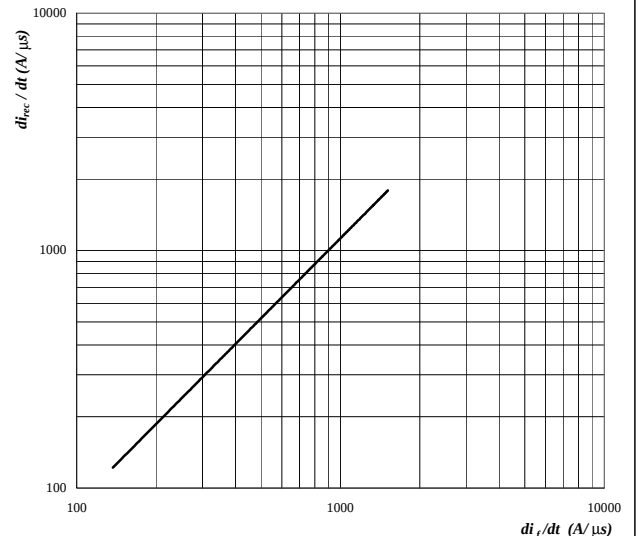


Typ. di_{rec} / dt

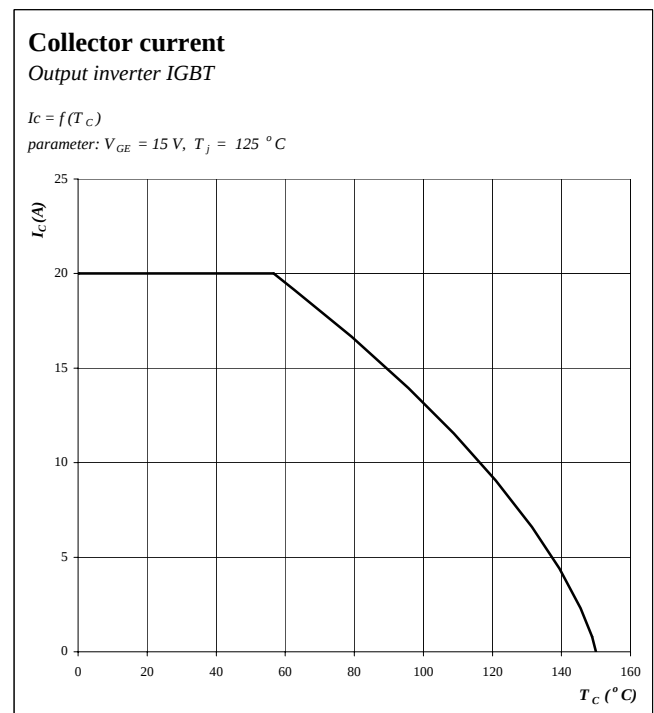
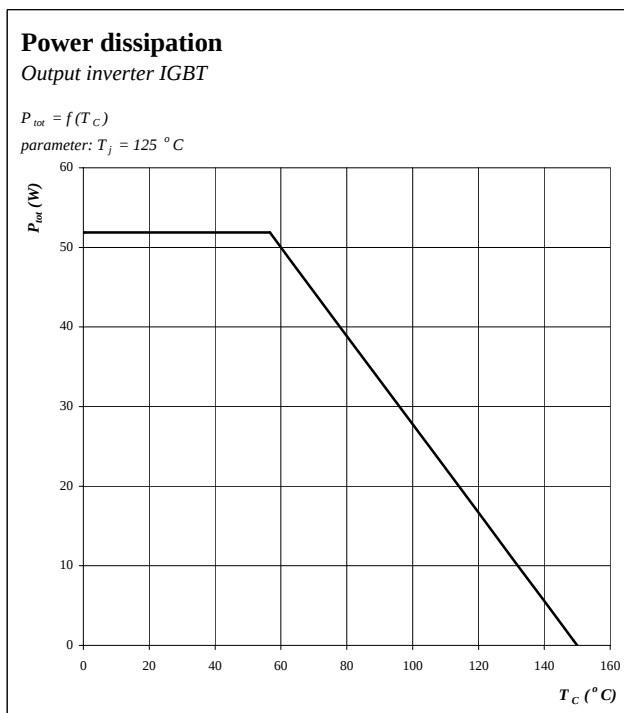
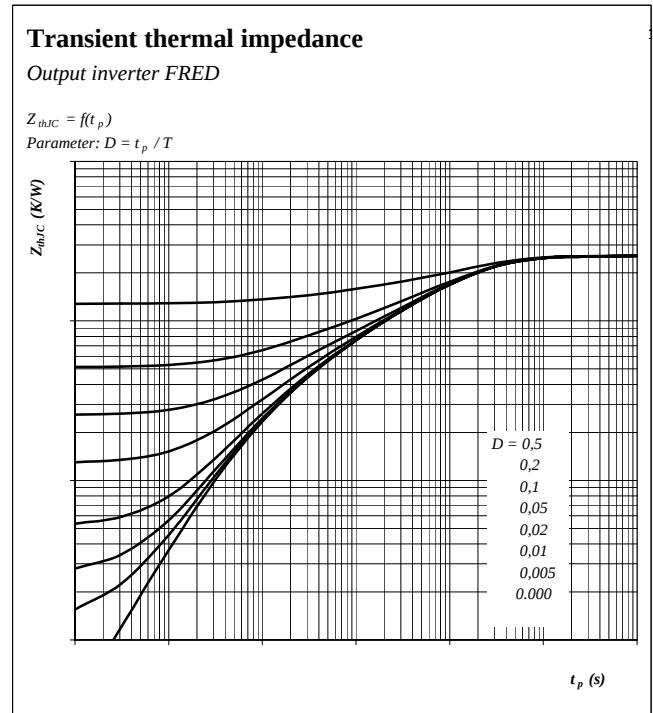
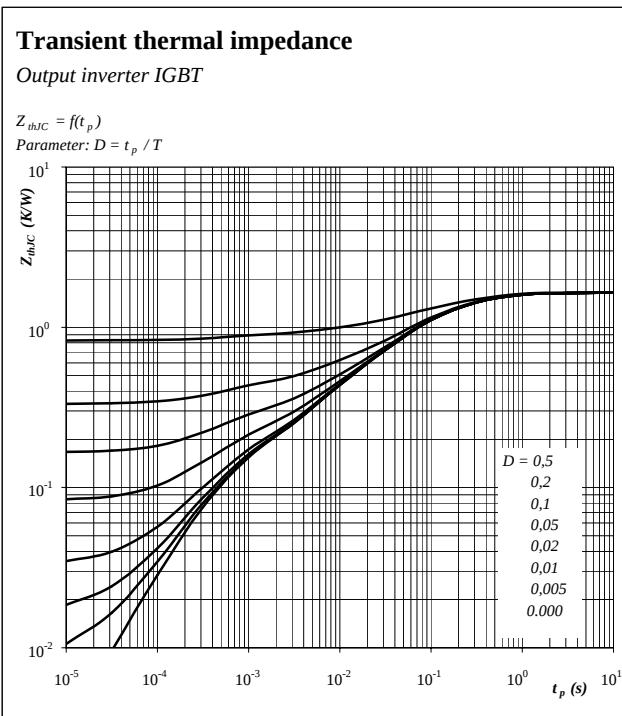
Output inverter FRED diode

$$I_{rr} = f(di_f / dt)$$

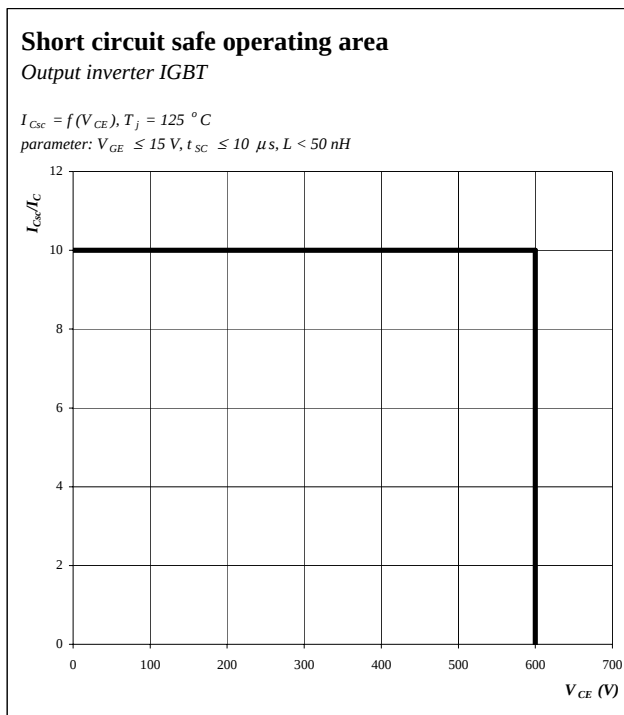
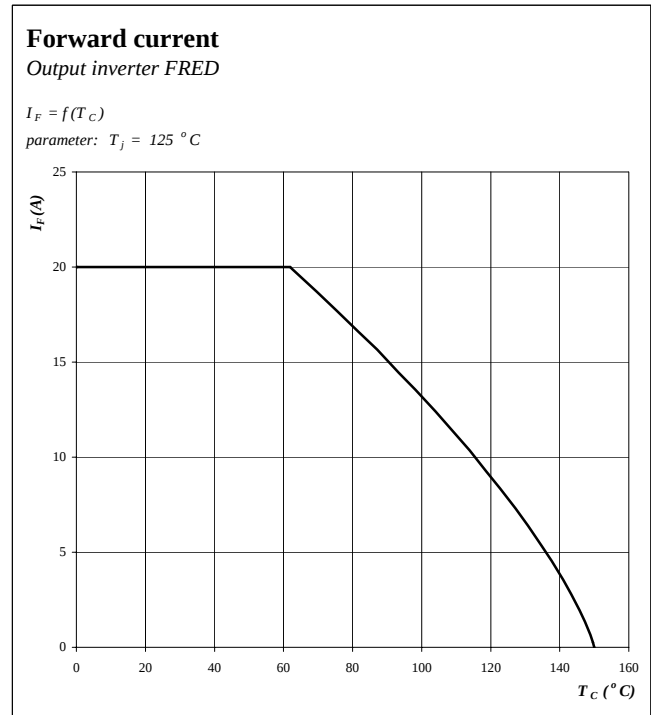
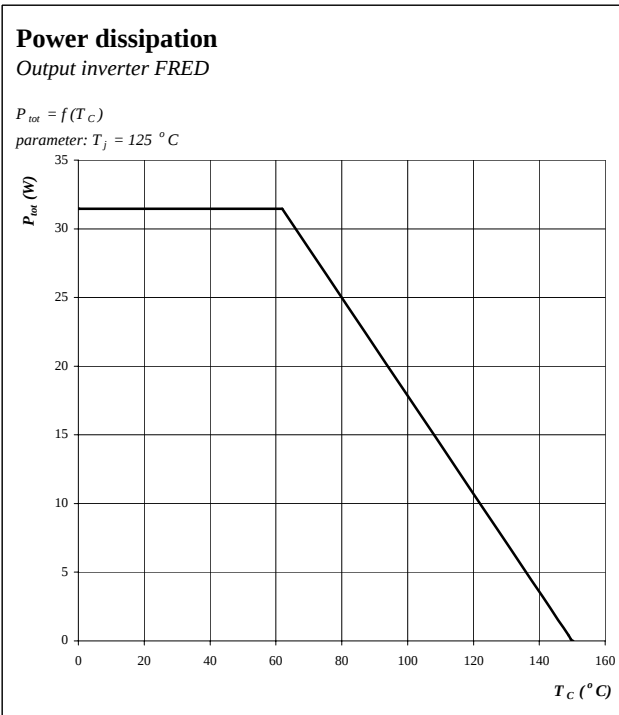
par.: $V_R = 400$ V, $T_J = 125$ °C



Output inverter



Output inverter



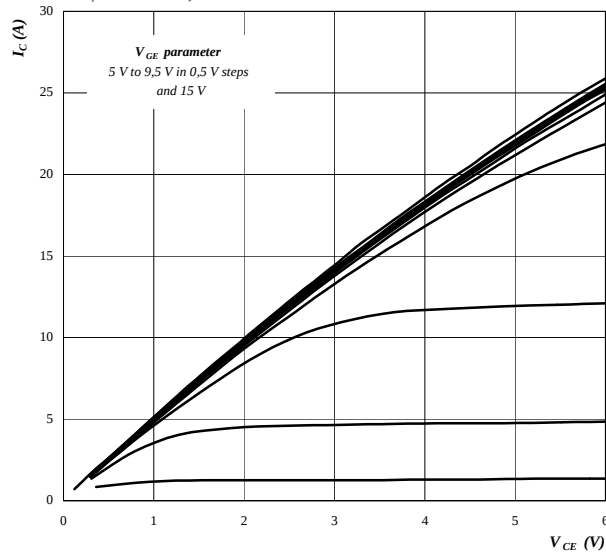
PFC

Typ. output characteristics

PFC FET

$$I_C = f(V_{CE})$$

parameter: $t_p = 250 \mu s$, $T_j = 25^\circ C$

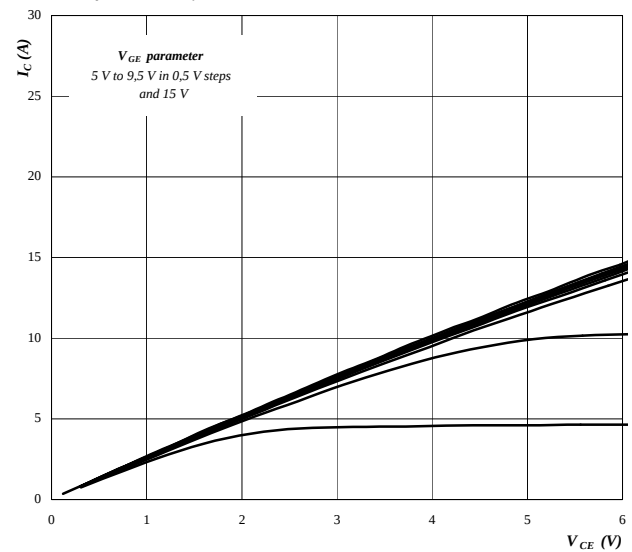


Typ. output characteristics

PFC FET

$$I_C = f(V_{CE})$$

parameter: $t_p = 250 \mu s$, $T_j = 125^\circ C$

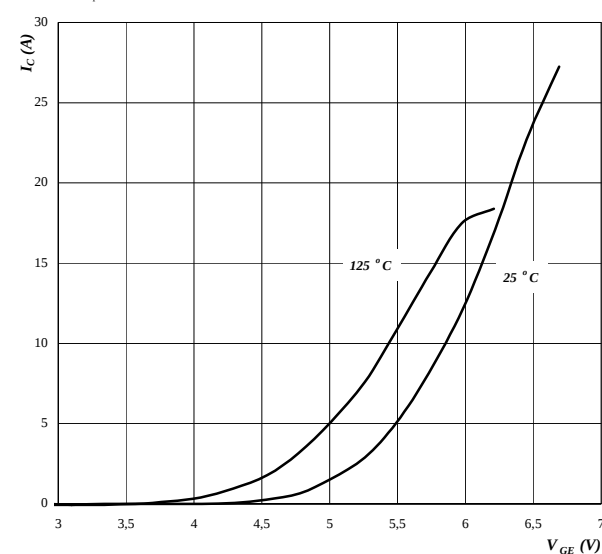


Typ. transfer characteristics

PFC FET

$$I_C = f(V_{GE})$$

parameter: $t_p = 250 \mu s$, $V_{CE} = 20 V$

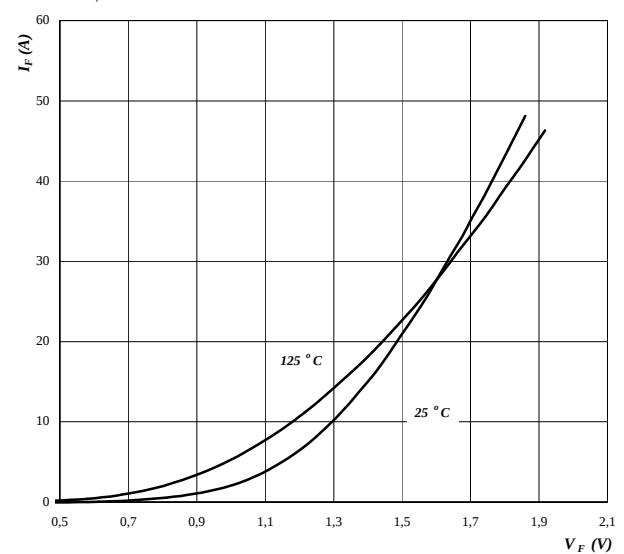


Typ. diode characteristics

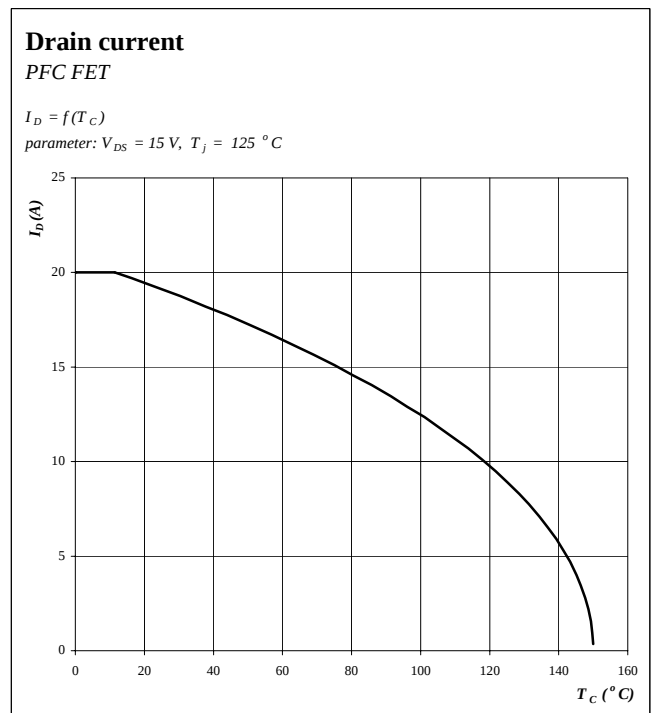
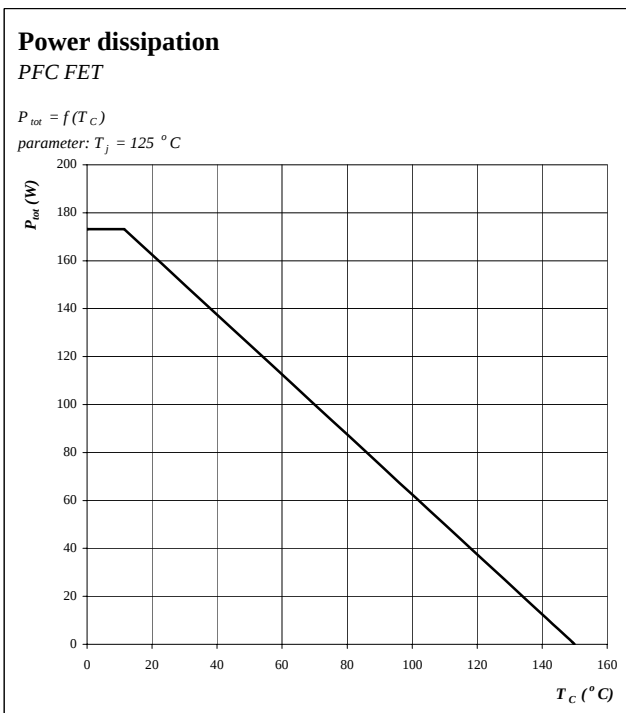
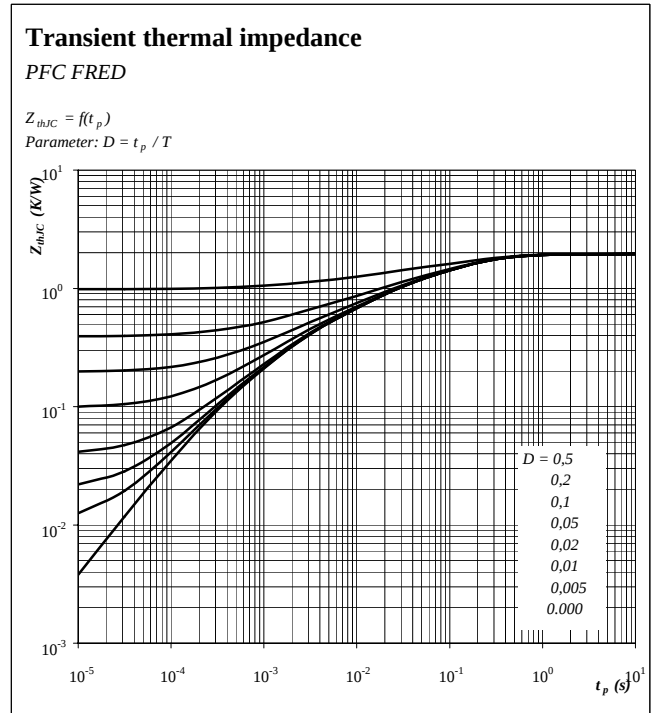
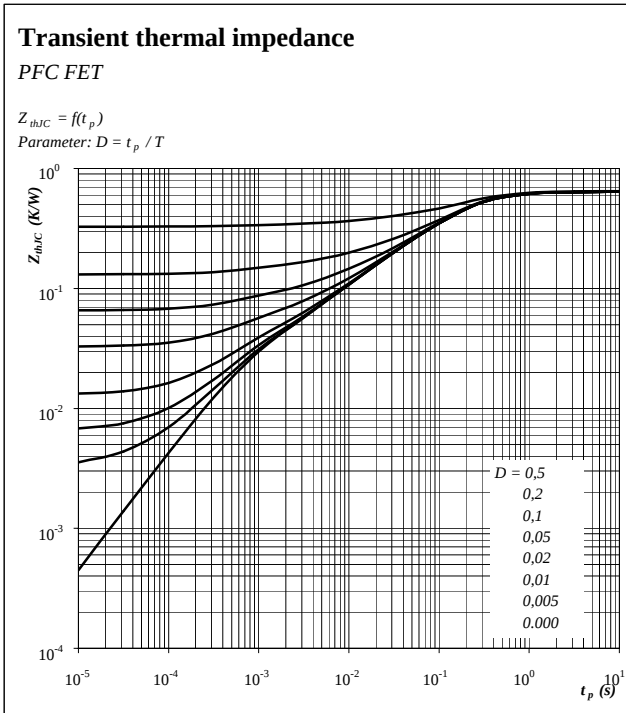
PFC FRED

$$I_F = f(V_F)$$

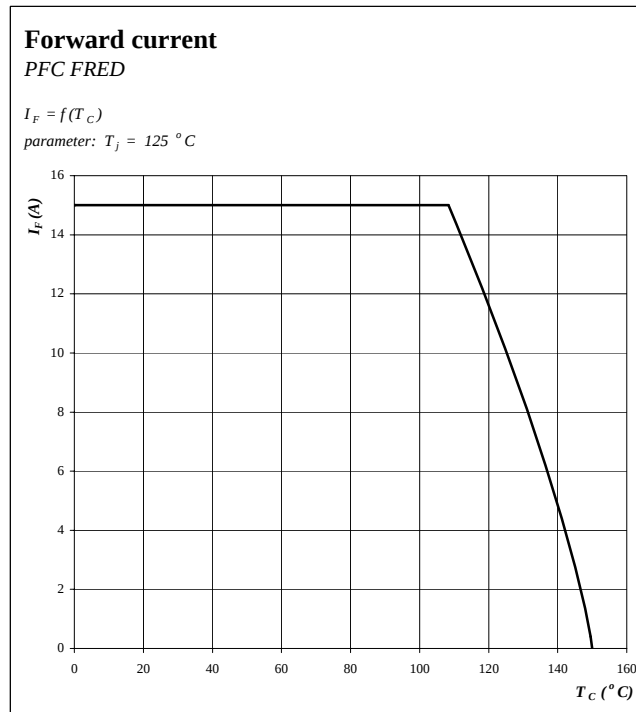
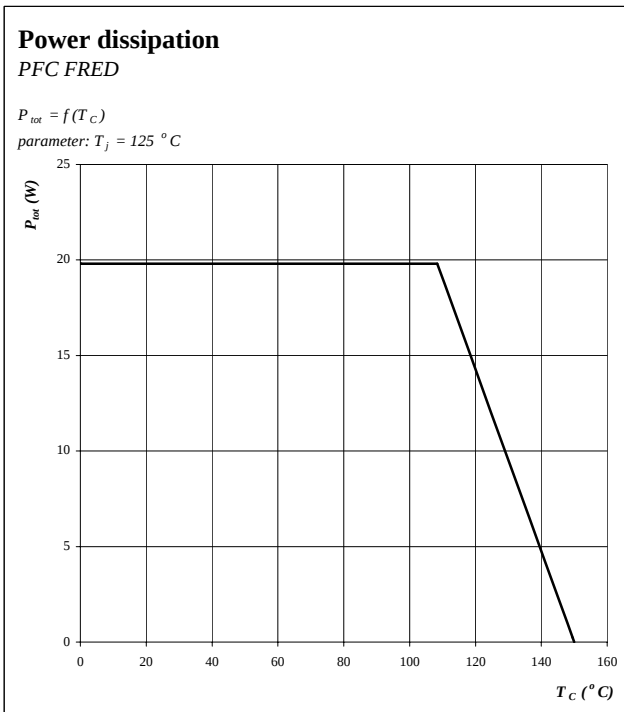
parameter: $t_p = 250 \mu s$



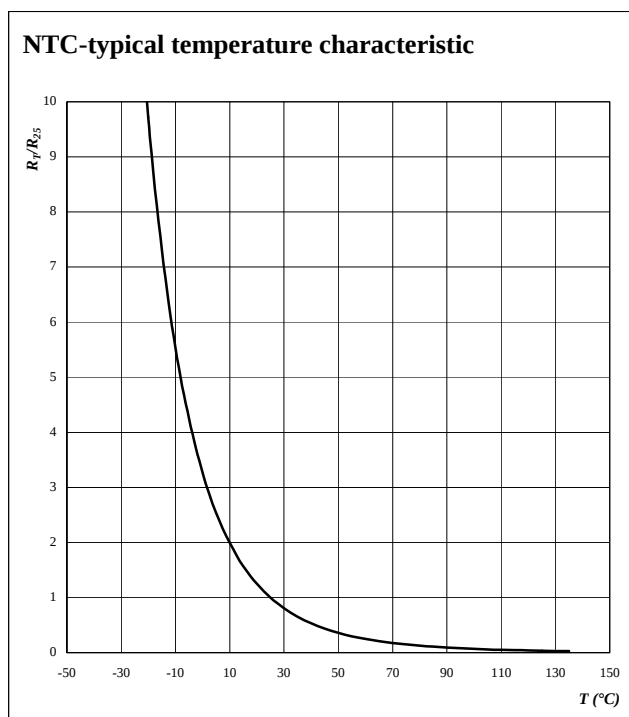
PFC



PFC



Thermistor



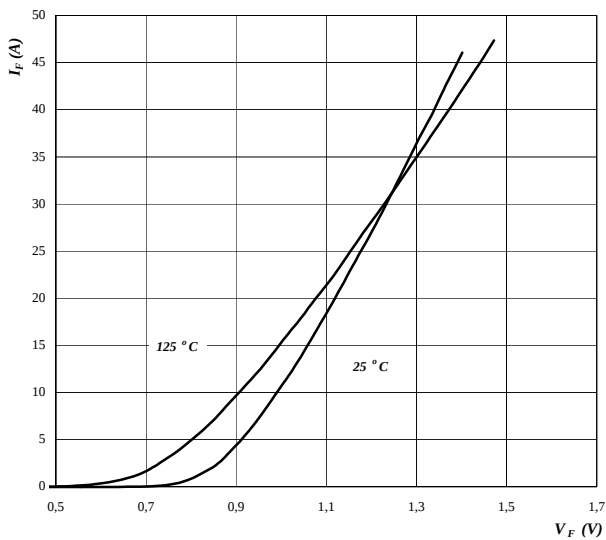
Input rectifier bridge

Typ. diode characteristics

Input rectifier Bridge

$$I_F = f(V_F)$$

parameter: $t_p = 250 \mu s$

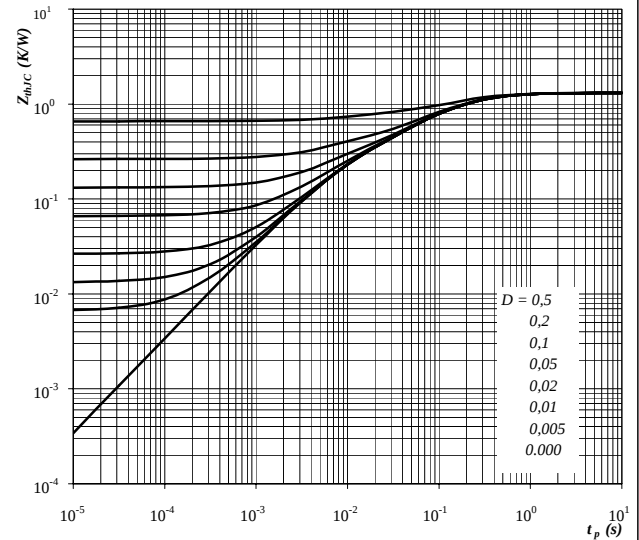


Transient thermal impedance

Input Rectifier Bridge

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

Parameter: $D = t_p / T$

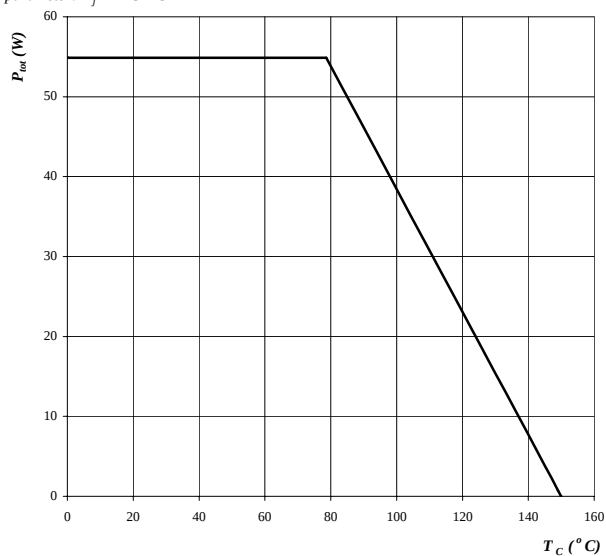


Power dissipation

Rectifier

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

parameter: $T_j = 125 \text{ °C}$



Forward current

Rectifier

$$I_F = f(T_C)$$

parameter: $T_j = 125 \text{ °C}$

