Standard Power Integrated Module with PFC and Shunts

***flow* PIM**® 1 + P; **600V, 15A**

V23990-P304-_10-PM

B: with PFC/ mit PFC

D: w/o PFC/ ohne PFC

Maximum Ratings / Höchstzulässige Werte

at Tj=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	Tj=150°C	TC=25°C TC=80°C	IF	15	A
Repetitive peak forward current Periodischer Spitzenstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	IFRM	30	A
Power dissipation per Diode Verlustleistung pro Diode	Tj=150°C	TC=25°C TC=80°C	Ptot	20	W
Thermal properties **Thermische Eigenschaften**					
max. Chip temperature max. Chiptemperatur			Tjmax	150	°C
Storage temperature Lagertemperatur			Tstg	-40…+125	°C
Operation temperature Betriebstemperatur			Top	-40…+125	°C
Thermal resistance, chip to case Wärmewiderstand Chip-Bodenplatte per chip	Diode Rectifier		RthJC	1,30	K/W
	Transistor Inverter		RthJC	1,80	K/W
	Diode Inverter		RthJC	2,80	K/W
	Transistor PFC		RthJC	0,80	K/W
	Diode PFC		RthJC	2,10	K/W
Insulation properties **Modulisolation**					
Insulation test voltage Isolationsspannung		t=1min	Vis	4000	Vdc
Creepage distance Kriechstrecke				12,7	mm
Clearance Luftstrecke				12,7	mm

Standard Power Integrated Module with PFC and Shunts

***flow* PIM®** 1 + P; **600V, 15A**

V23990-P304-_10-PM

- B: with PFC/ mit PFC
- D: w/o PFC/ ohne PFC

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

Parameter **FET Parameter**	**Symbol**	**Condition:**	**T**	**RG** **RG**	**VGE** **VGS**	**VCE** **VDS**	**IF**	**IC** **Id**	**Value**			**Unit**
			(°C)	**(W)**	**(V)**	**(V)**	**(A)**	**(A)**	**min.**	**typ.**	**max.**	
Input Rectifier Bridge **Gleichrichter**												
Forward voltage Durchlaßpannung	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	Ir	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 VDS=VGS, ID=250A	TJ=25°C						2		4	V
Drain to Source breakdown voltage Drain source Leckstrom	V(BR)DSS	ID=350µA	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 **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 V 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 Sperreverzögerungszeit	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

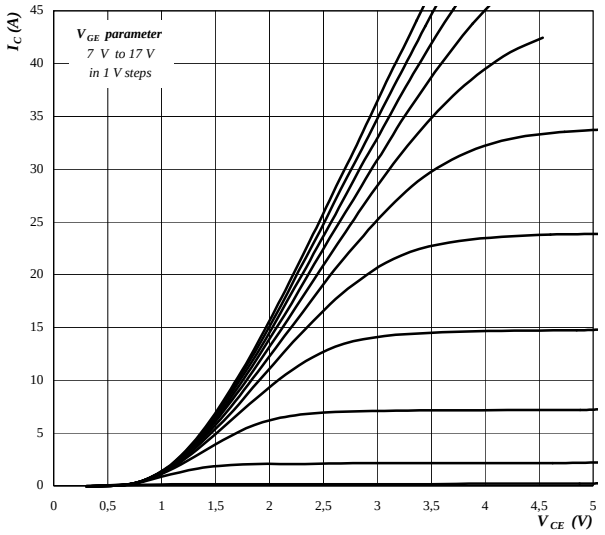
Output inverter

Typ. output characteristics

Output inverter IGBT

$I_C = f(V_{CE})$

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

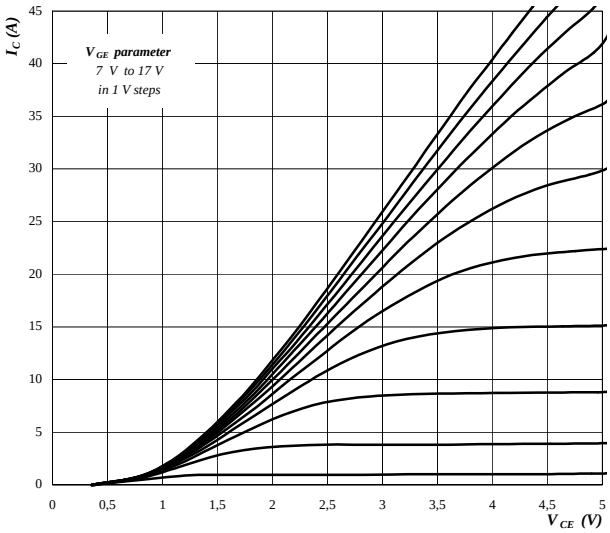


Typ. output characteristics

Output inverter IGBT

$I_C = f(V_{CE})$

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

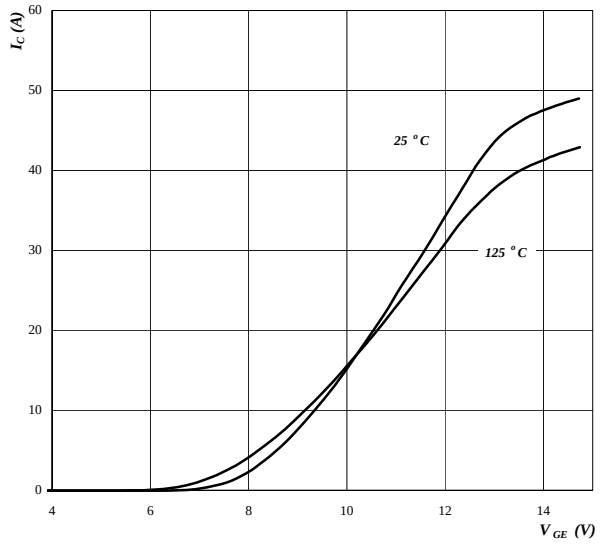


Typ. transfer characteristics

Output inverter IGBT

$I_C = f(V_{GE})$

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

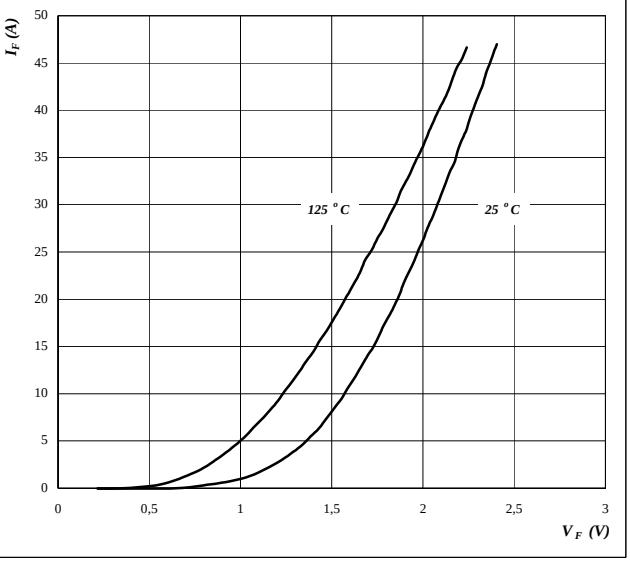


Typ. diode characteristics

Output inverter FRED

$I_F = f(V_F)$

parameter: $t_p = 250\ \mu s$

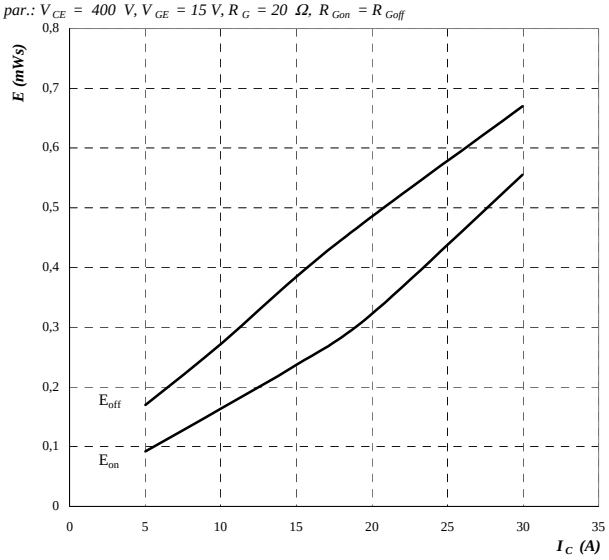


Output inverter

Typ. Switching losses

Output inverter IGBT

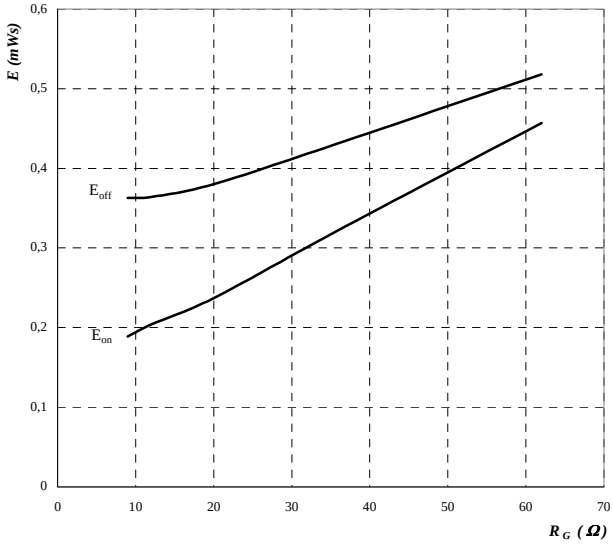
E = f (I C), inductive load, T j = 25 °C
par.: V CE = 400 V, V GE = 15 V, R G = 20 Ω, R Gon = R Goff



Typ. Switching losses

Output inverter IGBT

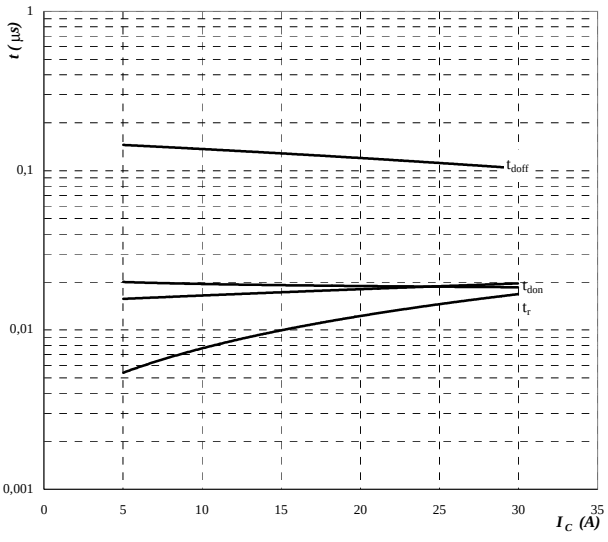
E = f (R G), inductive load, T j = 25 °C
par.: V CE = 400 V, V GE = 15 V, I C = 15 A, R Gon = R Goff



Typ. Switching time

Output inverter IGBT

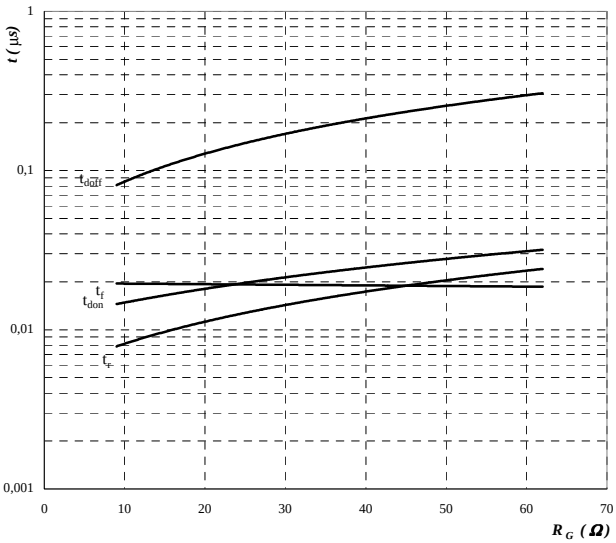
t = f (I C), inductive load, T j = 25 °C
par.: V CE = 400 V, V GE = 15 V, R G = 20 Ω, R Gon = R Goff



Typ. Switching time

Output inverter IGBT

t = f (R G), inductive load, T j = 25 °C
par.: V CE = 400 V, V GE = 15 V, I C = 15 A, R Gon = R Goff

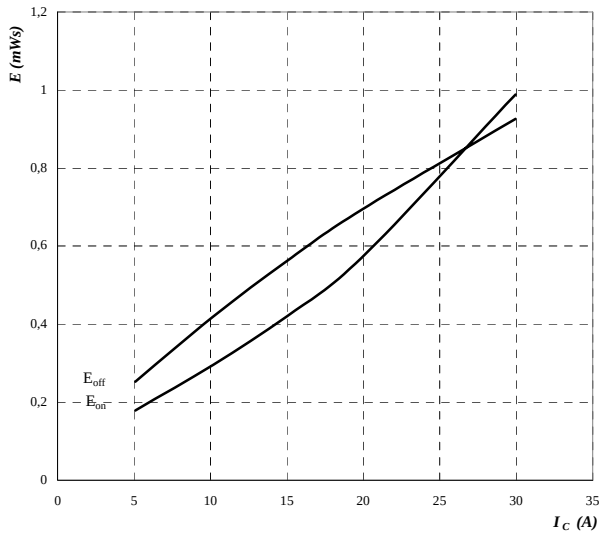


Output inverter

Typ. Switching losses

Output inverter IGBT

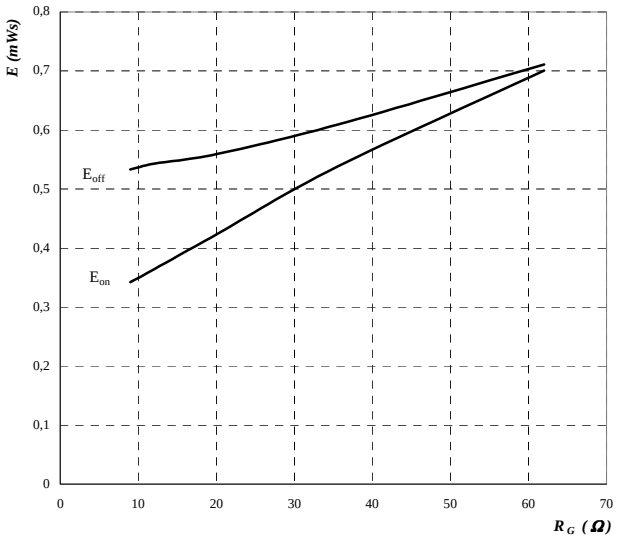
E = f (I C), inductive load, T j = 125 °C
par.: V CE = 400 V, V GE = 15 V, R G = 20 Ω, R Gon = R Goff



Typ. Switching losses

Output inverter IGBT

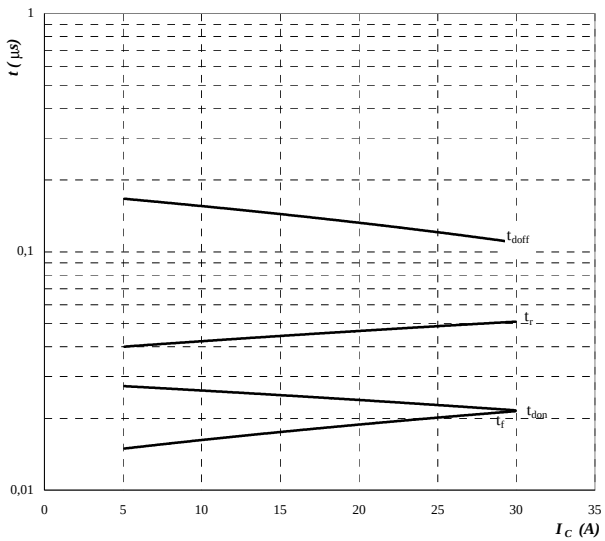
E = f (R G), inductive load, T j = 125 °C
par.: V CE = 400 V, V GE = 15 V, I C = 15 A, R Gon = R Goff



Typ. Switching time

Output inverter IGBT

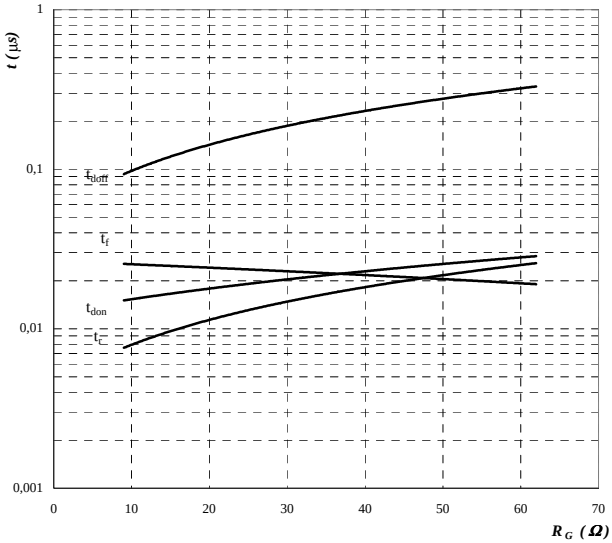
t = f (I C), inductive load, T j = 125 °C
par.: V CE = 400 V, V GE = 15 V, R G = 20 Ω, R Gon = R Goff



Typ. Switching time

Output inverter IGBT

t = f (R G), inductive load, T j = 125 °C
par.: V CE = 400 V, V GE = 15 V, I C = 15 A, R Gon = R Goff



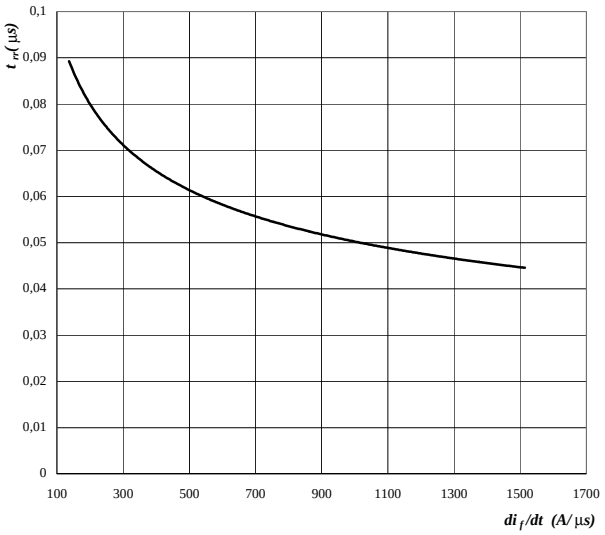
FRED diode

Typ. Reverse recovery time

Output inverter FRED diode

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

par.: $V_R = 400\ V, T_J = 125\ ^oC$

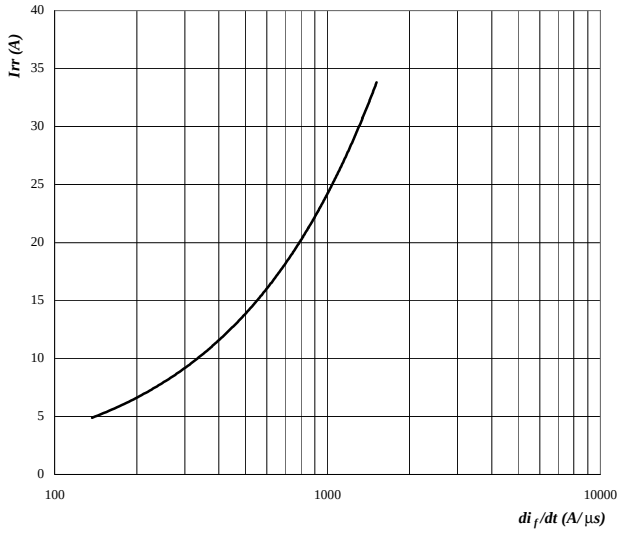


Typ. Reverse recovery current

Output inverter FRED diode

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

par.: $V_R = 400\ V, T_J = 125\ ^oC$

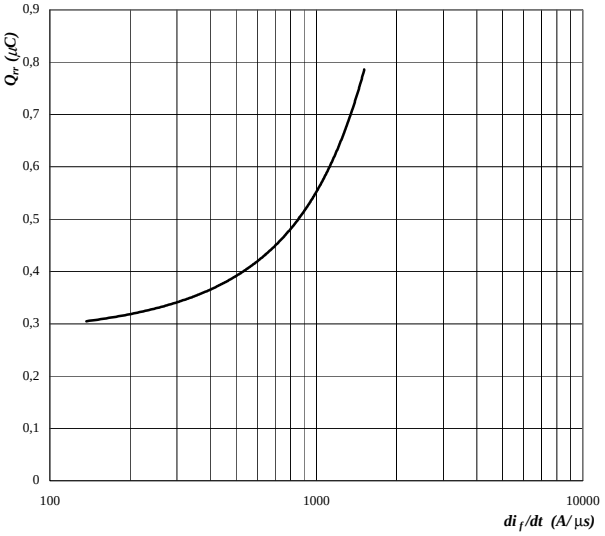


Typ. Reverse stored charge

Output inverter FRED diode

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

par.: $V_R = 400\ V, T_J = 125\ ^oC$

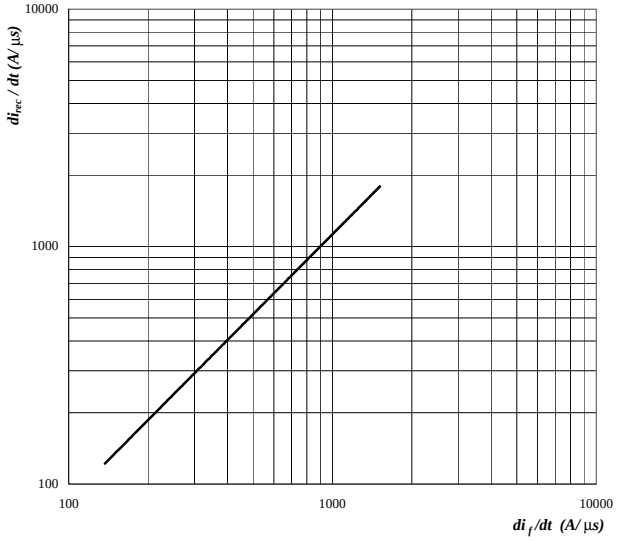


Typ. di_{rec} / dt

Output inverter FRED diode

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

par.: $V_R = 400\ V, T_J = 125\ ^oC$

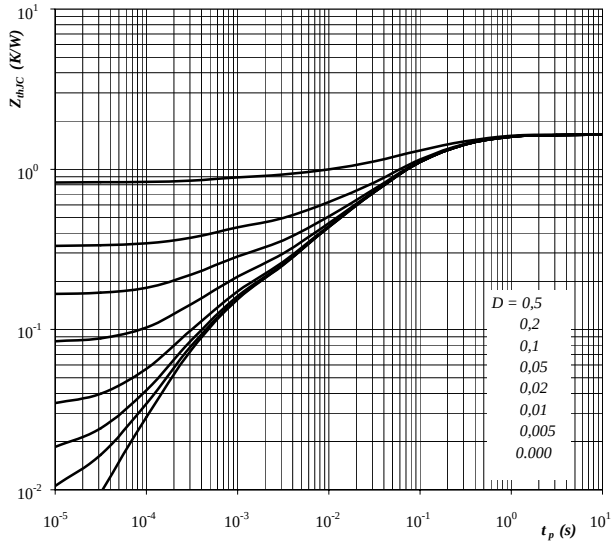


Output inverter

Transient thermal impedance

Output inverter IGBT

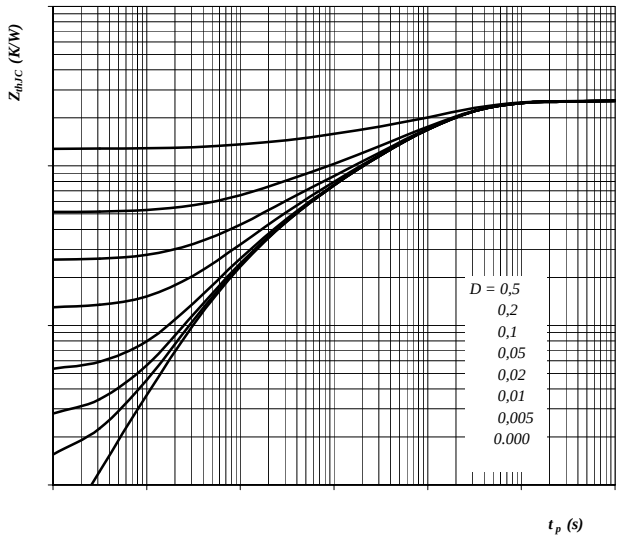
$Z_{thJC} = f(t_p)$
Parameter: $D = t_p / T$



Transient thermal impedance

Output inverter FRED

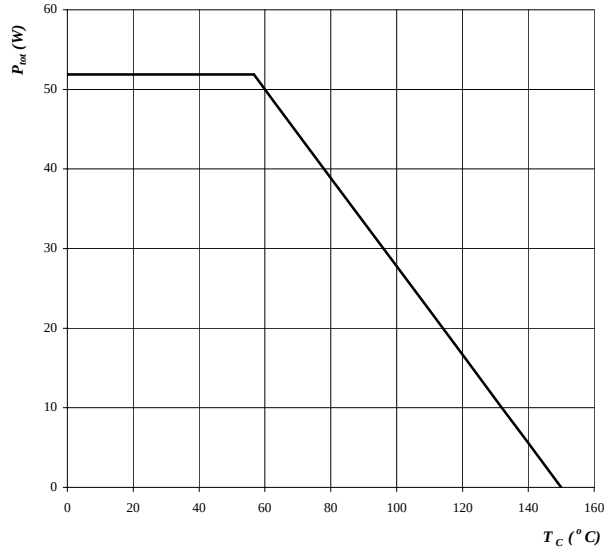
$Z_{thJC} = f(t_p)$
Parameter: $D = t_p / T$



Power dissipation

Output inverter IGBT

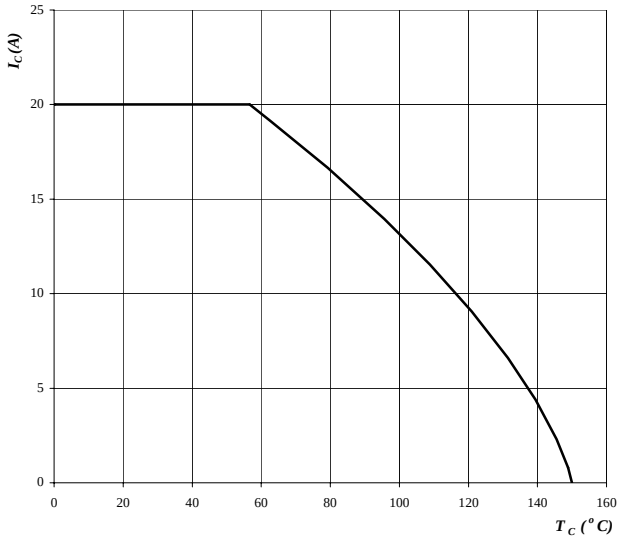
$P_{tot} = f(T_C)$
parameter: $T_j = 125\ ^\circ C$



Collector current

Output inverter IGBT

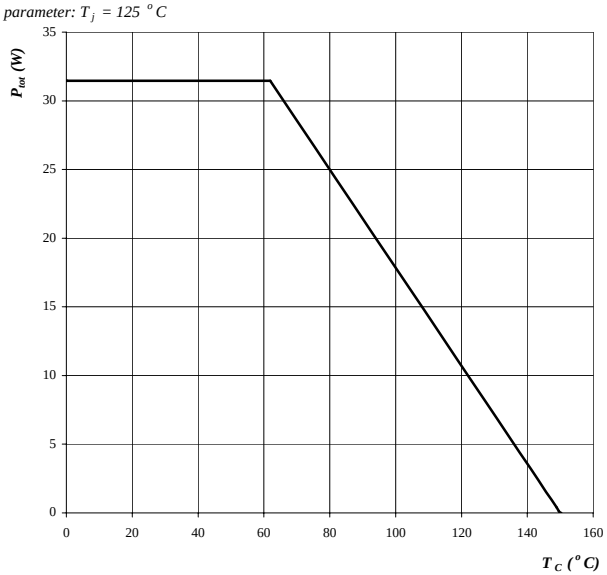
$Ic = f(T_C)$
parameter: $V_{GE} = 15\ V$, $T_j = 125\ ^\circ C$



Output inverter

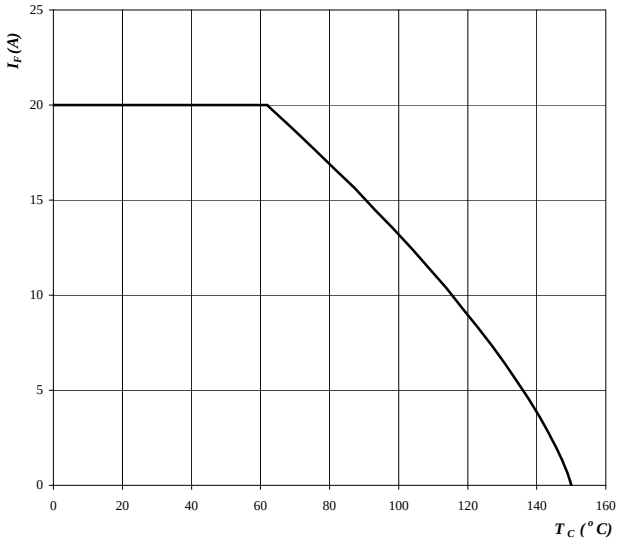
Power dissipation
Output inverter FRED

$P_{tot} = f(T_C)$
parameter: $T_j = 125\ ^oC$



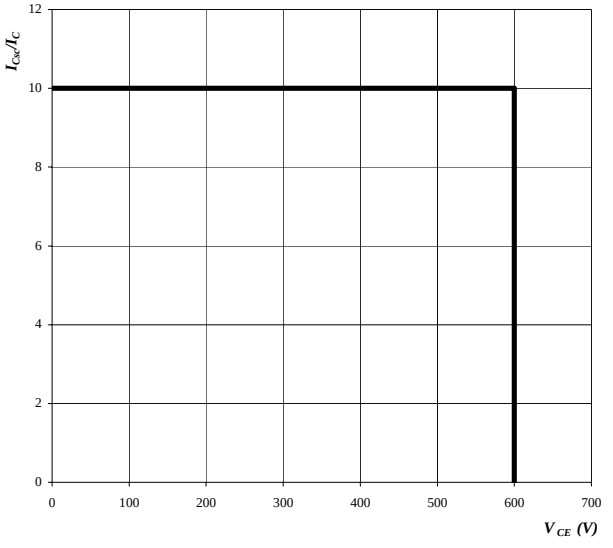
Forward current
Output inverter FRED

$I_F = f(T_C)$
parameter: $T_j = 125\ ^oC$



Short circuit safe operating area
Output inverter IGBT

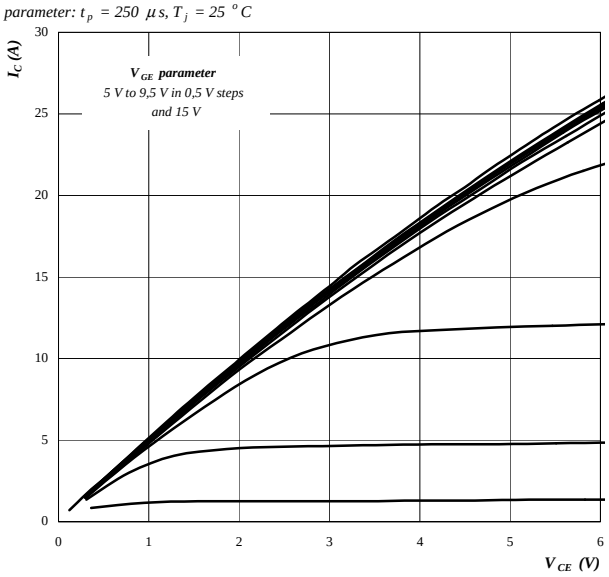
$I_{Csc} = f(V_{CE})$, $T_j = 125\ ^oC$
parameter: $V_{GE} \leq 15$ V, $t_{SC} \leq 10\ \mu s$, $L < 50$ nH



PFC

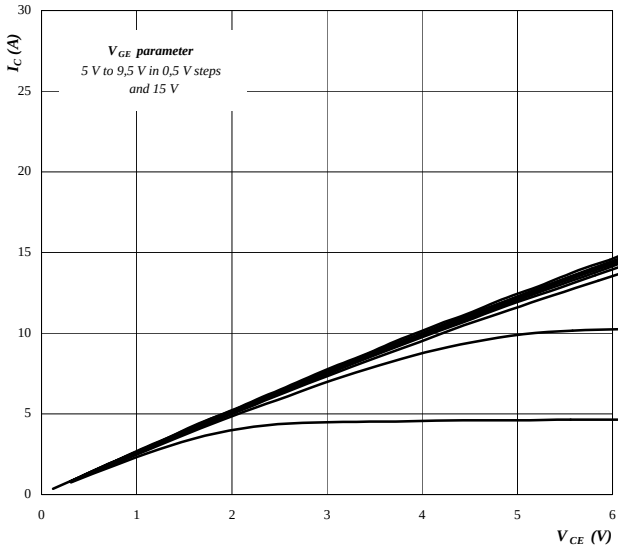
Typ. output characteristics
PFC FET

$I_C = f(V_{CE})$
parameter: t_p = 250 µs, T_j = 25 °C



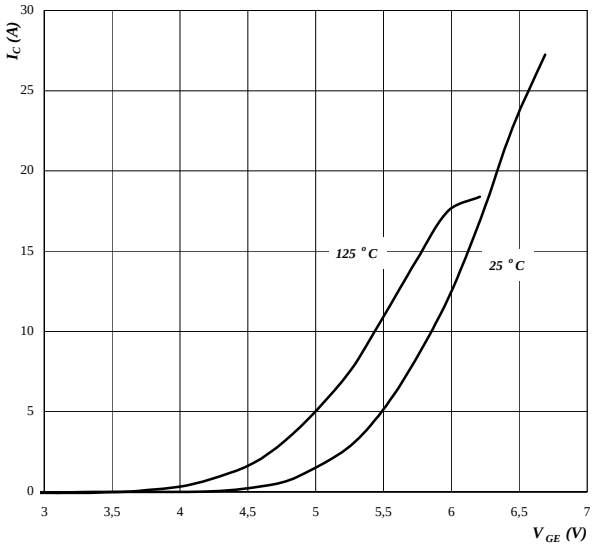
Typ. output characteristics
PFC FET

$I_C = f(V_{CE})$
parameter: t_p = 250 µs, T_j = 125 °C



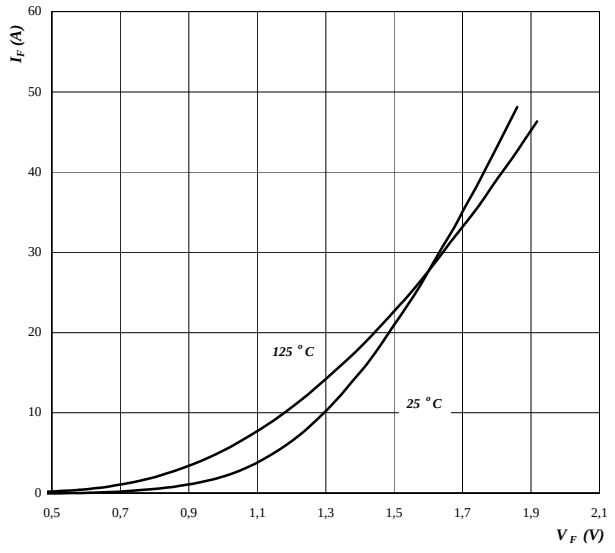
Typ. transfer characteristics
PFC FET

$I_C = f(V_{GE})$
parameter: t_p = 250 µs, V_{CE} = 20 V



Typ. diode chararacteristics
PFC FRED

$I_F = f(V_F)$
parameter: t_p = 250 µs

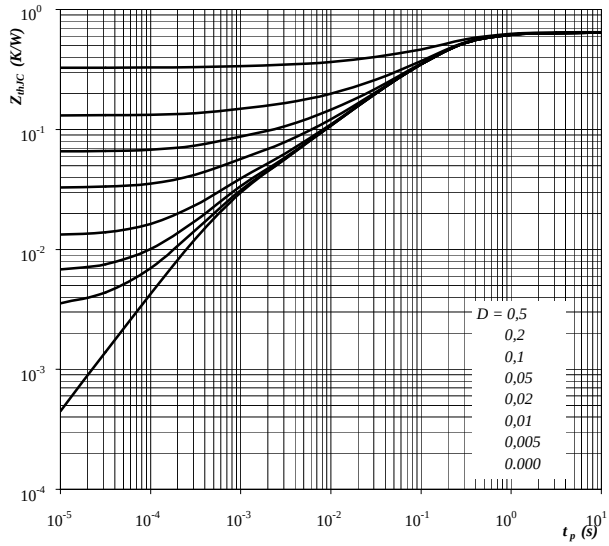


PFC

Transient thermal impedance

PFC FET

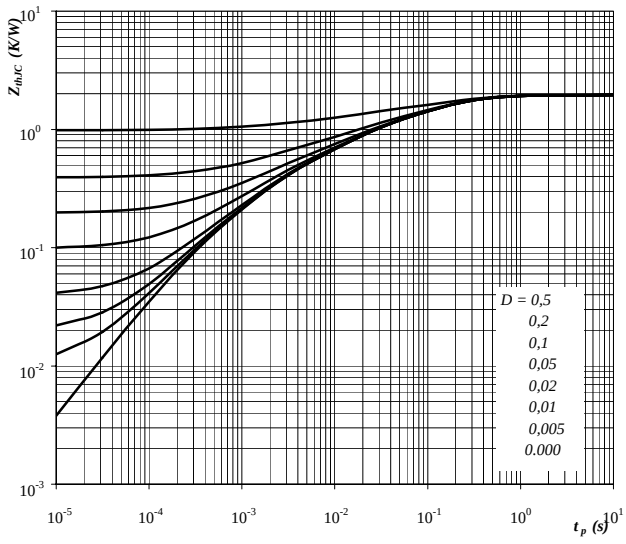
$Z_{thJC} = f(t_p)$
Parameter: $D = t_p / T$



Transient thermal impedance

PFC FRED

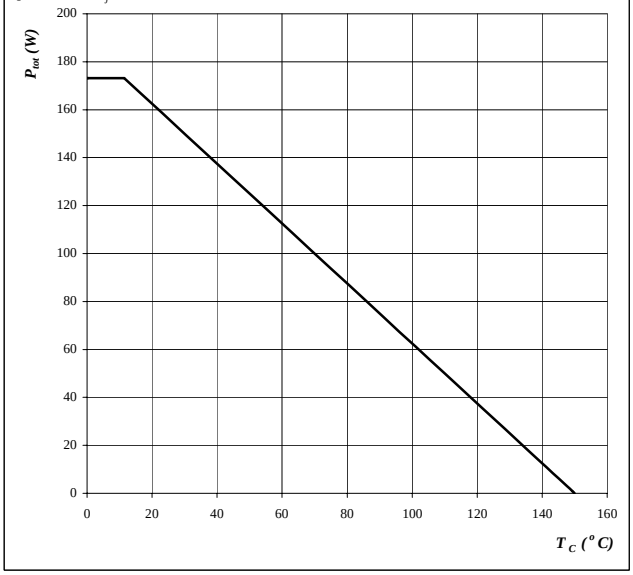
$Z_{thJC} = f(t_p)$
Parameter: $D = t_p / T$



Power dissipation

PFC FET

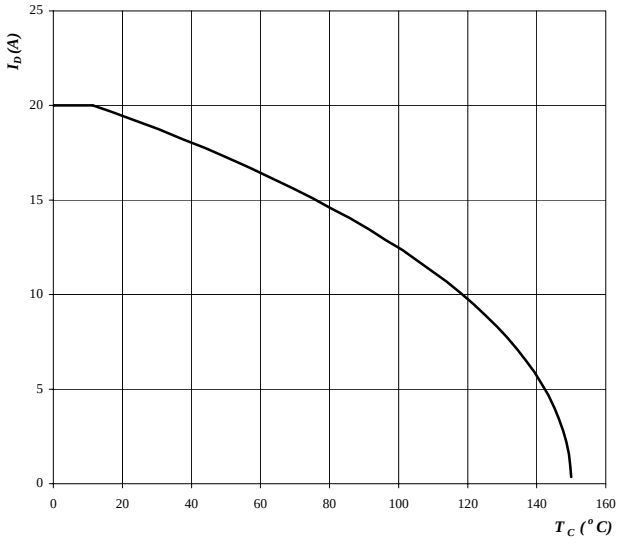
$P_{tot} = f(T_C)$
parameter: $T_j = 125\ ^{o}C$



Drain current

PFC FET

$I_D = f(T_C)$
parameter: $V_{DS} = 15\ V$, $T_j = 125\ ^{o}C$



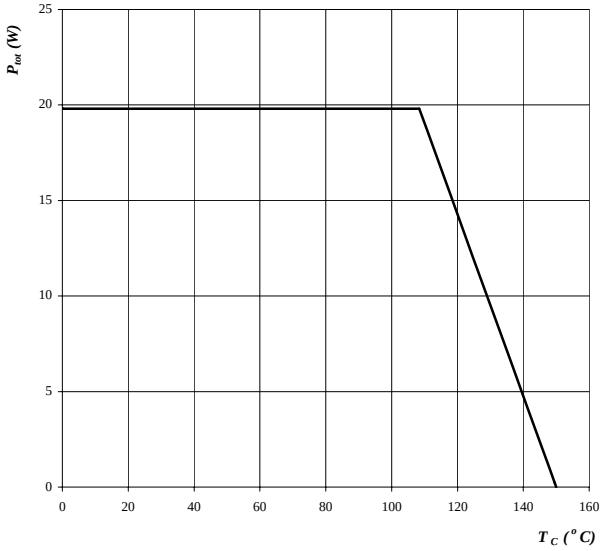
PFC

Power dissipation

PFC FRED

$P_{tot} = f(T_C)$

parameter: $T_j = 125\ ^oC$

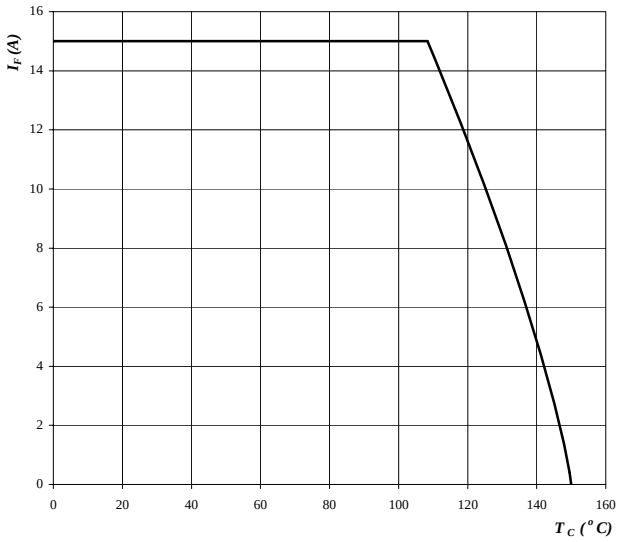


Forward current

PFC FRED

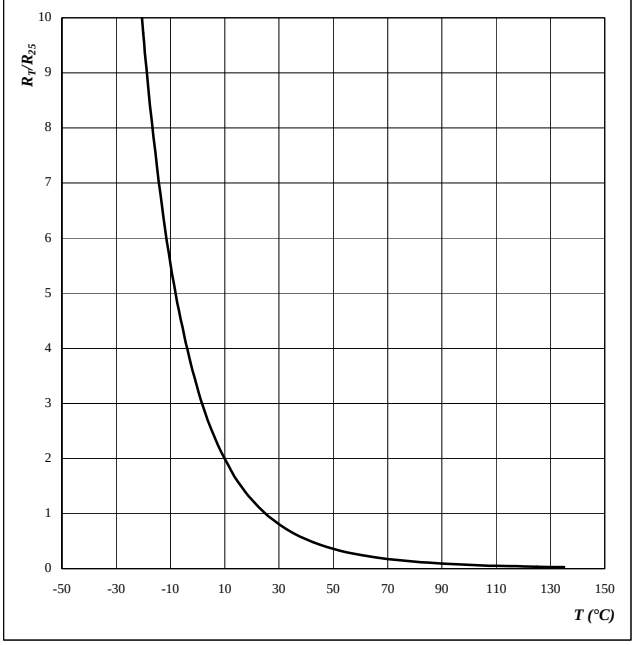
$I_F = f(T_C)$

parameter: $T_j = 125\ ^oC$



Thermistor

NTC-typical temperature characteristic

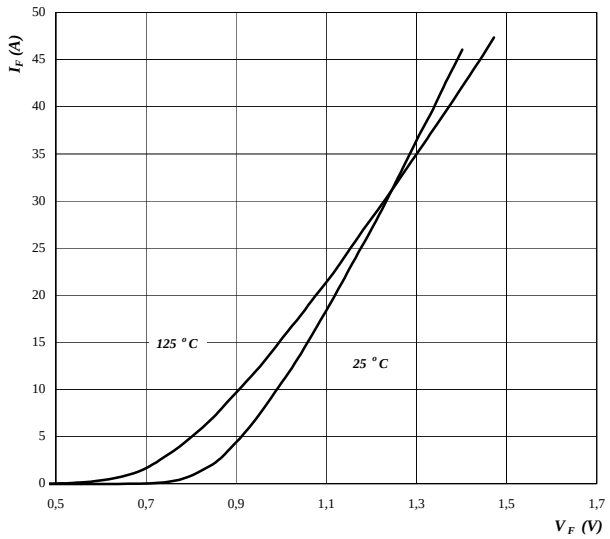


Input rectifier bridge

Typ. diode characteristics

Input rectifier Bridge

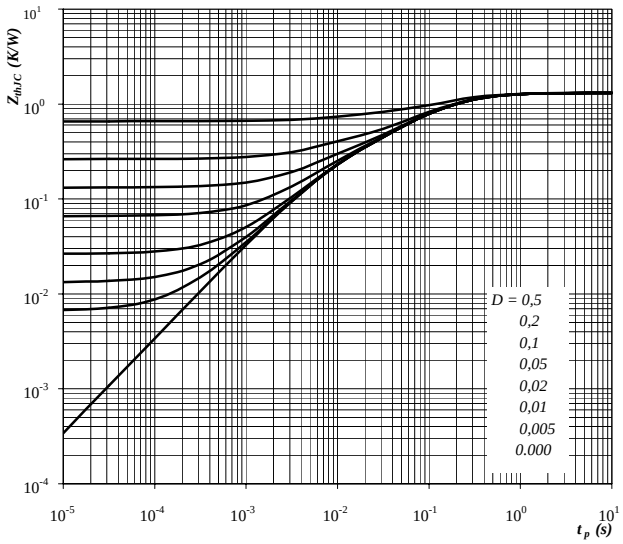
$I_F = f(V_F)$
parameter: $t_p = 250\ \mu s$



Transient thermal impedance

Input Rectifier Bridge

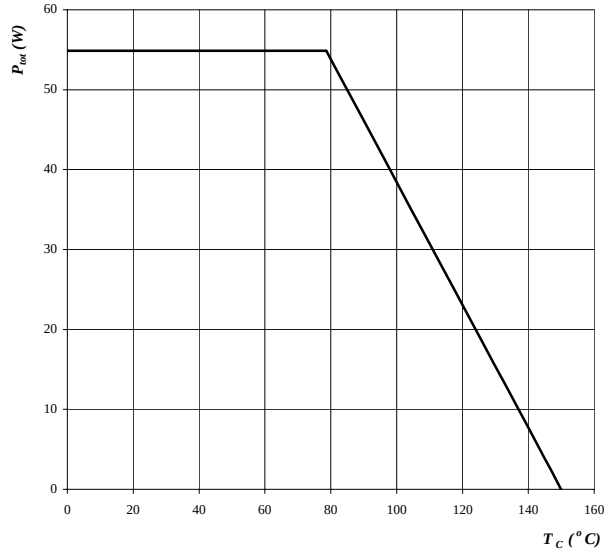
$Z_{thJC} = f(t_p)$
Parameter: $D = t_p / T$



Power dissipation

Rectifier

$P_{tot} = f(T_C)$
parameter: $T_j = 125\ ^\circ C$



Forward current

Rectifier

$I_F = f(T_C)$
parameter: $T_j = 125\ ^\circ C$