

flow PIM® 1+P; 600V
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
I _{2t} -value Grenzlastintegral	tp=10ms	TJ=25°C	I ² t	310	A ² s
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	20	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	Icpuls	40	A
Power dissipation per IGBT Verlustleistung pro IGBT	Tj=150°C	TC=25°C TC=80°C	Ptot	45	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	17	A
Repetitive peak forward current Periodischer Spitzenstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	IFRM	34	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 Drai-Source Sperrspannung			Vbr	500	V
DC drain current Drain-Dauergleichstrom	Tj=150°C	TC=25°C TC=80°C	Id	30 21	A
Pulsed drain current Periodischer Drainstrom	Tj=150°C tp=1ms	TC=25°C TC=80°C	Idpuls	60 42	A
Power dissipation Verlustleistung	Tj=150°C	TC=25°C TC=80°C	Ptot	210 115	W
Gate-source peak voltage Gate-Source-Spitzenspannung			Vgs	±20	V

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Parameter	Condition	Symbol	Value	Unit
PFC Diode				
DC forward current Dauergleichstrom	T _j =150°C TC=25°C TC=80°C	IF	20	A
Repetitive peak forward current Periodischer Spitzenstrom	T _j =150°C tp=1ms TC=25°C TC=80°C	IFRM	40	A
Power dissipation per Diode Verlustleistung pro Diode	T _j =150°C TC=25°C TC=80°C	P _{tot}	23	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}	1,60	K/W
	Diode Inverter	R _{thJC}	2,80	K/W
	Transistor PFC	R _{thJC}	0,60	K/W
	Diode PFC	R _{thJC}	1,20	K/W

Insulation properties
Modulisolation

Insulation test voltage Isolationsspannung	t=1min	V _{is}	4000	Vdc
Creepage distance Kriechstrecke			12,7	mm
Clearance Luftstrecke			12,7	mm

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

Parameter FET Parameter	Symbol	Condition	T (°C)	RG	VGE	VCE	IF	IC	Value			Unit
				RG (W)	VGS (V)	VDS (V)	(A)	Id (A)	min.	typ.	max.	

Input Rectifier Bridge
Gleichrichter

Forward voltage Durchlaßspannung	VF		T _J =25°C				20			1,17		V
Threshold voltage (for pwr. loss calc. only) Schleusenspannung	Vto		T _J =25°C				20			0,92		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	rt		T _J =25°C				20			12,5		mΩ
Reverse current Sperrstrom	Ir	VR=VRmax	T _J =25°C								0,02	mA

Transistor Inverter, inductive load
Transistor Wechselrichter

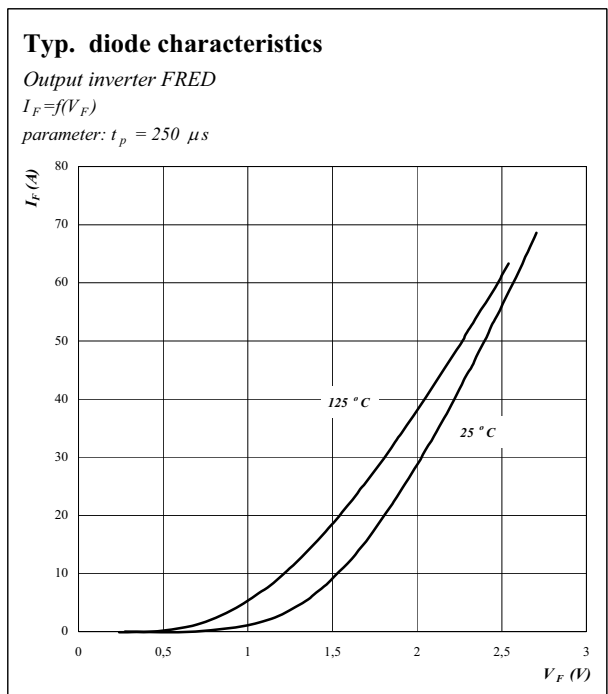
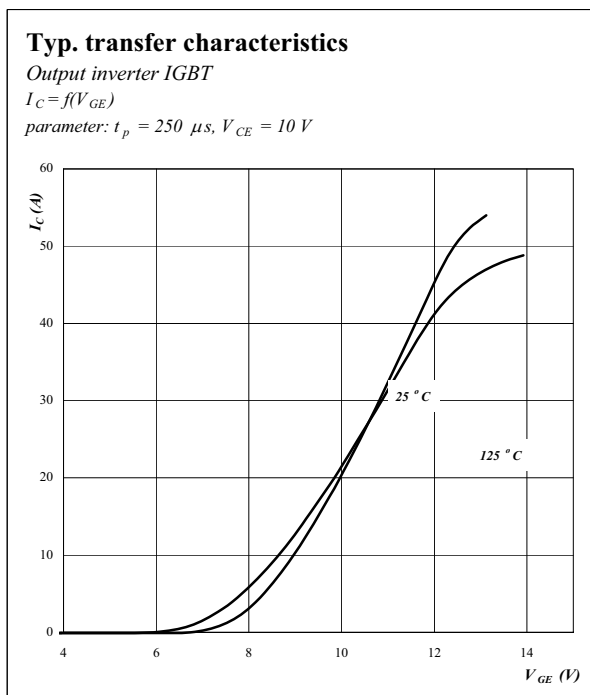
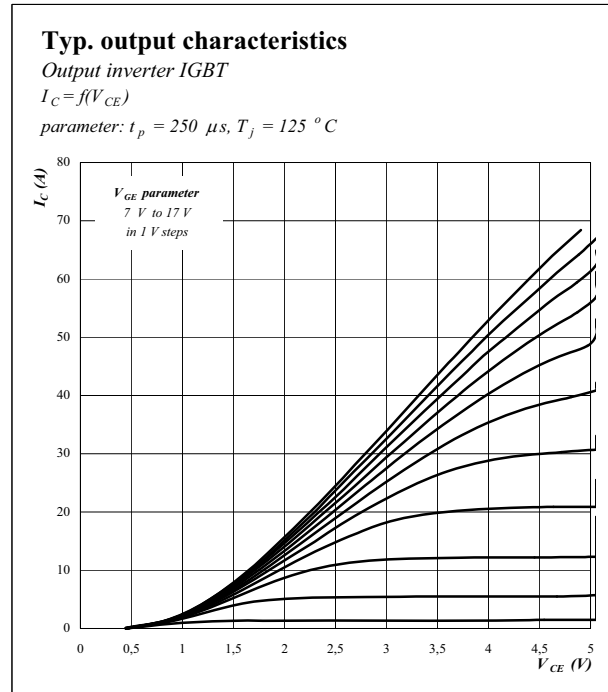
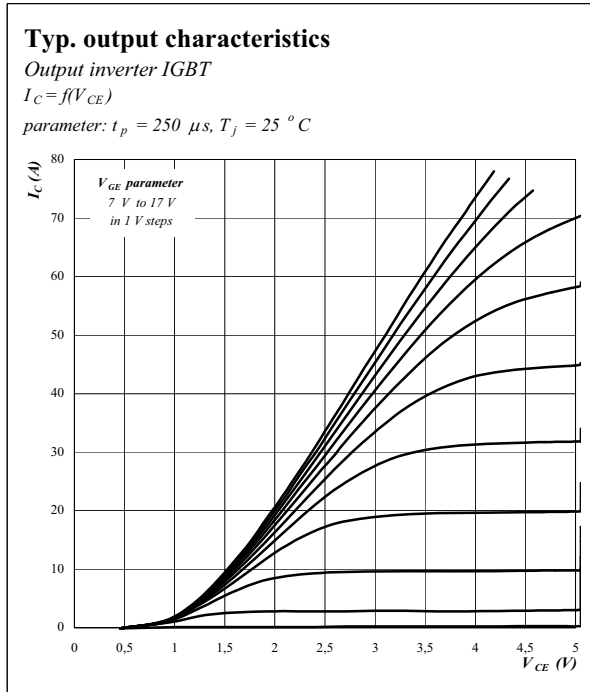
Gate emitter threshold voltage Gate-Schwellenspannung	VGE(th)	Vge=Vce	T _J =25°C					500μ	4,5	5,5	6,5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	VCE(sat)		T _C =25°C		15			20,0	1,7	2	2,5	V
Collector-emitter cut-off current incl. FRED Kollektor-Emitter Reststrom inkl. FRED	ICES		T _C =25°C		0	600					70	μA
Gate-emitter leakage current Gate-Emitter Reststrom	IGES		T _J =25°C		30	0					120	nA
Turn-on delay time Einschaltverzögerungszeit	td(on)	Rg(on)=Rg(off)	T _J =25°C T _J =125°C	62	15	400		20,0		22 20	50 42	ns
Rise time Anstiegszeit	tr	Rg(on)=Rg(off)	T _J =25°C T _J =125°C	62	15	400		20,0		12 14	30 30	ns
Turn-off delay time Abschaltverzögerungszeit	td(off)	Rg(on)=Rg(off)	T _J =25°C T _J =125°C	62	15	400		20,0		143 156	300 330	ns
Fall time Fallzeit	tf	Rg(on)=Rg(off)	T _J =25°C T _J =125°C	62	15	400		20,0		19 24	50 58	ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	Eon	Rg(on)=Rg(off)	T _J =125°C		15	400		20,0		645		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	Eoff	Rg(on)=Rg(off)	T _J =125°C		25	400		20,0		862		mWs
SC withstand time Kurzschlußverhalten	tSC	@ 10*Ic(max)	T _J =125°C								10	μs
Input capacitance Eingangskapazität	Cies	f=1MHz	T _J =25°C		0	25				1,1		nF
Output capacitance Ausgangskapazität	Coss	f=1MHz	T _J =25°C									nF

Diode Inverter
Diode Wechselrichter

Diode forward voltage Durchlaßspannung	VF		T _J =25°C					20			2	V
Peak reverse recovery current Rückstromspitze	IRM	dIF/dt= -200A/μs	T _J =25°C T _J =125°C			400	20			6,4		A
Reverse recovery time Sperrverzögerungszeit	trr	dIF/dt= -200A/μs	T _J =125°C			400	20			74		ns
Reverse recovered charge Sperrverzögerungsladung	Qrr	dIF/dt= -200A/μs	T _J =125°C			400	20			0,35		μC

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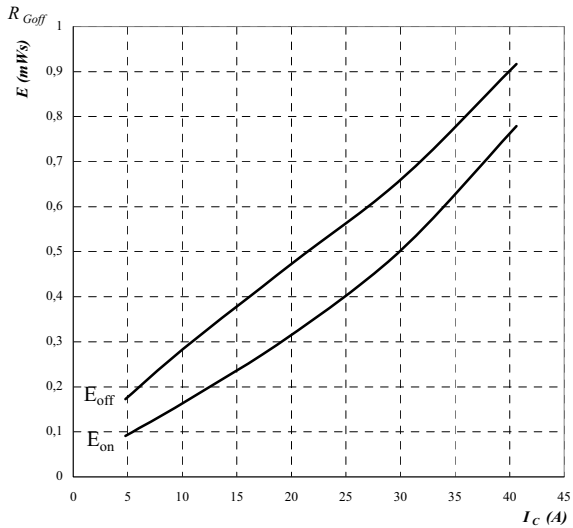
Parameter FET Parameter	Symbol	Condition	T (°C)	RG	VGE	VCE	IF	IC	Value			Unit	
				RG (W)	VGS (V)	VDS (V)	(A)	Id (A)	min.	typ.	max.		
Transistor PFC													
Transistor PFC													
Static drain to source ON resistance Statische drain-source Widerstand	Rds(on)		TJ=25°C	10				22,0			0,15	Ω	
Gate 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	2,15				36,0		23		ns	
Rise Time Anstiegszeit	tr	VDD=350V	TJ=25°C	2,15				36,0		98		ns	
Turn off delay time Abschaltverzögerung	td(OFF)	VDD=350V	TJ=25°C	2,15				36,0		52		ns	
Fall time Abstiegszeit	tf	VDD=350V	TJ=25°C	2,15				36,0		80		ns	
Total gate charge Gate Ladung	Qg	VDD=350V	TJ=25°C		10	400		36,0			180	nC	
Gate to source charge Gate source Ladung	Qgs		TJ=25°C		10	400		36,0			46	nC	
Input capacitance Eingangskapazität	Ciss	f=1MHz	TJ=25°C		0	25				5579		pF	
Output capacitance Ausgangskapazität	Coss	f=1MHz	TJ=25°C		0	400				221		pF	
Diode PFC													
Diode PFC													
Forward voltage Durchlaßspannung	VF		TJ=25°C TJ=25°C TJ=125°C					25 50 25			1,3 1,5 1,3	1,7 2 1,7	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							1,5 600		20 2000	µA
Reverse recovery time Sperrverzögerungszeit	trr	Vr=200V dif/dt=-200A/µs	TJ=25°C TJ=125°C				25			50 105		75 160	ns
Peak recovery current Rückstromspitze	Irrm	Vr=200V dif/dt=-200A/µs	TJ=25°C TJ=125°C				25			4,5 8		10 15	A
Reverse recovery charge Sperrverzögerungsladung	Qrr	Vr=200V dif/dt=-200A/µs	TJ=25°C TJ=125°C				25			112 420		375 1200	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				25			250 160			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
Shunt resistors													
Shuntwiderstände													
R1 value R1 Wert	R	Tol. 1%	Tc=25°C							15			mΩ
Power dissipation Verlustleistung	P		Tc=25°C									5	W
R2 value R2 Wert	R	Tol. 1%	Tc=25°C							22			mΩ
Power dissipation Verlustleistung	P		Tc=25°C									3	W
R3 value R3 Wert	R	Tol. 1%	Tc=25°C							22			mΩ
Power dissipation Verlustleistung	P		Tc=25°C									3	W

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Output inverter


flow PIM® 1 + P; 600V
Output inverter
Typ. Switching losses

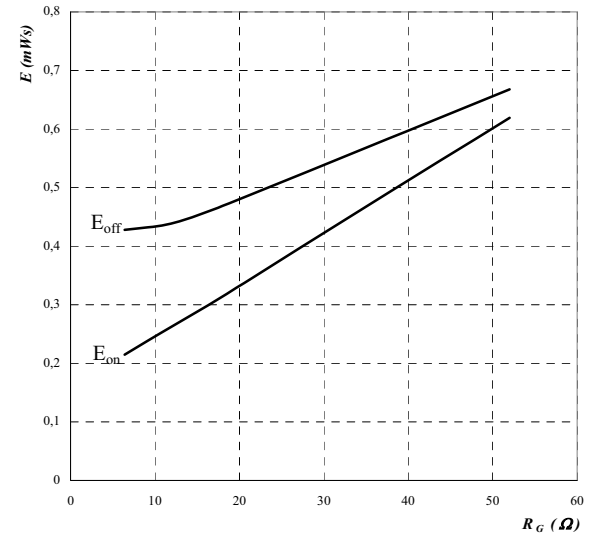
Output inverter IGBT

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

 par.: $V_{CE} = 400 V$, $V_{GE} = 15 V$, $R_G = 18 \Omega$, $R_{Gon} =$

Typ. Switching losses

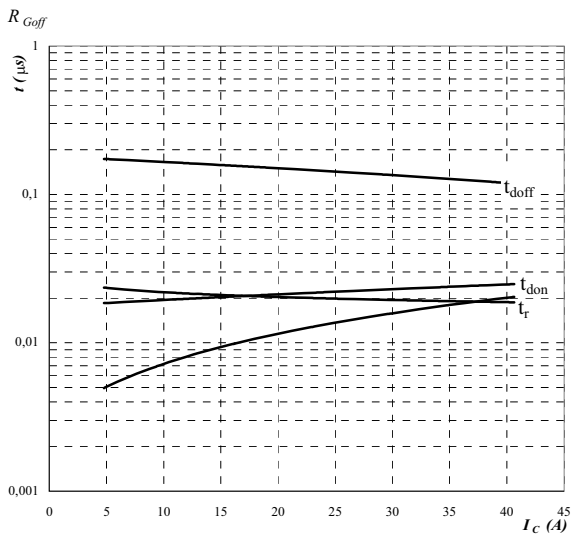
Output inverter IGBT

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

 par.: $V_{CE} = 400 V$, $V_{GE} = 15 V$, $I_C = 20 A$, $R_{Gon} = R_{Goff}$

Typ. Switching time

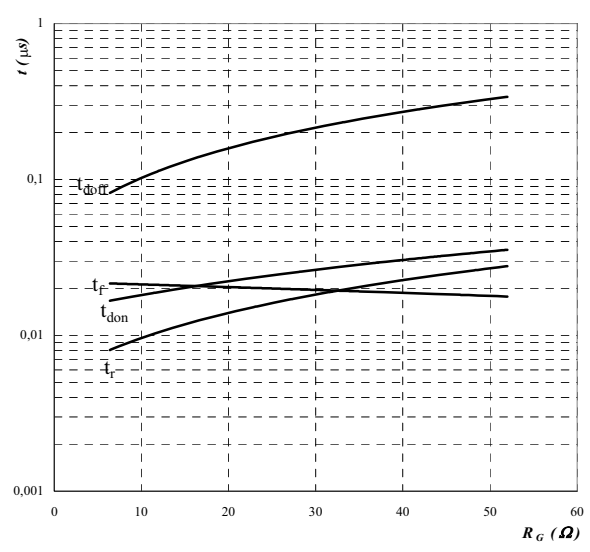
Output inverter IGBT

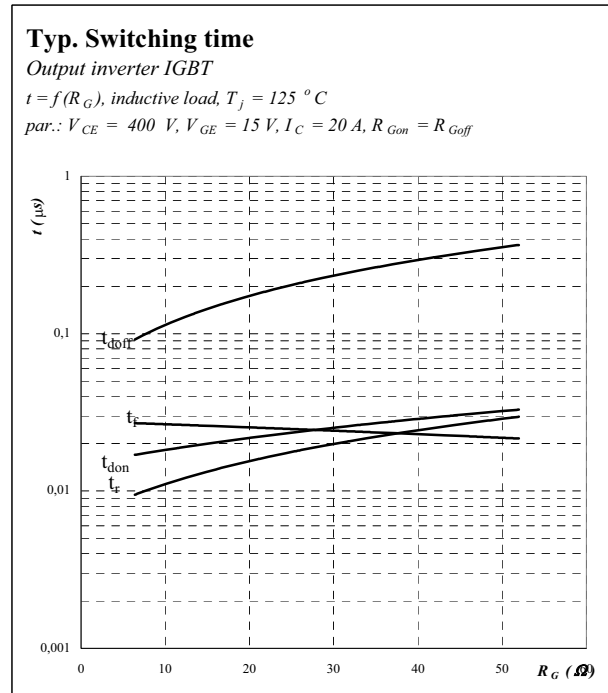
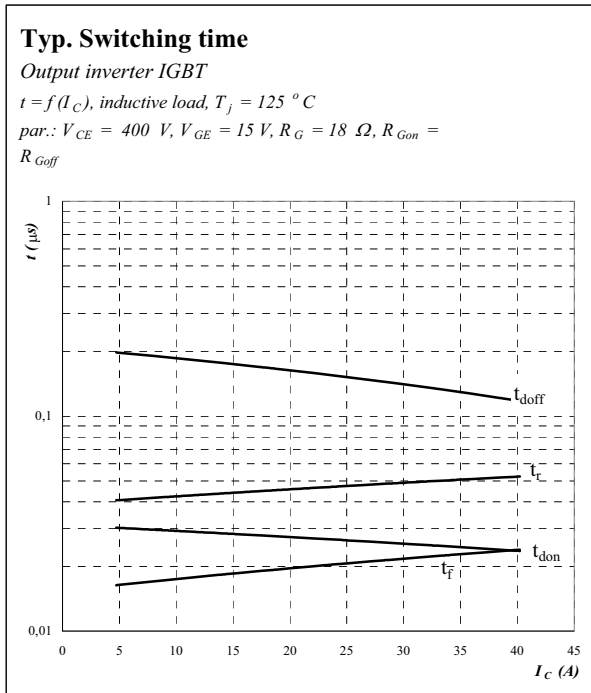
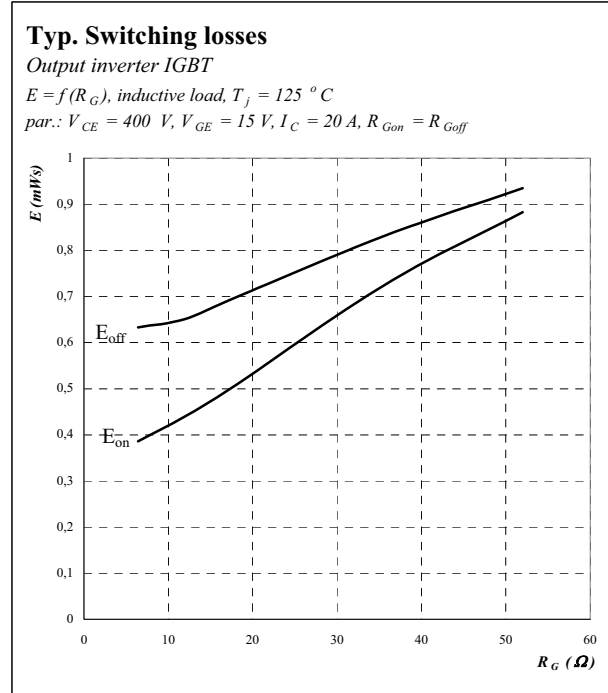
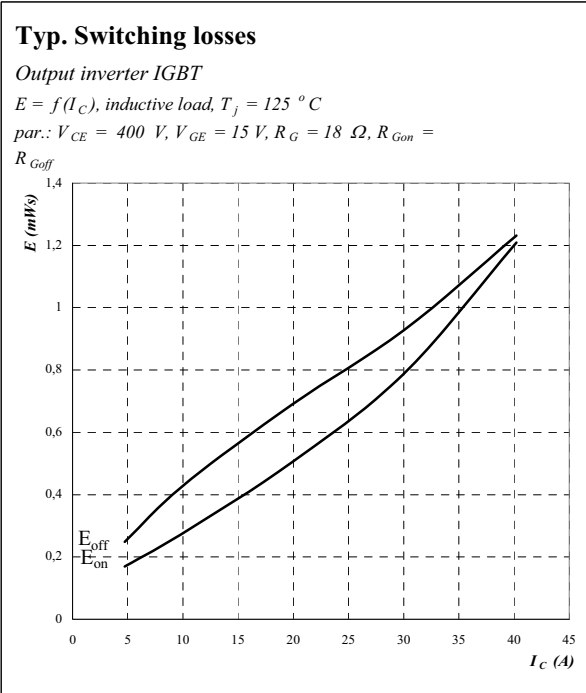
 $t = f(I_C)$, inductive load, $T_j = 25^\circ C$

 par.: $V_{CE} = 400 V$, $V_{GE} = 15 V$, $R_G = 18 \Omega$, $R_{Gon} =$

Typ. Switching time

Output inverter IGBT

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

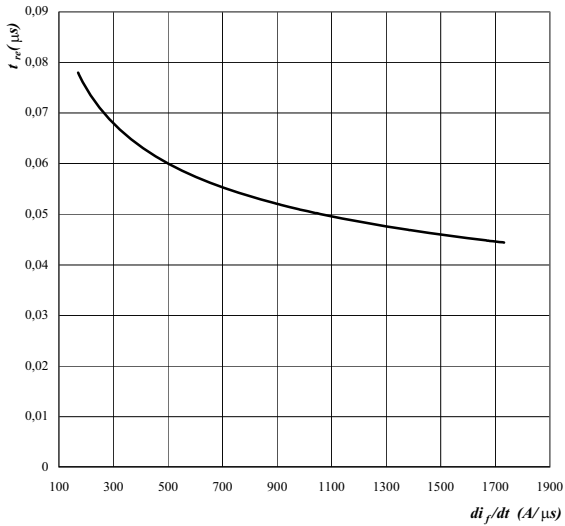
 par.: $V_{CE} = 400 V$, $V_{GE} = 20 V$, $I_C = 15 A$, $R_{Gon} = R_{Goff}$


flow PIM[®] 1 + P; 600V
Output inverter


flow PIM® 1 + P; 600V
FRED diode
Typ. Reverse recovery time

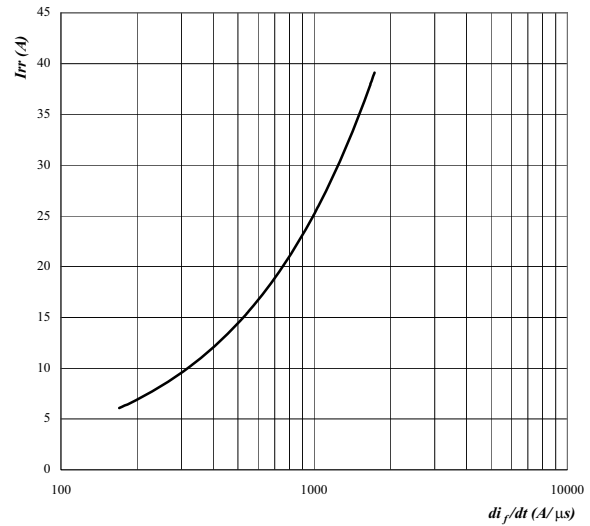
Output inverter FRED diode

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

 par.: $V_R = 400\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$

Typ. Reverse recovery current

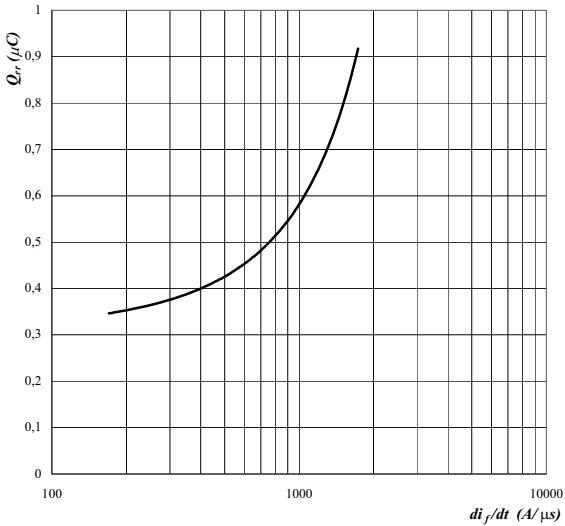
Output inverter FRED diode

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

 par.: $V_R = 400\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$

Typ. Reverse stored charge

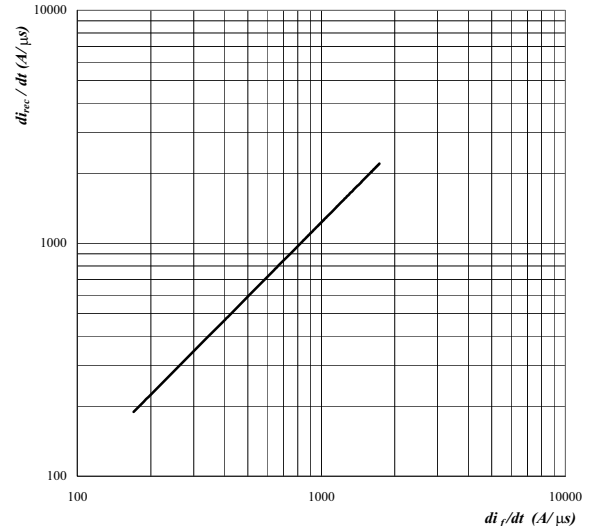
Output inverter FRED diode

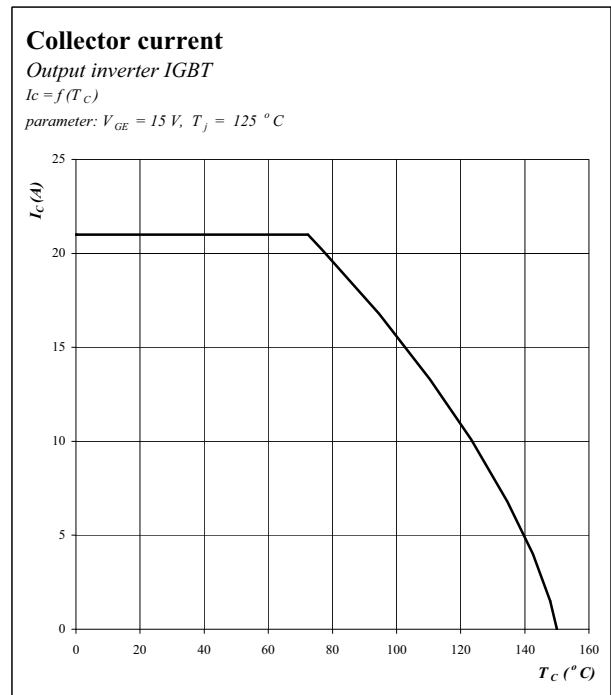
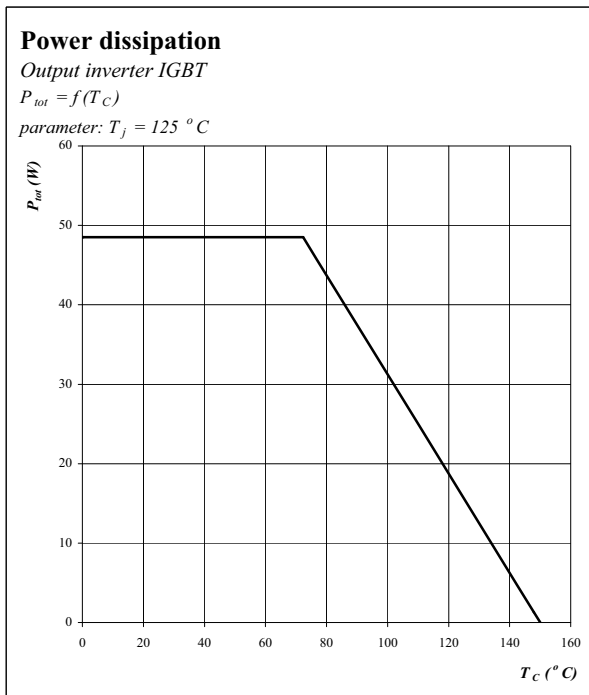
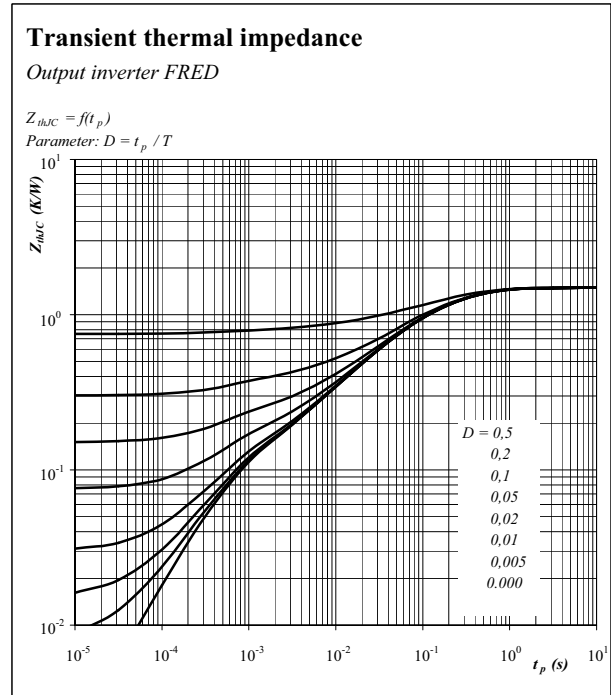
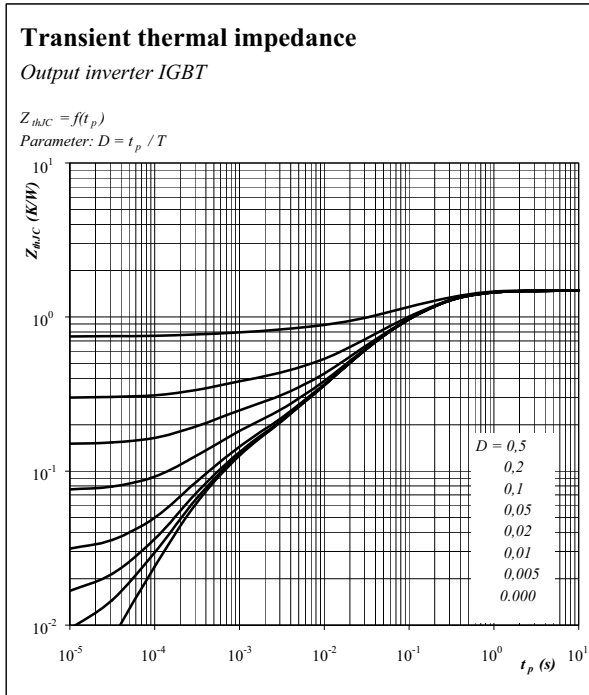
$$Q_{rr} = f(di_f / dt)$$

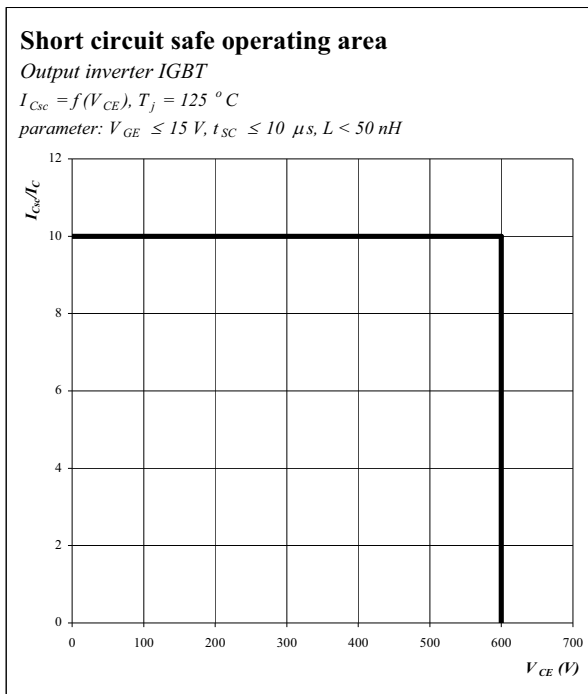
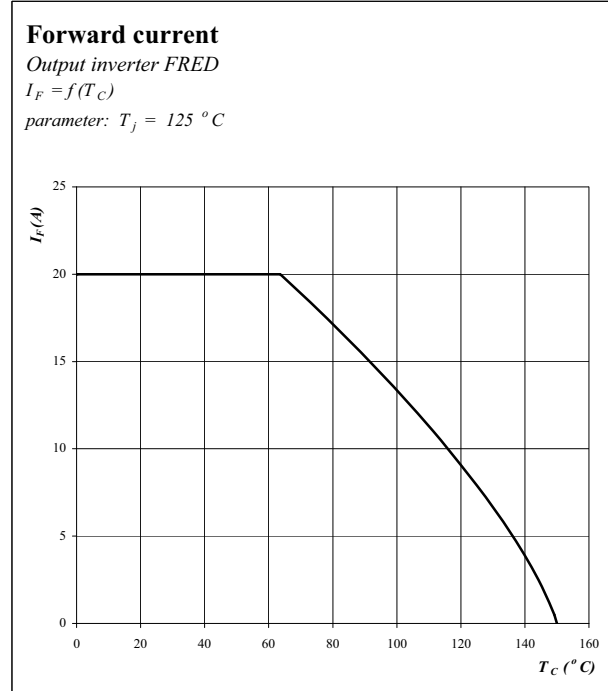
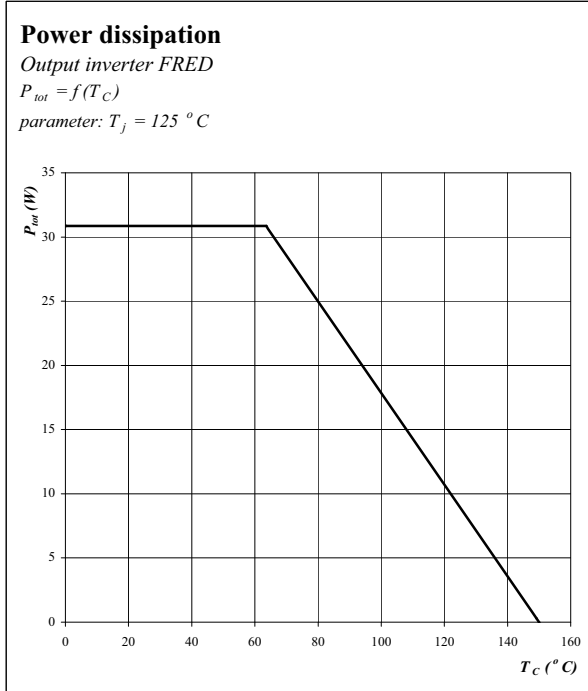
 par.: $V_R = 400\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$

Typ. di_{rec} / dt

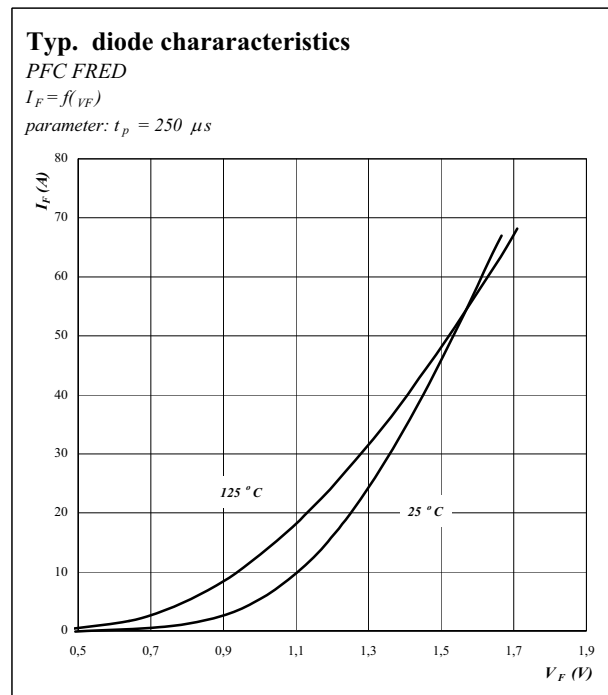
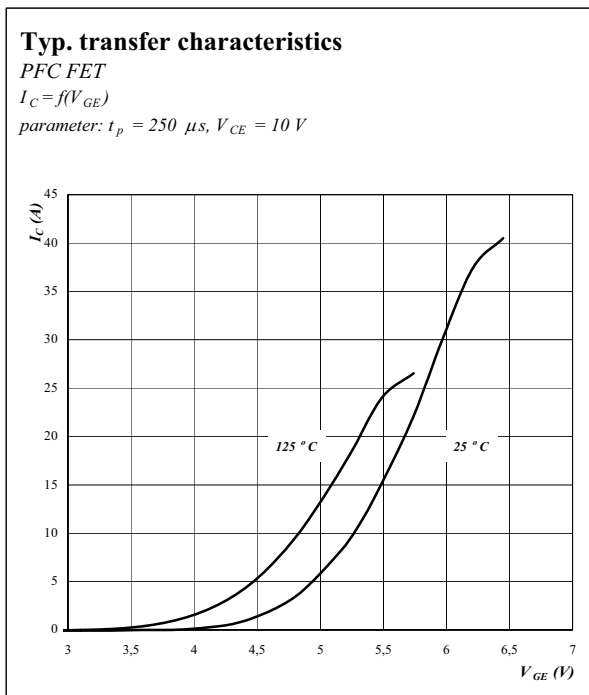
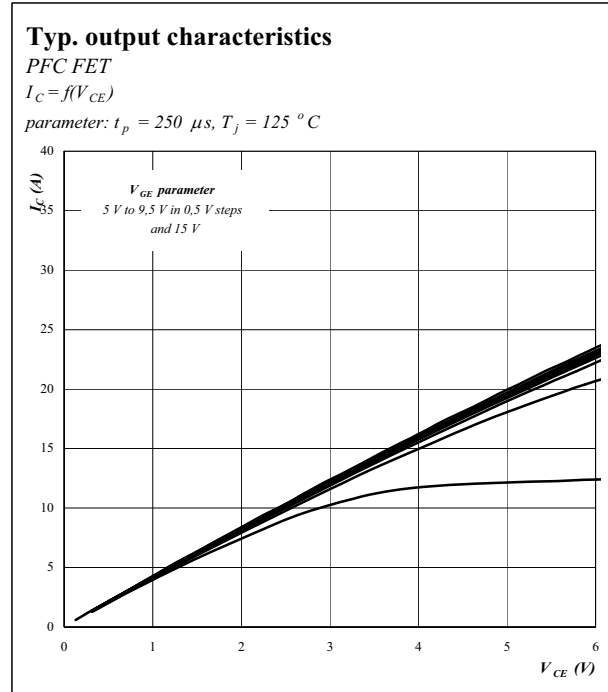
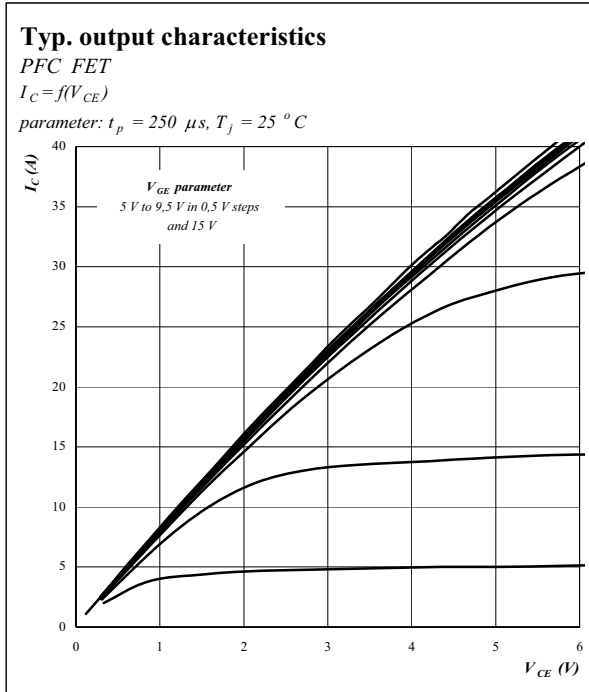
Output inverter FRED diode

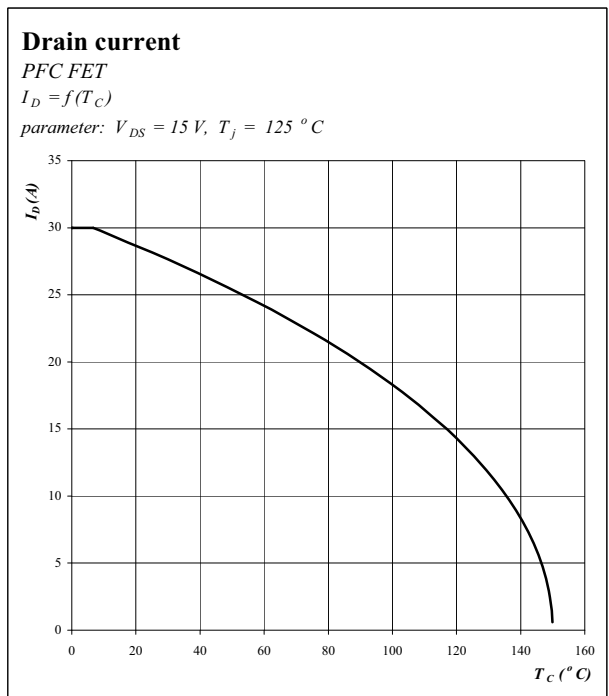
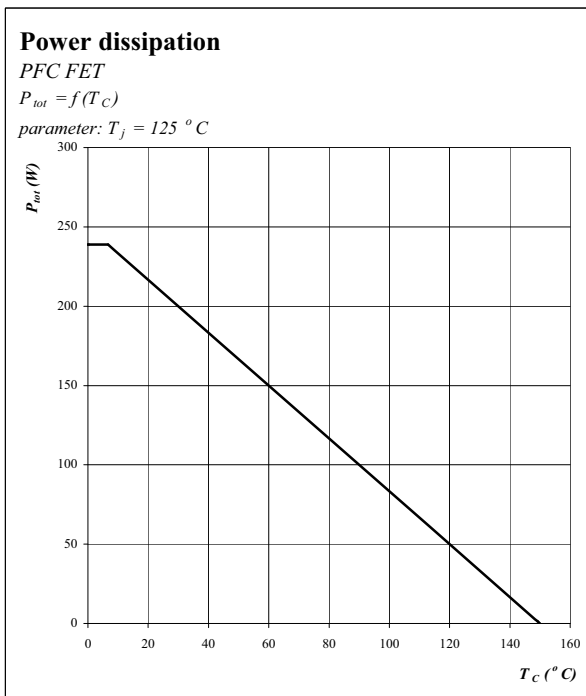
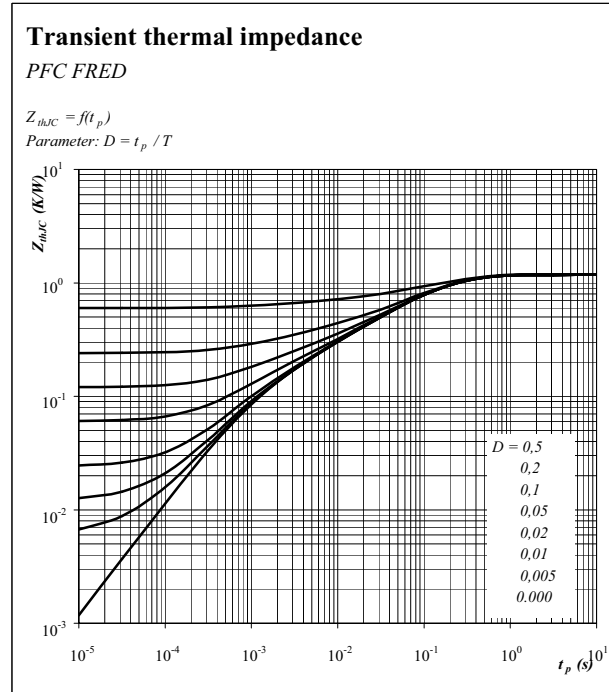
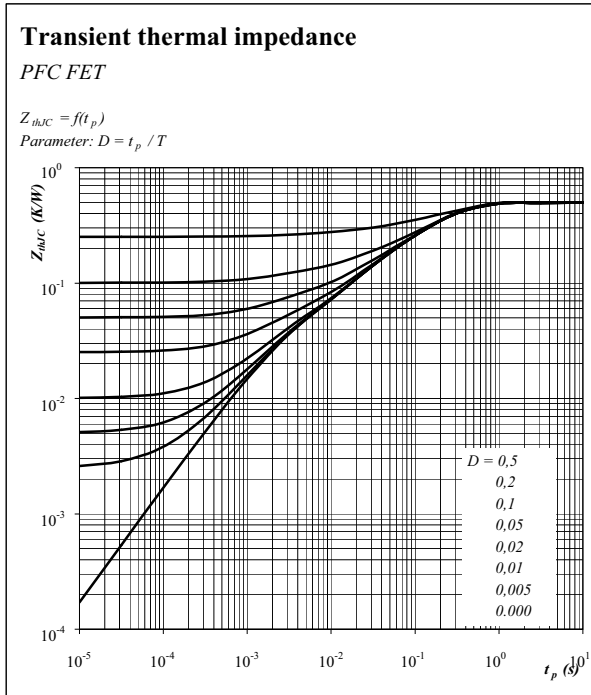
$$I_{rr} = f(di_f / dt)$$

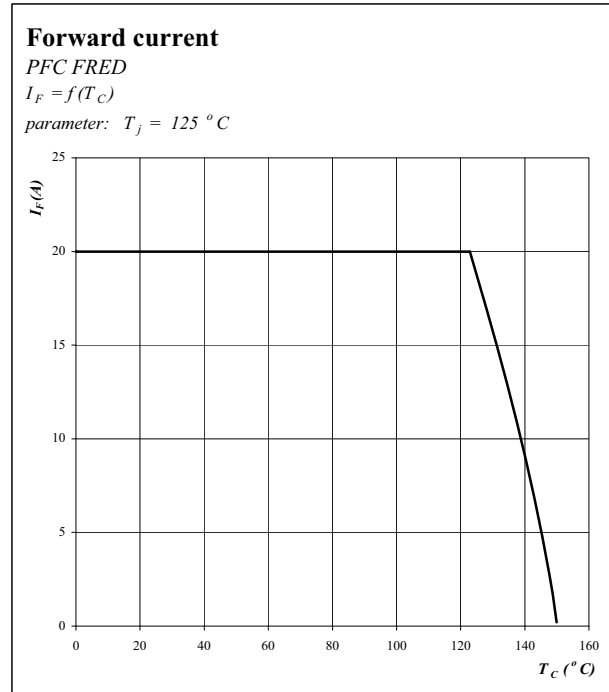
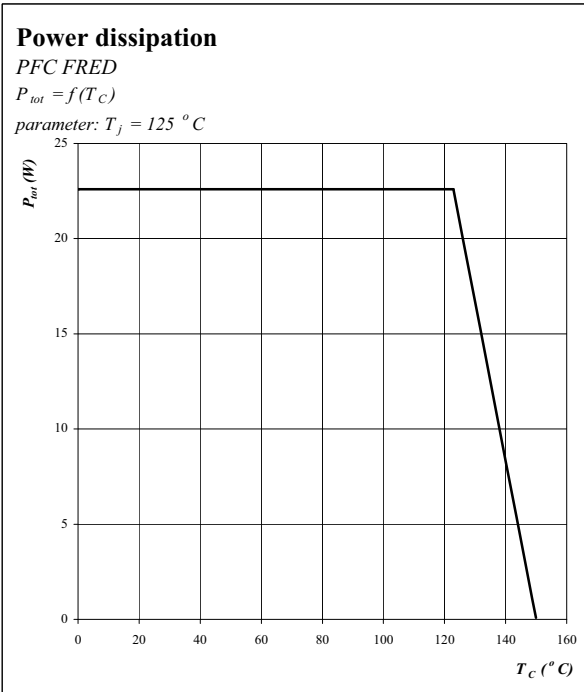
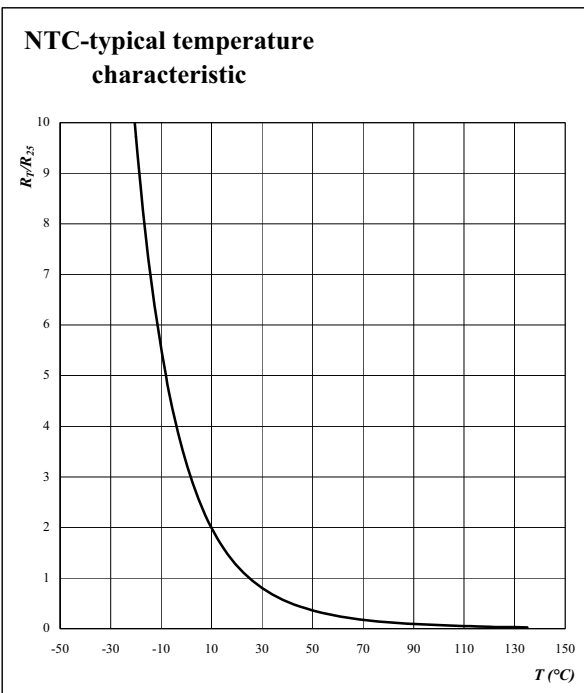
 par.: $V_R = 400\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$


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Output inverter


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Output inverter


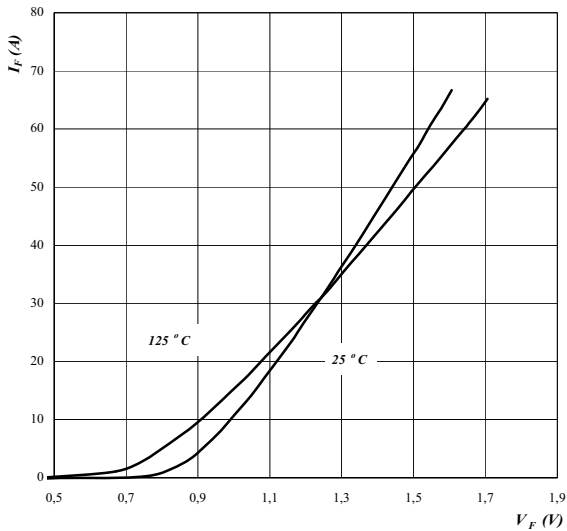
flow PIM[®] 1 + P; 600V
PFC


flow PIM® 1 + P; 600V
PFC


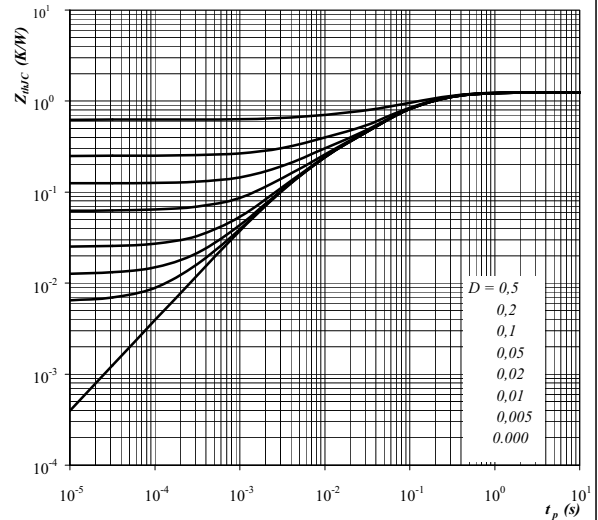
flow PIM[®] 1 + P; 600V
PFC

Thermistor


flow PIM® 1 + P; 600V
Input rectifier bridge
Typ. diode characteristics
Input rectifier Bridge

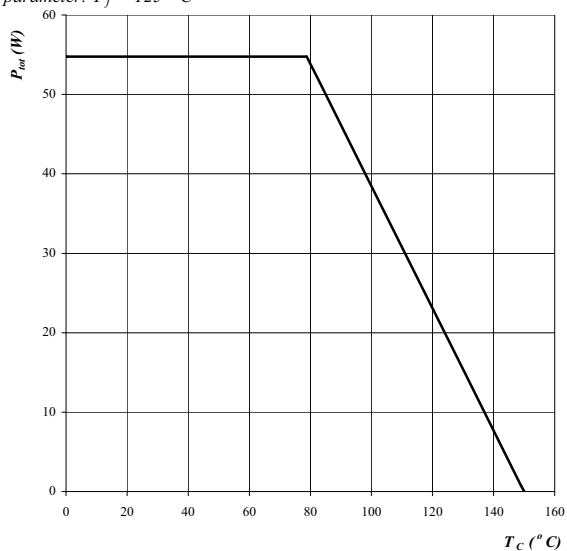
$$I_F = f(V_F)$$

 parameter: $t_p = 250 \mu s$

Transient thermal impedance
Input Rectifier Bridge

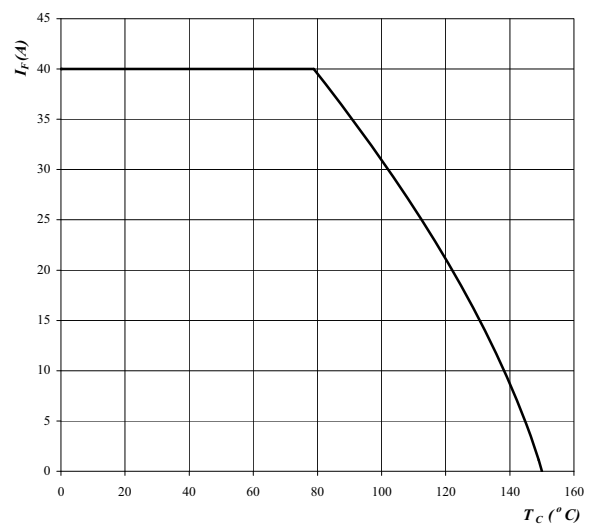
$$Z_{thJC} = f(t_p)$$

 Parameter: $D = t_p / T$

Power dissipation
Rectifier

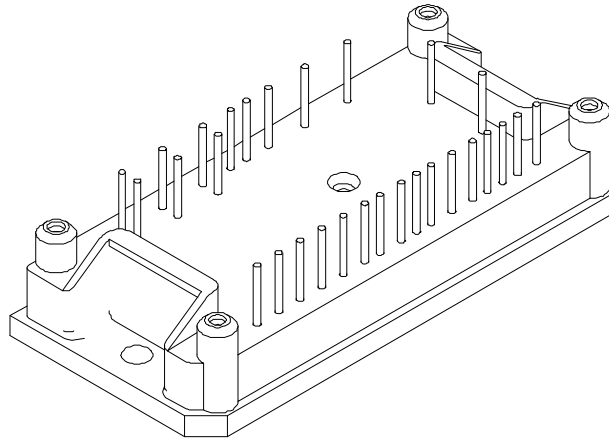
$$P_{tot} = f(T_C)$$

 parameter: $T_j = 125 \text{ } ^\circ C$

Forward current
Rectifier

$$I_F = f(T_C)$$

 parameter: $T_j = 125 \text{ } ^\circ C$


Standard Power Integrated Module with PFC



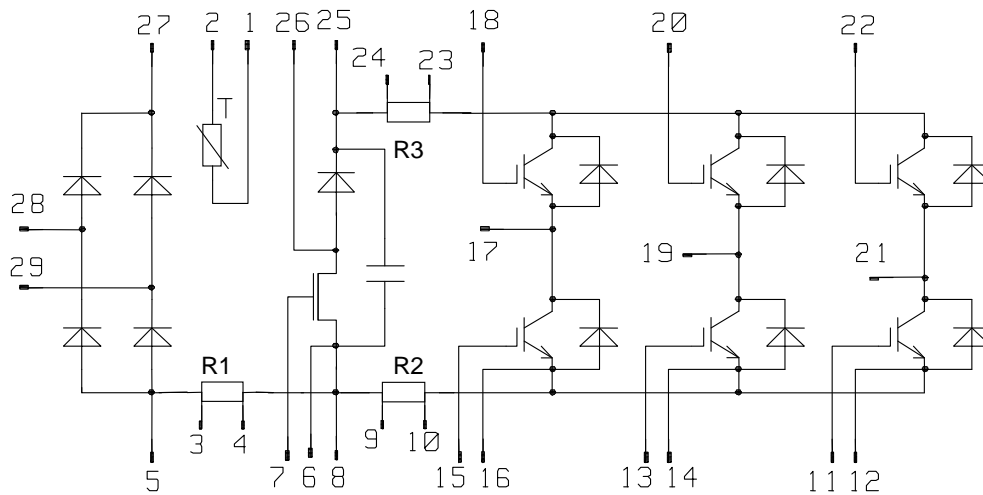
***flowPIM*[®] 1 + P**

Features / Eigenschaften

- 1 Phase Input Rectifier
- PFC Transistor + Diode
- 3 Phase Inverter IGBT + FRED
- HF-Capacitor in DC Link
- Shunt for short to Ground protection in the B+
- Current sense shunt in the B –
- Current sense shunt for PFC controlling in the DC-
- NTC

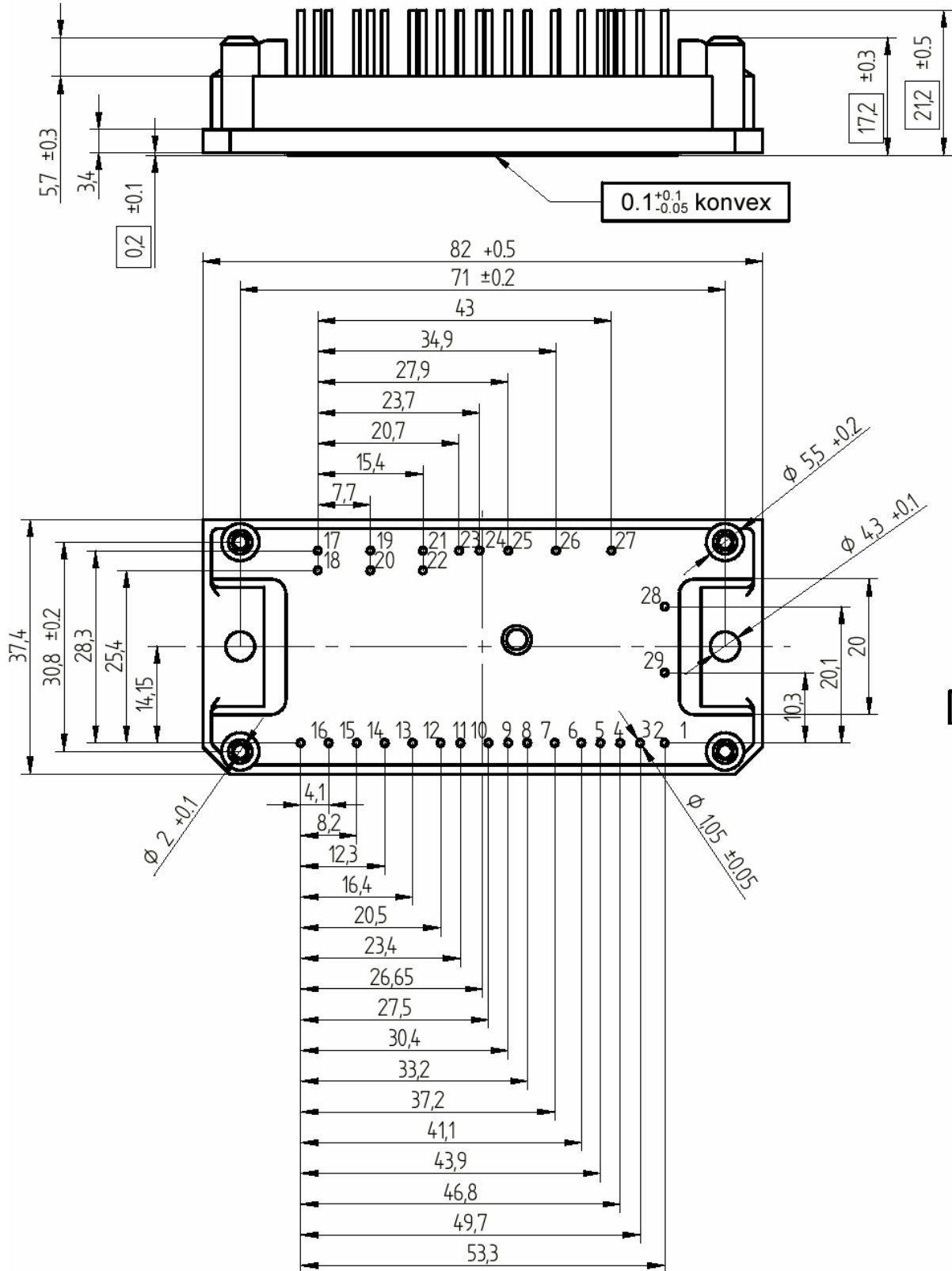
module types / Produkttypen

part – number V23990-	voltage	current
P303-B-PM	600V	10A
P304-B-PM	600V	15A
P305-B-PM	600V	20A

Schematic / Schaltplan


Outline / Pinout:

Overall tolerances: ISO 2768-m



Handling Instruction/ Montagehinweise:

...für den Kühlkörper

- die Montagefläche des Kühlkörpers muß sauber und frei von Partikeln sein.
- die Ebenheit muß < 0.05mm auf einer Länge von 100mm sein.
- die Rauigkeit muß geringer als Rz <10 sein.

...für die Wärmeleitpaste

- homogene Verteilung der Wärmeleitpaste auf der ganzen Modulbodenplatte mit einer Dicke von 0.05mm.

... für die Befestigung zum Kühlkörper

- zuerst die Schrauben mit halben Drehmoment festziehen.
- dann mit max. Drehmoment festziehen (falls möglich nach 3 Stunden noch einmal festziehen).

Anzugsdrehmomente für den Kühlkörper
Befestigungsschrauben M4
Schraubenunterlegscheibe Außendurchmesser /
D=9mm
Anzugsdrehmoment $M_a = 2.0-2.2Nm$

...to the heatsink

- the heatsink surface must be clean and particleless.
- the flatness must be < 0.05mm for 100mm continous.
- the surface roughness must be Rz <10.

...to the thermal paste:

- homogenous surfaceing of the thermal conducting paste over the whole module plate with a thickness of 0.05mm.

...fastening to heatsink:

- tighten screw with the half torque first.
- tighten screw with max. torque second (if possible tighten after three hours again).

Torque instruction to the heatsink:
Screw M4
Washer outer diameter D= 9mm
Torque force $M_a = 2.0-2.2Nm$

...Befestigung zur Leiterplatte

- das Modul muß mit 4 Schrauben zur Leiterplatte befestigt werden Typ: Bossard BN82428
- D=2,5mm L=6mm
- Nach der Verschraubung müssen alle Kontakt pin eingelötet werden
- Die Pins dürfen während und nach der Montage bei einer max. Modultemperatur von 25°C , nicht mehr als ± 0.2 mm bzw 35 N gedehnt bzw gestaucht werden.
- Die Pins dürfen bei einer max Substrattemperatur von 100°C mit nicht mehr als ± 5 N auf Dauer belastet werden.
- Eine Vibrationsbelastung der Pins ist unbedingt vermeiden.

...to mount the module in a PCB

- the module has to be screwed onto the PCB with 4 screw. Typ: Bossard BN82428
- D=2,5mm L=6mm
- After screwing all pins must be soldered into the PCB
- During assembly, at a max. module temperature of 25°C, the pins should not be drawn or phused over ± 0.2 mm or loaded with bigger force than 35N.
- At a maximum substrate-temperature of 100°C the load of the pin should not exceed $\pm 5N$.
- Vibration stress on pin is not allowed

This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.

Diese technischen Informationen spezifizieren Halbleiter Module, stellen aber keine Charakteristiken dar. Diese ergeben sich in Kombinataion mit den dazugehörigen technischen Vermerken.