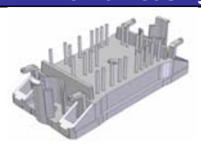
10-F0062TA099FH02
preliminary datasheet

flow PFC 0 — 600 V/ 2 x 99mOhm / 200 kHz

Features
- Vincotech clip-in housing
- Compact and low inductance design
- Suitable for Interleaved topology
- Suitable for curent sensing in source
- CP series CoolMOS[TM] and SiC boost FRED

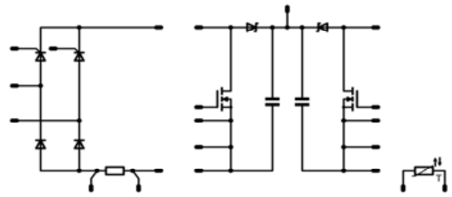
flow 0 housing



Target Applications
- PFC for welding
- PFC for SMPS
- PFC for motor drives
- PFC for UPS
- PFC for battery charger

Schematic

F0062TA099FH02



Types
- F0062TA099FH02; with SCR, current sense in source

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_F	$T_j=T_j max$	T_h=80°C T_c=80°C	35	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	250	A
I2t-value	I^2t			310	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_j max$	T_h=80°C T_c=80°C	40	W
Maximum Junction Temperature	$T_j max$			150	°C
Input Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			800	V
DC forward current	I_F	$T_j=T_j max$	T_h=80°C T_c=80°C	34	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	250	A
I2t-value	I^2t			310	A^2s
Power dissipation per Thyristor	P_{tot}	$T_j=T_j max$	T_h=80°C T_c=80°C	44	W
Maximum Junction Temperature	$T_j max$			150	°C

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Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
PFC Transistor (MOSFET)-per leg					
Drain to source voltage	V_{DS}			600	V
DC drain current	I_D	$T_j=T_j$max	T_h=80°C T_c=80°C	16	A
Pulsed drain current	I_{Dpulse}	t_p limited by $T_j$max		93	A
Avalanche energy, single pulse	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	800	mJ
Avalanche energy, repetitive	V_{GS}			1.2	mJ
Avalanche current, repetitive	$T_j$max			11	A
dv/dt ruggedness	dv/dt	V_{DS}=0...480V		50	V/ns
Reverse diode dv/dt	dv/dt			15	V/ns
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	62	W
Gate-source peak voltage	V_{GS}			+/- 20	V
Maximum Junction Temperature	$T_j$max			150	°C
PFC diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	$T_j=T_j$max	T_h=80°C T_c=80°C	15	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		42	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	34	W
Maximum Junction Temperature	$T_j$max			175	°C
PFC Shunt					
DC forward current	I_F		T_c=25°C	23	A
Power dissipation per Shunt	P_{tot}		T_c=25°C	5	W
DC link Capacitor					
Max.DC voltage	V_{MAX}		T_c=25°C	500	V
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Input Rectifier Diode										
Forward voltage	V_F				30	Tj=25°C Tj=125°C		1.16 1.11	1.4	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25°C Tj=125°C		0.9 0.77		V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25°C Tj=125°C		9 12		mΩ
Reverse current	I_r			1500		Tj=25°C Tj=150°C			0.02 2	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ =1 W/mK						1.72		K/W
Input Rectifier Thyristor										
Forward voltage	V_F				30	Tj=25°C Tj=125°C		1.25 1.22	1.6	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25°C Tj=125°C		0.93 0.82		V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25°C Tj=125°C		0.011 0.014		mΩ
Reverse current	I_r			800		Tj=25°C Tj=125°C			0.05 2	mA
Gate controlled delay time	t_{GD}	Ig=0,5A dig/dt=0,5A/us		VD=1/2Vdrm		Tj=25°C			2	µs
Gate controlled rise time	t_{GR}	Ig=0,2A dig/dt=0,2A/us				Tj=25°C		<1		µs
Critical rate of rise of off-state voltage	(dv/dt)cr			VD=2/3Vdrm		Tj=125°C			500	V/µs
Critical rate of rise of on-state current	(di/dt)cr	Ig=0,2A f=50Hz		VD=2/3Vdrm	40	Tj=125°C			150	A/µs
Circuit commutated turn-off time	t_q	VD=2/3Vdrm tp=200us		100	26	Tj=125°C		150		µs
Holding current	I_H	VD=6V				Tj=25°C			50	mA
Latching current	I_L	tp=10us Ig=0,2A				Tj=25°C			90	mA
Gate trigger voltage	V_{GT}	VD=6V				Tj=25°C Tj=-40°C			1.3 1.6	V
Gate trigger current	I_{GT}	VD=6V				Tj=25°C Tj=-40°C	11		28 50	mA
Gate non-trigger voltage	V_{GD}			VD=1/2Vdrm		Tj=125°C			0.2	V
Gate non-trigger current	I_{GD}			VD=1/2Vdrm		Tj=125°C			1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1.57		K/W
PFC Transistor (MOSFET)-per leg										
Avalanche breakdown voltage	$V_{(BR)DS}$		0		0.0003	Tj=25°C	600			V
Static drain to source ON resistance	$R_{DS(on)}$		10		18	Tj=25°C Tj=125°C		111 223		mΩ
Gate threshold voltage	$V_{(GS)th}$		Vds		0.0012	Tj=25°C Tj=125°C	2.5	3.0	3.9	V
Gate to Source Leakage Current	I_{GSS}		20	0		Tj=25°C Tj=125°C			200	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	600		Tj=25°C Tj=125°C			10	uA
Turn On Delay Time	$t_{d(ON)}$	Rgoff=4 Ω Rgon=4 Ω	10	400	15	Tj=25°C Tj=125°C		21 20		ns
Rise Time	t_r					Tj=25°C Tj=125°C		3 4		
Turn off delay time	$t_{d(OFF)}$					Tj=25°C Tj=125°C		72 73		
Fall time	t_f					Tj=25°C Tj=125°C		3 3		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0.044 0.051		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0.010 0.009		
Total gate charge	Q_{GE}		0	400	18	Tj=25°C Tj=125°C		60		nC
Gate to source charge	Q_{GS}					Tj=25°C Tj=125°C		14		
Gate to drain charge	Q_{GD}					Tj=25°C Tj=125°C		20		
Input capacitance	C_{iss}	f=1MHz	0	100		Tj=25°C		2800		pF
Output capacitance	C_{oss}							130		
Reverse transfer capacitance	C_{rss}							2.5		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1.13		K/W

Characteristic Values

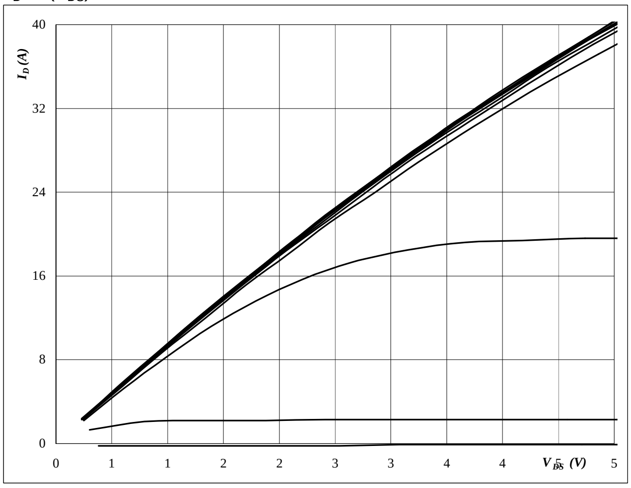
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
PFC Diode-per leg										
Forward voltage	V_F				10	Tj=25°C Tj=150°C		1.53 1.68	1.8	V
Reverse leakage current	I_{rm}			600		Tj=25°C Tj=150°C			140	μA
Peak recovery current	I_{RRM}					Tj=25°C Tj=150°C		22.7 19.6		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		6.6 7.0		ns
Reverse recovery charge	Q_{rr}	Rgon=4 Ω	10	400	15	Tj=25°C Tj=150°C		0.09 0.06		μC
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		0.008 0.002		mWs
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		10900 8149		A/μs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2.80		K/W
PFC Shunt										
R1 value	R						9.4	10	10.6	mΩ
Temperature coeficient	t_c	20°C to 60°C						< 50		ppm/K
Internal heat resistance	R_{thi}							<13		K/W
Inductance	L							< 3		nH
DC link Capacitor										
C value	C						480	540	600	nF
Thermistor										
Rated resistance	R					Tj=25°C		22		kΩ
Deviation of R100	ΔR/R	R25=22 KΩ				Tj=100°C	-5		5	%
Power dissipation	P					Tj=25°C			210	mW
Power dissipation constant						Tj=25°C		3.5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3940		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		4000		K

PFC

Figure 1 PFC MOSFET

Typical output characteristics

$I_D = f(V_{DS})$

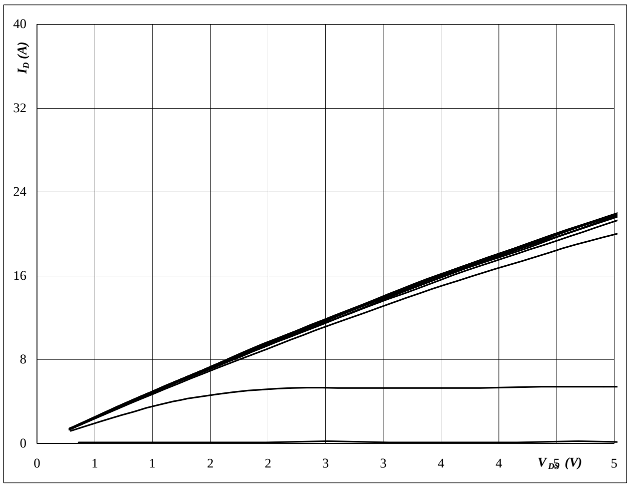


t_p = 250 µs
T_j = 25 °C
V_{GS} from 3 V to 13 V in steps of 1 V

Figure 2 PFC MOSFET

Typical output characteristics

$I_D = f(V_{DS})$

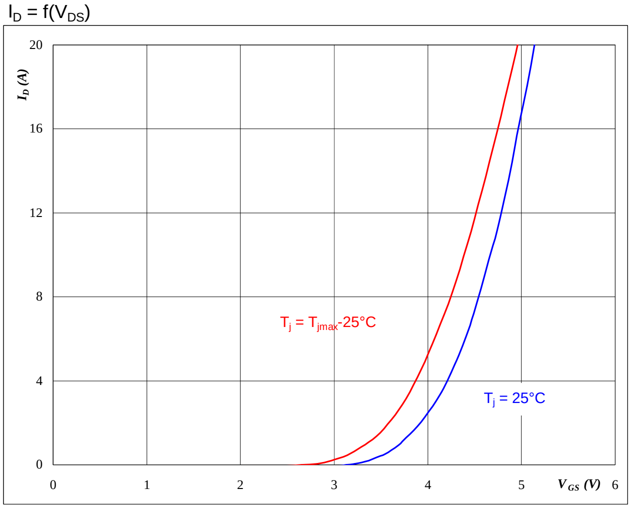


t_p = 250 µs
T_j = 125 °C
V_{GS} from 3 V to 13 V in steps of 1 V

Figure 3 PFC MOSFET

Typical transfer characteristics

$I_D = f(V_{DS})$

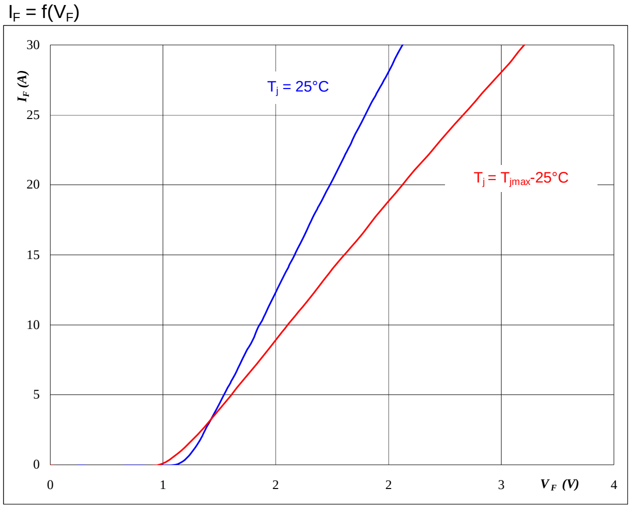


t_p = 250 µs
V_{DS} = 10 V

Figure 4 PFC FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

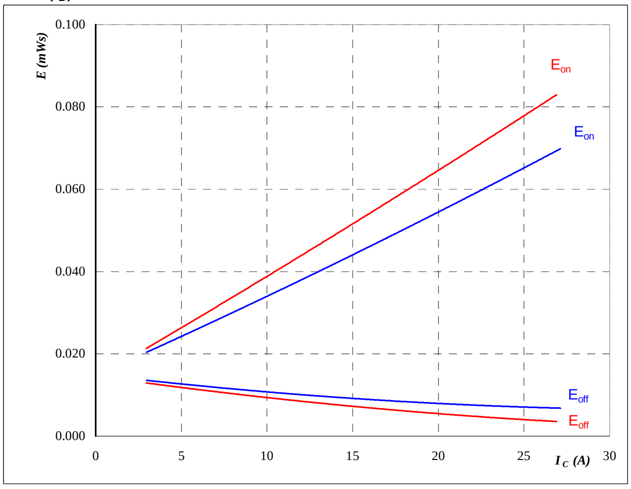


t_p = 250 µs

PFC

Figure 5 PFC MOSFET

Typical switching energy losses
as a function of collector current
$E = f(I_D)$

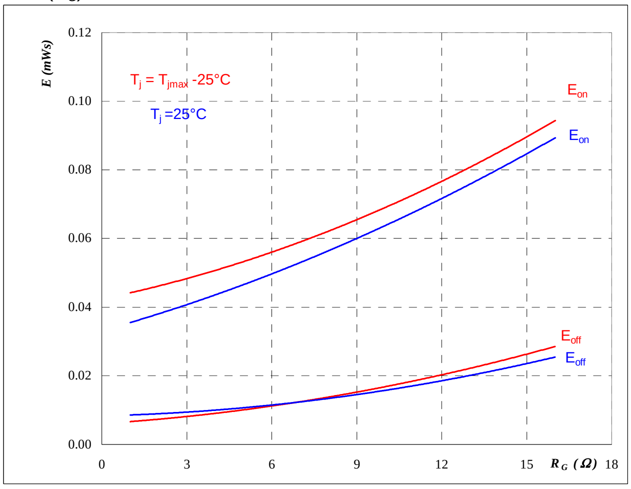


With an inductive load at

T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	10	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 PFC MOSFET

Typical switching energy losses
as a function of gate resistor
$E = f(R_G)$

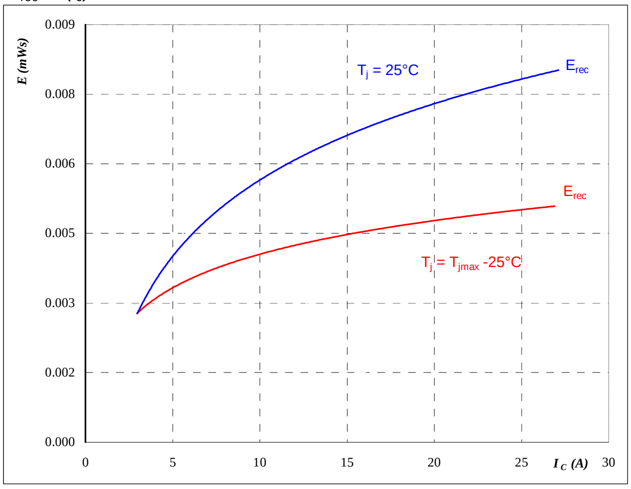


With an inductive load at

T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	10	V
I_D =	15	A

Figure 7 PFC MOSFET

Typical reverse recovery energy loss
as a function of collector (drain) current
$E_{rec} = f(I_c)$

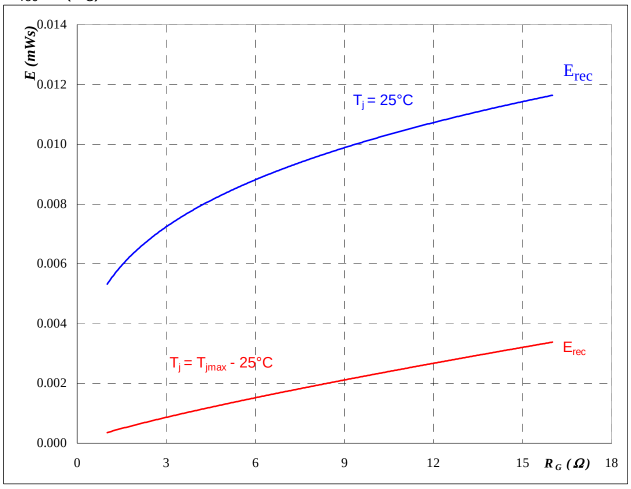


With an inductive load at

T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	10	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 8 PFC MOSFET

Typical reverse recovery energy loss
as a function of gate resistor
$E_{rec} = f(R_G)$



With an inductive load at

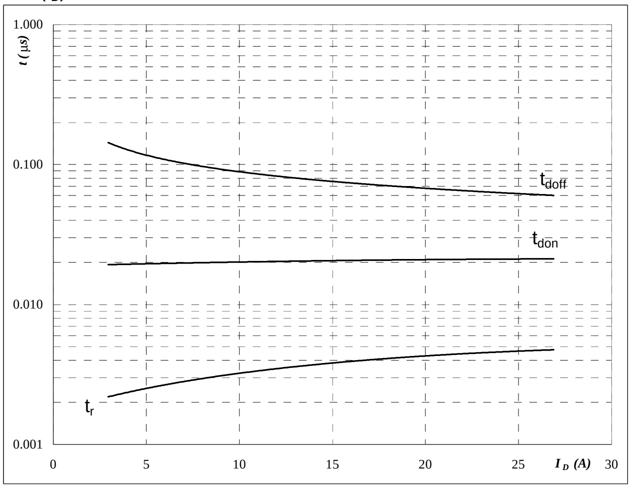
T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	10	V
I_D =	15	A

PFC

Figure 9 PFC MOSFET

Typical switching times as a function of collector current

t = f(I_D)



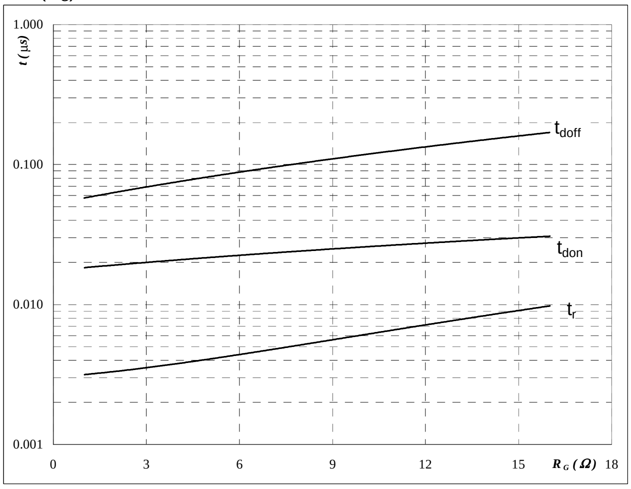
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	10	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 PFC MOSFET

Typical switching times as a function of gate resistor

t = f(R_G)



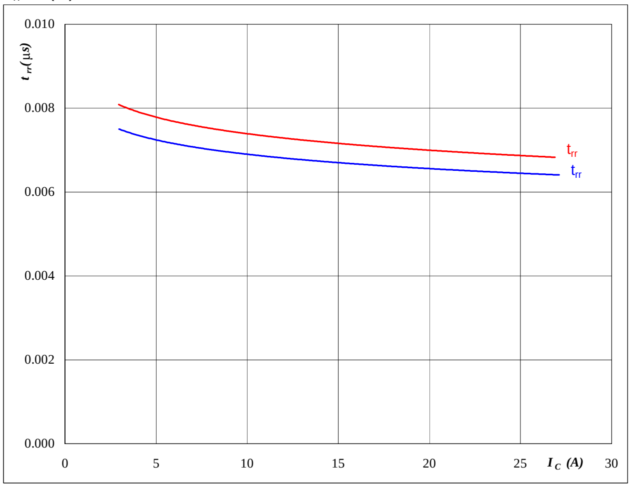
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	10	V
I_C =	15	A

Figure 11 PFC FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)

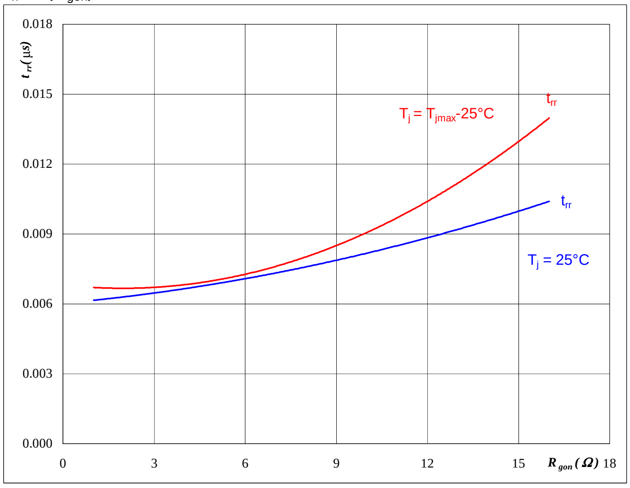


T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω

Figure 12 PFC FRED

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

t_{rr} = f(R_{gon})



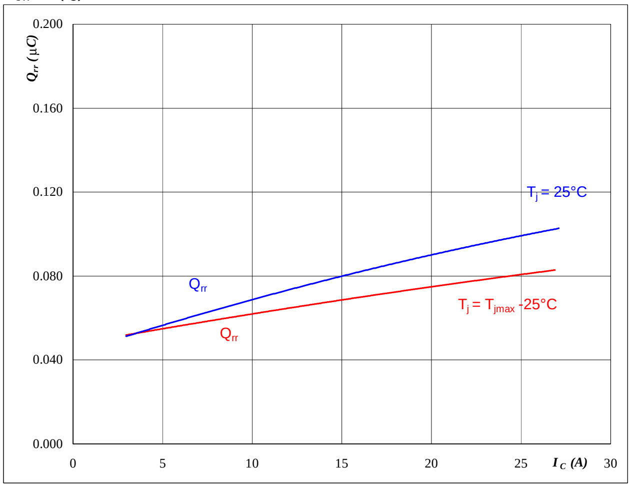
T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GS} =	10	V

PFC

Figure 13 PFC FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

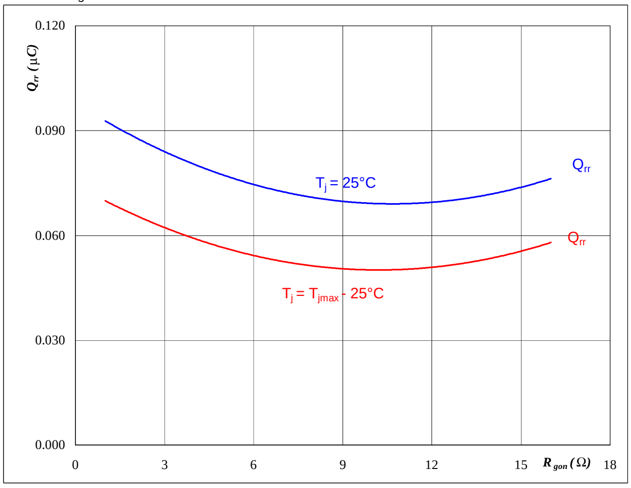


T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω

Figure 14 PFC FRED

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

$Q_{rr} = f(R_{gon})$

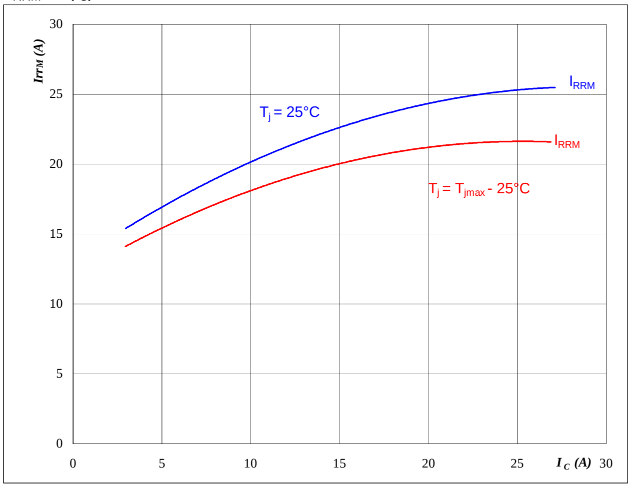


T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GS} =	10	V

Figure 15 PFC FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

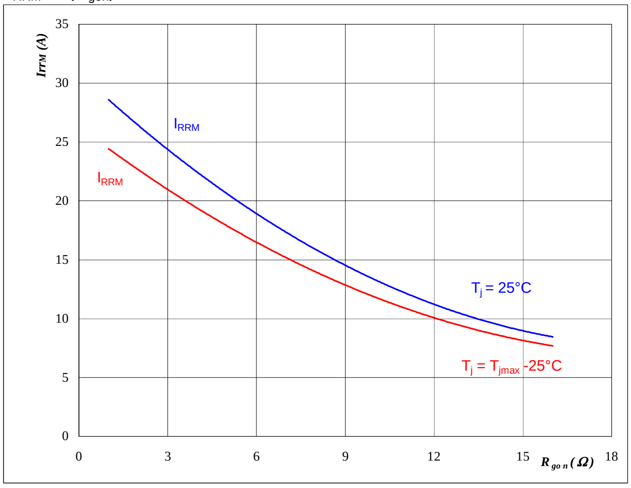


T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω

Figure 16 PFC FRED

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

$I_{RRM} = f(R_{gon})$



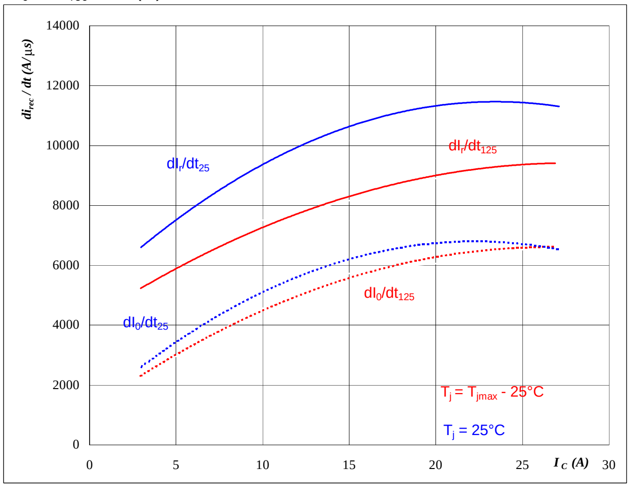
T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GS} =	10	V

PFC

Figure 17 PFC FRED

Typical rate of fall of forward and reverse recovery current as a function of collector current

$dI_0/dt, dI_{rec}/dt = f(Ic)$

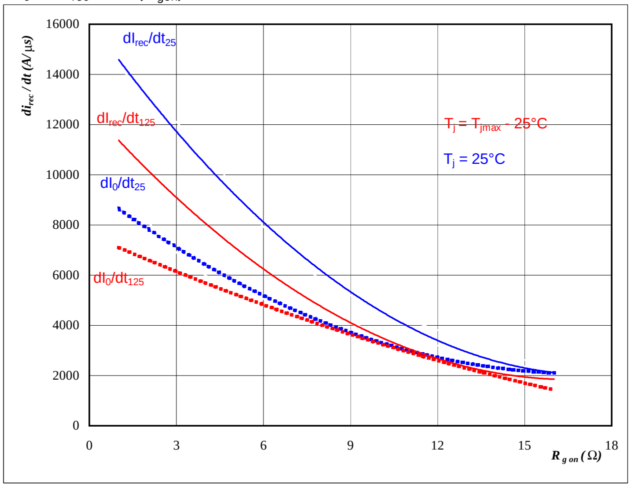


T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	4	Ω

Figure 18 PFC FRED

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$

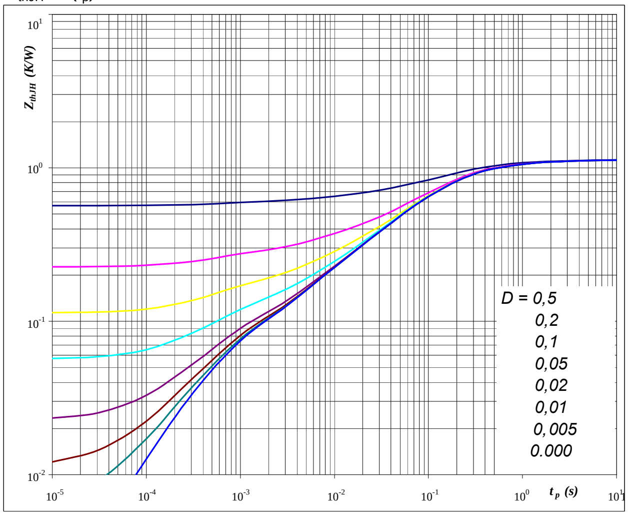


T_j =	25/125	°C
V_R =	400	V
I_F =	15	A
V_{GS} =	10	V

Figure 19 PFC MOSFET

IGBT/MOSFET transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	1.13	K/W

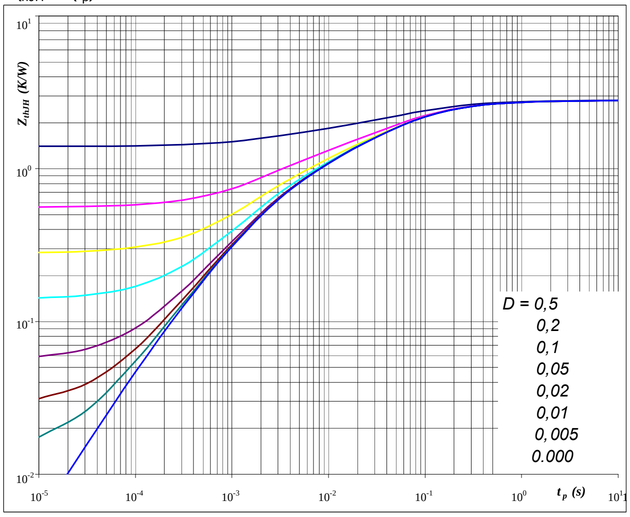
IGBT thermal model values

R (C/W)	Tau (s)
0.026	8.47E+00
0.127	1.17E+00
0.544	1.77E-01
0.266	4.73E-02
0.107	7.23E-03
0.062	5.51E-04

Figure 20 PFC FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	2.80	K/W

FRED thermal model values

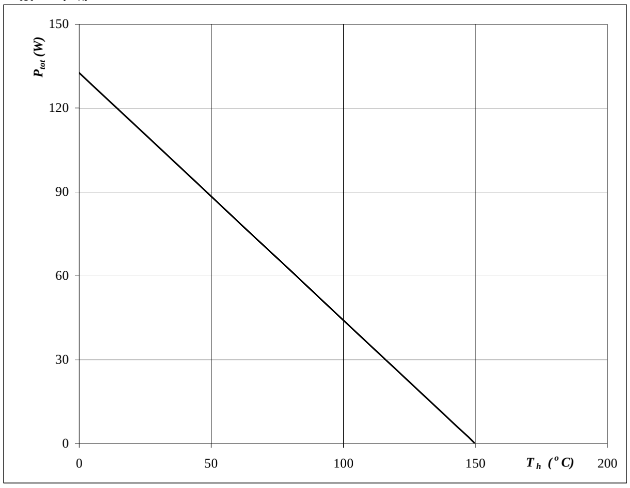
R (C/W)	Tau (s)
0.12	2.13E+00
0.46	2.58E-01
1.13	5.66E-02
0.66	8.78E-03
0.41	1.61E-03
0.03	1.71E-04

PFC

Figure 21 PFC MOSFET

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

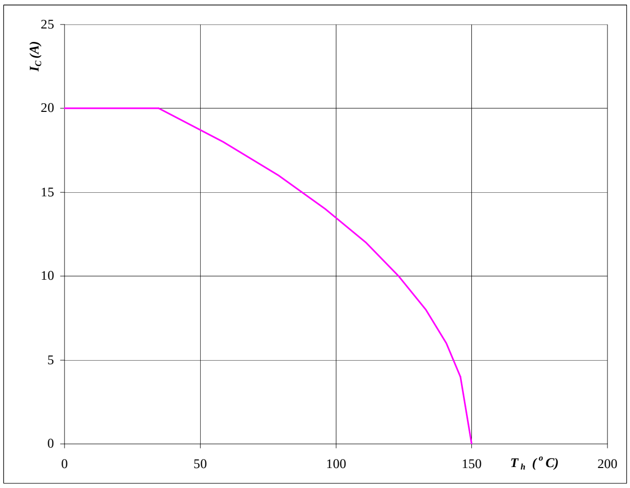


T_j = 150 ºC

Figure 22 PFC MOSFET

Collector/Drain current as a function of heatsink temperature

$I_C = f(T_h)$

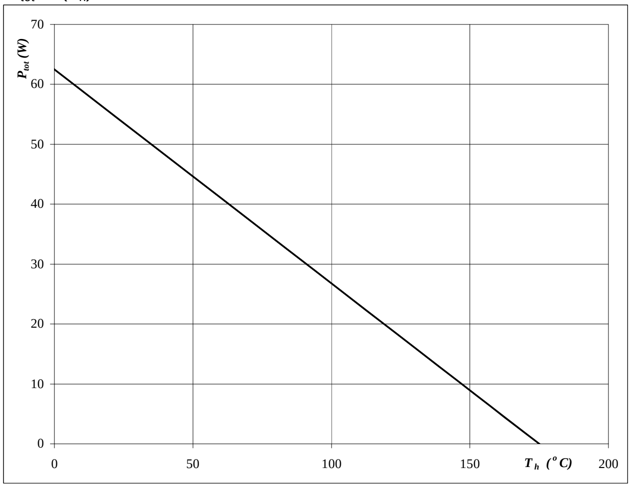


T_j = 150 ºC
V_{GS} = 10 V

Figure 23 PFC FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

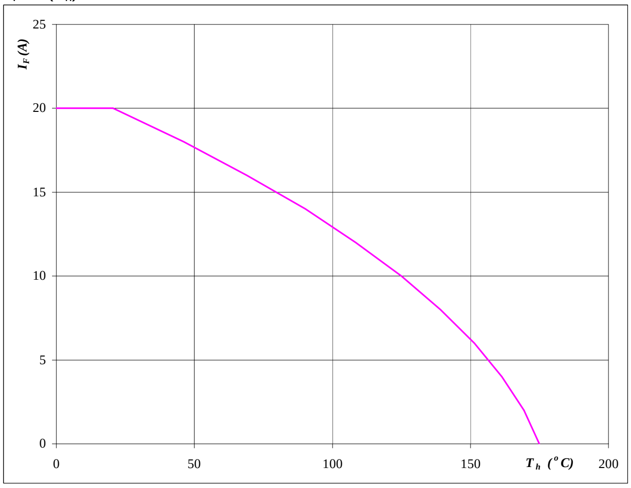


T_j = 175 ºC

Figure 24 PFC FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



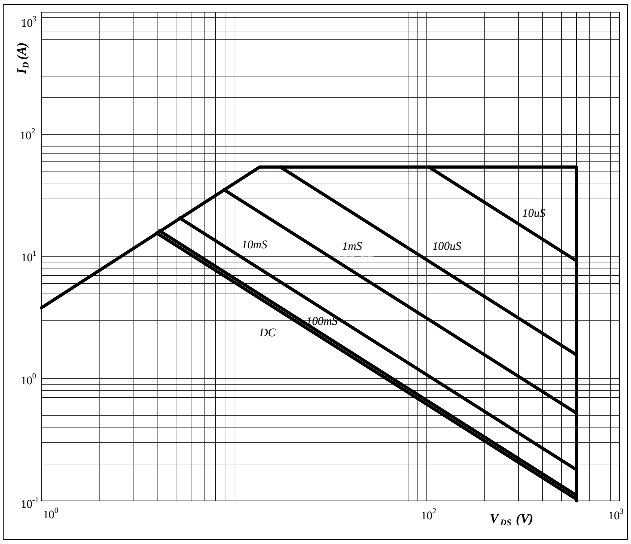
T_j = 175 ºC

PFC

Figure 25	PFC MOSFET

Safe operating area as a function of drain-source voltage

$I_D = f(V_{DS})$

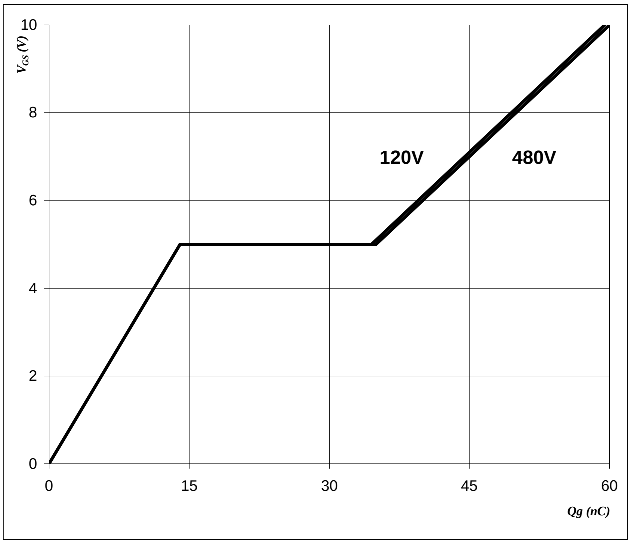


D =	single pulse	
T_h =	80	ºC
V_{GS} =	10	V
T_j =	T_{jmax}	ºC

Figure 26	PFC MOSFET

Gate voltage vs Gate charge

$V_{GS} = f(Qg)$



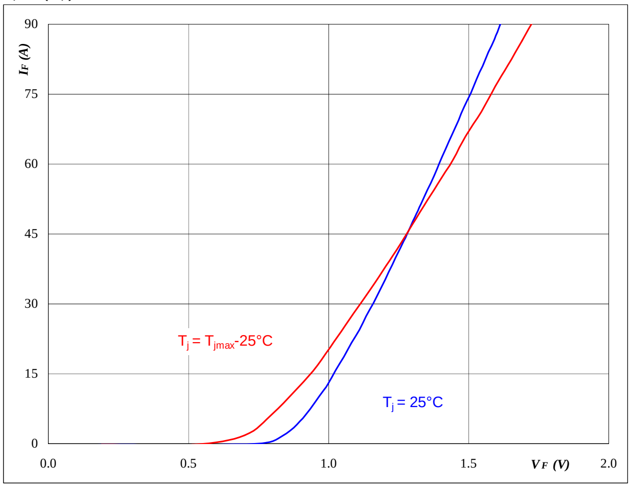
I_D =	15	A

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

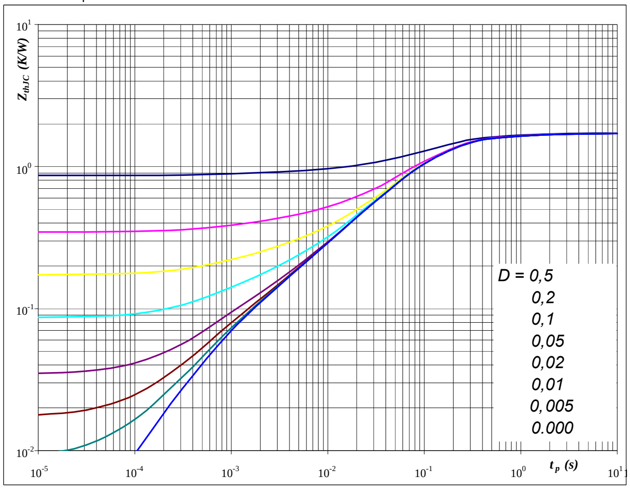


t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



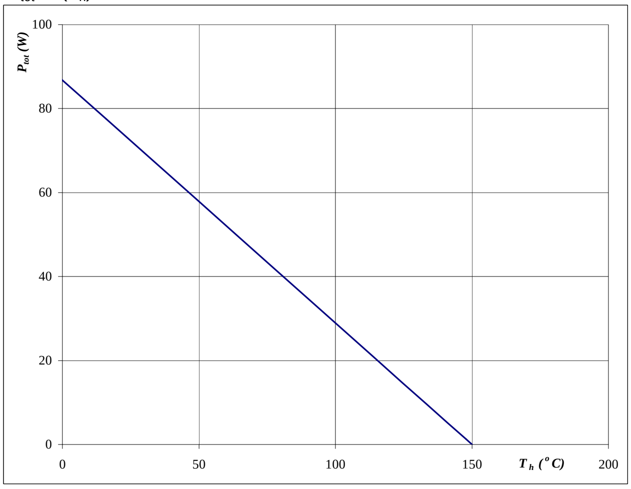
D = t_p / T

R_{thJH} = 1.728 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

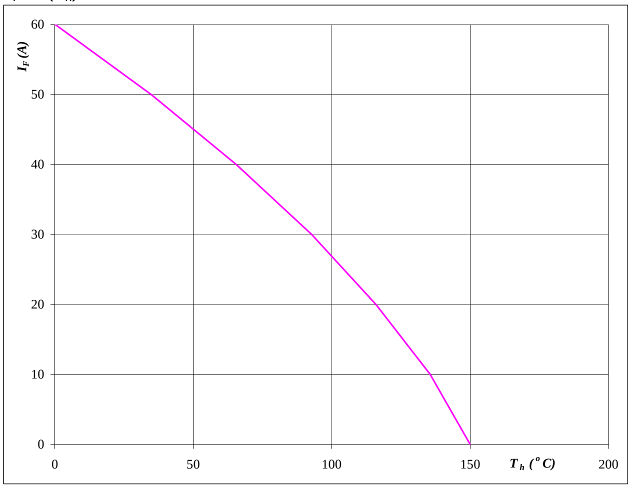


T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



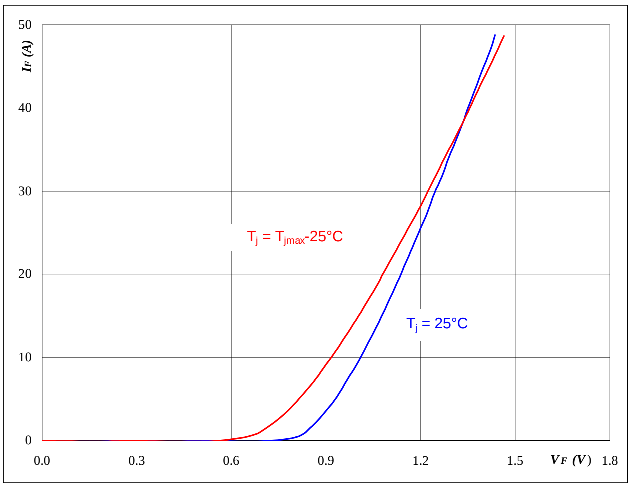
T_j = 150 ºC

Thyristor

Figure 1 Thyristor

Typical thyristor forward current as a function of forward voltage

$I_F = f(V_F)$

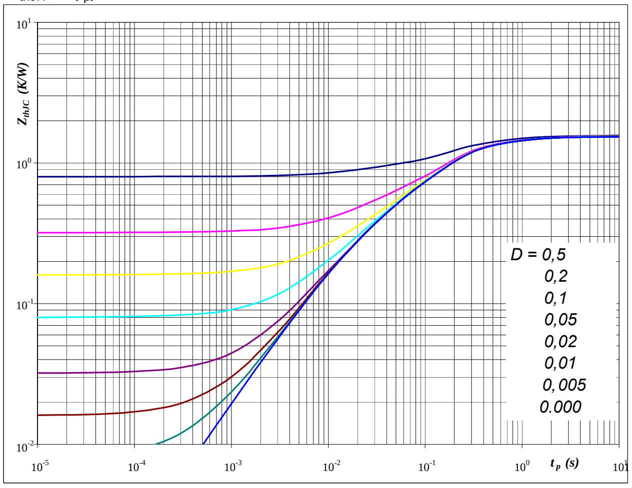


t_p = 250 µs

Figure 2 Thyristor

Thyristor transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



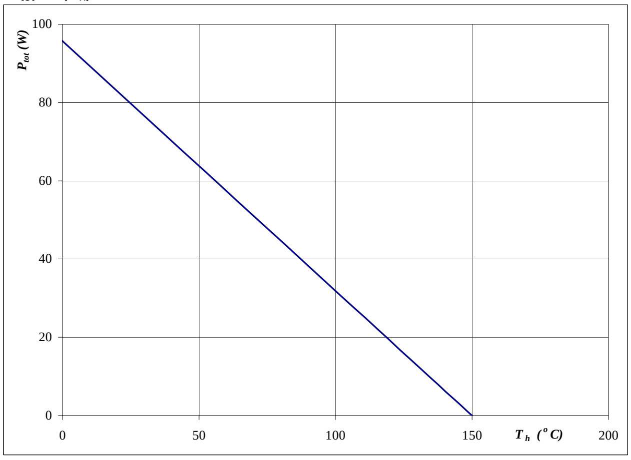
D = t_p / T

R_{thJH} = 1.57 K/W

Figure 3 Thyristor

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

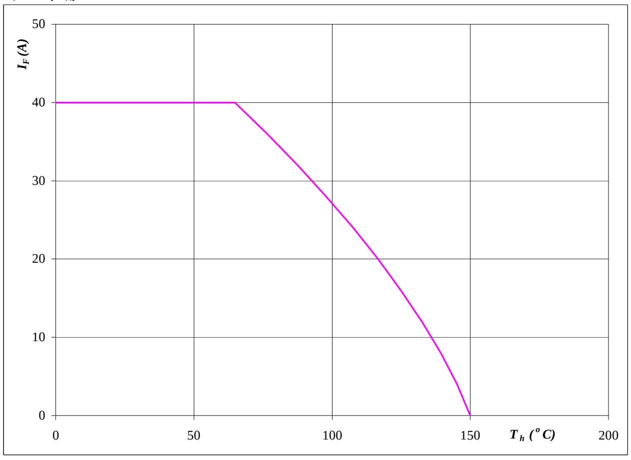


T_j = 150 ºC

Figure 4 Thyristor

Forward current as a function of heatsink temperature

$I_F = f(T_h)$

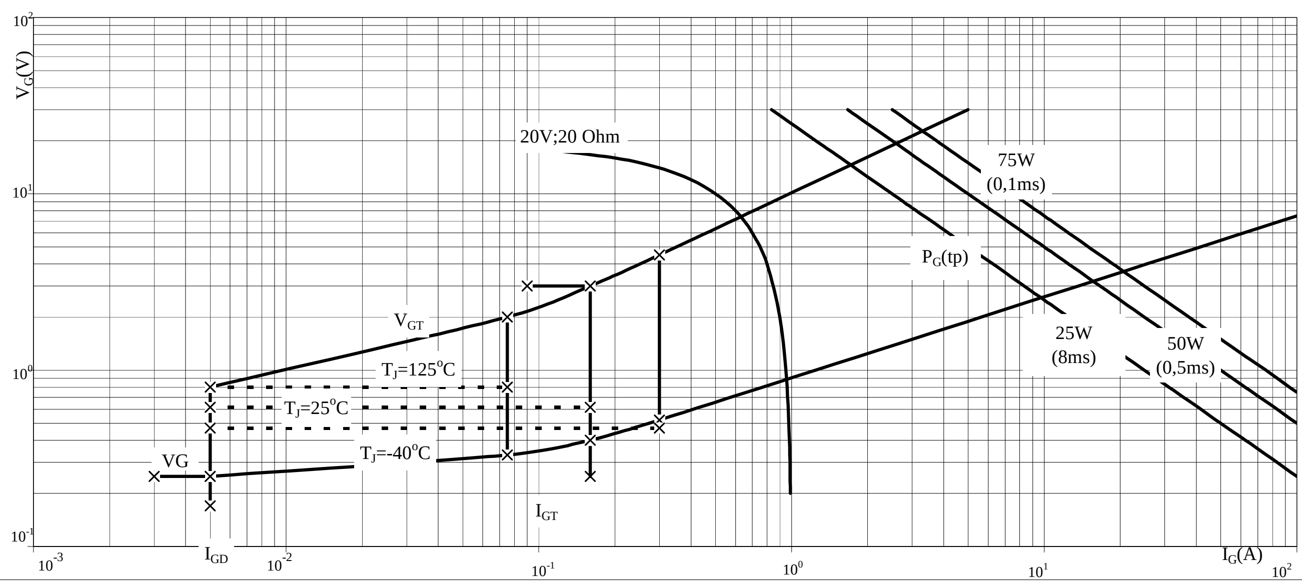


T_j = 150 ºC

Thyristor

Figure 5 Thyristor

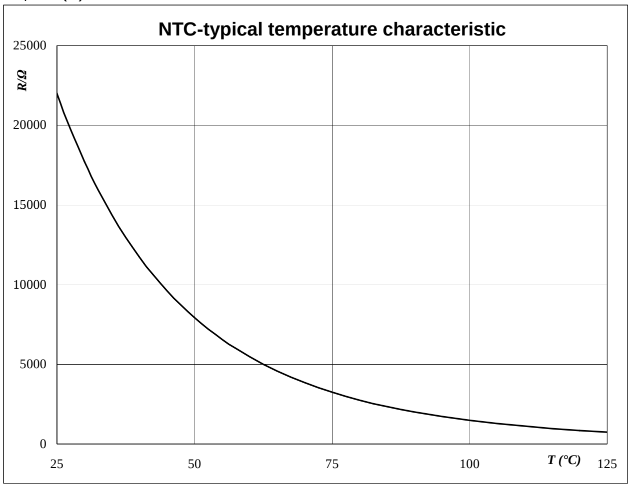
Gate trigger characteristics



Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature
R_T = f(T)



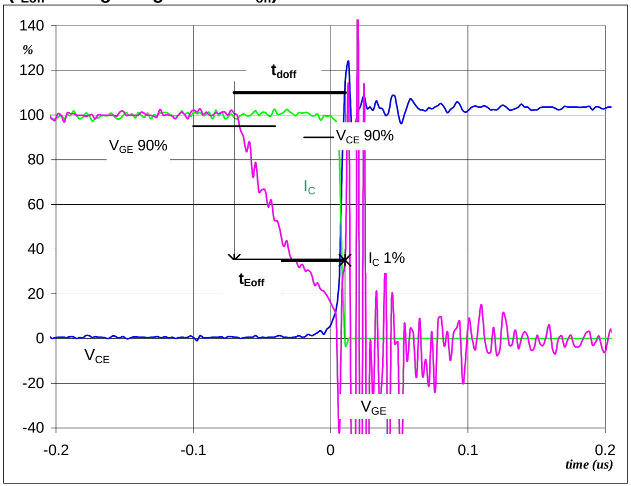
Switching Definitions PFC

General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 PFC MOSFET

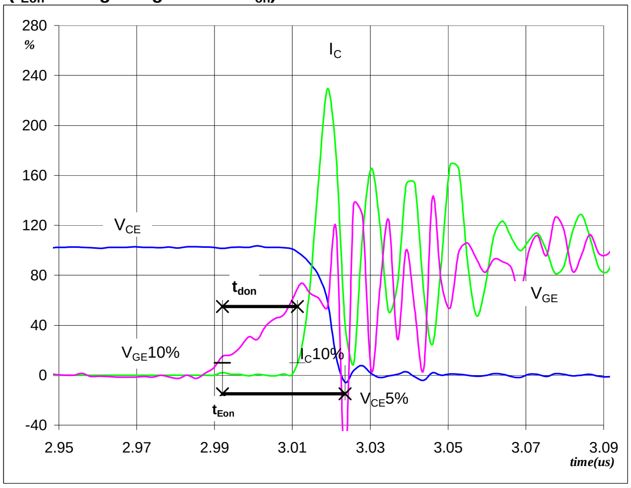
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	15	A
t_{doff} =	0.07	μs
t_{Eoff} =	0.08	μs

Figure 2 PFC MOSFET

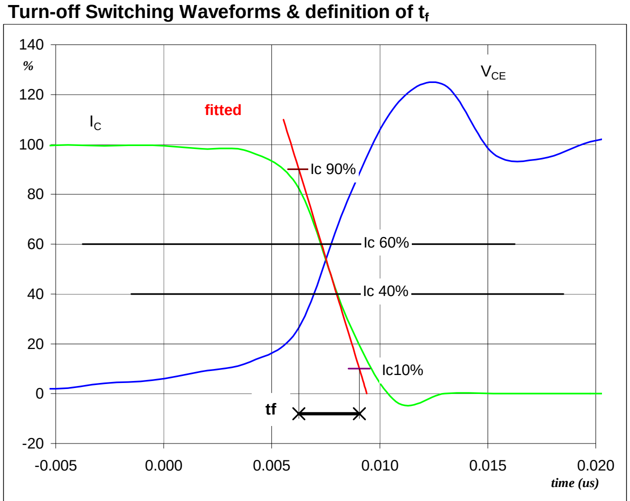
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	15	A
t_{don} =	0.02	μs
t_{Eon} =	0.03	μs

Figure 3 PFC MOSFET

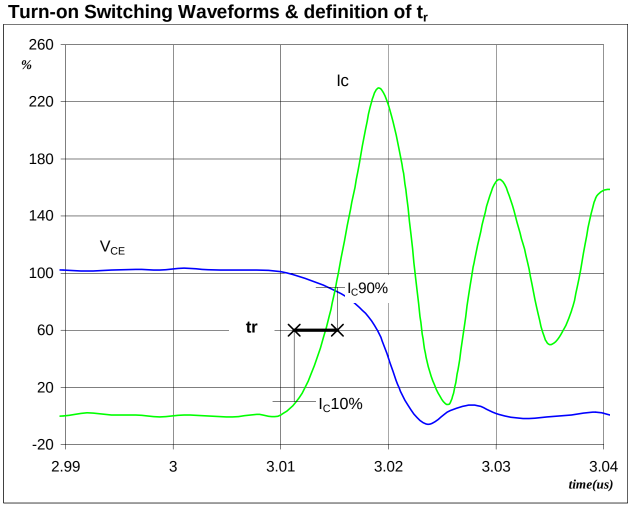
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	15	A
t_f =	0.003	μs

Figure 4 PFC MOSFET

Turn-on Switching Waveforms & definition of t_r

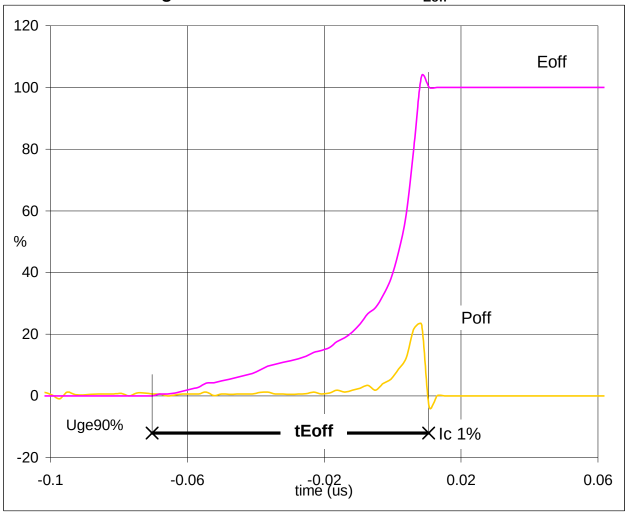


V_C (100%) =	400	V
I_C (100%) =	15	A
t_r =	0.004	μs

Switching Definitions PFC

Figure 5 PFC MOSFET

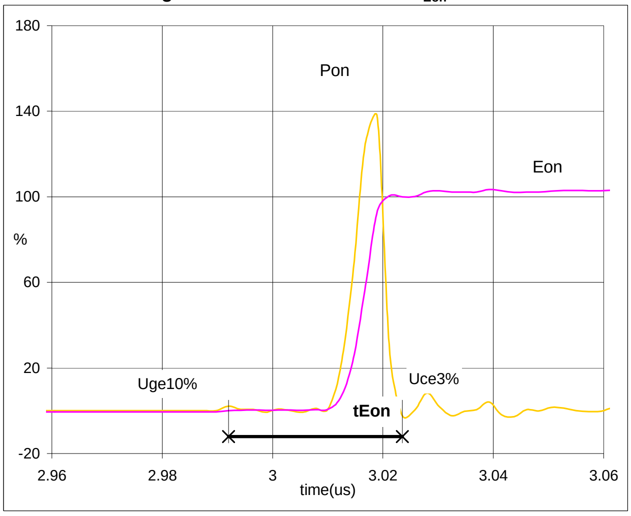
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	5.97	kW
E_{off} (100%) =	0.01	mJ
t_{Eoff} =	0.08	μs

Figure 6 PFC MOSFET

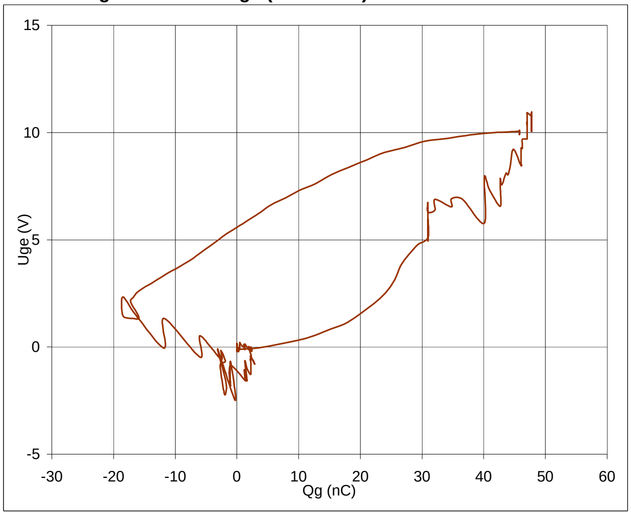
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	5.9656	kW
E_{on} (100%) =	0.05	mJ
t_{Eon} =	0.0315	μs

Figure 7 PFC MOSFET

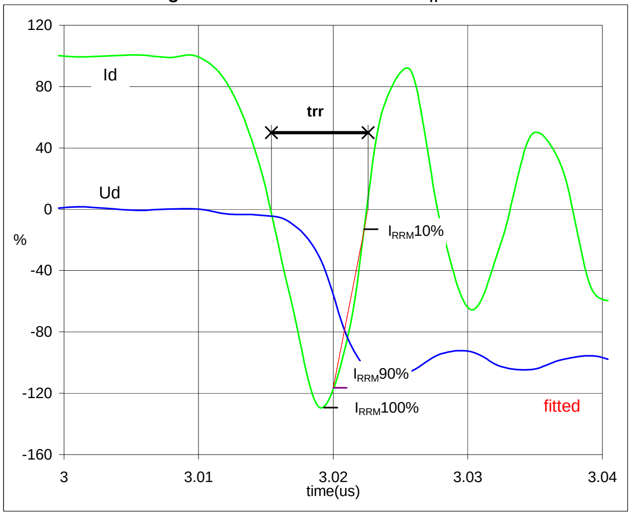
Gate voltage vs Gate charge (measured)



V_{GEoff} =	0	V
V_{GEon} =	10	V
V_C (100%) =	400	V
I_C (100%) =	15	A
Q_g =	47.78	nC

Figure 8 PFC FRED

Turn-off Switching Waveforms & definition of t_{rr}

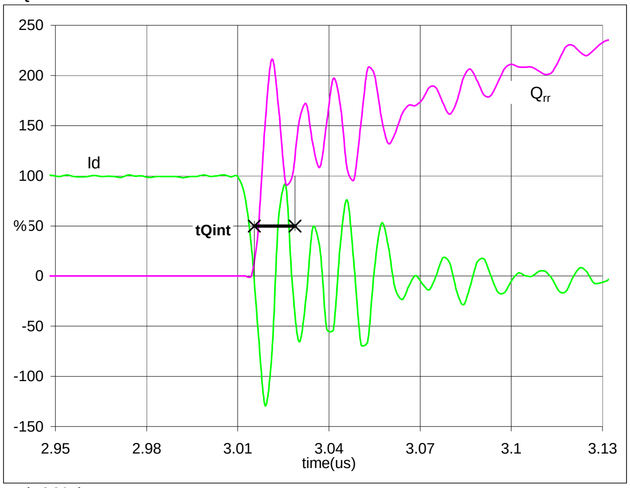


V_d (100%) =	400	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-20	A
t_{rr} =	0.01	μs

Switching Definitions PFC

Figure 9	PFC FRED

Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	0.06	µC
t_{Qint} =	0.013	µs

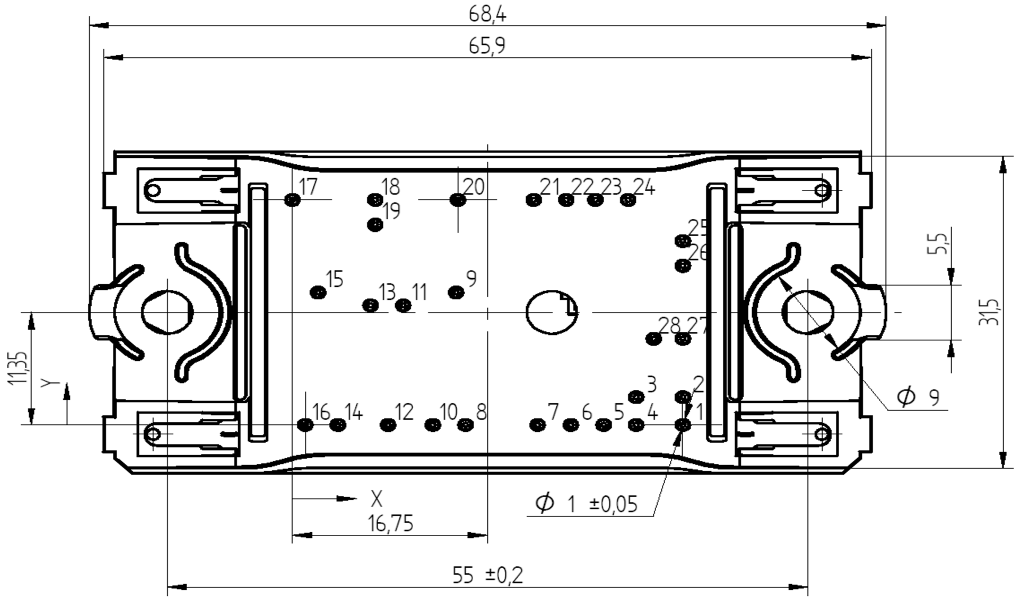
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

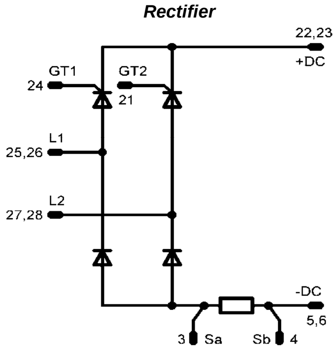
Version	Ordering Code	in DataMatrix as	in packaging barcode as
with SCR, current sense in source	10-F0062TA099FH02-P980D49	P980D49	P980D49

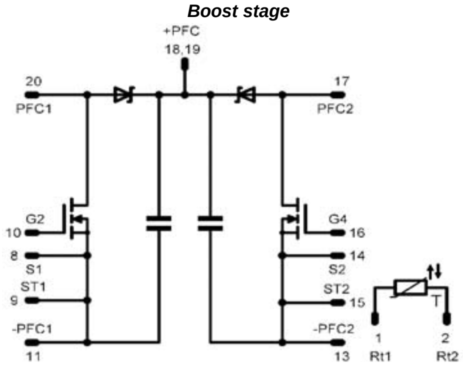
Outline

Pin table		
Pin	X	Y
1	33,5	0
2	33,5	2,8
3	29,5	2,8
4	29,5	0
5	26,7	0
6	23,9	0
7	21,05	0
8	14,85	0
9	14,05	13,35
10	12,05	0
11	9,5	12,05
12	8,2	0
13	6,7	12,05
14	3,9	0
15	2,2	13,35
16	1,1	0
17	0	22,7
18	7,1	22,7
19	7,1	20,2
20	14,2	22,7
21	20,7	22,7
22	23,5	22,7
23	26	22,7
24	28,8	22,7
25	33,5	18,55
26	33,5	16,05
27	33,5	8,7
28	31	8,7



Pinout





Pin nr. 7 & 12 without electrical connection

PRODUCT STATUS DEFINITIONS

Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
Final	Full Production	This datasheet contains final specifications. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.