Vincotech

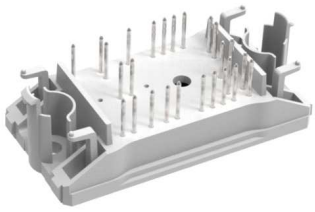
10-F0062TA099FS-P980D59
datasheet

flow PFC 0 — **600 V / 99 mΩ**

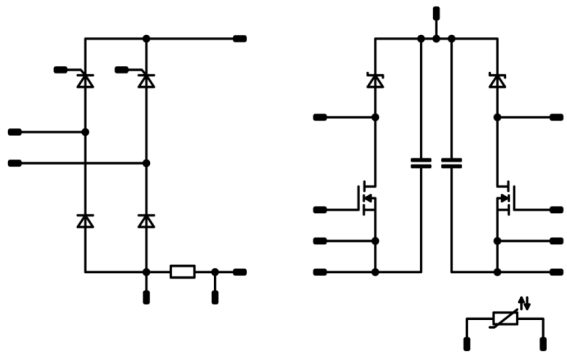
Features

- Vincotech clip-in housing
- Compact and low inductance design
- Suitable for Interleaved topology
- Suitable for current sensing in source
- C6 series CoolMos™ and SiC boost diode

flow 0 17mm housing



Schematic



Target applications

- Welding
- SMPS
- Motor Drives
- UPS
- Battery Charger

Types

- 10-F0062TA099FS-P980D59

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	51	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave T_j = 150 °C t_p = 10 ms	280	A
Surge current capability	I^2t		390	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	68	W
Maximum Junction Temperature	T_{jmax}		150	°C

Parameter	Symbol	Condition	Value	Unit
Rectifier Thyristor				
Repetitive peak reverse voltage	V_{RRM}		1200	V
Forward average current	I_{FAV}	sine, d = 0,5 $T_j = T_{jmax}$ T_s = 80 °C	48	A
Surge forward current	I_{FSM}	t_p = 10 ms T_j = 25 °C	250	A
I^2t value	I^2t		310	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	71	W
Maximum Junction Temperature	T_{jmax}		150	°C
PFC Switch				
Drain-source voltage	V_{DSS}		600	V
Drain current	I_D	$T_j = T_{jmax}$ T_s = 80 °C	18	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	112	A
Avalanche energy, single pulse	E_{AS}	I_D = 6,6 A V_{DD} = 50 V	796	mJ
Avalanche energy, repetitive	E_{AR}	I_D = 6,6 A V_{DD} = 50 V	1,20	mJ
Avalanche current, repetitive	I_{AR}	t_p limited by T_{jmax} PAV=EAR*f	6,6	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS} = 480 V	50	V/ns
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	88	W
Gate-source voltage	V_{GSS}		±20	V
Reverse diode dv/dt	dv/dt		15	V/ns
Maximum Junction Temperature	T_{jmax}		150	°C
PFC Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	15	A
Repetitive peak forward current	I_{FRM}		67	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80°C	35	W
Maximum Junction Temperature	T_{jmax}		175	°C

Parameter	Symbol	Condition	Value	Unit
PFC Shunt				
DC forward current	I_F	T_c = 105 °C	35	A
Power dissipation	P_{tot}	T_c = 105 °C	5	W
PFC Capacitance				
Maximum DC voltage	V_{MAX}		500	V
Operation Temperature	T_{op}		-55...+125	°C
Module Properties				
Thermal Properties				
Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{jop}		-40...+(T_{jmax} - 25)	°C
Isolation Properties				
Isolation voltage	V_{isol}	DC Voltage t_p = 2s	4000	V
Creepage distance			min. 12,7	mm
Clearance			min. 12,7	mm
Comparative Tracking Index	CTI		> 200	

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{GS} [V] V_r [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Rectifier Diode										
Static										
Forward voltage	V_F				50	25 125		1,31 1,33	1,4	V
Reverse leakage current	I_r			1600		25 150			20 1500	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,03		K/W
Rectifier Thyristor										
Static										
Forward voltage	V_T				30	25 125		1,26 1,22	1,33 1,32	V
Threshold voltage (for power loss calc. only)	V_{to}				30	25 125			0,9	V
Slope resistance (for power loss calc. only)	r_t				30	25 125			9	mΩ
Reverse current	I_r			1200		25 125			0,01 2	mA
Gate controlled delay time	t_{GD}	T_{vj} = 25 °C I_G = 0,5 A di/dt = 0,5 A/µs V_D = 2/3 V_{DRM}				25 125		2		µs
Gate controlled rise time	t_{GR}			1072		25 125		2		µs
Critical rate of rise of off-state voltage	$(dv/dt)_{cr}$			2/3 V_{DRM}		25 125			500	V/µs
Critical rate of rise of on-state current	$(di/dt)_{cr}$	I_G = 0,2 A t_P = 200 µs di_G/dt = 0,2 A/µs f = 50 Hz				25 125			150	A/µs
Circuit commutated turn-off time	t_q	dv/dt = 20 V/µs -di/dt = 10 µs I_T = 26 A t_P = 200 µs		100		25 125		150		µs
Holding current	I_H			6		25 125			220	mA
Latching current	I_L	t_p = 10 µs I_G = 0,2 A di_G/dt = 0,2 A/µs				25 125			90	mA
Gate trigger voltage	V_{GT}			6		25 -40			1,3 1,6	V
Gate trigger current	I_{GT}					25 -40	11		28 50	mA
Gate non-trigger voltage	V_{GD}			2/3 V_{DRM}		25 125			0,2	V
Gate non-trigger current	I_{GD}					25 125			1	mA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						1		K/W

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{GS} [V] V_r [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
PFC Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		10		18,1	25 125 150		100 209		mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$			0,00121	25 125	2,5	3	3,5	V
Gate to Source Leakage Current	I_{GSS}		20	0		25 125			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	600		25 125			5	µA
Internal gate resistance	r_g							1,6		Ω
Gate charge	Q_G							119		
Gate to source charge	Q_{GS}		0/10	480	18,1	25		14		nC
Gate to drain charge	Q_{GD}							61		
Short-circuit input capacitance	C_{iss}							2660		
Short-circuit output capacitance	C_{oss}	f = 1MHz	0	100		25		154		pF
Reverse transfer capacitance	C_{rss}							7		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4 W/mK						0,8		K/W
MOSFET Switching										
Turn-on delay time	$t_{d(on)}$					25 125		20 19		
Rise time	t_r	R_{goff} = 2 Ω R_{gon} = 2 Ω				25 125		4 4		ns
Turn-off delay time	$t_{d(off)}$		10	400	18	25 125		90 92		
Fall time	t_f					25 125		3 4		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,1 µC				25 125		0,053 0,063		mWs
Turn-off energy (per pulse)	E_{off}	Q_{rFWD} = 0,1 µC				25 125		0,015 0,024		

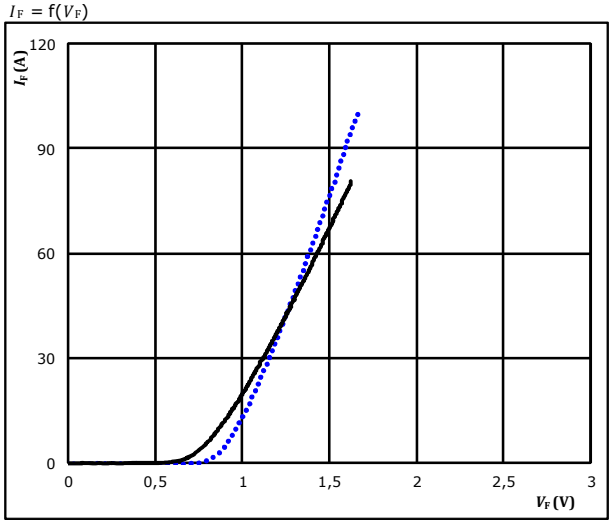
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{GS} [V] V_r [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
PFC Diode										
Static										
Forward voltage	V_F				10	25 125 150		1,49 1,69 1,78	2,4	V
Reverse leakage current	I_r			600		25 150			50 200	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,75		K/W
FWD Switching										
Peak recovery current	I_{RRM}	di/dt = 5949 A/µs di/dt = 4798 A/µs	10	400	18	25 125		18 16		A
Reverse recovery time	t_{rr}					25 125		7 7		ns
Recovered charge	Q_r					25 125		0,060 0,051		µC
Reverse recovered energy	E_{rec}					25 125		0,003 0,002		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		8682 5922		A/µs
PFC Shunt										
Resistance	R							10,05		mΩ
Tolerance							-1,5		+1,5	%
Temperature coeficient	t_c					20 - 60			50	ppm/K
Internal heat resistance	R_{thi}							13		K/W
Inductance	L								3	nH
PFC Capacitance										
Capacitance	C							270		nF
Tolerance							-20		+20	%

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{GS} [V] V_r [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	R100=1484 Ω				100	-5		5	%
Power dissipation	P					25		5		mW
Power dissipation constant						25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1%				25		3962		K
B-value	$B_{(25/100)}$	Tol. ±1%				25		4000		K
Vincotech NTC Reference									I	

Rectifier Diode Characteristics

Typical forward characteristics **Diode**

$I_F = f(V_F)$

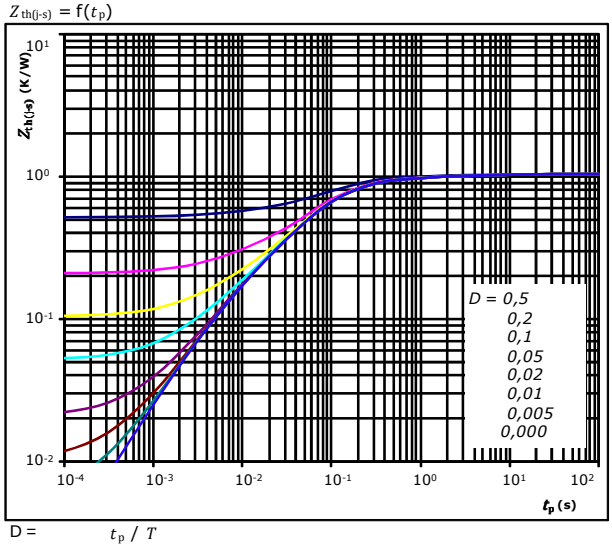


t_p = 250 µs 25 °C

T_j: 125 °C

Transient thermal impedance as a function of pulse width **Diode**

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 1,03 K/W

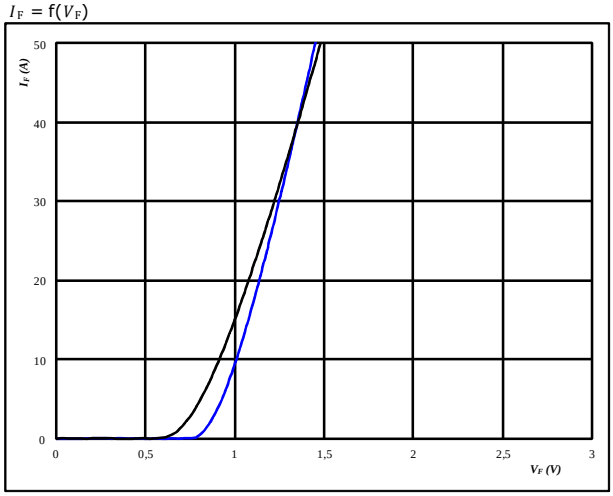
Diode thermal model values

R (K/W)	τ (s)
4,2180E-02	6,7950E+00
1,3600E-01	6,2940E-01
6,3390E-01	9,0540E-02
1,4600E-01	3,1010E-02
6,3770E-02	4,7560E-03
1,2000E-02	1,5250E-02

Rectifier Thyristor Characteristics

Typical forward characteristics **Thyristor**

$I_F = f(V_F)$

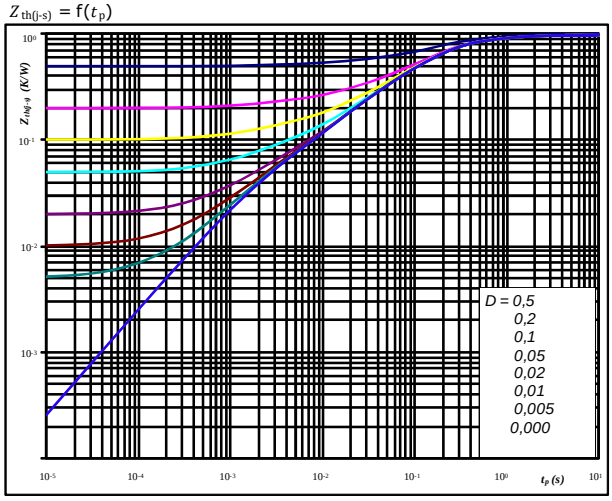


t_p = 250 µs 25 °C

T_j: 125 °C

Transient thermal impedance as a function of pulse width **Thyristor**

$Z_{th(j-s)} = f(t_p)$



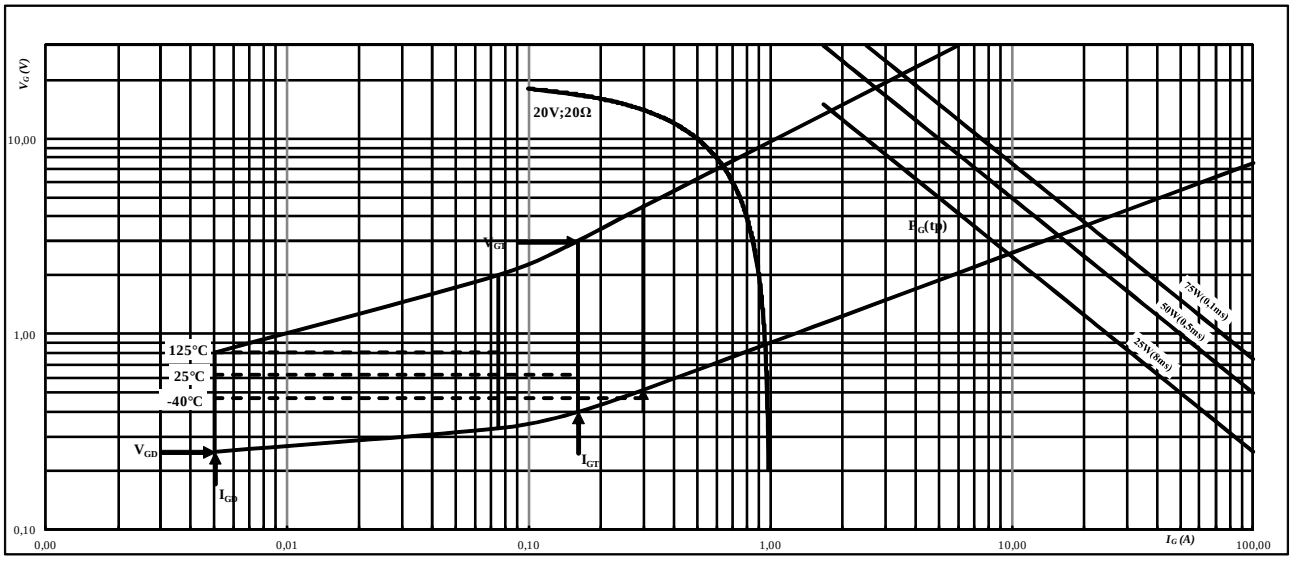
D = t_p / T

$R_{th(j-s)}$ = 1 K/W

FWD thermal model values

R (K/W)	τ (s)
2,07E-02	2,12E+01
1,60E-01	9,80E-01
6,58E-01	1,61E-01
1,28E-01	2,45E-02
3,31E-02	2,04E-03

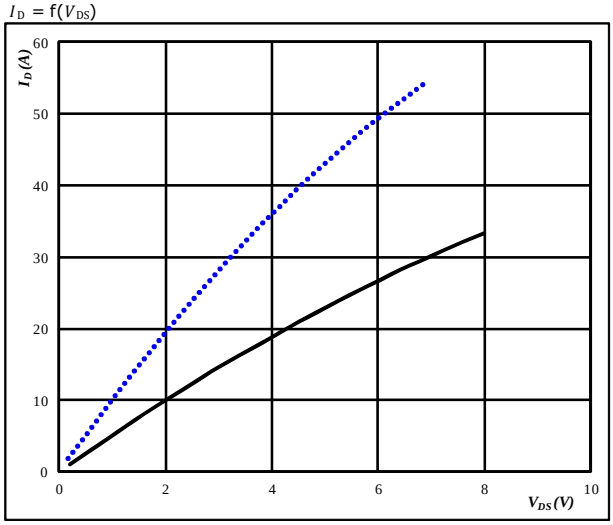
Gate trigger characteristics **Thyristor**



PFC Switch Characteristics

Typical output characteristics **MOSFET**

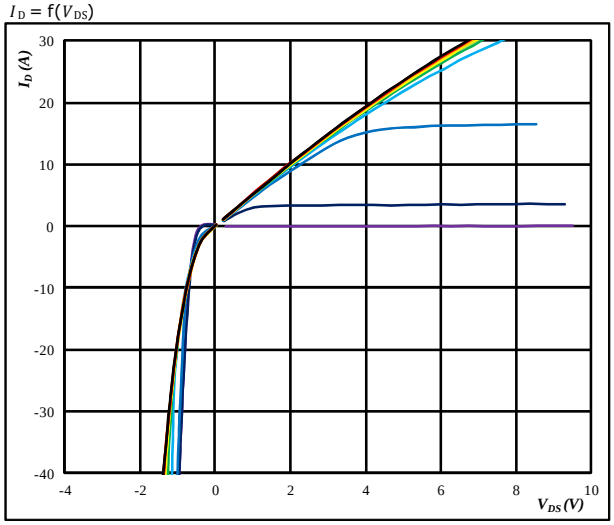
$I_D = f(V_{DS})$



t_p =	250	µs		25 °C	
V_{GS}=	10	V	T_j:	125 °C	

Typical output characteristics **MOSFET**

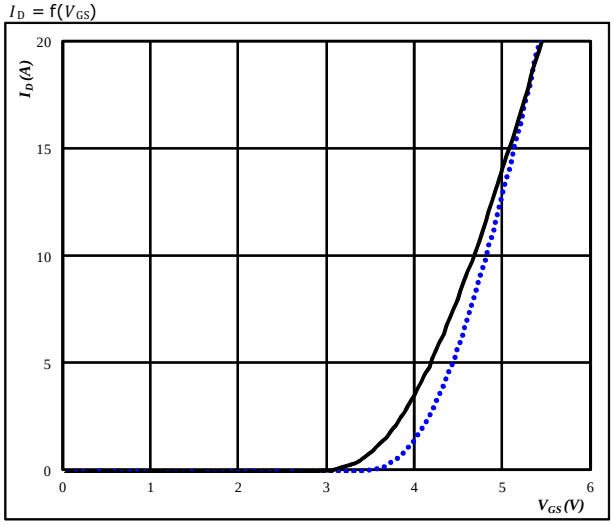
$I_D = f(V_{DS})$



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

Typical transfer characteristics **MOSFET**

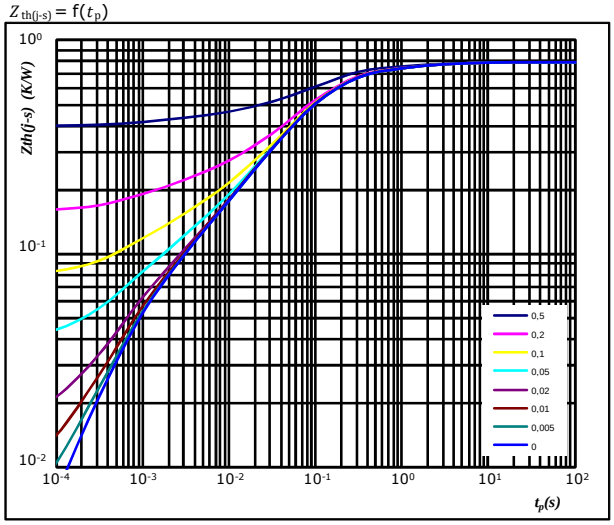
$I_D = f(V_{GS})$



t_p =	100	µs		25 °C	
V_{DS} =	10	V	T_j:	125 °C	

Transient thermal impedance as a function of pulse width **MOSFET**

$Z_{th(j-s)} = f(t_p)$



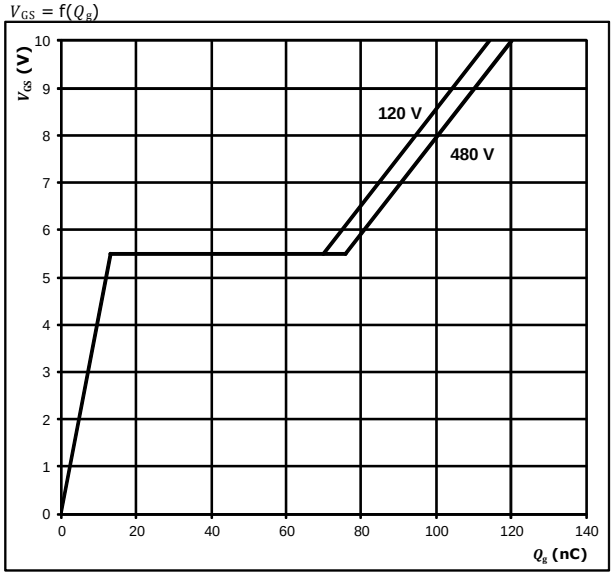
D =	t_p / T	
$R_{th(j-s)}$ =	0,8	K/W

R (K/W)	τ (s)
6,19E-02	2,26E+00
1,10E-01	4,08E-01
4,12E-01	9,23E-02
1,04E-01	2,31E-02
5,73E-02	5,67E-03
4,98E-02	8,49E-04

PFC Switch Characteristics

Gate voltage vs Gate charge **MOSFET**

$V_{GS} = f(Q_g)$



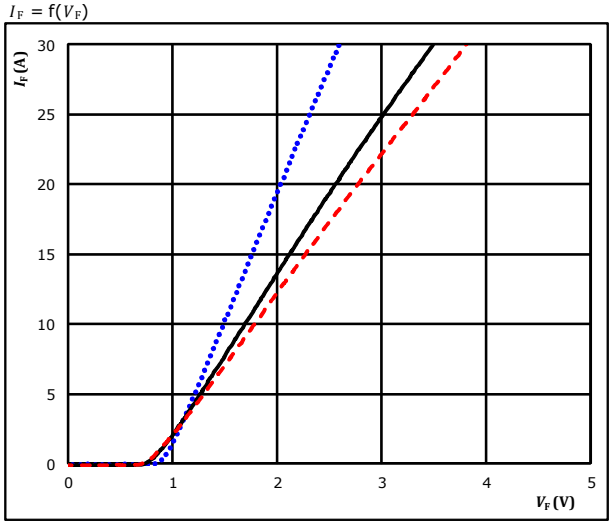
At

$I_D =$ 18 A

PFC Diode Characteristics

Typical forward characteristics **FWD**

$I_F = f(V_F)$

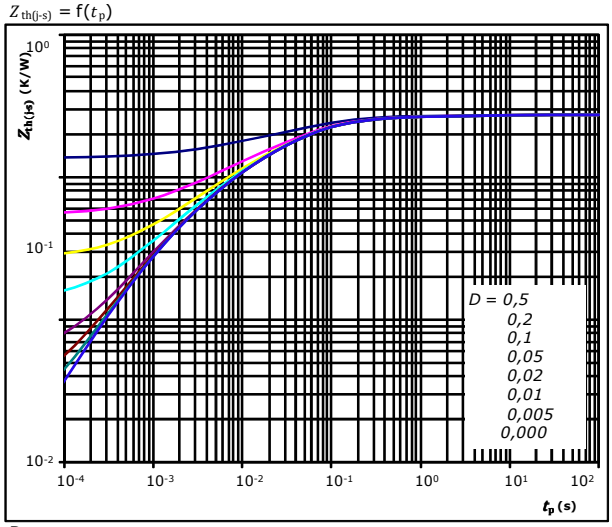


t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

Transient thermal impedance as a function of pulse width **FWD**

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 2,75 K/W

FWD thermal model values

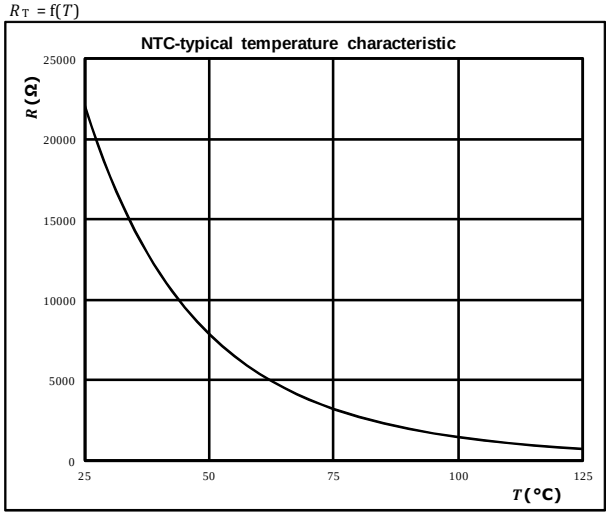
R (K/W)	τ (s)
7,6230E-02	7,9980E+00
2,3080E-01	4,5940E-01
1,1880E+00	6,1570E-02
6,9160E-01	1,3630E-02
4,4070E-01	3,2880E-03
1,1880E-01	6,6820E-04

Thermistor

Thermistor typical temperature characteristic

Typical NTC characteristic as a function of temperature

$R_T = f(T)$

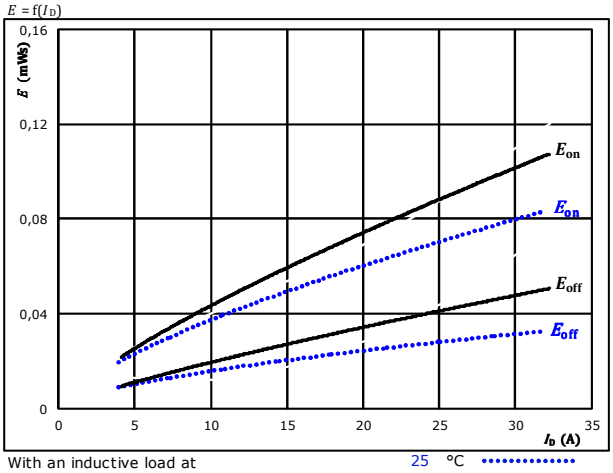


PFC Switching Characteristics

figure 1. MOSFET

Typical switching energy losses as a function of drain current

$E = f(I_D)$



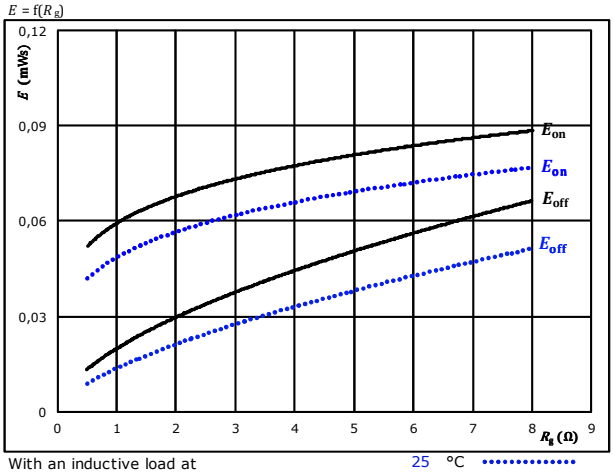
With an inductive load at

V_{DS} =	400	V	T_j:	25 °C	
V_{GS} =	10	V		125 °C	
R_{gon} =	2	Ω			
R_{goff} =	2	Ω			

figure 2. MOSFET

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



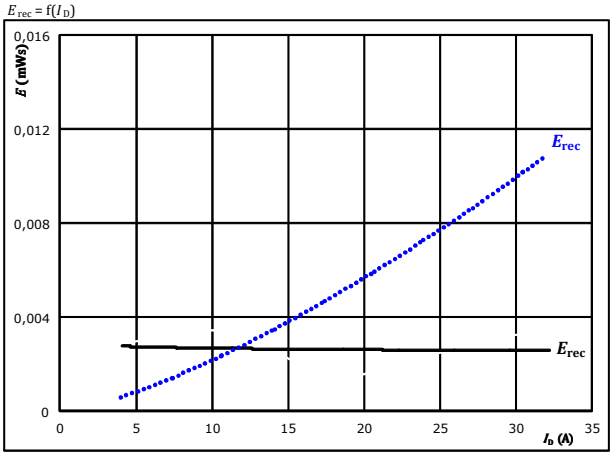
With an inductive load at

V_{DS} =	400	V	T_j:	25 °C	
V_{GS} =	10	V		125 °C	
I_D =	18	A			

figure 3. FWD

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



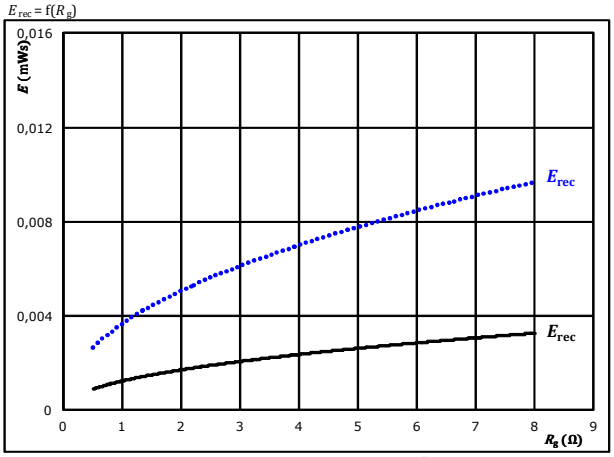
With an inductive load at

V_{DS} =	400	V	T_j:	25 °C	
V_{GS} =	10	V		125 °C	
R_{gon} =	2	Ω			

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

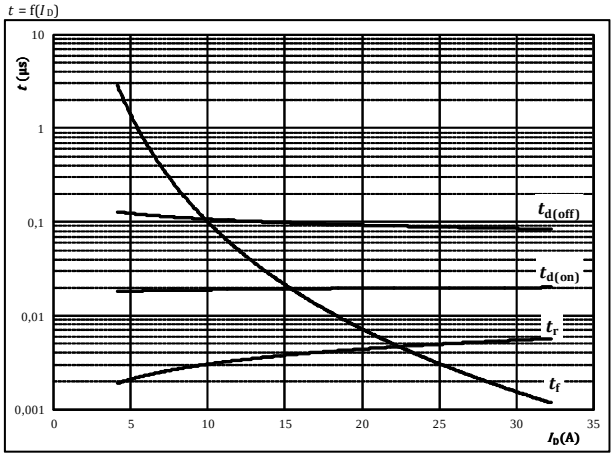
V_{DS} =	400	V	T_j:	25 °C	
V_{GS} =	10	V		125 °C	
I_D =	18	A			

PFC Switching Characteristics

figure 5. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



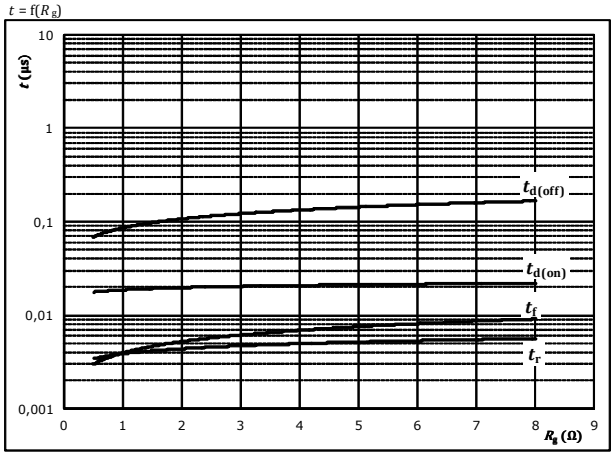
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	10	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

figure 6. **MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_g)$



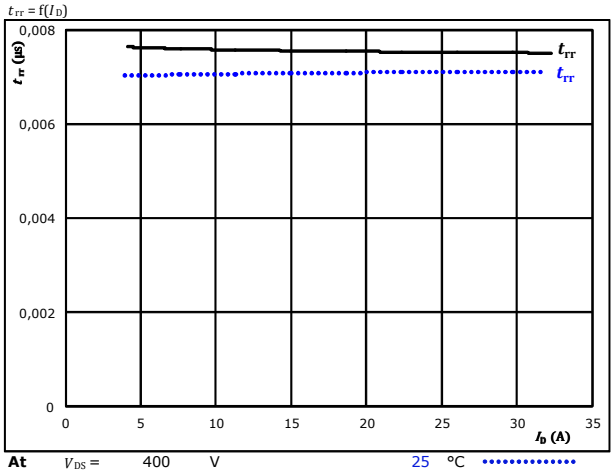
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	10	V
I_D =	18	A

figure 7. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$

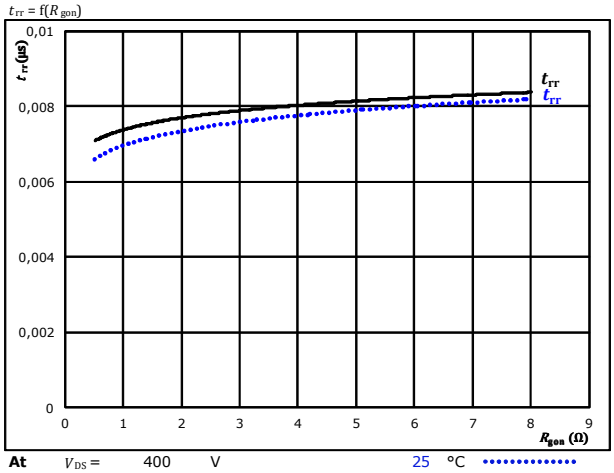


At	V_{DS} =	400	V	25 °C	•••••••••••••••
	V_{GS} =	10	V	T_j: 125 °C	———
	R_{gon} =	2	Ω		

figure 8. **FWD**

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

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



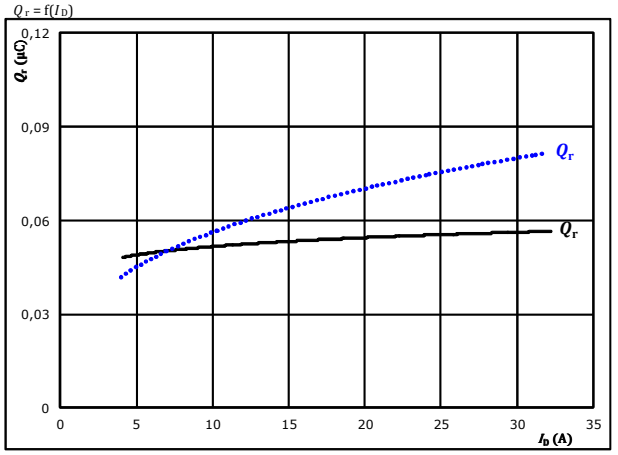
At	V_{DS} =	400	V	25 °C	•••••••••••••••
	V_{GS} =	10	V	T_j: 125 °C	———
	I_D =	18	A		

PFC Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

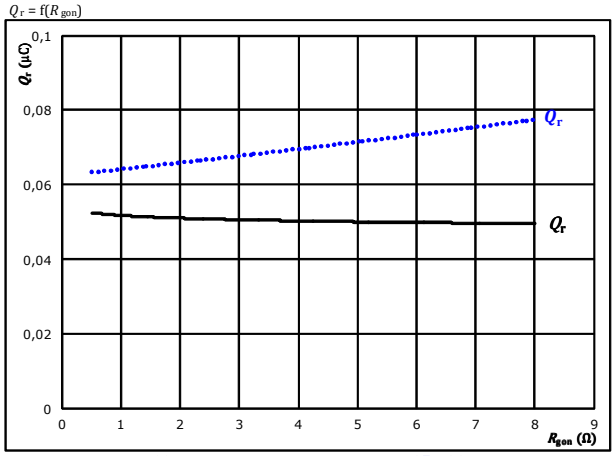


At	V_{DS} =	400	V		25 °C
	V_{GS} =	10	V	T_j:	125 °C
	R_{gon} =	2	Ω		

figure 10. FWD

Typical recoved charge as a function of MOSFET turn on gate resistor

$Q_r = f(R_{gon})$

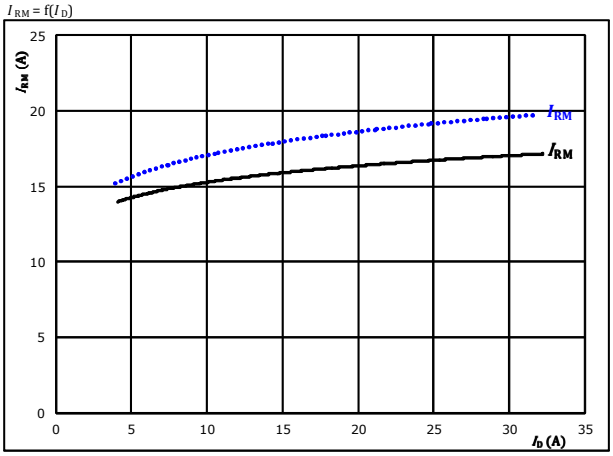


At	V_{DS} =	400	V		25 °C
	V_{GS} =	10	V	T_j:	125 °C
	I_D =	18	A		

figure 11. FWD

Typical peak reverse recovery current current as a function of drain current

$I_{RM} = f(I_D)$

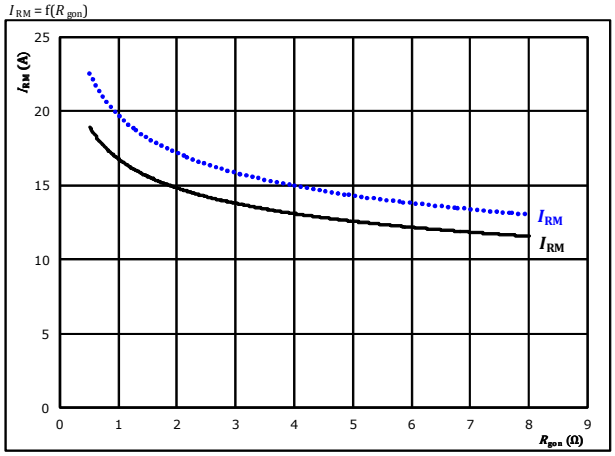


At	V_{DS} =	400	V		25 °C
	V_{GS} =	10	V	T_j:	125 °C
	R_{gon} =	2	Ω		

figure 12. FWD

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

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



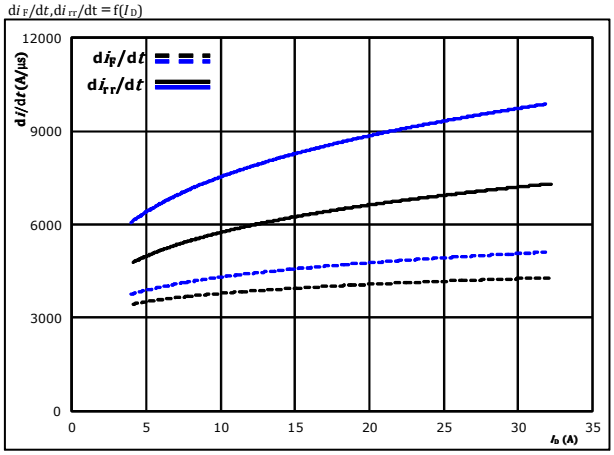
At	V_{DS} =	400	V		25 °C
	V_{GS} =	10	V	T_j:	125 °C
	I_D =	18	A		

PFC Switching Characteristics

figure 13. **FWD**

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

$di_F/dt, di_{rr}/dt = f(I_D)$

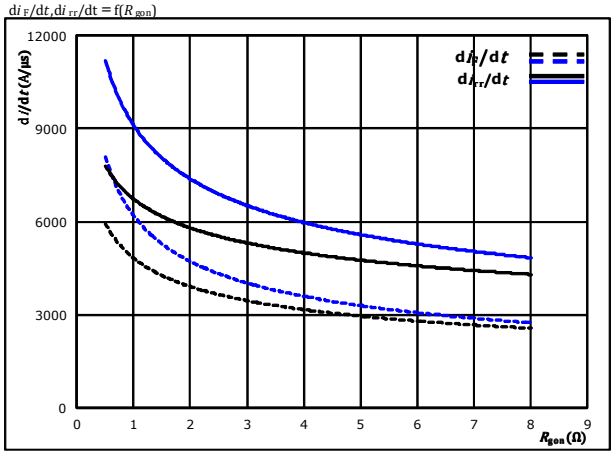


At					
V_{DS} =	400	V		25 °C	
V_{GS} =	10	V	T_j:	125 °C	
R_{gon} =	2	Ω			

figure 14. **FWD**

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

$di_F/dt, di_{rr}/dt = f(R_{gon})$

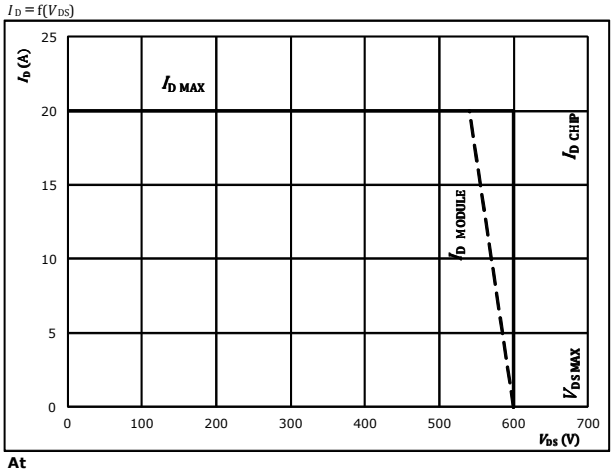


At					
V_{DS} =	400	V		25 °C	
V_{GS} =	10	V	T_j:	125 °C	
I_D =	18	A			

figure 15. **MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$



At			
T_j =	150	°C	
R_{gon} =	2	Ω	
R_{goff} =	2	Ω	

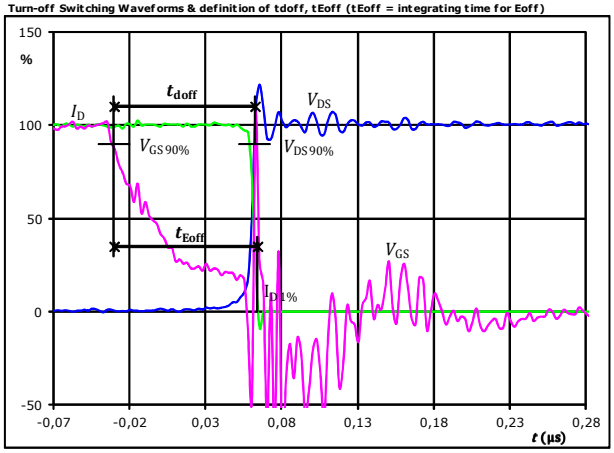
PFC Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	2 Ω
R_{goff}	=	2 Ω

figure 1. MOSFET

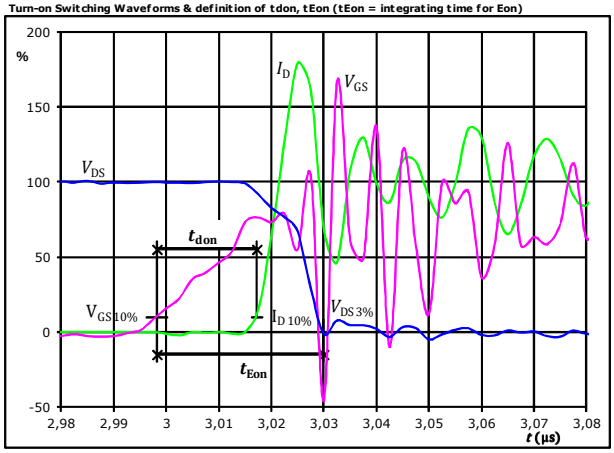
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



$V_{GS}(0\%)$ =	0	V
$V_{GS}(100\%)$ =	10	V
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	18	A
t_{doff} =	0,092	µs
t_{Eoff} =	0,094	µs

figure 2. MOSFET

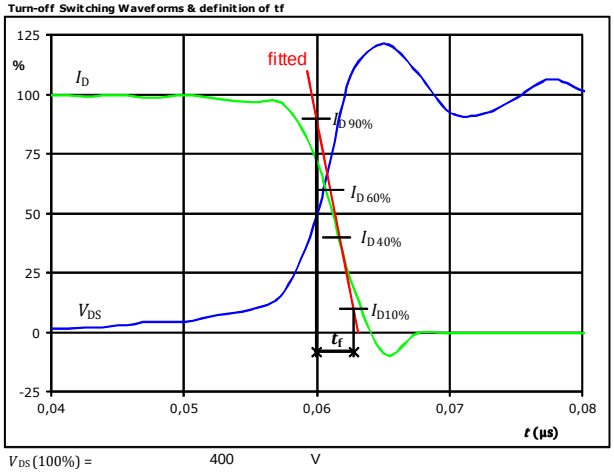
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



$V_{GS}(0\%)$ =	0	V
$V_{GS}(100\%)$ =	10	V
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	18	A
t_{don} =	0,019	µs
t_{Eon} =	0,032	µs

figure 3. MOSFET

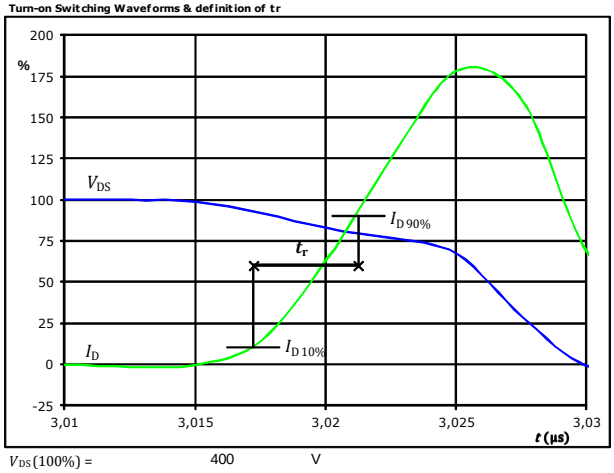
Turn-off Switching Waveforms & definition of tf



$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	18	A
t_f =	0,004	µs

figure 4. MOSFET

Turn-on Switching Waveforms & definition of tr

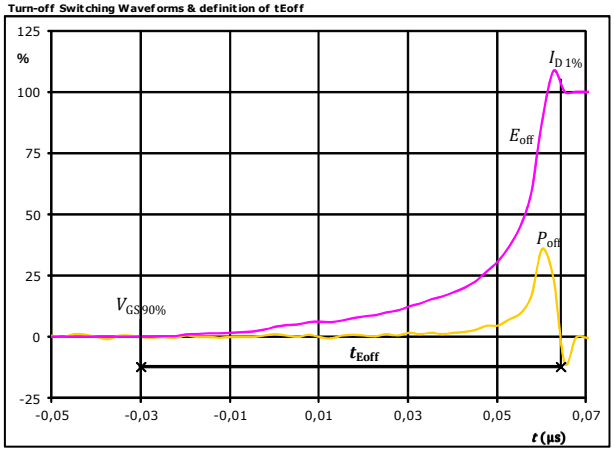


$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	18	A
t_r =	0,004	µs

PFC Switching Definitions

figure 5. **MOSFET**

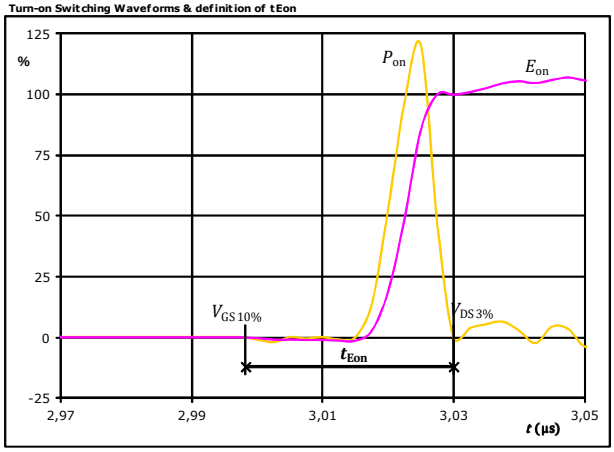
Turn-off Switching Waveforms & definition of tEoff



$P_{off}(100\%)$ =	7,21	kW
$E_{off}(100\%)$ =	0,02	mJ
t_{Eoff} =	0,09	µs

figure 6. **MOSFET**

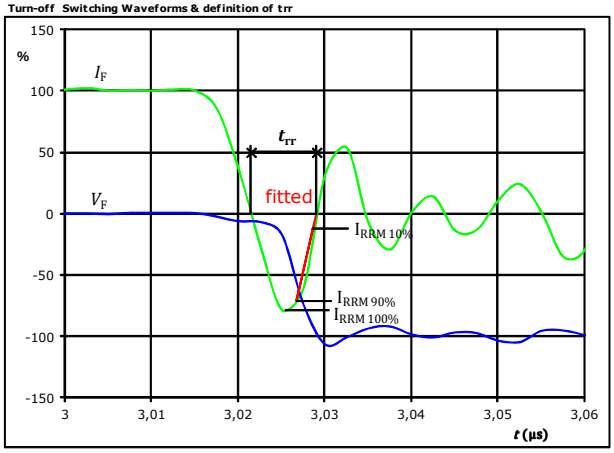
Turn-on Switching Waveforms & definition of tEon



$P_{on}(100\%)$ =	7,21	kW
$E_{on}(100\%)$ =	0,06	mJ
t_{Eon} =	0,03	µs

figure 7. **FWD**

Turn-off Switching Waveforms & definition of trr

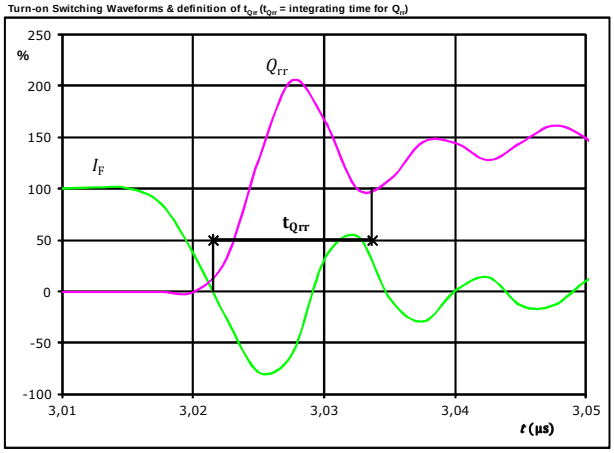


$V_F(100\%)$ =	400	V
$I_F(100\%)$ =	18	A
$I_{RRM}(100\%)$ =	-16	A
t_{rr} =	0,007	µs

PFC Switching Definitions

figure 8. **FWD**

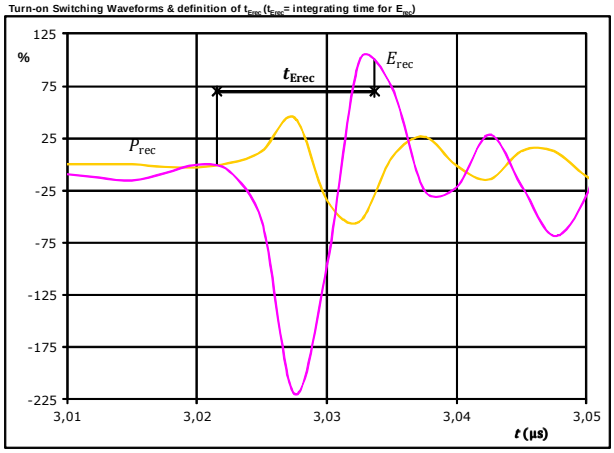
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_F (100%) =	18	A
Q_{rr} (100%) =	0,05	µC
t_{Qrr} =	0,01	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	7,21	kW
E_{rec} (100%) =	0,002	mJ
t_{Erec} =	0,01	µs

Vincotech

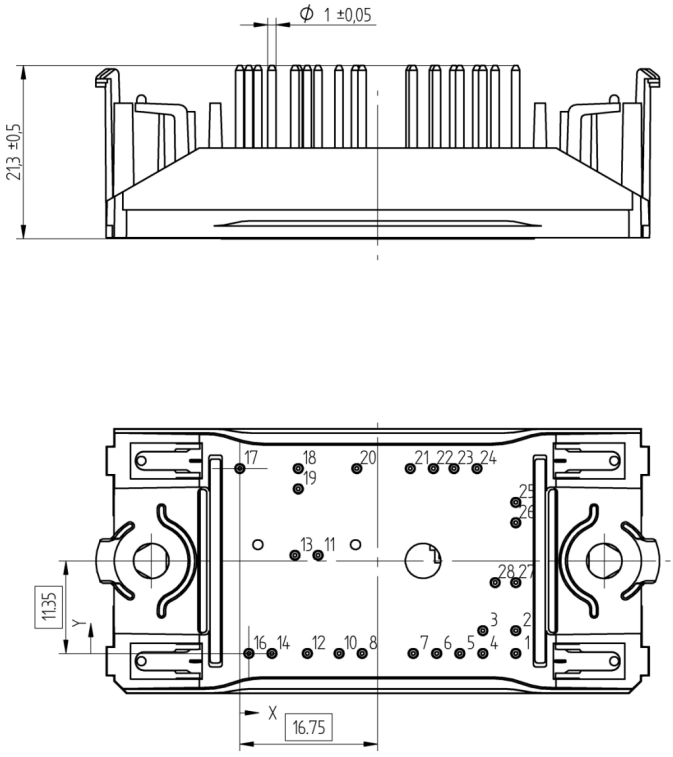
Ordering Code & Marking

Version	Ordering Code
without thermal paste with Solder pins 17mm housing	10-F0062TA099FS-P980D59

		Name		Date code	UL & Vinco	Lot	Serial
Text		NN-NNNNNNNNNNNNN-TTTTTTW		WWYY	UL Vinco	LLLLL	SSSS
		Type&Ver	**Lot number**	**Serial**	**Date code**		
Datamatrix		TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table [mm]			
Pin	X	Y	Function
1	33,5	0	Rt1
2	33,5	2,8	Rt2
3	29,5	2,8	Sa
4	29,5	0	Sb
5	26,7	0	-DC
6	23,9	0	-DC
7	21,05	0	N.C.
8	14,85	0	S1
9	not assembled		
10	12,05	0	G2
11	9,5	12,05	-PFC1
12	8,2	0	N.C.
13	6,7	12,05	-PFC2
14	3,9	0	S2
15	not assembled		
16	1,1	0	G4
17	0	22,7	PFC2
18	7,1	22,7	PFC+
19	7,1	20,2	PFC+
20	14,2	22,7	PFC1
21	20,7	22,7	GT2
22	23,5	22,7	+DC
23	26	22,7	+DC
24	28,8	22,7	GT1
25	33,5	18,55	L1
26	33,5	16,05	L1
27	33,5	8,7	L2
28	31	8,7	L2



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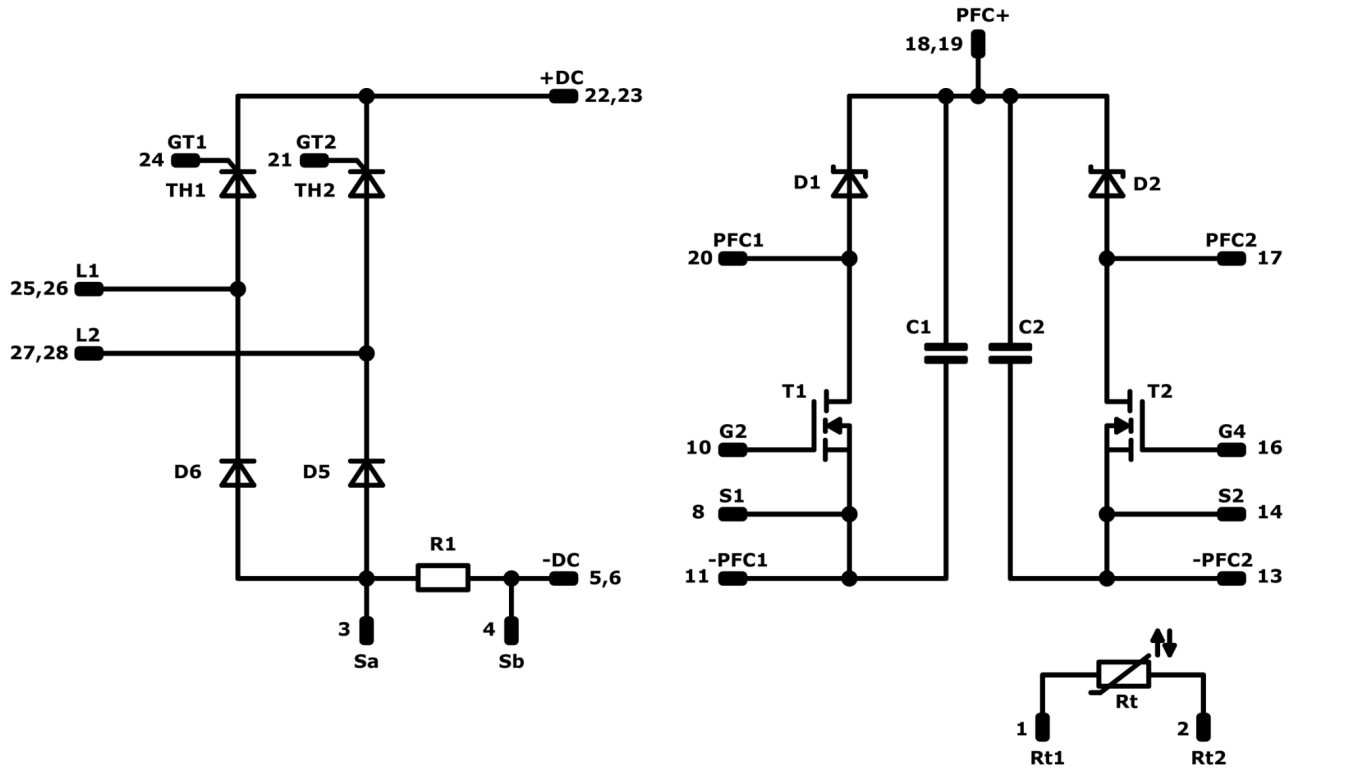
Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1, T2	MOSFET	600V	99mΩ	PFC Switch	
D1, D2	FWD	600V	10A	PFC Diode	
D5, D6	Rectifier	1600V	50A	Rectifier Diode	
TH1, TH2	Thyristor	1200V	26A	Rectifier Thyristor	
R1	Resistor			PFC Shunt	
C1, C2	Capacitor	500V		PFC Capacitance	
Rt	NTC			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

General datasheet
General datasheet for *flow* 0 packages see vincotech.com website.

Document No.:	Date:	Modification:	Pages
10-F0062TA099FS-P980D59-D3-14	08 Nov. 2016		