Vincotech

10-x006PPA010SB-M683Bx
10-PC06PPA010SB-M683B06Y
datasheet

flow PIM 0 + PFC — **600 V / 10 A**

Features

- Clip in PCB mounting
- Trench Fieldstop IGBT's for low saturation losses
- Latest generation superjunction MOSFET for PFC
- Integrated PFC shunt
- Temperature sensor

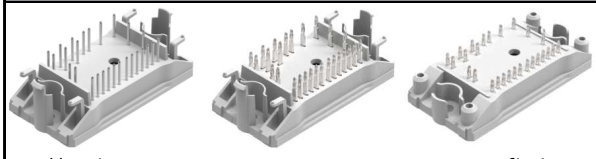
Target applications

- Industrial Drives
- Embedded Drives

Types

- 10-F006PPA010SB-M683B
- 10-P006PPA010SB-M683BY
- 10-PC06PPA010SB-M683B06Y

flow 0 housing

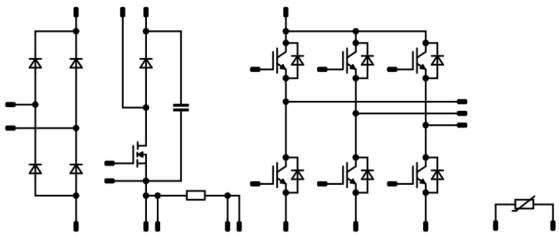


solder pins
M683Bx
17 mm housing

press-fit pins

press-fit pins
M683B06Y
12 mm housing

Schematic



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	33	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms T_j = 150 °C	200	A
Surge current capability	I^2t		200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	44	W
Maximum Junction Temperature	T_{jmax}		150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		600	V
Collector current	I_C	$T_j = T_{jmax}$ T_s = 80 °C	14	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	44	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V	6 360	µs V
Maximum Junction Temperature	T_{jmax}		175	°C
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	14	A
Repetitive peak forward current	I_{FRM}	$T_j = T_{jmax}$ T_s = 80 °C	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	32	W
Maximum Junction Temperature	T_{jmax}		175	°C
PFC Switch				
Drain-source voltage	V_{DSS}		600	V
Drain current	I_D	$T_j = T_{jmax}$ T_s = 80 °C	16	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 P_{AV}=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	72	W
Gate-source voltage	V_{GSS}		±20	V
Reverse diode dv/dt	dv/dt		15	V/ns
Maximum Junction Temperature	T_{jmax}		150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
PFC Diode				
Peak repetitive reverse voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F	T_j = T_{jmax} T_s = 80 °C	20	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	40	W
Maximum junction temperature	T_{jmax}		150	°C
PFC Shunt				
DC forward current	I_F	T_c = 25 °C	15,81	A
Capacitor (PFC)				
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 Test Voltage* t_p = 2 s	6000	V
		AC Voltage t_p = 1 min	2500	V
Creepage distance			min. 12,7	mm
Clearance		Solder pin / Press-fit pin	min. 12,7 / 9,03	mm
Comparative Tracking Index	CTI		> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Rectifier Diode										
Static										
Forward voltage	V_F				25	25 125		1,22 1,21	1,90	V
Reverse leakage current	I_r			1600		25 145			50 1100	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,59		K/W
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00015	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 150	1,1	1,50 1,79	1,9	V
Collector-emitter cut-off current	I_{CES}		0	600		25			0,6	µA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f= 1 MHz	0	25		25		551		pF
Output capacitance	C_{oes}							40		
Reverse transfer capacitance	C_{res}							17		
Gate charge	Q_g		15	480	10	25		70		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,15		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 32 Ω R_{gon} = 32 Ω	±15	400	10	25 125		75 74		ns
Rise time	t_r					25 125		24 26		
Turn-off delay time	$t_{d(off)}$					25 125		136 159		
Fall time	t_f					25 125		83 123		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,5 µC Q_{rFWD} = 0,9 µC				25 125		0,28 0,38		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,33 0,45		

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Diode										
Static										
Forward voltage	V_F				10	25		1,58	1,95	V
Reverse leakage current	I_r			600		25			27	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,99		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 400 A/µs di/dt = 467 A/µs	±15	400	10	25 125		5 7		A
Reverse recovery time	t_{rr}					25 125		194 270		ns
Recovered charge	Q_r					25 125		0,47 0,90		µC
Reverse recovered energy	E_{rec}					25 125		0,13 0,26		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		21 65		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [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		100 209		mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$			0,00121	25	2,5	3	3,5	V
Gate to Source Leakage Current	I_{GSS}		20	0		25			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	600		25			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
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,97		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125		21 23		
Rise time	t_r	R_{goff} = 8 Ω R_{gon} = 8 Ω				25 125		5 4		
Turn-off delay time	$t_{d(off)}$		0/10	400	10	25 125		131 202		ns
Fall time	t_f					25 125		8 4		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,2 µC Q_{rFWD} = 0,5 µC				25 125		0,083 0,147		
Turn-off energy (per pulse)	E_{off}					25 125		0,020 0,045		mWs

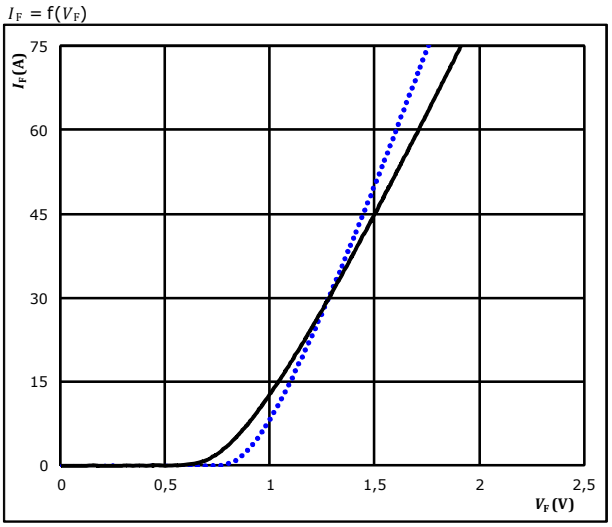
Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
PFC Diode										
Static										
Forward voltage	V_F				15	25 125		2,85 1,81	3,2	V
Reverse leakage current	I_R			600		25			50	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,75		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2415 A/µs di/dt = 2378 A/µs	0/10	400	10	25 125		20 36		A
Reverse recovery time	t_{rr}					25 125		14 23		ns
Recovered charge	Q_r					25 125		0,160 0,493		µC
Reverse recovered energy	E_{rec}					25 125		0,047 0,106		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		4429 6331		A/µs
PFC Shunt										
R1 value	R						18,8	20	21,2	mΩ
Temperature coeficient	t_c					20 - 60			50	ppm/K
Internal heat resistance	R_{thi}								6,5	K/W
Inductance	L								3	nH
Capacitor (PFC)										
Capacitance	C							100		nF
Tolerance							-10		+10	%
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 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 Characteristics

figure 1. **FWD**

Typical forward characteristics



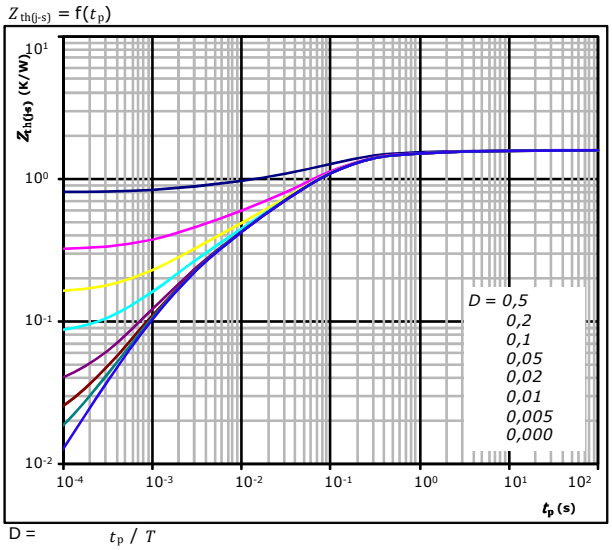
t_p = 250 µs

25 °C

T_j: 125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width



D = t_p / T

$R_{th(j-s)}$ = 1,59 K/W

Diode thermal model values

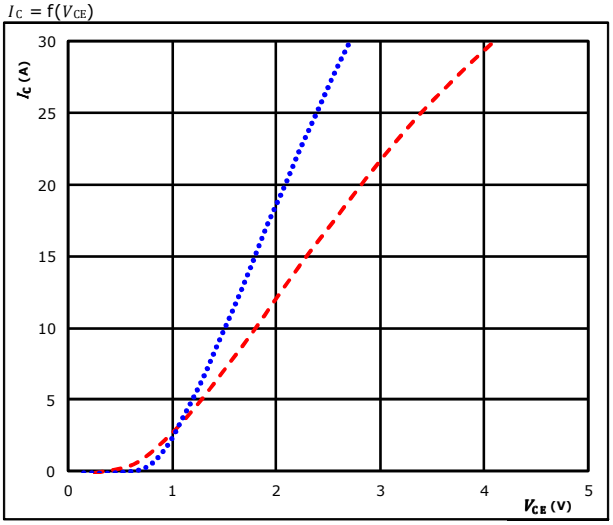
R (K/W)	τ (s)
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,2160E-01	1,7910E-03
1,8080E-02	7,8790E-04

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

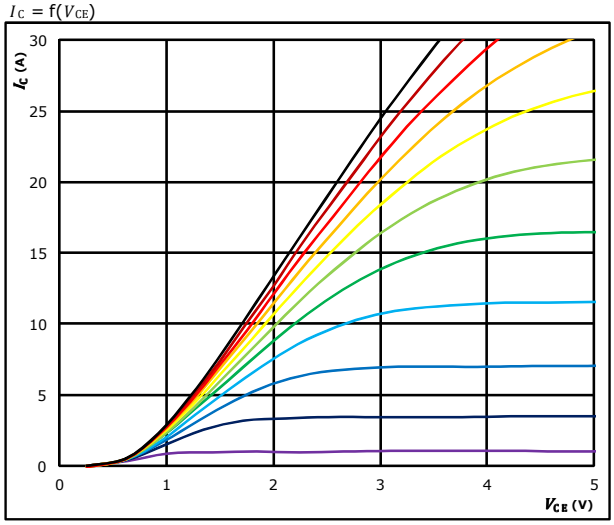


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

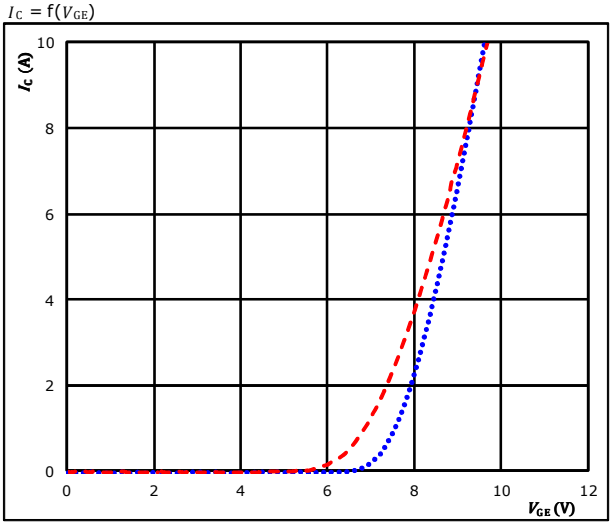


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

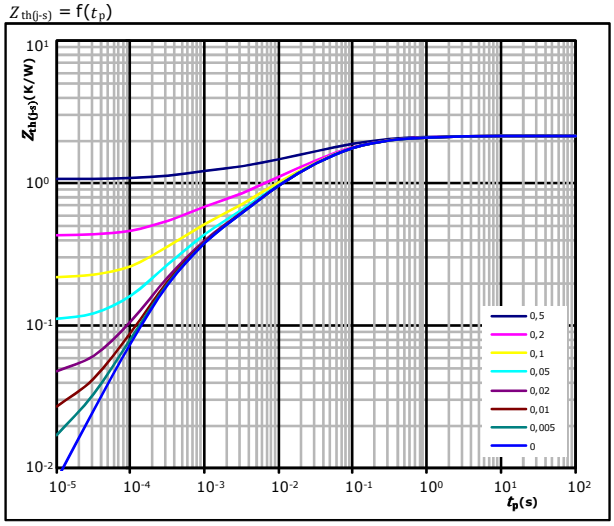


t_p =	100	µs		25 °C	
V_{CE} =	10	V	T_j:	150 °C	

figure 4. **IGBT**

Transient Thermal Impedance as function of Pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	2,15	K/W

IGBT thermal model values

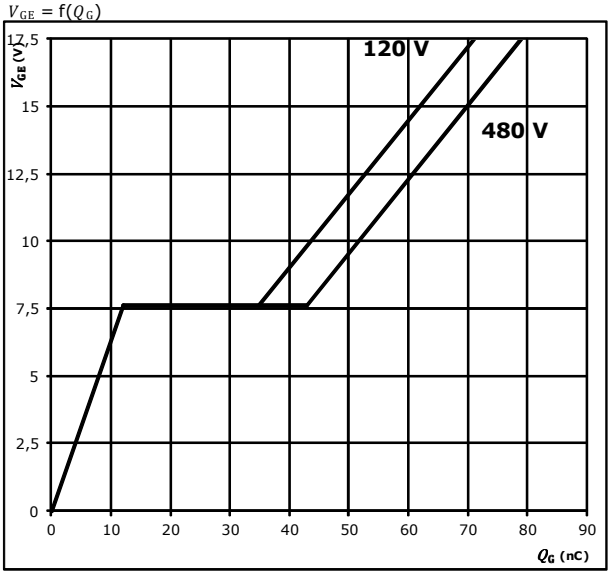
R (K/W)	τ (s)
1,04E-01	1,37E+00
2,88E-01	2,01E-01
6,99E-01	5,27E-02
4,91E-01	1,22E-02
3,07E-01	2,97E-03
2,60E-01	3,80E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_G)$



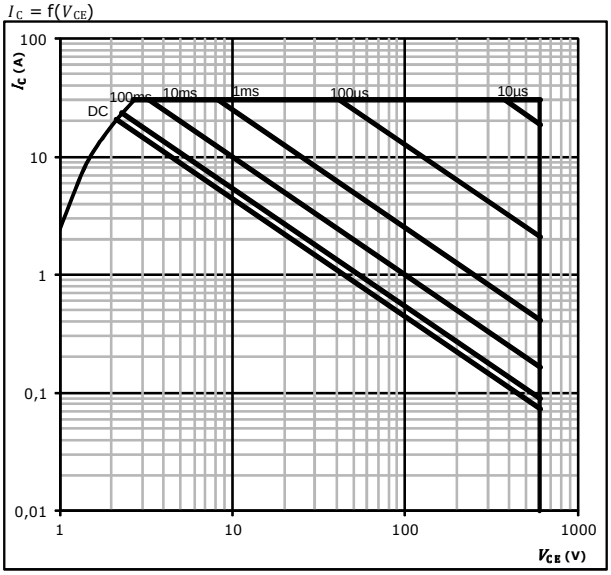
At

I_C= 10 A

figure 6. **IGBT**

Safe operating area as a function of V_{GE}

$I_C = f(V_{CE})$



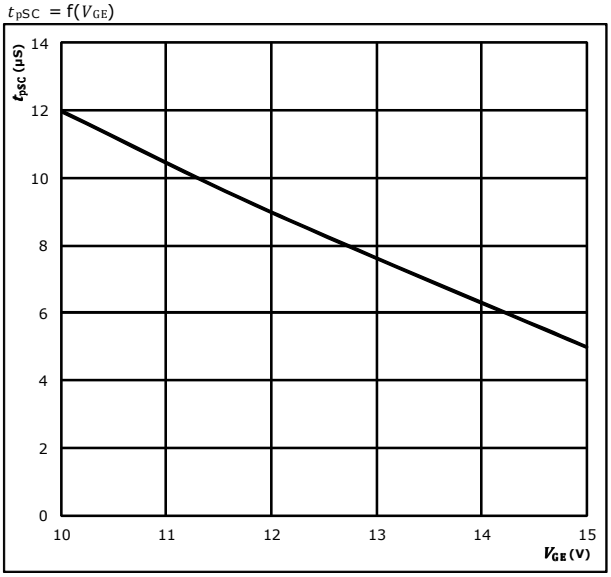
At

D = single pulse
T_s = 80 °C
V_{GE} = ±15 V
T_j = T_{jmax}

figure 7. **IGBT**

Short circuit withstand time as a function of V_{GE}

$t_{pSC} = f(V_{GE})$



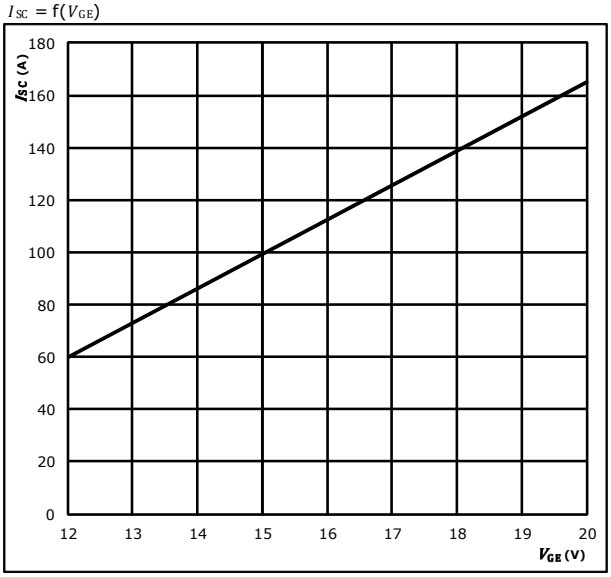
At

V_{CE} = 600 V
T_j ≤ 175 °C

figure 8. **IGBT**

Typical short circuit collector current as a function of V_{GE}

$I_{SC} = f(V_{GE})$



At

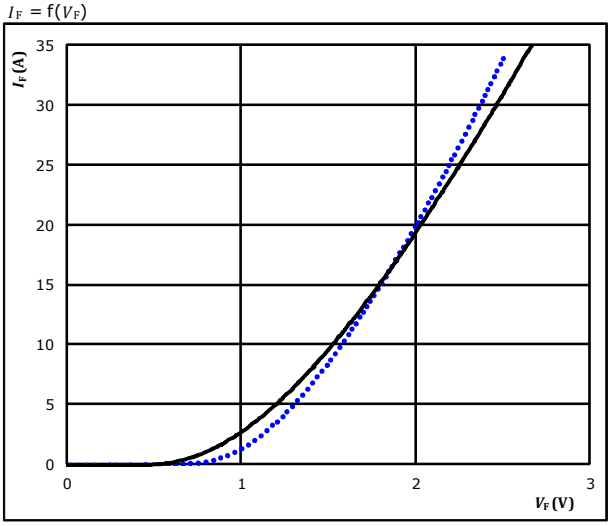
V_{CE} ≤ 600 V
T_j ≤ 175 °C

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



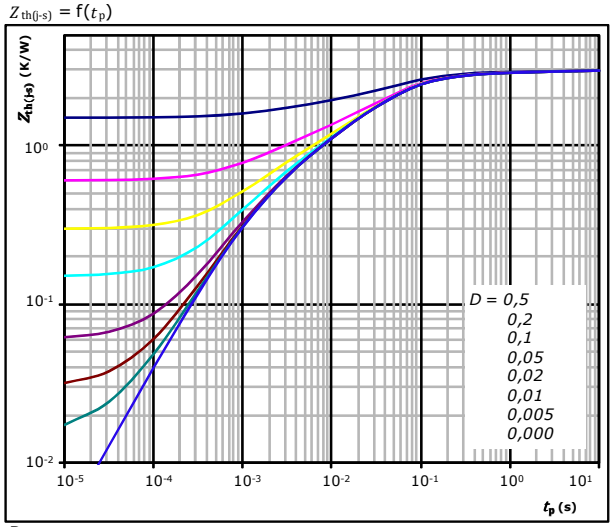
t_p = 250 µs 25 °C

T_j: 125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,99 K/W

FWD thermal model values

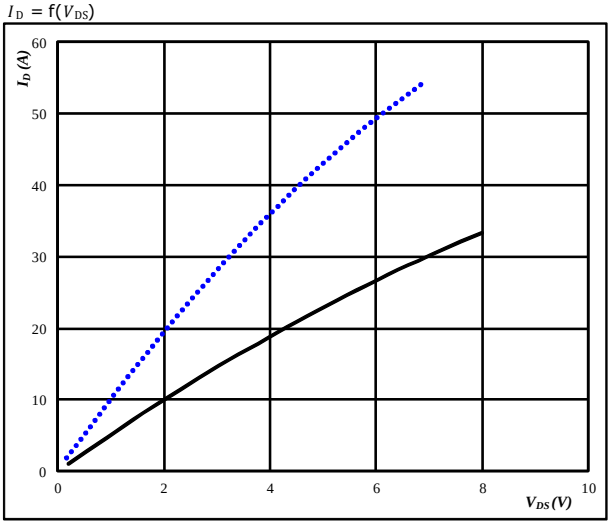
R (K/W)	τ (s)
8,74E-02	5,59E+00
2,41E-01	4,60E-01
1,22E+00	6,53E-02
6,89E-01	2,20E-02
4,52E-01	5,14E-03
2,99E-01	1,11E-03

PFC Switch Characteristics

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

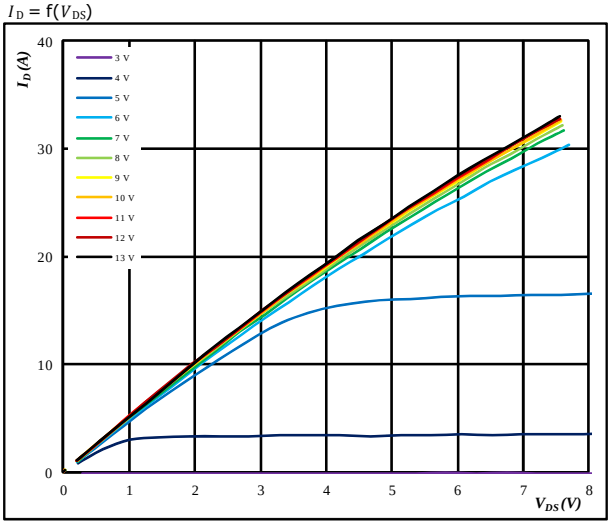


t_p =	250	µs		25 °C	
V_{GS}=	10	V	T_j:	125 °C	

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

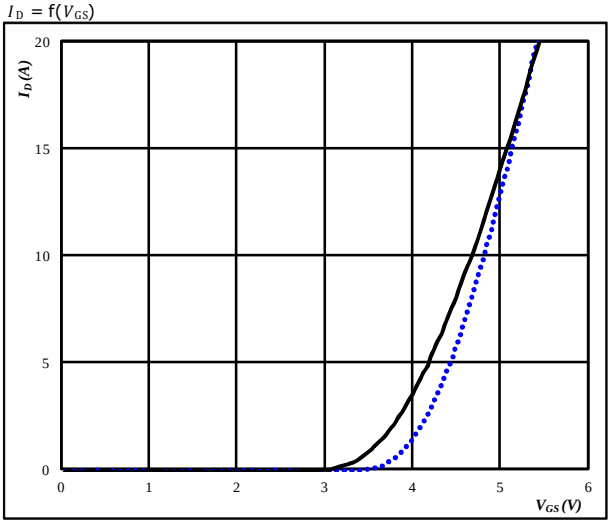


t_p =	250	µs
T_j =	125	°C
V_{GS} from	3 V to 13 V in steps of 1 V	

figure 3. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$

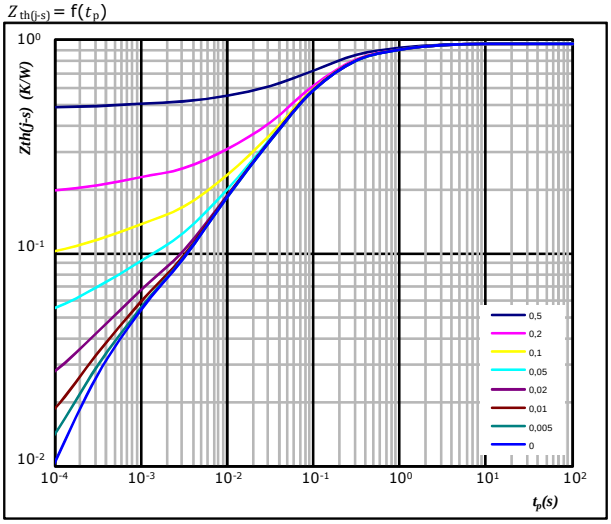


t_p =	100	µs		25 °C	
V_{DS} =	10	V	T_j:	125 °C	

figure 4. **MOSFET**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,97	K/W

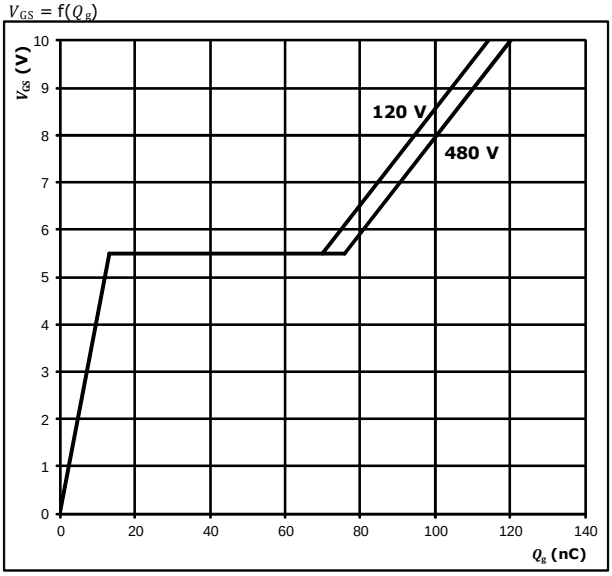
R (K/W)	τ (s)
1,16E-01	1,34E+00
2,88E-01	2,07E-01
4,26E-01	6,72E-02
9,86E-02	7,51E-03
3,70E-02	4,03E-04

PFC Switch Characteristics

figure 5. **MOSFET**

Gate voltage vs Gate charge

$V_{GS} = f(Q_g)$



At

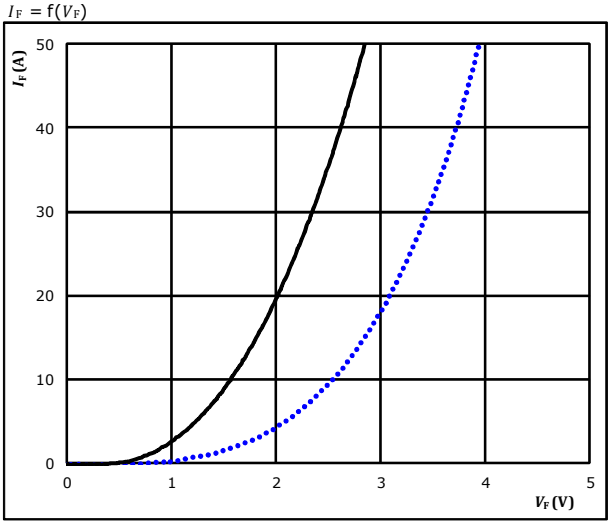
I_D = 18 A

PFC Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

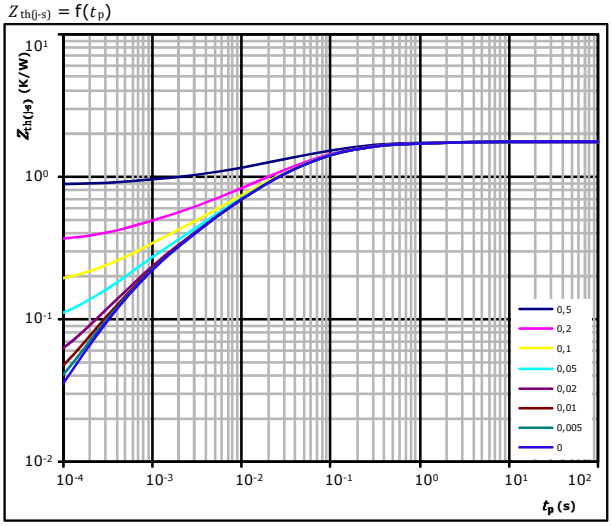
T_j: 25 °C

125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,75 K/W

FWD thermal model values

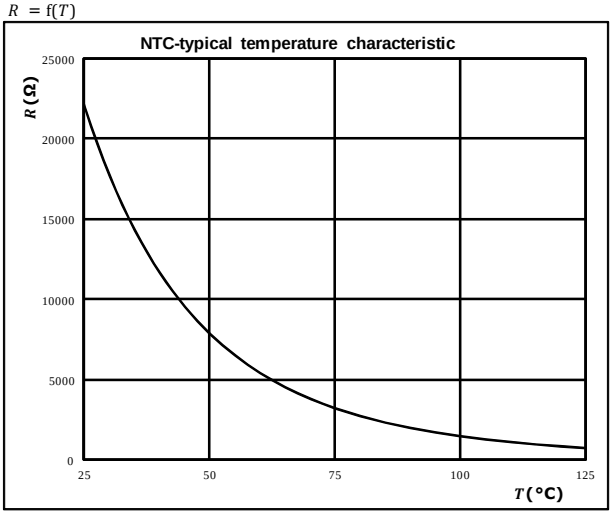
R (K/W)	τ (s)
8,09E-02	1,93E+00
1,89E-01	2,40E-01
6,58E-01	6,34E-02
4,62E-01	1,40E-02
2,29E-01	2,92E-03
1,31E-01	5,08E-04

NTC Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

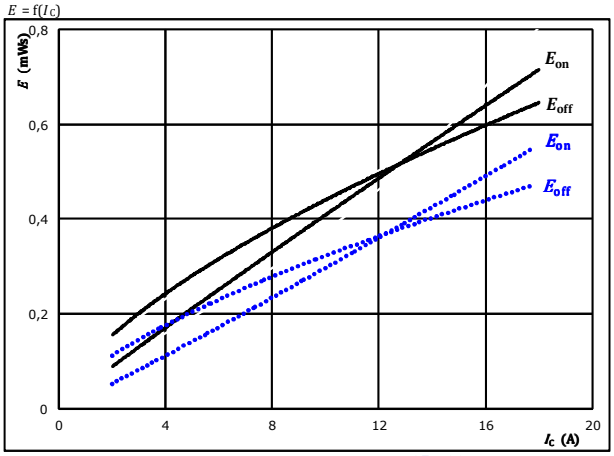


Inverter Switching Characteristics

figure 1. IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



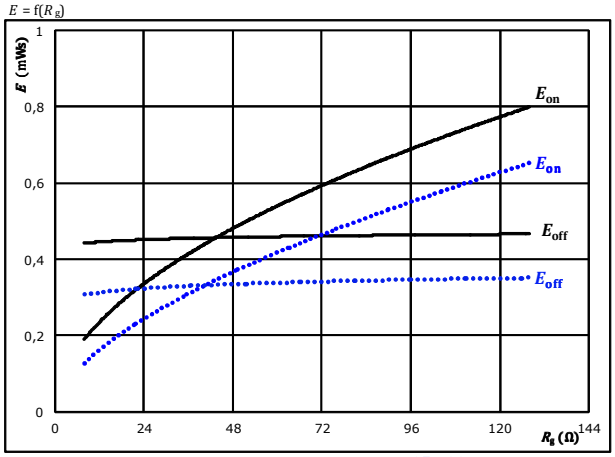
With an inductive load at — 25 °C ••••••••••••••

V_{CE} =	400	V	T_J:	125 °C	———
V_{GE} =	±15	V			
R_{gon} =	32	Ω			
R_{goff} =	32	Ω			

figure 2. IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



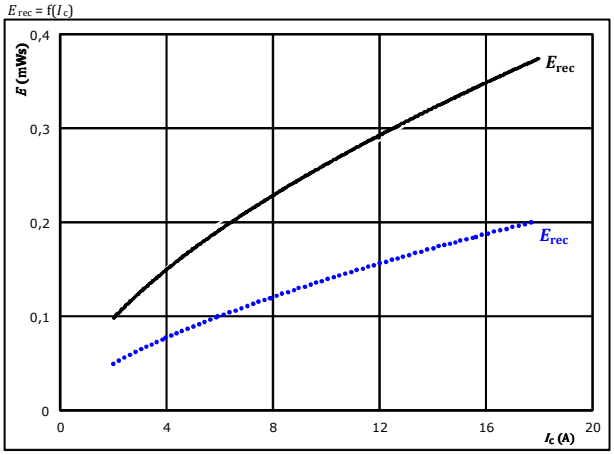
With an inductive load at — 25 °C ••••••••••••••

V_{CE} =	400	V	T_J:	125 °C	———
V_{GE} =	±15	V			
I_C =	10	A			

figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



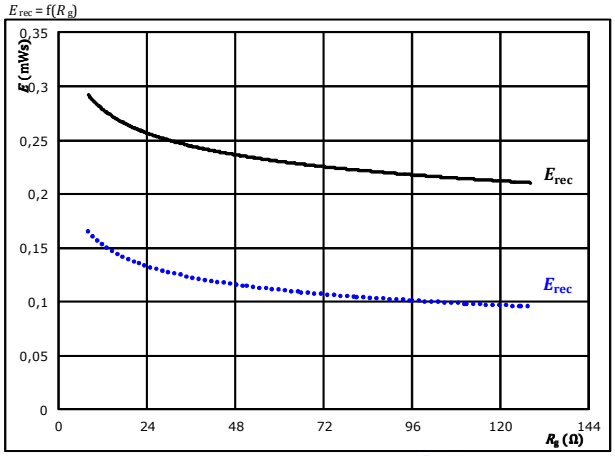
With an inductive load at — 25 °C ••••••••••••••

V_{CE} =	400	V	T_J:	125 °C	———
V_{GE} =	±15	V			
R_{gon} =	32	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 — 25 °C ••••••••••••••

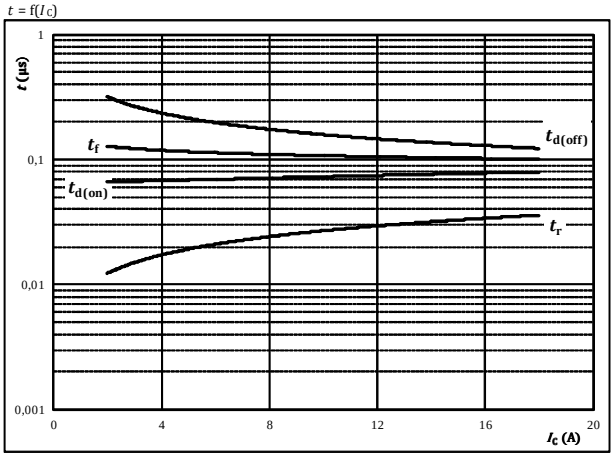
V_{CE} =	400	V	T_J:	125 °C	———
V_{GE} =	±15	V			
I_C =	10	A			

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



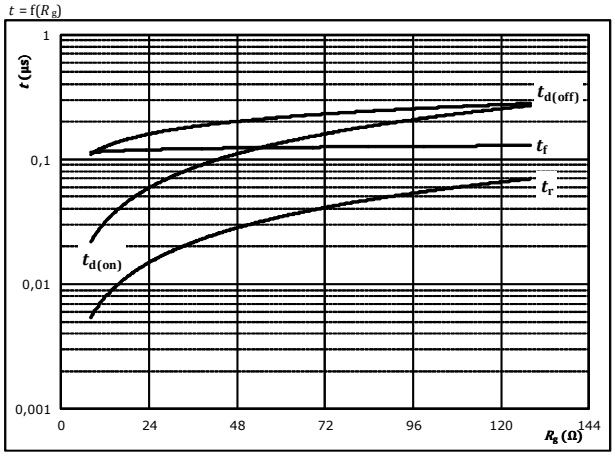
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



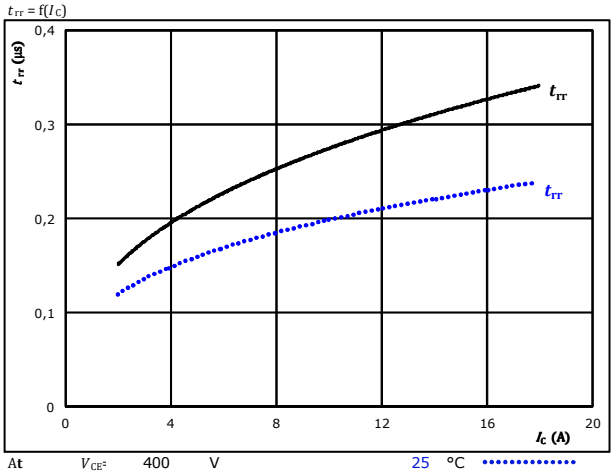
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	±15	V
I_C =	10	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

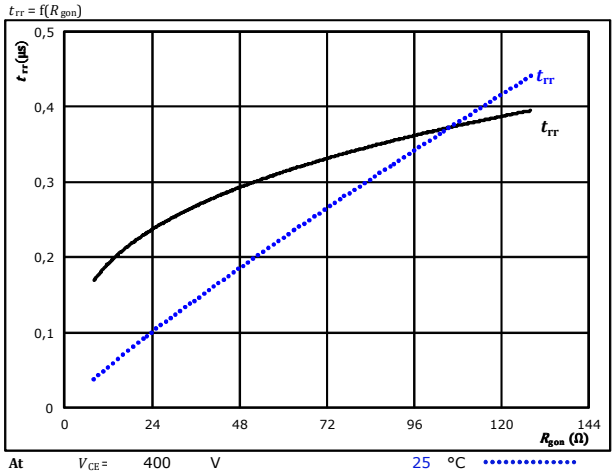


At					
	V_{CE} =	400	V	25 °C	•••••••••••••••
	V_{GE} =	±15	V	T_j: 125 °C	———————
	R_{gon} =	32	Ω		

figure 8. **FWD**

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

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



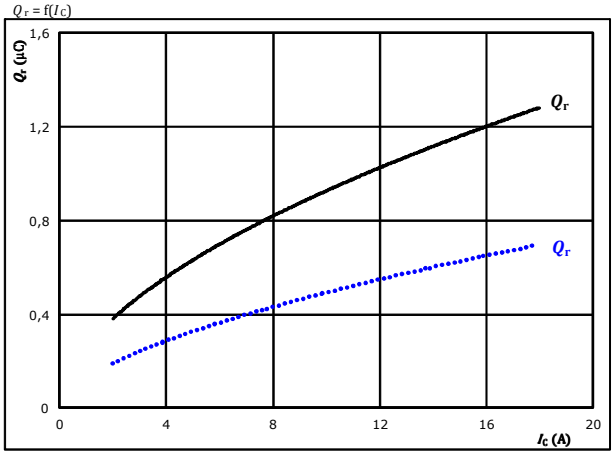
At					
	V_{CE} =	400	V	25 °C	•••••••••••••••
	V_{GE} =	±15	V	T_j: 125 °C	———————
	I_C =	10	A		

Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

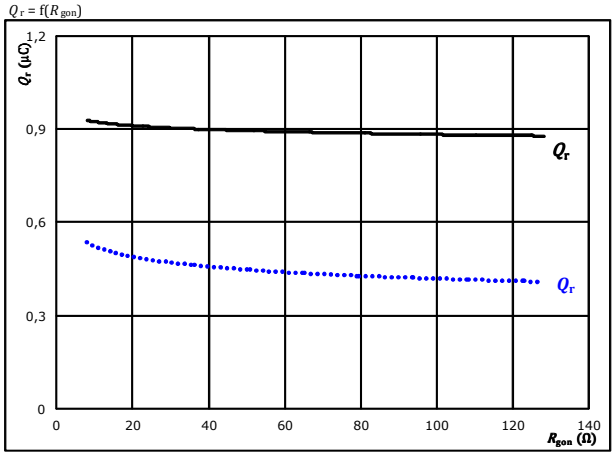


At						
	V_{CE} =	400	V		25 °C	·····
	V_{GE} =	±15	V	T_j:	125 °C	———
	R_{gon} =	32	Ω			

figure 10. FWD

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

$Q_r = f(R_{gon})$

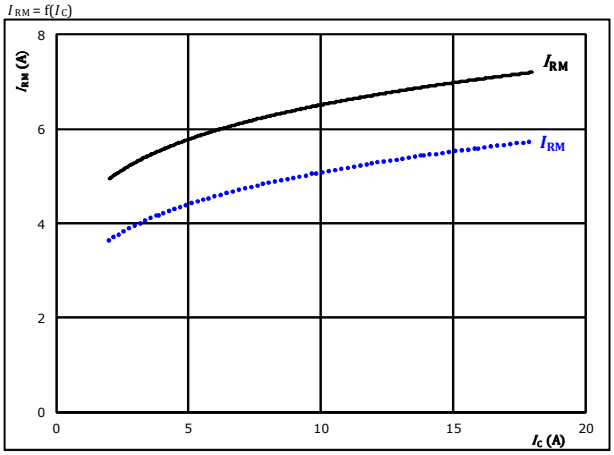


At						
	V_{CE}=	400	V		25 °C	·····
	V_{GE} =	±15	V	T_j:	125 °C	———
	I_C=	10	A			

figure 11. FWD

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

$I_{RM} = f(I_C)$

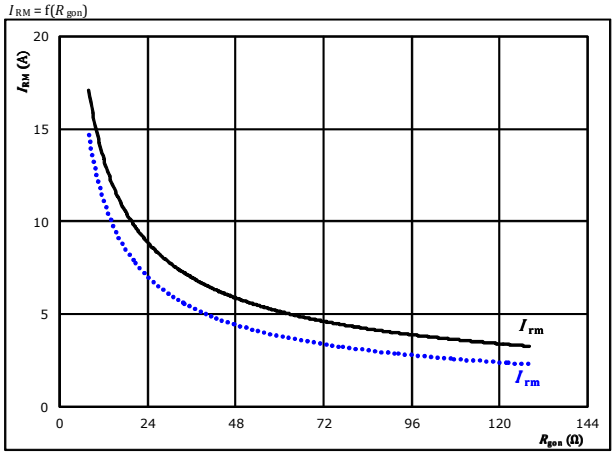


At						
	V_{CE}:	400	V		25 °C	·····
	V_{GE} =	±15	V	T_j:	125 °C	———
	R_{gon} =	32	Ω			

figure 12. FWD

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

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



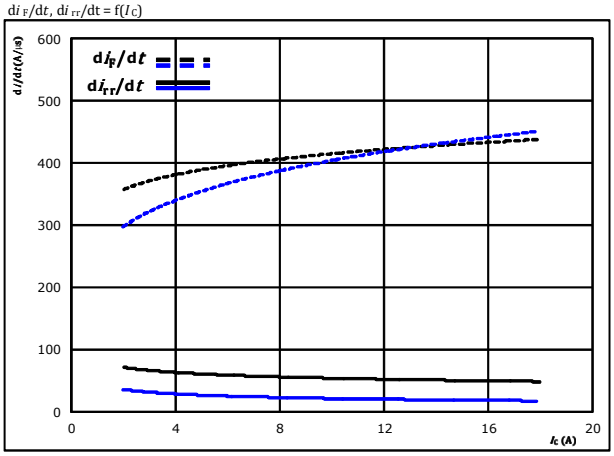
At						
	V_{CE} =	400	V		25 °C	·····
	V_{GE} =	±15	V	T_j:	125 °C	———
	I_C =	10	A			

Inverter Switching Characteristics

figure 13. **FWD**

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

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

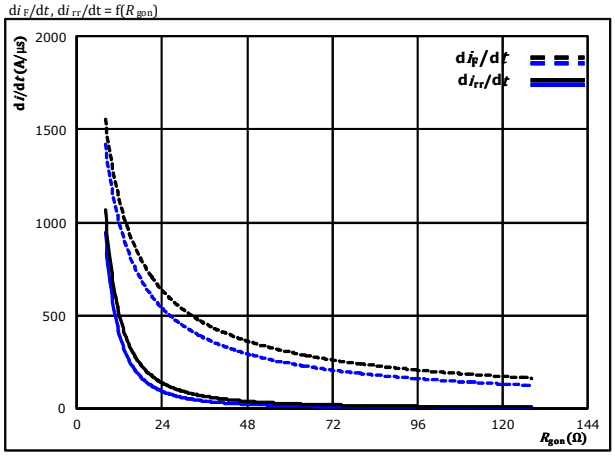


At						
V_{CE} =	400	V		T_j:	25 °C	
V_{GE} =	±15	V			125 °C	
R_{gon} =	32	Ω				

figure 14. **FWD**

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

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

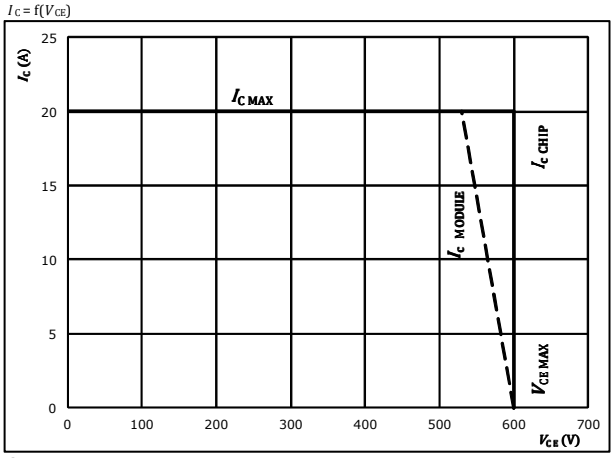


At						
V_{CE} =	400	V		T_j:	25 °C	
V_{GE} =	±15	V			125 °C	
I_C =	10	A				

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C
R_{gon} =	32	Ω
R_{goff} =	32	Ω

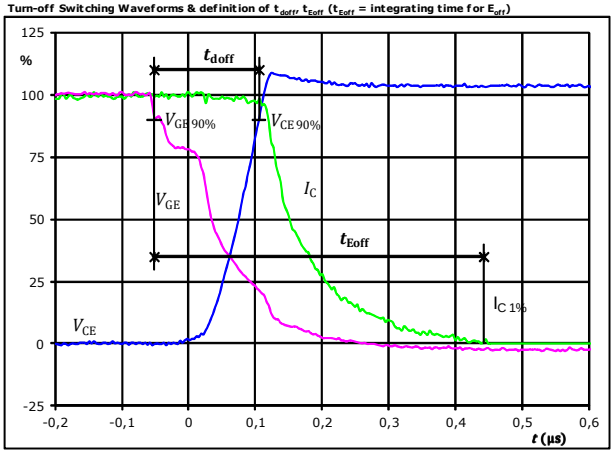
Inverter Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**32 Ω**
R_{goff}	=	**32 Ω**

figure 1. **IGBT**

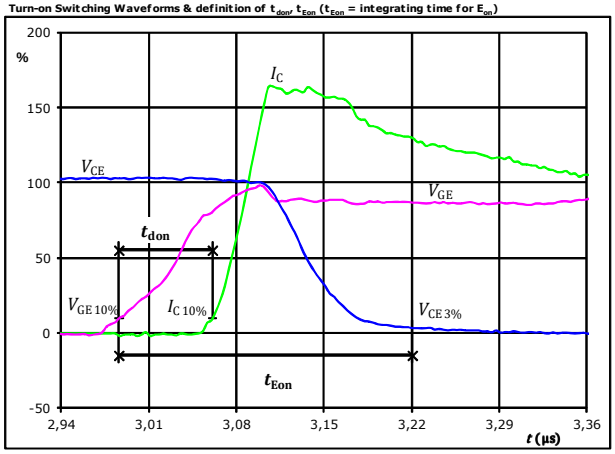
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	10	A
t_{doff} =	0,159	µs
t_{Eoff} =	0,494	µs

figure 2. **IGBT**

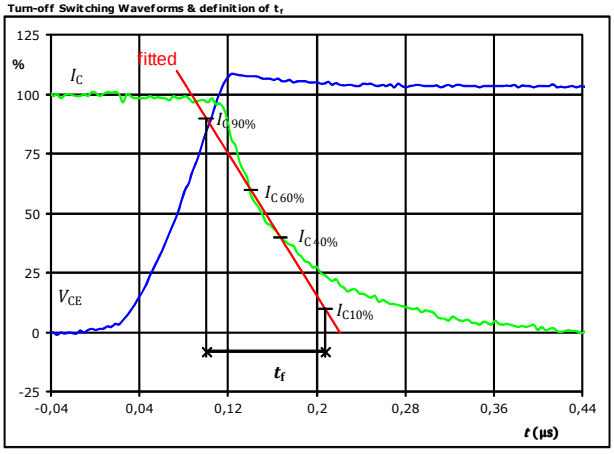
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	10	A
t_{don} =	0,074	µs
t_{Eon} =	0,234	µs

figure 3. **IGBT**

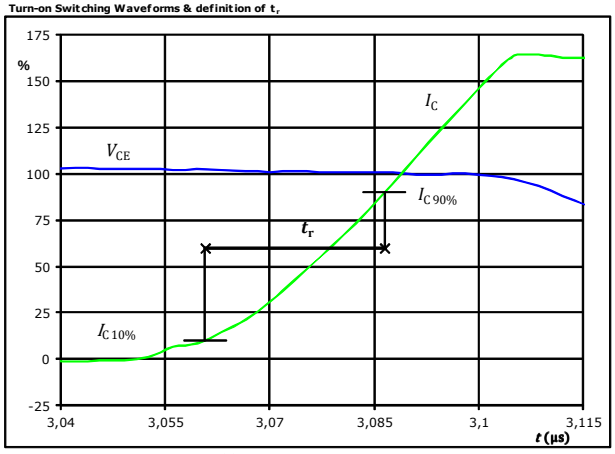
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	10	A
t_f =	0,123	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

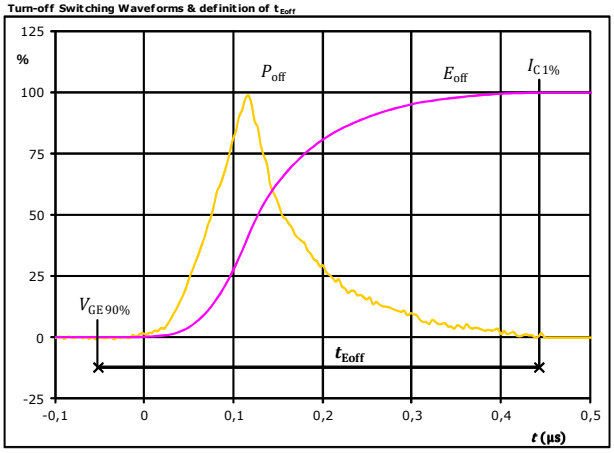


$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	10	A
t_r =	0,026	µs

Inverter Switching Characteristics

figure 5. IGBT

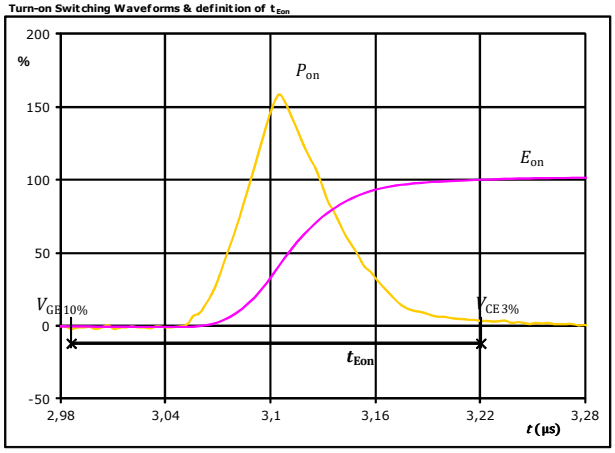
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	4,00	kW
$E_{off}(100\%)$ =	0,45	mJ
t_{Eoff} =	0,49	µs

figure 6. IGBT

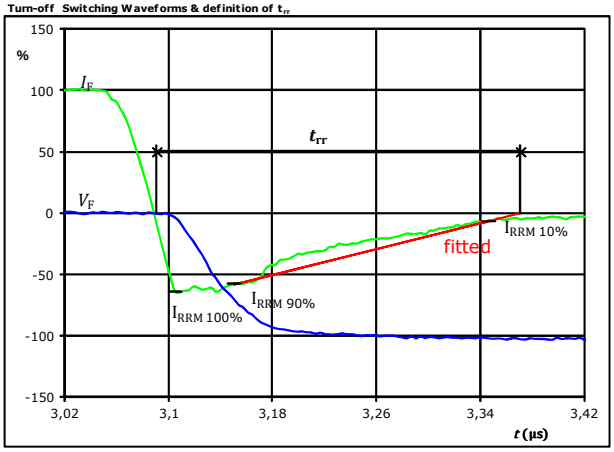
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	4,00	kW
$E_{on}(100\%)$ =	0,38	mJ
t_{Eon} =	0,23	µs

figure 7. FWD

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

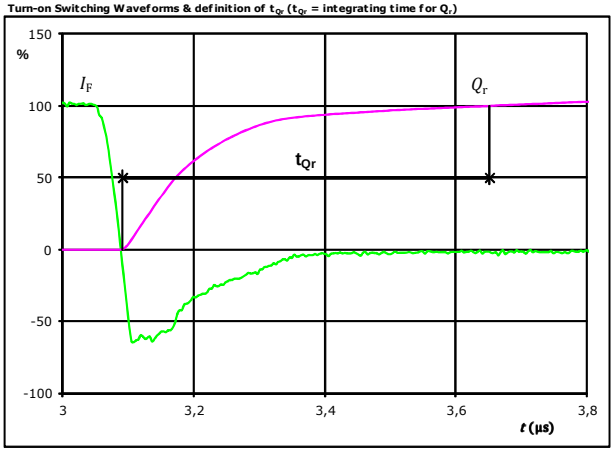


$V_F(100\%)$ =	400	V
$I_F(100\%)$ =	10	A
$I_{RRM}(100\%)$ =	-7	A
t_{rr} =	0,270	µs

Inverter Switching Characteristics

figure 8. **FWD**

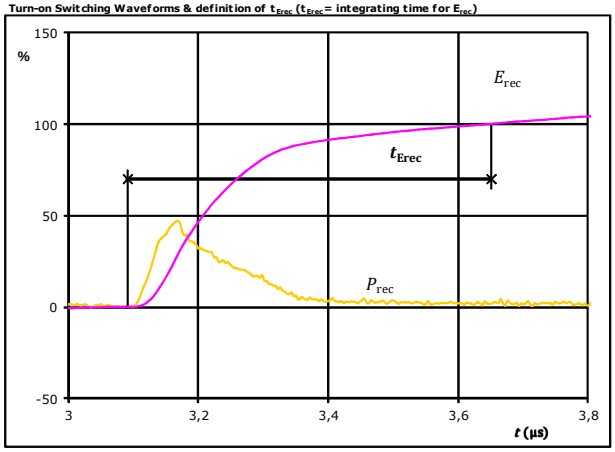
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	10	A
Q_r (100%) =	0,90	µC
t_{Qr} =	0,56	µs

figure 9. **FWD**

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



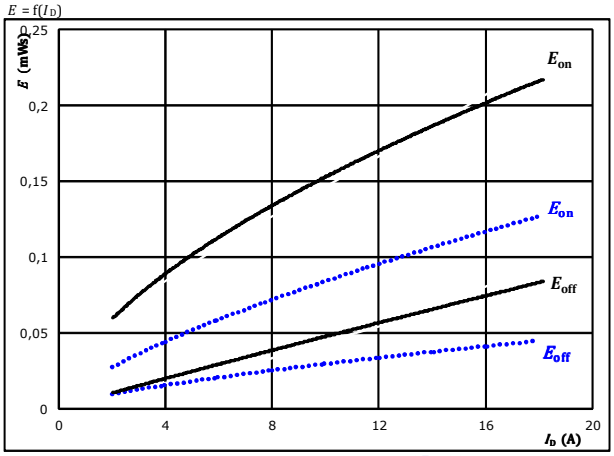
P_{rec} (100%) =	4,00	kW
E_{rec} (100%) =	0,26	mJ
t_{Erec} =	0,56	µs

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 — 25 °C

V_{DS} = 400 V — T_J: 125 °C

V_{GS} = 0/10 V

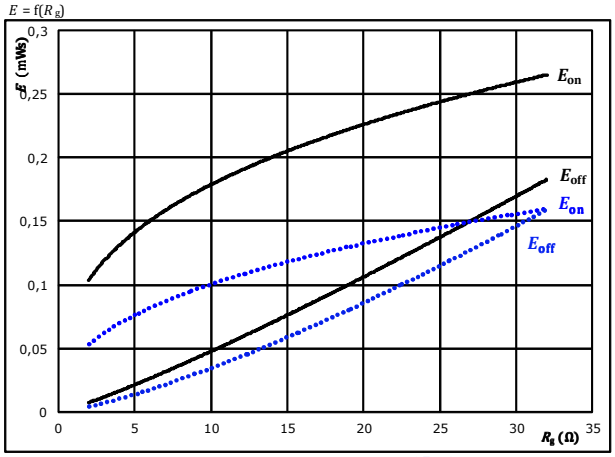
R_{gon} = 8 Ω

R_{goff} = 8 Ω

figure 2. **MOSFET**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at — 25 °C

V_{DS} = 400 V — T_J: 125 °C

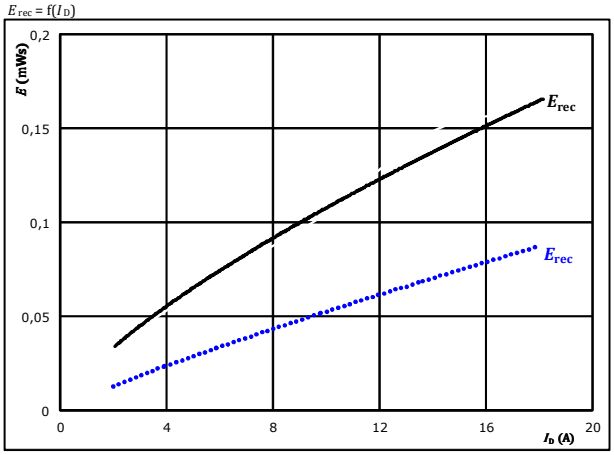
V_{GS} = 0/10 V

I_D = 10 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 — 25 °C

V_{DS} = 400 V — T_J: 125 °C

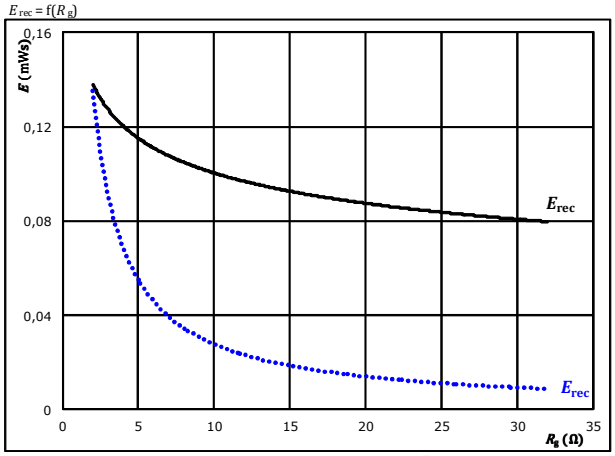
V_{GS} = 0/10 V

R_{gon} = 8 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 — 25 °C

V_{DS} = 400 V — T_J: 125 °C

V_{GS} = 0/10 V

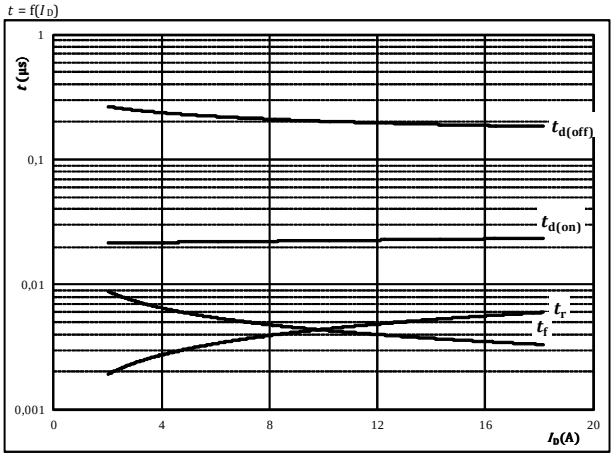
I_D = 10 A

PFC Switching Characteristics

figure 5. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



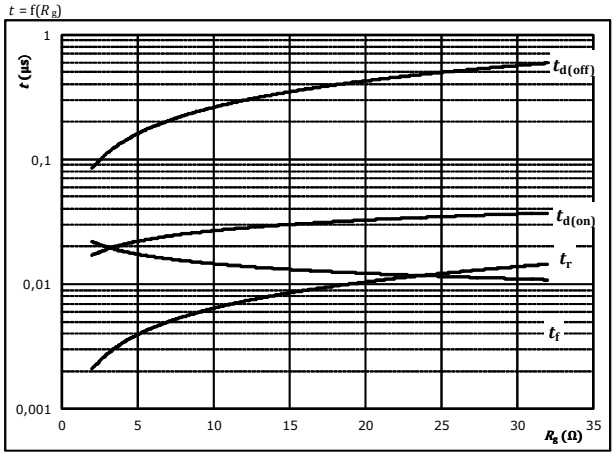
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	0/10	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 6. **MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_g)$



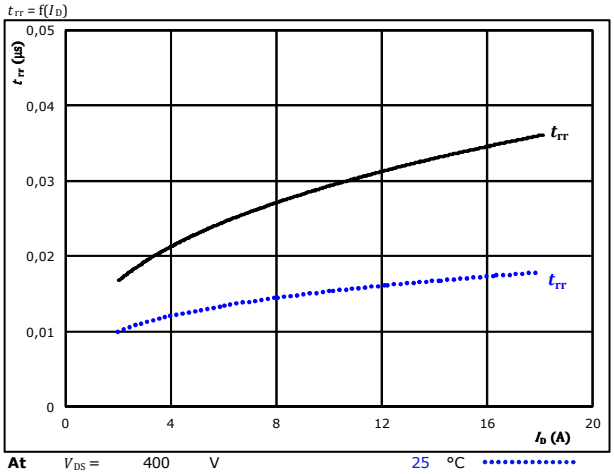
With an inductive load at

T_j =	125	°C
V_{DS} =	400	V
V_{GS} =	0/10	V
I_D =	10	A

figure 7. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$



At

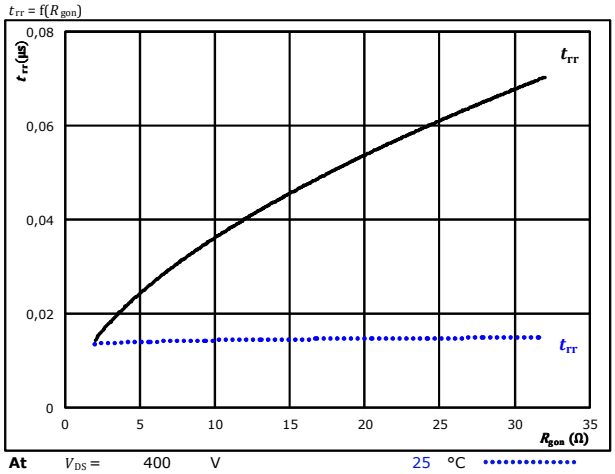
V_{DS} =	400	V
V_{GS} =	0/10	V
R_{gon} =	8	Ω

T_j: 25 °C (dotted) / 125 °C (solid)

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
V_{GS} =	0/10	V
I_D =	10	A

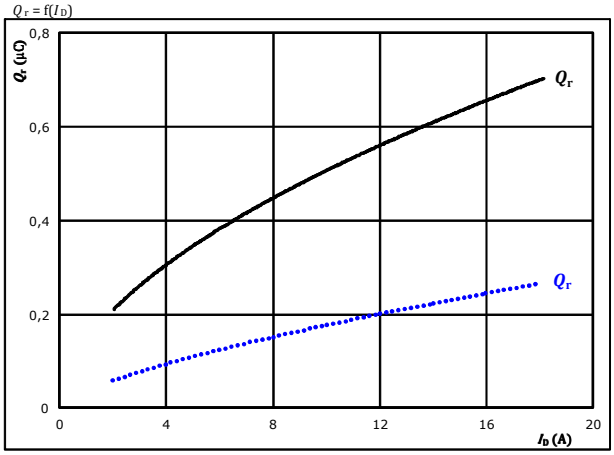
T_j: 25 °C (dotted) / 125 °C (solid)

PFC Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

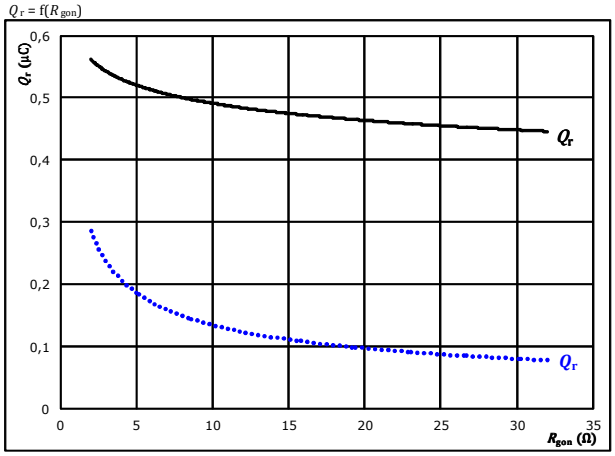


At						
	V_{DS} =	400	V		25 °C	·····
	V_{GS} =	0/10	V	T_j:	125 °C	———
	R_{gon} =	8	Ω			

figure 10. FWD

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

$Q_r = f(R_{gon})$

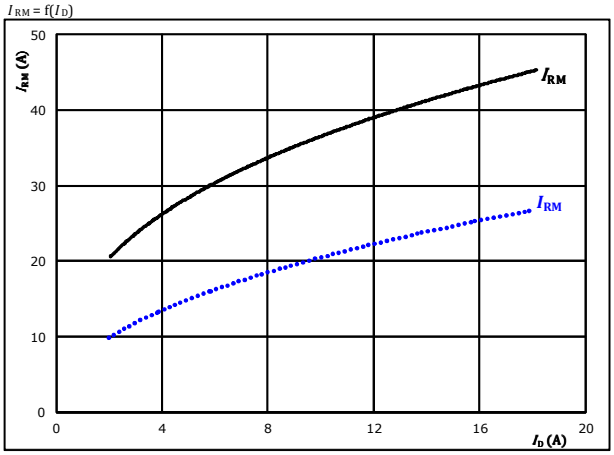


At						
	V_{DS} =	400	V		25 °C	·····
	V_{GS} =	0/10	V	T_j:	125 °C	———
	I_D =	10	A			

figure 11. FWD

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

$I_{RM} = f(I_D)$

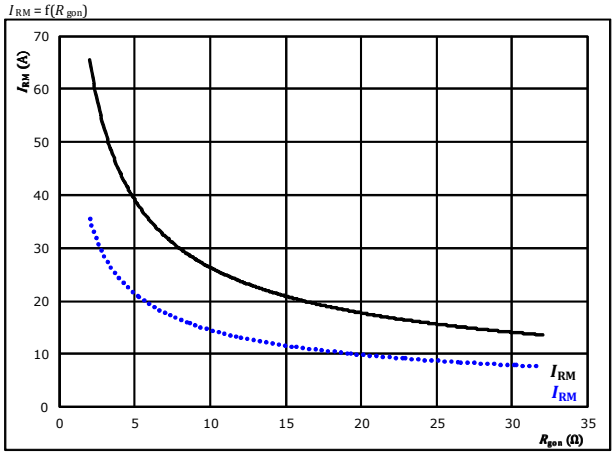


At						
	V_{DS} =	400	V		25 °C	·····
	V_{GS} =	0/10	V	T_j:	125 °C	———
	R_{gon} =	8	Ω			

figure 12. FWD

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

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



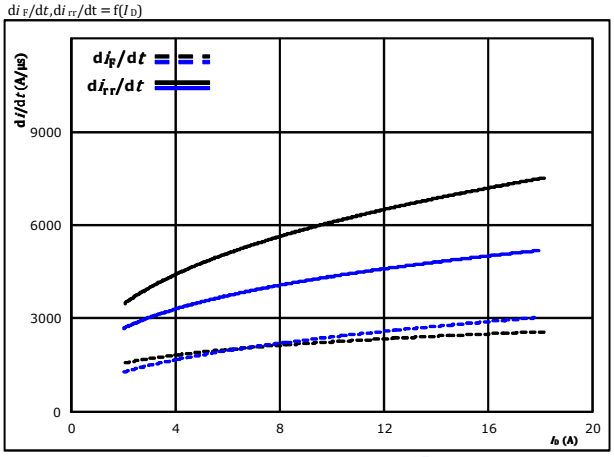
At						
	V_{DS} =	400	V		25 °C	·····
	V_{GS} =	0/10	V	T_j:	125 °C	———
	I_D =	10	A			

PFC Switching Characteristics

figure 13. **FWD**

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

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

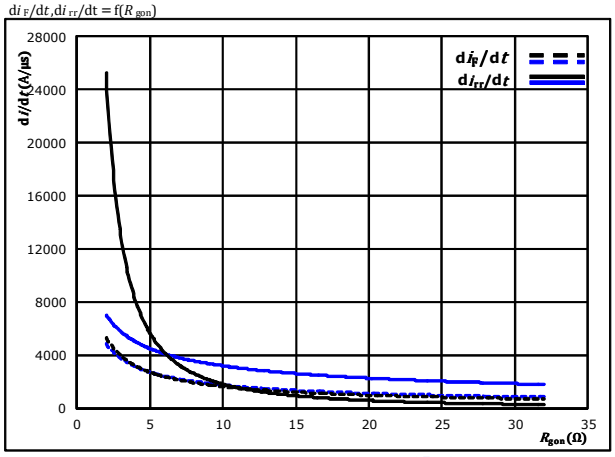


At	V_{DS} =	400	V		25 °C	
	V_{GS} =	0/10	V	T_j:	125 °C	
	R_{gon} =	8	Ω			

figure 14. **FWD**

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

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

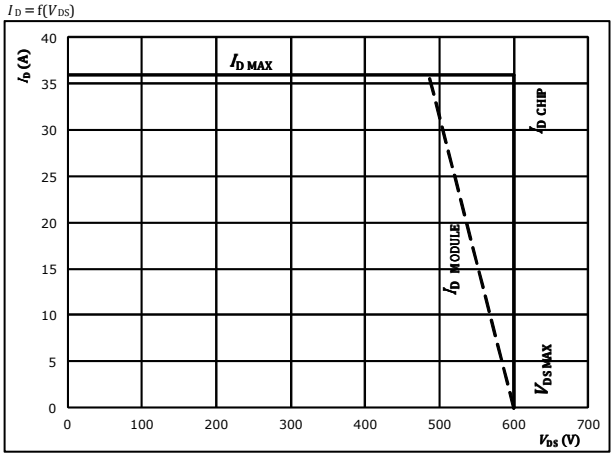


At	V_{DS} =	400	V		25 °C	
	V_{GS} =	0/10	V	T_j:	125 °C	
	I_D =	10	A			

figure 15. **MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$



At

T_j =	175	°C	
R_{gon} =	8	Ω	
R_{goff} =	8	Ω	

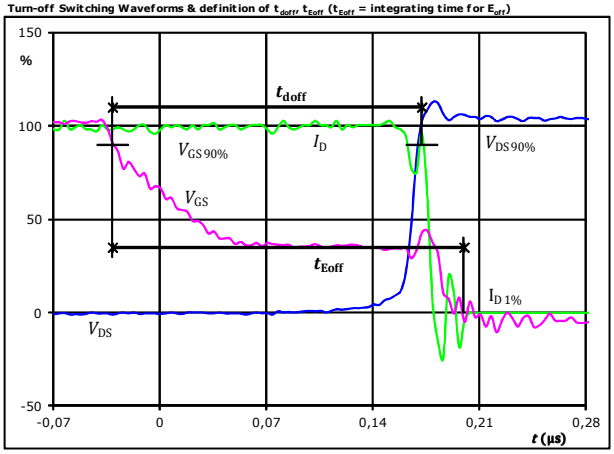
PFC Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**8 Ω**
R_{goff}	=	**8 Ω**

figure 1. MOSFET

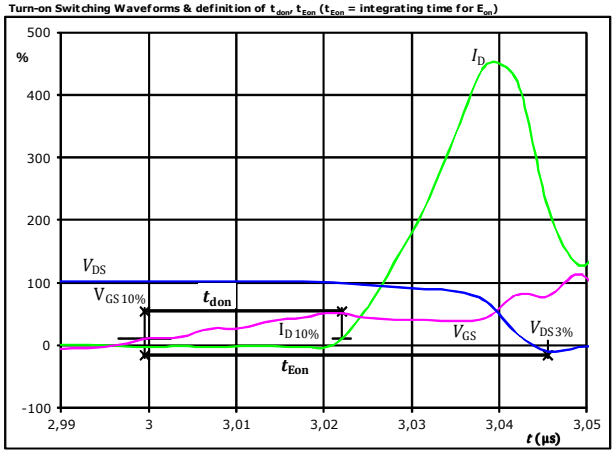
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GS}(0\%)$ =	0	V
$V_{GS}(100\%)$ =	10	V
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	10	A
t_{doff} =	0,202	µs
t_{Eoff} =	0,231	µs

figure 2. MOSFET

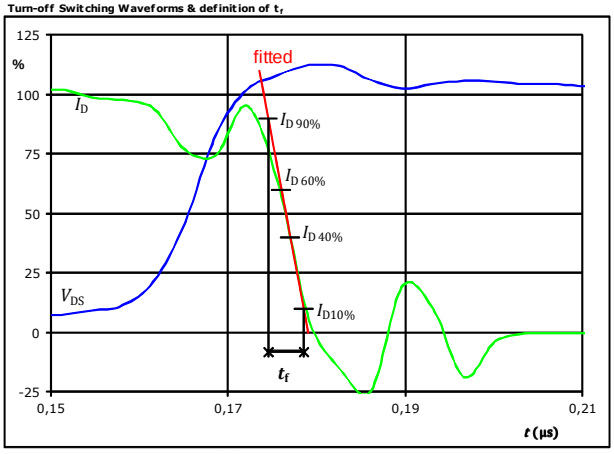
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GS}(0\%)$ =	0	V
$V_{GS}(100\%)$ =	10	V
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	10	A
t_{don} =	0,023	µs
t_{Eon} =	0,046	µs

figure 3. MOSFET

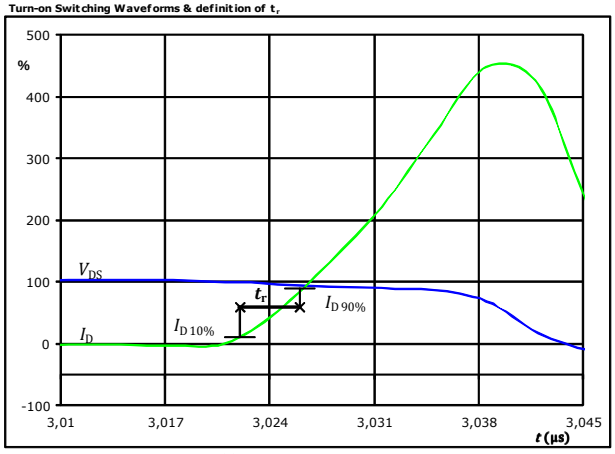
Turn-off Switching Waveforms & definition of t_f



$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	10	A
t_f =	0,004	µs

figure 4. MOSFET

Turn-on Switching Waveforms & definition of t_r

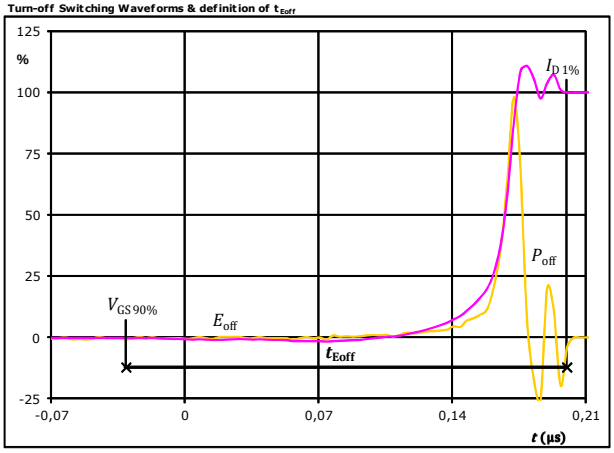


$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	10	A
t_r =	0,004	µs

PFC Switching Characteristics

figure 5. MOSFET

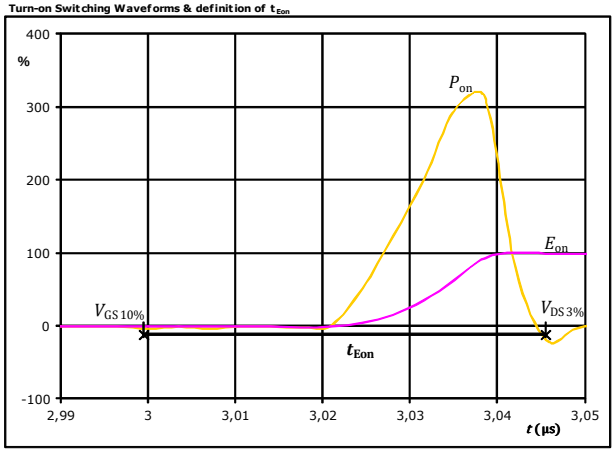
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	4,03	kW
$E_{off}(100\%)$ =	0,05	mJ
t_{Eoff} =	0,23	µs

figure 6. MOSFET

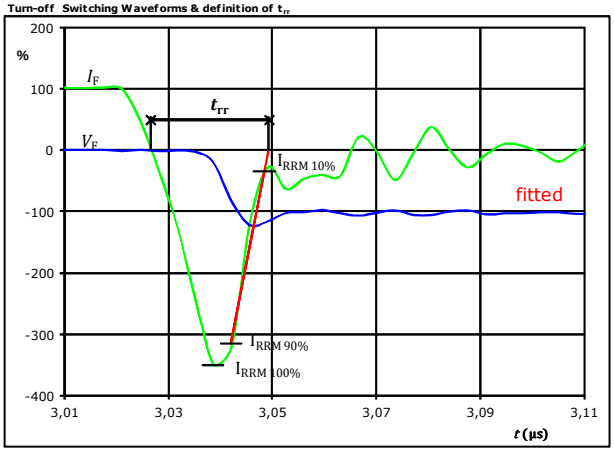
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	4,03	kW
$E_{on}(100\%)$ =	0,15	mJ
t_{Eon} =	0,05	µs

figure 7. FWD

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

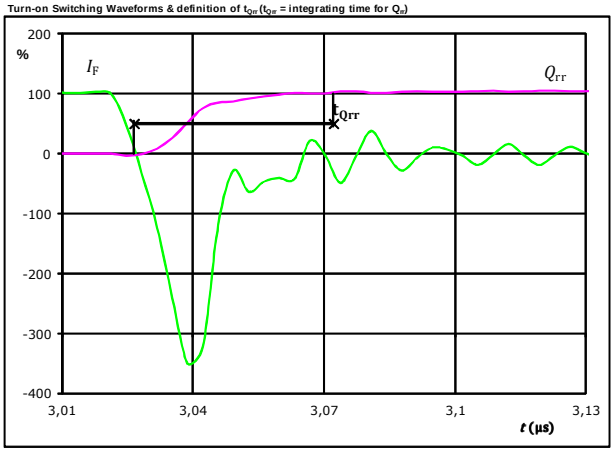


$V_F(100\%)$ =	400	V
$I_F(100\%)$ =	10	A
$I_{RRM}(100\%)$ =	-36	A
t_{rr} =	0,023	µs

PFC Switching Characteristics

figure 8. **FWD**

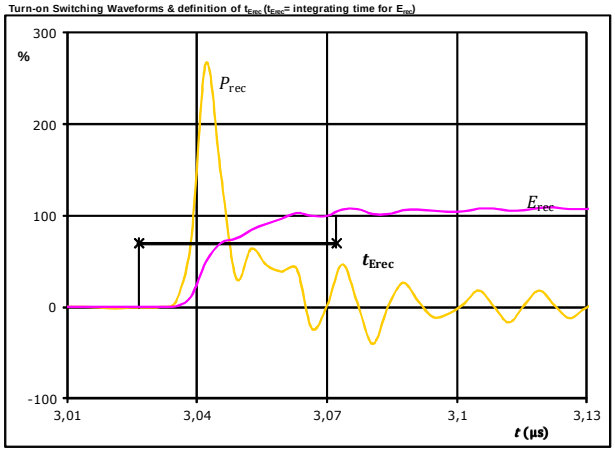
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_F (100%) =	10	A
Q_{rr} (100%) =	0,49	µC
t_{Qrr} =	0,05	µs

figure 9. **FWD**

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



P_{rec} (100%) =	4,03	kW
E_{rec} (100%) =	0,11	mJ
t_{Erec} =	0,05	µs

Ordering Code & Marking

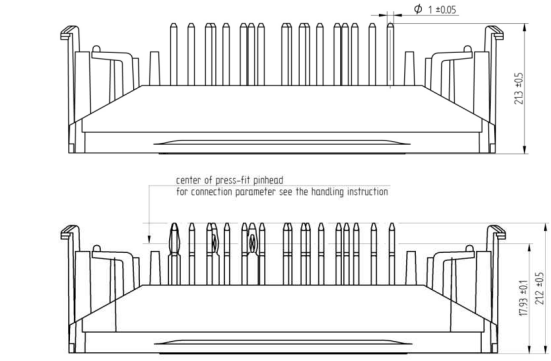
Version	Ordering Code
without thermal paste with solder pins with 17 mm housing	10-F006PPA010SB-M683B
with thermal paste with solder pins with 17 mm housing	10-F006PPA010SB-M683B-/3/
without thermal paste with press-fit pins with 17 mm housing	10-P006PPA010SB-M683BY
with thermal paste with press-fit pins with 17 mm housing	10-P006PPA010SB-M683BY-/3/
without thermal paste with press-fit pins with 12 mm housing	10-PC06PPA010SB-M683B06Y
with thermal paste with press-fit pins with 12 mm housing	10-PC06PPA010SB-M683B06Y-/3/

Text	Name		Date code	UL & VIN	Lot	Serial
	NN-NNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTVV	LLLLL	SSSS	WWYY		

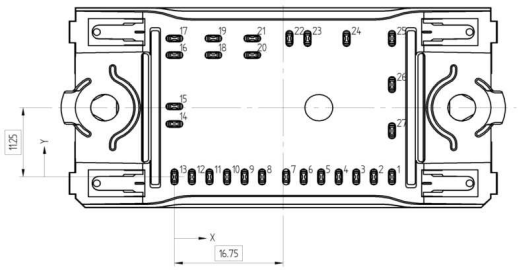
Outline

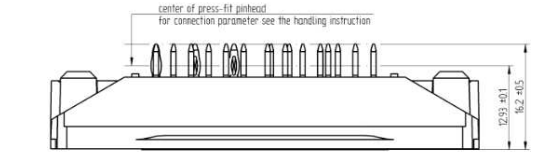
Pin table

Pin	X	Y	Function
1	33,5	0	DC-
2	30,7	0	PFC-
3	28	0	S1
4	25,3	0	S2
5	22,6	0	INV-
6	19,9	0	G7
7	17,2	0	S7
8	13,5	0	G6
9	10,8	0	E6
10	8,1	0	G5
11	5,4	0	E5
12	2,7	0	G4
13	0	0	E4
14	0	8,6	NTC1
15	0	11,45	NTC2
16	0	19,8	G1
17	0	22,5	U
18	6	19,8	G2
19	6	22,5	V
20	12	19,8	G3
21	12	22,5	W
22	17,7	22,5	+INV
23	20,5	22,5	PFC+
24	26,5	22,5	PFC IN
25	33,5	22,5	DC+
26	33,5	15	L1
27	33,5	7,5	L2

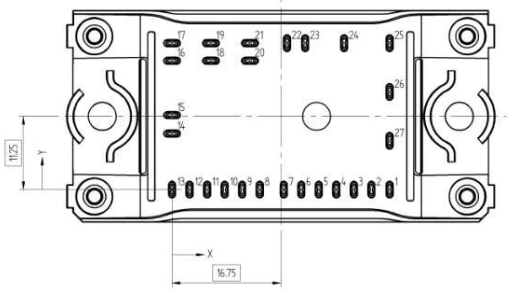


M683Bx



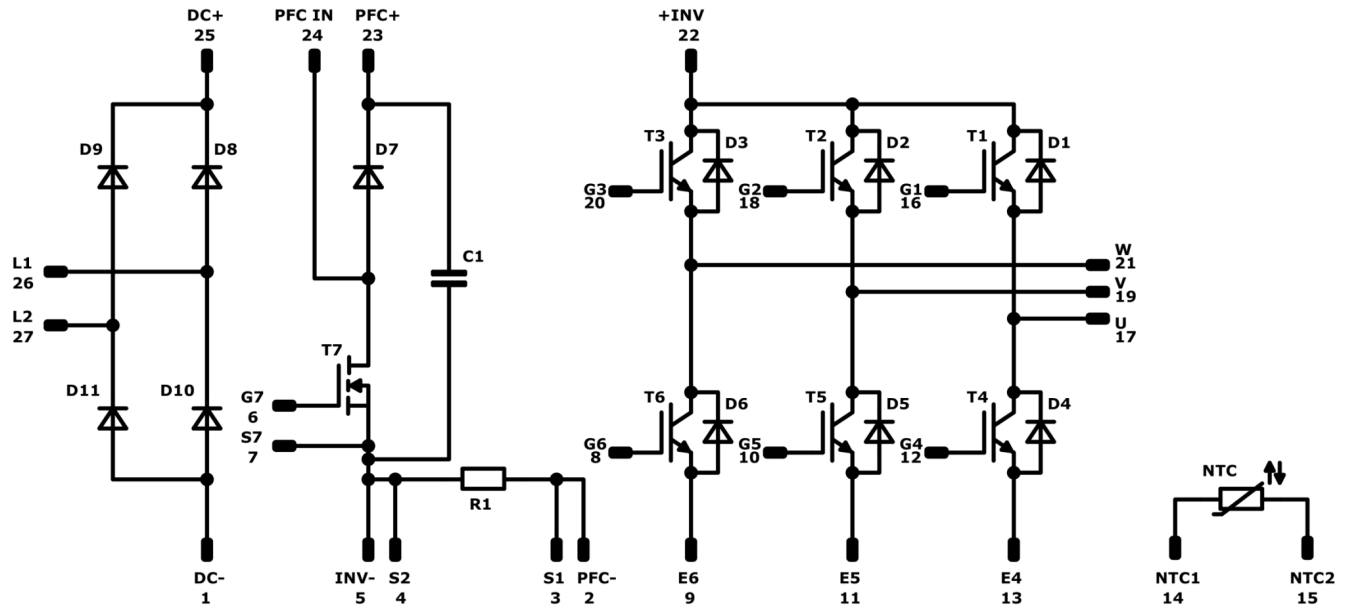


M683B06Y



Tolerance of pinpositions ±0.5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D8, D9,D10, D11	Rectifier	1600 V	25 A	Rectifier	
T1, T2, T3, T4, T5, T6	IGBT	600 V	10 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	600 V	10 A	Inverter Diode	
T7	MOSFET	600 V	99 mΩ	PFC Switch	
D7	FWD	600 V	15 A	PFC Diode	
R1	Resistor	600 V	10 A	PFC Shunt	
C1	Capacitor	500 V		Capacitor (PFC)	
NTC	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.

Package data
Package data for *flow* 0 packages see vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
10-xx06PPA010SB-M683Bxxx-D4-14	29 Sep. 2017	Thermal values updated	All