Vincotech

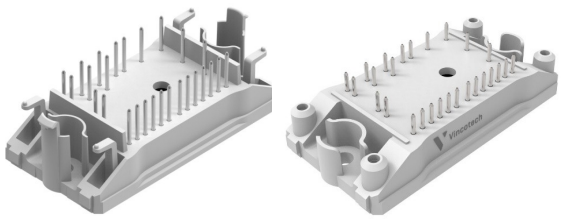
10-Fx06PPA015SB-M684Bxx
datasheet

flow **PIM 0 + PFC** **600 V / 15 A**

Features

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

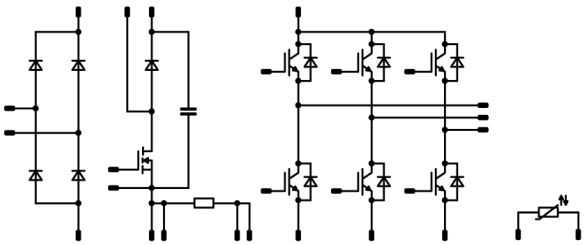
flow 0 housing



Target applications

- Industrial Drives
- Embedded Drives

Schematic



Types

- 10-F006PPA015SB-M684B
- 10-FU06PPA015SB-M684B06

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		25	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave T_j = 150 °C t_p = 10 ms	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
PFC Switch				
Drain-source voltage	V_{DS}		600	V
Drain current	I_D		20	A
Peak drain current	I_{Dpulse}	t_p limited by T_{jmax}	159	A
Avalanche energy, single pulse	E_{AS}	I_D = 9,3 A V_{DD} = 50 V	1135	mJ
Avalanche energy, repetitive	E_{AR}	I_D = 9,3 A V_{DD} = 50 V	1,7	mJ
Avalanche current, repetitive	I_{AR}	t_p limited by T_{jmax} P_{AV} = E_{AR}*f	9,3	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS} = 0-480 V	50	V/ns
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	64	W
Gate-source voltage	V_{GS}		±20	V
Reverse diode dv/dt	dv/dt	V_{DS} = 0-480 V	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		30	A
Surge (non-repetitive) forward current	I_{FSM}	60 Hz Single Half Sine Wave t_p = 8,3 ms	300	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	52	W
Maximum Junction Temperature	T_{jmax}		175	°C
Capacitor (PFC)				
Maximum DC voltage	V_{MAX}		500	V
Operation Temperature	T_{op}		-55…+125	°C
PFC Shunt				
DC forward current	I_F	terminal temperature T_k ≤ 90 °C	22	A
Power dissipation	P_{tot}	terminal temperature T_k ≤ 90 °C	5	W

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		15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	52	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 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		15	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	35	W
Maximum Junction Temperature	T_{jmax}		175	°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		17 mm housing / 12 mm housing	min. 12,7 / 8,75	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	1,75	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

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		26	25 125		72 150	80	mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$			0,00172	25	2,4	3	3,6	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							0,85		Ω
Gate charge	Q_g							170		
Gate to source charge	Q_{GS}		0/10	480	25,8	25		21		nC
Gate to drain charge	Q_{GD}							87		
Short-circuit input capacitance	C_{iss}							3800		
Short-circuit output capacitance	C_{oss}	f= 1MHz	0	100		25		215		pF
Reverse transfer capacitance	C_{rss}							35		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,09		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125 150		38 44 25		
Rise time	t_r	R_{goff} = 8 Ω R_{gon} = 8 Ω				25 125 150		5 6 7		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		130 136 250		
Fall time	t_f		10/-5	400	15	25 125 150		11 14 5		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,3 µC Q_{rFWD} = 0,6 µC Q_{rFWD} = 0,8 µC				25 125 150		0,136 0,208 0,345		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,042 0,053 0,120		

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				30	25 125 150		2,26 1,67 1,55	2,78	V
Reverse leakage current	I_r			600		25			10	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,81		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2946 A/µs di/dt = 2625 A/µs di/dt = 2104 A/µs	10/-5	400	15	25 125 150		29 43 45		A
Reverse recovery time	t_{rr}					25 125 150		14 25 30		ns
Recovered charge	Q_r					25 125 150		0,253 0,585 0,787		µC
Reverse recovered energy	E_{rec}					25 125 150		0,046 0,185 0,125		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		8586 6089 4643		A/µs
Capacitor (PFC)										
Capacitance	C							100		nF
Tolerance							-10		+10	%
PFC Shunt										
Resistance	R							10		mΩ
Temperature coeficient	t_c					20 - 60			30	ppm/K
Internal heat resistance	R_{thi}								10	K/W

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 Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,1	1,59 1,85	1,9	V
Collector-emitter cut-off current	I_{CES}		0	600		25			28	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		860		pF
Output capacitance	C_{oes}							55		
Reverse transfer capacitance	C_{res}							24		
Gate charge	Q_g		15	480	15	25		87		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,83		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 32 Ω R_{gon} = 32 Ω	±15	400	15	25 125 150		102 101 101		ns
Rise time	t_r					25 125 150		29 31 31		
Turn-off delay time	$t_{d(off)}$					25 125 150		157 179 181		
Fall time	t_f					25 125 150		62 72 85		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,6 µC Q_{rFWD} = 1,3 µC Q_{rFWD} = 1,5 µC				25 125 150		0,482 0,678 0,693		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,426 0,553 0,598		

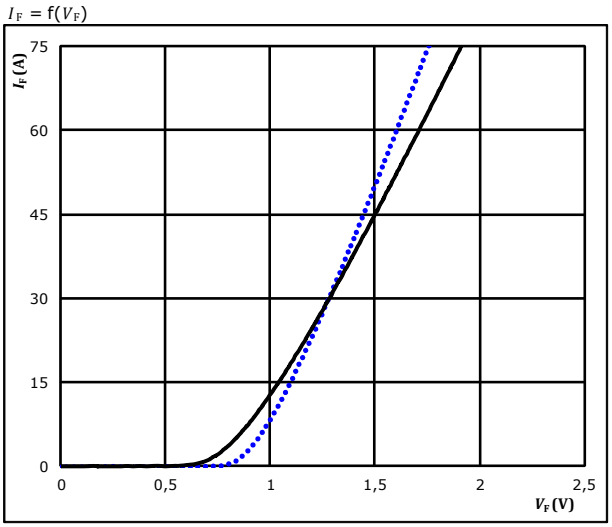
Characteristic Values

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										
Forward voltage	V_F				15	25 150		1,60 1,51	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)						2,75		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 446 A/µs di/dt = 490 A/µs di/dt = 382 A/µs	±15	400	15	25 125 150		6 8 9		A
Reverse recovery time	t_{rr}					25 125 150		231 309 350		ns
Recovered charge	Q_r					25 125 150		0,646 1,30 1,53		µC
Reverse recovered energy	E_{rec}					25 125 150		0,178 0,353 0,431		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		21 43 51		A/µs
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 Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

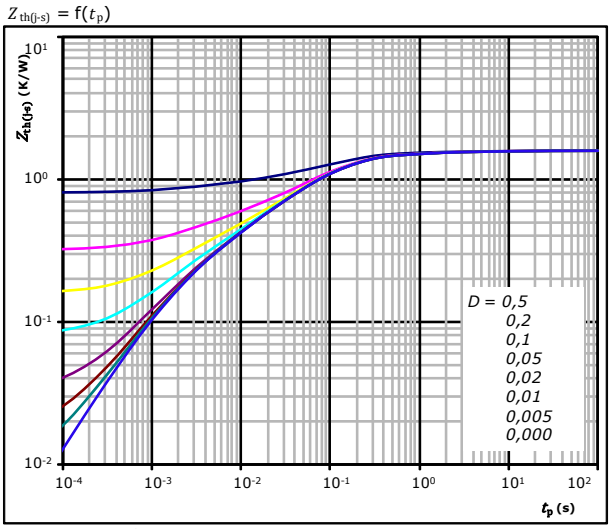


t_p = 250 µs 25 °C

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

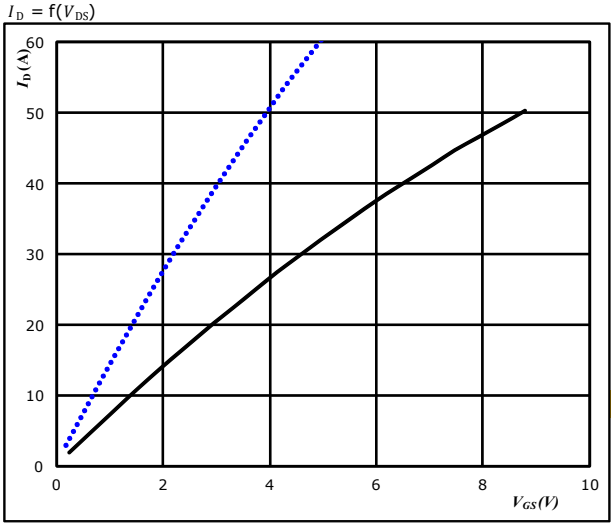
R (K/W)	τ (s)
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,22E-01	1,79E-03

PFC Switch Characteristics

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

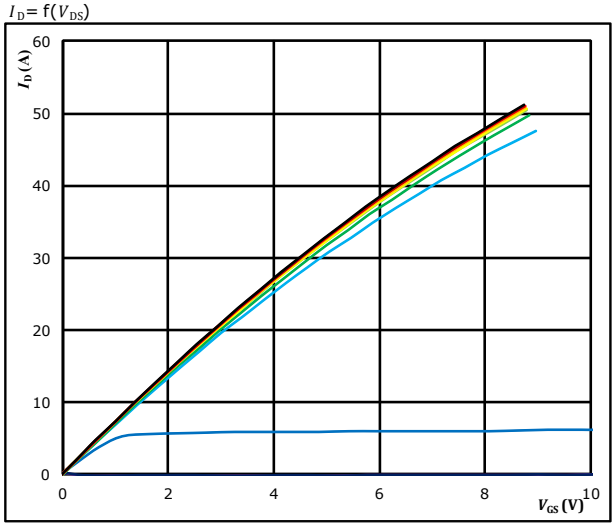


t_p =	250	µs		25 °C	
V_{GS}=	10	V	T_j:	125 °C	

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

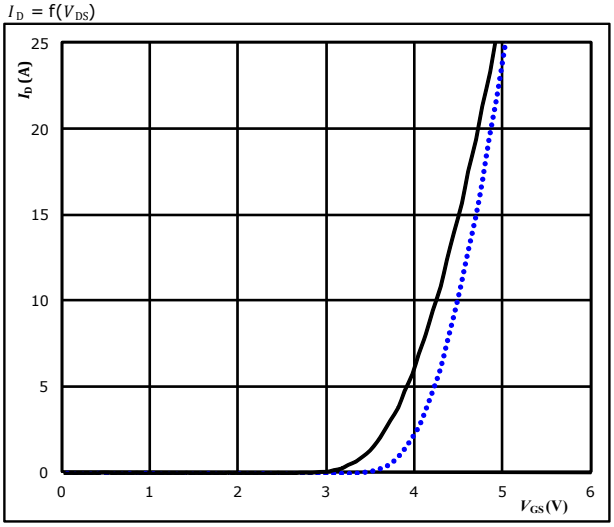


t_p =	250	µs
T_j =	125	°C
V_{GS} from	0 V to 20 V in steps of 2 V	

figure 2. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{DS})$

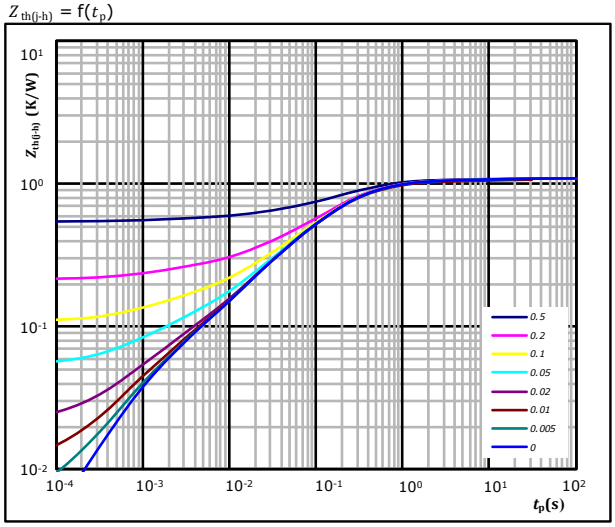


t_p =	100	µs		25 °C	
V_{DS} =	10	V	T_j:	125 °C	

figure 4. **MOSFET**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,09	K/W

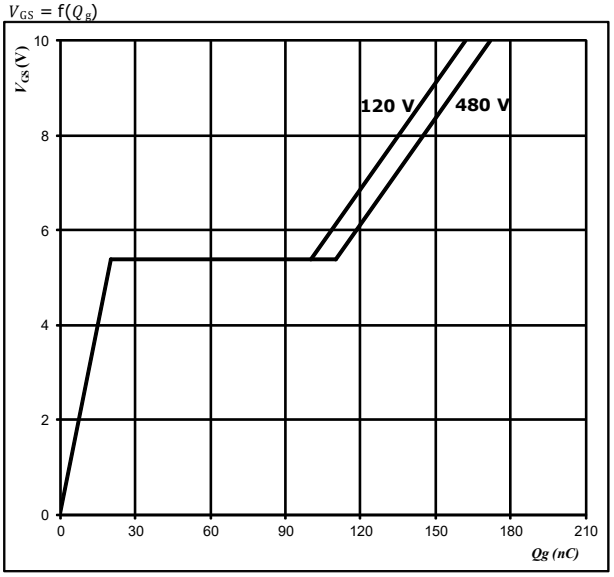
R (K/W)	Tau (s)
3,89E-02	1,48E+01
1,28E-01	1,22E+00
5,81E-01	2,24E-01
2,08E-01	5,85E-02
8,88E-02	1,29E-02
4,38E-02	1,19E-03

PFC Switch Characteristics

figure 5. MOSFET

Gate voltage vs Gate charge

$V_{GS} = f(Q_g)$



At

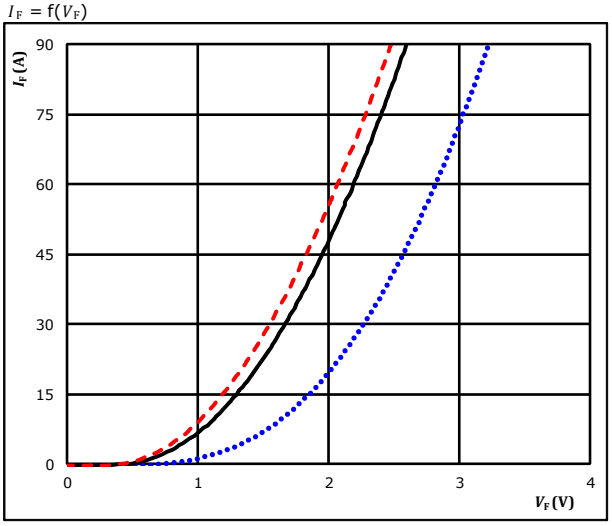
I_D= 26 A

PFC Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



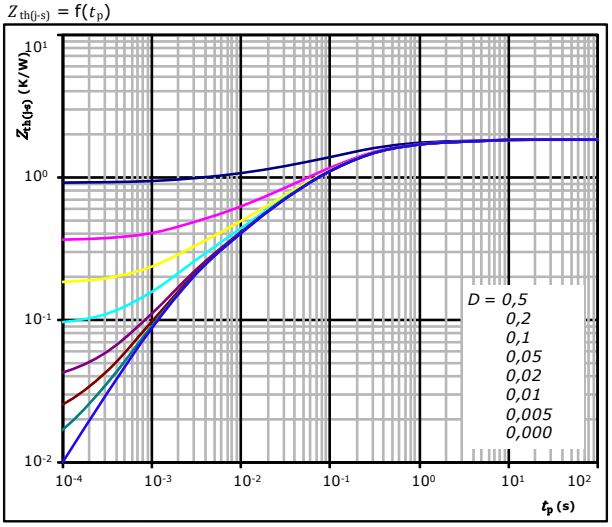
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D =$ t_p / T

$R_{th(j-s)}$ = 1,81 K/W

FWD thermal model values

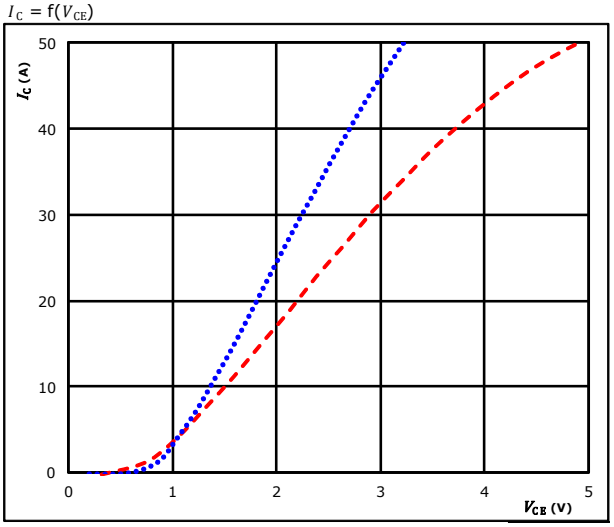
R (K/W)	τ (s)
1,53E-01	3,12E+00
5,19E-01	3,17E-01
6,76E-01	7,98E-02
3,13E-01	1,47E-02
1,53E-01	2,20E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

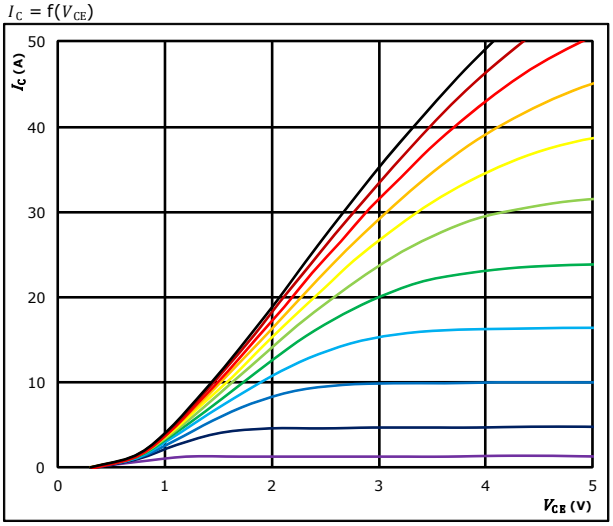


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

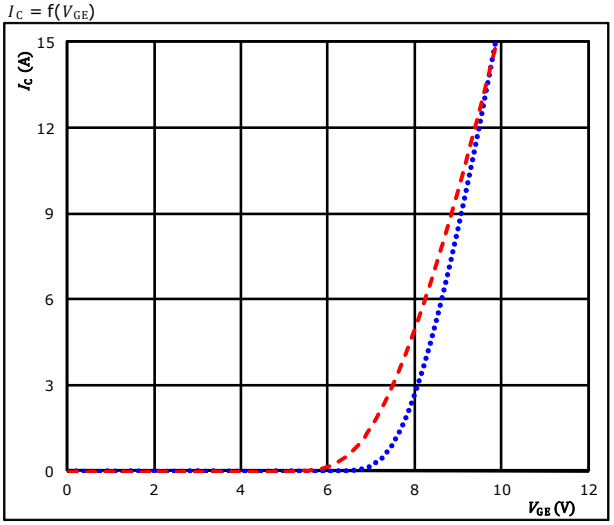


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

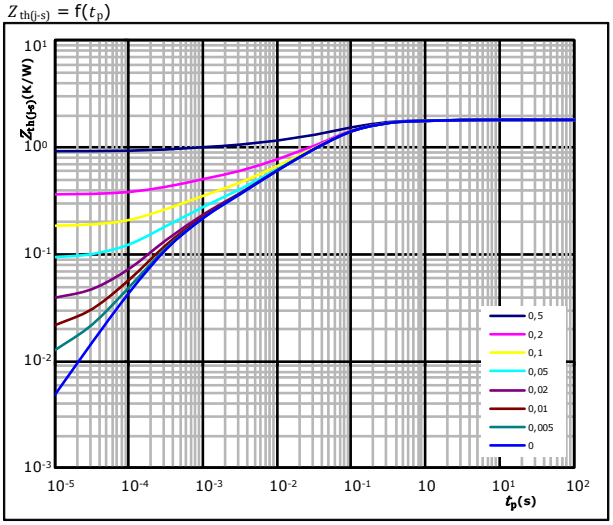


t_p =	100	µs		25 °C	
V_{CE} =	10	V	T_j:	150 °C	

figure 4. **IGBT**

Transient Thermal Impedance as function of Pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,83	K/W

IGBT thermal model values

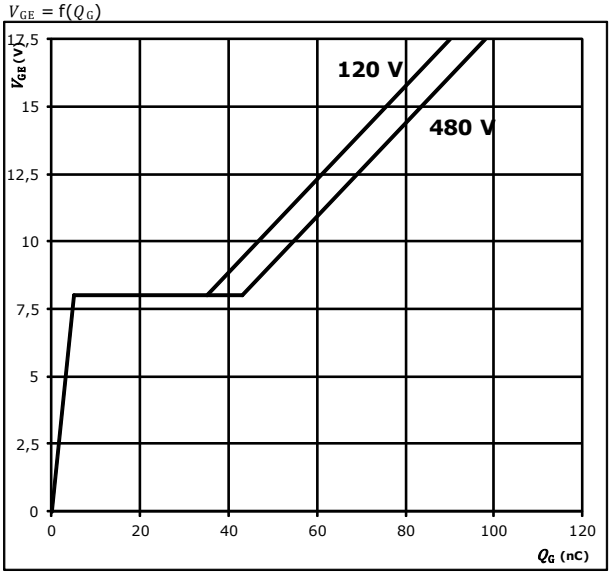
R (K/W)	τ (s)
8,30E-02	1,29E+00
3,76E-01	1,56E-01
8,46E-01	5,15E-02
2,81E-01	8,16E-03
1,16E-01	2,04E-03
1,32E-01	3,43E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_G)$



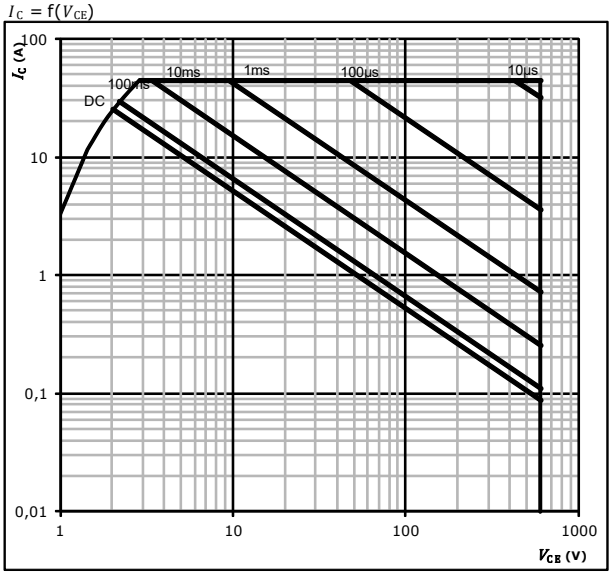
At

I_C =	15	A

figure 6. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



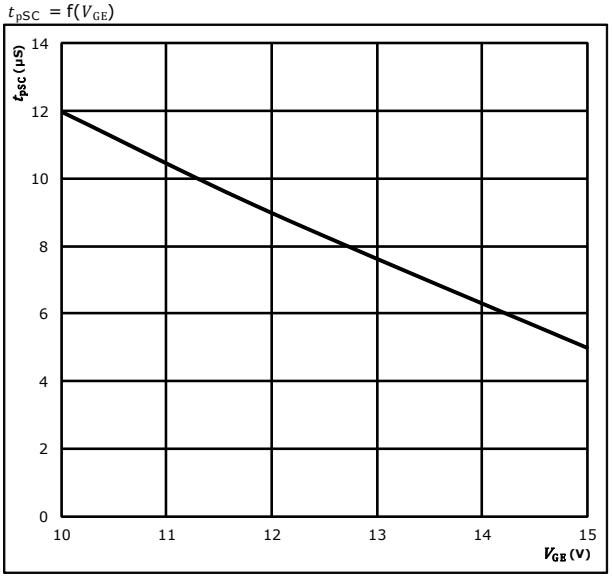
At

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

figure 7. **IGBT**

Short circuit duration as a function of V_{GE}

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



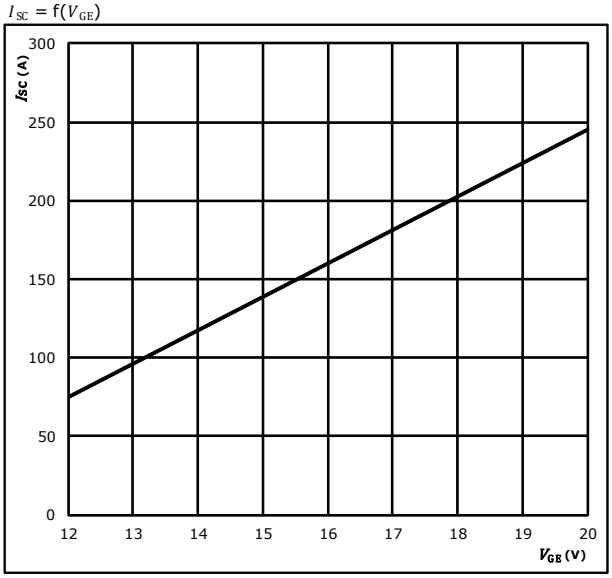
At

V_{CE} =	600	V
T_j ≤	175	ºC

figure 8. **IGBT**

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

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

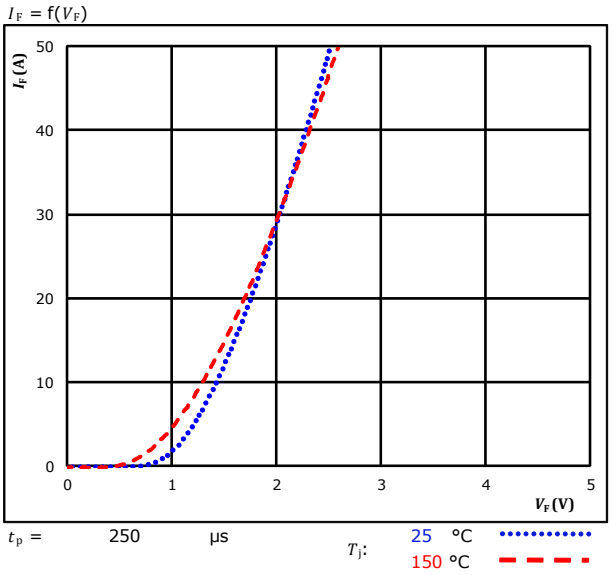


At

V_{CE} ≤	600	V
T_j ≤	175	ºC

Inverter Diode Characteristics

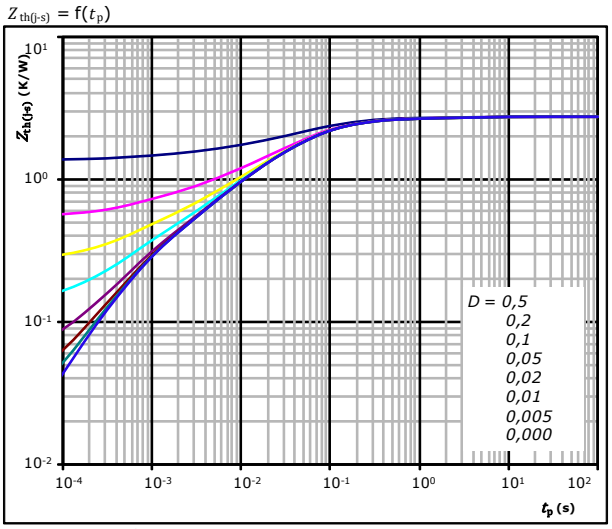
figure 1. **FWD**
Typical forward characteristics



t_p = 250 µs

T_j: 25 °C
150 °C

figure 2. **FWD**
Transient thermal impedance as a function of pulse width



D = t_p / T

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

FWD thermal model values

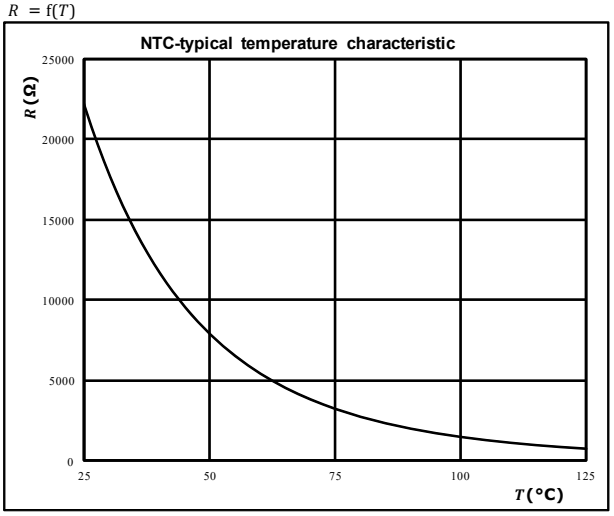
R (K/W)	τ (s)
1,03E-01	3,14E+00
3,03E-01	2,74E-01
1,23E+00	6,07E-02
5,94E-01	1,63E-02
3,18E-01	4,11E-03
2,02E-01	6,37E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

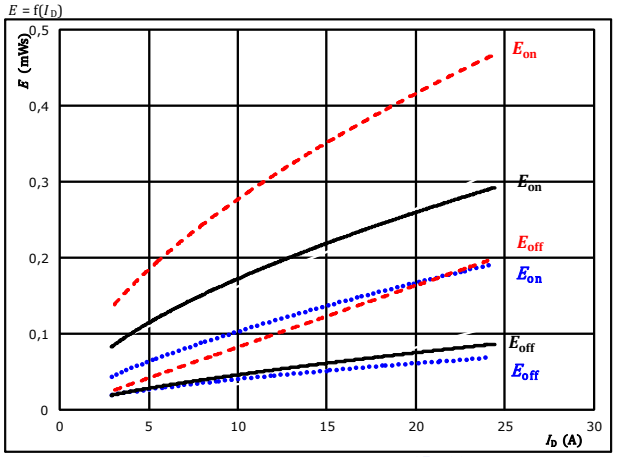


PFC Switching Characteristics

figure 1. MOSFET

Typical switching energy losses as a function of drain current

$E = f(I_D)$



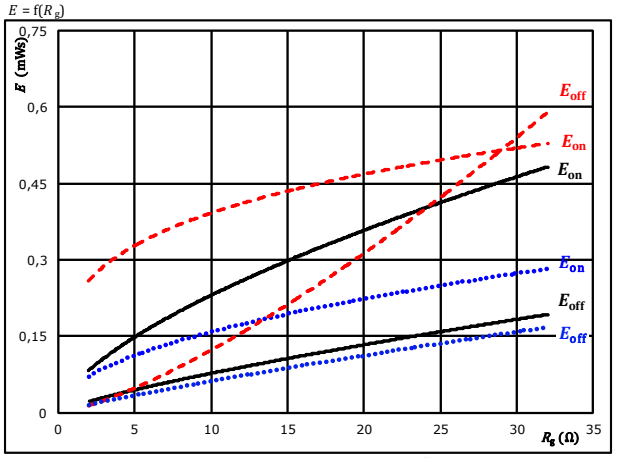
With an inductive load at

V_{DS} =	400	V	T_j:	25 °C	·····
V_{GS} =	10/-5	V		125 °C	———
R_{gon} =	8	Ω		150 °C	- - - -
R_{goff} =	8	Ω			

figure 2. MOSFET

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



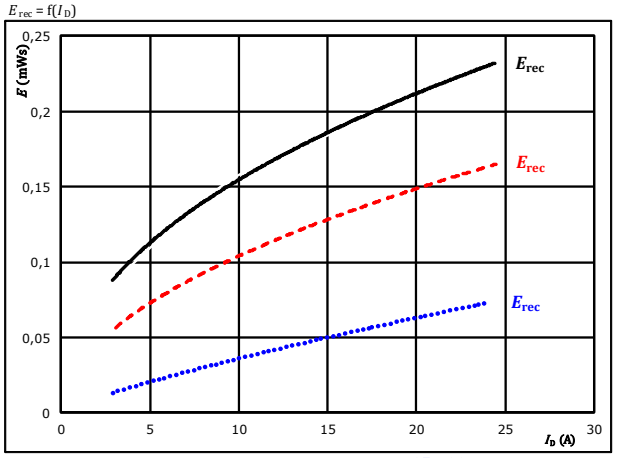
With an inductive load at

V_{DS} =	400	V	T_j:	25 °C	·····
V_{GS} =	10/-5	V		125 °C	———
I_D =	15	A		150 °C	- - - -

figure 3. FWD

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



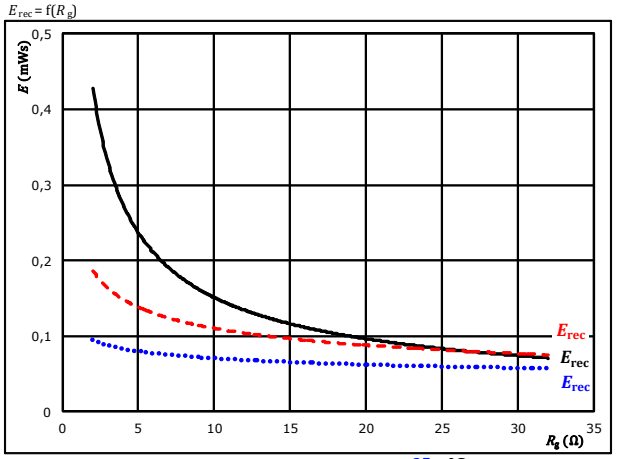
With an inductive load at

V_{DS} =	400	V	T_j:	25 °C	·····
V_{GS} =	10/-5	V		125 °C	———
R_{gon} =	8	Ω		150 °C	- - - -

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

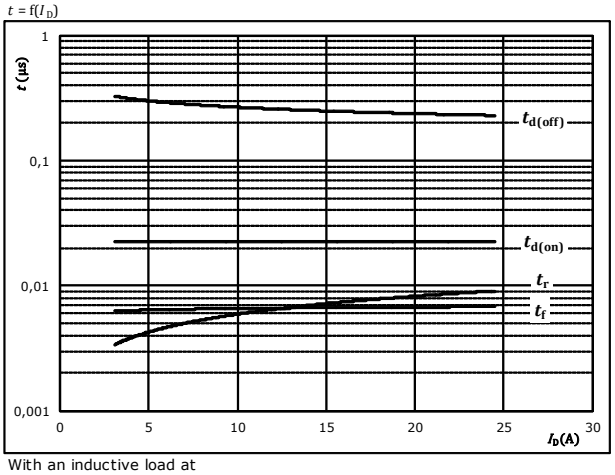
V_{DS} =	400	V	T_j:	25 °C	·····
V_{GS} =	10/-5	V		125 °C	———
I_D =	15	A		150 °C	- - - -

PFC Switching Characteristics

figure 5. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



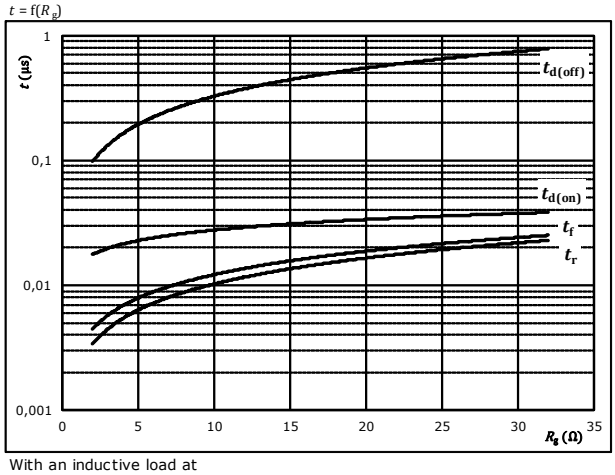
With an inductive load at

T_j =	150	°C
V_{DS} =	400	V
V_{GS} =	10/-5	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 6. **MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_g)$



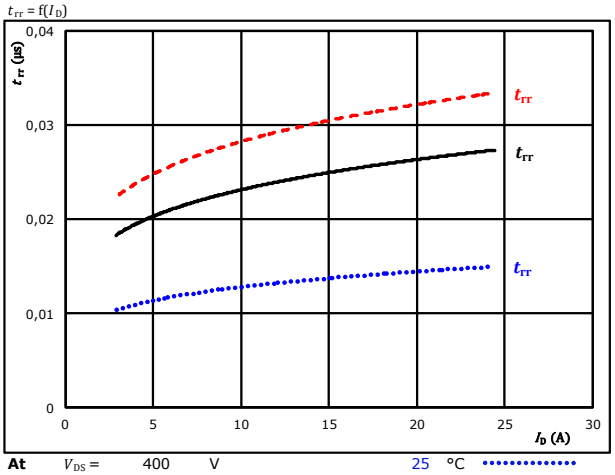
With an inductive load at

T_j =	150	°C
V_{DS} =	400	V
V_{GS} =	10/-5	V
I_D =	15	A

figure 7. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$

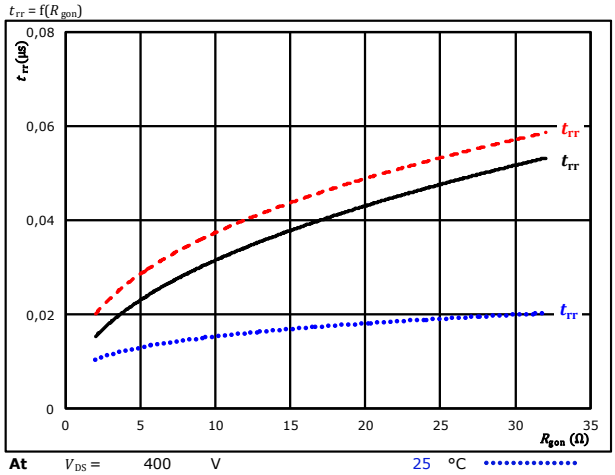


At	V_{DS} =	400	V		25 °C
	V_{GS} =	10/-5	V	T_j:	125 °C
	R_{gon} =	8	Ω		150 °C

figure 8. **FWD**

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

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



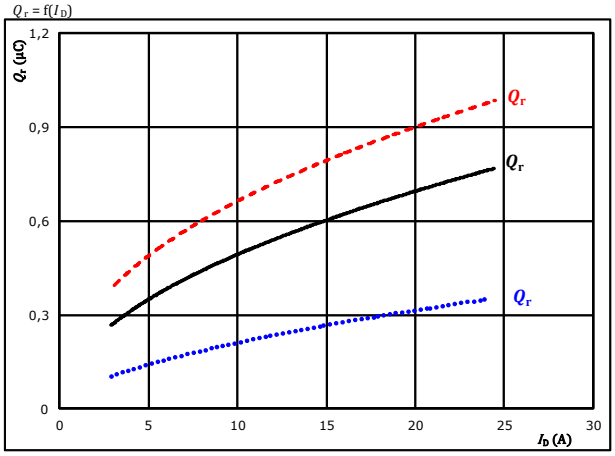
At	V_{DS} =	400	V		25 °C
	V_{GS} =	10/-5	V	T_j:	125 °C
	I_D =	15	A		150 °C

PFC Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

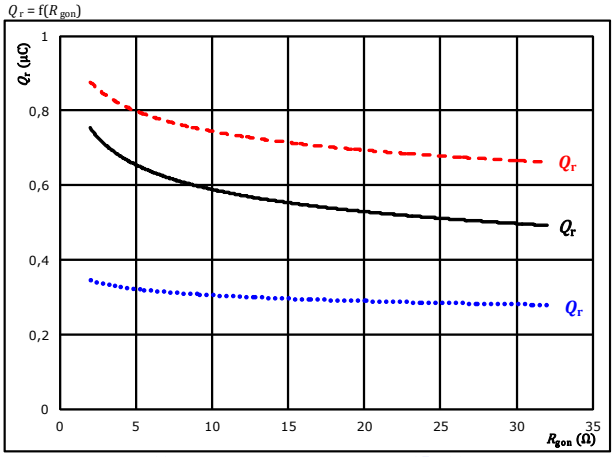


At	V_{DS} =	400	V		25 °C	
	V_{GS} =	10/-5	V	T_j:	125 °C	
	R_{gon} =	8	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

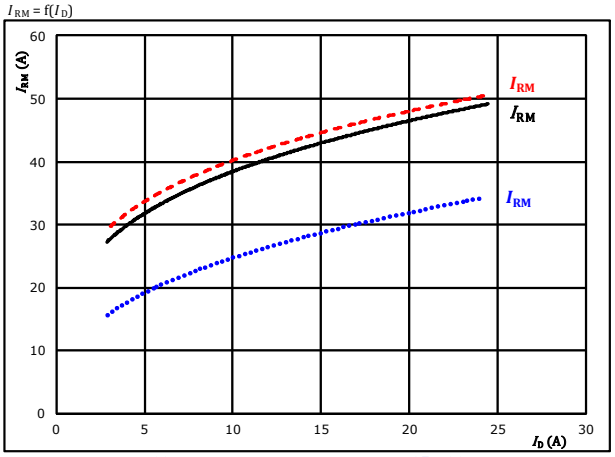


At	V_{DS} =	400	V		25 °C	
	V_{GS} =	10/-5	V	T_j:	125 °C	
	I_D =	15	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_D)$

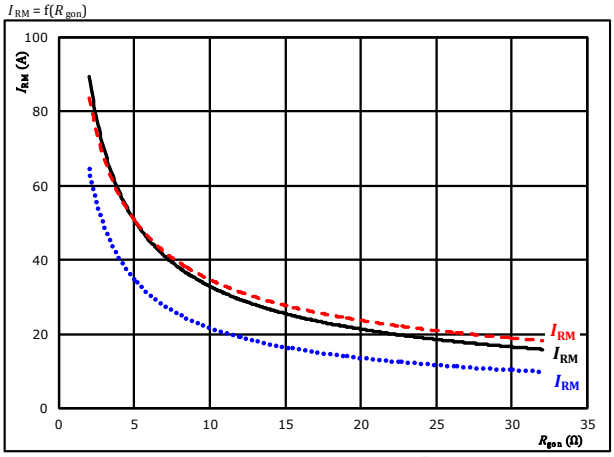


At	V_{DS} =	400	V		25 °C	
	V_{GS} =	10/-5	V	T_j:	125 °C	
	R_{gon} =	8	Ω		150 °C	

figure 12. **FWD**

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

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



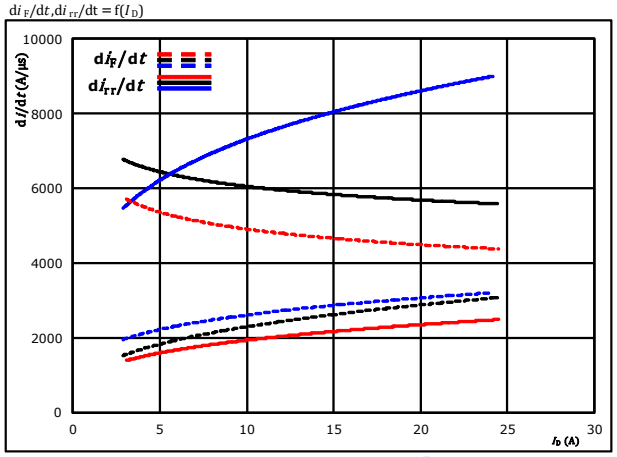
At	V_{DS} =	400	V		25 °C	
	V_{GS} =	10/-5	V	T_j:	125 °C	
	I_D =	15	A		150 °C	

PFC Switching Characteristics

figure 13. **FWD**

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

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

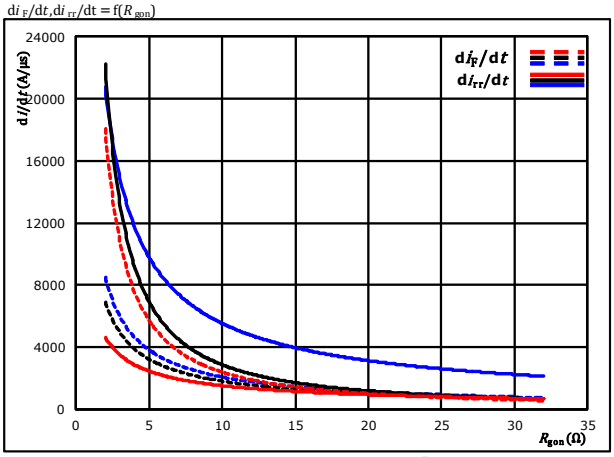


At	V_{DS} =	400	V		25 °C
	V_{GS} =	10/-5	V	T_j:	125 °C
	R_{gon} =	8	Ω		150 °C

figure 14. **FWD**

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

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

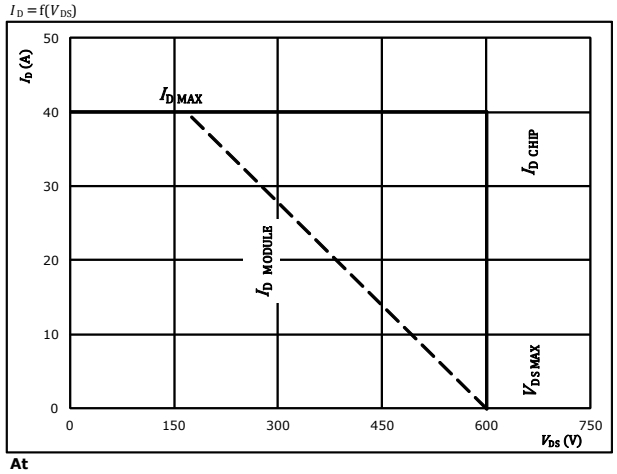


At	V_{DS} =	400	V		25 °C
	V_{GS} =	10/-5	V	T_j:	125 °C
	I_D =	15	A		150 °C

figure 15. **MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$



At

T_j =	150	°C
R_{gon} =	8	Ω
R_{goff} =	8	Ω

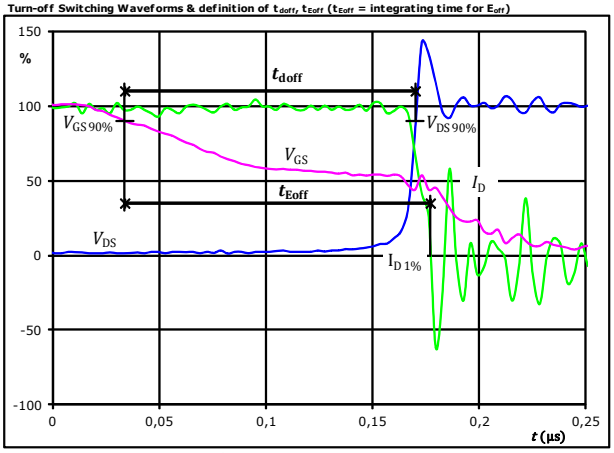
PFC Switching Definitions

General conditions

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

figure 1. MOSFET

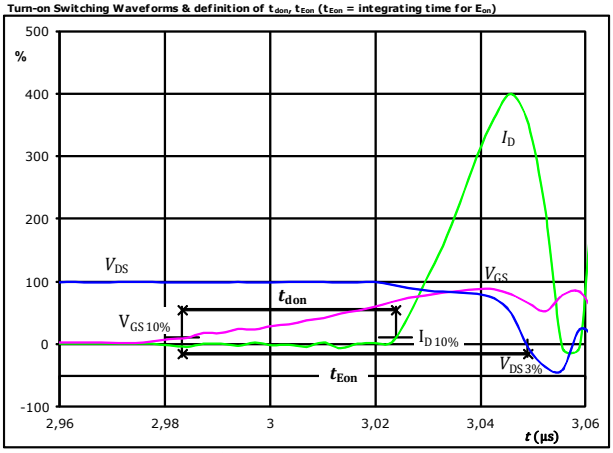
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GS}(0\%)$ =	10	V
$V_{GS}(100\%)$ =	-5	V
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	15	A
t_{doff} =	0,136	µs
t_{Eoff} =	0,143	µs

figure 2. MOSFET

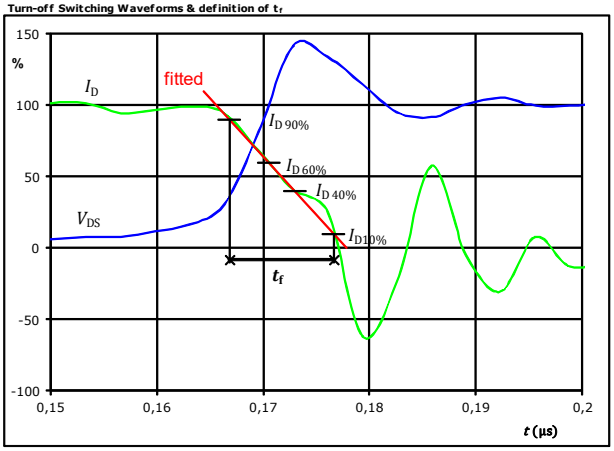
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GS}(0\%)$ =	10	V
$V_{GS}(100\%)$ =	-5	V
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	15	A
t_{don} =	0,044	µs
t_{Eon} =	0,066	µs

figure 3. MOSFET

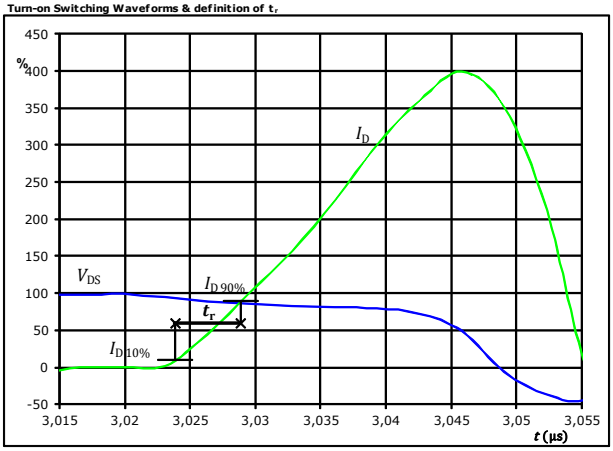
Turn-off Switching Waveforms & definition of t_f



$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	15	A
t_f =	0,014	µs

figure 4. MOSFET

Turn-on Switching Waveforms & definition of t_r

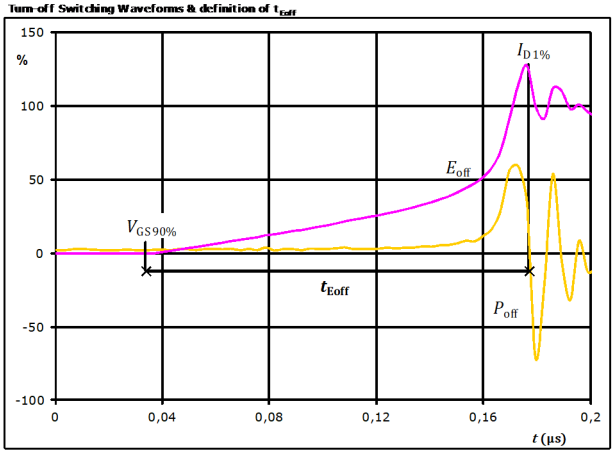


$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	15	A
t_r =	0,006	µs

PFC Switching Characteristics

figure 5. MOSFET

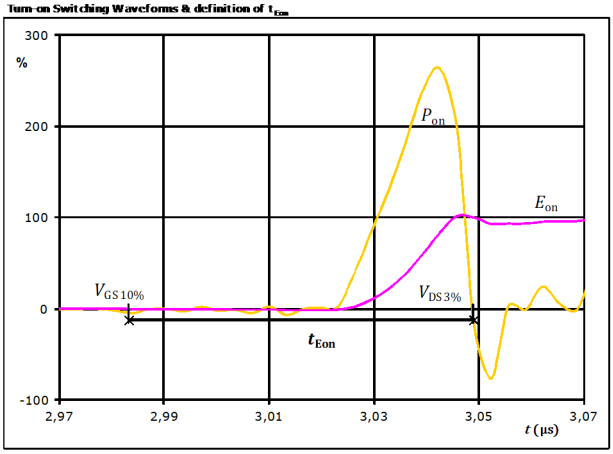
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	6,02	kW
$E_{off}(100\%)$ =	0,05	mJ
t_{Eoff} =	0,14	µs

figure 6. MOSFET

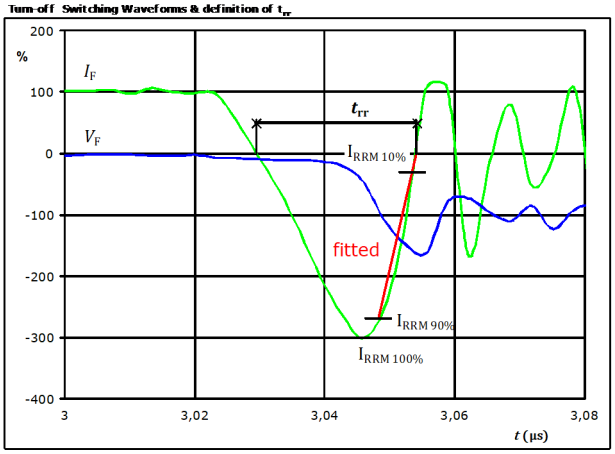
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	6,02	kW
$E_{on}(100\%)$ =	0,21	mJ
t_{Eon} =	0,07	µs

figure 7. FWD

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

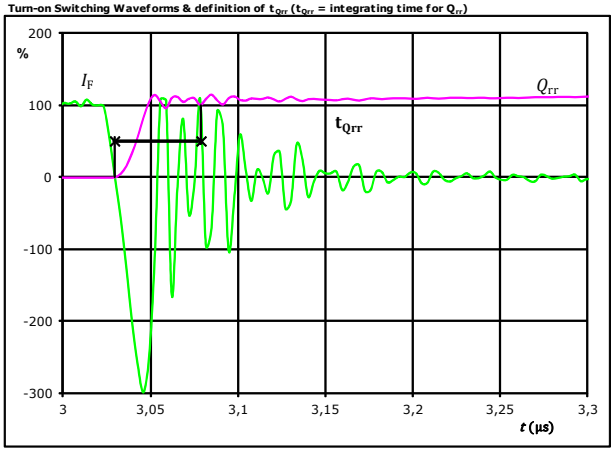


$V_F(100\%)$ =	400	V
$I_F(100\%)$ =	15	A
$I_{RRM}(100\%)$ =	-43	A
t_{rr} =	0,025	µs

PFC Switching Characteristics

figure 8. **FWD**

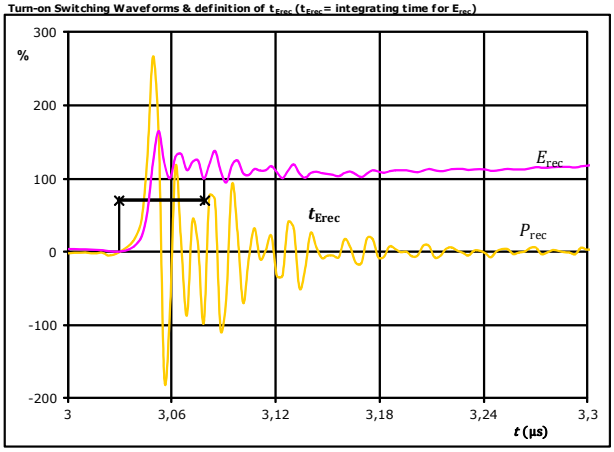
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_F (100%) =	15	A
Q_{rr} (100%) =	0,59	µC
t_{Qrr} =	0,05	µs

figure 9. **FWD**

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



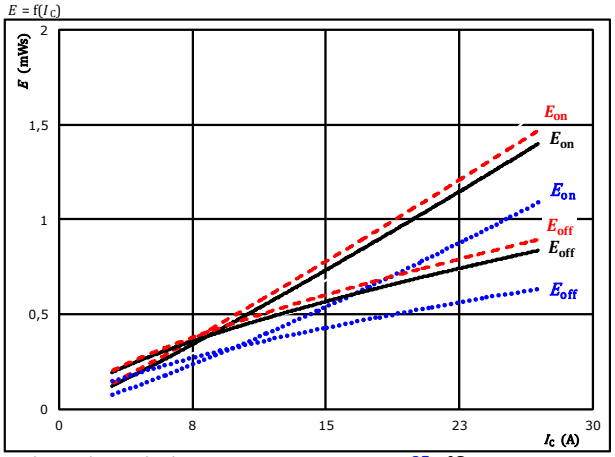
P_{rec} (100%) =	6,02	kW
E_{rec} (100%) =	0,19	mJ
t_{Erec} =	0,05	µs

Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



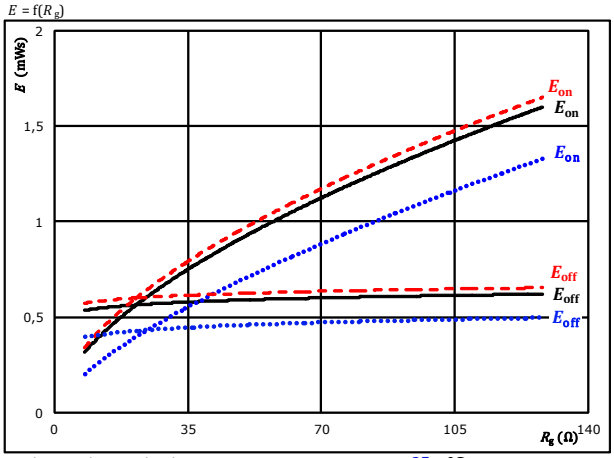
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C	
V_{GE} =	±15	V		125 °C	
R_{gon} =	32	Ω		150 °C	
R_{goff} =	32	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



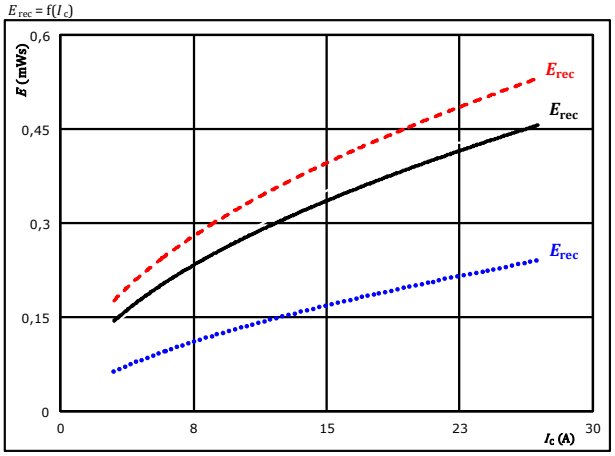
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C	
V_{GE} =	±15	V		125 °C	
I_C =	15	A		150 °C	

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



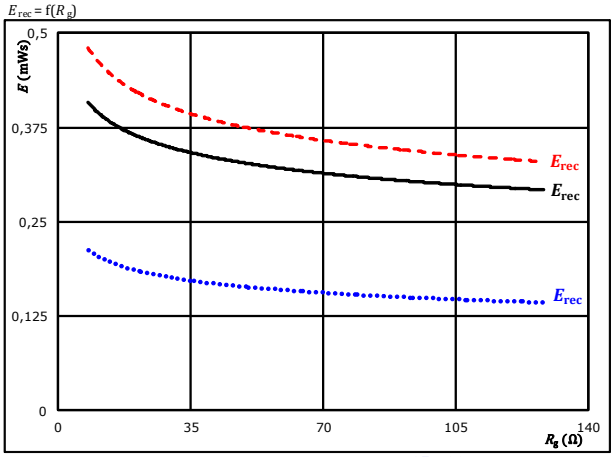
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C	
V_{GE} =	±15	V		125 °C	
R_{gon} =	32	Ω		150 °C	

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

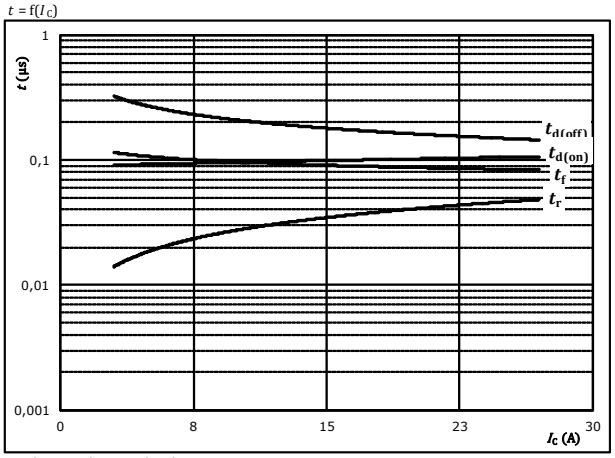
V_{CE} =	400	V	T_j:	25 °C	
V_{GE} =	±15	V		125 °C	
I_C =	15	A		150 °C	

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



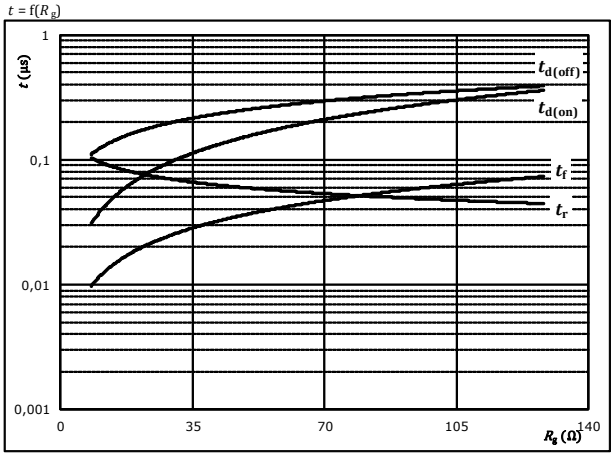
With an inductive load at

T_j =	150	°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

$t = f(R_g)$



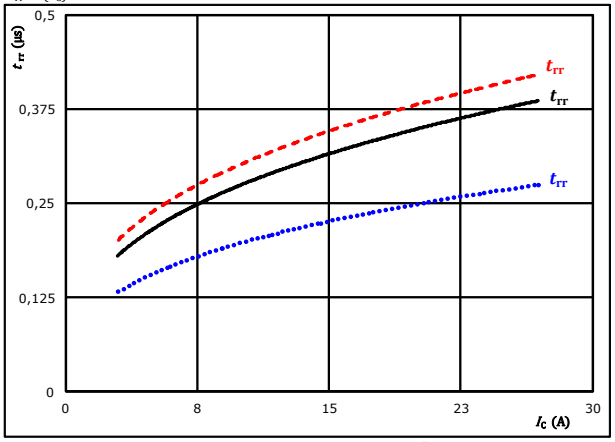
With an inductive load at

T_j =	150	°C
V_{CE} =	400	V
V_{GE} =	±15	V
I_C =	15	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

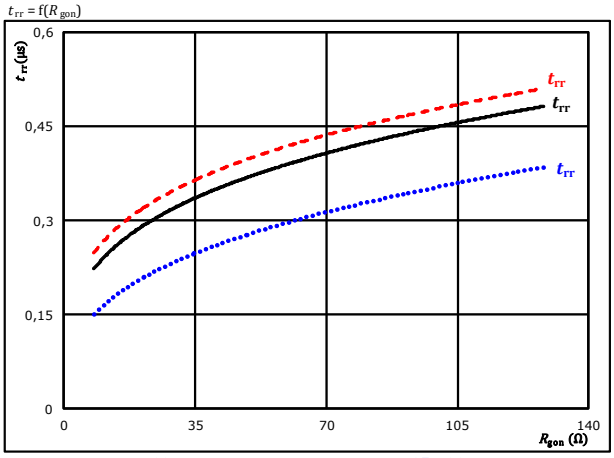


At	V_{CE} =	400	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	R_{gon} =	32	Ω		150 °C

figure 8. **FWD**

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

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



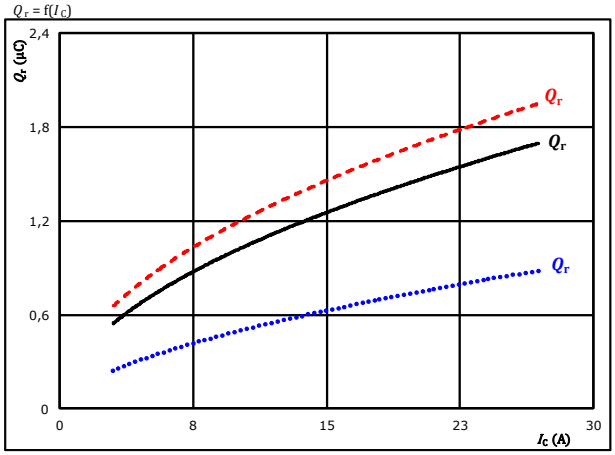
At	V_{CE} =	400	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	I_C =	15	A		150 °C

Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

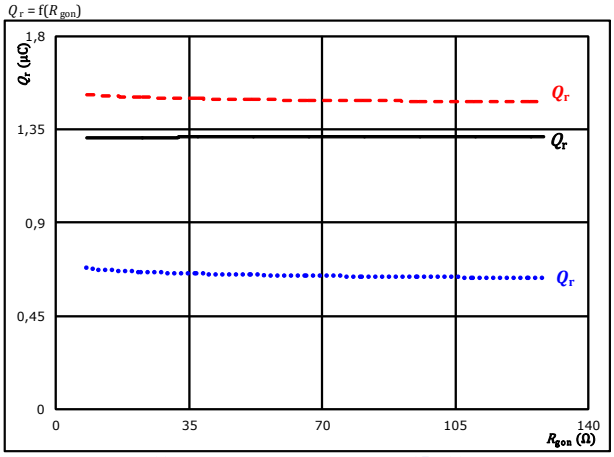


At						
	V_{CE} =	400	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	32	Ω		150 °C	

figure 10. FWD

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

$Q_r = f(R_{gon})$

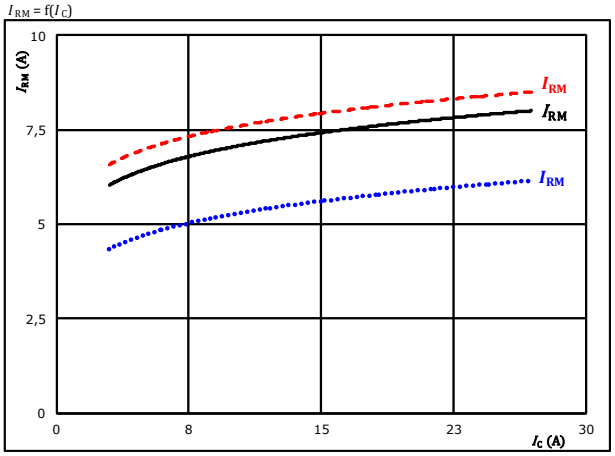


At						
	V_{CE}=	400	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C=	15	A		150 °C	

figure 11. FWD

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

$I_{RM} = f(I_C)$

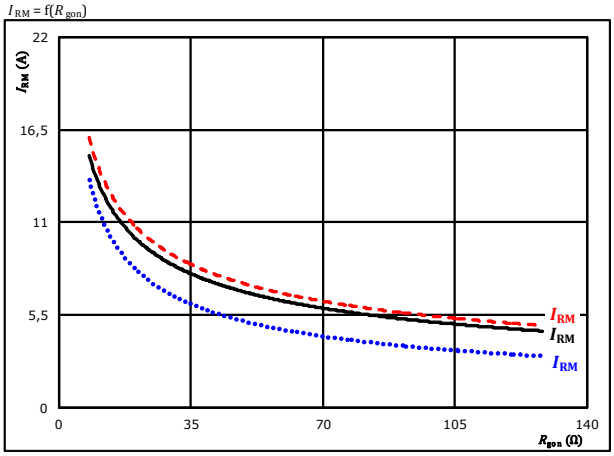


At						
	V_{CE}:	400	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	32	Ω		150 °C	

figure 12. FWD

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

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



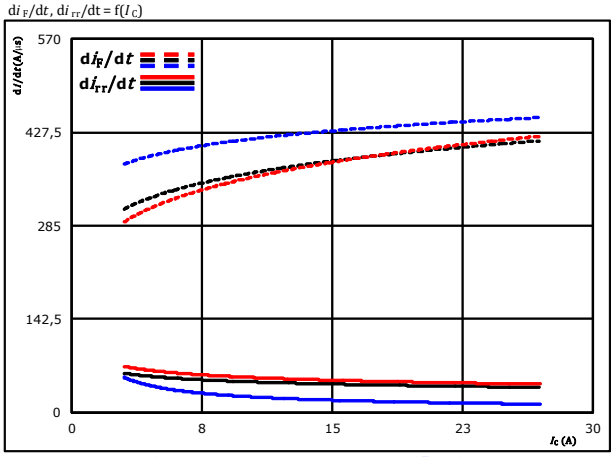
At						
	V_{CE} =	400	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	15	A		150 °C	

Inverter Switching Characteristics

figure 13. **FWD**

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

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

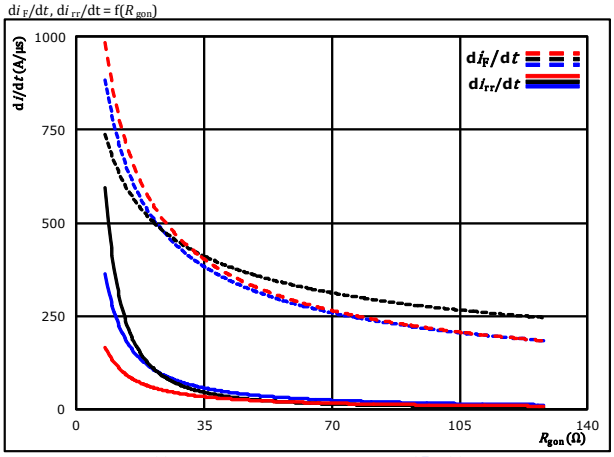


At						
	V_{CE} =	400	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	R_{gon} =	32	Ω		150	°C

figure 14. **FWD**

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

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

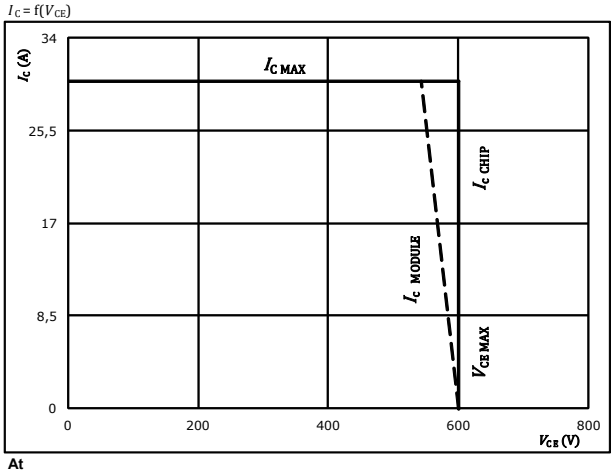


At						
	V_{CE} =	400	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	I_C =	15	A		150	°C

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

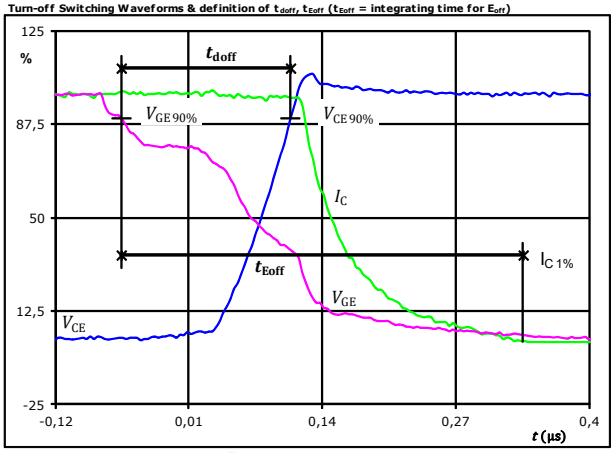
Inverter Switching Definitions

General conditions

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

figure 1. IGBT

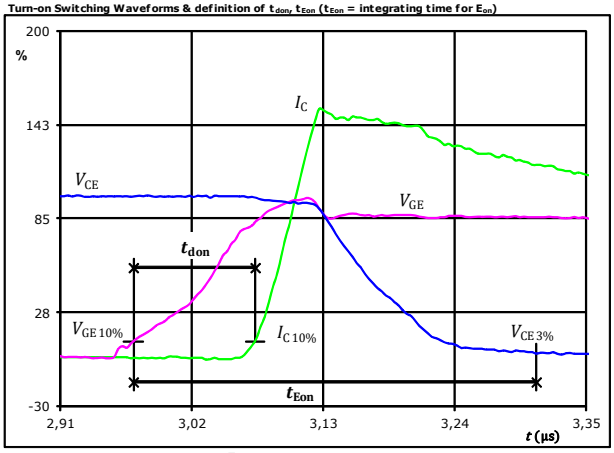
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	15	A
t_{doff} =	0,179	µs
t_{Eoff} =	0,392	µs

figure 2. IGBT

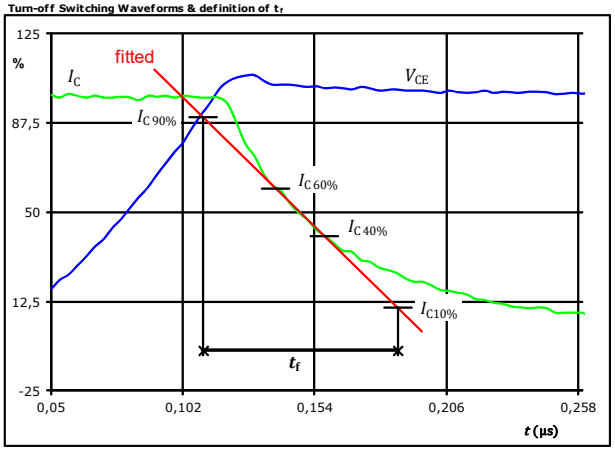
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	15	A
t_{don} =	0,101	µs
t_{Eon} =	0,337	µs

figure 3. IGBT

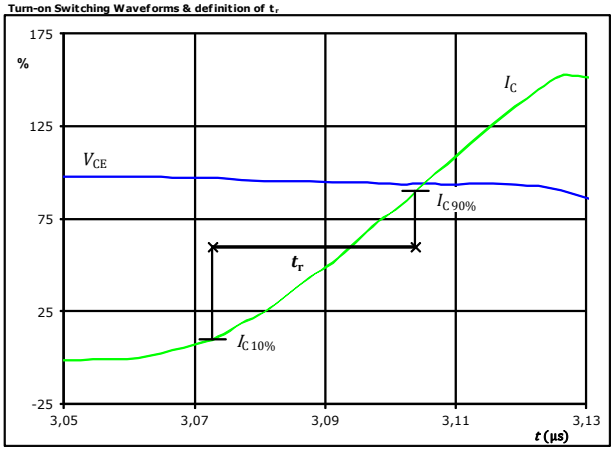
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	15	A
t_f =	0,072	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

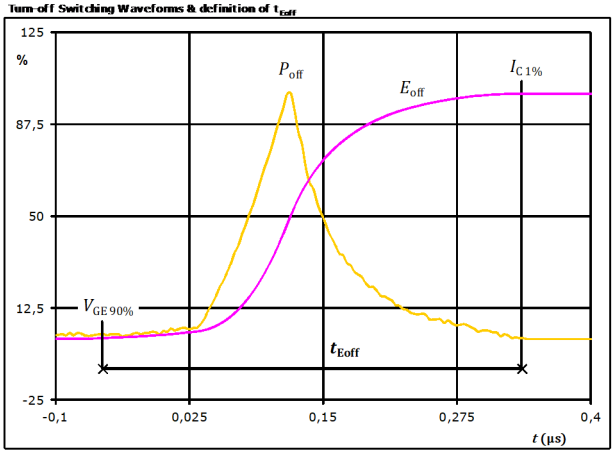


$V_C(100\%)$ =	400	V
$I_C(100\%)$ =	15	A
t_r =	0,031	µs

Inverter Switching Characteristics

figure 5. IGBT

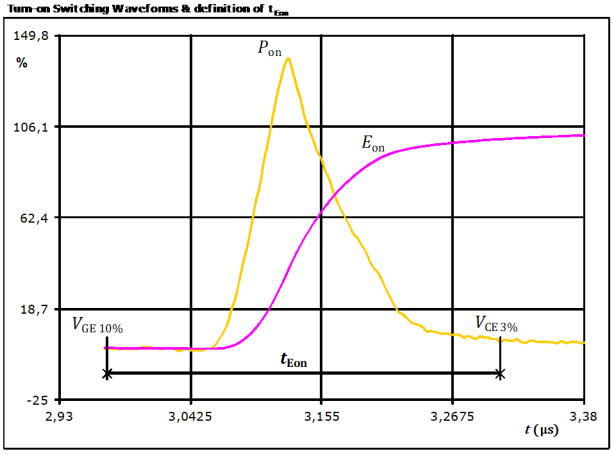
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	5,99	kW
E_{off} (100%) =	0,55	mJ
t_{Eoff} =	0,39	µs

figure 6. IGBT

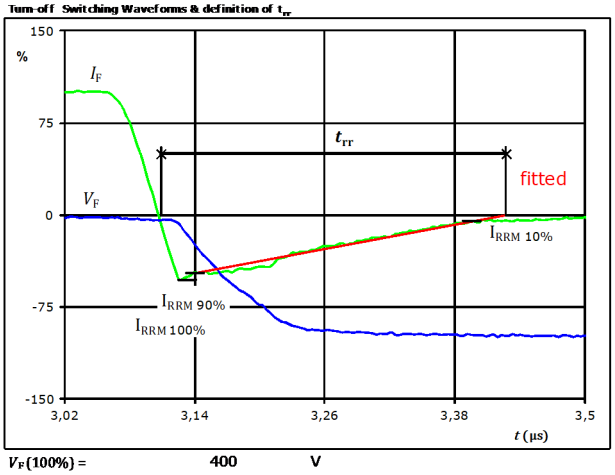
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	5,99	kW
E_{on} (100%) =	0,68	mJ
t_{Eon} =	0,34	µs

figure 7. FWD

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

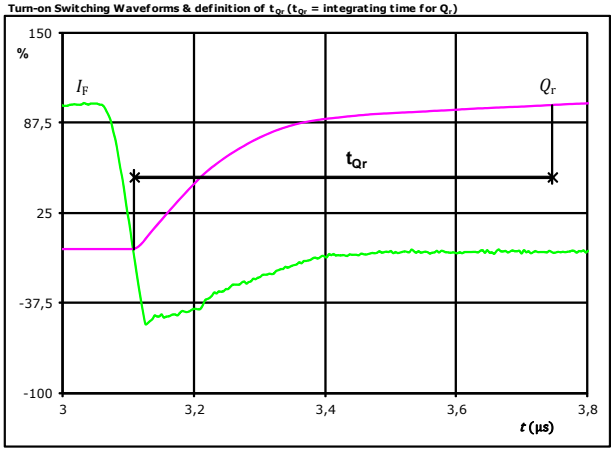


V_F (100%) =	400	V
I_F (100%) =	15	A
I_{RRM} (100%) =	-8	A
t_{rr} =	0,309	µs

Inverter Switching Characteristics

figure 8. **FWD**

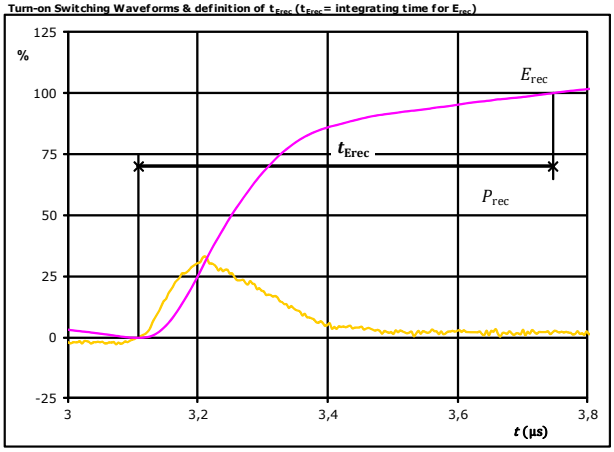
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	15	A
Q_r (100%) =	1,30	µC
t_{Qr} =	0,64	µs

figure 9. **FWD**

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



P_{rec} (100%) =	5,99	kW
E_{rec} (100%) =	0,35	mJ
t_{Erec} =	0,64	µs

Ordering Code & Marking

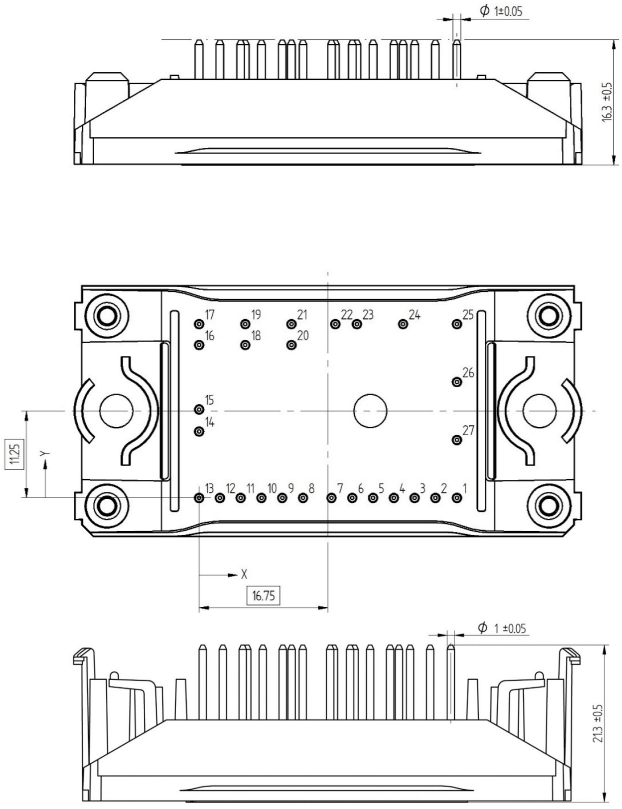
Version	Ordering Code
without thermal paste 17 mm housing with solder pins	10-F006PPA015SB-M684B
with thermal paste 17 mm housing with solder pins	10-F006PPA015SB-M684B-/3/
without thermal paste 12 mm housing with solder pins	10-FU06PPA015SB-M684B06
with thermal paste 12 mm housing with solder pins	10-FU06PPA015SB-M684B06-/3/

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		

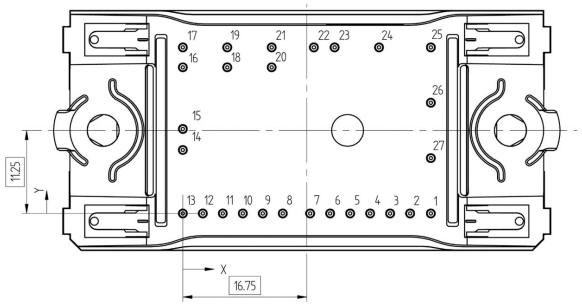
Outline

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

M684B06

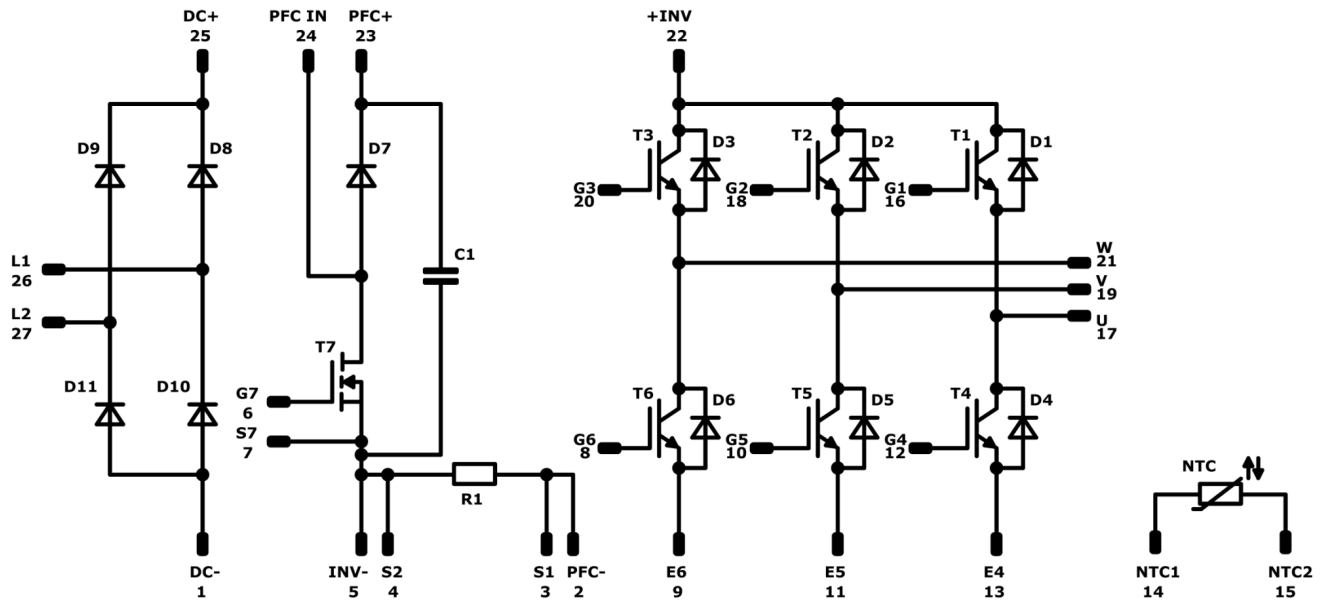


M684B



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 Diode	
T7	MOSFET	600 V	63 mΩ	PFC Switch	
D7	FWD	600 V	30 A	PFC Diode	
C1	Capacitor	500 V		Capacitor (PFC)	
R1	Shunt		22 A	PFC Shunt	
T1, T2, T3, T4, T5, T6	IGBT	600 V	15 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	600 V	15 A	Inverter Diode	
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-Fx06PPA015SB-M684Bxx-D3-14	22 Jan. 2020	New housing construction added	1, 3, 31