10-F006PPA020SB-M685B
datasheet

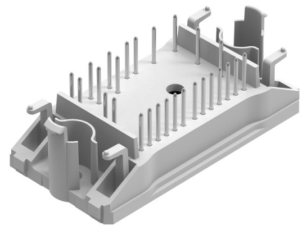
Vincotech

flow **PIM 0 + PFC** — **600 V / 20 A**

Features

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

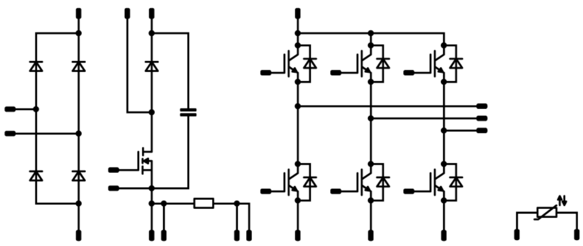
flow 0 17 mm housing



Target applications

- Embedded Drives
- Industial Drives

Schematic



Types

- 10-F006PPA020SB-M685B

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_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	43	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			23	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} = 0-480V		50	V/ns
Total power dissipation	P_{tot}	T_j = T_{jmax}	T_s = 80 °C	90	W
Gate-source voltage	V_{GS}			±20	V
Reverse diode dv/dt	dv/dt	V_{DS} = 0-480V		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	66	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_c ≤ 90 °C		22	A
Power dissipation	P_{tot}	terminal temperature T_c ≤ 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		20	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	60	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	53	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150°C V_{GE} = 15V	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		30	A
Repetitive peak forward current	I_{FRM}	t_p limitied by T_{jmax}	60	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80°C	61	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			min. 12,7	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)						1,64		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		70 150	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	f= 1MHz	0	100		25		0,85		Ω
Gate charge	Q_g		0/10	480	25,8	25		170		nC
Gate to source charge	Q_{GS}							21		
Gate to drain charge	Q_{GD}							87		
Short-circuit input capacitance	C_{iss}	f= 1MHz	0	100		25		3800		pF
Short-circuit output capacitance	C_{oss}							215		
Reverse transfer capacitance	C_{rss}							35		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,78		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	10/-5	400	15	25 125 150		38 44 25		ns
Rise time	t_r					25 125 150		5 6 7		
Turn-off delay time	$t_{d(off)}$					25 125 150		130 136 250		
Fall time	t_f					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)						1,43		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	tc					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	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00029	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		20	25 125	1,1	1,52 1,75	1,9	V
Collector-emitter cut-off current	I_{CES}		0	600		25			1,1	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		1100		pF
Output capacitance	C_{oes}							71		
Reverse transfer capacitance	C_{res}							32		
Gate charge	Q_g		15	480	20	25		120		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,81		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 16 Ω R_{gon} = 16 Ω	±15	400	15	25 125		66 65		ns
Rise time	t_r					25 125		20 21		
Turn-off delay time	$t_{d(off)}$					25 125		142 167		
Fall time	t_f					25 125		76 86		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,9 µC Q_{rFWD} = 1,8 µC				25 125		0,450 0,667		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,385 0,523		

Characteristic Values

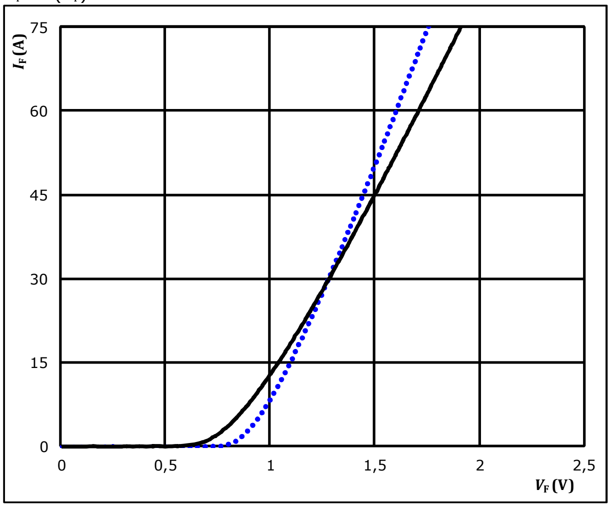
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Diode										
Static										
Forward voltage	V_F				30	25 125		1,65 1,62	1,95	V
Reverse leakage current	I_r			600		25			200	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,56		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 731 A/µs di/dt = 708 A/µs	±15	400	15	25 125		10 14		A
Reverse recovery time	t_{rr}					25 125		174 233		ns
Recovered charge	Q_r					25 125		0,883 1,790		µC
Reverse recovered energy	E_{rec}					25 125		0,236 0,474		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		36 85		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. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



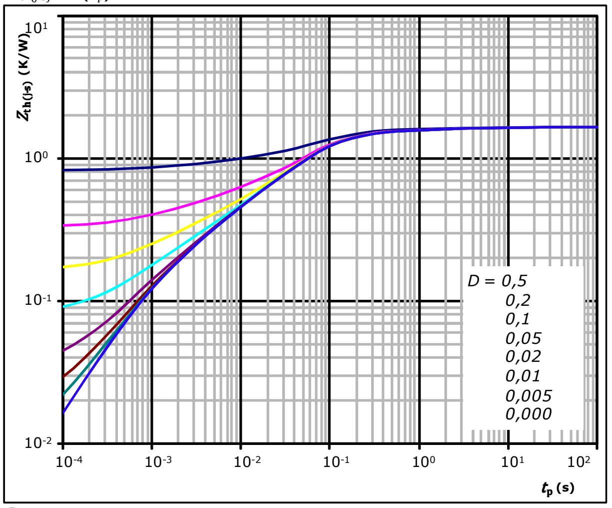
t_p = 250 μs

T_j: 25 °C (dotted), 125 °C (solid)

figure 2. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,64 K/W

Diode thermal model values

R (K/W)	τ (s)
4,73E-02	6,99E+00
1,06E-01	9,98E-01
4,37E-01	1,30E-01
7,47E-01	4,61E-02
2,09E-01	5,25E-03
9,49E-02	8,85E-04
9,49E-02	8,85E-04

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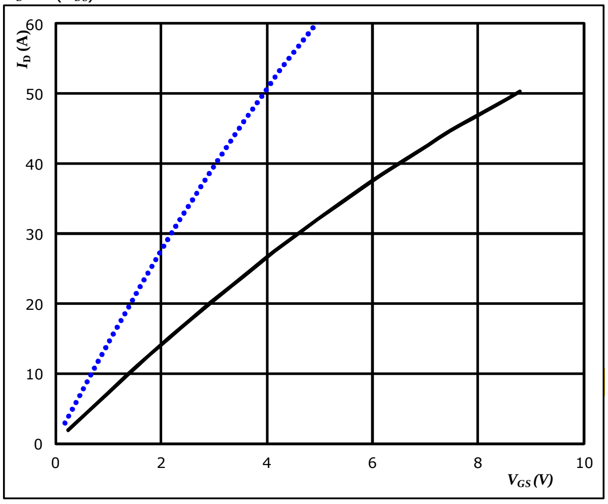
PFC Switch Characteristics

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

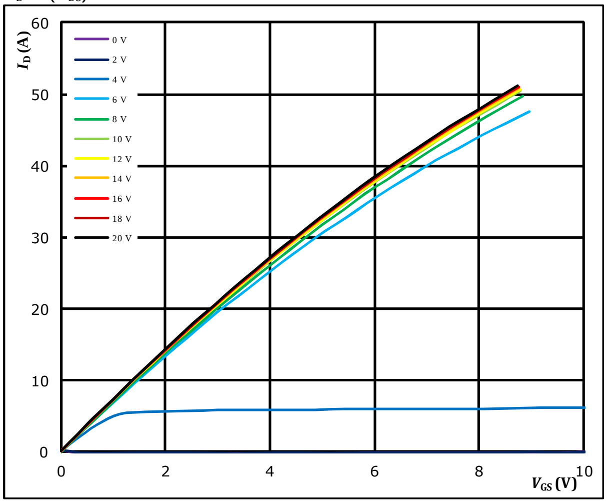


t_p =	250	µs		25	°C ············
V_{GS}=	10	V	T_j:	125	°C ———

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



t_p = 250 µs

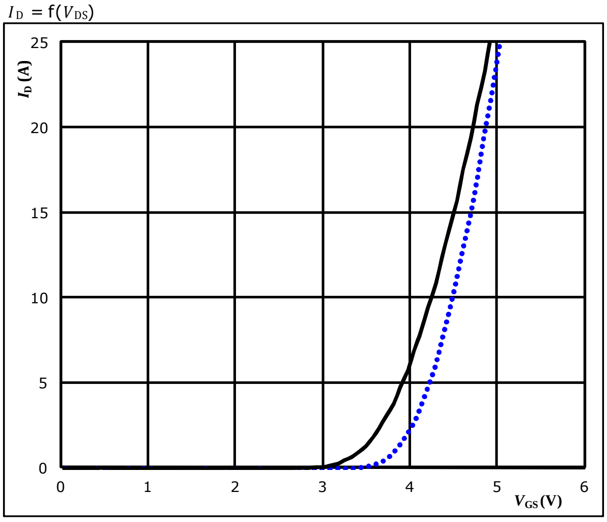
T_j = 125 °C

V_{GS} from 0 V to 20 V in steps of 2 V

figure 2. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{DS})$

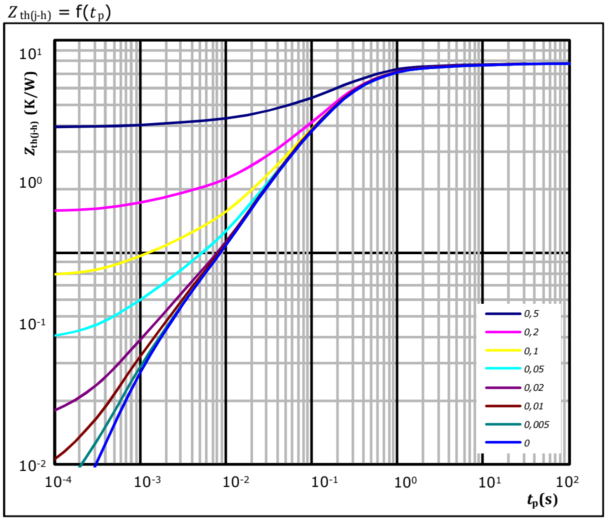


t_p =	100	µs		25	°C ············
V_{DS} =	10	V	T_j:	125	°C ———

figure 4. **MOSFET**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,78 K/W

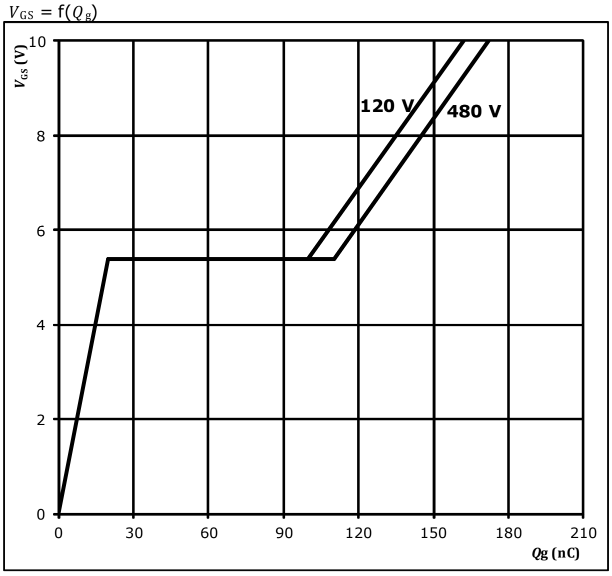
R (K/W)	Tau (s)
2,79E-02	1,48E+01
9,18E-02	1,22E+00
4,16E-01	2,24E-01
1,49E-01	5,85E-02
6,36E-02	1,29E-02
3,14E-02	1,19E-03

PFC Switch Characteristics

figure 5.	MOSFET

Gate voltage vs Gate charge

$V_{GS} = f(Q_g)$



At

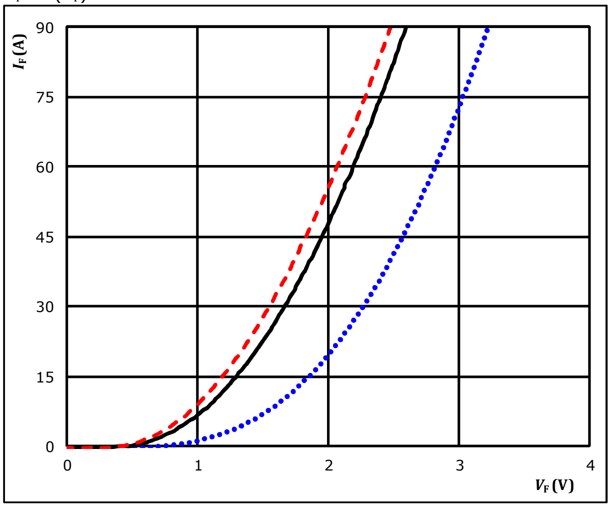
I_D=	26	A

PFC Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



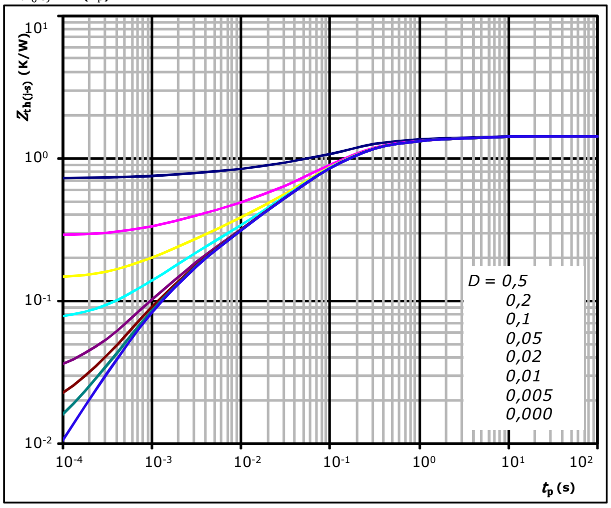
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,43 K/W

FWD thermal model values

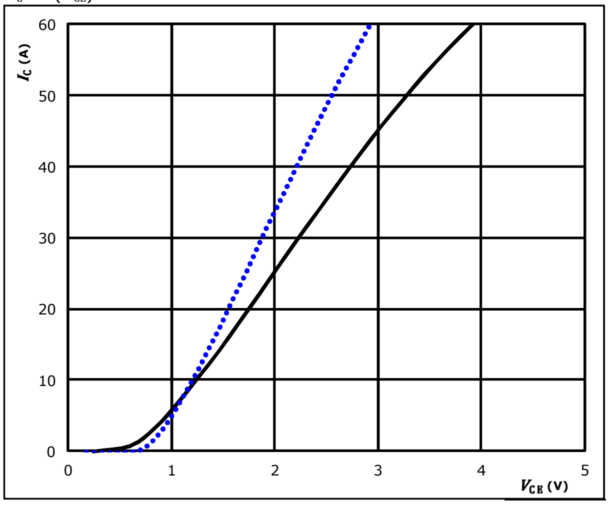
R (K/W)	τ (s)
1,15E-01	3,33E+00
3,20E-01	3,63E-01
6,97E-01	8,76E-02
2,02E-01	9,87E-03
1,00E-01	1,27E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

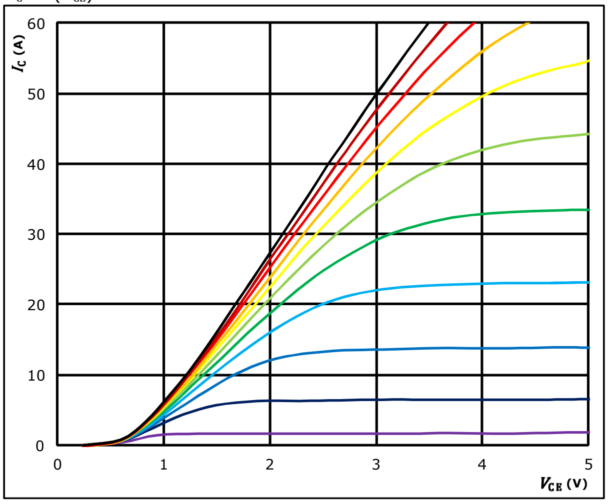


t_p =	250	µs	T_j:	25 °C	dotted
V_{GE} =	15	V		125 °C	solid

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

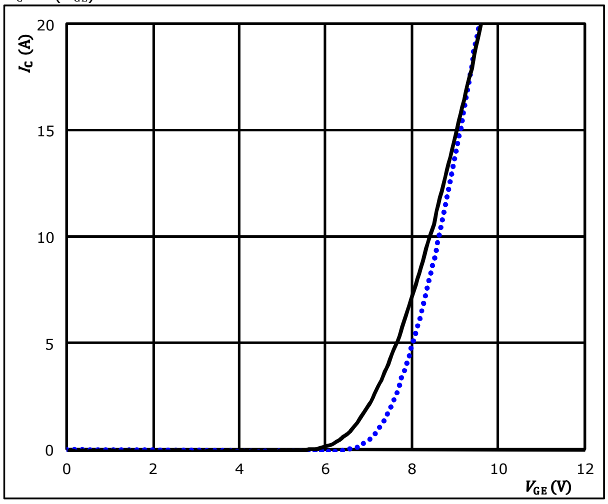


t_p =	250	µs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

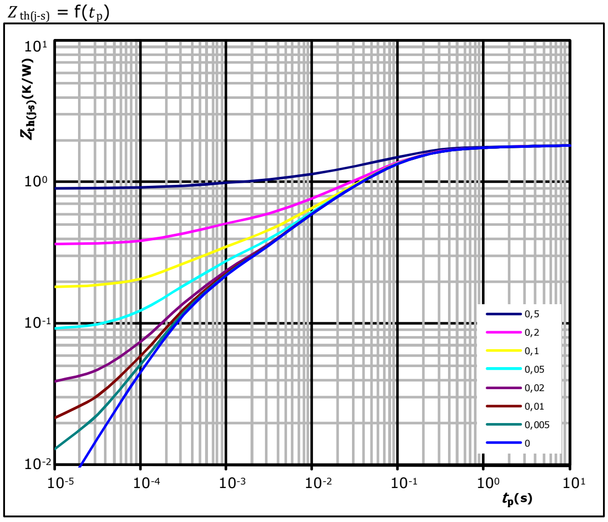


t_p =	100	µs	T_j:	25 °C	dotted
V_{CE} =	10	V		125 °C	solid

figure 4. **IGBT**

Transient Thermal Impedance as function of Pulse duration

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



D = t_p / T

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

IGBT thermal model values

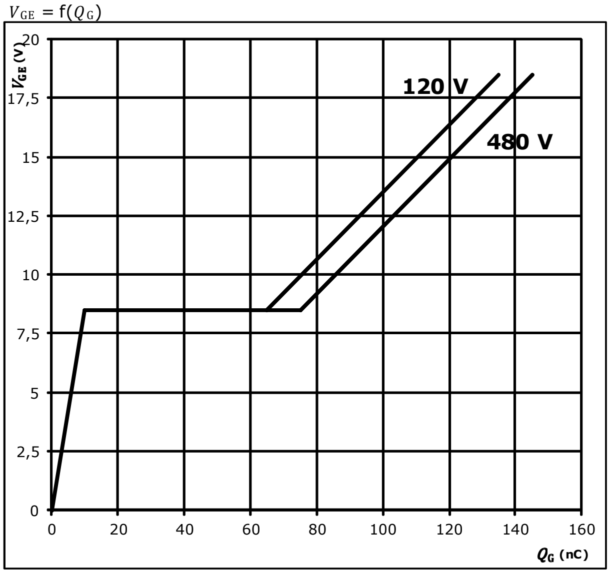
R (K/W)	τ (s)
6,63E-02	3,68E+00
1,83E-01	4,61E-01
8,24E-01	8,38E-02
3,93E-01	1,82E-02
1,96E-01	3,57E-03
1,49E-01	3,52E-04

Inverter Switch Characteristics

figure 5.	**IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_G)$



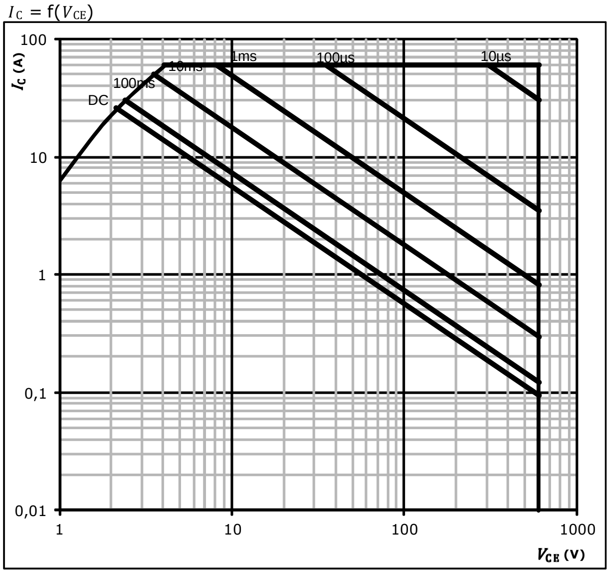
At

I_C= 20 A

figure 6.	**IGBT**

Safe operating area

$I_C = f(V_{CE})$



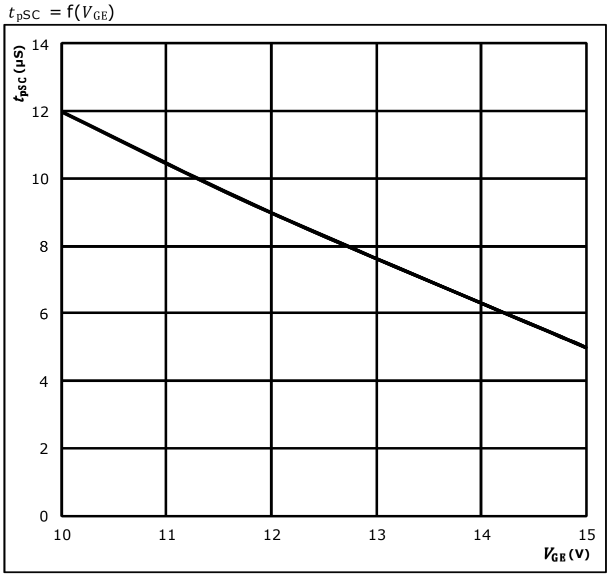
At

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 VGE

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



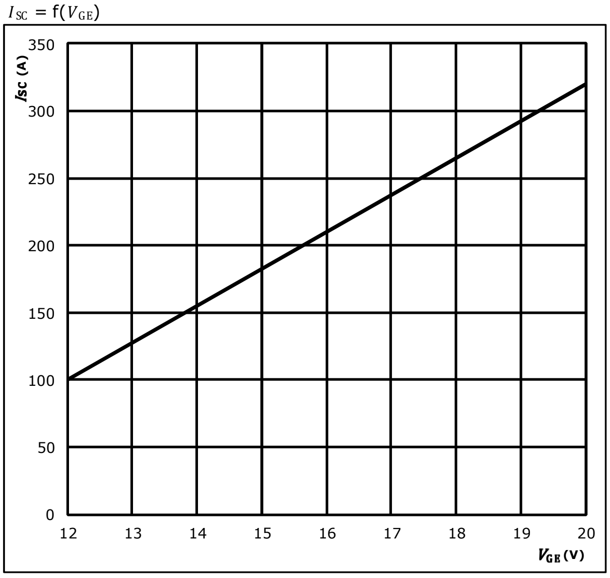
At

V_{CE} =	600	V
T_j ≤	175	ºC

figure 8.	**IGBT**

Typical short circuit current as a function of VGE

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



At

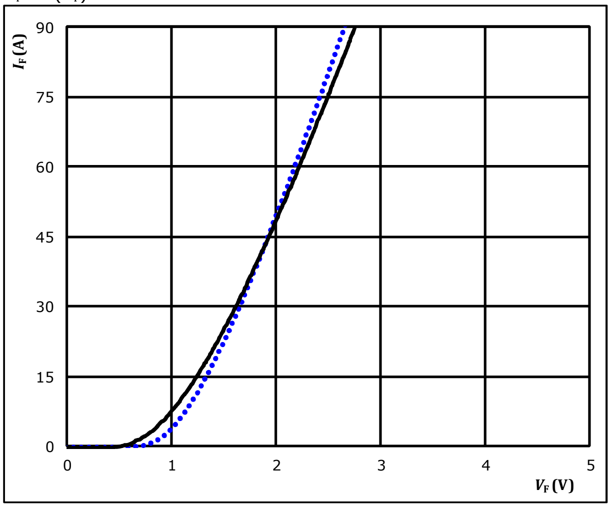
V_{CE} ≤	600	V
T_j ≤	175	ºC

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



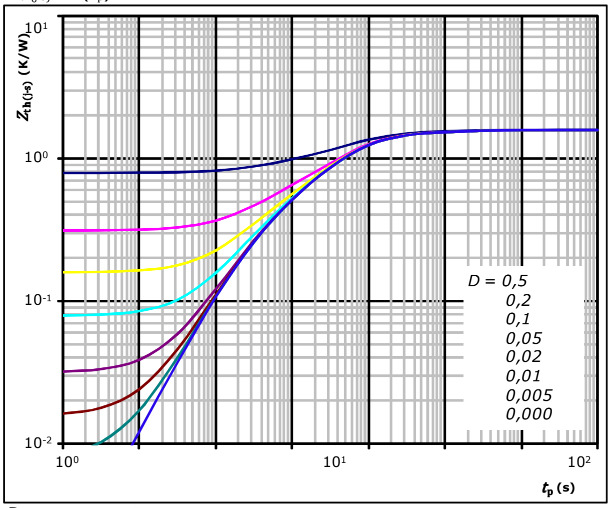
t_p = 250 µs

T_j: 25 °C (dotted), 125 °C (solid)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 1,56 K/W

FWD thermal model values

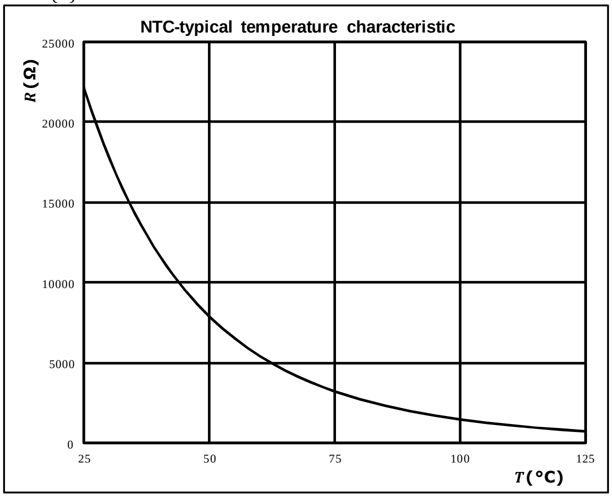
R (K/W)	τ (s)
9,10E-02	2,00E+00
3,45E-01	1,68E-01
7,17E-01	4,13E-02
2,97E-01	7,43E-03
1,15E-01	1,80E-03

Thermistor Characteristics

figure 1.	Thermistor

Typical NTC characteristic as a function of temperature

$R = \mathrm{f}(T)$

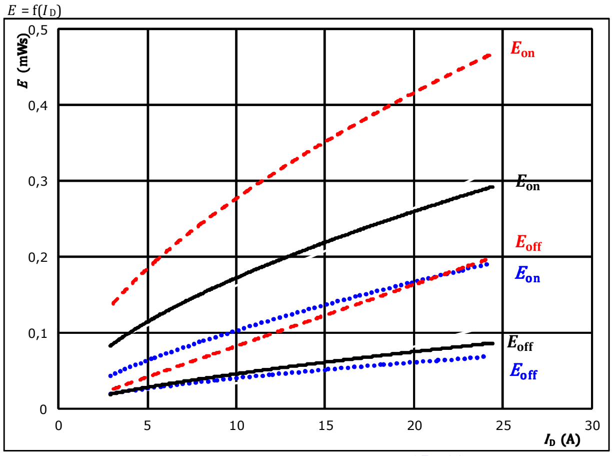


PFC Switching Characteristics

figure 1. — **MOSFET**

Typical switching energy losses as a function of drain current

$E = f(I_D)$



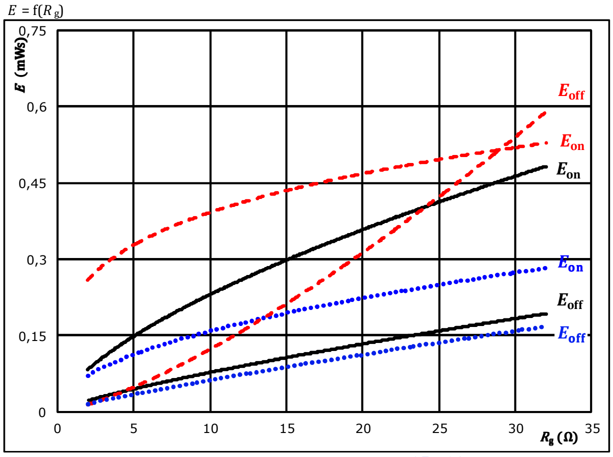
With an inductive load at

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

$E = f(R_g)$



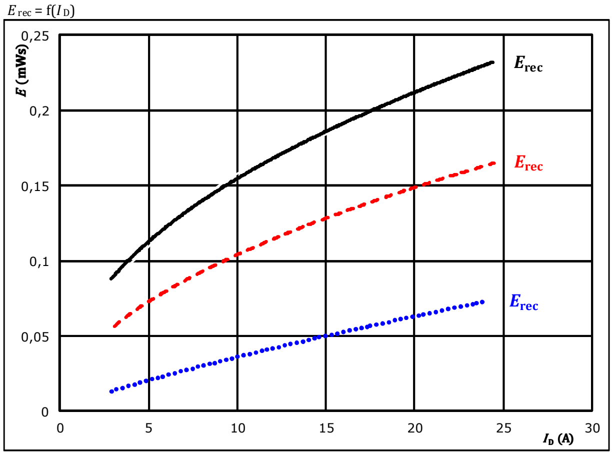
With an inductive load at

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

$E_{rec} = f(I_D)$



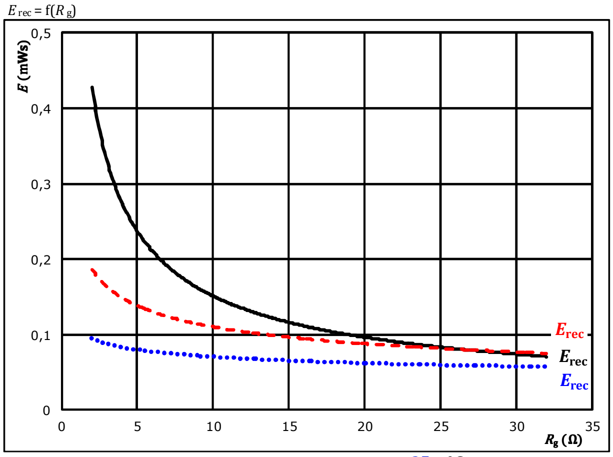
With an inductive load at

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

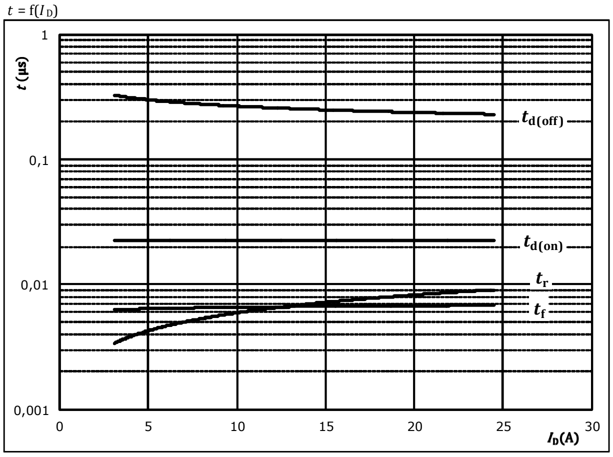
V_{DS} =	400	V	T_j:	25 °C	···········
V_{GS} =	10/-5	V		125 °C	———
I_D =	15	A		150 °C	- - -

PFC Switching Characteristics

figure 5. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



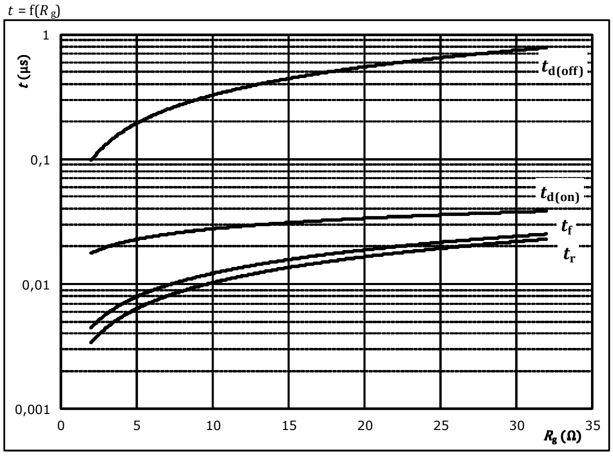
With an inductive load at

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

$t = f(R_g)$



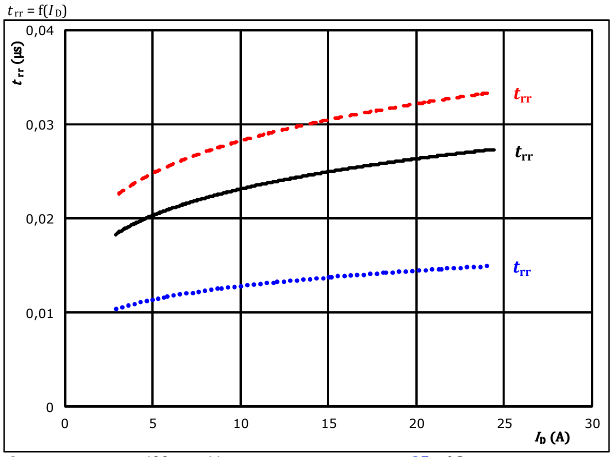
With an inductive load at

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

$t_{rr} = f(I_D)$

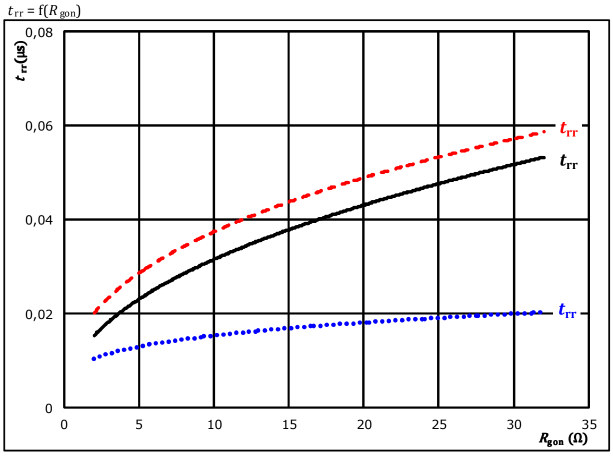


At V_{DS} =	400	V		25	°C	···········
V_{GS} =	10/-5	V	T_j:	125	°C	———
R_{gon} =	8	Ω		150	°C	– – –

figure 8. **FWD**

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

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



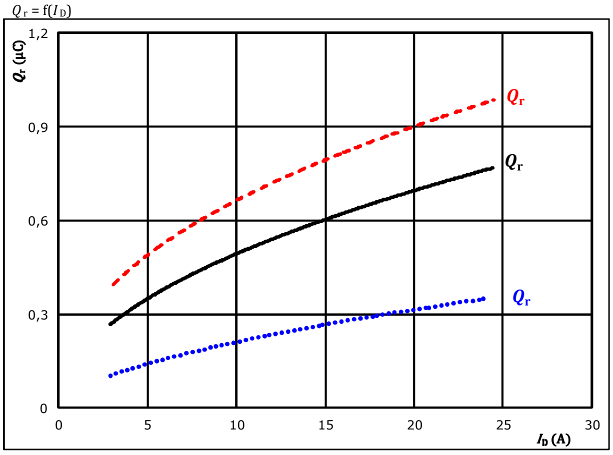
At V_{DS} =	400	V		25	°C	···········
V_{GS} =	10/-5	V	T_j:	125	°C	———
I_D =	15	A		150	°C	– – –

PFC Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

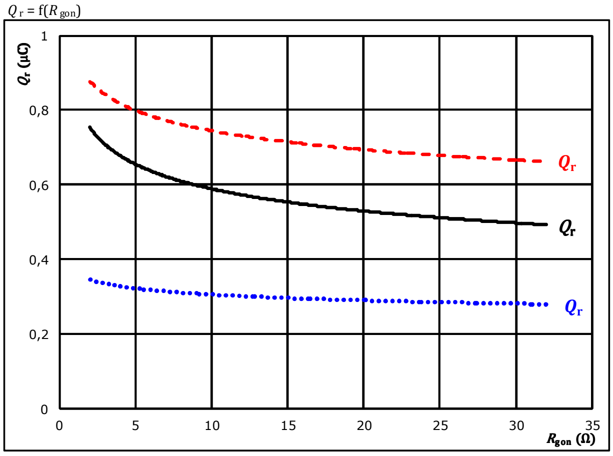


At					
V_{DS} =	400	V		25 °C	············
V_{GS} =	10/-5	V	T_j:	125 °C	———
R_{gon} =	8	Ω		150 °C	– – –

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

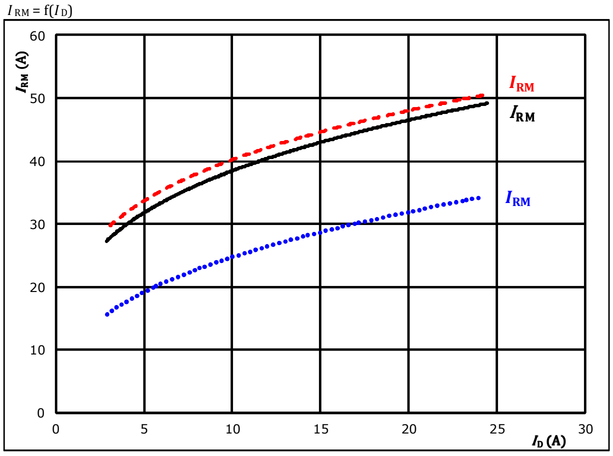


At					
V_{DS} =	400	V		25 °C	············
V_{GS} =	10/-5	V	T_j:	125 °C	———
I_D =	15	A		150 °C	– – –

figure 11. **FWD**

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

$I_{RM} = f(I_D)$

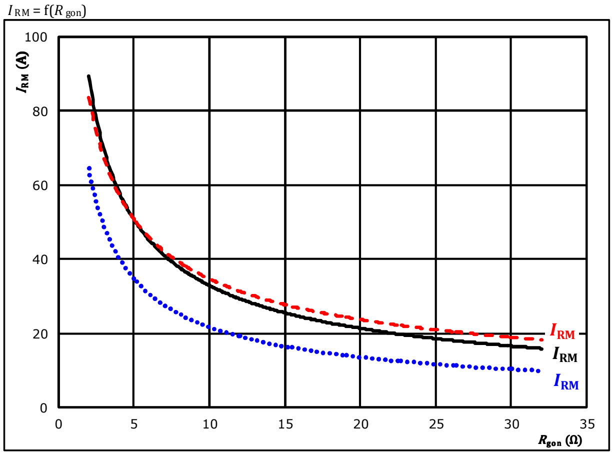


At					
V_{DS} =	400	V		25 °C	············
V_{GS} =	10/-5	V	T_j:	125 °C	———
R_{gon} =	8	Ω		150 °C	– – –

figure 12. **FWD**

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

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



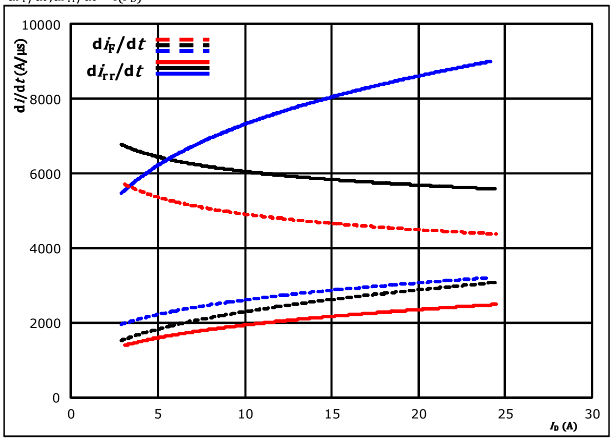
At					
V_{DS} =	400	V		25 °C	············
V_{GS} =	10/-5	V	T_j:	125 °C	———
I_D =	15	A		150 °C	– – –

PFC Switching Characteristics

figure 13. **FWD**

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

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

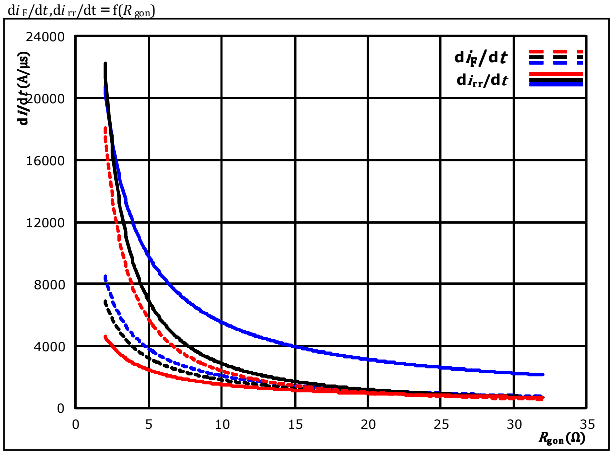


At						
V_{DS} =	400	V		25	°C	•••••••••••
V_{GS} =	10/-5	V	T_j:	125	°C	———
R_{gon} =	8	Ω		150	°C	– – –

figure 14. **FWD**

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

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

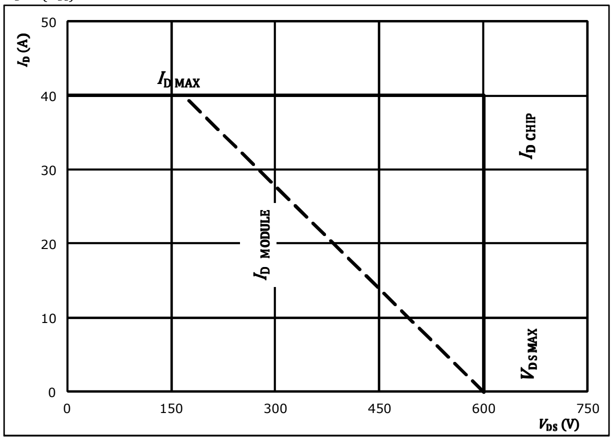


At						
V_{DS} =	400	V		25	°C	•••••••••••
V_{GS} =	10/-5	V	T_j:	125	°C	———
I_D =	15	A		150	°C	– – –

figure 15. **MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$



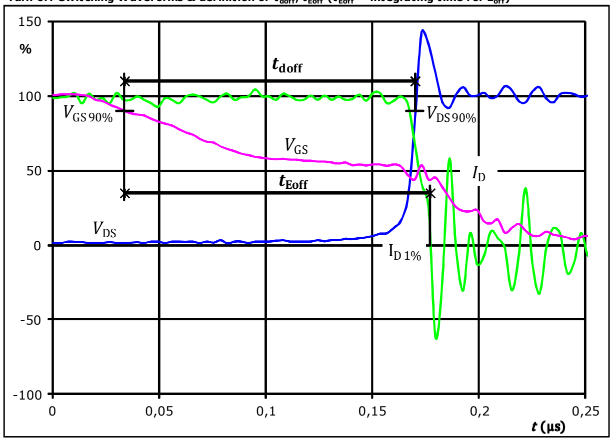
At		
T_j =	150	°C
R_{gon} =	8	Ω
R_{goff} =	8	Ω

PFC Switching Definitions

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

figure 1. **MOSFET**

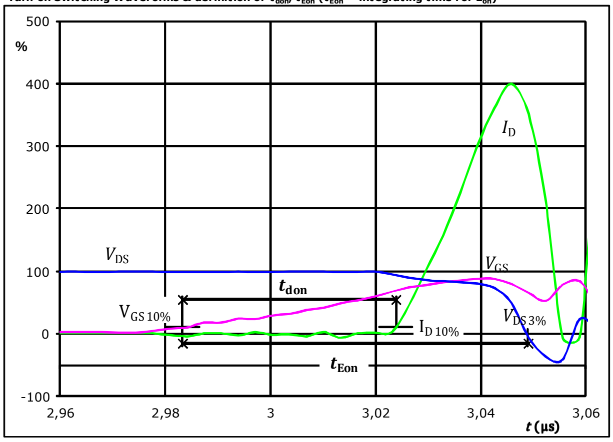
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GS}(0\%)$ =	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**

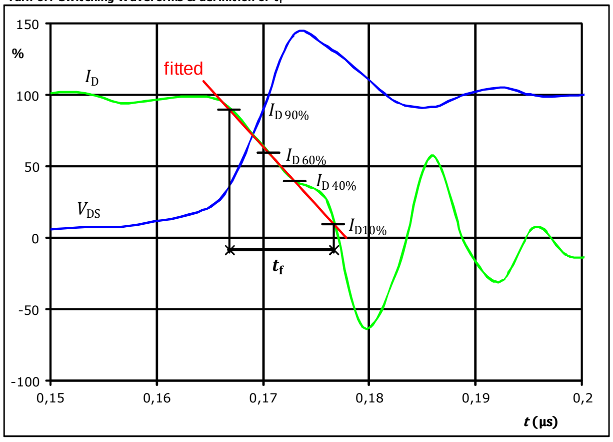
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GS}(0\%)$ =	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**

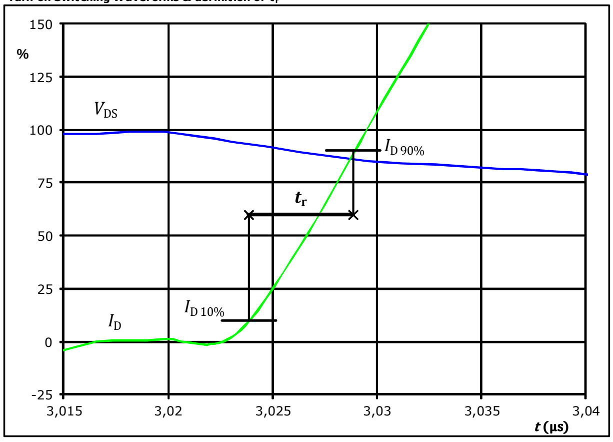
Turn-off Switching Waveforms & definition of t_f



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

figure 4. **MOSFET**

Turn-on Switching Waveforms & definition of t_r



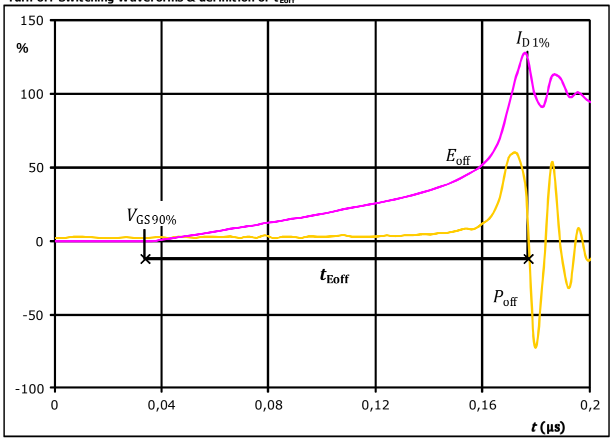
$V_{DS}(100\%)$ =	400	V
$I_D(100\%)$ =	15	A
t_r =	0,006	µs

Vincotech

PFC Switching Characteristics

figure 5. **MOSFET**

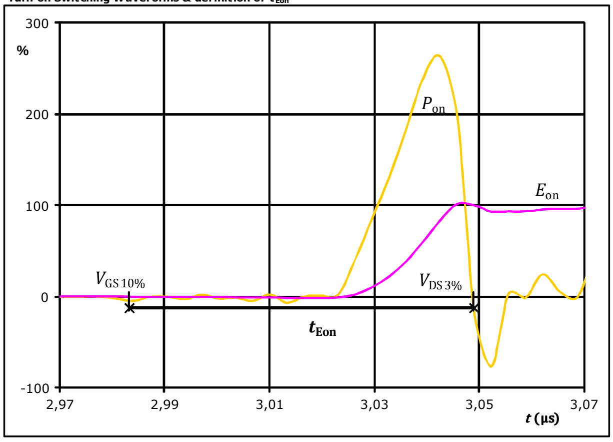
Turn-off Switching Waveforms & definition of t_{Eoff}



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

figure 6. **MOSFET**

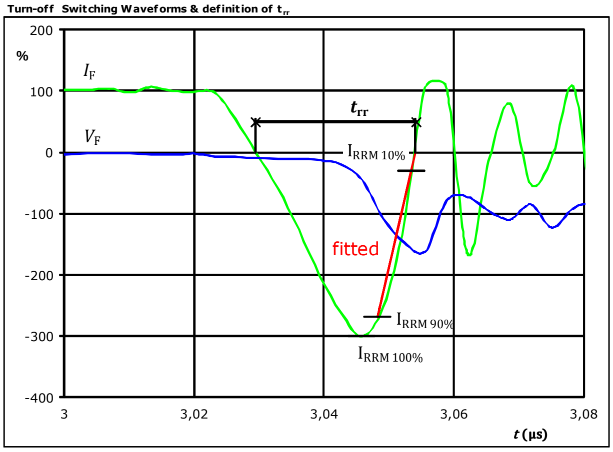
Turn-on Switching Waveforms & definition of t_{Eon}



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

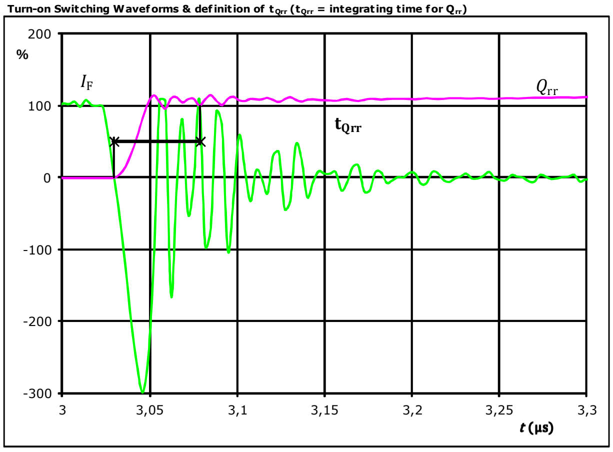
10-F006PPA020SB-M685B
datasheet

Vincotech

PFC Switching Characteristics

figure 8. **FWD**

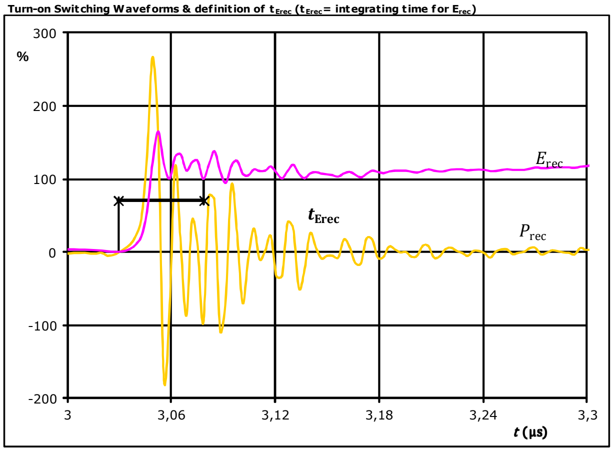
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



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})



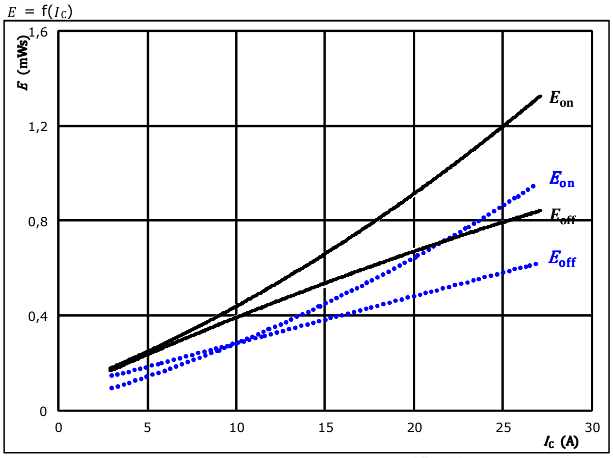
P_{rec} (100%) =	6,02	kW
E_{rec} (100%) =	0,19	mJ
t_{Erec} =	0,05	µs

Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



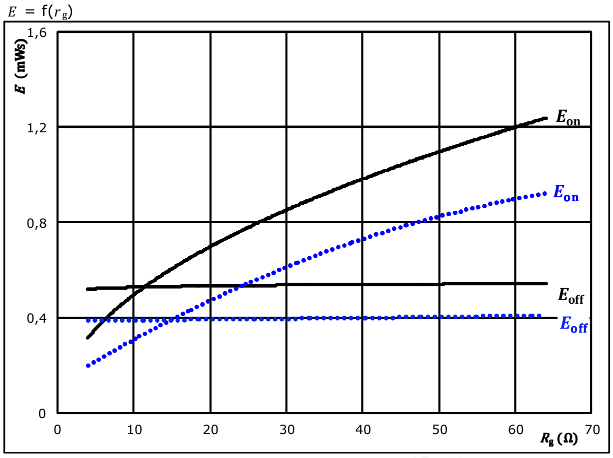
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		125 °C (solid)
R_{gon} =	16	Ω		
R_{goff} =	16	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



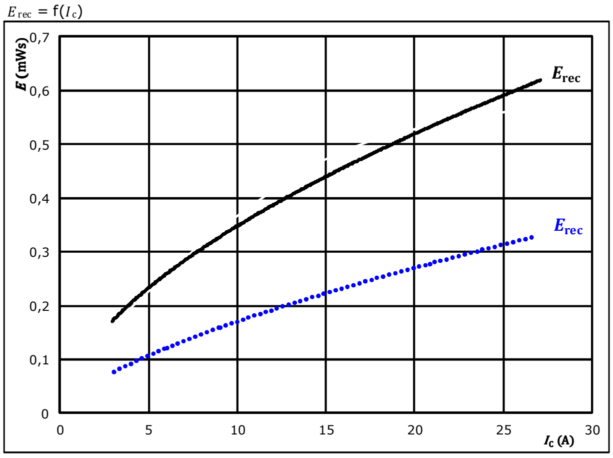
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		125 °C (solid)
I_C =	15	A		

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



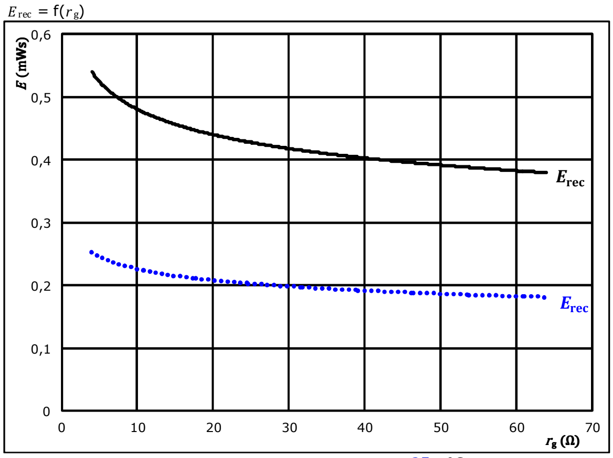
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		125 °C (solid)
R_{gon} =	16	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

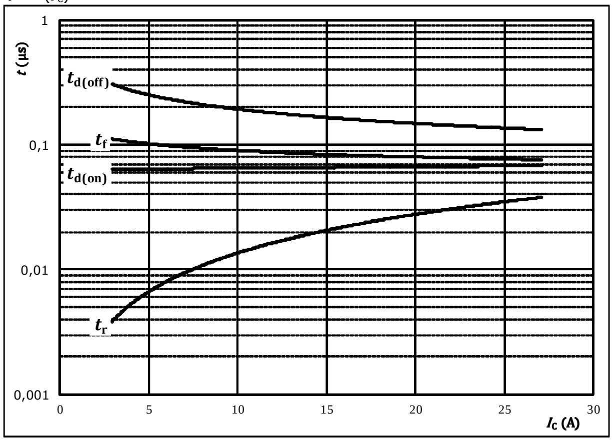
V_{CE} =	400	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		125 °C (solid)
I_C =	15	A		

Inverter Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



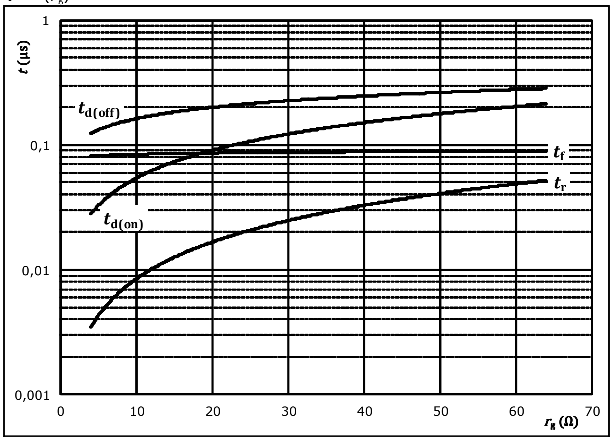
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$t = f(r_g)$



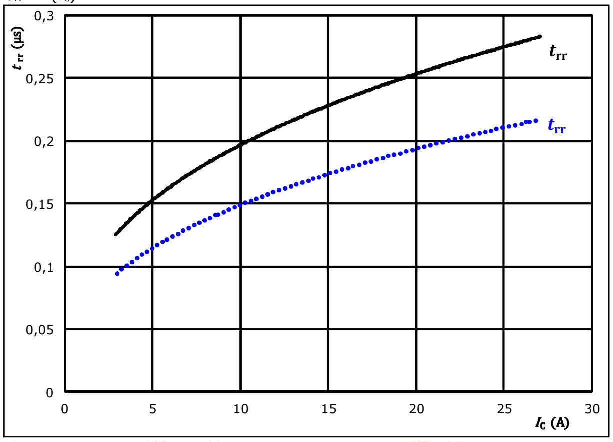
With an inductive load at

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

figure 7. FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

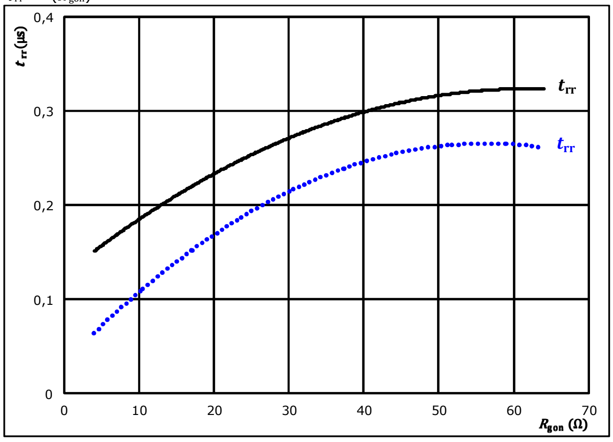


At						
V_{CE}=	400	V		25	°C	··············
V_{GE} =	±15	V	T_j:	125	°C	————
R_{gon} =	16	Ω				

figure 8. FWD

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

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



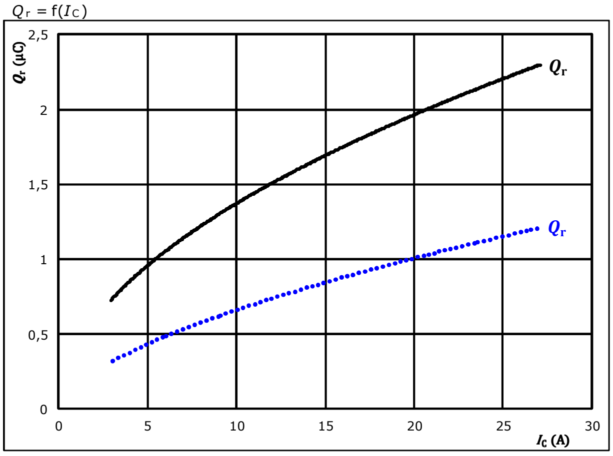
At						
V_{CE} =	400	V		25	°C	··············
V_{GE} =	±15	V	T_j:	125	°C	————
I_C =	15	A				

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

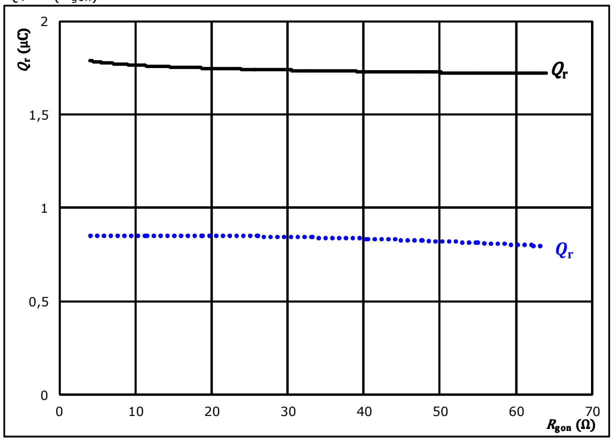


At					
V_{CE} =	400	V		25 °C	·············
V_{GE} =	±15	V	T_j:	125 °C	———
R_{gon} =	16	Ω			

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

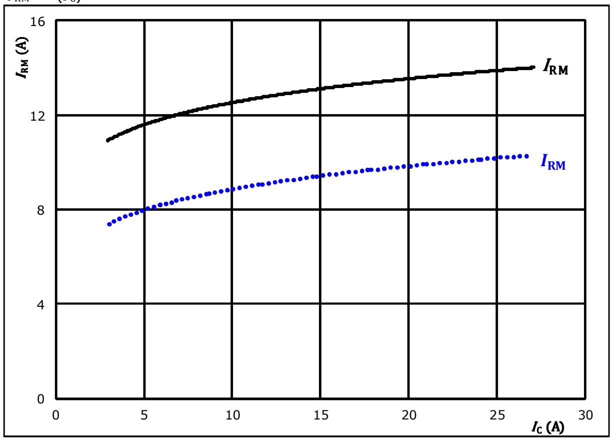


At					
V_{CE}=	400	V		25 °C	·············
V_{GE} =	±15	V	T_j:	125 °C	———
I_C=	15	A			

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

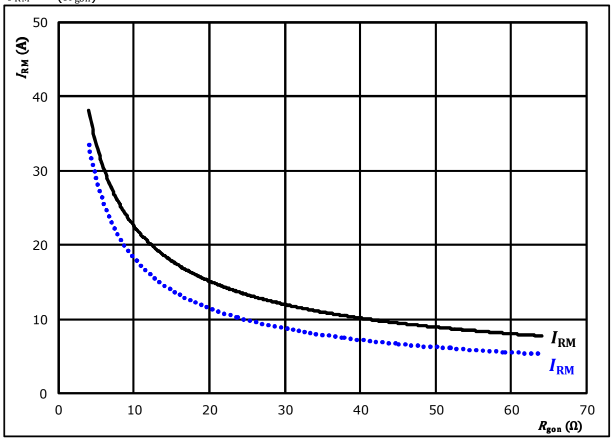


At					
V_{CE} =	400	V		25 °C	·············
V_{GE} =	±15	V	T_j:	125 °C	———
R_{gon} =	16	Ω			

figure 12. **FWD**

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

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



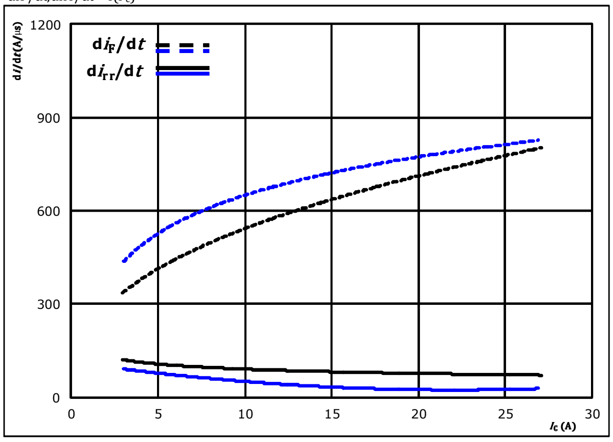
At					
V_{CE} =	400	V		25 °C	·············
V_{GE} =	±15	V	T_j:	125 °C	———
I_C =	15	A			

Inverter Switching Characteristics

figure 13. **FWD**

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

diF/dt,dirr/dt = f(I_c)

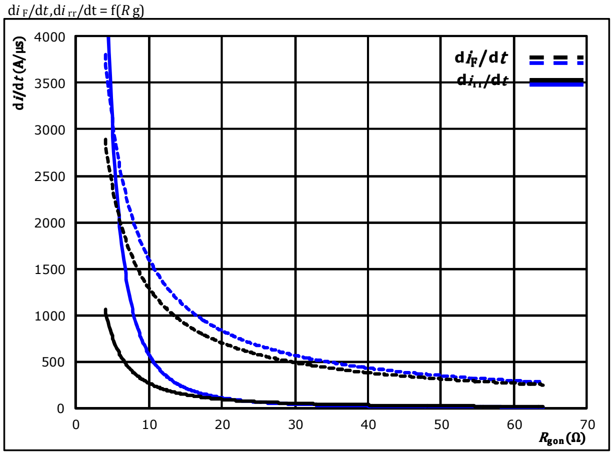


At						
V_{CE} =	400	V		25	°C	·············
V_{GE} =	±15	V	T_j:	125	°C	————
R_{gon} =	16	Ω				

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_g)

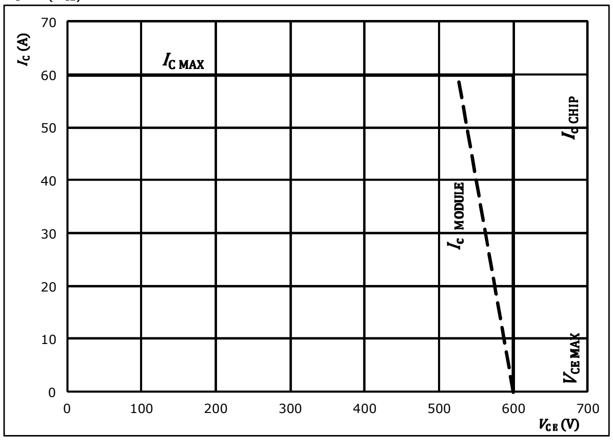


At					
V_{CE} =	400	V	25	°C	·············
V_{GE} =	±15	V	125	°C	————
I_C=	15	A			

figure 15. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



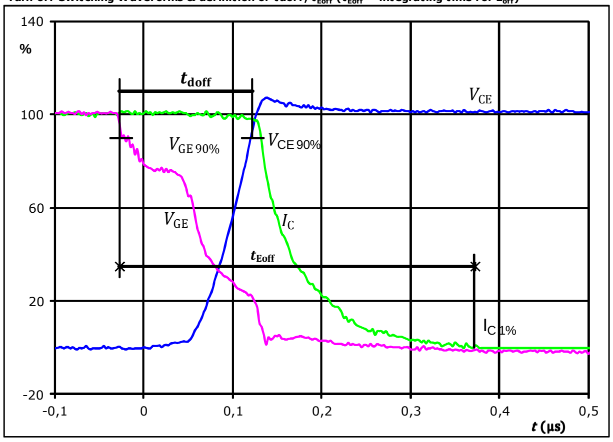
At		
T_j =	175	°C
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Inverter Switching Definitions

General conditions		
T_j	=	125 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

figure 1. IGBT

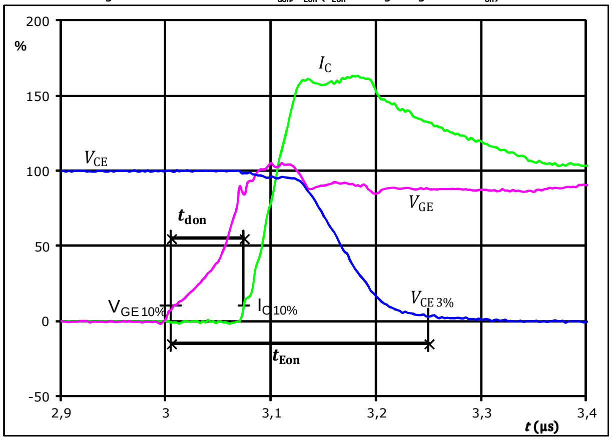
Turn-off Switching Waveforms & definition of tdoff, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	400	V
I_C (100%) =	21	A
t_{doff} =	0,145	µs
t_{Eoff} =	0,400	µs

figure 2. IGBT

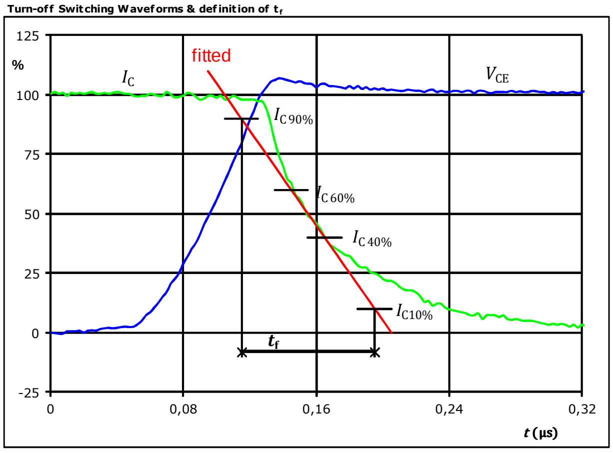
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	400	V
I_C (100%) =	21	A
t_{don} =	0,067	µs
t_{Eon} =	0,245	µs

figure 3. IGBT

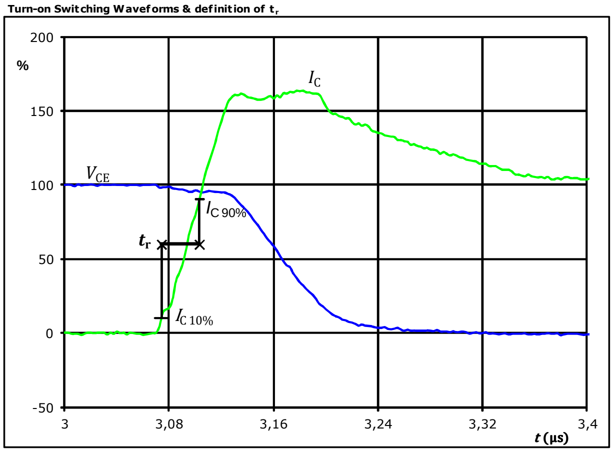
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	21	A
t_f =	0,075	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

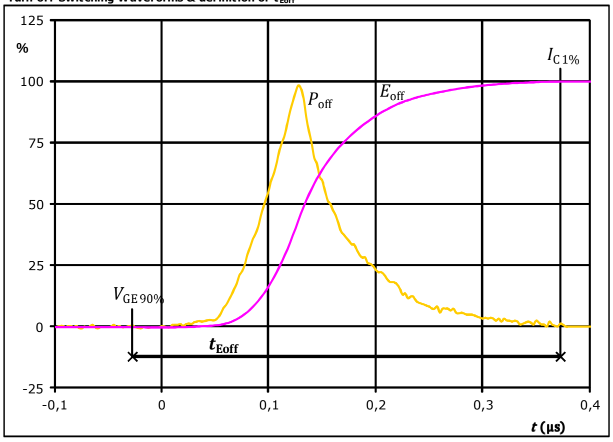


V_C (100%) =	400	V
I_C (100%) =	21	A
t_r =	0,029	µs

Inverter Switching Characteristics

figure 5. **IGBT**

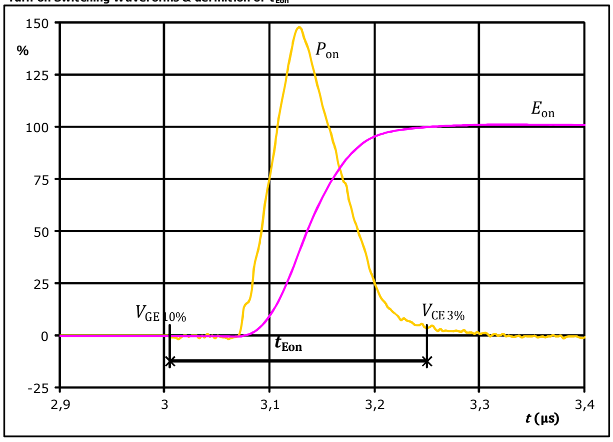
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	8,37	kW
E_{off} (100%) =	0,71	mJ
t_{Eoff} =	0,40	µs

figure 6. **IGBT**

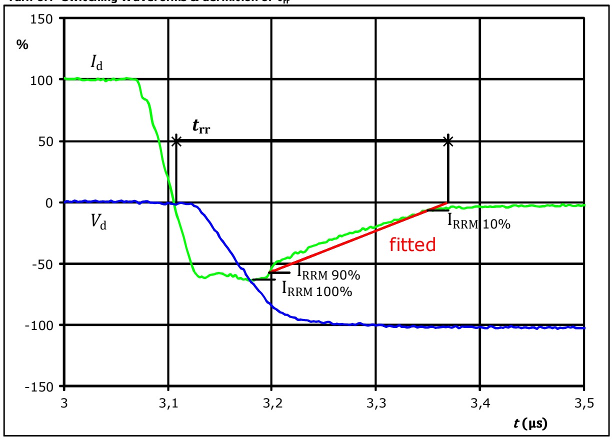
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	8,37	kW
E_{on} (100%) =	0,96	mJ
t_{Eon} =	0,24	µs

figure 7. **FWD**

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

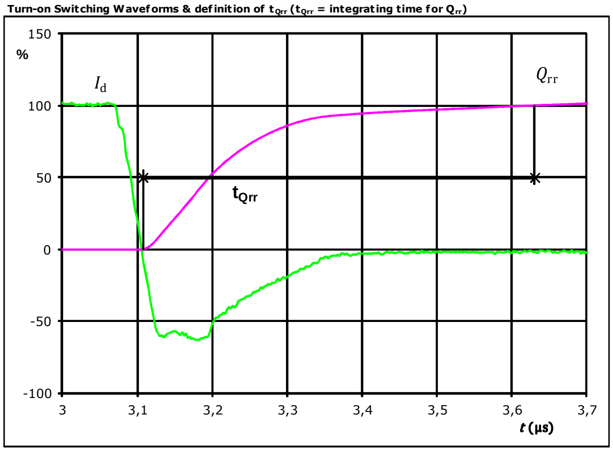


V_d (100%) =	400	V
I_d (100%) =	21	A
I_{RRM} (100%) =	-13	A
t_{rr} =	0,257	µs

Inverter Switching Characteristics

figure 8. FWD

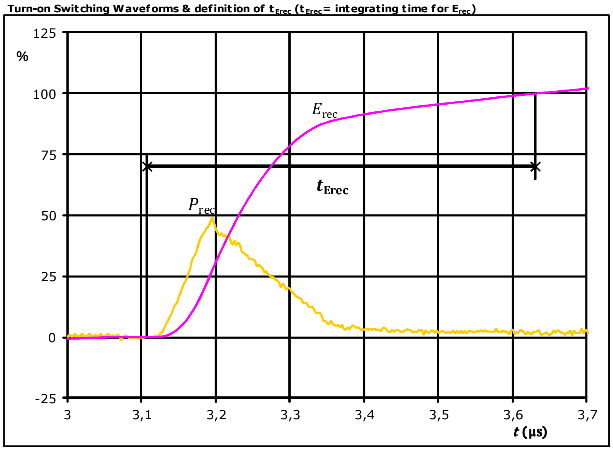
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	21	A
Q_{rr} (100%) =	2,01	µC
t_{Qrr} =	0,52	µs

figure 9. FWD

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

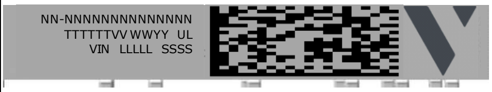


P_{rec} (100%) =	8,37	kW
E_{rec} (100%) =	0,54	mJ
t_{Erec} =	0,52	µs

Vincotech

Ordering Code & Marking

Version	Ordering Code
without thermal paste 17 mm housing with solder pins	10-F006PPA020SB-M685B
with thermal paste 17 mm housing with solder pins	10-F006PPA020SB-M685B-/3/

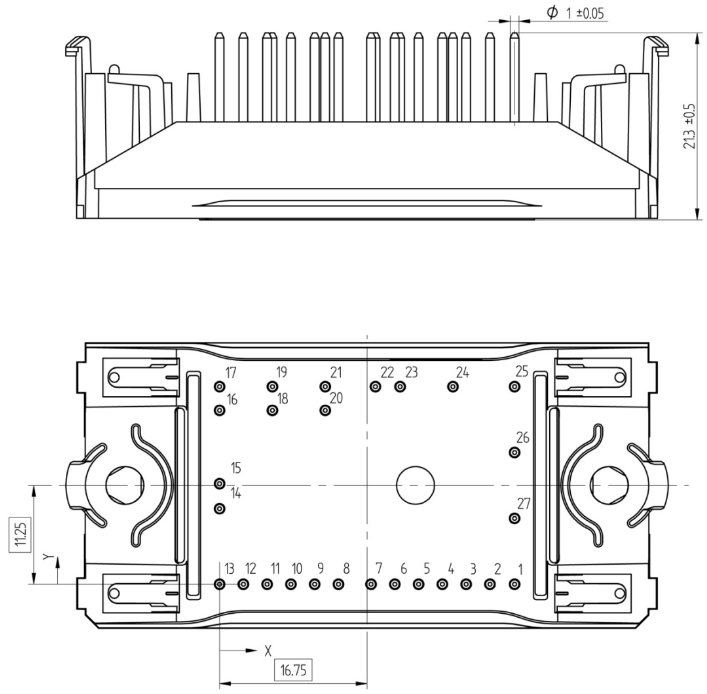


	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

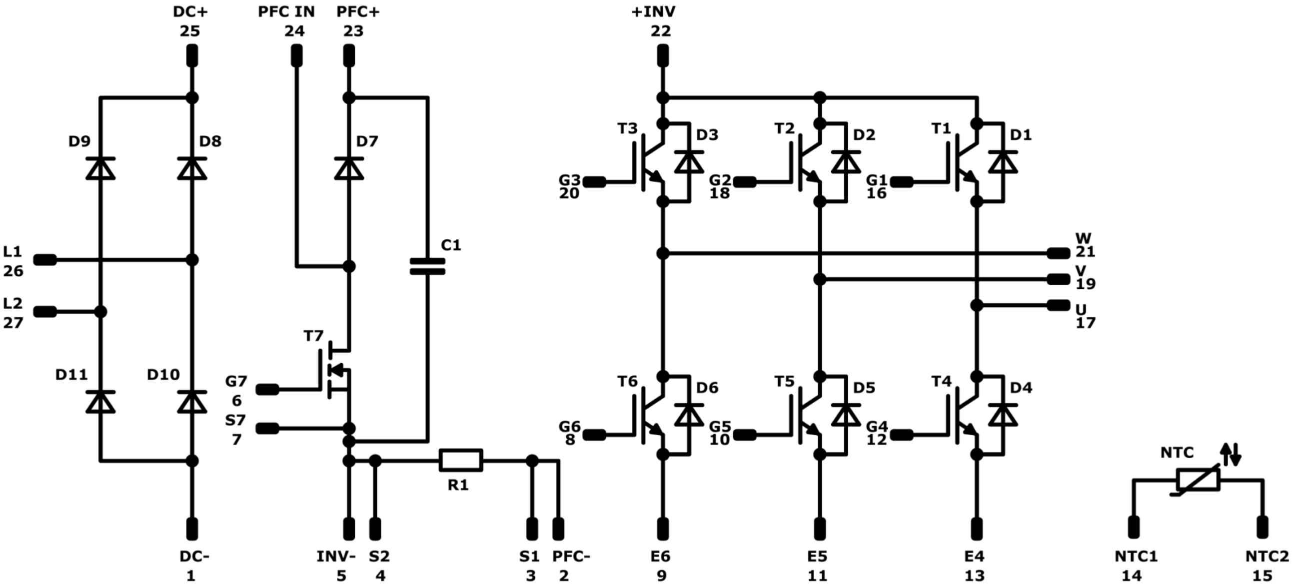
Pin table

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



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	
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	20 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	600 V	30 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-F006PPA020SB-M685B-D2-14	04 Dec. 2017		