10-F006PPA010SB-M683B
10-P006PPA010SB-M683BY
datasheet

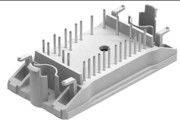
Vincotech

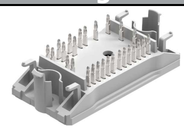
flow PIM 0 + PFC — 600 V / 10 A

Features

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

flow 0 17mm housing

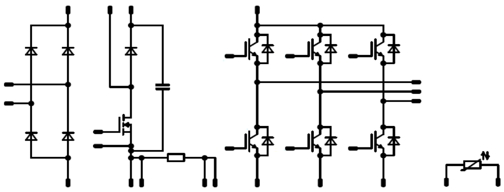

solder pin


Press-fit pin

Target Applications

- Industrial Drives
- Embedded Drives

Schematic



Types

- 10-F006PPA010SB-M683B
- 10-P006PPA010SB-M683BY

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	26 36	A
Surge forward current	I_{FSM}	t_p = 10 ms	T_j=150°C	200	A
I2t-value	I^2t			200	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	32 48	W
Maximum Junction Temperature	T_{jmax}			150	°C
PFC Switch					
Drain to source breakdown voltage	V_{DS}			600	V
DC drain current	I_D	$T_j = T_{jmax}$	T_s = 80 °C	17 20	A
Pulsed drain current	I_{Dpulse}	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		1,2	mJ
Avalanche current, repetitive	I_{AR}			6,6	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS} = 0...480 V		50	V/ns
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	59 90	W
Gate-source peak 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
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	20 20	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	36 54	W
Maximum Junction Temperature	T_{jmax}			175	°C
PFC Shunt					
DC forward current	I_F		T_c = 105 °C	15,8	A
Power dissipation per Shunt	P_{tot}		T_c = 105 °C	5	W
Inverter Switch					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	14 18	A
Pulsed collector current	I_{CRM}	t_p limited by T_{jmax}		30	A
Turn off safe operating area		V_{CE} ≤ 400 V, T_j ≤ 150 °C		30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	33 51	W
Gate-emitter peak voltage	V_{GE}			20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		5 360	μs V
Maximum Junction Temperature	T_{jmax}			175	°C
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	14 18	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		20	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	26 39	W
Maximum Junction Temperature	T_{jmax}			175	°C
DC link Capacitor					
Max.DC voltage	V_{MAX}		T_c = 25 °C	500	V
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t = 2 s	DC Test Voltage	4000	V
Creepage distance				min 12,7	mm
Clearance		solder pin / Press-fit pin		min 12,7	mm
Comparative tracking index	CTI			>200	

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Rectifier Diode										
Forward voltage	V_F				25	25 125		1,20 1,17		V
Threshold voltage (for power loss calc. only)	V_{to}					25 125		0,92 0,81		V
Slope resistance (for power loss calc. only)	r_t					25 125		11 14		mΩ
Reverse current	I_r			1600		25			0.05	mA
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						2,20		K/W
PFC Switch										
Static drain to source ON resistance	$r_{DS(on)}$		10		10	25 125		98 198		mΩ
Gate threshold voltage	$V_{(GS)th}$	$V_{GS} = V_{DS}$			0,00121	25	2,4	3,0	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			5000	nA
Turn On Delay Time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	10	400	10	25 125		20 23		ns
Rise Time	t_r					25 125		4 4		
Turn off delay time	$t_{d(off)}$					25 125,00		131 202		
Fall time	t_f					25 125		4 4		
Turn-on energy loss	E_{on}					25 125		0,083 0,147		mWs
Turn-off energy loss	E_{off}					25 125		0,023 0,045		
Total gate charge	Q_{GE}	R_{gon} = 8 Ω	0/10	480	18,1	25		119		nC
Gate to source charge	Q_{GS}							14		
Gate to drain charge	Q_{GD}							61		
Input capacitance	C_{iss}	f = 1 MHz	0	100		25		2660		pF
Output capacitance	C_{oss}							154		
Gate resistance	C_{rss}							1,6		Ω
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						1,18		K/W
PFC Diode										
Forward voltage	V_F				10	25 125		2,54 1,56		V
Reverse leakage current	I_{rm}			600		25 125			50 300	μA
Peak recovery current	I_{RRM}	R_{gon} = 8 Ω	10	400	10	25 125		24 36		A
Reverse recovery time	t_{rr}					25 125		12 23		ns
Reverse recovery charge	Q_{rr}					25 125		0,16 0,49		μC
Reverse recovered energy	E_{rec}					25 125		0,02 0,11		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		8698 6331		A/μs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						2,66		K/W
PFC Shunt										
R1 value	R							20		mΩ
Temperature coeficient	tc	20 °C to 60 °C							100	ppm/K
Internal heat resistance	Rthi								13	K/W
Inductance	L								3	nH

Characteristic Values

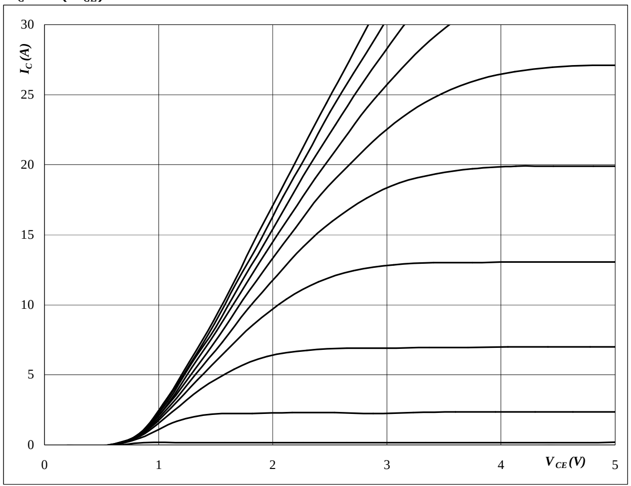
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0003	25	4,1	4,6	5,7	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 125		1,57 1,75		V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		25			0,057	mA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
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 loss	E_{on}					25 125		0,28 0,38		mWs
Turn-off energy loss	E_{off}					25 125		0,33 0,45		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		551		pF
Output capacitance	C_{oss}							40		
Reverse transfer capacitance	C_{rss}							17		
Gate charge	Q_G		±15	480	10	25		62		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						2,84		K/W
Inverter Diode										
Diode forward voltage	V_F				10	25 125	1,25	1,58 1,52	1,95	V
Peak reverse recovery current	I_{RRM}	R_{gon} = 32 Ω	±15	400	10	25 125		5 7		A
Reverse recovery time	t_{rr}					25 125		194 270		ns
Reverse recovered charge	Q_{rr}					25 125		0,47 0,90		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		21 65		A/µs
Reverse recovered energy	E_{rec}					25 125		0,13 0,26		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 W/mK						3,66		K/W
DC link Capacitor										
C value	C							100		nF
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-5		5	%
Power dissipation	P					25		210		mW
Power dissipation constant						25		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25				K
B-value	$B_{(25/100)}$	Tol. ±3%				25		4000		K
Vincotech NTC Reference									A	

Output Inverter

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



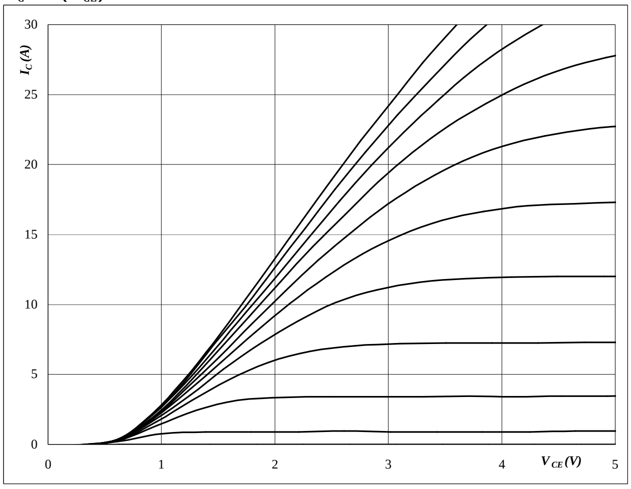
At

t_p =	250	µs
T_j =	25	°C
V_{GE} from	6 V to 16 V in steps of 1 V	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



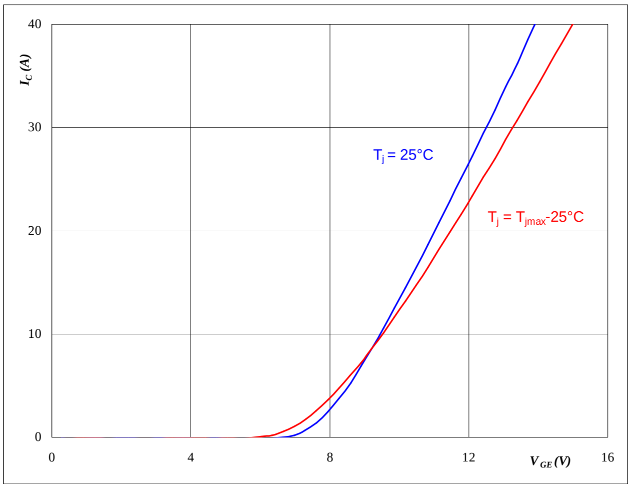
At

t_p =	250	µs
T_j =	125	°C
V_{GE} from	6 V to 16 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



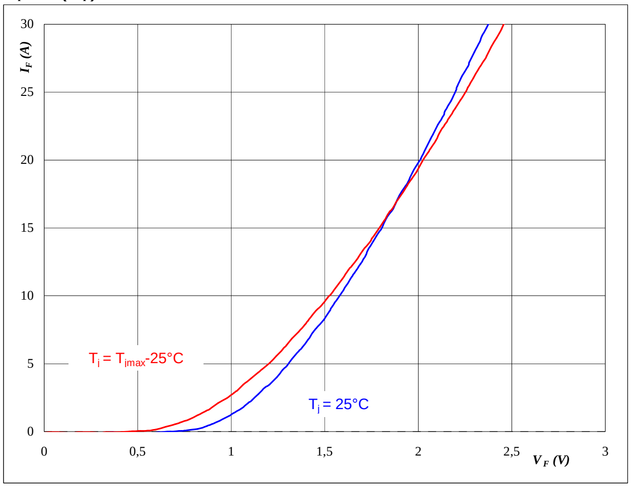
At

t_p =	250	µs
V_{CE} =	10	V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

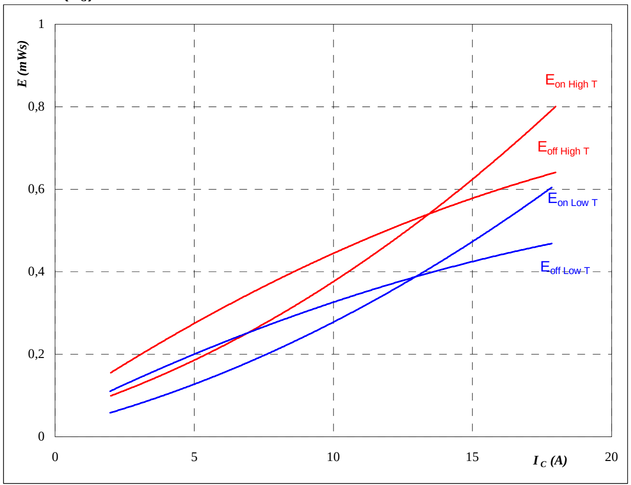
t_p =	250	µs

Output Inverter

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



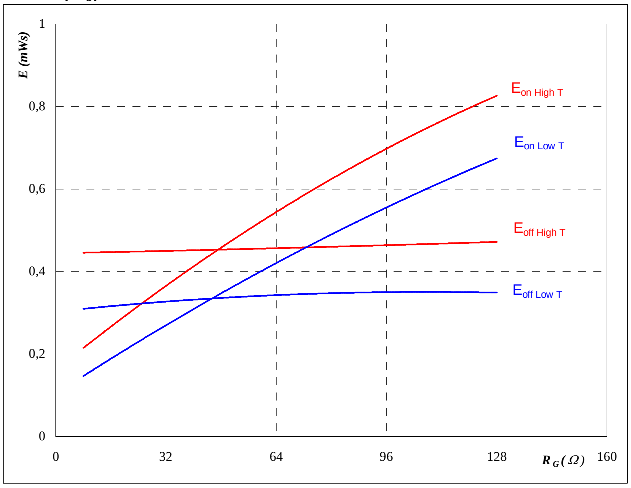
With an inductive load at

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

figure 6. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



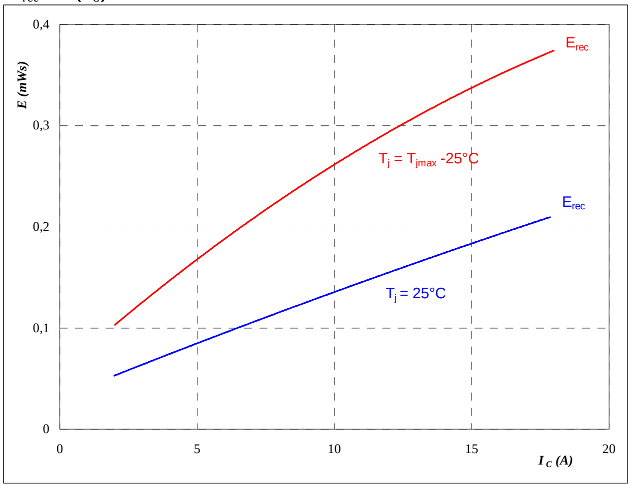
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



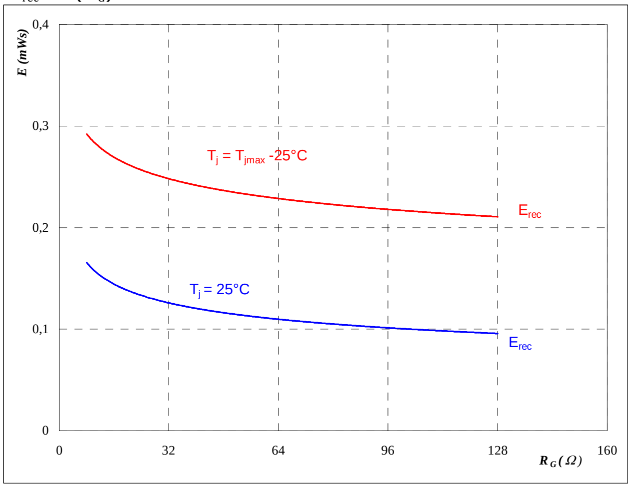
With an inductive load at

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

figure 8. **FWD**

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

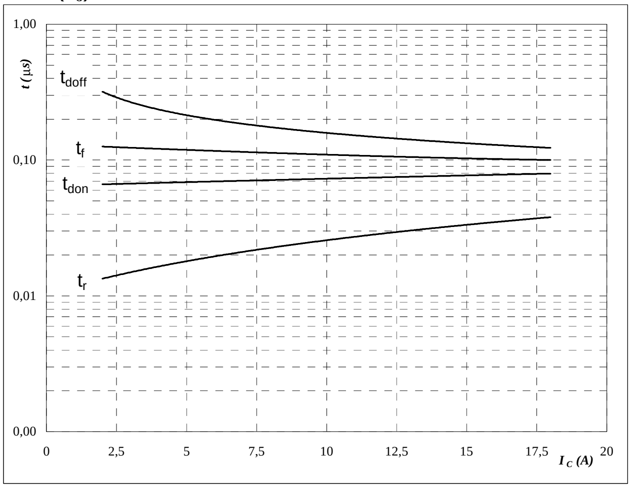
T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	±15	V
I_C =	10	A

Output Inverter

figure 9.	IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



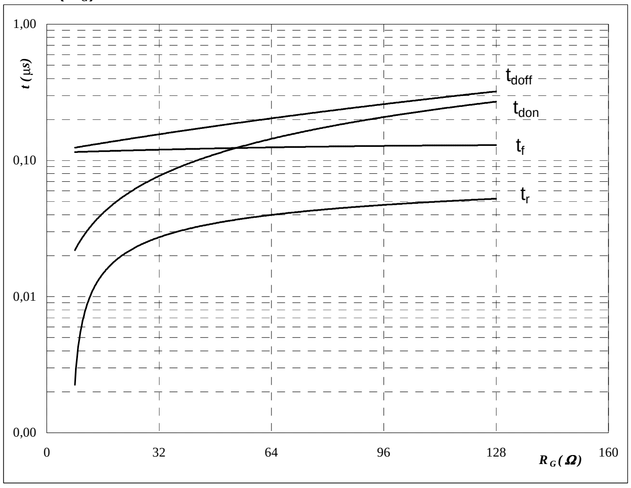
With an inductive load at

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

figure 10.	IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



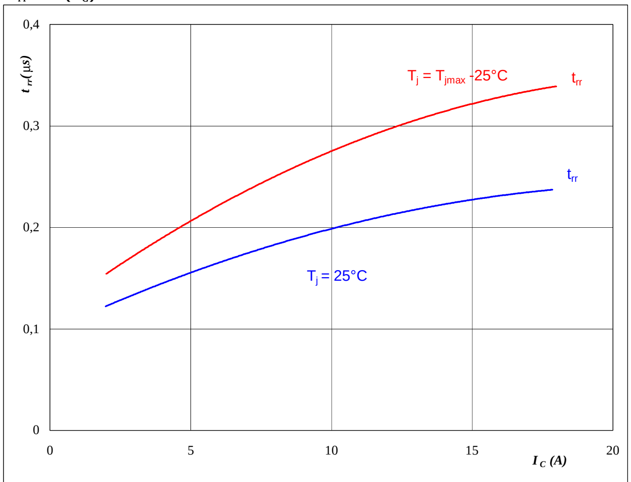
With an inductive load at

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

figure 11.	FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



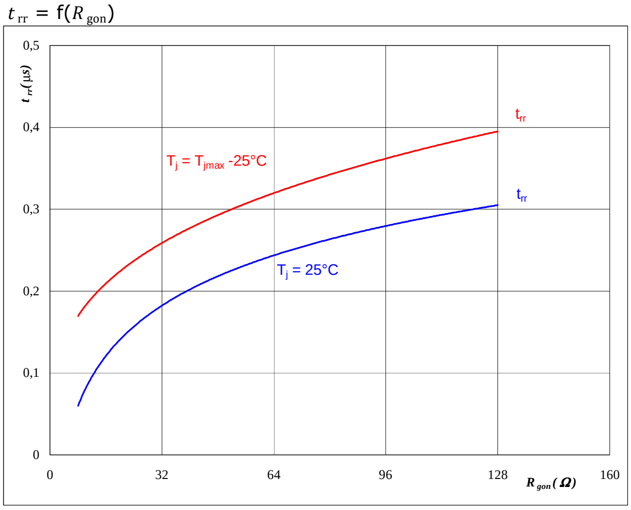
At

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

figure 12.	FWD

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

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



At

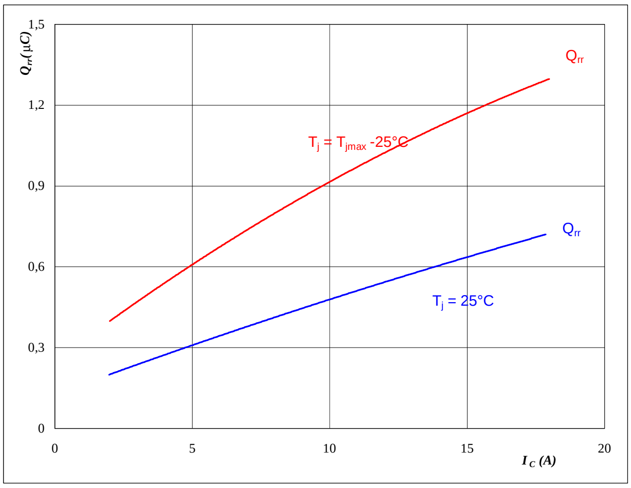
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GE} =	±15	V

Output Inverter

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



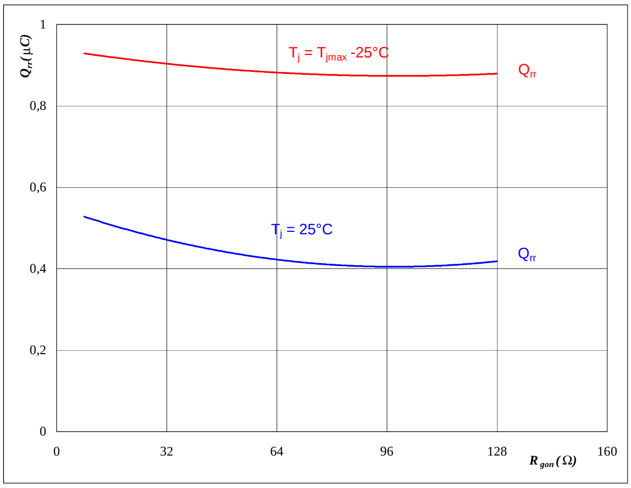
At

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

figure 14. **FWD**

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

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



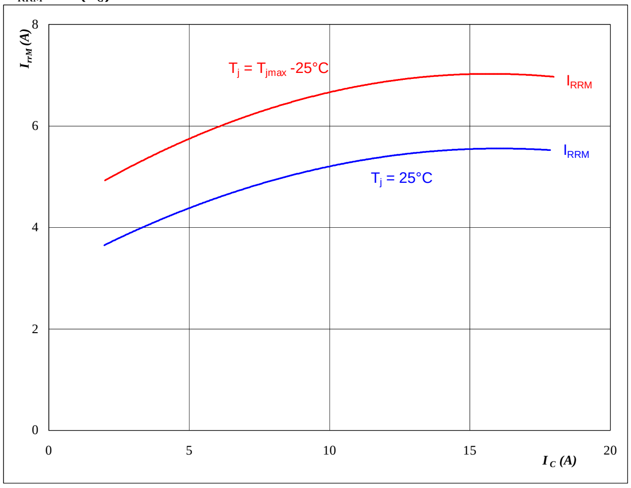
At

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

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



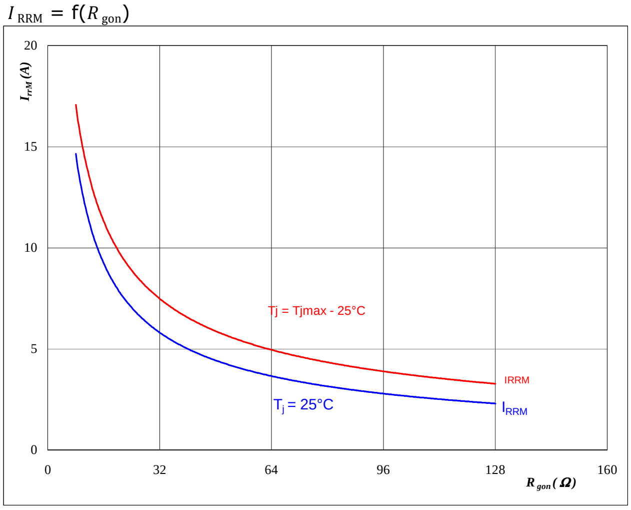
At

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

figure 16. **FWD**

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

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



At

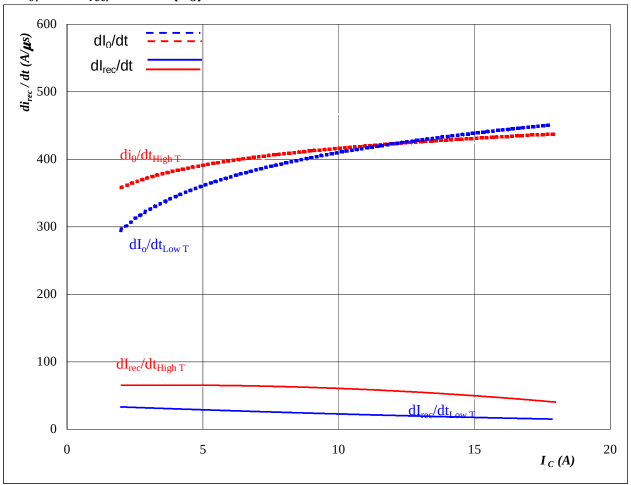
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GE} =	±15	V

Output Inverter

figure 17. **FWD**

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

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



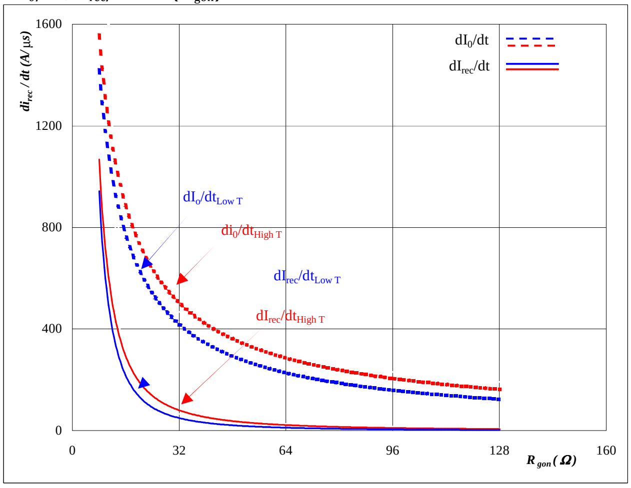
At

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

figure 18. **FWD**

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

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



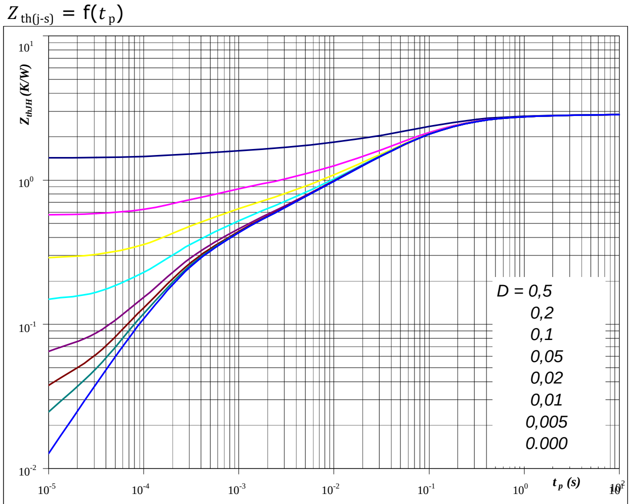
At

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

figure 19. **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



At

D = t_p / T

$R_{th(j\text{-}s)}$ = 2,84 K/W $R_{th(j\text{-}s)}$ = 2,31 K/W

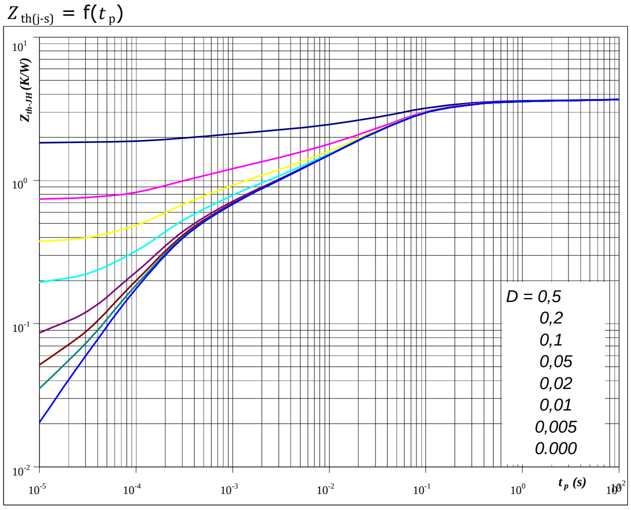
IGBT thermal model values

R (K/W)	Tau (s)	R (K/W)	Tau (s)
1,71E-01	1,82E+00	1,39E-01	1,47E+00
7,93E-01	1,90E-01	6,43E-01	1,54E-01
9,91E-01	4,92E-02	8,03E-01	3,99E-02
4,21E-01	8,38E-03	3,42E-01	6,80E-03
2,13E-01	1,41E-03	1,72E-01	1,14E-03
2,56E-01	2,39E-04	2,07E-01	1,94E-04

figure 20. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

D = t_p / T

$R_{th(j\text{-}s)}$ = 3,66 K/W $R_{th(j\text{-}s)}$ = 2,97 K/W

FWD thermal model values

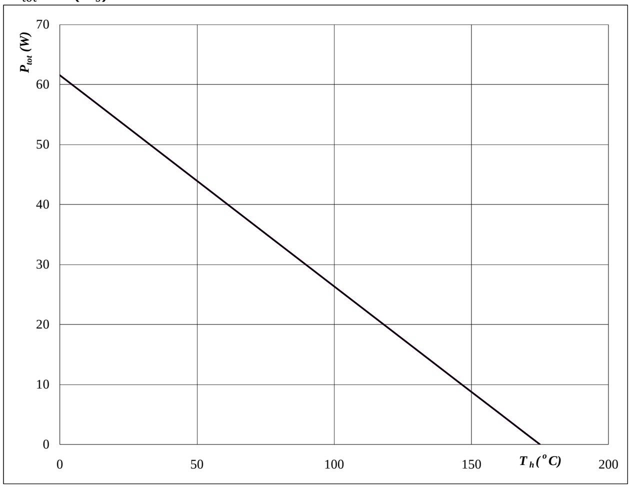
R (K/W)	Tau (s)	R (K/W)	Tau (s)
1,66E-01	2,32E+00	1,34E-01	1,88E+00
6,89E-01	1,76E-01	5,59E-01	1,42E-01
1,50E+00	4,29E-02	1,22E+00	3,48E-02
5,65E-01	7,64E-03	4,58E-01	6,19E-03
3,45E-01	1,31E-03	2,80E-01	1,07E-03
3,95E-01	2,31E-04	3,21E-01	1,88E-04

Output Inverter

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



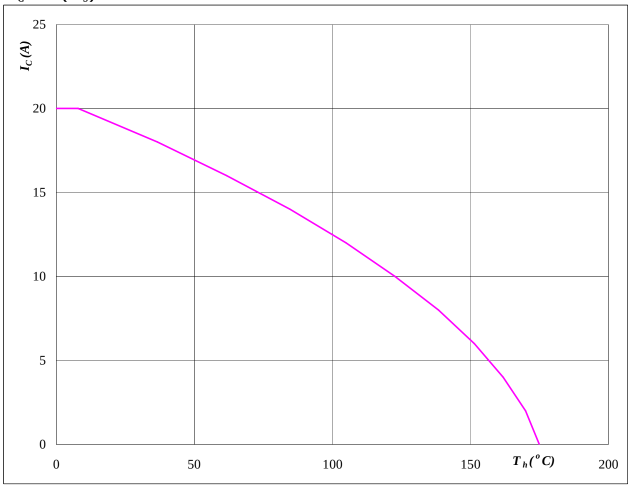
At

T_j = 175 °C

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

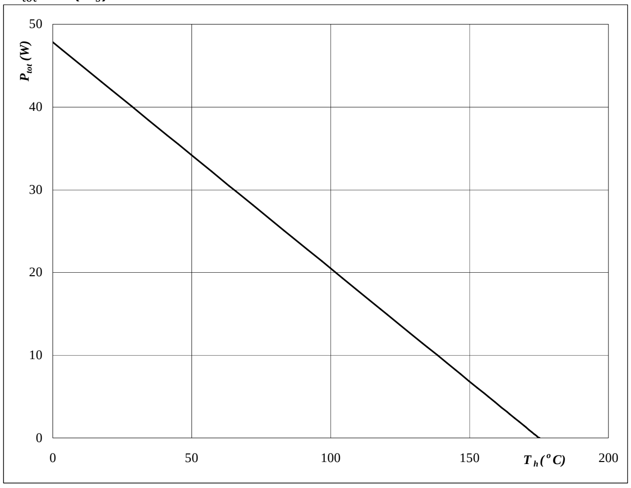
T_j = 175 °C

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



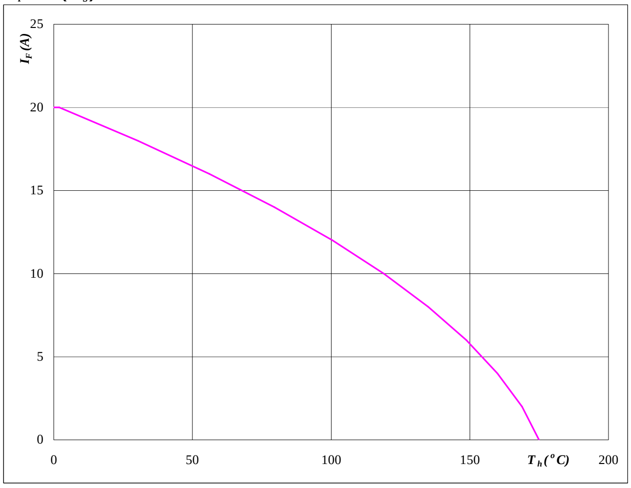
At

T_j = 175 °C

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

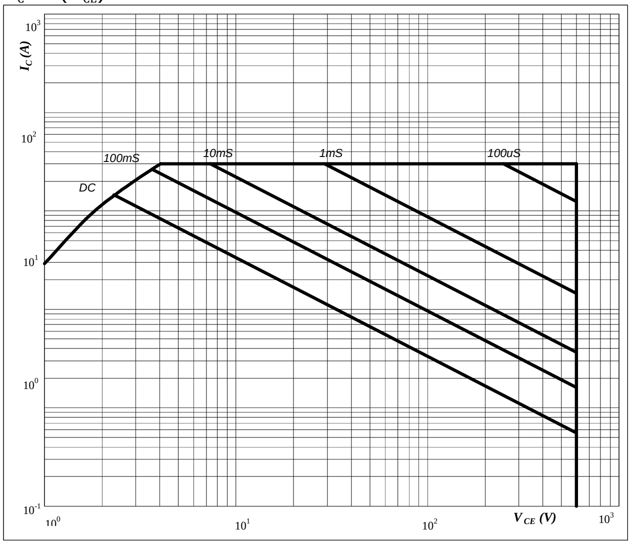
T_j = 175 °C

Output Inverter

figure 25. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



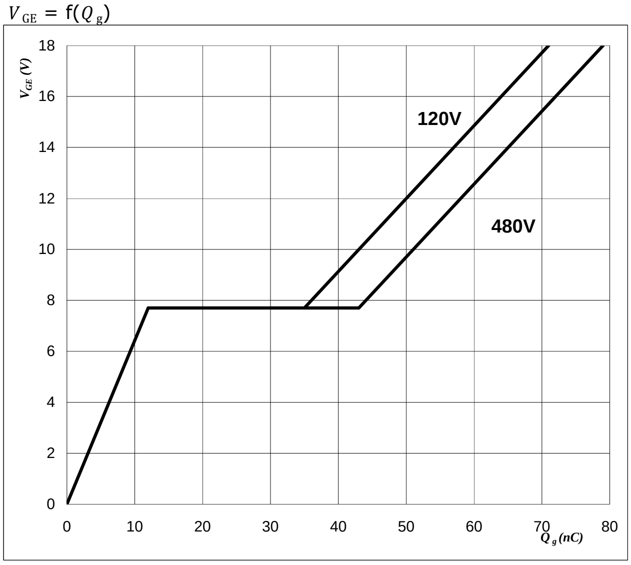
At

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

figure 26. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



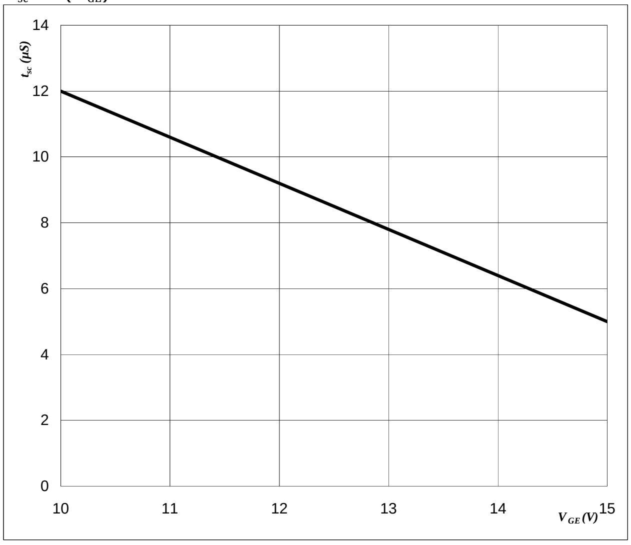
At

I_C =	10	A

figure 27. **IGBT**

Short circuit withstand time as a function of gate-emitter voltage

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



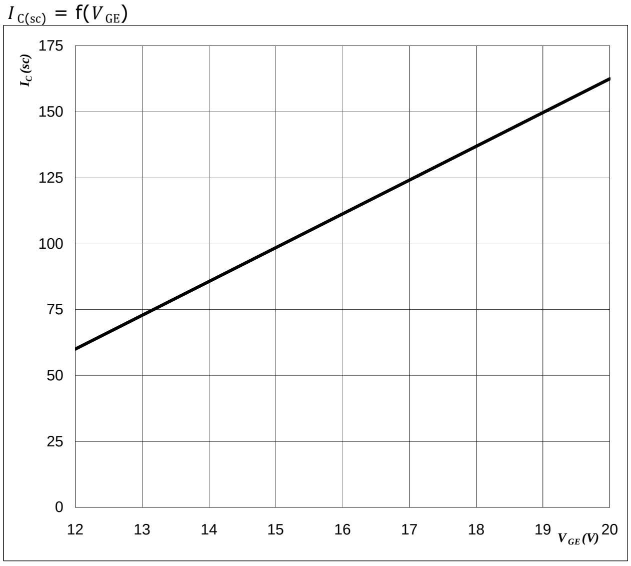
At

V_{CE} =	600	V
T_j ≤	175	ºC

figure 28. **IGBT**

Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(sc)} = f(V_{GE})$



At

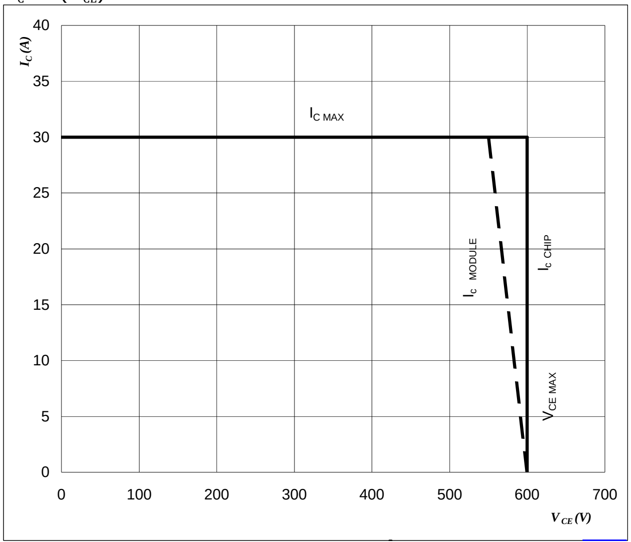
V_{CE} ≤	600	V
T_j =	175	ºC

Output Inverter

figure 29.	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax}-25 ºC

$U_{ccminus}$=U_{ccplus}

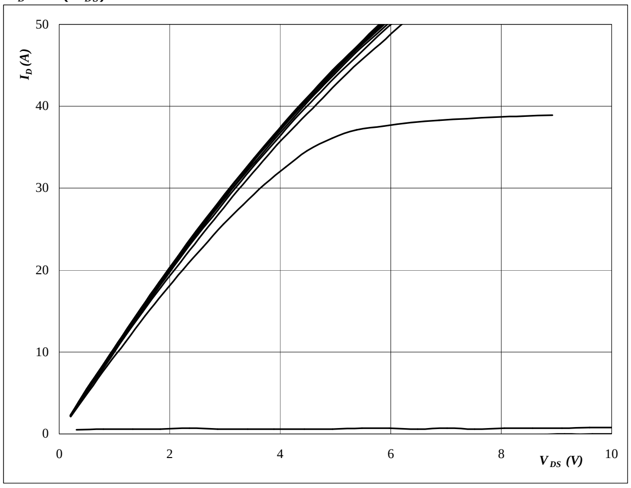
Switching mode : 3phase SPWM

PFC

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

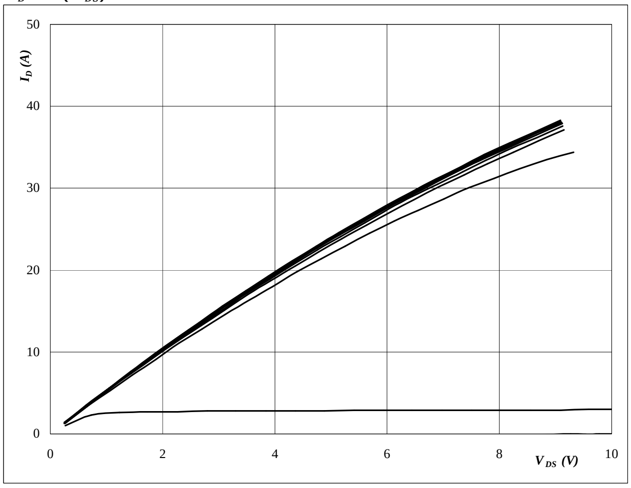
T_j = 25 °C

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

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

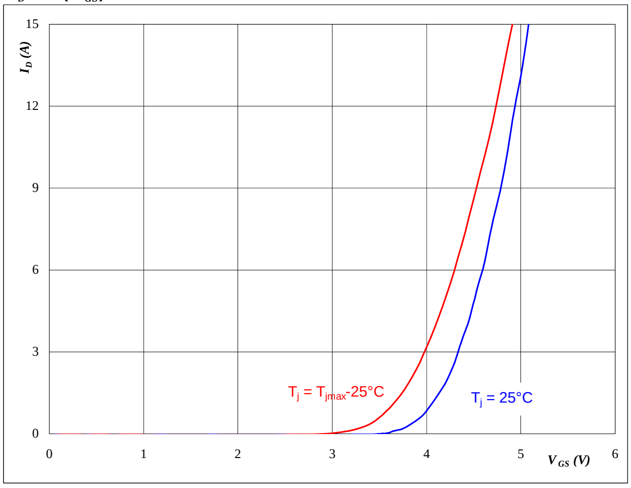
T_j = 125 °C

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

figure 3. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$



At

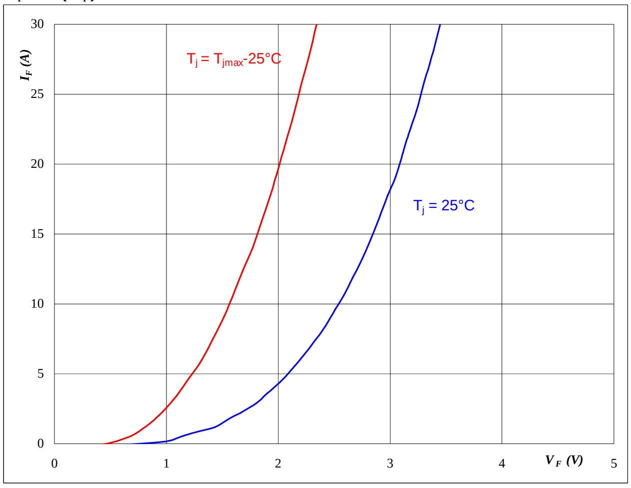
t_p = 250 µs

V_{DS} = 10 V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

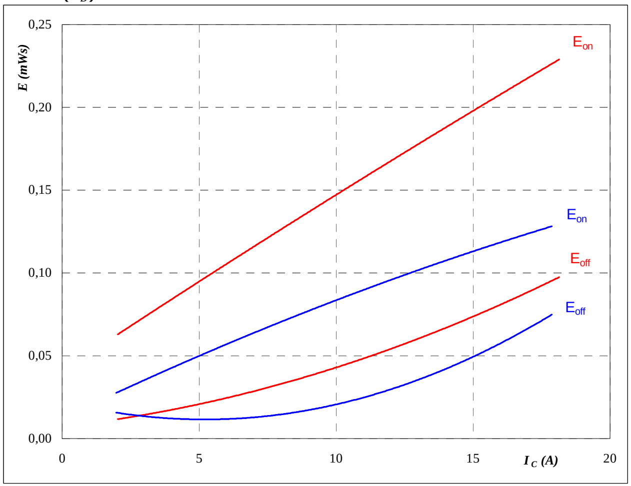
t_p = 250 µs

PFC

figure 5.	MOSFET

Typical switching energy losses
as a function of collector current

$E = f(I_D)$



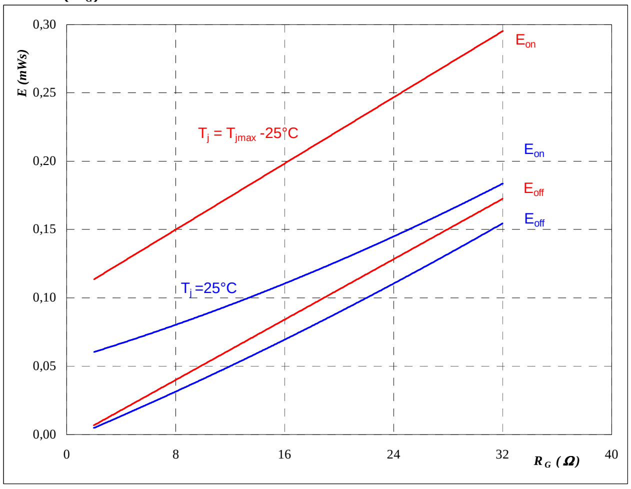
With an inductive load at

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

figure 6.	MOSFET

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



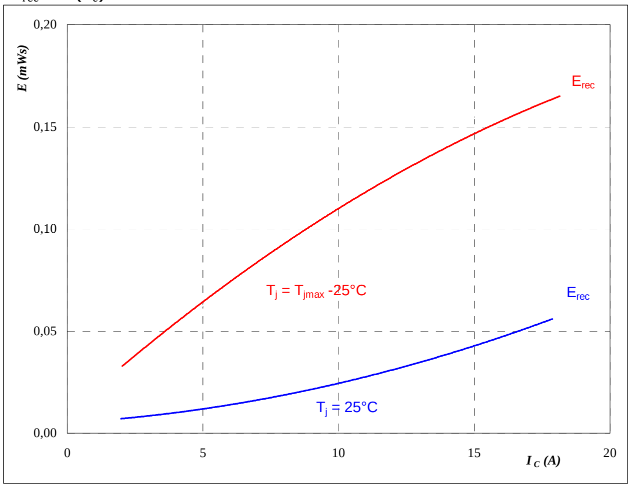
With an inductive load at

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

figure 7.	MOSFET

Typical reverse recovery energy loss
as a function of collector (drain) current

$E_{rec} = f(I_c)$



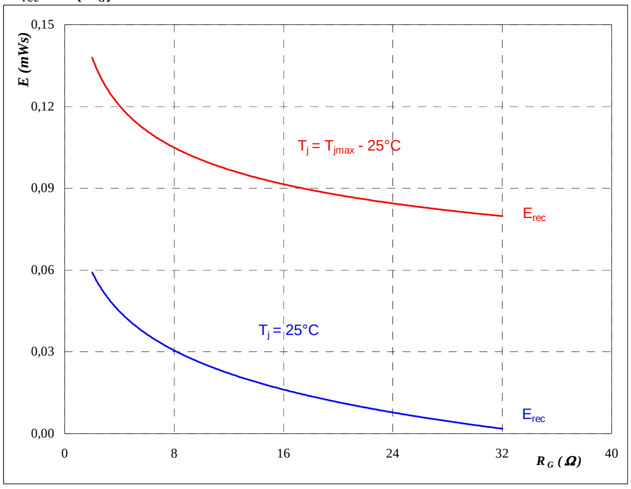
With an inductive load at

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

figure 8.	MOSFET

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

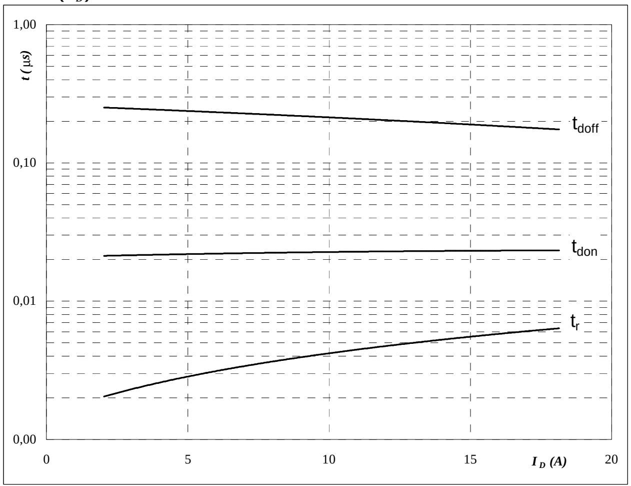
T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	10	V
I_D =	10	A

PFC

figure 9. **MOSFET**

Typical switching times as a function of collector current

$t = f(I_D)$



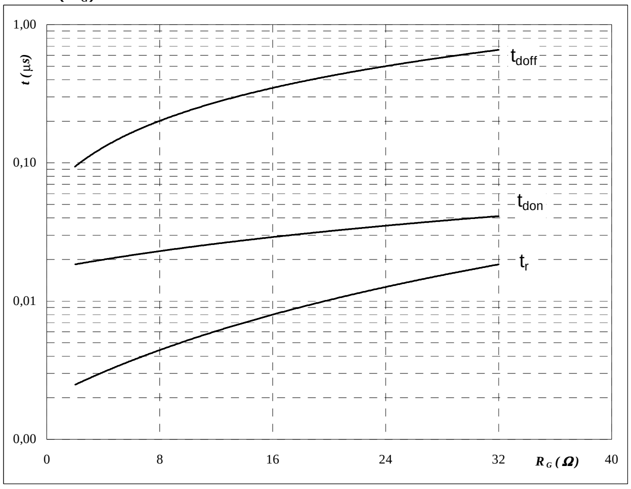
With an inductive load at

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

figure 10. **MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_G)$



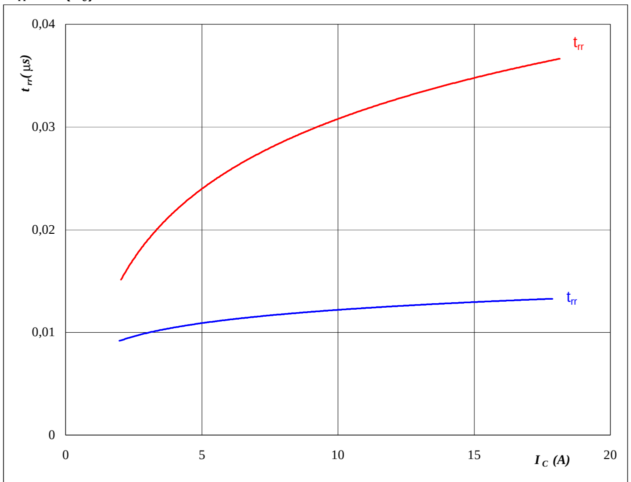
With an inductive load at

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

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



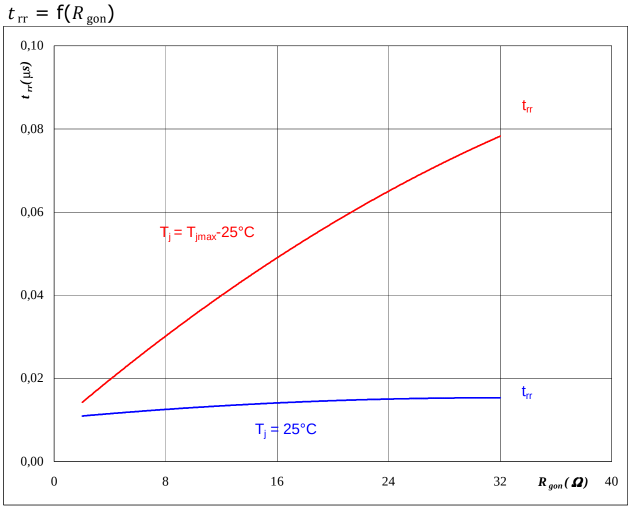
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8	Ω

figure 12. **FWD**

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

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



At

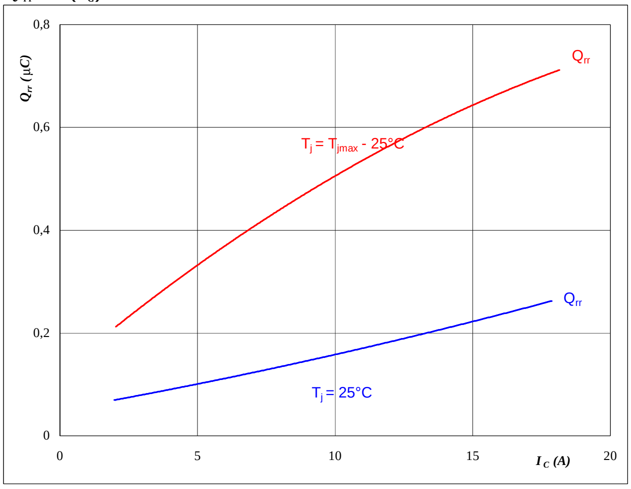
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GS} =	10	V

PFC

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



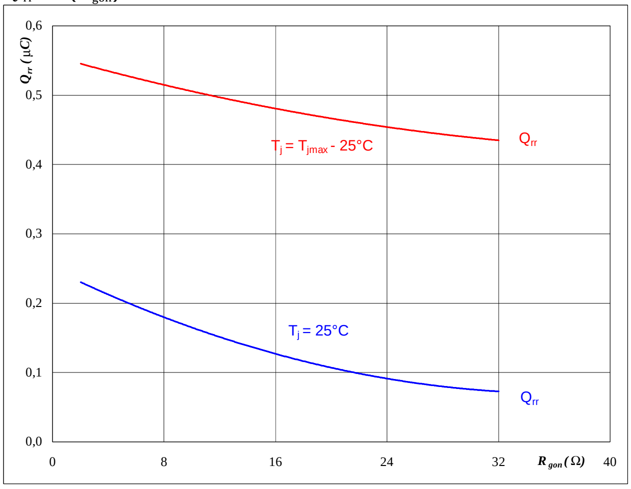
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8	Ω

figure 14. **FWD**

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

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



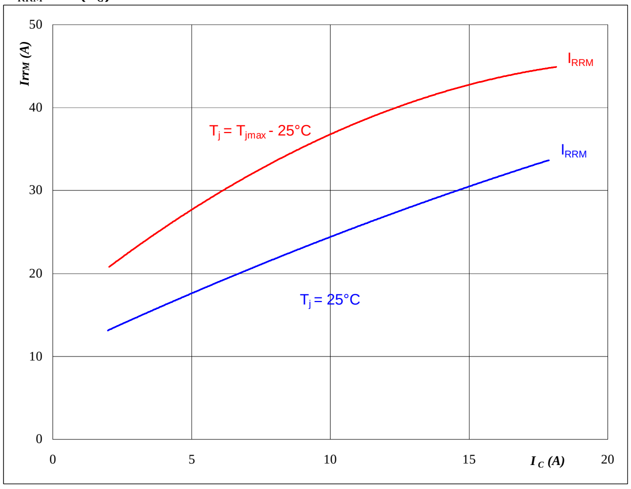
At

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

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



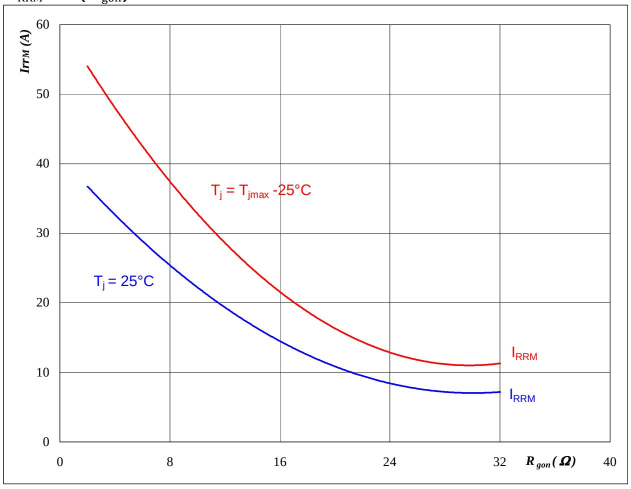
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R (K/W)	8	Ω

figure 16. **FWD**

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

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



At

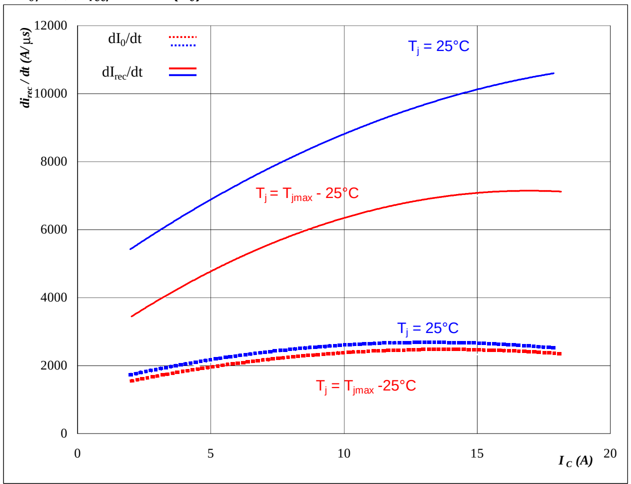
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
R (K/W)	10	V

PFC

figure 17. **FWD**

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

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



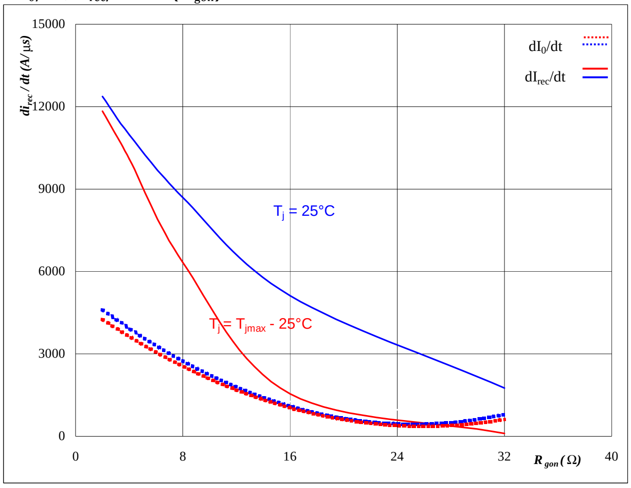
At

T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	10	V
R_{gon} =	8,01	Ω

figure 18. **FWD**

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

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



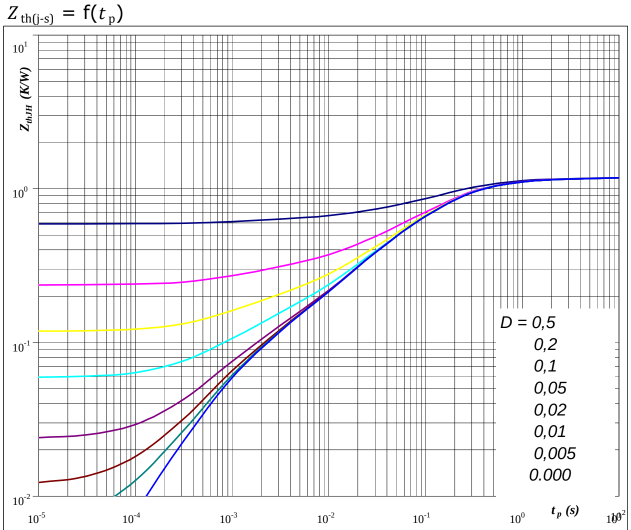
At

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

figure 19. **MOSFET**

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

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



At

D = t_p / T

$R_{th(j-s)}$ = 1,18 K/W $R_{th(j-s)}$ = 0,96 K/W

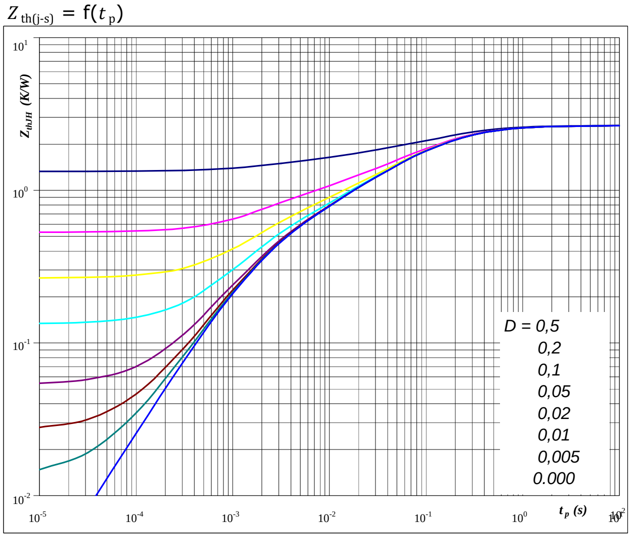
IGBT thermal model values

R (K/W)	Tau (s)	R (K/W)	Tau (s)
5,07E-02	3,88E+00	4,11E-02	3,147E+00
1,28E-01	7,53E-01	1,04E-01	6,110E-01
5,98E-01	1,71E-01	4,85E-01	1,390E-01
2,44E-01	4,22E-02	1,98E-01	3,420E-02
9,58E-02	9,60E-03	7,77E-02	7,786E-03
6,55E-02	1,06E-03	5,31E-02	8,596E-04
4,94E-02	4,30E-04	4,01E-02	3,488E-04

figure 20. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

D = t_p / T

$R_{th(j-s)}$ = 2,66 K/W $R_{th(j-s)}$ = 2,16 K/W

FWD thermal model values

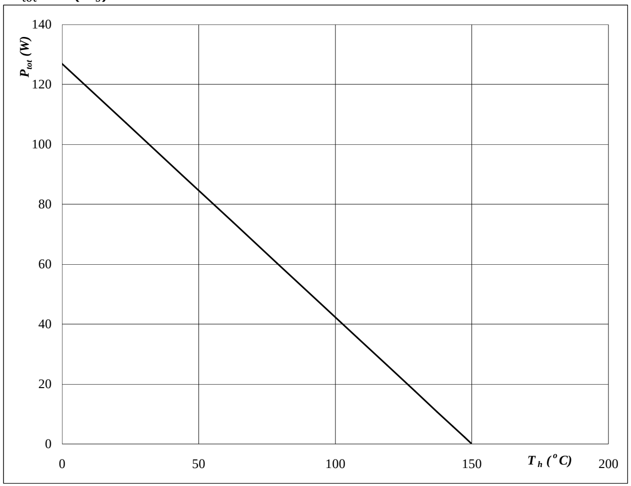
R (K/W)	Tau (s)	R (K/W)	Tau (s)
1,51E-01	1,84E+00	1,22E-01	1,49E+00
8,56E-01	2,23E-01	6,94E-01	1,80E-01
8,77E-01	5,86E-02	7,11E-01	4,76E-02
4,41E-01	1,01E-02	3,58E-01	8,15E-03
3,33E-01	1,67E-03	2,70E-01	1,36E-03
5,23E-01	1,12E-03	4,24E-01	9,04E-04
2,21E-01	6,47E-04	1,79E-01	5,25E-04

PFC

figure 21. **MOSFET**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



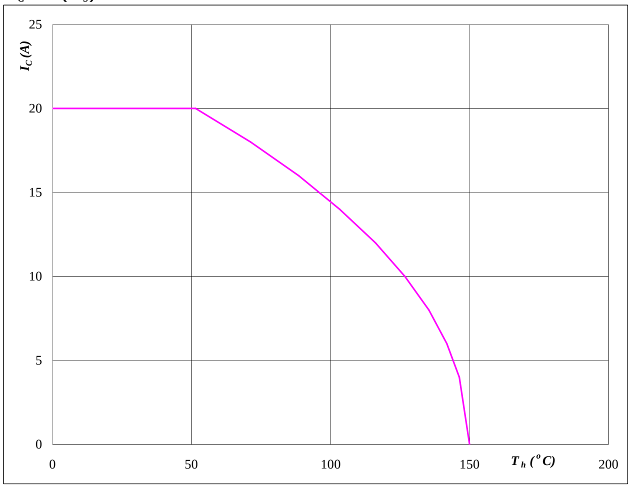
At

T_j = 150 ºC

figure 22. **MOSFET**

Collector/Drain current as a function of heatsink temperature

$I_C = f(T_s)$



At

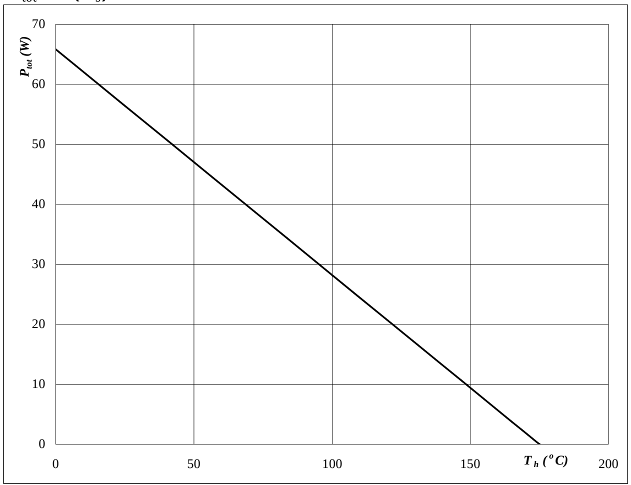
T_j = 150 ºC

V_{GS} = 10 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



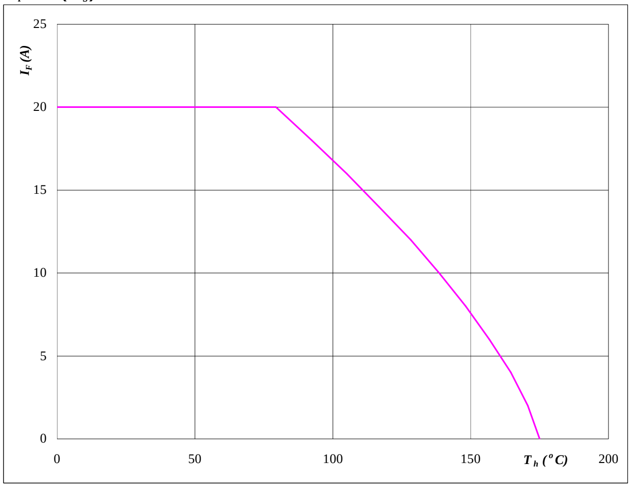
At

T_j = 175 ºC

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

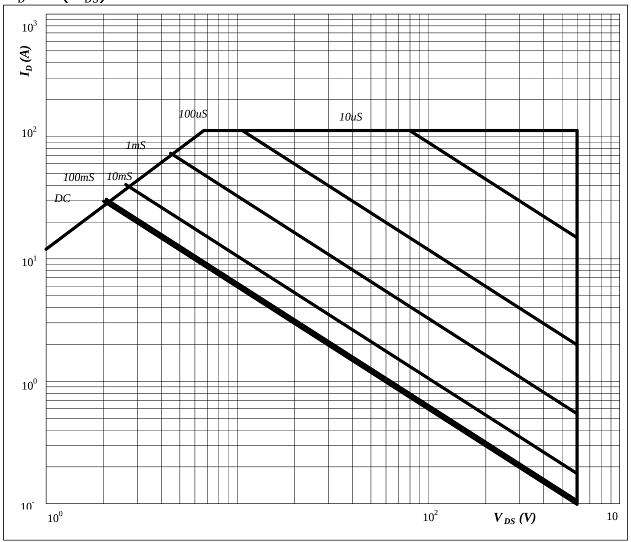
T_j = 175 ºC

PFC

figure 25. **MOSFET**

Safe operating area as a function of drain-source voltage

$I_D = f(V_{DS})$



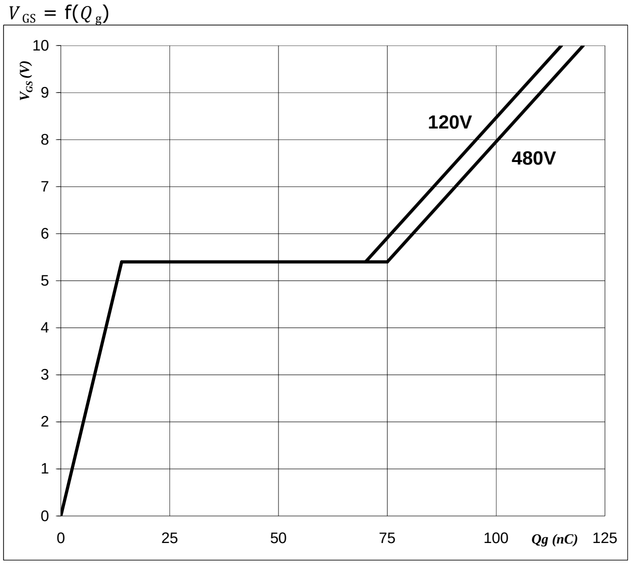
At

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

figure 26. **MOSFET**

Gate voltage vs Gate charge

$V_{GS} = f(Q_g)$



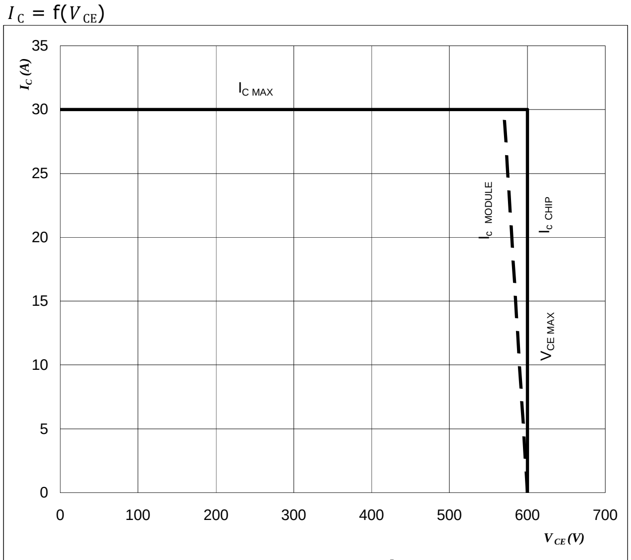
At

I_D =	10	A

figure 29. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

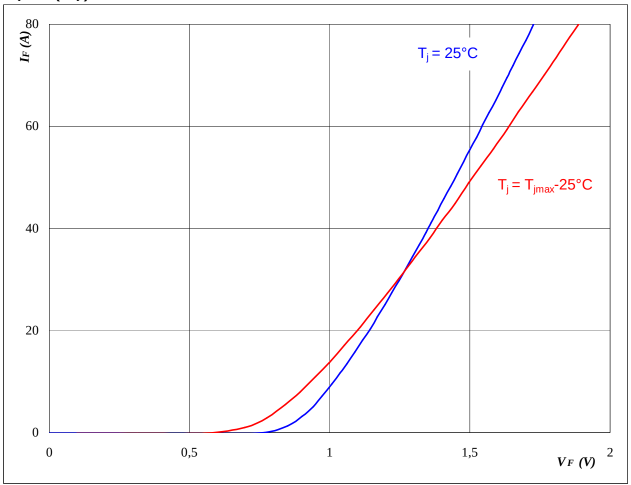
T_j =	T_{jmax}-25	ºC
$U_{ccminus}=U_{ccplus}$		
Switching mode :	3phase SPWM	

Input Rectifier Bridge

figure 1. **Rectifier Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



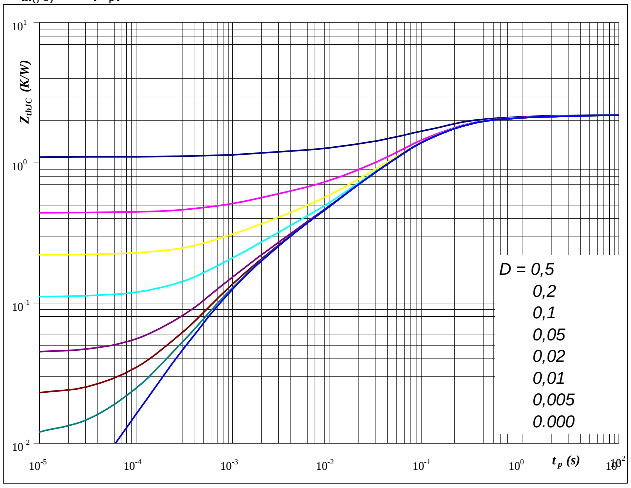
At

t_p = 250 µs

figure 2. **Rectifier Diode**

Diode transient thermal impedance as a function of pulse width

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



At

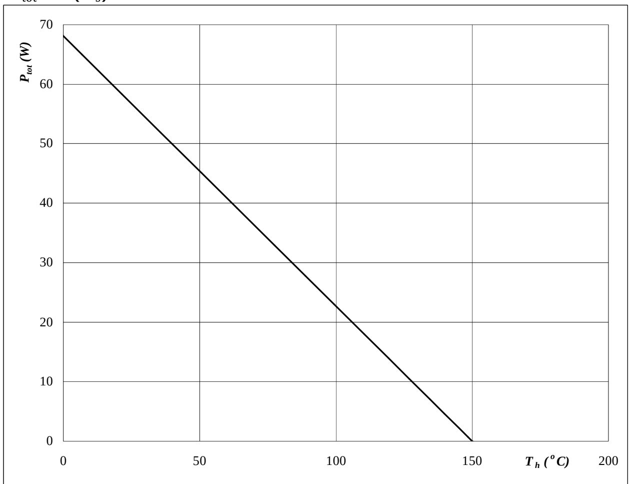
$D = t_p / T$

$R_{th(j-s)}$ = 2,20 K/W

figure 3. **Rectifier Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



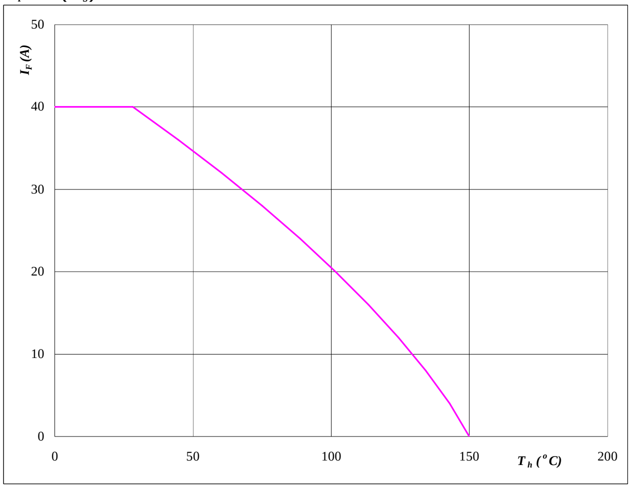
At

T_j = 150 ºC

figure 4. **Rectifier Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

T_j = 150 ºC

Thermistor

figure 1. **Thermistor**

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$

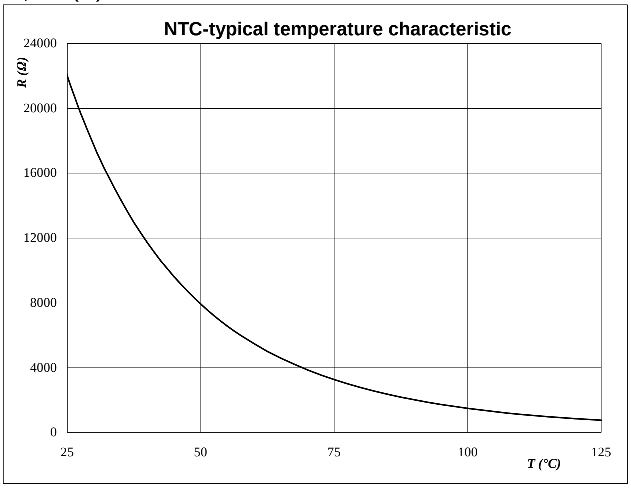


figure 2. **Thermistor**

Typical NTC resistance values

$$R(T) = R_{25} \cdot e^{\left(B_{25/100} \cdot \left(\frac{1}{T} - \frac{1}{T_{25}}\right)\right)} \quad [\Omega]$$

T [°C]	R_{nom} [Ω]	R_{min} [Ω]	R_{max} [Ω]	△R/R [±%]
-55	2089434,5	1506495,4	2672373,6	27,9
0	71804,2	59724,4	83884	16,8
10	43780,4	37094,4	50466,5	15,3
20	27484,6	23684,6	31284,7	13,8
25	22000	19109,3	24890,7	13,1
30	17723,3	15512,2	19934,4	12,5
60	5467,9	4980,6	5955,1	8,9
70	3848,6	3546	4151,1	7,9
80	2757,7	2568,2	2947,1	6,9
90	2008,9	1889,7	2128,2	5,9
100	**1486,1**	**1411,8**	**1560,4**	**5**
150	400,2	364,8	435,7	8,8

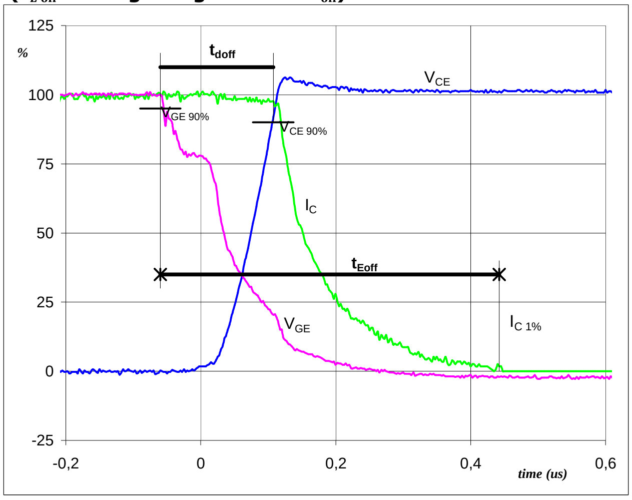
Switching Definitions Output Inverter

General conditions

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

figure 1. **IGBT**

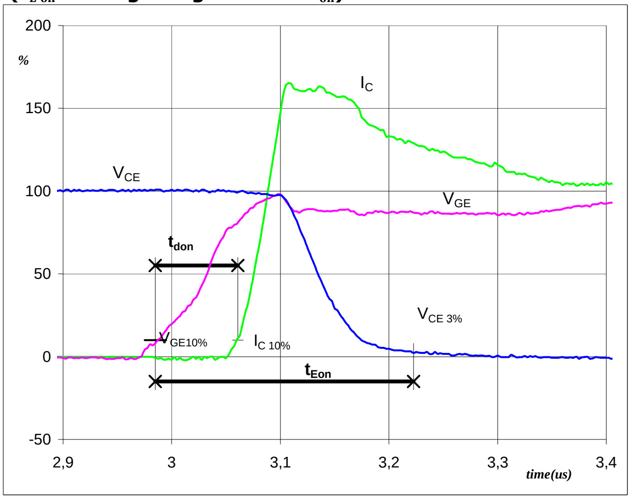
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	400	V
I_C (100%) =	10	A
t_{doff} =	0,16	μs
$t_{E\,off}$ =	0,50	μs

figure 2. **IGBT**

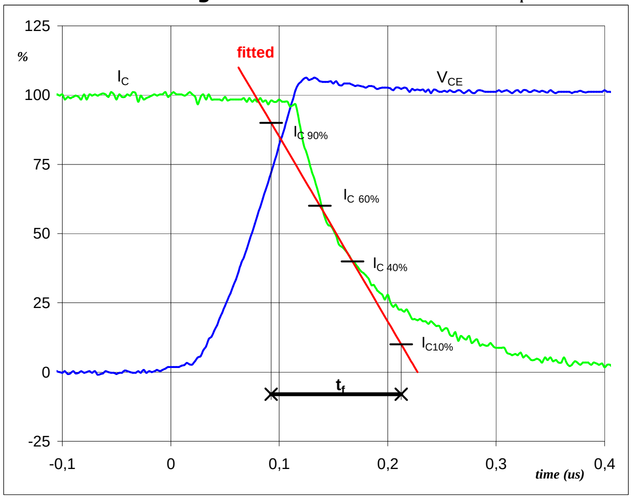
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	400	V
I_C (100%) =	10	A
t_{don} =	0,07	μs
$t_{E\,on}$ =	0,24	μs

figure 3. **IGBT**

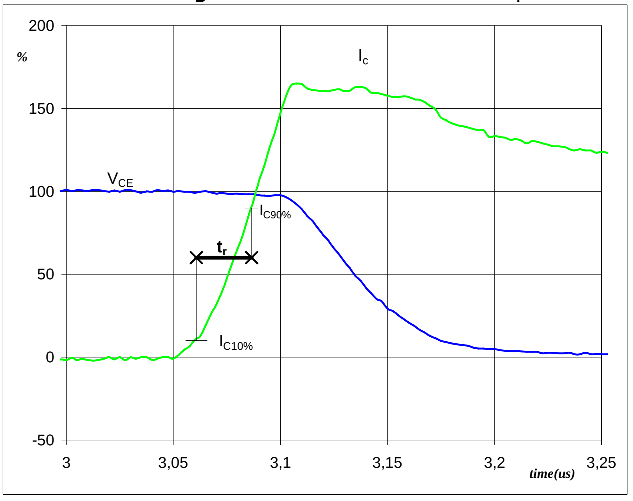
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	10	A
t_f =	0,12	μs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

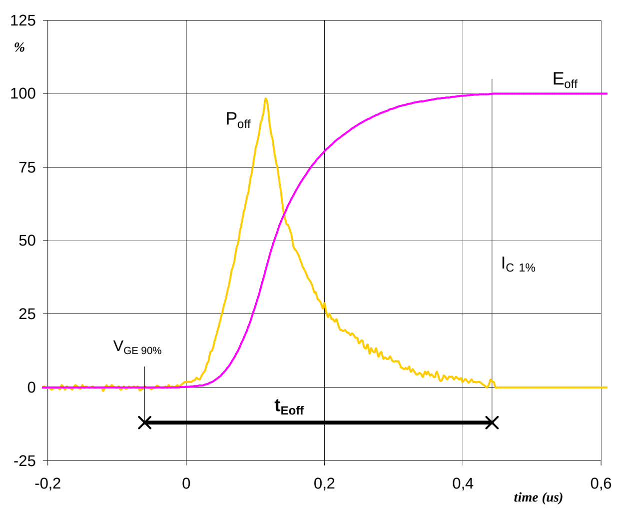


V_C (100%) =	400	V
I_C (100%) =	10	A
t_r =	0,03	μs

Switching Definitions Output Inverter

figure 5. **IGBT**

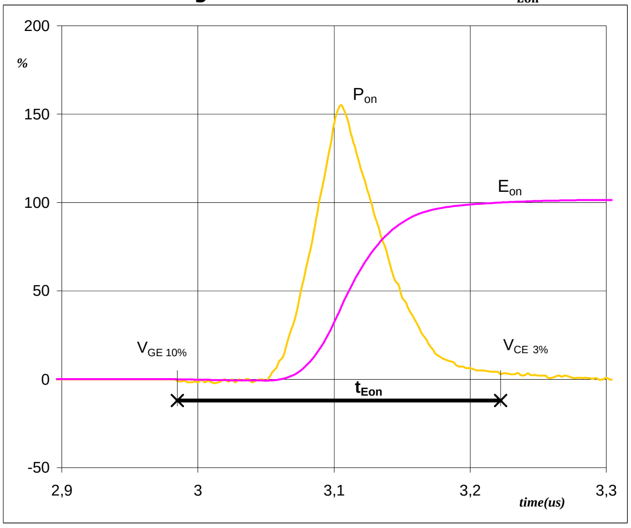
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	4,00	kW
E_{off} (100%) =	0,45	mJ
$t_{E\,off}$ =	0,50	μs

figure 6. **IGBT**

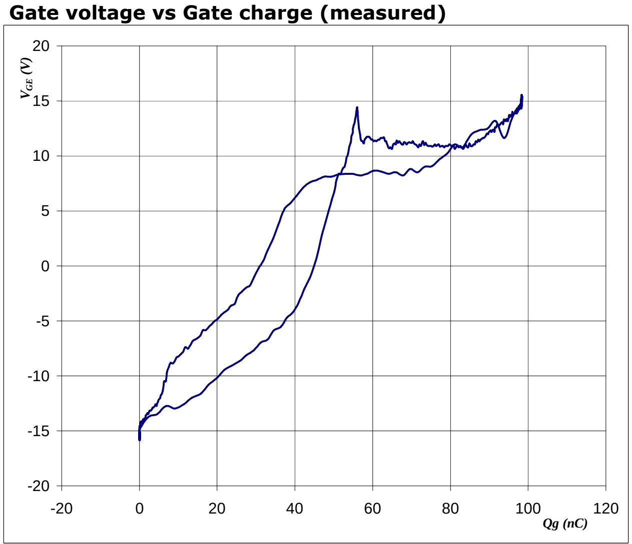
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	4,00	kW
E_{on} (100%) =	0,38	mJ
$t_{E\,on}$ =	0,24	μs

figure 7. **FWD**

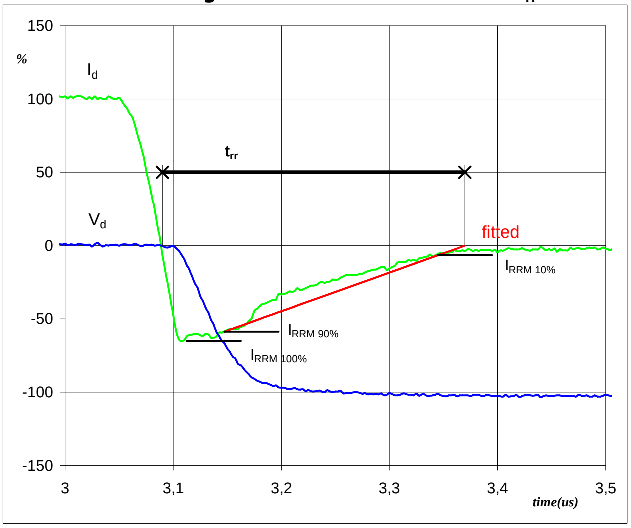
Gate voltage vs Gate charge (measured)



$V_{GE\,off}$ =	-15	V
$V_{GE\,on}$ =	15	V
V_C (100%) =	400	V
I_C (100%) =	10	A
Q_g =	98,29	nC

figure 8. **IGBT**

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

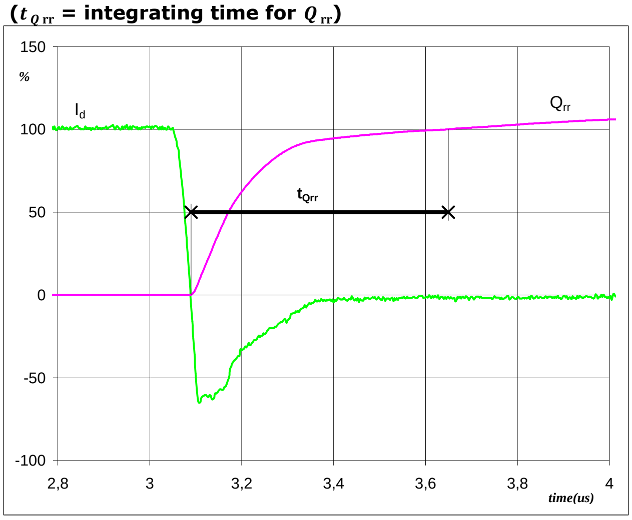


V_d (100%) =	400	V
I_d (100%) =	10	A
I_{RRM} (100%) =	-7	A
t_{rr} =	0,27	μs

Switching Definitions Output Inverter

figure 9. **FWD**

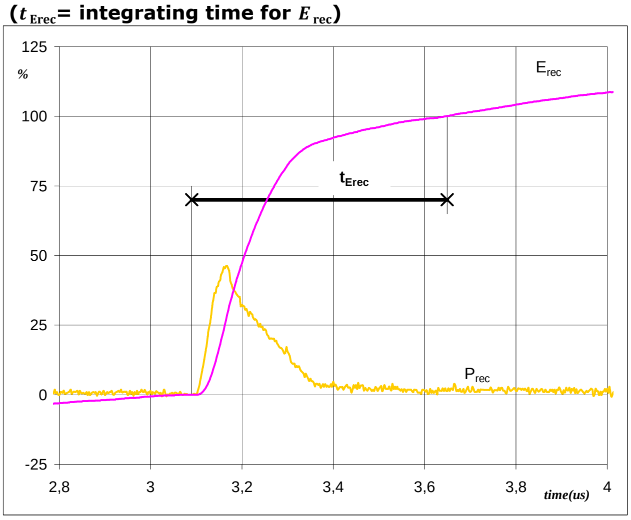
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	10	A
Q_{rr} (100%) =	0,90	μC
$t_{Q\,rr}$ =	0,56	μs

figure 10. **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
$t_{E\,rec}$ =	0,56	μs

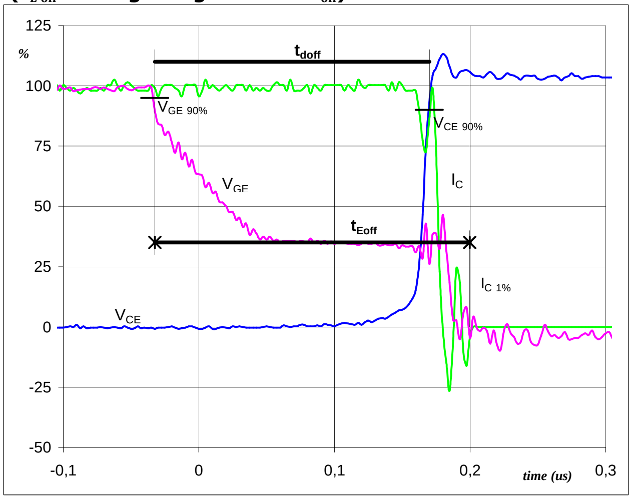
Switching Definitions PFC

General conditions

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

figure 1. **PFC MOSFET**

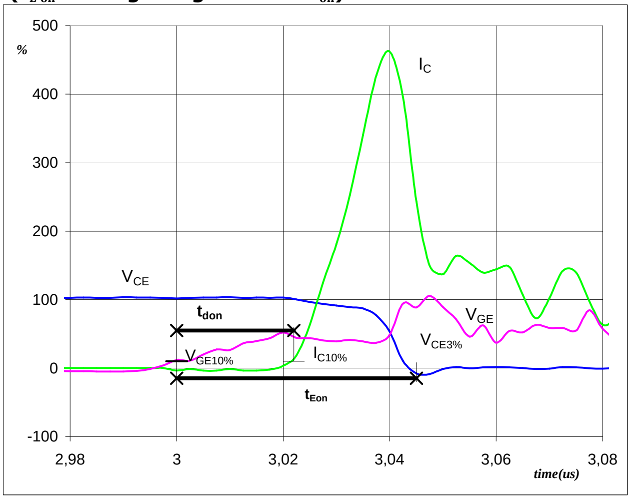
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	10	A
t_{doff} =	0,20	μs
$t_{E\,off}$ =	0,23	μs

figure 2. **PFC MOSFET**

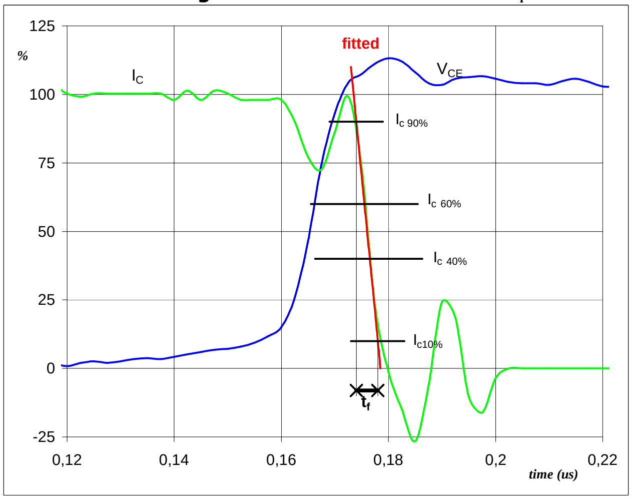
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	10	V
V_C (100%) =	400	V
I_C (100%) =	10	A
t_{don} =	0,02	μs
$t_{E\,on}$ =	0,04	μs

figure 3. **PFC MOSFET**

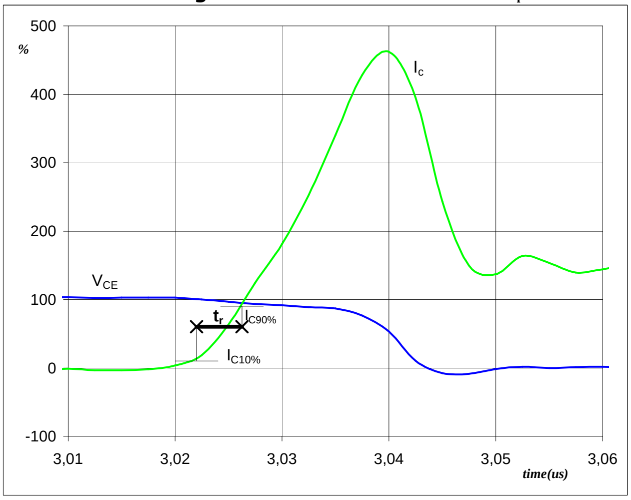
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	10	A
t_f =	0,0040	μs

figure 4. **PFC MOSFET**

Turn-on Switching Waveforms & definition of t_r

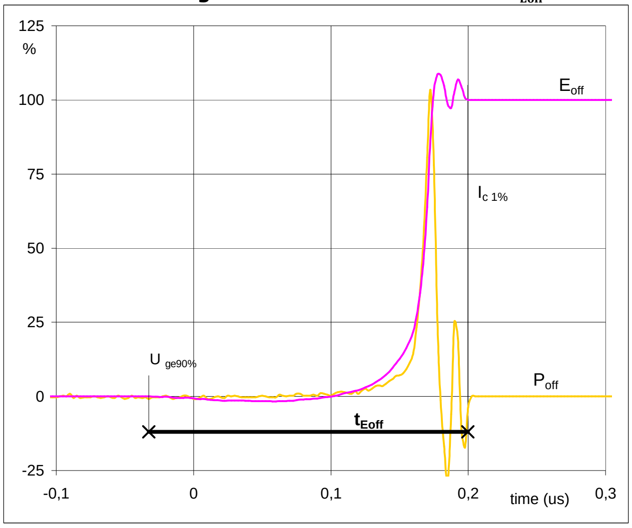


V_C (100%) =	400	V
I_C (100%) =	10	A
t_r =	0,0040	μs

Switching Definitions PFC

figure 5. **PFC MOSFET**

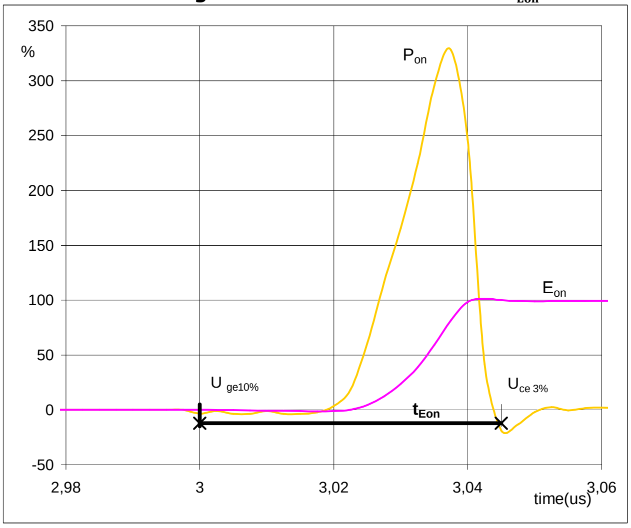
Turn-off Switching Waveforms & definition of t_{Eoff}



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

figure 6. **PFC MOSFET**

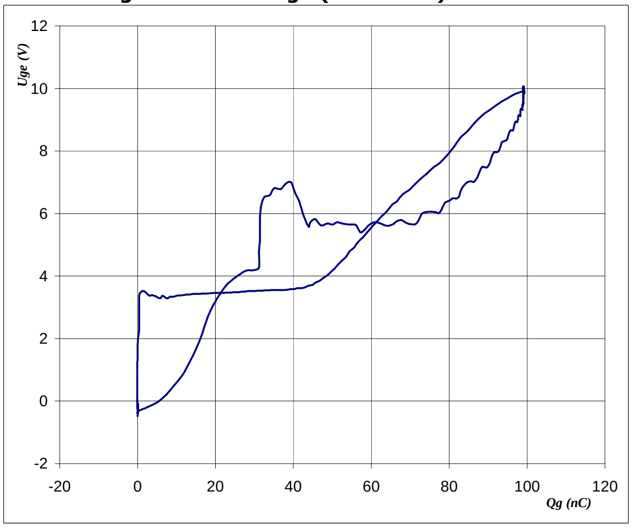
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	4,0252	kW
E_{on} (100%) =	0,15	mJ
$t_{E\,on}$ =	0,045	μs

figure 7. **PFC MOSFET**

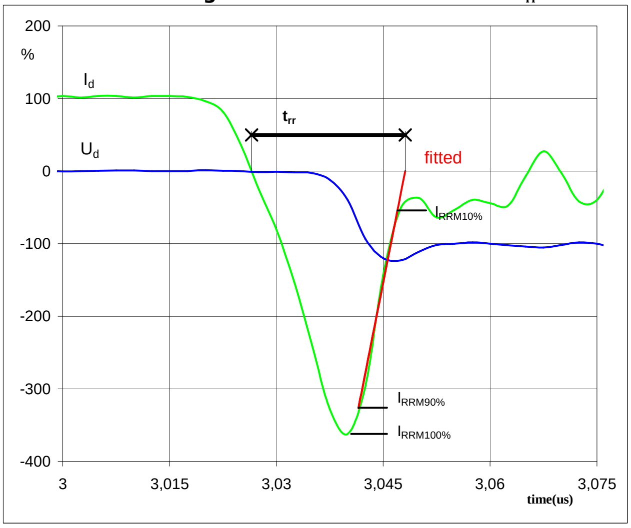
Gate voltage vs Gate charge (measured)



$V_{GE\,off}$ =	0	V
$V_{GE\,on}$ =	10	V
V_C (100%) =	400	V
I_C (100%) =	10	A
Q_g =	99,15	nC

figure 8. **PFC FWD**

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

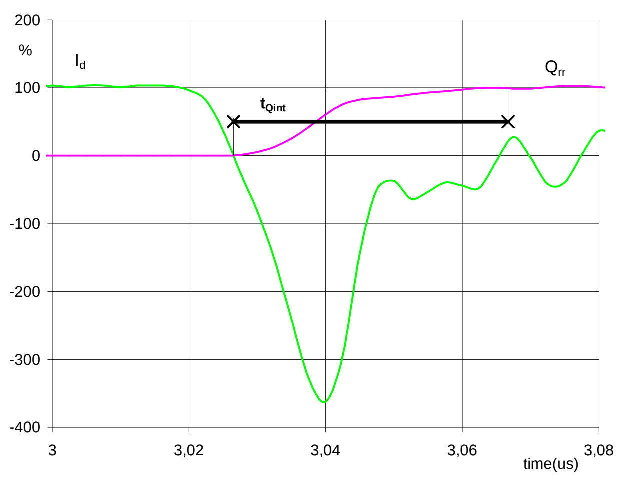


V_d (100%) =	400	V
I_d (100%) =	10	A
I_{RRM} (100%) =	-36	A
t_{rr} =	0,02	μs

Switching Definitions PFC

figure 9.	PFC FWD

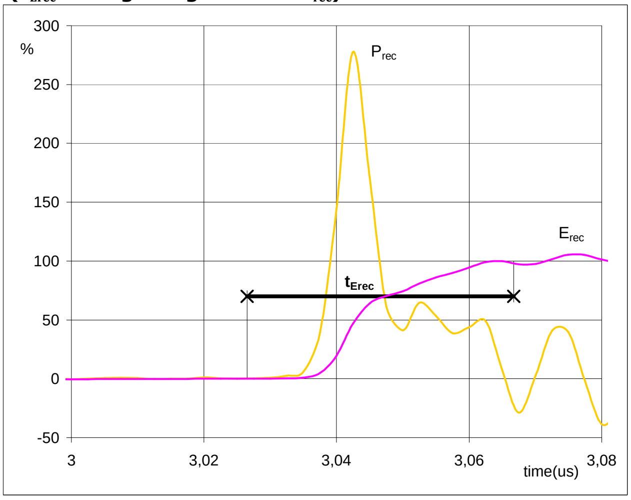
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	10	A
Q_{rr} (100%) =	0,49	µC
t_{Qint} =	0,04	µs

figure 10.	PFC 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
$t_{E\,rec}$ =	0,04	µs

Ordering Code & Marking

Version	Ordering Code
without thermal paste 17mm housing with solder pin	10-F006PPA010SB-M683B
without thermal paste 17mm housing with Press-fit pin	10-P006PPA010SB-M683BY
with thermal paste 17mm housing with solder pin	10-F006PPA010SB-M683B-/3/
with thermal paste 17mm housing with Press-fit pin	10-P006PPA010SB-M683BY-/3/

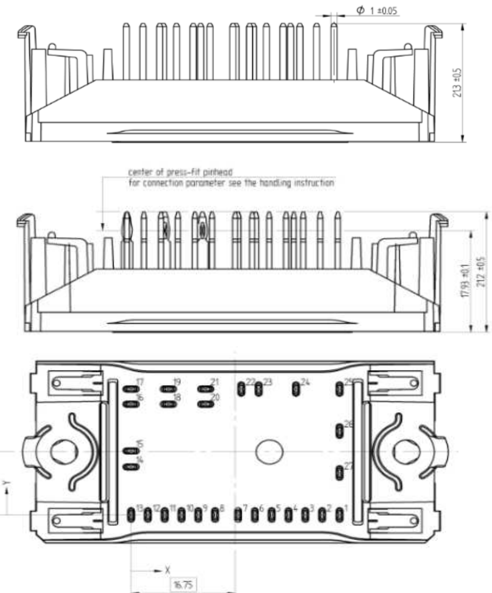
Text	Name	Date code	UL & VIN	Lot	Serial
	NN-NNNNNNNNNNNNNN-TTTTTTVV	WWYY	UL VIN	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code	
	TTTTTTTVV	LLLLL	SSSS	WWYY	

Outline

Pin table [mm]				Pin table [mm]			
Pin	X	Y	Function	Pin	X	Y	Function
1	33,5	0	DC-	21	12	22,5	W
2	30,7	0	PFC-	22	17,7	22,5	+INV
3	28	0	S1	23	20,5	22,5	PFC+
4	25,3	0	S2	24	26,5	22,5	PFC IN
5	22,6	0	INV-	25	33,5	22,5	DC+
6	19,9	0	G7	26	33,5	15	L1
7	17,2	0	S7	27	33,5	7,5	L2
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				

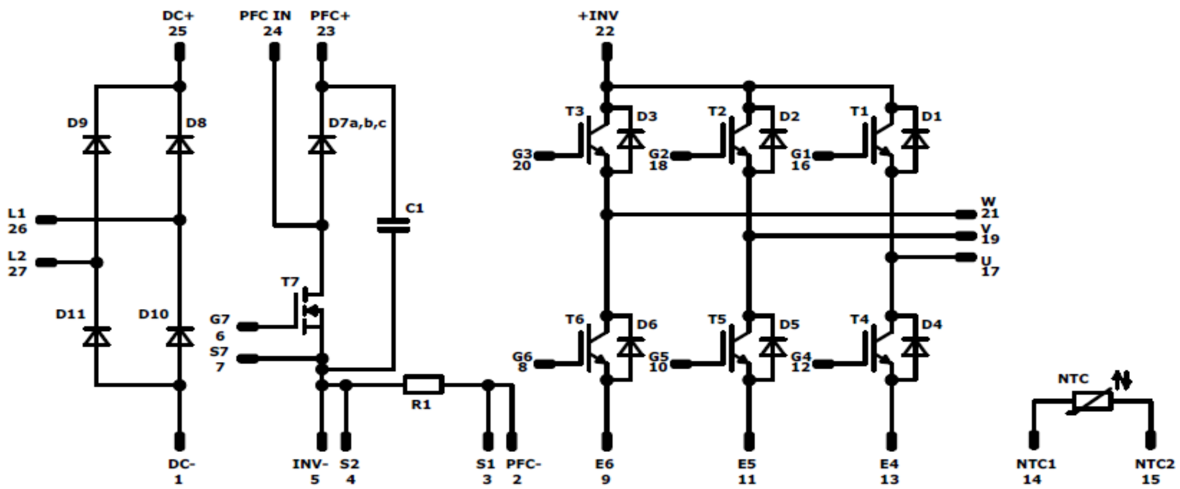
solder pin

Press-fit pin



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
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	10 A	PFC Diode	
D8,D9,D10,D11	Diode	1600 V	25 A	Rectifier Diode	
C1	Capacitor	500 V		DC link Capacitor	
R1	Resistor			PFC Shunt	
NTC	Thermistor			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-x006PPA010SB-M683Bx-D3-14	20 Oct. 2016	New brand, new PFC shunt values	all