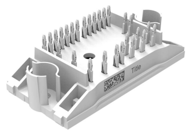
flowPIM0+PFC 2nd — 600 V / 10 A

Features

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

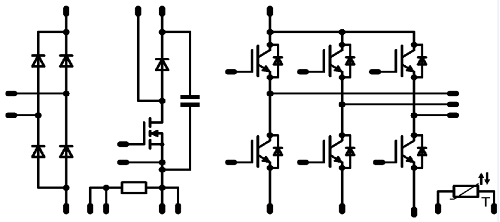
flowPIM0+PFC 2nd



Target Applications

- Industrial Drives
- Embedded Drives

Schematic



Types

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

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	T_j=$T_j$max	T_h=80°C T_c=80°C	26 36	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=150°C	200	A
I2t-value	I^2t			200	A^2s
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	32 48	W
Maximum Junction Temperature	T_{jmax}			150	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
PFC MOSFET					
Drain to source breakdown voltage	V_{DS}			600	V
DC drain current	I_D	$T_j=T_jmax$	T_h=80°C T_c=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=6,6A V_{DD}=50V	Tj=25°C	796	mJ
Avalanche energy, repetitive	E_{AR}	I_D=6,6A V_{DD}=50V	Tj=25°C	1,2	mJ
Avalanche current, repetitive	I_{AR}			6,6	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS}=0...480V		50	V/ns
Power dissipation	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=80°C	59 90	W
Gate-source peak voltage	V_{GS}			20	V
Reverse diode dv/dt	dv/dt			15	V/ns
Maximum Junction Temperature	T_{jmax}			150	°C
PFC Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	$T_j=T_jmax$	T_h=80°C T_c=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_h=80°C T_c=80°C	36 54	W
Maximum Junction Temperature	T_{jmax}			175	°C
PFC Shunt					
DC forward current	I_F		T_c=25°C	15,8	A
Power dissipation per Shunt	P_{tot}		T_c=25°C	5	W
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_jmax$	T_h=80°C T_c=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} ≤ 400V, Tj≤150°C		30	A
Power dissipation	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=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}=15V		5 360	μs V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	14 18	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		20	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=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…+(Tjmax - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
Input Rectifier Diode										
Forward voltage	V_F				25	Tj=25°C Tj=125°C		1,20 1,17		V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=125°C		0,92 0,81		V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=125°C		11 14		mΩ
Reverse current	I_r			1600		Tj=25°C Tj=125°C			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 MOSFET										
Static drain to source ON resistance	$r_{DS(on)}$		10		10	Tj=25°C Tj=125°C		98 198		mΩ
Gate threshold voltage	$V_{(GS)th}$	$V_{GS}=V_{DS}$			0,00121	Tj=25°C Tj=125°C	2,4	3,0	3,6	V
Gate to Source Leakage Current	I_{GSS}		20	0		Tj=25°C Tj=125°C			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	600		Tj=25°C Tj=125°C			5000	nA
Turn On Delay Time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	10	400	10	Tj=25°C Tj=125°C		20 23		ns
Rise Time	t_r					Tj=25°C Tj=125°C		4 4		
Turn off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		131 202		
Fall time	t_f					Tj=25°C Tj=125°C		4 4		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		0,083 0,147		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		0,023 0,045		
Total gate charge	Q_{GE}	Rgon=8 Ω	0/10	480	18,1	Tj=25°C		119		nC
Gate to source charge	Q_{GS}							14		
Gate to drain charge	Q_{GD}							61		
Input capacitance	C_{iss}	f=1MHz	0	100		Tj=25°C		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	Tj=25°C Tj=125°C		2,54 1,56		V
Reverse leakage current	I_{rm}			600		Tj=25°C Tj=125°C			50 300	μA
Peak recovery current	I_{RRM}	Rgon=8 Ω	10	400	10	Tj=25°C Tj=125°C		24 36		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		12 23		ns
Reverse recovery charge	Q_{rr}					Tj=25°C Tj=125°C		0,16 0,49		μC
Reverse recovered energy	E_{rec}					Tj=25°C Tj=125°C		0,02 0,11		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=125°C		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							30	ppm/K
Internal heat resistance	Rthi								10	K/W
Inductance	L								3	nH

Characteristic Values

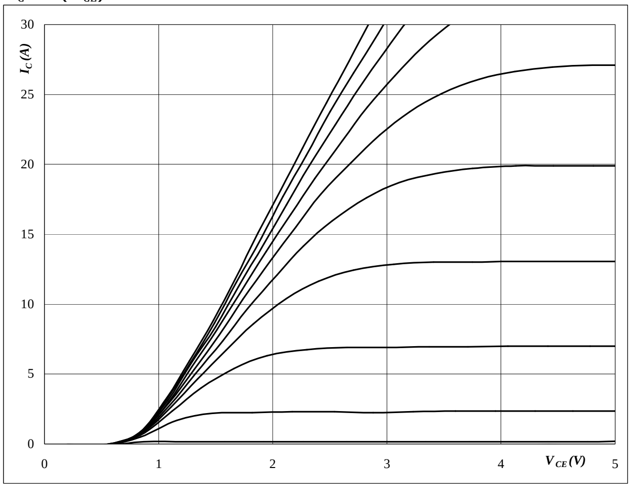
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0003	Tj=25°C Tj=125°C	4,1	4,6	5,7	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	Tj=25°C Tj=125°C		1,57 1,75		V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=125°C			0,057	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=32 Ω Rgon=32 Ω	±15	400	10	Tj=25°C Tj=125°C		75 74		ns
Rise time	t_r					Tj=25°C Tj=125°C		24 26		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		136 159		
Fall time	t_f					Tj=25°C Tj=125°C		83 123		
Turn-on energy loss	E_{on}					Tj=25°C Tj=125°C		0,28 0,38		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=125°C		0,33 0,45		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		551		pF
Output capacitance	C_{oss}							40		
Reverse transfer capacitance	C_{rss}							17		
Gate charge	Q_G		±15	480	10	Tj=25°C		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	Tj=25°C Tj=125°C	1,25	1,58 1,52	1,95	V
Peak reverse recovery current	I_{RRM}	Rgon=32 Ω	±15	400	10	Tj=25°C Tj=125°C		5 7		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		194 270		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,47 0,90		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=125°C		21 65		A/μs
Reverse recovered energy	E_{rec}					Tj=25°C Tj=125°C		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					T=25°C		22000		Ω
Deviation of R100	$\Delta_{R/R}$	R100=1486 Ω				T=100°C	-5		5	%
Power dissipation	P					T=25°C		210		mW
Power dissipation constant						T=25°C		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				T=25°C				K
B-value	$B_{(25/100)}$	Tol. ±3%				T=25°C		4000		K
Vincotech NTC Reference									A	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



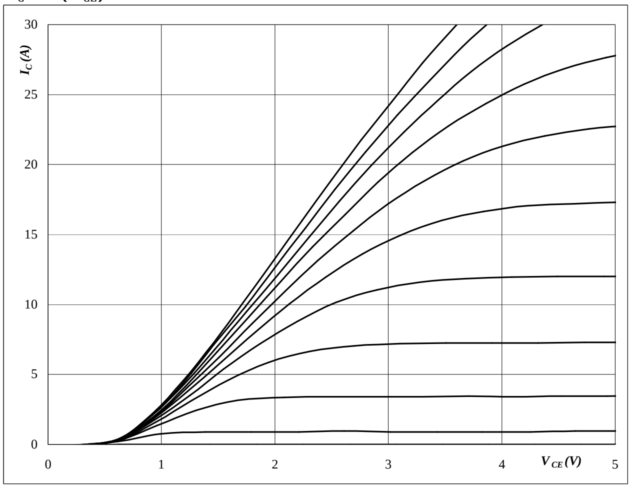
At

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

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



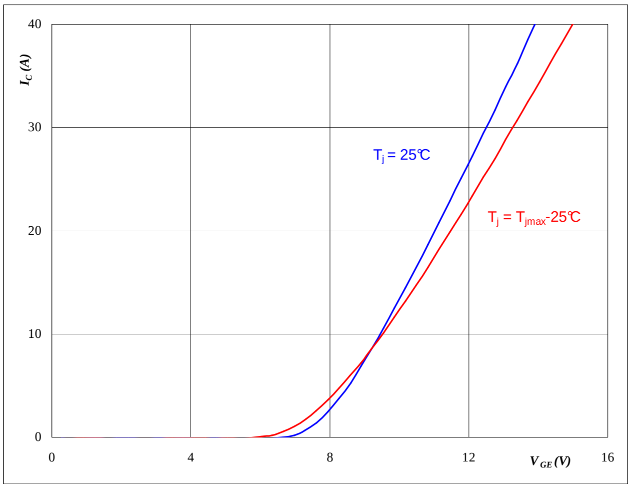
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



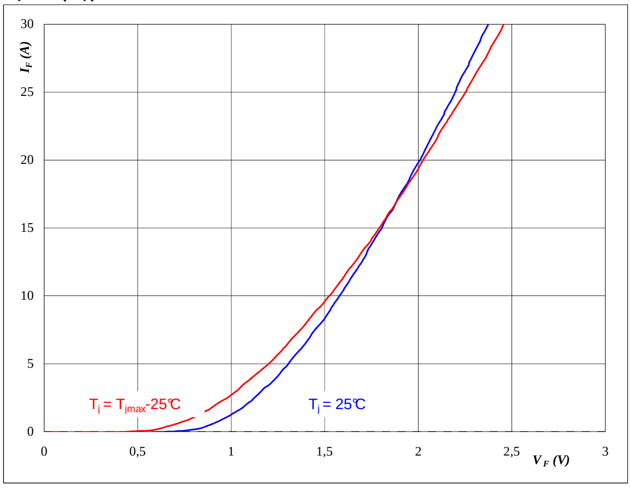
At

t_p =	250	µs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

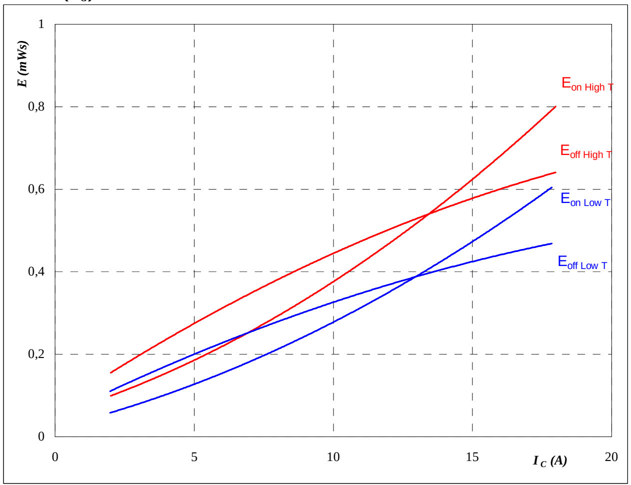
t_p =	250	µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



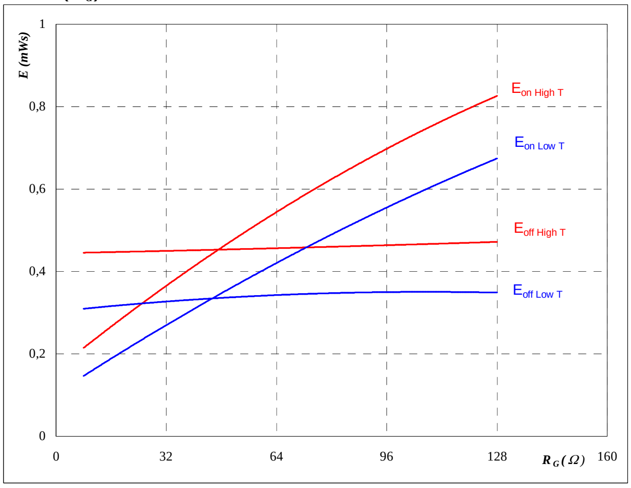
With an inductive load at

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

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



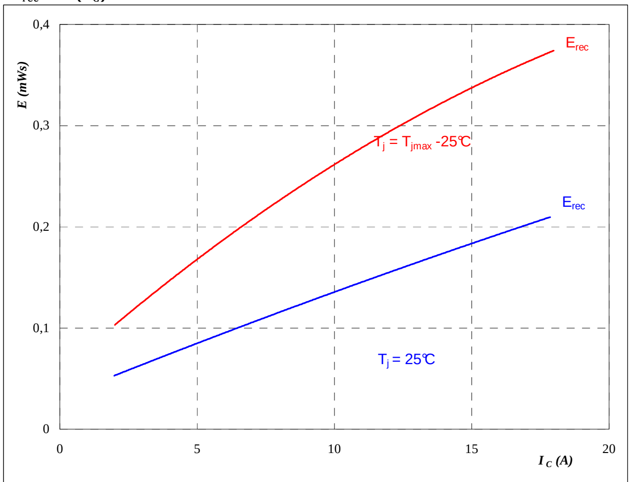
With an inductive load at

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

Figure 7 Output inverter FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



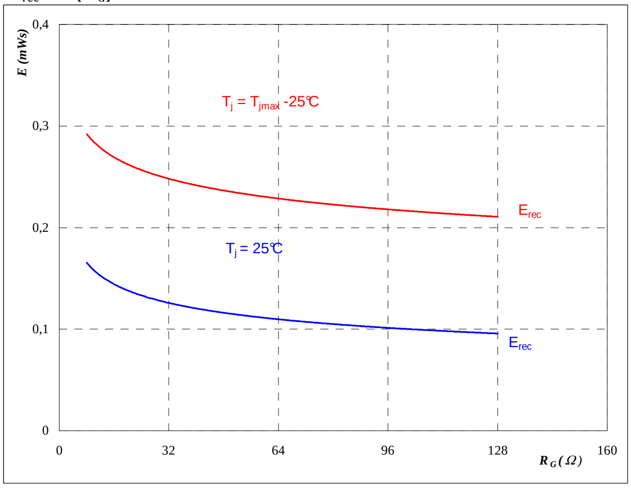
With an inductive load at

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

Figure 8 Output inverter FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

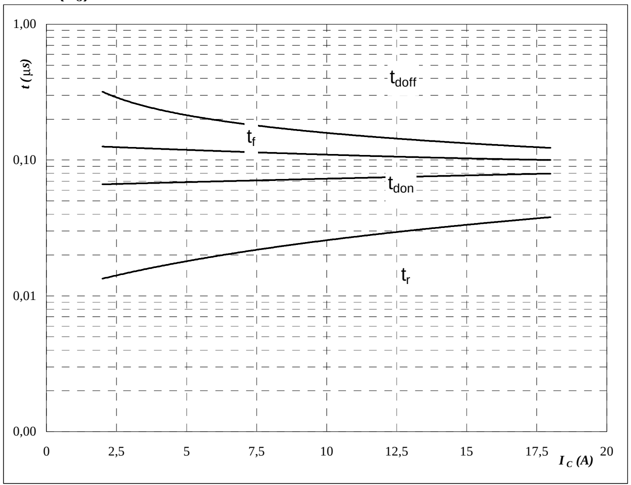
T_j =	25/125	°C
V_{CE} =	400	V
V_{GE} =	±15	V
I_C =	10	A

Output Inverter

Figure 9 — Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



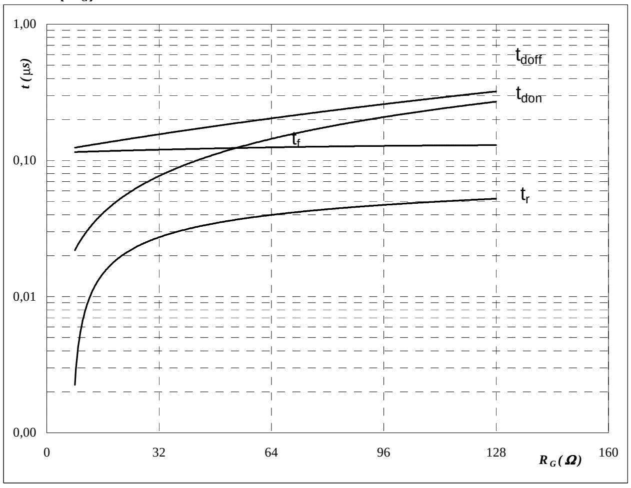
With an inductive load at

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

Figure 10 — Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



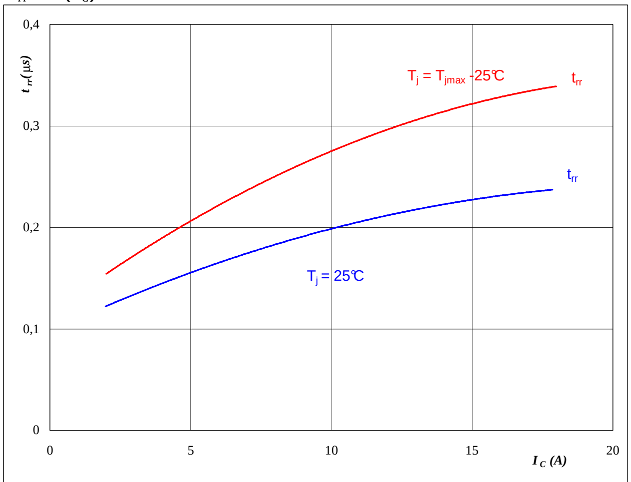
With an inductive load at

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

Figure 11 — Output inverter FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



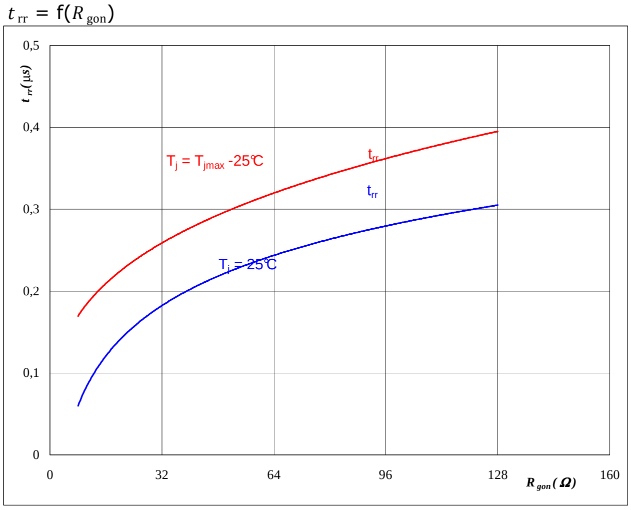
At

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

Figure 12 — Output inverter FWD

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

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



At

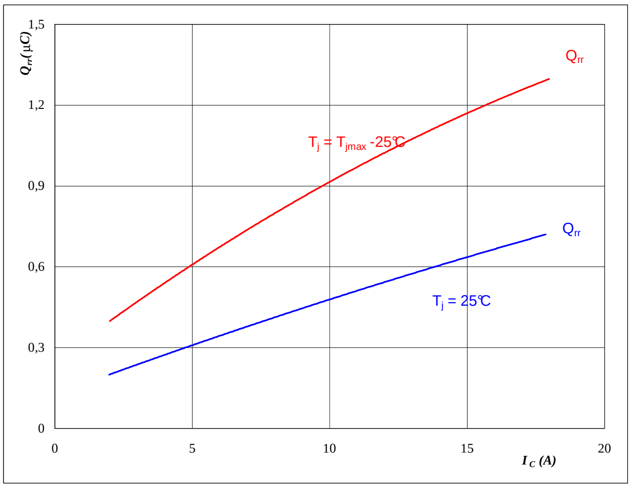
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



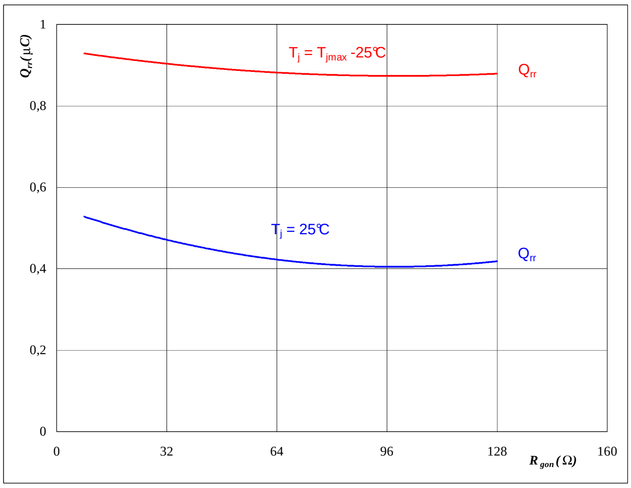
At

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

Figure 14 Output inverter FWD

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

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



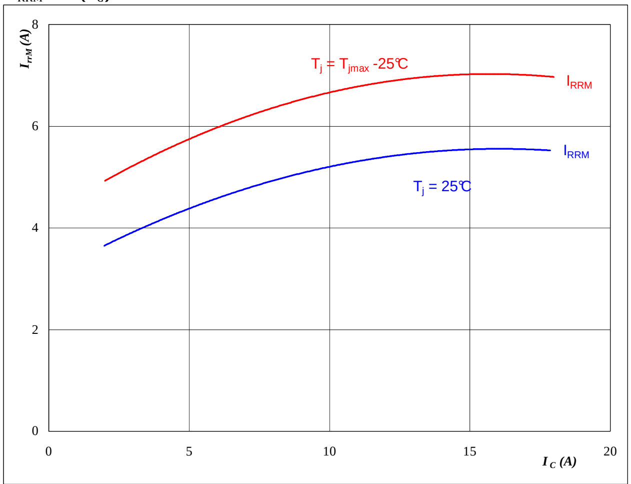
At

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

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



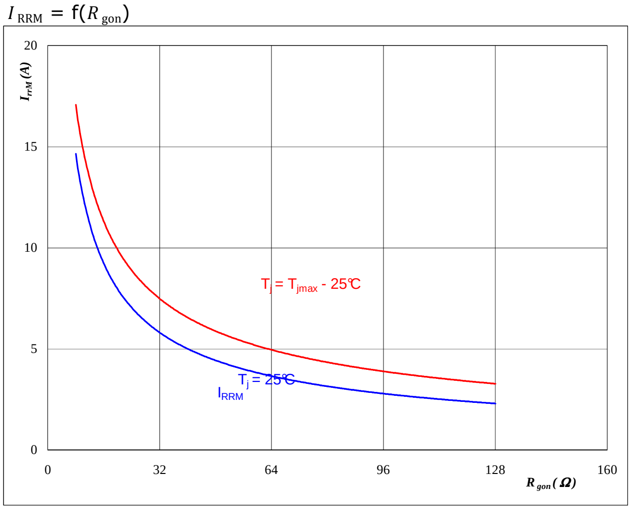
At

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

Figure 16 Output inverter FWD

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

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



At

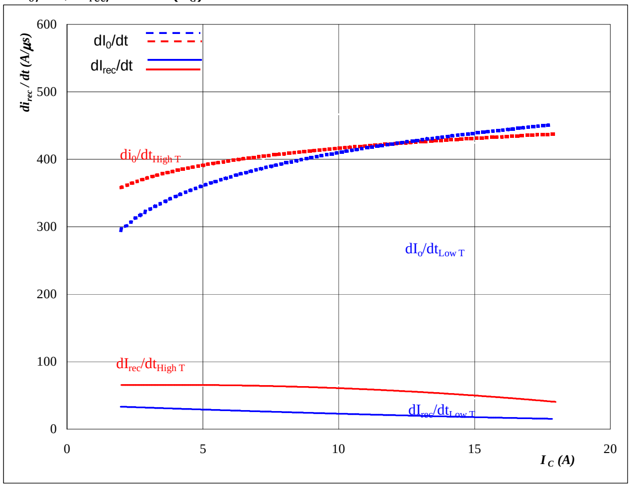
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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



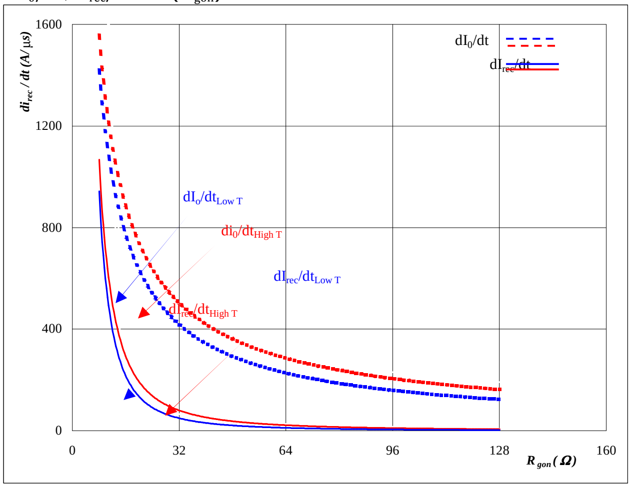
At

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

Figure 18 Output inverter FWD

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

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



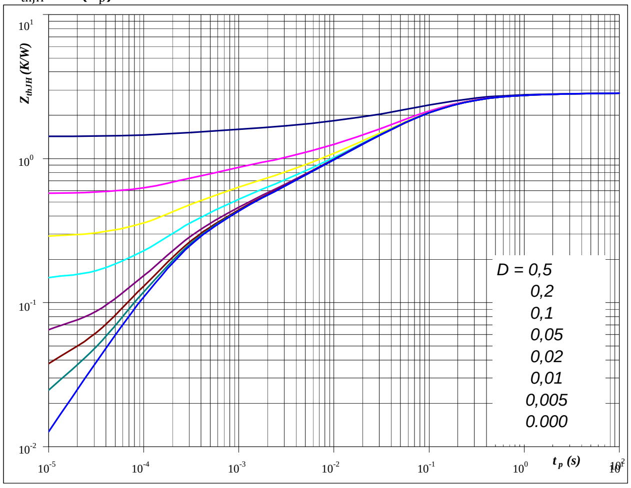
At

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

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

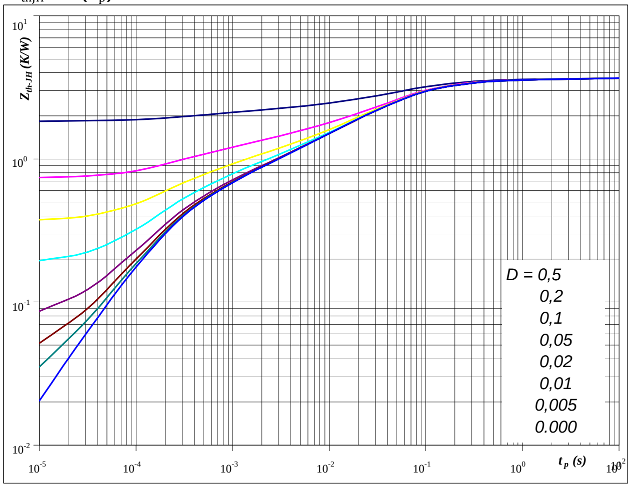
D = t_p / T

R_{thJH} = 2,84 K/W R_{thJH} = 2,31 K/W

Figure 20 Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D = t_p / T

R_{thJH} = 3,66 K/W R_{thJH} = 2,97 K/W

IGBT thermal model values

Thermal grease		Phase change interface	
R (K/W)	Tau (s)	*R (K/W)*	Tau (s)
0,17	1,8E+00	0,14	1,5E+00
0,79	1,9E-01	0,64	1,5E-01
0,99	4,9E-02	0,80	4,0E-02
0,42	8,4E-03	0,34	6,8E-03
0,21	1,4E-03	0,17	1,1E-03
0,26	2,4E-04	0,21	1,9E-04

FWD thermal model values

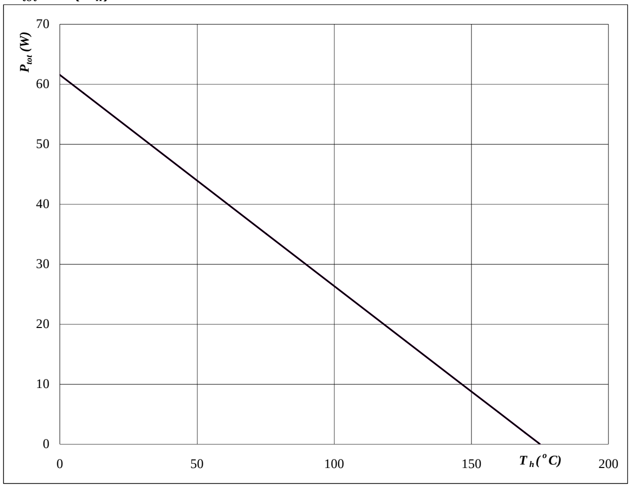
Thermal grease		Phase change interface	
R (K/W)	Tau (s)	*R (K/W)*	Tau (s)
0,17	2,3E+00	0,13	1,9E+00
0,69	1,8E-01	0,56	1,4E-01
1,50	4,3E-02	1,22	3,5E-02
0,57	7,6E-03	0,46	6,2E-03
0,35	1,3E-03	0,28	1,1E-03
0,40	2,3E-04	0,32	1,9E-04

Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



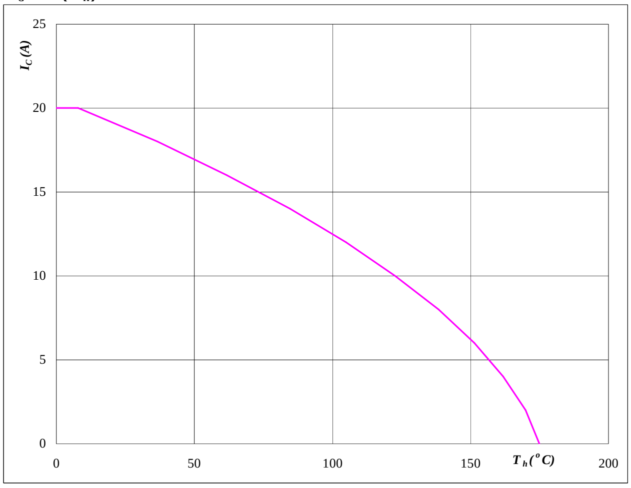
At

T_j =	175	°C

Figure 22	Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



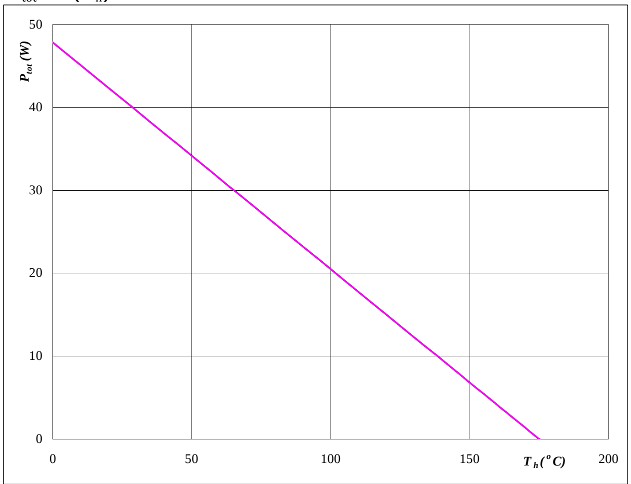
At

T_j =	175	°C
V_{GE} =	15	V

Figure 23	Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



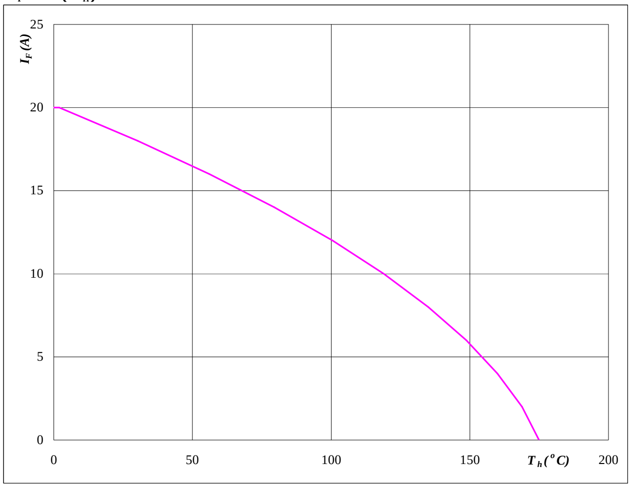
At

T_j =	175	°C

Figure 24	Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

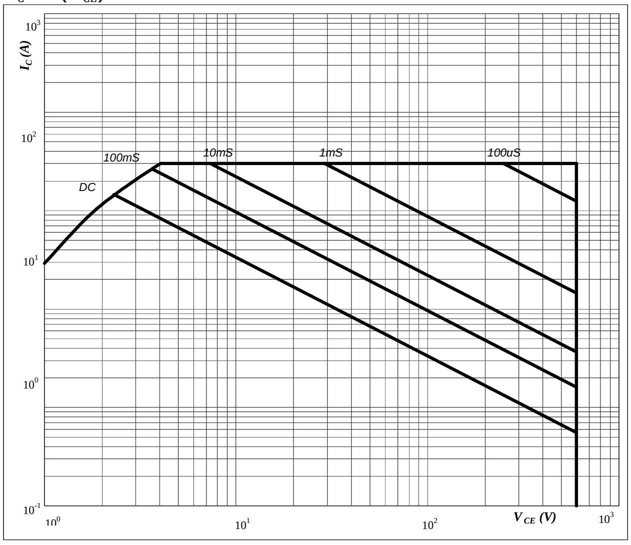
T_j =	175	°C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



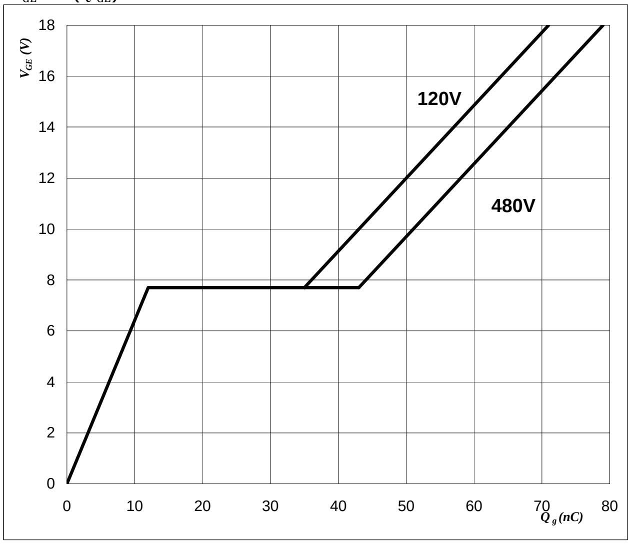
At

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

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_{GE})$



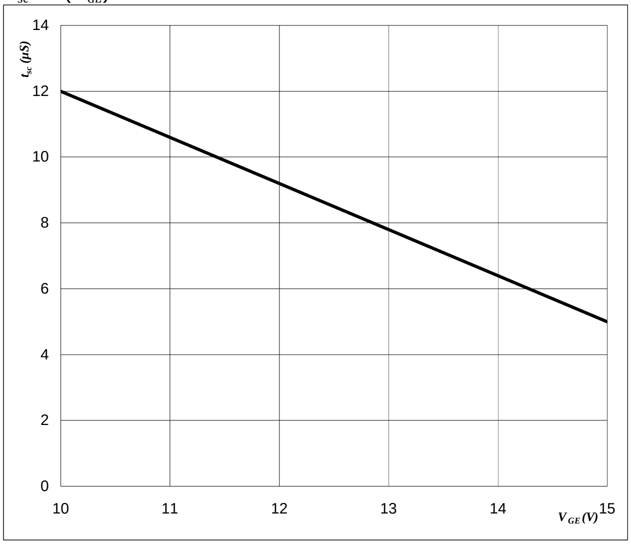
At

I_C =	10	A

Figure 27 Output inverter IGBT

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

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



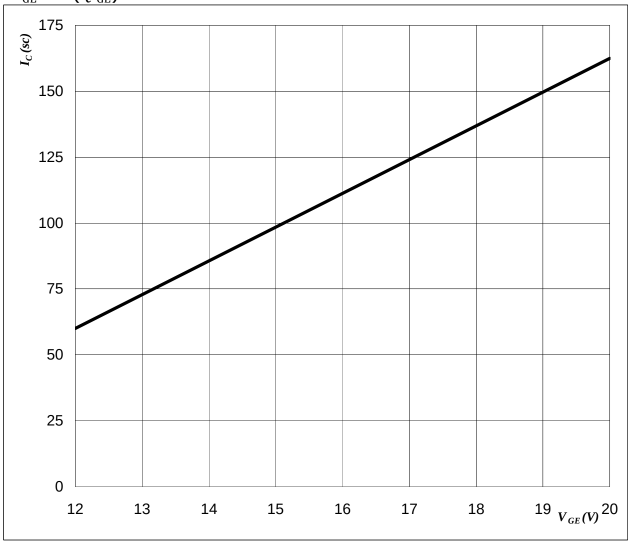
At

V_{CE} =	600	V
T_j ≤	175	ºC

Figure 28 Output inverter IGBT

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

$V_{GE} = f(Q_{GE})$



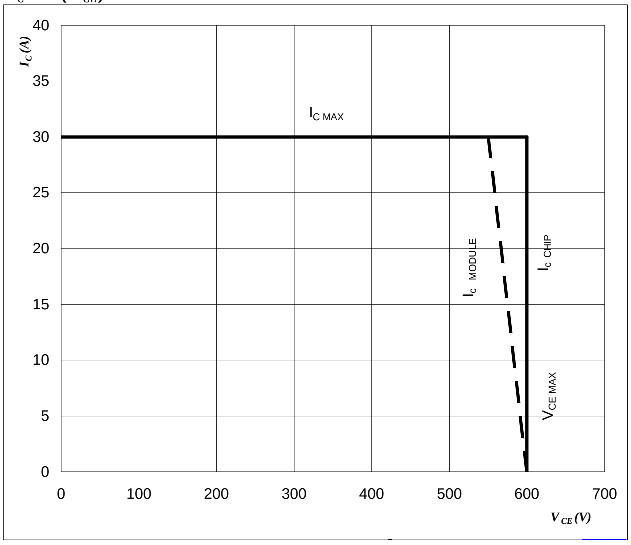
At

V_{CE} ≤	600	V
T_j =	175	ºC

Figure 29 IGBT

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j = T_{jmax}-25 ºC

$U_{ccminus}$=U_{ccplus}

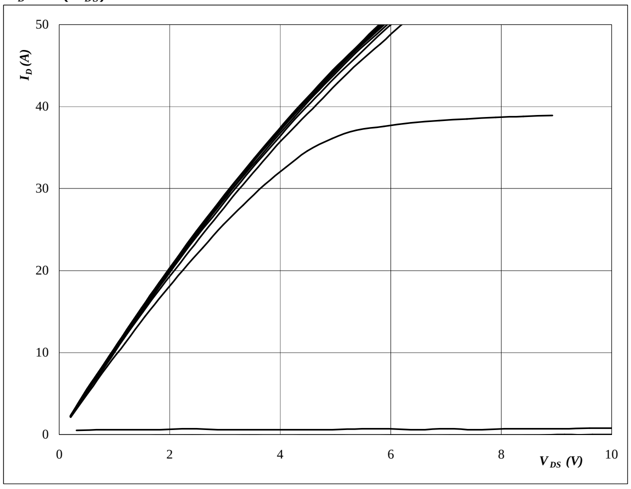
Switching mode : 3phase SPWM

PFC

Figure 1 PFC MOSFET

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

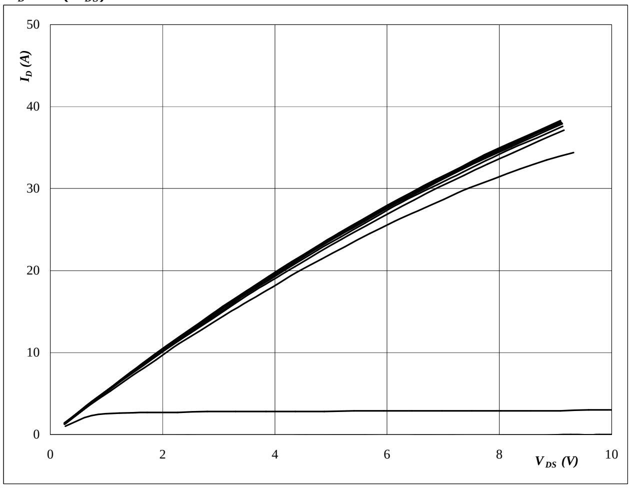
T_j = 25 °C

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

Figure 2 PFC MOSFET

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

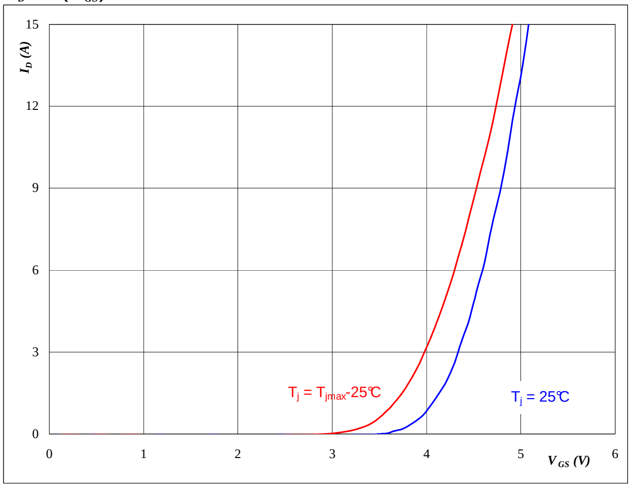
T_j = 125 °C

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

Figure 3 PFC MOSFET

Typical transfer characteristics

$I_D = f(V_{GS})$



At

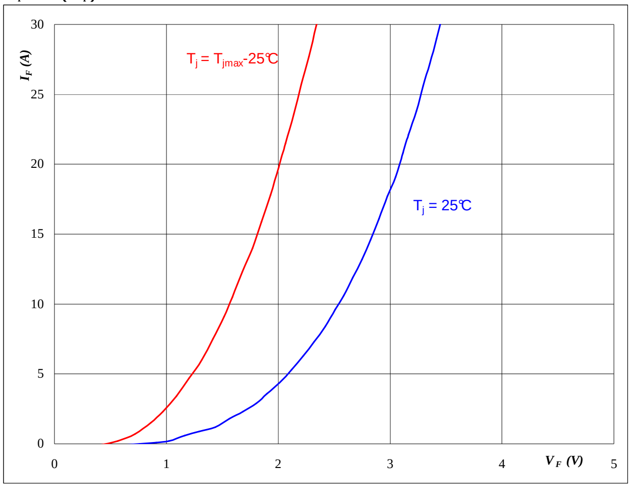
t_p = 250 µs

V_{DS} = 10 V

Figure 4 PFC FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

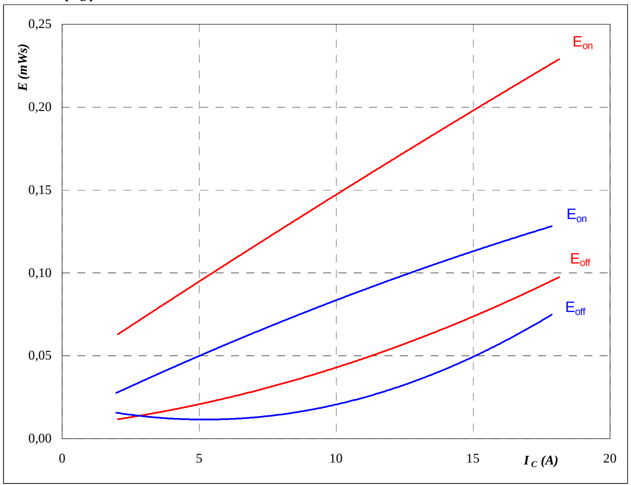
t_p = 250 µs

PFC

Figure 5 PFC MOSFET

Typical switching energy losses
as a function of collector current

$E = f(I_D)$



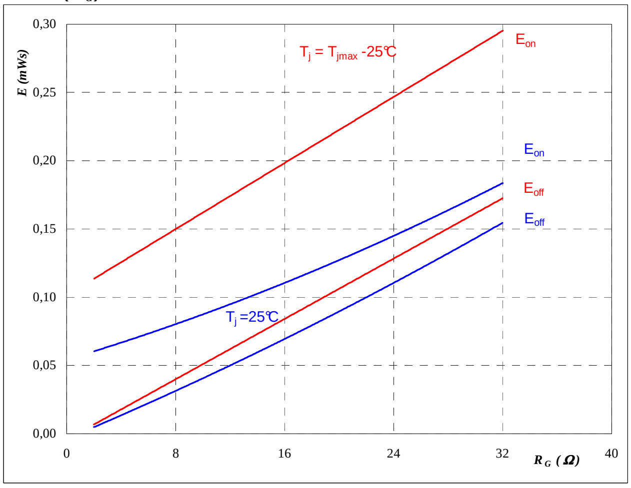
With an inductive load at

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

Figure 6 PFC MOSFET

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



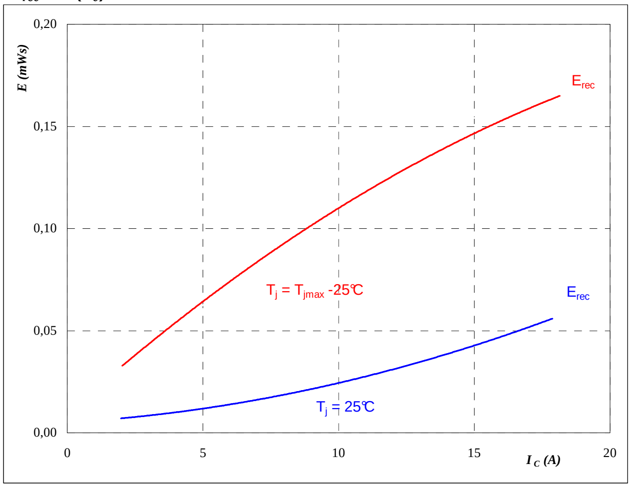
With an inductive load at

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

Figure 7 PFC MOSFET

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

$E_{rec} = f(I_c)$



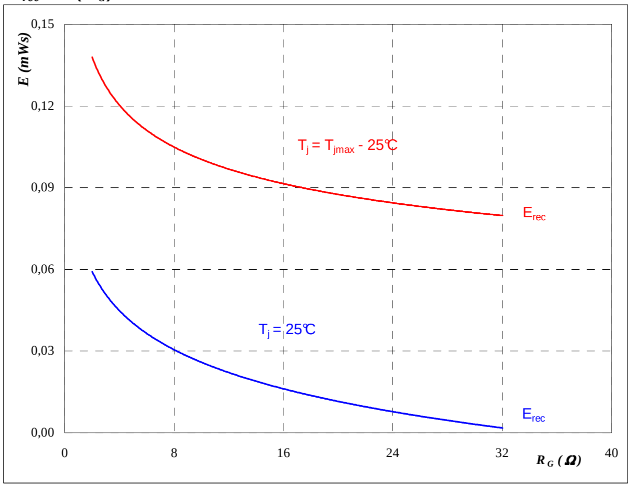
With an inductive load at

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

Figure 8 PFC MOSFET

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

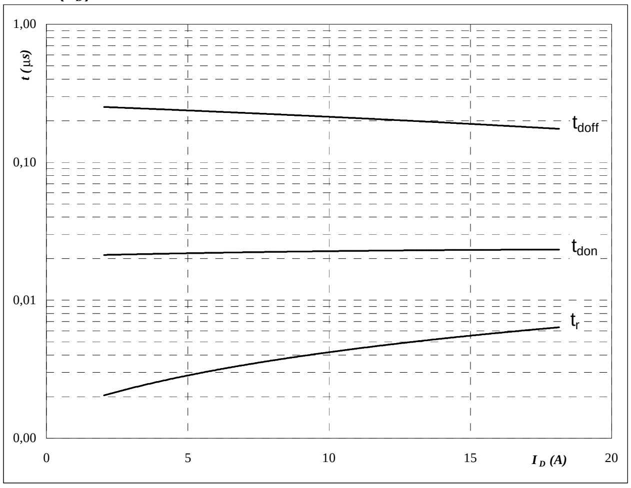
T_j =	25/125	°C
V_{DS} =	400	V
V_{GS} =	10	V
I_D =	10	A

PFC

Figure 9 PFC MOSFET

Typical switching times as a function of collector current

$t = f(I_D)$



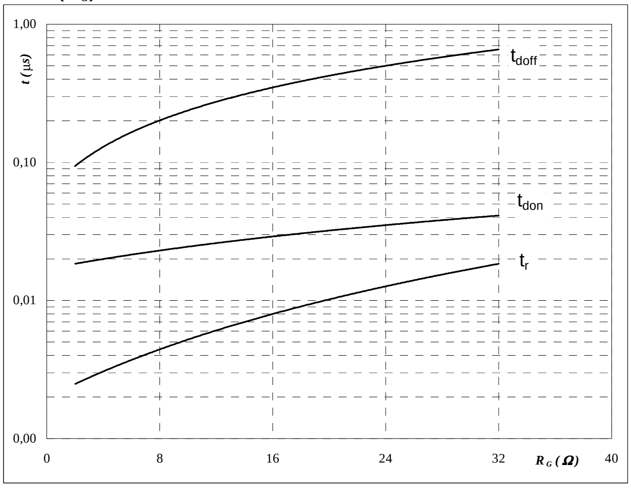
With an inductive load at

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

Figure 10 PFC MOSFET

Typical switching times as a function of gate resistor

$t = f(R_G)$



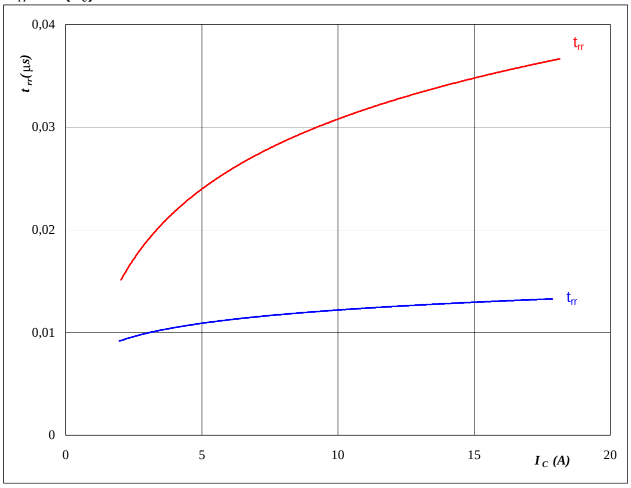
With an inductive load at

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

Figure 11 PFC FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



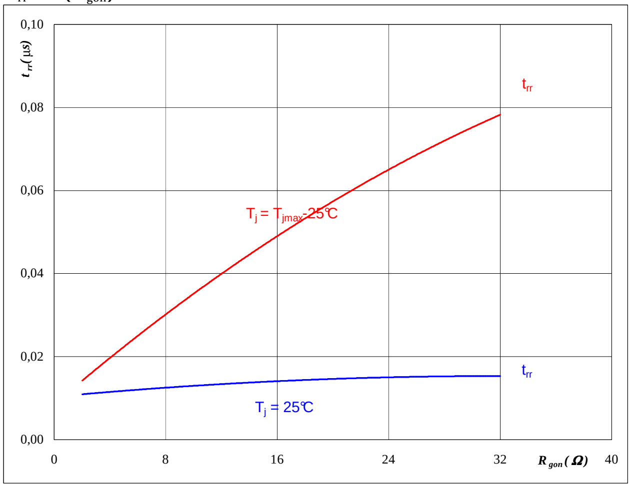
At

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

Figure 12 PFC FWD

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

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



At

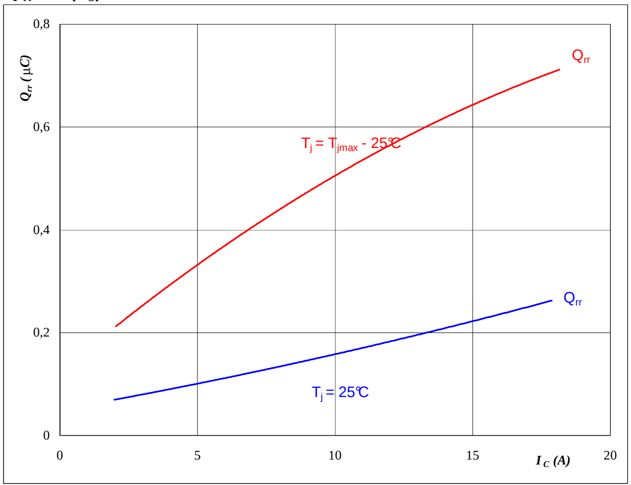
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GS} =	10	V

PFC

Figure 13 PFC FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



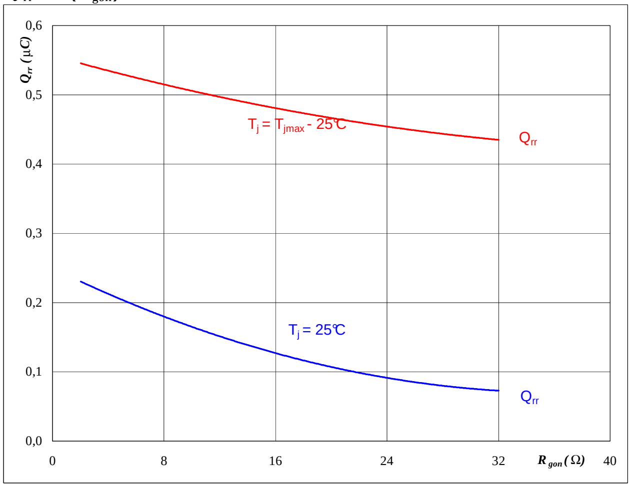
At

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

Figure 14 PFC FWD

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

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



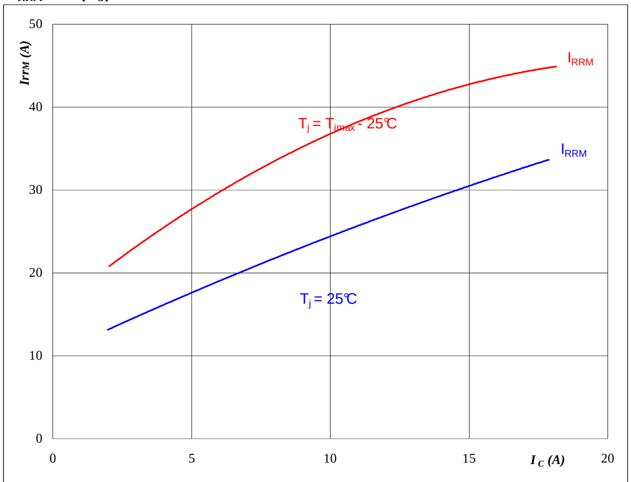
At

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

Figure 15 PFC FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



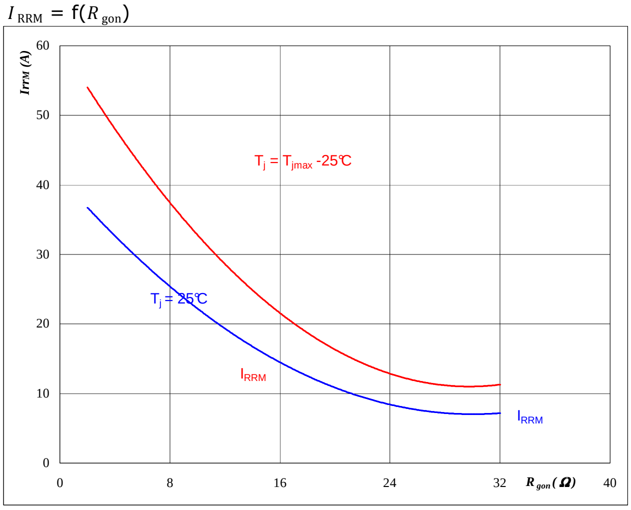
At

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

Figure 16 PFC FWD

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

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



At

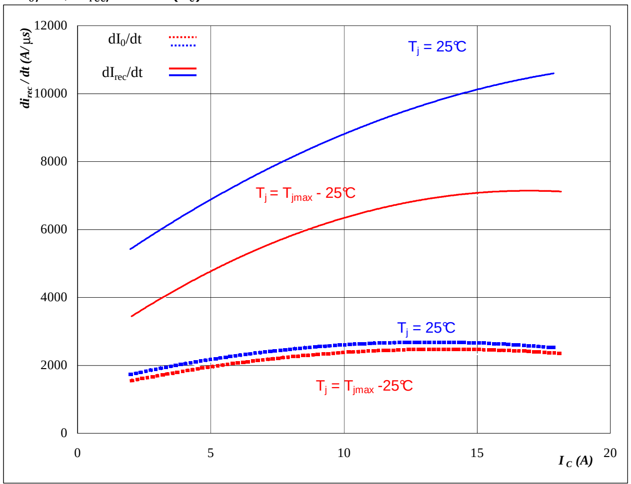
T_j =	25/125	°C
V_R =	400	V
I_F =	10	A
V_{GE} =	10	V

PFC

Figure 17 PFC FWD

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

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



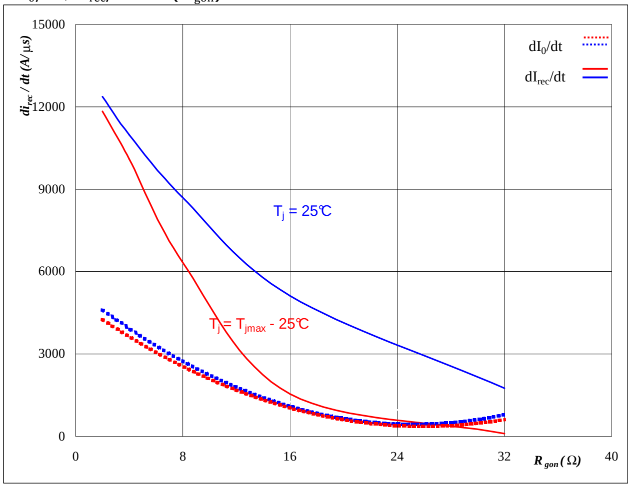
At

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

Figure 18 PFC FWD

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

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



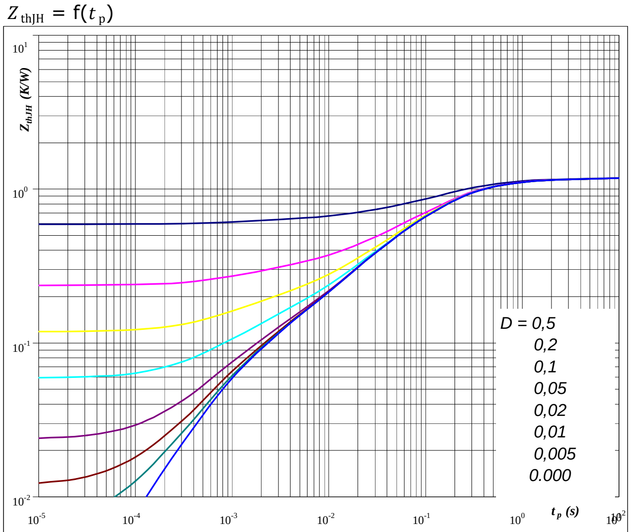
At

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

Figure 19 PFC MOSFET

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

$Z_{thJH} = f(t_p)$



At

$D = t_p / T$

R_{thJH} =	1,18	K/W	R_{thJH} =	0,96	K/W

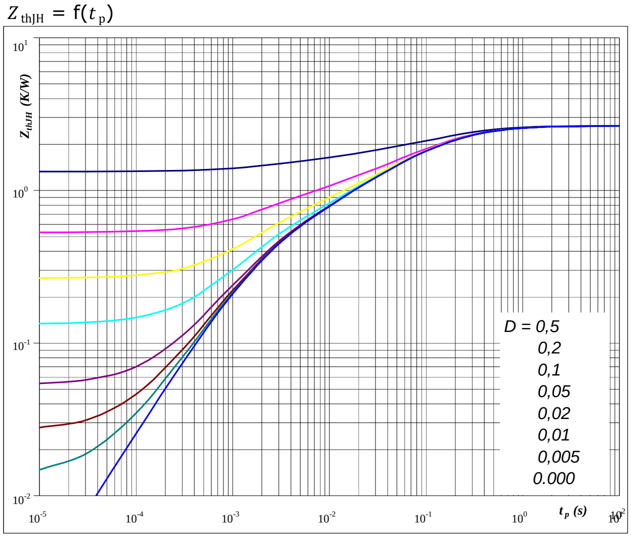
IGBT thermal model values

Thermal grease		Phase change interface	
R (K/W)	Tau (s)	*R (K/W)*	Tau (s)
0,05	3,88	0,041	3,147
0,13	0,75	0,104	0,611
0,60	0,17	0,485	0,139
0,24	0,04	0,198	0,034
0,10	0,01	0,078	0,008
0,07	0,00	0,053	0,001
0,05	0,00	0,040	0,000

Figure 20 PFC FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

$D = t_p / T$

R_{thJH} =	2,66	K/W	R_{thJH} =	2,16	K/W

FWD thermal model values

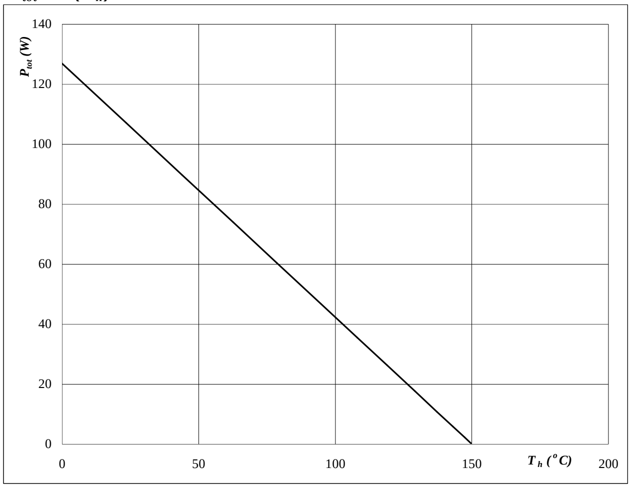
Thermal grease		Phase change interface	
R (K/W)	Tau (s)	*R (K/W)*	Tau (s)
0,15	1,84	0,12	1,49
0,86	0,22	0,69	0,18
0,88	0,06	0,71	0,05
0,44	0,01	0,36	0,01
0,33	0,00	0,27	0,00
0,52	0,00	0,42	0,00
0,22	0,00	0,18	0,00

PFC

Figure 21 PFC MOSFET

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



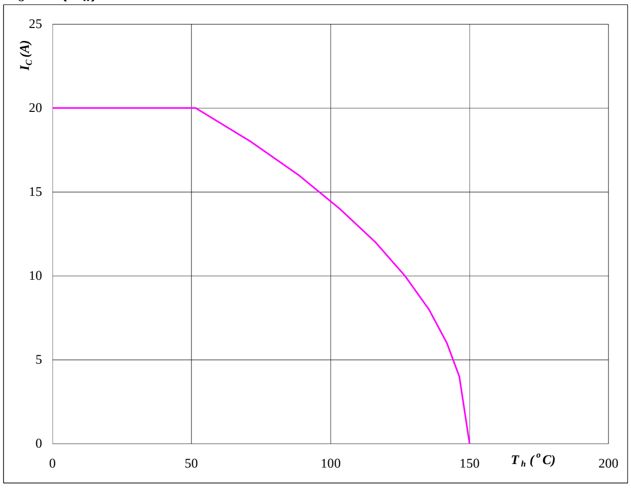
At

T_j = 150 ºC

Figure 22 PFC MOSFET

Collector/Drain current as a function of heatsink temperature

$I_C = f(T_h)$



At

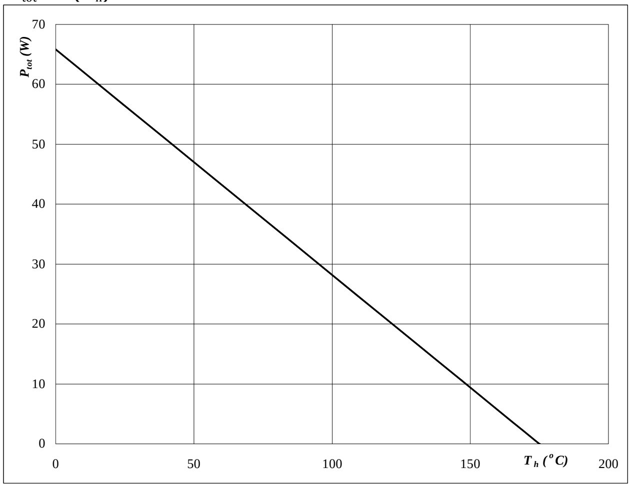
T_j = 150 ºC

V_{GS} = 10 V

Figure 23 PFC FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



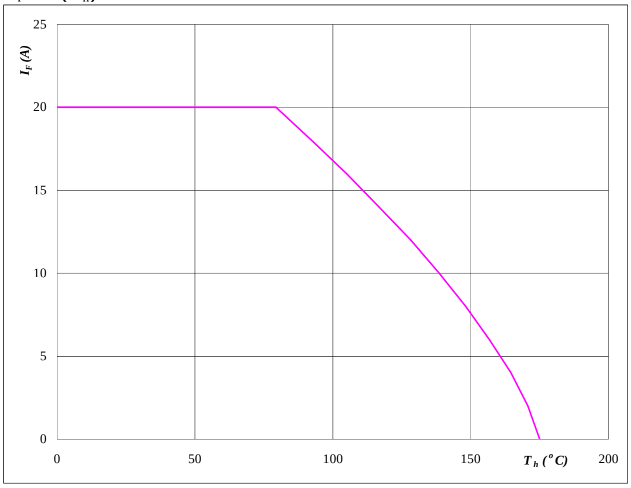
At

T_j = 175 ºC

Figure 24 PFC FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

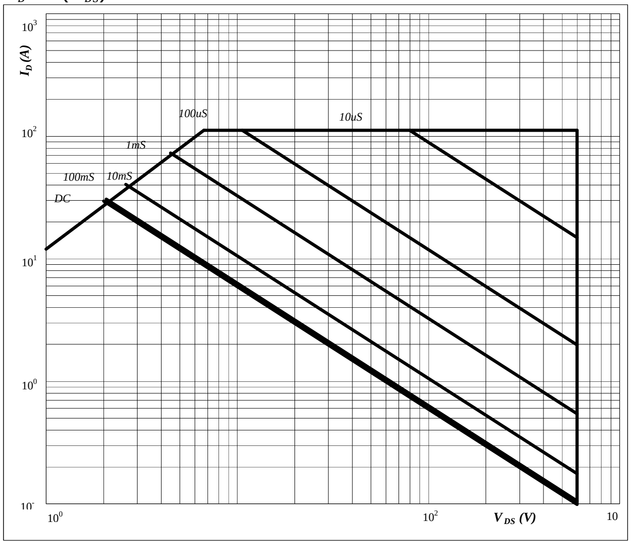
T_j = 175 ºC

PFC

Figure 25 PFC MOSFET

Safe operating area as a function of drain-source voltage

$I_D = f(V_{DS})$



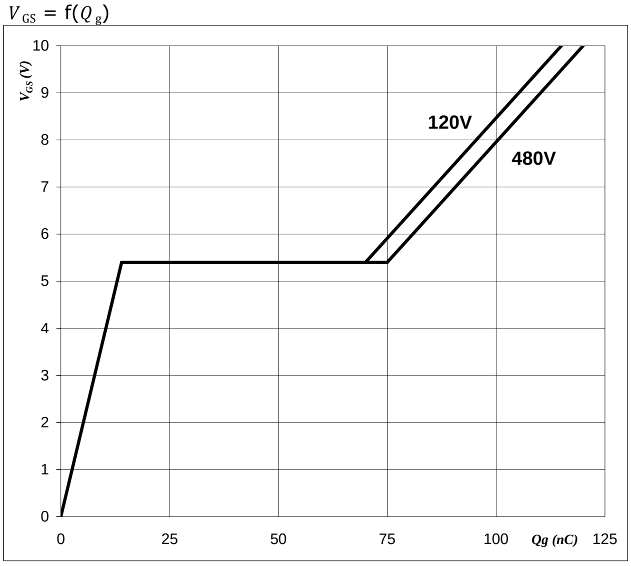
At

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

Figure 26 PFC MOSFET

Gate voltage vs Gate charge

$V_{GS} = f(Q_g)$



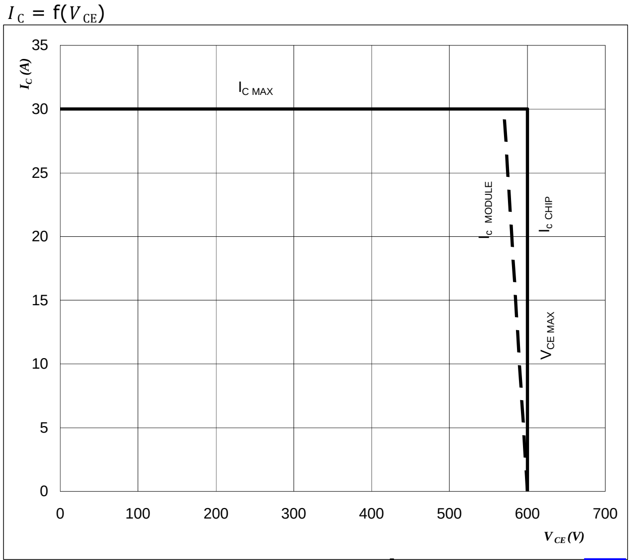
At

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}

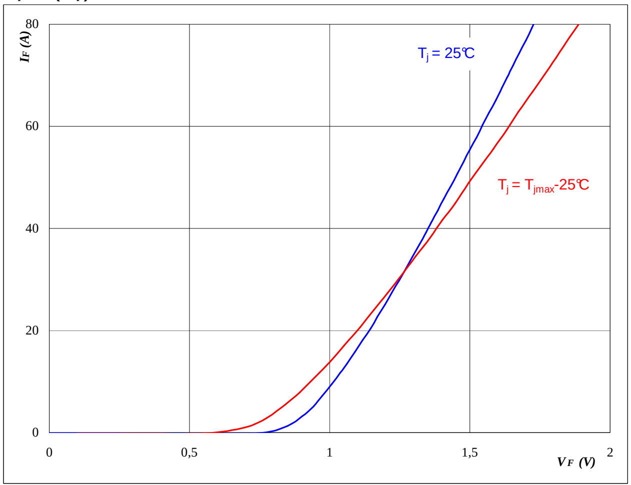
Switching mode : 3phase SPWM

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



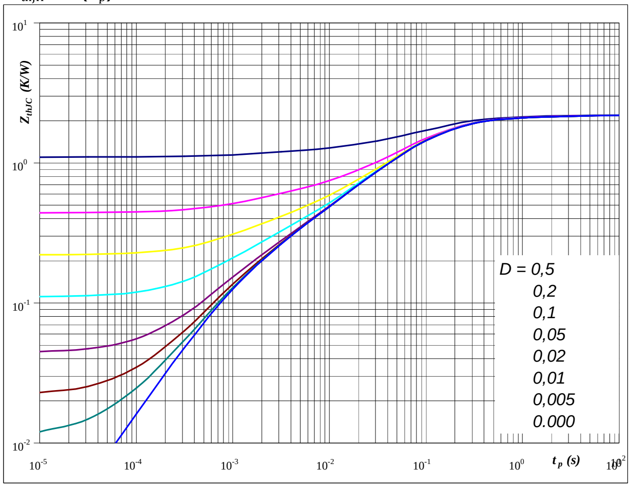
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

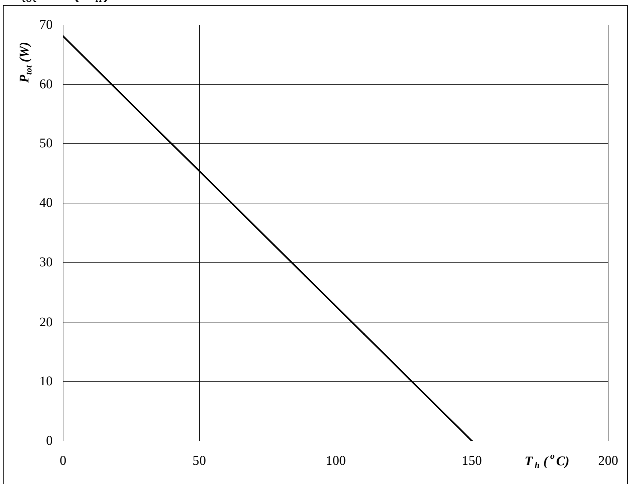
D = t_p / T

R_{thJH} = 2,20 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



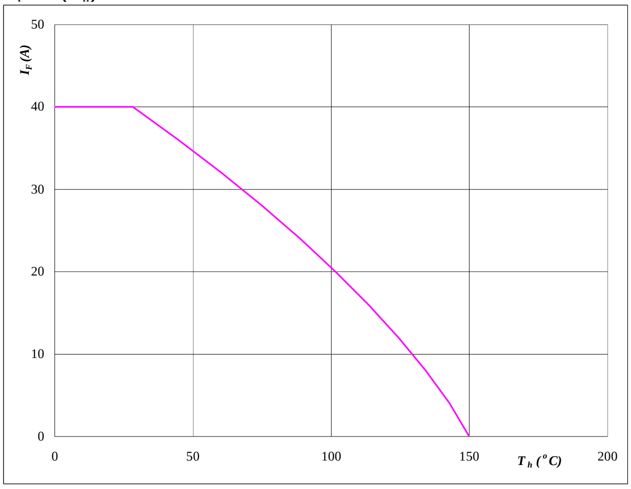
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

T_j = 150 ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature
$R_T = f(T)$

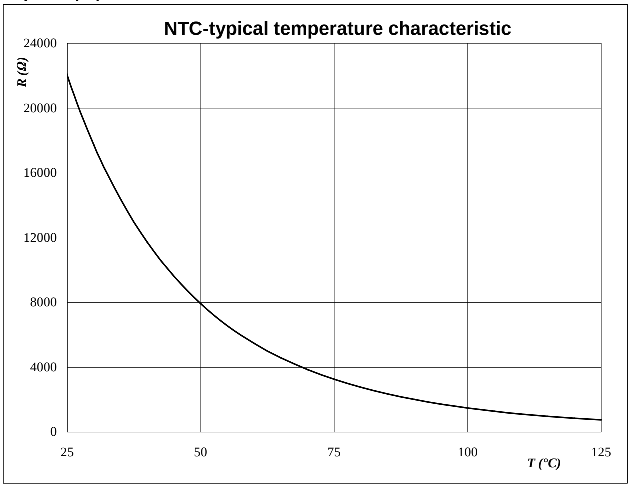


Figure 2 Thermistor

Typical NTC resistance values

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

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

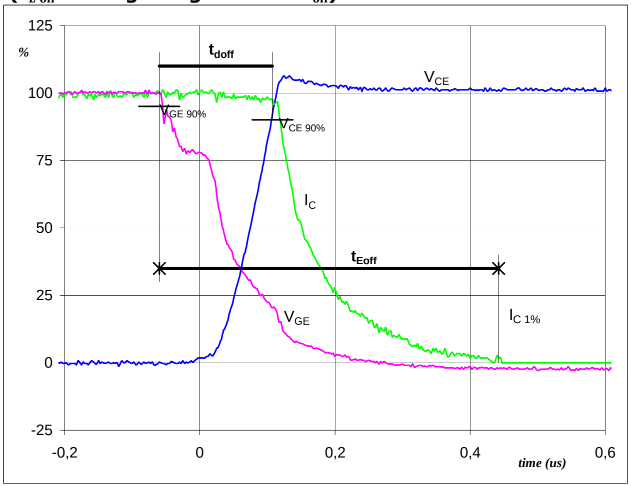
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

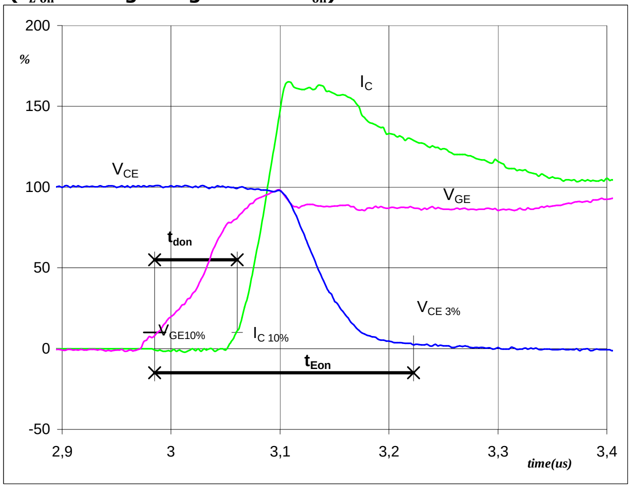
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



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 Output inverter IGBT

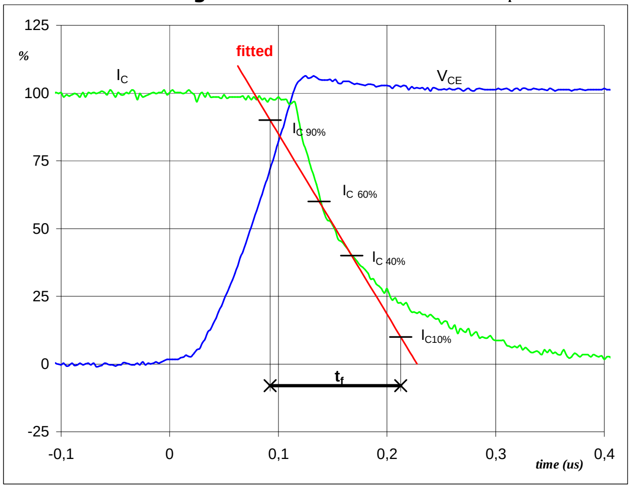
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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 Output inverter IGBT

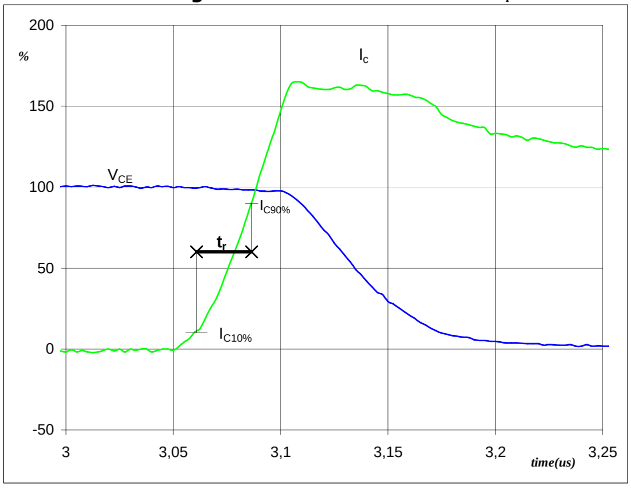
Turn-off Switching Waveforms & definition of t_f



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

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

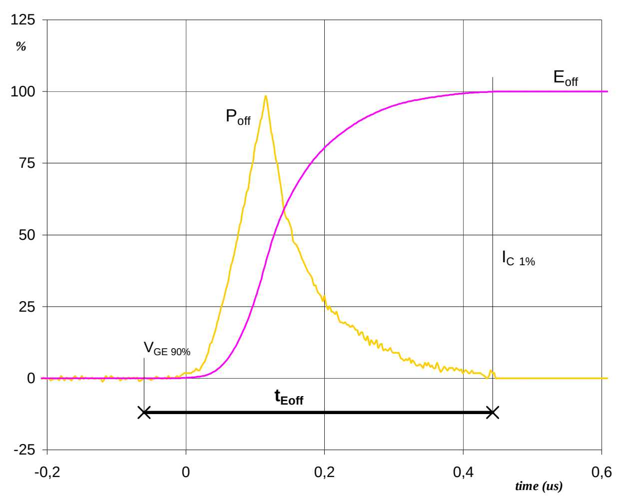


V_C (100%) =	400	V
I_C (100%) =	10	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

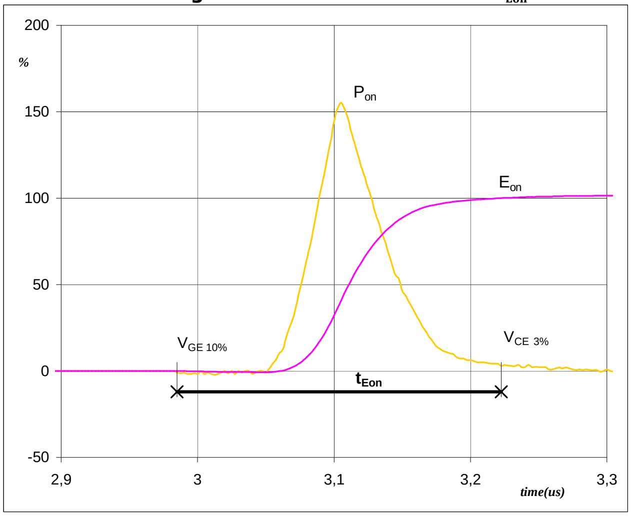
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 Output inverter IGBT

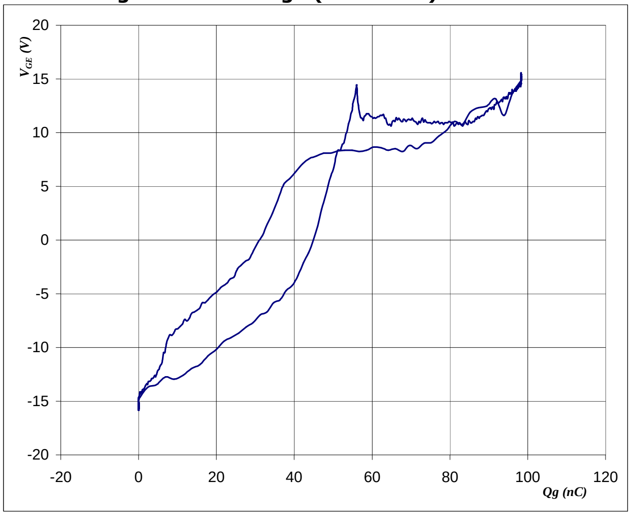
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 Output inverter FWD

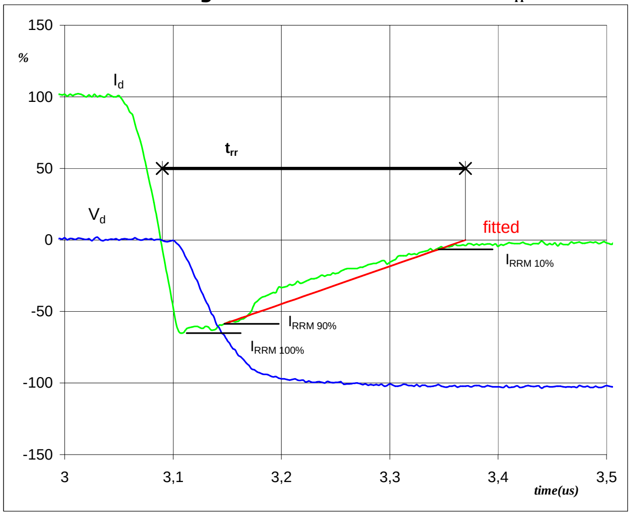
Gate voltage vs Gate charge (measured)



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

Figure 8 Output inverter IGBT

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

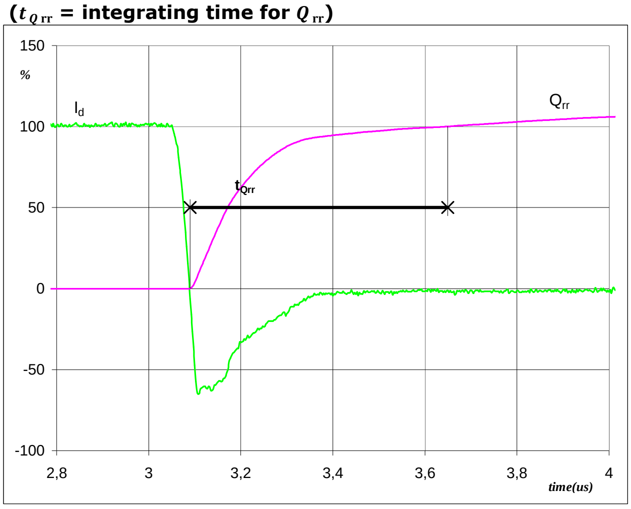


V_d (100%) =	400	V
I_d (100%) =	10	A
I_{RRM} (100%) =	-7	A
t_{rr} =	0,27	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FWD

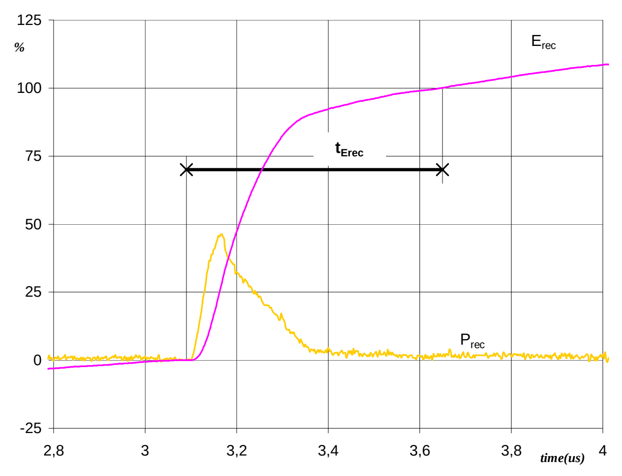
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



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

Figure 10 Output inverter 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

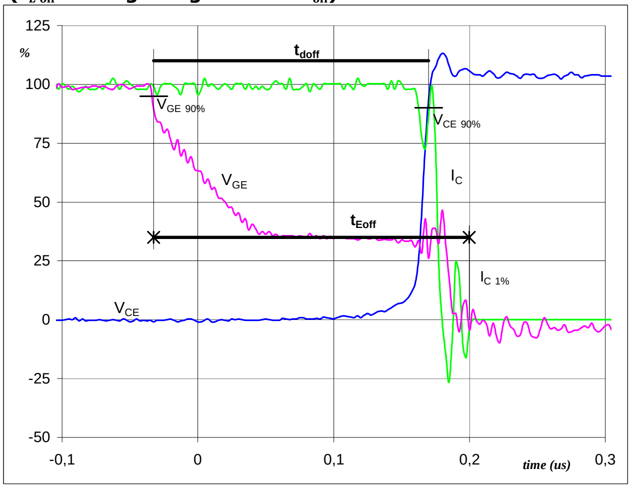
Switching Definitions PFC

General conditions

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

Figure 1 PFC MOSFET

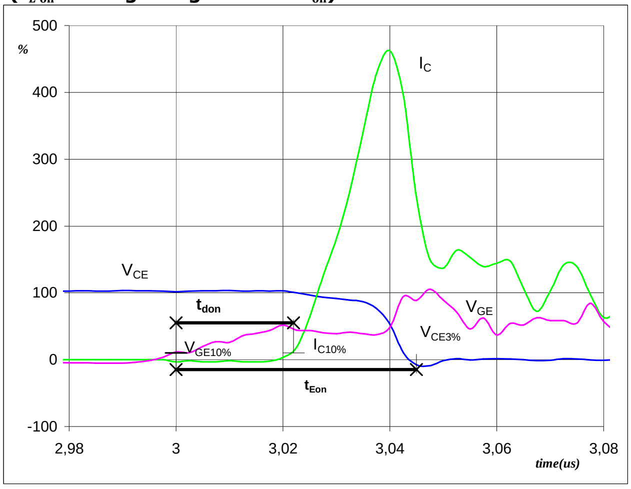
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



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

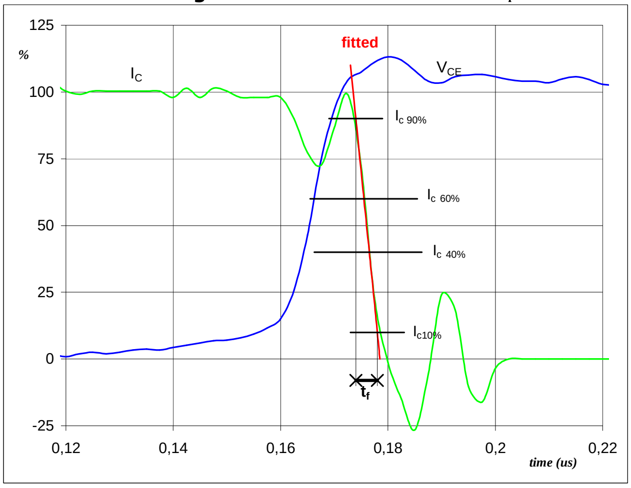
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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

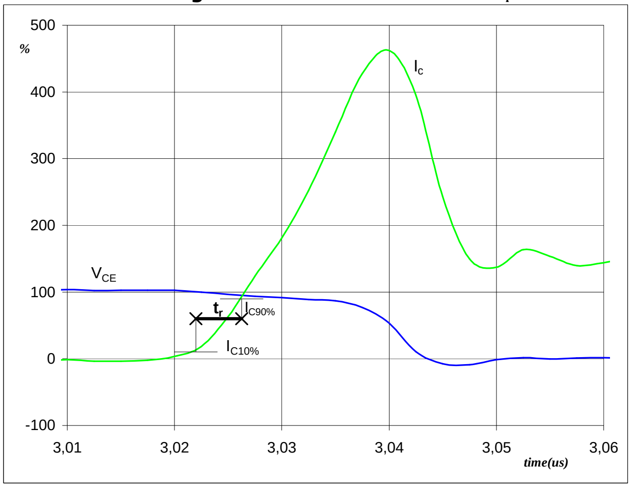
Turn-off Switching Waveforms & definition of t_f



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

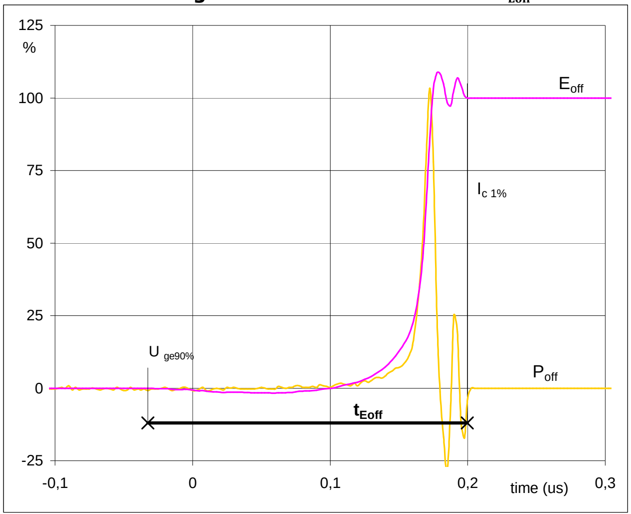


V_C (100%) =	400	V
I_C (100%) =	10	A
t_r =	0,0040	μs

Switching Definitions PFC

Figure 5 PFC MOSFET

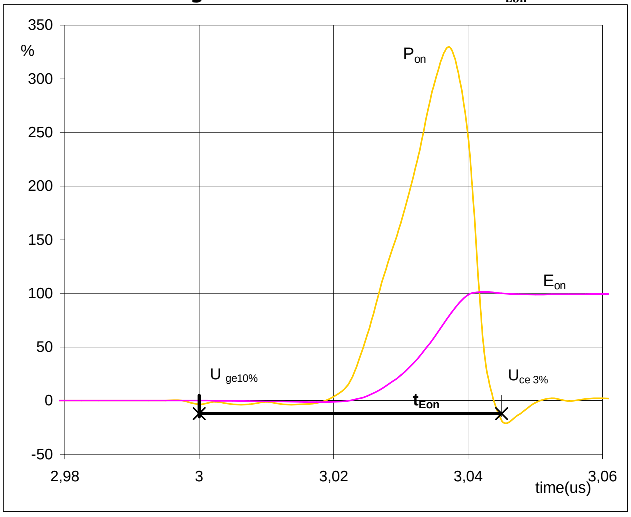
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 PFC MOSFET

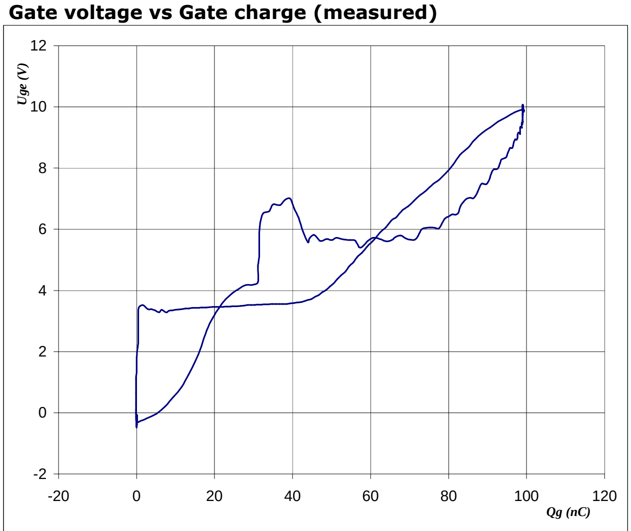
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 PFC MOSFET

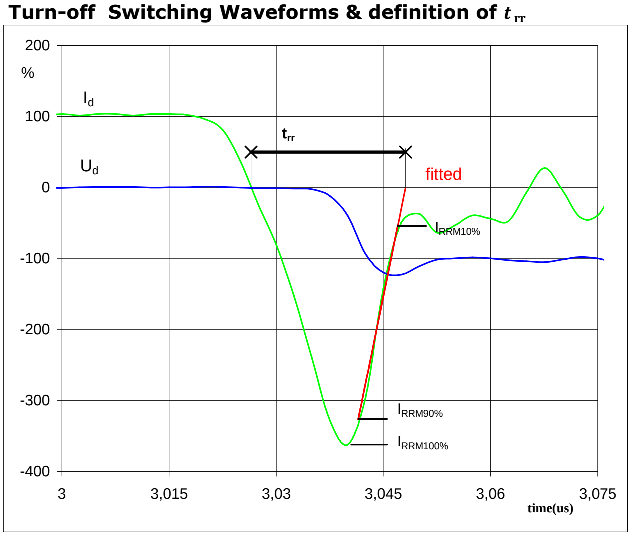
Gate voltage vs Gate charge (measured)



$V_{GE\ off}$ = 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}

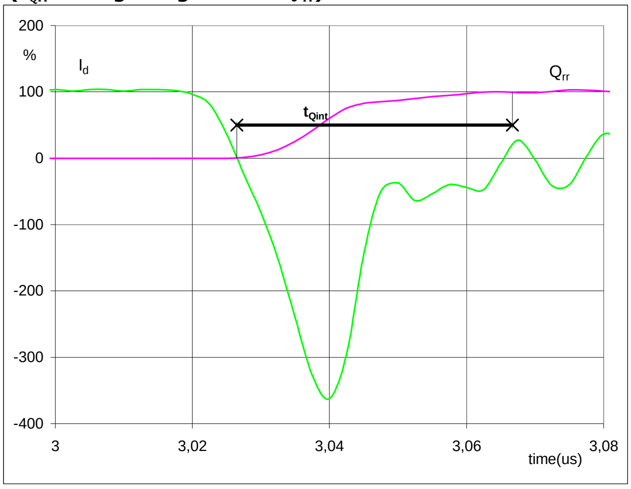


V_d (100%) = 400 V
I_d (100%) = 10 A
I_{RRM} (100%) = -36 A
t_{rr} = 0,02 μs

Switching Definitions PFC

Figure 9 PFC FWD

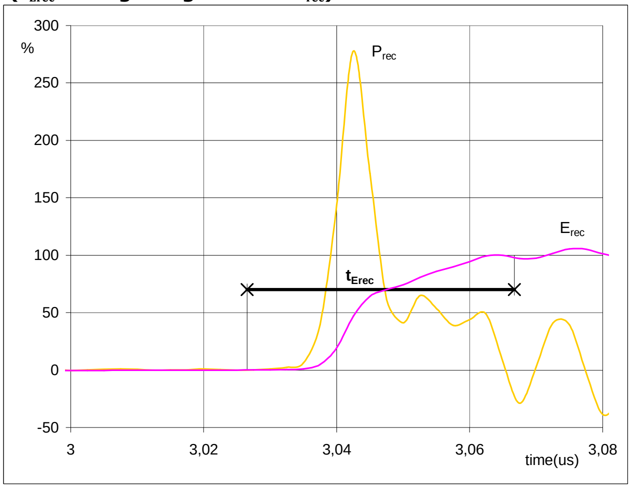
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



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 and Marking - Outline - Pinout

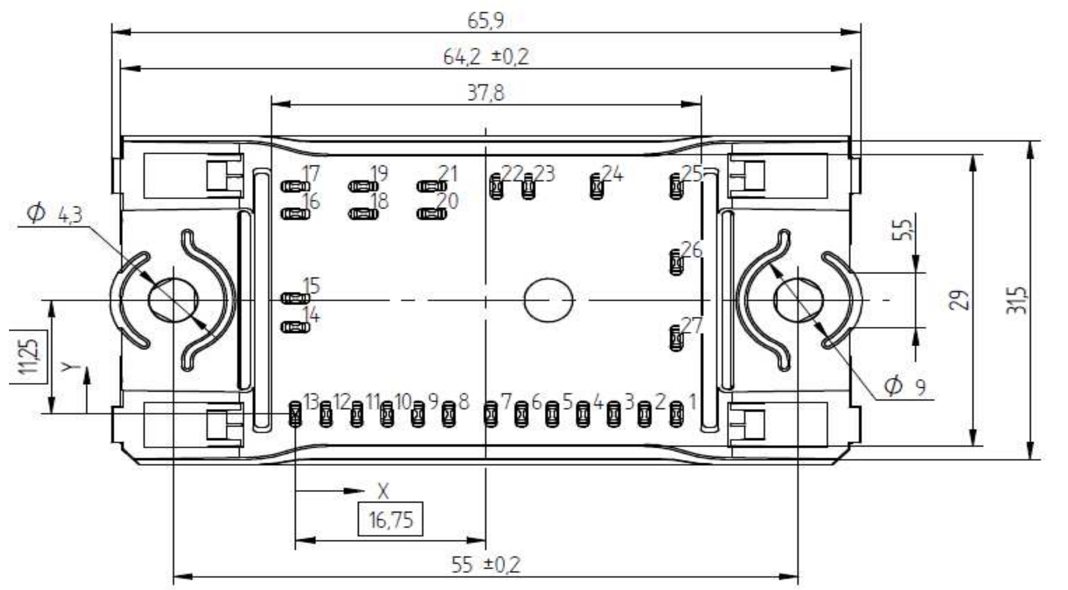
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste with solder pins	10-F006PPA010SB-M683B	M683B	M683-B
without thermal paste with Press-fit pins	10-F006PPA010SB-M683BY	M683BY	M683-BY
with thermal paste and solder pins	10-F006PPA010SB-M683B-/3/	M683B-/3/	M683B-/3/
with thermal paste and Press-fit pins	10-F006PPA010SB-M683BY-/3/	M683BY-/3/	M683BY-/3/

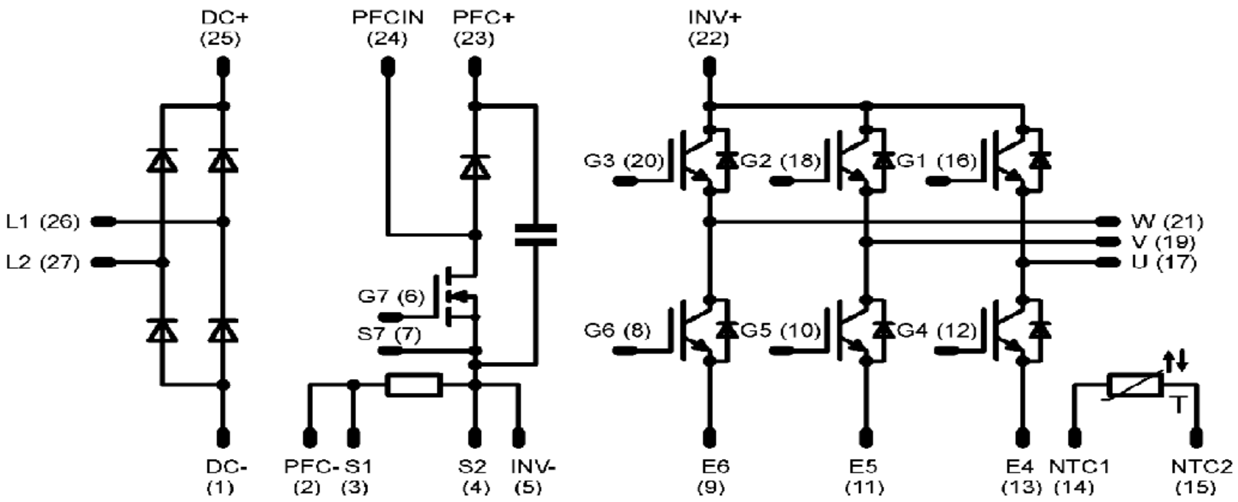
Outline

Pin table

Pin	X	Y
1	33,5	0
2	30,7	0
3	28	0
4	25,3	0
5	22,6	0
6	19,9	0
7	17,2	0
8	13,5	0
9	10,8	0
10	8,1	0
11	5,4	0
12	2,7	0
13	0	0
14	0	8,6
15	0	11,45
16	0	19,8
17	0	22,5
18	6	19,8
19	6	22,5
20	12	19,8
21	12	22,5
22	17,7	22,5
23	20,5	22,5
24	26,5	22,5
25	33,5	22,5
26	33,5	15
27	33,5	7,5



Pinout



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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.