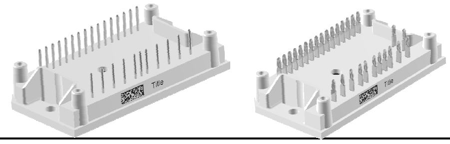
***flow* IPM 1B** **600 V / 4 A**

Features

- Input Rectifier, PFC-Boost with integrated PFC-Shunt, PFC-Controller and DC-capacitor
- 3 phase inverter with integrated DC Shunt, gate driver circuit incl. bootstrap circuit and over current protection
- Sense output of DC-current
- Temperature sensor
- Conclusive Power Flow, all power connections on one side, no input output X-ing

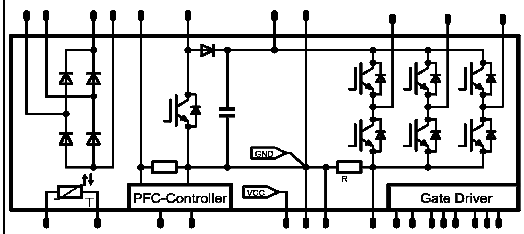
***flow* 1B housing**



Target Applications

- Low Power Industrial Drives
- Motor Integrated Fans and Pumps
- AirCon
- Electrical Tools

Schematic



Types

- 20-1B06IPB004RC-P952A40
- 20-PB06IPB004RC-P952A40Y

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	16 21	A
Surge forward current	I_{FSM}	t_p=10ms 50 Hz half sine wave	T_j=45°C	130	A
I^2t-value	I^2t			80	A^2s
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	19 29	W
Maximum Junction Temperature	T_{jmax}			150	°C
PFC IGBT					
Collector-emitter break down voltage	V_{CE}			650	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	10 14	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_j$max		45	A
Turn off safe operating area		V_{CE} ≤ 650V, T_j ≤ $T_{op\ max}$		45	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	20 30	W
Gate-emitter peak voltage	V_{GE}			±20	V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
PFC Inverse Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			650	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	7 9	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		12	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	11 17	W
Maximum Junction Temperature	T_{jmax}			175	°C
PFC Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			650	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	9 12	A
Surge forward current	I_{FSM}	t_p=8,3ms 60 Hz half sine wave		100	A
I^2t-value	I^2t			40	A^2s
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		30	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	15 23	W
Maximum Junction Temperature	T_{jmax}			175	°C
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	4 6	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_j$max		12	A
Turn off safe operating area		V_{CE} ≤ 600V, T_j ≤$T_j$max		8	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	11 17	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		8 400	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=$T_j$max	T_h=80°C T_c=80°C	5 6	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		8	A
Power dissipation	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	10 15	W
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
PFC Shunt				
DC forward current	I_F	T_c=25°C	10	A
Power dissipation	P_{tot}	T_c=25°C	9	W
PFC Controller*				
VCC supply voltage	V_{CC}	V_{CC} common with gate driver IC	26	V
VSENSE voltage	V_{VSENSE}		5,3	V
Vsense Current	I_{VSENSE}		±1	mA
FREQ pin voltage	V_{FREQ}		5,3	V
Maximum Junction Temperature	T_{jmax}		125	°C

* for more information see Infineon's datasheet ICE3PCS02

Parameter	Symbol	Condition	Value	Unit
DC - Shunt				
DC forward current	I_F	T_c=25°C	8	A
Power dissipation	P_{tot}	T_c=25°C	3,2	W
DC link Capacitor				
Max.DC voltage	V_{MAX}	T_c=25°C	500	V
Gate Driver*				
Supply voltage	V_{CC}	V_{CC} common with PFC driver	20	V
Input voltage (LIN, HIN, EN)	U_{IN}		10	V
Output voltage (FAULT)	U_{OUT}		VCC + 0.5	V

* for more information see infineon's datasheet 6ED003L02-F2

Parameter	Symbol	Condition	Value	Unit
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	Min	Typ	Max	Unit
Input Rectifier Diode										
Forward voltage *	V_F				7	Tj=25°C Tj=125°C		1,04 0,97		V
Threshold voltage (for power loss calc. only)	V_{to}				7	Tj=25°C Tj=125°C		0,87 0,74		V
Slope resistance (for power loss calc. only)	r_t				7	Tj=25°C Tj=125°C		25 33		mΩ
Reverse current	I_r			1200		Tj=25°C Tj=125°C			0,01	mA
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4W/mK						3,54		K/W
* chip data										
PFC IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}$			0,0004	Tj=25°C Tj=150°C	3,3	4	4,7	V
Collector-emitter saturation voltage*	V_{CEsat}		15		15	Tj=25°C Tj=150°C		2,18 2,74	2,22	V
Collector-emitter cut-off	I_{CES}		0	650		Tj=25°C Tj=150°C			0,04	mA
Rise time	t_r		U_{CC}=15V	400	4	Tj=25°C Tj=150°C		2 2		ns
Turn-off delay time **	$t_{d(off)}$					Tj=25°C Tj=150°C		107 161		ns
Fall time	t_f					Tj=25°C Tj=150°C		4 2		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,055 0,091		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,020 0,038		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		930		pF
Output capacitance	C_{oss}							24		pF
Reverse transfer capacitance	C_{rss}							4		pF
Gate charge	Q_G		±15	520	15	Tj=25°C		38		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4W/mK						4,77		K/W
* chip data										
PFC Inverse Diode										
Diode forward voltage	V_F				6	Tj=25°C Tj=125°C		1,17 0,91		V
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4W/mK						8,45		K/W
PFC Diode										
Forward voltage *	V_F				15	Tj=25°C Tj=150°C		2,05 2,10	2,22	V
Peak recovery current	I_{RRM}		U_{CC}=15V	400	4	Tj=25°C Tj=150°C		11 13		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		18 28		ns
Reverse recovery charge	Q_{rr}					Tj=25°C Tj=150°C		0,12 0,24		µC
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		0,013 0,033		mWs
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		959 452		A/µs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4W/mK						6,16		K/W
* chip data										
PFC Shunt										
R1 value	R							100		mΩ

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	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,000075	Tj=25°C Tj=150°C	4,4	5	5,6	V
Collector-emitter saturation voltage*	V_{CEsat}		15		4	Tj=25°C Tj=150°C	0,8	2,20 2,29	2,8	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,1	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time **	$t_{d(on)}$		U_{CC}=15V V_{IN}=5V	400	4	Tj=25°C Tj=150°C		586 635		ns
Rise time	t_r					Tj=25°C Tj=150°C		21 30		
Turn-off delay time **	$t_{d(off)}$					Tj=25°C Tj=150°C		666 749		
Fall time	t_f					Tj=25°C Tj=150°C		20 50		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,117 0,198		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,072 0,115		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		305		pF
Output capacitance	C_{oss}							18		
Reverse transfer capacitance	C_{rss}							9		
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4W/mK						8,32		K/W
* chip data ** including gate driver										
Inverter Diode										
Diode forward voltage *	V_F				10	Tj=25°C Tj=150°C	0,7	2,93 2,83	2,5	V
Peak reverse recovery current	I_{RRM}		U_{CC}=15V V_{IN}=5V	400	4	Tj=25°C Tj=150°C		2 3		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		166 254		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0,18 0,35		nC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=150°C		25 16		A/μs
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		0,045 0,085		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Phase-Change Material λ = 3,4W/mK						9,86		K/W
* chip data										
DC - Shunt										
R2 value	R					Tj=25°C		50		mΩ
DC link Capacitor										
C value	C							100		nF

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	
Gate Driver										
Supply voltage	V_{CC}					Tj=25°C Tj=125°C	13	15	17,5	V
Quiescent Vcc supply current	I_{QCC}	V_{LIN}=0V; V_{HIN}=3,3V				Tj=25°C Tj=125°C		1,3	2	mA
Input voltage (LIN, HIN, EN)	V_{IN}	V_{CC} = 15V				Tj=25°C Tj=125°C	0		5	V
Input voltage (GATE)	V_{GATE}					Tj=25°C Tj=125°C	0		15	
Logic "0" input voltage (LIN, HIN)	V_{IH}					Tj=25°C Tj=125°C	1,7	2,1	2,4	
Logic "1" input voltage (LIN, HIN)	V_{IL}					Tj=25°C Tj=125°C	0,7	0,9	1,1	
Positive going threshold voltage (EN)	$V_{EN, TH+}$					Tj=25°C Tj=125°C	1,9	2,1	2,3	
Negative going threshold voltage (EN)	$V_{EN, TH-}$					Tj=25°C Tj=125°C	1,1	1,3	1,5	
Input clamp voltage (LIN, HIN, EN)	$V_{IN, CLAMP}$	I_{IN} = 4mA				Tj=25°C Tj=125°C	9	10,3	12	
ITRIP positive going threshold	$V_{IT, TH+}$					Tj=25°C Tj=125°C	380	445	510	mV
Input bias current LIN high	I_{LIN+}	V_{LIN} = 3,3V				Tj=25°C Tj=125°C		70	100	µA
Input bias current LIN low	I_{LIN-}	V_{LIN} = 0V				Tj=25°C Tj=125°C		110	200	
Input bias current HIN high	I_{HIN+}	V_{HIN} = 3,3V				Tj=25°C Tj=125°C		70	100	
Input bias current HIN low	I_{HIN-}	V_{HIN} = 0V				Tj=25°C Tj=125°C		110	200	
Input bias current EN high	I_{EN+}	V_{HIN} = 3,3V				Tj=25°C Tj=125°C		45	120	
Output voltage (FAULT)	V_{FLT}					Tj=25°C Tj=125°C	0		V_{CC}	V
Low on resistor of pull down trans. (FAULT)	$R_{ON, FLT}$	V_{FAULT}=0.5 V				Tj=25°C Tj=125°C		45	100	Ω
Pulse width for ON or OFF	t_{IN}					Tj=25°C Tj=125°C	1			µs
Turn-on propagation delay (LIN, HIN)	t_{ON}	$V_{LIN/HIN}$ = 0V or 3,3V				Tj=25°C Tj=125°C	400	530	800	ns
Turn-off propagation delay (LIN, HIN)	t_{OFF}	$V_{LIN/HIN}$ = 0V or 3,3V				Tj=25°C Tj=125°C	360	490	760	
FAULT reset time	t_{RST}					Tj=25°C Tj=125°C		4		ms
Fixed deadtime between high and low side	t_{DT}	$V_{LIN/HIN}$ = 0V & 3,3V				Tj=25°C Tj=125°C	150	310		ns

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
Thermistor										
Rated resistance	R					Tj=25°C		22000		Ω
Deviation of R100	ΔR/R					Tj=100°C	-12		12	%
Power dissipation	P					Tj=25°C		200		mW
Power dissipation constant						Tj=25°C		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3998		K
Vincotech NTC Reference						Tj=25°C			B	
PFC Controller										
VCC turn-on threshold	V_{CCon}					Tj=25°C	11,5	12,0	12,9	V
VCC turn-off threshold	V_{CCUVLO}					Tj=25°C	10,5	11,0	11,9	V
Operating current with active GATE	I_{CCHG}	C_L=1nF				Tj=25°C		6,4	8,5	mA
Operating current during standby	I_{CCstby}					Tj=25°C		3,5	4,7	mA
PFC switching fequency	F_{SWnom}	Set with an internal resistor R_{FREQ}=220kΩ*				Tj=25°C		20		kHz
DC link voltage	DC2+	Set with an internal resistor divider**				Tj=25°C	339	350	361	V
DC link treshold (OVP1) low to high	$V_{OVP1L2H}$	relative to output voltage OVP1 values varies with external resistor Feedback voltage V_{DClink}/130 can be measured at VSENSE pin				Tj=25°C		108		%
DC link treshold (OVP1) high to low	$V_{OVP1H2L}$					Tj=25°C		100		%
Blanking time for OVP1	t_{OVP1}					Tj=25°C		12		μs
DC link treshold (OVP1) hysteresis	V_{OVP1_HYS}					Tj=25°C	6	8	11	%
DC link treshold (OVP2) low to high	V_{OVP2_L2H}					Tj=25°C	428	443	460	V
DC link treshold (OVP2) high to low	V_{OVP2_H2L}	relative to OVP2				Tj=25°C		92		%
Blanking time for OVP2	t_{OVP2}					Tj=25°C		12		μs

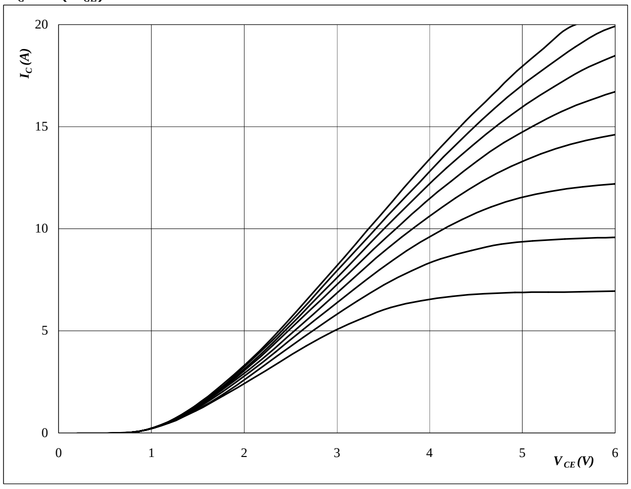
*switching frequency is setable by an external resistor between pins 14-16 (see figure 1 on page28 for values)
**DC link voltage is setable by an external resistor between pins 14-15 (see figure 2 on page28 for values)

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



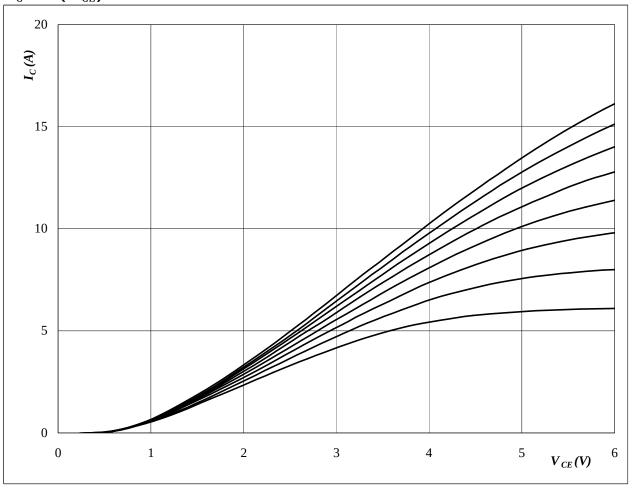
At

t_p =	250	μs
T_j =	25	°C
U_{CC} from	10 V to	17V in steps of 1V

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



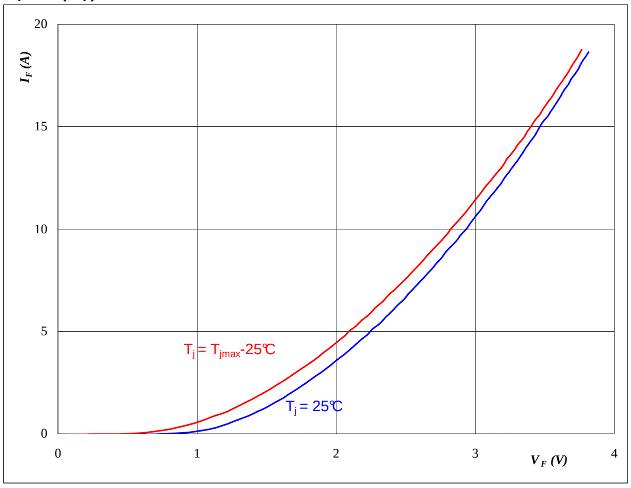
At

t_p =	250	μs
T_j =	125	°C
U_{CC} from	10 V to	17V in steps of 1V

Figure 3 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

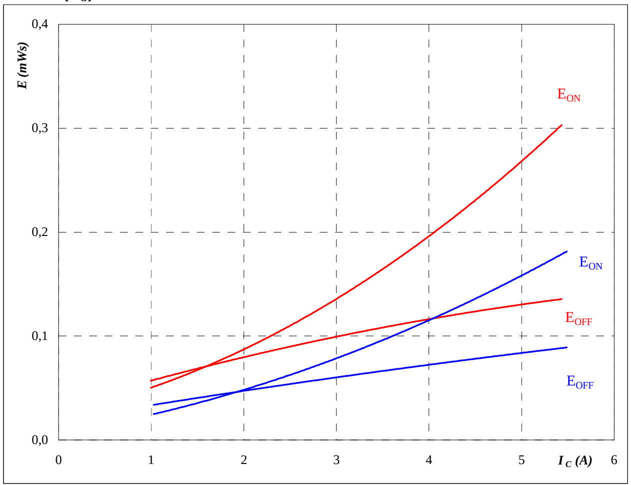
t_p =	250	μs

Output Inverter

Figure 4 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



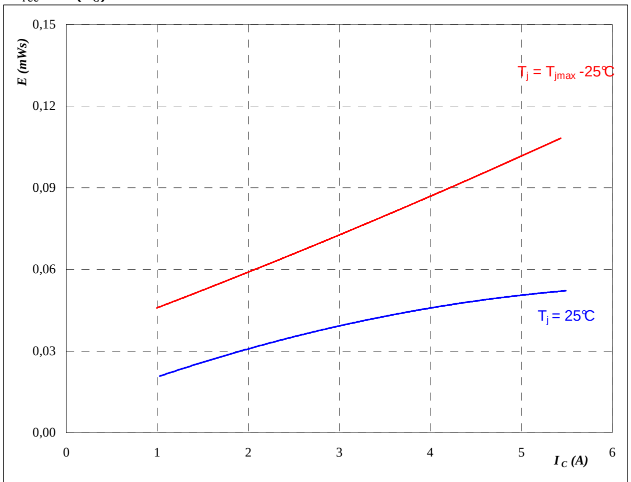
With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 5 Output inverter FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

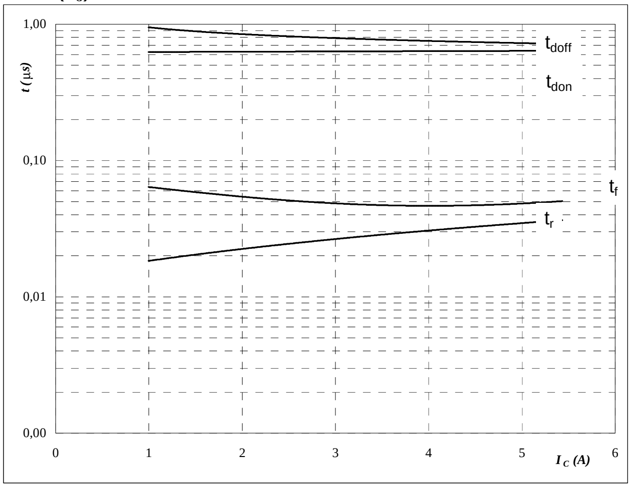
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Output Inverter

Figure 6 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



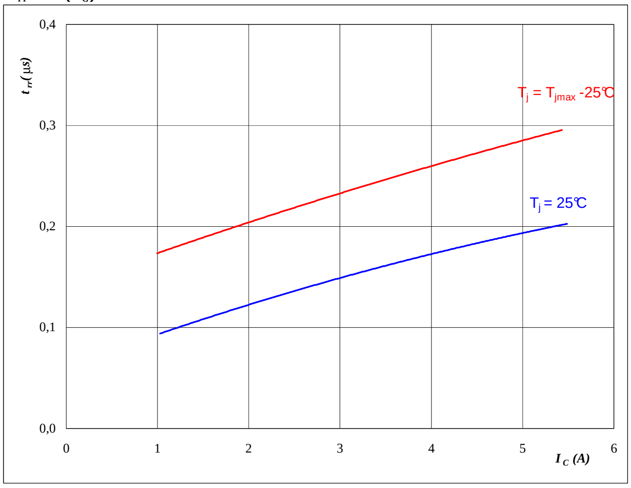
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 7 Output inverter FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



At

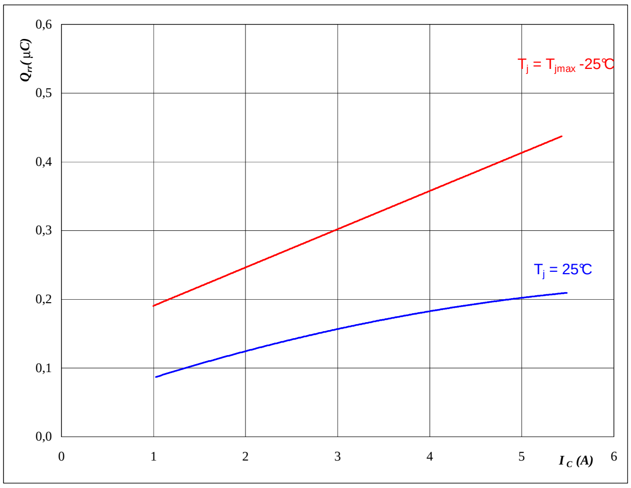
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Output Inverter

Figure 8 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



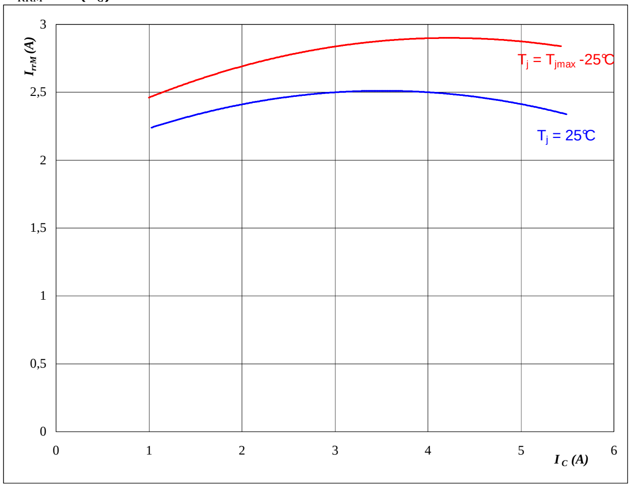
At

T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 9 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



At

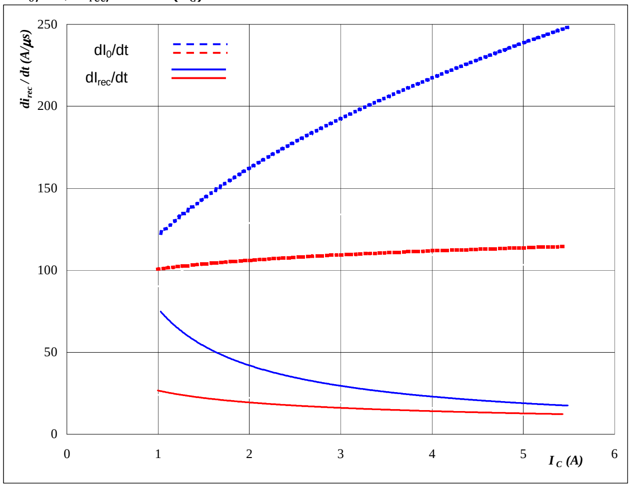
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Output Inverter

Figure 10 Output inverter FWD

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

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



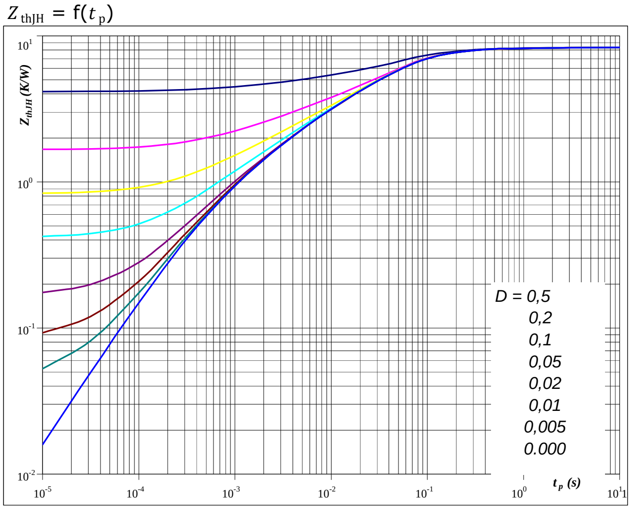
At

T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 11 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} =	8,32	K/W

IGBT thermal model values

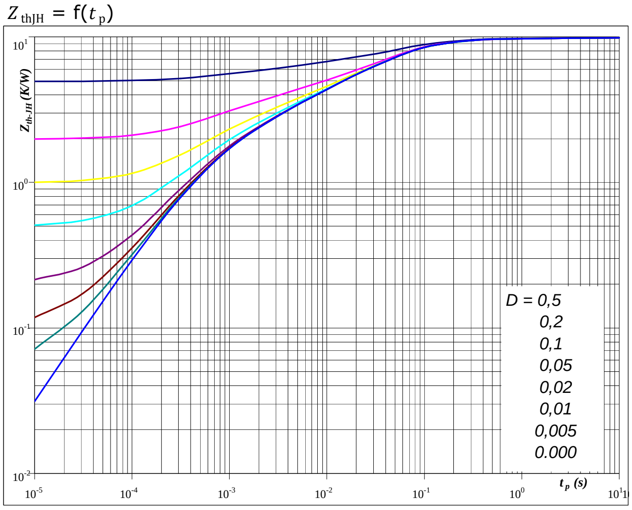
Thermal grease

R (K/W)	Tau (s)
0,24	1,4470
1,23	0,1572
4,17	0,0448
1,43	0,0085
0,87	0,0021
0,37	0,0004

Figure 12 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} =	9,86	K/W

FWD thermal model values

Thermal grease

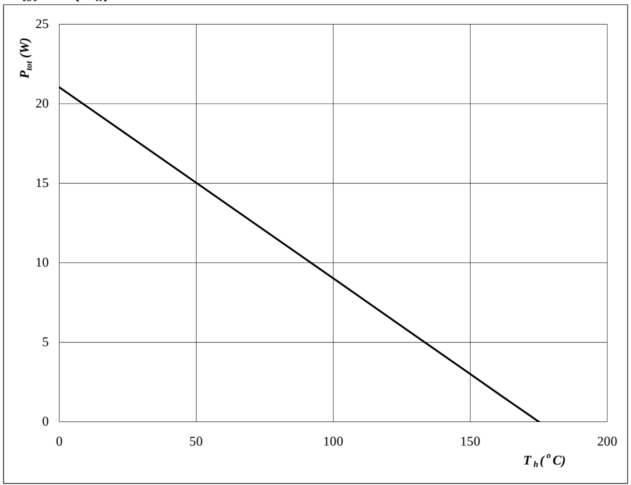
R (K/W)	Tau (s)
0,21	2,7550
0,95	0,2138
4,60	0,0490
1,66	0,0101
1,33	0,0022
1,11	0,0005

Output Inverter

Figure 13	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



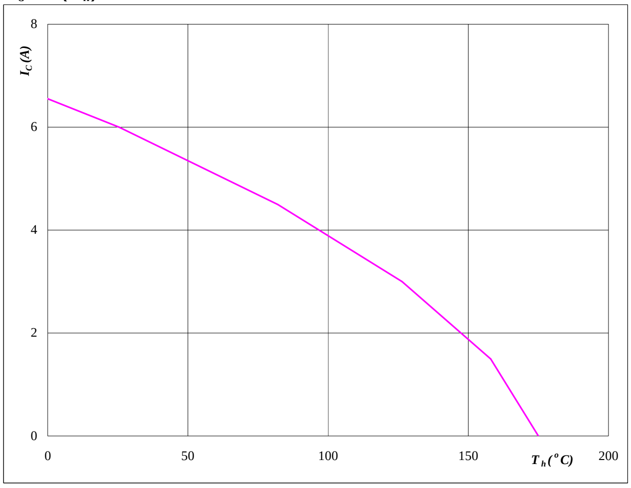
At

T_j = 175 °C

Figure 14	Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

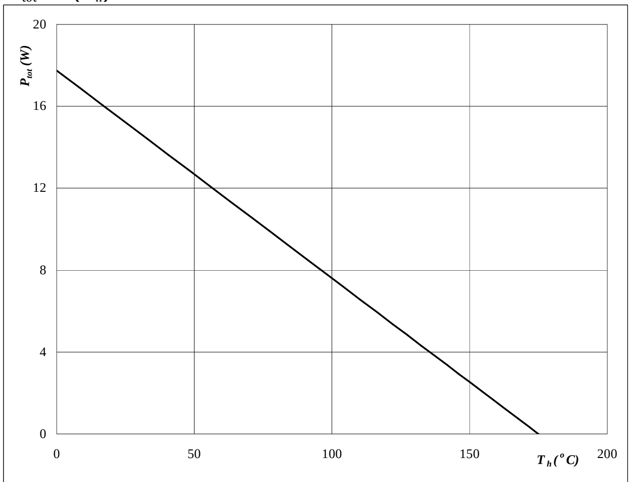
T_j = 175 °C

U_{CC} = 15 V

Figure 15	Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



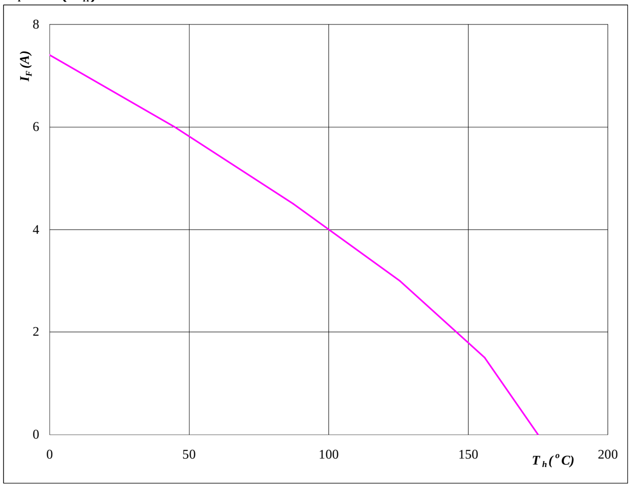
At

T_j = 175 °C

Figure 16	Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

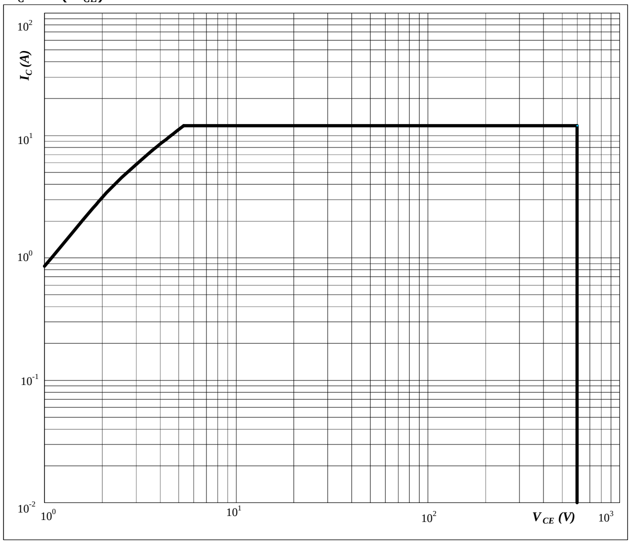
T_j = 175 °C

Output Inverter

Figure 17 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



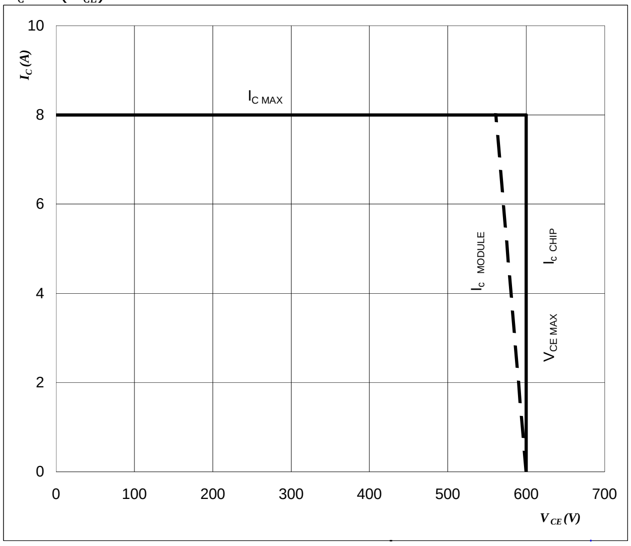
At

$T_j \leq$	T_{jmax}	ºC
U_{CC}=	15	V

Figure 18 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

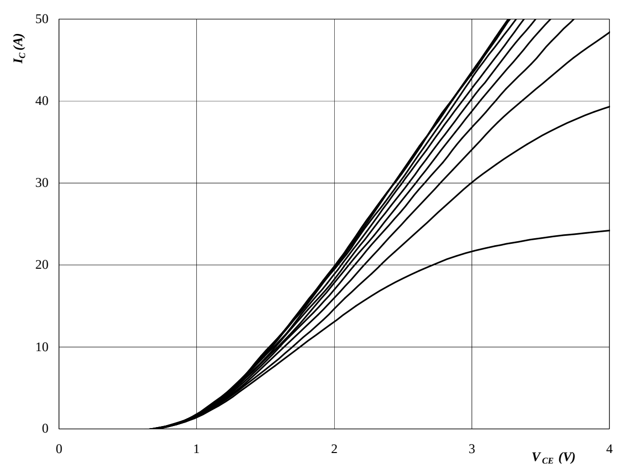
T_j =	T_{jmax}-25	ºC

PFC

Figure 1 PFC IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

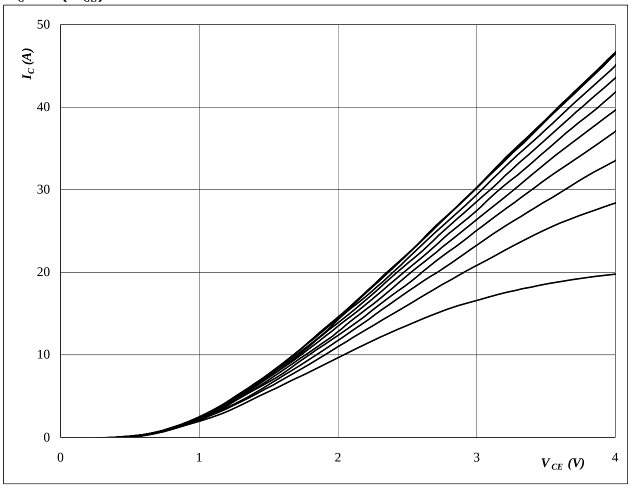
T_j = 25 °C

U_{CC} from 7 V to 17V in steps of 1V

Figure 2 PFC IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

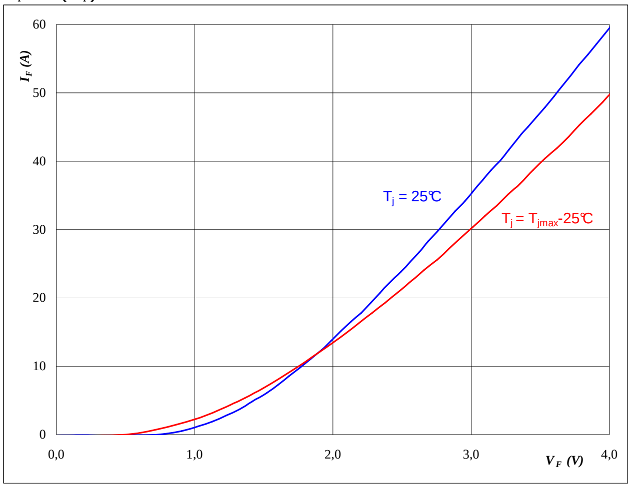
T_j = 150 °C

U_{CC} from 7 V to 17V in steps of 1V

Figure 3 PFC FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

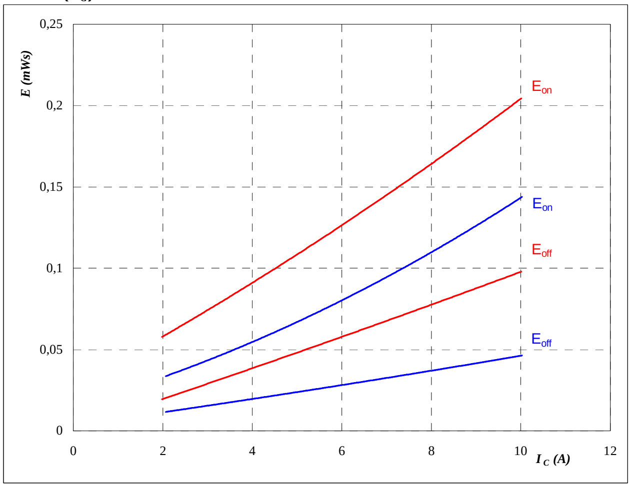
t_p = 250 µs

PFC

Figure 4	PFC IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



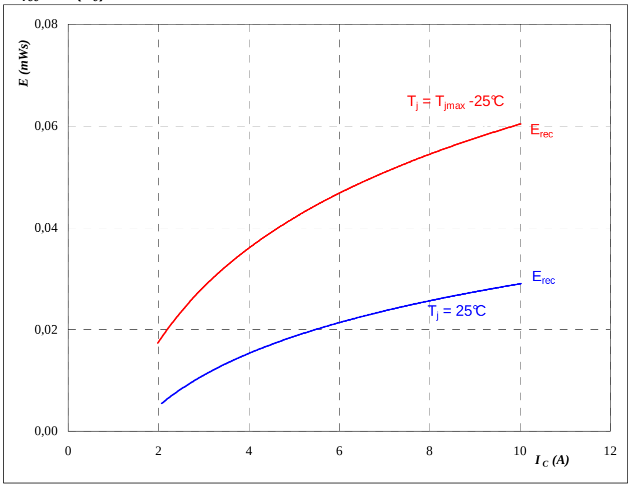
With an inductive load at

T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 5	PFC IGBT

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_c)$



With an inductive load at

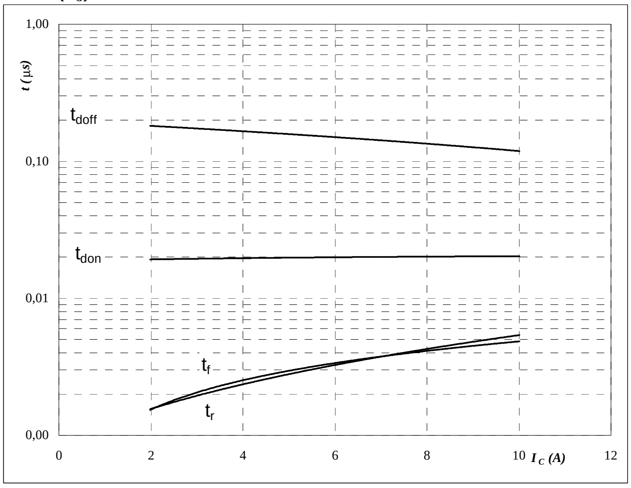
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

PFC

Figure 6 PFC IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



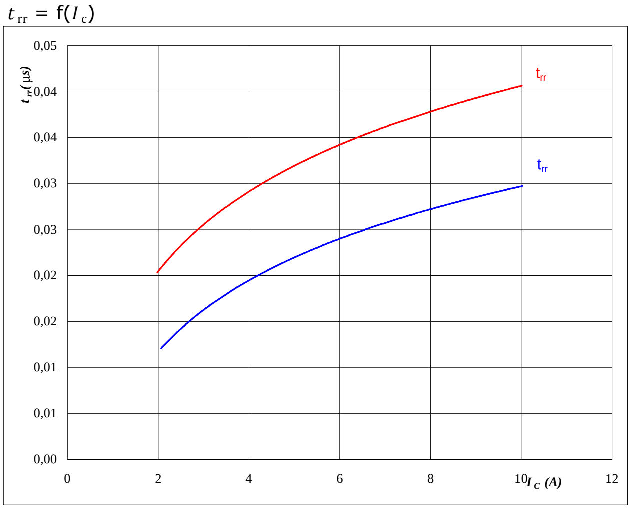
With an inductive load at

T_j =	125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 7 PFC FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



At

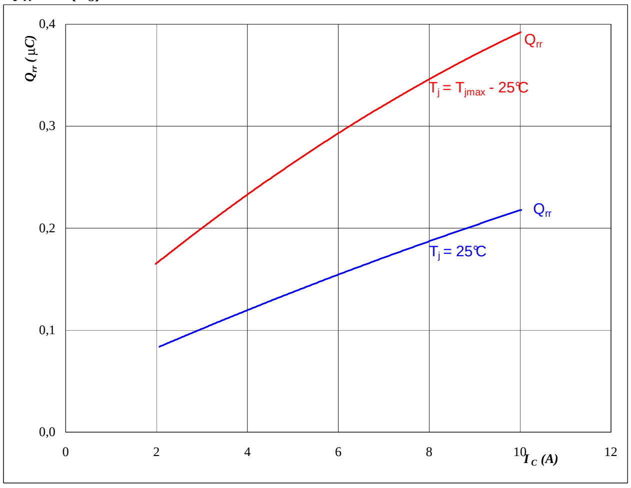
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

PFC

Figure 8 PFC FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



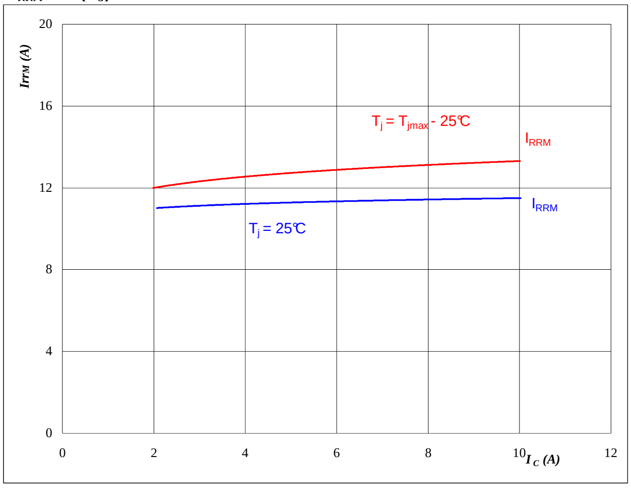
At

T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 9 PFC FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



At

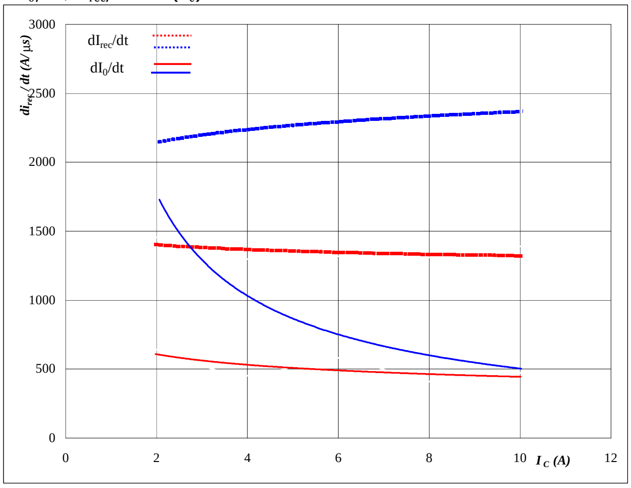
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

PFC

Figure 10 PFC FWD

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

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



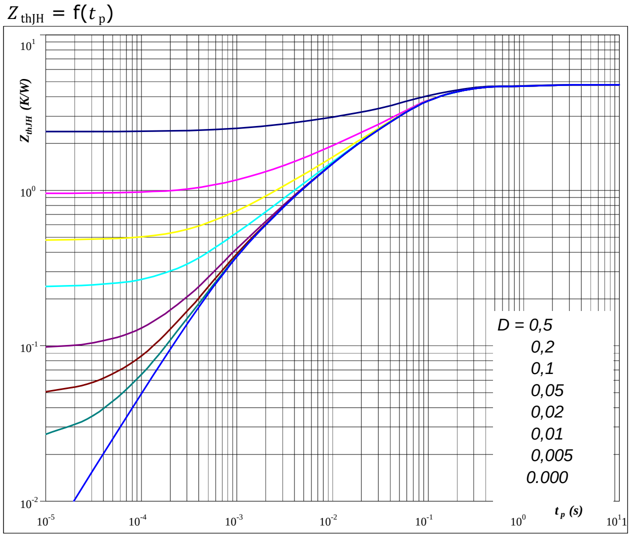
At

T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Figure 11 PFC IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	4,77	K/W

IGBT thermal model values

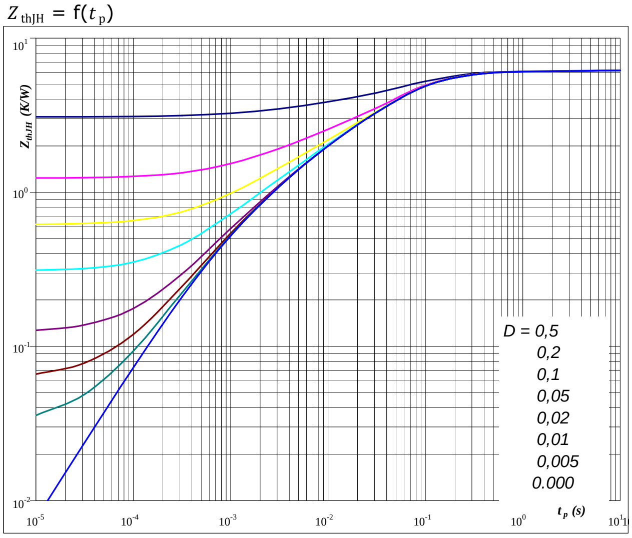
Thermal grease

R (K/W)	Tau (s)
0,24	0,9339
2,01	0,09693
1,56	0,03256
0,71	0,004783
0,25	0,000845

Figure 12 PFC FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	6,16	K/W

FWD thermal model values

Thermal grease

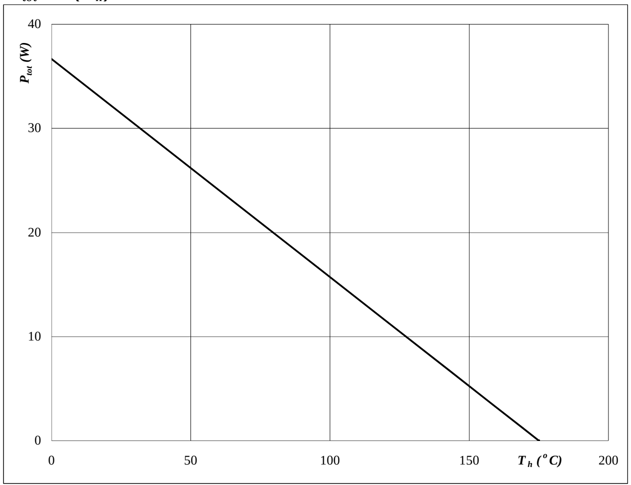
R (K/W)	Tau (s)
0,16	2,278
0,78	0,2352
3,34	0,05952
0,97	0,01208
0,69	0,00294
0,23	0,000584

PFC

Figure 13	PFC IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



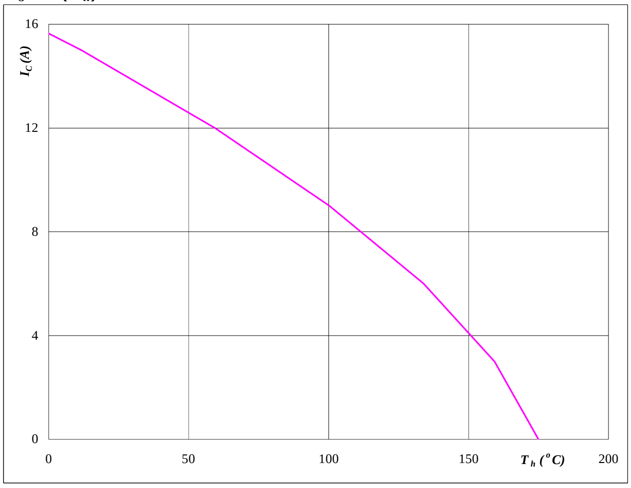
At

T_j = 175 °C

Figure 14	PFC IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

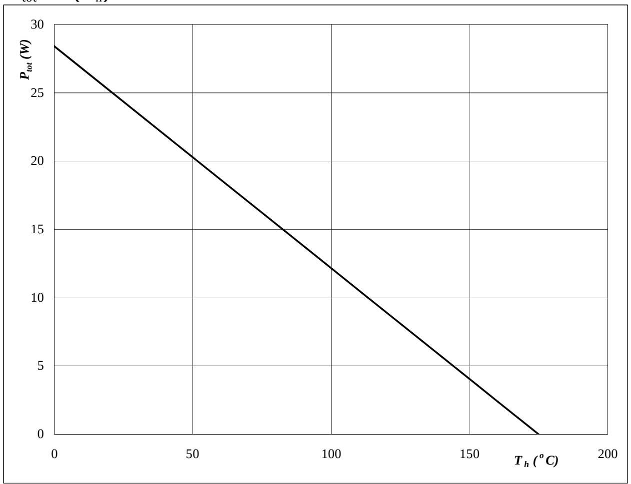
T_j = 175 °C

U_{CC}= 15 V

Figure 15	PFC FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



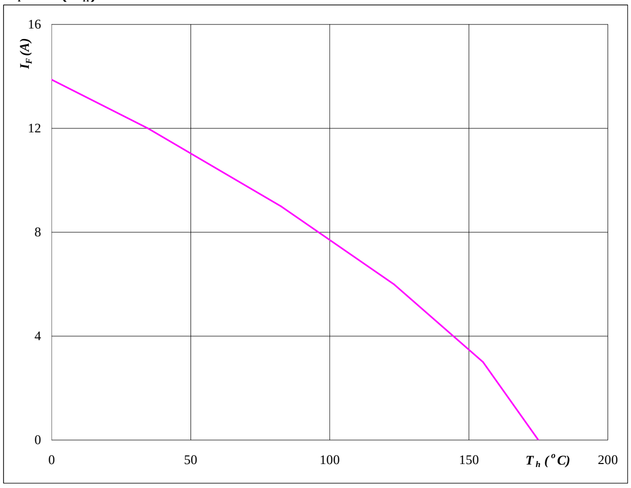
At

T_j = 175 °C

Figure 16	PFC FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

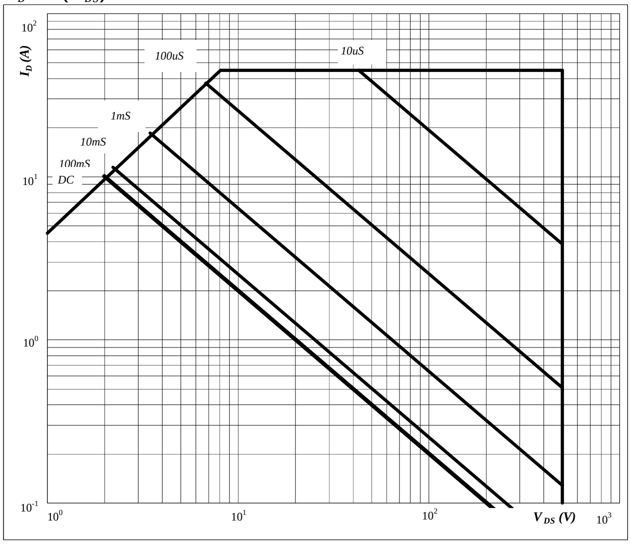
T_j = 175 °C

PFC

Figure 17 PFC IGBT

Safe operating area as a function of collector-emitter voltage

$I_D = f(V_{DS})$



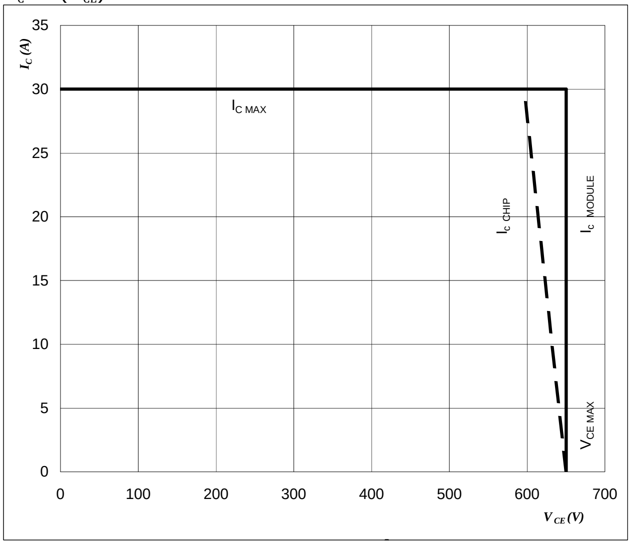
At

D =	single pulse	
T_h =	80	ºC
U_{CC}=	15	V
T_j =	T_{jmax}	ºC

Figure 18 PFC IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

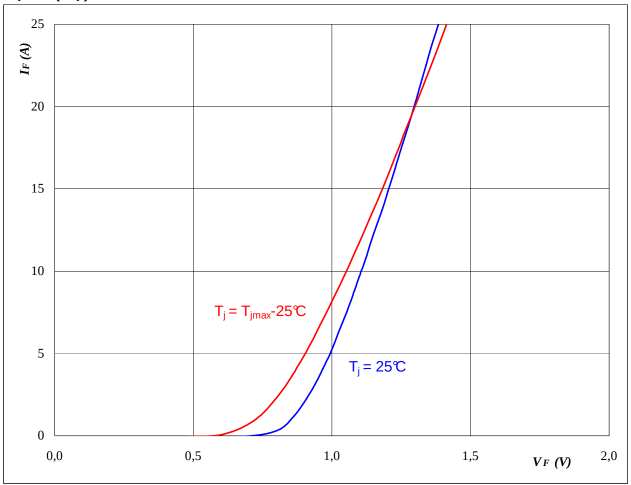
T_j =	T_{jmax}-25	ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



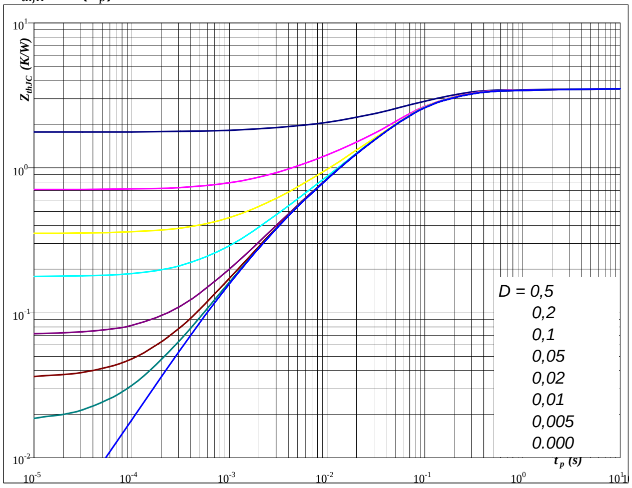
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

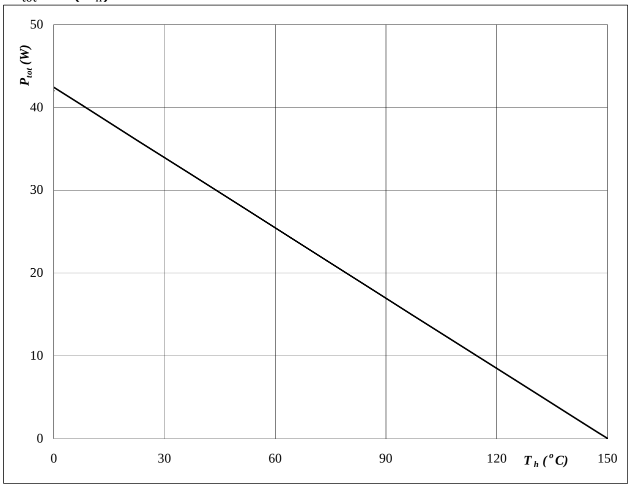
D = t_p / T

R_{thJH} = 3,54 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



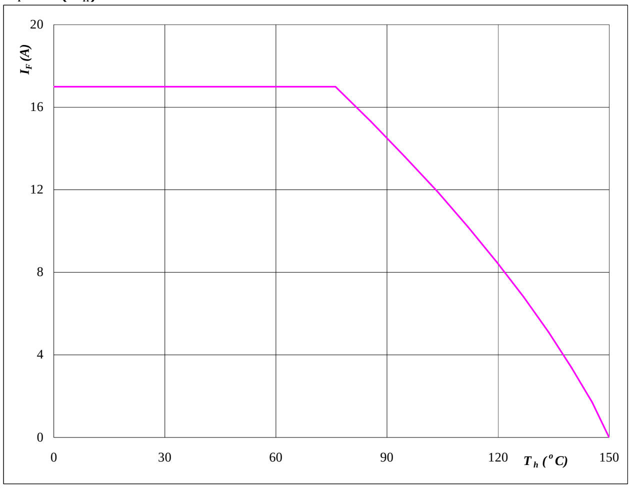
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



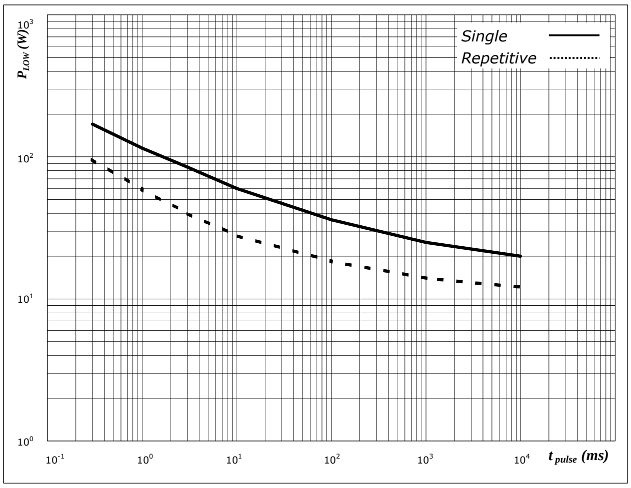
At

T_j = 150 ºC

Shunt

Figure 1	PFC Shunt

Pulse Power R1

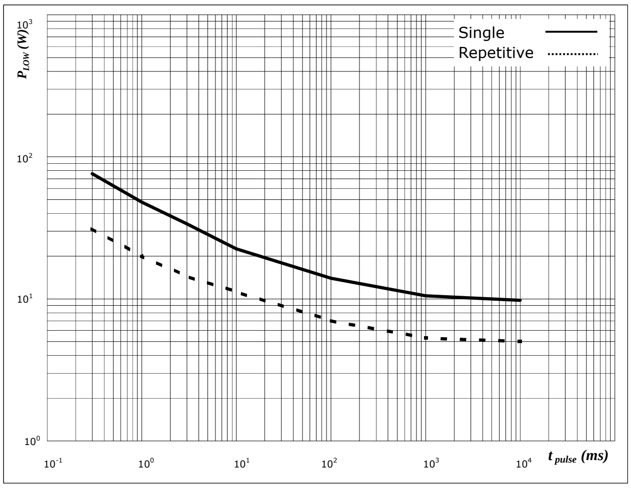


——— dR/R_0 < 1% after 1 pulse

.... dR/R_0 < 1% after 10.000 cycles; duty cycle< 0,1%

Figure 2	DC Shunt

Pulse Power R2



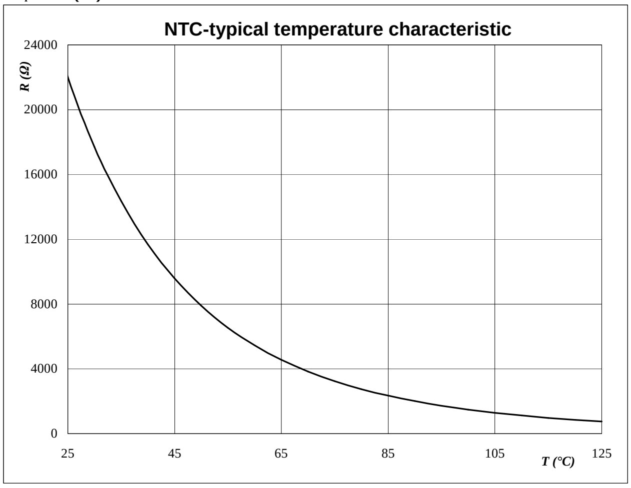
——— dR/R_0 < 1% after 1 pulse

.... dR/R_0 < 1% after 10.000 cycles; duty cycle< 0,1%

Thermistor

Figure 1	Thermistor

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



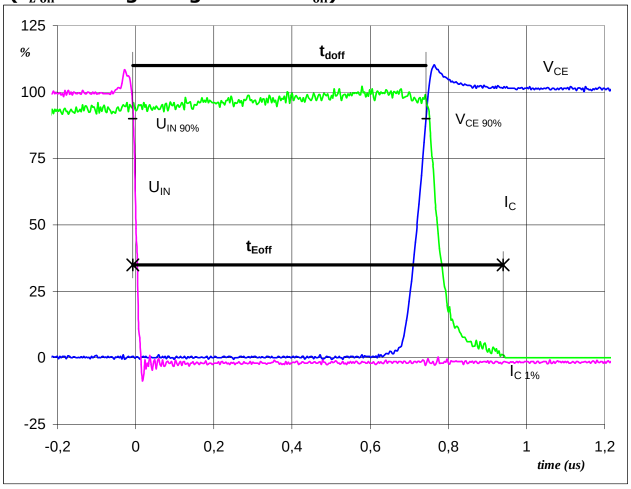
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C

Figure 1 Output inverter IGBT

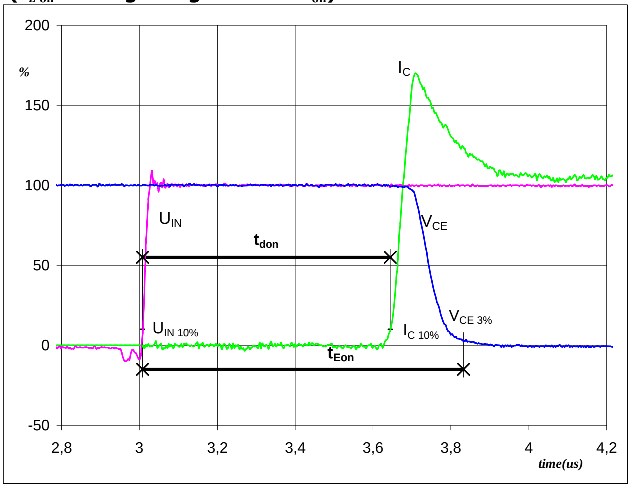
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



U_{IN} (0%) =	0	V
U_{IN} (100%) =	5	V
V_C (100%) =	400	V
I_C (100%) =	4	A
t_{doff} =	0,75	µs
$t_{E\,off}$ =	0,95	µs

Figure 2 Output inverter IGBT

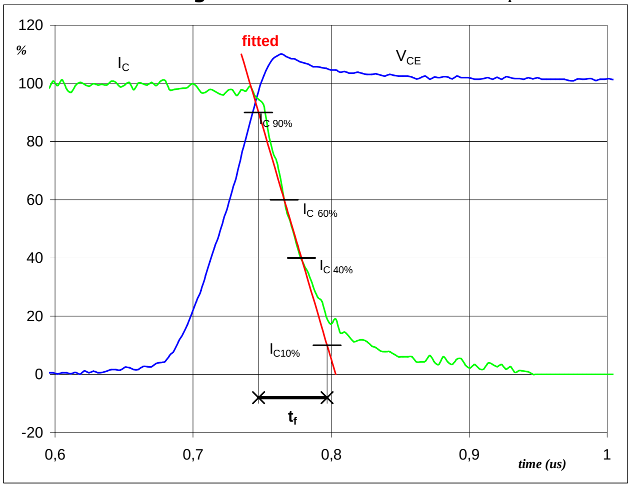
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



U_{IN} (0%) =	0	V
U_{IN} (100%) =	5	V
V_C (100%) =	400	V
I_C (100%) =	4	A
t_{don} =	0,64	µs
$t_{E\,on}$ =	0,82	µs

Figure 3 Output inverter IGBT

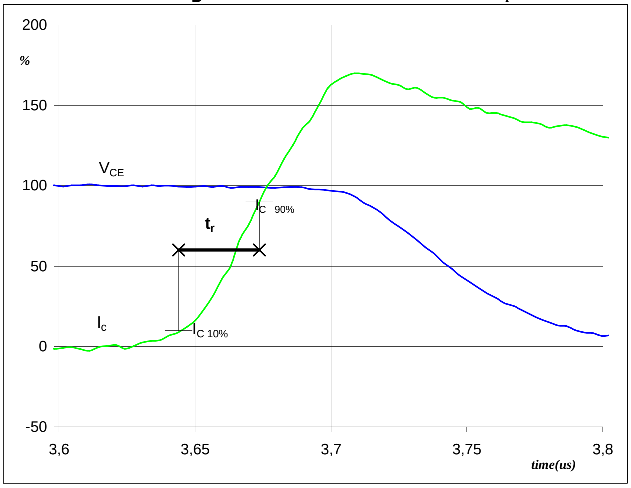
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	4	A
t_f =	0,05	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

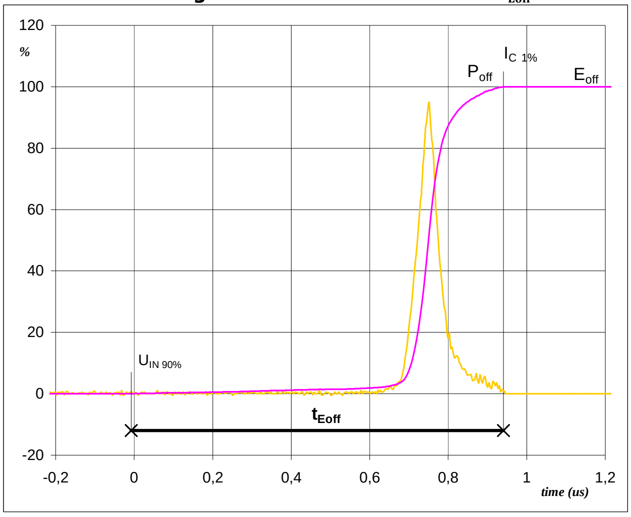


V_C (100%) =	400	V
I_C (100%) =	4	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

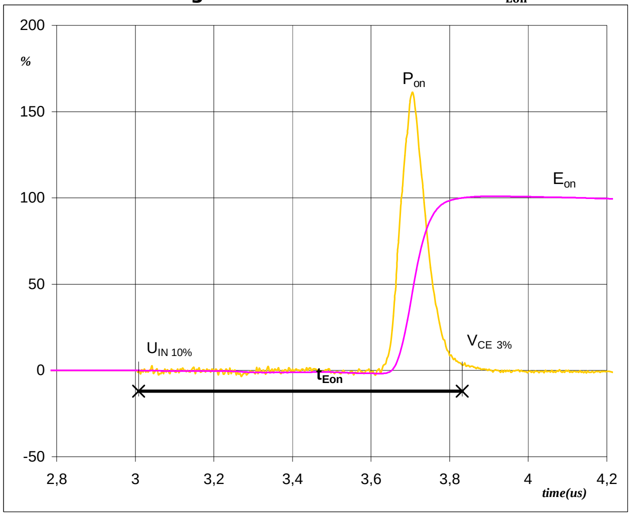
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	1,61	kW
E_{off} (100%) =	0,12	mJ
$t_{E\ off}$ =	0,95	μs

Figure 6 Output inverter IGBT

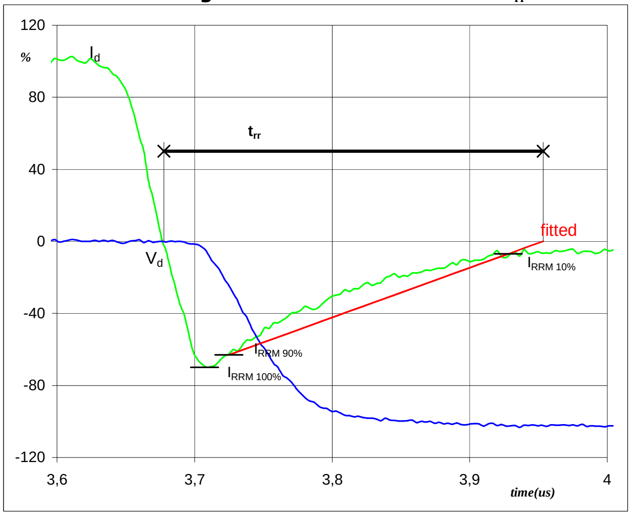
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	1,61	kW
E_{on} (100%) =	0,20	mJ
$t_{E\ on}$ =	0,82	μs

Figure 7 Output inverter FWD

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

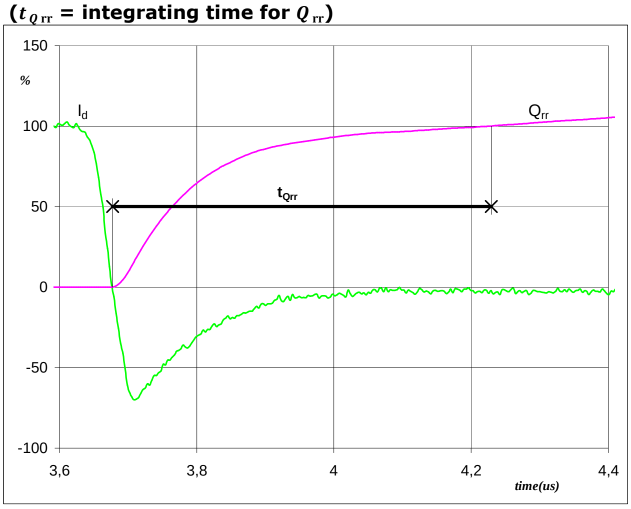


V_d (100%) =	400	V
I_d (100%) =	4	A
I_{RRM} (100%) =	-3	A
t_{rr} =	0,25	μs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

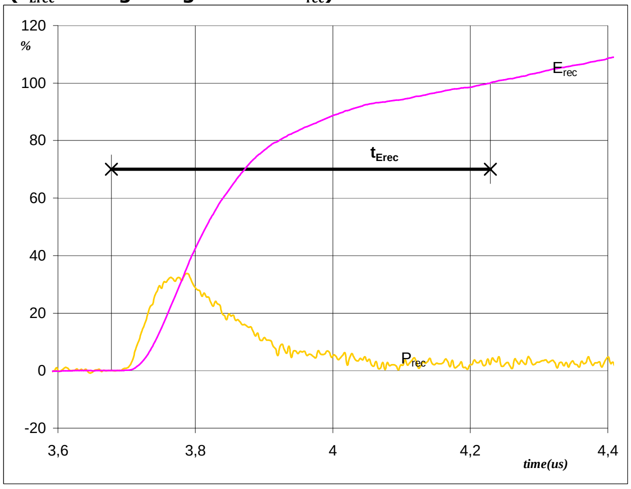
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	4	A
Q_{rr} (100%) =	0,35	µC
$t_{Q\,rr}$ =	0,55	µs

Figure 9 Output inverter FWD

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



P_{rec} (100%) =	1,61	kW
E_{rec} (100%) =	0,09	mJ
$t_{E\,rec}$ =	0,55	µs

Ordering Code and Marking - Outline - Pinout

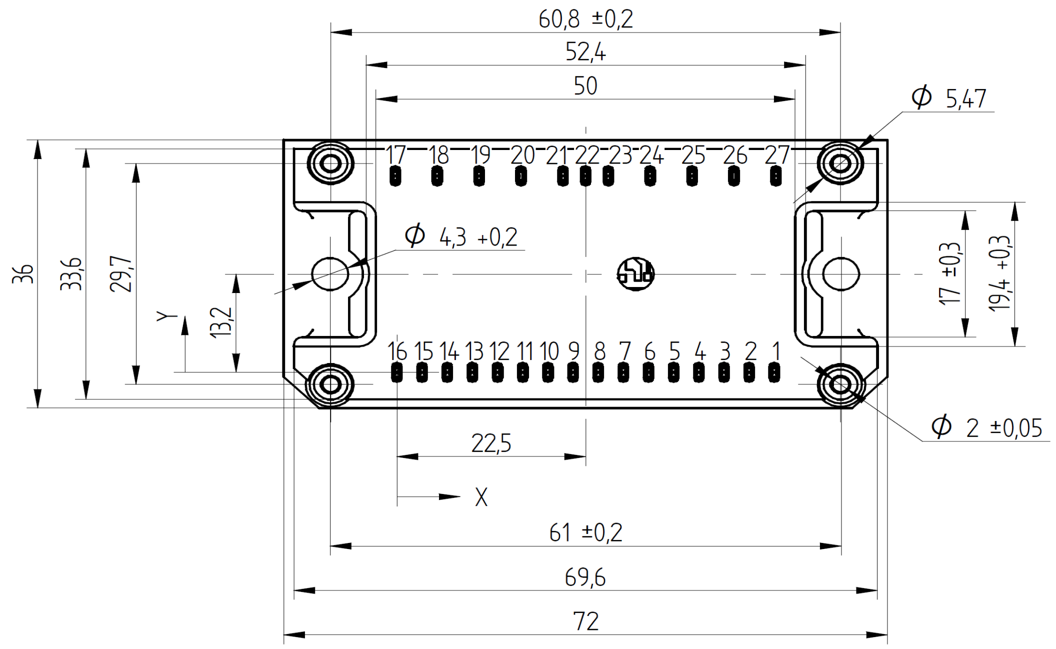
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste, solder pins	20-1B06IPB004RC-P952A40	P952A40	P952A40
with thermal paste, solder pins	20-1B06IPB004RC-P952A40-/3/	P952A40	P952A40
without thermal paste, press fit pins	20-PB06IPB004RC-P952A40Y	P952A40Y	P952A40Y
with thermal paste, press fit solder pins	20-PB06IPB004RC-P952A40Y-/3/	P952A40Y	P952A40Y

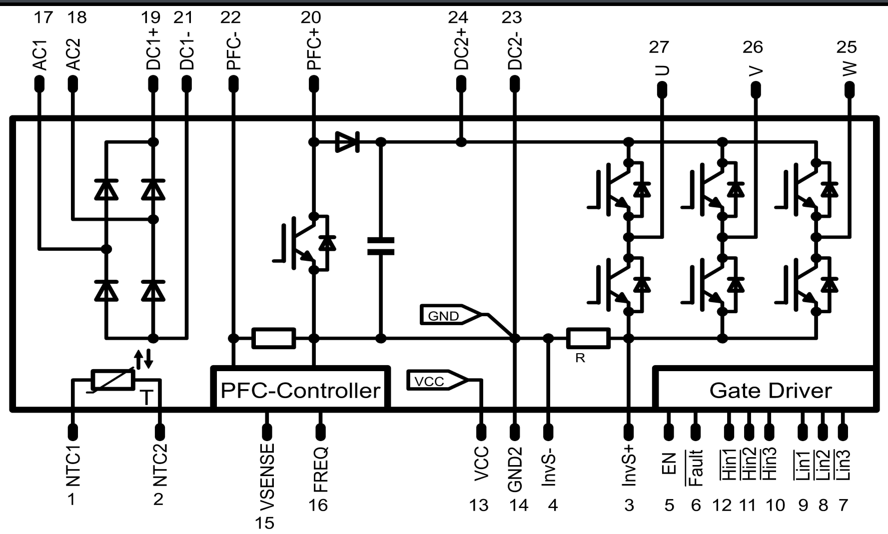
Outline

Pin table

Pin	X	Y
1	45	0
2	42	0
3	39	0
4	36	0
5	33	0
6	30	0
7	27	0
8	24	0
9	21	0
10	18	0
11	15	0
12	12	0
13	9	0
14	6	0
15	3	0
16	0	0
17	-0,2	26,4
18	4,8	26,4
19	9,8	26,4
20	14,8	26,4
21	19,8	26,4
22	22,5	26,4
23	25,2	26,4
24	30,2	26,4
25	35,2	26,4
26	40,2	26,4
27	45,2	26,4



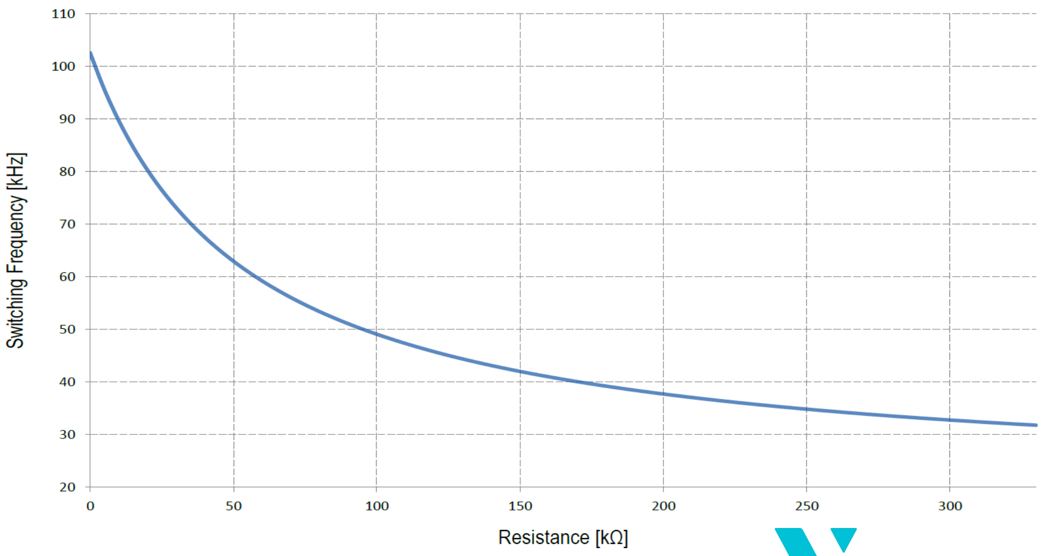
Pinout



Application data

Static logic funtion table

VCC	VBS	RCIN	ITRIP	ENABLE	FAULT	LO1,2,3	HO1,2,3
$<V_{CCUV-}$	X	X	X	X	0	0	0
15V	$<V_{BSUV-}$	X	0	3.3V	High imp	/LIN1,2,3	0
15V	15V	<3.2V↓	0	3.3V	0	0	0
15V	15V	X	$> V_{IT,TH+}$	3.3V	0	0	0
15V	15V	$> V_{RCIN,TH}$	0	3.3V	High imp	/LIN1,2,3	/HIN1,2,3
15V	15V	$> V_{RCIN,TH}$	0	0	High imp	0	0



Resistance on f_{set}	Switching Frequency
0Ω	102.6kHz
5.1kΩ	95.5kHz
10.0kΩ	89.7kHz
15.0kΩ	84.7kHz
20.0kΩ	80.3kHz
24.0kΩ	77.2kHz
30.0kΩ	73.2kHz
36.0kΩ	69.6kHz
39.0kΩ	68.0kHz
47.0kΩ	64.3kHz
51.0kΩ	62.6kHz
56.0kΩ	60.7kHz
62.0kΩ	58.6kHz
68.0kΩ	56.7kHz
75.0kΩ	54.7kHz
82.0kΩ	52.9kHz
91.0kΩ	50.9kHz
100.0kΩ	49.1kHz
110.0kΩ	47.3kHz
120.0kΩ	45.8kHz
150.0kΩ	42.0kHz
180.0kΩ	39.2kHz
200.0kΩ	37.7kHz

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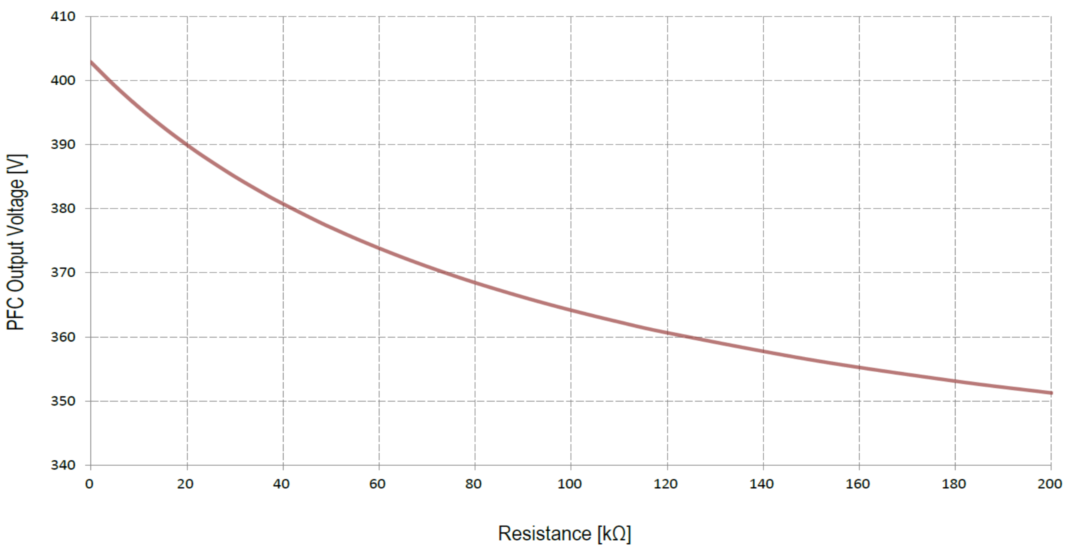

Resistance on V_{set}	Output Voltage
0Ω	402.9V
5.1kΩ	399.2V
10.0kΩ	395.9V
15.0kΩ	392.8V
20.0kΩ	390.0V
24.0kΩ	387.9V
30.0kΩ	385.0V
36.0kΩ	382.4V
39.0kΩ	381.2V
47.0kΩ	378.1V
51.0kΩ	376.7V
56.0kΩ	375.1V
62.0kΩ	373.3V
68.0kΩ	371.5V
75.0kΩ	369.7V
82.0kΩ	368.0V
91.0kΩ	366.0V
100.0kΩ	364.2V
110.0kΩ	362.3V
120.0kΩ	360.6V
150.0kΩ	356.4V
180.0kΩ	353.1V
200.0kΩ	351.3V

Pin Descriptions

Pin #	Pin Name	Pin Description
1	NTC2	Temperature sensor connector 1
2	NTC1	Temperature sensor connector 2
3	InvS +	Inverter sense resistor high-side
4	InvS -	Inverter sense resistor low-side
5	EN	Enable I/O functionality
6	¬Fault	Fault output, indicates over current or under voltage (negative
7	¬LIN3	Signal input for low-side W phase
8	¬LIN2	Signal input for low-side V phase
9	¬LIN1	Signal input for low-side U phase
10	¬HIN3	Signal input for high-side W phase
11	¬HIN2	Signal input for high-side V phase
12	¬HIN1	Signal input for high-side U phase
13	V_{CC}	Driver circuit supply voltage
14	GND2	Inverter ground
15	VSENSE	PFC Bulk voltage sense
16	FREQ	PFC Switching frequency adjust
17	AC1	Rectifier input
18	AC2	Rectifier input
19	DC1 + (coil)	Rectifier output DC +
20	PFC + (coil)	PFC coil connector
21	DC1 -	Rectifier output DC -
22	PFC -	PFC return
23	DC2 -	Inverter input DC -
24	DC2 +	Inverter input DC +
25	W	Output for W phase
26	V	Output for V phase
27	U	Output for U phase

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