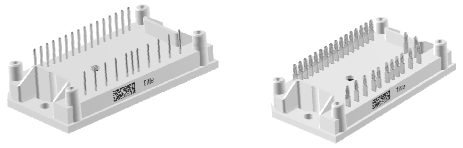
flow IPM 1B — 600 V / 4 A

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

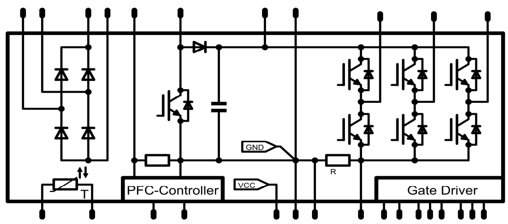


solder pins — Press-fit pins

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}	$T_j = T_{jmax}$	T_s = 80 °C	13	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms 50 Hz half sine wave	T_j = 45 °C	130	A
I^2t-value	I^2t			80	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	15	W
Maximum Junction Temperature	T_{jmax}			150	°C
PFC IGBT					
Collector-emitter breakdown voltage	V_{CE}			650	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	8	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		45	A
Turn off safe operating area		V_{CE} ≤ 650V, $T_j \le T_{op}$ max		45	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	16	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	$T_j = T_{jmax}$	T_s = 80 °C	6	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		12	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	10	W
Maximum Junction Temperature	T_{jmax}			175	°C
PFC Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			650	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	9	A
Surge (non-repetitive) 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_{jmax}		30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	15	W
Maximum Junction Temperature	T_{jmax}			175	°C
Inverter Transistor					
Collector-emitter breakdown voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	4	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		12	A
Turn off safe operating area		$V_{CE} \leq$ 600V, $T_j \leq$Tjmax		8	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	12	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V		8 400	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}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	5	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		8	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	9	W
Maximum Junction Temperature	T_{jmax}			175	°C
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 I_C		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}			V_{CC} + 0.5	V

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

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{is}	t = 2 s	DC Test 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] 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	Unit
Input Rectifier Diode										
Forward voltage *	V_F				7	25 125		1,04 0,97		V
Threshold voltage (for power loss calc. only)	V_{to}				7	25 125		0,87 0,74		V
Slope resistance (for power loss calc. only)	r_t				7	25 125		25 33		mΩ
Reverse current	I_r			1600		25 125			0,01	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4W/mK						4,56		K/W
* chip data										
PFC IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0004	25	3,3	4	4,7	V
Collector-emitter saturation voltage*	V_{CEsat}		15		6	25 150		1,43 1,55	2,05	V
Collector-emitter cut-off	I_{CES}		0	650		25			0,04	mA
Rise time	t_r					25 150		2 2		
Turn-off delay time **	$t_{d(off)}$					25 150		107 161		ns
Fall time	t_f		U_{CC} = 15V	400	4	25 150		4 2		
Turn-on energy loss	E_{on}					25 150		0,055 0,091		mWs
Turn-off energy loss	E_{off}					25 150		0,020 0,038		
Input capacitance	C_{ies}							930		
Output capacitance	C_{oss}	f = 1 MHz	0	25		25		24		pF
Reverse transfer capacitance	C_{rss}							4		
Gate charge	Q_G		±15	520	15	25		38		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4W/mK						5,80		K/W
* chip data										
PFC Inverse Diode										
Diode forward voltage	V_F				6	25 125	1,23	1,73 1,59	2,15	V
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4W/mK						9,56		K/W
PFC Diode										
Forward voltage *	V_F				6	25 150		1,51 1,42	2,13	V
Peak recovery current	I_{RRM}					25 150		11 13		A
Reverse recovery time	t_{rr}					25 150		18 28		ns
Reverse recovery charge	Q_{rr}		U_{CC}=15V	400	4	25 150		0,12 0,24		μC
Reverse recovered energy	E_{rec}					25 150		0,013 0,033		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		959 452		A/μs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4W/mK						7,19		K/W
* chip data										
PFC Shunt										
R1 value	R							100		mΩ

Characteristic Values

Parameter	Symbol	Conditions	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]	Value Min	Typ	Max	Unit
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,000075	25	4,4	5	5,6	V
Collector-emitter saturation voltage*	V_{CEsat}		15		4	25 150	1,7	2,20 2,29	2,8	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		25			0,1	mA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time **	$t_{d(on)}$					25 150		586 635		
Rise time	t_r					25 150		21 30		ns
Turn-off delay time **	$t_{d(off)}$		U_{CC}=15V V_{IN}=5V	400	4	25 150		666 749		
Fall time	t_f					25 150		20 50		
Turn-on energy loss	E_{on}					25 150		0,117 0,198		mWs
Turn-off energy loss	E_{off}					25 150		0,072 0,115		
Input capacitance	C_{ies}							305		
Output capacitance	C_{oss}	f = 1 MHz	0	25		25		18		pF
Reverse transfer capacitance	C_{rss}							9		
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4W/mK						8,93		K/W

* chip data
** including gate driver

Parameter	Symbol	Conditions	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	Unit
Inverter Diode										
Diode forward voltage *	V_F				4	25 150	1,5	2,08 1,92	2,6	V
Peak reverse recovery current	I_{RRM}					25 150		2 3		A
Reverse recovery time	t_{rr}					25 150		166 254		ns
Reverse recovered charge	Q_{rr}		U_{CC}=15V V_{IN}=5V	400	4	25 150		0,18 0,35		nC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		25 16		A/μs
Reverse recovered energy	E_{rec}					25 150		0,045 0,085		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4W/mK						10,05		K/W

* chip data

Parameter	Symbol	Conditions	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
DC - Shunt										
R2 value	R					25		50		mΩ
DC link Capacitor										
C value	C							100		nF

Characteristic Values

Parameter	Symbol	Conditions	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	Unit
Gate Driver										
Supply voltage	V_{CC}					25 125	13	15	17,5	V
Quiescent Vcc supply current	IQCC	VLIN=0V; VHIN=3,3V				25 125		1,3	2	mA
Input voltage (LIN, HIN, EN)	VIN	V_{CC} = 15V				25 125	0		5	V
Input voltage (GATE)	VGATE	V_{CC} = 15V				25 125	0		15	V
Logic "0" input voltage (LIN, HIN)	VIH	V_{CC} = 15V				25 125	1,7	2,1	2,4	V
Logic "1" input voltage (LIN, HIN)	VIL	V_{CC} = 15V				25 125	0,7	0,9	1,1	V
Positive going threshold voltage (EN)	VEN, TH+	V_{CC} = 15V				25 125	1,9	2,1	2,3	V
Negative going threshold voltage (EN)	VEN, TH-	V_{CC} = 15V				25 125	1,1	1,3	1,5	V
Input clamp voltage (LIN, HIN, EN)	VIN, CLAMP	IIN = 4mA				25 125	9	10,3	12	V
ITRIP positive going threshold	VIT, TH+					25 125	380	445	510	mV
Input bias current LIN high	I_LIN+	VLIN = 3,3V				25 125		70	100	µA
Input bias current LIN low	I_LIN-	VLIN = 0V				25 125		110	200	µA
Input bias current HIN high	I_HIN+	VHIN = 3,3V				25 125		70	100	µA
Input bias current HIN low	I_HIN-	VHIN = 0V				25 125		110	200	µA
Input bias current EN high	IEN+	VHIN = 3,3V				25 125		45	120	µA
Output voltage (FAULT)	V_FLT					25 125	0		V_{CC}	V
Low on resistor of pull down trans. (FAULT)	RON, FLT	V_FAULT=0.5 V				25 125		45	100	Ω
Pulse width for ON or OFF	tIN					25 125	1			µs
Turn-on propagation delay (LIN, HIN)	tON	VLIN/HIN = 0V or 3,3V				25 125	400	530	800	ns
Turn-off propagation delay (LIN, HIN)	tOFF	VLIN/HIN = 0V or 3,3V				25 125	360	490	760	ns
FAULT reset time	tRST					25 125		4		ms
Fixed deadtime between high and low side	tDT	VLIN/HIN = 0V & 3,3V				25 125	150	310		ns

Characteristic Values

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

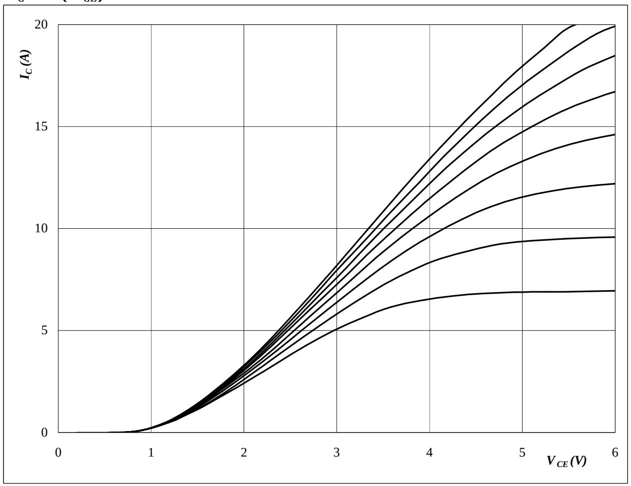
*switching frequency is setable by an external resistor between pins 14-16 (see figure 1 on page28 for values)
**DC link voltage is setable by an external resistor between pins 14-15 (see figure 2 on page28 for values)

Output Inverter

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



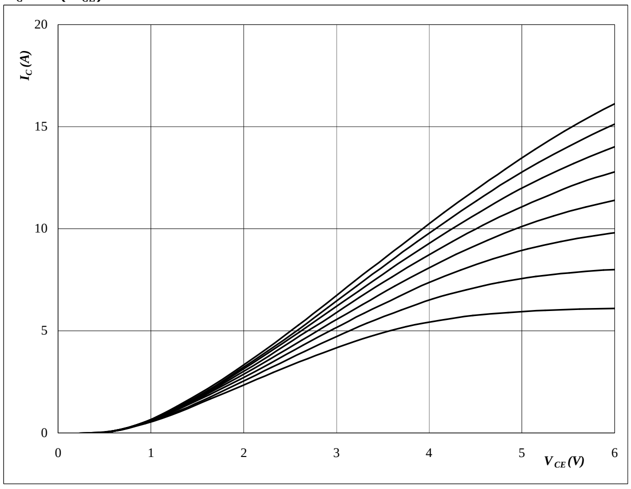
At

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

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



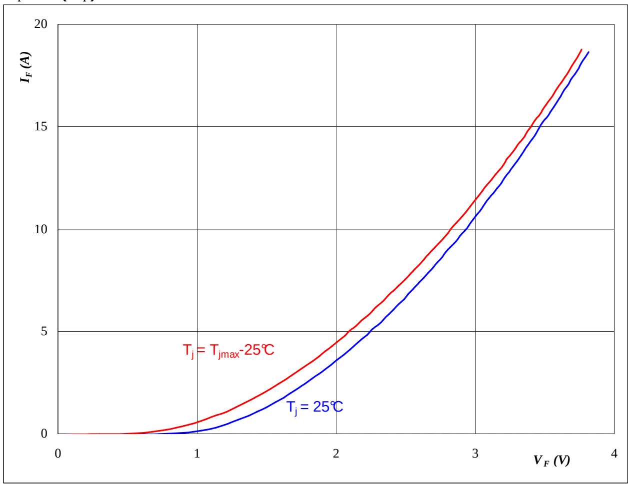
At

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

figure 3. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

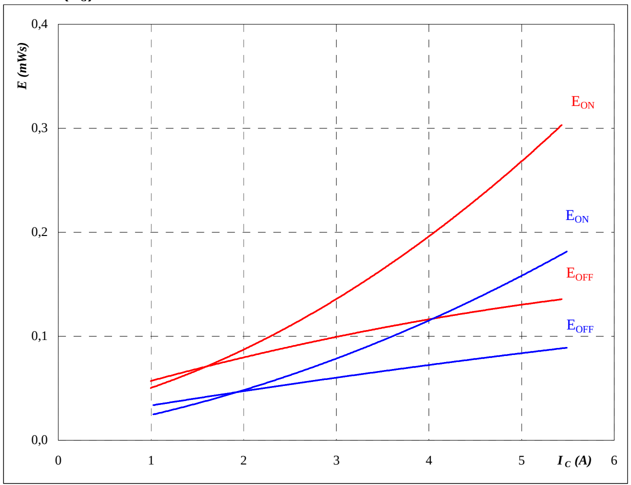
t_p =	250	µs

Output Inverter

figure 4. **IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



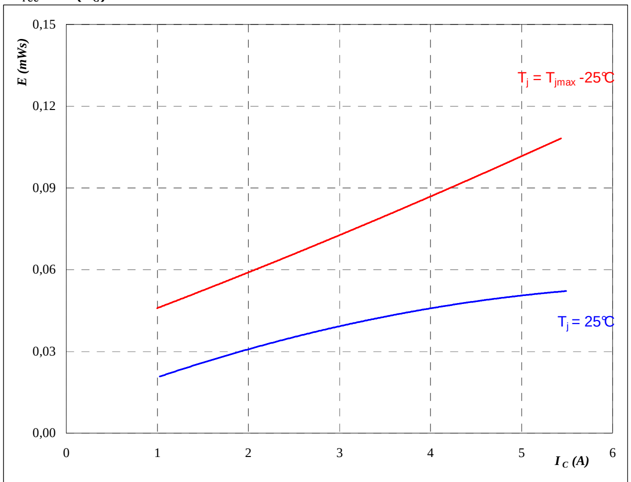
With an inductive load at

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

figure 5. **FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

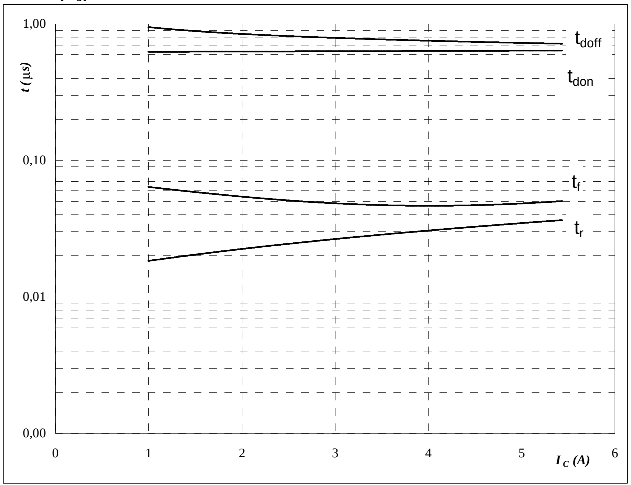
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Output Inverter

figure 6. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



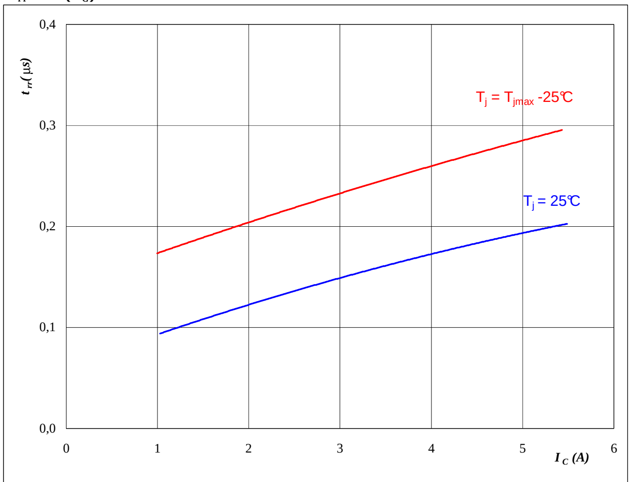
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

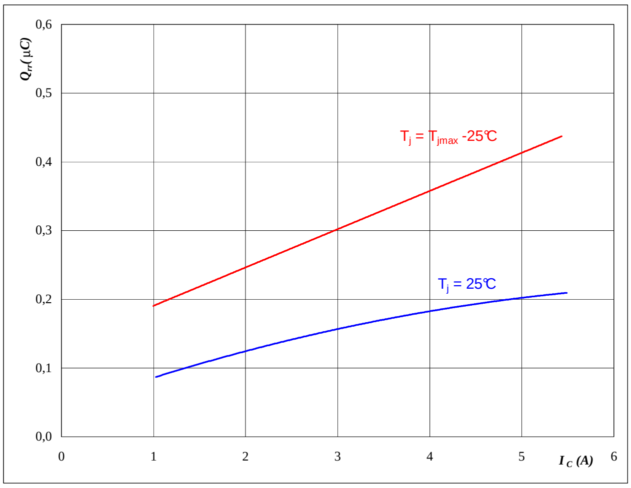
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Output Inverter

figure 8. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



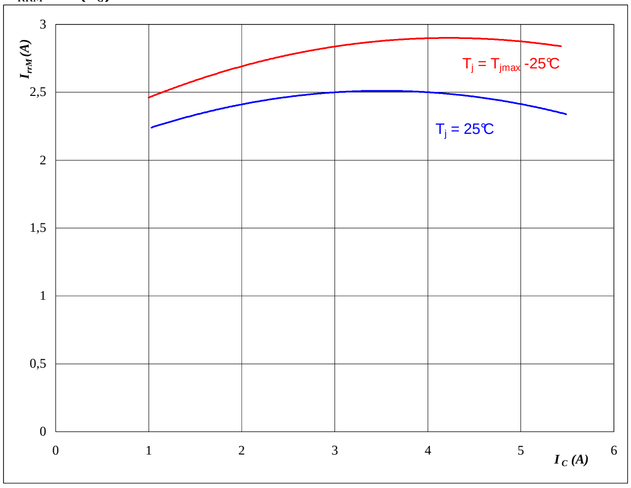
At

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

figure 9. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



At

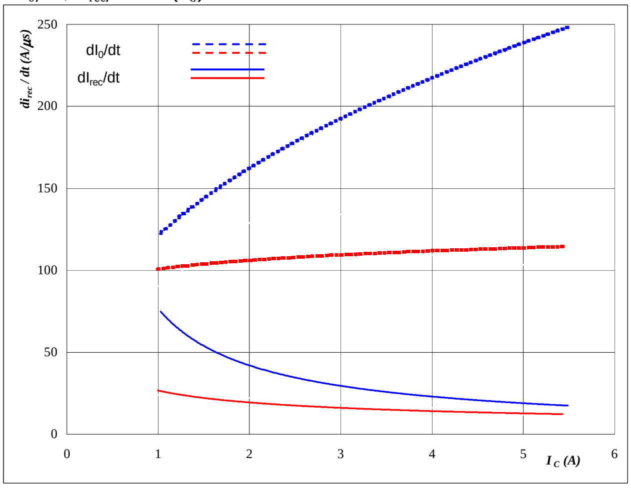
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

Output Inverter

figure 10. **FWD**

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

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



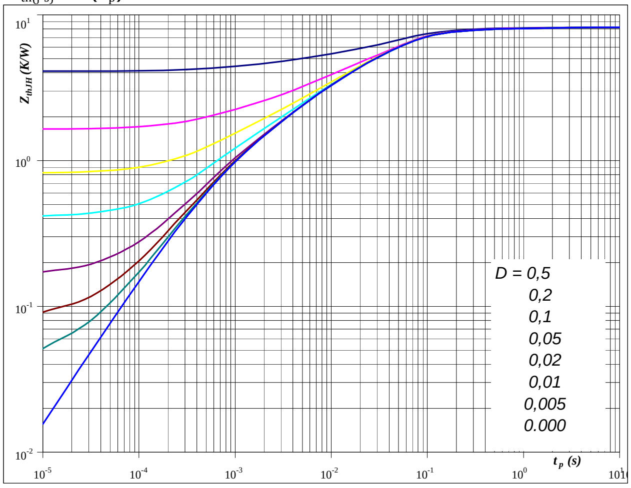
At

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

figure 11. **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	8,20	K/W

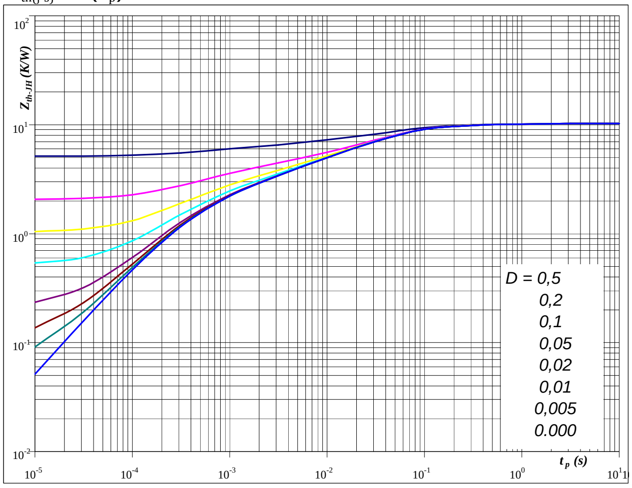
IGBT thermal model values

R (K/W)	Tau (s)
2,49E-01	1,64E+00
9,97E-01	1,59E-01
4,55E+00	3,81E-02
1,65E+00	5,10E-03
6,64E-01	7,96E-04
9,00E-02	3,11E-04

figure 12. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	10,24	K/W

FWD thermal model values

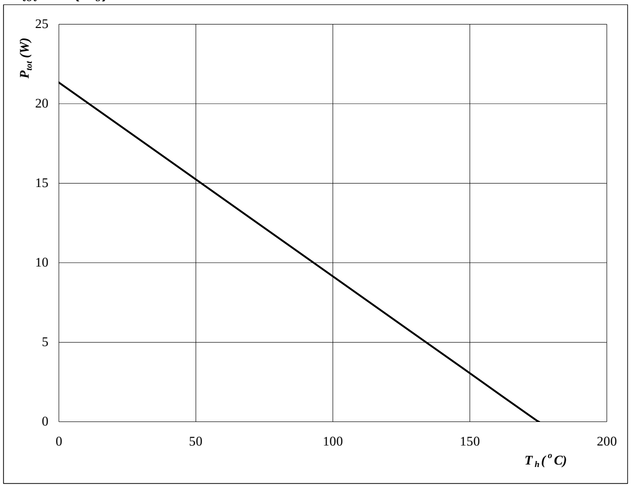
R (K/W)	Tau (s)
5,43E-01	6,92E-01
3,81E+00	5,93E-02
2,56E+00	1,81E-02
1,83E+00	2,58E-03
1,50E+00	3,50E-04

Output Inverter

figure 13.	IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



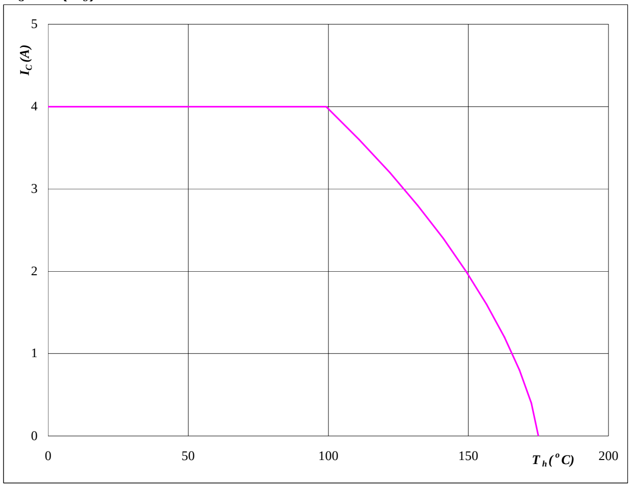
At

T_j =	175	°C

figure 14.	IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



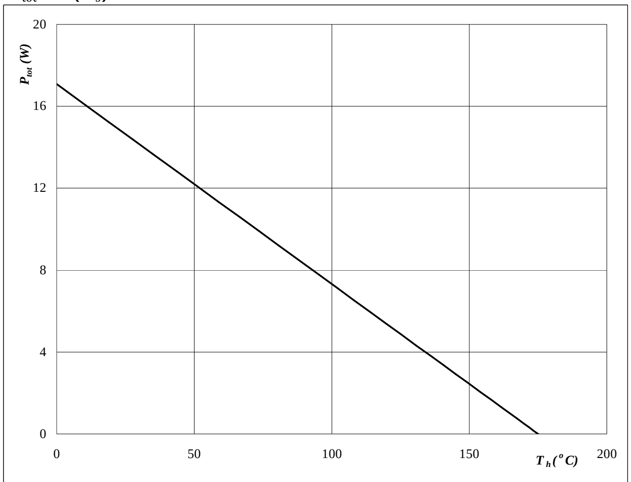
At

T_j =	175	°C
U_{CC} =	15	V

figure 15.	FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



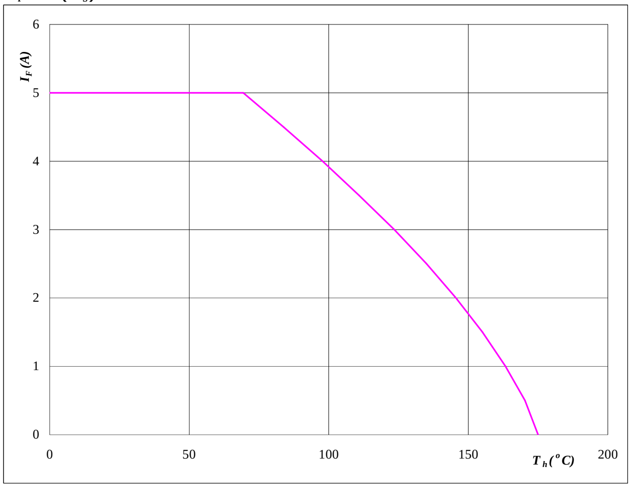
At

T_j =	175	°C

figure 16.	FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

T_j =	175	°C

Output Inverter

figure 17. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

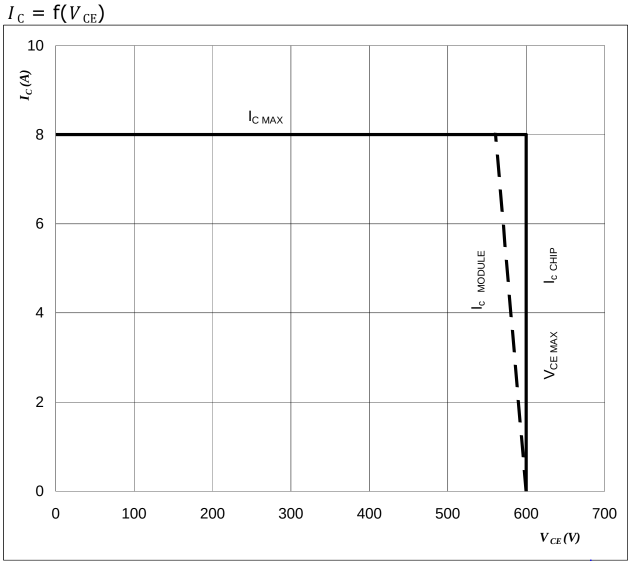
At

$T_j \leq$	T_{jmax}	ºC
U_{CC}=	15	V

figure 18. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

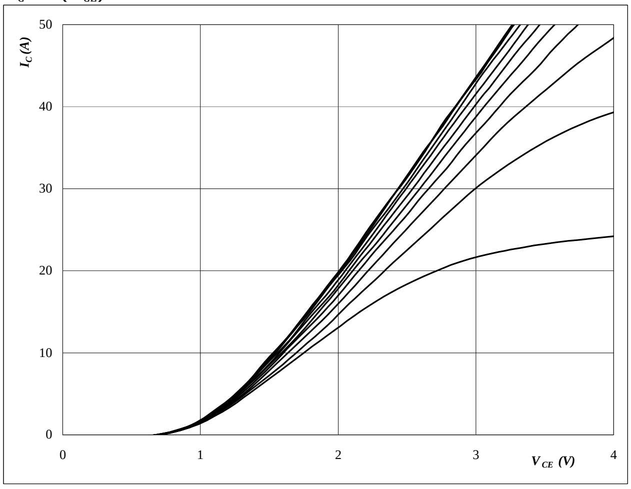
T_j =	T_{jmax}-25	ºC

PFC

figure 1. **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. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

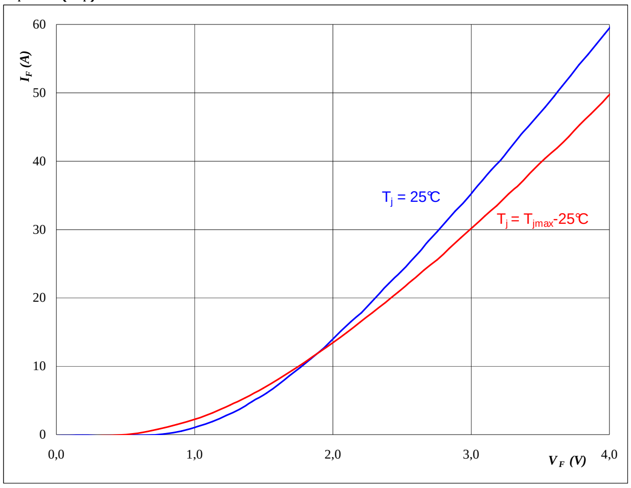
At

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

figure 3. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

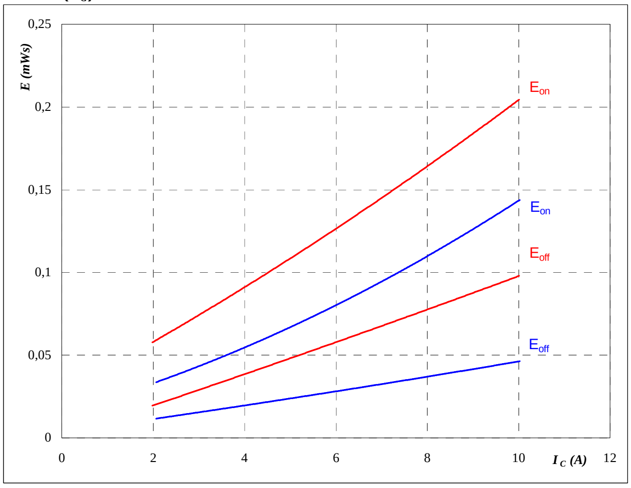
t_p =	250	µs

PFC

figure 4. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



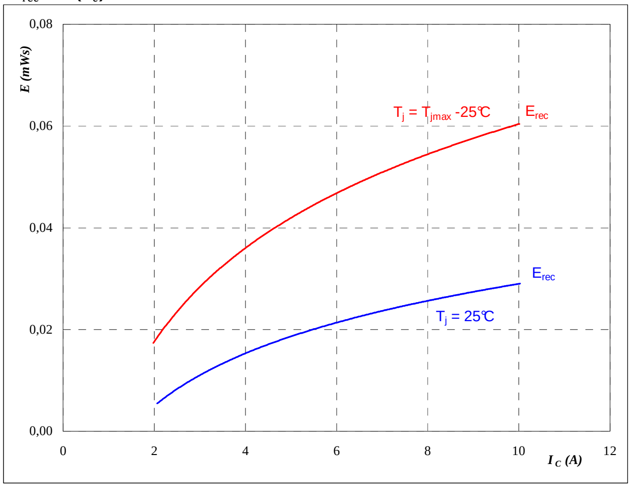
With an inductive load at

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

figure 5. **IGBT**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



With an inductive load at

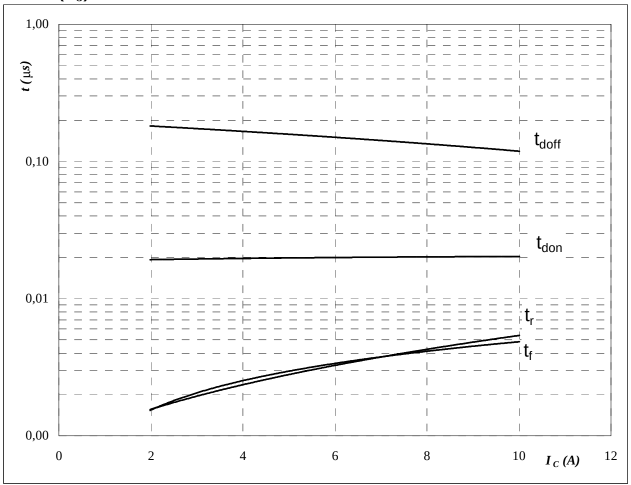
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

PFC

figure 6. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



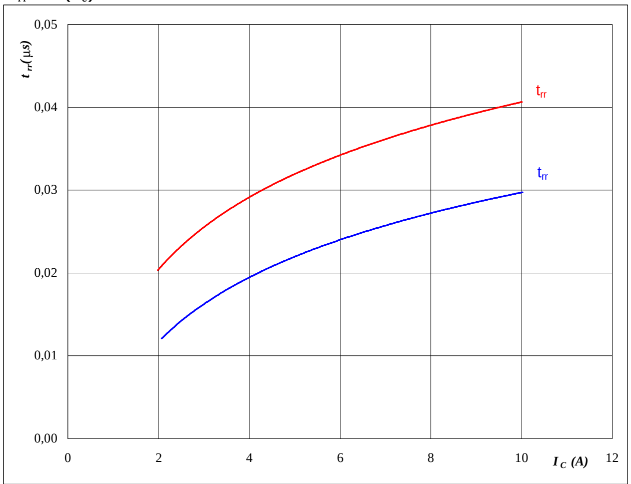
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_c)$



At

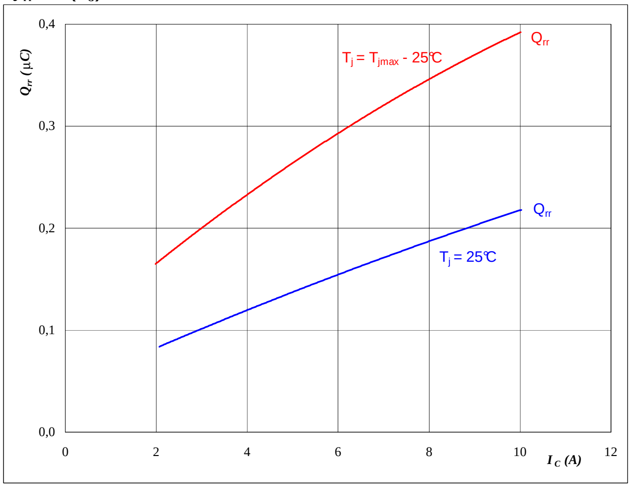
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

PFC

figure 8. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



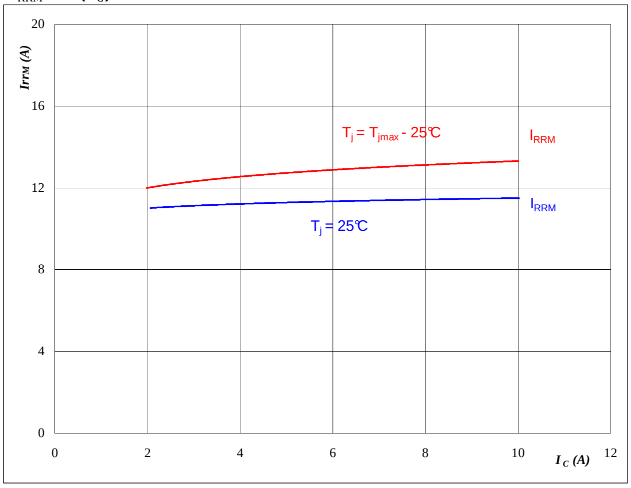
At

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

figure 9. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



At

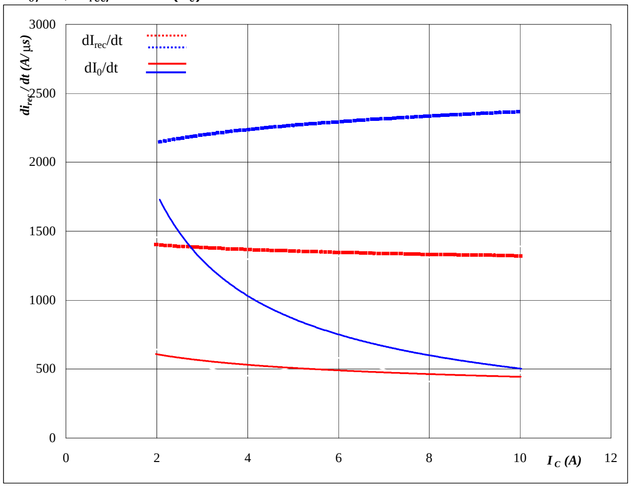
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}=	15	V

PFC

figure 10. **FWD**

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

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



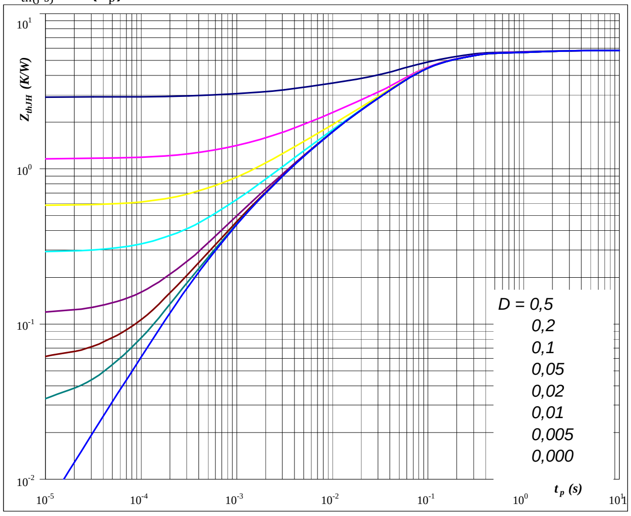
At

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

figure 11. **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	5,80	K/W

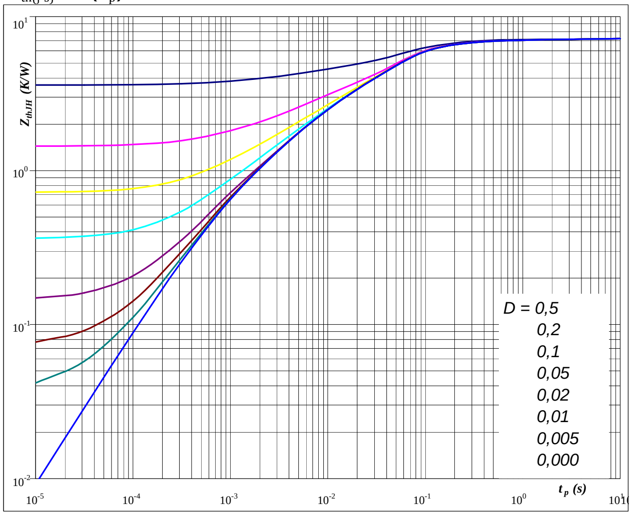
IGBT thermal model values

R (C/W)	Tau (s)
8,85E-02	4,38E+00
3,12E-01	8,32E-01
1,99E+00	1,12E-01
2,31E+00	3,80E-02
8,99E-01	4,25E-03
	5,94E-04

figure 12. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	7,19	K/W

FWD thermal model values

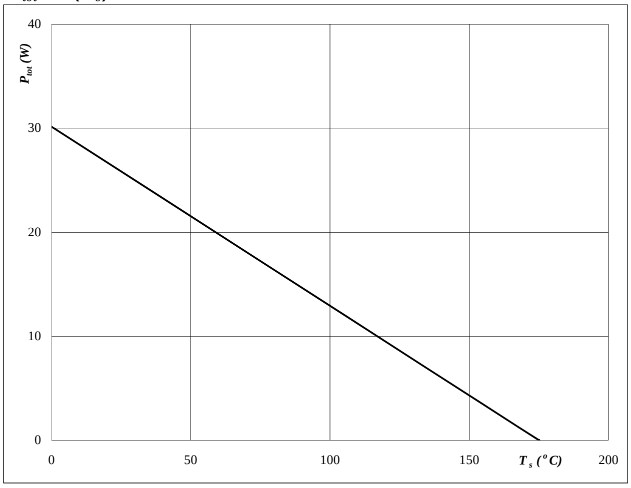
R (C/W)	Tau (s)
2,22E-01	2,69E+00
6,61E-01	2,71E-01
4,47E+00	4,89E-02
1,43E+00	5,11E-03
4,13E-01	7,51E-04

PFC

figure 13. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



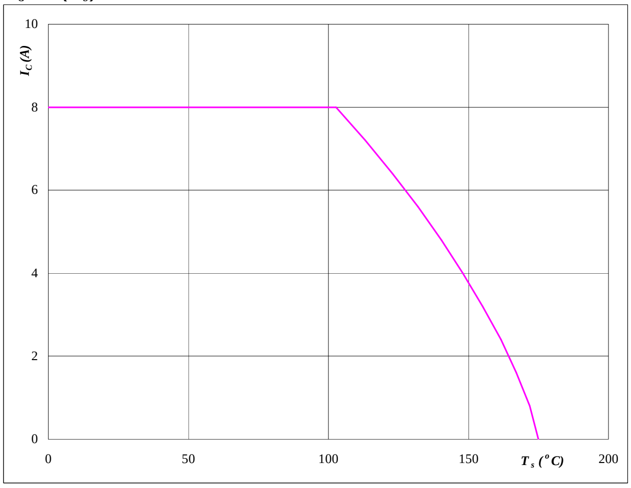
At

T_j = 175 ºC

figure 14. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

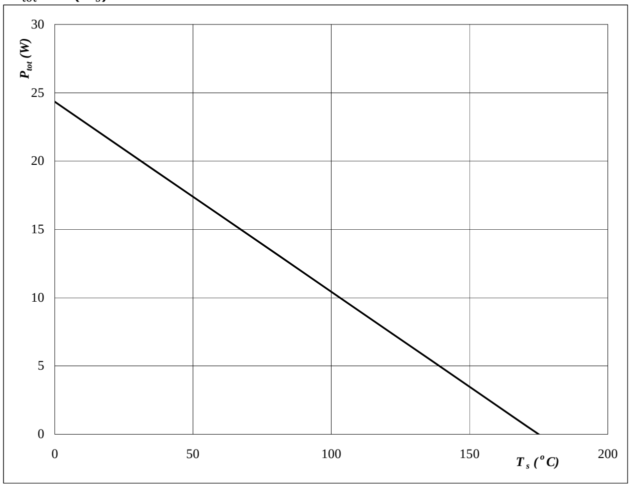
T_j = 175 ºC

U_{CC}= 15 V

figure 15. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



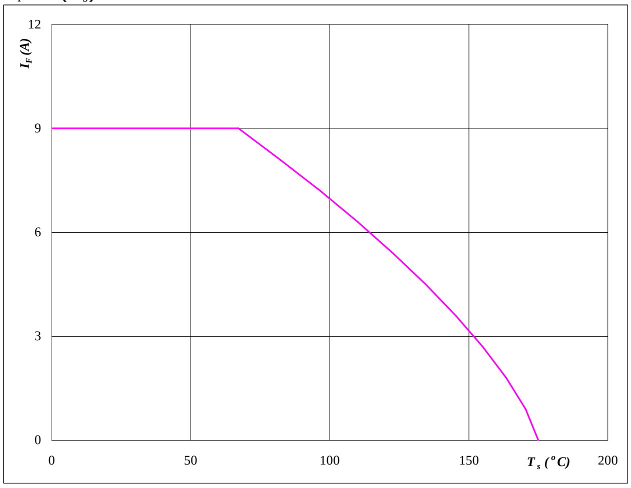
At

T_j = 175 ºC

figure 16. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

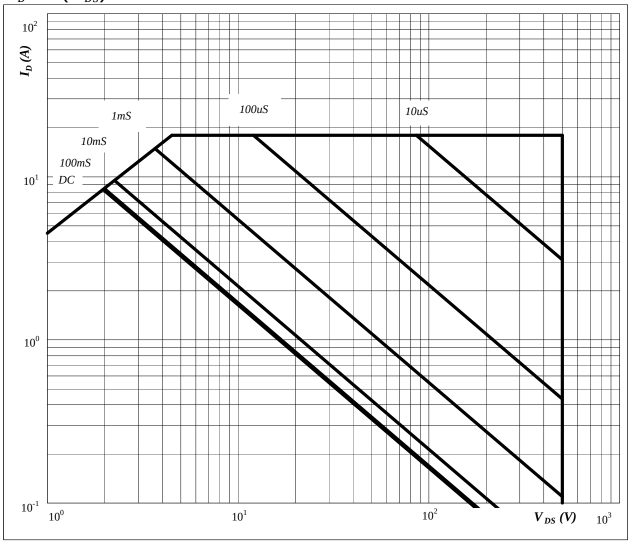
T_j = 175 ºC

PFC

figure 17. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_D = f(V_{DS})$



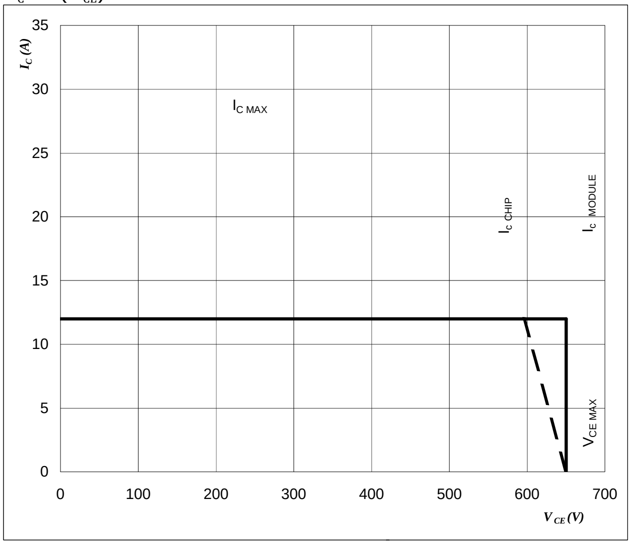
At

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

figure 18. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

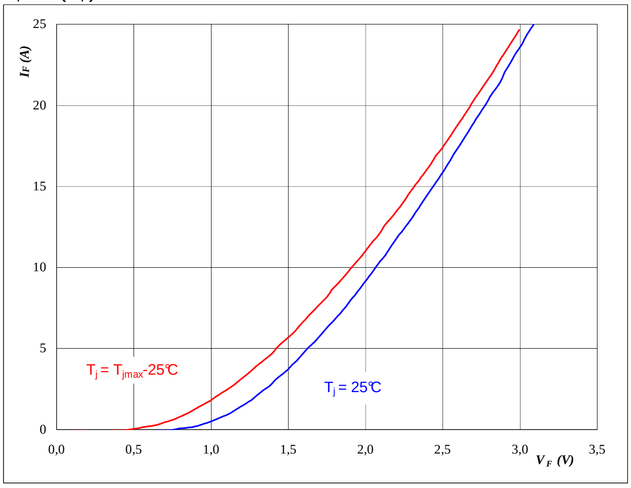
T_j =	T_{jmax}-25	ºC

PFC Inverse.Diode

Figure 1	PFC Inverse.Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



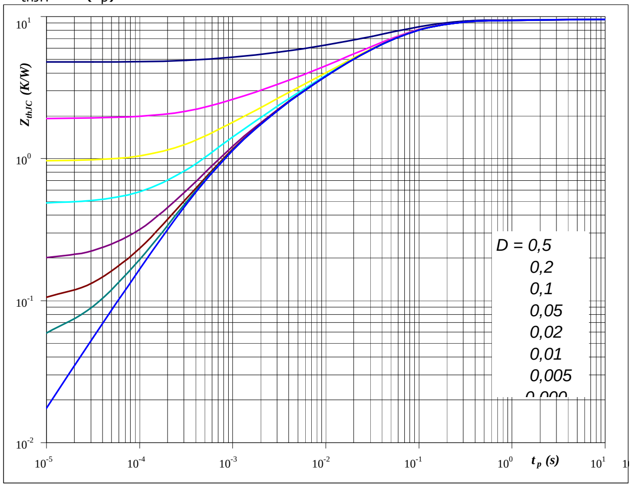
At

t_p = 250 µs

Figure 2	PFC Inverse.Diode

Thyristor transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At D = tp / T

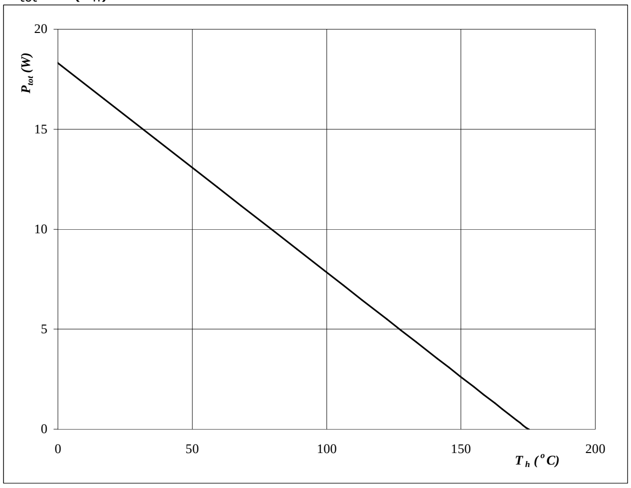
Thermal grease

R_{thJH} = 9,56 K/W

Figure 3	PFC Inverse.Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



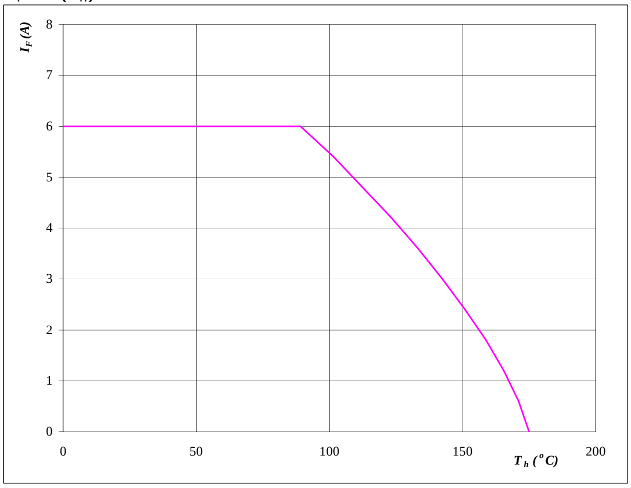
At

T_j = 175 ºC

Figure 4	PFC Inverse.Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

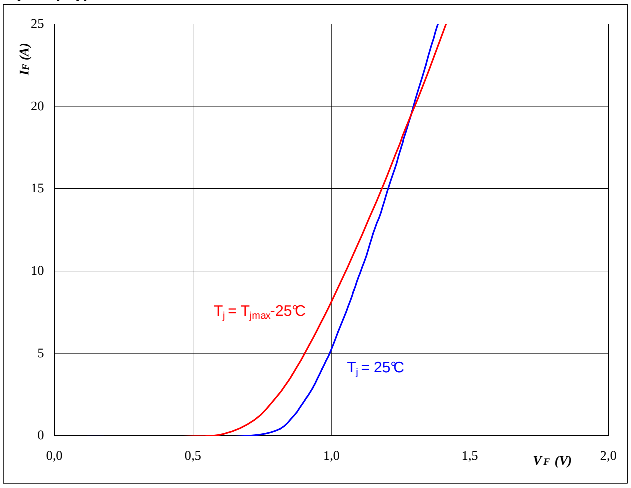
T_j = 175 ºC

Input Rectifier Diode

figure 1. **Rectifier Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



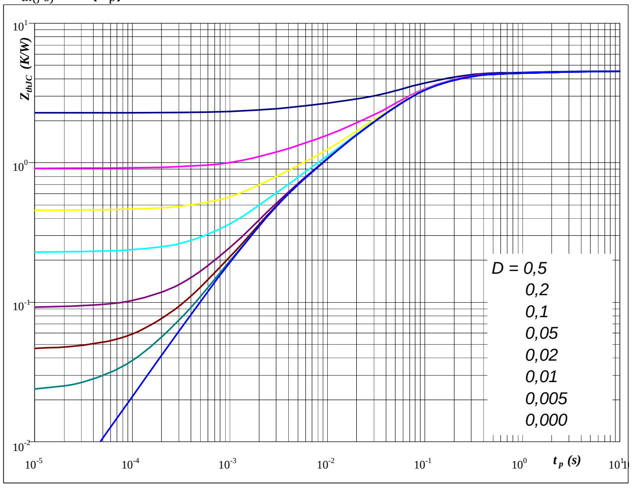
At

t_p = 250 µs

figure 2. **Rectifier Diode**

Diode transient thermal impedance as a function of pulse width

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



At

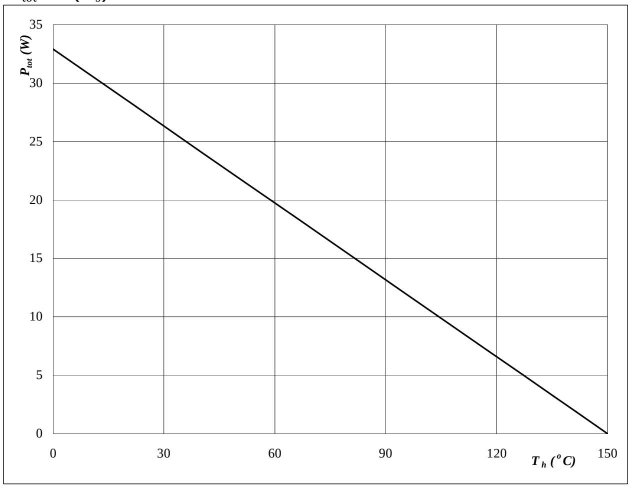
D = t_p / T

$R_{th(j\text{-}s)}$ = 4,56 K/W

figure 3. **Rectifier Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



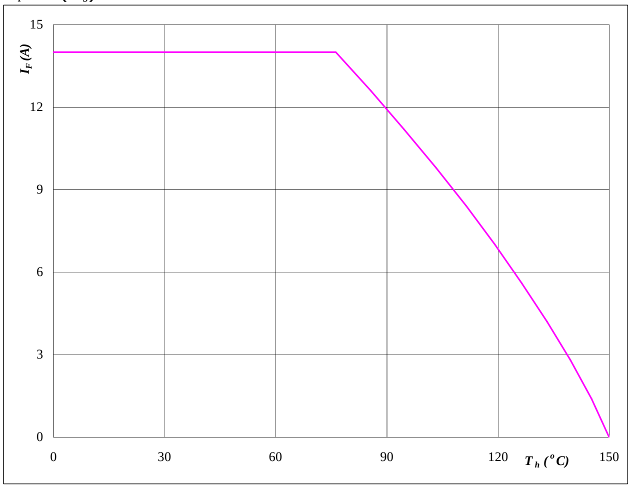
At

T_j = 150 ºC

figure 4. **Rectifier Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



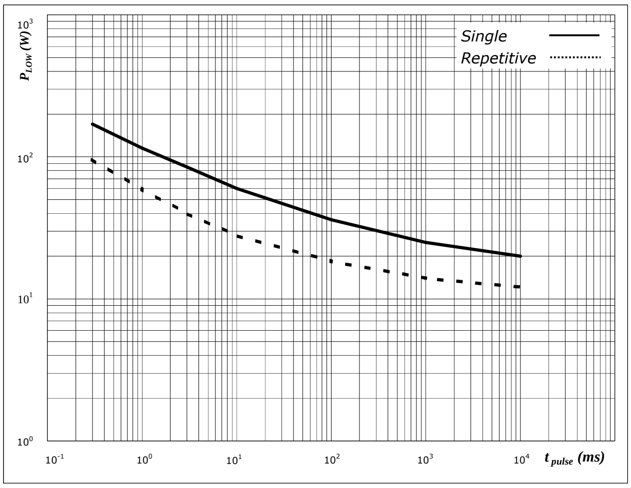
At

T_j = 150 ºC

Shunt

figure 1. **PFC Shunt**

Pulse Power R1

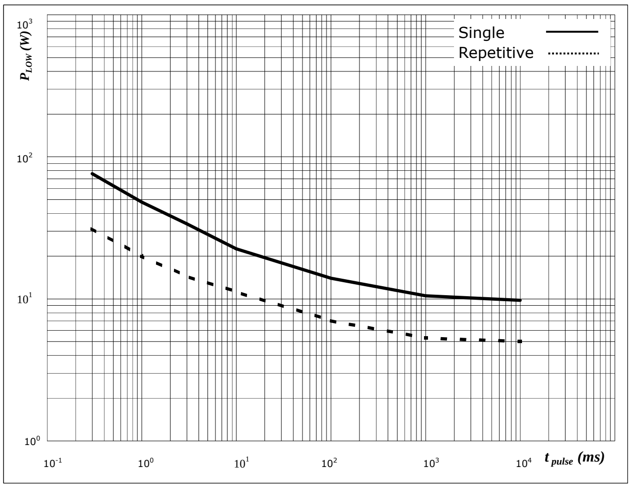


——— dR/R_0 < 5% after 1 pulse

········ dR/R_0 < 5% after 10.000 cycles; duty cycle< 0,1%

figure 2. **DC Shunt**

Pulse Power R2



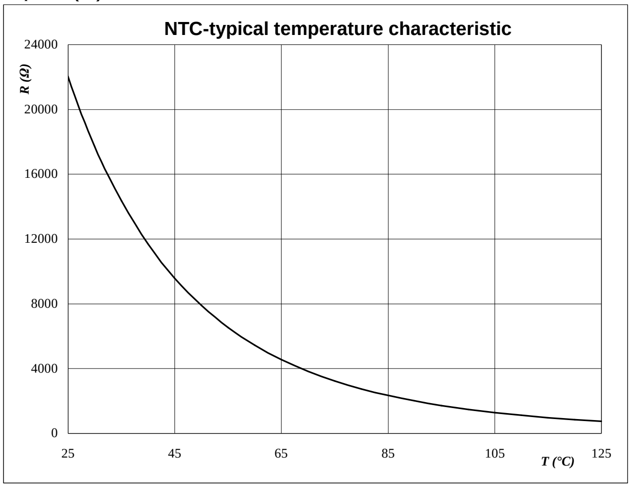
——— dR/R_0 < 1% after 1 pulse

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

Thermistor

figure 1.	Thermistor

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



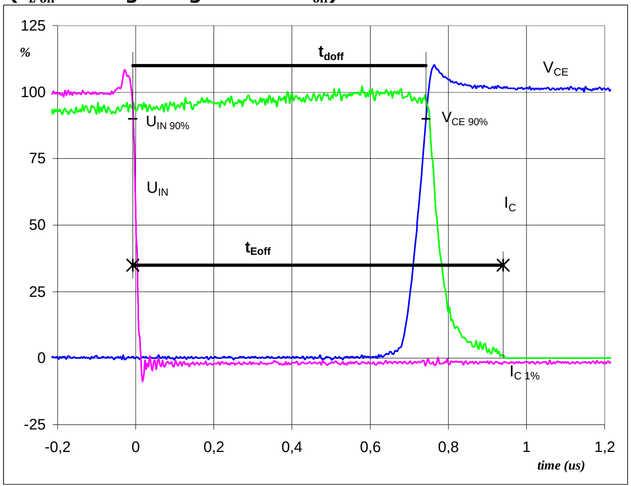
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C

figure 1. **IGBT**

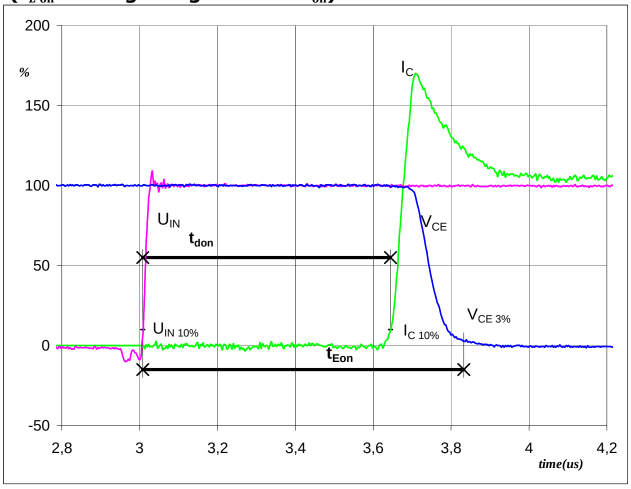
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



UIN (0%) =	0	V
UIN (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. **IGBT**

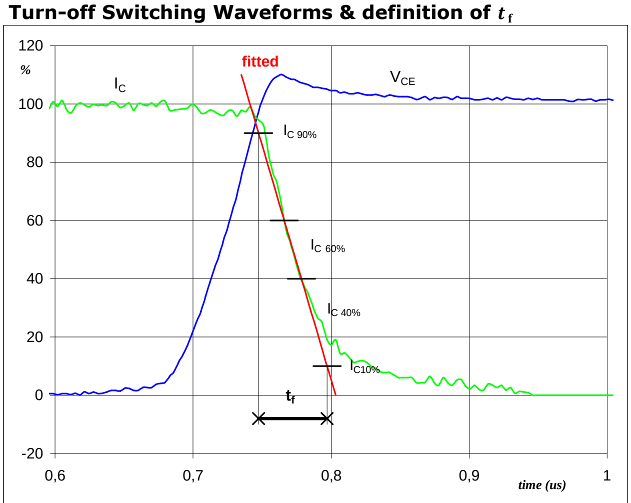
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



UIN (0%) =	0	V
UIN (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. **IGBT**

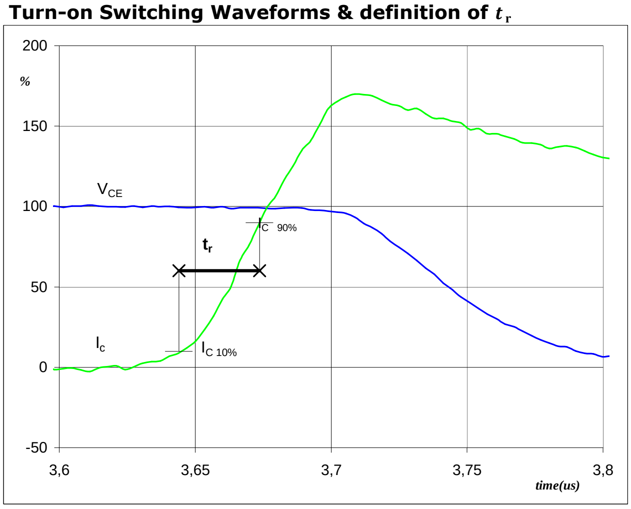
Turn-off Switching Waveforms & definition of t_f



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

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

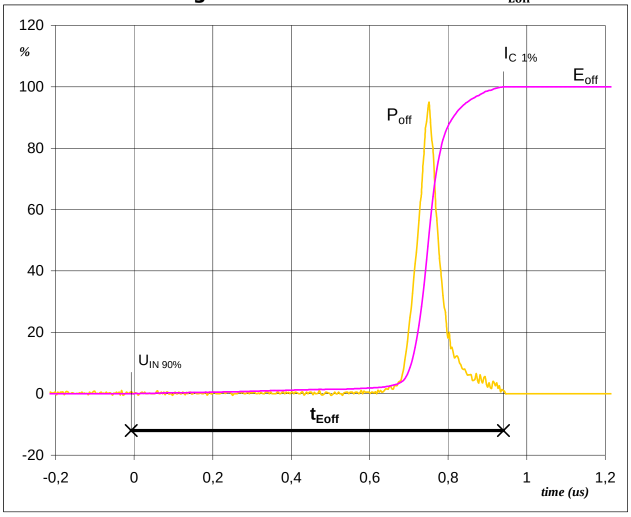


V_C (100%) =	400	V
I_C (100%) =	4	A
t_r =	0,03	μs

Switching Definitions Output Inverter

figure 5. **IGBT**

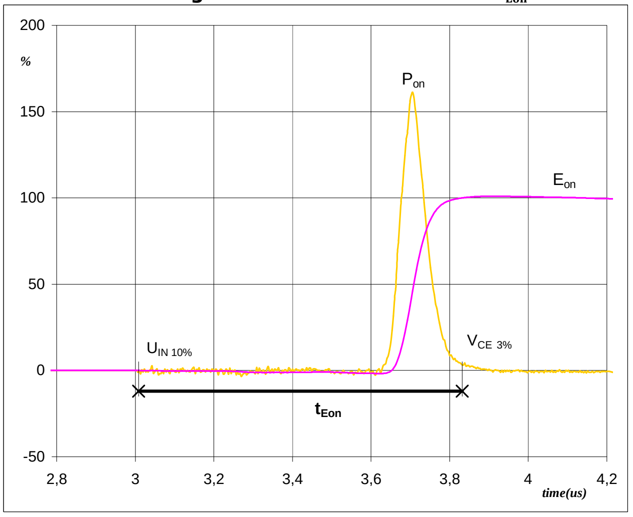
Turn-off Switching Waveforms & definition of t_{Eoff}



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

figure 6. **IGBT**

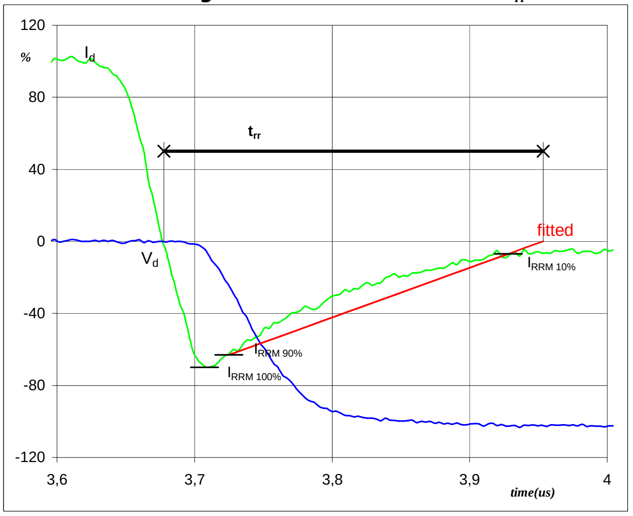
Turn-on Switching Waveforms & definition of t_{Eon}



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

figure 7. **FWD**

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

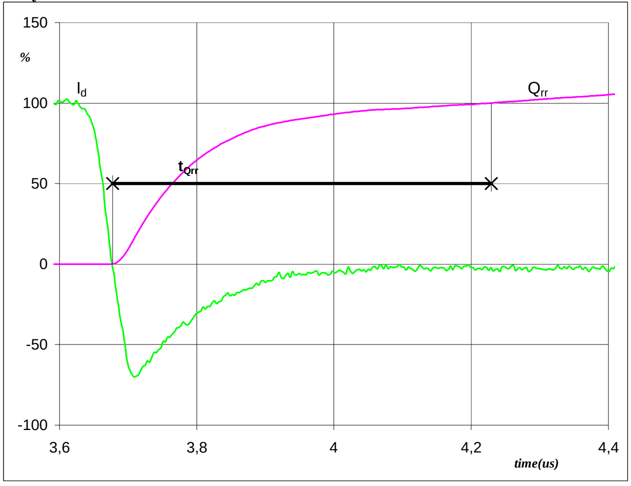


V_d (100%) =	400	V
I_d (100%) =	4	A
I_{RRM} (100%) =	-3	A
t_{rr} =	0,25	µs

Switching Definitions Output Inverter

figure 8.	FWD

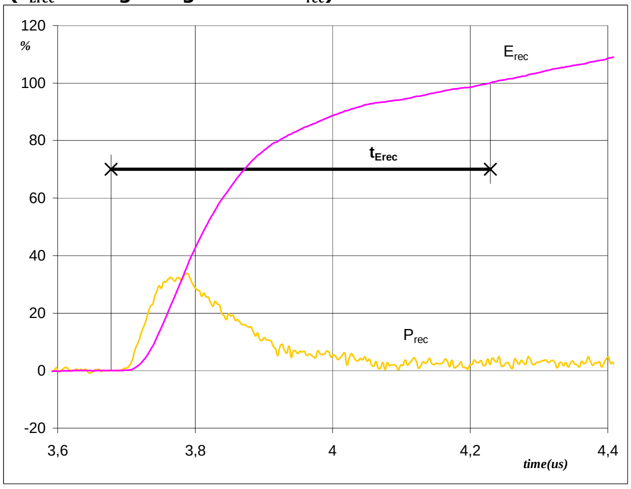
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



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

figure 9.	FWD

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

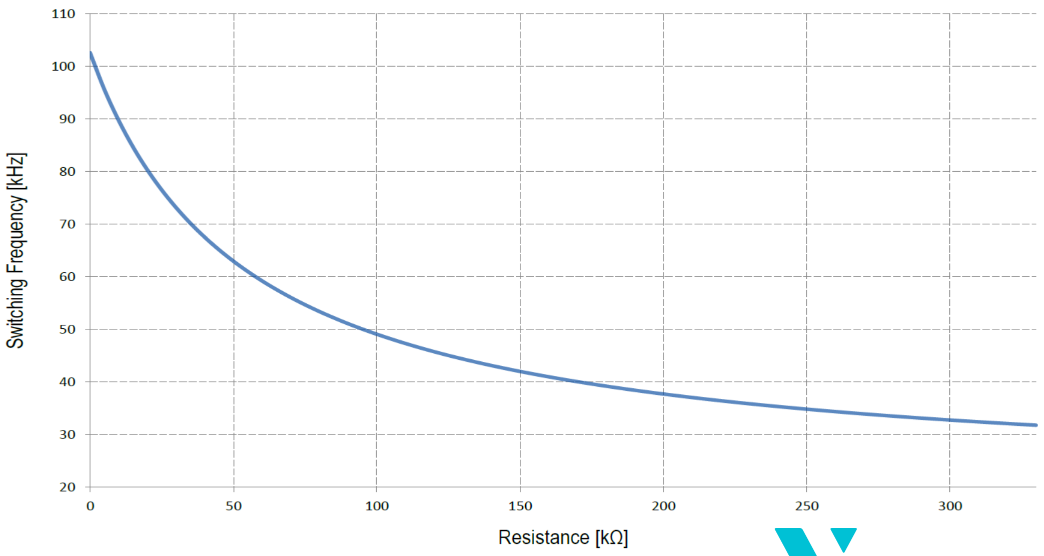


P_{rec} (100%) =	1,61	kW
E_{rec} (100%) =	0,09	mJ
$t_{E\,rec}$ =	0,55	µs

Application data

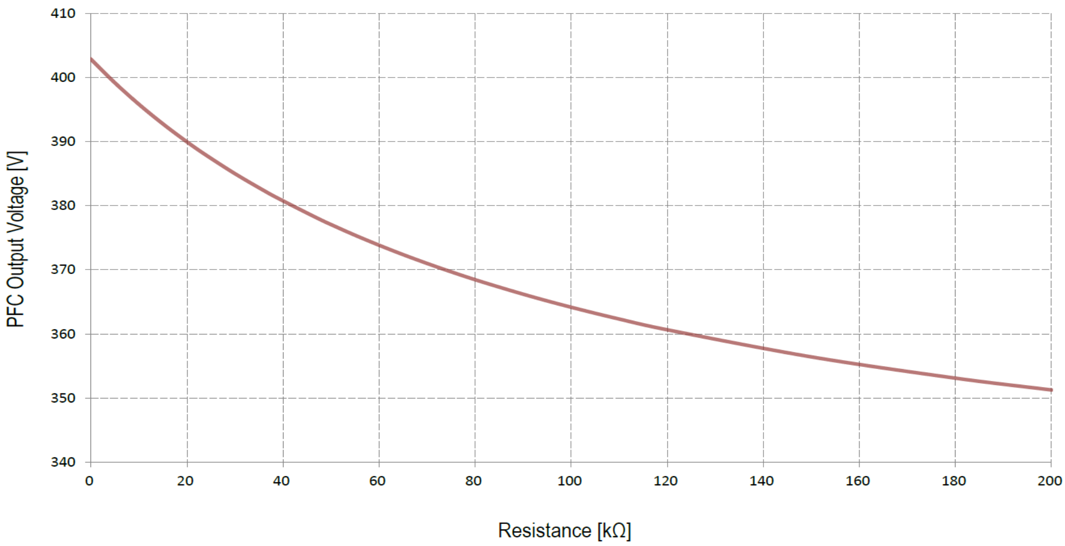
Static logic funtion table

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

Vincotech



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

Ordering Code & Marking - Outline - Pinout

Ordering Code & Marking

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

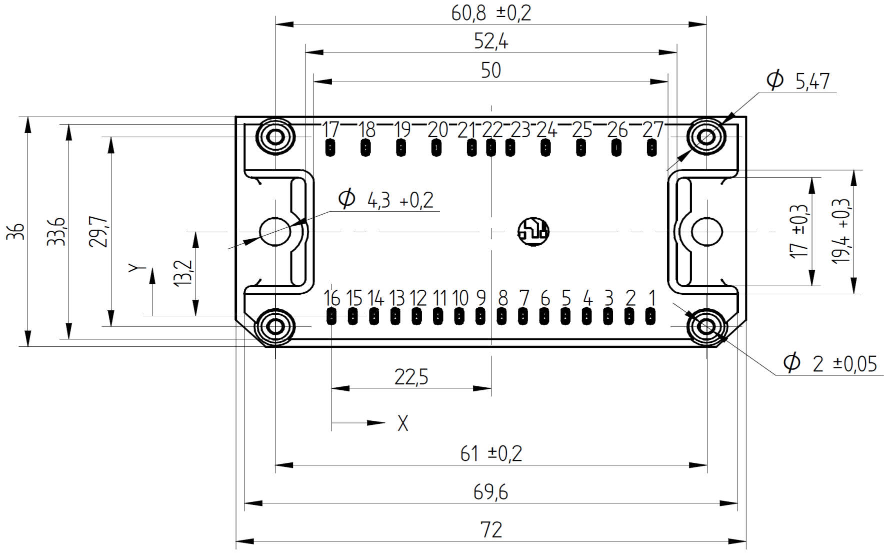
	Name	Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV	WWYY	UL VIN	LLLLL	SSSS

	Type&Ver	Lot number	Serial	Date code
Datamatrix	TTTTTTTVV	LLLLL	SSSS	WWYY

Outline

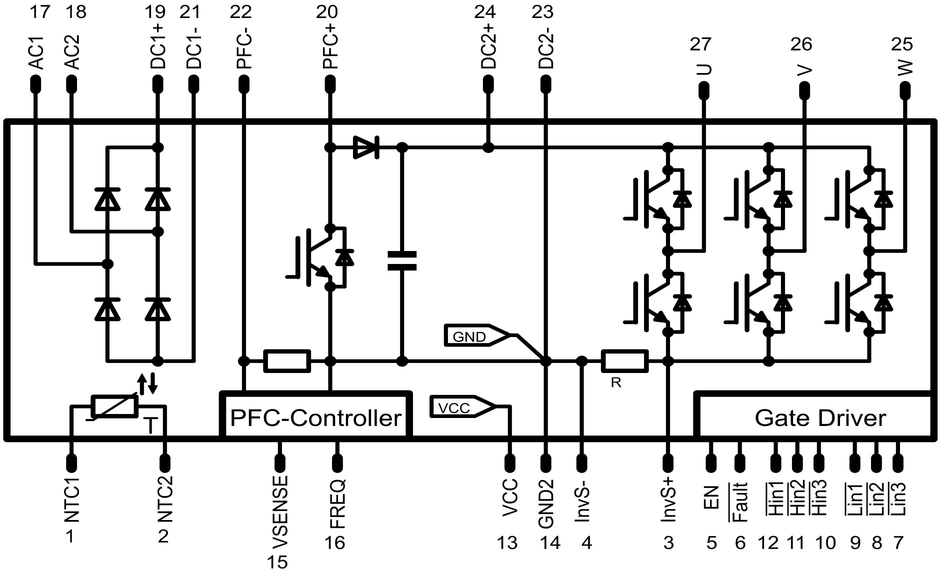
Pin table [mm]

Pin	X	Y	Function
1	45	0	NTC2
2	42	0	NTC1
3	39	0	Inv_S+
4	36	0	Inv_S-
5	33	0	EN
6	30	0	FAULT
7	27	0	LIN3
8	24	0	LIN2
9	21	0	LIN1
10	18	0	HIN3
11	15	0	HIN2
12	12	0	HIN1
13	9	0	VCC
14	6	0	GND2
15	3	0	VSENSE
16	0	0	FREQ
17	-0,2	26,4	AC1
18	4,8	26,4	AC2
19	9,8	26,4	DC1+
20	14,8	26,4	PFC+
21	19,8	26,4	DC1-
22	22,5	26,4	PFC-
23	25,2	26,4	DC2-
24	30,2	26,4	DC2+
25	35,2	26,4	W
26	40,2	26,4	V
27	45,2	26,4	U



Ordering Code & Marking - Outline - Pinout

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	600 V	4 A	Inverter Transistor	
T7	IGBT	650 V	15 A	PFC IGBT	
D12	FWD	650 V	15 A	PFC Diode	
D11	FWD	650 V	6 A	PFC inverse Diode	
R3	Resistor			PFC Shunt	
D7,D8,D9,D10	Rectifier	1600 V	12 A	Input Rectifier Diode	
R2	Resistor			DC - Shunt	
C1	Capacitor	500 V		DC link Capacitor	
T	Thermistor			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**100**	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 1B packages see vincotech.com website.

Package data
Package data for *flow* 1B 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
20-xB06IPB004RC-P952A40x-D3-14	20 Jan. 2017	Rth values and conditions values changed	1-3, 5-6, 12, 19, 22