20-1B06IPB010RC03-P955A65

datasheet

***flow*IPM 1B (CIP)** **600 V / 10 A**

Topology features

- Integrated DC capacitor
- Temperature sensor
- Converter+PFC+Inverter
- PFC Shunt
- Gate Drive Circuit including complete Bootstrap Circuit
- Inverter Shunt
- PFC Gate Drive

Component features

- Optimised collector emitter saturation voltage and forward voltage for low conduction losses
- Reverse conductive IGBT technology
- Smooth switching performance leading to low EMI levels

Housing features

- Base isolation: Al_2O_3
- Ceramic substrate for Thick-film based designs
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

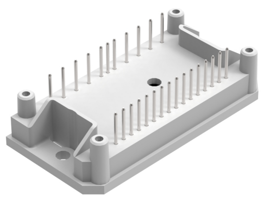
Target applications

- Embedded Drives
- Industrial Drives

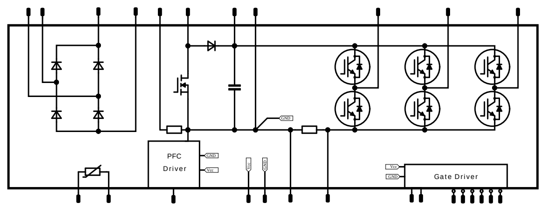
Types

- 20-1B06IPB010RC03-P955A65

flow 1B 17 mm housing



Schematic



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	T_j = 150 °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 MOSFET					
Drain to source breakdown voltage	V_{DS}			600	V
DC drain current	I_D	$T_j = T_{jmax}$	T_s = 80 °C	13	A
Pulsed drain current	I_{Dpulse}	T_C = 25 °C		159	A
Avalanche energy, single pulse	E_{AS}	I_D = 9,3 A , V_{DD} = 50 V		1135	mJ
Avalanche energy, repetitive	E_{AR}	I_D = 9,3 A , V_{DD} = 50 V		1,7	mJ
Avalanche current, repetitive	I_{AR}	t_p limited by T_{jmax}		9,3	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS} = 480 V $P_{AV} = E_{AR}$*f		50	V/ns
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	33	W
Gate-source peak voltage	V_{GSS}			±20	V
Reverse diode dv/dt	dv/dt	V_{DS}=0..400V, $I_{SD} \le I_D$, T_j=25°C		15	V/ns
Maximum Junction Temperature	T_{jmax}			150	°C
PFC Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			650	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	56	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		10	A
Power dissipation	P_{tot}		5	W
Pulse energy	E_P	Repetitive pulse energy limited by max. power dissipation	0,8	Ws
Inverter IGBT				
Collector-emitter breakdown voltage	V_{CE}		600	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}	30	A
Turn off safe operating area		$V_{CE} \leq$ 600 V, $T_j \leq$ 150 °C	20	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	16	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	5 400	μs V
Maximum Junction Temperature	T_{jmax}		175	°C
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
DC forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	8	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	14	W
Maximum Junction Temperature	T_{jmax}		175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
PFC Driver*					
Supply Voltage Range	V_{DD}			18	V
PFC Gate Input Voltage	$V_{PFC\ GATE}$			18	V
Maximum Junction Temperature	T_{jmax}			150	°C

* for more information see Fairchild's datasheet FAN3100CSX

Parameter	Symbol	Condition		Value	Unit
DC - Shunt					
DC forward current	I_F			8	A
Power dissipation	P_{tot}			5	W
DC link Capacitor					
Maximum DC voltage	U_{MAX}			500	V
Gate Driver					
Supply voltage	U_{CC}			20	V
Input voltage (LIN, HIN, EN)	U_{IN}			10	V
Output voltage (FAULT)	U_{OUT}			V_{CC}+0,5	V
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 voltage*	6000	V
		t = 1 min	AC Voltage	2500	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

* 100 % Tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Input Rectifier Diode										
Forward voltage	V_F				7	25 125		1,04 0,97	1,11(1)	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			0,01	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4W/mK (PSX)						4,56		K/W
PFC MOSFET										
Static drain to source ON resistance	$r_{DS(on)}$		10		26	25 125		92,86 106,58	70(1)	mΩ
Gate threshold voltage	$V_{(GS)th}$	$V_{GS} = V_{DS}$			0,002	25	2,4	3	3,6	V
Gate to Source Leakage Current	I_{GSS}		20	0		25			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	600		25			5	μA
Internal gate resistance	r_g							0,85		Ω
Total gate charge	Q_{GE}					25		170		
Gate to source charge	Q_{GS}		0/10	480	25,8	25		21		nC
Gate to drain charge	Q_{GD}					25		87		
Input capacitance	C_{iss}							3800		
Output capacitance	C_{oss}	f = 1 MHz	0	100		25		215		pF
Reverse transfer capacitance	C_{rss}							35		
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4W/mK (PSX)						1,25		K/W
PFC Diode										
Forward voltage	V_F				10	25 125		1,45 1,14	2,8(1)	V
Reverse leakage current	I_{rm}			600		25			10	μA
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4W/mK (PSX)						1,69		K/W
PFC Shunt										
Resistance value	R							50		mΩ
PFC Gate Pull Down Resistor										
Resistance value	R							2,7		kΩ

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
PFC Drive										
Operating Range	V_{DD}					25	4,5		18	V
Supply Current Inputs/ EN Not Connected	I_D					25		0,2	0,35	mA
Turn-On Voltage	V_{ON}					25	3,5	3,9	4,3	V
Turn-Off Voltage	V_{OFF}					25	3,3	3,7	4,1	V
IN+, IN- Logic Low Voltage	V_{INL}					25	30			$\%V_{DD}$
IN+, IN- Logic High Voltage	V_{INH}					25			70	$\%V_{DD}$
IN+, IN- Logic Hysteresis Voltage	V_{HYS}					25		17		$\%V_{DD}$
OUT Current, Mid-Voltage, Sinking	I_{SINK}	OUT at $V_{DD}/2$, C_{LOAD} = 0,1µF, f = 1 kHz				25		2,5		A
OUT Current, Mid-Voltage, Sourcing	I_{SOURCE}	OUT at $V_{DD}/2$, C_{LOAD} = 0,1µF, f = 1 kHz				25		-1,8		A
OUT Current, Peak, Sinking	I_{PK_SINK}	C_{LOAD} = 0,1µF, f = 1 kHz				25		3		A
OUT Current, Peak, Sourcing	I_{PK_SOURCE}	C_{LOAD} = 0,1µF, f = 1 kHz				25		-3		A
Inverter IGBT										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0002	25	4,4	5	5,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 125	1,7	2,20 2,32	2,62(1)	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		25			0,1	mA
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		655		pF
Output capacitance	C_{oss}							37		
Reverse transfer capacitance	C_{rss}							22		
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4W/mK (PSX)						5,79		K/W
Inverter Diode										
Diode forward voltage	V_F				10	25 125	1,5	2,23 2,18	2,42(1)	V
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4W/mK (PSX)						6,66		K/W
DC - Shunt										
Resistance value	R					25		25		mΩ
DC link Capacitor										
C value	C							100		nF

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Gate Driver										
Supply voltage	V_{CC}					25	13	15	17,5	V
Quiescent Vcc supply current	I_{QCC}	U_{LIN} = 0 V; U_{HIN} = 3,3 V				25		1,3	2	mA
Input voltage (LIN, HIN, EN)	V_{IN}					25	0		5	
Input voltage (GATE)	V_{GATE}					25	0		15	
Logic "0" input voltage (LIN, HIN)	V_{IH}	U_{CC} = 15 V				25	1,7	2,1	2,4	
Logic "1" input voltage (LIN, HIN)	V_{IL}					25	0,7	0,9	1,1	V
Positive going threshold voltage (EN)	$V_{EN,TH+}$					25	1,9	2,1	2,3	
Negative going threshold voltage (EN)	$V_{EN,TH-}$					25	1,1	1,3	1,5	
Input clamp voltage (LIN, HIN, EN)	$V_{IN,CLAMP}$	I_{IN} = 4 mA				25	9	10,3	12	
ITRIP positive going threshold	$V_{IT,TH+}$					25	380	445	510	mV
Input bias current LIN high	I_{LIN+}	U_{LIN} = 3,3 V				25		70	100	
Input bias current LIN low	I_{LIN-}	U_{LIN} = 0 V				25		110	200	
Input bias current HIN high	I_{HIN+}	U_{HIN} = 3,3 V				25		70	100	μA
Input bias current HIN low	I_{HIN-}	U_{HIN} = 0 V				25		110	120	
Input bias current EN high	I_{EN+}	U_{HIN} = 3,3 V				25		45	120	
Output voltage (FAULT)	V_{FLT}					25	0		U_{CC}	V
Low on resistor of pull down trans. (FAULT)	$R_{ON,FLT}$	U_{FAULT} = 0,5 V				25		45	100	Ω
Pulse width for ON or OFF	t_{IN}					25	1			μs
Turn-on propagation delay (LIN, HIN)	t_{ON}	$U_{LIN/HIN}$ = 0 V or 3,3 V				25	400	530	800	ns
Turn-off propagation delay (LIN, HIN)	t_{OFF}					25	360	490	760	
FAULT reset time	t_{RST}					25		4		ms
Fixed deadtime between high and low side	t_{DT}	$U_{LIN/HIN}$ = 0 V & 3,3 V				25	150	310		ns
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				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									B	

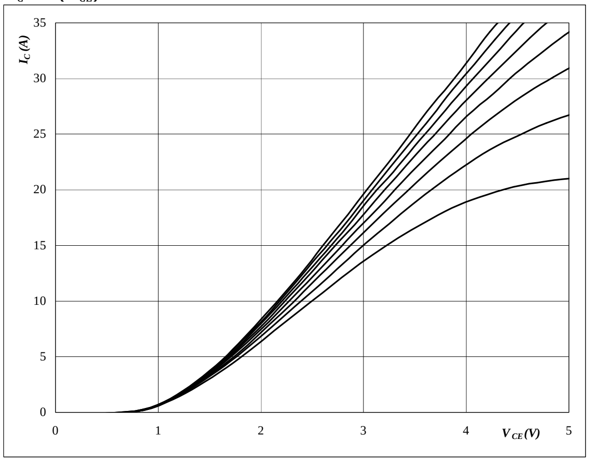
(1) value at chip level
** including gate driver

Output Inverter

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



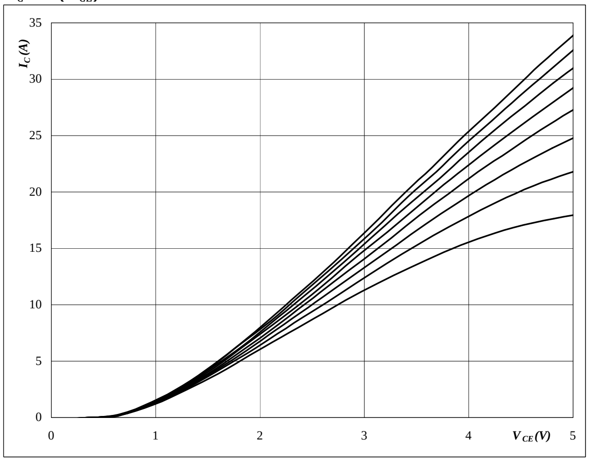
At

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

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



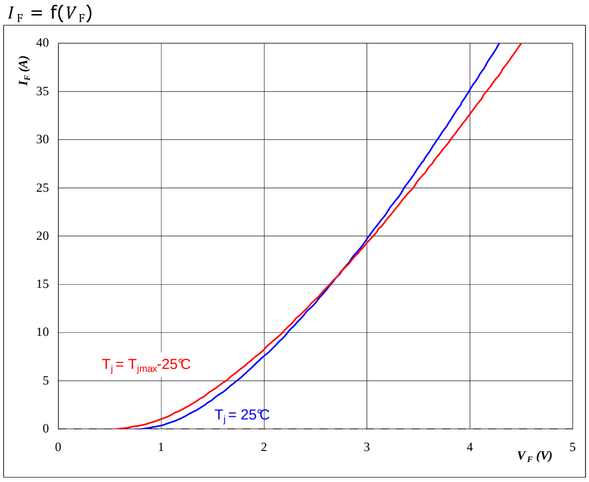
At

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

figure 3. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

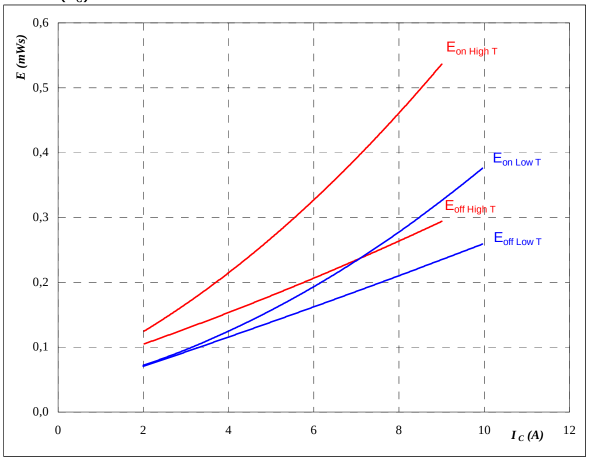
t_p =	250	µs

Output Inverter

figure 4. **IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



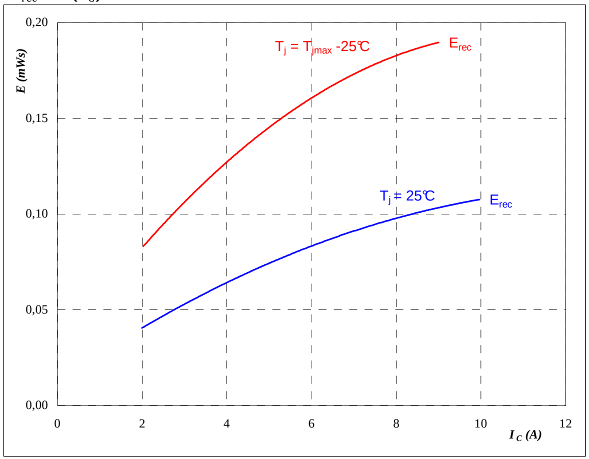
With an inductive load at

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

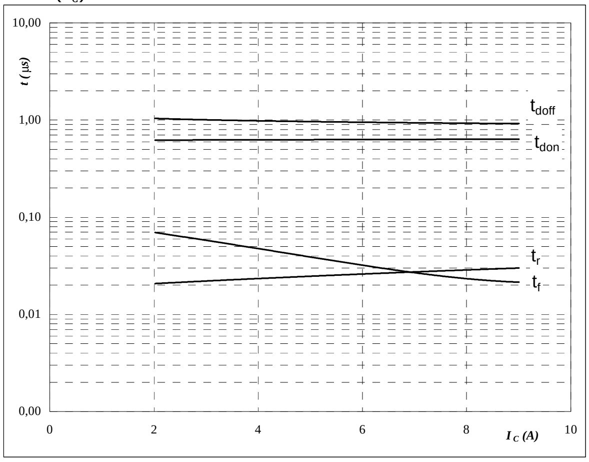
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}	15	V

Output Inverter

figure 6.	IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



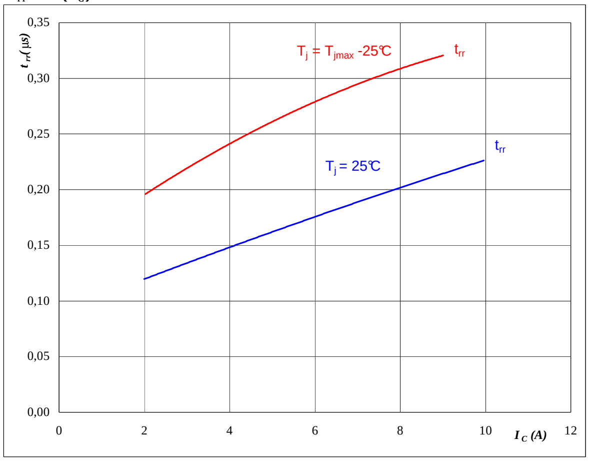
With an inductive load at

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

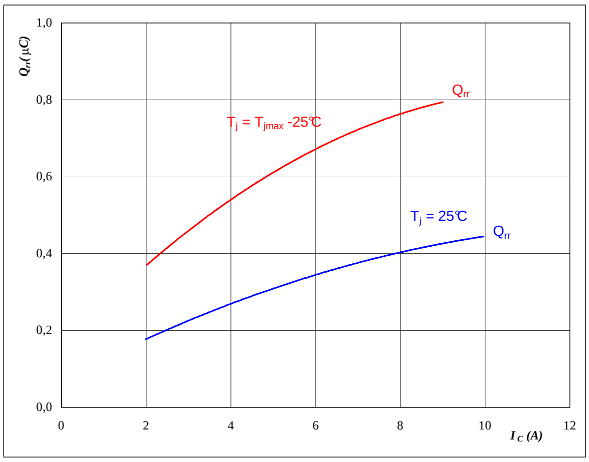
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}	15	V

Output Inverter

figure 8. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



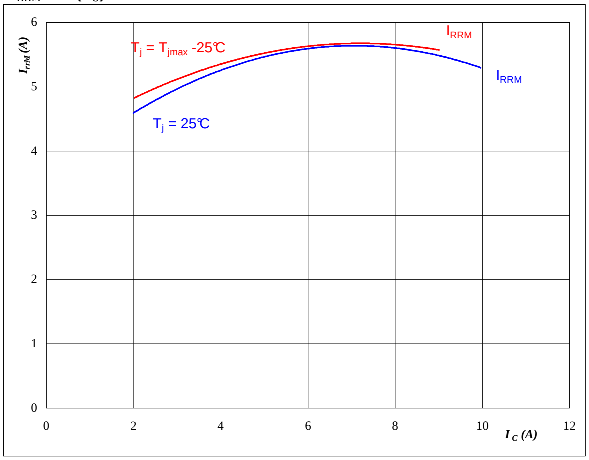
At

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

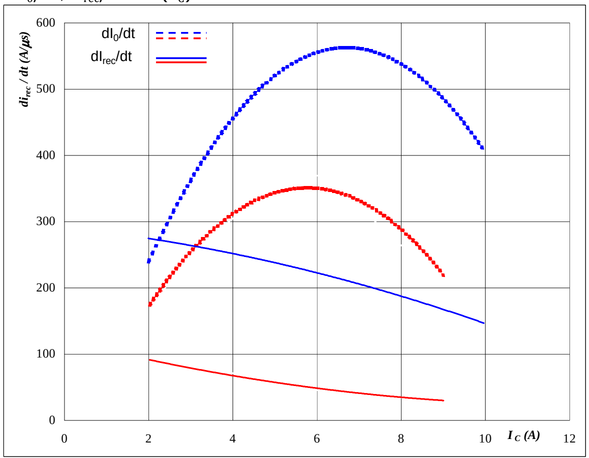
T_j =	25/125	°C
V_{CE} =	400	V
U_{CC}	15	V

Output Inverter

figure 10. **FWD**

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

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



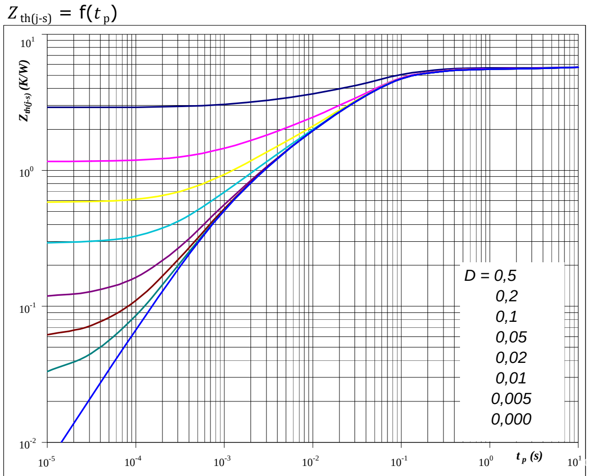
At

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	
$R_{th(j-s)}$ =	5,79	K/W

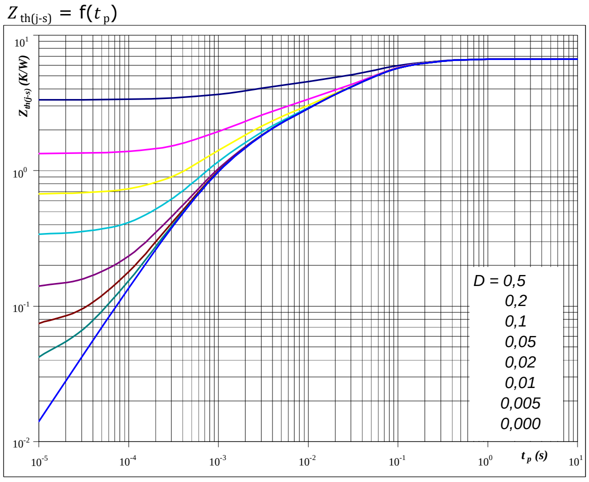
IGBT thermal model values

R (K/W)	Tau (s)
3,03E-01	6,63E+00
6,11E-01	2,13E-01
3,21E+00	4,88E-02
8,43E-01	1,03E-02
5,62E-01	2,85E-03
2,59E-01	7,40E-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	
$R_{th(j-s)}$ =	6,66	K/W

FWD thermal model values

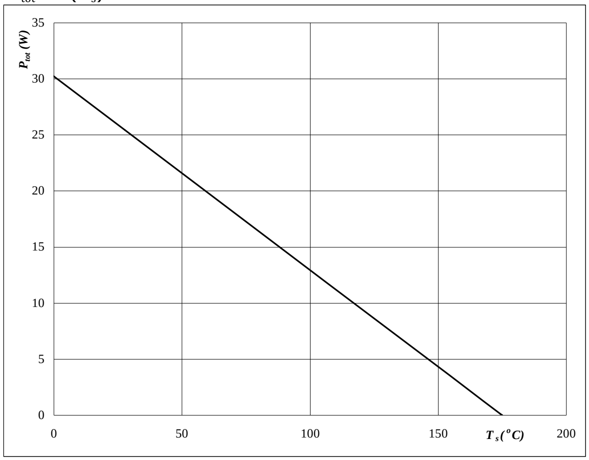
R (K/W)	Tau (s)
6,16E-01	3,13E-01
3,07E+00	5,41E-02
7,56E-01	2,30E-02
1,19E+00	4,70E-03
9,47E-01	9,78E-04
7,59E-02	7,51E-04

Output Inverter

figure 13. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



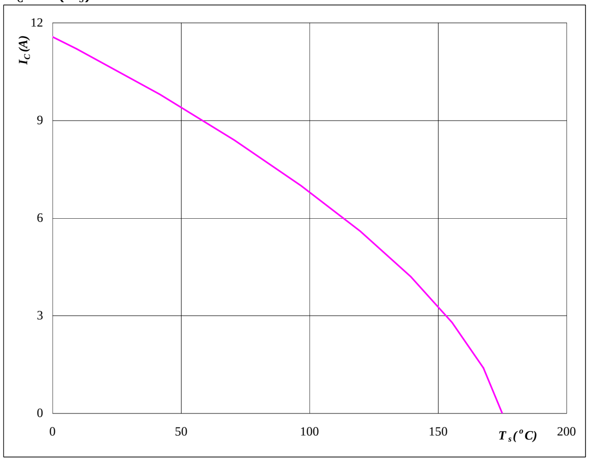
At

T_j = 175 °C

figure 14. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

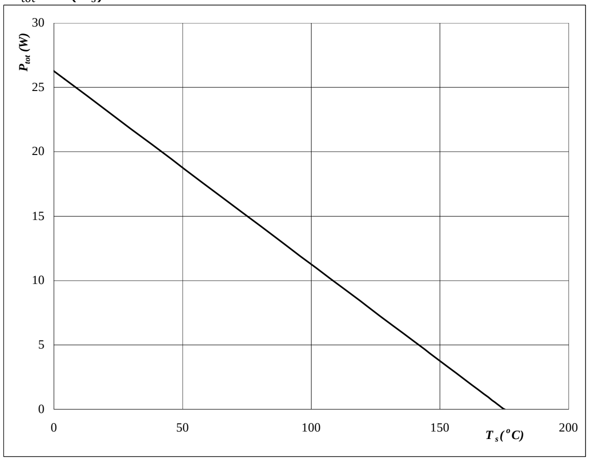
T_j = 175 °C

U_{CC} 15 V

figure 15. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



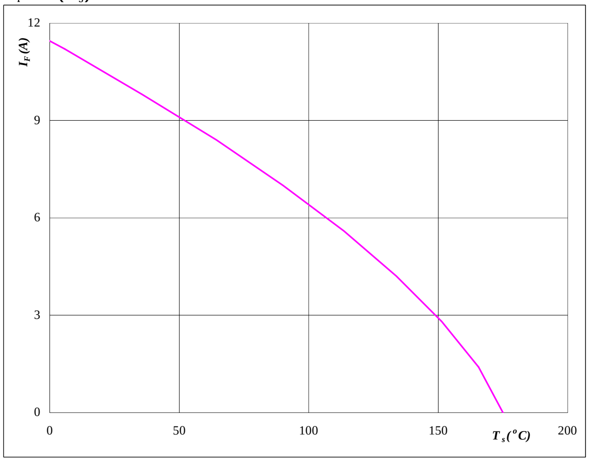
At

T_j = 175 °C

figure 16. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

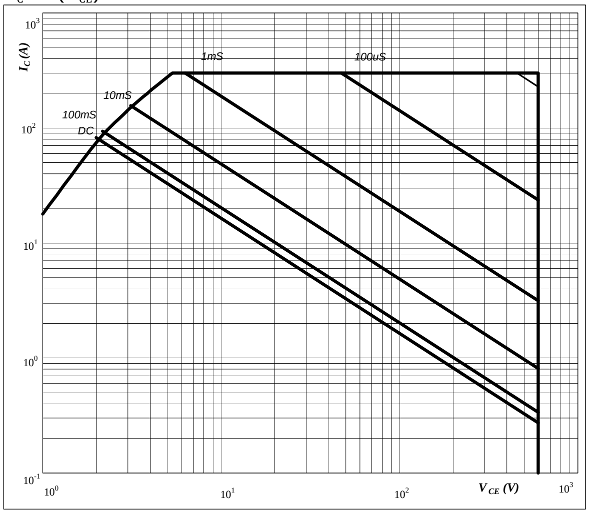
T_j = 175 °C

Output Inverter

figure 17.	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



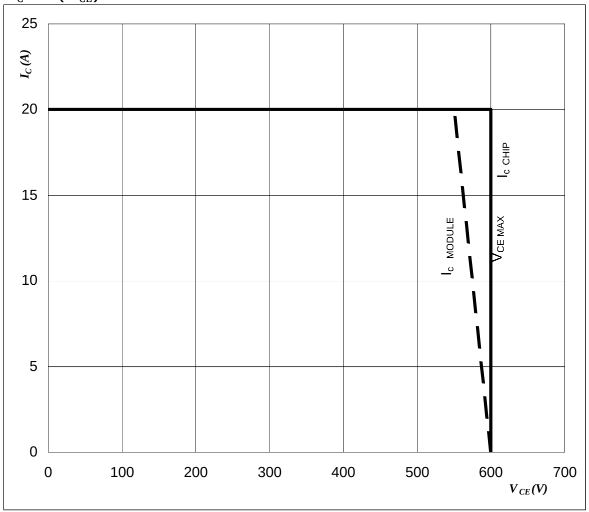
At

U_{CC}	15	V
T_j =	T_{jmax}	

figure 18.	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

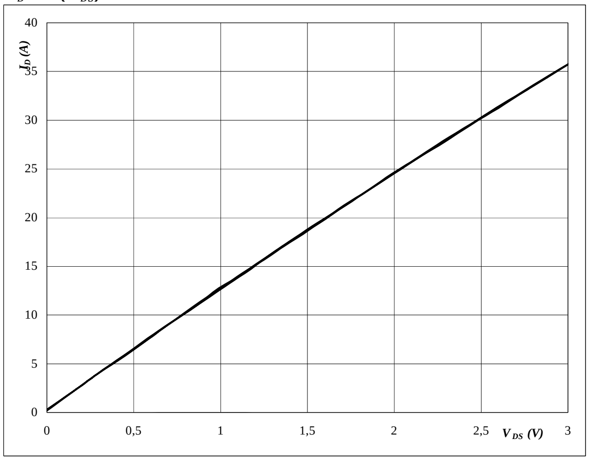
T_j =	T_{jmax}-25	ºC

PFC

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

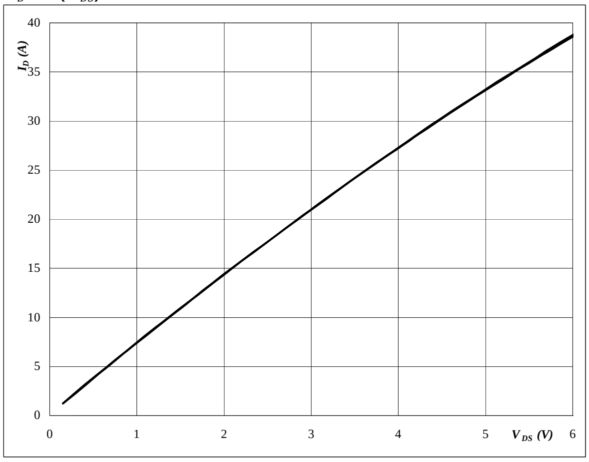
T_j = 25 °C

U_{CC} from 0,3 V to 20,3 V in steps of 2 V

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



At

t_p = 250 µs

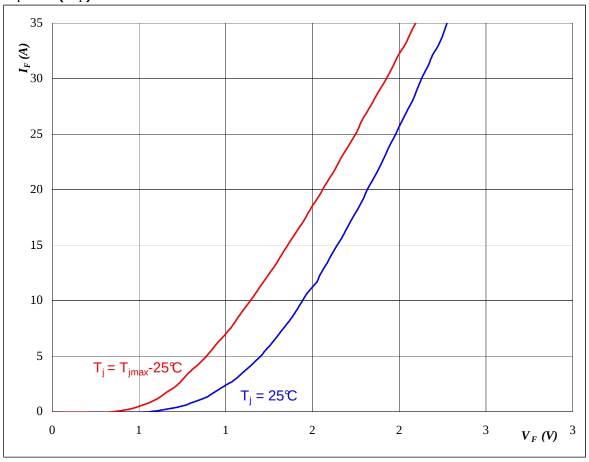
T_j = 125 °C

U_{CC} from 0,3 V to 20,3 V in steps of 2 V

figure 3. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

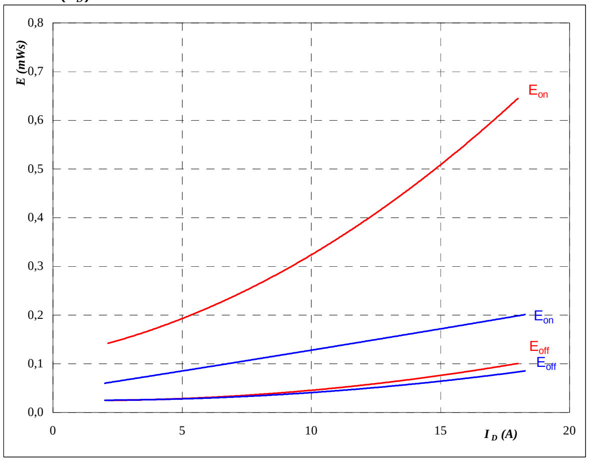
t_p = 250 µs

PFC

figure 4.	MOSFET

Typical switching energy losses
as a function of collector current

$E = f(I_D)$



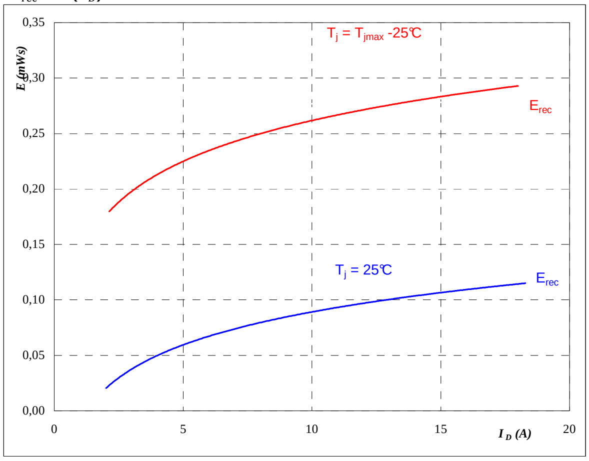
With an inductive load at

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

figure 5.	MOSFET

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_D)$



With an inductive load at

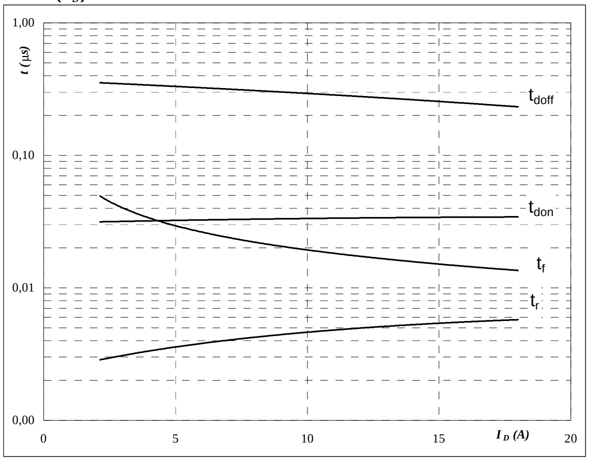
T_j =	25/125	°C
V_{DS} =	400	V
U_{CC} =	15	V

PFC

figure 6.	MOSFET

Typical switching times as a function of collector current

$t = f(I_D)$



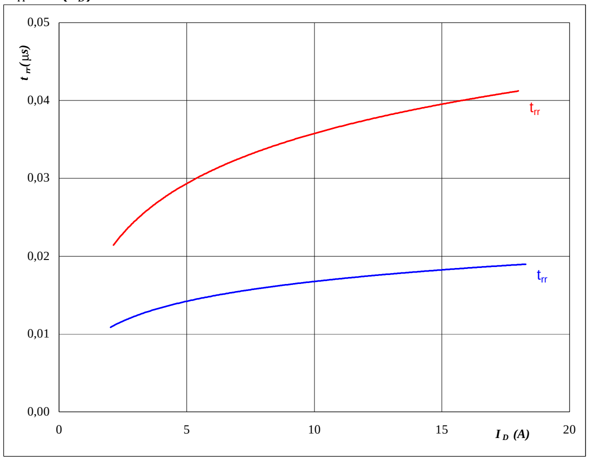
With an inductive load at

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

figure 7.	FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_D)$



At

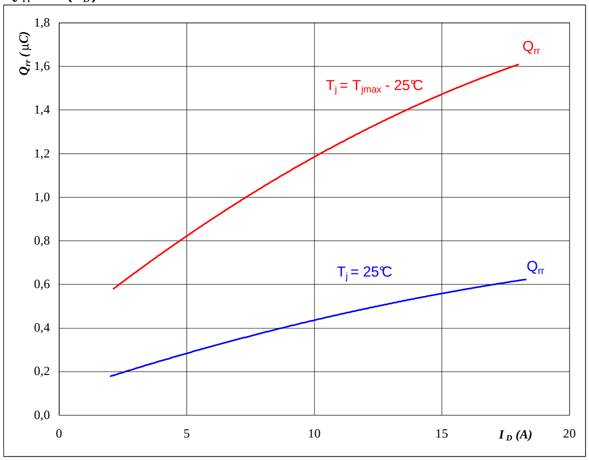
T_j =	25/125	°C
V_{DS} =	400	V
U_{CC} =	15	V

PFC

figure 8. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_D)$



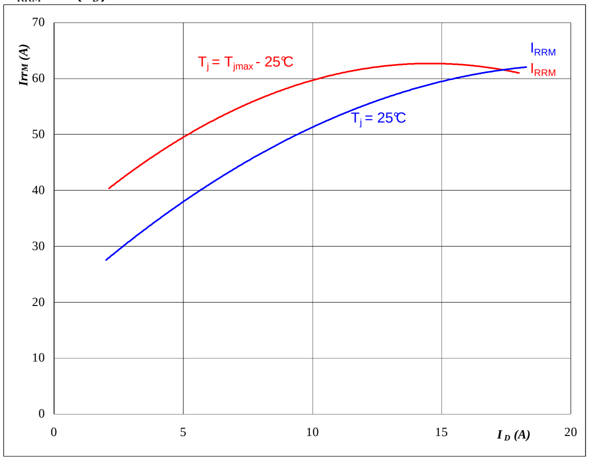
At

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

figure 9. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_D)$



At

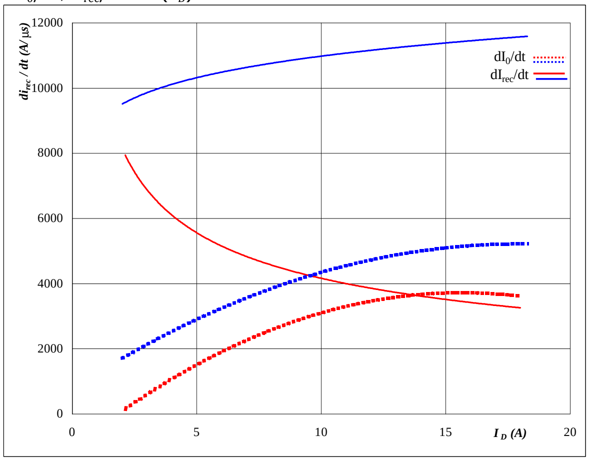
T_j =	25/125	°C
V_{DS} =	400	V
U_{CC} =	15	V

PFC

figure 10. **FWD**

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

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



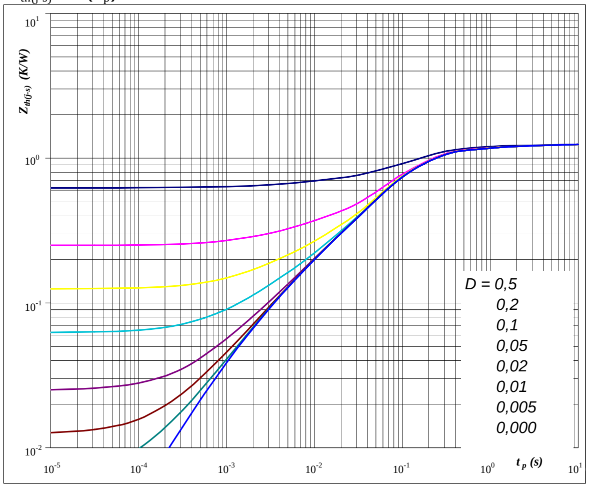
At

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

figure 11. **MOSFET**

IGBT transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j\text{-}s)}$ =	1,25	K/W

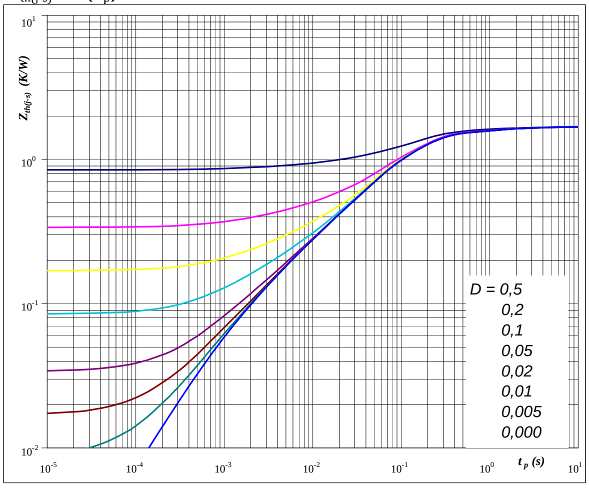
IGBT thermal model values

R (K/W)	Tau (s)
5,14E-02	4,27E+00
1,07E-01	8,50E-01
5,60E-01	1,43E-01
4,22E-01	6,14E-02
9,52E-02	4,55E-03
1,23E-02	7,73E-04

figure 12. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j\text{-}s)}$ =	1,69	K/W

FWD thermal model values

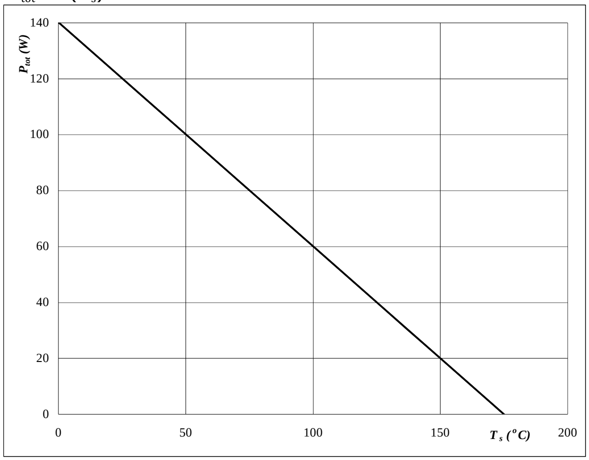
R (K/W)	Tau (s)
8,05E-02	4,27E+00
1,91E-01	6,99E-01
1,02E+00	1,19E-01
2,22E-01	4,31E-02
1,35E-01	7,08E-03
4,15E-02	1,19E-03
4,59E-03	7,10E-04

PFC

figure 13.	MOSFET

Power dissipation as a function of heatsink temperature

P_{tot} = f(T_s)



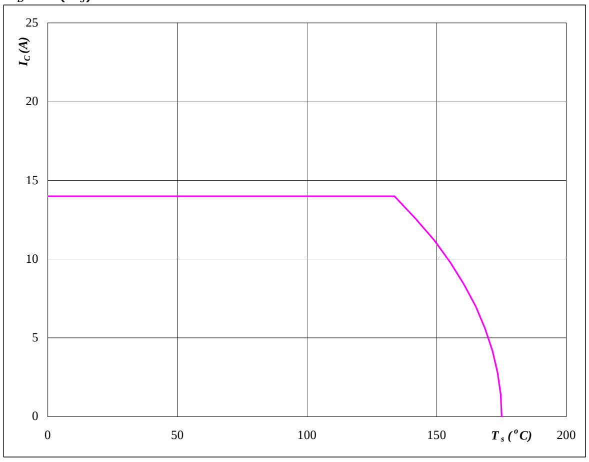
At

T_j = 175 ºC

figure 14.	MOSFET

Collector current as a function of heatsink temperature

I_D = f(T_s)



At

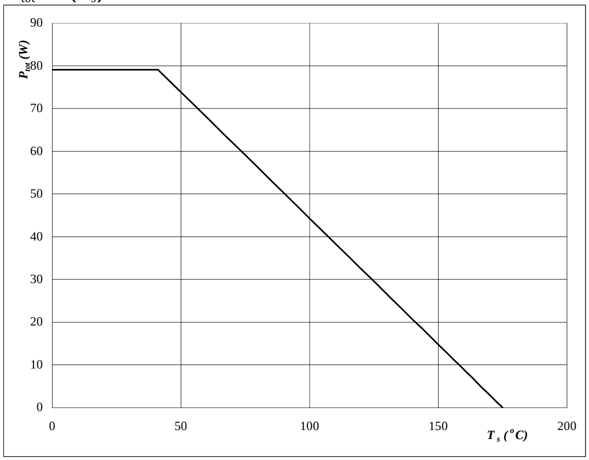
T_j = 175 ºC

U_{CC} = 15 V

figure 15.	FWD

Power dissipation as a function of heatsink temperature

P_{tot} = f(T_s)



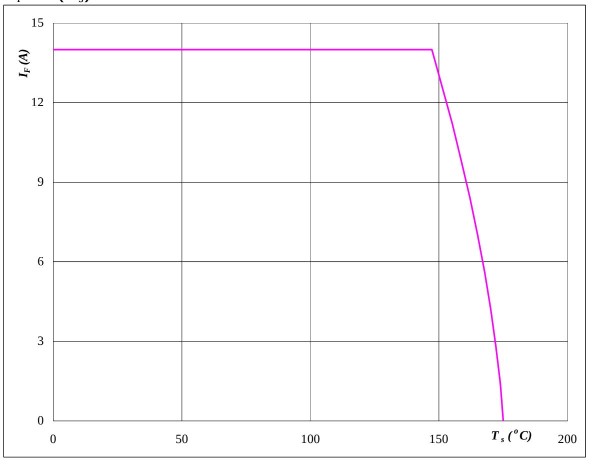
At

T_j = 175 ºC

figure 16.	FWD

Forward current as a function of heatsink temperature

I_F = f(T_s)



At

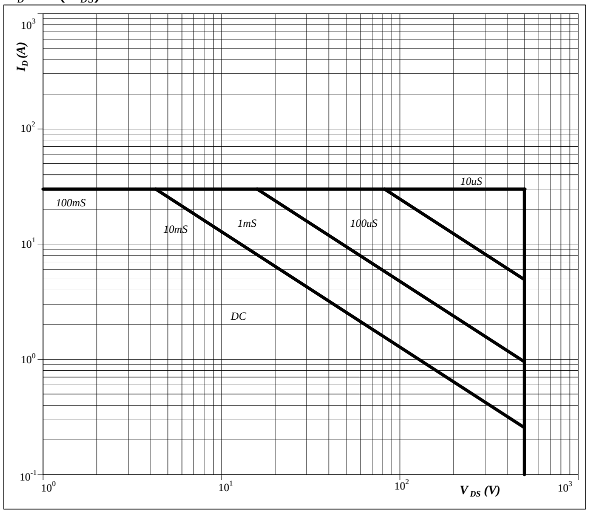
T_j = 175 ºC

PFC

figure 17.	MOSFET

Safe operating area as a function of collector-emitter voltage

$I_D = f(V_{DS})$



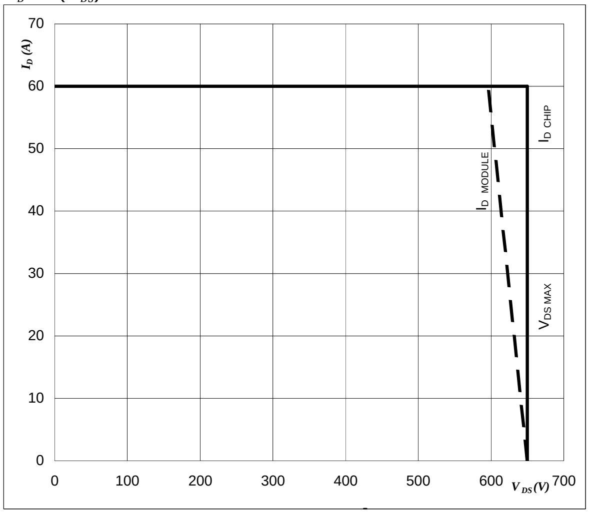
At

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

figure 18.	MOSFET

Reverse bias safe operating area

$I_D = f(V_{DS})$



At

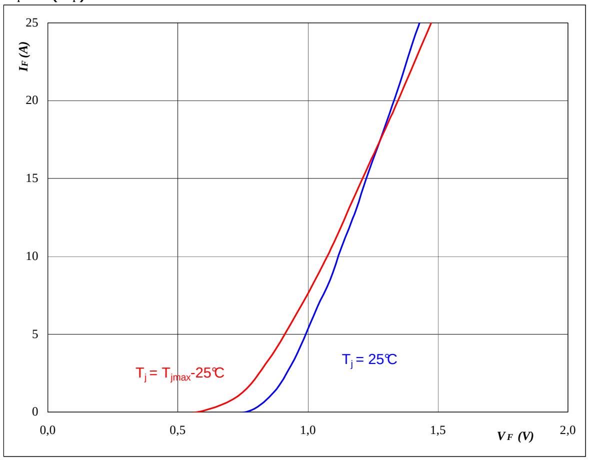
T_j = T_{jmax}-25 ºC

Input Rectifier Diode

figure 1.	Rectifier Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



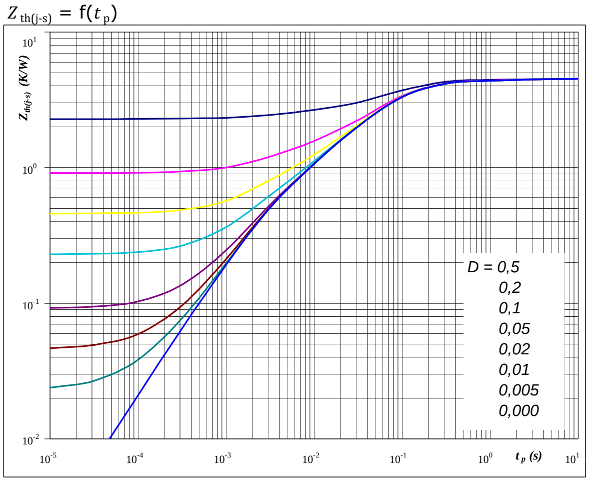
At

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

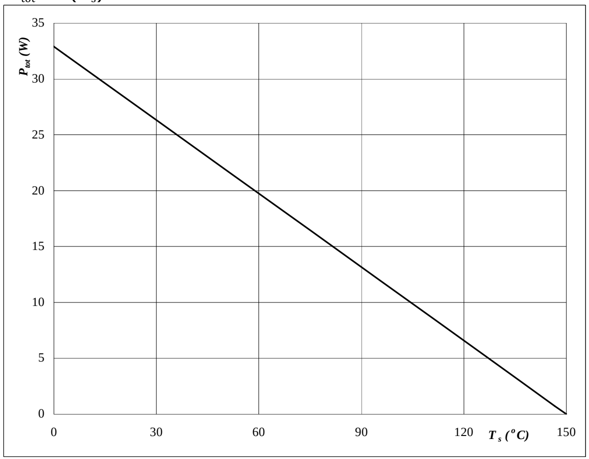
$D = t_p / T$

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

figure 3.	Rectifier Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



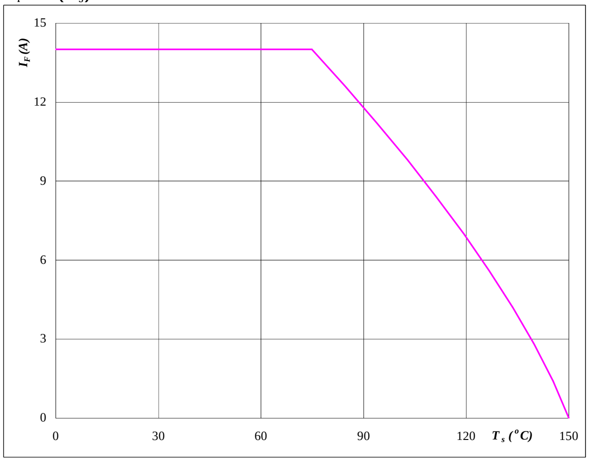
At

T_j = 150 ºC

figure 4.	Rectifier Diode

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



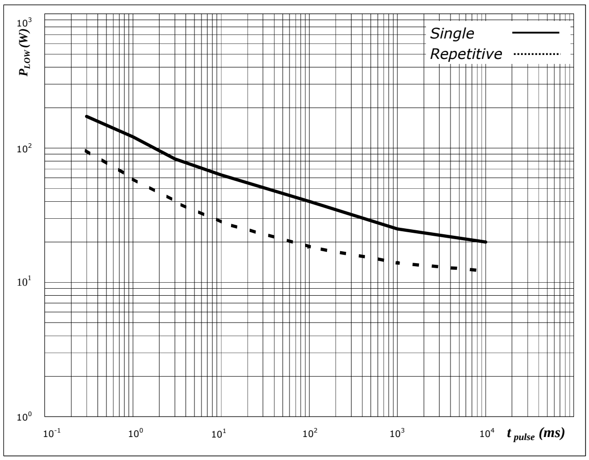
At

T_j = 150 ºC

Shunt

figure 1. **PFC Shunt**

Pulse Power R1

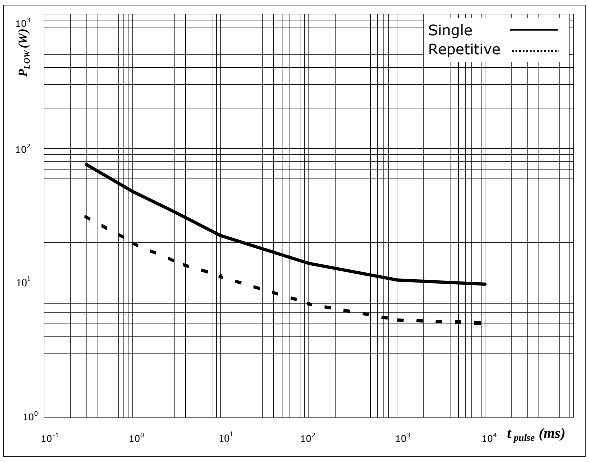


——— dR/R 0 < 5% after 1 pulse

.... 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

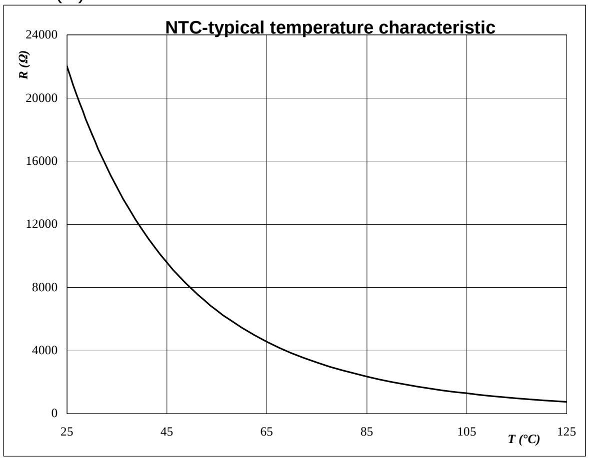
.... dR/R 0 < 1% after 10.000 cycles; duty cycle< 0,1%

Thermistor

figure 1. **Thermistor**

Typical NTC characteristic
as a function of temperature

R = f(T)



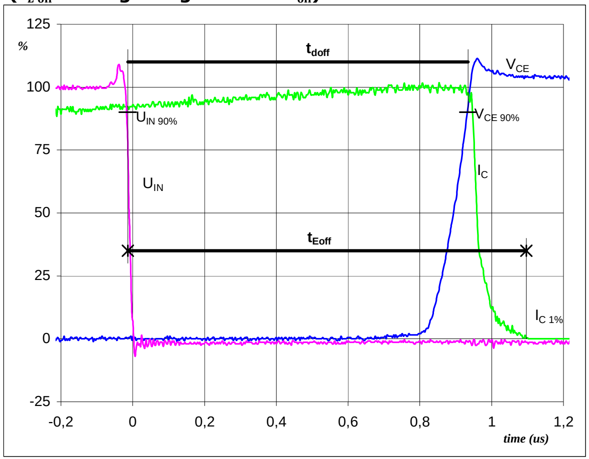
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C

figure 1. **IGBT**

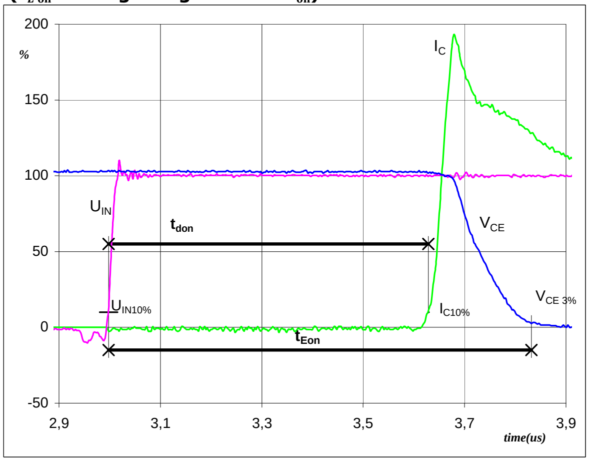
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} ($t_{E\,off}$ = integrating time for E_{off})



UIN (0%) =	0	V
UIN (100%) =	5	V
V_C (100%) =	400	V
I_C (100%) =	6	A
t_{doff} =	0,95	µs
$t_{E\,off}$ =	1,11	µs

figure 2. **IGBT**

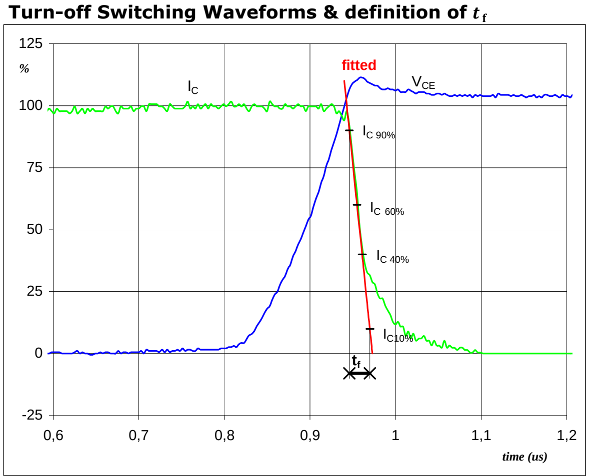
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} ($t_{E\,on}$ = integrating time for E_{on})



UIN (0%) =	0	V
UIN (100%) =	5	V
V_C (100%) =	400	V
I_C (100%) =	6	A
t_{don} =	0,63	µs
$t_{E\,on}$ =	0,83	µs

figure 3. **IGBT**

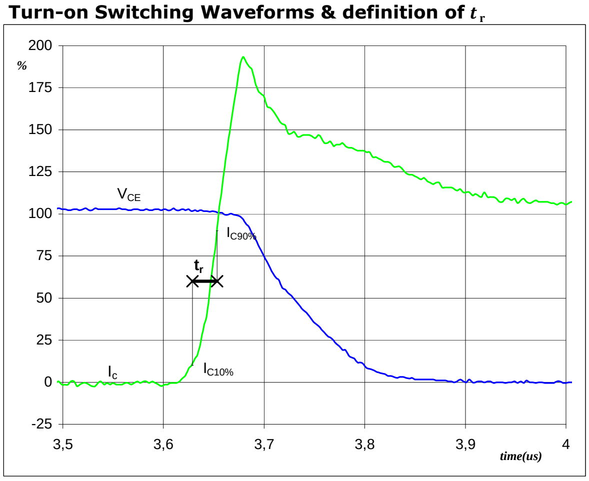
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	400	V
I_C (100%) =	6	A
t_f =	0,02	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

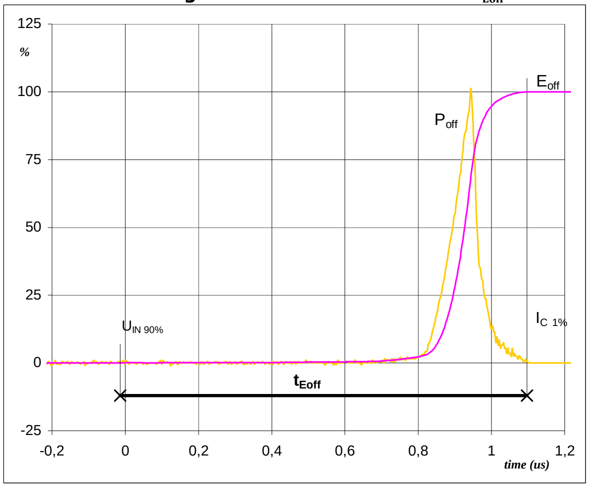


V_C (100%) =	400	V
I_C (100%) =	6	A
t_r =	0,03	µs

Switching Definitions Output Inverter

figure 5. **IGBT**

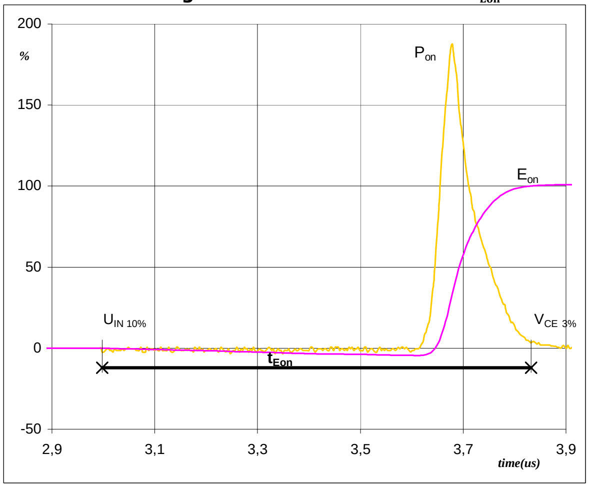
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	2,39	kW
E_{off} (100%) =	0,20	mJ
$t_{E\,off}$ =	1,11	μs

figure 6. **IGBT**

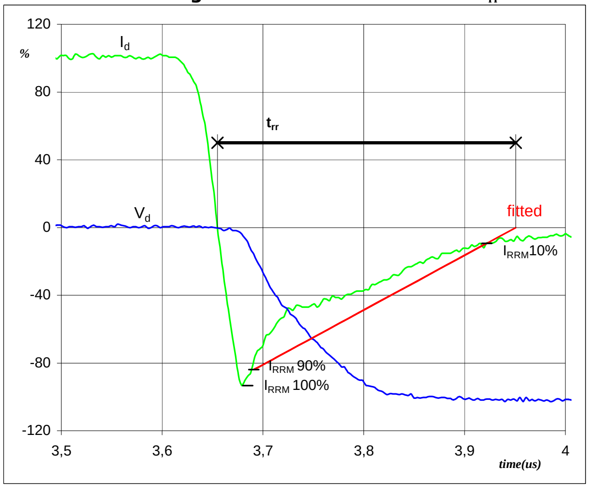
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	2,39	kW
E_{on} (100%) =	0,32	mJ
$t_{E\,on}$ =	0,83	μs

figure 7. **FWD**

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

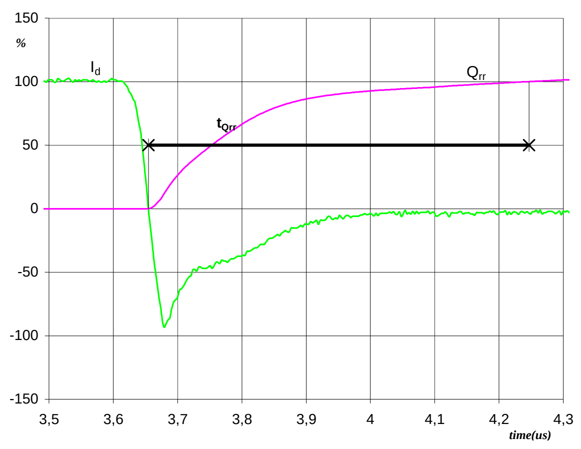


V_d (100%) =	400	V
I_d (100%) =	6	A
I_{RRM} (100%) =	-6	A
t_{rr} =	0,28	μs

Switching Definitions Output Inverter

figure 8. **FWD**

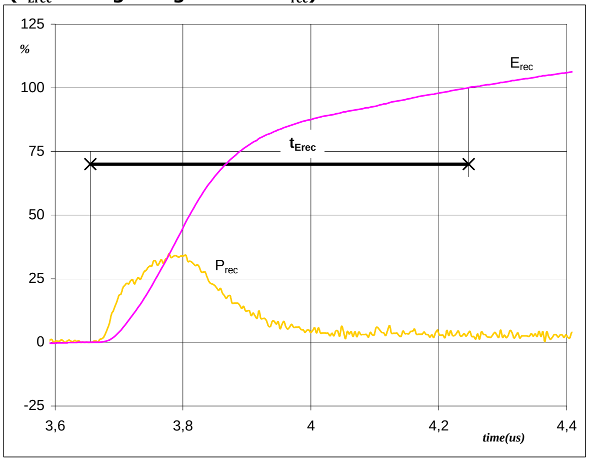
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	6	A
Q_{rr} (100%) =	0,67	μC
$t_{Q\,rr}$ =	0,59	μs

figure 9. **FWD**

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



P_{rec} (100%) =	2,39	kW
E_{rec} (100%) =	0,16	mJ
$t_{E\,rec}$ =	0,59	μs

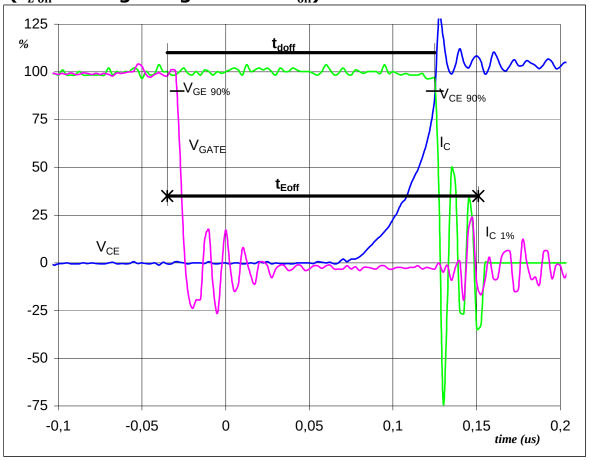
Switching Definitions PFC

General conditions

T_j	=	125 °C

figure 1. **MOSFET**

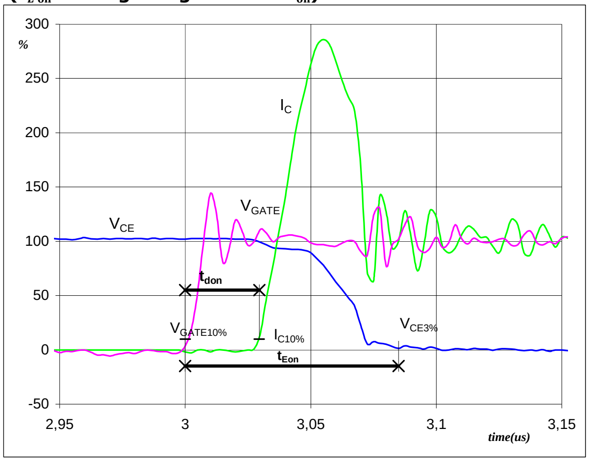
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} ($t_{E\,off}$ = integrating time for E_{off})



V_{GATE} (0%) =	0	V
V_{GATE} (100%) =	5	V
V_D (100%) =	400	V
I_D (100%) =	10	A
t_{doff} =	0,15	μs
$t_{E\,off}$ =	0,19	μs

figure 2. **MOSFET**

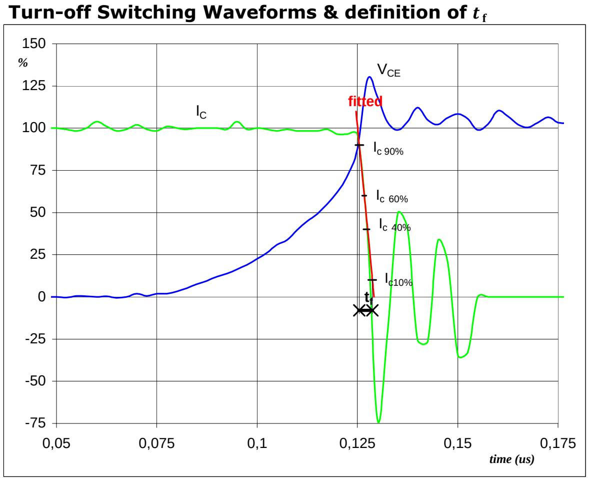
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} ($t_{E\,on}$ = integrating time for E_{on})



V_{GATE} (0%) =	0	V
V_{GATE} (100%) =	5	V
V_D (100%) =	400	V
I_D (100%) =	10	A
t_{don} =	0,03	μs
$t_{E\,on}$ =	0,08	μs

figure 3. **MOSFET**

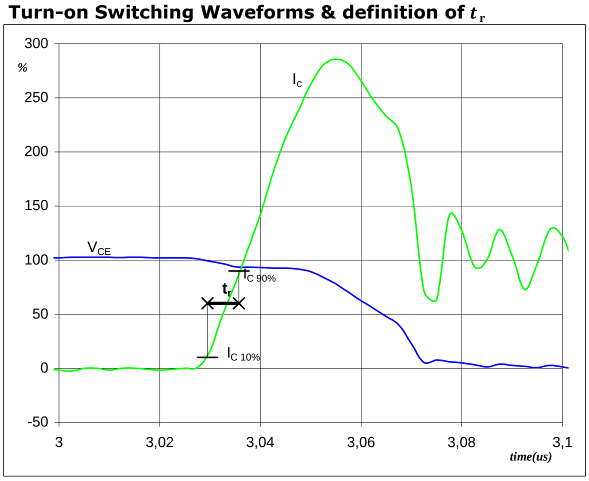
Turn-off Switching Waveforms & definition of t_f



V_D (100%) =	400	V
I_D (100%) =	10	A
t_f =	0,002	μs

figure 4. **MOSFET**

Turn-on Switching Waveforms & definition of t_r

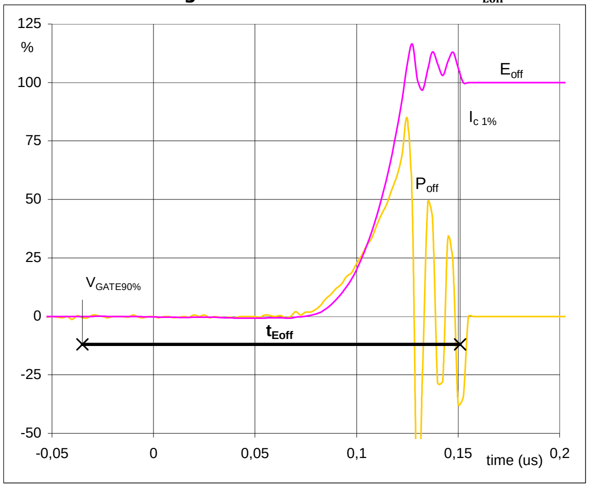


V_D (100%) =	400	V
I_D (100%) =	10	A
t_r =	0,007	μs

Switching Definitions PFC

figure 5.	MOSFET

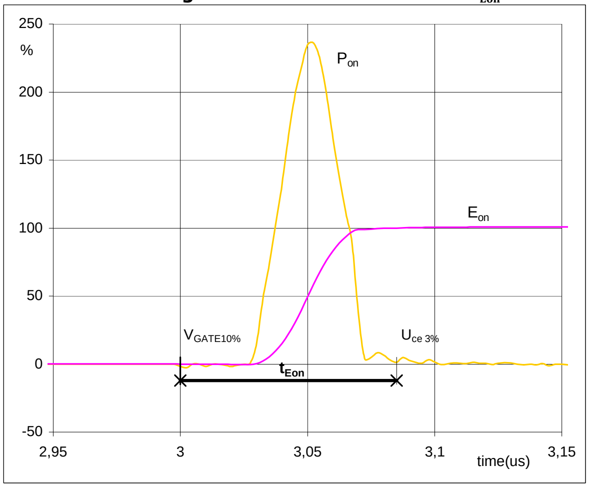
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	3,99	kW
E_{off} (100%) =	0,06	mJ
$t_{E\ off}$ =	0,19	µs

figure 6.	MOSFET

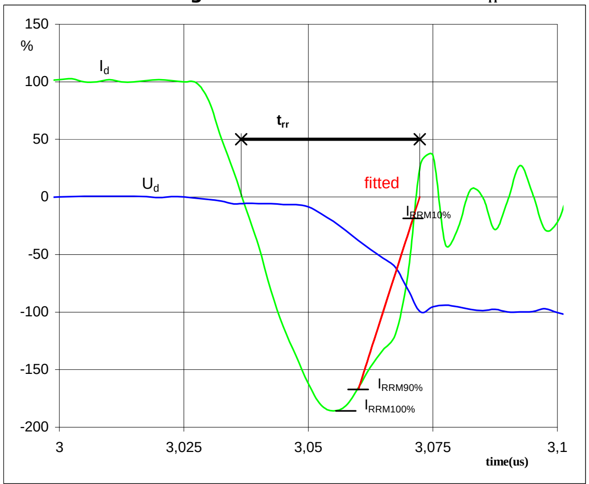
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	3,99	kW
E_{on} (100%) =	0,24	mJ
$t_{E\ on}$ =	0,085	µs

figure 7.	FWD

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

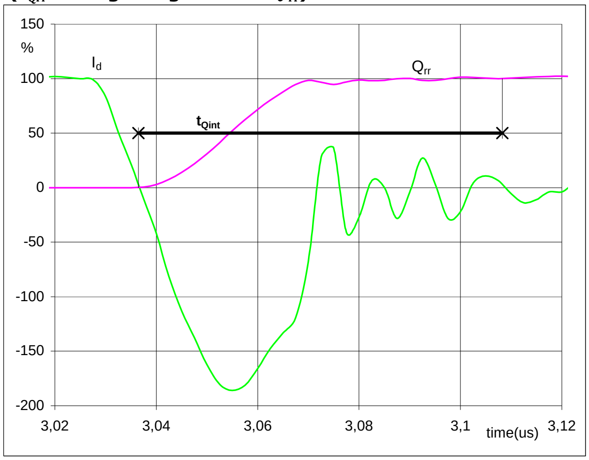


V_d (100%) =	400	V
I_d (100%) =	10	A
I_{RRM} (100%) =	-19	A
t_{rr} =	0,04	µs

Switching Definitions PFC

figure 8.	**FWD**

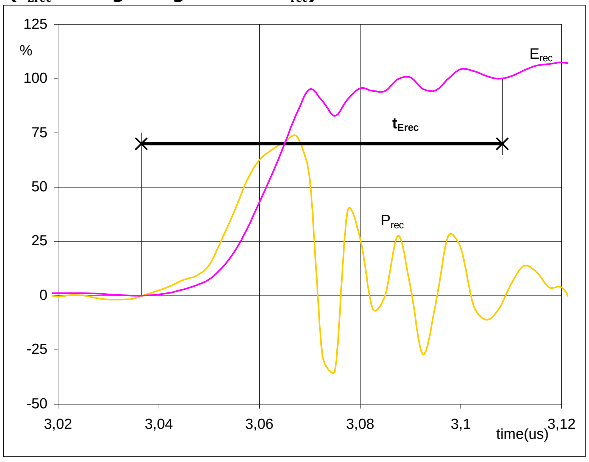
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr}= integrating time for Q_{rr})



I_d (100%) =	10	A
Q_{rr} (100%) =	0,44	μC
t_{Qint} =	0,07	μs

figure 9.	**FWD**

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



P_{rec} (100%) =	3,99	kW
E_{rec} (100%) =	0,05	mJ
$t_{E\,rec}$ =	0,07	μs

Application data

Static logic funtion table

V_{CC}	V_{BS}	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

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 logic, open-drain output)
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	GND	PFC gate driver GND
16	GATE	PFC Switch gate driver input
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 and Marking - Outline - Pinout

Ordering Code & Marking

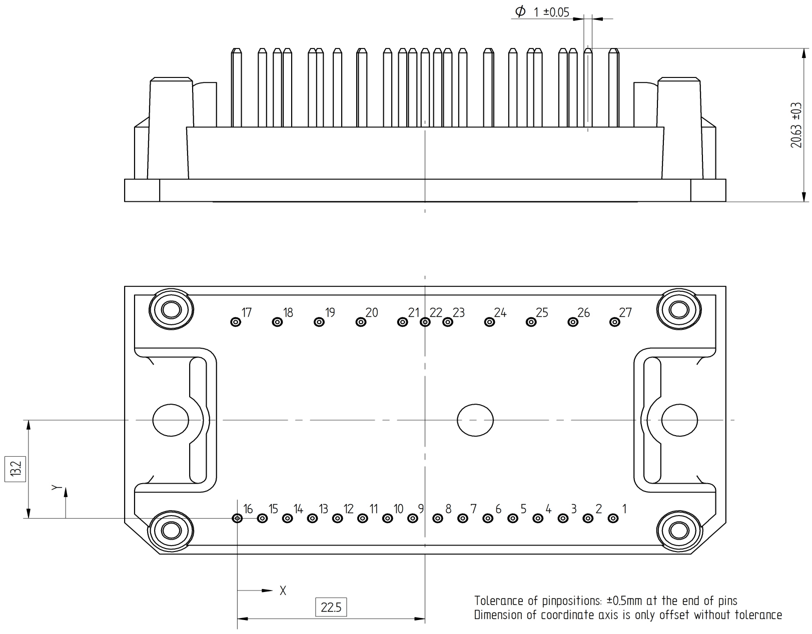
Version	Ordering Code
without thermal paste, 17 mm housing with solder pins	20-1B06IPB010RC03-P955A65
with thermal paste, 17 mm housing with solder pins	20-1B06IPB010RC03-P955A65-/3/

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

Outline

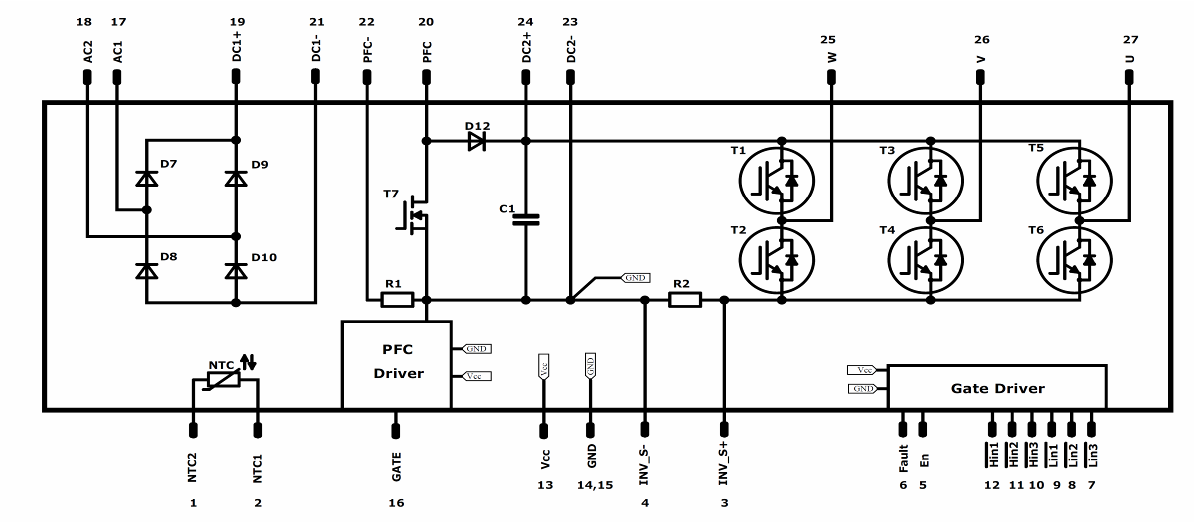
Pin table

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	GND
16	0	0	GATE
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 and Marking - Outline - Pinout

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	600 V	10 A	Inverter Switch	
T7	MOSFET	600 V	70 mΩ	PFC Switch	
D12	FWD	600 V	60 A	PFC Diode	
R1	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	
NTC	NTC			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
20-1B06IPB010RC03-P955A65-D2-14	12 Aug. 2022	Change V_{CEsat} and V_F max values to chip level values	