10-F0072TA030S5-P982D54
datasheet

***flow*PIM 0** **650 V / 30 A**

Topology features

- Dual Boost PFC
- Current sense interface in the collector with low inductive bypass diode
- Integrated Shunt Resistor
- Integrated DC capacitor
- Temperature sensor

Component features

- High speed and smooth switching
- Low gate charge
- Very low collector emitter saturation voltage

Housing features

- Base isolation: Al_2O_3
- Clip-in, reliable mechanical connection, qualified for wave soldering
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

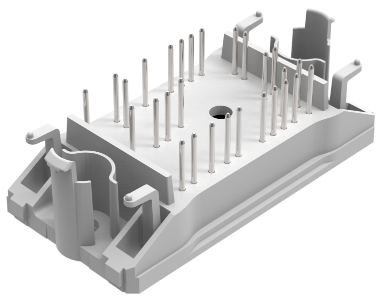
Target applications

- Embedded Drives
- Heat Pumps
- HVAC
- Industrial Drives

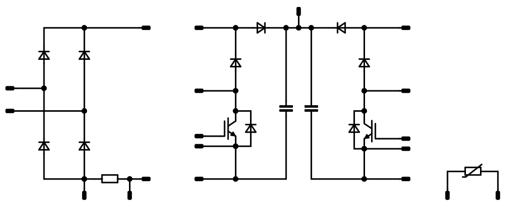
Types

- 10-F0072TA030S5-P982D54

flow 0 17 mm housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
PFC Switch					
Collector-emitter voltage	V_{CES}			650	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	36	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		90	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	58	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			175	°C
PFC Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	32	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		90	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	45	W
Maximum junction temperature	T_{jmax}			175	°C
PFC Sw. Protection Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s <= 80 °C	12 (1)	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		12	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	24	W
Maximum junction temperature	T_{jmax}			175	°C

(1) limited by I_{FRM}

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Current Transformer Protection Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s <= 80 °C	12 (2)	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		12	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	24	W
Maximum junction temperature	T_{jmax}			175	°C

(2) limited by I_{FRM}

Parameter	Symbol	Conditions		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	54	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	280	A
Surge current capability	I^2t			390	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	68	W
Maximum junction temperature	T_{jmax}			150	°C
Resistor					
DC current	I			31,6	A
Power dissipation	P_{tot}		T_c = 70 °C	10	W
Operation Temperature	T_{op}			-55 ... 170	°C
Capacitor (DC)					
Maximum DC voltage	V_{MAX}			500	V
Operation Temperature	T_{op}			-55 ... 125	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Module Properties					
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{jop}			-40…+(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	DC Test Voltage*	t_p = 2 s	6000	V
Creepage distance				>12,7	mm
Clearance				>12,7	mm
Comparative Tracking Index	CTI			≥ 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
PFC Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0003	25	3,2	4	4,8	V
Collector-emitter saturation voltage	V_{CEsat}		15		30	25 125 150		1,35 1,45 1,47	1,75(3)	V
Collector-emitter cut-off current	I_{CES}		0	650		25			50	µA
Gate-emitter leakage current	I_{GES}		20	0		25			100	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		1800		pF
Output capacitance	C_{oes}							55		pF
Reverse transfer capacitance	C_{res}							7		pF
Gate charge	Q_g	V_{CC} = 520 V	15		30	25		70		nC
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,64		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω	0/15	400	30	25 125 150		13,56 13,39 13,23		ns
Rise time	t_r					25 125 150		5,22 6,51 6,86		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		73,77 91,19 95,67		ns
Fall time	t_f					25 125 150		12,56 27,93 31,94		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,895 µC Q_{rFWD}=1,73 µC Q_{rFWD}=1,99 µC				25 125 150		0,142 0,212 0,234		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,346 0,534 0,577		mWs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
PFC Diode										
Static										
Forward voltage	V_F				30	25 125 150		1,52 1,46 1,43	1,92(3)	V
Reverse leakage current	I_R	V_r = 650 V				25			1,6	µA
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,09		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=3528 A/µs di/dt=3669 A/µs di/dt=3662 A/µs	0/15	400	30	25 125 150		49,04 61,35 64,86		A
Reverse recovery time	t_{rr}					25 125 150		39,45 62,55 68,66		ns
Recovered charge	Q_r					25 125 150		0,895 1,73 1,99		µC
Reverse recovered energy	E_{rec}					25 125 150		0,3 0,58 0,666		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		2867,07 2277,92 2308,26		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	

PFC Sw. Protection Diode

Static

Parameter	Symbol	Conditions	V_{GE} / V_{GS} [V]	V_{CE} / V_{DS} / V_F [V]	I_C / I_D / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F				6	25 125 150	1,23	1,72 1,58 1,54	1,87(3)	V
Reverse leakage current	I_R	V_r = 650 V				25			0,1	µA

Thermal

Parameter	Symbol	Conditions	V_{GE} / V_{GS} [V]	V_{CE} / V_{DS} / V_F [V]	I_C / I_D / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						4,03		K/W

Current Transformer Protection Diode

Static

Parameter	Symbol	Conditions	V_{GE} / V_{GS} [V]	V_{CE} / V_{DS} / V_F [V]	I_C / I_D / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F				6	25 125 150	1,23	1,72 1,58 1,54	1,87(3)	V
Reverse leakage current	I_R	V_r = 650 V				25			0,1	µA

Thermal

Parameter	Symbol	Conditions	V_{GE} / V_{GS} [V]	V_{CE} / V_{DS} / V_F [V]	I_C / I_D / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						4,03		K/W

Rectifier Diode

Static

Parameter	Symbol	Conditions	V_{GE} / V_{GS} [V]	V_{CE} / V_{DS} / V_F [V]	I_C / I_D / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F				50	25 125		1,24 1,24	1,3(3) 1,33(3)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			20 1500	µA

Thermal

Parameter	Symbol	Conditions	V_{GE} / V_{GS} [V]	V_{CE} / V_{DS} / V_F [V]	I_C / I_D / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,03		K/W

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_{F} [V]	I_{C} [A] I_{D} [A] I_{F} [A]	T_j [°C]	Min	Typ	Max	
Resistor										
Static										
Resistance	R							10		mΩ
Tolerance							-1		1	%
Temperature coeficient	tc							50		ppm/K
Capacitor (DC)										
Static										
Capacitance	C	DC bias voltage = 0 V				25		270		nF
Tolerance							-20		20	%
Thermistor										
Static										
Rated resistance	R					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P					25		130		mW
Power dissipation constant	d					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %						3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %						4000		K
Vincotech Thermistor Reference									I	

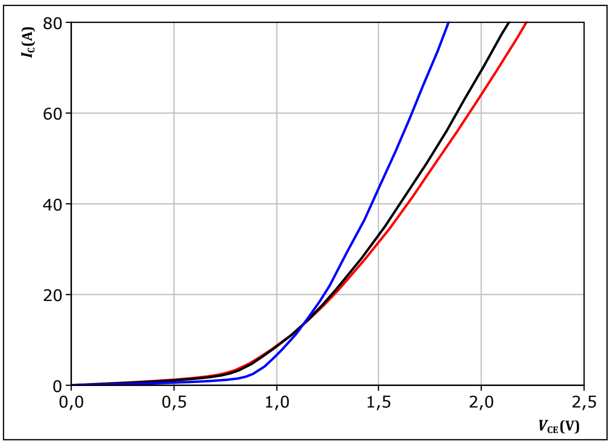
(3) Value at chip level
(4) Only valid with pre-applied Vincotech thermal interface material.

PFC Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})

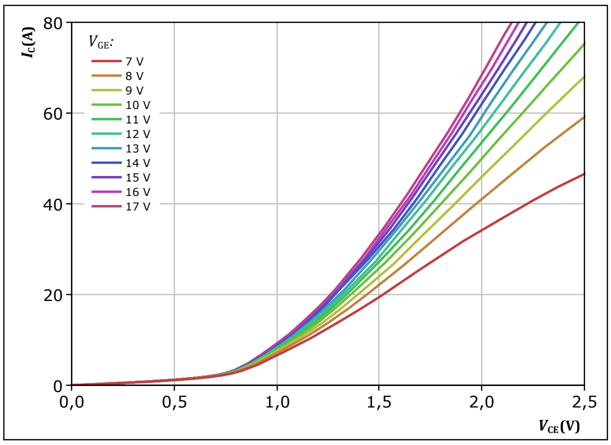


t_p =	250	μs		25 °C
V_{GE} =	15	V	T_j:	125 °C
				150 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



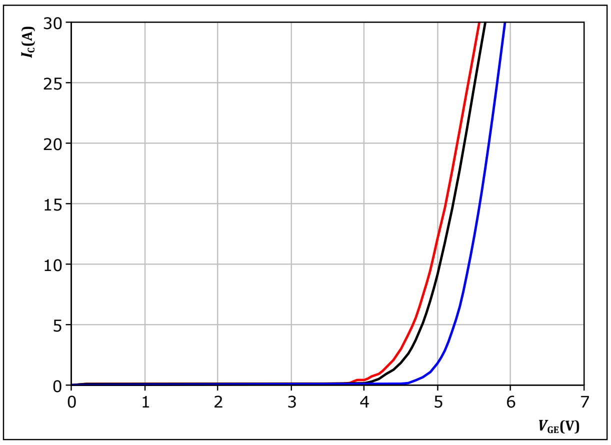
t_p =	250	μs
T_j =	150	°C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})

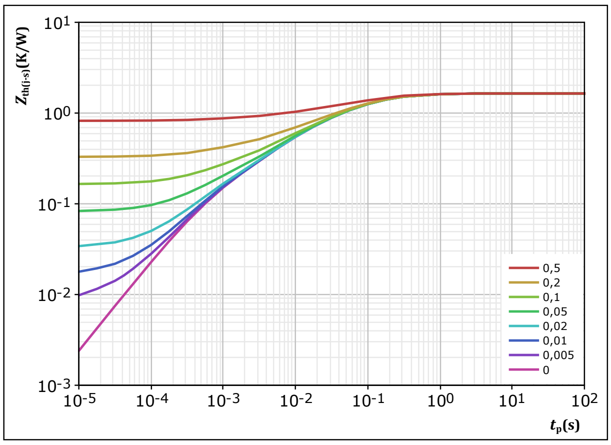


t_p =	250	μs		25 °C
V_{CE} =	30	V	T_j:	125 °C
				150 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,643	K/W

IGBT thermal model values

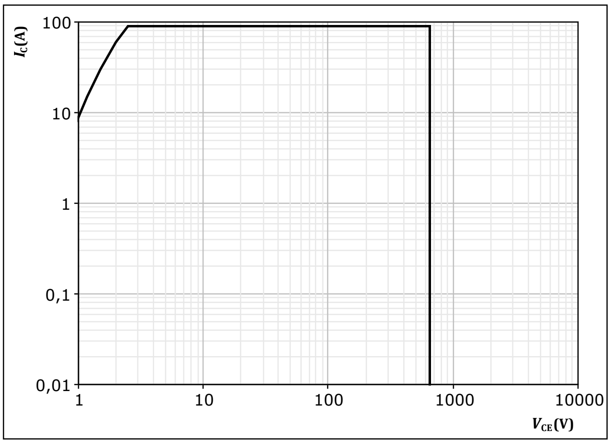
R (K/W)	τ (s)
2,02E-01	5,18E-01
7,34E-01	8,30E-02
4,15E-01	1,67E-02
1,98E-01	4,28E-03
9,39E-02	5,84E-04

PFC Switch Characteristics

figure 5. **IGBT**

Safe operating area

I_C = f(V_{CE})

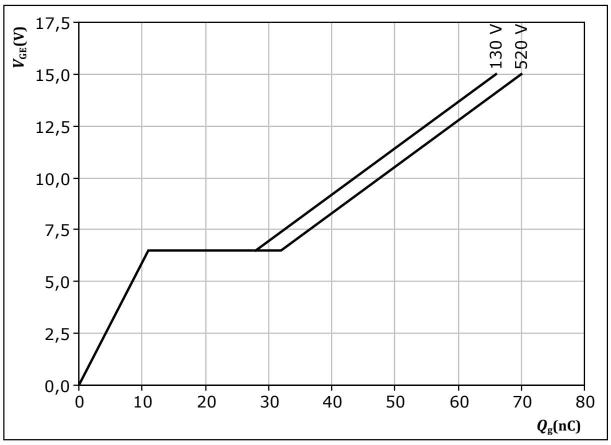


D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

figure 6. **IGBT**

Gate voltage vs gate charge

V_{GE} = f(Q_g)



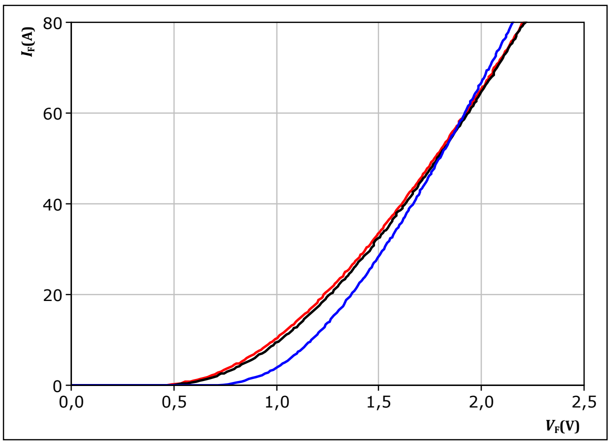
I_C =	30	A
T_j =	25	°C

PFC Diode Characteristics

figure 7.	**FWD**

Typical forward characteristics

I_F = f(V_F)



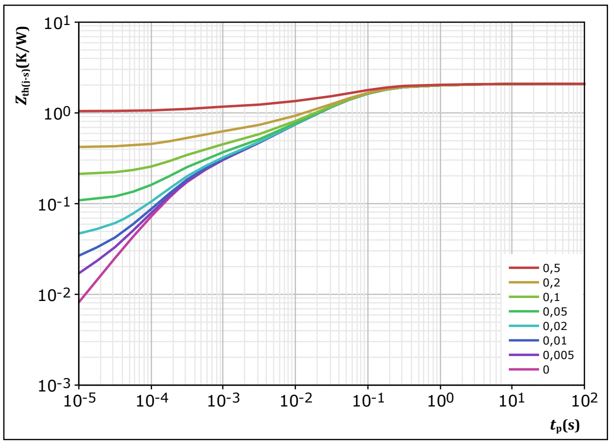
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 8.	**FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,09 K/W

FWD thermal model values

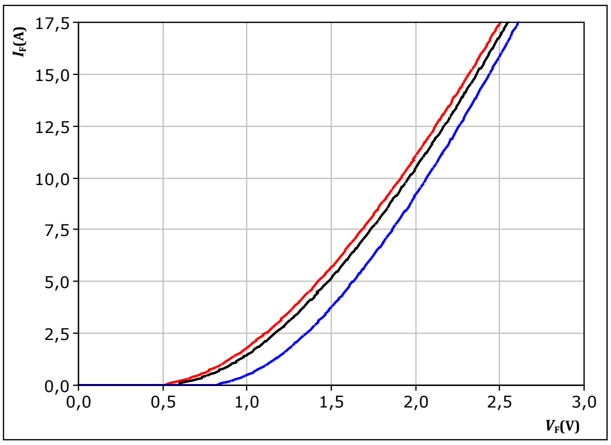
R (K/W)	τ (s)
4,56E-02	5,65E+00
1,41E-01	7,78E-01
8,06E-01	9,49E-02
6,37E-01	2,37E-02
2,49E-01	3,36E-03
2,12E-01	2,94E-04

PFC Sw. Protection Diode Characteristics

figure 9. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



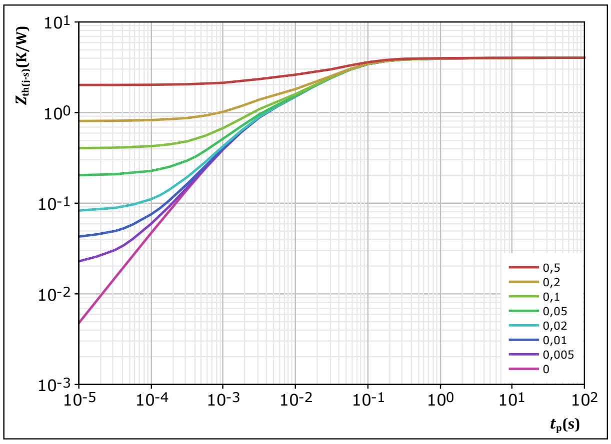
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 10. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 4,033 K/W

FWD thermal model values

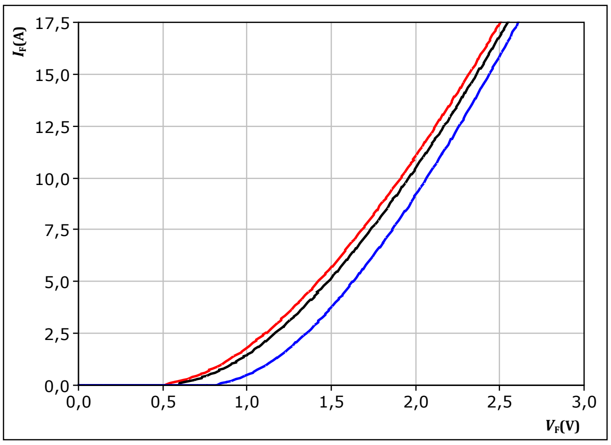
R (K/W)	τ (s)
5,78E-02	1,22E+01
1,55E-01	7,00E-01
1,57E+00	7,18E-02
1,44E+00	2,40E-02
8,16E-01	2,06E-03

Current Transformer Protection Diode Characteristics

figure 11. FWD

Typical forward characteristics

$I_F = f(V_F)$



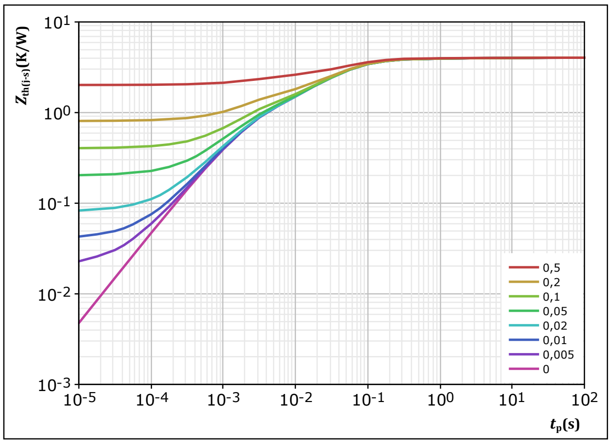
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 12. FWD

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 4,033 K/W

FWD thermal model values

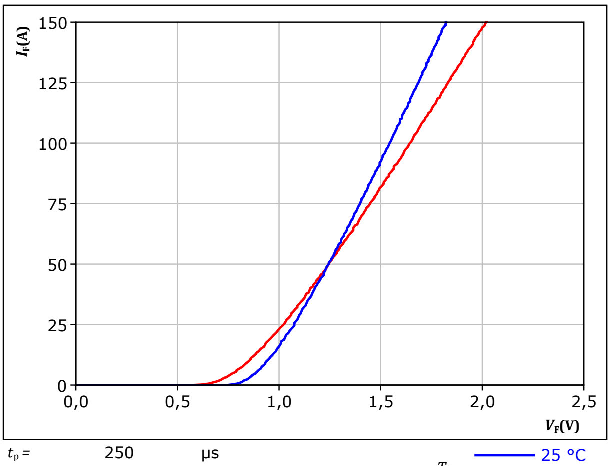
R (K/W)	τ (s)
5,78E-02	1,22E+01
1,55E-01	7,00E-01
1,57E+00	7,18E-02
1,44E+00	2,40E-02
8,16E-01	2,06E-03

Rectifier Diode Characteristics

figure 13. **Rectifier**

Typical forward characteristics

I_F = f(V_F)



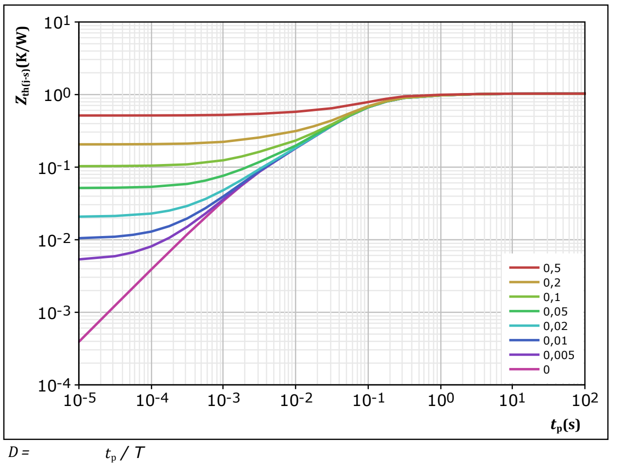
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 14. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,03 K/W

Rectifier thermal model values

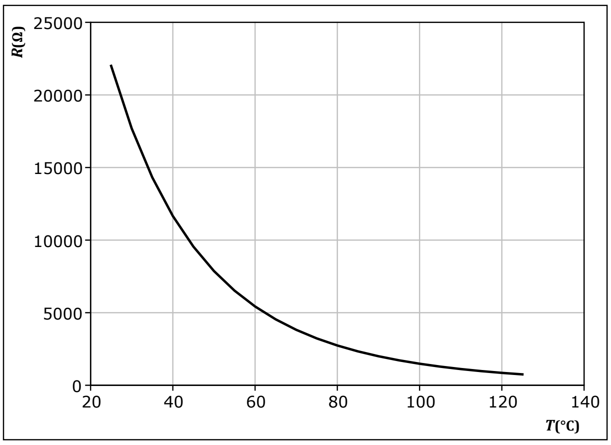
R (K/W)	τ (s)
5,79E-02	2,65E+00
1,32E-01	4,48E-01
6,73E-01	8,28E-02
1,09E-01	1,86E-02
5,86E-02	2,34E-03

Thermistor Characteristics

figure 15.	Thermistor

Typical NTC characteristic as function of temperature

R_T = f(T)

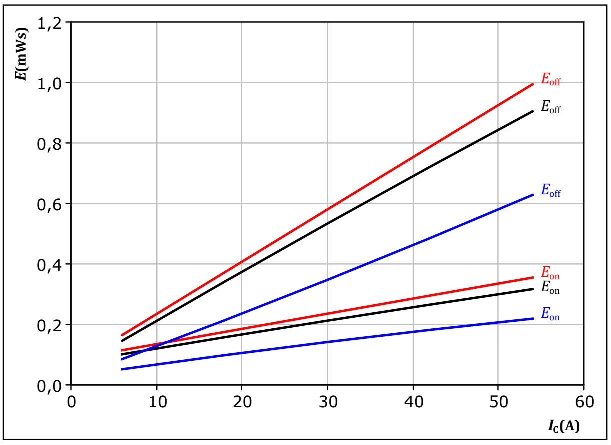


PFC Switching Characteristics

figure 16. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



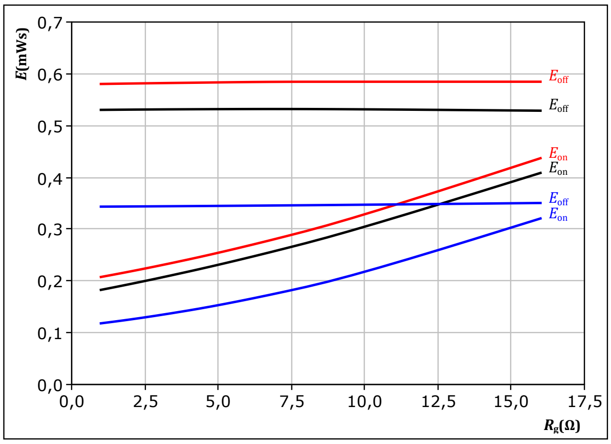
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C
R_{goff} =	4	Ω		

figure 17. **IGBT**

Typical switching energy losses as a function of IGBT turn on gate resistor

$E = f(R_g)$



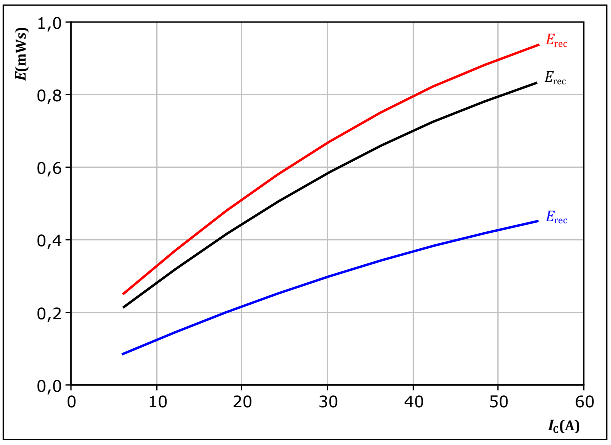
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	30	A		150 °C

figure 18. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



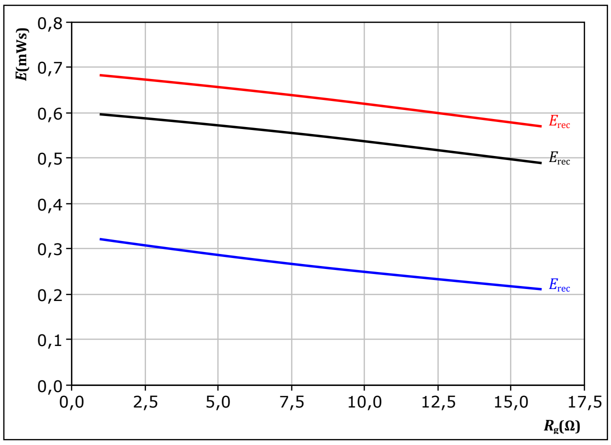
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 19. **FWD**

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

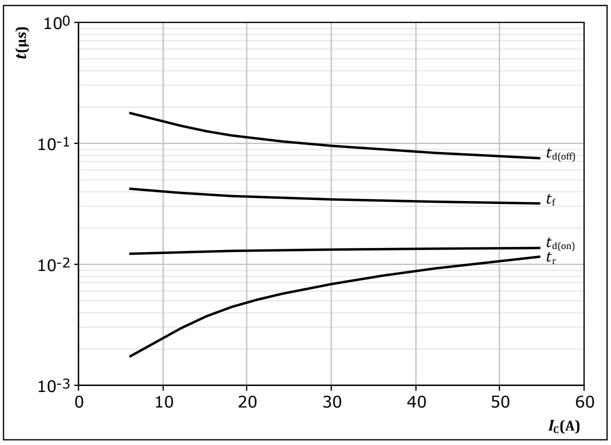
V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	30	A		150 °C

PFC Switching Characteristics

figure 20. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



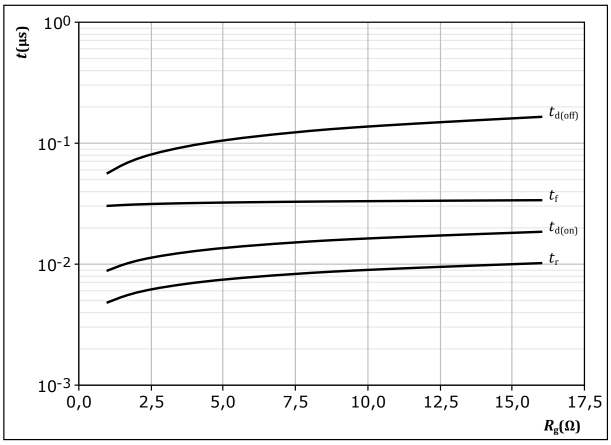
With an inductive load at

T_j =	150	°C
V_{CE} =	400	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 21. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

t = f(R_g)



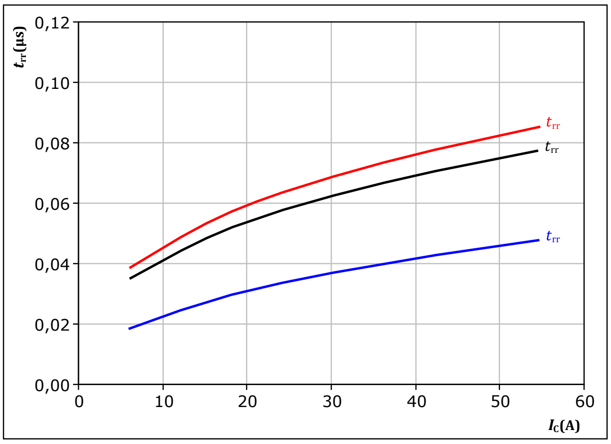
With an inductive load at

T_j =	150	°C
V_{CE} =	400	V
V_{GE} =	0/15	V
I_C =	30	A

figure 22. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

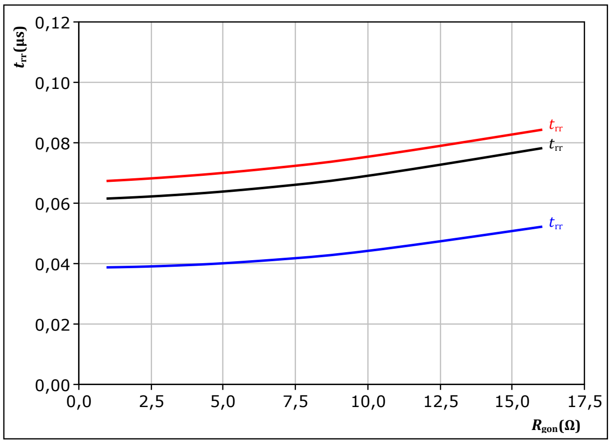
V_{CE} =	400	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 23. **FWD**

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

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



With an inductive load at

V_{CE} =	400	V
V_{GE} =	0/15	V
I_C =	30	A

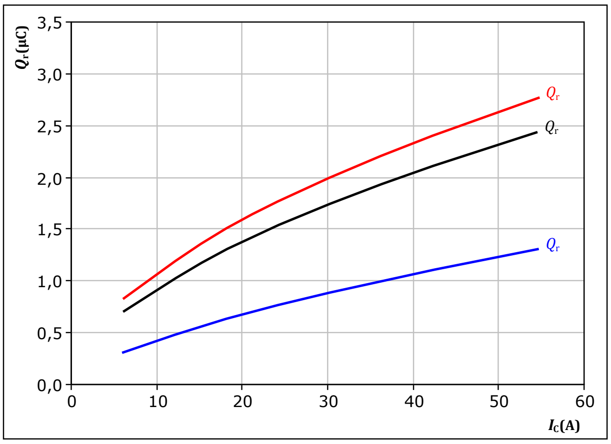
T_j: 25 °C, 125 °C, 150 °C

PFC Switching Characteristics

figure 24. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



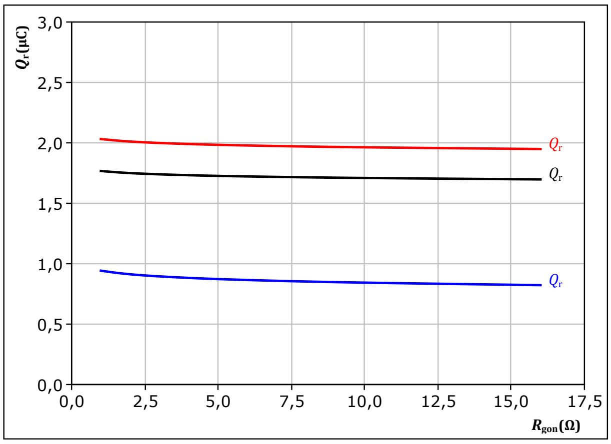
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 25. FWD

Typical recovered charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$



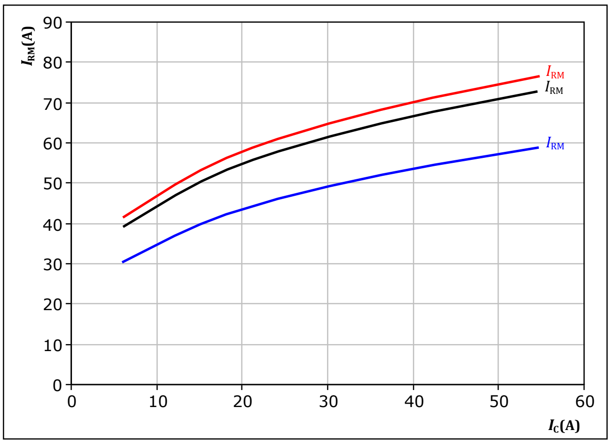
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	30	A		150 °C

figure 26. FWD

Typical peak reverse recovery current as a function of collector current

$I_{RM} = f(I_C)$



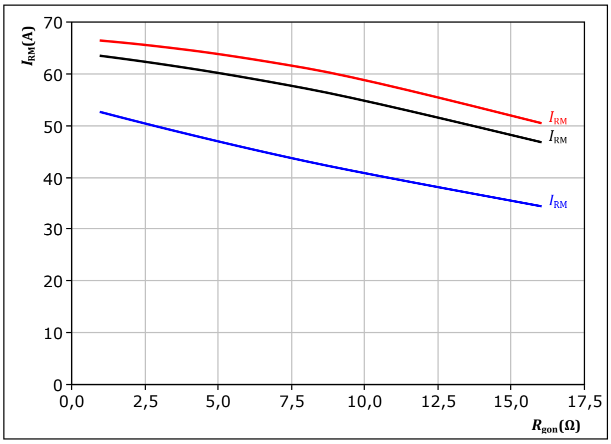
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 27. FWD

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

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



With an inductive load at

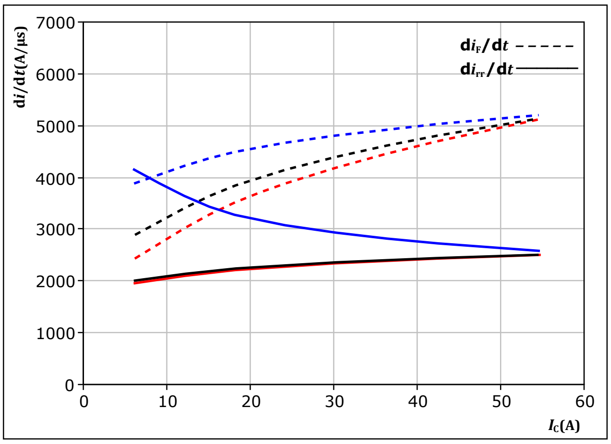
V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	30	A		150 °C

PFC Switching Characteristics

figure 28. **FWD**

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

di_F/dt, di_{rr}/dt = f(I_C)



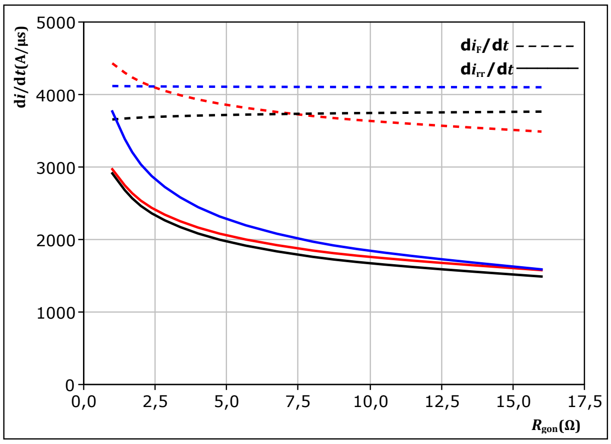
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 29. **FWD**

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

di_F/dt, di_{rr}/dt = f(R_{gon})



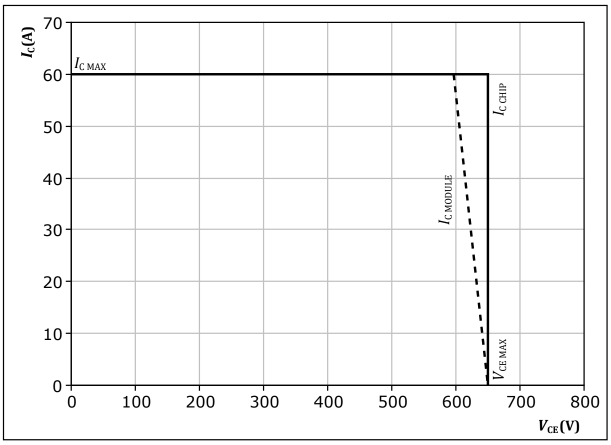
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	30	A		150 °C

figure 30. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At	T_j =	150	°C
	R_{gon} =	4	Ω
	R_{goff} =	4	Ω

PFC Switching Definitions

figure 31. **IGBT**

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

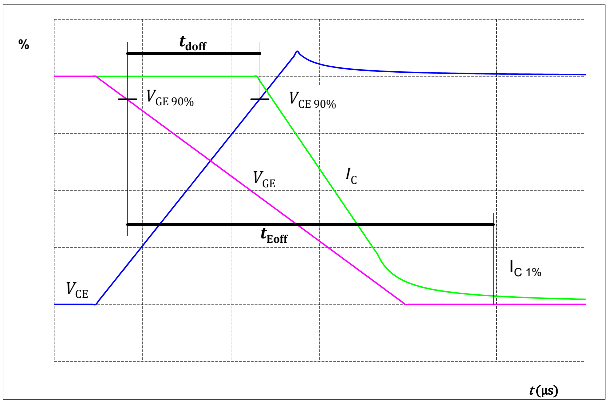


figure 32. **IGBT**

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

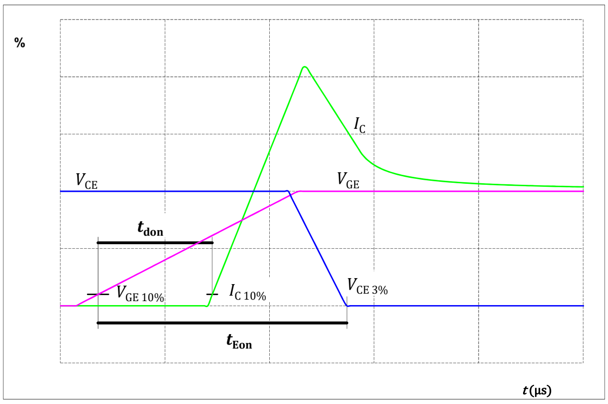


figure 33. **IGBT**

Turn-off Switching Waveforms & definition of t_f

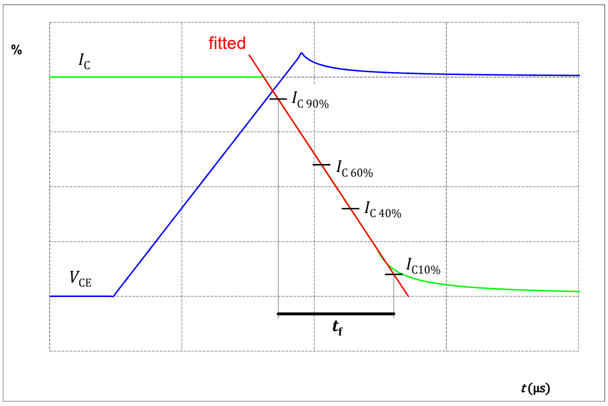
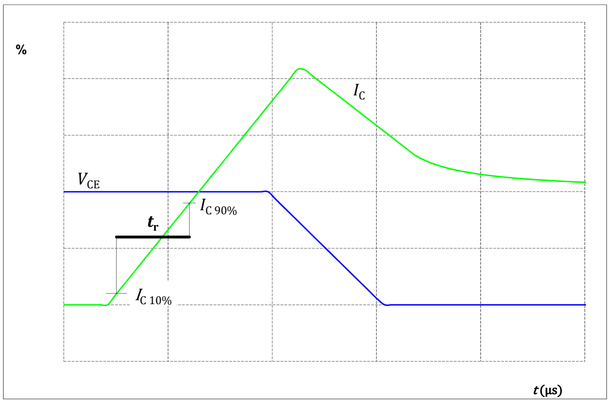


figure 34. **IGBT**

Turn-on Switching Waveforms & definition of t_r



PFC Switching Definitions

figure 35. **FWD**

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

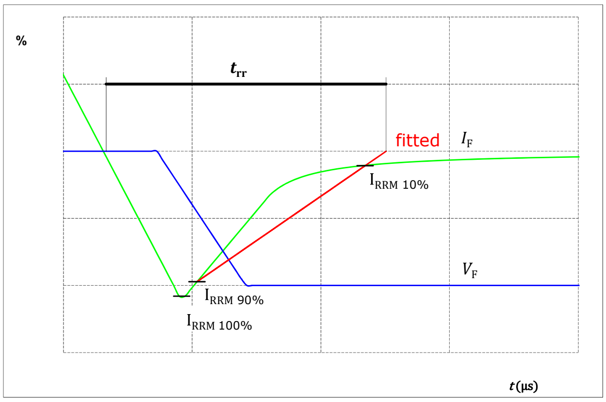
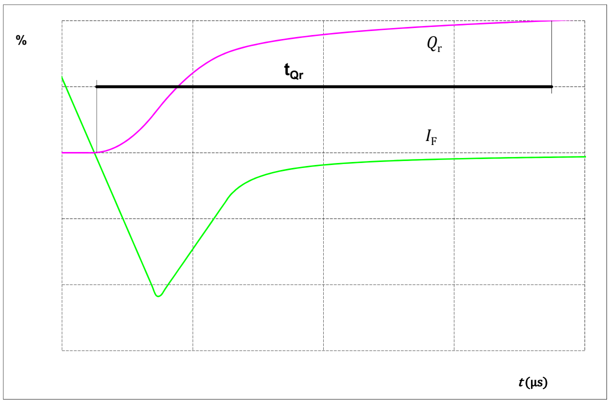


figure 36. **FWD**

Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



10-F0072TA030S5-P982D54
datasheet

Ordering Code

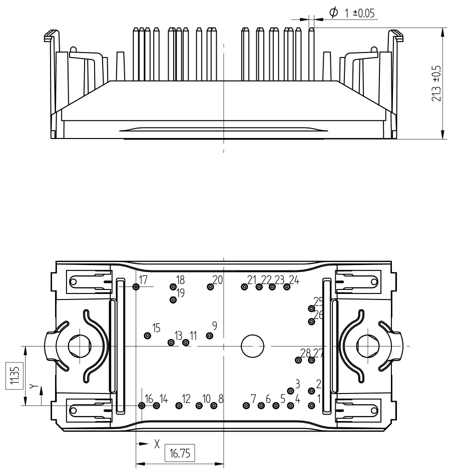
Version	Ordering Code
Without thermal paste	10-F0072TA030S5-P982D54
With thermal paste (5,2 W/mK, PTM6000HV)	10-F0072TA030S5-P982D54-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-F0072TA030S5-P982D54-/3/

Marking

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

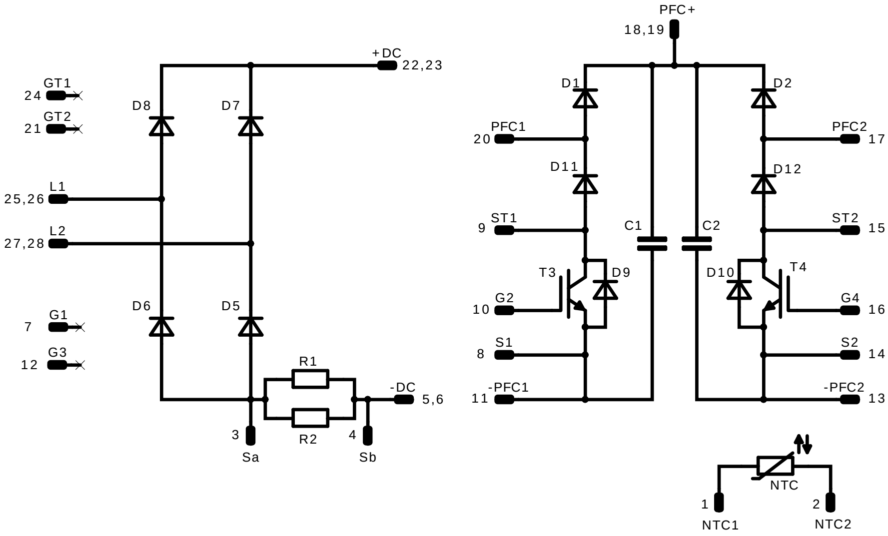
Outline

Pin table [mm]			
Pin	X	Y	Function
1	33,5	0	Rt1
2	33,5	2,8	Rt2
3	29,5	2,8	Sa
4	29,5	0	Sb
5	26,7	0	-DC
6	23,9	0	-DC
7	21,05	0	G1
8	14,85	0	S1
9	14,05	13,35	ST1
10	12,05	0	G2
11	9,5	12,05	-PFC1
12	8,2	0	G3
13	6,7	12,05	-PFC2
14	3,9	0	S2
15	2,2	13,35	ST2
16	1,1	0	G4
17	0	22,7	PFC2
18	7,1	22,7	+PFC
19	7,1	20,2	+PFC
20	14,2	22,7	PFC1
21	20,7	22,7	GT2
22	23,5	22,7	+DC
23	26	22,7	+DC
24	28,8	22,7	GT1
25	33,5	18,55	L1
26	33,5	16,05	L1
27	33,5	8,7	L2
28	31	8,7	L2



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T3, T4	IGBT	650 V	30 A	PFC Switch	
D1, D2	FWD	650 V	30 A	PFC Diode	
D9, D10	FWD	650 V	6 A	PFC Sw. Protection Diode	
D11, D12	FWD	650 V	6 A	Current Transformer Protection Diode	
D6, D8, D5, D7	Rectifier	1600 V	50 A	Rectifier Diode	
R1, R2	Shunt			Resistor	Parallel devices. Values apply to complete device.
C1, C2	Capacitor	500 V		Capacitor (DC)	
NTC	Thermistor			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 packages see vincotech.com website.

Vincotech thermistor reference
See Vincotech thermistor reference table at vincotech.com website.

UL recognition and file number
This device is UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,op}$=175°C and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
10-F0072TA030S5-P982D54-D1-14	27 Apr. 2024		