Vincotech

10-F0072TA040S503-P983D74
datasheet

*flow*PFC 0 CD	650 V / 40 A

Features

- Dual Boost PFC suitable for interleaved mode
- High speed IGBT
- Current sense interface in the collector with low inductive bypass diode
- Integrated DC capacitor and shunt
- Temperature sensor

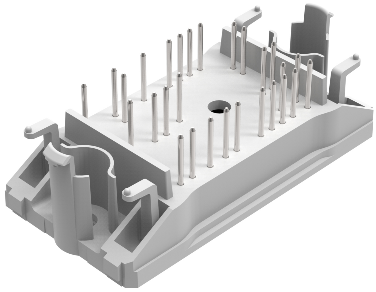
Target applications

- Industrial Drives
- Power Supply
- Welding & Cutting

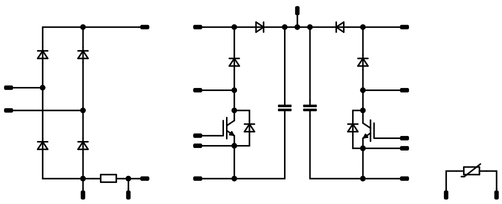
Types

- 10-F0072TA040S503-P983D74

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	I_C	$T_j = T_{jmax}$	T_s = 80 °C	42	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		120	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	65	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
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	35	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		60	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	50	W
Maximum junction temperature	T_{jmax}			175	°C
PFC Sw. Protection Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	8	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	36	W
Maximum junction temperature	T_{jmax}			175	°C

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
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	8	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	36	W
Maximum junction temperature	T_{jmax}			175	°C
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward average current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	48	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	59	W
Maximum junction temperature	T_{jmax}			150	°C
PFC Shunt					
DC current	I		T_c = 70 °C	21	A
Power dissipation	P_{tot}		T_c = 70 °C	7	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
Isolation voltage	V_{isol}	AC Voltage	t_p = 1 min	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					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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0004	25	3,2	4	4,8	V
Collector-emitter saturation voltage	V_{CEsat}		15		40	25 125 150		1,34 1,42 1,46	1,75(1)	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		2500		pF
Reverse transfer capacitance	C_{res}							9		pF
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,46		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	0/15	400	15	25 125 150		9,6 8,96 8,96		ns
Rise time	t_r					25 125 150		4,48 4,8 5,12		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		137,6 175,68 186,56		ns
Fall time	t_f					25 125 150		15,65 32,6 39,44		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,615 µC Q_{rFWD}=1,2 µC Q_{rFWD}=1,4 µC				25 125 150		0,182 0,261 0,286		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,171 0,303 0,353		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		1,48 1,4 1,38	1,92(1)	V
Reverse leakage current	I_R	V_r = 650 V				25			1,6	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,92		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt=4066 A/µs di/dt=3382 A/µs di/dt=3137 A/µs	0/15	400	15	25 125 150		34,18 43,44 46,85		A
Reverse recovery time	t_{rr}					25 125 150		32,94 53,7 60,78		ns
Recovered charge	Q_r					25 125 150		0,615 1,2 1,4		µC
Reverse recovered energy	E_{rec}					25 125 150		0,132 0,3 0,357		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		1484 1258 1429		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										
Forward voltage	V_F				6	25 125 150	1,23	1,72 1,58 1,53	1,87(1)	V
Reverse leakage current	I_R	V_r = 650 V				25			0,1	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,65		K/W
Current Transformer Protection Diode										
Static										
Forward voltage	V_F				6	25 125 150	1,23	1,72 1,58 1,53	1,87(1)	V
Reverse leakage current	I_R	V_r = 650 V				25			0,1	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,65		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				50	25 125		1,25 1,24	1,3(1) 1,33(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			20 1500	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,2		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	
PFC Shunt										
Static										
Resistance	R							15		mΩ
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 R_{100}	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P							5		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	

(1) Value at chip level

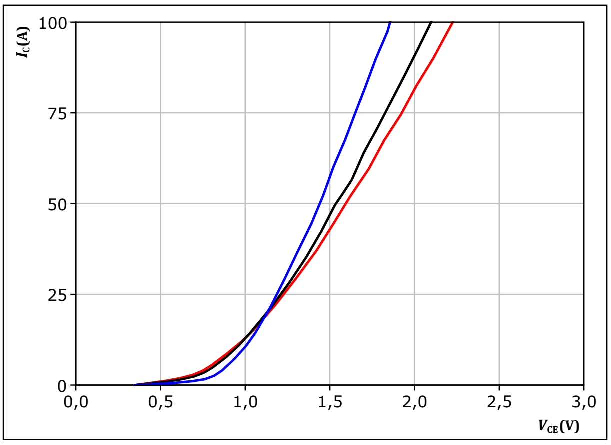
(2) Only valid with pre-applied Vincotech thermal interface material.

PFC Switch Characteristics

figure 1. IGBT

Typical output characteristics

I_C = f(V_{CE})

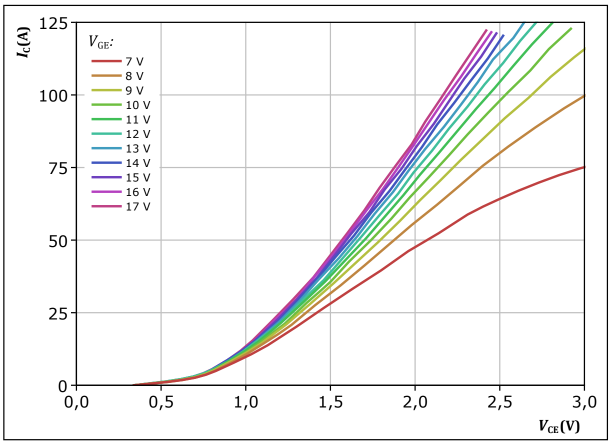


t_p = 250 µs
V_{GE} = 15 V
T_j: 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

I_C = f(V_{CE})

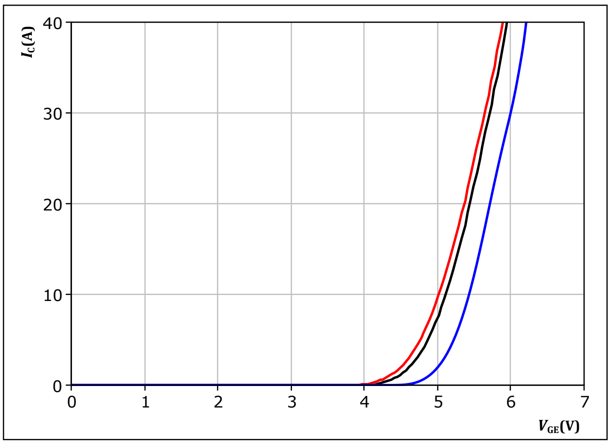


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

I_C = f(V_{GE})

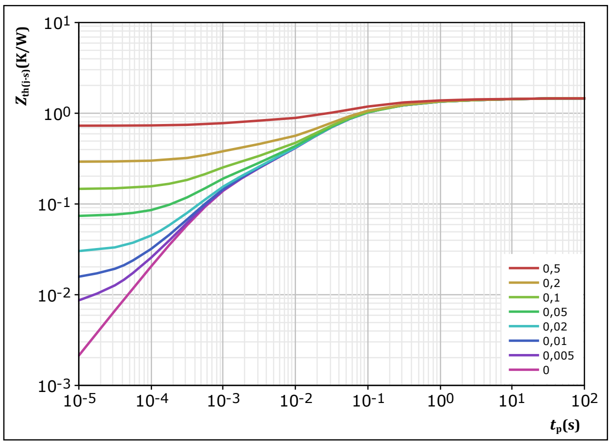


t_p = 250 µs
V_{CE} = 10 V
T_j: 25 °C, 125 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



D = t_p / T
$R_{th(j-s)}$ = 1,458 K/W

IGBT thermal model values

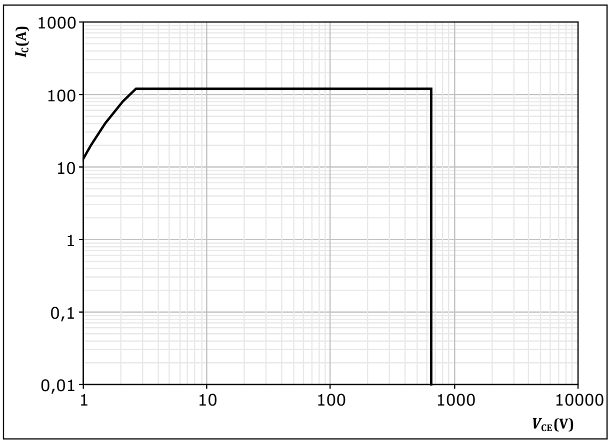
R (K/W)	τ (s)
8,80E-02	8,35E+00
2,70E-01	4,97E-01
6,06E-01	6,43E-02
2,71E-01	1,70E-02
6,68E-02	8,32E-03
1,56E-01	8,63E-04

PFC Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



D = single pulse

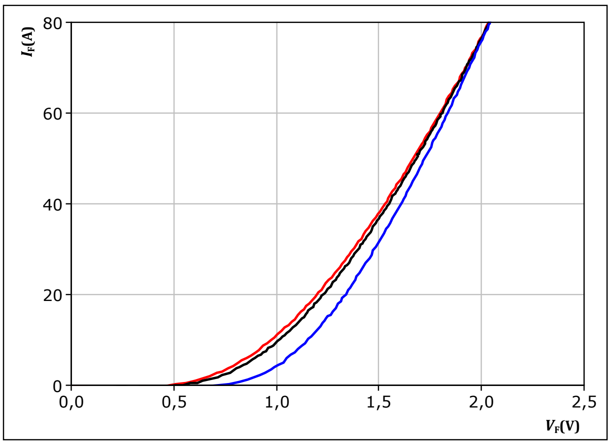
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

PFC Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

I_F = f(V_F)



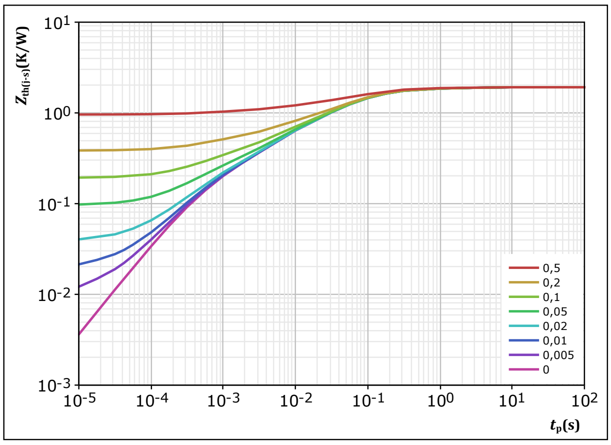
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,918 K/W

FWD thermal model values

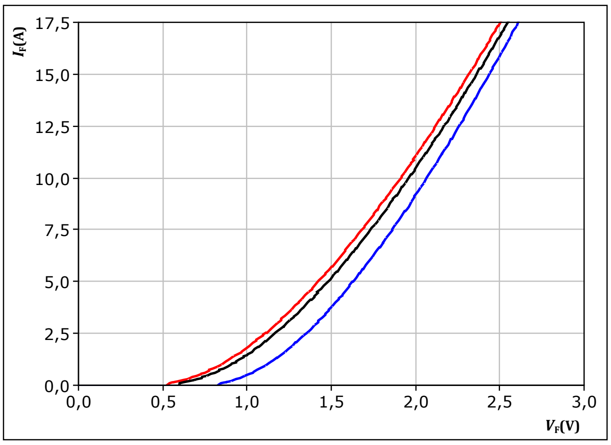
R (K/W)	τ (s)
9,41E-02	2,25E+00
3,44E-01	2,12E-01
8,56E-01	5,84E-02
3,61E-01	9,83E-03
1,37E-01	2,89E-03
1,27E-01	4,79E-04

PFC Sw. Protection Diode Characteristics

figure 8. **FWD**

Typical forward characteristics

I_F = f(V_F)



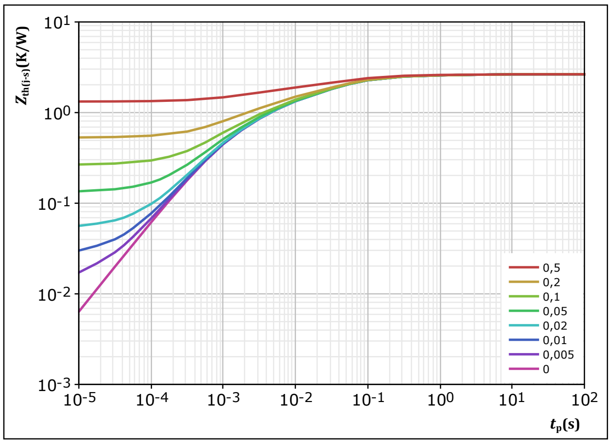
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 9. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,646 K/W

FWD thermal model values

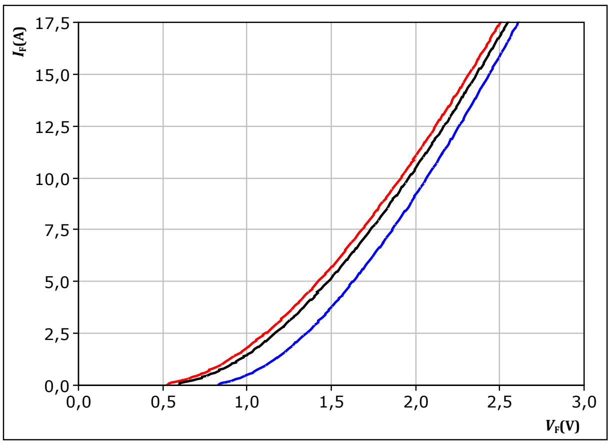
R (K/W)	τ (s)
1,02E-01	2,56E+00
3,50E-01	1,72E-01
9,53E-01	3,96E-02
7,66E-01	5,83E-03
4,76E-01	9,87E-04

Current Transformer Protection Diode Characteristics

figure 10. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



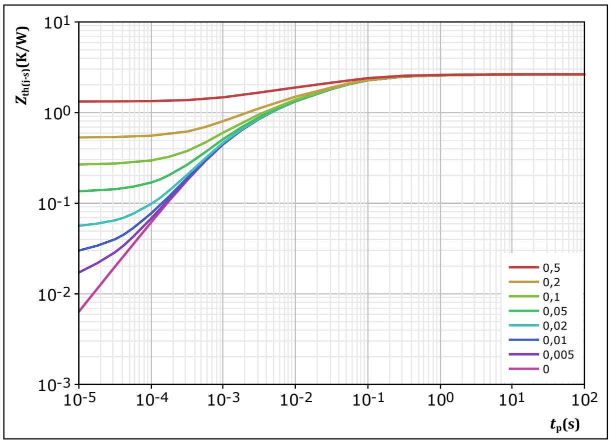
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 11. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,646 K/W

FWD thermal model values

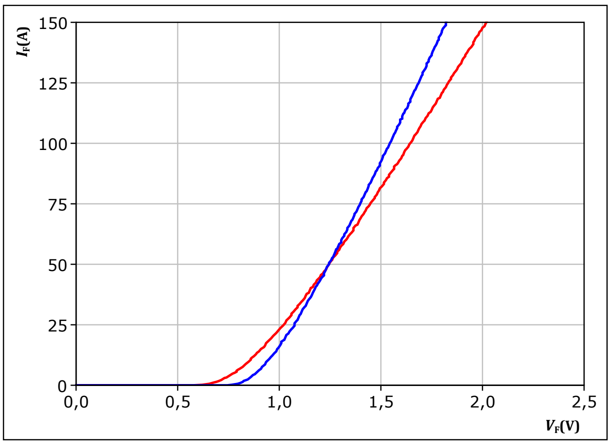
R (K/W)	τ (s)
1,02E-01	2,56E+00
3,50E-01	1,72E-01
9,53E-01	3,96E-02
7,66E-01	5,83E-03
4,76E-01	9,87E-04

Rectifier Diode Characteristics

figure 12. **Rectifier**

Typical forward characteristics

I_F = f(V_F)



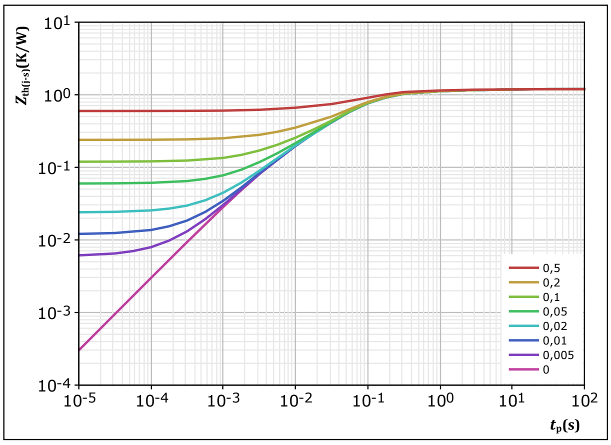
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 13. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,195 K/W

Rectifier thermal model values

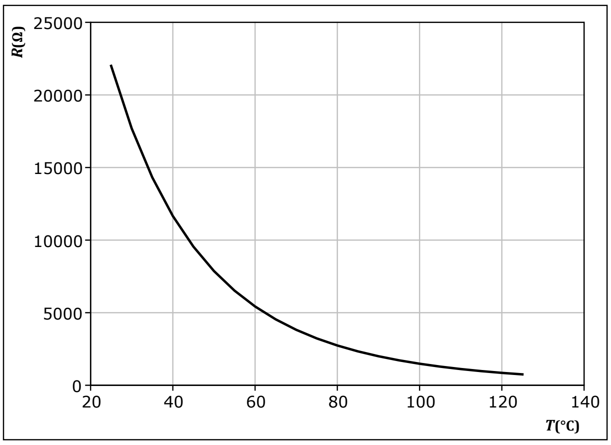
R (K/W)	τ (s)
4,87E-02	6,80E+00
1,57E-01	6,29E-01
7,33E-01	9,05E-02
1,69E-01	3,10E-02
7,37E-02	4,76E-03
1,39E-02	1,53E-02

Thermistor Characteristics

figure 14.	Thermistor

Typical NTC characteristic as function of temperature

R_T = f(T)

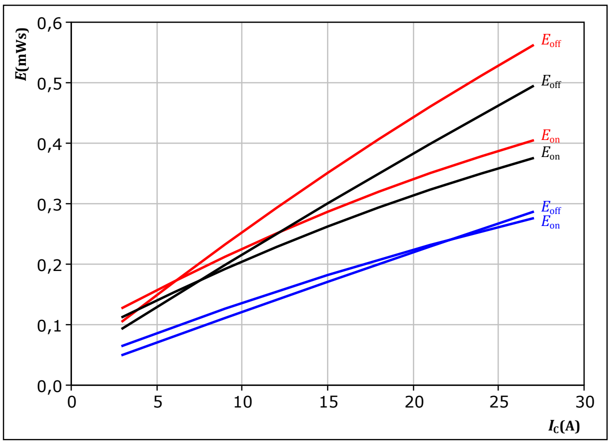


PFC Switching Characteristics

figure 15. **IGBT**

Typical switching energy losses as a function of collector current

E = f(I_C)



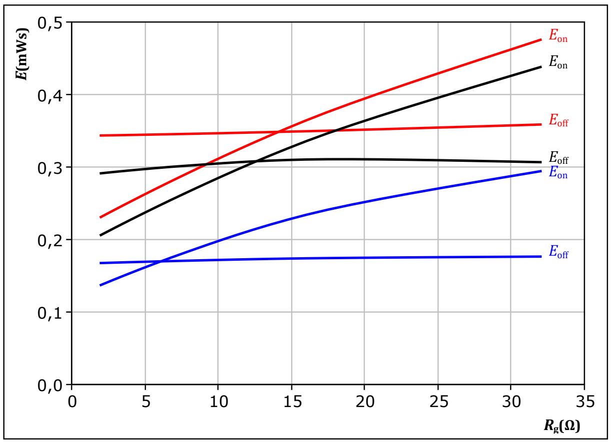
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C
R_{goff} =	8	Ω		

figure 16. **IGBT**

Typical switching energy losses as a function of gate resistor

E = f(R_g)



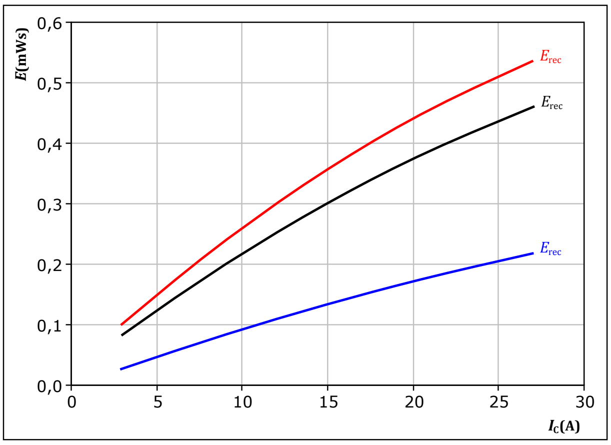
With an inductive load at

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

figure 17. **FWD**

Typical reverse recovered energy loss as a function of collector current

E_{rec} = f(I_C)



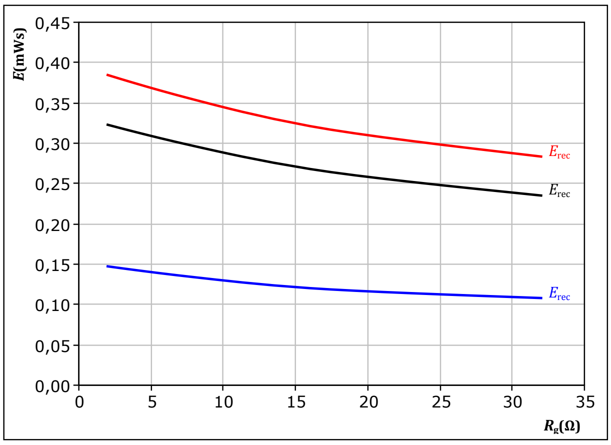
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 18. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

E_{rec} = f(R_g)



With an inductive load at

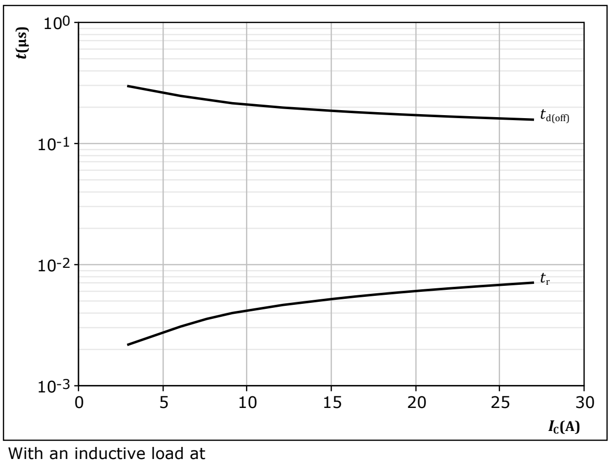
V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	15	A		150 °C

PFC Switching Characteristics

figure 19. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



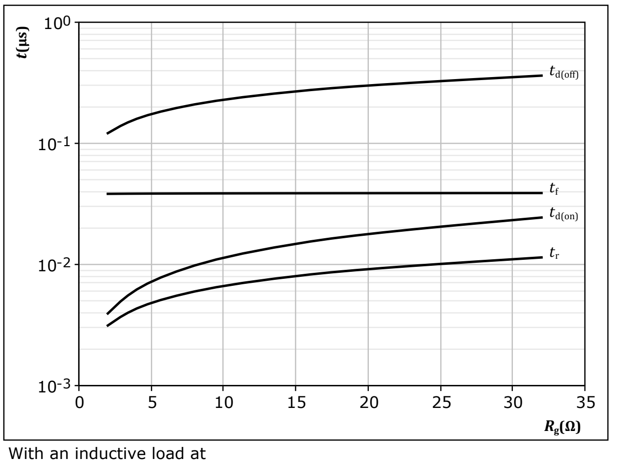
With an inductive load at

T_j =	150	°C
V_{CE} =	400	V
V_{GE} =	0/15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 20. **IGBT**

Typical switching times as a function of gate resistor

t = f(R_g)



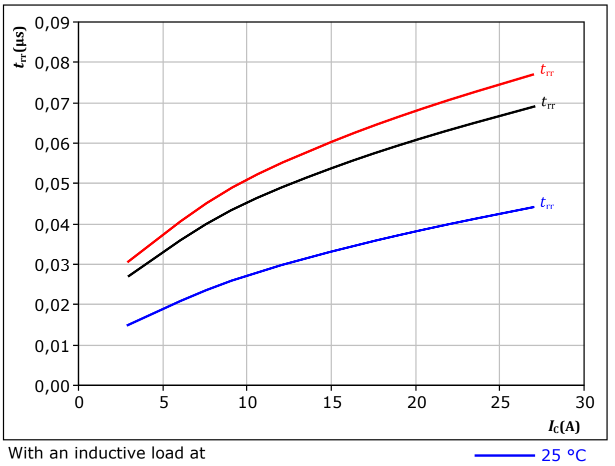
With an inductive load at

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

figure 21. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

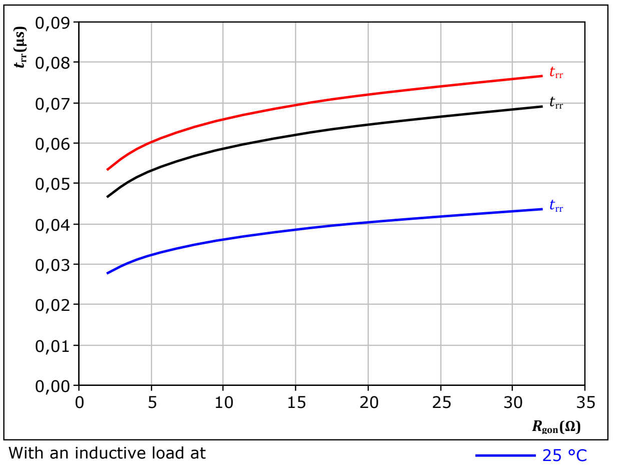
V_{CE} =	400	V
V_{GE} =	0/15	V
R_{gon} =	8	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 22. **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 =	15	A

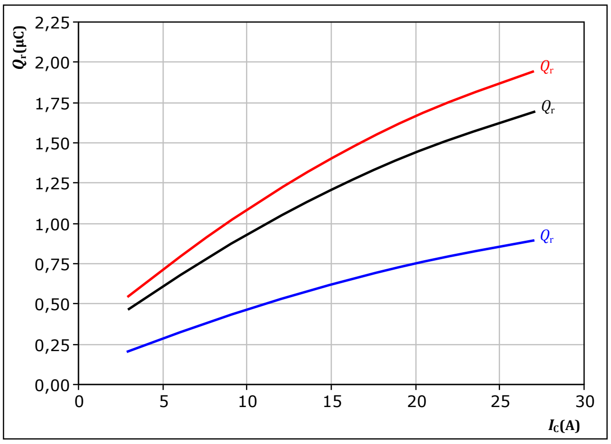
T_j: 25 °C, 125 °C, 150 °C

PFC Switching Characteristics

figure 23. **FWD**

Typical recovered charge as a function of collector current

Q_r = f(I_C)



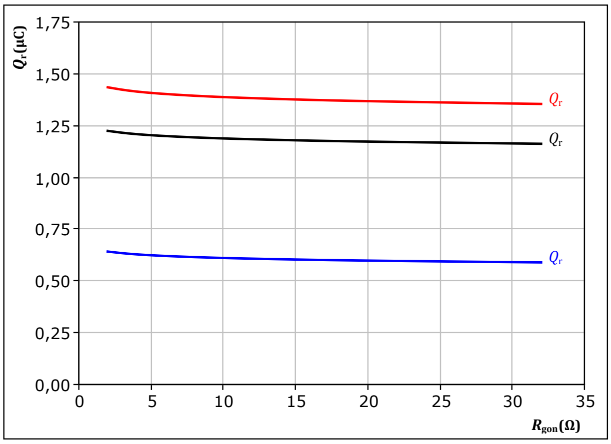
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 24. **FWD**

Typical recovered charge as a function of turn on gate resistor

Q_r = f(R_{gon})



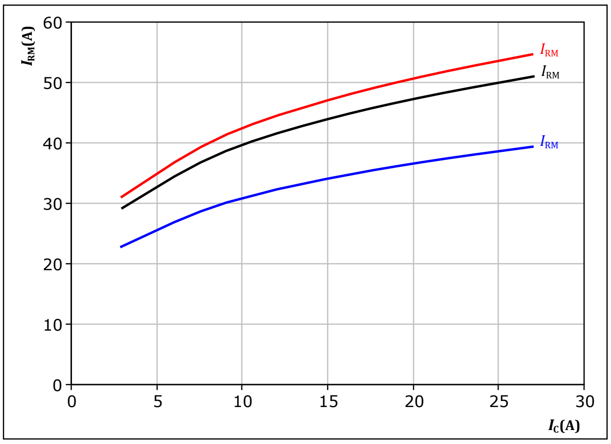
With an inductive load at

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

figure 25. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



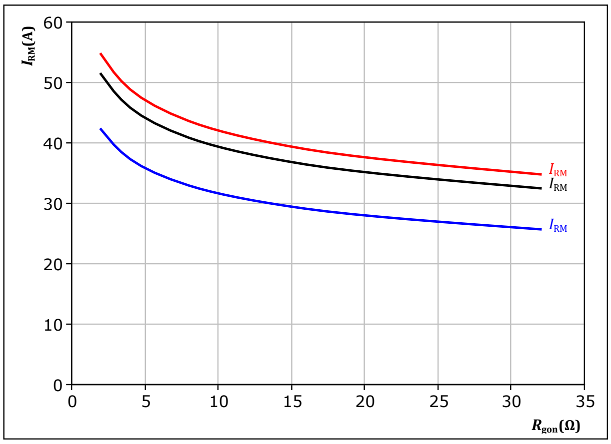
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 26. **FWD**

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

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



With an inductive load at

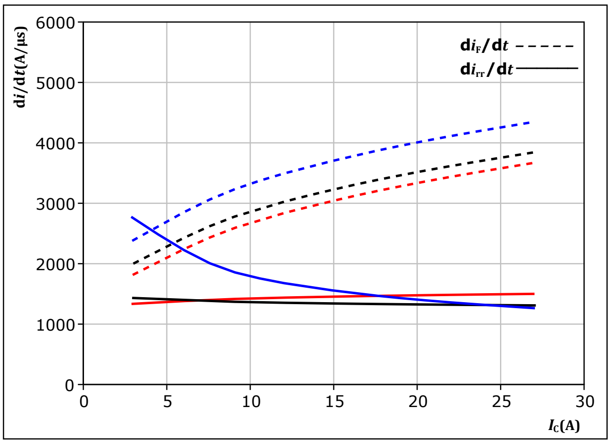
V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	15	A		150 °C

PFC Switching Characteristics

figure 27. **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)



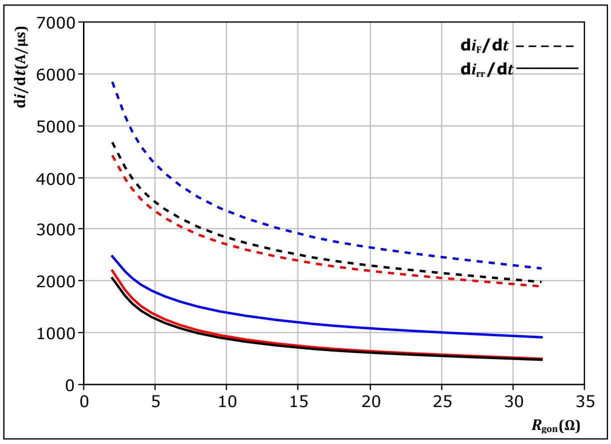
With an inductive load at

V_{CE} =	400	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 28. **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})



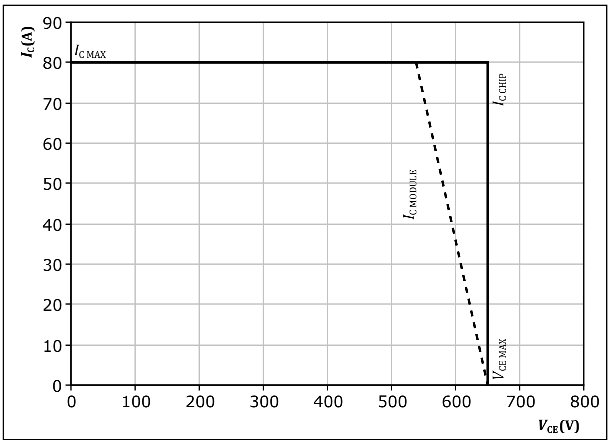
With an inductive load at

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

figure 29. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At			
	T_j =	150	°C
	R_{gon} =	8	Ω
	R_{goff} =	8	Ω

PFC Switching Definitions

figure 30. **IGBT**

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

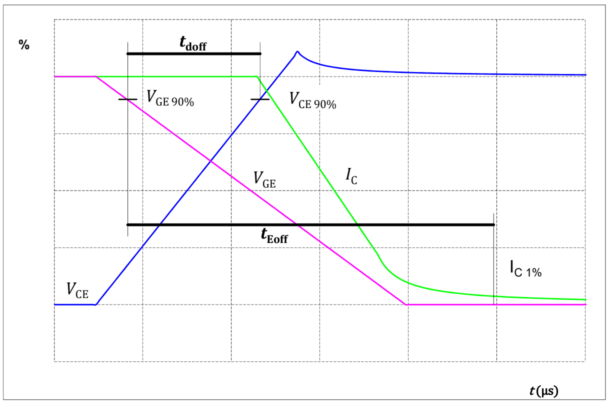


figure 31. **IGBT**

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

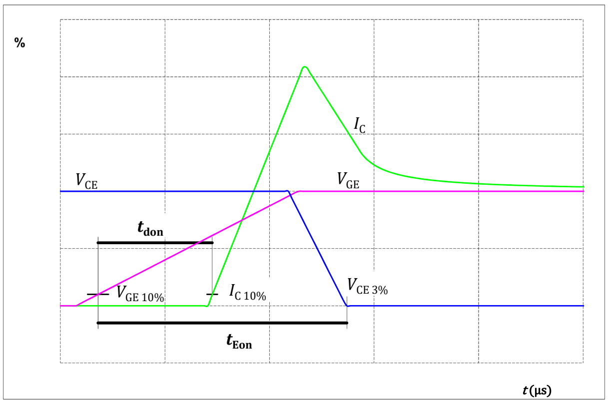


figure 32. **IGBT**

Turn-off Switching Waveforms & definition of t_f

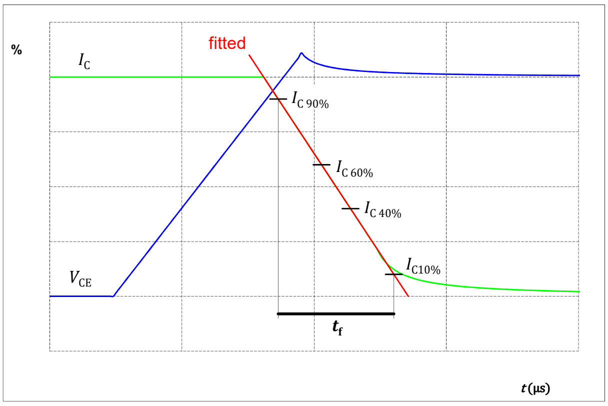
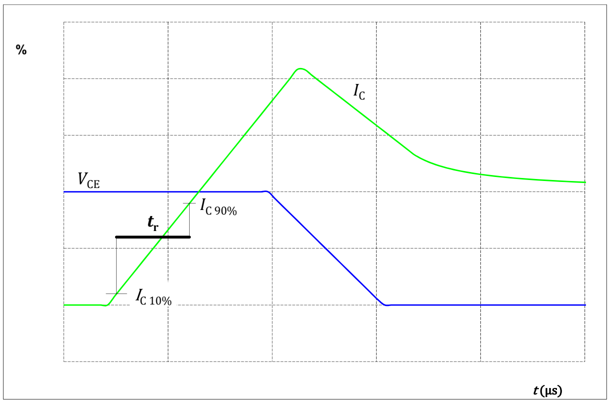


figure 33. **IGBT**

Turn-on Switching Waveforms & definition of t_r



PFC Switching Definitions

figure 34.	FWD

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

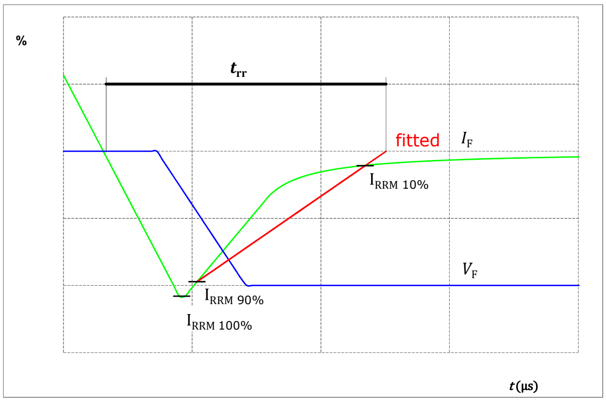
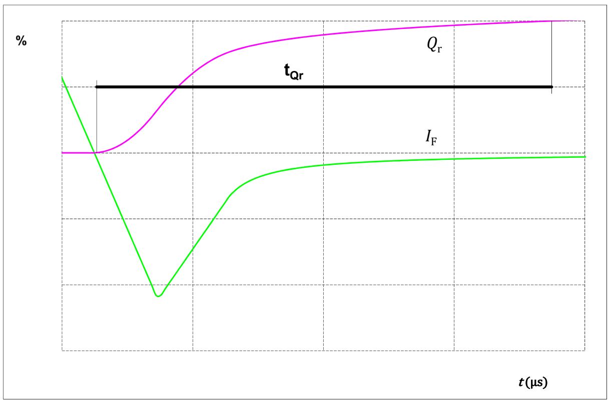


figure 35.	FWD

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

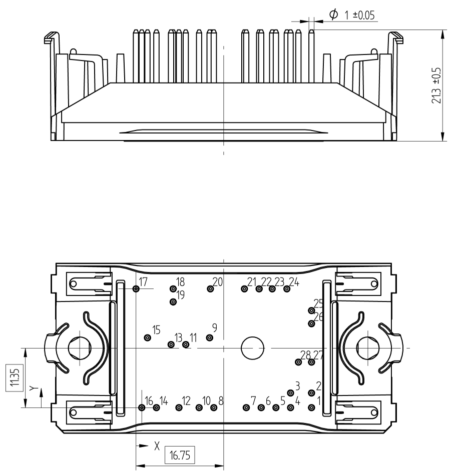


Ordering Code	
Version	**Ordering Code**
Without thermal paste	10-F0072TA040S503-P983D74
With thermal paste	10-F0072TA040S503-P983D74-/3/

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		

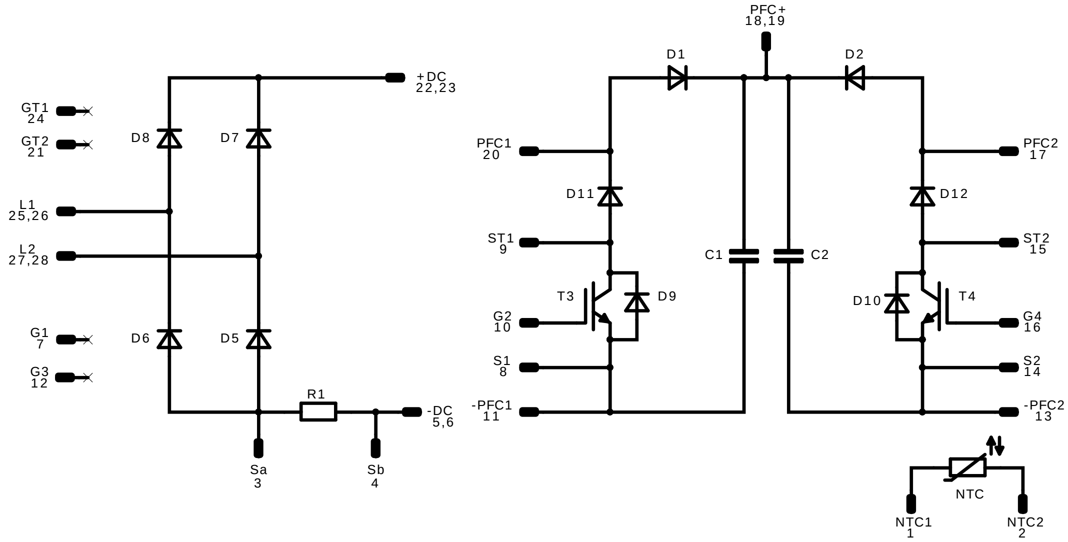
Outline

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	40 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	Shunt			PFC Shunt	
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 certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
10-F0072TA040S503-P983D74-D1-14	22 Jul. 2020		